

suiteDXT and suiteHEART® Software

DICOM Conformance Statement

NeoSoft, LLC

NEOSOFT

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1. OVERVIEW

1.1 suiteDXT

The suiteDXT software is intended to allow users to manage DICOM communication and storage of medical images. The software shall provide a persistent communication path allowing DICOM images to be pushed to the product from DICOM compliant modalities. The software shall allow users to send DICOM images to DICOM compliant endpoints. The software shall allow users to query and retrieve DICOM images from DICOM compliant endpoints. The product shall store the DICOM images received by either automated or requested processes to the local magnetic media. This product is intended to be a temporary persistent storage point.

Network services supported by suiteDXT are shown in Table 1. Supported media services are listed in Table 2.

Table 1: Network Services

Networking SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Transfer		
Verification (echo)	Yes	Yes
Enhanced MR Image Storage	Yes	Yes
MR Image Storage	Yes	Yes
Secondary Capture Image Storage	Yes	Yes
Query/Retrieve		
Study Root Query/Retrieve Information Model - FIND	Yes	Yes
Study Root Query/Retrieve Information Model - MOVE	Yes	Yes

Table 2: Media Services

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
Compact Disc - Recordable		
General Purpose CD-R Interchange	No	Yes
CT/MR Studies on CD-R	No	Yes
Digital Versatile Disc		
CT/MR Studies on DVD Media	No	Yes
CT/MR Studies on DVD-RAM Media	No	Yes

1.2 suiteHEART® Software

suiteHEART® Software is intended to assist trained clinical personnel in the qualification and quantification of cardiac function. The software provides the tools to adjust the parameters of the DICOM images and provides presentation states where the user can appreciate various MRI acquired images of the heart and vasculature over time. Additionally, the software provides tools for measuring linear distances, areas, and volumes that can be used to quantify cardiac function. Finally, the software provides the tools for volumetric flow measurements and the ability to calculate flow values. Multiphase sequences of images can be displayed in cine mode to facilitate visualization.

The results of the measurement tools are interpreted by the physician and can be communicated to referring physicians.

When interpreted by a trained physician these tools may be useful in supporting the determination of a diagnosis.

2. INTRODUCTION

This DICOM Conformance Statement specifies the behavior and functionality of suiteDXT and suiteHEART® Software, with regards to supported DICOM networking SOP Classes and Media Storage Application Profiles.

2.1 Abbreviations

The following list illustrates all abbreviations that are used in this document.

AE	Application Entity
CD-R	Compact Disc - Recordable
CT	Computer Tomography
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DVD	Digital Versatile Disc
FSC	File Set Creator
FSR	File Set Reader
FSU	File Set Updater
IOD	Information Object Definition
ISO	International Standards Organization
JPEG	Joint Photographic Experts Group
MR	Magnetic Resonance
PACS	Picture Archiving and Communication System
PDU	Protocol Data Unit
SC	Secondary Capture
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
TCP/IP	Transmission Control Protocol / Internet Protocol
UID	Unique Identifier

VR	Value Representation
VNAP	Value Not Always Present

2.2 Audience

This document is written for the people that need to understand how suiteDXT and suiteHEART® Software 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.

2.3 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between suiteDXT and suiteHEART® Software with other DICOM products. 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 intended 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 this 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.

2.4 Terms and Definitions

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard [DICOM] 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 or DVDs)

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.

Secondary Capture(SC) - suiteDXT uses SC images to store its custom data. suiteHEART® Software uses SC images to store its custom 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 (PACS 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.

2.5 Basics of DICOM Communication

This section describes terminology used in this Conformance Statement for the non-specialist. This section is not a substitute for training about DICOM, and it makes many simplifications about the meanings of DICOM terms.

Two Application Entities (devices) that want to communicate with each other over a network using DICOM protocol must first agree on several things during an initial network “handshake.” One of the two devices must initiate an Association (a connection to the other device) and ask if specific services, information, and encoding can be supported by the other device (Negotiation).

DICOM specifies several network services and types of information objects, each of which is called an Abstract Syntax for the Negotiation. DICOM also specifies a variety of methods for encoding data, denoted Transfer Syntaxes. The Negotiation allows the initiating Application Entity to propose combinations of Abstract Syntax and Transfer Syntax to be used on the Association; these combinations are called Presentation Contexts. The receiving Application Entity accepts the Presentation Contexts it supports.

For each Presentation Context, the Association Negotiation also allows the devices to agree on Roles - which one is the Service Class User (SCU - client) and which is the Service Class Provider (SCP - server). Normally the device initiating the connection is the SCU, i.e., the client system calls the server, but not always.

The Association Negotiation finally enables exchange of maximum network packet (PDU) size, security information, and network service options (called Extended Negotiation information).

The Application Entities, having negotiated the Association parameters, may now commence exchanging data. Common data exchanges include queries for worklists and lists of stored images, transfer of image objects and analyses (structured reports), and sending images to film printers. Each exchangeable unit of data is formatted by the sender in accordance with the appropriate Information Object Definition, and sent using the negotiated Transfer Syntax. There is a Default Transfer Syntax that all systems must accept, but it may not be the most efficient for some use cases. Each transfer is explicitly acknowledged by the receiver with a Response Status indicating success, failure, or that query or retrieve operations are still in process.

Two Application Entities may also communicate with each other by exchanging media (such as a CD-R). Since there is no Association Negotiation possible, they both use a Media Application Profile that specifies “pre-negotiated” exchange media format, Abstract Syntax, and Transfer Syntax.

Wrapping network communication in SSL is supported using the DICOM Security Profiles: BCP 195 TLS Profile, Non-downgrading SCP 195 TLS Profile, and Extended BCP 195 TLS Profile.

2.6 *References*

See Digital Imaging and Communications in Medicine (DICOM) standard, 2011 available at <http://medical.nema.org/>

2.7 *Supported Character Sets*

suiteDXT supports images with the following character sets, ISO-IR 6, ISO-IR 100, ISO-IR 192, ISO-IR 138, ISO 2022 IR 138, and ISO 2022 IR 100.

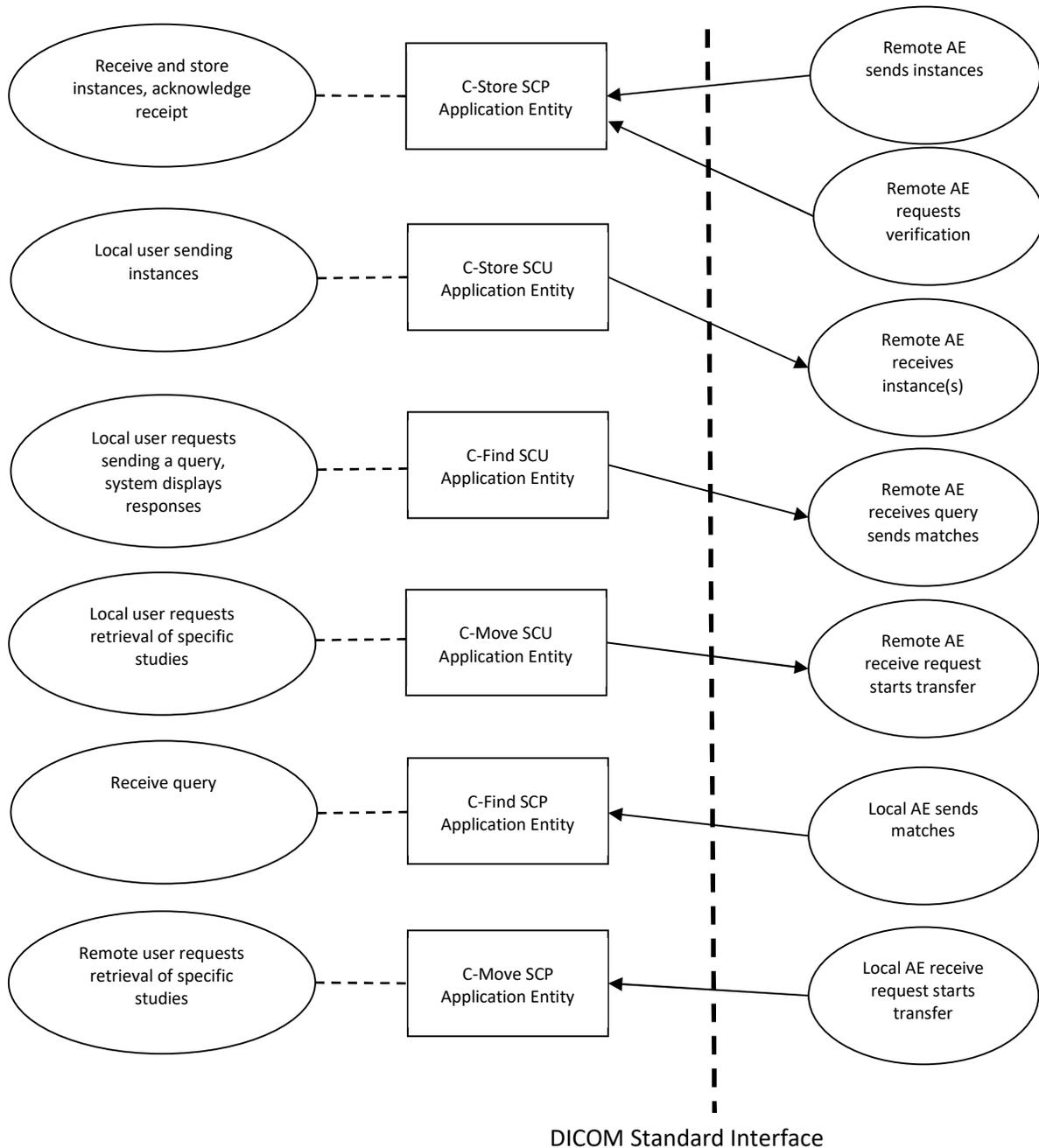
suiteHEART® Software supports the following character sets for both reading in primary images and writing out secondary data: ISO-IR 6, ISO-IR 100, ISO-IR 192, ISO-IR 138, ISO 2022 IR 138, and ISO 2022 IR 100.

3. suiteDXT

3.1 NETWORKING

3.1.1 Implementation Model

(1) Application Data Flow Diagram



Conceptually, the networking services which are implemented in suiteDXT may be modeled as the following separate AEs.

(2) Functional Definitions of AEs

STORAGE-SCP (C-Store SCP) listens for connection requests at the port number configured for it. It will accept Presentation Contexts for Storage and Verification SOP Classes. Upon receipt of a Verification Request, STORAGE-SCP will respond with a successful Verification response. Upon receipt of a Storage Request, STORAGE-SCP will store the object that has been successfully received in the local system. The stored instances are subsequently listed and may be viewed through the user interface.

STORAGE-SCU (C-Store SCU) is activated through the user interface when a user selects one or more instances from the local system and requests that they be sent to a remote AE. The remote AE is selected from a pre-configured list of communication partners.

FIND-SCU (C-Find SCU) is activated through the user interface when a user selects a remote AE (from a preconfigured list) and initiates a query on study level. Subsequently, the matching studies are presented to the user as a list from which studies can be selected for retrieval.

MOVE-SCU (C-Move SCU) is activated through the user interface when a user selects studies from a list for retrieval. A connection to the remote AE is established to initiate the retrieval. The STORAGE-SCP AE receives the retrieved instances and stores them in the local system.

FIND-SCP (C-Find SCP) listens for connection requests at the port number configured for it. It will accept the Presentation Context for the Find class. Upon receipt of a Find Request, FIND-SCP will respond with all matching instances to the query parameters.

MOVE-SCP (C-Move SCP) listens for connection requests at the port number configured for it. A connection to the local AE is established by the remote AE to initiate the retrieval. The STORAGE-SCU AE sends the requested instances to the remote system.

(3) Sequencing of Real-World Activities

All SCP activities are performed asynchronously in the background and are not dependent on any sequencing. The only limitation is that the STORAGE-SCP can accept more than one association concurrently.

All SCU activities are initiated in the user interface. For each remote AE, a new background thread is started which allows for multiple associations at the same time.

3.1.2 AE Specifications

(1) STORAGE-SCP

STORAGE-SCP provides standard conformance to the following DICOM SOP classes.

Table 3: SOP Classes for AE STORAGE-SCP

SOP Class Name	SOP Class UID	SCP
Verification SOP Class	1.2.840.10008.1.1	Yes

Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes

Association Policies

STORAGE-SCP accepts but never initiates associations. The DICOM standard application context name, which is always proposed, is shown in Table 4.

Table 4: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size is set to the default, 16384 bytes.

SOP Class extended negotiation is not supported.

Table 5: Number of Associations as an Association Acceptor for AE STORAGE-SCP

Number of Associations as an Association Acceptor for AE STORAGE-SCP	
Maximum number of simultaneous associations	Currently not limited

Asynchronous mode of operation is not supported.

Table 6: DICOM Implementation Class and Version for AE STORAGE-SCP

DICOM Implementation Class and Version for AE STORAGE-SCP	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

Association Initiation and Acceptance Policies

STORAGE-SCP does not initiate associations. It accepts any association for which at least one presentation context is accepted. The calling application entity titles are ignored. The called application entity title must be the STORAGE-SCP configured application entity title.

Association requests may be rejected with the reasons shown in Table 7.

Table 7: Association Rejection Reasons

Result	Source	Reason	Description
Rejected permanent	Provider, presentation related	Temporary congestion	Resource limitation: process creation failed
Rejected transient	User	Application context name not supported	Incorrect application context name
Rejected permanent	Provider	Called AE not found	Incorrect called AE title

Activity: Remote AE Sends Instance(s)

As one instance is received from a remote AE, STORAGE-SCP will store this instance in the local file system and insert a record into the local database. If the received instance is a duplicate of a previously received instance, the new instance will be discarded. Table 8 lists the acceptable presentation contexts for AE STORAGE-SCP and real-world activity 'remote AE sends instance(s).'

Table 8: Acceptable Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	SCP	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

No extended negotiation is performed.

SOP Specific Conformance

STORAGE-SCP provides standard conformance to the Storage Service Class.

STORAGE-SCP will receive any supported DICOM instances transmitted on the open association provided that the correct presentation context is used. If an instance is received successfully, it is stored on the local file system and a record is inserted in the local database. For all supported storage SOP classes, no integrity checks of the received instances are performed beyond tests of a very basic structural integrity. In particular, the sending system is not prevented from transmitting incomplete or incorrect IODs. When storing an instance in the local system, group length values and sequence lengths of an instance are re-computed by STORAGE-SCP; these values may, therefore, be changed.

Presentation Context Acceptance Criterion

STORAGE-SCP will accept all presentation contexts which contain one of the supported SOP classes and one of the supported transfer syntaxes.

Transfer Syntax Selection Policies

For uncompressed transmission, the default behavior of STORAGE-SCP is to select for each presentation context containing a supported SOP class the explicit VR transfer syntax with the byte order matching little endian byte order. If this is not available, implicit VR little endian is selected if available, otherwise the presentation context is rejected.

Response Status

STORAGE-SCP will behave as described in Table 9 when generating the C-STORE response command message.

Table 9: Response Status for AE STORAGE-SCP

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A700	Application out of memory, file system or database write error (e. g. disk full or missing rights). The DICOM instance was not stored. An error message is output to the service logs.
	SOP Class Not Supported	A800	Application received some images with unsupported SOP Class UID.
Error	Data set does not match SOP class	A900	The SOP Class UID or SOP Instance UID in the C-STORE-RQ does not match the corresponding UID in the received dataset. The DICOM instance was stored anyway. An error message is output to the service logs.
	Cannot understand	C000	The received DICOM instance did not include a SOP Class UID or SOP Instance UID. The DICOM instance was stored anyway. An error message is output to the service logs.
Warning	Coercion of DataElements	B000	Never sent, no coercion is ever performed.
	Data Set does not match SOP Class	B007	Never sent.
	Elements Discarded	B006	Never sent.
Success	Success	0000	The DICOM instance was successfully received and stored in the local system.

Activity: Remote AE Requests Verification

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

Table 10: Acceptable Presentation Contexts for AE STORAGE-SCP

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		

Verification	1.2.840.10008.1.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70	SCP	None
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No extended negotiation is performed.

SOP Specific Conformance

STORAGE-SCP provides standard conformance to the Verification Service Class.

Presentation Context Acceptance Criterion

STORAGE-SCP will accept all presentation contexts which contain the supported SOP class and one of the supported transfer syntaxes.

Transfer Syntax Selection Policies

The default behavior of STORAGE-SCP is to select for each presentation context containing a supported SOP class the explicit VR transfer syntax little endian byte order. If this is unavailable, implicit VR little endian is selected if available, otherwise the presentation context is rejected.

(2) STORAGE-SCU

STORAGE-SCU provides standard conformance to the following DICOM SOP classes.

Table 11: SOP Classes for AE STORAGE-SCU

SOP Class Name	SOP Class UID	SCU
Verification SOP Class	1.2.840.10008.1.1	Yes
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Yes
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Yes
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Yes

Association Policies

STORAGE-SCU initiates but never accepts associations. The DICOM standard application context name, which is always proposed, is shown in Table 12.

Table 12: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size is set the default, 16384 bytes.

SOP Class extended negotiation is not supported.

Table 13: Number of Associations as an Association Initiator for AE STORAGE-SCU

Number of Associations as an Association Initiator for AE STORAGE-SCU	
Maximum number of simultaneous associations	1

Asynchronous mode of operation is not supported.

Table 14: DICOM Implementation Class and Version for AE STORAGE-SCU

DICOM Implementation Class and Version for AE STORAGE-SCU	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

STORAGE-SCU attempts to initiate a new association each time the user requests to send a group of instances.

Activity: Local User Requests Sending Instance(s)

For each group of instances selected from the user interface to be transferred, a single attempt will be made to transmit it to the selected remote AE. If the send fails, no retry will be performed but an error message will be reported to the user.

Table 15: Proposed Presentation Contexts for AE STORAGE-SCU

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70	SCU	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70	SCU	None
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian, Explicit VR Little Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1	SCU	None

STORAGE-SCU will always propose all Presentation Contexts, independently of the instances that are to be sent.

No extended negotiation is performed.

SOP Specific Conformance

STORAGE-SCU provides standard conformance to the Storage Service Class.

Presentation Context Acceptance Criterion

STORAGE-SCU does not accept associations.

Transfer Syntax Selection Policies

If offered a choice of transfer syntaxes in the accepted presentation contexts, the default behavior of STORAGE-SCU is to prefer the transfer syntax that is used for the DICOM file stored on the local system.

If this transfer syntax is not available, an explicit VR uncompressed transfer syntax is selected. If this is also unavailable, implicit VR little endian is selected. Finally, any matching presentation context is accepted independent of the transfer syntax.

Response Status

STORAGE-SCU will behave as described in Table 16 when receiving the C-STORE response command message.

Table 16: Response Status Handling Behavior for AE STORAGE-SCU

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A7xx	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
	SOP Class Not Supported	A800	Application received some images with unsupported SOP Class UID.
Error	Data set does not match SOP class	A9xx	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
	Cannot understand	Cxxx	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
Warning		Bxxx	Transmission of the DICOM instance is considered successful. A warning message is output to the service logs. No message is posted to the user interface.
Success		0000	The DICOM instance was successfully received by the remote AE. No message is reported to the service logs or posted to the user interface.

Table 17: Communication Failure Behavior for AE STORAGE-SCU

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is logged and reported to the user interface.
ASCE response message could not be received within the specified time range (configurable parameter).	An error message is logged and reported to the user interface.

DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is logged and reported to the user interface.
Association aborted by the SCP using A-ABORT or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	An error message is logged and reported to the user interface.

Association Acceptance Policy

STORAGE-SCU does not accept associations.

(3) FIND-SCU

FIND-SCU provides standard conformance to the following DICOM SOP classes.

Table 18: SOP Classes for AE FIND-SCU

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Yes	Yes

Association Policies

FIND-SCU initiates but never accepts associations. The DICOM standard application context name, which is always proposed, is shown in Table 19.

Table 19: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU is set to its default, 16384 bytes.
SOP Class extended negotiation is not supported.

Table 20: Number of Associations as an Association Initiator for AE FIND-SCU

Number of Associations as an Association Initiator for AE FIND-SCU	
Maximum number of simultaneous associations	1

Asynchronous mode of operation is not supported.

Table 21: DICOM Implementation Class and Version for AE FIND--SCU

DICOM Implementation Class and Version for AE FIND--SCU	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

FIND-SCU attempts to initiate a new association each time the user requests sending a query.

Activity: Local User Requests Sending a Query

A single attempt will be made to query the remote AE. If the query fails, no retry will be performed but an error message will be reported to the user. In case no error occurs, the result of the query is presented to the user as a list of studies.

Table 22: Proposed Presentation Contexts for AE FIND-SCU

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70	SCU	None

By default, FIND-SCU will propose all uncompressed transfer syntaxes with local byte ordering first. No extended negotiation is performed. In particular, relational queries are not supported.

SOP Specific Conformance

FIND-SCU provides standard conformance to the supported C-FIND SOP Class.

Only a single information model, Study Root, is supported. All queries are initiated at the highest level of the information model (the STUDY level). A C-CANCEL request is issued when the returned results exceed 2000 matches.

Unexpected attributes returned in a C-FIND response (those not requested) are ignored. Non-matching responses returned by the SCP due to unsupported matching keys are not filtered locally by the FIND-SCU and, thus, will still be presented in the list. No attempt is made to filter out duplicate responses.

Since extended character sets are not supported (see section 5), the Specific Character Set (0008,0005) attribute is not used in the query.

Table 23: Study Root Request Identifier for AE FIND-SCU

Attribute Name	Tag	Types of Matching
Study Date	(0008,0020)	Universal, Range, Single Value
Modalities in Study	(0008,0061)	Universal, Single Value
Study ID	(0020,0010)	Universal, Wildcard
Patient's Name	(0010,0010)	Universal, Wildcard
Patient's ID	(0010,0020)	Universal, Single Value, Wildcard
Accession	(0008,0050)	Universal, Single Value, Wildcard
Study Description	(0008,1030)	Universal, Wildcard
Hospital/Institution Name	(0008,0080)	Universal, Wildcard
Referring Physician Name	(0008,0090)	Universal, Wildcard

Presentation Context Acceptance Criterion

FIND-SCU does not accept associations.

Transfer Syntax Selection Policies

Since FIND-SCU proposes a single presentation context only, the SCP is responsible for the transfer syntax selection.

Response Status

FIND-SCU will behave as described in Table 24 when receiving the C-FIND response command message.

Table 24: Response Status Handling Behavior for AE FIND-SCU

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A700	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
	SOP Class Not Supported	A800	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
Failed	Data set does not match SOP class	A900	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
	Unable to process	Cxxx	This is treated as a permanent failure. An error message is reported to both the service logs and to the user interface.
Pending	Matches are continuing - Warning that one or more optional keys were not supported for existence and/or matching for this identifier.	FF01	Current match is added to the internal list of studies but not yet presented to the user. A warning message is output to the service logs. No message is posted to the user interface.
Success	Matching is complete - No final identifier is supplied	0000	Current query is completed successfully; resulting list of studies is presented to the user. If the C-Find operation was canceled due to the returned match count, a warning dialog is presented to the user.
Cancel	Matching terminated due to Cancel request	FE00	A warning message is output to the service logs.

Table 25: Communication Failure Behavior for AE FIND-SCU

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
ASCE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
Association aborted by the SCP using A-ABORT or the network layers indicate communication loss (i.e. low-level TCP/IP socket closure)	An error message is reported to both the service logs and to the user interface.

Association Acceptance Policy

FIND-SCU does not accept associations.

(4) MOVE-SCU

MOVE-SCU provides standard conformance to the following DICOM SOP classes.

Table 26: SOP Classes for AE MOVE-SCU

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Query/Retrieve Information Model C-Move	1.2.840.10008.5.1.4.1.2.2.2	Yes	No

Association Policies

MOVE-SCU initiates but never accepts associations. The DICOM standard application context name, which is always proposed, is shown in Table 27.

Table 27: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size is set to the default of 16384 bytes.

SOP Class extended negotiation is not supported.

Table 28: Number of Associations as an Association Initiator for AE MOVE-SCU

Number of Associations as an Association Initiator for AE MOVE-SCU	
Maximum number of simultaneous associations	1

Asynchronous mode of operation is not supported.

Table 29: DICOM Implementation Class and Version for AE MOVE-SCU

DICOM Implementation Class and Version for AE MOVE-SCU	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

Association Initiation Policy

MOVE-SCU attempts to initiate a new association each time the user requests retrieval of a particular study. Each study is retrieved using a separate association, i.e. if the user selects multiple studies multiple successive associations are initiated.

Activity: Local User Requests Sending a Move

A single attempt will be made to retrieve a study from the remote AE. If the retrieval fails, no retry will be performed but an error message will be reported to the user.

Table 30: Proposed Presentation Contexts for AE MOVE-SCU

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian,	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70	SCU	None

		JPEG Lossless			
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No extended negotiation is performed.

SOP Specific Conformance

MOVE-SCU provides standard conformance to the supported C-MOVE SOP Class.

Only a single information model, Study Root, is supported. All retrieval is performed at the highest level of the information model (the STUDY level). C-CANCEL request are issued via user interaction with the application.

The retrieval is performed from the same AE that was used for the query performed by FIND-SCU. The studies are retrieved to the local system by specifying the destination as the AE Title of the local STORAGE-SCP. This implies that the remote AE must be preconfigured to determine the presentation address corresponding to the STORAGE-SCP. The STORAGE-SCP will accept storage requests addressed to it from anywhere, so no pre-configuration of the local AE to accept associations from the remote AE is necessary.

Table 31: Study Root Request Identifier for AE MOVE-SCU

Attribute Name	Tag	Request Key
Study Instance UID	(0020,000D)	Single Study Instance UID

Presentation Context Acceptance Criterion

MOVE-SCU does not accept associations.

Transfer Syntax Selection Policies

Since MOVE-SCU proposes a single presentation context only, the SCP is responsible for the transfer syntax selection.

Response Status

MOVE-SCU will behave as described in Table 32 when receiving the C-MOVE response command message.

Table 32: Response Status Handling Behavior for AE MOVE-SCU

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources - Unable to calculate number of matches	A701	Retrieval is terminated. An error message is reported to both the service logs and to the user interface.
	Out of resources - Unable to perform sub-operations	A702	Retrieval is terminated. An error message is reported to both the service logs and to the user interface.
Failed	Data set does not match SOP class	A900	Retrieval is terminated. An error message is reported to both the service logs and to the user interface.
	Unable to process	C000	Retrieval is terminated. An error message is reported to both the service logs and to the user interface.
	SOP Class Not Supported	A800	Retrieval is terminated.

			An error message is reported to both the service logs and to the user interface.
	Move Destination Unknown	A801	Retrieval is terminated. An error message is reported to both the service logs and to the user interface.
Cancel	Sub--operations terminated due to Cancel indication	FE00	A warning message is output to the service logs. Message is posted to the user interface.
Warning	Sub-operations complete - One or more failures	B000	Retrieval is considered successful. A warning message is output to the service logs. Message is posted to the user interface.
Success	Sub--operations complete – No failures	0000	Current retrieval is completed successfully. If the number of failed is 0 and number remaining equals 0 user interface indicates success, otherwise failure.

Table 33: Communication Failure Behavior for AE MOVE-SCU

Exception	Behavior
TCP/IP connection could not be established within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
ASCE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
DIMSE response message could not be received within the specified time range (configurable parameter).	An error message is reported to both the service logs and to the user interface.
Association aborted by the SCP using A-ABORT or the network layers indicate communication loss (ie. low--level TCP/IP socket closure)	An error message is reported to both the service logs and to the user interface.

Since the C-MOVE operation is dependent on completion of C-STORE sub-operations that are occurring on a separate association, the question of failure of operations on the other association(s) must be considered.

MOVE-SCU completely ignores whatever activities are taking place in relation to the STORAGE-SCP AE that is receiving the retrieved instances. Once the C-MOVE has been initiated, it runs to completion (or failure) as described in the C-MOVE response command message(s). There is no attempt by MOVE-SCU to confirm that instances have actually been successfully received or locally stored.

Whether or not completely or partially successful retrievals are made available in the local system to the user is purely dependent on the success or failure of the C-STORE sub-operations, not on any explicit action by MOVE-SCU.

Whether or not the remote AE attempts to retry any failed C-STORE sub-operations is beyond the control of MOVE-SCU.

If the association on which the C-MOVE was issued is aborted for any reason, whether or not the C-STORE sub-operations continue is dependent on the remote AE; the local STORAGE-SCP will continue to accept associations and storage operations regardless.

Association Acceptance Policy

MOVE-SCU does not accept associations.

(5) FIND-SCP

FIND-SCP provides standard conformance to the following DICOM SOP classes.

Table 34: SOP Classes for AE FIND-SCP

SOP Class Name	SOP Class UID	SCU	SCP
Study Root Query/Retrieve Information Model - FIND	1.2.840.10008.5.1.4.1.2.2.1	No	Yes

Association Policies

FIND-SCP accepts but never initiates associations. The DICOM standard application context name, which is always proposed, is shown in Table 35.

Table 35: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size is set to the default, 16384 bytes.

SOP Class extended negotiation is not supported.

Table 36: Number of Associations as an Association Acceptor for AE FIND-SCP

Number of Associations as an Association Acceptor for AE STORAGE-SCP	
Maximum number of simultaneous associations	Currently not limited

Asynchronous mode of operation is not supported.

Table 37: DICOM Implementation Class and Version for AE FIND-SCP

DICOM Implementation Class and Version for AE STORAGE-SCP	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

Association Initiation and Acceptance Policies

FIND-SCP does not initiate associations. The calling application entity titles are ignored. The called application entity title must be the FIND-SCP configured application entity title.

Association requests may be rejected with the reasons shown in Table 38.

Table 38: Association Rejection Reasons

Result	Source	Reason	Description
Rejected permanent	Provider, presentation related	Temporary congestion	Resource limitation: process creation failed
Rejected permanent	Provider	Called AE not found	Incorrect called AE title

Table 39: Acceptable Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian	1.2.840.10008.1.2, 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	SCP	None

Acceptable Presentation Contexts

Non-compressed presentation contexts are accepted. No extended negotiation is performed.

SOP Specific Conformance

FIND-SCP provides matching against keys described in table 40.

Table 40: Query Implementation

Attribute Name	Tag	Match use
Query Retrieve Level	(008,0052)	Level of query. STUDY SERIES
Study Date	(0008,0020)	Date Range. Only in STUDY level.
Accession Number	(0008,0050)	Matched. Only in STUDY level. Wildcard * supported.
Study ID	(0020,0010)	Matched. Only in STUDY level. Wildcard * supported.
Patient's Name	(0010,0010)	Matched. Only in STUDY level. Wildcard * supported.
Study Instance UID	(0020,000D)	Matched. Only in SERIES level.
Patient ID	(0010,0020)	Matched. Only in STUDY level. Wildcard * supported.

Transfer Syntax Selection Policies

For uncompressed transmission, the default behavior of FIND-SCP is to select for each presentation context containing a supported SOP class the explicit VR transfer syntax with the byte order matching

little endian byte order. If this is not available, implicit VR little endian is selected if available, otherwise the presentation context is rejected.

Response Status

FIND-SCP will behave as described in Table 41 when generating the C-FIND response command message.

Table 41: Response Status for AE FIND-SCP

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A700	Application out of memory, file system or database write error (e. g. disk full or missing rights). The DICOM instance was not stored. An error message is output to the service logs.
	SOP Class Not Supported	A800	Application received some images with unsupported SOP Class UID.
Error	Data set does not match SOP class	A900	The SOP Class UID or SOP Instance UID in the C-STORE-RQ does not match the corresponding UID in the received dataset. The DICOM instance was stored anyway. An error message is output to the service logs.
	Cannot understand	C000	The received DICOM instance did not include a SOP Class UID or SOP Instance UID. The DICOM instance was stored anyway. An error message is output to the service logs.
Success	Success	0000	The DICOM instance was successfully received and stored in the local system.

(6) MOVE-SCP

MOVE-SCP provides standard conformance to the following DICOM SOP classes.

Table 42: SOP Classes for AE FIND-SCP

SOP Class Name	SOP Class UID	SCP
Study Root Query/Retrieve Information Model - MOVE	1.2.840.10008.5.1.4.1.2.2.2	Yes

Association Policies

MOVE-SCP accepts but never initiates associations. The DICOM standard application context name, which is always proposed, is shown in Table 43.

Table 43: DICOM Application Context

DICOM Application Context	
Application context name	1.2.840.10008.3.1.1.1

The maximum PDU size is set to the default, 16384 bytes.

SOP Class extended negotiation is not supported.

Table 44: Number of Associations as an Association Acceptor for AE MOVE-SCP

Number of Associations as an Association Acceptor for AE STORAGE-SCP	
Maximum number of simultaneous associations	Currently not limited

Asynchronous mode of operation is not supported.

Table 45: DICOM Implementation Class and Version for AE MOVE-SCP

DICOM Implementation Class and Version for AE STORAGE-SCP	
Implementation Class UID	1.2.826.0.1.3680043.9.1400.1
Implementation Version Name	NEOSOFT_365

Association Initiation and Acceptance Policies

MOVE-SCP does not initiate associations. The calling application entity titles are ignored. The called application entity title must be the MOVE-SCP configured application entity title.

Association requests may be rejected with the reasons shown in Table 46.

Table 46: Association Rejection Reasons

Result	Source	Reason	Description
Rejected permanent	Provider, presentation related	Temporary congestion	Resource limitation: process creation failed
Rejected permanent	Provider	Called AE not found	Incorrect called AE title

Table 47: Acceptable Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Study Root	1.2.840.10008.	Implicit VR Little Endian,	1.2.840.10008.1.2,	SCP	None
Query/Retrieve Information Model – MOVE	5.1.4.1.2.2.2	Explicit VR Little Endian,	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Acceptable Presentation Contexts

No extended negotiation is performed.

SOP Specific Conformance

MOVE-SCP initiates a STORE-SCU to the CallingAE for a valid Study or Series Instance UID. The CallingAE must be configured in the local AE.

Transfer Syntax Selection Policies

The default behavior of MOVE-SCP is to select for each presentation context containing a supported SOP class the explicit VR transfer syntax with the byte order matching little endian byte order. If this is not available, implicit VR little endian is selected if available, otherwise the presentation context is rejected.

Response Status

MOVE-SCP will behave as described in Table 48 when generating the C-MOVE response command message.

Table 48: Response Status for AE MOVE-SCP

Service Status	Further Meaning	Error Code	Behavior
Refused	Out of resources	A700	Application out of memory, file system or database write error (e. g. disk full or missing rights). The DICOM instance was not stored. An error message is output to the service logs.
	SOP Class Not Supported	A800	Application received some images with unsupported SOP Class UID.
Error	Data set does not match SOP class	A900	The SOP Class UID or SOP Instance UID in the C-STORE-RQ does not match the corresponding UID in the received dataset. The DICOM instance was stored anyway. An error message is output to the service logs.
	Cannot understand	C000	The received DICOM instance did not include a SOP Class UID or SOP Instance UID. The DICOM instance was stored anyway. An error message is output to the service logs.
Success	Success	0000	The DICOM instance was successfully received and stored in the local system.

3.1.3 Physical Network Interfaces

(1) Physical Network Interfaces

The DICOM applications of suiteDXT are indifferent to the physical medium over which TCP/IP is used.

(2) Additional Protocols

When host names are used rather than IP addresses in the configuration to specify presentation addresses for remote AEs, the application is dependent on the name resolution mechanism of the underlying operating system.

3.2 MEDIA IMPORT

3.2.1 Introduction

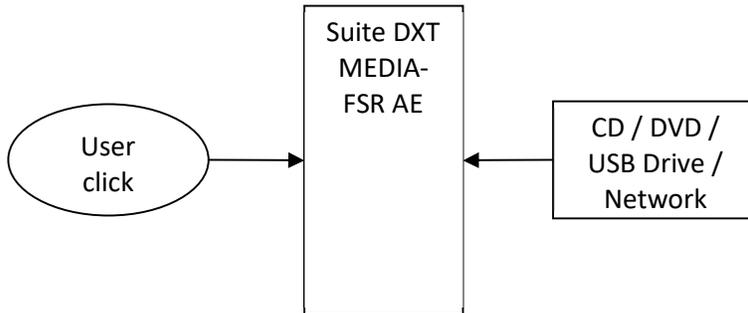
The suiteDXT application provides the ability to import DICOM objects from CD/DVD/USB/local file system. Import is initiated by the local user through the user interface.

3.2.2 Implementation Model

The suiteDXT application Media File Set Reader handles the importing of DICOM objects. The user will initiate the import process by clicking a user interface button and selecting the import file location. Each DICOM object is examined to determine if it meets the criteria defined in table and if so, is added to the suiteDXT system.

The Media File Set Reader AE Model for suiteDXT is shown in the Application Data Flow Diagram.

Application Data Flow Diagram



The MEDIA-FSR application entity reads DICOM images from a storage medium. The local real-world activity “Import from medium” is executed on user’s request.

The suiteDXT application has local storage that may contain various SOP instances. These may have been obtained by network (DICOM or proprietary) or by removable media using other application entities. These instances are external to this conformance claim and the origin of SOP instances is outside the scope of this claim. If importing a SOP instance that currently exists in the suiteDXT application database, the SOP instance being imported will be skipped.

The supported media during creation and restore are listed in Table 49.

Table 49: Supported Media Types for AE MEDIA-FSR

Media	Supported for Media Creator	Supported for Media Reader
CD-R	NA	Yes
CD-RW	NA	Yes
DVD-R	NA	Yes
DVD-RW	NA	Yes
DVD+R	NA	Yes
DVD+RW	NA	Yes
USB Storage	NA	Yes

(1) Functional Definition of AEs

Functional Definition of the MEDIA-FSR Application Entity

MEDIA-FSR is activated through the user interface to select a medium for import. All files found on the storage medium are evaluated and possibly imported into the local database.

(2) Sequencing of Real-World Activities

All activities of the MEDIA-FSR application entity are sequentially initiated in the user interface, and another activity may not be initiated until the prior activity has completed.

(3) File Meta Information for Implementation Class and Version

Not applicable.

3.2.3 AE Specifications

(1) MEDIA-FSR

The MEDIA-FSR application entity provides standard conformance to the DICOM Interchange Option of the Media Storage Service Class. The application profiles and roles are shown in Table 50.

Table 50: Supported Application Profiles for AE MEDIA-FSR

Application Profiles Supported	Real--World Activity	Role	SC Option
STD-XABC-CD	Import from medium	FSR	Interchange
STD-XA1K-CD	Import from medium	FSR	Interchange
STD-XA1K-DVD	Import from medium	FSR	Interchange
STD-US-ID-SF-CD	Import from medium	FSR	Interchange
STD-US-ID-MF-CD	Import from medium	FSR	Interchange
STD-GEN-CD	Import from medium	FSR	Interchange
STD-CTMR-CD	Import from medium	FSR	Interchange
STD-CTMR-DVD	Import from medium	FSR	Interchange
STD-CTMR-DVD-RAM	Import from medium	FSR	Interchange

File Meta Information

Not applicable.

Real-World Activity: Import from Medium

The MEDIA-FSR application entity acts as an FSR using the interchange option when requested to import SOP instances from a storage medium to the local system.

The MEDIA-FSR application entity supports the following SOP classes and transfer syntaxes.

Table 51: IODS, SOP Classes and Transfer Syntaxes for AE MEDIA-FSR

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian,	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2,

		JPEG Lossless	1.2.840.10008.1.2.4.70
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2, 1.2.840.10008.1.2.1, 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian, Implicit VR Little Endian	1.2.840.10008.1.2.1, 1.2.840.10008.1.2

3.2.4 Augmented and Private Application Profiles

The MEDIA-FSR application entity does not use any augmented or private application profiles.

3.2.5 Media Configuration

Concerning the MEDIA-FSR application entity, there are no configurable parameters.

3.3 SECURITY

3.3.1 Security Profiles

suiteDXT does not support any security profiles.

3.3.2 Association Level Security

The STORAGE-SCP accepts associations from all remote AEs, i.e. there is no restriction as to certain AE titles and/or IP addresses. STORAGE-SCP will accept associations from AEs not configured in the suiteDXT application.

3.3.3 Application Level Security

suiteDXT does not support any application level security.

3.4 De-identification or Anonymization

3.4.1 Introduction

The suiteDXT application provides the ability to anonymize DICOM objects. The DICOM standard Part 15 (PS3.15 Security Profiles) is used for guidance on which tags should be anonymized. Not all tags listed in part 15 are anonymized. The tags anonymized should allow for de-identification while the tags not removed or anonymized allow the study to contain enough information to be used for research or teaching. This process is initiated by the local user through the user interface.

3.4.2 Implementation Model

The suiteDXT application handles the anonymization of DICOM objects. The user will initiate the anonymize process by selecting a study and clicking the Anonymize button. Each DICOM object contained in the study will be anonymized. The Study/Series/image hierarchy will be maintained. The new anonymized study is added to the suiteDXT system.

3.4.3 Anonymization of SOP Instances

suiteDXT supports the de-identification (anonymization) of DICOM instances for supported storage SOP Classes and derives a new de-identified instance from an existing instance.

De-identification is performed in accordance with the DICOM Basic Application Level Confidentiality Profile as defined in DICOM [PS3.15](#)., with the exceptions described below. The following deviations from the Basic Application Level Confidentiality Profile are intentionally implemented to support suiteDXT and suiteHEART® Software application functionality:

- Series Description (0008,103E) is retained unchanged, as it is required by suiteDXT and suiteHEART® Software for correct series identification and analysis.
- A defined whitelist of private attributes is retained, consisting of 62 private attributes used internally by suiteHEART® Software for image processing and analysis. All other private attributes are removed. Retained private attributes are anonymized and verified to contain no patient-identifying information.

All other attributes are processed according to the Basic Application Level Confidentiality Profile,

Table 52 lists retained private attributes.

Attribute Name	DICOM Tag
Philips Rescale Outer Sequence	0x2001, 0x9000
Philips Rescale Inner Sequence	0x2001, 0x1068
Philips Private Creator Group 2001	0x2001, 0x0010
Philips Prepulse Delay	0x2001, 0x1018
Philips Prepulse Type	0x2001, 0x101C
Philips Private Creator DD 001	0x2005, 0x0010
Philips Private Creator DD 002	0x2005, 0x0011
Philips Private Creator DD 003	0x2005, 0x0012
Philips Private Creator DD 004	0x2005, 0x0013
Philips Private Creator DD 005	0x2005, 0x0014
Philips Private Creator DD 006	0x2005, 0x0015
Philips Rescale Intercept	0x2005, 0x1409
Philips Rescale Slope	0x2005, 0x140A
Philips Inversion Time	0x2005, 0x1527
Philips Private Imaging DD 001	0x2001, 0x0010

Philips Private Imaging DD 002	0x2001, 0x0011
Philips Private Imaging DD 129	0x2001, 0x0012
Philips Pulse Sequence	0x2001, 0x1020
Philips SPIR	0x2001, 0x1021
GE Number of Echos	0x0019, 0x107E
GE Pulse Sequence Name	0x0019, 0x109C
GE New QP Flag	0x0019, 0x10B2
GE Velocity Encoding	0x0019, 0x10CC
GE PC Flow Axis	0x0019, 0x10CB
GE Cardiac Phase Number	0x0019, 0x10D7
GE Velocity Encoding Scale	0x0019, 0x10E2
GE Acquisition Time MR	0x0019, 0x105A
GE Fast Phase	0x0019, 0x10F2
GE Pulse Sequence	0x0027, 0x1032
GE Plane Type	0x0027, 0x1035
GE Ortho Plane Type	0x0027, 0x1036
GE Scan RAS	0x0027, 0x1040
GE Views Per Segment	0x0043, 0x1007
GE Filter Mode	0x0043, 0x102D
GE VAS Collapse Flag	0x0043, 0x1030
GE VAS Flags	0x0043, 0x1032
GE SLOP INT 6	0x0043, 0x1039
GE Functional Processing	0x0051, 0x1002
Siemens CSA Image Private Creator	0x0029, 0x0010
Siemens CSA Image Header Type	0x0029, 0x1008
Siemens CSA Image Header Version	0x0029, 0x1009
Siemens CSA Image Header Data	0x0029, 0x1010

Siemens CSA Series Header Type	0x0029, 0x1018
Siemens CSA Series Header Version	0x0029, 0x1019
Siemens CSA Series Header Data	0x0029, 0x1020
Siemens MR SDS 01 Private Creator	0x0021, 0x0010
Siemens MR SDI 02 Private Creator	0x0021, 0x0011
Siemens MR SDR 01 Private Creator	0x0021, 0x0012
Siemens MR SDR 01 Private Creator	0x0021, 0x0012
Siemens Scan Option	0x0021, 0x105C
Siemens Image Type	0x0021, 0x1175
Siemens Image Sequence	0x07A3, 0x10CE
Toshiba Flow Scaling Factor	0x700D, 0x1000
Application Name	0x0099, 0x0010
Neo Private Creator	0x0099, 0x0011
Neo Private Signer ID	0x0099, 0x0015
Neo Original Manufacturer	0x0099, 0x1101
Neo SCPT Source	0x0099, 0x1102
Neo 4D Flow Series Creation Source	0x0099, 0x1103
Neo MOCO Series Creation Source	0x0099, 0x1104
Neo MOCO Original Series UID	0x0099, 0x1105
SCPT Data	0x0099, 0x1001

4. suiteHEART® Software

4.1 NETWORKING & MEDIA STORAGE

4.1.1 Networking

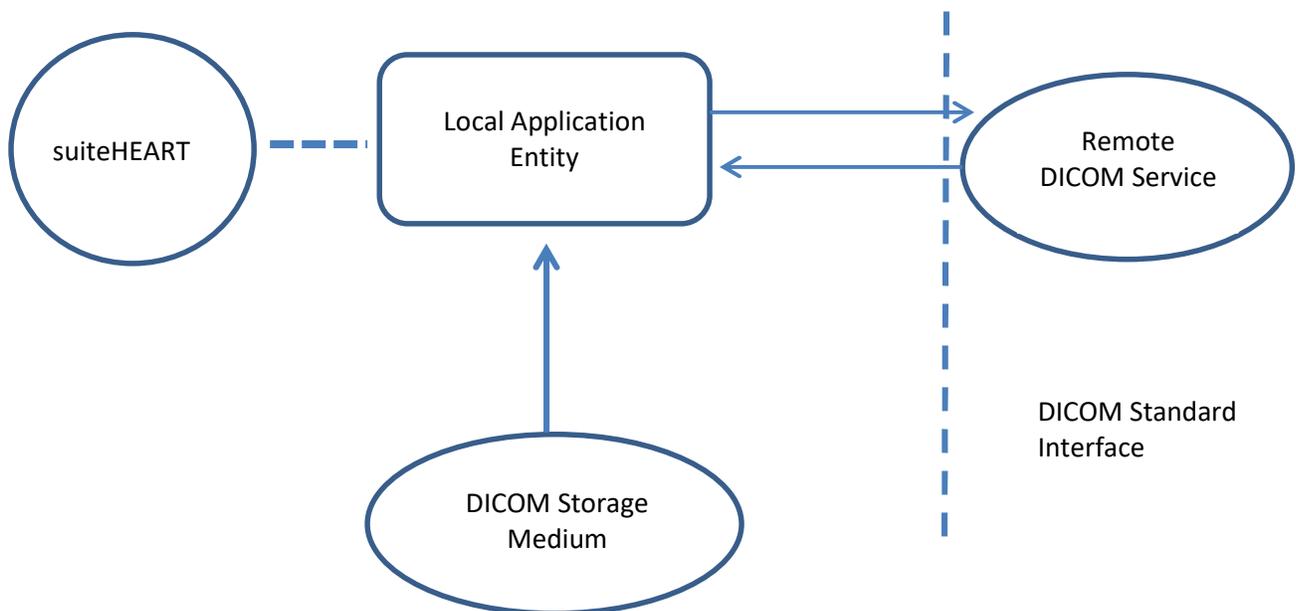
The suiteHEART® Software application works on DICOM files accessible in the local computers file system and does not send or retrieve DICOM data from the network.

In case there is a need for DICOM data to be pulled and pushed to network DICOM services, NeoSoft's application suiteDXT is used to perform this task. The following figure shows the data flow.

4.1.2 Media Storage

(1) Implementation Model

Figure 1: Application Data Flow Diagram



(2) Application Data Flow Diagram

The suiteHEART® Software application works on DICOM files available in the local system.

If there is a need for the DICOM data to be pulled and pushed to network DICOM services, another NeoSoft application, suiteDXT, is used to perform this task. Figure 1 shows the data connection

(3) Functional Definition of AEs

suiteHEART® Software is accessed through the suiteDXT application with a user selected study, which is in the local AE system. The application can also be started with a product configuration file that tells the location of the study, which can be any accessible directory through the computer's file system. In either

case, if a study (a group of DICOM MRI images) could not be found, an error is given, and the application will quit.

(4) File Meta Information for Implementation Class and Version

Not applicable.

4.1.3 AE Specifications

(1) Real-World Activities

All activities of suiteHEART® Software are sequentially initiated in the user interface. Application data, including temporary analysis state data, signed report data, and custom series, are stored as DICOM secondary capture data in the computer file system. The application DICOM data then can be pushed to remote DICOM service using suiteDXT or imported by other DICOM service application.

Table 53: SOP Classes for AE STORAGE-SCP

SOP Class Name	SOP Class UID	SCU	SCP
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	NA	NA
MR Enhanced Image Storage	1.2.840.10008.5.1.4.1.1.4.1	NA	NA
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	NA	NA

(2) Media Storage Application Profiles

suiteHEART® Software supports write access to the computer's file systems per the user's permission. It does not support direct writing to CD or DVD drive.

(3) Options

suiteHEART® Software supports the following SOP classes and transfer syntaxes. It writes its own application data using secondary capture DICOM data class, with AE entity (0x0002,0x0016) same as read from the study.

Table 54: IODS, SOP Classes and Transfer Syntaxes for AE MEDIA-FSR

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless JPEG Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70
MR Enhanced Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Implicit VR Little Endian, Explicit VR Little Endian, Explicit VR Big Endian, JPEG Lossless	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2, 1.2.840.10008.1.2.4.70
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian, Implicit VR Little Endian	1.2.840.10008.1.2.1 1.2.840.10008.1.2

4.1.4 Augmented and Private Application Profiles

Not applicable.

4.1.5 Media Configuration

Not applicable.

4.2 SECURITY

4.2.1 Security Profiles

suiteHEART® Software does not support any security profiles.

4.2.2 Association Level Security

Not applicable.

4.2.3 Application Level Security

suiteHEART® Software does not support any application level security.

4.3 ANNEXES

4.3.1 IOD Contents

suiteHEART® Software reads & writes the following tags to understand and analyze images.

(1) Consumed SOP Instances

suiteHEART® Software relies on the tags shown in the following table to perform its functions.

Table 55: IOD Tags for SOP Instances

Module	Attribute Name	Tag
FILE META INFORMATION	AE Title	(0002,0016)
MULTI-FRAME FUNCTIONAL GROUPS MODULE	Stack Position Number	(0020,9057)
FRAME OF REFERENCE MODULE	Frame Of Reference UID	(0020,0052)
GENERAL EQUIPMENT MODULE	Manufacturer	(0008,0070)
	Institution Name	(0008,0080)
GENERAL IMAGE MODULE	Image Type	(0008,0008)
	Content Time	(0008,0033)
	Acquisition Number	(0020,0012)
	Instance Number	(0020,0013)

	Images In Acquisition	(0020,1002)
GENERAL SERIES MODULE	Modality	(0008,0060)
	Series Description	(0008,103E)
	Patient Position	(0018,5100)
	Series Instance UID	(0020,000E)
	Series Number	(0020,0011)
GENERAL STUDY MODULE	Study Date	(0008,0020)
	Accession Number	(0008,0050)
	Referring Physician Name	(0008,0090)
	Study Description	(0008,1030)
	Study Instance UID	(0020,000D)
IMAGE PIXEL MODULE	Study Id	(0020,0010)
	Samples Per Pixel	(0028,0002)
	Photometric Interpretation	(0028,0004)
	Planar Configuration	(0028,0006)
	Rows	(0028,0010)
	Columns	(0028,0011)
	Bits Stored	(0028,0101)
	High Bit	(0028,0102)
	Pixel Representation	(0028,0103)
	Pixel Min Value	(0028,0106)
	Pixel Max Value	(0028,0107)
Pixel Data	(7FE0,0010)	
IMAGE PLANE MODULE	Slice Thickness	(0018,0050)
	Image Position	(0020,0032)
	Image Orientation	(0020,0037)
	Slice Location	(0020,1041)
	Pixel Spacing	(0028,0030)
MR IMAGE MODULE	Scanning Sequence	(0018,0020)
	Sequence Variant	(0018,0021)
	Scan Options	(0018,0022)
	Sequence Name	(0018,0024)
	Repetition Time	(0018,0080)
	Echo Time	(0018,0081)
	Inversion Time	(0018,0082)
	Number Of Averages	(0018,0083)
	Image Frequency	(0018,0084)
	Slice Spacing	(0018,0088)
	Echo Numbers	(0018,0086)
	Magnetic Field Strength	(0018,0087)
	Echo Train Length	(0018,0091)
Pixel Bandwidth	(0018,0095)	
Percent Phase Field Of View	(0018,0094)	

	Trigger Time	(0018,1060)
	Norminal Interval	(0018,1062)
	Heart Rate	(0018,1088)
	Receive Coil Name	(0018,1250)
	Acquisition Matrix	(0018,1310)
	Phase Encode Direction	(0018,1312)
	Flip Angle	(0018,1314)
	Temporal Position Identifier	(0020,0100)
	Bits Allocated	(0028,0100)
MR PULSE SEQUENCE MODULE	Philips Phase Contrast	(0018,9014)
MULTI-FRAME MODULE	Number Of Frames	(0028,0008)
PATIENT MODULE	Patient Name	(0010,0010)
	Patient Id	(0010,0020)
	Patient Birth Date	(0010,0030)
	Patient Sex	(0010,0040)
	Patient Age	(0010,1010)
	Patient Size	(0010,1020)
	Patient Weight	(0010,1030)
MULTI-FRAME FUNCTIONAL GROUPS MODULE	Rescale Intercept	(0028,1052)
	Rescale Slope	(0028,1053)
	Rescale Type	(0028,1054)
SOP COMMON MODULE	Specific Char Set	(0008,0005)
	Sop Class UID	(0008,0016)
	Sop Instance UID	(0008,0018)
VOI LUT MODULE	Window Center	(0028,1050)
	Window Width	(0028,1051)
NEOSOFT PRIVATE DATA MODULE	Secondary Capture Data	(0099,1001)

(2) Created SOP Instances

suiteHEART® Software uses secondary captured (SC) storage class for this application data and report. The actual data is stored in private tag (0099,1001).

(3) SC Image IOD

suiteHEART® Software creates SC Image objects showing the results of a quantitative evaluation in a graphical presentation (e.g. polar map, diagram). Table 4 describes the modules and attributes of the underlying IOD. Most attributes that are never present in a created SOP instance are omitted from the tables in order to increase the readability.

(4) Attribute Mapping

suiteHEART® Software does not use any attribute mapping.

(5) Coerced/Modified Fields

suiteHEART® Software does not modify any fields of existing DICOM object it reads.

4.4 DATA DICTIONARY OF PRIVATE ATTRIBUTES

The private attributes added to created SOP instances are listed in Table 5. suiteHEART® Software uses blocks of private attributes. Further details on the usage of these private attributes are described in “IOD Contents.”

Table 56: Data Dictionary of Private Attributes in Created SOP INSTANCES

Tag	Attribute Name	VR	VM	Attribute Description
(0099,0010)	Private Tag Owner	CS	1	Product ID (suiteHEART) that creates the DICOM

4.4.1 Coded Terminology and Templates

suiteHEART® Software does not use any coded terminology or templates.

4.4.2 Grayscale Image Consistency

suiteHEART® Software does not make use of the DICOM Grayscale Standard Display Function.

4.4.3 Standard Extended / Specialized / Private SOP Classes

The system does not support any other specialized or private SOP classes beside MR SOP, Enhanced MR SOP classed and its own SC class data.

4.4.4 Private Transfer Syntaxes

suiteHEART® Software does not use any private transfer syntaxes.