SIEMENS

Opdima ASW3.0

SPS

DICOM Conformance Statement

X173 423 001 V 1.0

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Anna Olsson
SPS-UP

Reviewed by	Approved by
Name/Dept.:	Name/Dept.:
Date:	Date:
Signature:	Signature:

History

Document History

Version	Release Date	Description
00	10 May 1999	First version
1.0	3 June 2002	Software version ASW3.0. Basic Grayscale Print Management added. See chapter Detailed revision history on page 37

1 Introduction

1.1 Purpose

This is the DICOM Conformance statement of the Siemens Mammography product Opdima. It is written according to part PS 3.2 of ref [1].

The applications described in this conformance statement implement the DICOM network functionality in Opdima.

The Opdima DICOM network implementation will act as SCU and SCP for the storage and verification DICOM network services. It will also work as SCU for the print management service.

1.2 Scope

This DICOM Conformance Statement refers to the Siemens Mammography product Opdima using software version ASW3.0.

1.3 Product Description

The Opdima is a digital mammography system used for stereotactic and spot imaging. The acquired images are stored in a local database and can be sent to remote DICOM nodes as MG, DX or SC images, depending on what the remote server can support.

Although it is not intended as a workstation or an archive, the Opdima is able to receive, display and store single-frame grayscale images from several other modalities including US and MR. However, there are limitations in the amount of data stored and displayed for such images.

Images can be printed from the Opdima, using the Basic Grayscale Print Management Meta SOP Class.

2 Definitions, Abbreviations

2.0.1 Definitions

DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DIMSE-C	DICOM Message Service Element with Composite information objects
Folder	Opdima specific name for a set of images. Corresponds to a DICOM Study
RECIM	The name used in this document for the Opdima DICOM SCP (server) software

SENDIM	The name used in this document for the Opdima DICOM Storage SCU (client) software
PRINTIM	The name used in this document for the Opdima DICOM Print Management SCU (client) software
TESTCOM	The name used in this document for the Opdima DICOM Verification SCU (client) software

2.0.2 Abbreviations

ACR	American College of Radiology
AE	Application Entity - corresponds to a DICOM client or server application
AET	Application Entity Title - an AE name that is unique on the network
ASCII	American Standard Code for Information Interchange
DS	Decimal String (16 bytes maximum)
DX	Digital X-Ray Image (DICOM IOD name)
GUI	Graphical User Interface
IOD	DICOM Information Object Definition
IS	Integer String (12 bytes maximum)
ISO	International Standard Organization
LO	Long String (64 characters maximum)
MG	Digital Mammography X-Ray Image (DICOM IOD name)
MR	Magnetic Resonance Image (DICOM IOD name)
NEMA	National Electrical Manufacturers Association
RIS	Radiology Information System
PDU	DICOM Protocol Data Unit
SC	Secondary Capture (DICOM IOD name)
SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SH	Short String (16 characters maximum)
SOP	DICOM Service-Object Pair
ST	Short Text (1024 characters maximum)
UID	Unique IDentifier, string unique in the whole network
UL	Unsigned Long (4 bytes fixed)
US	Ultrasound Image (DICOM IOD name)
USh	Unsigned Short (2 bytes fixed)

2.1 References

[1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-14, 1998

[2] Digital Imaging and Communications in Medicine (DICOM) Supplement 32: Digital X-Ray Supplement

2.2 Connectivity and Interoperability

The implementation of the Siemens Opdima DICOM interface has been carefully tested to assure correspondence with this Conformance Statement. But the Conformance Statement and the DICOM standard do not guarantee interoperability of Siemens modalities and modalities of other vendors. The user must compare the relevant Conformance Statements and if a successful interconnection should be possible, the user is responsible for specifying an appropriate test suite and validating the interoperability that is required. A network environment may need additional functions out of the scope of DICOM.

3 Implementation Model

The Siemens SENDIM DICOM Application Entity originates associations for Storage of DICOM Composite Information Objects in Remote Application Entities.

The RECIM DICOM application entity accepts associations for Verification and for Storage of DICOM Composite Information Objects from Remote Application Entities.

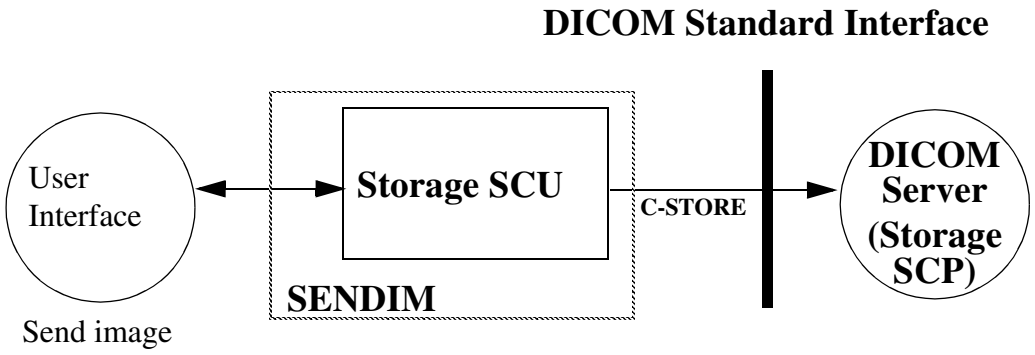
The TESTCOM application entity originates associations for Verification of Remote Application Entities.

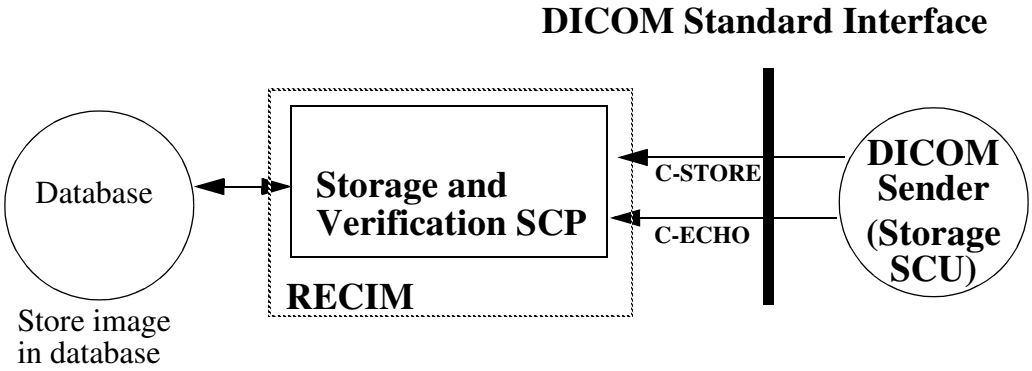
The Siemens PRINTIM DICOM Application Entity originates associations for Print of DICOM Composite Information Objects in Remote Application Entities.

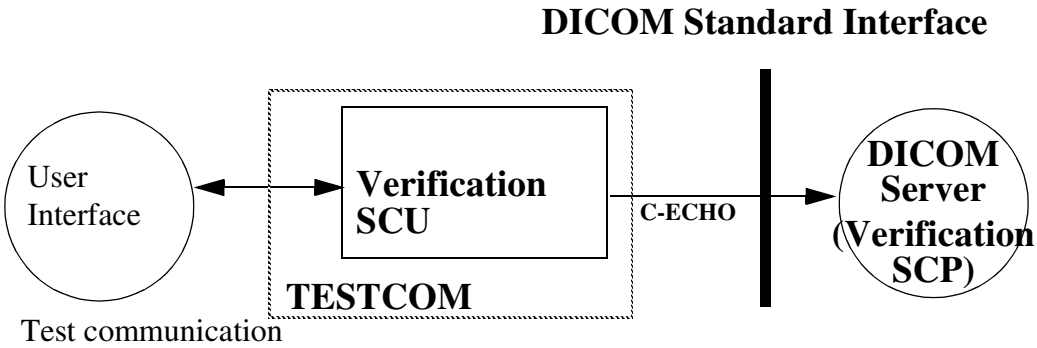
3.1 Application Data Flow Diagram

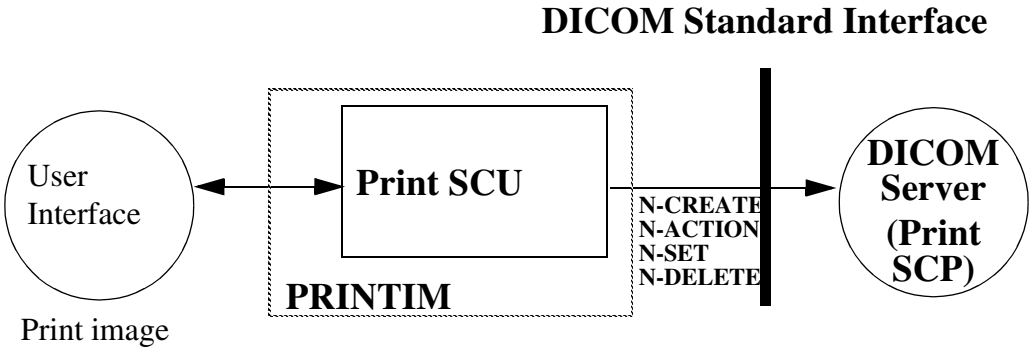
The Opdima DICOM network implementation is a UNIX application. It acts as SCU and SCP for the C-STORE and C-ECHO DICOM network service. It acts as SCU for the print management network service.

It consists of four parts: SENDIM (the C-STORE SCU), RECIM (the SCP for storage and verification), PRINTIM (the SCU for print management) and TESTCOM (the C-ECHO SCU):









3.2 Functional Definitions of Application Entities

All components of the Siemens Opdima DICOM application operate as background processes.

The Storage and Verification SCP part RECIM is started when the machine is powered on. It waits for association requests from remote DICOM clients. The AET and the port number it is listening on are defined in section 7.1 on page 36.

The Storage SCU part SENDIM is started by user interaction with the Opdima GUI. It initiates an association with a remote DICOM server.

The Verification SCU part TESTCOM is started by user interaction with the Opdima service user interface. It initiates an association with a remote DICOM server.

The Print Management SCU part PRINTIM is started by user interaction with the Opdima GUI. It initiates an association with a remote DICOM server.

All servers must be configured on the Opdima by entering the hostname, AET etc. in the Opdima service interface before they can be used as remote SCP:s.

Both SCU and SCP Storage jobs as well as SCU Print jobs can be monitored and aborted from the DICOM Job Control Dialog.

3.3 Sequencing of Real World Activities

Not applicable.

4 Application Entity Specifications

4.1 Storage and Verification AEs Specification

The SENDIM SCU application provides one AE being used when initiating associations to remote DICOM nodes.

The TESTCOM SCU application provides one AE being used when initiating associations to remote DICOM nodes.

The RECIM SCP provides one AE being used when associations are requested from remote servers.

The Siemens Opdima DICOM product provides Standard Extended Conformance to the following DICOM V3.0 SOP Classes as an SCU:

Table 1 *SOP Classes as an SCU*

SOP Class Name	SOP Class UID
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
CR Image Information Object Storage	1.2.840.10008.5.1.4.1.1.1
MR Image Information Object Storage	1.2.840.10008.5.1.4.1.1.4
CT Image Information Object Storage	1.2.840.10008.5.1.4.1.1.2
NM Image Information Object Storage	1.2.840.10008.5.1.4.1.1.20
US Image Information Object Storage	1.2.840.10008.5.1.4.1.1.6.1
X-Ray Angiographic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.2

The Siemens Opdima DICOM product provides Standard Conformance to the following DICOM V3.0 SOP Classes as SCP (Note: There are some conformance limitations, see section 4.1.3.2.4 on page 28 and section 4.1.3.2.5 on page 29):

Table 2 *SOP Classes as SCP*

SOP Class Name	SOP Class UID
Digital Mammography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
CR Image Information Object Storage	1.2.840.10008.5.1.4.1.1.1
MR Image Information Object Storage	1.2.840.10008.5.1.4.1.1.4
CT Image Information Object Storage	1.2.840.10008.5.1.4.1.1.2
NM Image Information Object Storage	1.2.840.10008.5.1.4.1.1.20
US Image Information Object Storage	1.2.840.10008.5.1.4.1.1.6.1
X-Ray Angiographic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.1
X-Ray Radiofluoroscopic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.2

The Siemens Opdima DICOM product provides Standard Conformance to the following DICOM V3.0 SOP Class as SCU and SCP:

Table 3 *SOP Classes as SCU and SCP*

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

4.1.1 Association Establishment Policies

4.1.1.1 General

The maximum PDU size is 28672 Bytes.

4.1.1.2 Number of Associations

The Siemens Opdima SENDIM DICOM application initiates several associations at a time, one for each transfer request being processed. There is no specified maximum number of simultaneous associations.

The Siemens Opdima RECIM DICOM application accepts several associations at a time. There is no specified maximum number of simultaneous associations.

The Siemens Opdima TESTCOM DICOM application initiates one association at a time.

4.1.1.3 Asynchronous Nature

The Siemens Opdima DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

4.1.1.4 Implementation Identification Information

The Siemens Opdima DICOM software provides a single Implementation Class UID of

- 1.3.12.2.1107.5.12.2

and an Implementation Version Name of

- “SIEMENS_OPD_3.0”

4.1.1.5 DICOM Application Context

The Siemens Opdima uses the following DICOM Application Context Name:

- 1.2.840.10008.3.1.1.1

4.1.2 Association Initiation Policy

The Siemens Opdima SENDIM DICOM application attempts to initiate a new association for the

- DIMSE C-STORE

service operation.

The Siemens Opdima TESTCOM DICOM application attempts to initiate a new association for the

- DIMSE C-ECHO

service operation.

4.1.2.1 Real-World Activity “Test connection to remote node“

4.1.2.1.1 Associated Real-World Activity

The operator performs connectivity tests from the Opdima service mode. This will start a TESTCOM process that will initiate an association with the selected DICOM server and send an C-ECHO request. The result (OK/Failed) will then be presented to the operator.

4.1.2.1.2 Proposed Presentation Contexts

The Siemens TESTCOM DICOM application will propose Presentation Contexts as shown in the following table:

Table 4 *Initiation presentation context*

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotia-tion
Verification SOP Class	1.2.840.10008.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

4.1.2.1.3 SOP Specific Conformance Statement to Verification SOP classes

The Opdima provides standard conformance to the DICOM Verification Service Class.

4.1.2.2 Real-World Activity “Send images to remote node”

4.1.2.2.1 Associated Real-World Activity

There are two ways to activate sending of images:

- The operator selects a number of folders in the database dialog and presses “Send...“ to send all images in these folders.
- The operator presses “Send image...“ in the frame of the active image in the image window to send a single image.

In both cases, a server selection dialog pops up. The operator selects the send destination and presses “OK”.

This will start a background process that will initiate a C-STORE request. If the process successfully establishes an association to a remote Application Entity, it will transfer each image one after another via the open association. If the C-STORE response from the remote Application contains a failure status, this will be indicated to the operator in the DICOM job dialog. A request resulting in a response with a success or warning status is considered successful.

The background send process can be monitored or aborted in a DICOM job dialog.

4.1.2.2.2 Proposed Presentation Contexts

The Siemens SENDIM DICOM application will propose Presentation Contexts as shown in the following table:

Table 5 *Initiation presentation context*

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotia-tion
MG Image Storage - For Presentation SOP Class	1.2.840.10008.5.1.4.1.1.1.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
DX Image Storage - For PresentationSOP Class	1.2.840.10008.5.1.4.1.1.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
SC Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Table 5 *Initiation presentation context*

CR Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
MR Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.4	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
CT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
NM Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.20	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
US Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None
X-Ray Angiographic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

Table 5 Initiation presentation context

X-Ray Radiofluoroscopic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

4.1.2.2.3 SOP Specific Conformance Statement to Storage SOP classes

The DICOM images created by Siemens Opdima SENDIM DICOM application conform to the DICOM IOD definitions (Standard extended IODs). However, they will contain additional private elements which have to be discarded by a remote DICOM system when modifying the image.

The remote DICOM nodes are responsible for data consistency when modifying images. All unknown private attributes have to be removed upon modification.

Opdima images will be sent as either MG, DX or SC (in that priority), depending on what the receiving server can handle. The SOP instance UID assigned to the image will depend on the modality used. However, Opdima images created with software version 1.3 or earlier will always be sent as SC, as there is not sufficient data stored to construct DX or MG image objects for such images.

Note: The Window Center and Window Width attributes correspond to the desired lookup parameters stored in the Opdima. These values may be modified by the Operator at any time. This will NOT change the SOP instance UID of the image.

A number of timeouts are used during association initiation, see section 7.3 on page 36.

Data Dictionary of DICOM Standard IOD Attributes

The tables below list the data dictionary of all DICOM standard IOD attributes that may be encoded with non-zero value length when sending images that have been created by the Opdima.

When sending a non-Opdima image (that has previously been received from a remote DICOM client) the Opdima will regenerate the original incoming message and attempt to send it without verifying the message contents. In this case, the attributes included may not confirm to what is specified below. However, if the receiving server does not accept the modality in question, the Opdima will create and attempt to send an SC image from the original image. The SC image will be assigned a new SOP instance UID and a new Series Instance UID. Tables 6 - 8 describe the attributes within the image.

The attributes in Table 6 are standard attributes for SC, DX and MG images that may be provided by the Opdima. Attributes listed as type 1 will always be provided.

Attributes in Table 7 are standard attributes for DX and MG images only. However these attributes may be sent from the Opdima for SC, DX and MG images. Attributes listed as type 1 will always be provided for DX and MG images, as well as for SC images that have been converted from DX or MG by Opdima.

Attributes in Table 8 are standard attributes for SC images, but not for DX or MG. These attributes are sent for SC images only. Attributes listed as type 1 will always be provided.

Table 6 *Data Dictionary of DICOM Standard IOD Attributes SC, DX and MG Image (Type for SC)*

Attribute Name	Tag	Type	Value
SOP Class UID	(0008,0016)	1	
SOP Instance UID	(0008,0018)	1	Opdima-generated images will have SOP Instance UID:s that begin with 1.3.12.2.1107.5.12.2.
Specific Character Set	(0008,0018)	1C	ISO_IR 100
Patient’s Name	(0010,0010)	2	
Patient ID	(0010,0020)	2	
Patient’s Birth Date	(0010,0030)	2	
Patient’s Sex	(0010,0040)	2	
Study Instance UID	(0010,000D)	1	
Study Date	(0008,0020)	2	
Study Time	(0008,0030)	2	
Referring Physician’s Name	(0008,0090)	2	
Study ID	(0020,0010)	2	
Accession Number	(0008,0050)	2	
Study Description	(0008,1030)	3	
Modality	(0008,0060)	1	
Series Instance UID	(0020,000E)	1	
Series Number	(0020,0011)	2	
Laterality	(0020,0060)	2C	
Image Number	(0020,0013)	2	
Patient Orientation	(0020,0020)	2C	
Image Date	(0008,0023)	2C	

Table 6 Data Dictionary of DICOM Standard IOD Attributes SC, DX and MG Image (Type for SC)

Attribute Name	Tag	Type	Value
Image Time	(0008,0033)	2C	
Image Type	(0008,0008)	3	
Image Comments	(0020,4000)	3	
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME1 or MONOCHROME2
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Bits Allocated	(0028,0100)	1	8 or 16
Bits Stored	(0028,0101)	1	6 to Bits Allocated
High Bit	(0028,0102)	1	One less than Bit Stored
Pixel Representation	(0028,0103)	1	
Pixel Data	(7FE0,0010)	1	
Smallest Image Pixel Value	(0028,0106)	3	
Largest Image Pixel Value	(0028,0107)	3	
Window Center	(0028,1050)	3	
Window Width	(0028,1051)	1C	
Referenced Image Sequence	(0008,1140)	3	Used only for Mammographic biopsy stereo images
>Referenced SOP Class UID	(0008,1150)	1C	
>Referenced SOP Instance UID	(0008,1155)	1C	
Manufacturer	(0008,0070)	2	
Institution Name	(0008,0080)	3	
Station Name	(0008,1010)	3	
Institutional Department Name	(0008,1040)	3	
Software Version	(0018,1020)	3	

Table 7 *Data Dictionary of DICOM Standard IOD Attributes DX and MG Images (type for DX)*

Attribute Name	Tag	Type	Value
Body Part Thickness	(0018,11A0)	3	
Organ Exposed	(0040,0318)	3	
Organ Dose	(0040,0316)	3	
KVP	(0018,0060)	3	
Exposure Time	(0018,1150)	3	
Exposure	(0018,1152)	3	
Exposure Control Mode	(0018,7060)	3	
Focal Spot	(0018,1190)	3	
Anode Target Material	(0018,1191)	3	
Filter Material	(0018,7050)	3	
Filter Thickness Minimum	(0018,7052)	3	
Filter Thickness Maximum	(0018,7054)	3	
Presentation Intent Type	(0008,0068)	1	FOR PRESENTATION
Image Laterality	(0020,0062)	1	
Anatomic Region sequence	(0008,2218)	2	
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	
Pixel Intensity Relationship	(0028,1040)	1	
Pixel Intensity Relationship Sign	(0028,1041)	1	
Rescale Intercept	(0028,1052)	1	0
Rescale Slope	(0028,1053)	1	1
Rescale Type	(0028,1054)	1	Enumerated value: Unspecified
Presentation LUT Shape	(2050,0020)	1	Enumerated values: IDENTITY/ INVERSE[a]
Lossy Image Compression	(0028,2110)	1	

Table 7 Data Dictionary of DICOM Standard IOD Attributes DX and MG Images (type for DX)

Attribute Name	Tag	Type	Value
Lossy Image Compression Ratio	(0028,2112)	1C	
Burned In Annotation	(0028,0301)	1	
Detector Type	(0018,7004)	2	
Imager Pixel Spacing	(0018,1164)	1	
View Code sequence	(0054,0220)	3	
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	Values according to ref [2] C.8.X.7.1.2
>View Modifier Code Sequence	(0054,0222)	3	
>Code Value	(0008,0100)	1C	
>Coding Scheme Designator	(0008,0102)	1C	
>Code Meaning	(0008,0104)	3	Values according to ref [2] C.8.X.7.1.3
Positioner Primary Angle	(0018,1510)	3	
Positioner Secondary Angle	(0018,1511)	3	
Positioner Type	(0018,1508)	2	

a. NOTE: This attribute indicates that the output of all the defined grayscale transformations is in P-Values, however, Opdima does not guarantee that this is true, since the necessary measurments to determine this have not been performed so far.

Table 8 Data Dictionary of DICOM Standard IOD Attributes SC Images Only

Attribute Name	Tag	Type	Value
Conversion Type	(0008,0064)	1	WSD

Data Dictionary of applied private IOD Attributes

Table 9 lists the data dictionary of all private IOD attributes that may be sent for images that have been created by the Opdima.

When sending a non-Opdima image (that has previously been received from a remote DICOM client) the Opdima will regenerate the original incoming message and attempt to send it without verifying the message contents. In this case, the private attributes included may not confirm to what is specified below.

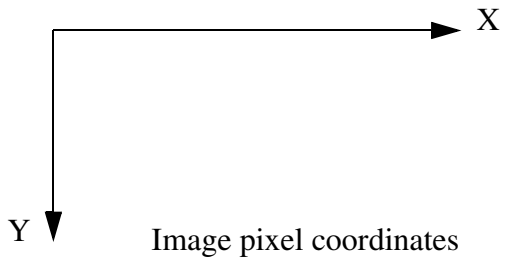


Figure 1: *The image coordinates used for several private attributes (image as displayed on monitor)*

Table 9 *Data Dictionary of private IOD Attributes for SC, DX and MG images*

Attribute Name	Tag	VR	VM	Description
Identifier	(0021,0010)	LO	1	SIEMENS MED SP OPDIMA STUDY
Folder Type	(0021,1005)	LO	1	Describes the type of folder. Defined Terms: SPOT_EXAMINATION ,STEREO_EXAMINAT ION, COLLECTION, EXTERNAL_STUDY
Folder Name	(0021,1004)	LO	1	Opdima specific folder name
Folder Creator	(0021,1002)	SH	1	Login name of current user when folder was created
Folder ID	(0021,1003)	SH	1	Opdima specific folder identification
Examination Type	(0021,1006)	SH	1	Describes the performed examination: Spot/FNA/ Core Biopsy/ Localization
Identifier	(0019,0010)	LO	1	SIEMENS MED SP OPDIMA IMAGE

Table 9 Data Dictionary of private IOD Attributes for SC, DX and MG images

Attribute Name	Tag	VR	VM	Description
Pre-mAs	(0019,1018)	FL	1	If Exposure Control Mode (0018,7060) is AUTOMATIC, the mAs-value of the pre-exposure, else 0
Detector Amplification	(0019,1005)	FL	1	Detector amplification value used when this image was acquired
Frame of Reference Origin X	(0019,1006)	FL	1	X-component of the origin of the real-world coordinate system expressed in image coordinates
Frame of Reference Origin Y	(0019,1007)	FL	1	Y-component of the origin of the real-world coordinate system expressed in image coordinates
Frame of Reference X-Base X	(0019,1008)	FL	1	X-component of the X base vector of the real-world coordinate system expressed in pixels/mm
Frame of Reference X-Base Y	(0019,1009)	FL	1	Y-component of the X base vector of the real-world coordinate system expressed in pixels/mm
Frame of Reference Y-Base X	(0019,1010)	FL	1	X-component of the Y base vector of the real-world coordinate system expressed in pixels/mm
Frame of Reference Y-Base Y	(0019,1011)	FL	1	Y-component of the Y base vector of the real-world coordinate system expressed in pixels/mm
Number of Reference Points	(0019,1016)	US	1	The number of items in the Reference Point Sequence. Values allowed are 0, 1, 2 or 3
Reference Point X	(0019,1019)	FL	1-n	In image pixels

Table 9 Data Dictionary of private IOD Attributes for SC, DX and MG images

Attribute Name	Tag	VR	VM	Description
Reference Point Y	(0019,1020)	FL	1-n	In image pixels
Number of Target Points	(0019,1017)	US	1	The number of items in the Target Point Sequence
Target Point X	(0019,1024)	FL	1-n	In image pixels
Target Point Y	(0019,1025)	FL	1-n	In image pixels
Default Center Pixel X	(0019,1001)	FL	1	In image pixels
Default Center Pixel Y	(0019,1002)	FL	1	In image pixels
Default Zoomscale	(0019,1004)	FL	1	Zoomscale relative to the Opdima default presentation
Default Target Visibility	(0019,1003)	US	1	0 or 1
Image ID	(0019,1013)	LO	1	Opdima specific image ID
Image Name	(0019,1015)	ST	1	Opdima specific image name
Image Index	(0019,1014)	US	1	Opdima specific image index
Stereo Angle	(0019,1022)	FL	1	Angle between the X-Ray beam and the normal of the object table. Negative value if generator tilted left of standing patient.
Grid Was Used	(0019,1012)	US	1	0 or 1
Resolution	(0019,1021)	SH	1	HIGH/NORMAL
Stereo Partner Image ID	(0019,1023)	LO	1	Image ID of the other image in stereo pair

4.1.2.2.4 Image Pixel Attribute Description for Grayscale Images

The Siemens Opdima SENDIM application will support monochrome 1 and monochrome 2 photometric interpretations for the following image attribute values:

+ samples per pixel (attribute 0028, 0002) = 1
+ photometric interpretation (attribute 0028,0004) = "MONOCHROME1"

+ photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
+ pixel representation (attribute 0028, 0103) = 000H = Unsigned Integer
+ bits allocated (attribute 0028, 0100) = 8 or16
+ bits stored (attribute 0028,0101) = 2 to bits allocated
+ high bit (attribute 0028,0102) = bits stored minus 1

No overlay data will be encoded in the pixel data planes.

4.1.2.2.5 Image Pixel Attribute Description for Color Images

The Siemens Opdima DICOM application does not support color images.

4.1.3 Association Acceptance Policy

The Siemens RECIM DICOM application attempts to accept new associations for

- DIMSE C-ECHO
- DIMSE C-STORE

service operations.

4.1.3.1 Real-World Activity “Reply to verification request from a remote node“

4.1.3.1.1 Associated Real-World Activity

The daemon server process RECIM will accept an association and reply to C-ECHO requests from any remote DICOM node. This is not visible for the Opdima operator (not logged, not displayed).

4.1.3.1.2 Accepted Presentation Contexts

The Siemens Opdima DICOM application will accept Presentation Contexts as shown in the following table:

Table 10 *Acceptable presentation contexts*

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotia-tion

Table 10 Acceptable presentation contexts

Verification SOP Class	1.2.840.10008.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

4.1.3.1.3 SOP Specific Conformance Statement to Verification SOP classes

The Opdima provides standard conformance to the DICOM Verification Service Class.

4.1.3.2 Real-World Activity "Receiving image objects from a remote node"

4.1.3.2.1 Associated Real-World Activity

The daemon server process will accept an association and will receive any images (specified in this conformance statement) transmitted on that association and will store the images on disk in the Opdima "DICOM Inbox" database.

The incoming message, with all attributes, including private ones, will be stored. However, any overlay data encoded in the pixel data will be discarded. A limited number of attributes will also be used to construct and store the image in the Opdima-specific format.

The background receive job can be monitored and aborted in a DICOM job dialog.

4.1.3.2.2 Accepted Presentation Contexts

The Siemens Opdima DICOM application will accept Presentation Contexts as shown in the following table:

Table 11 Acceptable presentation contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotia-tion
MG Image Storage - For Presentation SOP Class	1.2.840.10008.5.1.4.1.1.1.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None

Table 11 Acceptable presentation contexts

DX Image Storage - For PresentationSOP Class	1.2.840.10008.5.1.4.1.1.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
SC Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.7	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
CR Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
MR Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.4	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
CT Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
NM Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.20	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None

Table 11 *Acceptable presentation contexts*

US Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.6.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
X-Ray Angiographic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.1	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None
X-Ray Radiofluoroscopic Image Storage SOP Class	1.2.840.10008.5.1.4.1.1.12.2	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCP	None

4.1.3.2.3 SOP Specific Conformance Statement

The Siemens Opdima DICOM application conforms to the Full Storage Service Class at Level 0. All data will be stored, except overlay data that is encoded in the image pixel data. However, it will not be possible to access all modality specific data from the Opdima interface.

In the event of a successful C-STORE operation, the image has successfully been written on disk.

The Opdima DICOM server returns the status Success upon successful operation otherwise one of the following status codes is returned and the association is thereafter aborted:

- Refused (A700):
  This error status indicates a lack of Resources (e.g. not enough disk space) on the Opdima modality.
- Error (A900 or C000):
  An error occurred while processing the image which makes it impossible to proceed. The image will not be stored and the association will be aborted.

4.1.3.2.4 Image Pixel Attribute Acceptance Criterion for Grayscale

Images

The Siemens Opdima RECIM application will support monochrome 1 and monochrome 2 photometric interpretations for the following image attribute values:

+ samples per pixel (attribute 0028, 0002) = 1
+ photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
+ photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
+ pixel representation (attribute 0028, 0103) = 000H = Unsigned Integer
+ bits allocated (attribute 0028, 0100) = 8 or16
+ bits stored (attribute 0028,0101) = 2 to bits allocated
+ high bit (attribute 0028,0102) = bits stored minus 1

Any overlay data encoded in the image pixel data (group 7Fe0) will be discarded.

4.1.3.2.5 Image Pixel Attribute Description for Color Images

The Siemens Opdima DICOM application does not support color images.

4.1.3.3 Presentation Context Acceptance Criterion

The Siemens Opdima DICOM application will accept any number of verification or storage SOP classes that are listed above. There is no limit on the number of presentation contexts accepted. In the event that the Siemens Opdima DICOM application runs out of resources, it will reject the association request.

4.1.3.4 Transfer Syntax Selection Policies

The Siemens Opdima DICOM application currently only supports the Implicit VR Little Endian, the Explicit VR Little Endian and Explicit VR Big Endian transfer syntax. Any proposed presentation context which includes one of these transfer syntaxes will be accepted Any proposed presentation context that does not include one of these transfer syntaxes will be rejected.

The transfer syntax will be selected in the following order:

- Explicit Big Endian
- Explicit Little Endian
- Implicit Little Endian

4.2 Print AE Specification

The PRINTIM SCU application provides one AE being used when initiating associations to remote DICOM nodes.

The Siemens Opdima DICOM implementation provides Standard Conformance to the following DICOM V3.0 Print Managment SOP Classes as an SCU:

Table 12 *SOP Classes as an SCU*

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class:	1.2.840.10008.5.1.1.18
- Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
- Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
- Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4

No optional SOP classes are supported.

4.2.1 Association Establishment Policies

4.2.1.1 General

The maximum PDU size is 28672 Bytes.

4.2.1.2 Number of Associations

The Siemens Opdima PRINTIM DICOM application initiates several associations at a time, one for each print request being processed. There is no specified maximum number of simultaneous associations.

4.2.1.3 Asynchronous Nature

The Siemens Opdima DICOM software does not support asynchronous communication (multiple outstanding transactions over a single association).

4.2.1.4 Implementation Identification Information

The Siemens Opdima DICOM software provides a single Implementation Class UID of

- 1.3.12.2.1107.5.12.2

and an Implementation Version Name of

- “SIEMENS_OPD_3.0”

4.2.2 Association Initiation Policy

The Siemens Opdima PRINTIM DICOM application attempts to initiate a new association for the

- DIMSE N-CREATE, N-SET, N-ACTION and N-DELETE

service operations.

4.2.2.1 Real-World Activity “Print images on remote node”

4.2.2.1.1 Associated Real-World Activity

There are two ways to activate printing of images:

- The operator selects a number of folders in the database dialog and presses “Print...“ to print all images in these folders.
- The operator presses “Print...“ in the frame of the active image in the image window to print a single image or a stereo pair.

In both cases, a server selection dialog pops up. The operator selects printer and presses “OK”.

This will start a background process that will initiate an association with the printer and send a number of N-CREATE, N-SET, N-ACTION and N-DELETE requests.

The images will be printed one by one (or two at a time for stereo pairs) via the open association. If any response from the remote Application contains a failure status, this will be indicated to the operator in the DICOM job dialog. A request resulting in a response with a success or warning status is considered successful.

The background print process can be monitored or aborted in the DICOM job dialog.

4.2.2.1.2 Proposed Presentation Contexts

The Siemens PRINTIM DICOM application will propose Presentation Contexts as shown in the following table:

Table 13 *Initiation presentation context*

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended
Name	UID	Name List	UID List		Negotia-tion
Basic Grayscale Print Management	1.2.840.10008.5.1.1.9	DICOM Explicit VR Big Endian Transfer Syntax DICOM Explicit VR Little Endian Transfer Syntax, DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2	SCU	None

4.2.2.1.3 SOP Specific Conformance Statement to Print SOP classes

The Opdima provides standard conformance to the DICOM Basic Grayscale Print Management Meta SOP Class.

4.2.2.2 Basic Film Session

The Siemens Opdima Print application supports the following DIMSE service elements for the Basic Film Session as an SCU:

- N-CREATE
- N-DELETE

The Basic Film Session SOP class N-CREATE-RQ uses the following attributes:

Table 14 *Supported N-CREATE attributes*

Attribute Name	Tag	Usage SCU	Value
Number of Copies	(2000,0010)	U	>0
Print Priority	(2000,0020)	U	LOW MED HIGH

After use, the Basic Film Session Basic Film Box is closed with N-DELETE.

4.2.2.3 Basic Film Box

The Siemens Opdima Print application supports the following DIMSE service elements for the Basic Film Box as an SCU:

- N-CREATE
- N-ACTION

The Basic Film Box SOP class N-CREATE-RQ uses the following attributes:

Table 15 *Supported N-CREATE attributes*

Attribute Name	Tag	Usage SCU	Value
Image Display Format	(2010,0010)	M	STANDARD\1,1
Referenced Film Session Sequence	(2010,0500)	M	-
> Referenced SOP Class UID	(0008,1150)	M	1.2.840.10008.5.1.1.1
> Referenced SOP Instance UID	(0008,1155)	M	Current Film Session UID

Table 15 Supported N-CREATE attributes

Attribute Name	Tag	Usage SCU	Value
Film Orientation	(2010,0040)	U	LANDSCAPE

N-ACTION is used to request start of the actual printing.

The Basic Film Box instance is closed by calling N-DELETE for the corresponding Basic Film Session instance.

4.2.2.4 Basic Image Box

The Siemens Opdima Print application supports the following DIMSE service elements for the Basic Image Box as an SCU:

- N-SET

The Basic Image Box SOP class N-SET-RQ uses the following attributes

Table 16 Supported N-SET attributes

Attribute Name	Tag	Usage SCU	Value
Image Position	(2020,0010)	M	1
Basic Grayscale Image Sequence	(2020,0110)	M	
>Samples Per Pixel	(0028,0002)	M	1
>Rows	(0028,0010)	M	
>Columns	(0028,0011)	M	
>Bits Allocated	(0028,0100)	M	8
>Bits Stored	(0028,0101)	M	8
>High Bit	(0028,0102)	M	7
>Pixel Representation	(0028,0103)	M	0
>Photometric Interpretation	(0028,0004)	M	MONOCHROME2
>Pixel Data	(7FE0,0010)	M	

The Basic Image Box instances are created by calling N-CREATE for the Basic Film Box, and closed by calling N-DELETE for the corresponding Basic Film Session instance.

5 Communication Profiles

5.1 Supported Communication Stacks

The Siemens Opdima DICOM application provide DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

5.1.1 OSI Stack

Not supported.

5.1.2 TCP/IP Stack

The Siemens Opdima DICOM application uses the TCP/IP stack from the Solaris system upon which it executes. It uses the MergeCOM subroutine library that is based on a Berkeley socket interface.

5.1.2.1 API

Not applicable for this product.

5.1.2.2 Physical Media Support

The Siemens Opdima DICOM application is indifferent to the physical medium over which TCP/IP executes.

The Opdima workstation can be connected to the network with half/full duplex, 10/100Mb/sec, fast ethernet through an RJ45 connector.

5.1.3 Point-to-Point Stack

Not supported.

6 Extensions/Specializations/ Privatizations

6.1 Standard Extended/Specialized/Private SOPs

The SENDIM Opdima DICOM application creates DICOM standard extended Information Objects in such a way that each image can contain additional private elements stored in private groups. These elements are used to store data not defined in DICOM.

If these images are modified on DICOM nodes then these applications are responsible for data consistency. All unknown private attributes have to be removed upon modification!

Images may contain additional standard DICOM attributes that are not normally included for the IOD in question, as defined in section 4.1.2.2.3 on page 17.

6.2 Private Transfer Syntaxes

None.

7 Configuration

7.1 AE Title / Presentation Address Mapping

The Siemens Opdima DICOM unique Application Entity Titles are assigned using the following mechanism:

The SENDIM and PRINTIM DICOM Sender Applications provide the Application Entity Title:

<host_name>_CL

The RECIM DICOM Receiver Application the Application Entity Title:

<host_name>_SRV

The TESTCOM DICOM Sender Application the Application Entity Title:

OPD_PING_CLIENT

The hostname of the Opdima workstation is configured as to be unique among all Opdima workstations in the world.

The Siemens RECIM DICOM SCP application uses the port number 1984.

The workstation IP address and SCP server title and port number will be displayed in the Opdima service interface.

7.2 Configurable Parameters

The Application Entity Titles, host names and port numbers of remote DICOM SCP:s are configured using the Siemens Opdima service interface.

7.3 Fixed Parameters

The following values are used:

- max PDU size set to 28672 Bytes (28kB)
- time-out for waiting for association request or waiting for the peer to shut down an association: 240s
- time-out waiting for reply to associate request: 240s
- time-out waiting for reply to associate release: 240s
- time-out waiting for a network write to be accepted: 240s
- time-out waiting for a network connect to be accepted: 240s
- time-out waiting for data between TCP/IP packets while reading message: 240s

8 Support of Extended Character Sets

The Siemens Opdima DICOM application supports the ISO 8859 Latin 1 (ISO-IR 100) character set.

9 Detailed revision history

9.1 v1.0

- Removed document subtitle “DICOM storage“
- Reference to print function added in the following chapters: 1.1, 1.3, 2.0.1, 3.1, 3.2, 3, 7.1
- New ASW version in chapter 1.2
- Implementation version changed in chapter 4.1.1.4
- New chapters: 4.2
- Organ Dose added in Table 6
- Fixed error in Table 9: “Target” changed to “Reference” in the description of the Number of Reference Points attribute
- Fixed error in chapter 4.1.2.2.3: “type“ changed to “type 1” in description of Table 7