

ACOM.net 1.1A

AX

DICOM Conformance Statement

DICOM Storage

V 1.3

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H. Blendinger

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Name/Dept.: _____

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Signature: _____

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1 Introduction

1.1 Purpose

This DICOM Conformance Statement (DCS) is written according to part PS 3.2 of [1].

The applications described in this conformance statement are the SIEMENS ACOM.net based products using the ACOM.net server. The ACOM.net Server DICOM network implementation acts as SCP for the Storage Service.

1.2 Scope

This DICOM Conformance Statement refers to SIEMENS ACOM.net based products using ACOM.net protocol software. The following table relates ACOM.net software names to SIEMENS ACOM.net products.

Table 1: Product Scope

Software Name	SIEMENS ACOM.net Product
VA11A	ACOM.net Server

1.3 Definitions, Abbreviations

1.3.1 Definitions

DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
DIMSE-C	DICOM Message Service Element with Composite information objects
ACOM.net client	This is an ACOM.PC (Version 3.0) or an ACOM.M/.B (version 3.0) connected to the ACOM.net server via private network connection

1.3.2 Abbreviations

ACR	American College of Radiology
AE	(DICOM) Application Entity
ASCII	American Standard Code for Information Interchange
DCS	DICOM Conformance Statement
IOD	DICOM Information Object Definition
ISO	International Standard Organisation
NEMA	National Electrical Manufacturers Association
PDU	DICOM Protocol Data Unit

SCU	DICOM Service Class User (DICOM client)
SCP	DICOM Service Class Provider (DICOM server)
SOP	DICOM Service-Object Pair
UI	User Interface

1.4 References

- [1] Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-9, 1996

1.5 Connectivity and Interoperability

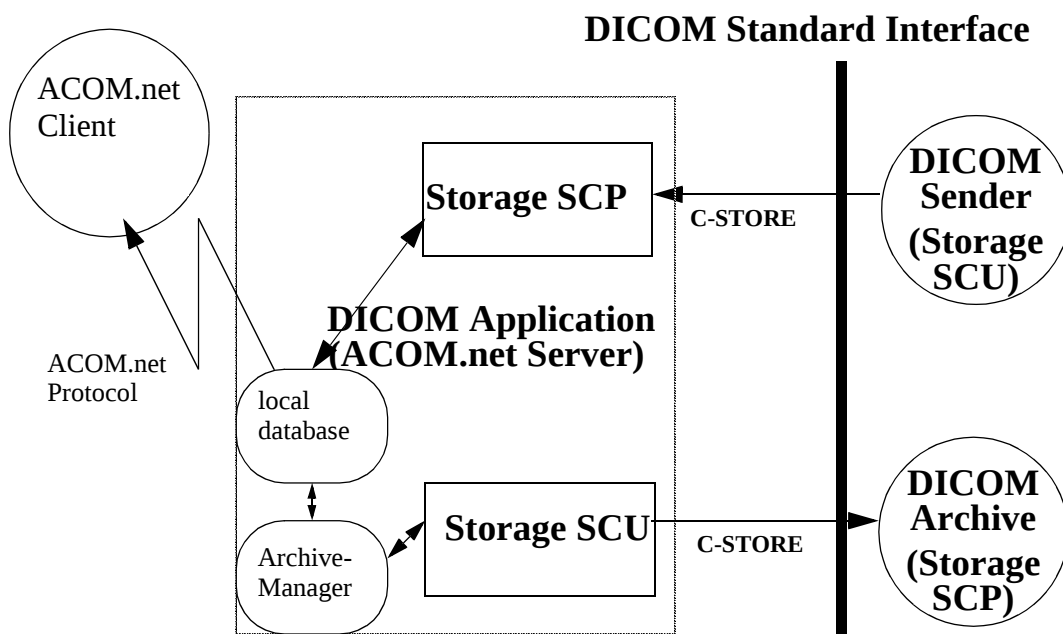
The implementation of the Siemens DICOM interface has been carefully tested to assure correspondence with this Conformance Statement. But the Conformance Statement and the DICOM standard does not guarantee interoperability of Siemens modalities and modalities of other vendors. The user must compare the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

2 Implementation Model Storage

The Siemens ACOM.net client modalities use the ACOM.net server as online- and long-term storage for DICOM IODs. The ACOM.net clients will access those IODs with the help of the ACOM.net protocol. All DICOM IODs of the support SOP classes that are sent to the ACOM.net Server will be forwarded to long-term storage and can be access by all connected ACOM.net clients.

2.1 Application Data Flow Diagram

The ACOM.net DICOM network implementation is a Windows NT application on the ACOM.net server and acts as SCP and SCU for the C-STORE DICOM network service. DICOM IOD SOP instances received by the ACOM.net server will be stored online and then are being forward to the long-term storage of the server. Via ACOM.net protocol interface the ACOM.net clients can access those SOP Instances¹ sent to the Server from other DICOM modalities. When configured, the Archive-Manager can decide to "auto-forward" received SOP Instances to a secondary DICOM Archive (up to 3 destinations possible)



1. In this version of ACOM.net the clients can only access and display compressed encoded Instances! (excepted from this rule, the ACOM.Report images can be displayed)

2.2 Functional Definitions of Application Entities

The Storage SCP component of the Siemens ACOM.net DICOM application is operating as background daemon processes. It is existing when the machine is powered on and waits for Storage association requests. Upon accepting an association with a negotiated Presentation Context it starts to receive the Composite Image Objects and imports them to local database.

If activated by configuration, the Archive Manager can "auto-forward" received Instances (either from ACOM.net clients or DICOM SCP) to a "secondary" DICOM Archive. The DICOM Send mechanism is then used to transfer the Images in this case. Up to three different destinations can be configured and will then be addressed in parallel.

2.3 Sequencing of real World Activities

not applicable.

3 Application Entity Specification Storage

3.1 Storage AEs Specification

The ACOM.net Server Storage service class user/service class provider use one AE when initiating/receiving associations to/from remote DICOM nodes.

SIEMENS ACOM.net Server DICOM application provides Standard Conformance to the following DICOM V3.0 SOP Classes as SCP:

Table 2: SOP Classes as SCP

SOP Class Name	SOP Class UID
X-Ray Angiographic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.1
Verification	1.2.840.10008.1.1

SIEMENS ACOM.net Server DICOM application provides Standard Conformance to the following DICOM V3.0 SOP Classes as SCU:

Table 3: SOP Classes as SCU

SOP Class Name	SOP Class UID
X-Ray Angiographic Image Information Object Storage	1.2.840.10008.5.1.4.1.1.12.1

3.1.1 Association Establishment Policies

3.1.1.1 General

When configured, the Archive Manager will trigger the Storage Application (SCU Component) to perform a DICOM Send operation for every SOP Instance that is "ready for long-term Storage". Up to three different destinations can be configured and operated in parallel. To each destination a n association request is sent and upon successful negotiation the transfer is started. SOP Instances received with compressed Transfer Syntax, will be transmitted "as is", which means no conversion of Transfer Syntax (i.e. Decompression) can be performed due to result of Transfer Syntax negotiation.

The default PDU size used will be 256 KB.

3.1.1.2 Number of Associations

The Siemens ACOM.net Server DICOM application initiates several associations at a time, one for each destination to which an Archive Manager auto-transfer request is being processed.

3.1.1.3 Asynchronous Nature

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

3.1.1.4 Implementation Identifying Information

The Siemens ACOM.net Server DICOM software provides a single Implementation Class UID of

- 1.3.12.2.1107.5.4.11.1.1.41

and an Implementation Version Name of

- "ACOMNET_11A"

3.1.2 Association Initiation Policy

If the Archive Manager is configured for 'auto-transfer' and there are Instances ready for archive, the Siemens ACOM.net Server DICOM application attempts to initiate a new association for

- DIMSE C-STORE

service operations.

3.1.2.1 Associated Real-World Activity

3.1.2.1.1 Associated Real-World Activity -Archive Manager "auto-transfer"

The associated Real-World activity is a C-STORE request initiated by an internal daemon process triggered by Archive Manager requests. 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 status other than Success or Warning the association is aborted.

It depends on the Archive Manager and related availability of Object Instances, if more than one Instance is transferred via an open association.

3.1.2.1.2 Proposed Presentation Contexts

The Siemens ACOM.net Server DICOM application will propose Presentation Contexts as shown in the following table:

Table 4: Proposed presentation contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
X-Ray Angio-graphic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCU	None
		DICOM Explicit VR Big Endian Transfer Syntax	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2.1		
		JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70		

The Transfer Syntax used is strongly influenced by the fact of "how was the Transfer Syntax when the Instance was accepted". The ACOM.net Server - in this version - is not capable of performing a Transfer Syntax conversion from "encapsulated Transfer Syntaxes" to "uncompressed Transfer Syntaxes" and vice-versa.

3.1.2.1.3 SOP-specific Conformance

The ACOM.net Server DICOM Storage application is not creating Image Instances itself. please refer to the section describing the Storage SCP Service behaviour. Only Instances successfully received by the ACOM.net Server and fulfilling the conditions for long-term storage can be sent out via "auto-forward".

3.1.3 Association Acceptance Policy

The Siemens ACOM.net DICOM application attempts to accept a new association for

- DIMSE C-ECHO
- DIMSE C-STORE

service operations. Any Information Objects transmitted on that association will be checked on conformance and stored in database if check was successful.

The ACOM.net Server will only support a maximum of 10 Associations accepted/running in parallel at one time.

3.1.3.1 Associated Real-World Activity

3.1.3.1.1 Associated Real-World Activity - Receiving Image Objects from a remote Node

The daemon receiving process will accept an association and will receive any images transmitted on that association and will store the images on disk in the ACOM.net server online storage if the conformance check is performed successfully.

3.1.3.1.2 Presentation Context Table

The Siemens ACOM.net Server DICOM application will accept Presentation Contexts as shown in the following table:

Table 5: Acceptable presentation contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotia- tion
Name	UID	Name List	UID List		
X-Ray Angio-graphic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	DICOM Implicit VR Little Endian *)	1.2.840.10008.1.2	SCP	None
		DICOM Explicit VR Big Endian *) **)	1.2.840.10008.1.2.2		
		DICOM Explicit VR Little Endian *)	1.2.840.10008.1.2.1		
		JPEG Lossless Process 14 (selection value 1)	1.2.840.10008.1.2.4.70		
Verification	1.2.840.10008.1.1	DICOM Implicit VR Little Endian Transfer Syntax	1.2.840.10008.1.2	SCP	None

*) All uncompressed XA-IOD SOP Instances will be properly handled regarding DICOM Storage Service, but - in this version - the ACOM.net clients will not be able to open these Instances for display (with the exception of ACOM.Report images)!

**) Big Endian encoding is not support for display at the ACOM.net clients

3.1.3.1.3 SOP Specific Conformance Statement

The Siemens ACOM.net Server DICOM application conforms to the Full Storage Service Class at Level 2. Private Attributes will be stored, unless they are Sequences. Private Attribute Sequences will be ignored during object storage. In the event of a successful C-STORE operation, the image has successful been written on disk in the Siemens ACOM.net Server image format.

The ACOM.net DICOM receiver returns the status Success (0000) upon successful operation otherwise one of the following status codes is returned and the association aborted:

- Refused (A700):
This error status indicates a lack of Resources (e.g. not enough disk space) on the ACOM.net Server.
- 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 is aborted.

3.1.3.1.3.1 Mandatory Attributes acceptance criterion

Upon receiving an IOD a check for attributes, mandatory to the ACOM.net Server implementation, is done and with successful completion the IOD is accepted for storage. In case of unsuccessful check result the IOD will be rejected with Error status. Some Type 2 attributes require appropriate values to assure image display of those IOD's even though storage would be possible with zero length content.

The following tables list the mandatory attributes in IOD-specific tables.

Attributes/Tags written in *Italics* are of type 1 and need to be supplied with correct values.

Table 6: Dictionary of XA IOD Mandatory Attributes - Acceptance Criteria

Attribute Name	Tag	Value
<i>Specific Character Set</i>	[0008,0005]	ISO_IR 100 (Latin 1 alphabet) If attribute is absent, usage of default character-set is assumed!
<i>Image Type</i>	[0008,0008]	ORIGINAL\PRIMARY\SINGLE PLANE or ORIGINAL\PRIMARY\BIPLANE A or ORIGINAL\PRIMARY\BIPLANE B
<i>SOP Class UID</i>	[0008,0016]	1.2.840.10008.5.1.4.1.1.12.1
<i>SOP Instance UID</i>	[0008,0018]	
Study Date	[0008,0020]	<yyyymmdd>
Image Date	[0008,0023]	<yyyymmdd>
Study Time	[0008,0030]	<hhmmss>
Image Time	[0008,0033]	<hhmmss>
Accession Number *)	[0008,0050]	Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported)
<i>Modality</i>	[0008,0060]	XA

Table 6: Dictionary of XA IOD Mandatory Attributes - Acceptance Criteria

Attribute Name	Tag	Value
Manufacturer	[0008,0070]	
Referring Physician's Name	[0008,0090]	
Study Description	[0008,1030]	
Referenced Image Sequence	[0008,1140]	(for Biplan Acquisitions = 3rd value of Image Type is BIPLANE A or BIPLANE B)
>Referenced SOP Class UID	[0008,1150]	1.2.840.10008.5.1.4.1.1.12.1
>Referenced SOP Instance UID	[0008,1155]	any
Patient's Name *)	[0010,0010]	Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported)
Patient ID *)	[0010,0020]	Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported)
Patient's Birth Date *)	[0010,0030]	<yyyymmdd> Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported) Retired format "yyyy.mm.dd" is supported.
Patient's Sex *)	[0010,0040]	M or F or O Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported)
Contrast/Bolus Agent	[0018,0010]	
KVP	[0018,0060]	
Frame Time	[0018,1063]	depends on (0028,0009)
Frame Time Vector	[0018,1065]	depends on (0028,0009)
Exposure Time	[0018,1150]	
X-Ray Tube Current	[0018,1151]	
Exposure	[0018,1152]	

Table 6: Dictionary of XA IOD Mandatory Attributes - Acceptance Criteria

Attribute Name	Tag	Value
Radiation Setting	[0018,1155]	SC (low dose, fluoro) or GR (high dose, acquisition)
Study Instance UID	[0020,000D]	any
Series Instance UID	[0020,000E]	any
Study ID *)	[0020,0010]	Value content is required to forward image to long-term storage ! (Correction via ACOM.net client is supported)
Series Number	[0020,0011]	
Image Number	[0020,0013]	value needed for correct sorting !
Patient Orientation	[0020,0020]	
Laterality	[0020,0060]	R or L or attribute absent
Samples per Pixel	[0028,0002]	1
Photometric Interpretation	[0028,0004]	MONOCHROME2
Number of Frames	[0028,0008]	<actual number of frames>
Frame Increment Pointer	[0028,0009]	00181063 _H or 00181065 _H
Rows	[0028,0010]	Cient display is optimized for 512x512 only. Larger formats are restricted unless those are ACOM.Report images.
Columns	[0028,0011]	
Pixel Aspect Ratio	[0028,0034]	v-size\h-size or absent (= 1:1)
Bits Allocated	[0028,0100]	8 or 16
Bits Stored	[0028,0101]	8 or 10 or 12 ^a
High Bit	[0028,0102]	7 or 9 or 11
Pixel Representation	[0028,0103]	0
Pixel Intensity Relationship	[0028,1040]	LIN or LOG
Window Center	[0028,1050]	value needed for correct display !
Window Width	[0028,1051]	value needed for correct display !
Recommended Viewing Mode	[0028,1090]	SUB or NAT
Lossy Image Compression	[0028,2110]	00 or 01 or attribute absent

Table 6: Dictionary of XA IOD Mandatory Attributes - Acceptance Criteria

Attribute Name	Tag	Value
Modality LUT Sequence ^b	[0028,3000]	(only with [0028,1040] set to LOG) The LUT Sequence will be removed during long-term storage
LUT Descriptor	[0028,3002]	<num of LUT entries>, <first pixel val mapped>, <Entry bits alloc>
Modality LUT Type	[0028,3004]	US
LUT Data	[0028,3006]	<array of data, accord. descriptor>
Representative Frame Number	[0028,6010]	value needed to create Icon Image, else always 2nd frame is used!
Mask Subtraction Sequence	[0028,6100]	(if Subtraction can be applied)
>Mask Operation	[0028,6101]	NONE or AVG_SUB
>Mask FrameNumbers	[0028,6110]	<numbers> (only for AVG_SUB)
Calibration Image	[0050,0004]	YES or NO or zero length (may require DEVICE module to specify Reference Object)
Pixel Data	[7FE0,0010]	

a. 12-Bit Images (Bits Stored) cannot be displayed with ACOM.net clients.

b. During display within ACOM.net clients the Modality LUT Sequence will not be used.

*) This attribute can be configured if value is mandatory for enabling long-term storage.

3.1.3.1.3.2 Optional Attributes acceptance criterion - applied defaults

Upon receiving an IOD a check for optional attributes is done. During check, defaults will be set when certain optional attributes are encountered to be absent from the object instance. Please see the following table for details.

Table 7: Applied Defaults when receiving images - Dictionary of DICOM type 2 and 3 IOD Attributes

Attribute Name	Tag	Default Value
Study Date	[0008,0020]	<unknown, zero length>
Image Date	[0008,0023]	<unknown, zero length>
Study Time	[0008,0030]	<unknown, zero length>
Image Time	[0008,0033]	<unknown, zero length>

Table 7: Applied Defaults when receiving images - Dictionary of DICOM type 2 and 3 IOD Attributes

Attribute Name	Tag	Default Value
Accession Number	[0008,0050]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Manufacturer	[0008,0070]	<unknown, zero length>
Referring Physician's Name	[0008,0090]	<unknown, zero length>
Study Description	[0008,1030]	<unknown, zero length>
Patient's Name	[0010,0010]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Patient ID	[0010,0020]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Patient's Birth Date	[0010,0030]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Patient's Sex	[0010,0040]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Patient Comments	[0010,4000]	<value (only when entered via ACOM.net client)>
Contrast/Bolus Agent	[0018,0010]	<unknown, zero length>
KVP	[0018,0060]	<unknown, zero length>
Exposure Time	[0018,1150]	<unknown, zero length>
X-Ray Tube Current	[0018,1151]	<unknown, zero length>
Exposure	[0018,1152]	<unknown, zero length>
Study ID	[0020,0010]	<unknown, zero length> (can be changed via ACOM.net client unless in long-term storage)
Series Number	[0020,0011]	<unknown, zero length>
Image Number	[0020,0013]	<unknown, zero length>
Patient Orientation	[0020,0020]	<unknown, zero length>
Window Center	[0028,1050]	<unknown, zero length>
Window Width	[0028,1051]	<unknown, zero length>

Table 7: Applied Defaults when receiving images - Dictionary of DICOM type 2 and 3 IOD Attributes

Attribute Name	Tag	Default Value
Recommended Viewing Mode	[0028,1090]	<unknown, zero length>
Representative Frame Number	[0028,6010]	<unknown, zero length>
Calibration Image	[0050,0004]	<unknown, zero length>

3.1.3.1.3.3 Image Pixel Attribute Acceptance Criterion for Grayscale Images

The Siemens ACOM.net Server DICOM application accepts the monochrome 1 and monochrome 2 photometric interpretation pixel format and graphic overlay with unsigned integer and 8 or 16 bits allocated. Accepted values:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
- pixel representation (attribute 0028, 0103) = 0
- bits allocated (attribute 0028, 0100) = 8, 16
- bits stored (attribute 0028,0101) = 8, 10, 12
- high bit (attribute 0028,0102) = 7, 9, 11

Overlay plane

- + rows (attribute 60xx, 0010) = same as attribute 0028, 0010
- + columns (attribute 60xx, 0011) = same as attribute 0028, 0011
- + overlay type (attribute 60xx, 0040) = "G"
- + origin (attribute 60xx, 0050) = 0,0
- + bits allocated (attribute 60xx, 0100) = 16
- + bit position (attribute 60xx, 0102) = 12
- + overlay data (attribute 60xx, 3000) = **not supported**

The Siemens ACOM.net Server DICOM application accepts (for storage) also the monochrome 1 and monochrome 2 photometric interpretation pixel format with binary 2's complement integer and 16 bits allocated. Accepted values:

Pixel plane

- samples per pixel (attribute 0028, 0002) = 1
- photometric interpretation (attribute 0028,0004) = "MONOCHROME1"
- photometric interpretation (attribute 0028,0004) = "MONOCHROME2"

- pixel representation (attribute 0028, 0103) = 1
- bits allocated (attribute 0028, 0100) = 16
- bits stored (attribute 0028,0101) = 16
- high bit (attribute 0028,0102) = 15

Overlay plane

- + overlay data (attribute 60xx, 3000) = **not supported**

3.1.3.1.4 Presentation Context Acceptance Criterion

The Siemens ACOM.net Server 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 except for the DICOM defined limit. In the event that the Siemens ACOM.net Server DICOM application runs out of resources, it will reject the association request.

3.1.3.1.5 Transfer Syntax Selection Policies

The Siemens ACOM.net Server DICOM application currently supports

- the Implicit VR Little Endian, the Explicit VR Little Endian, Explicit VR Big Endian Transfer Syntaxes.
- the JPEG Lossless Non-Hierarchical (process 14) 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.

With Implicit VR Little Endian Transfer Syntax the ACOM.net Server DICOM application will remove any Private Attributes not known to the application. Decision on removal of a Private Element is done if there is NO entry in the dictionary of attributes of the ACOM.net Server DICOM application.

Therefore any Explicit VR Transfer Syntax shall preferably be used by the Storage SCU's when sending Composite Image Instances to the ACOM.net Server DICOM application.

4 Communication Profiles

4.1 Supported Communication Stacks

The Siemens ACOM.net server DICOM application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.1.1 OSI Stack

not supported.

4.1.2 TCP/IP Stack

The Siemens ACOM.net server DICOM application uses the TCP/IP stack from the Windows NT system upon which it executes. It uses the MergeCOM-3 subroutine library from Merge Technologies Inc. that is based on a Berkeley socket interface.

4.1.2.1 API

The Siemens ACOM.net server DICOM application uses the MergeCOM library that is based on a TCP/IP socket interface.

4.1.2.2 Physical Media Support

The Siemens ACOM.net server DICOM application is indifferent to the physical medium over which TCP/IP executes; it inherits this from the Windows NT system upon which it executes.

4.1.3 Point-to-Point Stack

not supported.

5 Extensions/Specializations/ Privatization

Not applicable.

6 Configuration

6.1 AE Title / Presentation Address Mapping

The ACOM.net server DICOM network unique application entity titles are assigned using the following mechanism:

e.g. each application entity title starts with a unique character string (max. 12) assigned for the local Siemens ACOM.net server DICOM node. This string is defaulted with the nodename and builds the AERoot. The AE suffix is a 4 character string and is constantly defined by the applications. The port numbers are predefined defaults that can be modified by the needs of the communication network environment.

6.1.1 DICOM Storage AE Title

The DICOM Storage application provides the application entity title:

STU_ACOMSERV

and the port number:

104

6.2 Configurable Parameters

None.

6.3 Default Parameters

ACOM.net uses default parameters:

- max PDU size set to 262144 Bytes (256 kB)
- time-out for accepting/rejecting an association request: 60 s
- time-out for responding to an association open/close request: 120 s
- time-out for accepting a message over network: 120 s

7 Support of Extended Character Sets

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

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