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MIStar v3.2

DICOM 3.0 Conformance Statement

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1. INTRODUCTION

1.1 Scope and Field of Application

This document is the DICOM Conformance Statement for the MISStar software package developed by Apollo Medical Imaging Technology Pty Ltd (APOLLO). This document can help the user to understand the level of connectivity between MISStar and other DICOM 3.0 compliant devices. Readers unfamiliar with the DICOM 3.0 standard are recommended to consult the NEMA DICOM 3.0 documentation prior to examining this conformance statement.

1.2 References and Resources

This conformance statement is written in accordance with “Digital Imaging and Communications in Medicine (DICOM) standard”, NEMA PS 3.1-16 (2001) and PS 3.1-18 (2006), <http://medical.nema.org>.

1.3 Abbreviations and Acronyms

All abbreviations and acronyms used in this documentation are defined at first appearance or as described in the DICOM standard references.

1.4 Revision History

Version 0.1: Initial Release	June 24, 2001
Version 2.0: Minor revision, add C-Echo response.	Jan 16, 2004
Version 3.0: Minor revision, Implementation UID and Version String	Sep 17, 2004
Version 3.2: Minor revision	Oct 18, 2005
Version 3.2.62: Minor revision	Oct 18, 2006
Version 3.2.62.02: Minor revision	March 30, 2007
Version 3.2.62.03: Minor revision, add support for enhanced MR/CT DICOM, allows anonymization of certain DICOM header information	February 30, 2007

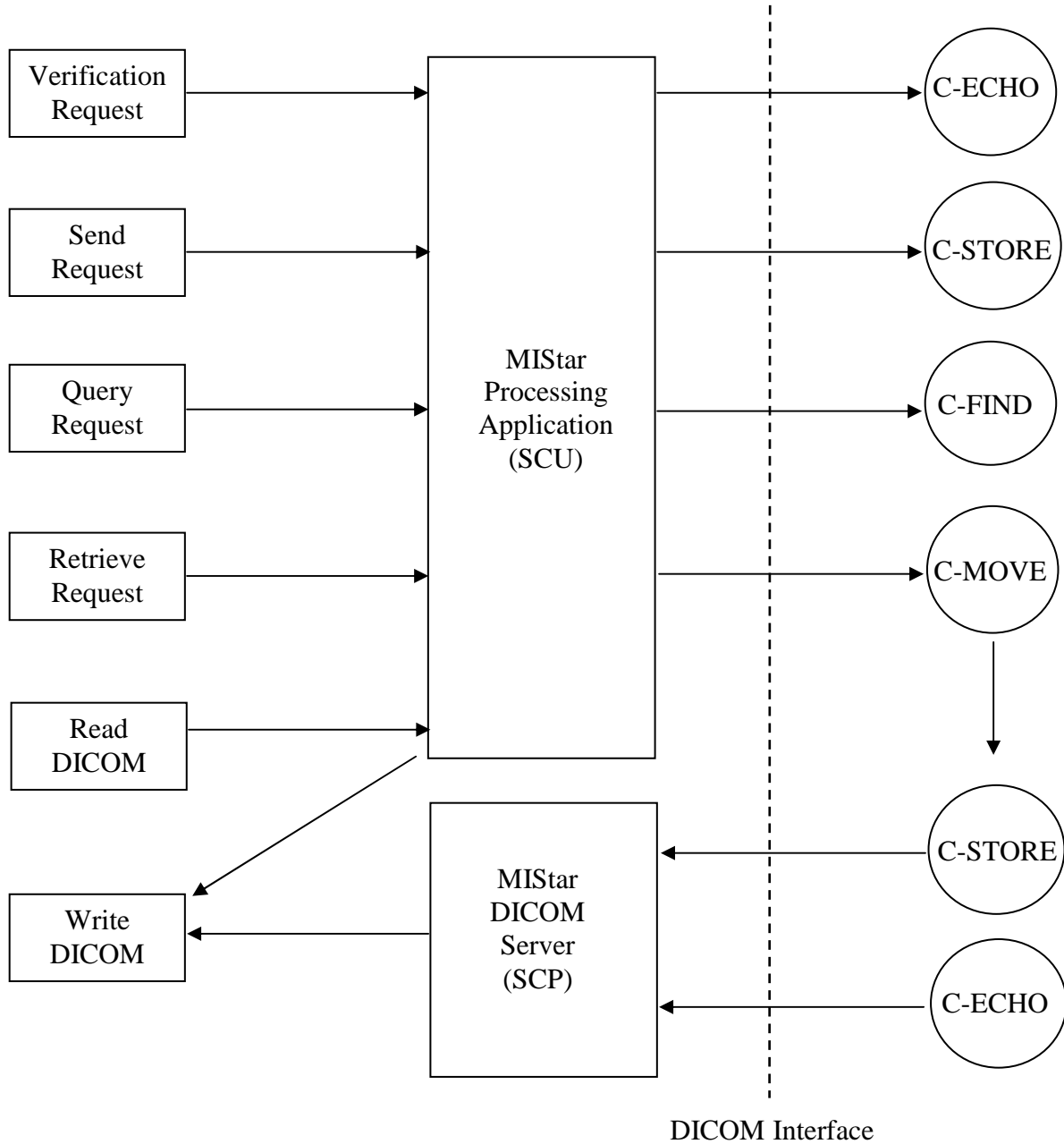
1.5 Warning to the Reader

This document on its own does not guarantee the connectivity between MISStar and any equipment and/or applications provided by other vendors. Integration of MISStar with other products of different vendors is beyond the scope of the DICOM 3.0 standard and this conformance statements. The user is responsible for testing and verifying the connectivity between MISStar and other products.

APOLLO reserves the right to make improvements or changes to the MISStar architecture, and this documentation from time to time without further notification. APOLLO disclaims any liability and makes no warranty of any kind, implied or expressed, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

2. IMPLEMENTATION MODEL

2.1 Application Data Flow Diagram



The MIStar DICOM Server acts as a C-STROE and C-ECHO SCP, which runs as a separate process from the MIStar application using a high level Application Programming Interface (API). The MIStar DICOM Server can be configured to start when MIStar is started, but need to be shut down manually or when the system is turned off. In addition, all requests (verification, send, query and retrieve) are made through the MIStar API directly between SCU and SCP devices. This allows the MIStar DICOM server to receive and store data in the background when the user performs image processing using the MIStar API or even when the MIStar API is not running. Further, if the MIStar DICOM Server is not started or turned off, query and send request can still be made. In addition, MIStar allows a user to read DICOM images from storage media including disk and CDROM. It also allows user to save processed image results into its database in DICOM format (see 2.2 below).

2.2 Functional Definition of AEs

The DICOM protocol is used for all communications and image transfer with a remote DICOM device over a network via the TCP/IP protocol stack. The MIStar software package supports the following application entities:

SCU	SCP
Verification Storage Query Retrieve	Verification Storage

MIStar allows a user to import DICOM images, view the images, manipulate and process those images. MIStar also allows the user to save processed results from DICOM images into its database as new DICOM images in a new series of the same study.

2.3 Sequencing of Real-World Activities

Not applicable

3. APPLICATION ENTITY SPECIFICATIONS

3.1 AE Specifications for MISStar DICOM Services

The MISStar DICOM services provides standard conformance to the following DICOM SOP classes:

SOP Classes as SCU	
SOP Class Name	SOP Class UID
Verification Verification	1.2.840.10008.1.1
Storage CR Image Storage CT Image Storage US Multi-Frame Image Storage MR Image Storage US Image Storage SC Image Storage XA Image Storage RF Image Storage NM Image Storage PT Image Storage	1.2.840.10008.5.1.4.1.1.1 1.2.840.10008.5.1.4.1.1.2 1.2.840.10008.5.1.4.1.1.3.1 1.2.840.10008.5.1.4.1.1.4 1.2.840.10008.5.1.4.1.1.6.1 1.2.840.10008.5.1.4.1.1.7 1.2.840.10008.5.1.4.1.1.12.1 1.2.840.10008.5.1.4.1.1.12.2 1.2.840.10008.5.1.4.1.1.20 1.2.840.10008.5.1.4.1.1.128
Query/Retrieve Study Root Query Study Root Retrieve	1.2.840.10008.5.1.4.1.2.2.1 1.2.840.10008.5.1.4.1.2.2.2

SOP Classes as SCP	
SOP Class Name	SOP Class UID
Verification Verification	1.2.840.10008.1.1
Storage CR Image Storage CT Image Storage US Multi-Frame Image Storage MR Image Storage US Image Storage SC Image Storage XA Image Storage RF Image Storage NM Image Storage PT Image Storage	1.2.840.10008.5.1.4.1.1.1 1.2.840.10008.5.1.4.1.1.2 1.2.840.10008.5.1.4.1.1.3.1 1.2.840.10008.5.1.4.1.1.4 1.2.840.10008.5.1.4.1.1.6.1 1.2.840.10008.5.1.4.1.1.7 1.2.840.10008.5.1.4.1.1.12.1 1.2.840.10008.5.1.4.1.1.12.2 1.2.840.10008.5.1.4.1.1.20 1.2.840.10008.5.1.4.1.1.128

3.1.1. Association Establishment Policies

3.1.1.1 General

The DICOM 3.0 standard Application Context Name (ACN) with UID 1.2.840.10008.3.1.1.1 is always proposed when MISStar initiates an association. When a DICOM association is detected by the MISStar SCP server, the ACN UID proposed by the remote AE is first checked against the DICOM 3.0 standard, which currently supports only one UID 1.2.840.10008.3.1.1.1 for the ACN. If not present or different from the above, the association will be rejected.

The maximum PDU size supported by MISStar can be configured from 4kB (4096 bytes) to 64kB (65536 bytes). The default maximum PDU size of 32kB (32767 bytes) will be used upon association initiation or acceptance associations initiated by remote applications. There is no limit on the number of Presentation Context Items that will be proposed.

3.1.1.2 Number of Associations

This implementation can support one association (connection) per SOP interaction between the MISStar SCU and a remote SCP and one association between the MISStar SCP and a remote SCU simultaneously. The association is closed at the completion of each interaction. The association will be aborted if the SOP class is not supported. This allows the MISStar DICOM server to receive and store data in the background while the user performs image processing or other query/retrieve requests at the same time.

3.1.1.3 Asynchronous Nature

MISStar does not support asynchronous operations. All operations will be performed synchronously.

3.1.1.4 Implementation Identifying Information

Implementation Class UID	1.2.826.0.1.3680043.2.1042
Implementation Version Name	AMIT/MISStar3.2.62.03

3.1.2. Association Initiation Policies

MISStar initiates associations for the following activities:

- Verify DICOM communication between the MISStar SCU and a remote DICOM system.
- Send images from the local MISStar database to a remote DICOM system.
- Query database contents of a remote DICOM system.
- Retrieve images from a remote DICOM database to the local MISStar database.

3.1.2.1 Associated Real World Activity

SOP Class	Associated Real World Activity
Verification	The user selects a device from the list of configured DICOM devices, and clicks the “Echo” button
Storage	The user selects one or more studies/series/images from the local MISStar database, and clicks “Send Study/Series/Image” to selected remote DICOM device.
Study Root Query - FIND	The user clicks “remote” option, select search criteria and clicks “Query”. The MISStar SCU can perform Study Root Query at “Study”, “Series” and “Image” levels. Subsequently, the user clicks on a study to update query results at “Series” and “Image” levels. The user clicks on a series to update query results at the “Image” level.
Study Root Retrieve - MOVE	The user selects one or more studies/series/images from the query results. Then clicks “Retrieve Study/Series/Image” from the selected remote DICOM device.

3.1.2.2 Proposed Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.3.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2				
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Explicit VR Little Endian	1.2.840.10008.1.2.1		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4				
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Explicit VR Big Endian	1.2.840.10008.1.2.2		
SC Image Storage	1.2.840.10008.5.1.4.1.1.7				
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1				
RF Image Storage	1.2.840.10008.5.1.4.1.1.12.2				
NM Image Storage	1.2.840.10008.5.1.4.1.1.20				
PT Image Storage	1.2.840.10008.5.1.4.1.1.128				
Study Root Query – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
Study Root Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.3 SOP Specific Conformance Statement

SOP Class	SOP Specific Conformance Statement
Verification	Standard conformance.
Storage	DICOM images stored in the MISStar database that are to be sent to a remote DICOM system are converted to instances of the corresponding SOP Storage class, then sent to the remote system subsequently. Each activity for sending multiple studies/series/images to a remote system requires one new association to be negotiated by MISStar. MISStar reads each DICOM image into memory as an IDL DICOM object, and sends the converted object to the remote device using the default transfer syntax stored in the DICOM file header. Should the remote DICOM device not support the requested transfer syntax, MISStar will use its default Implicit VR Little Endian transfer syntax.
Study Root Query - FIND	MISStar supports C-FIND response values as defined in DICOM 3.0 Part 4. See below for the supported key values for Study, Series, and Image levels for Study Root Query/Retrieve information models.
Study Root Retrieve – MOVE	Standard conformance.

Study Root Query/Retrieve: Supported Keys			
Data Level	Description	Tag	Type
Study	Study Date	(0008,0020)	R
Study	Study Time	(0008,0030)	R
Study	Study Accession Number	(0008,0050)	R
Study	Patient Name	(0010,0010)	R
Study	Patient ID	(0010,0020)	R
Study	Study ID	(0020,0010)	R
Study	Study Instance UID	(0020,000D)	U
Study	Study Referring MD's Name	(0008,0090)	O
Study	Study Description	(0008,1030)	O
Study	Patient Date of Birth	(0010,0030)	O
Study	Patient Sex	(0010,0040)	O
Study	Patient Age	(0010,1010)	O
Series	Series Modality	(0008,0060)	R
Series	Series Number	(0020,0011)	R
Series	Series Instance UID	(0020,000E)	U
Series	Manufacturer	(0008,0070)	O
Series	Series Description	(0008,103E)	O
Series	Image Orientation (Patient)	(0020,0037)	O
Series	Number of Series Related Instances	(0020,1209)	O
Image	Image Number	(0020,0013)	R
Image	Image SOP Instance UID	(0008,0018)	U
Image	Slice Thickness	(0018,0050)	O
Image	Percent Phase Field of View	(0018,0094)	O
Image	Reconstruction Diameter	(0018,1100)	O
Image	Slice Location	(0020,1041)	O
Image	Number of Frames	(0028,0008)	O
Image	Rows	(0028,0010)	O
Image	Columns	(0028,0011)	O

Error messages will be displayed online by default. Otherwise, detailed error messages can be logged into a log file. The log option can be enabled or disabled via the Configuration panel.

3.1.3 Association Acceptance Policies

MISStar accepts associations for the following activities:

- DICOM communication verification requests from a remote DICOM system.
- DICOM image storage requests from a remote DICOM system.

3.1.3.1 Associated Real World Activity

SOP Class	Associated Real World Activity
Verification	MISStar SCP server will send a C-ECHO response to the verification requests.
Storage	A remote system sends images to MISStar SCP server. Received images are saved into the local MISStar database. The image transfer process can be monitored via the MISStar SCP API. Upon completion of the transfer, received images will be updated in the database lists.

3.1.3.2 Accepted Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name	UID		
Verification	1.2.840.10008.3.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CR Image Storage	1.2.840.10008.5.1.4.1.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2				
US Multi-Frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1				
MR Image Storage	1.2.840.10008.5.1.4.1.1.4				
US Image Storage	1.2.840.10008.5.1.4.1.1.6.1				
SC Image Storage	1.2.840.10008.5.1.4.1.1.7				
XA Image Storage	1.2.840.10008.5.1.4.1.1.12.1				
RF Image Storage	1.2.840.10008.5.1.4.1.1.12.2				
NM Image Storage	1.2.840.10008.5.1.4.1.1.20				
PT Image Storage	1.2.840.10008.5.1.4.1.1.128				

3.1.3.3 Presentation Context Acceptance Criterion

MISStar SCP server only supports standard Implicit VR Little Endian transfer syntax. No compression method is supported. No other specific acceptance rules are required.

3.1.2.4 SOP Specific Conformance Statement

The MISStar SCP server supports standard conformance to the DICOM verification SOP class. Upon receiving a C-ECHO request, the MISStar SCP will send a C-ECHO-RSP message with a status code of 0000 for success.

The MISStar SCP server supports the Storage SOP Class at Level 2 (full) with no elements discarded or coerced. Upon successful transfer of a DICOM object, the standard DICOM preamble and the meta-header information defined within Part 10 of the DICOM 3.0 will be added in front of all data elements, then saved as a DICOM file in the MISStar database. The MISStar database lists will be updated accordingly. The MISStar SCP responds to a C-STORE request with a status code of either 0000 for Success or C000 for Fail due to unknown command or error.

Error messages will be displayed online by default. Detailed communication message can be examined in debug mode. Also all messages can be saved with enabled log option. The debug and log option can be enabled or disabled via Setup.

3.1.4 MISStar DICOM Import Services

MISStar is built with IDL (the Interactive Data Language) and operates on the IDL run-time engine. IDL supports reading files that conform to the DICOM Standard PS 3.10 DICOM File Format. MISStar allows a user to read and import DICOM images from storage media including disk and CDROM into the database. MISStar does not remove the DICOM files from their original location. MISStar simply reads the header information of each file to be imported, and copy it into the MISStar database.

MISStar supports reading DICOM files with the following transfer syntaxes determined by the tag field (0002, 0010).

UID Value	UID Name
1.2.840.10008.1.2	Implicit VR Little Endian: Default Transfer Syntax for DICOM
1.2.840.10008.1.2.1	Explicit VR Little Endian
1.2.840.10008.1.2.2	Explicit VR Big Endian

MISStar does not support reading DICOM Part 10 files whose contents have compressed data using other transfer syntaxes.

MISStar supports reading DICOM Part 10 files of the following SOP Classes determined by the tag field (0008, 0016).

UID Value	UID Name
1.2.840.10008.5.1.4.1.1.1	CR Image Storage
1.2.840.10008.5.1.4.1.1.2	CT Image Storage
1.2.840.10008.5.1.4.1.1.3.1	US Multi-Frame Image Storage
1.2.840.10008.5.1.4.1.1.4	MR Image Storage
1.2.840.10008.5.1.4.1.1.6.1	US Image Storage
1.2.840.10008.5.1.4.1.1.7	SC Image Storage
1.2.840.10008.5.1.4.1.1.12.1	XA Image Storage
1.2.840.10008.5.1.4.1.1.12.2	RF Image Storage
1.2.840.10008.5.1.4.1.1.20	NM Image Storage
1.2.840.10008.5.1.4.1.1.128	PT Image Storage

Handling of odd length data elements

The DICOM Standard PS 3.5 (Data Structures and Encoding) specifies that the data element values which make up a DICOM data stream must be padded to an even length. The IDL DICOM reading functionality is built strictly enforces this specification. If IDL encounters an incorrectly formed odd length data field while reading a DICOM Part 10 file it will report an error and stop the reading process. In such a case, MISStar will switch to an internal debugging DICOM mode which only allows reading the DICOM images (without permission for communication with other DICOM devices).

Handling of undefined VRs

The VR (Value Representation) of a data element describes the data type and format of that data element's values. If IDL encounters an undefined VR while reading a DICOM Part 10 file, it will set that data element's VR to be UN (unknown).

Handling of retired and private data elements

Certain data elements are no longer supported under the DICOM 3.0 standard and are denoted as retired. Also, some DICOM implementations may require the communication of information that cannot be contained in standard data elements, and thus create private data elements to contain such information. Retired and private data elements should pose no problem to the DICOM Part 10 file reading capability of IDL. When IDL encounters a retired or private data element tag during reading a DICOM Part 10 file, it will treat it just like any standard data element: read the data value and allow it to be accessed via the IDL DICOM object.

3.1.5 MISStar DICOM Export Services

MISStar provides advanced functional processing of DICOM images. MISStar allows user to save processed image results (maps) into the MISStar database in either the same DICOM format of the original raw DICOM images or in secondary capture DICOM format (with 32-bit RGB color).

To save a map in original DICOM format, MISStar first reads the header information tags from the raw image of the corresponding slice location. Then it modifies the following tag values which exist in the corresponding raw image header. Each map is saved with the modified header appended with the map pixel data. Each type of maps will be saved as a new series of DICOM images into the MISStar database.

Description	Tag	New Value
Series Description	(0008,103E)	Map title (full)
Series Number	(0020,0011)	Unique Series Number (>200)
Series Instance UID	(0020,000E)	MISStar implementation UID + Generated Unique Number
Image Number	(0020,0013)	Slice Number
Image SOP Instance UID	(0008,0018)	MISStar implementation UID + Generated Unique Number
Sequence Name	(0018,0024)	Map title (short)
Slice Thickness	(0018,0050)	Slice Thickness
Slice Location	(0020,1041)	Slice Location
Number of Frames	(0028,0008)	1
Rows	(0028,0010)	NY of map
Columns	(0028,0011)	NX of map
Bits Allocated	(0028,0100)	16
Number of Bytes for Pixel Data	(7FE0,0000)	NX*NY*2

3.1.6 MISStar DICOM Anonymization Services

MISStar allows user to modify the following tag values stored in the raw DICOM image header from the MISStar database.

Data Level	Description	Tag	Permission
Study	Study Date	(0008,0020)	Modify
Study	Series Date	(0008,0021)	Set same as modified Study Date
Study	Acquisition Date	(0008,0022)	Set same as modified Study Date
Study	Content Date	(0008,0023)	Set same as modified Study Date
Study	Accession Number	(0008,0050)	Modify
Study	Institution Name	(0008,0080)	Modify
Study	Study Description	(0008,1030)	Modify
Study	Patient's Name	(0010,0010)	Modify
Study	Patient ID	(0010,0020)	Modify
Study	Patient's Birth Date	(0010,0030)	Set to "00010101" if Age changed
Study	Patient's Sex	(0010,0040)	Modify
Study	Patient's Age	(0010,1010)	Modify

4. COMMUNICATION PROFILE

4.1 Supported Communication Stacks

DICOM (Part 8) Upper Layer over TCP/IP is supported.

4.2 OSI Stack

Not supported.

4.3 TCP/IP Stack

The TCP/IP stack is inherited from the host operating system (Windows NT/2000/XP/Vista).

4.3.1 Physical Media Support

Any Windows NT/2000/XP/Vista supported physical media.

4.4 Point-to-Point Stack

Not supported

4.5 Configurable Parameters

Parameter	Configurable	Default Value
MIStar Host Name	System	Auto detection by MIStar
MIStar IP Address	System	Auto detection by MIStar
MIStar AE Title	Yes	MIStar
MIStar TCP/IP Port	Yes	104
Maximum PDU size	Yes	32kB
Network connection time-out	Yes	30 sec
Network read time-out	Yes	300 sec
Network write time-out	Yes	60 sec
MIStar SCP database folder	Yes	Same as SCU database folder
MIStar SCP log option	Yes	Online
MIStar SCP debug option	Yes	Off
MIStar database folder	Yes	Prompt at initial setup
MIStar SCU log option	Yes	Off
Remote AE Title	Yes	User input
Remote IP Address	Yes	User input
Remote TCP/IP Port	Yes	User input

5. SUPPORT OF EXTENDED CHARACTER SETS

Extended character sets are not supported.