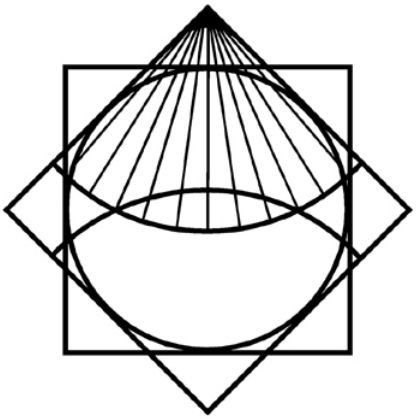
Agilent Technologies
Innovating the HP Way

# EnConcert

Software Version B.0

Technical Data

# DICOM
# Conformance Statement



# REVISION HISTORY

| Production Change Order | Rev | Date | Affected Sections/Pages | Summary of Change(s) |
|---|---|---|---|---|
| | B.0 | 9/08/99 | | preliminary version |
| | B.0 | 11/04/99 | | combined FSR and SCP |
| | B.0 | 02/06/00 | | Added Export to DICOM media |
| | B.0 | 06/08/00 | | CR26953 |
| | B.0 | 08/31/00 | | CR27986 |
| | B.0 | 09/13/00 | | CR28072 |
| | B.0 | 09/18/00 | | CR28119 |
| | B.0 | 10/09/00 | | CR28261 |

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# A. EnConcert DICOM Conformance Statement

## A.0 Introduction

DICOM (Digital Imaging and Communications in Medicine) is a standard that specifies how images and related clinical information are passed between medical devices that produce or use this data. The DICOM conformance statement is a required document for any device claiming conformance to DICOM.

This document defines the conformance of Agilent Technologies' EnConcert echo information management solution as a Storage-Service Class Provider and a File Set Reader (FSR), File Set Creator (FSC), File Set Updater (FSU). In particular, the DICOM system interface and capabilities are described. While the DICOM Conformance Statement is not intended to be a complete product specification, some areas of this document will reference system operation where it is necessary to add a context for the discussion or to help explain a capability. This document specifies the compliance to the DICOM Standard V3.0, NEMA PS 3.1-14, 1999 and is written according to Part PS 3.2.

## A.1 Implementation Model

EnConcert is a patient-oriented image database and storage facility. EnConcert Net SCP is a single application entity that stores images sent to it by Storage service class users and takes responsibility for storage of the images in Patient folders. The FSR Application Entity is used to Import DICOM Objects from media. The FSC/FSU Application Entity is used to Export DICOM Objects to media.

### A.1.1 Application Data Flow Diagram

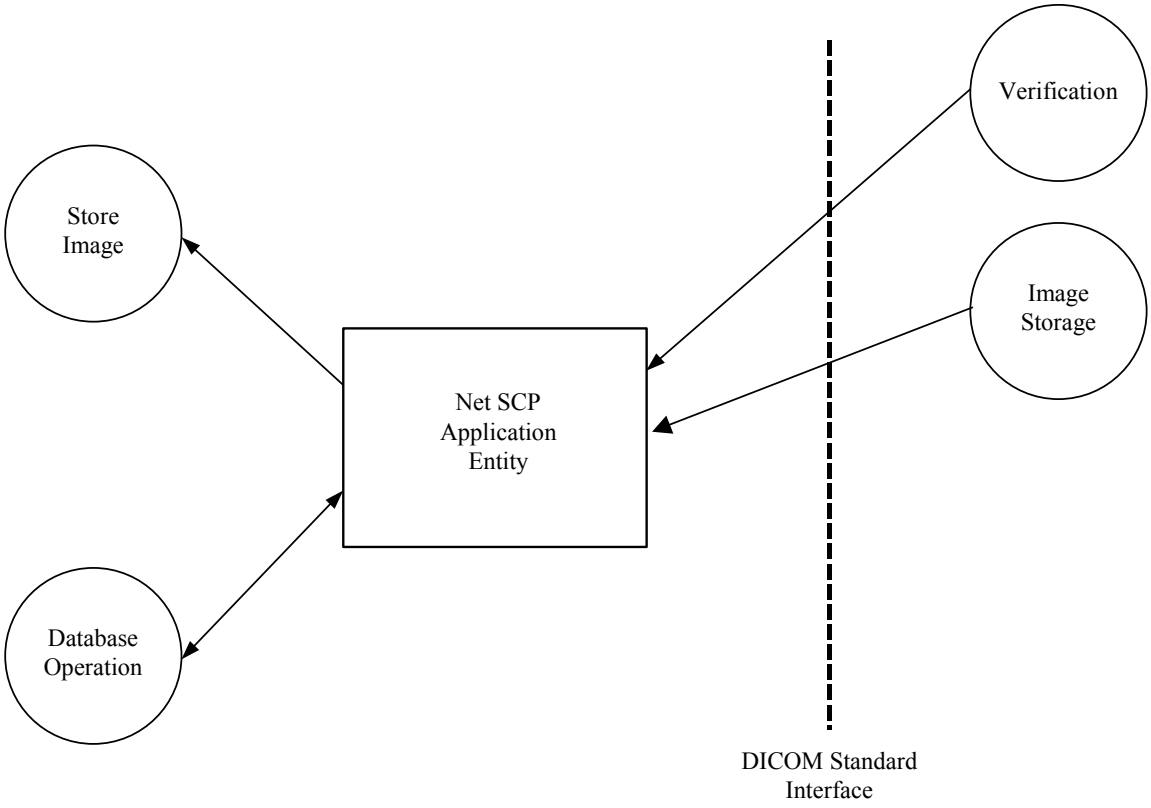


**Figure A.1.1-1: Net SCP DICOM Implementation Model**

The Net SCP Application Entity (AE) accepts associations from remote AEs and then processes the DICOM requests until the association is closed.

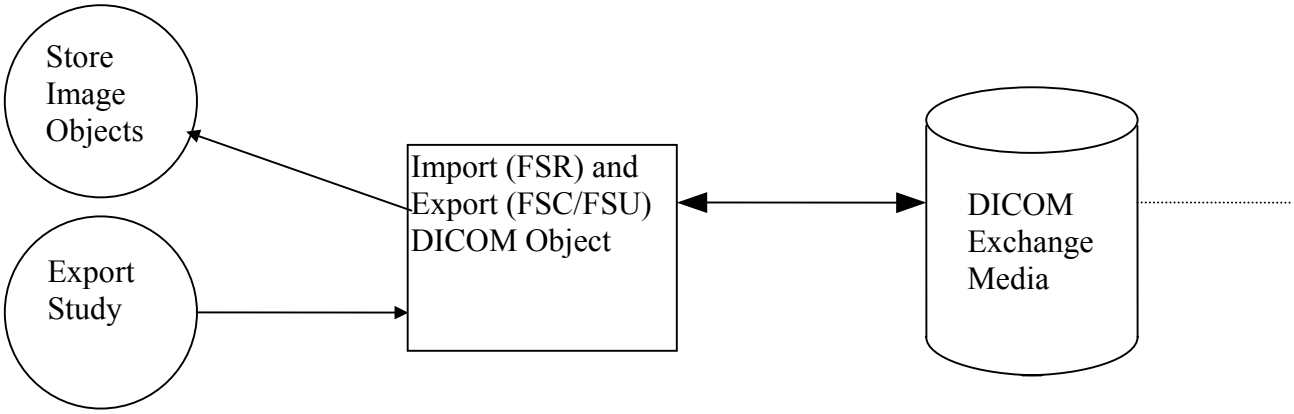


**Figure A.1.1-2: FSR and FSC/FSU Application Data Flow Diagram**

Data flow between Store Image Objects and the FSR Application Entity (AE) consists of DICOM image objects. Data flow between Export Study and the FSC/FSU Application Entity (AE) consists of DICOM image objects. Data flow between the AE and the DICOM Exchange Media consists of DICOM image objects together with the DICOM directory object (DICOMDIR).

## A.1.2 Functional Definition of Application Entities

### A.1.2.1 NetSCP Receive DICOM Objects

EnConcert waits for another application to connect at the presentation address configured for its Application Entity Title. When another application connects, EnConcert expects it to be a DICOM application. EnConcert will accept associations with Presentation Contexts for SOP Classes of the Storage Service Class. It will receive images on these Presentation Contexts and write them to files in the format specified in PS 3.10.

### A.1.2.2 Import DICOM Objects

This Application Entity provides for importing DICOM objects from media. The DICOM file set consists of all DICOM image files on the media (or on the loaded side of the media, in some cases), represented by a DICOM Medical Information Directory (the file named “DICOMDIR”). Images on the media are organized by Patient, with each Patient consisting of zero or more DICOM Studies, with each DICOM Study consisting of zero or more Series, and with each Series consisting of zero or more image objects. EnConcert organizes patient data into Ultrasound Studies, where an Ultrasound Study includes the image set from a DICOM Study. The EnConcert user may select one, several, or all the Ultrasound Studies from a file-set (and their associated image objects) to be imported from the media. The selected Ultrasound Studies are stored in the system database. Image files are stored in the format specified in PS 3.10.

#### A.1.2.3 Export study to DICOM media

This Application Entity provides for exporting studies to DICOM media. If the media is blank then the FSC role is employed. If the media already contains a DICOMDIR then the FSU role is employed. The following DICOMDIR record types are handled: PATIENT, STUDY, SERIES, IMAGE.

### A.1.3 Sequencing of Real-World Activities

All selected Ultrasound Studies and associated images from the DICOM network or media are stored within EnConcert at the time of import. Association of each Ultrasound Study with the correct patient folder is verified by the clinician at a later time prior to the use of the information in the study.

The Export function can be performed on a piece of media whether it has a DICOM File-set or is just formatted. There are no sequencing requirements.

### A.1.4 File Meta Information for Implementation Class and Version

- File Meta Information Version = 00\01

- Implementation Class UID = 1.2.840.113543.6.6.1.1

- Implementation Version Name = “EnConcert_B.0”.

- Source Application Entity title is not provided.

## A.2 AE Specifications

### A.2.1 NetSCP - Specification

NetSCP provides Standard Conformance to the following DICOM V3.0 SOP Classes as a SCP:

| SOP Class Name | SOP Class UID |
|---|---|
| Ultrasound Image Storage | 1.2.840.10008.5.1.4.1.1.6.1 |
| Ultrasound Multi-frame Image Storage | 1.2.840.10008.5.1.4.1.1.3.1 |
| Verification SOP Class | 1.2.840.10008.1.1 |

#### A.2.1.1 Association Establishment Policies

##### A.2.1.1.1 General

The following Application Context Name will be accepted by NetSCP:

DICOM 3.0 Application Context **`1.2.840.10008.3.1.1.1`**

The default maximum PDU size is 258,048 bytes, and is configurable.

#### A.2.1.1.2 Number of Associations

The number of simultaneous associations which will be accepted by NetSCP are limited by a local configuration parameter, which is easily changed. NetSCP will spawn a new thread for each connection request it receives. Therefore, NetSCP can have multiple simultaneous connections.

#### A.2.1.1.3 Asynchronous Nature

NetSCP will only allow a single outstanding operation on an Association, and will not perform asynchronous operations window negotiation.

#### A.2.1.1.4 Implementation Identifying Information

NetSCP is identified by:

Implementation Class UID = 1.2.840.113543.6.6.1.1

Implementation Version Name = "EnConcert_B.0"

### A.2.1.2 Association Initiation Policy

NetSCP does not initiated associations.

### A.2.1.3 Association Acceptance Policy

NetSCP accepts associations based on A.6.1 AE Title/Presentation Address Mapping. When NetSCP accepts an association, it will receive any images transmitted on that association and store the images on disk in the file system in the format specified by PS 3.10. The user configures the maximum number of simultaneous connects NetSCP will support, based upon the system resources.

#### A.2.1.3.1 Store Image Real-World Activity

The associated Real-World Activity associated with the C-STORE operation is the storage of the image on the disk of the system upon which NetSCP is running. NetSCP will issue a non-success status if it is unable to store the image on disk, or if image transferred does not conform to the IOD of the SOP class under which it was transmitted.

#### A.2.1.3.2 Presentation Context Table

Any of the Presentation Contexts shown in Table A.2.1-1 are acceptable for NetSCP to receive images.

**Table A.2.1-1**
**Acceptable Presentation Contexts for NetSCP**

| Presentation Context Table | | | |
|---|---|---|---|
| **Abstract Syntax** | **Transfer Syntax** | **Role** | **Extended** |

| Name | UID | Name | UID | | Negotiation |
|---|---|---|---|---|---|
| Verification | 1.2.840.10008.1.1 | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP | None |
| | | 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 | SCP | None |
| Ultrasound Multi-frame Image Storage SOP Class | 1.2.840.10008.5.1.4.1.1.3.1 | RLE Lossless | 1.2.840.10008.1.2.5 | SCP | None |
| | | JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression | 1.2.840.10008.1.2.4.50 | SCP | None |
| | | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP | None |
| | | DICOM Explicit VR Big Endian | 1.2.840.10008.1.2.2 | SCP | None |
| | | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCP | None |
| Ultrasound Image Storage SOP Class | 1.2.840.10008.5.1.4.1.1.6.1 | RLE Lossless | 1.2.840.10008.1.2.5 | SCP | None |
| | | JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8 Bit Image Compression | 1.2.840.10008.1.2.4.50 | SCP | None |
| | | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP | None |

| | | | | | |
|---|---|---|---|---|---|
| | | DICOM Explicit VR Big Endian | 1.2.840.10008.1.2.2 | SCP | None |
| | | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCP | None |

#### A.2.1.3.2.1 SOP Specific Conformance to Verification SOP Class

NetSCP provides standard conformance to the DICOM Verification Service Class.

#### A.2.1.3.2.2 SOP Specific Conformance to Storage SOP Classes

NetSCP provides Standard Extended Conformance to the SOP's of the Storage Service Class at Level 2 (Full). No elements are discarded or coerced by NetSCP. In the event of a successful C-STORE operation, the Image has successfully been written to disk as a standard file, and will be retained as long as the Study is retained by the user.

Access to the Images is provided via the Image Diagnosis Application. . Any Image that has undergone lossy compression will have the text “LossyCR ??:1” or “JPEG CRnn:1” displayed.

If NetSCP returns one of the following status codes, then the C-STORE was unsuccessful:

- 0111 (warning) - Indicates SOP Instance UID is a duplicate in study. See Affected SOP Instance UID.
- 0122 (SOP Class Not Supported) - Indicates that the SOP Class of the Image in the C-STORE operation did not match the Abstract Syntax negotiated for the Presentation Context.
- A700 (Out of Resources) - Indicates that there was not enough disk space to store the image.
- C000 (failed) - Indicates the operation was not successful.
- C010 (failed) - Indicates a required attribute is missing. See Offending Element.
- C012 (failed) - Indicates UID is already in use. See Offending Element.

For some of the unsuccessful cases above, the Offending Element and the Error Comment could be followed to provide more details.

### A.2.1.3.3 Presentation Context Acceptance Criterion

NetSCP will always accept a Presentation Context for the Verification SOP Class with the DICOM Default Transfer Syntax, as well as the Explicit Transfer Syntaxes. In addition to this,

NetSCP will accept all Presentation Contexts that convey Abstract Syntaxes defined in Table A.2.1-1.

#### A.2.1.3.4 Transfer Syntax Selection Policies

NetSCP prefers to receive images encoded using lossless transfer syntax. If offered a choice of Transfer Syntaxes in a Presentation Context, it will choose one in the order listed in Table A.2.1-1.

### A.2.2 Import DICOM Objects Specifications

This Application Entity conforms to the Application Profile for Ultrasound Media Storage applications. The particular physical media used is limited only by the availability of compatible storage devices on the host computer system. Image Display and Spatial Calibration of Single and Multi-Frame image objects on any media in the Ultrasound Application Profile is therefore supported. For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Reader (FSR).

| Supported Application Profile | Real-World Activity | Roles | Service Class Option |
|---|---|---|---|
| STD-US-SC-SF&MF-FLOP | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD128 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD230 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD540 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD650 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD12 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-MOD23 | Import Studies | FSR | Interchange |
| STD-US-SC-SF&MF-CDR | Import Studies | FSR | Interchange |

**Table A.2.2-2: Import DICOM Objects Application Profiles**

#### A.2.2.1 File Meta Information for the Application Entity

Source Application Entity Title is not used.

### A.2.2.2 Real-World Activity: Import DICOM Objects from Exchange Media

The Import DICOM Objects Application Entity acts as FSR using the Interchange Option, when requested to read the media directory.

Importing of images is initiated by the user choosing the Import operation from a menu. See the system user manuals for a description of the specific user interface capabilities.

#### A.2.2.2.1 Media Storage Application Profiles

The supported Application Profiles are listed in Table A.2.2-2: Import DICOM Objects Application Profiles.

##### A.2.2.2.1.1 SOP Specific Conformance for "DICOM Directory" SOP Class

Type 1, 1C, 2, and 2C data elements present in the Basic Directory Object are supported as required in DICOM 3.0, Parts 3 and 10. They are used for properly navigating through the directory data structures, recognizing and conforming to the character set being used, and in the Import DICOM Objects user interface to aid in the selection of objects to import. Data elements that elicit behavior that is specific to this Application Entity are described in the sections below. If Type 2 data elements are null or if Type 3 data elements are absent, the data elements are ignored by the system and the corresponding display fields in the user interface screen(s) are left blank.

##### A.2.2.2.1.2 File-set Identification Module

Contents of the File-set Identification Module are not displayed or otherwise used in this version of EnConcert.

##### A.2.2.2.1.3 Directory Information Module

All data elements are used as described in DICOM 3.0 Part 3 for Basic Directory Object Definitions. As stated in the Ultrasound Application Profile, "The (DICOMDIR) Directory shall include Directory Records of PATIENT, STUDY, SERIES, and IMAGE corresponding to the information object files in the File-set". Given this requirement, EnConcert uses these directory records to identify the study to import. If there are DICOM image files on the import media that do not appear in the DICOMDIR Directory Information Module (either because references to these files were omitted or the because the Directory Information Module, optional in DICOM but required in the Ultrasound Application Profile, does not exist), these files are not recognized by the system.

Directory Record Types other than those stated above are ignored by EnConcert.

The "File-set Consistency Flag" (0004,1212) is also ignored by EnConcert.

###### A.2.2.2.1.3.1 Patient Directory Record

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details. |
| Patient Name | (0010,0010) | 2 | Displayed to help the user identify the patient folder in which to place the studies for this patient. |
| Patient ID | (0010,0020) | 1 | Displayed to help the user identify the patient folder in which to place the studies for this patient. |

**Table A.2.2-3: Specific Usage of Patient Directory Record Information**

### A.2.2.2.1.3.2 Study Directory Record

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details. |
| Study Date | (0008,0020) | 1 | Used, together with the Study Time, as the study start time. |
| Study Time | (0008,0030) | 1 | Used, together with the Study Date, as the study start time. |
| Accession Number | (0008,0050) | 2 | Stored in the system database |
| Study Description | (0008,1030) | 2 | Generated. |
| Study Instance UID | (0020,000D) | 1C | Stored in the system database |
| Study ID | (0020,0010) | 1 | Stored in the system database |

**Table A.2.2-4: Specific Usage of Study Directory Record Information**

### A.2.2.2.1.3.3 Series Directory Record

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR |

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| | | | 100 (Latin 1) are supported. See Section A.7 for details. |
| Modality | (0008,0060) | 1 | Only US, CD, EC (ultrasound) is supported. The presence of Series from other modalities does not affect the readability of ultrasound series; those other series are ignored. |
| Series Description | (0008,103E) | 3 | Stored |
| Series Instance UID | (0020,000E) | 1 | Stored in the system database |
| Series Number | (0020,0011) | 1 | Stored |

**Table A.2.2-5: Specific Usage of Series Directory Record Information**

### A.2.2.2.1.3.4 Image Directory Record

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details. |
| Referenced File ID | (0004,1500) | 1C | Used |
| Referenced SOP Class UID in File | (0004,1510) | 1C | Used |
| Referenced SOP Instance UID in File | (0004,1511) | 1C | Used |
| Referenced Transfer Syntax UID in File | (0004,1512) | 1C | Used |
| Image Date | (0008,0023) | 3 | Used for ordering the thumbnail display, if Image Number cannot be used. On Export, comes from the image. |
| Image Time | (0008,0033) | 3 | Used for ordering the thumbnail display, if Image Number cannot be used. On Export, comes from the image. |
| Image Number | (0020,0013) | 1 | Used for ordering the original thumbnail display. |
| Image Comments | (0020,4000) | 3 | Displayed with image. On Export, comes from the image. |

**Table A.2.2-6: Specific Usage of Image Directory Record Information**

### A.2.3 Export study to DICOM media Specifications

When exporting a Study that was stored in DSR-TIFF format, this Application Entity conforms to the Application Profile for Ultrasound Media Storage applications. When exporting a Study that was received in DICOM format, this Application Entity will export the IODs using the transfer syntax and tags that were used when the study was originally received.

For all SOP Classes described in the Application Profile, this AE performs in the role of File Set Creator and File Set Updater (FSC and FSU). The media supported for Export are the same as specified in A.2.2 Import DICOM Objects Specifications.

| Supported Application Profile | Real-World Activity | Roles | Service Class Option |
|---|---|---|---|
| STD-US-SC-SF&MF | Export Study | FSC and FSU | Interchange |
| STD-US-ID-SF&MF | Export Study | FSC and FSU | Interchange |

**Table A.2.3-7: Export study to DICOM media Application Profiles**

#### A.2.3.1 File Meta Information for the Application Entity

See A.1.4 File Meta Information for Implementation Class and Version

#### A.2.3.2 Real-World Activity: Export study to DICOM Exchange Media

The Export DICOM Objects Application Entity acts as FSC and FSU using the Interchange Option.

Exporting studies is initiated by the user choosing the Export operation from a menu. See the system user manuals for a description of the specific user interface capabilities. When exporting a DSR-TIFF study, the user can control the photometric interpretation and transfer syntax used to create DICOM files by setting options in the Export dialog.

##### A.2.3.2.1 Media Storage Application Profiles

The supported Application Profiles are listed in Table A.2.3-7: Export study to DICOM media Application Profiles.

## A.3 Communication Profiles

EnConcert conforms to the DICOM Application Context 1.2.840.10008.3.1.1.1.

### A.3.1 Supported Communications Stacks (parts 8,9)

NetSCP provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8.

### A.3.2 TCP/IP Stack

NetSCP inherits the TCP/IP stack from the operating system.

#### A.3.2.1 Physical Media Support

NetSCP is indifferent to the physical medium over which TCP/IP executes; and inherit this from the NT system.

#### A.3.2.2 Communication Timeouts and Wait Periods

Network timeouts are pre-selected to be appropriate to a large range of network configurations, including:

| | |
|---|---|
| "Association and Release" (DICOM "ARTIM") | The time to use as a time out waiting for an association request or waiting for the peer to shut down an association. Set to 120 seconds. |
| "Release" | The time to wait for a reply to an associate release. Set to 120 seconds. |
| "Write" | The time to wait for a network write operation to be accepted. Set to 120 seconds. |
| "Inactivity" | The time to wait for successive TCP/IP data packets when reading a message from the SCU. Set to 120 seconds. |

Should an association be aborted or closed as part of network error detection and recovery (see A.2.1.3.1 Store Image Real-World Activity), EnConcert will terminate the thread. Further action is initiated by the SCU. All these timeout parameters are configurable.

## A.4 Augmented and Private Application Profiles

None.

## A.5 Extensions/Specializations/Privatizations

The system accepts and stores any optional data elements (standard and/or private) when importing DICOM images.

## A.6 Configuration

NetSCP obtains configuration information from the system.

### A.6.1 AE Title/Presentation Address Mapping

NetSCP keeps a list consisting of AETitle, Hostname, and IPAddress for each SCU system that is allowed to connect. If this list is empty, then any system is allowed to connect.

### A.6.2 Configurable Parameters

The following parameters may be configured for NetSCP:

- Application Entity Title
- Port Number upon which to wait for connections. Default is 104.
- Maximum PDU size

## A.7 Support of Extended Character Sets

EnConcert does not take any specific action on the "Specific Character Set" data element. The character set used by EnConcert is compatible with both the default DICOM character repertoire and the optional character set "ISO-IR 100", the Latin Alphabet No. 1 supplementary set.

## A.8 IOD and Attribute specifications

### A.8.1 SOP Specific Conformance for "Ultrasound Image Storage" SOP Class

The Import DICOM Objects AE accepts all the data elements defined for the Standard Extended Ultrasound Image SOP Class. All of the data elements present in the SOP Instance are stored. Not all data elements are used as inputs to system applications, however. The following sections indicate the role each data element has within system applications; data elements with no role in system applications are not explicitly listed.

#### A.8.1.1 Patient Module

The Patient Module is Mandatory. Certain attributes in the Patient Directory Record were originally extracted from corresponding attributes from this image object module, and produce the behavior described in section *A.2.2.2.1.1 SOP Specific Conformance for "DICOM Directory" SOP Class*.

#### A.8.1.2 General Study Module

The General Study Module is Mandatory. Certain attributes in the Study Directory Record were originally extracted from corresponding attributes from this image object module, and produce the behavior described in section *A.2.2.2.1.1 SOP Specific Conformance for "DICOM Directory" SOP Class*

### A.8.1.3 Patient Study Module

The inclusion of this module in this SOP Class is optional.

### A.8.1.4 General Series Module

The General Series Module is Mandatory. Certain attributes in the Series Directory Record were originally extracted from corresponding attributes from this image object module, and produce the behavior described in section *A.2.2.2.1.1 SOP Specific Conformance for "DICOM Directory" SOP Class*.

### A.8.1.5 Frame of Reference Module

The inclusion of this module in this SOP Class is optional.

### A.8.1.6 Ultrasound Frame of Reference Module

The inclusion of this module in this SOP Class is Conditional: the Module is required if the image is a member of a set of spatially related images.

### A.8.1.7 General Equipment Module

The General Equipment Module is Mandatory.

### A.8.1.8 General Image Module

The General Image Module is Mandatory. Certain attributes in the Series Directory Record were originally extracted from corresponding attributes from this image object module, and produce the behavior described in section *A.2.2.2.1.1 SOP Specific Conformance for "DICOM Directory" SOP Class*. Additional behavior related to attributes of this module is described in *Table A.8.1-8: General Image Module Usage*.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Image Comments | (0020,4000) | 3 | Used to label displayed images |

**Table A.8.1-8: General Image Module Usage**

### A.8.1.9 Image Pixel Module

The Image Pixel Module is Mandatory. Certain attributes have a role in EnConcert as described in *Table A.8.1-9: Image Pixel Module Usage*.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Samples per Pixel | (0028,0002) | 1 | Attribute necessary for display of this image. |
| Photometric Interpretation | (0028,0004) | 1 | Attribute necessary for display of this image. |
| Rows | (0028,0010) | 1 | Attribute necessary for display of this image. |
| Columns | (0028,0011) | 1 | Attribute necessary for display of this image. |
| Bits Allocated | (0028,0100) | 1 | Attribute necessary for display of this image. |
| Bits Stored | (0028,0101) | 1 | Attribute necessary for display of this image. |
| High Bit | (0028,0102) | 1 | Attribute necessary for display of this image. |
| Pixel Representation | (0028,0103) | 1 | Unsigned integer pixels are assumed. |
| Pixel Data | (7FE0,0010) | 1 | Image data |
| Planar Configuration | (0028,0006) | 1C | Attribute necessary for display of images with more than 1 sample per pixel, except when RLE or JPEG Compressed Transfer Syntax (1.2.840.10008.1.2.5 or 1.2.840.10008.1.2.4.50) is used, which overrides the meaning of this element. |
| Pixel Aspect Ratio | (0028,0034) | 1C | Attribute necessary for display of images with non-square pixels. |
| Red Palette Color Lookup Table Descriptor | (0028,1101) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |
| Green Palette Color Lookup Table Descriptor | (0028,1102) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |
| Blue Palette Color Lookup Table Descriptor | (0028,1103) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Palette Color Lookup Table UID | (0028,1199) | 1C | Not used. |
| Red Palette Color LUT Data<br>**or**<br>Segmented Red Palette Color Lookup Table Data | (0028,1201)<br><br>(0028,1221) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |
| Green Palette Color LUT Data<br>**or**<br>Segmented Green Palette Color Lookup Table Data | (0028,1202)<br><br>(0028,1222) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |
| Blue Palette Color LUT Data<br>**or**<br>Segmented Blue Palette Color Lookup Table Data | (0028,1203)<br><br>(0028,1223) | 1C | Attribute necessary for display of images with PALETTE COLOR photometric interpretation. |

**Table A.8.1-9: Image Pixel Module Usage**

### A.8.1.10 Contrast/Bolus Module

The inclusion of this module in this SOP Class is Conditional: the Module is required if contrast media was used in the acquisition of this image.

### A.8.1.11 Ultrasound Region Calibration Module

The inclusion of this module in this SOP Class is optional.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Sequence of Ultrasound Regions | (0018,6011) | 1 | Sequence containing a set of rectangular regions of the image, with each region sharing the same calibration characteristics. |
| >Region Location Min x0 | (0018,6018) | 1 | Upper left point of region where (x,y) = (0,0) is upper left corner of image. |
| >Region Location Min y0 | (0018,601A) | 1 | |
| >Region Location Max x1 | (0018,601C) | 1 | Lower right point of region where (x,y) = (0,0) is upper left corner of image. |
| >Region Location Max y1 | (0018,601E) | 1 | |
| >Physical Units X Direction | (0018,6024) | 1 | Units in X direction which Physical Delta X and Ref. Pixel Physical Value X are measured in. |
| >Physical Units Y Direction | (0018,6026) | 1 | Units in Y direction which Physical Delta Y and Ref. Pixel Physical Value Y are measured in. |
| >Physical Delta X | (0018,602C) | 1 | Difference in physical value, in terms of above units, a move of 1 pixel in the positive X direction corresponds to. |
| >Physical Delta Y | (0018,602E) | 1 | Difference in physical value, in terms of above units, a move of 1 pixel in the positive Y direction corresponds to. |
| >Reference Pixel $x_0$ | (0018,6020) | 3 | Used in some waveform and spectral displays where an absolute pixel value in the region should be established. |
| >Reference Pixel $y_0$ | (0018,6022) | | |
| >Ref. Pixel Physical Value X | (0018,6028) | 3 | Used in some waveform and spectral displays where an absolute pixel value in the region should be established. |
| >Ref. Pixel Physical Value Y | (0018,602A) | 3 | Used in some waveform and spectral displays where an absolute pixel value in the region should be established. This will be the Y value in “Physical Units Y Direction” units at the Reference Pixel. |
| >Region Spatial Format | (0018,6012) | 1 | Spatial organization of region data<br>Used in making measurements in the region |

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| >Region Data Type | (0018,6014) | 1 | Type of data within the region |
| >Region Flags | (0018,6016) | 1 | Transparent + Protected + Velocity or<br>Transparent + Protected + Frequency |

**Table A.8.1-10: US Region Calibration Module Attributes**

### A.8.1.12 Ultrasound Image Module

The Ultrasound Image Module is Mandatory. Some elements already have been discussed in previous modules; their appearance in this module is a specialization for Ultrasound.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Photometric Interpretation | (0028,0004) | 1 | Attribute necessary for display of this image. |
| Pixel Representation | (0028,0103) | 1 | Unsigned integer pixels are assumed. |
| Frame Increment Pointer | (0028,0009) | 1C | Not used in this SOP Class (single frame) |
| Image Type | (0008,0008) | 2 | Not used |

**Table A.8.1-11: Ultrasound Image Module Usage in Ultrasound Image Storage SOP Class**

### A.8.1.13 Overlay Plane Module

The inclusion of this module in this SOP Class is optional.

### A.8.1.14 Volume of Interest Lookup Table (VOI LUT) Module

The inclusion of this module in this SOP Class is optional.

### A.8.1.15 Curve Identification Module

The Curve Identification Module is Mandatory for instances of this SOP Class containing the Curve Information Entity, which is mutually exclusive with the Image Information Entity.

While the system stores these instances, it does not display or otherwise manipulate Curve objects.

### A.8.1.16 Curve Module

The Curve Module is Mandatory for instances of this SOP Class containing the Curve Information Entity, which is mutually exclusive with the Image Information Entity. While the system stores these instances, it does not display or otherwise manipulate Curve objects.

### A.8.1.17 Audio Module

The Audio Module is optional for instances of this SOP Class containing the Curve Information Entity, which is mutually exclusive with the Image Information Entity. While the system stores these instances, it does not play or otherwise manipulate Curve or associated Audio objects.

### A.8.1.18 SOP Common Module

The SOP Common Module is Mandatory. Certain attributes have a role in EnConcert as described in *Table A.8.1-12: SOP Common Module Usage*.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| SOP Class UID | (0008,0016) | 1 | "1.2.840.10008.5.1.4.1.1.6.1" |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details. |

**Table A.8.1-12: SOP Common Module Usage**

## A.8.2 SOP Specific Conformance for "Ultrasound MF Image Storage"

The Import DICOM Objects AE accepts all the data elements defined for the Standard Extended Ultrasound Multi-frame Image SOP Class. All of the data elements present in the SOP Instance are stored. Not all data elements are used as inputs to system applications, however. Data elements in this SOP Class have the same role in the system as do elements in the Ultrasound Image Storage SOP Class described above, with the exceptions and additions noted in the following sections. Data elements with no role in system applications are not explicitly listed.

### A.8.2.1 Ultrasound Image Module

The Ultrasound Image Module is Mandatory.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Frame Increment Pointer | (0028,0009) | 1C | Attribute necessary for display of this image. |

**Table A.8.2-13: Ultrasound Image Module Usage in Ultrasound Multi-frame Image Storage SOP Class**

### A.8.2.2 Cine Module

The Cine Module is Mandatory for the Ultrasound Multi-frame Image Storage SOP Class.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Frame Time | (0018,1063) | 1C | Attribute necessary for display of this image, if the temporal spacing of frames in the image is uniform. |
| Frame Time Vector | (0018,1065) | 1C | Attribute necessary for display of this image, if the temporal spacing of frames in the image is non-uniform (varies from frame to frame). |
| Recommended Display Frame Rate | (0008,2144) | 3 | Attribute used in the display of this image. If present, overrides Frame Time and Frame Time Vector in determining display frame rate. |

**Table A.8.2-14: Cine Module Usage**

### A.8.2.3 Multi-frame Module

The Multi-frame Module is Mandatory for the Ultrasound Multi-frame Image Storage SOP Class.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| Number of Frames | (0028,0008) | 1 | Attribute necessary for display of this image. |
| Frame Increment Pointer | (0028,0009) | 1 | Attribute necessary for display of this image. |

**Table A.8.2-15: Multi-frame Module Usage**

### A.8.2.4 SOP Common Module

The SOP Common Module is Mandatory. Certain attributes have a role in EnConcert as described in *Table A.8.2-16: SOP Common Module Usage in Ultrasound Multi-frame Image Storage SOP Class*.

| Attribute Name | Tag | Type | Usage |
|---|---|---|---|
| SOP Class UID | (0008,0016) | 1 | "1.2.840.10008.5.1.4.1.1.3.1" |
| Specific Character Set | (0008,0005) | 1C | The default DICOM character set and optional set ISO-IR 100 (Latin 1) are supported. See Section A.7 for details. |

**Table A.8.2-16: SOP Common Module Usage in Ultrasound Multi-frame Image Storage SOP Class**

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