

**Philips Medical Systems
DICOM Conformance Statement**

CT-SR 6000

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1 Introduction

This chapter provides general information about the purpose, scope and contents of this Conformance Statement.

1.1 Scope and field of application

The scope of this DICOM Conformance Statement is to facilitate data exchange with equipment of Philips Medical Systems. This document specifies the compliance to the DICOM standard (formally called the NEMA PS 3.X-1993 standards). It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are: the supported DICOM Service Object Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntaxes.

The field of application is the integration of the Philips Medical Systems equipment into an environment of medical devices.

This Conformance Statement should be read in conjunction with the DICOM standard and its addenda. The conformance to the DICOM standard is a key element of the Inturis Program (see [INTURIS]).

1.2 Intended audience

This Conformance Statement is intended for:

- (potential) customers,
- system integrators of medical equipment,
- marketing staff interested in system functionality,
- software designers implementing DICOM interfaces.

It is assumed that the reader is familiar with the DICOM standard.

1.3 Contents and structure

The DICOM Conformance Statement is contained in chapter 2 through 7 and follows the contents and structuring requirements of DICOM PS 3.2-1993 and Supplement 2 (in case of Media specifications).

Additionally, the chapters following 7 specify the details of the applied IODs.

1.4 Used definitions, terms and abbreviations

DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see NEMA PS 3.3-1993 and PS 3.4-1994.

The word Philips in this document refers to Philips Medical Systems.

1.5 References

- [DICOM] The Digital Imaging and Communications in Medicine (DICOM) standard:
NEMA PS 3.X (X refers to the part 1 - 13) and Supplements
National Electrical Manufacturers Association (NEMA) Publication Sales
1300 N. 17th Street, Suite 1847
Rosslyn, Va. 22209, United States of America
- [INTURIS] Philips Inturis Program
Integrated Clinical Solutions
Philips Medical Systems Nederland B.V. (see address at page ii)

1.6 Important note to the reader

This Conformance Statement by itself does not guarantee successful interoperability of Philips equipment with non-Philips equipment. The user (or user's agent) should be aware of the following issues:

- **Interoperability**

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Philips equipment with non-Philips equipment. It is the user's responsibility to analyse thoroughly the application requirements and to specify a solution that integrates Philips equipment with non-Philips equipment.

- **Validation**

Philips equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement.

Where Philips equipment is linked to non-Philips equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

- **New versions of the DICOM Standard**

The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Philips is actively involved in this evolution and plans to adapt its equipment to future versions of the DICOM Standard. In order to do so, Philips reserves the right to make changes to its products or to discontinue its delivery. The user should ensure that any non-Philips provider linking to Philips equipment, also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Philips equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

2 Implementation model

The CT-SR 6000 system (short CT-SR) of Philips Medical Systems is a scanner generating Computed Tomography (CT) images. The system can be installed with an Export function based on the DICOM Image Storage to transfer image data from the CT-SR system to a remote system. This DICOM Export function implies the presence of the CT-SR Net I/F option software 1.3E or higher.

The DICOM Export function is described in this document.

The DICOM Export function is implemented via a DICOM converter box (the MVP DMIA box). This box is validated and conforms to the DICOM Standard and to this Conformance Statement.

It might be that other types of converter boxes are connected to the CT-SR (not delivered by Philips Medical Systems, possibly installed on hospital project basis). Conformance to the DICOM standard and to this Conformance Statement is not guaranteed for these converter boxes.

2.1 Application Data Flow Diagram

The CT-SR system behaves as a single Application Entity. The related Implementation Model is shown in Figure 2-1 on page 4.

The Export function is activated by an operator request. The images to be transferred are selected from the user interface, followed by the selection of the destination.

The CT-SR system is able to transfer the following types of images:

- Normal scans: fast scan, serial scan
- Dynamic scans
- Volume scans
- Scanograms

The system does **not** support the transfer of Tomoscan 350 (converted) images, Graphical Annotated images and any images which are result of analysis.

Image data to be transferred are instances of the DICOM CT SOP Class. The images transferred are intended for viewing purposes. Postprocessing like MPR, 3D reconstruction and rendering may be possible, depending on the capabilities of the workstation receiving the CT images.

The system supports verification requests of the operator (mostly the service engineer) and answers verification requests from remote systems.

2.2 Functional definition of Application Entities

The CT-SR DICOM Export application entity acts as a Service Class User (SCU) of the Storage Service Class. After invoking it will open an association to the remote system. For each image to be transported a retrieve action from the internal CT-SR storage will take place followed by the conversion to a DICOM message to be sent to the remote system.

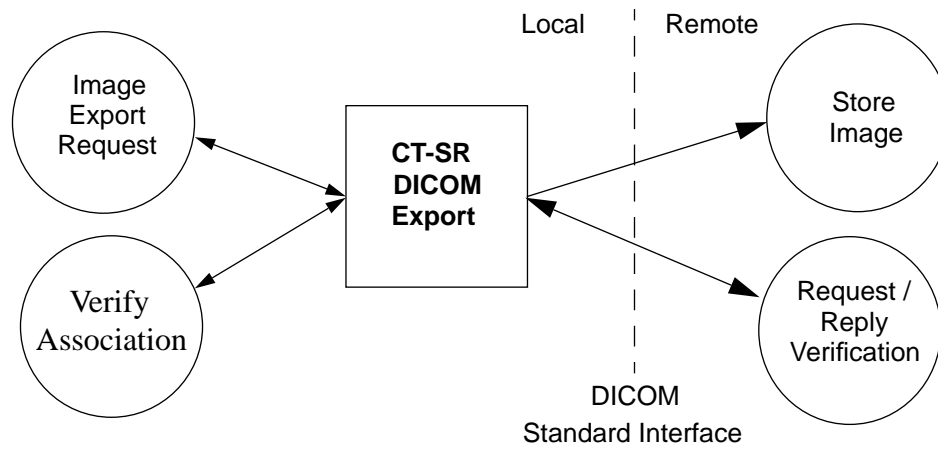


Figure 2-1: The CT-SR Implementation Model

The CT-SR DICOM Export application entity supports also the Verification SOP Class both as SCU and SCP.

2.3 Sequencing of Real World Activities

Not applicable.

3 AE Specifications

CT-SR system acts as a single Application Entity.

3.1 AE CT-SR DICOM Export Specification

The CT-SR DICOM Export Application Entity provides Standard Conformance to the following DICOM 3.0 SOP classes as an SCU:

Table 3-1: Supported SOP classes by the CT-SR DICOM Export AE as SCU

<i>SOP class Name</i>	<i>UID</i>
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2

The CT-SR DICOM Export Application Entity provides Standard Conformance to the following DICOM 3.0 SOP classes as an SCP:

Table 3-2: Supported SOP classes by the CT-SR DICOM Export AE as SCP

<i>SOP class Name</i>	<i>UID</i>
Verification	1.2.840.10008.1.1

3.1.1 Association Establishment Policies

3.1.1.1 General

The maximum PDU size is 16K (16384 bytes) on associations.

3.1.1.2 Number of Associations

CT-SR DICOM Export will attempt to establish one association at a time.

3.1.1.3 Asynchronous Nature

CT-SR DICOM Export does not support asynchronous operations and will not perform asynchronous window negotiation.

3.1.1.4 Implementation Identifying Information

The Implementation Class UID is: "1.3.46.670589.10.10.800143.1".

The implementation Version Name is: "HMC/M_SR6000_1".

3.1.2 Association Initiation Policy

CT-SR DICOM Export initiates associations as a result of the following events:

- The CT-SR operator requests export of one or more images to a remote system (section 3.1.2.1),
- The CT-SR operator requests for Association (i.e. application level communication) verification (section 3.1.2.2).

3.1.2.1 Image export from CT-SR system

3.1.2.1.1 Associated Real-World Activity

The CT-SR DICOM Export function will be accessible through the CT-SR user interface (Select Mode 43). The user will select the patient (also called examination), one or more images of that selected patient and the destination. The selected images are marked.

After the (successful, partly successful or failed) transfer of the selected images, the association is released.

3.1.2.1.2 Proposed Presentation Contexts

CT-SR DICOM Export will propose the following presentation contexts:

Table 3-3: Proposed Presentation Contexts for the image export

<i>Presentation Context table</i>					
<i>Abstract Syntax</i>		<i>Transfer Syntax</i>		<i>Role</i>	<i>Extended Negotiation</i>
<i>Name</i>	<i>UID</i>	<i>Name List</i>	<i>UID List</i>		
CT Image Storage	1.2.840.10008.5 .1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.1.3 SOP Specific Conformance to Storage SOP Class

During and after the transfer of images, the user interface shows an image counter indicating the number of successfully transferred images and the total number of images to transfer.

When the transfer is ended, CT-SR behaves as follows on the possible response states of the C-STORE messages:

Table 3-4: Behaviour on successful, unsuccessful and warning C-STORE response states

<i>C-STORE return status</i>	<i>Behaviour of the CT-SR system</i>
Success (status 0000) on all C-STORE messages	Status 'Completed' is shown on the console at the end of the transfer.
Refused (status A7xx) on one or more C-STORE messages	Status 'Incomplete' is shown on the console at the end of the transfer.
Error (status A9xx or Cxxx or 01xx) on one or more C-STORE messages	Status 'NetError' is shown on the console at the end of the transfer.

Table 3-4: Behaviour on successful, unsuccessful and warning C-STORE response states (Continued)

<i>C-STORE return status</i>	<i>Behaviour of the CT-SR system</i>
Warning (status B00x) on one or more C-STORE messages	All images are transferred successfully. Status 'Completed' is shown on the console, the warning is not shown or logged.

The CT-SR system will **not** retry after a failed transfer of one or more images.

The association is released when ready with the (complete or incomplete) transfer of selected images.

Extended negotiation is not supported.

Table 3-5 lists the applied Conditional and Optional attributes in the CT images. The full list of applied attributes is given in chapter 8 on page 11.

Table 3-5: Applied Conditional and Optional attributes of the CT IOD

<i>IE</i>	<i>Module</i>	<i>Conditional attributes</i>	<i>Optional attributes</i>
Patient	Patient	-	-
Study	General Study	-	-
Series	General Series	Patient Position	Protocol Name
Frame of Reference	Frame of Reference	-	-
Equipment	General Equipment	-	Institution Name, Station Name, Institutional Department Name, Manufacturer's Model name, Device Serial Number, Software Version(s)
Image	General Image	Patient Orientation	Image Comments
	Image Plane	-	Slice Location
	Image Pixel	-	-
	Contrast/Bolus	-	-
	CT Image	-	Scan Options, Reconstruction Diameter, Gantry/Detector Tilt, Table Height, Rotation Direction, Exposure Time, X-Ray Tube Current, Exposure, Convolution Kernel
	VOI LUT	Window Width	Window Center
	SOP Common	SOP Class UID, SOP Instance UID	Instance Creation Date, Instance Creation Time, Instance Creator UID

3.1.2.2 Verify Application Level Communication

3.1.2.2.1 Associated Real-World Activity

The CT-SR DICOM Export AE supports the Verification requests from the operator (usually the service engineer). This results in trying to setup an association to the selected remote system. The association is released after the verification.

3.1.2.2.2 Proposed Presentation Contexts

CT-SR DICOM Export will propose the following presentation contexts:

Table 3-6: Proposed Presentation Contexts for the Verification

<i>Presentation Context table</i>					
<i>Abstract Syntax</i>		<i>Transfer Syntax</i>		<i>Role</i>	<i>Extended Negotiation</i>
<i>Name</i>	<i>UID</i>	<i>Name List</i>	<i>UID List</i>		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.2.3 SOP Specific Conformance to the Verification SOP Class

CT-SR provides standard conformance.

3.1.3 Association Acceptance Policy

The CT-SR DICOM Export Application Entity accepts associations for only one purpose: to allow remote applications to verify application level communication.

3.1.3.1 Verify Application Level Communication

3.1.3.1.1 Associated Real-World Activity

CT-SR accepts associations from systems that wish to verify application level communication using the C-ECHO command.

3.1.3.1.2 Presentation Context Table

Any of the presentation contexts shown in the table below are acceptable.

Table 3-7: Acceptable Presentation Contexts for the Verification

<i>Presentation Context table</i>					
<i>Abstract Syntax</i>		<i>Transfer Syntax</i>		<i>Role</i>	<i>Extended Negotiation</i>
<i>Name</i>	<i>UID</i>	<i>Name List</i>	<i>UID List</i>		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.1.3 C-ECHO SCP Conformance

CT-SR provides standard conformance.

3.1.3.1.4 Presentation Context Acceptance Criterion

Not applicable.

3.1.3.1.5 Transfer Syntax Selection Policies

Not applicable.

4 Communication Profiles

4.1 TCP/IP Stack

CT-SR provides DICOM 3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM 3.0 Standard.

4.1.1 Physical Media Support

CT-SR supports ISO 8802-3 10BASE5 (Thick-wire), 10BASE2 (Thin-wire) and 10BASET (Twisted-pair) Ethernet.

5 Extensions/Specializations/Privatizations

Not applicable.

6 Configuration

The configuration of a CT-SR system is done by updating the DMIA-DICOM configuration files. It is intended to be done by Philips service engineers only.

6.1 AE Title/Presentation Address mapping

6.1.1 Local AE Titles and Presentation Addresses

The local Application Entity Title and Presentation Address are configurable.

6.1.2 Remote AE Titles and Presentation Addresses

All remote applications to be selected as export destination (SCP) are configurable for the following items:

- The Application Entity Title of the remote application.
- The Presentation Address (i.e. IP-address plus port number) at which the remote application should accept association requests.
- The Remote Host Name of the system on which the remote application resides.

6.2 Configurable parameters

None.

7 Support of Extended Character Sets

Not applicable.

8 Applied Computed Tomography (CT) Image IOD

The modules selected from the IOD module table of DICOM are given in the table below.

Table 8-1: CT IOD Modules

<i>IE</i>	<i>Module</i>
Patient	Patient
Study	General Study
Series	General Series
Frame of Reference	Frame of Reference
Equipment	General Equipment
Image	General Image
	Image Plane
	Image Pixel
	Contrast/Bolus
	CT Image
	VOI LUT
	SOP Common

The details of these applied modules are given in the tables below. The list of possible values are given (if applicable). The situation that an attribute is present conditionally/optionally or that an attribute may contain a zero length value, is indicated too. Standard DICOM Conditions and Defined/Enumerated Values are applicable but are not shown in the tables.

Table 8-2: CT Image Storage SOP Class - Patient Module

Attribute Name	Tag	Note
Patient's Name	0010,0010	
Patient ID	0010,0020	Zero length value if not entered by the user
Patient's Birth Date	0010,0030	Zero length value if not entered by the user
Patient's Sex	0010,0040	

Table 8-3: CT Image Storage SOP Class - General Study Module

Attribute Name	Tag	Note
Study Date	0008,0020	

Table 8-3: CT Image Storage SOP Class - General Study Module (Continued)

Attribute Name	Tag	Note
Study Time	0008,0030	
Accession Number	0008,0050	Always zero length value
Referring Physician's Name	0008,0090	Always zero length value
Study Instance UID	0020,000D	
Study ID	0020,0010	

Table 8-4: CT Image Storage SOP Class - General Series Module

Attribute Name	Tag	Note
Modality	0008,0060	Applied value(s): CT
Protocol Name	0018,1030	
Patient Position	0018,5100	
Series Instance UID	0020,000E	
Series Number	0020,0011	

Table 8-5: CT Image Storage SOP Class - Frame of Reference Module

Attribute Name	Tag	Note
Frame of Reference UID	0020,0052	Frame of Reference UID of Scannogram is the same as those of the related slices.
Position Reference Indicator	0020,1040	Always zero length value

Table 8-6: CT Image Storage SOP Class - General Equipment Module

Attribute Name	Tag	Note
Manufacturer	0008,0070	Applied value(s): Philips Medical Systems
Institution Name	0008,0080	May be empty
Station Name	0008,1010	
Institutional Department Name	0008,1040	
Manufacturer's Model Name	0008,1090	
Device Serial Number	0018,1000	

Table 8-6: CT Image Storage SOP Class - General Equipment Module (Continued)

Attribute Name	Tag	Note
Software Version(s)	0018,1020	Always zero length value

Table 8-7: CT Image Storage SOP Class - General Image Module

Attribute Name	Tag	Note
Image Number	0020,0013	
Patient Orientation	0020,0020	
Image Comments	0020,4000	Only present if entered by the user

Table 8-8: CT Image Storage SOP Class - Image Plane Module

Attribute Name	Tag	Note
Slice Thickness	0018,0050	
Image Position (Patient)	0020,0032	
Image Orientation (Patient)	0020,0037	
Slice Location	0020,1041	
Pixel Spacing	0028,0030	

Table 8-9: CT Image Storage SOP Class - Image Pixel Module

Attribute Name	Tag	Note
Photometric Interpretation	0028,0004	
Rows	0028,0010	
Columns	0028,0011	
Bits Allocated	0028,0100	
Bits Stored	0028,0101	
High Bit	0028,0102	
Pixel Representation	0028,0103	Applied value(s): 0000
Pixel Data	7FE0,0010	

Table 8-10: CT Image Storage SOP Class - Contrast/Bolus Module

Attribute Name	Tag	Note
Contrast/Bolus Agent	0018,0010	

Table 8-11: CT Image Storage SOP Class - CT Image Module

Attribute Name	Tag	Note
Image Type	0008,0008	Applied value(s): ORIGINAL \ PRIMARY \ AXIAL \ DYNAMIC, NORMAL, VOLUME or ORIGINAL \ PRIMARY \ LOCALIZER
Scan Options	0018,0022	
KVP	0018,0060	
Reconstruction Diameter	0018,1100	
Gantry/Detector Tilt	0018,1120	
Table Height	0018,1130	
Rotation Direction	0018,1140	
Exposure Time	0018,1150	
X-Ray Tube Current	0018,1151	
Exposure	0018,1152	
Convolution Kernel	0018,1210	
Acquisition Number	0020,0012	Always zero length value
Samples per Pixel	0028,0002	Applied value(s): 1
Photometric Interpretation	0028,0004	Applied value(s): MONOCHROME2
Bits Allocated	0028,0100	Applied value(s): 16
Bits Stored	0028,0101	Applied value(s): 12
High Bit	0028,0102	Applied value(s): 11
Rescale Intercept	0028,1052	Applied value(s): -1200
Rescale Slope	0028,1053	Applied value(s): 1

Table 8-12: CT Image Storage SOP Class - VOI LUT Module

Attribute Name	Tag	Note
Window Center	0028,1050	Two values are possible (for multiple viewing purpose).
Window Width	0028,1051	Two values are possible (for multiple viewing purpose).

Table 8-13: CT Image Storage SOP Class - SOP Common Module

Attribute Name	Tag	Note
Instance Creation Date	0008,0012	
Instance Creation Time	0008,0013	
Instance Creator UID	0008,0014	
SOP Class UID	0008,0016	Applied value(s): 1.2.840.10008.5.1.4.1.1.2
SOP Instance UID	0008,0018	