

**Philips Medical Systems
DICOM Conformance Statement**

CT-SR 4000

Document Number 4522 983 63781
17 January 1997

© Copyright Philips Medical Systems Nederland B.V. 1997

All rights reserved

Issued by:

Philips Medical Systems Nederland B.V.
Integrated Clinical Solutions, Marketing & Communications
Building QP-0233
P.O. Box 10.000
5680 DA Best
The Netherlands
Tel.: +31 40 2763827
Fax.: +31 40 2763810
email: dicom@best.ms.philips.com

Table of Contents

| | | |
|-------|---|----|
| 1 | Introduction | 1 |
| 1.1 | Scope and field of application | 1 |
| 1.2 | Intended audience | 1 |
| 1.3 | Contents and structure | 1 |
| 1.4 | Used definitions, terms and abbreviations | 1 |
| 1.5 | References | 2 |
| 1.6 | Important note to the reader | 2 |
| 2 | Implementation model | 3 |
| 2.1 | Application Data Flow Diagram | 3 |
| 2.2 | Functional definition of Application Entities | 3 |
| 2.3 | Sequencing of Real World Activities | 4 |
| 3 | AE Specifications | 5 |
| 3.1 | AE CT-SR DICOM Export Specification | 5 |
| 3.1.1 | Association Establishment Policies | 5 |
| 3.1.2 | Association Initiation Policy | 6 |
| 3.1.3 | Association Acceptance Policy | 9 |
| 4 | Communication Profiles | 10 |
| 4.1 | TCP/IP Stack | 10 |
| 4.1.1 | Physical Media Support | 10 |
| 5 | Extensions/Specializations/Privatizations | 10 |
| 6 | Configuration | 10 |
| 6.1 | AE Title/Presentation Address mapping | 10 |
| 6.1.1 | Local AE Titles and Presentation Addresses | 10 |
| 6.1.2 | Remote AE Titles and Presentation Addresses | 10 |
| 6.2 | Configurable parameters | 10 |
| 7 | Support of Extended Character Sets | 10 |
| 8 | Applied Computed Tomography (CT) Image IOD | 11 |

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 4000 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.

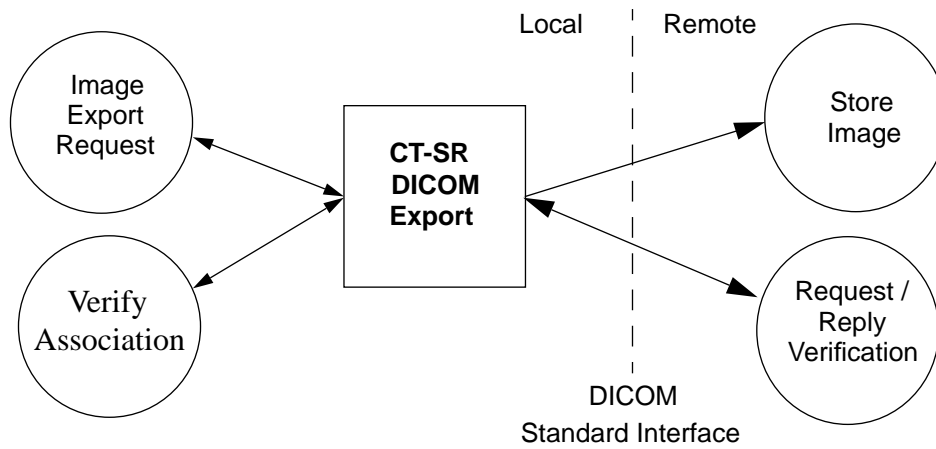


Figure 2-1: The CT-SR Implementation Model

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: "1.3.46.670589.10.8.800143.1".

The implementation Version Name is: "HMC/M_SR4000_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 | |