Philips Medical Systems DICOM Conformance Statement

DSI Release 4.2.1 & 4.3

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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.

Introduction

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 DSI (Digital Spot Imaging) is a digital fluorography modality. It is part of an X-ray system. The main functions are:

- image acquisition and display
- image review and processing
- image handling, storage and networking
- administration of patient, physician and examination data

The main application areas are:

- R/F examinations
- vascular and non-vascular examinations
- angiography examinations
- tomography examinations
- interventional procedures

DSI Release 4.2.1 and 4.3 contains a DICOM Export function based on the DICOM Image Storage to transfer image data from the DSI system to a remote system.

2.1 Application Data Flow Diagram

The DSI DICOM Export behaves as a single Application Entity. The related Implementation Model is shown in Figure 2-1 on page 3.

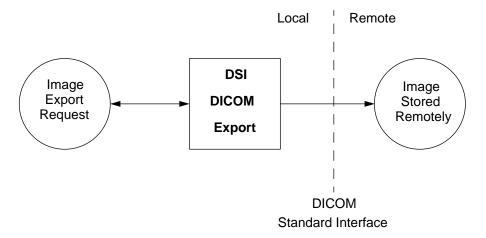


Figure 2-1: DSI DICOM Export Implementation Model

The DSI Export function is activated by an operator request. A remote destination is selected from the user interface, followed by the selection of the examination.

With DSI systems an examination corresponds to the DICOM Patient and Study level. Each examination contains one or more runs, corresponding to the DICOM Series level. Each run contains one or more images, corresponding to the DICOM Image level. This relationship is depicted in Figure 2-1 on page 3. DSI can contain up to 14 examinations, maximum 1280 runs

per examination and maximum 1280 images per run.

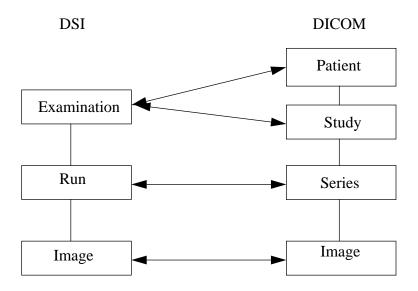


Figure 2-2: Relationship between the DSI and DICOM levels

The DSI DICOM Export transfers a complete examination to a remote DICOM node. The transfer of a subset of images in an examination is not possible. During the DICOM store operation it is possible to perform a cancel operation on the store.

Image data to be transferred are instances of the DICOM X-Ray Radiofluoroscopic (XRF) or Secondary Capture (SC) classes. The following cases can be distinguished:

- The remote station supports both XRF and SC classes. Result will be that all fluoroscopy and exposure images are exported as XRF images and all other images (like external video) as SC images.
- The remote station supports the XRF class only.

 Result will be that all fluoroscopy and exposure images are exported as XRF images and all other images (like external video) are **not** exported.
- The remote station supports the SC class only. Result will be that all images are exported as SC images.
- The remote station supports neither the XRF nor SC class. Result will be that none of the image types can be exported.

During the DICOM export of an exposure or fluoroscopy image as XRF image the following image processing is performed by DSI: video invert, subtraction, pixel shift.

During the DICOM export of an exposure or fluoroscopy image as SC image the following image processing is performed by DSI: video invert, contrast, brightness, edge enhancement, subtraction, pixel shift.

During the DICOM export of an external video image as SC image the following image processing is performed by DSI: video invert, contrast, brightness, edge enhancement.

In case of a subtracted run the DICOM Export first stores the mask image, followed by the sub-

Implementation model

tracted images from that run. No explicit indication is sent with the subtracted images, as to which image was used as the mask image. The image number in the run can be used as an implicit indication.

Images shown zoomed on the DIS are exported as normal (i.e. non zoomed) images. Annotations on zoomed images are not sent. DSI annotations on normal images are exported as Image Comments.

The images are intended for viewing purpose only.

The compatibility of image data re-imported (by media exchange) of the exported DICOM image data in an earlier stage is not defined.

DSI logs certain events related to the DICOM export at three different levels, see the service manual of the DSI system.

2.2 Functional definition of Application Entities

The DSI 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 DSI storage will take place followed by the conversion to a DICOM message to be transferred to the remote system.

2.3 Sequencing of Real World Activities

Not applicable.

3 AE Specifications

DSI DICOM Export acts as a single Application Entity.

3.1 AE DSI DICOM Export Specification

The DSI 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 DSI Export AE as SCU

SOP class Name	UID	
Secondary Capture Image Storage ^a	1.2.840.10008.5.1.4.1.1.7	
X-Ray Radiofluoroscopic Image Storage ^a	1.2.840.10008.5.1.4.1.1.12.2	

a. See chapter 2.1 on page 3 for the mapping of the DSI image types to these DICOM XRF and SC SOP Classes.

3.1.1 Association Establishment Policies

3.1.1.1 General

DSI Export offers a configurable maximum PDU size in steps of 1K, 2K, 4K, 8K and 16K (default is 16K = 16384 bytes) on associations initiated by the application itself.

3.1.1.2 Number of Associations

DSI Export will attempt to establish one association at a time.

3.1.1.3 Asynchronous Nature

DSI 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: "1.3.46.670589.6.1.1.4.2.1". The Implementation Version Name is: "DSI R421, 950531".

3.1.2 Association Initiation Policy

DSI Export initiates associations as a result of the following events:

• The DSI operator requests export of one examination or a list of examinations to a remote system (see chapter 2.1 on page 3 for the definition of an examination).

3.1.2.1 Export from DSI system

3.1.2.1.1 Associated Real-World Activity

The DSI Export function will be accessible through the DSI F2 Copy page. With the F4 Config page the remote DICOM system is selected from a list of maximum of five configurable nodes.

The complete examination is transferred to the remote system.

The current transfer can be aborted by the DSI F2 Cancel function.

After the transfer the association is released.

3.1.2.1.2 Proposed Presentation Contexts

DSI Export will propose the following presentation contexts:

Table 3-2: Proposed Presentation Contexts for DSI Export

Presentation Context table					
Abstract	Syntax	Transfer Syntax			Extended
Name UID N		Name List	UID List	Role	Negotiation
See Note ^a	See Note ^a	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
See Note ^a See Note ^a		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
See Note ^a	See Note ^a	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

a. Any of the STORE SOP classes listed in Table 3-1, "Supported SOP classes by the DSI Export AE as SCU," on page 6

3.1.2.1.2.1 SOP Specific Conformance to Storage SOP Classes

During the selection and export of an examination, the user interface shows the status:

Export flag examination flagged for DICOM export

Export busy examination being exported

Export done examination exported successfully

Export error error while exporting examination

Export cancel export of examination being cancelled

Not exported export of examination cancelled

DSI Export will stop the transfer of the image data and release the association as soon as it receives an unsuccessful or warning C-STORE Response status, or when the association is aborted by the remote application. The reason will logged, the user interface of the DSI console will show the status "Export Error".

AE Specifications

Extended negotiation is not supported.

Table 3-3 lists the applied optional modules and attributes in the XRF images. Conditional attributes Laterality (type 2C), Patient Orientation (type 2C), Image Date (type 2C), Image Time (type 2C), Exposure (type 2C), Window Width (type 1C) are always present. A detailed overview of the applied XRF Image IOD is given chapter 8 on page 11.

Table 3-3: Applied optional Modules and Attributes of the XRF Image IOD

IE	Module	Optional Attributes
Patient	Patient	-
Study	General Study	Study Description
Series	General Series	Series Date, Series Time, Performing Physician's Name, Protocol Name
Equipment	General Equipment	Institution Name, Station Name, Manufacturer's Model name, Device Serial Number, Software Version(s)
Image General Image Acquisition Number, A Comments		Acquisition Number, Acquisition Date, Acquisition Time, Image Comments
	Image Pixel	-
	Display Shutter (applied optional Module)	-
	X-Ray Image	-
	X-Ray Acquisition	-
	VOI LUT (applied optional Module)	Window Center
	SOP Common	Specific Character Set

Table 3-4 lists the applied optional modules and attributes in the SC images. Conditional attributes Laterality (type 2C), Patient Orientation (type 2C), Image Date (type 2C), Image Time (type 2C) are always present. A detailed overview of the applied SC Image IOD is given chapter 9 on page 15.

Table 3-4: Applied optional Modules and Attributes of the SC Image IOD

IE	Module	Optional Attributes
Patient	Patient	-
Study	General Study	Study Description

Table 3-4: Applied optional Modules and Attributes of the SC Image IOD (Continued)

IE	Module	Optional Attributes
Series	General Series	Series Date, Series Time, Performing Physician's Name, Protocol Name
Equipment	SC Equipment	Secondary Capture Device Manufacturer, Secondary Capture Device Manufacturer's Model Name, Secondary Capture Soft- ware Version(s)
Image	General Image	Acquisition Number, Acquisition Date, Acquisition Time, Image Comments
	Image Pixel	-
	SC Image	Date of Secondary Capture, Time of Secondary Capture
	SOP Common	Specific Character Set

All UIDs in the images are generated at DICOM export time. This implies that the same image exported at different sessions contains a different Study, Series and Image UID.

3.1.3 Association Acceptance Policy

DSI does not accept associations.

4 Communication Profiles

4.1 TCP/IP Stack

DSI 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

The DSI system supports ISO 8802-3 10BASE5 Ethernet.

5 Extensions/Specializations/Privatizations

Not applicable.

6 Configuration

The configuration of a DSI system is done by means of a configuration program. It is intended to be used 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 selected by service programs.

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 at which the remote application should accept association requests.
- The Remote Host Name of the system on which the remote application resides.

The Remote Host Name is used as remote DICOM system list with the F4 Config page.

6.2 Configurable parameters

The maximum PDU size is configurable.

7 Support of Extended Character Sets

DSI Export supports the Extended Character Set "ISO_IR 100" which is the Latin alphabet No 1, supplementary set.

Applied X-Ray Fluoroscopy (XRF) Image IOD

8 Applied X-Ray Fluoroscopy (XRF) Image IOD

The modules selected from the IOD module table of DICOM 3.0 are given in the table below.

Table 8-1: Applied Modules in the XRF IOD

Information Entity	Module
Patient	Patient
Study	General Study
Series	General Series
Equipment	General Equipment
Image	General Image
	Image Pixel
	X-Ray Image
	Display Shutter
	X-Ray Acquisition
	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. Conditions and Defined/Enumerated Values of DICOM 3.0 are applicable but are not shown in the tables.

Table 8-2: Patient Module

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

Table 8-3: General Study Module

Attribute Description	Tag	Note
Study Instance UID	0020,000D	Generated at DICOM export time
Study Date	0008,0020	

Table 8-3: General Study Module (Continued)

Attribute Description	Tag	Note
Study Time	0008,0030	
Referring Physician's Name	0008,0090	zero length value if not entered by user
Study ID	0020,0010	always zero length value
Accession Number	0008,0050	always zero length value
Study Description	0008,1030	not present if not entered by user

Table 8-4: General Series Module

Attribute Description	Tag	Note
Modality	0008,0060	RF
Series Instance UID	0020,000E	Generated at DICOM export time
Series Number	0020,0011	
Series Date	0008,0021	
Series Time	0008,0031	
Performing Physician's Name	0008,1050	not present if not entered by user
Protocol Name	0018,1030	not present if not entered by user
Laterality	0020,0060	always zero length value

Table 8-5: General Equipment Module

Attribute Name	Tag	Note
Manufacturer	0008,0070	Philips Medical Systems
Institution Name	0008,0080	
Station name	0008,1010	
Manufacturer's Model Name	0008,1090	In format DSI <release number=""></release>
Device Serial Number	0018,1000	
Software Version(s)	0018,1020	

Table 8-6: General Image Module

Attribute Name	Tag	Note
Image Number	0020,0013	1

Table 8-6: General Image Module (Continued)

Attribute Name	Tag	Note
Patient Orientation	0020,0020	always zero length value
Image Date	0008,0023	
Image Time	0008,0033	
Acquisition Number	0020,0012	
Acquisition Date	0008,0022	
Acquisition Time	0008,0032	
Image Comments	0020,4000	Contains also the DSI image annotations on normal (i.e. non zoomed) images in the format "(x,y) <text>". This attribute is not present if not entered by user and if no annotations are present.</text>

Table 8-7: Image Pixel Module and X-Ray Image Module^a

Attribute Name	Tag	Note
Image Type	0008,0008	ORIGINAL\PRIMARY\SINGLE PLANE
Pixel Intensity Relationship	0028,1040	DISP
Samples per Pixel	0028,0002	1
Photometric Interpretation	0028,0004	MONOCHROME2
Rows	0028,0010	512 or 1024 The actual image size in 60 Hz DSI systems is smaller: 480 or 960.
Columns	0028,0011	equal to the value of Rows (512 or 1024). The actual image size in 60 Hz DSI systems is smaller: 480 or 960.
Bits Allocated	0028,0100	8
Bits Stored	0028,0101	8
High Bit	0028,0102	7
Pixel Representation	0028,0103	0000Н
Pixel Data	7FE0,0010	

a. These two modules are combined because some attributes are present in both modules.

Table 8-8: Display Shutter Module

Attribute Name	Tag	Note
Shutter Shape	0018,1600	CIRCULAR or CIRCULAR\RECTANGULAR
Shutter Left Vertical Edge	0018,1602	
Shutter Right Vertical Edge	0018,1604	
Shutter Upper Horizontal Edge	0018,1606	
Shutter Lower Horizontal Edge	0018,1608	
Center of Circular Shutter	0018,1610	
Radius of Circular Shutter	0018,1612	

Table 8-9: X-Ray Acquisition Module

Attribute Name	Tag	Note
KVP	0018,0060	always zero length value
Exposure	0018,1152	always zero length value
Radiation Setting	0018,1155	SC or GR

Table 8-10: VOI LUT Module

Attribute Name	Tag	Note
Window Center	0028,1050	This attribute is related to the DSI Contrast / Brightness.
Window Width	0028,1051	This attribute is related to the DSI Contrast / Brightness.

Table 8-11: SOP Common Module

Attribute Name	Tag	Note
SOP Class UID	0008,0016	1.2.840.10008.5.1.4.1.1.12.2
SOP Instance UID	0008,0018	Generated at DICOM export time
Specific Character Set	0008,0005	ISO_IR 100

Applied Secondary Capture (SC) Image IOD

9 Applied Secondary Capture (SC) Image IOD

The modules selected from the IOD module table of DICOM 3.0 are given in the table below.

Table 9-1: Applied Modules in the SC IOD

Information Entity	Module
Patient	Patient
Study	General Study
Series	General Series
Equipment	SC Equipment
Image	General Image
	Image Pixel
	SC Image
	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. Conditions and Defined/Enumerated Values of DICOM 3.0 are applicable but are not shown in the tables.

Table 9-2: Patient Module

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

Table 9-3: General Study Module

Attribute Description	Tag	Note
Study Instance UID	0020,000D	Generated at DICOM export time
Study Date	0008,0020	
Study Time	0008,0030	
Referring Physician's Name	0008,0090	zero length value if not entered by user
Study ID	0020,0010	always zero length value

Applied Secondary Capture (SC) Image IOD

Table 9-3: General Study Module (Continued)

Attribute Description	Tag	Note
Accession Number	0008,0050	always zero length value
Study Description	0008,1030	not present if not entered by user

Table 9-4: General Series Module

Attribute Description	Tag	Note
Modality	0008,0060	OT
Series Instance UID	0020,000E	Generated at DICOM export time
Series Number	0020,0011	
Series Date	0008,0021	
Series Time	0008,0031	
Performing Physician's Name	0008,1050	not present if not entered by user
Protocol Name	0018,1030	not present if not entered by user
Laterality	0020,0060	always zero length value

Table 9-5: SC Equipment Module

Attribute Name	Tag	Note
Conversion Type	0008,0064	DV
Secondary Capture Device Manufacturer	0018,1016	Philips Medical Systems
Secondary Capture Device Manufacturer's Model Name	0018,1018	In format DSI <release number=""></release>
Secondary Capture Software Version(s)	0018,1019	

Table 9-6: General Image Module

Attribute Name	Tag	Note
Image Number	0020,0013	1
Patient Orientation	0020,0020	always zero length value
Image Date	0008,0023	
Image Time	0008,0033	
Acquisition Number	0020,0012	
Acquisition Date	0008,0022	

Table 9-6: General Image Module (Continued)

Attribute Name	Tag	Note
Acquisition Time	0008,0032	
Image Comments	0020,4000	Contains also the DSI image annotations on normal (i.e. non zoomed) images in the format "(x,y) <text>". This attribute is not present if not entered by user and if no annotations are present.</text>

Table 9-7: Image Pixel Module

Attribute Name	Tag	Note
Samples per Pixel	0028,0002	1
Photometric Interpretation	0028,0004	MONOCHROME2
Rows	0028,0010	512 or 1024 The actual image size in 60 Hz DSI systems is smaller: 480 or 960.
Columns	0028,0011	equal to the value of Rows (512 or 1024) The actual image size in 60 Hz DSI systems is smaller: 480 or 960.
Bits Allocated	0028,0100	8
Bits Stored	0028,0101	8
High Bit	0028,0102	7
Pixel Representation	0028,0103	0000Н
Pixel Data	7FE0,0010	

Table 9-8: SC Image Module

Attribute Name	Tag	Note
Date of Secondary Capture	0018,1012	
Time of Secondary Capture	0018,1014	

Table 9-9: SOP Common Module

Attribute Name	Tag	Note
SOP Class UID	0008,0016	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	0008,0018	Generated at DICOM export time
Specific Character Set	0008,0005	ISO_IR 100