Philips Medical Systems
DICOM Conformance Statement

CT Secura Release 1.2

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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-1996 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 [DICOM]. The conformance to the DICOM standard is a key element of the Philips 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 3.2-1996.

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 3.3-1996 and PS 3.4-1996.
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 1996
National Electrical Manufacturers Association (NEMA) Publication Sales
1300 N. 17th Street, Suite 1847
Rosslyn, Va. 22209, United States of America

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[INTURIS] Inturis for Radiology
Doc. nr. 4522 982 63281
Philips Medical Systems Ned. BV

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).

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1.7 General Acronyms and Abbreviations.

The following acronyms and abbreviations are used in all Philips Conformance Statements.

- ACC American College of Cardiology
- AE Application Entity
- ACR American College of Radiology
- ANSI American National Standard Institute
- BOT Basic Offset Table
- CD-R CD Recordable
- CD-M CD Medical
- DCI Digital Cardio Imaging
- DCR Dynamic Cardio Review
- DICOM Digital Imaging and Communication in Medicine
- DIMSE DICOM Message Service Element
- DIMSE-C DICOM Message Service Element-Composite
- DIMSE-N DICOM Message Service Element-Normalized
- ELE Explicit VR Little Endian
- EBE Explicit VR Big Endian
- FSC File Set Creator
- GUI Graphic User Interface
- HIS Hospital Information System
- HL7 Health Level Seven
- ILE Implicit VR Little Endian
- IOD Information Object Definition
- ISIS Information System - Imaging System
- NEMA National Electrical Manufacturers Association
- PDU Protocol Data Unit
- RIS Radiology Information System
- RWA Real World Activity
- SC Secondary Capture
- SCM Study Component Management
- SCP Service Class Provider
- SCU Service Class User
- SOP Service Object Pair
- TCP/IP Transmission Control Protocol/Internet protocol
- UID Unique Identifier
- WLM Worklist Management

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2 Implementation model

The CT Secura Release 1.2 system (from now on mentioned as CT) of Philips Medical Systems is a scanner generating Computed Tomography (CT) images.

he converter boxes might be connected to the CT (although they are 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.

The CT provides the following DICOM data exchange features:
- It allows the user to export CT and SC Images.
- It allows the user to import CT, SC and MR Images
- It allows the user to print to a DICOM network printer.
- It allows the user to export and import images to a CD.

See for more details the release bulletin.

2.1 Application Data Flow Diagram

The CT system behaves as a single Application Entity. Its related Implementation Model is shown in Figure 2-1 on page 5.

Furthermore the CT system is able to display the contents (i.e., directory listing) of DICOM CD-Recordable disks and to write, read and update images on/from a DICOM CD-Recordable disk.

2.2 Functional definition of Application Entities

The CT Application Entity acts as a Service Class User (SCU) and Service Class Provider (SCP) for C-Store:
- SCU for CT and SC.
- SCP for CT, SC and MR

The CT-Print Application Entity acts as Service Class User (SCU) for the Print Service Class.

The CT acts also as a File Set Creator (FSC), File Set Reader (FSR) and File Set Updater (FSU) of the Media Service Class.

2.3 Sequencing of Real World Activities

All Real-World Activities as specified in Figure 2-1 may occur independently from each other, except that the two local Print Real-World Activities are mutually exclusive: A request for the printer status is not done when a request for image printing is busy, and vice versa.

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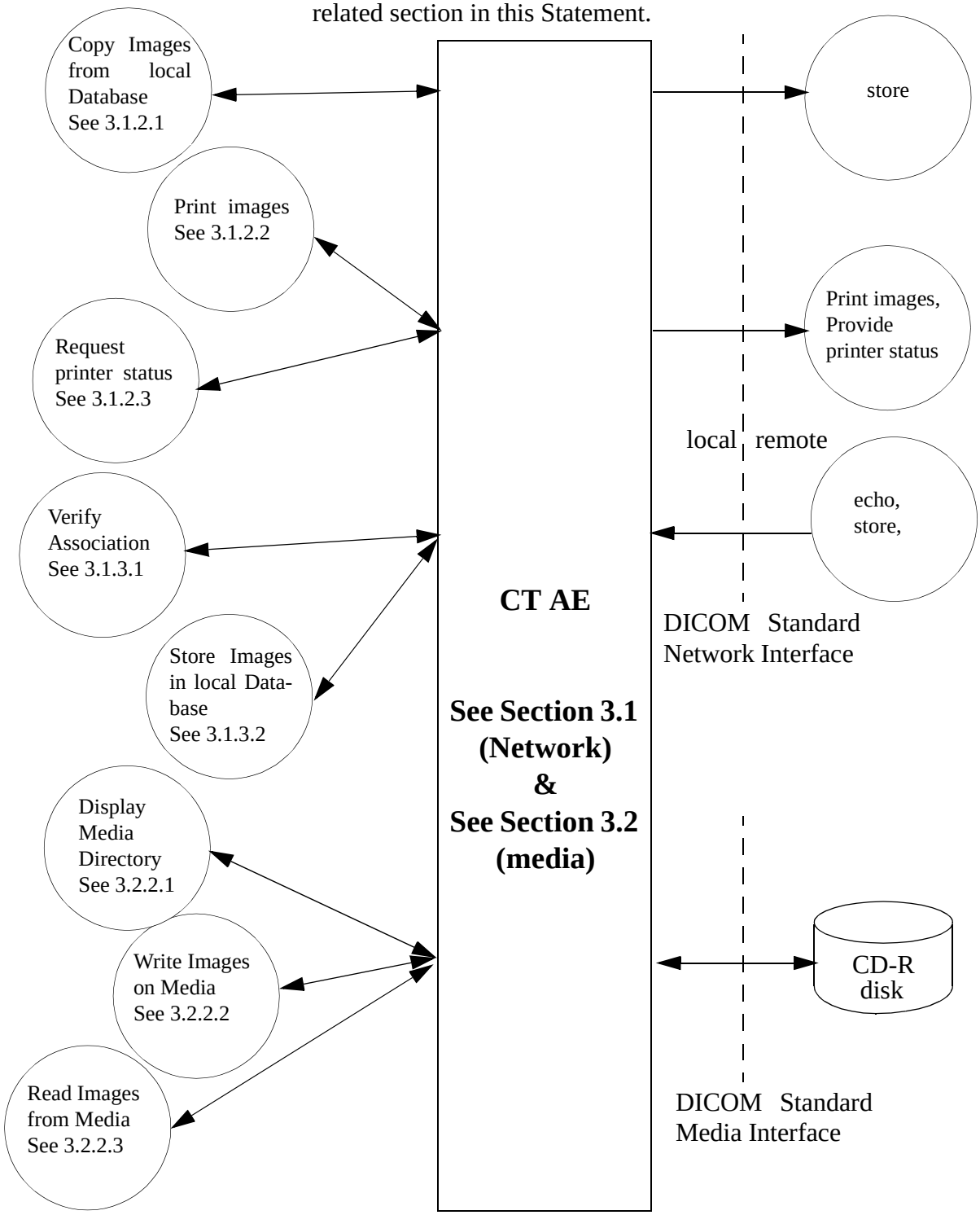
Figure 2-1: CT Implementation Model

The circles to the left represent the Local Real-World Activities and refer to the related section in this Statement.



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3 AE Specifications

The Network capabilities of the CT DICOM Application Entity are specified in section 3.1 and the Media capabilities are specified in section 3.2.

3.1 CT AE Network Specification

The CT Application Entity provides Standard Conformance to the DICOM V3.0 SOP classes as an SCU specified in Table 3-1. The following remarks are important:

- The Private SOP Classes may be stored in image archives but are to be used in the CT systems only. See also section 5 on page 35.

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

SOP class Name	UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
Basic Color Print Management Meta SOP Class	1.2.840.10008.5.1.1.18
>[a] Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
> Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
> Basic Color Image Box SOP Class	1.2.840.10008.5.1.4.1
> Printer SOP Class	1.2.840.10008.5.1.1.16
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
> Basic Film Session SOP Class	1.2.840.10008.5.1.1.1
> Basic Film Box SOP Class	1.2.840.10008.5.1.1.2
> Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4
> Printer SOP Class	1.2.840.10008.5.1.1.16
3D Volume Storage (**Private class**)	1.3.46.670589.5.0.1
3D Object Storage (**Private class**)	1.3.46.670589.5.0.2
Surface Storage (**Private class**)	1.3.46.670589.5.0.3
Composite Object Storage (**Private class**)	1.3.46.670589.5.0.4

a. The '>' sign indicates that the SOP Class is part of the above mentioned Meta SOP Class.

The CT Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCP specified in Table 3-2. The following remarks are important:

- The Private SOP Classes may be stored in image archives but are to be used in the CT systems only. See also section 5 on page 35.

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

SOP class Name	UID
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
SC Image Storage	1.2.840.10008.5.1.4.1.1.7
3D Volume Storage (**Private class**)	1.3.46.670589.5.0.1
3D Object Storage (**Private class**)	1.3.46.670589.5.0.2
Surface Storage (**Private class**)	1.3.46.670589.5.0.3
Composite Object Storage (**Private class**)	1.3.46.670589.5.0.4

3.1.1 Association Establishment Policies

3.1.1.1 General

The CT as SCU will offer unrestricted maximum PDU size on Associations initiated by the CT itself. This is also configurable per remote station. The CT as SCP will offer the same PDU size as offered on Associations initiated by remote applications (SCU), this is not configurable, and will then use that same value as its own maximum PDU size.

3.1.1.2 Number of Associations

As SCP: The number of simultaneous Associations supported by the CT as a Service Class Provider is in principle not limited. The practical maximum number of supported Associations is determined by the amount of resources (CPU, memory, hard disk size).

As SCU: As a result of local activities, the CT will initiate at most 1 simultaneous Associations.

3.1.1.3 Asynchronous Nature

The CT does not support asynchronous operations and will not perform asynchronous window negotiation.

3.1.1.4 Implementation Identifying Information

The Implementation Class UID is: 1.3.46.670589.5.2.11
The implementation version name is: EV42

3.1.2 Association Initiation Policy

The CT initiates Associations as a result of the following events:

- The CT operator requests to send selected images from the CT database to another database (i.e., image export), see section 3.1.2.1 on page 8;

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- The CT operator requests to print selected images in the CT database, see section 3.1.2.2 on page 23.
- The CT operator requests for the status of a selected printer, see section 3.1.2.3 on page 28.

3.1.2.1 Request to send Images from the CT to a remote system.

3.1.2.1.1 Associated Real-World Activity

The operator is able to copy all/selected images in a patient folder from the local CT database to a another database (i.e., image export) by means of the copy tool on the image handling system. The CT initiates for each selected patient an Association to the selected peer entity and uses it to send C-STORE requests (and receive the associated store replies). The Association is released when all selected images in the selected folder have been transmitted. The CT handles operator copy requests one after the other.

The CT is able to send the CT Image IOD and the SC Image IOD to a remote location.

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3.1.2.1.2 Proposed Presentation Contexts

The CT will propose the following presentation contexts:

Table 3-3: Proposed Presentation Contexts for the CT to Other

Presentation Context table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
See Note	See Note	ILE	1.2.840.10008.1.2	SCU	None
		ELE	1.2.840.10008.1.2.1	SCU	None
		EBE	1.2.840.10008.1.2.2	SCU	None
		JPEG Baseline (Process 1)	1.2.840.10008.1.2.4.50	SCU	None
		JPEG Extended (Process 2 & 4)	1.2.840.10008.1.2.4.51	SCU	None
		JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57	SCU	None
		JPEG Lossless, Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCU	None

Note: Any of the Standard Image Storage and Private SOP classes listed in Table 3-1, “Supported SOP classes by the CT AE as SCU,” on page 6.
For performance reasons the EBE is preferred.

3.1.2.1.3 C-STORE SCU Conformance

Extended negotiation is not supported.

Status display and error handling:
The store response status is displayed via the user interface of the CT.
The CT will stop the transfer of the images and release the Association as soon as it receives an unsuccessful or warning store response status. In case a remote application requested the transfer (by means of a C-MOVE request), a move response with status unsuccessful is sent to the retrieve requester.

Generation of new images:
Some CT applications are able to generate new derived images from a set of received (original) images. An example is a 3D reconstructed image from a CT image set. The attributes in these generated images are not specified in this Conformance Statement.

3.1.2.1.4 CT SCU Conformance

Table 3-4 list the applied Conditional (DICOM Type 1C and 2C) and Optional (DICOM Type 3) attributes in the CT Image IOD. These attributes are always present in the CT Images sent by the CT and created by the CT scanner.

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Table 3-4: Applied Conditional and Optional attributes of the CT IOD

IE	*Module*	*Conditional attributes*	*Optional attributes*
Patient	Patient	-	-
Study	General Study	-	Study Description.
Series	General Series	Patient Position.	Series Date, Series Time, Series Description, Performing Physician(s) Name, Operator's Name, Protocol Name.
Frame of Reference	Frame of Reference	-	-
Equipment	General Equipment	-	Institution Name, Station Name, Institutional Department Name, Manufacturer's Model name, Software Version(s), Date of last Calibration, Time of last Calibration.
Image	General Image	Image Date, Image Time	Referenced Image Sequence
	Image Plane	-	-
	Image Pixel	-	-
	Contrast/Bolus	-	-
	CT Image	-	Data Collection Diameter, Reconstruction Diameter, Gantry/Detector Tilt, Table Height, Exposure Time, X-Ray Tube Current, Exposure, Convolution Kernel.
	VOI LUT	Window Width	Window Center
	SOP Common	Specific Character Set, SOP Class UID, SOP Instance UID	-

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3.1.2.1.5 Attributes used in the CT Image IOD

This Paragraph will list the Modules and the Attributes in the CT Image IOD.

Table 3-5: Overview of the used Modules in the CT Image IOD

IE	*Module*	*Reference*
Patient	Patient	Table 3-6
Study	General Study	Table 3-7
Series	General Series	Table 3-8
Frame of Reference	Frame of Reference	Table 3-9
Equipment	General Equipment	Table 3-10
Image	General Image	Table 3-11
	Image Plane	Table 3-12
	Image Pixel	Table 3-13
	Contrast/Bolus	Table 3-14
	CT Image	Table 3-15
	VOI LUT	Table 3-16
	SOP Common	Table 3-17

Table 3-6: CT Image Storage SOP Class - Patient Module

Attribute Name	*Tag*	*Note*
Patient's Name	0010,0010	Patient's full name.
Patient ID	0010,0020	Primary hospital identification number or code for the patient.
Patient's Birth Date	0010,0030	Birth date of the patient.
Patient's Sex	0010,0040	Sex of the named patient. Applied value(s): F, M, O

Table 3-7: CT Image Storage SOP Class - General Study Module

Attribute Name	*Tag*	*Note*
Study Date	0008,0020	Date the Study started.

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Table 3-7: CT Image Storage SOP Class - General Study Module (Continued)

Attribute Name	*Tag*	*Note*
Study Time	0008,0030	Time the Study started.
Accession Number	0008,0050	Empty or entered by operator
Referring Physician's Name	0008,0090	Patient's referring physician.
Study Description	0008,1030	Institution-generated description or classification of the Study (component) performed.
Study Instance UID	0020,000D	Unique identifier for the Study.
Study ID	0020,0010	Empty.

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

Attribute Name	*Tag*	*Note*
Series Date	0008,0021	Date the Series started.
Series Time	0008,0031	Time the Series started.
Modality	0008,0060	Type of equipment that originally acquired the data used to create the images in this Series. Applied value(s): CT
Series Description	0008,103E	User provided description of the Series.
Performing Physician's Name	0008,1050	Name of the physicians administering the Series.
Protocol Name	0018,1030	Pre-defined description of the conditions under which the Series was performed.
Patient Position	0018,5100	Patient position descriptor relative to the equipment. Applied value(s): FFDL, FFDR, FFP, FFS, HFDL, HFDR, HFP, HFS
Series Instance UID	0020,000E	Unique identifier of the Series.
Series Number	0020,0011	A number that identifies this Series.

Table 3-9: CT Image Storage SOP Class - Frame of Reference Module

Attribute Name	*Tag*	*Note*
Frame of Reference UID	0020,0052	Uniquely identifies the frame of reference for a Series.

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Table 3-9: CT Image Storage SOP Class - Frame of Reference Module (Continued)

Attribute Name	*Tag*	*Note*
Position Reference Indicator	0020,1040	Always Empty.

Table 3-10: CT Image Storage SOP Class - General Equipment Module

Attribute Name	*Tag*	*Note*
Manufacturer	0008,0070	Manufacturer of the equipment that produced the digital images. Applied value(s): Philips Medical Systems
Institution Name	0008,0080	Institution where the equipment is located that produced the digital images.
Station Name	0008,1010	User defined name identifying the machine that produced the digital images.
Institutional Department Name	0008,1040	Department in the institution where the equipment is located that produced the digital images.
Manufacturer’s Model Name	0008,1090	Manufacturer’s model Name. Applied value(s): CT Secura
Software Version(s)	0018,1020	Manufacturer’s designation of software version of the equipment that produced the digital images. Applied value(s): CT Secura Release 1.2
Date of Last Calibration	0018,1200	Date when the image acquisition device calibration was last changed in any way. Multiple entries may be used for additional calibrations at other times.
Time of Last Calibration	0018,1201	Time when the image device was last changed in any way. Multiple entries may be used.

Table 3-11: CT Image Storage SOP Class - General Image Module

Attribute Name	*Tag*	*Note*
Image Date	0008,0023	The date the image pixel data creation started.
Image Time	0008,0033	The time the image pixel data creation started.

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Table 3-11: CT Image Storage SOP Class - General Image Module (Continued)

Attribute Name	*Tag*	*Note*
Referenced Image Sequence	0008,1140	A sequence which provides reference to a set of Image SOP Class/Instance identifying other images significantly related to this image (e.g. post-localizer CT image)
> Referenced SOP Class UID	0008,1150	
> Referenced SOP Instance UID	0008,1155	
Image Number	0020,0013	A number that identifies this image. The images are numbered in chronological order.

Table 3-12: CT Image Storage SOP Class - Image Plane Module

Attribute Name	*Tag*	*Note*
Slice Thickness	0018,0050	Nominal slice thickness, in mm
Image Position (Patient)	0020,0032	The x, y, and z coordinates of the upper left hand corner (first pixel transmitted) of the image, in mm.
Image Orientation (Patient)	0020,0037	The direction cosines of the first row and the first column with respect to the patient.
Slice Location	0020,1041	
Pixel Spacing	0028,0030	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.

Table 3-13: CT Image Storage SOP Class - Image Pixel Module

Attribute Name	*Tag*	*Note*
Samples per Pixel	0028,0002	Number of samples (planes) in this image. Applied value(s): 1
Photometric Interpretation	0028,0004	Specifies the intended interpretation of the pixel data. Applied value(s): MONOCHROME2
Rows	0028,0010	Number of rows in the image.
Columns	0028,0011	Number of columns in the image.

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Table 3-13: CT Image Storage SOP Class - Image Pixel Module (Continued)

Attribute Name	*Tag*	*Note*
Bits Allocated	0028,0100	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated. Applied value(s): 16
Bits Stored	0028,0101	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored. Applied value(s): 12
High Bit	0028,0102	Most significant bit for pixel sample data. Each sample shall have the same high bit. Applied value(s): 11
Pixel Representation	0028,0103	Data representation of the pixel samples. Each sample shall have the same pixel representation. Applied value(s): 0000
Pixel Data	7FE0,0010	A data stream of the pixel samples which comprise the Image.

Table 3-14: CT Image Storage SOP Class - Contrast/Bolus Module

Attribute Name	*Tag*	*Note*
Contrast/Bolus Agent	0018,0010	

Table 3-15: CT Image Storage SOP Class - CT Image Module

Attribute Name	*Tag*	*Note*
Image Type	0008,0008	Image identification characteristics. Applied value(s): ORIGINAL \ PRIMARY \ AXIAL, LOCALIZER\ SCANNOGRAM, SERIAL, VOLUME, DYNAMIC
KVP	0018,0060	Applied kilo voltage output of the x-ray generator used.
Data Collection Diameter	0018,0090	The diameter in mm of the region over which data were collected.
Reconstruction Diameter	0018,1100	Diameter in mm of the region from within which data were used in creating the reconstruction of the image. (Field of View)

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Table 3-15: CT Image Storage SOP Class - CT Image Module (Continued)

Attribute Name	*Tag*	*Note*
Gantry/Detector Tilt	0018,1120	Nominal angle of tilt in degrees of the scanning gantry.
Table Height	0018,1130	The distance in mm of the top of the patient table to an arbitrary reference point.
Exposure Time	0018,1150	Time of x-ray exposure in ms.
X-ray Tube Current	0018,1151	X-ray Tube Current in mA.
Exposure	0018,1152	The product of exposure time and X-ray Tube Current expressed in mAs.
Convolution Kernel	0018,1210	
Acquisition Number	0020,0012	A number identifying the single continuous gathering of data over a period of time which resulted in this image
Rescale Intercept	0028,1052	The value b in relationship between stored values (SV) and Hounsfield (HU). Does not equal -1200 in case of scanogram. HU = m*SV+b. Applied value(s): -1200
Rescale Slope	0028,1053	m in the equation specified in Rescale Intercept. Does not equal 1 in case of scanogram

Table 3-16: CT Image Storage SOP Class - VOI LUT Module

Attribute Name	*Tag*	*Note*
Window Center	0028,1050	Window Center for display.
Window Width	0028,1051	Window Width for display.

Table 3-17: CT Image Storage SOP Class - SOP Common Module

Attribute Name	*Tag*	*Note*
Specific Character Set	0008,0005	Character Set that expands or replaces the Basic Graphic Set. Applied value(s): ISO_IR 100
SOP Class UID	0008,0016	Uniquely identifies the SOP Class. Applied value(s): 1.2.840.10008.5.1.4.1.1.2

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Table 3-17: CT Image Storage SOP Class - SOP Common Module (Continued)

Attribute Name	*Tag*	*Note*
SOP Instance UID	0008,0018	Uniquely identifies the SOP Instance.

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3.1.2.1.6 SC SCU Conformance

Table 3-4 list the applied Conditional (DICOM Type 1C and 2C) and Optional (DICOM Type 3) attributes in the SC Image IOD. These attributes are always present in the SC Images send by the CT.

Table 3-18: Applied Conditional and Optional Attributes of the SC Image IOD

Information Entity	Module	Conditional Attributes	Optional Attributes
Patient	Patient	-	-
Study	General Study	-	-
Series	General Series	-	-
Equipment	General Equipment	-	-
	SC Equipment	-	-
Image	General Image	-	-
	Image Pixel	-	-
	VOI LUT	Window Width	Window Center
	SOP Common	Specific Character Set	-

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3.1.2.1.7 Attributes used in the SC Image IOD

This Paragraph will list the Modules and the Attributes in the SC Image IOD.

Table 3-19: Applied Conditional and Optional Attributes of the SC Image IOD

Information Entity	Module	References
Patient	Patient	Table 3-20
Study	General Study	Table 3-22
Series	General Series	Table 3-21
Equipment	General Equipment	Table 3-23
	SC Equipment	Table 3-24
Image	General Image	Table 3-25
	Image Pixel	Table 3-26
	VOI LUT	Table 3-27
	SOP Common	Table 3-28

Table 3-20: Secondary Capture Image Storage SOP Class - Patient Module

Attribute Name	*Tag*	*Note*
Patient's Name	0010,0010	Patient's full name.
Patient ID	0010,0020	Primary hospital identification number or code for the patient
Patient's Birth Date	0010,0030	
Patient's Sex	0010,0040	Sex of the named patient.

Table 3-21: Secondary Capture Image Storage SOP Class - General Study Module

Attribute Name	*Tag*	*Note*
Study Date	0008,0020	Date the Study started.
Study Time	0008,0030	Time the Study started.
Accession Number	0008,0050	
Referring Physician's Name	0008,0090	Patient's referring physician

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Table 3-21: Secondary Capture Image Storage SOP Class - General Study Module (Continued)

Attribute Name	*Tag*	*Note*
Study Instance UID	0020,000D	Unique identifier for the Study.
Study ID	0020,0010	User or equipment generated Study identifier.

Table 3-22: Secondary Capture Image Storage SOP Class - General Series Module

Attribute Name	*Tag*	*Note*
Modality	0008,0060	Type of equipment that originally acquired the data used to create the images in this Series.
Series Instance UID	0020,000E	Unique identifier of the Series.
Series Number	0020,0011	A number that identifies this Series.

Table 3-23: Secondary Capture Image Storage SOP Class - General Equipment Module

Attribute Name	*Tag*	*Note*
Manufacturer	0008,0070	Manufacturer of the equipment that produced the digital images.

Table 3-24: Secondary Capture Image Storage SOP Class - SC Equipment Module

Attribute Name	*Tag*	*Note*
Conversion Type	0008,0064	Describes the kind of image conversion. Applied value(s): WSD

Table 3-25: Secondary Capture Image Storage SOP Class - General Image Module

Attribute Name	*Tag*	*Note*
Image Type	0008,0008	
Image Number	0020,0013	A number that identifies this image. The images are numbered in chronological order.

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Table 3-26: Secondary Capture Image Storage SOP Class - Image Pixel Module

Attribute Name	*Tag*	*Note*
Samples per Pixel	0028,0002	Number of samples (planes) in this image.
Photometric Interpretation	0028,0004	Specifies the intended interpretation of the pixel data.
Rows	0028,0010	Number of rows in the image.
Columns	0028,0011	Number of columns in the image.
Bits Allocated	0028,0100	Number of bits allocated for each pixel sample. Each sample shall have the same number of bits allocated.
Bits Stored	0028,0101	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
High Bit	0028,0102	Most significant bit for pixel sample data. Each sample shall have the same high bit.
Pixel Representation	0028,0103	Data representation of the pixel samples. Each sample shall have the same pixel representation. Applied value(s): 0000
Pixel Data	7FE0,0010	A data stream of the pixel samples which comprise the Image.

Table 3-27: Secondary Capture Image Storage SOP Class - VOI LUT Module

Attribute Name	*Tag*	*Note*
Window Center	0028,1050	
Window Width	0028,1051	

Table 3-28: Secondary Capture Image Storage SOP Class - SOP Common Module

Attribute Name	*Tag*	*Note*
Specific Character Set	0008,0005	Character Set that expands or replaces the Basic Graphic Set.

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Table 3-28: Secondary Capture Image Storage SOP Class - SOP Common Module (Continued)

Attribute Name	*Tag*	*Note*
SOP Class UID	0008,0016	Uniquely identifies the SOP Class. Applied value(s): 1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	0008,0018	Uniquely identifies the SOP Instance.

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3.1.2.2 Print images

3.1.2.2.1 Associated Real-World Activity

There are two ways to request for image printing:

- Print Compose
  The operator is able to select one or more images from the internal database (via the Data Handling facility) and perform the Print operation on them.
- Print Protocol
  The operator is also able to print images via the various clinical applications of the CT.

The operator will select the print destination (out of choice list of configured printers) and some print parameters (depending on the configuration and the selected printer).
As a result, the CT will initiate an association to the selected printer and use(s) it to send the Print Service Elements of the Print SOP Classes.

The CT allows to have a print preview first.

3.1.2.2.2 Proposed Presentation Contexts

The CT will propose the presentation contexts as given in: Table 3-3.

3.1.2.2.3 Conformance to the Print SOP Classes

The CT provides standard conformance to the Basic Grayscale Print Management Meta SOP Class.

The applied order of Print Service Elements (DIMSE's) is specified in Table 3-29. A description and the applied optional (i.e. non-mandatory attributes as Print SCU) attributes in these Service Elements are specified too. Note that the Service Elements order is not specified by the DICOM standard.

An explicit N-DELETE Request on the created instances is not done by the CT; these are deleted implicitly when releasing the association.

Overlay, Annotation (showing the values of some major identifying attributes) and Shutter information is processed in the images sent to the printer (i.e. burnt-in in the image).

The **full list of (Mandatory and Optional) attributes** applied in these Service Elements are given in section 3.1.2.2.4 on page 25.

Table 3-29: The applied order of Print Service Elements and its optional attributes

Service Element of SOP Class	Description and applied optional attributes
N-GET of the Printer SOP Class	Purpose is to retrieve printer information.

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Table 3-29: The applied order of Print Service Elements and its optional attributes

Service Element of SOP Class	Description and applied optional attributes
N-CREATE of the Basic Film Session SOP Class	The CT specifies the DICOM Printer about some general presentation parameters, applicable for all films in the Film Session. Applied optional attributes are: Number of Copies, Print Priority, Medium Type, Film Destination
N-CREATE of the Basic Film Box SOP Class	The CT specifies the DICOM Printer about some general presentation parameters, applicable for all images in the Film Box. Applied optional attributes are: Film Orientation, Film Size ID, Magnification Type, Max. Density, Configuration Information, Trim.
N-SET of the Basic Grayscale/ Color Image Box SOP Class	The CT will send the images to be printed. Applied optional attributes are: Polarity
N-ACTION of the Basic Film Box SOP Class	The CT triggers the DICOM Printer to print, this actual print action is done at film box level. No (optional) attributes are present.

The table below specifies the supported Service Elements which may be generated by the Printer at any time during the association.

Table 3-30: The applied sequence of Print Service Elements and its optional attributes

Service Element of SOP Class	Note
N-EVENT-REPORT of the Printer SOP Class	May be sent at any moment by the Printer SCP (i.e. the DICOM Printer). The CT will ignore the contents of these events. However, the printer status is polled via a separate association, see section See 3.1.2.3.

The Status Codes of DIMSE Responses (Success, Warning, Failure) as returned by the printer will also be logged (for service purposes) and are mapped onto general print job status messages towards the operator. These User Interface messages indicate:

- “Job Completed” and has the meaning that the print job is accepted by the printer; the actual printing will be done afterwards.
- “General Print Error” indicating that a failure occurred during the DICOM Print. Also, most warning cases (like default printer values applied on optional print attributes) are interpreted as a print error because this will mostly result in a different print quality or print layout than expected.

The following implementation remarks are important to achieve successful printing:

- The number of Film Boxes per Film Session is **one**.
- The number of images per Film Box is **one**.
  The images to be printed on one film are rendered by the CT into one logical image. This logical image is very large, depending on the pixel matrix size (pixels per line, lines per image), use of color or not. A rough indication is 20 MByte. One should take this into account when selecting the DICOM printer and the printer configuration (e.g. the amount of

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memory).
- The CT will release the association when the print command is given (i.e. the N-ACTION Request); the association is not kept open for receiving N-EVENT-REPORTs of the Printer SOP Class.
- On status-errors/warnings in a DIMSE response, the datatransfer will be stopped and film will not be printed.

3.1.2.2.4 Attributes used in the Print Management Service Elements.

This section gives an overview of the applied attributes in the applied Service Elements of the supported SOP Classes.
Note that not all Service Elements of the SOP Classes are applied, see also section 3.1.2.2.3 on page 23. For the order of sending these Service Elements, see that same section.

The list of possible attribute values are given (if applicable). The situation that an attribute is present conditionally. The standard DICOM Conditions and Defined Terms and Enumerated Values are applicable.

3.1.2.2.4.1 Basic Film Session SOP Class

Table 3-31: Basic Film Session SOP Class - N-CREATE

Attribute Name	*Tag*	*Note*
Number of Copies	2000,0010	Between 1 and 99.
Print Priority	2000,0020	Applied value(s): HIGH
Medium Type	2000,0030	Applied value(s): BLUE FILM, CLEAR FILM, PAPER
Film Destination	2000,0040	Applied value(s): MAGAZINE, PROCESSOR

3.1.2.2.4.2 Basic Film Box SOP Class

Table 3-32: Basic Film Box SOP Class - N-CREATE

Attribute Name	*Tag*	*Note*
Image Display Format	2010,0010	The applied value below is a CT specific value indicating that one (large) image is contained in a Film Box. Applied value(s): CUSTOM\1, STANDARD\1,1 (I is a vendor specific index, i.e.an integer) is applied if the Standard Image Display Format does not result in acceptable films. Purpose of this value is to use the film surface as much as possible for image printing (and avoid large margins). This should be agreed per printer vendor.
Film Orientation	2010,0040	Applied value(s): LANDSCAPE, PORTRAIT
Film Size ID	2010,0050	DICOM specifies a number of Defined Terms; more values are possible and is print configuration dependent.

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Table 3-32: Basic Film Box SOP Class - N-CREATE (Continued)

Attribute Name	*Tag*	*Note*
Magnification Type	2010,0060	Normally sent out, however sometimes send out empty because some DICOM printers are not able to handle (value NONE for) this attribute. Applied value(s): NONE
Trim	2010,0140	
Configuration Information	2010,0150	Contains a vendor specific Lookup-table (LUT); should be applied by the DICOM printer if LUT data is present.

Table 3-33: Basic Film Box SOP Class - Basic Film Box Relationship Module

Attribute Name	*Tag*	*Note*
Referenced Film Session Sequence	2010,0500	Parent Film Session.
> Referenced SOP Class UID	0008,1150	
> Referenced SOP Instance UID	0008,1155	

Table 3-34: Basic Film Box SOP Class - N-ACTION

Attribute Name	*Tag*	*Note*
No attributes present		

3.1.2.2.4.3 Basic Grayscale Image Box SOP Class

Table 3-35: Basic Grayscale Image Box SOP Class - N-SET

Attribute Name	*Tag*	*Note*
Image Position	2020,0010	Applied value(s): 1
Polarity	2020,0020	Applied value(s): NORMAL
Preformatted Grayscale Image Sequence	2020,0110	
> Samples per Pixel	0028,0002	Applied value(s): 1
> Photometric Interpretation	0028,0004	Applied value(s): MONOCHROME2
> Rows	0028,0010	Depending on the selected printer type and film size.
> Columns	0028,0011	Depending on the selected printer type and film size.

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Table 3-35: Basic Grayscale Image Box SOP Class - N-SET (Continued)

Attribute Name	*Tag*	*Note*
> Bits Allocated	0028,0100	Applied value(s): 16, 8
> Bits Stored	0028,0101	Applied value(s): 12, 8
> High Bit	0028,0102	Applied value(s): 11, 7
> Pixel Representation	0028,0103	Applied value(s): 0x0000
> Pixel Data	7FE0,0010	

3.1.2.2.4.4 Color Grayscale Image Box SOP Class

Table 3-36: Basic Color Image Box SOP Class - Image Box Pixel Presentation Module

Attribute Name	*Tag*	*Note*
Image Position	2020,0010	Applied value(s): 1
Polarity	2020,0020	Applied value(s): NORMAL
Preformatted Color Image Sequence	2020,0111	
> Samples per Pixel	0028,0002	Applied value(s): 3
> Photometric Interpretation	0028,0004	Applied value(s): RGB
> Planar Configuration	0028,0006	Applied value(s): 0000, 0001 0000, is not interleaved, 0001, frame interleaved.
> Rows	0028,0010	
> Columns	0028,0011	Depending on the selected printer type and film size.
> Bits Allocated	0028,0100	Applied value(s): 8
> Bits Stored	0028,0101	Applied value(s): 8
> High Bit	0028,0102	Applied value(s): 7
> Pixel Representation	0028,0103	Applied value(s): 0000
> Pixel Data	7FE0,0010	

The CT does not send an attribute list to the printer, therefore the only attributes which are needed to be supported by the printer, are the mandatory attributes listed in Table 3-38, “Printer SOP Class - N-GET,” on page 28.

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3.1.2.3 Request for the printer status

3.1.2.3.1 Associated Real-World Activity

The CT will periodically (every 10 seconds) request for the printer status. This is only done when no association is set-up for a print job. In case of a print job association the printer status is requested in that association.
The received printer status is displayed in the Printer Status Tool.

3.1.2.3.2 Proposed Presentation Contexts

The CT will propose the presentation contexts as given in: Table 3-3.

3.1.2.3.3 Conformance to the Printer SOP Class

The CT provides standard conformance to this SOP Class.
The applied optional attributes in the N-GET Service Element are specified in Table 3-37. The **detailed list of (Mandatory and Optional) attributes** applied in this Service Element is given in section 3.1.2.2.4 on page 25.

Table 3-37: The applied optional attributes in the N-GET Service Element

Service Element of SOP Class	Note
N-GET of the Printer SOP Class	Purpose is to retrieve printer information. Applied optional attributes are: Printer Status, Printer Status Info, Printer Name, Manufacturer, Manufacturer Model Name

The Status Codes of Printer N-GET Responses (Success, Warning, Failure) as returned by the printer will also be logged (for service purposes) and are not indicated towards the operator.

3.1.2.3.3.1 Printer SOP Class

Table 3-38: Printer SOP Class - N-GET

Attribute Name	*Tag*	*Note*
Printer Status	2110,0010	
Printer Status Info	2110,0020	

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Table 3-39: Printer SOP Class - N-EVENT-REPORT[a]

Attribute Name	*Tag*	*Note*
Printer Status Info	2110,0020	Conditionally sent by the Printer. The CT will ignore this status information. However, polling this status via the N-GET Service Element is done.

a. This Service Element is sent by the printer and interpreted by the CT.

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3.1.3 Association Acceptance Policy

The CT accepts Associations for the following purposes:

- To allow remote applications to verify application level communication with the CT, see section 3.1.3.1 on page 30;
- To allow remote applications to store CT, SC and MR images in the CT database (i.e. image import), see section 3.1.3.2 on page 30;

The CT Application Entity rejects Association requests from unknown applications, i.e. applications that offer an unknown “calling AE title”. An application is known if and only if it is defined during configuration of the CT system.
The CT Application Entity rejects Association requests from applications that do not address the CT AE, i.e. that offer a wrong “called AE title”. The CT AE title is defined during configuration of the CT system.

Any of the presentation contexts shown in Table 3-3 are acceptable.

3.1.3.1 Verify Application Level Communication

3.1.3.1.1 Associated Real-World Activity

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

3.1.3.1.2 Presentation Context Table

See Table 3-3.

3.1.3.1.3 C-ECHO SCP Conformance

The CT provides standard conformance.

3.1.3.1.4 Presentation Context Acceptance Criterion

The CT accepts all contexts in the intersection of the proposed and acceptable Presentation Contexts. This means that multiple proposed Presentation Contexts with the same SOP Class but different Transfer Syntaxes are accepted by the CT.
There is no check for duplicate contexts and are therefore accepted.

3.1.3.1.5 Transfer Syntax Selection Policies

Any of the presentation context show in Table 3-3, are acceptable.

3.1.3.2 Store Images in the CT Database (i.e. Image Import)

3.1.3.2.1 Associated Real-World Activity

The CT accepts Associations from systems that wish to store images in the CT database using the C-STORE command.

3.1.3.2.2 Presentation Context Table

See Table 3-3.

3.1.3.2.3 C-STORE SCP Conformance

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Options:
The CT provides level 2 (Full) conformance for the Storage Service Class. In the event of a successful C-STORE operation, the image has been stored in the CT database. The duration of the storage of the image is determined by the operator of the CT system.

If CT receives improper DICOM, CT tries as much as possible (if configured so), to make them proper DICOM. However, the CT also tries to remain as transparent on images as possible. So, on export the images must be changed only as far as really necessary.

Therefore, not guaranteed all DICOM violations of incoming images are repaired (e.g. attributes as one with enumerated values, are not changed). So, improper DICOM input to the CT can result in improper DICOM output.

This feature is only meant for reference image review.

3.1.3.2.4 Presentation Context Acceptance Criterion

See section 3.1.3.1.4 on page 30.

3.1.3.2.5 Transfer Syntax Selection Policies

Any of the Presentation context show in Table 3-3, are acceptable.

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3.2 The CT AE Media Specification

The CT AE provides Standard Conformance to the DICOM Media Storage Service and File Format (PS 3.10) and the Media Storage Application Profiles (PS 3.11), the General Purpose Application Profile, as far as the reading of uncompressed images on CD-Recordable medium is concerned.
The CT supports **multi-patient** and **multi-session** (both for reading and writing) CD-R disks.

The supported Application Profiles, their Roles and the Service Class (SC) options, all defined in DICOM terminology, are listed in Table 3-40.

Table 3-40: Application Profile, Activities and Roles of the DICOM Media part of the CT

Application Profile	*Identifier*	*Real World Activity*	*Role*	*SC Option*
General Purpose CD-R Image Interchange Profile	STD-GEN-CD	Display Directory of CD-R disk	FSR	Interchange
	STD-GEN-CD	Write image(s) on CD-R disk	FSC	Interchange
	STD-GEN-CD	Read image(s) from CD-R disk	FSR	Interchange

The same SOP Classes are supported as mentioned in Table 3-1 on page 6 (for Write) and Table 3-2 on page 7 (for Read) via this Application Profile.

3.2.1 File Meta Information

The (Source) Application Entity Title is specified in section 3.1.1.4 on page 7.
The Implementation Class UID and the Implementation Version Name in the File Meta Header is specified in section 3.1.1.4 on page 7.

3.2.2 Media related Real-World Activities

3.2.2.1 RWA Display Directory

The CT AE will act as a FSR when reading the directory of the medium. This will result in an overview of the patients, studies, series and images on the CT screen.

Implementation restriction:
- The CT is not guaranteed able to display the directory listing of CD-ROM disks on which the data is pressed by the disk producer (like is the case with software CD's).

3.2.2.1.1 Application Profile(s) for this RWA

See Table 3-40.

3.2.2.1.2 Required and optionally DICOMDIR Keys

The Mandatory DICOMDIR Keys are required for the correct display of Directory information. The display is structured according the DICOM Composite Information Model: Patient,

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Study, Series, Image.
Possibly present optional DICOMDIR Keys are not displayed.

3.2.2.2 RWA Write images on CD-R disk

The CT AE will act as a FSC when writing all/selected images in a patient folder onto the CD-R medium.
Note that the images are written in ELE (by default), so are uncompressed, as specified in the STD-GEN-CD Application Profile. Other Presentation contexts are configurable.

3.2.2.2.1 Application Profile(s) for this RWA

See Table 3-40.

3.2.2.2.2 Support for Attributes in the images

The same remarks as in section 3.1.2.1 on page 8 about the existence of Optional, Retired and Private Attributes are applicable.
The DICOMDIR file will be extended when new images are written. In case some attributes are not present in the images but are specified Mandatory in the DICOMDIR definition in DICOM Media, a dummy ID will be filled in.

Implementation remarks and restriction:

- When writing the DICOMDIR records the key values are generated when no value of the corresponding attribute is supplied:
  -PATIENT_ID
  -STUDY_ID
  -STUDY_INSTANCE_UID
  -SERIES_NUMBER
  -SERIES_INSTANCE_UID
  -IMAGE_NUMBER
  -SOP_INSTANCE_UID
- The mechanism of generating a value for PATIENT_ID creates each time a new value based on PATIENT_NAME for each new study written to the CD-R, even if this study belongs to a patient recorded earlier.
- The default value for the Pixel Intensity Relationship (0028,1040) is set to DISP.
- A number of attributes (e.g., Window Width and Window Center) can be formatted as floating point numbers.

3.2.2.3 RWA Read images from CD-R disk

The CT AE will act as a FSR when reading all/selected images from the CD-R medium.

Implementation remarks and restriction:

- The CT is also able to read images coded in all of the JPEG codes as specified in Table 3-3, “Proposed Presentation Contexts for the CT to Other,” on page 9.

3.2.2.3.1 Application Profile(s) for this RWA

See Table 3-40.

3.2.2.3.2 Support for Attributes in the images

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The Mandatory Attributes of the DICOM images are required for the correct storage of the images in the CT internal image database. Optionally Attributes and Retired/Private Attributes are stored too if present; this is equivalent with the Level 2 (Full) conformance for the Storage Service Class in the Network support, see section 3.1.3.2 on page 30.

3.2.3 General Application Profile

The CT supports all transfer syntaxes as mentioned Table 3-3 on page 9.

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4 Communication Profiles

4.1 Supported Communication Stacks

The CT application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 TCP/IP Stack

The CT inherits its TCP/IP stack from the SUN Solaris system upon which it executes.

4.2.1 Physical Media Support

Ethernet ISO.8802-3. Standard AUI, optional twisted pair, 10/100-BaseT.

5 Extensions/Specializations/Privatizations

The Standard DICOM SOP Classes may be Extended with additional attributes:

- Standard attributes of other SOP Classes; the presence of these attributes in exported images can be configured, see section 6.2 on page 36
- Retired (from ACR NEMA 1.0 or 2.0) attributes; the presence of these attributes in exported images can be configured, see section 6.2 on page 36
- Private attributes; the presence of these attributes in exported images can be configured, see section 6.2 on page 36.

There are no Specialised SOP Classes.

The Table 3-1 on page 6 and Table 3-2 on page 7 list the supported Private SOP Classes. The usage of these SOP Classes are in the CT domain only. However instances of these Private SOP Classes may be exported towards a PACS environment and stored in a (central) DICOM archive and should be configured in order to make this possible. This is why the CT Private SOP Classes UIDs are mentioned in this Conformance Statements. The table below gives a short description of the Private SOP Classes.

Table 5-1: Short description of the Private SOP classes of the CT

SOP Class	Description
3D Volume Storage	This type of image can be generated in the CT in the volume facility.
3D Object Storage	This type of image can be generated in the CT in the volume facility.
Surface Storage	This type of image can be generated in the CT in the volume facility.
Composite Object Storage	This type of image can be generated in the CT in the volume facility.

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6 Configuration

The CT system is configured by means of a configuration program. This program is accessible at start-up of the CT system. It is password protected and intended to be used by Philips Customer Support Engineers only. The program prompts the Customer Support Engineer to enter configuration information needed by the CT application.

6.1 AE Title/Presentation Address mapping

6.1.1 Local AE Title and Presentation Address

The CT AE title is default equal to the IP host name. This host name can be changed by the Customer Support Engineer at installation.

The CT listens on port **3010**. This port number is **not** configurable.

6.1.2 Remote AE Titles and Presentation Addresses

All relevant remote applications able to setup a DICOM Association towards the CT must be configured at the CT configuration time. The Customer Support Engineer must provide the following information for each remote application:
- The Application Entity title.
- The SOP classes and Transfer Syntaxes for which the CT accepts Associations.

All relevant remote applications able to accept DICOM Associations from the CT, the following information must be provided:
- The Application Entity title.
- The host name/IP address on which the remote application resides.
- The port number at which the remote application accepts Association requests.

6.2 Configurable parameters.

6.2.1 Configuration per CT system.

The following items are configurable **per CT installation**:
- The SOP classes (out of the full list of SOP Classes in Table 3-1 on page 6 and Table 3-2 on page 7) and Transfer Syntaxes (out of the full list in Presentation Context tables in this Statement) to be used.
- The maximum PDU size for associations initiated by the CT (default is 0 meaning unlimited PDU size)

6.2.2 Configuration per remote system

The following items are configurable **per remote system**:
- The SOP classes and Transfer Syntaxes for which the CT sets-up and accepts Associations.
- Automatic conversion of images of SOP classes not supported by remote systems into SC Image Storage SOP instances,
- The maximum PDU size for Associations initiated by the CT,
- Export of ‘pure’ DICOM images (i.e. only the standard DICOM attributes defined in the related IOD) or ‘rich’ DICOM images (with additional Standard DICOM, Private and

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Retired Attributes)

6.2.3 Print Configuration

Configurable per CT installation:
- The DICOM printers to be selected by the operator.

The following print parameters are configured per DICOM printer type (see also the Print Management overview of the supported attributes in section 3.1.2.2.4 on page 25):
- The Medium Type
- Film Size ID (i.e. Media Size)
- Film Orientation
- Image Display Format
- Film Size in X an Y direction (this influences the Rows and Columns in the Image Box instances)
- Configuration Information (configurable per print destination)
  This is a character string containing implementation specific print parameters.
- Magnification Type.
- Trim.
- Film Destination.
- Max. Density.

These print parameters can be selected from choice lists. These choice lists are defined via so-called prototypes for each type of printer and print medium. These prototype are also configurable.

7 Support of Extended Character Sets

The CT supports Extended Character Set “ISO_IR 100” which is the Latin alphabet No 1, supplementary set.

8 Remarks

- The input of Image Data from legacy systems (e.g., SR 4/5/6/7000), using 5 1/4" MOD may result in an unclear patient date of birth. The reason is that this data has been stored with a two digit year date, and patients of 100 years or older will have a year of birth of '00, '01, etc., instead of 1900, 1901, etc.
  Image Data stored with four digit year dates will be problem free.

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