

# **Patienten-CD Systeme**

## **1.2**

### **DICOM Conformance Statement**

V 1.0

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# Introduction

## 1.1 Purpose

A DICOM Conformance Statement is intended to describe which components, optional components or extensions of the DICOM standard are supported by a particular implementation. The Conformance Statement of one implementation can be compared with the Conformance Statement from another implementation to determine which capabilities are commonly supported.

DICOM does not, by itself, guarantee interoperability. Furthermore, the identification of common capabilities by comparing DICOM Conformance Statements is also not sufficient to guarantee connectivity between two devices.

A DICOM Conformance Statement cannot replace validation and cross-vendor testing with other devices. Validation and cross-vendor testing are still required to ensure that both devices are performing as intended.

The reader should be aware of a number of important issues:

- Even when comparing this Conformance Statement with the Conformance Statement of another device indicates that connectivity is possible, the system integrator is responsible for carrying out test procedures to ensure that the required connectivity is actually met.
- Neither the DICOM Standard nor this Conformance Statement can ensure interoperability when integrating devices from different vendors. It is the system integrator's responsibility to ensure that the application requirements of all devices within the complete system are met.
- The DICOM standard undergoes continual review and improvement in order to meet changing requirements. Corrections, extensions and additional services are added from time to time. Medigration reserves the right to make changes to the product described in this conformance statement in order to cover changes in the DICOM standard. Readers should be aware that connected devices should also follow changes in the DICOM standard in order to retain connectivity.

The intended audience for this Conformance Statement is hospital technical staff, system integrators and software engineers. The reader is assumed to have good understanding of the DICOM standard.

## 1.2 Scope

This conformance statement describes the DICOM capabilities of the medigration PAT-CD-System. The PAT-CD-System is designed to produce DICOM compatible CDs with images of a single patient. The content of these CDs consist of the DICOM images, a DICOMDIR, a simple tool to view the images and maybe some additional information (e.g. static HTML pages). The CDs produced can be read by any DICOM application which can read DICOM CDs. However the viewing tool is reduced to run on the Windows operating system.

The PAT-CD-System supports those DICOM services needed to receive images and to store images on offline media.

## 1.3 Definitions, Acronyms and Abbreviations

### 1.3.1 Definitions

System Integrator	A person or organization responsible for integrating devices into a new or existing system. The System Integrator takes responsibility for ensuring that the system works as a whole.
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Table 1: Definitions

Other definitions can be found within the different parts of the DICOM standard [1].

### 1.3.2 Acronyms and Abbreviations

ACR-NEMA	<b>A</b> merican <b>C</b> ollege of <b>R</b> adiology - <b>N</b> ational <b>E</b> lectrical <b>M</b> anufacturers <b>A</b> ssociation.
AE	<b>A</b> pplication <b>E</b> ntity
CD	<b>C</b> ompact <b>D</b> isc
DCO	<b>D</b> ICOM <b>C</b> omposite <b>O</b> bject. A DICOM object such as an image, overlay, lookup-table, waveform, presentation state or radiotherapy plan which can be stored using the Storage Service Class.
FSC	<b>F</b> ile- <b>S</b> et <b>C</b> reator
FSR	<b>F</b> ile- <b>S</b> et <b>R</b> eader
FSU	<b>F</b> ile- <b>S</b> et <b>U</b> pdater
IOD	<b>I</b> nformation <b>O</b> bject <b>D</b> efinition
PACS	<b>P</b> icture <b>A</b> rchiving and <b>C</b> ommunication <b>S</b> ystem
PDU	<b>P</b> rotocol <b>D</b> ata <b>U</b> nit
SCP	<b>S</b> ervice <b>C</b> lass <b>P</b> rovider
SCU	<b>S</b> ervice <b>C</b> lass <b>U</b> ser
SOP	<b>S</b> ervice <b>O</b> bject <b>P</b> air

Table 2: Acronyms and abbreviations

Other acronyms and abbreviations used within this document are defined within the different parts of the DICOM standard [1].

## 1.4 References

- [1] DICOM, PS3.(1-16)-2003, National Electrical Manufacturers Association, 1300 N. 17<sup>th</sup> Street Rosslyn, Virginia 22209, USA.

## 2 Implementation Model

The **PAT-CD-System** is a single Application Entity which provides the services of the DICOM Storage Service Class and the DICOM Media Storage Service Class. It accepts images from Storage Service Class Users and stores images of a single patient on CD-R.

### 2.1 Application Data Flow Diagram

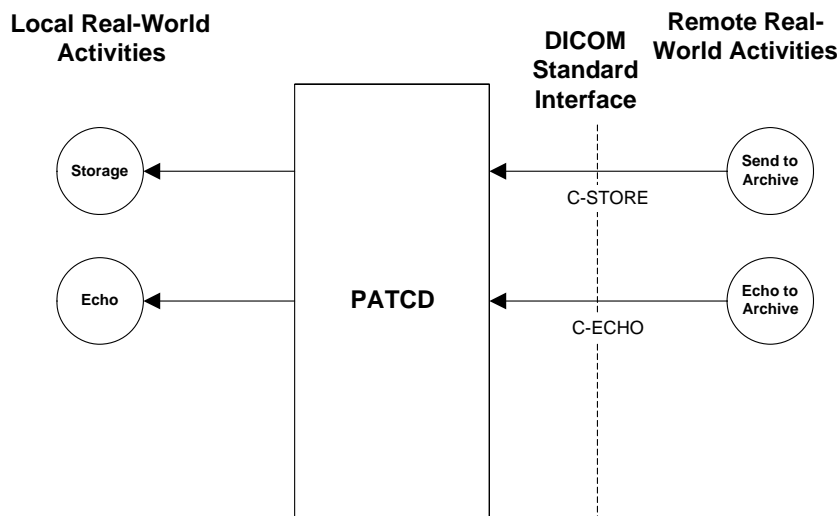


Figure 1: PATCD Implementation Model

Figure 1 illustrates the relationships between the PATCD Application Entity and its associated Real-World Activities. The **Remote Real-World Activities** are shown on the right and the **Local Real-World Activities** are shown on the left.

**Send to Archive** is an activity performed by a remote device to send images to the PATCD application to be stored by the **Storage** local activity.

**Echo to Archive** is an activity performed by a remote device to verify the ability of the PATCD application to respond to DICOM messages. The local activity **Echo Provider** will respond to a received echo message.

### 2.2 Functional Definition of Application Entities

The PATCD Application Entity is designed to retrieve images from one or more SCU's. It acts as an SCP of the following DICOM Service Classes:

- DICOM Verification Service Class
- DICOM Storage Service Class

### 2.3 Sequencing of Real World Activities

No sequencing of Real-World Activities is relevant.

## 3 PATCD Application Entity Specification

The PATCD application provides standard conformance to the Verification Service Class by supporting the SOP Class and roles listed in Table 3.

SOP Class Name	UID	Role
Verification	1.2.840.10008.1.1	SCP

Table 3: Supported DICOM Verification SOP Classes and Roles

The PATCD application provides standard conformance to the Storage Service class by supporting the SOP Classes and roles listed in Table 4.

SOP Class Name	UID	Role
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	SCP
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	SCP
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30	SCP
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29	SCP
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	SCP
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	SCP
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2	SCP
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	SCP
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	SCP
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	SCP
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	SCP
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	SCP
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	SCP
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	SCP
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	SCP
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6	SCP
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	SCP
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	SCP
Multi-frame Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1	SCP
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	SCP
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	SCP
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	SCP
Stand-alone Curve Storage	1.2.840.10008.5.1.4.1.1.9	SCP
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	SCP

General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	SCP
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3	SCP
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1	SCP
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1	SCP
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1	SCP
Stand-alone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10	SCP
Stand-alone Overlay Storage	1.2.840.10008.5.1.4.1.1.8	SCP
Stand-alone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11	SCP
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	SCP
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129	SCP
Stored Print Storage	1.2.840.10008.5.1.1.1.27	SCP
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	SCP
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	SCP
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	SCP
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	SCP
Digital X-Ray Image Storage – For Presentation	1.2.840.10008.5.1.4.1.1.1.1	SCP
Digital X-Ray Image Storage – For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	SCP
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	SCP
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	SCP
Digital Intra-oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	SCP
Digital Intra-oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	SCP
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	SCP
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	SCP
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	SCP
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	SCP
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	SCP
Enhanced SR	1.2.840.10008.5.1.4.1.1.88.22	SCP
Comprehensive SR	1.2.840.10008.5.1.4.1.1.88.33	SCP
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50	SCP
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65	SCP
Key Object Selection	1.2.840.10008.5.1.4.1.1.88.59	SCP

Table 4: Supported DICOM Storage SOP Classes and Roles

## 3.1 Association Establishment Policies

### 3.1.1 General

All relevant DICOM communication parameters (AE-Title, port numbers, etc.) are configurable. See section 5 for more information on configurable parameters.

A maximum PDU size of 16 kB will be offered when establishing associations. Any maximum PDU size will be accepted although PDU sizes larger than 128k will never be sent.

### 3.1.2 Number of Associations

The number of concurrent associations which can be accepted is configurable. See section 5 for more information on configurable parameters.

No fixed limit exists on the number of associations which can be initiated other than the resource limits imposed by the underlying operating system.

### 3.1.3 Asynchronous Nature

The PATCD application does not support asynchronous transactions.

### 3.1.4 Implementation Identifying Information

Implementation Class UID:	1.2.276.0.33.0.20010702.0.1.3
Implementation Version Name:	MDCMTK20010702

## 3.2 Association Initiation Policy

PATCD will never initiate an associations.

## 3.3 Association Acceptance Policy

The PATCD application will accept associations for the following situations:

- To respond to communication verification requests from remote devices.
- To receive images for storage from remote devices.

Associations can be accepted at any time the PATCD application entity is active. The PATCD application entity may not be active if stopped or restarted by an operator.

Associations will be terminated (A-ABORT) if they are idle for more than 20 minutes.

### 3.3.1 Respond to Communication Verification Requests

#### 3.3.1.1 Associated Real-World Activity

An association will be accepted from a remote Application Entity in order to respond to communication verification requests. The local real-world activity is **Echo Provider** and the remote real world activity is **Echo to Archive**.

#### 3.3.1.2 Acceptable Presentation Contexts

Any of the presentation contexts shown in Table 5 can be accepted.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 5: Acceptable presentation context for verification

#### 3.3.1.3 SOP Specific Conformance

Standard conformance is provided for the Verification SOP Class.

#### 3.3.1.4 Presentation Context Acceptance Criteria

A presentation context for the Verification SOP Class will always be accepted provided the transfer syntax selection policy is met. Presentation contexts for other supported activities may also be accepted on the same association.

#### 3.3.1.5 Transfer Syntax Selection Policies

Only the default DICOM Transfer Syntax (Implicit VR Little Endian) will be accepted.

### 3.3.2 Receive Images for Storage

#### 3.3.2.1 Associated Real-World Activity

An association will be accepted from a remote Application Entity in order to receive images for storage. The local real-world activity is **Storage** and the remote real world activity is **Send to Archive**.

Received images are stored on local disk, summary information is extracted from the image and stored to a central database. The extraction of summary information is tolerant of encoding errors wherever possible. Invalid attribute

values will be retained in the image files but may be ignored or truncated when inserted into the central database.

### 3.3.2.2 Acceptable Presentation Contexts

Any of the presentation contexts shown in Table 6 can be accepted.

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
Any of the Storage SOP Class names listed in Table 4.	Any of the Storage SOP Class UIDs listed in Table 4.	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

Table 6: Acceptable presentation contexts for storage

### 3.3.2.3 SOP Specific Conformance

Conformance to the SOP Classes of the Storage Service Class is at Level 2 (Full). Moreover, all received attributes (Type 1, Type 2, Type 3 and Private) are stored without modification. No attributes are discarded. Received images are written to local disk using the DICOM File Format as specified in PS 3.10. The storage architecture is bit-preserving and images are written to the Data Set portion of the File Format exactly as received over the network interface. The identity of the transfer syntax used to receive the image is recorded in the File Format meta header along with the Source Application Entity Title.

No specific policies are required concerning the attribute Lossy Image Compression (0028,2110).

No automatic coercion of attribute values will be performed.

If a success or warning status is returned in a C-STORE response the image has been stored to local disk and registered in the central database. If an image is received containing a SOP Instance UID which is already stored in the database then a success status is returned and the local image is replaced.

The meaning of status codes which can be returned in a C-STORE response are listed in Table 7. More detailed error information may be provided in the related fields Offending Element (0000, 0901) and Error Comment (0000,0902).

Status Code	Meaning	Detail
A700	Refused – Out of Resources	Insufficient disk space is available or insufficient permissions exist to store the image. The image cannot be stored. An error message is recorded in a log file.
A900	Error – Data Set does not match SOP Class	A serious incompatibility between the dataset and the supposed SOP Class was detected. The image cannot be stored. An error message is recorded in a log file.
C000	Error – Cannot Understand	A serious error occurred while parsing the image or an error occurred while updating the database. The image cannot be stored. An error message is recorded in a log file.

0000	Success	The image has been successfully stored or an image with the same SOP Instance UID already exists. A message is recorded in a log file.
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Table 7: C-STORE response status codes

### 3.3.2.4 Presentation Context Acceptance Criteria

Presentation contexts for any of the supported Storage SOP Classes will always be accepted provided the transfer syntax selection policy is met. Presentation contexts for other supported activities may also be accepted on the same association.

### 3.3.2.5 Transfer Syntax Selection Policies

Preference is by default given to receiving images encoded using an explicit transfer syntax. However, configuration options can be used to limit acceptance to only the default DICOM Transfer Syntax (Implicit VR Little Endian) when accepting associations from specific application entities (see section 5 for configuration options).

When multiple Transfer Syntaxes are presented, a selection is made using following priority:

1. Explicit VR Little Endian
2. Explicit VR Big Endian
3. Implicit VR Little Endian

## 4 Communication Profiles

### 4.1 Supported Communication Stacks

TCP/IP Network Communication is supported as defined in Part 8 of the DICOM Standard.

#### 4.1.1 TCP/IP Stack

The TCP/IP stack is inherited from the underlying operating system.

##### 4.1.1.1 Physical Network Media Support

No dependency exists on the physical network medium over which TCP/IP executes. The supported physical network media are inherited from the underlying operating system. Typical physical network media options include 10BASE-T Ethernet, 100BASE-TX Ethernet, FDDI and ATM.

## 5 Configuration

The following DICOM-related network parameters are configurable by the user via a graphical user interface and are stored in the central database:

- The title of the PATCD Application Entity. Associations will not be accepted if the Called AE Title is not equal to the configured AE Title.
- The Port Number to use when listening for associations (default 104).
- The AE Titles, IP Address and Port Number for all peer application entities. These parameters must be configured before associations can be initiated or accepted. Association attempts from unknown AE Title and IP Address pairs will not be accepted.
- Support by peer application entities for the Verification SOP Class. If supported, a connectivity test can be performed upon user request.
- The preferred transfer syntax for each peer application entity. The transfer syntax selection policies can be configured such that only the Implicit VR Little Endian Transfer Syntax will be accepted for individual application entities.

The following DICOM-related network parameters are configurable by a field service engineer for the *Storage* local activity

- The number of concurrent associations which can be accepted (default 20). This limit is bound only by the availability of underlying operating system resources.
- General association inactivity timeout (default 1800 seconds).
- Timeout waiting for a DIMSE request (default 1200 seconds).
- Timeout waiting for a DIMSE response (default 300 seconds).
- Maximum size of a received PDU (default 16KB).

## 6 Support of Extended Character Sets

The extended character sets listed in Table 8 are supported:

ISO-IR 100	Latin Alphabet Supplementary Set No. 1 (ISO 8859-1)

Table 8: Extended character sets

Note, the DICOM default character set (ISO-IR 6) is a subset of ISO-IR 100.