



## **DICOM Conformance Statement**

### **DYNACAD**

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## 1 INTRODUCTION

This DICOM conformance statement specifies the behavior and functionality of the DYNACAD application, version 1.0. This software provides the following capabilities:

- Reads and displays uncompressed DICOM images of all modalities and image SOP classes.
- Prints on a remote printer using Basic Grayscale Print Service Class
- Sends and receives DICOM objects via the DICOM Storage Service Class.

### 1.1 Revision History

Version	Date	Software Version	Description
1.1	2002-11-20	MDJADE 1.2	Preliminary version
1.2	2003-03-01	MDJADE 1.31	Revision by Sebastian Meyer
1.3	2003-03-07	MDJADE 1.32	Release by Oliver Heidkamp
1.4	2004-02-26	DynaCAD 1.0	Preliminary version by Sven Kohle
1.5	2004-04-23	DynaCAD 1.0	Revision by Oliver Heidkamp
1.6	2004-08-09	DynaCAD 1.0	Revision by Bernd Kümmerlen

### 1.2 Abbreviations and Acronyms

ASCII	American Standard Code for Information Interchange
AE	Application Entity
ANSI	American National Standards Institute
CR	Computed Radiography
CT	Computed Tomography
DCMTK	OFFIS DICOM Toolkit
DICOM	Digital Imaging and Communications in Medicine
ECR	European Congress of Radiology
GSPS	Grayscale Softcopy Presentation State
HIMSS	Healthcare Information and Management Systems Society
IE	Information Entity
IHE	Integrating the Healthcare Enterprise
IOD	Information Object Definition
ISO	International Standards Organization
NEMA	National Electrical Manufacturers Association
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
RSNA	Radiological Society of North America
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
SR	Structured Reporting
TCP/IP	Transmission Control Protocol / Internet Protocol
TLS	Transport Layer Security
UID	Unique Identifier
VM	Value Multiplicity

VR            Value Representation

**1.3    Scope**

This DICOM Conformance Statement documents the conformance of the DYNACAD software with the Digital Imaging and Communications in Medicine (DICOM) standard. This document is essential in order to evaluate whether or not another DICOM compliant device can communicate with this software product. This statement is conformant with the recommended format as described in PS 3.2 of the DICOM standard.

**1.4    Warning to the reader**

If another device matches this Conformance Statement based on the comparison with its own Conformance Statement, there is a chance, but no guarantee that they interoperate. DICOM only deals with communication, it is not a standard which specifies what is needed for certain applications to run on a device.

## 2 IMPLEMENTATION MODEL

### 2.1 Application Data Flow Diagram

DYNACAD consists of a set of parallel, communicating but independent processes that deal with the DICOM communication. There is a process that takes care of receiving the images (C-STORE SCP) and storing them in the database, one that sends images out on request (C-STORE SCU), and a spooler process that manages communication with printers, using the Basic Grayscale Print Management Meta SOP Class. From a functional perspective, the processes that implement DYNACAD's DICOM network interface can be separated into the application entities:

Print SCU, Store SCP and Store SCU. The application entity titles attached to the different application entities are freely configurable.

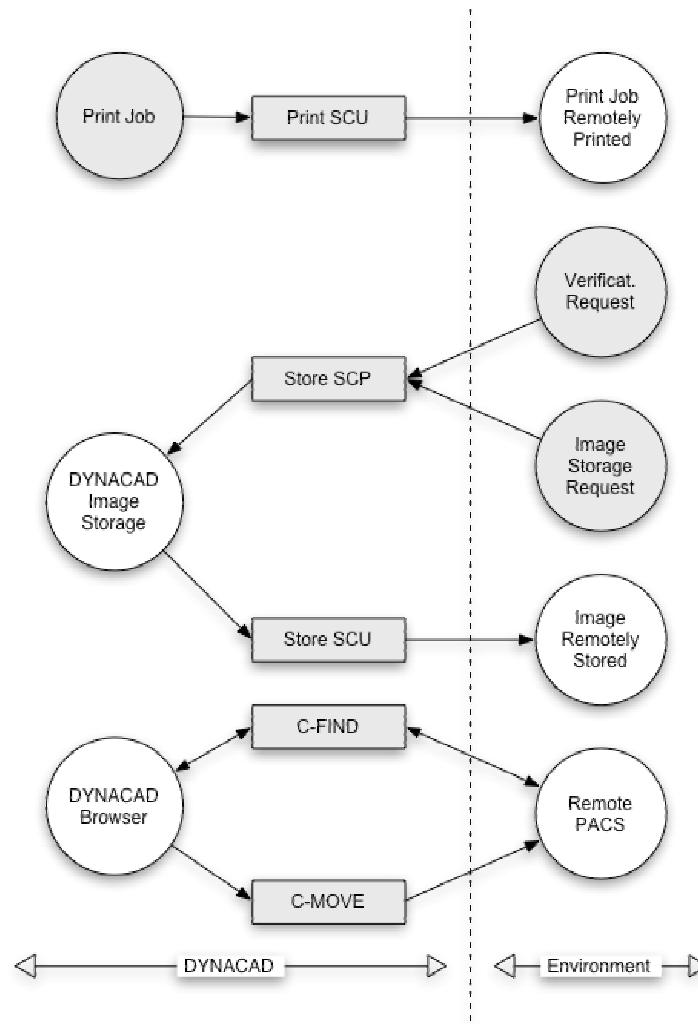


Figure 1 Implementation Model

## **2.2 Functional Definitions of AEs**

### **2.2.1 Store SCP**

Store SCP is an application that implements the DICOM Storage Service Class and the Verification Service Class as SCP. Store SCP is automatically started together with the operating system. Store SCP spawns a new process for each incoming DICOM association request. The association remains open until the remote application entity closes the association or until an error condition occurs that leads to an association abort.

### **2.2.2 Store SCU**

Store SCU is an application that implements the DICOM Storage Service Class as SCU. Store SCU is activated by DYNACAD whenever the user requests transmission of one or more objects from the local database to a remote node. When DYNACAD is terminated, Store SCU continues to transmit until the transmission is completed or aborted because of a fatal error. For each transmission request a separate Store SCU is spawned. A transmission request may consist of the transmission of a single image, a complete series or study or several studies. All objects comprising one transmission request are transmitted over one association. When transmission is finished, the association is released and Store SCU terminates. If the transmission of an object fails because the peer Store SCP sends back an error code or no valid presentation context for the transmission of the object is available, the association is aborted and Store SCU also terminates.

### **2.2.3 Print SCU**

Print SCU is an application that implements the Basic Grayscale Print Management Meta SOP Class as SCU. One generic spooler process is started together with the viewer. Whenever the user requests a print on a particular printer, the spooler manages the communication to this printer. When DYNACAD is terminated, the Print SCUs continue to transmit until the print job is completed or aborted because of a fatal error.

### 3 APPLICATION ENTITY SPECIFICATIONS

#### 3.1 Store SCP

This application entity provides standard conformance to the following DICOM SOP classes as an SCP:

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-ray Image Storage For Presentation	1.2.840.10008.5.1.4.1.1.1.1
*Digital X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-ray Image Storage For Present.	1.2.840.10008.5.1.4.1.1.1.2
*Digital Mammography X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra Oral X-ray Image Storage For Presentation	1.2.840.10008.5.1.4.1.1.1.3
*Digital Intra Oral X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
*Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
X-ray Angiographic Bi-Plane Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.12.3
*RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
*RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
*RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
*RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
*RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
*RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
*RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
*Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
*Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9
*Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
*Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
*Stored Print Storage	1.2.840.10008.5.1.1.27
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Visible Light Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
Visible Light Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2

SOP Class Name	SOP Class UID
*Visible Light Slide Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
Visible Light Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
*Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
*Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
*Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22
*Comprehensive SR Storage	1.2.840.10008.5.1.4.1.1.88.33
*Twelve Lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
*General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
*Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
*Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
*Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1
*Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
*Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Multiframe Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multiframe Grayscale Byte Secondary Capture Image St.	1.2.840.10008.5.1.4.1.1.7.2
Multiframe Grayscale Word Secondary Capture Image St.	1.2.840.10008.5.1.4.1.1.7.3
*Multiframe True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
*Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
Draft Visible Light Image Storage (sup15_fz 1997)	1.2.840.10008.5.1.4.1.1.77.1
Draft Visible Light Multi Frame Image Storage (sup15_fz 97)	1.2.840.10008.5.1.4.1.1.77.2
*Structured Reporting Text Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.1
*Structured Reporting Audio Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.2
*Structured Reporting Detail Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.3
*Structured Reporting Comprehensive Storage (sup23_fz 97)	1.2.840.10008.5.1.4.1.1.88.4
*Draft Waveform Storage (sup30_fz 1997)	1.2.840.10008.5.1.4.1.1.9.1

This application entity does not provide standard conformance to any SOP class as SCU. Objects of the service classes marked with an asterisk (\*) may not be handled as expected by the DYNACAD Application itself, though the handling of the DICOM objects will be successful. See 3.1.3.1.2.1

### 3.1.1 Association Establishment Policies

#### 3.1.1.1 General

The DICOM standard application context name, which is always proposed, is:

Application context name 1.2.840.10008.3.1.1.1

The maximum PDU length can be configured at installation time in the range 4096..131072 bytes. The default is 16384 bytes.

SOP Class extended negotiation is not supported.

### **3.1.1.2 Number of Associations**

The number of parallel associations is only limited by the resources of the underlying operating system.

### **3.1.1.3 Asynchronous Nature**

Asynchronous mode of operation is not supported.

### **3.1.1.4 Implementation Identifying Information**

The implementation UID of this application is:

OFFIS DCMTK 3.5.2 Implementation Class UID            1.2.276.0.7230010.3.0.3.5.2

### **3.1.2 Association Initiation by Real-World Activity**

This application entity never initiates associations.

### **3.1.3 Association Acceptance Policy**

When Store SCU accepts an association, it will answer a C-ECHO request or receive any images transmitted on that association and store the images on disk. Store SCU requires that the called Application Entity Title (AET) matches the AET configured for the application. It places no limitations on who may connect to it, nor on the number of simultaneous connects it will support.

#### **3.1.3.1 Real-World Activity “Image receipt”**

The Store SCP application entity accepts an association when it receives an association request from a remote DICOM Storage. The application accepts incoming association requests on every port number defined in the DICOM configurator, if the called AET matches the respective entry in its DICOM configuration. It accepts any association for which at least one presentation context is accepted. The calling application entity title is ignored. The responding application entity name can be configured in the DICOM configurator.

##### **3.1.3.1.1 Associated Real-World Activity**

The associated Real-World Activity associated with the C-STORE operation is the storage of the image on the disk of the system upon which Store SCU is running. The data received is then added to a database and analyzed for proper viewing by processed out of the scope of this document.

##### **3.1.3.1.2 Presentation Context Table**

The default behavior of the Store SCP is to accept as SCP for each of the supported SOP classes all presentation contexts containing one or more of the following transfer syntaxes:

Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2

The default behavior can be changed in the configuration file such that only presentation contexts for supported SOP classes containing the Implicit VR Little Endian transfer syntax are accepted.

### 3.1.3.1.2.1 SOP Specific Conformance for all Storage SOP Classes

The Store SCP will receive any DICOM objects (images and non-image objects) transmitted in the open association provided that the correct presentation context is used. If the objects are received successfully, they are stored and registered in the local database, from where they can be loaded into DYNACAD. No integrity checks of the received objects are performed beyond tests of a very basic structural integrity. In particular, the sending system is not prevented from transmitting incomplete or incorrect IODs or objects that are correct but cannot be displayed. Such objects will be visible in the PACS browser, but they cannot be viewed.

Objects are stored in the local database as files in DICOM part 10 format with Explicit VR Little Endian Transfer Syntax. When objects received in Implicit VR contain attributes unknown to this application, they are stored as “Unknown VR” (UN) elements. Certain element values may be changed during storage, i. e. group length values and sequence lengths are re-computed. This behavior can be changed in two ways in the configuration file:

- The support for unknown VR can be disabled. In this case, unknown elements are stored as “OB”.
- The Store SCP can be switched to “bit preserving mode”. In this case, objects are stored without any modification in the transfer syntax in which they are received.

The following error/warning status codes can be sent by the Store SCP in the context of a CSTORE- RSP message:

Code	Name	Severity	Description
a700	refused: out of resources	failure	Application out of memory, file system or database write error (e. g. file system full)
a800	refused: SOP class not supported	failure	Received C-STORE-RQ for non-storage SOP class
a900	error: data set does not match SOP class	failure	SOP class or instance UID in C-STORE-RQ does not match UIDs in the received dataset
c000	error: cannot understand	failure	Received dataset without SOP class or instance UID; received Presentation State that failed syntax check; internal application error

Store SCP never removes, coerces or changes attribute values, except for the special case of group length attributes mentioned above. The duration of storage depends on the user, who can delete objects from the local database at any time and on the configuration of the storage database, that can be configured to auto-delete studies after a given time.

Store SCP implements Level 2 (Full) conformance to the Storage Service Class. Store SCP implements Signature Level 3 conformance since the integrity of incoming Digital Signatures is preserved even if “bit preserving mode” is not activated. However, extended negotiation is not supported.

### 3.1.3.1.3 Transfer Syntax Selection Policies

The default behavior of the Store SCP is to select for each presentation context containing a supported SOP class the explicit VR transfer syntax with the byte order matching the local machine byte order (i. e. little endian on PC, big endian on Mac OS). If this transfer syntax is not available, the explicit VR transfer syntax with opposite byte order is selected. If this is also

unavailable, Implicit VR little endian is selected if available, otherwise the presentation context is rejected.

### 3.2 Store SCU

This application entity provides standard conformance to the following DICOM SOP classes as an SCU:

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
Digital X-ray Image Storage For Presentation	1.2.840.10008.5.1.4.1.1.1.1
Digital X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography X-ray Image Storage For Present.	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra Oral X-ray Image Storage For Presentation	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra Oral X-ray Image Storage For Processing	1.2.840.10008.5.1.4.1.1.1.3.1
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
X-ray Angiographic Bi-Plane Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.12.3
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7
Standalone Overlay Storage	1.2.840.10008.5.1.4.1.1.8
Standalone Curve Storage	1.2.840.10008.5.1.4.1.1.9
Standalone Modality LUT Storage	1.2.840.10008.5.1.4.1.1.10
Standalone VOI LUT Storage	1.2.840.10008.5.1.4.1.1.11
Stored Print Storage	1.2.840.10008.5.1.1.27
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
Visible Light Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1
Visible Light Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2

SOP Class Name	SOP Class UID
Visible Light Slide Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3
Visible Light Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4
X-ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
X-ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22
Comprehensive SR Storage	1.2.840.10008.5.1.4.1.1.88.33
Twelve Lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
Multiframe Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multiframe Grayscale Byte Secondary Capture Image St.	1.2.840.10008.5.1.4.1.1.7.2
Multiframe Grayscale Word Secondary Capture Image St.	1.2.840.10008.5.1.4.1.1.7.3
Multiframe True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
Draft Visible Light Image Storage (sup15_fz 1997)	1.2.840.10008.5.1.4.1.1.77.1
Draft Visible Light Multi Frame Image Storage (sup15_fz 97)	1.2.840.10008.5.1.4.1.1.77.2
Structured Reporting Text Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.1
Structured Reporting Audio Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.2
Structured Reporting Detail Storage (sup23_fz 1997)	1.2.840.10008.5.1.4.1.1.88.3
Structured Reporting Comprehensive Storage (sup23_fz 97)	1.2.840.10008.5.1.4.1.1.88.4
Draft Waveform Storage (sup30_fz 1997)	1.2.840.10008.5.1.4.1.1.9.1

This application entity does not provide standard conformance to any SOP class as SCU.

Note: Results generated by the application are stored and sent out as Secondary Capture Images or as Grayscale Softcopy Presentation State, if configured.

### 3.2.1 Association Establishment Policies

#### 3.2.1.1 General

The DICOM standard application context name, which is always proposed, is:

Application context name 1.2.840.10008.3.1.1.1

The maximum PDU length can be configured at installation time in the range 4096..131072 bytes. The default is 16384 bytes.

SOP Class extended negotiation is not supported.

### 3.2.1.2 Number of Associations

Store SCU will only propose a single association. However, multiple instances of Store SCU may be running at the same time. The number of parallel instances is only limited by the resources of the underlying operating system.

### 3.2.1.3 Asynchronous Nature

Asynchronous mode of operation is not supported.

### 3.2.1.4 Implementation Identifying Information

The implementation UID of this application is:

OFFIS DCMTK 3.5.2 Implementation Class UID 1.2.276.0.7230010.3.0.3.5.2

## 3.2.2 Association Initiation by Real-World Activity

### 3.2.2.1 Real-World Activity “Image transmission”

An instance of the Store SCU application entity is started in order to execute a transmission request. The application initiates an association with the selected remote Storage SCP. The calling application entity name can be configured. The called application entity name must be configured together with the related host name or address in the DICOM configurator.

#### 3.2.2.1.1 Associated Real-World Activity

There are two ways to start a file transfer:

- DYNACAD Browser: The user selects an object, series or study in the DYNACAD browser. He selects the “send” function, chooses a send target and selects “OK”.
- Result Storage: The result images or presentation contexts generated within the viewing application can be sent to an arbitrary known C-STORE SCP by the user or are sent to the C-STORE SCP, that is marked as “Default PACS” in the DICOM configuration.

#### 3.2.2.1.2 Proposed Presentation Contexts

The default behavior of the Store SCU is to propose for each of the supported SOP classes a single presentation context containing the following transfer syntaxes:

Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2

The explicit VR transfer syntax with local byte order (i. e. little endian on PC, big endian on Mac OS) will always be the first in the list of the proposed transfer syntaxes, followed by the explicit VR transfer syntax with opposite byte order, followed by the DICOM default transfer syntax.

##### 3.2.2.1.2.1 SOP Specific Conformance for all Storage SOP Classes

Store SCU transmits the selected objects from the local DYNACAD datastorage and creates a log entry for each C-STORE operation. The log entry shows whether or not the transmission was successful. If the SCP returns a DIMSE error or warning status code for one C-STORE

operation, this information is logged, and transmission continues with the next object. Store SCU never attempts to automatically repeat failed transmissions. If transmission of one selected object fails because no appropriate presentation context could be negotiated, Store SCU aborts the association and creates a log entry indicating the unsuccessful termination. Store SCU always transmits all elements contained in an object, independent from their type within the IOD of the corresponding SOP Class.

### 3.2.3 Association Acceptance Policy

This application does not accept associations.

## 3.3 Print SCU

This application entity provides a standard conformance to the following DICOM SOP classes as an SCU:

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Basic Annotation Box SOP Class	1.2.840.10008.5.1.1.15
Print Job SOP Class	1.2.840.10008.5.1.1.17

This application entity does not provide standard conformance to any SOP as an SCP.

### 3.3.1 Association Establishment Policies

#### 3.3.1.1 General

The DICOM standard application context name used is:

Application context name 1.2.840.10008.3.1.1.1

The maximum PDU length is set to 16384 = 16K and cannot be configured.

SOP Class extended negotiation is not supported.

#### 3.3.1.2 Number of Associations

Only one association can be opened and processed, at a time.

#### 3.3.1.3 Asynchronous Nature

The asynchronous mode of operations is not supported.

#### 3.3.1.4 Implementation Identifying Information

The implementation UID of the application is:

OFFIS DCMTK 3.5.2 Implementation Class UID 1.2.276.0.7230010.3.0.3.5.2

### 3.3.2 Association Initiation by Real-World-Activity

#### 3.3.2.1 Real-World Activity "Print Job"

An instance of the Print SCU application entity is requested to spool a print job, assembled by the user through the DICOM Print dialogue to a particular printer. The application entity initiates an association with that selected Print Management Service Class Provider. The calling and called application entity names, as well as the presentation address to be used are configured when the printer is configured in DYNACAD.

### 3.3.2.1.1 Associated Real-World Activity

After creating results, the user selects the DICOM Print button in DYNACAD to open the DICOM Print dialogue. In this dialogue pressing the print button creates the print job.

### 3.3.2.1.2 Proposed Presentation Contexts

By default the application entity proposes as an SCU for each of the supported SOP classes a single presentation context containing the following transfer syntaxes:

Implicit VR Little Endian	1.2.840.10008.1.2
Explicit VR Little Endian	1.2.840.10008.1.2.1
Explicit VR Big Endian	1.2.840.10008.1.2.2

The transfer syntaxes are sorted in the following order: First the SCU proposes the explicit VR transfer syntax with local byte order (little endian for PC, big endian for Mac OS). After that the explicit VR transfer syntax with opposite byte order is proposed. The last transfer syntax to be proposed is the DICOM default transfer syntax.

#### 3.3.2.1.2.1 SOP Specific Conformance for Printer SOP Class

After a successful association negotiation the Print SCU issues an N-GET request to retrieve the contents of the Printer SOP Instance. For this request the attribute identifier list is kept empty, thus requesting the Print SCP to transmit the contents of all attributes of the Printer SOP Instance. If this request fails the connection with the associated printer is released. The Print SCU is able to accept N-EVENT-REPORT requests from the Printer SOP instance, as well as to respond with an N-EVENT-REPORT response.

#### 3.3.2.1.2.2 SOP Specific Conformance for Basic Film Session SOP Class

After the retrieval of the Printer SOP instance the Print SCU creates a Basic Film Session. The Print SCP responds with the elements for the Basic Film Session known to the printer. If the creation fails, the association with SCP is released. The Basic Film Session is deleted before releasing the association, after the print job has been completed, successfully, using the N-DELETE request. For the Basic Film Session the SCU issues a single N-SET request for each of the following elements:

Attribute Name	Tag	Type	VR	VM	Comment
Number Of Copies	(2000,0010)	U/M	IS	1	Specified by user
Print Priority	(2000,0020)	U/M	CS	1	Specified by user
Medium Type	(2000,0030)	U/M	CS	1	Specified by user
Film Destination	(2000,0040)	U/M	CS	1	Specified by user

No other requests are sent on this level.

#### 3.3.2.1.2.3 SOP Specific Conformance for Basic Film Box SOP Class

If the Basic Film Session SOP instance has been created, successfully, the Print SCU creates a Basic Film Box, using the N-CREATE request, containing the following elements:

Attribute Name	Tag	Type	VR	VM	Comment
Image Display Format	(2010,0010)	M/M	ST	1	Possible values: STANDARDx,y ROWx,y,...,z, COLx,y,...,z

Attribute Name	Tag	Type	VR	VM	Comment
					SLIDE, SUPERSLIDE CUSTOM-X as defined for the printer
Annotation Display Format ID	(2010,0030)	U/U	CS	1	Sent if specified by user and Basic Annotation Box SOP Class was successfully negotiated
Film Orientation	(2010,0040)	U/M	CS	1	Specified by user
Film Size ID	(2010,0050)	U/M	CS	1	Specified by user
Referenced Film Session Sequence	(2010,0500)	M/M	SQ	1	
>Referenced SOP Class UID	(0008,1150)	M/M	UI	1	
>Referenced SOP Instance UID	(0008,1155)	M/M	UI	1	

If the creation fails, the association with the SCP is released. There is only one Basic Film Box in the context of one association. An N-ACTION request is used by the SCU to request the Print SCP to process the print job. After the successful completion of the print job, the Print SCU uses an N-DELETE request to delete the Basic Film Box SOP instance before deleting the Basic Film Session SOP instance and releasing the association.

For the Basic Film Box the Print SCU issues a single N-SET request to set each of the following elements:

Attribute Name	Tag	Type	VR	VM	Comment
Annotation Position	(2030,0010)	M/M	US	1	Set by user
Text String	(2030,0020)	M/M	LO	1	Set by user
Magnification Type	(2010,0060)	U/M	CS	1	Set by user
Border Density	(2010,0100)	U/U	CS	1	Set by user
Empty Image Density	(2010,0110)	U/U	CS	1	Set by user
Min Density	(2010,0120)	U/U	US	1	Set in configuration
Max Density	(2010,0130)	U/M	US	1	Set in configuration
Trim	(2010,0140)	U/U	CS	1	Set by user

No other requests are sent.

### 3.3.2.1.2.4 SOP Specific Conformance for Basic Grayscale Image Box SOP Class

For each Basic Grayscale Image Box created as part of the Basic Film Box the Print SCU issues a single N-SET request for each image box, as long as an image for the image box is present. The following elements may be set as part of the N-SET request.

Attribute Name	Tag	Type	VC	VM	Comment
Image Position	(2020,0010)	M/M	US	1	
Polarity	(2020,0020)	U/M	CS	1	Set by user
Basic Grayscale Image Sequence	(2020,0110)	M/M	SQ	1	
>Samples per Pixel	(0028,0002)	M/M	US	1	Value is 1

Attribute Name	Tag	Type	VC	VM	Comment
>Photometric Interpretation	(0028,0004)	M/M	CS	1	Value is MONOCHROME2
>Pixel Aspect Ratio	(0228,0034)	MC/M	IS	1	Set if pixel aspect ratio != 1/1
>Rows	(0028,0010)	M/M	US	1	
>Columns	(0028,0011)	M/M	US	1	
>Bits Allocated	(0028,0100)	M/M	US	1	Value is 8
>Bits Stored	(0028,0101)	M/M	US	1	Value is 8
>High Bit	(0028,0102)	M/M	US	1	Value is 7
>Pixel Representation	(0028,0103)	M/M	US	1	Value is 0
>Pixel Data	(7fe0,0010)	M/M	OW	1	See note below

Since support for the Presentation LUT SOP Class has not been negotiated with Print SCP, the Print SCU assumes that the printer uses a display curve related to the DICOM Grayscale Display Standard Function with viewing conditions (illumination and reflection) defined in a proprietary manner outside the print protocol. All images will be sent in P-values, with all Presentation LUTs "burned in" as if Presentation LUT Shape of "IDENTITY" had been negotiated

### 3.3.2.1.2.5 SOP Specific Conformance for Basic Annotation Box SOP Class

If supported and the Annotation Boxes have been created as part of the Basic Film Box the Print SCU may set a single N-SET request for each annotation box. The following elements may be set:

Attribute Name	Tag	Type	VR	VM	Comment
Annotation Position	(2030,0010)	M/M	US	1	Set by user
Text String	(2030,0020)	U/M	LO	1	Set by user

### 3.3.3 Association Acceptance Policy

The application entity never accepts associations.

## **4 COMMUNICATION PROFILES**

### **4.1 Supported Communication Stacks**

DICOM Upper Layer over TCP/IP is supported.

### **4.2 OSI Stack**

Not supported.

### **4.3 TCP/IP Stack**

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

#### **4.3.1 API**

The application makes use of the Berkeley Sockets interface on Unix and of the WinSock interface on Win32 platforms.

#### **4.3.2 Physical Media Support**

DICOM is indifferent to the physical medium over which TCP/IP executes.

### **4.4 Point-to-Point Stack**

Not supported.

## 5 CONFIGURATION

### 5.1 AE Title / Presentation Address Mapping

The mapping of application entity titles to presentation addresses is configurable during runtime in the DICOM Config Editor, see details below.

### 5.2 Configurable Parameters

#### 5.2.1 Store SCP

For the Store SCP component, the following parameters are configurable:

- Listening IP port numbers
- Application entity title
- Support for explicit VR transfer syntaxes (default: on)

The number of listening application entities is not restricted.

#### 5.2.2 Store SCU

For the Store SCU component, the following parameters are configurable for each send target:

- Presentation address (DNS hostname or IP address)
- IP port number
- Called application entity title
- Calling application entity title

The number of send targets is not restricted.

### 5.3 Print SCU

For the Print SCU the following parameters are configurable

- in the DICOM Config Editor:
  - Presentation address (DNS hostname or IP address)
  - IP port number
  - Called application entity title
  - Calling application entity title
- either in the configuration associated to a printer or in the DICOM print dialogue:
  - number of copies (default: 1)
  - orientation (default: PORTRAIT)
  - priority (default: MED)
  - destination (default: MAGAZINE)
  - optional trim element in Basic Film Box SOP Class (default: OFF)

- Border Density identifiers (default: 20)
- Empty Image Density identifiers (default: WHITE)
- Frame Number (default: 0)
- optional display of patient data (default: 1)
- usage of the Basic Annotation Box SOP class (default: - => no annotation box is to be used)
- Annotation text (default: "")
- in the configuration associated to the printer, only:
  - supported Image Display Formats (STANDARD\c,r, ROW\c1,c2,....,cn, ...)
  - supported Film Size IDs (A4, 8INX10IN, ...)
  - supported Medium Types (BLUEFILEM, PAPER)
  - supported Magnification (default: BILINEAR)
  - supported Max Density (default: 300)
  - supported Min Density (default: 0)
  - supported Overlay Mode (default: THRESHOLDREPLACE)
  - supported Foreground Density (default: 300)
  - supported Threshold Density (default: 200)
  - supported VOI (default: 0)

## **6 SUPPORT OF EXTENDED CHARACTER SETS**

This application supports only ISO\_IR 100 (ISO 8859-1 Latin 1) as extended character set.

## 7 INFORMATION OBJECT IMPLEMENTATION

This section specifies the subsets of DICOM Information Object Definitions (IOD) used to represent the information objects produced by this implementation.

### 7.1 Secondary Capture Module Table

Entity Name	Module	Reference
Patient	Patient	7.2.1.1
Study	General Study	7.2.1.2
	Patient Study	7.2.1.3
	Study Identification Module	7.2.1.4
	Study Classification Module	7.2.1.5
	General Series	7.2.1.6
Series	General Series	7.2.1.6
	General Equipment	7.2.1.7
Equipment	General Equipment	7.2.1.7
	SC Equipment	7.2.1.14
Image	General Image	7.2.1.7.1
	Image Pixel	7.2.1.9
	SC Image	7.2.1.15
	Overlay Plane	7.2.1.10
	Modality LUT	7.2.1.11
	VOI LUT	7.2.1.12
	SOP Common	7.2.1.13

### 7.2 Secondary Capture Module Descriptions

#### 7.2.1.1 Patient Module

Attribute Name	Tag	Type	VR	VM	Comment
Patient's Name	(0010,0010)	2	PN	1	Copied from Original
Patient ID	(0010,0020)	2	LO	1	Copied from Original
Patient's Birth Date	(0010,0030)	2	DA	1	Copied from Original
Patient's Sex	(0010,0040)	2	CS	1	Copied from Original

#### 7.2.1.2 General Study Module

Attribute Name	Tag	Type	VR	VM	Comment
Study Instance UID	(0020,000D)	1	UI	1	Copied from Original
Study Date	(0008,0020)	2	DA	1	Copied from Original
Study Time	(0008,0030)	2	TM	1	Copied from Original
Referring Physician's Name	(0008,0090)	2	PN	1	Copied from Original
Study ID	(0020,0010)	2	SH	1	Copied from Original
Accession Number	(0008,0050)	2	SH	1	Copied from Original
Study Description	(0008,1030)	3	LO	1	Copied from Original

### 7.2.1.3 Patient Study Module

Attribute Name	Tag	Type	VR	VM	Comment
Patient's Age	(0010,1010)	3	AS	1	Copied from Original
Patient's Size	(0010,1020)	3	DS	1	Copied from Original
Patient's Weight	(0010,1030)	3	DS	1	Copied from Original

### 7.2.1.4 Study Identification Module

Attribute Name	Tag	Type	VR	VM	Comment
Study ID Issuer	(0032,0012)		LO	1	Copied from Original
Other Study Numbers	(0020,1070)		IS	1-n	Copied from Original

### 7.2.1.5 Study Classification Module

Attribute Name	Tag	Type	VR	VM	Comment
Study Comments	(0032,4000)		LT	1	Copied from Original

### 7.2.1.6 General Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Copied from Original
Series Instance UID	(0020,000E)	1	UI	1	Generated
Series Number	(0020,0011)	2	IS	1	???
Laterality	(0020,0060)	2c	CS	1	Copied from Original
Series Description	(0008,103E)	3	LO	1	'DynaCAD Capture'
Operator's Name	(0008,1070)	3	PN	1-n	<DynaCAD user>
Body Part Examined	(0018,0015)	3	CS	1	Copied from Original
Patient Position	(0018,5100)	2c	CS	1	Copied from Original

### 7.2.1.7 General Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Manufacturer	(0008,0070)	2	CS	1	Copied from Original / 'MRI Devices' (see 7.2.1.7.1)
Institution Name	(0008,0080)	3	LO	1	Copied from Original
Institution Address	(0008,0081)	3	ST	1	Copied from Original
Station Name	(0008,1010)	3	SH	1	Copied from Original / 'DynaCAD' (see 7.2.1.7.1)
Institutional Department Name	(0008,1040)	3	LO	1	Copied from Original
Manufacturer's Model Name	(0008,1090)	3	LO	1	Copied from Original / 'DynaCAD' (see 7.2.1.7.1)
Device Serial Number	(0018,1000)	3	LO	1	Copied from Original
Software Versions	(0018,1020)	3	LO	1-n	Copied from Original / <DynaCAD version number> (see 7.2.1.7.1)

#### 7.2.1.7.1

The values of these attribute depend on the value of the configuration flag "Results\_OverwriteManufacturer". For a value of '0', the original values are copied, for '1', the values mentioned above are used.

### 7.2.1.8 General Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	2	IS	1	???
Patient Orientation	(0020,0020)	2c	CS	2	Copied from Original
Content Date	(0008,0023)	2c	DA	1	Copied from Original
Content Time	(0008,0033)	2c	TM	1	Copied from Original
Image Type	(0008,0008)	3	CS	1-n	'DERIVED\SECONDARY\OTHER\DYNACAD'

### 7.2.1.9 Image Pixel Module

Attribute Name	Tag	Type	VR	VM	Comment
Samples per Pixel	(0028,0002)	1	US	1	'1' – for graylevel images '3' – for color images
Photometric Interpretation	(0028,0004)	1	CS	1	'MONOCHROME2' – for graylevel images 'RGB' – for color images
Rows	(0028,0010)	1	US	1	Depending on the size of the image on screen, but at least 512
Columns	(0028,0011)	1	US	1	Depending on the size of the image on screen, but at least 512
Bits Allocated	(0028,0100)	1	US	1	'8'
Bits Stored	(0028,0101)	1	US	1	'8'
High Bit	(0028,0102)	1	US	1	'7'
Pixel Representation	(0028,0103)	1	US	1	'0'
Pixel Data	(7FE0,0010)	1	OW/ OB	1	Always sent as OW
Planar Configuration	(0028,0006)	1c	US	1	'0' – for color images not present otherwise

### 7.2.1.10 Overlay Plane Module

This module is not implemented for this IOD.

### 7.2.1.11 Modality LUT Module

This module is not implemented for this IOD.

### 7.2.1.12 VOI LUT Module

This module is not implemented for this IOD.

### 7.2.1.13 SOP Common Module

Attribute Name	Tag	Type	VR	VM	Comment
SOP Class UID	(0008,0016)	1	UI	1	Secondary Capture Image Storage: '1.2.840.10008.5.1.4.1.1.7'
SOP Instance UID	(0008,0018)	1	UI	1	Generated
Specific Character Set	(0008,0005)	1c	CS	1-n	Never sent

**7.2.1.14 SC Equipment Module**

Attribute Name	Tag	Type	VR	VM	Comment
Conversion Type	(0008,0064)	1	CS	1	'WSD'
Secondary Capture Device Manufacturer	(0018,1016)	3	LO	1	'MRI Devices'
Secondary Capture Device Manufacturers Model Name	(0018,1018)	3	LO	1	'DynaCAD'
Secondary Capture Device Software Versions	(0018,1019)	3	LO	1	<DynaCAD version number>

**7.2.1.15 SC Image Module**

Attribute Name	Tag	Type	VR	VM	Comment
Date of Secondary Capture	(0008,1012)	3	DA	1	Creation date of Secondary Capture object
Time of Secondary Capture	(0018,1014)	3	TM	1	Creation time of Secondary Capture object