DICOM Conformance Statement

DICOMscope 3.6.0

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1 INTRODUCTION

This DICOM conformance statement specifies the behavior and functionality of the DICOMscope application, release 3.6.0. This software provides the following capabilities:

- Reads and displays uncompressed monochrome DICOM images of all modalities and image SOP classes.
- Supports calibration of the display device (monitor) according to the DICOM Grayscale Standard Display Function, either in hardware or in software.
- Creates, reads, writes and updates Grayscale Softcopy Presentation State objects.
- Prints on a remote printer (Basic Grayscale Print SCP) and supports the optional Presentation LUT SOP Class that enables hardcopy display consistency. Both conventional DICOM communication and secure network connections conforming to the DICOM Basic TLS Secure Transport Connection Profile are supported.
- Acts as a "virtual printer" (Basic Grayscale Print SCP) and receives print jobs from remote print clients. Print jobs are stored in the local database and can be visualized on-screen. Both conventional DICOM communication and secure network connections conforming to the DICOM Basic TLS Secure Transport Connection Profile are supported.
- Sends and receives DICOM objects via the DICOM Storage Service Class. Both conventional DICOM communication and secure network connections conforming to the DICOM Basic TLS Secure Transport Connection Profile are supported.
- Reads, writes and updates Structured Reports (SR) of all three SR SOP Classes defined in NEMA PS.3-2003. Structured Reports can be displayed and edited.
- Verifies Digital Signatures contained in DICOM images, presentation states and structured reports. Allows to create one or more Digital Signatures on Structured Reports.

The first release of this software was demonstrated at the European Congress of Radiology (ECR) in Vienna in 1999 and implemented calibration and presentation states. The second release was demonstrated at the Radiological Society of North America's (RSNA) annual meeting in 1999. It implemented the final text version of the presentation states and added the Print SCU. The third release was developed on behalf of the "Integrating the Healthcare Enterprise" (IHE) initiative in preparation for IHE at RSNA 2000 and HIMSS 2001. This release added among other things the Print SCP. Release 3.5 was developed as a demonstrator for DICOM Structured Reporting and two of the DICOM Security Enhancements (Supplements 31 and 41) on behalf of DICOM Working Group 14 (Security) and the NEMA Committee for the Advancement of DICOM. It was demonstrated at RSNA 2000 and ECR 2001. It adds the Structured Reporting viewer and editor, secure network communication, and support for Digital Signatures in DICOM. This release fixes a number of know bugs, adds support for Java 1.4 and supports decoding of compressed images.

The Project team for the implementation consists of:

OTech Inc.: Main contractor and project management
OFFIS e.V.: Implementation of the DICOM toolkit software
Institute for Microtherapy; University of Witten/Herdecke: Graphical user interface

This software is available in the public domain at:

http://dicom.offis.de/dscope

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1.1 Revision History

Version 1.0	HJO/ME	1999-05-17
Version 2.0	ME/JR	2000-03-20
Version 3.5	ME/JR	2001-05-28
Version 3.6.0	ME/JR	2004-01-12

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 DICOMscope 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].

1.4 How to use this document

This Conformance Statement consists of the following sections:

2 Implementation model: The first section describes the Implementation Model. It explains the functional relation between the device and the DICOM services. A DICOM service is implemented on a device by a software process, which is called an “Application Entity” (AE). Each AE has a unique name called the “AE Title” which is used to identify it to other AEs. The

[1] Digital Imaging and Communications in Medicine (DICOM), NEMA PS 3.1-16, 2003.

AE Title is configurable to avoid two devices with the same name on a network. The "bubble diagram" (Application Data Flow Diagram) shows the interaction of the AE with the outside world across the dashed line, i. e. the DICOM interface. This Application Data Flow Diagram depicts graphically the relationship of the DICOM AE with local functions at the workstation as well as the relationship with external activities.
One should compare this implementation model and its description with the model of the other devices that the DICOMscope software will connect to in order to determine connectivity.

3 **AE Specifications:** Each AE supports one or more Service Object Pair (SOP) classes. A SOP class consists of a combination of an object or information model with specific DICOM services. An example of such a SOP class is the CT Image Storage Class, which consists of the combination of the DICOM C_STORE command with the CT image object. Each of these classes is uniquely identified by an Identification number (UID), which is issued by the NEMA. The role of the AE is specified, which can be a client or server (compare with a speaker or listener). In DICOM terms, this is called a Service Class User or Service Class Provider (SCU or SCP).
In order to interconnect with another device, the SOP classes as well as their role (SCU or SCP) have to be matched, i. e. a SCU has to match a SCP at another device with an identical SOP class. Make sure to compare the UID itself, not the description because there are SOP classes which have the same name, but support a different (newer) object.
Each SOP class supports a particular presentation context which is the combination of the SOP Class and the transfer syntax. The transfer syntax defines the encoding of the DICOM basic elements, i. e. its attributes and how the data is represented. The encoding of the data type, or Value Representation (VR), can be done in two ways – implicitly or explicitly. Explicit VR means that the transmitted data will include the VR information along with data and attribute tags. Implicit VR means the VR information will not be included, and the receiving application must determine the VR type from the Attribute Tag.
In addition, the data can be communicated in the Little Endian (Intel) or Big Endian (Motorola, Sparc, MIPS) byte ordering. This means that for certain 16 bit words, the two 8 bit bytes might have to be swapped to be able to interpret the information by a different device. The transfer syntax of two devices have to match in order to communicate.

4 **Communication Profiles:** This section specifies the communication options. There are two levels that have to be compared. The first one is the supported communication stack that the device supports, which usually is the OSI or TCP/IP stack. In addition, the physical media has to match. Note that in general, matching physical media can be achieved by standard off-the-shelf devices. For example, if one device supports standard Ethernet 10BaseT, it can be bridged to a Fast Ethernet, ATM, or whatever is supported.

5 **Extensions/Specializations/Privatizations:** This section specifies implementation specific extensions to the Standard SOP classes as well as so-called specialized and private SOP classes, which are essentially proprietary services that make use of the underlying DICOM infrastructure such as DICOM network communication and association negotiation.

6 **Configuration:** This section specifies how the system configuration of an implementation affects its behavior at the DICOM network interface. DICOM implementations often support a multitude of configuration options which might be helpful in solving communication or interoperability problems.

7 **Support of Extended Character Sets:** DICOM supports a large number of character sets, including ASCII (the default), some of the ISO 8859 character sets for use with most European languages and a number of character sets for use in the Far East. This section of the conformance statement specifies the character sets that an implementation actually supports. The supported character sets should be compared carefully if extended character sets are to be used, since the inability of a system to handle extended characters might affect the way names and identifiers can be entered, displayed, queried etc.

8 **Codes and Controlled Terminology:** Some DICOM information objects and services (notably Structured Reporting) make use of coding schemes and controlled terminology such as

SNOMED or ICD. This section describe the context groups and coding schemes supported by an implementation.

9 **Security Profiles:** For any implementation supporting one of the DICOM security extensions, this section describes the supported security profiles as well as other parameters with relevance to security, such as key management policies, supported key sizes and key types, etc.

10 **Information Object Implementation:** Although not required, many devices specify which DICOM attributes they require and/or store in their internal database. It is important to compare these because a mismatch could have the effect that certain functionality or applications might fail.

1.5 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

DICOMscope 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 and storing them in the database, one that sends images out on request, and one that is responsible for the User interface. There is one spooler process for each printer known to DICOMscope which handles communication with the printer and there can be a number of processes implementing the "virtual printers" that DICOMscope allows to emulate. From a functional perspective, the processes that implement DICOMscope's DICOM network interface can be separated into five application entities: Print SCU, Print SCP, Store SCP and Store SCU. The application entity titles attached to the different application entities are freely configurable.

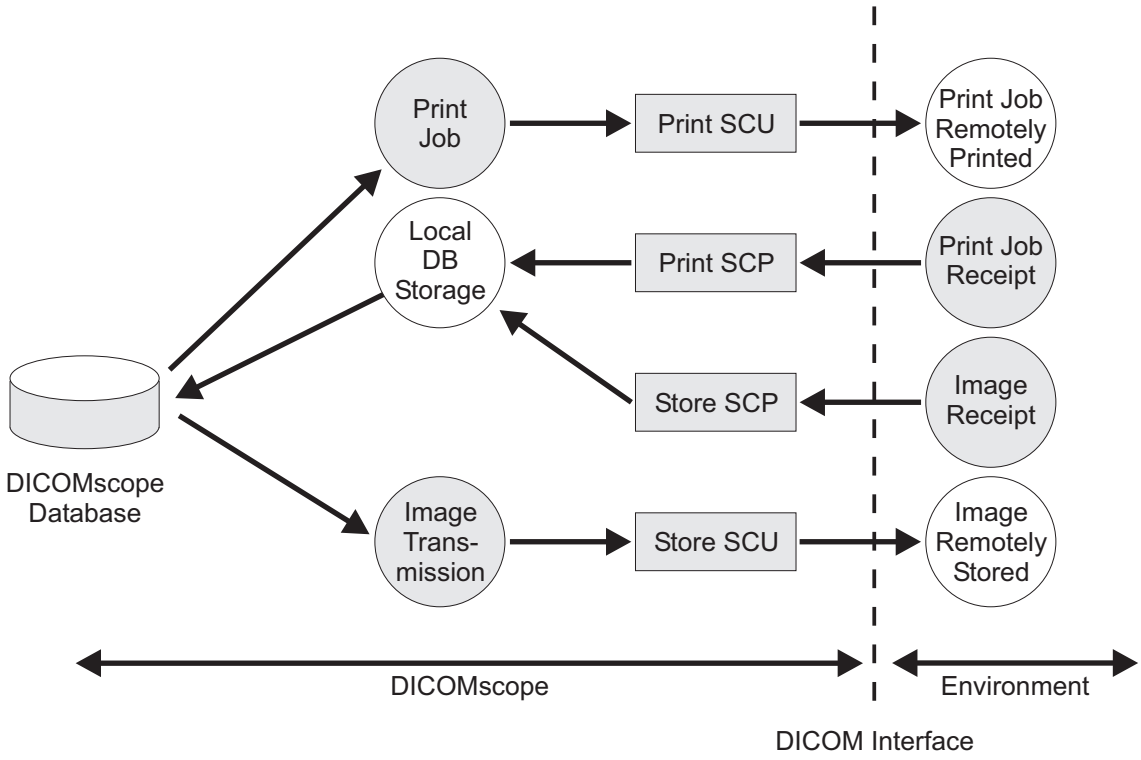

Figure 1. Implementation Model

2.2 Functional Definitions of AEs

2.2.1 Store SCP

Store SCP is an application entity that implements the DICOM Storage Service Class and the Verification Service Class as SCP. Store SCP is automatically started together with the main DICOMscope application. When DICOMscope is terminated, Store SCP stops to accept any further associations and terminates as soon as all currently active associations are closed. 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 entity that implements the DICOM Storage Service Class as SCU. Store SCU is activated by DICOMscope whenever the user requests transmission of one or more objects from the local database to a remote node. When DICOMscope 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 sparked. A transmission request may consist of the transmission of a single image, a complete series or study. 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 SCP

Print SCP is an application entity that implements the DICOM Print Management Service Class as SCP. When the main DICOMscope application is started, one separate Print SCP instance is started for each virtual printer that is configured in the DICOMscope configuration file. When DICOMscope is terminated, Print SCP terminates as soon as the active association (if any) is closed. Each Print SCP instance (virtual printer) only handles a single association at a time. The association remains open until the remote application entity closes the association or until an error condition occurs that leads to an association abort.

2.2.4 Print SCU

Print SCU is an application entity that implements the DICOM Print Management Service Class as SCU. For each printer (remote Print Management Service Class Provider) known to DICOMscope (i. e. configured in the DICOMscope configuration file), one Print SCU instance is started together with the viewer. Whenever the user requests a print on a particular printer, the corresponding Print SCU “spools” the print job to this printer. When DICOMscope is terminated, the Print SCUs continue to transmit until the print job is completed or aborted because of a fatal error. Print SCU only handles print jobs consisting of a single Film Box (page or sheet of film) which may, however, be printed in multiple copies.

2.3 Sequencing of Real-World Activities

Not applicable.

3 AE 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
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65
Comprehensive SR Storage	1.2.840.10008.5.1.4.1.1.88.33
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
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
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 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
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
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 Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multiframe True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40
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
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66
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
Twelve Lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
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
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
OFFIS Private Presentation State IPC	1.2.276.0.7230010.3.4.1915765545.18030.917282194.0

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

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.

Store SCP can be configured to use secure DICOM communication conforming to the Basic TLS Secure Transport Connection Profile. See configuration options in section 6.2.1 and security profiles in section 9.

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

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 or Verification SCU. The application entity accepts incoming association requests on a single port number defined in the configuration file. It accepts any association for which at least one presentation context is accepted. The calling and called

application entity titles are ignored. The responding application entity name can be configured in the configuration file, the default is DCMPSTAT. Association requests can be rejected with the following status codes and reasons:

Result	Source	Reason	Description
rejected permanent	provider, present. related	temporary congestion	Resource limitation: process creation Failed
rejected transient	user	app. context name not supported	Incorrect application context name
rejected permanent	user	no reason	Private shutdown mechanism initiated, see section 5.1.1

3.1.3.1.1 Associated Real-World Activity

The application entity waits for incoming associations. No operator action is required to receive DICOM data.

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 on 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 the DICOMscope viewer. For all storage SOP classes except Grayscale Softcopy Presentation State Storage, 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 in the viewer (i. e. color images, unsupported non-image objects). Such objects will be visible in the database browser, and can be further transmitted with the Store SCU component, 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.

For Grayscale Softcopy Presentation State Storage, transmitted objects are checked thoroughly. If a required element is absent or has an incorrect value, or if a feature of the Grayscale Softcopy Presentation State that is not supported by this implementation is used, the storage is rejected with the error code 0xC000: “Error, cannot understand”. Presentation State features not supported by this application are: Mask module.

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

Code	Name	Severity	Description
a700	refused: out of resources	failure	Application out of memory, file system or database write error (e. g. 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 Lossy Image Compression (0028,2110) attribute is ignored both during reception of an object and in the DICOMscope viewer. The DICOMscope application is not intended for clinical application. The duration of storage depends on the user, who can delete objects from the local database at any 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.

3.1.3.1.2.2 SOP Specific Conformance for SR SOP Classes

In the DICOMscope viewer an SR document is rendered in HTML format with captions, paragraphs and emphasized text blocks. All SR content items specified in PS.3-2003 are supported and their full content is displayed in the rendered view. By default the codes for concept names and numeric measurement units are represented by their code meaning only. For a clear representation of the hierarchical structure of an SR document, internal hyperlinks are created automatically, referring to footnotes and annexes (and back to the reference source) when appropriate.

References to external objects (COMPOSITE, IMAGE, WAVEFORM) are translated into HTML hyperlinks, but only references to uncompressed monochrome images, grayscale softcopy presentation states and structured reports can be resolved and visualized in the viewer.
Any Storage SOP class may be referenced by an SR document but only the above mentioned are displayed in the viewer.

The only structured report related attribute which is used to influence the display of an image is the optional reference to a presentation state (which may be contained in an IMAGE content item).

3.1.3.1.3 Presentation Context Acceptance Criterion

The application entity will accept all presentation contexts which contain one of the supported SOP classes and one of the supported transfer syntaxes.

3.1.3.1.4 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 SPARC). 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.

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

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**
Ambulatory ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.3
Basic Text SR Storage	1.2.840.10008.5.1.4.1.1.88.11
Basic Voice Audio Waveform Storage	1.2.840.10008.5.1.4.1.1.9.4.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Cardiac Electrophysiology Waveform Storage	1.2.840.10008.5.1.4.1.1.9.3.1
Chest CAD SR	1.2.840.10008.5.1.4.1.1.88.65
Comprehensive SR Storage	1.2.840.10008.5.1.4.1.1.88.33
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
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
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 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
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1
Enhanced SR Storage	1.2.840.10008.5.1.4.1.1.88.22
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
Hemodynamic Waveform Storage	1.2.840.10008.5.1.4.1.1.9.2.1
Key Object Selection Document	1.2.840.10008.5.1.4.1.1.88.59
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
MR Spectroscopy Storage	1.2.840.10008.5.1.4.1.1.4.2
Mammography CAD SR	1.2.840.10008.5.1.4.1.1.88.50
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 Single Bit Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.1
Multiframe True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
Standalone PET Curve Storage	1.2.840.10008.5.1.4.1.1.129
Procedure Log	1.2.840.10008.5.1.4.1.1.88.40
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
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66
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
Twelve Lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1
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
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

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

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.

Store SCU an be configured to use secure DICOM communication conforming to the Basic TLS Secure Transport Connection Profile. See configuration options in section 6.2.2 and security profiles in section 9.

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 sparked in order to execute a transmission request. The application entity initiates an association with the selected remote Storage SCP. The calling application entity name can be configured, the default is DCMPSTATE. The called application entity name must be configured together with the presentation address to be used in the configuration file.

3.2.2.1.1 Associated Real-World Activity

The user selects an object, series or study in the database browser. He selects the "send" function, chooses a send target and selects "OK".

3.2.2.1.2 Proposed Presentation Contexts

The default behavior of the Store SCP is to propose as 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 explicit VR transfer syntax with local byte order (i. e. little endian on PC, big endian on SPARC) 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.
The default behavior can be changed for each send target in the configuration file such that only the Implicit VR Little Endian transfer syntax is proposed instead.

3.2.2.1.2.1 SOP Specific Conformance for all Storage SOP Classes

Store SCU transmits the selected objects from the local DICOMscope database 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.

3.2.2.1.2.2 SOP Specific Conformance for SR SOP Classes

The SR editor in DICOMscope allows to create references to all types of images which can be loaded and displayed in the viewer, i. e. uncompressed monochrome images of all Image SOP Classes defined in the table in section 3.2. References to grayscale softcopy presentation states associated with such images are also supported.

All SR Value Types and Relationship Types defined in PS3.3-2003 are supported (i. e. can be created, apart from by-reference relationships which are only read and displayed). However, the value of COMPOSITE, SCOORD, TCOORD and WAVEFORM content items cannot be modified/set in the SR editor.

A new SOP Instance UID is generated each time a modified SR document is stored in the local database.

3.2.3 Association Acceptance Policy

This application entity never accepts associations.

3.3 Print SCP

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

SOP Class Name	SOP Class UID
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9
Presentation LUT SOP Class	1.2.840.10008.5.1.1.23
OFFIS Private Presentation State IPC	1.2.276.0.7230010.3.4.1915765545. 18030.917282194.0

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

3.3.1 Association Establishment Policies

3.3.1.1 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.

Print SCP can be configured to use secure DICOM communication conforming to the Basic TLS Secure Transport Connection Profile. See configuration options in section 6.2.3 and security profiles in section 9.

SOP Class extended negotiation is not supported.

3.3.1.2 Number of Associations

Each instance of this application entity only accepts a single association at a time. Multiple instances of Print SCP may be running in parallel, accepting associations on different TCP/IP port numbers.

3.3.1.3 Asynchronous Nature

Asynchronous mode of operation is not supported.

3.3.1.4 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

3.3.2 Association Initiation by Real-World Activity

This application entity never initiates associations.

3.3.3 Association Acceptance Policy

3.3.3.1 Real-World Activity "Print Job Receipt"

Print SCP application entity accepts an association when it receives an association request from a remote DICOM Print SCU. The application entity accepts incoming association requests on a single port number defined in the configuration file. It accepts any association for which at least one presentation context for the Basic Grayscale Print Management Meta SOP Class is accepted. The calling and called application entity titles are ignored. The responding application entity name can be configured in the configuration file, the default is DCMPSTAT. Association requests can be rejected with the following status codes and reasons:

Result	Source	Reason	Description
rejected transient	user	app. context name not supported	Incorrect application context name
rejected permanent	user	no reason	Private shutdown mechanism initiated, see section 5.1.1

3.3.3.1.1 Associated Real-World Activity

The application entity waits for incoming associations. No operator action is required to receive DICOM print jobs.

3.3.3.1.2 Presentation Context Table

The default behavior of Print SCP is to accept as SCP for each of the supported SOP classes all presentation contexts containing on 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.

3.3.3.1.2.1 SOP Specific Conformance for Printer SOP Class

Print SCP supports the following attributes in the Attribute Identifier List of an N-GET-RQ message:

Attribute Name	Tag	Type	VR	VM	Comment
Printer Status	(2110,0010)	U/M	CS	1	always returns 'NORMAL'
Printer Status Info	(2110,0020)	U/M	CS	1	always returns 'NORMAL'

If any other attribute is requested in an N-GET-RQ, an N-GET-RSP with status code 0105H (No Such Attribute) is returned. If the Attribute Identifier List of an N-GET-RQ message is empty, an N-GET-RSP containing the two attributes shown above is returned.

Print SCP never sends N-EVENT-REPORT-RSP messages.

3.3.3.1.2.2 SOP Specific Conformance for Basic Film Session SOP Class

The following attributes are supported for an N-CREATE-RQ or an N-SET-RQ message in the context of the Basic Film Session SOP Class:

Attribute Name	Tag	Type	VR	VM	Comment
Number of Copies	(2000,0010)	U/M	IS	1	Default: 1. Value must be > 0
Print Priority	(2000,0020)	U/M	CS	1	Default: 'MED'. Enumerated values: LOW, MED, HIGH.
Medium Type	(2000,0030)	U/M	CS	1	Enumerated values and default defined in configuration file.
Film Destination	(2000,0040)	U/M	CS	1	Enumerated values and default defined in configuration file.
Film Session Label	(2000,0050)	U/U	LO	1	Default: 'print job for "*AETITLE*" created *DATE TIME*'
Memory Allocation	(2000,0060)	U/U	IS	1	Not supported; results in warning
Owner ID	(2100,0160)	U/U	SH	1	Default: 'DEFAULT'
Referenced Presentation LUT Sequence	(2050,0500)	U/MC	SQ	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Session level instead of Film Box.
>Referenced SOP Class UID	(0008,1150)	U/MC	UI	1	Required if sequence is present
>Referenced SOP Instance UID	(0008,1155)	U/MC	UI	1	Required if sequence is present
Illumination	(2010,015E)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Session level instead of Film Box. Default: 2000
Reflected Ambient Light	(2010,0160)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Session level instead of Film Box. Default: 10

The default values specified in the Comment field above only apply to the N-CREATE protocol. The following error/warning status codes can be sent by Print SCP in the context of a N-CREATE-RSP or N-SET-RSP message for the Basic Film Session SOP Class:

Code	Name	Severity	Description
0105H	No Such Attribute	Failure	An unknown or unsupported attribute was submitted.
0106H	Invalid Attribute Value	Failure	An invalid attribute value was submitted.

0110H	Processing Failure	Failure	Unspecified application failure
0111H	Duplicate SOP Instance	Failure	An instance of the Basic Film Session SOP Class already exists (N-CREATE only).
0112H	No Such Object Instance	Failure	Attempt to address an unknown object (N-SET only)
B600H	Memory allocation not supported	Warning	Memory allocation is not supported by StoreSCP, the attribute will be ignored.

The following error/warning status codes can be sent by Print SCP in the context of a N-DELETE-RSP message for the Basic Film Session SOP Class:

Code	Name	Severity	Description
0112H	No Such Object Instance	Failure	Attempt to address an unknown object

The optional N-ACTION service is supported by Print SCP for the Basic Film Session SOP Class. Since Store SCP is only a printer emulation, the N-ACTION service does not lead to the creation of a physical hardcopy. Instead the current print job is stored in the local database as a set of Stored Print and Hardcopy Grayscale SOP Instances. The maximum number of collated films is only limited by the underlying system resources (i. e. system memory). The following error/warning status codes can be sent by Print SCP in the context of a N-ACTION-RSP message for the Basic Film Session SOP Class:

Code	Name	Severity	Description
0110H	Processing Failure	Failure	Unspecified application failure
0112H	No Such Object Instance	Failure	Attempt to address an unknown object
C600H	No Film Box	Failure	Film Session SOP Instance hierarchy does not contain any Film Box SOP Instance.
B602H	Empty Page	Warning	One or more of the Basic Film Boxes do not contain any images and will not be stored.

3.3.3.1.2.3 SOP Specific Conformance for Basic Film Box SOP Class

The following attributes are supported for an N-CREATE-RQ message in the context of the Basic Film Box SOP Class:

Attribute Name	Tag	Type	VR	VM	Comment
Image Display Format	(2010,0010)	M/M	ST	1	Supports STANDARD\c,r layouts. Possible (c,r) combinations are defined in the configuration file.
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	
Film Orientation	(2010,0040)	U/M	CS	1	Default: PORTRAIT. Enumerated values: PORTRAIT, LANDSCAPE
Film Size ID	(2010,0050)	U/M	CS	1	Enumerated values and default defined in configuration file.
Magnification Type	(2010,0060)	U/M	CS	1	Enumerated values and default defined in configuration file.
Max Density	(2010,0130)	U/M	US	1	Enumerated values and default defined in configuration file.
Configuration Information	(2010,0150)	U/M	ST	1	Enumerated values defined in configuration file. Default is empty.

Smoothing Type	(2010,0080)	U/U	CS	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Border Density	(2010,0100)	U/U	CS	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Empty Image Density	(2010,0110)	U/U	CS	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Min Density	(2010,0120)	U/U	US	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Trim	(2010,0140)	U/U	CS	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Requested Resolution ID	(2020,0050)	U/U	CS	1	Enumerated values and default defined in configuration file. Support for this attribute can be disabled in the configuration file.
Referenced Presentation LUT Sequence	(2050,0500)	U/MC	SQ	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level.
>Referenced SOP Class UID	(0008,1150)	U/MC	UI	1	Required if sequence is present
>Referenced SOP Instance UID	(0008,1155)	U/MC	UI	1	Required if sequence is present
Illumination	(2010,015E)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level. Default: 2000
Reflected Ambient Light	(2010,0160)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level. Default: 10

The following error/warning status codes can be sent by Print SCP in the context of a N-CREATE-RSP message for the Basic Film Box SOP Class:

Code	**Name**	**Severity**	**Description**
0105H	No Such Attribute	Failure	An unknown or unsupported attribute was submitted
0106H	Invalid Attribute Value	Failure	An invalid attribute value was submitted
0110H	Processing Failure	Failure	Unspecified application failure
0111H	Duplicate SOP Instance	Failure	Requested SOP Instance already exists
0117H	Invalid Object Instance	Failure	Cannot create Film Box without Film Session
0120H	Missing Attribute	Failure	Mandatory attribute missing

The following attributes are supported for an N-SET-RQ message in the context of the Basic Film Box SOP Class:

Attribute Name	Tag	Type	VR	VM	Comment
Magnification Type	(2010,0060)	U/M	CS	1	Enumerated values defined in configuration file.
Max Density	(2010,0130)	U/M	US	1	Enumerated values defined in configuration file.
Configuration Information	(2010,0150)	U/M	ST	1	Enumerated values defined in configuration file.
Smoothing Type	(2010,0080)	U/U	CS	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Border Density	(2010,0100)	U/U	CS	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Empty Image Density	(2010,0110)	U/U	CS	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Min Density	(2010,0120)	U/U	US	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Trim	(2010,0140)	U/U	CS	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Referenced Presentation LUT Sequence	(2050,0500)	U/MC	SQ	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level. Depending on the configuration Print SCP will refuse the operation if the number of entries in the referenced presentation LUT does not match the bit depth of one or more images in the image boxes of this film box.
>Referenced SOP Class UID	(0008,1150)	U/MC	UI	1	Required if sequence is present
>Referenced SOP Instance UID	(0008,1155)	U/MC	UI	1	Required if sequence is present
Illumination	(2010,015E)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level.
Reflected Ambient Light	(2010,0160)	U/MC	US	1	Accepted if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCP is configured to use the Referenced Presentation LUT SQ on Film Box level.

The following error/warning status codes can be sent by Print SCP in the context of a N-SET-RSP message for the Basic Film Box SOP Class:

Code	Name	Severity	Description
0105H	No Such Attribute	Failure	An unknown or unsupported attribute was submitted.
0106H	Invalid Attribute Value	Failure	An invalid attribute value was submitted.
0110H	Processing Failure	Failure	Unspecified application failure
0112H	No Such Object Instance	Failure	Attempt to address an unknown object

The following error/warning status codes can be sent by Print SCP in the context of a N-DELETE-RSP message for the Basic Film Box SOP Class:

Code	Name	Severity	Description
0112H	No Such Object Instance	Failure	Attempt to address an unknown object

Since Store SCP is only a printer emulation, the N-ACTION service does not lead to the creation of a physical hardcopy. Instead the current print job is stored in the local database as a set of Stored Print and Hardcopy Grayscale SOP Instances. The following error/warning status codes can be sent by Print SCP in the context of a N-ACTION-RSP message for the Basic Film Box SOP Class:

Code	Name	Severity	Description
0110H	Processing Failure	Failure	Unspecified application failure
0112H	No Such Object Instance	Failure	Attempt to address an unknown object
B603H	Empty Page	Warning	Basic Film Box does not contain any images and will not be stored.

3.3.3.1.2.4 SOP Specific Conformance for Basic Grayscale Image Box SOP Class

The following attributes are supported for an N-SET-RQ message in the context of the Basic Grayscale Image Box SOP Class:

Attribute Name	Tag	Type	VR	VM	Comment
Image Position	(2020,0010)	M/M	US	1	
Basic Grayscale Image Sequence	(2020,0110)	M/M	SQ	1	
>Samples Per Pixel	(0028,0002)	M/M	US	1	Enumerated value: 1
>Photometric Interpretation	(0028,0004)	M/M	CS	1	Enumerated values: MONOCHROME1, MONOCHROME2
>Rows	(0028,0010)	M/M	US	1	
>Columns	(0028,0011)	M/M	US	1	
>Pixel Aspect Ratio	(0028,0034)	MC/M	IS	2	
>Bits Allocated	(0028,0100)	M/M	US	1	Enumerated values: 8, 16. Support for 12 bit image transmission can be disabled in the configuration file, in which case only 8 is accepted.
>Bits Stored	(0028,0101)	M/M	US	1	Enumerated values: 8, 12. Support for 12 bit image transmission can be disabled in the configuration file, in which case only 8 is accepted. Depending on the configuration Print SCP will refuse the operation if the number of bits does not match the number of entries of the referenced presentation LUT.

>High Bit	(0028,0102)	M/M	US	1	Enumerated values: 7, 11. Support for 12 bit image transmission can be disabled in the configuration file, in which case only 7 is accepted.
>Pixel Representation	(0028,0103)	M/M	US	1	Enumerated value: 0
>Pixel Data	(7FE0,0010)	M/M	OW	1	
Polarity	(2020,0020)	U/M	CS	1	Enumerated values: NORMAL, REVERSE. Default: NORMAL.
Magnification Type	(2010,0060)	U/U	CS	1	Enumerated values defined in configuration file.
Smoothing Type	(2010,0080)	U/U	CS	1	Enumerated values defined in configuration file. Support for this attribute can be disabled in the configuration file.
Configuration Information	(2010,0150)	U/U	ST	1	Enumerated values defined in configuration file.
Requested Image Size	(2020,0030)	U/U	DS	1	Support for this attribute can be disabled in the configuration file.
Requested Decimate/Crop Behavior	(2020,0040)	U/U	CS	1	Enumerated Values: DECIMATE, CROP, FAIL. Support for this attribute can be disabled in the configuration file.

The following error/warning status codes can be sent by Print SCP in the context of a N-SET-RSP message for the Basic Grayscale Image Box SOP Class:

Code	Name	Severity	Description
0105H	No Such Attribute	Failure	An unknown or unsupported attribute was submitted.
0106H	Invalid Attribute Value	Failure	An invalid attribute value was submitted.
0110H	Processing Failure	Failure	Unspecified application failure
0112H	No Such Object Instance	Failure	Attempt to address an unknown object
0120H	Missing Attribute	Failure	Mandatory attribute missing

3.3.3.1.2.5 SOP Specific Conformance for Presentation LUT SOP Class

The following attributes are supported for an N-CREATE-RQ message in the context of the Presentation LUT SOP Class:

Attribute Name	Tag	Type	VR	VM	Comment
Presentation LUT Sequence	(2050,0010)	MC/M	SQ	1	
>LUT Descriptor	(0028,3002)	MC/M	US/ SS	3	
>LUT Explanation	(0028,3003)	U/U	LO	1	
>LUT Data	(0028,3006)	MC/M	OW/ US/ SS	1/ 1-n/ 1-n	
Presentation LUT Shape	(2050,0020)	MC/M	CS	1	Enumerated values: IDENTITY, INVERSE, LIN OD.

The following error/warning status codes can be sent by Print SCP in the context of a N-CREATE-RSP message for the Presentation LUT SOP Class:

Code	Name	Severity	Description
0105H	No Such Attribute	Failure	An unknown or unsupported attribute was submitted.
0110H	Processing Failure	Failure	Unspecified application failure
0111H	Duplicate SOP Instance	Failure	Requested SOP Instance already exists.

The following error/warning status codes can be sent by Print SCP in the context of a N-DELETE-RSP message for the Presentation LUT SOP Class:

Code	Name	Severity	Description
0110H	Processing Failure	Failure	Presentation LUT in use, cannot be deleted
0112H	No Such Object Instance	Failure	Attempt to address an unknown object

3.3.3.1.3 Presentation Context Acceptance Criterion

The default behavior of Print SCP is to accept all presentation contexts which contain one of the supported SOP classes and one of the supported transfer syntaxes. The default behavior can be changed in the configuration file such that presentation contexts for the Presentation LUT SOP Class are never accepted (i. e. support for Presentation LUT can be disabled).

3.3.3.1.4 Transfer Syntax Selection Policies

The default behavior of Print 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 SPARC). 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. The default behavior can be changed in the configuration file such that presentation contexts are only accepted with the default Implicit VR Little Endian transfer syntax.

3.4 Print SCU

This application entity provides 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
Presentation LUT SOP Class	1.2.840.10008.5.1.1.23
Basic Annotation Box SOP Class	1.2.840.10008.5.1.1.15

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

3.4.1 Association Establishment Policies

3.4.1.1 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.

Print SCU can be configured to use secure DICOM communication conforming to the Basic TLS Secure Transport Connection Profile. See configuration options in section 6.2.4 and security profiles in section 9.

SOP Class extended negotiation is not supported.

3.4.1.2 Number of Associations

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

3.4.1.3 Asynchronous Nature

Asynchronous mode of operation is not supported.

3.4.1.4 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

3.4.2 Association Initiation by Real-World Activity

3.4.2.1 Real-World Activity "Print Job"

An instance of the Print SCU application entity is requested to spool a print job assembled by the user on the print preview panel of the DICOMscope viewing software to a particular printer. The application entity initiates an association with the selected remote Print Management Service Class Provider. The calling application entity name can be configured, the default is DCMPSTATE. The called application entity name must be configured together with the presentation address to be used in the configuration file.

3.4.2.1.1 Associated Real-World Activity

The user, after having assembled or loaded a print job, selects the "print" button in the print preview panel of the DICOMscope application.

3.4.2.1.2 Proposed Presentation Contexts

The default behavior of the Print SCU is to propose as 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 explicit VR transfer syntax with local byte order (i. e. little endian on PC, big endian on SPARC) 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.
The default behavior can be changed for each send target in the configuration file such that only the Implicit VR Little Endian transfer syntax is proposed instead.

3.4.2.1.2.1 SOP Specific Conformance for Printer SOP Class

Immediately after successful association negotiation, Print SCU issues an N-GET-RQ message in order to retrieve the contents of the well-known Printer SOP Instance. The attribute identifier list element of the message remains empty which means that the Print SCP is requested to transmit the contents of all attributes of the well-known Printer SOP Instance. If this request fails, the connection with the printer is released.
Print SCU is able to accept N-EVENT-REPORT requests from the well-known Printer SOP instance at any time (e. g. after sending one of its own requests and before receiving a reply to that request) and immediately confirms with a N-EVENT-REPORT response message. Event reports may or may not be used to notify the user of the software of the event.

3.4.2.1.2.2 SOP Specific Conformance for Basic Film Session SOP Class

After retrieval of the well-known Printer SOP instance and (optionally) the creation of a Presentation LUT SOP instance, Print SCU creates a Basic Film Session. The following elements may be sent as part of the N-CREATE request:

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

Film Session Label	(2000,0050)	U/U	LO	1	Sent only if specified by user
Owner ID	(2100,0160)	U/U	SH	1	Sent only if specified by user
Referenced Presentation LUT Sequence	(2050,0500)	U/MC	SQ	1	Sent if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCU is configured to send the Referenced Presentation LUT SQ on Film Session level instead of Film Box.
>Referenced SOP Class UID	(0008,1150)	U/MC	UI	1	Sent if sequence is present
>Referenced SOP Instance UID	(0008,1155)	U/MC	UI	1	Sent if sequence is present
Illumination	(2010,015E)	U/MC	US	1	Sent if Referenced Presentation LUT Sequence is present
Reflected Ambient Light	(2010,0160)	U/MC	US	1	Sent if Referenced Presentation LUT Sequence is present

If creation of the Basic Film Session fails, Print SCU releases the association with the printer. After a successful completion of the print job, Print SCU uses an N-DELETE request to delete the Basic Film Session SOP instance before releasing the association. Other requests are never sent. In particular, Print SCU never sends an N-ACTION request on Basic Film Session level.

3.4.2.1.2.3 SOP Specific Conformance for Basic Film Box SOP Class

After successful creation of the Basic Film Session SOP instance, Print SCU creates a Basic Film Box. The following elements may be sent as part of the N-CREATE request:

Attribute Name	**Tag**	**Type**	**VR**	**VM**	**Comment**
Image Display Format	(2010,0010)	M/M	ST	1	Possible values: “STANDARD\x,y” where x,y combinations can be configured for each target printer.
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	
Film Orientation	(2010,0040)	U/M	CS	1	Sent only if specified by user
Film Size ID	(2010,0050)	U/M	CS	1	Sent only if specified by user
Magnification Type	(2010,0060)	U/M	CS	1	Sent only if specified by user
Max Density	(2010,0130)	U/M	US	1	Sent only if specified by user
Configuration Information	(2010,0150)	U/M	ST	1	Sent only if specified by user
Annotation Display Format ID	(2010,0030)	U/U	CS	1	Sent only if specified by user and support for the Basic Annotation Box SOP Class was successfully negotiated.
Smoothing Type	(2010,0080)	U/U	CS	1	Sent only if specified by user
Border Density	(2010,0100)	U/U	CS	1	Sent only if specified by user
Empty Image Density	(2010,0110)	U/U	CS	1	Sent only if specified by user
Min Density	(2010,0120)	U/U	US	1	Sent only if specified by user
Trim	(2010,0140)	U/U	CS	1	Sent only if specified by user
Requested Resolution ID	(2020,0050)	U/U	CS	1	Sent only if specified by user
Referenced Presentation LUT Sequence	(2050,0500)	U/MC	SQ	1	Sent if support for the Presentation LUT SOP class was negotiated, a Presentation LUT SOP instance has been successfully created and Print SCU is configured to send the

					Referenced Presentation LUT SQ on Film Box level.
>Referenced SOP Class UID	(0008,1150)	U/MC	UI	1	Sent if sequence is present
>Referenced SOP Instance UID	(0008,1155)	U/MC	UI	1	Sent if sequence is present
Illumination	(2010,015E)	U/MC	US	1	Sent if Referenced Presentation LUT Sequence is present
Reflected Ambient Light	(2010,0160)	U/MC	US	1	Sent if Referenced Presentation LUT Sequence is present

If creation of the Basic Film Box fails, Print SCU releases the association with the printer. Print SCU never creates more than a single Basic Film Box in the context of one association. Print SCU uses an N-ACTION request to request processing of the print job from the Print SCP. After a successful completion of the print job, 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. Other requests are never sent.

3.4.2.1.2.4 SOP Specific Conformance for Basic Grayscale Image Box SOP Class

For each Basic Grayscale Image Box created as part of the Basic Film Box, Print SCU issues a single N-SET request for each image box unless there are more image boxes than images to print, in which no N-SET request is sent for the unused image boxes. The following elements may be sent as part of the N-SET request:

Attribute Name	**Tag**	**Type**	**VR**	**VM**	**Comment**
Image Position	(2020,0010)	M/M	US	1	
Basic Grayscale Image Sequence	(2020,0110)	M/M	SQ	1	
>Samples Per Pixel	(0028,0002)	M/M	US	1	Value is 1.
>Photometric Interpretation	(0028,0004)	M/M	CS	1	Value is “MONOCHROME2”.
>Rows	(0028,0010)	M/M	US	1	
>Columns	(0028,0011)	M/M	US	1	
>Pixel Aspect Ratio	(0028,0034)	MC/M	IS	2	Sent if pixel aspect ratio is not 1\1
>Bits Allocated	(0028,0100)	M/M	US	1	Value is 16 unless Print SCU has been configured to send 8-bit bitmaps to the printer, in which case the value is 8.
>Bits Stored	(0028,0101)	M/M	US	1	Value is 12 if Bits Allocated is 16, 8 otherwise.
>High Bit	(0028,0102)	M/M	US	1	Value is 11 if Bits Allocated is 16, 7 otherwise.
>Pixel Representation	(0028,0103)	M/M	US	1	Value is 0.
>Pixel Data	(7FE0,0010)	M/M	OW	1	See note below
Polarity	(2020,0020)	U/M	CS	1	Sent only if specified by user
Magnification Type	(2010,0060)	U/U	CS	1	Sent only if specified by user
Smoothing Type	(2010,0080)	U/U	CS	1	Sent only if specified by user
Configuration Information	(2010,0150)	U/U	ST	1	Sent only if specified by user
Requested Image Size	(2020,0030)	U/U	DS	1	Sent only if specified by user
Requested Decimate/Crop Behavior	(2020,0040)	U/U	CS	1	Sent only if specified by user

If support for the Presentation LUT SOP Class has not been negotiated with the Print SCP, then 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 a Presentation LUT Shape of "IDENTITY" had been negotiated.

3.4.2.1.2.5 SOP Specific Conformance for Presentation LUT SOP Class

If support for the Presentation LUT SOP Class has been negotiated, Print SCU creates a Presentation LUT SOP instance immediately after association negotiation. The following elements may be sent as part of the N-CREATE request:

Attribute Name	Tag	Type	VR	VM	Comment
Presentation LUT Sequence	(2050,0010)	MC/M	SQ	1	Sent if Presentation LUT Shape is not present. Only one item is sent.
>LUT Descriptor	(0028,3002)	MC/M	US/ SS	3	Sent if sequence is present
>LUT Explanation	(0028,3003)	U/U	LO	1	May or may not be sent depending on the contents of the presentation LUT files used by the DICOMscope application.
>LUT Data	(0028,3006)	MC/M	OW/ US/ SS	1/ 1-n/ 1-n	Sent if sequence is present, VR depends on the contents of the presentation LUT files used by the DICOMscope application
Presentation LUT Shape	(2050,0020)	MC/M	CS	1	Sent if Presentation LUT Sequence is not present

Print SCU never creates more than a single Presentation LUT as part of a single association. If a print job contains images that are to be printed with different Presentation LUTs, then Print SCU renders the Presentation LUTs into the image data before sending it to the printer and uses a Presentation LUT Shape of IDENTITY for the print job.
The Presentation LUT SOP instance is deleted with an N-DELETE request after completion of the print job and before release of the association.

3.4.2.1.2.6 SOP Specific Conformance for Basic Annotation Box SOP Class

If support for the Basic Annotation Box SOP Class has been negotiated and Annotation Boxes have been created as part of the Basic Film Box, Print SCU may issue a single N-SET request for each annotation box. The following elements may be sent as part of the N-SET request:

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

3.4.3 Association Acceptance Policy

This 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 EXTENSIONS / SPECIALIZATIONS / PRIVATIZATIONS

5.1 Standard Extended/Specialized/Private SOPs

5.1.1 OFFIS Private Presentation State IPC

This private SOP class is only used for inter-process communication between components of this application. At the time being, the Store SCP and Print SCP application entities will refuse any association request proposing this SOP class in a presentation context with one of the supported transfer syntaxes. After that the process awaiting incoming association requests will terminate, i. e. shutdown the SCP. However, this behavior may change in future versions.

5.2 Private Transfer Syntaxes

Not supported or negotiated.

6 CONFIGURATION

6.1 AE Title / Presentation Address Mapping

The mapping of application entity titles to presentation addresses is configurable in the configuration file (not at runtime), see details below.

6.2 Configurable Parameters

6.2.1 Store SCP

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

- Listening IP port number
- Maximum PDU size (4096..131072)
- Application entity title (default: DCMPSTAT). This entity title is also used by Store SCU and Print SCU.
- Support for explicit VR transfer syntaxes (default: on)
- Support for UN value representation (default: on)
- Bit-preserving receipt (default: off)
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation
  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)

6.2.2 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
- Maximum PDU size (4096..131072)
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation
  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)

The number of send targets is not restricted. Store SCU always uses the same application entity title as the Store SCP.

6.2.3 Print SCP

For the Print SCP component, the following parameters are configurable for each virtual printer:

- Listening IP port number
- Application entity title (default: DCMPSTAT)
- Maximum PDU size (4096..131072)
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation

  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)
- Support for explicit VR transfer syntaxes (default: on)
- Support for UN value representation (default: on)
- Support for image transmission with 12 bits/pixel instead of 8 bits/pixel (default: on)
- Support for the Presentation LUT SOP Class (default: off)
- Support for DICOM Correction Proposal 173 (creation of Referenced Presentation LUT Sequence, Illumination and Reflected Ambient Light on Film Box level instead of Film Session level, default: on)
- Support for the optional Image Size attribute in the Basic Grayscale Image Box SOP Class (default: off). If switched off, N-SET requests containing a requested image size attribute are refused.
- Support for the optional Decimate/Crop Behavior Element in the Basic Grayscale Image Box SOP Class (default:off). If switched off, N-SET requests containing a decimate/crop behavior attribute are refused.
- Support for the optional Trim element in the Basic Film Box SOP Class (default: off). If switched off, N-CREATE / N-SET requests containing a trim attribute are refused.
- Whether or not the Print SCP requires that the number of entries in a Presentation LUT matches the image bitmap (4096 entries for 12 bits/pixel, 256 entries for 8 bits/pixel, default: on). If switched on, all Presentation LUT N-CREATE or Basic Grayscale Image Box N-SET operations that would violate the rule will be refused.
- Supported STANDARD\C,R Image Display Formats
- Supported Film Size IDs and default Film Size IDs
- Supported Medium Types and default Medium Type
- Supported Resolution IDs and default Resolution ID. Support for Resolution ID can be switched off. In this case all Basic Film Box N-CREATE or N-SET requests containing the attribute are refused.
- Supported Magnification Types and default Magnification Type
- Supported Smoothing Types and default Smoothing Type. Support for Smoothing Type can be switched off. In this case all Basic Film Box and Image Box requests containing the attribute are refused.
- Supported Border Density identifiers and default Border Density. Support for Border Density can be switched off. In this case all Basic Film Box requests containing the attribute are refused.
- Supported Empty Image Density identifiers and default Empty Image Density. Support for Empty Image Density can be switched off. In this case all Basic Film Box requests containing the attribute are refused.
- Default Max Density
- Default Min Density. Support for Min Density can be switched off. In this case all Basic Film Box requests containing the attribute are refused.
- Supported Configuration Information identifiers (default: empty). Support for Configuration Information can be switched off. In this case all Basic Film Box or Image Box requests containing the attribute are refused.
- Supported Film Destination identifiers and default Film Destination
- Whether or not Print SCP should send the optional Affected SOP Class UID attribute as part of DIMSE N-CREATE-RSP messages (default: send Affected SOP Class UID).
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation
  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)

6.2.4 Print SCU

For the Print SCU component, the following parameters are configurable for each target printer:

- Presentation address (DNS hostname or IP address)
- IP port number

- Called application entity title
- Maximum PDU size (4096..131072)
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation
  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)
- Support for explicit VR transfer syntaxes (default: on)
- Support for UN value representation (default: on)
- Support for image transmission with 12 bits/pixel instead of 8 bits/pixel (default: on)
- Support for the Presentation LUT SOP Class (default: off)
- Support for DICOM Correction Proposal 173 (creation of Referenced Presentation LUT Sequence, Illumination and Reflected Ambient Light on Film Box level instead of Film Session level, default: on)
- Support for the optional Image Size attribute in the Basic Grayscale Image Box SOP Class (default: off). If switched on, allows to print images in “TRUE SIZE” if demanded by a presentation state.
- Support for the optional Decimate/Crop Behavior Element in the Basic Grayscale Image Box SOP Class (default:off). Not used currently.
- Support for the optional Trim element in the Basic Film Box SOP Class (default: off)
- Whether or not the Print SCP requires that the number of entries in a Presentation LUT matches the image bitmap (4096 entries for 12 bits/pixel, 256 entries for 8 bits/pixel, default: on). If switched on, all Presentation LUTs not fulfilling this requirement are rendered into the image bitmap before it is sent to the printer and a Presentation LUT Shape of IDENTITY is used in the Print SCP.
- Whether a Presentation LUT that could be processed both by the Print SCU and the Print SCP without consequences should be processed in the Print SCU or in the Print SCP (default: Print SCU).
- Whether or not the Print SCP “abuses” the Film Session Label attribute in the Basic Film Session SOP Class as a replacement for Annotation Box. In this case, an annotation may be transmitted in the Basic Film Session Label attribute.
- Supported STANDARD\C,R Image Display Formats
- Supported Film Size IDs (default: don’t transmit Film Size ID)
- Supported Medium Types (default: don’t transmit Medium Type)
- Supported Resolution IDs (default: don’t transmit Resolution ID)
- Supported Magnification Types (default: don’t transmit Magnification Type)
- Supported Smoothing Types (default: don’t transmit Smoothing Type)
- Supported Border Density identifiers (default: don’t transmit Border Density)
- Supported Empty Image Density identifiers (default: don’t transmit Empty Image Density)
- Supported Max Density identifiers (default: don’t transmit Max Density)
- Supported Min Density identifiers (default: don’t transmit Min Density)
- Supported Configuration Information (default: don’t transmit Configuration Information)
- Support for the optional Basic Annotation Box SOP class (default: off). If activated, the Annotation Display Format ID and Annotation Position for the single annotation currently supported by Print SCU can be configured.
- Support for the Basic TLS Secure Transport Connection Profile (default: off)
  - Certificate and private key for TLS authentication
  - Certificates of trusted Certification Authorities
  - Supported TLS ciphersuites and order or negotiation
  - Parameter set for Diffie-Hellman key agreement
  - Seed for cryptographically secure pseudo-random number generator
  - Peer authentication policy (default: authentication required)

7 SUPPORT OF EXTENDED CHARACTER SETS

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

8 CODES AND CONTROLLED TERMINOLOGY

This application uses its own local code dictionary to facilitate the code entry in the SR editor. The dictionary is stored in a simple, extensible text file which is loaded during application start. The codes are divided into self-defined context groups for easier application.

The SR viewer (HTML rendering) does not make any use of the code dictionary. The stored Code Meaning value, which is mandatory for all codes in SR, is used instead.

Future versions of this application might make full use of Codes, Coding Schemes and Context Groups as defined in the DICOM standard.

9 SECURITY PROFILES

9.1 Secure Transport Connection Profiles

The StoreSCP, StoreSCU, PrintSCP and PrintSCU application entities can be configured to use secure DICOM communication in conformance with the Basic TLS Secure Transport Connection Profile. The configuration options are explained in section 6.2.1 to 6.2.4.

9.1.1 Key Management

In the current release, DICOMscope uses one set of TLS keys and certificates *per installation*. This means that it is not possible to authenticate that user who has started a transmission or who is receiving a transmission, only the DICOMscope installation that is sending or receiving can be identified uniquely. Keys and certificates are required to be available in file, hardware tokens such as smartcards are not supported.
The application entities implement three different key management policies that can be configured:

- With the default *"Require"* policy, TLS connections are refused if the remote application entity does not transmit a certificate. If the remote application entity transmits a certificate, it is validated and the connection is refused unless the validation succeeds. The validation process attempts to construct a certification chain beginning with the received certificate up to the self-signed root Certification Authority (CA) certificate. All CA certificates up to the root CA certificate are read from a directory of *trusted CA certificates*, which is part of the DICOMscope installation and can be configured by the user. Validation succeeds if the complete certification chain can be constructed and none of the certificates is expired. Certificate Revocation Lists (CRLs) are not supported at this time.
- With the *"Verify"* policy, anonymous TLS connections are accepted. However, if a certificate is received, the same validation process as described above is performed. If validation fails, the connection is refused.
- With the *"Ignore"* policy, all TLS connections including anonymous TLS connections are accepted. Certificates are not validated.

The directory of trusted CA certificates is shared by all application entity instances of one DICOMscope installation. The key and certificate used for authentication of an application entity as well as the key management policy can be configured for each individual instance.

9.1.2 Selection of TLS Features

DICOMscope supports all TLS 1.0 ciphersuites that do not require Diffie/Hellman certificates, i. e. all ciphersuites with an identifier *not* starting with one of the following prefixes:

TLS_DH_DSS…
TLS_DH_RSA…

For each application entity instance, a list of TLS ciphersuites can be configured. This list defines the ciphersuites that are proposed/accepted during TLS negotiation and the order in which selection takes place. It should be noted that TLS ciphersuites that are not based on RSA certificates are supported but cannot be used in conformance with the DICOM Basic TLS Secure Transport Connection Profile. DICOMscope also does not enforce the requirement that the TLS ciphersuite TLS_RSA_WITH_3DES_EDE_CBC_SHA is included in each configuration, however, this is required for conformance with the DICOM Basic TLS Secure Transport Connection Profile.

9.1.3 Selection of IP Ports for TLS Connections

For each StoreSCP and PrintSCP instance the configuration file defines

- whether or not TLS should be used for all incoming associations, and
- on which IP port the application entity should accept connections.

Port numbers can be configured freely, but cannot be shared by multiple SCP instances.

9.1.4 Upper Layer A-P-ABORT Indication

When a TLS integrity check fails, the connection is dropped and an A-P-ABORT indication is issued to the application by the DICOM upper layer state machine, together with an implementation-specific

provider reason. For the current DCMTK implementation used by DICOMscope, the provider reason for any A-P-ABORT indication is always “unspecified”. The error code reported to the application layer is DUL_PEERABORTEDASSOCIATION. A detailed error description including TLS status information is available to the application layer through an API that is outside the scope of the DICOM upper layer interface.

9.2 Digital Signature Profiles

Note: Digital Signatures created or verified with this DICOMscope release are conforming to NEMA PS.3-2003. Earlier releases of DICOMscope (up to 3.5) implemented Working Draft 7 (2000-05-30) of DICOM Supplement 41, which is not compatible with the final text of the standard. Signatures created with older versions of DICOMscope will, therefore, always be reported as being invalid by this DICOMscope release, and vice versa.

9.2.1 Verification of Digital Signatures

The DICOMscope application verifies all Digital Signatures contained in DICOM images, grayscale softcopy presentation states and structured reports. Digital Signatures are verified when an object is loaded into the DICOMscope viewer, not during network receipt. The detailed results of the signature verification can be viewed by the user. Warnings are displayed to the user if:

- an object containing one or more signatures is loaded, and verification does not succeed for all signatures, or
- the user activates a reference to an image (optionally accompanied by a softcopy presentation state) in a structured report that is digitally signed, but the referenced image or presentation state is not digitally signed (the display of this warning message can be disabled in the configuration file).

However, these warnings do not prevent the display of the objects in question.

DICOMscope supports the verification of signatures created with the following MAC algorithms: RIPEMD160, MD5 or SHA1.

9.2.2 Creation, Removal and Replacement of Digital Signatures

Signatures on images and presentation states are never created, removed or replaced by this implementation. When a structured report containing digital signatures is modified (i. e. the SR editor is activated), a new SOP instance UID is assigned to the structured report and all digital signatures are removed.

When the status of a structured report is set to complete and verified, one or more digital signatures can be created in the report. Two different signature schemes are available:

- *”Verify and Sign (Finalize)”* creates an entry for the verifying observer in the SR verifying observer sequence and then creates a digital signature that covers all attributes of the DICOM object. This signature conforms to both the Creator RSA Digital Signature Profile and the Authorization RSA Digital Signature Profile, which also implies conformance to the Base RSA Digital Signature Profile. It should be noted that any modification of the signed structured report, including the creation of another entry in the verifying observer sequence would destroy the signature. Therefore, a warning is displayed to the user if an attempt is performed to add another verifying observer to a “finalized” report.
- *”Verify and Sign”* creates an entry for the verifying observer in the SR verifying observer sequence and then creates a digital signature that covers all attributes of the DICOM object except the following ones:
  - SOP Instance UID
  - Verifying Observer Sequence
  - Instance Creation Date
  - Instance Creation Time
  - Instance Creator UID

  Alternatively, individual content items of the SR content tree can be marked in the SR editor by the user. In this case only the marked content items are signed with a separate signature for each marked content item.

This type of signature conforms to the Base RSA Digital Signature Profile and allows additional verifying observers to be added to the SR document. It is recommended that the final signature on any SR document should be performed with the *"Verify and Sign (Finalize)"* signature scheme.

Signatures are always created using RIPEMD160 as the MAC algorithm and Explicit VR Little Endian as the transfer syntax.

9.2.3 Key Management

The RSA keys and certificates used for the creation of digital signatures are *user* certificates, unlike the keys and certificates used for TLS negotiation which are *per installation* certificates. The DICOMscope configuration file identifies user names and assigns a private key and a certificate to each user. Keys and certificates are required to be available in file, hardware tokens such as smartcards are not supported. However, private keys may be stored in encrypted form (3DES encryption with pass phrase protection), which is strongly recommended.

Verification of a digital signature includes a validation of the certificate of signer. The validation process attempts to construct a certification chain beginning with the certificate of signer up to the self-signed root Certification Authority (CA) certificate. All CA certificates up to the root CA certificate are read from a directory of *trusted CA certificates*, which is part of the DICOMscope installation and can be configured by the user. Validation succeeds if the complete certification chain can be constructed and none of the certificates is expired. If a digital signature is valid but the certificate of signer cannot be validated, the signature is reported as “untrustworthy” since it might be the result of a man-in-the-middle attack. Certificate Revocation Lists (CRLs) are not supported at this time.

The directory of trusted CA certificates is shared with the Secure Transport Connection key management described in section 9.1.1.

9.2.4 Time Stamps

Time stamps are not supported.

10 INFORMATION OBJECT IMPLEMENTATION

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

10.1 Grayscale Softcopy Presentation State IOD

This section describes the Grayscale Softcopy Presentation State IODs which are created by this implementation. Attributes which are not mentioned in the Module tables are not created by this application and are ignored when reading a Presentation State object.

Note: Unlike versions 1.x of the DICOMscope software, which were based on the frozen draft for trial implementation of the Grayscale Softcopy Presentation State Storage supplement, this version is based on the final text. Therefore, Presentation State objects cannot be exchanged between version 1.x and later versions.

10.1.1 Grayscale Softcopy Presentation State IOD Modules

IE	Module	Usage	Reference
Patient	Patient	M	10.1.2.1
	Clinical Trial Subject	U	Never sent
Study	General Study	M	10.1.2.2
	Patient Study	U	10.1.2.3
	Clinical Trial Study	U	Never sent
Series	General Series	M	10.1.2.4
	Clinical Trial Series	U	Never sent
	Presentation Series	M	10.1.2.5
Equipment	General Equipment	M	10.1.2.6
Presentation	Presentation State	M	10.1.2.7
	Mask	C	10.1.2.8
	Display Shutter	C	10.1.2.9
	Bitmap Display Shutter	C	10.1.2.10
	Overlay Plane	C	10.1.2.11
	Overlay/Curve Activation	C	10.1.2.12
	Displayed Area	M	10.1.2.13
	Graphic Annotation	C	10.1.2.14
	Spatial Transformation	C	10.1.2.15
	Graphic Layer	C	10.1.2.16
	Modality LUT	C	10.1.2.17
	Softcopy VOI LUT	C	10.1.2.18
	Softcopy Presentation LUT	M	10.1.2.19
	SOP Common	M	10.1.2.20

10.1.2 Grayscale Softcopy Presentation State Module Descriptions

10.1.2.1 Patient Module

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

10.1.2.2 General Study Module

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

10.1.2.3 Patient Study Module

This optional module is not supported. When creating Presentation State objects, it is never sent. When reading Presentation State objects, it is ignored if present.

10.1.2.4 General Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value 'PR'
Series Instance UID	(0020,000E)	1	UI	1	
Series Number	(0020,0011)	2	IS	1	
Laterality	(0020,0060)	2c	CS	1	Never sent; ignored when read

10.1.2.5 Presentation Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value 'PR'

10.1.2.6 General Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Manufacturer	(0008,0070)	2	LO	1	Copied from referenced image object

10.1.2.7 Presentation State Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	1	IS	1	
Presentation Label	(0070,0080)	1	CS	1	
Presentation Description	(0070,0081)	2	LO	1	User defined text
Presentation Creation Date	(0070,0082)	1	DA	1	Date of initial creation (not last modification) of presentation state
Presentation Creation Time	(0070,0083)	1	TM	1	Time of initial creation (not last modification) of presentation state
Presentation Creator's Name	(0070,0084)	2	PN	1	User defined text
Referenced Series Sequence	(0008,1115)	1	SQ	1	
>Series Instance UID	(0020,000E)	1c	UI	1	
>Retrieve AE Title	(0008,0054)	3	AE	1-n	
>Storage Media File-Set ID	(0088,0130)	3	SH	1	
>Storage Media File-Set UID	(0088,0140)	3	UI	1	
>Referenced Image Sequence	(0008,1140)	1c	SQ	1	
>>Referenced SOP Class UID	(0008,1150)	1c	UI	1	

>>Reference SOP Instance UID	(0008,1155)	1c	UI	1	
>>Referenced Frame Number	(0008,1160)	1c	IS	1-n	VM re-defined in Supplement 33
Shutter Presentation Value	(0018,1622)	1c	US	1	
Mask Subtraction Sequence	(0028,6100)	1c	SQ	1	Unsupported. See Mask Module for details.
>Mask Operation	(0028,6101)	1	CS	1	Unsupported. See Mask Module for details.
Recommended Viewing Mode	(0028,1090)	1c	CS	1	Unsupported. See Mask Module for details.

10.1.2.8 Mask Module

The Mask Module is not supported by this implementation. When writing a Presentation State, it is never sent. This implementation will refuse to read or display Presentation States containing the Mask Module, i. e. containing the Mask Subtraction Sequence (0028,6100).

10.1.2.9 Display Shutter Module

This conditional module is sent if a non-bitmap display shutter is present in the Presentation State.

Attribute Name	Tag	Type	VR	VM	Comment
Shutter Shape	(0018,1600)	1	CS	1-3	
Shutter Left Vertical Edge	(0018,1602)	1c	IS	1	Sent if one value of Shutter Shape is RECTANGULAR.
Shutter Right Vertical Edge	(0018,1604)	1c	IS	1	Sent if one value of Shutter Shape is RECTANGULAR.
Shutter Upper Horizontal Edge	(0018,1606)	1c	IS	1	Sent if one value of Shutter Shape is RECTANGULAR.
Shutter Lower Horizontal Edge	(0018,1608)	1c	IS	1	Sent if one value of Shutter Shape is RECTANGULAR.
Center of Circular Shutter	(0018,1610)	1c	IS	2	Sent if one value of Shutter Shape is CIRCULAR.
Radius of Circular Shutter	(0018,1612)	1c	IS	1	Sent if one value of Shutter Shape is CIRCULAR.
Vertices of the Polygonal Shutter	(0018,1620)	1c	IS	2-2n	Sent if one value of Shutter Shape is POLYGONAL.
Shutter Presentation Value	(0018,1622)	3	US	1	Always sent.

10.1.2.10 Bitmap Display Shutter Module

This conditional module is sent if a bitmap display shutter is present in the Presentation State.

Attribute Name	Tag	Type	VR	VM	Comment
Shutter Shape	(0018,1600)	1	CS	1-3	Enumerated value: BITMAP
Shutter Overlay Group	(0018,1623)	1	US	1	
Shutter Presentation Value	(0018,1622)	1	US	1	

10.1.2.11 Overlay Plane Module

This conditional module is sent if an overlay or bitmap shutter is present in the presentation state (as opposed to being only referenced from the presentation state).

Attribute Name	Tag	Type	VR	VM	Comment
Overlay Rows	(60xx,0010)	1	US	1	
Overlay Columns	(60xx,0011)	1	US	1	
Overlay Type	(60xx,0040)	1	CS	1	Enumerated Values: G, R
Overlay Origin	(60xx,0050)	1	SS	2	

Overlay Bits Allocated	(60xx,0100)	1	US	1	
Overlay Bit Position	(60xx,0102)	1	US	1	
Overlay Data	(60xx,3000)	1c	OW	1	Always sent if module is present. Required to be present when reading.
Overlay Description	(60xx,0022)	3	LO	1	Sent if value defined by user
Overlay Label	(60xx,1500)	3	LO	1	Sent if value defined by user

10.1.2.12 Overlay / Curve Activation Module

This conditional module is sent if bitmap overlays or curve data are referenced in the image(s) to which the Presentation State applies, or if the Overlay Plane Module is present.

Attribute Name	Tag	Type	VR	VM	Comment
Overlay Activation Layer	(60xx,1001)	2c	CS	1	
Curve Activation Layer	(50xx,1001)	2c	CS	1	

10.1.2.13 Displayed Area Module

Attribute Name	Tag	Type	VR	VM	Comment
Displayed Area Selection SQ	(0070,005A)	1	SQ	1	
>Referenced Image Sequence	(0008,1140)	1C	SQ	1	Sent if the displayed area selection in this Item does not apply to all the images listed in the Presentation State Module.
>>Referenced SOP Class UID	(0008,1150)	1C	UI	1	Sent if sequence is present
>>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Sent if sequence is present
>>Referenced Frame Number	(0008,1160)	1C	IS	1-n	Sent if sequence item is present and the referenced image is a multi-frame image and the displayed area selection does not apply to all frames. Note: VM re-defined in Supplement 33.
>Displayed Area Top Left Hand Corner	(0070,0052)	1	SL	2	
>Displayed Area Bottom Right Hand Corner	(0070,0053)	1	SL	2	
>Presentation Size Mode	(0070,0100)	1	CS	1	Enumerated Values: SCALE TO FIT, TRUE SIZE, MAGNIFY.
>Presentation Pixel Spacing	(0070,0101)	1C	DS	2	Sent if Presentation Size Mode (0070,0100) is TRUE SIZE. May be sent otherwise as well.
>Presentation Pixel Aspect Ratio	(0070,0102)	1C	IS	2	Sent if Presentation Pixel Spacing is not present.
>Presentation Pixel Magnification Ratio	(0070,0103)	1C	FL	1	Sent if Presentation Size Mode is MAGNIFY.

10.1.2.14 Graphic Annotation Module

This conditional module is sent if one or more graphic or textual annotations are present in the Presentation State.

Attribute Name	Tag	Type	VR	VM	Comment
Graphic Annotation Sequence	(0070,0001)	1	SQ	1	

>Referenced Image Sequence	(0008,1140)	1C	SQ	1	Sent if the annotations in this Item do not apply to all the images listed in the Presentation State Module.
>>Referenced SOP Class UID	(0008,1150)	1C	UI	1	Sent if sequence is present
>>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Sent if sequence is present
>>Referenced Frame Number	(0008,1160)	1C	IS	1-n	Sent if sequence item is present and the referenced image is a multi-frame image and the annotations do not apply to all frames. Note: VM re-defined in Supplement 33.
>Graphic Layer	(0070,0002)	1	CS	1	
>Text Object Sequence	(0070,0008)	1c	SQ	1	Sent when text objects are present in the graphic annotation.
>>Bounding Box Annotation Units	(0070,0003)	1c	CS	1	
>>Anchor Point Annotation Units	(0070,0004)	1c	CS	1	
>>Unformatted Text Value	(0070,0006)	1	ST	1	
>>Bounding Box Top Left Hand Corner	(0070,0010)	1c	FL	2	
>>Bounding Box Bottom Right Hand Corner	(0070,0011)	1c	FL	2	
>>Bounding Box Text Horizontal Justification	(0070,0012)	1c	CS	1	
>>Anchor Point	(0070,0014)	1c	FL	2	
>>Anchor Point Visibility	(0070,0015)	1c	CS	1	
>Graphic Object Sequence	(0070,0009)	1c	SQ	1	Sent when graphic objects are present in the graphic annotation.
>>Graphic Annotation Units	(0070,0005)	1	CS	1	
>>Graphic Dimensions	(0070,0020)	1	US	1	Enumerated Value: 2
>>Number of Graphic Points	(0070,0021)	1	US	1	
>> Graphic Data	(0070,0022)	1	FL	2-n	
>>Graphic Type	(0070,0023)	1	CS	1	
>>Graphic Filled	(0070,0024)	1c	CS	1	

10.1.2.15 Spatial Transformation Module

This conditional module is sent if the Presentation State requires that the image be rotated or flipped.

Attribute Name	Tag	Type	VR	VM	Comment
Image Rotation	(0070,0042)	1	US	1	Enumerated Values: 0, 90,180,270
Image Horizontal Flip	(0070,0041)	1	CS	1	Enumerated Values: Y, N

10.1.2.16 Graphic Layer Module

This conditional module is sent if graphical annotations are present in the Presentation State, i. e. if the Graphic Annotation Module or the Overlay/Curve Activation Module is present.

Attribute Name	Tag	Type	VR	VM	Comment
Graphic Layer Sequence	(0070,0060)	1	SQ	1	
>Graphic Layer	(0070,0002)	1	CS	1	
>Graphic Layer Order	(0070,0062)	1	IS	1	
>Graphic Layer Recommended Display Grayscale Value	(0070,0066)	3	US	1	
>Graphic Layer Recommended Display RGB Value	(0070,0067)	3	US	3	
>Graphic Layer Description	(0070,0068)	3	LO	1	Sent if value defined by user

10.1.2.17 Modality LUT Module

This conditional module is sent if the Presentation State contains a modality transformation. When creating a Presentation State for an existing image object, a modality transformation that is present in the image is copied into the Presentation State.

Attribute Name	Tag	Type	VR	VM	Comment
Modality LUT Sequence	(0028,3000)	1c	SQ	1	Copied from referenced image object
>LUT Descriptor	(0028,3002)	1c	US/ SS	3	Copied from referenced image object
>LUT Explanation	(0028,3003)	3	LO	1	Copied from referenced image object
>Modality LUT Type	(0028,3004)	1c	LO	1	Copied from referenced image object
>LUT Data	(0028,3006)	1c	OW/ US/ SS	1-n	Copied from referenced image object
Rescale Intercept	(0028,1052)	1c	DS	1	Copied from referenced image object
Rescale Slope	(0028,1053)	1c	DS	1	Copied from referenced image object
Rescale Type	(0028,1054)	1c	LO	1	Copied from referenced image object if present, default value: US (unspecified)

10.1.2.18 Softcopy VOI LUT Module

This conditional module is sent if the Presentation State contains a value of interest (VOI) transformation. When creating a Presentation State for an existing image object, VOI transformations present in the image object can be copied into the Presentation State (under user control).

Attribute Name	Tag	Type	VR	VM	Comment
Softcopy VOI LUT Sequence	(0028,3110)	1	SQ	1	
>Referenced Image Sequence	(0008,1140)	1C	SQ	1	Sent if the VOI LUT in this Item does not apply to all the images listed in the Presentation State Module.
>>Referenced SOP Class UID	(0008,1150)	1C	UI	1	Sent if sequence is present
>>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Sent if sequence is present
>>Referenced Frame Number	(0008,1160)	1C	IS	1-n	Sent if sequence item is present and the referenced image is a multi-frame image and the VOI LUT does not apply to all frames. Note: VM re-defined in Sup. 33.
>VOI LUT Sequence	(0028,3010)	1c	SQ	1	Copied from referenced image object

>>LUT Descriptor	(0028,3002)	1c	US/ SS	3	Copied from referenced image object
>>LUT Explanation	(0028,3003)	3	LO	1	Copied from referenced image object
>>LUT Data	(0028,3006)	1c	OW/ US/ SS	1-n	Copied from referenced image object
>Window Center	(0028,1050)	1c	DS	1-n	Copied from referenced image object (first value, only if no VOI LUT SQ)
>Window Width	(0028,1051)	1c	DS	1-n	Copied from referenced image object (first value, only if no VOI LUT SQ)
>Window Center & Width Explanation	(0028,1055)	3	LO	1-n	Copied from referenced image object (first value, only if no VOI LUT SQ)

10.1.2.19 Softcopy Presentation LUT Module

Attribute Name	Tag	Type	VR	VM	Comment
Presentation LUT Sequence	(2050,0010)	1c	SQ	1	
>LUT Descriptor	(0028,3002)	1c	US/ SS	3	
>LUT Explanation	(0028,3003)	3	LO	1	
>LUT Data	(0028,3006)	1c	OW/ US/ SS	1-n	
Presentation LUT Shape	(2050,0020)	1c	CS	1	Enumerated values: NORMAL, INVERSE

10.1.2.20 SOP Common Module

Attribute Name	Tag	Type	VR	VM	Comment
SOP Class UID	(0008,0016)	1	UI	1	Grayscale Softcopy Presentation State Storage: “1.2.840.10008.5.1.4.1.1.11.1”
SOP Instance UID	(0008,0018)	1	UI	1	
Specific Character Set	(0008,0005)	1c	CS	1-n	Sent if an extended character set is used in the presentation state.
Instance Creation Date	(0008,0012)	3	DA	1	Date of creation (or last modification) of the presentation state, always sent.
Instance Creation Time	(0008,0013)	3	TM	1	Time of creation (or last modification) of the presentation state, always sent.
Instance Creator UID	(0008,0014)	3	UI	1	Sent if read from existing presentation state before.

10.2 Secondary Capture IOD

This section describes the Secondary Capture IODs which are created by this implementation when the user activates the “screen snapshot” (save screen) function.

10.2.1 Secondary Capture IOD Modules

IE	Module	Usage	Reference
Patient	Patient	M	4.2.2.1
	Clinical Trial Subject	U	Never sent
Study	General Study	M	4.2.2.2
	Patient Study	U	Never sent
	Clinical Trial Study	U	Never sent
Series	General Series	M	4.2.2.3
Equipment	General Equipment	U	Never sent
	SC Equipment	M	4.2.2.4

Image	General Image	M	4.2.2.5
	Image Pixel	M	4.2.2.6
	SC Image	M	4.2.2.7
	Overlay Plane	U	Never sent
	Modality LUT	U	Never sent
	VOI LUT	U	Never sent
	SOP Common	M	4.2.2.8

10.2.2 Secondary Capture Module Descriptions

10.2.2.1 Patient Module

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

10.2.2.2 General Study Module

Attribute Name	Tag	Type	VR	VM	Comment
Study Instance UID	(0020,000D)	1	UI	1	
Study Date	(0008,0020)	2	DA	1	Empty field sent
Study Time	(0008,0030)	2	TM	1	Empty field sent
Referring Physician's Name	(0008,0090)	2	PN	1	Empty field sent
Study ID	(0020,0010)	2	SH	1	Empty field sent
Accession Number	(0008,0050)	2	SH	1	Empty field sent

10.2.2.3 General Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value ‘OT’
Series Instance UID	(0020,000E)	1	UI	1	
Series Number	(0020,0011)	2	IS	1	Empty field sent
Laterality	(0020,0060)	2c	CS	1	Empty field sent

10.2.2.4 SC Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Conversion Type	(0008,0064)	1	CS	1	Enumerated value ‘WSD’

10.2.2.5 General Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	2	IS	1	Empty field sent
Patient Orientation	(0020,0020)	2c	CS	2	Never sent
Image Date	(0008,0023)	2c	DA	1	Never sent
Image Time	(0008,0033)	2c	TM	1	Never sent

10.2.2.6 Image Pixel Module

Attribute Name	Tag	Type	VR	VM	Comment
Samples per Pixel	(0028,0002)	1	US	1	Value sent: 1
Photometric Interpretation	(0028,0004)	1	CS	1	Defined term: "MONOCHROME2"
Rows	(0028,0010)	1	US	1	
Columns	(0028,0011)	1	US	1	
Bits Allocated	(0028,0100)	1	US	1	Value sent: 8
Bits Stored	(0028,0101)	1	US	1	Value sent: 8

High Bit	(0028,0102)	1	US	1	Value sent: 7
Pixel Representation	(0028,0103)	1	US	1	Enumerated value: 0
Pixel Data	(7FE0,0010)	1	OW/ OB	1	Always sent as OW
Planar Configuration	(0028,0006)	1c	US	1	Never sent
Pixel Aspect Ratio	(0028,0034)	1c	IS	2	Sent if pixels are non-square

10.2.2.7 SC Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Date of Secondary Capture	(0018,1012)	3	DA	1	Never sent
Time of Secondary Capture	(0018,1014)	3	TM	1	Never sent

10.2.2.8 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	
Specific Character Set	(0008,0005)	1c	CS	1-n	Never sent

10.3 Hardcopy Grayscale IOD

This section describes the Hardcopy Grayscale IODs which are created by this implementation when the user activates the “add to print” function. A print job that is spooled to the printer consists of one Stored Print IOD and one or more Hardcopy Grayscale IOD that are used by the Print SCU to create a print-out on a Print SCP.
The Hardcopy Grayscale objects created by DICOMscope are conforming with the Hardcopy Grayscale Image Storage SOP Class as Standard Extended SOP Class. In addition to elements defined in the standard IOD, an optional Presentation LUT Sequence is added. This contains the Presentation LUT intended to be used when printing the Hardcopy Grayscale image. This addition allows to re-use a Hardcopy Grayscale image for a new print job (Stored Print object) while maintaining the presentation LUT that was used to print the hardcopy image for the first time.

10.3.1 Hardcopy Grayscale IOD Modules

IE	Module	Usage	Reference
Patient	Patient	M	10.3.2.1
	Clinical Trial Subject	U	Never sent
Study	General Study	M	10.3.2.2
	Patient Study	U	Never sent
	Clinical Trial Study	U	Never sent
Series	General Series	M	10.3.2.3
	Clinical Trial Series	U	Never sent
Equipment	General Equipment	U	Never sent
	Hardcopy Equipment	M	10.3.2.4
Image	General Image	M	10.3.2.5
	HC Grayscale Image	M	10.3.2.6
	SOP Common Information	M	10.3.2.7
Presentation	*HC Presentation LUT*	*U*	*10.3.2.8*

10.3.2 Hardcopy Grayscale Module Descriptions

10.3.2.1 Patient Module

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

10.3.2.2 General Study Module

Attribute Name	Tag	Type	VR	VM	Comment
Study Instance UID	(0020,000D)	1	UI	1	Values consistent with Stored Print
Study Date	(0008,0020)	2	DA	1	Values consistent with Stored Print
Study Time	(0008,0030)	2	TM	1	Values consistent with Stored Print
Referring Physician's Name	(0008,0090)	2	PN	1	Values consistent with Stored Print
Study ID	(0020,0010)	2	SH	1	Values consistent with Stored Print
Accession Number	(0008,0050)	2	SH	1	Values consistent with Stored Print

10.3.2.3 General Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value ‘HC’
Series Instance UID	(0020,000E)	1	UI	1	
Series Number	(0020,0011)	2	IS	1	
Laterality	(0020,0060)	2c	CS	1	Never sent

10.3.2.4 Hardcopy Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value ‘HC’
Hardcopy Creation Device ID	(0018,1011)	3	LO	1	Never sent
Hardcopy Device Manufacturer	(0018,1017)	3	LO	1	‘OFFIS’
Hardcopy Device Software Versions	(0018,101A)	3	LO	1-n	‘3.5.2’
Hardcopy Device Manufacturer's Model Name	(0018,101B)	3	LO	1	Never sent

10.3.2.5 General Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	2	IS	1	Empty field sent
Patient Orientation	(0020,0020)	2c	CS	2	Empty field sent
Image Type	(0008,0008)	3	CS	1-n	‘DERIVED\SECONDARY’
Derivation Description	(0008,2111)	3	ST	1	‘Hardcopy rendered using Presentation State’
Source Image Sequence	(0008,2112)	3	SQ	1	This sequence is always sent with two items. The first items references the image from which this hardcopy was derived, the second one references the presentation state that was used to render this hardcopy.
>Referenced SOP Class UID	(0008,1150)	1C	UI	1	Always sent

>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Always sent
>Referenced Frame Number	(0008,1160)	1C	IS	1-n	Never sent

10.3.2.6 HC Grayscale Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Samples Per Pixel	(0028,0002)	1	US	1	Enumerated Value: 1
Photometric Interpretation	(0028,0004)	1	CS	1	Enumerated Values: MONOCHROME1, MONOCHROME2
Rows	(0028,0010)	1	US	1	
Columns	(0028,0011)	1	US	1	
Pixel Aspect Ratio	(0028,0034)	1c	IS	2	Sent if the aspect ratio is not 1\1.
Bits Allocated	(0028,0100)	1	US	1	Enumerated Values: 16, 8
Bits Stored	(0028,0101)	1	US	1	Enumerated Values: 12, 8
High Bit	(0028,0102)	1	US	1	Enumerated Values: 11, 7
Pixel Representation	(0028,0103)	1	US	1	Enumerated Value: 0
Pixel Data	(7FE0,0010	1	OW/ OB	1	Always sent as OW

10.3.2.7 SOP Common Information Module

Attribute Name	Tag	Type	VR	VM	Comment
SOP Class UID	(0008,0016)	1	UI	1	Hardcopy Grayscale Image Storage: "1.2.840.10008.5.1.1.29"
SOP Instance UID	(0008,0018)	1	UI	1	
Specific Character Set	(0008,0005)	1c	CS	1-n	Never sent
Instance Creation Date	(0008,0012)	3	DA	1	Always sent
Instance Creation Time	(0008,0013)	3	TM	1	Always sent

10.3.2.8 HC Presentation LUT Module (Standard Extended SOP Class)

Attribute Name	Tag	Type	VR	VM	Comment
Presentation LUT Sequence	(2050,0010)	3	SQ	1	If present, only a single item is sent
>>LUT Descriptor	(0028,3002)	1c	US/ SS	3	Sent if sequence is present
>>LUT Explanation	(0028,3003)	3	LO	1	
>>LUT Data	(0028,3006)	1c	OW/ US/ SS	1-n	Sent if sequence is present

10.4 Stored Print IOD

10.4.1 Stored Print IOD Modules

IE	Module	Usage	Reference
Patient	Patient	M	10.4.2.1
	Clinical Trial Subject	U	Never sent, ignored when read.
Study	General Study	M	10.4.2.2
	Patient Study	U	Never sent, ignored when read.
	Clinical Trial Study	U	Never sent, ignored when read.

Series	General Series	M	10.4.2.3
	Clinical Trial Series	U	Never sent, ignored when read.
Equipment	General Equipment	M	10.4.2.4
	Printer Characteristics	M	10.4.2.5
Image	Film Box	M	10.4.2.6
	Image Box List	M	10.4.2.7
	Annotation List	U	10.4.2.8
	Image Overlay Box List	U	Never sent, ignored when read.
	Presentation LUT List	U	10.4.2.9
	SOP Common Information	M	10.4.2.10

10.4.2 Stored Print Module Descriptions

10.4.2.1 Patient Module

Attribute Name	Tag	Type	VR	VM	Comment
Patient's Name	(0010,0010)	2	PN	1	'^^^^'
Patient ID	(0010,0020)	2	LO	1	Empty field sent
Patient's Birth Date	(0010,0030)	2	DA	1	Empty field sent
Patient's Sex	(0010,0040)	2	CS	1	Empty field sent

10.4.2.2 General Study Module

Attribute Name	Tag	Type	VR	VM	Comment
Study Instance UID	(0020,000D)	1	UI	1	All print jobs created during one run of the DICOMscope software use the same Study Instance UID.
Study Date	(0008,0020)	2	DA	1	Always sent
Study Time	(0008,0030)	2	TM	1	Always sent
Referring Physician's Name	(0008,0090)	2	PN	1	Empty field sent
Study ID	(0020,0010)	2	SH	1	Empty field sent
Accession Number	(0008,0050)	2	SH	1	Empty field sent

10.4.2.3 General Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Defined term 'STORED_PRINT' – *note*: this term is not defined in PS 3.3. It is used by the DICOMscope application to distinguish between stored print objects and hardcopy grayscale images which use the 'HC' (Hardcopy) modality.
Series Instance UID	(0020,000E)	1	UI	1	
Series Number	(0020,0011)	2	IS	1	Empty field sent
Laterality	(0020,0060)	2c	CS	1	Never sent, ignored when read.

10.4.2.4 General Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Manufacturer	(0008,0070)	2	LO	1	Empty field sent

10.4.2.5 Printer Characteristics Module

Attribute Name	Tag	Type	VR	VM	Comment
Print Management Capabilities SQ	(2130,0010)	1	SQ	1	SOP classes are: Basic Film Session, Basic Film Box, Basic Grayscale Image Box, Image Storage SOP Classes referenced by this object (normally Hardcopy Grayscale Image Storage),

					Presentation LUT (if present) and Basic Annotation Box (if present).
>Referenced SOP Class UID	(0008,1150)	1	UI	1	
Printer Characteristics SQ	(2130,0015)	2	SQ	1	always sent. Attributes of the Printer Characteristics SQ not specified below are never sent and ignored when read.
>Originator	(2100,0070)	2	AE	1	Calling application entity title
>Destination AE	(2100,0140)	2	AE	1	Responding application entity title
>Printer Name	(2110,0030)	3	LO	1	Printer name from configuration file

10.4.2.6 Film Box Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	2	IS	1	Empty field sent
Film Box Content Sequence	(2130,0030)	1	SQ	1	
>Image Display Format	(2010,0010)	1	ST	1	
>Annotation Display Format ID	(2010,0030)	3	CS	1	Sent if Annotation Box contained in the object
>Film Orientation	(2010,0040)	2	CS	1	
>Film Size ID	(2010,0050)	2	CS	1	
>Magnification Type	(2010,0060)	2	CS	1	
>Smoothing Type	(2010,0080)	3	CS	1	May be sent if specified by user
>Border Density	(2010,0100)	3	CS	1	May be sent if specified by user
>Empty Image Density	(2010,0110)	3	CS	1	May be sent if specified by user
>Min Density	(2010,0120)	3	US	1	May be sent if specified by user
>Max Density	(2010,0130)	2	US	1	May be sent if specified by user
>Trim	(2010,0140)	3	CS	1	May be sent if specified by user
>Configuration Information	(2010,0150)	2	ST	1	
>Illumination	(2010,015E)	2C	US	1	Sent if Presentation LUT SOP Class is present
>Reflected Ambient Light	(2010,0160)	2C	US	1	Sent if Presentation LUT SOP Class is present
>Requested Resolution ID	(2020,0050)	3	CS	1	May be sent if specified by user
>Referenced Presentation LUT Sequence	(2050,0500)	1C	SQ	1	Sent if Presentation LUT SOP Class is present
>>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Sent if sequence is present

10.4.2.7 Image Box List Module

Attribute Name	Tag	Type	VR	VM	Comment
Image Box Content Sequence	(2130,0040)	1	SQ	1	
>SOP Instance UID	(0008,0018)	1C	UI	1	Sent if sequence is present
>Image Position	(2020,0010)	1	US	1	
>Polarity	(2020,0020)	2	CS	1	
>Magnification Type	(2010,0060)	3	CS	1	May be sent if specified by user
>Configuration Information	(2010,0150)	3	ST	1	May be sent if specified by user
>Smoothing Type	(2010,0080)	3	CS	1	May be sent if specified by user

>Requested Image Size	(2020,0030)	3	DS	1	May be sent if specified by user
>Requested Decimate/Crop Behavior	(2020,0040)	3	CS	1	May be sent if specified by user
>Referenced Image Sequence	(0008,1140)	1	SQ	1	
>>Retrieve AE Title	(0008,0054)	1	AE	1-n	
>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
>>Study Instance UID	(0020,000D)	1	UI	1	
>>Series Instance UID	(0020,000E)	1	UI	1	
>>Referenced Frame Number	(0008,1160)	1C	IS	1	Sent if referenced image is multi-frame
>>Patient ID	(0010,0020)	2	LO	1	Empty field sent
>Referenced Image Overlay Box Sequence	(2020,0130)	1C	SQ	1	Never sent, ignored when read
>Referenced Presentation LUT Sequence	(2050,0500)	1C	SQ	1	Sent if Presentation LUT is attached to image box
>>Referenced SOP Instance UID	(0008,1155)	1C	UI	1	Sent if sequence is present

10.4.2.8 Annotation List Module

Attribute Name	Tag	Type	VR	VM	Comment
Annotation Content Sequence	(2130,0050)	3	SQ	1	Sent if print jobs contains annotations
>SOP Instance UID	(0008,0018)	1C	UI	1	Sent if sequence is present
>Annotation Position	(2030,0010)	1C	US	1	Sent if sequence is present
>Text String	(2030,0020)	1C	LO	1	Sent if sequence is present

10.4.2.9 Presentation LUT List Module

Attribute Name	Tag	Type	VR	VM	Comment
Presentation LUT Content Sequence	(2130,0080)	3	SQ	1	Sent if print job contains Presentation LUTs
>SOP Instance UID	(0008,0018)	1C	UI	1	Sent if sequence is present
>Presentation LUT Sequence	(2050,0010)	1C	SQ	1	Sent if sequence is present
>>LUT Descriptor	(0028,3002)	1C	US/ SS	3	Sent if Presentation LUT Sequence is present
>>LUT Explanation	(0028,3003)	3	LO	1	May or may not be sent depending on the contents of the presentation LUT files used by the DICOMscope application
>>LUT Data	(0028,3006)	1C	OW/ US/ SS	1/ 1-n/ 1-n	Sent if Presentation LUT Sequence is present
>Presentation LUT Shape	(2050,0020)	1C	CS	1	Sent if sequence item is present and Presentation LUT Sequence is not present in sequence item

10.4.2.10 SOP Common Information Module

Attribute Name	Tag	Type	VR	VM	Comment
SOP Class UID	(0008,0016)	1	UI	1	Stored Print Storage: "1.2.840.10008.5.1.1.27"
SOP Instance UID	(0008,0018)	1	UI	1	
Specific Character Set	(0008,0005)	1c	CS	1-n	Sent if an extended character set is used in the print job.
Instance Creation Date	(0008,0012)	3	DA	1	Date of creation (or last modification) of the stored print object, always sent.
Instance Creation Time	(0008,0013)	3	TM	1	Time of creation (or last modification) of the stored print object, always sent.

10.5 Structured Report Document IOD

This section describes the Structured Report Document IODs which are created by this implementation. Attributes which are not mentioned in the Module tables are not created by this application and are ignored when reading a Structured Report (SR) object.

This implementation supports all three general purpose SR document classes as specified in the DICOM 2003 standard: Basic Text SR, Enhanced SR and Comprehensive SR.

10.5.1 Structured Report Document IOD Modules

The following Module table is valid for all three supported SR document classes.

IE	Module	Usage	Reference
Patient	Patient	M	10.5.2.1
	Specimen Identification	C	Never sent, ignored when read.
	Clinical Trial Subject	U	Never sent, ignored when read.
Study	General Study	M	10.5.2.2
	Patient Study	U	Never sent, ignored when read.
	Clinical Trial Study	U	Never sent, ignored when read.
Series	SR Document Series	M	10.5.2.3
	Clinical Trial Series	U	Never sent, ignored when read.
Equipment	General Equipment	M	10.5.2.4
Document	SR Document General	M	10.5.2.5
	SR Document Content	M	10.5.2.6
	SOP Common	M	10.5.2.7

10.5.2 Structured Report Document Module Descriptions

10.5.2.1 Patient Module

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

10.5.2.2 General Study Module

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

Study Description	(0008,1030)	3	LO	1	Sent if non-empty.

10.5.2.3 SR Document Series Module

Attribute Name	Tag	Type	VR	VM	Comment
Modality	(0008,0060)	1	CS	1	Enumerated value 'SR'.
Series Instance UID	(0020,000E)	1	UI	1	
Series Number	(0020,0011)	1	IS	1	Set to "1" if empty.
Referenced Study Component Sequence	(0008,1111)	2	SQ	1	Empty sequence sent, checked whether present when read.

10.5.2.4 General Equipment Module

Attribute Name	Tag	Type	VR	VM	Comment
Manufacturer	(0008,0070)	2	LO	1	

10.5.2.5 SR Document General Module

Attribute Name	Tag	Type	VR	VM	Comment
Instance Number	(0020,0013)	1	IS	1	Set to "1" if empty.
Completion Flag	(0040,A491)	1	CS	1	
Completion Flag Description	(0040,A492)	3	LO	1	Sent if non-empty.
Verification Flag	(0040A493)	1	CS	1	
Content Date	(0008,0023)	1	DA	1	
Content Time	(0008,0033)	1	TM	1	
Verifying Observer Sequence	(0040,A073)	1C	SQ	1	Sent if non-empty.
>Verifying Observer Name	(0040,A075)	1	PN	1	
>Verifying Observer Identification Code Sequence	(0040,A088)	2	SQ	1	
>>Code Value	(0008,0100)	1C	SH	1	
>>Coding Scheme Designator	(0008,0102)	1C	SH	1	
>>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>>Code Meaning	(0008,0104)	1C	LO	1	
>Verifying Organization	(0040,A027)	1	LO	1	
>Verification DateTime	(0040,A030)	1	DT	1	
Predecessor Documents Sequence	(0040,A360)	1C	SQ	1	Sent if non-empty.
>Study Instance UID	(0020,000D)	1	UI	1	
>Referenced Series Sequence	(0008,1115)	1	SQ	1	
>>Series Instance UID	(0020,000E)	1	UI	1	
>>Retrieve AE Title	(0008,0054)	3	AE	1-n	Sent if non-empty.
>>Storage Media File-Set ID	(0088,0130)	3	SH	1	Sent if non-empty.
>>Storage Media File-Set UID	(0088,0140)	3	UI	1	Sent if non-empty.
>>Referenced SOP Sequence	(0008,1199)	1	SQ	1	
>>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
Identical Documents Sequence	(0040,A525)	1C	SQ	1	Sent if non-empty.
>Study Instance UID	(0020,000D)	1	UI	1	

>Referenced Series Sequence	(0008,1115)	1	SQ	1	
>>Series Instance UID	(0020,000E)	1	UI	1	
>>Retrieve AE Title	(0008,0054)	3	AE	1-n	Sent if non-empty.
>>Storage Media File-Set ID	(0088,0130)	3	SH	1	Sent if non-empty.
>>Storage Media File-Set UID	(0088,0140)	3	UI	1	Sent if non-empty.
>>Referenced SOP Sequence	(0008,1199)	1	SQ	1	
>>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
Referenced Request Sequence	(0040,A370)	1C	SQ	1	Never sent, ignored when read.
Performed Procedure Code Sequence	(0040,A372)	2	SQ	1	Empty sequence sent, checked whether present when read.
Current Requested Procedure Evidence Sequence	(0040,A375)	1C	SQ	1	Sent if non-empty.
>Study Instance UID	(0020,000D)	1	UI	1	
>Referenced Series Sequence	(0008,1115)	1	SQ	1	
>>Series Instance UID	(0020,000E)	1	UI	1	
>>Retrieve AE Title	(0008,0054)	3	AE	1-n	Sent if non-empty.
>>Storage Media File-Set ID	(0088,0130)	3	SH	1	Sent if non-empty.
>>Storage Media File-Set UID	(0088,0140)	3	UI	1	Sent if non-empty.
>>Referenced SOP Sequence	(0008,1199)	1	SQ	1	
>>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
Pertinent Other Evidence Sequence	(0040,A385)	1C	SQ	1	Sent if non-empty.
>Study Instance UID	(0020,000D)	1	UI	1	
>Referenced Series Sequence	(0008,1115)	1	SQ	1	
>>Series Instance UID	(0020,000E)	1	UI	1	
>>Retrieve AE Title	(0008,0054)	3	AE	1-n	Sent if non-empty.
>>Storage Media File-Set ID	(0088,0130)	3	SH	1	Sent if non-empty.
>>Storage Media File-Set UID	(0088,0140)	3	UI	1	Sent if non-empty.
>>Referenced SOP Sequence	(0008,1199)	1	SQ	1	
>>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	

10.5.2.6 SR Document Content Module

Attribute Name	Tag	Type	VR	VM	Comment
Include Document Relationship Macro (see 10.5.2.6.1).					
Value Type	(0040,A040)	1	CS	1	Enumerated Value 'CONTAINER'

Concept Name Code Sequence	(0040,A043)	1	SQ	1	Required for the root content item.
>Code Value	(0008,0100)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Designator	(0008,0102)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>Code Meaning	(0008,0104)	1C	LO	1	Sent if sequence item is present.
Continuity of Content	(0040,A050)	1	CS	1	

10.5.2.6.1 Document Relationship Macro Attributes

Attribute Name	Tag	Type	VR	VM	Comment
Observation DateTime	(0040,A032)	1C	DT	1	Sent if non-empty.
Content Template Sequence	(0040,A504)	1C	SQ	1	Sent if non-empty.
>Template Identifier	(0040,DB00)	1	CS	1	
>Mapping Resource	(0008,0105)	1	CS	1	
Content Sequence	(0040,A730)	1C	SQ	1	
>Relationship Type	(0040,A010)	1	CS	1	
>Include Document Relationship Macro (see 10.5.2.6.1) if the Target Content Item is included by-value in the Source Content Item. The Macro shall not be present if the relationship is by-reference.					
>Include Document Content Macro (see 10.5.2.6.2) if the Target Content Item is included by-value in the Source Content Item. The Macro shall not be present if the relationship is by-reference.					
>Referenced Content Item Identifier	(0040,DB73)	1C	UL	1-n	

10.5.2.6.2 Document Content Macro Attributes

Attribute Name	Tag	Type	VR	VM	Comment
Value Type	(0040,A040)	1	CS	1	
Concept Name Code Sequence	(0040,A043)	1C	SQ	1	
>Code Value	(0008,0100)	1C	SH	1	
>Coding Scheme Designator	(0008,0102)	1C	SH	1	
>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>Code Meaning	(0008,0104)	1C	LO	1	
Continuity of Content	(0040,A050)	1C	CS	1	Sent if Value Type is CONTAINER.
Text Value	(0040,A160)	1C	UT	1	Sent if Value Type is TEXT.
DateTime	(0040,A120)	1C	DT	1	Sent if Value Type is DATETIME.
Date	(0040,A121)	1C	DA	1	Sent if Value Type is DATE.
Time	(0040,A122)	1C	TM	1	Sent if Value Type is TIME.
Person Name	(0040,A123)	1C	PN	1	Sent if Value Type is PNAME.
UID	(0040,A124)	1C	UI	1	Sent if Value Type is UIDREF.
Measured Value Sequence	(0040,A300)	2	SQ	1	Sent if Value Type is NUM.
>Numeric Value	(0040,A30A)	1	DS	1	
>Measurement Units Code Sequence	(0040,08EA)	1	SQ	1	
>>Code Value	(0008,0100)	1C	SH	1	Sent if sequence item is present.
>>Coding Scheme Designator	(0008,0102)	1C	SH	1	Sent if sequence item is present.
>>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>>Code Meaning	(0008,0104)	1C	LO	1	Sent if sequence item is present.
Numeric Value Qualifier Code Sequence	(0040,A301)	1	SQ	1	Sent if Value Type is NUM and non-empty.

>Code Value	(0008,0100)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Designator	(0008,0102)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>Code Meaning	(0008,0104)	1C	LO	1	Sent if sequence item is present.
Concept Code Sequence	(0040,A168)	1C	SQ	1	Sent if Value Type is CODE.
>Code Value	(0008,0100)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Designator	(0008,0102)	1C	SH	1	Sent if sequence item is present.
>Coding Scheme Version	(0008,0103)	1C	SH	1	Sent if non-empty.
>Code Meaning	(0008,0104)	1C	LO	1	Sent if sequence item is present.
Referenced SOP Sequence	(0008,1199)	1	SQ	1	Sent if Value Type is COMPOSITE.
>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
Referenced SOP Sequence	(0008,1199)	1C	SQ	1	Sent if Value Type is IMAGE.
>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
>Referenced Frame Numbers	(0008,1160)	1C	US	1-n	
>Referenced SOP Sequence	(0008,1199)	3	SQ	1	
>>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
Referenced SOP Sequence	(0008,1150)	1C	SQ	1	Sent if Value Type is WAVEFORM.
>Referenced SOP Class UID	(0008,1150)	1	UI	1	
>Referenced SOP Instance UID	(0008,1155)	1	UI	1	
>Referenced Waveform Channels	(0040,A0B0)	1C	US	2-2n	
Graphic Data	(0070,0022)	1C	FL	2-2n	Sent if Value Type is SCOORD.
Graphic Type	(0070,0023)	1C	CS	1	Sent if Value Type is SCOORD.
Temporal Range Type	(0040,A130)	1C	CS	1	Sent if Value Type is TCOORD.
Referenced Sample Positions	(0040,A132)	1C	UL	1-n	Sent if Value Type is TCOORD and Referenced Time Offsets and Referenced Datetime are not present.
Referenced Time Offsets	(0040,A138)	1C	US	1-n	Sent if Value Type is TCOORD and Referenced Sample Positions and Referenced Datetime are not present.
Referenced Datetime	(0040,A13A)	1C	DT	1-n	Sent if Value Type is TCOORD and Referenced Sample Positions and Referenced Time Offsets are not present.

10.5.2.7 SOP Common Module

Attribute Name	Tag	Type	VR	VM	Comment
SOP Class UID	(0008,0016)	1	UI	1	One of the three supported SOP classes: Basic Text SR, Enhanced SR, Comprehensive SR.
SOP Instance UID	(0008,0018)	1	UI	1	
Specific Character Set	(0008,0005)	1C	CS	1-n	Sent if an extended character set is used in the structured report (VM=1)
Instance Creation Date	(0008,0012)	3	DA	1	Date of creation of the structured report, always sent.
Instance Creation Time	(0008,0013)	3	TM	1	Time of creation of the structured report, always sent.
Instance Creator UID	(0008,0014)	3	UI	1	Sent if non-empty, set if new instance is created.
Coding Scheme Identification Sequence	(0008,0110)	3	SQ	1	Sent if non-empty, private OFFIS DCMTK coding scheme added by default.
>Coding Scheme Designator	(0008,0102)	1	SH	1	
>Coding Scheme Registry	(0008,0112)	1C	LO	1	Sent if non-empty.
>Coding Scheme UID	(0008,010C)	1C	UI	1	Sent if non-empty.
>Coding Scheme External ID	(0008,0114)	2C	ST	1	Sent if non-empty.
>Coding Scheme Name	(0008,0115)	3	ST	1	Sent if non-empty.
>Coding Scheme Version	(0008,0103)	3	SH	1	Sent if non-empty.
>Responsible Organization	(0008,0116)	3	ST	1	Sent if non-empty.