



DICOM CONFORMANCE STATEMENT

DICOMscope Software

Version 1.0, May, 1999

Our mission:

*“to design and provide
high quality tools for connectivity
in the public domain”*



LakeGriffin



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1 BACKGROUND AND INTRODUCTION

This DICOM conformance statement specifies the behavior and functionality of the DICOM interface of the DICOMscope software product. This software provides the capability to demonstrate the DICOM Softcopy Presentation State. This software was demonstrated initially at the European Congress of Radiology (ECR) in Vienna in 1999. The development of this software was funded by the NEMA Committee for the Advancement of DICOM, supported by the DICOM Working Group XI (Display).

The objective to develop and demonstration this software is:

- To educate the user community and solicit feedback about the effectiveness of interchange of presentation information and the achievement of grayscale consistency
- Demonstrate to the vendor community the opportunity to support presentation interchange and grayscale consistency features
- Demonstrate the feasibility of implementation, promote early implementation and adoption.

This software effort was sponsored by the following DICOM member companies, i.e. :

General Electric Company, Imation/CEMAX-ICON, ISG Technologies, Philips Medical Systems, and Siemens AG.

The Project team for the implementation consists of:

OTech Inc.: Main contractor and project management
Lake Griffin Ltd.: Project management and hardware coordination
OFFIS; University of Oldenburg: Implementation of the DICOM toolkit software
Institute for Microtherapy; University of Witten/Herdecke: Graphical user interface

This software will be available in the public domain at:

<http://www.microtherapy.de/go/dicomscope/> and
<http://www.offis.uni-oldenburg.de/projekte/dicom/>

Contact addresses:

Institute for Microtherapy
Universitätsstraße 142, D-44799 Bochum, Germany
<http://www.microtherapy.de/go/cs/>

Kuratorium OFFIS e.V.
Escherweg 2, D-26121 Oldenburg, Germany
<http://www.offis.uni-oldenburg.de/>

Lake Griffin Ltd.
Bisikonstrasse 42, CH-8308 Illnau, Switzerland
<http://www.lakegriffin.ch/>

OTech Inc.
2001 East Oakshores Drive, Crossroads, TX 76227, USA
<http://www.otechimg.com/>

1.1 Revision History

Version 1.0	HJO/ME	1999-05-17
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1.2 Abbreviations and ACRONYMS

ASCII	American Standard Code for Information Interchange
AE	Application Entity
ANSI	American National Standards Institute
CR	Computerized Radiography
CT	Computerized Tomography
DICOM	Digital Imaging and Communications in Medicine
IE	Information Entity
IOD	Information Object Definition
ISO	International Standards Organization
NEMA	National Electrical Manufacturers Association
OSI	Open Systems Interconnection
PDU	Protocol Data Unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service-Object Pair
TCP/IP	Transmission Control Protocol/Internet Protocol
UID	Unique Identifier
VM	Value Multiplicity
VR	Value Representation

2 SCOPE

This DICOM Conformance statement documents the conformance of 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 Standard¹.

2.1 How to use this document

This statement consists of 5 sections:

1. Implementation model: The first section describes the Implementation Model. It describes 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 AE’s. The AE Title is configurable to avoid two devices with the same name on a network. The “bubble diagram” (Application Data Flow Diagram, Fig.1) 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 Aurora Workstation will connect to in order to determine connectivity.

2. AE Specifications: Each AE supports one or more Service-Object-Pair classes or SOP Class for short. 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.

3. Presentation Context: Each SOP class supports a particular presentation context which is the combination of the SOP Class as specified under (2) 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.

For example, when receiving the Attribute “Patient Name” in an explicit transfer syntax, there is an additional “Persons Name” field to identify the Value Representation. In the

¹ Digital Imaging and Communications in Medicine (DICOM) 3.0, NEMA PS 3.1-14, 1998

case of an implicit Value Representation, this is assumed to be known by the receiver and not explicitly specified.

In addition, the data can be communicated in the Intel or Motorola Byte ordering, AKA “Little Endian” or “Big Endian”. 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. Supported Attributes: 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.

2.2 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.

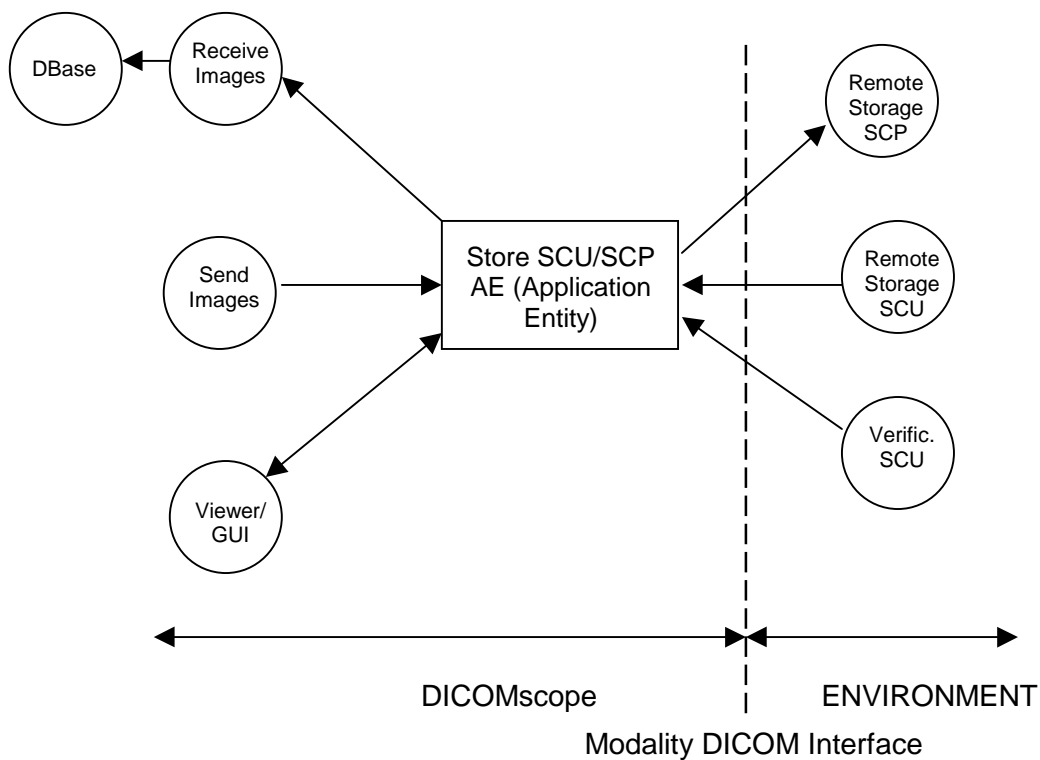
3 IMPLEMENTATION MODEL

DICOMscope receives Image and Presentation Objects sent to it by remote applications using the DICOM protocol. It stores these Objects in its local storage for future review. It can create new Presentation State objects and send them to a DICOM compatible receiver.

3.1 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. They all share the same Application Entity. From a functional perspective, one could consider this as a separate Store SCP and Store SCU, the characteristics of which is defined further in this document.

Figure 1. Implementation Model



3.2 Functional Definitions of AE's

3.2.1 Store SCP

The Store SCP is an application entity that is automatically started together with the viewer. When the viewer is terminated, the Store SCP stops to accept any further associations and terminates as soon as all currently active associations are closed.

The Store SCP spawns a new process for each incoming DICOM association request. The association remains open until the remote application entity closes the application or until an error condition that leads to an association abort occurs.

The Store SCP implements the DICOM Storage Service as well as the Verification Service.

3.2.1.1 Store AE Specification

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
Stored Print Storage	1.2.840.10008.5.1.1.27
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
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 Image Storage	1.2.840.10008.5.1.4.1.1.6.1
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
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
X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
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
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
Digital Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.1
Digital Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra Oral Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra Oral Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.3.1
Draft Visible Light Image Storage (Supp. 15 frozen 1997)	1.2.840.10008.5.1.4.1.1.77.1

Draft Visible Light Multi Frame Image Storage (Supp. 15 frozen 1997)	1.2.840.10008.5.1.4.1.1.77.2
Visible Light Endoscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.1
Visible Light Microscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.2
Visible Light Slide Coordinates Microscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.3
Visible Light Photographic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.4
Structured Reporting Text Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.1
Structured Reporting Audio Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.2
Structured Reporting Detail Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.3
Structured Reporting Comprehensive Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.4
RT Beams Treatment Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.7
Draft Waveform Storage (Supp. 30 frozen)	1.2.840.10008.5.1.4.1.1.9.1
Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.0
Twelve Lead ECG Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.1
General ECG Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.2
Cardiac Electrophysiology Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.3
Hemodynamic Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.4
Basic Audio Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.2.1
High Resolution Audio Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.2.2
Grayscale Softcopy Presentation State Storage (Supp. 33 frozen 1998)	1.2.840.10008.5.1.4.1.1.11.1
OFFIS Private Presentation State IPC	1.2.276.0.7230010.3.4.1915765 545.18030.917282194.0

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

3.2.1.2 General

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

Application context name	1.2.840.10008.3.1.1.1
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The maximum PDU length can be configured at installation time in the range 8192..65536 bytes. The default is 16384 bytes.

SOP Class extended negotiation is not supported.

3.2.1.3 Number of Associations

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

3.2.1.4 Asynchronous Nature

Asynchronous mode of operation is not supported.

3.2.1.5 Implementation Identifying Information

The implementation UID of this application is:

OFFIS DCMTK 3.4.0 Implementation Class UID	1.2.276.0.7230010.3.0.3.4.0
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3.2.1.6 Real-World Activity “Image receipt”

The Store SCP application entity accepts an association when it receives an association request from a DICOM Storage or Verification SCU.

3.2.1.6.1 Associated Real-World Activity

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

3.2.1.6.2 Association Acceptance Policy

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 DCMSTAT. 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 3.4.1.1

3.2.1.6.3 Accepted 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 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.

3.2.1.7 SOP Specific DICOM Conformance Statement for 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. 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, 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 (i.e. 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

3.2.1.8 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.

3.2.1.9 Transfer Syntax Selection Policies

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

3.2.2 Store SCU

The Store SCU is an application entity that is started whenever the user requests transmission of one or more objects from the local database to a remote node. When the viewer is terminated, the 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 by the viewer. 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 terminates.

3.2.2.1 Store SCU AE Specification

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

SOP Class Name	SOP Class UID
Stored Print Storage	1.2.840.10008.5.1.1.27
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29
Hardcopy Color Image Storage	1.2.840.10008.5.1.1.30
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
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 Image Storage	1.2.840.10008.5.1.4.1.1.6.1
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
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
X-Ray Angiographic Bi-Plane Image Storage	1.2.840.10008.5.1.4.1.1.12.3
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
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
Digital Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.1
Digital Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.1.1
Digital Mammography Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.2
Digital Mammography Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.2.1
Digital Intra Oral Xray Image Storage For Presentation (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.3
Digital Intra Oral Xray Image Storage For Processing (Supp. 32 final text)	1.2.840.10008.5.1.4.1.1.1.3.1
Draft Visible Light Image Storage (Supp. 15 frozen 1997)	1.2.840.10008.5.1.4.1.1.77.1
Draft Visible Light Multi Frame Image Storage (Supp. 15 frozen 1997)	1.2.840.10008.5.1.4.1.1.77.2
Visible Light Endoscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.1
Visible Light Microscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.2
Visible Light Slide Coordinates Microscopic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.3
Visible Light Photographic Image Storage (Supp. 15 draft 07)	1.2.840.10008.5.1.4.1.1.77.1.4
Structured Reporting Text Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.1
Structured Reporting Audio Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.2
Structured Reporting Detail Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.3
Structured Reporting Comprehensive Storage (Supp. 23 frozen 1997)	1.2.840.10008.5.1.4.1.1.88.4

1997)	
RT Beams Treatment Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.4
RT Brachy Treatment Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.6
RT Treatment Summary Record Storage (Supp. 29 draft 0.7)	1.2.840.10008.5.1.4.1.1.481.7
Draft Waveform Storage (Supp. 30 frozen)	1.2.840.10008.5.1.4.1.1.9.1
Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.0
Twelve Lead ECG Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.1
General ECG Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.2
Cardiac Electrophysiology Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.3
Hemodynamic Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.1.4
Basic Audio Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.2.1
High Resolution Audio Waveform Storage (Supp. 30 public comment)	1.2.840.10008.5.1.4.1.1.9.2.2
Grayscale Softcopy Presentation State Storage (Supp. 33 frozen 1998)	1.2.840.10008.5.1.4.1.1.11.1
OFFIS Private Presentation State IPC	1.2.276.0.7230010.3.4.1915765 545.18030.917282194.0

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

3.2.2.2 General

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

Application context name	1.2.840.10008.3.1.1.1
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The maximum PDU length can be configured at installation time in the range 8192..65536 bytes. The default is 16384 bytes.

SOP Class extended negotiation is not supported.

3.2.2.3 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.

3.2.2.4 Asynchronous Nature

Asynchronous mode of operation is not supported.

3.2.2.5 Implementation Identifying Information

The implementation UID of this application is:

OFFIS DCMTK 3.4.0 Implementation Class UID	1.2.276.0.7230010.3.0.3.4.0
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3.2.2.6 Real-World Activity “Image transmission”

An instance of the Store SCU application entity is sparked in order to execute a transmission request.

3.2.2.6.1 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“.

3.2.2.6.2 Association Initiation Policy

The application entity initiates an association with the selected remote Storage SCP. The calling application entity name can be configured, the default is DCMSTATE. The called application entity name must be configured together with the presentation address to be used in the configuration file.

3.2.2.6.3 Proposed Presentation Context Table

The default behaviour 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 behaviour can be changed for each send target in the configuration file such that only the Implicit VR Little Endian transfer syntax is proposed instead.

3.3 Communication Profiles

3.3.1 Supported Communication Stacks

DICOM Upper Layer over TCP/IP is supported.

3.3.2 OSI Stack

Not supported.

3.3.3 TCP/IP Stack

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

3.3.3.1 API

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

3.3.3.2 Physical Media Support

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

3.3.4 Point-to-Point Stack

Not supported.

3.4 Extensions / Specializations / Privatizations

3.4.1 Standard Extended /Specialized/Private SOPs

3.4.1.1 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 application entity 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 Store SCP. However, this behavior may change in future versions.

3.4.2 Private Transfer Syntaxes

Not supported or negotiated.

3.5 Configuration

3.5.1 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.

3.5.2 Configurable Parameters

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

- Listening IP port number
- Maximum PDU size (8192..65536)
- Application entity title (default: DCMSTAT)
- Support for explicit VR transfer syntaxes (default: on)
- Support for UN value representation (default: on)
- Bit-preserving receipt (default: off)

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 (8192..65536)

The number of send targets is not restricted

Store SCU always uses the same application entity title as the Store SCP.

3.6 Support of extended character sets

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

4 INFORMATION OBJECT IMPLEMENTATION

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

4.1 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: As explained in the introduction, this application primarily serves as a trial implementation of DICOM Supplement 33 (Grayscale Softcopy Presentation State Storage). Therefore, the implementation is based on a draft version of the Supplement and not on the final text. The objects created by this implementations are likely to differ in structure and content from the final IOD definition. The reference document for this implementation is the Revised Frozen Draft for Demonstration (Version 18), dated 1998-11-13. For all definitions not present in Supplement 33, the 1998 edition of the DICOM standard is used.

4.1.1 Grayscale Softcopy Presentation State IOD MODULES

IE	Module	Usage	Reference
Patient	Patient	M	4.1.2
Study	General Study	M	4.1.3
	Patient Study	U	4.1.4
Series	General Series	M	4.1.5
	Presentation Series	M	4.1.6
Equipment	General Equipment	M	4.1.7
Presentation	Presentation State	M	4.1.8
	Mask	C	4.1.9
	Display Shutter	C	4.1.10
	Bitmap Display Shutter	C	4.1.11
	Overlay Plane	C	4.1.12
	Overlay/Curve Activation	C	4.1.13
	Displayed Area	M	4.1.14
	Graphic Annotation	C	4.1.15
	Spatial Transformation	C	4.1.16
	Graphic Layer	C	4.1.17
	Modality LUT	C	4.1.18
	VOI LUT	C	4.1.19
	Softcopy Presentation LUT	M	4.1.20
	SOP Common	M	4.1.21

4.1.2 Grayscale Softcopy Presentation State Module Descriptions

4.1.2.1 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

4.1.2.2 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

4.1.2.3 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.

4.1.2.4 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

4.1.2.5 Presentation Series Module

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

4.1.2.6 General Equipment Module

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

4.1.2.7 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	
>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.

4.1.2.8 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).

4.1.2.9 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

4.1.2.10 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	

4.1.2.11 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
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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

4.1.2.12 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	

4.1.2.13 Displayed Area Module

Attribute Name	Tag	Type	VR	VM	Comment
Displayed Area TLHC	(0070,0050)	1	US	2	
Displayed Area BRHC	(0070,0051)	1	US	2	

4.1.2.14 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)	2	SQ	1	Sent when graphic annotations are present.
>Referenced Frame Number	(0008,1160)	1c	IS	1-n	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.
>>Specific Character Set	(0008,0005)	1c	CS	1-n	Sent if the specific character set used for the textual annotation differs from the character set specified in the SOP common module.
>>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 TLHC	(0070,0010)	1c	FL	2	
>>Bounding Box BRHC	(0070,0011)	1c	FL	2	
>>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	

4.1.2.15 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	(0070,0040)	1	IS	1	Enumerated Values: 0, 90,180,270
Image Horizontal Flip	(0070,0041)	1	CS	1	Enumerated Values: Y, N

4.1.2.16 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)	1c	SQ	1	Sent if layers are referenced from the Graphic Annotation Module or the Overlay/Curve Activation Module.
>Graphic Layer	(0070,0002)	1	CS	1	
>Graphic Layer Order	(0070,0062)	1	IS	1	
>Graphic Layer Recommended Display Value	(0070,0066)	3	US	1-3	Sent if value defined by user. Both color and monochrome formats are supported.
>Graphic Layer Description	(0070,0068)	3	LO	1	Sent if value defined by user

4.1.2.17 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)	3	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	US/	1-n	Copied from referenced image object

			SS		
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)

4.1.2.18 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
VOI LUT Sequence	(0028,3010)	3	SQ	1	Copied from referenced image object (first item only)
>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	US/SS	1-n	Copied from referenced image object
Window Center	(0028,1050)	3	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)

4.1.2.19 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	US/SS	1-n	
Presentation LUT Shape	(2050,0020)	1c	CS	1	Enumerated values: NORMAL, INVERSE

4.1.2.20 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.

4.2 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.

4.2.1 Secondary Capture IOD MODULES

IE	Module	Usage	Reference
Patient	Patient	M	4.2.2
Study	General Study	M	4.2.3
	Patient Study	U	Never sent
Series	General Series	M	4.2.4
Equipment	General Equipment	U	Never sent
	SC Equipment	M	4.2.5
Image	General Image	M	4.2.6
	Image Pixel	M	4.2.7
	SC Image	M	4.2.8
	Overlay Plane	U	Never sent
	Modality LUT	U	Never sent
	VOI LUT	U	Never sent
	SOP Common	M	4.2.9

4.2.2 Secondary Capture Module Descriptions

4.2.2.1 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

4.2.2.2 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

4.2.2.3 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

4.2.2.4 SC Equipment Module

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

4.2.2.5 General Image Module

Attribute Name	Tag	Type	VR	VM	Comment
Image 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

4.2.2.6 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

4.2.2.7 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

4.2.2.8 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