Advanced IMRT verification software

OmniPro-I´mRT

DICOM Conformance Statement

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1 Conformance Statement Overview

OmniPro-I´m*RT* is a common platform for digital, film and EPID IMRT verification. To support these functions some of the radiotherapy objects (RT Plan, RT Image and RT Dose) but also the CR Image modality defined by the DICOM standard are supported for import.

Provided Network services:

SOP Classes	Network Role
RT Dose Storage	Service Class Provider
RT Plan Storage	Service Class Provider
RT Image Storage	Service Class Provider

Table 1 Network Services

Provided Media services:

Media Storage Application Profile	Write Files (FSC or FSU)	Read Files (FSR)
General Purpose CD-R	No	Yes
General Purpose DVD-RAM	No	Yes
Magneto - Optical Disc	No	Yes

Table 2 Media Services

Additionally files of modality CR can be read from media (without providing the possibility to import them from DICOMDIR).

2 Introduction

2.1 Revision History

Document Version	Date of Issue	Description
1.0		Released DICOM Conformance Statement for OmniPro Im*RT* 1.6
2.0		Update version numbers

2.2 Scope and Field of Application

The scope of this DICOM Conformance Statement is to facilitate data exchange of OmniPro Im*RT* with other applications. This document specifies the compliance to the DICOM standard (formally called the NEMA PS 3.X standards). It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are: the supported DICOM Service Object Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntaxes.

The field of application is the integration of OmniPro Im*RT* into an environment of medical devices. This Conformance Statement should be read in conjunction with the DICOM standard and its addenda.

2.3 Intended Audience

The intended audience is:

- (potential) customers
- marketing and sales staff interested in system functionality
- support and service personnel.
- system integrators of medical equipment

It is assumed, that the reader is familiar with the DICOM standard.

2.4 Contents and Structure

The DICOM Conformance Statement is contained in chapter 2 through 7 and follows the contents and structuring requirements of DICOM PS 3.2.

2.5 Used Definitions, Terms and Abbreviations

DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see NEMA PS 3.3 and PS 3.4.

2.6 Important Note to the Reader

This Conformance Statement by itself does not guarantee successful interoperability of OmniPro Im*RT* with equipment of other vendors. The user (or user's agent) should be aware of the following issues:

- **Interoperability**

Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a IT environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of OmniPro Im*RT* with equipment of other vendors.

It is the user's responsibility to analyze thoroughly the application requirements and to specify a solution that integrates OmniPro Im*RT* with equipment from other vendors.

- **Validation**

OmniPro Im*RT* has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement.

Where OmniPro Im*RT* is linked to equipment from other vendors, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

- **New versions of the DICOM Standard**

The DICOM Standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. It is planned that OmniPro Im*RT* will be adapted to future versions of the DICOM Standard. In order to do so, changes in the application might be neccessary.

The user should ensure that interfaced equipmement also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into OmniPro Im*RT* may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

2.7 General Acronyms and Abbreviations

This section provides the definitions of terms, acronyms, and abbreviations, which are used throughout the document.

AE	Application Entity
DICOM	Digital Imaging and Communications in Medicine, a standard on image communications in medical applications
NEMA	National Electrical Manufacturers Association
SCU	Service Class User
SCP	Service Class Provider
SOP	Service-Object-Pair, a definition of an information object (like an image) and of a service (like storage) that can be performed for the object
IE	Information Entity
TCP/IP	Transmission Control Protocol / Internet Protocol
Multi-frame Image	Image that contains multiple two-dimensional pixel planes
RLE	Run Length Encoding
UID	Unique Identifier
FSR	File Set Reader
FSC	File Set Creator

2.8 References

[1]	Digital Imaging and Communications in Medicine (DICOM), Parts 1-18 (2007), National Electrical Manufacturers Association (NEMA) 1300 N. 17th Street Rosslyn, VA 22209, United States of America
[2]	VARIAN Vision Rel. 6.5, DICOM Conformance Statement Identification Number: VA7202D3CS Document Version: 7.2.02 Effective Date: June 21 , 2004

3 Networking

3.1 Implementation Model

3.1.1 Application Data Flow Diagram

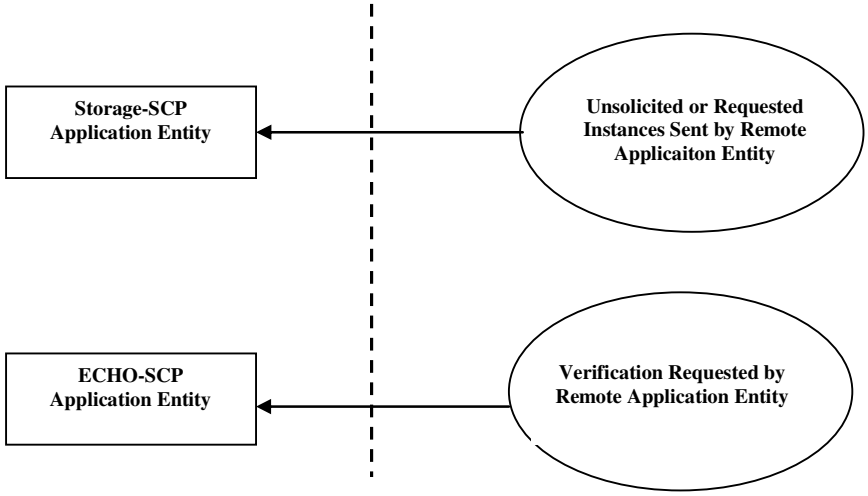

Figure 1 Networking Implementation Model

Conceptually the network services may be modeled as the following separate AEs, though in fact all AEs share a single (configurable) AE Title:

- STORAGE-SCP, which receives incoming images and other composite instances
- ECHO-SCP, which responds to verification requests

3.1.2 Functional Definition of AEs

3.1.2.1 ECHO-SCP

ECHO-SCP waits in the background for connections, will accept associations with Presentation Contexts for SOP Class of the Verification Service Class, and will respond successfully to echo requests.

3.1.2.2 STORAGE-SCP

STORAGE-SCP waits in the background for connections, will accept associations with Presentation Contexts for SOP Classes of the Storage Service Class, and will store the received instances to the local directoy structure where they may subsequently be listed and viewed through the user interface.

The storage SCP is implementented as a windows service which will be started during system boot and runs continously.

3.1.2.3 Sequencing of Real-World Activities

All SCP activities are performed asynchronously in the background and not dependent on any sequencing.

3.2 AE Specifications

3.2.1 ECHO-SCP

3.2.1.1 SOP Classes

ECHO-SCP provice standard conformance to the following SOP Class

SOP Class Name	SOP Class UID	SCU	SCP
Verfication SOP Class	1.2.840.10008.1.1	No	Yes

Table 3 SOP Classes supported by ECHO-SCU

3.2.1.2 Association Policies

3.2.1.2.1 General

ECHO-SCP accepts but never initiates associations.

Maximum PDU size received	Unlimited

Table 4 Maximum PDU size received as a SCP for ECHO-SCP

3.2.1.2.2 Number of Associations

Maximum number of simultaneous associations	Unlimited

Table 5 Number of associations as a SCP for ECHO-SCP

3.2.1.2.3 Asynchronous Nature

ECHO-SCP will only allow a single outstanding operation on an Association. Therefore, ECHO-SCP will not perform asynchronous operations window negotiation.

3.2.1.3 Association Initiation Policy

ECHO-SCP does not initiate associations.

3.2.1.4 Association Acceptance Policy

When ECHO-SCP accepts an association, it will respond to echo requests. If the Called AE Title does not match the pre-configured AE Title shared by all the SCPs of the application, the association will be rejected.

3.2.1.4.1 Activity - Receive Echo Request

3.2.1.4.1.1 Description and Sequencing of Activities

3.2.1.4.1.2 Accepted Presentation Contexts

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

		Little Endian			
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

Table 6 Acceptable presentation contexts for ECHO-SCP and receive ECHO request

3.2.1.4.1.2.1 Extended Negotiation

No extended negotiation is performed.

3.2.1.4.1.3 SOP Specific Conformance

3.2.1.4.1.3.1 SOP Specific Conformance to Verification SOP Class

ECHO-SCP provides standard conformance to the Verification Service Class

3.2.1.4.1.3.2 Presentation Context Acceptance Criterion

ECHO-SCP will always accept any Presentation Context for the supported SOP Classes with the supported Transfer Syntaxes. More than one proposed Presentation Context will be accepted for the same Abstract Syntax if the Transfer Syntax is supported, whether or not it is the same as another Presentation Context.

3.2.1.4.1.3.3 Transfer Syntax Selection Policies

ECHO-SCP prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in a Presentation Context, it will apply the following priority to the choice of Transfer Syntax:

1. first encountered explicit Transfer Syntax,
2. default Transfer Syntax.

ECHO-SCP will accept duplicate Presentation Contexts, that is, if it is offered multiple Presentation Contexts, each of which offers acceptable Transfer Syntaxes, it will accept all Presentation Contexts, applying the same priority for selecting a Transfer Syntax for each.

3.2.2 Storage-SCP

3.2.2.1 SOP Classes

STORAGE-SCP provides Standard Conformance to the following SOP Class(es):

SOP Classes Name	SOP Class UID
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1
CR Image Storage	1.2.840.10008.5.1.4.1.1.1

Table 7 SOP Classes supported by Storage SCP

3.2.2.2 Association Policies

3.2.2.2.1 General

STORAGE-SCP accepts but never initiates associations.

Maximum PDU size received	16384 bit

Table 8 Maximum PDU size received as a SCP for STORAGE-SCP

3.2.2.2.2 Number of Associations

Maximum number of simultaneous associations	Unlimited

Table 9 Number of associations as a SCP for STORAGE-SCP

3.2.2.2.3 Asynchronous Nature

STORAGE-SCP will only allow a single outstanding operation on an Association. Therefore, STORAGE-SCP will not perform asynchronous operations window negotiation.

3.2.2.3 Association Initiation Policy

STORAGE-SCP does not initiate associations.

3.2.2.4 Association Acceptance Policy

When STORAGE-SCP accepts an association, it will respond to echo requests. If the Called AE Title does not match the pre-configured AE Title shared by all the SCPs of the application, the association will be rejected.

3.2.2.4.1 Activity - Receive Storage Request

3.2.2.4.1.1 Description and Sequencing of Activities

All received instances are copied to the local file system and a record inserted into the local database by a windows service called “DICOM Storage SCP”. COMPASS will connect to the service and provide access to the received files for the SOP classes listen in **Error! Reference source not found.**. A browser will be displayed, from which instances may be selected and in turn loaded for further usage.

If the received instance is a duplicate of a previously received instance, the old file and database record will be overwritten with the new one.

3.2.2.4.1.2 Accepted Presentation Contexts

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name	UID		
See Table 7	See Table 7	Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		JPEG Lossless, Non-Hierarchical	1.2.840.10008.1.2.4.57	SCP	None
		JPEG Lossless, Non-Hierarchical, First-Order Prediction	1.2.840.10008.1.2.4.70	SCP	None
		RLE Lossless	1.2.840.10008.1.2.5	SCP	None
		JPEG Extended: Default Transfer Syntax for Lossy JPEG 12 Bit Image Compression	1.2.840.10008.1.2.4.51	SCP	None

Table 10 Accepted Presentation Contexts for STORAGE SCP

3.2.2.4.1.2.1 Extended Negotiation

No extended negotiation is performed, though STORAGE-SCP:

- is a Level 2 Storage SCP (Full – does not discard any data elements)
- does not support digital signatures
- does not coerce any received data elements

3.2.2.4.1.3 SOP Specific Conformance

3.2.2.4.1.3.1 SOP Specific Conformance to Storage SOP Class

STORAGE-SCP provides standard conformance to the Storage Service Class.

3.2.2.4.1.3.2 Presentation Context Acceptance Criterion

STORAGE-SCP will always accept any Presentation Context for the supported SOP Classes with the supported Transfer Syntaxes. More than one proposed Presentation Context will be accepted for the same Abstract Syntax if the Transfer Syntax is supported, whether or not it is the same as another Presentation Context.

3.2.2.4.1.3.3 Transfer Syntax Selection Policies

STORAGE-SCP prefers explicit Transfer Syntaxes. If offered a choice of Transfer Syntaxes in a Presentation Context, it will apply the following priority to the choice of Transfer Syntax:

1. first encountered explicit Transfer Syntax,
2. default Transfer Syntax.

STORAGE-SCP will accept duplicate Presentation Contexts, that is, if it is offered multiple Presentation Contexts, each of which offers acceptable Transfer Syntaxes, it will accept all Presentation Contexts, applying the same priority for selecting a Transfer Syntax for each.

3.3 Network Interfaces

3.3.1 Physical Network Interface

The application is indifferent to the physical medium over which TCP/IP executes; which is dependent on the underlying operating system and hardware.

3.3.2 Additional Protocols

When host names rather than IP addresses are used in the configuration properties to specify presentation addresses for remote AEs, the application is dependent on the name resolution mechanism of the underlying operating system.

3.3.3 IPv4 and IPv6 Support

This product supports both IPv4 and IPv6. It does not utilize any of the optional configuration identification or security features of IPv6.

3.4 Configuration

All configuration is performed through options settings in the application. Refer to the User Manual for specific details.

4 Media Interchange

4.1 Implementation Model

4.1.1 Application Data Flow

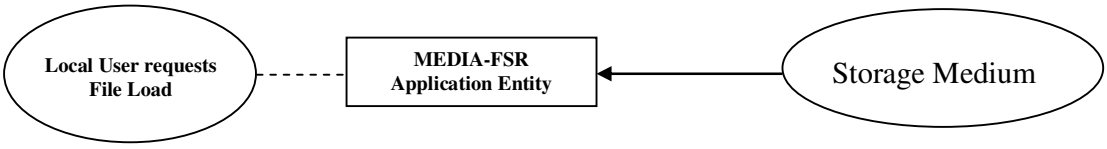

Figure 2 Media Interchange Implementation Model

The application provides a user interface, network support and media support as a File Set Reader (except for import of CR images which cannot be imported by DICOMDIR).

Conceptually it may be modeled as the following single AE:

- MEDIA-FSR, which loads a user-selected PS 3.10 compliant file, which may be a DICOMDIR (except CR) or an image or spectroscopy object, either from the local file system or from PS 3.12 compliant media according to one of the General Purpose Media Application Profiles of PS 3.11 (CD-R or DVD-RAM)

In effect, the application is media-neutral, since the user is required to browse and locate the DICOMDIR file. Furthermore, any DICOM image out of Table 7 SOP Classes supported by Storage SCP may be loaded, even in the absence of a PS 3.10 compliant meta-information header, in which case a "best guess" at the Transfer Syntax will be made.

4.1.2 Functional Definitions of AE's

4.1.2.1 Media FSR

MEDIA-FSR is activated through the user interface to select directories or images for import into the local database or network transmission.

4.1.3 Sequenceing of Real-World Activities

All FSR activities are sequentially initiated in the user interface, and another activity may not be initiated until the prior activity has completed.

4.2 AE Specifications

4.2.1 Media - FSR

MEDIA-FSR provides standard conformance to the Media Storage Service Class.

Application Profiles Supported	Real World Activity	Role
STD-GEN-CD	Load directory or file	FSR
STD-GEN-DVD-RAM	Load directory or file	FSR

Table 11 Application Profiles, Activities, and Roles for MEDIA - FSR

4.2.1.2 Real World Activities

4.2.1.3 Activity – Load Directory or File

MEDIA-FSR is activated through the user interface when a user selects the Browse for DICOM Files or Browse from DICOMDIR operation. In both cases, a browser will be displayed, from which instances may be selected and in turn loaded for further usage.

4.2.1.3.1 Application Profile Specific Conformance

There are no extensions of specializations.

4.3 Augmented and Private Profiles

4.3.1 Augmented Profiles

None.

4.3.2 Private Profiles

None

4.3.3 Media Configuration

None.

5 Support of Extended Character Sets

Extended character sets are not directly supported.

6 Security

6.1 Security Profiles

None supported.

6.2 Association Level Security

None supported.

Any calling AE Title and/or IP address may open an association.

6.3 Application Level Security

None supported.

7 Annexes

7.1 IOD Contents

7.1.1 Usage of Attributes from received IOD's

7.1.1.1 RT Dose Storage SOP class

The STORAGE-SCP conforms to the RT Dose storage service classes at level 0 (local). This means that only the attributes of the dose that can be converted to meaningful information for the OmniPro-I'm*RT* application are utilized.

Attribute Name	Tag	Comments
SOP Class UID	(0008,0016)	Uniquely identifies the SOP Class. Used for determination if data will be accepted
SOP Instance UID	(0008,0018)	Uniquely identifies the SOP Instance.
Patient's Name	(0010,0010)	Used for display purposes only.
Patient ID	(0010,0020)	Used for display purposes only.
Images in Acquisition	(0020,1002)	Number of images that resulted from this acquisition of data
Image Position (Patient)	(0020,0032)	The x, y, and z coordinates of the upper left hand corner (centre of the first voxel transmitted) of the image, in mm.
Pixel Spacing	(0028,0030)	Distance between pixels in image
Normalisation Point	(3004,0008)	If supplied, the origin of the imported dose is set to this position.
Software Versions	(0018,1020)	If "TMS 6.0", the scale factor (3004,000E) is inversed.
Image Orientation (Patient)	(0020,0037)	The direction cosines of the first row and the first column with respect to the patient. The image axes must be aligned with the principal axes of the patient coordinate system.
Rows	(0028,0010)	Rows in image.
Columns	(0028,0011)	Columns in image.
Bits Allocated	(0028,0100)	Number of samples (planes) in this image.16 or 32 supported.
Bits Stored	(0028,0101)	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
Pixel Representation	(0028,0103)	Data representation of the pixel samples. Each sample shall have the same pixel representation.
Number of Frames	(0028,0008)	Number of frames in a Multi-frame Image.
Grid Frame Offset Vector	(3004,000C)	An array which contains the z coordinates (in mm) of the image frames in a multiframe dose. Required if multi-frame pixel data are present and Frame increment Pointer (0028,0009) points to Grid Frame Offset Vector (3004,000C).
Dose Grid Scaling	(3004,000E)	Scaling factor that when multiplied by the dose grid data found in the Pixel Data (7FE0, 0010) attribute of the Image Pixel Module, yields grid doses in the dose units as specified by Dose Units (3004,0002).

Pixel Data	(7FE0,0010)	A data stream of the pixel samples that comprise the Image.

Table 12 Used Attributes for STORAGE-SCP of RT Dose

7.1.1.2 RT Plan Storage SOP class

The STORAGE-SCP conforms to the RT Plan storage service classes at level 0 (local). This means that only the attributes of the plan that can be converted to meaningful information for the OmniPro-I'm*RT* application are utilized.

Only the attributes used for transfer of fluence maps in the Compensator Transmission Data according to [2] are used.

Attribute Name	Tag	Comments
Modality	(0008,0060)	Only "RTPLAN" is accepted.
Beam Sequence	(300A,00B0)	Introduces sequence of treatment beams for current RT Plan. One or more items may be included in this sequence.
Patient's Name	(0010,0010)	Used for display purposes only.
Patient ID	(0010,0020)	Used for display purposes only.
Number of Compensators	(300A,00E0)	Number of compensators associated with current Beam.
Beam Number	(300A,00C0)	Identification number of the Beam.
Beam Name	(300A,00C2)	User-defined name for Beam.
Source-Axis Distance	(300A,00B4)	Radiation source to Gantry rotation axis distance of the equipment that is to be used for beam delivery (mm).
Compensator Sequence	(300A,00E3)	Introduces sequence of treatment compensators. Required if Number of Compensators (300A,00E0) is non-zero. One or more items may be included in this sequence.
Compensator Type	(3004,00EE)	Type of compensator (if any). Only "OPTIMAL" and "TOTAL ACTUAL" types are read
Compensator Rows	(300A,00E7)	Number of rows in the compensator.
Compensator Columns	(300A,00E8)	Number of columns in the compensator.
Compensator Pixel Spacing	(300A,00E9)	Physical distance (in mm) between the center of each pixel projected onto machine isocentric plane. Specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing.
Compensator Position	(300A,00EA)	The x and y coordinates of the upper left hand corner (first pixel transmitted) of the compensator, projected onto the machine isocentric plane in the IEC BEAM LIMITING DEVICE coordinate system (mm).
Compensator Transmission Data	(300A,00EB)	A data stream of the pixel samples which comprise the fluence map. The values are not limited between 0 and 1. The order of pixels sent is left to right, top to bottom, i.e., the upper left pixel is sent first followed by the remainder of the first row , followed by the first pixel of the 2nd row, then the remainder of the 2nd row and so on) when viewed from the radiation source..

Table 13 Used Attributes for STORAGE-SCP of RT Plan

7.1.1.3 RT Image Storage SOP class

The STORAGE-SCP conforms to the RT Image storage service classes at level 0 (local). This means that only the attributes of the image that can be converted to meaningful information for the OmniPro-I'mRT application are utilized.

Modality LUT and VOI LUT transformation will be applied to the image data if available (see section 7.1.1.4 and 7.1.1.5).

Attribute Name	Tag	Attribute Description
SOP Class UID	(0008,0016)	Uniquely identifies the SOP Class. Used for determination if data will be accepted
SOP Instance UID	(0008,0018)	Uniquely identifies the SOP Instance.
Image Type	(0008,0008)	Image identification characteristics. RT Images shall use one of the following Defined Terms for Value 3: DRR = digitally reconstructed radiograph PORTAL = digital portal image or portal film image SIMULATOR = conventional simulator image RADIOGRAPH = radiographic image BLANK = image pixels set to background value FLUENCE = fluence map Only PORTAL, FLUENCE and DRR will be supported in the current version.
Patient's Name	(0010,0010)	Patient's full name
Patient ID	(0010,0020)	Primary hospital identification number or code for the patient
Pixel Spacing	(0028,0030)	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Rows	(0028,0010)	Number of rows in the image.
Columns	(0028,0011)	Number of columns in the image
Bits Allocated	(0028,0100)	Number of samples (planes) in this image.
Bits Stored	(0028,0101)	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
Pixel Representation	(0028,0103)	Data representation of the pixel samples. Each sample shall have the same pixel representation.
Number of Frames	(0028,0008)	Number of frames in a Multi-frameImage.
Pixel Data	(7FE0,0010)	A data stream of the pixel samples that comprise the Image.
RT Image Plane	(3002,000C)	Describes whether or not image plane is normal to beam axis. Enumerated Values: NORMAL = image plane normal to beam axis NON_NORMAL = image plane non-normal to beam axis Only NORMAL will be supported in the current version
X-Ray Image Receptor Translation	(3002,000D)	Position in (x,y,z) coordinates of origin of IEC X-RAY IMAGE RECEPTOR System in the IEC GANTRY coordinate system (mm).
X-Ray Image Receptor Angle	(3002,000E)	X-Ray Image Receptor Angle i.e.orientation of IEC X-RAY IMAGE RECEPTOR coordinate

		system with respect to IEC GANTRY coordinate system (degrees).
Image Plane Pixel Spacing	(3002,0011)	Physical distance (in mm) between the center of each image pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing. Will be used in case pixel spacing is not available.
RT Image Position	(3002,0012)	The x and y coordinates (in mm) of the upper left hand corner of the image, in the IEC X-RAY IMAGE RECEPTOR coordinate system. This is the center of the first pixel transmitted.
Radiation Machine SAD	(3002,0022)	Radiation source to Gantry rotation axis distance of radiation machine used in acquiring or computing image (mm).
Radiation Machine SSD	(3002,0024)	Source to patient surface distance (in mm) of radiation machine used in acquiring or computing image.
RT Image SID	(3002,0026)	Distance from radiation machine source to image plane (in mm) along radiation beam axis.
Grid Frame Offset Vector	(3004,000C)	An array which contains the z coordinates (in mm) of the image frames in a multiframe dose. Required if multi-frame pixel data are present and Frame increment Pointer (0028,0009) points to Grid Frame Offset Vector (3004,000C).
Pixel Data	(7FE0,0010)	A data stream of the pixel samples that comprise the Image.

Table 14 Used Attributes for STORAGE-SCP of RT Image

7.1.1.4 MODALITY LUT module

The Modality LUT IE defines the Attributes that describe the transformation of manufacturer dependent pixel values into pixel values, which are manufacturer independent (e.g. Hounsfield units for CT, Optical Density for film digitizers, etc.).

The modality LUT module is implemented as part of an image only and not as standalone module.

If Rescale Type is OD, the number in the LUT represents thousands of optical density. That is, a value of 2140 represents an optical density of 2.140.

Attribute Name	Tag	Attribute Description
Modality LUT Sequence	(0028,3000)	Defines a sequence of Modality LUTs. Only one Item may be present. Shall not be present if Rescale Intercept (0028,1052) is present.
>LUT Descriptor	(0028,3002)	Specifies the format of the LUT Data in this Sequence. Required if the Modality LUT Sequence (0028,3000) is sent.
>LUT Explanation	(0028,3003)	Free form text explanation of the meaning of the LUT.
>Modality LUT Type	(0028,3004)	Specifies the output values of this Modality LUT. Required if the Modality LUT Sequence (0028,3000) is sent.
>LUT Data	(0028,3006)	LUT Data in this Sequence. Required if the Modality LUT Sequence (0028,3000) is sent.
Rescale Intercept	0028,1052)	The value b in relationship between stored values (SV) and the output units specified in Rescale Type (0028,1054). Output units = m*SV

		+ b. Required if Modality LUT Sequence (0028,3000) is not present. Shall not be present otherwise.
Rescale Slope	(0028,1053)	m in the equation specified by Rescale Intercept (0028,1052). Required if Rescale Intercept is present.
Rescale Type	(0028,1053)	Specifies the output units of Rescale Slope (0028,1053) and Rescale Intercept (0028,1052).

Table 15 Used Attributes of Modality LUT module

7.1.1.5 VOI LUT module

The VOI LUT IE defines the Attributes that describe the transformation of the modality pixel values into pixel values that are meaningful for print, display, etc. This transformation is applied after any Modality LUT.

The VOI LUT module is implemented as part of an image only and not as standalone module. Only the first item of the VOI LUT sequence will be used and there is no possibility to select another available VOI LUT sequence item.

Attribute Name	Tag	Attribute Description
VOI LUT Sequence	(0028,3010)	Defines a sequence of VOI LUTs.
>LUT Descriptor	(0028,3002)	Specifies the format of the LUT Data in this Sequence.
>LUT Explanation	(0028,3003)	Free form text explanation of the meaning of the LUT.
>LUT Data	(0028,3006)	LUT Data in this Sequence. Required if the VOI LUT Sequence (0028,3010) is sent.
Window Center	(0028,1050)	Window Center for display.
Window Width	(0028,1051)	Window Width for display.

Table 16 Used Attributes of VOI LUT module

7.1.1.6 CR Image

Attribute Name	Tag	Attribute Description
SOP Class UID	(0008,0016)	Uniquely identifies the SOP Class. Used for determination if data will be accepted
SOP Instance UID	(0008,0018)	Uniquely identifies the SOP Instance.
Patient's Name	(0010,0010)	Patient's full name
Patient ID	(0010,0020)	Primary hospital identification number or code for the patient
Imager Pixel Spacing	(0018,1164)	Physical distance measured at the front plane of the Image Receptor housing between the center of each pixel. Specified by a numeric pair - row spacing value (delimiter) column spacing value - in mm. Will be used for instead of pixel spacing if this attribute is not available.
Pixel Spacing	(0028,0030)	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Rows	(0028,0010)	Number of rows in the image.
Columns	(0028,0011)	Number of columns in the image
Bits Allocated	(0028,0100)	Number of samples (planes) in this image.

Bits Stored	(0028,0101)	Number of bits stored for each pixel sample. Each sample shall have the same number of bits stored.
Pixel Representation	(0028,0103)	Data representation of the pixel samples. Each sample shall have the same pixel representation.
Number of Frames	(0028,0008)	Number of frames in a Multi-frameImage.
Pixel Data	(7FE0,0010)	A data stream of the pixel samples that comprise the Image.
Grid Frame Offset Vector	(3004,000C)	An array which contains the z coordinates (in mm) of the image frames in a multiframe dose. Required if multi-frame pixel data are present and Frame increment Pointer (0028,0009) points to Grid Frame Offset Vector (3004,000C).
Pixel Data	(7FE0,0010)	A data stream of the pixel samples that comprise the Image.

Table 17 Used Attributes of CR image