

DICOM CONFORMANCE STATEMENT

modiCAS||plan
V.2.2.3

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1 Conformance Statement Overview

modiCAS||plan supports surgery planning for hip or knee replacements. It supports receiving Computed Radiography Images, Digital X-Ray Images (For Presentation, For Processing) and Secondary Capture Images. Such images can also be loaded from local or network storage. The result of the planning procedure is stored locally or on network storage as a Secondary Capture Image or can be sent as such to a configured DICOM Storage SCP.

SOP Classes	User of Service (SCU)	Provider of Service (SCP)
Verification		
Verification	No	Yes
Transfer (Image SOP Class)		
Computed Radiography Image Storage	No	Yes
Digital X-Ray Image Storage - For Presentation	No	Yes
Digital X-Ray Image Storage - For Processing	No	Yes
Secondary Capture Image Storage	Yes	Yes

Network Services

Name	Value
Application Context Name	1.2.840.100008.3.1.1.1
Implementation Class UID	1.2.276.0.7230010.3.0.3.6.0
Implementation Version Name	OFFIS_DCMTK_360

Implementation Identifying Information

2 Introduction

2.1 Audience

This DCS is written for people that need to understand how *modiCAS||plan* will integrate into their healthcare facility. This includes both those responsible for overall imaging network policy and architecture, as well as integrators who need to have a detailed understanding of the DICOM features of the product. However, integrators are expected to fully understand all the DICOM terminology, how the tables in this document relate to the product's functionality, and how that functionality integrates with other devices that support compatible DICOM features.

2.2 Remarks

The scope of this DICOM Conformance Statement is to facilitate integration between *modiCAS||plan* and other DICOM products. The Conformance Statement should be read and understood in conjunction with the DICOM Standard. DICOM by itself does not guarantee interoperability. The Conformance Statement does, however, facilitate a first-level comparison for interoperability between different applications supporting compatible DICOM functionality.

This Conformance Statement is not supposed to replace validation with other DICOM equipment to ensure proper exchange of intended information. In fact, the user should be aware of the following important issues:

- The comparison of different Conformance Statements is only the first step towards assessing interconnectivity and interoperability between the product and other DICOM conformant equipment.
- Test procedures should be defined and executed to validate the required level of interoperability with specific compatible DICOM equipment, as established by the healthcare facility.

2.3 Terms, Definitions and Abbreviations

Informal definitions are provided for the following terms used in this Conformance Statement. The DICOM Standard is the authoritative source for formal definitions of these terms.

Term	Definition
Abstract Syntax	The information agreed to be exchanged between applications, generally equivalent to a Service/Object Pair (SOP) Class. Examples: Verification SOP Class, Secondary Capture Image Storage, Computed Radiography Image Storage SOP Class.
Application Entity (AE)	A DICOM information exchange implementation, including the DICOM network or media interface software; i.e., the software that sends or receives DICOM information objects or messages. A single device may have multiple Application Entities.
Application Entity Title (AET)	The unique name of an <i>Application Entity</i> , used to identify a DICOM application to other DICOM applications on a given network.
Association	A network communication channel set up between two <i>Application Entities</i> .

Term	Definition
Attribute	A unit of information in an object definition; a data element identified by a <i>tag</i> . The information may be a complex data structure (Sequence), composed of lower level data elements. Examples: Patient ID (0010,0020), Accession Number (0008,0050), Source Image Sequence (0008,2112).
Information Object Definition (IOD)	The specified set of <i>Attributes</i> that comprise a type of data object; does not represent a specific instance of the data object, but rather a class of similar data objects that have the same properties. The <i>Attributes</i> may be specified as Mandatory (Type 1), Required but possibly unknown (Type 2), or Optional (Type 3), and there may be conditions associated with the use of an Attribute (Types 1C and 2C). Examples: SC Image IOD, DX Image IOD.
Module	A set of <i>Attributes</i> within an <i>Information Object Definition</i> that are logically related to each other. Example: Patient Module includes Patient Name, Patient ID, Patient Birth Date, Patient Sex et al.
Negotiation	First phase of <i>Association</i> establishment that allows <i>Application Entities</i> to agree on the types of data to be exchanged and how that data will be encoded.
Presentation Context	The set of DICOM network services used over an <i>Association</i> , as negotiated between <i>Application Entities</i> ; includes <i>Abstract Syntaxes</i> and <i>Transfer Syntaxes</i> .
Protocol Data Unit (PDU)	A packet (piece) of a DICOM message sent across the network. Devices must specify the maximum size packet they can receive for DICOM messages.
Service Class Provider (SCP)	Role of an <i>Application Entity</i> that provides a DICOM network service; typically, a server that performs operations requested by another <i>Application Entity (Service Class User)</i> . Examples: Picture Archiving and Communication System (image storage SCP, and image query/retrieve SCP), Radiology Information System (modality worklist SCP).
Service Class User (SCU)	Role of an <i>Application Entity</i> that uses a DICOM network service; typically, a client. Examples: imaging modality (image storage SCU, and modality worklist SCU), imaging workstation (image query/retrieve SCU)
Service/Object Pair (SOP) Class	The specification of the network or media transfer (service) of a particular type of data (object); the fundamental unit of DICOM interoperability specification. Examples: Secondary Capture Image Storage Service.
Service/Object Pair (SOP) Instance	An information object; a specific occurrence of information exchanged in a <i>SOP Class</i> . Examples: a specific x-ray image.
Tag	A 32-bit identifier for a data element, represented as a pair of four digit hexadecimal numbers, the "group" and the "element". Examples: Patient ID (0010,0020)
Transfer Syntax	The encoding used for exchange of DICOM information objects and messages.
Unique Identifier (UID)	A globally unique "dotted decimal" string that identifies a specific object or a class of objects; an ISO-8824 Object Identifier. Examples: Study Instance UID, SOP Class UID, SOP Instance UID.

Term	Definition
Value Representation (VR)	The format type of an individual DICOM data element, such as text, an integer, a person's name, or a code. DICOM information objects can be transmitted with either explicit identification of the type of each data element (Explicit VR), or without explicit identification (Implicit VR); with Implicit VR, the receiving application must use a DICOM data dictionary to be able to identify the format of each data element.

Defintions

2.4 References

NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/>

3 Networking

3.1 Implementation Model

Verification

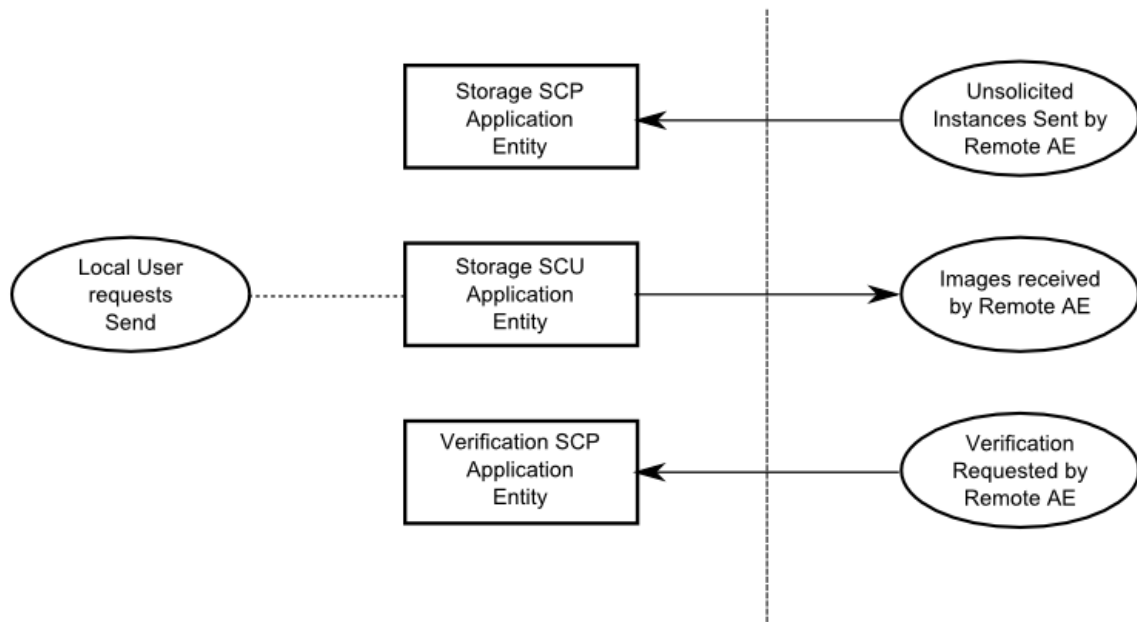
modiCAS||plan responds to Verification requests from remote nodes. The Verification Request is handled by the Storage SCP.

Storage

The DICOM implementation of *modiCAS||plan* is able to initiate associations for Storage of Secondary Capture DICOM Composite Information Objects to Remote AEs and to receive and respond to associations for Storage from Remote AEs.

3.1.1 Application Data Flow

The following figure represents the functionality of *modiCAS||plan*. The graphical layout does not necessarily represent the actual design of the software.



DICOM Standard Interface

Implementation Model Data Flow

3.1.2 Functional Definitions of AEs

3.1.2.1 Verification SCP

ECHO-SCP (as part of STORAGE SCP) waits in the background for incoming connections, where it will accept associations with Presentation Contexts for SOP Class of the Verification Service Class and responds with 'success' to echo requests.

3.1.2.2 Storage SCU

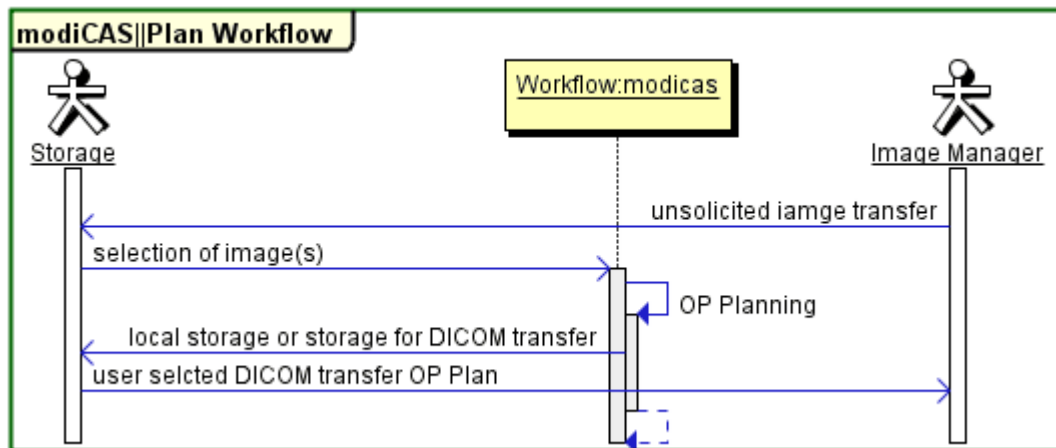
STORAGE-SCU is activated through the user interface when a user selects to send the processed image from the User Interface (currently displayed instance) to a remote AE (pre-configured

single target).

3.1.2.3 Storage SCP

STORAGE-SCP waits in the background for incoming connections, where it will accept associations with Presentation Contexts for SOP Classes of the Storage Service Class and stores the received instances to the local database, where they may subsequently be opened and processed through the user interface.

3.1.3 Sequencing of Activities



Sequencing of Activities

For surgical planning of a hip or knee replacement procedure, the operator selects one or more images from either local or network storage, or selects one or more images from a list of images sent to modiCAS||plan via DICOM transfer from a remote Image Manager.

Using implants, measurements (lines, circles, angles and others) or additional supporting information, the operator creates the operation plan (OP Plan). The OP Plan can be saved locally for further refinement at a later time.

When finalized, the OP Plan can be stored on a network storage directory or sent via DICOM transfer to a remote AET, e.g. an Image Management Server.

3.2 Application Entity Specification

3.2.1 Verification SCP AE Specification

3.2.1.1 SOPClasses

For SOP Classes supported, please refer to Table 1 – Network Services (Provider of Service) in the DCS Overview.

3.2.1.2 Association Policies

ECHO-SCP accepts but never initiates associations.

3.2.1.2.1 Number of Associations

ECHO-SCP accepts one association at a time to response to a request for verification.

3.2.1.2.2 Asynchronous Nature

ECHO-SCP software does not support asynchronous communication (multiple outstanding transactions over a single association).

3.2.1.2.3 Implementation Identifying Information

For Implementation Identifying Information please refer to Table 2 – Implementation Identifying Information in the DCS Overview.

3.2.1.3 Associations Initiation Policy

Does not apply.

3.2.1.4 Association Acceptance Policy

modiCAS||plan DICOM application accepts incoming DIMSE C-ECHO Verification requests.

3.2.2 Storage SCP AE Specification

3.2.2.1 SOP Classes

For SOP Classes supported, please refer to Table 1 – Network Services (Provider of Service) in the DCS Overview.

3.2.2.2 Association Policies

modiCAS||plan will accept instances of SOP Classes according to Table 1 – Network Services (Provider of Service) in the DCS Overview. There is no limit on the number of presentation contexts accepted except for the DICOM limit. In the event that the **modiCAS||plan** DICOM application runs out of resources, it will reject the association request.

modiCAS||plan will support the following Transfer Syntaxes as SCP

Presentation Context Table – “Store SCP”				
Abstract Syntax Description	Transfer Syntax Name List	Transfer Syntax UID List	Role	Ext. Neg.
SOP Classes Table 1 (column SCP)	JPEG Lossless (Process 14)	1.2.840.10008.1.2.4.70	SCP	None
	JPEG 2000 Lossless Only	1.2.840.10008.1.2.4.90		
	Explicit VR Little Endian	1.2.840.10008.1.2.1		
	Explicit VR Big Endian	1.2.840.10008.1.2.2		
	Implicit VR Little Endian	1.2.840.10008.1.2		

Presentation Contexts Store SCP

The default PDU size used will be 16 kB (max 128 kB).

3.2.2.2.1 Number of Associations

modiCAS||plan Storage-SCP accepts one association at a time.

3.2.2.2.2 Asynchronous Nature

modiCAS||plan Storage-SCP software does not support asynchronous communication (multiple outstanding transactions over a single association).

3.2.2.2.3 Implementation Identifying Information

For Implementation Identifying Information please refer to Table 2 – Implementation Identifying Information in the DCS Overview.

3.2.2.3 Association Initiation Policy

Does not apply.

3.2.2.4 Association Acceptance Policy

The *modiCAS||plan* DICOM application accepts incoming DIMSE C-STORE Storage requests. *modiCAS||plan* has two modes of acceptance policy depending on the entry for Remote AET in the "Application Settings / DICOM Settings".

In case a name for an AET is entered, *modiCAS||plan* will only accept Associations from this AET. In case this field remains empty or carries the name ANY-SCP, associations will be accepted from any SCU. Host and AET have to be entered in "Application Settings / DICOM Settings " by an administrator of that system (see also chapter 4.4 - Configuration).

3.2.3 Storage SCU AE Specification

3.2.3.1 SOP Classes

For SOP Classes supported, please refer to Table 1 – Network Services (Provider of Service) in the DCS Overview.

3.2.3.2 Association Policies

modiCAS||plan will attempt to send the processed image from the User Interface (currently displayed instance) to a remote AE (pre-configured single target). This service is activated through the user interface. In case an OP Plan consists of two or more images, each image has to be sent individually.

In case the remote Service Provider is not able to accept an association, an appropriate message will be displayed to the user.

The default PDU size used will be 16 KB.

3.2.3.2.1 Number of Associations

modiCAS||plan Storage-SCU initiates a single association at a time.

3.2.3.2.2 Asynchronous Nature

modiCAS||plan Storage-SCU software does not support asynchronous communication (multiple outstanding transactions over a single association).

3.2.3.2.3 Implementation Identifying Information

For Implementation Identifying Information please refer Table 2 – Implementation Identifying Information in the DCS Overview.

3.2.3.3 Association Initiation Policy

In case a user requests DICOM Send, *modiCAS||plan* will attempt to initiate a new association for Secondary Caption Image Storage SOP CLASS to send a single image (currently displayed instance) to the configured destination.

3.2.3.3.1 Activity – “Send to ...”

The C-STORE request is triggered by a user interaction. If the process successfully establishes an association to a remote Application Entity, it will transfer a single image (currently displayed instance) via the open association.

If the C-STORE Response from the remote Application contains a status other than “Success” or “Warning”, the association is aborted.

With success status for the transfer, the association will be closed.

3.2.3.3.2 Proposed Presentation Contexts

Presentation Context Table – “Send to ...”					
Abstract Description	Syntax	Transfer Syntax Name List	Transfer Syntax UID List	Role	Ext. Neg.
Secondary Capture SOP CLASS (Send Compressed - disabled)		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCU	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		
Secondary Capture SOP CLASS (Send Compressed - activated)		JPEG Lossless (Process 14)	1.2.840.10008.1.2.4.70	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		Implicit VR Little Endian	1.2.840.10008.1.2		

Presentation ContextsSend to...

3.2.3.3.3 SOP-specific Conformance – “Sen to ...”

The DICOM images sent by **modiCAS||plan** DICOM application conform to the DICOM IOD Definition (Secondary Capture Standard extended IOD).

The matrix size depends on screen resolution and operator’s usage of the screen area (see also chapter 8.2 – Matrix Sizes).

Please refer to the Image Object definition table in chapter 8.1 - IOD Content for a list of all DICOM IOD attributes of type 1, 2 and 3, which are encoded by the **modiCAS||plan** application.

3.2.3.4 Association Acceptance Policy

Does not apply.

3.3 Networking Interfaces

3.3.1 Physical Network Interface

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

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 Supported Operating Systems

modiCAS||plan requires Windows XP SP 3 or higher (Vista, Windows 7). Both, 32 bit and 64 bit systems are supported.

3.4 Configuration

The parameters can be configured by a user with administrative privileges in „Application Settings“ / „DICOM Settings“

Parameter Name	SCP (Remote Service)	SCU (Local Service)	Default
DICOM Receive Directory	Directory <i>modiCAS plan</i> uses to read DICOM-sent images from		User Documents/Received DICOM Series
Exported Images Directory		Directory <i>modiCAS plan</i> uses to write images to	User Documents/Exported Images
Local Port	Port number <i>modiCAS plan</i> listens to incoming requests		104
Local AET	"defined AET" or „empty" (1)		MODICAS (3)
Remote Host		Hostname or IP-Address	localhost
Remote Port		Port number <i>modiCAS plan</i> tries to send to	4499
Remote AET		ANY-SCP or "defined AET" (2)	ANY-SCP (3)
Send Monochrome		If checkmark set, <i>modiCAS plan</i> will send images monochrome (4)	Checkmark set
Send Compressed		If checkmark set, <i>modiCAS plan</i> will negotiate JPEG Lossless Transfer Syntax	Checkmark not set

DICOM Configuration

(1): If a specific name is entered into the field „Local AET“, *modiCAS||plan* will only accept requests from AETs with this „specific name“ in their field "Remote SCP".

If the field „Local Port“ is empty, *modiCAS||plan* will accept requests from all AETs with "ANY-SCP" or "MODICAS" in their field "Remote SCP".

(2): If a specific name is entered into the field „Remote Port“, *modiCAS||plan* will send requests with this „specific name“.

If the field „Remote Port“ is empty, *modiCAS||plan* will send requests with the AET "ANY-SCP". The acceptance of such a request by the remote application is application-specific to the remote application.

(3): The DICOM Standard restricts an AET to max 16 characters 7-bit ASCII, no Control Characters must be used. For connectivity reasons with other DICOM implementations only capital letters should be used. The use of leading and/or trailing spaces should be avoided because of the same reasons.

(4): If the checkmark is not set, *modiCAS||plan* will send the OP Plan as Secondary Capture RGB pixel interleaved (color by pixel) image.

Timeout Values [sec] and PDU Size			
Parameter	SCU	SCP	Comment
Association Request	30	30	Accepting or Rejecting an Association Request
DICOM Message	∞	∞	Accepting a DICOM Message
PDU Size [bytes]	16384	16384	For SCP: a maximum of 131072 bytes is accepted

Timeouts

4 Media Interchange

Not supported.

5 Support of Character Sets

modiCAS||plan supports all character sets of incoming images. Secondary Capture Operation Plan images will carry the same value within 0008,0005 as in the original image.

6 Security

modiCAS||plan does not support any specific security measures.

modiCAS||plan supports security utilizing the firewall of the underlying operating system.

modiCAS||plan only accepts associations from other systems if this system's host name, AET and port is configured accordingly within the application settings of *modiCAS||plan*.

7 Additional Information

7.1 IOD Content (SC IOD)

This section describes the Secondary Capture IODs which are created by this implementation when the user activates the "Send DICOM" function.

Attribute Name	Tag	Type	Comment
Specific Character Set	0008,0005	1C	from Original
Image Type	0008,0008	1	DERIVED\SECONDARY
SOP Class UID	0008,0016	1	SecondaryCaptureImageStorage (1.2.840.10008.5.1.4.1.1.7)
SOP Instance UID	0008,0018	1	new Value
Study Date	0008,0020	2	from Original
Series Date	0008,0021	3	new Value
Content Date	0008,0023	2C	new Value
Study Time	0008,0030	2	from Original
Series Time	0008,0031	3	new Value
Content Time	0008,0033	2C	new Value
Accession Number	0008,0050	2	from Original
Modality	0008,0060	1	from Original
Conversion Type	0008,0064	1	WSD
Manufacturer	0008,0070	2	modicas GmbH
Institution Name	0008,0080	3	from "Settings/General"
Institution Address	0008,0081	3	from "Settings/General"
Referring Physician's Name	0008,0090	2	from Original
Station Name	0008,1010	3	from "hostname"
Study Description	0008,1030	3	from Original
Series Description	0008,103E	3	from "Planning Properties/Description"
Institutional Department Name	0008,1040	3	from "Settings/General"
Performing Physician's Name	0008,1050	3	from "Planning Properties/Physician"
Operator's Name	0008,1070	3	>/+ WinUserName
Manufacturer's Model Name	0008,1090	3	modiCAS plan <Application Version>
Derivation Description	0008,2111	3	Lossless JPEG compression ...
Source Image Sequence	0008,2112	3	new Attribute (references the SOP Class UID and the SOP Instance UID of the original image used the OP Plan)
Derivation Code Sequence	0008,9215	3	new Attribute (Full fidelity image)
Patient's Name	0010,0010	2	from Original
Patient ID	0010,0020	2	from Original
Patient's Birth Date	0010,0030	2	from Original
Patient's Birth Time	0010,0032	3	from Original
Patient's Sex	0010,0040	2	from Original
Patient's Weight	0010,1030	3	from Original
Ethnic Group	0010,2160	3	from Original

Attribute Name	Tag	Type	Comment
Occupation	0010,2180	3	from Original
Date of Secondary Capture	0018,1012	3	as 0008,0023
Time of Secondary Capture	0018,1014	3	as 0008,0033
Secondary Capture Device Manufacturer	0018,1016	3	modiCAS GmbH
Secondary Capture Device Manufacturers Model Name	0018,1018	3	modiCAS plan V<Application Version>
Secondary Capture Device Software Versions	0018,1019	3	<Application Version>
Nominal Scanned Pixel Spacing	0018,2010	3	as 0028,0030
Study Instance UID	0020,000D	1	from Original
Series Instance UID	0020,000E	1	new Value
Study ID	0020,0010	2	from Original
Series Number	0020,0011	2	1
Instance Number	0020,0013	2	1
Patient Orientation	0020,0020	1C	from Original (or modified by user)
Laterality	0020,0060	2C	from Original (or modified by user)
Samples per Pixel	0028,0002	1	1 or 3 (RGB)
Photometric Interpretation	0028,0004	1	MONOCHROME2 or RGB
Planar Configuration	0028,0006	1C	0 (only RGB)
Rows	0028,0010	1	depending on zoom
Columns	0028,0011	1	depending on zoom
Pixel Spacing	0028,0030	1C	depending on zoom
Bits Allocated	0028,0100	1	8
Bits Stored	0028,0101	1	8
High Bit	0028,0102	1	7
Pixel Representation	0028,0103	1	0
Smallest Image Pixel Value	0028,0106	3	depending image content (only MONOCHROME2)
Largest Image Pixel Value	0028,0106	3	depending image content (only MONOCHROME2)
Window Center	0028,1050	1C	128 (only MONOCHROME2)
Window Width	0028,1051	1C	256 (only MONOCHROME2)
Lossy Image Compression	0028,2110	3	from Original
Pixel Data	7FE0,0010	1	new Value

SC IOD

7.2 Matrix Sizes

The matrix size for the OP Plan images sent (or stored) is based on two facts:

1. Physically available display matrix size of the planning area and
2. Bounding box of image used for planning including any text, lines, circles or other measurements outside of the image.

Therefore, to increase the resolution of the OP Plan result image, it is advisable to

- Avoid text, lines or the like outside the planning image and
- To zoom the image with the OP Plan planning details filling the available screen.