



VELOCITY
DICOM CONFORMANCE
STATEMENT

VELOCITY 4.0



PD0001_DIC

JAN 2016

Abstract	This document provides information about the DICOM Conformance of Velocity 4.0.
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1 Introduction

1.1 Purpose and Limitations

The Velocity software application is used for the registration, fusion, annotation and display of medical images from multi-modalities. This document describes the complete set of DICOM functionality provided by Velocity. The Velocity server application supports C-ECHO, C-STORE, C-FIND and C-MOVE as both a Service Class User (SCU) and Service Class Provider (SCP).

The Velocity standalone workstation application provides a subset of these DICOM features which does not include the C-FIND SCP and C-MOVE SCP Application Entities.

1.2 Notice

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1.3 Definitions

Table 1-1 Table of Definitions

Item	Definition
AE	Application Entity
CT	Computed tomography images
DICOM	Digital Imaging and Communications in Medicine, a standard on image communications in medical applications
DIMSE	DICOM Message Service element
FSC	File-set Creator
FSR	File-set Reader
IE	Information Entity
IOD	Information Object Definition
MR	Magnetic resonance imaging
NEMA	National Electrical Manufacturers Association

NM	Nuclear medicine imaging
PDU	Protocol Data Unit
PT	Positron emission tomography imaging
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
SPECT	Single photon emission computed tomography
TCP/IP	Transmission Control Protocol / Internet Protocol, a widely used computer networking protocol
VR	Value Representation, a data encoding method in DICOM; Multi-frame ImageImage that contains multiple two-dimensional pixel planes
UID	Unique Identifier used to identify an object by a worldwide unique identifier

1.4 Related Documents

[1] Digital Imaging and Communications in Medicine (DICOM), Parts 1-14 (2009), National Electrical Manufacturers Association (NEMA) Rosslyn, VA United States of America.

1.5 Intended Audience

The reader of this document is concerned with software design and/or system integration issues.

It is assumed that the reader of this document is familiar with the DICOM 3.0 Standard and with the terminology and concepts which are used in this standard.

This document specifies the compliance of Velocity to file reading/writing and file transferring support to the DICOM 3.0 standard.

2 Implementation Model

The Application Entities Data Flow diagram illustrates the DICOM functionality provided by Velocity.

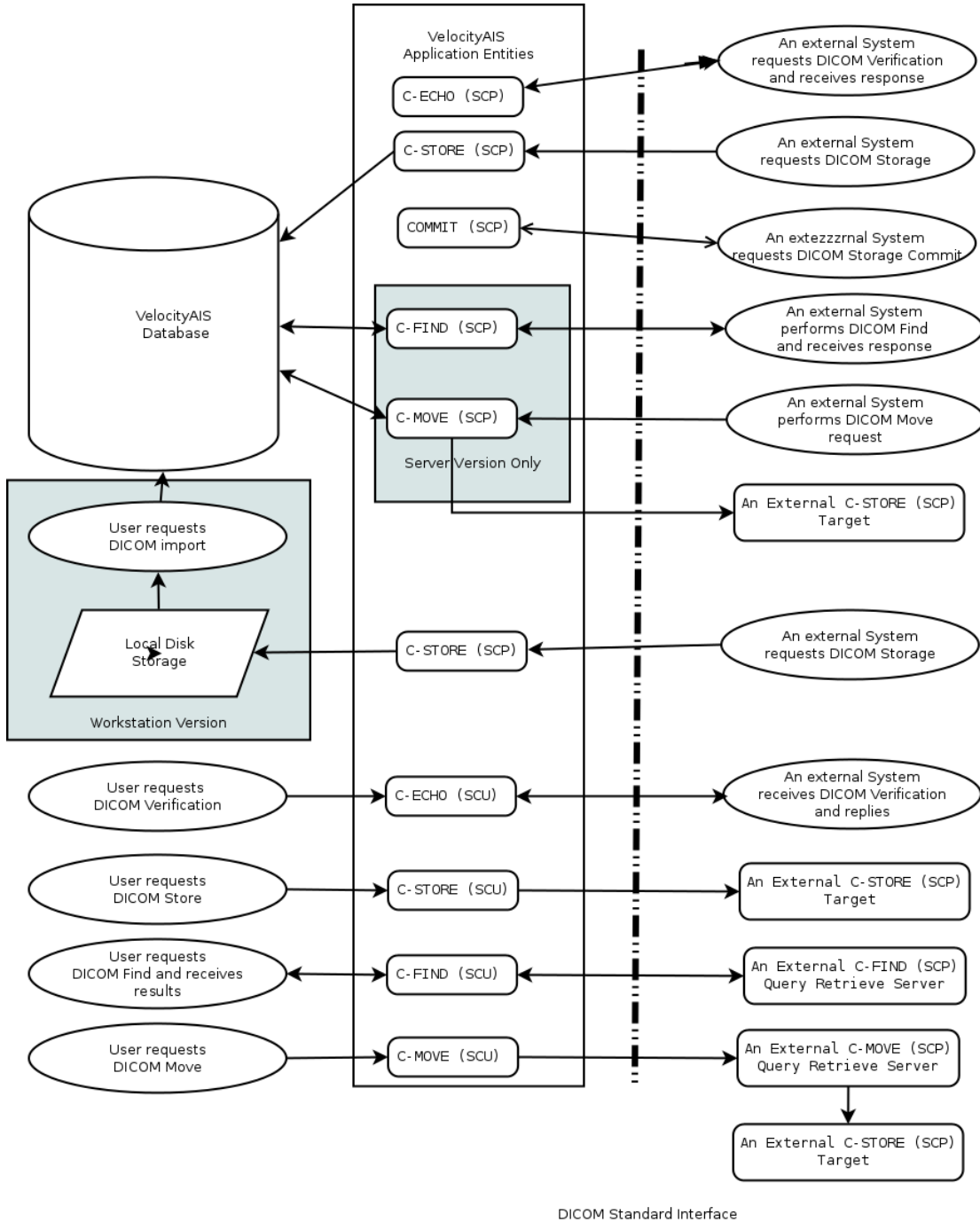


Figure 2-1 Velocity SCU Application Entities Data Flow Diagram

2.1 Functional Definition of Application Entities

2.1.1 C-ECHO (SCU), (SCP)

Velocity can send and respond to DICOM Verification requests.

2.1.2 C-STORE (SCU)

Velocity can send DICOM objects through a C-STORE (SCU) function. The user selects the destination AE through a graphic user interface.

2.1.3 C-STORE (SCP)

Velocity can accept C-STORE associations at anytime, including multiple associations at the same time. Each object received through this association are written on the disk, and inserted into the Velocity database. All AE Titles are accepted, there is no restrictions based on the AE Title.

2.1.4 STORAGE-COMMIT (SCP)

Velocity can accept N_ACTION_RQ storage commit associations at anytime. Velocity will respond on a separate association with the N_EVENT_REPORT response.

2.1.5 C-FIND (SCU)

Velocity can generate C-FIND association requests to browse and search studies on a remote DICOM node. The C-FIND (SCU) is at STUDY or SERIES level.

2.1.6 C-MOVE (SCU)

Following a C-FIND (SCU) query, the user can move the selected studies or series to a selected target location by generating a C-MOVE (SCU) retrieve.

2.1.7 C-FIND, C-MOVE (SCP)

Velocity can act as a DICOM server, answering to DICOM queries and retrieves from a distant DICOM compatible application.

2.2 Sequencing of Real World Activities

All the SCP Application Entities are asynchronous processes that can run at the same time. All DICOM objects are stored in the Velocity database when received. Velocity can send DICOM

objects that are stored in the Velocity database – or any other DICOM objects stored on a users local file system.

3 Application Entity Specifications

3.1 C-STORE SCU

3.1.1 SOP Classes

Velocity C-STORE SCU provides standard conformance to the following DICOM 3.0 SOP Classes.

Table 3-1 C-STORE SCU SOP Classes

SOP Class	UID	SCU
CTImageStorage	1.2.840.10008.5.1.4.1.1.2	YES
PositronEmissionTomographyImageStorage	1.2.840.10008.5.1.4.1.1.128	YES
MRImageStorage	1.2.840.10008.5.1.4.1.1.4	YES
RTDoseStorage	1.2.840.10008.5.1.4.1.1.481.2	YES
RTImageStorage	1.2.840.10008.5.1.4.1.1.481.1	YES
UltrasoundMultiframeImageStorage	1.2.840.10008.5.1.4.1.1.3.1	YES
UltrasoundImageStorage	1.2.840.10008.5.1.4.1.1.6.1	YES
ComputedRadiographyImageStorage	1.2.840.10008.5.1.4.1.1.1	YES
XRayAngiographicImageStorage	1.2.840.10008.5.1.4.1.1.12.1	YES
RTStructureSetStorage	1.2.840.10008.5.1.4.1.1.481.3	YES
RTPlanStorage	1.2.840.10008.5.1.4.1.1.481.5	YES
SpatialRegistrationStorage	1.2.840.10008.5.1.4.1.1.66.1	YES
DeformableSpatialRegistrationStorage	1.2.840.10008.5.1.4.1.1.66.3	YES
RTBeamsTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.4	YES
RTBrachyTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.6	YES
RTTreatmentSummaryRecordStorage	1.2.840.10008.5.1.4.1.1.481.7	YES
EncapsulatedPDFStorage	1.2.840.10008.5.1.4.1.1.104.1	YES

3.1.2 Association Policies

Velocity creates C-STORE associations according to the DICOM 3.0 standard. The Velocity AE Title is configurable from the User Interface. There are no restrictions on external AE Title. The default PDU size is 16384 bytes.

3.1.3 Number of Associations

The number of associations is unlimited.

3.1.4 Asynchronous Nature

Each C-STORE SCU association is handled synchronously.

3.1.5 Association Initiation Policy

Velocity C-STORE SCU AE will initiate a new association to transmit DICOM objects with a CSTORE command when the user requests sending of data from the GUI. The proposed Presentation Contexts are shown in Table 3-2.

The timeout is configured for each target location in the Velocity user interface. Default is 40 seconds.

Table 3-2 C-STORE SCU Proposed Presentation Contexts

Name	UID	Role	Ext.Neg
LittleEndianExplicitTransferSyntax	1.2.840.10008.1.2.1	SCU	None
BigEndianExplicitTransferSyntax	1.2.840.10008.1.2.2	SCU	None
LittleEndianImplicitTransferSyntax	1.2.840.10008.1.2	SCU	None

3.2 C-STORE SCP

3.2.1 SOP Classes

Velocity C-STORE SCP provides standard conformance to the following DICOM 3.0 SOP Classes

Table 3-3 C-STORE SCP SOP Classes

SOP Class	UID	SCP
CTImageStorage	1.2.840.10008.5.1.4.1.1.2	YES
PositronEmissionTomographyImageStorage	1.2.840.10008.5.1.4.1.1.128	YES

MRImageStorage	1.2.840.10008.5.1.4.1.1.4	YES
RTDoseStorage	1.2.840.10008.5.1.4.1.1.481.2	YES
RTImageStorage	1.2.840.10008.5.1.4.1.1.481.1	YES
UltrasoundMultiframeImageStorage	1.2.840.10008.5.1.4.1.1.3.1	YES
UltrasoundImageStorage	1.2.840.10008.5.1.4.1.1.6.1	YES
ComputedRadiographyImageStorage	1.2.840.10008.5.1.4.1.1.1	YES
XRayAngiographicImageStorage	1.2.840.10008.5.1.4.1.1.12.1	YES
RTStructureSetStorage	1.2.840.10008.5.1.4.1.1.481.3	YES
RTPlanStorage	1.2.840.10008.5.1.4.1.1.481.5	YES
SpatialRegistrationStorage	1.2.840.10008.5.1.4.1.1.66.1	YES
DeformableSpatialRegistrationStorage	1.2.840.10008.5.1.4.1.1.66.3	YES
RTBeamsTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.4	YES
RTBrachyTreatmentRecordStorage	1.2.840.10008.5.1.4.1.1.481.6	YES
RTTreatmentSummaryRecordStorage	1.2.840.10008.5.1.4.1.1.481.7	YES
EncapsulatedPDFStorage	1.2.840.10008.5.1.4.1.1.104.1	YES

3.2.2 Association Policies

Velocity accepts C-STORE associations according to the DICOM 3.0 standard. The Velocity AE Title is configurable from the User Interface. There are no restrictions on external AE Title. The default PDU size is 16384 bytes.

3.2.3 Number of Associations

The maximum number of associations is 16.

3.2.4 Asynchronous Nature

C-STORE SCP associations are handled asynchronously by processes that can run at the same time. All DICOM objects are stored in the Velocity database when received.

3.2.5 Association Initiation Policy

Velocity C-STORE AE will initiate a new association to receive DICOM objects with a C-STORE command when a remote computer connects to the local computer on the defined IP port. The accepted Presentation Contexts will match the DICOM objects that are to be offered by the remote computer.

The default timeout for all communications (TCP/IP and DICOM) is 40 seconds.

Table 3-4 C-STORE SCP Accepted Presentation Contexts

Name	UID	Role	Ext.Neg
JPEGProcess25_27TransferSyntax	1.2.840.10008.1.2.4.64	SCP	None
JPEGProcess28TransferSyntax	1.2.840.10008.1.2.4.65	SCP	None
JPEGProcess29TransferSyntax	1.2.840.10008.1.2.4.66	SCP	None
JPEGProcess14SV1TransferSyntax	1.2.840.10008.1.2.4.70	SCP	None
JPEGLSLosslessTransferSyntax	1.2.840.10008.1.2.4.80	SCP	None
JPEG2000LosslessOnlyTransferSyntax	1.2.840.10008.1.2.4.90	SCP	None
DeflatedExplicitVRLittleEndianTransferSyntax	1.2.840.10008.1.2.1.99	SCP	None
JPEGProcess1TransferSyntax	1.2.840.10008.1.2.4.50	SCP	None
JPEGProcess2_4TransferSyntax	1.2.840.10008.1.2.4.51	SCP	None
JPEGProcess3_5TransferSyntax	1.2.840.10008.1.2.4.52	SCP	None
JPEGProcess6_8TransferSyntax	1.2.840.10008.1.2.4.53	SCP	None
JPEGProcess7_9TransferSyntax	1.2.840.10008.1.2.4.54	SCP	None
JPEGProcess10_12TransferSyntax	1.2.840.10008.1.2.4.55	SCP	None
JPEGProcess11_13TransferSyntax	1.2.840.10008.1.2.4.56	SCP	None
JPEGProcess14TransferSyntax	1.2.840.10008.1.2.4.57	SCP	None
JPEGProcess15TransferSyntax	1.2.840.10008.1.2.4.58	SCP	None
JPEGProcess16_18TransferSyntax	1.2.840.10008.1.2.4.59	SCP	None
JPEGProcess17_19TransferSyntax	1.2.840.10008.1.2.4.60	SCP	None
JPEGProcess20_22TransferSyntax	1.2.840.10008.1.2.4.61	SCP	None
JPEGProcess21_23TransferSyntax	1.2.840.10008.1.2.4.62	SCP	None
JPEGProcess24_26TransferSyntax	1.2.840.10008.1.2.4.63	SCP	None
JPEGLSLossyTransferSyntax	1.2.840.10008.1.2.4.81	SCP	None
RLELosslessTransferSyntax	1.2.840.10008.1.2.5	SCP	None
JPEG2000TransferSyntax	1.2.840.10008.1.2.4.91	SCP	None
LittleEndianExplicitTransferSyntax	1.2.840.10008.1.2.1	SCP	None
BigEndianExplicitTransferSyntax	1.2.840.10008.1.2.2	SCP	None
LittleEndianImplicitTransferSyntax	1.2.840.10008.1.2	SCP	None

3.2.6 Association Acceptance Policy

Velocity C-STORE SCP will try to accept all incoming associations. There are no restrictions based on the network address or on the AE Title, for example.

When a successful C-STORE operation has completed, Velocity will return a successful operation C-STORE response. If a C-STORE operation cannot be completed successfully, the C-STORE Response will contain a status code defining the reason for the failure, as well as whether the failure was transient or permanent. The possible C-STORE Response status codes are given in Table 3-5

Table 3-5 C-STORE SCP Error response codes

Service Status	Description	Error Code	Details
Success	Success	0000	The object has been successfully stored.
Refused	Out of resources	A700-A7ff	A transient error has occurred. It could be too many sessions, lack of memory, etc.
Refused	Data Set does not match SOP Class	A900-A9FF	The Association is aborted using A-ABORT and the send job is marked as failed. The status meaning is logged and the job failure is reported to the user via an alert window.
Error	Cannot Understand	C000- CFFF	Velocity was unable to parse the incoming DICOM object.

3.3 C-FIND and C-MOVE SCU

3.3.1 SOP Classes

Velocity C-FIND and C-MOVE SCU provides standard conformance to the following DICOM 3.0 SOP Classes.

Table 3-6 C-STORE SCU SOP Classes

SOP Class	UID	SCU
FINDStudyRootQueryRetrieveInformationModel	1.2.840.10008.5.1.4.1.2.2.1	YES
MOVEStudyRootQueryRetrieveInformationModel	1.2.840.10008.5.1.4.1.2.2.2	YES

DICOM queries (C-FIND SCU) are generated the STUDY for the purpose of retrieving patient lists. Queries are generated at the STUDY level for the purposes on listing patient data and at the SERIES level for move (C-MOVE SCU) requests.

Table 3-7 Query (C-FIND and C-MOVE SCU) Tags Supported

Tag	Description	Query Level	Role
0010,0010	Patient Name	STUDY	SCU
0010,0020	Patient ID	STUDY	SCU
0010,0030	Patient Birth Date	STUDY	SCU
0010,0040	Patient Sex	STUDY	SCU
0008,0020	Study Date	STUDY	SCU
0008,0061	Modalities in Study	STUDY	SCU
0020,000d	Study InstanceUID	STUDY	SCU
0020,000e	Series InstanceUID	SERIES	SCU
0008,0060	Modality	SERIES	SCU

3.3.2 Association Policies

Velocity creates C-FIND and C-MOVE SCU associations according to the DICOM 3.0 standard. The Velocity AE Title is configurable from the User Interface. There are no restrictions on external AE Title. The default PDU size is 16384 bytes.

3.3.3 Number of Associations

The number of associations is unlimited.

3.3.4 Asynchronous Nature

Each C-FIND and C-MOVE SCU association is handled synchronously.

3.3.5 Association Initiation Policy

Velocity C-FIND and C-MOVE SCU AE will initiate a new association to transmit DICOM objects with a command when the user requests find or move of data from the GUI. The proposed Presentation Contexts are shown in Table 3-2.

The timeout is configured for each target location in the Velocity user interface. Default is 40 seconds.

Table 3-8 C-FIND and C-MOVE SCU Proposed Presentation Contexts

Name	UID	Role	Ext.Neg
LittleEndianExplicitTransferSyntax	1.2.840.10008.1.2.1	SCU	None
BigEndianExplicitTransferSyntax	1.2.840.10008.1.2.2	SCU	None

LittleEndianImplicitTransferSyntax	1.2.840.10008.1.2	SCU	None
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3.4 C-FIND and C-MOVE SCP (Velocity server version only)

3.4.1 SOP Classes

Same as for C-STORE SCP (See 3.2.1)

3.4.2 Association Policies

Same as for C-STORE SCP (See 3.2.2)

3.4.3 Number of Associations

Same as for C-STORE SCP (See 3.2.3)

3.4.4 Asynchronous Nature

Same as for C-STORE SCP (See 3.2.4)

3.4.5 Association Initiation Policy

Same as for C-STORE SCP (See 3.2.5)

Table 3-9 lists the DICOM Query Retrieve tags that are supported by the Velocity C-FIND and C-MOVE SCP.

Table 3-9 DICOM Query (C-FIND SCP) Tags Supported

Tag	Description	Query Level	Type	Match Support	Return Support
0010,0010	Patient Name	PATIENT	R	Y	Y
0010,0020	Patient ID	PATIENT	U	Y	Y
0010,0030	Patient Birth Date	PATIENT	O	Y	Y
0010,0040	Patient Sex	PATIENT	O	Y	Y
0008,0020	Study Date	STUDY	R	Y	Y
0008,0030	Study Time	STUDY	R	Y	Y
0008,0061	Modalities in Study	STUDY	O	Y	Y
0020,0010	Study ID	STUDY	R	Y	Y
0008,0050	Accession Number	STUDY	R	Y	Y
0008,0090	Referring Physician	STUDY	O	Y	Y

0008,1030	Study Description	STUDY	O	N	Y
0020,000d	Study InstanceUID	STUDY	U	Y	Y
0010,1020	Patient Size	STUDY	O	Y	Y
0010,1030	Patient Weight	STUDY	O	Y	Y
0020,0011	Series Number	SERIES	R	Y	Y
0020,0003	Series InstanceUID	SERIES	U	Y	Y
0008,103e	Series Description	SERIES	O	N	Y
0008,0060	Series Modality	SERIES	R	Y	Y
0008,0018	SOP InstanceUID	IMAGE	U	N	Y

3.4.6 Association Acceptance Policy

Same as C-STORE SCP. (See 3.2.6)

When the Velocity C-MOVE SCP receives a move request with a given target AE Title – is searches the Velocity database locations (See section 4.1) table for the entry (or entries) with a matching AE Title (case sensitive match is used). If no entry matches – the request is not performed and an error is returned. If one or matches occurs – a DICOM store request of the selected DICOM objects is performed to each match.

For the C-MOVE SCP – there is additional diagnostic error processing that occurs when requesting a target that does not exist in the locations table - or requesting a move to a location which is not currently listening. Table 3-10 summarizes this behavior.

Table 3-10 C-MOVE SCP Error Details Summary

Cause	Error Code	Behavior
Move target not found in locations table	A700-A7ff (Out of Resources)	The move response dataset contains DICOM tag 0x0000, 0x0902) with error details
Transmission error has occurred while sending DICOM object to target	A700-A7ff (Out of Resources)	The move response dataset contains DICOM tag 0x0000, 0x0902) with error details

4 Networking

4.1 Application Entity Configuration

Velocity maintains a database table with DICOM locations including name, AE Title, TCP/IP address and port information. The database also includes information with respect to Query

Retrieve functionality for each Application Entity. When performing any request from an external DICOM AE – the user selects the entity from this list of locations.

5 Media Storage

Velocity does not support creation of DICOM Media Storage.

6 Character Set Support

In addition to the default character repertoire, the Defined Terms for Specific Character Set in Table 6-1 are supported (Note that proper display of characters depends on the font support in the users operating system).

Table 6-1 Supported Character Sets (DICOM Tag Field (0008,0005))

Character Set Description	Defined Term (See DICOM PS3.3 C12.1.1.2)
Latin alphabet No. 1	ISO_IR 100
Latin alphabet No. 2	ISO_IR 101
Latin alphabet No. 3	ISO_IR 102
Latin alphabet No. 4	ISO_IR 104
Cyrillic	ISO_IR 144
Arabic	ISO_IR 127
Greek	ISO_IR 126
Hebrew	ISO_IR 138
Latin alphabet No. 5	ISO_IR 148
Japanese	ISO_IR 13
Thai	ISO_IR 166
Default repertoire	ISO 2022 IR 6
Latin alphabet No. 1	ISO 2022 IR 100
Latin alphabet No. 2	ISO 2022 IR 101
Latin alphabet No. 3	ISO 2022 IR 109
Latin alphabet No. 4	ISO 2022 IR 110
Cyrillic	ISO 2022 IR 144
Arabic	ISO 2022 IR 127
Greek	ISO 2022 IR 126
Hebrew	ISO 2022 IR 138
Latin alphabet No. 5	ISO 2022 IR 148

Japanese	ISO 2022 IR 13
Thai	ISO 2022 IR 166
Unicode in UTF-8	ISO_IR 192
GB18030	GB18030

7 Image Orientation Support

Velocity supports the patient orientations listed below:

1. Head First-Supine (Axial, Coronal, Sagittal)
2. Head First-Decubitus Left (Axial)
3. Head First-Decubitus Right (Axial)
4. Head First-Prone (Axial, Coronal, Sagittal)
5. Feet First-Supine (Axial)
6. Feet First-Prone (Axial)