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Syngo Carbon Enterprise Access

DICOM 3.0 Conformance Statement

SIEMENS Healthineers

Unrestricted

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Overview

Content and transfer

Table 1: Supported Storage SOP Classes

SOP Class	SOP Class UID	DIMSE services		DICOM web services		Media services		Function			
		SCU	SCP	UA	OS	FSC	FSR	Create	Display	Process	Archive
Hardcopy Grayscale Image Storage	1.2.840.10008.5.1.1.29	Y	N	N	N	Y	N	N	Y	N	N
HardcopS Color Image Storage	1.2.840.10008.5.1.1.30	Y	N	N	N	Y	N	N	Y	N	N
Computed Radiography Image Storage	1.2.840.10008.5.1.4.1.1.1	Y	N	N	N	Y	N	N	Y	N	N
Digital X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.1	Y	N	N	N	Y	N	N	Y	N	N
Digital X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.1.1	Y	N	N	N	Y	N	N	Y	N	N
Digital Mammography X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.2	Y	N	N	N	Y	N	N	Y	N	N
Digital Mammography X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.2.1	Y	N	N	N	Y	N	N	Y	N	N
Digital Intra-Oral X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.1.3	Y	N	N	N	Y	N	N	Y	N	N
Digital Intra-Oral X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.1.3.1	Y	N	N	N	Y	N	N	Y	N	N
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Y	N	N	N	Y	N	N	Y	Y	N
Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.1	Y	N	N	N	Y	N	N	Y	N	N
Legacy Converted Enhanced CT Image Storage	1.2.840.10008.5.1.4.1.1.2.2	Y	N	N	N	Y	N	N	Y	N	N
Ultrasound Multi-frame Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.3	Y	N	N	N	Y	N	N	Y	N	N
Ultrasound Multi-frame Image Storage	1.2.840.10008.5.1.4.1.1.3.1	Y	N	N	N	Y	N	N	Y	N	N
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Y	N	N	N	Y	N	N	Y	Y	N
Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.1	Y	N	N	N	Y	N	N	Y	N	N
Enhanced MR Color Image Storage	1.2.840.10008.5.1.4.1.1.4.3	Y	N	N	N	Y	N	N	Y	N	N
Legacy Converted Enhanced MR Image Storage	1.2.840.10008.5.1.4.1.1.4.4	Y	N	N	N	Y	N	N	Y	N	N
Nuclear Medicine Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.5	Y	N	N	N	Y	N	N	Y	N	N
Ultrasound Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.6	Y	N	N	N	Y	N	N	Y	N	N
Ultrasound Image Storage	1.2.840.10008.5.1.4.1.1.6.1	Y	N	N	N	Y	N	N	Y	N	N
Enhanced US Volume Storage	1.2.840.10008.5.1.4.1.1.6.2	Y	N	N	N	Y	N	N	Y	N	N
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Y	N	N	N	Y	N	N	Y	N	N
Multi-frame Grayscale Byte Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.2	Y	N	N	N	Y	N	N	Y	N	N

Table 1

Table 1

SOP Class	SOP Class UID	DIMSE services		DICOM web services		Media services		Function			
		SCU	SCP	UA	OS	FSC	FSR	Create	Display	Process	Archive
Multi-frame Grayscale Word Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.3	Y	N	N	N	Y	N	N	Y	N	N
Multi-frame True Color Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7.4	Y	N	N	N	Y	N	S	Y	N	N
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Y	N	N	N	Y	N	N	Y	N	N
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Y	N	N	N	Y	N	N	Y	N	N
Grayscale Softcopy Presentation State Storage	1.2.840.10008.5.1.4.1.1.11.1	Y	N	N	N	Y	N	N	Y	N	N
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Y	N	N	N	Y	N	N	Y	N	N
Enhanced xA Image Storage	1.2.840.10008.5.1.4.1.1.12.1.1	Y	N	N	N	Y	N	N	Y	N	N
X-Ray Radiofluoroscopic Image Storage	1.2.840.10008.5.1.4.1.1.12.2	Y	N	N	N	Y	N	N	Y	N	N
Enhanced xRF Image Storage	1.2.840.10008.5.1.4.1.1.12.2.1	Y	N	N	N	Y	N	N	Y	N	N
X-Ray Angiographic Bi-Plane Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.12.3	Y	N	N	N	Y	N	N	Y	N	N
X-Ray 3D Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.13.1.1	Y	N	N	N	Y	N	N	Y	N	N
X-Ray 3D Craniofacial Image Storage	1.2.840.10008.5.1.4.1.1.13.1.2	Y	N	N	N	Y	N	N	Y	N	N
Breast Tomosynthesis Image Storage	1.2.840.10008.5.1.4.1.1.13.1.3	Y	N	N	N	Y	N	N	Y	N	N
Breast Projection X-Ray Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.13.1.4	Y	N	N	N	Y	N	N	Y	N	N
Breast Projection X-Ray Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.13.1.5	Y	N	N	N	Y	N	N	Y	N	N
Intravascular Optical Coherence Tomography Image Storage - For Presentation	1.2.840.10008.5.1.4.1.1.14.1	Y	N	N	N	Y	N	N	Y	N	N
Intravascular Optical Coherence Tomography Image Storage - For Processing	1.2.840.10008.5.1.4.1.1.14.2	Y	N	N	N	Y	N	N	Y	N	N
Nuclear Medicine Image Storage	1.2.840.10008.5.1.4.1.1.20	Y	N	N	N	Y	N	N	Y	N	N
VL Image Storage (Retired)	1.2.840.10008.5.1.4.1.1.77.1	Y	N	N	N	Y	N	N	Y	N	N
VL Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1	Y	N	N	N	Y	N	N	Y	N	N
Video Endoscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.1.1	Y	N	N	N	Y	N	N	Y	N	N
VL Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2	Y	N	N	N	Y	N	N	Y	N	N
Video Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.2.1	Y	N	N	N	Y	N	N	Y	N	N
VL Slide-Coordinates Microscopic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.3	Y	N	N	N	Y	N	N	Y	N	N
VL Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4	Y	N	N	N	Y	N	N	Y	N	N
Video Photographic Image Storage	1.2.840.10008.5.1.4.1.1.77.1.4.1	Y	N	N	N	Y	N	N	Y	N	N
Ophthalmic Photography 8 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.1	Y	N	N	N	Y	N	N	Y	N	N
Ophthalmic Photography 16 Bit Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.2	Y	N	N	N	Y	N	N	Y	N	N
Ophthalmic Tomography Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.4	Y	N	N	N	Y	N	N	Y	N	N

Table 1

Table 1

SOP Class	SOP Class UID	DIMSE services		DICOM web services		Media services		Function			
		SCU	SCP	UA	OS	FSC	FSR	Create	Display	Process	Archive
Wide Field Ophthalmic Photography Stereographic Projection Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.5	Y	N	N	N	Y	N	N	Y	N	N
Wide Field Ophthalmic Photography 3D Coordinates Image Storage	1.2.840.10008.5.1.4.1.1.77.1.5.6	Y	N	N	N	Y	N	N	Y	N	N
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6	Y	N	N	N	Y	N	N	Y	N	N
VL Multi-frame Image Storage - Trial (Retired)	1.2.840.10008.5.1.4.1.1.77.2	Y	N	N	N	Y	N	N	Y	N	N
Ophthalmic Thickness Map Storage	1.2.840.10008.5.1.4.1.1.81.1	Y	N	N	N	Y	N	N	Y	N	N
Corneal Topography Map Storage	1.2.840.10008.5.1.4.1.1.82.1	Y	N	N	N	Y	N	N	Y	N	N
Basic Text SR	1.2.840.10008.5.1.4.1.1.88.11	Y	N	N	N	Y	N	N	Y	N	N
Key Object Selection Document Storage	1.2.840.10008.5.1.4.1.1.88.59	Y	N	N	N	Y	N	N	Y	N	N
X-Ray Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.67	Y	N	N	N	Y	N	N	Y	N	N
Radiopharmaceutical Radiation Dose SR Storage	1.2.840.10008.5.1.4.1.1.88.68	Y	N	N	N	Y	N	N	Y	N	N
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Y	N	N	N	Y	N	N	Y	N	N
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Y	N	N	N	Y	N	N	Y	Y	N
Legacy Converted Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.128.1	Y	N	N	N	Y	N	N	Y	N	N
Enhanced PET Image Storage	1.2.840.10008.5.1.4.1.1.130	Y	N	N	N	Y	N	N	Y	N	N
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	Y	N	N	N	Y	N	N	Y	N	N
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Y	N	N	N	Y	N	N	Y	N	N
DICOS CT Image Storage	1.2.840.10008.5.1.4.1.1.501.1	Y	N	N	N	Y	N	N	Y	N	N

Table 2: Supported Storage Transfer Syntaxes

Transfer Syntax set	Transfer Syntax name	Transfer Syntax UID
Lossless Compressed Transfer Syntax Set (LL)	Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99
	JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
	JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]): Default Transfer Syntax for Lossless JPEG Image Compression	1.2.840.10008.1.2.4.70
	JPEG-LS Lossless Image Compression	1.2.840.10008.1.2.4.80
	JPEG 2000 Image Compression (Lossless Only)	1.2.840.10008.1.2.4.90
	RLE Lossless	1.2.840.10008.1.2.5
Lossy Compressed Transfer Syntax Set (L)	JPEG Baseline (Process 1): Default Transfer Syntax for Lossy JPEG 8-bit Image Compression	1.2.840.10008.1.2.4.50
	JPEG Extended (Processes 2 & 4): Default Transfer Syntax for Lossy JPEG 12-bit Image Compression (Process 4 only)	1.2.840.10008.1.2.4.51
	JPEG-LS Lossy (Near-Lossless) Image Compression	1.2.840.10008.1.2.4.81
	JPEG 2000 Image Compression	1.2.840.10008.1.2.4.91
Non-Image Transfer Syntax Set (NI)	Implicit VR Little Endian: Default Transfer Syntax for DICOM	1.2.840.10008.1.2
	Explicit VR Little Endian	1.2.840.10008.1.2.1
	Deflated Explicit VR Little Endian	1.2.840.10008.1.2.1.99
	Explicit VR Big Endian	1.2.840.10008.1.2.2
Uncompressed Transfer Syntax Set (U)	Implicit VR Little Endian: Default Transfer Syntax for DICOM	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
Video Transfer Syntax Set (V)	MPEG2 Main Profile / Main Level	1.2.840.10008.1.2.4.100
	MPEG2 Main Profile / High Level	1.2.840.10008.1.2.4.101
	MPEG-4 AVC/H.264 High Profile / Level 4.1	1.2.840.10008.1.2.4.102
	MPEG-4 AVC/H.264 BD-compatible High Profile / Level 4.1	1.2.840.10008.1.2.4.103
	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 2D Video	1.2.840.10008.1.2.4.104
	MPEG-4 AVC/H.264 High Profile / Level 4.2 For 3D Video	1.2.840.10008.1.2.4.105
	MPEG-4 AVC/H.264 Stereo High Profile / Level 4.2	1.2.840.10008.1.2.4.106
	HEVC/H.265 Main Profile / Level 5.1	1.2.840.10008.1.2.4.107
	HEVC/H.265 Main 10 Profile / Level 5.1	1.2.840.10008.1.2.4.108

DIMSE services

Query/Retrieve

Table 3: Supported Query/Retrieve SOP Classes

SOP Class	SOP Class UID	Transfer Syntax	Transfer Syntax UID	SCU	SCP
Study Root Query/Retrieve Information Model – FIND	1.2.840.10008.5.1.4.1.2.2.1	Implicit VR Little Endian	1.2.840.10008.1.2	Y	N
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	Y	N
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

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1 Introduction

This document is a DICOM 3.0 Conformance Statement that describes the DICOM capabilities of Syngo Carbon Enterprise Access.

Syngo Carbon Enterprise Access is a versatile multi-modality display system for DICOM images. It is able to retrieve and display DICOM images from *syngo*.share core or, via Query/Retrieve, from third-party DICOM archives. Additionally, Syngo Carbon Enterprise Access supports the export of DICOM images, series and studies.

1.1 Remarks

This Conformance Statement is intended to aid in the validation of the integration of Syngo Carbon Enterprise Access within a DICOM environment. This statement is not meant to replace the validation with other DICOM equipment to ensure the intended, proper exchange of information. Thus, it is still important to ensure the proper interoperability of the intended DICOM integration.

The user must be aware of the following issues:

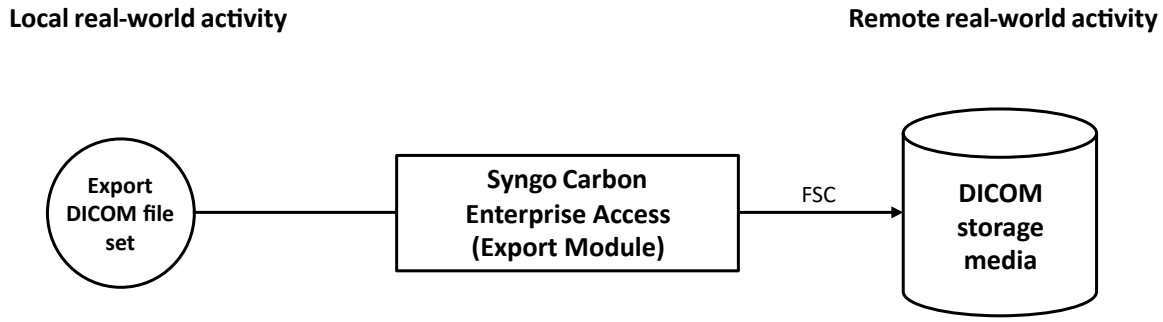
- The comparison of different Conformance Statements should be the first step towards an assessment of the interoperability within a DICOM environment.
- Testing procedures should be defined to validate the desired level of connectivity.

2 Implementation model

2.1 Application data flow diagram

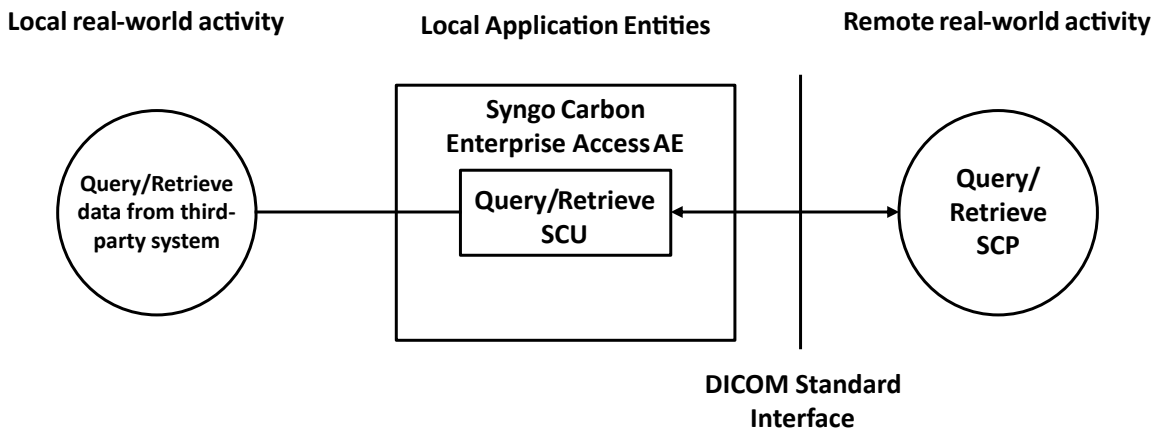
Syngo Carbon Enterprise Access provides a user interface for exporting DICOM files – the FSC (File Set Creator) – to portable media (such as USB sticks), network directories or the local file system. These functions are integral components of Syngo Carbon Enterprise Access. Within the context of this Conformance Statement, the exporting functionality is referred to as the Syngo Carbon Enterprise Access FSC AE.

Figure 1: Syngo Carbon Enterprise Access FSC data flow diagram



Additionally, Syngo Carbon Enterprise Access provides the ability to query third-party PACS and retrieve data from them. Syngo Carbon Enterprise Access also provides report-reading capabilities for Structured Reports and the possibility to apply Grayscale Softcopy Presentation States (GSPS) as defined in DICOM PS3.3.

Figure 2: Syngo Carbon Enterprise Access AE application data flow diagram



2.2 Functional definition of AEs

The Syngo Carbon Enterprise Access FSC AE is able to write user-selected DICOM files like DICOMDIRs or image objects which are compliant with DICOM PS3.10. These files can be located either on the local file system or on DICOM PS3.12-compliant media.

The Syngo Carbon Enterprise Access AE is able to query third-party PACS using the C-FIND service and retrieve data using the C-MOVE service in accordance with DICOM PS3.7. The third-party PACS can be queried using the Study Root Query/Retrieve Information Model as defined in DICOM PS3.4, C.3.2. Baseline behavior is supported for C-FIND SCU and C-MOVE SCU.

The Syngo Carbon Enterprise Access AE is able to render DICOM instances received via Query/Retrieve. Section 3.1 describes the supported SOP Classes for Syngo Carbon Enterprise Access.

2.3 Sequencing of real-world activities

- The user can request the services of the Syngo Carbon Enterprise Access AE at any time through the user interface.

3 Application Entity specifications

The Syngo Carbon Enterprise Access FSC provides functionalities for the sole purpose of handling DICOM media. The DICOM Storage SOP Classes listed in Table 1 are supported for viewing. For SOP Classes not listed in Table 1, accessing the DICOM header is possible within the application.

3.1 Supported SOP Classes and Transfer Syntaxes

The supported DICOM SOP Classes are described in Table 1 and Table 3. Table 2 lists the supported storage Transfer Syntaxes.

Note that SOP Classes for the purpose of image data storage require the DICOM Image Pixel module to exist in order to display image data. Also, a value must be provided in the DICOM element Pixel Data (`7FE0,0010`), and the underlying Transfer Syntax must be supported. For limitations please see Appendix B.

3.2 Association establishment policies

3.2.1 General

The Syngo Carbon Enterprise Access AE supports TCP/IP. When a user requests a C-FIND or C-MOVE operation, it attempts to establish an association with a remote AE. The host, port and remote AE title are defined within the server configuration. The maximum accepted PDU size is 16378.

3.2.2 Number of associations

The Syngo Carbon Enterprise Access AE supports multiple simultaneous associations for C-FIND, C-MOVE and C-STORE operations. The Syngo Carbon Enterprise Access AE is configured for ten simultaneous connections for C-STORE by default. This value can be changed but requires a restart.

3.2.3 Asynchronous nature

The Syngo Carbon Enterprise Access AE only allows a single outstanding operation on each association, meaning that it does not perform asynchronous negotiation.

3.2.4 Implementation identifying information

- **Implementation Class UID**
  1.2.40.0.13.1.3
- **Implementation Version Name**
  dcm4che-5.31.2

3.2.5 Association initiation policy by real-world activity

The Syngo Carbon Enterprise Access AE initiates an association with a remote AE for C-FIND and C-MOVE requests. The proposed Transfer Syntaxes for association establishment for C-FIND and C-MOVE are defined in Table 3.

4 DICOM media AE specification

This chapter describes the DICOM media functionalities of the Syngo Carbon Enterprise Access AE.

4.1 Implementation model

4.1.1 Application data flow diagram

See Section 2.1 (Syngo Carbon Enterprise Access data flow diagram).

4.1.2 Functional definitions of the AE

The Syngo Carbon Enterprise Access AE implements standard DICOM-conformant service classes for the creation of DICOM file sets (according to DICOM PS3.10).

4.1.3 Sequencing of real-world activities

The DICOM media functionalities of the Syngo Carbon Enterprise Access AE can be used at any time through its user interface.

4.1.4 File meta information

- **Implementation Class UID**
  1.2.40.0.13.1.3
- **Implementation Version Name**
  dcm4che-5.31.2

4.2 Application Entity specification

See Section 3 for supported SOP Classes for the export of media.

Table 4: Syngo Carbon Enterprise Access AE-related application profiles, real-world activity roles, and roles for interchanging

Supported application profiles	Real-world activity	Role	SC option
Syngo Carbon Enterprise Access FSC	Export DICOM file set	FSC	Interchange

4.2.1 Real-world activities

4.2.1.1 Creating DICOMDIRs

The Syngo Carbon Enterprise Access AE supports the creation of DICOMDIR with all mandatory keys, as defined in DICOM PS3.10.

Exporting media

The Syngo Carbon Enterprise Access AE is able to organize DICOM images, series and studies into a file set which is then saved to the local file system or to DICOM PS3.12-compliant media. The Syngo Carbon Enterprise Access AE, here acting as an FSC, uses the following Transfer Syntaxes:

Table 5: Supported Syngo Carbon Enterprise Access Export Transfer Syntaxes

Transfer Syntax name	Transfer Syntax UID
Explicit VR Little Endian	1.2.840.10008.1.2.1

The Syngo Carbon Enterprise Access AE also supports the usage of the original Transfer Syntax if the DICOM instance cannot be converted to the Explicit VR Little Endian Syntax. In this case, the created DICOMDIR is not compliant with the DICOM Standard. This option can be deactivated in Syngo Carbon Enterprise Access.

4.3 Augmented and private application profiles

Not used.

5 Communication profiles

5.1 Supported communication stacks

Syngo Carbon Enterprise Access provides plain TCP (see DICOM PS3.8, 9) communication. It uses the dcm4che library and toolkit for its communication.

6 Configuration

Syngo Carbon Enterprise Access is configured in *syngo*.share Configuration and static configuration files. See the product-specific technical documentation for further information.

7 Support of extended character sets

7.1 Supported character sets

Table 6 contains the character sets which are supported with and without code extension techniques.

Table 6: Supported character sets

MIME name	Without code extensions	With code extensions
US-ASCII		ISO 2022 IR 6
ISO-8859-1	ISO_IR 100	ISO 2022 IR 100
ISO-8859-2	ISO_IR 101	ISO 2022 IR 101
ISO-8859-3	ISO_IR 109	ISO 2022 IR 109
ISO-8859-4	ISO_IR 110	ISO 2022 IR 110
ISO-8859-5	ISO_IR 144	ISO 2022 IR 144
ISO-8859-6	ISO_IR 127	ISO 2022 IR 127
ISO-8859-7	ISO_IR 126	ISO 2022 IR 126
ISO-8859-8	ISO_IR 138	ISO 2022 IR 138
ISO-8859-9	ISO_IR 148	ISO 2022 IR 148
JIS_X0201	ISO_IR 13	ISO 2022 IR 13
TIS-620	ISO_IR 166	ISO 2022 IR 166
JIS_X0208-1990	-	ISO 2022 IR 87
JIS_X0212-1990	-	ISO 2022 IR 159
KS_X_1001-1997	-	ISO 2022 IR 149
GB2312	-	ISO 2022 IR 58
UTF-8	ISO_IR 192	-
GB18030	GB18030	-
GBK	GBK	-

7.2 Usage of Specific Character Set in C-FIND and C-MOVE requests

Syngo Carbon Enterprise Access AE as C-FIND and C-MOVE SCU uses Specific Character Set (0008,0005) with a value of ISO_IR 192 for requests.

A DICOM attribute list for Query/Retrieve service classes

The following tables list the DICOM keys used for matching and/or return on the study (Table 7), series (Table 8) and image (Table 9) level in C-FIND requests issued by Syngo Carbon Enterprise Access AE as C-FIND SCU.

The Query Retrieve Level (0008,0052) and Specific Character Set (0008,0005) attributes are set in every C-FIND request and are therefore not mentioned in the tables below. The value of Query Retrieve Level is set to the respective level (study, series, image). The value of Specific Character Set is set to ISO_IR 192. In addition, the Unique Key Attribute for each level above the Query/Retrieve level is sent as well with a single value (baseline behavior).

A.1 Used C-FIND attributes in requests issued by Syngo Carbon Enterprise Access

Table 7: Used C-FIND attributes in requests issued by Syngo Carbon Enterprise Access AE (C-FIND SCU) on the study level

Attribute name	Tag	Usage
StudyDate	(0008,0020)	Matching and Return
StudyTime	(0008,0030)	Matching and Return
AccessionNumber	(0008,0050)	Matching and Return
ModalitiesInStudy	(0008,0061)	Matching and Return
ReferringPhysicianName	(0008,0090)	Matching and Return
StudyDescription	(0008,1030)	Matching and Return
PatientName	(0010,0010)	Matching and Return
PatientID	(0010,0020)	Matching and Return
PatientBirthDate	(0010,0030)	Matching and Return
PatientBirthTime	(0010,0032)	Return
PatientSex	(0010,0040)	Matching and Return
PatientBirthName	(0010,1005)	Matching and Return
PatientMotherBirthName	(0010,1060)	Matching and Return
StudyInstanceUID	(0020,000D)	Matching and Return
StudyID	(0020,0010)	Matching and Return
NumberOfStudyRelatedSeries	(0020,1206)	Return
NumberOfStudyRelatedInstances	(0020,1208)	Return
AdmissionID	(0038,0010)	Return

Table 8: Used C-FIND attributes in requests issued by Syngo Carbon Enterprise Access AE (C-FIND SCU) on the series level

Attribute name	Tag	Usage
SeriesDate	(0008,0021)	Return
SeriesTime	(0008,0031)	Return
Modality	(0008,0060)	Return
Manufacturer	(0008,0070)	Return

Table 8

Table 8

Attribute name	Tag	Usage
InstitutionName	(0008,0080)	Matching and Return
StationName	(0008,1010)	Matching and Return
SeriesDescription	(0008,103E)	Return
InstitutionalDepartmentName	(0008,1040)	Matching and Return
PerformingPhysicianName	(0008,1050)	Return
OperatorsName	(0008,1070)	Return
ManufacturerModelName	(0008,1090)	Return
BodyPartExamined	(0018,0015)	Matching and Return
SeriesInstanceUID	(0020,000E)	Matching and Return
SeriesNumber	(0020,0011)	Matching and Return
Laterality	(0020,0060)	Matching and Return
NumberOfSeriesRelatedInstances	(0020,1209)	Return
PerformedProcedureStepStartDate	(0040,0244)	Matching and Return
PerformedProcedureStepStartTime	(0040,0245)	Return
RequestAttributesSequence/ ScheduledProcedureStepID	(0040,0275)/(0040,0009)	Matching and Return
RequestAttributesSequence/ RequestedProcedureID	(0040,0275)/(0040,1001)	Matching and Return

Table 9: Used C-FIND attributes in requests issued by Syngo Carbon Enterprise Access AE (C-FIND SCU) on the image level

Attribute name	Tag	Usage
ImageType	(0008,0008)	Return
SOPClassUID	(0008,0016)	Return
SliceThickness	(0018,0050)	Return
AcquisitionNumber	(0020,0012)	Return
InstanceNumber	(0020,0013)	Return
ImagePositionPatient	(0020,0032)	Return
ImageOrientationPatient	(0020,0037)	Return
SliceLocation	(0020,1041)	Return
SamplesPerPixel	(0028,0002)	Return
PhotometricInterpretation	(0028,0004)	Return
NumberOfFrames	(0028,0008)	Return
Rows	(0028,0010)	Return
Columns	(0028,0011)	Return
BitsAllocated	(0028,0100)	Return
BitsStored	(0028,0101)	Return
ConceptNameCodeSequence/ CodeValue	(0040,A043)/(0008,0100)	Matching and Return
ConceptNameCodeSequence/ CodingSchemeDesignator	(0040,A043)/(0008,0102)	Matching and Return
ConceptNameCodeSequence/ CodingSchemeVersion	(0040,A043)/(0008,0103)	Return
ConceptNameCodeSequence/ CodeMeaning	(0040,A043)/(0008,0104)	Return
ReferencedRequestSequence/ AccessionNumber	(0040,A370)/(0008,0050)	Return
ReferencedRequestSequence/ StudyInstanceUID	(0040,A370)/(0020,000D)	Return
ReferencedRequestSequence/ RequestedProcedureID	(0040,A370)/(0040,1001)	Return
ContentLabel	(0070,0080)	Return
ContentDescription	(0070,0081)	Return
PresentationCreationDate	(0070,0082)	Return
PresentationCreationTime	(0070,0083)	Return
ContentCreatorName	(0070,0084)	Return

B Limitations

DICOM instances

- Timezone Offset From UTC (0008,0201) is not applied on DA, TM, and DT attributes.
- Instances for which the value length of a tag exceeds 2 GiB (2^{31} - 9 bytes) are not supported.

DICOM images

- Images with 1 bit allocated for each pixel sample (binary images) are not supported.
- Images with more than 16 bits per sample (Bits Stored (0028,0101)) are not supported.
- Multiple window center and width presets are not supported.
- VOI LUTs present in the Functional Group of multiframe images are not considered.
- VOI LUT functions are not supported.
- Overlays stored in the unused bit planes of Pixel Data (7FE0,0010) are not supported, since this method was retired from the DICOM Standard in 2004.
- Display Shutter and other graphical modules defined in image IODs are not applied.
- Length calculations on ultrasound images are not supported.
- ECG visualization is available only for color and monochrome images of modality XA. Only the first repeating group (5000 group) of the Curve Module is considered if Type of Data (5000,0020) is ECG. In addition, Curve Dimensions (5000,0005) must be 2, and Curve Data Descriptor (5000,0110) must be present with values 0\1. Value representation is limited to unsigned short data: Data Value Representation (5000,0103) must be 0 and VR of Curve Data (5000,3000) must be OW.

DICOM whole slide microscopy images

- Images are interpreted as common multiframe images if DICOM header- and frame-based access is not available.
- Monochrome images are currently not supported.
- Images for which the Dimension Organization Type (0020,9311) is present with value must either follow TILED_FULL or TILED_SPARSE dimension organization.
- All images with an Image Flavor (third value of Image Type (0008,0008)) of VOLUME must use the same dimension organization.
- Thumbnail and overview layer are not available if the edge length of the topmost image of the image pyramid exceeds 5,000 pixels.
- Overview layer is not available if the edge length of the topmost image of the image pyramid falls below 800 pixels.
- Multiple items in the Dimension Organization Sequence (0020,9221) and Dimension Index Sequence (0020A,9222) are not supported.
- Images with multiple optical paths are not supported.
- Images with Dimension Index Pointer (003A,0210) not targeting the Plane Position Slide Sequence (0048,021A) are not supported.

- All images of the underlying series must share the same Frame of Reference UID (0020,0052), Container Identifier (0040,0512), Issuer of the Container Identifier Sequence (0040,0513), Specimen UID (0040,0554), and Image Orientation (Slide) (0048,0102).
- Images with an Image Flavor (third value of Image Type (0008,0008)) of LABEL or OVERVIEW consisting of multiple frames are not supported.
- The number of Z-layers and the spacing between slices must be uniform across all zoom layers.
- Images with a layer width or height exceeding 2^{31} - 1 pixels are not supported.
- Images with a number of Z-layers exceeding 2^{31} - 1 are not supported.
- Images with layers exceeding 2^{31} - 9 tiles (frames) are not supported.
- Images with Dimension Organization Type (0020,9311) of TILED_FULL and with an Image Flavor (third value of Image Type (0008,0008)) of VOLUME are not supported if they are part of a concatenation or if the number of frames per layer or in total exceeds 2^{31} - 1.

DICOM ECGs

- Only ECG SOP Classes listed in Table 1 are currently supported.
- Channel Sensitivity (003A,0210) is required to be present since samples shall represent defined (not arbitrary) units.
- An ECG is not supported if Channel Time Skew (003A,0214), Channel Sample Skew (003A,0215), or Channel Offset (003A,0218) is present with a non-zero value.
- Channel layouts are only possible if exactly 12 channels are present in the selected Waveform Multiplex Group.
- Display properties (e.g. presentation groups, display colors, display scale) of the Waveform Module are not supported.

DICOM videos

- Videos with an encapsulated video data stream segmented into more than one fragment are not supported.

DICOM Grayscale Softcopy Presentation States

- GSPS functionality is limited to viewing, as no GSPS are created.
- GSPS are not applied on instances of the SOP Classes listed in Table 10 due to their limited support.
- GSPS module limitations are listed in Table 11.
- Only the Presentation State Storage SOP Classes listed above (see Table 1) are currently supported.

Table 10: SOP Classes and corresponding UIDs for which Grayscale Softcopy Presentation States are not applied

SOP Class name	SOP Class UID
Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.4
Surface Segmentation Storage	1.2.840.10008.5.1.4.1.1.66.5
VL Whole Slide Microscopy Image Storage	1.2.840.10008.5.1.4.1.1.77.1.6

Table 11: Grayscale Softcopy Presentation State module coverage and limitations

Module	Implemented	Limitations
Presentation State Identification	Partially	No further attributes beside Presentation Creation Date (0070,0082), Presentation Creation Time (0070,0083), and Content Label (0070,0080) with Content Creator's Name (0070,0084) from the Content Identification Macro are processed.
Presentation State Relationship	Partially	The Referenced Segment Number (0062,000B) from the Image SOP Instance Reference Macro is not considered.
Presentation State Shutter	No	-
Presentation State Mask	No	-
Mask	No	-
Display Shutter	No	-
Bitmap Display Shutter	No	-
Overlay Plane	No	-
Overlay Activation	No	-
Displayed Area	Partially	The Referenced Segment Number (0062,000B) from the Image SOP Instance Reference Macro is not considered. The enumerated value `VOLUME` of Pixel Origin Interpretation (0048,0301) is not supported. The enumerated value `TRUE SIZE` of Presentation Size Mode (0048,0301) is interpreted as a magnification factor of 1: 1, as the client currently does not provide the physical pixel size of the display.
Graphic Annotation	Partially	The Referenced Segment Number (0062,000B) from the Image SOP Instance Reference Macro is not considered. The enumerated value `MATRIX` for all annotation units of this module is not supported. The Text Style Sequence Macro, Compound Graphic Instance ID (0070,0226), and Graphic Group ID (0070,0295) from the Text Object Sequence (0070,0008) are not supported. The Line Style Sequence Macro, Fill Style Sequence Macro, Compound Graphic Instance ID (0070,0226), and Graphic Group ID (0070,0295) from the Graphic Object Sequence are not supported. The Compound Graphic Sequence is not considered.
Spatial Transformation	Yes	-
Graphic Layer	Partially	The Graphic Layer Description (0070,0068) is not considered.
Graphic Group	No	-
Modality LUT	No	-
Softcopy VOI LUT	No	-
Softcopy Presentation LUT	No	-
SOP Common	Partially	No further information is read from this module for GSPS instances apart from common information required for every supported DICOM instance (e.g. Specific Character Set (0008,0005)).

DICOM Structured Reports

- Support is currently limited to the rendering of Basic Text Structured Reports, X-Ray Radiation Dose Structured Reports, Radiopharmaceutical Radiation Dose Structured Reports, and Key Object Selection Documents.
- Referenced images need to be in the same study in order to be resolved automatically.
- Referenced images do not consider a referenced Presentation State or Segment Number.
- Referenced multiframe images not referencing all frames only consider the first referenced frame.

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