

SYNAPSE

PACS

DICOM Conformance Statement

Document Version

– 21 –

Revision History

* SYNAPSE is a registered trademark of FUJIFILM MEDICAL SYSTEMS U.S.A., Inc. in United States, Australia and Canada.

* SYNAPSE is a registered trademark of FUJIFILM Corporation in China, Japan, Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, The Netherlands, Portugal, Spain, Sweden, United Kingdom, Latvia, Slovakia, Slovenia, Cyprus, Lithuania, Hungary, Czech Republic, Malta, Poland, Estonia, Bulgaria, & Romania.

* PHILIPS is a registered trademark of Koninklijke Philips N.V.

* Blu-ray™ is a trademark of the Blu-ray Disc Association.

Manufactured For:
FUJIFILM CORPORATION
798 Miyanodai Kaisei-Machi
Ashigarakami-Gun Kanagawa, JAPAN 258-8538

Manufactured By:
FUJIFILM Medical Systems U.S.A., Inc.
3020 Carrington Mill Blvd
Morrisville, NC 27560
Telephone: 1-800-272-8465

Copyright © 1997-2018 FUJIFILM Medical Systems U.S.A., Inc. All rights reserved.

Revision History

Document Version	Applicable Software Versions	Comments
03	Synapse2.2.1, 2.3.1	
04	Synapse3.0	
04.1	Updated for correction	Minor corrections
05	Synapse 3.1	New SOPs and Transfer syntaxes, new DICOM Q/R SCU
06	Synapse 3.1.1	Retrieve Synapse Diagnostic Report. More supported SOP classes for DicomSCU.
07	Synapse 3.2.0	MG CAD, C-FIND and MWL max rows, Added Requested Procedure Priority, Requesting Physician and Admission ID as MWL outputs. Removed Scheduled Procedure Step Protocol Code sequence from MWL output. Added comment on C-MOVE timeout for DICOM SCU. Sorted Appendix A table.
08	Synapse 3.2.1	Added C-STORE SCU, Pre-fetching Studies, and Media Management. Also added Series Description, Concept Name Code Sequence Code Value and Concept Name Code Sequence Coding Scheme Designator to Appendix A. Additional minor corrections.
09	Synapse 3.2.1 SR-320	Corrected an error: SC-MF-Color was listed with the wrong SOP Class UID for Query/Retrieve SCU
10	Synapse 3.2.1 SR-334	Added full support for GSPS and KOS, Site ID returned for C-MOVE
11	Synapse 3.2.1 SR-347	Extended Structure Report support.
12	Synapse 3.2.1 SR-362	Added WADO-URI, and DICOM Specific Audit Messages.
13	Synapse 4.0.0 Full Release	<i>NOTE: This change is on top of version 11. As such, neither WADO nor DICOM Specific Audit Messages are part of this version.</i> Added support for many new SOP Classes, Instance Root Level Retrieve (C-MOVE and C-GET modes), as well as C-GET for Study Root.
14	Synapse 4.1.0 Full Release	Added WADO-URI, and DICOM Specific Audit Messages. <i>NOTE: This is a merge of version 12 changes which were excluded from version 13.</i>
15	Synapse 4.3.0 Full Release	Added clarification to the DICOM Query/Retrieve limitation.
16	Synapse 4.4.0 Full Release	Added JPEG 2000 Compression/Decompression support.
17	Synapse 5.1.100 Full Release	Added QIDO-RS, updated C-MOVE in Appendix A
18	Synapse CV 7.0 Upgrade	Synapse integrated with Cardio Vascular features.
19	Synapse 5.2.000 Upgrade	<i>NOTE: This change is on top of version 17. I does not contain features from CV 7.0.</i> Added WADO-RS. WADO is now WADO-URI. Added workstation access via QIDO-RS and WADO-RS.
20	Synapse 5.3.000 Upgrade	Added STOW-RS and extended features of WADO-RS. Blu-ray support added.
21	Manufacture change	Manufacture Address change.

REVISION HISTORY	2
1. INTRODUCTION	5
2. QUICK SUMMARY	6
3. STORING STUDIES	10
3.1 IDEAL STORE SCENARIO.....	10
3.2 NON-IDEAL SCENARIOS.....	10
3.2.1 Accession number.....	11
3.2.2 No indication of completion.....	11
3.3 C-STORE.....	12
3.4 MODALITY WORKLIST.....	13
3.5 STORAGE COMMITMENT.....	13
3.6 PERFORMED PROCEDURE STEP.....	14
4. RETRIEVING STUDIES	15
4.1 C-FIND.....	15
4.2 C-MOVE AND C-GET.....	15
4.2.1 Matching Attributes.....	16
5. DICOM PRINT SCU	18
5.1 OVERVIEW.....	18
5.2 REQUIRED SOP CLASSES.....	18
5.3 OPTIONAL SOP CLASSES.....	18
5.4 SUPPORTED DICOM ATTRIBUTES.....	18
6. DICOM QUERY/RETRIEVE SCU	20
6.1 OVERVIEW.....	20
6.2 SUPPORTED SOP CLASSES.....	20
6.3 SUPPORTED DICOM ATTRIBUTES DURING C-FIND AND C-MOVE.....	21
7. DICOM C-STORE SCU	22
7.1 OVERVIEW.....	22
7.2 SUPPORTED SOP CLASSES.....	22
8. PRE-FETCHING STUDIES	24
8.1 OVERVIEW.....	24
8.2 SUPPORTED SOP CLASSES.....	24
9. MEDIA MANAGEMENT	24
9.1 OVERVIEW.....	24
9.2 SUPPORTED SOP CLASSES.....	25
10. QIDO-RS	26
10.1 REQUEST.....	26
10.2 RESPONSE AND MATCHING.....	26
10.2.1 Response Restrictions.....	26
10.2.2 Query/Retrieve Matching.....	26
10.2.3 Private Tag Matching and Return Value.....	26
10.2.4 Hierarchical and Non-Hierarchical Search.....	26
10.2.5 Special HTTP GET name/value pairs.....	26
10.2.6 Unsupported Tags.....	27
11. WADO-URI	27
11.1 OVERVIEW.....	27
11.2 URL QUERY PARAMETERS.....	27
11.3 SUPPORTED SOP CLASSES.....	28

12.	WADO-RS	28
12.1	WADO-RS REQUEST.....	28
12.1.1	<i>Supported Accept Types</i>	<i>28</i>
12.1.2	<i>Supported Transfer-Syntax for application/dicom</i>	<i>30</i>
12.2	WADO-RS RESPONSE	30
13.	STOW-RS	30
13.1	STOW-RS REQUEST.....	30
13.1.1	<i>Supported SOP Classes</i>	<i>30</i>
13.2	STOW-RS RESPONSE	30
14.	SECURITY AND SYSTEM MANAGEMENT PROFILES	31
14.1	ASSOCIATION LEVEL SECURITY	31
14.2	APPLICATION LEVEL SECURITY	31
14.2.1	<i>Security Profiles</i>	<i>31</i>
14.2.2	<i>Audit Trail Messages.....</i>	<i>31</i>
APPENDIX A – QUERY/RETRIEVE ATTRIBUTE SUPPORT		32

1. Introduction

This is a DICOM conformance statement for the FUJIFILM Medical Systems U.S.A., Inc. Synapse PACS System.

Synapse PACS system contains one or more instances of the DicomServer application which provides the necessary services as a DICOM Service Class Provider (SCP).

The Synapse Workstation also has the capability of querying/retrieving DICOM images from other DICOM SCP's to be viewed at the Workstation. In other words, the Synapse Workstation can act as a DICOM C-FIND and C-MOVE Service Class User (SCU).

The DICOM Print SCU capability is provided through a separate DICOM Printer driver, which installs a DICOM printer within the Windows operating system environment.

Synapse includes the capability of forwarding DICOM objects to a DICOM C-STORE SCP. When forwarding, Synapse acts as a DICOM C-STORE SCU.

Synapse can act as a Modality Worklist SCU to determine which patients have scheduled visits in the near future. Studies for those patients will then be retrieved and stored in a cache so that the Synapse Workstation can view while avoiding potentially long delays waiting for them to be retrieved from an SCP.

Synapse Workstation includes the capability to create DICOM file-sets CD-R, DVD, and Blu-ray media.

2. Quick Summary

As Storage SCP			
SOP Class Name	SOP UID	Transfer Syntax UID	Comments
Verification	1.2.840.10008.1.1	1.2.840.10008.1.2	
Standard Storage	1.2.840.10008.5.1.1.29 (HGI) 1.2.840.10008.5.1.1.30 (HCI) 1.2.840.10008.5.1.4.1.1.1 (CR) 1.2.840.10008.5.1.4.1.1.1.1 (DX-Prs) 1.2.840.10008.5.1.4.1.1.1.1.1 (DX-Proc) 1.2.840.10008.5.1.4.1.1.2 (MG-Prs) 1.2.840.10008.5.1.4.1.1.2.1 (MG-Proc) 1.2.840.10008.5.1.4.1.1.3 (IO-Prs) 1.2.840.10008.5.1.4.1.1.3.1 (IO-Proc) 1.2.840.10008.5.1.4.1.1.2 (CT) 1.2.840.10008.5.1.4.1.1.3 (retUS-MF) 1.2.840.10008.5.1.4.1.1.3.1 (US-MF) 1.2.840.10008.5.1.4.1.1.4 (MR) 1.2.840.10008.5.1.4.1.1.4.2 (MRS) 1.2.840.10008.5.1.4.1.1.5 (retNM) 1.2.840.10008.5.1.4.1.1.6 (retUS) 1.2.840.10008.5.1.4.1.1.6.1 (US) 1.2.840.10008.5.1.4.1.1.7 (SC) 1.2.840.10008.5.1.4.1.1.7.1 (SC-MF-SB) 1.2.840.10008.5.1.4.1.1.7.2 (SC-MF-Byte) 1.2.840.10008.5.1.4.1.1.7.3 (SC-MF-Word) 1.2.840.10008.5.1.4.1.1.7.4 (SC-MF-Color) 1.2.840.10008.5.1.4.1.1.8 (STD OVLY) 1.2.840.10008.5.1.4.1.1.9 (STD CRV) 1.2.840.10008.5.1.4.1.1.10 (MOD LUT) 1.2.840.10008.5.1.4.1.1.11 (VOI LUT) 1.2.840.10008.5.1.4.1.1.12.1 (XA) 1.2.840.10008.5.1.4.1.1.12.2 (RF) 1.2.840.10008.5.1.4.1.1.12.3 (RF-BP) 1.2.840.10008.5.1.4.1.1.13.1.3 (MGT) support for the 3 cardiovascular SOP Class UID's in the appropriate sections (C-MOVE, C-FIND, etc.) support for the 3 cardiovascular SOP Class UID's in the appropriate sections (C-MOVE, C-FIND, etc.) (IVOCT Pres) 1.2.840.10008.5.1.4.1.1.14.2 (IVOCT Proc) 1.2.840.10008.5.1.4.1.1.20 (NM-MF) 1.2.840.10008.5.1.4.1.1.77.1 (VL) 1.2.840.10008.5.1.4.1.1.77.1.1 (ES) 1.2.840.10008.5.1.4.1.1.77.1.1.1 (ESV) 1.2.840.10008.5.1.4.1.1.77.1.2 (GM) 1.2.840.10008.5.1.4.1.1.77.1.3 (SM) 1.2.840.10008.5.1.4.1.1.77.1.4 (XC) 1.2.840.10008.5.1.4.1.1.77.2 (ESMF) 1.2.840.10008.5.1.4.1.1.128 (PET) 1.2.840.10008.5.1.4.1.1.481.1 (RTIMAGE)	Accepted Transfer Syntaxes: 1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91 Additionally: 1.2.840.10008.1.2.4.50 for HCI, retUS-MF, US-MF, retUS, US, MR, SC, SC-MF-Byte, SC-MF-Word, SC-MF-Color, retNM, NM-MF, XA, RF, VL, ES, GM, SM, XC, ESMF. Additionally: 1.2.840.10008.1.2.5 for retUS-MF, US-MF, retUS, US. Only: 1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 for STD OVLY, STD CRV, MOD LUT, VOI LUT, MRS, SC-MF-SB, ESV.	Explicit VR Little Endian recommended if Private Elements exist in the dataset Return codes = 0000, A700, C000

	1.2.840.10008.5.1.1.27 (SP) 1.2.840.10008.5.1.4.1.1.9.1.1 (12LECG) 1.2.840.10008.5.1.4.1.1.9.1.2 (GECG) 1.2.840.10008.5.1.4.1.1.9.1.3 (AECG) 1.2.840.10008.5.1.4.1.1.9.2.1 (HD) 1.2.840.10008.5.1.4.1.1.9.3.1 (EPS) 1.2.840.10008.5.1.4.1.1.9.4.1 (AU) 1.2.840.10008.5.1.4.1.1.11.1 (GSPS) 1.2.840.10008.5.1.4.1.1.11.2 (CSPS) 1.2.840.10008.5.1.4.1.1.11.3 (PCSPS) 1.2.840.10008.5.1.4.1.1.11.4 (BSPS) 1.2.840.10008.5.1.4.1.1.66 (RAW) 1.2.840.10008.5.1.4.1.1.88.11 (SR Basic Text) 1.2.840.10008.5.1.4.1.1.88.22 (SR Enhanced) 1.2.840.10008.5.1.4.1.1.88.33 (SR Comprehensive) 1.2.840.10008.5.1.4.1.1.88.50 (MG CAD SR) 1.2.840.10008.5.1.4.1.1.88.59 (KOS Document) 1.2.840.10008.5.1.4.1.1.88.65 (CCADSR) 1.2.840.10008.5.1.4.1.1.88.67 (DOSES SR) 1.2.840.10008.5.1.4.1.1.104.1 (PDF) 1.2.840.10008.5.1.4.1.1.129 (SPTCV) 1.2.840.10008.5.1.4.1.1.481.2 (RTDOSE) 1.2.840.10008.5.1.4.1.1.481.3 (RTSTRUCT) 1.2.840.10008.5.1.4.1.1.481.4 (RTBEAMS) 1.2.840.10008.5.1.4.1.1.481.5 (RTPLAN) 1.2.840.10008.5.1.4.1.1.481.6 (RTBRACHY) 1.2.840.10008.5.1.4.1.1.481.7 (RTSUMMARY) 1.2.840.10008.5.1.4.1.1.481.8 (RTION) 1.2.840.10008.5.1.4.1.1.481.9 (RTIONBEAMS)	Accepted Transfer Syntaxes: 1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2	
Fuji Private CR Storage	1.2.392.200036.9125.1.1.2	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	Return codes = 0000, A700, C000
Philips Private 3D Presentation State	1.3.46.670589.2.5.1.1	1.2.840.10008.1.2 1.2.840.10008.1.2.1	
Modality worklist-FIND	1.2.840.10008.5.1.4.31	1.2.840.10008.1.2	See Modality Worklist (Section 3.4) for details
Patient Root Q/R-FIND	1.2.840.10008.5.1.4.1.2.1.1	1.2.840.10008.1.2	Relational queries not supported
Study Root Q/R-FIND	1.2.840.10008.5.1.4.1.2.2.1	1.2.840.10008.1.2	Relational queries not supported
Patient/Study Q/R-FIND	1.2.840.10008.5.1.4.1.2.3.1	1.2.840.10008.1.2	Relational queries not supported
Patient Root Q/R-MOVE	1.2.840.10008.5.1.4.1.2.1.2	1.2.840.10008.1.2 1.2.840.10008.1.2.1	If the image is stored compressed and its transfer syntax negotiated, then this syntax will be used for transfer. Otherwise Explicit VR Little Endian will be tried first.
Study Root Q/R-MOVE	1.2.840.10008.5.1.4.1.2.2.2	If stored and negotiated: 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.50 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	
Study Root Q/R-GET	1.2.840.10008.5.1.4.1.2.2.3		
Patient/Study Q/R-MOVE	1.2.840.10008.5.1.4.1.2.3.2		
Composite Instance Root Retrieve – MOVE	1.2.840.10008.5.1.4.1.2.4.2		
Composite Instance Root Retrieve – GET	1.2.840.10008.5.1.4.1.2.4.3		
Composite Instance Retrieve Without Bulk Data – GET	1.2.840.10008.5.1.4.1.2.5.3	1.2.840.10008.1.2 1.2.840.10008.1.2.1	

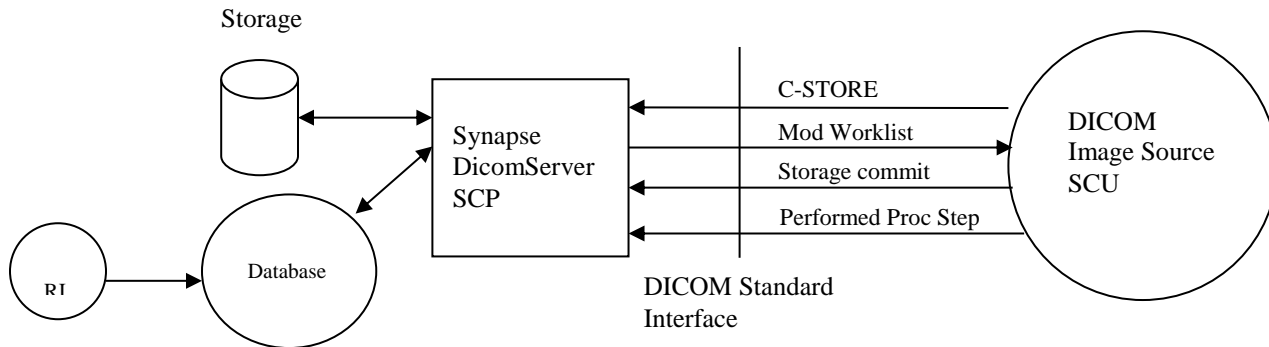
Q/R-MOVE Synapse Diagnostic Report	1.2.840.10008.5.1.4.1.1.88.11	1.2.840.10008.1.2	Diagnostic report can be retrieved as Basic Structured report only on Study Query level along with the images.
Storage commitment push	1.2.840.10008.1.20.1	1.2.840.10008.1.2	See Storage Commitment (Section 3.5) for details
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	1.2.840.10008.1.2	See Performed Procedure Step (Section 3.6) for details

- Storage SOP Classes have Level 2 (Full) conformance.
- SCP has Level 1 of Digital Signature support.
- Extended negotiations are not supported for any of the above service classes.
- There is no enforced limit on number of associations. System configuration (CPU, memory, Disk) may enforce practical limitations
- Only TCP/IP protocol is supported. Any physical media supporting the TCP/IP protocol is supported.
- AE Title, host (or IP address), port, and maximum PDU size are configurable.
- Implementation UID is 1.2.840.113845.1.1, Implementation version is the currently applicable Synapse software release version number.
- Extended character sets ARE supported
- Maximum number of rows the standard C-FIND and Modality Worklist will retrieve is:
 - 20,000 when involving multiple patients
 - Unlimited (no hard limit) when involving a single patient.
- Maximum number of rows the standard C-GET and C-MOVE will retrieve is as follows:
 - If the request is at the patient root, and multiple patients are queried the retrieval will be limited to 20,000 rows.
 - If the request is at the study root, and multiple studies are queried the retrieval will be limited to 20,000 rows.
 - In any other case, there will have no hard limit (unlimited) on the number of rows.
- Supported photometric interpretations: MONOCHROME1, MONOCHROME2, PALETTE COLOR, RGB, YBR_FULL, YBR_FULL_422
- Bits allocated greater than 16 are not supported.
- Pixels have to be right justified: high_bit = bits_stored - 1

As Print SCU:			
SOP Class Name	SOP UID	Transfer Syntax UID	Comments
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	1.2.840.10008.1.2	
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	1.2.840.10008.1.2	N-CREATE, N-DELETE
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	1.2.840.10008.1.2	N-CREATE, N-DELETE, N-ACTION
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	1.2.840.10008.1.2	N-SET
Printer SOP Class	1.2.840.10008.5.1.1.16	1.2.840.10008.1.2	N-GET
Print Job SOP Class	1.2.840.10008.5.1.1.14	1.2.840.10008.1.2	N-GET

As Query/Retrieve SCU:			
SOP Class Name	SOP UID	Transfer Syntax UID	Comments
STUDY ROOT Q/R FIND SCU	1.2.840.10008.5.1.4.1.2.2.1	1.2.840.10008.1.2	C-FIND
STUDY ROOT Q/R MOVE SCU	1.2.840.10008.5.1.4.1.2.2.2	1.2.840.10008.1.2	C-MOVE
VERIFICATION SCU	1.2.840.10008.1.1	1.2.840.10008.1.2	C-ECHO
Standard Storage SCP (receiving retrieved objects)	<p>See "Standard Storage" section of "As Storage SCP" table in "Quick Summary".</p>		<p>C-STORE SCP receiving DICOM objects that are retrieved.</p> <ul style="list-style-type: none"> Extended negotiations are not supported. No enforced limit on number of associations. Only TCP/IP protocol is supported. Any physical media supporting the TCP/IP protocol is supported. AE Title, host (or IP address) and port are configurable. Extended character sets are not supported Implementation UID is 1.2.124.113532.1.1, Implementation Version is "FujiDicomSCU"; max. PDU size is 65000.
<u>Fuji Private CR Storage</u>	1.2.392.200036.9125.1.1.2 (Fuji Private CR)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	
<u>Philips Private 3D Presentation State</u>	1.3.46.670589.2.5.1.1	1.2.840.10008.1.2 1.2.840.10008.1.2.1	

3. Storing Studies



A modality will use CSTORE service to store images into Synapse.

3.1 Ideal Store scenario

1. Study is ordered in RIS, which assigns a unique identifier to the study. In DICOM terms this unique ID is called the accession number.
2. The modality requests a modality worklist from the DICOM SCP, which provides a list of studies to be performed. The list contains all the pertinent study and patient data such that the data does not need to be entered again at the modality. The accession number as well as the study instance UID is also provided to the modality.
3. The modality generates the study and populates the DICOM headers of the images with the correct accession number, study instance UID and patient demographics. The modality also creates a unique series, and SOP instance UIDs as required by the DICOM standard. If a study consists of images from different modalities, each modality will generate a different study instance UID for the same study, and then it is only the accession number that will indicate if images from different modalities are to be placed in the same study.
4. The modality sends images to the DICOM SCP using C-STORE operations.
5. The modality verifies that the images have been stored via the Storage commitment service class so that it can delete the images from its own local storage.
6. The modality indicates that the procedure has been performed via the performed procedure step service class.

3.2 Non-ideal scenarios

Not all modalities support Modality Worklist, performed procedure step, or Storage Commitment. Due to lack of full DICOM support at the modalities several conditions arise:

- If the modality does not support Modality worklist and only allows patient demographics to be entered manually or via a barcode scan, a DICOM SCP has to use other means to determine to which study the image belongs. This is true even if the modality allows manual entry of a medical record number or accession number, but it does not insert it in the DICOM header.
- If the modality has no Modality Worklist support but allows entry of the accession number and inserts it into the DICOM header, the primary concern is that the accession number may be typed incorrectly and consequently the images could be associated with the wrong study.
- If the modality does not indicate that the procedure has been completed (i.e. no support for Performed Procedure Step), then the DICOM SCP has no way to know that all images of a study have been sent. Unless some mechanism is built in the SCP, a PACS system database would potentially wait forever to determine if all images of a study are available. This may adversely affect the way a PACS system determines when

studies should be available to a Radiologist for reading. Under such circumstances, Synapse Dicom Server assumes that when the C-STORE association is closed, it signals the completion of the transmission of a study.

3.2.1 Accession number

If a modality is unable to provide the accession number in the DICOM headers, the Synapse DicomServer attempts to match the incoming study with a pre-ordered study. If it cannot find a match, a new study is created in the Synapse system as a place to hold the images. If Synapse is able to find the patient, it creates the study for that patient. If Synapse is not able to find the patient then it creates a new patient and stores the study. The creation of a new patient in Synapse is not related to creation of a patient in RIS in this case.

The Fuji Synapse DICOM server uses patient name, ID, gender, date, to “best fit” the image to a study. However, this method does not guarantee 100% success rate.

3.2.2 No indication of completion

If an SCU does not support MPPS, the DicomServer can be configured to consider end of C-STORE association as the completion of transmission of the study.

3.3 C-STORE

The DicomServer generates a “Refused: Out of resources” response if it cannot write the image to a disk or if it cannot update the Synapse database.

The DicomServer generates a “Cannot Understand” response if the image does not contain Study Instance UID. The following table lists the elements in the DICOM header used to display images. See comments for each element.

Attribute	Tag	Comments
Patient name	(0010,0010)	Not required but recommended if Accession number is not present
Patient ID	(0010,0020)	Not required but recommended if Accession number is not present
Accession number	(0008,0050)	Recommended to be present
Study Instance UID	(0020,000D)	Must be present
Modality	(0008,0060)	Must be present
Window Width	(0028,1051)	If not present, an internal algorithm is used
Window Level/Center	(0028,1050)	If not present, an internal algorithm is used
Bits allocated	(0028,0100)	Must be present and must be less than or equal to 16
Bits Stored	(0028,0101)	Must be present
High bit	(0028,0102)	Must be present
Rows	(0028,0010)	Must be present
Columns	(0028,0011)	Must be present
SOP Instance UID	(0008,0018)	Must be present

3.4 Modality Worklist

For all supported matching keys and return values see the Appendix A.

3.5 Storage commitment

Storage commitment Request – Action Information

Attribute	Tag
Transaction UID	(0008,1195)
Reference SOP Seq	(0008,1199)
>Referenced SOP Class UID	(0008,1150)
>Referenced SOP Instance UID	(0008,1155)

- The SCP deletes SOP instances only when there is no space for new images. In that case, the images will be deleted only if the System is configured to do so. New images are refused if there is no space for new images and deletion is not explicitly enabled.
- All images are committed to disk during the CSTORE operations.
- Application Profiles, Storage Media File-Set ID and UID attributes are not supported.

Storage commitment Result – Report, No failures

Attribute	Tag
Transaction UID	(0008,1195)
Reference SOP Seq	(0008,1199)
>Referenced SOP Class UID	(0008,1150)
>Referenced SOP Instance UID	(0008,1155)

Storage commitment Result – Report, Failures

Attribute	Tag
Transaction UID	(0008,1195)
Reference SOP Seq	(0008,1199)
>Referenced SOP Class UID	(0008,1150)
>Referenced SOP Instance UID	(0008,1155)
Failed SOP sequence	(0008,1198)
>Referenced SOP Class UID	(0008,1150)
>Reference SOP Instance UID	(0008,1155)
>Failure reason	(0008,1197)

- N-EVENT-REPORT is generated in response to the storage commitment request, as specified in the DICOM standard. Upon receipt of the storage commitment request, the SCP will check the Synapse database for the specified SOP instances and generate the result response
- Storage Media file-set ID & UID attributes are not supported
- Application profiles are not supported
- The Retrieve AE title is not supported. An SCU must explicitly use the supported Query/Retrieve models to retrieve such information
- N-EVENT-REPORT will be sent immediately after receiving the N-ACTION message on a separate association but BEFORE the response to N-ACTION is sent. SCUs must be able to handle the request for a separate association.

3.6 Performed procedure step

N-CREATE required attributes

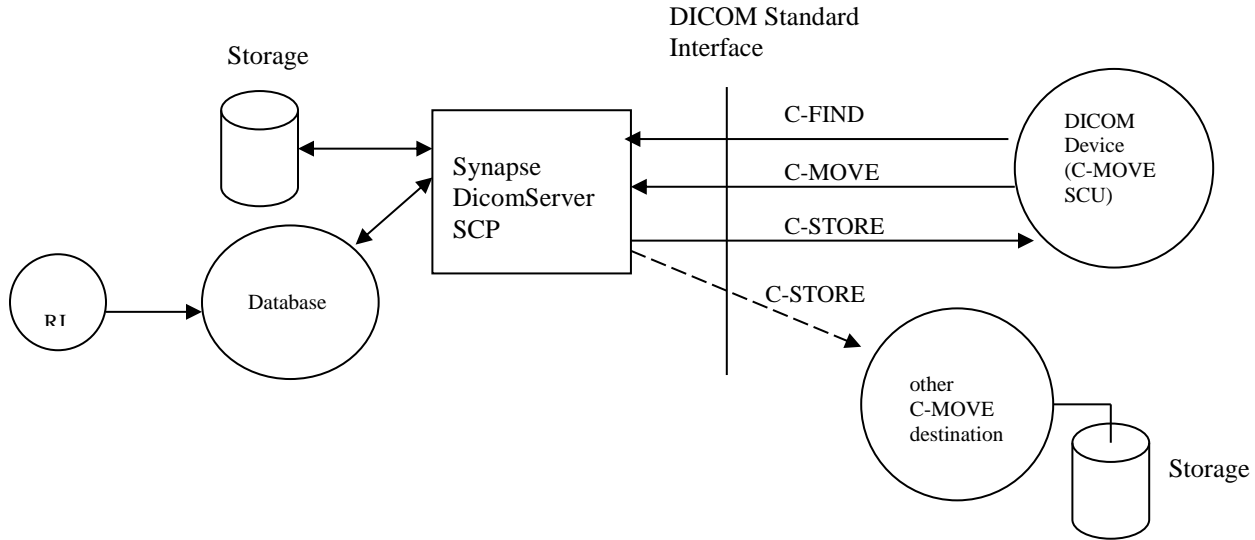
Attribute	Tag
Scheduled Step attribute Sequence	(0040,0270)
>Study Instance UID	(0020,000D)
Performed procedure step ID	(0040,0253)
Performed station AE Title	(0040,0241)
Start date	(0040,0244)
Start time	(0040,0245)
Status	(0040,0252) Must be "IN PROGRESS"
Modality	(0008,0060)

N-SET supported attributes, items in italics must be supplied to properly execute N-SET

Attribute	Tag
<i>Scheduled Step attribute Sequence</i>	<i>(0040,0270)</i>
<i>>Study Instance UID</i>	<i>(0020,000D)</i>
<i>Performed procedure step ID</i>	<i>(0040,0253)</i>
Status	(0040,0252) No changes after COMPLETED or DISCONTINUED

4. Retrieving Studies

Any DICOM-compliant device can retrieve studies from Synapse via the supported Query/Retrieve SOP classes.



The Synapse DicomServer supports the following two Q/R service classes

- Patient Root (C-FIND, C-MOVE)
- Study Root (C-FIND, C-MOVE)

Relational queries are not supported.

4.1 C-FIND

Supported levels

Q/R model	Supported query levels	Operation
Patient Root	Patient, Study, Series, Image	Unique keys for higher levels are required for lower level queries
Study Root	Study, Series, Image	Unique keys for higher levels are required for lower level queries

- As specified in the DICOM standard, in order to retrieve information at lower levels, unique keys for higher levels must be specified. These unique keys for the levels higher than the query level can be obtained by first performing a C-FIND at that same query level. For example, Patient, Study and Series C-FIND operations must be performed to obtain the unique keys for an Image level query in the Patient Root model.

For all supported matching keys and return values see the Appendix A.

The following matching criteria are supported:

- Wildcard matching (* or ?) for the level of the query (except for date and time)
- Range matching (for dates and time)
- Universal matching (data is returned but not used in match)
- UID list matching

4.2 C-MOVE and C-GET

The Synapse DicomServer supports the following C-MOVE models as specified by the DICOM standard.

Supported levels

Q/R model	Supported retrieve levels	Operation
Patient Root (C-MOVE only)	Patient, Study, Series, Image	Unique keys for higher levels are required for lower level queries
Study Root	Study, Series, Image	Unique keys for higher levels are required for lower level queries
Composite Instance Root	Image, Frame	
Composite Instance Root Without Bulk Data (C-GET only)	Image	

For all supported matching keys and return values see the Appendix A.

4.2.1 Matching Attributes

In contrast to the case of C-FIND, only the unique attributes are matched against in a C-MOVE query, i.e.

Patient Level Attributes

Attribute	Tag
Patient ID	(0010,0020) - Unique

Study Level Attributes

Attribute	Tag
Study Instance UID	(0020,000D) - Unique

Series Level Attributes

Attribute	Tag
Series Instance UID	(0020,000E)- Unique

Image Level Attributes

Attribute	Tag
SOP Instance UID	(0008,0018) - Unique

Frame Level Attributes (Only one at a time.)

Attribute	Tag
Simple Frame List	(0008,1161)
Calculated Frame List	(0008,1162)
Time Range	(0008,1163)

The matching criteria are more restrictive than they are in the case with C-FIND. At all levels above the retrieve level, only single value matching is allowed. At the retrieve level, only single value and list-of-UID matching are allowed. For example, if a patient-root retrieve is requested with a retrieve level of 'series', the SCU must supply single values for the patient ID and Study Instance UID, but could supply either a single or a list of series instance UIDs.

In case of C-MOVE, the actual transmission of the matched results takes place on a separate C-STORE association between the Synapse DicomServer and the move destination (which is not necessarily the C-MOVE SCU) and it is done one image at a time. In negotiating the C-STORE association with the C-MOVE destination, JPEG Lossless, JPEG Lossy, JPEG 2000 Lossy, JPEG 2000 Lossless, little endian explicit and little endian implicit transfer syntaxes are attempted to be negotiated. If the stored image is compressed and its transfer syntax is negotiated, then this transfer syntax will be used for transfer, otherwise little endian explicit transfer syntax is attempted first and then little endian implicit.

A pending status response is sent to the SCU every 10 seconds while images are being transmitted. A final response will be issued when the entire operation has completed. In every C-MOVE response, the number of completed sub-operations and number of failed sub-operations are indicated, with a data set containing the list of failed SOP Instance UIDs if appropriate. The number of warning sub-operations is absent as we do not keep track of those figures.

Synapse DicomServer does not handle the C-MOVE-CANCEL indication. Once the C-MOVE operation has started, it will continue until completion.

5. DICOM Print SCU

The Synapse system includes standard printer drivers to provide an interface to various DICOM printers. The Dicom Print SCU is part of the Synapse Workstation.

5.1 Overview

A Synapse Workstation formats one or more images on a page to be printed. The Workstation sends each page to the DICOM printer as a basic 8-bit grayscale image box. An association is created for each print job and closed at the completion of the job. Print jobs are queued so each printer has one active association open at a time. Windows operating system allows multiple printers to be active, so there is no fixed maximum number of associations.

5.2 Required SOP Classes

The print driver uses the Basic Grayscale Print Management Meta SOP Class.

SOP Class Name	Class UID	Service Group
Basic Grayscale Print Management Meta SOP Class	1.2.840.10008.5.1.1.9	
Basic Film Session SOP Class	1.2.840.10008.5.1.1.1	N-CREATE, N-DELETE
Basic Film Box SOP Class	1.2.840.10008.5.1.1.2	N-CREATE, N-DELETE, N-ACTION
Basic Grayscale Image Box SOP Class	1.2.840.10008.5.1.1.4	N-SET
Printer SOP Class	1.2.840.10008.5.1.1.16	N-GET
Optional:		
Print Job SOP Class	1.2.840.10008.5.1.1.14	N-GET

5.3 Optional SOP Classes

The Print Job SOP Class (1.2.840.10008.5.1.1.14) is optional. If supported it is used to monitor completion of the print job through the N_GET Service Group.

5.4 Supported DICOM Attributes

The SCU can support the following attributes. Individual printer drivers may support a subset of these options.

Attribute	Tag	Supported Options
Copies	(2000,0010)	
Priority	(2000,0020)	HIGH, MED, LOW
Medium Type	(2000,0030)	PAPER, CLEAR FILM, BLUE FILM
Film Destination	(2000,0040)	MAGAZINE, PROCESSOR, BIN_j
Film Session Label	(2000,0050)	
Image Display Format	(2010,0010)	STANDARD\1,1
Film Orientation	(2010,0040)	PORTRAIT, LANDSCAPE
Film Size	(2010,0050)	Display
		8INX10IN, 10INX12IN, 10INX14IN,
		11INX14IN, 14INX14IN, 14INX17IN
		24CMX24CM, 24CMX30CM
Magnification Type	(2010,0060)	REPLICATE, BILINEAR, CUBIC, NONE
Smoothing Type	(2010,0080)	SHARP, SMOOTH, MEDIUM
Border Density	(2010,0100)	BLACK, WHITE, 0-300
Empty Image Density	(2010,0110)	BLACK, WHITE, 0-300
Min Density	(2010,0120)	0-300
Max Density	(2010,0130)	0-300

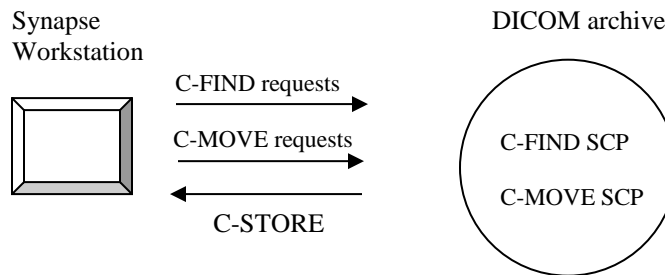
Trim	(2010,0140)	YES, NO
Polarity	(2020,0020)	NORMAL, REVERSE
Bits stored	(0028,0101)	8
Bits allocated	(0028,0100)	8
Printer configuration table	(2010,0150)	CS000-CS999
Printer Status	(2110,0010)	NORMAL, WARNING, FAILURE
Printer Status Info	(2110,0020)	
Execution Status	(2100,0020)	PENDING, PRINTING, DONE, FAILURE

6. DICOM Query/Retrieve SCU

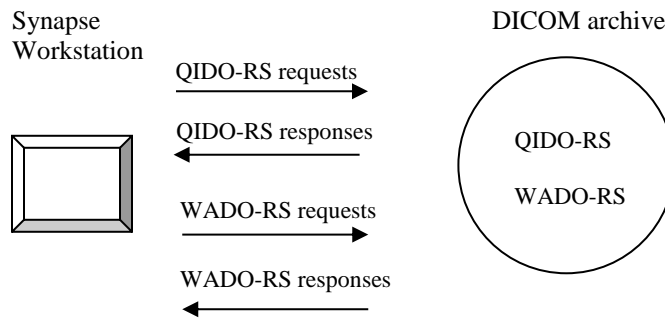
The Synapse system includes the capability of querying/retrieving DICOM images to be viewed at the Synapse Workstation. In DICOM parlance, the Synapse Workstation can act as a DICOM C-FIND and C-MOVE SCU. In addition the workstation can query/retrieve DICOM images via web access by means of QIDO-RS and WADO-RS.

6.1 Overview

The basic interactions are depicted in the following diagrams



Or



The Synapse Workstation, depending on the access mechanism, either:

1) Issues DICOM C-FIND and C-MOVE requests. The DICOM archive responds to the requests, and sends the requested items via DICOM C-STORE (on a separate association). In this sense, the Workstation is both a SCU (for C-FIND and C-MOVE) and a SCP (for C-STORE). The Workstation can have (but does not have to have) two distinct DICOM AE titles for these two roles. There is a configurable C-MOVE timeout with a factory default value of 60 seconds.

Or

2) Issues QIDO-RS and WADO-RS requests. The DICOM archive responds to the QIDO-RS HTTP GET requests, and sends the query results back to the workstation, the workstation can then request the images for display via WADO-RS HTTP GET calls.

6.2 Supported SOP Classes

SOP Class Name	Class UID	Service Group
STUDY ROOT Q/R FIND	1.2.840.10008.5.1.4.1.2.2.1	C-FIND SCU
STUDY ROOT Q/R MOVE	1.2.840.10008.5.1.4.1.2.2.2	C-MOVE SCU

SOP Class Name	Class UID	Service Group
VERIFICATION	1.2.840.10008.1.1	C-ECHO SCU
Standard Storage	See "Standard Storage" section of "As Storage SCP" table in "Quick Summary".	C-STORE SCP
<u>Fuji Private CR Storage</u> 1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70	1.2.392.200036.9125.1.1.2 (Fuji Private CR)	C-STORE SCP
<u>Philips Private 3D Presentation State</u> 1.2.840.10008.1.2 1.2.840.10008.1.2.1	1.3.46.670589.2.5.1.1 (Philips Private 3D Presentation State)	C-STORE SCP

6.3 Supported DICOM Attributes during C-FIND and C-MOVE

	Query Level	Attribute Name	DICOM Tag	Match/Return
C-FIND	All	SOP Class UID	0002,0002	-
		Query/Retrieve Level	0008,0052	-
	Study	Patient Name	0010,0010	M, R
		Patient ID	0010,0020	M, R
		Study Date	0008,0020	M, R
		Study Time	0008,0030	R
		Accession Number	0008,0050	M, R
		Study ID	0020,0010	R
		Study Instance UID	0020,000D	R
	Series	Modality in Study	0008,0061	R
		Modality	0008,0060	R
		Series Number	0020,0011	R
	Instance	Series Instance UID	0020,000E	M, R
		Instance Number	0020,0013	R
		SOP Instance UID	0008,0018	M, R
		Rows	0028,0010	R
		Columns	0028,0011	R
Number of Frames		0028,0008	R	
SOP Class UID		0008,0016	R	
C-MOVE	Instance	SOP Class UID	0002,0002	-
		Query/Retrieve Level	0008,0052	-
		Destination AE Title	0000,0600	-
		Patient ID	0010,0020	M
		Study Instance UID	0020,000D	M
		Series Instance UID	0020,000E	M
		SOP Instance UID	0008,0018	M

7. DICOM C-STORE SCU

Synapse includes the capability of forwarding DICOM objects to a DICOM C-STORE SCP. When forwarding, Synapse acts as a DICOM C-STORE SCU.

7.1 Overview

The basic interactions are depicted in the following diagram



7.2 Supported SOP Classes

SOP Class Name	Class UID	Service Group
Standard Storage	1.2.392.200036.9125.1.1.2 (Fuji Private CR)	C-STORE SCU
	1.2.840.10008.5.1.1.29 (HGI)	
	1.2.840.10008.5.1.1.30 (HCI)	
<u>Proposed Transfer Syntaxes:</u>	1.2.840.10008.5.1.4.1.1.1 (CR)	
	1.2.840.10008.5.1.4.1.1.1.1 (DX-Prs)	
	1.2.840.10008.5.1.4.1.1.1.1.1 (DX-Proc)	
1.2.840.10008.1.2	1.2.840.10008.5.1.4.1.1.1.2 (MG-Prs)	
1.2.840.10008.1.2.1	1.2.840.10008.5.1.4.1.1.1.2.1 (MG-Proc)	
1.2.840.10008.1.2.4.70	1.2.840.10008.5.1.4.1.1.1.3 (IO-Prs)	
1.2.840.10008.1.2.4.90	1.2.840.10008.5.1.4.1.1.1.3.1 (IO-Proc)	
1.2.840.10008.1.2.4.91	1.2.840.10008.5.1.4.1.1.2 (CT)	
Additionally:	1.2.840.10008.5.1.4.1.1.3 (retUS-MF)	
1.2.840.10008.1.2.4.50	1.2.840.10008.5.1.4.1.1.3.1 (US-MF)	
for HCI, retUS-MF, US-MF, retUS, US, MR, SC, SC-MF-Byte, SC-MF-Word, SC-MF-Color, retNM, NM-MF, XA, RF, VL, ES, GM, SM, XC, ESMF.	1.2.840.10008.5.1.4.1.1.4 (MR)	
	1.2.840.10008.5.1.4.1.1.4.2 (MRS)	
	1.2.840.10008.5.1.4.1.1.5 (retNM)	
	1.2.840.10008.5.1.4.1.1.6 (retUS)	
	1.2.840.10008.5.1.4.1.1.6.1 (US)	
	1.2.840.10008.5.1.4.1.1.7 (SC)	
	1.2.840.10008.5.1.4.1.1.7.1 (SC-MF-SB)	
	1.2.840.10008.5.1.4.1.1.7.2 (SC-MF-Byte)	
	1.2.840.10008.5.1.4.1.1.7.3 (SC-MF-Word)	
	1.2.840.10008.5.1.4.1.1.7.4 (SC-MF-Color)	
Additionally:	1.2.840.10008.5.1.4.1.1.8 (STD OVLY)	
1.2.840.10008.1.2.5	1.2.840.10008.5.1.4.1.1.9 (STD CRV)	
for retUS-MF, US-MF, retUS, US.	1.2.840.10008.5.1.4.1.1.10 (MOD LUT)	
	1.2.840.10008.5.1.4.1.1.11 (VOI LUT)	
Only:	1.2.840.10008.5.1.4.1.1.12.1 (XA)	
1.2.840.10008.1.2	1.2.840.10008.5.1.4.1.1.12.2 (RF)	
1.2.840.10008.1.2.1	1.2.840.10008.5.1.4.1.1.12.3 (RF-BP)	
for STD OVLY, STD CRV, MOD LUT, VOI LUT, MRS, SC-MF-SB, ESV.	1.2.840.10008.5.1.4.1.1.13.1.3 (MGT)	
	1.2.840.10008.5.1.4.1.1.14.1 (IVOCT Pres)	
	1.2.840.10008.5.1.4.1.1.14.2 (IVOCT Proc)	
	1.2.840.10008.5.1.4.1.1.20 (NM-MF)	
	1.2.840.10008.5.1.4.1.1.77.1 (VL)	
	1.2.840.10008.5.1.4.1.1.77.1.1 (ES)	
	1.2.840.10008.5.1.4.1.1.77.1.1.1 (ESV)	

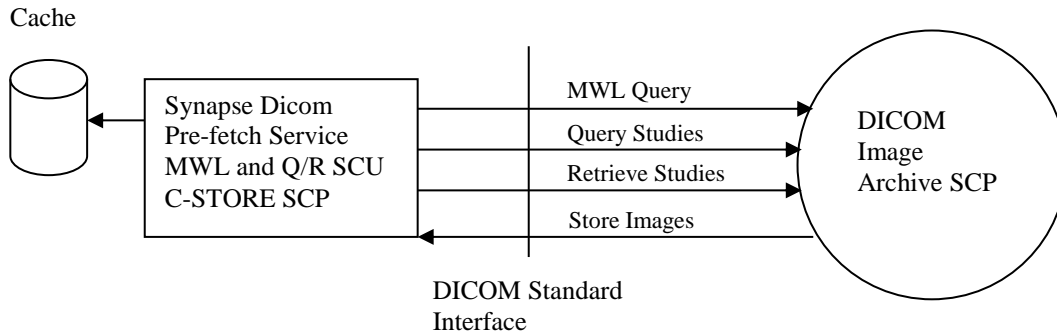
SOP Class Name	Class UID	Service Group
	1.2.840.10008.5.1.4.1.1.77.1.2 (GM) 1.2.840.10008.5.1.4.1.1.77.1.3 (SM) 1.2.840.10008.5.1.4.1.1.77.1.4 (XC) 1.2.840.10008.5.1.4.1.1.77.2 (ESMF) 1.2.840.10008.5.1.4.1.1.128 (PET) 1.2.840.10008.5.1.4.1.1.481.1 (RTIMAGE)	
Standard Storage <u>Proposed Transfer Syntaxes:</u> 1.2.840.10008.1.2 1.2.840.10008.1.2.1	1.2.840.10008.5.1.1.27 (SP) 1.2.840.10008.5.1.4.1.1.9.1.1 (12LECG) 1.2.840.10008.5.1.4.1.1.9.1.2 (GECG) 1.2.840.10008.5.1.4.1.1.9.1.3 (AECG) 1.2.840.10008.5.1.4.1.1.9.2.1 (HD) 1.2.840.10008.5.1.4.1.1.9.3.1 (EPS) 1.2.840.10008.5.1.4.1.1.9.4.1 (AU) 1.2.840.10008.5.1.4.1.1.11.1 (GSPS) 1.2.840.10008.5.1.4.1.1.11.2 (CSPS) 1.2.840.10008.5.1.4.1.1.11.3 (PCSPS) 1.2.840.10008.5.1.4.1.1.11.4 (BSPS) 1.2.840.10008.5.1.4.1.1.66 (RAW) 1.2.840.10008.5.1.4.1.1.88.11 (SR Basic Text) 1.2.840.10008.5.1.4.1.1.88.22 (SR Enhanced) 1.2.840.10008.5.1.4.1.1.88.33 (SR Comprehensive) 1.2.840.10008.5.1.4.1.1.88.50 (MG CAD SR) 1.2.840.10008.5.1.4.1.1.88.59 (KOS Document) 1.2.840.10008.5.1.4.1.1.88.65 (CCADSR) 1.2.840.10008.5.1.4.1.1.88.67 (DOSESR) 1.2.840.10008.5.1.4.1.1.104.1 (PDF) 1.2.840.10008.5.1.4.1.1.129 (SPTCV) 1.2.840.10008.5.1.4.1.1.481.2 (RTDOSE) 1.2.840.10008.5.1.4.1.1.481.3 (RTSTRUCT) 1.2.840.10008.5.1.4.1.1.481.4 (RTBEAMS) 1.2.840.10008.5.1.4.1.1.481.5 (RTPLAN) 1.2.840.10008.5.1.4.1.1.481.6 (RTBRACHY) 1.2.840.10008.5.1.4.1.1.481.7 (RTSUMMARY) 1.2.840.10008.5.1.4.1.1.481.8 (RTION) 1.2.840.10008.5.1.4.1.1.481.9 (RTIONBEAMS) 1.3.46.670589.2.5.1.1 (Philips Private 3D Presentation State)	C-STORE SCU

8. Pre-fetching Studies

Synapse includes the capability to load images from a Query/Retrieve SCP such as a third-party PACS in advance of a patient’s visit. In order to accomplish this, Synapse will act as a Modality Worklist and Query/Retrieve SCU.

8.1 Overview

Modality Worklist C-FIND queries will be performed, with Synapse acting as the SCU, to determine which patients will be visiting in the near future. This will be followed by additional query and retrieve requests to acquire all of the studies for a patient and load them into a cache prior to the patient’s arrival.



8.2 Supported SOP Classes

SOP Class Name	Class UID	Service Group
MODALITY WORKLIST	1.2.840.10008.5.1.4.31	C-FIND SCU
STUDY ROOT Q/R FIND	1.2.840.10008.5.1.4.1.2.2.1	C-FIND SCU
STUDY ROOT Q/R MOVE	1.2.840.10008.5.1.4.1.2.2.2	C-MOVE SCU
VERIFICATION	1.2.840.10008.1.1	C-ECHO SCU
Standard Storage	See “Standard Storage” section of “As Storage SCP” table in “Quick Summary”.	C-STORE SCP
<u>Fuji Private CR Storage</u> 1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.90 1.2.840.10008.1.2.4.91	1.2.392.200036.9125.1.1.2 (Fuji Private CR)	C-STORE SCP
<u>Philips Private 3D Presentation State</u> 1.2.840.10008.1.2 1.2.840.10008.1.2.1	1.3.46.670589.2.5.1.1 (Philips Private 3D Presentation State)	C-STORE SCP

9. Intravascular Optical Coherence Media Management

Synapse Workstation includes the capability to create DICOM file-sets CD-R, DVD, and Blu-ray media.

9.1 Overview

The file-sets are generated in accordance with DICOM Part 10 through the use of the Application Profile “STD-GEN-CD” which is described as “General Purpose CD-R Image Interchange”. Synapse Workstation will act as an FSC (File-set Creator) when creating the file-set through the Real World Activity of “Write image(s) on CD-R disk”. Multi-session writing is not supported. Joliet extensions will be written in addition to the ISO 9660 extensions. The Implementation Class UID is: 1.2.840.113845.1.1.

9.2 Supported SOP Classes

The supported SOP Classes are the same as those supported for C-STORE SCU.

10. QIDO-RS

Synapse implements the restful service QIDO-RS Request/Response as stipulated in PS 3.18 DICOM standard: “Part 18 – Web Access to DICOM Objects, Section 6.7: QIDO-RS Request/Response.” Implementation details follow. The base URL for the QIDO-RS service is {http://<host>:10080/qido-rs/} or {https://<host>:10443/qido-rs/}.

10.1 Request

Synapse QIDO-RS supports the all Search forms specified in PS 3.18 Section 6.7.1.1.

HTTP GET Requests are serviced with the SearchForStudies, SearchForSeries and SearchForInstances facilities

- All valid query parameters are supported, including matching by tag and matching by keyword.
- Both forms of Accept headers specified are accepted, leading to the conforming response
 - multipart/related; type=application/dicom+xml
 - application/json

10.2 Response and Matching

The Synapse QIDO-RS response conforms to the requirements in Section PS 3.18 6.7.1.2.

10.2.1 Response Restrictions

- The QIDO-RS service is limited to examining a maximum of 20,000 returned items.
- QIDO-RS response is limited to metadata. The response will not contain image pixels.

10.2.2 Query/Retrieve Matching

Synapse QIDO-RS supports all matching tags and match types specified from Synapse C-FIND. In addition, the client may request matching on most DICOM elements by tag number or keyword.

QIDO-RS handles matching as follows for tags not handled by C-FIND.

- List of UID matching is supported for all tags of VR UID
- Sequence matching is supported for all tags of VR SQ
- Universal matching is supported for all tags
- Single value matching is supported for all tags
- Wildcard matching is supported for tags specified in PS 3.04 Section C.2.2.2.4
- Matching multiple values is supported (for VM >1, any single matching value indicates a match)
- Range matching is not supported (outside C-FIND tags)

10.2.3 Private Tag Matching and Return Value

- For private tags, information is extracted to the extent possible. In most cases the tag return value will be base64-encoded

10.2.4 Hierarchical and Non-Hierarchical Search

For non-hierarchical matching, e.g. search for SOPInstanceUID where StudyUID and SeriesUID are not provided, an exhaustive searching of the database may be required, which may result in incomplete responses due to timeouts or other implementation limitations.

10.2.5 Special HTTP GET name/value pairs

- ‘offset’ and ‘limit’ HTTP GET name-value pairs are supported

- ‘fuzzymatching=true’ is not supported and will be ignored in matching. The response will include the warning header specified in Part 6.7.1.2.1.

10.2.6 Unsupported Tags

Synapse supports all required match keys for Study, Series and Instance-level queries with the exception of these keys in Series-level queries:

- 00400244 PerformedProcedureStepStartDate
- 00400245 PerformedProcedureStepStartTime
- 00400275 RequestAttributeSequence
- 00400009 >ScheduledProcedureStepID
- 00401001 >RequestedProcedureID

11. WADO-URI

Synapse provides access to DICOM images (as well as non-image objects) via WEB technology as stipulated in DICOM standard: “Part 18 -- Web Access to DICOM Persistent Objects (WADO).” The base URL for the WADO-URI service is {http://<host>:9080/services/wado/} or {https://<host>:9443/services/wado/}.

Example: http://myhost:9080/services/Wado?requestType=WADO&studyUID=1.3.6.1&seriesUID=1.3.6.2&objectUID=1.3.6.3&contentType=application/dicom&transferSyntax=1.2.840.10008.1.2.4.70

11.1 Overview

WADO-URI requests will be performed, with Synapse acting as the WADO SCP. Persisted DICOM objects will be returned to the user agent as JPEG image, JPEG 2000 image, DICOM Part 10 file, plain text, html formatted text or, XML document.

The character set utilized in the response is the one used in storage of such object.
HTTP error code 406 will be issued when request cannot be successfully completed.

11.2 URL Query Parameters

The query parameters handling is as follows:

Table A. WADO URI Request Query Parameters Handling

URL Query Parameter	Name	If Present	If Absent	Requirement
requestType	Request Type must equal “WADO”	OK	406	Required
studyUID	Unique identifier of the study	OK	406	Required
seriesUID	Unique identifier of the series	OK	406	Required
objectUID	Unique identifier of the object	OK	406	Required
contentType	See WADO-URI Request Query Parameter "contentType" Allowable Values <i>table</i> .	OK	Default	Optional
charset		Ignored	OK	Not Supported
anonymize	Anonymize object (if “yes”)	OK	OK	Optional
annotation		Ignored	OK	Not Supported
rows	Number of pixel rows	OK	OK	Optional
columns	Number of pixel columns	OK	OK	Optional
region		Ignored	OK	Not Supported
windowCenter	Window center of the image	OK	OK	Optional
windowWidth	Window width of the image	OK	OK	Optional
frameNumber	Frame number	OK	OK	Optional
imageQuality	Image quality	OK	OK	Optional

presentationUID		Ignored	OK	Not Supported
presentationSeriesUID		Ignored	OK	Not Supported
transferSyntax	Transfer Syntax UID	OK	OK	Optional

The parameter “contentType” specifies the MIME type of the response and it takes on a value, from a set of available values, dependent on the DICOM object type. In itself, being an optional parameter, each object type has a default value assigned to it.

Table B. WADO-URI Request Query Parameter "contentType" Allowable Values

Single Frame Image Objects	Multi-Frame Image Objects	Text Objects	Other Objects	Server response MIME type (contentType)	Default
•				image/jpeg	•
•		•		application/dicom	
	•		•	application/dicom	•
		•		text/plain	
		•		text/html	•
		•		text/xml	

For “application/dicom” MIME type requests that do not specify transfer syntax, the return DICOM object will be in "Explicit VR Little Endian" transfer syntax. For other transfer syntaxes, See “Standard Storage” section of “As Storage SCP” table in “Quick Summary”, as not all are applicable for all DICOM objects. And, not all of those transfer syntaxes that are applicable for a given SOP Class are necessarily supported.

11.3 Supported SOP Classes

All the DICOM objects stored via C-STORE can be retrieved via WADO-URI.

12. WADO-RS

Synapse provides web access to multiple DICOM objects with the restful service WADO-RS as stipulated in NEMA PS3.18: “Part 18 – Web Access to DICOM Objects”.

The base URL for the WADO-RS service is {http://<host>:12080/wado-rs/} or {https://<host>:12443/wado-rs/}.

Example: http://myhost:12080/wado-rs/studies/123.456?accept=multipart/related;type=application/dicom

12.1 WADO-RS Request

Synapse WADO-RS supports RetrieveStudy, RetrieveSeries, RetrieveInstance, RetrieveFrames, RetrieveBulkdata, RetrieveMetadata and RetrieveRendered requests as specified in PS3.18 Section 6.5.

12.1.1 Supported Accept Types

Mode	AcceptType	Sample URL
DICOM format	multipart/related;type=application/dicom [;transfer-syntax=<UID>] application/dicom[;transfer-syntax=<UID>] (single instance only)	Wado-rs/studies/<ID> Wado-rs/studies/<ID>/series/<ID> Wado-rs/studies/<ID>/series/<ID>/instances/<ID> Note: To save space, only the study level URL will be listed below.
DICOM XML	multipart/related;type=application/dicom+xml	Wado-rs/studies/<ID>/ metadata
DICOM JSON	application/dicom+json (never multipart)	Wado-rs/studies/<ID>/ metadata
Rendered JPEG Lossy	multipart/related;type=image/jpeg image/jpeg (single image or frame only)	Wado-rs/studies/<ID>/ rendered Wado-rs/studies/<ID>/series/<ID>/instances/<ID>/

		frames/<list>/ rendered (for requested frames)
Rendered HTML Text	multipart/related;type=text/html text/html (single instance only)	Wado-rs/studies/<ID>/ rendered Note: text/* defaults to text/html
Rendered Plain Text	multipart/related;type=text/plain text/plain (single instance only)	Wado-rs/studies/<ID>/ rendered Note: any of the text/--- options can also be applied to images for readable header dumps
Rendered XML Text	multipart/related;type=text/xml text/xml (single instance only)	Wado-rs/studies/<ID>/ rendered Note: returns the same output as DICOM+XML
All Bulkdata	multipart/related;type=application/octet-stream[;transfer-syntax=<UID>] Note: uncompressed pixels are delivered one frame per body part.	Wado-rs/studies/<ID> Pixels will default to value of registry key DefaultTransferSyntax
Bulkdata: pixels only	multipart/related;type=image/dicom+jpeg[;transfer-syntax=<UID>] multipart/related;type=image/dicom+jp2[;transfer-syntax=<UID>] Note: image/jpeg and image/jp2 will return DICOM compressed pixels. .	Wado-rs/studies/<ID> Wado-rs/studies/<ID>/series/<ID>/instances/<ID>/frames/<list> (for requested frames only)
BulkDataURI	multipart/related;type=application/octet-stream[;transfer-syntax=<UID>] any mimetype from “Bulkdata: pixels only” if pixel buffer or frame	Wado-rs/studies/<ID>/series/<ID>/instances/<ID>/bulkdata/<ID> .../bulkdata/7FE0001,OW (all frames, 16 bit) .../bulkdata/7FE0001,OB/frames/<n> (nth frame, 8 bit)

Notes:

1. Multiple accept types are allowed as per the standard. Priority goes to highest weight (q=1 vs q=.7), left to right, for mimetypes that match the content.
Synapse WADO-RS allows text rendering of images for readable header dumps. To render all objects in a study with images as pixel and reports as text, be sure to place the image mimetype before the text, e.g.
 multipart/related;type=image/jpeg,multipart/related;type=text/plain
Reports will ignore image/jpeg and use the next available mimetype.
Web browsers typically add accept type text/html to the header sent. Be sure to put your accept types in the URL as these are examined before the ones in the http header.
2. Limited wild carding is supported:
 - a. Metadata: application/* and */* default to application\dicom+xml
 - b. Rendering: image/* and */* default to image/jpeg, text/* defaults to text/html
 - c. Frames & Bulkdata: image/* defaults to image/dicom+jpeg, */* defaults to application/octet-stream
 - d. None of the above: */* defaults to application/dicom
3. BulkDataURI's are supplied by XML and JSON metadata responses for all pixel buffers and for DICOM fields > 1K in size. Non-pixel bulk items are returned as uncompressed binary. Pixels (7FE0,0010) default to JPEG Lossless (.70) unless otherwise requested in the AcceptType transfer-syntax parameter.
4. Note: if “multipart/related” is NOT requested but the query finds more than one object, only the first is returned and the HTTP status will be 206 – Partial.
 Exceptions:
 Bulkdata requests are always multipart.
 JSON supports multi-object metadata in a single part body.
5. For Rendered JPEG
 The compression will be JPEG Lossy. 16 bit images will be converted to 8 bit for compression.
 The following URL parameters are supported:
 - a. &quality=#, where # = 100 to 1, with 100 = lossless and 1 = compressed to 1% of size.

- b. &viewport=x,y[,a,b,c,d] where x = columns (width) and y = rows (height) in pixels. The sub-region values a,b,c,d are ignored at this time.
- c. &window=c,w[,t] where c= window level center, w = widow level width. The type t is ignored at this time.
- 6. For report rendering:
 - a. application/dicom+xml will be used for text/xml or application/xml requests
 - b. With text/plain and text/html, binary fields are truncated and only the first few bytes are shown. For a complete header use RetrieveMetadata or render as text/xml

12.1.2 Supported Transfer-Syntax for application/dicom

Transfer-Syntax	Description
1.2.840.10008.1.2.4.50	JPEG Lossy (8 bit only)
1.2.840.10008.1.2.4.70	JPEG Lossless
1.2.840.10008.1.2.4.91	JPEG 2000 Lossy
1.2.840.10008.1.2.4.90	JPEG 2000 Lossless
1.2.840.10008.1.2	Uncompressed Little Endian Implicit
1.2.840.10008.1.2.1	Uncompressed Little Endian Explicit
1.2.840.113845.1.2.1	Fuji Wavelet

12.2 WADO-RS Response

The Error Codes conform to Section PS3.18 Section 6.5.7 with the following exception:

The Http status is sent prior to image rendering. If an image fails to render after the response header is sent, WADO-RS will try to return the image with the Little Endian Explicit transfer syntax. In the unlikely event that this fails, there is no way to change the status from 200 to 206 to alert the client of a partial response.

For an internal error, status 500 may be returned.

13. STOW-RS

Section implementing the restful web service STOW-RS as stipulated in NEMA PS3.18: “Part 18 – Web Access to DICOM Objects”.

The base URL for the STOW-RS service is {http://<host>:13080/stow-rs/} or {https://<host>:13443/stow-rs/}.

Example: POST http://myhost:13080/stow-rs/studies

13.1 STOW-RS Request

Synapse STOW-RS supports StoreInstances requests as specified in PS3.18 Section 6.6, for binary DICOM objects.

Content type must be multipart/related; type="application/dicom".

Storage via XML/JSON metadata + bulk items is not supported.

13.1.1 Supported SOP Classes

SOP Classes supported by STOW-RS are the same as those supported by Synapse C-Find, as represented in Section 6.2 of this document.

13.2 STOW-RS Response

The Synapse STOW-RS HTTP response contains storage confirmation in XML per PS3.18 Section 6.6.1.3.

14. Security and System Management Profiles

Synapse conforms with parts of DICOM Standard that aim to secure the system.

14.1 Association Level Security

Application Entity Titles can be used to restrict DICOM Associations for C-STORE, Query/Retrieve, MWL Query, Storage Commitment.

14.2 Application Level Security

14.2.1 Security Profiles

No security profiles are supported in current software release.

14.2.2 Audit Trail Messages

See Table C. DICOM Specific Audit Messages.

Table C. DICOM Specific Audit Messages

Message	Message ID	Event
Application Activity	110100	<i>DICOM Server</i> start up and shutdown
DICOM Instance Transferred	110104	C-MOVE, C-GET
Import	110107	C-STORE
Query	110112	C-FIND

Appendix A – Query/Retrieve Attribute Support

	COMMAND	C-FIND					C-MOVE				C-MOVE & C-GET							
	ROOT LEVEL	Patient		Study			Patient				Study			Instance				
	QUERY LEVEL	Study	Patient	Study	Series	Image	Study	Series	Image	Patient	Study	Series	Image	Study	Series	Image	Image	Frame
DICOM Tag																		
00080016,UI SOP Class UID						o			o	o	o	o	o	o	o	o	o	o
00080018,UI SOP Instance UID						f,o			f,o			f			f	x	x	
00080020,DA Study Date				f,o	o	o	f,o	o	o	o	o	o	o	o	o	o	o	o
00080030,TM Study Time				f,o	o	o	f,o	o	o	o	o	o	o	o	o	o	o	o
00080056,CS Instance Availability			o	o	o	o	o	o	o									
00080050,SH Accession Number	f,o		f,o	o	o	f,o	o	o	o	o	o	o	o	o	o	o	o	o
00080060,CS Modality				f,o	o	f,o	o											
00080061,CS Modalities in Study				f,o	o	f,o	o	o										
00080080,LO Institution Name				o	o	o	o	o	o									
00080090,PN Referring Physician's Name	o		o		o	f,o		o	o	o	o	o	o	o	o	o	o	o
00081030,LO Study Description				o		o			o	o	o	o	o	o	o	o	o	o
0008103E,LO Series Description					o		o											
00081032,SQ,1:00080100,SH Procedure Code									o	o	o	o	o	o	o	o	o	o
00081032,SQ,1:00080102,SH Procedure Designator									o	o	o	o	o	o	o	o	o	o
00081032,SQ,1:00080104,LO Procedure Description									o	o	o	o	o	o	o	o	o	o
00081161,LU Simple Frame List																		x ¹
00081162,LU Calculated Frame List																		x ¹
00081163,FD Time Range																		x ¹
00100010,PN Patient's Name	f,o	f,o	o	o	o	f,o	f,o	f,o	o	o	o	o	o	o	o	o	o	o
00100020,LO Patient ID	f,o	f,o	x,o	x,o	x,o	f,o	f,o	f,o	f,o	x,o	x,o	x,o	f,o	f,o	f,o	o	o	o
00100030,DA Patient's Birth Date	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
00100040,CS Patient's Sex	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
00102160,SH Ethnic Group			o	o	o	o	o	o	o	o	o	o	o	o	o	o	o	o
00200010,SH Study ID	f		f,o	o	o	f,o	o	o	o	o	o	o	o	o	o	o	o	o
0020000D,UI Study Instance UID	f,o		f,o	x,o	x,o	f,o	x,o	x,o	o	f,o	x,o	x,o	f,o	x,o	x,o	o	o	o
0020000E,UISeries Instance UID				f,o	x,o	f,o	x,o	o	o	f,o	x,o	o	f,o	x,o	o	o	o	o
00200011,IS Series Number				f,o	o	f,o	o											
00200013,IS Instance Number					f,o		f,o											
00201206,IS # of Study Related Series				o	o	o	o	o	o									
00201208,IS # of Study Related Instances				o	o	o	o	o	o									
00201209,IS # of Series Related Instances				o	o		o	o										
00280008,IS Number of Frames						o			o									
00280010,US Rows						o			o									
00280011,US Columns						o			o									
00321032,PN Requesting Physician	o																	
00321033,LO Site ID										o	o	o	o	o	o	o	o	o
00321060,LO Requested Procedure Description	o																	
00321064,SQ,1:00080100,SH Requested Procedure Code	o																	
00321064,SQ,1:00080102,SH Requested Procedure Designator	o																	
00321064,SQ,1:00080104,LO Requested Procedure Description	o																	
00380010,LO Admission ID	o																	
00400100,SQ,1:00080060,CS Sched Proc Step Modality	f,o																	
00400100,SQ,1:00400001,AE Scheduled Station AE Title	o																	
00400100,SQ,1:00400002,DA Sched Proc Step Start Date	f,o																	
00400100,SQ,1:00400003,TM Sched Proc Step Start Time	f,o																	
00400100,SQ,1:00400006,PN Sched Perform Phys Name	o																	
00400100,SQ,1:00400007,LO Sched Proc Step Description	o																	
00400100,SQ,1:00400009,SH Scheduled Procedure Step ID	o																	
00400241,AE Performed Station AE Title			o	o	o		o											
00401001,SH Requested Procedure ID	o																	

