



Product Data

Synapse Release Version 4.0.0

Server Modules and Interfaces

Application

Synapse server is a collection of software modules built on Microsoft® Windows® Server, which together provide the core software functionality for Synapse - FUJIFILM's next generation PACS.

Communication between Synapse server and workstation is entirely web-based and uses Microsoft Internet Information Server (IIS) to provide image access to client workstations. Server modules provide foundation technologies that communicate among server components including the Synapse Database, Web / CodeBase Server, Storage Server, DICOM Server, HIIIS Server, Acceleration Server, PreCache Server and, when required, Hierarchical Storage Manager (HSM).

Synapse server components run on standard Windows servers and can be installed in clustered configurations to provide high availability. Because all data traffic is over standard TCP/IP ports, web and DICOM communication can be routed through content switches to provide greater system scalability and reliability.

Server Modules

Database Server

The Synapse Database Server manages all functional aspects of the PACS. Its

Oracle® 11g database is based on a patient and study data model that provides an intuitive and feature-rich application suite for the end user. Synapse workstations communicate with the database through Hyper Text Transfer Protocol (HTTP).

At least one logical copy of the database exists in the PACS. For enterprise deployments requiring separate physical databases, multiple logical databases can be deployed. The database provides centralized storage and administration of user configurations including access rights, presets, and context menus. This allows 'roaming' user profiles, where users may login at different workstations and retain their personalized settings.

For high availability applications, the Synapse database can be clustered on multiple servers using VMware® virtual systems and Oracle Data Guard.

Web Server

Synapse uses Windows Internet Information Server (IIS) as its core web server. Synapse is a truly web-based system where all data going to and from the Synapse workstation flows through the Synapse Web Server. All images, information and user authentication is sent over standard web ports. In most installations, port 80 is used for standard communication and port 443 for secure SSL communication.

The Synapse CodeBase Server provides installation files and automatic code update notifications for the Synapse workstation. For enterprise distribution of MultiView and CommonView datasources, the CodeBase server can publish settings for other available datasources.

The Synapse Web Server can be configured as a single server, or in a multiple server solution depending on study volume, available bandwidth and number of users.

Storage Server

Synapse Storage servers are Windows servers that are used for the storage and distribution of images, documents and other Synapse file objects. Storage directories are presented as UNC paths to the web servers that wrap the file content for web-based distribution to the Synapse workstation.

DICOMServer

Synapse DICOMServer receives studies directly from DICOM modalities without the need for modality interface gateways or proprietary interfaces. All modalities use direct TCP/IP connections to Synapse. Synapse DICOMServer also provides direct, brokerless DICOM Modality Worklist Management (DMWL) to any modality supporting this functionality. DICOMServer responds to all Query/Retrieve, Modality

Performed Procedure Step and Storage Commitment requests.

DICOMServer writes images to standard NTFS file locations and inserts an entry for each image into the Synapse database as a Uniform Resource Locator (URL). From there, the Synapse database maintains the image locations for on-demand delivery to workstations. When images are requested, they are streamed directly from the storage system to the workstation.

Upon receipt of images from a modality, the Synapse AON™ (Access Over Network) engine enables the DICOMServer to generate multiple image versions at varying levels of compression. The AON engine can write JPEG lossless and FUJIFILM Wavelet lossy image files at user selectable levels of compression based on body part, modality type or modality AE-Title. DICOMServer can run on one multifunction server or on multiple servers depending on the medical facility's study volume.

HIIS Server

The HIIS (Hospital Information Interface) Server is an integrated HL7 interface engine that provides direct brokerless connections to any HL7 information system. HIIS Server processes patient, order and report information and events that originate from the RIS or HIS.

Synapse RIS/HIS interface software can run on a single multi-function server system or on one server in a multi-server system.

A bi-directional version of HIIS supports study and image notification back to the HIS/RIS and EMR systems for better coordinated enterprise workflow and information sharing.

Synapse Acceleration Server

The Synapse Acceleration Server provides a central cache for remote locations connecting to a centrally hosted Synapse system. The DICOM and Acceleration Servers work together to store images in this central cache, thereby improving image access at the remote workstations. Multiple

Acceleration Servers can be deployed throughout the enterprise at various remote locations.

PreCache Server

PreCache Server is a Windows service that listens for scheduled exams and retrieves comparison images for the scheduled patient from the archive. The service triggers the HSM to bring the near and offline archived files back to primary storage. PreCache can be configured to retrieve a defined number of historical studies and can be set to run on a specified schedule.

Smart Prefetch

Smart Prefetch is a utility that listens for scheduled studies and retrieves them from third party DICOM storage in advance of the imaging procedures being performed. System performance is enhanced by retrieving existing studies from one or more DICOM archives before they are needed by a radiologist at the Synapse workstation. Studies are pre-fetched to the DICOM SCP that resides within the Synapse server core.

Smart Prefetch does the following:

- Periodically queries scheduled patients and their existing studies
- Filters studies by time depth and optionally by procedure code and modality
- Requests the DICOM archive transfer the studies to the Synapse destination SCP

Smart Prefetch provides several workflow enhancements:

- Extensive filtering capabilities by procedure code, modalities, or their combination
- Persistent queue preventing data loss in case of process interruption due to network problems, power failure, etc.
- Configurable pre-fetch level by studies or by series
- Verifies that the data to be transferred to the Synapse SCP does not already exist there

- Transfer recent data for all patients to the destination SCP, when modalities send the studies to DICOM archive only
- Ad hoc pre-fetch of existing studies from the provided list
- Ad hoc transfer of studies from the provided list
- Supports scripting for query customization and pre-processing of query results
- Graphical user-friendly configuration utility

Auto Routing

Synapse provides event and rule-based forwarding of DICOM objects from Synapse to third party DICOM Archives:

- Control timing of study forwarding so reporting and QA operations may be completed before the studies are forwarded from Synapse
- Event triggers are configurable and include changing of study status and elapsed time since last study modification
- Studies to be forwarded may be filtered by modality, procedure code, sender, requesting physician, and priority
- Independently configurable forwarding of studies to multiple destinations
- Destinations may be defined either as permanent or temporary storage locations
- “Forward and remember” destinations are permanent third party storage locations. Following confirmation of a successful store to the third party PACS, Synapse updates its database records, and deletes the study from its local storage
- “Send and forget” destinations are temporary third party storage locations, including re-construction workstations and teaching file systems. Synapse forwards the study, and keeps it in its own storage system

- Event and rule-based forwarding is configurable based on earliest and latest study date. Studies that fall within those dates are the only ones that are forwarded
- Event and-rule based forwarding is configurable by daily time interval, to prevent excessive loading of the Synapse DICOM Server during peak activity times
- FCR images being forwarded to third party DICOM servers may be converted to standard CR images, so the third party server does not reject the FCR private DICOM presentation context
- Events to trigger the forwarding operations are configurable, including:
 - Changing of the study status
 - Elapse of certain time since the last study modification.

These features allow delaying of study forwarding in order to ensure that all Quality Assurance operations are completed.

- Study to be forwarded can be filtered by the following rules:
 - Modality type
 - Procedure code
 - Sender
 - Requesting physician
 - Priority
- Event and rule-based forwarding can serve multiple destinations. Events and rules for each destination are configured independently. The combination of the destination, events, and rules is called the *forwarding profile*. Event and rule-based forwarding supports the following destination types:
 - **Permanent storage** (“forward-and-remember” type). Forwarded DICOM objects are deleted from the local storage after confirmation of successful forwarding to the remote location. Synapse database records are updated to point to the remote location for those forwarded

objects. Deletion from local storage may be delayed for configurable amount of time.

- **Temporary storage** (“send-and-forget” type). DICOM objects remain stored locally and database records are not modified.

HSM (Hierarchical Storage Manager)

Synapse reads from and writes images to spinning disk media. HSM is responsible for archiving images, copies and backups to multiple tiers of storage. The Synapse HSM monitors the storage levels of any disk on the Synapse network. HSM scans the disks for new data and writes or migrates the data to the archive device. HSM also creates a redundant archive copy for disaster recovery.

Synapse HSM provides a vendor-neutral archive solution that uses any storage device (spinning disk, SAN, NAS, CAS, tape, DVD, UDO, etc.) that is validated to the HSM.

Interfaces

Inbound HL7 Interface

This is the standard HL7 interface into Synapse that supports ADT, order and report transactions into Synapse. When a clinically significant event occurs in the HIS or RIS system, an HL7 transaction is usually created. The Synapse HIIS Server accepts the transaction, parses it, and updates the Synapse Database.

The following HL7 message types are supported:

- General Acknowledgement (ACK)
- Admit/Discharge/Transfer (ADT)
- Master File Notification (MFN)
- Order Message (ORM)
- Report Message (ORU)

The following HL7 event types are supported:

- Admit/Visit Notification (A01)
- Patient Transfer (A02)
- Patient Discharge (A03)
- Patient Registration (A04)
- Patient Information Update (A08)

- Patient Merge (A18)
- Patient Merge – patient ID only(A34)
- Patient Merge – account number only (A35)
- Patient Internal ID Change (A47)
- Order Message (O01)
- Report Message (includes preliminary report, report correction, and final report) (R01)

Many event types not listed above are supported by mapping them to higher level event types.

Typical examples:

- A05 → A04
- A05, A06 → A02
- A09, A10 → A08
- A11 → A03
- A13 → A01

Bi-directional Outbound HL7 Interface (upgrade to standard HIIS)

A bi-directional HIIS interface enables Synapse to send study status to a third party system via an outbound HL7 based order message (ORM). Synapse can be configured to trigger an outbound message anytime a study’s status changes to:

- Started
- Sent
- Completed
- Dictated

Note: Not all status changes have to trigger an outbound message – trigger activation is site configurable.

Along with the expected standard demographic and study information, the outbound ORM message can send PACS specific information that may be useful for third party portal, EMR, RIS and other systems.

Information includes:

- Internal Study Instance EUID
- AE title for the study
- Study date/time

- Image Count
- Study URL

Note: Additional details on the inbound and outbound HL7 capabilities of Synapse can be found in the Synapse RIS Interface Specification document.

DICOM Interface

Supported SCP (Service Class Providers) Classes:

- Standard Storage
- Multi-frame Image Storage
- FUJIFILM Private CR Storage
- Modality Worklist C-FIND
- Patient Root Q/R-FIND

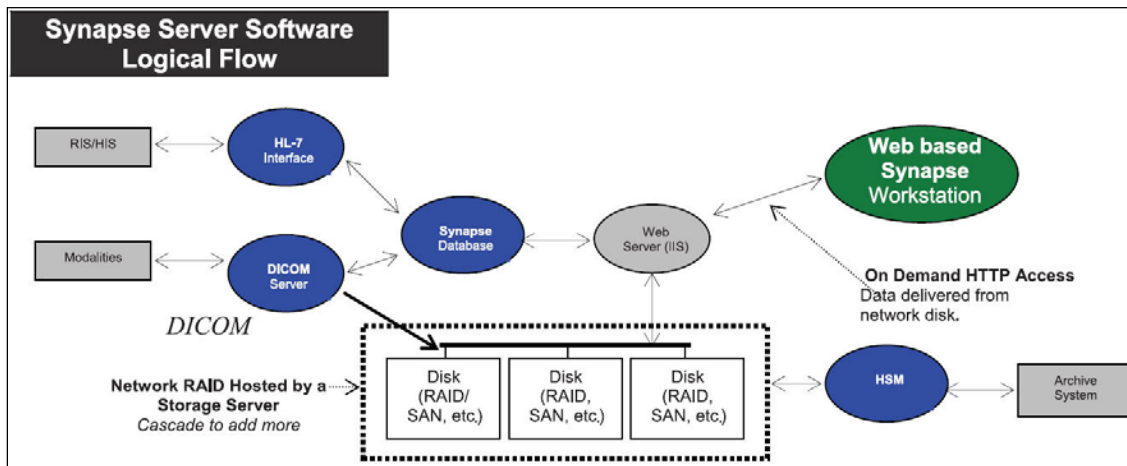
- Study Root Q/R-FIND
- Patient/Study Q/R-FIND
- Patient Root Q/R-MOVE
- Study Root Q/R-MOVE
- Patient/Study Q/R-MOVE
- Storage Commitment Push
- Modality Performed Procedure Step

Supported SCU (Service Class User) Classes:

- Basic Grayscale Print Management Meta SOP Class
- Basic Film Session SOP Class
- Basic Film Box SOP Class
- Basic Structured Report

- Basic Grayscale Image Box SOP Class
- CAD-SR
- Comprehensive Structured Report
- Enhanced Structured Report
- Printer SOP Class
- Print Job SOP Class
- Study Root Q/R-Find SCU
- Study Root Q/R-Move SCU
- Verification SCU

Please refer to the Synapse 4.X DICOM Conformance Statement for greater detail.



Server Operating System Support

OPERATING SYSTEM	VENDOR	BROWSER	ADDITIONAL
Windows 2003 Server SP2 (32-bit only)	Microsoft	Internet Explorer 7.0 Internet Explorer 8.0	<ul style="list-style-type: none"> • Oracle 11g Enterprise Server • Oracle 11g Client • Oracle Data Guard
Windows 2003 R2 with SP2 (32-bit only)	Microsoft	Internet Explorer 7.0 Internet Explorer 8.0	<ul style="list-style-type: none"> • Microsoft MSMQ version 2.0† • Oracle 11g Enterprise Server • Oracle 11g Client‡
Windows 2008 with SP2 (32-bit only)	Microsoft	Internet Explorer 7.0 Internet Explorer 8.0	<ul style="list-style-type: none"> • Microsoft MSMQ version 2.0† • Oracle 11g Enterprise Server • Oracle 11g Client‡
Windows 2008 Server R2 SP2 (64-bit only)	Microsoft	Internet Explorer 7.0 Internet Explorer 8.0	<ul style="list-style-type: none"> • Oracle 11g Enterprise Server • Oracle 11g Client‡ • Oracle Data Guard

- Existing Synapse 3.2.1 systems may be upgraded to Synapse 4.X without changing the operating system
 - All brand new installations of Synapse 4.X are on 64-bit Windows
 - FUJIFILM offers several operating system upgrade options for current Synapse 3.2.1 customers
 - Synapse Acceleration Server runs on Windows 2008 32-bit operating system
 - Oracle 11g Server is only installed on the Database Server or Cluster
- † MSMQ is necessary for servers hosting HIIS Server
- ‡ Oracle 11g Client is for the Storage, Web CodeBase, DICOMServer, HIIS, Acceleration, and PreCache Servers

CPU Requirements

Synapse server requires a minimum of two Quad-Core Xeon processors or AMD Opteron™ processors to run a combined system. Multi-server systems will have different CPU requirements, based on standard best practices used by FUJIFILM.

Memory Requirements

The following general requirements apply for physical and virtual servers:

- Synapse 32-bit servers should contain a minimum and maximum of 4 GB of RAM. The extended 3 GB switch should be setup for 32-bit OS
- The 32-bit server memory requirements have not changed from prior versions in Synapse 4.X
- Synapse 64-bit servers should contain a minimum of 4 GB of RAM. For medium, large or enterprise sites, 6-8 GB of RAM is recommended
- Synapse 4.X servers will have recommended memory and virtual CPU requirements shown in the table below:

SITE STUDY COUNT	DATABASE	DICOM + WEB (Combo)	DICOM	WEB	STORAGE	HIIS
Small Scale Systems <=100K Express, vSSD, ID1, SSD	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit
	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit
CPU Count	2 vCPU	2 vCPU	1 vCPU	1 vCPU	1 vCPU	1 vCPU
Small 120K – 250K	8 GB 64-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit
		4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit
CPU Count	2 vCPU	2 vCPU	1 vCPU	1 vCPU	1 vCPU	1 vCPU
Medium 250K – 400K	16 GB 64-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit
		8 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit	4 GB 64-bit
CPU Count	4 vCPU	2 vCPU	1 vCPU	1 vCPU	1 vCPU	1 vCPU
Large 400K – 800K	32 GB 64-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit	4 GB 32-bit
		8 GB 64-bit	8 GB 64-bit	8 GB 64-bit	8 GB 64-bit	8 GB 64-bit
CPU Count	4 vCPU	2 vCPU	2 vCPU	2 vCPU	2 vCPU	2 vCPU
Enterprise 800K+ - 1.0M+	64 GB 64-bit	4GB 32-bit	4GB 32-bit	4GB 32-bit	4GB 32-bit	4GB 32-bit
		8GB 64-bit	8GB 64-bit	8GB 64-bit	8GB 64-bit	8GB 64-bit
CPU Count	8 vCPU	2 vCPU	2 vCPU	2 vCPU	2 vCPU	2 vCPU

Supported IHE Profiles

PROFILE	ACTORS
Scheduled Workflow	Image Manager Image Display Perform Procedure Step Manager
Patient Information Reconciliation	Image Manager Perform Procedure Step Manager
Access to Radiology Information	Image Manager Image Display Report Reader
Simple Image and Numeric Report	Report Reader
Consistent Time	Time Client
Teaching File and Clinical Trial Export	Export Selector
Mammography Image	Image Manager
PDI	Portable Media Creator

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