



Product Data

Synapse Release Version 4.3

Foundation Technologies

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.

Server modules work with the workstation software to provide powerful foundation technologies that serve the radiology department, the healthcare enterprise and beyond. Multi-site authentication, comparison access and network utilization technologies include MultiView, CommonView, DICOM SCU, AON™ (Access Over Network) Compression, AON Subscription and Synapse Acceleration Server.

MultiView

MultiView allows a user to access multiple Synapse systems (each Synapse system is referred to as a datasource) from a single workstation client. When the user first opens Synapse they are presented with a list or a set of tabs for all available datasources they can access from the one workstation. Credentials, login information and connection settings are configured for each system individually, but user preferences stay with them from system to system.

Synapse uses Microsoft Information and Internet Security with Active Directory for information distribution and authentication. When the user chooses a system attached to the Active Directory (AD) to which the user is logged in, the user is automatically logged in without an additional login prompt. The username

then translates to a user in Synapse with an assigned role and set of privileges.

When connecting without a direct AD login (e.g. from the Internet or across a WAN with separate AD trees), the user is prompted for a valid username and password to access the Synapse application. Synapse can be opened multiple times to allow the user to access multiple systems without having to close a working session.

CommonView

CommonView (or Group Search as it is called in the Synapse Workstation properties page) is a multi-site enabling technology that allows for patient context search across multiple datasources (includes internal datasources). This allows the user to view a patient's entire radiographic history within a single Synapse session. The technology is designed to accommodate disparate patient identifiers across multiple facilities and uses common identifiers for exact matching (if available) or available demographics (name, birth date, gender, etc.) for pre-defined partial matches. Relevant priors are invaluable to the diagnostic process, but most PACS and information systems are limited in that they can only display information contained within their own databases and storage systems. This means the feature rich information contained in other imaging and information systems at other facilities is inaccessible and/or can only be accessed through manual processes that are inefficient and prone to error.

CommonView can be configured to search for matching studies in internal or external datasources. Internal datasource search enables presentation of a patient's entire radiographic history even when there are multiple instances of the same patient. This usually occurs when multiple sites send studies to a single datasource.

DICOM backfill, running on a site where historical data are stored, can identify the patients scheduled for relevant procedures by querying the modality worklist held by that site. The DICOM backfill processor has an option to match patients returned by modality worklist query using CommonView settings.

The Synapse workstation user interface with CommonView looks and feels nearly identical to one without CommonView. The only difference is that the comparison exam list in the PowerJacket™ includes studies across multiple datasources along with the likelihood the matching study is actually from the same patient. The likelihood of a patient match is displayed as a percentage. Patient matching criteria and associated match percentages are site configurable and can use almost all patient demographic data fields.

CommonView also integrates with DICOM SCU to give users a comprehensive list of comparisons from Synapse datasources as well as from third party DICOM sources. Patient matching is accomplished through DICOM queries using C-FIND with patient's first and last name.

DICOM SCU

DICOM SCU makes a third party DICOM source look and feel like a Synapse datasource. The DICOM datasource is added to the Synapse client workstation as an HTTP or HTTPS address in the same manner as a native Synapse datasource.

On the server side, DICOM SCU is a service that performs C-FIND and C-MOVE operations and wraps the third party DICOM data with Synapse web pages that can be accessed from any Synapse workstation.

DICOM datasources appear as three Synapse folders that are used to query the third party via C-FIND. The folders are All Studies, All Recent Studies and All Patients. Once a study is selected, a C-MOVE is performed. Images from the third party datasource are wrapped as web content and then viewed directly on the Synapse workstation.

AON Compression

The AON Engine consists of image compression software integrated with the Synapse DICOM Server software, and image decompression software on the Synapse workstation. When an image is acquired, DICOM Server compresses it into multiple compression ratios. The compression ratio is configurable based on modality, AE Title and body part. Images can be JPEG lossless compressed (up to 3:1) or FUJIFILM Wavelet Lossy compressed (upwards of 100:1) depending on modality and facility preference. The AON engine stores these multiple image versions in separate and distinct cache folders.

The AON factor is the relative value of the compression applied by the AON engine to any image. There are two standard AON factors:

- Original
- Clinical

Each factor has a different intended use. Original is used for primary diagnosis. Clinical can be used for intranet distribution, historical image comparison, and for physician desktop review by any user connected via slow networks.

Having multiple AON factors also enables Synapse to uniquely and efficiently use networked storage. Typical Synapse installations will use AON clinical images for historical comparisons. Since AON clinicals are smaller than AON originals, they can be stored on first tier media in a fraction of the space required for originals. Sites will then send AON originals off to less expensive long term media archives while keeping AON clinical images on first tier spinning disk media for the useful life of the studies.

Once images are acquired, compressed and stored, they are immediately available to any Synapse workstation on the network. When requested, the images are transferred over the network in the compressed state in a streaming format. Synapse Workstation software uses the AON engine decompression algorithm to decompress the image in less than one second and display it in HTML format.

The Synapse workstation may be configured with a workstation image cache (WIC) to facilitate operations that include large studies and pre-caching of prior studies for comparison. The WIC extends workstation caching capabilities beyond the 1 GB Internet Explorer caching limit. Internet Explorer caching is supported for those Synapse workstations that employ third party integrations that require an Internet Explorer cache.

AON Subscription

Subscription provides the user the ability to proactively subscribe to any folder in Synapse for:

- Event Notification
- Caching
- Reservation

Combined, these features enable radiologists to efficiently work through high priority exams from home, their office or from the reading room. Subscriptions can be created for any folder in Synapse including reading folders, location folders or specific patient folders.

Event Notification:

The user is notified anytime new content is added to the subscribed folder.

Notifications can be in the form of message alerts or system sounds.

Example: STAT Study Notification

1. Administrator creates a system folder that contains all studies prioritized as STAT
2. Radiologist subscribes to this folder and activates notification
3. When new STAT studies arrive in Synapse, the radiologist is alerted to the new content by a dialog box telling them new content has arrived in the STAT Unread Studies folder
4. The radiologist opens the folder directly from the dialog window without having to manually find the study or get called from the Emergency Department

Caching:

With this option, any new studies associated with the subscribed folder will be automatically pulled to the user's PC. AON uses the PC's internet cache to hold the images until they are reviewed. With caching, users can read ahead and have images pulled to their PC in multiple prescribed groups.

Example: On-Call Teleradiology Caching

1. Administrator creates a folder for all unread exams received from 5PM to 8AM
2. The on-call radiologist or nighthawk provider subscribes to this folder and activates caching
3. All images for studies in this folder will be pulled into the user's local cache, providing LAN-based performance over a WAN connection because images are already being pulled and cached locally before the radiologist needs to look at them
4. Both unread studies and relevant priors will be cached
5. The radiologist can also activate notification so they are alerted to on-call exams automatically

Reservations:

A reservation is a way to lock a study so that other interpreting radiologists do not accidentally open the exam for reading. When a reserved study is opened, the user receives a concurrency alert to tell them someone else is intending to read the exam. This way a user does not accidentally interpret studies that are already being read, or are intended for someone else.

Example: Specialty Reading

1. Administrator creates a folder for all CT and MR Neuro exams

4. Users with dictation privileges who accidentally open the reserved exams are prompted with a concurrency alert so they don't accidentally attempt to double read the exam

2. The neuro specialist subscribes to this folder and activates caching
3. All CT and MR exams are then reserved for this user which keeps the

studies from opening for other users using Synapse automated unread workflow

Synapse Acceleration Server

The Synapse Acceleration Server increases image access speeds for remote WAN-connecting locations by storing images to a centralized Synapse datasource. It uses a specialized proxy server to provide a local cache for the remote workstations.

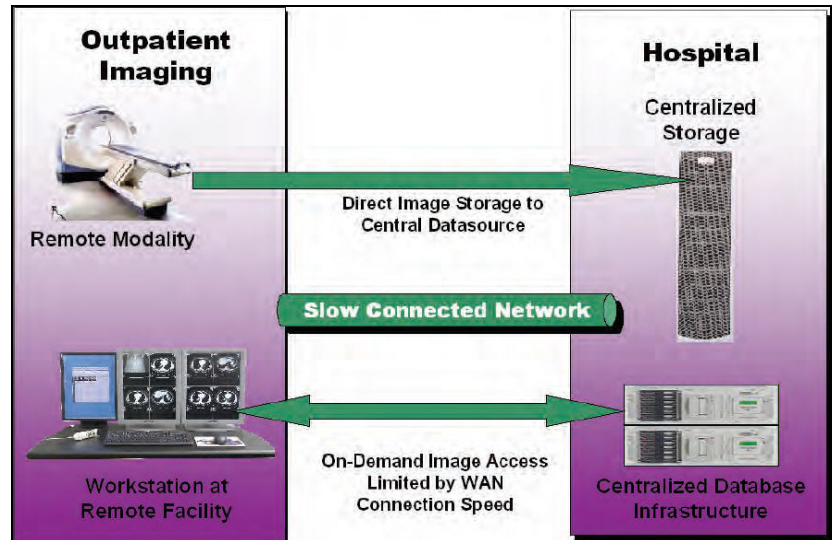
Normally, all workstations pull their images directly from the centralized Synapse web servers, including the remote workstations that may reside in the same room as the remote facility's modalities that send images across the WAN. For remote locations connected by a slow network, this could lead to relatively slow on-demand access, even for newly acquired exams.

The Synapse Acceleration Server intercepts all images sent from the medical facility and creates a site cache of the images. All workstations at the remote facility get their images from the server-based cache residing on their LAN.

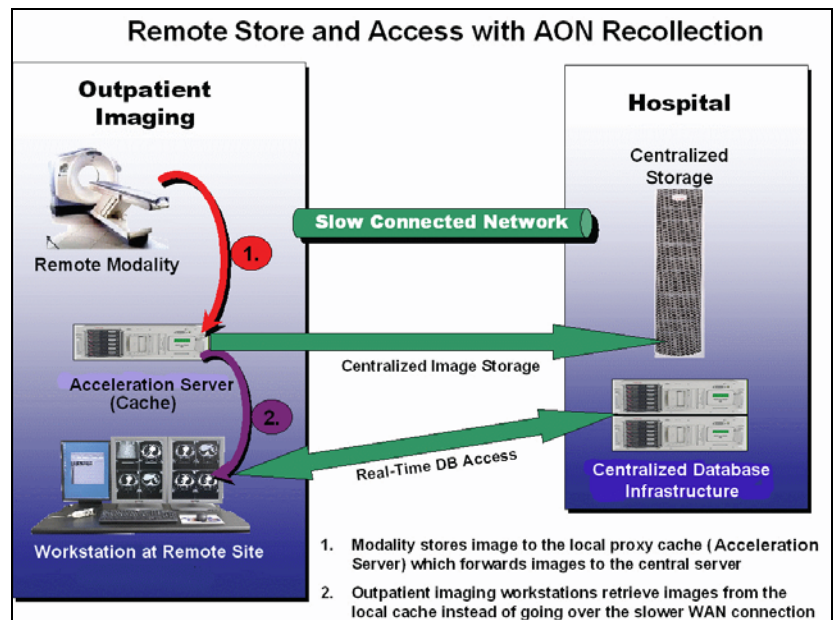
While images are retrieved locally, all login, database, audit and workflow communication is still conducted real-time through the WAN connection.

This means users get near LAN image display performance without sacrificing workflow functionality or productivity.

Remote Store and Access without Synapse Acceleration Server



Remote Store and Access with Synapse Acceleration Server



AON™ Impact on RAID Time Depth

Synapse stores images with multiple AON versions in separate system partitions on the PACS RAID. Each partition can have a different time depth or actual size. The following example illustrates the impact of AON on RAID storage using the goal of storing one year of images online with 100 GB of RAID. CR studies are used in the following example:

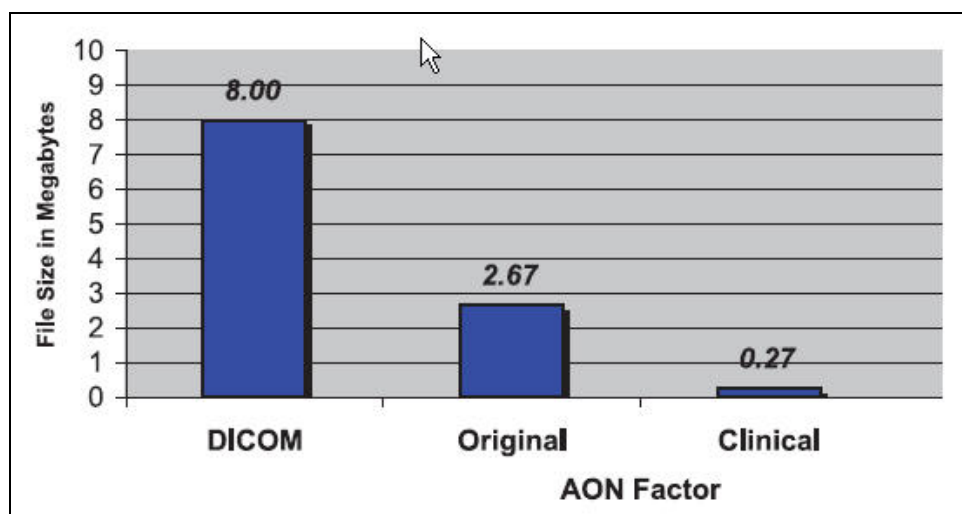
AON Engine Compression AON Factor	1:1	3:1 Original	30:1 Clinical
Studies per Day	200	200	200
Image Size in MB	8.0	2.67	0.27
Images per Study	2.5	2.5	2.5
Images per Day	500	500	500
Megabytes per Day	4,000	1,333	133
<i>If Stored as a Single AON Version - Days Online</i>		75	750
RAID Requirement for 1 Year Online (MB)		480,000	48,000
<i>Desired Days Online</i>		14	360
RAID Consumption using Multiple AON Factors (Originals @ two weeks, clinicals @ one year)		18,667	48,000

Without AON, the storage requirement for one year online is 480 GB, even when lossless compressed at 3:1. Since the original images are only used for diagnosis, they only need to be retained in RAID for approximately two weeks (configurable). Two weeks of originals consumes only 18 ½ GB, thus leaving over 80 GB for clinical images. One year of clinical images requires about 48 GB. This storage paradigm provides a full year of online storage in only one seventh the RAID of a traditional system.

The compression ratio and number of days stored online are configurable to meet the storage requirements of the clinical facility. The following chart displays the AON impact on file size. Since the AON factor of clinical is used for intranet distribution, the resulting impact on network traffic is significant.

$$\text{AON} = f(\text{image quality/RAID size/network traffic})$$

AON Impact on File Size



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