syngo® Imaging

System Description as of Software Version V30A

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Overview

This document provides a description of the components, principles and technical concepts of *syngo* Imaging.

It is intended for sales personnel, product specialists and customers.

This system description is based on a modular concept. Each topic is described in a self-contained chapter.

Detailed information and instructions are provided in the *syngo* Imaging data sheets, user manuals and administration manuals.

About *syngo* Imaging

syngo Imaging is a scalable PACS for viewing, editing, reporting, distributing, and archiving digital radiological images including digital mammography images[1].

syngo Imaging supports the physician with diagnostics and treatment planning and permits the storage and archiving of structured DICOM reports.

Central server architecture

syngo Imaging is based on the two core components - SDM and OPM.

syngo Data Manager (SDM) stores the images, holds the business logic, and provides various services (Web Service, Application Service, File Service, Database Service).

syngo Operation Manager (OPM) provides administration services throughout the system, e.g. license administration, system monitoring, configuration, and user administration.

syngo® - the common platform

syngo is the common software platform for all Siemens medical devices.
The users benefit from working with the same software platform and the uniform user interface: the time needed for familiarization can be reduced and users can focus on their actual tasks. Moreover, the number of operator errors can be limited, if all workplaces are based on the same software platform.

syngo Imaging workplaces

Various variants of *syngo* Imaging workplaces are available. They differ with respect to their scope of functions and areas of application.

syngo Studio

For report preparation, reporting and demonstration
Main users: technicians, radiologists

syngo web-based Studio

For viewing images and reports and, if diagnostic monitors are connected, also for reporting
Main users: technicians, radiologists and referring physicians

syngo Studio Advanced

For report preparation, 3D post-processing, reporting and demonstrating
Main users: technicians and radiologists

Common characteristics

- Uniform *syngo* user interface
- Quick selection of functions through Smart Select
- Many configurable functions (e.g. “Intelligent Layout”)
- Quick image build-up through “Dynamic Loading”
- Several diagnostic monitors
- Quick image call-up through iMaxcess

[1] For primary diagnosis of digital mammographic images the display systems need clearance for primary mammographic image interpretation by FDA or respective local regulations in other countries.

Optional modules

Numerous optional modules are available beyond the standard scope of functions. They can be used for extending *syngo* Studio and adapting it to the customer's requirements.

***syngo* Filming**	Allows filming according to the DICOM standard (exposing images on film sheets); for reading and writing CDs and DVDs
***syngo* Imaging 3D**	For 3D post-processing of images (MIP, MPR, SSD)
	Additional 3D post-processing functionalities are optionally available for *syngo* Studio Advanced workplaces:
***syngo* 3D VRT**	3D display using the Volume Rendering Technique
***syngo* FlyThrough**	Visualization of hollow spaces
***syngo* Image Fusion**	Combination of several 3D datasets of different modalities
***syngo* Colonography**	Clinical application for the non-invasive examination of the entire colon using spiral CT and MR datasets. *syngo* Colonography supports the complete clinical process of virtual colonoscopy from evaluation to diagnosis to documentation of the clinical findings.
***syngo* Colonography (PEV)**	Option for *syngo* Colonography: tool for the second-reading physician for automated detection of polyps and other colon lesions.
***syngo* WebSpace**	Client/server application for evaluating and post-processing 3D images via a separate server. The time-consuming and effort-intensive reconstruction of the image data is performed by the WebSpace server and no longer burdened onto the workplaces. This server has a separate memory for the temporary administration of image data. The series are transferred from the modality to the WebSpace server via a fast data connection for processing to volume views. It is possible to access the WebSpace server and volume views from *syngo* Imaging workplaces via the Intranet and evaluate the volume views using ***syngo* InSpace 4D**. *syngo* WebSpace was developed for evaluating CT thin slice series, but is also suitable for the evaluation of 3D image data of other modalities.
***syngo* WebAccess**	For simplified communication of the *syngo* Imaging workplaces with the SDM and OPM via Internet or in-house firewalls. All data is exchanged using only http or https.
High Availability	Redundant server system increases the availability in the event of failure of system components or processes. You can choose one of several “High availability” configurations.

License model

syngo Imaging licenses include both the server and the front-end functionalities of the system (Campus Licenses). They are granted for a specific number of procedures per year.

If the number of procedures per year increases, a simple fee must be paid for extending the license to the new number of procedures per year. The license is extended by increments of 10,000.

The licenses are not tied to specific workplaces or users. In other words, *one* license is sufficient for operating all required workplaces with several concurrently working users.

However, a specific number of concurrent users should not be exceeded in order to ensure system performance.

A standard license is available for customers with less than 20,000 procedures per year.

Maintenance contract

A software maintenance contract is concluded with the customer for each *syngo* Imaging system. This contract includes the supply of updates and upgrades, software support and regular training of the IT administrator.

Special workplaces

syngo special workplaces are workplaces for specific tasks in connection with radiological images. They are based on the locally installable *syngo* Imaging XS software.

The DICOM standard allows the application of these special workplaces in *syngo* Imaging. Special workplaces can be set up inside or outside the hospital or medical practice.

Hardware

Siemens offers an optimally equipped PC for *syngo* special workplaces. However, existing PCs can also be used, provided they meet the minimum requirements specified.

Monitors

Various commercially available monitors with a maximum resolution of 5 MP can be connected to *syngo* special workplaces.

The modules below can be used to create special workplaces that are optimally tailored to specific requirements. Several modules can be combined.

CD/DVD Producer

This special workplace allows the automatic generation of patient media using a CD/DVD producer.

All important information can be forwarded to the patient or referring physician electronically on CD or DVD. Along with the images, various DICOM viewers can be written to CD/DVD. That makes it possible to view the images on any PC.

You can choose one of three robot types.

In the fully automatic workflow, all data received at this special workplace is automatically written to CD/DVD.
One medium is produced for each patient.

The medium production can also be started manually and data can be selected manually.

This special workplace can also be used for image viewing.

Scanner

The scanner workplace is used to scan, and thus digitize, film sheets and hardcopy documents.

The digitized data is saved in the database in the DICOM format. In order to scanning film sheets, VIDAR image scanners can be connected via a SCSI and TWAIN interface.

For scanning hardcopy documents (e.g. reports, referrals), conventional flat-bed scanners with USB connection can be used.

Scanned images can be edited and stored in the viewer. Moreover, the scanned images can be automatically forwarded to configured network partners.

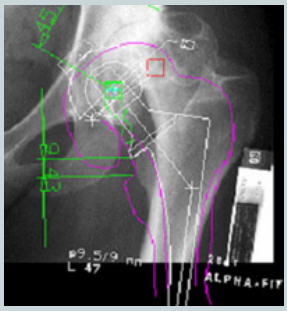
Framegrabber

Framegrabber is a workplace for digitizing PAL or NTSC video signals.

It can be used to view videos recorded with ultrasound units or endoscopy systems and “cut out” important details from a video as individual images.

These images are saved as SC or US objects in the DICOM 3.0 format and stored in a study.

EndoMap



The EndoMap special workplace is used for surgical prosthesis planning in traumatology, surgery, orthopedics or pediatrics.

Digital prosthesis templates of almost all manufacturers are available.
All planning data is stored with a copy of the digital X-ray image in the DICOM database or can be output to printers.

EndoMap consists of five software modules:

- Hip planning
- Hip planning with biometry
- Knee planning
- Coxometry
- Trauma

Servers and services

syngo Imaging has a central server and storage architecture.

syngo Imaging is based on medical standards (DICOM and HL7) and takes into account state-of-the-art requirements (HIPAA, IHE and RöV).

syngo Imaging can be integrated into existing IT structures. This makes it possible to reduce the investment and operating costs.

Server architecture

syngo Imaging consists of the following server components:

- *syngo Data Manager (SDM)*
  based on SUSE Linux Enterprise Server (SLES 9)
- *syngo Operation Manager (OPM)*
  based on Windows Server 2003

syngo Imaging clients are set up at the typical workplaces in radiology.

Some optional extensions may require additional servers.

syngo Data Manager (SDM)

The SDM is the central component for business logic, image storage, and image administration. It receives radiological image data from the modalities, stores the image data and provides image data and the work list for the *syngo* Imaging workplaces (clients) and connected DICOM workplaces.

The images are transferred between the SDM and the syngo Imaging workplaces using the “iMaxcess” protocol.

Services provided by SDM are:

Application service
The application service holds the business logic and provides the infrastructure for the business logic, such as Archive Manager, Compression Manager and Persistency Framework.

File service
The file service stores data objects in the short-term storage system (STS), retrieves objects for the workplaces and copies data to and from the long-term storage (LTS).

Web service
The web service provides the interface to the workplaces. It is used to call up the patient browser and forwards the “Load images” request to the application service.

Archiving service
This service covers all processes in connection with archiving - from the selection of the objects to be archived, to time control, bundling of archive objects in an LTS object, actual writing to archive media, to confirmation of completed archiving to the SDM.

Database service
This component manages the database and handles all access to the database.

Backup service
The backup service covers all processes in connection with backup - from collecting objects that must be backed up, to storage of the backup objects in a storage system.

syngo Operation Manager (OPM)

The OPM provides services that are used throughout the system.

User administration

syngo Imaging uses Microsoft Active Directory for managing users, roles, groups, and privileges.

System monitoring

A watchdog monitors critical processes and system resources. All system and audit messages are logged in a central messaging repository. Failed processes can be automatically restarted.
Critical events can be forwarded to Siemens Remote Service.

License management

The license management is used to import licenses, display installed licenses, and monitor license usage.

Configuration

The central configuration service provides:

- configuration of *syngo* Imaging servers (OPM and SDM)
- addition and modification of DICOM partners (e.g. modalities)
- configuration of *syngo* Imaging workplaces and user profiles

Administration GUI

The web-based administration graphical user interface supports all important administration tasks.

Remote service access

Remote access to the OPM server is provided for both customer and Siemens Customer Service. The customer's system administrator can enable or disable remote access for Siemens Customer Service.

The two options available for remote access are:

- http(s) to access the Admin GUI
- Remote Desktop to access the OPM on Windows level

Software distribution

The OPM server receives the new software package from Siemens and distributes it to the SDM server and the workplaces.

If a suitable software distribution infrastructure already exists at the customer site, new software packages can be exported from the *syngo* Imaging software depot and imported in and distributed by the customer's infrastructure.

SLPA service

The SLPA service enables the single log-in procedure: user log-in is required only once at integrated workplaces.

RIS interface

The RIS interface in the OPM establishes the link with the RIS. Modules of the Siemens OPENLink Interface Engine are used for this communication.

- HL7 messages, e.g. ADT or ORM messages between RIS and PACS
- DICOM messages, e.g. communication of implemented work steps from PACS to RIS

Additional servers

The scope of functions of *syngo* Imaging can be extended by optional modules. Some of the optional modules may require additional server hardware.

syngo WebSpace

The WebSpace server is used for evaluating and post-processing 3D image data. This server has a separate memory for the temporary administration of image data.

syngo WebAccess

There are various solutions for the web-based communication between OPM/SDM and *syngo* Imaging workplaces. For two of these solutions, the WebAccess software as well as a separate Linux computer (see below) are required.

High Availability

Various cluster solutions can be configured to ensure maximum availability of the system:

- Up to 99.99 % availability: 2 OPM server, 2 SDM server, double RAID configuration
- Up to 99.9 % availability: 2 OPM servers, 2 SDM servers, single RAID configuration
- Up to 98.9 % availability: 1 OPM server, 1 SDM server, double RAID configuration

syngo Imaging WebAccess

Data on authentication, configuration (e.g. user profiles), worklists and image data is exchanged between the *syngo* Imaging workplaces (clients) and OPM/SDM.

Without WebAccess

Without *syngo* Imaging WebAccess, communication between clients and OPM/SDM would be direct. Various communication protocols and ports are used for this purpose. Additional efforts arise, if firewalls are installed between the clients and OPM/SDM or if access via the Internet should be made available:

- Complex administration of the firewalls
- Need for a VPN infrastructure for clients which are connected via WAN or Internet

With WebAccess

With *syngo* Imaging WebAccess, these additional efforts are not necessary. The clients no longer communicate directly with SDM/OPM, but via *syngo* Imaging WebAccess, using only the http/http(s) standard protocols. This is achieved by installing a web server which acts as a proxy.

Area of application

syngo Imaging WebAccess is required if one of the following applies:

- Clients access OPM/SDM via the Internet. Access should not be made via VPN.
- Clients access OPM/SDM via an Intranet. Access to OPM/SDM is made via firewalls.

WebAccess variants

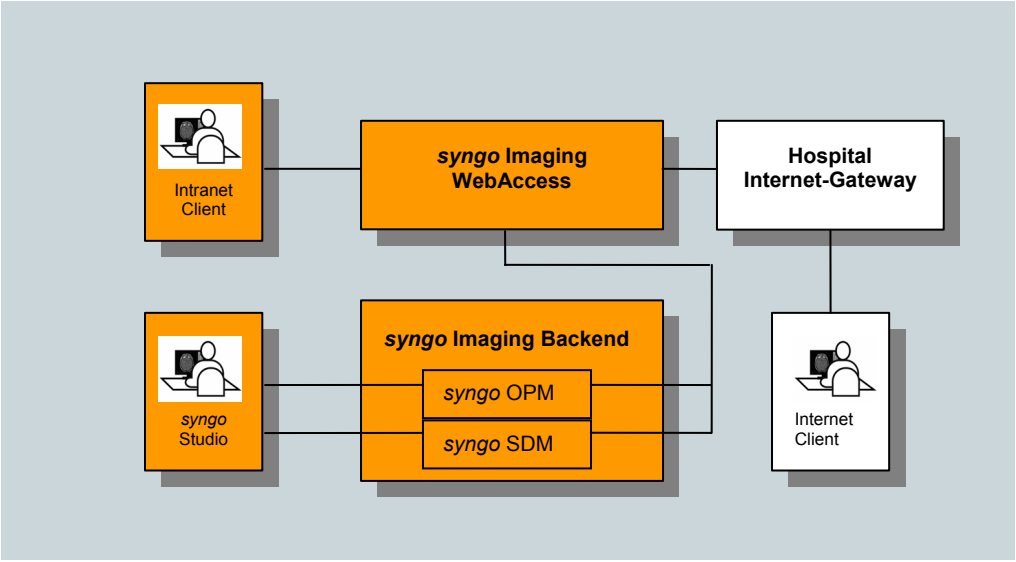
The three different variants available for WebAccess are:

1) *syngo* Imaging WebAccess embedded:
   The web server runs on the SDM as a process in this case.
   This option allows a maximum of 5 clients. For safety reasons, this variant is not recommended for access via the Internet.
2) *syngo* Imaging WebAccess:
   This variant requires WebAccess software and hardware. The WebAccess server runs on a separate Linux computer. This option allows a maximum of 50 clients. The external WebAccess server can be duplicated for redundancy and load reasons.
3) *syngo* Imaging WebAccess SW-only:
   For customers who wish to operate *syngo* Imaging WebAccess on their own hardware with Linux (SLES9).

Combination

The two methods of communication between clients and OPM/SDM can be combined:

- Workplaces within the hospital can continue to be directly connected with *syngo* Imaging Backend (*syngo* Studio).
- Workplaces outside the hospital are connected via WebAccess with the *syngo* Imaging Backend (*syngo* web-based Studio).
  - Workplaces in the intranet are connected directly to WebAccess.
  - Workplaces in the Internet are connected via the Internet gateway of the hospital.



The figure shows the three different ways of connecting workplaces to the syngo Imaging Backend.

Switching between *syngo* Studio and *syngo* web-based Studio

A *syngo* Imaging workplace can be used in various environments. It is possible to switch between *syngo* Studio and *syngo* web-based Studio by making a simple configuration setting.

Example: *syngo* Imaging on a radiologist's laptop

- If the radiologist works in the hospital (in the hospital LAN), he/she can configure the workplace as a *syngo* Studio.
- If the radiologist works with this laptop at home, he/she can configure the workplace so that it accesses the data via https and *syngo* WebAccess.

Note

Workplaces which communicate with OPM/SDM via syngo WebAccess cannot perform DICOM Query/Retrieve to other DICOM workplaces.

System interfaces

As a PACS, *syngo* Imaging is a central image management system in radiology and is surrounded by information systems. Usually, there is not only a PACS but also a RIS, a HIS, and modalities.

To achieve efficient workflow and optimum patient care in radiology, fast and smooth data as well as information exchange between these different systems are required.

syngo Imaging is suitable for integration into existing information systems.

Overview

The following figure shows an example of how the various information systems and image systems in radiology and the interfaces between these systems interact. The *syngo* Imaging workplaces are marked orange.

In practice, many other constellations and scenarios are possible.

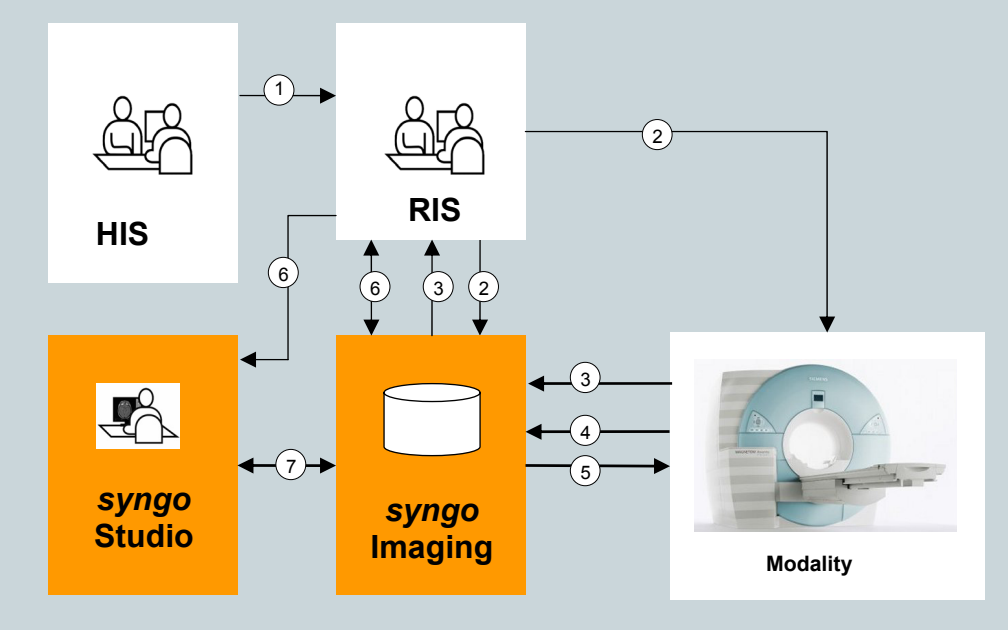


Figure C–1: Data flow in syngo Imaging

1 New patients are registered in the HIS. This data is transferred into the RIS (HL7).

2 Examinations and appointments are planned in the RIS. This data is transmitted to the modality as the DICOM Modality Worklist.

3 Information about the examination steps performed (DICOM MPPS) are transmitted via the PACS (*syngo* Imaging) to the RIS.

4 New images are sent by the modality via DICOM to *syngo* Imaging where they are stored and later archived.

5 *syngo* Imaging reports successful archiving of the images back to the modality (storage commitment).

6 Reports are created and stored in the RIS and can be retrieved from the RIS and displayed in *syngo* Imaging.

7 Images are exchanged between the *syngo* Studio workplaces and the *syngo* Imaging Backend via the fast transmission protocol iMaxcess.

Integration of *syngo* Imaging into a RIS

Deep integration of the RIS and PACS is especially important for the workflow in radiology.

Three different levels are generally distinguished in conjunction with integration between RIS and PACS:

- **Basic integration** allows the exchange of simple DICOM and HL7 messages between RIS and PACS.
- **IHE integration** enables IHE workflows to be additionally implemented in the interaction between RIS and PACS.
- **Extended integration** includes the basic and IHE integration and additional functionalities. Extended integration means seamless working with RIS and PACS.

The integration level depends mainly on the RIS functionalities.

	Basic integration	IHE integration	Extended integration
DICOM Modality Worklist	☑	☑	☑
HL7 scheduled procedure	☑	☑	☑
Merge / Modify patient data	☑	☑	☑
Scheduled Workflow IHE	☐	☑	☑
Patient Information Reconciliation IHE	☐	☑	☑
Image call-up	☐	☐	☑
Single Log-in Procedure	☐	☐	☑
Advanced patient / study administration	☐	☐	☑

Note

Combining syngo Workflow and syngo Imaging to form the syngo Suite results in continuous RIS- PACS workflow.

Basic integration

HL7 messages about scheduled procedures and modifications of patient data are exchanged between the RIS and *syngo* Imaging using the HL7 interface.

The planned procedures are transmitted to the modality as the DICOM Worklist. Manual entry of this data at the modality is no longer required, which is a potential source of error.

Requirements

The RIS must meet the following requirements:

- DICOM Modality Worklist SCP
- HL7 ORM messages (to be forwarded to *syngo* Imaging)
- HL7 ADT messages about the change to the patient data (for forwarding to *syngo* Imaging)

IHE integration

syngo Imaging can implement and partially extend several important IHE profiles with 3rd-party RIS. These IHE profiles are based on procedures that are actually applied in radiology.

- Scheduled Workflow
- Patient Information Reconciliation

"Scheduled Workflow" IHE profile

This profile specifies transactions that maintain the consistency of patient information throughout registration, ordering, scheduling, image acquisition, storage, and viewing. This consistency is the foundation for subsequent workflow steps, such as reporting.

Systems involved in this profile are: HIS, RIS, PACS and modalities.

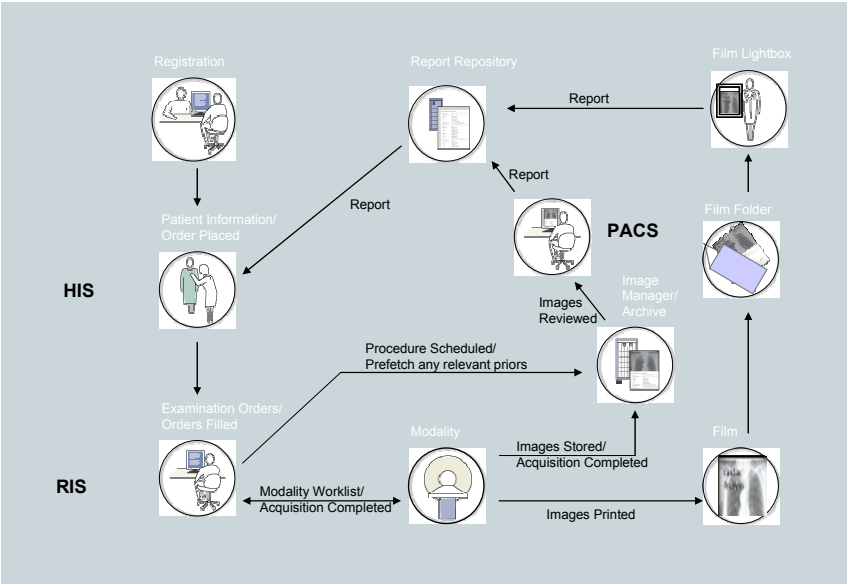


Figure C–2: Scheduled Workflow according to IHE

- A procedure is scheduled in the RIS.
- The scheduled procedure is communicated to the modality as a DICOM Modality Worklist to *syngo* Imaging as a HL7 ORM message.
- The examination is performed at the modality.
- The images are sent to *syngo* Imaging.
- *syngo* Imaging informs the RIS about DICOM MPPS, the work steps performed and the next scheduled work step.

syngo Imaging extends this profile and functions as a “General Purpose Worklist Manager”:

- *syngo* Imaging schedules the next procedure step.
- *syngo* Imaging manages Performed Procedure Steps.
- *syngo* Imaging prefetches images from the repository.

Requirements

The RIS must meet the following requirements:

- Planning radiological examinations and communicating the scheduled examination to *syngo* Imaging as an HL7 ORM message.
- Communicating the DICOM Modality Worklist to the modalities.
- Receiving and processing information about Performed Procedure Steps (GPPPS) and Scheduled Procedure Steps (GPSPS) as DICOM GPWL or HL7 messages.

“Patient Information Reconciliation” IHE profile

This profile extends the “Scheduled Workflow” profile.
It enables the allocation of images acquired for an unidentified patient, for example in an emergency case, at a later date.

Systems involved in this profile are: HIS, RIS, PACS and modalities.

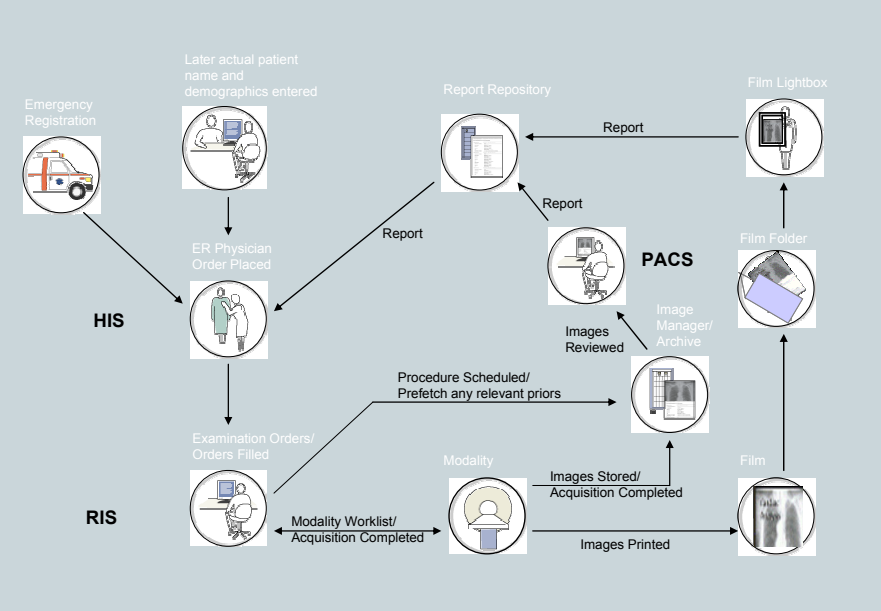


Figure C–3: Patient Information Reconciliation according to IHE

“Patient Information Reconciliation” can by triggered by the following events:

Triggering by the PACS

- An unscheduled examination or emergency case is performed on the modality
- The modality transmits images/MPPS to *syngo* Imaging
- *syngo* Imaging passes MPPS on to the RIS
- The RIS detects unscheduled and performed procedures and adds their data

Triggering by the RIS

- The higher-level RIS corrects erroneous data in the lower-level PACS

Requirements

The RIS must meet the following requirements:

- Receiving “Patient Information Reconciliation” messages from the HIS (HL7 ADT message) or providing a possibility to correct patient data
- Forwarding the updated patient data via HL7 ADT messages to *syngo* Imaging
- Receiving and interpreting GPPPS as DICOM GPWL Worklist or HL7 messages from *syngo* Imaging with unknown patient data
- Reconciling patient data and forwarding the correction to *syngo* Imaging

Extended integration

The implementation of this highest level of integration requires close cooperation between Siemens and the RIS manufacturer and project-specific clarification.

Desktop integration

The users work simultaneously with the RIS and PACS component on the integrated RIS-PACS workplaces.

Single Log-in Procedure

At the integrated workplaces, users only have to log in once to work with both the RIS and PACS applications. The automatic log-off closes both the RIS and the PACS.

Calling up and unloading images

syngo Imaging offers the option to call up or unload images from an external application (RIS, HIS and EPR).

- Calling up images – as a function of the selected environment
- Unloading images – when the patient context is lost
  e.g. when a patient entry is closed, when a new patient entry is opened, or the application is changed

Advanced patient and study data administration

To keep patient and study information up to date, *syngo* Imaging offers an interface in addition to the “Scheduled Workflow” and “Patient Information Reconciliation” IHE profiles.

The messages accepted from this interface are based on HL7. This enables the RIS to modify or merge the patient and examination data in *syngo* Imaging as required.

These HL7 messages are used for the following operations:

- modify patient data
- merge patient data
- modify study identifiers
- move studies to other patients
- move studies to other studies
- merge studies
- delete studies and/or examinations

Requirements

For the Single Login Procedure:

- Identical username and password in the RIS and PACS (e.g. using Microsoft Active Directory)
- The RIS must be able to be started by an external application and accept the username and password
- The RIS must accept an external trigger for automatic log-off

For image call-up:

- Loading and unloading via COM interface is supported by the RIS.
  Under certain conditions a URL-based call-up is possible.

For advanced patient data administration:

- The RIS must be able to perform these merges and modifications and send information via HL7 messages in fields, of which some are private, (“z-segments”).

Hardware configuration

There is no general hardware configuration for *syngo* Imaging.
Every *syngo* Imaging system is based on individual configuration – depending on the customer's requirements and specific conditions.

Siemens offers validated hardware products of various manufacturers.
Not including *syngo* Studio Advanced, the hardware for *syngo* Imaging workplaces can also be provided by the customer, provided it meets the minimum requirements specified.

Project sequence

Between analysis and implementation of a specific hardware configuration, every project basically completes the following phases:

- The first step is to analyze the customer requirements and create a system concept. The appropriate hardware configuration is then defined for this system concept.
- Upon acceptance of the system concept and receipt of the customer order, the hardware is ordered, preconfigured and the software is installed, if necessary. The complete solution is tested at Siemens.
- The hardware is then installed and integrated into the existing systems at the customer site. The hardware solution is documented.

Hardware configuration criteria

Which hardware configuration is proposed depends first of all on the required performance and capacity of the server and storage systems and the customer preferences. Moreover, the hardware configuration is influenced by the planned network structure.

Performance and capacity

The following aspects must be considered

- System type (SingleSite or MultiSite)
- Number of examinations per day or year
  Data volumes per examination
- Annual growth of numbers of examinations and resulting data volume
- LTS capacity
  Number of years and copies for which the LTS should be designed
- STS capacity
  How long should examinations be available in the STS?
  How much storage space should be allowed for previous images retrieved from the archive?

The following table gives a comparative example of the amount of data acquired per examination from different modalities:

Modality	Images per exam	Typical matrix	Bits per pixel	MB per image	MB per exam
CT/MRI	100	512	16	0.52	52.4
CT Sensation 16	2,000	512	16	0.52	1048.6
CR	4	2048	16	8.39	33.6
CR Mammo	4	4760 x 5840	16	55.60	222.4
FD	2	3121	16	19.48	30
Film digitizers	2	2048 x 2560	16	10.00	20

Customer preferences

The following information can be derived from the customer's preferences:

- Preferred hardware vendor
- Type of RAID system for short-term storage
- Number of days images should be available in STS
- Type of long-term storage
- Concept for data security and availability

Number of procedures and users

Data traffic as well as the number and type of users who will concurrently work on the system have a decisive influence on the *syngo* Imaging system capacity planning.

Depending on the number of new examinations per year, the planning is based on the following scheme:

Procedures per year	Reporting physicians (concurrent users)	Referring physicians (concurrent users)
up to 20,000	3 – 5	0
20,000 – 50,000	5 – 7	10
50,000 – 75,000	7 – 10	25
100,000 – 200,000	10 – 15	50
200,000 – 300,000	15 – 20	100
300,000 – 400,000	20 – 25	200
400,000 – 500,000	25 – 30	300

Licenses

This staggering principle is also applied to *syngo* Imaging licenses:
syngo Imaging licenses include both the server and the front-end functionalities of the system (Campus Licenses). They are valid for a specific number of procedures per year, starting at 20,000 and expandable by increments of 10,000. A standard license is available for systems with less than 20,000 procedures per year.

Licenses are not granted per workplace. However, the maximum number of concurrent users specified in the table must not be exceeded for performance reasons.

Note

If the customer's workflow does not comply with this scheme, dimensioning can be adapted accordingly.
A message is sent to the administrator and Siemens Customer Service if the system reaches its performance limit, i.e. the number of procedures or users is exceeded. The license will then be adjusted to the new requirements.

Examples

This section presents examples of typical *syngo* Imaging hardware solutions for different site sizes and requirements.

Facility performing up to 50,000 procedures per year

The following figure shows a typical configuration for a medical enterprise facility performing up to 50,000 procedures per year.

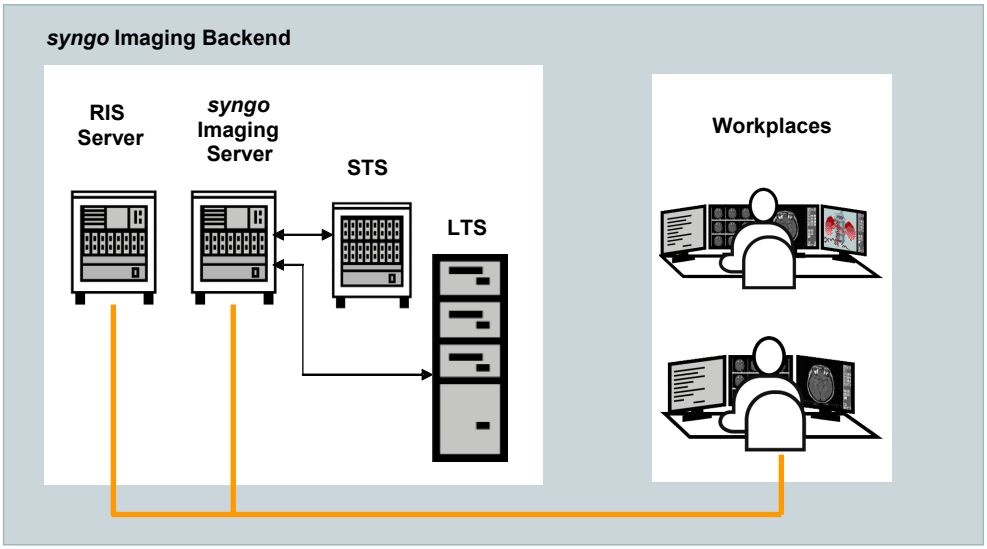


Figure D–1: Minimum configuration for up to 50,000 procedures per year

Five workplaces are installed inside radiology:

- Three integrated *syngo* Studio workplaces for reporting (with *syngo* Imaging 3D license)
- Two integrated *syngo* Studio Advanced workplaces for reporting and *syngo* post-processing (with specific 3D licenses)

Outside radiology, additional *syngo* web-based Studio workplaces for referring physicians may be equipped with standard PCs.

Facility performing up to 150,000 procedures per year

The following figure shows a typical configuration for a medical enterprise facility performing up to 150,000 procedures per year.

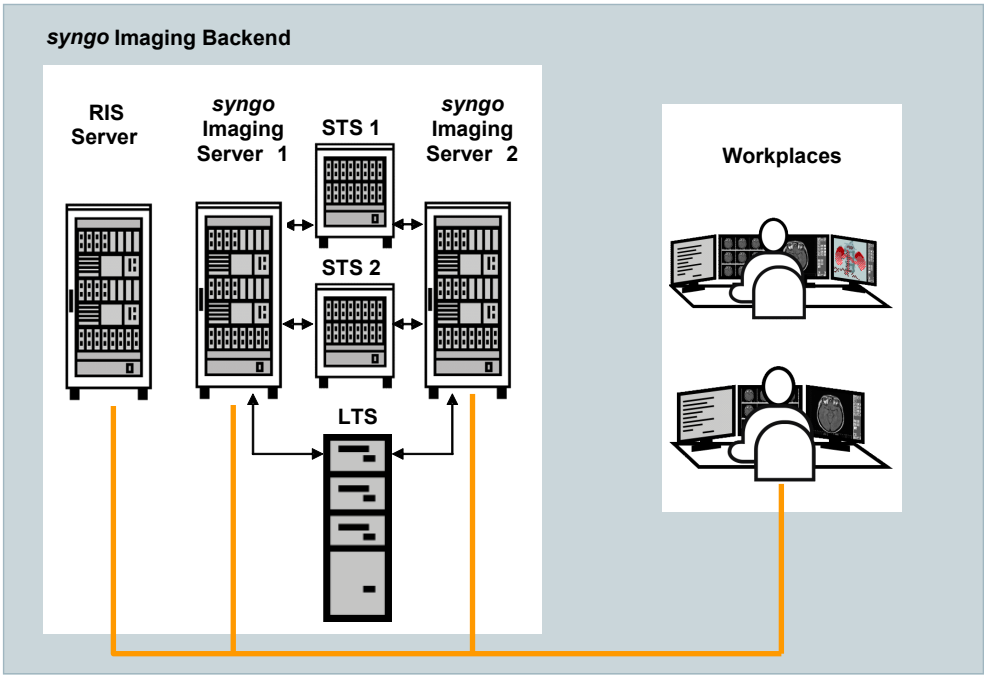


Figure D–2: High-availability configuration for radiological facilities performing up to 150,000 procedures per year

Twelve workplaces are installed inside radiology:

- Six integrated *syngo* Studio workplaces for reporting (with *syngo* Imaging 3D license)
- Six integrated *syngo* Studio Advanced workplaces for reporting and *syngo* post-processing (with specific 3D licenses)

Outside radiology, additional *syngo* web-based Studio workplaces for referring physicians may be equipped with standard PCs.

Redundant servers

To ensure maximum availability, the system is equipped with additional servers.

The *syngo* Imaging cluster consists of two SDM and two OPM servers, both of which are active. In the event of failure of central functions in a server, the other corresponding server will take over. Redundancy of the *syngo* Imaging servers is linked to the optional “High availability” license.

In *syngo* Imaging, cluster operation is controlled by a Veritas cluster server (VCS).

Redundant STS

Redundant short-term storage devices mirror image data and ensure availability in case an STS should fail.

HW configuration with safeguarding in the event of a disaster

Unforeseen events like short circuits, flooding or earthquake may lead to data loss and the physical destruction of components in the radiological institution.

To safeguard against the impact of such events, critical components of *syngo* Imaging can be split and positioned at separate locations. This is illustrated in the following figure.

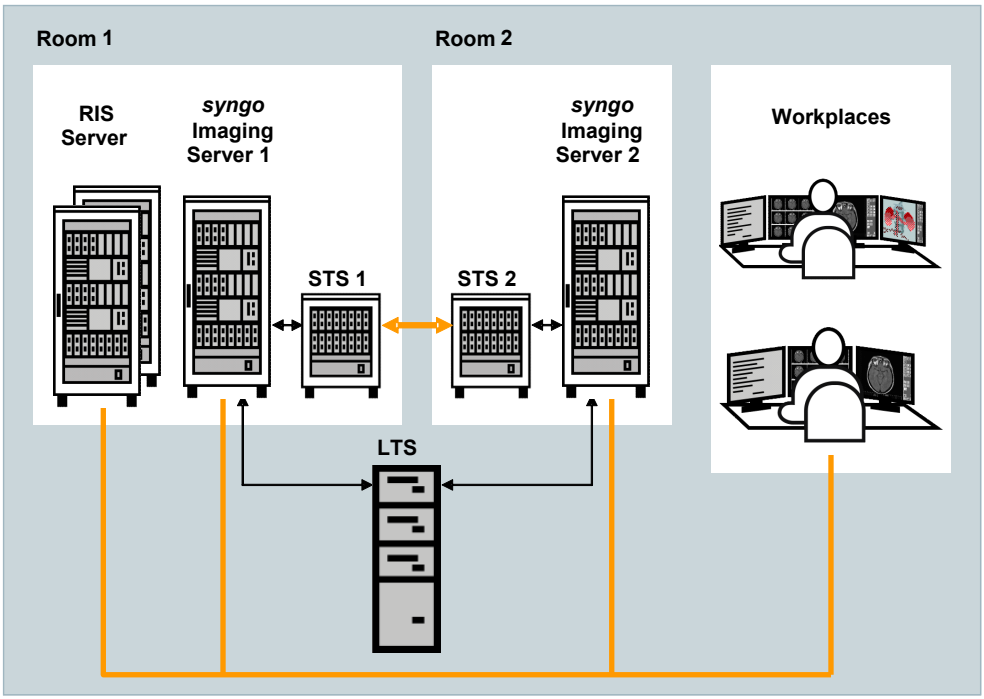


Figure D–3: Dual-room server configuration

Hardware for optional extensions

The scope of functions of *syngo* Imaging can be extended by optional modules. Some of the optional modules may require additional hardware components.

syngo WebSpace

The WebSpace server is used for evaluating and post-processing 3D image data. The hardware must be ordered from Siemens.

syngo WebAccess

There are various solutions for connecting workplaces outside radiology. They depend on the infrastructure of the relevant institution. A separate WebAccess server may be required in some cases.

High Availability

Depending on the required availability, you can choose one of three “High availability” options:

- Up to 99.99 % availability: 2 OPM server, 2 SDM server, double RAID configuration
- Up to 99.9 % availability: 2 OPM servers, 2 SDM servers, single RAID configuration
- Up to 98.9 % availability: 1 OPM server, 1 SDM server, double RAID configuration

Workplaces for clinical demonstration

In large radiological facilities or hospitals, demonstrations or conferences are regularly held in which medical cases of a certain specialism are demonstrated and discussed by experts.

Siemens offers all necessary hardware and software components for demonstration workplaces.

Software

syngo Studio Advanced is suitable for clinical demonstrations with its highly developed display and image processing functions. To prepare the demonstration, lists can be manually combined to form cases to be demonstrated.

Ideally, the workplace for demonstration is an integrated RIS-PACS workplace with *syngo* Portal Radiologist as the RIS component. *syngo* Portal Radiologist provides optimum support for the demonstration workflow.

PC hardware

Validated PCs from FSC or HP are available that are precisely matched to the specific requirements of *syngo* Studio Advanced workplaces.

Monitors

Demonstration workplaces are usually equipped with two 1.3 MP color monitors for displaying images and with one monitor for the demonstration worklist.

Beamer

Siemens provides a beamer validated for medical applications that features SXGA+ resolution (1400 x 1050 pixels) and is characterized by excellent image rendering and quiet operation.

Monitors

A large selection of validated flat screens from various manufacturers is available for *syngo* Imaging. Color monitors (c) or black/white monitors (b/w) with different resolutions can be used for reporting, depending on the imaging modality and the customer's workflow preferences.

Color monitors with 1.3 MP are used for 3D post-processing and for clinical demonstrations. In the case of RIS-PACS integration, commercial type color monitors can be used for the RIS application.

Common monitor configurations

The RIS application and 3D post-processing may be run on existing monitors for a better overview and easier working.
Each line in the following table represents a common configuration.

syngo web-based Studio

For *syngo* web-based Studio workplaces, a maximum of two reporting monitors and a RIS monitor can be installed.

Monitor 1	Monitor 2		
2MP, c	2MP, c, RIS		The RIS application runs on the second reporting monitor.
3MP, b/w	3MP, b/w, RIS		
Monitor 1	**Monitor 2**	**Monitor 3**	
2MP, c	2MP, c	RIS	The third monitor is used for the RIS application, only.
3MP, b/w	3MP, b/w	RIS	
3MP, b/w	3MP, b/w	2MP, c, RIS	The RIS application runs on the third reporting monitor.
3MP, b/w	3MP, b/w	3MP, b/w, RIS	
5MP, b/w	5MP, b/w	RIS	

syngo Studio

For *syngo* Studio workplaces, a maximum of four reporting monitors and a RIS monitor can be installed. For two or three installed monitors, you can choose between the configurations as for *syngo* web-based Studio.

Monitor 1	Monitor 2	Monitor 3	Monitor 4	
2MP, c	2MP, c	2MP, c	2MP, c, RIS	
3MP, b/w	3MP, b/w	2MP, c	RIS	
3MP, b/w	3MP, b/w	2MP, c	2MP, c, RIS	
3MP, b/w	3MP, b/w	3MP, b/w	RIS	
3MP, b/w	3MP, b/w	3MP, b/w	2MP, c, RIS	
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w, RIS	
Monitor 1	**Monitor 2**	**Monitor 3**	**Monitor 4**	**Monitor 5**
2MP, c	2MP, c	2MP, c	2MP, c	RIS
3MP, b/w	3MP, b/w	2MP, c	2MP, c	RIS
3MP, b/w	3MP, b/w	3MP, b/w	2MP, c	RIS

Monitor 1	Monitor 2	Monitor 3	Monitor 4	
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	RIS
5MP, b/w	5MP, b/w	3MP, b/w	3MP, b/w	RIS

syngo Studio Advanced

For *syngo* Studio Advanced workplaces, a maximum of four reporting monitors, a RIS monitor, and a monitor for 3D post-processing can be installed.

Monitor 1	Monitor 2	Monitor 3	
2MP, c	2MP, c	2MP, c, RIS, 3D	The RIS application and 3D post-processing run on the third reporting monitor.
3MP, b/w	3MP, b/w	2MP, c, RIS, 3D	
5MP, b/w	5MP, b/w	2MP, c, RIS, 3D	

Monitor 1	Monitor 2	Monitor 3	Monitor 4	
3MP, b/w	3MP, b/w	3D	RIS	RIS and 3D run on separate monitors
3MP, b/w	3MP, b/w	2MP, c	RIS, 3D	RIS and 3D run on a separate monitor
3MP, b/w	3MP, b/w	2MP, c	2MP, RIS, 3D	RIS and 3D run on the fourth reporting monitor
3MP, b/w	3MP, b/w	3MP, b/w	RIS, 3D	RIS and 3D run on a separate monitor
3MP, b/w	3MP, b/w	3MP, b/w	2MP, RIS, 3D	
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w, RIS, 3D	
5MP, b/w	5MP, b/w	2MP, c	2MP, c, RIS, 3D	

Monitor 1	Monitor 2	Monitor 3	Monitor 4	
3MP, b/w	3MP, b/w	3D	RIS	RIS and 3D run on separate monitors
3MP, b/w	3MP, b/w	2MP, c	RIS, 3D	RIS and 3D run on a separate monitor
3MP, b/w	3MP, b/w	2MP, c	2MP, RIS, 3D	RIS and 3D run on the fourth reporting monitor
3MP, b/w	3MP, b/w	3MP, b/w	RIS, 3D	RIS and 3D run on a separate monitor
3MP, b/w	3MP, b/w	3MP, b/w	2MP, RIS, 3D	
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w, RIS, 3D	
5MP, b/w	5MP, b/w	2MP, c	2MP, c, RIS, 3D	

Monitor 1	Monitor 2	Monitor 3	Monitor 4	Monitor 5
2MP, c	2MP, c	2MP, c	2MP, c, 3D	RIS
3MP, b/w	3MP, b/w	2MP, c	2MP, c	RIS, 3D
3MP, b/w	3MP, b/w	3MP, b/w	2MP, c	2MP, c, RIS, 3D
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	RIS, 3D
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	2MP, c, RIS, 3D
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w, RIS, 3D

Monitor 1	Monitor 2	Monitor 3	Monitor 4	Monitor 5	Monitor 6
2MP, c	2MP, c	2MP, c	2MP, c	3D	RIS
3MP, b/w	3MP, b/w	2MP, c	2MP, c	3D	RIS
3MP, b/w	3MP, b/w	3MP, b/w	2MP, c	2MP, c, 3D	RIS
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	3D	RIS
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	2MP, c, 3D	RIS
3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	3MP, b/w	RIS, 3D

Monitor calibration

For calibrating the monitors, the manufacturers provide a specific calibration tool which includes a measuring device and software.

This tool is used to calibrate and release the monitors on site during the acceptance test.

The calibration must be repeated and the result documented at regular intervals in compliance with the country-specific statutory regulations.

Storage and archiving

Storage and archiving of radiological images is one of the core tasks of *syngo* Imaging.

The *syngo* Data Manager (SDM Server) provides the central storage and archiving system for the *syngo* Imaging workplaces for connected DICOM modalities and other DICOM workplaces.

Radiological images are large data objects that differ greatly in file size and structure, depending on the type of examination (modality).
The data volumes to be archived continue to grow. This places an increasing demand on storage and archiving systems.

Principles

Requirements

The handling of huge amounts of data is an essential requirement for the storage and archiving of radiological images.

Moreover, quick access to all archived data must be possible, even if the data was archived a long time ago.

Storage media used must remain functional throughout the legally required period.

It must be possible to tailor the storage and archiving concept to the specific customer requirements.

STS and LTS

In compliance with the Hierarchical Storage Management (HSM) concept, a distinction is made between Short-Term Storage (STS) and Long-Term Storage (LTS).

STS

New images sent from the modality to *syngo* Imaging are registered in the database and stored in the STS. The STS has a limited storage capacity, but allows direct access to the images, for example during image post-processing and reporting.

To save storage space, images are stored in the STS lossless compressed (JPEG2000).

LTS

When data in the STS has a configurable “age”, it is archived in the LTS. Data that has already migrated to the LTS is deleted from the STS as soon as a configurable STS watermark has been reached.

The LTS provides very large storage capacity. Images can be stored there for many years.

To open and process images that are archived in the LTS, these images must be transferred to the STS again. This step is equivalent to dearchiving. The archived images in the LTS are not changed.To open and process images that are archived in the LTS, these images must be transferred to the STS again. This step is equivalent to dearchiving. The archived images in the LTS are not changed.

Comparison of STS and LTS

The following table provides a comparison between STS and LTS.

	Archive status	Suitable hardware	Capacity
STS	Online	Hard disks RAID systems	Scalable 10-12 TB recommended
LTS	Nearline	RAID systems Tape libraries	Unlimitedly scalable

The LTS can be connected with the SDM server in various ways:

- DAS (Direct Attached Storage)
  Point-to-point connection using SCSI or FC
- SAN (Storage Area Network)
  Via the server of a “Storage Area Network”

The STS can be connected to the SDM server directly (DAS) or via SAN.

Note

Existing storage systems can also be used for syngo Imaging.
These storage systems must comply with the specification and be validated for operation with syngo Imaging.

Details

Compressing

To save storage space and optimize the transfer times between clients and servers, all images that were received uncompressed in *syngo* Imaging are stored compressed in the STS. The JPEG2000 procedure is used for this purpose. JPEG compression is also possible.
In either case, no image information is lost – compression is lossless.

The tasks of compression, validation of the compressed objects, and decompression are performed by the Compression Manager, a component of the File Server.

Moreover, a thumbnail is generated for each object during compression and displayed, for example, as a preview image in the “Radiological patient record”.

Archiving

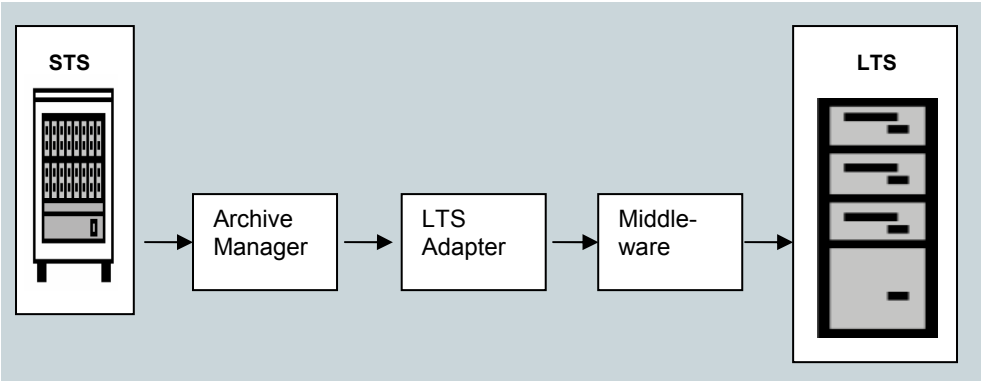


Figure E–1: Important storage / archiving components

Migration of the images from the STS to the LTS follows a configurable time schedule, for example, daily between 6pm and 1am.

The **Archive Manager** queries from the business logic, which objects should be archived. During this process, the “age” and archive status of these objects are checked: which objects have resided on STS for a configurable period and have not yet been archived?

The Archive Manager transfers the objects to be archived to the **LTS Adapter**. The LTS Adapter groups the images, generates LTS objects (all objects of a series become one LTS object), and transfers these objects to the **LTS middleware**.

The LTS middleware is an external tool for connecting the STS and the LTS. The LTS middleware controls the LTS hardware and manages the archive media. Each LTS object is saved to an archive medium.
The archived objects are validated.

Prefetching images

The objective of prefetching is to be able to access all relevant prior images of a patient, which are only on LTS, in addition to the images on STS, during the diagnosis and reporting process.

Specific prefetching rules are followed to retrieve prior images in the system and dearchive them, if they are available only on LTS. After dearchiving, the DICOM image headers are updated with more recent data from the database, if applicable.

When prior images have been prefetched from LTS, they are stored on STS and can be directly opened and compared with the current images.

Prefetching is a background process automatically triggered by the following events:

- A new examination is planned or an already planned examination is modified in the RIS. The RIS sends an appropriate HL7 message to the PACS
- An examination not previously planned in the RIS was performed at the modality. The modality sends an appropriate MPPS message or the images to the PACS.

Rules for prefetching

Prefetching rules are configurable per customer site and define which event should trigger prefetching and which images should be prefetched.

Criteria for prefetching rules:

1. Look for the most recent examination of the current patient.
2. Look for examinations with the same modality, organ or procedure description.
3. Prefetch a maximum of x examinations.
4. Look for the oldest examination of the current patient.

Deleting images from STS

Due to the limited STS storage capacity, objects that are already archived on LTS are deleted from the STS when a specific STS watermark has been reached.

The order of deletion depends on the “age” of the examination. In this context, “age” stands for the last access to the examination. The last accessed examination will be the last to be removed from STS.

The File Server checks the filling level of the STS at regular intervals. When the maximum watermark has been reached, suitable objects that can be deleted are searched and deleted from the STS together with their thumbnail, until a configurable minimum watermark has been reached. The archive status of these objects changes to nearline.

Examples

The following archiving scenarios are frequently implemented in practice.

Hard disk & tape library

In scenario 1, *syngo* Imaging uses hard disks and one tape library as LTS to store one copy of each image on hard disk and one on tape.

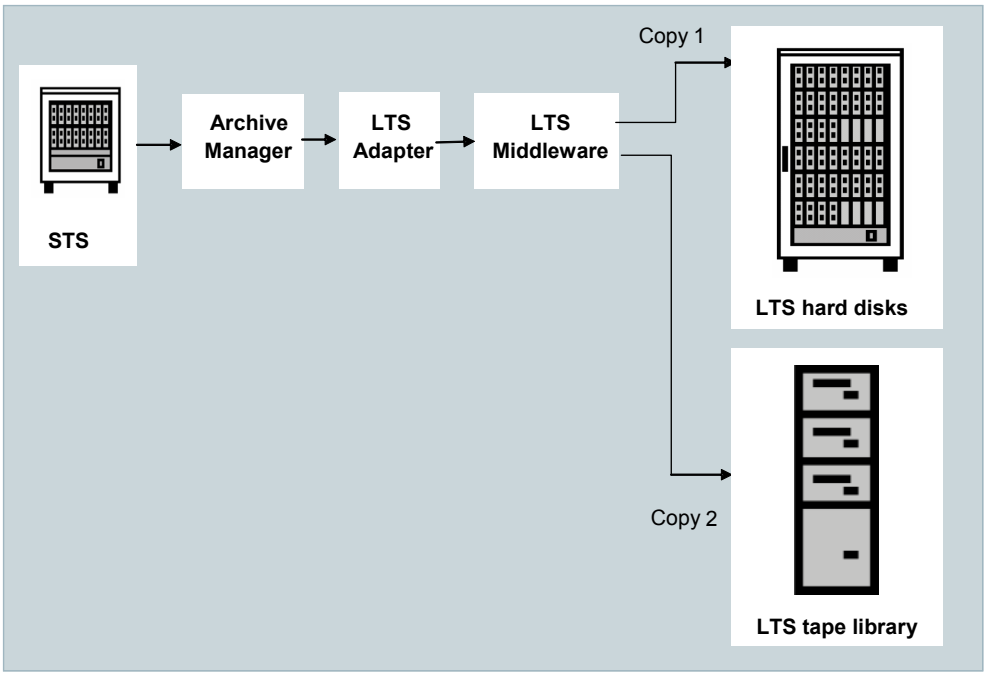


Figure E–2: Long-term storage on hard disks and tapes

The characteristics of this scenario are:

- Quick access to LTS data because images are read from hard disk.
- Appropriate hardware drivers for the tape library are required.
- *syngo* Imaging knows the migration status (succeeded / failed) and generates event messages.

To protect the data from catastrophes, e.g. fire, hard disks and tape libraries must be installed at different locations. Otherwise the tapes must be removed manually and stored in a safe place.

Using an external system

In scenario 2, *syngo* Imaging uses an NFS Mount Point to hand over images to the server of an external storage system. The external HSM or NAS server is “mounted” in *syngo* Imaging via NFS.

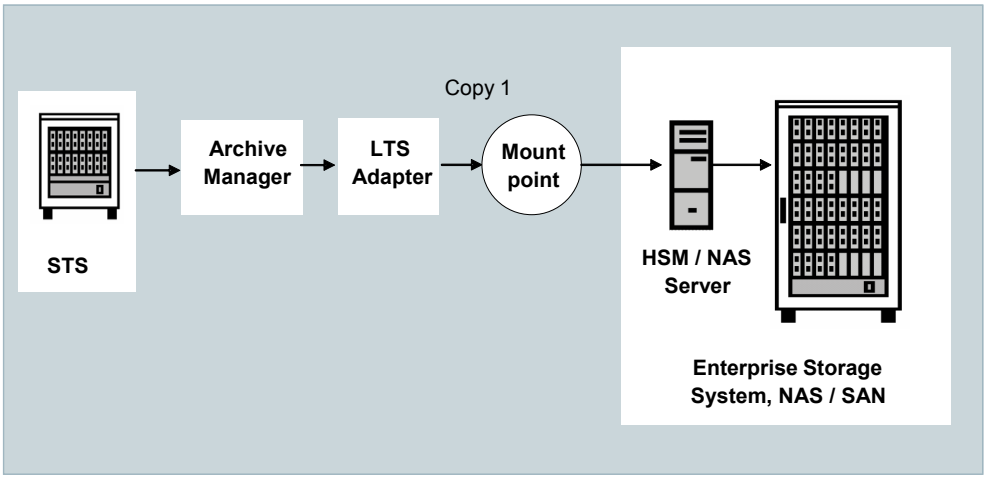


Figure E–3: Long-term storage via mount point

The characteristics of this scenario are:

- *syngo* Imaging is not dependent on the hardware-specific requirements of the external storage system (e.g. drivers).
- *syngo* Imaging is not notified of the internal migration status (online or nearline). This method is called “Trusted Archiving”.
- Storage levels and physical storage are managed by the external system.

The operator of the storage system must ensure that all objects that need to be archived or dearchived are available at the mount point.

Tape library

In scenario 3, *syngo* Imaging uses one tape library as LTS. Each object is stored on two different tapes to ensure redundancy.

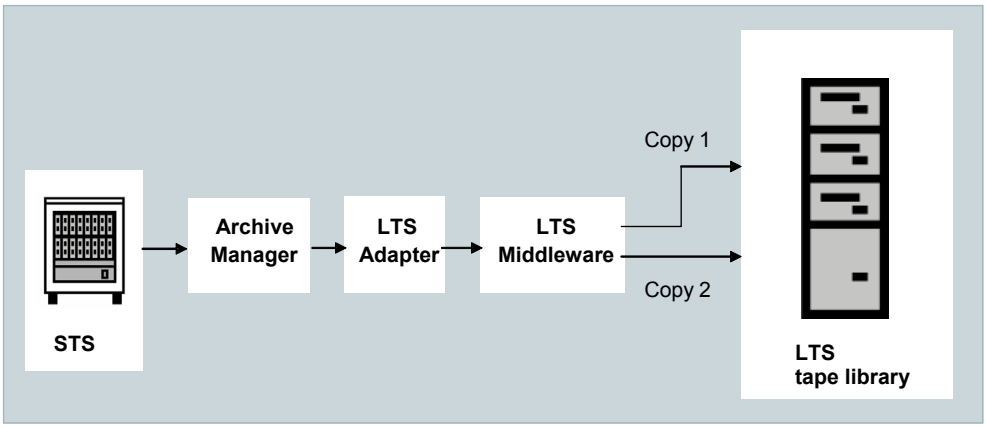


Figure E–4: Long-term storage on tapes

The characteristics of this scenario are:

- Simple setup at low cost.
- Appropriate hardware drivers for the tape library are required.
- *syngo* Imaging knows the migration status (succeeded / failed) and generates event messages.
- To protect the data from disaster, e.g. in the event of fire, a copy of the tape must be removed and stored at a secure place.

Note

This scenario is only recommended for systems in which images need to be prefetched rarely. Tape libraries are not optimized for frequent non-sequential access.

Shared use of storage devices

In scenario 4, certain areas of an enterprise storage system are dedicated to *syngo* Imaging.

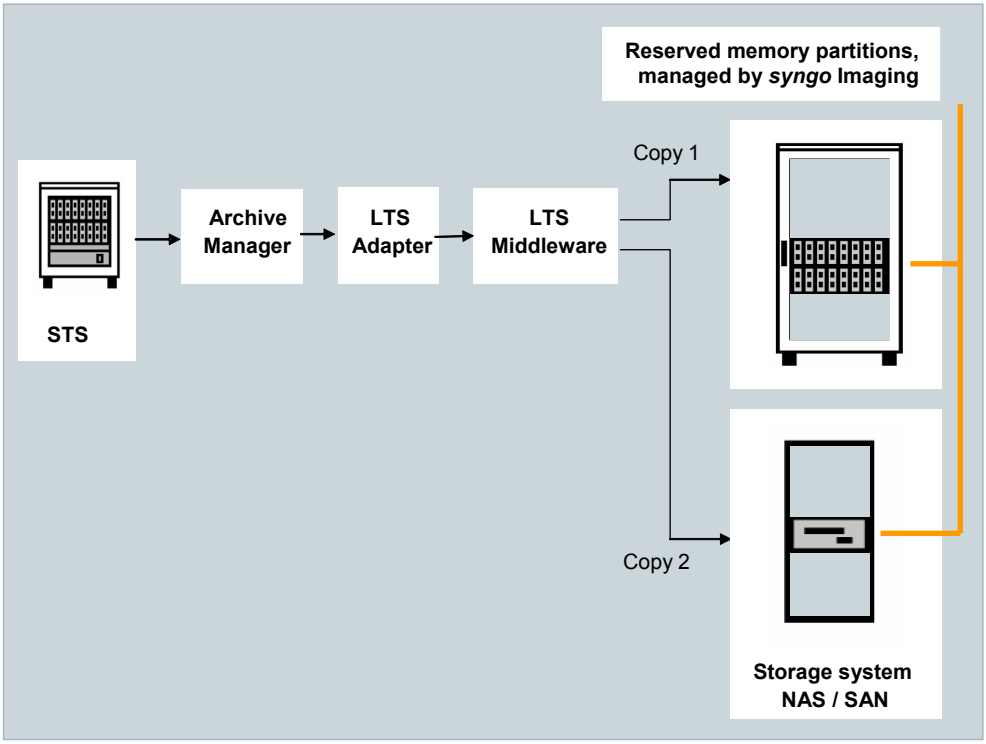


Figure E–5: Long-term storage on a shared storage system

The characteristics of this scenario are:

- Quick access to LTS data because images are read from hard disk.
- *syngo* Imaging knows the migration status (succeeded / failed) and generates event messages.
- Enterprise-wide storage consolidation is supported.
- The operator of the storage system must ensure availability.

Using external storage systems

Sophisticated storage and archiving systems and methods are used not only in medical imaging, but also in many areas of the IT sector.

A shared storage infrastructure for all data (administration data and images) is an important goal, especially for large hospitals. This produces a considerable reduction in operating and administration costs.

syngo Imaging can be integrated into an existing storage infrastructure. The degree of integration depends on the customer's site conditions and business goals.

Possible integration levels of external storage systems are:

- No integration
  Both STS and LTS are part of the *syngo* Imaging system.
- Partial integration
  syngo Imaging provides only the STS. An existing system is used for LTS.
- Full integration
  Neither STS nor LTS are part of the *syngo* Imaging system. Existing systems are used for both storage levels.

Using external LTS hardware (scenario 4)

Using external LTS hardware means that *syngo* Imaging shares the LTS with other users, (e.g. SAP data). In this case, *syngo* Imaging owns just a specific share of the external LTS.

The performance specification for *syngo* Imaging must be complied with. For example, the drives of the tape library may be very busy with other applications when images are requested. This would result in a strong loss of performance for the PACS.

Note

The customer is responsible for operating the LTS.

Using external STS in SANs

syngo Imaging can use online repositories in an existing SAN for STS. *syngo* Imaging uses LUNs to address the provided repositories in the SAN.

Note

The customer is responsible for operating the STS. As perfect functioning of syngo Imaging vitally depends on the STS, STS functionality needs to be 100% guaranteed.

Using external backup systems

syngo Imaging can also use external backup systems that are connected to *syngo* Imaging via a mount point.

Both backup management systems and NAS are possible.

Integration into the IT infrastructure

The following aspects must be considered for the integration of *syngo* Imaging components into an existing IT infrastructure.

Project-specific installation

A standard installation includes only product components that are delivered and assembled by Siemens. As soon as customer-specific components are integrated, the solution becomes project-specific.

Components

Depending on the components to be integrated, the integration effort may vary:

- UPS
- Active network components (switches / routers)
- SAN infrastructure (cables and switches)
- Tape library
- Backup system
- External mount-point LTS

Implications

Project-specific implementation of storage, archiving, and backup components in a *syngo* Imaging system has the following implications:

- The responsibility for these components, including monitoring, operation, troubleshooting, and maintenance, is defined in the customer contract.
- The components provided by the customer have to meet the “Requirement Specifications for Vendors” for the specific version of *syngo* Imaging.
- For the installation, the customer must provide the required functionality at the interface between the existing infrastructure and the delivered *syngo* Imaging system.

DICOM-Archive

syngo Imaging can act as a user or provider of a DICOM Archive.

In contrast to archiving via an HSM/IT archiving system, DICOM mechanisms are used for archiving in this case.

For a DICOM Archive, a specific DICOM adapter is used instead of the LTS adapter. This adapter uses the required DICOM services C-STORE, STORAGE COMMITMENT, and QUERY/RETRIEVE.

Note

syngo Imaging systems, acting as user and as provider, were the only systems tested for the V30A version. Other systems, used as user or provider, must be tested for each specific project.

syngo Imaging acting as DICOM Archive User

As DICOM Archive User, *syngo* Imaging comes with STS only. The LTS is provided by the DICOM Archive Provider.

For archiving, images are sent to the DICOM Archive Provider via DICOM. As soon as the DICOM Archive Provider communicates to *syngo* Imaging that the archiving process was successful (Storage Commitment), the archived images can be deleted from the STS.

The business logic of *syngo* Imaging acting as DICOM Archive User is very much the same as if it were connected to its own LTS: images are automatically archived and dearchived without user interaction. The same prefetch rules apply.

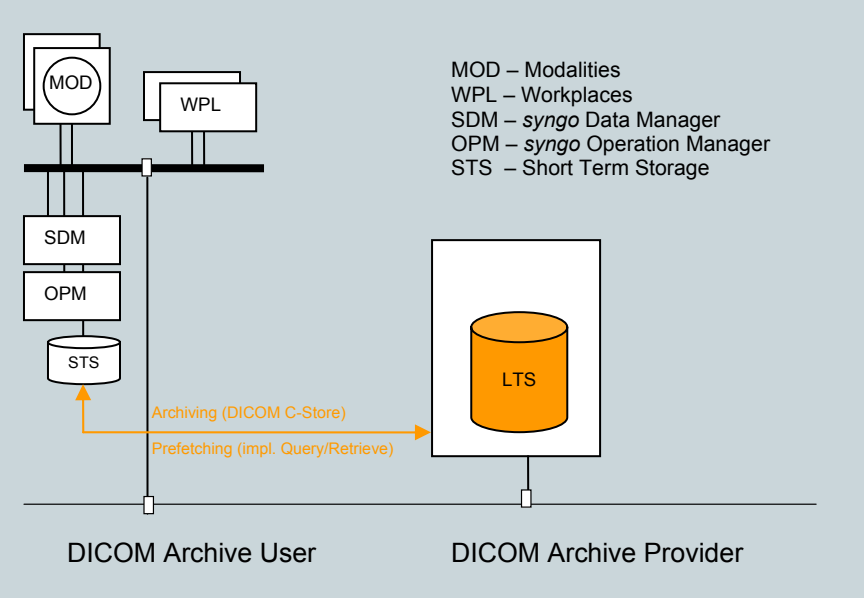


Figure E–6: syngo Imaging acting as DICOM Archive User

syngo Imaging acting as DICOM Archive Provider

When acting as DICOM Archive Provider, *syngo* Imaging archives the images for the connected DICOM Archive Users. The users do not need LTS capacity on their own.

syngo Imaging stores the images sent via DICOM and confirms successful archiving by sending a Storage Commitment message.

Requests for dearchiving are sent from the DICOM Archive User using DICOM Query/Retrieve functions in *syngo* Imaging. No user interaction is required.

syngo Imaging as DICOM Archive Provider is more than just a storage system. It is a complete data management system. The meta data of all images is stored in a database and accessible to all connected DICOM Archive Users.

Requirements

All connected systems (DICOM Archive Users and Provider) must maintain unique patient and study identifiers. This can be achieved by a shared information system or organizational means.

This prerequisite also applies in cases where connected DICOM Archive Users do not use an information system. Example: a cardiology department uses *syngo* Imaging as DICOM Archive Provider.

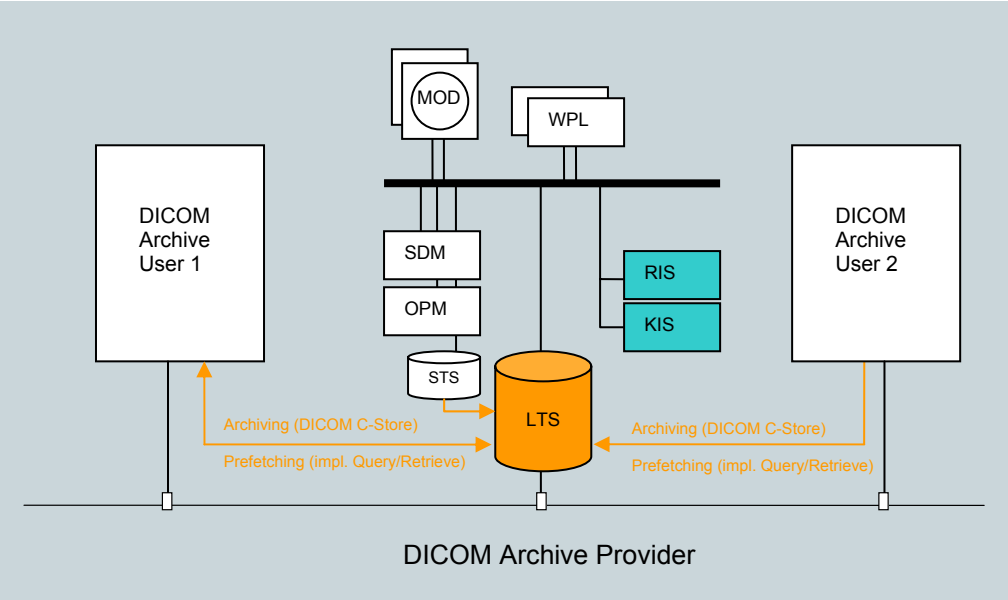


Figure E–7: syngo Imaging acting as DICOM Archive Provider

One DICOM Archive for several *syngo* Imaging systems (MultiSite)

Several institutions using *syngo* Imaging as PACS can use *one syngo* Imaging system as DICOM Archive. Such a configuration allows, for example, several hospitals of a hospital chain to share a DICOM Archive.

Concept

- Both the DICOM Archive Users (satellites) and the DICOM Archive Provider (main) are complete PACS systems.
- Only the main system comes with LTS. The satellites have only STS.
- The main system confirms successful archiving (Storage Commitment) to the satellites.
- Every satellite can access its own data in the DICOM Archive. Access to the archived data of all satellites is possible from the main system.
- Each satellite represents a separate reporting system. Even in the event of network interruptions, reporting with the satellites can continue – using the data stored on STS.
- Other DICOM workplaces can retrieve images of their “own” system via OEM.

Requirements

It is mandatory that all *syngo* Imaging systems are connected to *one* RIS to prevent conflicts of patient and study identifiers. If satellites are not connected to the higher-level RIS, organizational actions must be taken to ensure that no conflicting identifiers occur.

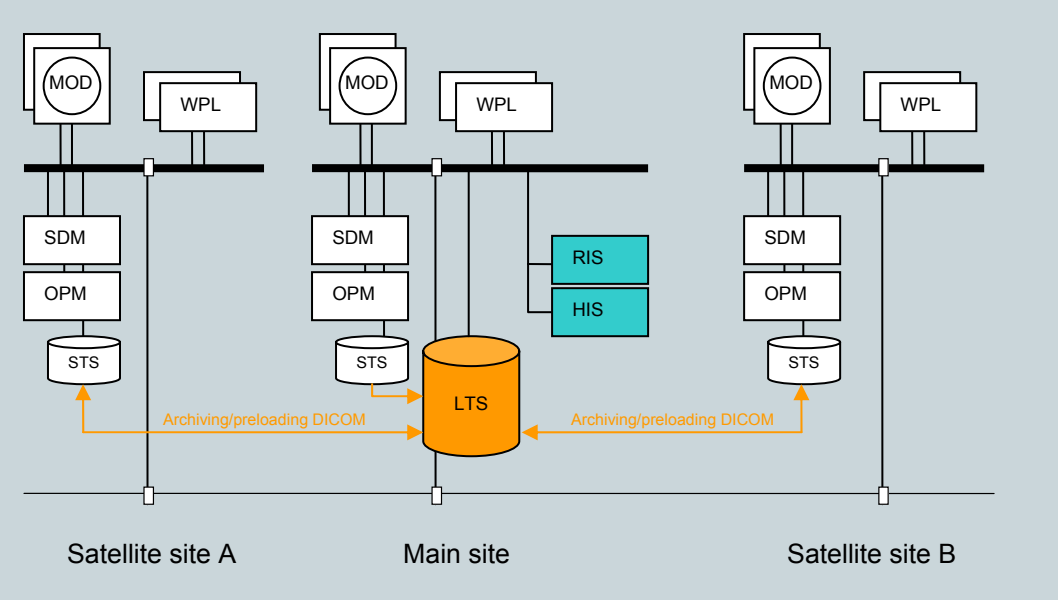


Figure E–8: syngo Imaging acting as MultiSite DICOM Archive

Data security

Data security means the protection of personal data (patient data) from misuse.

Data security has top priority in *syngo* Imaging. The data encryption, role-specific access authorization and an integrated administration of user rights guarantee that the data security requirements are met.

User administration

A unique identification of the user is the basis and prerequisite for access control and logging of relevant user activities (audit trail).

Every user must log in at the system with a username and a password.

syngo Imaging uses Active Directory (AD) as a user repository.

In case the hospital already runs an AD domain, this AD may be used as a *syngo* Imaging user repository.

Otherwise, an Active Directory, which is exclusively used as *syngo* Imaging user repository, is installed and preconfigured on the OPM server during system installation.

Note

There is always an Active Directory installed on the OPM. It stores vital information and configuration data for Siemens Customer Service, access control management, and syngo Imaging Authentication Service.

Log-in behavior

Users of *syngo* Studio and/or *syngo* web-based Studio log in with their *syngo* Imaging username and password using the Single Log-in Point Application (SLPA).

Image call-up with OEM interface

The *syngo* Imaging OEM interface allows you to open images in the patient context from any EPR system.

You use this feature, for example, at *syngo* Workflow workplaces, if you want to view the images associated with a current report. The OEM interface will start *syngo* web-based Studio, which shows the requested images.

Usually, every start of *syngo* Imaging would require the user to log in. To avoid this request, *syngo* web-based Studio can be configured so that the username and password is also valid for *syngo* web-based Studio.

This scenario applies under the precondition that the EPR software already performs user authentication and access control and the hospital agrees with the fact that there is no user-specific auditing possible for this session.

Examples of user repositories:

Case 1

The *syngo* user repository is provided by the OPM.

- The *syngo* user repository is under the control of the PACS administrator.
- There is no impact on *syngo* Imaging if the clinical domain controller fails.
- There is no need to communicate the AD domain of the OPM as a “Trusted site” to the hospital.
- The users have to remember an additional username & password.

Case 2

The *syngo* user repository is provided by the clinical AD domain.

- Users of *syngo* Imaging use their Windows log-in data and do not have to remember an additional username and password.
- The *syngo* user repository is under the control of the IT administrator.

Case 3

The *syngo* user repository is synchronized with an existing repository.

- The *syngo* user repository is provided by the OPM. However, the user accounts are synchronized with an existing user repository. Any user repository may be used as a source, for example Novell NDS/eDirectory, NT4 domain, Linux NIS, etc.
- Users log in with an already well-known username and password.
- The *syngo* user repository is under the control of the PACS administrator.
- There is no impact on *syngo* Imaging if the clinical user repository should fail.

Access control

Access to functions

syngo Imaging provides flexible role-based access control mechanisms.

- Users who have similar workflows are assigned to a role.
  The roles already created in *syngo* Imaging after installation are: technician, junior radiologist, senior radiologist, referring physician, and system administrator.

  The user roles can be flexibly defined according to the department's workflow.

  A user may be a member of several roles.

- Each role is linked with specific user privileges which define the functions available to the user at the *syngo* Imaging workplace.

Ward-related access to data

Access to data can be restricted to certain wards and/or departments.

It is possible to allow access only for users of the actual department, the performing department or the requesting department or ward.

Actual department

The actual department is the ward at which the patient is treated.
Use this restriction, for example, to restrict patient image data access to only the staff of this ward.

Performing department

The performing department is the one performing the radiological examination.
Use this restriction to restrict image data access to the staff of this department (multi-client capability). Example: radiology staff cannot see images generated in cardiology.

Requesting department

The requesting department is an external referring physician or a ward that placed the examination request. Use this restriction to restrict access to images ordered by a certain referring physician.

Logging

All user activities are recorded in a log file (the so-called audit trail). This file cannot be edited.

Audit trails are protected files. They can only be viewed by authorized users.

The audit trail is stored and automatically archived at a central location, separately from the patient data.

The required archiving period for audit trails is specified by statutory regulations. The storage lies within the system administrator's area of responsibility.

Logging

Depending on the configuration, the following actions can be logged:

- Service access and all administrative actions
- Change of access rights
- Access to, and modifications of patient data and images
- User log-in and log-off
  Log-in attempts as well as beginning and end of sessions
- Modifications to patient or procedure/examination data initiated by the RIS

Backup and restore

As opposed to archiving, which means permanent storage of data, backup means generating a temporary copy of changing data for data security reasons.

The objective of data backup is to limit loss of data in the event of system failure.

Typical backup data are databases, system configuration data, HSM index files, etc.

The restoration of a backup copy is called data restore.

Overview

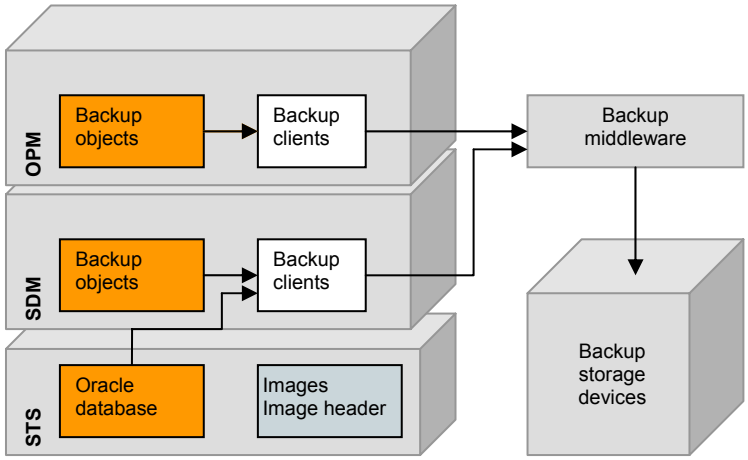


Figure G–1: Backup overview

Backup clients

Backup clients are provided on the OPM and SDM. Backup clients collect the objects to be saved at regular intervals and pass them on to the backup middleware.

Backup objects

Backup objects are all files that have changed since the last backup.

Backup middleware

The backup middleware connects to the storage devices.
It controls storage and restore of the backup data according to the configured rules.

Storage devices

Various systems can be used for backup storage as well as for long-term archiving.

- Backup solutions with internal storage systems:
  2 copies on 2 tapes in a tape library
  1 copy on hard disk, the 2nd copy in the tape library
  2 copies on 2 hard disks
- Backup solutions via mount point on external storage systems:
  external NAS

Database backup

Database backup is incremental:

- Backup of the complete database is performed every Sunday (full backup).
- Daily backup includes only the changes since the last full backup.

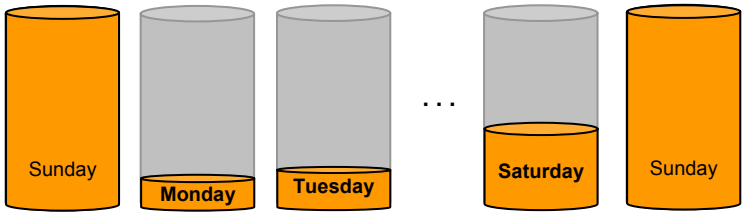


Figure G–2: Incremental database backup

OPM data backup

Backup for OPM data is progressive:

- The first backup includes all data of the OPM (full backup).
- All following backups include only the changes since the last backup. These backups are performed daily.

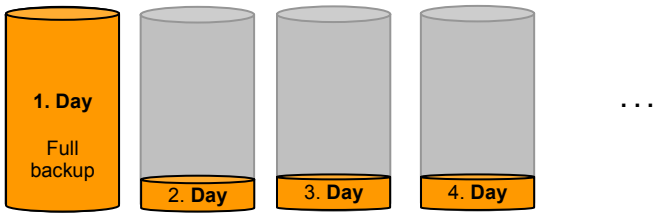


Figure G–3: Progressive backup for OPM data

SDM data backup

- Configuration backup
  Backup of the application-specific configuration files is performed daily.
- Node backup
  Backup of the directories and hard disk partitions is performed weekly.

Meta data backup

The database of the backup middleware is saved on tape daily.

syngo Studio workplaces

No backup is necessary for *syngo* Studio workplaces, because no local data is stored at these workplaces. To set up or restore a workplace, only the software needs to be installed.

Note

For configurations with more than one monitor, the screen settings might need to be adjusted after the software is installed.

syngo Studio Advanced workplaces

These workplaces are saved through an online image backup.

For this backup method, the current state of the hard disks is saved and written to DVD or stored on the OPM server during operation.

Online image backup is performed before and after a software update by the administrator.

Availability

Availability is the time ratio within a defined period in which a technical system is operatively available for its intended purpose. Hence, availability is a system characteristic and serves as a quality criterion for the system.

High availability means that operation can continue with minor or no downtimes in the event of component or system failure.

Overview

To ensure maximum availability, *syngo* Imaging provides a number of solutions: from redundant hardware components to completely redundant cluster configuration.

System availability

Redundant hardware components

All *syngo* Imaging servers can be equipped with redundant hardware components:

- At least two power supplies and redundant fans
- At least two network interfaces, CPUs and RAID controllers
- Redundant system hard disks for each server

Cluster solution

The cluster solution provides maximum availability for the *syngo* Imaging servers: two SDM and OPM servers and two RAID systems in separate rooms.

Data availability

Data in STS

syngo Imaging can be equipped with two RAID systems (mirrored). This increases availability of the data stored in the STS.

Data in LTS

To increase availability of the data on LTS, every image can be archived in two copies which in the ideal case is stored at separate places.
You can choose between the following options:

- Images are archived in a tape library on two different tapes.
- Images are archived on hard disk and a tape.
- Images are archived in the NAS and on hard disk.

Cluster solution for *syngo* Imaging

syngo Imaging uses the cluster solution to ensure maximum availability. This configuration consists of two server clusters:
two SDM servers and two OPM servers.

The Veritas cluster software (VCS) groups the two OPM servers in a first cluster and the two SDM servers in a second cluster.

If a server in the cluster fails, VCS initiates “failover” to the second cluster. If just a service within a system fails, VCS attempts to restart this service on the system. If the service fails again, the entire service group is switched over via “failover” to the correspondingly functioning second system. After the failed system has restarted, the cluster does not automatically perform failback to the restarted system. The administrator can decide whether the failed system needs to be repaired before it resumes operation.

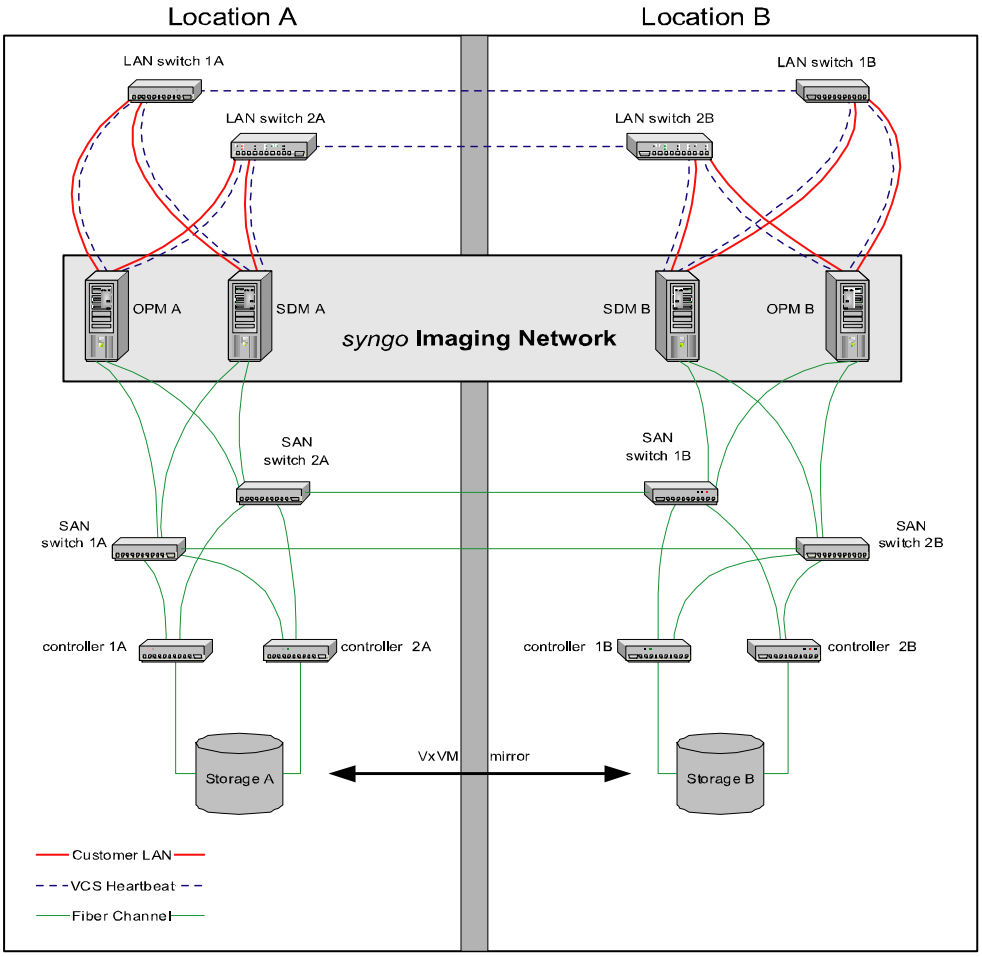


Figure H–1: Topology of a cluster solution

Veritas cluster software

The Veritas cluster software is implemented on the SDM and OPM servers and controls the start, stop, monitoring, and failover of all business-critical *syngo* Imaging system components.

This increases system availability in the following events:

- Failure of business-critical processes
- Failure of the server hardware
- Failure of the server software
- Failure of network components
- Failure of the storage system

High availability options for *syngo* Imaging

Depending on the required availability, you can choose one of three “High availability” options for *syngo* Imaging:

- Up to 99.99 % availability:
  2 OPM server, 2 SDM server, double RAID configuration
- Up to 99.9 % availability:
  2 OPM servers, 2 SDM servers, single RAID configuration
- Up to 98.9 % availability:
  1 OPM server, 1 SDM server, double RAID configuration

Failure and restore scenarios

The following scenarios serve as examples to demonstrate how *syngo* Imaging reacts to the failure of the integrated information systems or to the failure of system components and how operation can be resumed.

Please note that the effects of failures and the actions to restore operation must be analyzed and clarified separately for each *syngo* Imaging system. The scenarios strongly depend on the involved systems, interfaces, and implemented workflow.

The basis for all scenarios is a *syngo*Suite System.

HIS failure

The HIS is considered a higher-level system and performs hospital-wide patient admission, transfer and discharge as well as maintenance of patient master data.

The HIS sends radiology-relevant master data to the RIS and receives billing data and reports from the RIS.

HIS failure or interruption of the HIS-RIS connection

- The PACS continues operation without any restriction.
- Work at the modality is not affected.
- Patient and hospital stay data must be administrated manually in the RIS.
- If the HIS is the master system for order management, the orders should be allocated to the correct patient / hospital stay.
- Reports and billing data cannot be sent to the HIS, but are cached in the RIS.

After restore

- Patients and hospital stays registered in the RIS must be merged with the correct re-sent HIS data.
- Information cached in the RIS (reports and billing data) is sequentially transferred to the HIS.
- Examination orders generated in the RIS are assigned RIS-specific identifiers. The HIS does not know these identifiers. They must be synchronized with the HIS as soon as it is available again.

RIS failure

In the event of RIS failure, the main PACS functions are still available. It is assumed that the data sent from the HIS to the RIS is stored in the HIS cache and can thus be transferred as soon as the RIS has resumed operation.

RIS failure

The following functions are no longer available:

- Patient management
- Scheduling and management of orders (examinations)
- Transfer of scheduled examinations to the modalities (via DICOM Worklist)
- Forwarding of information about scheduled or current examinations to the PACS
- RIS worklist at integrated workplaces
- Communication of performed procedures and available images from the RIS to the PACS
- Reporting and sign-off of reports (reports must be prepared offline)

Restricted work with PACS

- At integrated workplaces, the PACS patient browser can be used instead of the RIS worklist.
- The PACS can receive images from modalities without any restriction. Patients and studies are manually entered at the modalities.
- The PACS stores notifications about performed procedures and available images in the cache. The notifications can therefore be sent to the RIS, as soon as the connection has been re-established.

After restore

- The RIS interface in *syngo* Imaging sends the “stuck” study data to the RIS.
- All examinations performed during RIS failure must be input in the RIS and billed at a later date.
- The images from the PACS must be manually assigned to the studies in the RIS.
- All inconsistencies / exceptions must be manually rectified in the RIS (RIS exception treatment).
- Reports that were generated offline must be input in the RIS.

Interrupted RIS-modality connection

- Input of patient data and examination planning are possible without any restriction.
- At the modality, patient data input and study selection must be performed manually.
  However, the correction of errors during manual data input at the modality requires a considerable amount of efforts.
- The reporting flow is not affected by the failure.

Interrupted RIS-PACS connection

HIS, RIS, and PACS are still available. Input of patient data and examination planning are possible without any restriction. Worklists can be prepared and retrieved at the modalities. Examinations can be performed and images can be sent to the PACS at the modalities.

Interrupted RIS-PACS connection

- The PACS does not receive any information about scheduled examinations.
- Patient and study data are no longer updated in the PACS.
- The RIS is not notified about the images available in the PACS.
  It is not possible to open these images from the RIS client.
  They can, however, be opened and reported using the PACS worklist.

After restore

As soon as the connection between the RIS and the PACS has been re-established, the information generated in the RIS is automatically sent to the PACS.

PACS failure

The HIS and RIS functionalities are not affected by failure of the PACS. Input of patient data and examination planning are possible without any restriction. Worklists can be prepared by the RIS and retrieved at the modalities.

PACS failure

- Images can no longer be received and stored in the PACS
- Reporting in the PACS is not possible
- No access to prior studies

Workaround

- At the modality: reporting images or filming images directly at the modality
- Perform reporting in the RIS, based on film sheets

After restore

- At the modality: send images manually to the PACS
- The PACS automatically informs the RIS about “forwarded” images
- Images are automatically assigned to the relevant study data in the RIS

Note

PACS failure is extremely unlikely in cluster configurations (“high availability”). If just one PACS workplace fails, all activities can be continued at other suitable workplaces. Failure of an individual workplace has no impact on other system components.

LTS failure

For *syngo* Imaging, failure of the LTS has the same effect as an interrupted connection to the LTS. Archiving and prefetching are not possible. The data stored on STS is available.

The RIS functionality is still available and is not affected by failure of the LTS.

After restore

Images not archived during the failure are automatically transferred to the LTS.

Network failure

In the event of failure of the network or parts, the components in the failed parts are not available.

Patients can be registered and then examined at the modality. If a DICOM camera is directly connected, the images can be output on film sheets and reported offline.

After restore

The same rework is required as after component failure.

Disaster recovery

The following procedure is recommended to restore the system as quickly as possible in case of an emergency (e.g. complete destruction of one or several servers)

- In addition to daily automatic backup, a backup (image) should be generated and written to a separate DVD after installation or after an upgrade or update. The necessary software, including a portable DVD writer drive, is supplied with the product.

  Importing the backup makes the more time-intensive manual installation of the operating system unnecessary. The last backup is then saved again so that the status of the last backup can be restored any time in the event of disaster.

- To restore clients that were installed on existing computers as software-only, just the client software needs to be installed again. The individual client settings need not be restored because this data is stored on the servers.

- For clients supplied complete with hardware (*syngo* Studio Advanced), a backup is performed by Siemens Customer Service after startup. In the event of a disaster, such a reporting workplace can very quickly be restored by importing the backup. Individual settings are stored on the servers, as for the software-only clients.

Impact of third-party software on availability

Detailed knowledge and validation of all software components used on the servers and client workplaces are vital aspects for ensuring availability.

On principle, the use of third-party software components is always subject to the Medical Device Act, which obliges the manufacturer (Siemens) to only permit software, that has been tested for compatibility with the product.

This also applies to the use of software developed by the customer, e.g. for constancy testing.

How to proceed

The following steps are required to ensure system availability and conformance with the Medical Device Act:

- The third-party software manufacturer prepares a validation specification. It specifies which software should be used (detailed product and version designation) and which essential tasks it should perform (e.g. read access to the system, required ports, etc.).
- Based on the validation specification, Siemens prepares an impact analysis which describes potential impact of the third-party software on the product and defines a list of tests to be performed at the customer site prior to release.
- After the tests on the customer systems have been successfully completed, the software is released by Siemens.

This procedure can be applied to any other third-party software intended to be run on the servers or client workplaces. It also applies to updates of the third-party software with a new version.

Validation can be performed on a test and demonstration system, if available.

System monitoring

To ensure the functionality of *syngo* Imaging, the system is automatically monitored. The administrator checks the system status and any error messages on a daily basis.

syngo Imaging servers are equipped with an internal watchdog. The watchdog monitors all services, processes, and system resources (e.g. capacity utilization of partitions and databases) that are required to ensure availability of a server component.

The system monitoring activities and results are displayed via the Admin GUI of the *syngo* Operation Manager. The administrator can check the status of all important processes and the system messages and intervene, if necessary.

Monitoring of the system resources is staggered. Exceeding of a first threshold will generate warnings and exceeding of a second threshold will generate error messages. Even when the second threshold is reached, there usually is still sufficient time left for corrective action by the administrator or Siemens Customer Service.

Functions for system monitoring

Status check

- Check the SDM and OPM process status
- Stop and restart processes
- Document the current system status in a snapshot and make it available to Siemens Remote Service

Message check

- Central storage of the system messages of all workplaces in the OPM
- Precise characterization and classification of the messages
- Display of messages in the “Message Viewer”
- Filtering of messages in the “Message Viewer”
- Marking of critical messages for forwarding to Siemens Remote Service
- Display and export of user actions (audit trail)

Interface to existing monitoring systems

If the hospital already has a monitoring infrastructure into which *syngo* Imaging is to be integrated, management agents can be installed on the servers. These are able to analyze certain log files.

The most important system statuses are saved in an LDAP directory on the PACS servers. If the management agent is able to read information from LDAP, this information can be transferred to the existing management system.

Software distribution

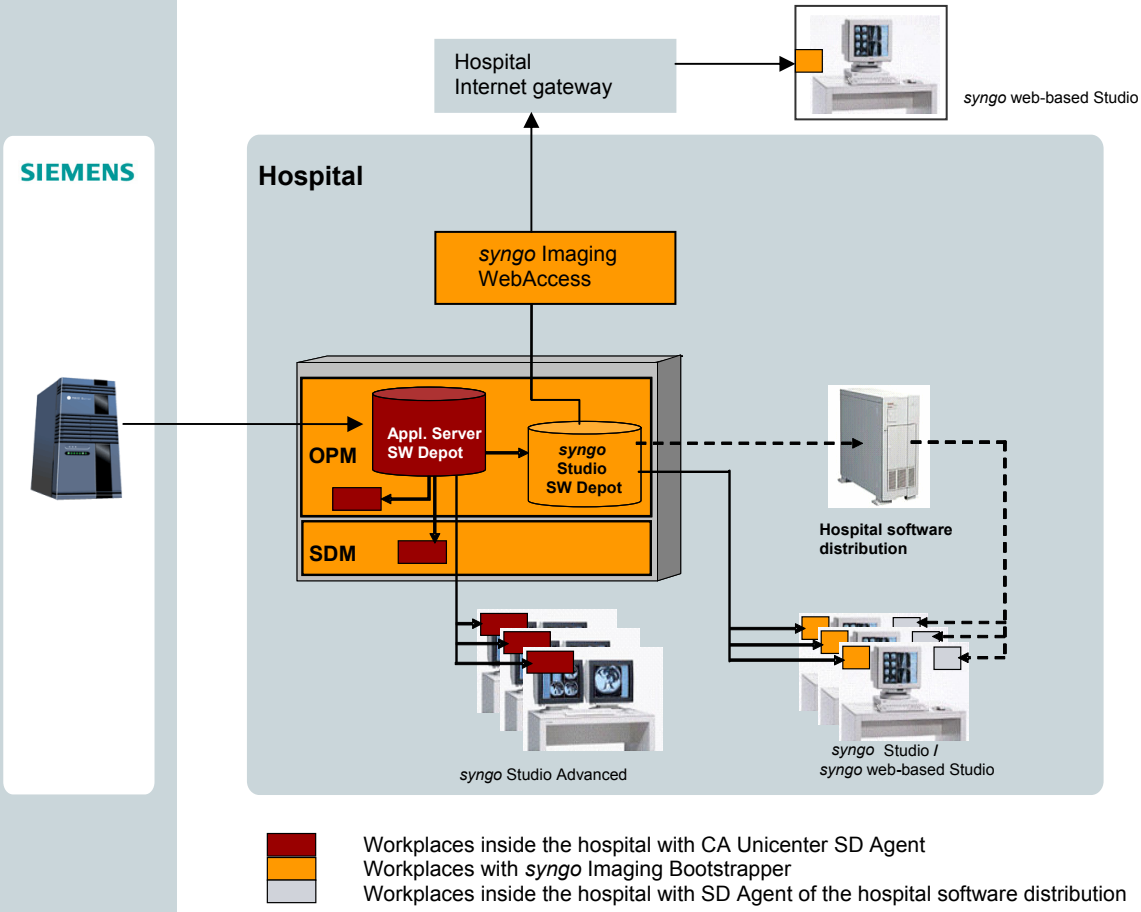
This section provides an overview of the various methods available for distributing the *syngo* Imaging software to the workplaces.
This includes software installation packages, updates, and patches.

Overview

New software versions for *syngo* Imaging servers are distributed via the Appliance Server or manually installed from CD/DVD.

There are several methods for distributing new software versions for the *syngo* Imaging workplaces.

The overview below shows the different options of software distribution.



Workplaces inside the hospital with CA Unicenter SD Agent
Workplaces with *syngo* Imaging Bootstrapper
Workplaces inside the hospital with SD Agent of the hospital software distribution

Appliance Server

The CA Unicenter Appliance Server is installed on the OPM server. It receives and stores new software packages from Siemens Remote Service. As soon as a new software package including documentation (release notes and installation instructions) arrives, the PACS administrator is informed by e-mail.

New software packages for *syngo* Studio workplaces are transferred from the Appliance Server to the *syngo* Studio software depot. The arrival of new software packages is displayed in the GUI of the CA Unicenter Appliance Server.

Distribution for SDM, OPM, and syngo Studio Advanced workplaces

New software packages for the servers (SDM and OPM) and for *syngo* Studio Advanced workplaces are distributed using the CA Unicenter software.

Features of the CA Unicenter software include:

- Graphical user interface for managing the software distribution process
- Central scheduling of the software deployment
- Logging of the deployment progress (success or failure messages)
- Inventory showing which clients run which software versions

Distribution for *syngo* Studio workplaces

Automatic software distribution through the *syngo* Imaging Bootstrapper can be used for *syngo* Studio workplaces.

The Bootstrapper is a module of the *syngo* Studio workplaces and allows software installation and update without administrator privileges.

Workplaces outside the hospital

syngo Studio workplaces outside the hospital can access the *syngo* Imaging WebAccess server via the Internet gateway of the hospital. The software is distributed through the *syngo* Imaging Bootstrapper – same as the workplaces inside the hospital.

User perspective

Installing the software

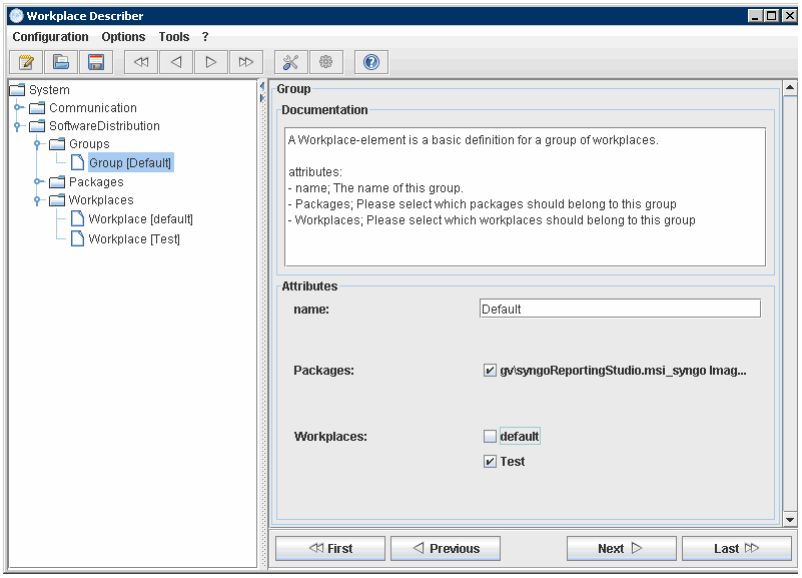
- Start the Internet Explorer and enter a specific URL
- Click the link on the installation page to start the installation
- Double-click the *syngo* Imaging program icon on the desktop to start the software

Software update

- Whenever *syngo* Imaging is started, the OPM software depot is automatically queried for new updates or upgrades.
- If new updates are available and released for the current workplace by the administrator, the installation is automatically started after the start of *syngo* Imaging.

Administrator perspective

A specific GUI, the *syngo* Studio Update Manager, is available to the administrator for managing and monitoring the installations.



To test new software packages, the administrator can set up test workplaces and enable the software for these workplaces.

After the test has been successfully completed, the administrator selects the software packages to be released for installation at defined workplaces.

Distribution using existing distribution methods

New software packages for *syngo* Studio workplaces can also be distributed using already existing distribution methods.

Any software distribution service is supported that can process MSI files as sources.

The new software packages are exported from the software depot to the hospital software distribution system and distributed from there to the workplaces.

System migration from Magic to *syngo*

Migration as described in this chapter must be thought of as the transition of a SIENET Magic system to *syngo* Imaging.

Migrating is a complex task requiring extensive preparation and, in many cases, specific technical solutions for each customer and each project.

Independently of the different requirements and objectives, each migration project completes defined phases and milestones as shown in the migration process.

This chapter describes the migration options with version V30A and provides an outlook on migration with version V30B.

Migration process

The phases to be completed by each migration project are:

Questionnaire

Questionnaires are completed at the start of a migration project to obtain information on the “old” system and the data volume.

SOW

The “Statement of Work” is prepared and signed by the customer at the end of the quotation phase. This document includes all relevant tasks, roles, and responsibilities.

Plan

After the contract has been signed, a detailed resource and project plan is prepared based on the migration concept and the SOW.

This may be followed by an update of the Magic software and migration of the storage media.

RIS migration

Depending on the starting situation, a new RIS system is installed or an existing RIS system is migrated.

Cleanup

Data cleanup is necessary due to the tight linkage of RIS and PACS. The identifiers for identifying patients and examinations must be the same in the RIS and the PACS to allow quick user access to images.

Test

The *syngo* software is installed, integrated, and tested prior to the actual migration.

Training

Users and administrators are trained prior to migration.

Interfaces

Based on an analysis, existing interfaces to external systems are replaced and adapted to *syngo* Imaging.

Customizing

The following settings are specifically adapted to customers and projects: IDs for identifying patients and examinations, rules for newly arriving DICOM objects, allocation of the reporting status, image order, and many more.

Test

This test is performed to check whether data cleanup and customizing were completed correctly. Special attention is paid to the format of the patient name, correct image display, and correct allocation of examinations between PACS and RIS.

PACS migration

You can choose between two migration methods depending on your Magic version and the data volume.

Successful migration and post-processing are documented in the migration report.

Migration procedures

The following procedures will in the future be available for migration from Magic to *syngo*:

- DICOM Migration
- Magic Compatibility Module (MCM)[1]
- Combination of DICOM Migration and MCM

DICOM Migration

In the case of DICOM migration, the images are transferred by DICOM protocol (C-Store) from the PACS source archive to the PACS target archive. The migration is controlled and monitored by the migration controller. The migration controller is a software module that is installed on a separate PC.

The Migration Controller is web-based and accessible via Siemens Remote Services. The migration plans can be scheduled flexibly according to individual needs of the customer.

User interface features

Web interface	You can log in from any PC in your facility using a web browser.
Controlling	You can control the status of every study to be transferred. Migration processes can be stopped, paused, or restarted.
Scheduling	Migration processes can be scheduled taking into account maintenance and downtimes.
Searching	The migration database can be searched for various parameters (e.g. patient name, case number and examination date).
Priority	The migration can be given priorities at examination level.
Errors	Errors during the migration are logged in log files.
Statistics	Statistical data regarding the migration can be retrieved and further processed, if required.
Prefetching	Prefetching of prior examinations is supported. The RIS is queried for scheduled patients, who then get the highest priority in the send queue. The query must be customized for a specific RIS.

[1] From V30B onwards

Scenarios for DICOM Migration

- Customers with SIENET Magic V22/V33
- Customers with third-party PACS
- Customers with SIENET Magic, where use of the MCM is unfavorable because:
  - MCM may require media migration. This may require great efforts for large data volumes.
  - MCM will be available from version V30B onwards.

Magic Compatibility Module (MCM)

Unlike DICOM Migration, MCM does not migrate the images, but merely “adapts” the database to the new system.

The images remain archived in the LTS of SIENET MagicStore.

In conjunction with MCM, we speak of transition instead of migration.

Transition takes place in four steps:

1. Database adaptation with the DB Upload Tool
   The patient and examination data are inserted from the MagicStore database into the *syngo* Imaging database.
2. The STS of *syngo* Imaging is “filled” with images from the LTS of MagicStore.
3. The images archived in the LTS by SIENET MagicStore can be accessed via MCM.
4. RIS update: database extraction and import into the RIS.

Scenarios for MCM

- Customers with SIENET Magic V50
  Customers with SIENET Magic V42 upgrade to version V50 and then use MCM
- Customers with SIENET Magic, for whom the use of DICOM Migration is unfavorable, since it is very time-consuming.

Note

If SIENET Magic V42/V50 was used for LTS with the DAS jukeboxes, media migration must be performed before system migration. The DAS archive media are converted to an HSM system.

Combination of DICOM Migration and MCM tool

A migration project can be started with DICOM Migration and continue with MCM, as soon as this tool is available.

Media migration

If system migration was performed using the MCM, migration of the archive media is required for jukeboxes that are not part of an HSM system.

A special tool is available for this purpose.

This tool transfers the images stored on the DAS jukeboxes (for example MOD/CD) to a Hierarchical Storage Management system.

The Professional Service Team is responsible for media migration. The media migration is performed in the background. Routine operation is hardly affected by this.

Functions

- Graphical user interface
- The migration order can be defined by Procedure Date, Media ID, Type of Modality or other criteria
- Migration can be started according to a defined time schedule
- Assignment of priorities for migration
  The same rules can be applied for prefetching.

Fast media migration

“Fast media migration” is a special case of media migration. It is used to transfer archive media from a NAS archive (for example NAS-attached jukebox) to an HSM archive.

The migration tool used is the same as that used for simple media migration. This migration process is much faster than migration from DAS archive media.

Project sequence and services

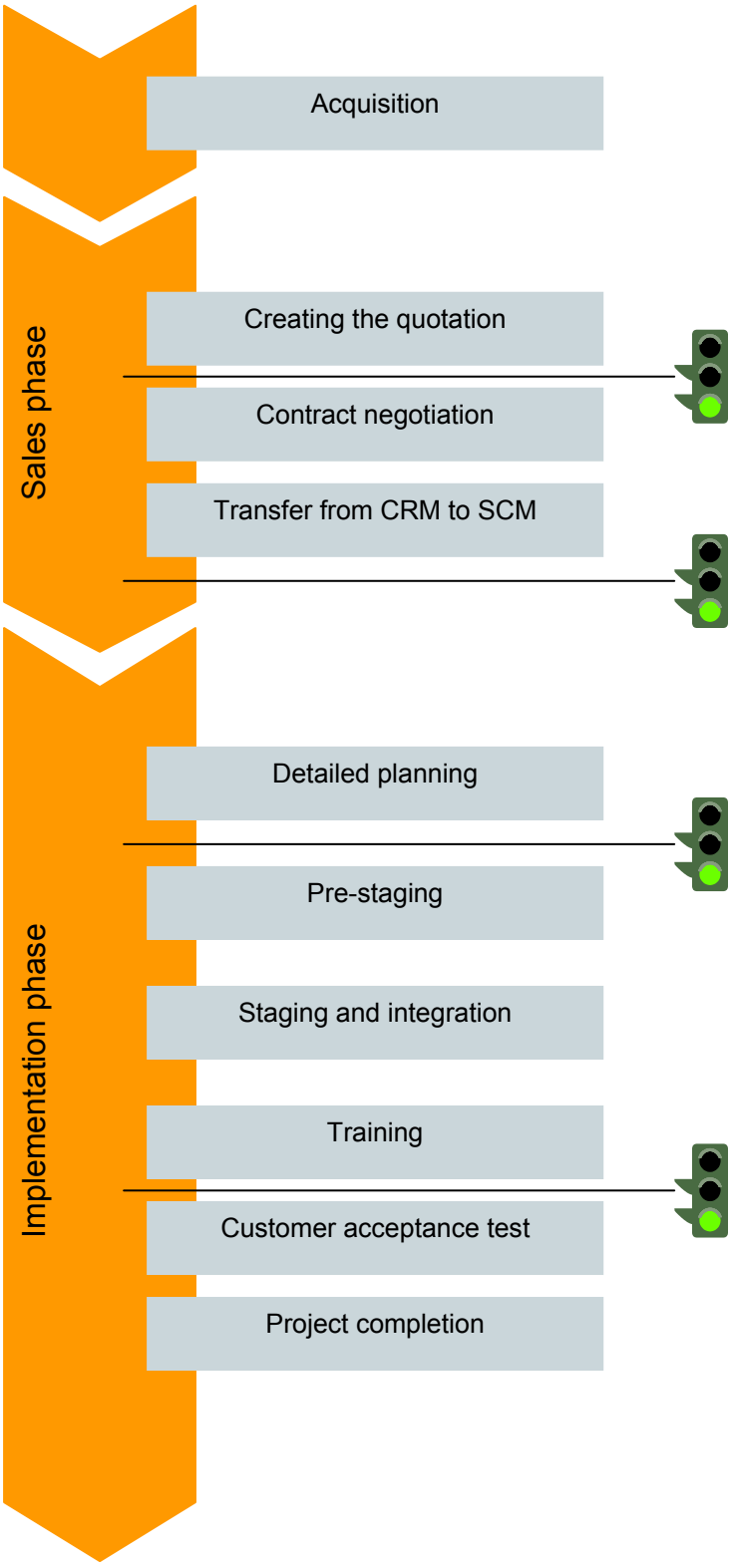
Each *syngo* Imaging project is processed according to a standardized procedure with defined project stages and milestones.

Quality gates are implemented at decisive stages in the course of the project to make the achieved project status transparent, allow intervention in the project sequence with appropriate action, and assure the success of the project.

After major project stages have been reached, tests are performed to assure the quality of the previous activities and document deviations or necessary corrective actions.

Project sequence

Within a project there are three main phases: the acquisition (business development) phase, the sales phase, and the implementation phase.



Sales phase

Creating the quotation

The sales phase is focused on creating the customer quotation.
The prerequisite for this is that the tendering documents have been responded to. Moreover, the interfaces and the workflow are analyzed and documented in many cases.

The customer quotation is composed of partial quotations for the software, hardware, and services.

The quotation includes a rough time schedule.

Furthermore, all site-specific prerequisites are listed, for which the customer is responsible.

Transfer from CRM to SCM

All information and documents required for the implementation of the project (description of the hardware solution, Statement of Work, site-specific solutions, service agreements, training concepts, etc.) are handed over to the project manager.

Thus, the responsibility for the project passes from CRM (Customer Relationship Management) to SCM (Supply Chain Management).

Implementation phase

Detailed planning

After the order reception, the project manager develops the detailed implementation plan. The documents prepared in this process are:

- Detailed time schedule and resource plan
- Description of the current project status
- Project calculation
- Description of the workflow
- Questionnaire for user training
- Plan for the management of site-specific risks

Pre-staging

As part of the pre-staging, the hardware components are prepared and combined, if necessary, at Siemens:

- Ordering of the hardware components
- Configuration of the hardware components according to customer specifications
- Installation and configuration of the operating systems and the *syngo* software
- Setup of the storage systems (STS and LTS)
- Installation and configuration of the *syngo* workplaces, if the hardware is purchased through Siemens

- Preparation of the network connection and interfaces
- If the “High availability” option is to be included in the system: Installation of the Veritas cluster software
- Performing the factory acceptance test.

Delivery to the customer takes place after the test has been successfully completed.

Staging and integration

All delivered components are installed at the customer site and integrated into the customer environment. This includes the following services:

- Installation and implementation of the components
  Integration into the customer's network
  Integration into existing IT systems (RIS, PACS)
  Connection of the existing modalities

  These steps are checked in the final acceptance test.
- Preparation of the operational management concept
  (documentation of the regular tasks of the IT administrator)
- Preparation of the concept for fail-safety
  Test of interfaces depending on the implemented workflow

Training

After the final acceptance test has been successfully completed, the administrators and users are trained directly on the system. Type and scope of the training are defined in the quotation.

Customer-acceptance test

This last test is performed by the customer prior to the handover of the system.

Project completion

The project is completed when Siemens declares the system ready for operation and the customer has signed the customer acceptance test.

Where necessary, a list of open issues is compiled and signed by both contracting parties.

Siemens UPTIME Service takes over further service of the system.

Training

A training concept tailored to the specific customer requirements is created for each project.

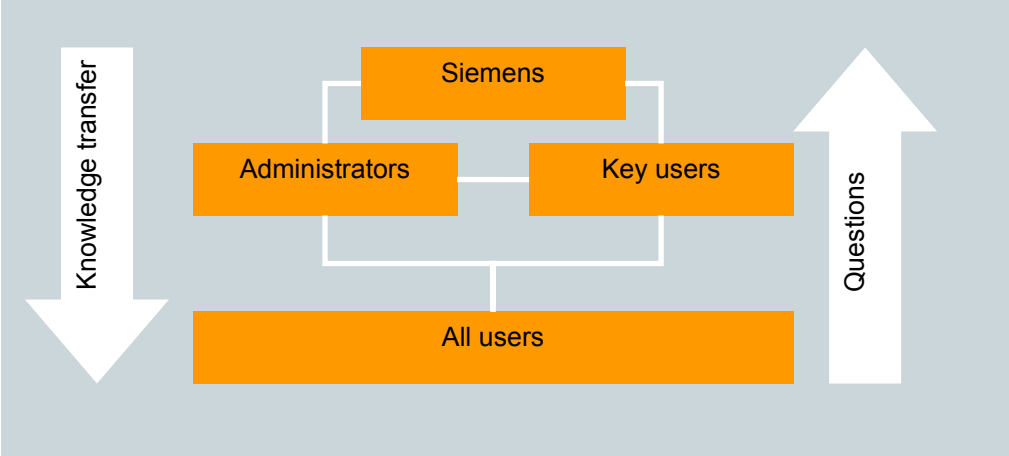
As a rule, administrator training takes place at the Siemens Training Center, whereas user training is mostly held on site.

We recommend training based on the “Train the trainer” concept. This means that Siemens trains the so-called key users who pass their knowledge on to all users on site.

“Train the Trainer” concept

Instead of training *all* end users, suitable representatives of each typical user group, the key users, are selected and trained by Siemens.

The key users pass their knowledge on to all colleagues within their user group. Typical user groups in syngo Imaging are radiologists, referring physicians and technicians.



The advantages of the “Train the trainer” concept versus training *all* users are:

- This method is more cost-effective and less time-consuming.
- Key users can also act as trainers during follow-up training.
- Know-how is accumulated within the department. Problems can be solved and new colleagues can be familiarized with the system without external assistance.

Training for administrators

Administrator training takes place mostly in the early implementation phase. The training schedule is defined in the project plan on consultation with the customer.

The training work is focused on clinical administrators and IT administrators. Separate training is held for both user groups.

Training for clinical administrators

The course is intended for application specialists responsible for all PACS and post-processing issues at the integrated workplace.

Requirements

- Good command of the English language
- Basic PC skills
- Technical radiological knowledge and knowledge of the clinical environment
- Overview of all imaging systems and applications

Contents

Administration:

- Charting of the clinical workflows
- User account administration, role assignment
- System settings (language, image forwarding, etc.)
- F-key assignment, image text configuration and browser configuration
- Multi-monitor configuration, evaluation of log files
- Consistency check of the data flow from modalities (e.g. DICOM Worklist)

Application:

- Detailed knowledge of the *syngo* Imaging application
- Adjustment of the “Intelligent layout” and adjustment of the film layout
- Configuration of tool palettes
- Search for prior studies
- Training concepts for selected users (key users)

Training for IT administrators

This course is intended for administrators familiar with the PACS workflow. IT administrators are the “classic” experts regarding networks, operating systems, and user administration. They attend to data security and backup, version management, and system monitoring.

Requirements

- Good command of the English language
- IT infrastructure (domain administration, DNS)
- User administration (MS Active Directory)
- Operating systems (MS or Linux) including basic knowledge of operating system checks, script level, data editing (notepad, vi)
- Basic knowledge of storage/backup management
- Knowledge of the clinical workflow

Contents

Administration:

- Backup management (control, implementation and adjustment)
- Restore concepts
- LTS management in *syngo* Imaging
- Software distribution
- Interfaces (HIS and billing system)

Workplace administration:

- User administration (user accounts and role assignment)
- DICOM configurations in *syngo* Imaging
- Handling of log files and system messages

Initial support and troubleshooting:

- System status control (SW/HW testing processes)
- Access control (Siemens Remote Service)
- Adjustment of clinical workflows in the system
- Integration into the clinical IT environment (DNS, NTP)

Training: optimizing Windows XP in the medical network

This course is intended for technically inclined physicians, technicians, and service engineers who want to optimize their workflows. The objective of the course is to convey a deeper understanding of the Windows XP functions in the medical network.

Contents

- Windows XP in general: installation, backup, generation of identical system images, Windows Security
- Network basics: TCP/IP, data communication, VPN
- Microsoft domain concepts: domain structure, Windows XP and Active Directory, Group Policy Management
- Windows XP and *syngo*: Basics of *syngo*, integration of XP/*syngo* into Active Directory domains
  configuration of Internet Information Services (IIS) for *syngo*
  IPsec, Windows Firewall
- Interoperability of Windows and Linux with Samba
  Integration of Samba servers into Active Directory domains
- DICOM basics: connectivity and interoperability, basics regarding DICOM header information
- HL7 basics: message structure and IHE workflow

Training for key users

As a rule, key users are trained at the customer site. The duration and scope of the training are tailored to each specific project. The training includes all basic functions, routine applications, examination techniques, and evaluation functions.

The key users' tasks are:

- Training of colleagues
- Acting as initial contact for questions and problems in daily routine
- Supporting, or acting as a substitute for, the system administrator
- Data maintenance at registration level and/or worklist level
- Problem analysis (log book, network monitoring via Job Control)

Maintenance contract

A software maintenance contract is concluded for each *syngo* Imaging system. This contract guarantees the customer the delivery of software updates and upgrades and support through the Call Center.

Glossary

AD	Active Directory Microsoft implementation of an X.500 directory service that stores information about a network's resources. In the case of *syngo* Imaging, the AD is used for user administration.
ADT	Admission, Discharge, Transfer of a patient Actions performed in every hospital. Patient data is usually collected in a HIS or RIS but must be communicated to all subsystems concerned.
DAS	Directly Attached Storage The simplest form of DAS is a hard disk in a computer. In conjunction with servers, it is equivalent, for example, to a hard disk system with RAID protection. For communication between server and DAS, the SCSI protocol is usually used.
DICOM	Digital Imaging and Communication in Medicine DICOM is a worldwide standard for exchanging patient images and data. It enables the exchange of images and data between heterogeneous information systems and various imaging and image producing and processing devices (modalities).
EPR	Electronic Patient Record An electronic patient record is a "paperless" medical record. It is an electronic set of information about a single patient containing the record of medical care provided mainly by one facility.
GPPPS	General Purpose Performed Procedure Step (DICOM)
GPSPS	General Purpose Scheduled Procedure Step (DICOM)
GPWL	General Purpose Worklist (DICOM) GPWL provides the worklist based on the RIS database of a patient's current and prior studies.
GUI	Graphical User Interface
HIPAA	Health Insurance Portability and Accountability Act HIPAA is a law concerning privacy, integrity, and consistency of patient data in healthcare. It applies in the USA.
HL7	Health Level 7 A standard for the exchange, management, and integration of electronic healthcare information.
HL7 ORM	HL7 Order Message
HL7 ORU	HL7 Result Message

HSM

Hierarchical Storage Management
Hierarchical Storage Management provides functions and strategies for storing and archiving data between or within various storage hierarchies (e.g. long-term and short-term storage) and storage media (e.g. RAID, tape).
Data transmission can be via a LAN or SAN network.

IHE

Integrating the Healthcare Enterprise
Initiative is taken by users and companies to achieve maximum interoperability of the digital information systems used in health services. The basis are integration profiles that are based on the working procedures actually followed in radiology.
You will find further information about IHE on the Internet (visit www.ihe.net).

JPEG

Joint Photographics Expert Group
Standardization group for the coding and compression of grayscale and color images. JPEG is a graphics format that enables up to 20-fold compression of individual images. The names of files in JPEG format usually have the extension ".JPG".

iMaxcess

iMaxcess means: "Image Access at its Maximum"
It is a fast transmission protocol that enables a *syngo* Imaging workplace to retrieve and send images to/from the SDM much faster than via a standard DICOM transfer. Communication with all DICOM-based modalities takes place at the usual speed.

LAN

Local Area Network
Network of PCs and workplaces that is usually restricted to one building. Several LANs can be interconnected to form a Wide Area Network (WAN).

LDAP

Lightweight Directory Access Protocol
A simple protocol for access to X.500 directory services, such as Microsoft Active Directory (MS AD).

LTS

Long Term Storage
A device used for long-term storage or archiving of radiological images. Tape libraries or jukeboxes are used in many cases.

LUN

Logical Unit Number
In terms of computerized data storage, a logical unit number (or LUN) is an address for an individual disk drive and by extension the disk device itself.

MP

Megapixel
Abbreviations for the resolution of monitors:

1.3 MP	1280 × 1024 pixel
2 MP	1600 × 1200 pixel
3 MP	1536 × 2048 pixel
5 MP	2048 × 2560 pixel

MIP

Maximum Intensity Projection .
Procedure for 3D image data processing. In the selected view through the volume, elements with the greatest intensity are determined and projected onto a surface irrespective of whether they are at the front or further back in the stack.

Mount Point

Ein Mount Point (/mnt) is the point within a directory structure at which a data medium or a file system from the network is mounted.

MPPS

Modality Performed Procedure Step (DICOM).

MPR

Multi-Planar Reconstruction
Procedure for 3D image data processing. New sectional images in random orientation are generated based on two-dimensional sectional images.

NAS

Network Attached Storage
NAS provides storage capacity for clients in the network. NAS systems are available for various operating systems and hard disk units.

OPM

syngo Operation Manager
syngo Imaging server for central services such as administration, monitoring, and licensing.

ORM

See HL7 ORM.

PACS

Picture Archiving and Communication System.
A system comprising of several components for digital storage, distribution, and display of images.

RAID

Redundant Array of Independent Disks.
A system that stores data redundantly on more than one hard disk. RAID systems always consist of more than one hard disk and can be configured to enhance both system performance and data security.

RIS

Radiology Information System
An administration system for the radiology department, which takes care of patient administration, documentation, acknowledgment of services, and the writing of reports (e.g. *syngo* Workflow).

RöV	German X-ray ordinance (“**Rö**ntgen**v**erordnung”) Ordinance concerning the protection against damage due to X-ray radiation.
SAN	Storage Area Network Networking of the server and storage devices (e.g. RAID or tape libraries) to form a high-performance network. All SAN components are connected with one another via Fiber Channel (FC). The SAN can be administered centrally and is extendable. The storage systems are connected directly to the SAN so that data backup can be performed independently of the LAN.
SC	Secondary Captured DICOM format for images which are generated as the result of post-processing (e.g. MPR).
SCP	Service Class Provider
SCSI	Small Computer Systems Interface SCSI is a standardized parallel interface for data transmission between devices on a computer bus.
SDM	*syngo* Data Manager A central component of the *syngo* Imaging server system used for image management and storage/archiving.
SSD	Shaded Surface Display A procedure for 3D image data surface reconstruction.
SLPA	Single Login Point Application The users log in at the system only once and can use several application programs.
STS	Short-Term Storage STS is based on storage technologies and connections that allow fast access to image data. Typically, a RAID system, which is connected to the server using a fiber channel, is used as an STS.
URL	Uniform Resource Locator An address of the format http://www.siemens.com/syngo-suite. It is used to direct the web browser to a specific page in the Internet.
UPS	Uninterruptible Power Supply A UPS backs up the power supply for a certain amount of time in the event of a power failure. This time should be used to shut down the computer properly to avoid loss of data.
VPN	Virtual Private Network An encrypted data connection via a public communication network.
VRT	Volume-Rendering-Technik Procedure for the display of 3D image data. Three-dimensional display of various types of tissue is achieved using effects such as transparency, shading, and color.
WAN	Wide Area Network A network that extends beyond one building, for example to link different sites via a leased line.

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