SIEMENS

DICOM

Planning Guide

English

Chapter	Page	Revision
all	all	01
all	all	02

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Contents

Structure of the DICOM Planning Guide

- Among other things, this Chapter 1 '**General Remarks**' describes the intention and restrictions of this Planning Guide.
- Chapter 2 '**DICOM Basics**' provides a brief introduction to DICOM, at least in terms of the topics that are required for the PM, as well as an overview of he most important configuration parameters.
- Chapter 3 '**DICOM Project Description**' defines the areas of responsibility in the various project phases. It provides a brief overview of the most important tasks of Sales, the Project Manager and of Service.
- In Chapter 4 '**Sources of Information and Contact Persons**' you will find corresponding information.
- Chapter 5 '**DICOM Test**' provides an overview of the tests that must be performed and the time required for them, including a calculation example.
- Chapter 6 '**Interoperability Database and Acquisition Tool**' presents the database and the corresponding DICOM Acquisition Tool.

Acronyms and Abbreviations

ACR-NEMA	American College of Radiology - National Electrical Manufacturers' Association
Connectivity	Standardized transmission of messages and objects
DICOM	Digital Imaging & Communication in Medicine
HIS	Hospital Information System
Interoperability	Functionality of the application, such as viewing, postprocessing
IHE	Integrating the Healthcare Enterprise -> initiative to define the clinical workflow based on standards like DICOM and HL7
IP	Internet Protocol
PACS	Picture Archiving and Communication Systems
PG	Planning Guide
PM	Project Manager
RIS	Radiology Information System
SOP Class	Service Object Pair Class - Definition of objects (images, reports)
TCP/IP	Transmission Control Protocol/Internet Protocol

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TDIT-000.891.02
Rev. 02   01.03

Page 1 of 2
CS SD1 / PS3

DICOM

Scope of the DICOM Planning Guide

The intention of this DICOM PG is to provide the Project Manager with guidelines to network medical products with each other using DICOM services (Digital Imaging and Communications in Medicine). In this regard, the entire process is described from acquisition to startup.

This PG should be used when
  - Products are to be networked with each other as a result of a **new project.**
  - **Products that are already in operation** are to be networked at a later time.
  - **Software updates** are to be performed on products.

This PG is intended mainly for networking projects where one or more Modalities are integrated into a customer environment.

It is not intended for big networking projects that are performed by HS (Health Services). Since this is an **extensive installation**, e.g. because adaptations between the RIS and the PACS are necessary or workflow settings need to be made, **this PG is not adequate**. In this instance, it is recommended that planning be performed by the local HS PM. The tasks of the HS PM are more comprehensive than the tasks described here, but they include all tasks described here.

Performing the networking procedure according to the requirements of this PG not only creates a professional impression with the customer, but also avoids a lot of unnecessary wasted time and costs.

Note:

Networking of medical products **should be treated as an autonomous project**. It is independent of other planning for a product. It is also irrelevant whether it is a new installation, a network expansion or a software update.

The **time and costs required for network planning**, for installation and for the required tests **absolutely must be taken into consideration by Sales** and calculated into the project. These are often significant. In the chapter 'DICOM Project Description', this subject will be discussed in more detail.

Note:

A Project Manager usually does not possess sufficient competence to perform networking via DICOM without **additional service providers** such as, e.g. network specialists. In the chapter 'DICOM Project Description', references to this are made at the appropriate places.

Training

Basic knowledge of networking and DICOM is prerequisite for every **Project Manager and Sales Engineer**, because almost all medial products are networked.

Since the topic of networking is far too comprehensive and is constantly expanding, the PM requires the support of **network specialists** for many projects

The CS Training Center provides training for both target groups.

Description of DICOM Services

DICOM (Digital Imaging and Communications in Medicine) is a globally acknowledged standard for digital communication from image generating systems in medical technology.

This DICOM standard has been continuously expanded since 1993; at this time there are 21 active "Working Groups" comprised of members in the industry and users who define new supplements (up to this time, 79 supplements) and add them to the standard.

DICOM assures the exchange of data (connectivity), but has no effect on the applications that the transferred data use. The ability to use the transferred data is referred to as interoperability, and includes such routines as image post-processing.

Every product requires a Conformance Statement, in which the extent of DICOM support is described.

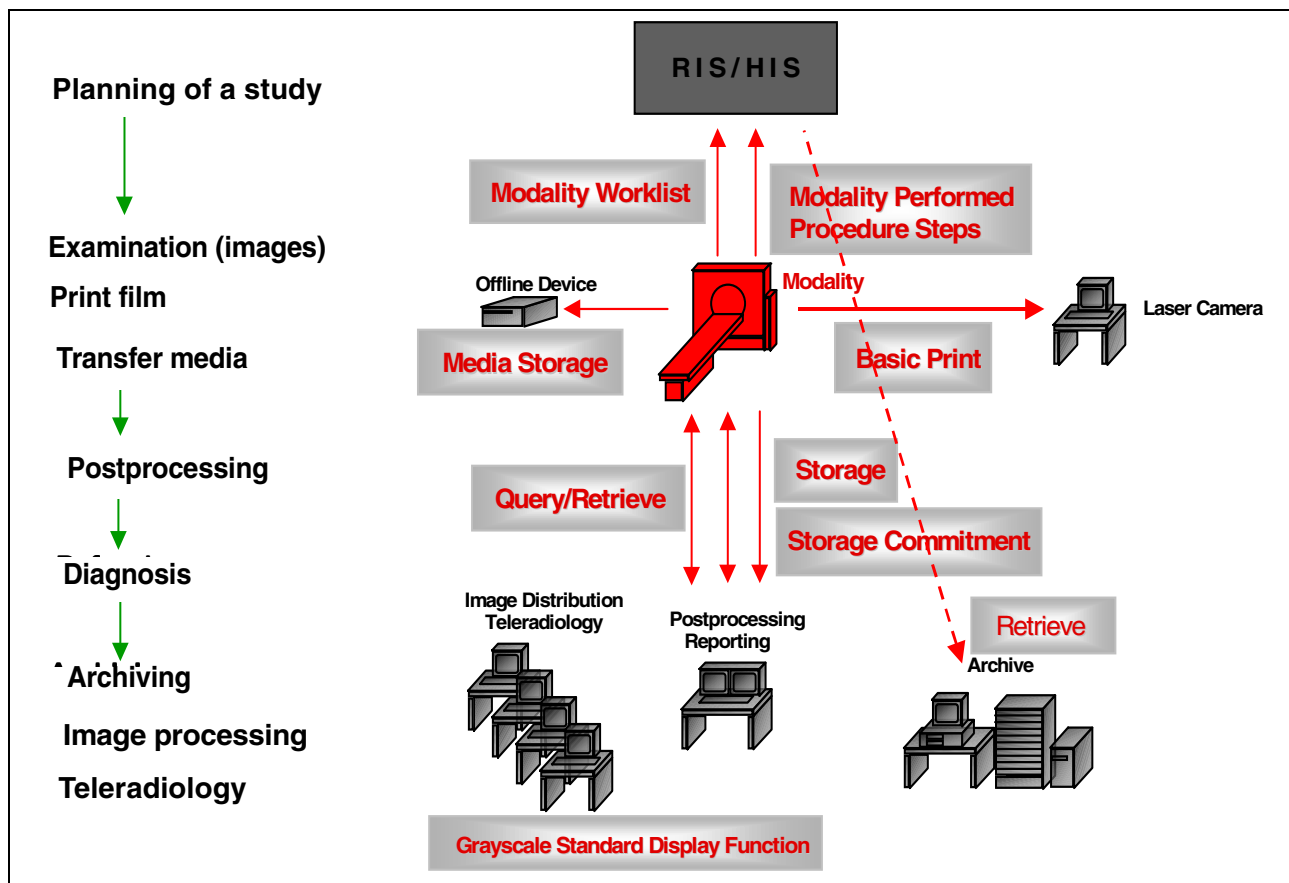## Overview Diagram

Radiological workflow based on DICOM services

Fig. 1

The DICOM services that are currently implemented in Siemens products are described briefly below.

Storage

Defined objects (images, reports, LUTs, ...) are transferred using this service. At this time, approx. 50 objects are defined (CT, MR, AX, structured reports, presentation state objects, ECG waveforms, ...). For every object, it is specified which attributes (fields) must be present, which syntax (value representation) these attributes must have and also often what content these attributes must have. In DICOM, this is referred to as the SOP Class Definition (Service Object Pair). A problem with DICOM is that too many attributes are optional, i.e., they do not have to be present.

Storage Commitment

Following transfer of objects to the storage service, a check can be performed using the Service Storage Commitment to determine whether the objects were successfully accepted by the destination product, in other words, whether the destination product accepts responsibility for these objects. For this, a list of object identifiers (UIDs) are transferred and there is a wait for a confirmation. Generally, this commitment is a trigger that the objects may be deleted in the transmission product.

Query / Retrieve

With this service, the contents of the database in a destination device can be inquired (Query). DICOM permits this query on several levels (hierarchically from the patient to the study, series to object level) or the relational query, with which any attribute can be queried. Using Retrieve, a request can be sent to the destination device to transfer selected objects using Query. The transfer then takes place via the storage service.

Basic Print

With this service, images are printed out, primarily on a laser camera. This takes place via the network and no longer over serial/parallel interfaces.

Modality Worklist

Here, a modality (image generating system) asks an information system (generally an RIS) for planned examinations. This can be d one automatically (polling) or manually from the user interface. The data from RIS are entered into the scheduler database with Syngo and are accepted into the registration platform.

Modality Performed Procedure Steps (MPPS)

With this service, relevant data are returned to the RIS during and after every examination. These are data that are required in the RIS for billing or for administrative purposes, such as completed examinations, time requirement, film use, dose values and a list of generated objects.

Media Storage

The formats and media for data exchange via offline media are defined with Media Storage. Here, a distinction is made between different application profiles (e.g. AX, CT/MR, US, General) to cover the particular needs. A file, what is called the DICOMDIR, that describes the content of the medium must be present in every medium.

Gray Scale Standard Display Function

DICOM specifies that all image display devices, such as monitors and cameras, must be set according to a standardized Look-Up-Table (LUT). Thus it is possible to achieve consistency for the display of images throughout the system.

DICOM Configuration Data

This paragraph provides a brief description of the parameters that are required for the DICOM configuration.

Overview of Parameters

```
┌─────────────────────────────┐                              ┌─────────────────────────────┐
│        Storage SCU          │                              │        Storage SCP          │
│                             │    Association Negotiation   │                             │
│           TCP IP Address    │─────────────────────────────▶│  TCP IP Address             │
│  AET  →   Port number       │                              │  Port number   →   AET      │
│                             │      C_Store Message         │                             │
└─────────────────────────────┘                              └─────────────────────────────┘
```
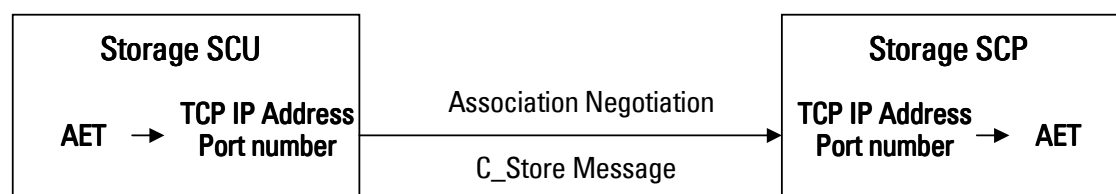
SCU (Service Class User)

The application that a network transfer initiates is referred to as the SCU. A product can play the role of an SCU, an SCP or both. This information can be found in the DICOM Conformance Statement and can be different for every DICOM service.

SCP (Service Class Provider)

The application that accepts a network transfer is referred to as the SCP. A product can play the role of an SCU, an SCP or both. This information can be found in the DICOM Conformance Statement and can be different for every DICOM service.

AET (Application Entity Title)

This is the name of the DICOM application that performs a specific service as SCU or as SCP. The AET must be unique for each service in a network.

TCP/ IP (Transmission Control Protocol / Internet Protocol)

A DICOM network transfer is always made using TCP/IP only. Every product receives a unique network address (IP address).

Port

In addition to the IP address, TCP/IP requires a port number to better determine the destination. A DICOM service waits or sends via a specific port, whereby the transfer port can change with every transfer. However, the destination port (SCP port) must be unique and can be found in the DICOM Conformance Statement. 104 has been defined as the default DICOM port (formerly the X400 Protocol port).

Association Negotiation

Every DICOM transfer begins with a negotiation of the network transmission (Association Negotiation). Here, the SCU specifies which DICOM service and which objects are supported. In addition, the SCU sends a list of the supported transfer syntaxes (see below). The SCP then sends its supported services and objects back and also specifies which of the proposed transfer syntaxes are to be used.

Transfer Syntax

By transfer syntax, we mean the type of data transfer. Here, DICOM defines several methods, such as compressed transfer (JPEG, JPEG2000, RLE) or decompressed transfer (with / without Byte swapping; with / without value representation).

Service (e.g. C-Store Message)

Data transfer is made according to the Association Negotiation, as it is defined for the particular service. C-Store, e.g for the storage service.

DICOM Conformance Statement

In the DICOM Standard (Part 2), it is specified that every medical device that supports DICOM must have what is called a Conformance Statement. The structure of this document is also defined in the standard.

In the Conformance Statement it is possible to see which DICOM services, in which role (SCU, SCP) and to what extent, are supported by a product. Unfortunately the Conformance Statement is not easy to read because it is full of DICOM terminology and numbers (UIDs or Unique Identifiers). Understanding a Conformance Statement requires basic knowledge of DICOM and some experience.

The Conformance Statement is not enough to make unequivocal statements about interoperability. Whether, and to what extent, the applications can process the objects (images) that are received can be checked only by using the product itself.

The Conformance Statements from the individual manufacturers are usually available on the Internet (Siemens: http://siemensmedical.com/ - Services). It is easy to access these pages on the Siemens Intranet at http://dicom.med.siemens.de.

IHE - Integrating the Health Care Enterprise

IHE is an initiative that is based on the DICOM standard and the HL7 (Health Level 7) standard and defines an overall workflow. HL7 is currently an ASCII-based standard (in the future, XML), which is broadly used in information systems.

In a program that will run over several years, workflow will be expanded in steps, starting from radiology and will eventually cover the entire clinical network. Scenarios will be defined in a very detailed technical framework that will be comprehensively demonstrated at large congresses (RSNA, HIMMS) covering all manufacturers.

In addition to IHE (USA), IHE Europe and IHE Japan have also been established that incorporate the local conditions and manufacturers.

Many customer requests for bids already require IHE conformity because with it, far fewer problems in the overall workflow can be anticipated. Siemens is a significant participant in IHE (several Chairmen).

A great deal of information on the topic of IHE can be found on the Siemens Intranet at http://dicom.med.siemens.de. You can find information for the USA on the Internet at http://www.rsna.org/IHE/ and for IHE Europe at http://www.ihe-europe.org/.

Siemens AG
Medical Solutions
TDIT-000.891.02
Rev. 01   03.02
Page 5 of 6
CS SD1 / PS3
DICOM

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Overview

A networking project via DICOM services is done in 3 phases, for which different areas of responsibility apply.

1. Acquisition phase (Sales)
2. Planning phase (Project Manager)
3. Installation phase (Customer Services)

Acquisition phase (Sales)	Planning phase (Project Manager)	Installation phase (Customer Services)
Check customer environment Check feasibility Incorporate all costs	Check of physical network Determine configuration data Planning the activities of the Service	Configuration, perfom tests and document tests Trouble shooting
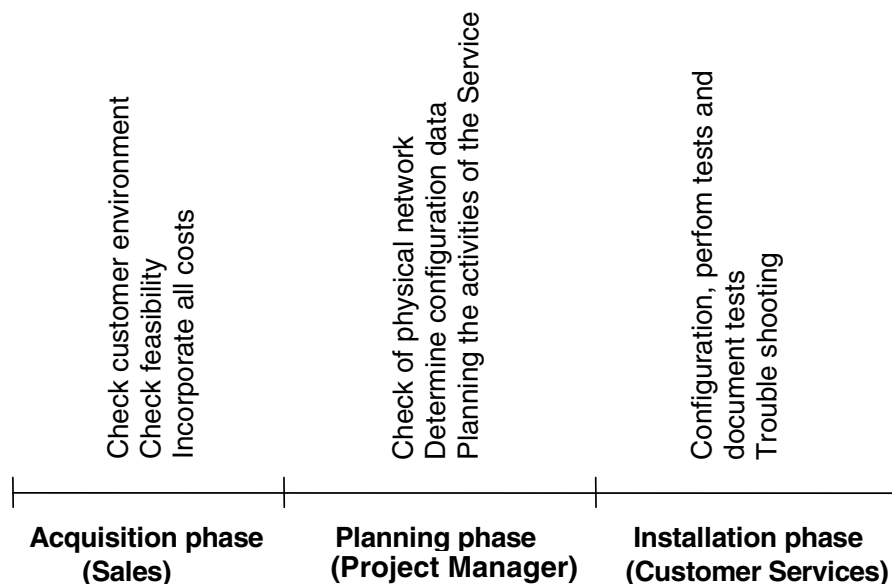
This chapter describes the tasks and the responsibilities in each of the phases.

1. Acquisition Phase

This is the most important phase, because the feasibility of a project must be investigated and the required cost for it is calculated. What is not taken into consideration in this phase can have a tremendous effect on the project.

Responsibility is with the Sales Engineer. To perform the required tasks, the support of a DICOM/network specialist is usually required.
It is recommended to have in each country / region these specialists to provide 'Technical Clarification' for each installation where networking is required!

Note:

Prerequisite for Sales taking the networking costs into consideration is that this network integration is taken into consideration in the price book (SIR Diagram) and in the Installation Time Catalog (PMI). Since this is currently not the case, except for cameras, Sales must currently take these costs into consideration separately from the price catalog!

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TDIT-000.891.02
Rev. 02   01.03

Page 1 of 8
CS SD1 / PS3

DICOM

1.1 Check of the Existing Customer Environment

This is already a task that should be performed by a Project Manager or network specialists. Here, the following points need to be considered:

- Which products are to be integrated into the networking project?

- Is the performance of the existing products sufficient enough?

- In particular with older products, it must be clarified whether additional hardware or an additional software license is required to enable integration into a DICOM network?

- With cameras, it must be checked whether they are approved by Siemens and whether the required specifications (memory expansion) is available. This information can be found on the Siemens Intranet at http://www-td.med.siemens.de - Product Information - Documentation.

- Does the network infrastructure exist or must it be included in planning as a result of the project?

1.2 Check of DICOM Connectivity

A check must be performed to determine whether and to what extent data exchange via DICOM is possible between the products in question. The information required for this can be found in the **DICOM Conformance Statement** (see the chapter 'DICOM Basics').

This task can normally not be performed by Sales because evaluation of DICOM Conformance Statements requires knowledge of DICOM. An additional service contractor is necessary, such as the local network specialist or the Connectivity Competence Center.

When is this check necessary?

- This check is necessary when the question concerns connection to **non-Siemens products** and no reference system is known. Reference systems can be found on the Siemens Intranet at http://dicom.med.siemens.de - DICOM Interoperability Database.

- Since only approved DICOM **cameras** may be connected, a Conformance Statement comparison for cameras is not necessary.
For cameras that are not approved, contact should be made with the particular business units (BU) to initiate an approval!

- If networking is with **Siemens internal products**, the costs involved in a Conformance Statement comparison are not necessary. However, it should still be clarified whether DICOM connection is possible. This information can be found on the Siemens Intranet at http://dicom.med.siemens.de - DICOM Interoperability Database

What does this check include?

- DICOM is a standard that defines **services** such as storage (transmission of objects), printing to cameras, modality worklist and modality performed procedure steps as the interface to the Radiology Information System.
It must be clarified whether the products involved support the same service.

- DICOM distinguishes between two **roles** per service, on the one hand whether the transfer is initiated (SCU Service Class User) and on the other hand whether a transfer

can be accepted (SCP Service Class Provider).
It must be clarified which roles the products involved support.

- DICOM defines **objects** such as images (approx. 50 different formats such as CT, MR, US, AX,..., wave forms, lookup tables, reports, ...)
  It must be clarified whether the destination product supports the sender's objects.

- DICOM also defines the **type of transfer**, e.g. lossy or lossless compression.
  It must be clarified whether compressed transfer is to be used and whether the products involved can support this.

1.3 Check of DICOM Interoperability

DICOM cannot assure whether and to what extent transferred objects can be processed on the destination computer. This is referred to as **interoperability** and depends on the particular application. For example, DICOM permits the most varied coding of color information (RGB, Color Palette, YBR, ...). Most applications do not support all color codes.

DICOM defines over 1600 attributes, of which color coding is just one. Many of these attribute have an effect on the application. In addition, there are the private attributes that are product-specific.

Because of this, it is strongly recommended that in addition to DICOM connectivity, interoperability also be checked. It is becoming much more common that the customer requires such a test results before he makes a commitment.

When is this check necessary?

- This check is also necessary when there is a connection to **non-Siemens products** and reference systems are not known. Reference system can be found on the Siemens Intranet at http://dicom.med.siemens.de - DICOM Interoperability Database.

- Since only released DICOM **cameras** may be connected, an interoperability test is not necessary.

- Connection to **information systems,** e.g. to an RIS, is very project-specific and requires detailed discussion with the customer and with the RIS manufacturer. Tests can be performed only under very specific conditions during the acquisition phase. The Connectivity Competence Center, e.g. provides this service.

- If networking is to **Siemens internal products**, the cost of an interoperability test is not necessary because in most cases this has already been done at the factory. However it still must be clarified whether any, and which, interoperability restrictions are known. This information can be found on the Siemens Intranet at http://dicom.med.siemens.de - DICOM Interoperability Database

What is the procedure for verifying DICOM interoperabilty?

- One possibility for this is at least the **validation of images** (only for DICOM Storage). For this, appropriate images must be obtained from the modality in DICOM format. These images are imported to the destination system and checked in the application. This service is provided, e.g. by the Connectivity Competence Center, but can also be performed by local application specialists.

Siemens AG
Medical Solutions

TDIT-000.891.02
Rev. 02   01.03

Page 3 of 8
CS SD1 / PS3

DICOM

- A better statement regarding DICOM interoperability can be obtained from what are called **cross-vendor tests.** Here, the equipment is networked to DICOM and tested. This test can be performed at the customer's location or can be performed between the company test centers.
  Cross-vendor tests between Siemens and major manufacturers have been made directly from the factory and can then be found in the interoperabilty database. All other cross-vendor tests must usually be planned into the customer project and can be performed by the Connectivity Competence Center.

1.4 Incorporating Planning and Installation Costs

The costs that are incurred for planning and installation (test costs) absolutely must be incorporated into the project. The table provided above, 'Cost Factors in a Networking Project (estimated costs)' can be used as a reference for this. A more exact description of the costs in Phases 2 and 3 can be found on the following pages.

It should not be forgot that in addition to the costs for our own service technicians, the costs incurred for service technicians from the non-Siemens product(s) that are to be connected must also be included in the project.

The following table is a reference for where costs can occur in a networking project in the particular phase and thus must be taken into consideration.

Cost factors in a networking project (estimated costs)

Activity	Cost
Acquisition Phase	
It must be clarified whether additional hardware or software licenses are required.	Hardware or license costs
Check DICOM connectivity for each product, e.g. by comparing the Conformance Statements	up to 1/2 day per product
Check DICOM interoperability for each product, e.g. by performing cross-vendor tests	1 day per product
Technical clarification regarding connection to the Information System (HIS/RIS)	2 days
Planning Phase	
Creation of the physical network by Siemens or the costs incurred from network expansion	Depending on time required
Compilation of all configuration data from the network administrator and from the non-Siemens manufacturer(s) and Organizational planning for the service technicians (equipment, personnel)	1/2 day
Installation Phase	
Configuration and test (see also Chapter 5).	Up to 1 day per modality
Costs for service technician for the non-Siemens products.	up to 1 day per product
Additional application training for workflow settings	1 day

Turnover of a project by Sales to the Project Manager is generally done in writing. The above-listed points must be included in this written report.

2. Planning Phase

Responsibility for this phase is generally with the Project Manager.

When a project is turned over, the PM should insist that the acquisition phase tasks have been performed properly. Frequently, the PM has already been a participant in Phase 1.

2.1 Check of the Physical Network

- Larger installations are usually planned, installed and managed by the customer through an external service contractor. The duty of the PM here is to check whether appropriate network connections are available and whether the bandwidth corresponds to the requirements. The network administrator must plug in the patch cables at the hub and configure the network components.

- For small installations, the network is also frequently planned and installed by Siemens Med. Such network planning is not the subject of this Planning Guide.

- The requirements of the products regarding data throughput must be clarified with the network administrator.

2.2 Clarifying DICOM Connections

- For the **connection to an information system** (RIS) a HS Project Manager or a network specialist is generally strongly recommended. It must be determined which data are to be sent from the RIS (Modality Worklist) and which data the RIS expects from our modality (Modality Performed Procedure Steps).
  The PM together with the customer must also determine what are the individual scenarios and corresponding tests, e.g.
  - How an **emergency patient** is handled (no patient data from the HIS/RIS using Modality Worklist),
  - How an **append case** is handled (additional procedures that were not contained in the worklist) or
  - How a **group case** is handled (combining of several procedures in one scanning procedure)

Note:
For planning and configuration of the interface between a Siemens Modality (syngo) and an Information System an additional document exists called '**DICOM HIS/RIS Connection**'!

- With **DICOM Print** it is absolutely necessary that the camera hardware be checked. In particular, Syngo places high requirements on the camera, because each film sheet is sent as a single file, and a 14x17" film has a size of 22 MB. In addition, there is a large performance difference between when one or when several devices are connected to one camera.

Siemens AG
Medical Solutions
TDIT-000.891.02
Rev. 02   01.03
Page 5 of 8
CS SD1 / PS3
DICOM

2.3 Determining Configuration Data

The **configuration data** of the products to be connected must be determined. The data can generally be obtained from the customer (network administrator) or from a representative for the non-Siemens products that are to be connected.

The Windows application, '**DICOM Acquisition Tool**', that is described in the chapter 'DICOM Interoperability Database' should be used for this. It provides input screens to compile the data, and in which a lot of known data (AET, Port, ...) can be immediately entered into a template.

In this regard, it must also be determined which possible DICOM services need to be configured, e.g. whether storage in both directions is really necessary. It should be noted that each superfluous service generates unnecessary costs.

2.4 Planning the Activities of the Service Technicians

- It is recommended that the service technicians perform the configuration and tests of the products involved at the same time.

- In addition, the products involved must be available without restrictions.

- If the configuration and the tests are performed by several Siemens Service Technicians (several products from different business divisions), it must be assured that the technicians share their findings with each other. Problems that one technician has, e.g. with printing, in most cases will be encountered by another.

- Usually, several hours must be planned for configuration and more importantly for the necessary tests. The chapter 'DICOM Tests' should provide some reference points for this. In this chapter you will also find a brief example of how to calculate this.

- The customer is also required during the tests. This must be communicated to the customer and planned in advance.

3. Installation Phase

The Service Engineer requires a written / electronic **list of tasks** from the Project Manager in which the DICOM services to be configured and the promised functionality is described. In addition, the PM should record the data in the '**DICOM Acquisition Tool**' and provide the file that is generated from this to the Service Engineer. The Service Engineer should then download the file to the 'DICOM Acquisition Tool' on his laptop and enter the missing data and the test results.

At this point, it should be mentioned again that the Service Engineer is **not** responsible for interoperability between two products and the functionality of the workflow. This must be clarified by Sales and by the Project Manager prior to startup and is their responsibility.

3.1 Tasks of the Service Technician

- Prior to the installation, the Service Engineer should inform himself about whether any and which problems he can anticipate in the 'CS Knowledge Base'.

- Configure the products based on the data that has been provided by the PM.

- Perform the interoperability tests as they are described in the chapter 'DICOM Tests' or as they are described in the Startup Instructions for the particular product.

- Record the test results in the 'DICOM Acquisition Tool'.

- Download the data from the Intranet into the 'DICOM Interoperability Database' or send the data as a mail attachment to mailto:CCC@med.siemens.de.

- If there is a malfunction, perform troubleshooting in accordance with the DICOM Troubleshooting Instructions. These instructions are available either on the CB-DOC for the product or as a Syngo-based version on the Intranet at http://dicom.med.siemens.de.

3.2 Application Settings

For each DICOM Service the user interface and workflow issues have to be considered. E.g. does the customer want to have Auto-forward rules, which attributes shall be visible in the patient browser of the customer user interface or when shall the images be removed from the hard disk?

Therefore a specialist is required who knows all the possible settings in the Service software, the Customer user interface and in future in the User / Security settings. It is recommended to involve the Service Engineer for this task.

Siemens AG
Medical Solutions
TDIT-000.891.02
Rev. 02   01.03
Page 7 of 8
CS SD1 / PS3
DICOM

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Intranet

On the Siemens Intranet, there is a separate page on which all requirements regarding DICOM can be found: http://dicom.med.siemens.de.

Among other things, you can find the following information:

- Links to Conformance Statements for the Siemens products as well as for the products from many other manufacturers
- DICOM Interoperability Database and DICOM Acquisition Tool
- Tutorials on the subject of DICOM
- Description and links to the most important DICOM tools
- Link to the CS Knowledge Base
- Services provided by the Connectivity Competence Center

Contact Persons

Local Network Specialist

It is strongly recommended that local competence be established. The local Service Technician with the appropriate training could, e.g. act as a network specialist and thus as a service provider for Sales and the Project Manager.

In addition, the HS Project Manager can assume these tasks.

The networks and the requirements placed on our product interfaces are becoming increasingly greater. There should be close cooperation with the Connectivity Competence Center.

Connectivity Competence Center CCC

http://dicom.med.siemens.de; mailto:ccc@med.siemens.de

Telephone (Help desk) 8877

This team provides various services, such as:

- Conformance Statement comparison and image validation
- Help desk (no charge for up to 2 hours)
- Cross-vendor tests and Siemens internal DICOM Tests
- DICOM training
- Support for the Intranet and the DICOM Interoperability Database

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General Remarks

A DICOM configuration is completed only when the interoperability has been tested. Successful transfer and the check of the required functionality on the destination device are part of this test.

The **DICOM Acquisition Tool** lists the minimum tests for each service that are explained in this chapter. However, if available, the tests that are described in the Startup Instructions must be performed because these tests take the product's features into better consideration.

The tests that are performed must be documented, which takes place automatically with the DICOM Acquisition Tool.

Note: The time requirements described take only the normal test procedure into consideration. Troubleshooting and configuration are not included in these figures.

When is a test necessary?

- A test is always required to determine whether data transfer between the products via DICOM functions. Along with it, the configuration errors and network errors are covered.

- When non-Siemens products are configured in, additional tests are absolutely necessary to check interoperability.

- If a product combination (e.g. Leonardo - non-Siemens archive) occurs more than once in the network, only the transfer needs to be tested. Interoperability only needs to be tested once.

- With Siemens internal connections, only the transfer needs to be tested. In most cases, interoperability tests should have already been done at the factory.

- The test should also be performed when the product combination is already entered in the DICOM Interoperability Database.

The tests required for each DICOM service are described below:

Verification

This test is normally performed during configuration and does not have to be documented. It is primarily needed for troubleshooting.

This service is started in the Service Tools either in Configuration or via the DICOM Service Tools. It checks the network connection on the DICOM level (AET, Port Number).

Storage

Test Data

- Images should be used that have been generated from the particular modality or with workstation images, that have been sent from a modality to the workstation. Some images should be manipulated at he modality or workstation (distance measurement, annotation, invert, rotate).
- If possible, several studies with several series for a patient should be sent.

Test Procedure

The support of the service technician for the non-Siemens device or from the customer is frequently required for the tests. These persons must be scheduled sufficiently ahead of time.

Transfer

- A check should be performed to determined whether the transfer of studies from or to the other DICOM nodes takes place without problem (connectivity). If 'Auto Forward' is configured for a modality, a check must be performed to determine whether the images are automatically transferred to the configured destination.

Study & Series Sorting

- Afterwards a test should be performed to determine whether this study is entered correctly into the database at the destination, i.e., whether it is correctly displayed in the patient browser (patient- / study- / series splitting).
The complete transfer should be performed again to check how the patient browser reacts (dual entries?).

Display of Image

- If images are to be displayed on the destination device, open the transferred study and check whether the presentation of images is okay (e.g. windowing) and whether the required image texts are displayed. It should also be checked to determine if the invert and rotate image manipulations are correctly displayed on the transfer device.

Display of Overlays

- When displaying images, the overlays are checked separately. The image manipulations (distance measurement, annotations) performed on the transfer device must be correctly displayed. With CT and MR, the cut lines in the topogram are transferred as overlay data.

Postprocessing

- If the customer wishes to perform postprocessing on the destination device, this needs to be checked using the transferred images. This includes, e.g. 3D calculation, subtraction (Angio), distance measuring, windowing, rotate.

Time Requirement per Product Combination:

- The time required depends very much on the number and type of images to be examined. Appropriate images must be generated or acquired. Some images must be manipulated and resaved. The support of the customer or the service technician is required for tests on a non-Siemens target device.
- The estimated required time is 1 to 2 hours.

Storage Commitment

Test Procedure

Transfer
- A check should be performed to determine whether the Storage Commitment Transfer is performed correctly (connectivity) following the transfer of image studies from or to another DICOM node.

Display of Commitment Result
- At the transfer device, a check should be performed to determine if the successful or even incorrect Commitment Response was correctly entered in the user interface. With Syngo, this can be seen in the patient browser on the image level under Status.

Time Requirement per Product Combination
- The test time requirement can be overlooked.

Query/Retrieve

Test Data
- Several patients (see the patient browser) must be available at the query provider (destination system). The patient names should contain country-specific special characters (ä, ß).

Test Procedure
- **Transfer**: A test should be performed to determine whether the transfer of the Query Requests and Responses from or to the other DICOM nodes has been performed without problem (connectivity),
- **SCU Receives Requested Attributes**: A test should be performed to determine whether Query (C_Find) has found the correct data sets and has indicated this. It must be taken into consideration that many query SCUs have a limit on the data sets (configurable).
- **Retrieve all Objects of Result List**: Afterwards, the examinations on the study, series and image level should be selected and imported (C_Move). The destination system will open a new DICOM Association and will transfer the images using the DICOM Storage Services.
- **Query by all Possible Attributes**: Here, all possible selections in the Query user interface should be checked (Wildcards *, Study Date, ...).

Time Requirement per Product Combination
- The estimated test time depends on the capabilities off the Query user interface and is approx. 1/2 hour per study.

Siemens AG
Medical Solutions

TDIT-000.891.02
Rev. 01   03.02

Page 3 of 8
CS SD1 / PS3

DICOM

Basic Print

A check should be performed to determine whether a transfer to a DICOM camera takes place without problem using the specified formats.

Only approved cameras should be connected.

Test Data

- A film job with at least 2 film sheets should be sent to the camera.

Test Procedure

The support of the customer is needed to evaluate the image quality, and therefore should be planned for the camera test.

Transfer
- A check should be performed to determine whether the transfer of film pages to the camera has taken place without error (connectivity).
  If several devices print to one camera, film jobs should be sent at the same time from these devices to the camera, including the device to be tested.

Receive and Display Warnings
- During the transfer, a film cassette should be pulled out. It must be checked when and which error message is displayed at the local user interface.

Display of Images
- The image quality must be checked together with the customer. Are all required texts displayed?

Display of Overlays
- The image manipulations (distance measurement, annotations) performed at the transferring device must be correctly displayed. For CT and MR, the cut lines should also be transferred in the topogram as overlay data.

Time Requirement per Camera

- The required test time is approx. 1 hour as long as no changes to the configuration data are necessary, which should not be the case with approved cameras.

Modality Worklist

Test Data

- The support of the customer is often required for this test, because studies for the modality need to be planned in the information system.

Test Procedure

Transfer
- A check must be performed to determine whether data sets are found on the HIS/RIS and are reported back without error. With a multiple worklist request, the data should not change in the scheduler.

Worklist Request by all Possible Attributes

- With Syngo, it is possible to set in Option - Configuration whether inquiry should be for modality type (CT, MR, XA, ...) or the system (AET), and even selection of a time window is possible.

  With Syngo, worklist requests can also be sent from the registration platform, whereby the search can be according to the following attributes: patient's name, patient ID, patient's date of birth, Accession No., requested procedure ID, modality, scheduled performing physician's name, scheduled station name and start date / time.

  Depending on the customer's request, the appropriate Worklist requests must be checked.

SCU Receives Requested Attributes

- This test must be viewed in conjunction with the previous test. A check must be performed to determine whether the worklist responses match the request. Following each request, the scheduler must be manually deleted.

Worklist Attributes in Image Header

- With larger installations, certain attributes are used for further workflow. To check whether these attributes have been correctly accepted into the image header by the HIS/RIS, images must be generated and sent. At the destination, a check should be performed to determine whether the attributes are correctly filled in.

Time Requirement

- The estimated test time is approx. 1 hour as long as studies were already planned in the HIS/RIS.

Modality Performed Procedure Steps (MPPS)

This test can be performed only in cooperation with the worklist test. The Service Technician must perform a study based on the modality worklist and then test whether the MPPS messages on the HIS/RIS were transferred. An additional study of the MPPS data must be performed by the customer (HIS/RIS Administrator).

There are very different types of cases that can be tested in MPPS. The tests must first be clarified with the Project Manager, e.g.

- how an **emergency patient** is handled (no patient data from the HIS/RIS using Modality Worklist),
- how an **append case** is handled (additional procedures that were not contained in the worklist) or
- how a **group case** is handled (combining of several procedures in one scanning procedure)

Test Data

- All required boxes in both the registration platform (prior to the application) as well as the MPPS platform (after the application) must be filled in. Names as long as possible should be used and, depending on the country, should include the special characters (e.g. ä,ß).

Test Procedure

Transfer

- A check must be performed to determine whether the MPPS data are successfully transferred to the RIS. It must be taken into consideration that MPPS data are transferred at the start of the application (Create) and at the end of the application (SET). Both transfers must be successful.

RIS Receives all Required Attributes

- This test is very time consuming and HIS/RIS-specific and can therefore only be performed by the customer. If problems occur, the Project Manager should usually be involved.

Time Requirement

- Estimated time requirement for transfer is approx. 1/2 hour.
- However, the time required for interoperability is several days, depending on the possible scenarios. This test should be performed by the customer.

Media Storage

Test Data

- Use images that were generated by the particular modality, or if they are workstation images, images that were sent from the modality to the workstation. Some images should be manipulated at the modality or workstation (distance measurement, annotation, invert, rotate).
- If possible, several studies with several series for one patient should be sent.

Test Procedure

File Set READ

- A test must be performed to determine whether media that are generated on our own device and on the other device can be read in and/or vice versa. The following points must be taken into consideration:
  - Are all patients and studies displayed in the correct sequence?
  - Can the images be imported and displayed?
  - Are overlay data (distance measurement, annotation) correctly displayed?

File Set CREATE

- If new media are to be written to, a test must be performed to determine whether
  - the patients and studies are written in the correct sequence
  - all desired image formats are written.

  This test has already been performed in the system test, in particular with workstations, all possible images can not be present for the different manufacturers. In addition, the generated media are needed to test File Set Read on the destination device.

File Set UPDATE
- For this, a medium (CD-R, DVD, ...) with existing studies is needed, and the following tests performed:
  - The contents of the original medium must be readable (like File Set Reader Test)
  - New images from the same and from other patients must be writable to the medium (Multi Session)
  - After the burn, all patients and studies must be available in the correct sequence. The Images must be readable on our device and, if configured, on non-Siemens device.

Example of a Calculation of the Estimated Time Requirement

In this calculation example, the times listed for tests in this chapter should indicate how much time is required for configuration and for the subsequent tests.

Here, any modality is connected to one workstation, one archive and one camera and to a RIS. The following conditions are assumed:
- All devices are available
- The Service Technicians who must connect the devices are present and will configure their devices at the same time
- The customer is available for the tests, whereby the MPPS tests are largely performed by the customer and are not taken into consideration here
- The configuration data are all available and correct
- The feasibility of the DICOM connection was checked during the acquisition phase or during the planning phase (Connectivity, Interoperability)
- Restart of the system is taken into consideration in the estimated overall configuration time

Device	Service	Role	Configuration	Test
Workstation	Storage	send (SCU)	5	40
		receive (SCP)	-	40
	Query/Retrieve	initiate (SCU)	5	20
		receive (SCP)		20
Archive	Storage	send to (SCU)	5	20
		receive (SCP)	-	20
	Storage Commitment	send (SCU)	-	10
	Query/Retrieve	initiate (SCU)	5	20
		receive (SCP)	-	20
Camera	Print	send (SCU)	5	60
RIS	Modality Worklist	request (SCU)	5	60
	MPPS	send (SCU)	.	30
			30 min	**6 hours**

This example shows that despite optimum preparations, and without errors in connecting the modalities, approx. 6 1/2 hours are required. If one takes simple troubleshooting into consideration, e.g. configuration errors, at least one day should be planned.

Siemens AG
Medical Solutions
TDIT-000.891.02
Rev. 01   03.02
Page 7 of 8
CS SD1 / PS3
DICOM

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General Remarks

Since the DICOM standard cannot assure that a device can achieve the required functionality with the transferred data, it is absolutely necessary that the experience (test results) that is available is compiled at a central location and is available to everyone.

This is the goal of the **DICOM Interoperabilty Database**. The tool to compile the data is what is referred to as the **DICOM Acquisition Tool**. This is a Windows application that both the Project Manager and the Service Technician should have installed on their laptops.

The database can be viewed on the Siemens Intranet at http://dicom.med.siemens.de. From there, it is also possible to download the current version of the DICOM Acquisition Tool and to find a description of the database and of the corresponding Acquisition Tool.

The objective is that this tool be used worldwide by all test groups, by the Project Managers and by Service.

The following illustration shows an example of an input screen from the current DICOM Acquisition Tool. In this screen, you can see which DICOM combinations are possible between two products and the Service Technician enters his test results here.

Fig. 1   Example of an input screen in the DICOM Acquisition Tool (Test Results)

This illustration shows the search screen (Query) for the DICOM Interoperability Database and an extract of the results list. There are details of test results, and if available, test reports for each product combination.

Fig. 2   Search screen (Query) in the DICOM Interoperability Database and an extract from the results list.