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DICOM Conformance Statement

Leksell GammaPlan® & Leksell SurgiPlan®

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1 Introduction

1.1 Scope and field of application

The scope of this DICOM conformance statement is to facilitate data exchange with equipment of Elekta Neuro Sciences. This document specifies the conformance to the DICOM standard (formally called the NEMA PS3.X-1993 standards). It contains a short description of the applications involved and provides technical information about the data exchange capabilities of the equipment. The main elements describing these capabilities are the supported DICOM service object pairs (SOP) classes, Roles and Transfer Syntaxes.

1.2 Reference documents

Digital Imaging and Communications in Medicine (DICOM). Version 3.0. National Electrical Manufacturer's Association. Rosslyn, VA, United States of America. 2007.

1.3 Revision history

Issue	Date	Author	Status	Description
1	1999-10	JrC	Approved	Version for SIF 4.6
1.1	2002-01-11	EH	Working	Added description of PET support for SIF 4.7
2	2002-02-25	EH	Approved	Approved for SIF 4.7.
2.1	2003-06-04	EH	Review	Added support for PET.
3	2003-08-11	EH	Approved	Approved for SIF 4.7.2.
3.1	2005-06-30	ErSa	Review	Updated for SIF 4.7.2.
4	2005-06-30	ErSa	Approved	Approved for SIF 4.7.2.
5	2006-03-22	HBo	Approved	Updated for Leksell GammaPlan® 7.
5.1	2006-10-13	ErSa	Review	Added support for read CD-R.
6	2006-10-24	ErSa	Approved	Approved for Leksell GammaPlan® 7.
7	2008-09-12	ErSa	Approved	Approved for Leksell GammaPlan® and Leksell SurgiPlan® 8.2
8	2008-09-12	ErSa	Approved	Approved for Leksell GammaPlan® and Leksell SurgiPlan® 8.3
8.1	2008-12-18	ErSa	Review	Updated for Leksell GammaPlan® and Leksell SurgiPlan® 9.
9	2008-09-21	ErSa	Approved	Approved for Leksell GammaPlan® and Leksell SurgiPlan® 9.

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1.4 Terminology

Term	Explanation
AE	Application Entity
AET	Application Entity Title
AP	Application Profile
FSR	File Set Reader
FSC	File Set Creator
PDU	Protocol data unit
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
UID	Unique Identifier

1.5 Important notes

This Conformance Statement by itself does not guarantee successful interoperability of Elekta equipment with non-Elekta equipment. The user (or user's agent) should be aware of the following issues:

Scope

The goal of DICOM is to facilitate inter-connectivity rather than interoperability. Interoperability refers to the ability of application functions, distributed over two or more systems, to work successfully together. The integration of medical devices into a networked environment may require application functions that are not specified within the scope of DICOM. Consequently, using only the information provided by this Conformance Statement does not guarantee interoperability of Elekta equipment with non-Elekta equipment. It is the user's responsibility to analyze thoroughly the application requirements and to specify a solution that integrates Elekta equipment with non-Elekta equipment.

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Validation

Elekta equipment has been carefully tested to assure that the actual implementation of the DICOM interface corresponds with this Conformance Statement. Where Elekta equipment is linked to non-Elekta equipment, the first step is to compare the relevant Conformance Statements. If the Conformance Statements indicate that successful information exchange should be possible, additional validation tests will be necessary to ensure the functionality, performance, accuracy and stability of image and image related data. It is the responsibility of the user (or user's agent) to specify the appropriate test suite and to carry out the additional validation tests.

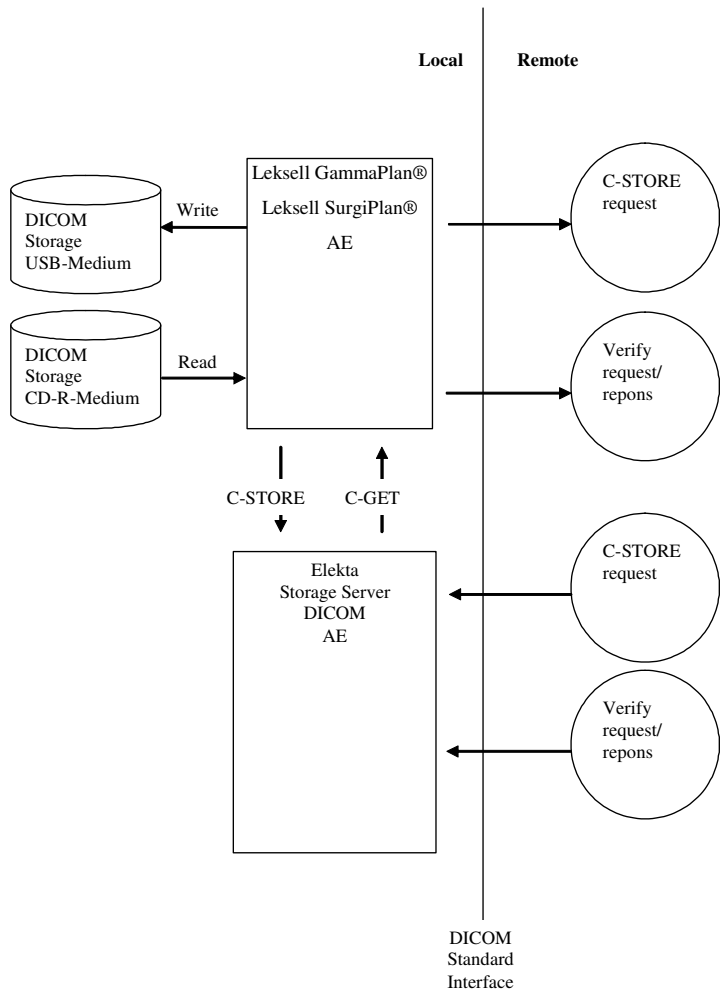
New versions of the DICOM Standard

The DICOM standard will evolve in future to meet the user's growing requirements and to incorporate new features and technologies. Elekta plans to adapt its equipment to future versions of the DICOM standard. In order to do so, Elekta reserves the right to make changes to its products or to discontinue its delivery. The user should ensure that any non-Elekta provider linking to Elekta equipment also adapts to future versions of the DICOM Standard. If not, the incorporation of DICOM enhancements into Elekta equipment may lead to loss of connectivity (in case of networking) and incompatibility (in case of media).

2 Implementation Model

The Elekta Neuro Treatment Planning system consist of one Storage Server Application Entity connected to one or more Leksell GammaPlan® or Leksell SurgiPlan® Treatment Planning Workstations.

2.1 Applications data flow diagram



2.2 Functional definitions of Application Entity

Elekta Storage Server

The Elekta Storage Server waits for another application to connect at the TCP/IP port number 104. When another application makes a DICOM association request, the Storage Server acts as a SCP for the storage service class: It stores the DICOM objects in the database of the Leksell GammaPlan® or Leksell SurgiPlan® Treatment Planning Workstation.

The Storage Server also acts as a SCP for the verification service class: It responds to C-ECHO requests from other applications.

Leksell GammaPlan[®] and Leksell SurgiPlan[®]

Leksell GammaPlan[®] and Leksell SurgiPlan[®] are DICOM Clients (SCU) for the purpose of

- Importing DICOM Images and DICOM RT Structure Sets, drawn in the image planes of an already imported image series.
- Exporting DICOM Images and DICOM Structure sets object to a remote Service Class Provider (DICOM Server). Leksell GammaPlan[®] also exports DICOM RT Dose and DICOM RT Plan objects. The objects are always exported together with an image series. Only 3D volumes can be exported. When exporting dose objects, the absolute dose is sampled in a grid that is aligned with the axes of the image series. For each selected object, an RT Dose object where the grid is spanning over a bounding box of the volume is created. A DICOM RT Plan object is created and used to connect the dose objects with the structure sets and images. The DICOM RT Object can be exported together with CT, MR and PET images.
- Writing DICOM Images and DICOM Structure sets objects to a USB flash drive. Leksell GammaPlan[®] also writes DICOM RT Dose and DICOM RT Plan objects. This is a partially conformant FSC as it is able to perform M-WRITE but not M-INQUIRE FILE SET or M-INQUIRE FILE Media Storage Operation.
- Reading DICOM object stored on a CD-ROM. This is a partially conformant FSR as it is able to perform M-READ but not M-INQUIRE FILE Media Storage Operation.
- Echo Utility for test and validation purposes. It sends a verify request to a specified DICOM node. It acts as a SCU for the verification service class.

2.3 Sequencing of Real World Activities

The user initiates the activity by selecting one or more objects and the corresponding image series to be exported or by sending a verification request.

3 AE specifications

3.1 Storage Server AE Specification

The Storage Server Application Entity provides Standard Conformance the following DICOM V3.0 SOP classes as a SCP:

SOP Class Name	UID
CT Image Storage – STORE	1.2.840.10008.5.1.4.1.1.2
MR Image Storage – STORE	1.2.840.10008.5.1.4.1.1.4
XA Image Storage – STORE	1.2.840.10008.5.1.4.1.1.12.1
PET Image Storage – STORE	1.2.840.10008.5.1.4.1.1.128
RT Structure Set – STORE	1.2.840.10008.5.1.4.1.1.481.3
SC Image Storage – STORE	1.2.840.10008.5.1.4.1.1.7
Verification	1.2.840.10008.1.1

Table 1: SOP Classes supported by the Storage Server.

Association Establishment Policies

General

The Elekta Storage Server accepts association in response to C-STORE requests from other Applications Entities. It will accept C-STORE requests for CT, MR, XA, PET, RT Structure Set and SC SOP classes and in this case will act as storage service class provider.

It also accepts association in response to C-ECHO requests and act as verification service class provider.

The Storage Server is a LINUX daemon, waits for C-STORE or C-ECHO requests, and performs the necessary operations upon it receiving such requests.

Number of Associations

The number of simultaneous associations that will be accepted by the Elekta Storage Server is limited to 5.

Asynchronous Nature

The Elekta Storage Server does not perform asynchronous operations window negotiation.

Implementation Identifying Information

The Elekta Storage Server does not export any DICOM object. The only occasion where an Implementation Identifier may be used is during the establishment of the association with a DICOM peer. For this reason the implementation identifying information of the OFFIS DCMTK

DICOM toolkit has been kept unchanged:

IMPLEMENTATION_CLASS_UID = 1.22276.0.7230010.3.0.3.5.4

IMPLEMENTATION_VERSION = OFFIS_DCMTK_354

Association Initiation by Real World Activity

The Elekta Storage Server never initiates an association.

Association Acceptance Policy

Remote System Requests Image Storage

Associated Real World Activity

A DICOM AE sends a storage request to the Elekta Storage Server. If the request is accepted the images and objects are stored on the Elekta Storage Server.

Presentation context table

Presentation Context Table					
Abstract Syntax		Transfer Syntax List		Role	Extended Negotiation
Name	UID	Name	UID		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Secondary Capture Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Table 2: Presentation context table: C-STORE service

C-STORE SCP conformance

The Elekta Storage Server is Conformance Level 0 Storage SCP. The stored attributes may be

accessed only through Leksell GammaPlan® and Leksell SurgiPlan® and only for display. The duration of storage of these attributes is at the user discretion.

Presentation context acceptance criterion

The Elekta Storage Server will accept any context listed in Table 2. There is no check for duplicate contexts.

Transfer syntax selection policies

The preference in acceptance of Transfer Syntaxes is:

Implicit Little Endian above Explicit Little Endian above Explicit Big Endian

Remote system requests verification

Associated real world activity

A remote DICOM AE wish to verify the application level communication using the C-ECHO command.

Presentation context table

Presentation Context Table					
Abstract Syntax		Transfer Syntax List		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

Table 3: Presentation context table: C-ECHO service

C-ECHO SCP conformance

The Elekta Storage Server provides standard conformance to the C-ECHO service as a Service Class Provider.

Presentation context acceptance criterion

The only accepted presentation context is defined in Table 3.

Transfer syntax selection policies

The preference in acceptance of Transfer Syntaxes is:

Implicit Little Endian above Explicit Little Endian above Explicit Big Endian

3.2 Leksell GammaPlan® and Leksell SurgiPlan® AE

Leksell GammaPlan® and Leksell SurgiPlan® Application Entity provides Standard Conformance the following DICOM V3.0 SOP classes as a SCU:

SOP Class Name	UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
PET Image Storage	1.2.840.10008.5.1.4.1.1.128
RT Structure Set	1.2.840.10008.5.1.4.1.1.481.3
Verification	1.2.840.10008.1.1

Table 4: SOP Classes supported by Leksell GammaPlan® and Leksell SurgiPlan®.

Leksell GammaPlan® Application Entity also provides Standard Conformance the following DICOM V3.0 SOP classes as a SCU:

SOP Class Name	UID
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5

Table 5: SOP Classes supported only by Leksell GammaPlan®.

Association Establishment Policies

General

The maximum PDU size for Leksell GammaPlan® and Leksell SurgiPlan® can be configurable from a minimum of 4 Kbytes. There is no upper limit. It is limited by the available system resources. The default value is 64 Kbytes.

Number of Associations

Leksell GammaPlan® and Leksell SurgiPlan® support one active association at a time as a Service Class User.

Asynchronous Nature

Leksell GammaPlan® and Leksell SurgiPlan® do not support asynchronous operations and will not perform asynchronous window negotiation.

Implementation Identifying Information

IMPLEMENTATION_CLASS_UID = 1.2.840.113854.88
 IMPLEMENTATION_VERSION = ELEKTA_NTPS_900

Association Initiation by Real World Activity

Leksell GammaPlan® or Leksell SurgiPlan® sends a C-STORE or a C-ECHO request to a remote Applications Entities.

Association Initiation Policy

Leksell GammaPlan® and Leksell SurgiPlan® initiates associations for the purpose of

- Exporting DICOM objects to a PACS, Linac or other similar systems
- Verify the application level communication to another system

Association Acceptance Policy

Leksell GammaPlan® or Leksell SurgiPlan® does not accept associations.

Requests for DICOM Object Storage on Remote Systems

Associated Real World Activity

Leksell GammaPlan® and Leksell SurgiPlan® requests associations with remote systems that it wishes to send DICOM object for storage to.

Presentation context table

Presentation Context Table					
Abstract Syntax		Transfer Syntax List		Role	Extended Negotiation
Name	UID	Name	UID		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
PET Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 6: Presentation context table: C-STORE service for Leksell GammaPlan® and Leksell SurgiPlan®

Presentation Context Table					
Abstract Syntax		Transfer Syntax List		Role	Extended Negotiation
Name	UID	Name	UID		
RT Dose	1.2.840.10008.5.1.4.1.1.481.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Storage					
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 7: Presentation context table: C-STORE service for Leksell GammaPlan® only

C-STORE SCU conformance

Leksell GammaPlan® and Leksell SurgiPlan® provides standard conformance for Storage as a SCU. The systems performs a Conformance Level 0 for Storage, i.e., not all DICOM Type 1 and 2 attributes received earlier by another module may have been stored for re-export.

Presentation context acceptance criterion

Not applicable.

Transfer syntax selection policies

Not applicable.

Remote system requests verification

Associated real world activity

Leksell GammaPlan® or Leksell SurgiPlan® requests associations from remote systems to verify the application level communication using the C-ECHO command.

Presentation context table

Presentation Context Table					
Abstract Syntax		Transfer Syntax List		Role	Extended Negotiation
Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

Table 8: Presentation context table: C-ECHO service

C-ECHO SCU conformance

Leksell GammaPlan® and Leksell SurgiPlan® provides standard conformance for Verification as an SCU.

Presentation context acceptance criterion

Not applicable.

Transfer syntax selection policies

Not applicable.

4 Communication profiles

4.1 Supported Communication Stacks

The Elekta Storage Server, Leksell GammaPlan® and Leksell SurgiPlan® provides DICOM V3.0 TCP/IP Network Communication Support as defined in part 8 of the DICOM standard.

4.2 TCP/IP Stack

Elekta Storage Server inherits the TCP/IP stack from the LINUX operating system upon which they execute.

4.3 OSI Stack

Not supported.

4.4 Physical Media Support

Reading DICOM Object stored on CD-ROM

Specification

Leksell GammaPlan® and Leksell SurgiPlan® can read DICOM part 10 formatted Objects stored on CD-R with the ISO/IEC 9660 Media Format. All DICOM objects on the CD-R will be sent to the Elekta Storage Server. I.e. the DICOM Directory File (DICOMDIR) is not used and it is not possible to select separate files to be stored. The Leksell GammaPlan® and Leksell SurgiPlan® are then not conformant to any application profiles defined in the DICOM standard.

Leksell GammaPlan® and Leksell SurgiPlan® is partially conformant as FSR because it supports the M-READ service but does not the M-INQUIRE FILE service. The following table defines which objects are read by the application and which transfer syntaxes are supported:

Information Object Definition	Service Object Pair Class UID	Transfer Syntax	UID
CT Image	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2
		Explicit VR Little Endian	1.2.840.10008.1.2.1
		Explicit VR Big Endian	1.2.840.10008.1.2.2
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70
		JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
MR Image	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2
		Explicit VR Little Endian	1.2.840.10008.1.2.1
		Explicit VR Big Endian	1.2.840.10008.1.2.2
		JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1])	1.2.840.10008.1.2.4.70
		JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2.4.57
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2
		Explicit VR Little Endian	1.2.840.10008.1.2.1
		Explicit VR Big Endian	1.2.840.10008.1.2.2
		JPEG Lossless, Non-Hierarchical, First-Order	1.2.840.10008.1.2.4.70

		Prediction (Process 14 [Selection Value 1]) JPEG Lossless, Non-Hierarchical (Process 14)	 1.2.840.10008.1.2.4.57
PET Image	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]) JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.57
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian JPEG Lossless, Non-Hierarchical, First-Order Prediction (Process 14 [Selection Value 1]) JPEG Lossless, Non-Hierarchical (Process 14)	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2 1.2.840.10008.1.2.4.70 1.2.840.10008.1.2.4.57
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian Explicit VR Little Endian Explicit VR Big Endian	1.2.840.10008.1.2 1.2.840.10008.1.2.1 1.2.840.10008.1.2.2

Table 9: Media Storage: Objects and Transfer

Writing DICOM Object to USB flash drives

Specification

Leksell GammaPlan[®] and Leksell SurgiPlan[®] can write DICOM part 10 formatted objects to USB flash drives. They are partially conformant as FSC as it is able to perform M-WRITE but not M-INQUIRE FILE SET or M-INQUIRE FILE Media Storage Operation. They are not conformant to any application profiles defined in the DICOM standard. The following table defines which objects are written by the applications and which transfer syntaxes are supported:

Information Object Definition	Service Object Pair Class UID	Transfer Syntax	UID
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CT Image	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2
MR Image	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2
X-Ray Angiographic Image	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2
PET Image	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian	1.2.840.10008.1.2
Secondary Capture Image	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2

Table 10: Media Storage: Objects and Transfer supported by Leksell GammaPlan® and Leksell SurgiPlan®.

Leksell GammaPlan® also supports writing the following objects:

Information Object Definition	Service Object Pair Class UID	Transfer Syntax	UID
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Implicit VR Little Endian	1.2.840.10008.1.2
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Implicit VR Little Endian	1.2.840.10008.1.2

Table 11: Media Storage: Objects and Transfer supported only by Leksell GammaPlan®

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5 Extensions, Specialization, Privatization

Not applicable.

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6 Configuration

Configuration is done by editing application configuration files. It is intended to be performed by Elekta service engineers only.

6.1 Elekta Storage Server

The Application Entity Title for the Storage Server and the port is defined in a configuration file. The default AET (as generated when the application is installed) is ELEKTA_STORAGE and the port is 104.

6.2 Leksell GammaPlan® and Leksell SurgiPlan®

The AET for Leksell GammaPlan® and Leksell SurgiPlan® cannot be configured. The value is ELEKTA_CLIENT. The AET, ip-address and port of the remote DICOM server (SCP) to which the DICOM object should be exported can be configured by the user. The maximum PDU size for Leksell GammaPlan® Leksell SurgiPlan® is configurable from a minimum of 4 Kbytes. There is no upper limit. It is limited by the available system resources. The default value is 64 Kbytes.

7 Support of Extended Character Sets

Leksell GammaPlan® and Leksell SurgiPlan® support the following character sets in addition to the default when handling DICOM RT objects:

- ISO_IR 100
- ISO_IR 101
- ISO_IR 109
- ISO_IR 110
- ISO_IR 144
- ISO_IR 127
- ISO_IR 126
- ISO_IR 138
- ISO_IR 148
- ISO_IR 192

Leksell GammaPlan® and Leksell SurgiPlan® support the following character sets in addition to the default when handling DICOM Images:

- ISO_IR 100

Code extension techniques are currently not supported.

A. Image Objects in the Database

The tables below list the attributes vital for Leksell GammaPlan[®] and Leksell SurgiPlan[®] together with their DICOM tags.

Name	TAG	Usage/Comment
Patient Name	(0010, 0010)	Identification
Patient ID	(0010, 0020)	Identification
Study Date	(0008,0020)	Identification
Study Time	(0008,0030)	Identification
Instance Number	(0020,0013)	User information
Patient Orientation	(0020, 0020)	3D reconstruction
Modality	(0008, 0060)	Identification/Validation See Note 1
Image Orientation Patient	(0020, 0037)	3D reconstruction
Bits Allocated	(0028, 0100)	Pixel data interpretation and display
Bits stored	(0028, 0101)	Pixel data interpretation and display
Samples per pixel	(0028, 0002)	Pixel data interpretation and display
Photometric Interpretation	(0028, 0004)	Pixel data interpretation
High Bit	(0028, 0102)	Pixel data interpretation and display
Pixel Representation	(0028, 0103)	Pixel data interpretation and display
Columns	(0028, 0011)	Pixel data interpretation and display
Rows	(0028, 0010)	Pixel data interpretation and display
Pixel Data	(7FE0, 0010)	Pixel data interpretation and display
Pixel Data Group Length	(7FE0,0000)	Must match length of Pixel Data attribute
Transfer Syntax UID	(0002, 0010)	Criteria to perform byte swapping
Pixel spacing	(0028, 0030)	3D reconstruction
Pixel Aspect Ratio	(0028,0034)	Pixel data interpretation and display
Series Number	(0020, 0011)	Separation of a stack in several series
Instance Number	(0020, 0013)	User information
Slice Location	(0020, 1041)	Separation of a stack in several series

Study Instance UID	(0020, 000D)	Separation of a stack in several series
Image Position Patient	(0020, 0032)	3D reconstruction
Slice Thickness	(0018, 0050)	3D reconstruction/validation. See Note 2
Spacing between Slices	(0018, 0088)	3D reconstruction/validation See Note 2
CT rescale slope	(0028, 1053)	Pixel data interpretation and display
CT rescale intercept	(0028, 1052)	Pixel data interpretation and display
Pixel Padding Value	(0028, 0120)	Pixel data interpretation and display
Window Center	(0028, 1050)	Pixel data interpretation and display
Window Width	(0028, 1051)	Pixel data interpretation and display
Manufacturer	(0008, 0070)	User information
Series Instance UID	(0020, 000E)	Separation of a stack in several series
SOP Instance UID	(0008, 0018)	Image object identification
Series Type	(0054,1000)	For rejection of dynamic PET studies.
Number Of Frames	(0028,0008)	For rejection of multi frame angio studies.
SOP Class UID	(0008,0016)	Identification/Validation
Specific Character Set	(0008,0005)	Character encodings
Frame of Reference UID	(0020,0052)	Image to RT object references.

Table 12: Attributes used by Elekta applications

Note 1

The accepted values for "modality" are: CT, MR, XA, PT, RTSTRUCT, OT and DS. Note DS is a retired enumerated value for modality since the introduction of XA, but it can still be found in some image headers.

Note 2

For a valid 3D reconstruction, it is required that "slice thickness" and "spacing between slices" do not differ more than an application-configured tolerance.