Elekta Limited

DICOM Conformance Statement
For
XVI
Release 5.1

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CONTENTS

1 Introduction

This chapter provides general information about the purpose, scope and contents of this Conformance Statement.

1.1 Scope and field of application

The scope of this DICOM Conformance Statement is to facilitate data exchange with equipment of Elekta Limited. This document specifies the compliance to the DICOM standard (formally called the NEMA PS 3.2-2021b 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 Pair (SOP) Classes, Roles, Information Object Definitions (IOD) and Transfer Syntax's.

The field of application is the integration of the Elekta Limited equipment into an environment of medical devices.

This Conformance Statement should be read in conjunction with the DICOM standard and its addenda.

1.2 Intended audience

This Conformance Statement is intended for:

- (potential) customers,
- system integrators of medical equipment,
- marketing staff interested in system functionality,
- software designers implementing DICOM interfaces.

It is assumed that the reader is familiar with the DICOM standard.

1.3 Contents and structure

The DICOM Conformance Statement is contained in chapter 2 through 6 and follows the contents and structuring requirements of DICOM PS 3.2-2021b. Additionally, the Appendices following chapter 6 specify the details of the applied IODs, SCP-specific status codes and extended configuration details.

1.4 Used definitions, terms and abbreviations

- DICOM definitions, terms and abbreviations are used throughout this Conformance Statement. For a description of these, see DICOM PS 3.2-2021b.
- The word Elekta in this document refers to Elekta Limited.
- The phrase Elekta XVI in this document refers to the Elekta XVI release 5.1 used in Elekta Synergy®, Elekta Infinity™, Versa HD™, Elekta Harmony, Elekta Harmony Pro, Elekta Evo.

1.5 References

[NEMA PS3]
Digital Imaging and Communications in Medicine (DICOM) Standard, available free at http://medical.nema.org/

1.6 Important notes to the reader

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 analyse thoroughly the application requirements and to specify a solution that integrates Elekta equipment with non-Elekta equipment.

- 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 to be 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 prescription and prescription related data. Prospective users may contact Elekta for up-to-date information regarding available validation status and any known compatibility issues with specific 3rd party vendors. Ultimately, however, it is the responsibility of the user (or user's agent) to specify an appropriate test suite and to carry out additional validation tests on combinations of equipment used within the user's environment. In particular, integrators should not assume that the Elekta equipment would always be able to detect all forms of invalid data originating from 3rd party equipment.

- 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 is actively involved in this evolution and 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 and/or incompatibility.

2 Implementation Model

The Elekta XVI SCP stores received DICOM message information in the Transit Dicom Database. The location of the Transit Dicom database is specified in the local Elekta XVI configuration file.
Elekta XVI is a networked information system comprising Control Systems and Operators Consoles for use with Elekta Linear Accelerators, together with a centralised Patient database for Image guidance therapy and Portal imaging purposes.

2.1 Application Data Flow Diagram

Elekta XVI behaves as a single Application Entity (AE). The related Implementation Model is shown in Figure 1.

2.2 Functional definition of Application Entity

Elekta XVI application entity acts as Service Class Provider (SCP) Storage Service Class, Service Class User (SCU) Storage Service Class and SCU Query/Retrieve Service Class.

The Application Entity is active when the Elekta XVI system is switched on.

2.3 Sequencing of Real-World Activities

Not applicable.

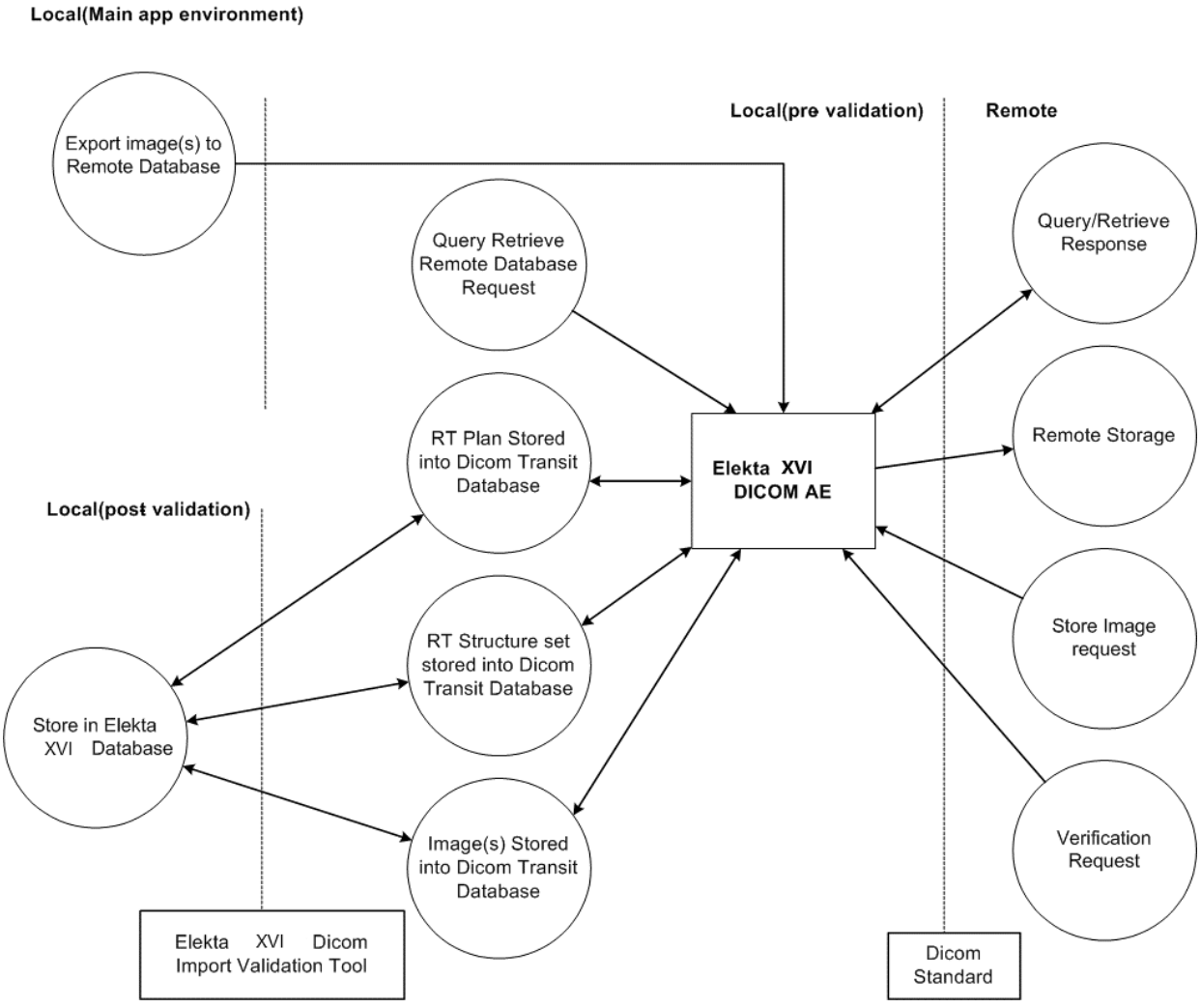

Figure 1 Elekta XVI Dicom implementation model

2.4 AE Specification

Elekta XVI Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCP:

Table 1 SOP Classes supported by Elekta XVI as SCP

RT Plan Storage - STORE	1.2.840.10008.5.1.4.1.1.481.5
RT Structure Set Storage - STORE	1.2.840.10008.5.1.4.1.1.481.3
RT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.481.1
SC Image Storage - STORE	1.2.840.10008.5.1.4.1.1.7
CT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.2
Raw Data Storage – STORE	1.2.840.10008.5.1.4.1.1.66
Verification	1.2.840.10008.1.1

Elekta XVI Application Entity provides Standard Conformance to the following DICOM V3.0 SOP classes as an SCU:

Table 2 SOP Classes supported by Elekta XVI as SCU

Patient Root Query/Retrieve Info Model - FIND	1.2.840.10008.5.1.4.1.2.1.1
Patient Root Query/Retrieve Info Model - MOVE	1.2.840.10008.5.1.4.1.2.1.2
SC Image Storage - STORE	1.2.840.10008.5.1.4.1.1.7
CT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.2
RT Image Storage - STORE	1.2.840.10008.5.1.4.1.1.481.1
Raw Data Storage – STORE	1.2.840.10008.5.1.4.1.1.66
Spatial Registration Storage - STORE	1.2.840.10008.5.1.4.1.1.66.1
Enhanced X-Ray Radiation Does SR Storage - STORE	1.2.840.10008.5.1.4.1.1.88.76

2.4.1 The Dicom Import Validation Tool mechanism:

All Dicom data received will be first saved as Dicom files into a local Elekta XVI DICOM Transit database. The location of this database is settable through Elekta XVI sri.ini initialisation file. The success of the transfer into the Elekta XVI DICOM Transit database will depend on the results of a Dicom validation test (test the Dicom object is valid as far as Dicom is concerned) and the compliance to our internal Validation rules (described in Appendix A).

To move the Dicom messages from the Elekta XVI DICOM Transit database to the Main Elekta XVI database the user will use the Elekta XVI Dicom Import Validation Tool (DIVT). This tool will ensure that the objects the user wishes to import are meeting more Elekta XVI Dicom validation rule. The tool requires the user to manually validate an import.

In order to import a CT Image set, a RT Plan and a RT Structure set, these 3 different objects must be part of the same study and be linked by some Dicom Tags (see **Note XV**). The RT Plan must contain an isocenter. The CT Image set must contain at least 2 images.

2.4.2 4D CT export

2.4.2.1 Export options:

XVI5.1 introduces options in order to export 4D CBCT in 3 different ways.
The Series Description (0008, 103E) can be used to detect which option is used and maximum number of slices to expect. (See Series Description)
Image comment (0020, 4000) can be used to know what 4D phase is being exported and the total number of phases. (See Image Comments)

1. **Averaged:** Equivalent to XVI 4.5 export of 4D data where all phases are averaged into one 3D phase.

2. **All phases:**

   a. If following setting in Sri.ini is set: [Dicom]OneSeriesForAllPhases=1

   All phases are exported one after the other starting with phase 0. The series description contains information about the total number of phases and maximum number of slices to expect. (The encoding is described here: Note XX 4D Phases:

   b. If following setting in Sri.ini is not set or set to 0: [Dicom]OneSeriesForAllPhases=0

   Each phase has a different series instance UID and series ID. The series description will be formatted as followed :

   PhaseIndex <index>/<max index> (TotalPhases <total>).CumulPhaseWeight: <cumulative weight>

   index : 0 based index .
   total: total number of 4d phases
   cumulative weight: weight of each previous phase and currently exported phase (value between 0 and 1)

3. **Single phase:** User can select a single phase (0 indexed) and export it as a 3D data set. The Series Description (0008, 103E) can be used to detect this option is used and which phase is being exported against the total number of phases. Series description will also contain information about maximum slices to expect.

2.4.2.2 Warning

XVI DOES NOT SUPPORT 4D CT IMPORTS and therefore 4D to 4D registration. There are measures in place to detect attempts to import such data but some different encoding of 4D data might make these detection check fail.
Importing 4D data undetected by XVI could result in unpredictable registration.

2.4.3 Association Establishment Policies

2.4.3.1 General

DICOM APPLICATION CONTEXT	
Application Context Name	1.2.840.10008.3.1.1.1

2.4.3.2 Number of Associations

Elekta XVI will support one active association as a Service Class Provider at a time.
The number of simultaneous pending associations supported is configurable via initialisation file mergecom.pro. The default is 5.

2.4.3.3 Asynchronous Nature

Elekta XVI does not support asynchronous operations and will not perform asynchronous operation negotiation.

2.4.3.4 Implementation Identifying Information

Release 5.1
The Implementation Class UID is: 1.3.46.423632.140000.5.1.0.0
The implementation version name is: XVI5.1.0.0

2.4.4 Association Initiation Policy

Elekta XVI initiates associations as a result of the following local real-world activities:

- The operator requests export of one or more images from the local database to a remote application (see section 2.4.4.1)
- The operator queries a remote database (see section 2.4.4.2)
- The operator requests retrieval of one or more Dicom Object(RT Plan, RT Structure Set, CT Image, RT Image, SC Image) following querying of a remote database (see section 2.4.4.3)

2.4.4.1 Export Image(s) from Elekta XVI to Remote Application

2.4.4.1.1 Associated Real World Activity

The operator exports one or more images from the local Elekta XVI database to a remote application by means of the Export function (accessed via the Elekta XVI system user interface). After selecting the image(s) to be exported, and nominating the remote peer DICOM application entity, the operator confirms the image transfer request.

Elekta XVI initiates one association to the selected peer and uses it to send the selected image(s) via C-STORE requests (and to receive the associated C-STORE Responses).

The association is released by Elekta XVI after successful transfer of the image(s), or, in the event of transfer errors, when Elekta XVI determines that too many errors have occurred.

2.4.4.1.2 Proposed Presentation Contexts

Elekta XVI will propose the following presentation contexts:

Table 3 Proposed Presentation Contexts for Elekta XVI Import

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
SC 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	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	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
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	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
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	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	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
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	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

2.4.4.1.3 C-STORE SCU Conformance

While Elekta XVI is busy transferring, the Busy status is displayed on the console and the user interface allows no interaction.

Elekta XVI has the following behaviour upon successful and unsuccessful transfer of images:

- Success (return status 0000)

The user is notified of progress during transfer and normal control is returned upon completion of all transfers.

- Refused (return status A7xx) Error (return status A9xx or Cxxx) and Warning (return status B00x)

The user is notified that an (unspecified) error occurred whilst transferring an image. If the failure was specifically due to a Network error the user is additionally notified of this, and any outstanding transfers are cancelled immediately. For any other transfer failures, Elekta XVI will attempt to continue transferring any remaining images in the selected set. If more than 5 transfer failures are reported during any export request the user is notified that too many errors have occurred, and any further outstanding transfers are cancelled.

APPENDIX A lists the applied DICOM attributes in the Secondary Capture IOD, RT Plan IOD, RT Structure Set IOD, RT Image IOD and CT Image IOD that are sent by Elekta XVI, and the mapping between these DICOM attributes and the Elekta XVI database fields.

2.4.4.2 Query a Remote Database

2.4.4.2.1 Associated Real World Activity

The operator queries a remote database by means of the Patient DICOM Import function (accessed via the Elekta XVI system user interface). The function permits the operator to browse the lists of patients held on remote applications and their corresponding Patient/Study/Series/Image hierarchies.

- Each time the operator selects a remote DICOM application and clicks the “query” button, Elekta XVI initiates an association to the selected entity. It uses it to send a single C-FIND request for the list of filtered patients available on the remote system (and to receive the associated C-FIND responses). To filter the request the user can use the wildcard character, it replaces any substring. The association is released immediately by Elekta XVI once all C-FIND responses have been received.
- Each time the operator selects a Patient, Study or Series from those presented as a result of a query, Elekta XVI initiates a new association to the selected entity. This is used to send a single C-FIND request at the Level of Patient, Study, Series for the list of Studies, Series or Images available respectively (and to receive the associated C-FIND responses). The association is released immediately by Elekta XVI once all C-FIND responses have been received.

2.4.4.2.2 Proposed Presentation Contexts

Elekta XVI will propose the following presentation contexts:

Table 4 Proposed Presentation Contexts for Elekta XVI Remote Database Query

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Model Query/Retrieve FIND	1.2.840.10008.5.1.4.1.2.1.1	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

2.4.4.2.3 C-FIND SCU Conformance

Elekta XVI generates queries containing optional keys and displays the corresponding attributes from C-FIND responses into the user interface. If the remote application does not support optional keys (determined by service status Pending FF01) Elekta XVI will silently ignore those attributes, displaying them as blank, and continue to receive responses.

The Required, Unique and Optional keys used in Elekta XVI queries at the respective levels are listed below:

Table 5 Patient Level Attributes used as Keys in C-FIND Queries

Patients Name	(0010, 0010)	R
Patient ID	(0010, 0020)	U
Patient's Birth Date	(0010, 0030)	O
Patient's Sex	(0010, 0040)	O

Table 6 Study Level Attributes used as Keys in C-FIND Queries

Study Instance UID	(0020, 000D)	U
Study ID	(0020, 0010)	R
Study Date	(0008, 0020)	R
Study Time	(0008, 0030)	R
Accession Number	(0008, 0050)	R
Study Description	(0008, 1030)	O

Table 7 Series Level Attributes used as Keys in C-FIND Queries

Modality	(0008, 0060)	R
Series Instance UID	(0020, 000E)	U
Series Number	(0020, 0011)	R
Series Date	(0008, 0021)	O
Series Time	(0008, 0031)	O

Table 8 Image Level Attributes used as Keys in C-FIND Queries

Image Number	(0008, 0013)	R
SOP Instance UID	(0008, 0018)	U
Image Date	(0008, 0023)	O
Image Time	(0008, 0033)	O

2.4.4.3 Retrieve Image(s) from a Remote Database

2.4.4.3.1 Associated Real World Activity

The operator retrieves one or more images from a remote application by means of the Patient DICOM Import function, having first performed a query on the remote database (as described in section 2.4.4.2). After selecting the image(s) from a selected Series to be imported, the operator confirms the Dicom object transfer request.

Elekta XVI initiates one association to the selected peer and uses it to retrieve the selected Dicom object(s) via C-MOVE requests (and to receive the associated C-MOVE responses).

The association is released by Elekta XVI after successful transfer of the Dicom object(s), or, in the event of transfer errors, when Elekta XVI determines that too many errors have occurred.

The Dicom object(s) are stored into the Elekta XVI DICOM Transit database as Dicom files (see section 2.4.1).

2.4.4.3.2 Proposed Presentation Contexts

Elekta XVI will propose the following presentation contexts:

Table 9 Proposed Presentation Contexts for Elekta XVI Remote Image Retrieve

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
Patient Root Model Query/Retrieve MOVE	1.2.840.10008.5.1.4.1.2.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

2.4.4.3.3 C-MOVE SCU Conformance

The Elekta XVI AE provides standard conformance.

C-MOVE requests are issued at the Image level for each Dicom object selected for retrieval.

2.4.5 Association Acceptance Policy

Elekta XVI SCP Application Entity accepts associations for the following purposes:

- To allow remote applications to store Planning information and images into the Elekta XVI Dicom Transit database (see section 2.4.5.1 below)
- To allow remote applications to verify application level communication with Elekta XVI (see section 2.4.5.2 below)

Elekta XVI may accept association requests from remote stations depending on Elekta XVI configuration:

- The Application Entity rejects association requests that incorrectly address Elekta XVI AE, i.e. from applications that offer a wrong “called AE title”. Elekta XVI AE title is defined during configuration of the system (See Section 5.1.1).

2.4.5.1 Store RT data and Images into Elekta XVI Database

2.4.5.1.1 Associated Real World Activity

Elekta XVI accepts associations from remote systems that wish to send images (RT Image, CT, SC Image) or RT data (RT Plan , RT Structure set) or Raw Data for storage into the Elekta XVI database.

2.4.5.1.2 Presentation Context Table

Any of the presentation contexts shown in Table 10 and Table 11 are acceptable:

Table 10 Acceptable Presentation Contexts for Elekta XVI Non image Object Storage

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
RT Plan Storage - STORE	1.2.840.10008.5.1.4.1.1.481.5	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- STORE	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		

Table 11. Acceptable Presentation contexts Elekta XVI Image Storage

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
CT Image Storage - STORE	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	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1	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
SC 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	SCP	None
		Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
Raw Data Storage	1.2.840.10008.5.1.4.1.1.66	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

2.4.5.1.3 C-STORE SCP Conformance

Elekta XVI provides standard conformance.

The AE is a Conformance Level 0 Storage SCP: not all DICOM Type 1 and 2 attributes are mapped in the database. However, no information is lost because we store the original Dicom message (except for SC Image) in the database and map only the attributes we are interested in. This should allow Elekta XVI to make use of more Dicom attributes as its development progresses.

Incoming Dicom objects will be stored into a temporary database called Elekta XVI Dicom Transit Database.
(See 2.4.1)

APPENDIX A. specifies which attributes from the received RT Plan C-STORE requests are stored for internal Elekta XVI use.

APPENDIX B. specifies which attributes from the received RT Structure Set C-STORE requests are stored for internal Elekta XVI use.

APPENDIX C. specifies which attributes from the received CT Image C-STORE requests are stored for internal Elekta XVI use.

APPENDIX B Explain the Extended Image Import Capability of Elekta XVI.

APPENDIX C lists the specific C-STORE response status codes returned by the AE.

The duration of the storage of the RT Data and Images is determined by the operator of Elekta XVI.

2.4.5.1.4 Presentation Context Acceptance Criterion

Elekta XVI accepts all contexts in the intersection of the proposed and acceptable presentation contexts. There is no check for duplicate contexts. Duplicate contexts are accepted.

2.4.5.1.5 Transfer Syntax Selection Policies

Elekta XVI prefers its native byte ordering (Little Endian), and will prefer explicit over implicit VR.

2.4.5.2 Verify Application Level Communication

2.4.5.2.1 Associated Real World Activity

Elekta XVI accepts associations from systems that wish to verify the application level communication using the C-ECHO command.

2.4.5.2.2 Presentation Context Table

Any of the presentation contexts shown in Table 12 below are acceptable:

Table 12 Acceptable Presentation Contexts for Verification

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
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

2.4.5.2.3 C-ECHO SCP Conformance

Elekta XVI provides standard conformance.

2.4.5.2.4 Presentation Context Acceptance Criterion

Elekta XVI accepts all contexts in the intersection of the proposed and acceptable presentation contexts. There is no check for duplicate contexts. Duplicate contexts are accepted.

2.4.5.2.5 Transfer Syntax Selection Policies

Elekta XVI prefers its native byte ordering (Little Endian), and will prefer explicit over implicit VR.

3 Communication Profiles

3.1 Supported Communication Stacks

Elekta XVI application provides DICOM V3.0 TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

3.2 Physical Media Support

Elekta XVI supports Ethernet ISO.8802-3.
On Elekta supplied hardware platforms the connection type provided is 100/10BASE-T (RJ45 twisted pair).

4 Extensions/Specialisations/Privatisations

Not applicable.

5 Configuration

Elekta XVI DICOM settings are configured by means of a DICOM-specific configuration program.

Configuration changes are effective immediately they are committed.

Configuration is intended to be performed by Elekta service engineers only.

5.1 AE Title/Presentation Address mapping

5.1.1 Local AE Titles and Presentation Addresses

The local Application Entity Title is configurable via initialisation file sri.ini. The default is “Default”.

The listen port number is configurable via the initialisation file mergecom.pro. The default is 104.

5.1.2 Remote AE Titles and Presentation Addresses

All remote applications that wish to communicate with Elekta XVI must be defined at Elekta XVI DICOM configuration time. The following information must be provided:

- The remote AE Title.
- The TCP/IP host name on which the remote application resides.
- The IP address of the remote host.
- The SOP classes for which the application provides conformance as an SCP.
- A user-readable alias string for identifying the remote application within the XVI user interface, (this string is presented to the operator when selecting a remote system, not the Remote AE Title.)

5.2 Configurable Parameters

5.2.1 Communication Parameters

- The Maximum PDU size is configurable.
- The maximum number of simultaneous pending associations is configurable.
- The AE can be configured either to accept or reject association requests offering an unknown called AE title.
- Dicom Upper Layer Timeouts are configurable.

6 Support of Extended Character Sets

None.

A. Applied RT Plan IOD and Mapping to Elekta XVI Database

The modules selected from the RT Plan IOD of DICOM for prescription import are given in Table 13 below. If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 13 Applied Modules in the RT Plan IOD for Import (SCP Role)

Patient	Patient	M
Study	General Study	M
Series	RT Series (Ignored)	M
Plan	RT General Plan	M
	RT Patient Setup	U
	RT Fraction Scheme	U
	RT Beams	C
	Approval (Ignored)	U
	SOP Common	M

A.1 RT Plan IOD Modules

Table 14 to Table 20 specify, for each of the applied modules above, the attributes stored by Elekta XVI, further details of mapping onto the Elekta XVI database, and any attribute specific constraints applicable to their use.

Ignored attributes are not stored into the Elekta XVI patient database. **However, all DICOM objects must conform to the DICOM standard.** If any part of a prescription does not conform to the standard then that prescription is not saved into the database and the storage request is rejected. Thus, Elekta XVI performs validation of the entire applied IOD. I.e. where attributes irrelevant to Elekta XVI are included in a message, they must still have values that are valid according to the DICOM standard. Storage requests containing invalid attributes will be REJECTED. (See Table 101, Status Code A901).

Table 14 RT Plan Storage SOP Class (SCP) – Patient Module

Patients Name	(0010,0010)	PN 1	2	Split into Patient.first_name, Patient.last_name, Patient.mid_name (Prefix, Suffix not stored). See Note I , Note II
Patient ID	(0010, 0020)	LO 1	2	Patient.id See Note II
Patient's Birth Date	(0010, 0030)	DA 1	2	Patient.birth_date
Patients Sex	(0010, 0040)	CS 1	2	Patient.sex
Referenced Patient Sequence	(0008, 1120)	SQ 1	3	Ignored
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Patient's Birth Time	(0010, 0032)	TM 1	3	
Other Patient IDs	(0010, 1000)	LO 1-N	3	
Other Patient Names	(0010, 1001)	PN 1-N	3	
Ethnic Group	(0010, 2160)	SH 1	3	
Patient Comments	(0010, 4000)	LT 1	3	

Note I Handling of Empty Patient Identification Attributes (RT Plan)

The Patient ID (0010, 0020) and Patient Name (0010, 0010) attributes of the Patient Module are specified by DICOM as Type 2 and so may legally have zero length.

As a safety measure, however, Elekta XVI treats these attributes as Type 1 and will REJECT any RT Plan Storage request **containing** zero length values for these attributes. Which means these RT Plans won't enter the Elekta XVI DICOM Transit database. (See
Table **101**, Status Code C001).

Note II Patient ID Already Exists in Elekta XVI Database (RT Plan)

If a patient with the Patient ID specified in the RT Plan Storage request already exists in the Elekta XVI Main database, no further Patient Module attributes in the request will be imported. The check for an existing Patient ID is insensitive to case or leading/trailing spaces.

Table 15 RT Plan Storage SOP Class (SCP) – General Study Module

Study Instance UID	(0020, 000D)	UI 1	1	Treatment.dicom_uid see Note III
Study Date	(0008, 0020)	DA 1	2	Ignored
Study Time	(0008, 0030)	TM 1	2	
Referring Physicians Name	(0008, 0090)	PN 1	2	
Study ID	(0020, 0010)	SH 1	2	Treatment.id see Note III
Accession Number	(0008, 0050)	SH 1	2	
Study Description	(0008, 1030)	LO 1	3	Treatment.descrip see Note IV
Physician(s) of Record	(0008, 1048)	PN 1-N	3	Ignored
Name of Physician(s) Reading Study	(0008, 1060)	PN 1-N	3	
Referenced Study Sequence	(0008, 1110)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	

Note III Handling of Empty Study ID Attribute and treatment creation

An incrementing counter is prepended to the treatment id then ":" and one of the following.

The applied Study ID (0020, 0010) is specified by DICOM as Type 2 and so may legally have zero length**.** This field is normally used by Elekta XVI to identify the Treatment to be created or updated.

In the situation where the Study ID attribute is empty, Elekta XVI will attempt to use the Accession Number (0008, 0050, Type 2) attribute as a Treatment ID instead. In such cases it will also append the Treatment Description with the text ": TRTID derived (Accession No.)" to assist the operator.

In the situation where both the Study ID and Accession Number attributes are empty, Elekta XVI will use the last 16 digits of the Study Instance UID (0020, 000D) as a Treatment ID. In such cases it will also append the Treatment Description with the text ": TRTID derived (StudyInstanceUID.)" to assist the operator.

Extreme caution is advised when handling data with limited Study identification information present. It is the responsibility of the Elekta XVI operator to ensure that incoming image data containing an empty Study ID attribute is correctly identified and qualified before relocation into the main Elekta XVI Clinical database.

Note IV Treatment Description

The treatment description is made of the Plan Name appended to the Study description appended to the Plan Label.

Table 16 RT Plan Storage SOP Class (SCP) – RT General Plan Module

RT Plan Label	(300A, 0002)	SH 1	1	Treatment.name + used in Treatment.description
RT Plan Name	(300A, 0003)	LO 1	3	Treatment.name and Treatment.description created from RT Plan label + RT Plan name
RT Plan Description	(300A, 0004)	ST 1	3	Ignored
Operators Name	(0008, 1070)	PN 1-N	2	
RT Plan Date	(300A, 0006)	DA 1	2	
RT Plan Time	(300A, 0007)	TM 1	2	
Treatment Protocols	(300A, 0009)	LO 1-N	3	
Treatment Intent	(300A, 000A)	CS 1	3	
Treatment Sites	(300A, 000B)	LO 1-N	3	
RT Plan Geometry	(300A, 000C)	CS 1	1	
Referenced Structure Set Sequence	(300C, 0060)	SQ 1	1C	Used to link to RT Structure set (see **Note XV**)
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	Ignored
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	Used to link to RT Structure set (see **Note XV**)
Referenced Dose Sequence	(300C, 0080)	SQ 1	3	Ignored
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Referenced RT Plan Sequence	(300C, 0002)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
>RT Plan Relationship	(300A, 0055)	CS 1	1C	

Table 17 RT Plan Storage SOP Class (SCP) – RT Patient Setup Module

Patient Setup Sequence	(300A, 0180)	SQ 1	1	Ignored
>Patient Setup Number	(300A, 0182)	IS 1	1	
>Patient Position	(0018, 5100)	CS 1	1C	
>Patient Additional Position	(300A, 0184)	LO 1	1C	
>Fixation Device Sequence	(300A, 0190)	SQ 1	3	
>>Fixation Device Type	(300A, 0192)	CS 1	1C	
>>Fixation Device Label	(300A, 0194)	SH 1	2C	
>>Fixation Device Description	(300A, 0196)	ST 1	3	
>>Fixation Device Position	(300A, 0198)	SH 1	3	
>Shielding Device Sequence	(300A, 01A0)	SQ 1	3	
>>Shielding Device Type	(300A, 01A2)	CS 1	1C	
>>Shielding Device Label	(300A, 01A4)	SH 1	2C	
>>Shielding Device Description	(300A, 01A6)	ST 1	3	
>>Shielding Device Position	(300A, 01A8)	SH 1	3	
>Setup Technique	(300A, 01B0)	CS 1	3	
>Setup Technique Description	(300A, 01B2)	ST 1	3	
>Setup Device Sequence	(300A, 01B4)	SQ 1	3	
>>Setup Device Type	(300A, 01B6)	CS 1	1C	
>>Setup Device Label	(300A, 01B8)	SH 1	2C	
>>Setup Device Description	(300A, 01BA)	ST 1	3	
>>Setup Device Parameter	(300A, 01BC)	DS 1	2C	
>>Setup Reference Description	(300A, 01D0)	ST 1	3	
>Table Top Vertical Setup Displacement	(300A, 01D2)	DS 1	3	Can be used for import validation. See **Note V Import validation**
>Table Top Longitudinal Setup Displacement	(300A, 01D4)	DS 1	3	
>Table Top Lateral Setup Displacement	(300A, 01D6)	DS 1	3	

Note V Import validation

The validation of a Dicom import into the main database has 3 different modes configurable via the sri.ini file.

1. Isocenter validation: the user is asked to enter the isocenter defined in the plan he is about to import.
2. Patient setup table displacement validation: the user is asked to enter the Table top vertical, longitudinal, lateral setup
3. No validation.

In all cases the user is warned about the implication of importing a wrong plan and is presented with extra information about the plan and asked a confirmation.

Table 18 RT Plan Storage SOP Class (SCP) – RT Fraction Scheme Module

Fraction Group Sequence	(300A, 0070)	SQ 1	1	Ignored
>Fraction Group Number	(300A, 0071)	IS 1	1	
>Referenced Patient Setup Number	(300C, 006A)	IS 1	3	
>Referenced Dose Sequence	(300C, 0080)	SQ 1	3	
>>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
>Referenced Dose Reference Sequence	(300C, 0050)	SQ 1	3	
>>Referenced Dose Reference Number	(300C, 0051)	IS 1	1C	
>>Constraint Weight	(300A, 0021)	DS 1	3	
>>Delivery Warning Dose	(300A, 0022)	DS 1	3	
>>Delivery Maximum Dose	(300A, 0023)	DS 1	3	
>>Target Minimum Dose	(300A, 0025)	DS 1	3	
>>Target Prescription Dose	(300A, 0026)	DS 1	3	
>>Target Maximum Dose	(300A, 0027)	DS 1	3	
>>Target Underdose Volume Fraction	(300A, 0028)	DS 1	3	
>>Organ at Risk Full-volume Dose	(300A, 002A)	DS 1	3	
>>Organ at Risk Limit Dose	(300A, 002B)	DS 1	3	
>>Organ at Risk Maximum Dose	(300A, 002C)	DS 1	3	
>>Organ at Risk Overdose Volume Fraction	(300A, 002D)	DS 1	3	
>Number of Fractions Planned	(300A, 0078)	IS 1	2	
>Number of Fractions Per Day	(300A, 0079)	IS 1	3	
>Repeat Fraction Cycle Length	(300A, 007A)	IS 1	3	
>Fraction Pattern	(300A, 007B)	LT 1	3	
>Number of Beams	(300A, 0080)	IS 1	1	
>Referenced Beam Sequence	(300C, 0004)	SQ 1	1C	
>>Referenced Beam Number	(300C, 0006)	IS 1	1C	
>>Beam Dose Specification Point	(300A, 0082)	DS 3	3	
>>Beam Dose	(300A, 0084)	DS 1	3	
>>Beam Meterset	(300A, 0086)	DS 1	3	
>Number of Brachy Application Setups	(300A, 00A0)	IS 1	1	
>Referenced Brachy Application Setup Sequence	(300C, 000A)	SQ 1	1C	
>>Referenced Brachy Application Setup Number	(300C, 000C)	IS 1	1C	
>>Brachy Application Setup Dose Specification Point	(300A, 00A2)	DS 3	3	
>>Brachy Application Setup Dose	(300A, 00A4)	DS 1	3	

Table 19 RT Plan Storage SOP Class (SCP) – RT Beams Module

Beam Sequence	(300A, 00B0)	SQ 1	1	
>Beam Number	(300A, 00C0)	IS 1	1	Field.beam_number Field.ID (combined Beam Number and Name)
>Beam Name	(300A, 00C2)	LO, 1	3	Field.beam_name
>Beam Description	(300A, 00C3)	ST 1	3	Field.description
>Beam Type	(300A, 00C4)	CS 1	1	Ignored
>Radiation Type	(300A, 00C6)	CS 1	2	
>Treatment Machine Name	(300A, 00B2)	SH 1	2	
>Manufacturer	(0008, 0070)	LO 1	3	
>Institution Name	(0008, 0080)	LO 1	3	
>Institution Address	(0008, 0081)	ST 1	3	
>Institutional Department Name	(0008, 1040)	LO 1	3	
>Manufacturers Model Name	(0008, 1090)	LO 1	3	
>Device Serial Number	(0018, 1000)	LO 1	3	
>Primary Dosimeter Unit	(300A, 00B3)	CS 1	3	
>Referenced Tolerance Table Number	(300C, 00A0)	IS 1	3	
>Source-Axis Distance	(300A, 00B4)	DS 1	3	
>Beam Limiting Device Sequence	(300A, 00B6)	SQ 1	1	
>>RT Beam Limiting Device Type	(300A, 00B8)	CS 1	1	
>>Source to Beam Limiting Device Distance	(300A, 00BA)	DS 1	3	
>>Number of Leaf/Jaw Pairs	(300A, 00BC)	IS 1	1	
>>Leaf Position Boundaries	(300A, 00BE)	DS 3-N	2C	
>Referenced Patient Setup Number	(300C, 006A)	IS 1	3	
>Referenced Reference Image Sequence	(300C, 0042)	SQ 1	3	
>>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
>>Reference Image Number	(300A, 00C8)	IS 1	1C	
>>Start Cumulative Meterset Weight	(300C, 0008)	DS 1	3	
>>End Cumulative Meterset Weight	(300C, 0009)	DS 1	3	
>Planned Verification Image Sequence	(300A, 00CA)	SQ 1	3	
>>Start Cumulative Meterset Weight	(300C, 0008)	DS 1	3	
>>Meterset Exposure	(3002, 0032)	DS 1	3	
>>End Cumulative Meterset Weight	(300C, 0009)	DS 1	3	
>>RT Image Plane	(3002, 000C)	CS 1	3	
>>X-Ray Image receptor Angle	(3002, 000E)	DS 1	3	
>>RT Image Orientation	(3002, 0010)	DS 6	3	
>>RT Image Position	(3002, 0012)	DS 2	3	
>>RT Image SID	(3002, 0026)	DS 1	3	
>>Imaging Device-Specific Acquisition Parameters	(300A, 00CC)	LO 1-N	3	

>>Referenced Reference Image Number	(300C, 0007)	IS 1	3	
>Treatment Delivery Type	(300A, 00CE)	CS 1	3	
>Referenced Dose Sequence	(300C, 0080)	SQ 1	3	
>>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
>Number of Wedges	(300A, 00D0)	IS 1	1	
>Wedge Sequence	(300A, 00D1)	SQ 1	1C	
>>Wedge Number	(300A, 00D2)	IS 1	1C	
>>Wedge Type	(300A, 00D3)	CS 1	2C	
>>Wedge ID	(300A, 00D4)	SH 1	3	
>>Wedge Angle	(300A, 00D5)	IS 1	2C	
>>Wedge Factor	(300A, 00D6)	DS 1	2C	
>>Wedge Orientation	(300A, 00D8)	DS 1	2C	
>>Source to Wedge Tray Distance	(300A, 00DA)	DS 1	3	
>Number of Compensators	(300A, 00E0)	IS 1	1	
>Total Compensator Tray Factor	(300A, 00E2)	DS 1	3	
>Compensator Sequence	(300A, 00E3)	SQ 1	1C	
>>Compensator Number	(300A, 00E4)	IS 1	1C	
>>Material ID	(300A, 00E1)	SH 1	2C	
>>Compensator ID	(300A, 00E5)	SH 1	3	
>>Source to Compensator Tray Distance	(300A, 00E6)	DS 1	2C	
>>Compensator Rows	(300A, 00E7)	IS 1	1C	
>>Compensator Columns	(300A, 00E8)	IS 1	1C	
>>Compensator Pixel Spacing	(300A, 00E9)	DS 2	1C	
>>Compensator Position	(300A, 00EA)	DS 2	1C	
>>Compensator Transmission Data	(300A, 00EB)	DS 1-N	1C	
>>Compensator Thickness Data	(300A, 00EC)	DS 1-N	1C	
>Number of Boli	(300A, 00ED)	IS 1	1	
>Referenced Bolus Sequence	(300C, 00B0)	SQ 1	1C	
>>Referenced ROI Number	(3006, 0084)	IS 1	1C	
>Number of Blocks	(300A, 00F0)	IS 1	1	
>Total Block Tray Factor	(300A, 00F2)	DS 1	3	
>Block Sequence	(300A, 00F4)	SQ 1	1C	
>>Block Tray ID	(300A, 00F5)	SH 1	3	
>>Source to Block Tray Distance	(300A, 00F6)	DS 1	2C	
>>Block Type	(300A, 00F8)	CS 1	1C	
>>Block Divergence	(300A, 00FA)	CS 1	2C	
>>Block Number	(300A, 00FC)	IS 1	1C	
>>Block Name	(300A, 00FE)	LO 1	3	
>>Material ID	(300A, 00E1)	SH 1	2C	
>>Block Thickness	(300A, 0100)	DS 1	2C	
>>Block Transmission	(300A, 0102)	DS 1	2C	
>>Block Number of Points	(300A, 0104)	IS 1	2C	
>>Block Data	(300A, 0106)	DS 2-2N	2C	
>Applicator Sequence	(300A, 0107)	SQ 1	3	
>>Applicator ID	(300A, 0108)	SH 1	1C	
>>Applicator Type	(300A, 0109)	CS 1	1C	
>>Applicator Description	(300A, 010A)	LO 1	3	
>Final Cumulative Meterset Weight	(300A, 010E)	DS 1	1C	

>Number of Control Points	(300A, 0110)	IS 1	1	
>Control Point Sequence	(300A, 0111)	SQ 1	1	
>>Control Point Index	(300A, 0112)	IS 1	1C	
>>Block Thickness	(300A, 0100)	DS 1	2C	
>>Block Transmission	(300A, 0102)	DS 1	2C	
>>Block Number of Points	(300A, 0104)	IS 1	2C	
>>Block Data	(300A, 0106)	DS 2-2N	2C	
>Applicator Sequence	(300A, 0107)	SQ 1	3	
>>Applicator ID	(300A, 0108)	SH 1	1C	
>>Applicator Type	(300A, 0109)	CS 1	1C	
>>Applicator Description	(300A, 010A)	LO 1	3	
>Final Cumulative Meterset Weight	(300A, 010E)	DS 1	1C	
>Number of Control Points	(300A, 0110)	IS 1	1	
>Control Point Sequence	(300A, 0111)	SQ 1	1	
>>Control Point Index	(300A, 0112)	IS 1	1C	
>>Cumulative Meterset Weight	(300A, 0134)	DS 1	2C	Field.total_dose (used the 1st control point of the sequence)
>>Referenced Dose Reference Sequence	(300C, 0050)	SQ 1	3	
>>>Referenced Dose Reference Number	(300C, 0051)	IS 1	1C	Ignored
>>>Cumulative Dose Reference Coefficient	(300A, 010C)	DS 1	2C	
>>Nominal Beam Energy	(300A, 0114)	DS 1	3	Field.energy (used the 1st control point of the sequence)
>>Dose Rate Set	(300A, 0115)	DS 1	3	Field.dose_rate (used the 1st control point of the sequence)
>>Wedge Position Sequence	(300A, 0116)	SQ 1	3	
>>Wedge Position Sequence	(300A, 0116)	SQ 1	3	
>>>Referenced Wedge Number	(300C, 00C0)	IS 1	1C	
>>>Wedge Position	(300A, 0118)	CS 1	1C	
>>Beam Limit ing Device Position Sequence	(300A, 011A)	SQ 1	1C	Ignored
>>>RT Beam Limiting Device Type	(300A, 00B8)	CS 1	1C	
>>>Leaf/Jaw Positions	(300A, 011C)	DS 2-2N	1C	
>>Gantry Angle	(300A, 011E)	DS 1	1C	Field.gantry_angle (used the 1st control point of the sequence)
>>Gantry Rotation Direction	(300A, 011F)	CS 1	1C	
>>Beam Limiting Device Angle	(300A, 0120)	DS 1	1C	
>>Beam Limiting Device Rotation Direction	(300A, 0121)	CS 1	1C	
>>Patient Support Angle	(300A, 0122)	DS 1	1C	
>>Patient Support Rotation Direction	(300A, 0123)	CS 1	1C	
>>Table Top Eccentric Axis Distance	(300A, 0124)	DS 1	3	Ignored
>>Table Top Eccentric Angle	(300A, 0125)	DS 1	1C	
>>Table Top Eccentric Rotation Direction	(300A, 0126)	CS 1	1C	
>>Table Top Vertical Position	(300A, 0128)	DS 1	2C	
>>Table Top Longitudinal Position	(300A, 0129)	DS 1	2C	
>>Table Top Lateral Position	(300A, 012A)	DS 1	2C	

>>Isocenter Position	(300A, 012C)	DS 3	2C	Split into Isocenter.x , Isocenter.y , Isocenter.z DIVT: These values will be checked against user input if DIVT uses Isocenter as Plan Validation method. See **Note V Import validation**
>>Surface Entry Point	(300A, 012E)	DS 3	3	
>>Source to Surface Distance	(300A, 0130)	DS 1	3	Field.ssd (used the 1st control point of the sequence)

Table 20 RT Plan Storage SOP Class (SCP) – SOP Common Module

SOP Class UID	(0008, 0016)	UI 1	1	
SOP Instance UID	(0008, 0018)	UI 1	1	RTPlan.dicom_uid
Specific Character Set	(0008, 0005)	CS 1-N	1C	
Instance Creation Date	(0008, 0012)	DA 1	3	
Instance Creation Time	(0008, 0013)	TM 1	3	
Instance Creator UID	(0008, 0014)	UI 1	3	

B. Applied RT Structure Set IOD and mapping to Elekta XVI Database

B.1 Import of RT Structure Set

The modules selected from the RT Structure Set IOD of DICOM for prescription import are given in Table 21. If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 21 Applied Modules in the RT Structure Set IOD for Import (SCP Role)

Patient	Patient	M
Study	General Study (Ignored)	M
Series	RT Series (Ignored)	M
Equipment	General Equipment (Ignored)	M
Structure Set	Structure set	M
	ROI contour	M
	ROI Observation (Ignored)	M
	SOP Common	M

B.2 RT Structure Set IOD Modules

Table 22 to Table 25 specify, for each of the applied modules above, the attributes stored by Elekta XVI, further details of mapping onto the Elekta XVI database, and any attribute specific constraints applicable to their use.

Ignored attributes are not stored into the Elekta XVI patient database. **However, all DICOM objects must conform to the DICOM standard.** If any part of a RT Structure Set does not conform to the standard then that prescription is not saved into the database and the storage request is rejected. Thus, Elekta XVI performs validation of the entire applied IOD. I.e. where attributes irrelevant to Elekta XVI are included in a message, they must still have values that are valid according to the DICOM standard. Storage requests containing invalid attributes will be REJECTED. (See Table 101, Status Code A901).

Table 22 RT Structure Set Storage SOP Class (SCP) – Patient Module

Patients Name	(0010,0010)	PN 1	2	See Note VI
Patient ID	(0010, 0020)	LO 1	2	See Note VII
Patient's Birth Date	(0010, 0030)	DA 1	2	Ignored
Patients Sex	(0010, 0040)	CS 1	2	
Referenced Patient Sequence	(0008, 1120)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Patient's Birth Time	(0010, 0032)	TM 1	3	
Other Patient IDs	(0010, 1000)	LO 1-N	3	
Other Patient Names	(0010, 1001)	PN 1-N	3	
Ethnic Group	(0010, 2160)	SH 1	3	
Patient Comments	(0010, 4000)	LT 1	3	

Note VI Handling of Empty Patient Identification Attributes

The Patient ID (0010, 0020) and Patient Name (0010, 0010) attributes of the Patient Module are specified by DICOM as Type 2 and so may legally have zero length.

As a safety measure, however, **Elekta XVI** treats these attributes as Type 1 and will REJECT any RT Structure Set Storage request containing zero length values for these attributes. Which means this RT Structure Set won't enter the Elekta XVI DICOM Transit database. (See
Table **101**, Status Code C001).

Note VII Patient ID Already Exists in Elekta XVI Database

If a patient with the Patient ID specified in the RT Structure Set Storage request already exists in the Elekta XVI Main database, no further Patient Module attributes in the request will be imported. The check for an existing Patient ID is insensitive to case or leading/trailing spaces.

Note VIII Mapping in Main database

The values of this module are not used directly to populate a patient record in the main database because a RT Structure set is always imported with a RT Plan and at least 2 Ct images. Nonetheless the Elekta XVI SCP performs the same checks on Patient ID and Patient name, and an error on one these would result in a transfer failure to our Elekta XVI DICOM Transit database.

Table 23 RT Structure Set Storage SOP Class (SCP) – ROI contour Module

ROI Contour Sequence	(3006,0039)	SQ	1	See **Note IX**
>Referenced ROI Number	(3006,0084)	IS 1	1	See **Note IX**
>ROI Display Color	(3006,002A)	IS 3	3	See **Note IX** (used to create LUT table)
>Contour Sequence	(3006,0040)	SQ 1	3	See **Note IX**
>>Contour Number	(3006,0048)	IS 1	3	See **Note IX**
>>Attached Contours	(3006,0049)	IS 1-n	3	Ignored
>>Contour Image Sequence	(3006,0016)	SQ 1	3	
>>>Referenced SOP Class UID	(0008,1150)	UI 1	1C	
>>>Referenced SOP Instance UID	(0008,1155)	UI 1	1C	
>>>Referenced Frame Number	(0008,1160)	IS 1-n	1C	
>>Contour Geometric Type	(3006,0042)	CS 1	1C	See **Note IX**
>>Contour Slab Thickness	(3006,0044)	DS 1	3	Ignored
>>Contour Offset Vector	(3006,0045)	DS 3	3	
>>Number of Contour Points	(3006,0046)	IS 1	1C	See **Note IX**
>>Contour Data	(3006,0050)	DS 3-3n	1C	See **Note IX**

Table 24 RT Structure Set SOP Class (SCP) – Structure Set Module

Structure Set Label	(3006,0002)	SH 1	1	Ignored
Structure Set Name	(3006,0004)	LO 1	3	
Structure Set Description	(3006,0006)	ST 1	3	
Instance Number	(0020,0013)	IS 1	3	
Structure Set Date	(3006,0008)	DA 1	2	
Referenced Frame of Reference Sequence	(3006,0010)	SQ 1	3	
>Frame of Reference UID	(0020,0052)	UI 1	1C	Used to link to CT Images (see **Note XV**)
>Frame of Reference Relationship Sequence	(3006,00C0)	SQ 1	3	Ignored
>>Related Frame of Reference UID	(3006,00C2)	UI 1	1C	
>>Frame of Reference Transformation Type	(3006,00C4)	CS 1	1C	
>>Frame of Reference Transformation Matrix	(3006,00C6)	DS 16	1C	
>>Frame of Reference Transformation Comment	(3006,00C8)	LO 1	3	
>RT Referenced Study Sequence	(3006,0012)	SQ 1	3	Used to link to CT Images (see **Note X**)
>>Referenced SOP Class UID	(0008,1150)	UI 1	1C	
>>Referenced SOP Instance UID	(0008,1155)	UI 1	1C	
>>RT Referenced Series Sequence	(3006,0014)	SQ 1	1C	
>>>Series Instance UID	(0020,000E)	UI 1	1C	
>>>Contour Image Sequence	(3006,0016)	SQ 1	1C	Ignored
>>>>Referenced SOP Class UID	(0008,1150)	UI 1	1C	
>>>>Referenced SOP Instance UID	(0008,1155)	UI 1	1C	
>>>>Referenced Frame Number	(0008,1160)	IS 1-n	3	
Structure Set ROI Sequence	(3006,0020)	SQ 1	3	
>ROI Number	(3006,0022)	IS 1	1C	See Note IX (used to create Lookup table)
>Referenced Frame of Reference UID	(3006,0024)	UI 1	1C	Ignored
>ROI Name	(3006,0026)	LO 1	2C	See Note IX (used to create Lookup table
>ROI Description	(3006,0028)	ST 1	3	Ignored
>ROI Volume	(3006,002C)	DS 1	3	
>ROI Generation Algorithm	(3006,0036)	CS 1	2C	
>ROI Generation Description	(3006,0038)	LO 1	3	

Note IX Useful attribute not saved in database:
These attributes are used in processing a visualisation file compatible with XVI viewer during import from the Elekta XVI DICOM Transit database to the main database.

Note X Linking RT Structure set and CT series:
In addition to the cross check on Frame of Reference UID (0020,0052) declared in CT Images and RT Structure set, after import was initiated XVI will check that the RT Structure set contain the following information:
>RT Referenced Study Sequence (3006,0012)
>> Referenced SOP Instance UID (0008,1155)
>> RT Referenced Series Sequence (3006,0014)
>>> Series Instance UID (0020,000E)

If any of this information is not present, XVI will display a warning as this information is required to be certain that the CT series imported with this Dicom data set is the one that was used during planning and not another scan that was made before or after the planning scan without zeroing the CT table in between.
If this information is present XVI will validate it against the information present in the CT series being imported. If a discrepancy is detected an error will be displayed and the import will stop.

Table 25 RT Structure Set Storage SOP Class (SCP) – SOP Common Module

SOP Class UID	(0008,0016)	UI 1	1	Ignored
SOP Instance UID	(0008,0018)	UI 1	1	StructureSet.dicom_uid, used to link to RT Plans. (see **Note XV)**
Specific Character Set	(0008,0005)	CS 1-N	1C	Ignored
Instance Creation Date	(0008,0012)	DA 1	3	
Instance Creation Time	(0008,0013)	TM 1	3	
Instance Creator UID	(0008,0014)	UI 1	3	

C. Applied CT Image IOD and mapping to Elekta XVI Database

C.1 Import of CT Image

The modules selected from the CT Image IOD of DICOM for prescription import are given in Table 26 If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 26 Applied Modules in the CT Image IOD for Import (SCP Role)

Patient	Patient	M
Study	General Study (Ignored)	M
Series	General Series	M
Frame of reference	Frame of Reference	M
Equipment	General equipment (Ignored)	M
Image	General image (Ignored)	M
	Image plane	M
	Image Pixel	M
	CT Image	M
	SOP Common (Ignored)	M

Table 27 to Table 32 specify, for each of the applied modules above, the attributes stored by Elekta XVI, further details of mapping onto the Elekta XVI database, and any attribute specific constraints applicable to their use.

Ignored attributes are not stored into the Elekta XVI patient database. **However, all DICOM objects must conform to the DICOM standard.** If any part of a CT Image does not conform to the standard then that prescription is not saved into the database and the storage request is rejected. Thus, Elekta XVI performs validation of the entire applied IOD. I.e. where attributes irrelevant to Elekta XVI are included in a message, they must still have values that are valid according to the DICOM standard. Storage requests containing invalid attributes will be REJECTED. (See Table 101, Status Code A901).

Table 27 CT Image Storage SOP Class (SCP) – Patient Module

Patients Name	(0010,0010)	PN 1	2	See Note XI and Note XII
Patient ID	(0010, 0020)	LO 1	2	See Note XI and Note XII
Patient's Birth Date	(0010, 0030)	DA 1	2	Ignored
Patients Sex	(0010, 0040)	CS 1	2	
Referenced Patient Sequence	(0008, 1120)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Patient's Birth Time	(0010, 0032)	TM 1	3	
Other Patient IDs	(0010, 1000)	LO 1-N	3	
Other Patient Names	(0010, 1001)	PN 1-N	3	
Ethnic Group	(0010, 2160)	SH 1	3	
Patient Comments	(0010, 4000)	LT 1	3	

Note XI Handling of Empty Patient Identification Attributes

The Patient ID (0010, 0020) and Patient Name (0010, 0010) attributes of the Patient Module **are** specified by DICOM as Type 2 and so may legally have zero length.

As a safety measure, however, **Elekta XVI** treats these attributes as Type 1 and will REJECT any CT Image Storage request containing zero length values for these attributes. (See Table **101**, Status Code C001).

Note XII Patient ID Already Exists in Elekta XVI Database

If a patient with the Patient ID specified in the CT Image Storage request already exists in the Elekta XVI database, no further Patient Module attributes in the request will be imported. The check for an existing Patient ID is insensitive to case or leading/trailing spaces.

Note XIII Mapping in Main database

The values of this module are not used directly to populate a patient record in the main database because a CT Image is always imported with a RT Plan and a RT Structure set. Nonetheless the Elekta XVI SCP performs the same checks on Patient ID and Patient name, and an error on one of these would result in a transfer failure to our Elekta XVI DICOM Transit Database.

Table 28 CT Image SOP Class (SCP) – General Series Module

Modality	(0008,0060)	1	CS 1	Ignored
Series Instance UID	(0020,000E)	1	UI 1	CT.dicom_uid
Series Number	(0020,0011)	2	IS 1	Ignored
Series Date	(0008,0021)	3	DA 1	
Series Time	(0008,0031)	3	TM 1	
Performing Physicians' Name	(0008,1050)	3	PN 1-n	
Performing Physician Identification Sequence	(0008,1052)	3	SQ 1	
Protocol Name	(0018,1030)	3	LO 1	
Series Description	(0008,103E)	3	LO 1	
Operators' Name	(0008,1070)	3	PN 1-n	
Operator Identification Sequence	(0008,1072)	3	SQ 1	
Referenced Performed Procedure Step Sequence	(0008,1111)	3	SQ 1	
>Referenced SOP Class UID	(0008,1150)	1C	UI 1	
>Referenced SOP Instance UID	(0008,1155)	1C	UI 1	
Body Part Examined	(0018,0015)	3	CS 1	
Patient Position	(0018,5100)	2C	CS 1	Used for viewer file creation(Note IX)
Smallest Pixel Value in Series	(0028,0108)	3	US or SS 1	Ignored
Largest Pixel Value in Series	(0028,0109)	3	US or SS 1	
Request Attributes Sequence	(0040,0275)	3	SQ 1	
>Requested Procedure ID	(0040,1001)	1C	SH 1	
>Scheduled Procedure Step ID	(0040,0009)	1C	SH 1	
>Scheduled Procedure Step Description	(0040,0007)	3	LO 1	
>Scheduled Protocol Code Sequence	(0040,0008)	3	SQ 1	
Performed Procedure Step ID	(0040,0253)	3	SH 1	
Performed Procedure Step Start Date	(0040,0244)	3	DA 1	
Performed Procedure Step Start Time	(0040,0245)	3	TM 1	
Performed Procedure Step Description	(0040,0254)	3	LO 1	

Performed Protocol Code Sequence	(0040,0260)	3	SQ 1	
Comments on the Performed Procedure Step	(0040,0280)	3	ST 1	

Note XIV Tags used but stored in Dicom file
All other tables are ignored as far as the database is concerned. However the Dicom file is saved and is loaded and processed every time it has to be displayed.

Table 29 CT Image Storage SOP Class (SCP) – Frame of reference Module

Frame of reference UID	(0020,0052)	UI 1	1	Used to link to Structure set (see **Note XV**)
Position Reference Indicator	(0020,1040)	LO 1	2	Ignored

Note XV Linking of Dicom objects:
Elekta XVI only allows import of CT Image, RT Structure set or RT Plan from the Elekta XVI Dicom Transit database to the main database (Using the interface DIVT) if they are part of a complete Dicom set. The relation between these objects is detected by checking the values of specific tags (see Figure 2)

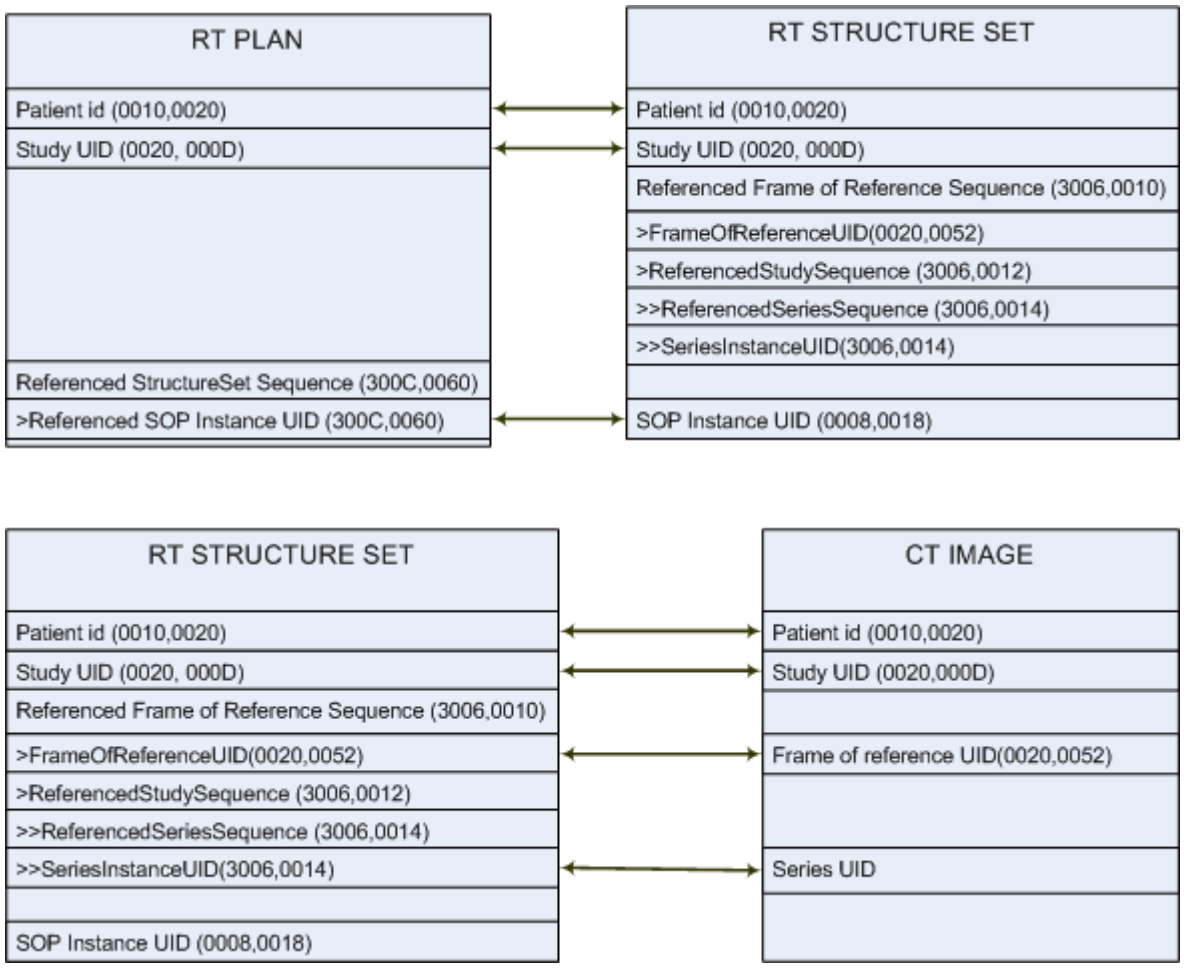

Figure 2 Tags used to link Dicom set

Table 30 CT Image Storage SOP Class (SCP) –Image Plane Module

Pixel spacing	(0028,0030)	1	DS 2	Used for viewer file creation(**Note IX**) If the pixel spacing value differs in one slice of the series , XVI will fail the import. (tolerance 1/10000 mm)
Image Orientation (Patient)	(0020,0037)	1	DS 6	Used for viewer file creation(**Note IX**) If the image orientation is not constant across the CT series , XVI will fail the import. (tolerance 1/10000 mm)
Image Position (Patient)	(0020,0032)	1	DS 3	Used for viewer file creation(**Note IX**) If image position for all slices in the series is not on a straight line, XVI will fail the import. (tolerance 1/100 mm)
Slice Thickness	(0018,0050)	1	DS 1	Used for viewer file creation(Note IX)
Slice Location	(0020,1041)	3	DS 1	Ignored

Table 31 CT Image Storage SOP Class (SCP) –Image Pixel Module

Samples per Pixel	(0028,0002)	1	US 1	Ignored
Photometric Interpretation	(0028,0004)	1	CS 1	
Rows	(0028,0010)	1	US 1	Used for viewer file creation(Note IX)
Columns	(0028,0011)	1	US 1	Used for viewer file creation(Note IX)
Bits Allocated	(0028,0100)	1	US 1	Used for viewer file creation(Note IX) (see Note XVI)
Bits Stored	(0028,0101)	1	US 1	Used for viewer file creation(Note IX)
High Bit	(0028,0102)	1	US 1	
Pixel Representation	(0028,0103)	1	US 1	Used for viewer file creation(Note IX)
Pixel Data	(7FE0,0010)	1	OW or OB 1	Used for viewer file creation(Note IX)
Planar Configuration	(0028,0006)	1C	US 1	Ignored
Pixel Aspect Ratio	(0028,0034)	1C	IS 2	
Smallest Image Pixel Value	(0028,0106)	3	US or SS 1	
Largest Image Pixel Value	(0028,0107)	3	US or SS 1	
Red Palette Color Lookup Table Descriptor	(0028,1101)	1C	US or SS 3	
Green Palette Color Lookup Table Descriptor	(0028,1102)	1C	US or SS 3	
Blue Palette Color Lookup Table Descriptor	(0028,1103)	1C	US or SS 3	
Red Palette Color Lookup Table Data	(0028,1201)	1C	OW 1	
Green Palette Color Lookup Table Data	(0028,1202)	1C	OW 1	
Blue Palette Color Lookup Table Data	(0028,1203)	1C	OW 1	

Note XVI handling of non 16 bit CT Images

We will reject the non 16 bit images, the check will be made against the Bits allocated tag (0028,0100) from the CT Image module (**Status Code C027)**

Table 32 CT Image Storage SOP Class (SCP) –CT Image Module

Image Type	(0008,0008)	1	CS 1-n	Ignored
Samples per Pixel	(0028,0002)	1	US 1	
Photometric Interpretation	(0028,0004)	1	CS 1	
Bits Allocated	(0028,0100)	1	US 1	Used for viewer file creation(Note IX) (see Note XVI)
Bits Stored	(0028,0101)	1	US 1	Used for viewer file creation (Note IX
High Bit	(0028,0102)	1	US 1	Ignored
Rescale Intercept	(0028,1052)	1	DS 1	Used for viewer file creation (Note IX)
Rescale Slope	(0028,1053)	1	DS 1	Used for viewer file creation (Note IX)
KVP	(0018,0060)	2	DS 1	Ignored
Acquisition Number	(0020,0012)	2	IS 1	
Scan Options	(0018,0022)	3	CS 1-n	
Data Collection Diameter	(0018,0090)	3	DS 1	
Reconstruction Diameter	(0018,1100)	3	DS 1	
Distance Source to Detector	(0018,1110)	3	DS 1	
Distance Source to Patient	(0018,1111)	3	DS 1	
Gantry/Detector Tilt	(0018,1120)	3	DS 1	
Table Height	(0018,1130)	3	DS 1	
Rotation Direction	(0018,1140)	3	CS 1	
Exposure Time	(0018,1150)	3	IS 1	
X-ray Tube Current	(0018,1151)	3	IS 1	
Exposure	(0018,1152)	3	IS 1	
Exposure in µAs	(0018,1153)	3	IS 1	
Filter Type	(0018,1160)	3	SH 1	
Generator Power	(0018,1170)	3	IS 1	
Focal Spot	(0018,1190)	3	DS 1-n	
Convolution Kernel	(0018,1210)	3	DS 1	

C.2 Export of CT Image

The modules selected from the CT Image IOD table of DICOM for image export are given in Table 33 Applied Modules in the CT Image IOD for Export (SCU Role) below. If a module is not listed, none of the attributes in that module is sent by Elekta XVI.

Table 33 Applied Modules in the CT Image IOD for Export (SCU Role)

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Frame of reference	Frame of Reference	M
Equipment	General equipment	M
Image	General image	M
	Image plane	M
	Image Pixel	M
	CT Image	M
	SOP Common	M

Table 34 to Table 42 below specify the applied attributes for each module, and note their mappings from the Elekta XVI database. If an attribute is not listed, it is not sent by Elekta XVI. If an attribute is listed without Notes, there is a mapping from a directly equivalent Elekta XVI database entry.
Only the tags populated are listed.

Table 34 CT Image Storage SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	PN 1	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	LO 1	Patient.ID
Patient's Birth Date	(0010, 0030)	2	DA 1	Patient.birth_date
Patients Sex	(0010, 0040)	2	CS 1	Patient.sex
Patient Comments	(0010, 4000)	3	LT 1	Patient.comment

Table 35 CT Image Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020, 000D)	1	New UID per reconstruction (generated by Elekta XVI for native treatments) see Note XVII
Study Date	(0008, 0020)	2	Date of image acquisition
Study Time	(0008, 0030)	2	Time of image acquisition
Referring Physicians Name	(0008, 0090)	2	Patient.doctor^^^^
Study ID	(0020, 0010)	2	Treatment.ID
Accession Number	(0008, 0050)	2	Empty
Study Description	(0008, 1030)	3	Treatment.Description

Note XVII generated UIDs:

XVI generates UIDs using the following format: <Elekta UID>.<XVI serial number >.<Date and time><increment count>
Elekta UID=1.3.46.423632
XVI serial number = sri.ini[station]SerialNumber
Date and time=date and time at UID generation
Increment count= 0 to 999, initialised when XVI starts up.

Important: New UID is generated when no reference data is present. If reference data is present, study instance UID of that will be sent during export.

Table 36 CT Image Storage SOP Class (SCU) – General Series Module

Modality	(0008, 0060)	1	"CT"
Series Instance UID	(0020, 000E)	1	New UID generated at export time. See Note XIX
Series Number	(0020, 0011)	2	Internally generated unique field-specific number. (New at each export)
Series Date	(0008,0021)	3	Date of image acquisition
Series Time	(0008,0031)	3	Time of image acquisition
Protocol Name	(0018, 1030)	3	"<Acquisition Preset Name> : <Reconstruction Preset Name>"
Series Description	(0008, 103E)	3	See **Note XVIII Series 4D**
Patient Position	(0018, 5100)	2C	Empty if position not specified by operator

Note XIX Series 4D:

- Generate and store a new UID per VolumeView projection set, all exported CBCT will include this UID as derived from the VolumeView projection set UID.

When setting sri.ini[Dicom]OneSeriesForAllPhases=1

- all phases are exported under the same series.
- The series description is as follow:

"CBCT(#phase:10) Option 1; All phases; Max slices: 211"

When setting sri.ini[Dicom]OneSeriesForAllPhases=0

- Each phase has a different series instance UID
- The series description is as follow:

"PhaseIndex 0 (TotalPhases 10).CumulPhaseWeight: 0.096500"

Note XX 4D Phases:

When setting sri.ini[Dicom]OneSeriesForAllPhases=1

- When export all phases of 4D volume is selected all phases are exported under the same series.
- The CT Images will be ordered (Instance Number (0020,0013)) by phase and z order.
  Phase 0 (Slice 0, Slice 1, ... Slice N-1), Phase 1 (Slice N, Slice N+1, ... Slice 2N-1) , ...
  ... Phase P-1 (Slice (P-1)N , Slice (P-1)N+1, ... Slice PN-1)

When setting sri.ini[Dicom]OneSeriesForAllPhases=0

- When export all phases of 4D volume is selected all phases are exported under a different series.
- The CT Images will be ordered (Instance Number (0020,0013)) by z order. Instance number restarting at 0 for each phase.

Table 37 CT Image Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	"ELEKTA"
Station Name	(0008, 1010)	3	IF an Elekta XVI acquired image: Acquiring Station Name, ELSE: "UNKNOWN" + any available origin detail.
Manufacturers Model Name	(0008, 1090)	3	"Elekta XVI"
Device Serial Number	(0018, 1000)	3	Elekta XVI Station Serial Number (see Note IV)
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station

Table 38 CT Image Storage SOP Class (SCU) – General Image Module

Instance Number	(0020, 0013)	2	An internally generated unique image number within the CT Image set exported. Starts at 0 and incremented by one for each slices ordered on
Patient Orientation	(0020, 0020)	2C	Empty
Content Date	(0008, 0023)	2C	Image acquisition date
Content Time	(0008, 0033)	2C	Image acquisition time
Image Type	(0008, 0008)	3	DERIVED\SECONDARY\AXIAL
Acquisition Date	(0008, 0022)	3	Image acquisition date
Acquisition Time	(0008, 0032)	3	Image acquisition time
Images in Acquisition	(0020, 1002)	3	1
Image Comments	(0020, 4000)	3	Image. Comment, when 4D is exported we append "Phase index n (Total phases p). Cumulative Phase Weight: x" where n represent the current exported phase (starting at 0), p the total number of phases, x the weight of this phase plus all precedent phases weight (between 0 and 1).
Source Image Sequence	(0008,2112)	3	Used to reference the volumeVIew image origin of the CBCT

>Referenced SOP Class UID	(0008,1150)	1	Rt Image storage class UID
>Referenced SOP instance UID	(0008,1155)	1	VolumeView.dicom_uid

Table 39 CT Image Storage SOP Class (SCU) –Image Plane Module

Pixel spacing	(0028,0030)	1	Option1: Pixel spacing of volume Option2: Same as reference scan (see **Note XXII**)
Image Orientation (Patient)	(0020,0037)	1	Option1: Depends on Patient orientation set at treatment level. Option2: Same as reference scan (see **Note XXII**)
Image Position (Patient)	(0020,0032)	1	Option1: Use isocentre position as origin. Option2: Same as reference scan (see **Note XXII**)
Slice Thickness	(0018,0050)	1	Option1: Distance between 2 consecutive slices. Option2: Same as reference scan (see **Note XXII**)

Table 40 CT Image Storage SOP Class (SCU) –Image Pixel Module

Samples per Pixel	(0028,0002)	1	See Table 41
Photometric Interpretation	(0028,0004)	1	
Rows	(0028,0010)	1	Option 1: Y dimension of volume Option 2&3: same as reference volume (see **Note XXII**)
Columns	(0028,0011)	1	Option 1: Z dimension of volume Option 2&3: same as reference volume (see **Note XXII**)
Bits Allocated	(0028,0100)	1	See Table 41
Bits Stored	(0028,0101)	1	
High Bit	(0028,0102)	1	
Pixel Representation	(0028,0103)	1	
Pixel Data	(7FE0,0010)	1	
Planar Configuration	(0028,0006)	1C	See Table 41
Pixel Aspect Ratio	(0028,0034)	1C	

Note XXI Internal coordinate system
The reconstructed volume is manipulated internally using a room fixed coordinate system

Table 41 CT Image Storage SOP Class (SCU) –CT Image Module

Image Type	(0008,0008)	1	DERIVED\SECONDARY\AXIAL
Samples per Pixel	(0028,0002)	1	1
Photometric Interpretation	(0028,0004)	1	MONOCHROME2
Bits Allocated	(0028,0100)	1	16
Bits Stored	(0028,0101)	1	16
High Bit	(0028,0102)	1	15
Rescale Intercept	(0028,1052)	1	Sri.ini[Dicom]RescaleIntercept
Rescale Slope	(0028,1053)	1	Sri.ini[Dicom]RescaleSlope
KVP	(0018,0060)	2	Image.Kv
Reconstruction Diameter	(0018,1100)	3	
Gantry/Detector Tilt	(0018,1120)	3	0
Exposure Time	(0018,1150)	3	Image.kVLength
X-ray Tube Current	(0018,1151)	3	Image.mA
Filter Type	(0018,1160)	3	Image. kVFilter

Focal Spot	(0018,1190)	3	Image.foc_spot
CTDIvol	(0018,9345)	3	Image.CTDIVol. Computed Tomography Dose Index in mGy according to IEC 60601-2-44. It is the average dose for this image for the selected CT conditions of operation.
CTDI Phantom Type Code Sequence	(0018,9346)	3	Image.CTDIPhantom. The type of phantom used for CTDI measurement according to IEC 60601-2-44. Only a single Item is permitted in this Sequence.

Phantom tag will contain the type of phantom used for CTDI measurement e.g Head 16 cm diameter or Body 32 cm diameter.
Value will be as per defined context ID 4052 (CID for Phantom devices)

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
DCM	113690	IEC Head Dosimetry Phantom
DCM	113691	IEC Body Dosimetry Phantom

Any one of the above values can be present in the sequence.

Table 42 CT Image Storage SOP Class (SCU) – SOP Common Module

SOP Class UID	(0008, 0016)	1	CT Image storage UID
SOP Instance UID	(0008, 0018)	1	Generate new at every export
Specific Character Set	(0008, 0005)	1C	Ignored
Instance Creation Date	(0008, 0012)	3	
Instance Creation Time	(0008, 0013)	3	
Instance Creator UID	(0008, 0014)	3	

Note XXII Export options:
Option 1: The user can export the full volume reconstructed choosing a factor to the original slice thickness.
Option 2: The volume is re-sampled in the reference scan coordinate and dimensions. Overlaps where data is missing on the reconstructed volume (i.e. the reference scan is bigger or offset compare to the reconstructed volume) are filled with black pixels.
Option 3: The user can export the reconstructed volume to the configured AETitle during the adaptive workflow (Meanwhile “Adaptive” parameter in volume acquisition preset needs to be set to “Yes”):
Sri.ini
[EnhancedDicomAutoExport]
CBCT_PostAcceptRecon_AETitlesList
CBCT_PostAcceptRegPreShift_AETitlesList

D. Applied RT Image IOD and mapping to Elekta XVI Database

D.1 Import of RT Image

The modules selected from the RT Image IOD of DICOM for prescription import are given in Table 43. If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 43 Applied Modules in the RT Image IOD for Import (SCP Role)

Patient	Patient	M
Study	General Study	M
Series	RT Series	M
Equipment	General equipment (Ignored)	M
Image	General image	M
	Image Pixel	M
	RT Image	M
	SOP Common	M

D.2 RT Image IOD Modules

Table 44 to Table 50 specify, for each of the applied modules above, the attributes stored by Elekta XVI, further details of mapping onto the Elekta XVI database, and any attribute specific constraints applicable to their use.

Ignored attributes are not stored into the Elekta XVI patient database. **However, all DICOM objects must conform to the DICOM standard.** If any part of a RT Image does not conform to the standard then that prescription is not saved into the database and the storage request is rejected. Thus, Elekta XVI performs validation of the entire applied IOD. I.e. where attributes irrelevant to Elekta XVI are included in a message, they must still have values that are valid according to the DICOM standard. Storage requests containing invalid attributes will be REJECTED. (See Table 101, Status Code A901).

Table 44 RT Image Storage SOP Class (SCP) – Patient Module

Patients Name	(0010,0010)	PN 1	2	Split into Patient.first_name, Patient.last_name, Patient.mid_name (Prefix, Suffix not stored). See Note XXIII.
Patient ID	(0010, 0020)	LO 1	2	Patient.id See Note XXIV
Patient's Birth Date	(0010, 0030)	DA 1	2	Patient.birth_date
Patients Sex	(0010, 0040)	CS 1	2	Patient.sex
Referenced Patient Sequence	(0008, 1120)	SQ 1	3	Ignored
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Patient's Birth Time	(0010, 0032)	TM 1	3	
Other Patient IDs	(0010, 1000)	LO 1-N	3	
Other Patient Names	(0010, 1001)	PN 1-N	3	
Ethnic Group	(0010, 2160)	SH 1	3	
Patient Comments	(0010, 4000)	LT 1	3	

Note XXIII Handling of Empty Patient Identification Attributes in a RT Image object

The Patient ID (0010, 0020) and Patient Name (0010, 0010) attributes of the Patient Module are specified by DICOM as Type 2 and so may legally have zero length.

As a safety measure, however, **Elekta XVI** treats these attributes as Type 1 and will REJECT any RT Image Storage request containing zero length values for these attributes. Which means these RT Images won't enter the Elekta XVI DICOM Transit database. (See
Table **101**, Status Code C001).

Note XXIV Patient ID Already Exists in Elekta XVI Database

If a patient with the Patient ID specified in the RT Image Storage request already exists in the Elekta XVI Main database, no further Patient Module attributes in the request will be imported. The check for an existing Patient ID is insensitive to case or leading/trailing spaces.

Table 45 RT Image Storage SOP Class (SCP) – General Study Module

Study Instance UID	(0020, 000D)	UI 1	1	Treatment.dicom_uid
Study Date	(0008, 0020)	DA 1	2	Ignored
Study Time	(0008, 0030)	TM 1	2	
Referring Physicians Name	(0008, 0090)	PN 1	2	
Study ID	(0020, 0010)	SH 1	2	Treatment.id
Accession Number	(0008, 0050)	SH 1	2	See Note XXV
Study Description	(0008, 1030)	LO 1	3	Treatment.descrip
Physician(s) of Record	(0008, 1048)	PN 1-N	3	Ignored
Name of Physician(s) Reading Study	(0008, 1060)	PN 1-N	3	
Referenced Study Sequence	(0008, 1110)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	

Note XXV Handling of Empty Study ID Attribute

If a the RT Plan has been previously imported

An incrementing counter is prepended to the treatment id then ":" and one of the following

The applied Study ID (0020, 0010) is specified by DICOM as Type 2 and so may legally have zero length**.** This field is normally used by Elekta XVI to identify the Treatment to be created or updated.

In the situation where the Study ID attribute is empty, Elekta XVI will attempt to use the Accession Number (0008, 0050, Type 2) attribute as a Treatment ID instead. In such cases it will also append the Treatment Description with the text ":TRTID derived (Accession No.)" to assist the operator.

In the situation where both the Study ID and Accession Number attributes are empty, Elekta XVI will use the last 16 digits of the Study Instance UID (0020, 000D) as a Treatment ID. In such cases it will also append the Treatment Description with the text ":TRTID derived (StudyInstanceUID.)" to assist the operator.

Extreme caution is advised when handling data with limited Study identification information present. It is the responsibility of the Elekta XVI operator to ensure that incoming image data containing an empty Study ID attribute is correctly identified and qualified before relocation into the main Elekta XVI Clinical database.

Table 46 RT Image SOP Class (SCP) – RT Series Module

Modality	(0008, 0060)	CS 1	1	Ignored
Series Instance UID	(0020, 000E)	UI 1	1	Field.dicom_uid
Series Number	(0020, 0011)	IS 1	2	Ignored
Series Description	(0008, 103E)	LO 1	3	Field.description
Referenced Study Component Sequence	(0008, 1111)	SQ 1	3	Ignored
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	

NoteXXVI: Field.ID during RT Image import

If the plan referenced by this RT image (Referenced RT Plan Sequence(300C,0002)) has been previously imported, the RT Image will be copied to the field created for the beam referenced by the beam number (Referenced Beam number (300C, 0006)) see Note XXXIV.

If the plan describing the Beam referenced by the beam number (Referenced Beam number (300C, 0006)) has not been imported a field will be created with as an ID the beam number and the series description appended.

If the beam number (Referenced Beam number (300C, 0006)) is not present we use as Field.ID the prefix ":RTIMAGE" prefixed by an incrementing counter.

Extreme caution is advised when handling data with limited Series identification information present. It is the responsibility of the Elekta XVI operator to ensure that incoming image data containing an empty Series Number attribute is correctly identified and qualified before relocation into the main Elekta XVI Clinical database.

Table 47 RT Image Storage SOP Class (SCP) –General Image Module

Instance Number	(0020,0013)	2	IS 1	Ignored
Patient Orientation	(0020,0020)	2C	CS 2	Image.orient
Content Date	(0008,0023)	2C	DA 1	Ignored
Content Time	(0008,0033)	2C	TM 1	
Image Type	(0008,0008)	3	CS 1-n	
Acquisition Number	(0020,0012)	3	IS 1	
Acquisition Date	(0008,0022)	3	DA 1	Image.Date. (if not present use date of import)
Acquisition Time	(0008,0032)	3	TM 1	Image.time (if not present use time of import)
Acquisition Datetime	(0008,002A)	3	DT 1	Ignored
Referenced Image Sequence	(0008,1140)	3	SQ 1	
>Referenced SOP Class UID	(0008,1150)	1C	UI 1	
>Referenced SOP Instance UID	(0008,1155)	1C	UI 1	
>Referenced Frame Number	(0008,1160)	3	IS 1-n	
>Purpose of Reference Code Sequence	(0040,A170)	3	SQ 1	
Derivation Description	(0008,2111)	3	ST 1	
Derivation Code Sequence	(0008,9215)	3	SQ 1	
Source Image Sequence	(0008,2112)	3	SQ 1	
>Referenced SOP Class UID	(0008,1150)	1C	UI 1	
>Referenced SOP Instance UID	(0008,1155)	1C	UI 1	
>Referenced Frame Number	(0008,1160)	3	IS 1-n	

>Purpose of Reference Code Sequence	(0040,A170)	3	SQ 1	
Referenced Waveform Sequence	(0008,113A)	3	SQ 1	
Images in Acquisition	(0020,1002)	3	IS 1	
Image Comments	(0020,4000)	3	LT 1	Image.comment
Quality Control Image	(0028,0300)	3	CS 1	Ignored
Burned In Annotation	(0028,0301)	3	CS 1	
Lossy Image Compression	(0028,2110)	3	CS 1	
Icon Image Sequence	(0088,0200)	3	SQ 1	
Presentation LUT Shape	(2050,0020)	3	CS 1	

Table 48 RT Image Storage SOP Class (SCP) –Image Pixel Module

Samples per Pixel	(0028, 0002)	1	**Assumed to be 1.**
Photometric Interpretation	(0028, 0004)	1	**MONOCHROME2.**
Rows	(0028, 0010)	1	Image.Height
Columns	(0028, 0011)	1	Image.Width
Bits Allocated	(0028, 0100)	1	Bits Allocated is 8 or 16
Bits Stored	(0028, 0101)	1	8 to 16
High Bit	(0028, 0102)	1	7 to 15
Pixel Representation	(0028, 0103)	1	Used to determine pixel scaling behaviour
Pixel Data	(7FE0, 0010)	1	Image pixel data interpreted.
Planar Configuration	(0028, 0006)	1C	**Assumed to be 0.**
Pixel Aspect Ratio	(0028, 0034)	1C	Image.Aspect

Table 49 RT Image Storage SOP Class (SCP) –RT Image Module

Samples per Pixel	(0028,0002)	1	US 1	See Table 48
Photometric Interpretation	(0028,0004)	1	CS 1	
Bits Allocated	(0028,0100)	1	US 1	
Bits Stored	(0028,0101)	1	US 1	
High Bit	(0028,0102)	1	US 1	
Pixel Representation	(0028,0103)	1	US 1	
RT Image Label	(3002,0002)	1	SH 1	
RT Image Name	(3002,0003)	3	LO 1	
RT Image Description	(3002,0003)	3	ST 1	
Operators' Name	(0008,1070)	2	PN 1-n	
Image Type	(0008,0008)	1	CS 1-n	
Conversion Type	(0008,0064)	2	CS 1	
Reported Values Origin	(3002,000A)	2C	CS 1	
RT Image Plane	(3002,000C)	1	CS 1	Checked during the processing of image scaling (see Note XXIX)
X-Ray Image Receptor Translation	(3002,000D)	3	DS 3	If different to 0 (0,0,SAD-SID) the image centre is not calculated.
X-Ray Image Receptor Angle	(3002,000E)	2	DS 1	If different than 0 the image centre is not calculated.
RT Image Orientation	(3002,0010)	2C	DS 6	If NON_NORMAL the image centre is not calculated.
Image Plane Pixel Spacing	(3002,0011)	2	DS 2	Used to process the pixel size at isocentre plane See Note XXIX

RT Image Position	(3002,0012)	2	DS 2	Used to set the centre of the image See Note XXVIII
Radiation Machine Name	(3002,0020)	2	SH 1	
Primary Dosimeter Unit	(300A,00B3)	2	CS 1	
Radiation Machine SAD	(3002,0022)	2	DS 1	Used to process the pixel size at isocentre plane See Note XXIX
Radiation Machine SSD	(3002,0024)	3	DS 1	
RT Image SID	(3002,0026)	2	DS 1	Used to process the pixel size at isocentre plane See Note XXIX
Source to Reference Object Distance	(3002,0028)	3	DS 1	
Referenced RT Plan Sequence	(300C,0002)	3	SQ 1	
>Referenced SOP Class UID	(0008,1150)	1C	UI 1	
>Referenced SOP Instance UID	(0008,1155)	1C	UI 1	
Referenced Beam Number	(300C,0006)	3	IS 1	Field.beam_number
Referenced Fraction Group Number	(300C,0022)	3	IS 1	Field.ID See NoteXXVI:
Fraction Number	(3002,0029)	3	IS 1	Fraction.ID
Start Cumulative Meterset Weight	(300C,0008)	3	DS 1	
End Cumulative Meterset Weight	(300C,0009)	3	DS 1	Ignored
Exposure Sequence	(3002,0030)	3	SQ 1	
>Referenced Frame Number	(0008,1160)	1C	IS 1-n	
>KVP	(0018,0060)	1C	DS 1	Image.Kv
>X-Ray Tube Current	(0018,1151)	2C	IS 1	Image.mA
>Exposure Time	(0018,1150)	2C	IS 1	Image.kVlength
>Meterset Exposure	(3002,0032)	2C	DS 1	
>Diaphragm Position	(3002,0034)	3	DS 4	
>Beam Limiting Device Sequence	(300A,00B6)	3	SQ 1	
>>RT Beam Limiting Device Type	(300A,00B8)	1C	CS 1	
>>Source to Beam Limiting Device Distance	(300A,00BA)	3	DS 1	
>>Number of Leaf/Jaw Pairs	(300A,00BC)	1C	IS 1	
>>Leaf Position Boundaries	(300A,00BE)	2C	DS 3-n	
>>Leaf/Jaw Positions	(300A,011C)	1C	DS 2-2n	
>Applicator Sequence	(300A,0107)	3	SQ 1	
>>Applicator ID	(300A,0108)	1C	SH 1	
>>Applicator Type	(300A,0109)	1C	CS 1	
>>Applicator Description	(300A,010A)	3	LO 1	Ignored
>Number of Blocks	(300A,00F0)	1C	IS 1	
>Block Sequence	(300A,00F4)	2C	SQ 1	
>>Block Tray ID	(300A,00F5)	3	SH 1	
>>Source to Block Tray Distance	(300A,00F6)	2C	DS 1	
>>Block Type	(300A,00F8)	1C	CS 1	
>>Block Divergence	(300A,00FA)	2C	CS 1	
>>Block Mounting Position	(300A,00FB)	3	CS 1	
>>Block Number	(300A,00FC)	1C	IS 1	
>>Block Name	(300A,00FE)	3	LO 1	
>>Material ID	(300A,00E1)	2C	SH 1	
>>Block Thickness	(300A,0100)	3	CS 1	

>>Block Number of Points	(300A,0104)	2C	IS 1	
>>Block Data	(300A,0106)	2C	DS 2-2n	
Gantry Angle	(300A,011E)	3	DS 1	Frame.proj_angle
Beam Limiting Device Angle	(300A,0120)	3	DS 1	Ignored
Patient Support Angle	(300A,0122)	3	DS 1	
Table Top Eccentric Axis Distance	(300A,0124)	3	DS 1	
Table Top Eccentric Angle	(300A,0125)	3	DS1	
Table Top Vertical Position	(300A,0128)	3	DS 1	
Table Top Longitudinal Position	(300A,0129)	3	DS 1	
Table Top Lateral Position	(300A,012A)	3	DS 1	
Patient Position	(0018,5100)	1C	CS 1	Field.Orientation Image.Orientation

Table 50 RT Image Storage SOP Class (SCP) – SOP Common Module

SOP Class UID	(0008, 0016)	UI 1	1	Ignored
SOP Instance UID	(0008, 0018)	UI 1	1	Image.dicom_uid
Specific Character Set	(0008, 0005)	CS 1-N	1C	Ignored
Instance Creation Date	(0008, 0012)	DA 1	3	
Instance Creation Time	(0008, 0013)	TM 1	3	
Instance Creator UID	(0008, 0014)	UI 1	3	

Note XXVII Image.origin

The field origin of the image table is populated with the sender AE title.

Note XXVIII Image Centre:
If the RT image plane isn't NORMAL or if X-Ray Image Receptor Translation (3002,000D) or X-Ray Image Receptor Angle (3002,000E) are present and different than 0, XVI won't use the RT Image position information and process the image centre.

Note XXIX Pixel size:

The pixel size used in iView is defined at isocenter plane. XVI will use the Image plane pixel spacing (expected to be at XRAY receptor plane) and translate it to the isocenter plane using the RT Image SID (3002,0026) and the Radiation Machine SAD (3002,0002). If any of the information is missing or X-Ray Image Receptor Angle (3002, 000E) is different than 0 XVI will not process the scaling of the image.
XVI only stores the horizontal pixel size and use the aspect ratio to adjust display for the difference between the vertical and horizontal size. For that reason, only the first value of image plane pixel spacing is stored and XVI relies on the information provided by the Pixel Aspect Ratio (0028, 0034).

D.3 Export of RT Images

The modules selected from the RT Image IOD table of DICOM for image export are given in Table 51 below. If a module is not listed, none of the attributes in that module is sent by XVI.

Table 51 Applied Modules in the RT Image IOD for Export (SCU Role)

Patient	Patient
Study	General Study
Series	RT Series
Equipment	General Equipment
Image	General Image
	Image Pixel
	RT Image
	SOP Common

Table 52 to Table 59 below specify the applied attributes for each module, and note their mappings from the XVI database. If an attribute is not listed, it is not sent by XVI. If an attribute is listed without Notes, there is a mapping from a directly equivalent XVI database entry.

Table 52 RT Image Storage SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	Patient.ID
Patient's Birth Date	(0010, 0030)	2	Patient.birth_date
Patients Sex	(0010, 0040)	2	Patient.sex
Patient Comments	(0010, 4000)	3	Patient.comment

Table 53 RT Image Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020, 000D)	1	Treatment.UID (generated by Elekta XVI for native treatments) see Note XVII
Study Date	(0008, 0020)	2	Image acquisition date
Study Time	(0008, 0030)	2	Image acquisition time
Referring Physicians Name	(0008, 0090)	2	Patient.doctor^^^^
Study ID	(0020, 0010)	2	Treatment.ID
Accession Number	(0008, 0050)	2	Empty
Study Description	(0008, 1030)	3	Treatment.Description

Table 54 RT Image Storage SOP Class (SCU) – RT Series Module

Modality	(0008, 0060)	1	"RTIMAGE"
Series Instance UID	(0020, 000E)	1	Field.UID (generated by XVI for native fields) see Note XXX and Note XVII
Series Number	(0020, 0011)	2	IF Field ID is numeric: Field.ID, ELSE: an internally generated unique field-specific number.
Series Description	(0008, 103E)	3	Field.Description

Note XXX Export of images belonging to fields created by DICOM Import:

When a field is created by a DICOM import, the field.UID is copied from the DICOM data. To avoid re-using at export time a code that doesn't belong to Elekta the series instance UID will be the treatment.UID with the first 20 characters replaced by the Elekta specific code and a machine specific code. (Basis of all DICOM UIDs generated by this station).

Table 55 RT Image Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	“ELEKTA”
Station Name	(0008, 1010)	3	Acquiring Station Name
Manufacturers Model Name	(0008, 1090)	3	“Elekta XVI”
Device Serial Number	(0018, 1000)	3	XVI Station Serial Number
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station
Institution name			

Table 56 RT Image Storage SOP Class (SCU) – General Image Module

Image Number	(0020, 0013)	2	An internally generated database-unique image-specific number.
Content Date	(0008, 0023)	2C	Image acquisition date
Content Time	(0008, 0033)	2C	Image acquisition time
Derivation Description	(0008,2111)	3	
Acquisition Date	(0008, 0022)	3	Image acquisition date
Acquisition Time	(0008, 0032)	3	Image acquisition time
Images in Acquisition	(0020, 1002)	3	1
Image Comments	(0020, 4000)	3	Image comments
Derivation description	(0008,2111)	3	Blank
Patient Orientation	(0020,0020)	2C	Blank
RT Image label	(3002,0002)	1	Field.ID

Table 57 RT Image Storage SOP Class (SCU) –Image Pixel Module

Samples per Pixel	(0028, 0002)	1	1
Photometric Interpretation	(0028, 0004)	1	“MONOCHROME2”
Rows	(0028, 0010)	1	
Columns	(0028, 0011)	1	
Bits Allocated	(0028, 0100)	1	16
Bits Stored	(0028, 0101)	1	16
High Bit	(0028, 0102)	1	15
Pixel Representation	(0028, 0103)	1	0
Pixel Data	(7FE0, 0010)	1	
Planar Configuration	(0028, 0006)	1C	0
Pixel Aspect Ratio	(0028, 0034)	1C	1
Smallest Image Pixel Value	(0028, 0106)	3	Actual smallest pixel value in the exported image.
Largest Image Pixel Value	(0028, 0107)	3	Actual largest pixel value in the exported image.
Window center	(0028,1050)	3	(1-brightness/100)*(ActualMaxVal - ActualMinVal) + ActualMinVal
Window width	(0028,1051)	3	(1-contrast/100)*(ActualMaxVal - ActualMinVal)

Table 58 RT Image Storage SOP Class (SCU) – RT Image Module

Samples per pixel	(0028, 0002)	1	1
Photometric Interpretation	(0028, 0004)	1	“MONOCHROME2.
Pixel Representation	(0028, 0103)	1	0
Bits Allocated	(0028, 0100)	1	16
Bits Stored	(0028, 0101)	1	16
High Bit	(0028, 0102)	1	15
Image Type	(0008, 0008)	1	ORIGINAL\\PRIMARY\\PORTAL
RT Image label	(3002, 0002)	1	Label corresponding to the type of acquired image : PlanarView : "XVIKVPlanarView " VolumeView : "XVIKVVolumeView " MotionView : "XVIKVMotionView "
Reported Values Origin	(3002, 000A)	2C	“ACTUAL”
RT Image Plane	(3002, 000C)	1	“NORMAL”
X-Ray Image Receptor Angle	(3002, 000E)	2	Always 0
Image Plane Pixel Spacing	(3002, 0011)	2	If the Horizontal scale factor is defined this tag is populated.
RT Image Position	(3002, 0012)	2	If the image centre is defined this tag is populated. x = – (image centre X in mm) + (half a pixel size in mm) y = (image centre Y in mm) – (half a pixel size in mm) All dimensions are at X-Ray image receptor plane. Image centre X and Y come from the XVI database and can be seen (in Pixel) in the “edit image” dialog box.
RT Image SID	(3002, 0026)	2	1536, can be overwritten by an optional setting in sri.ini ([Linac]KV_SSD) see Note XXXI
Radiation machine SAD	(3002, 0022)	2	1000, can be overwritten by an optional setting in sri.ini([Linac]KV_SID) see Note XXXI
Gantry Angle	(300A, 011E)	3	Gantry Angle recorded at acquisition time + 90 degrees.
Conversion type	(0008,0064)	2	“DI” (Digital Interface)
Patient Position	(0018, 5100)	1C	Field.Orientation Image.Orientation

Note XXXI SID and SAD:
If the setting in sri.ini file is present and valid it is used, if any error is detected the default value is used. (Sanity checks on SID are: maximum 3000 minimum 500, on SAD: maximum 1500 minimum 500)

Table 59 RT Image Storage SOP Class (SCU) – SOP Common Module

SOP Class UID	(0008, 0016)	1	1.2.840.10008.5.1.4.1.1.481.1
SOP Instance UID	(0008, 0018)	1	Image.UID (generated by XVI for natively acquired images, and images imported from any source, including DICOM) see Note XVII
Instance Creation Date	(0008, 0012)	3	Date of export
Instance Creation Time	(0008, 0013)	3	Time of export
Instance Creator UID	(0008, 0014)	3	Derived from 6-digit XVI workstation serial number. 1.3.46.423632 .<abcxyz>

E. Applied SC Image IOD and mapping to Elekta XVI Database

E.1 Import of SC Image

The modules selected from the Secondary Capture Image IOD table of DICOM for image import are given in Table 60 If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 60 Applied Modules in the SC Image IOD for Import (SCP Role)

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Image	General Image	M
	Image Pixel	M
	SC Image	M
	SOP Common	M

Table 61 to Table 67 specify, for each of the applied modules above, the attributes stored by Elekta XVI, and their mapping onto the Elekta XVI database.

Ignored attributes are not stored into the Elekta XVI patient database. **However, all DICOM objects must conform to the DICOM standard.** If any part of a Secondary Capture Image does not conform to the standard then that prescription is not saved into the database and the storage request is rejected. Thus, Elekta XVI performs validation of the entire applied IOD. I.e. where attributes irrelevant to Elekta XVI are included in a message, they must still have values that are valid according to the DICOM standard. Storage requests containing invalid attributes will be REJECTED. (See Table 101, Status Code A901).

Table 61 SC Image Storage SOP Class (SCP) – Patient Module

Patients Name	(0010,0010)	PN 1	2	Split into Patient.first_name, Patient.last_name, Patient.mid_name (Prefix, Suffix not stored). (See Note XXXII , Note XXXIII).
Patient ID	(0010, 0020)	LO 1	2	Patient.id (See Note XXXII , Note XXXIII)
Patient's Birth Date	(0010, 0030)	DA 1	2	Patient.birth_date
Patients Sex	(0010, 0040)	CS 1	2	Patient.sex
Referenced Patient Sequence	(0008, 1120)	SQ 1	3	Ignored
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	
Patient's Birth Time	(0010, 0032)	TM 1	3	
Other Patient IDs	(0010, 1000)	LO 1-N	3	
Other Patient Names	(0010, 1001)	PN 1-N	3	
Ethnic Group	(0010, 2160)	SH 1	3	
Patient Comments	(0010, 4000)	LT 1	3	

Note XXXII Handling of Empty Patient Identification Attributes

The Patient ID (0010, 0020) and Patient Name (0010, 0010) attributes of the Patient Module are specified by DICOM as Type 2 and so may legally have zero length.

As a safety measure, however, **Elekta XVI** treats these attributes as Type 1 and will REJECT any Secondary Capture Image Storage request containing zero length values for these attributes. Which means these Secondary Capture Images won't enter the Elekta XVI DICOM Transit database. (See Table **101**, Status Code C001).

Note XXXIII Patient ID Already Exists in Elekta XVI Database

If a patient with the Patient ID specified in the Secondary Capture Storage request already exists in the Elekta XVI Main database, no further Patient Module attributes in the request will be imported. The check for an existing Patient ID is insensitive to case or leading/trailing spaces.

Table 62 SC Image Storage SOP Class (SCP) – General Study Module

Study Instance UID	(0020, 000D)	UI 1	1	Treatment.dicom_uid
Study Date	(0008, 0020)	DA 1	2	Ignored
Study Time	(0008, 0030)	TM 1	2	
Referring Physicians Name	(0008, 0090)	PN 1	2	
Study ID	(0020, 0010)	SH 1	2	Treatment.id see Note XXXIV
Accession Number	(0008, 0050)	SH 1	2	
Study Description	(0008, 1030)	LO 1	3	Treatment.descrip
Physician(s) of Record	(0008, 1048)	PN 1-N	3	Ignored
Name of Physician(s) Reading Study	(0008, 1060)	PN 1-N	3	
Referenced Study Sequence	(0008, 1110)	SQ 1	3	
>Referenced SOP Class UID	(0008, 1150)	UI 1	1C	
>Referenced SOP Instance UID	(0008, 1155)	UI 1	1C	

Note XXXIV Handling of Empty Study ID Attribute

An incrementing counter is prepended to the treatment id then ":" and one of the following.

The applied Study ID (0020, 0010) is specified by DICOM as Type 2 and so may legally have zero length**.** This field is normally used by Elekta XVI to identify the Treatment to be created or updated.

In the situation where the Study ID attribute is empty, Elekta XVI will attempt to use the Accession Number (0008, 0050, Type 2) attribute as a Treatment ID instead. In such cases it will also append the Treatment Description with the text ":TRTID derived (Accession No.)" to assist the operator.

In the situation where both the Study ID and Accession Number attributes are empty, Elekta XVI will use the last 16 digits of the Study Instance UID (0020, 000D) as a Treatment ID. In such cases it will also append the Treatment Description with the text ":TRTID derived (StudyInstanceUID.)" to assist the operator.

Extreme caution is advised when handling data with limited Study identification information present. It is the responsibility of the Elekta XVI operator to ensure that incoming image data containing an empty Study ID attribute is correctly identified and qualified before relocation into the main Elekta XVI Clinical database.

Table 63 SC Image Storage SOP Class (SCP) – General Series Module

Series Instance UID	(0020, 000E)	1	Field.UID . See Note XXXV below
Modality	(0008, 0060)	1	Ignored
Series Number	(0020, 0011)	2	Field.ID. See Note XXXV below
Laterality	(0020, 0060)	2C	Appended to Field.Site
Series Date	(0008, 0021)	3	Appended to Field.Description
Series Time	(0008, 0031)	3	Appended to Field.Description
Protocol Name	(0018, 1030)	3	Appended to Field.Description
Series Description	(0008, 103E)	3	Field.Description
Body Part Examined	(0018, 0015)	3	Field.Site
Patient Position	(0018, 5100)	2C	Field.orientation

Note XXXV Handling of Empty Series Number Attribute

The applied Series Number (0020, 0011) is specified by DICOM as Type 2 and so may legally have zero length**.** This field is normally used by Elekta XVI to identify the Field to be created or updated.

In the situation where the Series Number attribute is empty, Elekta XVI will use the last 16 digits of the Series Instance UID (0020, 000E) as a Field ID. In such cases it will also append the Field Description with the ":FLDID derived (SeriesInstanceUID)" to assist the operator.

Note XXXVI Field ID

For fields created from secondary images import the ID will start with the prefix ":SC IMAGE" and be prefixed by an incrementing counter. A new field will be created for every image imported.

Extreme caution is advised when handling data with limited Series identification information present. It is the responsibility of the Elekta XVI operator to ensure that incoming image data containing an empty Series Number attribute is correctly identified and qualified before relocation into the main Elekta XVI Clinical database.

Table 64 SC Image Storage SOP Class (SCP) – General Image Module

Instance Number	(0020,0013)	2	IS 1	Ignored
Patient Orientation	(0020,0020)	2C	CS 2	Image.orient (using a single character based coding)
Content Date	(0008,0023)	2C	DA 1	Ignored
Content Time	(0008,0033)	2C	TM 1	
Image Type	(0008,0008)	3	CS 1-n	
Acquisition Number	(0020,0012)	3	IS 1	
Acquisition Date	(0008,0022)	3	DA 1	Image.Date. (if not present use date of import)
Acquisition Time	(0008,0032)	3	TM 1	Image.time (if not present use time of import)
Acquisition Datetime	(0008,002A)	3	DT 1	Ignored
Referenced Image Sequence	(0008,1140)	3	SQ 1	
>Referenced SOP Class UID	(0008,1150)	1C	UI 1	
>Referenced SOP Instance UID	(0008,1155)	1C	UI 1	
>Referenced Frame Number	(0008,1160)	3	IS 1-n	

Table 65 SC Image Storage SOP Class (SCP) – Image Pixel Module

Samples per Pixel	(0028, 0002)	1	**Assumed to be 1.**
Photometric Interpretation	(0028, 0004)	1	**Assumed to be "MONOCHROME1" or "MONOCHROME2. See** **Note XXXVII.**
Rows	(0028, 0010)	1	Image.Height
Columns	(0028, 0011)	1	Image.Width
Bits Allocated	(0028, 0100)	1	Bits Allocated is 8 or 16
Bits Stored	(0028, 0101)	1	8 to 16
High Bit	(0028, 0102)	1	7 to 15
Pixel Representation	(0028, 0103)	1	Used to determine pixel scaling behaviour
Pixel Data	(7FE0, 0010)	1	Image pixel data interpreted.
Planar Configuration	(0028, 0006)	1C	**Assumed to be 0**
Pixel Aspect Ratio	(0028, 0034)	1C	Image.Aspect

Note XXXVII Stored Image Formats

Elekta XVI will **always** assume that pixel data is organised as 1 sample per pixel, either MONOCHROME1 or MONOCHROME2 interpretation and will store images accordingly.

Table 66 SC Image Storage SOP Class (SCP) – SC Image Module

Date of Secondary Capture	(0018, 1012)	3	Image.Acquistion Date
Time of Secondary Capture	(0018, 1014)	3	Image.Acquistion Time

Table 67 SC Image Storage SOP Class (SCP) – SOP Common Module

SOP Class UID	(0008, 0016)	1	Ignored.
SOP Instance UID	(0008, 0018)	1	Discarded. **A new UID is generated for Image.UID** (see Note XVII)
Specific Character Set	(0008, 0005)	1C	Ignored.

E.2 Export of SC Image

The modules selected from the Secondary Capture Image IOD table of DICOM for image export are given in Table 68 below. If a module is not listed, none of the attributes in that module is sent by Elekta XVI.

Table 68 Applied Modules in the SC Image IOD for Export (SCU Role)

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Equipment	General Equipment	U
	SC Equipment	M
Image	General Image	M
	Image Pixel	M
	SC Image	M
	SOP Common	M

Table 69 to Table 77 below specify the applied attributes for each module, and note their mappings from the Elekta XVI database. If an attribute is not listed, it is not sent by Elekta XVI. If an attribute is listed without Notes, there is a mapping from a directly equivalent Elekta XVI database entry.
Only the tags populated are listed.

Table 69 SC Image Storage SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	Patient.ID
Patient's Birth Date	(0010, 0030)	2	Patient.birth_date
Patients Sex	(0010, 0040)	2	Patient.sex
Patient Comments	(0010, 4000)	3	Patient.comment

Table 70 SC Image Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020, 000D)	1	Treatment.UID (generated by Elekta XVI for native treatments , see Note XVII)
Study Date	(0008, 0020)	2	Empty
Study Time	(0008, 0030)	2	Empty
Referring Physicians Name	(0008, 0090)	2	Patient.doctor^^^^
Study ID	(0020, 0010)	2	Treatment.ID
Accession Number	(0008, 0050)	2	Empty
Study Description	(0008, 1030)	3	Treatment.Description

Table 71 SC Image Storage SOP Class (SCU) – General Series Module

Modality	(0008, 0060)	1	"CR"
Series Instance UID	(0020, 000E)	1	Field.UID (generated by Elekta XVI for native fields, see Note XVII)
Series Number	(0020, 0011)	2	IF Field ID is numeric: Field.ID, ELSE: an internally generated unique field-specific number.
Protocol Name	(0018, 1030)	3	"XVI Synergy"
Series Description	(0008, 103E)	3	Field.Description
Patient Position	(0018, 5100)	2C	Empty if position not specified by operator

Table 72 SC Image Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	“ELEKTA”
Station Name	(0008, 1010)	3	IF an Elekta XVI acquired image: Acquiring Station Name, ELSE: “UNKNOWN” + any available origin detail.
Manufacturers Model Name	(0008, 1090)	3	“Elekta XVI”
Device Serial Number	(0018, 1000)	3	Elekta XVI Station Serial Number (see Note IV)
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station

Note XXXVIII Serial number:
The station serial number is set through the initialisation file “sri.ini”

Table 73 SC Image Storage SOP Class (SCU) – SC Equipment Module

Conversion Type	(0008, 0064)	1	“DI”
Modality	(0008, 0060)	3	“CR”
Secondary Capture Device ID	(0018, 1010)	3	IF an Elekta XVI acquired image: Acquiring Station Name, ELSE: “UNKNOWN” + any available origin detail.
Secondary Capture Device Manufacturer	(0018, 1016)	3	“ELEKTA”
Secondary Capture Device Manufacturer’s Model Name	(0018, 1018)	3	“Elekta XVI”
Secondary Capture Device Software Version	(0018, 1019)	3	Software revision of EXPORTING Station

Table 74 SC Image Storage SOP Class (SCU) – General Image Module

Image Number	(0020, 0013)	2	An internally generated database-unique image-specific number.
Patient Orientation	(0020, 0020)	2C	Empty if orientation not specified by operator
Image Date	(0008, 0023)	2C	Image acquisition date
Image Time	(0008, 0033)	2C	Image acquisition time
Image Type	(0008, 0008)	3	IF an Elekta XVI acquired image: ORIGINAL\\PRIMARY ELSE: DERIVED\\SECONDARY
Acquisition Date	(0008, 0022)	3	Image acquisition date
Acquisition Time	(0008, 0032)	3	Image acquisition time
Images in Acquisition	(0020, 1002)	3	1
Image Comments	(0020, 4000)	3	Image. comment

Table 75 SC Image Storage SOP Class (SCU) –Image Pixel Module

Samples per Pixel	(0028, 0002)	1	1
Photometric Interpretation	(0028, 0004)	1	"MONOCHROME2"
Rows	(0028, 0010)	1	Image. height
Columns	(0028, 0011)	1	Image. width
Bits Allocated	(0028, 0100)	1	8 or 16
Bits Stored	(0028, 0101)	1	8 to 16
High Bit	(0028, 0102)	1	7 to 15
Pixel Representation	(0028, 0103)	1	0
Pixel Data	(7FE0, 0010)	1	
Planar Configuration	(0028, 0006)	1C	0
Pixel Aspect Ratio	(0028, 0034)	1C	Image.aspect
Smallest Image Pixel Value	(0028, 0106)	3	Actual smallest pixel value in the exported image.
Largest Image Pixel Value	(0028, 0107)	3	Actual largest pixel value in the exported image.
Window center	(0028,1050)	3	(1-brightness/100)*(ActualMaxVal - ActualMinVal) + ActualMinVal
Window width	(0028,1051)	3	(1-contrast/100)*(ActualMaxVal - ActualMinVal)

Table 76 SC Image Storage SOP Class (SCU) – SC Image Module

Date of Secondary Capture	(0018, 1012)	3	Image acquisition date
Time of Secondary Capture	(0018, 1014)	3	Image acquisition time

Table 77 SC Image Storage SOP Class (SCU) – SOP Common Module

SOP Class UID	(0008, 0016)	1	1.2.840.10008.5.1.4.1.1.7
SOP Instance UID	(0008, 0018)	1	Image.UID (generated by Elekta XVI for natively acquired images, and images imported from any source, including DICOM) see Note XVII
Instance Creation Date	(0008, 0012)	3	Date of export
Instance Creation Time	(0008, 0013)	3	Time of export
Instance Creator UID	(0008, 0014)	3	Derived from 6 digit Elekta XVI workstation serial number. 1.3.46.423632 .<abcxyz>

F. Applied Spatial registration IOD and mapping to Elekta XVI Database

F.1 Configuration

XVI exports SRO objects to the configured Distributed Solution AETitle
Sri.ini
[Dicom]
DistributedSolutionAETitle

XVI can export SRO objects to the configured AETitle during the adaptive workflow (Meanwhile “Adaptive” parameter in volume acquisition preset needs to be set to “Yes”)
Sri.ini
[EnhancedDicomAutoExport]
SRO_PostAcceptRegPreShift_AETitlesList

There are 2 kinds of SRO objects: SRO-Standard and SRO-Lite. The difference between SRO-Standard and SRO-Lite is just as following:
SRO-Standard:
1) Contains at least 2 registration results, maybe more (At least contains “Correction”)
2) Include private tags in exported SRO object
3) Export together with RPS
SRO-Lite:
1) Contains only 1 registration result – “Correction”
2) Don’t include any private tags in exported SRO object
3) Only export of SRO, no RPS
As shown in C:\XVI\Merge\Mergecom.app,
- “Storage_Only_Service_List” is a service list used for SRO-Standard export
- “Storage_Only_Service_List_SROLite” is a service list used for SRO-Lite export

You can set such kind of service list for each AE in the beginning Application entries of Mergecom.app file.

F.2 Export of Spatial registration object

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Frame of reference	Frame of Reference	M
Equipment	General equipment	M
Spatial registration	Spatial registration	M
	Common instance Reference	M
	SOP Common	M

Table 78 Spatial Registration SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	Patient.ID
Patient’s Birth Date	(0010, 0030)	2	Patient.birth_date
Patients Sex	(0010, 0040)	2	Patient.sex
Patient Comments	(0010, 4000)	3	Patient.comment

Table 79 Spatial Registration Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020,000D)	1	Same as CBCT used during registration
Study Date	(0008,0020)	2	Same as CBCT this SRO relates to.

Study Time	(0008,0030)	2	Same as CBCT this SRO relates to.
Referring Physicians Name	(0008,0090)	2	Same as CBCT this SRO relates to.
Study ID	(0020,0010)	2	Same as CBCT this SRO relates to.
Accession Number	(0008,0050)	2	Same as CBCT this SRO relates to.
Study Description	(0008,1030)	3	Same as CBCT this SRO relates to.

Table 80 Spatial Registration Storage SOP Class (SCU) – General Series Module

Modality	(0008, 0060)	1	REG
Series Instance UID	(0020, 000E)	1	New UID generated at export time
Series Number	(0020, 0011)	2	1
Series Date	(0008,0021)	3	Date of registration
Series Time	(0008,0031)	3	Time of registration
Protocol Name	(0018, 1030)	3	Registration protocol name (Clipbox, Mask, Clipbox --> Mask).
Series Description	(0008, 103E)	3	"Elekta SRO : <Registration protocol>;<Registration approval date>;<Registration approval time>"
Patient Position	(0018, 5100)	2C	Same as CBCT this SRO relates to.

Table 81 Spatial Registration Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	"ELEKTA"
Station Name	(0008, 1010)	3	Station name as defined in sri.ini at time of export
Manufacturers Model Name	(0008, 1090)	3	"Elekta XVI"
Device Serial Number	(0018, 1000)	3	Elekta XVI Station Serial Number
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station

Table 82 Spatial Registration Storage SOP Class (SCU) – Frame of reference Module

Frame of reference UID	(0020,0052)	1	Same as the reference CT scan used during in registration.
Position Reference Indicator	(0020,1040)	2	Ignored

Table 83 Spatial Registration Storage SOP Class (SCU) – Spatial Registration Module

Content Date	(0008,0023)	1	Registration approval date.
Content Time	(0008,0033)	1	Registration approval time.
Private data	(0021,xx5C)	1	Only applicable to SRO-Standard, not applicable to SRO-Lite.
Private data	(0021,xx60)	1	Only applicable to SRO-Standard, not applicable to SRO-Lite.
Private data	(0021,xx61)	1	Only applicable to SRO-Standard, not applicable to SRO-Lite.
Registration Sequence	(0070,0308)	1	
>Frame of reference UID	(0020,0052)	1C	Frame of reference UID of CBCT used during registration (First element of this sequence contains the Frame of reference UID of the reference CT and an identity matrix to help consumers understand which Frame of reference relates to the reference data.)
> Referenced image sequence	(0008,1140)	1C	
>> Referenced SOP class UID	(0008,1150)	1C	Standard CT Image call UID "1.2.840.10008.5.1.4.1.1.2"
>> Referenced SOP Instance UID	(0008,1155)	1C	Sop instance UID on image used in registration
>> Referenced Frame number	(0008,1160)	1C	Image number of image used in registration.

>Matrix Registration Sequence	(0070,0309)	1	
>>Matrix registration label	(0021,xx39)	1	Identifies the registration. Matches data in RPS (Only applicable to SRO-Standard, not applicable to SRO-Lite). Possible values: • Identity • Correction • Align.Clip1 • Align.Mask1 • Align .Clip1.Frame0 • ... • Align.Clip1.FrameN • Align.Mask1.Frame0 • … • Align.Mask1.FrameN
>>Frame of Reference Transformation Comment	(3006,00C8)	3	Reflects the match method used to generate that registration. For 4D registration, will tell how many frames to expect (“4D Frame %d of %d” index starts at 0) For correction the comment is “Correction”
>>Matrix Sequence	(0070,030A)	1	
>>>Frame of Reference Transformation Matrix	(3006,00C6)	1	A 4x4 homogeneous transformation matrix that registers the referenced images to the local RCS. Matrix elements shall be listed in row-major order.
>>>Frame of Reference Transformation Matrix Type	(0070,030C)	1	RIGID

Table 84 Spatial Registration Storage SOP Class (SCU) – Common instance reference Module

Referenced Series Sequence	(0008,1115)	1C	Sequence of Items each of which includes the Attributes of one Series. 2 items will be present
>Series Instance UID	(0020,000E)	1	Item1: the Reference CT series used in registration Item2: The CBCT used in registration
>Referenced Instance Sequence	(0008,114A)	1	Sequence of Items each providing a reference to an Instance that is part of the Series defined by Series Instance UID (0020,000E) in the enclosing Item. One or more Items shall be included in this sequence.
>>Referenced SOP Class UID	(0008,1150)	1	Standard CT Image call UID “1.2.840.10008.5.1.4.1.1.2”
>>Referenced SOP Instance UID	(0008,1155)	1	Sop instance UID on image used in registration

Table 85 Spatial Registration Storage SOP Class (SCU) – SOP Common Module

SOP Class UID	(0008, 0016)	1	SRO storage UID
SOP Instance UID	(0008, 0018)	1	Generate new at every export

G. Applied Raw Data IOD and mapping to Elekta XVI Database

G.1 Configuration

XVI exports Raw data objects to the configured Distributed Solution AETitle
Sri.ini
[Dicom]
DistributedSolutionAETitle

G.2 Export of Spatial registration object

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Equipment	General equipment	M
Raw data	Acquisition context	M
	Raw data	M
	SOP Common	M

Table 86 Raw data SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	Patient.ID
Patient's Birth Date	(0010, 0030)	2	Patient.birth_date
Patients Sex	(0010, 0040)	2	Patient.sex
Patient Comments	(0010, 4000)	3	Patient.comment

Table 87 Raw data Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020,000D)	1	Same UID as CBCT Study UID (same as Reference CT Study UID) (generated by Elekta XVI for native treatments)
Study Date	(0008,0020)	2	Date of image acquisition
Study Time	(0008,0030)	2	Time of image acquisition
Referring Physicians Name	(0008,0090)	2	Patient.doctor^^^^
Study ID	(0020,0010)	2	Treatment.ID
Accession Number	(0008,0050)	2	Empty
Study Description	(0008,1030)	3	Treatment.Description

Table 88 Raw data Storage SOP Class (SCU) – General Series Module

Modality	(0008, 0060)	1	REG
Series Instance UID	(0020, 000E)	1	New UID generated at export time
Series Description	(0008, 103E)	3	"RPS"

Table 89 Raw data Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	“ELEKTA”
Station Name	(0008, 1010)	3	Station name as defined in sri.ini at time of export
Manufacturers Model Name	(0008, 1090)	3	“Elekta XVI”
Device Serial Number	(0018, 1000)	3	Elekta XVI Station Serial Number
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station

Table 90 Raw data Storage SOP Class (SCU) – Raw data Module

Instance Number	(0020,0013)	2	1
Content Date	(0008,0023)	1	The date the raw data creation was started.
Content Time	(0008,0033)	1	The time the raw data creation was started.
Creator-Version UID	(0008,9123)	1	Unique identification of the equipment and version of the software that has created the Raw Data information. The UID allows one to avoid attempting to interpret raw data with an unknown format.
Elekta private group	0x0021		Group Elekta reserved for transmission of private data.
	(0021,xxxx)		Private tags

H. Applied Enhanced X-Ray Radiation Dose SR IOD and mapping to Elekta XVI Database

H.1 Configuration

XVI exports Enhanced X-Ray Radiation Dose SR objects to the configured Auto Push AETitle
Sri.ini
[Dicom]
AutoPushAETitle

H.2 Export of Enhanced X-Ray Radiation Dose SR object

Patient	Patient	M
Study	General Study	M
Series	SR Document Series	M
Equipment	General Equipment	M
	Enhanced General Equipment	M
Document	SR Document General	M
	SR Document Content	M
	SOP Common	M

Table 91 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – Patient Module

Patients Name	(0010,0010)	2	Patient.Last^ Patient.First^ Patient.Middle^^ (no Prefix or Suffix)
Patient ID	(0010, 0020)	2	Patient.ID
Patient's Birth Date	(0010, 0030)	2	Patient.birth_date
Patients Sex	(0010, 0040)	2	Patient.sex
Patient Comments	(0010, 4000)	3	Patient.comment

Table 92 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – General Study Module

Study Instance UID	(0020,000D)	1	Same as CBCT this Enhanced X-Ray RDSR relates to.
Study Date	(0008,0020)	2	Same as CBCT this Enhanced X-Ray RDSR relates to.
Study Time	(0008,0030)	2	Same as CBCT this Enhanced X-Ray RDSR relates to.
Referring Physicians Name	(0008,0090)	2	Same as CBCT this Enhanced X-Ray RDSR relates to.
Study ID	(0020,0010)	2	Same as CBCT this Enhanced X-Ray RDSR relates to.
Accession Number	(0008,0050)	2	Same as CBCT this Enhanced X-Ray RDSR relates to.
Study Description	(0008,1030)	3	Same as CBCT this Enhanced X-Ray RDSR relates to.

Table 93 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – SR Document Series Module

Modality	(0008, 0060)	1	"SR"
Series Instance UID	(0020, 000E)	1	New UID generated at export time
Series Number	(0020, 0011)	1	Internally generated unique field-specific number. (New at each export)

Series Date	(0008,0021)	3	Date of image acquisition
Series Time	(0008,0031)	3	Time of image acquisition
Protocol Name	(0018, 1030)	3	“<Acquisition Preset Name> : <Reconstruction Preset Name>”
Series Description	(0008, 103E)	3	Same as CBCT this Enhanced X-Ray RDSR relates to.

Table 94 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – General Equipment Module

Manufacturer	(0008, 0070)	2	“ELEKTA”
Station Name	(0008, 1010)	3	IF an Elekta XVI acquired image: Acquiring Station Name, ELSE: “UNKNOWN” + any available origin detail.
Manufacturers Model Name	(0008, 1090)	3	“Elekta XVI”
Device Serial Number	(0018, 1000)	3	Elekta XVI Station Serial Number
Software Versions	(0018, 1020)	3	Software revision of EXPORTING Station

Table 95 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – Enhanced General Equipment Module

Manufacturer	(0008, 0070)	1	“ELEKTA”
Manufacturers Model Name	(0008, 1090)	1	“Elekta XVI”
Device Serial Number	(0018, 1000)	1	Elekta XVI Station Serial Number
Software Versions	(0018, 1020)	1	Software revision of EXPORTING Station

Table 96 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – SR Document General Module

Instance Number	(0020,0013)	1	Internally generated unique field-specific number. (New at each export)
Completion Flag	(0040,A491)	1	“COMPLETE”
Verification Flag	(0040,A493)	1	“UNVERIFIED”
Content Date	(0008,0023)	1	Date at export time
Content Time	(0008,0033)	1	Time at export time

Table 97 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – SR Document Content Module

1	CONTAINER	X-Ray Radiation Dose Report	M	
1.1	CODE	Language of Content Item and Descendants	M	“English”
1.2	CODE	Procedure reported	M	“Cone Beam Acquisition”
1.2.1	CODE	Has Intent	M	“Diagnostic Intent”
1.3	CODE	Observer Type	MC	“Device”
1.4	UIDREF	Device Observer UID	M	Same as Device ID in General Equipment module
1.5	TEXT	Device Observer Manufacturer	U	Same as Manufacturer in General Equipment module
1.6	TEXT	Device Observer Model Name	U	Same as Manufacturers Model Name in General Equipment module

1.7	TEXT	Device Observer Serial Number	U	Same as Device Serial Number in General Equipment module
1.8	CODE	Scope of Accumulation	M	“Study”
1.9	CONTAINER	Irradiation Event Summary Data	M	
1.9.1	UIDREF	Irradiation Event UID	M	Same as Study Instance UID in General Study module
1.9.2	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.9.3	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.9.4	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.9.5	CODE	Irradiation Event Type	M	“Rotational Acquisition”
1.9.6	NUM	Exposure Time	U	Same as Exposure Time in CT Image module of CBCT
1.9.7	CONTAINER	CT Dose	U	
1.9.7.1	NUM	Mean CTDIvol	M	Same as CTDIvol in CT Image module of CBCT
1.9.7.2	CODE	CTDIw Phantom Type	M	Same as CTDI Phantom Type in CT Image module of CBCT
1.9.7.3	NUM	DLP	M	Dose Length Product calculated by nominal scan dose and collimator
1.10	CONTAINER	Irradiation Details	M	
1.10.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.3	UIDREF	Frame of Reference UID	M	Same as Reference UID in Frame of Reference module of CBCT
1.10.4	CODE	RDSR Frame of Reference Origin	M	“Equipment Origin”
1.10.5	CONTAINER	Radiation Source Characteristics	M	
1.10.5.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.5.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.5.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.5.4	NUM	Focal Spot Size	M	Same as Focal Spot in CT Image module of CBCT
1.10.6	CONTAINER	Radiation Technique	M	
1.10.6.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.6.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.6.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.6.4	NUM	KVP	M	Same as KVP in CT Image module of CBCT
1.10.6.5	NUM	X-Ray Tube Current	M	Same as X-Ray Tube Current in CT Image module of CBCT
1.10.7	CONTAINER	Radiation Output	M	
1.10.7.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT

1.10.7.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.7.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.7.4	NUM	Air Kerma at Output Measurement Point	M	Same as CTDIvol in CT Image module of CBCT
1.10.8	CONTAINER	Radiation Field Area	M	
1.10.8.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.8.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.8.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.8.4	SCOORD3D	Radiation Field Outline	M	Ignore
1.10.9	CONTAINER	X-Ray Source Reference Coordinate System	M	
1.10.9.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.9.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.9.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.9.4	TABLE	Transformation Matrix	M	Ignore
1.10.10	CONTAINER	Beam Position	M	
1.10.10.1	DATETIME	DateTime Started	M	Same as Acquisition Datetime in General Image module of CBCT
1.10.10.2	DATETIME	DateTime Ended	M	The DateTime when Volume acquisition is ended
1.10.10.3	TEXT	Identification of the X-Ray Source	M	Same as Device Serial Number in General Equipment module
1.10.10.4	SCOORD3D	Output Measurement Point Position	M	Ignore
1.11	CODE	Source of Dose Information	M	“Automated Data Collection”

Table 98 Enhanced X-Ray Radiation Dose SR Storage SOP Class (SCU) – SOP Common Module

SOP Class UID	(0008, 0016)	1	Enhanced X-Ray Radiation Dose SR storage UID
SOP Instance UID	(0008, 0018)	1	Generate new at every export
Specific Character Set	(0008, 0005)	1C	Ignore
Instance Creation Date	(0008, 0012)	3	
Instance Creation Time	(0008, 0013)	3	
Instance Creator UID	(0008, 0014)	3	

I. Extended Image Import Capability

In addition to the SOP classes supported by Elekta XVI as SCP listed in Table 1 on page 9,above, the Elekta XVI AE has the optional ability to store images of types other than Secondary Capture.

This feature is provided to extend the potential usefulness of the system as a general-purpose image viewing station, and is configurable to be enabled or disabled.

NOTE: The viewing, analysis, processing and printing functions within Elekta XVI are primarily designed for portal images acquired by the Elekta XVI system. When applied to images that are sent to Elekta XVI by means of DICOM, in particular from modalities other than Portal Imagers, some of these functions may not perform optimally or may not be relevant.

When the capability is enabled the following additional SOP classes are supported by Elekta XVI as SCP:

Table 99 Additional SOP Classes supported by Elekta XVI as SCP (Extended Import Option Enabled)

CR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.1
MR Image Storage - STORE	1.2.840.10008.5.1.4.1.1.4

The modules selected from the Image IOD's for Extended Image Import are given in Table 100 below. If a module is not listed, none of the attributes in that module is stored by Elekta XVI.

Table 100 Applied Modules in the Image IOD for Import (SCP Role: Extended Import)

Patient	Patient	M
Study	General Study	M
Series	General Series	M
Image	General Image	M
	Image Pixel	M
	SOP Common	M

For the modules listed in Table 100, the attributes stored by Elekta XVI, and their mapping onto the Elekta XVI database are as listed in the respective tables in Section A.2 above.

I.1 C-STORE Conformance when Extended Import is enabled.

With Extended Import enabled, Elekta XVI will provide standard conformance as a Conformance Level 0 Storage SCP for Secondary Capture.

For the additional SOP classes listed in Table 99 above, however, note the following:

- Should the images be re-exported, they will be exported as Secondary Capture, not as the original SOP class (the new SOP Instance UID generated at Storage time will be used).

J. C-STORE Response Status Codes

Table 101 below lists the specific status code values returned by Elekta XVI in a C-STORE response.

Table 101 C-STORE Status Codes

Refused	Out of Resources	A7xx	
	- Dicom object already present in Elekta XVI DICOM Transit database	A705	
	- No File set available (can't create or access)	A706	
	- The file set was locked for a period longer than timeout	A707	
Error	Data Set does not match SOP Class	A9xx	
	- Invalid Dicom message	A901	
Error	Cannot Understand	Cxxx	
	- Missing Patient Identification data	C001	See Note I
	- Non 16 Bit Image	C027	
	- Image too small (number of rows and columns)	C028	
	- Plan contain multiple isocenter	C029	
Success		0000	