

The background of the page features a stylized, glowing green outline of a hand holding a CyberKnife device. The hand is positioned as if holding the handle of the device, which is shown in a similar glowing green outline. The device has a rectangular head with a small protrusion at the bottom. The entire graphic is set against a dark green background with some faint, thin white lines.

CyberKnife[®]
ACCURAY[®]

**Cyberknife Stereotactic
Radiosurgery/Radiotherapy System
DICOM™ 3.0 Conformance Statement**

**Cyberknife Robotic Radiosurgery System
DICOM 3.0 Conformance Statement**

CyberKnife Robotic Radiosurgery System

DICOM 3.0 Conformance Statement

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REVISION HISTORY

Rev.	ECO #	Description of Change	Revised By	Date
A	1119	Initial Release.	J. R. Dooley	7/12/02
B	1453	V3.2.2 Open Architecture Release.	J. R. Dooley	6/25/03
C	1660	V3.3.3 Open Architecture Release	J. R. Dooley	12/17/03
D	2010	CyRIS™ InView® 1.1.0 Product Release	J. R. Dooley	9/3/04
E	2259	CyRIS MultiPlan® 1.3.0 Product Release	J. R. Dooley	6/1/05
F	3536	CyberKnife MultiPlan 2.0 Product Release	I-Ning Chang	12/1/06
G	4440	CyberKnife MultiPlan 2.1 Product Release	I-Ning Chang	11/15/07
H	4766	CyberKnife 8.0 Product Release	D. R. DeWitt	5/14/08
J	5099	CyberKnife 8.5 Product Release	I-Ning Chang J. Cambra	3/16/09
K	5709	CyberKnife 9.0 Product Release	I-Ning Chang Annie Ju	6/25/10
L	6066	CyberKnife 9.5 Product Release	I-Ning Chang J. Cambra	04/14/2011
M	7897	Changes to RTSS export format	David Scherch	3/10/2014
N	ECO-02231	Removed CE Mark	D. Peterson	See Agile

Cover Page

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1 CONFORMANCE STATEMENT OVERVIEW

The CyberKnife System currently supports CT, MR, PET, 3DRA image studies with up to 4 patient positions: HFS (head-first supine), FFS (feet-first supine), HFP (head-first prone), and FFP (feet-first prone). Contact Accuray for a list of supported patient positions for each modality.

DICOM RT Structure Set is the RT object that can be imported from verified external nodes into the CyberKnife On-Target™, MultiPlan and InView applications. Contact Accuray for a complete, current list of external nodes.

DICOM RT Structure Set and RT Dose are currently the RT objects that can be exported from the CyberKnife System and MultiPlan System. In CyberKnife 9.0 and later systems, DICOM RT Plan and RT Beams Treatment Record can be exported from the CyberKnife System. Exportable DICOM RT Dose information includes a multi-frame volume dose grid, dose volume histograms (DVH), and isodose curves. This RT Dose could be imported into InView to review the DVH, isodose curves/clouds, and statistical information. Also the dose grid and DVH of RT Dose could be imported into ITC Remote Review Tool 34 after pushing to the ITC DICOMpiler software 5 for adding DICOM File Meta Information and Clinical Trial Subject C.7.1.3 module (0012 00xx), and the anonymization.

The 16 February, 2001 are ATC Compliant 4 after the version 1.5.1 product release 6.

Regarding Part 10 file format, our software, as of version CyberKnife 5.2.0, can export DICOM part 10 files. After pushing back to InView and CyberKnife databases via CTN_SEND/ CTN_STORAGE/ CTN_ARCHIVE applications, CTN's DICOM server will trim **DICOM File Meta Information** out because it only supports **Implicit VR Little Endian Transfer Syntax** prior to the CyberKnife 8.5.

The 16 February, 2001 1.6, and the CyberKnife Data Management System (CDMS) 1.0/1.1 do not support those images that have two Image Header (0028,xxxx) for two Pixel Data(7FE0,0010), i.e. two instances of the Image Pixel Module, within one slice image file.

The CyberKnife System and MultiPlan System support 3D X-Ray rotational angiography(3DRA) in axial and coronal slices of XA modality, whose volumes are routinely generated from rotational angiography sequences - currently for Philips and Siemens machines which are capable of performing high speed rotational acquisition that enables 3D reconstruction. The CyberKnife System does not support 2D X-Ray angiographic projection image. Contact Accuray for the recommended scanning protocol.

The DICOM application entity for the CyberKnife System evolved with different product releases in the below table.

Table 1. The DICOM Application Entity for the CyberKnife System

CyberKnife Version	Application Entity
CKS 2.x/3.x/4.x	CTN_STORAGE/ CTN_SEND
CKS 5.x/6.x/7.x/8.0/8.1	CTN_STORAGE/ CTN_ARCHIVE/ CTN_SEND
CKS 8.5 and later	CDMS_STORAGE/ CDMS_SEND/ CDMS_QR/ CDMS_UPS

1.1 For CyberKnife 7.x and Earlier Systems Only

Images received are sorted by Study Instance UID; all images received with the same Study UID will be grouped into the same case in the CyberKnife central database. Multiple modalities could be within the same case. Also, note that images received with the same Study Instance UID and modality over different associations will be imported to the CyberKnife central database just once. So, the user should ensure that a complete image study has been exported to the CyberKnife System before importing that study to the CyberKnife central database.

Note that image series of the same modality are effectively concatenated into a single series. This allows the user to scan the patient anatomy for a single plan in two or more series. If, however, the user desires to divide the scans for separate treatment plans of different anatomical regions, the user should ensure that the scans have different Study Instance UIDs. Beginning with CyberKnife 4.3.0 patch (On-Target™ 3.6.0 patch) or CyberKnife Japanese Maintenance 3.4.0.4, the split series feature is provided for users' needs.

The DICOM server used is available at all times except during treatment delivery.

1.2 For CyberKnife 8.0 and Later Systems Only

With the 8.0 release the split option has been removed. Series with the same modality will be treated as separate series. A merge option is available if two image series represent a single image series. The following are other changes that apply to CyberKnife release 8.0 and beyond.

- Series are imported using the Image Review and Import application located on the Administration Workstation.
- DICOM server has been relocated to a dedicated data storage system.
- DICOM server accepts storage associations independently of treatment delivery¹

1.3 For CyberKnife 8.5 and Later Systems Only

Beginning with the 8.5 release the CyberKnife System employs a new DICOM infrastructure based on the MergeCOM-3™ Advanced Integrator's Toolkit 7 by Merge Healthcare™. This DICOM interface is continuously implementing support for most recent updates to DICOM standards, which in turn enables the CyberKnife System to offer extensive DICOM capability including

- The newly added DICOM transfer syntaxes referenced below with their UIDs:
- Implicit VR Little Endian² (1.2.840.10008.1.2)
- Explicit VR Little Endian (1.2.840.10008.1.2.1)
- Explicit VR Big Endian (1.2.840.10008.1.2.2)
- JPEG Lossless coding Process 14 (1.2.840.10008.1.2.4.70)

¹ The DICOM server is available 24/7 beginning with the 8.0 release.

² The Implicit VR Little Endian is the only DICOM transfer syntax prior the CyberKnife 8.0 release .

- The DICOM Files are stored in Part 10 format ³
- Multi-threaded DICOM Server
- DICOM Interface utilizing RT Plan, RT Beams Treatment Record, RT Beams Delivery Instruction8, and Unified Procedure Step 9 objects.

The Standardized Uptake Value (SUV) of PET imaging for [F-18] fluorodeoxyglucose (FDG) studies that is commonly used to differentiate malignant from benign tumors and to assess the efficacy of therapy. Beginning with the 9.0 release the CyberKnife System supports PET SUV calculation based on the standard DICOM attributes, such as SIEMENS Biograph or CPS/ECAT systems, and the private DICOM attributes, such as GE Advance and Discovery family systems and PHILIPS Allegro™ and Gemini™ systems.

An Oncology Information System (OIS) provides workflow solutions for radiation therapy and radiosurgery treatment delivery. Beginning with the 9.0 release the CyberKnife System utilizes the industry-standard DICOM protocol to (1) export patient treatment plan to an OIS for charting and scheduling, (2) query the OIS for scheduled treatment sessions and (3) export treatment results following delivery.

The Dynamic Contrast Enhanced MR imaging (DCE MRI) is a well-established method for detecting and quantifying tumor angiogenesis. Beginning with the 9.5 release the CyberKnife System supports DCE MR images and the Pharmacokinetics data created by the iCAD MR Analysis System (SpectraLook®, VividLook® and OmniLook™) based on the standard and private DICOM attributes from iCAD system.

There are well-known Quality Assurance(QA) tools offered to compare a scanned film with a 2D planar dose created from the treatment plan. Beginning with the 9.5 release the CyberKnife System supports 2D planar dose export in the DICOM RT Dose for axial, coronal and sagittal planes, but the 2D planar dose is not intended to use in any InView system.

³ The DICOM file is stored in DICOM stream format prior the CyberKnife 8.0 release.

TABLE OF CONTENTS

1	Conformance Statement Overview	vii
1.1	For CyberKnife 7.x and Earlier Systems Only	viii
1.2	For CyberKnife 8.0 and Later Systems Only	viii
1.3	For CyberKnife 8.5 and Later Systems Only	viii
2	Introduction	1
2.1	Applicability	1
2.2	Acronyms/Terminology	1
2.3	References	3
3	Implementation Model	4
3.1	Application Data Flow Diagram	4
3.1.1	For CyberKnife 7.x and Earlier Systems Only	4
3.1.2	For CyberKnife 8.0/8.1 Systems Only	4
3.1.3	For CyberKnife 8.5 and Later Systems Only	5
3.2	Functional Definitions of Application Entity.....	8
3.2.1	For CyberKnife 8.1/8.0/7.x and Earlier Systems Only	8
3.2.2	For CyberKnife 8.5 and Later Systems Only	8
3.3	Sequencing of Real-World Activities	8
3.3.1	For CyberKnife 9.0 and Later Systems Only	9
4	AE Specifications	11
4.1	Supported Storage Service Object Pair (SOP) Classes by CyberKnife System as an SCP	11
4.1.1	Association Establishment Policies	11
4.1.2	Association Initiation Policy	12
4.1.3	Association Acceptance Policy	12
4.2	Supported Storage, Unified Procedure Step, Query/Retrieve Service Object Pair (SOP) Classes by CyberKnife System as an SCU.....	30
4.2.1	Association Establishment Policies	31
4.2.2	Association Initiation Policy	32
4.2.3	Association Acceptance Policy	47
5	RT Structure Set Information Object Implementation (RT Structure Set Storage SCP)48	
5.1	RT Structure Set IOD Implementation	48
5.1.1	Entity Relationship Model	48
5.1.2	CyberKnife Mapping of DICOM Entities	48
5.2	RT Structure Set IOD Module Table.....	48
5.3	Information Module Definitions – RT Structure Set	49
5.3.1	Structure Set Module	49
5.3.2	ROI Contour Module	50
5.3.3	RT ROI Observations Module.....	52

6	RT Structure Set Information Object Implementation (RT Structure Set Storage SCU)	54
6.1	RT Structure Set IOD Implementation	54
6.1.1	Entity Relationship Model	54
6.1.2	CyberKnife Mapping of DICOM Entities	54
6.2	RT Structure Set IOD Module Table.....	55
6.3	Information Module Definitions – RT Structure Set	55
6.3.1	Structure Set Module	55
6.3.2	ROI Contour Module	57
6.3.3	RT ROI Observations Module.....	58
7	RT Dose Information Object Implementation (RT Dose Storage SCP)	60
7.1	RT Dose IOD Implementation	60
7.1.1	Entity Relationship Model	60
7.1.2	CyberKnife Mapping of DICOM Entities	60
7.2	RT Dose IOD Module Table	61
7.3	Information Module Definitions – RT Dose.....	61
7.3.1	RT Dose Module	61
7.3.2	RT DVH Module.....	62
7.3.3	Structure Set Module	63
8	RT Dose Information Object Implementation (RT Dose Storage SCU)	64
8.1	RT Dose IOD Implementation	64
8.1.1	Entity Relationship Model	64
8.1.2	CyberKnife Mapping of DICOM Entities	64
8.2	RT Dose IOD Module Table	65
8.3	Information Module Definitions – RT Dose.....	65
8.3.1	RT Dose Module	65
8.3.2	RT DVH Module.....	66
8.3.3	Structure Set Module	68
8.3.4	ROI Contour Module	69
8.3.5	RT Dose ROI Module	70
9	RT Plan IOD (RT Plan Storage SCU)	71
9.1	RT Plan IOD Implementation.....	71
9.1.1	Entity Relationship Model	71
9.2	RT Plan IOD Module Table.....	71
9.3	Information Module Definitions – RT Plan.....	72
10	RT Plan IOD (RT Plan Storage SCP)	82
10.1	RT Plan IOD Implementation.....	82
10.1.1	Entity Relationship Model	82
10.2	RT Plan IOD Module Table.....	82
11	RT Beams Treatment Record IOD (RT Beam Treatment Record Storage SCU)	83

11.1	RT Beams Treatment Record IOD Implementation	83
11.1.1	Entity Relationship Model	83
11.2	RT Beams Treatment Record IOD Module Table	83
11.3	Information Model Definitions – RT Beams Treatment Record	84
12	RT Beams Delivery Instruction IOD (RT Beams Delivery Instruction Storage SCP).....	90
12.1	RT Beams Delivery Instruction IOD Implementation	90
12.1.1	Entity Relationship Model	90
12.2	RT Beams Delivery Instruction IOD Module Table	90
12.3	Information Module Definitions – RT Beams Delivery Instruction	91
13	Unified Procedure Step IOD (Unified Procedure Step – PULL SCU).....	92
13.1	Unified Procedure Step_IOD Implementation	92
13.1.1	Entity Relationship Model	92
13.2	Unified Procedure Step IOD Module Table	92
13.3	Information Module Definitions – Unified Procedure Step.....	93
14	Study Root Query/Retrieve Information Model SCU	95
14.1	Query/Retrieve (SCU) Implementation	95
15	RT Treatment Summary Record IOD (RT Treatment Summary Record Storage SCP) .96	
15.1	RT Treatment Summary Record IOD Implementation	96
15.1.1	Entity Relationship Model	96
15.2	RT Treatment Summary Record IOD Module Table	96
15.3	Information Module Definitions – RT Treatment Summary	97
16	Communication Profiles	99
16.1	Supported Communication Stacks	99
16.2	Network Media Support	99
17	Extensions, Specializations, Privatizations.....	100
18	Configuration.....	101
19	Support for Extended Character Sets.....	102
20	Annexes	103
20.1	Miscellaneous Macros	103
20.2	Data Dictionary of Private Attributes.....	103
20.2.1	GE Private Attributes for PET Images	103
20.2.2	PHILIPS Private Attributes for PET Images	104
20.2.3	VARIAN Private Attributes for OIS Interface	104
20.2.4	iCAD Private Attributes for MR DCE Images.....	105

2 INTRODUCTION

This document is a DICOM v3.0 1 Conformance Statement for the CyberKnife Robotic Radiosurgery System. It details the DICOM Service Classes and roles supported by this product.

The CyberKnife System represents an entirely new approach to radiosurgery. Incorporating a compact, lightweight linear accelerator mounted on a robotic arm, the CyberKnife System provides the surgeon unparalleled flexibility in targeting. Advanced image guidance technology tracks patient and target position during treatment, ensuring accuracy without the use of an invasive head frame. The CyberKnife System is intended to provide radiosurgery for lesions anywhere in the body when radiation treatment is indicated. The CyberKnife System has often been used to radiosurgically treat otherwise untreatable tumors and malformations.

The CyberKnife System prior to the 8.5 release was developed using MIR DICOM Software CTN v3.0.6 Tool Kit 2 for DICOM v3.0 Services supplied by Electronic Radiology Laboratory, Mallinckrodt Institute of Radiology, Washington University School of Medicine, St. Louis, Missouri USA.

2.1 Applicability

This document is intended to facilitate DICOM data exchange between the CyberKnife System and other DICOM compliant systems.

2.2 Acronyms/Terminology

3DRA	3 Dimensional X-Ray Rotational Angiography
AE	Application Entity
ATC	Advanced Technology Consortium
CKS	CyberKnife System
CDMS	CyberKnife Data Management System
CT	Computerized Tomography
CTN	Central Test Node
DCE MRI	Dynamic Contrast Enhanced Magnetic Resonance Imaging
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message
DVH	Dose-Volume Histogram
EVF	Extra-cellular Volume Fraction based on Pharmacokinetics analysis of DCE MRI
FSN	AccuFusion Image Registration Program
IOD	Information Object Definition

Introduction

IRI	Image Review and ImportITC Image-Guided Therapy Center
Ktrans	Same as PERM: permeability surface area product per unit volume of tissue
NEMA	National Electrical Manufacturers Association
MIR	Mallinckrodt Institute of Radiology
MIRIT	Medical Image Review and Import Tool
MRI	Magnetic Resonance Imaging
OIS	Oncology Information System
PET	Positron Emission Tomography
PDU	Protocol Data Unit
PERM	Vascular Permeability based on Pharmacokinetics analysis of DCE MRIQR Query and Retrieve
ROI	Region of Interest
RTOG	Radiation Therapy Oncology Group
RSNA	Radiological Society of North America
SCP	Service Class Provider (receiver)
SCU	Service Class User (sender)
SOP	Service Object Pair
SQL	Structured Query Language
SUV	Standardized Uptake Values
TCP/IP	Transmission Control Protocol/Internet Protocol
TMS	Treatment Management System
TPS	Treatment Planning System
UID	Unique Identification
UPS	Unified Procedure Step
Ve	Same as EVF: volume of extravascular extracellular space per unit volume of tissue
VOI	Volume of Interest
XA	X-ray Angiography

2.3 References

1. Digital Imaging and Communications in Medicine Standard v3.0, National Electrical Manufacturers Association, 2008.
2. Stephen M. Moore, Conformance Statements for MIR CTN Applications, v2.11.0, Electronic Radiology Laboratory, Mallinckrodt Institute of Radiology, January 7, 2000.
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(ftp://medical.nema.org/medical/dicom/supps/sup96_fz2.pdf)

3 IMPLEMENTATION MODEL

The CyberKnife Systems prior to the 8.5 release uses the CTN application for creation of DICOM Storage Service Class server. The storage service classes, CTN_STORAGE/CTN_ARCHIVE Application Entity and CTN_SEND Application Entity, will act respectively in the role of an SCP and an SCU, and facilitates the transfer of a DICOM file between a location and a CKS workstation via a network.

The CyberKnife 8.5 and later systems use the MergeCOM-3™ Advanced Integrator's Toolkit for creation of DICOM Storage Service Class server. The storage service classes, CDMS_STORAGE Application Entity and CDMS_SEND Application Entity, will act respectively in the role of an SCP and an SCU, and facilitates the transfer of a DICOM file between a remote workstation and a CKS workstation via a network.

3.1 Application Data Flow Diagram

3.1.1 For CyberKnife 7.x and Earlier Systems Only

The CTN_STORAGE server application stores received DICOM files within a standard UNIX directory 2. The DICOM files may then be imported into the CyberKnife central database via the MIRIT application.

MIRIT is a CyberKnife application which provides the capability to review and import DICOM images to the CKS central database.

When MIRIT is invoked, it will scan the directory of files, written by CTN_STORAGE, to determine if individual files may be associated. The association criterion is matching Study UID. If files belong to the same study they will be imported to CKS as a single dataset.

The CTN_ARCHIVE server application imports the received DICOM files into an SQL database and a DICOM hierarchical directory 2 used by the InView and the MultiPlan Systems.

The CTN_SEND application pushes the DICOM files to the remote AEs, supporting DICOM Storage as SCP. The DICOM files are exported from the CyberKnife On-Target or MultiPlan and InView applications, or are imported into the CyberKnife central database or InView local database.

CTN_SEND is initiated by the user of the CyberKnife On-Target, MultiPlan or InView applications.

3.1.2 For CyberKnife 8.0/8.1 Systems Only

The CTN_STORAGE server application stores received DICOM files onto the CDMS Data Server file system. These files are moved into the CDMS database following arrival.

The DICOM files may then be reviewed and imported into a patient record using the CDMS IRI application located on the CDMS Administration Workstation.

CTN_ARCHIVE server application imports the received DICOM files into the SQL database and a DICOM hierarchical directory 2 used by the InView and the MultiPlan Systems.

The CTN_SEND application pushes the DICOM files to the remote AEs, acting as a DICOM Storage as SCP. The DICOM files can be exported from the CDMS Data Server, MultiPlan and InView applications. DICOM series are stored in the CDMS database or InView local database.

CTN_SEND is initiated by the user of the MultiPlan and InView applications. CTN_SEND from CDMS Data Server can be initiated by the user of Plan Administration or DICOM Administration, located on the CDMS Administration Workstation, for both DICOM image and RT series.

3.1.3 For CyberKnife 8.5 and Later Systems Only

The CDMS_STORAGE server application stores received DICOM files onto the CDMS Data Server file system. These files are moved into the CDMS database following arrival.

The DICOM files may then be reviewed and imported into a patient record using the CDMS IRI application.

The CDMS_SEND application pushes the DICOM files to the remote AEs, acting as a DICOM Storage as SCP. The DICOM files can be exported from the CDMS Data Server.

The CDMS_SEND is initiated by the user of the MultiPlan System after exporting DICOM image and RT files. The user can initiate CDMS_SEND for both DICOM image and RT series on a CDMS Data Server from IRI, Plan Administration or DICOM Administration.

The CDMS_QR is used to query a remote DICOM SCP for plans available for delivery and is initiated following launch of the CyberKnife System Treatment option.

The CDMS_UPS is used to communicate the delivery intent to a remote Treatment Management System, and is initiated at the start of a treatment session.

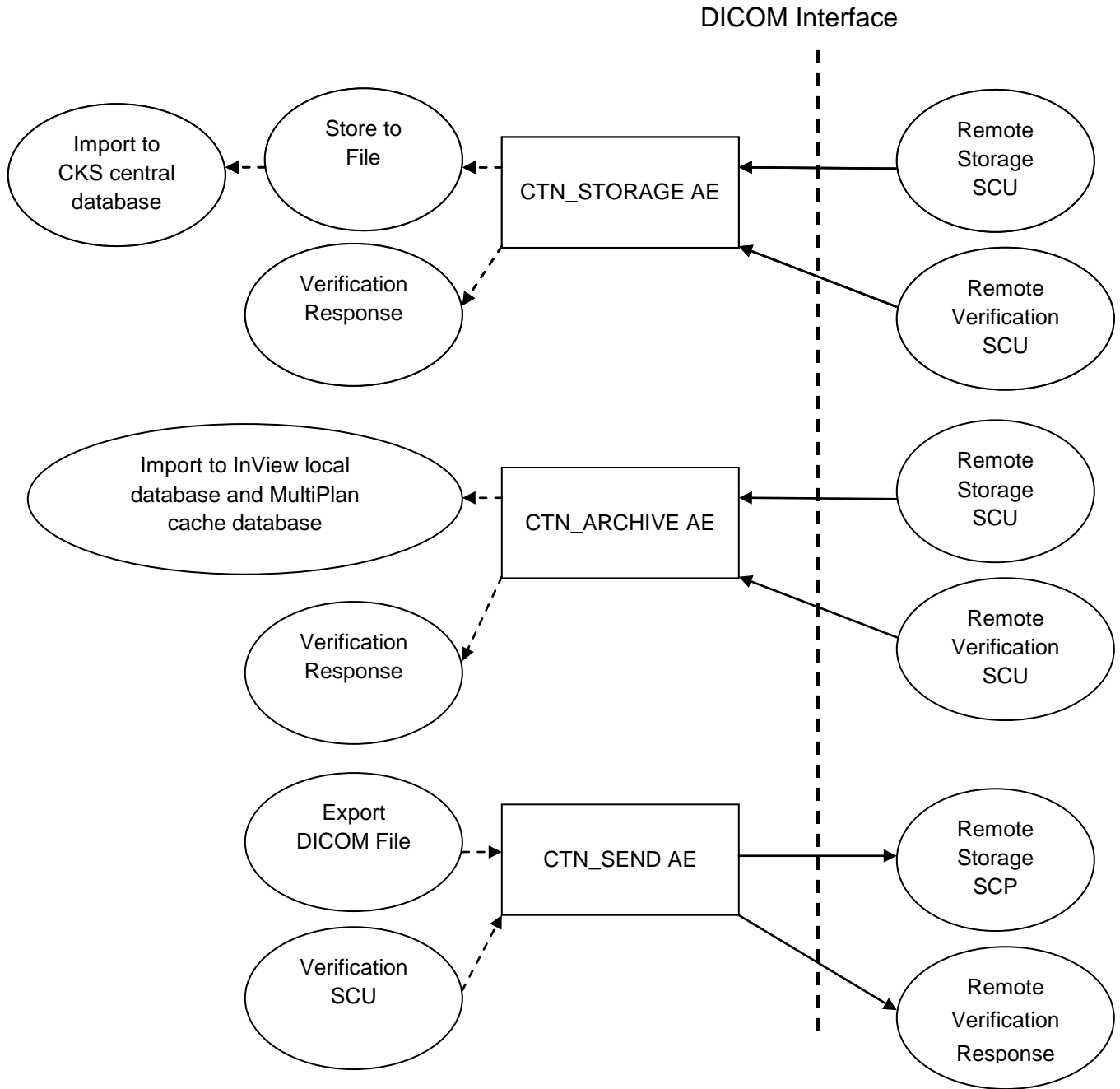


Figure 1: Application Data Flow Diagram for the CyberKnife Systems prior to 8.5 release.

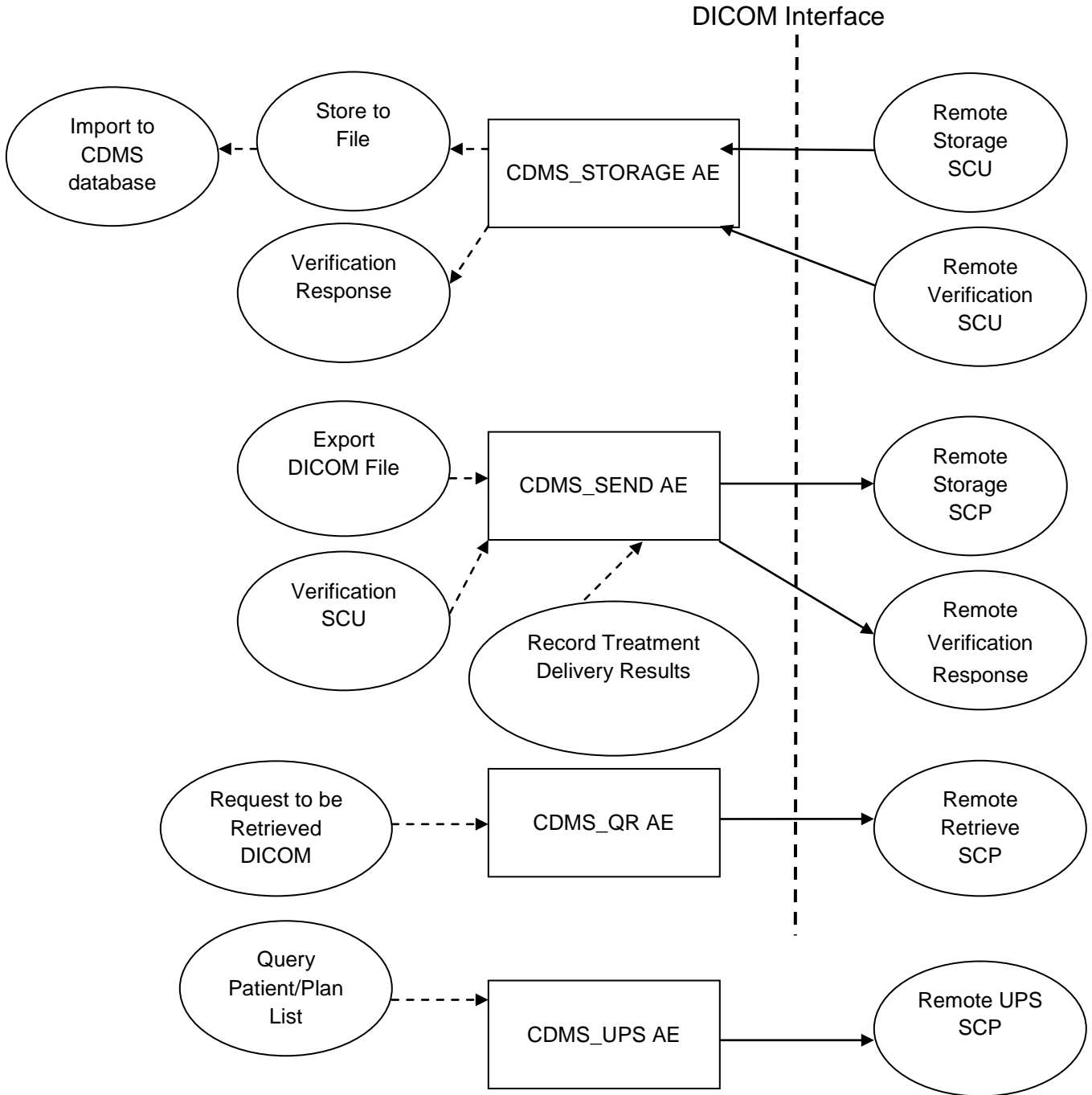


Figure 2: Application Data Flow Diagram for the CyberKnife 8.5 and later systems.

3.2 Functional Definitions of Application Entity

3.2.1 For CyberKnife 8.1/8.0/7.x and Earlier Systems Only

The CTN_STORAGE server application waits until it receives a C-STORE request from a remote SCU. Upon receipt, it saves the received data to a directory with a unique file name. The server handles one association at a time.

The CTN_ARCHIVE server application waits until it receives a C-STORE request from a remote SCU. Upon receipt, it saves the received data to a DICOM hierarchical directory with a unique file name and inserts the header information into the SQL database. The server handles multiple associations simultaneously.

CTN_ARCHIVE is a service that runs continuously after boot of the 16 February, 2001 workstations.

The CTN_SEND application invokes a C-STORE DIMSE service with a SOP instance and then an association will be established with the AE identified by the user. Information objects will be transferred one at a time until there are no more to transfer.

CTN_SEND and CTN_STORAGE/CTN_ARCHIVE act as SCUs role and SCPs respectively for the SOP classes of the Storage Service Class.

3.2.2 For CyberKnife 8.5 and Later Systems Only

The CDMS_STORAGE server application waits until it receives a C-STORE request from a remote SCU. Upon receipt, it saves the received data to a DICOM hierarchical directory with a unique file name and then inserts the header information into the CKS database. The server handles multiple associations simultaneously.

CDMS_STORAGE is a service, started right after booting the CDMS Data Server workstation, which run continuously.

The CDMS_SEND application invokes a C-STORE DIMSE service with a SOP instance. After this occurs, an association will be established with the AE identified by the user. Information objects will be transferred one at a time until have been transferred.

CDMS_SEND and CDMS_STORAGE serve in the SCU role and the SCP role respectively for SOP classes of the Storage Service Class.

CDMS_QR serves in the SCU role for the SOP class of the Query and Retrieve Service Class.

CDMS_UPS serves in the SCU role for the SOP class of the Unified Procedure Step Service Class.

3.3 Sequencing of Real-World Activities

The CyberKnife System has no way of knowing when it has a complete study or what constitutes a complete study. Users should be aware of how many DICOM image files constitute a complete image study before importing into the CyberKnife database.

3.3.1 For CyberKnife 9.0 and Later Systems Only

The CDMS_UPS/CDMS_SEND perform a sequence of the treatment delivery normal activities as follows when communicating with the Aria Oncology Information System:

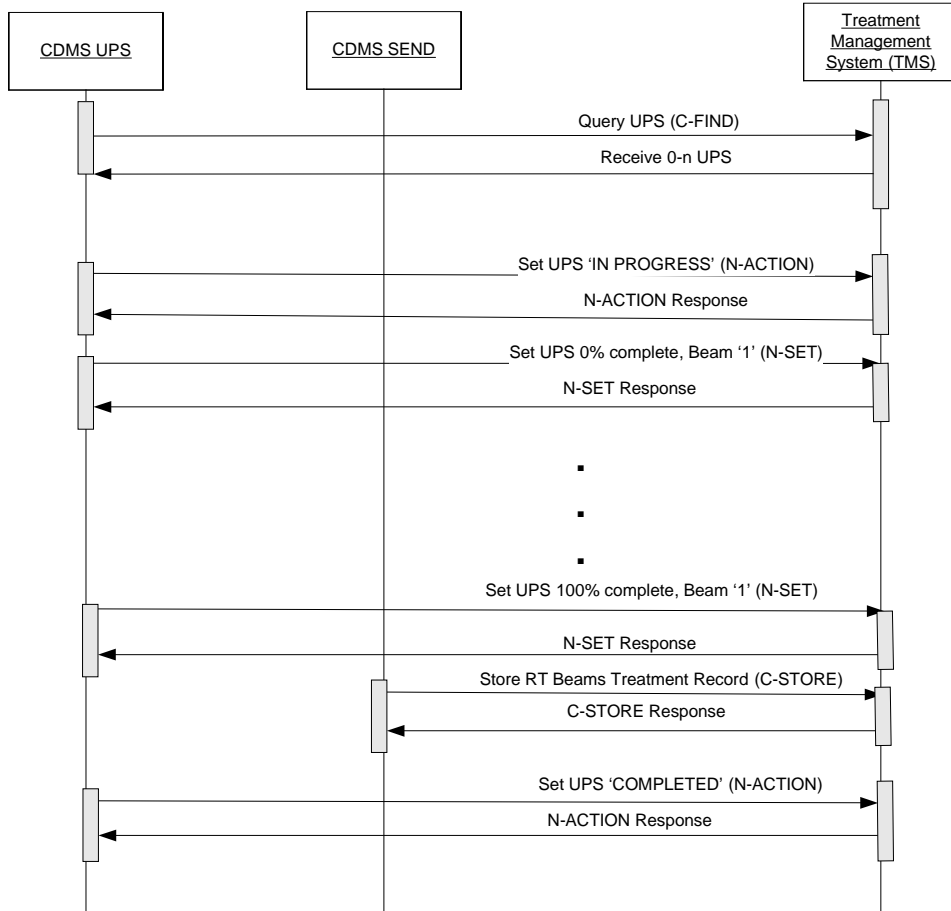


Figure 3: Sequence Diagram CDMS_UPS/CDMS_SEND for CyberKnife 9.0 and later systems and ARIA Oncology Information System.

The CDMS_UPS/CDMS_QR/CDMS_STORAGE/CDMS_SEND perform a sequence of the treatment delivery normal activities as follows when communicating with the MOSAIQ Oncology Information System:

Implementation Model

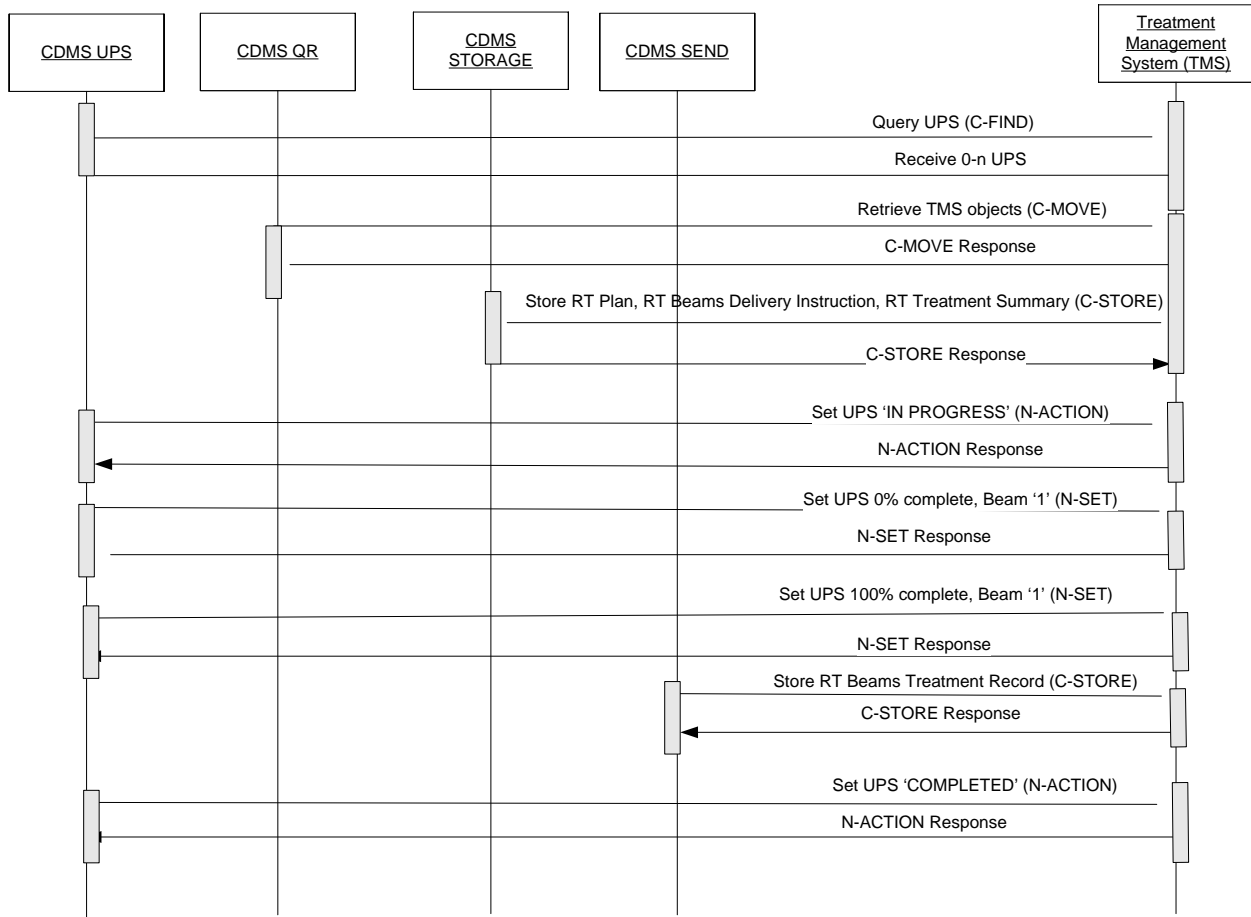


Figure 4: Sequence Diagram CDMS_UPS/CDMS_QR/CDMS_STORAGE/CDMS_SEND for CyberKnife 9.5 and later systems and MOSAIQ Oncology Information System.

4 AE SPECIFICATIONS

4.1 Supported Storage Service Object Pair (SOP) Classes by CyberKnife System as an SCP

Table 2. Storage SOP Classes Supported by CyberKnife as an SCP.

SOP Class Name	SOP Class UID
Verification SOP Class	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
Philips Private CX Image Storage	1.3.46.670589.2.4.1.1
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.1
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7

4.1.1 Association Establishment Policies

4.1.1.1 General

The default maximum PDU size which can be received by the CTN_STORAGE/CTN_ARCHIVE server is configurable with a default value of 16KB and a maximum value of 32KB.

The default maximum PDU size which can be received by the CDMS_STORAGE server is configurable with a default value of 64KB and a minimum value of 4KB.

The CTN_STORAGE server needs at least 150MB free disk space to run.

For configuration information, see the “Configuration” section, page 101.

4.1.1.2 Number of Associations

The number of simultaneous associations which will be accepted by the CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server are limited only by the kernel parameters of the underlying TCP/IP implementation. The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server will spawn a new process/thread for each association request that it receives. Therefore, the

CTN_ARCHIVE/CDMS_STORAGE server can have multiple simultaneous connections, and there is no inherent limitation on the total number of simultaneous associations which the CTN_ARCHIVE/CDMS_STORAGE server can maintain.

4.1.1.3 Asynchronous Nature

Not supported.

4.1.1.4 Implementation Identifying Information

Not applicable.

4.1.2 Association Initiation Policy

The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE AE does not initiate associations.

4.1.3 Association Acceptance Policy

When CTN_STORAGE/CDMS_STORAGE accepts an association, it will receive supported image SOP Instances and store them on disk. CTN_STORAGE/CDMS_STORAGE does not limit who may connect to it.

When the CTN_ARCHIVE/CDMS_STORAGE accepts an association, it will receive supported image SOP Instances and store them in its database that needs to be configured in CTNControl database. The CTN_ARCHIVE does not limit who may connect to it.

When Verification SCP accepts an association it responds with a success status.

4.1.3.1 Associated Real-World Activity – Store Request from an External Node

The associated Real-World activity associated with the C-STORE operation is the storage of the image on the disk of the system upon which the CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server is running. Images are stored by writing the data set of the C-STORE command directory to disk with no further header or interpretation.

The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server application responds to remote C-ECHO requests.

The CTN_STORAGE/CDMS_STORAGE server application will automatically handle request for image storage and store them on receipt of C-STORE requests. The file will be stored in the directory specified at startup of the daemon.

The CTN_ARCHIVE server application updates an image database with patient, study, series and image information after the image is stored to disk.

4.1.3.2 Presentation Context Table

Any of the Presentation Contexts shown in Table 3 is acceptable to the CyberKnife System for receiving and importing information objects.

Table 3. Presentation Contexts for the CyberKnife System

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Philips Private CX Image Storage	1.3.46.670589.2.4.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG	1.2.840.10008.1.2.4.70		

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
		Lossless coding Process 14			
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		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Little Endian	1.2.840.10008.1.2.2		

4.1.3.2.1 Presentation Context Acceptance Criterion

The CTN_STORAGE/CTN_ARCHIVE server will accept any number of storage SOP classes that are listed in Table 3 above, provided that the requesting application is known to the CTN_ARCHIVE server and has been enabled to store images on the 16 February, 2001 (via a configuration step). The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server doesn't define a limit on the number of presentation contexts accepted. In the event that the CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE server runs out of resources when trying to accept multiple presentation contexts, it will reject the association request.

The CTN_STORAGE/CTN_ARCHIVE server does not check for duplicate presentation contexts and will accept duplicate presentation contexts.

4.1.3.2.2 Transfer Syntax Selection Policies

The CTN_STORAGE/CTN_ARCHIVE server only supports the Implicit VR Little Endian transfer syntax. Any proposed presentation context which includes the Implicit VR Little Endian transfer syntax will be accepted with the Implicit VR Little Endian transfer syntax. Any proposed presentation context that does not include the Implicit VR Little Endian transfer syntax will be rejected.

Note: DICOM Part 10 format is recommended to use one of the DICOM Transfer Syntaxes support explicit Value Representation encoding to facilitate interpretation of File Meta Element Values (See PS 3.5 of the DICOM Standard), such as Explicit VR Little Endian Transfer Syntax(UID=1.2.840.10008.1.2.1).

The CDMS_STORAGE server supports the following transfer syntaxes.

- Implicit VR Little Endian,
- Explicit VR Little Endian,
- Explicit VR Big Endian, and
- JPEG Lossless coding Process 14.

Any proposed presentation context are listed in above will be accepted with the listed transfer syntax sequence in order. Any proposed presentation context that is not listed in Table 3 above will be rejected.

4.1.3.3 SOP Specific Conformance to Verification SOP Class

The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE provides standard conformance to the DICOM Verification Service Class.

4.1.3.4 SOP Specific Conformance to Storage SOP Class

The table shown below lists the Modules that are received and imported by the CKS central database, the InView local database, the MultiPlan cache database, and the CDMS database. Unlisted Modules are not used by the CyberKnife System. References in the right column are to the DICOM standard, Part 3 (Information Object Definitions).

Table 4. Modules received and imported by the CKS central database

Module Name	Reference
Patient	C.7.1.1
General Study	C.7.2.1
General Series	C.7.3.1
Frame of Reference	C.7.4.1
General Equipment	C.7.5.1
General Image	C.7.6.1
Image Plane	C.7.6.2

Module Name	Reference
Image Pixel	C.7.6.3
Multi-Frame	C.7.6.6
VOI LUT	C.11.2
SOP Common	C.12.1
CT Image	C.8.2.1
MR Image	C.8.3.1
XA Image	C.8.7.1
PET Image	C.8.9.4
Patient Study	C.7.2.2
PET Series	C.8.9.1
PET Isotope	C.8.9.2

The CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes as described in the Notes column.

Table 5. Patient Module

Attribute Name	Tag	Type	VR	Notes
Patient Name	(0010,0010)	2	PN	Displayed to the user. User can modify the first time an image study for a given patient is imported to the CKS central database. Displayed in the InView System.
Patient ID	(0010,0020)	2	LO	Only the "a-z", "A-Z", "0-9", "-", and "_" text are acceptable in the value of this attribute. Displayed to the user. This attribute is the key identifier in the CKS central database and CDMS database. Displayed in the InView System.
Patient Birth Date	(0010,0030)	2	TM	Used to determine patient age.
Patient Birth Time	(0010,0032)	3	TM	Not used.
Patient Sex	(0010,0040)	2	CS	Sex of the named patient. Used in PET SUV calculation.

Table 6. General Study Module

Attribute Name	Tag	Type	VR	Notes
Study Instance UID	(0020,000D)	1	UI	Displayed to the user. Used to associate multiple images into a single case in the CKS central database. Displayed in the InView System.
Study Date	(0008,0020)	2	DA	Displayed in the InView System.
Study Time	(0008,0030)	2	TM	Not used.
Referring Physician Name	(0008,0090)	2	PN	Displayed to the user. Can be modified by the user when image is imported to the CKS central database.
Study ID	(0020,0010)	2	SH	Not used.
Accession Number	(0008,0050)	2	SH	Not used.
Study Description	(0008,1030)	3	LO	Displayed in the InView System.

Table 7. General Series Module

Attribute Name	Tag	Type	VR	Notes
Modality	(0008,0060)	1	CS	Determine special processing required for interpretation of the image data. CKS currently supports 'CT', 'MR', 'PT', 'XA' and 'RTSTRUCT'. The InView System additionally supports 'RTDOSE'.
Series Instance UID	(0020,000E)	1	UI	Displayed in the InView System.
Series Description	(0008,103E)	3	LO	Displayed in the InView System. Beginning with MultiPlan 2.0 and CyberKnife 7.0, it is used to initialize the CyberKnife respiration phase for GE and SIEMENS 4D CT scanners with the below conversion protocol. <ul style="list-style-type: none"> The conversion of GE : Accuray T=0% (full Inhale): 50% T=10% : 60%

Attribute Name	Tag	Type	VR	Notes
				<p>T=20% : 70%</p> <p>T=30% : 80%</p> <p>T=40% : 90%</p> <p>T=50% (full Exhale): 0%</p> <p>T=60% : 10%</p> <p>T=70% : 20%</p> <p>T=80% : 30%</p> <p>T=90% : 40%</p> <p>T=100%(full Inhale) : 50%</p> <ul style="list-style-type: none"> The conversion of SIEMENS: Accuray 0% Exhale (=0% Inhale): 0% 20% Inhale: 10% 40% Inhale: 20% 60% Inhale: 30% 80% Inhale: 40% 100% Inhale (=100% Exhale): 50% 80% Exhale: 60% 60% Exhale: 70% 40% Exhale: 80% 20% Exhale: 90% <ul style="list-style-type: none"> Validated 4D CT scanners include: GE MEDICAL SYSTEMS, Discovery ST SIEMENS, Sensation Open
Series Number	(0020,0011)	2	IS	Not used.
Patient Position	(0018,5100)	2C	CS	Determine the orientation of the scan for On-Target and FSN rendering. Currently CKS and MultiPlan support 'HFS', and 'FFS'. However, the InView System only supports 'HFS'.
Series Date	(0008,0021)	3	DA	Date the Series started.
Series Time	(0008,0031)	3	TM	Time the Series started.

Table 8. Frame of Reference Module

Attribute Name	Tag	Type	VR	Notes
Frame of Reference UID	(0020,0052)	1	UI	For CT and MR data, this attribute must be the same for every image in the series.

Table 9. General Equipment Module

Attribute Name	Tag	Type	VR	Notes
Manufacturer	(0008,0070)	2	LO	<p>Required for validation in CKS. Validated CT scanners include:</p> <ul style="list-style-type: none"> • GE MEDICAL SYSTEMS, LightSpeed16, LightSpeed Plus, LightSpeed Pro16, LightSpeed QX/i, LightSpeed Ultra, Discovery LS, HiSpeed, HiSpeed LXi, HiSpeed QXi, HiSpeed NX/i • Marconi Medical Systems, PQ5000 (Picker) • Philips, Mx8000, Mx8000 IDT, PQ5000 • SIEMENS, Volume Zoom, SOMATOM PLUS 4, Emotion, Emotion Duo, Somatom Sensation 16 • Varian Medical Systems, CTScanner • TOSHIBA, Aquilion <p>Validated MR scanners include:</p> <ul style="list-style-type: none"> • GE MEDICAL SYSTEMS, GENESIS_SIGNA, SIGNA EXCITE • Philips Medical Systems, Gyroscan Intera (Picker), ACS • SIEMENS, MAGNETOM VISION, Symphony, Harmony Expert • Canon Medical Systems <p>Validated PET scanners include:</p> <ul style="list-style-type: none"> • GE MEDICAL SYSTEMS, Discovery LS, Discovery QXi • CPS, 1023/1062/1080 <p>Validated XA scanners include:</p> <ul style="list-style-type: none"> • Philips Medical Systems, Integris 3D-RA Release2 <p>Validated Workstations include:</p> <ul style="list-style-type: none"> • Marconi Medical Systems, AcQSim,

Attribute Name	Tag	Type	VR	Notes
				<ul style="list-style-type: none"> • VARIAN Medical Systems, Vision 7.1 (Somavision), Vision 7.1/7.2/7.3(Eclipse) • MDS NORDION, TheraplanPlus, Helax-TMS • ADAC, Pinnacle3 • NOMOS CORVUS5.0 • GE AdvantageSim • 3DLine DYART • MIMvista FUSION <p>See also Manufacturer Model Name (0008, 1090) for more specific models.</p> <p>InView uses "Accuray Inc." to check if DICOM RT comes from Accuray.</p>
Pixel Padding Value	(0028,0120)	3	SS	Not used.

Table 10. General Image Module

Attribute Name	Tag	Type	VR	Notes
Instance Number	(0020,0013)	2	IS	Not used.
Acquisition Date	(00080022)	3	DT	Used in PET SUV calculation The date the acquisition of data that resulted in this image started.
Acquisition Time	(00080032)	3	TM	Used in PET SUV calculation The time the acquisition of data that resulted in this image started.

Table 11. Image Plane Module

Attribute Name	Tag	Type	VR	Notes
Pixel Spacing	(0028,0030)	1	DS	Physical distance in the patient between the center of each pixel.
Image Orientation (Patient)	(0020,0037)	1	DS	CKS uses this info to reorient image buffer in different patient position (0018, 5100). The MultiPlan and InView Systems use this info to define the patient coordinate system.
Image Position	(0020,0032)	1	DS	CKS uses the value of the X and Y coordinates to

Attribute Name	Tag	Type	VR	Notes
(Patient)				recalculate the ROI coordinates of RT Structure Set in On-Target. CKS uses the value of the Z coordinate to determine “slice thickness” and “slice number”. The MultiPlan and InView Systems use this info to define the patient coordinate system.
Slice Thickness	(0018,0050)	2	DS	CKS uses to identify “variable slice thickness” errors. Default 10% tolerance can be modified.
Slice Location	(0020,1041)	3	DS	Not used.

Table 12. Image Pixel Module

Attribute Name	Tag	Type	VR	Notes
Samples per Pixel	(0028,0002)	1	US	Must be 1.
Photometric Interpretation	(0028,0004)	1	CS	Must be ‘MONOCHROME1’ or ‘MONOCHROME2’
Rows	(0028,0010)	1	US	Number of rows in the image
Columns	(0028,0011)	1	US	Number of columns image
Bits Allocated	(0028,0100)	1	US	Number of bits allocated for each pixel sample.
Bits Stored	(0028,0101)	1	US	Number of bits stored for each pixel sample.
High Bit	(0028,0102)	1	US	Most significant bit for each pixel sample.
Pixel Representation	(0028,0103)	1	US	Data representation of the pixel samples. CKS currently supports both unsigned integer and 2’s complement.
Pixel Data	(7FE0,0010)	1	OW	Pixel Data.
Pixel Aspect Ratio	(0028,0034)	1C	IS	Must be 1/1.

Table 13. Multi-Frame

Attribute Name	Tag	Type	VR	Notes
Number of Frames	(0028,0008)	1	IS	The number of pixel in Z coordinate for dose volume, i.e. 3D dose grid. Required for the InView and MultiPlan Systems. Beginning with MultiPlan 4.5, 2D planar dose export with value=1 is not supported by the InView and Multiplan Systems.
Frame Increment Pointer	(0028,0009)	1	AT	

Table 14. VOI LUT Module

Attribute Name	Tag	Type	VR	Notes
Window Center	(0028,1050)	3	UI	Not used.
Window Width	(0028,1051)	1C	UI	Not used.

4.1.3.4.1 SOP Common Module

Attribute Name	Tag	Type	VR	Notes
SOP Class UID	(0008,0016)	1	UI	Not used.
SOP Instance UID	(0008,0018)	1	UI	Not used.

Table 15. CT Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'ORIGINAL/PRIMARY/AXIAL' or 'ORIGINAL/PRIMARY/LOCALIZER' which indicates scout image in Picker CT scanner. 'DERIVED/SECONDARY' indicates mixed or fused image from the MultiPlan and InView Systems.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME1' or 'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16
Bits Stored	(0028,0101)	1	US	Value = 12 to 16
High Bit	(0028,0102)	1	US	Value = 11 to 15
Rescale Intercept	(0028,1052)	1	DS	The value b in relationship between stored

Attribute Name	Tag	Type	VR	Notes
				value (SV) and Hounsfield (HU). $HU = m * SV + b$ Used to scale data to CT number (CT) via Hounsfield Units in On-Target. $CT = HU + 1000 = m * SV + b + 1000.$
Rescale Slope	(0028,1053)	1	DS	m in the equation specified in Rescale Intercept (0028,1052). Used to scale data to CT number via Hounsfield Units in On-Target.
Gantry/Detector Tilt	(0018,1120)	3	DS	If present, Value = zero. Otherwise, CKS does not allow import to the central database.

Table 16. MR Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'ORIGINAL/PRIMARY/OTHER' or 'DERIVED/SECONDARY' or 'T1-MAP' In the MultiPlan and InView Systems, 'DERIVED/SECONDARY' indicates mixed and/or fused image exported from the MultiPlan and InView Systems. Beginning with MultiPlan 4.5, 'T1 MAP' indicates T1-weighted MR image and will be used by the MultiPlan application to identify T1-weighted MR datasets.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME1' or 'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16

Table 17. XA Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'DERIVED/SECONDARY' indicates the reconstructed 3DRA image from Philips Integris scanner.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16

Table 18. PET Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'ORIGINAL/PRIMARY' or 'DERIVED/SECONDARY' indicates mixed or fused image from the MultiPlan and InView Systems.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16
Bits Stored	(0028,0101)	1	US	Value = 16
High Bit	(0028,0102)	1	US	Value = 15
Rescale Intercept	(0028,1052)	1	DS	Value = 0 The value b in relationship between stored value (SV) and Hounsfield (HU). $HU = m * SV + b$ Used to scale data to pixel number (PET) via Hounsfield Units in On-Target. $PET = HU + 1000 = m*SV + b + 1000.$
Rescale Slope	(0028,1053)	1	DS	m in the equation specified in Rescale Intercept (0028,1052). Used to scale data to pixel number via Hounsfield Units in On-Target.
Frame Reference Time	(0054,1300)	1	DS	Not used
Image Index	(0054,1330)	1	US	Not used

Table 19. Patient Study Module

Attribute Name	Tag	Type	VR	Notes
Patient Age	(0010,1010)	3	AS	Age of the Patient.
Patient Size	(0010,1020)	3	DS	Length or size of the Patient, in meters.
Patient Weight	(0010,1030)	3	DS	Weight of the Patient, in kilograms.

Table 20. PET Series Module

Attribute Name	Tag	Type	VR	Notes
Series Date	(0008,0021)	1	DA	Date the Series started.
Series Time	(0008,0031)		TM	Time the Series started.
Units	(0054,1001)	1	CS	Pixel value units. Value= CNTS, BQML, PROPCPS, CPS, PROCNTS
Counts Source	(0054,1002)	1	CS	The primary source of counts. The primary source leads to the underlying image Units (0054,1001), as opposed to secondary sources which are used during reconstruction correction. Enumerated Values: EMISSION TRANSMISSION
Series Type	(0054,1000)	1	CS	A multi-valued indicator of the type of Series. See C.8.9.1.1.4 for explanation. Value 1 Enumerated Values: STATIC DYNAMIC GATED WHOLE BODY Value 2 Enumerated Values: IMAGE REPROJECTION
Reprojection Method	(0054,1004)	2C	CS	Not used.
Number of R-R Intervals	(0054,0061)	1C	US	Not used.
Number of Time Slots	(0054,0071)	1C	US	Not used.
Number of Time Slices	(0054,0101)	1C	US	Not used

Attribute Name	Tag	Type	VR	Notes
Number of Slices	(0054,0081)	1	US	Not used
Corrected Image	(0028,0051)	2	CS	A value that indicates which, if any, corrections have been applied to the images in this series. Defined terms: DECY=decay corrected ATTN=attenuation corrected SCAT=scatter corrected DTIM=dead time corrected MOTN=gantry motion corrected (e.g. wobble, clamshell) PMOT=patient motion corrected CLN=count loss normalization (correction for count loss in gated Time Slots). RAN=randoms corrected RADL=non-uniform radial sampling corrected DCAL=sensitivity calibrated using dose calibrator NORM=detector normalization
Decay Correction	(0054,1102)	1	CS	Not used.
Collimator Type	(0018,1181)	2	CS	Not used.

Table 21. PET Isotope Module

Attribute Name	Tag	Type	VR	Notes
Radiopharmaceutical Information Sequence	(0054,0016)	2	SQ	Sequence of Items that describe isotope information. Zero or more Items may be included in this sequence.
>Radionuclide Code Sequence	(0054,0300)	2	SQ	Sequence that identifies the radionuclide. Zero or one item shall be present in the sequence.
>>Include 'Code Sequence Macro' 0				Not used. Baseline Context ID is 4020 .
>Radiopharmaceutical Route	(0018,1070)	3	LO	Route of administration.

Attribute Name	Tag	Type	VR	Notes
>Administration Route Code Sequence	(0054,0302)	3	SQ	Sequence that identifies the administration route of the radiopharmaceutical. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' 0				<i>Not used.</i> <i>Baseline Context ID is 11 .</i>
>Radiopharmaceutical Volume	(0018,1071)	3	DS	Volume of administered radiopharmaceutical in cubic cm.
>Radiopharmaceutical Start Time	(0018,1072)	3	TM	Time of start of administration. The actual time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031). The use of this Attribute is deprecated in favor of Radiopharmaceutical StartDateTime (0018,1078). Note: The use of a time alone can cause confusion when the procedure spans midnight.
>Radiopharmaceutical Start DateTime	(0018,1078)	3	DT	Date and time of start of administration. The actual date and time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031).
>Radiopharmaceutical Stop Time	(0018,1073)	3	TM	Time of end of administration. The actual ending time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031). The use of this Attribute is deprecated in favor of Radiopharmaceutical Stop DateTime (0018,1079). Note: The use of a time alone can cause confusion when the procedure spans midnight.
>Radiopharmaceutical	(0018,1079)	3	DT	Date and time of end of administration.

Attribute Name	Tag	Type	VR	Notes
Stop DateTime				The actual ending date and time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031).
>Radionuclide Total Dose	(0018,1074)	3	DS	The radiopharmaceutical dose administered to the patient measured in Becquerels (Bq) at the Radiopharmaceutical Start Time (0018,1072). Note: In other IODs, such as the NM IOD, this same attribute is specified in MegaBecquerels (MBq).
>Radionuclide Half Life	(0018,1075)	3	DS	The radionuclide half life, in seconds, that was used in the correction of this image.
>Radionuclide Positron Fraction	(0018,1076)	3	DS	The radionuclide positron fraction (fraction of decays that are by positron emission) that was used in the correction of this image.
>Radiopharmaceutical Specific Activity	(0018,1077)	3	DS	The activity per unit mass of the radiopharmaceutical, in Bq/micromole, at the Radiopharmaceutical Start Time (0018,1072).
>Radiopharmaceutical	(0018,0031)	3	LO	Name of the radiopharmaceutical.
>Radiopharmaceutical Code Sequence	(0054,0304)	3	SQ	Sequence that identifies the radiopharmaceutical. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' 0				<i>Not used.</i> <i>Baseline Context ID is 4021 .</i>

4.1.3.5 SOP Specific Conformance to RT Structure Set Storage SCP

CTN_STORAGE/CTN_ARCHIVE/CDMS_STORAGE implement Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Structure Set Information Object Implementation (RT Structure Set Storage SCP),” page 48.

4.1.3.6 SOP Specific Conformance to RT Dose Storage SCP

CTN_ARCHIVE/CDMS_STORAGE implement Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Dose Information Object Implementation (RT Dose Storage SCP),” page 60.

4.1.3.7 SOP Specific Conformance to RT Plan Storage SCP

CDMS_STORAGE implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Plan IOD (RT Plan Storage SCP),” page 82.

4.1.3.8 SOP Specific Conformance to RT Beam Delivery Instruction Storage SCP

CDMS_STORAGE implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Beams Delivery Instruction IOD (RT Beams Delivery Instruction Storage SCP),” page 90.

4.1.3.9 SOP Specific Conformance to RT Treatment Summary Storage SCP

CDMS_STORAGE implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Treatment Summary Record IOD (RT Treatment Summary Record Storage SCP),” page 96.

4.2 Supported Storage, Unified Procedure Step, Query/Retrieve Service Object Pair (SOP) Classes by CyberKnife System as an SCU

Table 22. Storage, Unified Procedure Step, Query/Retrieve SOP Classes Supported by the CyberKnife System as an SCU

SOP Class Name	SOP Class UID
Verification SOP Class	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
Unified Procedure Step – PULL	1.2.840.10008.5.1.4.34.4.3

SOP Class Name	SOP Class UID
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2

4.2.1 Association Establishment Policies

4.2.1.1 General

In On-Target application, CTN_SEND attempts to establish an association when the user chooses the Export DICOM RT menu item and selects a remote node which performs store operations. The user may select to send the RT Structure Set, RT Dose and CT Image set associated with DICOM RT or any combination of those information objects. The RT Structure Set sent includes all organs contours created for the CT image study and the RT Dose sent includes any combination of dose grid, DVH, and isodose curves.

In the InView application, CTN_SEND attempts to establish an association when the user chooses the SAVE button on the global toolbar on the right-hand side of user interface and selects a local or remote node which performs the store operations. The user may select to send the fused moving image, mixed image, Volume of Interest (VOI), original fixed and moving image set. The Volume of Interest which is RT Structure Set includes all organs contours created for the CT image study.

In the MultiPlan application, CTN_SEND attempts to establish an association when the user chooses the PUSH button on the global toolbar on the right-hand side of user interface and selects a remote node which performs the export operations. The user may select to send the fused moving image, mixed image, Volume of Interest (VOI), RT Dose, original fixed and moving image set. The Volume of Interest which is RT Structure Set includes all organs contours created for the CT image study and the RT Dose includes any combination of dose grid, DVH, and isodose curves.

In the CDMS Data Server, CTN_SEND/CDMS_SEND attempt to establish an association when the CDMS client applications make the DICOM SEND request.

The CTN_SEND/CDMS_SEND will keep the association up until the selected information objects have been sent.

The maximum PDU size which can be transmitted by the CTN_SEND is fixed at 16KB.

The maximum PDU size which can be transmitted by the CDMS_SEND is fixed at 64KB

For configuration information, see the “Configuration” section, page 101.

4.2.1.2 Number of Associations

The CyberKnife System only establishes only one simultaneous association at a time.

4.2.1.3 Asynchronous Nature

Not supported.

4.2.1.4 Implementation Identifying Information

The implementation Class UID uniquely defines system. This will be **1.2.840.114358.<DEVICE_SERIAL_ID>**

4.2.2 Association Initiation Policy

4.2.2.1 Associated Real-World Activity – Push Request to an External Node

The CTN_SEND application sends the C-ECHO requests to the remote AE.

The CTN_SEND/CDMS_SEND application will automatically handle request for storage services and transfer them on sending C-STORE requests.

4.2.2.2 Associated Real-World Activity – Pull Request to an External Node

The CDMS_UPS application will automatically handle requests for unified procedure step - PULL services and transfer them on sending the C_FIND/N_ACTION/N_SET requests in the CDMS Data Server.

The CDMS_QR sends C_MOVE request to retrieve RT objects.

4.2.2.3 Presentation Context Table

Any of the Presentation Contexts shown in Table 23 are acceptable to the CyberKnife System for pushing, exporting, retrieving and updating information objects.

Table 23. Presentation Contexts for the CyberKnife System

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little	1.2.840.10008.1.2.1		

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
		Endian			
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		
Positron Emission Tomography Image Storage	1.2.840.10008.5.1.4.1.1.128	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding	1.2.840.10008.1.2.4.70		

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
		Process 14			
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
X-Ray Angiographic Image Storage	1.2.840.10008.5.1.4.1.1.12.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
		JPEG Lossless coding Process 14	1.2.840.10008.1.2.4.70		

Presentation Contexts Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
SOP Name	UID	Name	UID		
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Unified Procedure Step – PULL	1.2.840.10008.5.1.4.34.4.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		
Study Root Query/Retrieve Information Model – MOVE	1.2.840.10008.5.1.4.1.2.2.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
		Explicit VR Big Endian	1.2.840.10008.1.2.2		

4.2.2.4 SOP Specific Conformance

4.2.2.5 SOP Specific Conformance to Verification SOP Class

The CTN_SEND provides standard conformance to the DICOM Verification Service Class.

4.2.2.6 SOP Specific Conformance to Storage SOP Class

The table shown below lists the Modules that are sent and exported by the CyberKnife, On-Target, MultiPlan and InView applications. Unlisted Modules are not used by the CyberKnife System. References in the right column are to DICOM standard, Part 3 (Information Object Definitions).

Table 24. Modules exported by the CyberKnife, On-Target, MultiPlan and InView applications.

Module Name	Reference
Patient	C.7.1.1
General Study	C.7.2.1
General Series	C.7.3.1
Frame of Reference	C.7.4.1
General Equipment	C.7.5.1
General Image	C.7.6.1
Image Plane	C.7.6.2
Image Pixel	C.7.6.3
Multi-Frame	C.7.6.6
VOI LUT	C.11.2
SOP Common	C.12.1
CT Image	C.8.2.1
MR Image	C.8.3.1
PET Image	C.8.9.4
Patient Study	C.7.2.2
PET Series	C.8.9.1
PET Isotope	C.8.9.2

The CTN_SEND/CDMS_SEND implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes as described in the Notes column.

Table 25. Patient Module

Attribute Name	Tag	Type	VR	Notes
Patient Name	(0010,0010)	2	PN	Reused from the associated CT Image set for the DICOM RT export. Reused from the secondary Image set for the mixed or fused image export.
Patient ID	(0010,0020)	2	LO	Only the "a-z", "A-Z", "0-9", "-", and "_" text are acceptable in the value of this attribute. Reused from the associated CT Image set for the DICOM RT export. Reused from the secondary Image set for the mixed or fused image export.
Patient Birth Date	(0010,0030)	2	TM	Reused from the associated CT Image set for the DICOM RT export. Reused from the secondary Image set for the mixed or fused image export.
Patient Sex	(0010,0040)	2	CS	Reused from the associated CT Image set for the DICOM RT export. Reused from the secondary Image set for the mixed or fused image export.

Table 26. General Study Module

Attribute Name	Tag	Type	VR	Notes
Study Instance UID	(0020,000D)	1	UI	Reused from the associated CT Image set for the DICOM RT export, but for the mixed or fused image export, 1.2.840.<accuray>.<device>.<uid> <accuray>=114358 <device> = value of (0018,1000)
Study Date	(0008,0020)	2	DA	Reused from the associated CT Image set for the DICOM RT export.
Study Time	(0008,0030)	2	TM	Reused from the associated CT Image set for the DICOM RT export.
Referring Physician Name	(0008,0090)	2	PN	Reused from the associated CT Image set for the DICOM RT export.
Study ID	(0020,0010)	2	SH	Reused from the associated CT Image set for the DICOM RT export.

Attribute Name	Tag	Type	VR	Notes
Accession Number	(0008,0050)	2	SH	Reused from the associated CT Image set for the DICOM RT export.
Study Description	(0008,1030)	3	LO	Entered by users for the DICOM RT export.

Table 27. Frame of Reference Module

Attribute Name	Tag	Type	VR	Notes
Frame of Reference UID	(0020,0052)	1	UI	Reused from the associated CT Image set for export DICOM RT, but for the mixed or fused image export, 1.2.840.<accuray>.<device>.<uid> <accuray>=114358 <device> = value of (0018,1000)

Table 28. General Series Module

Attribute Name	Tag	Type	VR	Notes
Modality	(0008,0060)	1	CS	'CT', 'MR', 'PT', 'XA', 'RTSTRUCT', 'RTDOSE' The MultiPlan and InView Systems will re-use the modality of the secondary Image set for the mixed and/or fused image export. Prior to MultiPlan 2.0 and InView 1.6, 'MR' is used for 3DRA mixed and/or fused image export.
Series Instance UID	(0020,000E)	1	UI	1.2.840.<accuray>.<device>.<uid> <accuray>=114358 <device> = value of (0018,1000)
Series Description	(0008,103E)	3	LO	Entered by users for the DICOM RT export. Beginning with MultiPlan 4.5, the series description of 2D planar dose export will have the following string suffix for Axial, Coronal, Sagittal planes. "_planar_axial" indicates the axial planar dose. "_planar_coronal" indicates the coronal planar dose. "_planar_sagittal" indicates the sagittal planar dose.
Series Number	(0020,0011)	2	IS	Reused from the associated CT Image set for the DICOM RT export.

Attribute Name	Tag	Type	VR	Notes
Patient Position	(0018,5100)	2C	CS	Reused from the associated CT Image set for the DICOM RT export. Reused from the secondary Image set for the mixed or fused image export.
Series Date	(0008,0021)	3	DA	Date the Series started.
Series Time	(0008,0031)	3	TM	Time the Series started.

Table 29. General Equipment Module

Attribute Name	Tag	Type	VR	Notes
Manufacturer	(0008,0070)	2	LO	'Accuray Inc.'
Manufacturer's Model	(0008,1090)	3	LO	CyberKnife Version number from the <i>Version</i> file.
Device Serial Number	(0018,1000)	3	LO	<device_serial_no> = CyberKnife Site number from the <i>site_name.dat</i> datafile.
Software Versions	(0018,1020)	3	LO	On-Target or MultiPlan and InView Version number

Table 30. General Image Module

Attribute Name	Tag	Type	VR	Notes
Instance Number	(0020,0013)	2	IS	Not used.
Acquisition Date	(0008 0022)	3	DT	Reused from the secondary Image set for the mixed or fused image export. The date the acquisition of data that resulted in this image started.
Acquisition Time	(0008 0032)	3	TM	Reused from the secondary Image set for the mixed or fused image export. The time the acquisition of data that resulted in this image started.

Table 31. Image Plane Module

Attribute Name	Tag	Type	VR	Notes
Pixel Spacing	(0028,0030)	1	DS	Physical distance in the patient between the center of each pixel.
Image Orientation (Patient)	(0020,0037)	1	DS	Reused from the associated CT Image set

Attribute Name	Tag	Type	VR	Notes
Image Position (Patient)	(0020,0032)	1	DS	On-Target uses the value of the X and Y coordinates to recalculate the ROI coordinates of RT Structure Set, but the MultiPlan and InView Systems don't. CKS uses the value of the Z coordinate to determine "slice spacing" and "slice number".
Slice Thickness	(0018,0050)	2	DS	
Slice Location	(0020,1041)	3	DS	Not used.

Table 32. Image Pixel Module

Attribute Name	Tag	Type	VR	Notes
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	Value = 'MONOCHROME2'
Rows	(0028,0010)	1	US	Number of rows in the image
Columns	(0028,0011)	1	US	Number of columns in the image
Bits Allocated	(0028,0100)	1	US	Value = 16
Bits Stored	(0028,0101)	1	US	Value = 16
High Bit	(0028,0102)	1	US	Value = 15
Pixel Representation	(0028,0103)	1	US	Value = 0
Pixel Data	(7FE0,0010)	1	OW	Pixel Data.
Pixel Aspect Ratio	(0028,0034)	1C	IS	Not used

Table 33. Multi-Frame

Attribute Name	Tag	Type	VR	Notes
Number of Frames	(0028,0008)	1	IS	The number of pixel in Z coordinate for dose volume, i.e. 3D dose grid. Required for On-Target and the MultiPlan System. Beginning with MultiPlan 4.5, value=1 for 2D planar dose export.
Frame Increment Pointer	(0028,0009)	1	AT	Value = '3004000c' which referred to Grid Frame Offset Vector(3004, 000C)

Table 34. VOI LUT Module

Attribute Name	Tag	Type	VR	Notes
Window Center	(0028,1050)	3	UI	Not used.
Window Width	(0028,1051)	1C	UI	Not used.

Table 35. SOP Common Module

Attribute Name	Tag	Type	VR	Notes
SOP Class UID	(0008,0016)	1	UI	RT Dose = "1.2.840.10008.5.1.4.1.1.481.2" RT Structure Set = "1.2.840.10008.5.1.4.1.1.481.3" CT Image ="1.2.840.10008.5.1.4.1.1.2" MR Image ="1.2.840.10008.5.1.4.1.1.4" Positron Emission Tomography ="1.2.840.10008.5.1.4.1.1.128"
SOP Instance UID	(0008,0018)	1	UI	1.2.840.<accuray>.<device>.<uid> <accuray>=114358 <device> = value of (0018,1000)

Table 36. CT Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'DERIVED/SECONDARY' indicates mixed or fused image from the MultiPlan and InView Systems.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16
Bits Stored	(0028,0101)	1	US	Value = 12 to 16
High Bit	(0028,0102)	1	US	Value = 11 to 15
Rescale Intercept	(0028,1052)	1	DS	Value = -1000.0 The value b in relationship between stored value (SV) and Hounsfield (HU). $HU = m * SV + b$ Used to scale data to CT number (CT) via Hounsfield Units in On-Target $CT = HU + 1000 = m*SV + b + 1000.$

Attribute Name	Tag	Type	VR	Notes
Rescale Slope	(0028,1053)	1	DS	Value = 0 m in the equation specified in Rescale Intercept (0028,1052). Used to scale data to CT number via Hounsfield Units in On-Target.
Gantry/Detector Tilt	(0018,1120)	3	DS	If present, Value = zero. Otherwise, CKS does not allow import to the central database.

Table 37. MR Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'DERIVED/SECONDARY' indicates mixed or fused image from the MultiPlan and InView Systems.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16

Table 38. PET Image Module

Attribute Name	Tag	Type	VR	Notes
Image Type	(0008,0008)	1	CS	'DERIVED/SECONDARY' indicates mixed or fused image from the MultiPlan and InView Systems.
Samples per Pixel	(0028,0002)	1	US	Value = 1
Photometric Interpretation	(0028,0004)	1	CS	'MONOCHROME2'
Bits Allocated	(0028,0100)	1	US	Value = 16
Bits Stored	(0028,0101)	1	US	Value = 16
High Bit	(0028,0102)	1	US	Value = 15
Rescale Intercept	(0028,1052)	1	DS	Value = -1000.0 The value b in relationship between stored value (SV) and Hounsfield (HU). $HU = m * SV + b$ Used to scale data to pixel number (PET) via Hounsfield Units in On-Target.

Attribute Name	Tag	Type	VR	Notes
				PET = HU + 1000 = m*SV + b + 1000.
Rescale Slope	(0028,1053)	1	DS	Value = 0 m in the equation specified in Rescale Intercept (0028,1052). Used to scale data to pixel number via Hounsfield Units in On-Target.
Frame Reference Time	(0054,1300)	1	DS	Not used
Image Index	(0054,1330)	1	US	Not used

Table 39. Patient Study Module

Attribute Name	Tag	Type	VR	Notes
Patient Age	(0010,1010)	3	AS	Age of the Patient.
Patient Size	(0010,1020)	3	DS	Length or size of the Patient, in meters.
Patient Weight	(0010,1030)	3	DS	Weight of the Patient, in kilograms.

Table 40. PET Series Module

Attribute Name	Tag	Type	VR	Notes
Series Date	(0008,0021)	1	DA	Date the Series started.
Series Time	(0008,0031)		TM	Time the Series started.
Units	(0054,1001)	1	CS	Pixel value units. Value= CNTS, BQML, PROPCPS,
Counts Source	(0054,1002)	1	CS	The primary source of counts. The primary source leads to the underlying image Units (0054,1001), as opposed to secondary sources which are used during reconstruction correction. Enumerated Values: EMISSION TRANSMISSION
Series Type	(0054,1000)	1	CS	A multi-valued indicator of the type of Series. See C.8.9.1.1.4 for explanation. Value 1 Enumerated Values: STATIC DYNAMIC

Attribute Name	Tag	Type	VR	Notes
				GATED WHOLE BODY Value 2 Enumerated Values: IMAGE REPROJECTION
Reprojection Method	(0054,1004)	2C	CS	Not used.
Number of R-R Intervals	(0054,0061)	1C	US	Not used.
Number of Time Slots	(0054,0071)	1C	US	Not used.
Number of Time Slices	(0054,0101)	1C	US	Not used
Number of Slices	(0054,0081)	1	US	Not used
Corrected Image	(0028,0051)	2	CS	A value that indicates which, if any, corrections have been applied to the images in this series. Defined terms: DECY=decay corrected ATTN=attenuation corrected SCAT=scatter corrected DTIM=dead time corrected MOTN=gantry motion corrected (e.g. wobble, clamshell) PMOT=patient motion corrected CLN=count loss normalization (correction for count loss in gated Time Slots). RAN=randoms corrected RADL=non-uniform radial sampling corrected DCAL=sensitivity calibrated using dose calibrator NORM=detector normalization
Decay Correction	(0054,1102)	1	CS	Not used.
Collimator Type	(0018,1181)	2	CS	Not used.

Table 41. PET Isotope Module

Attribute Name	Tag	Type	VR	Notes
Radiopharmaceutical Information Sequence	(0054,0016)	2	SQ	Sequence of Items that describe isotope information. Zero or more Items may be included in this sequence.
>Radionuclide Code Sequence	(0054,0300)	2	SQ	Sequence that identifies the radionuclide. Zero or one item shall be present in the sequence.
>>Include 'Code Sequence Macro' 0				<i>Not used.</i> <i>Baseline Context ID is 4020 .</i>
>Radiopharmaceutical Route	(0018,1070)	3	LO	Route of administration.
>Administration Route Code Sequence	(0054,0302)	3	SQ	Sequence that identifies the administration route of the radiopharmaceutical. This sequence shall contain exactly one item.
>>Include 'Code Sequence Macro' 0				<i>Not used.</i> <i>Baseline Context ID is 11 .</i>
>Radiopharmaceutical Volume	(0018,1071)	3	DS	Volume of administered radiopharmaceutical in cubic cm.
>Radiopharmaceutical Start Time	(0018,1072)	3	TM	Time of start of administration. The actual time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031). The use of this Attribute is deprecated in favor of Radiopharmaceutical Start DateTime (0018,1078). Note: The use of a time alone can cause confusion when the procedure spans midnight.
>Radiopharmaceutical Start DateTime	(0018,1078)	3	DT	Date and time of start of administration. The actual date and time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031).

Attribute Name	Tag	Type	VR	Notes
>Radiopharmaceutical Stop Time	(0018,1073)	3	TM	Time of end of administration. The actual ending time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031). The use of this Attribute is deprecated in favor of Radiopharmaceutical Stop DateTime (0018,1079). Note: The use of a time alone can cause confusion when the procedure spans midnight.
>Radiopharmaceutical Stop DateTime	(0018,1079)	3	DT	Date and time of end of administration. The actual ending date and time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031).
>Radionuclide Total Dose	(0018,1074)	3	DS	The radiopharmaceutical dose administered to the patient measured in Becquerels (Bq) at the Radiopharmaceutical Start Time (0018,1072). Note: In other IODs, such as the NM IOD, this same attribute is specified in MegaBecquerels (MBq).
>Radionuclide Half Life	(0018,1075)	3	DS	The radionuclide half life, in seconds, that was used in the correction of this image.
>Radionuclide Positron Fraction	(0018,1076)	3	DS	The radionuclide positron fraction (fraction of decays that are by positron emission) that was used in the correction of this image.
>Radiopharmaceutical Specific Activity	(0018,1077)	3	DS	The activity per unit mass of the radiopharmaceutical, in Bq/micromole, at the Radiopharmaceutical Start Time (0018,1072).
>Radiopharmaceutical	(0018,0031)	3	LO	Name of the radiopharmaceutical.
>Radiopharmaceutical	(0054,0304)	3	SQ	Sequence that identifies the radiopharmaceutical. This sequence shall

Attribute Name	Tag	Type	VR	Notes
Code Sequence				contain exactly one item.
>>Include 'Code Sequence Macro' 0				Not used. Baseline Context ID is 4021.

4.2.2.7 SOP Specific Conformance to RT Structure Set Storage SCU

CTN_SEND/CDMS_SEND implement Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Structure Set Information Object Implementation (RT Structure Set Storage SCU),” page 54.

4.2.2.8 SOP Specific Conformance to RT Dose Storage SCU

CTN_SEND/CDMS_SEND implement Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Dose Information Object Implementation (RT Dose Storage SCU),” page 64.

4.2.2.9 SOP Specific Conformance to RT Plan Storage SCU

CDMS_SEND implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Plan IOD (RT Plan Storage SCU),” page 71.

4.2.2.10 SOP Specific Conformance to RT Beams Treatment Record Storage SCU

CDMS_SEND implements Level 2 (Full) conformance for the Storage SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “RT Beams Treatment Record IOD (RT Beam Treatment Record Storage SCU),” page 83.

4.2.2.11 SOP Specific Conformance to Unified Procedure Step – PULL SCU

CDMS_UPS implements Level 2 (Full) conformance for the Unified Procedures Step SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “Unified Procedure Step IOD (Unified Procedure Step – PULL SCU),” page 92.

4.2.2.12 SOP Specific Conformance to Study Root Query/Retrieve – MOVE SCU

CDMS_QR implements Level 2 (Full) conformance for the Query/Retrieve SOP Class, but the CyberKnife System only uses a subset of the attributes described in the section “Study Root Query/Retrieve Information Model SCU,” page 95.

4.2.3 Association Acceptance Policy

CTN_SEND/CDMS_SEND/CDMS_UPS/CDMS_QR AE does not accept associations.

5 RT STRUCTURE SET INFORMATION OBJECT IMPLEMENTATION (RT STRUCTURE SET STORAGE SCP)

This section specifies the use of the DICOM RT Structure Set Information Object Definition (IOD) by the On-Target, and MultiPlan and InView applications.

5.1 RT Structure Set IOD Implementation

This section defines the implementation of the RT Structure Set information object by the On-Target, MultiPlan and InView applications in the CyberKnife System. It refers to DICOM v3.0 standard, Part 3 (Information Object Definitions). The On-Target, MultiPlan and InView applications import and display an RT Structure Set as Regions of Interest (ROI) in the corresponding CT image study via the same Study UID.

5.1.1 Entity Relationship Model

Refer to section A.19.2 in DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Structure Set IOD and a description of each of the entities contained within it.

5.1.2 CyberKnife Mapping of DICOM Entities

DICOM entities map to CyberKnife entities in the following manner.

Table 42. CyberKnife mapping of DICOM entities

DICOM	CyberKnife	
	Central Database	InView Local Database
Patient Entity	Patient Entity (set from associated CT Image)	Patient Entity
Study Entity	Case Entity (set from associated CT Image)	Study Entity
Series Entity	Not mapping	Series Entity
Equipment Entity	Not used	Not used
Structure Set	On-Target™ and MultiPlan geometric information related to defined ROI	InView geometric information related to defined VOI

5.2 RT Structure Set IOD Module Table

The table in this section describes the mandatory modules to support the RT Structure Set IOD. The Reference column refers to sections in this document.

Table 43. Mandatory modules to support RT Structure Set IOD.

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 5	M
Study	General Study	Table 6	M
	Patient Study	Not used	U
Series	RT Series	Table 7	M
Equipment	General Equipment	Table 9	M
Structure Set	Structure Set	Table 44	M
	ROI Contour	Table 45	M
	RT ROI Observations	Table 46	M
	Approval	Not used	U
	Audio	Not used	U
	SOP Common	Table 14	M

5.3 Information Module Definitions – RT Structure Set

5.3.1 Structure Set Module

The table shown below lists the elements in the Structure Set Module that are read by the On-Target, MultiPlan and InView applications. Unlisted elements are not used by the applications. The Notes column describes special considerations for the usage of each element. Refer to section C.8.8.5 of the DICOM standard, Part 3(Information Object Definitions) for the complete Structure Set Module.

Table 44. Elements in the Structure Set Module read by On-Target, MultiPlan and InView

Attribute Name	Tag	Type	VR	Notes
Structure Set Label	(3006,0002)	1	SH	In MultiPlan and InView, Value = 'CyRISRTSS3.0.0' which is used to distinguish if RTSS is exported from MultiPlan and InView for advanced contouring capability.
Structure Set Date	(3006,0008)	2	DA	Not used.
Structure Set Time	(3006,0009)	2	TM	Not used.
Referenced Frame of Reference Sequence	(3006,0010)	3	SQ	Introduces the sequence describing the frame of reference for the data set. Not used in On-Target, and the MultiPlan and InView Systems.

Attribute Name	Tag	Type	VR	Notes
>Frame of Reference UID	(0020,0052)	1C	UI	Must equal the Frame of Reference UID of the corresponding CT image study. Not used in On-Target and the MultiPlan and InView Systems.
>RT Referenced Study Sequence	(3006,0012)	3	SQ	Not used in On-Target and the MultiPlan and InView Systems.
Structure Set ROI Sequence	(3006,0020)	3	SQ	Sequence contains items corresponding to organs. Required for On-Target and the MultiPlan and InView Systems.
>ROI Number	(3006,0022)	1C	IS	ROI number used to make an association with ROI Contour Module and RT ROI Observations Module. Required for On-Target and the MultiPlan and InView Systems. The MultiPlan and InView Systems use ROI number to be a unique number which consists of VOI ID as 16-bit MSB and Contour set ID as 16-bit LSB to support the multiple Contour set feature.
>Referenced Frame of Reference UID	(3006,0024)	1C	UI	Not used in On-Target, and the MultiPlan and InView Systems.
>ROI Name	(3006,0026)	2C	LO	Organ name. Required for On-Target, and the MultiPlan and InView Systems. The MultiPlan and InView Systems have different ROI Name per Contour set.
>ROI Generation Algorithm	(3006,0036)	2C	CS	'AUTOMATIC', 'SEMIAUTOMATIC', 'MANUAL' depending on the method used to outline the organ. Not used in On-Target. The MultiPlan and InView Systems use 'AUTOMATIC' to set the interpolation flag of the VOI.

5.3.2 ROI Contour Module

The table shown below lists the elements in the ROI Contour Module that are read by the On-Target and InView applications. Unlisted elements are not used by the applications. The Notes column indicates

special considerations for the usage of each element. Refer to section C.8.8.6 in DICOM standard, Part 3 (Information Object Definitions) for a complete ROI Contour Module.

Table 45. Elements of the ROI Contour Module read by On-Target and InView.

Attribute Name	Tag	Type	VR	Notes
ROI Contour Sequence	(3006,0039)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target, and the MultiPlan and InView Systems.
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and RT ROI Observations Module. Required for On-Target, and the MultiPlan and InView Systems.
> ROI Display Color	(3006,002A)	3	IS	RGB triplet color representation for ROI, specified using the range 0-255. Not used in On-Target, but in the MultiPlan and InView Systems.
>Contour Sequence	(3006,0040)	3	SQ	Sequence contains items corresponding to the contours used to define the ROI (organs). Required for On-Target, and the MultiPlan and InView Systems.
>>Contour Number	(3006,0048)	3	IS	Unique ID encoding the contour stack ID, Geometry type (solid=0,cavity=1,shell=2) and Contour Number. ----- StackID (8 bits) Geometry 8 bits Contour # (16 bits) -----
>>Contour Geometric Type	(3006,0042)	1C	CS	Must be 'CLOSED_PLANAR'. Required for On-Target, and the MultiPlan and InView Systems.
>>Number of Contour Points	(3006,0046)	1C	IS	Number of points in Contour Data (3006,0050). Required for On-Target, and the MultiPlan and InView Systems.
>>>Contour Data	(3006,0050)	1C	DS	Sequence of points stored as (x, y, z) triplets defining a contour in the patient-based coordinate system.

Attribute Name	Tag	Type	VR	Notes
				Required for On-Target, and the MultiPlan and InView Systems.
>>Contour Image Sequence	(3006,0016)	3	SQ	Sequence contains 1 item corresponding to the image to which the contour applies. On-Target uses this information first, but if this value doesn't exist, On-Target uses the geometric information of Contour Data (3006,0050) instead. The MultiPlan and InView Systems always use the geometric information of Contour Data (3006,0050) instead.
>>>Referenced SOP Class UID	(0008,1150)	1C	UI	
>>>Referenced SOP Instance UID	(0008,1155)	1C	UI	

5.3.3 RT ROI Observations Module

The table shown below lists the elements in the RT ROI Observations Module that are read by the On-Target and InView applications. Unlisted elements are not used by the applications. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.8 in DICOM standard, Part 3(Information Object Definitions) for a complete RT ROI Observations Module.

Table 46. Elements in RT ROI Observations Module read by On-Target and InView

Attribute Name	Tag	Type	VR	Notes
ROI Contour Observations Sequence	(3006,0080)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target, and the MultiPlan and InView Systems.
>Observation Number	(3006,0082)	1	IS	Not used in On-Target. In the MultiPlan and InView Systems, it is the same unique number as ROI Number (3006,0022).
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and ROI Contour Module. Required for On-Target, and the MultiPlan and InView Systems.
>ROI Observation Label	(3006,0085)	3	SH	Not used in On-Target.

Attribute Name	Tag	Type	VR	Notes
				In the MultiPlan and InView Systems, It refers to ContourSet plane and its value = 'AXIAL', 'SAGITTAL', 'CORONAL'.
>RT Related ROI Sequence	(3006,0030)	3	SQ	Not used in On-Target. In the MultiPlan and InView Systems,
>>Referenced ROI Number	(3006,0084)	1C	IS	Not used in On-Target. In the MultiPlan and InView System
>>RT ROI Relationship	(3006,0033)	3	CS	Not used in On-Target. In the MultiPlan and InView Systems
>RT ROI Interpreted Type	(3006,00A4)	2	CS	Type of ROI. Defined terms: EXTERNAL = external patient contour PTV = Planning Target Volume CTV = Clinical Target Volume GTV = Gross Tumor Volume. ORGAN = patient organ Not used in On-Target, but in InView. The MultiPlan and InView Systems use 'ORGAN' and 'EXTERNAL' as a critical structure, and 'GTV' and 'PTV' as a tumor site to perform the automatic classification.
> ROI Interpreter	(3006,00A6)	2	PN	Name of person performing the interpretation. Not used in On-Target and the MultiPlan and InView Systems.

6 RT STRUCTURE SET INFORMATION OBJECT IMPLEMENTATION (RT STRUCTURE SET STORAGE SCU)

This section specifies the use of the DICOM RT Structure Set Information Object Definition (IOD) by the On-Target application.

6.1 RT Structure Set IOD Implementation

This section defines the implementation of the RT Structure Set information object by the On-Target, MultiPlan and InView applications in the CyberKnife System. It refers to DICOM v3.0 standard, Part 3 (Information Object Definitions). The On-Target, MultiPlan and InView applications display and export an RT Structure Set as Regions of Interest (ROI) in the corresponding CT image study via the same Study UID.

6.1.1 Entity Relationship Model

Refer to section A.19.2 in DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Structure Set IOD and a description of each of the entities contained within it.

6.1.2 CyberKnife Mapping of DICOM Entities

DICOM entities map to CyberKnife entities in the following manner:

Table 47. DICOM entity mapping to the CyberKnife System.

DICOM	CyberKnife	
	Central Database	InView Local Database
Patient Entity	Patient Entity (set from associated CT Image)	Patient Entity
Study Entity	Case Entity (set from associated CT Image)	Study Entity
Series Entity	Not mapping	Series Entity
Equipment Entity	Not used	Not used
Structure Set	On-Target and MultiPlan geometric information related to defined ROI Beginning with MultiPlan 2.0, geometric information saved as "rtss.dcm" for a deliverable plan.	InView geometric information related to defined VOI

6.2 RT Structure Set IOD Module Table

The table in this section describes the mandatory modules to support the RT Structure Set IOD. The Reference column refers to sections in this document.

Table 48. Mandatory modules for RT Structure Set IOD

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 25	M
Study	General Study	Table 26	M
	Patient Study	Not used	U
Series	RT Series	Table 28	M
Equipment	General Equipment	Table 29	M
Structure Set	Structure Set	Table 49	M
	ROI Contour	Table 50	M
	RT ROI Observations	Table 51	M
	Approval	Not used	U
	Audio	Not used	U
	SOP Common	Table 33	M

6.3 Information Module Definitions – RT Structure Set

6.3.1 Structure Set Module

The table shown below lists the elements in the Structure Set Module that are exported by the On-Target, MultiPlan and InView applications. Unlisted elements are not used by the applications. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.5 in DICOM standard, Part 3(Information Object Definitions) for a complete Structure Set Module.

Table 49. Elements in Structure Set Module exported by On-Target, MultiPlan, and InView

Attribute Name	Tag	Type	VR	Notes
Structure Set Label	(3006,0002)	1	SH	In On-Target, Value = 'ACCURAY_RTSS' In the MultiPlan and InView Systems, Value = 'CyRISRTSS3.0.0'
Structure Set Date	(3006,0008)	2	DA	Required for On-Target, and the MultiPlan and InView Systems.
Structure Set Time	(3006,0009)	2	TM	Required for On-Target, and the MultiPlan and InView Systems.

Attribute Name	Tag	Type	VR	Notes
Referenced Frame of Reference Sequence	(3006,0010)	3	SQ	Introduces the sequence describing the frame of reference for the data set. Not used in On-Target, and MultiPlan and InView Systems.
>Frame of Reference UID	(0020,0052)	1C	UI	Must equal the Frame of Reference UID of the corresponding CT image study. Not used in On-Target, and theMultiPlan and InView Systems.
>RT Referenced Study Sequence	(3006,0012)	3	SQ	Not used in On-Target and the InView System.
Structure Set ROI Sequence	(3006,0020)	3	SQ	Sequence contains items corresponding to organs. Required for On-Target, and the MultiPlan and InView Systems.
>ROI Number	(3006,0022)	1C	IS	ROI number used to make an association with ROI Contour Module and RT ROI Observations Module. Required for On-Target, and the MultiPlan and InView Systems. The MultiPlan and InView Systems use ROI number to be a unique number which consists of VOI ID as 16-bit MSB and Contour set ID as 16-bit LSB to support the multiple Contour set feature.
>Referenced Frame of Reference UID	(3006,0024)	1C	UI	Equal to the Frame of Reference UID above. Not used in On-Target, and theMultiPlan and InView Systems.
>ROI Name	(3006,0026)	2C	LO	Organ name. Required for On-Target, and the MultiPlan and InView Systems. The MultiPlan and InView Systems have different ROI Name per Contour set. The MultiPlan System uses case insensitive Value = 'SKIN' to determine RT ROI Interpreted Type = 'EXTERNAL' for RTOG compliant.
>ROI Generation	(3006,0036)	2C	CS	Required for On-Target, and theMultiPlan

Attribute Name	Tag	Type	VR	Notes
Algorithm				and InView Systems. In On-Target, Value = 'MANUAL' In the MultiPlan and InView Systems, Value = 'MANUAL' or 'AUTOMATIC'.

6.3.2 ROI Contour Module

The table shown below lists the elements in the ROI Contour Module that are exported by the On-Target and InView applications. Unlisted elements are not used by the applications. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.6 in DICOM standard, Part 3(Information Object Definitions) for a complete ROI Contour Module.

Table 50. Elements in ROI Contour Module exported by On-Target and InView.

Attribute Name	Tag	Type	VR	Notes
ROI Contour Sequence	(3006,0039)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target, and the MultiPlan and InView Systems.
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and RT ROI Observations Module. Required for On-Target, and the MultiPlan and InView Systems.
> ROI Display Color	(3006,002A)	3	IS	RGB triplet color representation for ROI, specified using the range 0-255. Required for the MultiPlan and InView Systems.
>Contour Sequence	(3006,0040)	3	SQ	Sequence contains items corresponding to the contours used to define the ROI (organs). Required for On-Target, and the MultiPlan and InView Systems.
>>Contour Number	(3006,0048)	3	IS	Unique ID encoding the contour stack ID, Geometry type (solid=0,cavity=1,shell=2) and Contour Number. ----- StackID (8 bits) Geometry 8 bits Contour #(16 bits) -----
>>Contour Geometric	(3006,0042)	1C	CS	Required for On-Target, and the MultiPlan and

Attribute Name	Tag	Type	VR	Notes
Type				InView Systems. In On-Target , Value = 'CLOSED_PLANAR' In the MultiPlan and InView Systems, Value = 'CLOSED_PLANAR' or 'OPEN_PLANAR'.
>>Number of Contour Points	(3006,0046)	1C	IS	Number of points in Contour Data (3006,0050). Required for On-Target, and the MultiPlan and InView Systems.
>>Contour Data	(3006,0050)	1C	DS	Sequence of points stored as (x, y, z) triplets defining a contour in the patient-based coordinate system. Required for On-Target, and theMultiPlan and InView Systems.
>>Contour Image Sequence	(3006,0016)	3	SQ	Sequence contains 1 item corresponding to the image to which the contour applies. Required for On-Target, and the MultiPlan and InView Systems.
>>>Referenced SOP Class UID	(0008,1150)	1C	UI	Reused from the associated CT Image set. Required for On-Target, and the MultiPlan and InView Systems.
>>>Referenced SOP Instance UID	(0008,1155)	1C	UI	Reused from the associated CT Image set. Required for On-Target, and theMultiPlan and InView Systems, but in the InView System sometimes, this value will be blank because the associated image slice is not found.

6.3.3 RT ROI Observations Module

The table shown below lists the elements in the RT ROI Observations Module that are exported by the On-Target and InView applications. Unlisted elements are not used by the applications. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.8 in the DICOM standard, Part 3(Information Object Definitions) for the complete RT ROI Observations Module.

Table 51. Elements in the RT ROI Observations Module exported by On-Target and InView

Attribute Name	Tag	Type	VR	Notes
ROI Contour Observations Sequence	(3006,0080)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target, and the MultiPlan and InView Systems.
>Observation Number	(3006,0082)	1	IS	Not used in On-Target. In the MultiPlan and InView Systems, it is the same unique number as ROI Number (3006,0022).
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and ROI Contour Module. Required for On-Target, and the MultiPlan and InView Systems.
>ROI Observation Label	(3006,0085)	3	SH	Not used in On-Target. In the MultiPlan and InView System, It refers to ContourSet plane and its value = 'AXIAL', 'SAGITTAL', 'CORONAL'.
>RT Related ROI Sequence	(3006,0030)	3	SQ	Not used in On-Target. In the MultiPlan and InView Systems,
>>Referenced ROI Number	(3006,0084)	1C	IS	Not used in On-Target. In the MultiPlan and InView Systems,
>>RT ROI Relationship	(3006,0033)	3	CS	Not used in On-Target. In the MultiPlan and InView Systems,
>RT ROI Interpreted Type	(3006,00A4)	2	CS	Type of ROI. In On-Target, Value = 'ORGAN' The InView System uses 'ORGAN' as a critical structure and 'GTV' and 'PTV' as a tumor site to perform the automatic classification. In MultiPlan®, Tumor Site = 'GTV' Critical Site = 'ORGAN' Skin Type = 'EXTERNAL' for RTOG complaint.
> ROI Interpreter	(3006,00A6)	2	PN	Name of person performing the interpretation. In On-Target, Value = 'ADLER'. The MultiPlan and InView Systems use Window login name.

7 RT DOSE INFORMATION OBJECT IMPLEMENTATION (RT DOSE STORAGE SCP)

This section specifies the use of the DICOM RT Dose Information Object Definition (IOD) by the InView application.

7.1 RT Dose IOD Implementation

This section defines the implementation of the RT Dose information object by the InView application in the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). For plan review, The InView application displays and imports the 3D dose grid exported via DICOM RT Dose corresponding CT image study from On-Target application.

7.1.1 Entity Relationship Model

Refer to section A.18.2 in DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Dose IOD and a description of each of the entities contained within it.

7.1.2 CyberKnife Mapping of DICOM Entities

DICOM entities map to CyberKnife entities in the following manner:

Table 52. DICOM entity mapping to the CyberKnife System

DICOM	CyberKnife	
	Central Database	InView Local Database
Patient Entity	Patient Entity (set from associated CT Image)	Patient Entity
Study Entity	Case Entity (set from associated CT Image)	Study Entity
Series Entity	Not mapping	Series Entity
Equipment Entity	Not used	Not used
RT Dose	Not used	InView volumetric information related to defined 3D dose grid.

7.2 RT Dose IOD Module Table

The table in this section describes the mandatory modules to support the RT Dose IOD. The Reference column refers to sections in this document.

Table 53. Mandatory modules for RT Dose IOD

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 25	M
Study	General Study	Table 26	M
	Patient Study	Not used	U
Series	RT Series	Table 28	M
Frame of Reference	Frame of Reference	Table 27	M
Equipment	General Equipment	Table 29	M
Dose	General Image	Table 30	C
	Image Plane	Table 31	C
	Image Pixel	Table 32	C
	Multi-Frame	Table 33	C
	RT Dose	Table 54	M
	RT DVH	Table 55	U
	Structure Set	Table 56	C
	ROI Contour	Not used	C
	RT Dose ROI	Not used	C
	Audio	Not used	U
	SOP Common	Table 33	M

7.3 Information Module Definitions – RT Dose

7.3.1 RT Dose Module

The table shown below lists the elements in the RT Dose Module that are imported to the InView application. Unlisted elements are not used by this application. Special considerations in the usage of elements are noted in the Notes column. Refer to section C.8.8.3 in the DICOM standard, Part 3 (Information Object Definitions) for a complete RT Dose Module.

Table 54. Elements in the RT Dose Module imported to the InView System.

Attribute Name	Tag	Type	VR	Notes
Dose Units	(3004,0002)	1	CS	Units used to describe dose. Value = 'GY' Required for the InView System .
Dose Type	(3004,0004)	1	CS	Type of dose. Value = 'PHYSICAL' Required for the InView System.
Dose Summation Type	(3004,000A)	1	CS	They of dose summation. Value = 'TOTALHETERO' Required for the InView System. For RTOG compliant, if the total dose DVHs refer to an RT Plan which is not provided, Dose Summation Type must be one of the following terms: TOTALHOMO = DVHs computed for total plan dose without heterogeneity correction, or TOTALHETERO = DVHs computed for total plan dose with heterogeneity correction
Dose Grid Scaling	(3004,000E)	1	DS	Scaling factor that when multiplied by the dose grid data found in the Pixel Data(7FE0,0010) attribute of the Image Pixel Module, yields grid doses in the dose units as specified by Dose Units(3004,0002). Required for the InView System.

7.3.2 RT DVH Module

The table shown below lists the elements in the RT DVH Module that are imported by the MultiPlan application. Unlisted elements are not used by this application. Special considerations in the usage of elements are noted in the Notes column. Refer to section C.8.8.4 in the DICOM standard, Part 3(Information Object Definitions) for a complete RT DVH Module.

Table 55. Elements in RT DVH Module imported by MultiPlan.

Attribute Name	Tag	Type	VR	Notes
DVH Normalization Point	(3004,0040)	3	DS	Coordinates (x,y,z) of Maximum Dose value in the patient based coordinate system. Required for MultiPlan. Beginning with MultiPlan 2.0, it is incorporated to 3D dose grid import as a reference point.
DVH Normalization Dose Value	(3004,0042)	3	DS	Maximum dose value. Required for MultiPlan. Beginning with MultiPlan 2.0, it is incorporated to 3D dose grid import as a reference dose.

7.3.3 Structure Set Module

The table shown below lists the elements in the Structure Set Module that are imported by the MultiPlan application. Unlisted elements are not used by this application. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.5 in the DICOM standard, Part 3(Information Object Definitions) for the complete Structure Set Module.

Table 56. Elements in Structure Set Module imported by the MultiPlan.

Attribute Name	Tag	Type	VR	Notes
Structure Set Label	(3006,0002)	1	SH	Beginning with MultiPlan 2.0, Value = 'CyRIS<RTDOSE_VERSION>' which is used to distinguish if RTDOSE is exported from the MultiPlan System for the normalization of dose distribution and DVH using reference dose as its point as maximum dose and its point.

8 RT DOSE INFORMATION OBJECT IMPLEMENTATION (RT DOSE STORAGE SCU)

This section specifies the use of the DICOM RT Dose Information Object Definition (IOD) by the On-Target application.

8.1 RT Dose IOD Implementation

This section defines the implementation of the RT Dose information object by the On-Target and MultiPlan applications in the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). The On-Target and MultiPlan applications display and export a RT Dose as any combination of the 3D dose grid, DVHs, and iosdose curves referencing the corresponding CT image study via use of the same Study UID.

8.1.1 Entity Relationship Model

Refer to section A.18.2 in the DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Dose IOD and a description of each of the entities contained within it.

8.1.2 CyberKnife Mapping of DICOM Entities

DICOM entities map to CyberKnife entities in the following manner:

Table 57. DICOM entity mapping to the CyberKnife System

DICOM	CyberKnife	
	Central Database	InView Local Database
Patient Entity	Patient Entity (set from associated CT Image)	Patient Entity
Study Entity	Case Entity (set from associated CT Image)	Study Entity
Series Entity	Not mapping	Series Entity
Equipment Entity	Not used	Not used
RT Dose	On-Target and MultiPlan volumetric information related to defined 3D dose grid, statistical information related to the defined DVH and geometric information related to defined isodose curves. Beginning with MultiPlan 2.0, 3D dose grid saved as “rtdose.dcm” for a deliverable plan.	Not used

8.2 RT Dose IOD Module Table

The table in this section describes the mandatory modules to support the RT Dose IOD. The Reference column refers to sections in this document.

Table 58. Mandatory modules for RT Dose IOD

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 5	M
Study	General Study	Table 6	M
	Patient Study	Not used	U
Series	RT Series	Table 8	M
Frame of Reference	Frame of Reference	Table 7	M
Equipment	General Equipment	Table 9	M
Dose	General Image	Table 10	C
	Image Plane	Table 11	C
	Image Pixel	Table 12	C
	Multi-Frame	Table 13	C
	RT Dose	Table 59	M
	RT DVH	Table 60	U
	Structure Set	Table 61	C
	ROI Contour	Table 62	C
	RT Dose ROI	Table 63	C
	Audio	Not used	U
	SOP Common	Table 13	M

8.3 Information Module Definitions – RT Dose

8.3.1 RT Dose Module

The table shown below lists the elements in the RT Dose Module that are exported by the On-Target and MultiPlan applications. Unlisted elements are not used by this application. Special considerations in the usage of the elements are noted in the Notes column. Refer to section C.8.8.3 in the DICOM standard, Part 3 (Information Object Definitions) for the complete RT Dose Module.

Table 59. Elements in RT Dose Module exported by the On-Target and MultiPlan.

Attribute Name	Tag	Type	VR	Notes
Dose Units	(3004,0002)	1	CS	Units used to describe dose. Value = 'GY' Required for On-Target and the MultiPlan System .
Dose Type	(3004,0004)	1	CS	Type of dose. Value = 'PHYSICAL' Required for On-Target and the MultiPlan System.
Dose Summation Type	(3004,000A)	1	CS	They of dose summation. Value = 'TOTALHETERO' Required for On-Target and the MultiPlan System . For RTOG compliant, if the total dose DVHs refer to an RT Plan which is not provided, Dose Summation Type must be one of the following terms: TOTALHOMO = DVHs computed for total plan dose without heterogeneity correction, or TOTALHETERO = DVHs computed for total plan dose with heterogeneity correction
Dose Grid Scaling	(3004,000E)	1	DS	Scaling factor that when multiplied by the dose grid data found in the Pixel Data(7FE0,0010) attribute of the Image Pixel Module, yields grid doses in the dose units as specified by Dose Units(3004,0002). Required for On-Target and the MultiPlan System .

8.3.2 RT DVH Module

The table shown below lists the elements in the RT DVH Module that are exported by the On-Target application. Unlisted elements are not used by this application. Special considerations in the usage of elements are noted in the Notes column. Refer to section C.8.8.4 in the DICOM standard, Part 3 (Information Object Definitions) for the complete RT DVH Module.

Table 60. Elements in RT DVH Module exported by the On-Target

Attribute Name	Tag	Type	VR	Notes
Referenced Structure Set Sequence	(300C,0060)	1	SQ	Introduces sequence of one class/instance pair describing Structure Set containing structures which are used to calculate Dose-Volume Histograms (DVHs). Only a single item shall be permitted in this sequence. Required for On-Target and the MultiPlan System.

Attribute Name	Tag	Type	VR	Notes
>Referenced SOP Class UID	(0008,1150)	1	UI	Value = '1.2.840.10008.5.1.4.1.1.481.3' Required for On-Target and the MultiPlan System.
>Referenced SOP Instance UID	(0008,1155)	1	UI	Uniquely identifies the referenced SOP instance which exported by On-Target and the MultiPlan System. Required for On-Target and the MultiPlan System.
DVH Normalization Point	(3004,0040)	3	DS	Coordinates (x,y,z) of Maximum Dose value in the patient based coordinate system. Required for On-Target and the MultiPlan System. Beginning with MultiPlan 2.0, it is incorporated to 3D dose grid export.
DVH Normalization Dose Value	(3004,0042)	3	DS	Maximum dose value. Required for On-Target and the MultiPlan System. Beginning with MultiPlan 2.0, it is incorporated to 3D dose grid export.
DVH Sequence	(3004,0050)	1	SQ	Introduces sequence of DVHs. One or more items may be included in this sequence. Required for On-Target and the MultiPlan System.
>DVH Referenced ROI Sequence	(3004,0060)	1	SQ	Introduces sequence of referenced ROIs used to calculate DVH. Required for On-Target and the MultiPlan System.
>>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and RT DVH Module. Required for On-Target and the MultiPlan System.
>>DVH ROI Contribution Type	(3004,0062)	1	CS	Value = 'INCLUDED' Required for On-Target and the MultiPlan System.
>DVH Type	(3004,0001)	1	CS	Value = 'CUMULATIVE' Required for On-Target and the MultiPlan System.
>Dose Units	(3004,0002)	1	CS	Units used to describe dose. Value = 'RELATIVE' Required for On-Target and the MultiPlan System.
>Dose Type	(3004,0004)	1	CS	Type of dose. Value = 'PHYSICAL' Required for On-Target and the MultiPlan System.

Attribute Name	Tag	Type	VR	Notes
>DVH Dose Scaling	(3004,0052)	1	DS	Value = 0.01. Required for On-Target and the MultiPlan System.
>DVH Volume Units	(3004,0054)	1	CS	Volume axis units. Value = 'CM3', cubic centimeters. Required for On-Target and the MultiPlan System.
>DVH Number of Bins	(3004,0056)	1	IS	Number of bins n used to store DVH Data (3004,0058). Value = 100. Required for On-Target and the MultiPlan System.
>DVH Data	(3004,0058)	1	DS	Required for On-Target and the MultiPlan System.
>DVH Minimum Dose	(3004,0070)	3	DS	Required for On-Target and the MultiPlan System.
>DVH Maximum Dose	(3004,0072)	3	DS	Required for On-Target and the MultiPlan System.
>DVH Mean Dose	(3004,0074)	3	DS	Required for On-Target and the MultiPlan System.

8.3.3 Structure Set Module

The table shown below lists the elements in the Structure Set Module that are exported by the On-Target application. Unlisted elements are not used by this application. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.5 in the DICOM standard, Part 3 (Information Object Definitions) for the complete Structure Set Module.

Table 61. Elements in Structure Set Module exported by On-Target

Attribute Name	Tag	Type	VR	Notes
Structure Set Label	(3006,0002)	1	SH	Value = 'CyRIS<RTDOSE_VERSION>'
Structure Set Date	(3006,0008)	2	DA	
Structure Set Time	(3006,0009)	2	TM	
Referenced Frame of Reference Sequence	(3006,0010)	3	SQ	Introduces the sequence describing the frame of reference for the data set. Not used in On-Target and the MultiPlan System.
>Frame of Reference UID	(0020,0052)	1C	UI	Must equal the Frame of Reference UID of the corresponding CT image study. Reused from the associated CT Image set
>RT Referenced	(3006,0012)	3	SQ	Not used in On-Target and the MultiPlan System.

Attribute Name	Tag	Type	VR	Notes
Study Sequence				
Structure Set ROI Sequence	(3006,0020)	3	SQ	Sequence contains items corresponding to organs. Required for On-Target.
>ROI Number	(3006,0022)	1C	IS	ROI number used to make an association with ROI Contour Module and RT Dose ROI Module. Required for On-Target.
>Referenced Frame of Reference UID	(3006,0024)	1C	UI	Equal to the Frame of Reference UID above. Not used in On-Target and the MultiPlan System.
>ROI Name	(3006,0026)	2C	LO	The Format of ROI name is <view>_Slice<no>_<percent>PCT_<isodose> <view> = {AXIAL, CORONAL, SAGITTAL} <no>= the slice number <percent>= the percentage of dose value <isodose>= the isodose number Required for On-Target.
>ROI Generation Algorithm	(3006,0036)	2C	CS	Value = 'AUTOMATIC' Required for On-Target.

8.3.4 ROI Contour Module

The table shown below lists the elements in the ROI Contour Module that are exported by the On-Target application. Unlisted elements are not used by this application. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.6 in the DICOM standard, Part 3(Information Object Definitions) for the complete ROI Contour Module.

Table 62. Elements in ROI Contour Module exported by On-Target

Attribute Name	Tag	Type	VR	Notes
ROI Contour Sequence	(3006,0039)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target.
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and RT Dose ROI Module. Required for On-Target.
>Contour Sequence	(3006,0040)	3	SQ	Sequence contains items corresponding to the contours used to define the ROI (organs). Required for On-Target.
>>Contour Number	(3006,0048)	3	IS	

Attribute Name	Tag	Type	VR	Notes
>>Contour Geometric Type	(3006,0042)	1C	CS	In On-Target, Value = 'OPEN_PLANAR'. Required for On-Target.
>>Number of Contour Points	(3006,0046)	1C	IS	Number of points in Contour Data (3006,0050). Required for On-Target.
>>Contour Data	(3006,0050)	1C	DS	Sequence of points stored as (x, y, z) triplets defining a contour in the patient-based coordinate system. Required for On-Target.
>>Contour Image Sequence	(3006,0016)	3	SQ	Sequence contains 1 item corresponding to the image to which the contour applies.
>>>Referenced SOP Class UID	(0008,1150)	1C	UI	Reused from the associated CT Image set
>>>Referenced SOP Instance UID	(0008,1155)	1C	UI	Reused from the associated CT Image set

8.3.5 RT Dose ROI Module

The table shown below lists the elements in the RT Dose ROI Module that are exported by the On-Target application. Unlisted elements are not used by this application. The Notes column indicates special considerations for the usage of each element. Refer to section C.8.8.7 in the DICOM standard, Part 3(Information Object Definitions) for the complete RT Dose ROI Module.

Table 63. Elements in RT Dose ROI Module exported by On-Target

Attribute Name	Tag	Type	VR	Notes
RT Dose ROI Sequence	(3004,0010)	1	SQ	Sequence contains items corresponding to organs. Required for On-Target.
>Referenced ROI Number	(3006,0084)	1	IS	ROI number used to make an association with Structure Set Module and ROI Contour Module. Required for On-Target.
>Dose Unit	(3004,0002)	1	CS	Value = 'RELATIVE' Required for On-Target.
>Dose Value	(3004,0012)	1	CS	Required for On-Target.

9 RT PLAN IOD (RT PLAN STORAGE SCU)

This section specifies the use of the DICOM RT Plan Information Object Definition (IOD) by the CyberKnife System.

9.1 RT Plan IOD Implementation

This section defines the implementation of the RT Plan information object by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). The CDMS system exports an RT Plan.

9.1.1 Entity Relationship Model

Refer to section A.20.3 in the DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Plan IOD and a description of each of the entities contained within it.

9.2 RT Plan IOD Module Table

The table in this section describes the mandatory modules to support the RT Plan IOD. The Reference column refers to sections in this document.

Table 64. Mandatory modules to support RT Plan IOD.

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 65	M
	Clinical Trial Subject	Not used	U
Study	General Study	Table 66	M
	Patient Study	Not used	U
	Clinical Trial Study	Not used	U
Series	RT Series	Table 67	M
	Clinical Trial Series	Not used	U
Frame of Reference	Frame of Reference	Table 68	U
Equipment	General Equipment	Table 69	M
Plan	RT General Plan	Table 70	M
	RT Prescription	Table 71	U
	RT Tolerance Tables	Table 72	U
	RT Patient Setup	Table 73	U
	RT Fraction Scheme	Table 74	U
	RT Beams	Table 75	C

Entity Name	Module Name	Reference	Usage
	RT Brachy Application Setups	Not used	C
	Approval	Table 76	U
	SOP Common	Table 77	M

9.3 Information Module Definitions – RT Plan

Table 65. Patient Module

Attribute Name	Tag	Type	VR	Notes
Patient Name	(0010,0010)	2	PN	Patient's full name.
Patient ID	(0010,0020)	2	LO	Only the "a-z", "A-Z", "0-9", "-", and "_" text are acceptable in the value of this attribute. Primary hospital identification number or code for the patient. This is set to the medical ID of the patient, or the HIS ID, if that is set.
Patient Birth Date	(0010,0030)	2	DA	Birth date of the patient.
Patient Sex	(0010,0040)	2	CS	Sex of the named patient. Enumeration Values: M = male F = female O = other

Table 66. General Study Module

Attribute Name	Tag	Type	VR	Notes
Study Instance UID	(0020,000D)	1	UI	Set to the Study Instance UID of the treatment plan primary fixed CT series.
Study Date	(0008,0020)	2	DA	Set to the Study Date of the treatment plan primary fixed CT series.
Study Time	(0008,0030)	2	TM	Set to the Study Time of the treatment plan primary fixed CT series.
Referring Physician Name	(0008,0090)	2	PN	Identification of the physician(s) who are responsible for overall patient care at time of Study. - Set to the name of the treatment plan referring physician.
Study ID	(0020,0010)	2	SH	Value = " (null)

Attribute Name	Tag	Type	VR	Notes
Accession Number	(0008,0050)	2	SH	Value = " (null)
Study Description	(0008,1030)	3	LO	Not used

Table 67. RT Series Module

Attribute Name	Tag	Type	VR	Notes
Modality	(0008,0060)	1	CS	Value = 'RTPLAN'
Series Instance UID	(0020,000E)	1	UI	Value = 1.2.840.<accuracy>.<device>.<uid> <accuracy>=114358 <device> = value of (0018,1000)
Series Number	(0020,0011)	2	IS	A number that identifies this series. Value="
Series Description	(0008,103E)	3	LO	User provided description of the series – Set to the treatment plan name.

Table 68. Frame of Reference Module

Attribute Name	Tag	Type	VR	Notes
Frame of Reference UID	(0020,0052)	1	UI	Value = Primary CT series Frame of Reference UID.
Position Reference Indicator	(0020,1040)	2	LO	Part of the patient's anatomy used as a reference, such as the iliac crest, orbitalmedial, sternal notch, symphysis pubis, xiphoid, lower coastal margin, external auditory meatus. Value = "

Table 69. General Equipment Module

Attribute Name	Tag	Type	VR	Notes
Manufacturer	(0008,0070)	2	LO	Value = 'Accuray Inc.'
Station Name	(0008,1010)	3	SH	User defined name identifying the machine that produced the composite instances. Set to the first 16 characters of the CK Name.
Manufacturer's Model Name	(0008,1090)	3	LO	Value ='CyberKnife'
Software Version	(0018,1020)	3	LO	Set to the CDMS version.
Device Serial Number	(0018,1000)	3	LO	Manufacturer's serial number of the equipment that produced the composite instances. Used to find machine.

Table 70. RT General Plan Module

Attribute Name	Tag	Type	VR	Notes
RT Plan Label	(300A,0002)	1	SH	Set to the first 16 characters of the course id and the treatment plan name.
RT Plan Name	(300A,0003)	2	LO	Set to the treatment plan name.
RT Plan Description	(300A,0004)	3		Not used.
Operator's Name	(0008,1070)	2	PN	Name of operator who last saved the treatment plan.
RT Plan Date	(300A,0006)	2	DA	Date treatment plan was last modified.
RT Plan Time	(300A,0007)	2	TM	Time treatment plan was last modified.
Treatment Protocol	(300A,0009)	3	LO	Technique.
Plan Intent	(300A,000A)	3	CS	Intent of the plan. Value='CURATIVE' for treatment or 'VERIFICATION' for QA
RT Plan Geometry	(300A,000C)	1	CS	Value = 'PATIENT'
Referenced Structure Set Sequence	(300C,0060)	1C	SQ	Introduces sequence of one Class/Instance pair describing instance of RT Structure Set on which the RT Plan is based.

Attribute Name	Tag	Type	VR	Notes
> Referenced SOP Class UID	(0008,1150)	1C	UI	RT Structure Set SOP Class UID
> Referenced SOP Instance UID	(0008,1155)	1C	UI	SOP Instance UID of the RTSSET associated to the treatment plan.

Table 71. RT Prescription Module

Attribute Name	Tag	Type	VR	Notes
Prescription Description	(300A,000E)	3	ST	Set to the treatment plan name.
Dose Reference Sequence	(300A,0010)	3	SQ	Introduces sequence of Dose References.
>Dose Reference Number	(300A,0012)	1C	IS	Value='1'
>Dose Reference Structure Type	(300A,0014)	1	CS	Value = 'SITE'
>Dose Reference Description	(300A,0016)	3	LO	Set to the treatment plan treatment site.
> Referenced ROI Number	(3006,0084)	1C	IS	Not used.
>Nominal Prior Dose	(300A,001A)	3	DS	Not used.
>Dose Reference Type	(300A,0020)	1C	CS	Value = 'TARGET'
>Delivery Warning Dose	(300A,0022)	3	DS	Not used.
>Target Prescription Dose	(300A,0026)	3	DS	Treatment plan dose (in Gy)
> Target maximum Dose	(300A,0027)	3	DS	Not used.

Table 72. RT Tolerance Table Module

Attribute Name	Tag	Type	VR	Notes
Tolerance Table Sequence	(300A,0040)	3	SQ	Introduces sequence of tolerance tables to be used for delivery of treatment plan. One or more items may be included in this sequence.
>Tolerance Table Number	(300A,0042)	1C	IS	Value='1'
>Tolerance Table Label	(300A,0043)	3	SH	User-defined label for Tolerance Table. Value = 'T1'

Table 73. RT Patient Setup

Attribute Name	Tag	Type	VR	Notes
Patient Setup Sequence	(300A,0180)	1	SQ	Introduces sequence of patient setup data for current plan.
>Patient Setup Number	(300A,0182)	1	IS	Value='1'
>Patient Position	(0018,5100)	1C	CS	Patient position description relative to the equipment. Set to the Series table's patient position field.
> Setup Technique	(300A,01B0)	3	CS	Setup Technique used in Patient Setup. Value = "ISOCENTRIC"

Table 74. RT Fraction Scheme Module

Attribute Name	Tag	Type	VR	Notes
Fraction Group Sequence	(300A,0070)	1	SQ	Introduces sequence of Fraction Groups in current Fraction Scheme.
>Fraction Group Number	(300A,0071)	1	IS	Value='1'
>Number of Fractions Planned	(300A,0078)	2	IS	Number of prescribed treatment plan fractions.
>Number of Beams	(300A,0080)	1	IS	Number of treatment plan fraction paths.
>Referenced Beam Sequence	(300C,0004)	1C	SQ	Introduces sequence of treatment paths in current Fraction Group.

Attribute Name	Tag	Type	VR	Notes
				One or more items may be included in this sequence.
>>Referenced Beam Number	(300C,0006)	1C	IS	Treatment plan fraction path number.
>>Beam Dose	(300A,0084)	3	DS	Prescribed path dose in Gy.
>>Beam Meterset	(300A,0086)	3	DS	Path MU to be delivered.
>Number of Brachy Application Setups	(300A,00A0)	1	IS	Value = '0'.
>Referenced Dose Reference Sequence	(300C,0050)	3	SQ	Introduces sequence of Dose References for the current Fraction Group.
>>Referenced Dose Reference Number	(300C,0051)	1C	IS	Value='1'

Table 75. RT Beams Module

Attribute Name	Tag	Type	VR	Notes
Beam Sequence	(300A,00B0)	1	SQ	Introduces sequence of treatment paths for current RT Plan.
>Beam Number	(300A,00C0)	1	IS	Treatment plan fraction path number.
>Beam Name	(300A,00C2)	3	LO	"Path" + path_number,
>Beam Description	(300A,00C3)	3	ST	Treatment plan fraction path name.
>Beam Type	(300A,00C4)	1	CS	Value = 'STATIC'
>Radiation Type	(300A,00C6)	2	CS	Value = 'PHOTON'
>Manufacturer	(0008,0070)	3	LO	Value = 'Accuray Inc.'
>Manufacturer's Model Name	(0008,1090)	3	LO	Value = 'CyberKnife'
>Treatment Machine Name	(300A,00B2)	2	SH	CyberKnife Treatment Delivery System name. Must be: Human readable Less than 20 characters Must match the name entered in the CK locations area in the OIS.
> Device Serial Number	(0018,1000)	3	LO	CyberKnife Treatment Delivery System Serial Number.

Attribute Name	Tag	Type	VR	Notes
>Primary Dosimeter Unit	(300A,00B3)	3	CS	Value = 'MU'
>Source-Axis Distance	(300A,00B4)	3	DS	Nominal fraction path SAD (mm).
>Beam Limiting Device Sequence	(300A,00B6)	1	SQ	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) item. – First item used to define the circular collimator in the X direction. – Second item used to define the circular collimator in the Y direction.
>>RT Beam Limiting Device Type	(300A,00B8)	1	FL	First item: Value = 'X' Second item: Value = 'Y'
>>Number of Leaf/Jaw Pairs	(300A,00BC)	1	IS	Value = '1'
>Treatment Delivery Type	(300A,00CE)	3	CS	Value = 'TREATMENT'
>Number of Wedges	(300A,00D0)	1	IS	Value = '0'.
>Number of Compensators	(300A,00E0)	1	IS	Value = '0'.
>Number of Boli	(300A,00ED)	1	IS	Value = '0'
>Number of Blocks	(300A,00F0)	1	IS	Value = '0'.
>Applicator Sequence	(300A,0107)	3	SQ	Not used.
>> Applicator ID	(300A,0108)	1C	SH	Not used.
>> Applicator Type	(300A,0109)	1C	CS	Not used.
>> Applicator Description	(300A,010A)	3	LO	Not used.
>Final Cumulative Meterset Weight	(300A,010E)	1C	DS	Value = '1'
>Number of Control Points	(300A,0110)	1	IS	Value = '2'
> Control Point Sequence	(300A,0111)	1	SQ	Introduces sequence of machine configurations describing treatment beam. One item provided in sequence.
>> Control Point Index	(300A,0112)	1C	IS	Value = '0', '1'

Attribute Name	Tag	Type	VR	Notes
>> Cumulative Meterset Weight	(300A,0134)	2C	DS	Value = '0', '1'
>>Nominal Beam Energy	(300A,0114)	3	DS	Nominal Beam Energy at control point (MV).
>>Dose Rate Set	(300A,0115)	3	DS	CyberKnife Treatment Delivery System Dose Rate.
>>Referenced Dose Reference Sequence	(300C, 0050)	3	SQ	
>>> Referenced Dose Reference Number	(300C, 0051)	1C	IS	Value = '1'
>>> Cumulative Dose Reference Coefficient	(300A,010C)	2C	DS	Value = '1'
>>Beam Limiting Device Position Sequence	(300A,011A)	1C	SQ	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) positions.
>>>RT Beam Limiting Device Type	(300A,00B8)	1C	CS	First item: Value = 'X' Second item: Value = 'Y'
>>>Leaf/Jaw Positions	(300A,011C)	1C	DS	Fixed Collimator - First item: Value = '(-collimator size/2, collimator size/2)' Iris Collimator – First item: Value = '(0,0)' Fixed Collimator - Second item: Value = '(-collimator size/2, collimator size/2)' Iris Collimator – Second item: Value = '(0,0)'
>>Gantry Angle	(300A,011E)	1C	DS	Value = '0'
>>Gantry Rotation Direction	(300A,011F)	1C	CS	Value = 'NONE'
>>Beam Limiting Device Angle	(300A,0120)	1C	DS	Value = '0'
>>Beam Limiting Device Rotation Direction	(300A,0121)	1C	CS	Value = 'NONE'
>>Patient Support Angle	(300A,0122)	1C	DS	Value = '0'
>>Patient Support	(300A,0123)	1C	CS	Value = 'NONE'

Attribute Name	Tag	Type	VR	Notes
Rotation Direction				
>>Table Top Eccentric Angle	(300A,0125)	1C	DS	Value = '0'
>>Table Top Eccentric Rotation Direction	(300A,0126)	1C	CS	Value = 'NONE'
>>Table top Pitch Angle	(300A,0140)	1C	FL	Value = '0'
>>Table Top Pitch Rotation Direction	(300A,0142)	1C	CS	Value = 'NONE'
>>Table Top Roll Angle	(300A,0144)	1C	FL	Value = '0'
>>Table Top Roll Rotation Direction	(300A,0146)	1C	CS	Value = 'NONE'
>>Table Top Vertical Position	(300A,0128)	2C	DS	Value = '' (null)
>>Table Top Longitudinal Position	(300A,0129)	2C	DS	Value = '' (null)
>>Table Top Lateral Position	(300A,012A)	2C	DS	Value = '' (null)
>>Isocenter Position	(300A,012C)	2C	DS	Value = '' (null)
>>Source to Surface Distance	(300A,0130)	3	DS	Source to Patient Surface distance (mm). Value = '800.0'

Table 76. Approval Module

Attribute Name	Tag	Type	VR	Notes
Approval Status	(300E,0002)	1	CS	Value='APPROVED'
Review Date	(300E,0004)	2C	DA	Treatment plan authorization date.
Review Time	(300E,0005)	2C	TM	Treatment plan authorization time.
Reviewer Name	(300E,0008)	2C	PN	Name of Physician that authorized the treatment plan.

Table 77. SOP Common Module

Attribute Name	Tag	Type	VR	Notes
SOP Class UID	(0008,0016)	1	UI	Value = "1.2.840.10008.5.1.4.1.1.481.5"
SOP Instance UID	(0008,0018)	1	UI	Value = 1.2.840.<accuray>.<device>.<uid> <accuray>=114358 <device> = value of (0018,1000)
Specific Character Set	(0008,0005)	1C	CS	Not used.

10 RT PLAN IOD (RT PLAN STORAGE SCP)

This section specifies the use of the DICOM RT Plan Information Object Definition (IOD) by the CyberKnife System.

10.1 RT Plan IOD Implementation

This section defines the implementation of the RT Plan information object by the CyberKnife System. It refers to DICOM v3.0 standard, Part 3 (Information Object Definitions). The CDMS system imports an RT Plan.

10.1.1 Entity Relationship Model

Refer to section A.20.3 in DICOM standard, Part 3 (Information Object Definitions) for the E_R Model of the RT Plan IOD and a description of each of the entities contained within it.

10.2 RT Plan IOD Module Table

The table in this section describes the mandatory modules to support the RT Plan IOD. The Reference column refers to sections in this document.

Table 78. Mandatory modules to support RT Plan IOD.

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 65	M
	Clinical Trial Subject	Not used	U
Study	General Study	Table 66	M
	Patient Study	Not used	U
	Clinical Trial Study	Not used	U
Series	RT Series	Table 67	M
	Clinical Trial Series	Not used	U
Frame of Reference	Frame of Reference	Table 68	U
Equipment	General Equipment	Table 69	M
Plan	RT General Plan	Table 70	M
	RT Prescription	Table 71	U
	RT Tolerance Tables	Table 72	U
	RT Patient Setup	Table 73	U
	RT Fraction Scheme	Table 74	U
	RT Beams	Table 75	C
	RT Brachy Application Setups	Not used	C
	Approval	Table 76	U
SOP Common	Table 76	M	

11 RT BEAMS TREATMENT RECORD IOD (RT BEAM TREATMENT RECORD STORAGE SCU)

This section specifies the use of the DICOM RT Beam Treatment Record Information Object Definition (IOD) by the CyberKnife System.

11.1 RT Beams Treatment Record IOD Implementation

This section defines the implementation of the RT Beam Treatment information object by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). The CDMS system exports an RT Beam Treatment Record.

11.1.1 Entity Relationship Model

Refer to section A.20.3 in the DICOM standard, Part 3(Information Object Definitions) for the E_R Model of the RT Plan IOD and a description of each of the entities contained within it.

11.2 RT Beams Treatment Record IOD Module Table

The table in this section describes the mandatory modules to support the RT Beams Treatment Record IOD. The Reference column refers to sections in this document.

Table 79. Mandatory modules to support RT Beams Treatment Record IOD

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 65	M
	Clinical Trial Subject	Not used	U
Study	General Study	Table 66	M
	Patient Study	Not used	U
	Clinical Trial Study	Not used	U
Series	RT Series	10.3.1 Table 80	M
	Clinical Trial Series	Not used	U
Equipment	General Equipment	Table 69	M
Treatment Record	RT General Treatment Record	Table 81	M
	RT Patient Setup	Table 72	U
	RT Treatment Machine Record	Table 82	M
	Measured Dose Reference Record	Not used	U

Entity Name	Module Name	Reference	Usage
	Calculated Dose Reference Record	Not used	U
	RT Beams Session Record	Table 83	M
	RT Treatment Summary Record	Not used	U
	SOP Common	Table 84	M

11.3 Information Model Definitions – RT Beams Treatment Record

Table 80. RT Series Module

Attribute Name	Tag	Type	VR	Notes
Modality	(0008,0060)	1	CS	Value = 'RTRECORD'
Series Instance UID	(0020,000E)	1	UI	Unique identifier of the series.
Series Description	(0008,103E)	3	LO	User provided description of the series – Set to the treatment plan fraction name;path number
Series Number	(0020,0011)	2	IS	A number that identifies this series.

Table 81. RT General Treatment Record Module

Attribute Name	Tag	Type	VR	Notes
Instance Number	(0020,0013)	1	IS	Instance number identifying this particular instance of the object.
Treatment Date	(3008,0250)	2	DA	Fraction delivery date.
Treatment Time	(300E,0005)	2	TM	Fraction delivery time.
Referenced RT Plan Sequence	(300C,0002)	2	SQ	A sequence which provides reference to a RT Plan SOP Class/Instance pair.
> Referenced SOP Class UID	(0008,1150)	1C	UI	RT Plan SOP Class UID
> Referenced SOP Instance UID	(0008,1155)	1C	UI	SOP Instance UID of the RTPLAN associated with the treatment plan.
Referenced Treatment Record Sequence	(3008,0030)	3	SQ	Not used.
> Referenced SOP	(0008,1150)	1C	UI	Not used.

Attribute Name	Tag	Type	VR	Notes
Class UID				
> Referenced SOP Instance UID	(0008,1155)	1C	UI	Not used.

Table 82. RT Treatment Machine Record Module

Attribute Name	Tag	Type	VR	Notes
Treatment Machine Sequence	(300A,0206)	1	SQ	Introduces sequence describing treatment machine used for treatment delivery. Only a single item shall be permitted in this Sequence.
> Treatment Machine Name	(300A,00B2)	2	SH	CyberKnife Treatment Delivery System name.
> Manufacturer	(0008,0070)	2	LO	Value = 'Accuray, Inc.'
> Institution Name	(0008,0070)	2	LO	Value = ''
>Manufacturer's Model Name	(0008,1090)	2	LO	Value ='CyberKnife'
> Device Serial Number	(0018,1000)	2	LO	CyberKnife Treatment Delivery System Serial Number.

Table 83. RT Beams Session Record Module

Attribute Name	Tag	Type	VR	Notes
Operators' Name	(0008,1070)	2	PN	Name of operator administering treatment session.
Referenced Fraction Group Number	(300C,0022)	3	IS	Value = RT Plan Fraction Group Number
Number of Fractions Planned	(300A,0078)	2	IS	Number of prescribed treatment plan fractions.
Primary Dosimeter Unit	(300A,00B3)	1	CS	Value = 'MU'
Treatment Session Beam Sequence	(3008,0020)	1	SQ	Introduces sequence of Paths administered during treatment session. The sequence may contain one or more items. Only paths that have been treated will appear within sequence.
>Referenced Beam Number	(300C,0006)	3	IS	References Beam specified by Beam Number (300A,00C0) in Beam Sequence (300A,00B0) in RT Beams Module within

Attribute Name	Tag	Type	VR	Notes
				referenced RT Plan.
>Beam Name	(300A,00C2)	3	LO	References Beam specified by Beam Name (300A, 00C2) in RT Beams Module within referenced RT Plan
>Beam Description	(300A,00C3)	3	ST	Treatment plan fraction path name.
>Beam Type	(300A,00C4)	1	CS	Value = 'STATIC'
>Radiation Type	(300A,00C6)	1	CS	Value = 'PHOTON'
>Referenced Calculated Dose Reference Sequence	(3008,0090)	3	SQ	Introduces sequence of doses estimated for each treatment delivery. The sequence may contain one or more items.
>>Referenced Dose Reference Number	(300C,0051)	1C	IS	Uniquely identifies Dose Reference specified by Dose Reference Number (300A,0012) in Dose Reference Sequence (300A,0010) in RT Prescription Module of referenced RT Plan.
>>Calculated Dose Reference Dose Value	(3008,0076)	1C	DS	Treatment plan fraction path calculated dose in Gy.
>Source-Axis Distance	(300A,00B4)	3	DS	Nominal fraction path SAD (mm).
>Beam Limiting Device Leaf Pairs Sequence	(3008,00A0)	1	IS	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) leaf pair values. – First item used to define the circular collimator in the X direction. – Second item used to define the circular collimator in the Y direction.
>>RT Beam Limiting Device Type	(300A,00B8)	1	CS	First item: Value = 'X' Second item: Value = 'Y'
>>Number of Leaf/Jaw Pairs	(300A,00BC)	1	IS	Value = '1'
>Number of Wedges	(300A,00D0)	1	IS	Value = '0'
>Number of Compensators	(300A,00E0)	2	IS	Value = 0
>Number of Boli	(300A,00ED)	2	IS	Value = '0'
>Number of Blocks	(300A,00F0)	2	IS	Value = '0'
>Current Fraction	(3008,0022)	2	IS	Delivered treatment plan fraction number.

Attribute Name	Tag	Type	VR	Notes
Number				
>Treatment Delivery Type	(300A,00CE)	2	CS	Value = 'TREATMENT'
>Treatment Termination Status	(3008,002A)	1	CS	Conditions under which treatment was terminated. Enumerated Values: NORMAL = treatment terminated normally OPERATOR = operator terminated treatment MACHINE = machine terminated treatment UNKNOWN = status at termination unknown
>Treatment Verification Status	(3008,002C)	2	CS	Value = 'VERIFIED'
>Specified Primary Meterset	(3008,0032)	3	DS	Specified treatment plan fraction path MU.
>Delivered Primary Meterset	(3008,0036)	3	DS	Delivered treatment plan fraction path MU
>Number of Control Points	(300A,0110)	1	DS	Value = '2'
>Control Point Delivery Sequence	(3008,0040)	1	SQ	Introduces sequence of beam control points for current treatment beam. The sequence will contain one item.
>>Referenced Control Point Index	(300C,00F0)	3	IS	Value = '0'
>>Treatment Control Point Date	(3008,0024)	1	DA	Completion date of treatment fraction path delivery.
>>Treatment Control Point Time	(3008,0025)	1	TM	Completion time of treatment fraction path delivery.
>>Specified Meterset	(3008,0042)	2	DS	Values = 0, n MU to be delivered for treatment plan fraction path.
>>Delivered Meterset	(3008,0044)	1	DS	Values = 0, Delivered Path MU from current session + Sum of Delivered Path MU from previous sessions.

Attribute Name	Tag	Type	VR	Notes
>>Dose Rate Set	(300A,0115)	2	DS	CyberKnife Treatment Delivery System Dose Rate.
>>Dose Rate Delivered	(3008,0048)	2	DS	CyberKnife Treatment Delivery System Dose Rate.
>>Nominal Beam Energy	(300A,0114)	3	DS	Value = '6'
>>Nominal Beam Energy Unit	(300A,0015)	1C	CS	Value = 'MV'
>>Beam Limiting Device Position Sequence	(300A,011A)	1C	SQ	Introduces sequence of beam limiting device (collimator) jaw or leaf (element) positions. Required for Control Point 0 of Control Point Delivery Sequence (3008,0040) or if beam limiting device (collimator) changes during beam administration. The sequence may contain one or more items.
>>>RT Beam Limiting Device Type	(300A,00B8)	1C	CS	First item: Value = 'X' Second item: Value = 'Y'
>>>Leaf/Jaw Positions	(300A,011C)	1C	DS	Fixed Collimator - First item: Value = '(collimator size/2, collimator size/2)' Iris Collimator – First item: Value = '(0,0)' Fixed Collimator - Second item: Value = '(collimator size/2, collimator size/2)' Iris Collimator – Second item: Value = '(0,0)'
>>Gantry Angle	(300A,011E)	1C	DS	Value = '0'
>>Gantry Rotation Direction	(300A,011F)	1C	CS	Value = 'NONE'
>>Beam Limiting Device Angle	(300A,0120)	1C	DS	Value = '0'
>>Beam Limiting Device Rotation Direction	(300A,0121)	1C	CS	Value = 'NONE'
>>Patient Support Angle	(300A,0122)	1C	DS	Value = '0'
>>Patient Support Rotation Direction	(300A,0123)	1C	CS	Value = 'NONE'
>>Table Top Eccentric Angle	(300A,0125)	1C	DS	Value = '0'

Attribute Name	Tag	Type	VR	Notes
>>Table Top Eccentric Rotation Direction	(300A,0126)	1C	CS	Value = 'NONE'
>>Table Top Pitch Angle	(300A,0140)	1C	FL	Value = '0'
>> Table Top Pitch Rotation Direction	(300A,0142)	1C	CS	Value = 'NONE'
>>Table Top Roll Angle	(300A,0144)	1C	FL	Value = '0'
>> Table Top Roll Rotation Direction	(300A,0146)	1C	CS	Value = 'NONE'
>>Table Top Vertical Position	(300A,0128)	2C	DS	Value = "" (null)
>>Table Top Longitudinal Position	(300A,0129)	2C	DS	Value = "" (null)
>>Table Top Lateral Position	(300A,012A)	2C	DS	Value = "" (null)

Table 84. SOP Common Module

Attribute Name	Tag	Type	VR	Notes
SOP Class UID	(0008,0016)	1	UI	Value = "1.2.840.10008.5.1.4.1.1.481.4"
SOP Instance UID	(0008,0018)	1	UI	Value = 1.2.840.<accurray>.<device>.<uid> <accurray>=114358 <device> = value of (0018,1000)
Specific Character Set	(0008,0005)	1C	CS	Not used.

12 RT BEAMS DELIVERY INSTRUCTION IOD (RT BEAMS DELIVERY INSTRUCTION STORAGE SCP)

This section specifies the use of the DICOM RT Beams Delivery Instruction Object Definition (IOD) by the CyberKnife System.

12.1 RT Beams Delivery Instruction IOD Implementation

This section defines the implementation of the RT Beams Delivery Instruction by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). The CDMS system imports an RT Beams Delivery Instruction.

12.1.1 Entity Relationship Model

Refer to section A.tt.3 in the DICOM Supplement 74 for the E_R Model of the RT Beams Delivery Instruction IOD and a description of each of the entities contained within it.

12.2 RT Beams Delivery Instruction IOD Module Table

The table in this section describes the mandatory modules to support the RT Beams Delivery Instruction IOD. The Reference column refers to sections in this document.

Table 85. Mandatory modules to support RT Beams Delivery Instruction IOD.

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 65	M
	Clinical Trial Subject	Not used	U
Study	General Study	Table 66	M
	Patient Study	Not used	U
	Clinical Trial Study	Not used	U
Series	RT Series	Table 67	M
	Clinical Trial Series	Not used	U
Frame of Reference	Frame of Reference	Table 68	U
Equipment	General Equipment	Table 69	M
Treatment Delivery	RT Beams Delivery Instruction	Table 86	M
	SOP Common	Table 77	M

12.3 Information Module Definitions – RT Beams Delivery Instruction

Table 86. RT Beams Delivery Instruction Module

Attribute Name	Tag	Type	VR	Notes
Beam Task Sequence	(0074,1020)	1C	SQ	Sequence of items identifying the beams to be delivered and/or verified. Required if beams are to be delivered or verified in this treatment session. One or more items may be included in this sequence.
>Beam Task Type	(0074,1022)	1	CS	Not used
>Treatment Delivery Type	(300A,00CE)	1	CS	Delivery Type of treatment. Enumerated Values: TREATMENT = normal patient treatment CONTINUATION = continuation of interrupted treatment
Referenced RT Plan Sequence	(300C,0002)	2	SQ	A sequence which provides reference to a RT Plan SOP Class/Instance pair.
> Referenced SOP Class UID	(0008,1150)	1C	UI	RT Plan SOP Class UID
> Referenced SOP Instance UID	(0008,1155)	1C	UI	SOP Instance UID of the RTPLAN associated with the treatment plan.
>Current Fraction Number	(3008,0022)	1	IS	The index of the fraction that is to be delivered or completed in this session. See C.8.8.aa.1.
>Referenced Fraction Group Number	(300C,0022)	1C	IS	Not used.
>Referenced Beam Number	(300C,0006)	1	IS	Not used.

13 UNIFIED PROCEDURE STEP IOD (UNIFIED PROCEDURE STEP – PULL SCU)

This section specifies the use of the DICOM Unified Procedure Step IOD by the CyberKnife System.

13.1 Unified Procedure Step_IOD Implementation

This section defines the implementation of the Unified Procedure Step by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions) in the Supplement 96.

13.1.1 Entity Relationship Model

Refer to Part 3 in the DICOM Supplement 96 for the Unified Procedure Step IOD Modules and a description of each of the entities contained within it.

13.2 Unified Procedure Step IOD Module Table

The table in this section describes the mandatory modules to support the Unified Procedure Step IOD. The Reference column refers to sections in this document.

Table 87. Mandatory modules to support Unified Procedure Step IOD.

Module Name	Reference	Module Description
SOP Common	Table 77	Contains SOP common information
Unified Procedure Step Relationship Module	Table 90	References the related SOPs and IEs
Unified Procedure Step Scheduled Procedure Information	Table 89	Describes the UPS task to be performed including information about place, time, priority and input data
Unified Procedure Step Progress Information	Table 88	Describes the progress of a UPS task
Unified Procedure Step Performed Procedure Information	Not used.	Describes the work performed including information about status, place, time and result data.

13.3 Information Module Definitions – Unified Procedure Step

Table 88. Unified Procedure Step Progress Information Module

Attribute Name	Tag	VR	Notes
Unified Procedure Step State	(0074,1000)	CS	<p>Contains the state of the Unified Procedure Step.</p> <p>Value = 'SCHEDULED'</p> <p>Enumerated Values:</p> <p>SCHEDULED = The UPS is scheduled to be performed.</p> <p>IN PROGRESS = An SCU has taken ownership of the UPS and has likely started performing the procedure step. This is the only state that implies an exclusive lock.</p> <p>CANCELED = The UPS has been permanently stopped before or during execution of the step due to voluntary or involuntary action by a human or machine.</p> <p>COMPLETED = The UPS has been completed.</p>

Table 89. Unified Procedure Step Schedule Procedure Information Module

Attribute Name	Tag	VR	Notes
Unified Procedure Step Priority	(0074,1200)	CS	<p>Priority of the schedule Unified Procedure Step.</p> <p>Not used.</p>
Scheduled Procedure Step Start Date and Time	(0040,4005)	DA	<p>Date and time on which the Unified Procedure Step is scheduled to start.</p>
Scheduled Workitem Code Sequence	(0040,4018)	SQ	<p>A sequence that conveys the code for the Workitem.</p> <p>Value = " (null)</p>
Scheduled Processing Parameters Sequence	(0074,1210)	SQ	<p>A sequence that conveys the processing parameters to be used by the performing system when carrying out the Workitem.</p> <p>Value = " (null)</p>
Input Information Sequence	(0040,4021)	SQ	<p>List of Composite SOP Instances that forms the input information needed to perform the scheduled Unified Procedure Step.</p> <p>Value = " (null)</p>

Attribute Name	Tag	VR	Notes
Study Instance UID	(0020,000D)		Unique Study Identification that shall be used for the created Composite SOP Instances resulting form the Unified Procedure Step. Value = " (null)

Table 90. Unified Procedure Step Relationship Module

Attribute Name	Tag	VR	Notes
Patient's Name	(0010,0010)	PN	Patient's full legal name . Value = " (null)
Patient ID	(0010,0020)	LO	Primary hospital identification number or code for the patient. See C.X.4.1. Value = " (null)
Patient's Birth Date	(0010,0030)	DA	Date of birth of the named patient. Value = " (null)
Patient's Sex	(0010,0040)	CS	Sex of the named Patient. Enumerated Values: M = male F = female O = other Value = " (null)
Admitting Diagnoses Description	(0008,1080)	LO	Description of admitting diagnosis (diagnoses). Value = " (null)
Admitting Diagnoses Code Sequence	(0008,1084)	SQ	A sequence that conveys the admitting diagnoses (diagnoses). One or more Items may be included in this Sequence. Value = " (null)

14 STUDY ROOT QUERY/RETRIEVE INFORMATION MODEL SCU

This section specifies the use of the DICOM Study Root Query/Retrieve Information Model by the CyberKnife System.

14.1 Query/Retrieve (SCU) Implementation

This section defines the implementation of the Study Root Query/Retrieve Information Model by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions).

Table 91. Specific Conformance for the Study Root Query/Retrieve Information Model - MOVE

Attribute Name	Tag	VR	Notes
Study Date	(0008,0020)	DA	Date the study started.
Patient's Name	(0010,0010)	PN	Patient's full name.
Patient ID	(0010,0020)	LO	Primary hospital identification number or code for the patient.
Study Instance UID	(0020,000D)	UI	Unique identifier for the study.
Series Instance UID	(0020,000E)	UI	Unique identifier for the series.

15 RT TREATMENT SUMMARY RECORD IOD (RT TREATMENT SUMMARY RECORD STORAGE SCP)

This section specifies the use of the DICOM RT Treatment Summary Record Object Definition (IOD) by the CyberKnife System.

15.1 RT Treatment Summary Record IOD Implementation

This section defines the implementation of the RT Treatment Summary Record by the CyberKnife System. It refers to the DICOM v3.0 standard, Part 3 (Information Object Definitions). The CDMS system imports an RT Treatment Summary Record.

15.1.1 Entity Relationship Model

Refer to section A.31.2 in the DICOM standard, Part 3 (Information Object Definitions) for the E_R Model of the RT Plan IOD and a description of each of the entities contained within it.

15.2 RT Treatment Summary Record IOD Module Table

The table in this section describes the mandatory modules to support the RT Treatment Summary Record IOD. The Reference column refers to sections in this document.

Table 92. Mandatory modules to support RT Treatment Summary Record IOD.

Entity Name	Module Name	Reference	Usage
Patient	Patient	Table 65	M
	Clinical Trial Subject	Not used	U
Study	General Study	Table 66	M
	Patient Study	Not used	U
	Clinical Trial Study	Not used	U
Series	RT Series	Table 67	M
	Clinical Trial Series	Not used	U
Equipment	General Equipment	Table 69	M
Treatment Record	RT General Treatment Record	Table 93	M
	RT Treatment Summary Record	Table 94	M
	SOP Common	Table 77	M

15.3 Information Module Definitions – RT Treatment Summary

Table 93. RT General Treatment Module

Attribute Name	Tag	Type	VR	Notes
Instance Number	(0020,0013)	1	IS	Used to ensure requested object received.
Treatment Date	(3008,0250)	2	DA	Not used.
Treatment Time	(3008,0251)	2	TM	Not used.
Referenced RT Plan Sequence	(300C,0002)	2	SQ	Not used.
> Referenced SOP Class UID	(0008,1150)	1	UI	RT Plan SOP Class UID
> Referenced SOP Instance UID	(0008,1155)	1	UI	SOP Instance UID of the RTPLAN associated with the treatment plan – used to check that appropriate plan used.
Referenced Treatment Record Sequence	(3008,0030)	3	SQ	Not used.

Table 94. RT Treatment Summary Record

Attribute Name	Tag	Type	VR	Notes
Current Treatment Status	(3008,0200)	1	CS	Not used.
Treatment Status Comment	(3008,0202)	3	ST	Not used.
First Treatment Date	(3008,0054)	2	DA	Not used.
Most Recent Treatment Date	(3008,0056)	2	DA	Not used.
Fraction Group Summary Sequence	(3008,0220)	3	SQ	Not used.
>Fraction Status Summary Sequence	(3008,0240)	3	SQ	Not used.
Treatment Summary Measured Dose Reference Sequence	(3008,00E0)	3	DQ	Not used.
Treatment Summary Calculated Dose Reference Sequence	(3008,0050)	3	DQ	Sequence of references to Calculated Dose References
>Referenced Dose Reference	(300C,0051)	3	IS	Dose Reference

RT Treatment Summary Record IOD (RT Treatment Summary Record Storage SCP)

Attribute Name	Tag	Type	VR	Notes
Number				specified by Dose Reference Number (300A,0012) in Dose Reference Sequence (300A,0010) in RT Prescription Module of referenced RT Plan
>Dose Reference Description	(300A,0016)	3	LO	Not used.
>Cumulative Dose to Dose Reference	(3008,0052)	1C	DS	Cumulative Dose delivered to Dose Reference (Gy). – Used to compare dose delivered against dose recorded in OIS.

16 COMMUNICATION PROFILES

16.1 Supported Communication Stacks

The CyberKnife AE supports the TCP/IP stack as defined in Part 8 of the DICOM 3.0 standard.

16.2 Network Media Support

The CyberKnife AE is not concerned about the physical network media, as long as it is based on the TCP/IP stack. The default physical media is 100baseT Ethernet.

17 EXTENSIONS, SPECIALIZATIONS, PRIVATIZATIONS

Not applicable.

18 CONFIGURATION

The CyberKnife AE DICOM configuration is intended to be performed by Accuray personnel only. The host name mapping to an IP address is defined in the local host table.

The AE title of the CyberKnife System is **N1000_STORAGE** and the listening port number is **104**.

The AE title of the MultiPlan and InView Workstations is **TPS-<COMPUTERNAME>** and the listening port number is **104**, where **<COMPUTERNAME>** is the computer name from system environment variable. It can be found in the About panel of the 16 February, 2001 applications.

For the detailed configuration information, see the Installation Instructions of the CyberKnife System and the 16 February, 2001 applications.

19 SUPPORT FOR EXTENDED CHARACTER SETS

Extended character sets are not supported by the CyberKnife System and the 16 February, 2001 applications. Only Support for DICOM's default character set repertoire, i.e. ISO-IR6, is provided.

20 ANNEXES

20.1 Miscellaneous Macros

Table 95. Standard Attributes Sets for Code Sequence Attributes (Code Sequence Macro)

Attribute Name	Tag	Type	VR	Notes
Code Value	(0008,0100)	1	SH	
Coding Scheme Designator	(0008,0102)	1	SH	
Coding Scheme Version	(0008,0103)	1C	SH	
Code Meaning	(0008,0104)	1	LO	

20.2 Data Dictionary of Private Attributes

Any private attributes should be specified, including VR and VM, should be specified.

20.2.1 GE Private Attributes for PET Images

The GE Advance and Discovery family systems reserves private attribute values in group number 0x0009. The private attributes added to PET SOP instances are listed in the following table:

Table 96. GE Advance and Discovery systems private attributes added to PET SOP instances.

Attribute Name	Tag	Type	VR	VM	Notes
Private Creator Data Element	(0009,0010)	1	SH	1	Private Creator Identification. Value = 'GEMS_PETD_01'

Table 97. GE Scan Module

Attribute Name	Tag	Type	VR	VM	Notes
Scan.scan_datetime	(0009,100D)	3	DT	1	
Scan.tracer_activity	(0009,1038)	3	FL	1	Unit in Million Becquerels (MBq)
Scan.meas_datetime	(0009,1039)	3	DT	1	
Scan.admin_datetime	(0009,103B)	3	DT	1	
Scan.post_inj_activity	(0009,103C)	3	FL	1	Unit in Million Becquerels (MBq)
Scan.post_inj_datetime	(0009,103D)	3	DT	1	
Scan.half_life	(0009,103F)	3	FL	1	Unit in seconds (Sec)

20.2.2 PHILIPS Private Attributes for PET Images

The PHILIPS Allegro™ and Gemini™ systems reserves private attribute values in group number 0x7053. The private attributes added to PET SOP instances are listed in the following table:

Table 98. PHILIPS Allegro™ and Gemini™ systems private attributes added to PET SOP instances.

Attribute Name	Tag	Type	VR	VM	Notes
Private Creator Data Element	(7053,0010)	3	LO	1	Private Creator Identification. Value = 'Philips PET Private Group'
SUV Factor	(7053,1000)	3	DS	1	SUV Factor. The SUV Factor is used to convert the pixel data from counts to an body mass SUV value. This is done by multiplying each pixel value by the SUV Factor. If the SUV Factor is 0.0, then the pixel data cannot be converted from counts to an SUV value.

20.2.3 VARIAN Private Attributes for OIS Interface

The VARIAN System Server product family reserves private attribute values in group number 0x3242. The private attributes added to the RT Beams Module and the RT Beams Session Record Module are listed in the following table:

Table 99. VARIAN System Server private attributes added to RT Beams Module and RT Beams Session Record Module.

Attribute Name	Tag	Type	VR	VM	Notes
Private Creator Data Element	(3243,0010)	3	LO	1	Private Creator Identification. Value = 'Varian Medical Systems VISION 3243'
Beam Secondary Name	(3243,1009)	3	SH	1	Secondary beam name. Set to the path name.

The VARIAN System Server product family reserves private attribute values in group number 0x3249. The private attributes added to the RT Fraction Scheme Module are listed in the following table:

Table 100. VARIAN System Server private attributes added to RT Fraction Scheme Module.

Attribute Name	Tag	Type	VR	VM	Notes
Private Creator Data Element	(3249,0010)	3	LO	1	Private Creator Identification. Value = 'Varian Medical Systems VISION 3249'
Maximum Treatment Time	(3249,1010)	3	DS	1	Maximum treatment time. Value = '30' (minutes)

20.2.4 iCAD Private Attributes for MR DCE Images

The iCAD system reserves private attribute values in group number 0x3335. The private attributes added to MR SOP instances are listed in the following table:

Table 101. iCAD system private attributes added to MR SOP instances.

Attribute Name	Tag	Type	VR	VM	Notes
Private Creator Data Element	(3335,0011)	3	LO	1	Private Creator Identification. Value = 'iCAD PK'
PERM CAP Value	(3335,1170)	3	LO	1	PERM CAP Value. The PERM CAP Value is used to cap the permeability value in DCE Ktrans series for the color overlay generation.
Ktrans series UID	(3335,0016)	3	LO	1	Ktrans series UID and Ve series UID are matching information for a pair of iCAD DCE series
Ve series UID	(3335,0017)	3	LO	1	Ktrans series UID and Ve series UID are matching information for a pair of iCAD DCE series