Integrating the Healthcare Enterprise

IHE Radiation Oncology (RO) Technical Framework

Volume 2
IHE RO TF-2
Transactions

Revision 3.0 - Final Text

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CONTENTS

1 Introduction

This document, Volume 2 of the IHE Radiation Oncology (RO) Technical Framework, defines transactions used in IHE Radiation Oncology profiles.

1.1 Introduction to IHE

Integrating the Healthcare Enterprise (IHE) is an international initiative to promote the use of standards to achieve interoperability among health information technology (HIT) systems and effective use of electronic health records (EHRs). IHE provides a forum for care providers, HIT experts and other stakeholders in several clinical and operational domains to reach consensus on standards-based solutions to critical interoperability issues.

The primary output of IHE is system implementation guides, called IHE Profiles. IHE publishes each profile through a well-defined process of public review and trial implementation and gathers profiles that have reached final text status into an IHE Technical Framework, of which this volume is a part.

For general information regarding IHE, refer to www.ihe.net. It is strongly recommended that, prior to reading this volume, the reader familiarizes themselves with the concepts defined in the IHE Technical Frameworks General Introduction.

1.2 Intended Audience

The intended audience of IHE Technical Frameworks Volume 2 is:

- IT departments of healthcare institutions
- Technical staff of vendors participating in the IHE initiative
- Experts involved in standards development

1.3 Overview of Technical Framework Volume 2

Volume 2 is comprised of several distinct sections:

- Section 1 provides background and reference material.
- Section 2 presents the conventions used in this volume to define the transactions.
- Section 3 defines Radiation Oncology transactions in detail, specifying the roles for each actor, the standards employed, the information exchanged, and in some cases, implementation options for the transaction.

The appendices in Volume 2 provide clarification of technical details of the IHE data model and transactions. Code and message samples may also be stored on the IHE Google Drive. In this case, explicit links to the applicable Google Drive folder will be provided in the transaction text.

Due to the length of the document, some domains may divide Volume 2 into smaller volumes labeled 2a, 2b, etc. In this case, the Volume 2 appendices are gathered in Volume 2x.

For a brief overview of additional Technical Framework Volumes (TF-1, TF-3, TF-4), please see the IHE Technical Frameworks General Introduction, Section 5 - Structure of the IHE Technical Frameworks.

1.4 Comment Process

AAPM welcomes comments on this document and the IHE-RO initiative. They should be submitted at http://www.ihe.net/Radiation_Oncology_Public_Comments or to:

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1.5 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, Section 9 - Copyright Licenses for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE International copyrighted materials is also available there.

1.6 Trademark

IHE® and the IHE logo are trademarks of the Healthcare Information Management Systems Society in the United States and trademarks of IHE Europe in the European Community. Please refer to the IHE Technical Frameworks General Introduction, Section 10 - Trademark for information on their use.

1.7 Disclaimer Regarding Patent Rights

Attention is called to the possibility that implementation of the specifications in this document may require use of subject matter covered by patent rights. By publication of this document, no position is taken with respect to the existence or validity of any patent rights in connection therewith. IHE International is not responsible for identifying Necessary Patent Claims for which a license may be required, for conducting inquiries into the legal validity or scope of Patents Claims or determining whether any licensing terms or conditions provided in connection with submission of a Letter of Assurance, if any, or in any licensing agreements are reasonable or non-discriminatory. Users of the specifications in this document are expressly advised that determination of the validity of any patent rights, and the risk of infringement of such rights, is entirely their own responsibility. Further information about the IHE International patent disclosure process including links to forms for making disclosures is available at http://www.ihe.net/Patent_Disclosure_Process. Please address questions about the patent disclosure process to the secretary of the IHE International Board: secretary@ihe.net.

1.8 History of Document Changes

This section provides a brief summary of changes and additions to this document.

Date	Document Revision	Change Summary
2007		Initiated the IHE Radiation Oncology Technical Frameworks with the *Basic Radiation Therapy Objects* Integration Profile (BRTO).
2011	1.7	Updated the front matter sections of Volumes 1 and 2 of the IHE Radiation Oncology Technical Frameworks to be consistent with newly released domain-wide sections.
2014	1.8	Updated Volumes 1 and 2 of the IHE Radiation Oncology Technical Frameworks to include approved 2013 change proposals and technical frameworks formatting changes.
2020	2.0	Updated Volumes 1 and 2 of the IHE Radiation Oncology Technical Frameworks to include profiles voted to Final Text. Also initiated a Volume 3 to include DICOM Content Modules.
2025	3.0	Updated to align with current template and incorporated TDW-II.

2 Conventions

This document has adopted the following conventions for representing the framework concepts and specifying how the standards upon which the IHE Technical Framework is based shall be applied.

2.1 Transaction Modeling and Profiling Conventions

In order to maintain consistent documentation, modeling methods for IHE transactions and profiling conventions for frequently used standards are maintained in the IHE Technical Frameworks General Introduction, Appendix E - Standards Profiling and Documentation Conventions. Methods described include the Unified Modeling Language (UML) and standards conventions include DICOM, HL7 v2.x, HL7 Clinical Document Architecture (CDA) Documents, etc. These conventions are critical to understanding this volume and should be reviewed prior to reading this text.

2.2 Additional Standards Profiling Conventions

This section defines profiling conventions for standards which are not described in the IHE Technical Frameworks General Introduction.

2.3 Use of Coded Entities and Coding Schemes

Where applicable, coding schemes required by the DICOM®, HL7®, LOINC®, and SNOMED® standards are used in IHE Profiles. In the cases where such resources are not explicitly identified by standards, implementations may utilize any resource (including proprietary or local) provided any licensing/copyright requirements are satisfied.

IHE does produce and maintain certain terminology. OIDs and URNs have been assigned for specific uses. The IHE process for managing OIDs and URNs is described at http://wiki.ihe.net/index.php/OID_Registration.

3 IHE Transactions

This section defines each IHE transaction in detail, specifying the standards used, the information transferred, and the conditions under which the transaction is required or optional.

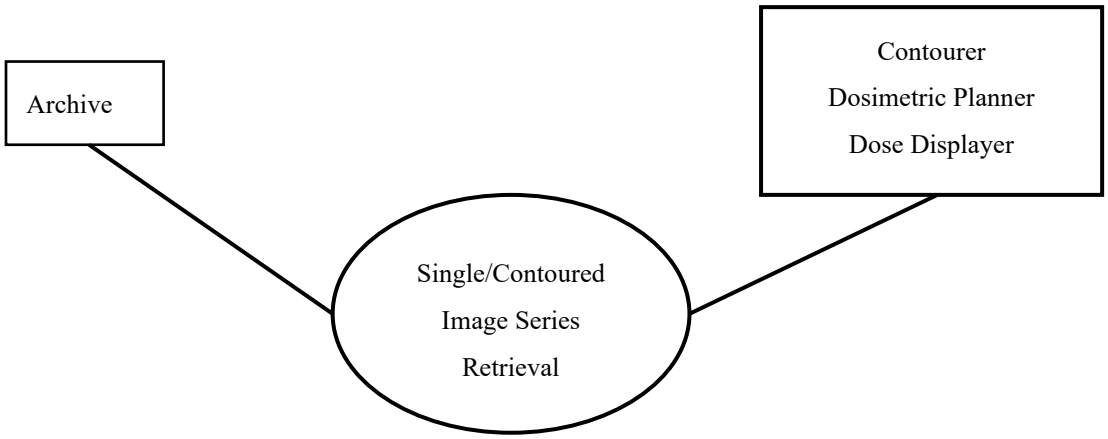
3.1 Single/Contoured Image Series Retrieval [RO-1]

This corresponds to transaction [RO-1] of the IHE Radiation Oncology Technical Framework. Transaction [RO-1] is used by the ***Archive***, ***Contourer***, ***Dosimetric Planner***, and ***Dose Displayer*** Actors.

3.1.1 Scope

This transaction is used to send a series of CT-Images from an ***Archive*** to an application.

3.1.2 Use Case Roles



Actor: Archive

Role: Send CT Series to Contourer, Dosimetric Planner or Dose Displayer

Actor: Contourer, Dosimetric Planner or Dose Displayer

Role: Receives and stores CT Series from Archive

3.1.3 Referenced Standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.1.4 Messages

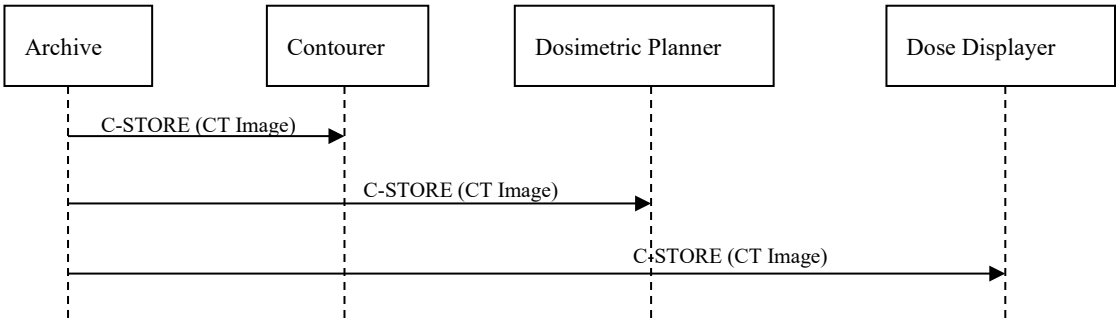


Figure 3.1.4-1: Interaction Diagram

3.1.4.1 Single/Contoured Image Series Retrieval

3.1.4.1.1 Trigger Events

The user of the ***Contourer***, in order to generate a set of contours, determines that a certain CT-Series is required, and requests that the ***Archive*** send the necessary CT-Series to the ***Contourer***.

The user of a ***Dosimetric Planner***, in order to generate a dosimetric plan and calculate dose, determines that a certain CT Series is required, and requests that the ***Archive*** send the necessary CT series to the ***Dosimetric Planner***.

The user of a ***Dose Displayer***, in order to view dose, determines that a certain CT Series is required, and requests that the ***Archive*** send the necessary CT series to the ***Dose Displayer.***

The mechanism(s) by which these transfers are initiated is outside the scope of this profile.

3.1.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the all of the CT Images in the series to the ***Contourer***, ***Dosimetric Planner*** or ***Dose Displayer***. The ***Archive*** is the DICOM Storage SCU and the ***Contourer***, ***Dosimetric Planner*** or ***Dose Displayer*** is the DICOM Storage SCP.

3.1.4.1.3 Expected Actions

The ***Contourer*** will store all of the CT Images, and will relate the images based on the study, series, and image identification information. These images will then be available to the user of the ***Contourer*** for use in construction a set of contours which will later be exported as an RT Structure Set ([RO-2]).

The ***Dosimetric Planner*** will store all of the CT Images, and will relate the images based on the study, series, and image identification information. These images will then be available to the user of the ***Dosimetric Planner*** for use in construction of a Dosimetric Plan which will later be exported ([RO-4]). These images will also be involved in the calculation of a related dose, which will be exported later as an RT Dose ([RO-BRTO-II-5]).

The ***Dose Displayer*** will store all of the CT Images, and will relate the images based on the study, series, and image identification information. These images will then be available to the user of the ***Dose Displayer*** for use in construction of a dose display.

3.1.5 Security Considerations

There are no explicit security considerations.

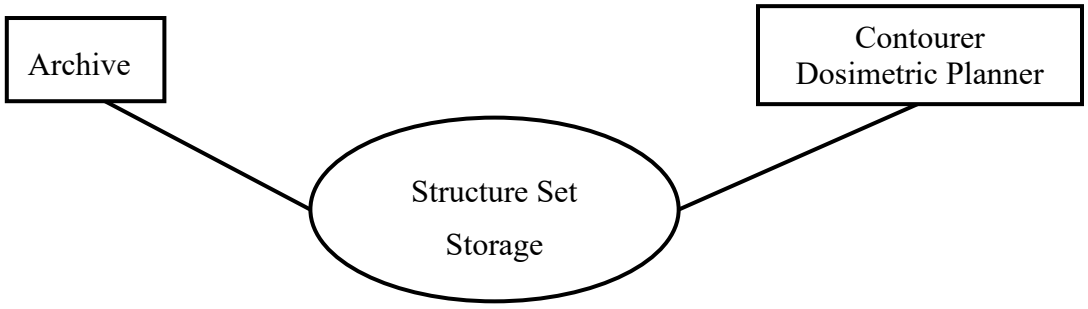
3.2 Structure Set Storage [RO-2]

This corresponds to transaction [RO-2] of the IHE Radiation Oncology Technical Framework. Transaction [RO-2] is used by the ***Archive*** and ***Contourer*** Actors.

3.2.1 Scope

In the Structure Set Storage Transaction, the ***Contourer*** stores an RT Structure Set on an ***Archive*** to make it available.

3.2.2 Use Case Roles



Actor: Contourer, Dosimetric Planner

Role: Sends RT Structure Set to Archive

Actor: Archive

Role: Stores RT Structure Set received from Contourer or Dosimetric Planner

3.2.3 Referenced Standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.2.4 Messages

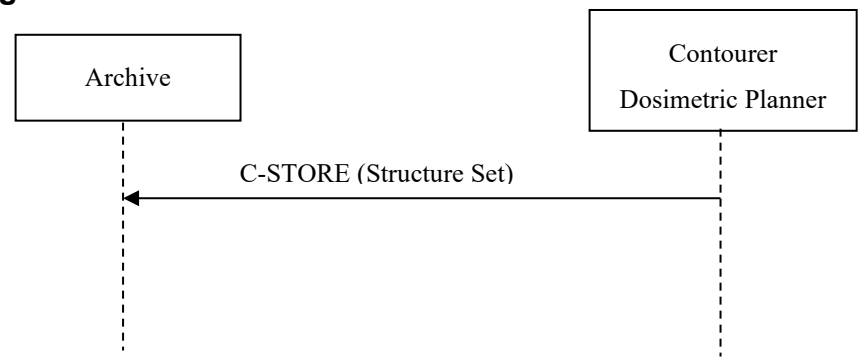


Figure 3.2.4-1: Interaction Diagram

3.2.4.1 Structure Set Storage

3.2.4.1.1 Trigger Events

The user of the ***Contourer*** selects an RT Structure Set to store.

3.2.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Contourer*** or ***Dosimetric Planner*** is the storage SCU and the ***Archive*** is the storage SCP.

The Contours in the ROI Contour module are restricted to Geometric Type POINT and CLOSED_PLANAR. ROI contours must correspond to exported image plane locations. If a system does not support unequally-spaced slices, for example, that system is responsible for creating a resampled image set (see [RO-11]) and creating an RT Structure Set in which the ROI contours reference the resampled image set. Furthermore, absence of an ROI contour on slice(s) between those containing contours of that ROI does not imply the existence of the ROI on the intervening slice(s).

Also refer to RO TF-3: 7.3.4.1.1 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set instance. In particular, the RT Structure Set must share a single Frame of Reference UID with the images.

3.2.4.1.3 Expected Actions

Upon receipt of the Structure Set, the ***Archive*** shall store it. This RT Structure Set is then available for subsequent retrieval ([RO-7]).

3.2.5 Security Considerations

There are no explicit security considerations.

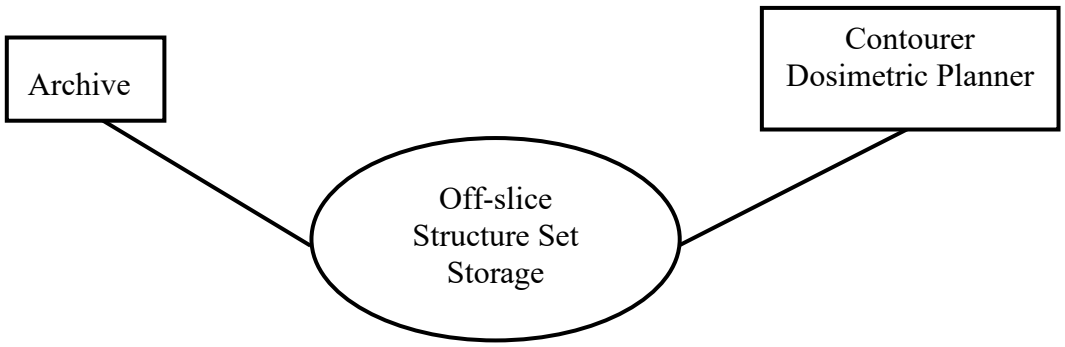
3.3 Off-slice Structure Set Storage [RO-BRTO-II-1]

This corresponds to transaction [RO-BRTO-II-1] of the IHE Radiation Oncology Technical Framework. Transaction [RO-BRTO-II-1] is used by the *Archive* and *Contourer* Actors.

3.3.1 Scope

In the Off-slice Structure Set Storage Transaction, the *Contourer* stores an RT Structure Set on an *Archive* to make it available.

3.3.2 Use Case Roles



Actor: Contourer, Dosimetric Planner

Role: Sends off-slice RT Structure Set to Archive

Actor: Archive

Role: Stores off- slice RT Structure Set received from Contourer

3.3.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.3.4 Messages

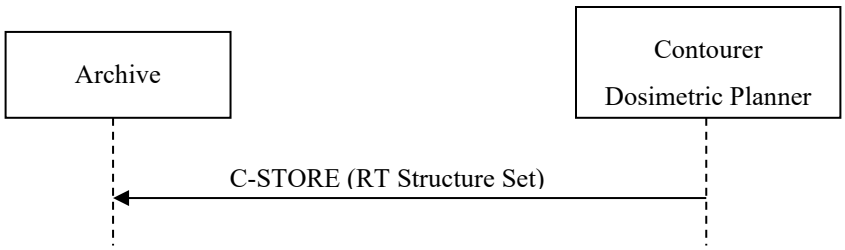


Figure 3.3.4-1: Interaction Diagram

3.3.4.1 Structure Set Storage

3.3.4.1.1 Trigger Events

The user of the ***Contourer*** selects an RT Structure Set to store.

3.3.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Contourer*** or the ***Dosimetric Planner*** is the storage SCU and the ***Archive*** is the storage SCP.

The Contours in the ROI Contour module are restricted to Geometric Type POINT and CLOSED_PLANAR. If a ROI Contour contains off-slice information, the Contour Number (3006,0048) and the Attached Contours (3006,0049) attributes must be present for all Contour Sequence items (3006,0040) of this ROI. For Contour Sequence items that are not referencing any other Contour Sequence items, the Attached Contours (3006,0049) shall be present but empty. The Attached Contours (3006,0049) shall reference the nearest, directly connected contours with a lower Contour Number (3006,0048).

Note that any two non-disjoint contours will be connected by a path on the undirected graph defined by Attached Contour references. If the ROI is intersected by an image plane, there has to be a contour on that plane. All contours shall be parallel to the image plane. The distance between off-slice contours may vary.

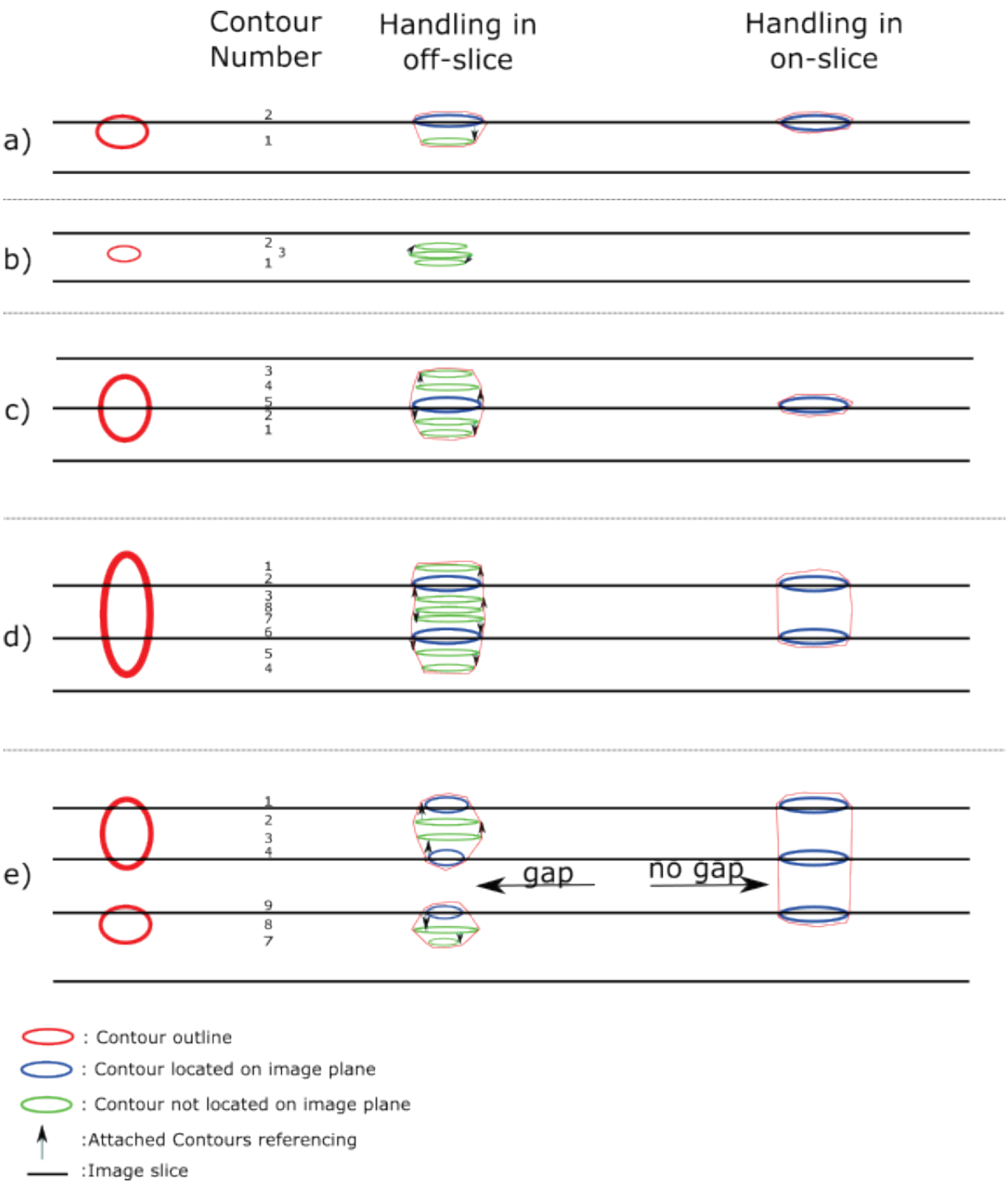


Figure 3.3.4.1.2-1: Overview handling in off-slice and on-slice option

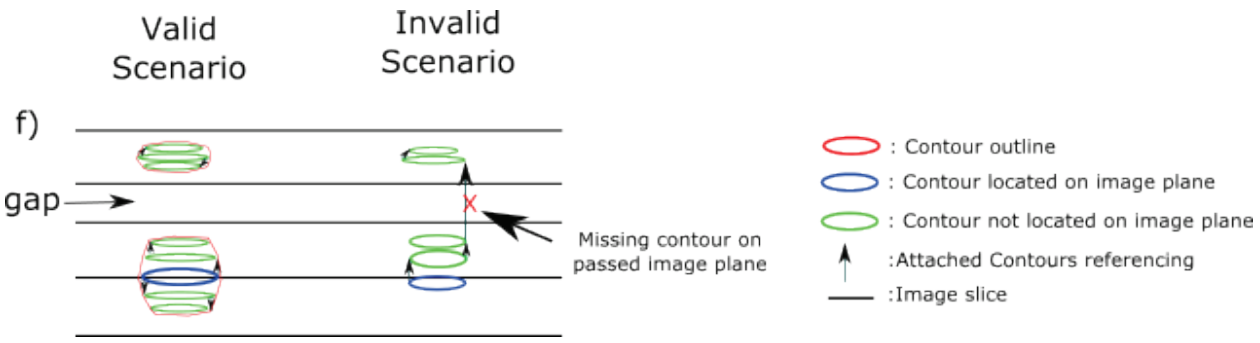


Figure 3.3.4.1.2-2: Invalid scenario off-slice contours

Figure 3.3.4.1.2-1 shows examples of off-slice contours with and without support of the off-slice option. Examples a) and c) show how to add a small caps to an object by adding an attached contour to the contour on the image slice. Example b) illustrates a very small object between two image slices which will only be shown in applications capable of off-slice handling. Examples c) and d) show that the order of contour number doesn't have to be continuous as long as the requirement of the Attached Contours (3006,0049) is fulfilled. An object having a gap is shown in example e). It can be created in off-slice handling by not connecting the contour with the Contour Number (3006,0048) 9 to the contour with the Contour Number (3006,0048) 4 as shown in example e). In on-slice handling it is not possible to properly encode this gap.

Figure 3.3.4.1.2-2 illustrates an invalid scenario in off-slice handling on the right side. Two contours that are not located on image slices shall be connected but the image slices that are intersected between those off-slice contours do not contain a contour definition. To correct this, additional contour definitions have to be done on these two image planes. If the invalid connecting Attached Contour is removed the definition would be correct too, but then it would represent a gap in off-slice handling (left side in example f).

Also refer to RO TF-3: 7.3.4.1.1 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set instance and refer to RO TF-3: 7.4.8.2.2 for the off-slice specific requirements for the RT ROI Contour Module. In particular, the RT Structure Set must share a single Frame of Reference UID with the images.

3.3.4.1.3 Expected Actions

Upon receipt of the RT Structure Set, the ***Archive*** shall store it. This RT Structure Set is then available for subsequent retrieval ([RO-BRTO-II-2]).

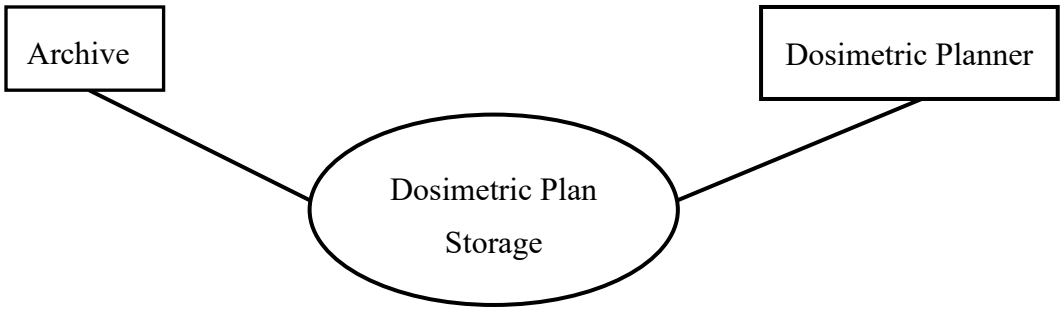
3.4 Dosimetric Plan Storage [RO-4]

This section corresponds to transaction [RO-4] of the IHE-RO Technical Framework. Transaction [RO-4] is used by the ***Archive*** and ***Dosimetric Planner*** Actors.

3.4.1 Scope

In this transaction, the ***Dosimetric Planner*** sends the plan containing the references to the RT Structure Set to the ***Archive***.

3.4.2 Use Case Roles



Actor: Dosimetric Planner

Role: Transmit generated RT Plan to Archive.

Actor: Archive

Role: Accept and store RT Plan from Dosimetric Planner.

3.4.3 Referenced Standards

DICOM 2018d Edition, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.4.4 Messages

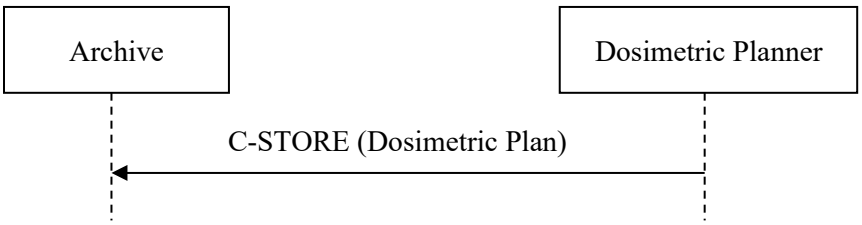


Figure 3.4.4-1: Interaction Diagram

3.4.4.1 Dosimetric Plan Storage

3.4.1.1.1 Trigger Events

The ***Dosimetric Planner*** transfers the ***Dosimetric Plan*** to the ***Archive***, once the dose calculation is finished.

3.4.1.1.2 Message Semantics

The ***Dosimetric Planner*** uses the DICOM C-STORE message to transfer the plan. The ***Dosimetric Planner*** is the DICOM Storage SCU and the ***Archive*** is the DICOM Storage SCP.

The ***Dosimetric Planner*** may create a new series containing the RT Plan or may use an existing series, where previous RT Plan(s) are contained.

The study where the series of the RT Plan is contained shall be the same study as the one containing the RT Structure Set referenced in the RT Plan.

The purpose of the Dosimetric Plan transferred is to convey the reference to the RT Structure Set, which has been used in definition of the plan and which contains the references to the CT Images used for plan calculation. The ***Dose Displayer*** will use this sequence to retrieve the RT Structure Set and the CT images referenced in the RT Structure Set for display.

The IHE-RO extension of the DICOM requirements for the RT General Plan module can be found in RO TF-3: 7.4.3.1.1 and for the General Equipment module in RO TF-3: 7.4.1.5.1.

The Dosimetric Plan shall not contain an RT Brachy Application Setup module.

The Dosimetric Plan may have zero beams, i.e., it may lack an RT Beams module. This is to support teletherapy plans that do not match the traditional isocentric model.

Applications should display RT Plan Label, RT Plan Date and RT Plan Time in order to safely identify matching RT Dose and RT Plan pairs.

3.4.5 Security Considerations

There are no explicit security considerations.

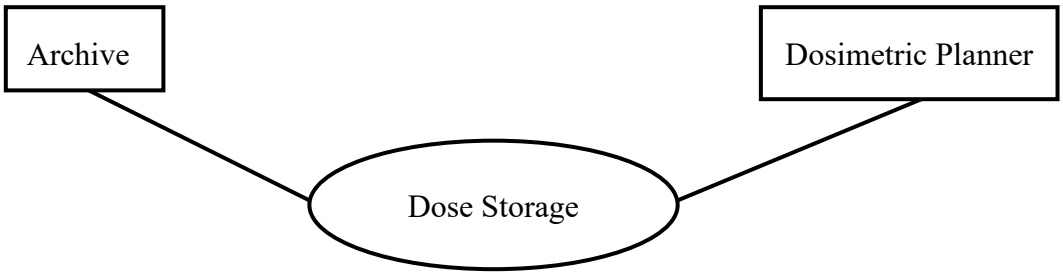
3.5 Dose Storage [RO-BRTO-II-5]

This corresponds to [RO-BRTO-II-5] of the IHE-RO Technical Framework. Transaction [RO-BRTO-II-5] is used by the ***Archive*** and ***Dosimetric Planner*** Actors.

3.5.1 Scope

In the Dose Storage transaction, the ***Dose planner*** sends the newly created Dose to the ***Archive***.

3.5.2 Use Case Roles



Actor: Dosimetric Planner

Role: Transmit generated Dose to the Archive

Actor: Archive

Role: Receives and stores Doses from the Dosimetric Planner

3.5.3 Referenced Standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.5.4 Messages

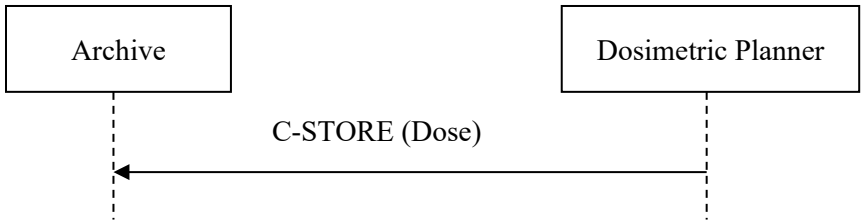


Figure 3.5.4-1: Interaction Diagram

3.5.4.1 Dose Storage

3.5.4.1.1 Trigger Events

The ***Dosimetric Planner*** transfers the Dose to the ***Archive*** within a DICOM association.

3.5.4.1.2 Message Semantics

The ***Dosimetric Planner*** uses the DICOM C-STORE command to transfer the Dose. The ***Dosimetric Planner*** is the DICOM Storage SCU and the ***Archive*** is the DICOM Storage SCP.

Also refer to RO TF-3: 7.3.5.1.1 for an overview of Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

3.5.4.1.3 Representation of Dose

This transaction shall support dose represented as a three-dimensional dose array sampled onto transverse image planes in the same DICOM Patient coordinate system Frame of Reference as the diagnostic images used to compute it. The dose image shall be orthogonal with respect to the DICOM patient coordinate system.

Not supported are point doses, projection of dose onto an oblique plane and isodose contours. The dose pixels shall represent absolute physical dose in units of Gray. The value of Dose Units (3004,0002) shall be GY. The value of Pixel Representation (0028,0103) shall be 0; negative dose values shall not be present.

3.5.4.1.4 Expected Actions

The ***Archive*** will store the received Dose.

The DICOM RT Dose object will be stored such that it can be later retrieved (see Dose Retrieval [RO-BRTO-II-6]) in a fashion meeting the requirements defined for a DICOM level 2 SCP (refer to DICOM PS 3.4 B.4.1).

3.5.5 Security Considerations

There are no explicit security considerations.

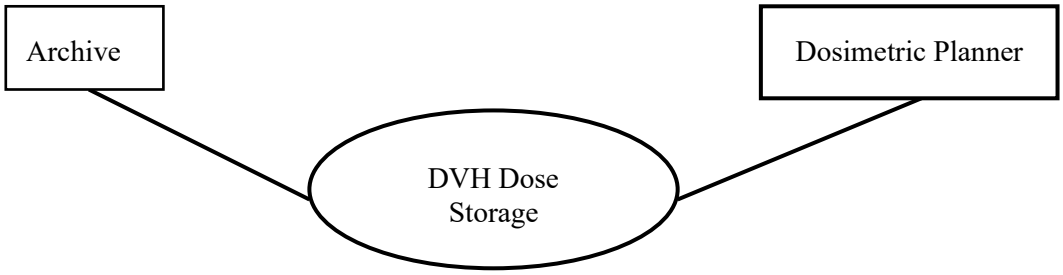
3.6 DVH Dose Storage [RO-BRTO-II-3]

This corresponds to [RO-BRTO-II-3] of the IHE-RO Technical Framework. Transaction [RO-BRTO-II-3] is used by the ***Archive, Dosimetric Planner and Dose Displayer*** Actors.

3.6.1 Scope

In the DVH Dose Storage transaction, the ***Dose Planner*** sends the newly created DVH to the ***Archive***.

3.6.2 Use Case Roles



Actor: Dosimetric Planner

Role: Transmit generated DVH Dose to the Archive

Actor: Archive

Role: Receives and stores DVH Doses from the Dosimetric Planner

3.6.3 Referenced Standard

DICOM 2018d Edition PS3.4: Storage Service Class.

3.6.4 Messages

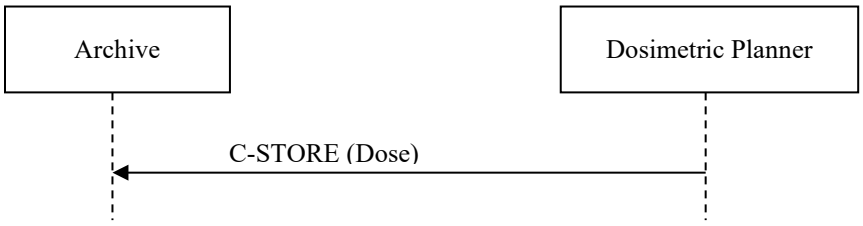


Figure 3.6.4-1: Interaction Diagram

3.6.4.1 DVH Dose Storage

3.6.4.1.1 Trigger Events

The ***Dosimetric Planner*** transfers the DVH Dose to the ***Archive*** within a DICOM association.

3.6.4.1.2 Message Semantics

The ***Dosimetric Planner*** uses the DICOM C-STORE command to transfer the DVH Dose. The ***Dosimetric Planner*** is the DICOM Storage SCU and the ***Archive*** is the DICOM Storage SCP.

Also refer to RO TF-3: 7.3.5.1.1 and RO TF-3: 7.4.13.4.1 for an overview of DVH Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

3.6.4.1.3 Expected Actions

The ***Archive*** will store the received DVH Dose.

The DICOM RT Dose object will be stored such that it can be later retrieved (see DVH Dose Retrieval [RO-BRTO-II-4]) in a fashion meeting the requirements defined for a DICOM level 2 SCP (Refer to DICOM PS 3.4 B.4.1). The DVH content may be stored in the same RT Dose instance as the volumetric dose grid, or may be stored in a separate RT Dose instance, containing only the DVH content.

3.6.5 Security Considerations

There are no explicit security considerations.

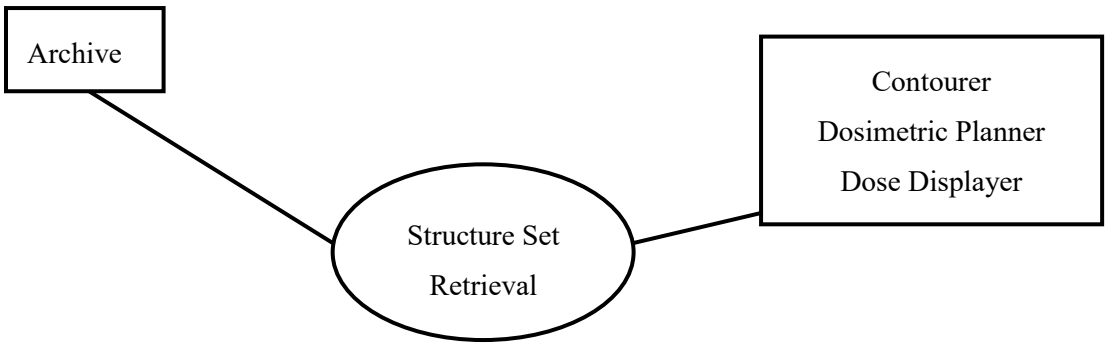
3.7 Structure Set Retrieval [RO-7]

This corresponds to [RO-7] of the IHE-RO Technical Framework. Transaction [RO-7] is used by the ***Archive, Contourer, Dosimetric Planner, and Dose Displayer*** Actors.

3.7.1 Scope

In the Structure Set Retrieval Transaction, the ***Archive*** stores an RT Structure Set on a ***Contourer***, ***Dosimetric Planner***, or ***Dose Displayer***.

3.7.2 Use Case Roles



Actor: Archive

Role: Sends RT Structure Set to Contourer, Dosimetric Planner, or Dose Displayer

Actor: Contourer, Dosimetric Planner, or Dose Displayer

Role: Stores RT Structure Set received from Archive

3.7.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.7.4 Messages

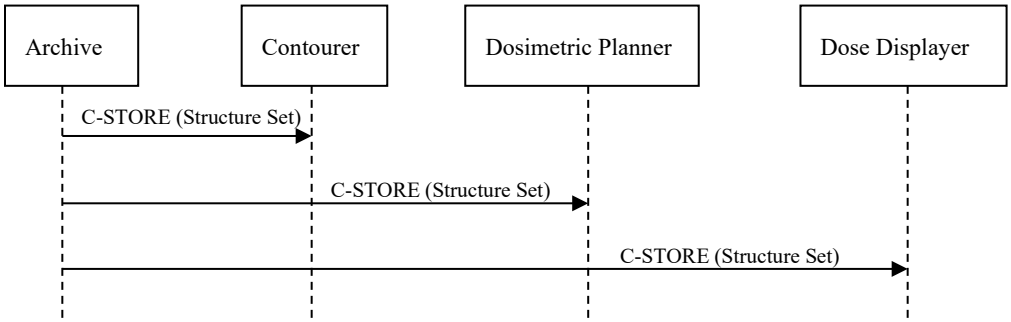


Figure 3.7.4-1: Interaction Diagram

3.7.4.1 Structure Set Retrieval

3.7.4.1.1 Trigger Events

The user of the ***Contourer*** determines that a new set of contours is to be based upon an existing RT Structure Set and requests that the ***Archive*** send this Structure Set to the ***Contourer***.

The user of the ***Dosimetric Planner*** determines that a new Dosimetric Plan is to be based upon an existing RT Structure Set and requests that the ***Archive*** send this RT Structure Set to the ***Dosimetric Planner***.

The user of the ***Dose Displayer*** determines that a dose display is to be based upon an existing Structure Set and requests that the ***Archive*** send this Structure Set to the ***Dose Displayer***.

The mechanism(s) by which these transfers are initiated is outside the scope of this profile.

3.7.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Contourer***, ***Dosimetric Planner***, or ***Dose Displayer*** is the storage SCP and the ***Archive*** is the storage SCU.

Also refer to RO TF-3: 7.3.4.1.1 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set object.

3.7.4.1.3 Expected Actions

The ***Contourer*** will store all of the RT Structure Set, and will relate it to images based on the study, series, and image identification information. The contours contained will then be available to the user of the ***Contourer*** for use in construction a new set of contours which will later be exported as a structure set ([RO-2]). This new RT Structure Set will have the same Frame of

Reference UID and Study Instance UID of the original images and structure set. It may have the same Series Instance UID as the original RT Structure Set.

The ***Dosimetric Planner*** will store the RT Structure Set, and will relate it to images based on the study, series, and image identification information. These contours contained in this RT Structure Set will then be available to the user of the ***Dosimetric Planner*** for use in construction of a Dosimetric Plan which will later be exported ([RO-4]). These images will also be involved in the calculation of a related dose, which will be exported later as an RT Dose ([RO-BRTO-II-5]).

The ***Dose Displayer*** will store the RT Structure Set, and will relate it to images based on the study, series, and image identification information. These contours contained in this RT Structure Set will then be available to the user of the ***Dose Displayer*** for display in relation to images, doses in the same Frame of Reference.

If the stored RT Structure Set contains off-slice information ([RO-BRTO-II-2]) and the ***Contourer***, ***Dosimetric Planner*** or ***Dose Displayer*** does not support this, the consuming actor has to handle it safely.

3.7.5 Security Considerations

There are no explicit security considerations.

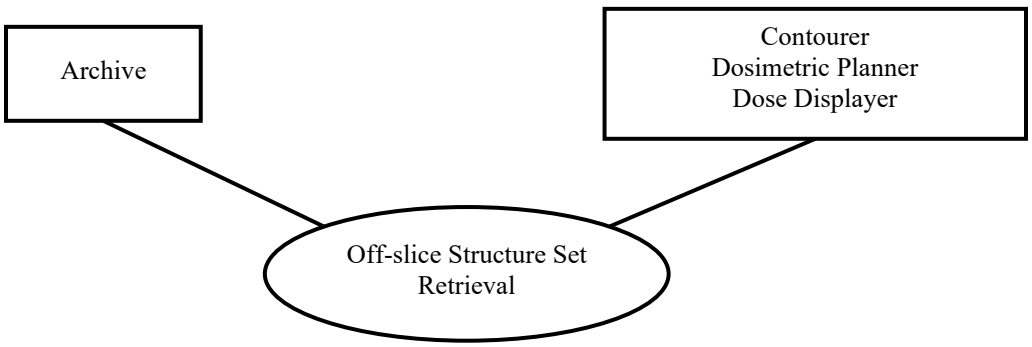
3.8 Off-slice Structure Set Retrieval [RO-BRTO-II-2]

This corresponds to [RO-BRTO-II-2] of the IHE-RO Technical Framework. Transaction [RO-BRTO-II-2] is used by the ***Archive***, ***Contourer***, ***Dosimetric Planner***, *and* ***Dose Displayer*** Actors.

3.8.1 Scope

In the Off-slice Structure Set Retrieval Transaction, the Archive stores a Structure Set on a Contourer, Dosimetric Planner, or Dose Displayer.

3.8.2 Use Case Roles



Actor: Archive

Role: Sends off-slice RT Structure Set to Contourer, Dosimetric Planner or Dose Displayer

Actor: Contourer, Dosimetric Planner or Dose Displayer

Role: Stores off-slice RT Structure Set received from Archive

3.8.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.8.4 Messages

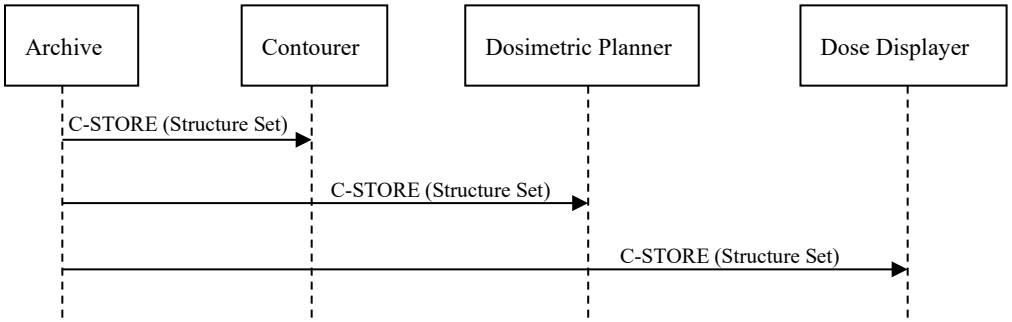


Figure 3.8.4-1: Interaction Diagram

3.8.4.1 Off-Slice Structure Set Retrieval

3.8.4.1.1 Trigger Events

The user of the ***Contourer*** determines that a new set off-slice contours is to be based upon an existing Structure Set and requests that the ***Archive*** send this Structure Set to the ***Contourer***.

The user of the ***Dosimetric Planner*** determines that a new dosimetric plan is to be based upon an existing Structure Set requests that the ***Archive*** send this Structure Set to the ***Dosimetric Planner***.

The user of the ***Dose Displayer*** determines that a dose display is to be based upon an existing Structure Set and requests that the ***Archive*** send this Structure Set to the ***Dose Displayer***.

The mechanism(s) by which these transfers are initiated is outside the scope of this profile.

3.8.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Contourer***, ***Dosimetric Planner***, or ***Dose Displayer*** is the storage SCP and the ***Archive*** is the storage SCU.

Also refer to RO TF-3: 7.3.4.1.1 and RO TF-3: 7.4.8.2.2 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set instance. Additionally, the attributes mentioned in RO TF-3: 7.4.8.2.2 have to be present according to their requirements.

3.8.4.1.3 Expected Actions

The receiving actor will receive the RT Structure Set, and will relate it to the referenced image instances. Contours not located on image slices will be arranged according to referenced contour

number in the Attached Contours (3006,0049). The contours contained will then be available to the user of the receiving actor.

The off-slice display has to be able to show the additional off-slice features (e.g., gaps).

3.8.5 Security Considerations

There are no explicit security considerations.

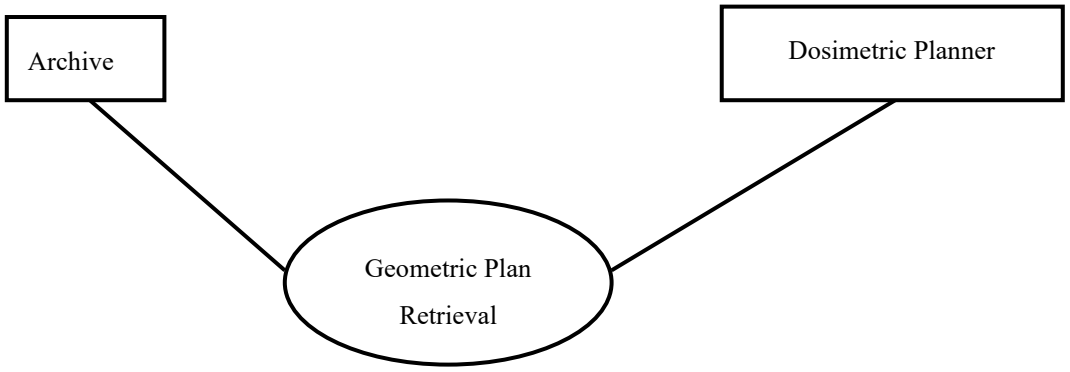
3.9 Geometric Plan Retrieval [RO-8]

This corresponds to [RO-8] of the IHE-RO Technical Framework. Transaction [RO-8] is used by the ***Archive*** and ***Dosimetric Planner*** Actors.

3.9.1 Scope

In the Geometric Plan Retrieval Transaction, the requested Geometric Plan is transferred from the ***Archive*** to the ***Dosimetric Planner***.

3.9.2 Use Case Roles



Actor: Dosimetric Planner

Role: Receives requested Geometric Plan from the Archive

Actor: Archive

Role: Sends requested Geometric Plan instance to the Dosimetric Planner

3.9.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.9.4 Messages

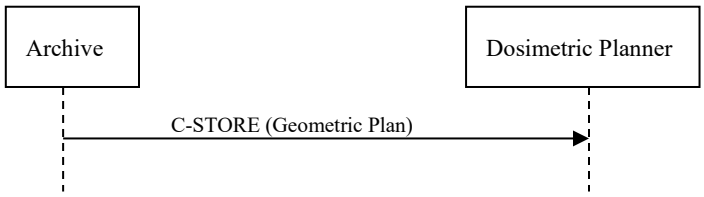


Figure 3.9.4-1: Interaction Diagram

3.9.4.1 Geometric Plan Retrieval

3.9.4.1.1 Trigger Events

The user of the ***Dosimetric Planner*** selects a Geometric Plan for completion of the plan and dose calculation.

3.9.4.1.2 Message Semantics

The plan shall be sent from the ***Archive*** to the ***Dosimetric Planner***. Also refer to Section RO TF-3: 7.3.2.2.5 for an overview of Geometric Plan specific requirements on the DICOM attributes that are included in an RT Plan object.

3.9.4.1.3 Expected Actions

The ***Archive*** shall return the requested Geometric Plan to the ***Dosimetric Planner***. The ***Dosimetric Planner*** shall validate the received Geometric Plan. In cases where the received Geometric Plan is valid, it shall be loaded into the ***Dosimetric Planner***. In cases where it is not valid, a warning message shall be displayed to the user, indicating the reason why it is not valid.

3.9.5 Security Considerations

There are no explicit security considerations.

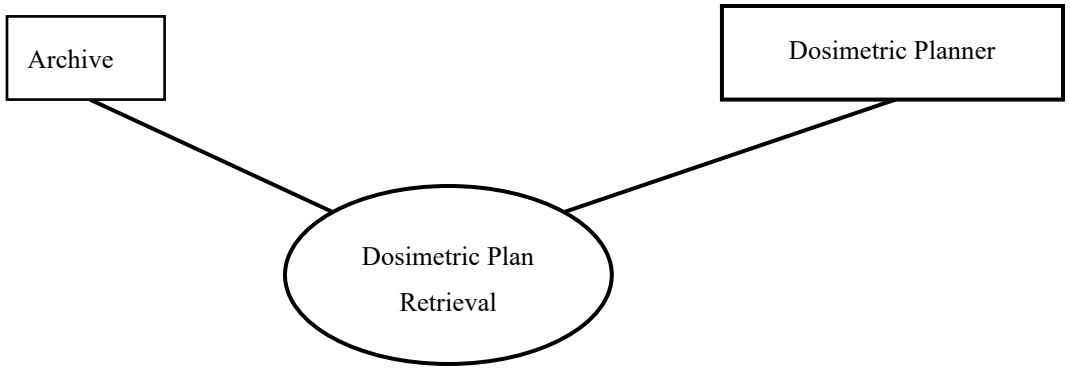
3.10 Dosimetric Plan Retrieval [RO-9]

This corresponds to [RO-9] of the IHE-RO Technical Framework. Transaction [RO-9] is used by the ***Archive*** and ***Dose Displayer*** Actors.

3.10.1 Scope

In this transaction, the ***Dose Displayer*** retrieves the plan containing the references to the structure set from the ***Archive***.

3.10.2 Use Case Roles



Actor: Dose Displayer

Role: Accepts plan from Archive.

Actor: Archive

Role: Transmits plan to Dose Viewer.

3.10.3 Referenced Standards

DICOM 2018d Edition, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.10.4 Messages

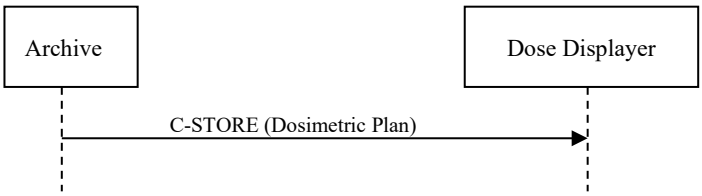


Figure 3.10.4-1: Interaction Diagram

3.10.4.1 Dosimetric Plan Retrieval

3.10.4.1.1Trigger Events

The ***Archive*** transfers the Dosimetric Plan to the ***Dose Displayer***. This action is initiated by the user in advance of the dose viewing session.

3.10.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the plan. The ***Archive*** is the DICOM Storage SCU and the ***Dose Displayer*** is the DICOM Storage SCP.

Also refer to RO TF-3: 7.3.2.2.1 and RO TF-3: 7.3.2.2.4 for an overview of the RT Plan specific requirements on the DICOM attributes that are included in a Dosimetric Plan.

3.10.5 Security Considerations

There are no explicit security considerations.

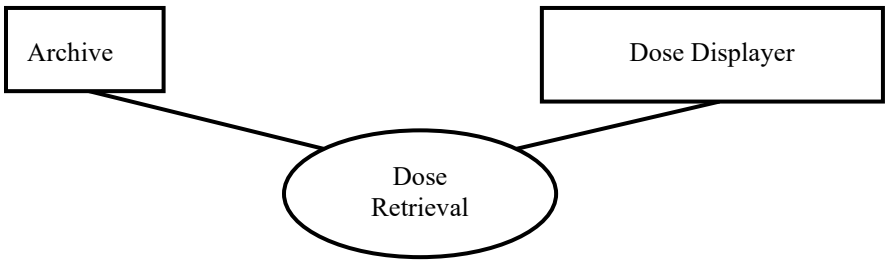
3.11 Dose Retrieval [RO-BRTO-II-6]

This corresponds to [RO-BRTO-II-6] of the IHE-RO Technical Framework. Transaction [RO-BRTO-II-6] is used by the ***Archive*** and ***Dose Displayer*** Actors.

3.11.1 Scope

In the Dose Retrieval Transaction, the requested Dose is transferred from the ***Archive*** to the ***Dose Displayer***.

3.11.2 Use Case Roles



Actor: Dose Displayer

Role: Receives requested Dose from the Archive

Actor: Archive

Role: Sends requested Dose instance to the Dose Displayer

3.11.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.11.4 Messages

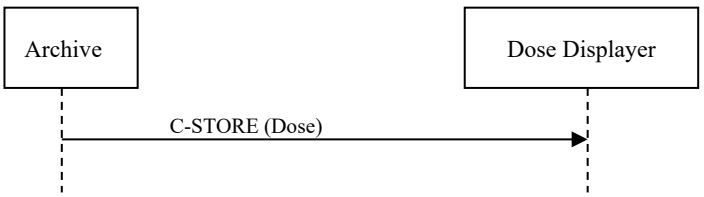


Figure 3.11.4-1: Interaction Diagram

3.11.4.1 Dose Retrieval

3.11.4.1.1 Trigger Events

The user of the ***Dose Displayer*** selects a Dose for display in the context of a particular CT Image Set and the targets and avoidance structures defined by an RT Structure Set.

3.11.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the dose. The ***Archive*** is the DICOM Storage SCU and the ***Dose Displayer*** is the DICOM Storage SCP.

Also refer to RO TF-3: 7.3.5.1.1 for an overview of Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

3.11.4.1.3 Representation of Dose

This transaction shall support Dose represented as a three-dimensional dose array sampled onto transverse image planes in the same DICOM Patient coordinate system Frame of Reference as the diagnostic images used to compute it. The dose image shall be orthogonal with respect to the DICOM patient coordinate system. The dose planes shall have equidistant spacing with allowed tolerance of 0.01mm.

Not supported are point doses, projection of dose onto an oblique plane and isodose contours. The dose pixels shall represent absolute physical dose in units of Gray. The value of Dose Units (3004,0002) shall be GY. The value of Pixel Representation (0028,0103) shall be 0; negative dose values shall not be present.

3.11.4.1.4 Expected Actions

Upon receiving the request for retrieval, the ***Archive*** shall return the requested Dose to the ***Dose Displayer***.

3.11.5 Security Considerations

There are no explicit security considerations.

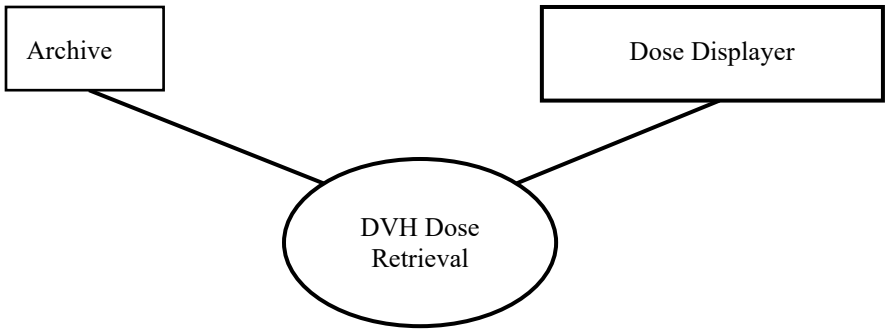
3.12 DVH Dose Retrieval [RO-BRTO-II-4]

In the DVH Dose Retrieval Transaction, the requested DVH Dose is transferred from the ***Archive*** to the ***Dose Displayer***.

3.12.1 Scope

In the DVH Dose Retrieval Transaction, the requested DVH Dose is transferred from the ***Archive*** to the ***Dose Displayer***.

3.12.2 Use Case Roles



Actor: Dose Displayer

Role: Receives requested DVH Dose from the Archive

Actor: Archive

Role: Sends requested DVH Dose instance to the Dose Displayer

3.12.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.12.4 Messages

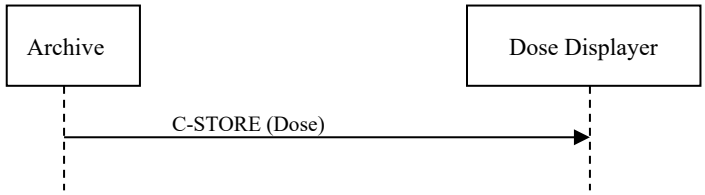


Figure 3.12.4-1: Interaction Diagram

3.12.4.1 DVH Dose Retrieval

3.12.4.1.1 Trigger Events

The user of the ***Dose Displayer*** selects a DVH Dose for display in the context of a particular dose distribution defined by itself or another RT Dose and the targets and avoidance structures defined by an RT Structure Set.

3.12.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the dose. The ***Archive*** is the DICOM Storage SCU and the ***Dose Displayer*** is the DICOM Storage SCP.

Also refer to RO TF-3: 7.3.5.1.1 and RO TF-3: 7.4.13.4.1 for an overview of DVH Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

The DVH content may be stored in the same RT Dose instance as the volumetric dose grid, or may be stored in a separate RT Dose instance, containing only the DVH content.

3.12.4.1.4 Expected Actions

Upon receiving the request for retrieval, the ***Archive*** shall return the requested DVH Dose to the ***Dose Displayer***.

3.12.5 Security Considerations

There are no explicit security considerations.

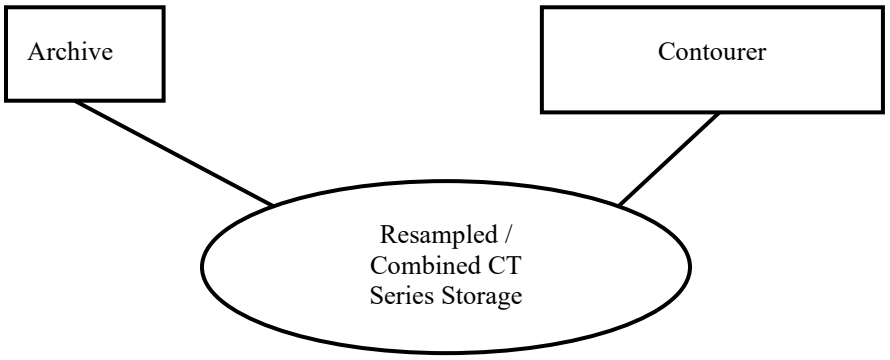
3.13 Resampled/Combined CT Series Storage[RO-11]

This corresponds to [RO-11] of the IHE-RO Technical Framework. Transaction [RO-11] is used by the ***Archive*** and ***Contourer*** Actors.

3.13.1 Scope

In the Resampled/Combined CT Series Storage Transaction, the ***Contourer*** stores CT Images which have been combined or resampled into a single series on the ***Archive***.

3.13.2 Use Case Roles



Actor: Contourer

Role: Sends CT Images to the Archive

Actor: Archive

Role: Stores CT Images received from Contourer

3.13.3 Referenced standards

DICOM 2018d Edition PS3.4: Storage Service Class.

3.13.4 Messages

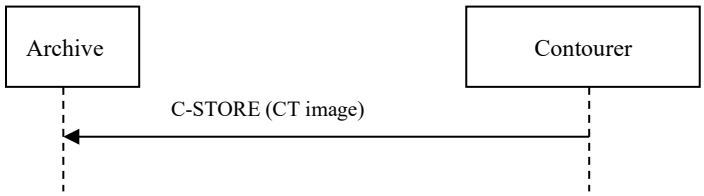


Figure 3.13.4-1: Interaction Diagram

3.13.4.1 Resampled/Combined CT Series Storage

3.13.4.1.1 Trigger Events

The ***Contourer*** has constructed a new CT Series. It has either combined CT Images from multiple series or has resampled CT Images from a single series to yield a more desirable slice spacing. The ***Contourer*** must export a single CT image series including all images on which Structure Set contours are defined. This new series must be stored on the ***Archive*** to make the images available for subsequent planning or review. This transaction must be performed prior to storage of a structure set ([RO-2]) which is based upon this new series.

3.13.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Archive*** is the SCP of this service class, and the ***Contourer*** is the SCU of this service Class.

Also refer to RO TF-3: 7.3.3.2.3 for an overview of the specific requirements on the DICOM attributes that are included in a CT Image object. In particular, these CT Images are required to share a study instance UID, and a frame of reference UID, and a series instance UID.

3.13.4.1.3 Expected Actions

Upon receiving the CT Series, the ***Archive*** will store the images, and will make this series available for subsequent retrieval ([RO-1]).

3.13.5 Security Considerations

There are no explicit security considerations.

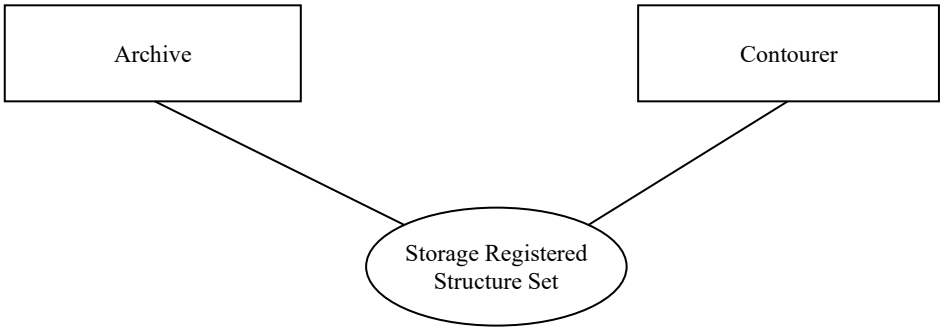
3.14 Registered Structure Set Storage [RO-MMRO-1]

This section corresponds to Transaction [RO-MMRO-1] of the IHE-RO Technical Framework. Transaction [RO-MMRO-1] is used by the ***Registered Contourer*** and ***Archive*** Actors.

3.14.1 Scope

In the Registered Structure Set Storage Transaction, the Registered Contourer stores a Structure Set on an Archive to make it available.

3.14.2 Use Case Roles



Actor:	Archive
Role:	Receive and store a Structure Set instance from the Registered Contourer
Actor:	Registered Contourer
Role:	Send a Structure Set instance for storage

3.14.3 Referenced standards

DICOM 2018d PS3.4: Storage Service Class

DICOM 2018d PS 3.4: RT Structure Set Storage

3.14.4 Messages

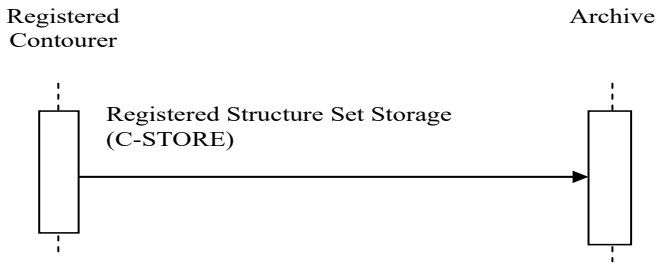


Figure 3.14.4-1: Interaction Diagram

3.14.4.1 Registered Structure Set Storage

3.14.4.1.1 Trigger Events

The user of the Registered Contourer selects a one or more Structure Sets to store.

3.14.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The Registered Contourer is the storage SCU and the Archive is the storage SCP.

The Contours in the ROI Contour module are restricted to Geometric Type POINT and CLOSED_PLANAR. ROI contours must correspond to exported image plane locations. If a system does not support unequally-spaced slices, for example, that system is responsible for creating a resampled image set (see [RO-11]) and creating a structure set in which the ROI contours reference the resampled image set. Absence of an ROI contour on a slice between slices on which contours are defined implies that the ROI does not intersect that slice.

An RT Structure Set object generated by a Registered Contourer will reference images from a single series and share the Frame of Reference UID of that series. It is implied that the coordinates in that object will exist in the coordinate system identified by the FoR UID. Finally, contours will exist on the same plane as the referenced image slices.

To make ROI's available to the downstream planning process or to the 2018 Basic RT Objects Interoperability II Profile's Contourer Actor, the Registrator Actor shall be able not only to transform contours from a source Frame of Reference to the Registered Frame of Reference, but also to resample the contour to the planes of the images referenced in the RT Structure Set which corresponds to the Registered Frame of Reference.

The set of contours transmitted in an RT Structure Set must not assume interpolation of contours across image slices. Absence of an ROI contour on a slice between slices on which contours are defined implies that the ROI does not intersect that slice.

The MMRO Profile has implicit limitations imposed by its dependency on the IHE-RO BRTO Profile. These limitations are described in the MMRO Profile description in Volume 1 of the IHE-RO Technical Frameworks.

Also refer to RO TF-3: 7.3.4.1.2 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set object. In particular, the structure set must share a single frame of reference UID with the images.

3.14.4.1.3 Expected Actions

Upon receipt of the Structure Set, the Archive shall store it. This Structure Set is then available for subsequent retrieval (RO-7 and MMRO-4).

3.14.5 Expected Actions

There are no explicit considerations.

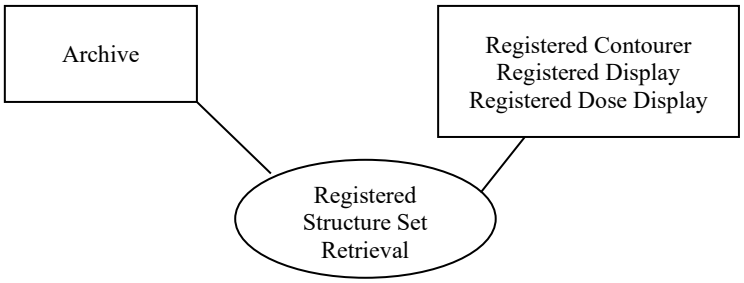
3.15 Registered Structure Set Retrieval [RO-MMRO-2]

This section corresponds to Transaction [RO-MMRO-2] of the IHE-RO Technical ***Framework. Transaction*** [RO-MMRO-2] ***is used by the Registered Contourer, Registered Display, Registered Dose Display***, and ***Archive*** Actors.

3.15.1 Scope

In the Registered Structure Set Retrieval Transaction, the ***Archive*** stores a Structure Set on a ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display***.

3.15.2 Use Case Roles



Actor:	Archive
Role:	Send Registered Structure Set instance(s) to the receiving actor
Actor:	Registered Contourer, Registered Display, Registered Dose Display
Role:	Receive Registered Structure Set instances from the Archive

3.15.3 Referenced standards

DICOM 2018d PS3.4: Storage Service Class

DICOM 2018d PS 3.4: RT Structure Set Storage

3.15.4 Messages

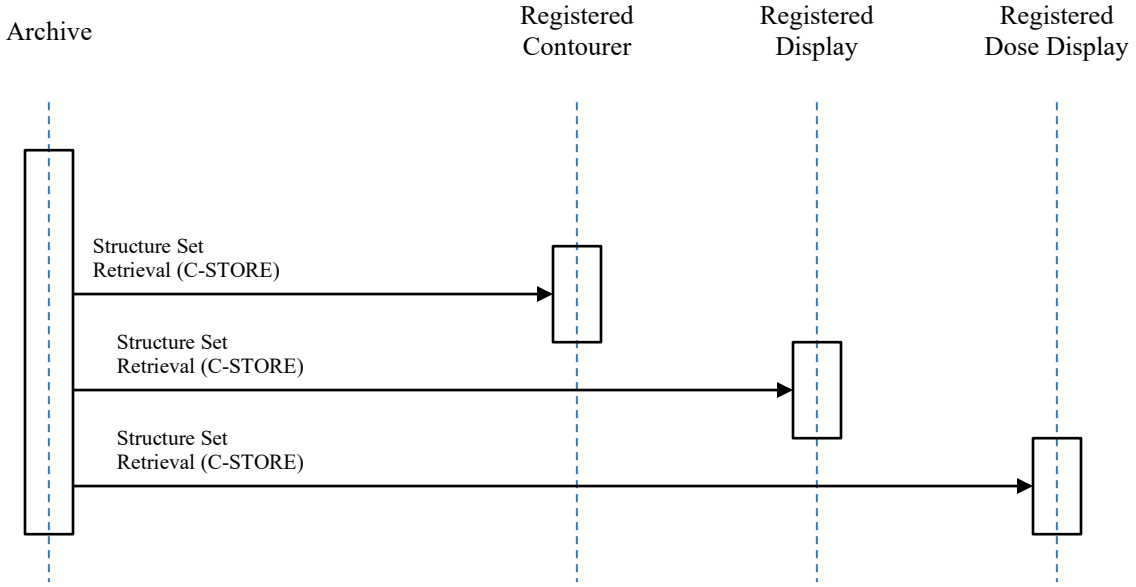


Figure 3.15.4-1: Interaction Diagram

3.15.4.1 Registered Structure Set Retrieval

3.15.4.1.1 Trigger Events

The user of the ***Registered Contourer*** determines that a new set of contours is to be based upon an existing Structure Set, and requests that the ***Archive*** send this Structure Set to the ***Registered Contourer***.

The user of the ***Registered Display*** determines that a display is to be based upon an existing Structure Set, and requests that the ***Archive*** send this Structure Set to the ***Registered Display***.

The user of the ***Registered Dose Display*** determines that a dose display is to be based upon an existing Structure Set, and requests that the ***Archive*** send this Structure Set to the ***Registered Dose Display***.

The mechanism(s) by which these transfers are initiated is outside the scope of this profile.

3.15.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** is the storage SCP and the ***Archive*** is the storage SCU.

Absence of an ROI contour on a slice between slices on which contours are defined implies that the ROI does not intersect that slice.

Also refer to RO TF-3: 7.3.4.1.2 for an overview of the specific requirements on the DICOM attributes that are included in an RT Structure Set object. In particular, the structure set must

have the same study instance UID, but a different series instance UID, than the CT image series upon which the contours are based.

3.15.4.1.3 Expected Actions

The ***Registered Contourer*** will upload image data sets, related structure sets and spatial registration objects. It will present the user with a ***Registered Display***, and allow the user to then construct a new set of contours which will later be exported as a new structure set (MMRO-3: Registered Structure Set Storage). The new structure set will have the same Frame of Reference UID and Study Instance UID of the original base image data set and structure set.

The ***Registered Display*** will load image data sets, related structure sets and spatial registration objects. It will display the information to the user.

The ***Registered Dose Display*** will load image data sets, related structure sets, dose and spatial registration objects. It will display the information to the user.

The ***Registered Contourer*** will load all of the Structure Set, and will relate it to images based on the Frame of Reference UID. The contours contained will then be available to the user of the ***Registered Contourer*** for use in construction a new set of contours which will later be exported as a structure set (MMRO-3: Registered Structure Set Storage). This new structure set will have the same frame of reference UID and study instance UID of the original images and structure set.

3.15.5 Security Considerations

There are no specific considerations.

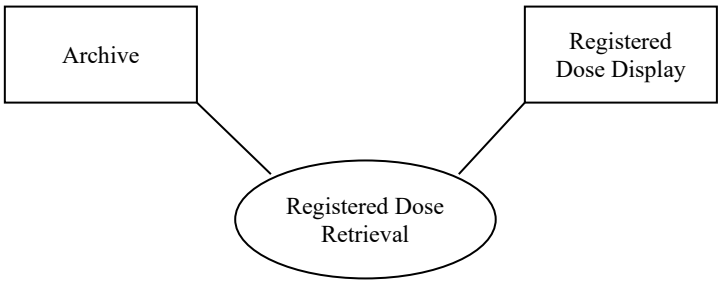
3.16 Registered Dose Retrieval [RO-MMRO-3]

This section corresponds to [RO-MMRO-3] of the IHE-RO Technical Framework. Transaction [RO-MMRO-3] is used by the ***Archive*** and ***Registered Dose Display*** Actors.

3.16.1 Scope

In the Registered Dose Retrieval Transaction, the requested RT Dose is transferred from the ***Archive*** to the ***Registered Dose Display***.

3.16.2 Use Case Roles



Actor:	Archive
Role:	Sends Registered Dose instance to the Registered Dose Display
Actor:	Registered Dose Display
Role:	Receives the Registered Dose instance from the Archive

3.16.3 Referenced Standards

DICOM 2018d PS3.4: Storage Service Class

DICOM 2018d PS 3.4: RT Dose Storage

3.16.4 Messages

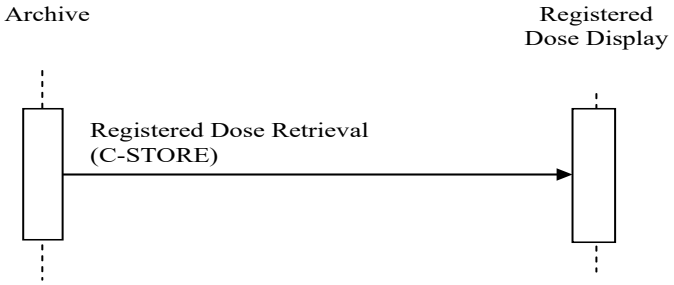


Figure 3.16.4-1: Interaction Diagram

3.16.4.1 Registered Dose Retrieval

3.16.4.1.1 Trigger Events

The user of the ***Registered Dose Display*** selects an RT Dose instance for display in the context of a one or more CT Image Sets and the targets and avoidance structures defined by corresponding RT Structure Set.

3.16.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the dose. The ***Archive*** is the DICOM Storage SCU and the ***Registered Dose Display*** is the DICOM Storage SCP.

This transaction shall support Dose represented as a three-dimensional dose array sampled onto axial image planes in the same DICOM Patient coordinate system Frame of Reference as the diagnostic images used to compute it. The dose image shall be orthogonal with respect to the DICOM patient coordinate system: the value of Image Orientation (Patient) (0020,0037) shall be [±1, 0, 0, 0, ±1, 0], within an uncertainty of 0.001 Radians. Dose Planes may be irregularly spaced, and they need not correspond to image planes.

Not supported are point doses, projection of dose onto an oblique plane, iso-dose contours and dose-volume histograms. The dose pixels shall represent absolute physical dose in units of Gray.

The value of Dose Units (3004,0002) shall be GY. The value of Pixel Representation (0016,0103) shall be 0; negative dose values shall not be present.

The RT Dose shall always share the same Frame of Reference as the related RT Plan.

3.16.4.1.3 Expected Actions

Upon receiving the request for retrieval, the ***Archive*** shall return the requested RT Dose to the ***Registered Dose Display***. The ***Registered Dose Display*** shall validate the received RT Dose. If the received RT Dose is valid, it shall be loaded in the ***Registered Dose Display***. If it is not valid, a warning message shall be displayed to the user, indicating the reason why it is not valid.

The received Dose will be displayed in the same coordinate system as the image set on which it was computed.

3.16.5 Security Considerations

There are no specific considerations.

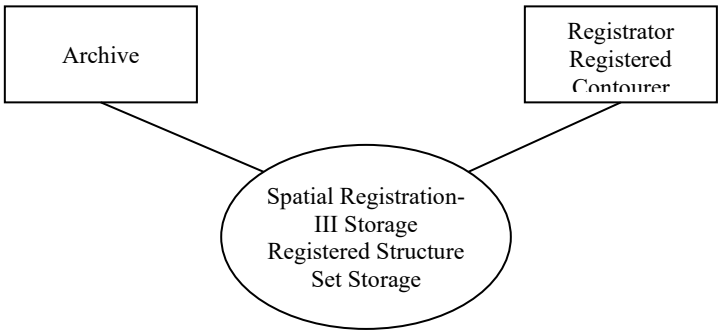
3.17 Spatial Registration Storage [RO-MMRO-4]

This section corresponds to the Spatial Registration Storage transaction of the IHE-RO Technical Framework. Transaction [RO-MMRO-4] is used by the ***Archive*** and ***Registrator*** Actors.

3.17.1 Scope

In the Spatial Registration-III Storage transaction, the ***Registrator*** sends one or more Spatial Registration instances to the ***Archive***. Spatial registration objects define how the pixel coordinates of one image data set are transformed to another coordinate system (for example to a coordinate system defined by another image data set thus allowing each dataset to be spatially aligned).

3.17.2 Use Case Roles



Actor:	Archive
Role:	Accept and store Spatial Registration instances from Registrator Actors

Actor:	Registrator
Role:	Create and transmit Spatial Registration instances to an Archive

3.17.3 Referenced Standards

DICOM 2018d PS 3.4: Storage Service Class

DICOM 2018d PS 3.4: Spatial Registration Storage

3.17.4 Messages

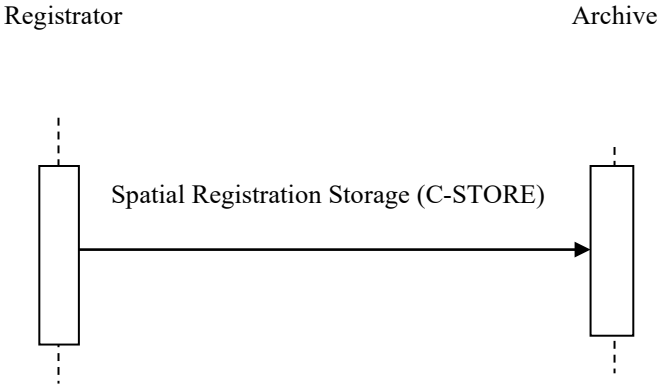


Figure 3.17.4-1: Interaction Diagram

3.17.4.1 Spatial Registration-III Storage

3.17.4.1.1 Trigger Events

A ***Registrator*** chooses to transfer one or more Spatial Registration objects to the ***Archive***. This may follow creation of the Spatial Registration object as part of a registration process.

3.17.4.1.2 Message Semantics

The ***Registrator*** uses the DICOM C-STORE message to transfer the Spatial Registration objects. The ***Registrator*** acts in the role of the DICOM Storage SCU and the ***Archive*** is the DICOM Storage SCP.

The ***Registrator*** is responsible for warning the user of mismatched patient demographics within registered series.

The Spatial Registration shall contain two Registration Sequences. Refer to DICOM 2018d PS 3.17 Figure O.4-1 for informative details on the structure of the Registration Sequences.

When registering volumetric datasets with different Frames of Reference, each Registration Sequence shall define the transformation of the corresponding Original Dataset into the Registered Frame of Reference. Typically, one of the Registration Sequences will contain an IDENTITY transform, indicating that the corresponding original dataset established the

Registered Frame of Reference. In that case the Frame of Reference of the Spatial Registration object may be the same as the Frame of Reference of that Original Dataset.

When registering more than 2 Frames of Reference each Spatial Registration object shall include a reference to the Registered Frame of Reference UID with an IDENTITY transformation as one of the elements of the Registration Sequence. Each Spatial Registration object shall specify its Frame of Reference UID attribute to be the same as the Registered Frame of Reference UID.

This profile shall not allow the re-registration of multiple series with the same Frame of Reference. The actor may re-write one or both of the series with new Frames of Reference and perform the registration on the new series. This capability is not required to satisfy this transaction.

A Registration Sequence item shall contain a Frame of Reference and a list of images which have been available to the user at the time of definition and contributed to the definition of the spatial registration. Images not included in the list of images shall not be assumed to be consistent with the Spatial Registration recorded, e.g., registration of these images is unverified.

Contrary to prior versions of this profile, the MMRO-III Profile does not have any implicit limitations: there is no requirement to specify a “base” or “primary” image set that is a CT. There is also no limitation that registrations shall be performed to a specific “base” or “primary” image set.

Modifying an existing Spatial Registration Object shall result in a new instance with a new instance UID.

The Spatial Registration object shall be stored:

- in the Study to which the Registered Frame of Reference belongs. This Study is identified by the Study UID of the images which establish the Registered Frame of Reference in the Spatial Registration objects as described above.
- in a different series from images.

Also refer to RO TF-3: 7.3.10.1.1 for an overview of the specific requirements on the DICOM attributes that are included in a Spatial Registration object.

3.17.4.1.3 Expected Actions

The Archive will store the received Spatial Registration objects. The Spatial Registration objects shall be stored such that they can be later retrieved (see MMRO-III-2 Spatial Registration Retrieval) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (see DICOM 2018d PS 3.4 B.4.1).

3.17.5 Security Considerations

No specific considerations.

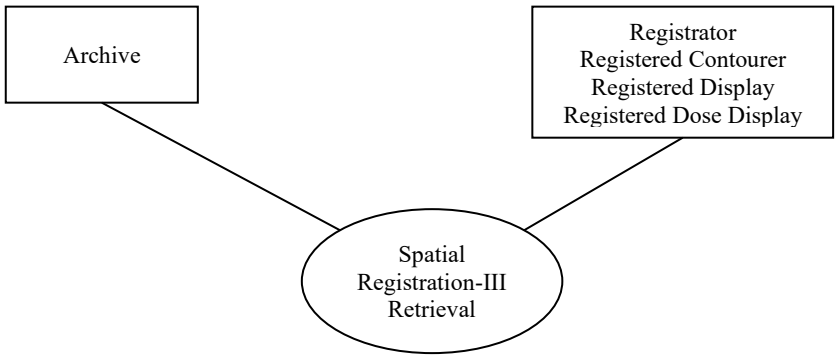
3.18 Spatial Registration-III Retrieval [RO-MMRO-5]

This section corresponds to Transaction [RO-MMRO-5] of the IHE-RO Technical Framework. Transaction [RO-MMRO-5] is used by the ***Registered Contourer***, ***Registered Display***, ***Registered Dose Display*** and ***Archive*** Actors. It is optionally used by the Registrator.

3.18.1 Scope

A ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** receives from an ***Archive*** one or more Spatial Registration objects carrying the transformation information to be applied to two image data sets intended for further processing or fused display. A ***Registrator*** may (optional transaction) receive from an ***Archive*** one or more Spatial Registration objects.

3.18.2 Use Case Roles



Actor:	Archive
Role:	Send Spatial Registration instance(s) to the receiving actor
Actor:	Registered Contourer, Registered Display, Registered Dose Display
Role:	Receive Spatial Registration instances from the Archive
Actor:	Registrator (optional)
Role:	Receive Spatial Registration instances from the Archive

3.18.3 3.18.3 Referenced Standards

DICOM 2018d PS 3.4: Storage Service Class

DICOM 2018d PS 3.4: CT Image Storage

DICOM 2018d PS 3.4: MR Image Storage

DICOM 2018d PS 3.4: Positron Emission Tomography Image Storage

DICOM 2018d PS 3.4: Spatial Registration Storage

3.18.4 Messages

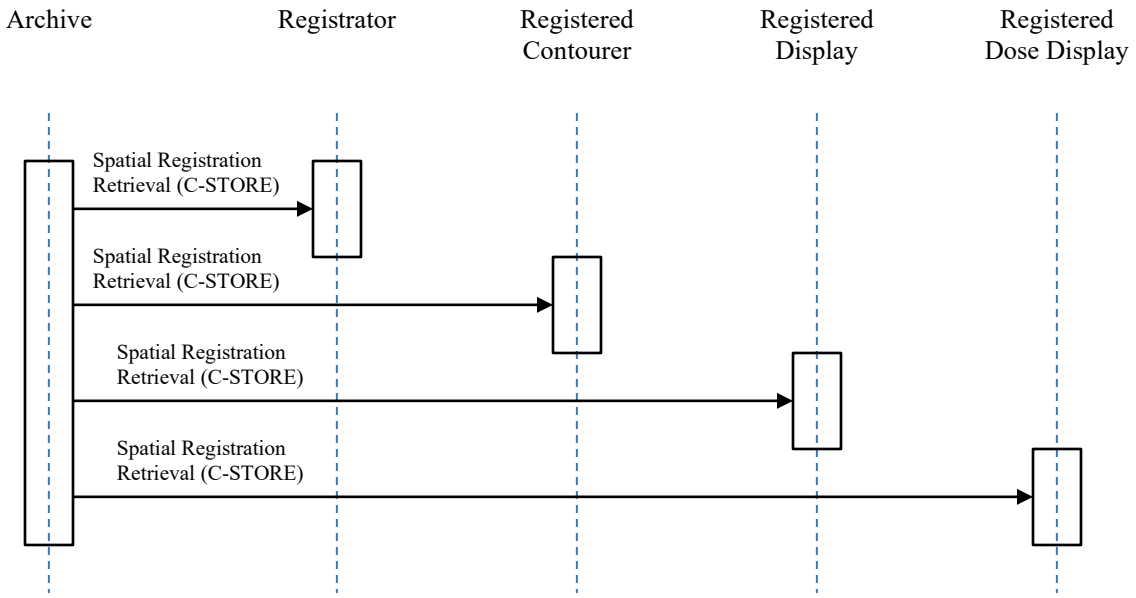


Figure 3.18.4-1: Interaction Diagram

3.18.4.1 Spatial Registration-III Storage

3.18.4.1.1 Trigger Events

The ***Registered Contourer***, ***Registered Display***, ***Registered Dose Display*** or (optionally) ***Registrator*** receives one or more specific Spatial Registration objects from the ***Archive***.

3.18.4.1.2 Message Semantics

The ***Archive*** uses the DICOM C-STORE message to transfer the Spatial Registration objects. The ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** is the DICOM Storage SCU and the ***Archive*** is the DICOM Storage SCP.

It is the responsibility of the ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** to apply the Spatial Registration as defined in DICOM. Refer to DICOM 2018d PS 3.4, Annex C, for detailed descriptive semantics.

It is the responsibility of the ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** to verify that the Registration Sequence item in the Spatial Registration contains a Frame of Reference and a list of images. Image instances present but not included in the list of images shall not be assumed to be consistent with the Spatial Registration recorded, e.g., registration of these images is unverified.

The ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** may want to re-organize the order and direction of Registrations accordingly.

Also refer to RO TF-3: 7.3.10.1.1 for an overview of the specific requirements on the DICOM attributes that are included in a Spatial Registration object.

3.18.4.1.3 Expected Actions

The ***Archive*** establishes a DICOM association with the ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display***, and uses the DICOM Spatial Registration Storage SOP Class to transfer the requested Spatial Registration objects.

The ***Registered Contourer***, ***Registered Display*** or ***Registered Dose Display*** shall use the most recently received instances to ensure that the most recent patient data from the Archive is displayed.

3.18.5 Security Considerations

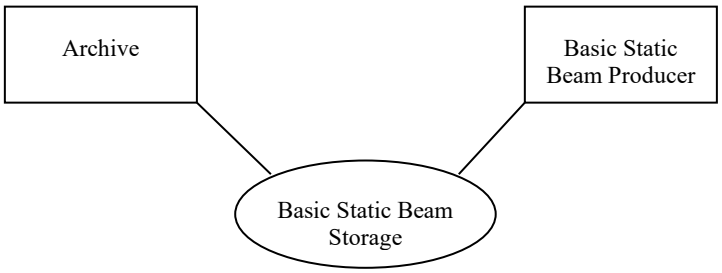
No specific considerations.

3.19 Basic Static Beam Storage [RO-TPPC-01]

3.19.1 Scope

In the Basic Static Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-01: Basic Static Beam Storage stores the plan to the Archive

3.19.2 Use Case Roles



Actor:	Basic Static Beam Producer
Role:	Creates Basic Static Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Basic Static Beam Producer

3.19.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.19.4 Messages

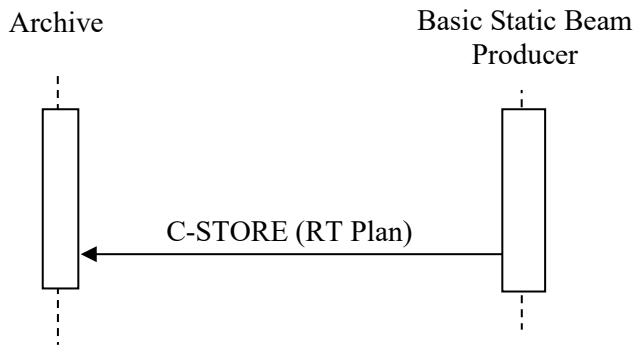


Figure 3.19.4-1: Interaction Diagram

3.19.4.1 Basic Static Beam Storage

3.19.4.1.1 Trigger Events

The Basic Static Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.19.4.1.2 Message Semantics

The Basic Static Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Basic Static Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Basic Static Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.19.4.1.2.1 Storage of RT Plan containing a Basic Static Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.19.4.1.2.2 Optional Modifiers

The Basic Static Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	7.4.4.3.3
Bolus Beam Modifier	7.4.4.3.1
Block Beam Modifier	7.4.4.3.2

3.19.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.19.5 Security Considerations

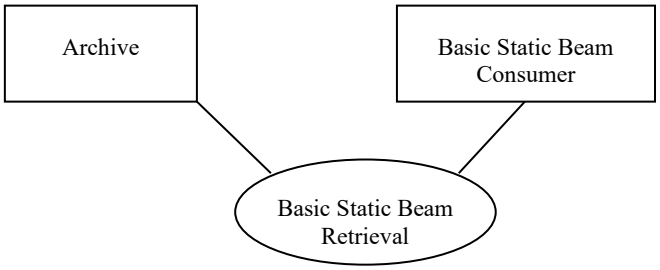
There are no specific security considerations.

3.20 Basic Static Beam Retrieval [RO-TPPC-02]

3.20.1 Scope

In the Basic Static Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-01: Basic Static Beam Storage, retrieves the plan from the Archive.

3.20.2 Use Case Roles



Actor:	Basic Static Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Basic Static Beam Consumer

3.20.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.20.4 Messages

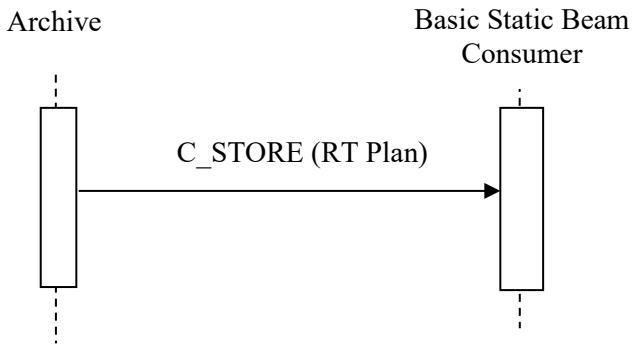


Figure 3.20.4-1: Interaction Diagram

3.20.4.1 Basic Static Beam Retrieval

3.20.4.1.1 Trigger Events

The Archive transfers the plan to the Basic Static Beam Consumer.

3.20.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Basic Static Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.20.4.1.2.1 Storage of RT Plan containing a Basic Static Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.20.4.1.2.2 Optional Modifiers

The Basic Static Beam Consumer may support the following optional modifications :

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.20.4.1.3 Expected Actions

The Basic Static Beam Consumer stores the RT Plan.

3.20.5 Security Considerations

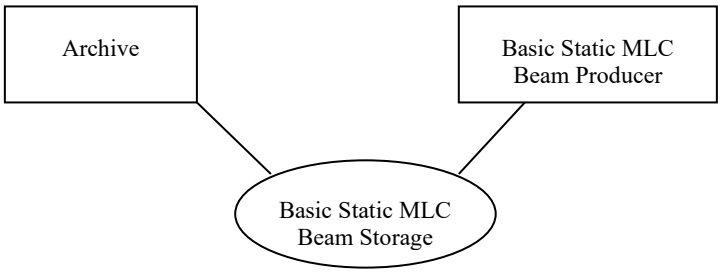
There are no specific security considerations.

3.21 Basic Static MLC Beam Storage [RO-TPPC-03]

3.21.1 Scope

In the Basic Static MLC Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-03: Basic Static MLC Beam Storage stores the plan to the Archive

3.21.2 Use Case Roles



Actor:	Basic Static MLC Beam Producer
Role:	Creates Basic Static MLC Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Basic Static MLCBeam Producer

3.21.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.21.4 Messages

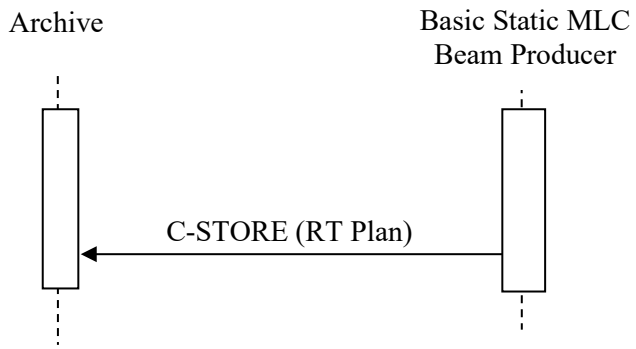


Figure 3.21.4-1: Interaction Diagram

3.21.4.1 Basic Static MLC Beam Storage

3.21.4.1.1 Trigger Events

The Basic Static MLC Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.21.4.1.2 Message Semantics

The Basic Static MLC Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Basic Static MLC Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Basic Static MLC Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.21.4.1.2.1 Storage of RT Plan containing a Basic Static MLC Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.21.4.1.2.2 Optional Modifiers

The Basic Static MLC Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.21.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.21.5 Security Considerations

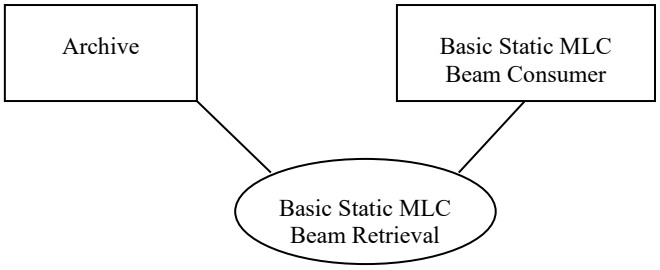
There are no specific security considerations.

3.22 Basic Static MLC Beam Retrieval [RO-TPPC-04]

3.22.1 Scope

In the Basic Static MLC Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-03: Basic Static MLC Beam Storage, retrieves the plan from the Archive.

3.22.2 Use Case Roles



Actor:	Basic Static MLC Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Basic Static MLC Beam Consumer

3.22.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.22.4 Messages

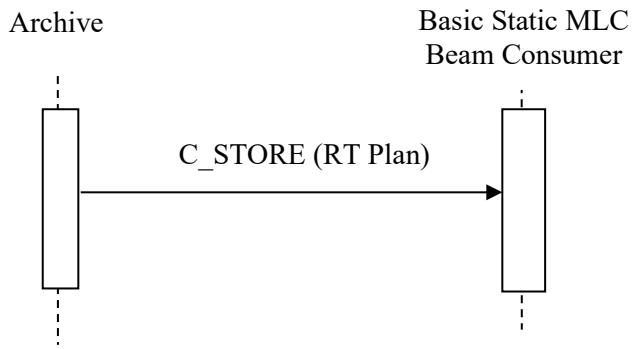


Figure 3.22.4-1: Interaction Diagram

3.22.4.1 Basic Static MLC Beam Retrieval

3.22.4.1.1 Trigger Events

The Archive transfers the plan to the Basic Static Beam Consumer.

3.22.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Basic Static MLC Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.22.4.1.2.1 Storage of RT Plan containing a Basic Static MLC Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.22.4.1.2.2 Optional Modifiers

The Basic Static Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

Optional Modifiers	Section
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.22.4.1.3 Expected Actions

The Basic Static MLC Beam Consumer stores the RT Plan.

3.22.5 Security Considerations

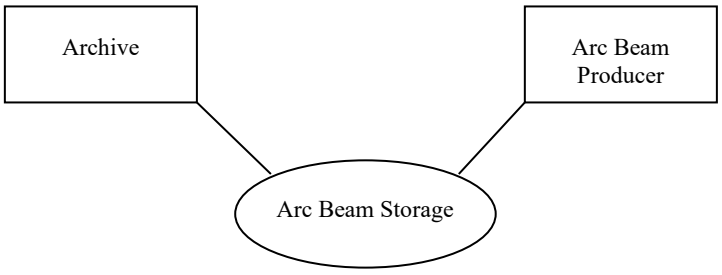
There are no specific security considerations.

3.23 Arc Beam Storage [RO-TPPC-05]

3.23.1 Scope

In the Arc Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-05: Arc Beam Storage stores the plan to the Archive

3.23.2 Use Case Roles



Actor:	Arc Beam Producer
Role:	Creates Arc Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Basic Arc Beam Producer

3.23.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.23.4 Messages

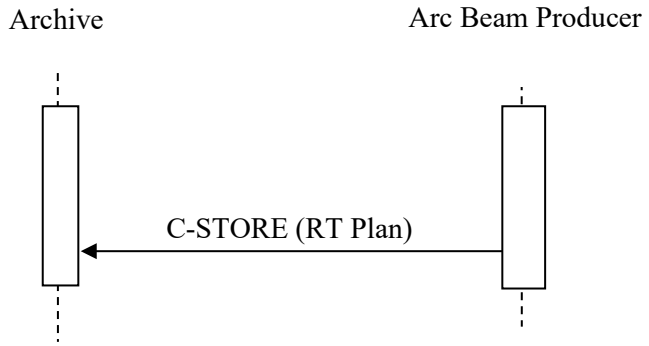


Figure 3.23.4-1: Interaction Diagram

3.23.4.1 Arc Beam Storage

3.23.4.1.1 Trigger Events

The Arc Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.23.4.1.2 Message Semantics

The Arc Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Arc Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Arc Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.23.4.1.2.1 Storage of RT Plan containing an Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.23.4.1.2.2 Optional Modifiers

The Arc Beam Producer may support the following optional :

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.23.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.23.5 Security Considerations

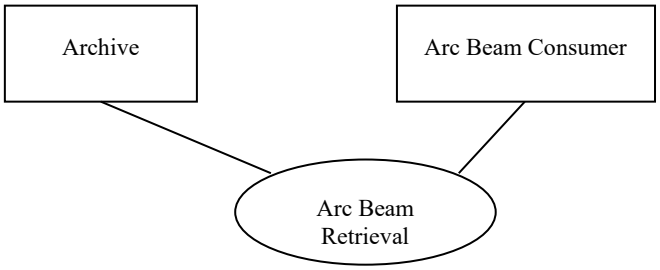
There are no specific security considerations.

3.24 Arc Beam Retrieval [RO-TPPC-06]

3.24.1 Scope

In the Arc Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-05: Arc Beam Storage, retrieves the plan from the Archive.

3.24.2 Use Case Roles



Actor:	Arc Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Arc Beam Consumer

3.24.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.24.4 Messages

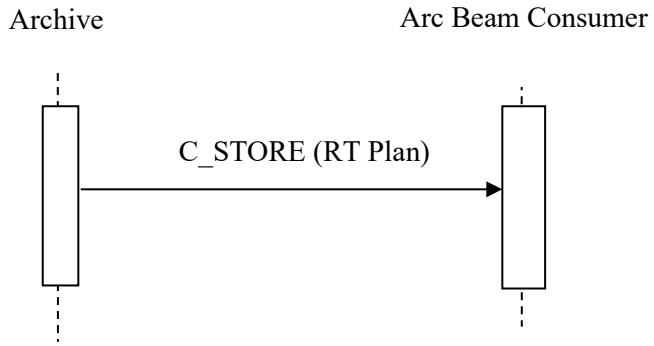


Figure 3.24.4-1: Interaction Diagram

3.24.4.1 Arc Beam Retrieval

3.24.4.1.1 Trigger Events

The Archive transfers the plan to the Arc Beam Consumer.

3.24.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Arc Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.24.4.1.2.1 Storage of RT Plan containing an Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.24.4.1.2.2 Optional Modifiers

The Arc Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.24.4.1.3 Expected Actions

The Arc Beam Consumer stores the RT Plan.

3.24.5 Security Considerations

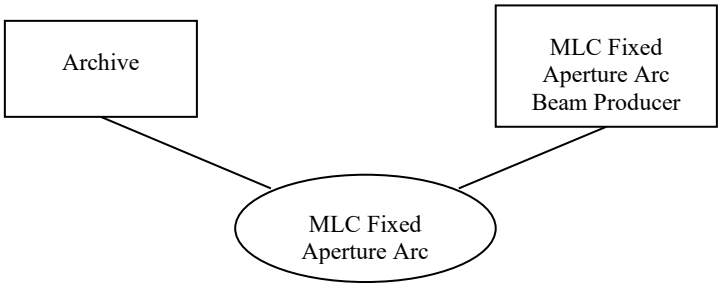
There are no specific security considerations.

3.25 MLC Fixed Aperture Arc Beam Storage [RO-TPPC-07]

3.25.1 Scope

In the MLC Fixed Aperture Arc Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-07: MLC Fixed Aperture Arc Beam Storage stores the plan to the Archive

3.25.2 Use Case Roles



Actor:	MLC Fixed Aperture Arc Beam Producer
Role:	Creates MLC Fixed Aperture Arc Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from MLC Fixed Aperture Arc Beam Producer

3.25.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.25.4 Messages

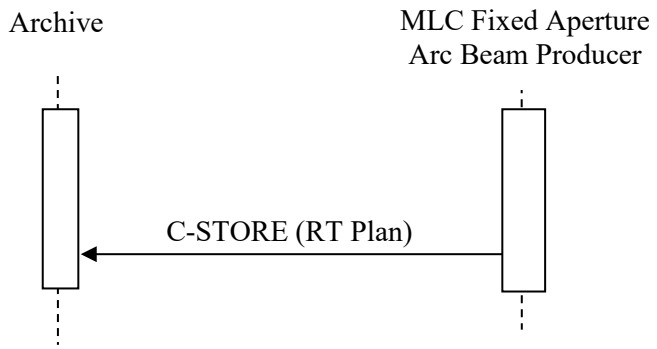


Figure 3.25.4-1: Interaction Diagram

3.25.4.1 MLC Fixed Aperture Arc Beam Storage

3.25.4.1.1 Trigger Events

The MLC Fixed Aperture Arc Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.25.4.1.2 Message Semantics

The MLC Fixed Aperture Arc Beam Producer uses the DICOM C-STORE message to transfer the plan.

The MLC Fixed Aperture Arc Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The MLC Fixed Aperture Arc Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.25.4.1.2.1 Storage of RT Plan containing a MLC Fixed Aperture Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.25.4.1.2.2 Optional Modifiers

The MLC Fixed Aperture Arc Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.25.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.25.5 Security Considerations

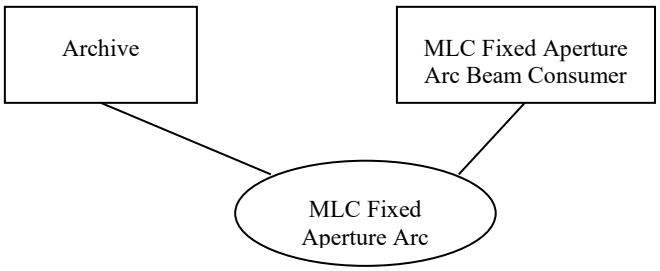
There are no specific security considerations.

3.26 MLC FIXED APERTURE ARC Beam Retrieval [RO-TPPC-08]

3.26.1 Scope

In the MLC Fixed Aperture Arc Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-07: MLC Fixed Aperture Arc Beam Storage, retrieves the plan from the Archive.

3.26.2 Use Case Roles



Actor:	MLC Fixed Aperture Arc Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to MLC Fixed Aperture Arc Beam Consumer

3.26.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.26.4 Messages

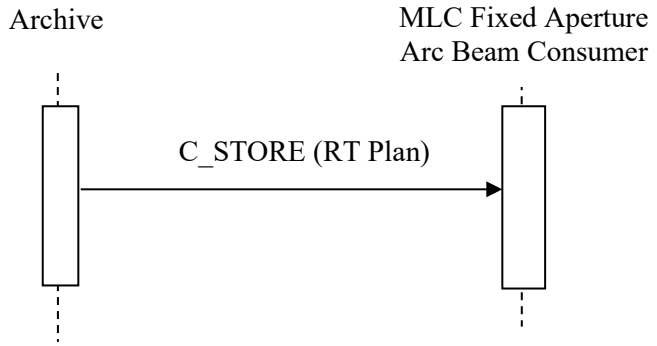


Figure 3.26.4-1: Interaction Diagram

3.26.4.1 MLC Fixed Aperture Arc Beam Retrieval

3.26.4.1.1 Trigger Events

The Archive transfers the plan to the MLC Fixed Aperture Arc Beam Consumer.

3.26.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the MLC Fixed Aperture Arc Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.26.4.1.2.1 Storage of RT Plan containing a MLC Fixed Aperture Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.26.4.1.2.2 Optional Modifiers

The MLC Fixed Aperture Arc Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.26.4.1.3 Expected Actions

The MLC Fixed Aperture Arc Beam Consumer stores the RT Plan.

3.26.5 Security Considerations

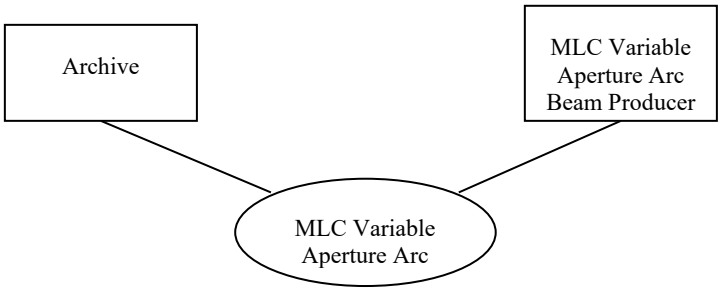
There are no specific security considerations.

3.27 MLC Variable Aperture Arc Beam Storage [RO-TPPC-09]

3.27.1 Scope

In the MLC Variable Aperture Arc Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-09: MLC Variable Aperture Arc Beam Storage stores the plan to the Archive

3.27.2 Use Case Roles



Actor:	MLC Variable Aperture Arc Beam Producer
Role:	Creates MLC Variable Aperture Arc Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from MLC Variable Aperture Arc Beam Producer

3.27.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.27.4 Messages

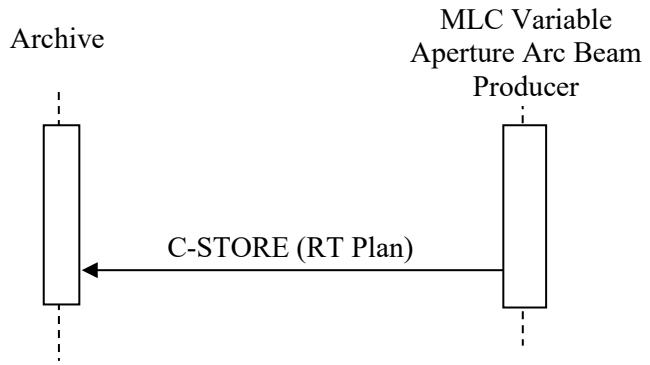


Figure 3.27.4-1: Interaction Diagram

3.27.4.1 MLC Variable Aperture Arc Beam Storage

3.27.4.1.1 Trigger Events

The MLC Variable Aperture Arc Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.27.4.1.2 Message Semantics

The MLC Variable Aperture Arc Beam Producer uses the DICOM C-STORE message to transfer the plan.

The MLC Variable Aperture Arc Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The MLC Variable Aperture Arc Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.27.4.1.2.1 Storage of RT Plan containing a MLC Variable Aperture Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.27.4.1.2.2 Optional Modifiers

The MLC Variable Aperture Arc Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.27.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.27.5 Security Considerations

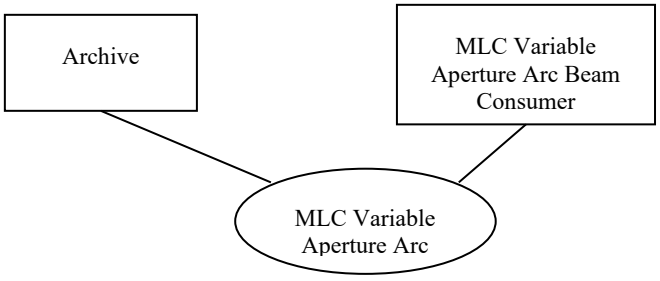
There are no specific security considerations.

3.28 MLC Variable Aperture Arc Beam Retrieval [RO-TPPC-10]

3.28.1 Scope

In the MLC Variable Aperture Arc Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-09: MLC Variable Aperture Arc Beam Storage, retrieves the plan from the Archive.

3.28.2 Use Case Roles



Actor:	MLC Variable Aperture Arc Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to MLC Variable Aperture Arc Beam Consumer

3.28.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.28.4 Messages

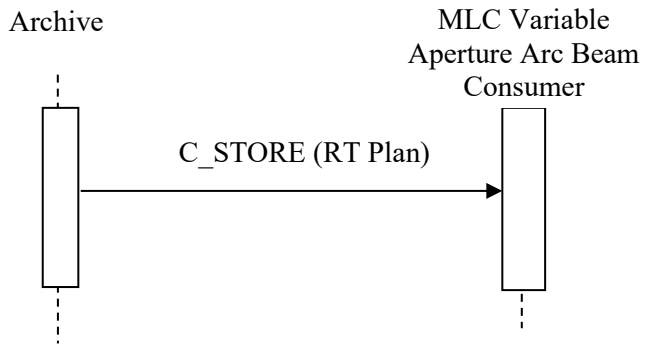


Figure 3.28.4-1: Interaction Diagram

3.28.4.1 MLC Variable Aperture Arc Beam Retrieval

3.28.4.1.1 Trigger Events

The Archive transfers the plan to the MLC Variable Aperture Arc Beam Consumer.

3.28.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the MLC Variable Aperture Arc Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.28.4.1.2.1 Storage of RT Plan containing a MLC Variable Aperture Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.28.4.1.2.2 Optional Modifiers

The MLC Variable Aperture Arc Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.28.4.1.3 Expected Actions

The MLC Variable Aperture Arc Beam Consumer stores the RT Plan.

3.28.5 Security Considerations

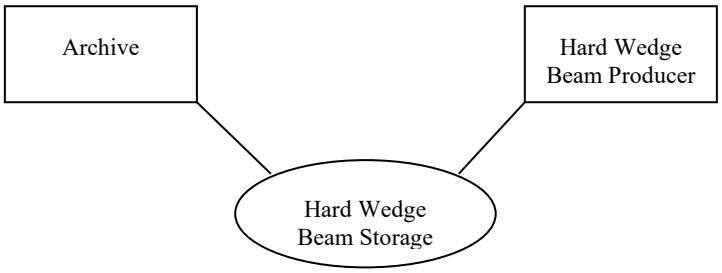
There are no specific security considerations.

3.29 Hard Wedge Beam Storage [RO-TPPC-11]

3.29.1 Scope

In the Hard Wedge Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-11: Hard Wedge Beam Storage stores the plan to the Archive

3.29.2 Use Case Roles



Actor:	Hard Wedge Beam Producer
Role:	Creates Hard Wedge Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Hard Wedge Beam Producer

3.29.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.29.4 Messages

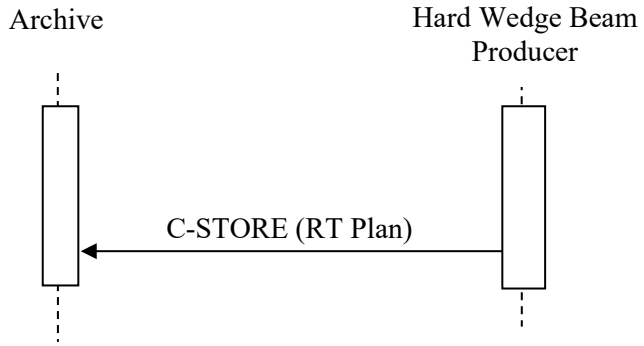


Figure 3.29.4-1: Interaction Diagram

3.29.4.1 Hard Wedge Beam Storage

3.29.4.1.1 Trigger Events

The Hard Wedge Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.29.4.1.2 Message Semantics

The Hard Wedge Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Hard Wedge Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Hard Wedge Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.29.4.1.2.1 Storage of RT Plan containing a Hard Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.29.4.1.2.2 Optional Modifiers

The Hard Wedge Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.29.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.29.5 Security Considerations

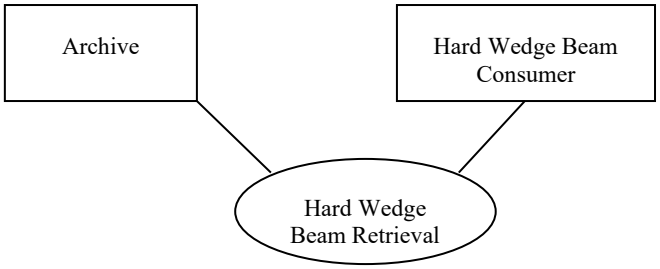
There are no specific security considerations.

3.30 Hard Wedge Beam Retrieval [RO-TPPC-12]

3.30.1 Scope

In the Hard Wedge Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-11: Hard Wedge Beam Storage, retrieves the plan from the Archive.

3.30.2 Use Case Roles



Actor:	Hard Wedge Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Hard Wedge Beam Consumer

3.30.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.30.4 Messages

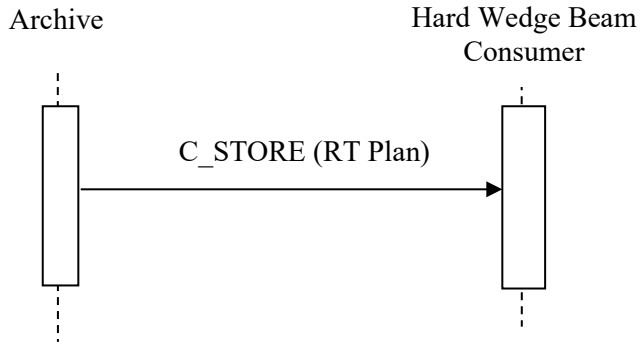


Figure 3.30.4-1: Interaction Diagram

3.30.4.1 Hard Wedge Beam Retrieval

3.30.4.1.1 Trigger Events

The Archive transfers the plan to the Hard Wedge Beam Consumer.

3.30.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Hard Wedge Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.30.4.1.2.1 Storage of RT Plan containing a Hard Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.30.4.1.2.2 Optional Modifiers

The Hard Wedge Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

Optional Modifiers	Section
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.30.4.1.3 Expected Actions

The Hard Wedge Beam Consumer stores the RT Plan.

3.30.5 Security Considerations

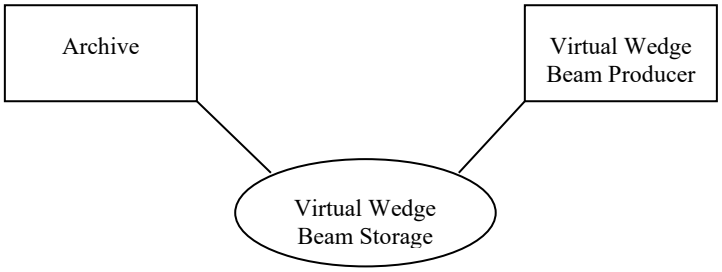
There are no specific security considerations.

3.31 Virtual Wedge Beam Storage [RO-TPPC-13]

3.31.1 Scope

In the Virtual Wedge Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-13: Virtual Wedge Beam Storage stores the plan to the Archive

3.31.2 Use Case Roles



Actor:	Virtual Wedge Beam Producer
Role:	Creates Virtual Wedge Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Virtual Wedge Beam Producer

3.31.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.31.4 Messages

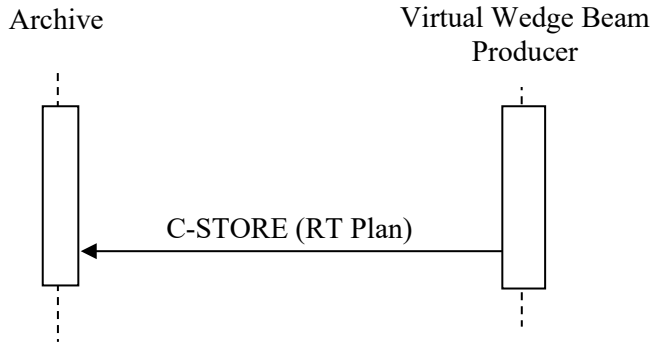


Figure 3.31.4-1: Interaction Diagram

3.31.4.1 Virtual Wedge Beam Storage

3.31.4.1.1 Trigger Events

The Virtual Wedge Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.31.4.1.2 Message Semantics

The Virtual Wedge Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Virtual Wedge Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Virtual Wedge Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.31.4.1.2.1 Storage of RT Plan containing a Virtual Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

A virtual wedge does not actually have an actual wedge angle (300A,00D5) in the same sense as a physical wedge. Most treatment planning systems, however, incorporate the concept of such an angle for reference during the planning and delivery process. This ‘physical’ setting of the delivery device should be placed in the wedge angle (300A,00D5) attribute.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.31.4.1.2.2 Optional Modifiers

The Virtual Wedge Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.31.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.31.5 Security Considerations

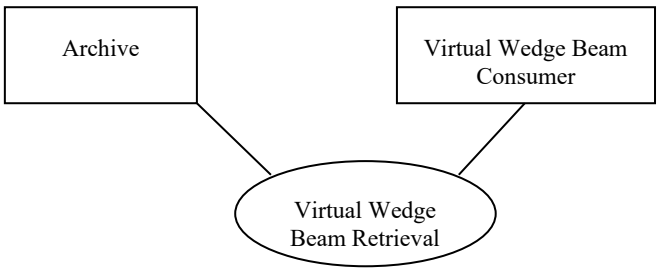
There are no specific security considerations.

3.32 Virtual Wedge Beam Retrieval [RO-TPPC-14]

3.32.1 Scope

In the Virtual Wedge Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-13: Virtual Wedge Beam Storage, retrieves the plan from the Archive.

3.32.2 Use Case Roles



Actor:	Virtual Wedge Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Virtual Wedge Beam Consumer

3.32.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.32.4 Messages

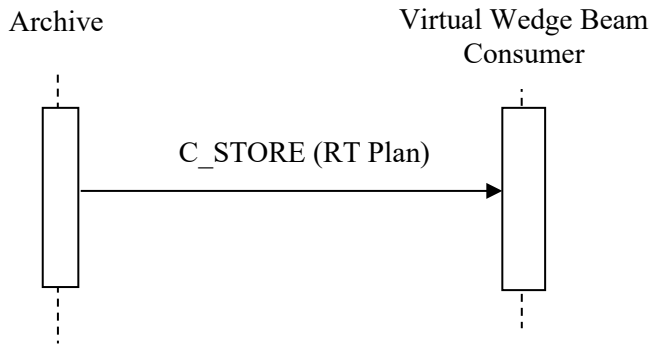


Figure 3.32.4-1: Interaction Diagram

3.32.4.1 Virtual Wedge Beam Retrieval

3.32.4.1.1 Trigger Events

The Archive transfers the plan to the Virtual Wedge Beam Consumer.

3.32.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Virtual Wedge Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.32.4.1.2.1 Storage of RT Plan containing a Virtual Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.32.4.1.2.2 Optional Modifiers

The Virtual Wedge Beam Consumer may support the following optional:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.32.4.1.3 Expected Actions

The Virtual Wedge Beam Consumer stores the RT Plan.

3.32.5 Security Considerations

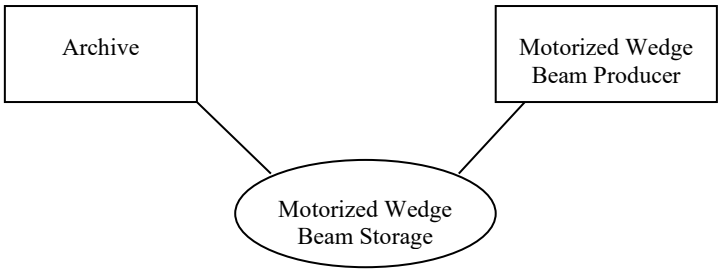
There are no specific security considerations.

3.33 Motorized Wedge Beam Storage [RO-TPPC-15]

3.33.1 Scope

In the Motorized Wedge Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-15: Virtual Wedge Beam Storage stores the plan to the Archive

3.33.2 Use Case Roles



Actor:	Motorized Wedge Beam Producer
Role:	Creates Motorized Wedge Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Motorized Wedge Beam Producer

3.33.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.33.4 Messages

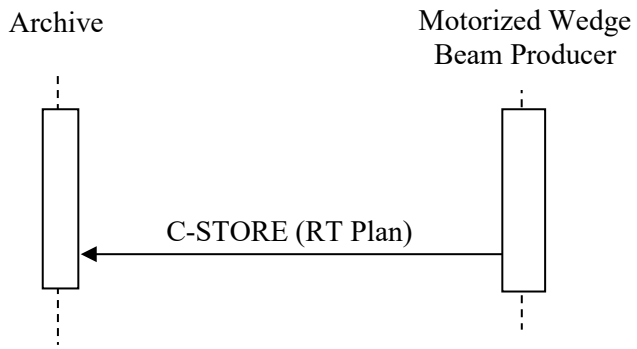


Figure 3.33.4-1: Interaction Diagram

3.33.4.1 Motorized Wedge Beam Storage

3.33.4.1.1 Trigger Events

The Motorized Wedge Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.33.4.1.2 Message Semantics

The Motorized Wedge Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Motorized Wedge Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Motorized Wedge Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.33.4.1.2.1 Storage of RT Plan containing a Motorized Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

In the delivery of a motorized wedge beam the wedge angle (300A,00D5) could represent either the effective angle of the total beam delivery or the angle of the physical wedge moved into the beam. For the TPPC Profile, the physical angle of the motorized wedge should be placed into the wedge angle (300A,00D5) attribute.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.33.4.1.2.2 Optional Modifiers

The Motorized Wedge Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

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3.33.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.33.5 Security Considerations

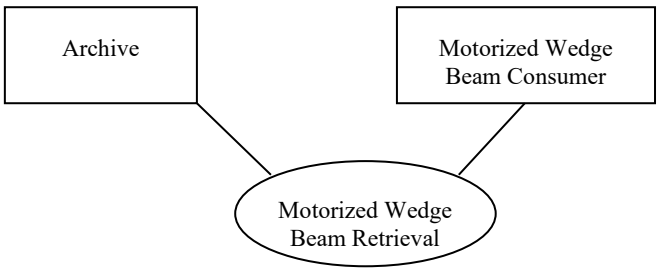
There are no specific security considerations.

2070 3.34 Motorized Wedge Beam Retrieval [RO-TPPC-16]

3.34.1 Scope

In the Motorized Wedge Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-15: Motorized Wedge Beam Storage, retrieves the plan from the Archive.

2075 3.34.2 Use Case Roles



Actor:	Motorized Wedge Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Motorized Wedge Beam Consumer

3.34.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.34.4 Messages

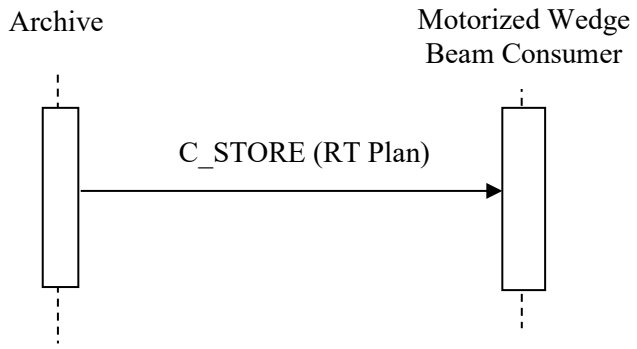


Figure 3.34.4-1: Interaction Diagram

3.34.4.1 Motorized Wedge Beam Retrieval

3.34.4.1.1 Trigger Events

The Archive transfers the plan to the Motorized Wedge Beam Consumer.

3.34.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Motorized Wedge Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.34.4.1.2.1 Storage of RT Plan containing a Motorized Wedge Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in Section 7.3.2.1.

3.34.4.1.2.2 Optional Modifiers

The Motorized Wedge Beam Consumer may support the following optional:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.34.4.1.3 Expected Actions

The Motorized Wedge Beam Consumer stores the RT Plan.

3.34.5 Security Considerations

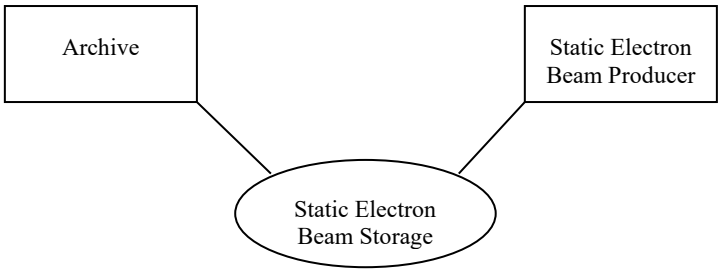
There are no specific security considerations.

3.35 Static Electron Beam Storage [RO-TPPC-17]

3.35.1 Scope

In the Static Electron Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-17: Static Electron Beam Storage stores the plan to the Archive

3.35.2 Use Case Roles



Actor:	Static Electron Beam Producer
Role:	Creates Static Electron Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Static Electron Beam Producer

3.35.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.35.4 Messages

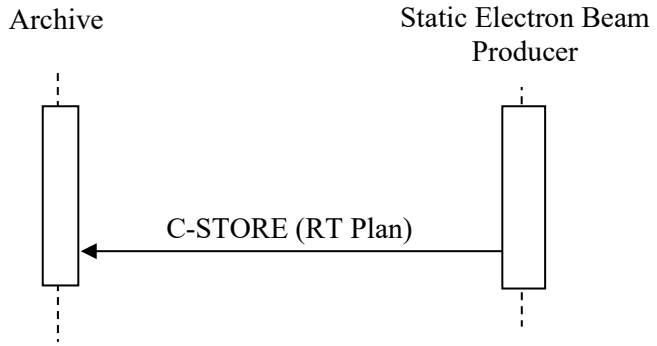


Figure 3.35.4-1: Interaction Diagram

3.35.4.1 Static Electron Beam Storage

3.35.4.1.1 Trigger Events

The Static Electron Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.35.4.1.2 Message Semantics

The Static Electron Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Static Electron Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Static Electron Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.35.4.1.2.1 Storage of RT Plan containing a Static Electron Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.1.1.

3.35.4.1.2.2 Optional Modifiers

The Static Electron Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.35.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.35.5 Security Considerations

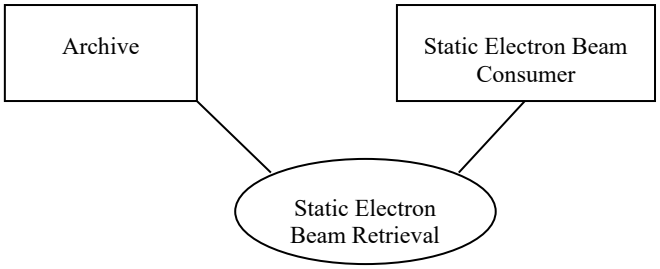
There are no specific security considerations.

3.36 Static Electron Beam Retrieval [RO-TPPC-18]

3.36.1 Scope

In the Static Electron Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-17: Static Electron Beam Storage, retrieves the plan from the Archive.

3.36.2 Use Case Roles



Actor:	Static Electron Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Static Electron Beam Consumer

3.36.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.36.4 Messages

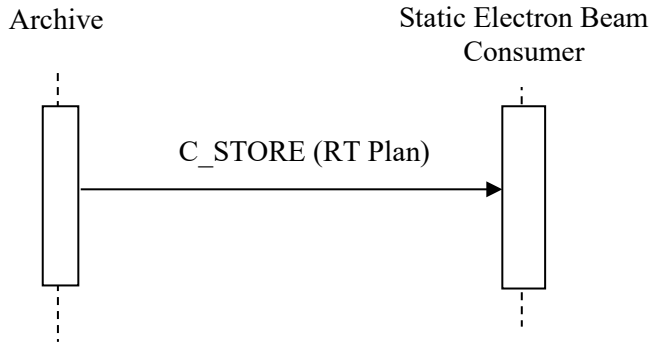


Figure 3.36.4-1: Interaction Diagram

3.36.4.1 Static Electron Beam Retrieval

3.36.4.1.1 Trigger Events

The Archive transfers the plan to the Static Electron Beam Consumer.

3.36.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Static Electron Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.36.4.1.2.1 Storage of RT Plan containing a Static Electron Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.36.4.1.2.2 Optional Modifiers

The Static Electron Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Compensator Beam Modifier	RO TF-3: 7.4.4.3.3
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

Optional Modifiers	Section
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.36.4.1.3 Expected Actions

The Static Electron Beam Consumer stores the RT Plan.

3.36.5 Security Considerations

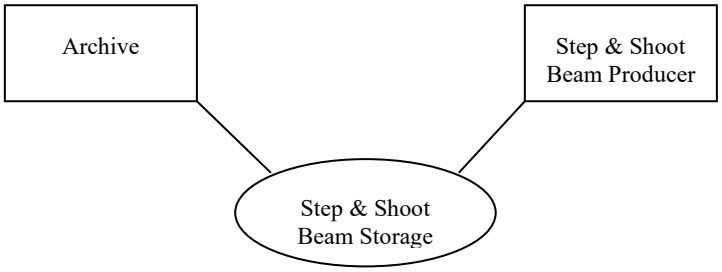
There are no specific security considerations.

3.37 Step & Shoot Beam Storage [RO-TPPC-19]

3.37.1 Scope

In the Step & Shoot Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-19: Step & Shoot Beam Storage stores the plan to the Archive

3.37.2 Use Case Roles



Actor:	Step & Shoot Beam Producer
Role:	Creates Step & Shoot Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Step & Shoot Beam Producer

3.37.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.37.4 Messages

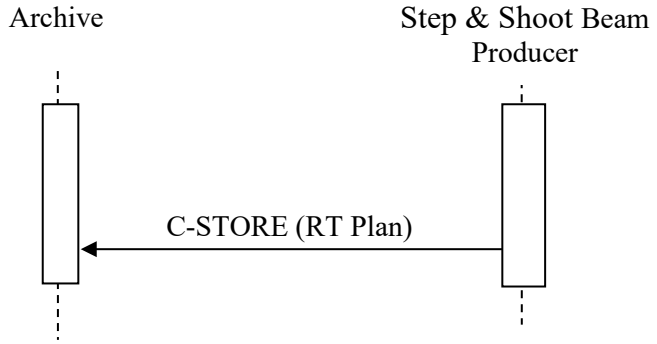


Figure 3.37.4-1: Interaction Diagram

3.37.4.1 Step & Shoot Beam Storage

3.37.4.1.1 Trigger Events

The Step & Shoot Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.37.4.1.2 Message Semantics

The Step & Shoot Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Step & Shoot Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Step & Shoot Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.37.4.1.2.1 Storage of RT Plan containing a Step & Shoot Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.37.4.1.2.2 Optional Modifiers

The Step & Shoot Beam Producer may support the following optional :

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.37.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.37.5 Security Considerations

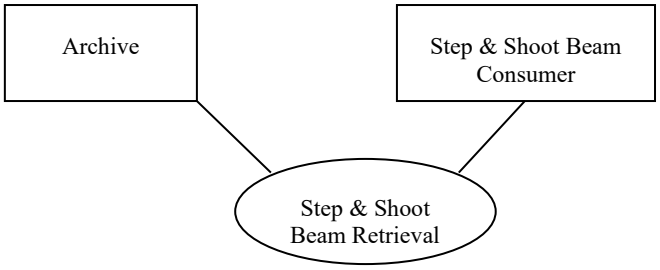
There are no specific security considerations.

3.38 Step & Shoot Beam Retrieval [RO-TPPC-20]

3.38.1 Scope

In the Step & Shoot Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-19: Step & Shoot Beam Storage, retrieves the plan from the Archive.

3.38.2 Use Case Roles



Actor:	Step & Shoot Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Step & Shoot Beam Consumer

3.38.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.38.4 Messages

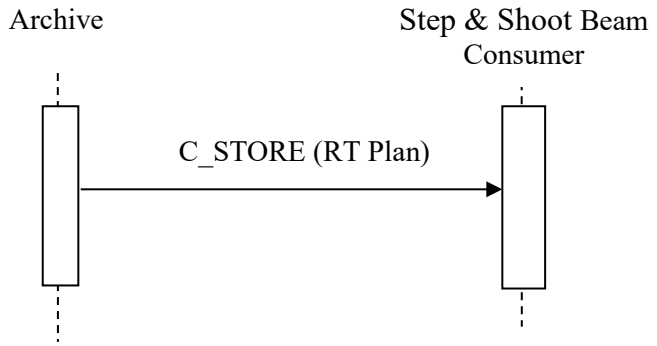


Figure 3.38.4-1: Interaction Diagram

3.38.4.1 Step & Shoot Beam Retrieval

3.38.4.1.1 Trigger Events

The Archive transfers the plan to the Step & Shoot Beam Consumer.

3.38.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Step & Shoot Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.38.4.1.2.1 Storage of RT Plan containing a Step & Shoot Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.38.4.1.2.2 Optional Modifiers

The Step & Shoot Beam Consumer may support the following optional:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

Optional Modifiers	Section
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.38.4.1.3 Expected Actions

The Step & Shoot Beam Consumer stores the RT Plan.

3.38.5 Security Considerations

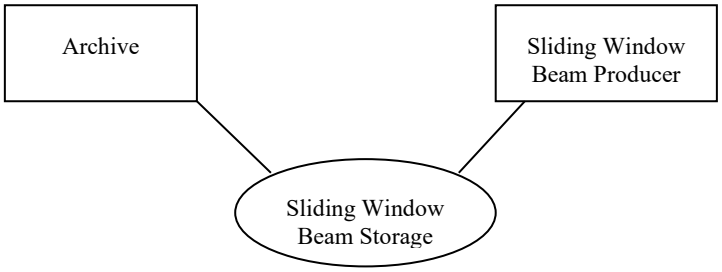
There are no specific security considerations.

3.39 Sliding Window Beam Storage [RO-TPPC-21]

3.39.1 Scope

In the Sliding Window Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-21: Sliding Window Beam Storage stores the plan to the Archive

3.39.2 Use Case Roles



Actor:	Sliding Window Beam Producer
Role:	Creates Sliding Window Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Sliding Window Beam Producer

3.39.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.39.4 Messages

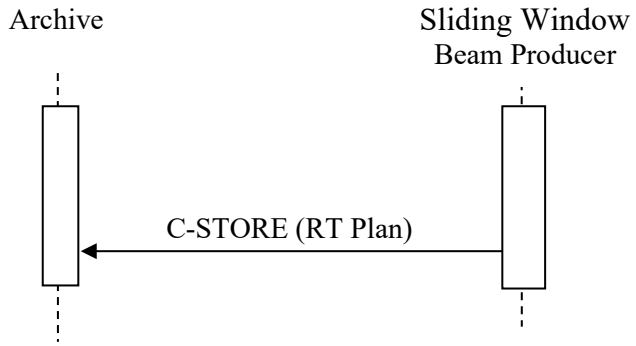


Figure 3.39.4-1: Interaction Diagram

3.39.4.1 Sliding Window Beam Storage

3.39.4.1.1 Trigger Events

The Sliding Window Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.39.4.1.2 Message Semantics

The Sliding Window Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Sliding Window Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Sliding Window Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.39.4.1.2.1 Storage of RT Plan containing a Sliding Window Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.39.4.1.2.2 Optional Modifiers

The Sliding Window Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.39.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.39.5 Security Considerations

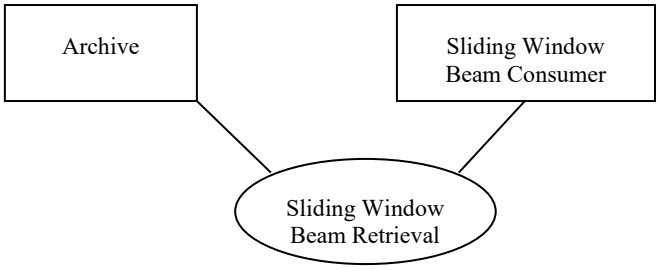
There are no specific security considerations.

3.40 Sliding Window Beam Retrieval [RO-TPPC-22]

3.40.1 Scope

In the Sliding Window Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-21: Sliding Window Beam Storage, retrieves the plan from the Archive.

3.40.2 Use Case Roles



Actor:	Sliding Window Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Sliding Window Beam Consumer

3.40.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.40.4 Messages

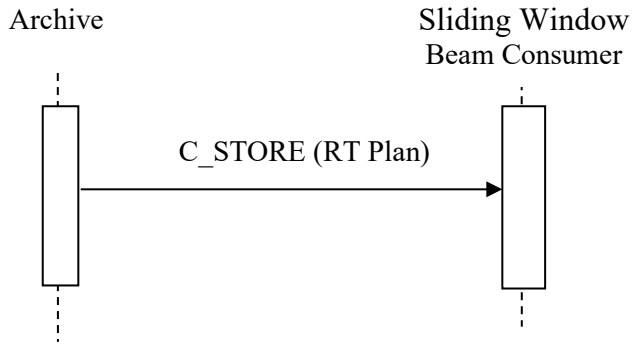


Figure 3.40.4-1: Interaction Diagram

3.40.4.1 Sliding Window Beam Retrieval

3.40.4.1.1 Trigger Events

The Archive transfers the plan to the Sliding Window Beam Consumer.

3.40.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Sliding Window Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.40.4.1.2.1 Storage of RT Plan containing a Sliding Window Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.40.4.1.2.2 Optional Modifiers

The Sliding Window Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Hard Wedge Beam Modifier	RO TF-3: 7.4.4.3.4
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

Optional Modifiers	Section
Block Beam Modifier	RO TF-3: 7.4.4.3.2

3.40.4.1.3 Expected Actions

The Sliding Window Beam Consumer stores the RT Plan.

3.40.5 Security Considerations

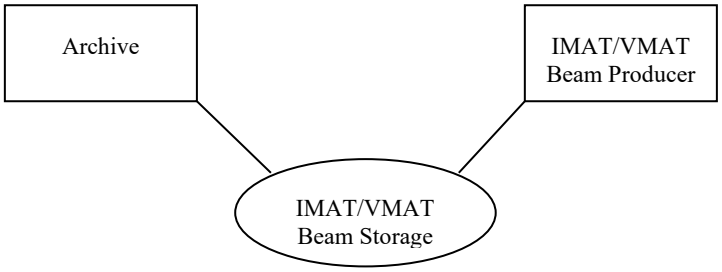
There are no specific security considerations.

3.41 IMAT/VMAT Beam Storage [RO-TPPC-23]

3.41.1 Scope

In the IMAT/VMAT Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-41: IMAT/VMAT Beam Storage stores the plan to the Archive

3.41.2 Use Case Roles



Actor:	IMAT/VMAT Beam Producer
Role:	Creates IMAT/VMAT Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from IMAT/VMAT Beam Producer

3.41.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.41.4 Messages

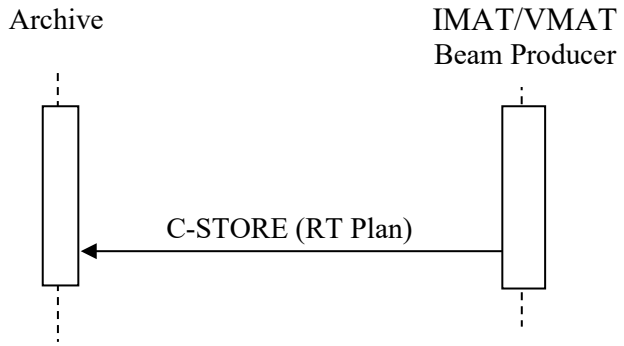


Figure 3.41.4-1: Interaction Diagram

3.41.4.1 IMAT/VMAT Beam Storage

3.41.4.1.1 Trigger Events

The IMAT/VMAT Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.41.4.1.2 Message Semantics

The IMAT/VMAT Beam Producer uses the DICOM C-STORE message to transfer the plan.

The IMAT/VMAT Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The IMAT/VMAT Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.41.4.1.2.1 Storage of RT Plan containing a IMAT/VMAT Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.41.4.1.2.2 Optional Modifiers

The IMAT/VMAT Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.41.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.41.5 Security Considerations

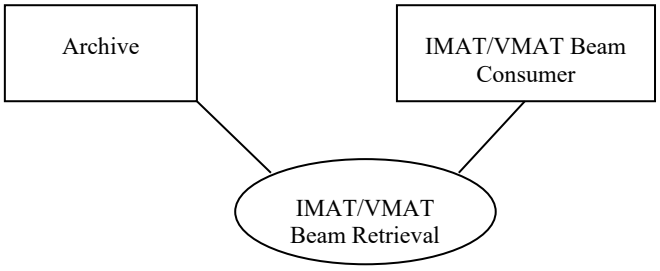
There are no specific security considerations.

3.42 IMAT/VMAT Beam Retrieval [RO-TPPC-24]

3.42.1 Scope

In the IMAT/VMAT Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-40: IMAT/VMAT Beam Storage, retrieves the plan from the Archive.

3.42.2 Use Case Roles



Actor:	IMAT/VMAT Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to IMAT/VMAT Beam Consumer

3.42.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.42.4 Messages

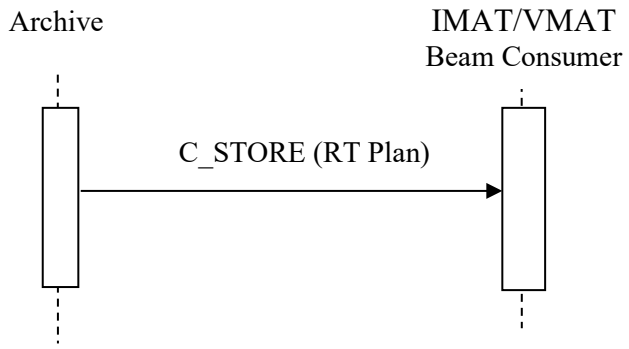


Figure 3.42.4-1: Interaction Diagram

3.42.4.1 IMAT/VMAT Beam Retrieval

3.42.4.1.1 Trigger Events

The Archive transfers the plan to the IMAT/VMAT Beam Consumer.

3.42.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the IMAT/VMAT Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.42.4.1.2.1 Storage of RT Plan containing a IMAT/VMAT Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.42.4.1.2.2 Optional Modifiers

The IMAT/VMAT Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.42.4.1.3 Expected Actions

The IMAT/VMAT Beam Consumer stores the RT Plan.

3.42.5 Security Considerations

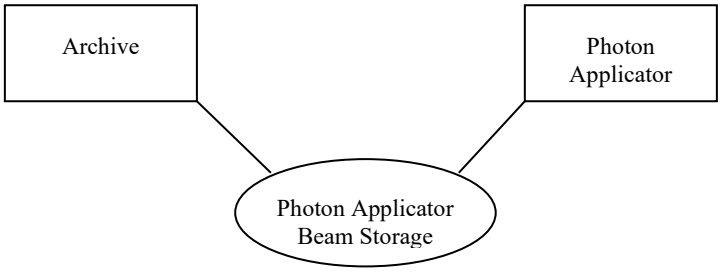
There are no specific security considerations.

3.43 Photon Applicator Beam Storage [RO-TPPC-25]

3.43.1 Scope

In the Photon Applicator Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-43: Photon Applicator Beam Storage stores the plan to the Archive

3.43.2 Use Case Roles



Actor:	Photon Applicator Beam Producer
Role:	Creates Photon Applicator Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Photon Applicator Beam Producer

3.43.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.43.4 Messages

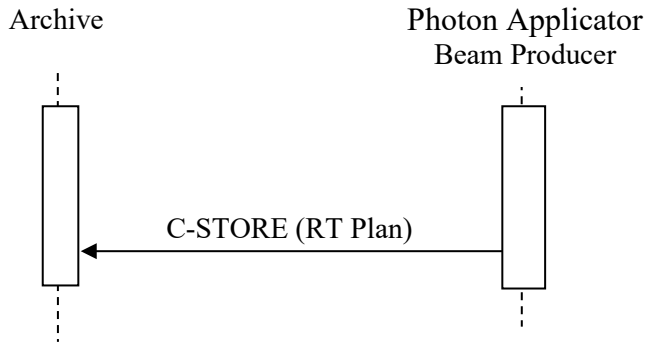


Figure 3.43.4-1: Interaction Diagram

3.43.4.1 Photon Applicator Beam Storage

3.43.4.1.1 Trigger Events

The Photon Applicator Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.43.4.1.2 Message Semantics

The Photon Applicator Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Photon Applicator Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Photon Applicator Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.43.4.1.2.1 Storage of RT Plan containing a Photon Applicator Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.43.4.1.2.2 Optional Modifiers

The Photon Applicator Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.43.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.43.5 Security Considerations

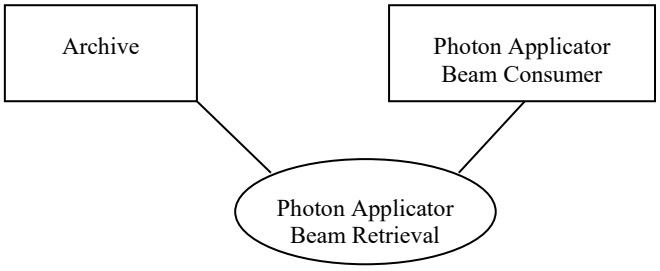
There are no specific security considerations.

3.44 Photon Applicator Beam Retrieval [RO-TPPC-26]

3.44.1 Scope

In the Photon Applicator Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-25: Photon Applicator Beam Storage, retrieves the plan from the Archive.

3.44.2 Use Case Roles



Actor:	Photon Applicator Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Photon Applicator Beam Consumer

3.44.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.44.4 Messages

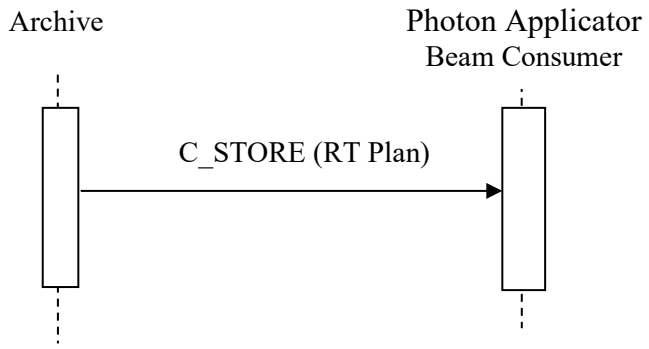


Figure 3.44.4-1: Interaction Diagram

3.44.4.1 Photon Applicator Beam Retrieval

3.44.4.1.1 Trigger Events

The Archive transfers the plan to the Photon Applicator Beam Consumer.

3.44.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Photon Applicator Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.44.4.1.2.1 Storage of RT Plan containing a Photon Applicator Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.44.4.1.2.2 Optional Modifiers

The Photon Applicator Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.44.4.1.3 Expected Actions

The Photon Applicator Beam Consumer stores the RT Plan.

3.44.5 Security Considerations

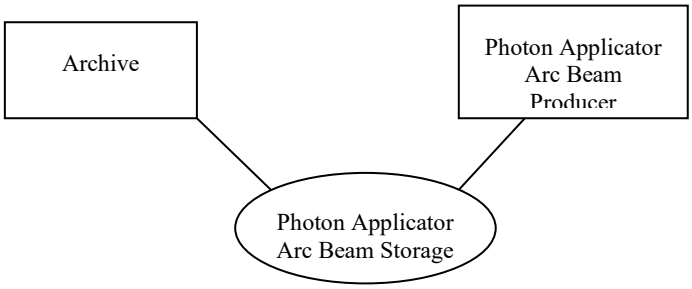
There are no specific security considerations.

3.45 Photon Applicator Arc Beam Storage [RO-TPPC-27]

3.45.1 Scope

In the Photon Applicator Arc Beam Storage transaction, a Producer of an RT Plan that incorporates the beam technique identified in TPPC-45: Photon Applicator Arc Beam Storage stores the plan to the Archive

3.45.2 Use Case Roles



Actor:	Photon Applicator Arc Beam Producer
Role:	Creates Basic Static Beam RT Plan and stores plan to an RT Archive
Actor:	Archive
Role:	Accept and store RT Plan from Photon Applicator Arc Beam Producer

3.45.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.45.4 Messages

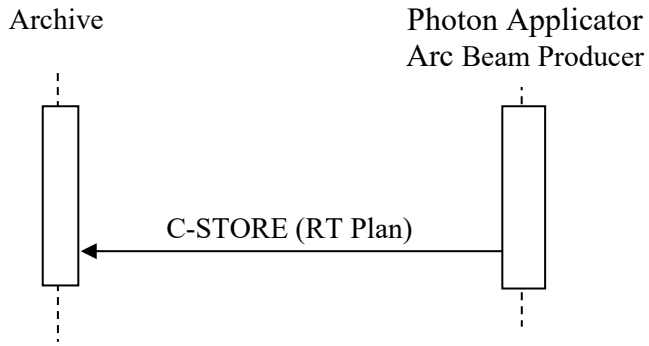


Figure 3.45.4-1: Interaction Diagram

3.45.4.1 Photon Applicator Arc Beam Storage

3.45.4.1.1 Trigger Events

The Photon Applicator Arc Beam Producer transfers the plan to the Archive once the plan is created and the dose calculation is finished.

3.45.4.1.2 Message Semantics

The Photon Applicator Arc Beam Producer uses the DICOM C-STORE message to transfer the plan.

The Photon Applicator Arc Beam Producer is the DICOM Storage SCU and the Archive is the DICOM Storage SCP.

The Photon Applicator Arc Beam Producer may create a new series containing the plan or may use an existing series, where previous plan(s) are contained.

The study where the series of the plan is contained shall be the same study as the one containing the structure set referenced in the plan.

3.45.4.1.2.1 Storage of RT Plan containing a Photon Applicator Arc Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.45.4.1.2.2 Optional Modifiers

The Photon Applicator Arc Beam Producer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.45.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.45.5 Security Considerations

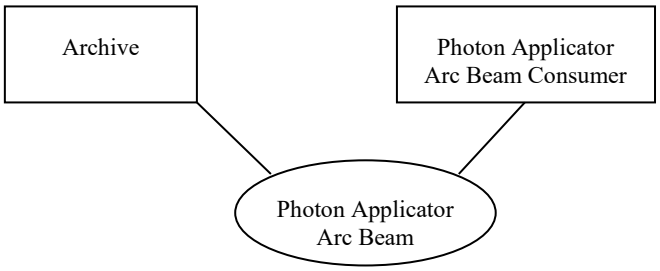
There are no specific security considerations.

3.46 Photon Applicator Arc Beam Retrieval [RO-TPPC-28]

3.46.1 Scope

In the Photon Applicator Arc Beam Retrieval transaction, a consumer of an RT Plan that incorporates the beam technique identified in TPPC-27: Photon Applicator Arc Beam Storage, retrieves the plan from the Archive.

3.46.2 Use Case Roles



Actor:	Photon Applicator Arc Beam Consumer
Role:	Stores plan transmitted from Archive
Actor:	Archive
Role:	Transmits Plan to Photon Applicator Arc Beam Consumer

3.46.3 Referenced Standards

DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.46.4 Messages

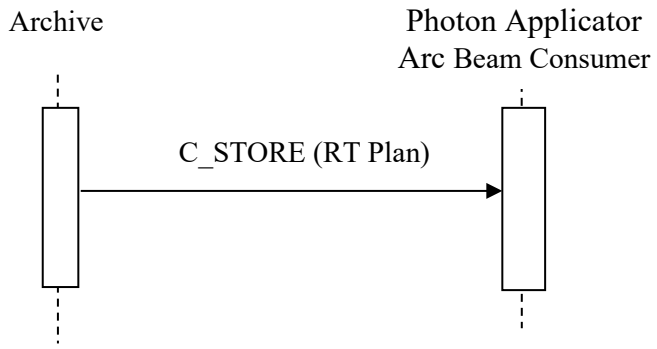


Figure 3.46.4-1: Interaction Diagram

3.46.4.1 Photon Applicator Arc Beam Retrieval

3.46.4.1.1 Trigger Events

The Archive transfers the plan to the Photon Applicator Arc Beam Consumer.

3.46.4.1.2 Message Semantics

The Archive uses the DICOM C-STORE message to transfer the plan.

The Archive is the DICOM Storage SCU and the Photon Applicator Arc Beam Consumer is the DICOM Storage SCP.

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.46.4.1.2.1 Storage of RT Plan containing a Photon Applicator Beam

Systems supporting the Treatment Planning - Plan Content Profile are required to support a number of attributes as described in the following tables and text. Many of these requirements build on attributes which are Type 2 or Type 3 in DICOM (such attributes are indicated with R+ or R+*).

All attributes in required modules for RT Plan as listed in RO TF-3: 7.3.2.1.

3.46.4.1.2.2 Optional Modifiers

The Photon Applicator Arc Beam Consumer may support the following optional modifications:

Optional Modifiers	Section
Bolus Beam Modifier	RO TF-3: 7.4.4.3.1

3.46.4.1.3 Expected Actions

The Photon Applicator Arc Beam Consumer stores the RT Plan.

3.46.5 Security Considerations

There are no specific security considerations.

3.58 Query Worklist for Treatment Sessions Workitems [RO-58]

3.58.1 Scope

In the Query Worklist for Treatment Sessions Workitems transaction, a TDD requests and receives worklists managed by a TMS.

3.58.2 Actor Roles

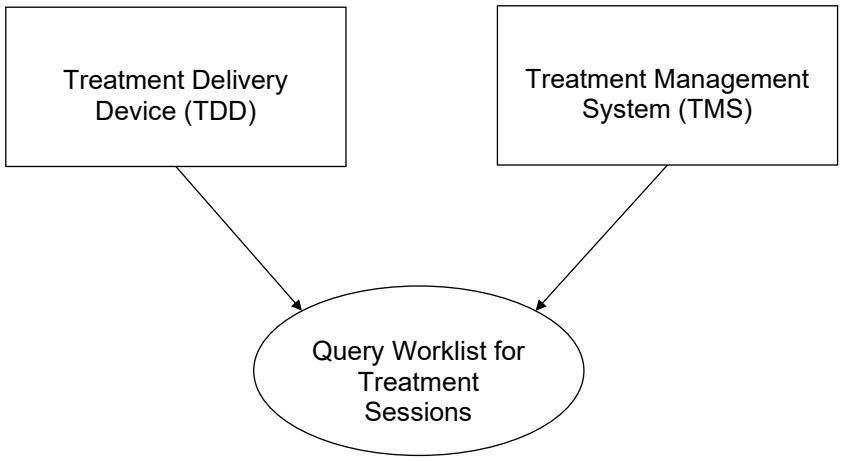


Figure 3.58.2-1: Use Case Diagram

Table 3.58.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Responds to a worklist query and sends the requested scheduled treatment sessions worklist to a TDD.
Actor:	Treatment Delivery Device
Role:	Queries a TMS and receives a scheduled treatment sessions worklist.

3.58.3 Referenced Standards

DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.58.4 Messages

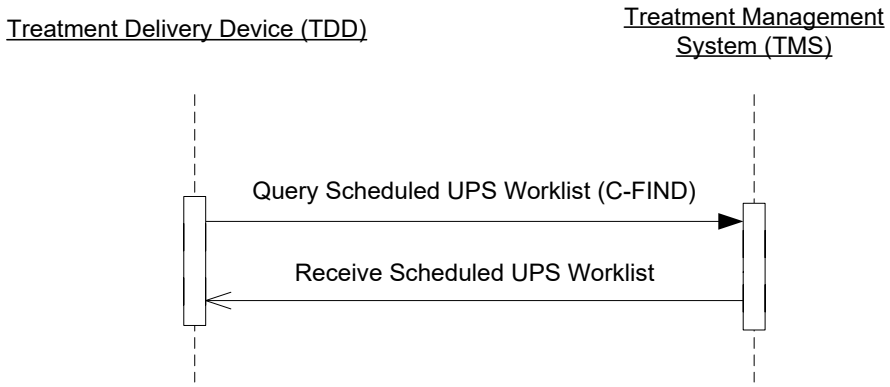


Figure 3.58.4-1: Interaction Diagram

3.58.4.1 Query Scheduled UPS Worklist Message

This is the worklist query message sent to the Treatment Management System.

3.58.4.1.1 Trigger Events

The user of the TDD, in order to deliver a treatment session, requests that the TMS send a scheduled treatment sessions worklist.

3.58.4.1.2 Message Semantics

The TDD uses the C-FIND request of the DICOM UPS – Pull SOP Class to query the desired worklist on the TMS. The TDD performs the SCU role, and the TMS performs the SCP role. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, and used as the Affected SOP Class in the C-FIND request (see DICOM Standard P3.4 CC.2.8.1.2.1).

Matching Keys and Return Keys for Display

The TMS replies to the query with a set of zero or more UPS C-FIND RSP containing scheduled treatment sessions worklist items, followed by a C-FIND final response. The expected content of the scheduled treatment sessions worklist items as created by the TMS is defined in section 7.5.1.

Matching Key and Return Key requirements are defined in section 7.5.2.1.

3.58.4.1.3 Expected Actions

The TMS retrieves the matching scheduled procedures, and sends the DICOM UPS Worklist responses to the requesting TDD.

3.58.4.2 Receive Scheduled UPS Worklist Message

This is the query response message that the Worklist Manager (TMS) sends to the TDD as a reply containing relevant DICOM UPS information.

3.58.4.2.1 Trigger Events

The TDD receives the UPS as requested by the query.

3.58.4.2.2 Message Semantics

For the Query Worklist for Treatment Sessions Workitems transaction one or more Unified Procedure Step (UPS C-FIND RSP in the 'pending' state) shall be returned for each matching treatment session.

Requirements on the Return Key values in the C-FIND RSP are defined in section 7.5.2.1.

3.58.4.2.3 Expected Actions

On reception of the UPS, the TDD will prepare to the execution of the UPS.

Exception Handling for Unexpected UPS

In case the C-FIND RSP contains one or more UPS which are unsupported by the TDD, the TDD shall display the unsupported UPS and disable their execution. At least the following tags out of the Scheduled Workitem Code Sequence (0040,4018) shall be displayed to provide information about the requested intent of the appropriate UPS:

- Patient Name
- Patient ID
- Scheduled Station Name Sequence/Code Meaning
- Scheduled Workitem Code Sequence/Code Meaning

3.58.5 Protocol Requirements

NA

3.58.6 Security Considerations

See section 9.5 TDW-II Security Considerations.

3.59 Retrieve Static Treatment Delivery Input Instances [RO-59]

3.59.1 Scope

In the Retrieve Static Treatment Delivery Input Instances transaction, A TDD requests and receives from the OST any 'static' SOP Class Instances required to perform the treatment delivery task of the workitem.

3.59.2 Actor Roles

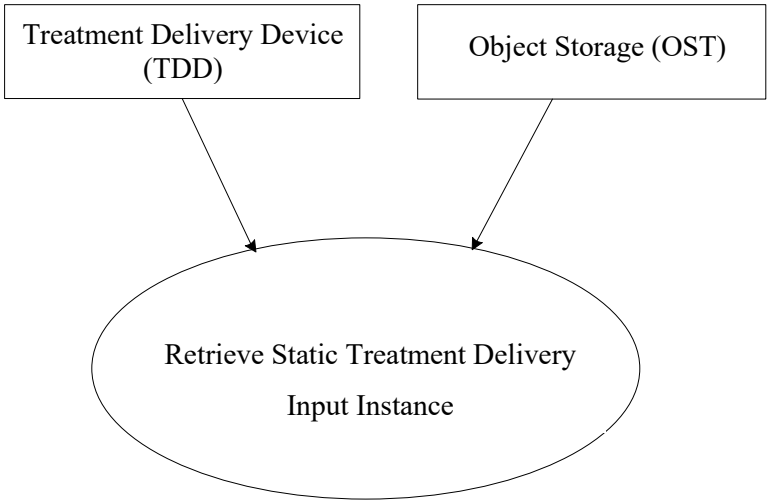


Figure 3.59.2-1: Use Case Diagram

Table 3.59.2-1: Actor Roles

Actor:	Object Storage
Role:	Sends requested DICOM objects to the TDD
Actor:	Treatment Delivery Device
Role:	Receives requested DICOM objects from the OST

3.59.3 Referenced Standards

DICOM PS 3.3: RT Modules

DICOM PS 3.4: Storage Service Class

DICOM PS 3.4: Query/Retrieve Service Class

3.59.4 Messages

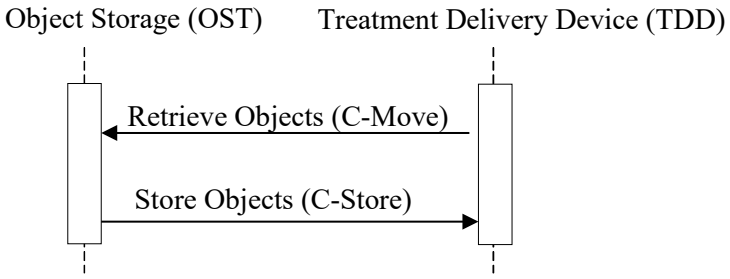


Figure 3.59.4-1: Interaction Diagram

3.59.4.1 Retrieve Objects Message

The Study Root Query/Retrieve Information Model – MOVE SOP Class shall be supported. SCP implementations shall support the instance-level mode of operation in which specific SOP Instances are retrieved from the OST using a Study Root C-MOVE. Refer to DICOM PS 3.4, Annex C, for detailed descriptive semantics.

A TDD shall be capable of issuing a Study Root C-MOVE at the instance level for the RT Plan/RT Ion Plan SOP Instance that is specified in the Input Information Sequence. A TDD may also be capable of retrieving other instances, but this is not required. Other mechanisms for obtaining the data (such as an independent C-STORE or restoring from a DICOM medium) shall not be permitted.

A TDD may receive SOP Instances in the Input Information Sequence for which it determines that it cannot perform the Procedure Step safely. In such cases:

- If the Procedure Step is not yet “IN PROGRESS”, the resolution is out of the scope of this profile.
- If the Procedure Step is already set “IN PROGRESS”, the TDD shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

3.59.4.1.1 Trigger Events

The TDD, in order to perform a treatment delivery, requests one or more of the referenced objects in the Input Information Sequence (0040,4021) of the selected procedure step, after the Input Readiness State (0040,4041) is set to “READY”

3.59.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Object Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the TDD (SCU) to the OST.

The TDD is required to issue a C-MOVE request for at least one instance of an RT Plan/RT Ion Plan IOD supplied in the Input Information Sequence of one or more returned UPS instances. It may also request other input instances (such as CT data sets, structure sets, dose, etc.), but is not required to do so. It may not request instances that are not supplied in the Input Information Sequence of one or more returned UPS instances.

A participating OST shall support this transaction for at least the RT Plan/RT Ion Plan IOD and for RT Beams Treatment Record Storage/RT Ion Beams Treatment Record Storage SOP instances from previous deliveries. Support of other IODs is permitted (e.g., SC Image for patient photo).

It is assumed that some requested objects have been placed in the OST by a means outside the scope of this IHE-RO profile. Typically, C-STORE operations from a Treatment Planning System or central Archive would have been performed previously to achieve this goal.

In implementations where the TDD manages DICOM objects itself, it may well have pre-fetched and processed the required objects, in which case the UIDs supplied in the Input Information Sequence (0040,4021) of the selected procedure step would be sufficient to locate the necessary data, and no retrievals would be necessary. However, in this profile the RT Plan/RT Ion Plan Instance shall be retrieved using C-MOVE.

The OST shall be capable of supplying at least the following SOP Class:

Table 3.59.4-1 SOP Class Support for OST on C-MOVE Request

SOP Class Name	SOP Class UID
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.6
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9

The display requirements of 7.3.2.1.2 RT Plan IOD for Photon External Beam in Delivery State are not applicable in this transaction.

3.59.4.1.3 Expected Actions

The OST receives the C-MOVE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Classes to transfer the requested objects.

The requesting TDD is then expected to use the requested objects in performing the selected procedure step. In cases where the TDD manages DICOM objects itself, this may be limited to ensuring that the supplied RT Plan/RT Ion Plan instance is consistent with internally stored data.

3.59.5 Protocol Requirements

NA

3.59.6 Security Considerations

See section 9.5 TDW-II Security Considerations.

3.60 Claim Treatment Session Workitem [RO-60]

3.60.1 Scope

In the Claim Treatment Session Workitem transaction, a TDD signals to the TMS that responsibility has been taken for the performing of the selected procedure step.

3.60.2 Actor Roles

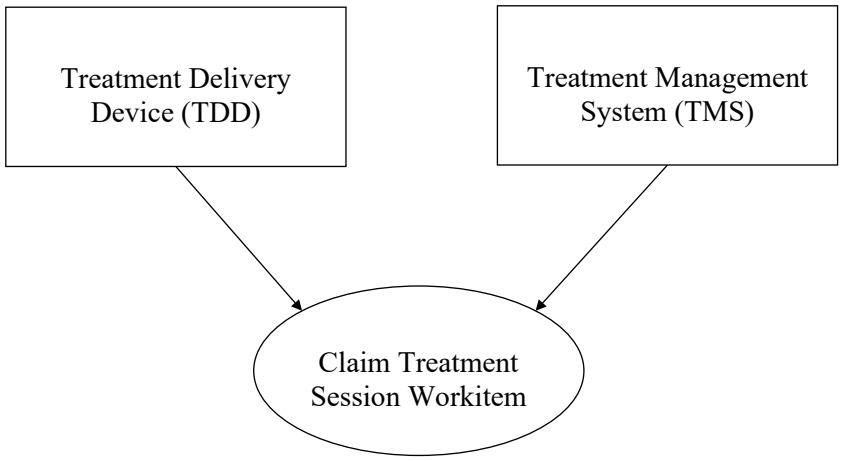


Figure 3.60.2-1: Use Case Diagram

Table 3.60.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Responds to a UPS N-ACTION and recognizes the specified UPS as in progress, thereby preventing any other Actors from performing the step. Receives and saves the Transaction UID as 'Locking UID'
Actor:	Treatment Delivery Device
Role:	Signals using UPS N-ACTION that the selected procedure step is in progress. Generates and sends Transaction UID.

3.60.3 Referenced Standards

DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.60.4 Messages

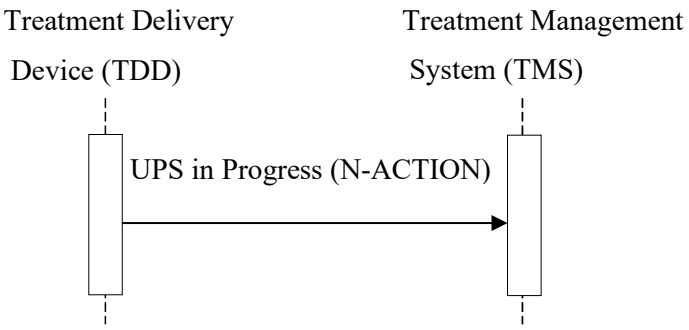


Figure 3.60.4-1: Interaction Diagram

3.60.4.1 UPS in Progress Message

The TDD uses the UPS N-ACTION service to inform the TMS that the specified scheduled Unified Procedure Step has been started and is in progress. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Requested SOP Class UID of the UID of the UPS in all subsequent DIMSE messaging (see DICOM Standard, P3.4 CC.2.8.1.2.1). The TDD generates and sends a Transaction UID that will be used by the Worklist Manager (TMS) as a 'Locking UID' to prevent other Actors from updating the UPS.

3.60.4.1.1 Trigger Events

The TDD has successfully queried and selected a suitable procedure step.

If the UPS Input Information sequence is not empty and includes 'dynamic' input instances, the TDD may have retrieved these instances using [RO-61] prior to this step.

If the UPS Input Information sequence is not empty and include an RT Plan/RT Ion Plan Instance, the TDD shall not be permitted to perform this transaction if this instance has not previously been obtained using [RO-59].

3.60.4.1.2 Message Semantics

The message semantics are defined in DICOM Standard. The value of the Procedure Step State (0074,1000) shall be 'IN PROGRESS'.

3.60.4.1.3 Expected Actions

The TDD SCU sends an N-ACTION request to the TMS SCP to change the state of a UPS Instance from 'SCHEDULED' to 'IN PROGRESS'. Included in the N-ACTION request is a SCU generated Transaction UID. This Transaction UID is used in all subsequent DIMSE messaging for that UPS Instance.

Upon successfully changing the state of a UPS instance to 'IN PROGRESS', the SCP shall record the Transaction UID provided by the SCU in the Transaction UID (0008,1195) of the UPS instance.

Upon successful completion of the N-ACTION request, the SCP shall return, via the N-ACTION response primitive, the N-ACTION Status Code of 0000H (Success). The TMS shall then be ready to receive UPS N-SET or UPS N-ACTION commands.

If the requested procedure step cannot be performed because the Unified Procedure Step is already IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Standard PS 3.4 Table CC.2.1-2 shall be returned. The TMS shall then be capable of accepting further UPS N-ACTION requests or worklist queries.

3.60.5 Protocol Requirements

NA

3.60.6 Security Considerations

Not applicable.

3.61 Retrieve Dynamic Treatment Delivery Input Instances [RO-61]

3.61.1 Scope

In the Retrieve Dynamic Treatment Input Instances from TMS transaction, the TDD requests and receives SOP Class Instances from the TMS in order to support execution of the requested procedure step. These requested instances are of a "transient" nature, typically generated 'on-the-fly' by the TMS.

3.61.2 Actor Roles

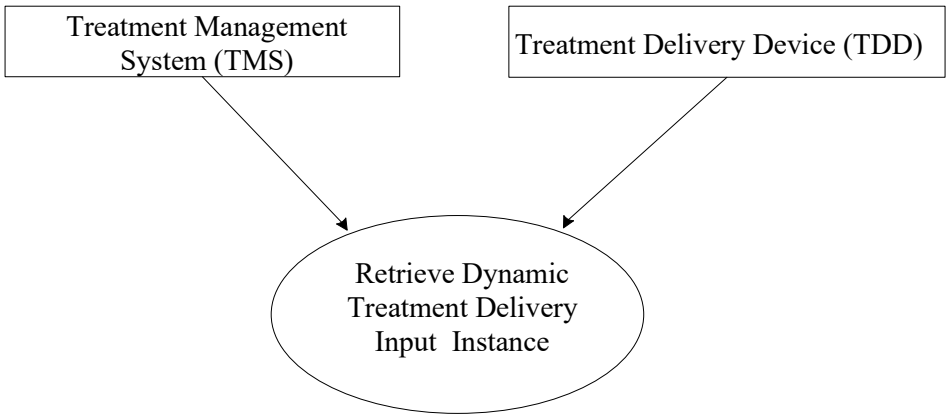


Figure 3.61.2-1: Use Case Diagram

Table 3.61.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Sends requested DICOM objects to the TDD

Actor:	Treatment Delivery Device
Role:	Retrieves requested DICOM objects from the TMS

3.61.3 Referenced Standards

DICOM PS 3.3

DICOM PS 3.4: Storage Service Class

DICOM PS 3.4: Query/Retrieve Service Class

3.61.4 Messages

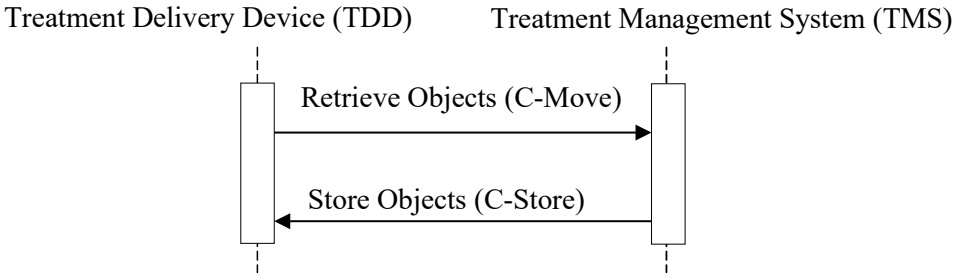


Figure 3.61.4-1: Interaction Diagram

3.61.4.1 Retrieve Objects Message

The Study Root Query/Retrieve Information Model - MOVE SOP Class shall be supported to the Instance-level. Implementations shall support a mode of operation in which specific SOP Instances (rather than entire studies) are retrieved from the TMS using a Study Root C–MOVE. Refer to DICOM PS 3.4, Annex C, for detailed descriptive semantics.

A TDD SCU shall be capable of issuing Study-Root C-MOVE for the RT Beams Delivery Instruction Storage SOP Instance that is specified in the Input Information Sequence. Other mechanisms for obtaining the data (such as an independent C-STORE or restoring from a DICOM medium) shall not be permitted.

A TDD may receive SOP Instances in the Input Information Sequence for which it determines that it cannot perform the Procedure Step safely. In such cases:

If the Procedure Step is not yet “IN PROGRESS”, the resolution is out of the scope of this profile.

If the Procedure Step is already “IN PROGRESS”, the TDD shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

3.61.4.1.1 Trigger Events

The TDD has successfully queried and selected a suitable procedure step. It may also have set the UPS in progress using [RO-60] prior to this step.

The TDD shall not be permitted to perform this transaction on a UPS for which the RT Plan/RT Ion Plan Instance supplied in its Input Instance Sequence has not previously been obtained using [RO-59].

The TDD shall only perform this transaction after the Input Readiness State (0040,4041) is set to "READY".

3.61.4.1.2 Message Semantics

The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Object Storage SOP Classes.

A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class, instance-level shall be sent from the TDD (SCU) to the Treatment Management System (SCP).

The TDD is required to issue a C-MOVE request for the instance of the RT Beams Delivery Instruction Storage IOD supplied in the Input Information Sequence of the UPS instance. It may also request other input instances, but is not required to do so. It may not request instances that were not supplied in the Input Information Sequence of the UPS instance.

The TMS shall be capable of supplying at least the following SOP Class:

Table 3.61-1 Required SOP Class Support for TMS on C-MOVE Request

SOP Class Name	SOP Class UID	DICOM Content Specification
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.7	See 7.3.9.1.1 RT Beams Delivery Instruction IOD

The TDD shall specify the SOP Class UID of the RT Beams Delivery Instruction Storage in the attributes of the C-MOVE RQ Identifier.

Note: The Affected SOP Class UID of the C-MOVE RQ is always set to the SOP Class of the Study Root Query/Retrieve Information Model. However, to allow a TMS to dynamically determine if the RT Beams Delivery Instruction IOD should be created along TDW or TDW-II, it has to know the requested SOP Class UID. To keep the TMS stateless this should not be determined on the negotiated transfer syntax on the initial association for the Worklist Query for Treatment Delivery [RO-58].

3.61.4.1.3 Expected Actions

The TMS receives the C-MOVE request, establishes a DICOM association with the requesting TDD, and uses the appropriate DICOM SOP Classes to transfer the requested object(s).

The requesting actor is then expected to use the requested object(s) in the performing of the selected procedure step.

When the RT Beams Delivery Instruction SOP Instance referenced in the Input Information Sequence of the UPS response will have the value 'CONTINUATION' in the Treatment Delivery Type (300A,00CE) for certain beam(s), the Treatment Delivery Device is expected to treat those

beams by resuming the previous partial treatment, observing the Continuation Start Meterset (0074,0120), and Continuation End Meterset (0074,0121).

Beams which have the value 'TREATMENT' in the Treatment Delivery Type (300A,00CE) are expected to be treated completely.

The user shall be informed about the scope of upcoming beam delivery of the beams included in the RT Plan/RT Ion Plan along with the information provided in RT Beams Delivery Instruction SOP Instance. If the user decides to treat the plan otherwise, an elevated sign-off shall be required.

The Current Fraction Number (3008,0022) shall be used to display the number of the fraction to be treated and shall be inserted in the treatment records which are created and sent back to the Object Storage.

3.61.5 Protocol Requirements

NA

3.61.6 Security Considerations

See section 9.5 TDW-II Security Considerations.

3.62 Update Treatment Delivery Progress [RO-62]

3.62.1 Scope

In the Update Treatment Delivery Progress transaction, a TDD signals to the TMS any changes in the progress of the procedure step that is currently in progress.

3.62.2 Actor Roles

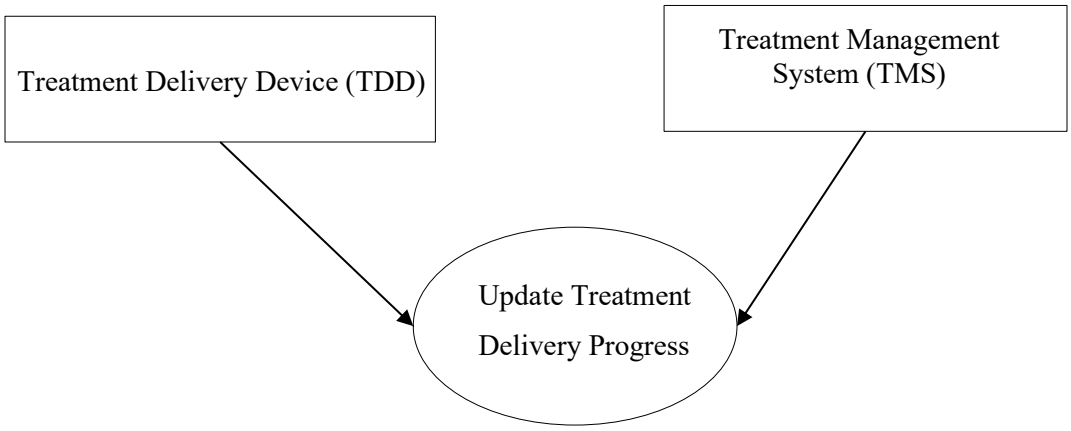


Figure 3.62.2-1: Use Case Diagram

Table 3.62.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Responds to a UPS N-SET and updates attributes in the specified Unified Procedure Step.
Actor:	Treatment Delivery Device
Role:	Signals using UPS N-SET that progress related to the selected procedure step has changed

3.62.3 Referenced Standards

DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.62.4 Messages

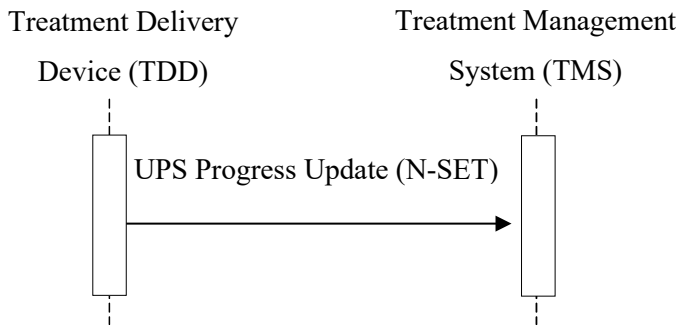


Figure 3.62.4-1: Interaction Diagram

3.62.4.1 UPS Progress Update Message

The TDD uses the UPS N-SET service to inform the TMS that progress relating to the specified Unified Procedure Step has changed. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Standard, PS3.4 CC.2.8.1.2.1).

3.62.4.1.1 Trigger Events

The TDD is in the process of performing the procedure step, and notifies the TMS of changes in the progress of the procedure step. Specifically:

The TDD has fetched necessary input data, and notifies the TMS that work is about to start on treatment delivery by indicating progress of 0%.

The TDD started work on treatment delivery and notifies the TMS that the treatment delivery started by indicating progress of greater than 0% and less than 100%. This indicates that the system entered a state where the system is ready to deliver therapeutic irradiation as specified in the treatment beams referenced by the UPS.

During delivery, the TDD may notify the TMS repeatedly that work has advanced by indicating progress of greater than 0% and less than 100%

It's at the discretion of the TDD how the overall progress of treatment delivery is reflected in the numerical procedure step progress indicator. The TMS shall not use this to somehow determine the total amount of MU delivered.

3.62.4.1.2 Message Semantics

The message semantics are defined in the DICOM Standard.

Requirements for SCUs using the UPS N-SET command are defined in Section 7.5.2.2. Note that at least one of the N-SET commands issued for a given UPS must contain the UPS Performed Procedure Sequence (0074,1216). The Final State requirements for the UPS may be met by this transaction in the case where the UPS is subsequently cancelled prior to radiation delivery, but if not, they shall ultimately be met by Treatment Delivery Final Update [RO-64].

The TMS shall then remain in the state it was in before the N-SET was received.

3.62.4.1.3 Expected Actions

The TMS receives the updates and updates its internal state as needed.

3.62.5 Protocol Requirements

NA

3.62.6 Security Considerations

Not applicable.

3.63 Store Treatment Delivery Results [RO-63]

3.63.1 Scope

In the Store Treatment Delivery Results transaction, when a treatment delivery procedure step has been performed by a TDD, the results of the treatment delivery operation are stored to the OST. These results shall subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

3.63.2 Actor Roles

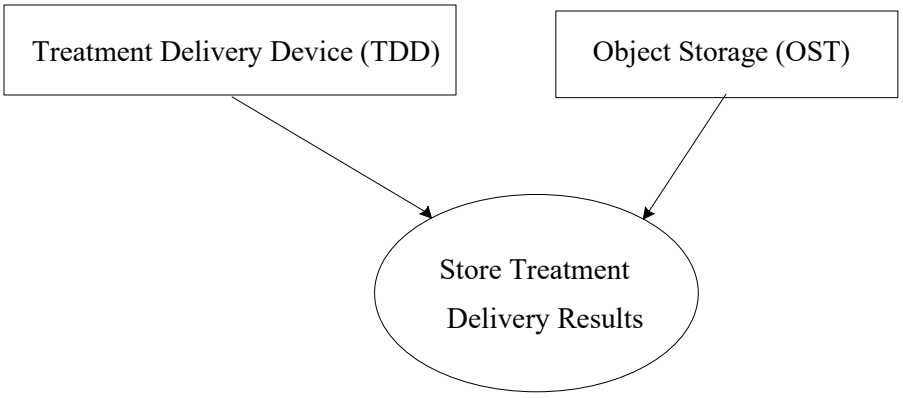


Figure 3.63.2-1: Use Case Diagram

Table 3.63.2-1: Actor Roles

Actor:	Object Storage
Role:	Responds to a C-STORE request and stores the transmitted objects.
Actor:	Treatment Delivery Device
Role:	Stores the output of the treatment delivery operation to the OST

3.63.3 Referenced Standards

DICOM PS 3.4: Storage Service Class

3.63.4 Messages

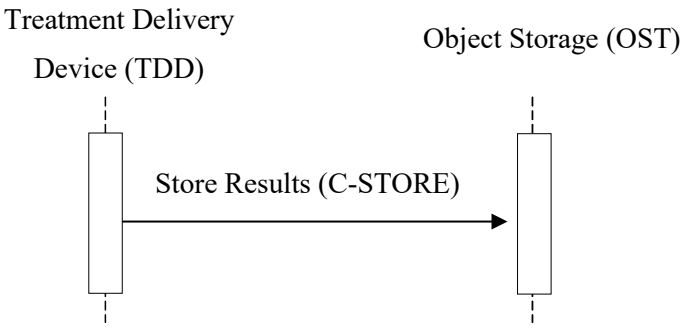


Figure 3.63.4-1: Interaction Diagram

3.63.4.1 Store Results Message

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes as specified below shall be supported by the OST as an SCP. Refer to DICOM PS 3.4, Annex C, for detailed descriptive semantics.

3.63.4.1.1 Trigger Events

The TDD has started a treatment delivery and stores the generated results of the delivery operation.

When the TDD completes or cancels a treatment session and progress is greater than 0%, it shall invoke this transaction. When progress is equal to 0%, this transaction is optional.

3.63.4.1.2 Message Semantics

The message semantics are defined by the DICOM Object Storage SOP Classes.

UPS does not specify the location to which output objects should be stored. Where objects shall be stored is defined by provider of the TMS Actor at the discretion of the provider.

In implementations where the TDD maintains a local storage of the RT Plan/RT Ion Plan SOP instances, Patient Name, Patient ID, Patient DOB, Patient Sex attributes values of local data may differ from those in the SOP instances retrieved from the OST. In such cases, it is allowed for the TDD to populate the static objects containing the Treatment Delivery Results such as records and images with the values of the locally stored objects, instead of the ones retrieved from the OST.

A participating TDD shall support this transaction for at least one of the SOP class listed in Table 3.63.4-1.

Table 3.63.4-1 SOP Class Support for TDD (SCU)

SOP Class Name	SOP Class UID
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9

A participating OST shall support this transaction for at least one of the SOP class listed in Table 3.63.4-2.

Table 3.63.4-2 SOP Class Support for OST (SCP)

SOP Class Name	SOP Class UID
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Ion Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.9

3.63.4.1.3 Expected Actions

The OST stores the objects received.

The TMS shall retrieve the object content from the OST by any means and present the accumulated dose values to the user allowing them to observe the progress of treatments.

3.63.5 Protocol Requirements

NA

3.63.6 Security Considerations

See section 9.5 TDW-II Security Considerations.

3.64 Update Workitem to Final State [RO-64]

3.64.1 Scope

In the Update Workitem to Final State transaction, a TDD signals to the TMS any changes in the properties of the procedure step prior to setting the UPS to COMPLETED or CANCELED.

3.64.2 Actor Roles

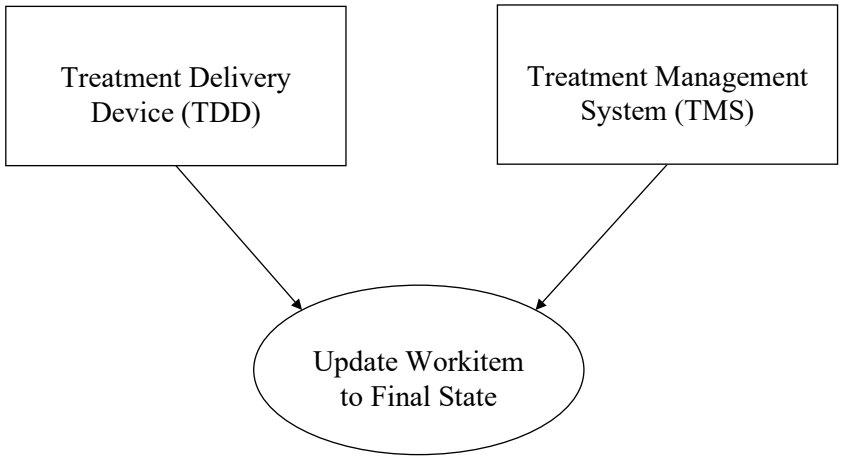


Figure 3.64.2-1: Use Case Diagram

Table 3.64.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Responds to a UPS N-SET and updates attributes in the specified Unified Procedure Step.
Actor:	Treatment Delivery Device

Role:	Signals using UPS N-SET that certain attributes related to the selected procedure step have changed

3.64.3 Referenced Standards

DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.64.4 Messages

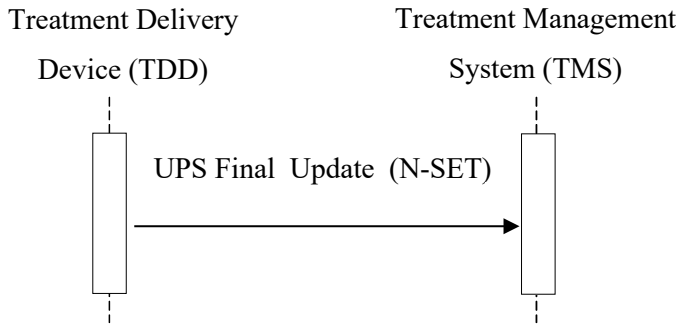


Figure 3.64.4-1: Interaction Diagram

3.64.4.1 UPS Final Update Message

The TDD uses the UPS N-SET service to inform the TMS that certain attributes relating to the specified Unified Procedure Step have changed.

3.64.4.1.1 Trigger Events

The TDD has finished the execution of the procedure step.

When progress is equal to 0%, this transaction is not required to be performed if the Final State conditions have already been met by previous Progress Update transaction(s).

3.64.4.1.2 Message Semantics

The message semantics are defined in DICOM Standard. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Standard, P3.4 CC.2.8.1.2.1).

Requirements for SCUs using the UPS N-SET command are defined in Section 7.5.2.3.

3.64.4.1.3 Expected Actions

The TMS receives the N-SET request and sends an N-SET response. The Transaction UID (0008,1195) shall always be supplied.

If the requested procedure step has been successfully updated, the TMS shall send an N-SET response with a status code of 0000H (success). The Treatment Management System shall then be ready to receive further N-SET or N-ACTION commands.

If the requested procedure step was not successfully updated, the TMS shall send an N-SET response with a failure (non-zero) status code. The TMS shall then be ready to receive further N-SET or N-ACTION commands.

If the requested procedure step cannot be updated because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-SET response with a status code as described in DICOM Standard P3.4 Table CC.2.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

3.64.5 Protocol Requirements

NA

3.64.6 Security Considerations

Not applicable.

3.65 Complete/Cancel Treatment Delivery [RO-65]

3.65.1 Scope

In the Complete/Cancel Treatment Delivery transaction, a TDD signals to the TMS that the selected procedure step has either been completed or canceled.

3.65.2 Actor Roles

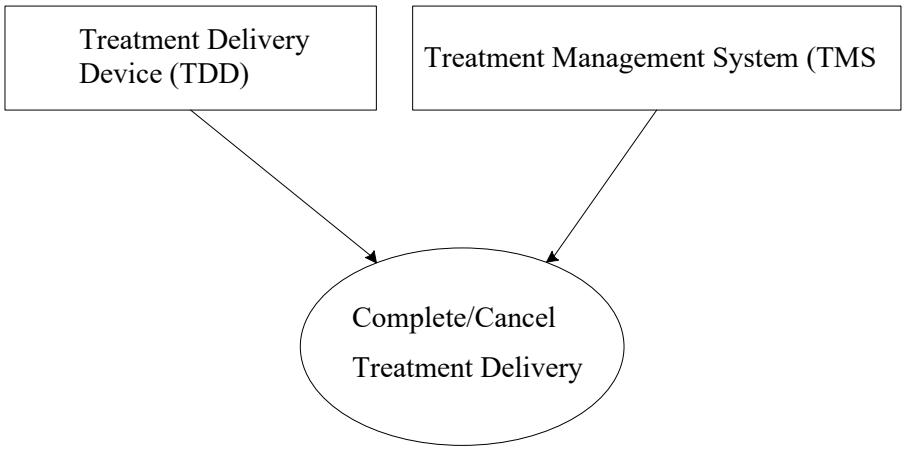


Figure 3.65.2-1: Use Case Diagram

Table 3.65.2-1: Actor Roles

Actor:	Treatment Management System

Role:	Responds to a UPS N-ACTION and sets the specified Unified Procedure Step as completed or canceled
Actor:	Treatment Delivery Device
Role:	Signals using UPS N-ACTION that the selected procedure step is completed or canceled.

3.65.3 Referenced Standards

DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.65.4 Messages

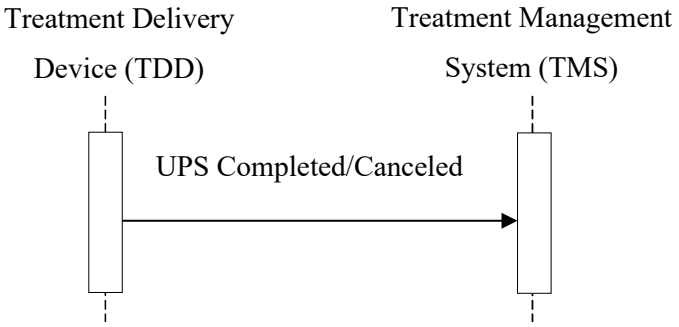


Figure 3.65.4-1: Interaction Diagram

3.65.4.1 UPS Completed/Canceled Message

The TDD uses the UPS N-ACTION service to inform the TMS that the specified Unified Procedure Step has been completed or canceled. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Referenced SOP Class UID of an UPS in all subsequent DIMSE messaging (see DICOM Standard, PS 3.4 CC.2.8.1.2.1).

3.65.4.1.1 Trigger Events

The TDD has successfully completed the procedure step, or has not been able to complete the procedure step and has determined that processing should be stopped and the Treatment Management System notified.

3.65.4.1.2 Message Semantics

The message semantics are defined in DICOM Standard. The value of the Procedure Step State (0074,1000) shall be ‘COMPLETED’ or ‘CANCELED’.

3.65.4.1.3 Expected Actions

The TMS receives the N-ACTION request and sends an N-ACTION response. The Transaction UID (0008,1195) shall always be supplied.

If the requested procedure step has been successfully completed (i.e., the received Procedure Step State (0074,1000) has a value of 'COMPLETED'), the TMS shall send an N-ACTION response echoing a Procedure Step State (0074,1000) of 'COMPLETED' and a status code of 0000H (success). The Treatment Management System shall then be ready to receive new worklist queries for this TDD.

If the requested procedure step was not successfully completed (i.e., the received Procedure Step State (0074,1000) has a value of 'CANCELED'), the TMS shall send an N-ACTION response echoing a Procedure Step State (0074,1000) of 'CANCELED' and a status code of 0000H (success). The TMS shall then be ready to receive new worklist queries. The TMS is not required to signal the cancellation with an N-EVENT-REPORT in this transaction. Note that if the requested procedure step was retrieved and locked, but never started (e.g., the user abandoned delivery, or the TDD determined that the retrieved plan was not deliverable), then Procedure Step Progress shall be set at 0%.

If the requested procedure step cannot be marked as completed or canceled because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Standard P3.4 Table CC.2.1-shall be returned. The TMS shall then remain in the state it was in before the N-ACTION was received.

DICOM Standard outlines the final state requirements for the UPS N-ACTION command, i.e., the attributes which must be valued before the procedure step can pass into the COMPLETED or CANCELED state. The stated requirements for Update Treatment Delivery Progress [RO-62], Treatment Delivery in Progress [RO-60] and Update Workitem to Final State transaction [RO-64] ensure that these conditions are met.

Table 3.65.2-2 defines how the partial or completed status of Treatment (Tx) Delivery can be determined based on Procedure Step State and Procedure Step Progress of the UPS. Treatment Delivery refers to the delivery of therapeutic irradiation as specified in the treatment beams referenced by the UPS. In any case, determination of what has been actually delivered during the treatment session, requires to check the content of the treatment record(s) as well.

Table 3.65.2-2: Status of (therapeutic) Tx Delivery

Procedure Step State (0074,1000)	Procedure Step Progress	Output Information Sequence (see also 7.5.2.3.2)	Status of (therapeutic) Tx Delivery
CANCELED	0%	May contain Tx Record(s) with delivered meterset equal 0	No Tx delivered
CANCELED	0% < progress < 100%	Shall contain Tx Record(s) with delivered meterset >= 0	Tx partially delivered
COMPLETED	100% (Note 1)	Shall contain Tx Record(s) with delivered meterset > 0	Tx fully delivered as requested

Note 1: Procedure Step State of COMPLETED is a strong enough statement that the intended task of the UPS was performed as expected (independent on the actual Procedure Step Progress). Nevertheless, the TDD shall set the Procedure Step Progress to 100% as part of the Treatment Delivery Final Update [RO-64] transaction.

3.65.5 Protocol Requirements

NA

3.65.6 Security Considerations

Not applicable.

Appendices to Volume 2

None

Glossary

Please see the IHE Technical Frameworks General Introduction, Appendix D - Glossary for the IHE Glossary.

