

Integrating the Healthcare Enterprise



5 **IHE Radiation Oncology (RO)
Technical Framework**

10 **Volume 2
IHE RO TF-2
Transactions**

15

20 **Revision 4.0 - Final Text
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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

435 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.

440 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.

445 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
- 450 • 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.
- 455 • 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.

460 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.

465 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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500 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 <i>Basic Radiation Therapy Objects</i> 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. |
| MAY 2026 | 4.0 | Updated per CP-RO-026 |

2 Conventions

505 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

510 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

520 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.

525 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.

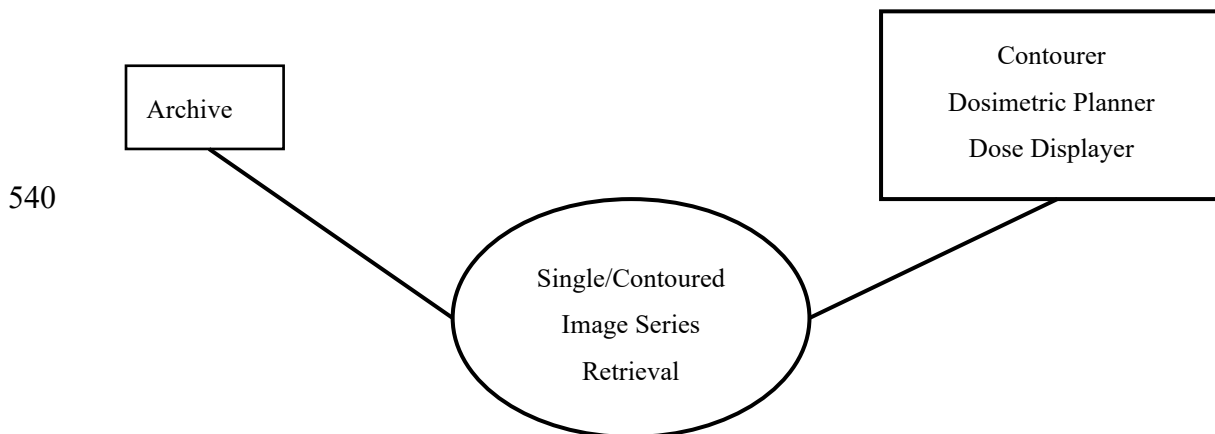
530 3.1 Single/Contoured Image Series Retrieval [RO-1]

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

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

3.1.2 Use Case Roles



545

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

550 3.1.3 Referenced Standards

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

3.1.4 Messages

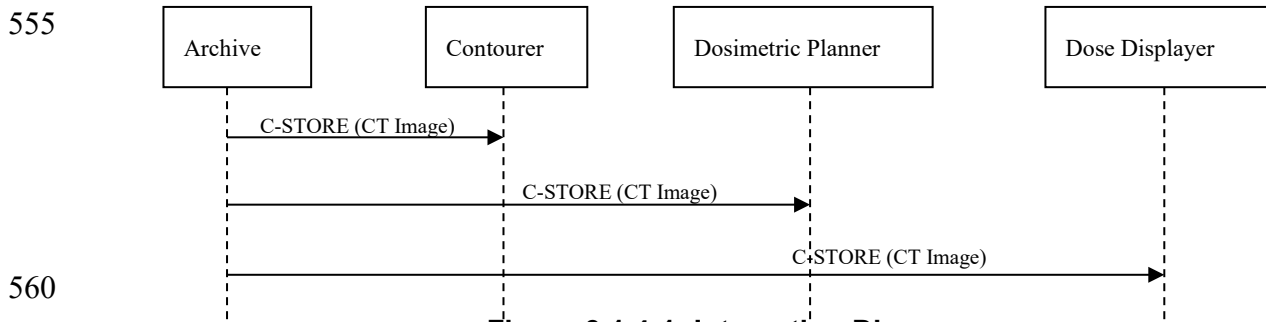


Figure 3.1.4-1: Interaction Diagram

3.1.4.1 Single/Contoured Image Series Retrieval

3.1.4.1.1 Trigger Events

565 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*.

570 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

575 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

580 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]).

585 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.

590 **3.1.5 Security Considerations**

There are no explicit security considerations.

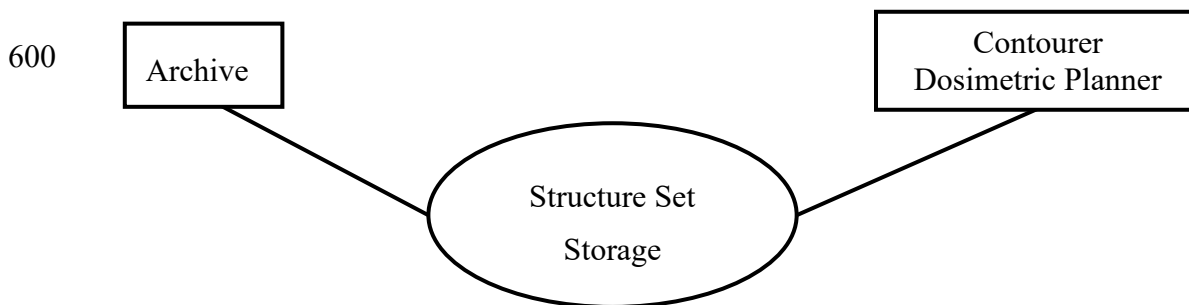
3.2 Structure Set Storage [RO-2]

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

595 **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

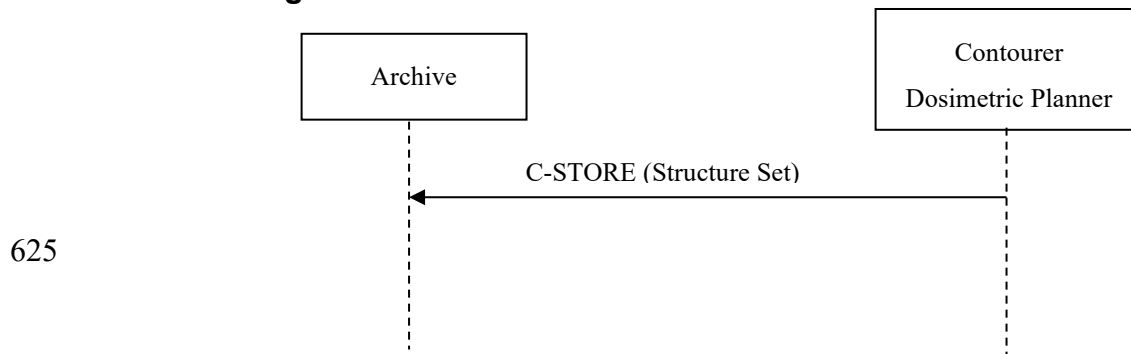
Actor: Archive

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

610 **3.2.3 Referenced Standards**

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

615

620 **3.2.4 Messages****Figure 3.2.4-1: Interaction Diagram****3.2.4.1 Structure Set Storage**630 **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.

635 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)
640 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.

645 **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.

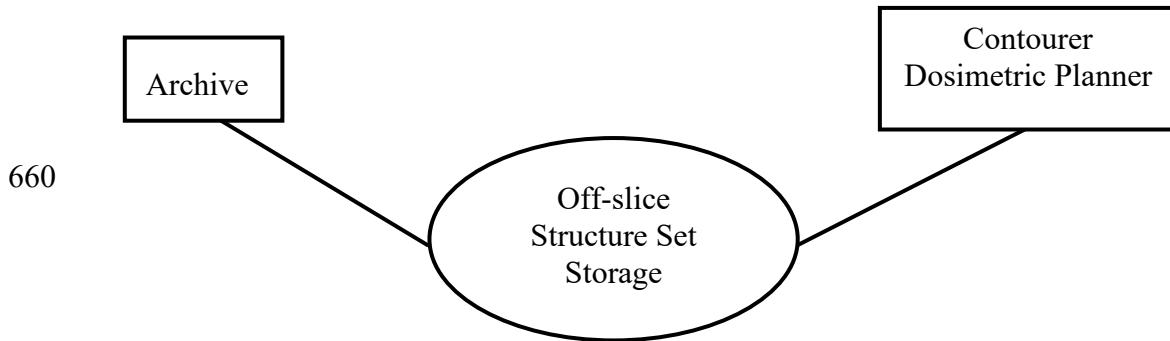
650 **3.3 Off-slice Structure Set Storage [RO-BRTO-II-1]**

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

655 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



665 **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

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

3.3.4 Messages

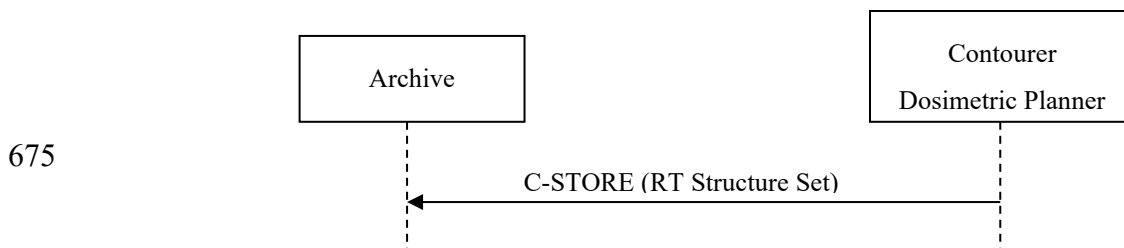


Figure 3.3.4-1: Interaction Diagram

3.3.4.1 Structure Set Storage

680 3.3.4.1.1 Trigger Events

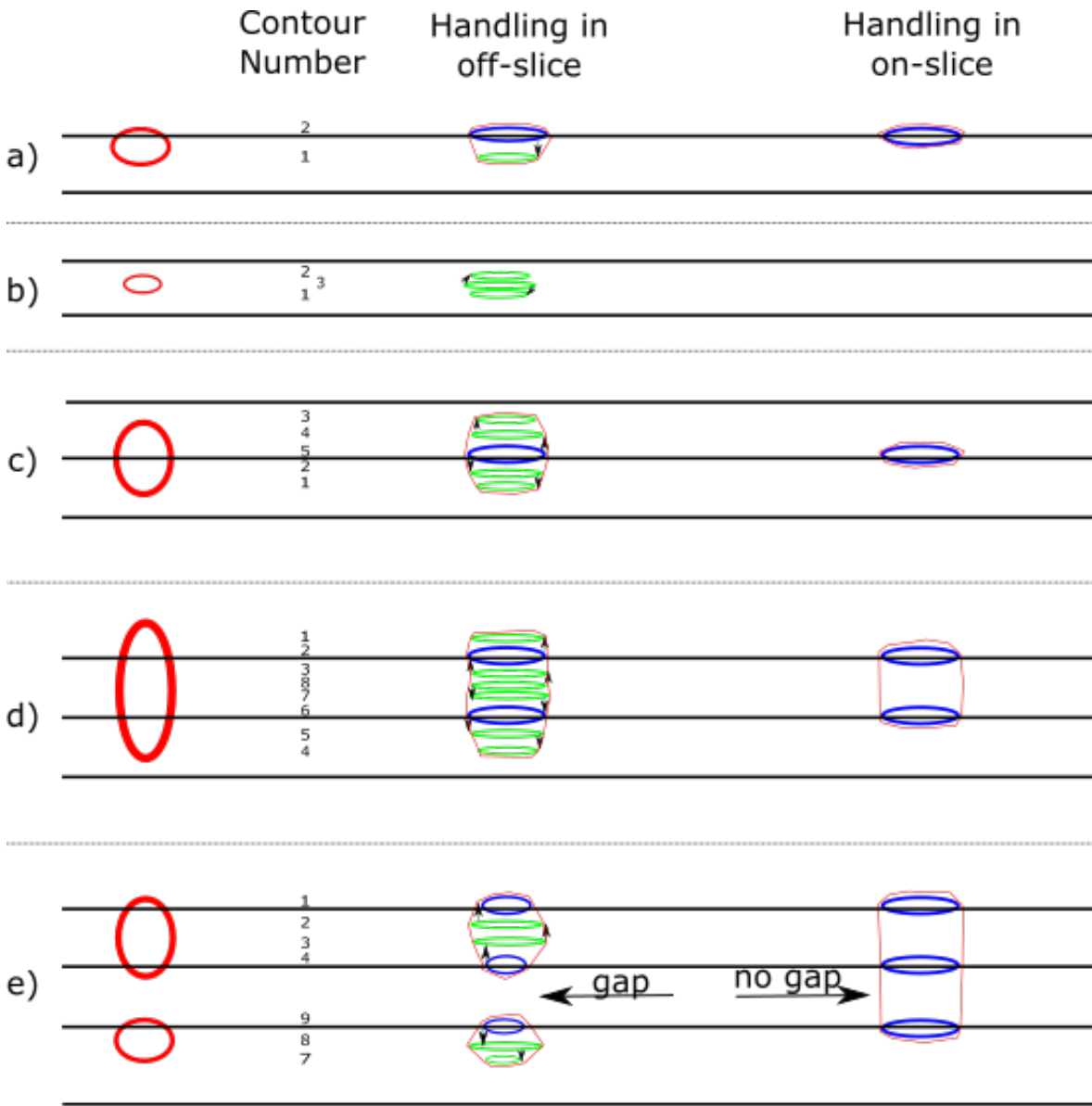
The user of the *Contourer* selects an RT Structure Set to store.

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.

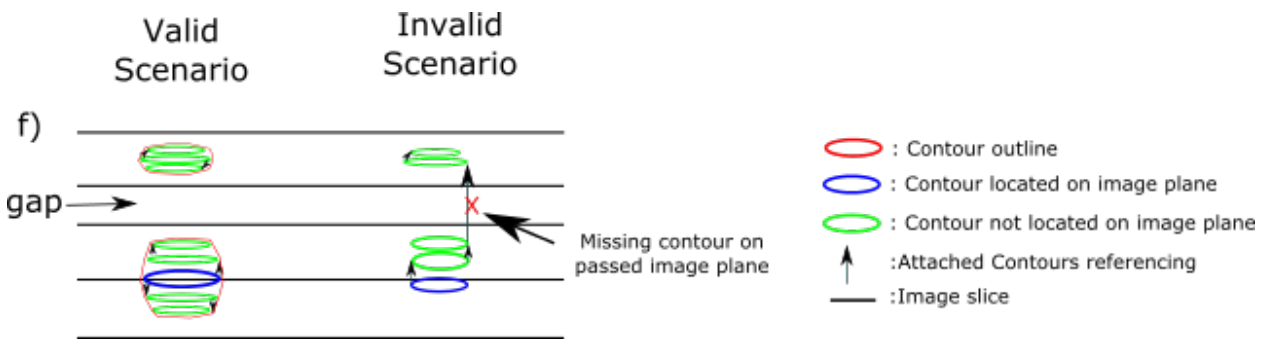
685 The Contours in the ROI Contour module are restricted to Geometric Type POINT and
CLOSED_PLANAR. If a ROI Contour contains off-slice information, the Contour Number
(3006,0048) and the Attached Contours (3006,0049) attributes must be present for all Contour
Sequence items (3006,0040) of this ROI. For Contour Sequence items that are not referencing
690 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
695 between off-slice contours may vary.



- : Contour outline
- : Contour located on image plane
- : Contour not located on image plane
- : Attached Contours referencing
- : Image slice

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



700

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]).

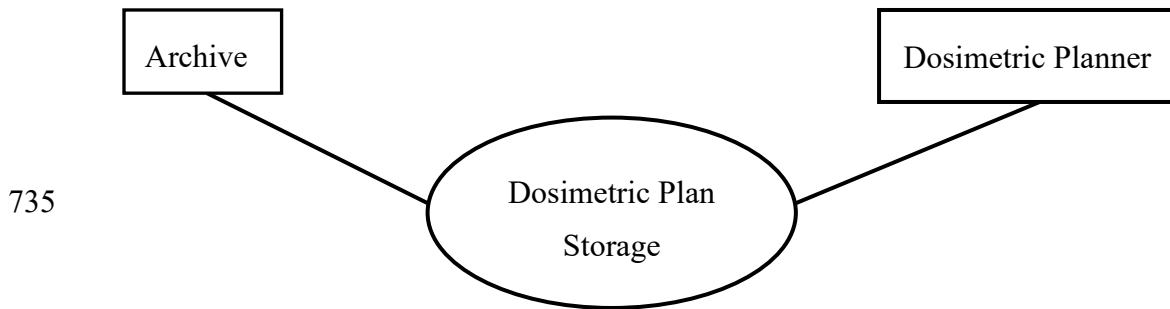
3.4 Dosimetric Plan Storage [RO-4]

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*.

730 **3.4.2 Use Case Roles**



Actor: Dosimetric Planner

Role: Transmit generated RT Plan to Archive.

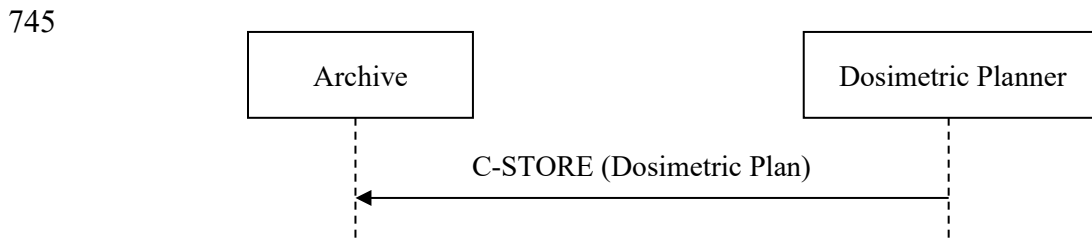
740 **Actor:** Archive

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



750 **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.

755 **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.

760 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.

765 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.

770 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.

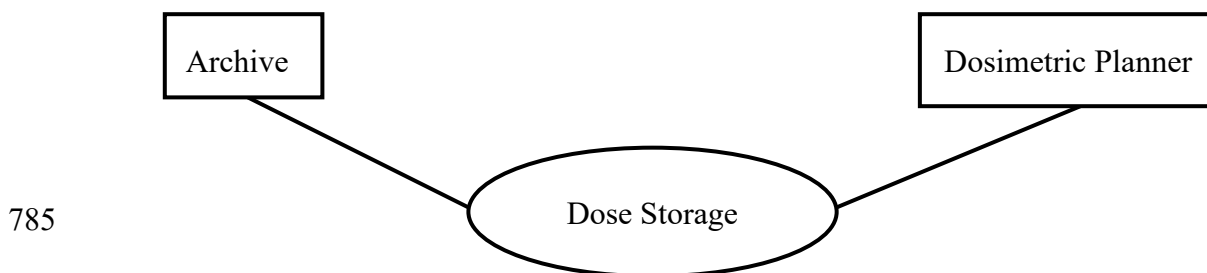
775 3.5 Dose Storage [RO-BRTO-II-5]

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*.

780 3.5.2 Use Case Roles



785 **Actor:** Dosimetric Planner

Role: Transmit generated Dose to the Archive

Actor: Archive

790 **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

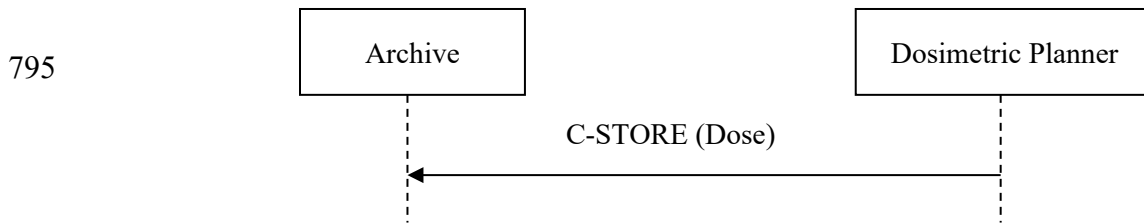


Figure 3.5.4-1: Interaction Diagram

800 **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

805 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

810 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.

815 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.

820 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.

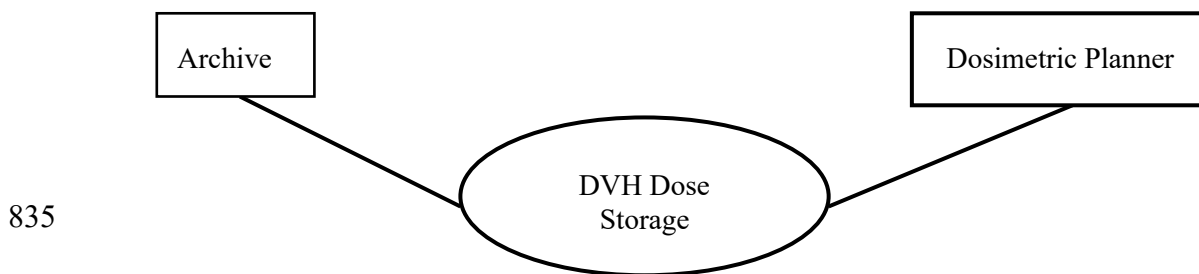
3.6 DVH Dose Storage [RO-BRTO-II-3]

825 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*.

830 **3.6.2 Use Case Roles**



Actor: Dosimetric Planner

Role: Transmit generated DVH Dose to the Archive

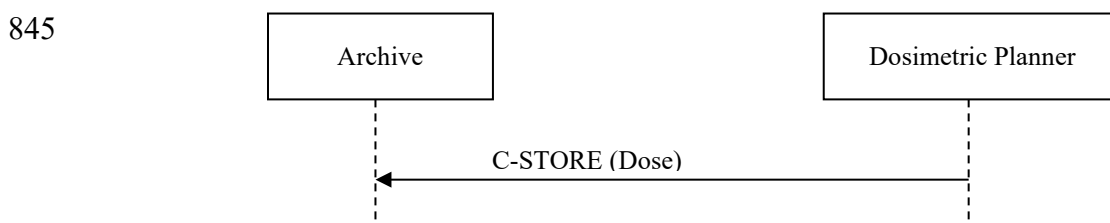
Actor: Archive

840 **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



850 **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

855 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

860 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
865 only the DVH content.

3.6.5 Security Considerations

There are no explicit security considerations.

3.7 Structure Set Retrieval [RO-7]

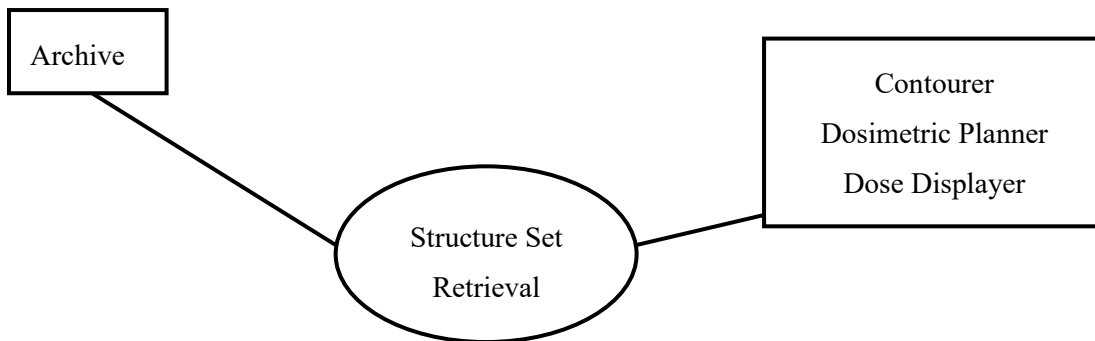
870 This corresponds to [RO-7] of the IHE-RO Technical Framework. Transaction [RO-7] is used by the *Archive*, *Contourer*, *Dosimetric Planner*, and *Dose Displayer* Actors.

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

875



880

Actor: Archive

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

885 **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

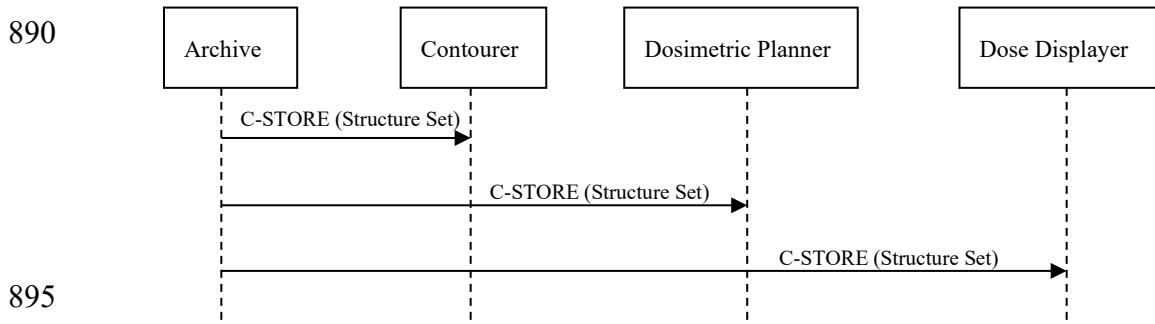


Figure 3.7.4-1: Interaction Diagram

3.7.4.1 Structure Set Retrieval

3.7.4.1.1 Trigger Events

900 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*.

905 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

910 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

915 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.

920 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.

930 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.

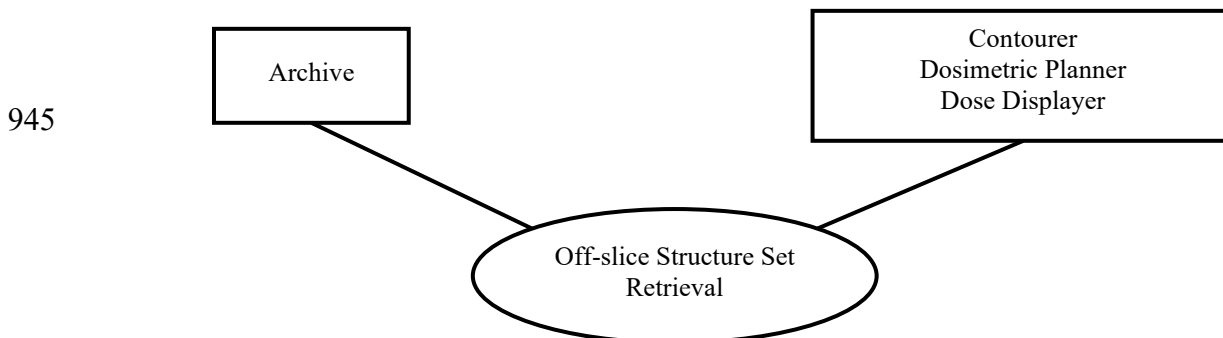
935 3.8 Off-slice Structure Set Retrieval [RO-BRTO-II-2]

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

940 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



950 **Actor:** Archive

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

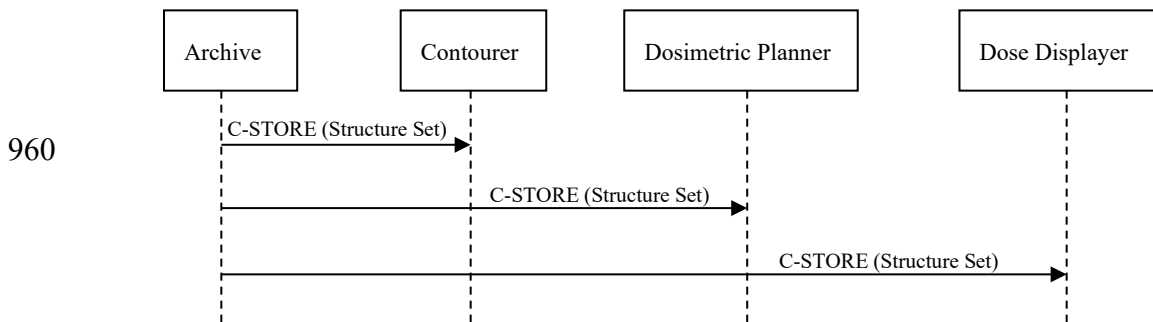
Actor: Contourer, Dosimetric Planner or Dose Displayer

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

3.8.3 Referenced standards

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

3.8.4 Messages



965 **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*.

970 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*.

975 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.

980 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

985 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

990 There are no explicit security considerations.

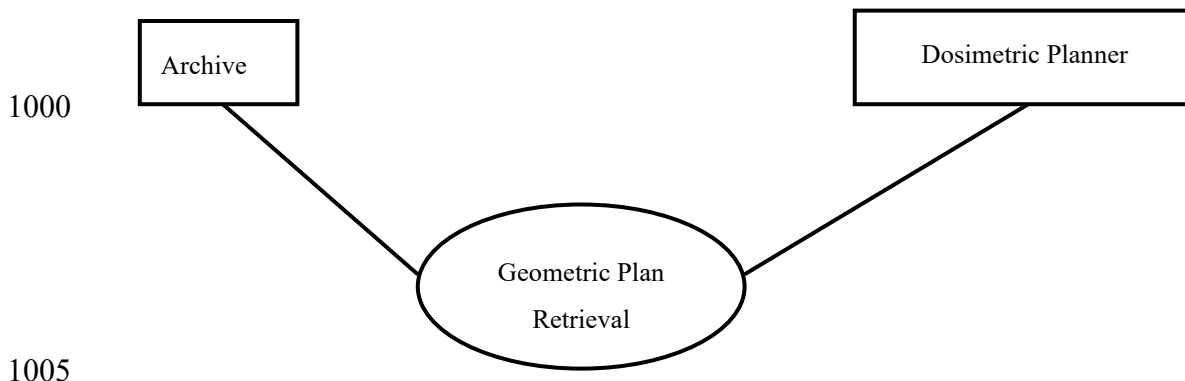
3.9 Geometric Plan Retrieval [RO-8]

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

995 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

1010 3.9.3 Referenced standards

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

3.9.4 Messages

1015

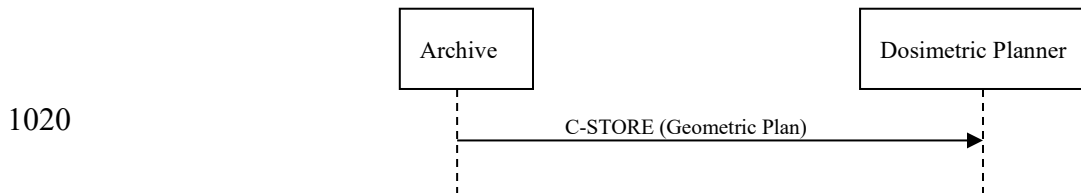


Figure 3.9.4-1: Interaction Diagram

3.9.4.1 Geometric Plan Retrieval

1025 **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

1030 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

1035 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.

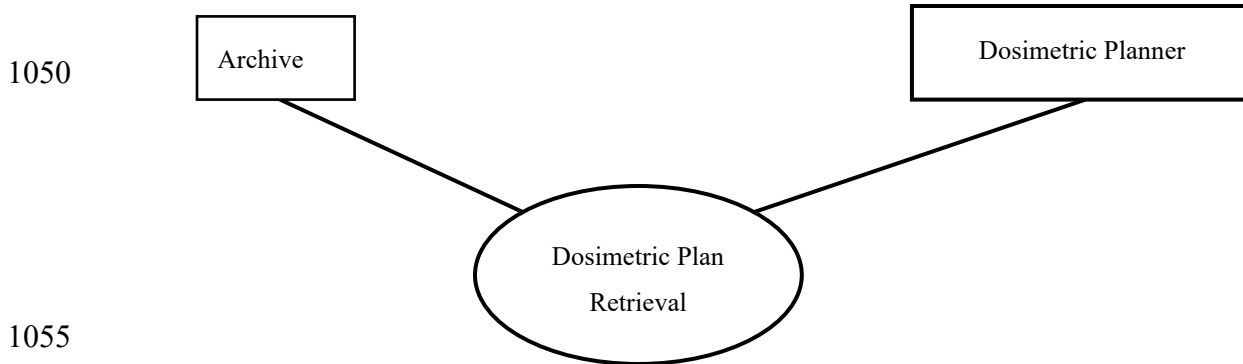
3.10 Dosimetric Plan Retrieval [RO-9]

1040 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*.

1045 **3.10.2 Use Case Roles**



Actor: Dose Displayer

Role: Accepts plan from Archive.

Actor: Archive

1060 **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

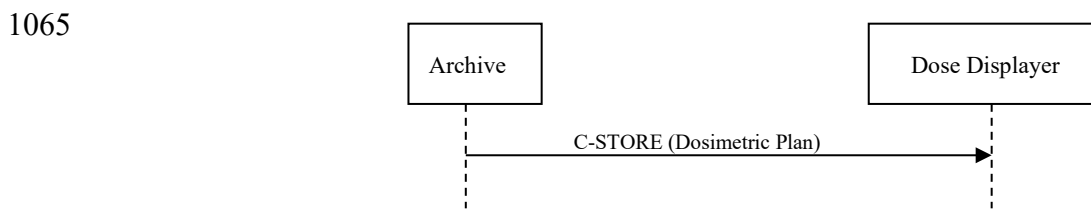


Figure 3.10.4-1: Interaction Diagram

3.10.4.1 Dosimetric Plan Retrieval

3.10.4.1.1 Trigger 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.

1075 **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.

1080 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 and RT Ion Plan respectively for 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]

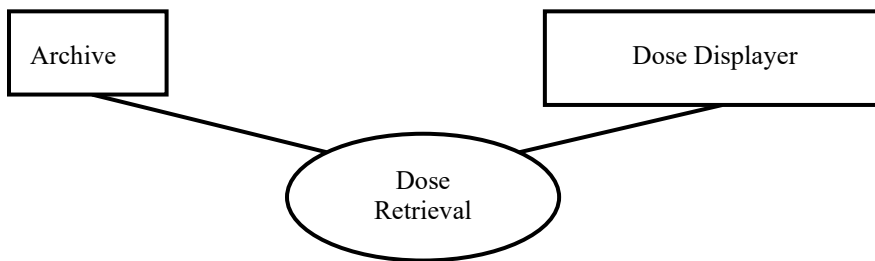
1085 This corresponds to [RO-BRTO-II-6] of the IHE-RO Technical Framework. Transaction [RO-BRTO-II-6] is used by the *Archive* and *Dose Displayer* Actors.

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

1090



1095

Actor: Dose Displayer

Role: Receives requested Dose from the Archive

Actor: Archive

Role: Sends requested Dose instance to the Dose Displayer

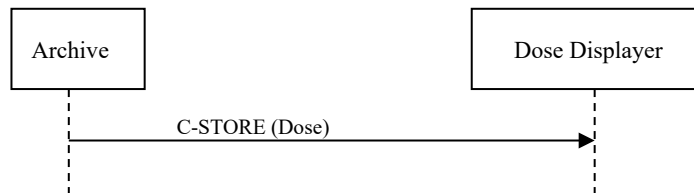
1100 3.11.3 Referenced standards

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

1105

3.11.4 Messages

1110



1115

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.

1120

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.

1125

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.

1130

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.

1135

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.

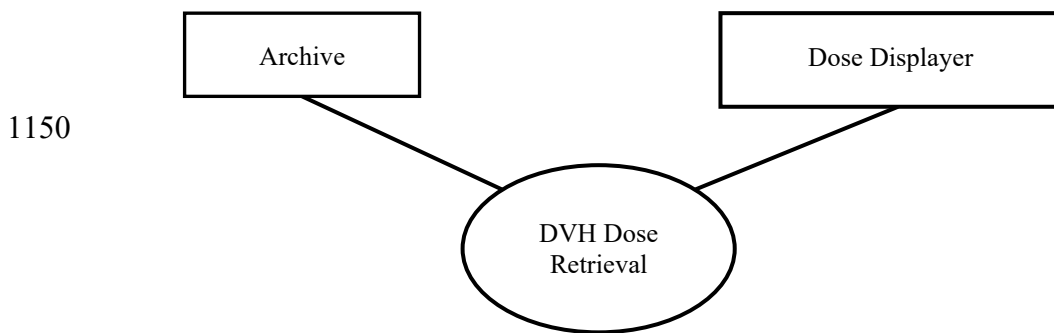
1140 **3.12 DVH Dose Retrieval [RO-BRTO-II-4]**

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

3.12.1 Scope

1145 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



1155 **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

1160 DICOM 2018d Edition PS3.4: Storage Service Class.

1165

1170 **3.12.4 Messages**

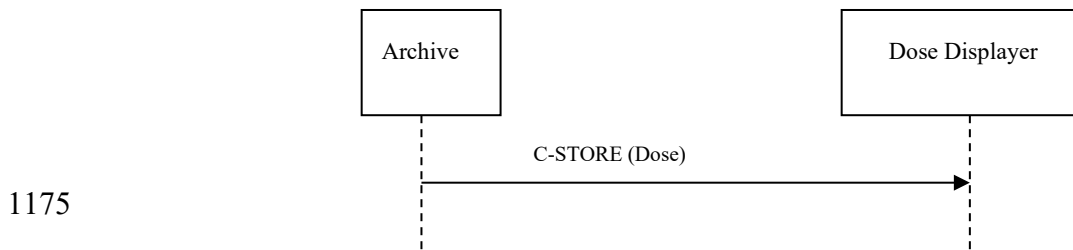


Figure 3.12.4-1: Interaction Diagram

3.12.4.1 DVH Dose Retrieval

3.12.4.1.1 Trigger Events

1180 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

1185 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.

1190 **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.

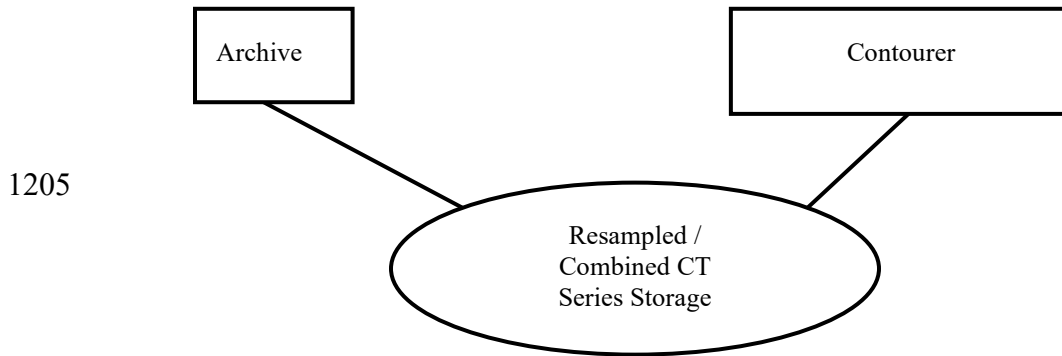
1195 **3.13 Resampled/Combined CT Series Storage [RO-11]**

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

1200 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

1210 **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.

1215 **3.13.4 Messages**

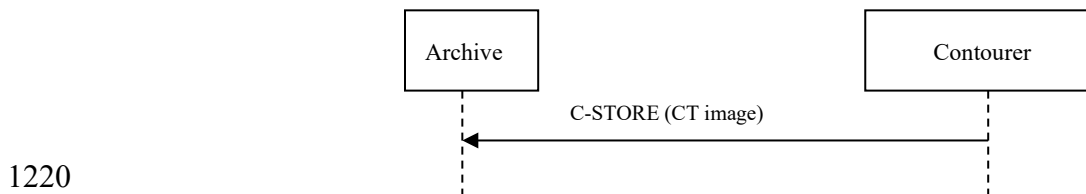


Figure 3.13.4-1: Interaction Diagram

3.13.4.1 Resampled/Combined CT Series Storage

3.13.4.1.1 Trigger Events

1225 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.

1230

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.

1235 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]).

1240 3.13.5 Security Considerations

There are no explicit security considerations.

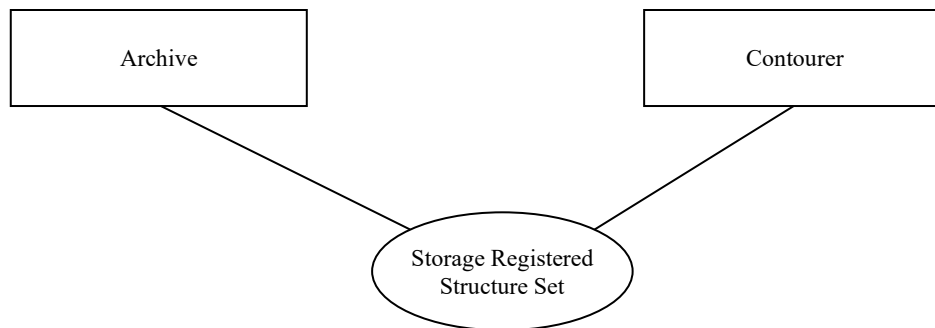
3.14 Registered Structure Set Storage [RO-MMRO-1]

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.

1245 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



1250

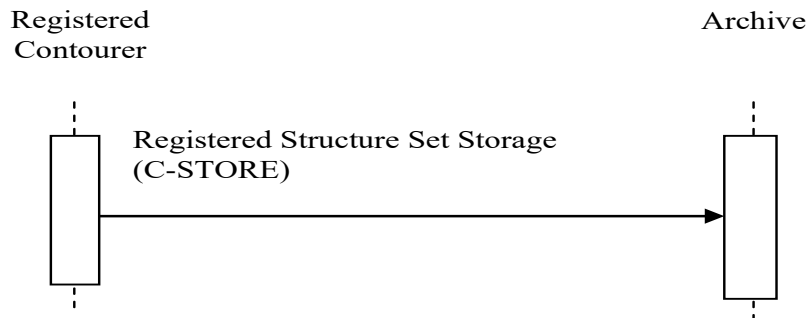
| | |
|---------------|--|
| Actor: | Archive |
| Role: | Receive and store a Structure Set instance from the Registered Contourer |
| Actor: | Registered Contourer |
| Role: | Send a Structure Set instance for storage |

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



1255

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.

1260 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.

1265 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.

1270 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.

1275 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.

1280 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.

1285 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).

1290 **3.14.5 Expected Actions**

There are no explicit considerations.

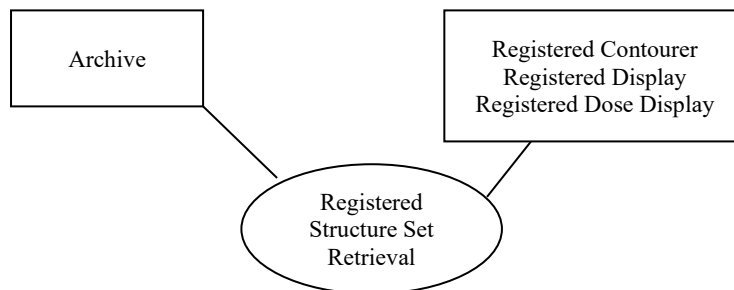
3.15 Registered Structure Set Retrieval [RO-MMRO-2]

1295 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



1300

| | |
|---------------|---|
| 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

1305 3.15.4 Messages

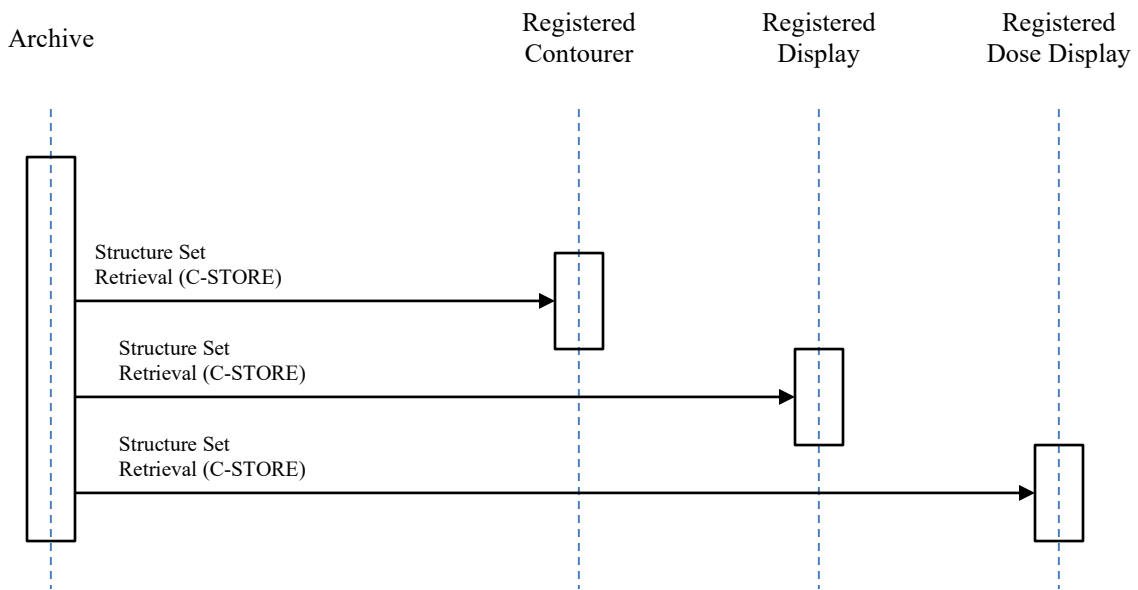


Figure 3.15.4-1: Interaction Diagram

3.15.4.1 Registered Structure Set Retrieval

3.15.4.1.1 Trigger Events

1310 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**.

1315 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

1320 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 a ROI contour on a slice between slices on which contours are defined implies that the ROI does not intersect that slice.

1325 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

1330 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.

1335 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.

1340 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

1345 There are no specific considerations.

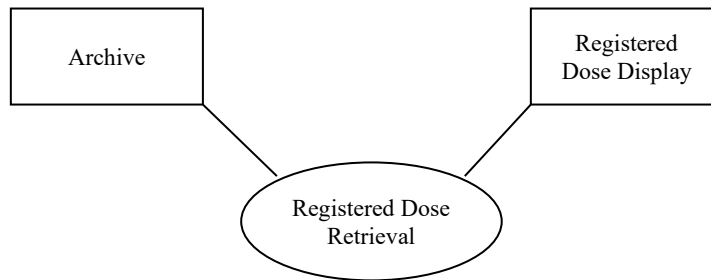
3.16 Registered Dose Retrieval [RO-MMRO-3]

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

1350 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



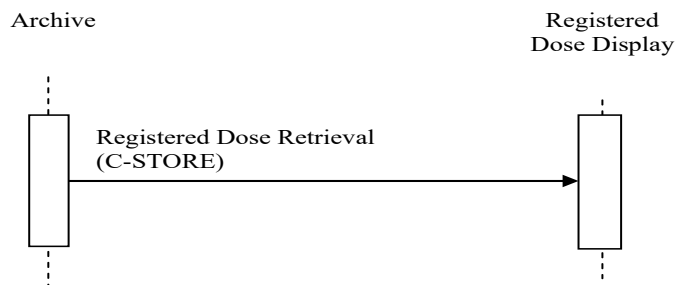
| | |
|---------------|---|
| Actor: | Archive |
| Role: | Sends Registered Dose instance to the Registered Dose Display |
| Actor: | Registered Dose Display |
| Role: | Receives the Registered Dose instance from the Archive |

1355 3.16.3 Referenced Standards

DICOM 2018d PS3.4: Storage Service Class

DICOM 2018d PS 3.4: RT Dose Storage

3.16.4 Messages



1360 **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.

1365

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.

1370 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 $[\pm 1, 0, 0, 0, \pm 1, 0]$, within an uncertainty of 0.001 Radians. Dose Planes may be irregularly spaced, and they need not correspond to image planes.

1375 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.

1380 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.

1385 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.

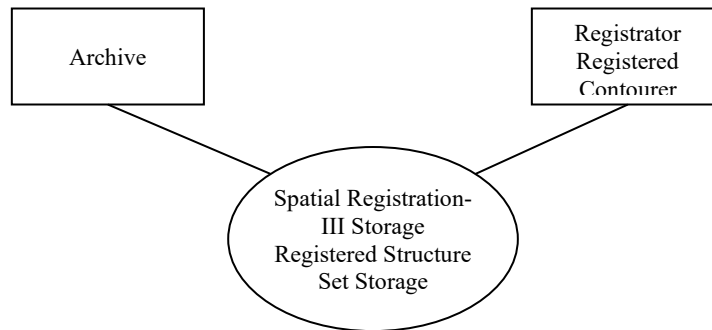
3.17 Spatial Registration Storage [RO-MMRO-4]

1390 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 *Registrar* Actors.

3.17.1 Scope

1395 In the Spatial Registration-III Storage transaction, the *Registrar* 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



1400

| | |
|---------------|---|
| Actor: | Archive |
| Role: | Accept and store Spatial Registration instances from Registrator Actors |
| Actor: | Registrator |
| Role: | Create and transmit Spatial Registration instances to an Archive |

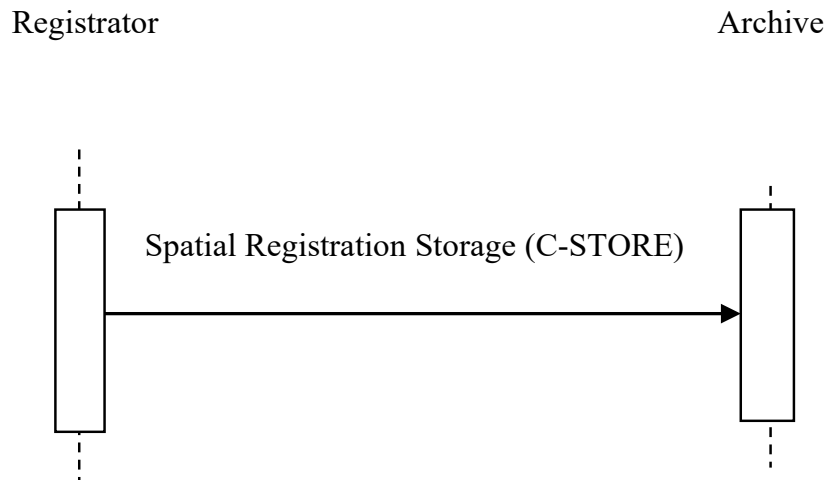
3.17.3 Referenced Standards

DICOM 2018d PS 3.4: Storage Service Class

DICOM 2018d PS 3.4: Spatial Registration Storage

1405

3.17.4 Messages



1410

Figure 3.17.4-1: Interaction Diagram

3.17.4.1 Spatial Registration-III Storage

3.17.4.1.1 Trigger Events

1415 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.

1420 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.

1425 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.

1430 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.

1435 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.

1440 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.

1445 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:

- 1450 • 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.

1455 **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).

1460 **3.17.5 Security Considerations**

No specific considerations.

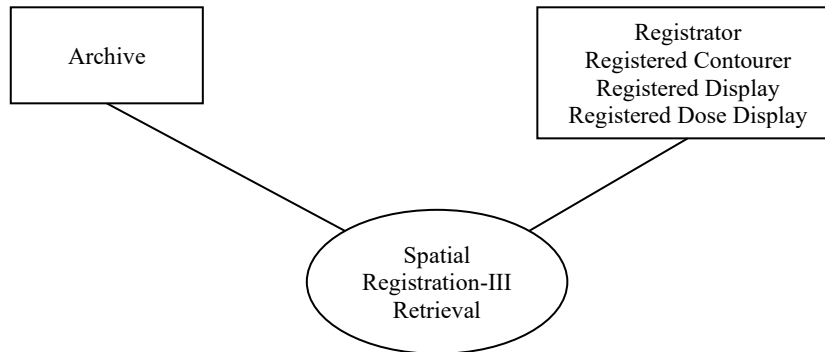
3.18 Spatial Registration-III Retrieval [RO-MMRO-5]

1465 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 Registrar.

3.18.1 Scope

1470 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
- 1475 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

1480

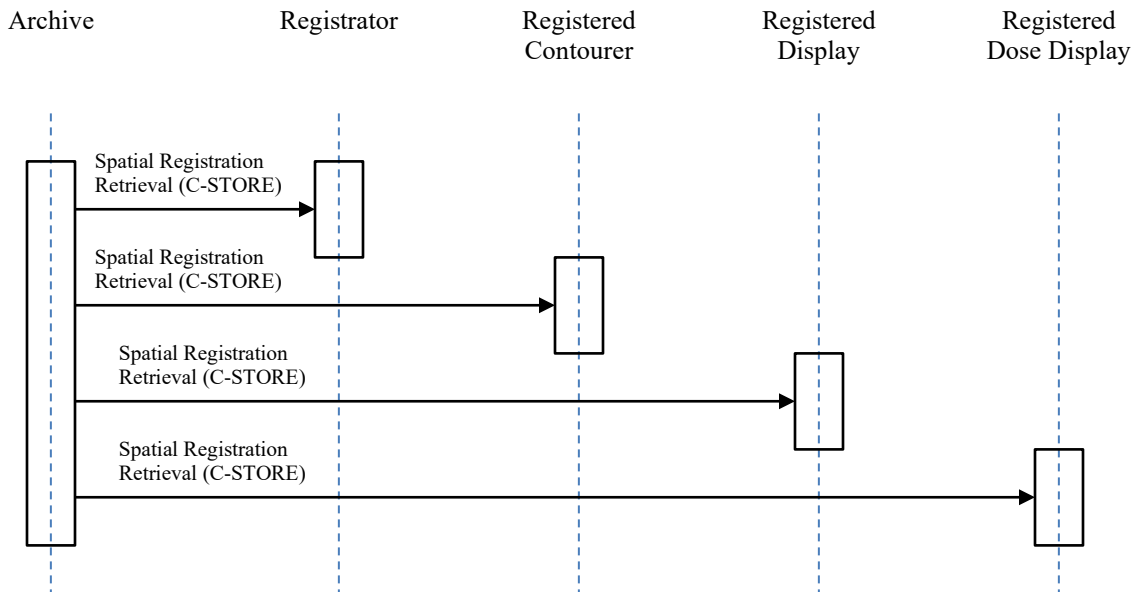


Figure 3.18.4-1: Interaction Diagram

3.18.4.1 Spatial Registration-III Storage

3.18.4.1.1 Trigger Events

1485 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

1490 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.

1495 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.

1500 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

1505 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.

1510 **3.18.5 Security Considerations**

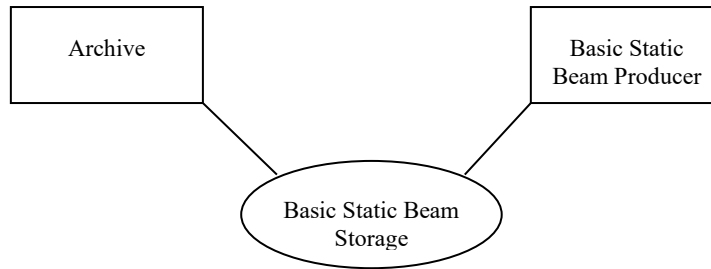
No specific considerations.

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

3.19.1 Scope

1515 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

1520 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.19.4 Messages

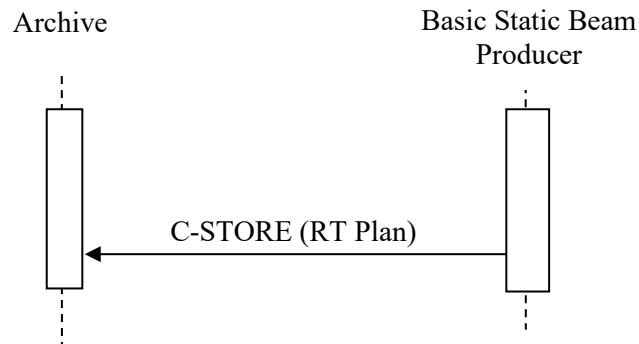


Figure 3.19.4-1: Interaction Diagram

3.19.4.1 Basic Static Beam Storage

1525 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.

1530 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.

1535 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

1540 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:

1545

| 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

1550 There are no specific security considerations.

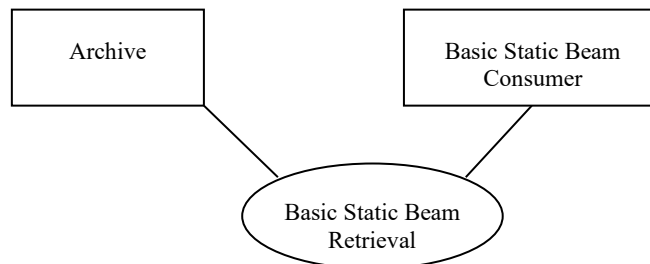
3.20 Basic Static Beam Retrieval [RO-TPPC-02]

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.

1555

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 |

1560 **3.20.3 Referenced Standards**

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

3.20.4 Messages

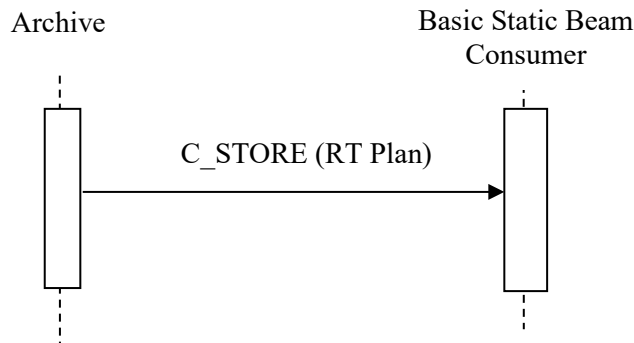


Figure 3.20.4-1: Interaction Diagram

1565 **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.

1570 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

1575 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

1580 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.

1585 3.20.5 Security Considerations

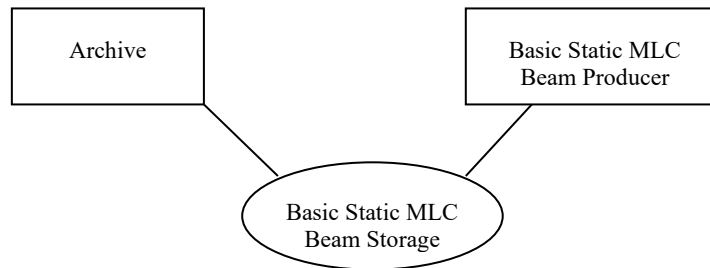
There are no specific security considerations.

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

3.21.1 Scope

1590 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 |

1595 3.21.3 Referenced Standards

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

3.21.4 Messages

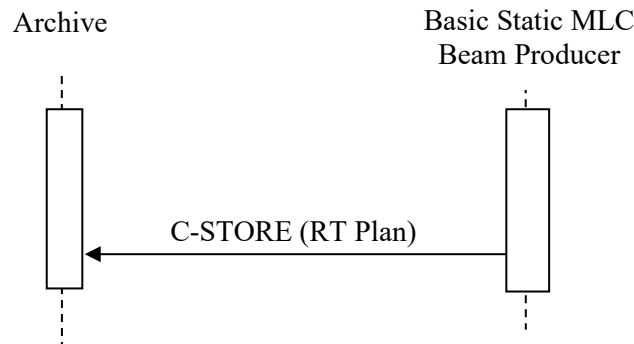


Figure 3.21.4-1: Interaction Diagram

1600 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

1605 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.

1610 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:

1620

| 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

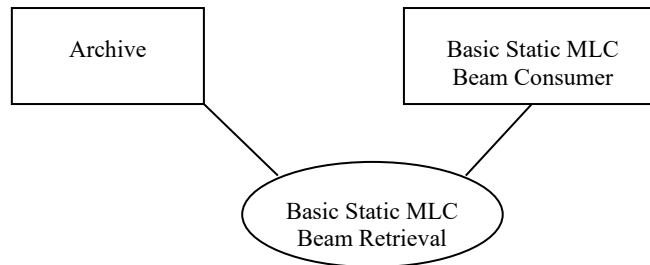
1625 There are no specific security considerations.

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

3.22.1 Scope

1630 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 |

1635 3.22.3 Referenced Standards

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

3.22.4 Messages

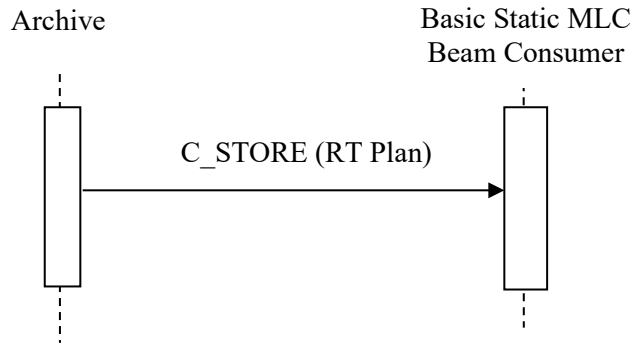


Figure 3.22.4-1: Interaction Diagram

1640 **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.

1645 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

1650 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

1655 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.

1660 3.22.5 Security Considerations

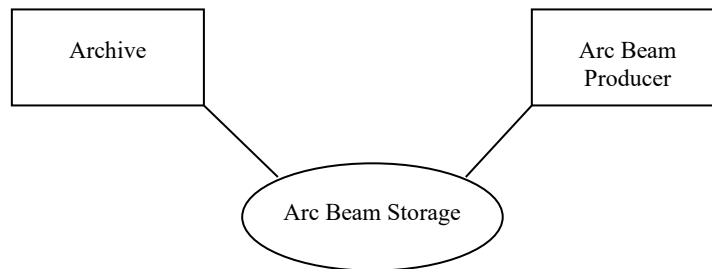
There are no specific security considerations.

3.23 Arc Beam Storage [RO-TPPC-05]

3.23.1 Scope

1665 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

1670 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.23.4 Messages

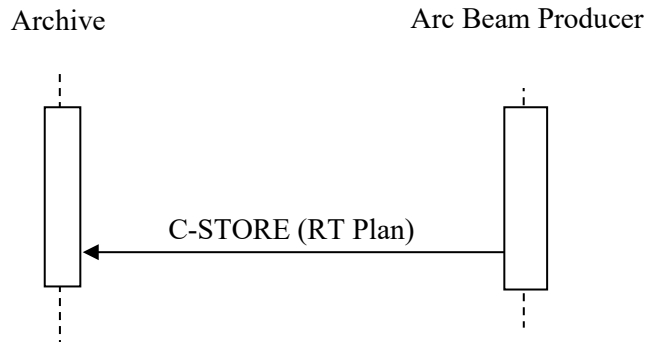


Figure 3.23.4-1: Interaction Diagram

3.23.4.1 Arc Beam Storage

1675 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.

1680 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.

1685 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

1690 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 |

1695

3.23.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.23.5 Security Considerations

There are no specific security considerations.

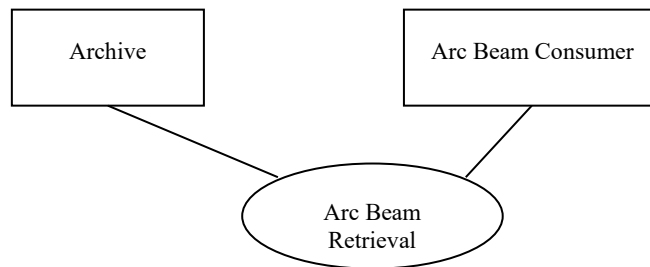
1700 3.24 Arc Beam Retrieval [RO-TPPC-06]

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

1705



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

3.24.3 Referenced Standards

1710 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.24.4 Messages

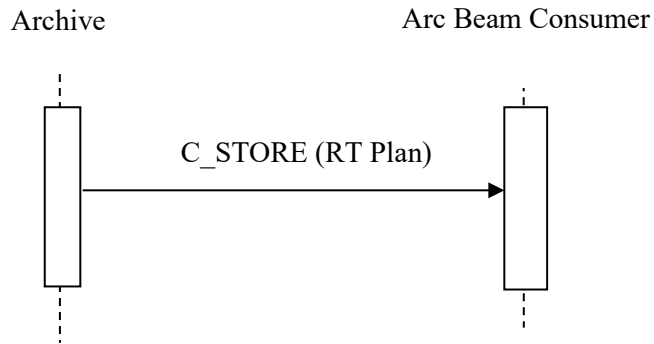


Figure 3.24.4-1: Interaction Diagram

3.24.4.1 Arc Beam Retrieval

1715 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.

1720 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

1725 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:

1730

| 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

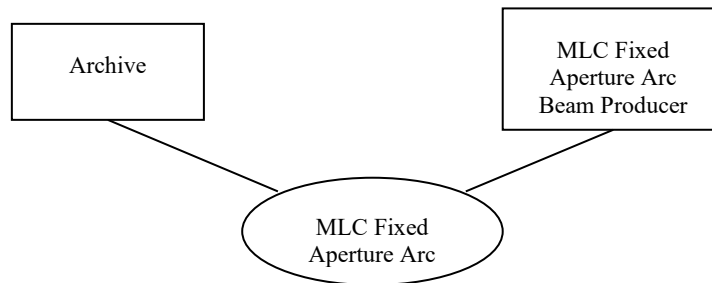
There are no specific security considerations.

1735 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

1740 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.

1745 **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**

1750 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.

1755 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.

1760 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 an MLC Fixed Aperture Arc Beam

1765 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 |

1770

3.25.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.25.5 Security Considerations

There are no specific security considerations.

1775

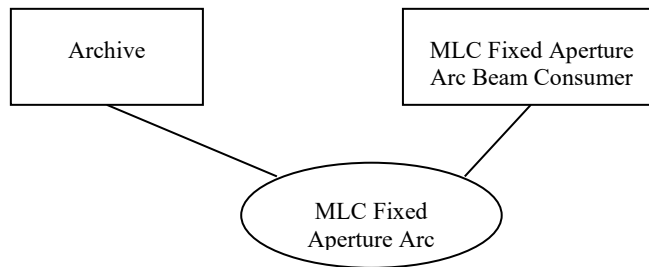
3.26 MLC FIXED APERTURE ARC Beam Retrieval [RO-TPPC-08]

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.

1780

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 |

1785

3.26.3 Referenced Standards

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

3.26.4 Messages

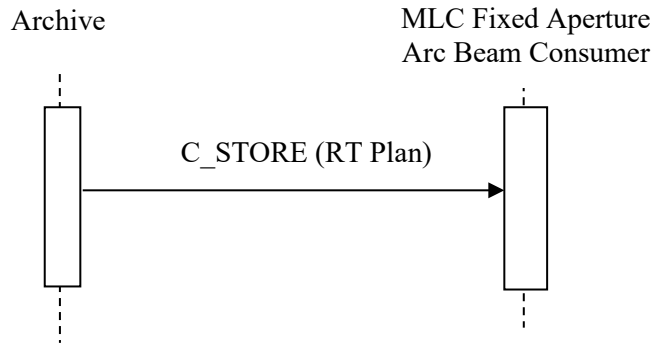


Figure 3.26.4-1: Interaction Diagram

1790 **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.

1795 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

1800 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

1805 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.

1810 **3.26.5 Security Considerations**

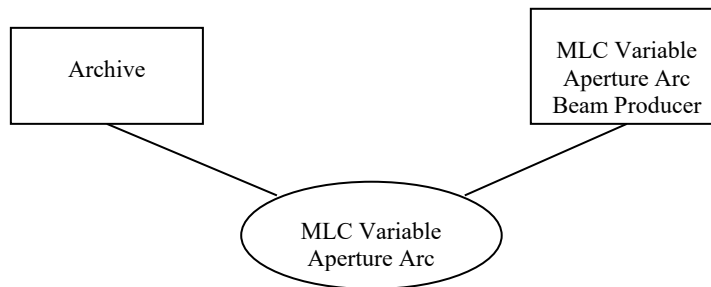
There are no specific security considerations.

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

3.27.1 Scope

1815 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 |

1820 **3.27.3 Referenced Standards**

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

3.27.4 Messages

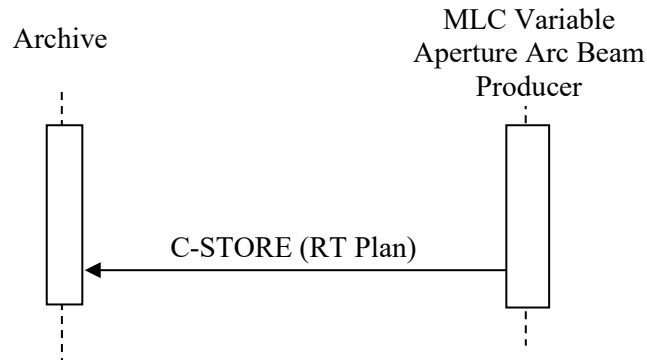


Figure 3.27.4-1: Interaction Diagram

1825 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

1830 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.

1835 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

1840 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

1845 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

1850 The Archive stores the RT Plan.

3.27.5 Security Considerations

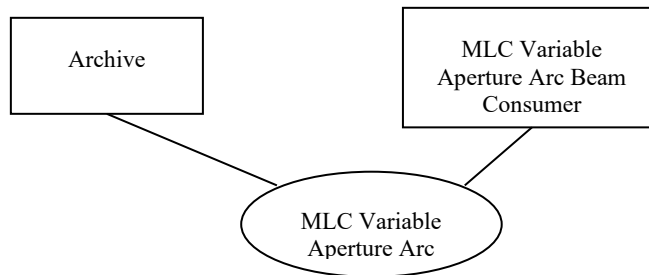
There are no specific security considerations.

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

3.28.1 Scope

1855 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



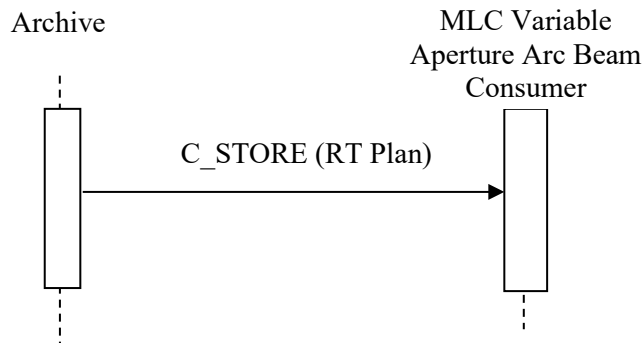
1860

| | |
|---------------|---|
| 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



1865

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.

1870 **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.

1875 **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+*).

1880 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

1885 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.

1890 3.28.5 Security Considerations

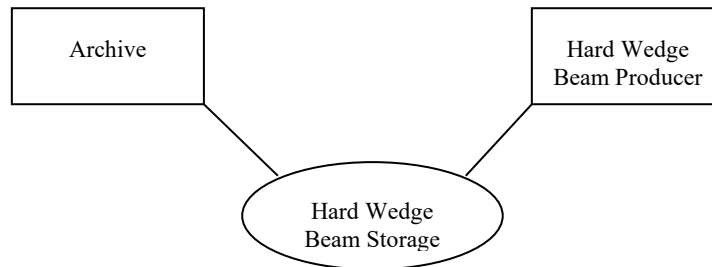
There are no specific security considerations.

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

3.29.1 Scope

1895 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

1900 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.29.4 Messages

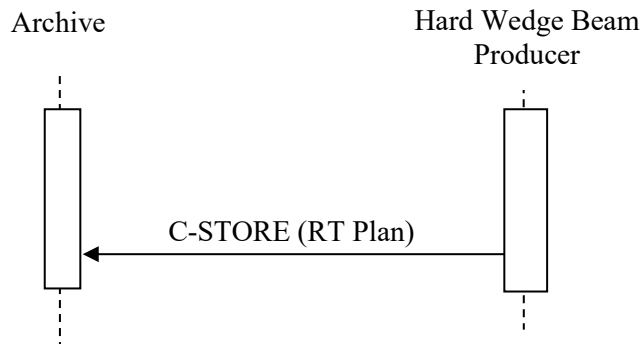


Figure 3.29.4-1: Interaction Diagram

3.29.4.1 Hard Wedge Beam Storage

1905 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.

1910 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.

1915 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

1920 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 |

1925

3.29.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.29.5 Security Considerations

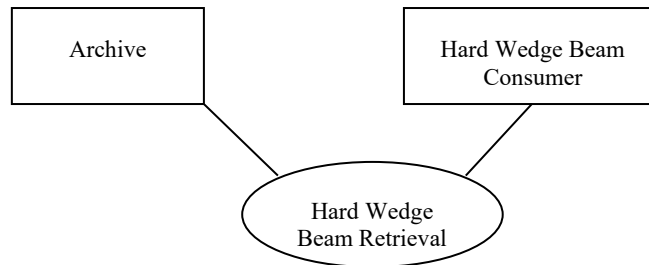
There are no specific security considerations.

1930 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.

1935 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

1940 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.30.4 Messages

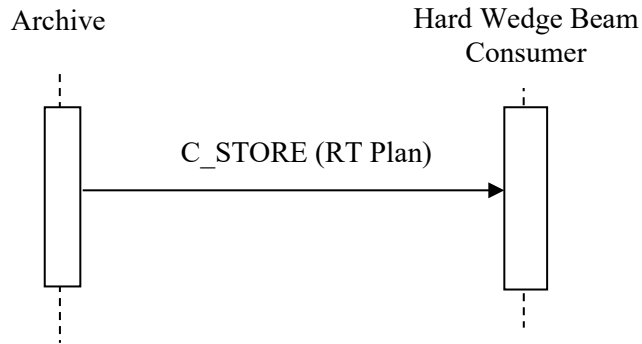


Figure 3.30.4-1: Interaction Diagram

3.30.4.1 Hard Wedge Beam Retrieval

1945 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.

1950 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

1955 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:

1960

| 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

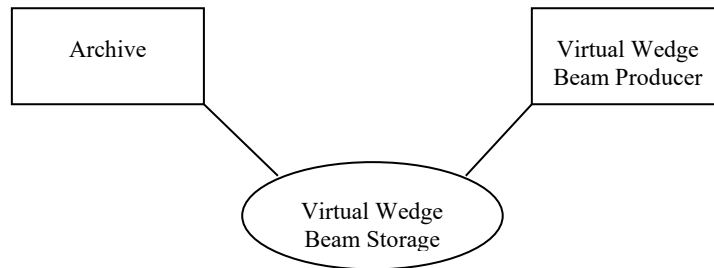
1965 There are no specific security considerations.

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

3.31.1 Scope

1970 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

1975 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.31.4 Messages

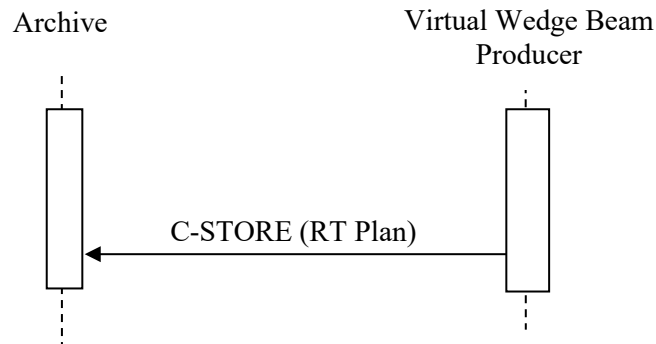


Figure 3.31.4-1: Interaction Diagram

3.31.4.1 Virtual Wedge Beam Storage

1980 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.

1985 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.

1990 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

1995 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.

2000 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 |

2005 **3.31.4.1.3 Expected Actions**

The Archive stores the RT Plan.

3.31.5 Security Considerations

There are no specific security considerations.

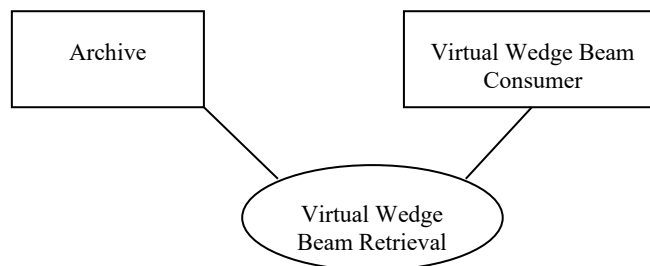
3.32 Virtual Wedge Beam Retrieval [RO-TPPC-14]

2010 **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

2015



| | |
|---------------|---|
| 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.

2020 3.32.4 Messages

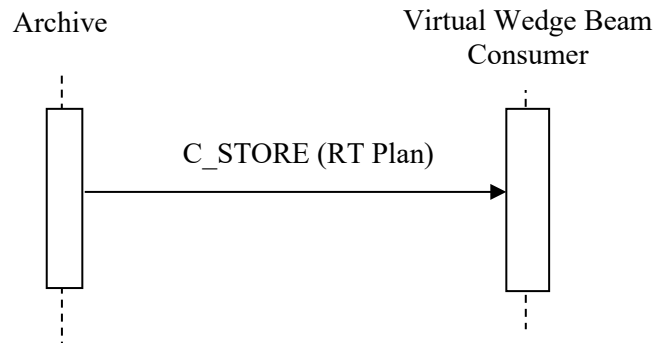


Figure 3.32.4-1: Interaction Diagram

3.32.4.1 Virtual Wedge Beam Retrieval

3.32.4.1.1 Trigger Events

2025 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.

2030 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+*).

2035

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 |

2040

3.32.4.1.3 Expected Actions

The Virtual Wedge Beam Consumer stores the RT Plan.

3.32.5 Security Considerations

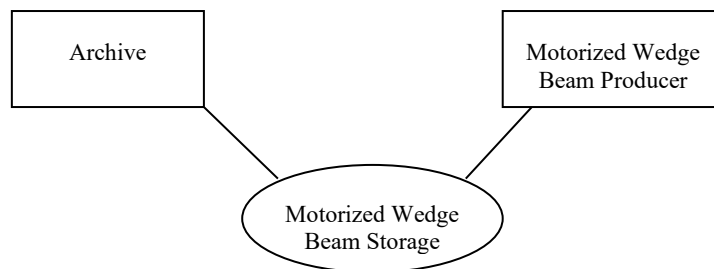
There are no specific security considerations.

2045 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

2050 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.

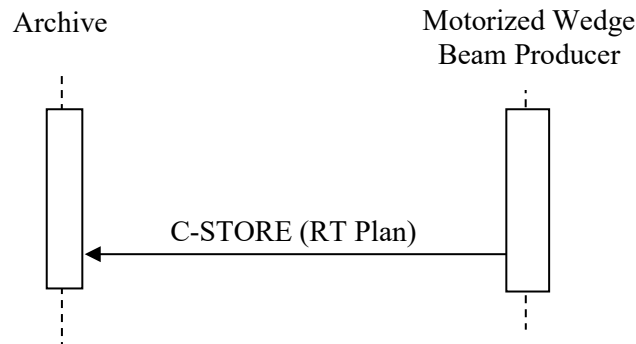
2055 **3.33.4 Messages**

Figure 3.33.4-1: Interaction Diagram

3.33.4.1 Motorized Wedge Beam Storage

3.33.4.1.1 Trigger Events

2060 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.

2065 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.

2070 **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+*).

2075 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.

2080 **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 |

3.33.4.1.3 Expected Actions

2085 The Archive stores the RT Plan.

3.33.5 Security Considerations

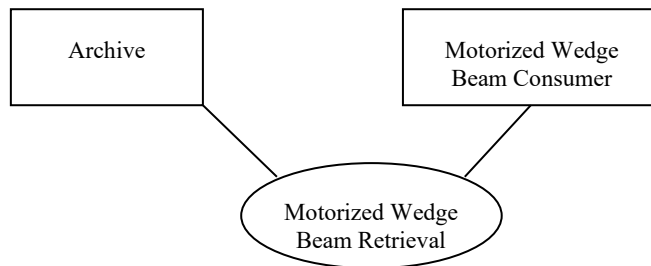
There are no specific security considerations.

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

3.34.1 Scope

2090 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.

3.34.2 Use Case Roles



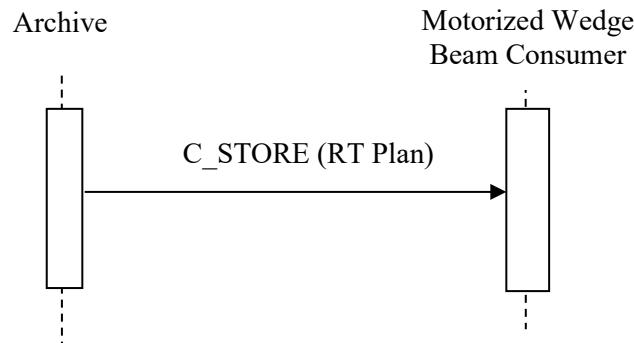
2095

| | |
|---------------|---|
| 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



2100

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.

2105 **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.

2110 **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+*).

2115 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 |

2120 **3.34.4.1.3 Expected Actions**

The Motorized Wedge Beam Consumer stores the RT Plan.

3.34.5 Security Considerations

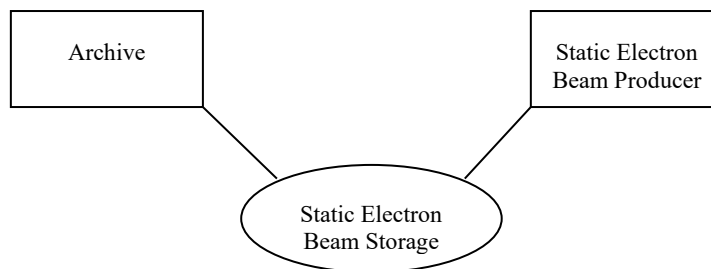
There are no specific security considerations.

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

2125 **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



2130

| | |
|---------------|---|
| 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.

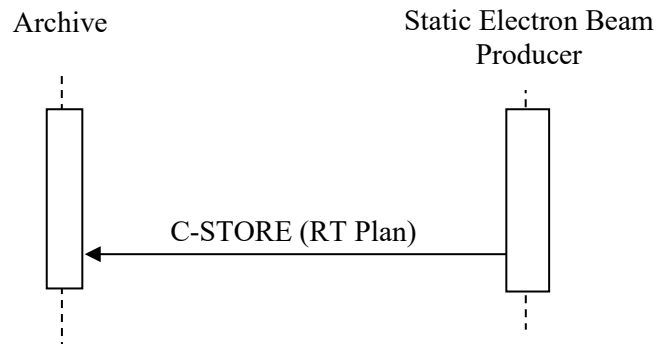
2135 **3.35.4 Messages**

Figure 3.35.4-1: Interaction Diagram

3.35.4.1 Static Electron Beam Storage

3.35.4.1.1 Trigger Events

2140 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.

2145 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.

2150 **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+*).

2155 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 |

2160 **3.35.4.1.3 Expected Actions**

The Archive stores the RT Plan.

3.35.5 Security Considerations

There are no specific security considerations.

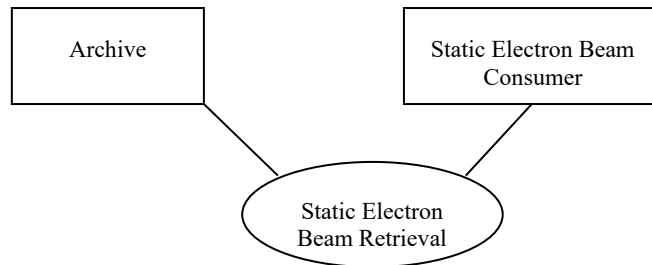
3.36 Static Electron Beam Retrieval [RO-TPPC-18]

2165 **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

2170



| | |
|---------------|---|
| 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.

2175 **3.36.4 Messages**

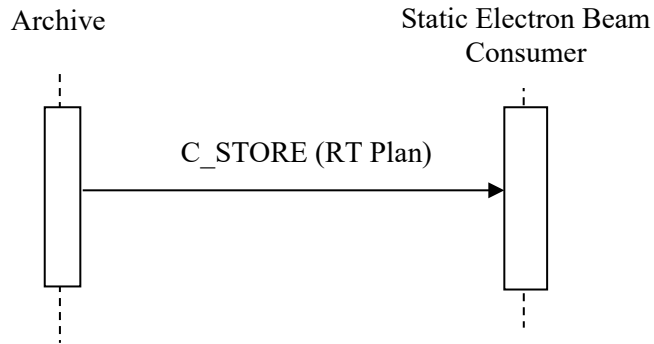


Figure 3.36.4-1: Interaction Diagram

3.36.4.1 Static Electron Beam Retrieval

3.36.4.1.1 Trigger Events

2180 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.

2185 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+*).

2190

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 |

2195

3.36.4.1.3 Expected Actions

The Static Electron Beam Consumer stores the RT Plan.

3.36.5 Security Considerations

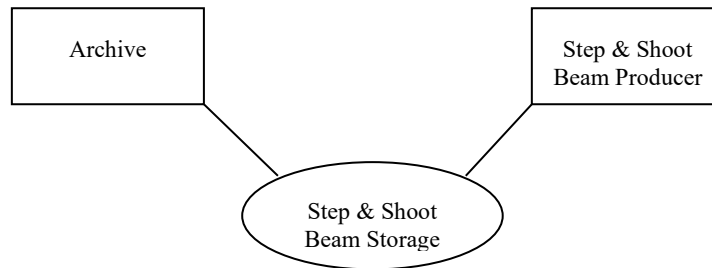
There are no specific security considerations.

2200 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

2205 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.

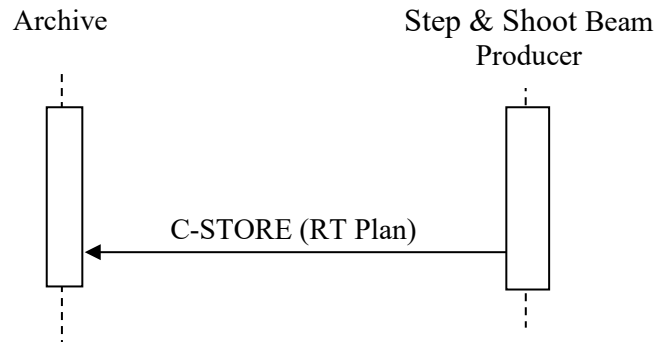
2210 **3.37.4 Messages**

Figure 3.37.4-1: Interaction Diagram

3.37.4.1 Step & Shoot Beam Storage

3.37.4.1.1 Trigger Events

2215 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.

2220 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.

2225 **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+*).

2230 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 |

2235 **3.37.4.1.3 Expected Actions**

The Archive stores the RT Plan.

3.37.5 Security Considerations

There are no specific security considerations.

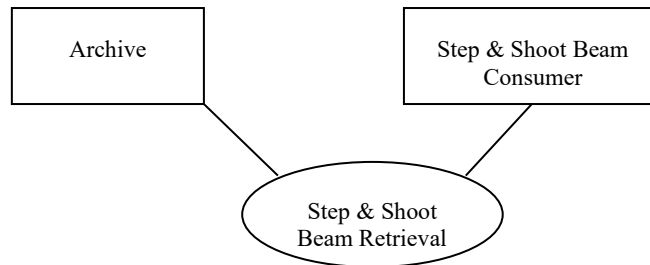
3.38 Step & Shoot Beam Retrieval [RO-TPPC-20]

2240 **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

2245



| | |
|---------------|--|
| 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

2250 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.38.4 Messages

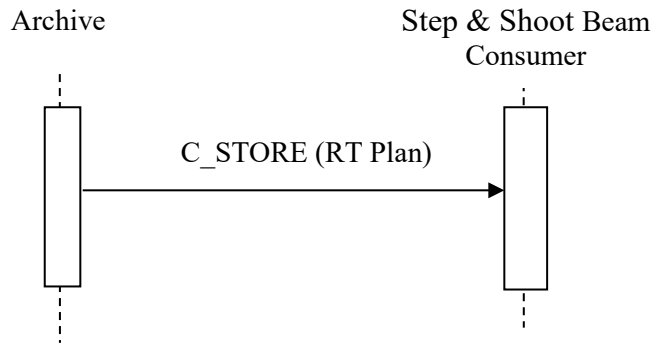


Figure 3.38.4-1: Interaction Diagram

3.38.4.1 Step & Shoot Beam Retrieval

2255 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.

2260 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

2265 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

2270 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

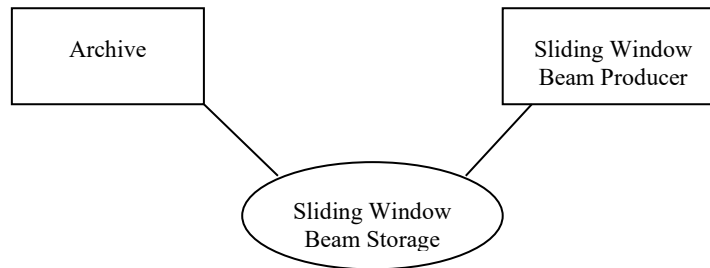
2275 There are no specific security considerations.

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

3.39.1 Scope

2280 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

2285 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.39.4 Messages

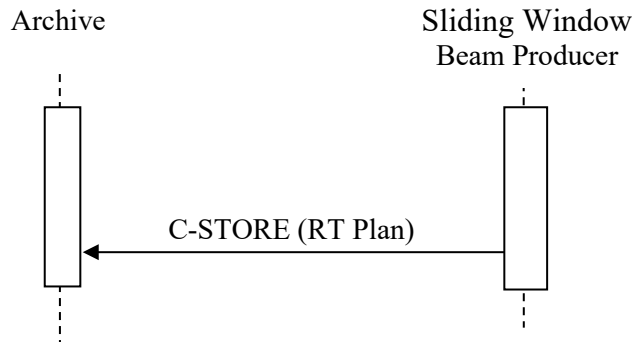


Figure 3.39.4-1: Interaction Diagram

3.39.4.1 Sliding Window Beam Storage

2290 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.

2295 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.

2300 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+*).

2305

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 |

2310

3.39.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.39.5 Security Considerations

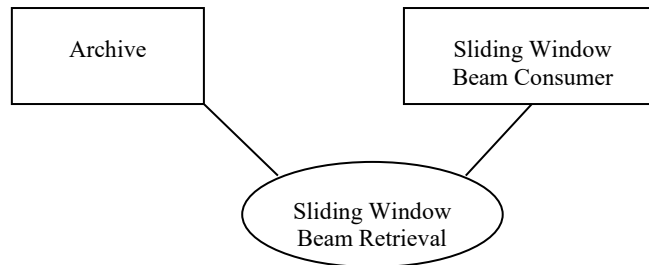
There are no specific security considerations.

2315 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.

2320 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

2325 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.40.4 Messages

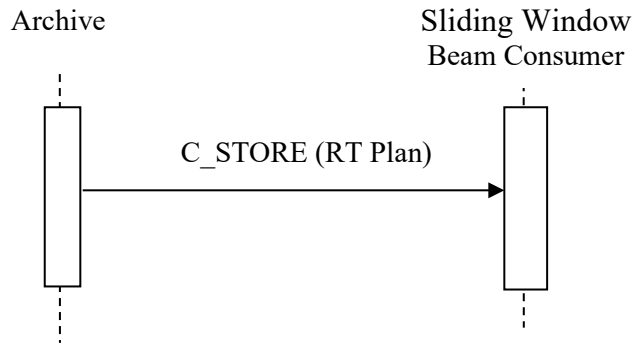


Figure 3.40.4-1: Interaction Diagram

3.40.4.1 Sliding Window Beam Retrieval

2330 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.

2335 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

2340 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:

2345

| 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

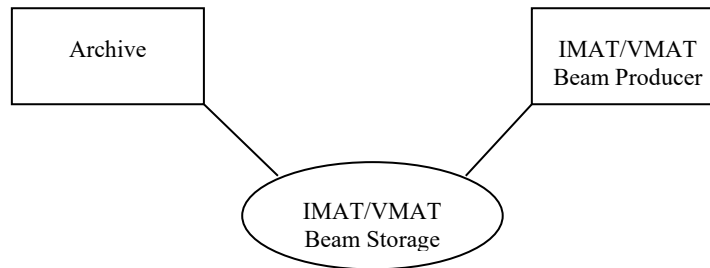
2350 There are no specific security considerations.

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

3.41.1 Scope

2355 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

2360 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.41.4 Messages

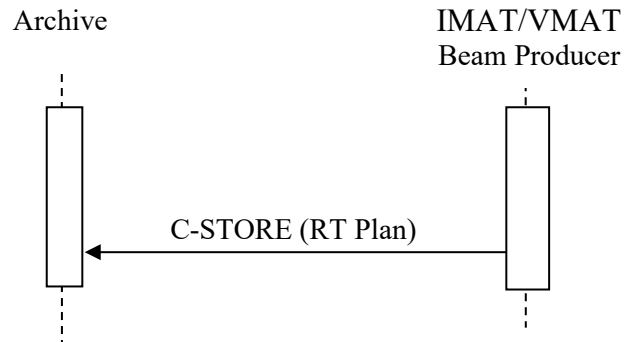


Figure 3.41.4-1: Interaction Diagram

3.41.4.1 IMAT/VMAT Beam Storage

2365 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.

2370 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.

2375 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

2380 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:

2385

| 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

2390

There are no specific security considerations.

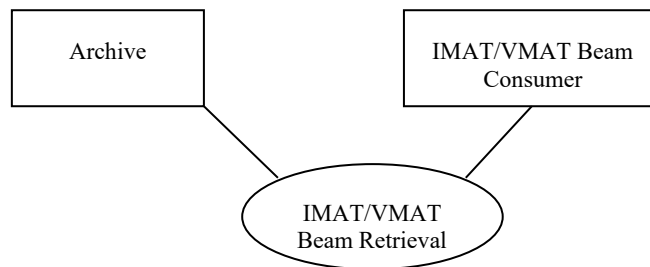
3.42 IMAT/VMAT Beam Retrieval [RO-TPPC-24]

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.

2395

3.42.2 Use Case Roles



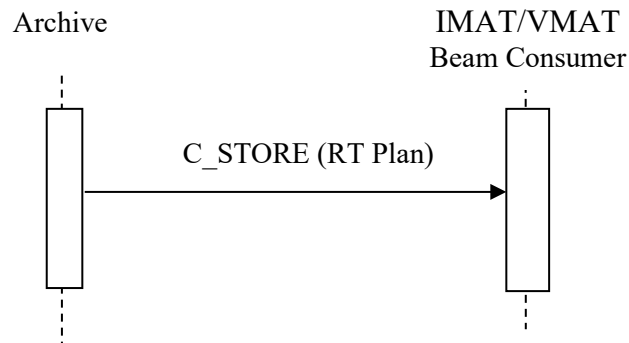
2400

| | |
|---------------|---|
| 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



2405

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.

2410 **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.

2415 **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+*).

2420 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 |

2425 **3.42.4.1.3 Expected Actions**

The IMAT/VMAT Beam Consumer stores the RT Plan.

3.42.5 Security Considerations

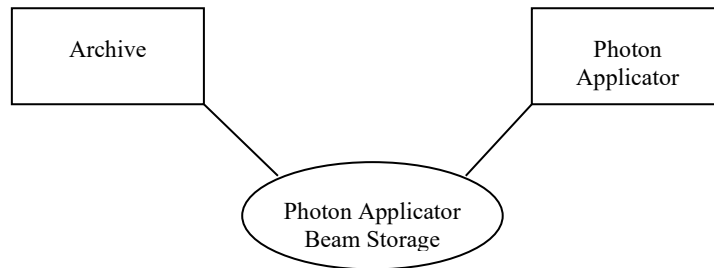
There are no specific security considerations.

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

2430 **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



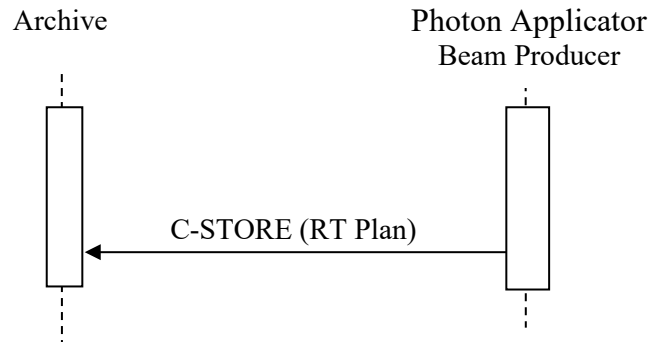
2435

| | |
|---------------|---|
| 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



2440

Figure 3.43.4-1: Interaction Diagram

3.43.4.1 Photon Applicator Beam Storage

3.43.4.1.1 Trigger Events

2445 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.

2450 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

2455 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.

2460

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 |

2465 3.43.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.43.5 Security Considerations

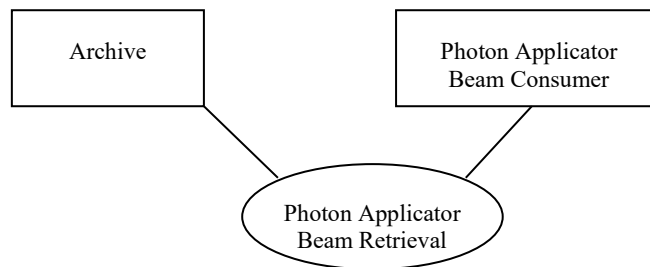
There are no specific security considerations.

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

2470 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.

2475 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 |

2480 **3.44.3 Referenced Standards**

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

3.44.4 Messages

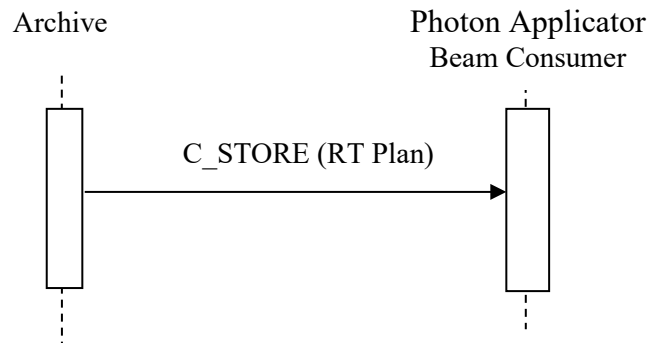


Figure 3.44.4-1: Interaction Diagram

2485 **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.

2490 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

2495 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

2500 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.

2505 3.44.5 Security Considerations

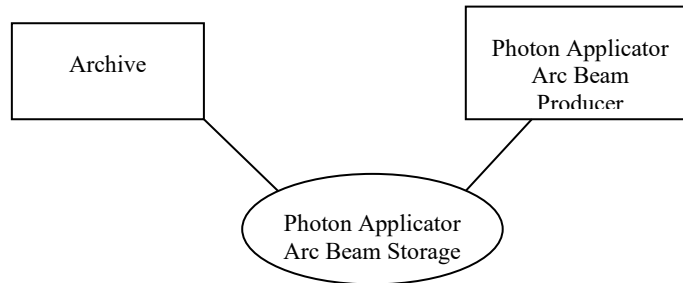
There are no specific security considerations.

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

3.45.1 Scope

2510 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



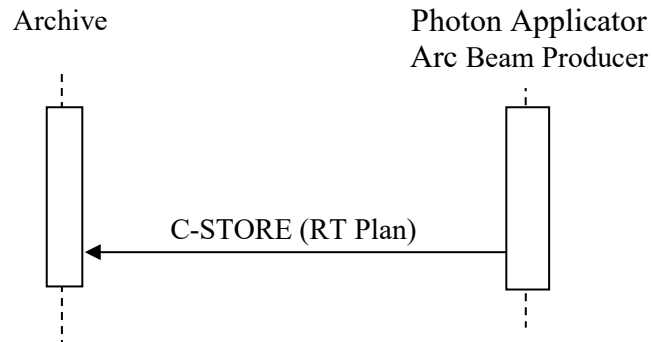
| | |
|---------------|--|
| Actor: | Photon Applicator Arc Beam Producer |
| Role: | Creates Basic Static Beam RT Plan and stores plan to an RT Archive |
| Actor: | Archive |
| Role: | Accept and store RT Plan from Photon Applicator Arc Beam Producer |

2515

3.45.3 Referenced Standards

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

3.45.4 Messages



2520

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.

2525

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.

2530

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

2535

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.

2540

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 |

2545 3.45.4.1.3 Expected Actions

The Archive stores the RT Plan.

3.45.5 Security Considerations

There are no specific security considerations.

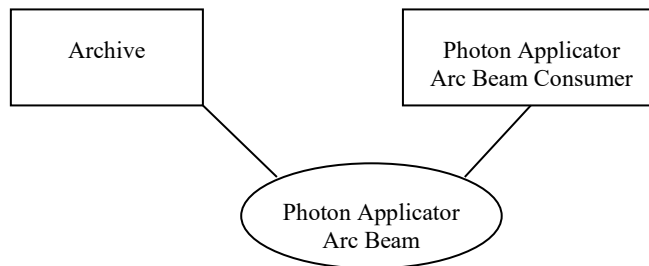
3.46 Photon Applicator Arc Beam Retrieval [RO-TPPC-28]

2550 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

2555



| | |
|---------------|---|
| 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

2560 DICOM 2018e, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.46.4 Messages

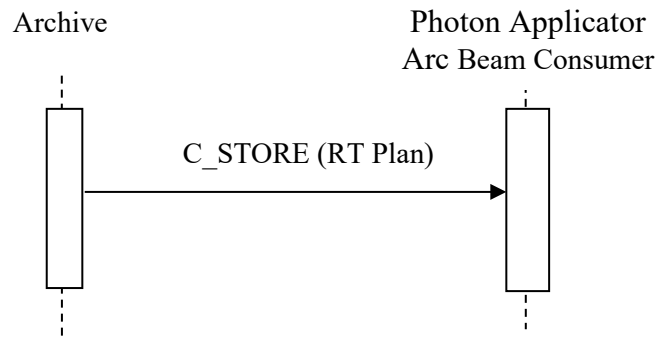


Figure 3.46.4-1: Interaction Diagram

3.46.4.1 Photon Applicator Arc Beam Retrieval

2565 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.

2570 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

2575 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

2580 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

2585 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.

2590 **3.58.2 Actor Roles**

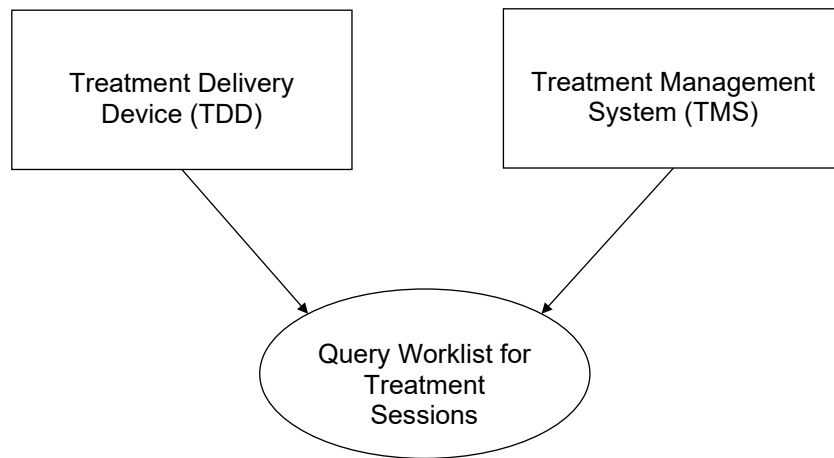


Figure 3.58.2-1: Use Case Diagram

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. |

2595 **3.58.3 Referenced Standards**

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

3.58.4 Messages

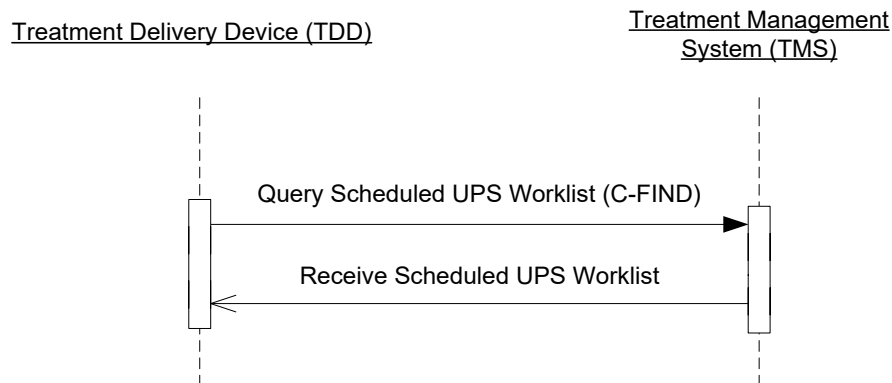


Figure 3.58.4-1: Interaction Diagram

2600 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.

2605 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).

2610 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.

2615 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

2620 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

2625 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.

2630 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:

- 2635
- Patient Name
 - Patient ID
 - Scheduled Station Name Sequence/Code Meaning
 - Scheduled Workitem Code Sequence/Code Meaning

3.58.5 Protocol Requirements

2640 NA

3.58.6 Security Considerations

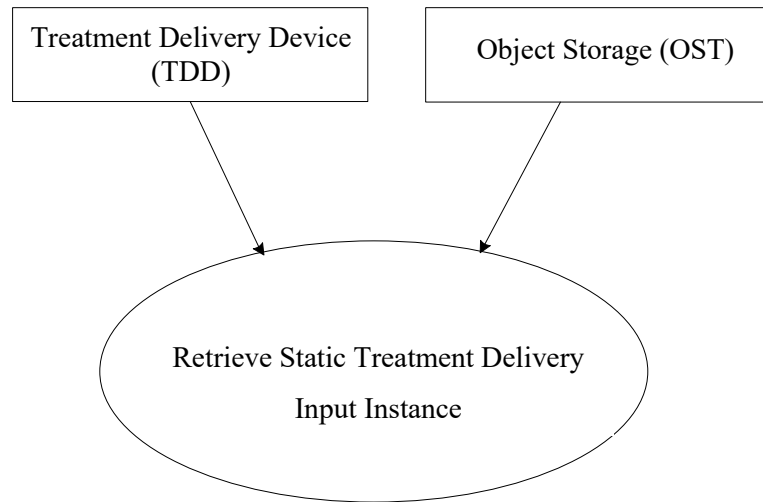
See section 9.5 TDW-II Security Considerations.

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

3.59.1 Scope

2645 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



2650

Figure 3.59.2-1: Use Case Diagram

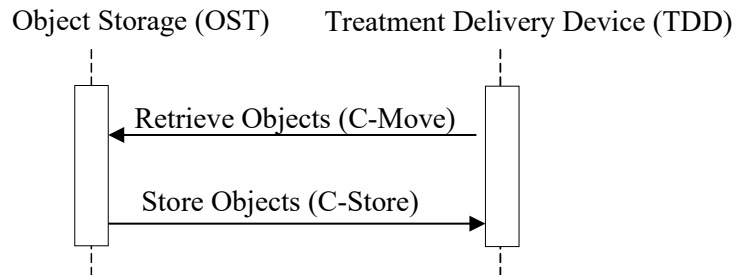
Table 3.59.2-1: Actor Roles

| | |
|---------------|---|
| 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

- 2655 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



2660

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.

2670

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.

2675

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”

2680

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.

2685 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.

2690

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).

2695

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.

2700

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:

2705

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

2710

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.

2715

3.59.5 Protocol Requirements

NA

3.59.6 Security Considerations

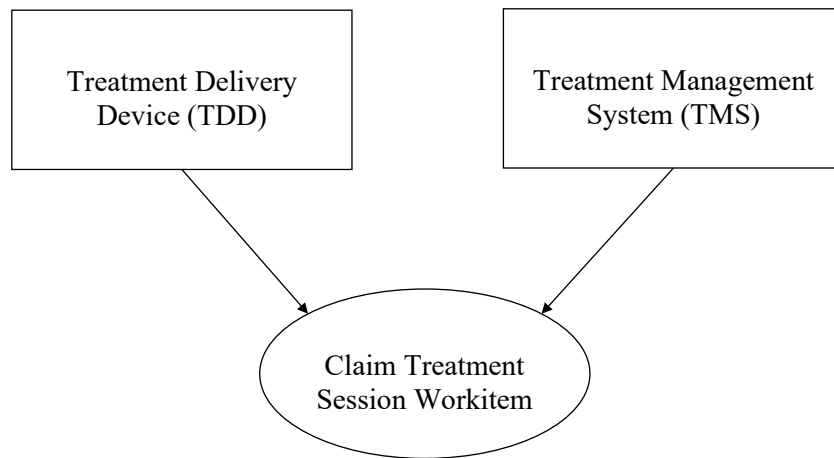
See section 9.5 TDW-II Security Considerations.

3.60 Claim Treatment Session Workitem [RO-60]

2720 **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



2725

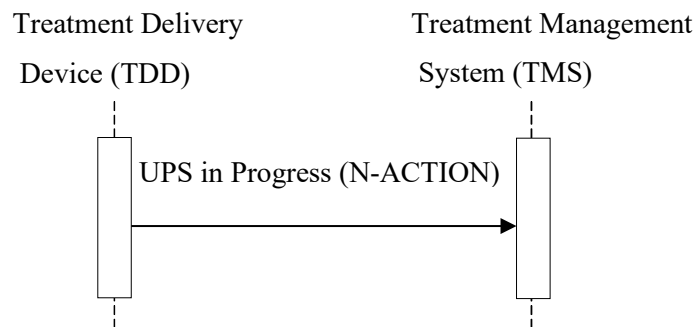
Figure 3.60.2-1: Use Case Diagram

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

2730 **3.60.4 Messages****Figure 3.60.4-1: Interaction Diagram****3.60.4.1 UPS in Progress Message**

2735 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.

2740

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.

2745 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

2750 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

2755 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.

2760 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.

2765 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.

2770 **3.61 Retrieve Dynamic Treatment Delivery Input Instances [RO-61]**

3.61.1 Scope

2775 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

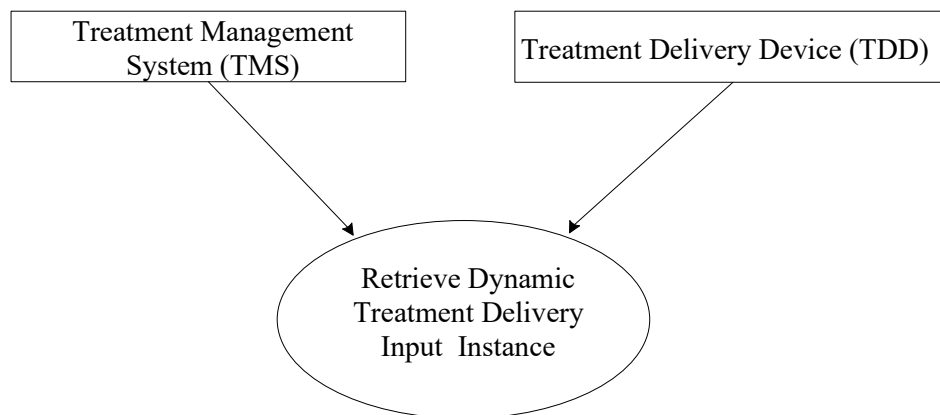


Figure 3.61.2-1: Use Case Diagram

2780

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

2785 DICOM PS 3.4: Query/Retrieve Service Class

3.61.4 Messages

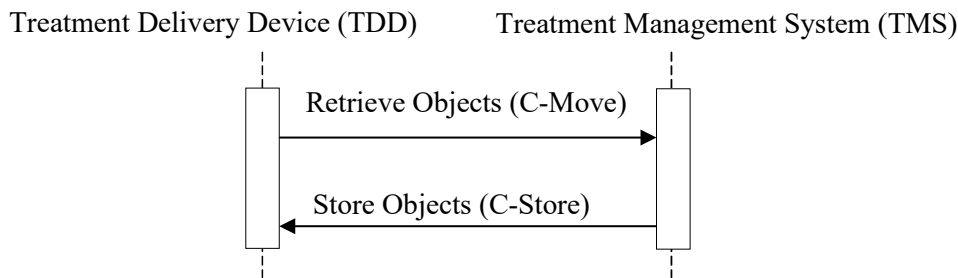


Figure 3.61.4-1: Interaction Diagram

3.61.4.1 Retrieve Objects Message

2790 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.

2795 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:

2800 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

2805 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].

2810 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.

2815 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.

2820

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 |

2825 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-IL, 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].

2830

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).

2835 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

2840 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.

2845 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.

2850 3.61.5 Protocol Requirements

NA

3.61.6 Security Considerations

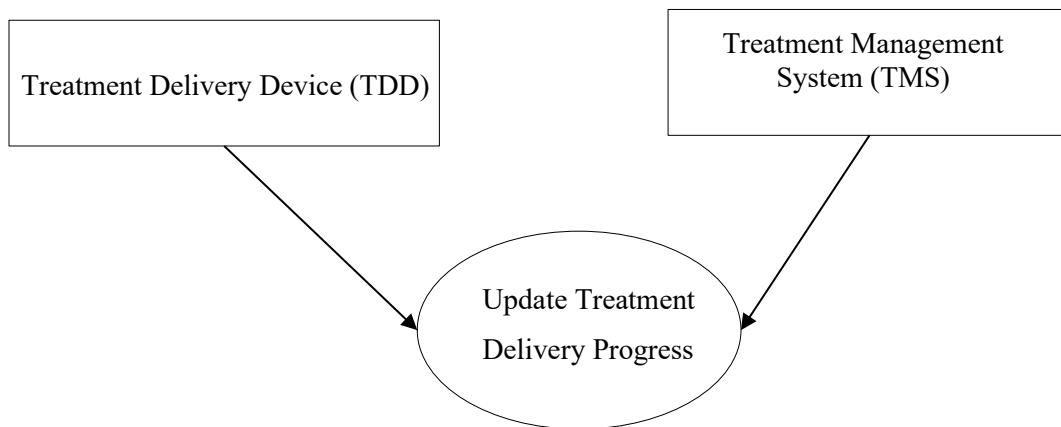
See section 9.5 TDW-II Security Considerations.

3.62 Update Treatment Delivery Progress [RO-62]

2855 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



2860

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

2865 DICOM PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.62.4 Messages

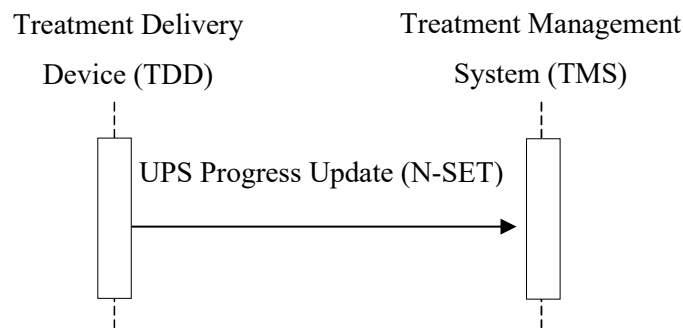


Figure 3.62.4-1: Interaction Diagram

3.62.4.1 UPS Progress Update Message

2870 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

2875 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%.

2880 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%

- 2885 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.

- 2890 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].
- 2895 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

- 2900 **3.62.6 Security Considerations**

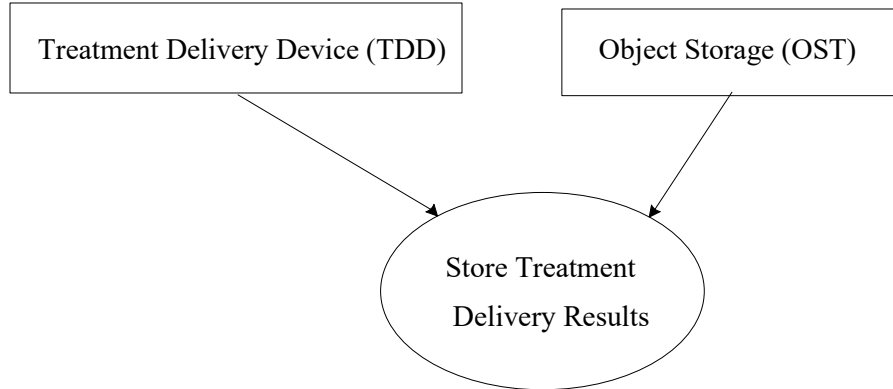
Not applicable.

3.63 Store Treatment Delivery Results [RO-63]

3.63.1 Scope

- 2905 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



2910

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

2915 DICOM PS 3.4: Storage Service Class

3.63.4 Messages

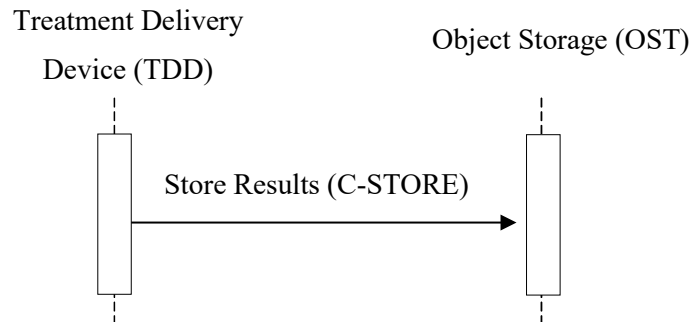


Figure 3.63.4-1: Interaction Diagram

2920 **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

2925 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

2930 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.

2935 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.

2940

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 |

2945 **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

2950 NA

3.63.6 Security Considerations

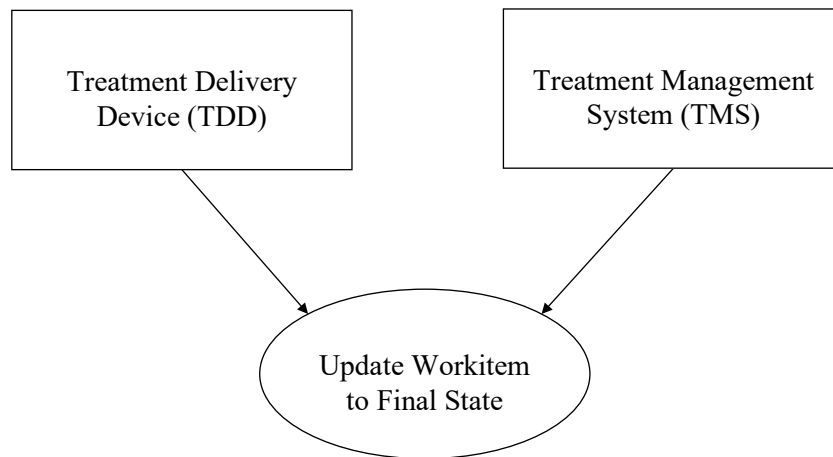
See section 9.5 TDW-II Security Considerations.

3.64 Update Workitem to Final State [RO-64]

3.64.1 Scope

2955 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



2960

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

2965 3.64.4 Messages

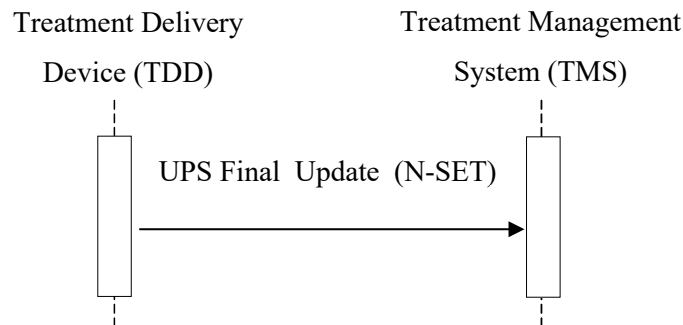


Figure 3.64.4-1: Interaction Diagram

3.64.4.1 UPS Final Update Message

2970 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).

2975 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.

2980 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.

2985 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.

2990 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

2995 **3.64.6 Security Considerations**

Not applicable.

3.65 Complete/Cancel Treatment Delivery [RO-65]

3.65.1 Scope

3000 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

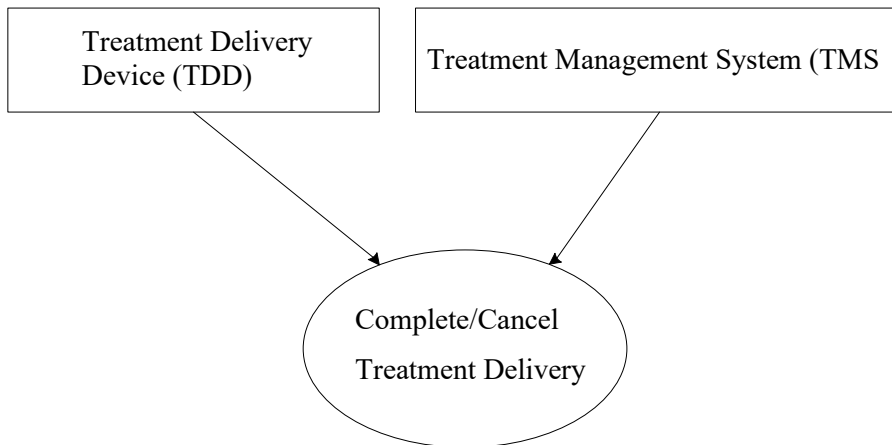


Figure 3.65.2-1: Use Case Diagram

3005

Table 3.65.2-1: Actor Roles

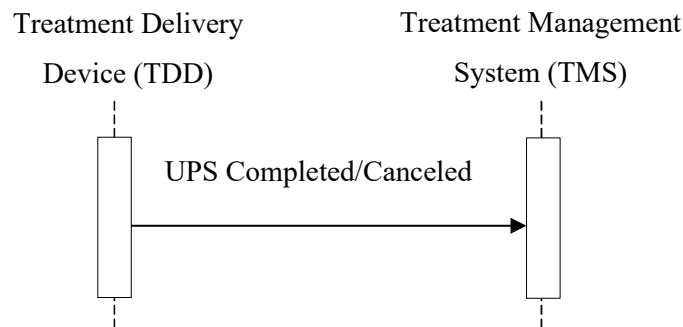
| | |
|---------------|-----------------------------|
| Actor: | Treatment Management System |
|---------------|-----------------------------|

| | |
|---------------|---|
| 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



3010

Figure 3.65.4-1: Interaction Diagram

3.65.4.1 UPS Completed/Canceled Message

3015 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

3020 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'.

3025 **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.

3030 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.

3035 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.

3045 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.

3050 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.

3055 **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

3060 NA

3.65.6 Security Considerations

Not applicable.

3065

Appendices to Volume 2

None

Glossary

3070 Please see the IHE Technical Frameworks General Introduction, [Appendix D - Glossary](#) for the IHE Glossary.