ASTRO

Integrating the Healthcare Enterprise

IHE-Radiation Oncology
Technical Framework
Volume 2 - Transactions

2008

Draft for Trial Implementation

November 13, 2008

_____

Contents

_____

Draft for Trial Implementation

_____

_____

Draft for Trial Implementation

_____

_____

Draft for Trial Implementation

_____

DRAFT

_____

_____

1 Preface to Volume 2

1.1 Intended Audience

The intended audience of this document is:

- Technical staff of vendors planning to participate in the IHE initiative
- IT departments of healthcare institutions
- Experts involved in standards development
- Anyone interested in the technical aspects of integrating healthcare information systems

1.2 How this Document is Organized

Section 1 is the preface, describing the intended audience, related resources, and organizations and conventions used within this document.

Section 2 provides an overview of the concepts of IHE actors and transactions used in IHE to define the functional components of a distributed healthcare environment.

Section 3 defines transactions in detail, specifying the roles for each actor, the standards employed, the information exchanged, and in some cases, implementation options for the transaction.

Section 4 defines a set of payload bindings with transactions.

Section 5 defines the high level content specifications used for the payloads of the transactions.

Section 6 defines the reusable sections of content payloads.

Section 7 defines the lower level building blocks used in various sections.

1.3 Conventions Used in this Volume

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 should be applied.

1.3.1 The Generic IHE Transaction Model

Transaction descriptions are provided in section 4. In each transaction description, the actors, the roles they play, and the transactions between them are presented as use cases.

The generic IHE transaction description includes the following components:

_____

_____

- Scope: a brief description of the transaction.
- Use case roles: textual definitions of the actors and their roles, with a simple diagram relating them, e.g.:
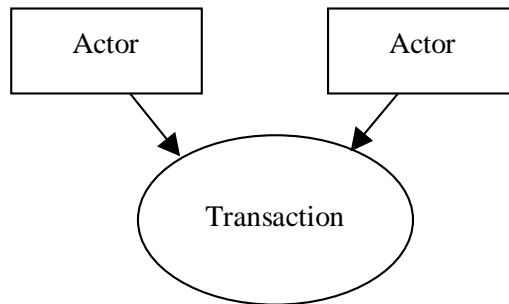
- *Referenced Standards*: the standards (stating the specific parts, chapters or sections thereof) to be used for the transaction.
- *Interaction Diagram*: a graphical depiction of the actors and transactions, with related processing within an actor shown as a rectangle and time progressing downward, similar to:
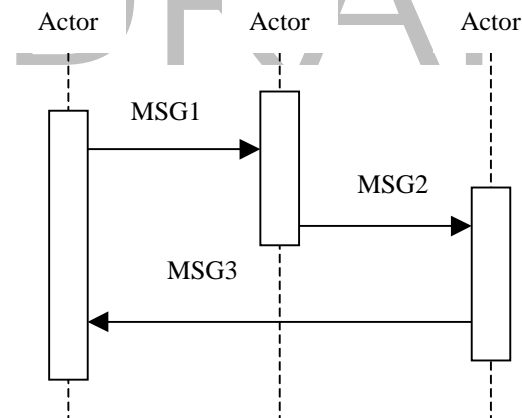
The interaction diagrams used in the IHE Technical Framework are modeled after those described in Grady Booch, James Rumbaugh, and Ivar Jacobson, *The Unified Modeling Language User Guide*, ISBN 0-201-57168-4. Simple acknowledgment messages are omitted from the diagrams for brevity.

_____

8

_____

- *Message definitions*: descriptions of each message involved in the transaction, the events that trigger the message, its semantics, and the actions that the message triggers in the receiver.

1.4 Copyright Permissions

Health Level Seven, Inc., has granted permission to the IHE to reproduce tables from the HL7 standard. The HL7 tables in this document are copyrighted by Health Level Seven, Inc. All rights reserved.

Material drawn from these documents is credited where used.

1.5 Comments

The IHE sponsors welcome comments on this document and the IHE initiative. They should be directed to the discussion server at http://forums.rsna.org or to:

Robyn Lynn Watson, PhD

Director of Research
American Society for Therapeutic Radiology and Oncology (ASTRO)
8280 Willow Oaks Corporate Drive, Suite 500
Fairfax, VA 22031
ihero@astro.org

_____

_____

2 Introduction

This document, the IHE Radiation Oncology Technical Framework (RO-TF), defines specific implementations of established standards. These are intended to achieve integration goals that promote appropriate exchange of medical information to coordinate the optimal patient care among care providers in different care settings. It is expanded annually, after a period of public review, and maintained regularly through the identification and correction of errata. The latest version of the document is always available via the Internet at http://www.ihe.net/Technical_Framework/index.cfm , where the technical framework volumes specific to the various healthcare domains addressed by IHE may be found.

The IHE Radiation Oncology Technical Framework identifies a subset of the functional components of the healthcare enterprises and health information networks, called IHE actors, and specifies their interactions in terms of a set of coordinated, standards-based transactions.

The other domains within the IHE initiative also produce Technical Frameworks within their respective areas that together form the IHE Technical Framework. Currently, the following IHE Technical Framework(s) are available:

- IHE IT Infrastructure Technical Framework
- IHE Cardiology Technical Framework
- IHE Eye Care Technical Framework
- IHE Laboratory Technical framework
- IHE Radiology Technical Framework
- IHE Patient Care Coordination Technical Framework

Where applicable, references are made to other technical frameworks. For the conventions on referencing other frameworks, see the preface of this volume.

2.1 Relationship to Standards

The IHE Technical Framework identifies functional components of a distributed healthcare environment (referred to as IHE actors), solely from the point of view of their interactions in the healthcare enterprise. At its current level of development, it defines a coordinated set of transactions based on standards (such as HL7, IETF, ASTM, DICOM, ISO, OASIS, etc.) in order to accomplish a particular use case. As the scope of the IHE initiative expands, transactions based on other standards may be included as required.

In some cases, IHE recommends selection of specific options supported by these standards. However, IHE does not introduce technical choices that contradict conformance to these standards. If errors in or extensions to existing standards are

_____

Draft for Trial Implementation

_____

identified, IHE's policy is to report them to the appropriate standards bodies for resolution within their conformance and standards evolution strategy.

IHE is therefore an implementation framework, not a standard. Conformance claims for products must still be made in direct reference to specific standards. In addition, vendors who have implemented IHE integration capabilities in their products may publish IHE Integration Statements to communicate their products' capabilities. Vendors publishing IHE Integration Statements accept full responsibility for their content. By comparing the IHE Integration Statements from different products, a user familiar with the IHE concepts of actors and integration profiles can determine the level of integration between them. See http://www.ihe.net/Resources/upload/ihe_integration_statements.pdf for the format of IHE Integration Statements.

2.2 Relationship to Product Implementations

The IHE actors and transactions described in the IHE Technical Framework are abstractions of the real-world healthcare information system environment. While some of the transactions are traditionally performed by specific product categories (e.g. HIS, Clinical Data Repository, Electronic Health record systems, Radiology Information Systems, Clinical Information Systems or Cardiology Information Systems), the IHE Technical Framework intentionally avoids associating functions or actors with such product categories. For each actor, the IHE Technical Framework defines only those functions associated with integrating information systems. The IHE definition of an actor should therefore not be taken as the complete definition of any product that might implement it, nor should the framework itself be taken to comprehensively describe the architecture of a healthcare information system.

The reason for defining actors and transactions is to provide a basis for defining the interactions among functional components of the healthcare information system environment. In situations where a single physical product implements multiple functions, only the interfaces between the product and external functions in the environment are considered to be significant by the IHE initiative. Therefore, the IHE initiative takes no position as to the relative merits of an integrated environment based on a single, all-encompassing information system versus one based on multiple systems that together achieve the same end.

2.3 Relation of this Volume to the Technical Framework

The IHE Technical Framework is based on actors that interact through transactions.

Actors are information systems or components of information systems that produce, manage, or act on information associated with operational activities in the enterprise.

Transactions are interactions between actors that transfer the required information through standards-based messages.

Draft for Trial Implementation

The implementation of the transactions described in this volume support the specification of Integration Profiles defined in Volume 1. The role and implementation of these transactions require the understanding of the Integration profile they support.

2.4 IHE Usage Conventions (included for reference)

For some DICOM transactions described in this document, IHE has strengthened the requirements on the use of selected Type 2 and Type 3 attributes. These situations are explicitly documented in section 4 and in the appendices.

IHE specifically emphasizes that DICOM Type 2 attributes (for instance, Patient Name, Patient ID) shall be transmitted with zero length if the source system does not possess valid values for such attributes; in other words, the source system shall not assign default values to such attributes. The receiving system must be able to handle zero-length values for such attributes.

IHE has also defined requirements related to the support for and use of matching and return keys in DICOM queries by both Service Class Users (SCUs) and Service Class Providers (SCPs). Matching keys are used to select instances for inclusion in the response by the query SCP to the SCU, whereas return keys only return specific data and are not used for matching.

- Required matching key SCU:

  A key that the Query SCU shall have the ability to offer to its user as a selection criterion. The definition of the means offered to the user of the Query SCU to trigger the sending of a matching key in the Query request is beyond the scope of IHE (e.g. enter a value, select an entry).

- Required matching key SCP:

  An IHE required matching key is processed by the Query SCP just as if it were a DICOM-required matching key. In most cases, IHE-required matching keys are also DICOM-required matching keys.

- Required return key SCU:

  A key that the Query SCU requests from the Query SCP, receives in the query responses, and displays for the user, if required. The definition of the means offered to the user of the Query SCU to request a return key (e.g. by default, check a box) and to make it visible to the user is beyond the scope of IHE.

- Required return key SCP:

  IHE-required return keys specified within DICOM as type 1 or type 2 return keys are processed according to their DICOM type. IHE-required return keys specified within DICOM as type 3 will be processed as if they were type 2.

_____

Query Key Requirement Tables in the framework use the following legend to specify requirements for SCUs and SCPs:

R Required   O Optional

The following modifiers are also used:

R+   The requirement is an IHE extension of the DICOM requirements

R*   The attribute is not required to be displayed

R+*   The Requirement is an IHE extension of the DICOM requirements, but it is NOT required to be displayed

DRAFT

_____

Draft for Trial Implementation

_____

3   IHE Transactions

This section defines each IHE transaction in detail, specifying the standards used, and the information transferred.

3.1   RO-1: Single/Contoured Image Series Retrieval

3.1.1   Scope

In the Single/Contoured Image Series Retrieve transaction, the Archive sends a series of CT-Images to the *Contourer*, *Geometric Planner*, *Dosimetric Planner* or *Dose Displayer*.

3.1.2   Use Case Roles
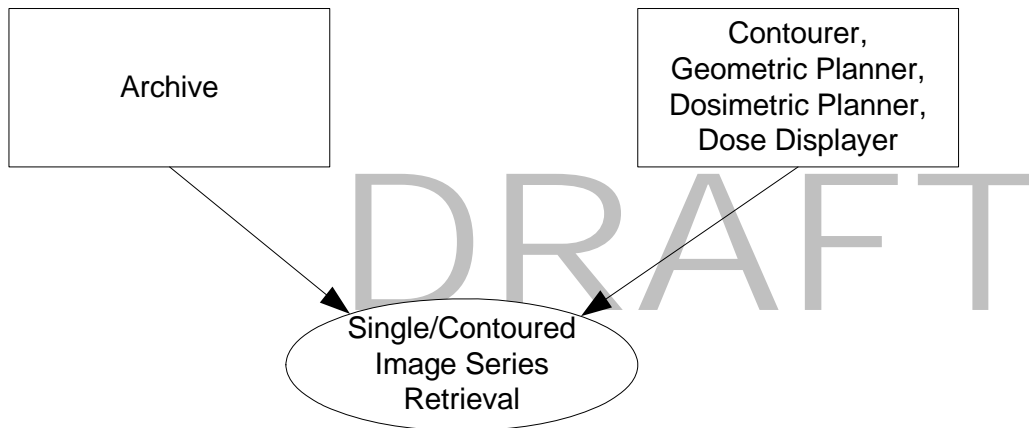
Actor: Archive

Role: Transmit CT Series to *Contourer*, *Geometric Planner*, *Dosimetric Planner* or *Dose Displayer*

Actor: *Contourer*, *Geometric Planner*, *Dosimetric Planner* or *Dose Displayer*

Role: Receives and stores CT Series from Archive

_____

Draft for Trial Implementation

_____

3.1.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

3.1.4   Interaction Diagram
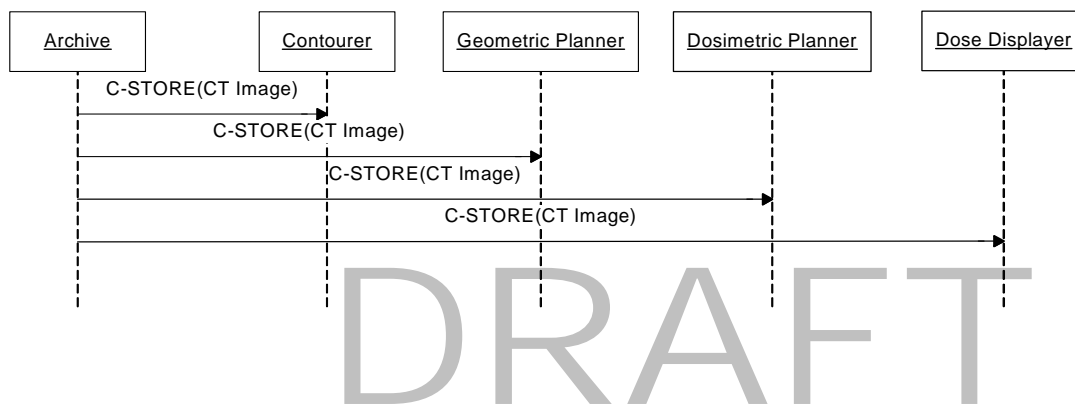
3.1.4.1   Single/Contoured Image Series Retrieval

3.1.4.1.1 Trigger Events

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

The user of a ***Geometric Planner***, in order to generate a geometric plan, determines that a certain CT Series is required, and requests that the archive send the necessary CT series to the ***Geometric Planner***.

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

_____

_____

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

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

3.1.4.1.2 Message Semantics

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

Also refer to appendix A for an overview of specific requirements on the DICOM attributes that are included in a CT Image Object. In particular, all of the CT images involved in this transaction must share a single series instance UID and a single frame of reference UID.

3.1.4.1.3 Expected Actions

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

The *Geometric 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 *Geometric Planner* for use in construction of a geometric plan which will later be exported as a *Geometric Plan* (RO-3).

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-5).

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

_____

_____

3.2   RO-2: Structure Set Storage

3.2.1   Scope

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

3.2.2   Use Case Roles
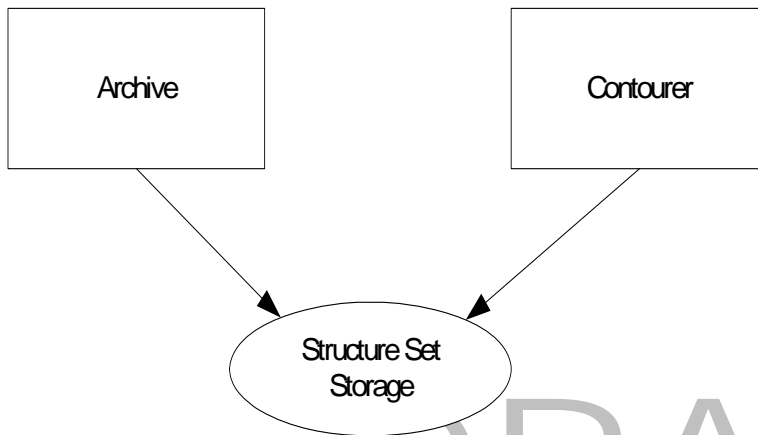
Actor: Contourer

Role: Sends Structure Set to Archive

Actor: Archive

Role: Stores Structure Set received from **Contourer**

3.2.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

_____

Draft for Trial Implementation

03/17/2009   Copyright ©2006- 2008: ASTRO, AAPM, RSNA, HIMSS

_____

3.2.4   Interaction Diagram

```
  ┌─────────────────┐                    ┌─────────────────┐
  │   A r c h i v e │                    │ C o n t o u r e r│
  └─────────────────┘                    └─────────────────┘
          ┆                                      ┆
          ┆      C - S T O R E (S t r u c t u r e  S e t)   ┆
          ┆◄─────────────────────────────────────┆
          ┆                                      ┆
```

3.2.4.1   Structure Set storage

3.2.4.1.1 Trigger Events

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

3.2.4.1.2   Semantics

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

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

Also refer to appendix B 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.

3.2.4.1.3 Expected Actions

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

_____

Draft for Trial Implementation

_____

3.3 RO-3: Geometric Plan Storage

3.3.1 Scope

In the *Geometric Plan* Storage transaction, the *Geometric Planner* sends the newly created *Geometric Plan* to the Archive.

3.3.2 Use Case Roles
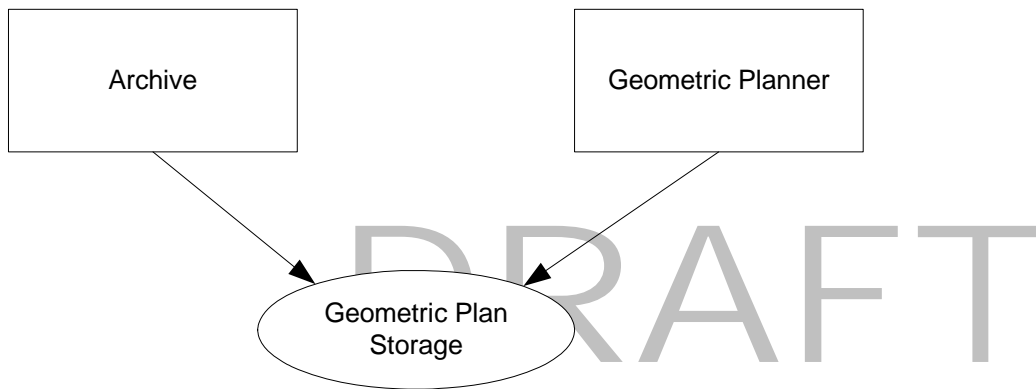
Actor: Geometric Planner

    Role: Transmit generated *Geometric Plan* to the Archive

    Actor: Archive

    Role: Receives and stores Geometric Plans from the *Geometric Planner*

3.3.3 Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

_____

Draft for Trial Implementation

_____

3.3.4   Interaction Diagram
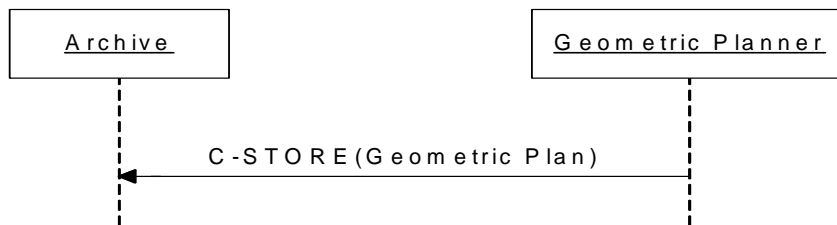
3.3.4.1 Geometric Plan Storage

3.3.4.1.1 Trigger Events

Upon successful creation of the Geometric Plan, the user of the *Geometric Planner* decides to store the Geometric Plan. The *Geometric Planner* transfers the *Geometric Plan* to the Archive within a DICOM association.

3.3.4.1.2 Message Semantics

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

Also refer to appendix A for an overview of *Geometric Plan* specific requirements on the DICOM attributes that are included in an RT Plan object.

3.3.4.1.3 Expected Actions

The Archive will store the received Geometric Plan.

3.4   RO-4: Dosimetric Plan Storage

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

_____

Draft for Trial Implementation

_____

structure set to the Archive.

3.4.2 Use Case Roles
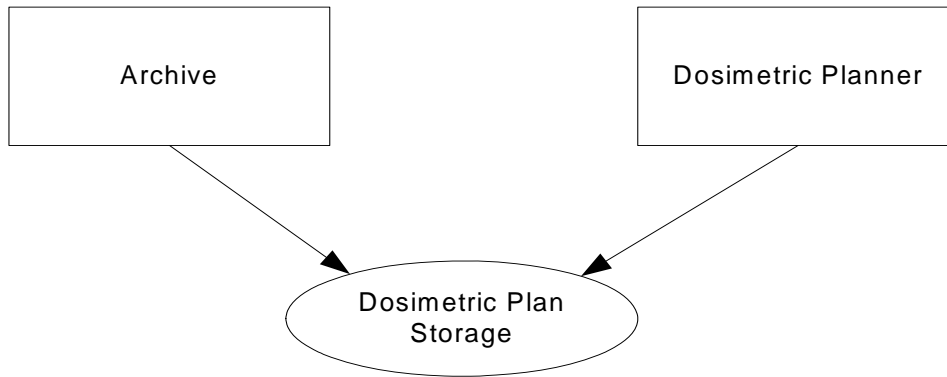
Actor: *Dosimetric Planner*

Role: Transmit generated plan to Archive.

Actor: Archive

Role: Accept and store plan from *Dosimetric Planner.*

3.4.3 Referenced Standards

DICOM 2008, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

3.4.4 Interaction Diagram

_____

_____
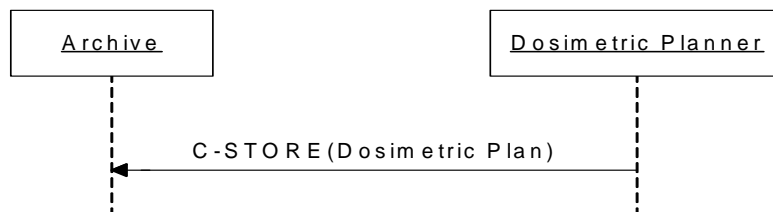
3.4.4.1 Dosimetric Plan Storage

3.4.4.1.1 Trigger Events

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

3.4.4.1.2 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 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.

The purpose of the *Dosimetric Plan* transferred is to convey the reference to the 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 structure set and the CT images referenced in the structure set for display.

The following table shows the IHE extension of the DICOM requirements for the RT General Plan module.

Table 3.4-1 Required Attributes for RT General Plan Module

Attribute	Tag	Type	Attribute Description
RT Plan Label	(300A,0002)	R+	The label, which serves as the identification of the plan for the user.
RT Plan Date	(300A,0006)	R+	The date, when the plan was last modified.
RT Plan Time	(300A,0007)	R+	The time, when the plan was last modified.
RT Plan Geometry	(300A,000C)	1	Shall be PATIENT. This implies, that the RT Structure Set exists and is referenced in the General Plan module.

The following table shows the IHE extension of the DICOM requirements for the General Equipment module.

_____

_____

Table 3.4-2 Required Attributes for General Equipment Module

Attribute	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	R+	The manufacturer of the *Dosimetric Planner* equipment creating the plan shall be provided.
Manufacturer's Model Name	(0008,1090)	R+	The manufacturer's model name of the *Dosimetric Planner* equipment creating the plan shall be provided.
Software Versions	(0008,1020)	R+	The software version of the *Dosimetric Planner* equipment creating the plan shall be provided.

On all other attributes of the RT Plan IOD, no IHE extension to the DICOM requirements exists.

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

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

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

3.5   RO-5: Dose Storage

This section corresponds to RO-5 of the IHE-RO technical framework. Transaction RO-5 is used by the Archive and *Dosimetric Planner* actors.

3.5.1   Scope

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

3.5.2   Use Case Roles

_____

Draft for Trial Implementation

_____
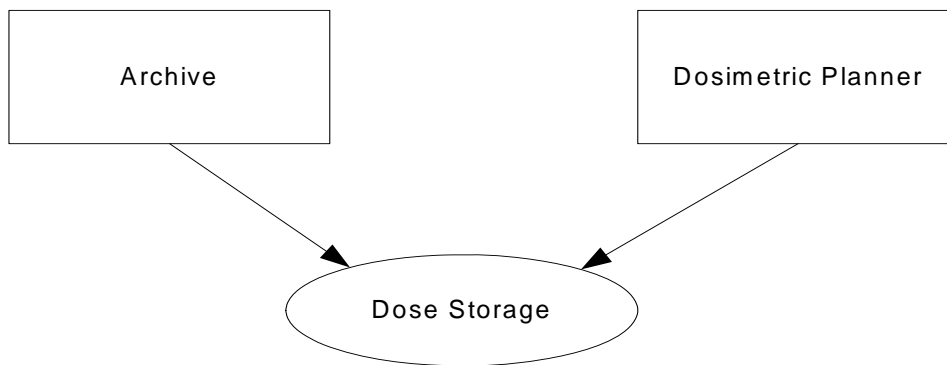
Actor: *Dosimetric Planner*

Role: Transmit generated Dose to the Archive

Actor: Archive

Role: Receives and stores Doses from the *Dosimetric Planner*

3.5.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

3.5.4   Interaction Diagram

_____

24

_____
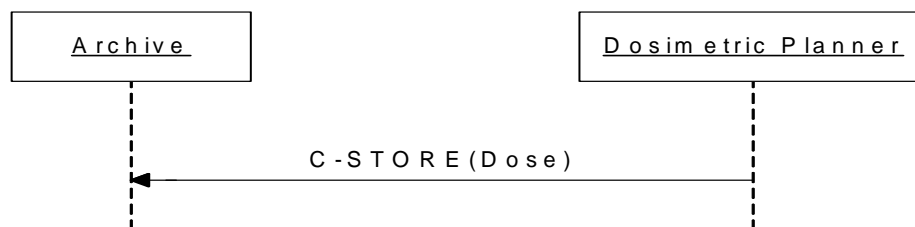
3.5.4.1 Dose Storage

3.5.4.1.1 Trigger Events

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

3.5.4.1.2 Message Semantics

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

Also refer to appendix A for an overview of Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

3.5.4.1.3 Representation of Dose

This transaction shall support Dose represented as a three-dimensional dose array sampled onto axial image planes in the same DICOM Patient coordinate system Frame of Reference as the diagnostic images used to compute it. The dose image shall be orthogonal with respect to the DICOM patient coordinate system: the value of Image Orientation (Patient) (0020,0037) shall be [±1, 0, 0, 0, ±1, 0].

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 (0028,0103) shall be 0; negative dose values shall not be present.

3.5.4.1.4 Expected Actions

The Archive will store the received Dose.

The DICOM RT Dose object will be stored such that it can be later retrieved (See RO-10 Dose Retrieve) in a fashion meeting the requirements defined for a DICOM level 2 SCP (Refer to DICOM PS 3.4 B.4.1).

The DICOM SOP Class UID and Name for the RT Dose object is defined in the table below.

SOP Class UID	SOP Class Name
1.2.840.10008.5.1.4.1.1.481.2	RT Dose Storage

_____

_____

3.6   RO-6: Multi-Series Image Retrieve

3.6.1   Scope

In the Multi-Series Image Retrieve Transaction, the Archive stores CT Images from multiple series (but a single study) on a *Contourer* to make these Images available for contouring.

3.6.2   Use Case Roles
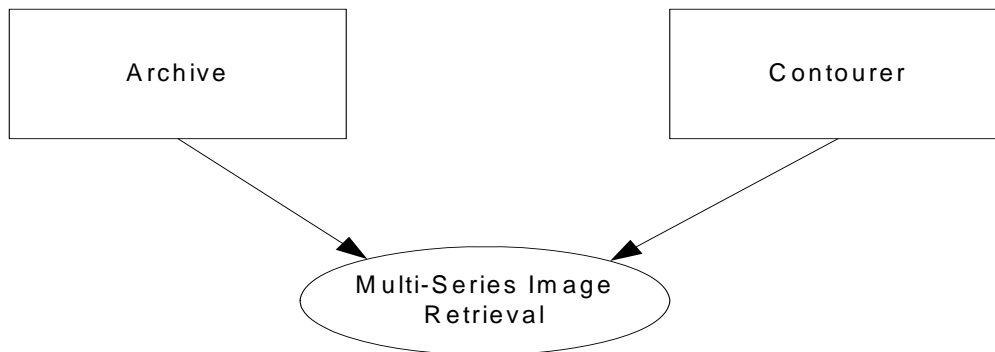
Actor: Archive

Role: Sends CT Images to the *Contourer*

Actor: *Contourer*

Role: Stores CT Images received from Archive

3.6.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

_____

Draft for Trial Implementation

_____

3.6.4 Interaction Diagram

3.6.4.1 Multi-Series Image Retrieve

3.6.4.1.1 Trigger Events

The user of the ***Contourer*** determines that Images from multiple CT Series are to be used in the construction of a single set of contours, and requests that the Archive send these Series to the ***Contourer***.

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

3.6.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The Archive is the SCU of this service class, and the ***Contourer*** is the SCP of this service Class.
Also refer to appendix A 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, but not a series instance UID.

3.6.4.1.3 Expected Actions

Upon receiving the multiple CT Series, the ***Contourer*** will resample the Series if necessary, and will combine Images from the various series into a single, new CT Series with a new series instance UID. A Contourer shall be required to support retrieval of multiple (1, 2, or 3) image series. Images in this new series will all share the same study instance UID with the original images. These new images must also share a single frame

_____

27

Draft for Trial Implementation

_____

of reference UID with the original images. This new series will be sent back to the archive using the Resampled/Combined CT Series Stored transaction (RO-11).

3.7   RO-7: Structure Set Retrieval

3.7.1   Scope

In the Structure Set Retrieval Transaction, the Archiver stores a Structure Set on a *Contourer*, *Geometric Planner*, *Dosimetric Planner*, or *Dose Displayer*.

3.7.2   Use Case Roles
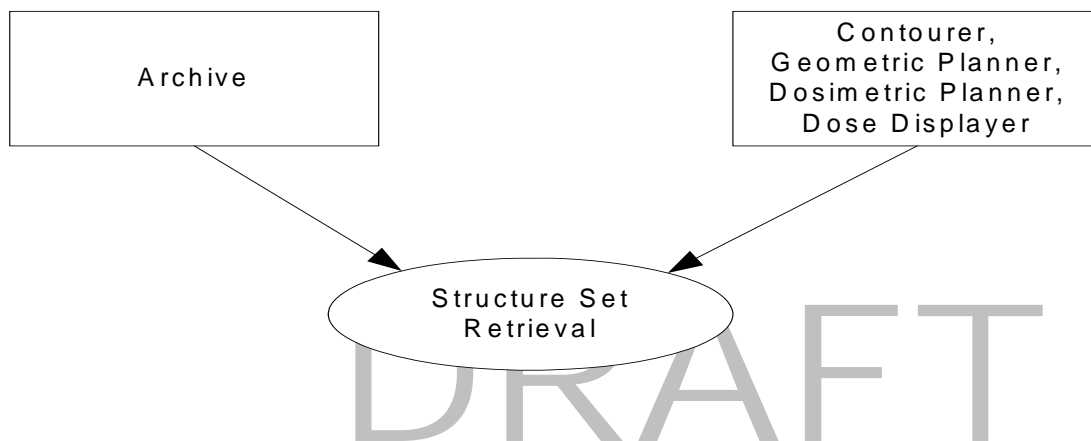
Actor: Archive

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

Actor: *Contourer*, *Geometric Planner*, *Dosimetric Planner*, or *Dose Displayer*

Role: Stores Structure Set received from Archive

3.7.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

_____

_____

3.7.4   Interaction Diagram
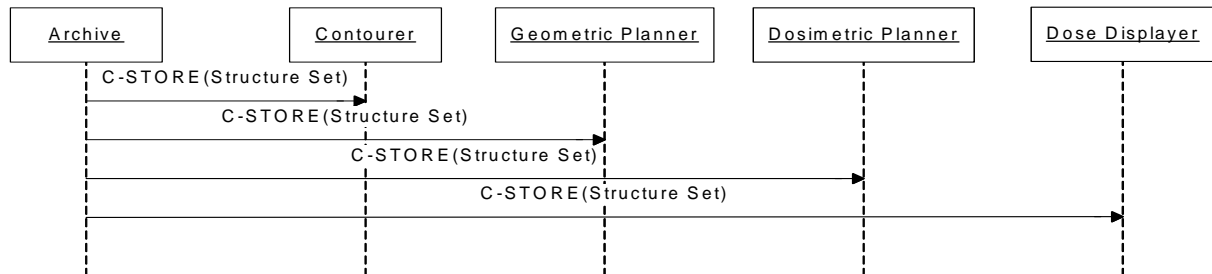
3.7.4.1   Structure Set Retrieval

3.7.4.1.1 Trigger Events

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

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

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

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

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

_____

Draft for Trial Implementation

_____

3.7.4.1.2 Message Semantics

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

Also refer to appendix B 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 series upon which the contours are based.

3.7.4.1.3 Expected Actions

The ***Contourer*** will store all of the 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 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 structure set.

The ***Geometric Planner*** will store the structure set, and will relate it to images based on the study, series, and image identification information. The contours contained in this structure set will then be available to the user of the ***Geometric Planner*** for use in construction of a geometric plan which will later be exported as a ***Geometric Plan*** (RO-3).

The ***Dosimetric Planner*** will store the structure set, and will relate it to images based on the study, series, and image identification information. These contours contained in this 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-5).

The ***Dose Displayer*** will store the structure set, and will relate it to images based on the study, series, and image identification information. These contours contained in this 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.

_____

_____

3.8   RO-8: Geometric Plan Retrieve

3.8.1   Scope

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

3.8.2   Use Case Roles
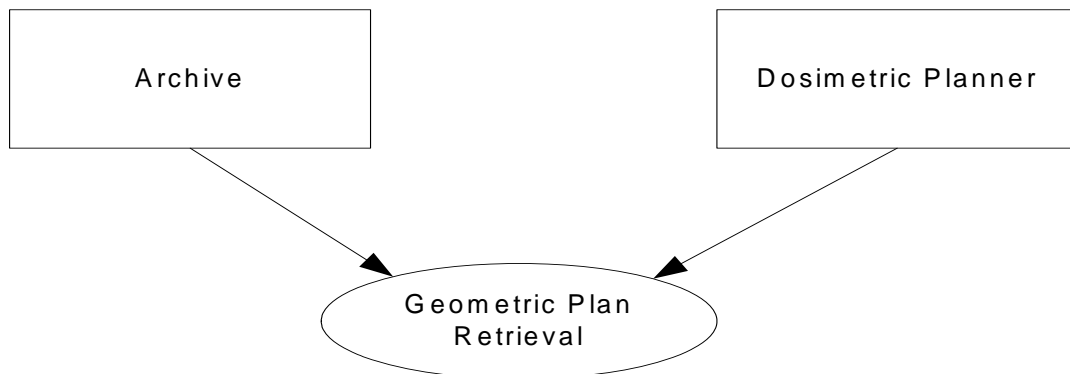
Actor: *Dosimetric Planner*

Role: Receives requested *Geometric Plan* from the Archive
Actor: Archive

Role: Sends requested *Geometric Plan* instance to the *Dosimetric Planner*

3.8.3   Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

_____

31

_____

3.8.4   Interaction Diagram

Archive		Dosimetric Planner

C - S T O R E (G e om e tric P la n)
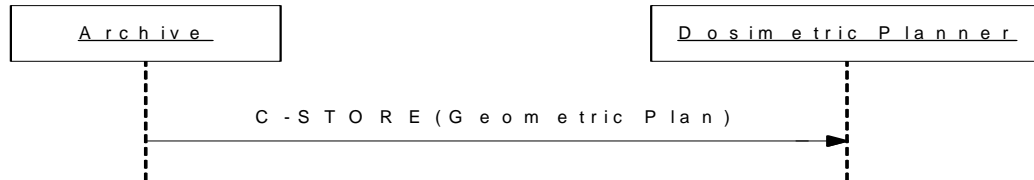
3.8.4.1   Geometric Plan Retrieve

3.8.4.1.1 Trigger Events

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

DRAFT

3.8.4.1.2 Message Semantics

The plan shall be sent from the archive to the ***Dosimetric Planner.*** Also refer to
appendix A for an overview of ***Geometric Plan*** specific requirements on the DICOM
attributes that are included in an RT Plan object.

3.8.4.1.3 Expected Actions

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

_____

_____

3.9 RO-9: Dosimetric Plan Retrieve

3.9.1

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

3.9.2 Use Case Roles
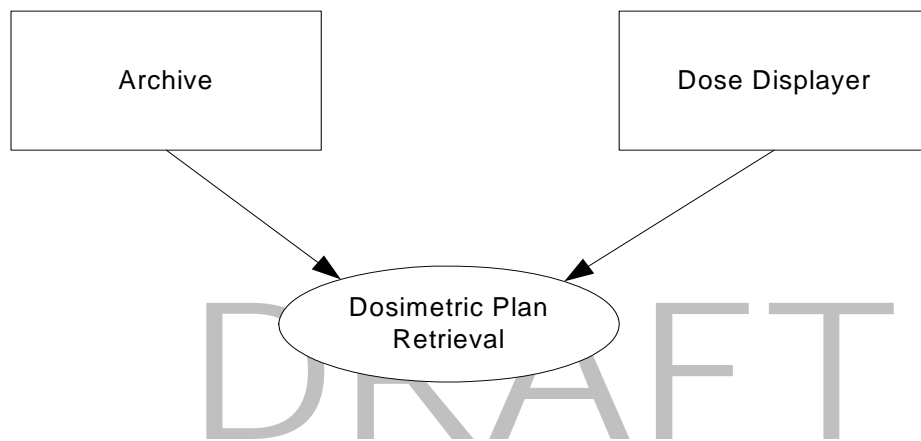
Actor: Dose Displayer

Role: Accepts plan from Archive.

Actor: Archive

Role: Transmits plan to Dose Viewer.

3.9.3 Referenced Standards

DICOM 2008, PS 3.3: RT Modules, PS 3.4: Storage Service Class.

_____

Draft for Trial Implementation

03/17/2009   Copyright ©2006- 2008: ASTRO, AAPM, RSNA, HIMSS

_____

3.9.4 3.9.4   Interaction Diagram

```
┌─────────────────┐                    ┌─────────────────┐
│    Archive      │                    │  Dose Displayer │
└─────────────────┘                    └─────────────────┘
         ┆                                      ┆
         ┆        C-STORE(Dosimetric Plan)      ┆
         ┆ ───────────────────────────────────▶ ┆
         ┆                                      ┆
```
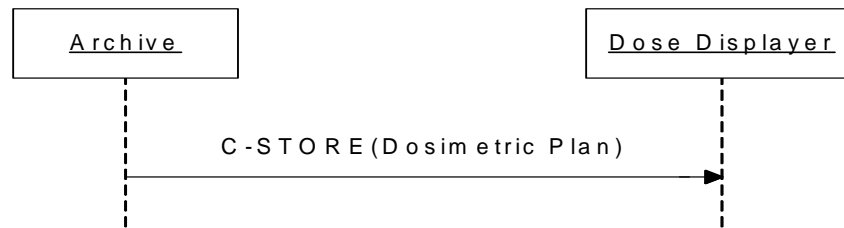
3.9.4.1 Dosimetric Plan Retrieve

3.9.4.1.1 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.

3.9.4.1.2 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.

The requirements for the Dosimetric Plan in this transaction are the same as defined in **Error! Reference source not found.**.

3.10 RO-10: Dose Retrieve

This section corresponds to RO-10 of the IHE-RO technical framework. Transaction RO-10 is used by the Archive and ***Dose Displayer*** actors.

3.10.1 Scope

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

_____

_____

3.10.2 Use Case Roles
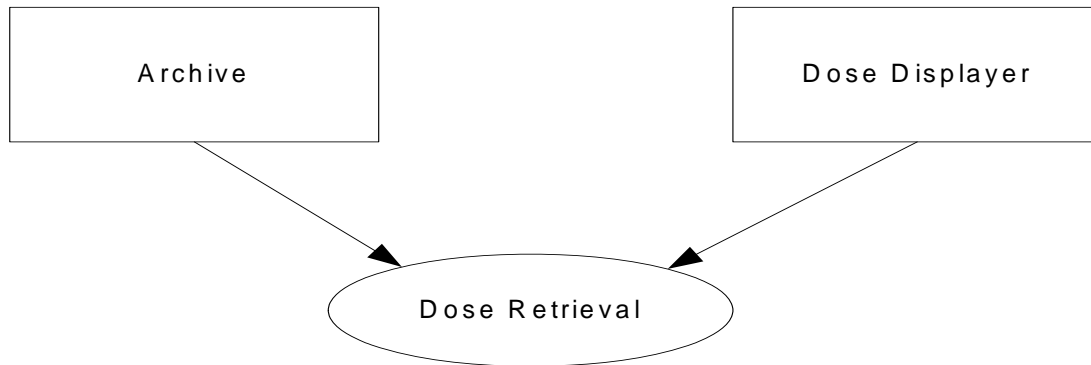
Actor: *Dose Displayer*

Role: Receives requested Dose from the Archive
Actor: Archive

Role: Sends requested Dose instance to the *Dose Displayer*

DRAFT

3.10.3 Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

3.10.4 Interaction Diagram

_____

35

_____

3.10.4.1 Dose Retrieve

3.10.4.1.1 Trigger Events

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

3.10.4.1.2 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 appendix A for an overview of Dose specific requirements on the DICOM attributes that are included in an RT Dose object.

3.10.4.1.3 Representation of Dose

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

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

3.10.4.1.4 Expected Actions

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

3.11 RO-11: Resampled/Combined CT Series Storage

3.11.1 Scope

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

_____

Draft for Trial Implementation

_____

3.11.2 Use Case Roles
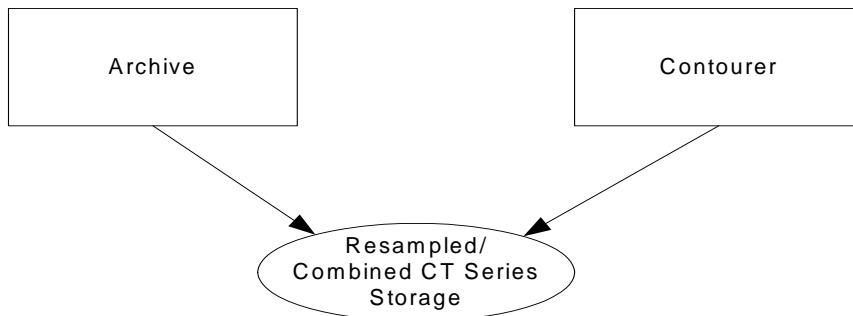
Actor: *Contourer*

Role: Sends CT Images to the Archive

Actor: Archive

Role: Stores CT Images received from *Contourer*

3.11.3 Referenced standards

DICOM 2008 PS3.4: Storage Service Class.

3.11.4 Interaction Diagram

3.11.4.1 Resampled/Combined CT Series Storage

3.11.4.1.1 Trigger Events

The *Contourer* has constructed a new CT Series. It has either combined CT Images from multiple series, or has resampled CT Images from a single series to yield a more desirable

_____

Draft for Trial Implementation

_____

slice spacing. The *Contourer* must export a single CT image series including all images on which Structure Set contours are defined.   This new series must be stored on the archive to make the images available for subsequent planning or review. This transaction must be performed prior to storage of a structure set (RO-2) which is based upon this new series.

3.11.4.1.2 Message Semantics

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

Also refer to appendix A 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.

3.11.4.1.3 Expected Actions

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

3.12 RO-12: Spatial Registrations Stored

This section corresponds to Transaction RO-12 of the IHE-RO Technical Framework. Transaction RO-12 is used by the **Archive** and **Registrator** actors.

3.12.1 Scope

In the Spatial Registrations Stored transaction, the **Registrator** sends 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).

_____

Draft for Trial Implementation

_____

3.12.2 Use Case Roles
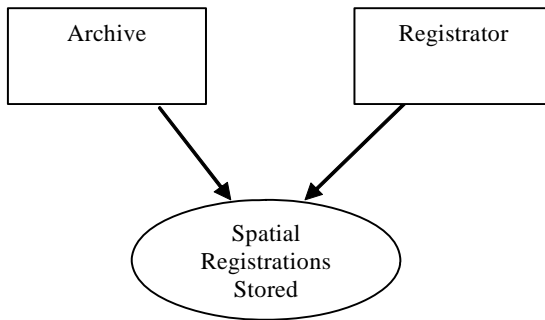
Actor: *Archive*

Role: Accept and store Spatial Registration instances from *Registrator* actors.

Actor: *Registrator*

Role: Transmit Spatial Registration instances to an *Archive.*

Actor: *Acquisition Modality*

Role: Transmit Spatial Registration instances to an *Archive.*

3.12.3 Referenced Standard

DICOM 2007 PS 3.4: Storage Service Class

DICOM 2007 PS 3.4: Spatial Registration Storage

3.12.4 Interaction Diagram

_____

Draft for Trial Implementation

_____
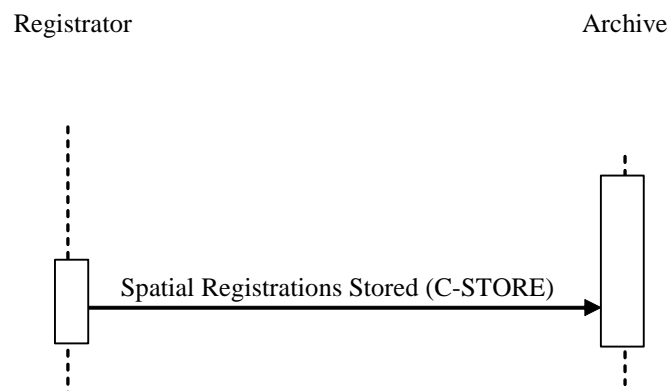
3.12.4.1 Spatial Registrations Stored

3.12.4.1.1 Trigger Events

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

3.12.4.1.2 Message Semantics

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

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

The Spatial Registration shall contain two Registration Sequences. Refer to DICOM 2007 PS 3.17 Figure O.4-1 for informative details on the structure of the Registration Sequences.

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

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

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

A Registration Sequence item shall contain a Frame of Reference and optionally a list of images, indicating that the transformation is applicable to all images within that Frame of Reference. No meaning may be inferred by the actor from the presence of the image references.

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

_____

_____

The Spatial Registration object shall be stored:

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

- in a different series from images.

3.12.4.1.3 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 4.58 Utilize Spatial Registrations) in a fashion meeting the requirements defined for a DICOM Level 2 Storage SCP (see DICOM PS 3.4 B.4.1).

3.13 RO-13: Utilize Spatial Registrations

This section corresponds to Transaction RO-13 of the IHE-RO Technical Framework. Transaction RO-13 is used by the Registered Display and Archive actors.

3.13.1 Scope

A **Registered 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.

3.13.2 Use Case Roles
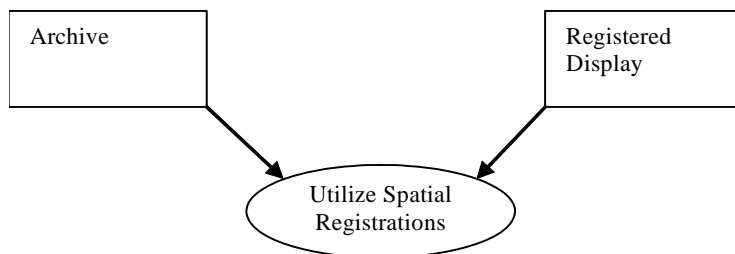
Actor: *Archive*

Role: Sends images to register to the *Registered Display* Actor.

Actor: *Archive*

Role: Sends requested Spatial Registrations to the *Registered Display* Actor.

_____

_____

Actor: *Registered Display*

Role: Receives requested Spatial Registrations from the Archive Actor.

3.13.3 Referenced Standards

DICOM 2007 PS 3.4: Spatial Registration Storage

3.13.4 Interaction Diagram
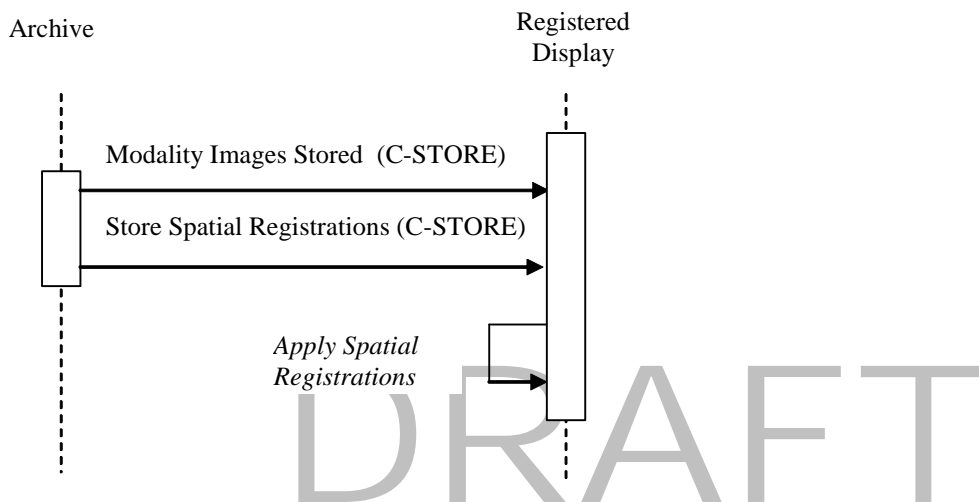
3.13.4.1 Utilize Spatial Registrations

3.13.4.1.1 Trigger Events

The **Registered Display** receives specific Spatial Registration objects from the **Archive**.

3.13.4.1.2 Message Semantics

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

It is the responsibility of the **Registered Display** to apply the Spatial Registration as defined in DICOM. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

A Registration Sequence item in the Spatial Registration will contain a Frame of Reference and no list of images, in which case the transformation shall be applied to all images within that Frame of Reference;

_____

_____

3.13.4.1.3 Expected Actions

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

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

3.14 RO-14: Registered Structure Set Storage

This section corresponds to Transaction RO-14 of the IHE-RO Technical Framework. Transaction RO-14 is used by the **Registered Contourer** and **Archive** actors.

3.14.1 Scope

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

3.14.2 Use Case Roles
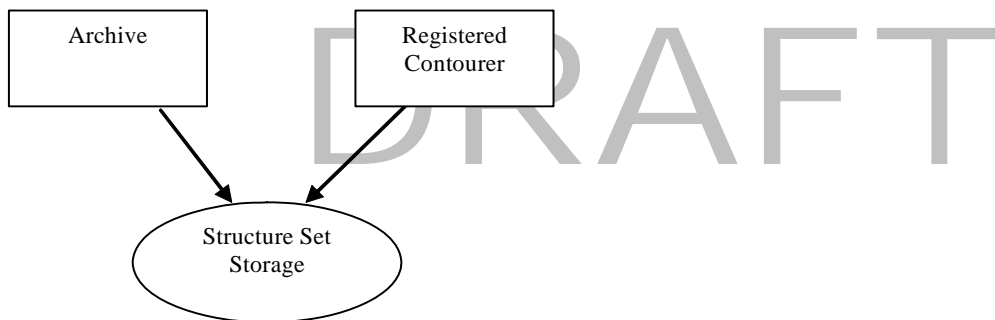
> **Actor:** *Registered Contourer*
>
> **Role:** Sends Structure Set to *Archive*
>
> **Actor:** *Archive*
>
> **Role:** Stores Structure Set received from *Registered Contourer*

3.14.3 Referenced standards

DICOM 2007 PS3.4: Storage Service Class.

3.14.4 Interaction Diagram

_____

Draft for Trial Implementation

_____

```
        Registered                                    Archive
        Contourer
```

RT Structure Set Stored (C-STORE)
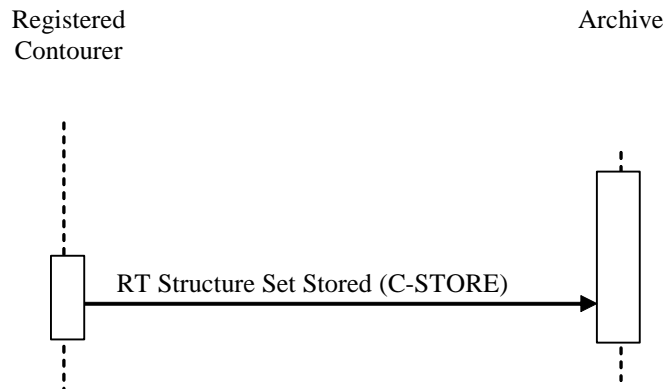
3.14.4.1 Registered Structure Set Storage

3.14.4.1.1 Trigger Events

The user of the **Registered Contourer** selects a Structure Set to store.

3.14.4.1.2 Message Semantics

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

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

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

To make ROI's available to the downstream planning process or to the 2007 Contourer actor, the Registrator actor shall be able not only to transform contours from a source Frame of Reference to the Registered Frame of Refererence, but also to resample the contour to the planes of the images referenced in the RT Structure Set which cooresponds to the Registered Frame of Reference.

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

_____

Draft for Trial Implementation

_____

Also refer to appendix B 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).

3.15 RO-15: Registered Structure Set Retrieval

This section corresponds to Transaction RO-15 of the IHE-RO Technical Framework. Transaction RO-15 is used by the **Registered Contourer**, **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** or **Registered Dose Displayer**.

3.15.2 Use Case Roles

DRAFT

```
┌──────────────┐          ┌──────────────┐
│              │          │  Registered  │
│   Archive    │          │  Contourer,  │
│              │          │  Registered  │
│              │          │ Dose Display │
└──────┬───────┘          └──────┬───────┘
       │                         │
        \                       /
         ╲                    ╱
        ┌──────────────────────┐
       ╱   Structure Set         ╲
      (     Retrieval             )
        ╲                        ╱
        └──────────────────────┘
```
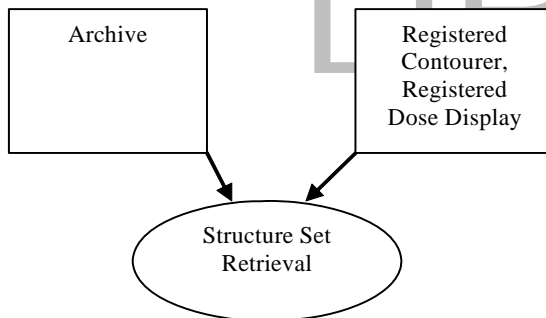
> **Actor***: Archive*
>
> **Role**: Sends Structure Set to *Registered Contourer* or *Registered Dose Displayer*
>
> **Actor**: *Registered Contourer* or *Registered Dose Displayer*
>
> **Role**: Stores Structure Set received from *Archive*

3.15.3 Referenced standards

DICOM 2007 PS3.4: Storage Service Class.

_____

45

_____

3.15.4 Interaction Diagram
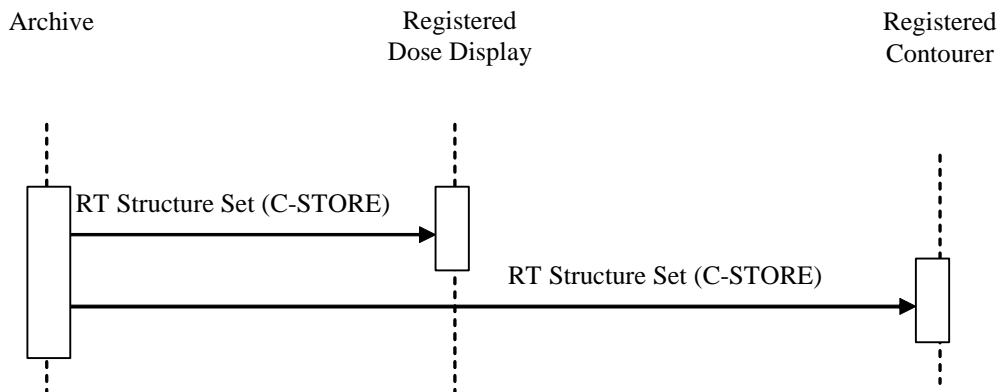
3.15.4.1 Registered Structure Set Retrieval

3.15.4.1.1 Trigger Events

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

The user of the **Registered 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 **Registered Dose Displayer**.

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

3.15.4.1.2 Message Semantics

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

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

Also refer to appendix B 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 series upon which the contours are based.

_____

_____

3.15.4.1.3 Expected Actions

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 (RO-14: 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.

3.16 RO-16: Registered Dose Retrieve

This section corresponds to RO-16 of the IHE-RO technical framework. Transaction RO-16 is used by the **Archive** and **Registered Dose Display** actor.

3.16.1 Scope

In the Registered Dose Retrieve Transaction, the requested Dose is transferred from the **Archive** to the **Registered Dose Display** actor.

3.16.2 Use Case Roles

DRAFT

```
┌──────────────┐        ┌──────────────┐
│   Archive    │        │  Registered  │
│              │        │ Dose Display │
└──────────────┘        └──────────────┘
         \                    /
          \                  /
           ↘                ↙
            ╭──────────────────╮
            │   Dose Retrieve  │
            ╰──────────────────╯
```
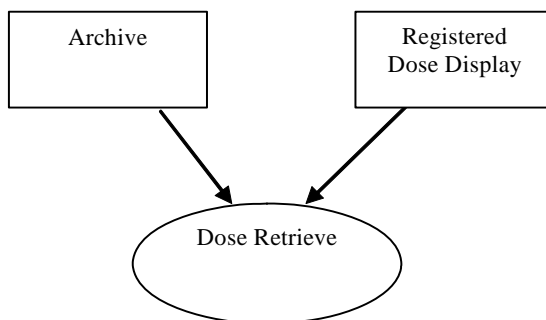
Actor: *Registered Dose Display*

Role: Receives requested Dose from the *Archive*

Actor: *Archive*

Role: Sends requested Dose instance to the *Registered Dose Display*

_____

Draft for Trial Implementation

_____

3.16.3 Referenced standards

DICOM 2007 PS3.4: Storage Service Class.

3.16.4   Interaction Diagram

Registered   Archive
Dose Display

RT Dose Stored (C-STORE)
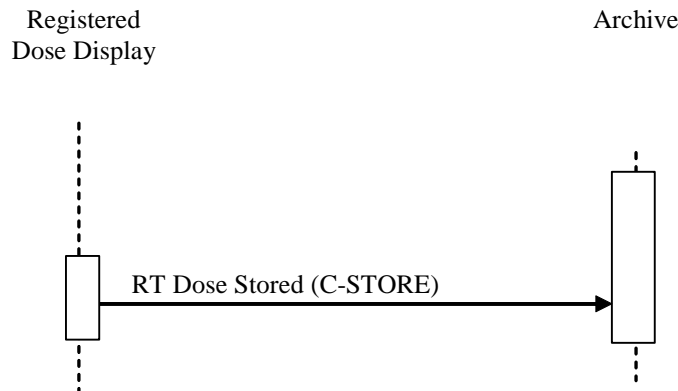
3.16.4.1 Registered Dose Retrieve

3.16.4.1.1 Trigger Events

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

3.16.4.1.2 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.

3.16.4.1.3 Representation of Dose

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

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

_____

_____

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

3.16.4.1.4 Expected Actions

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

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

DRAFT

_____

Draft for Trial Implementation

_____

3.17 RO-17: Worklist Query for Positioning and Delivery

3.17.1 Scope

In the Worklist Query for Positioning and Delivery transaction, a PDS requests and receives a patient positioning and treatment delivery worklist from a TMS.

3.17.2 Use Case Roles
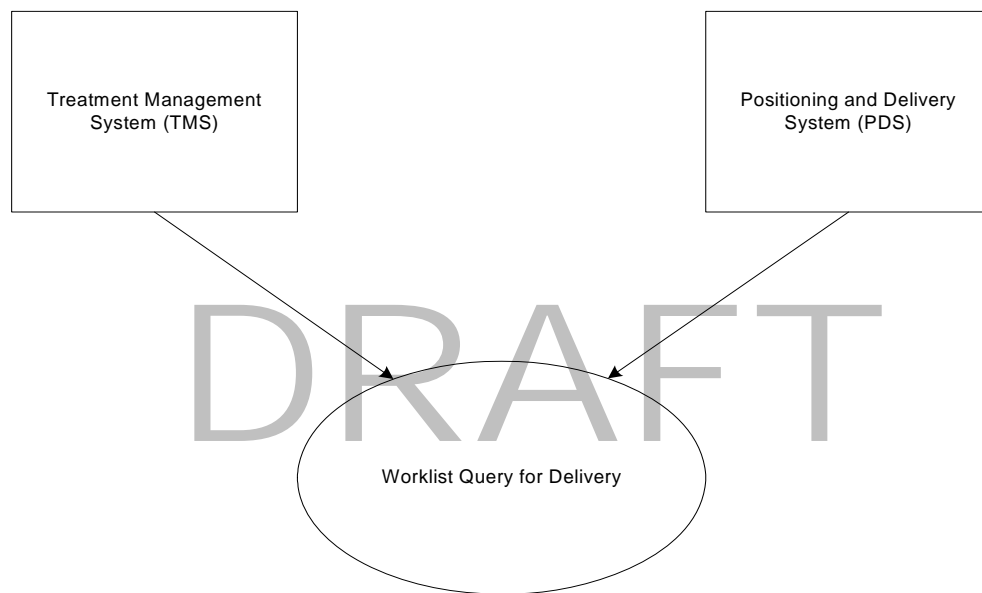
Actor: *Treatment Management System*

Role: Responds to a worklist query and send a scheduled patient positioning and delivery worklist to a *PDS.*

Actor: *Positioning and Delivery System ('Performing Device')*

Role: Queries a *TMS* and receives a scheduled patient positioning and treatment delivery worklist.

3.17.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

_____

Draft for Trial Implementation

_____

DICOM Supplement 96 (Frozen Draft): Unified Worklist and Procedure Step

3.17.4 Interaction Diagram
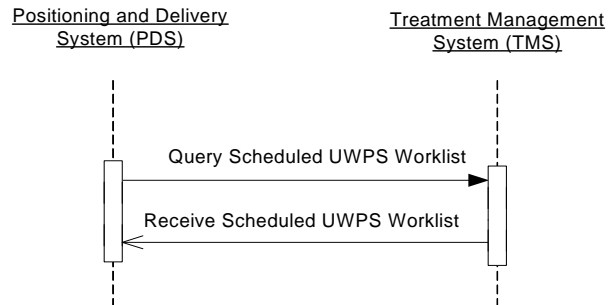
3.17.4.1 Query Scheduled UWPS Worklist Message

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

3.17.4.1.1 Trigger Events

The user of the PDS, in order to position the patient and deliver a treatment, requests that the TMS send a scheduled patient positioning and treatment delivery worklist.

3.17.4.1.2 Message Semantics

The Performing Device uses the C-FIND request of the DICOM Unified Procedure Step – Pull SOP Class to query the worklist from the TMS. The Performing Device 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 Supplement 96, Part 4, Section F.X.3.8.1.2.1).

.

3.17.4.1.2.1 Matching Keys and Return Keys for Display

In the query to the TMS, the Performing Device (SCU) is required to query for matching on the attributes as shown in Table 3.17-1 Worklist Query for Positioning and Delivery. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient's Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence (0040,4025) would be optional matching query key attributes that would be commonly supplied.

_____

Draft for Trial Implementation

_____

Table 3.17-1 Worklist Query for Positioning and Delivery

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Specific Character Set	(0008,0005)	-	-	O	RC
SOP Class UID	(0008,1016)	-	-	O	R
SOP Instance UID	(0008,0018)	-	-	O	R
Unified Procedure Step State	(0074,1000)	R	R	R* (Note 1)	R
Procedure Step Label	(0074,1204)	-	-	R+	R+
Scheduled Station Name Code Sequence	(0040,4025)				
>Code Value	(0008,0100)	O (Note 2)	R	R+*	R
>Coding Scheme Designator	(0008,0102)	O (Note 3)	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+	R (Note 4)
Scheduled Procedure Step Start Date and Time	(0040,4005)	R+ (Note 5)	R	R+	R
Scheduled Workitem Code Sequence	(0040,4018)	-	-	R+ (Note 6)	R
Scheduled Processing Parameters Sequence	(0074,1210)	-	-	R+* (Note 7)	R
Input Information Sequence	(0040,4021)	-	-	R+*	R+ (Note 8)
Study Instance UID	(0020,000D)	-	-	O	R+ (Note 9)
Patient's Name	(0010,0010)	O	R	R+	R
Patient ID	(0010,0020)	O	R	R+	R
All other attributes	As described in DICOM Supplement 96				

Note 1: A Unified Procedure Step State of 'SCHEDULED' shall be supplied.

Note 2: Code Value for the Scheduled Station Name shall contain the string used to definitively match the Performing Device instance with its representation on the TMS. It is not necessarily human-readable.

Note 3: Coding Scheme Designator for the Scheduled Station Name is a private coding scheme, and is not used explicitly in this profile.

Note 4: Coding Meaning for the Scheduled Station Name shall contain the human-readable description of the Station Name, and shall be displayed on the Performing Device. Note that this attribute is required by IHE-RO in this profile, but is not required in DICOM Supplement 96.

Note 5: A 'reasonable' date time range (such as the rest of the current day) shall be supplied to limit the size of the returned result set. If operating in a mode where the patient is selected on the TMS, the TMS is permitted to over-filter the result set based upon this selection and return just the worklist items for the selected fraction.

Note 6: Scheduled Workitem Code Sequence shall be specified as an empty (null) sequence.

_____

Draft for Trial Implementation

_____

Note 7: Scheduled Processing Parameters Sequence shall be specified as an empty (null) sequence

Note 8: Input Information Sequence shall contain all the input objects that will ultimately be needed to perform the specified procedure step, and no others. This allows the Performing Device to determine whether or not the instances are available prior to starting the procedure, and avoids the need for an additional N-GET on the UPS. If the Performing Device considers that the Input Information Sequence contains inadequate or inconsistent information, then it shall address any such inconsistencies in a safe manner before performing the Requested Procedure.

Note 9: Study Instance UID must be supplied by the TMS (SCP) if performance of the procedure step is expected to create composite SOP Instances as output. The supplied Study Instance shall be used by the SCU in creation of such SOP Instances (see transactions RO-22: Store Position Acquisition Results to Archive, RO-23: Store Position Registration Results to Archive, and RO-24: Store Delivery Results to Archive).

In the query to the TMS, the Performing Device (SCU) is required to query for <u>matching</u> on the attributes shown as "R" or "R+" in the appropriate column in Table 3.17-1 Worklist Query for Positioning and Delivery. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient's Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence (0040,4025) would be optional matching query key attributes that would be commonly supplied.

In the query to the TMS, the Performing Device (SCU) is required to supply return keys for <u>display</u> as shown in "Query Keys Return SCU' column of Table 3.17-2 Required Query Keys Returned within the Scheduled Processing Parameters Sequence. All other potential return keys for display may be optionally supplied as described in DICOM Supplement 96. The SCU is NOT required to display items marked with an asterisk.

The TMS replies to the query with a set of UPS C-FIND responses containing zero or more scheduled patient positioning worklist items.

3.17.4.1.3 Expected Actions

The TMS retrieves the matching scheduled procedures, and sends the DICOM UWPS Worklist to the requesting Performing Device.

3.17.4.2 Receive Scheduled UWPS Worklist Message

This is the message that the TMS sends to the Performing Device as a reply containing DICOM UPS information.

For the Worklist Query for Positioning and Delivery transaction exactly <u>four</u> Unified Procedure Steps (UPS C-FIND responses in the 'pending' state) shall be returned for each matching treatment session:

- **Response 1:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121702-121711 (acquisition) and Coding Scheme Designator shall be 'DCM'. If the Code Value is in the range 121702-121706, one or more RT Image

_____

Draft for Trial Implementation

_____

SOP Instance references shall be supplied in the Input Information Sequence (0040,4021). If the Code Value is in the range 121707-121708, one CT Image Series reference shall be supplied in the Input Information Sequence (0040,4021). The specified location of the SOP Instances shall be an Archive. Note that a specific product implementation could fulfill the roles of both a TMS and an Archive, in which case one AE Title could be used to retrieve and store all input and output SOP Instances for the UPS.

- **Response 2:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121712-121721 (registration) and Coding Scheme Designator shall be 'DCM'. No Input Information SOP Instances need be supplied.

- **Response 3:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121722' (RT Patient Position Adjustment) and Coding Scheme Designator shall be equal to 'DCM'. No Input Information SOP Instances need be supplied.

- **Response 4:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to 'DCM'. The Input Information Sequence (0040,4021) shall contain reference to a least the following items (additional items may be required for continuation procedures):

1. The RT Plan SOP Instance to be delivered. Its specified location shall be an Archive. Note that a specific product implementation could fulfill the roles of both a TMS and an Archive, in which case one AE Title could be used to retrieve all input SOP Instances for the UPS.

2. An RT Beams Delivery Instruction SOP Instance. Its specified location shall be the TMS.

In addition, the following values shall be supplied by the SCP for the Scheduled Processing Parameters Sequence:

Table 3.17-2 Required Query Keys Returned within the Scheduled Processing Parameters Sequence

Attribute Name	Tag	Query Keys Return
		SCP
Scheduled Processing Parameters Sequence	(0074,1210)	
>Value Type	(0040,A040)	R+* (Note 1)
>Concept Name Code Sequence	(0040,A043)	R+*
>>Code Value	(0008,0100)	R+* (Note 2)
>>Coding Scheme Designator	(0008,0102)	R+* (Note 3)

_____

_____

>>Code Meaning	(0008,0104)	R+* (Note 4)
>Text Value	(0040,A160)	R+ (Note 5)

Note 1: A Value Type of 'TEXT' shall be supplied.

Note 2: Code Value supplied for the Concept Name Code Sequence shall be '2008001'.

Note 3: Coding Scheme Designator supplied for the Concept Name Code Sequence shall be '99IHERO2008'.

Note 4: Code Meaning supplied for the Concept Name Code Sequence shall be 'Treatment Delivery Type'.

Note 5: A Text Value of 'CONTINUATION' shall be supplied for scheduled treatment delivery procedures that complete a previously interrupted UPS (that ended in the 'CANCELED" state). Otherwise, a Text Value of 'TREATMENT' shall be supplied.

3.18 RO-18: Retrieve Workitem Input Objects from Archive

3.18.1 Scope

In the Retrieve Workitem Input Objects from Archive transaction, a PPS, PDS, or TDD requests and receives from the Archive any SOP Class Instances required for performing desired procedure steps returned by a previous query. Each SOP instance must have been supplied in the Input Information Sequence of one or more of the returned worklist items.

3.18.2 Use Case Roles

Actor: *Archive*

_____

Draft for Trial Implementation

_____
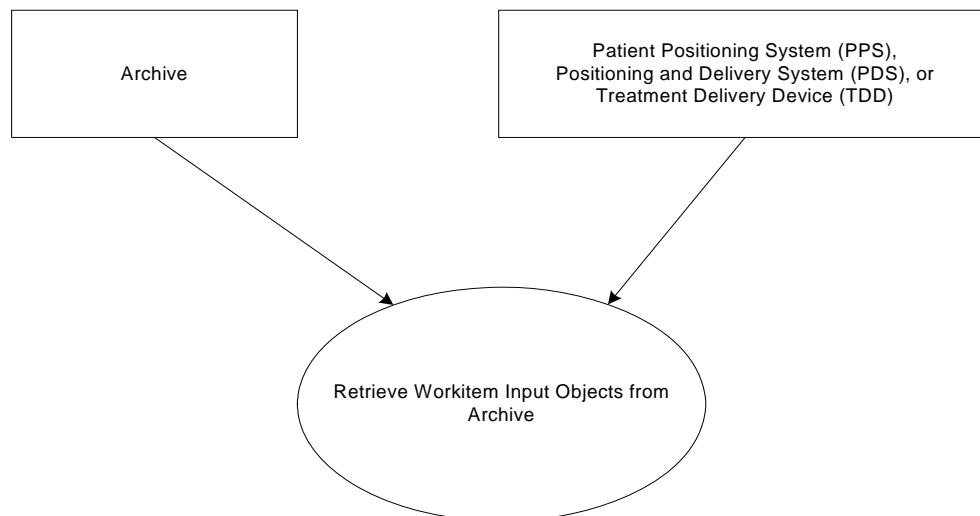
Role: Sends requested DICOM objects to the *PPS, PDS,* or *TDD.*

Actor: *Patient Positioning System, Positioning and Delivery System, or Treatment Delivery Device ('Performing Device')*

Role: Receives requested DICOM objects from the *Archive.*

3.18.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

DICOM 2007 PS 3.4: Query/Retrieve Service Class

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

3.18.4 Interaction Diagram
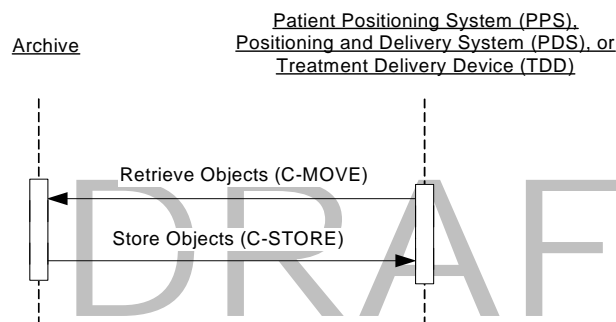
3.18.4.1 Retrieve Objects

The Retrieve (Study Root – MOVE) SOP Class shall be supported. Implementations shall support modes of operation in which a single series (e.g. input CT Series) or specific SOP Instances (e.g. an RT Plan) are retrieved from the Archive using the Study Root – MOVE SOP Class. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

A Performing Device shall be capable of issuing Study-Root C-MOVE for all relevant SOP Instances that are specified in the Input Information Sequence. Other mechanisms for obtaining the data (such as C-STORE or restoring from a DICOM medium) shall not be relied upon to obtain the data. However:

- If in routine use a Performing Device already has access to the input object instances then it is not <u>required</u> to use its C-MOVE capability to obtain those instances again. This would occur either because the objects have been transmitted previously in another operation, or if the requested instance has been created internally.

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

_____

_____

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

- If the Procedure Step is already "IN PROGRESS", the Performing Device shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

3.18.4.1.1 Trigger Events

The PPS, in order to position a patient prior to treatment delivery, requests one or more of the referenced objects in the Input Information Sequence (0040,4021) of the selected work item, where the Archive is specified as the storage location of that item.

The PDS, in order to position a patient prior to treatment delivery or perform a treatment delivery, or both, requests one or more of the referenced objects in the Input Information Sequence (0040,4021) of the selected work item, where the Archive is specified as the storage location of that item.

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 work item, where the Archive is specified as the storage location of that item.

3.18.4.1.2 Message Semantics

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

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

The objects that may potentially be required by the Performing Device are specific to the nature and capabilities of the Performing Device. As such, there are no requirements that objects of any specific type be requested. It is assuming that any requested objects have been placed in the Archive by a means outside the scope of IHE-RO. Typically C-STORE operations from a Treatment Planning System would have been performed to achieve this goal.

In cases where the Performing Device manages DICOM objects itself, it may well have prefetched and processed the required objects, in which case the UIDs supplied in the Input Information Sequence (0040,4021) of the selected work items will be sufficient to locate the necessary data, and no retrievals would be necessary (hence the optionality of this transaction in the profiles).

The specific attribute contents of the retrieved objects are also not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and Treatment Management System, and is not specified by IHE-RO.

_____

_____

However, a participating Archive shall support this transaction for at least the objects listed in Table **Error! Reference source not found.**-1.

Table Error! Reference source not found.**-1: Required SOP Class Support for Archive Actor**

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
RT Structure Set Storage	1.2.840.10008.5.1.4.1.1.481.3
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5
RT Dose Storage	1.2.840.10008.5.1.4.1.1.481.2
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1

3.18.4.1.3 Expected Actions

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

The requesting Performing Device is then expected to use the requested objects in the performing of the selected work items. This could include displaying overlaid image, structure, and dose information for registration, or using plan information to prepare treatment delivery.

3.19 RO-19: UPS in Progress

3.19.1 Scope

In the UPS in Progress transaction, a PPS, PDS, or TDD signals to the TMS that responsibility has been taken for the performing of the selected work item.

3.19.2 Use Case Roles

_____

_____
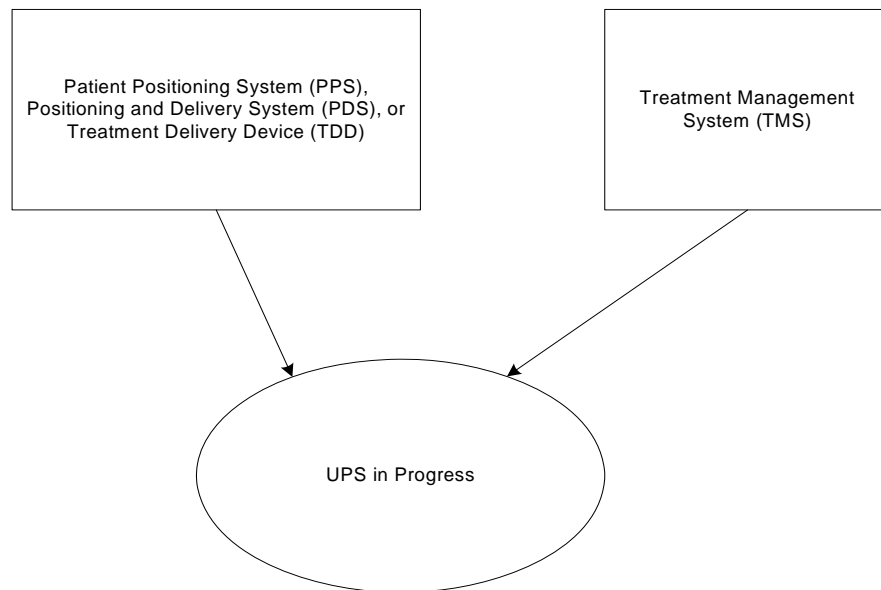
Actor: *Treatment Management System*

Role: Responds to a UPS N-ACTION and recognizes the specified Unified Procedure Step as in progress, thereby preventing other *Actors* from performing the step.

Actor*: Patient Positioning System, Positioning and Delivery System,* or *Treatment Delivery Device ('Performing Device')*

Role: Signals using UPS N-ACTION that the selected work item is in progress.

3.19.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96 (Frozen Draft): Unified Worklist and Procedure Step

_____

Draft for Trial Implementation

_____

3.19.4 Interaction Diagram
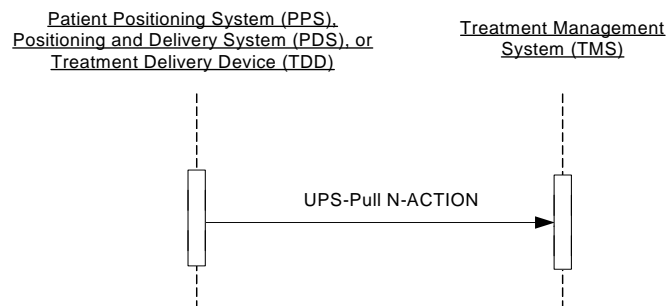
3.19.4.1 UPS in Progress Message

The Performing Device uses the UPS N-ACTION service to inform the TMS that the specified 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 SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.19.4.1.1 Trigger Events

The Performing Device has successfully queried and selected a suitable work item, and has retrieved any necessary Input Information Objects from the Archive.

3.19.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step State (0074,1000) shall be 'IN PROGRESS'. The requested Transaction UID (0008,1195) shall be supplied as zero length (see next section for expected TMS behavior).

3.19.4.1.3 Expected Actions

The TMS receives the N-ACTION request and sends an N-ACTION response.

If the requested work item is still available for performing, the TMS shall send an N-ACTION response with a Unified Procedure Step State (0074,1000) of 'IN PROGRESS' and a status code of 0000H (success). The TMS shall then be ready to receive UPS N-SET or UPS N-ACTION commands. A unique value for the Transaction UID (0008,1195) shall be supplied by the TMS, and used subsequently by the TMS in authorizing further UPS requests (which must supply the Transaction UID first returned in this transaction).

If the requested work item 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 Supplement 96 Table F.X.3.1-2 shall be returned.

_____

Draft for Trial Implementation

_____

The TMS shall then be capable of accepting further UPS N-ACTION requests or worklist queries.

3.20 RO-20: Retrieve Workitem Input Objects from TMS

3.20.1 Scope

In the Retrieve Workitem Input Objects from TMS transaction, a PDS or TDD requests and receives requests and receives SOP Class instances from the TMS, in order to support execution of the requested work item. These requested instances are of a "transient" nature, typically generated 'on-the-fly' by the TMS.

3.20.2 Use Case Roles
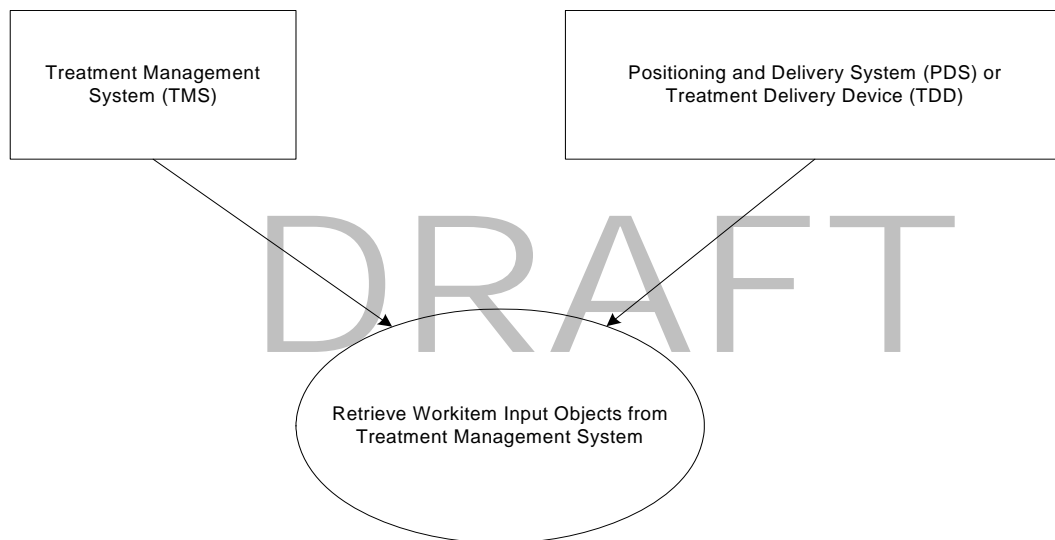
Actor: *Treatment Management System*

Role: Sends requested DICOM objects to the *PDS* or *TDD.*

Actor: *Positioning and Delivery System or Treatment Delivery Device ('Performing Device')*

Role: Receives requested DICOM objects from the *TMS.*

3.20.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

DICOM 2007 PS 3.4: Query/Retrieve Service Class

_____

_____

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

3.20.4 Interaction Diagram
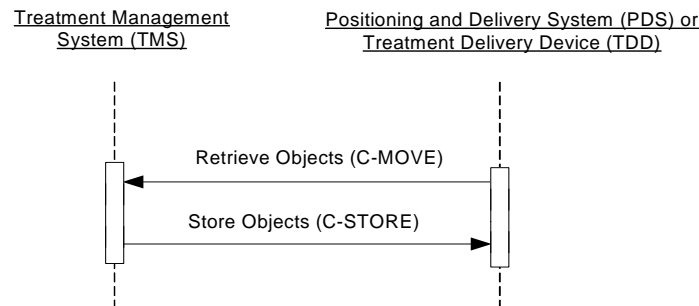
3.20.4.1 Retrieve Objects

The Retrieve (Study Root – MOVE) SOP Class shall be supported, with Series support. . Implementations shall support a mode of operation in which specific SOP Instances (rather than entire studies) are retrieved from the TMS using the Study Root – MOVE SOP Class. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

A Performing Device shall be capable of issuing Study-Root C-MOVE for all relevant SOP Instances that are specified in the Input Information Sequence. Other mechanisms for obtaining the data (such as C-STORE or restoring from a DICOM medium) shall not be relied upon to obtain the data. However:

- If in routine use a Performing Device already has access to the input object instances then it is not <u>required</u> to use its C-MOVE capability to obtain those instances again. This would occur either because the objects have been transmitted previously in another operation, or if the requested instance has been created internally.

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

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

- If the Procedure Step is already "IN PROGRESS", the Performing Device shall cancel the Procedure Step, providing an explanation in the Reason For Cancellation in the N-ACTION command.

_____

Draft for Trial Implementation

_____

3.20.4.1.1 Trigger Events

The PDS, 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 work item, where the TMS is specified as the storage location of that item.

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 work item, where the TMS is specified as the storage location of that item.

3.20.4.1.2 Message Semantics

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

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

The TMS shall be capable of supplying all objects that it originally supplied in the Input Information Sequence (0040,4021) of the UPS as having an AE Title corresponding to the AE Title of the TMS. Note that a specific product implementation could fulfill the roles of <u>both</u> a TMS and an Archive, in which case one AE Title could be used to retrieve and store all input and output SOP Instances for the UPS. In the TMS role, only the following SOP Classes may be included in this set:

Table 3.20-1 Potential SOP Class Support for TMS C-MOVE

SOP Class Name	SOP Class UID
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.1 (see DICOM Supplement 74)
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4

The objects that may potentially be required by the Performing Device are specific to the nature and capabilities of that device. As such, there are no requirements that objects of any specific type be requested. It is assuming that any requested objects have been (or will be) generated by the TMS itself.

In some cases where the Performing Device may have obtained all necessary objects from the Archive, it may not require any additional objects to performed the scheduled procedure (hence the optionality of this transaction).

_____

_____

The specific attribute contents of the retrieved objects are also not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and is not specified by IHE-RO.

3.20.4.1.3 Expected Actions

The TMS receives the C-MOVE request, establishes a DICOM association with the requesting Performing Device, and uses the appropriate DICOM SOP Classes to transfer the requested objects.

The requesting actor is then expected to use the requested objects in the performing of the selected work item.

3.21 RO-21: UPS Final Update

3.21.1 Scope

In the UPS Final Update transaction, a PPS, PDS, or TDD signals to the TMS any changes in the properties of the work item that is currently in progress, prior to the UPS being signaled as completed or canceled.

3.21.2 Use Case Roles
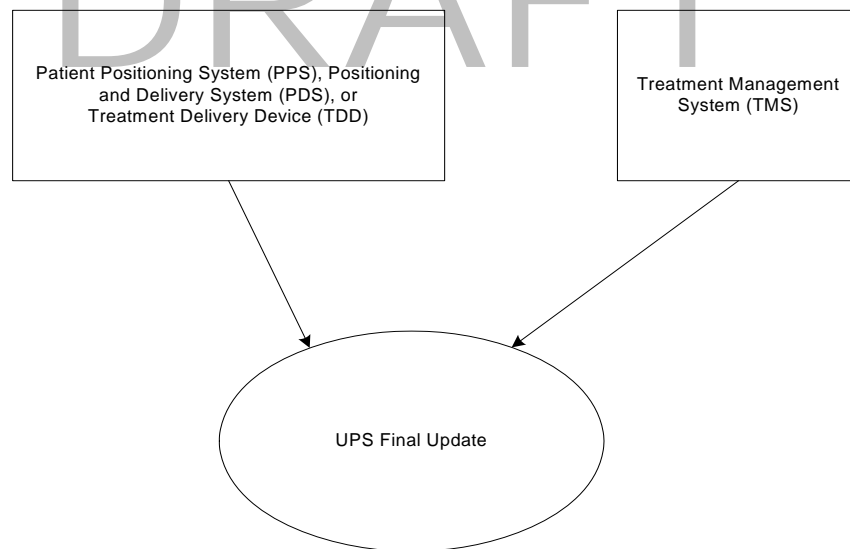
Actor: *Treatment Management System*

Role: Responds to a UPS N-SET and updates attributes in the specified *Unified Procedure Step.*

_____

_____

Actor: *Patient Positioning System, Positioning and Delivery System*, or *Treatment Delivery Device ('Performing Device')*

Role: Signals using UPS N-SET that that certain attributes related to the selected work item have changed.

3.21.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96 (Frozen Draft): Unified Worklist and Procedure Step

3.21.4 Interaction Diagram

Patient Positioning System (PPS), Positioning and Delivery System (PDS), or Treatment Delivery Device (TDD)

Treatment Management System (TMS)

UPS-Pull N-SET
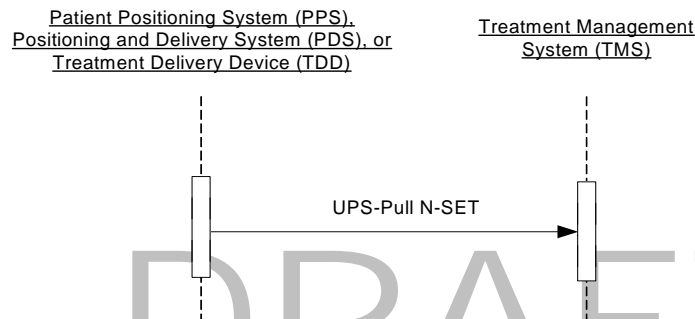
3.21.4.1 UPS Final Update Message

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

3.21.4.1.1 Trigger Events

The Performing Device is in the process or performing the work item, and wishes to notify the TMS of changes in certain attributes related to the work item. This may include an update to the completion progress of the work item.

3.21.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. 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 Supplement 96, Part 4, Section F.X.4).

Requirement for SCUs using the UWPS N-SET command are detailed in Table 3.21-1: UPS N-Set Final State Attribute Requirements. The table contains only those attributes having a Final State requirement of 'R' (required if procedure is COMPLETED or CANCELED) or 'X' (required if procedure is COMPLETED). Of particular note is the

_____

_____

last column which indicates the attributes that must be supplied by the SCU in the N-SET command in order to satisfy the Final State requirements. Note that IHE-RO is more restrictive than DICOM Supplement 96 in that a number of attributes are required to be set for all UPS N-SET commands. DICOM Supplement 96 only requires that the attributes have been set by any N-SET or N-ACTION message prior to the procedure step being moved into the COMPLETED or CANCELED state.

DRAFT

_____

Draft for Trial Implementation

_____

Table 3.21-1: UPS N-Set Final State Attribute Requirements

Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
Transaction UID	(0008,1195)	(See DICOM Supp 96 F.X.3.6.3)	R	
SOP Common Information Module				
Specific Character Set	(0008,0005)	1C/1C (Required if extended or replacement character set is used)	Set if required	Only ISO-IR 100 (Latin-1) shall be supported.
SOP Class UID	(0008,0016)	Not allowed	R	Affected SOP Class (0000,0002) is always 'UPS-Push" SOP Class
SOP Instance UID	(0008,0018)	Not allowed.	R	Affected SOP Instance (0000,1000) supplied by C-FIND responses of UPS query
Unified Procedure Step Progress Information Module				
Unified Procedure Step State	(0074,1000)	Not Allowed. Use N-ACTION	R	
Unified Procedure Step Scheduled Procedure Information Module				
Scheduled Procedure Step Priority	(0040,4003)	3/1	R	Supplied implicitly by TMS – not required in N-SET.
Scheduled Procedure Step Modification Date and Time	(0040,4010)	-/1 SCP will use time of SET	R	Supplied implicitly by TMS – not required in N-SET.
Unified Procedure Step Performed Procedure Information Module				
UPS Performed Procedure Sequence	(0040,eee8)	3/2	X	Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO, if UPS was not 'CANCELED'
>Actual Human Performers Sequence	(0040,4035)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer Code Sequence	(0040,4009)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer's Name	(0040,4037)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>Performed Station Name Code Sequence	(0040,4028)	3/2	R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.

_____

67

_____

>>Code Value	(0008,0100)	1/1		Name of machine performing UPS. Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO.
>>Coding Scheme Designator	(0008,0102)	1/1		Any private coding scheme designator. Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>>Code Meaning	(0008,0104)	1/1		Value shall be 'Performed Station Name'. Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>Performed Processing Applications Code Sequence	(0040,4007)	3/2	RC	Shall be provided if known. Not required to be known in IHE-RO.
>Performed Procedure Step Start Date	(0040,0244)	3/1	R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>Performed Procedure Step Start Time	(0040,0245)	3/1	R	Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO
>Performed Workitem Code Sequence	(0040,4019)	3/1	R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>>Code Value	(0008,0100)	1/1		Performed work item code value. Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>>Coding Scheme Designator	(0008,0102)	1/1		Value shall be 'DCM'. Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>>Code Meaning	(0008,0104)	1/1		Value shall be consistent with Code Value as described in Supplement 74 PS 3.16 Annex B. Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>Performed Procedure Step End Date	(0040,0250)	3/1	X	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>Performed Procedure Step End Time	(0040,0251)	3/1	X	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO.
>Output Information Sequence	(0040,4033)	2/2	X	Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO. May be empty (null) in N-SET if no output objects are created.

_____

Draft for Trial Implementation

_____

>>Study Instance UID	(0020,000D)	1/1		R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>>Referenced Series Sequence	(0008,1115)	1/1		R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>>>Series Instance UID	(0020,000E)	1/1		R	Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO
>>>Retrieve AE Title	(0008,0054)	2C/2		RC	Supplied by this transaction (RO-21: UPS Final Update) for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set ID	(0088,0130)	2C/2	RC		Never supplied for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set UID	(0088,0140)	2C/2	RC		Never supplied for IHE-RO (File Media Set not supported)
>>>Referenced SOP Sequence	(0008,1199)	1/1	R		Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO
>>>>Referenced SOP Class UID	(0008,1150)	1/1	R		Supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO. See transactions RO-22: Store Position Acquisition Results to Archive, RO-23: Store Position Registration Results to Archive, RO-24: Store Delivery Results to Archivefor permitted SOP Classes.
>>>>Referenced SOP Instance UID	(0008,1155)	1/1	R		Supplied by this transaction (RO-21: UPS Final Update) in IHE-RO
>Non-DICOM Output Code Sequence	(0040,4032)	2/2	X		Empty value always supplied by this transaction (RO-21: UPS Final Update)) in IHE-RO

3.21.4.1.3 Expected Actions

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

If the requested work item 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 work item 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.

_____

Draft for Trial Implementation

_____

If the requested work item 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 Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

3.22 RO-22: Store Position Acquisition Results to Archive

3.22.1 Scope

In the Store Position Acquisition Results to Archive transaction, when a patient position acquisition work item has been completed by a PPS or PDS, the results of the acquisition are stored to the Archive. These results may subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

3.22.2 Use Case Roles
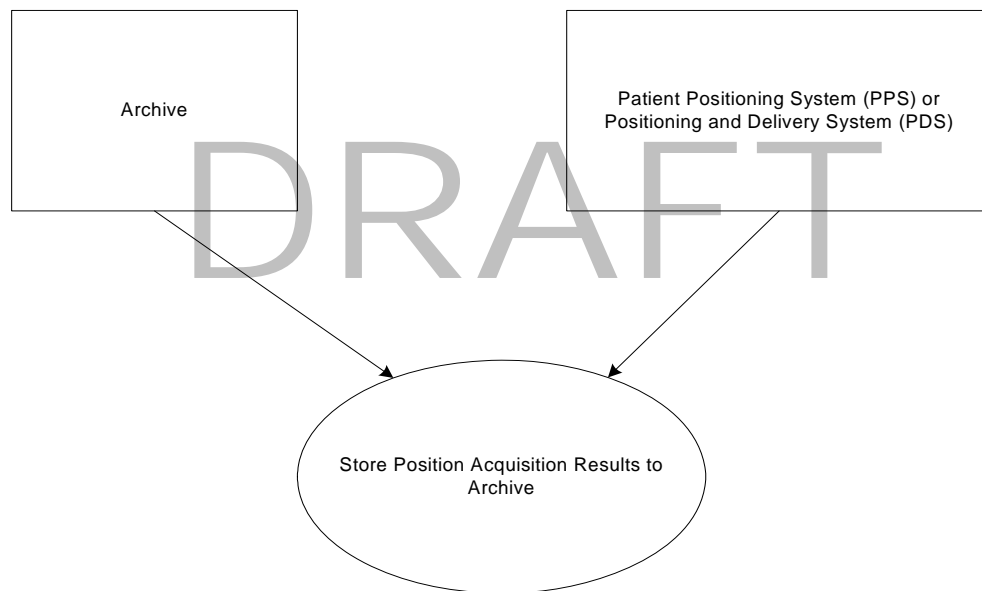
Actor: *Archive*

Role: Responds to a C-STORE request and stores the transmitted objects.

Actor: *Patient Positioning System* or *Positioning and Delivery System ('Performing Device')*

Role: Stores the output of the position acquisition operation to the *Archive.*

_____

70

_____

3.22.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.22.4 Interaction Diagram
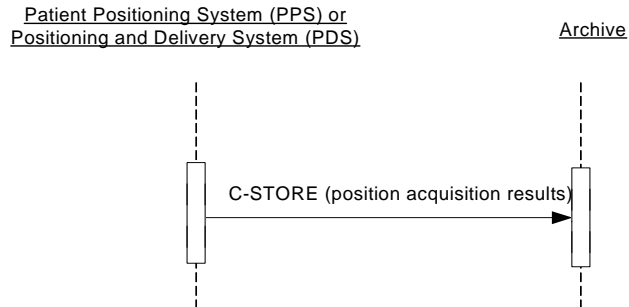
3.22.4.1 Store Objects

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes will be supported by the Archive as an SCP. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

3.22.4.1.1 Trigger Events

The Performing Device has completed a patient position acquisition and wishes to store the generated results of the registration operation.

3.22.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. One or more objects shall be stored, with one of the SOP Classes denoted in the Table 3.22-1 Permitted SOP Class Support for Performing Device (SCU). The table also denotes the permitted Workitem Code Values in the corresponding UPS for each object type.

Table 3.22-1 Permitted SOP Class Support for Performing Device (SCU)

Workitem Code Value	SOP Class Name	SOP Class UID
121707-121708	CT Image Storage	1.2.840.10008.5.1.4.1.1.2
121702-121706	RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1

_____

_____

A PDS may choose not to expose the results of the patient position acquisition operation as storage of acquisition objects (typically image sets), since the following treatment delivery is also managed by the same device. For a PPS, the ultimate output of the device is a successful position adjustment, and output of the position acquisition step is not required either. Hence storage of the position acquisition results (this transaction) is an optional step.

The specific attribute contents of the generated object are not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and is not specified by IHE-RO.

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-17: Worklist Query for Positioning and Delivery(see Table 3.17-1 Worklist Query for Positioning and Delivery).

A participating Archive must support this transaction for at least the objects listed in Table 3.22-2 Required SOP Class Support fo Archive (SCP).

Table 3.22-2 Required SOP Class Support fo Archive (SCP)

SOP Class Name	SOP Class UID
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
RT Image Storage	1.2.840.10008.5.1.4.1.1.481.1

3.22.4.1.3 Expected Actions

The Archive receives the C-STORE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Classes to receive the requested objects and store them.

3.23 RO-23: Store Position Registration Results to Archive

3.23.1 Scope

In the Store Position Registration Results to Archive transaction, when a patient registration workitem has been completed by a PPS or PDS, the results of the registration operation are stored to the Archive. These results may subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

3.23.2 Use Case Roles
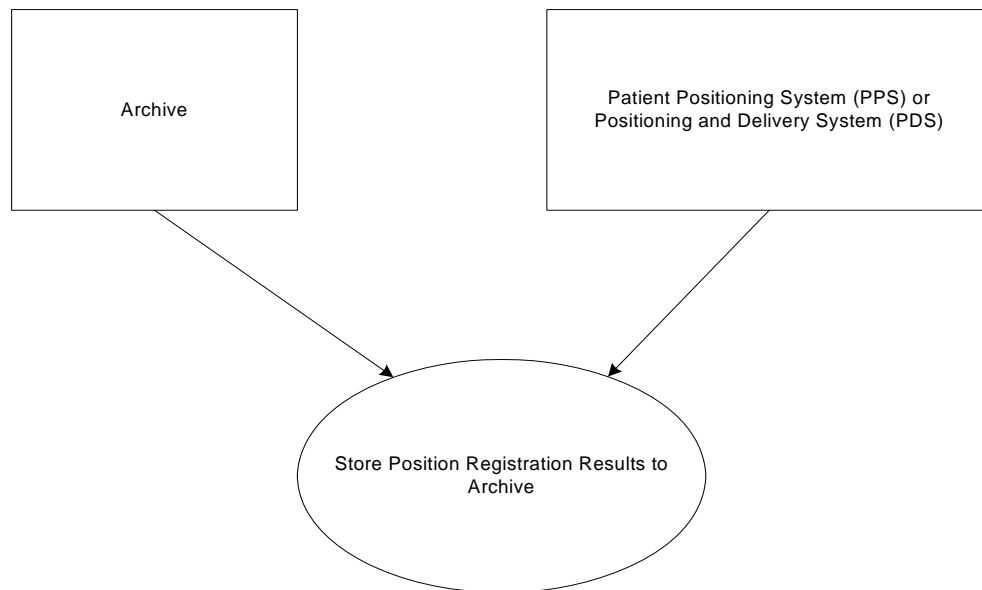
_____

Draft for Trial Implementation

_____

Actor: *Archive*

Role: Responds to a C-STORE request and stores the transmitted objects.

**Actor:** *Patient Positioning System* or *Positioning and Delivery System ('Performing Device')*

Role: Stores the output of the positioning registration operation to the *Archive.*

3.23.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.23.4 Interaction Diagram

_____

73

_____
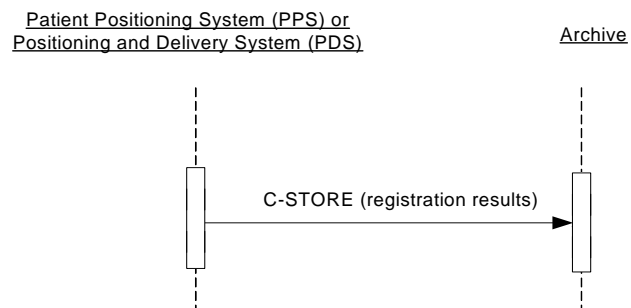
3.23.4.1 Store Objects

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes will be supported by the Archive as an SCP. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

3.23.4.1.1 Trigger Events

The Performing Device has completed a patient position registration and wishes to store the generated results of the registration operation.

3.23.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. A single object shall be stored, with one of the SOP Classes denoted in the Table 3.23-1 Permitted SOP Class Support for Performing Device (SCU):

Table 3.23-1 Permitted SOP Class Support for Performing Device (SCU)

SOP Class Name	SOP Class UID
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3

A PDS may choose not to expose the results of the patient positioning operation as storage of a registration object, since the following treatment delivery is also managed by the same device. For a PPS, the ultimate output of the device is a successful position adjustment, and output of the registration step result is not required either. Hence storage of the registration result (this transaction) is an optional step.

The specific attribute contents of the generated object are not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and is not specified by IHE-RO.

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-17: Worklist Query for Positioning and Delivery(see Table 3.17-1 Worklist Query for Positioning and Delivery).

A participating Archive must support this transaction for at least the objects listed in Table 3.23-2 Required SOP Class Support for Archive (SCP).

_____

Draft for Trial Implementation

_____

Table 3.23-2 Required SOP Class Support for Archive (SCP)

| SOP Class Name	SOP Class UID
Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.1
Deformable Spatial Registration Storage	1.2.840.10008.5.1.4.1.1.66.3

3.23.4.1.3 Expected Actions

The Archive receives the C-STORE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Class to receive the requested object and store it.

3.24 RO-24: Store Delivery Results to Archive

3.24.1 Scope

In the Store Delivery Results to Archive transaction, when a treatment delivery workitem has been completed by a PDS or TDD, the results of the treatment delivery operation are stored to the Archive. These results may subsequently be referenced in the Output Information Sequence of the corresponding Unified Procedure Step.

3.24.2 Use Case Roles

DRAFT

```
┌──────────────────┐          ┌──────────────────────────────────────┐
│                  │          │                                      │
│                  │          │  Positioning and Delivery System (PDS) or │
│     Archive      │          │     Treatment Delivery Device (TDD)       │
│                  │          │                                      │
│                  │          │                                      │
└──────────────────┘          └──────────────────────────────────────┘
            \                               /
             \                             /
              \                           /
               ╭─────────────────────────────╮
              (   Store Delivery Results to Archive   )
               ╰─────────────────────────────╯
```

Actor: *Archive*

_____

Draft for Trial Implementation

_____

Role: Responds to a C-STORE request and stores the transmitted objects.

Actor: *Positioning and Delivery System* or *Treatment Delivery Device ('Performing Device')*

Role: Stores the output of the treatment delivery operation to the *Archive.*

3.24.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.24.4 Interaction Diagram

Positioning and Delivery System (PDS) or
Treatment Delivery Device (TDD)

Archive

C-STORE (delivery results)

DRAFT
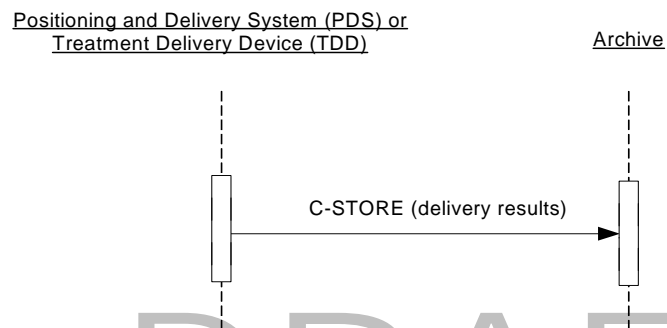
3.24.4.1 Store Objects

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes will be supported by the Archive as an SCP. Refer to DICOM 2007 PS 3.4, Annex C, for detailed descriptive semantics.

3.24.4.1.1 Trigger Events

The Performing Device has completed a treatment delivery wishes to store the generated results of the delivery operation.

3.24.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. A single object shall be stored, with the SOP Classes denoted in the Table 3.24-1 Permitted SOP Class Support for Performing Device (SCU):

Table 3.24-1 Permitted SOP Class Support for Performing Device (SCU)

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

_____

Draft for Trial Implementation

_____

The specific attribute contents of the generated object are not specified in IHE-RO profiles. It is assumed that the object contents will be specific to the particular combination of Performing Device and TMS, and is not specified by IHE-RO.

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-17: Worklist Query for Positioning and Delivery(see Table 3.17-1 Worklist Query for Positioning and Delivery).

A participating Archive must support this transaction for the object listed in Table 3.24-2 Required SOP Class Support for Archive (SCP).

Table 3.24-2 Required SOP Class Support for Archive (SCP)

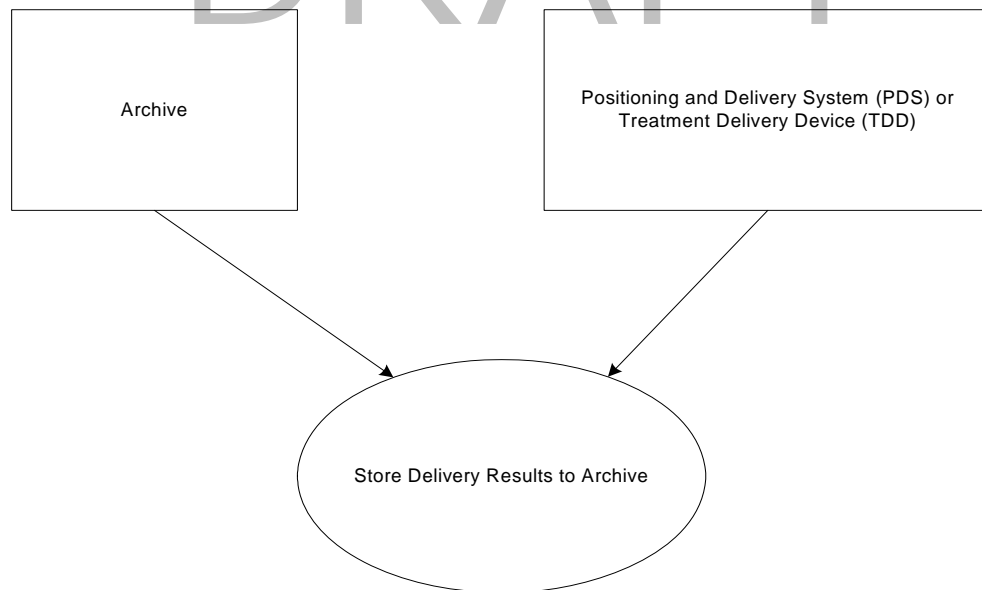| SOP Class Name	SOP Class UID
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4

3.24.4.1.3 Expected Actions

The Archive receives the C-STORE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Class to receive the requested object and store it.

3.25 RO-25: UPS Completed/Canceled

3.25.1 Scope

In the UPS Completed/Canceled transaction, a PPS, PDS, or TDD signals to the TMS that the selected work item has either been completed or canceled.

3.25.2 Use Case Roles

_____

77

_____
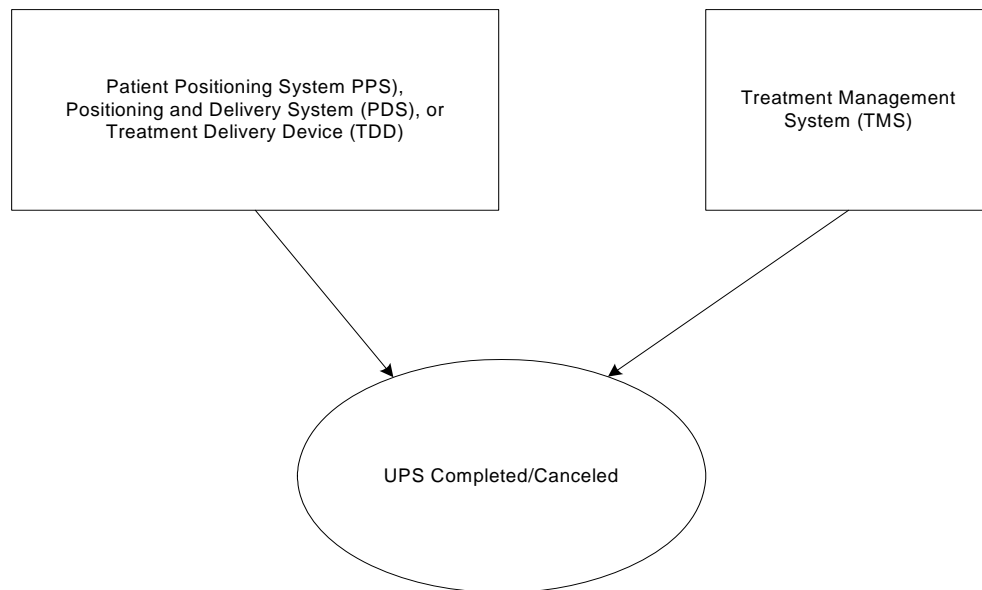
Actor: *Treatment Management System*

Role: Responds to a UPS N-ACTION and sets the specified Unified Procedure Step as completed or canceled.

Actor: *Patient Positioning System, Positioning and Delivery System*, or *Treatment Delivery Device ('Performing Device')*

Role: Signals using UPS N-ACTION that the selected work item is completed or canceled.

3.25.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96 (Frozen Draft): Unified Worklist and Procedure Step

_____

Draft for Trial Implementation

_____

3.25.4 Interaction Diagram
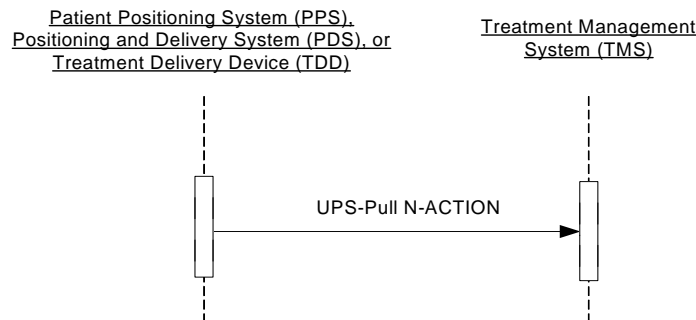
3.25.4.1 UPS in Progress Message

The Performing Device 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 SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.25.4.1.1 Trigger Events

The Performing Device has successfully completed the work item, or has not been able to complete the work item and has determined that processing should be stopped and the Treatment Management System notified.

3.25.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step State (0074,1000) shall be 'COMPLETED' or 'CANCELED'.

3.25.4.1.3 Expected Actions

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

If the requested work item has been successfully completed (i.e. the received Unified Procedure Step State (0074,1000) has a value of 'COMPLETED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step State (0074,1000) of 'COMPLETED', a Procedure Step Progress of 100%, and a status code of 0000H (success). The Treatment Management System shall then be ready to receive new worklist queries.

If the requested work item was not successfully completed (i.e. the received Unified Procedure Step State (0074,1000) has a value of 'CANCELED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step State (0074,1000) of

_____

Draft for Trial Implementation

_____

'CANCELED', a Procedure Step Progress of between 0% and 100%, 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 work item was retrieved and locked, but never started (e.g. the user abandoned delivery, or the Performing Device determined that the retrieved plan was not deliverable), then Procedure Step Progress shall be set at 0%.

If the requested work item 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 Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-ACTION was received.

DICOM Supplement 96 Section F.X.3.4.1.1 outlines the final state requirements for the UPS N-ACTION command, i.e. the attributes which must be value before the procedure step is allowed to pass into the COMPLETED or CANCELED state. The stated requirements for the UPS in Progress and UPS Final Update transactions ensure that these conditions are met.

3.26 RO-26: UPS Progress Update

3.26.1 Scope

In the UPS Progress Update transaction, a PDS or TDD signals to the TMS any changes in the progress of the work item that is currently in progress.

3.26.2 Use Case Roles
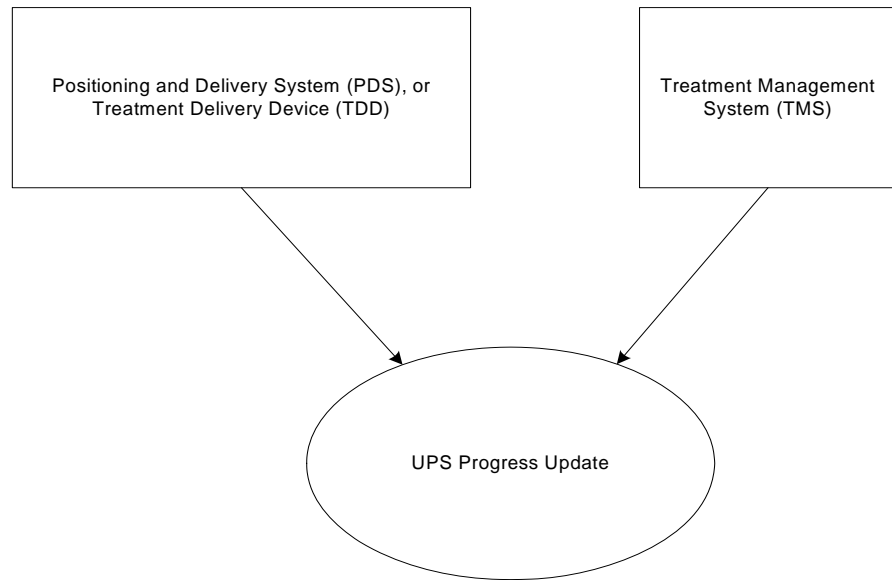
_____

Draft for Trial Implementation

_____

Actor: *Treatment Management System*

Role: Responds to a UPS N-SET and updates attributes in the specified Unified Procedure Step.

Actor: *Positioning and Delivery System* or *Treatment Delivery Device ('Performing Device')*

Role: Signals using UPS N-SET that that progress related to the selected work item has changed.

3.26.3 Referenced Standards

DICOM Supplement 74 (Frozen Draft): Utilization of Worklist in Radiotherapy Treatment Delivery

DICOM Supplement 96 (Frozen Draft): Unified Worklist and Procedure Step

_____

Draft for Trial Implementation

_____

3.26.4 Interaction Diagram

Positioning and Delivery System (PDS), or
Treatment Delivery Device (TDD)

Treatment Management
System (TMS)
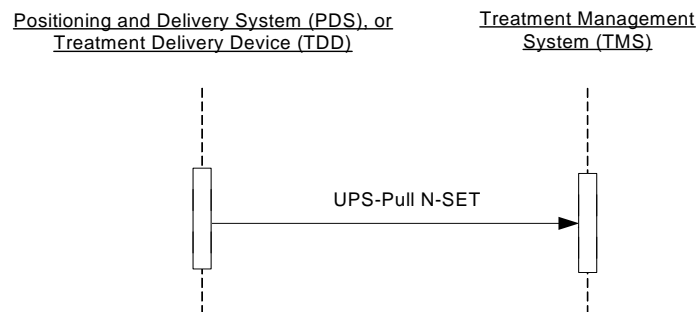
UPS-Pull N-SET

3.26.4.1 UPS Progress Update Message

The Performing Device 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 Supplement 96, Part 4, Section F.X.4).

3.26.4.1.1 Trigger Events

The Performing Device is in the process or performing the work item, and wishes to notify the TMS of changes in the progress of the work item. Specifically:

- The Performing Device has fetched necessary input data, and notifies the TMS that work is about to start on treatment delivery by indicating progress of 0% and indicating the Referenced Beam Number in Progress (see 3.26.4.1.2).

- The Performing Device has completed or abandoned the work, and indicates progress prior to storing output data (RO-22: Store Position Acquisition Results to Archive, RO-23: Store Position Registration Results to Archive, or RO-24: Store Delivery Results to Archive).

3.26.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96.

Minimum requirements for SCUs using the UWPS N-SET command for this transaction are detailed in Table 3.26-1 UPS N-SET Attribute Requirements for UPS Progress Update Transaction. 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 of the UPS are met by the UPS Final Update transaction (see Section 3.21).

_____

_____

Table 3.26-1 UPS N-SET Attribute Requirements for UPS Progress Update Transaction

Attribute Name	Tag	Type	IHE-RO Additional Requirements on SCU
Transaction UID	(0008,1195)	(See DICOM Supp 96 F.X.3.6.3)	
Unified Procedure Step Progress Information Module			
UPS Progress Information Sequence	(0040,4003)	3	Required by IHE-RO in all instances of this transaction.
>Unified Procedure Step Progress	(0040,4010)	1	
>Unified Procedure Step Discontinuation Reason Code Sequence	(0074,100e)	3	Not required to be supplied for this profile.
Unified Procedure Step Performed Procedure Information Module			
UPS Performed Procedure Sequence	(0074,1216)	1C	Required by IHE-RO in at least one instance of this transaction if Code Value for Scheduled Workitem Code Sequence of UPS is '121726' (RT Treatment with Internal Verification)
>Performed Processing Parameters Sequence	(0074,1212)	3	Required by IHE-RO if UPS Performed Procedure Sequence is provided
>>Value Type	(0040,A040)	1	'TEXT'
>>Concept Name Code Sequence	(0040,A043)	1	
>>>Code Value	(0008,0100)	1	'121700'
>>>Coding Scheme Designator	(0008,0102)	1	'DCM'
>>>Code Meaning	(0008,0104)	1	'Referenced Beam Number in Progress'
>>Text Value	(0040,A160)	1	Integer string equal to the value of Referenced Beam Number (300C,0006)
>Output Information Sequence	(0040,4033)	2	Shall be empty

DRAFT

_____

Draft for Trial Implementation

_____

>Non-DICOM Output Information Sequence	(0040,4032)	2	Shall be empty

3.26.4.1.3 Expected Actions

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

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

If the requested work item 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 Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

DRAFT

_____

Draft for Trial Implementation

Appendix A   Atribute Consistency Between Composite IODs

This appendix is an integral part of the IHE-RO Technical Framework.

The first section provides attribute mappings for the Evidence Creators with additional IHE Requirements based on a number of critical attributes (Type 2 and 3 in DICOM) common to most composite instances (Images, and RT IODs).

- The second section provides additional constraints on the population and use of a number of modules for particular IODs.

- The third section provides additional constraints on the population and use of a number of critical attributes.

A.1   Radiation Oncology Critical Attribute Mapping

The tables below describe requirements, recommendations or explanations on integration-critical attributes for radiation oncology cases. They define which integration-critical attributes need to be equal (copied or generated locally). The 2008 IHE-RO Profile does not include the use of Work List, which precludes its use as the source for the integration-critical attributes. It is anticipated that once Work List is utilized in the IHE-RO Profiles, it will be utilized in favor of the preceding Composite IOD (CT, or RT Structure Set) utilized in the Profile. The purpose in allowing the RT Structure Set to have a differing Study IE is to allow separation of the Study Semantics of a Diagnostic CT from activities that are Oncology related.

For attributes related to clinical trials, it is assumed that the data will be post-processed in to a form suitable for clinical trials after the "complete" set (for the purposes of the clinical trial submission) of a patient's data has been created.

General table structure:

The 1st column denotes the DICOM attributes whose values shall be mapped between the

DICOM objects (equal values in the same table row), including DICOM attribute tag (for clarity).

The 2nd column and following columns define where attribute values come from: all defined attribute values of one table row are equal.

Draft for Trial Implementation

_____

Required mapping of corresponding attributes

Attribute (Tag)	CT IMAGE	RT Structure Set	Geometric RT Plan	Dosimetric RT Plan	RT Dose	Spatial Registration
Patient's Name (0010,0010)	Source	Copy	Copy	Copy	Copy	Copy
Patient ID (0010,0020)	Source	Copy	Copy	Copy	Copy	Copy
Patient's Birth Date (0010,0030)	Source	Copy	Copy	Copy	Copy	Copy
Patient's Sex (0010,0040)	Source	Copy	Copy	Copy	Copy	Copy
Study Instance UID (0020,000D)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **
Study Date (0008,0020)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **
Study Time (0008,0030)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **
Referring Physician's Name (0008,0090)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **

_____

_____

Attribute (Tag)	CT IMAGE	RT Structure Set	Geometric RT Plan	Dosimetric RT Plan	RT Dose	Spatial Registration
Study ID (0020,0010)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **
Accession Number (0008,0050)	Source	New Source (May Copy *)	Copy	Copy	Copy	Copy from Base Study Images **
Study Description (0008,1030)	Source	New Source (May Copy *)	Copy	Copy	Copy	
Frame of Reference UID (0020,0052)	Source	Copy	Copy	Copy	Copy	Copy from Base Study Images **
Position Reference Indicator (0020,1040)	Source	NA	Copy	Copy	Copy	Copy from Base Study Images **
						NA

* If one copies the Study Instance UID, no study level attributes may be altered.

** The Base Study Images are identified as the images which establish the Base Frame of Reference of the Spatial Registration objects.

_____

Draft for Trial Implementation

_____

A.2   Radiation Oncology Critical Modules

The tables below describe requirements, recommendations or explanations on integration-critical attributes for radiation oncology cases. They define which integration-critical modules need to be populated for the various RT IODs. The table follows the structure defined in DICOM PS3.3 section A.1.3

DRAFT

_____

88

RT PLAN IOD MODULES

IE	Module	Reference	Usage	IHE-RO Usage
Patient	Patient	C.7.1.1	M	M
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	RT Series	C.8.8.1	M	M
	Clinical Trial Series	C.7.3.2	U	U
Frame of Reference	Frame of Reference	C.7.4.1	U – See Note.	M
Equipment	General Equipment	C.7.5.1	M	M
Plan	RT General Plan	C.8.8.9	M	M
	RT Prescription	C.8.8.10	U	U(geometric), M(dosimetric)
	RT Tolerance Tables	C.8.8.11	U	U
	RT Patient Setup	C.8.8.12	U	U
	RT Fraction Scheme	C.8.8.13	U	U(geometric), M(dosimetric)
	RT Beams	C.8.8.14	C - Required if RT Fraction Scheme Module exists and Number of Beams (300A,0080) is greater than zero for one or more fraction groups	M (Can be excluded for zero beams with non-isocentricc model)
	RT Brachy Application Setups	C.8.8.15	C - Required if RT Fraction Scheme Module exists and Number of Brachy Application Setups (300A,00A0) is greater than zero for one or more fraction groups	N/A

89

_____

Approval	C.8.8.16	U	M
Audio	C.10.3	U	U
SOP Common	C.12.1	M	M

DRAFT

_____

90

Draft for Trial Implementation

_____

RT PLAN IOD MODULES

IE	Module	Reference	Usage	IHE-RO Usage
Patient	Patient	C.7.1.1	M	
	Clinical Trial Subject	C.7.1.3	U	
Study	General Study	C.7.2.1	M	
	Patient Study	C.7.2.2	U	
	Clinical Trial Study	C.7.2.3	U	
Series	RT Series	C.8.8.1	M	
	Clinical Trial Series	C.7.3.2	U	
Frame of Reference	Frame of Reference	C.7.4.1	M	
Equipment	General Equipment	C.7.5.1	M	
Dose	General Image	C.7.6.1	C - Required if dose data contains grid-based doses.	Shall be present
	Image Plane	C.7.6.2	C - Required if dose data contains grid-based doses.	Shall be present
	Image Pixel	C.7.6.3	C - Required if dose data contains grid-based doses.	Shall be present
	Multi-Frame	C.7.6.6	C - Required if dose data contains grid-based doses and pixel data is multi-frame data.	Shall be present
	Overlay Plane	C.9.2	U	
	Multi-Frame Overlay	C.9.3	U	
	Modality LUT	C.11.1	U	
	RT Dose	C.8.8.3	M	

_____

Draft for Trial Implementation

_____

RT DVH	C.8.8.4	U	This module is outside the scope of this profile.
Structure Set	C.8.8.5	C - Required if dose data contains dose points or isodose curves	This module is outside the scope of this profile.
ROI Contour	C.8.8.6	C - Required if dose data contains dose points or isodose curves	This module is outside the scope of this profile.
RT Dose ROI	C.8.8.7	C - Required if dose data contains dose points or isodose curves	This module is outside the scope of this profile.
Audio	C.10.3	U	This module is outside the scope of this profile.
SOP Common	C.12.1	M	

DRAFT

_____

Draft for Trial Implementation

_____

SPATIAL REGISTRATION IOD MODULES

IE	Module	Reference	Usage	IHE-RO Usage
Patient	Patient	C.7.1.1	M	M
	Specimen Identification	C.7.1.2	U	U
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	General Series	C.7.3.1	M	M
	Clinical Trial Series	C.7.3.2	U	U
	Spatial Registration Series	C.20.1	M	M
Frame of Reference	Frame of Reference	C.7.4.1	M	M
Equipment	General Equipment	C.7.5.1	M	M
Spatial Registration	Spatial Registration	C.20.2	M	M
	Common Instance Reference	C.12.2	M	M
	SOP Common	C.12.1	M	M

DRAFT

A.3 Radiation Oncology Critical Attributes

The tables below describe requirements, recommendations or explanations on integration-critical attributes for radiation oncology cases.

There are a number of attributes intended to be populated in the original CT

_____

Draft for Trial Implementation

_____

General table structure:

The 1st column denotes the DICOM attributes whose values shall be mapped between the DICOM objects (equal values in the same table row).

The 2nd column denotesThe DICOM attribute tag (for clarity).

The 3rd column defines the IHE-RO criteria for being present and/or displayed. The plus (+) symbol indicates an IHE extension of DICOM, the star (*) symbol indicates the attribute is not required to be displayed. The letter R indicates that the element is required, the letter O that it is optional. An element with type O (with or without the + or * modifiers) is typically called out specifically because some additional constraint has been made on the use of the element. That additional constraint might be that it is to be propagated from an "input object", that it must not be relied upon by an actor using it as input, that it is not to be utilized in output by a particular actor, or that it must be made readily viewable by an actor.

The 4th column provides additional information on the constraints for the attribtue as well as guidance in the use of the attribute.

Patient Module

Attribute	Tag	Type	Attribute Note
Patient's Name	(0010,0010)	R+	IHE requires that this element be present. This element is one of the primary patient identifying elements, and as such, all DICOM objects with the same Study Instance UID, must have the same value in this element. Equipment which creates new series based on other series (i.e. resampled series, new structure sets, plans, etc) must preserve the value of this element to adhere to this profile.
Patient ID	(0010,0020)	R+	See Patient's Name (0010,0010)
Patient's Birth Date	(0010,0030)	O+	See Patient's Name (0010,0010) See Also RAD TF Vol2 A.3

_____

94

Draft for Trial Implementation

_____

| Patient's Sex | (0010,0040) | O+ | See Patient's Name (0010,0010) |
| | | | See Also RAD TF Vol2 A.3 |

General Study Module

Attribute	Tag	Type	Attribute Note
Study Instance UID	(0020,000D)	R+*	IHE requires that this value be preserved in the following cases:
			If a set of images are resampled and re-exported. This new set of images will be a new series. This series will belong to the same study and will have the same study date. This is to facilitate grouping the images in a PACS
			When a plan is constructed from a structure set. The plan will be in the same study, and will have the same study date IHE requires that this element be present. This element is one of the primary patient identifying elements, and as such, all DICOM objects with the same Study Instance UID, must have the same value in this element.
			Equipment which creates new series based on other series (i.e. resampled series, new structure sets, plans, etc) must preserve the value of this element

DRAFT

_____

95

_____

			to adhere to this profile.
Study Date	(0008,0020)	R+	[See (0020,000D)]
Study Time	(0008,0030)	R+	[See (0020,000D)]
Study ID	(0020,0010)	R+	[See (0020,000D)]
Study Description	(0008,1030)	O+	[See (0020,000D)]

GENERAL SERIES MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Note
Series Instance UID	(0020,000E)	R*	Unique identifier of the Series.
Series Number	(0020,0011)	R+	A number that identifies this Series. Shall not be empty.
Series Date	(0008,0021)	R+	Date the Series started.
Series Time	(0008,0031)	R+	Time the Series started.
Series Description	(0008,103E)	R+	User provided description of the Series

DRAFT

_____

96

Draft for Trial Implementation

_____

SPATIAL REGISTRATION MODULE ATTRIBUTES

Attribute Name	Tag	Type	Attribute Note
Registration Sequence	(0070,0308)	R	A sequence of 2 registration items. The first Frame of Reference will be to the Registered Frame of Reference, the second will define the spatial registration from the specified Frame of Reference to the Registered Frame of Reference.
>Frame of Reference UID	(0020,0052)	R	Identifies a Frame of Reference that may or may not be an image set (e.g. atlas or physical space). See C.7.4.1.1.1 for further explanation. Shall be present.
>Referenced Image Sequence	(0008,1140)	1C	Identifies the set of images registered in this sequence item. One or more items shall be present. Required if Frame of Reference UID (0020,0052) is absent. May be present otherwise. No semantics may be inferred from the presence of the image references.
>>Include 'Image SOP Instance Reference Macro' Table 10-3			
>Matrix Registration Sequence	(0070,0309)	1	A sequence that specifies one spatial registration. Exactly one item shall be present
>>Matrix Sequence	(0070,030A)	1	One item shall be present. The item specifies a transformation. See C.20.2.1.1.
>>>Frame of Reference Transformation Matrix	(3006,00C6)	1	A 4x4 homogeneous transformation matrix that registers the referenced images to the Registered Frame of Reference. Matrix elements shall be listed in row-major order. See C.20.2.1.1.
>>>Frame of Reference Transformation Matrix Type	(0070,030C)	1	The only type of Frame of Reference Transformation Matrix (3006,00C6) supported in this profile is RIGID. See C.20.2.1.2

_____

Draft for Trial Implementation

General Equipment Module

Attribute	Tag	Type	Attribute Note
Manufacturer	(0008,0070)	R+*	IHE requires that this element be present, and should contain the manufacturer of the equipment creating the structure set, plan, or dose. If the equipment is storing and forwarding information, the value of this element shall be preserved. If a new plan is created from a previous plan, the manufacturer of the equipment producing the new plan shall insert their identifier in this element. If a new structure set is created from a previous structure set, the manufacturer of the equipment producing the new structure set shall insert their identifier in this element.
Manufacturer's Model Name	(0008,1090)	R+*	If an application resamples and re-exports a series of CT images, or modifies an instance then this element must be present, and must contain the model name of the equipment doing the resampling.

_____

Draft for Trial Implementation

_____

Frame Of Reference Module

Attribute	Tag	Type	Attribute Note
Frame of Reference UID	(0020,0052)	R+*	All related DICOM objects (CT images, Structure Sets, Plans, and Doses) are required to be in the same frame of reference and have the same Frame of Reference UID.
Position Reference Indicator	(0020,1040)	O+*	Equipment which creates new series based on other series (i.e. resampled series, new structure sets, plans, etc) must preserve the value of this element to adhere to this profile.

RT General Plan Module

Attribute	Tag	Type	Attribute Note
RT Plan Label	(300A,0002)	R+	The label which serves as the identification of the plan for the user.
RT Plan Date	(300A,0006)	R+	The date when the plan was last modified.
RT Plan Time	(300A,0007)	R+	The time when the plan was last modified.

_____

99

RT Plan Geometry	(300A,000C)	R+*	Shall be PATIENT. This implies that the RT Structure Set exists and is referenced in the General Plan module.

RT Patient Setup Module

Attribute	Tag	Type	Attribute Note
Patient Setup Sequence	(300A,0180)	R+*	An actor must not rely on the presence of: • Fixation Device Sequence • Shielding Device Sequence • Setup Device Sequence • Table Top Vertical Setup Displacement • Table Top Longitudinal Setup Displacement • Table Top Lateral Setup Displacement within the Patient Setup Sequence for proper operation.
>Patient Position	(0018,5100)	R+	Must be constrained to HFS, FFS, HFP, FFP

_____

Draft for Trial Implementation

_____

			(Decubitus Left and Decubitus Right Positions shall not be supported)
>Setup Technique	(300A,01B0)	R+*	

RT Fraction Group Module

Attribute	Tag	Type	Attribute Note
Fraction Group Sequence	(300A,0070)	R+*	Must be constrained to contain only 1 item in the sequence
>Number of Brachy Application Setups	(300A,00A0)	R+*	Must be constrained to a value 0. Brachytherapy is not supported in the 2008 IHE-RO Profiles.

DRAFT

_____

Draft for Trial Implementation

_____

RT BEAMS MODULE (for Geometric Planner)

Attribute	Tag	Type	Attribute Note
Beam Sequence	(300A,00B0)	R+*	An actor must be able to safely handle up to 100 Beam Sequence Items (beams)
>Beam Name	(300A,00C2)	R+	Equipment which creates new series based on other series (i.e. resampled series, new structure sets, plans, etc) must preserve the value of this element to adhere to this profile. The Beam Name must be unique within the sequence
>Beam Type	(300A,00C4)	R+*	For Geometric Plans the value is constrained to: STATIC Only static beams shall be specified in Geometric Plans. This will allow non-arc-based IMRT (such as Step-and-Shoot or Sliding Window techniques, but not techniques such as fixed aperture arc beams, conformal arc beams, or intensity modulated arc beams. As a result, all beams in Geometric Plans shall consist of exactly two control points.
>Radiation Type	(300A,00C6)	R+*	Any value other than PHOTON is outside the scope of the profile

DRAFT

_____

Draft for Trial Implementation

03/17/2009 Copyright ©2006- 2008: ASTRO, AAPM, RSNA, HIMSS

>High-Dose Technique Type	(300A,00C7)	O+*	Geometric Plans shall not specify this attribute.
>Treatment Machine Name	(300A,00B2)	O+*	An Actor must not rely on the presence of this attribute.
>Source-Axis Distance	(300A,00B4)	R+*	This attribute is critical for providing information regarding beam divergence.
>Beam Limiting Device Sequence	(300A,00B6)		For IHE-RO, shall report at least one set of MLC descriptions or the descriptions of two sets of jaws.
>Referenced Patient Setup Number	(300C,006A)	R+*	
>Number of Wedges	(300A,00D0)	R+*	Geometric Plans are constrained to a value of 0 (i.e. a Geometric Plan must not include a Wedge).
>Number of Compensators	(300A,00E0)	R+*	Geometric Plans are constrained to a value of 0 (i.e. a Geometric Plan must not include a Compensator).
>Number of Boli	(300A,00ED)	R+*	Geometric Plans are constrained to a value of 0 (i.e. a Geometric Plan must not include any Boli).
>Number of Blocks	(300A,00F0)	R+*	All actors shall be able to handle 8 block items, of which no more than one may be an aperture
>Block Sequence	(300A,00F4)		

_____

Draft for Trial Implementation

_____

>>Block Divergence	(300A,00FA)	R+*	Must be present and non-null if Block Sequence is present (i.e. when Number of Blocks is 1 or more), with a value of PRESENT
>>Block Number of Points	(300A,0104)	R+*	The value is constrained to be 3 or more.
>>Block Data	(300A,0106)	R+*	Shall be present and non-null. Limitations on the total number of points are limited only by DICOM limitations on representation with 'explicit VR' in total byte lengths. Systems that limit support of legal sequences shall safely handle receipt of such sequences that exceed their limitations, and document this behavior in their IHE-RO Profile adherence statement.
>Applicator Sequence	(300A,0107)		Not expected in Geometric Plans. However, if present, shall be handled in a safe manner by the receiving system (and document this behavior in their IHE-RO Profile adherence statement). Applications exporting this value are outside the scope of the 2006 Profile.
>Final Cumulative Meterset Weight	(300A,010E)	O+*	Shall not be present in a Geometric Plan.
>Number of Control Points	(300A,0110)	R+*	Shall have a value of 2 for Geometric Plans.

_____

Draft for Trial Implementation

>Control Point Sequence	(300A,0111)	R+*	For Geometric Plans the second control point (sequence item) shall contain only: • Control Point Index (300A,0112) with a value of 1 • Cumulative Meterset Weight (300A,0134) set NULL.
>>Cumulative Meterset Weight	(300A,0134)	O+*	Shall be NULL for Geometric Plans (in both the first and second control point).
>>Referenced Dose Reference Sequence	(300C,0050)	O+*	Shall not be present for Geometric Plans. Must not be relied upon by actors operating on the object as a Geometric Plan.
>>Nominal Beam Energy	(300A,0114)	O+*	Actors must not rely on the presence of this attribute to operate correctly. However, if this attribute is present, actors may not ignore the value.
>>Dose Rate Set	(300A,0115)	O+*	Actors must not rely on the presence of this attribute to operate correctly. However, if this attribute is present, actors may not ignore the value.
>>Wedge Position Sequence	(300A,0116)	O+*	Must not be present in a Geometric Plan

_____

Draft for Trial Implementation

_____

>>Beam Limiting Device Position Sequence	(300A,011A)	R+*	Must be present and correspond to those devices defined in the Beam Limiting Device Sequence.

It shall be present for a Geometric Plan for Control Point Index 0 only. |
| >>Gantry Rotation Direction | (300A,011F) | R+* | For a Geometric Plan for Control Point Index 0 only, must have a value of NONE. |

MULTI-FRAME MODULE ATTRIBUTES

Attribute	Tag	Type	Attribute Note
Frame Increment Pointer	(0028,0009)	R+*	Required For RT Dose, Shall be equal to (3004,000C) = Grid Frame Offset Vector.

RT Dose Module

Attribute	Tag	Type	Attribute Note
Samples per Pixel	(0028,0002)	R+*	Shall be present and equal to 1
Photometric Interpretation	(0028,0004)	R+*	Shall be present and equal to **MONOCHROME2**
Bits Allocated	(0028,0100)	R+*	Shall be present and equal to 16 or 32
Bits Stored	(0028,0101)	R+*	Shall be equal to Bits Allocated
High Bit	(0028,0102)	R+*	Shall be one less than Bits Stored
Pixel Representation	(0028,0103)	R+*	Shall have the value 0 = unsigned integer. Negative dose values shall not be present.
Dose Units	(3004,0002)	R+*	Shall be equal to the enumerated value **GY**
Dose Type	(3004,0004)	R+*	Shall be equal to the defined term **PHYSICAL**

_____

Draft for Trial Implementation

Dose Comment	(3004,0006)	R+	Shall be present and not empty if Referenced RT Plan Sequence (300C,0002) is missing, in which case it should have the same value as RT Plan Description.
Normalization Point	(3004,0008)	O+*	Shall not be relied on.
Dose Summation Type	(3004,000A)	R+*	Shall have the value **PLAN**.
Referenced RT Plan Sequence	(300C,0002)	R	Shall be present if Dose Summation Type (3004,000A) has the value **PLAN**.
>Referenced Fraction Group Sequence	(300C,0020)	R+*	Shall be present if the parent sequence is present, and shall reference a single fraction group within the referenced RT Plan.
Grid Frame Offset Vector	(3004,000C)	R+*	First z coordinate shall be equal to zero. The remaining z coordinates shall be relative to the starting z position in Image Position (Patient) (0020,0032).
Tissue Heterogeneity Correction	(3004,0014)	O+	Shall be present but may be null. The value shall be given if known.

DRAFT

IMAGE PLANE MODULE ATTRIBUTES

Attribute	Tag	Type	Attribute Note
Image Orientation (Patient)	(0020,0037)	R+*	This element shall be present in every RT Dose IOD. For IHE-RO 2006, this element shall be restricted to AXIAL images only. For an axial image, direction cosines shall be (± 1, 0, 0, 0, ± 1, 0) with an angle tolerance of 0.001 radians (~0.057 degrees)

_____

Draft for Trial Implementation

Slice Thickness	(0018,0050)	O+*	Shall not be relied on.
Slice Location	(0020,1041)	O+*	Shall not be relied on.
Pixel Spacing	(0028,0030)	O+*	For CT, non-isotropic pixels are outside the scope of the profile. For RT Dose, pixel spacing may be non-isotropic

RT Structure Set Module

Attribute	Tag	Type	Attribute Note
Structure Set Label	(3006,0002)	R+	
Structure Set Date	(3006,0008)	R+	
Structure Set Time	(3006,0009)	R+	
Referenced Frame of Reference Sequence	(3006,0010)	R+*	This element is required for all 3D RT Structure Sets which are image based. It is to contain a set of references to the entire set of images which comprise the volume from which the Structure Set was constructed, and which is to be used for planning. There should only be one item in this sequence, as a Structure is only based on a single set of images, which is all in the same frame of reference.
>Frame of Reference UID	(0020,0052)	R+*	This frame of reference UID shall be the same as the frame of reference of the image series from which the RTSTRUCT was constructed.

_____

03/17/2009   Copyright ©2006- 2008: ASTRO, AAPM, RSNA, HIMSS

_____

>RT Referenced Study Sequence	(3006,0012)	R+*	Must be present, to contain series sequence. Only one item allowed in this sequence.
>>Referenced SOP Instance UID	(0008,1155)	R+*	This Study Instance UID shall be the same as the Study Instance UID of the related image instances.
>>RT Referenced Series Sequence	(3006,0014)	R+*	Must be present, to contain Contour Image Sequence. Only one item allowed in this sequence.
>>>Series Instance UID	(0020,000E)	R+*	Must be present, and shall contain the series to which the set of images upon which the structure set is based belong.
>>>Contour Image Sequence	(3006,0016)	R+*	Must be present. Contains an item for each image in the volume upon which the Structure Set is based.
>>>>Referenced SOP Class UID	(0008,1155)	R+*	Must be present with a value of '1.2.840.10008.5.1.4.1.1.2', '1.2.840.10008.5.1.4.1.1.4' or '1.2.840.10008.5.1.4.1.1.128'
>>>>Referenced Frame Number	(0008,1160)	O+*	Shall not be present
Structure Set ROI Sequence	(3006,0020)	R+	This sequence must be present. It defines the ROI's in this RTSTRUCT
>ROI Number	(3006,0022)	R*	This defines an index to be used for referencing a particular ROI item from other sequences. It is required to be unique within the scope of this message. No limitation on values other than

_____

Draft for Trial Implementation

_____

			uniqueness within sequence
>Referenced Frame of Reference UID	(3006,0024)	R*	This frame of reference UID shall be the same as the frame of reference of the image series from which the RTSTRUCT was constructed.
>ROI Name	(3006,0026)	R+	This is the primary identifier for an ROI (from user perspective). Must be present and should match UI display. Must be unique within ROI sequence
>ROI Description	(3006,0028)	O+*	Not required - no compliant implementation shall rely on this element being present for proper operation.
>ROI Volume	(3006,002C)	O+*	Not required - no compliant implementation shall rely on this element being present for proper operation.
>ROI Generation Algorithm	(3006,0036)	R+	Must be present, with a value of AUTOMATIC, SEMIAUTOMATIC, MANUAL, or RESAMPLED. This information may be presented to a user, but no semantics for handling an RTSTRUCT is required for this profile. RESAMPLED indicates that the ROI Contours have been resampled onto a different set of images from those on which the contours were originally created. Implementations which create RTSTRUCT instances must provide an appropriate value.

_____

Draft for Trial Implementation

_____

RT Observations Module

Attribute	Tag	Type	Attribute Note
RT ROI Observations Sequence	(3006,0080)	R+*	This sequence contains information about an ROI. It references the ROI in Referenced ROI Number which contains a number which must match one of the ROI numbers in one of the elements of the Structure Set ROI Sequence. In particular, an RTSTRUCT must contain an element in this sequence for ISOCENTER.
>Referenced ROI Number	(3006,0084)	R+*	Specifies the ROI to which this observation applies. For every item in Structure Set ROI sequence, at least one observation is required, with values in ROI Interpreted Type and ROI Interpreter.
>RT ROI Interpreted Type	(3006,00A4)	O+*	Required if there is not another item in the RT ROI observation sequence with the same Referenced ROI number which has this element populated or the ROI is only utilized to describe a physical property. If referenced ROI has associated contours of type CLOSED_PLANAR, must be one of: EXTERNAL

DRAFT

_____

Draft for Trial Implementation

_____

			PTV
			CTV
			GTV
			TREATED_VOLUME
			IRRAD_VOLUME
			BOLUS
			AVOIDANCE
			ORGAN
			MARKER
			CONTRAST_AGENT
			CAVITY
			If referenced ROI has associated contours of type POINT, must be one of:
			MARKER
			REGISTRATION
			ISOCENTER
>ROI Physical Properties Sequence	(3006,00B0)	O+*	Not required, but shall not be ignored if supplied.
>>ROI Physical Property	(3006,00B2)	R+*	Only relative electron density: REL_ELEC_DENSITY

RT Contour Module

Attribute	Tag	Type	Attribute Note
ROI Contour Sequence	(3006,0039)	R	

_____

Draft for Trial Implementation

_____

>ROI Display Color	(3006,002A)	O+*	Not required - no compliant implementation shall rely on this element being present for proper operation. However applications are allowed to be aware of this element and use it to map display colors.
>Contour Sequence	(3006,0040)	R+*	Must be present. Must contain an item for each contour in the ROI. Compliant implementations must be able to handle as many as 100 contours on a single slice. That is, the number of contours in items in all Contour Sequences with the same z-coordinate (and referenced CT image) should be less than or equal to 100.
>>Contour Image Sequence	(3006,0016)	R+*	Must be present with a single item. This item is the image upon which this contour should be placed. If the contour type is CLOSED_PLANAR, then the z-coordinates of the contour must match the z-coordinate of Image Position Patient in the image.
>>>Referenced SOP Class UID	(0008,1150)	R+*	Must be present with a value of '1.2.840.10008.5.1.4.1.1.2'
>>>Referenced SOP Instance UID	(0008,1155)	R*	SOP Instance UID of the image being referenced.
>>>Referenced Frame Number	(0008,1160)	O+*	Shall not be present

_____

Draft for Trial Implementation

_____

>>Contour Geometric Type	(3006,0042)	R+*	Must be present, with a value of POINT or CLOSED_PLANAR. Conforming implementations must properly interpret this value.
>>Contour Slab Thickness	(3006,0044)	O+*	Not required - no compliant implementation shall rely on this element being present for proper operation.
>>Contour Offset Vector	(3006,0045)	O+*	The profile requires that this be zero if present.
>>Number of Contour Points	(3006,0046)	R+*	Required, and must match the actual number of points in Contour Data. Shall not exceed the number for which the Contour Data can not be encoded when using explicit transfer syntax.
>>Contour Data	(3006,0050)	R+*	Must be present. If contour type is CLOSED_PLANAR, then all points must have the same z-coordinate. This z-coordinate must match the z-coordinate in the related CT image within 0.01 mm (contained in the Contour Image sequence in the same item of the ROI Contour sequence as this data). An implication of this is that the CLOSED_PLANAR contours are axial.

DRAFT

_____

114

Draft for Trial Implementation

_____

SOP Common Module

Attribute	Tag	Type	Attribute Note
SOP Instance UID	(0008,0018)	R+*	If an application alters an Information Object instance, then the new Information Object instance shall be assigned a new UID.
Specific Character Set	(0008,0005)	O+*	Shall be blank or present with value "ISO_IR 100" Only ASCII and ISO_IR 100 are supportedin this profile. Character codes in message will reflect value of this element. IHE-RO has a goal of providing broader multi-language support, potentially using Unicode UTF-8 but not in this profile
Instance Creation Date	(0008,0012)	O+*	Actors must not rely on the presence of this attribute to operate correctly
Instance Creation Time	(0008,0013)	O+*	Actors must not rely on the presence of this attribute to operate correctly
Instance Creator UID	(0008,0014)	O+*	Actors must not rely on the presence of this attribute to operate correctly
Instance Number	(0020,0013)	O+*	Actors must not rely on the presence of this attribute to operate correctly

_____

115

Draft for Trial Implementation