

Integrating the Healthcare Enterprise



**IHE-Radiation Oncology**  
**Technical Framework Supplement**

**Supplement Proposal for Dose Compositing**

**Draft for Trial Implementation**

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This is a supplement to the IHE-Radiation Oncology Technical Framework V3.x.

Details about IHE may be found at: [www.ihe.net](http://www.ihe.net)

Details about the IHE Radiation Oncology Domain may be found at:  
<http://www.ihe.net/Domains/index.cfm>

Details about the structure of IHE Technical Frameworks and Supplements may be found at: <http://www.ihe.net/About/process.cfm> and <http://www.ihe.net/profiles/index.cfm>

The current version of the IHE Radiation Oncology Technical Framework may be found at: [http://www.ihe.net/Technical\\_Framework/index.cfm](http://www.ihe.net/Technical_Framework/index.cfm)

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## Introduction

This supplement defines the relevant standards and constraints on those standards needed to implement interoperable transfer of spatially related dose information between systems.

## Profile Abstract

In the present context, the term *Dose Compositing* is used to denote the process of combining information from two spatially-related 3-D dose (matrices). Two use cases are supported by this profile. The first use case (*Registered Dose Compositor*) involves accepting two or more dose instances and spatial registration instance(s) and combining the spatially-registered doses to produce a new dose instance. The second use case (*Registered Compositing Planner*) involves accepting (prior) dose instance(s) and spatial registration instance(s) and creating a new treatment plan and dose instance(s) based on the prior dose.

## Open Issues and Questions

1. Remove references to “prior” and “subsequent” in description of *Registered Dose Compositor*.
2. Closed Change Actor name: *Compositing Planner* to *Registered Compositing Planner*? Does this actor need to support multiple prior dose instances?
3. How many dose instances must be handled by the *Registered Dose Compositor*? How many doses will be used to test this Actor?
4. Can Transactions be described without explicit references to the specific Actors of this Profile (to facilitate their future re-use)?

## Issues

1. Is an RT Plan Instance needed to accompany an RT Dose either for the source or result of dose compositing? NO.
2. How are composite dose instance identified? See DICOM CP\_938 (LB Mar 09) – Adds Dose Summation Type = (3004,000a) = MULTI\_PLAN and allows multiple values in Referenced RT Plan Sequence (300c,0002)
  - a. A Dose Reference Plan is not needed.
  - b. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence must be a Dosimetric Plan (for legacy Dose Viewers)

3. Can the Dose Compositor *scale* constituent RT Doses? Yes: document scaling in Dose Comment
4. Need **new Composite Dose Viewer** to support composite RT Dose, i.e. with Dose Summation Type = MULTI\_PLAN and multiple values in Referenced RT Plan Sequence
5. RT Dose IOD Attribute Requirements for Composite Dose
  - a. **Dose Type:** If *any* contributing dose has Dose Type = EFFECTIVE, the Composite Dose must have Dose Type = EFFECTIVE.
  - b. **Dose Summation Type:** Composite Dose has Dose Summation Type = MULTI\_PLAN (see CP\_938)
  - c. **Referenced RT Plan Sequence:** Composite Dose has Referenced RT Plan Sequence containing SOP Instance Macro references to each constituent RT Plan. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence must be a Dosimetric Plan (for legacy Dose Viewers)
  - d. **Tissue Heterogeneity Correction:** has items representing all tissue heterogeneity correction techniques used in computing all constituent doses.
6. The **Composite Dose Viewer** extends the **Registered Dose Display Actor**: do we need an extended version of the **Dose Viewer Actor** (without registration)? Per 7/9/09 TC T-con: Re-cast the **Composite Dose Viewer** as two Actors, one with optional spatial registration, and one without registration: [Done, now have **General Dose Viewer and Registered General Dose Viewer**, 11/7/2009]
  - a. **Composite Dose Viewer:** accepts Modality Image, RT Structure Set, Composite Dose – displays composite dose (requires that composite dose, images, and structure set share the same frame of reference)
  - b. **Registered Composite Dose Viewer:** accepts Modality Image(s), Registered RT Structure Set, Composite Dose, Spatial Registration – displays composite doses registered to image/structure set frame of reference
7. (7/9/09) Change **Compositing Dosimetric Planner** to **Compositing Planner** to de-couple specifications of dose compositing and planning. Thus, it is expected that a product might behave as both an *Advance RT Objects Plan Producer* and a *Compositing Planner*. The **Compositing Planner Actor** does the following: [Done, with slight mods, 11/7/2009]
  - a. Retrieve (Composite) Dose [RO-DC3], Spatial Registration [RO-13] objects
  - b. Compute new composite dose matrix using retrieved dose and internal (Plan) doses.
  - c. Store Composite Dose [RO-DC2]
8. What, if any, options should be specified for the actors? [None so far]

9. Discussion of Dose Compositing Actors Supplement at IHE-RO Technical Committee meeting 9/20/09: [Done, changes made as needed, 11/7/2009]
  - a. Check Transactions with respect to IHE-RO Profile v. 3.1
  - b. Require Dose Compositor and Compositing Planner to support multiple prior doses
  - c. Allow scaling (for RBE, delivered fractions, etc.) of (prior) doses
  - d. Need to define Dose Producer Actor (specifies requirements for dose accepted by other compositing actors)
10. Comments from IHE-RO Technical Committee meeting 1/27/2010
  - a. Should the Registered Dose Compositor be capable of receiving Composite Dose Instances. It currently can only receive Single Plan Dose Instances. [Yes]
  - b. Simple Dose Storage should be “Single Plan Dose Storage” in table X.1-1 [Done]
  - c. General Dose Retrieval should be used for RO-DC1 in all cases (all dose retrievals are General in this profile) [Done]
  - d. Only three new transactions. Reorder transactions to make numeric sense. [Done]
  - e. Discussion on the description of the Registered Dose Compositor Actor; prior and subsequent vs. primary and secondary FoR. Change to two or more General Dose Instances. [Done]
  - f. There was a discussion on the structure of the Spatial Registration Objects. Each SRO shall contain only two registration sequences. Multiple SROs can be used to achieve a registration. (Rewording done).
  - g. Changes to the Compositing Planner Actor to allow storage of a Single Plan Dose. [Done]
  - h. Registered and General Dose Viewer wording improvements. [Done]
  - i. Should the Compositing Planner be a Registered Compositing Planner? **YES** Is it required to support more than one input dose & SRO instance? **NO**
  - j. Two inputs for the Dose Compositor and one input for the Compositing Planner are sufficient.
  - k. Better description of actors, which produce transactions? How do we re-use in a reasonable way? → **Open Question**
  - l. Some figures have mismatched {}. [Corrected]

# Volume 1 – Integration Profiles

## Glossary

|  |
|--|
| Add the following terms to the Glossary: |
|--|

*<any glossary additions associated with the profile draft go here>*

## 2.1 Dependencies among Integration Profiles

|                                |
|--------------------------------|
| Add the following to Table 2-1 |
|--------------------------------|

|                          |     |     |     |
|--------------------------|-----|-----|-----|
| Dose Compositing Profile | <?> | <?> | <-> |
|--------------------------|-----|-----|-----|

|  |
|--|
| Add the following section to section 2.2 |
|--|

### 2.2.X Radiation Oncology Dose Compositing Integration Profile

This supplement defines the relevant standards and constraints on those standards needed to implement interoperable transfer of spatially-related dose information between systems for the purpose of combining or *compositing* radiation doses. In this context, the term *Dose Compositing* is used to denote the process of combining information from two or more spatially-related 3-D dose matrices for a patient, where the dose matrices are encoded as DICOM RT Dose instances. The spatial relationship between doses is defined by the rigid transformation encoded in a DICOM Spatial Registration object. (Affine and deformable registrations are not supported by this profile.) The process of combining two or more 3-D dose matrices may involve resampling of the dose array or scaling of dose values as needed to account for differing fractionation and radiation type.

|               |
|---------------|
| Add Section X |
|---------------|

## X. Radiation Oncology Dose Compositing Integration Profile

This supplement defines the relevant standards and constraints on those standards needed to implement interoperable transfer of spatially-related dose information between systems for the purpose of combining or *compositing* radiation doses. In this context, the term *Dose Compositing* is used to denote the process of combining information from two or more spatially-related 3-D dose matrices for a patient, where the dose matrices are encoded as DICOM RT Dose instances. The spatial relationship between doses is defined by the rigid transformation encoded in a DICOM Spatial Registration object. (Affine and deformable registrations are not supported by

this profile.) The process of combining two 3-D dose matrices may involve resampling, scaling, or transformations needed to account for differing fractionation and radiation type.

Two distinct Use Cases are supported by this profile. Both involve accepting dose matrices, each defined in its own frame of reference, as well as Spatial Registration object(s) relating those frames of reference to a “destination” frame of reference. In the first Use Case, the **Registered Dose Compositor Actor** combines two or more, spatially-related dose instances to produce an output dose instance in the destination frame of reference. In the second Use Case, the **Registered Compositing Planner Actor** uses one or more dose instances as the basis (“prior dose”) for creating a new treatment plan and dose instances. Dose objects accepted by the **Registered Dose Compositor** and **Registered Compositing Planner Actors** are those stored by the **Single Plan Dose Producer**, **Registered Dose Compositor**, or **Registered Compositing Planner** actors.

In addition, the profile defines two dose viewer actors to permit display of single plan or composite doses without requiring an accompanying plan instance. The **General Dose Viewer Actor** retrieves and displays Modality Image(s), RT Structure Set, and a General Dose. It requires that dose, images, and structure set share the same frame of reference. The **Registered General Dose Viewer Actor** retrieves Modality Image(s), Registered RT Structure Set, General Dose, and Spatial Registration. It displays doses registered to the image/structure set frame of reference.

## X.1 Actors/ Transactions

The Dose Compositing Profile defines five new Actors: a **Registered Dose Compositor Actor**, a **Registered Compositing Planner Actor**, a **Single Plan Dose Producer Actor**, a **General Dose Viewer Actor**, and a **Registered General Dose Viewer Actor**. All transactions are between these actors and an **Archive Actor**. Three new transactions are defined in this profile: General Dose Retrieval [RO-DC1], Composite Dose Storage [RO-DC2], and Single Plan Dose Storage [RO-DC3].

The **Registered Dose Compositor Actor** retrieves two or more General Dose instances [RO-DC1], as well as spatial registration instances representing the spatial relationship between each of the dose instances from an **Archive** [RO-13]. It combines the spatially-registered doses to produce a new dose instance that represents the composite dose and stores this new instance [RO-DC2] to the **Archive**. [The **Registered Dose Compositor Actor** must accept be able to accept two General Dose instances. It may accept more, but is not required to do so.]

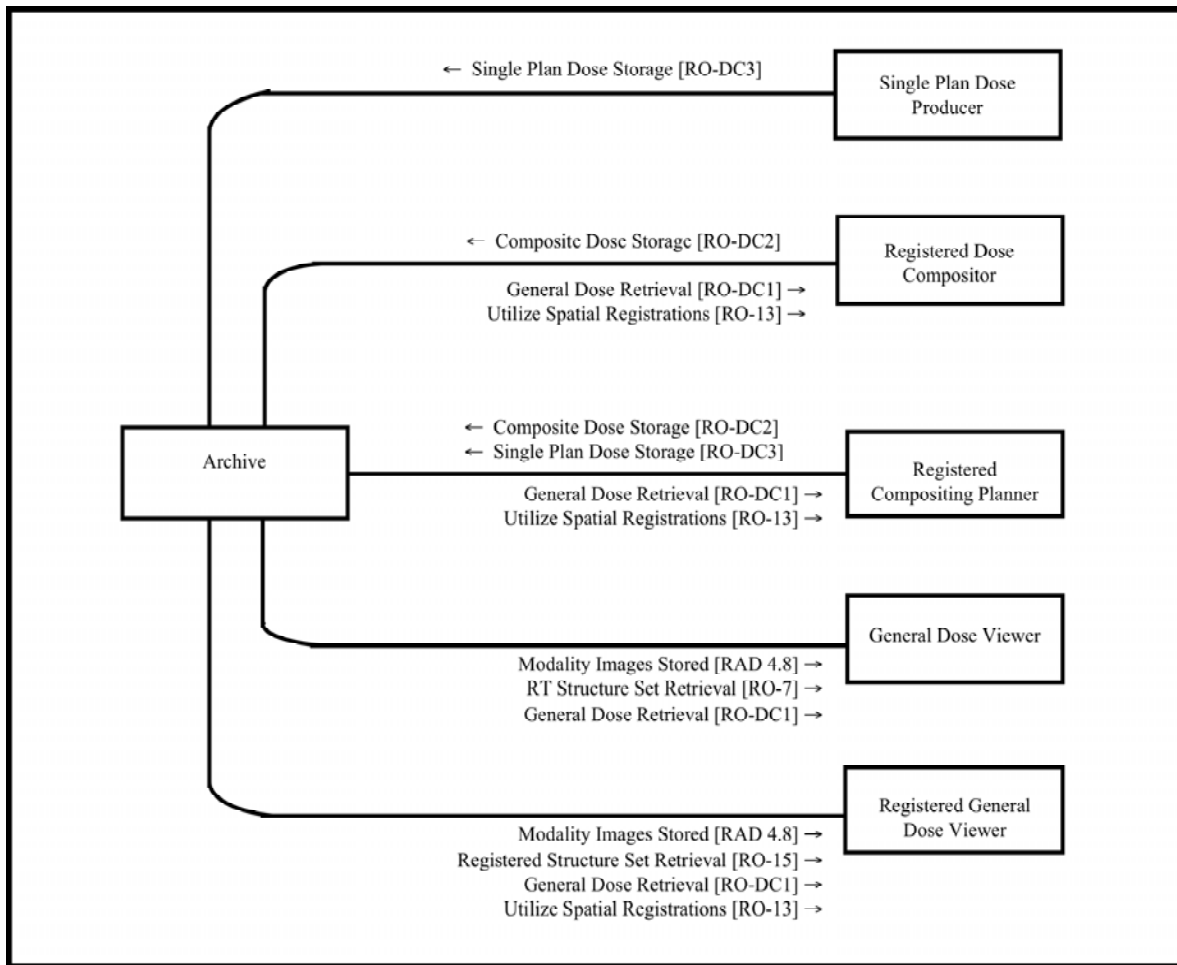
The **Registered Compositing Planner Actor** retrieves one or more General Dose [RO-DC1] and Spatial Registration [RO-13] object pair(s), computes a new composite dose matrix using retrieved dose and an internal (plan) dose, and stores Composite Dose [RO-DC2]. The **Registered Compositing Planner Actor** may also store a Single Plan Dose [RO-DC3]. Details regarding the retrieval and storage of data objects used to create the internal dose is out of band

for this profile. (The **Registered Compositing Planner Actor** must be able to accept one General Dose instance. It may accept more, but is not required to do so.)

The **General Dose Viewer Actor** is an extension of the **Dose Display Actor**. This actor retrieves Modality Images [RAD 4.8], an RT Structure Set [RO-7], and a General Dose instance [RO-DC1]. It presents a display of images, structures, and dose. It requires that the images, structure set, and dose it displays share a common frame of reference.

The **Registered General Dose Viewer Actor** retrieves Modality Images [RAD 4.8], a Registered Structure Set [RO-15], a General Dose instance [RO-DC1], and spatial registration instance(s) [RO-13] relating the dose to the frame(s) of reference of the image series. It presents a registered display of images, structures, and dose.

The **Single Plan Dose Producer Actor** creates and stores Single Plan Dose instances [RO-DC3] in an **Archive**. Details regarding the process used to create this dose matrix are out of band for this profile. This actor is included to specify the requirements for Single Plan Dose instances used by the **Registered Dose Compositor** and **Registered Compositing Planner Actors**.



**Figure X.1-1. Radiation Oncology Dose Compositing Profile Actor/Transaction Diagram**

Figure X.1-1 shows the actors directly involved in the Dose Compositing Integration Profile and the relevant transactions between them. Other actors that may be indirectly involved due to their participation in the Basic RT Objects Interoperability Profile and Multi-modality Registration for Radiation Oncology Profile, etc. are not shown.

Table X.1-1 lists the transactions for each actor directly involved in the Dose Compositing Profile. In order to claim support of this Integration Profile, an implementation must perform the required transactions (labeled “R”). Transactions labeled “O” are optional. A complete list of options defined by this Integration Profile and that implementations may choose to support is listed in Volume I, Section X.2. There are no options in this profile.

**Table X.1-1. Dose Compositing Integration Profile - Actors and Transactions**

| Actors                         | Transactions                               | Optionality | Section in Vol. 2 |
|--------------------------------|--|-------------|-------------------|
| Registered Dose Compositor     | Utilize Spatial Registrations [RO-13]      | R           | 3.13              |
|                                | General Dose Retrieval [RO-DC1]            | R           | 3.X               |
|                                | Composite Dose Storage [RO-DC2]            | R           | 3.Y               |
| Registered Compositing Planner | General Dose Retrieval [RO-DC1]            | R           | 3.X               |
|                                | Utilize Spatial Registrations [RO-13]      | R           | 3.13              |
|                                | Single Plan Dose Storage [RO-DC3]          | R           | 3.Z               |
|                                | Composite Dose Storage [RO-DC2]            | R           | 3.Y               |
| General Dose Viewer            | Modality Images Stored [RAD 4.8]           | R           |                   |
|                                | RT Structure Set Retrieval [RO-7]          | R           | 3.7               |
|                                | General Dose Retrieval [RO-DC1]            | R           | 3.X               |
| Registered General Dose Viewer | Modality Images Stored [RAD 4.8]           | R           |                   |
|                                | Registered Structure Set Retrieval [RO-15] | R           | 3.15              |
|                                | General Dose Retrieval [RO-DC1]            | R           | 3.X               |
|                                | Utilize Spatial Registrations [RO-13]      | R           | 3.13              |
| Single Plan Dose Producer      | Single Plan Dose Storage [RO-DC3]          | R           | 3.Z               |
| Archive                        | Structure Set Retrieval [RO-7]             | R           | 3.7               |
|                                | Registered Structure Set Retrieval [RO-15] | R           | 3.15              |
|                                | Modality Images Stored [RAD 4.8]           | R           |                   |
|                                | Utilize Spatial Registrations [RO-13]      | R           | 3.13              |
|                                | Single Plan Dose Storage [RO-DC3]          | R           | 3.Z               |
|                                | General Dose Retrieval [RO-DC1]            | R           | 3.X               |
|                                | Composite Dose Storage [RO-DC2]            | R           | 3.Y               |

## X.2 Radiation Oncology Dose Compositing Integration Profile Options

Options that may be selected for this Integration Profile are listed in the table X.2-1 along with the Actors to which they apply. Dependencies between options when applicable are specified in notes.

**Table X.2-1 Dose Compositing Integration Profile - Actors and Options**

| Actor | Options | Vol & Section |
|-------|---------|---------------|
|-------|---------|---------------|

| Actor                            | Options                   | Vol & Section |
|----------------------------------|---------------------------|---------------|
| Registered Dose Compositor       | <i>No options defined</i> | - -           |
| Registered Compositing Planner   | <i>No options defined</i> | - -           |
| Composite Dose Viewer            | <i>No options defined</i> | - -           |
| Registered Composite Dose Viewer | <i>No options defined</i> | - -           |
| Single Plan Dose Producer        | <i>No options defined</i> | - -           |
| Archive                          | <i>No options defined</i> | - -           |

### X.3 Radiation Oncology Dose Compositing Process Flow

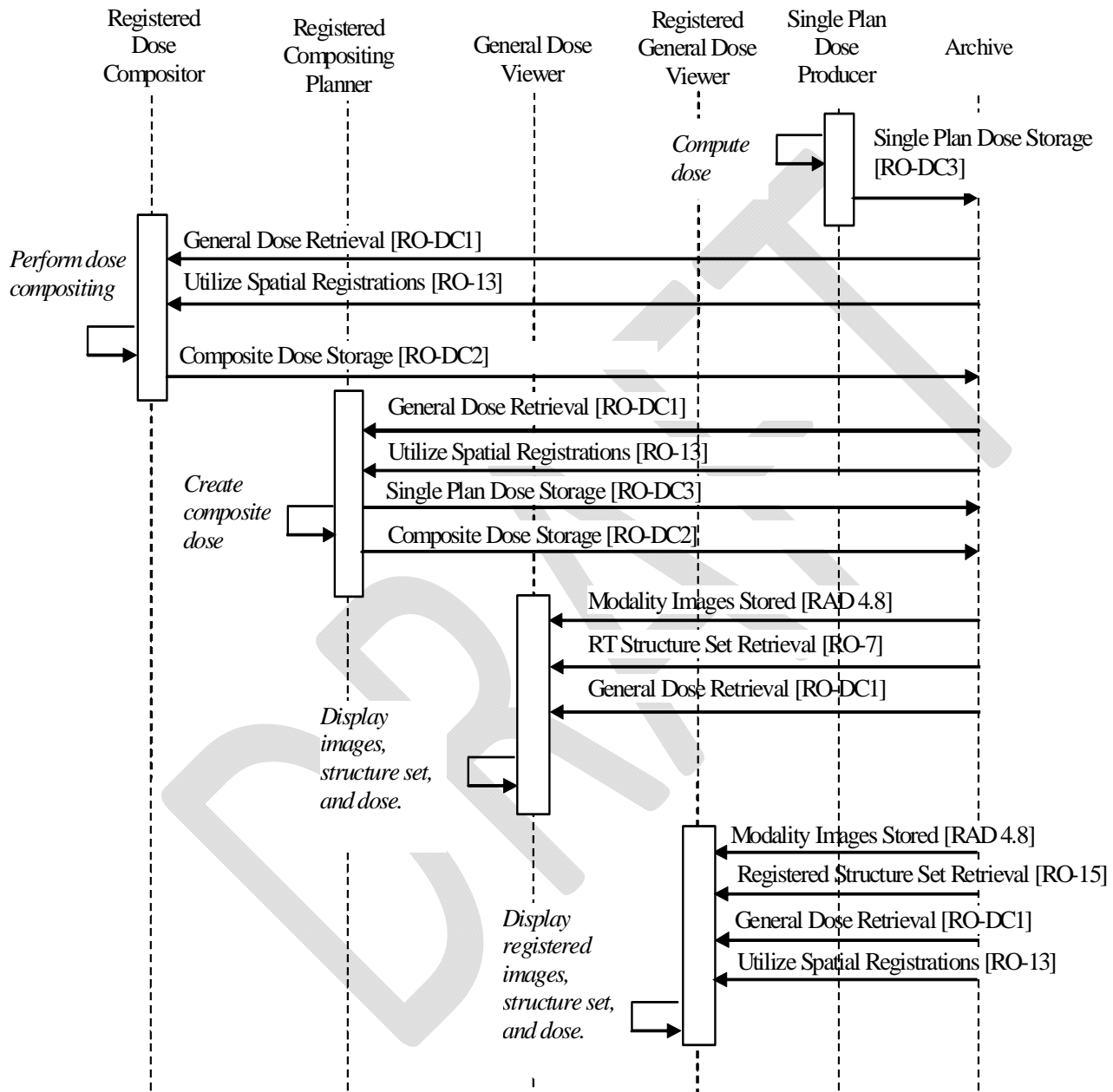


Figure X.3-1. Basic Process Flow in Radiation Oncology Dose Compositing Profile

## **X.4 Radiation Oncology Dose Compositing Security Considerations**

*<Description of the Profile specific security considerations. This should include the outcomes of a risk assessment. This likely will include profile groupings, and residual risks that need to be assigned to the product design, system administration, or policy.>*

DRAFT

## Volume 2 - Transactions

Add sections 3.X – 3.Z

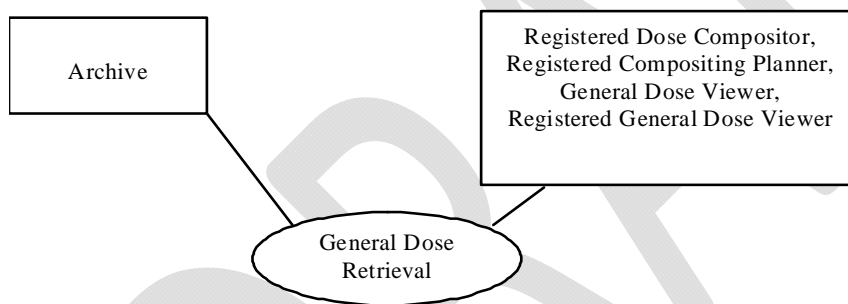
### 3.X General Dose Retrieval [RO-DC1]

This section corresponds to Transaction RO-DC1 of the IHE Technical Framework. Transaction RO-DC1 is used by the ***Registered Dose Compositor, Registered Compositing Planner, General Dose Viewer, Registered General Dose Viewer, and Archive*** actors.

#### 3.X.1 Scope

In the General Dose Retrieval Transaction, the ***Archive*** stores an RT Dose instance on the relevant actor to make it available for use in dose compositing and viewing.

#### 3.X.2 Use Case Roles



**Actor:** *Archive*

**Role:** Sends RT Dose instance to the ***Registered Dose Compositor, Registered General Dose Viewer, General Dose Viewer or Registered Compositing Planner***

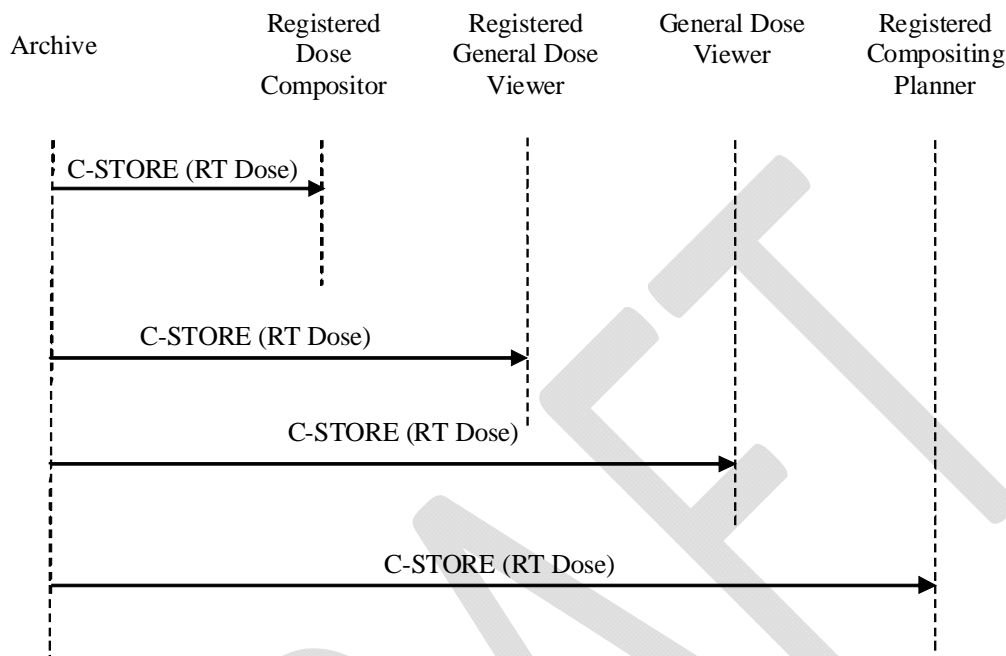
**Actor:** ***Registered Dose Compositor, Registered Compositing Planner, General Dose Viewer, Registered Dose Viewer***

**Role:** Stores RT Dose instance received from the ***Archive***

#### 3.X.3 Referenced Standard

DICOM 2008 PS3.4: Storage Service Class.

### 3.X.4 Interaction Diagram



#### 3.X.4.1 General Dose Retrieval

##### 3.X.4.1.1 Trigger Events

The user of the *Registered Dose Compositor*, *Registered General Dose Viewer*, *General Dose Viewer* or *Registered Compositing Planner* determines that a General Dose instance is needed for computing a composite dose or dose viewing.

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

##### 3.X.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 *Registered Dose Compositor*, *Registered General Dose Viewer*, *General Dose Viewer* or *Registered Compositing Planner* is the SCP of this service class.

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

Not supported are point doses, projection of dose onto an oblique plane, iso-dose contours and dose-volume histograms. The Dose Summation Type (3004,000A) shall be PLAN or MULTI\_PLAN. The Dose Type (3004,0004) shall be either PHYSICAL or EFFECTIVE. 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.

**Table X-1 Expected Attributes for RT Dose Module**

| Attribute                       | Tag         | Type | Attribute Description   |
|---------------------------------|-------------|------|---|
| Dose Units                      | (3004,0002) | R+   | Shall be GY   |
| Dose Type                       | (3004,0004) | R+   | Shall be either PHYSICAL or EFFECTIVE.  |
| Dose Summation Type             | (3004,000A) | R+   | Shall be PLAN or MULTI_PLAN   |
| Pixel Representation            | (0016,0103) | R+   | Shall be 0.   |
| Referenced RT Plan Sequence     | (300C,0002) | R+   | Must reference the RT Plan or RT Ion Plan instance(s) associated with composited doses. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence must be a Dosimetric Plan. |
| Tissue Heterogeneity Correction | (3004,0014) | R+   | Shall be present. Multi-valued attribute has items representing tissue heterogeneity correction techniques corresponding to contributing entries in the Referenced RT Plan Sequence.                                  |

#### 3.X.4.1.3 Expected Actions

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

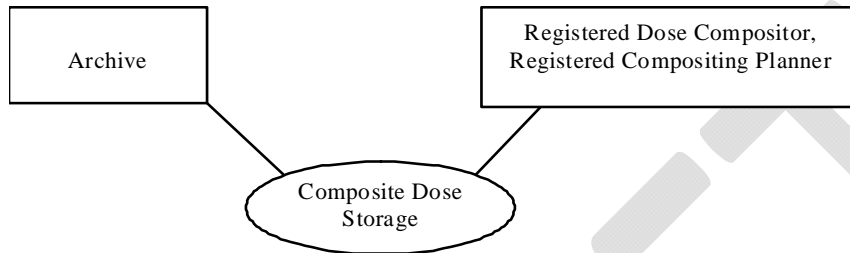
### 3.Y Composite Dose Storage [RO-DC2]

This section corresponds to Transaction RO-DC2 of the IHE Technical Framework. Transaction RO-DC2 is used by the **Registered Dose Compositor**, **Registered Compositing Planner** and **Archive** actors.

### 3.Y.1 Scope

In the Composite Dose Storage Transaction, the **Registered Dose Compositor** and **Registered Compositing Planner** actors store an RT Dose instance on an **Archive** to make it available.

### 3.Y.2 Use Case Roles



**Actor:** *Registered Dose Compositor, Registered Compositing Planner*

**Role:** Transmit RT Dose instance to *Archive*

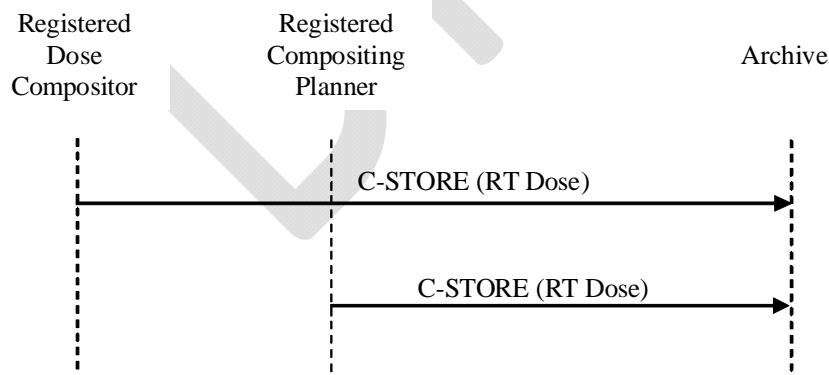
**Actor:** Archive

**Role:** Receives and stores RT Dose instance from *Registered Dose Compositor, Registered Compositing Planner*

### 3.Y.3 Referenced Standard

DICOM 2008 PS 3.4: Storage Service Class

### 3.Y.4 Interaction Diagram



### 3.Y.4.1 Composite Dose Storage

#### 3.Y.4.1.1 Trigger Events

The user of the *Registered Dose Compositor* or *Registered Compositing Planner* requests that a composite dose be stored.

#### 3.Y.4.1.2 Message Semantics

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

The composite dose to be stored must be represented as a multi-frame grid-based RT Dose instance. Dose Summation Type (3004,000A) must be MULTI\_PLAN and entries of the Referenced RT Plan Sequence (300C,0002) must reference the RT Plan or RT Ion Plan instance(s) associated with the doses used to compute the composite dose. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence must be a Dosimetric Plan (for legacy Dose Viewers).

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

Not supported are point doses, projection of dose onto an oblique plane, iso-dose contours and dose-volume histograms. The Dose Summation Type (3004,000A) shall be MULTI\_PLAN. The value of Dose Units (3004,0002) shall be GY. The value of Pixel Representation (0016,0103) shall be 0; negative dose values shall not be present.

The following table shows the IHE extension of the DICOM requirements for the RT Dose Module.

**Table 0-1 Required Attributes for RT Dose Module**

| Attribute            | Tag         | Type | Attribute Description  |
|----------------------|-------------|------|--|
| Dose Units           | (3004,0002) | R+   | Shall be GY  |
| Pixel Representation | (0016,0103) | R+   | Shall be 0.  |
| Dose Type            | (3004,0004) | R+   | If <i>any</i> contributing dose has Dose Type = EFFECTIVE, the composite dose must have Dose |

|                                 |             |    |   |
|---------------------------------|-------------|----|---|
|                                 |             |    | Type = EFFECTIVE  |
| Dose Summation Type             | (3004,000A) | R+ | Must be MULTI_PLAN (see DICOM CP 938)   |
| Referenced RT Plan Sequence     | (300C,0002) | R+ | Must reference the RT Plan or RT Ion Plan instance(s) associated with composited doses. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence must be a Dosimetric Plan. |
| Tissue Heterogeneity Correction | (3004,0014) | R+ | Shall be present. Multi-valued attribute has items representing tissue heterogeneity correction techniques corresponding to contributing entries in the Referenced RT Plan Sequence.                                  |

### 3.Y.4.1.3 Expected Actions

Upon receipt of the Composite Dose, the Archive shall store it. This Composite Dose is then available for subsequent retrieval (RO-DC1).

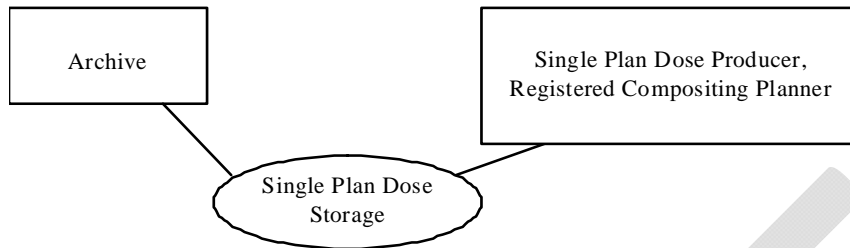
## 3.Z Single Plan Dose Storage [RO-DC3]

This section corresponds to Transaction RO-DC3 of the IHE Technical Framework. Transaction RO-DC3 is used by the *Single Plan Dose Producer*, *Registered Compositing Planner*, and *Archive* actors.

### 3.Z.1 Scope

In the Single Plan Dose Storage Transaction, the relevant actor stores an RT Dose instance on an Archive to make it available.

### 3.Z.2 Use Case Roles



**Actor: *Single Plan Dose Producer***

**Role:** Transmit RT Dose instance to Archive

**Actor: *Registered Compositing Planner***

**Role:** Transmit RT Dose instance to Archive

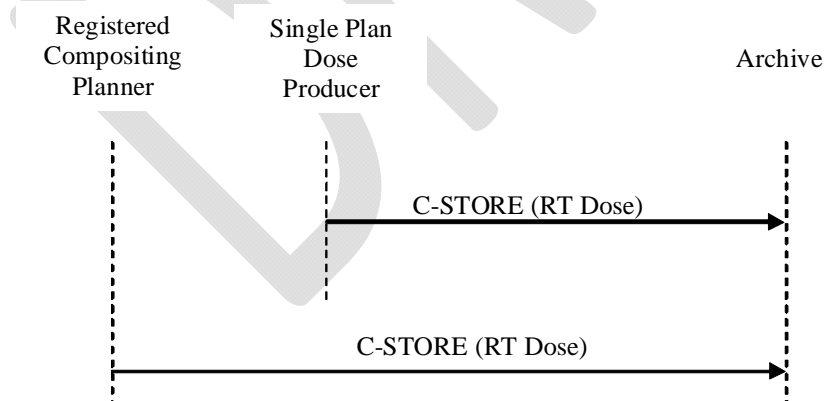
**Actor: *Archive***

**Role:** Receives and stores RT Dose instance from *Single Plan Dose Producer and Registered Compositing Planner*

### 3.Z.3 Referenced Standard

DICOM 2008 PS 3.4: Storage Service Class

### 3.Z.4 Interaction Diagram



### 3.Z.4.1 Single Plan Dose Storage

#### 3.Z.4.1.1 Trigger Events

The user of the *Single Plan Dose Producer* or a *Registered Compositing Planner* requests that a Single Plan dose instance be stored.

#### 3.Z.4.1.2 Message Semantics

The message semantics are defined by the DICOM Storage SOP Class. The *Single Plan Dose Producer* or the *Registered Compositing Planner* is the storage SCU and the *Archive* is the storage SCP.

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

Not supported are point doses, projection of dose onto an oblique plane, iso-dose contours and dose-volume histograms. The Dose Summation Type (3004,000A) shall be PLAN. The Dose Type (3004,0004) shall be either PHYSICAL or EFFECTIVE. The value of Dose Units (3004,0002) shall be GY. The value of Pixel Representation (0016,0103) shall be 0; negative dose values shall not be present.

The following table shows the IHE extension of the DICOM requirements for the RT Dose Module.

**Table W-1 Required Attributes for RT Dose Module**

| Attribute                   | Tag         | Type | Attribute Description  |
|-----------------------------|-------------|------|--|
| Dose Units                  | (3004,0002) | R+   | Shall be GY  |
| Dose Type                   | (3004,0004) | R+   | Shall be either PHYSICAL or EFFECTIVE.   |
| Dose Summation Type         | (3004,000A) | R+   | Shall be PLAN  |
| Pixel Representation        | (0016,0103) | R+   | Shall be 0.  |
| Referenced RT Plan Sequence | (300C,0002) | R+   | Must reference the RT Plan or RT Ion Plan instance(s) associated with composited doses. If any of the summed plans is a Dosimetric Plan, the first item in the Referenced RT Plan Sequence |

|                                 |             |    |  |
|---------------------------------|-------------|----|--|
|                                 |             |    | must be a Dosimetric Plan.   |
| Tissue Heterogeneity Correction | (3004,0014) | R+ | Shall be present. Multi-valued attribute has items representing tissue heterogeneity correction techniques corresponding to contributing entries in the Referenced RT Plan Sequence. |

#### 3.Z.4.1.3 Expected Actions

Upon receipt of the Single Plan Dose instance, the **Archive** shall store it. This Single Plan Dose instance is then available for subsequent retrieval (RO-DC1).

#### <Appendix letter> Appendix\_Name

*<Detailed cross transaction relationships or mapping details are described in an appendix in Volume 2>*