



**4D Integrated  
Treatment Console**

DICOM Conformance Statement



P/N 100016768-04

MAY 2010

|  |  |   |
|--|--|---|
| <b>Abstract</b>  | The 4D Integrated Treatment Console Version 10.0, DICOM Conformance Statement (P/N 100016768-03).  |   |
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## Document History

| <b>Version:</b> | <b>Date:</b>                | <b>Changes, Remarks</b>  |
|-----------------|-----------------------------|--|
| 10.0            | March 24 <sup>th</sup> 2010 | Updated for 4DITC 10 Releases.   |
| 8.8             | Mar 30, 2009                | Updated for 4DITC 8.8 Release. Changes due to support for DICOM standard 2007 & QA mode. |
| 6.5.06          | July 2, 2004                | Changed Treatment 6.5 with 4D Treatment Console 6.5/7.x                                  |
| 6.5.00          | Feb. 5, 2003                | Initial version  |

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# 1. Introduction

## 1.1 Purpose

The definition of the DICOM standard for radiotherapy data started in 1994 and has now reached a productive state. Today, DICOM is the primary choice for exchanging data with an open standard protocol for the majority of vendors and institutions. Varian Medical Systems is committed to this notion and supports the full range of radiotherapy objects (e.g. RT Plan, RT Image, RT Beams Treatment Record) for their V & R system.

This conformance statement specifies the conformance of the 4D Integrated Treatment Console version 10.0 with the DICOM V 3.0 standard.

## 1.2 Scope

The scope and format of this document from section 2 onwards are defined by Part 2 of the DICOM V3.0 standard. Some sections defined in the standard that are not applicable to the software are left out for clarity.

This Conformance Statement is applicable for 4D Console version 10.0.

The general DICOM conformance statement for Varian Medical Systems products is defined in [2] (see section 1.5). The 4D Treatment Console 8.8 Conformance Statement describes only the specials and the variations as implemented in the 4D Console version 10.0.

## 1.3 Intended Audience

- Marketing and Sales.
- System Integrators of medical equipment.
- Other vendors interfacing via DICOM

## 1.4 Definitions

This section provides the definitions of terms, acronyms, and abbreviations, which are used throughout the document.

|                   |   |
|-------------------|---|
| AE                | Application Entity  |
| DICOM             | Digital Imaging and Communications in Medicine            |
| IOD               | Information Object Definition                             |
| NEMA              | National Electrical Manufacturers Association             |
| SCU               | Service Class User  |
| SCP               | Service Class Provider                                    |
| SOP               | Service Object Pair                                       |
| TCP/IP            | Transmission Control Protocol / Internet Protocol         |
| VR                | Value Representation                                      |
| Multi-Frame Image | Image that contains multiple two-dimensional pixel planes |
| UID               | Unique Identifier   |
| 4DITC             | 4D Integrated Treatment Console 7                         |
| Management System | DICOM entity from which 4DITC retrieves patient data      |

## 1.5 Related Documents

- [1] Digital Imaging and Communications in Medicine (DICOM), Parts 1-14 (2007), National Electrical Manufacturers Association (NEMA)  
Rosslyn, VA  
United States of America
- [2] Vision Release 6.5, DICOM Conformance Statement' (P/N VA7202D3CS)  
Varian Medical Systems International AG  
Baden, Switzerland
- [3] ARIA Release 8.2, DICOM Conformance Statement' (P/N VA8203D3CS)  
Varian Medical Systems International AG  
Baden, Switzerland

## 2. Implementation Model

### 2.1 Application Data Flow Diagram

Three diagrams illustrating the application model, two for the SCU and one for the SCP role, are shown in Figure 1, Figure 2, and Figure 3.

The initial function to load the plan into the 4DC application is represented by *Load RT Plan* (This function is typically performed by the application after the Patient and the Plan UIDs have been received by the Management System). 4DITC invokes a move command for each DICOM RT Plan. This requires the 4DITC application to provide the RT Plan Storage SCP. Figure 2 shows the Service Class Providers (SCP) role supported by 4DITC. 4DITC then issues a move command to request and retrieve the RT Treatment Summary Record. Based on the last fraction state, a find command is executed to request the *Load Beam Record Information* (shown in Figure 1) to recover from a partial treatment.

A *Save* issued by the operator will invoke a storage command, which requires the remote application to provide a storage SCP as shown in Figure 3.

Closing the patient in 4DITC will result in a *Save* if the plan data has been modified and/or treatment records and images have been created. 4DITC will delete the objects temporarily stored. In case the Management System is not accessible, 4DITC will save the changes into one or several DICOM Media File(s).

### 2.1.1 Application Data Flow Diagram

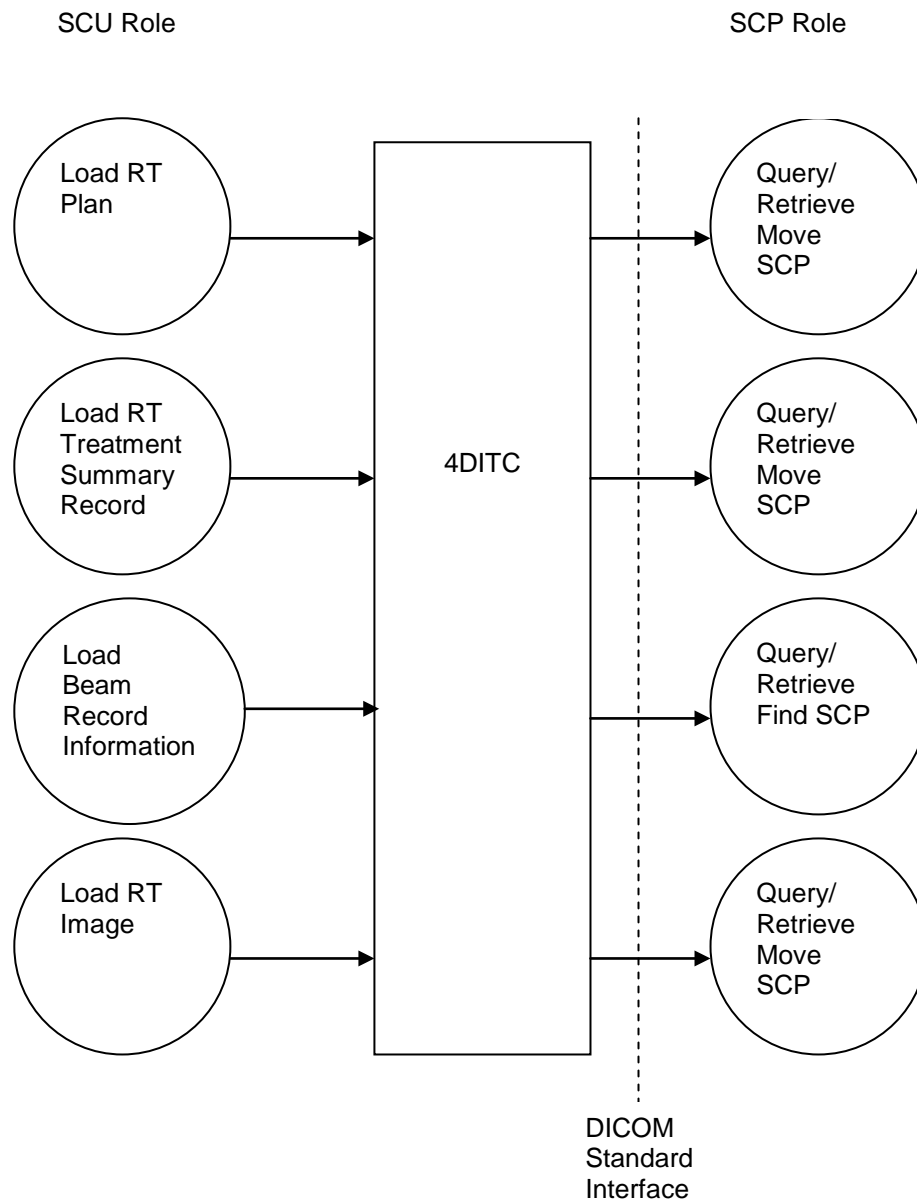
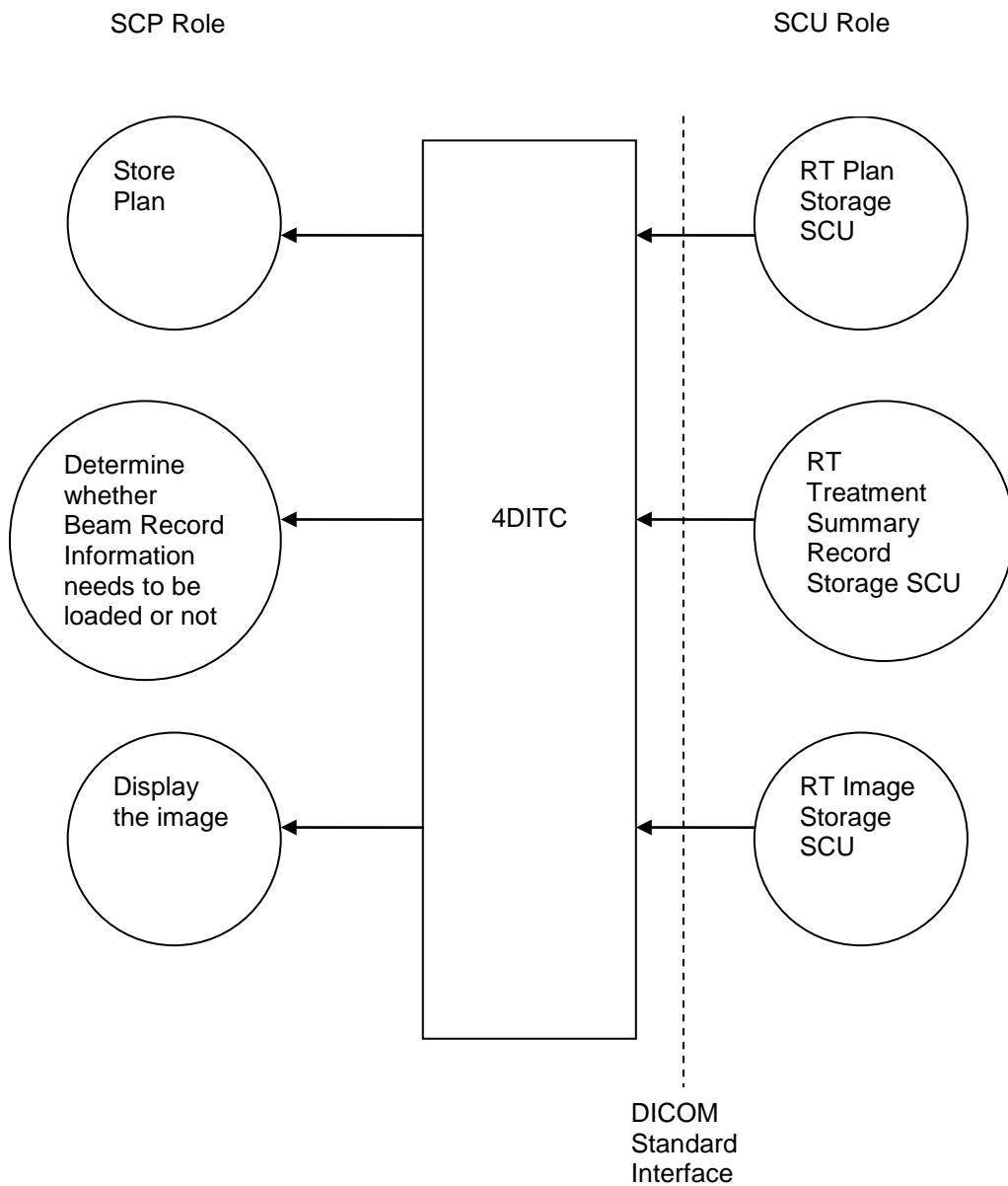
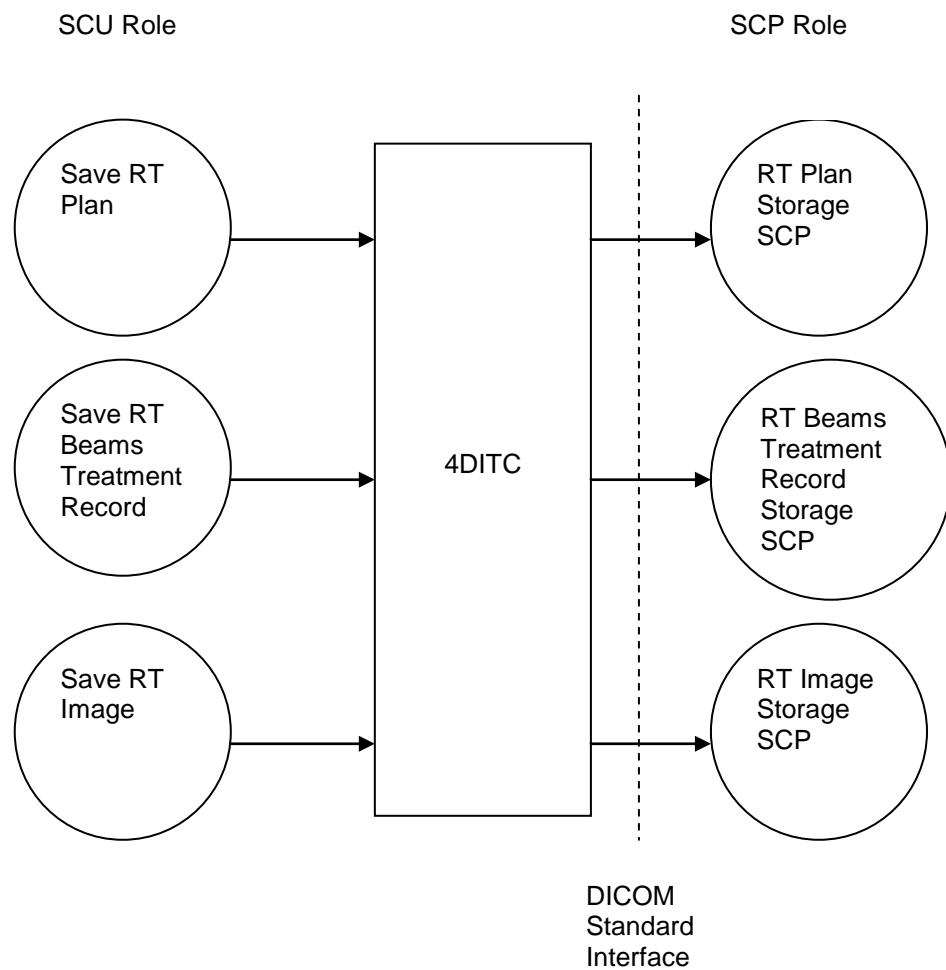


Figure 1: SCU Role Application Data Flow Diagram for loading patient data



**Figure 2: SCP Role Application Data Flow Diagram for loading patient data**



**Figure 3: SCU Role Application Data Flow Diagram for saving patient data**

## 2.2 Functional Definition of AE's

The 4DITC Entity's main responsibility is to execute a patient treatment. Before treating, 4DITC loads the patient data from the Management System using DICOM services. After treating, 4DITC generates RT Beams Treatment Record(s) and RT Image(s). 4DITC then stores them back to the Management System again using DICOM services.

4DITC is also capable of modifying RT Plan(s) and/or creating new RT Plan(s).

## 2.3 Sequencing of Real-World Activities

4DITC executes the activities for loading a patient in the following order.

- C-Find RT Plan SOP class (see section 3.1.2.2.3.2)
- C-Move RT Plan SOP class
- C-Move RT Treatment Summary Record SOP class

- C-Find RT Beams Treatment Record SOP class if needed (NOTE: The C-Find RT Beams Treatment Record query is only executed in order to finalize the previous treated fraction)
- C-Move RT Image SOP class (for Reference Image(s) if referred in the RT Plan)
- C-Find RT Image SOP class (for query Portal Image(s))
- C-Move RT Image SOP class (for Portal Image(s) if query returned Portal Image Instance UID(s))

The only requirement is to load the RT Plan first before the others. This sequence may be performed for more than 1 plan at the beginning of a treatment session.

The following sequence is for saving the patient to 4DITC:

- C-Storage RT Plan SOP class (executed if a plan changed in 4DITC)
- C-Storage RT Beams Treatment Record SOP class (executed if a beam got treated)
- C-Storage RT Image SOP class (executed if a Portal Image got acquired)

The only requirement is to save RT Plan(s) first before the RT Beam Record(s) and RT Image(s). This is because the RT Beams Treatment Record and/or RT Image may refer to the new RT Plan.

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### 3. AE Specifications

#### 3.1 4DITC Entity Specification

The 4DITC Entity provides standard conformance to the following DICOM V3.0 SOP classes:

| SOP Class Name                                    | SCU/SCP Role | SOP Class UID                 |
|---|--------------|-------------------------------|
| Verification (Echo)                               | SCU / SCP    | 1.2.840.10008.1.1             |
| RT Image Storage                                  | SCU / SCP    | 1.2.840.10008.5.1.4.1.1.481.1 |
| RT Plan Storage                                   | SCU / SCP    | 1.2.840.10008.5.1.4.1.1.481.5 |
| RT Treatment Summary Record Storage               | SCP          | 1.2.840.10008.5.1.4.1.1.481.7 |
| Study Root Query/Retrieve information model- FIND | SCU          | 1.2.840.10008.5.1.4.1.2.2.1   |
| Study Root Query/Retrieve information model- MOVE | SCU          | 1.2.840.10008.5.1.4.1.2.2.2   |
| RT Beams Treatment Record Storage                 | SCU          | 1.2.840.10008.5.1.4.1.1.481.4 |

**Table 1: Supported SCU/SCP SOP Classes for 4DITC Entity**

#### 3.1.1 Association Establishment Policies

##### 3.1.1.1 General

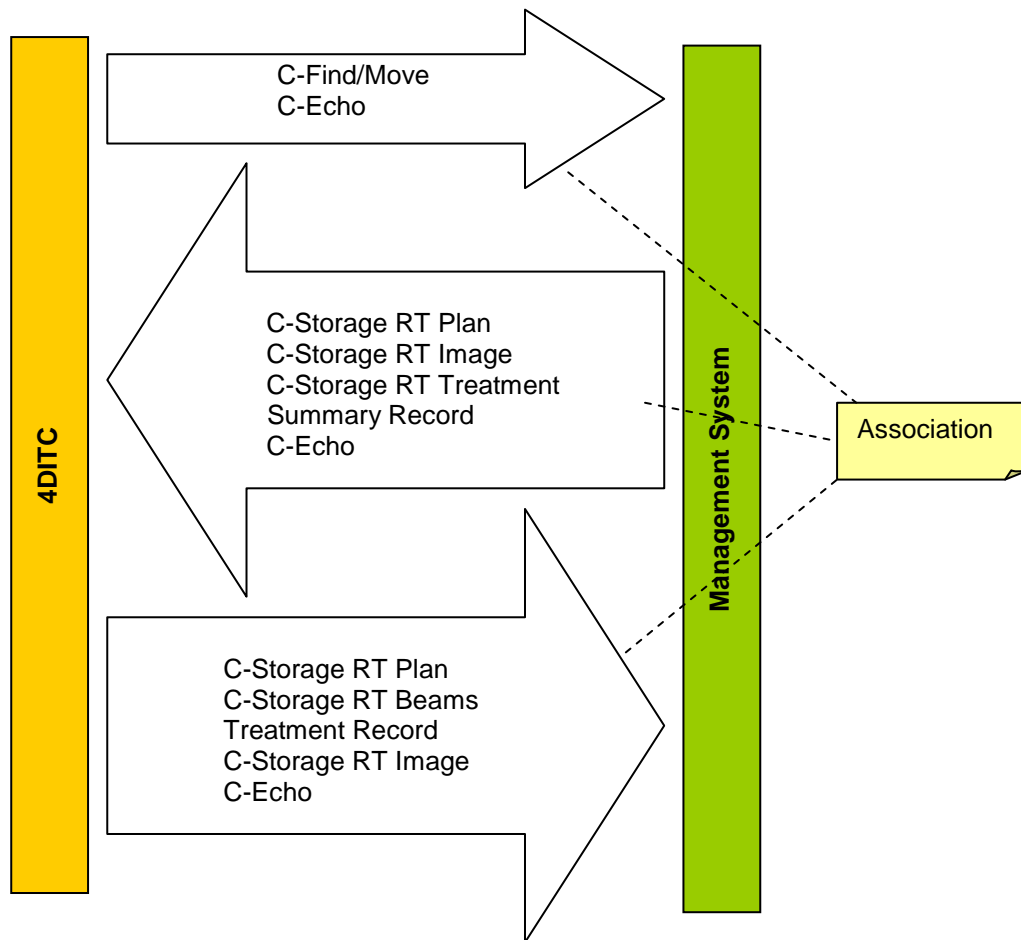
See details in Related Documents [2].

There are a total of three associations. 4DITC establishes two associations while the Management System establishes one association. The first association established by 4DITC is to support the C-Move and C-Find services. The second association established by 4DITC is to support the C-Storage service. The association established by the Management System is for storing patient data to 4DITC.

All of the association supports the C-Echo service to determine whether the association is still alive or not.

A diagram of the associations is in Figure 4.

4DITC accepts any maximum PDU size for incoming data streams and suggests the size of 65536 for outgoing data streams.



**Figure 4: Associations used for 4DITC**

**3.1.1.2 Number of Associations**

4DITC supports a total of three associations as shown in Figure 4. 4DITC supports having one association for each batch of services at a time (Note: A batch of services refers to the list of services contained in an arrow in Figure 4).

**3.1.1.3 Asynchronous Nature**

Asynchronous operation is not supported.

**3.1.1.4 Implementation identifying information**

| UID Value             | UID Name  | Notes |
|-----------------------|---|-------|
| 1.2.246.352.70.2.1.9  | VMS Console System 6.5 SCU<br>(VMS Console Interface 1) |       |
| 1.2.246.352.70.2.1.10 | VMS Console System 6.5 SCP                              |       |

|                           |                                       |                          |
|---------------------------|---------------------------------------|--------------------------|
| 1.2.246.352.70.2.1.17     | VMS Console Interface 3               | 4DITC 8.8                |
| 1.2.246.352.70.2.1.18     | VMS Console System 8.8 SCP            | Treatment Daemon 8.8     |
| 1.2.246.352.70.2.1.19     | VMS Console Interface 3 QA Mode       | 4DITC 8.8 (for QA Mode)  |
| 1.2.246.352.70.2.1.20     | VMS Console System 8.8 QA Mode SCP    | Treatment Daemon 8.8     |
| 1.2.246.352.70.2.1.81.4.1 | VMS Console Interface 4               | 4DITC 10                 |
| 1.2.246.352.70.2.1.82.4.1 | VMS Treatment Daemon 10.0 SCP         | Treatment Daemon 10.0    |
| 1.2.246.352.70.2.1.81.4.2 | VMS Console Interface 4 QA Mode       | 4DITC 10.0 (for QA Mode) |
| 1.2.246.352.70.2.1.82.4.2 | VMS Treatment Daemon 10.0 QA Mode SCP | Treatment Daemon 10.0    |

### 3.1.2 Association Initiation Policy

The 4DITC Entity will initiate one association for all Query/Retrieve Services (Q/R SCU) that contains the C-Find and the C-Move service. When the user starts up 4DITC and clicks on “Open Patient”, 4DITC initiates an association for all Query/Retrieve Services for the first time. All subsequent actions of clicking “Open Patient” no longer require initiating this association since it will use the existing association.

The 4DITC Entity will initiate one association for all Storage Services where it acts as a user (Storage SCU). When the user clicks on “Save Images” or “Close Patient”, 4DITC checks if an association already exists for all Storage Services. If an association does not exist for all Storage Services, 4DITC initiates an association for all Storage Services. Otherwise, 4DITC uses the existing association.

The Management System will initiate one association for all C-Storage services used for sending all patient data. In this association, 4DITC acts as a provider (Storage SCP).

For performance reasons, 4DITC maintains its associations until one of the following occurs:

- 1) 4DITC is terminated (this results with all associations being terminated)
- or
- 2) The Echo/Verification service fails (this results with the Echo/Verification’s corresponding association to be terminated)

#### 3.1.2.1 Storage SCU

##### 3.1.2.1.1 Associated Real-World Activity

The C-Storage service is used by 4DITC to store patient data into the Management System. This service gets executed whenever the operator selects ‘Close Patient’ or ‘Save Image’.

##### 3.1.2.1.2 Presentation Context Table

| Presentation Context Table        |                               |                                 |                   |      |                      |
|-----------------------------------|-------------------------------|---------------------------------|-------------------|------|----------------------|
| Abstract Syntax                   |                               | Transfer Syntax                 |                   | Role | Extended Negotiation |
| Name                              | UID                           | Name                            | UID               |      |                      |
| RT Plan Storage                   | 1.2.840.10008.5.1.4.1.1.481.5 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU  | None                 |
| RT Beams Treatment Record Storage | 1.2.840.10008.5.1.4.1.1.481.4 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU  | None                 |
| RT Image Storage                  | 1.2.840.10008.5.1.4.1.1.481.1 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU  | None                 |

**Table 2: Proposed Presentation Contexts for Storage SCU**

### 3.1.2.1.3 SOP Specific Conformance

#### 3.1.2.1.3.1 SOP specific conformance for all Storage SOP classes

After a successful C-STORE operation, 4DITC does not display any information to the user but returns to its normal state. If the C-STORE operation results with a warning or an error, 4DITC displays the appropriate warning or error message to the operator.

#### 3.1.2.1.3.2 SOP specific conformance for the RT Plan Storage SOP class

The following SOP specific conformance rules apply to 4DITC with implementation UID 'Varian Console Interface 4' and 'Varian Console Interface 4 QA Mode'. These tags are in addition to conformance rules applied for lower version of implementation UIDs supported in older version of 4DITC.

4DITC uses following tags from 'Patient Setup Sequence (300A, 0180)

- Table Top Vertical Setup Displacement (300A, 01d2)
- Table Top Longitudinal Setup Displacement (300A, 01d4)
- Table Top Lateral Setup Displacement(300A,01d6)

Also, when SOP object has at least one table top setup displacement defined, 4DITC considers zero value for remaining undefined table top setup displacements.

The following SOP specific conformance rules apply to 4DITC with implementation UID "Varian Console Interface 3" and "Varian Console Interface 3 QA Mode":

Bolus is not supported.

Setup Fields are supported. (Note: The Field Type attribute defines whether it is a Setup field or a Treatment field (see Table 10). It is supported for Field Type 'Setup' for implementation UID "Varian Console Interface 3" and "Varian Console Interface 3 QA Mode")

Setup beams in RT Plans and RT Ion Plans are imported and exported via new Defined Term SETUP in attribute Treatment Delivery Type (300A, 00CE).

Accessory Code (300A,00F9) for Wedge, Compensator, Block and Applicator

4DITC does not accept Arc-Dynamic Beam(s), which contains gantry rotations that is not equally spaced (e.g. 0, 10, 30, 100).

Only the first Fraction Group sequence (300A, 0070) is read. The others are discarded.

A maximum of two wedges per field are supported.

A maximum of one MLC per field is supported.

Beam energy, table parameter and rotation direction changes in the control points are not supported.

Wedge position changes are only supported for static technique (motorized wedge).

Whenever an operator changes a dose relevant attribute from the RT Plan in 4DITC, a new RT Plan is created. The new RT Plan will refer to the originally loaded RT Plan through the

Referenced RT Plan Sequence (300C,0002). The Referenced RT Plan Sequence (300C,0002) can only contain at most one item.

General Accessory Sequence (300A,0420) used for empty Trays

RT Plan extended interface and privatization are described in section 4.

### Replacement for FieldType

In Extended Interface FieldType is used to distinguish between treatment and setup fields (values: TREATMENT, SETUP) while DICOM attribute Treatment Delivery Type (300A,00CE) always contains value TREATMENT. When FieldType is removed from Extended Interface, the new value SETUP for Treatment Delivery Type (300A,00CE) is used to designate setup fields.

### Replacement for CustomAddOn for Block and Compensator

For Block and Compensator the Extended Interface has been used only to transport the accessory code. This has been added to the DICOM standard and is now available in various accessory sequences as attribute Accessory Code (300A,00F9), see **Error! Reference source not found..**

#### RT Beams Module

- Compensator Sequence (300A,00E3)
  - Accessory Code (300A,00F9) - Not exported, ignored on import.
- Block Sequence (300A, 00F4) - Not exported, ignored on import.
  - Accessory Code (300A,00F9) - Not exported, ignored on import.

### Replacement for CustomAddOn for Empty Trays

Empty trays are trays that are not used for mounting a block or compensator but for different purposes not supported specifically by DICOM. With the introduction of the General Accessory Sequence (300A,0420) in RT Beams Module the CustomAddOn attribute in Extended Interface gets obsolete for empty trays.

#### Empty Trays in General Accessory Sequence

- General Accessory Sequence (300A,0420)
  - General Accessory Number (300A,0424) –
  - General Accessory ID (300A,0421) – Replaces TrayID
  - General Accessory Description (300A,0422) –
  - General Accessory Type (300A,0423) – Defined Term: TRAY
  - Accessory Code (300A,00F9) – Replaces CustomCode

#### 3.1.2.1.3.3 SOP specific conformance for the RT Beams Treatment Record storage SOP class

Beam Limiting Device Position Sequence (300A,011A) only contains collimator jaws positions. It does not contain any MLC leaf position information. MLC leaf positions will not be reported within the RT Beams Treatment Record IOD.

Beams with Treatment Delivery Type (300A,00CE) set to OPEN\_PORTFILM or TRMT\_PORTFILM are Image Beams. Beams with Treatment Delivery Type set to TREATMENT are Treatment Beams.

All image beams attached to a treatment beam refer to the corresponding treatment beam. Similarly, all image beams attached to a setup beam refer to that setup beam. Beams refer to a Treatment Beam through the attribute Related Referenced Beam Number defined in section 4.2.1.

The Treatment Termination Status (3008,002A) specifies whether the treatment was completed or partially completed.

If MU Subtraction is set for an Image Beam, the treated MU count will be deducted from the related Treatment Beam. For Treatment Beams, MU Subtraction is always set. The following attributes are used to determine whether the MU Subtraction is set or not set:

| Treatment Delivery Type (300A,00CE) | Related Beam Number (*) | Treatment Termination Status (3008, 002A) | MU Subtraction |
|-------------------------------------|-------------------------|---|----------------|
| OPEN_PORTFILM<br>TRMT_PORTFILM      | set                     | MACHINE                                   | set            |
| OPEN_PORTFILM<br>TRMT_PORTFILM      | set                     | NORMAL                                    | not set        |
| TREATMENT                           | -                       | -   | set            |

**Table 3: MU Subtraction Status**

(\*) Related Beam Number is a private tag added to the RT Beams Session Record module (see section 4.1.2)

RT Beams Treatment Record Extended Interface and Privatizations are described in section 4.

3.1.2.1.3.4 SOP specific conformance for the RT Image Storage SOP class

The 4DITC Entity only stores images with the Image Type (0008,0008) set to PORTAL.

3.1.2.2 Query/Retrieve SCU

3.1.2.2.1 Associated Real-World Activity

4DITC uses the Query/Retrieve information model MOVE for retrieving patient data from the Management System. After a successful query, the Management System sends the requested data with the C-Store service.

4DITC uses the Query/Retrieve information model FIND for gathering information from the Management System. In order to determine whether a Beam was partially treated or completed, 4DITC queries for several attributes in the RT Beams Treatment Record stored in the management.

3.1.2.2.2 Presentation Context Table

| Presentation Context Table                          |                             |                                 |                   |      |                      |
|---|-----------------------------|---------------------------------|-------------------|------|----------------------|
| Abstract Syntax                                     |                             | Transfer Syntax                 |                   | Role | Extended Negotiation |
| Name  | UID                         | Name                            | UID               |      |                      |
| Study Root Query/ Retrieve Information Model - FIND | 1.2.840.10008.5.1.4.1.2.2.1 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU  | None                 |
| Study Root Query/ Retrieve Information Model - MOVE | 1.2.840.10008.5.1.4.1.2.2.2 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2 | SCU  | None                 |

**Table 4: Proposed Presentation Contexts for Query/Retrieve SCU**

3.1.2.2.3 SOP Specific Conformance

The following Query/Retrieve SOP classes are used by 4DITC as a Service Class User (SCU):

- C-Move RT Plan
- C-Move RT Treatment Summary Record
- C-Move RT Image
- C-Find RT Beams Treatment Record
- C-Find RT Plan
- C-Find RT Image

3.1.2.2.3.1 SOP specific conformance for the C-Move SOP classes

For all C-Move SOP classes, the query key is always the SOP Instance UID of the particular DICOM IOD that 4DITC requests. There are no other matching criteria's for the C-Move key. All keys used for the C-Move service are defined in section B 1.1.

The C-Move service requires 4DITC to be an SCP of the C-Storage service for the same DICOM IOD. For example whenever 4DITC is a SCU of C-Move RT Plan it implies that 4DITC is a SCP of C-Storage RT Plan (see Table 1).

### 3.1.2.2.3.2 SOP specific conformance for the C-Find RT Beams Treatment Record SOP class

The C-Find RT Beams Treatment Record SOP class will be used for calculating the remaining MU. The remaining monitor units are calculated with the *Beam Meterset (300A,0086)* in the RT Fraction Scheme module (provided from the Plan IOD) minus the *Delivered Primary Meterset (3008, 0036)* (provided from the Beam Record Information) -see Table 18). If the monitor units were overridden, the Beam Record Information contains the overridden value in the *Specified Meterset (3008, 0042)*. In this case, the overridden *Specified Meterset (3008, 0042)* is used instead of the *Beam Meterset (300A,0086)* to calculate the remaining monitor units.

*Calculation of Remaining MU when monitor units are not overridden:*

*Remaining MU = Beam Meterset (300A,0086) – Delivered Primary Meterset (3008,0036)*

*Calculation of Remaining MU when monitor units are overridden:*

*Remaining MU = Specified Meterset (3008, 0042) – Delivered Primary Meterset (3008,0036)*

The Treatment Record key contains the matching criteria for the RT Beams Treatment Record. Whenever the key matches the particular RT Beams Treatment Record, the attributes defined in Table 18 (SCP column) gets filled in. Note that the Treatment Session Beam Sequence may contain one or more item. It is up to the Management System to decide whether for each Treatment Session Beam one Treatment Record key gets sent or if all Treatment Session Beams are sent within one Treatment Record key.

Only the last treated fraction is the fraction of interest.

### 3.1.2.2.3.3 SOP specific conformance for the C – Find RT Plan SOP class

Plans may be loaded into 4DITC without having them scheduled for the current session. Therefore 4DITC has to know how many treatment plans a patient has. This information gets retrieved with the C – Find RT Plan SOP Class. The Plan key contains the matching criteria and the placeholder for all attributes. The Plan key is defined in Table 17. The SOP Instance UID defined in the Plan key is the Plan Instance UID which will be used to load an unscheduled Plan in 4DITC.

### 3.1.2.2.3.4 SOP specific conformance for the C – Find RT Image SOP class

Since Portal Images are not referenced within the RT Plan, 4DITC queries the Portal Images from the Management System with the C – Find RT Image service SOP class. The Image key is defined in Table 16. The Referenced SOP Instance UID (i.e. the Plan Instance UID) and the Referenced Beam Number uniquely identifies the Beam, which 4DITC needs to query the Portal Images from. 4DITC uses the SOP Instance UID (i.e. the RT Image Instance UID ) to retrieve previous acquired Portal Image. The C – Find confirmation returns as many Image keys as Portal Images stored in the Management System for that particular beam.

## 3.1.3 Association Acceptance Policy

The 4DITC Entity accepts association requests for the supported service classes shown in Figure 4. 4DITC accepts only one Management System Application Entity for the possible association.

3.1.3.1 Storage SCP

3.1.3.1.1 Associated Real-World Activity

The patient data is sent from the Management System to 4DITC through the C- Storage service. This is the only service that 4DITC supports as an SCP.

3.1.3.1.2 Presentation Context Table

| Presentation Context Table          |                               |                                 |                     |      |                      |
|-------------------------------------|-------------------------------|---------------------------------|---------------------|------|----------------------|
| Abstract Syntax                     |                               | Transfer Syntax                 |                     | Role | Extended Negotiation |
| Name                                | UID                           | Name                            | UID                 |      |                      |
| RT Plan Storage                     | 1.2.840.10008.5.1.4.1.1.481.5 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2   | SCP  | None                 |
|                                     |                               | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP  | None                 |
| RT Plan Storage                     | 1.2.840.10008.5.1.4.1.1.481.5 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2   | SCP  | None                 |
|                                     |                               | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP  | None                 |
| RT Treatment Summary Record Storage | 1.2.840.10008.5.1.4.1.1.481.7 | DICOM Implicit VR Little Endian | 1.2.840.10008.1.2   | SCP  | None                 |
|                                     |                               | DICOM Explicit VR Little Endian | 1.2.840.10008.1.2.1 | SCP  | None                 |

**Table 5: Acceptable Presentation Contexts for Storage SCP**

3.1.3.1.3 SOP Specific Conformance

3.1.3.1.3.1 SOP specific conformance for the Storage SOP class

4DITC is not an archive system. Thus DICOM IOD's are temporarily stored during a treatment session and deleted once the session is finished.

3.1.3.1.3.2 SOP specific conformance for RT Image Storage SOP class

The 4DITC Entity supports the following image types: DRR, PORTAL, and SIMULATOR.

To represent portal dose, RT Images of image type PORTAL are used. This is based on DICOM standard Part 3, section A.17.3 (RT Image IOD Module Table), Notes 2. The conversion between portal image pixel values and portal dose is defined by the Modality LUT module through re-scale Slope and Intercept. The unit depends on the re-scale Type. The image type in Table 6 distinguishes the two types of portal doses:

| Image Type                               | Meaning   |
|--|---|
| DERIVED\SECONDARY\PORTAL\CALCULATED_DOSE | Portal dose predicted by a treatment planning system, i.e. an estimate of the dose that will be perceived by the portal imaging device. |
| ORIGINAL\PRIMARY\PORTAL\ACQUIRED_DOSE    | Portal dose actually measured by the portal imaging device based on its calibration.  |

**Table 6: Image Type**

**RT Image Geometrical Values**

RT Images (used as reference images) require a sufficient amount of geometrical parameters that will define the position of RT Images with respect to the machine. The following parameters are required for proper operation of image verification applications associated with 4DITC:

X-Ray Image Receptor Translation (3002,000D)

Value must be present.

X-Ray Image Receptor Angle (3002,000E)

Value must be present.

Note: In the current release, only 0 is supported. Providing this value will ensure safe interpretation.

RT Image Position (3002,0012)

It is recommended to have this value defined. If the value is not defined, the application will assume that the image was centered on the X-Ray Image Receptor System.

Radiation Machine SAD (3002,0022) or RT Image SID (3002,0026)

At least one of the two values must be present.

Image Plane Pixel Spacing (3002,0011)

Value must be present.

Gantry Angle (300A,011E)

Value must be present. This value shall represent the angle (in IEC GANTRY system coordinates) where the physical or virtual (in case of DRR) source of radiation is located.

Note: When kV images are used as Reference Images, this value describes the projection geometry. Therefore, this value may not coincide with the Gantry Hardware Readout of the linear accelerator since the kV Image radiation source may be on a different position than the linear accelerator' target focus.

RT Orientation (3002,0010)

In the future, it is recommended to have this value defined for images that have the RT Image Plane set to NORMAL (this value is required for NON-NORMAL images). This is because the DICOM standard does not unambiguously define the position of the RT Image pixel area in the IEC Image Receptor system when this value is missing. If this value is not provided, the application assumes that the value is (1,0,0,0,-1,0).

3.1.3.1.3.4 SOP specific conformance for the RT Treatment Summary Record SOP class

RT Treatment Summary Record IOD contains additional private tags defined in section 4.1.3.

3.1.3.2. Presentation Context Acceptance Criterion

The 4DITC Entity will accept the presentation contexts listed in Table 4: Proposed Presentation Contexts for Query/Retrieve SCU.

3.1.3.3 Transfer Syntax Selection Policies

4DITC accepts both Implicit VR Little Endian and Explicit VR Little Endian as shown in Table 5. 4DITC does not prefer one presentation context over the other.

## 4. Privatizations/Extensions/Specializations

### 4.1 Privatization

#### 4.1.1 Privatization for RT Plan Storage SOP class

The DICOM Extended Interface is a private module added to the RT Plan IOD. This module contains an XML stream that contains the Plan Extended Interface described in section 4.2.1.

| Module  | Tag                                   | Description   | Type | VR |
|---|---------------------------------------|---|------|----|
| DICOM Extended Interface  | Extended Interface Data (3253,1000)   | XML stream.   | 3    | LT |
| DICOM Extended Interface  | Extended Interface Length (3253,1001) | Data length of the XML stream   | 3    | IS |
| DICOM Extended Interface  | Extended Interface Format (3253,1002) | Extended Interface Format tag. A possible value is: 'ExtendedIF'  | 3    | CS |
| RT Beam/Beam Sequence   | Beam Secondary Name (3243,1009)       | Second user-defined beam name   | 3    | LO |
| RT Fraction Scheme/Fraction Group Sequence/Referenced Beam Sequence | Maximum Treatment Time (3249,1000)    | The maximum treatment time, which should not be exceeded (in min). This item serves as a secondary safety limit besides the Beam Meterset (300A,0086) value itself. | 3    | DS |

Table 7: RT Plan IOD Privatization

#### 4.1.2 Privatization for RT Beams Treatment Record Storage SOP class

| Module   | Tag  | Description  | Type | VR |
|--|--|--|------|----|
| RT Beam Session Record/Treatment Session Beam Sequence | Treatment Machine Note (3251, 1000)        | A description of the treatment machine details.  | 3    | LO |
| RT Beam Session Record/Treatment Session Beam Sequence | Treatment Session Beam Data (3261,102A)    | Extended interface in XML format (see 4.2.2).  | 3    | OB |
| RT Beam Session Record/Treatment Session Beam Sequence | Related Referenced Beam Number (3243,1028) | If TreatmentDeliveryType of the treated beam is either OPEN_PORTFILM or TRMT_PORTFILM then the Related Referenced Beam Number must be used instead of the Referenced Beam Number (300C, 0006). The Related Referenced Beam Number refers to the treatment field for which the image was taken. | 3    | IS |

**Table 8: RT Beams Treatment Record IOD Privatization**

The Extended Interface for the RT Beams Treatment Record IOD is described in section 4.2.2.

### 4.1.3 Privatization for Treatment Summary Record Storage SOP class

| Module   | Tag  | Description  | Type | VR |
|--|--|--|------|----|
| >RT Treatment Summary Record                                   | Additional Dose Value Sequence (3259,1000) | Introduces sequence of Additional Session Dose Sequence. The sequence may contain one or more items.<br>Sequence for additional Dose Information to a Reference Point. The ReferencePoint must be connected to Referenced Plan of this TreatmentSummary Record, but also the Dose of other Plans which have the same Reference Point have influence on this values.  | 3    | SQ |
| RT Treatment Summary Record/<br>Additional Dose Value Sequence | Actual Session Dose (3259,1002)            | Session Dose Delivered of Actual Session<br>Required if Actual Session Dose Sequence is sent.  | 1C   | DS |
| RT Treatment Summary Record/<br>Additional Dose Value Sequence | Daily Dose (3259,1004)                     | Daily Dose of current day.<br>Required if Actual Session Dose Sequence is sent.  | 1C   | DS |
| RT Treatment Summary Record/<br>Additional Dose Value Sequence | Life Time Total Dose (3259,1006)           | Total Dose of Reference Point over all Plans.<br>Required if Actual Session Dose Sequence is sent.   | 1C   | DS |
| RT Treatment Summary Record                                    | Total Number of Fractions (3265,1000)      | Total number of Fractions planned for the current plan and all its former plans.   | 1    | SL |
| RT Treatment Summary Record                                    | Last Treated Fraction (3265,1001)          | The index of the last fraction treated across the current plan and all its former plans. In other words, this tag will always contain the fraction, which was last treated (completely or partially). So it will be the same as in the Fraction Status Summary Sequence (3008,0240) on the last item of the sequence in the tag Referenced Fraction Number (3008,0223), as soon as the sequence is not empty any more (so after the 1st treatment has got at least 1 MU).<br><br>In case of completing a partial treatment, the plan's current fraction number is equal to <i>Last Treated Fraction (3265, 1001)</i> . | 1    | SL |

Table 9: RT Treatment Summary Record IOD Privatization

## 4.2 Extensions

This section describes items that are not available through standard DICOM. The Extended Interface for RT Plan is supported through an additional module that gets added to the RT Plan IOD (see 4.1.1). The Extended Interface for RT Beams Treatment Record is supported through a private attribute in the Treatment Session Beam (see 4.1.2).

### 4.2.1 RT Plan Extended Interface

The RT Plan Extended Interface is contained in the DICOM Extended Interface module (mentioned in section 4.1.1).

Table 10 shows the contents of the RT Plan Extended Interface. Node names that have an empty Data Type are parent XML nodes. The XML values are all text (not attributes). The Data Type defines which type the XML text has to be converted to.

Note: Some of the tags like CustomAddOn may not be available in ARIA 8.8

| Node Name                   | min occurs | max occurs | Data Type          | Node Description   |
|-----------------------------|------------|------------|--------------------|--|
| ExtendedVAPlanInterface     | 0          | 1          |                    |  |
| > Beams                     | 0          | 1          |                    |  |
| >> Beam                     | 0          | Unbounded  |                    |  |
| >>> ReferencedBeamNumber    | 1          | 1          | nonNegativeInteger | The Beam Number of the beam this extension applies to.   |
| >>> BeamExtension           | 1          | 1          |                    | Additional items provided from Vision to expand the features of RT Beams.  |
| >>>> FieldType              | 1          | 1          | string             | Treatment Field Type. This field can have one of the following values: TREATMENT SETUP. For implementation UID "Varian Console Interface 3" and "Varian Console Interface 3 QA Mode", the value is read from standard DICOM tag        |
| >>>> RelatedTreatBeamNumber | 0          | 1          | int                | For an image beam, this field defines the related treatment/setup beam.  |
| >>>> FieldOrder             | 1          | 1          | int                | Whenever 4DITC has the "auto sequence mode" enabled, fields are treated in the order they are shown on the display (i.e. from top to bottom). The FieldOrder value defines where this field belongs to on the display. For example, if |

|                             |   |   |        |   |
|-----------------------------|---|---|--------|---|
|                             |   |   |        | there are 3 fields in a plan, a FieldOrder value of 1 means that this field should be displayed above the other 2 fields while a FieldOrder value of 3 means that this field should be displayed beneath the other two fields.  |
| >>>> GantryRtnExtendedStart | 0 | 1 | string | This field can have one of the following values:<br>true<br>false<br><br>When 'true', gantry angle position is in the extended range, which means it has an over travel (a Gantry can move most typical 400' and not only 360').  |
| >>>> GantryRtnExtendedStop  | 0 | 1 | string | This field can have one of the following values:<br>true<br>false<br><br>When 'true', gantry angle position is in the extended range, which means it has an over travel (a Gantry can move most typical 400' and not only 360').  |
| >>>> MUSubtraction          | 0 | 1 | string | This field can have one of the following values:<br>true<br>false<br><br>When 'true' the MU delivered when taking images will be included in the related treatment's delivered MU. When 'false' the MU delivered when taking images will not be factored into the related treatment's delivered MU. |
| >>>> FieldSetupPhotos       | 0 | 1 |        |   |
| >>>>> FieldSetupPhoto       | 0 | 2 |        | Two setup photos max  |
| >>>>>> SetupPhotoNumber     | 1 | 1 | int    | Identifies the setup photo. If this was the 1 <sup>st</sup> photo, this field would have a value of 1. If this was the 2 <sup>nd</sup> photo, this field would have a value of 2, etc.  |

|                               |   |   |           |  |
|-------------------------------|---|---|-----------|--|
| >>>>>> SetupPhotoFormat       | 1 | 1 | string    | The format of the pixel information. This field can have one of the following values:<br>JPG<br>BMP  |
| >>>>>> SetupPhotoPicture      | 1 | 1 | hexBinary | Pixel information of the photo in the corresponding format.  |
| >>>>>> PhotoModified          | 1 | 1 | string    | Defines whether the photo has been modified.<br>This field can have one of the following values:<br>true<br>false  |
| >>>>> CustomAddOns            | 0 | 1 |           |  |
| >>>>>> CustomAddOn            | 0 | 4 |           |  |
| >>>>>> CustomAddOnType        | 1 | 1 | string    | Defines what type of CustomAddOn this is. This field can have one of the following values:<br>BLOCK<br>COMPENSATOR<br>TRAY   |
| >>>>>> CustomCode             | 0 | 1 | int       | For a custom made accessory, this field defines the code for that accessory. For a factory made accessory this field just mimics the internal code.  |
| >>>>>>> ReferencedAddOnNumber | 0 | 1 | int       | When CustomAddOnType is set to BLOCK, this value is the identification number of the Block.<br>When CustomAddOnType is set to COMPENSATOR, this value is the identification number of the Compensator. |
| >>>>>>> TraySpecification     | 0 | 1 |           | This node is only needed when a tray is defined with no block or compensator mounted on the tray.  |
| >>>>>>>> TrayID               | 1 | 1 | string    | User-supplied identifier for the tray. Max length is 16 characters.  |
| >>>>>>>>> SourceTrayDistance  | 0 | 1 | int       | The distance between the Radiation Source to the attachment edge of the tray assembly (in mm).   |
| > ToleranceTables             | 0 | 1 |           |  |

|                                    |   |           |         |  |
|------------------------------------|---|-----------|---------|--|
| >> ToleranceTable                  | 0 | Unbounded |         | Additional items provided from Vision to expand the features of Tolerance Tables with AutoSetup capabilities |
| >>> ReferencedToleranceTableNumber | 1 | 1         | int     | The Tolerance Table Number of the tolerance table this extension applies to.                                 |
| >>> ToleranceTableExtension        | 1 | 1         |         |  |
| >>>> GantryRtnSetup                | 0 | 1         | string  | Setup attributes may have following type:<br>Automatic<br>Manual<br>Remote                                   |
| >>>> CollRtnSetup                  | 0 | 1         | string  |  |
| >>>> CollXSetup                    | 0 | 1         | string  |  |
| >>>> CollYSetup                    | 0 | 1         | string  |  |
| >>>> PatientSupportAngleSetup      | 0 | 1         | string  |  |
| >>>> CouchLngSetup                 | 0 | 1         | string  |  |
| >>>> CouchVrtSetup                 | 0 | 1         | string  |  |
| >>>> CouchLatSetup                 | 0 | 1         | string  |  |
| >>>> TableTopEccentricAngleSetup   | 0 | 1         | string  |  |
| > DoseReferences                   | 0 | 1         |         |  |
| >> DoseReference                   | 0 | Unbounded |         |  |
| >>> ReferencedDoseReferenceNumber  | 1 | 1         | int     | The Dose Reference Number of the dose reference this extension applies to.                                   |
| >>> DoseReferenceExtension         | 1 | 1         |         | Additional items provided from Vision to expand the features of reference points.                            |
| >>>> DailyDoseLimit                | 0 | 1         | decimal | Daily dose limit of the reference point (in Gy)  |
| >>>> SessionDoseLimit              | 0 | 1         | decimal | Session dose limit of the reference point (in Gy)  |
| >>>> Breakpoints                   | 0 | 1         |         |  |
| >>>>> Breakpoint                   | 0 | Unbounded |         | Breakpoint extensions. Standard DICOM does not support Breakpoints.  |
| >>>>>> BreakpointDose              | 1 | 1         | decimal | The breakpoint warning is displayed when the Breakpoint Dose value (in Gy) is reached.                       |
| >>>>>>> BreakpointWarning          | 1 | 1         | string  | This is the text displayed on the breakpoint warning dialog. The max length for this text is 254 characters. |

Table 10: RT Plan Extended Interface

## 4.2.2 Treatment Session Extended Interface

The Treatment Session Beam Data private attribute (mentioned in section 4.1.2) contains the Treatment Session Extended Interface as an XML stream.

Table 11 shows the contents of the Treatment Session Extended Interface. Node names that have an empty Data Type are parent XML nodes. The XML values are all text (not attributes). The Data Type defines which type the XML text has to be converted to.

| Node Name                      | min occurs | max occurs | Data Type          | Node Description   |
|--------------------------------|------------|------------|--------------------|--|
| RTBeamSessionRecordExtended IF | 0          | 1          |                    |  |
| > DoseOverrides                | 0          | 1          |                    |  |
| >> DoseOverride                | 0          | Unbound    |                    | There may be as many DoseOverride nodes as Reference Points.   |
| >>> DoseOverrideType           | 1          | 1          | string             | The type of dose override. This field can have one of the following values:<br>BREAKPOINT<br>DAILYDOSE<br>SESSIONDOSE<br>TOTALDOSE |
| >>> Dose                       | 0          | 1          | decimal            | When the DoseOverrideType is set to BREAKPOINT, this field defines the dose value that triggered the breakpoint.                   |
| >>> DoseReferenceNumber        | 1          | 1          | nonNegativeInteger | The Dose Reference Number of the dose reference this extension applies to.   |
| >>> OperatorsName              | 1          | 1          |                    | The name of the operator that overrode/approved the specific doses.  |
| >>>> FamilyName                | 0          | 1          | string             | Max length is 64 characters.   |
| >>>> GivenName                 | 0          | 1          | string             | Max length is 64 characters  |
| >>>> MiddleName                | 0          | 1          | string             | Max length is 64 characters  |
| >>>> Prefix                    | 0          | 1          | string             | Max length is 64 characters  |
| >>>> Suffix                    | 0          | 1          | string             | Max length is 64 characters  |
| > TraySpecifications           | 0          | 1          |                    |  |
| >> TraySpecification           | 1          | Unbound    |                    | As many nodes as tray applied for the treated beam.  |
| >>> TrayID                     | 1          | 1          | string             | User-supplied identifier for the tray. Max length is 16 characters.  |
| >>> SourceTrayDistance         | 0          | 1          | int                | The distance between the Radiation Source to   |

|                       |   |   |        |   |
|-----------------------|---|---|--------|---|
|                       |   |   |        | the attachment edge of the tray assembly (in mm).   |
| > AdditionalOperators | 0 | 1 |        |   |
| >> OperatorsName      | 1 | 2 |        | If the 'Show Sign Off Dialog' is checked in ITAdmin -> MachineConfiguration -> Preferences, the Sign Off Dialog will be shown after closing the patient. Three OperatorsName may be entered in this dialog. The first OperatorsName will be sent through the standard attribute Operator Name (0008,1070) in the RT Beams Session Record module, the remaining two names if available will be sent here in the Extended Interface |
| >>> FamilyName        | 0 | 1 | string | Max length is 64 characters.  |
| >>> GivenName         | 0 | 1 | string | Max length is 64 characters   |
| >>> MiddleName        | 0 | 1 | string | Max length is 64 characters   |
| >>> Prefix            | 0 | 1 | string | Max length is 64 characters   |
| >>> Suffix            | 0 | 1 | string | Max length is 64 characters   |
| > PortFilmImageFlag   | 0 | 1 | string | Indicates if this record represents a Port Film or a Port Image. By default, Port Image is assumed. This tag shall only be sent for images. It is optional for Port Images.   |

**Table 11: Treatment Session Extended Interface**

### 4.3 Specializations

This section shows how 4DITC uses certain DICOM attributes in a specialized manner. It also describes some special features supported by the 4DITC Application and the IT Daemon.

### 4.3.1 Specialization for RT Plan Storage SOP class

| Module  | Tag  | Description   | Type | VR |
|---|--|---|------|----|
| RT Beam/Beam Sequence/Planned Verification Image Sequence | Imaging Device-Specific Acquisition Parameters (300A,00CC) | Type/quality used to acquire verification image.<br>This field can have one of the following values:<br><u>PortImageHighQuality</u><br>Single port image optimized for image quality.<br><u>PortImageLowDose</u><br>Single port image optimized for low dose.<br><u>PortImageContinuous</u><br>Multiple port images acquired at highest possible rate. Start Cumulative Meterset Weight (300C,0008) must be 0.<br><u>PortImageIntegrated</u><br>Integrated port image with frames averaged during the entire beam on time.<br><u>Default Imaging Parameters (*)</u><br>Indicates that there is no during image planned and that the imager positions specified apply to the existing Before Image and/or After Image Beam(s). | 3    | LO |

(\*) The IT Daemon stores Treatment Field data (which includes the During Image Beam) but does not store Before Image Beam and After Image Beam data. In the case where there are Before Image and/or After Image Beam(s) along with a During Image Beam, since the imager positions of the Before Image and/or After Image Beam(s) are always set equal to the During Image data, changes to the imager positions of the Before Image and After Image Beam(s) are stored in the During Beam and thus stored in IT Daemon. However, in the case where there are Before Image and/or After Image Beam(s) without a During Image Beam, changes to the Before Image and After Image Beam(s) are lost on the next retrieve from IT Daemon. To resolve this problem, the Default Imaging Parameters value was introduced. Setting Imaging Device-Specific Acquisition Parameters to Default Imaging Parameters indicates that there is no During Image Beam planned but that the imager positions contained in the Treatment Field apply to the existing Before Image and/or After Image Beam(s). The introduction of the Default Imaging Parameters value allowed imager position values of the Before Image and/or After Image Beam(s) to be stored in the Treatment Field without a During Image Beam having to be present.

### 4.3.2 Undefined Values

ARIA/Vision applications (applications on the management system side) allow the user to let some type 1 attributes of an RT Plan to be undefined even when plans are ready for treatment, the Storage SCP of 4DITC Application supports an "undefined value" for those attributes to nonetheless allow the creation of valid DICOM files.

The value of the mentioned "undefined value" is 88'888'888.

It may be used for the attributes listed in Table 12 when sending an RT Plan IOD to the 4DITC Application (see Table 12):

| Module   | Attribute Name               | Tag         | Type | Remarks                                 |
|--|------------------------------|-------------|------|---|
| RT Beams/Beam Sequence/Control Point Sequence/Beam Limiting Device Position Sequence | >>>Leaf/Jaw Positions        | (300A,011C) | 1C   | Only for collimator pairs, not for MLCs |
| RT Beams/Beam Sequence/Control Point Sequence  | >>Gantry Angle               | (300A,011E) | 1C   |   |
| RT Beams/Beam Sequence/Control Point Sequence  | >>Beam Limiting Device Angle | (300A,0120) | 1C   |   |
| RT Beams/Beam Sequence/Control Point Sequence  | >>Patient Support Angle      | (300A,0122) | 1C   |   |

**Table 12: Tags that allow usage of “undefined value”**

Note that 4DITC Applications will never send back any attribute with the “undefined value” 88’888’888.

### 4.3.3 Load and Save of Imager Positions

It is possible to transfer the imager positions between the management system (via IT Daemon) and 4DITC Applications even if no verification images are planned or taken and thus “Planned Verification Image Sequence” (300A,00CA) in RT Beams Module is empty.

If the “Planned Verification Image Sequence” is empty, a pseudo verification image will be added to this sequence whose only purpose is to transmit the imager positions. This is done by adding an item to this sequence containing only the following attributes:

- X-Ray Image Receptor Angle (3002,000E)
- RT Image Position (3002,0012)
- RT Image SID (3002,0026)
- Imaging Device-Specific Acquisition Parameters (300A,00CC) containing the string “Default Imaging Parameters”

When 4DITC Application sends back a plan to the management System (IT Daemon) it may omit the tag “X-Ray Image Receptor Angle” (3002,000E) because this value must be 0.0 (zero) anyway.

When imager positions are changed on 4DITC Application they will be saved back to the IT Daemon when closing the patient. IT Daemon saves imager positions that are listed in the “Planned Verification Image Sequence” for sending them again to 4DITC Application when the plan is requested next time.

#### **4.3.4 RT Image Position vs. Imager Position in “Planned Verification Image Sequence”**

The DICOM standard defines the “RT Image Position” (3002,0012) as “The x and y coordinates [...] of the upper left hand corner [...] of the image [...]”.

Because the size of an image to be taken is not known in advance, a width and height of zero pixels is assumed in the “Planned Verification Image Sequence” of an RT Plan IOD. Therefore the position of the center of the image receptor will be used for the “RT Image Position” tag instead. This is because these are the same coordinates as those of the upper left hand corner of an image with zero pixels in x and y directions.

This is true for IT Daemon as well as for 4DITC Application.

## **5. Communication profiles**

### **5.1 Supported communications stacks**

4DITC Entity provides DICOM V3.0 TCP/IP Network Communication Support as defined in PS 3.8 (part 8 of the DICOM V3.0 standard).

#### **5.1.1 TCP/IP stack**

4DITC Entity uses the TCP/IP stack of Microsoft Windows Operating Systems (Winsock), which is the operating system platform of the Vision applications.

##### **5.1.1.1 Physical media support**

4DITC Entity can run on any physical network media that is supported by the underlying hardware and operating system (i.e. standard PCs and Windows XP). These include, but are not limited to: thin, thick, and twisted-pair Ethernet, token ring network and FDDI.

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## 6. Configuration

4DITC is configured through the 4DITC Administration application.

### 6.1 AE Title/Presentation Address Mapping

4DITC Administration provides a mapping of an Application Entity Title to a Presentation Address. A Presentation Address consists of a host name and a port number. In 4DITC Administration, the related Application Entity Title, host name, and port number are grouped under the section Daemon (remote) that is within the DICOM Configuration box (see Figure 5).

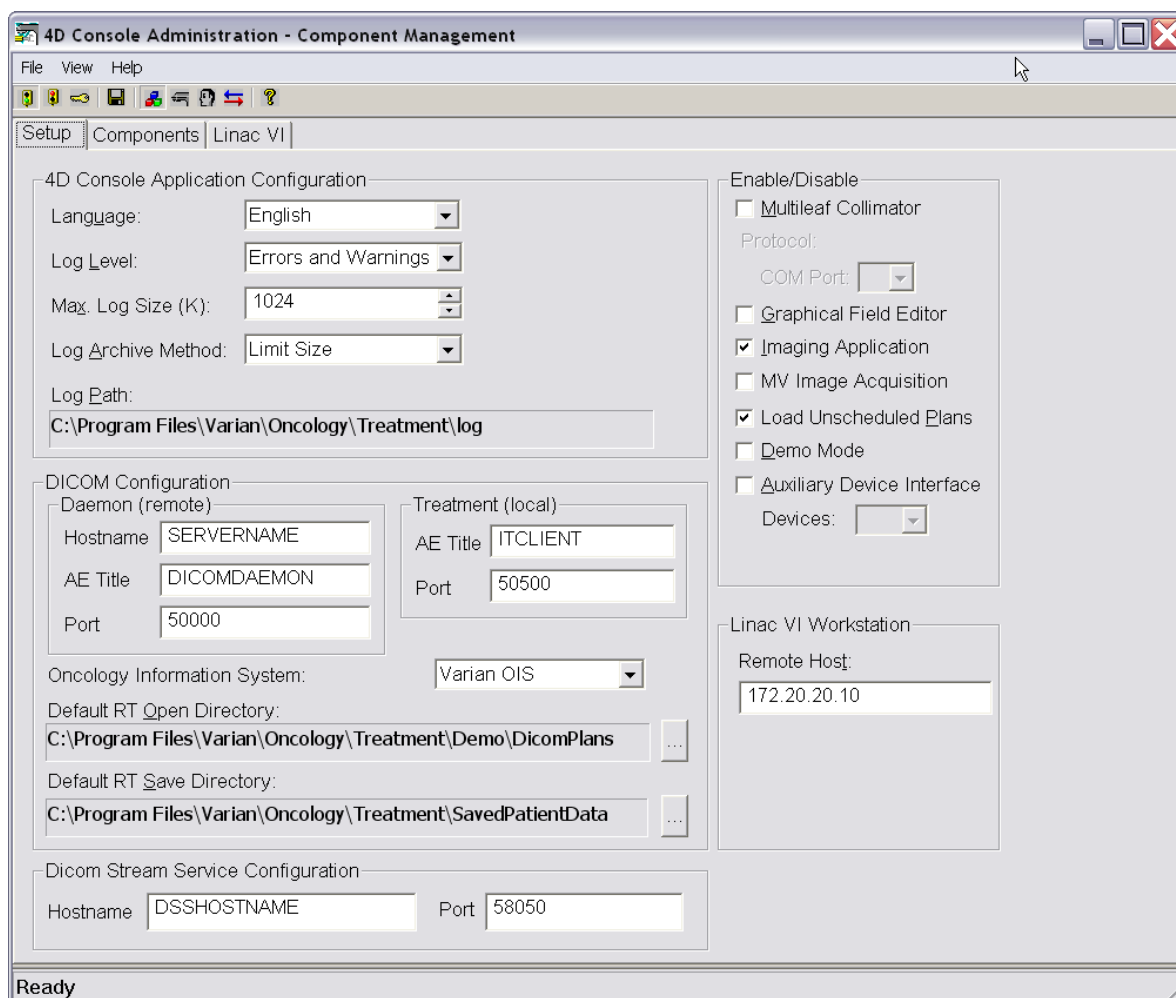


Figure 5: 4DITC Administration Setup

### 6.2 Configurable Parameters

#### 6.2.1 4DITC Entity

The configurable parameters are located within the “DICOM Configuration” box of 4DITC Administration. The destination’s AE Title, hostname or TCP/IP address, and port number

can be configured under the “Daemon (remote)” section. The local AE Title and port number can be configured under the “Treatment (local)” section (see Figure 5).

Note: In case warnings or errors are encountered after configuration, there are logs available to assist in determining the cause of the problem. 4DITC Administration has a “4D Console Application Configuration” section with a Log Level setting. When this Log Level is set to “Detailed” 4DITC writes more information to the log that will help in debugging the problem.

## **7. Support of Extended Character Sets**

Extended character sets are not supported.

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## Appendix A: IOD Specific Implementation Details

The following tables define the modules that are and are not supported for a particular IOD. For specific IOD details, refer to Related Documents [2].

### A. RT Plan IOD Module Table

| IE        | Module                       | Reference                  | DICOM Usage | Notes   |
|-----------|------------------------------|----------------------------|-------------|---|
| Patient   | Patient                      | C.7.1.1                    | M           |   |
| Study     | General Study                | C.7.2.1                    | M           |   |
|           | Patient Study                | C.7.2.2                    | U           | Not supported                                       |
| Series    | RT Series                    | C.8.8.1                    | M           |   |
| Equipment | General Equipment            | C.7.5.1                    | M           |   |
| Plan      | RT General Plan              | C.8.8.9                    | M           |   |
|           | RT Prescription              | C.8.8.10                   | U           |   |
|           | RT Tolerance Tables          | C.8.8.11                   | U           |   |
|           | RT Patient Setup             | C.8.8.12                   | U           |   |
|           | RT Fraction Scheme           | C.8.8.13                   | U           |   |
|           | RT Beams                     | C.8.8.14                   | C           |   |
|           | RT Brachy Application Setups | C.8.8.15                   | C           | Not supported                                       |
|           | Approval                     | C.8.8.16                   | U           |   |
|           | Audio                        | C.10.3                     | U           | Not supported                                       |
|           | SOP Common                   | C.12.1                     | M           |   |
|           | DICOM Extended Interface     | Private module (see 4.1.1) | C           | Additional features are supported with this module. |

**B. RT Beams Treatment Record IOD Module Table**

| IE               | Module                           | Reference | DICOM Usage | Notes         |
|------------------|----------------------------------|-----------|-------------|---------------|
| Patient          | Patient                          | C.7.1.1   | M           |               |
| Study            | General Study                    | C.7.2.1   | M           |               |
|                  | Patient Study                    | C.7.2.2   | U           | Not supported |
| Series           | RT Series                        | C.8.8.1   | M           |               |
| Equipment        | General Equipment                | C.7.5.1   | M           |               |
| Treatment Record | RT General Treatment Record      | C.8.8.17  | M           |               |
|                  | RT Patient Setup                 | C.8.8.12  | U           | Not supported |
|                  | RT Treatment Machine Record      | C.8.8.18  | M           |               |
|                  | Measured Dose Reference Record   | C.8.8.19  | U           | Not supported |
|                  | Calculated Dose Reference Record | C.8.8.20  | U           | Not supported |
|                  | RT Beams Session Record          | C.8.8.21  | M           |               |
|                  | RT Treatment Summary Record      | C.8.8.22  | U           | Not supported |
|                  | Curve                            | C.10.2    | U           | Not supported |
|                  | SOP Common                       | C.12.1    | M           |               |

**c. RT Image IOD Module Table**

| IE                 | Module             | Reference | DICOM Usage | Notes         |
|--------------------|--------------------|-----------|-------------|---------------|
| Patient            | Patient            | C.7.1.1   | M           |               |
| Study              | General Study      | C.7.2.1   | M           |               |
|                    | Patient Study      | C.7.2.2   | U           | Not supported |
| Series             | RT Series          | C.8.8.1   | M           |               |
| Frame Of Reference | Frame of Reference | C.7.4.1   | U           |               |
| Equipment          | General Equipment  | C.7.5.1   | M           |               |
| Image              | General Image      | C.7.6.1   | M           |               |
|                    | Image Pixel        | C.7.6.1   | M           |               |
|                    | Contrast/bolus     | C.7.6.3   | C           | Not supported |

|  |              |          |   |               |
|--|--------------|----------|---|---------------|
|  | Cine         | C.7.6.5  | C | Not supported |
|  | Multi-Frame  | C.7.6.6  | C | Not supported |
|  | RT Image     | C.8.8.2  | M |               |
|  | Modality LUT | C.11.1   | U |               |
|  | VOI LUT      | C.11.2   | U |               |
|  | Approval     | C.8.8.16 | U |               |
|  | Curve        | C.10.2   | U |               |
|  | Audio        | C.10.3   | U | Not supported |
|  | SOP Common   | C.12.1   | M |               |

**D. RT Treatment Summary Record Module Table**

| <b>IE</b>        | <b>Module</b>               | <b>Reference</b> | <b>DICOM Usage</b> | <b>Notes</b>  |
|------------------|-----------------------------|------------------|--------------------|---------------|
| Patient          | Patient                     | C.7.1.1          | M                  |               |
| Study            | General Study               | C.7.2.1          | M                  |               |
|                  | Patient Study               | C.7.2.2          | U                  | Not supported |
| Series           | RT Series                   | C.8.8.1          | M                  |               |
| Equipment        | General Equipment           | C.7.5.1          | M                  |               |
| Treatment Record | RT General Treatment Record | C.8.8.17         | M                  |               |
|                  | RT Treatment Summary Record | C.8.8.23         | M                  |               |
|                  | Curve                       | C.10.2           | U                  | Not supported |
|                  | SOP Common                  | C.12.1           | M                  |               |

## Appendix B: Query/Retrieve

### B 1 Study Root SOP Class Group

Table 13 shows the supported values for the tag Query/Retrieve Level (0008,0052):

| Query/Retrieve Level                  |   | Value in (0008,0052)   |
|---------------------------------------|---|------------------------|
| Study Information                     |   | STUDY                  |
| Series Information                    |   | SERIES                 |
| Composite Object Instance Information | Image Information   | IMAGE                  |
|                                       | Plan Information  | PLAN                   |
|                                       | Treatment Record Information  | TREATMENTRECORD        |
|                                       | Treatment Summary Record Information  | TREATMENTSUMMARYRECORD |
|                                       | Treatment Summary Record Information  | TREATMENTSUMREC        |
|                                       | Note : 4DITC uses this value when association is established with Varian Console Interface 3 or higher. |                        |

**Table 13: Supported Query/Retrieve Levels for Query/Retrieve SCU**

**Note:** In addition to the IMAGE value for the Composite Object Instance Level, we expect the following values for querying/retrieving the respective objects: PLAN, TREATMENTRECORD, TREATMENTSUMMARYRECORD, TREATMENTSUMREC.

#### B 1.1 Supported Keys

The tables in the following sub section show which keys the SCU and the SCP support. Since Treatment is not an SCP of any C-Find service, the SCP column indicates what the Management System shall support. A check mark in the SCU and/or SCP column indicates that SCP shall supports this key. A "M" in the SCP column indicates that the SCP uses this key for matching if a value is defined for it.

The Type column applies only to the SCU role. Type "R" means this attribute is required, Type "U" means this attribute is user-defined, and Type "O" means the attribute is optional.

## B.1.1.1 Study Level

| Description        | Tag         | Type | SCU | SCP |
|--------------------|-------------|------|-----|-----|
| Query Level        | (0008,0052) | R    | ✓   | ✓   |
| Study Date         | (0008,0020) | R    | ✓   | M   |
| Study Time         | (0008,0030) | R    | ✓   | M   |
| Accession Number   | (0008,0050) | R    | ✓   | M   |
| Patient's Name     | (0010,0010) | R    | ✓   | M   |
| Patient ID         | (0010,0020) | R    | ✓   | M   |
| Study ID           | (0020,0010) | R    | ✓   | M   |
| Study Instance UID | (0020,000D) | U    | ✓   | M   |

Table 14: Study key

## B.1.1.2 Series Level

| Description         | Tag         | Type | SCU | SCP |
|---------------------|-------------|------|-----|-----|
| Query Level         | (0008,0052) | R    | ✓   | ✓   |
| Modality            | (0008,0060) | R    | ✓   | M   |
| Series Number       | (0020,0011) | R    | ✓   | M   |
| Series Instance UID | (0020,000E) | U    | ✓   | M   |
| Study Instance UID  | (0020,000D) | U    | ✓   | M   |

Table 15: Series key

## B.1.1.3 Composite Object Instance Level

## B.1.1.3.1.1 Image

| Description                 | Tag         | Type | SCU | SCP |
|-----------------------------|-------------|------|-----|-----|
| Query Level                 | (0008,0052) | R    | ✓   | ✓   |
| Image Number                | (0020,0013) | R    | ✓   | M   |
| SOP Instance UID            | (0008,0018) | U    | ✓   | M   |
| Series Instance UID         | (0020,000E) | U    | ✓   | M   |
| Study Instance UID          | (0020,000D) | U    | ✓   | M   |
| Image Type                  | (0008,0008) | O    | ✓   | M   |
| Image Date                  | (0008,0023) | O    | ✓   | M   |
| Image Time                  | (0008,0033) | O    | ✓   | M   |
| Referenced SOP Class UID    | (0008,1150) | O    | ✓   | M   |
| Referenced SOP Instance UID | (0008,1155) | O    | ✓   | M   |
| Referenced Beam Number      | (300C,0006) | O    | ✓   | M   |
| Patient ID                  | (0010,0020) | O    | ✓   |     |

|            |             |   |   |  |
|------------|-------------|---|---|--|
| Field Type | (3257,1000) | O | ✓ |  |
|------------|-------------|---|---|--|

**Table 16: Image key**

## B.1.1.3.1.2 Plan

| Description                  | Tag         | Type | SCU | SCP      |
|------------------------------|-------------|------|-----|----------|
| Query Level                  | (0008,0052) | R    | ✓   | ✓        |
| SOP Instance UID             | (0008,0018) | U    | ✓   | <b>M</b> |
| Series Instance UID          | (0020,000E) | U    | ✓   | <b>M</b> |
| Study Instance UID           | (0020,000D) | U    | ✓   | <b>M</b> |
| Patient's Name               | (0010,0010) | O    | ✓   | <b>M</b> |
| Patient ID                   | (0010,0020) | O    | ✓   | <b>M</b> |
| Plan Label                   | (300A,0002) | O    | ✓   | <b>M</b> |
| Plan Date                    | (300A,0006) | O    | ✓   | <b>M</b> |
| Plan Time                    | (300A,0007) | O    | ✓   | ✓        |
| Number of Beams              | (300A,0080) | O    | ✓   | ✓        |
| Referenced RT Plan Sequence  | (300C,0002) | O    | ✓   | ✓        |
| >Referenced SOP Class UID    | (0008,1150) | O    | ✓   | ✓        |
| >Referenced SOP Instance UID | (0008,1155) | O    | ✓   | ✓        |
| >RT Plan Relationship        | (300A,0055) | O    | ✓   | ✓        |
| Field Type                   | (3257,1000) | O    | ✓   |          |
| Plan Type                    | (3257,1001) | O    |     | ✓        |

**Table 17: Plan key**

## B.1.1.3.1.3 Treatment Record

| Description                      | Tag         | Type | SCU | SCP      |
|----------------------------------|-------------|------|-----|----------|
| Query Level                      | (0008,0052) | R    | ✓   | ✓        |
| SOP Instance UID                 | (0008,0018) | U    | ✓   | <b>M</b> |
| Series Instance UID              | (0020,000E) | U    | ✓   | <b>M</b> |
| Study Instance UID               | (0020,000D) | U    | ✓   | <b>M</b> |
| Referenced SOP Class UID         | (0008,1150) | O    | ✓   | <b>M</b> |
| Referenced SOP Instance UID      | (0008,1155) | O    | ✓   | <b>M</b> |
| Treatment Date                   | (3008,0250) | O    | ✓   | <b>M</b> |
| Treatment Time                   | (3008,0251) | O    | ✓   | <b>M</b> |
| Referenced Fraction Group Number | (300C,0022) | O    | ✓   | ✓        |
| Treatment Session Beam Sequence  | (3008,0020) | O    | ✓   | ✓        |
| >Referenced Beam Number          | (300C,0006) | O    | ✓   | ✓        |
| >Treatment Delivery Type         | (300A,00CE) | O    | ✓   | ✓        |
| >Treatment Termination Status    | (3008,002A) | O    | ✓   | ✓        |

|  |             |   |   |   |
|--|-------------|---|---|---|
| >Delivered Primary Meterset                    | (3008,0036) | O | ✓ | ✓ |
| >Current Fraction Number                       | (3008,0022) | O | ✓ | ✓ |
| >Treatment Date                                | (3008,0250) |   |   |   |
| >Treatment Time                                | (3008,0251) |   |   |   |
| >Referenced Calculated Dose Reference Sequence | (3008,0090) | O | ✓ | ✓ |
| >>Referenced Dose Reference Number             | (300C,0051) | O | ✓ | ✓ |
| >>Calculated Dose Reference Value              | (3008,0076) | O | ✓ | ✓ |
| >Control Point Delivery Sequence               | (3008,0040) | O | ✓ | ✓ |
| >>Referenced Control Point Index               | (300C,00F0) | O | ✓ | ✓ |
| >>Specified Meterset                           | (3008,0042) | O | ✓ | ✓ |
| >>Override Sequence                            | (3008,0060) | O | ✓ | ✓ |
| >>>Override Parameter Pointer                  | (3008,0062) | O | ✓ | ✓ |
| >>Gantry Angle                                 | (300A,011E) |   |   |   |

**Table 18: Treatment Record key**

## B 1.1.3.1.4 Treatment Summary Record

| Description  | Tag         | Type | SCU | SCP      |
|--|-------------|------|-----|----------|
| Query Level  | (0008,0052) | R    | ✓   | ✓        |
| Referenced SOP Class UID                             | (0008,1150) | O    | ✓   | <b>M</b> |
| Referenced SOP Instance UID                          | (0008,1155) | O    | ✓   | <b>M</b> |
| Current Treatment Status                             | (3008,0200) | O    | ✓   | ✓        |
| Number of Fractions Delivered                        | (3008,005A) | O    | ✓   | ✓        |
| Treatment Summary Calculated Dose Reference Sequence | (3008,0050) | O    | ✓   | ✓        |
| >Referenced Dose Reference Number                    | (300C,0051) | O    | ✓   | ✓        |
| >Dose Reference Description                          | (300A,0016) | O    | ✓   | ✓        |
| >Cumulative Dose to Dose Reference                   | (3008,0052) | O    | ✓   | ✓        |

**Table 19: Treatment Summary Record key**