

Integrating the Healthcare Enterprise



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**IHE Radiation Oncology
Technical Framework Supplement**

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**Treatment Delivery Workflow - II
(TDW-II)**

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Rev. 1.0 - Draft for Public Comment

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Please verify you have the most recent version of this document. See [here](#) for Trial Implementation and Final Text versions and [here](#) for Public Comment versions.

Foreword

30 This is a supplement to the IHE Radiation Oncology Technical Framework V1.8. Each supplement undergoes a process of public comment and trial implementation before being incorporated into the volumes of the Technical Frameworks.

This supplement is published on July 29, 2016 for Public Comment. Comments are invited and can be submitted at [http://www.ihe.net/Radiation Oncology Public Comments/](http://www.ihe.net/Radiation_Oncology_Public_Comments/). In order to be considered in development of the Trial Implementation version of the supplement, comments 35 must be received by August 28, 2016.

This supplement describes changes to the existing technical framework documents.

“Boxed” instructions like the sample below indicate to the Volume Editor how to integrate the relevant section(s) into the relevant Technical Framework volume.

<i>Amend Section X.X by the following:</i>
--

40 Where the amendment adds text, make the added text **bold underline**. Where the amendment removes text, make the removed text **~~bold strikethrough~~**. When entire new sections are added, introduce with editor’s instructions to “add new text” or similar, which for readability are not bolded or underlined.

45 General information about IHE can be found at: www.ihe.net.

Information about the IHE Radiation Oncology domain can be found at: ihe.net/IHE_Domains.

Information about the organization of IHE Technical Frameworks and Supplements and the process used to create them can be found at: http://ihe.net/IHE_Process and <http://ihe.net/Profiles>.

50 The current version of the IHE Radiation Oncology Technical Framework can be found at: http://ihe.net/Technical_Frameworks.

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205 Introduction to this Supplement

This supplement defines the Treatment Delivery Workflow - II Profile (TDW-II). It adds information to Volumes 1 and 2 of the IHE Radiation Oncology Technical Frameworks to describe the profile and define the actors and transactions that are present in the profile. The TDW-II Profile is an updated version of the 2010 TDW Profile. This profile uses the final text version of the DICOM^{®1} Unified Worklist and Procedure Step Service, while TDW used the trial implementation version of DICOM Supplements 74 (RT delivery instructions) and Supplement 96 (Unified Procedure Step). The final text is part of the DICOM Standard since 2011.

In this profile a single system, a Treatment Delivery Device (TDD), acquires delivery information from a Treatment Management System (TMS) and the Object Storage (OST) and performs a treatment delivery using internal verification (see DICOM Standard 2011 P3.3, A.64). Other optional activities, such as verification image acquisition, registration and patient positioning may be performed by this TDD, but are not explicitly scheduled in this profile.

Open Issues and Questions

220

#	Intr. in	Resp.	Description
16	11	Ulrich Busch	Just for confirmation: During the Review, inclusion of the Omitted Beam Task Sequence (300C,0111) in Section 7.4.2.1. IRT Beams Delivery Instruction Base should be reviewed and confirmed. In general, the inclusion was already decided by the TC – see Issue 14. However, the DICOM CP 1438 was not finished at this time, and it was not explicitly decided upon whether it should be mandatory.

Closed Issues

#	Intr. in	Resp.	Description
1		Ulrich Busch (ulrich.busch@varian.com)	Update of diagram to use new Transaction identifiers. Done in Revision 5.0

¹ DICOM is the registered trademark of the National Electrical Manufacturers Association for its standards publications relating to digital communications of medical information.

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#	Intr. in	Resp.	Description
2		Ulrich Busch (ulrich.busch@varian.com)	Check references to Section F.X and update them (some reminders are there). Done in Revision 4.0
3		Ulrich Busch (ulrich.busch@varian.com)	Check all table references. Done in Revision 4.0.
4		Ulrich Busch (ulrich.busch@varian.com)	Replace concept code for Scheduled Parameter Sequence by standardized code as requested by an appropriate change proposal of WG-07. Done in Revision 4.0
5		Ulrich Busch (ulrich.busch@varian.com)	Replace Performing Device with TDD. Done in Revision 4.0
6		Ulrich Busch (ulrich.busch@varian.com)	Re-number against new numbering (provided by Bruce). Done in Revision 4.0
7		Ulrich Busch (ulrich.busch@varian.com)	Independent verification that this TDW-II supplement is in adherence with Final versions of Supp 96 & 74/2011 DICOM Standard; identify differences between TDW I and TDW-II
8		Ulrich Busch (ulrich.busch@varian.com)	<p>(Done prior to Revision 4.0)</p> <p>From Uli, BBS:Action item from TC Meeting May 2011:</p> <p>ACTION: (Uli) Post the differences of Supp 96 and 74 between versions used in TDW and FT version.</p> <p>Those changes are as follows:</p> <p>Changes between the frozen draft version of Supplement 96 (fx2) and the second letter ballot version (lb2) were reviewed line-by-line by WG-07. The most important of these changes has been collected by Dave as follows:</p> <ul style="list-style-type: none"> • The SCU now assigns the Locking UID (formerly Transaction UID), not the SCP, primarily to avoid a small race condition. • The Input Information Sequence has been restructured to specify instance locations fully (see Table 10-3b). • A previous procedure that was replaced (e.g., ‘completed’ by the current one) can now be encoded (see Table C.X.4-1). • The Beam Number parameter formerly encoded as a Code Sequence must now be encoded in the Procedure Step Progress Description attribute (the code sequence has been deleted). WG-07 discussed this and considered that this information is not important enough in our context to warrant inclusion of a code sequence in the progress module to encode this. • Final state requirements have changed, including addition of a new final state type (‘P’). • The Study UID for output instances must be supplied by the SCP, but may be ignored by the SCU (the opposite of the situation in the Frozen Draft). • ‘Input Readiness State’ has been added, and is required. • Cancellation date/time has been added, and is required. • Date and Time attribute pairs have been changed to single DT attributes. • Some text attributes have been changed to CS.

IHE Radiation Oncology Technical Framework Supplement – Treatment Delivery Workflow-II (TDW-II)

#	Intr. in	Resp.	Description
9		Ulrich Busch (ulrich.busch@varian.com)	TC Meeting January 2013: We deliberately included TDW-RO-XX5 (new: RO-62) to annotate the start of radiation with a progress indication greater than 0. This should ensure, that the Worklist is exploited to ensure indication that the radiation starts. The question is whether we want to keep that concept or make XX5 optional / respectively remove it completely. TC Meeting May 2013: Decision: We want to have at least one progress update > 0 as soon as the TDD has information about that Radiation has started. Done in 5.1 – esp. review changes in RO-62 TC Meeting October 2013: Reconfirmed.
10		Ulrich Busch (ulrich.busch@varian.com)	TC Meeting January 2013: What do the requirements on character set in the Match/Return key table mean? Should we make a more general statement about character sets support for the whole profile? Done in 5.1 – added Appendix A. Not sure though yet, if that is the correct place, since in TF it would apply to all transactions, unless otherwise stated. Did not find a good approach in other profiles yet on that issue.
11		Ulrich Busch (ulrich.busch@varian.com)	TC Meeting January 2013: Clarify Storage Actor (TMS or OST). Should be updated along IPDW – just with less optionality, since we only store on SOP Class. Done in 5.1 – esp. review text in 9.1.1.3 Object Storage (OST)
12	5.0	Ulrich Busch (ulrich.busch@varian.com)	TC Meeting May 2013: Clarify, what headers shall be used on Tx Records, when the TDD has a local storage and has inconsistencies with the received data in those header data. Also define in detail which attributes are included in that header definition. Done in 5.1: Added definition to Section 3.63.4.1.2 Message Semantics.
13	6.0	Ulrich Busch (ulrich.busch@varian.com)	3.58.4.1.2.1 Matching Keys and Return Keys for Display: '-' means, that there are no additional requirements. ! This maybe mis-read by some readers. Of course it's required to provide them as empty keys to get the return values. Add an appropriate note.
14	9	Ulrich Busch	For a continuation fraction there is currently no facility in the BDI to declare, that some Beams have been completely treated in a prior fraction. Those beams are just not present. However, it is highly indicated to be able to tell the user, why a beam should not be treated in the current session. Therefore, WG-07 should investigate, whether it is possible to extend the Treatment Delivery Type (300A,00CE) by values of TREATED (and eventually SKIPPED). Include DICOM cp1438 Omitted Beams Sequence In BDI. 2015-09-30 U. Busch: Done in Version 11.
15	10	Chris Pauer	Check Section 9.5 TDW-II Security Considerations if it is still a relevant and effective wording. Eventually it can be improved or straightened. Also check, whether the provision in 3.63.4.1.2 Message Semantics about the following is still needed: In such cases, it is allowed to populate the static objects containing the Treatment Delivery Results with the header data of the locally stored objects, instead of the ones retrieved from the OST. 2015-09-30 U. Busch: Kept it since the conditions where TDW-II is applied did not change in that respect.

General Introduction

225 *Update the following Appendices to the General Introduction as indicated below. Note that these are not appendices to Volume 1.*

Appendix A – Actor Summary Definitions

Add the following actors to the IHE Technical Frameworks General Introduction list of actors:

Actor	Definition
Treatment Delivery Device	A system that delivers therapeutic radiation to a correctly positioned patient. It can receive and transmit the transactions as documented in this profile.
Treatment Management System	An information system that manages oncology information and is responsible for the scheduling of radiotherapy activities. In this profile the Treatment Management System also fulfills the role of archive.

230 Appendix B – Transaction Summary Definitions

Add the following transactions to the IHE Technical Frameworks General Introduction list of Transactions:

Transaction	Definition
RO-58: Worklist Query for Treatment Delivery	A TDD requests and receives a treatment delivery worklist from a TMS.
RO-59: Retrieve Static Treatment Delivery Input Instances from OST	A TDD requests and receives from the OST any ‘static’ SOP Class Instances required in order to perform the desired procedure steps returned by a previous query. Each requested SOP Instance must have been supplied in the Input Information Sequence of one the returned worklist items. These instances are of a persistent nature, specifically the RT Plan input instance.
RO-60: Treatment Delivery in Progress	A TDD signals to the TMS that responsibility has been taken to perform the selected procedure step by changing its status to IN PROGRESS.
RO-61: Retrieve Dynamic Treatment Delivery Input Instances from TMS	A TDD requests and receives SOP Class Instances from the TMS to support the execution of the selected procedure step. These requested instances are of a “transient” nature, specifically the RT Beams Delivery Instruction. Note that this transaction shall be present either before or after RO-60, but not both.
RO-62: Treatment Delivery Progress Update	A TDD signals to the TMS changes in the progress of the procedure step that is currently in progress. This transaction may occur more than once in this profile, as the delivery status changes.
RO-63: Store Treatment Delivery Results to OST	When a procedure step has been completed by a TDD, the results of the procedure step are stored to the OST. These results are referenced in the Output Information Sequence of the corresponding Unified Procedure Step.
RO-64: Treatment Delivery Final Update	A TDD signals to the TMS final changes in the properties of the procedure step that is currently in progress just prior to the UPS being signaled as completed or canceled.

Transaction	Definition
RO-65: Treatment Delivery Completed/Canceled	A TDD signals to the TMS that the selected procedure step has either been completed or canceled.

235 **Glossary**

Add the following glossary terms to the IHE Technical Frameworks General Introduction Glossary:

Glossary Term	Definition
TDD	Treatment Delivery Device
TMS	Treatment Management System
OST	Object Storage
UPS	Unified Procedure Step

240

Volume 1 – Profiles

Copyright Licenses

NA

Add the following to the IHE Technical Frameworks General Introduction Copyright section:

245 2014 DICOM Standard PS 3.3, 3.4, 3.7

Domain-specific additions

NA

250 *Add to Section ...*

9 Treatment Delivery Workflow – II (TDW-II) Profile

255 The Treatment Delivery Workflow - II Integration Profile describes the necessary workflow
between a Treatment Management System (TMS) and Treatment Delivery Device (TDD) for
treatment delivery. This profile grew out of the Technical Committee’s work on the Integrated
Positioning and Delivery Workflow (IPDW) Integration Profile, which was found to specify too
many required elements for some Treatment Delivery Devices. A number of commercially
available delivery machines either do not handle positioning interactions at all or they are not
260 externalized in significant or easily modifiable ways. This profile describes the workflow
between the TMS and TDD and when the TDD is largely only concerned with delivery
scheduling.

This profile is a workflow profile.

9.1 TDW-II Actors, Transactions, and Content Modules

265 This section defines the actors, transactions, and/or content modules in this profile. General
definitions of actors are given in the Technical Frameworks General Introduction Appendix A at
http://www.ihe.net/Technical_Framework/index.cfm.

Figure 9.1-1 shows the actors directly involved in the TDW-II Profile and the relevant
transactions between them. If needed for context, other actors that may be indirectly involved
due to their participation in other related profiles are shown in dotted lines. Actors which have a
270 mandatory grouping are shown in conjoined boxes.



Figure 9.1-1: TDW-II Actor Diagram

275

Table 9.1-1 lists the transactions for each actor directly involved in the TDW-II Profile. To claim compliance with this profile, an actor shall support all required transactions (labeled “R”) and may support the optional transactions (labeled “O”).

Table 9.1-1: TDW-II Profile - Actors and Transactions

Actors	Transactions	Optionality	Reference
Treatment Management System	RO-58 Worklist Query for Treatment Delivery	R	RO TF-2: 3.58
	RO-60 Treatment Delivery in Progress	R	RO TF-2: 3.60
	RO-61 Retrieve Dynamic Treatment Delivery Input Instances from TMS	R	RO TF-2: 3.61
	RO-62 Treatment Delivery Progress Update	R	RO TF-2: 3.62
	RO-63 Store Treatment Delivery Results to TMS	R	RO TF-2: 3.63
	RO-64 Treatment Delivery Final Update	R	RO TF-2: 3.64
	RO-65 Treatment Delivery Completed/Canceled	R	RO TF-2: 3.65
Treatment Delivery Device	RO-58 Worklist Query for Treatment Delivery	R	RO TF-2: 3.58
	RO-59 Retrieve Static Treatment Delivery Input Instances from OST	R	RO TF-2: 3.59
	RO-60 Treatment Delivery in Progress	R	RO TF-2: 3.60
	RO-61 Retrieve Dynamic Treatment Delivery Input Instances from TMS	R	RO TF-2: 3.61
	RO-62 Treatment Delivery Progress Update	R	RO TF-2: 3.62
	RO-64 Treatment Delivery Final Update	R	RO TF-2: 3.64
	RO-65 Treatment Delivery Completed/Canceled	R	RO TF-2: 3.65
Object Storage	TDW-RO-59 Retrieve Static Treatment Delivery Input Instances from OST	R	RO TF-2: 3.59
	RO-63 Store Treatment Delivery Results to OST	R	RO TF-2: 3.63

9.1.1 Actor Descriptions and Actor Profile Requirements

Most requirements are documented in Transactions (Volume 2) and Content Modules (Volume 3). This section documents any additional requirements on profile’s actors.

285 **9.1.1.1 Treatment Delivery Device (TDD)**

A system that delivers therapeutic radiation to a correctly positioned patient. It may perform other functions such as verification image acquisition, registration, and positioning, but is not required to do so. The TDD fulfills the role of a UPS-Pull ‘Pull Performer’ SCU as described in DICOM Standard Part 17 Table GGG.1-1. Note that the TDD actors in other IHE-RO profiles have functionality that is different from that described in this profile.

290 **9.1.1.2 Treatment Management System (TMS)**

An information system that manages oncology information and is responsible for the scheduling of radiotherapy activities (i.e., is a workflow manager). The TMS fulfills the role of a UPS-Pull ‘Worklist Manager’ SCP as described in DICOM Standard 2011 Part 17 Table GGG.1-1. Note that in this profile the TMS also fulfills the role of an Archive for the data objects; therefore, the Retrieve AE Title (0008,0054) supplied in Input and Output Information Sequences must be managed by the TMS. Note that the TMS actors in other IHE-RO profiles have functionality that is different from that described in this profile.

9.1.1.3 Object Storage (OST)

300 A system that supports retrieval and storage of the output objects by providing the SCP role of the DICOM Storage Service Class and the SCP role of the DICOM Query/Retrieve Service Class. For retrieval, the UPS Input Information sequence specifies the AE title from which the performing actor is to retrieve the input objects from.

305 The location, from which each class of objects shall be retrieved from, is defined by and at the discretion of each vendor’s TMS implementation.

For retrieval, the UPS Input Information sequence specifies the AE title from which the performing actor is to retrieve the input objects from.

The location, from which the RT Plan SOP instances shall be retrieved from, is defined by and at the discretion of each vendor’s TMS implementation.

310 The storage, where Treatment Record SOP instances are to be stored, is also defined by and at the discretion of each vendor’s TMS implementation.

A system that supports retrieval and storage of the output objects by providing the SCP role of the DICOM Storage Service Class and the SCP role of the DICOM Query/Retrieve Service Class.

315 **9.2 TDW-II Actor Options**

Options that may be selected for each actor in this profile, if any, are listed in the Table 9.2-1. Dependencies between options when applicable are specified in notes.

Table 9.2-1: Treatment Delivery Workflow - II - Actors and Options

Actor	Option Name	Reference
Treatment Delivery Device	Support of Multiple Targets	RO TF-2: 3.59
Treatment Management System	Support of Multiple Targets	RO TF-2: 3.59
Object Storage	No options defined	--

320

9.3 TDW-II Required Actor Groupings

Not applicable.

9.4 TDW-II Overview

9.4.1 Concepts

325 The Treatment Delivery Workflow II Integration Profile covers the delivery of a treatment session scheduled in a treatment management system and carried out by a treatment delivery device.

330 Driven by a worklist on the Treatment Management System (TMS), the Treatment Delivery Device (TDD) delivers the intended treatment. The TDD may optionally perform other unscheduled activities such as verification image acquisition, registration and positioning, but is not required to do so within the scope of this profile.

9.4.2 Use Case #1: Treatment Delivery Workflow

9.4.2.1 Treatment Delivery Workflow Use Case Description

335 The Treatment Delivery Workflow II Integration Profile describes the necessary workflow between a Treatment Management System (TMS) and Treatment Delivery Device (TDD) for treatment delivery. This profile addresses the use cases for TDDs, which handle imaging and positioning completely internally.

9.4.2.2 Treatment Delivery Workflow Process Flow

340 The process flow for the Treatment Delivery Workflow II Integration Profile is shown in Figure 9.4.2.2-1.

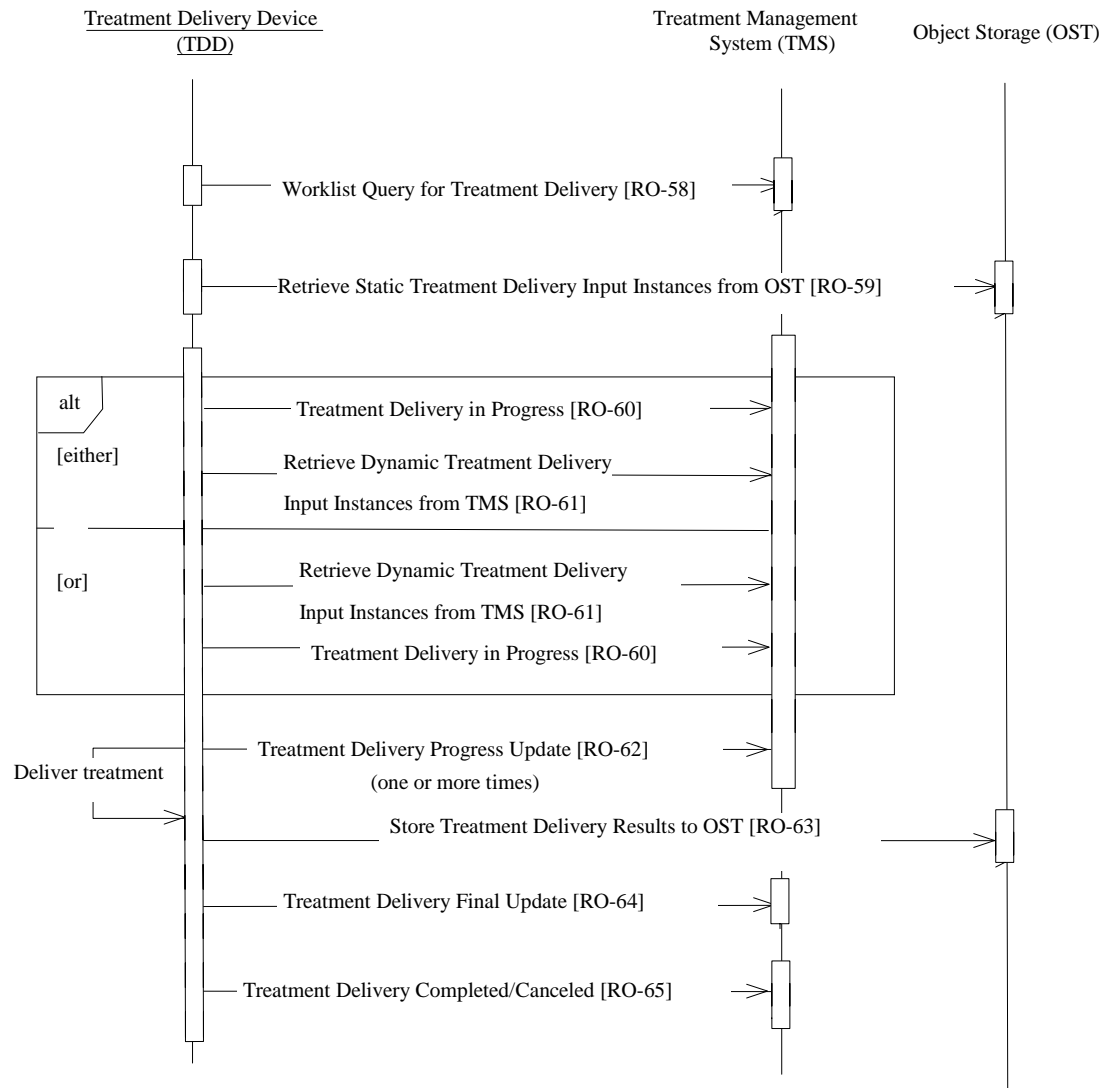


Figure 9.4.2.2-1: Basic Process Flow in TDW-II Profile

350 In Figure 9.4.2.2-1 above, transactions RO-60 and RO-61 may be performed in either order, as decided by the Treatment Delivery Device (TDD). One or the other (but not both) of these options must be taken.

Pre-conditions:

355 The Treatment Delivery Workflow - II Integration Profile requires that the TMS has previously received all information required (generated externally or internally) to effectively respond to queries issued by the TDD. In particular, the TMS must know the SOP Instance UID of the specific RT Plan to be delivered by the TDD. The OST is required to be in possession of the plan and the records in order to be able to fulfill its role as the repository of plans for the TMS. The TMS uses this repository to allow the user to select and schedule the plans to be treated. The TDD shall retrieve that plan from the OST to ensure that the plan treated is consistent with the plan having been scheduled in the TMS. The acquisition of such information by the OST is out
360 of band for this profile.

Main Flow:

The user at the TDD invokes a Worklist Query to request that the TMS sends a scheduled treatment delivery worklist. The TDD gets a list of Patients to be treated, which may have zero or more entries. If the patient to be treated is found, the user selects the patient to be treated.

365 The TDD delivers the treatment.

Once the treatment delivery is finished (completely or partially), the TDD reports the results of the treatment delivery session to the TMS.

Treatment Cancellation Prior to Radiation:

370 Cancellation of a treatment delivery during radiation is fully described by Figure 9.4.2.1-1, taking into account the different final state requirements of RO-64 and the CANCELED status in RO-65. However, when a cancellation occurs prior to radiation delivery, the process flow in this case is shown in Figure 9.4.2.1-1. Note from the Figure 9.4.2.2-1 that:

Any Treatment Delivery Progress Updates RO-62, if present, issued prior to cancellation will have a reported Procedure Step Progress (0074,1004) of 0% in this scenario.

375 The Treatment Delivery Final Update (RO-64) transaction will not be required to be performed if the Final State conditions (described in Table 7-1 in RO-64) have already been met by previous RO-62 transaction(s).

Treatment Completion:

380 An important use case associated with treatment delivery is that of treatment completion following a delivery interruption.

If the delivery interruption is of a transient nature (e.g., a temporary issue with the delivery machine or a patient position issue caused temporary interruption of the delivery), then the TDD may choose to manage the completion internally and notify the TMS that the UPS has finally completed normally.

385 If the delivery interruption leads to the UPS being moved to the ‘CANCELED’ state, this
requires that a new UPS be scheduled (e.g., if the completion requires re-planning or needs to be
performed in a different time slot). The TMS shall then manage the new UPS, specify a Text
Value of ‘CONTINUATION’ in the Scheduled Processing Parameters Sequence when returning
a query result, and supply the Start Meterset of the continuation treatment in the Delivery
390 Instruction.

Post-conditions:

After completion of the treatment delivery, the Treatment Delivery Result objects are stored in
the TMS and the UPS is updated with the state COMPLETED.

9.5 TDW-II Security Considerations

395 At a minimum, the consistency checks specified in this appendix shall be performed. Vendors
are expected to handle inconsistencies according to their hazard analysis. The relevant hazard
analysis information shall be made available upon request.

Where Patient Name components are mentioned, they must agree in First Name and Last Name
only (in default character set). Comparison may be case-insensitive.

400 In the UPS contained in the C-Find response it is expected that there will be consistency between
TMS response and TDD local data in the following elements, but no safety check is required at
this point, since no commitment to treat exists:

- a. Patient Name
- b. Patient ID
- 405 c. Patient DOB
- d. Patient Sex
- e. SOP Instance UID of RT Plan

In the RT Plan instance retrieved from the OST it is expected that there will be consistency with
TDD local data in the following elements:

- 410 a. Patient Name
- b. Patient ID
- c. Patient DOB
- d. Patient Sex
- e. SOP Instance UID of RT Plan
- 415 f. Number of Beams
- g. Beam Number for each beam to be treated

h. Beam Meterset for each beam in the Referenced Beam Sequence of the Fraction Group Sequence

420 i. Referenced Beam Number in the Referenced Beam Sequence of the Fraction Group Sequence

In the RT Beams Delivery Instruction instance retrieved from the TMS it is expected that there will be consistency with PDS local data in the following elements:

a. Patient Name

b. Patient ID

425 c. Patient DOB

d. Patient Sex

e. SOP Instance UID of RT Plan

f. Referenced Beam Number in the Beam Task Sequence

g. Continuation Start Meterset (if present) for each beam

430 h. Continuation End Meterset (if present) for each beam

All comparisons of Meterset values in RT Plan and RT Beams Delivery Instruction instances retrieved from the TMS must agree with corresponding TDD local data within clinically meaningful precision (as defined by the TDD).

435 Meterset values in RT Plan and RT Beams Delivery Instruction instances retrieved from the TMS must satisfy

a. Continuation Start Meterset ≥ 0

b. Continuation Start Meterset \leq Beam Meterset

c. Continuation End Meterset \leq Beam Meterset

d. Continuation End Meterset \geq Continuation Start Meterset

440 Inconsistency in Fraction Number is handled at the discretion of the TDD.

In case of inconsistency between RT Plan and RT Beams Delivery Instruction instances retrieved from the TMS and local data, the TDD must either (1) refuse treatment or (2) require user to override in a recorded and auditable manner.

a. Override of Meterset may be recorded in RT Beam Treatment Record, but it is not mandated.

445 b. Reason for cancellation may be reported in N-Set in UPS Discontinuation Reason Code Sequence.

The TDD will ensure that the RT Beams Treatment Record instance returned to the TMS is consistent with the RT Plan instance retrieved from the TMS:

a. Patient Name

- 450
 - b. Patient ID
 - c. Patient DOB
 - d. Patient Sex
 - e. SOP Instance UID of RT Plan in Referenced RT Plan Sequence
 - f. Referenced Beam Number
- 455 In case of inconsistency in the elements listed below between the RT Plan instance retrieved from the OST and the RT Beams Treatment Record instance returned by the TDD, the TMS will require audited review of the misidentified record(s):
 - a. Patient Name
 - b. Patient ID
- 460
 - c. Patient DOB
 - d. Patient Sex
 - e. SOP Instance UID of RT Plan in Referenced RT Plan Sequence
 - f. Referenced Beam Number

9.6 TDW-II Cross Profile Considerations

- 465 The profile supports scheduling of treatments and resumptions only, and does not cover transactions within the workflow for other procedures executed during a treatment session like image acquisition, matching and positioning. Those other use cases are handled by the Integrated Positioning and Delivery Workflow (IPDW) Integration Profile.

Appendices

470 None

Volume 2 – Transactions

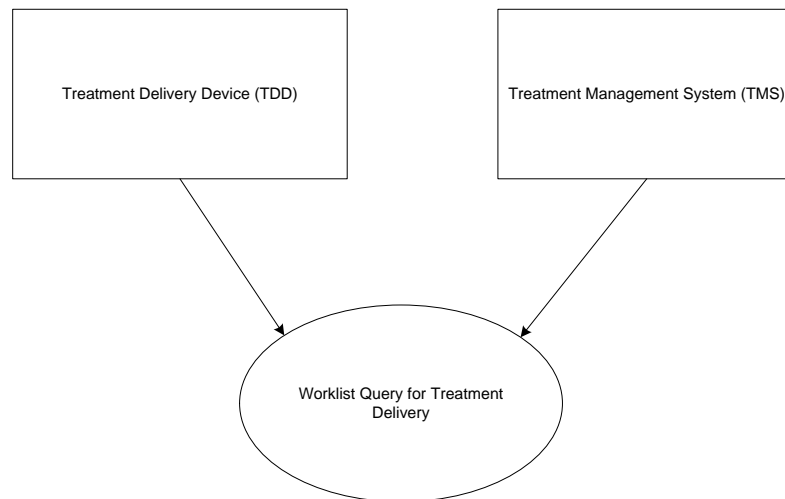
Add Section 3.58

3.58 Worklist Query for Treatment Delivery [RO-58]

3.58.1 Scope

475 In the Worklist Query for Treatment Delivery transaction, a TDD requests and receives a treatment delivery worklist from a TMS.

3.58.2 Actor Roles



480

Figure 3.58.2-1: Use Case Diagram

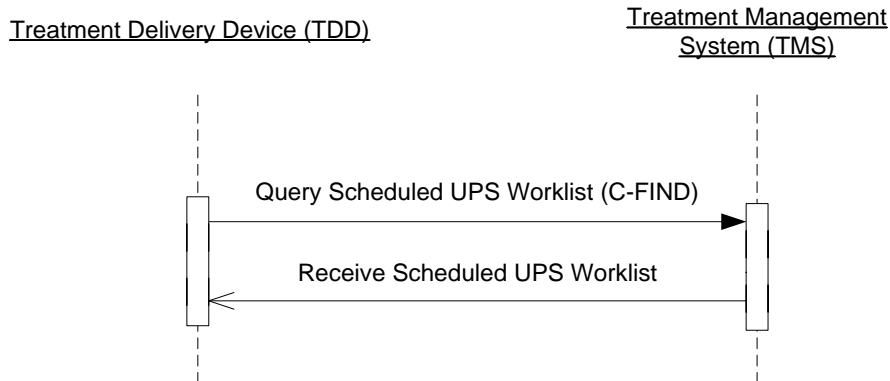
Table 3.58.2-1: Actor Roles

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

485 **3.58.3 Referenced Standards**

DICOM 2014c Edition PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.58.4 Interaction Diagram



490

3.58.4.1 Query Scheduled UPS Worklist Message

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

3.58.4.1.1 Trigger Events

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

3.58.4.1.2 Message Semantics

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

Matching Keys and Return Keys for Display

The TMS replies to the query with a set of zero or more UPS C-FIND responses containing scheduled treatment delivery worklist items, followed by a C-FIND final response.

Matching Key and Return Key requirements are defined in Section 7.5.1.2.1.

505 **3.58.4.1.3 Expected Actions**

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

3.58.4.2 Receive Scheduled UPS Worklist Message

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

3.58.4.2.1 Trigger Events

The TDD receives the UPS as requested by the query.

3.58.4.2.2 Message Semantics

515 For the Worklist Query for Treatment Delivery transaction exactly one Unified Procedure Step (UPS C-FIND response in the ‘pending’ state) shall be returned for each matching treatment session. For each response:

Scheduled Procedure Step Code Sequence (0040,4018) Code Value shall be equal to ‘121726’ (RT Treatment with Internal Verification) and Coding Scheme Designator shall be equal to ‘DCM’.

520 The Input Information Sequence (0040,4021) shall contain reference to a least the following items (additional items may be supplied for continuation procedures or other reasons, but are not required):

- The RT Plan SOP Instance to be delivered
- An RT Beams Delivery Instruction SOP Instance

525 Object Retrieval:

The UPS Input Information Sequence specifies AE title(s) from which input objects are to be retrieved. Storage location(s) are defined by the provider of the TMS Actor, at the discretion of this provider. Configuration of AE Titles for object retrieval is communicated out of band.

530 As stated in Note 5 of Table 3.58.4-2, the Scheduled Processing Parameters Sequence (0074,1210) shall contain a Text Value (0040,A160) of ‘CONTINUATION’ for scheduled treatment delivery procedures that complete a previously interrupted UPS (that ended in the ‘CANCELED’ state), and a Text Value of ‘TREATMENT’ otherwise. This parameter indicates the requested scope on plan level for current fraction.

535 The RT Beams Delivery Instruction SOP Instance referenced in the Input Information Sequence of the UPS response will have the value 'CONTINUATION' in the Treatment Delivery Type (300A,00CE) attribute for beam(s) which have been partially radiated. Beams which have not yet been treated at all during the execution of the previous UPS will have the value 'TREATMENT'.

540 Note that no beam in the Beam Delivery instruction may have a value of 'CONTINUATION' in the case, when some beams have been treated completely, but the other beam of the plans have not yet been started at all during the execution of the previous UPS. In this case the all of the latter beams will have the value 'TREATMENT' in the RT Beams Delivery Instruction of the current UPS.

545 Note that in the case of a 'CONTINUATION', the attributes describing the continuation are documented in DICOM 2014c Edition P3 -C.8.8.29. In case of 'CONTINUATION' treatments, Primary Dosimeter Unit (300A,00B3), Continuation Start Meterset (0074,0120), and Continuation End Meterset (0074,0121) shall be supplied in the RT Beams Delivery Instruction. Note that the Value Representation for Continuation Start Meterset and Continuation End Meterset is 'FD' (double-precision floating point).

3.58.4.2.3 Expected Actions

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

3.58.5 Security Considerations

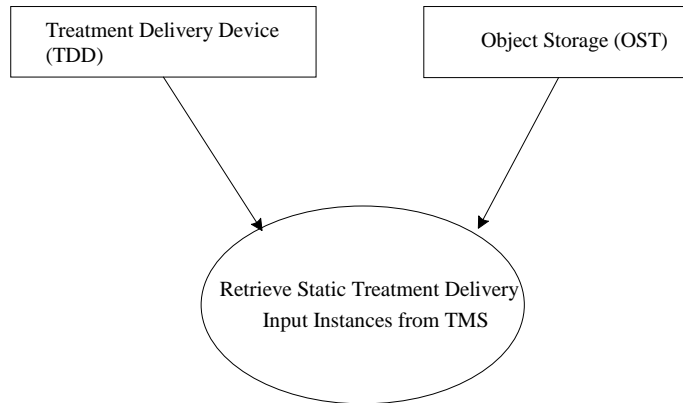
See Section 2.51.5 TDW-II Security Considerations

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

3.59.1 Scope

560 In the Retrieve Static Treatment Input Instances from OST transaction, a TDD requests and receives from the OST any 'static' SOP Class Instances required for performing the desired Scheduled Treatment Delivery procedure steps returned by a previous query. Each SOP instance must have been supplied in the Input Information Sequence of one or more of the returned worklist items.

3.59.2 Actor Roles



565

Figure 3.59.2-1: Use Case Diagram

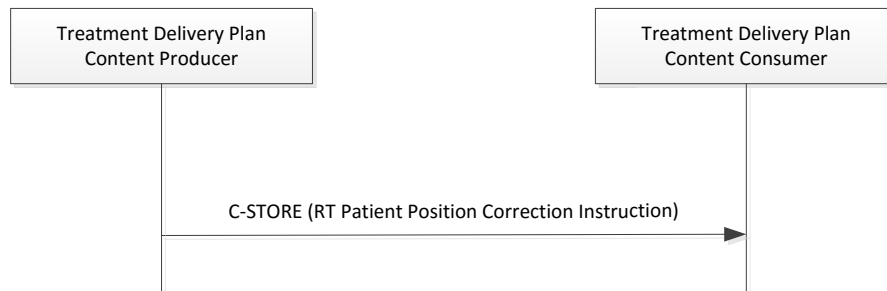
Table 3.59.2-1: Actor Roles

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

3.59.3 Referenced Standards

- 570 DICOM 2014c Edition PS 3.3: RT Modules
- DICOM 2014c Edition PS 3.4: Storage Service Class
- DICOM 2014c Edition PS 3.4: Query/Retrieve Service Class

3.59.4 Interaction Diagram



575

3.59.4.1 Retrieve Objects Message

580 The Study Root Query/Retrieve Information Model – MOVE SOP Class shall be supported. SCP implementations shall support the instance-level mode of operation in which specific SOP Instances are retrieved from the OST using a Study Root C-MOVE. Refer to DICOM 2014c Edition PS 3.4, Annex C, for detailed descriptive semantics.

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

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

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

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

3.59.4.1.1 Trigger Events

595 The TDD, in order to perform a treatment delivery, requests one or more of the referenced objects in the Input Information Sequence (0040,4021) of the selected procedure step.

3.59.4.1.2 Message Semantics

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

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

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

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

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

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

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

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

SOP Class Name	SOP Class UID	DICOM Content Specification
RT Plan Storage	1.2.840.10008.5.1.4.1.1.481.5	RT Plans shall conform to 7.3.2.1.2 RT Plan IOD for Photon External Beam in Delivery State, when the treatment technique is covered by that specification. All Plans IODs shall conform to 7.3.2.2.3 RT Plan IOD for Consistent Dose Tracking
RT Ion Plan Storage	1.2.840.10008.5.1.4.1.1.481.8	All Plans IODs shall conform to 7.3.2.2.3 RT Ion Plan IOD for Consistent Dose Tracking

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

Multiple Targets Option

The Plan retrieved from the Object Storage (OST) may include Multiple Targets as defined in Consistent Dose for External Beam (CDEB), when this Option is supported.

625 **3.59.4.1.3 Expected Actions**

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

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

3.59.5 Security Considerations

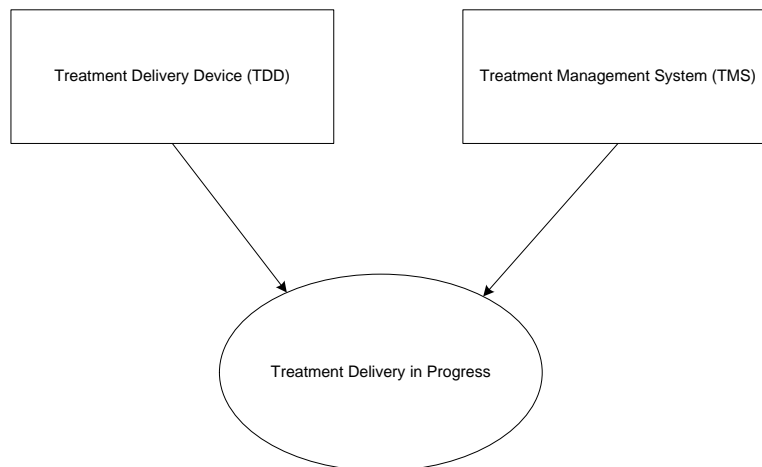
See Section 2.51.5 TDW-II Security Considerations.

3.60 Treatment Delivery in Progress [RO-60]

635 **3.60.1 Scope**

In the Treatment Delivery in Progress transaction, a TDD signals to the TMS that responsibility has been taken for the performing of the selected procedure step.

3.60.2 Actor Roles



640

Figure 3.60.2-1: Use Case Diagram

Table 3.60.2-1: Actor Roles

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

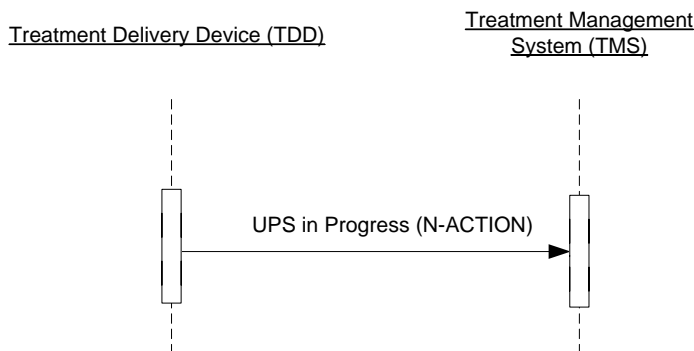
Role:	Responds to a UPS N-ACTION and recognizes the specified UPS as in progress, thereby preventing any other actors from performing the step. Receives and saves the Transaction UID as 'Locking UID'
Actor:	Treatment Delivery Device
Role:	Signals using UPS N-ACTION that the selected procedure step is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

645

3.60.3 Referenced Standards

DICOM 2014c Edition PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.60.4 Interaction Diagram



650

3.60.4.1 UPS in Progress Message

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

655

3.60.4.1.1 Trigger Events

The TDD has successfully queried and selected a suitable procedure step. It may also have retrieved 'dynamic' input instances using TDW-R0-XX4 prior to this step.

660

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

3.60.4.1.2 Message Semantics

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

3.60.4.1.3 Expected Actions

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

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

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

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

3.60.5 Security Considerations

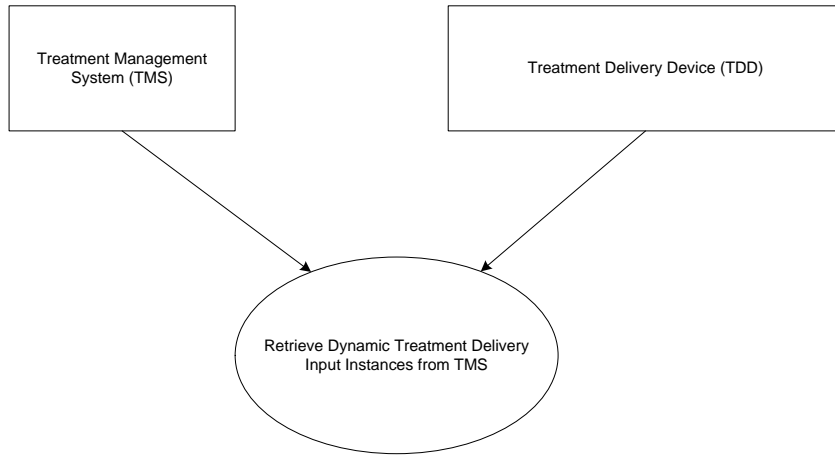
Not applicable.

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

3.61.1 Scope

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

3.61.2 Actor Roles



695

Figure 3.61.2-1: Use Case Diagram

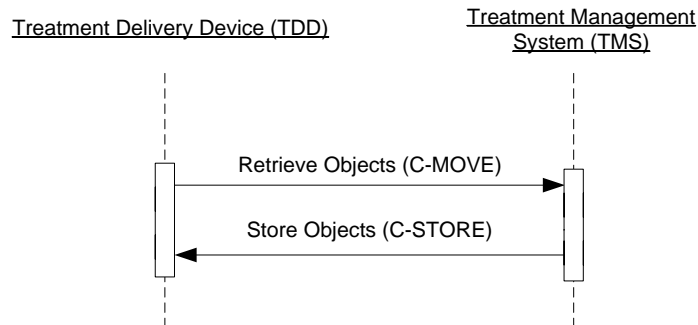
Table 3.61.2-1: Actor Roles

Actor:	Treatment Management System
Role:	Sends requested DICOM objects to the TDD
Actor:	Treatment Delivery Device
Role:	Retrieves requested DICOM objects from the TMS

3.61.3 Referenced Standards

- 700 DICOM 2014c Edition PS 3.3
- DICOM 2014c Edition PS 3.4: Storage Service Class
- DICOM 2014c Edition PS 3.4: Query/Retrieve Service Class

3.61.4 Interaction Diagram



705

3.61.4.1 Retrieve Objects Message

The Study Root Query/Retrieve Information Model - MOVE SOP Class shall be supported to the Instance-level. Implementations shall support a mode of operation in which specific SOP
710 Instances (rather than entire studies) are retrieved from the TMS using a Study Root C-MOVE. Refer to DICOM 2014c Edition PS 3.4, Annex C, for detailed descriptive semantics.

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

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

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

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

3.61.4.1.1 Trigger Events

The TDD has successfully queried and selected a suitable procedure step. It may also have set the UPS in progress using TDW-R0-XX3 prior to this step.

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

3.61.4.1.2 Message Semantics

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

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

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

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

Table 3.61.4.1.2-1: Required SOP Class Support for TMS on C-MOVE Request

SOP Class Name	SOP Class UID	DICOM Content Specification
RT Beams Delivery Instruction Storage	1.2.840.10008.5.1.4.34.7	See 7.3.6.1.1 RT Beams Delivery Instruction IOD

740

3.61.4.1.3 Expected Actions

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

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

750 When the RT Beams Delivery Instruction SOP Instance referenced in the Input Information Sequence of the UPS response will have the value 'CONTINUATION' in the Treatment Delivery Type (300A,00CE) for certain beam(s), the Treatment Delivery Device is expected to treat those beams by resuming the previous partial treatment, observing the Continuation Start Meterset (0074,0120), and Continuation End Meterset (0074,0121).

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

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

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

3.61.5 Security Considerations

760 See Section 2.51.5 TDW-II Security Considerations

3.62 Treatment Delivery Progress Update [RO-62]

3.62.1 Scope

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

765 **3.62.2 Actor Roles**

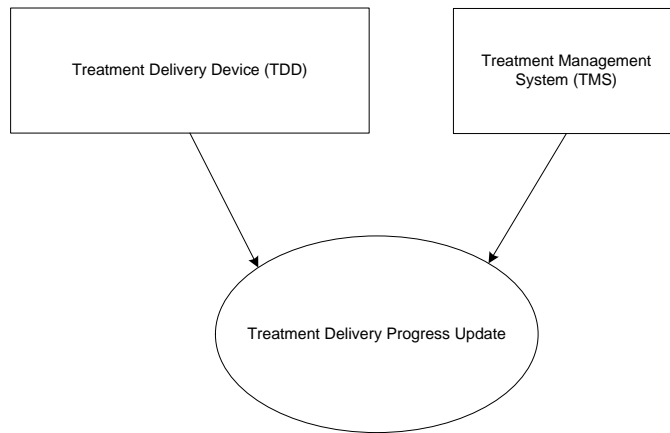


Figure 3.62.2-1: Use Case Diagram

770

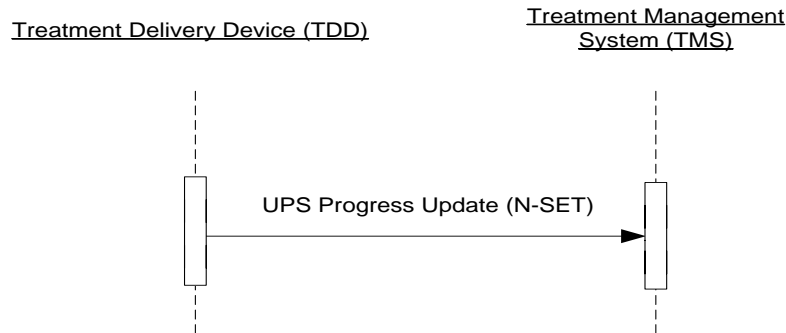
Table 3.62.2-1: Actor Roles

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

3.62.3 Referenced Standards

DICOM 2014c Edition PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

775 **3.62.4 Interaction Diagram**



3.62.4.1 UPS Progress Update Message

780 The TDD uses the UPS N-SET service to inform the TMS that progress relating to the specified Unified Procedure Step has changed. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the SOP Class of an UPS in all subsequent DIMSE messaging (see DICOM Standard, P3.4 CC.2.8.1.2.1).

3.62.4.1.1 Trigger Events

785 The TDD is in the process of performing the procedure step, and wishes to notify the TMS of changes in the progress of the procedure step. Specifically:

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

790 On the first occasion, when the TDD got information, that the treatment machine has started radiating, it shall invoke this transaction indicating progress of between 0% and 100%, and indicating the Referenced Beam Number in Progress.

During delivery, The TDD may notify the TMS repeatedly, that work has advanced by indicating progress of between 0% and 100%, and indicating the Referenced Beam Number in Progress.

795 **3.62.4.1.2 Message Semantics**

The message semantics are defined in the DICOM Standard.

Minimum requirements for SCUs using the UPS N-SET command for this transaction are detailed in Table 3.62.4-1. Note that at least one of the N-SET commands issued for a given UPS must contain the UPS Performed Procedure Sequence (0074,1216). The Final State requirements
800 for the UPS may be met by this transaction in the case where the UPS is subsequently cancelled

prior to radiation delivery, but if not they will ultimately be met by Treatment Delivery Final Update [RO-64], as specified in Table 3.64.4-1.

805

Table 3.62.4-1: UPS N-SET Attribute Requirements for Treatment Delivery Progress Update Transaction

Attribute Name	Tag	Type	IHE-RO Additional Requirements on SCU
Unified Procedure Step Progress Information Module			
Procedure Step Progress Information Sequence	(0074,1002)	R+*	Required by IHE-RO in all instances of this transaction.
> Procedure Step Progress	(0074,1004)	R+*	
Unified Procedure Step Performed Procedure Information Module			
UPS Performed Procedure Sequence	(0074,1216)	R+*	
>Output Information Sequence	(0040,4033)	R+*	Shall be empty

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

3.62.4.1.3 Expected Actions

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

810 **3.62.5 Security Considerations**

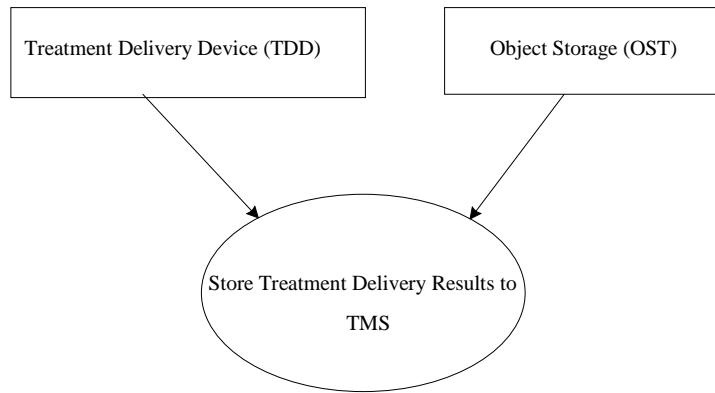
Not applicable.

3.63 Store Treatment Delivery Results to TMS [RO-63]

3.63.1 Scope

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

3.63.2 Actor Roles



820

Figure 3.63.2-1: Use Case Diagram

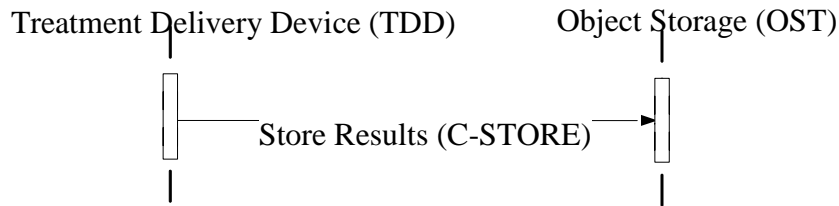
Table 3.63.2-1: Actor Roles

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

825 3.63.3 Referenced Standards

DICOM 2014c Edition PS 3.4: Storage Service Class

3.63.4 Interaction Diagram



830

3.63.4.1 Store Results Message

The C-STORE Service shall be supported. The DICOM Object Storage SOP Classes as specified below will be supported by the OST as an SCP. Refer to DICOM 2014c Edition PS 3.4, Annex C, for detailed descriptive semantics.

3.63.4.1.1 Trigger Events

The TDD has completed a treatment delivery and wishes to store the generated results of the delivery operation.

3.63.4.1.2 Message Semantics

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

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

In implementations where the TDD maintains a local storage of the RT Plan SOP instances, the Patient Header data may differ from those in the SOP instances retrieved from the OST. In such cases, it is allowed to populate the static objects containing the Treatment Delivery Results with the header data of the locally stored objects, instead of the ones retrieved from the OST.

845

A participating TDD must support this transaction for the object listed in Table 3.63.4-1.

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

SOP Class Name	SOP Class UID	DICOM Content Specification
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Treatment Records IODs shall conform to 7.3.6.2.1 RT Treatment Record IOD for Consistent Dose Tracking.
RT Ion Beams Tx Record	1.2.840.10008.5.1.4.1.1.481.9	Treatment Records IODs shall conform to 7.3.6.2.1 RT Treatment Record IOD for Consistent Dose Tracking.

A participating OST must support this transaction for the object listed in Table 3.63.4-2.

850

Table 3.63.4-2: Required SOP Class Support for TMS (SCP)

SOP Class Name	SOP Class UID	DICOM Content Specification
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4	Treatment Records IODs shall conform to 7.3.6.2.1 RT Treatment Record IOD for Consistent Dose Tracking.
RT Ion Beams Tx Record	1.2.840.10008.5.1.4.1.1.481.9	Treatment Records IODs shall conform to 7.3.6.2.1 RT Treatment Record IOD for Consistent Dose Tracking.

3.63.4.1.3 Expected Actions

The OST stores the objects received.

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

3.63.5 Security Considerations

See Section 2.51.5 TDW-II Security Considerations

3.64 Treatment Delivery Final Update [RO-64]

860 3.64.1 Scope

In the Treatment Delivery Final Update transaction, a TDD signals to the TMS any changes in the properties of the procedure step that is currently in progress prior to the UPS being signaled as completed or canceled.

3.64.2 Actor Roles

865

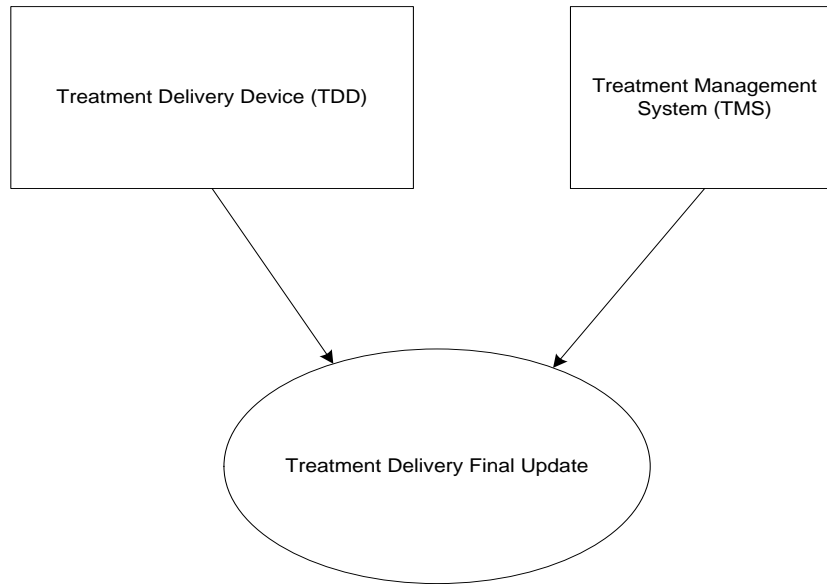


Figure 3.64.2-1: Use Case Diagram

870

Table 3.64.2-1: Actor Roles

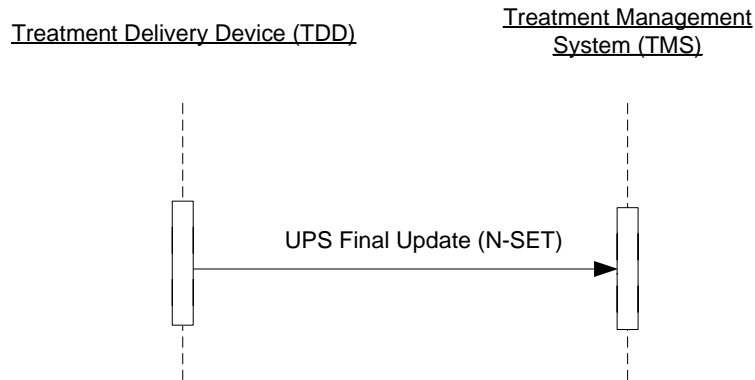
Actor:	Treatment Management System
Role:	Responds to a UPS N-SET and updates attributes in the specified Unified Procedure Step.
Actor:	Treatment Delivery Device
Role:	Signals using UPS N-SET that that certain attributes related to the selected procedure step have changed

3.64.3 Referenced Standards

DICOM 2014c Edition PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.64.4 Interaction Diagram

875



3.64.4.1 UPS Final Update Message

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

3.64.4.1.1 Trigger Events

The TDD has finished the execution of the procedure step.

3.64.4.1.2 Message Semantics

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

890 Requirement for SCUs using the UPS N-SET command are detailed in Table 3.64.4-1. The table contains only those attributes having a Final State requirement of ‘R’ (required if procedure is COMPLETED or CANCELED) or ‘X’ (required if procedure is COMPLETED). Of particular note is the last column which indicates the attributes that must be supplied by the SCU in the N-SET command in order to satisfy the Final State requirements. Note that IHE-RO is more restrictive than DICOM Standard in that a number of attributes are required to be set for all UPS N-SET commands. DICOM Standard only requires that the attributes have been set by any N-SET or N-ACTION message prior to the procedure step being moved into the COMPLETED or
895 CANCELED state.

The TDD shall send at least one item in the Performed Procedure Step Code Sequence (0040,4019). Other items may be sent representing other unscheduled activities performed by the TDD, but these may be ignored by the TMS.

900 The required item shall have a Code Value equal to ‘121726’ (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to ‘DCM’.

Table 3.64.4-1: UPS N-Set Final State Attribute Requirements

Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
SOP Common Information Module				
Specific Character Set	(0008,0005)	1C/1C (Required if extended or replacement character set is used)	Set if required	See Section 7.2.1.1.
SOP Class UID	(0008,0016)	Not allowed	R*	Affected SOP Class (0000,0002) is always ‘UPS-Push’ SOP Class
SOP Instance UID	(0008,0018)	Not allowed.	R*	Affected SOP Instance (0000,1000) supplied by C-FIND responses of UPS query
Unified Procedure Step Progress Information Module				
Procedure Step State	(0074,1000)	Not Allowed. Use N-ACTION	R*	
Unified Procedure Step Scheduled Procedure Information Module				
Scheduled Procedure Step Modification Date and Time	(0040,4010)	-/1 SCP will use time of SET	O*	Supplied implicitly by TMS – not required in N-SET.
Unified Procedure Step Performed Procedure Information Module				
UPS Performed Procedure Sequence	(0074,1216)	3/2	R*	Supplied by this transaction in IHE-RO, if UPS was not ‘CANCELED’ prior to radiation delivery. May be supplied otherwise.
>Actual Human Performers Sequence	(0040,4035)	3/1	RC*	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer Code Sequence	(0040,4009)	3/1	RC*	Shall be provided if known. Not required to be known in IHE-RO.
>>Human Performer’s Name	(0040,4037)	3/1	RC	Shall be provided if known. Not required to be known in IHE-RO.
>Performed Station Name Code Sequence	(0040,4028)	3/2	R*	Supplied by this transaction in IHE-RO.
>>Code Value	(0008,0100)	1/1	R	Name of machine performing UPS. Supplied by this transaction in IHE-RO.

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Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
>>Coding Scheme Designator	(0008,0102)	1/1	R*	Any private coding scheme designator. Supplied by this transaction in IHE-RO.
>>Code Meaning	(0008,0104)	1/1	R*	Value shall be 'Performed Station Name'. Supplied by this transaction in IHE-RO.
>Performed Procedure Step Start DateTime	(0040,4050)	3/1	R	Supplied by this transaction in IHE-RO
>Performed Workitem Code Sequence	(0040,4019)	3/1	R*	Supplied by this transaction in IHE-RO. See Y.3.4.1.2.
>>Code Value	(0008,0100)	1/1	R*	Performed work item code value. Supplied by this transaction in IHE-RO.
>>Coding Scheme Designator	(0008,0102)	1/1	R*	Value shall be 'DCM'. Supplied by this transaction in IHE-RO.
>>Code Meaning	(0008,0104)	1/1	R	Supplied by this transaction IHE-RO.
>Performed Procedure Step End DateTime	(0040,4051)	3/1	R*	Supplied by this transaction in IHE-RO
>Output Information Sequence	(0040,4033)	2/2	R*	Supplied by this transaction IHE-RO. May be empty (null) in N-SET if no output objects are created.
>>Type of Instances	(0040,E020)	1	R*	Supplied by this transaction in IHE -RO Value shall be "DICOM"
>>Study Instance UID	(0020,000D)	1C	R*	Supplied by this transaction in IHE -RO
>>Series Instance UID	(0020,000E)	1C	R*	Supplied by this transaction in IHE -RO
>>Referenced SOP Sequence	(0008,1199)	1	R*	Supplied by this transaction in IHE -RO
>>>Referenced SOP Class UID	(0008,1150)	1	R*	Supplied by this transaction in IHE -RO
>>>Referenced SOP Instance UID	(0008,1155)	1	R*	Supplied by this transaction in IHE -RO
>>>HL7 ² Instance Identifier	(0040,E001)	1C	RC+	Shall not be used in IHE -RO

² HL7 is the registered trademark of Health Level Seven International.

Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
>>>Referenced Frame Number	(0008,1160)	1C	RC+	Shall not be used in IHE –RO
>>>Referenced Segment Number	(0062,000B)	1C	RC+	Shall not be used in IHE –RO
>>DICOM Retrieval Sequence	(0040,E021)	1C	R	
>>>Retrieve AE Title	(0008,0054)	1	R	
>>Media Retrieval Sequence	(0040,E022)	1C	RC	Shall not be used in IHE -RO
>>>Storage Media File-Set ID	(0088,0130)	2		
>>>Storage Media File-Set UID	(0088,0140)	1		
>>WADO Retrieval Sequence	(0040,E023)	1C	RC	Shall not be used in IHE -RO
>>>Retrieve URI	(0040,E010)	1		
XDS Retrieval Sequence	(0040,E024)	1C	RC	Shall not be used in IHE -RO
>>>Repository Unique ID	(0040,E030)	1		
>>>Home Community ID	(0040,E031)	3		

3.64.4.1.3 Expected Actions

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

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

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

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

3.64.5 Security Considerations

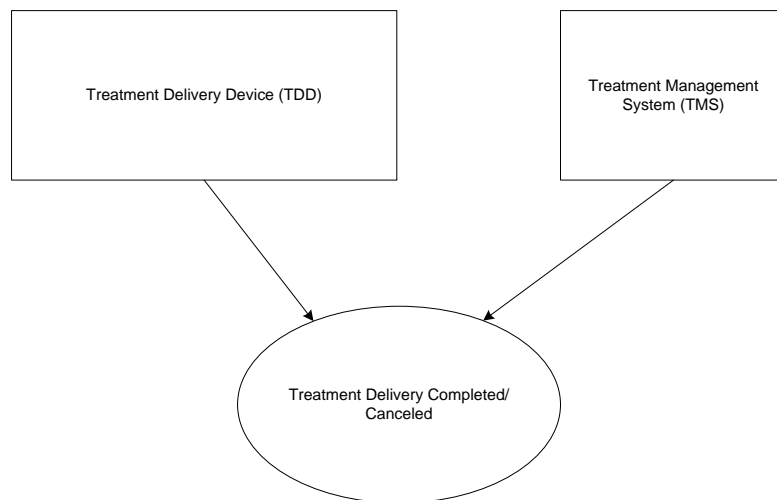
Not applicable.

3.65 Treatment Delivery Completed/Canceled [RO-65]

3.65.1 Scope

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

3.65.2 Actor Roles



925

Figure 3.65.2-1: Use Case Diagram

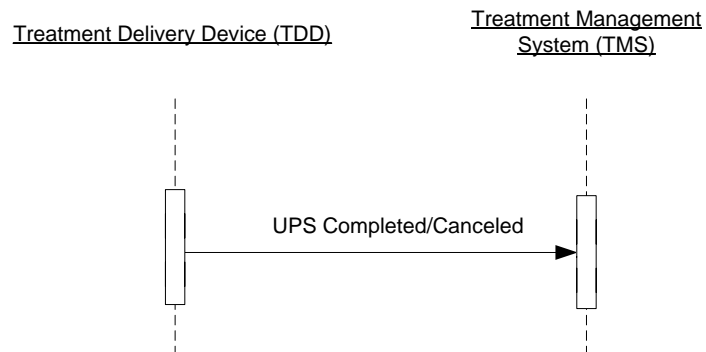
Table 3.65.2-1: Actor Roles

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

930 **3.65.3 Referenced Standards**

DICOM 2014c Edition PS 3.4: Annex CC Unified Procedure Step Service and SOP Classes

3.65.4 Interaction Diagram



935

3.65.4.1 UPS Completed/Canceled Message

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

940

3.65.4.1.1 Trigger Events

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

945

3.65.4.1.2 Message Semantics

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

3.65.4.1.3 Expected Actions

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

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

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

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

970 DICOM Standard outlines the final state requirements for the UPS N-ACTION command, i.e., the attributes which must be valued before the procedure step is allowed to pass into the COMPLETED or CANCELED state. The stated requirements for TDW-RO-5XX5: Treatment Delivery Progress Update, RO-60: Treatment Delivery in Progress, and RO-64: Treatment Delivery Final Update ensure that these conditions are met.

3.65.5 Security Considerations

975 Not applicable.

Appendices

Not applicable.

Volume 2 Namespace Additions

980 Not applicable.

Volume 3 – Content Modules

985 **7 DICOM Content Definition**

7.1 Conventions

No change to framework

7.1.1 Scope of Requirements

No change to framework

990 **7.1.2 Requirements Definitions**

No change to framework

7.1.3 Requirement Inheritance

No change to framework

7.1.4 Display Requirements

995 No change to framework

7.1.5 Service Specification

7.1.5.1 Query Keys

1000 When a Query Key specifications contains “R”, “R+” or “R+*”, the SCU is required to query for matching on the attributes. '-' indicates, that there are no additional requirements in respect to the DICOM Standard. Non-empty keys are not allowed to be provided by the SCU.

When a Query Key Return specification contains "R", the SCU must provide the key with a zero length value for Universal Matching, in which case the SCP shall return those attributes in the response.

1005 When the Query Key Return specification contains "O", the SCU may choose to provide such keys for Universal Matching, but the SCP must support matching on this key.

'-' in a cell means, that there are no additional requirements by IHE compared with the DICOM requirements. Implementer shall be aware though, that DICOM requires empty attributes to be present where return values are expected. Therefore '-' must not be read as permitting absence of those attributes in the C-FIND command when such return values shall be present.

1010 **7.2 General Definitions**

7.2.1 Character Sets

7.2.1.1 Support of Character Sets other than ISO-IR 100

1015 All actors shall support at least the Default Character Set and ISO-IR 100 (Latin-1) in all transactions. Other character sets shall be supported along the specification of the conformance statements of the involved actors. Especially that means the following:

It shall be possible for all actors involved in a transaction to use those character sets in their communication which all actors support along their conformance statements.

When there are no character sets shared across all actors, ISO-RO 100 shall be used.

1020 Where C-FIND is used, the Identifier (Matching Query Keys) may include the Specific Character Set (0008,0005) specifying a character set which is supported by all involved actors. In accordance with the specifications of the DICOM Standard, this attribute is never used for matching, but specifies how other Attributes are encoded in the Request and Response Identifiers.

7.3 IOD Definitions

1025 **7.3.1 (Reserved)**

7.3.2 (Reserved)

7.3.3 (Reserved)

7.3.4 (Reserved)

7.3.5 (Reserved)

1030 **7.3.6 Workflow IOD**

7.3.6.1 Delivery Instruction

7.3.6.1.1 RT Beams Delivery Instruction IOD

IE	Module	Reference	Usage	IHE Usage
Patient	Patient	C.7.1.1	M	M See 7.4.1.1.1

IE	Module	Reference	Usage	IHE Usage
	Clinical Trial Subject	C.7.1.3	U	U
Study	General Study	C.7.2.1	M	M See 7.4.1.2.1
	Patient Study	C.7.2.2	U	U
	Clinical Trial Study	C.7.2.3	U	U
Series	General Series	C.7.3.1	M	M
	Clinical Trial Series	C.7.3.2	U	U
Equipment	General Equipment	C.7.5.1	M	M See 7.4.1.5.1
Plan	RT Beams Delivery Instruction	C.8.8.29	M	M See 7.4.2.1.1
	Common Instance Reference	C.12.2	C - Required if not conveyed by a Unified Procedure Step. May be present otherwise.	C
	SOP Common	C.12.1	M	M See 7.4.1.6.1

1035 **7.4 Module Definitions**

7.4.1 General Modules

This section is present only to convey the envisioned section numbering.

7.4.2 Workflow Modules

7.4.2.1 RT Beams Delivery Instruction Module

1040 **7.4.2.1.1 RT Beams Delivery Instruction Base**

Attribute Name	Tag	Type	Description

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(TDW-II)

Attribute Name	Tag	Type	Description
Beam Task Sequence	(0074,1020)	1	Specification of beams to be delivered and/or verified. One or more Items shall be included in this sequence.
>Current Fraction Number	(3008,0022)	R+	The fraction number shall not vary within this sequence.
>Beam Order Index	(0074,1324)	O	If present, should be used if the delivery device allows.
>Autosequence Flag	(0074,1025)	O	If present, should be used if the delivery device allows
>Delivery Verification Image Sequence	(0074,1030)	R+*	Zero Items shall be included
Omitted Beam Task Sequence	(300C,0111)	RC+*	Beams not to be delivered and/or verified. If there are beams to be omitted, one or more Items shall be present in this sequence.
>Referenced Beam Number	(300C,0006)	R+	Uniquely identifies the Beam that is specified by Beam Number (300A,00C0) within Beam Sequence (300A,00B0) in RT Beams Module of referenced RT Plan or RT Ion Plan.
>Reason for Omission	(300C,0112)	R+	Reason why the referenced beam is not to be delivered and/or verified: Defined Terms: ALREADY_TREATED The beam has been already treated in an earlier treatment session

7.5 Service Definitions

7.5.1 Unified Worklist and Procedure Step

1045 7.5.1.1 General Requirements

7.5.1.1.1 C-FIND General Purpose Requirements

1050 In a C-FIND query the Worklist Client (SCU) is required to query for return on the attributes as shown in the ‘Query Keys Return’ SCU column in Table 7.5.1.1.1-1 Worklist Query. The Worklist Manager (SCP) is required to return the values for these keys. All other potential return keys may be optionally supplied as described in DICOM Standard.

Table 7.5.1.1.1-1: Worklist Query

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Specific Character Set	(0008,0005)	-	-	O* (Note 10)	R (Note 10)
SOP Class UID	(0008,1016)	-	-	O*	R
SOP Instance UID	(0008,0018)	-	-	R+*	R
Procedure Step State	(0074,1000)	R+* (Note 1)	R*	R*	R*
Scheduled Station Name Code Sequence	(0040,4025)	R*	R*	R*	R*
>Code Value	(0008,0100)	R+* (Note 2)	R	R+*	R
>Coding Scheme Designator	(0008,0102)	O+* (Note 3)	R	R+*	R
>Code Meaning	(0008,0104)	-	-	R+ (Note 4)	R (Note 4)
Scheduled Procedure Step Start Date and Time	(0040,4005)	R* (Note 5)	R	R	R
Scheduled Workitem Code Sequence	(0040,4018)	R+*	R+*	R+	R
>Code Value	(0008,0100)	-	-	R+*	R
>Coding Scheme Designator	(0008,0102)	-	-	R+*	R
>Code Meaning	(0008,0104)	-	-	O	R
Study Instance UID	(0020,000D)	-	-	R+*	R+ (Note 9)
Patient’s Name	(0010,0010)	R+ (Note 11)	R	R+	R+

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Patient ID	(0010,0020)	R+ (Note 11)	R	R+	R+
All other attributes	As described in DICOM Standard				

Note 1: A Procedure Step State of ‘SCHEDULED’ shall be supplied.

1055

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

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

Note 4: Coding Meaning for the Scheduled Station Name shall contain the human-readable description of the Station Name.

1060

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

Note 9: Study Instance UID must be supplied by the SCP if performance of the procedure step is expected to create composite SOP Instances as output. The supplied Study Instance shall be used by the SCU in creation of such SOP Instances.

Note 10: See 7.2.1.1.

1065

Note 11: Shall be empty.

7.5.1.2 Unified Worklist and Procedure Step for Delivery

7.5.1.2.1 C-FIND Minimum Requirements for Treatment Delivery

The requirements of Section 7.5.1.1.1 C-FIND General Purpose Requirements apply.

Additionally, the following requirements apply:

1070

Table 7.5.1.2.1-1: Worklist Query for Treatment Delivery

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Scheduled Station Name Code Sequence	(0040,4025)	R* (Note 1)	R*	R*	R*
Scheduled Workitem Code Sequence	(0040,4018)	R+* (Note 2)	R+*	R+	R
Scheduled Processing Parameters Sequence	(0074,1210)	R+* (Note 3)	-	R+ (Note 3)	R+* (Note 3)
Input Information Sequence	(0040,4021)	R+* (Note 4)	-	R+* (Note 4)	R+* (Note 4)
> (all other attributes)		-	-	R	R
Study Instance UID	(0020,000D)	-	-	R+*	R+ (Note 5)
Patient’s Name	(0010,0010)	R+	R	R+	R+

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		(Note 11)			
Patient ID	(0010,0020)	R+ (Note 11)	R	R+	R+
All other attributes	As described in DICOM Standard				

Note 1: Code Meaning (0008,0104) of the Scheduled Station Name Code Sequence (0040,4025) shall be displayed on the TDD.

1075

Note 2: The Code Value (0008,0100) in the Scheduled Workitem Code Sequence (0040,4018) shall be supplied with a value equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to 'DCM'.

Note 3: Scheduled Processing Parameters Sequence shall be specified as an empty (null) sequence. The Return Key of this sequence shall contain the values as specified in Table 7.5.1.2.1-2.

1080

Note 4: Input Information Sequence shall be specified as an empty (null) sequence. The Return Key of the Input Information Sequence shall contain all the input objects that will ultimately be needed to perform the specified procedure step, and no others. This allows the TDD to determine whether or not the instances are available prior to starting the procedure, and avoids the need for an additional N-GET on the UPS. If the TDD considers that the Input Information Sequence contains inadequate or inconsistent information, then it shall address any such inconsistencies in a safe manner before performing the Requested Procedure. Note 5: The supplied Study Instance shall be used by the SCU in creation of such SOP Instances (see transaction TDW-RO-6: Store Treatment Delivery Results to TMS).

1085

Table 7.5.1.2.1-2: Required Query Keys Returned within the Scheduled Processing Parameters Sequence

Attribute Name	Tag	Query Keys Return
		SCP
Scheduled Processing Parameters Sequence	(0074,1210)	
>Value Type	(0040,A040)	R+* (Note 1)
>Concept Name Code Sequence	(0040,A043)	R+*
>>Code Value	(0008,0100)	R+* (Note 2)
>>Coding Scheme Designator	(0008,0102)	R+* (Note 3)
>>Code Meaning	(0008,0104)	R+* (Note 4)
>Text Value	(0040,A160)	R+ (Note 5)

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

1090

Note 2: Code Value supplied for the Concept Name Code Sequence shall be '121740'.

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

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

1095

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

Appendices

Not applicable.

1100

Volume 4 – National Extensions

Add appropriate Country section

Not Applicable.