



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

10                   **Treatment Delivery Offline Recording**  
**(TDOR)**

15                   **Revision 1.1 – Trial Implementation**

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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. 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 December 19, 2022 for trial implementation and may be  
available for testing at subsequent IHE Connectathons. The supplement may be amended based  
on the results of testing. Following successful testing it will be incorporated into the Radiation  
35 Oncology Technical Framework. Comments are invited and can be submitted at [Radiation  
Oncology Public Comments](#).

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.

40 *Amend section X.X by the following:*

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 [IHE.net](#).

Information about the IHE Radiation Oncology domain can be found at [IHE Domains](#).

Information about the organization of IHE Technical Frameworks and Supplements and the  
process used to create them can be found at [Profiles](#) and [IHE Process](#).

50 The current version of the IHE Radiation Oncology Technical Framework can be found at [IHE  
Technical Frameworks](#).

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## Introduction to this Supplement

180 This profile is an extension to the Treatment Delivery Workflow - II (TDW-II) Profile. It specifies the recording of treatment sessions which have been initially scheduled and performed as a managed treatment delivery workflow along TDW-II but which cannot be recorded within the treatment session because of system crashes or outages.

## Open Issues and Questions

| # | Intr. in | Description                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                                |
|---|----------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 2 | 1.1      | WG-07 is working on a CP (CP2185 Extend Use of treatment Session UID) to add Treatment Session UID (300A,0070) as a dedicated attribute into the Modality Worklist Scheduled Procedure Step. Discussion is on-going to include it in the Unified Procedure Step Scheduled Procedure Information module as well. If this goes through TDOR can use the attribute directly instead of adding Treatment Session UID as a parameter in the Scheduled Processing Parameters Sequence.                                                                                                                                                                                                                                                           |
| 3 | 1.1      | <p>Claiming a UPS is a generic transaction that is used in multiple profiles. Current version of TDW-II uses “Treatment Delivery in Progress [RO-60]” for that purpose while TDOR uses “Claim Record Treatment Session UPS Workitem [TDOR-02]”.</p> <p>IHE-RO TC to discuss if TDW-II [RO-60] could be defined in a generic way so it could be re-used in multiple profiles. The profile specific stuff then goes into the (profile-specific) use case and service sections. Since TDW-II is still not in the TF, this should be possible rather easily.</p> <p>Other candidates for generalization:<br/>Final Update “Record Treatment Session” UPS Workitem [TDOR-03]<br/>Complete “Record Treatment Session” UPS Workitem [TDOR-04]</p> |

## Closed Issues

| # | Intr. in | Description                                                                                                                                                                                                                                                                                                                            |
|---|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| 1 | 0.4      | <p>Should the TDD not only store the remaining treatment records but rather all treatment records of this particular session? The OST will simply respond with success in case a storage request is issued for an instance that already exists.</p> <p>TC Meeting 20 Sep 2021: Decision to store remaining treatment records only.</p> |

185

## IHE Technical Frameworks General Introduction

The [IHE Technical Frameworks General Introduction](#) is shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to this document where appropriate.

### 190 9 Copyright Licenses

IHE technical documents refer to, and make use of, a number of standards developed and published by several standards development organizations. Please refer to the IHE Technical Frameworks General Introduction, [Section 9 - Copyright Licenses](#) for copyright license information for frequently referenced base standards. Information pertaining to the use of IHE  
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## IHE Technical Frameworks General Introduction Appendices

The [IHE Technical Framework General Introduction Appendices](#) are components shared by all of the IHE domain technical frameworks. Each technical framework volume contains links to these documents where appropriate.

*Update the following appendices to the General Introduction as indicated below. Note that these are **not** appendices to this domain's Technical Framework (TF-1, TF-2, TF-3 or TF-4) but rather, they are appendices the IHE Technical Frameworks General Introduction located [here](#).*

### [Appendix A](#) – Actors

Add the following **new or modified** actors to the [IHE Technical Frameworks General Introduction Appendix A](#):

| New (or modified) Actor Name | Description |
|------------------------------|-------------|
| No new actors                |             |
|                              |             |

The table below lists *existing* actors that are utilized in this profile.

#### Complete List of Existing Actors Utilized in this Profile

| Existing Actor Name               | Definition                                                                                                                                                                                               |
|-----------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Treatment Management System (TMS) | Manages oncology information and is responsible for the scheduling of radiotherapy activities. Consumes beams for use in treatment delivery and manages the treatment in the Radiation Oncology workflow |
| Treatment Delivery Device (TDD)   | A system that delivers therapeutic radiation to a patient                                                                                                                                                |
| Object Storage (OST)              | A system that supports storage and retrieval of DICOM instances                                                                                                                                          |

## **Appendix B – Transactions**

225 *Add the following **new or modified** transactions to the [IHE Technical Frameworks General Introduction Appendix B](#):*

| New (or modified) Transaction Name and Number                  | Definition                                                                                                   |
|----------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| Create “Record Treatment Session” UPS Workitem [TDOR-01]       | The TDD requests creation of the UPS to record the performed Treatment Session from the TDD back to the TMS. |
| Claim “Record Treatment Session” UPS Workitem [TDOR-02]        | The TDD claims and starts performing the recording of the treatment session UPS.                             |
| Final Update “Record Treatment Session” UPS Workitem [TDOR-03] | The TDD requests a final update of the UPS just prior to complete it.                                        |
| Complete “Record Treatment Session” UPS Workitem [TDOR-04]     | The TDD records the UPS as completed or canceled.                                                            |

## **Appendix D – Glossary**

230 *Add the following **new or modified** glossary terms to the [IHE Technical Frameworks General Introduction Appendix D](#):*

| New (or modified) Glossary Term | Definition                                                                                                                  |
|---------------------------------|-----------------------------------------------------------------------------------------------------------------------------|
| Treatment Session               | Treatment Session follows the exact same definition of an (RT) Treatment Session as defined in DICOM PS 3.3 section 7.14.10 |

## Volume 1 – Profiles

### 235 **Domain-specific additions**

NA

|                          |
|--------------------------|
| <i>Add new Section X</i> |
|--------------------------|

240

## **X Treatment Delivery Offline Recording (TDOR) Profile**

245 The Treatment Delivery Offline Recording (TDOR) Profile is an extension to the Treatment Delivery Workflow - II (TDW-II) Profile dealing with the recording of treatment sessions in case of system outages and/or crashes. It is applicable for managed treatment sessions only, i.e., the treatment sessions have to be initially scheduled in the TMS and retrieved by the TDD along the transactions specified in TDW-II. The standardization of the recording process allows for a safe continuation of the next treatment session upon successful recovery of the system and the treatment artifacts.

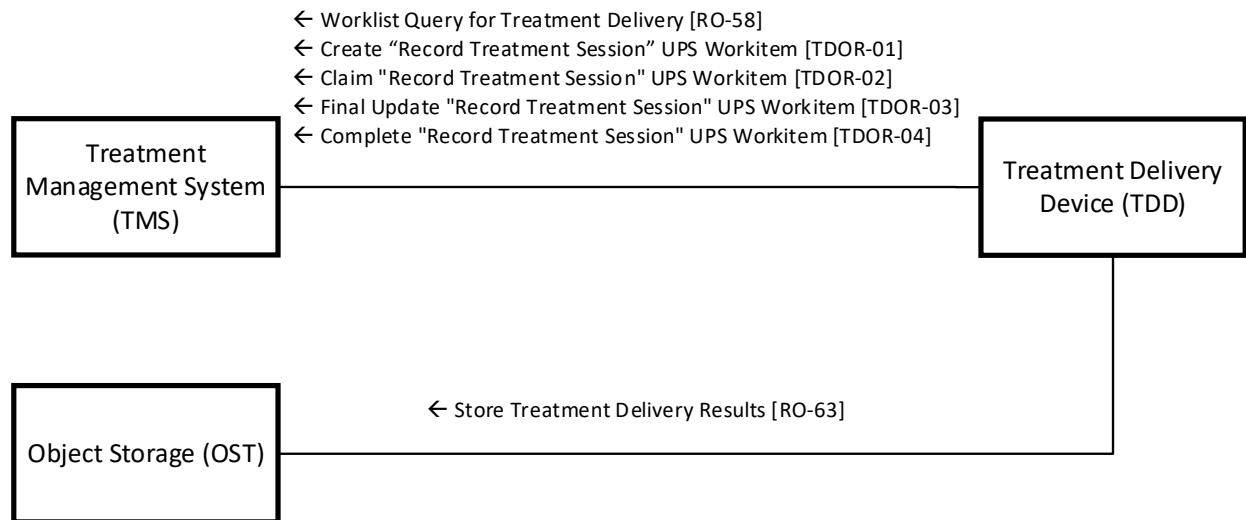
The TDOR Profile is a workflow profile.

### **250 X.1 TDOR Actors, Transactions, and Content Modules**

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. IHE Transactions can be found in the Technical Frameworks General Introduction Appendix B. Both appendices are located at [http://ihe.net/Technical\\_Frameworks/#GenIntro](http://ihe.net/Technical_Frameworks/#GenIntro)

255 Figure X.1-1 shows the actors directly involved in the TDOR 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 required grouping are shown in conjoined boxes (see Section X.3).

260



**Figure X.1-1: TDOR Actor Diagram**

265 Table X.1-1 lists the transactions for each actor directly involved in the TDOR 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 X.1-1: TDOR Profile - Actors and Transactions**

| Actors                      | Transactions                                                   | Initiator or Responder | Optionality | Reference           |
|-----------------------------|----------------------------------------------------------------|------------------------|-------------|---------------------|
| Treatment Management System | Worklist Query for Treatment Delivery [RO-58]                  | Responder              | R           | TDW-II Section 3.58 |
|                             | Create “Record Treatment Session” UPS Workitem [TDOR-01]       | Responder              | R           | Section 3.TDOR1     |
|                             | Claim "Record Treatment Session" UPS Workitem [TDOR-02]        | Responder              | R           | Section 3.TDOR2     |
|                             | Final Update "Record Treatment Session" UPS Workitem [TDOR-03] | Responder              | R           | Section 3.TDOR3     |
|                             | Complete "Record Treatment Session" UPS Workitem [TDOR-04]     | Responder              | R           | Section 3.TDOR4     |

| Actors                    | Transactions                                                   | Initiator or Responder | Optionality | Reference           |
|---------------------------|----------------------------------------------------------------|------------------------|-------------|---------------------|
| Treatment Delivery Device | Worklist Query for Treatment Delivery [RO-58]                  | Initiator              | R           | TDW-II Section 3.58 |
|                           | Create "Record Treatment Session" UPS Workitem [TDOR-01]       | Initiator              | R           | Section 3.TDOR1     |
|                           | Claim "Record Treatment Session" UPS Workitem [TDOR-02]        | Initiator              | R           | Section 3.TDOR2     |
|                           | Final Update "Record Treatment Session" UPS Workitem [TDOR-03] | Initiator              | R           | Section 3.TDOR3     |
|                           | Complete "Record Treatment Session" UPS Workitem [TDOR-04]     | Initiator              | R           | Section 3.TDOR4     |
|                           | Store Treatment Delivery Results [RO-63]                       | Initiator              | R           | TDW-II Section 3.63 |
| Object Storage            | Store Treatment Delivery Results [RO-63]                       | Responder              | R           | TDW-II Section 3.63 |

## X.1.1 Actor Descriptions and Actor Profile Requirements

### 270 X.1.1.1 Treatment Delivery Device (TDD)

The Treatment Delivery Device Actor in this profile is an extension to the Treatment Delivery Device Actor as specified in TDW-II. In addition to its responsibilities in TDW-II, the TDD is responsible for initiating and performing the recording of the treatment session on the TMS and OST when the recording could not be performed during the treatment session and upon successful recovery of all involved actors.

275

### X.1.1.2 Treatment Management System (TMS)

The Treatment Management System Actor in this profile is an extension to the Treatment Management System Actor as specified in TDW-II. In addition to its responsibilities in TDW-II, the TMS provides the Treatment Session UID to the TDD as part of the initial Treatment UPS. Furthermore, the TMS will reconcile the treatment session using the information provided by the TDD during the offline recording process.

280

## X.2 TDOR Actor Options

Options that may be selected for each actor in this profile, if any, are listed in the Table X.2-1. Dependencies between options, when applicable, are specified in notes.

**Table X.2-1: TDOR – Actors and Options**

| Actor                       | Option Name        | Reference |
|-----------------------------|--------------------|-----------|
| Treatment Delivery Device   | No options defined |           |
| Treatment Management System | No options defined |           |
| Object Storage              | No options defined |           |

## X.3 TDOR Required Actor Groupings

An actor from this profile (Column 1) shall implement all of the required transactions and/or content modules in this profile *in addition to all* of the requirements for the grouped actor (Column 2) (Column 3 in alternative 2).

If this is a content profile, and actors from this profile are grouped with actors from a workflow or transport profile, the Reference column references any specifications for mapping data from the content module into data elements from the workflow or transport transactions.

In some cases, required groupings are defined as at least one of an enumerated set of possible actors; this is designated by merging column one into a single cell spanning multiple potential grouped actors. Notes are used to highlight this situation.

Section X.5 describes some optional groupings that may be of interest for security considerations and Section X.6 describes some optional groupings in other related profiles.

**Table X.3-1: TDOR - Required Actor Groupings**

| TDOR Actor                  | Actor(s) to be grouped with | Reference | Content Bindings Reference |
|-----------------------------|-----------------------------|-----------|----------------------------|
| Treatment Delivery Device   | None                        |           |                            |
| Treatment Management System | None                        |           |                            |
| Object Storage              | None                        |           |                            |

## X.4 TDOR Overview

The TDOR Profile is intended to standardize the recording of treatment sessions that could not be recorded along the regular workflow as specified in TDW-II. This allows for a safe continuation of the treatment after the information recovery and reconciliation procedure.

## 305 **X.4.1 Concepts**

One of the key requirements in the TDOR Profile is about relating the treatment artifacts to the right treatment session in the TMS. When the TDD is initiating the offline recording process, the TMS must know for which treatment session the recording is being done.

310 When scheduling a treatment session for treatment delivery, the TMS assigns a Treatment Session UID to that treatment session. The Treatment Session UID is initially communicated as part of the treatment UPS from the TMS to the TDD. In addition to the treatment artifacts references, the TDD adds the very same Treatment Session UID as a parameter to the offline recording UPS allowing the TMS to properly link the recorded artifacts to the appropriate treatment session.

315 The definition of a treatment session follows the exact same definition as in the DICOM standard, see also Appendix D – Glossary.

320 The introduction of the Treatment Session UID and adding it as an additional parameter to the UPS enables the grouping of scheduled UPSes into treatment sessions. TDOR provides the framework to enable such more advanced concepts. However, it is up to the vendor specific implementations to define the boundaries of a treatment session. A TDD shall not use the Treatment Session UID for purposes other than grouping and linking the treatment artifacts to a treatment session. For example, an implementation may schedule the delivery of multiple treatment plans into a single treatment session or into distinct treatment sessions.

325 TDOR is not limited to treatment delivery only as defined in TDW-II Profile. The same concepts can be applied in future workflow profiles as well.

Furthermore, TDOR specifications are agnostic on before mentioned vendor specific implementation aspects. For example «Starting a treatment session» means when the first UPS of a treatment session is set to IN PROGRESS.

## **X.4.2 Use Cases**

### 330 **X.4.2.1 Use Case #1: Treatment Record Unavailable**

The TDD is not able to properly record the performed treatment session back to the TMS because the treatment record(s) is/are not available in the treatment session output artifacts at time of closing the session. It signals to the TMS that the recording will be done at a later point in time.

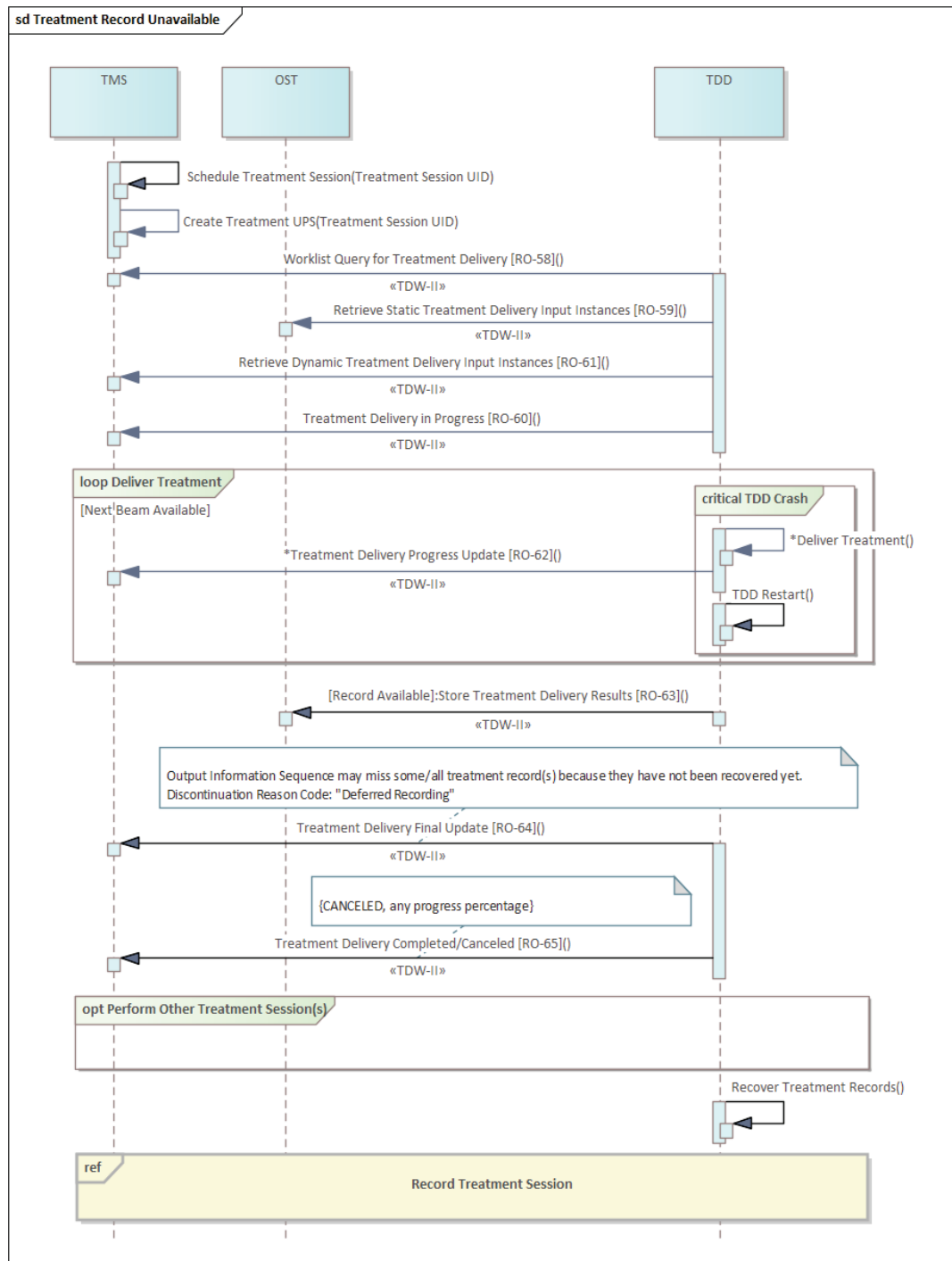
#### 335 **X.4.2.1.1 Treatment Record Unavailable Use Case Description**

In this scenario the TDD crashes any point after having started delivery of a treatment session initiated along TDW-II sequence. The TDD is able to fully recover the worklist information but recovery of the treatment record(s) cannot be done automatically and may require involvement of service personnel. The TDD may or may not complete the treatment delivery as planned and

340 finally closes the session signaling to the TMS that the recording of the treatment artifacts is  
deferred. In this case the Output Information Sequence of the UPS is incomplete or even empty.  
Meanwhile the TDD may continue to deliver treatments for other patients as scheduled.

At a later point in time (e.g., at the end of the day) the TDD recovers the treatment record(s),  
either automatically or with assistance of the user or service personnel, and initiates the deferred  
345 recording from the TDD to the TMS for the failed treatment session. The TDD requests creation  
of a “Record Treatment Session” UPS on the TMS, starts performing the UPS by storing the  
recovered treatment records to the OST and finally sets the UPS to the completed state. The  
TMS reconciles the appropriate treatment session (i.e., links the records to the appropriate  
treatment session) and does any internal cleanup as needed. The TMS is supposed to verify that  
350 the treatment session being recorded is managed by this TMS.

### X.4.2.1.2 Treatment Record Unavailable Process Flow



**Figure X.4.2.1.2-1: Treatment Record Unavailable Basic Process Flow in TDOR Profile**

355

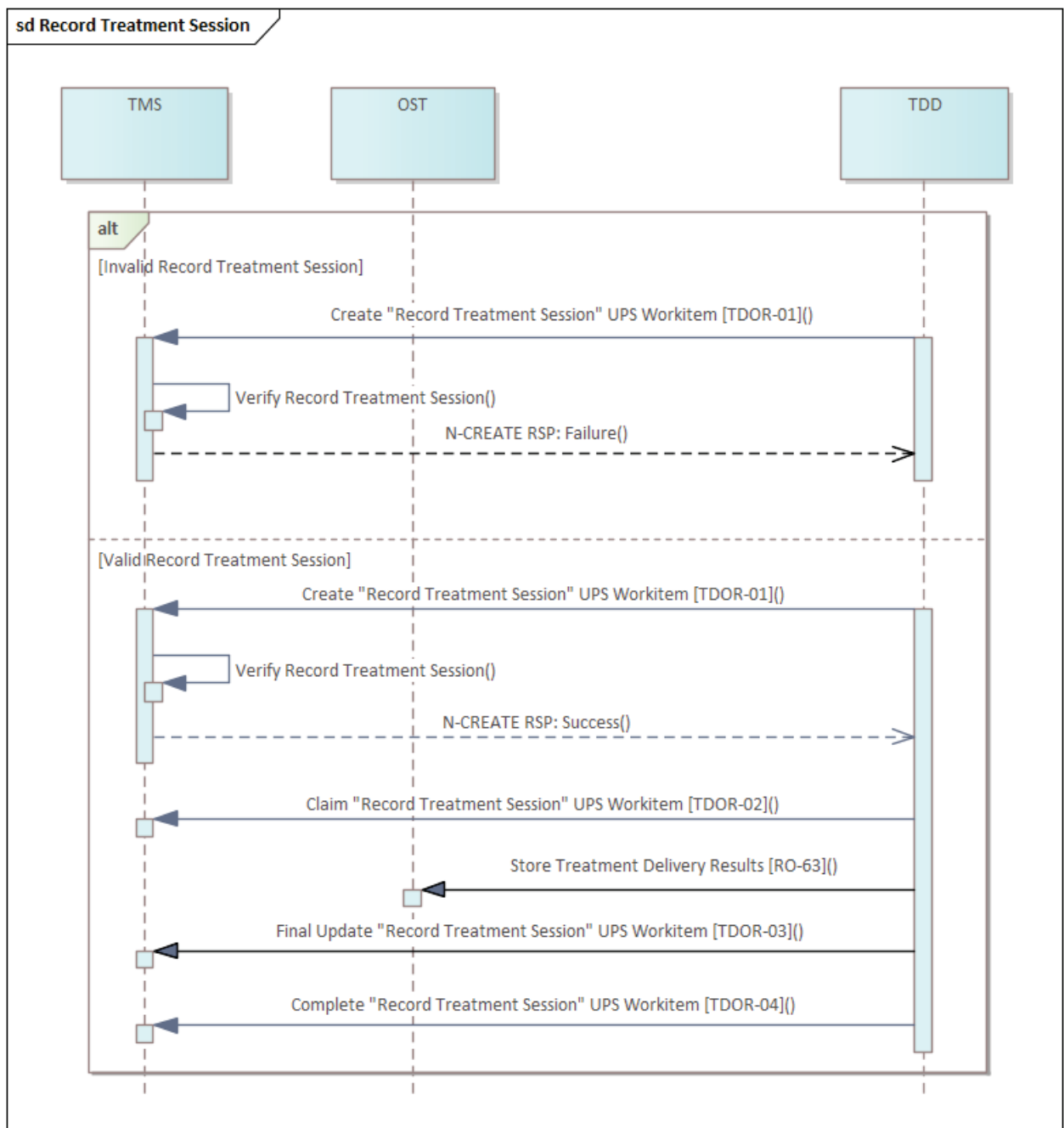
Note: For the sake of clarity, the diagram may show additional (existing) transactions.

During initial scheduling of the treatment session in the TMS, the TMS assigns a Treatment Session UID to the session. This UID is conveyed in the treatment UPS.

360 After starting the treatment session along TDW-II, the TDD may crash at any point in time during the treatment session or may not be able to access the OST. This may potentially result in a situation where the treatment record(s) need to be recovered, either automatically or with assistance of the user or service personnel, and will be recorded to OST/TMS at a later point in time (even multiple days after the session was delivered).

365 In this scenario the Output Information Sequence of the treatment UPS misses some/all treatment record(s) because they have not been recovered yet. The TDD signals this to the TMS by setting the treatment UPS to CANCELED together with a dedicated Discontinuation Reason Code. The TMS may indicate this situation to the user.

Once the recovery procedure on the TDD was performed, the actual recording of the treatment session goes along the following sequence:



370

**Figure X.4.2.1.2-2: Record Treatment Session Process Flow in TDOR Profile**

After recovery of the information required to do the recording of the treatment session, the TDD requests the creation of the “Record Treatment Session” UPS on the TMS including the Treatment Session UID as an additional parameter. This allows the TMS to prepare, if needed,

375 for the subsequent start of the deferred recording. The TDD then claims and performs the UPS  
by storing the recovered treatment record(s) to the OST. Finally, the TDD updates the UPS with  
the list of the treatment records being stored as part of this recording process and sets the UPS to  
completed.

380 The TMS can then do any reconciliation of the treatment session using the information conveyed  
in the UPS.

In case the verification of the Record Treatment Session UPS fails, the TMS rejects the creation  
of the UPS. The following non-exhaustive list shows some potential reasons why this  
verification could fail:

- 385 • The Treatment Session UID provided in the UPS is not known to the TMS, i.e., the TDD  
tries to record a session that is not managed by this TMS.
- In the meantime the user did record the treatment session through some other means and the  
TMS considers this session as properly recorded already.
- The TMS is in a state where it is not ready to accept the recording.

#### 390 **Use Case Variation #1:**

Instead of a TDD crash the storage request for the treatment record(s) are rejected by the OST  
because of mal-formatted and/or missing DICOM attributes. The TDD closes the session  
signaling to the TMS that the recording of the treatment artifacts is deferred. At a later point in  
time, user or service personnel fix the treatment record(s) locally stored on the TDD and initiates  
395 the deferred recording from the TDD to the TMS for the fixed treatment records along the main  
flow.

#### **Use Case Variation #2:**

Instead of a TDD crash and after having started the treatment session along TDW-II main flow,  
the network to the OST experiences non-intermittent outages. This results in failure of Store  
400 Treatment Delivery Results [RO-63] transaction. After a couple of retries the TDD decides to  
store the treatment record(s) locally and continues with treatment delivery. At time of closing the  
treatment session at the TDD the connection to the OST is still not recovered. This results in the  
very same situation of missing treatment record(s) and the TDD signals this to the TMS using the  
same means as in the main scenario. Upon recovery of the network the user initiates the deferred  
405 recording from the TDD to the TMS for the missing treatment records along the main flow.

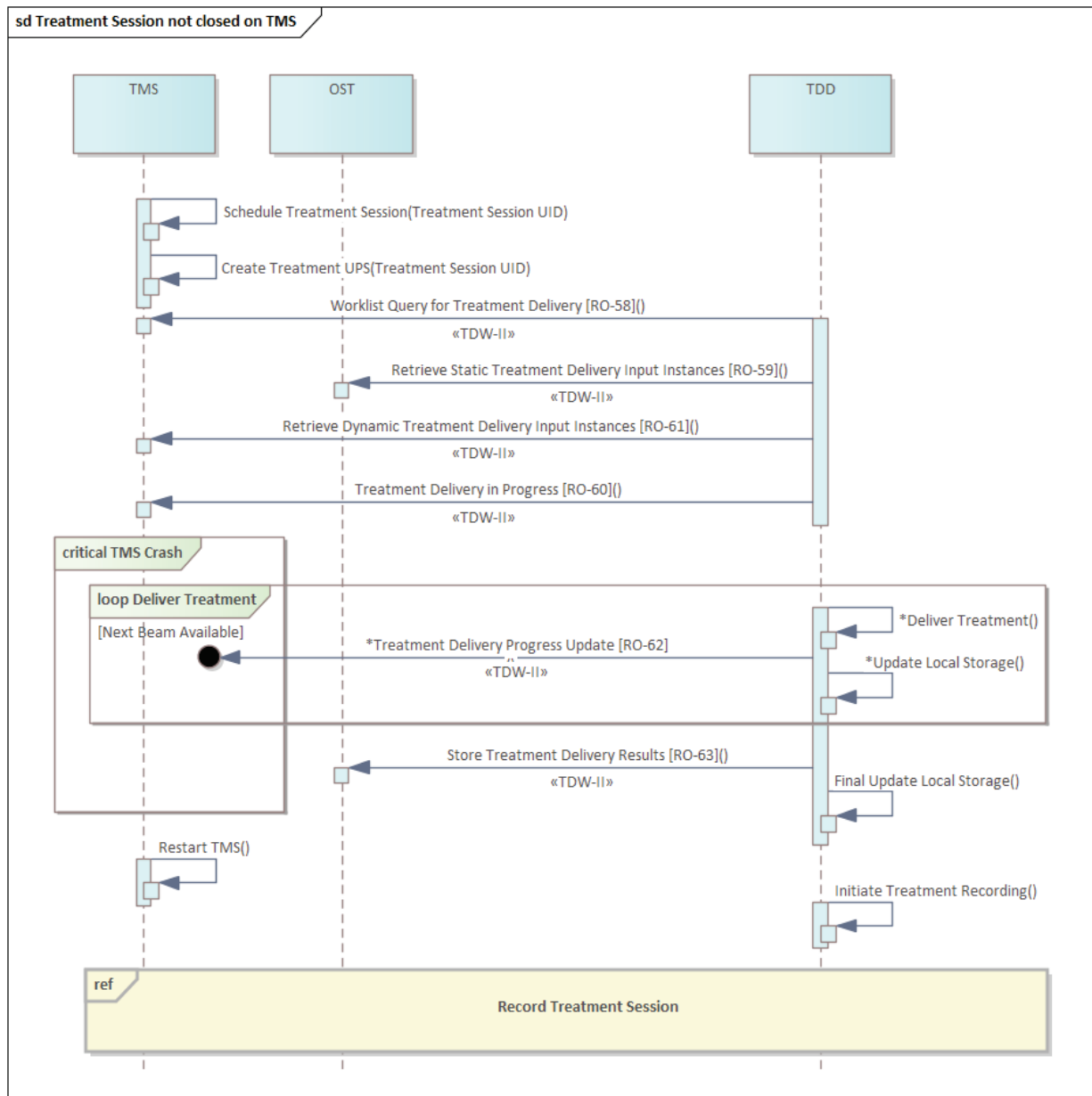
### **X.4.2.2 Use Case #2: Treatment Session not closed on TMS**

After having started and performed (partially or complete) the treatment session along TDW-II  
main flow, the TDD is not able to close the treatment session on the TMS. There are different  
410 reasons for this as described in the following section.

#### **X.4.2.2.1 Treatment Session not closed on TMS Use Case Description**

415 In this scenario the TMS crashes any point after the TDD started delivery of a treatment session  
initiated along TDW-II sequence. At time of closing the treatment session at the TDD, the TMS  
is still not available and the TDD proceeds with closing the session locally. System, user or  
service personnel recovers the TMS and initiates the deferred recording from the TDD to the  
TMS along the “Record Treatment Session” flow in use case #1. The difference to use case #1 is  
that, in this scenario, the initial treatment UPS on the TMS may still be in IN PROGRESS state  
(not only for the main use case but also for all the variations). The TDD is not expected to update  
420 that treatment UPS on the TMS. As part of the reconciliation, the TMS may also clean up that  
treatment UPS once the TDD performed the deferred recording.

#### X.4.2.2.2 Treatment Session not closed on TMS Process Flow



**Figure X.4.2.2.2-1: Treatment Session not closed on TMS Process Flow in TDOR Profile**

Note: For the sake of clarity, the diagram may show additional (existing) transactions.

425 During initial scheduling of the treatment session in the TMS, the TMS assigns a Treatment Session UID to the session. This UID is conveyed in the treatment UPS.

After starting the treatment session along TDW-II, the TMS may crash at any point in time during the treatment session. While trying to update the TMS/OST issuing Treatment Delivery

Progress Update [RO-62] and/or Store Treatment Delivery Results [RO-63], the TDD detects that the TMS (and potentially the OST as well) is not reachable. The TDD continues with the treatment session and finally proceeds with closing the treatment session w/o updating the TMS as it is still not reachable. In case the OST was not reachable, the TDD stores the treatment artifacts and other session information to a TDD local storage.

Note: The treatment record(s) might have already been stored to the OST (in particular when the TMS and the OST are independent actors). However, the initial treatment UPS on the TMS is still in IN PROGRESS state.

At a later point in time system, user or service personnel recovers the connectivity to the TMS (e.g., by restarting the TMS) and initiates the deferred recording from the TDD local storage to the TMS for the treatment session(s) that could not be properly recorded along the regular TDW-II flow. The actual recording goes along the same sequence as in Use Case #1.

Note: Since the TDD does not update the initial treatment UPS on the TMS (which is still in IN PROGRESS state), the TMS may also internally clean up that treatment UPS once the TDD performed the deferred recording.

#### **Variation #1:**

Instead of a TMS crash and after having started the treatment session along TDW-II main flow, the network to the TMS experiences non-intermittent outages. From a TDD point of view this looks exactly the same as a TMS crash and the sequence goes along the main flow of this use case.

#### **Variation #2:**

Instead of a TMS crash and after having started the treatment session along TDW-II main flow, the TDD crashes and it cannot completely recover the treatment session. The TDD may or may not complete the treatment as intended but it cannot finally close the treatment session on the TMS. A potential reason for this is because the TDD could not recover the worklist information. The TDD proceeds with closing the session locally. User or Service personnel recover the information on the TDD and initiate the deferred recording from the TDD to the TMS along the main flow of this use case.

### **X.4.2.3 Use Case #3: Treating from TDD Local Cache**

While querying the TMS for the worklist of the day, the TDD may store the worklist as well as the static/dynamic input objects into a TDD local cache. Reasons for doing this include not only performance optimizations but also providing the option to treat the treatment session from that local cache in case of network and/or TMS outages at time of starting a treatment session.

Note: The profile does not promote this use case but lists it as an exceptional case allowing to perform patient treatments even in case of system outages (recent news about cyber security attacks showed that this might become more important in the future). Allowing treatments in disconnected mode in an isolated TDD environment comes together with additional risks. It is recommended that the system warns the user and enforces elevated privileges.

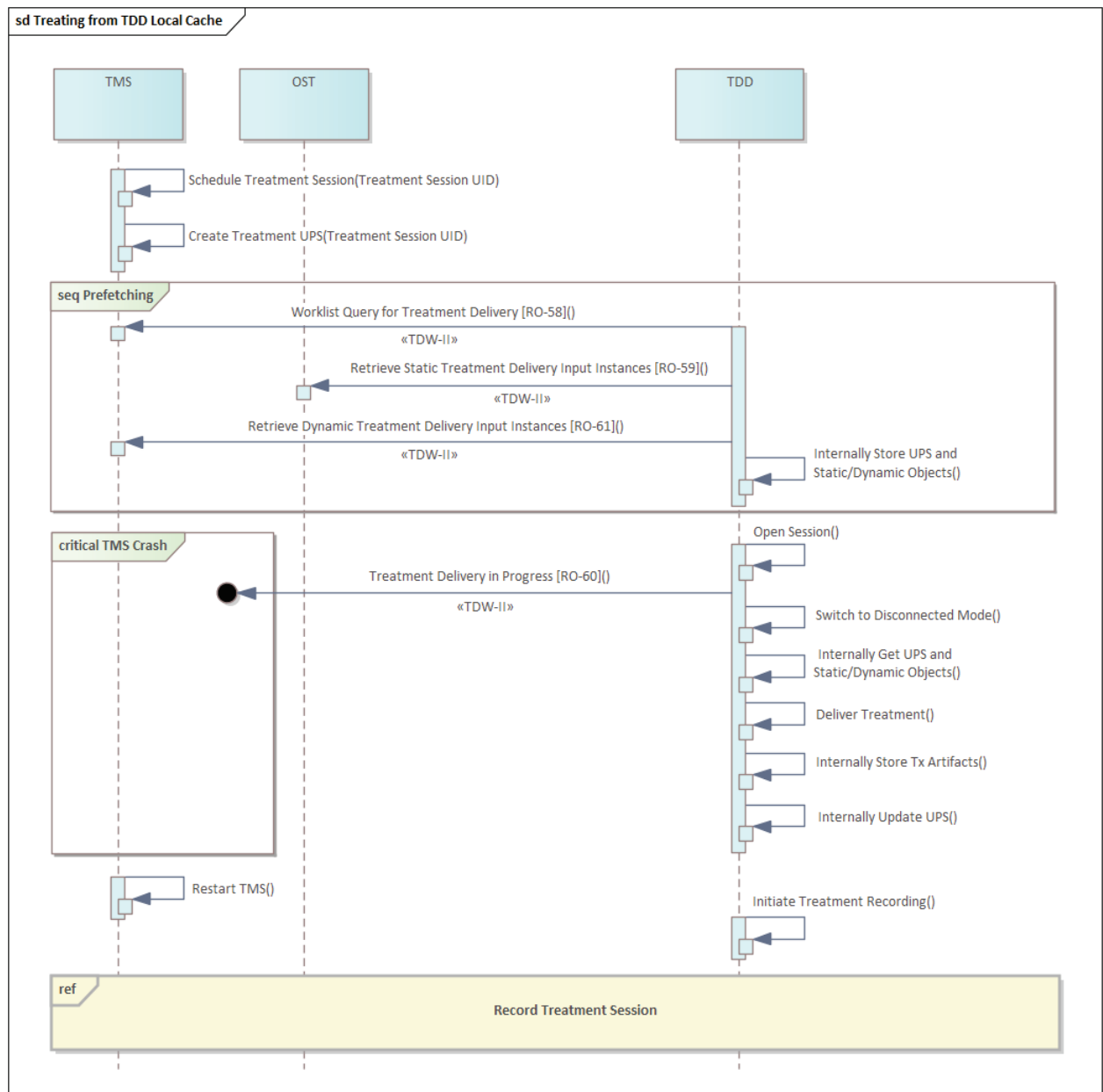
#### **X.4.2.3.1 Treating from TDD Local Cache Use Case Description**

470 In this scenario the TDD queried the worklist on the TMS and pre-fetched static as well as  
dynamic treatment delivery input instances from TMS/OST into a TDD local cache. At time of  
starting a session at the TDD, the TMS is not available (e.g., because of a network outage) and  
the TDD provides the option to deliver the session from that local cache in disconnected mode  
(note that the TDD is required to check TMS availability when opening a session and go along  
standard TDW-II sequence if available). The TDD delivers the treatment and closes the session  
but does not update the worklist on the TMS. Furthermore, the TDD stores the treatment session  
information to the local cache only.

475 After recovery of the TMS, the TDD initiates the recording of the treatment artifacts for the  
session delivered in disconnected mode. The recording goes along the sequence as defined in the  
previous use cases.

Note that the TDD is not expected to update the originally retrieved treatment UPS. That UPS  
remains unchanged on the TMS and must not be exposed anymore.

#### 480 X.4.2.3.2 Treating from TDD Local Cache Process Flow



**Figure X.4.2.3.2-1: Treating from TDD Local Cache Process Flow in TDOR Profile**

Note: For the sake of clarity, the diagram may show additional (existing) transactions.

485 During initial scheduling of the treatment session in the TMS, the TMS assigns a Treatment Session UID to the session. This UID is conveyed in the treatment UPS.

The TDD prefetches the worklist information as well as their static and dynamic input information into a TDD local cache using existing TDW-II transactions.

- 490 When starting a session, the TDD tries to go along the sequence of TDW-II. In case the TMS is not reachable, and only in this case, the TDD provides the option to treat this particular session from the local cache in disconnected mode.

Note: Special attention needs to be put on the Input Readiness State of the treatment UPS, i.e., in case of BID treatments the second treatment UPS will have the Input Readiness State set to INCOMPLETE/UNAVAILABLE. This UPS should not be enabled for treating in disconnected mode.

- 495 The TDD delivers the treatment and updates the local cache accordingly. It does not record anything neither to the OST nor to the TMS.

User or service personnel then recovers connectivity to the TMS and initiates the recording of treatment session from the TDD back to the TMS using the same sequence as in the previous use case.

## 500 **X.5 TDOR Security Considerations**

The security considerations for a content module are dependent upon the security provisions defined by the grouped actor(s).

## **X.6 TDOR Cross Profile Considerations**

Not applicable.

505

## Appendices to Volume 1

Not applicable.

## Volume 2 – Transactions

*Add Section 3.TDOR1*

### 510 3.TDOR1 Create “Record Treatment Session” UPS Workitem [TDOR-01]

#### 3.TDOR1.1 Scope

This transaction is used to create the UPS Workitem on the TMS for the (deferred) recording of the treatment session.

### 515 3.TDOR1.2 Actor Roles

**Table 3.TDOR1.2-1: Actor Roles**

|               |                                      |
|---------------|--------------------------------------|
| <b>Actor:</b> | Treatment Delivery Device            |
| <b>Role:</b>  | Initiator/performer of the recording |
| <b>Actor:</b> | Treatment Management System          |
| <b>Role:</b>  | Responds to the UPS creation request |

#### 3.TDOR1.3 Referenced Standards

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

DICOM PS 3.3: B.26 Unified Procedure Information Object

### 520 3.TDOR1.4 Messages



**Figure 3.TDOR1.4-1: Interaction Diagram**

### **3.TDOR1.4.1 Request UPS Creation Message**

525 The TDD sends a request to the TMS to create a new UPS instance representing the new workitem. The request contains the details for the requested workitem.

#### **3.TDOR1.4.1.1 Trigger Events**

Upon performing the recovery procedure on the TDD or the TMS, the TDD starts performing the recording of the treatment session by creating the appropriate UPS on the TMS.

#### **3.TDOR1.4.1.2 Message Semantics**

530 The message is an N-CREATE Request of the DICOM UPS Push SOP Class. The TDD is the SCU, and the TMS is the SCP.

##### **3.TDOR1.4.1.2.1 UPS Attribute Requirements**

See Section 7.5.1.1.3.

#### **3.TDOR1.4.1.3 Expected Actions**

535 The TMS shall attempt to create the requested UPS instance as described in DICOM PS 3.4 Annex CC and return appropriate success or failure codes to the TDD. In case the verification of the Record Treatment Session is failing, the TMS shall reject the creation of the UPS by issuing an N-CREATE response primitive with an appropriate error code. The used error code should be documented in the DICOM Conformance Statement of the TMS.

### **540 3.TDOR1.5 Protocol Requirements**

NA.

### **3.TDOR1.6 Security Considerations**

NA.

### **545 3.TDOR2 Claim "Record Treatment Session" UPS Workitem [TDOR-02]**

#### **3.TDOR2.1 Scope**

This transaction is used to notify the TMS that the TDD claimed and is starting performing the UPS.

#### **3.TDOR2.2 Actor Roles**

550 **Table 3.TDOR2.2-1: Actor Roles**

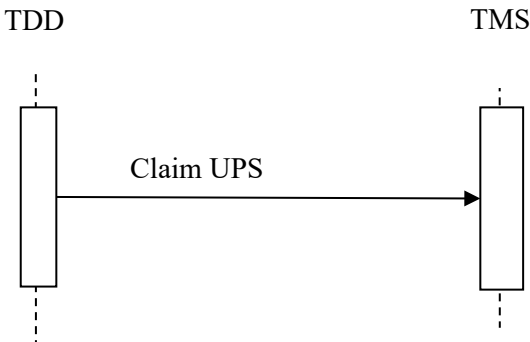
|               |                           |
|---------------|---------------------------|
| <b>Actor:</b> | Treatment Delivery Device |
|---------------|---------------------------|

|               |                                                           |
|---------------|-----------------------------------------------------------|
| <b>Role:</b>  | Requests the TMS to change the UPS status to IN PROGRESS. |
| <b>Actor:</b> | Treatment Management System                               |
| <b>Role:</b>  | Responds to the UPS status change request                 |

3.TDOR2.3 Referenced Standards

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

3.TDOR2.4 Messages



555 **Figure 3.TDOR2.4-1: Interaction Diagram**

3.TDOR2.4.1 Claim UPS Message

See TDW-II Section 3.60.4.1.

3.TDOR2.4.1.1 Trigger Events

560 The TDD has successfully recovered the information of the treatment session and is about to record that information back to the TMS.

3.TDOR2.4.1.2 Message Semantics

See TDW-II Section 3.60.4.1.2.

3.TDOR2.4.1.3 Expected Actions

See TDW-II Section 3.60.4.1.3.

565 If needed the TMS and/or the OST may prepare for the subsequent receipt of storage requests for the treatment records being recorded.

In case the TMS is in a state where it is not ready to accept the recording, it shall reject the claim of the UPS by issuing an N-ACTION response primitive with an appropriate error code. The used error code should be documented in the DICOM Conformance Statement of the TMS.

570 **3.TDOR2.5 Protocol Requirements**

NA.

**3.TDOR2.6 Security Considerations**

NA.

575 **3.TDOR3 Final Update “Record Treatment Session” UPS Workitem  
[TDOR-03]**

**3.TDOR3.1 Scope**

This transaction is used to finally update the UPS on the TMS prior to setting it to completed or canceled.

**3.TDOR3.2 Actor Roles**

580 **Table 3.TDOR3.2-1: Actor Roles**

|               |                                                                          |
|---------------|--------------------------------------------------------------------------|
| <b>Actor:</b> | Treatment Delivery Device                                                |
| <b>Role:</b>  | Requests the TMS to finally update the UPS with the provided information |
| <b>Actor:</b> | Treatment Management System                                              |
| <b>Role:</b>  | Updates the attributes of the UPS with the provided information          |

**3.TDOR3.3 Referenced Standards**

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

DICOM PS 3.3: B.26 Unified Procedure Information Object

### 3.TDOR3.4 Messages

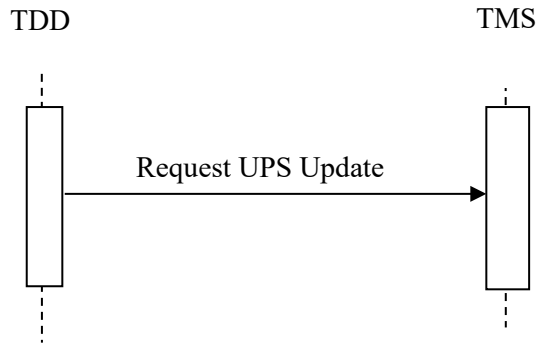


Figure 3.TDOR3.4-1: Interaction Diagram

#### 3.TDOR3.4.1 Request UPS Update Message

The TDD sends a request to the TMS to update a UPS instance with the provided attribute values.

##### 3.TDOR3.4.1.1 Trigger Events

Upon storing the treatment record(s) to the OST, the TDD requests the TMS to finally update the UPS with the provided information.

##### 3.TDOR3.4.1.2 Message Semantics

See TDW-II Section 3.64.4.1.2.

##### 3.TDOR3.4.1.2.1 UPS Attribute Requirements

See Section 7.5.2.3.4.

##### 3.TDOR3.4.1.3 Expected Actions

See TDW-II Section 3.64.4.1.3.

### 3.TDOR3.5 Protocol Requirements

NA.

### 3.TDOR3.6 Security Considerations

NA.

### 3.TDOR4 Complete “Record Treatment Session” UPS Workitem [TDOR-04]

#### 605 3.TDOR4.1 Scope

This transaction is used to request the TMS to set the UPS to either completed or canceled.

#### 3.TDOR4.2 Actor Roles

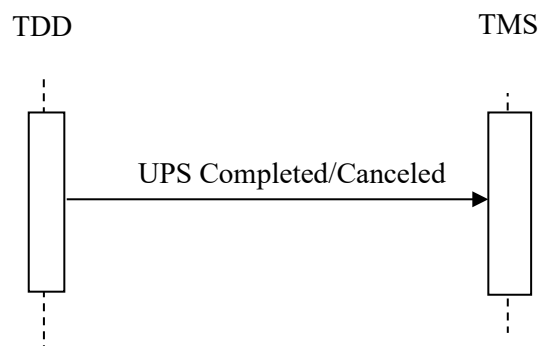
**Table 3.TDOR4.2-1: Actor Roles**

|               |                                                                 |
|---------------|-----------------------------------------------------------------|
| <b>Actor:</b> | Treatment Delivery Device                                       |
| <b>Role:</b>  | Requests the TMS to change the UPS status to COMPLETED/CANCELED |
| <b>Actor:</b> | Treatment Management System                                     |
| <b>Role:</b>  | Responds to the UPS status change request                       |

#### 3.TDOR4.3 Referenced Standards

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

#### 3.TDOR4.4 Messages



**Figure 3.TDOR4.4-1: Interaction Diagram**

#### 3.TDOR4.4.1 UPS Completed/Canceled Message

615 See TDW-II Section 3.65.4.1.

##### 3.TDOR4.4.1.1 Trigger Events

The TDD has either successfully completed the recording of the treatment session or has determined that processing should be stopped.

### **3.TDOR4.4.1.2 Message Semantics**

620 See TDW-II Section 3.65.4.1.2.

### **3.TDOR4.4.1.3 Expected Actions**

See TDW-II Section 3.65.4.1.3.

The TMS may perform internal reconciliation of the treatment session using the information provided in the Record Treatment Session UPS.

### **625 3.TDOR4.5 Protocol Requirements**

NA

### **3.TDOR4.6 Security Considerations**

NA

630

## **Appendices to Volume 2**

Not applicable.

## **Namespace Additions for Volume 2**

635

The Radiation Oncology registry of OIDs is located at:  
NA

Volume 2 additions to the Radiation Oncology OID Registry are:

640

NA

## Volume 3 – Content Modules

### 5 IHE Namespaces, Concept Domains and Vocabularies

645 

|                                                                          |
|--------------------------------------------------------------------------|
| <i>Add to Section 5 IHE Namespaces, Concept Domains and Vocabularies</i> |
|--------------------------------------------------------------------------|

NA

### 6 Radiation Oncology HL7 V3 CDA Content Modules

650 NA

## 7 Radiation Oncology DICOM Content Definitions

DICOM Content Definitions constrain the use of instances of specific DICOM IODs (also referred to as DICOM objects). This typically means placing requirements on the creators of those instances, although requirements may also be placed on the receivers and users.

- 655 The most common such requirements are to:
- Make a module that is optional (U) in a DICOM IOD be required or conditional,
  - Make an attribute that is optional (Type 3) in a DICOM Module be required or conditional,
  - Require that an attribute that is optional (Type 3) in a DICOM Module be absent
- 660
- Constrain the content of an attribute to be empty
  - Constrain the content of an attribute to be populated in a certain way, such as:
    - Constraining the value to be taken from a specific table
    - Constraining the value to be copied from a specific source
    - Constraining the value to encode certain information
- 665
- Require that an attribute be displayed/accessible to the operator

Reiterating DICOM requirements is kept to a minimum sufficient to provide context for the IHE requirements. Implementers are still required to be familiar with, and conform to, the underlying DICOM specification.

- 670 Content Definitions may be referenced from a Profile independent of transactions to constrain content without specifying the transport. Content Definitions may also be referenced from within a Transaction specification to constrain the content without duplicating the same constraint text across multiple related transactions.

For attributes that are optional, the creator is permitted but not required to include them, and the receiver is permitted but not required to ignore them.

### 675 7.1 Conventions

DICOM Conventions are defined in [Appendix E](#) to the *IHE Technical Frameworks General Introduction*.

**Table 7.1-1: Usage of DICOM Modules in IHE**

|           |                                                                                                                                                                       |
|-----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| M / C / U | As defined in DICOM PS 3.3                                                                                                                                            |
| R         | The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present. |

|    |                                                                                                                                                                                                           |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| RC | The Module is defined as Conditional (C) or User Option (U) in DICOM. The Requirement is an IHE extension of the DICOM requirements, and the module shall be present when the specified conditions apply. |
|----|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|

**Table 7.1-2: Usage of DICOM Attributes in IHE**

|     |                                                                                                                                                                                                                                                                                                                                                                                          |
|-----|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| O   | The attribute or its value is optional, i.e., in DICOM it is Type 2 or 3.                                                                                                                                                                                                                                                                                                                |
| O+* | The attribute is optional, but additional constraints have been added. Note: The specification approach does not force a Type 2 or Type 3 value to become a Type 1 by stating O+.                                                                                                                                                                                                        |
| R   | The attribute is required, and is not an IHE extension of the DICOM requirements; i.e., it is already Type 1 in DICOM, but additional constraints are placed by IHE, for example on the value set that may be used for the attribute.                                                                                                                                                    |
| R+  | The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present, i.e., is Type 1, whereas the DICOM requirement may be Type 2 or 3.                                                                                                                                                                                                                    |
| RC+ | The Requirement is an IHE extension of the DICOM requirements, and the attribute shall be present when the condition is satisfied, i.e., is Type 1C, whereas the DICOM requirement may be Type 2 or 3. If the condition is not fulfilled, the DICOM definitions apply. Note, that this means that the attribute may be present / have a value also in case the condition does not apply. |
| D   | The requirements of DICOM apply unchanged, but the attribute needs to be displayed.                                                                                                                                                                                                                                                                                                      |
| -   | No IHE extension of the DICOM requirements is defined. The attribute is listed for better readability or similar purpose.                                                                                                                                                                                                                                                                |
| X+  | The attribute information is required to be absent. DICOM Type 2 attributes shall be present with no value. DICOM Type 3 attributes shall be absent.                                                                                                                                                                                                                                     |

680

### 7.1.1 DICOM Structured Report

Conventions for constraining instances of DICOM Structured Reports as IHE Content Definitions are not yet worked out. In many cases, requiring the use of a specific DICOM SR Template may be sufficient.

### 685 7.1.2 Display Requirements

If a requirement lists \*, then that attribute is not required to be displayed.

## 7.2 General Definitions

## 7.3 IOD Definitions

## 7.4 Module Definitions

## 690 7.5 Service Definitions

### 7.5.1 UPS Push Workflow Service Groups

#### 7.5.1.1 N-CREATE Service

##### 7.5.1.1.1 N-CREATE Service Base

See TDW-II.

##### 695 7.5.1.1.2 N-CREATE Service for ‘Treatment Delivery’

See TDW-II.

##### 7.5.1.1.3 N-CREATE Service for ‘Treatment Delivery Offline Recording’

###### 7.5.1.1.3.1 Referenced Standards

DICOM PS 3.4: CC.2.5 Create a Unified Procedure Step (N-CREATE)

###### 700 7.5.1.1.3.2 Service Definition

The N-CREATE service for the offline recording use case shall comply with the requirements for the N-CREATE Service for ‘Treatment Delivery’ as specified in Section 7.5.1.1.2. In addition, the following shall apply:

- The Scheduled Processing Parameters Sequence shall include the following parameters:

705 **Table 7.5.1.1.3.2-1: Scheduled Processing Parameters Sequence Items**

|   | NL | VT     | Concept Name                                    | VM | Req Type | Condition | Value Set Constraint |
|---|----|--------|-------------------------------------------------|----|----------|-----------|----------------------|
| 1 |    | UIDREF | (2021001, 99IHERO2021, “Treatment Session UID”) | 1  | M        |           |                      |

Content Item Descriptions

|       |                                                                                                         |
|-------|---------------------------------------------------------------------------------------------------------|
| Row 1 | This parameter conveys the UID of the treatment session as initially scheduled and assigned by the TMS. |
|-------|---------------------------------------------------------------------------------------------------------|

710

Note: The scope of a Treatment Session UID is determined by the specific implementation of a TMS. A Treatment Session UID may be associated with a previous partially delivered session and its continuation or may be assigned only to the continuation session.

#### 7.5.1.1.4 N-CREATE Service for ‘Record Treatment Session’

##### 7.5.1.1.4.1 Referenced Standards

DICOM PS 3.4: CC.2.5 Create a Unified Procedure Step (N-CREATE)

715

##### 7.5.1.1.4.2 Service Definition

| Attribute                                | Tag                            | Type | Attribute Note                                                                |
|------------------------------------------|--------------------------------|------|-------------------------------------------------------------------------------|
| Scheduled Station Name Code Sequence     | (0040,4025)                    | R*   | Shall contain the code of the actual TDD issuing and performing the recording |
| Scheduled Workitem Code Sequence         | (0040,4018)                    | R+*  | (2021002, 99IHERO2021, “Record Treatment Session”)                            |
| >Code Value                              | (0008,0100)                    | R*   |                                                                               |
| >Coding Scheme Designator                | (0008,0102)                    | R*   |                                                                               |
| >Code Meaning                            | (0008,0104)                    | R*   |                                                                               |
| Scheduled Processing Parameters Sequence | (0074,1210)                    | R+*  | See below                                                                     |
| Input Readiness State                    | (0040,4041)                    | R+*  | Shall be READY                                                                |
| Input Information Sequence               | (0040,4021)                    | R+*  | Shall be empty                                                                |
| Patient’s Name                           | (0010,0010)                    | R+*  | Shall be copied from the treatment session record as available on the TDD     |
| Patient ID                               | (0010,0020)                    | R+*  | Shall be copied from the treatment session record as available on the TDD     |
| All other attributes                     | As described in DICOM Standard |      |                                                                               |

The Scheduled Processing Parameters Sequence shall include the following parameters:

**Table 7.5.1.1.4.2-1: Scheduled Processing Parameters Sequence Items**

|   | NL | VT     | Concept Name                                    | VM | Req Type | Condition | Value Set Constraint |
|---|----|--------|-------------------------------------------------|----|----------|-----------|----------------------|
| 1 |    | UIDREF | (2021001, 99IHERO2021, “Treatment Session UID”) | 1  | M        |           |                      |

720

##### Content Item Descriptions

|       |                                                                                                                                                     |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------|
| Row 1 | This parameter conveys the UID of the treatment session as initially scheduled and assigned by the TMS and as received in the initial treatment UPS |
|-------|-----------------------------------------------------------------------------------------------------------------------------------------------------|

## **7.5.2 UPS Pull Workflow Service Groups**

### **7.5.2.1 C-FIND Service**

#### **7.5.2.1.1 C-FIND Service for ‘Treatment Delivery’**

See TDW-II.

### **725 7.5.2.2 N-SET Progress Update Service**

#### **7.5.2.2.1 N-SET Progress Update Service Base**

See TDW-II.

#### **7.5.2.2.2 N-SET Progress Update Service for ‘Treatment Delivery’**

See TDW-II.

### **730 7.5.2.3 N-SET Final Update Service**

#### **7.5.2.3.1 N-SET Final Update Base**

See TDW-II.

#### **7.5.2.3.2 N-SET Final Update for ‘Treatment Delivery’**

See TDW-II.

### **735 7.5.2.3.3 N-SET Final Update for ‘Treatment Delivery Offline Recording’**

#### **7.5.2.3.3.1 Referenced Standards**

DICOM PS 3.4: CC.2.6 Set Unified Procedure Step Information (N-SET)

#### **7.5.2.3.3.2 Service Definition**

740 The final update of the treatment UPS for the offline recording use case shall comply with the requirements for a general treatment UPS as specified in Section 7.5.2.3.1.

Note: The Output Information shall only contain references to the treatment record(s) that have been successfully stored to the OST.

The TDD shall signal to the TMS that the final recording of the treatment session will be deferred by setting the Discontinuation Reason Code as follows:

745

| Attribute                                                 | Tag         | Type | Attribute Note |
|-----------------------------------------------------------|-------------|------|----------------|
| <b>Unified Procedure Step Progress Information Module</b> |             |      |                |
| Procedure Step State<br>(Note 1)                          | (0074,1000) | -    | CANCELED       |

| Attribute                                            | Tag         | Type | Attribute Note                               |
|------------------------------------------------------|-------------|------|----------------------------------------------|
| Progress Information Sequence                        | (0074,1002) |      |                                              |
| >Procedure Step Discontinuation Reason Code Sequence | (0074,100E) | R+   |                                              |
| >>Code Value                                         | (0008,0100) | R*   | (2021003, 99IHERO2021, “Deferred Recording”) |
| >>Coding Scheme Designator                           | (0008,0102) | R*   |                                              |
| >>Code Meaning                                       | (0008,0104) | R    |                                              |

Note 1: Procedure Step State is listed for completeness only. This will be set by the Treatment Delivery Completed/Canceled [RO-65] transaction.

### 7.5.2.3.4 N-SET Final Update ‘Record Treatment Session’

#### 7.5.2.3.4.1 Referenced Standards

750 DICOM PS 3.4: CC.2.6 Set Unified Procedure Step Information (N-SET)

#### 7.5.2.3.4.2 Service Definition

| Attribute                                                     | Tag                            | Type | Attribute Note                                                                                                                                           |
|---------------------------------------------------------------|--------------------------------|------|----------------------------------------------------------------------------------------------------------------------------------------------------------|
| Unified Procedure Step Performed Procedure Information Module |                                |      |                                                                                                                                                          |
| UPS Performed Procedure Sequence                              | (0074,1216)                    | RC*  | Required if UPS is not CANCELED.                                                                                                                         |
| >Performed Procedure Step Start<br>DateTime                   | (0040,4050)                    | R*   |                                                                                                                                                          |
| >Performed Workitem Code Sequence                             | (0040,4019)                    | R*   | The code of the performed workitem.<br>Shall be identical to the Scheduled Workitem<br>Code, i.e., (2021002, 99IHERO2021, “Record<br>Treatment Session”) |
| >>Code Value                                                  | (0008,0100)                    | R*   |                                                                                                                                                          |
| >>Coding Scheme Designator                                    | (0008,0102)                    | R*   |                                                                                                                                                          |
| >>Code Meaning                                                | (0008,0104)                    | R*   |                                                                                                                                                          |
| >Performed Procedure Step End<br>DateTime                     | (0040,4051)                    | R*   |                                                                                                                                                          |
| >Output Information Sequence                                  | (0040,4033)                    | R+*  | See below                                                                                                                                                |
| Unified Procedure Step Progress Information Module            |                                |      |                                                                                                                                                          |
| Progress Information Sequence                                 | (0074,1002)                    |      |                                                                                                                                                          |
| >Procedure Step Discontinuation<br>Reason Code Sequence       | (0074,100E)                    | RC+  | Required if Procedure Step State is<br>CANCELED                                                                                                          |
| >>Code Value                                                  | (0008,0100)                    | R*   | Shall be one of CID 9300 Procedure<br>Discontinuation Reasons or according to the<br>vendor’s DICOM Conformance Statement                                |
| >>Coding Scheme Designator                                    | (0008,0102)                    | R*   |                                                                                                                                                          |
| >>Code Meaning                                                | (0008,0104)                    | R*   |                                                                                                                                                          |
| All other attributes                                          | As described in DICOM Standard |      |                                                                                                                                                          |

The Output Information Sequence (0040,4033) shall contain references to a least the following items (additional items may be supplied for other reasons, but are out of scope for this profile):

**Table 7.5.2.3.4.2-1: Input Information Sequence Items for Record Treatment Session**

| SOP Class Name                                                                                | SOP Class UID                                                  | Retrieve Location |
|-----------------------------------------------------------------------------------------------|----------------------------------------------------------------|-------------------|
| RT Beams Treatment Record Storage or<br>RT Ion Beams Treatment Record Storage<br>(see Note 1) | 1.2.840.10008.5.1.4.1.1.481.4<br>1.2.840.10008.5.1.4.1.1.481.9 | Object Storage    |

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Note 1: The Output Information Sequence shall only include references to the Treatment Records that could not be recorded during the regular treatment workflow.

## **Appendices to Volume 3**

Not applicable.

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## Volume 4 – National Extensions

|                                        |
|----------------------------------------|
| <i>Add appropriate Country section</i> |
|----------------------------------------|

None at this time

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