

ASTRO
Integrating the Healthcare Enterprise



IHE-Radiation Oncology
Technical Framework
Volumes 1-2

Managed Delivery Workflow Addenda for
Version 2.0 (2008)

Draft for Public Comment
August 20, 2007

Comments may be submitted to:

<http://forums.rsna.org> under the “IHE” forum

Select the “*Radiation Oncology Technical Framework*” sub-forum.

RESOLVED & OPEN ISSUES (ADDITIONAL OPEN ISSUES HIGHLIGHTED TEXT)

Should the UPS’s for just a specific treatment session be returned (as currently specified), or should multiple sets (for different patients) be returned, in which case the SCU would need to filter these for the user (e.g. display the patient names in a list for selection)? It should not be restricted to a single treatment session. Answer (June 11 T-con): Potentially multiple sets should be returned, and they should be displayed on the TMS for selection (the TMS may wish to display only one item per returned session for this purpose).

Should Q/R support be mandated in this profile? The C MOVE part is currently required, but C FIND (of composite objects, not UPS) is not. Answer (June 11 T-con): No, not needed for this profile.

What is the meaning of a CANCELED procedure in radiotherapy? Specifically, is a treatment delivery where there was 60% completion before a machine failure considered to be COMPLETED (but with non-expected results), or CANCELED? Currently Supplement 74 describes this as CANCELED, but COMPLETED may be more consistent with the workflow meaning (i.e. in this case the UPS cannot be performed again and a new UPS needs to be created for the remainder of the delivery). Answer (June 11 T-con): CANCELED should be used for interrupted treatments — there is enough information (e.g. completion percentage, interruption reason) to determine what is to be done, and potentially schedule a new UPS to be completed. However, we need to be clear how the TMS determines if completion did occur.

Should the TDS (Treatment Delivery System) Actor be given a name that does not confuse it with the Supplement 74 actor of the same name, e.g. should it be called a STDS (Standalone Treatment Delivery System)? Answer (June 11 T-con) Will use Patient Positioning System (PPS), Positioning and Delivery System (PDS), and Treatment Delivery Device (TDD).

Is it OK to update the UPS (with N SET) before the generated composite objects are stored? Specifically, the Performing Device will need to know in advance the location where the objects will be stored, in order to populate the Output Information Sequence in the UPS. Answer (June 11 T-con): Will use C STORE, N SET (with Output Information Sequence), then N ACTION. Treatment procedures will use an additional N SET with progress update only, prior to C STORE of composite result objects.

Redo Table of Contents so that section and page numbers are automatic.

<p>Should TMS have to support PPD as a SCP? Will there be any PPD participants? Yes, interest from independent PPD vendors in 2008-2009 time frame.</p>
<p>For RO-20, is a Spatial Registration object the correct data item to exchange (in which case the onus is on the TDD to interpret it and adjust the couch accordingly), or would it be better to exchange a custom "Couch Positioning Instruction" IOD (that would have to be added to DICOM), in which case the onus would be on the PPD to have sufficient knowledge of the couch to create such as object? This does not need to be addressed in the 2008 profile since this interface is not exposed. Will require WG7 work for 2009 profile, however.</p>
<p>This document support three kinds of work item: Positioning, Delivery, and Positioning and delivery. Would it be simpler to force positioning and delivery to be separate work items (i.e. a TDD would typically chain together two requested work items)? Yes, decided 4/17/07 to use this approach.</p>
<p>Should Storage Commitment be modeled? No, we have decided to omit any description of storage commitment in this profile. Systems that support Storage Commitment may choose to use it, but it is not required by this profile.</p>
<p>Transaction UID (2007/06/25 T-con): value shall be supplied by the TMS (SCP) in the N-ACTION response (see Section 3.16); or by the TDS (SCU) in the request. TMS shall support both modes.</p>
<p>TMS acting as Archive (2007/06/25 T-con): Clauses have been added to state that a single product could act in both the role of a TMS and an Archive.</p>
<p>C-MOVE Study Root (2007/06/25 T-con): Clauses have been added to state that Study Level C-MOVE shall be supported in such a way that a single series or specific SOP Instances can be retrieved, rather than a whole study.</p>
<p>Specification of Query (92007/06/25 T-con):</p> <p>These issues were discussed at length in the T-con:</p> <p>Issue A: How should the SCU specify its capabilities? At least three different modes of operation were proposed for inserting in the wording of Volume 2 Section 3.12):</p> <ol style="list-style-type: none">1) A Performing Device specifies the procedure types it is capable of performing (via the Scheduled Workitem Code Sequence), and the TMS (Worklist SCP) uses this to determine which UPSs should be returned to the Performing Device. This approach is standardized, and is probably in line with other worklist cases where a Performing Device declares its capabilities in the Query. Concern was expressed that this would cause certain UPSs on the TMS to be 'filtered' such that they do not appear on the SCU and would be 'lost'. Some thought that management of this situation was however the role of the TMS in any case. Assignment of UPSs originally destined for other machines could occur if the Scheduled Station Name of the UPS was coerced by the TMS to be the querying station name.

2) A Performing Device just specifies its Station Name (via the Scheduled Station Name Code Sequence), and the TMS (Worklist SCP) uses this ID to determine which UPSs should be returned to the Performing Device. This places the responsibility for matching station name with UPSs outside the responsibility of the standard (a TMS would use a table to map machines to capabilities). The TMS could also return UPSs originally designated for other machines by using the table to understand machine equivalence.

3) A Performing Device specifies its Station Name and also 'Class' (via the Scheduled Station Class Code Sequence), and the TMS (Worklist SCP) uses this ID to determine which UPSs should be returned to the Performing Device. This also places the responsibility for matching station name with UPSs outside the responsibility of the standard, but is different from the above approach in that the SCU supplies its own Station Class according to some pre-agreed set of terms, rather than have the TMS manage the equivalence. Concern was expressed that this approach could potentially lead to a large number of defined terms to handle different product configurations, and the information may be a repetition of the information available in the Workitem Code approach.

Decision (Meeting of July 26, 2007): Option 2. Station Name sequence shall be supplied (code value as the 'database key' and code description as the human-readable string). Supported procedure types shall NOT be supplied (TMS will decide what is capable of being performed on the SCU based upon its knowledge of that device).

Issue B: Shall the TMS (SCP) be required to return all candidate workitems?

Some thought that the TMS should be obliged to return all the workitems that fit a particular query. They considered that this is how worklist 'should' operate, and would guarantee that workitems would not be 'lost' because the TMS decided not to return them. Others thought that it is the role of the TMS to manage suitability of UPSs, and it should be free to return the ones it considers appropriate at the time of query (e.g. return UPSs originally destined for another machine as well if that machine is known to be unavailable, or not return imaging UPSs if the imager of the requesting machine is known to be broken). The specific case that illustrated the issue best was that where the user selects the "current" patient on the TMS, it would then return only the set of procedures pertaining to the next fraction for that patient. Some thought this approach contrary to the spirit of workflow management and not acceptable for IHE-RO. Others thought that it was a viable approach that should not be ruled out by IHE-RO (and stated that a significant fraction of the installed base currently operates in this way in a proprietary manner). Essentially, the key question is whether the TMS should be allowed to "over-filter" the query response based upon certain workflow knowledge that it possesses, or should it be required to return all procedures that could potentially be performed by the querying device, based upon a strict interpretation of the query rather than other workflow knowledge.

One suggestion to address the one patient vs many issue was to add an option to the query to specify which mode was to be used (i.e. specifying in the query whether one or many treatment sessions is required to be returned). Possible attributes that could be used for this include

~~Scheduled Procedure Step Priority (HIGH for the patient that is actually present), or a Scheduled Procedure Step Start Date and Time that is a single value with the current time, rather than a time range (a whole day). These approaches don't seem entirely consistent with the semantics of those attributes. At least one person preferred that this approach not be used, since at the time of query the Performing Device may not know or care which mode is being used by the TMS.~~

~~Decision (Meeting of July 26, 2007): The TMS (SCP) shall not be required to return all potential items. If operating in a mode where the patient is selected on a TMS, it can return just the single set of procedures. If not operating in this mode, it can return multiple sets of procedures base upon the supplied date range, confidentiality privileges, machine capabilities etc.~~

V7 Changes: Added Private Creator tags in UPS messages; Updated Codes per Supplement 74 changes; added Study Instance UID; Re-ordered attributes in query, many other minor changes.

V8 Changes: Identified fiducial set in future work; Added paragraph regarding future real-time monitoring of treatment delivery; Added SOP Class table per Supplement 97 Part 17. Section 3.12: Stated that Supplied Study Instance UID must be used; Added asterisks for attributes NOT required to be displayed; Removed unnecessary specification of Private Attribute Creator; Removed Scheduled Workitem Code Sequence; Made Code Meaning required in Scheduled Station Name Code Sequence. Section 3.12-1: Added Notes below table per meeting discussions. Sections 3.19-3.21: Made use of supplied Study Instance UID mandatory.

V9 Changes: Table 3.12-1 Added option of CANCEL (see open issue below); Added back empty Scheduled Workitem Code Sequence.

Open issue (see Table 3.12-1): Should a query specifying a status of CANCELED be permitted in order to retrieve interrupted procedures? Does this place unacceptable burden on TMS systems for the purpose of this profile?

Open issue (see Table 3.23-1): In the case of an interrupted procedure, should we specify in the UPS whether or not we would like a continuation (completion) procedure to be scheduled, and how? Also, should we create defined terms for the discontinuation reason (in addition to the treatment record)?

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Foreword

No changes for Managed Delivery Workflow profiles.

Volume 1- Integration Profiles

ASTRO

Integrating the Healthcare Enterprise



IHE-RO

Technical Framework

**Managed Delivery Workflow Addendum for
Version 2.0 (2008)**

Draft for Public Comment

August 20, 2007

1 Preface to Volume 1

No changes for Managed Delivery Workflow profiles.

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2 Introduction

No changes for Managed Delivery Workflow profiles.

2.1 Relationship to Standards

No changes for Managed Delivery Workflow profiles.

2.2 Relationship to Product Implementations

No changes for Managed Delivery Workflow profiles.

2.3 Framework Development and Maintenance

No changes for Managed Delivery Workflow profile.

2.4 Radiation Oncology Integration Profiles

Add the following to this section.

The following profiles are documented in this framework:

- **Discrete Positioning and Delivery Profile:** In this profile a Patient Positioning System (PPS) acquires positioning images or other information, performs a registration of that data with the desired position then adjusts the patient position accordingly. Although these three steps are managed independently using UWPS, the intermediate results of these steps are not required to be exposed, and the output of the PPS is simply indication that the positioning was either completed successfully or canceled. For Positioning Systems that require the patient position be adjusted manually, the actor is responsible for indicating that the positioning was completed. Following the positioning steps, the Treatment Delivery Device (TDD) then performs a treatment delivery using internal verification (see DICOM Supplement 74).
- **Integrated Positioning and Delivery Profile:** In this profile a single system, a Positioning and Delivery System (PDS) acquires positioning images or other information, performs a registration of that data with the desired position, adjusts the patient position accordingly, and finally performs a treatment delivery using internal verification (see DICOM Supplement 74).

In the course of this work the following profiles were identified as suitable for implementation in following years:

- A standalone device acquires positioning information (e.g. an image or fiducial set) and performs a registration. A second device then performs the indicated adjustments and delivers the radiation.

Performing Actor 1: Acquisition and Registration

Performing Actor 2: Patient position correction and Delivery

- A standalone device acquires positioning information (e.g. an in-room CT, portal imaging device, or non-image-based device). A second device performs a registration. A third device then performs the indicated adjustments and delivers the radiation.

Performing Actor 1: Acquisition

Performing Actor 2: Registration

Performing Actor 3: Patient position correction and Delivery

Evolution

The Treatment Delivery Workflow integration profile for 2008 involves the flow of DICOM data necessary for treatment delivery from Archive and Treatment Management System (TMS) actors to Positioning, Delivery, and Positioning and Delivery systems.

This document describes the first profiles in a progression of profiles that will implement workflow features in radiation oncology. The intended sequence of development for these profiles is as follows:

- **Phase 1** (these profiles): Scheduled workflow for patient positioning and delivery.
- **Phase 2:** Scheduled workflow for remaining procedure step types in radiation oncology. These steps may include items such as simulation, planning, plan review, and treatment review, as well as other modes of positioning and delivery. At this stage, the profile will then cover the vast majority of cases in radiation therapy, and enable charge capture by the Treatment Management System or billing system.
- **Phase 3:** ADT (admission, discharge, and transfer) support. This profile will enable a Treatment Management System to acquire patient demographic information from a Hospital Information System (via the HL7 protocol), based upon existing IHE patient registration profiles. This functionality has already been implemented in some commercially available products and this phase may potentially be combined with Phase 2.
- **Phase 4:** Non-managed workflow. Special cases such as emergency treatments may result in performed procedures that have no corresponding Unified Procedure Step. This profile will be concerned with updating the Treatment Management System to take this into account, so that the performed items are then recorded and billed through the normal processes. This phase may require the RT Course IOD being developed as part of DICOM WG7 work on second-generation RT objects.
- **Phase 5:** Partially-managed workflow and media archive. This profile will support situations where some procedures (e.g. CT acquisition and an initial plan) have not been performed under managed workflow, but the output objects from those procedures are introduced into the workflow environment via media archive. It will also support generation of media

archives. This phase may require the RT Course IOD being developed as part of DICOM WG7 work on second-generation RT objects.

2.5 Integration Profiles Overview

No changes for Managed Delivery Workflow profile.

2.6 Product Implementations

No changes for Managed Delivery Workflow profile.

DRAFT

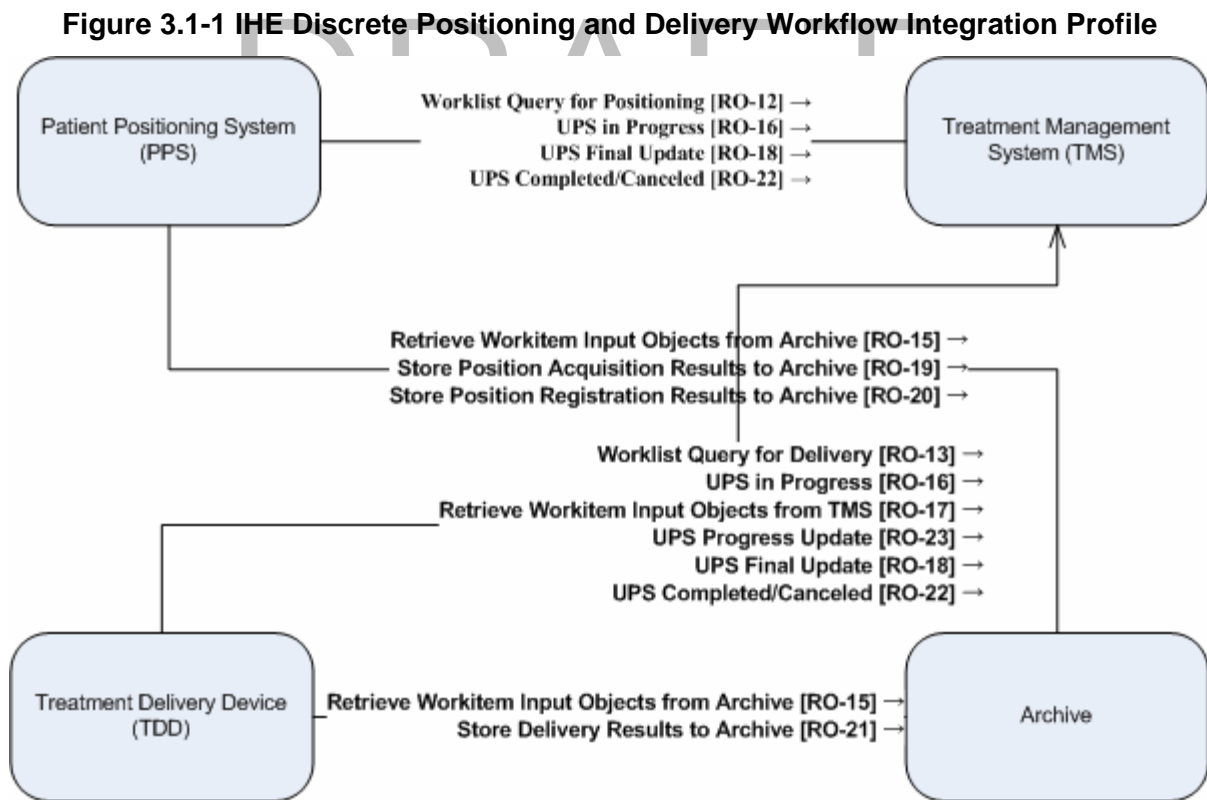
3 Discrete Positioning and Delivery Workflow Integration Profile

3.1 Scope and Purpose

The Discrete Positioning and Delivery Workflow Profile involves the positioning of a patient and subsequent treatment delivery, where the positioning and delivery are performed by separate devices, as follows:

- The Patient Positioning System (PPS) acquires a set of 2D (planar projection) or 3D (CT) positioning images, performs a registration with previously retrieved reference images, and repositions the patient if necessary. Note that for this profile, the output of these steps is the fact that the patient positioning has been successfully performed.
- The Treatment Delivery Device (TDD) then delivers the intended treatment.

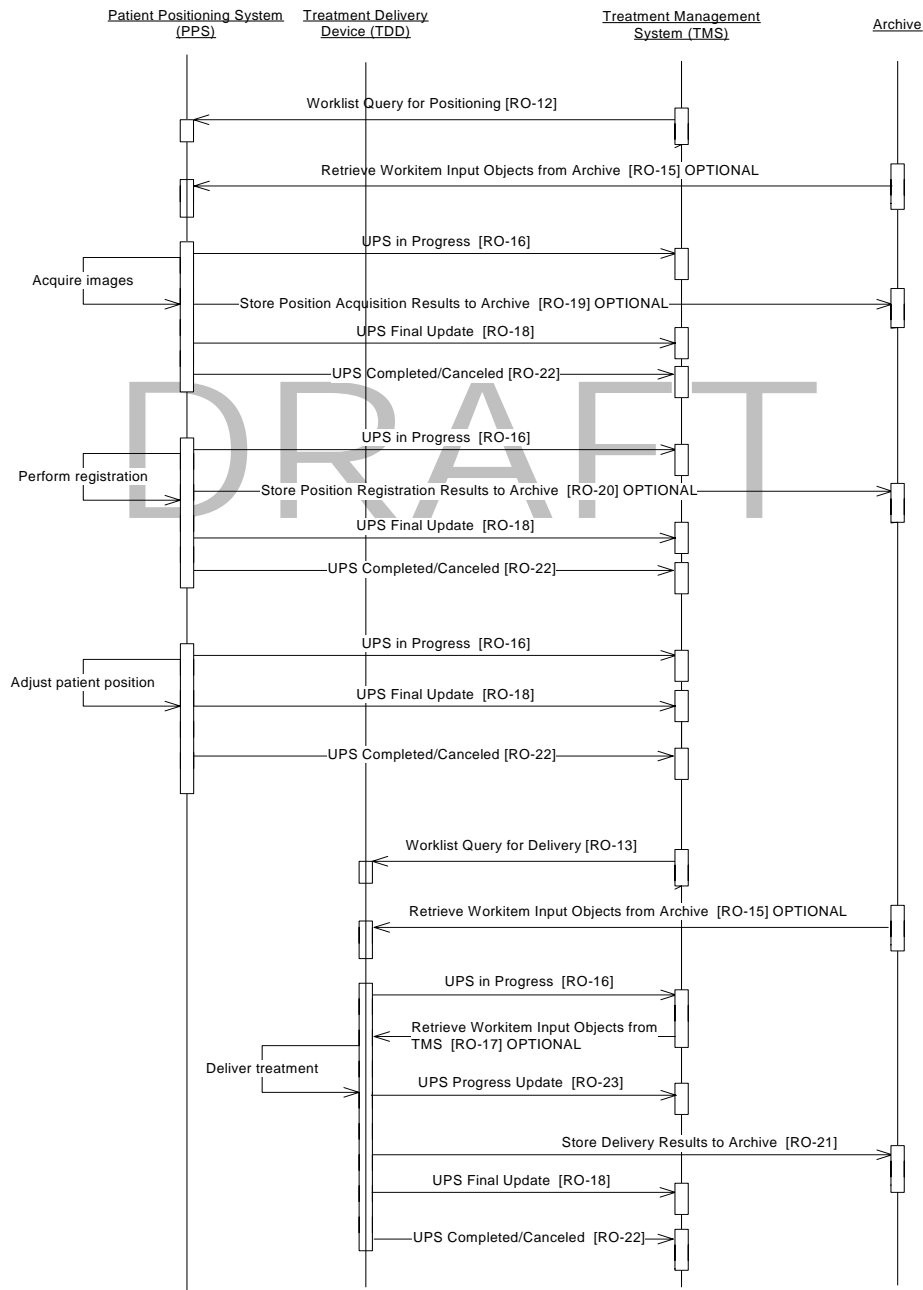
Figure 3.1-1 shows the Actors and Transactions involved in this profile.



3.2 Process Flow

The process flow for the Discrete Positioning and Delivery Workflow Profile is shown in Figure 3.2-1.

Figure 3.2-1 IHE Discrete Positioning and Delivery Workflow Integration Profile



4 Integrated Positioning and Delivery Workflow Integration Profile

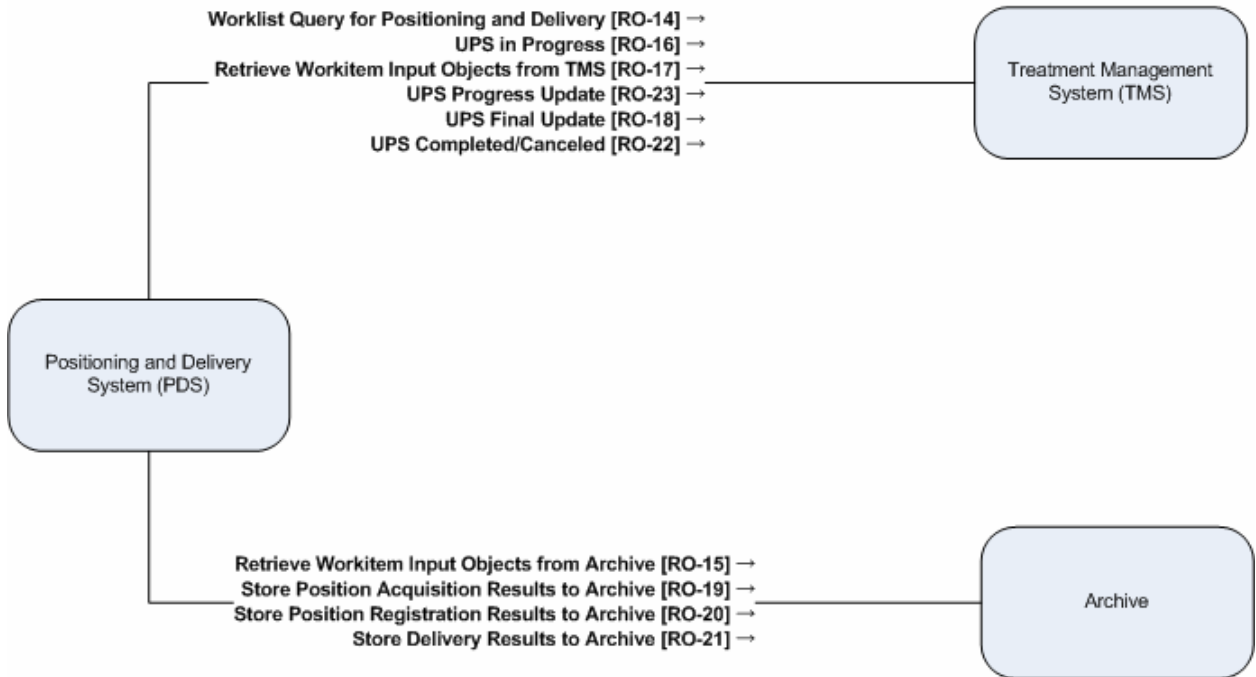
4.1 Scope and Purpose

The Integrated Positioning and Delivery Workflow Profile involves the positioning of a patient and subsequent treatment delivery, where the positioning and delivery are performed by a single device, as follows:

- The Positioning and Delivery System (PDS) acquires a set of 2D (planar projection) or 3D (CT) positioning images, performs a registration with previously retrieved reference images, and repositions the patient if necessary. It then delivers the intended treatment.

Figure 4.1-1 shows the Actors and Transactions involved in this profile.

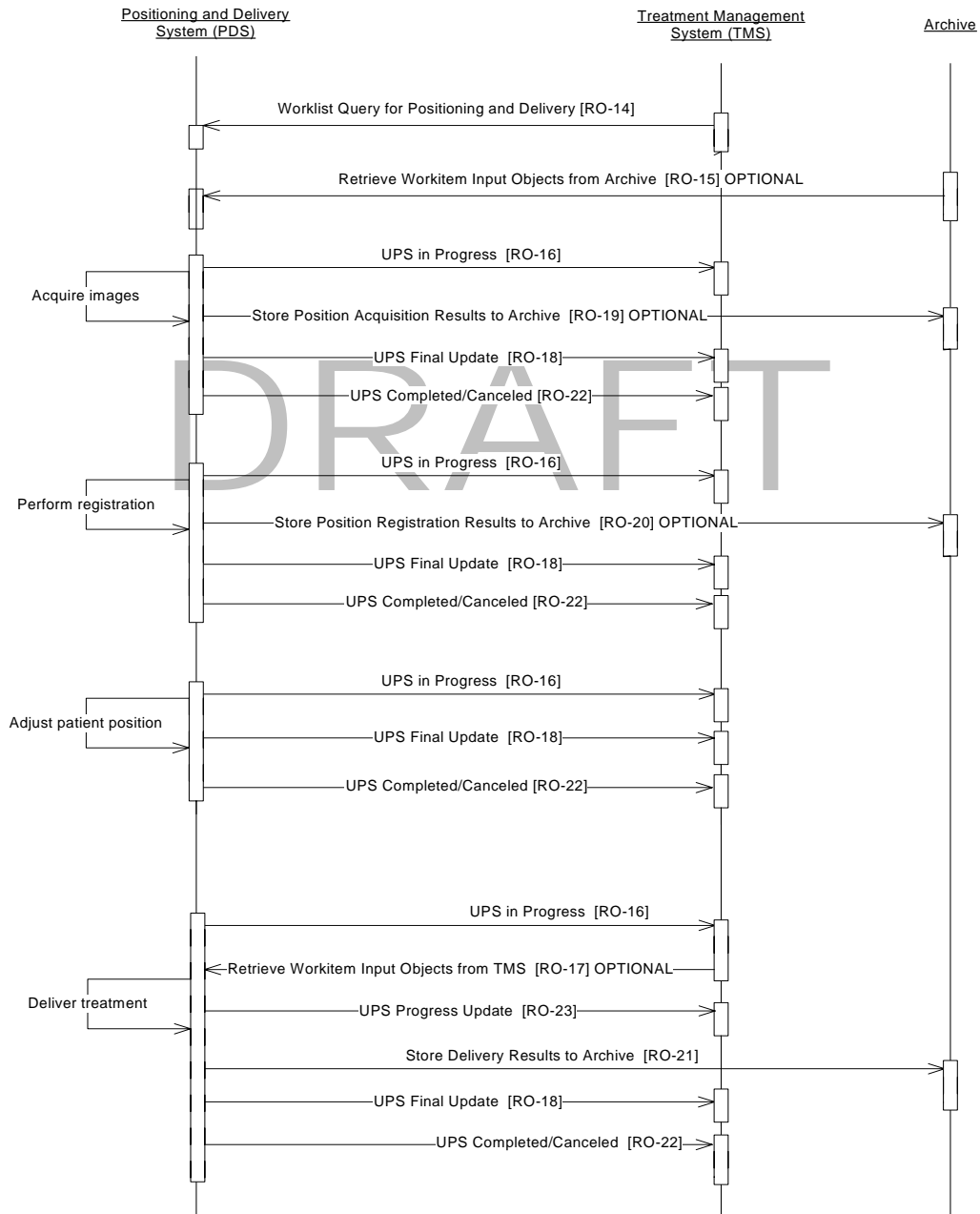
Figure 4.1-1 IHE Integrated Positioning and Delivery Workflow Integration Profile



4.2 Process Flow

The process flow for the Integrated Positioning and Delivery Workflow Profile is shown in Figure 4.2-1.

Figure 4.2-1 IHE Integrated Positioning and Delivery Workflow Integration Profile



Appendix A: Actors

A.1 Actor Descriptions

No changes for Managed Delivery Workflow profile.

A.2 RT Specific Actors

Add the following actors:

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 fulfils the role of a UPS-Pull ‘Worklist Manager’ SCP as described in DICOM Supplement 96 Part 17 Table Z.1-1. Note that a specific product implementation could potentially fulfill the role of both a TMS and an Archive, in which case the supplied AE Title in Input and Output Sequences may be an AE Title managed by that implementation.

Patient Positioning System (PPS) – A system responsible for determining patient positioning prior to treatment, determining any adjustment required, and then adjusting it such that the patient is then in a position appropriate for treatment. A PPS is a combination of the future PAD, PRD, and PMD devices described below. The PPS fulfils the role of a UPS-Pull ‘Pull Performer’ SCU as described in DICOM Supplement 96 Part 17 Table Z.1-1.

Treatment Delivery Device (TDD) – A system that delivers therapeutic radiation to a correctly positioned patient. The TDD fulfils the role of a UPS-Pull ‘Pull Performer’ SCU as described in DICOM Supplement 96 Part 17 Table Z.1-1.

Positioning and Delivery System (PDS) – A system that determines and corrects patient position then delivers therapeutic radiation. A PDS is a combination of a PPS and TDD described above. The PDS fulfils the role of a UPS-Pull ‘Pull Performer’ SCU as described in DICOM Supplement 96 Part 17 Table Z.1-1.

Note that the Acquisition Modality (CT) is not included as an RT Specific actor in the profile - it is assumed that it will have performed its function within the scope of RAD-8 (Modality images stored).

The following table shows which transactions are required to be supported by the actors in the Managed Delivery Workflow Profiles.

Actors	Transactions	Optionality for Discrete Positioning & Delivery Workflow Profile	Optionality for Integrated Positioning & Delivery Workflow Profile	Volume II section
Archive	RO-15 Retrieve Workitem Input Objects from Archive	R	R	3.15
	RO-19 Store Position Acquisition Results to Archive	R	R	3.19
	RO-20 Store Position Registration Results to Archive	R	R	3.20
	RO-21 Store Delivery Results to Archive	R	R	3.21
Treatment Management System (TMS)	RO-12 Worklist Query for Positioning	R	-	3.12
	RO-13 Worklist Query for Delivery	R	-	3.13
	RO-14 Worklist Query for Positioning and Delivery	-	R	3.14
	RO-16 UPS in Progress	R	R	3.16
	RO-17 Retrieve Workitem Input Objects from TMS	R	R	3.17
	RO-18 UPS Final Update	R	R	3.18
	RO-22 UPS Completed/Canceled	R	R	3.22
	RO-23 UPS Progress Update	R	R	3.23
Patient Positioning System (PPS)	RO-12 Worklist Query for Positioning	R	-	3.12
	RO-15 Retrieve Workitem Input Objects from Archive	R	-	3.15
	RO-16 UPS in Progress	R	-	3.16
	RO-17 Retrieve Workitem	R	-	3.17

Actors	Transactions	Optionality for Discrete Positioning & Delivery Workflow Profile	Optionality for Integrated Positioning & Delivery Workflow Profile	Volume II section
	Input Objects from TMS			
	RO-18 UPS Final Update	R	-	3.18
	RO-19 Store Position Acquisition Results to Archive	O	-	3.19
	RO-20 Store Position Registration Results to Archive	O	-	3.20
	RO-22 UPS Completed/Canceled	R	-	3.22
Treatment Delivery Device (TDD)	RO-13 Worklist Query for Delivery	R	-	3.13
	RO-15 Retrieve Workitem Input Objects from Archive	R	-	3.15
	RO-16 UPS in Progress	R	-	3.16
	RO-17 Retrieve Workitem Input Objects from TMS	R	-	3.17
	RO-18 UPS Final Update	R	-	3.18
	RO-21 Store Delivery Results to Archive	R	-	3.21
	RO-22 UPS Completed/Canceled	R	-	3.22
	RO-23 UPS Progress Update	R	-	3.23
Positioning and Delivery System (PDS)	RO-14 Worklist Query for Positioning and Delivery	-	R	3.14
	RO-15 Retrieve Workitem Input Objects from Archive	-	R	3.15
	RO-16 UPS in Progress	-	R	3.16
	RO-17 Retrieve Workitem Input Objects from TMS	-	R	3.17

Actors	Transactions	Optionality for Discrete Positioning & Delivery Workflow Profile	Optionality for Integrated Positioning & Delivery Workflow Profile	Volume II section
	RO-18 UPS Final Update	-	R	3.18
	RO-19 Store Position Acquisition Results to Archive	-	O	3.19
	RO-20 Store Position Registration Results to Archive	-	O	3.20
	RO-22 UPS Completed/Canceled	-	R	3.22
	RO-23 UPS Progress Update	-	R	3.23

The following table illustrates the SOP Classes implemented by the above actors relative to PS3.17 Table Z.1-1 of DICOM Supplement 96. Note that the TMS is not required to support UPS Push, UPS Watch, or UPS Event for these profiles.

SOP Classes for Workflow Actors

SOP Classes	SCU				SCP			
	UPS Push	UPS Watch	UPS Event	UPS Pull	UPS Push	UPS Watch	UPS Event	UPS Pull

Worklist SCPs

Worklist Manager: TMS								X
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Performing SCUs

Pull Performer: TMS, PPS, TDD, PDS				X				
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Future Actors

In future IHE-RO frameworks, the subcomponents of a PPS will be modeled separately in some profiles. These subcomponents are as follows:

- **Position Acquisition Device (PAD)** – A device that obtains information regarding the location of the patient prior to undergoing radiation therapy. The data obtained from such a process may include projection images, 3D image sets, fiducial information, or some other data that can be used to determine or infer the position of the patient.
- **Position Registration Device (PRD)** – A device that uses the information obtained by a PAD in order to determine the relationship between the actual and desired patient position. An example of the output from this actor would be a six-dimensional vector indicating the translational and rotational offsets that need to be applied to the patient position in order that the patient is positioned correctly for the treatment.

Position Modification Device (PMD) – A device that uses the information generated by a PRD in order to modify patient position. Such a device could modify treatment couch parameters, for example. In some use cases, a human operator may act in the role of a PMD (e.g. when couch position is adjusted manually, or when the patient is moved relative to the couch).

In addition, future profiles could potentially address monitoring of patient position during treatment (especially for gated deliveries). This may require new actors such as a Position Monitoring System that detect changes in patient or tumor position and notify other actors of these changes.

DRAFT

Appendix B: Transactions

B.1: Transaction Descriptions

Add the following transactions:

RO-12: Worklist Query for Positioning

In the Worklist Query for Positioning transaction, a PPS or PDS requests and receives a patient positioning worklist from a TMS.

RO-13: Worklist Query for Delivery

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

RO-14: Worklist Query for Positioning and Delivery

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

RO-15: Retrieve Workitem Input Objects from Archive

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

RO-16: UPS in Progress

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

RO-17: Retrieve Workitem Input Objects from TMS

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

RO-18: UPS Final Update

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

RO-19: Store Position Acquisition Results to Archive

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

RO-20: Store Position Registration Results to Archive

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

RO-21: Store Delivery Results to Archive

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

RO-22: UPS Completed/Canceled

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

RO-23: UPS Progress Update

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

Add the following columns to the table:

IHE-RO Managed Workflow Profile Transactions

Transactions	Profiles	
	Discrete Positioning and Delivery Workflow	Integrated Positioning and Delivery Workflow
RO-12 Worklist Query for Positioning	X	
RO-13 Worklist Query for Delivery	X	
RO-14 Worklist Query for Positioning and Delivery		X
RO-15 Retrieve Workitem Input Objects from Archive	X	X
RO-16 UPS in Progress	X	X
RO-17 Retrieve Workitem Input Objects from TMS	X	X
RO-18 UPS Final Update	X	X
RO-19 Store Position Acquisition Results to Archive	X	X
RO-20 Store Position Registration Results to Archive	X	X
RO-21 Store Delivery Results to Archive	X	X
RO-22 UPS Completed/Canceled	X	X
RO-23 UPS Progress Update	X	X

Volume 2 - Transactions

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IHE-RO
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for
Version 2.0 (2008)

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1 Preface to Volume 2

No changes for Managed Delivery Workflow profile.

DRAFT

2 Introduction

No changes for Managed Delivery Workflow profile.

Usage conventions included here for reference:

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

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

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

- Required matching key SCU:

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

- Required matching key SCP:

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

- Required return key SCU:

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

- Required return key SCP:

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

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

R Required O Optional

The following modifiers are also used:

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

R* The attribute is not required to be displayed

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

DRAFT

3 IHE-RO Transactions

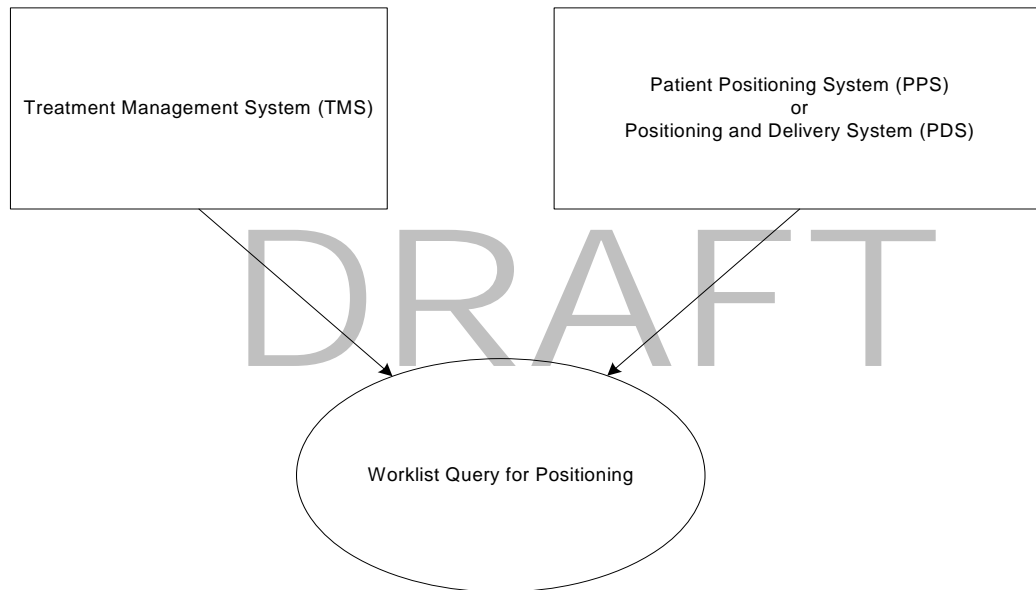
Add the following transactions:

3.12 RO-12: Worklist Query for Positioning

3.12.1 Scope

In the Worklist Query for Positioning transaction, a PPS or PDS requests and receives a patient positioning worklist from a TMS.

3.12.2 Use Case Roles



Actor: Treatment Management System

Role: Responds to a worklist query and sends a scheduled patient positioning worklist to a PPS or PDS.

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

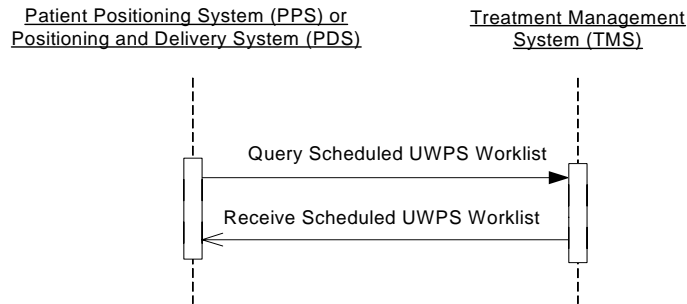
Role: Queries a TMS and receives a scheduled patient positioning worklist.

3.12.3 Referenced Standards

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

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

3.12.4 Interaction Diagram



3.12.4.1 Query Scheduled UWPS Worklist Message

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

3.12.4.1.1 Trigger Events

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

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

3.12.4.1.2 Message Semantics

The Performing Device uses the C-FIND request of the DICOM Unified Procedure Step – Push SOP Class to query the worklist from the TMS. The Performing Device performs the SCU role, and the TMS performs the SCP role. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Affected SOP Class in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.12.4.1.2.1 Matching Keys and Return Keys for Display

In the query to the TMS, the Performing Device (SCU) is required to query for matching on the attributes as shown in Table 3.12-1. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient's Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence

(0040,4025) would be optional matching query key attributes that would be commonly supplied.

Table 3.12-1: Matching and Return Keys for UWPS Worklist Query for Positioning

Attribute Name	Tag	Query Keys Matching		Query Keys Return	
		SCU	SCP	SCU	SCP
Specific Character Set	(0008,0005)	-	-	O	RC
SOP Class UID	(0008,1016)	-	-	O	R
SOP Instance UID	(0008,0018)	-	-	O	R
Unified Procedure Step Status. See Note 1.	(0041,1000)	R	R	R*	R
Procedure Step Label	(0041,1022)	-	-	R+	R+
Scheduled Station Name Code Sequence	(0040,4025)				
>Code Value. See Note 2.	(0008,0100)	O	R	R+*	R
>Coding Scheme Designator. See Note 3.	(0008,0102)	O	R	R+*	R
>Code Meaning. See Note 4.	(0008,0104)	-	-	R+	R
Scheduled Procedure Step Start Date and Time. See Note 5.	(0040,4005)	R+	R	R+	R
Scheduled Workitem Code Sequence. See Note 6.	(0040,4018)	-	-	R+	R
Input Information Sequence. See Note 7.	(0040,4021)	-	-	R+*	R+
Study Instance UID. See Note 8.	(0020,000D)	-	-	O	R+
Patient's Name	(0010,0010)	O	R	R+	R
Patient ID	(0010,0020)	O	R	R+	R
All other attributes	As described in DICOM Supplement 96				

Note 1: A Unified Procedure Step Status of 'SCHEDULED' or 'CANCELED' shall be supplied.

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

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

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

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

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

Note 7: Input Information Sequence shall contain all the input objects that will ultimately be needed to perform the specified procedure step. This allows the Performing Device to determine whether or not the instances are available prior to starting the procedure, and avoids the need for an additional N-GET on the UPS.

Note 8: Study Instance UID must be supplied by the TMS (SCP) if performance of the procedure step is expected to create composite SOP Instances as output. The supplied Study Instance shall be used by the SCU in creation of such SOP Instances (see transactions RO-19, RO-20, and RO-21).

In the query to the TMS, the Performing Device (SCU) is required to query for matching on the attributes shown as “R” or “R+” in the appropriate column in Table 3.12-1. All other potential query keys may be optionally supplied as described in DICOM Supplement 96. It is anticipated that Patient’s Name (0010,0010), Patient ID (0010,0020), and Scheduled Station Name Code Sequence (0040,4025) would be optional matching query key attributes that would be commonly supplied.

In the query to the TMS, the Performing Device (SCU) is required to supply return keys for display as shown in “Query Keys Return SCU” column of Table 3.12-1. All other potential return keys for display may be optionally supplied as described in DICOM Supplement 96. The SCU is NOT required to display items marked with an asterisk.

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

3.12.4.1.3 Expected Actions

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

3.12.4.2 Receive Scheduled UWPS Worklist Message

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

3.12.4.2.1 Trigger Events

The TMS has received a query for a UWPS Worklist.

3.12.4.2.2 Message Semantics

C-FIND Responses from the DICOM Unified Procedure Step – Push SOP Class will be used for this message. The TMS will determine the procedure steps required to fulfill the request, based upon the supplied query keys and any additional internal information it may have.

Important: Each matching scheduled UPS shall be returned as a separate UPS C-FIND response item (SOP instance), and each response shall contain exactly one item in the Scheduled Workitem Code Sequence (0040,4018). All procedure steps that need to be performed by the Performing Device shall be returned, i.e. there shall be no additional query for subsequent steps after the first procedure step has been performed.

More than one matching treatment session may be returned by the TMS. For each matching treatment session, a set of Unified Procedure Steps shall be returned, corresponding to the specific procedures that comprise the treatment session. For example, if four matching sessions are found, each composed of four procedures, then the TMS shall return twelve matching Unified Procedure Steps. The specific Scheduled Workitem codes supplied by the TMS shall be consistent with the capabilities of the Performing Device.

For the Worklist Query for Positioning transaction, exactly three Unified Procedure Steps (UPS C-FIND responses in the 'pending' state) shall be returned for each matching treatment session:

- **Response 1:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121702-121711 (acquisition) and Coding Scheme Designator shall be '99SUP74FZ'. If the Code Value is in the range 121702-121706, one or more RT Image SOP Instance references shall be supplied in the Input Information Sequence (0040,4021). If the Code Value is in the range 121707-121708, one CT Image Series reference shall be supplied in the Input Information Sequence (0040,4021). The specified location of the SOP Instances shall be an Archive. Note that a specific product implementation could fulfill the roles of both a TMS and an Archive, in which case one AE Title could be used to retrieve all input SOP Instances for the UPS.
- **Response 2:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121712-121721 (registration) and Coding Scheme Designator shall be '99SUP74FZ'. No Input Information SOP Instances need be supplied.
- **Response 3:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121722' ('RT Patient Position Adjustment') and Coding Scheme Designator shall be equal to '99SUP74FZ'. No Input Information SOP Instances need be supplied.

3.12.4.2.3 Expected Actions

For each matching treatment session, it is then the responsibility of the Performing Device to present the returned responses in a way that allows the user to select which of the sessions is to be performed. For example, each session might be summarized as a single item the user interface of the Performing Device. The operator on the Performing Device will then analyze the supplied information, and select one of the supplied treatment sessions as the set of procedures to be performed. If there is only one treatment

session capable of being performed by the Performing Device, then this step may be omitted.

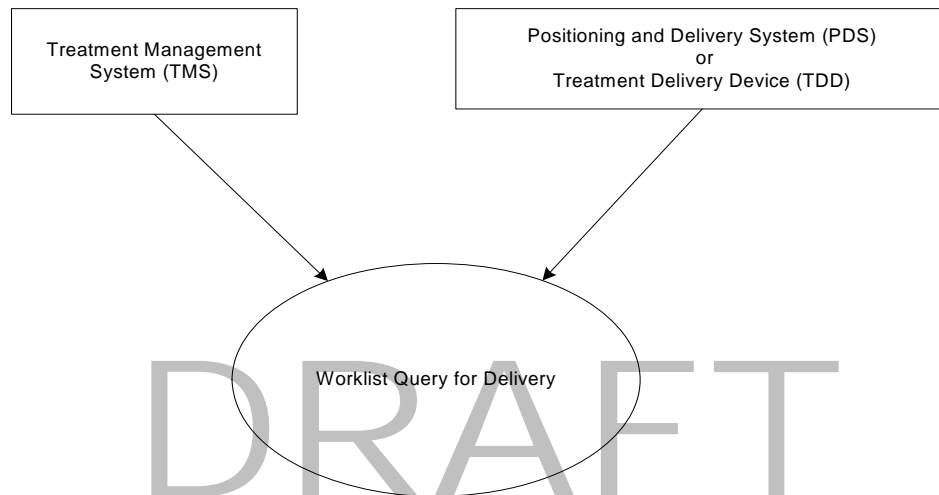
DRAFT

3.13 RO-13: Worklist Query for Delivery

3.13.1 Scope

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

3.13.2 Use Case Roles



Actor: Treatment Management System

Role: Responds to a worklist query and send a scheduled treatment delivery worklist to a PDS or TDD.

Actor: Positioning and Delivery System or Treatment Delivery Device

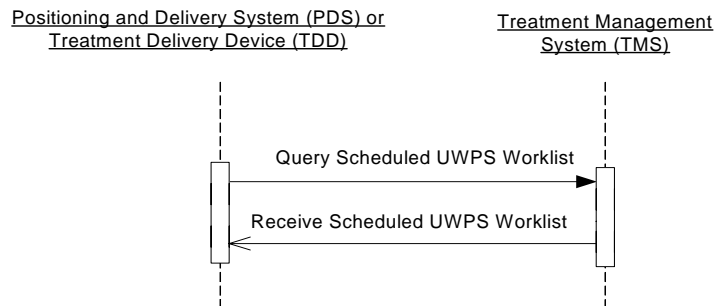
Role: Queries a TMS and receives a scheduled treatment delivery worklist.

3.13.3 Referenced Standards

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

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

3.13.4 Interaction Diagram



3.13.4.1 Query Scheduled UWPS Worklist Message

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

3.13.4.1.1 Trigger Events

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

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

3.13.4.1.2 Message Semantics

See transaction RO-12 Section 3.12.4.1.2.

3.13.4.1.2.1 Matching Keys and Return Keys for Display

See transaction RO-12 Section 3.13.4.1.2.1.

3.13.4.1.3 Expected Actions

See transaction RO-12 Section 3.12.4.1.3.

3.13.4.2 Receive Scheduled UWPS Worklist Message

See transaction RO-12 Section 3.12.4.2, except that for the Worklist Query for Delivery transaction exactly one Unified Procedure Step (UPS C-FIND response in the 'pending' state) shall be returned for each matching treatment session:

- **Response 1:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to '99SUP74FZ'. The Input Information Sequence (0040,4021) shall contain reference to a least the following items:

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

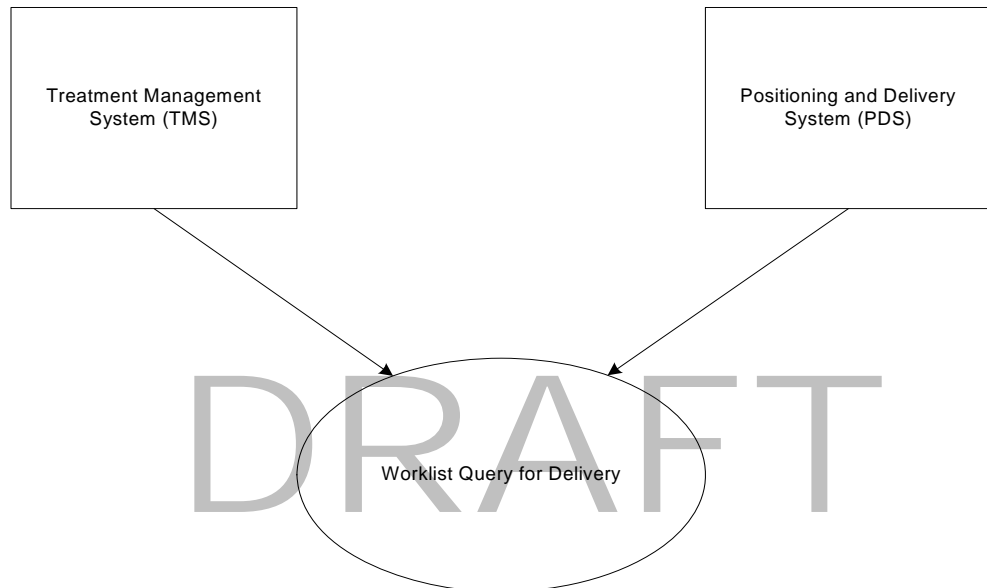
DRAFT

3.14 RO-14: Worklist Query for Positioning and Delivery

3.14.1 Scope

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

3.14.2 Use Case Roles



Actor: Treatment Management System

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

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

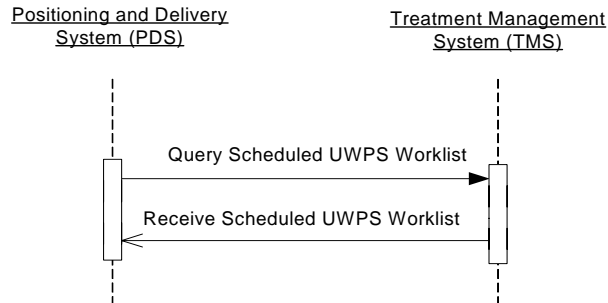
Role: Queries a TMS and receives a scheduled patient positioning and treatment delivery worklist.

3.14.3 Referenced Standards

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

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

3.14.4 Interaction Diagram



3.14.4.1 Query Scheduled UWPS Worklist Message

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

3.14.4.1.1 Trigger Events

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

3.14.4.1.2 Message Semantics

See transaction RO-12 Section 3.12.4.1.2.

3.14.4.1.2.1 Matching Keys and Return Keys for Display

See transaction RO-12 Section 3.12.4.1.2.

3.14.4.1.3 Expected Actions

See transaction RO-12 Section 3.12.4.1.3.

3.14.4.2 Receive Scheduled UWPS Worklist Message

See transaction RO-12 Section 3.12.4.2, except that for the Worklist Query for Delivery transaction exactly four Unified Procedure Steps (UPS C-FIND responses in the 'pending' state) shall be returned for each matching treatment session:

- Response 1:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121702-121711 (acquisition) and Coding Scheme Designator shall be '99SUP74FZ'. If the Code Value is in the range 121702-121706, one or more RT Image SOP Instance references shall be supplied in the Input Information Sequence (0040,4021). If the Code Value is in the range 121707-121708, one CT Image Series reference shall be supplied in the Input Information Sequence (0040,4021). The specified location of the SOP Instances shall be an Archive. Note that a specific product implementation could fulfill the roles of both a TMS and an Archive, in

which case one AE Title could be used to retrieve and store all input and output SOP Instances for the UPS.

- **Response 2:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be in the range 121712-121721 (registration) and Coding Scheme Designator shall be '99SUP74FZ'. No Input Information SOP Instances need be supplied.
- **Response 3:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121722' (RT Patient Position Adjustment) and Coding Scheme Designator shall be equal to '99SUP74FZ'. No Input Information SOP Instances need be supplied.
- **Response 4:** Scheduled Workitem Code Sequence (0040,4018) Code Value shall be equal to '121726' (RT Treatment with Internal Verification), and Coding Scheme Designator shall be equal to '99SUP74FZ'. The Input Information Sequence (0040,4021) shall contain reference to a least the following items:
 1. The RT Plan SOP Instance to be delivered. Its specified location shall be an Archive. Note that a specific product implementation could fulfill the roles of both a TMS and an Archive, in which case one AE Title could be used to retrieve and store all input and output SOP Instances for the UPS.
 2. An RT Beams Delivery Instruction SOP Instance. Its specified location shall be the TMS.

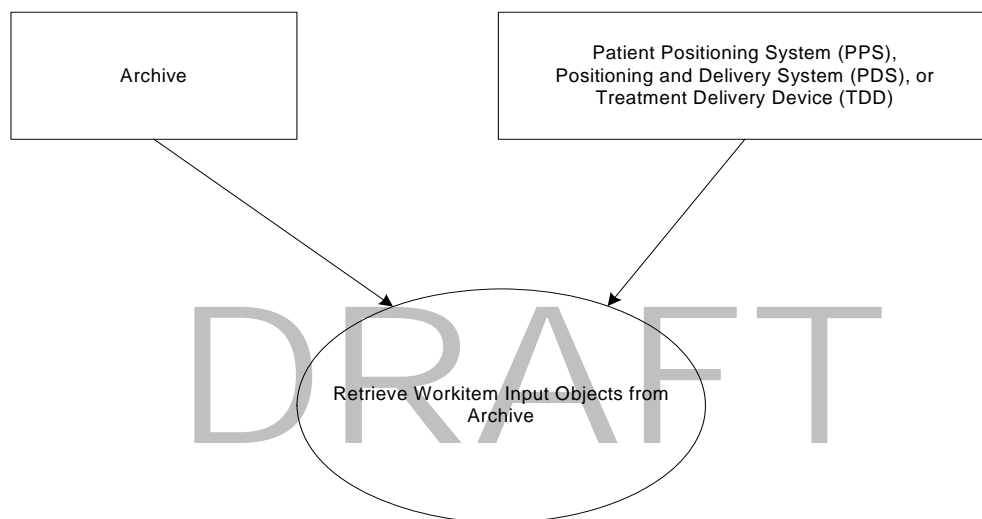
DRAFT

3.15 RO-15: Retrieve Workitem Input Objects from Archive

3.15.1 Scope

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

3.15.2 Use Case Roles



Actor: Archive

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

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

Role: Receives requested DICOM objects from the Archive.

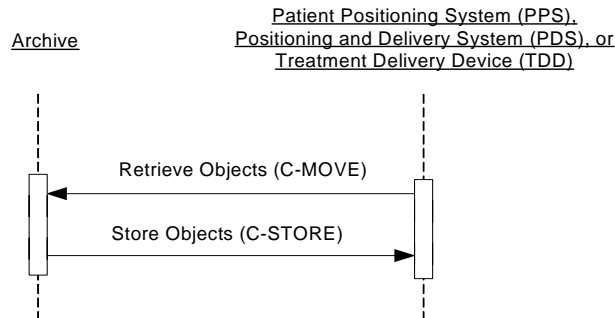
3.15.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

DICOM 2007 PS 3.4: Query/Retrieve Service Class

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

3.15.4 Interaction Diagram



3.15.4.1 Retrieve Objects

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

3.15.4.1.1 Trigger Events

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

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

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

3.15.4.1.2 Message Semantics

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

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

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

STORE operations from a Treatment Planning System would have been performed to achieve this goal.

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

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

However, a participating Archive shall support this transaction for at least the objects listed in Table 3.15-1.

Table 3.15-1: Required SOP Class Support for Archive Actor

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

3.15.4.1.3 Expected Actions

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

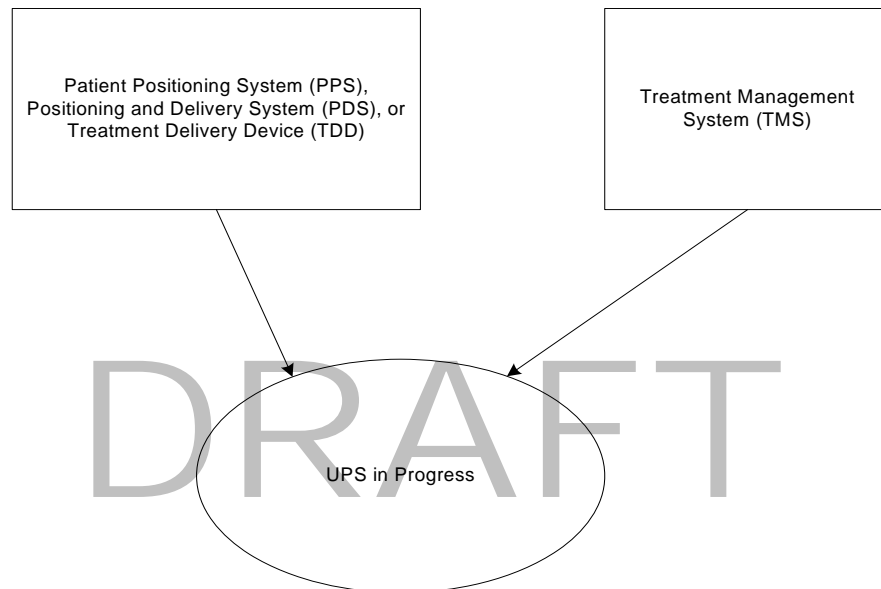
The requesting Performing Device is then expected to use the requested objects in the performing of the selected work items. This could include displaying overlaid image, structure, and dose information for registration, or using plan information to prepare treatment delivery.

3.16 RO-16: UPS in Progress

3.16.1 Scope

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

3.16.2 Use Case Roles



Actor: Treatment Management System

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

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

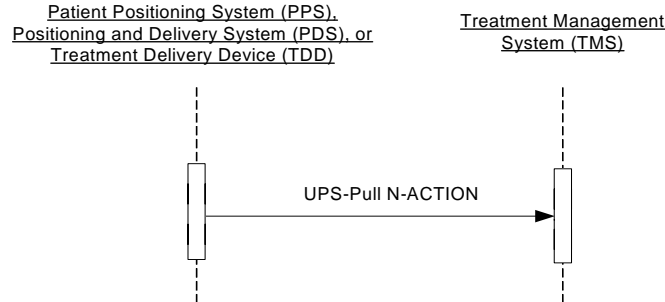
Role: Signals using UPS N-ACTION that the selected work item is in progress.

3.16.3 Referenced Standards

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

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

3.16.4 Interaction Diagram



3.16.4.1 UPS in Progress Message

The Performing Device uses the UPS N-ACTION service to inform the TMS that the specified Unified Procedure Step has been started and is in progress. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Affected SOP Class in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.16.4.1.1 Trigger Events

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

3.16.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step Status (0041,1000) shall be 'IN PROGRESS'. The requested Transaction UID (0008,1195) may either be valued or supplied as zero length (see next section for expected TMS behavior).

3.16.4.1.3 Expected Actions

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

If the requested work item is still available for performing, the TMS shall send an N-ACTION response with a Unified Procedure Step Status (0041,1000) of 'IN PROGRESS' and a status code of 0000H (success). The TMS shall then be ready to receive UPS N-SET or UPS N-ACTION commands. A unique value for the Transaction UID (0008,1195) shall be supplied if it was not specified in the request. If the Transaction UID was specified in the request, then it shall be returned in the response and used subsequently by the TMS in authorizing further UPS requests.

If the requested work item cannot be performed because the Unified Procedure Step is already IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then be capable of accepting further UPS N-ACTION requests or worklist queries.

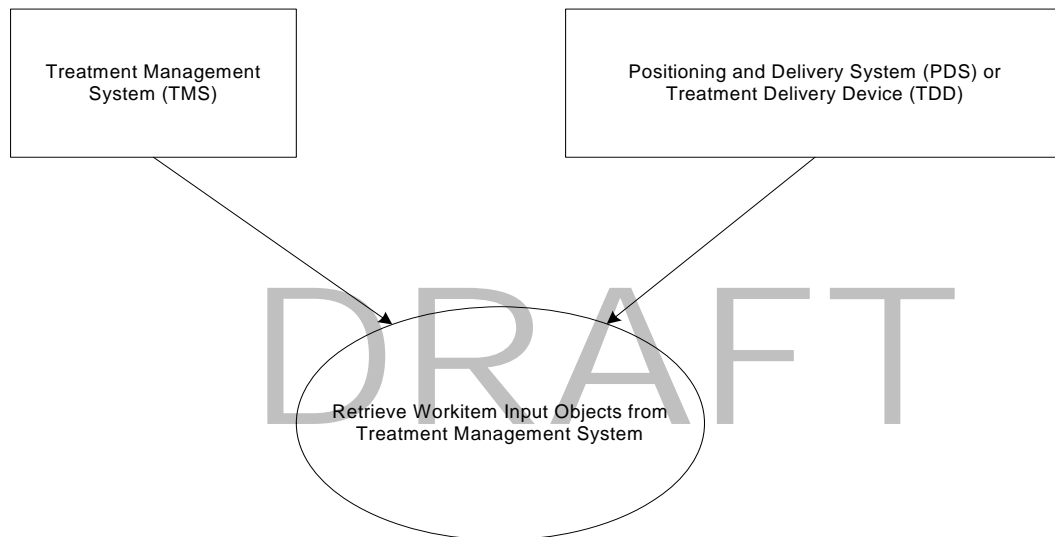
DRAFT

3.17 RO-17: Retrieve Workitem Input Objects from TMS

3.17.1 Scope

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

3.17.2 Use Case Roles



Actor: Treatment Management System

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

Actor: Positioning and Delivery System or Treatment Delivery Device
(‘Performing Device’)

Role: Receives requested DICOM objects from the TMS.

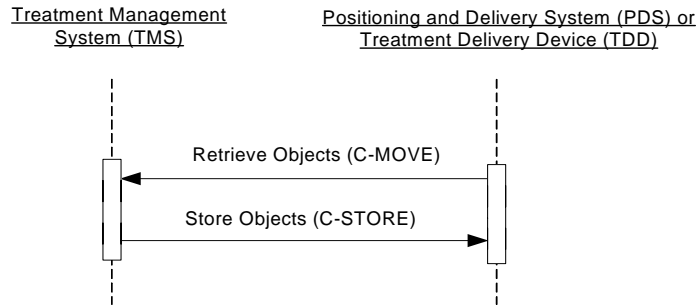
3.17.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

DICOM 2007 PS 3.4: Query/Retrieve Service Class

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

3.17.4 Interaction Diagram



3.17.4.1 Retrieve Objects

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

3.17.4.1.1 Trigger Events

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

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

3.17.4.1.2 Message Semantics

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

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

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

Table 3.17-1: Potential SOP Class Support for TMS C-MOVE

SOP Class Name	SOP Class UID
RT Beams Delivery Instruction Storage	1.2.826.0.1.3680043.8.189.1 (see DICOM Supplement 74)
RT Treatment Summary Record Storage	1.2.840.10008.5.1.4.1.1.481.7
RT Beams Treatment Record Storage	1.2.840.10008.5.1.4.1.1.481.4

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

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

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

3.17.4.1.3 Expected Actions

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

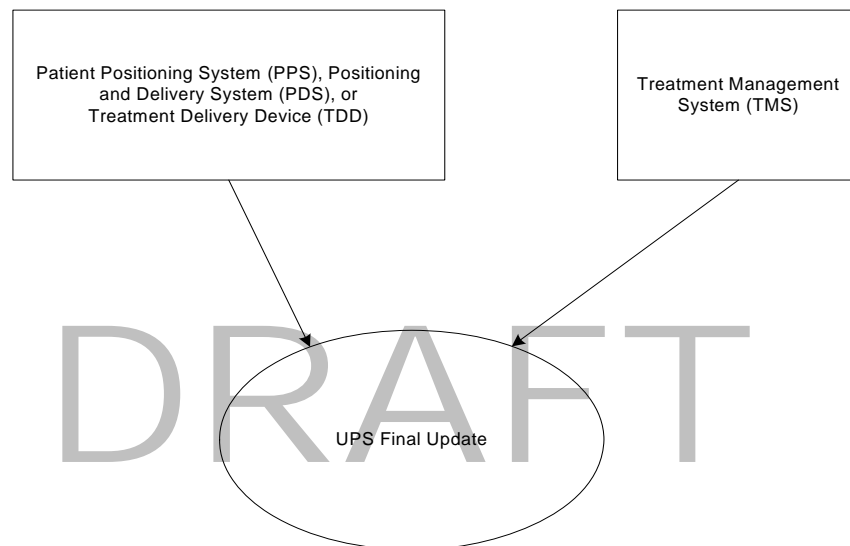
The requesting actor is then expected to use the requested objects in the performing of the selected work item.

3.18 RO-18: UPS Final Update

3.18.1 Scope

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

3.18.2 Use Case Roles



Actor: Treatment Management System

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

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

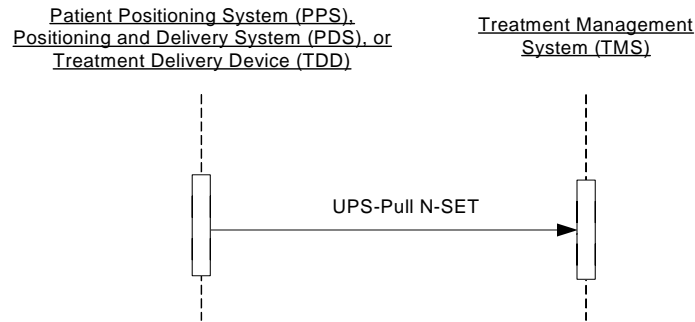
Role: Signals using UPS N-SET that that certain attributes related to the selected work item have changed.

3.18.3 Referenced Standards

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

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

3.18.4 Interaction Diagram



3.18.4.1 UPS Final Update Message

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

3.18.4.1.1 Trigger Events

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

3.18.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Affected SOP Class in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

Requirement for SCUs using the UWPS N-SET command are detailed in Table 3.18-1. 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 Supplement 96 in that a number of attributes are required to be set for all UPS N-SET commands. DICOM Supplement 96 only requires that the attributes have been set by any N-SET or N-ACTION message prior to the procedure step being moved into the COMPLETED or CANCELED state.

Table 3.18-1: UPS N-Set Final State Attribute Requirements

Attribute Name	Tag	Req. Type N-SET (SCU/SCP)	Final State	IHE-RO Additional Notes/Requirements on SCU
Transaction UID	(0008,1195)	(See F.X.3.5.3)	R	
SOP Common Information Module				
Specific Character Set	(0008,0005)	1C/1C (Required if extended or replacement character set is used)	Set if require d	Only ISO-IR 100 (Latin-1) shall be supported.
SOP Class UID	(0008,0016)	Not allowed	R	Affected SOP Class (0000,0002) is always 'UPS-Push' SOP Class
SOP Instance UID	(0008,0018)	Not allowed.	R	Affected SOP Instance (0000,1000) supplied by C-FIND responses of UPS query
Unified Procedure Step Progress Information Module				
Private Attribute Creator	(0041,0010)	1/-	-	Value '99SUP96FZ'
Unified Procedure Step Status	(0041,1000)	Not Allowed. Use N- ACTION	R	
Unified Procedure Step Scheduled Procedure Information Module				
Scheduled Procedure Step Priority	(0040,4003)	3/1	R	Supplied implicitly by TMS – not required in N-SET.
Scheduled Procedure Step Modification Date and Time	(0040,4010)	-/1 SCP will use time of SET	R	
Unified Procedure Step Performed Procedure Information Module				
UPS Performed Procedure Sequence	(0040,eee8)	3/2	X	Supplied by N-SET in IHE-RO. See transaction RO-18.
>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 N-SET in IHE-RO. See transaction RO-18.
>Performed Processing Applications Code Sequence	(0040,4007)	3/2	RC	Shall be provided if known. Not required to be known in IHE-RO.

>Performed Procedure Step Start Date	(0040,0244)	3/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Performed Procedure Step Start Time	(0040,0245)	3/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Performed Workitem Code Sequence	(0040,4019)	3/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Performed Procedure Step End Date	(0040,0250)	3/1	X	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Performed Procedure Step End Time	(0040,0251)	3/1	X	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Output Information Sequence	(0040,4033)	2/2	X	Supplied by N-SET in IHE-RO. See transaction RO-18. May be empty (null) in N-SET if no output objects are created. See transaction RO-18.
>>Study Instance UID	(0020,000D)	1/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>>Referenced Series Sequence	(0008,1115)	1/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>>>Series Instance UID	(0020,000E)	1/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>>>Retrieve AE Title	(0008,0054)	2C/2	RC	Always supplied for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set ID	(0088,0130)	2C/2	RC	Never supplied for IHE-RO (File Media Set not supported)
>>>Storage Media File-Set UID	(0088,0140)	2C/2	RC	Never supplied for IHE-RO (File Media Set not supported)
>>>Referenced SOP Sequence	(0008,1199)	1/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>>>>Referenced SOP Class UID	(0008,1150)	1/1	R	See transactions RO-19, RO-20, RO-21 for permitted SOP Classes
>>>>Referenced SOP Instance UID	(0008,1155)	1/1	R	Supplied by N-SET in IHE-RO. See transaction RO-18.
>Non-DICOM Output Code Sequence	(0040,4032)	2/2	X	Empty value always supplied by N-SET for IHE-RO

3.18.4.1.3 Expected Actions

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

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

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

If the requested work item cannot be updated because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-SET response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.

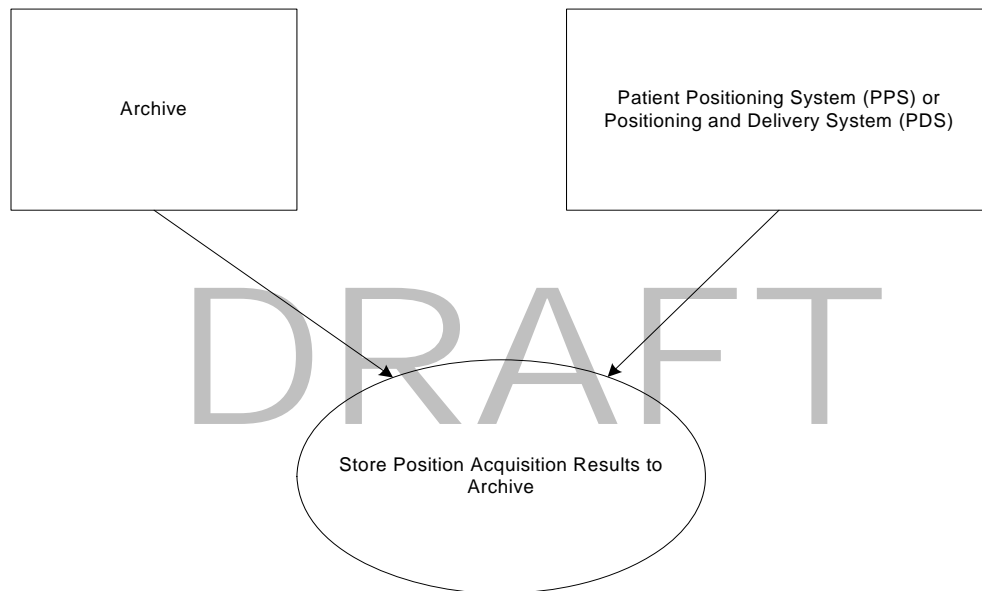
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3.19 RO-19: Store Position Acquisition Results to Archive

3.19.1 Scope

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

3.19.2 Use Case Roles



Actor: Archive

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

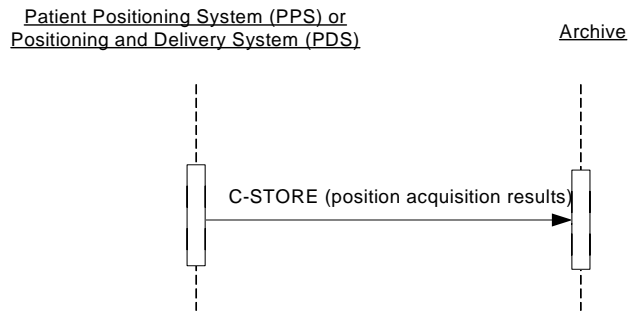
Actor: Patient Positioning System or Positioning and Delivery System
(‘Performing Device’)

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

3.19.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.19.4 Interaction Diagram



3.19.4.1 Store Objects

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

3.19.4.1.1 Trigger Events

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

3.19.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. One or more objects shall be stored, with one of the SOP Classes denoted in the Table 3.19-1. The table also denotes the permitted Workitem Code Values in the corresponding UPS for each object type.

Table 3.19-1: Permitted SOP Class Support for Performing Device (SCU)

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

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

required either. Hence storage of the position acquisition results (this transaction) is an optional step.

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

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-12, RO-13, or RO-14 (see Table 3.12-1).

A participating Archive must support this transaction for at least the objects listed in Table 3.19-2.

Table 3.19-2: Required SOP Class Support for Archive (SCP)

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

3.19.4.1.3 Expected Actions

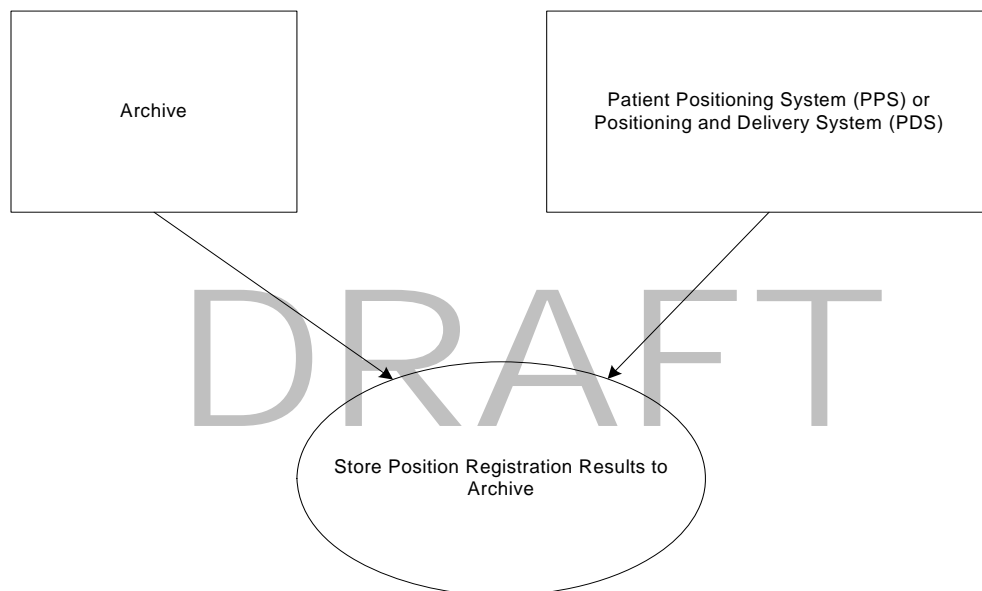
The Archive receives the C-STORE request, establishes a DICOM association with the requesting actor, and uses the appropriate DICOM Object Storage SOP Classes to receive the requested objects and store them.

3.20 RO-20: Store Position Registration Results to Archive

3.20.1 Scope

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

3.20.2 Use Case Roles



Actor: Archive

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

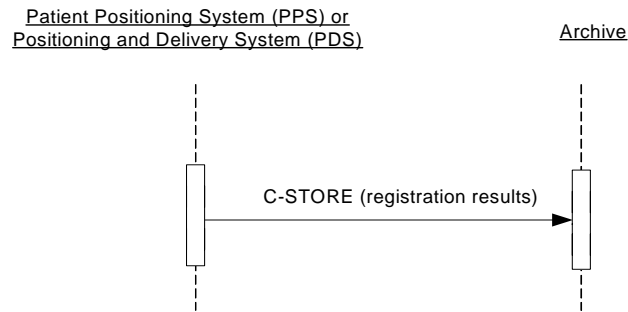
Actor: Patient Positioning System or Positioning and Delivery System
(‘Performing Device’)

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

3.20.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.20.4 Interaction Diagram



3.20.4.1 Store Objects

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

3.20.4.1.1 Trigger Events

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

3.20.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. A single object shall be stored, with one of the SOP Classes denoted in the Table 3.20-1:

Table 3.20-1: Permitted SOP Class Support for Performing Device (SCU)

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

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

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

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-12, RO-13, or RO-14 (see Table 3.12-1).

A participating Archive must support this transaction for at least the objects listed in Table 3.20-2.

Table 3.20-2: Required SOP Class Support for Archive (SCP)

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

3.20.4.1.3 Expected Actions

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

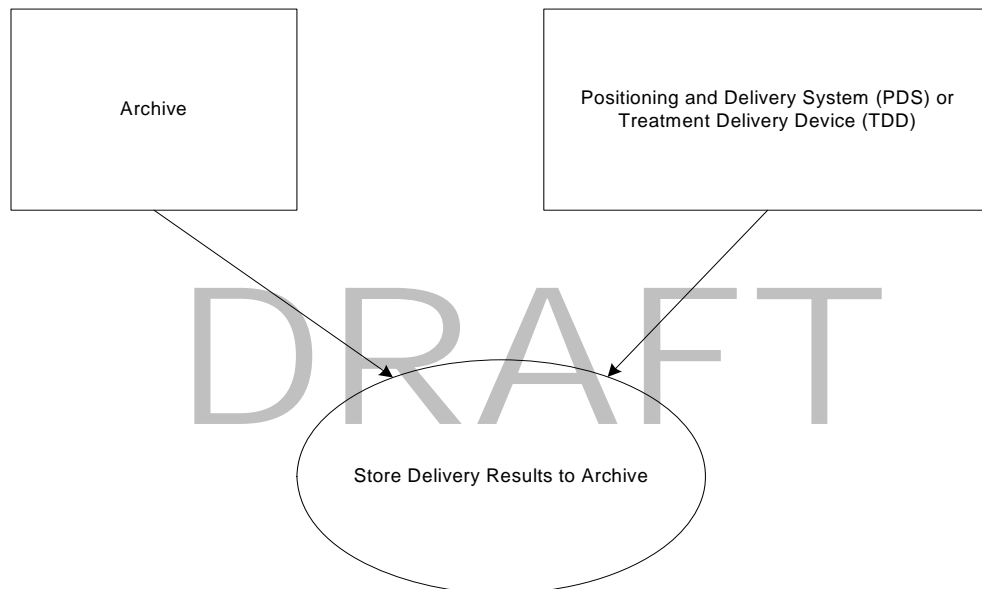
DRAFT

3.21 RO-21: Store Delivery Results to Archive

3.21.1 Scope

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

3.21.2 Use Case Roles



Actor: Archive

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

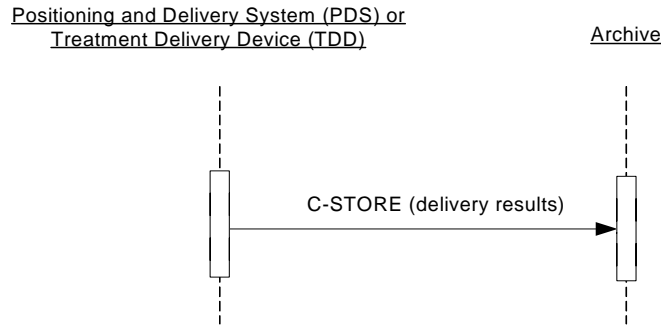
Actor: Positioning and Delivery System or Treatment Delivery Device
(‘Performing Device’)

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

3.21.3 Referenced Standards

DICOM 2007 PS 3.4: Storage Service Class

3.21.4 Interaction Diagram



3.21.4.1 Store Objects

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

3.21.4.1.1 Trigger Events

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

3.21.4.1.2 Message Semantics

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

A C-STORE Request shall be sent from the Performing Device to the Archive. A single object shall be stored, with the SOP Classes denoted in the Table 3.21-1:

Table 3.21-1: Permitted SOP Class Support for Performing Device (SCU)

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

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

Any stored objects shall contain the Study Instance UID (0020,000D) supplied by the TMS in the UPS C-FIND response of Transaction RO-12, RO-13, or RO-14 (see Table 3.12-1).

A participating Archive must support this transaction for the object listed in Table 3.21-2.

Table 3.21-2: Required SOP Class Support for Archive (SCP)

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

3.21.4.1.3 Expected Actions

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

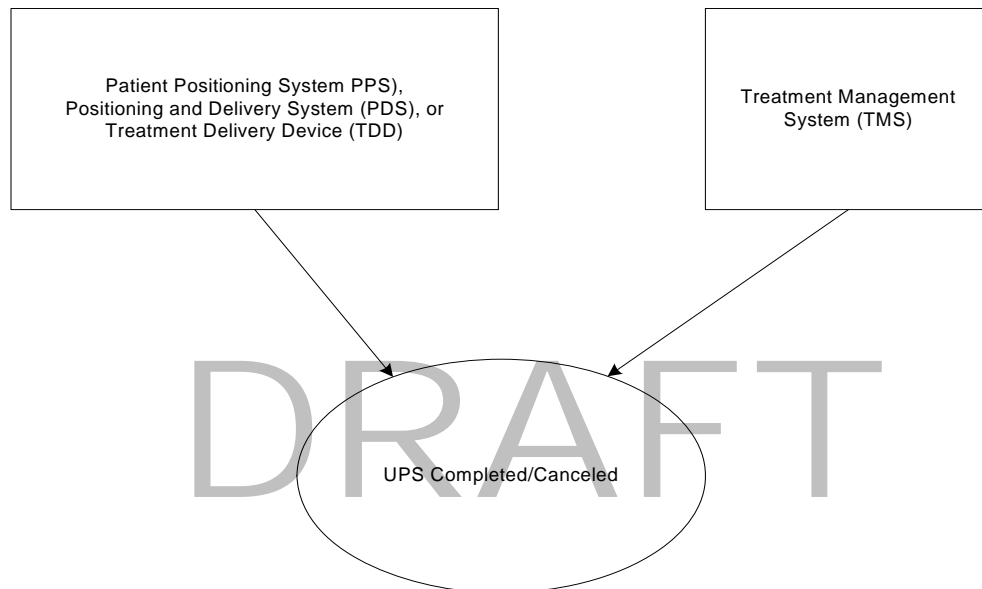
DRAFT

3.22 RO-22: UPS Completed/Canceled

3.22.1 Scope

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

3.22.2 Use Case Roles



Actor: Treatment Management System

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

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

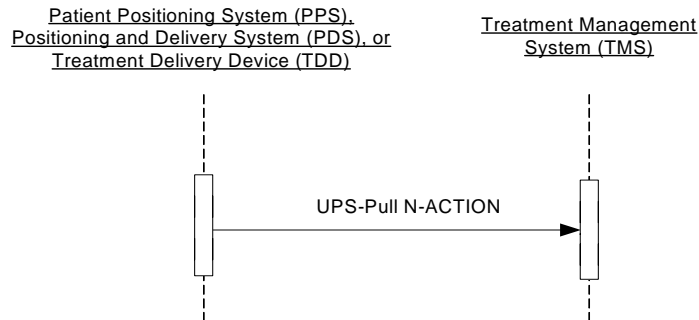
Role: Signals using UPS N-ACTION that the selected work item is completed or canceled.

3.22.3 Referenced Standards

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

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

3.22.4 Interaction Diagram



3.22.4.1 UPS in Progress Message

The Performing Device uses the UPS N-ACTION service to inform the TMS that the specified Unified Procedure Step has been completed or canceled. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Affected SOP Class in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.22.4.1.1 Trigger Events

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

3.22.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96. The value of the Unified Procedure Step Status (0041,1000) shall be 'COMPLETED' or 'CANCELED'.

3.22.4.1.3 Expected Actions

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

If the requested work item has been successfully completed (i.e. the received Unified Procedure Step Status (0041,1000) has a value of 'COMPLETED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step Status (0041,1000) of 'COMPLETED' and a status code of 0000H (success). The Treatment Management System shall then be ready to receive new worklist queries.

If the requested work item was not successfully completed (i.e. the received Unified Procedure Step Status (0041,1000) has a value of 'CANCELED'), the TMS shall send an N-ACTION response echoing a Unified Procedure Step Status (0041,1000) 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.

If the requested work item cannot be marked as completed or canceled because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-ACTION response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-ACTION was received.

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

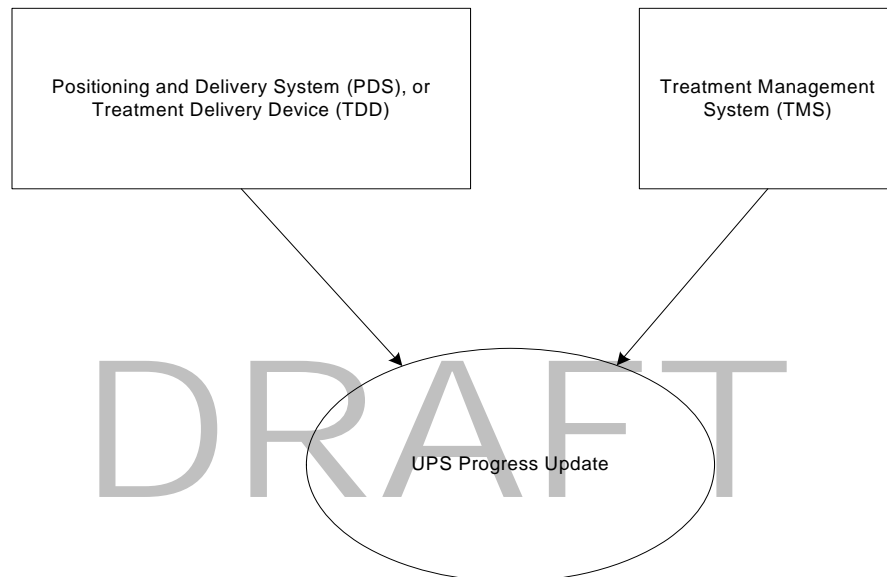
DRAFT

3.23 RO-23: UPS Progress Update

3.23.1 Scope

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

3.23.2 Use Case Roles



Actor: Treatment Management System

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

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

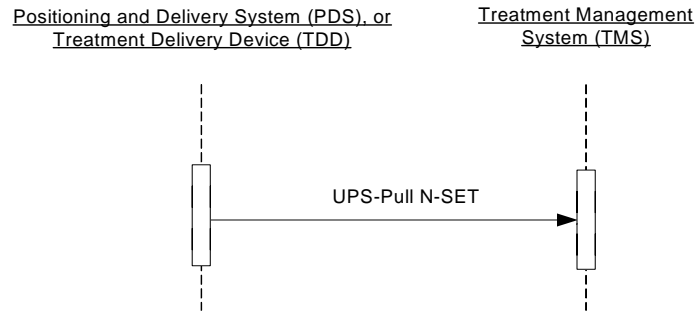
Role: Signals using UPS N-SET that that progress related to the selected work item has changed.

3.23.3 Referenced Standards

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

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

3.23.4 Interaction Diagram



3.23.4.1 UPS Progress Update Message

The Performing Device uses the UPS N-SET service to inform the TMS that progress relating to the specified Unified Procedure Step has changed. Note that the UPS-Pull SOP Class is negotiated as the abstract transfer syntax, but the UPS-Push SOP Class is used as the Affected SOP Class in all subsequent DIMSE messaging (see DICOM Supplement 96, Part 4, Section F.X.4).

3.23.4.1.1 Trigger Events

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

3.23.4.1.2 Message Semantics

The message semantics are defined in DICOM Supplement 96.

Minimum requirements for SCUs using the UWPS N-SET command for this transaction are detailed in Table 3.23-1. The Final State requirements of the UPS are met by the UPS Final Update transaction (see Section 3.18).

Table 3.23-1: UPS N-SET Attribute Requirements for UPS Progress Update Transaction

Attribute Name	Tag	Type	IHE-RO Additional Requirements on SCU
Unified Procedure Step Progress Information Module			
UPS Progress Information Sequence	(0040,4003)	3	Required in this transaction.
>Unified Procedure Step Progress	(0040,4010)	1	
>Private Attribute Creator	(0041,0010)	1	Value '99SUP74FZ'
>Unified Procedure Step Discontinuation Code Sequence	(0041,100e)	3	Any requirements for this attribute, i.e. should we require it for a canceled treatment, or any other procedure type? Should we also provide information regarding a decision to potentially complete the treatment?
Unified Procedure Step Performed Procedure Information Module			
UPS Performed Procedure Sequence	(0041,1016)	1C	Required if Code Value for Scheduled Workitem Code Sequence of UPS is '121726' (RT Treatment with Internal Verification)
>Private Attribute Creator	(0041,0010)	1	Value '99SUP74FZ'
>Performed Processing Parameters Sequence	(0041,1012)	3	Required if Code Value for Scheduled Workitem Code Sequence of UPS is '121726' (RT Treatment with Internal Verification).
>>Value Type	(0040,A040)	1	'NUMERIC'
>>>Concept Name Code Sequence	(0040,A043)	1	
>>>>Code Value	(0008,0100)	1	'121700'
>>>>Coding Scheme Designator	(0008,0102)	1	'99SUP74FZ'
>>>>Code Meaning	(0008,0104)	1	'Referenced Beam Number in Progress'

>>Numeric Value	(0040,A30A)	1	Integer string equal to the value of Referenced Beam Number (300C,0006)
>Output Information Sequence	(0040,4033)	2	Shall be empty
>Non-DICOM Output Information Sequence	(0040,4032)	2	Shall be empty

3.23.4.1.3 Expected Actions

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

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

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

If the requested work item cannot be updated because the Unified Procedure Step is not IN PROGRESS, or for any other reason, then an N-SET response with a status code as described in DICOM Supplement 96 Table F.X.3.1-2 shall be returned. The TMS shall then remain in the state it was in before the N-SET was received.