Integrating the Healthcare Enterprise

IHE

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IHE Radiology
Technical Framework Supplement

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AI Workflow for Imaging
(AIW-I)

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Revision 1.1 – Trial Implementation

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Foreword

This is a supplement to the IHE Radiology Technical Framework V19.0. 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 August 6, 2020 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 Radiology
Technical Framework. Comments are invited and may be submitted at
http://www.ihe.net/Radiology_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.

> *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
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Information about the IHE Radiology domain can be found at ihe.net/IHE_Domains.

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

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

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Introduction to this Supplement

The AI Workflow for Imaging Profile addresses workflow use cases involving the request, management, and performance of AI Inference on digital image data acquired by an imaging modality.

275 The profile specifies transactions for workflow management that are based on the RESTful worklist service defined by DICOM UPS-RS.

Open Issues

None.

Closed Issues

1	**Not in Scope**
	This profile does not address the following:
	- AI Results content, including imaging and/or non-imaging. - Access and distribution of non-imaging content - AI Service Discovery and Control. - Means of management and sharing of AI Service input parameters. - Means of access non-imaging data and distributing results using FHIR - Training and feedback for training during use.
	Note: these may be subject for future work.
2	Q. Should the profile explicitly include open workitem assignment of AI Inference Requests?
	Currently the open query use case is not addressed in AIW-I (see PAWF). For AIW-I, the Task Manager maintains knowledge of the capabilities and limitations of all the AI Models it manages and is expected to assign the workitems at creation as shown in 50.4.2.1, 50.4.2.2 and 50.4.2.3.
	Pull Workflow (50.4.2.1) uses a query with the Task Manager assigning each task and the Task Performer filtering on its own name. The profile does not prohibit the Task Manager to leave tasks unassigned and allow the Task Performers to filter on the task characteristics (e.g., Find pneumothorax detection tasks for CT that are not assigned or claimed).
3	Q. Are additional data transport methods needed? If so, which?
	The Concepts Section 50.4.1.3 (Types and Transfer Methods for Input and Output Data) describes the data types and transfer methods between the Task Performer and the

	enterprise data repositories (PACS, VNA, XDS, etc.) currently handled by UPS-RS. It proposes the addition of a FHIR Resource Retrieval Sequence and Storage Sequence (which will depend on a DICOM CP).
	Security Considerations Section 50.6 identifies cross-profile considerations which leverage these types and methods.
	It seems conceivable that some Task Performers which are cloud-hosted AI Models might use other REST-based APIs such as S3 to exchange data. Using the FHIR Endpoint resource https://www.hl7.org/fhir/endpoint.html may be a general method which could be extended to facilitate the inclusion.
	Note: this may be subject for future work.
4	Q. Does the profile need to mandate specific deidentification capabilities for specific actors?
	Section 50.5.3 Protected Health Information discusses possible patterns of limiting access to PHI. De-identification and re-identification create additional work and risks for systems which provide support for this capability. This profile neither prohibits nor requires that support is necessary.
	Note: this may be subject for future work.
5	Q. Are there other triggers or clinical information triggers that should be considered for AI Workflow automation?
	The IAN Option is included as one trigger for automating the AI Workflow process. However, this transaction, by itself is insufficient to know what inference should be run. For example, should Detection of Pneumothorax be performed on a chest x-ray without knowing if the patient is symptomatic?
	Note: this may be subject for future work.

IHE Technical Frameworks General Introduction

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

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IHE Technical Frameworks General Introduction Appendices

325 ## Appendix A – Actor Summary Definitions

There are no new actors for this profile.

Appendix B – Transaction Summary Definitions

There are no new transactions for this profile.

Glossary

330 *Add the following new glossary term to the IHE Technical Frameworks General Introduction Glossary:*

Term	Definition
AI Inference	The process of using trained AI Models or machine learning algorithms to make a prediction.

Volume 1 – Profiles

335 | *Add new Section 50* |

50 AI Workflow for Imaging (AIW-I) Profile

The AI Workflow for Imaging Profile addresses use cases to request, manage, perform, and monitor AI Inference on digital image data. AI Inference is the process of using trained AI Models or machine learning algorithms to make a prediction.

340 AI Inference tasks are managed using transactions based on RESTful protocols defined in DICOM UPS-RS. This profile provides flexibility in how the AI Inference task is managed. AI Inference tasks may be managed using either a pull, triggered-pull or push workflow. AIW-I defines DICOM RESTful transactions, also referred to as DICOMweb, and DICOM DIMSE transactions, sometimes referred to as Conventional DICOM, for accessing the inputs image data
345 for the inference task and distributing the outputs, i.e., the AI Results Profile (AIR).

50.1 AIW-I 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.
350 Both appendices are located at http://ihe.net/Technical_Frameworks/#GenIntro

Figure 50.1-1 shows the actors directly involved in the AIW-I Profile and the relevant transactions between them.

To see how these transactions are used in sequence, see Section 50.4.2.
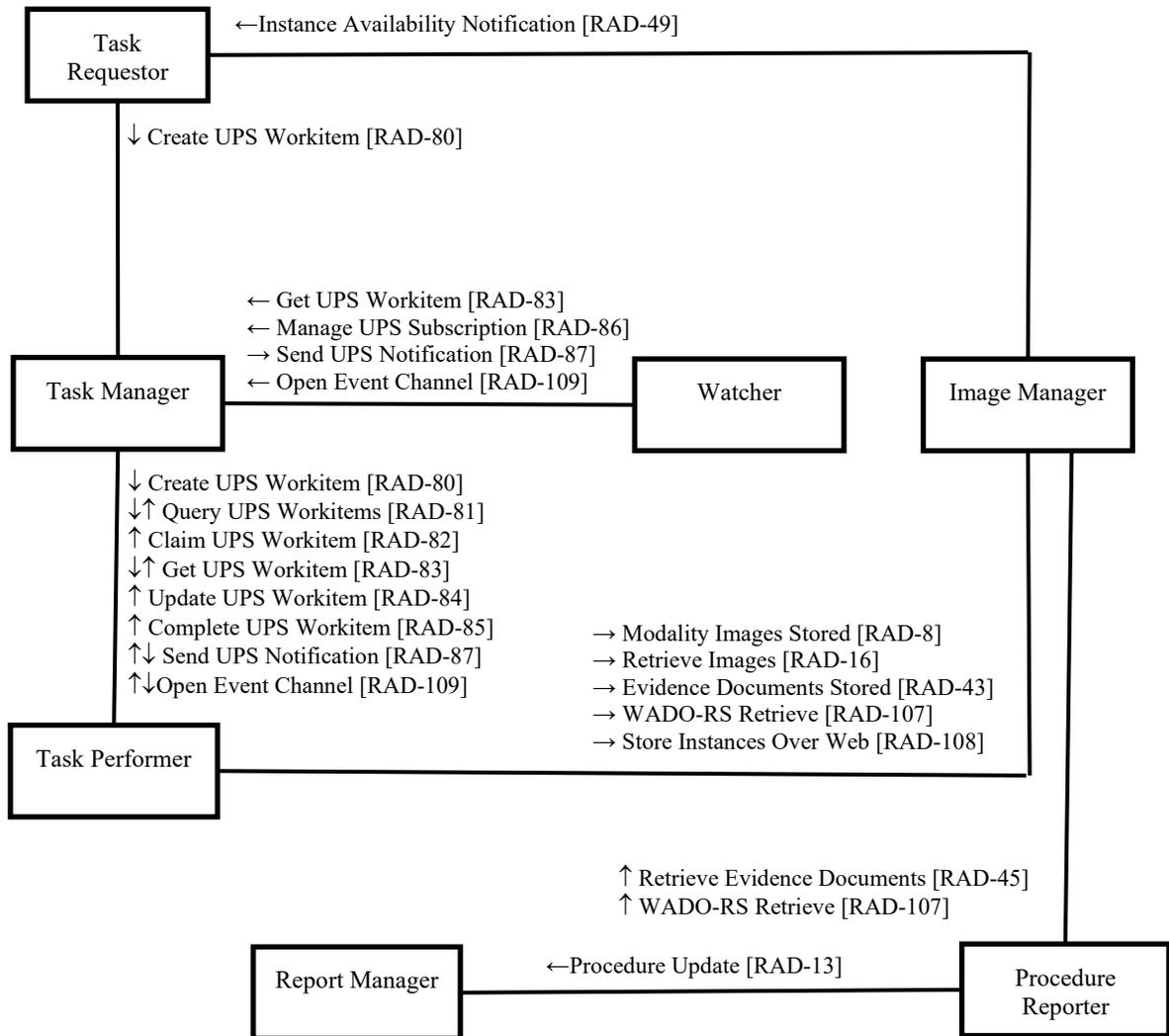
355 **Figure 50.1-1: AIW-I Actor Diagram**

Table 50.1-1 lists the transactions for each actor directly involved in the AIW-I Profile. To claim compliance with this profile, an actor shall support all required transactions (labeled "R") and may support the optional transactions (labeled "O").

360   **Table 50.1-1: AIW-I Profile - Actors and Transactions**

Actors	Transactions	Initiator or Responder	Optionality	Reference
Task Requestor	Instance Availability Notification [RAD-49]	Responder	O	RAD TF-2: 4.49 RAD TF-1: 50.2.1
	Create UPS Workitem [RAD-80]	Initiator	R	RAD TF-2: 4.80
Task Manager	Create UPS Workitem [RAD-80]	Initiator and Responder	R	RAD TF-2: 4.80
	Query UPS Workitem [RAD-80]	Responder	R	RAD TF-2: 4.81
	Claim UPS Workitem [RAD-82]	Responder	R	RAD TF-2: 4.82
	Get UPS Workitem [RAD-83]	Initiator and Responder	R	RAD TF-2: 4.83
	Update UPS Workitem [RAD-84]	Responder	R	RAD TF-2: 4.84
	Complete UPS Workitem [RAD-85]	Responder	R	RAD TF-2: 4.85
	Manage UPS Subscription [RAD-86]	Responder	R	RAD TF-2: 4.86
	Send UPS Notification [RAD-87]	Initiator and Responder	R	RAD TF-2: 4.87
	Open Event Channel [RAD-109]	Initiator and Responder	R	RAD TF-2: 4.109
Task Performer	Modality Images Stored [RAD-8]	Initiator	O	RAD TF-2: 4.8
	Retrieve Images [RAD-16]	Initiator	O (see Section 50.1.1.3)	RAD TF-2: 4.16
	Evidence Documents Stored [RAD-43]	Initiator	O	RAD TF-2: 4.43
	Create UPS Workitem [RAD-80]	Responder	O (see Section 50.1.1.3)	RAD TF-2: 4.80
	Query UPS Workitem [RAD-81]	Initiator and Responder	O (see Section 50.1.1.3)	RAD TF-2: 4.81
	Claim UPS Workitem [RAD-82]	Initiator	O (see Section 50.1.1.3)	RAD TF-2: 4.82
	Get UPS Workitem [RAD-83]	Initiator and Responder	O (see Section 50.1.1.3)	RAD TF-2: 4.83
	Update UPS Workitem [RAD-84]	Initiator	O (see Section 50.1.1.3)	RAD TF-2: 4.84
	Complete UPS Workitem [RAD-85]	Initiator	O	RAD TF-2: 4.85
	Send UPS Notification [RAD-87]	Initiator and Responder	O (see Section 50.1.1.3)	RAD TF-2: 4.87
	WADO-RS Retrieve [RAD-107]	Initiator	O (see Section 50.1.1.3)	RAD TF-2: 4.107
	Store Instances Over the Web [RAD-108]	Initiator	O	RAD TF-2: 4.108
	Open Event Channel [RAD-109]	Initiator and Responder	O (see Section 50.1.1.3)	RAD TF-2: 4.109
Image Manager	Modality Images Stored [RAD-8]	Responder	R	RAD TF-2: 4.8
	Retrieve Images [RAD-16]	Responder	R	RAD TF-2: 4.16

Actors	Transactions	Initiator or Responder	Optionality	Reference
	Evidence Documents Stored [RAD-43]	Responder	R	RAD TF-2: 4.43
	Instance Availability Notification [RAD-49]	Initiator	O	RAD TF-2: 4.49 RAD TF-1: 50.2.1
	Store Instances Over the Web [RAD-108]	Responder	R	RAD TF-2: 4.108
	WADO-RS Retrieve [RAD-107]	Responder	R	RAD TF-2: 4.107
Watcher	Get UPS Workitem [RAD-83]	Initiator	O	RAD TF-2: 4.83
	Manage UPS Subscription [RAD-86]	Initiator	R	RAD TF-2: 4.86
	Send UPS Notification [RAD-87]	Responder	R	RAD TF-2: 4.87
	Open Event Channel [RAD-109]	Initiator	R	RAD TF-2: 4.109
Procedure Reporter	Procedure Update [RAD-13]	Initiator	R	RAD TF-2: 4.13
	Retrieve Images [RAD-16]	Initiator	O (see Section 50.1.1.6)	RAD TF-2: 4.16
	WADO-RS Retrieve [RAD-107]	Initiator	O (see Section 50.1.1.6)	RAD TF-2: 4.107
Report Manager	Procedure Update [RAD-13]	Responder	R	RAD TF-2: 4.13

50.1.1 Actor Descriptions and Actor Profile Requirements

Most workflow requirements are documented in RAD TF-2 Transactions. This section documents additional requirements on profile's actors.

50.1.1.1 Task Requestor

The Task Requestor initiates the AI Inference by creating and populating a UPS workitem. The Task Requestor identifies within the UPS workitem the images the AI model will use to create a result.

The Task Requestor may be, for example:

- PACS/VNA

- RIS or Reading Worklist System

- DICOM Router

- Standalone Requestor

- Acquisition modality

There may be multiple Task Requestors in an enterprise environment.

The Task Requestor shall implement the UPS-RS (RESTful) Message Semantics for the Create UPS Workitem [RAD-80]. As a baseline, the Task Requestor shall support Content-Type of application/dicom+json according to

___

http://dicom.nema.org/medical/dicom/current/output/html/part18; application/dicom+xml may
additionally be supported.

The Task Requestor is expected to populate the attributes sufficiently in the Create UPS
Workitem [RAD-80] transaction for the Task Manager to appropriately assign the task and to
facilitate Task Performers efficiently performing the AI Inference tasks.

At a minimum, the Task Requestor:

- shall populate the Scheduled Workitem Code Sequence (0040,4018) with a code that
  identifies the requested inference procedure. The Task Requestor may request a generic
  AI Inference procedure, for example if it has no preference of the processing to be
  performed. See Section 50.4.1.2 for additional guidance.

- shall populate the Input Information Sequence (0040,4021) with at least one instance. See
  Section 50.4.1.3 for additional guidance. The Task Requestor may also provide
  references to other relevant input documents (see Table 50.4.1.1-1).

- shall be able to populate the Output Destination Sequence (0040,4070). Note that the
  Task Performer may not be configured for, or may not have network access to, the
  requested output destination and thus may store results to a different destination. The
  Requestor can use the Get UPS Workitem Contents [RAD-83] transaction and examine
  the Output Information Sequence to find out where the Task Performer has ultimately
  stored the results.

- shall be able to populate the workitem attributes (see Table 50.4.1.1-1) to properly
  facilitate the assignment to a Task Performer by the Task Manager.

- shall populate the Scheduled Procedure Step Priority (0074,1200). A default value of
  "Normal" is appropriate.

- shall populate the Study Instance UID (0020,000D) for the study in which the AI Results
  are to be created.

The Task Requestor may be grouped with the Watcher to receive Send UPS Notification [RAD-
87] about updates to the workitem, such as changes to workitem status, including completion or
cancellation. The Task Requestor may use the Get UPS Workitem Contents [RAD-83] to access
details of the workitem, including where the results were stored and what algorithms provided
those results.

50.1.1.2 Task Manager

The Task Manager accepts and manages workitems from one or more Task Requestors. The
Task Manager may assign them to one or more Task Performers. The Task Manager may be, for
example:

- an AI Marketplace/Platform System

- a component of a PACS/VNA

415   • a RIS

       • a standalone task manager

The Task Manager shall implement the DICOM RESTful Message Semantics of the transactions listed in Table 50.1-1. As a baseline, a Content-Type of application/dicom+json according to [http://dicom.nema.org/medical/dicom/current/output/html/part18.html - table_11.1.3-1](http://dicom.nema.org/medical/dicom/current/output/html/part18.html) shall be
420   supported; application/dicom+xml may additionally be supported.

The Task Manager is responsible for interpreting the AI Inference Request provided by the Task Requestor in Create UPS Workitem [RAD-80] and updating the request as necessary for a Task Performer to process.

The Task Manager shall be able to decide and assign the workitem to a Task Performer using the
425   Performer's AE Title in Scheduled Station Name Code Sequence (0040,4025).

The Task Manager shall be configurable to include a default output destination in the Output Destination Sequence (0040,4070) if no output destination is included in the AI Inference Request.

The Task Manager shall support the three workflow models (Pull, Triggered Pull and Push
430   Workflow) as described in Section 50.4.2.

The Task Manager shall support the Station-oriented Query as described in Query UPS Workitems [RAD-81] transaction; see RAD-TF-2: 4.81.4.1.2.1.

A Task Manager may be grouped with an Image Manager to cache and/or proxy images for Task Performers that may not be able to access the primary Image Manager directly (e.g., Task
435   Performers that are hosted in the cloud). Caching is illustrated in Section 50.4.2.5.

50.1.1.3 Task Performer

The Task Performer responds to workitems and processes inputs to generate results.

The Task Performer is responsible for interacting with the Task Manager to obtain the task details and record the result details. The Task Performer also interacts with the Image Manager
440   to retrieve inputs and store results.

While the Task Performer might perform the requested inferences itself, it is also possible to act as a proxy, extracting key data from the inputs, passing it to an AI Model, collecting the results from the AI Model, and formatting them as medical documents for storage. See Section 50.4.2.6.

The Task Performer may be, for example,

445   • An AI Model hosted on a platform

       • A standalone system, such as a CAD Server for Mammography Screening

The Task Performer shall implement the DICOM RESTful Message Semantics of the UPS workitem transactions listed in Table 50.1-1. As a baseline, a Content-Type of application/dicom+json shall be supported as described in

450 http://dicom.nema.org/medical/dicom/current/output/html/part18.html#table_11.1.3-1;
application/dicom+xml may additionally be supported.

The Task Performer shall implement one or more of the three workflow models (Pull, Triggered Pull and Push) as described in Section 50.4.2.

If the Task Performer implements the Pull Workflow, it shall support:

455
- Query UPS Workitem [RAD-81] as an Initiator
- Claim UPS Workitem [RAD-82] as a Responder
- Get UPS Workitem [RAD-83] as an Initiator
- Update UPS Workitem [RAD-84] as a Responder
- Complete UPS Workitem [RAD-85] as a Responder

460 If the Task Performer implements the Triggered Pull Workflow, it shall support:

- Claim UPS Workitem [RAD-82] as a Responder
- Get UPS Workitem [RAD-83] as an Initiator
- Update UPS Workitem [RAD-84] as a Responder
- Complete UPS Workitem [RAD-85] as a Responder

465
- Send UPS Notification [RAD-87] as a Responder
- Open Event Channel [RAD-109] as an Initiator

If the Task Performer implements the Push Workflow, it shall support:

- Create UPS Workitem [RAD-80] as a Responder
- Get UPS Workitem [RAD-83] as a Responder

470
- Query UPS Workitem [RAD-84] as a Responder
- Send UPS Notification [RAD-87] as an Initiator
- Open Event Channel [RAD-109] as a Responder

The Task Performer implements DICOM DIMSE and/or DICOM RESTful transactions for the retrieval or transfer of DICOM encoded instances.

475 The Task Performer shall implement at least one of the following transactions to retrieve image instances identified in the Input Information Sequence (0040,4021):

- Retrieve Images [RAD-16]
- WADO-RS Retrieve [RAD-107]

Note: If the Task Performer makes use of other types of instances, such as presentation states or evidence documents, it will
480   implement additional retrieval transactions.

For the output results, Task Performers are recommended to use the AI Results Profile for DICOM encoding and transfer. Non-DICOM results, such as FHIR encoding, are not prohibited by this profile. This profile does not provide further guidance on the encoding of the results created by the Task Performer.

485 When implementing Query UPS Workitems [RAD-81], the Task Performer shall support, as a minimum, the Station-oriented Query as described in RAD TF-2: 4.81.4.1.2.1.

The Task Performer shall support the attribute mapping requirements specified in RAD TF-2x: Appendix V for results created.

The Task Performer shall populate the Performed Workitem Code Sequence (0040,4029) with a
490 Workitem code that identifies the task performed (which is permitted to differ from the workitem code in the Scheduled Workitem Code Sequence (0040,4018)). The Task Performer may be configured with alternate codes that will be understood by the Task Manager. Section 50.4.1.2 describes the selection and usage of Workitem Code Sets.

The Task Performer will update the Output Information Sequence (0040,4033) to identify the
495 results stored, if any, and the location where they were stored. Note that this location may differ from the Output Destination Sequence (0040,4070) in the request.

The Task Performer will update the Performed Station Name Code Sequence (0040,4028) to identify the Task Performer in the UPS Workitem.

The Task Performer will update the UPS workitem Final State using the semantics of Complete
500 UPS Workitem [RAD-85] for all workflow models as specified in RAD-TF-2: 4.85.4.1.2.1.

As shown in 50.4.2.3, when implementing the Push workflow, the Task Performer will be internally updating workitem Y and notifying the task manager rather than updating workitem X directly. The Task Performer shall still conform to the semantics in RAD TF-2: 4.84.4.2.1.2.1. and complete the workitem using the semantics in RAD TF-2: 4.85.4.1.2.

505 **50.1.1.4 Image Manager**

The Image Manager provides access to input images and receives DICOM results.

The Image Manager may be:

- PACS/VNA
- temporary cache

510 The Image Manager shall support both DICOM DIMSE and DICOM RESTful retrieval methods independent of how the instances were stored.

50.1.1.5 Watcher

The Watcher subscribes to and receives notifications about workitems being scheduled and performed. What such an actor might do with that information depends on the nature of the
515 product and is not otherwise mandated in this profile.

The Watcher may be:

- A Task Requester that wants to monitor the progress and outcome of tasks it has requested

- A Business analytics engine monitoring usage/volume of AI and performance metrics

520
- An EMR, RIS, Enterprise Workflow Manager or a Reporting Worklist Manager monitoring when AI tasks are complete

- An enterprise billing system

- A Clinical Decision Support system

Note that simple workitem state information will be available in the notifications, but to get more
525 detailed information, the Watcher will need to support Get UPS Workitem [RAD-83].

50.1.1.6 Procedure Reporter

The Procedure Reporter provides information to the Report Manager which may impact the reading worklist priority. See Section 50.4.1.4 for additional details.

The Procedure Reporter may be grouped with the Task Performer, Task Manager, Image
530 Manager, Watcher or any system which has access to the AI Results created by the Task Performer.

The procedure Reporter may use Retrieve Images [RAD-16] or WADO-RS Retrieve [RAD-107] to access AI Results.

If the Procedure Reporter is neither the source of the results (grouped with the Task Performer)
535 nor the recipient of the results, then the Procedure Reporter shall be capable of retrieving AI Results, using either DICOM DIMSE or DICOM RESTful retrieval methods to obtain objects which contain findings characterizations.

The Procedure Reporter uses the content of the AI Results to encode information that may affect the reading worklist priority in Procedure Update [RAD-13].

540 The business logic that maps the relevant semantics from the AI Results into the Procedure Update are left to the implementation.

50.1.1.7 Report Manager

The Report Manager manages the reading worklist using internal business logic to filter and sort the imaging procedures that are to be read.

545 The Report Manager receives Procedure Update [RAD-13] with a status change that identifies the completion of the AI processing and includes prioritization indicators.

The Report Manager may use these prioritization indicators in its internal business logic for reading worklist priority. See Section 50.4.1.4 for additional details on Reading Worklist Priority filtering and sorting.

50.2 AIW-I Actor Options

Options that may be selected for each actor in this profile, if any, are listed in the Table 50.2-1. Dependencies between options, when applicable, are specified in notes.

Table 50.2-1: AI Workflow for Imaging – Actors and Options

Actor	Option Name	Reference
Task Requestor	Instance Availability Option	Section 50.2.1
Task Manager	*No options defined*	--
Task Performer	*No options defined*	--
Image Manager	Instance Availability Option	Section 50.2.1
Watcher	*No options defined*	--
Procedure Reporter	*No options defined*	--
Report Manager	*No options defined*	--

50.2.1 Instance Availability Option

This option provides information about instance availability from an Image Manager to a Task Requestor for use when deciding what inference tasks to schedule and when populating the details of those tasks, such as the list of input data.

An Image Manager that claims the Instance Availability Option shall implement Instance Availability Notification [RAD-49].

A Task Requestor that claims the Instance Availability Option shall implement Instance Availability Notification [RAD-49].

The Task Requestor uses the information in the DICOM Instance Availability Notification to know when and where the input image instances are available as input to the business logic to create workitems.

The Task Requestor shall be able to incorporate the information received from the Image Manager via Instance Availability Notification [RAD-49] when creating and/or populating UPS workitems.

The Task Requestor shall populate the Referenced SOP Sequence inside the Input Information Sequence with each of the image instances needed for inference. The Input Information Sequence shall include the location end points and the access method as derived from the received Instance Availability Notification.

For example, a centralized Task Requestor might use this information to schedule AI Inference for the hospital in a fully automated fashion. Note that this information, by itself is insufficient to accurately know what AI Inference is necessary, if any, for a given instance or set of instances. Therefore, the Task Requestor's business logic would be expected to support configurability to allow automated selection of UPS workitem codes for available Task Performers based on the Performed Workitem Code Sequence, study type or other information available to the Task

Requestor. A Task Requestor may use multiple [RAD-49] notifications to create a single
580 workitem, and it is not expected that every notification will create a workitem.

50.3 AIW-I Required Actor Groupings

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

585

Table 50.3-1: AIW-I Profile - Required Actor Groupings

AIW-I Actor	Actor(s) to be grouped with	Reference
Task Requestor	--	--
Task Manager	--	--
Task Performer	ITI Consistent Time / Time Client	ITI TF-1: 7
Image Manager	--	--
Watcher	--	--
Procedure Reporter	--	--
Report Manager	ITI Consistent Time / Time Client	ITI TF-1: 7

Consistent Time is required to ensure the AI results are properly time stamped and reflected in
the results.

50.4 AIW-I Overview

590 ### 50.4.1 Concepts

50.4.1.1 AI Inference Request

The AI Inference Request is a UPS workitem created by the Task Requestor using Create UPS
Workitem [RAD-80]. This request should provide necessary details for a Task Manager to assign
the AI Inference Request to a Task Performer and sufficient information for the Task Performer
595 to perform the task.

Table 50.4.1.1-1 identifies detailed input values of an AI Inference Request to assist the Task
Manager with the workitem assignment. The input values assist the Task Performer with
performing the AI Inference.

Table 50.4.1.1-1: Inference Workitem

Detail	Corresponding UPS Attribute
Process requested	Scheduled Workitem Code Sequence (0040,4018) (see Section 4.1.2)
Patient Age	Patient's Age (0010,1010)

Detail	Corresponding UPS Attribute
Patient Sex	Patient's Sex (0010,0040)
Patient Weight	Patient Weight (0010,1030)
Patient race and ethnicity	Ethnic Group (0010,2160)
Contrast agent	Scheduled Processing Parameters Sequence (0074,1210)
Modality (e.g., CT, MR, etc.)	Scheduled Processing Parameters Sequence (0074,1210)
Disciplines (e.g., NM, Neuro, etc.)	Scheduled Processing Parameters Sequence (0074,1210)
Procedure being processed (the "orderable")	Requested Procedure Code Sequence (0032,1064)
Body Region/Anatomic Focus	Scheduled Processing Parameters Sequence (0074,1210)
Expected Completion Date/Time	Expected Completion Date and Time (0040,4011)
Priority/Urgency	Scheduled Procedure Step Priority (0074,1200)
References to the images and clinical documents for inference and location	Input Information Sequence (0040,4021) Referenced SOP Sequence (0008,1199) Referenced SOP Instance UID (0008,1155) Retrieval Sequence (0040,E024) WADO-RS Retrieval Sequence (0040,E025) DICOM Retrieval Sequence (0040,E021) FHIR Resource Retrieval Sequence (XXXX,YYYY) (see DICOM CP 2034)
Admitting Diagnoses	Admitting Diagnoses Description (0008,1080) Admitting Diagnoses Code Sequence (0008,1084)
Reason for Exam	Reason for the Requested Procedure (0040,1002) Reason for Requested Procedure Code Sequence (0040,100A)
Ordering Department	Requesting Service (0032,1033)
References to Other Relevant Input Documents	
Evidence Documents	Input Information Sequence (0040,4021)
Prior Studies	Input Information Sequence (0040,4021)
Radiation Dose Report	Input Information Sequence (0040,4021)

600

The onus is on the Task Performer to provide documentation on the input parameters, including values they support. Ideally, this should be a machine-readable description for a Task Manager or Task Requestor to ensure it is providing the input information necessary to perform the AI Inference identified in the Scheduled Workitem Code Sequence (0040,4018); see Section 605   50.4.1.2.

As a minimum, these input parameters should be documented in the DICOM Conformance Statement of the product implementing the Task Performer.

50.4.1.2 Code sets

While this profile does not mandate the use of specific code sets, identifying a common code set 610   will be a key pre-requisite of any deployment of this profile. Conformance to regional or national code sets would be a forward-looking step that might yield benefits in the future when evaluating

patients who have been at multiple institutions, when applying national clinical guidelines, or when compiling training datasets from diverse sources, etc.

Workitem Code set

615 The Task Requester uses a code in Scheduled Workitem Code Sequence (0040,4018) to communicate the processing service type to be performed and the expected workflow associated with it.

For example, a patient is presented in the ER after a motor vehicle accident. An x-ray technologist performs a chest exam. The technologist selects a workitem code that specifies the

620 detection of pneumothorax. The workitem is created including the workitem code, priority, and a reference to the performed chest exam. The workitem is provided electronically to an AI Marketplace/Platform System where the AI Model performs the pneumothorax detection algorithm. The AI Model returns a finding indicating the presence of pneumothorax to the AI Marketplace/Platform System. The finding requires urgent action and is sent to the reading

625 worklist for urgent interpretation and reporting. The findings and graphic annotation highlighting the pneumothorax is sent to the PACS to be included in the study for reading.

The ACR has defined and published several AI use cases with clinical prerequisites and clinical outcomes for AI procedures at https://www.acrdsi.org. The ACR and RSNA have jointly identified the finding attributes and allowable values for use cases using Common Data Elements

630 (CDE) for Radiology, at https://radelement.org. The RadElement Set code may be used for specifying workitems. For example, to request inference for the Pneumothorax Detection, the RadElement Set code is RDES44.

There may be other sources of standardized AI Inference procedure code sets which could be utilized for AI Workitem Codes. RadElement Set codes are one example of how inference can be

635 requested, but the Task Requester, Task Manager, and Task Performer must agree upon the codes used. The code sets in RadElements are based on use cases which can be tied directly to Task Performer capabilities. The key is to use standardized code sets so the Task Manager can properly delegate the AI Inference Request. Table 50.4.1.2-1 contains a sample of some of the codes developed by ACR and RSNA.

640 **Table 50.4.1.2-1: Example Workitem Codes**

Coding Scheme	Code Value	Code Meaning
RadElement	RDES3	Adrenal Nodule on CT or MR
RadElement	RDES14	Pediatric Bone Age
RadElement	RDES26	Appendicitis Detection
RadElement	RDES39	Midline Shift
RadElement	RDES44	Pneumothorax
RadElement	RDES51	Scoliosis
RadElement	RDES52	Quantification of Myocardial Perfusion
RadElement	RDES73	Pneumonia Detection

Coding Scheme	Code Value	Code Meaning
RadElement	RDES75	Breast Density
RadElement	RDES78	Cardiomegaly
RadElement	RDES99	Pulmonary Nodules on CT
RadElement	RDES112	Rib Fracture Identification

Scheduled Processing Parameters Sequence

The Task Manager may require additional input parameters to successfully assign the workitem. The Scheduled Processing Parameters Sequence (0074,1210) contains attributes with specific details of the Inference Request not explicitly specified in the UPS Scheduled Procedure Step Information Module, such as the modality, age, body region, and other parameters specific to determining the assignment and the processing involved (see Section 50.4.1.1).

The RadElement Set includes input data elements. For example, input images may need to be identifiable by views: e.g., AP, PA/Lat, inclination e.g., upright, semi-upright, supine. Patient age, gender, modality, Anatomical Region and focus might be required in either the image object or in the AI Inference Request.

There may be application specific processing parameters required not identified in Table 50.4.1.1-1.

Deployments should select codes from standard code sets such as RadElement, LOINC and SNOMED when possible.

50.4.1.3 Input and Output Data Types and Transfer Methods

UPS-RS is a worklist service capable of handling multiple types of clinical data objects as input and output data. This profile focuses on medical imaging instances (i.e., DICOM and DICOMweb) and support for those object types are specifically required in this profile. Although not required by this profile, implementations are permitted to support the other non-imaging medical data object types such as HL7 CDA and HL7 FHIR resources.

The object type for each input and output object is described in the Type of Instances (0040,E020) attribute in the Input Information Sequence (0040,4021) and Output Information Sequence (0040,4033) respectively of the UPS workitem. The Task Performer updates the Output Information Sequence inside the UPS Performed Procedure Sequence (0074,1216) to list the output objects and where it stored them.

UPS-RS also supports multiple different methods for transferring input and output data between the Task Performer and the relevant storage system. The connection details for these transfer methods are described in the following UPS workitem sequences:

- DICOM Retrieval Sequence (0040,E021)

- DICOM Media Retrieval Sequence (0040,E022)

- WADO Retrieval Sequence (0040,E023)

- WADO-RS Retrieval Sequence (0040,E025)

- XDS Retrieval Sequence (0040,E024)

675
- FHIR Resource Retrieval Sequence (XXXX,YYY1)

Note: DICOM CP 2034 adds the FHIR Resource Retrieval Sequence

The Output Destination Sequence (0040,4070) identifies where the Task Performer has been requested to store the AI Results. The Task Performer is expected to use that destination if possible. The destination where the results are actually stored is always recorded in the Output
680 Information Sequence. The connection details for these access methods are described in the following UPS workitem sequences:

- DICOM Storage Sequence (0040,4071)

- STOW-RS Storage Sequence (0040,4072)

- XDS Storage Sequence (0040,4074)

685
- FHIR Resource Storage Sequence (XXXX,YYY2)

Note: DICOM CP 2034 adds the FHIR Resource Storage Sequence

50.4.1.4 Procedure Update, Reading Worklist Priority

When an AI Model processing is complete, the procedure status and findings may need to be conveyed to a system, which manages the reading worklist. These findings may impact the
690 reading worklist priority. A clinical example is the detection and quantification of pneumothorax on a chest x-ray. This is a potentially life-threatening, but readily treated, emergency. Detection of its presence might raise the priority of the reporting of this study to facilitate treating the patient more quickly.

AI Result factors that could influence Reading Worklist Priority

695 With the availability of AI Results prior to reading, factors that could influence the worklist priority include:

1. Characterization of findings

   For example, the presence of a pneumothorax might increase the priority.

2. Criticality/severity

700   For example, a large pneumothorax might be higher priority than a small one.

3. Confidence

   For example, the AI Model having a very high confidence in a positive result might be a higher priority than a result with a low confidence. A very high confidence in a negative result might be a lower priority.

705 4. Specificity/sensitivity

Although these communicate the overall statistical performance of the algorithm not the strength of an individual result, a result from a model operating with higher specificity and sensitivity might be weighted more strongly than a result from a model operating with lower specificity and sensitivity.

710 **Existing factors impacting Reading Worklist Priority**

These factors are introduced and combined with the existing factors that are typically used by reading worklist managers to prioritize the reading tasks. These existing factors might include, but are not limited to:

1. Expected turn-around time for read

715 A site may have an expected turn-around time (TAT) for reading studies relative to the date and time of image acquisition completion. Approaching or exceeding this TAT value may increase the priority.

2. Order urgency

An order placed may include a priority, such as "Routine", "ASAP" or "STAT". ASAP 720 or STAT may be prioritized higher than Routine.

3. Ordering physician department

Radiology may have negotiated different service level agreements with different departments.

4. Reason for requested procedure

725 For example, "Rule out Stroke" and "Suspect Broken Bone", may be prioritized differently.

How an institution prioritizes worklists, including what impact critical findings might have, is determined by the institution's policies.

Imaging Analysis Results Content Mapping to Procedure Update

730 RAD TF-3: 6.5 defines standard encodings for the results of medical imaging data analysis. The specification abstracts imaging analysis results as being composed from a set of primitives. The procedure update message may abstract content encoded in the primitives which could impact worklist priority. There are six primitives specified for Imaging Analysis Results Content. Two primitives relevant for encoding in the OBX Findings are described and discussed in this section.

735 **Qualitative Findings:** Qualitative findings are expected to be coded concepts. However, the finding could be pre-defined text from the analysis application. For the latter, it is expected that the Procedure Reporter or the Task Performer would have internal business logic to encode the Abnormality Flag based on the predefined text representing the AI Result.

Measurement Findings: Measurements findings are useful if used with limits to encode the 740 Abnormality Flag. An example is Pneumothorax, a large pneumothorax is more critical than a small pneumothorax. A large pneumothorax may be considered as critical. The Abnormality Flag would be encoded as AA.

The following primitives are useful for the Image Display for viewing but are not necessarily relevant to worklist prioritization and should not be sent to the Report Manager:

- Locations
- Regions
- Tracking Identifiers
- Parametric Maps
- Image References

The mapping is not part of Procedure Update [RAD-13]. If a specific primitive is deemed useful to assist with worklist priority or clinical care prior to reading, the primitive could be encoded. With no threshold associated, the Abnormality Flag would not be included. The usage of Sub ID may be used to associate the region with the primary observation which has the Abnormality Flag set.

50.4.1.5 Pull, Triggered-Pull, and Push Workflow

AI Workflow is built on the UPS-RS worklist service, which supports several workflow models.

Pull Workflow

In "Pull" workflow, a Task Performer queries the Task Manager for a list of tasks and chooses which to claim and work on (see Section 50.4.2.1 for more details). Typically, the Task Performer will make its selection based on the Scheduled Workitem Code (which defines the type of processing being requested) and perhaps details of the input data, or the parameters.

This workflow is particularly useful when the Task Manager has not been configured with (or downloaded) information about all the available Task Performers, what types of tasks they can perform, any data constraints they have (e.g., can process chest x-rays, but not CT scans), and what their current workload/availability is. Task Performers query for relevant tasks and claim tasks as they are able.

For efficiency, the Task Performer can include filter details in the query, like the Scheduled Workitem Code(s) it is capable of performing, so the Task Manager will only return matching workitems. Such filters are typically pre-configured. Alternatively, the Task Performer can request a longer list of workitems and internally examine the details.

It is also possible to use the Pull workflow when the Task Manager assigns tasks to Task Performers. In that case the Task Manager will have populated the Scheduled Station Name field of the workitem with the name of the intended Task Performer. The Task Performer includes a filter for its own Station Name in the query (referred to as a "Station-based Query") to find its assigned tasks.

Triggered-Pull Workflow

In "Triggered-Pull" workflow, the Task Manager sends a notification to the Task Performer that there is a task the Task Manager thinks is appropriate for the Task Performer. The notification

triggers the Task Performer to get the workitem, claim it and start work (see Section 50.4.2.2 for more details).

The Task Manager may specifically assign a workitem to a single notified Task Performer, or it may send out notifications to multiple Task Performers for an unassigned workitem, in which case the first Task Performer to claim it gets ownership of the task (UPS prevents performers from claiming or updating an already claimed task).

Push Workflow

In "Push" workflow, the Task Manager instructs the assigned Task Performer to create a copy of the assigned workitem (see Section 50.4.2.3 for more details). The Task Performer works on that copy and coordinates with the Task Manager to resynchronize with the original workitem.

In both Push workflow and Triggered-Pull workflow, the business logic for determining whether a workitem is appropriate for a given Task Performer is built into the Task Manager, rather than the Task Performer.

50.4.1.6 UPS Tasks and Subtasks

UPS (Unified Procedure Step) maintains a strict 1:1 relationship between a scheduled procedure step and the corresponding performed procedure step, capturing the details of both in a single unified normalized object. For example, the scheduled procedure step section of a workitem could describe a request for detection of pneumothorax, and the performed procedure step section would describe the corresponding result generated by the assigned AI Model.

This does not, however, disallow the creation of "subtasks" as independent UPS workitems.

For example, a Task Requester might create a very general workitem to perform all possible AI Inference on a Study. This workitem might be claimed and performed by a Task Performer whose role is to determine what AI Inference Models would be appropriate to perform on a study. That Task Performer could create multiple new workitems ("subtasks") to, say, perform tumor detection, heart segmentation, and cracked rib detection. The Task Performer that claimed the original generic workitem would monitor these new tasks and once they are complete, collate the results to update the original workitem and mark it complete.

Similarly, a requested workitem may identify a panel of AI Inference Tasks, such as a chest x-ray panel. A Task Performer, or even a function of the Task Manager, could claim the panel workitem and schedule new workitems for detection of pneumonia, pneumothorax, and rib fractures.

Task Performers could also create workitems to "subcontract" work like segmenting lung nodules for which it is preparing a LungRADS assessment. Note: when installing such a performer, it would be wise to also install performers capable of performing the subtasks on which it depends.

Lastly, in a use case illustrated in Section 50.4.2.6, a Task Manager might create a subtask to have a human verify the results of an original task prior to sending the results to an output destination.

In each of the above examples, it would be appropriate for the Scheduled Workitem Code Sequence (0040,4018) in the main workitem to be copied into the Performed Workitem Code Sequence (0040,4019) since the scheduled work was performed. The Task Performer might additionally be able to collect the contents of the Performed Workitem Code Sequence in each of the subtask workitems and append those codes to the Performed Workitem Code Sequence in the main workitem, however the semantics of this (e.g., whether the additional codes are children, peers, or alternate codes) is not defined. Similarly, the Performed Station Name Code Sequence (0040,4028) in the main workitem would contain the name of the Task Performer that claimed that main workitem, but the names of the performers of the subtasks could also be appended.

50.4.1.7 Interactive AI

Some implementations may involve "interactively requested" AI Models in the sense that an operator might choose "on the fly" to invoke one analysis or another while reviewing the image. For example, a radiologist could initiate AI Inference for the presence of pneumothorax while reading a chest x-ray. This could be achieved by grouping a Task Requestor with the Image Display or Report Creator.

The Radiologist could also provide human input such as a seed point for a segmentation or a region of interest for analysis.

Further details, such as machine-to-human interactions are not included in this profile.

50.4.1.8 Workflow Management using local Data Cache

There are several use cases where it is advantageous for a Task Manager to provide a local data cache. For example, the Task Performer may not have direct access to the input data or output destination points, so the Task Manager would retrieve the data on behalf of the Task Performer, enabling access. Also, in a case where multiple Task Performers would require access to the same data, a Task Manager retrieving the data local for these multiple Task Performers would improve the efficiencies of the network performance. The Task Manager may need to aggregate the results for validation and distribution.

50.4.2 Use Cases

An AI Workflow clinical example is detection and quantification of pneumothorax in a chest radiograph.

- A patient presents to an ER department with chest pains and shortness of breath.

- The attending physician suspects Pneumothorax and orders a chest x-ray.

- The patient has a chest x-ray procedure performed.

- After the chest x-ray is acquired, the technologist submits an electronic request for AI Inference for "Detection and Quantification of Pneumothorax",

- An AI Model runs inference, per the request, to detect and quantify the presence of pneumothorax.

- The presence of pneumothorax with the associated image markups are provided to the radiologists during interpretation and to clinicians providing care.

855 This example illustrates the inference request initiated by a clinical specialist after the images are acquired. The system that initiates the workflow could be the x-ray system, a RIS workstation, a QC workstation, or a PACS workstation to name a few. Workflow could be automated as well. An AI Marketplace/Platform System, as an example, could receive the necessary clinical information from an EMR and RIS, plus the availability of images (see Task Requestor IAN

860 Option) to determine what inference would be appropriate. Conversely, a workflow management system hosted by a PACS, RIS or standalone could effectively automate the AI Workflow as well.

The following sections describe the use of DICOM UPS-RS to enable the AI workflow. In these sections, the Task Requestor is the system requesting inference on the images, the Task Manager

865 is the orchestrator, and the Task Performer is the software responsible for collecting the input data, getting the inference performed, and storing the results. The AI model may be internal to the Task Performer or may be a partner or hosted system.

50.4.2.1 Use Case 1: Pull Workflow

The "Pull" method is where the Task Performer queries the Task Manager for available tasks and
870 performs them as appropriate. See Section 50.4.1.5 for more details.

Particular to this workflow, the Task Performer implements a Query transaction and selection logic.

Often in AI, the Task Manager assigns workitems when they are created, as shown here. The Task Performer uses Query UPS Workitem [RAD-82] with a "Station-based Query" to find the

875 assigned workitem. The Task Performer may have been already running or may have been just launched by the Task Manager with this specific workitem to perform.

The "Pull" method also supports open queries, where the Task Manager does not assign the workitem to a specific Task Performer, but rather lets Task Performers claim tasks appropriate to them. The Task Performer uses Query UPS Workitem [RAD-82] with a "Procedure-Oriented

880 Query" looking for a workitem code it supports such as (RDE421, RADELEMENT, "Detection of Pneumothorax").

Figure 50.4.2.1-1 illustrates the Task Requestor using Open Event Channel [RAD-109] to establish a WebSocket for receiving notifications of progress on the workitem. This presumes that the Task Requestor has been grouped with a Watcher, which is not required. As an

885 alternative, the Task Requestor could use Get UPS Workitem [RAD-83] to check the workitem status or could ignore the task progress completely.
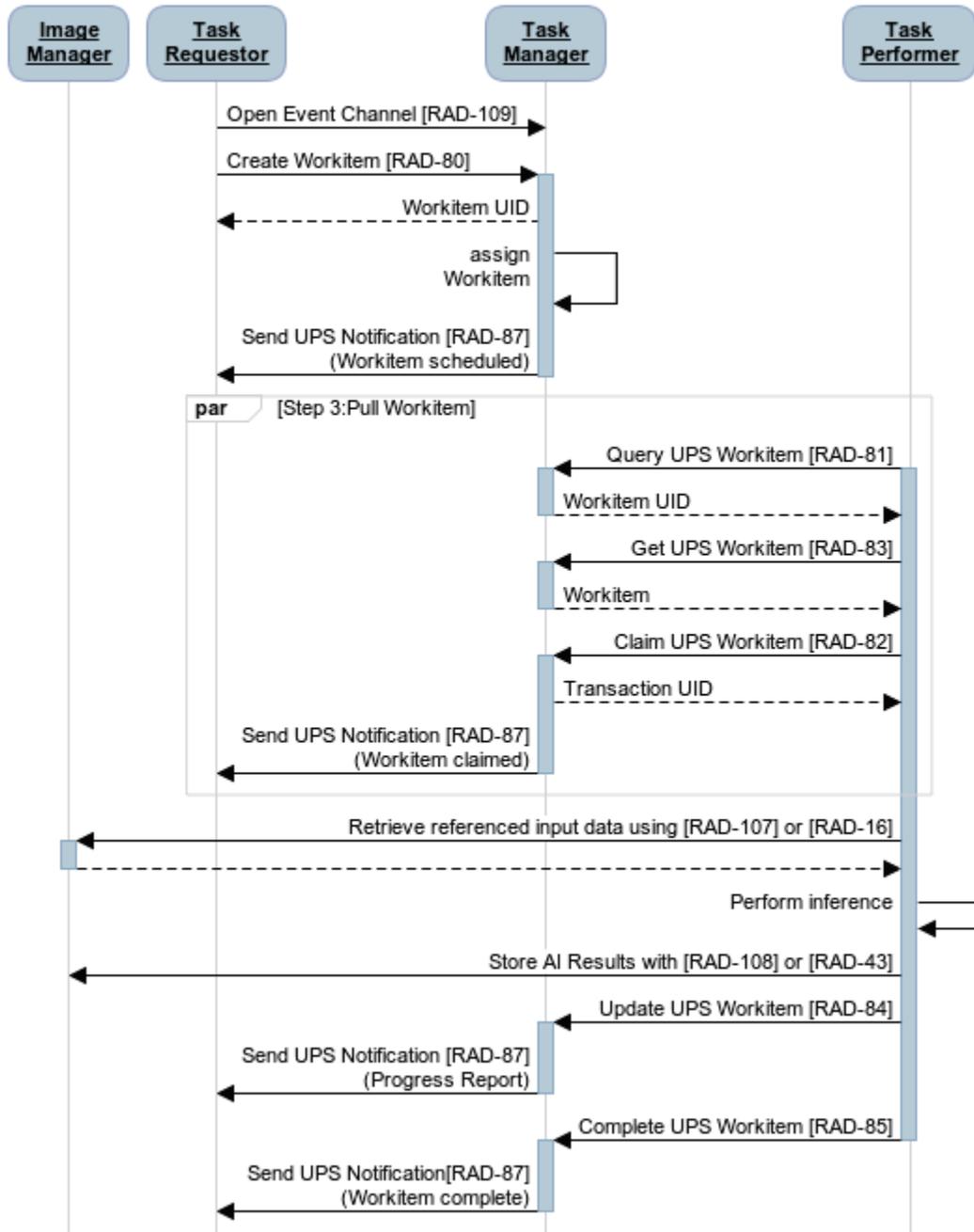
Figure 50.4.2.1-1: Pull Workflow

890   The UML sequence diagram was created using https://www.websequencediagrams.com/ with
the following script:

```
participant Image\nManager as IM
participant Task\nRequestor as REQ
participant Task\nManager as ORC
participant Task\nPerformer as PER
REQ->ORC: Open Event Channel [RAD-109]

REQ->+ORC: Create Workitem [RAD-80]
ORC-->REQ: Workitem UID
ORC->ORC: assign\nWorkitem
ORC->-REQ: Send UPS Notification [RAD-87]\n(Workitem scheduled)
par Step 3:Pull Workitem
PER->+ORC: Query UPS Workitem [RAD-81]
activate PER
ORC-->-PER: Workitem UID
PER->+ORC: Get UPS Workitem [RAD-83]
ORC-->-PER: Workitem
PER->+ ORC: Claim UPS Workitem [RAD-82]
ORC-->PER: Transaction UID
ORC->- REQ: Send UPS Notification [RAD-87]\n(Workitem claimed)
end
PER->+IM: Retrieve referenced input data using [RAD-107] or [RAD-16]
IM-->-PER:
PER->PER: Perform inference
PER->IM: Store AI Results with [RAD-108] or [RAD-43]
PER->+ORC: Update UPS Workitem [RAD-84]
ORC->-REQ: Send UPS Notification [RAD-87]\n(Progress Report)
PER->+ORC: Complete UPS Workitem [RAD-85]
deactivate PER
ORC->- REQ: Send UPS Notification[RAD-87]\n(Workitem complete)
```

Figure 50.4.2.1-2: Script for Pull Workflow Sequence Diagram

Step 1: Create Workitem

895 The Task Requestor prepares the AI Inference Request by populating Create UPS Workitem
[RAD-80]. The Task Requestor provides details such as the workitem code indicating the type of
inference to perform, and references to the input image data and the location from which they
can be retrieved. The Task Requestor specifies the desired endpoint where the AI results are to
be stored and the corresponding Study Instance UID.

900 The Task Manager creates the UPS Workitem as requested and assigns a Workitem UID. The
assigned Workitem UID is returned to the Task Requestor. This workitem UID can be used to
retrieve the details of this specific workitem and its status.

Step 2: Assign Task Performer

The Task Manager assigns the workitem to a specific Task Performer by setting the Scheduled
905 Station Name attribute in the workitem.

The Task Requestor is notified of the workitem status (SCHEDULED) using Send UPS
Notification [RAD-87].

Step 3: Pull Workitem

910 Once the Task Performer is ready and available, it queries the Task Manager, using Query UPS Workitem [RAD-81] with the Station-Based Query for the workitems it is assigned to.

The Query returns the assigned workitem UID to the Task Performer.

The Task Performer uses the workitem UID to retrieve the workitem with Get UPS Workitem [RAD-83].

915 After retrieving the workitem, the Task Performer claims the workitem using Claim UPS Workitem [RAD-84], confirming that it can perform the workitem and locking the UPS workitem from being claimed or modified by other performers.

The Task Manager, upon receiving the claim, locks the workitem and sets the status to INPROGRESS.

920 The Task Requestor is notified of the new workitem status (INPROGRESS) using Send UPS Notification [RAD-87].

Step 4: Retrieve Referenced Input Data

The Task Performer retrieves the instances identified in the workitem using either the WADO-RS method with [RAD-107] or the DICOM DIMSE method with [RAD-16]. Some Task Performers might do this step prior to claiming the workitem, e.g., to make sure they are able to
925 access the designated inputs and support the images types being provided.

Step 5: Store AI Results

Once the processing is completed, the Task Performer stores the AI Results to endpoints referenced in the Output Destination Sequence (0040,4070) of the workitem with either the WADO-RS method [RAD-108] or the DICOM DIMSE method [RAD-43]. Note that the output
930 destination may or may not be the same Image Manager as the source images. Should the output location not be available, the Task Performer may store the results at a different location and record where they are stored in the Output Information Sequence (0040,4033).

Step 6: Update UPS Workitem

The Task Performer updates the workitem UPS Performed Procedure Information with the list of
935 the AI Results, their location, the Performed AI Procedure, the identity of the AI Algorithm and other details using Update UPS Workitem.

The Task Manager notifies the Task Requestor by Send UPS Notification [RAD-87] that the workitem has been updated.

Step 7: Complete UPS Workitem

940 The Task Performer completes the workitem by updating the workitem status to COMPLETE using Complete UPS Workitem [RAD-85].

The Task Manager notifies the Task Requestor that the workitem is complete using Send UPS Notification [RAD-87].

50.4.2.2 Use Case 2: Triggered Pull Workflow

945　The "Triggered Pull" method is where the Task Performer is notified of assignments and simply gets the assigned workitem. See Section 50.4.1.5 for more details.

Particular to this workflow, the Task Performer implements a WebSocket for receiving notifications.

Notifications avoid the need for a Task Performer to poll the Task Manager for work. However, 950　the Task Performer may still optionally implement Query UPS Workitem [RAD-81] to check for unassigned work, or for assignments it might have received during a period when the event channel or the performer were not running.
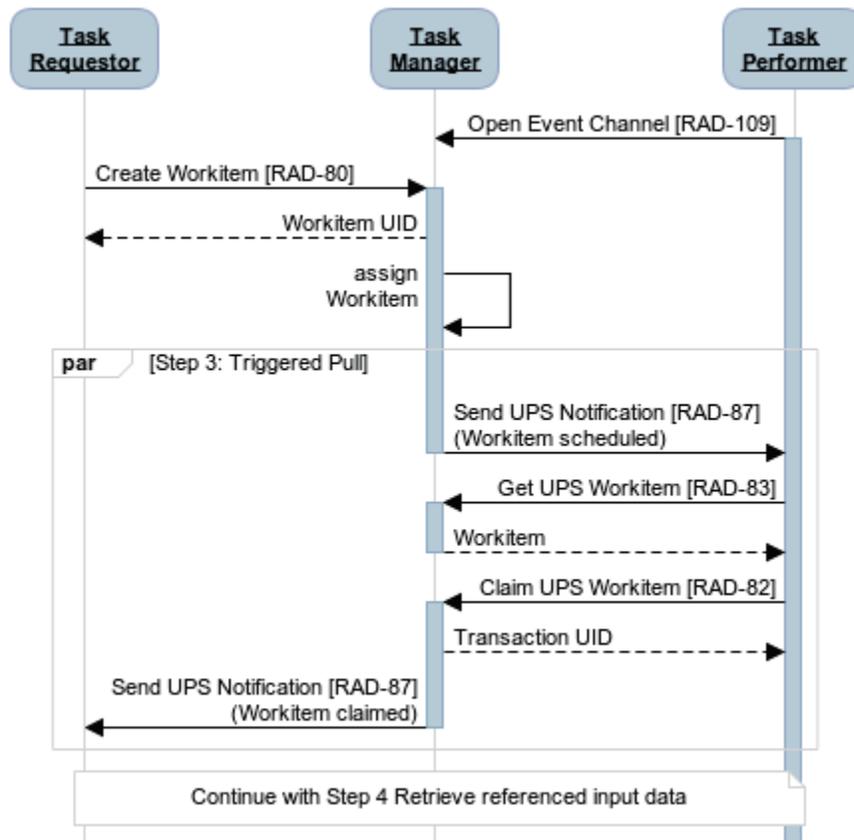
955　**Figure 50.4.2.2-1: Step 3: Triggered Pull Workitem**

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

```
participant Task\nRequestor as REQ
participant Task\nManager as ORC
participant Task\nPerformer as PER
PER-> ORC: Open Event Channel [RAD-109]
activate PER
REQ->+ORC: Create Workitem [RAD-80]
ORC-->REQ: Workitem UID
ORC->ORC: assign\nWorkitem
par Step 3: Triggered Pull
ORC->-PER: Send UPS Notification [RAD-87]\n(Workitem scheduled)
PER->+ORC: Get UPS Workitem [RAD-83]
ORC-->-PER: Workitem
PER->+ ORC: Claim UPS Workitem [RAD-82]
ORC-->PER: Transaction UID
ORC->-REQ: Send UPS Notification [RAD-87]\n(Workitem claimed)
end
note over REQ,PER: Continue with Step 4 Retrieve referenced input data
```

Figure 50.4.2.2-2: Script for Triggered Pull Workitem Sequence Diagram

960 **Step 3: Triggered Pull Workitem**

Once the Workitem is assigned, the Task Manager provides Send UPS Notification [RAD-87] with the Workitem UID and the assigned AETitle to the Task Performer.

The Task Performer does Get UPS Workitem [RAD-83] using the Workitem UID, and then claims the workitem.

965 The Task Manager, upon receiving the claim, locks the workitem, sets the status to INPROGRESS and returns the Transaction UID to the Task Performer.

The Task Manager notifies the Task Requestor of the workitem status update (INPROGRESS) using Send UPS Notification [RAD-87].

50.4.2.3 Use Case 3: Push Workflow

970 The "Push" method is where the Task Manager assigns and then pushes the workitem to the Task Performer. The Task Performer then performs and updates the pushed workitem. See Section 50.4.1.5 for more details.

Particular to this workflow, the Task Performer implements the transactions of a Task Manager, including accepting WebSockets and sending notifications.

975 Figure 50.4.2.3-1 illustrates the Task Manager using Open Event Channel [RAD-109] to establish a WebSocket for receiving notifications of progress on the workitem by the Task Performer. This is optional. As an alternative, to check whether the workitem is complete, the Task Manager could use Get UPS Workitem [RAD-83] periodically or each time it observes AI Results being stored.

980
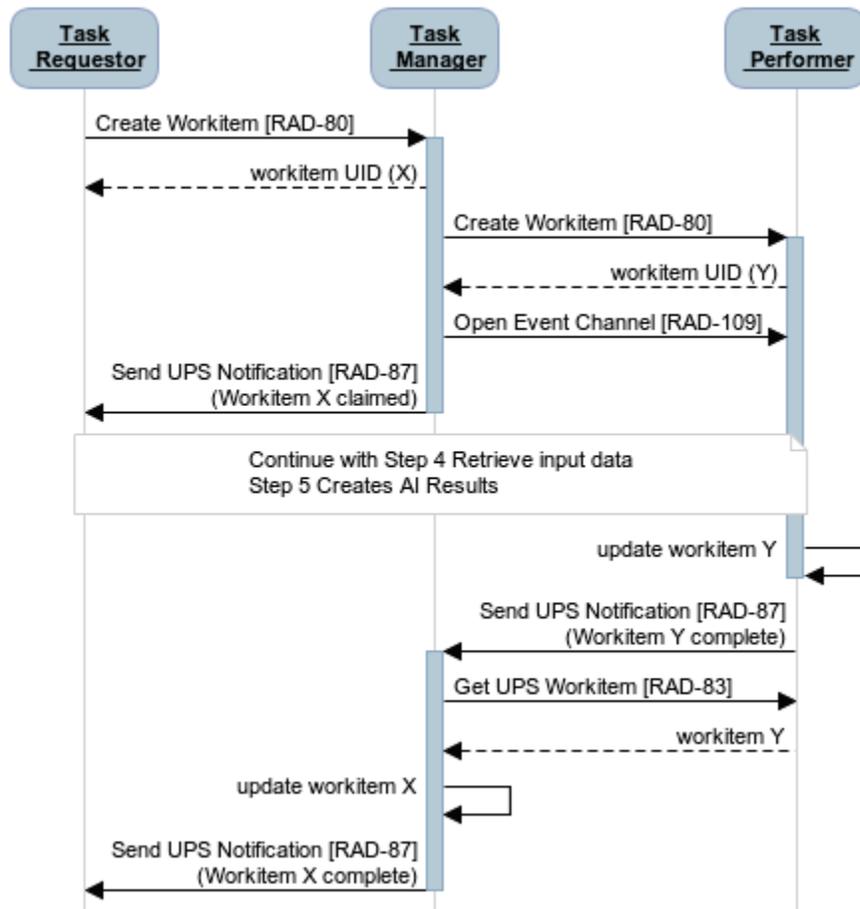
Figure 50.4.2.3-1: Step 3: Push Workflow

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

985

```
participant Task\n Requestor as REQ
participant Task\n Manager as ORC
participant Task Performer as PER
REQ->+ORC: Create Workitem [RAD-80]
ORC-->REQ: workitem UID (X)
ORC->+PER: Create Workitem [RAD-80]
PER-->ORC: workitem UID (Y)
ORC-> PER: Open Event Channel [RAD-109]
ORC->REQ: Send UPS Notification [RAD-87]\n(Workitem X claimed)
deactivate ORC
note over REQ,PER:
Continue with Step 4 Retrieve input data
Step 5 Creates AI Results
end note over
PER->-PER: update workitem Y
PER->-ORC: Send UPS Notification [RAD-87]\n(Workitem Y complete)
```

```
activate ORC
ORC->PER: Get UPS Workitem [RAD-83]
PER-->ORC: workitem Y
ORC->ORC: update workitem X
ORC->-REQ: Send UPS Notification [RAD-87]\n(Workitem X complete)
```

Figure 50.4.2.3-2: Script for Push Workflow Sequence Diagram

Create Workitem

The Task Requestor sends the Create UPS Workitem for an Inference Request as described in Section 50.2.1.

990 The Task Manager creates the workitem as requested and assigns a Workitem UID identifying the workitem here as Workitem X. The assigned Workitem UID for Workitem X is returned to the Task Requestor. The Task Requestor can use this workitem UID to get the workitem and its status.

Assign Workitem

995 The Task Manager assigns the workitem to a specific Task Performer by setting the Scheduled Station Name attribute in the workitem.

Push Workitem

The Task Manager prepares a "Push" workitem by populating Create UPS Workitem [RAD-80] with the entire contents of workitem X, including the assignment. This new UPS Workitem is 1000 sent to the assigned Task Performer.

After receiving the workitem, the Task Performer creates the UPS Workitem locally as requested and assigns a Workitem UID identifying the workitem here as Workitem Y. The assigned Workitem UID for Workitem Y is returned to the Task Manager. This workitem UID can be used by the Task Manager to get this workitem and its status.

1005 **Step 4 and 5 Process Workitem**

The Task Performer processes Workitem Y as outlined in Steps 4 and 5 in Section 50.4.2.1.

Update UPS Workitem

The Task Performer updates the Workitem Y with the list of the AI Results, their location, the Performed AI Procedure, the identity of the AI Algorithm and other details using Update UPS 1010 Workitem [RAD-84].

Complete UPS Workitem

The Task Performer completes workitem Y and sets the workitem status.

If the Task Manager supports the Notification, the Task Performer uses Send UPS Notification [RAD-87] to notify the Task Manager it is complete. The Task Manger uses Get UPS Workitem 1015 [RAD-83] to retrieve the workitem Y results and populates the results of workitem X with the results of workitem Y. The Task Requestor for Workitem X is notified using the Send UPS Notification.

50.4.2.4 Use Case 4: Exception Management Workflow

In the normal workflow process, there are cases where exceptions need to be managed at the
1020 Task Performer.

1) Workitem Rejection (before claiming)

After a workitem has been assigned, but before it is claimed, for example in Use Case 1 or Use
Case 2, the Task Performer may recognize that it would be unable to perform the workitem.
Possible reasons include:

1025
- It does not recognize the workitem code.

- It does not recognize a source location in the Input Information Sequence (0040,4021).

- It does not have available computational resources.

The Task Performer communicates to the Task Manager that it does not intend to claim the
workitem by sending Request UPS Workitem Cancelation [RAD-88]. The Task Performer sets
1030 the Procedure Step Discontinuation Reason Code Sequence (0074,100e) to (110530, DCM,
"Workitem assignment rejected by assigned resource").

The Task Manager, upon receiving this request, will likely re-assign the task to another Task
Performer. However, if none is available the Task Manager might simply cancel the workitem
which would result in a cancel notification to subscribed actors.

1035
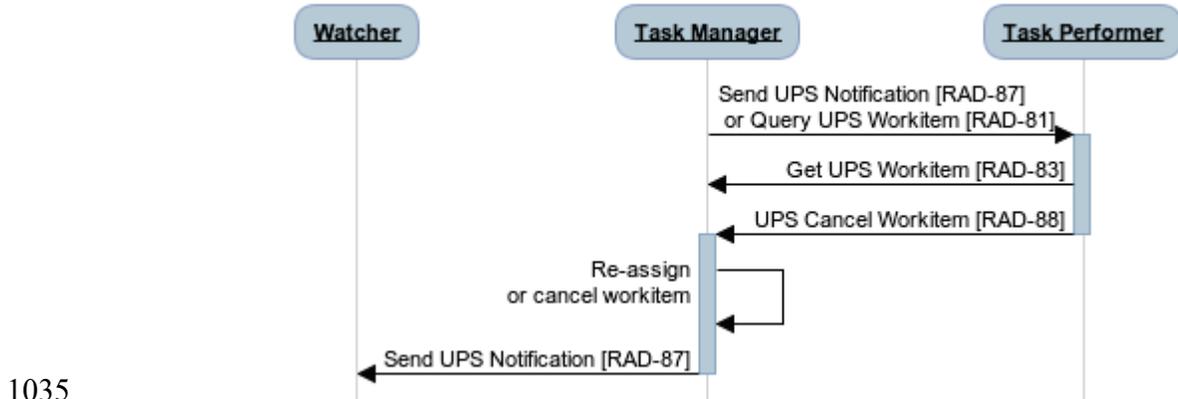
Figure 50.4.2.4-1: Workitem Rejection (before claiming)

The UML sequence diagram was created using https://www.websequencediagrams.com/ with
the following script:

```
Participant Watcher as WA
participant Task Manager as ORC
participant Task Performer as PER
ORC->+PER: Send UPS Notification [RAD-87]\n or Query UPS Workitem [RAD-81]
PER->ORC: Get UPS Workitem [RAD-83]
PER->- ORC: Request UPS Workitem Cancelation [RAD-88]
Activate ORC
```

> ORC->ORC: Re-assign\nor cancel workitem
> ORC->-WA: Send UPS Notification [RAD-87]

1040   **Figure 50.4.2.4-2: Script for Workitem Rejection (before claiming) Sequence Diagram**

2) Workitem Cancellation (after Claiming)

After the Task Performer has claimed a workitem, it may determine that it is unable to successfully finish processing the workitem. The Task Performer may have produced some or no results but determines that it is unable to finish processing to create the primary output results.

1045 The Task Performer communicates to the Task Manager that it is unable to successfully finish processing by sending Complete UPS Workitem [RAD-85] with a CANCELLED state.

The Procedure Discontinuation Code is encoded in the Procedure Step Discontinuation Reason Code Sequence (0074,100e) to (110530, DCM, "Workitem assignment rejected by assigned resource"). Other discontinuation reasons include:

1050
- (110521, DCM, "Objects incorrectly formatted") - Upon retrieving the inputs, the Task Performer determines that some of the necessary objects are not encoded correctly.

- (110523, DCM, "Object Set Incomplete") - The Task Performer determines that some of the necessary objects are missing.

- (110522, DCM, "Objects Types not supported") - The Task Performer determines that it
1055   does not support the objects types.

The Task Manager updates the workitem to the canceled state, and then sends the appropriate notifications. The Task Manger or another system could analyze the failed workitem and data sets and create a new workitem that addresses the issues for assignment to the same or another Task Performer.
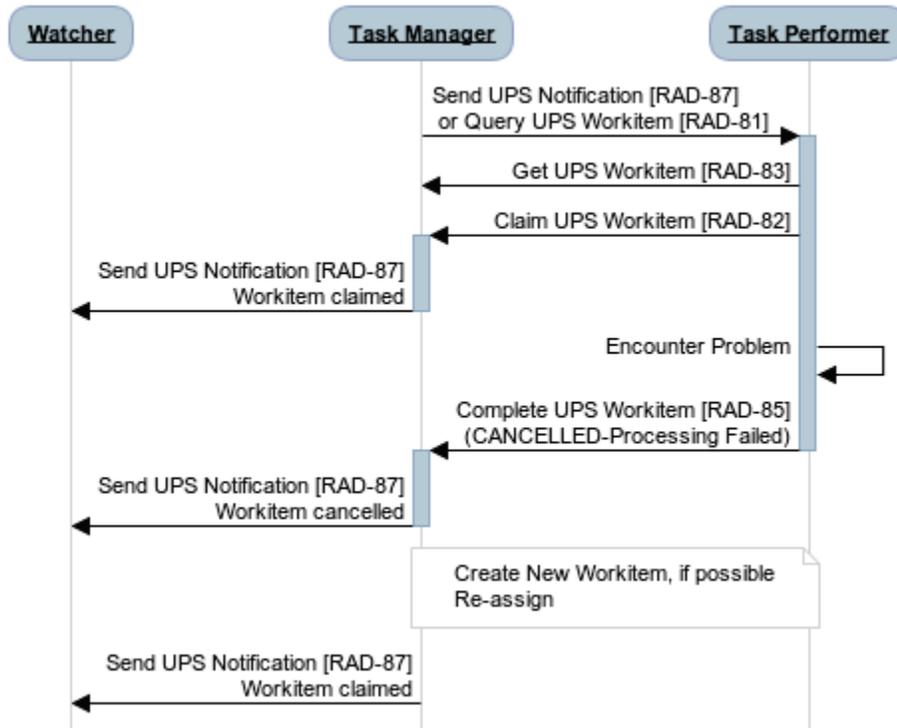
Figure 50.4.2.4-3: Workitem Cancellation (after claiming)

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

```
Participant Watcher as WA
Participant Task Manager as ORC
Participant Task Performer as PER
ORC->+PER: Send UPS Notification [RAD-87]\n or Query UPS Workitem [RAD-81]
PER->ORC:Get UPS Workitem [RAD-83]
PER->+ORC:Claim UPS Workitem [RAD-82]
ORC->-WA: Send UPS Notification [RAD-87]\nWorkitem claimed
PER->PER:Encounter Problem
PER->- ORC:Complete UPS Workitem [RAD-85]\n(CANCELLED-Processing Failed)
Activate ORC
ORC->-WA: Send UPS Notification [RAD-87]\nWorkitem cancelled
Note over PER,ORC: Create New Workitem, if possible\nRe-assign
ORC->-WA: Send UPS Notification [RAD-87]\nWorkitem claimed
```

Figure 50.4.2.4-4: Script for Workitem Cancellation (after claiming) Sequence Diagram

3) Workitem Complete (primary results available, some secondary results missing)

DICOM allows a workitem performer to communicate that a workitem performed was different than what was requested, i.e., the contents of the Performed Workitem Code Sequence (0040,4019) may be different than the contents of the Scheduled Workitem Code Sequence (0040,4018). If the results do address the workitem that was requested, but some of the

secondary results were inconclusive or incomplete, then the workitem processing may be considered successful. The Task Performer communicates the partial results to the Task Manager with Update UPS Workitem [RAD-84]. Once the Task Performer finishes processing, the Task Performer communicates to the Task Manager that it successfully finished processing by sending
1075   Complete UPS Workitem [RAD-85] with a COMPLETE state.

The Task Manager then sends the appropriate notifications.

4) Workitem Rejection (before claiming - Push Workflow)

In the Push Workflow, if the assigned Task Performer is unable to process the workitem, the Task Performer returns a Failure status to the Create UPS Workitem request from the Task
1080   Manager.

In the diagram below, the Task Manager cancels the original Workitem X which results in a cancel notification to subscribed actors. If the Task Manager was aware of other resources, e.g., a different Task Performer, it might first attempt to Push the workitem to the other Task Performer in hopes of a successful completion, allowing Workitem X to be completed.

1085
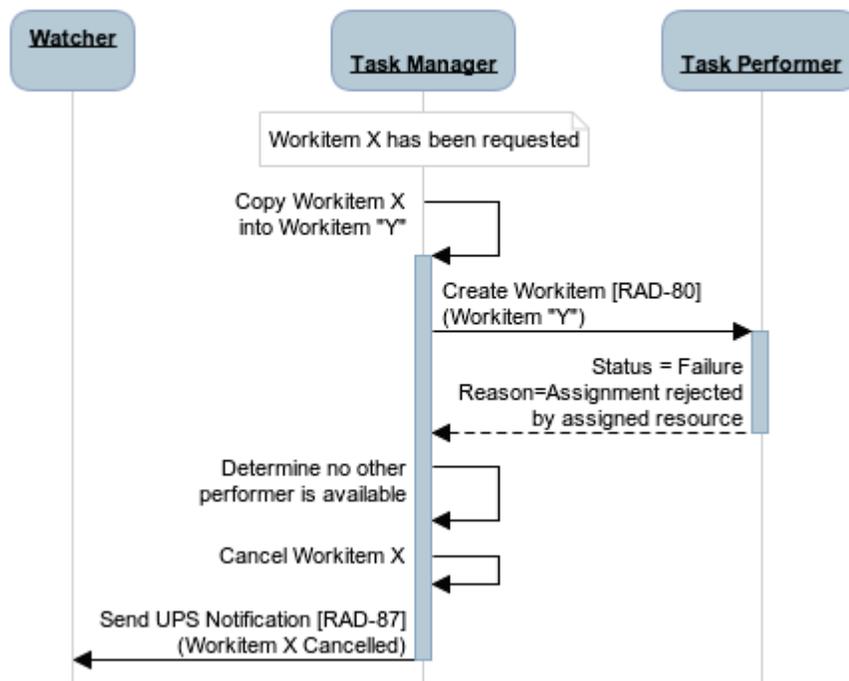
Figure 50.4.2.4-5: Workitem Rejection (before claiming - Push Workflow)

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

1090

```
participant Watcher\n as REQ
participant Task Manager as ORC
participant Task Performer as PER
note over ORC: Workitem X has been requested
ORC->+ORC: Copy Workitem X\ninto Workitem "Y"
ORC->+PER: Create Workitem [RAD-80]\n(Workitem "Y")
PER-->-ORC: Status = Failure \nReason=Assignment rejected\nby assigned resource
ORC->ORC: Determine no other\nperformer is available
ORC->ORC: Cancel Workitem X
ORC->REQ: Send UPS Notification [RAD-87]\n(Workitem X Cancelled)
deactivate ORC
```

Figure 50.4.2.4-6: Script for Workitem Rejection (before claiming – Push Workflow) Sequence Diagram

5) Workitem Complete (but no result objects produced)

It is conceivable for a Task Performer to successfully complete a workitem but create no output items. The Task Performer communicates no results to the Task Manager with Update UPS Workitem [RAD-84]. The Output Information Sequence (0040, 4033) is zero length, thereby including no items. The Performed Workitem Code Sequence (0040,4019) is set to the Procedure performed. Once the Task Performer finishes processing, the Task Performer communicates to the Task Manager that it has successfully finished processing by sending Complete UPS Workitem [RAD-85] with a COMPLETE state.

The Task Manager then sends the appropriate notifications.

50.4.2.5 Use Case 5: Proxied AI Models

In today's environment there are scenarios where AI Models have very limited enterprise integration capabilities.

In such a case, a Task Performer could serve as a proxy between the hospital enterprise and the processing-focused AI Model. The Task Performer implements the "hospital-facing" interfaces to interact with workitems and to retrieve and store medical images and other medical data. The Task Performer implements "application-facing" interfaces to exchange data and control one or more proxied AI Models.

In the simplest form, the Task Performer unwraps a DICOM image and passes the pixel matrix to a single proxied AI Model to perform its specific inference, say determining the presence of pneumonia, which is returned to the Task Performer as a single value. The Task Performer would generate a fully populated medical result, including the patient information, imaging procedure details, and an encoded pneumonia observation which is stored, the workitem updated and marked as complete.

In a more sophisticated example, for detection of Pneumothorax (https://www.acrdsi.org/DSI-Services/Define-AI/Use-Cases/Pneumothorax), a Task Performer may use one or more proxied AI Models to perform a series of subtasks, e.g.:

1. Determine if the image is a chest x-ray in the proper view with sufficient quality to access

2. Detect if pneumothorax is present.

3. Identify if there are skin fold artifacts.

4. Measure the pleural separation.

5. Classify the size of pneumothorax.

6. Detect the presence of chest tubes.

1125 The output of each of these subtasks could be aggregated into a single report by the Task Performer proxy.

A Task Performer acting as an AI Model proxy could use any of the workflow models described above.
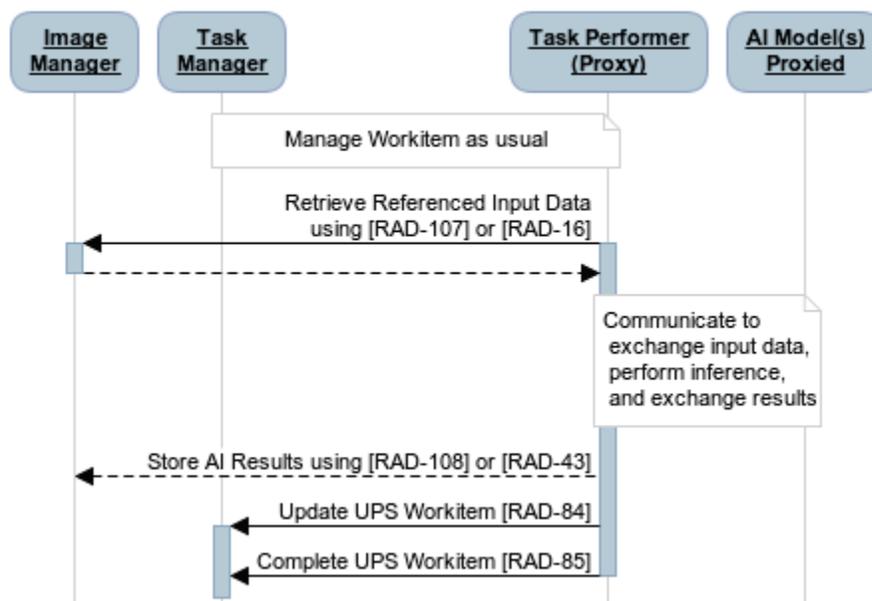
1130 **Figure 50.4.2.5-1: Proxied AI Model**

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

```
participant Image\nManager as IM
participant Task\nManager as ORC
participant Task Performer\n(Proxy) as PER
participant AI Model(s)\nProxied as PAM
 note over ORC,PER: Manage Workitem as usual
PER->+IM: Retrieve Referenced Input Data\nusing [RAD-107] or [RAD-16]
activate PER
IM-->-PER:
note over PER,PAM: Communicate to\n exchange input data,\n perform inference,\n and exchange results
PER-->IM:Store AI Results using [RAD-108] or [RAD-43]
PER->+ORC: Update UPS Workitem [RAD-84]
PER->-ORC: Complete UPS Workitem [RAD-85]
```

Figure 50.4.2.5-2: Script for Proxied AI Model Sequence Diagram

50.4.2.6 Use Case 6: Inference with Verification

The Inference with Verification use case describes human review/feedback of the results before they are stored and made widely available. The process flow illustrates the verification step as a separate Human Reviewer process step independent of the PACS.

The Task Manager creates two sub-task workitems, one for the inference step and one for the verification step. The inference workitem is mostly a copy of the original requested workitem, but the Output Destination is revised to redirect the output to a Verification Cache. The Verification Cache is essentially an Image Manager. The Verification Cache might be standalone, or might be implemented as a component of the Task Manager or the PACS/VNA.

When the inference step is complete, the verification workitem is created, populating the Input Information Sequence with the contents of the Output Information Sequence from the inference workitem, setting the Scheduled Workitem Code Sequence to request verification, and setting the Output Destination to be that from the original requested workitem.

The effect is that the results remain in the cache until the verification step is complete, when they are distributed for general consumption.

How the results are verified is not specified as part of this use case. Similarly, behaviors such as using verification outputs (including whether the results were accepted as is, edited, or rejected) to provide feedback to inference algorithms for re-training or to characterize the AI Model's confidence rating (see Section 50.4.1.4), are not currently specified. Another consideration is how would the Task Manager distinguish between trusted algorithms not requiring verification, and untrusted algorithms which need verification.
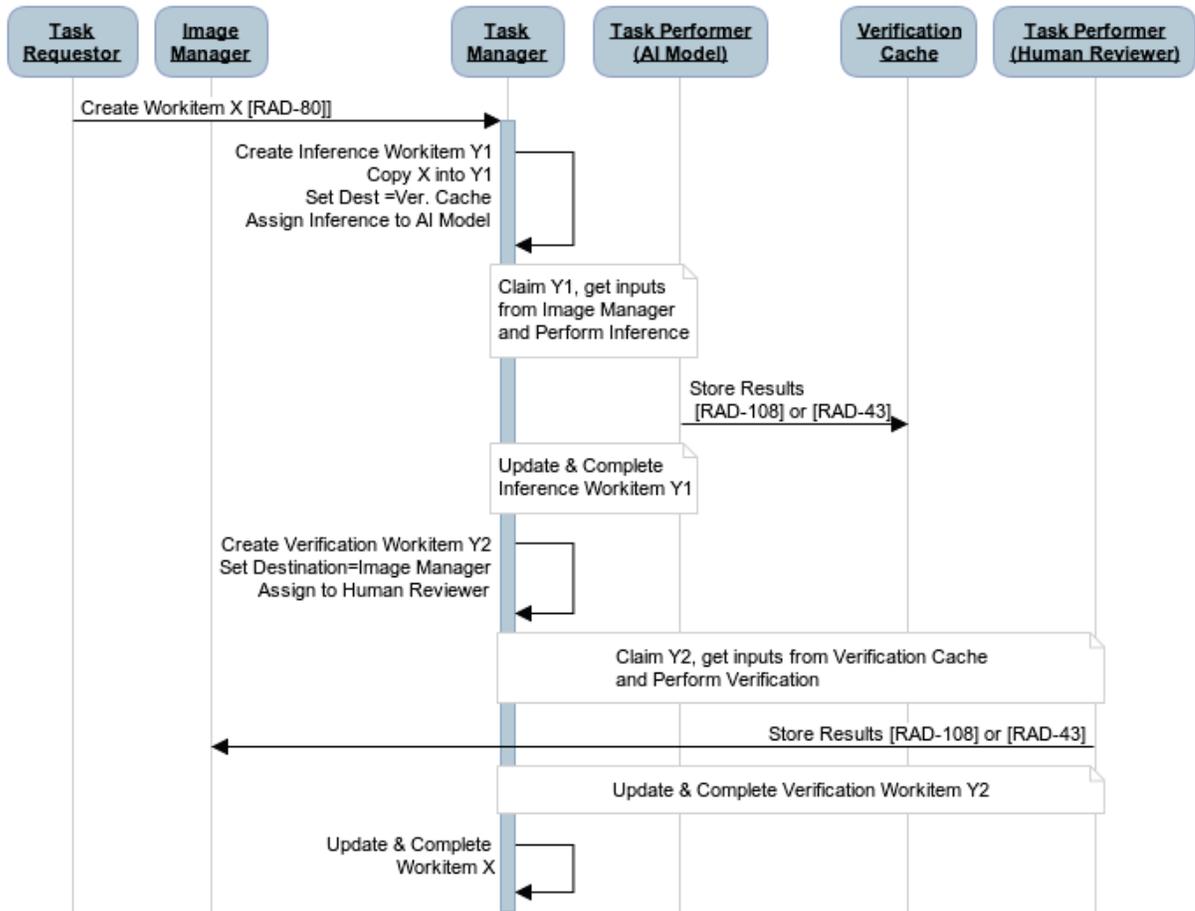
Figure 50.4.2.6-1: Inference with Verification

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

1160

```
participant Task\nRequestor as REQ
participant Image\nManager as IDS
participant Task\nManager as ORC
participant Task Performer\n(AI Model) as PER
participant Verification\n Cache as IDC
participant Task Performer\n(Human Reviewer) as HUM
REQ->+ORC: Create Workitem X [RAD-80]]
ORC->ORC: Create Inference Workitem Y1\nCopy X into Y1\nSet Dest =Ver. Cache\nAssign Inference to AI Model
Note over PER,ORC: Claim Y1, get inputs\nfrom Image Manager\nand Perform Inference
PER->IDC: Store Results \n [RAD-108] or [RAD-43]
Note over PER, ORC:  Update & Complete\nInference Workitem Y1
ORC->ORC: Create Verification Workitem Y2\nSet Destination=Image Manager\nAssign to Human Reviewer
note over ORC,HUM: Claim Y2, get inputs from Verification Cache\nand Perform Verification
HUM->IDS:  Store Results [RAD-108] or [RAD-43]
note over HUM, ORC: Update & Complete Verification Workitem Y2
ORC->ORC:  Update & Complete\n Workitem X
```

Figure 50.4.2.6-2: Script for Inference with Verification Sequence Diagram

50.4.2.7 Use Case 7: Reading Workflow Priority

The typical process flow starts with an AI Model, acting as the Task Performer, detects an abnormality. The results in their entirety are sent to the PACS/VNA for the Radiologist to review. In this use case, the Task Performer is grouped with the Procedure Reporter. The Procedure Reporter may be grouped with any actor that has knowledge of the AI Results which include the abnormality. Using the Pneumothorax example, the AI Model may return a result which includes whether Pneumothorax is present, absent, or undetermined. The attributes which impact workflow prioritization are relayed to the Report Manager as a Procedure Update.

The process flow is illustrated in the figure below.
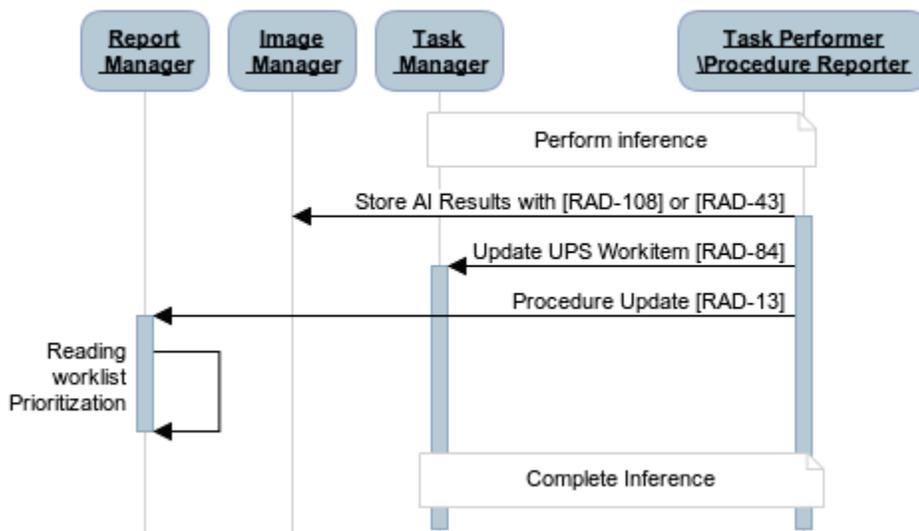
Figure 50.4.2.7-1: Reading Worklist Priority

The UML sequence diagram was created using https://www.websequencediagrams.com/ with the following script:

1175

```
participant Report\n Manager as RM
participant Image\n Manager as IM
participant Task\n Manager as ORC
Participant Task Performer\n\\Procedure Reporter as PER
note over PER,ORC: Perform inference
PER->IM: Store AI Results with [RAD-108] or [RAD-43]
activate PER
PER->+ORC: Update UPS Workitem [RAD-84]
PER->+RM: Procedure Update [RAD-13]
RM->-RM: Reading\nworklist\nPrioritization
note over PER, ORC: Complete Inference
```

Figure 50.4.2.7-2: Script for Reading Worklist Priority Sequence Diagram

50.5 AIW Security Considerations

Refer to RAD TF-1x: Appendix F Security Environment Considerations.

Protected Healthcare Information (PHI) is present in the DICOM instances being stored,
1180 retrieved, processed, and displayed.

50.5.1 Security Considerations for Actors

This profile strongly recommends that all AIW-I actors group with a Secure Application or Secure Node Actor, with the Radiology Audit Trail Option, in the ITI Audit Trail and Node Authentication (ATNA) Profile.

1185 The ATNA Profile requires actors to implement:

- Record Audit Event [ITI-20] transaction which would record when and where analysis results are distributed and displayed.

- Authenticate Node [ITI-19] transaction to further ensure the integrity of transactions via node authentication and communication encryption.

1190 In many controlled enterprise environments, the clinical IT infrastructure allows for the PHI to be included as part of the normal workflow. With the introduction of cloud-based architectures involving AI, there are now new security consideration due to the PHI transferred. Security and access to the Image Manager and other clinical content is a major concern. Architectural considerations should include limiting the access to non-relevant clinical content. Specifying
1195 such mechanisms and features is outside the scope of this profile.

Many inferences do not need PHI to be included as part of the processing. It is conceivable for a gateway proxy to create deidentified workitems and datasets which might still allow the Task Performer to complete its processing without accessing PHI, and the proxy would put the results back into the correct patient record.

1200 Deploying a clinical data cache/gateway, hosting only relevant clinical data and PHI removed, as the access point for cloud-based Task Performers, could be a consideration for limiting the vulnerability. Using an authentication layer, such as OAuth 2.0 will help with issues regarding consent and access. Use of the IHE ITI Internet User Authorization (IUA) Profile, which profiles the use of OAuth 2.0 is recommended with RESTful services in a cloud-based infrastructure.

1205 50.6 AIW-I Cross Profile Considerations

WIA - Web-based Image Access

An Imaging Document Consumer in the WIA Profile might be grouped with a Task Requestor to find other relevant imaging data or obtain the additional information from the DICOM study, series or instances for reference in the Input Information Sequence.

1210 An Imaging Document Consumer in the WIA Profile might be grouped with a Task Performer to find other relevant imaging data or obtain the additional information from the DICOM study, series or instances for reference in the Input Information Sequence.

MHD - Mobile access to Health Documents

A Document Consumer in the ITI MHD Profile might be grouped with a Task Requestor to
1215 access FHIR Document Reference Resources in the Input information Sequence.

A Document Consumer in the MHD Profile might be grouped with a Task Performer to access FHIR Document Reference Resources in the Input information Sequence.

XDS-I.b - Cross Enterprise Document Sharing for Imaging

An Imaging Document Consumer in the XDS-I.b Profile might be grouped with a Task
1220 Requestor to find other relevant imaging data or obtain the additional information from the DICOM study, series or instances for reference in the Input Information Sequence.

An Imaging Document Consumer in the XDS-I.b Profile might be grouped with a Task Performer to find other relevant imaging data or obtain the additional information from the DICOM study, series or instances for reference in the Input Information Sequence.

1225 XDS - Cross Enterprise Document Sharing

A Document Consumer in the ITI XDS Profile might be grouped with a Task Requestor to find other relevant data sources for reference in the Input Information Sequence.

A Document Consumer in the XDS Profile might be grouped with a Task Performer to find other relevant data sources for reference in the Input Information Sequence.

1230 QEDm - Query for Existing Data for Mobile

A Clinical Data Consumer in the PCC QEDm Profile might be grouped with a Task Requestor to query for clinical data elements (e.g., observations, allergies, conditions, diagnostic results, medications, immunizations, procedures, etc.) for use in the UPS workitem.

A Clinical Data Consumer in the QEDm Profile might be grouped with a Task Performer to query for clinical data elements (e.g., observations, allergies, conditions, diagnostic results, medications, immunizations, procedures, etc.) for use in the UPS workitem.

IDEP - Import and Display of External Priors

An Importer in the IDEP Profile might be grouped with a Task Requestor for the discovery and import of relevant prior imaging studies and reports from affiliated facilities, i.e., "external priors" and inclusion in the UPS workitem.

An Importer in the IDEP Profile might be grouped with a Task Performer for the discovery and import of relevant prior imaging studies and reports from affiliated facilities, i.e., "external priors" and inclusion in the UPS workitem.

AIR - AI Results

An Evidence Creator in the AIR Profile might be grouped with a Task Performer to encode the AI Results in a DICOM format.

An Image Display in the AIR Profile might be grouped with a Task Performer to view the AI Results encoded in DICOM format.

An Image Document Consumer in the AIR Profile might be grouped with the Procedure Reporter to provide results aggregation.

IID - Invoke Image Display

The Image Display in the Invoke Image Display (IID) Profile might be grouped with the Task Manager or Task Performer to allow for the AI Results to be reviewed prior to archive.

The Display Invoker in the Invoke Image Display (IID) Profile might be grouped with a Task Performer to allow for a Human to interact with the AI Results.

SOLE- Standardized Operational Log of Events

The Event Reporter in the SOLE Profile might be grouped with Task Requestor to log AI Inference request events.

The Event Reporter in the SOLE Profile might be grouped with Task Manager to log AI Inference processing events.

SVS – Sharing Value Sets

The Value Set Consumer in the ITI SVS Profile might be grouped with Task Requestor to receive the standardized list of workitem codes supported.

The Value Set Repository in the SVS Profile might be grouped with Task Manager to share the standardized list of workitem codes supported.

Volume 2 – Transactions

> *Note to reader:*

1270 The specification of [RAD-107] can be found in the Web-based Image Access (WIA) Trial Implementation Supplement, and the specification of [RAD-108] can be found in the Web-based Image Capture (WIC) Trial Implementation Supplement.

4.13 Procedure Update [RAD-13]

> *Modify Section 4.13.1*

4.13.1 Scope

1275 This transaction involves changes to procedure information communicated from the Department System Scheduler **or Procedure Reporter** to the Image Manager and Report Manager. Unlike the order message sent between the Order Placer and Order Filler **(where only the order status can be updated without requiring a Cancel/New Order to change an order)** , the ORM or OMI message **from the Department System Scheduler/Order Filler and Image Manager**

1280 may reference a previously scheduled Requested Procedure identified by a Study Instance UID.

This transaction may communicate that some results are available by the Procedure Reporter to the Report Manager and include OBX segment(s) with findings that may impact the read workflow priority.

The organization operating the DSS/OF and the Image Manager/Image Archive is responsible

1285 for synchronizing Procedure and Protocol Codes between all the systems that use such codes. **IHE does not yet define a common mechanism for code synchronization or access.**

> *Update Section 4.13.2: Add new Actor & Role*

4.13.2 Actor Roles

1290 **Actor:** Department System Scheduler/Order Filler

Role: Responsible for scheduling placed orders and sending the timing, resource, procedure and other information to the Image Manager.

Actor: Image Manager

Role: May use the scheduling, resource, procedure, and other information to perform image

1295 management tasks such as auto routing or pre fetching of images.

Actor: Report Manager

Role: May use the scheduling, resource, procedure, and other information to perform detailed report scheduling tasks.

Actor: Procedure Reporter

1300 **<u>Role: Responsible for providing an update to the Report Manager with content that may</u>**
<u>impact the report scheduling tasks.</u>

…

4.13.4 Messages

The following diagram illustrates interactions between actors implementing HL7 v2.5.1:
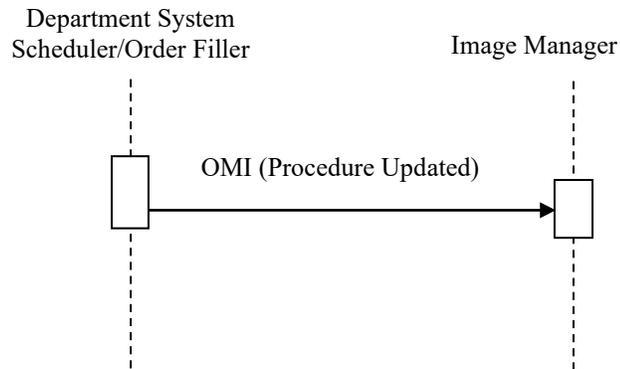
1305
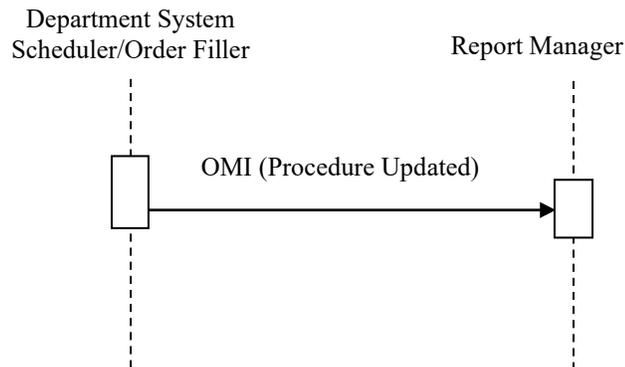
Add *new Figure 4.13.4-2*
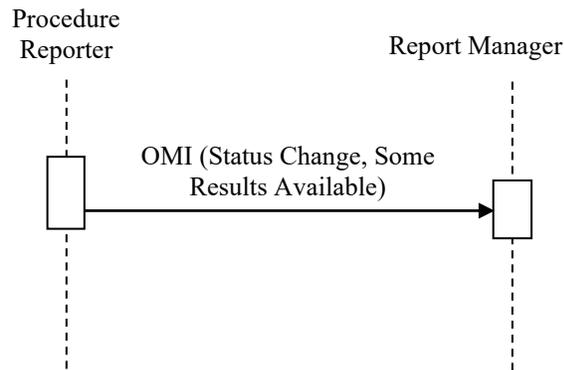
1310   **Figure 4.13.4-2: Interactions between actors implementing HL7 v2.5.1**

Update Section 4.13.4.1:

4.13.4.1 Trigger Events

A Procedure Update transaction is triggered in the case when the Department System Scheduler
1315   cancels, re-schedules or modifies characteristics of the procedure it previously scheduled and
transmitted to the Image Manager and Report Manager via a Procedure Scheduled [RAD-4]
transaction.

**A Procedure Update transaction is triggered in the case when the Procedure Reporter has
become aware that new AI results are available. Whether the Procedure Reporter sends a
1320   Procedure Update as each new result becomes available or the Procedure Reporter groups
multiple triggering results into a single Procedure Update message is left to the
implementation. There is an inherent tradeoff between sending updates in a timely fashion
to have the largest possible effect on the turn-around time, and conserving bandwidth.**

4.13.4.2 Message Semantics

1325   …

Update Section 4.13.4.2.2:

Editor: note the addition of a bullet list under the table

4.13.4.2.2 Message Semantics (HL7 v2.5.1)

The Procedure Update message is conveyed by the HL7 OMI message formatted according to
1330   the rules described in Section 4.4.

**The Procedure Scheduled transaction will perform the additional task of providing
Findings which could impact read worklist priority from the Procedure Reporter to the
Report Manager. The Report Manager shall include one or more OBX Segment(s) as
specified in Section 4.13.4.2.2.1.**

1335 The following Order Control Codes and Order Statuses are applicable for use in the *ORC-1* and *ORC-5* fields respectively.

Table 4.13-3: IHE Profile - Required Order Control Codes and Order Statuses

ORC-1 Value	ORC-1 Description	Originator	ORC-5 Value
CA	Cancel order request	DSS	CA
DC	Discontinue order request	DSS	CA
XO	Change order request, order is still scheduled or in progress	DSS	SC
XO	Change order request, order has been completed	DSS	CM
SC	**Status Change, some results are available.**	**Procedure Reporter**	**A**

Adapted from the HL7 Standard, version 2.5.1

1340 The value of field *ORC-5-Order Status* shall reflect the status of the underlying order. If the order has been cancelled by either the Order Placer or the Order Filler, the value in field ORC-5 shall be set to CA. In particular:

- if field ORC-1 is sent with a value of CA or DC, field ORC-5 shall be valued CA.

- if the order is changed and is still scheduled or in progress, ORC-1 shall be valued XO
1345 and ORC-5 shall be valued SC.

- if the order is changed and has been completed, ORC-1 shall be valued XO and *ORC-5* shall be valued CM. (This is done by the DSS/OF to update or synchronize procedure information with the IM/IA in the case the modality performed a procedure other than what was originally requested.)

1350 - **if the order has not changed, and is in progress with some results available, ORC-1 shall be valued SC and ORC-5 shall be valued A.**

Only procedural information that is conveyed in the OBR and ORC segments of the message may be changed. Any updates of patient or visit information shall be performed by the Patient Update [RAD-12] transaction (see Sections 4.1 and 4.12 for PID and PV1 information and
1355 updates).

All ORC-TQ1-OBR-IPC segment groups sent in the Procedure Scheduled message shall be present in the Procedure Update message, not only the pairs introducing a change.

The ORC and OBR elements given in Table 4.13-4 shall not be altered after the initial Procedure Scheduled message (Section 4.4), regardless of the type of control code.

1360 **Table 4.13-4: Procedure Update Elements that shall not be changed**

Element Name	Element Number(s)
Placer Order Number	OBR-2, ORC-2
Filler Order Number	OBR-3, ORC-3
Placer Group Number	ORC-4
Study Instance UID	IPC-3

Any other elements in the OBR or ORC segments may be changed when the Order Control Code = XO.

Note: Additional information regarding HL7 conventions, profiling, and implementation
1365 considerations are given in Section 2.3.

Add **new** Sections 4.13.4.2.2.1 and 4.13.4.2.2.1.1:

4.13.4.2.2.1 OBX segments - Findings

This section specifies the OBX segment provided by the Procedure Reporter.

When the imaging read has not yet been performed, the Procedure Reporter uses this Findings
1370 OBX segment is to convey finding primitives in AI Results that may influence reading worklist
priority or patient care. The specification of this OBX assumes that the AI algorithm has encoded
the results using the two finding primitives defined in the IHE Technical Framework Supplement
- AI Results RAD TF-3: 6.5.3. (currently published for trial implementation).

Optionality: This OBX segment should be included if the Procedure Reporter is aware of
1375 abnormal findings in the study identified in IPC-3. This OBX segment may be included for
normal or indeterminate findings.

Multiplicity: This OBX segment may repeat. The Procedure Reporter may create separate OBX
segments for each finding included in the Procedure Update message. It is common for an
imaging result to have many findings which could refine a different impact the read priority.

1380 The Observation/Result (OBX) Segment definition is based on HL7 Version 2.5.1 (Chapter 7,
Observation Reporting, Section 7.4.2).

This OBX Segment shall be further constrained as specified in Table 4.13.4.2.2.1-1.

Table 4.13.4.2.2.1-1: OBX Segments - Findings

SEQ	LEN	DT	Usage	Card	TBL#	ITEM #	ELEMENT NAME
1	4	SI	R	[1..1]		00569	Set ID – OBX
2	2	ID	R	[1..1]	0125	00570	Value Type
3	250	CE	R	[1..1]		00571	Observation Identifier
5	483 or 99999	NM, CE or TX	R	[1..1]		00573	Observation Value
6	250	CE	C	[0..1]		00574	Units

SEQ	LEN	DT	Usage	Card	TBL#	ITEM #	ELEMENT NAME
8	5	IS	RE	[0..1]	0078	00576	Abnormal Flags
9	5	NM	RE	[0..1]		00577	Probability
11	1	ID	R	[1..1]	0085	00579	Observation Result Status
14	26	TS	R	[1..1]		00582	Date/Time of the Observation
15	250	CE	R	[1..1]		00583	Producer's ID
17	250	CE	R	[1..1]		00936	Observation Method
18	22	EI	R	[1..1]		01479	Equipment Instance Identifier

Adapted from the HL7 Standard, version 2.5.1

1385

Field *OBX-2 Value Type* identifies the encoding of Field *OBX-5 Observation Value*. *OBX-2* shall have the value "CE" (coded element), NM (numeric) or TX (text data).

Field *OBX-3 Observation Identifier* shall contain the coded value associated with observation value for the Qualitative Finding or Measurement:

1390
- The value may be extracted from the attribute (121071,DCM,"Finding") in an Imaging Analysis Result formatted SR document.

- Universally recognized coding systems, such as RadElements, LOINC and SNOMED are strongly recommended, although local coding systems may be used.

Field *OBX-5 Observation Value* shall contain the finding itself as:

1395
- *If OBX*-3 is a coded concept (i.e., a coded question), then OBX-5 Observation Value Components 1-3 shall contain whether the characteristic finding as a coded value.

- If *OBX-3* identifies a quantitative measurement, then *OBX-5 Observation Value* Component 2 shall contain the measurement value.

Field *OBX-6 Units* If the finding is a quantitative measurement, then this field shall be included
1400 and contain the ISO or ANSI units, as defined in HL7 v2.5.1.

Field *OBX-8 Abnormal Flag* shall contain the abnormal status that is applicable to this specific finding value identified in *OBX-5*. The abnormal flag may differ between Finding OBX segments, based on the abnormality of each individual finding.

Field *OBX-9 Probability* shall be populated if the algorithm includes a probability or confidence
1405 level of the observation value.

Field *OBX-11 Observation Result Status* shall be populated with the value of R, indicating that the results are preliminary and not verified by a Radiologist.

Field *OBX-14 Date Time of the Observation* shall be populated with the date and time when the analysis was performed.

1410 Field *OBX-15.1 - OBX-15.3 Producer's Reference* shall use the mapped coded values defined in Section 4.13.4.2.2.1. For this OBX segment, the *OBX-15 Producer's Reference* shall contain the actionable category which is applicable to this specific finding. The actionable category may differ between Finding OBX segments, based on each individual finding.

1415 Field *OBX-17 Observation Method* shall be populated with the analysis procedure by which the observation was obtained. See RAD-1: 50.4.1.2 regarding the usage of AI Inference procedure code sets.

Field *OBX-18 Equipment Instance Identifier* shall be populated with the Device UID of the AI Model.

4.13.4.2.2.1.1 Actionable Finding Category and Abnormality

1420 Actionable and non-actionable findings are discussed extensively in the Results Distribution (RD) Profile; see RAD TF-1: 45.4.1.5. The encoding follows the guidelines introduced by the RD Profile in RAD TF-2: 4.128.4.1.2.1.

The following *Abnormal Flag* values from HL7 v2.5.1 Abnormal Flag (Table 0078) shall be used in this transaction:

1425
- N - Normal

- A - Abnormal

- AA - Critical abnormal

Table 4.13.4.2.2.1-2 specifies how to populate fields in OBX-15 to assist reading worklist prioritization in the AIW-I Profile.

1430 Different OBX segments may contain different levels of actionable observations. Table 4.13.4.2.2.1-2 lists the observations in order of severity, where a Normal observation is the least severe and an Emergent Actionable Finding observation is the most severe.

Table 4.13.4.2.2.1-2: Abnormal Flag and Actionable Findings Category Mapping

Field	Abnormal Flag	Actionable Findings Category
Segment field:	*OBX-8 Abnormal Flag*	*OBX-15 Producer's Reference*
Value Set:	*HL7 v2.5.1 Table 0078*	*RadLex*
Normal observation: (least severe)	N^Normal^HL70078	RID13173^Normal^RadLex
Non-actionable observation:	N^Normal^HL70078	RID50261^Non-actionable^ RadLex
Non-critical Actionable Finding observation:	A^Abnormal^HL70078	RID49482^Category 3 Non-critical Actionable Finding^ RadLex
Urgent Actionable Finding observation:	AA^Critical Abnormal^HL70078	RID49481^Category 2 Urgent Actionable Finding^ RadLex
Emergent Actionable Finding observation: (most severe)	AA^Critical Abnormal^ HL70078	RID49480^Category 1 Emergent Actionable Finding^RadLex

1435   It is possible that a result sent to a Report Manager was created by system that does not comply with the Procedure Reporter in the AI Workflow for Imaging (AIW-I) Profile and that the *Abnormal*, *Category* values are not known. If the Procedure Reporter is unable to determine these values from the AI result content, then the *OBX-8 Abnormal Flag* and the *OBX-15 Producer's Reference* shall not be populated.

1440   Examples of multiple Finding OBX segments including both coded entries and numerical findings are shown below for the example Pneumothorax:

```
OBX|1|CE|||RDE421^Detection of
pneumothorax^RadElement|||1^Pneumothorax present^RDE421|||
A^Abnormal^HL70078|.9||  |||R|||||||||RID50261^Non-
1445    actionable^RadLex||RDES44^Pneumothorax^RadElement|1.2.840.99999.1234|

OBX|2|NM|RDE422^Measure pleural separation in
mm1|CE|RDE421^^RadElement|  |||10|mm||||AA^Critical
Abnormal^HL70078|||R|||| RID49480^Category 1 Emergent Actionable
Finding^RadLex||RDES44^Pneumothorax^RadElement|1.2.840.99999.1234
```

1450

> *Update Section 4.13.4.3 to add the following paragraphs*

4.13.4.3 Expected Actions

The Image Manager and Report Manager are expected to perform the following actions based on the value of the field *ORC-1 Order Control Code*:

1455 **CA** – Procedure has been cancelled, usually due to the cancellation of the underlying order; the Image Manager and the Report Manager shall inactivate corresponding procedure information using Study Instance UID as a unique key of the Requested Procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information. If the Department System Scheduler/Order Filler has been notified that a Performed Procedure Step is
1460 in progress for a Requested Procedure, the order control code DC shall be used.

XO – Procedure-related information (including scheduled date/time and/or resource) has been changed. The Image Manager and Report Manager shall modify corresponding procedure information using the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient or visit information.

1465 **DC** – Order to which the particular procedure is related has been discontinued after at least one Performed Procedure Step for this procedure has started. The Image Manager and the Report Manager shall consider all remaining SPS known for that procedure (if any) cancelled. The Image Manager shall use the Study Instance UID as a unique key of the procedure in question. Information from PID and PV1 segments shall not be used to update patient information.

1470 **The Report Manager is expected to perform the following actions based on the value of the field *ORC-1 Order Control Code* set to *SC* and the value of the field *ORC-5 Order Status Code* set to *A* with an Order:**

- **The Report Manager shall use the Study Instance UID as a unique key of the procedure in question.**

1475 **The Report Manager evaluates the OBX segment content to determine if they include findings which might impact to the read worklist priority or other clinical actions.**

4.16 Retrieve Images [RAD-16]

> *Update Section 4.16.1:*

4.16.1 Scope

1480 After **an actor requests** ~~the Image Display or Imaging Document Consumer request for~~ image retrieval, the requested DICOM Images are transferred **to the actor** ~~from the Image Archive to the Image Display or from the Imaging Document Source to the Imaging Document Consumer~~ for viewing **or other processing**.

> *Update Section 4.16.1.1:*
>
> *Add the Task Requester to the list of Actors and Roles*

1485 **4.16.1.1 Actor Roles**

Actor: Image Archive

Role: Sends requested images to the Image Display **or Task Performer**.

Actor: Imaging Document Source:

Role: Sends requested images to the Imaging Document Consumer.

1490 **Actor:** Image Display **or Task Requester**

Role: Receives requested images from the Image Archive.

Actor: Imaging Document Consumer

Role: Receives requested images from the Imaging Document Source.

Update figure in Section 4.16.4 as follows:

1495 **4.16.4 Messages**

…
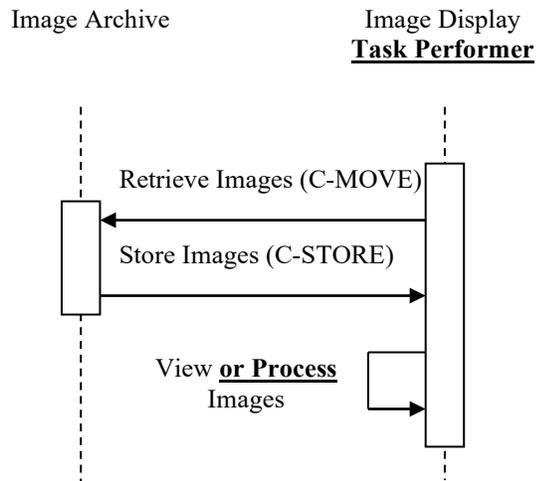
Update Section 4.16.4.1.1 as follows:

4.16.4.1.1 Trigger Events

1500 Images are selected for viewing at the Image Display**, Task Performer,** or Imaging Document Consumer.

Update Section 4.16.4.1.2 as follows:

4.16.4.1.2 Message Semantics

1505 The message semantics are defined by the DICOM Query/Retrieve SOP Classes and the DICOM Image Storage SOP Classes.

An Image Display, Task Performer, or Imaging Document Consumer is the SCU.

An Image Manager or Imaging Document Source is the SCP.

1510 A C-MOVE Request from the DICOM Study Root Query/Retrieve Information Model – MOVE SOP Class or the DICOM Patient Root Query/Retrieve Information Model – MOVE SOP Class shall be sent from the **SCU to the SCP.** ~~Image Display to the Image Archive or from the Imaging Document Consumer to the Imaging Document Source~~.

Update Section 4.16.4.1.3 as follows:

4.16.4.1.3 Expected Actions

1515 The Image Archive or Imaging Document Source receives the C-MOVE request, establishes a DICOM association with the Image Display**, Task Performer,** or Imaging Document Consumer, ~~respectively,~~ and uses the appropriate DICOM Image Storage SOP Classes to transfer the requested images.

1520 The Image Display or Imaging Document Consumer is expected to support at least one of the SOP Classes specified in Table 4.8-1. It is assumed that support of retrieval for a SOP Class also means support for display. **Display requirements for some IHE profiles are specified in Section 4.16.4.2 "View Images".**

The Task Performer in some IHE profiles performs processing on the retrieved images as specified in the profile.

1525 ## 4.18 Creator Images Stored [RAD-18]

Update Section 4.18.1 as follows:

4.18.1 Scope

In the Creator Images Stored transaction, the Evidence Creator **or Task Performer** sends the newly generated images for a study to the Image Archive.

1530

Update Section 4.18.2:

4.18.2 Actor Roles

Actor: Evidence Creator **or Task Performer**

Role: Transmit generated image data to Image Archive.

Actor: Image Archive

1535 **Role:** Accept and store images from Evidence Creators **or Task Performers**.

Update figure in Section 4.18.4 as follows:

4.18.4 Messages

Evidence Creator
Task Performer   Image
                                                  Archive

C-STORE (Images Stored)
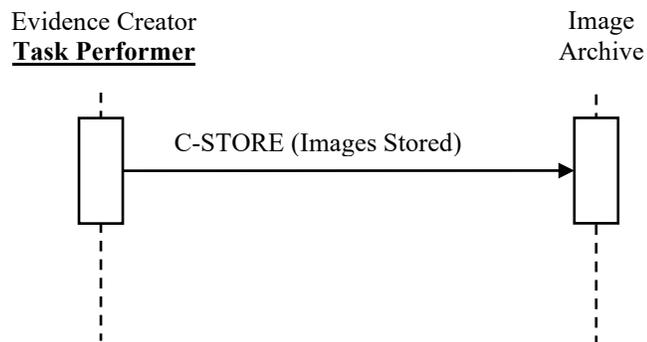
1540 **Figure 4.18.4-1: Interaction Diagram**

Update Sections 4.18.1.1 and 4.18.1.2 as follows:

4.18.4.1 Images Stored

1545 **4.18.4.1.1 Trigger Events**

The Evidence Creator **or Task Performer** transfers images to the Image Archive sequentially within one or more DICOM associations, as the images become available or collectively.

Details about when it is appropriate to trigger the creation of a new Study/Series/Image Instance are described in Section 4.8.4.1.1.1 "Study UIDs and Series UIDs".

1550 **4.18.4.1.2 Message Semantics**

The Evidence Creator **or Task Performer** uses the DICOM C-STORE message to transfer the images. The Evidence Creator **or Task Performer** is the DICOM Storage SCU and the Image Archive is the DICOM Storage SCP.

Per the DICOM Standard, the ~~Evidence Creator~~ **C-STORE SCU** shall create a new series for
1555   its created images and not extend series containing source images.

The Evidence Creator **or Task Performer** derives images from source images, and the derived
images may or may not have the same Image SOP Class as the source images.

The source images may include Performed Procedure Step relationship information. This
information will include Scheduled Procedure Step information for the procedure performed at
1560   an Acquisition Modality. When present in the source images, the Evidence Creator shall extract
appropriate Scheduled Procedure Step information and include it with PPS information produced
by the Evidence Creator.

See RAD TF-2x: Appendix A for rules on how to use the source image information in the
derived image objects.

1565

> *Update Section 4.49 and sub-sections as follows:*

4.49 Instance Availability Notification [RAD-49]

4.49.1 Scope

~~In the Instance Availability Notification Transaction, a~~**A Sende**r~~n~~ **Image Manager/Image**
1570   ~~Archive sends a message to relevant actors to~~ inform**s Receivers** ~~them~~ of the availability
status of newly stored DICOM objects. ~~Actors being notified are known to~~**Receivers may**
need these objects for fulfilling scheduled workflow processes and can retrieve and use the
objects referenced in this message. This ~~allows for~~ support**sing** a variety of workflow conditions
in imaging departments.

1575   ### 4.49.2 Actor Roles

**The roles in this transaction are defined in the following table and may be played by the
actors shown here:**

Table 4.49.2-1: Actor Roles

Role:	**Sender:**
	Notifies one or more Receivers of instances becoming available.
Actor(s):	**The following actors may play the role of Initiator:**
	Image Manager/Image Archive
Role:	**Receiver**
	Receives and processes notifications.
Actor(s):	**The following actors may play the role of Responder:**

	DSS/Order Filler
	Post-Processing Manager
	Report Manager
	Task Requestor

Transaction text specifies behavior for each role. The behavior of specific actors may also
1580 **be specified when it goes beyond that of the general role.**

~~Actor: Image Manager/Image Archive~~

~~Role: Generate an Instance Availability Notification message and send it to the DSS/Order Filler and optionally to other workflow managing actors (Post-Processing Manager, Report Manager).~~

1585 ~~Actor: DSS/Order Filler~~

~~Role: Receive an Instance Availability Notification message and internally process it.~~

~~Actor: Post-Processing Manager~~

~~Role: Receive an Instance Availability Notification message and internally process it.~~

~~Actor: Report Manager~~

1590 ~~Role: Receive an Instance Availability Notification message and internally process it.~~

4.49.3 Referenced Standard

DICOM PS3.4: Instance Availability Notification Service Class **(IAN)**

DICOM PS3.3: Instance Availability Notification Information Object Definition

1595 ## 4.49.4 Messages

Replace Figure 4.49.4-1 with the following figure
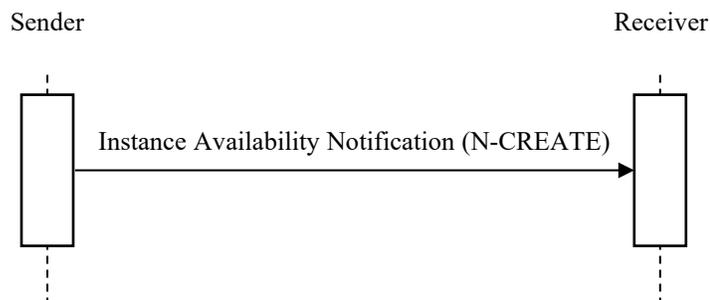
Figure 4.49.4-1: Interaction Diagram

4.49.4.1 Instance Availability Notification

1600 ~~This message uses the DICOM Instance Availability Notification Service from an Image Manager/Image Archive to~~ **The Sender** inform**s** other ~~workflow managing~~ actors about the availability of DICOM instances they may be waiting for ~~in order to be able to schedule or start procedure steps~~.

The Receiver shall support handling this message from more than one Sender. The Sender
1605 **shall support sending this message to more than one Receiver.**

The Receivers to which the Sender sends this message are typically managed by configuration or other business logic of the Sender.

4.49.4.1.1 Trigger Events

The intended usage of IAN is not to send a separate message as each instance is received,
1610 **but rather to communicate new availability information for logical sets of instances. Imaging instances are frequently created and stored in large sets that have been acquired or processed together, but can also consist of a single instance (e.g., an acquisition that just produced a single image).**

The message is triggered by the Sender determining that it has new availability
1615 **information for a logical set of instances.**

The Sender will be monitoring newly stored instances. The determination that it has a logical set may be MPPS-driven or non-MPPS-driven. MPPS-driven triggers do not apply to Senders that do not receive MPPS messages.

4.49.4.1.1.1 MPPS-driven Triggers

1620 ~~During image acquisition, an MPPS-capable Acquisition Modality creates a set of instances and stores them to an Image Manager/Image Archive. Alternatively, as a part of importing Evidence Objects, an MPPS capable Importer imports instances and stores them to an Image Manager/Image Archive.~~

The Image Manager/Image Archive, after having received the last instance of the instance set
1625 referenced in the MPPS Completed/Discontinued message or after a configurable timeout, shall send an Instance Availability Notification referencing the received instances to the DSS/Order Filler that has also received the related MPPS.

> Note: This includes Import MPPS Completed / Discontinued messages from an Importer (see Section 4.59 and 4.60)
> referencing imported instances, and MPPS Completed / Discontinued messages from an Acquisition Modality
1630 > (See Section 4.6 and 4.7) referencing created instances with the exception of the "incorrect worklist entry
> selected" case.

A Sender ~~It~~ may also decide to send the Instance Availability Notification to other **Receivers** ~~instance managing actors in the workflow~~ to inform them that all instances referenced in the related MPPS are available.

1635 One Instance Availability Notification shall be sent for each MPPS that contains references to instances. MPPS without references to instances shall not trigger the sending of an Instance

---

Availability Notification. ~~This applies to all the MPPS cases described in transaction [RAD-6] (Section 4.6 Simple Case, Unscheduled Case, Group Case, Append Case (Normal and Group Case, Abandoned Case) and in transaction [RAD-7] (Section 4.7 MPPS DISCONTINUED, except the case of incorrect worklist entry selected (Section 4.7.4.1.3.1). It also applies to the Import PPS cases described in Section 4.59.4.1.2. (Unscheduled Import and Unscheduled Import Cases) and Section 4.60.4.1.2.2 (Import PPS Discontinued).~~

Note: Due to various factors, a DSS/Order Filler may receive notifications of instance availability (IAN) and notifications of procedure completion (MPPS) in either order for a given study and possibly with significant time in between.

4.49.4.1.1.2 Non-MPPS-driven Triggers

When MPPS is not available, the Sender shall determine by other methods when a logical set has been received. Suggested methods include:

- **A Sender that manages quality control (QC) review of newly received instances might use completion of the QC step to trigger notification for the QC'ed instances.**

- **A Sender that receives HL7 Order Update messages conveying completion of study acquisition might use that to trigger notification for all instances in the study related to that order.**

- **A Sender that receives DICOM Storage Commit requests might use that to trigger notification for all instances referenced in the SC request.**

- **A Sender that has started receiving new instances for a study might wait until a configurable timeout period, e.g., 1 minute, passes without any new instances and trigger a notification for the received instances. This can be used as a fallback mechanism to ensure a notification is sent for every study, even in the absence of the above signals.**

When additional instances for a study are received after the Sender has sent an Instance Availability Notification for that study, the Sender shall send an additional Instance Availability Notification with references to the newly received instances.

4.49.4.1.2 Message Semantics

~~The end of the image acquisition is indicated to the Department System Scheduler/Order Filler and Image Manager/ Image Archive by an MPPS Completed / Discontinued message from the Acquisition Modality referencing the DICOM instances that were created and are to be stored in the Image Manager/Image Archive. The end of the DICOM object import is indicated to the Department System Scheduler/Order Filler and Image Manager/ Image Archive by an Import MPPS Completed / Discontinued message from the Importer referencing the DICOM instances that were created and are to be stored in the Image Manager/Image Archive.~~

1675 ~~Note that the MPPS and Instance Availability Notification inform about different events. Thus, depending on the total volume of the images stored and characteristics of the local system environment, the MPPS Completed / Discontinued may arrive considerably earlier at the DSS/OF than the Instance Availability Notification. The dependency of the IAN transaction on the MPPS Completed / Discontinued transaction may result in delayed notification to the DSS/OF available instances, if the MPPS is not sent from the Acquisition~~
1680 ~~Modality or Importer to the Image Manager/Image Archive in a timely fashion. This delay may be adjustable if there is a configurable timeout on the Image Manager / Image Archive regarding when to send the Instance Availability Notification.~~

~~The Image Manager/Image Archive shall act as an Instance Notification SOP Class SCU and create an Instance Availability Notification SOP Class. It shall populate the Reference~~
1685 ~~SOP Instance UID in the Referenced Performed Procedure Step Sequence. It shall include references to all received instances that are referenced in the corresponding MPPS. The Instance Availability (0008,0056) attribute of each instance shall be set to one of ONLINE, NEARLINE or OFFLINE if they are available for retrieve, or set to UNAVAILABLE if they are not available for retrieve (e.g., if the Image Manager deletes the referenced~~
1690 ~~instances upon receiving a MPPS Discontinued message). The other attributes of the SOP Class are used as specified in DICOM.~~

~~The Image Manager/Image Archive shall be able to send the Instance Availability Notification to multiple actors. The Image Manager/Image Archive shall send the Instance Availability Notification to the DSS/Order Filler and may be configured to also send it to~~
1695 ~~other actors described in this transaction.~~

~~The DSS/Order Filler, Post-Processing Manager or the Report Manager shall understand that the receipt of this notification message implies that a complete set of instances is available at the Image Manager/Image Archive that is identified by the Retrieve AE Title attribute.~~

1700 **The message is an N-CREATE request of the DICOM Instance Availability Notification Service Class. The Sender is the SCU, and the Receiver is the SCP.**

For an MPPS-driven Trigger, the Sender:

- **shall populate the Referenced Performed Procedure Step Sequence (0008,1111) with the SOP Instance UID of the corresponding MPPS**

1705 - **shall include references to all received instances that are referenced in the corresponding MPPS**

   Note: If an instance was deleted, e.g., upon receiving an MPPS Discontinued message, Instance Availability (0008,0056) would be set to UNAVAILABLE. See DICOM PS3.3 C.4.23 for further details.

For a non-MPPS-driven Trigger, the Sender:

1710 - **shall populate the Referenced Performed Procedure Step Sequence (0008,1111) with the Referenced SOP Instance UID from the Referenced Performed Procedure Step Sequence in the received instances, if present, or leave the sequence empty if not**

A notification communicates availability of the referenced instances but does not imply the list comprises a complete study or a complete series, and is not intended to communicate the state of any associated procedures.

Due to transient error conditions (e.g., corrupted storage media, Query/Retrieve SCP not running) that may occur ~~within the Image Manager/Image Archive~~, an actor may not be able to retrieve instances for which it has received availability notifications. ~~If an a~~**A**ctor~~s is uncertain about the availability status of instances referenced by the Instance Availability Notification, it~~ can use the Image Availability Query [RAD-11] transaction to confirm **availability.** ~~the status as a supplementary method~~. ~~Additionally, the Image Manager/Image Archive is assumed to be able to handle exceptions in instance storage or provision internally, based on local policy.~~

4.49.4.1.3 Expected Actions

~~The Department System Scheduler/Order Filler, Post-Processing Manager and Report Manager shall act as an Instance Notification SOP Class SCP. As a result of receiving the notification, the Department System Scheduler/Order Filler (or other actors)~~

The Receiver shall take appropriate action knowing that the referenced instances are available for ~~further~~ use ~~in the workflow~~. Examples of such actions can be:

- The Department System Scheduler/Order Filler updates the procedure status internally, indicating that images for the procedure have been stored.

- The Post-Processing Manager adds items to a corresponding worklist.

- The Report Manager adds items to a **list of current images to be reported in a** corresponding worklist.

- The Report Manager adds items to a list of relevant priors for use within Reporting.

- **The Task Requestor adds items to a processing worklist if appropriate. See RAD TF-1: 50.2.1 "Instance Availability Option" for more details.**

> *Modify Create UPS Workitem [RAD-80], originally published in IHE Radiology Technical Framework Supplement- Post Acquisition Workflow (PAWF) and updated in the IHE Radiology Technical Framework - Radiology Remote Reading (RRR-WF)*

4.80 Create UPS Workitem [RAD-80]

4.80.1 Scope

This transaction is used to create a new workitem.

The contents of the workitem describe both the task to be performed and associated information such as references to the input data, the order and accession number with which the task is associated, etc.

1750

This transaction allows a Requestor ~~(such as a RIS or Departmental Workflow Manager)~~ to instruct a Manager to add a new workitem to a worklist. When a Manager adds a new workitem to its worklist based on internal business logic, it would comply with the semantics of this transaction although it would not actually send itself a message.

1755

In **profiles where** an unscheduled or append case **is specified**, this transaction allows a Workitem Performer (adopting the role of a Requestor) to instruct a Manager to create a new workitem for unscheduled or appended work being performed by the Workitem Performer. This is directly analogous (and similar in structure) to the MPPS N-CREATE used for unscheduled acquisition work.

4.80.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

1760

Role:	Requestor:
	Submits the relevant details and requests the creation of a new workitem.
Actor(s):	The following actors may play the role of Requestor:
	Task Requestor: when requesting workitems Workitem Creator: when requesting workitems Workitem Performer: when performing unscheduled workitems
Role:	Manager:
	Creates and manages a Unified Procedure Step instance for the requested workitem.
Actor(s):	The following actors may play the role of Manager:
	Workitem Manager
	Task Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.80.3 Referenced Standards

1765

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes
- DICOM PS3.3: Unified Procedure Step Information Object

- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)
- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.80.4 Messages

1770

Requestor   Manager

Request UPS Creation
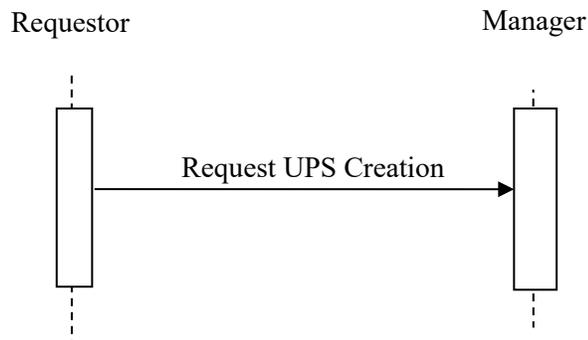
Figure 4.80.4-1: Interaction Diagram

4.80.4.1 Request UPS Creation Message

The Requestor sends a request to the Manager to create a new UPS instance representing the new
1775   workitem. The request contains the details for the requested workitem.

The Manager shall support handling such messages from more than one Requestor. The
Requestor may choose to support making requests to more than one Manager.

4.80.4.1.1 Trigger Events

A user or an automated function on the Requestor determines that a new workitem is required.

1780   The Requestor shall not request creation of a workitem unless the full list of input instances is
known, and those instances are available for retrieval.

4.80.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE
Message Semantics. Profiles using this transaction will specify which semantics actors are
1785   required to support.

DICOM RESTful Message Semantics

The message is a Create ~~UPS Action~~ **Workitem Transaction** of the DICOM UPS-RS Worklist
Service. The Requestor is the User Agent, and the Manager is the Origin Server.

DICOM DIMSE Message Semantics

1790   The message is an N-CREATE Request of the DICOM UPS Push SOP Class. The Requestor is the SCU, and the Manager is the SCP.

The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section ~~6.9~~ **11.4**.

4.80.4.1.2.1 UPS Attribute Requirements

1795

In addition to the UPS N-CREATE requirements described in DICOM PS3.4, **<u>the following requirements apply to</u>** the Requestor ~~shall comply with the following requirements~~.

The Input Readiness State (0040,4041) shall have a value of READY, indicating that the list of instances in the Input Information Sequence (0040,4021) is complete, and the instances are all

1800   available for retrieval.

The Scheduled Workitem Code Sequence (0040,4018) shall contain a single code that identifies the task to be performed. Requestors shall allow sites to configure the code to be used for the various tasks the Requestor can request.

> Note: DICOM CID 9231 provides a handful of very generic codes.

1805   The Scheduled Processing Parameter Sequence (0074,1210) is intended to support some control by the Requestor over the exact processing performed. Some profiles may define specific parameters and values. Beyond that, the onus is on the Workitem Performer or Task Performer to provide documentation of the parameters and values they support so that Requestors can be configured to populate it appropriately.

1810   The Issuer of Patient ID (0010,0021) attribute shall be populated for each patient ID provided.

Requestors may specify the intended performing person by populating the Human Performer Code Sequence (0040,4026) inside the Scheduled Human Performers Sequence (0040,4034). The Code Value (0008,0100) shall contain the identifier of the designated person (for example their National Provider ID). The Code Meaning (0008,0104) may contain a human-readable

1815   name of the designated person, but is only used for display, not matching.

Requestors may specify the intended performing organization by populating the Human Performer's Organization (0040,4036) inside the Scheduled Human Performers Sequence (0040,4034). To match reliably against this string, the exact values should be coordinated between the organizations using them.

1820   Requestors may specify the intended **<u>Task Performer or</u>** performing organization-by populating the Scheduled Station Name Code Sequence (0040,4025). The Code Value (0008,0100) shall contain the AE-Title of the **<u>Task Performer or</u>** designated system. The Code Meaning (0008,0104) shall contain either the AE-Title of the **<u>Task Performer,</u>** designated system or a human-readable name for the designated system.

1825

> Note: The Coding Scheme Designator (0008,0102) will likely have a value of "L" or a value beginning with "99". See DICOM PS3.3 Section 8.2.

See **RAD TF-2x:** Appendix W ~~(currently in the PAWF Trial Implementation Supplement)~~ for details on the correspondence between attribute values in unscheduled UPS instances and associated DICOM objects.

1830 **4.80.4.1.2.2 Examples for the Use of Attributes**

Requestors may provide a flat list of processing parameters in the Scheduled Processing Parameters Sequence (0074,1210); however, coordination of the parameters and their value coding is outside the scope of this transaction. Creators of workitems should look to the documentation provided by the Workitem Performer for such details.

1835 **4.80.4.1.2.3 Work Items for Remote Radiology Reporting Tasks**

The contents of this section are required for Requestors claiming the Remote Radiology Reporting Workflow Profile.

The Requestor shall support including a content item in the Scheduled Processing Parameter Sequence (0074,1210) with a Value Type (0040,A040) of CODE, a Concept Name Code

1840 Sequence (0040,A043) of (RRR000, 99IHE, "Report Requested") and the value of Concept Code Sequence (0040,A168) shall be drawn from Table 40.4.1.2-3. This is used by the Requestor to indicate whether the Task Performer is requested to return a preliminary report, a final report or both.

4.80.4.1.2.4 Work Items for AI Workflow for Imaging Tasks

1845 **The contents of this section are required for Requestors claiming the AI Workflow for Imaging Profile.**

The Requestor shall populate the following UPS attributes:

- **Scheduled Workitem Code Sequence (0040,4018)**

    See RAD TF-1: 50.4.1.2 for guidance on code values.

1850 - **Scheduled Procedure Step Priority (0074,1200)**

- **Input Information Sequence (0040,4021)**

See RAD TF-1: 50.4.1.3 for guidance on data types and transfer methods.

For additional guidance on optional attributes, see section RAD TF-1: 50.4.1.1.

4.80.4.1.3 Expected Actions

1855 The Manager shall attempt to create the requested UPS instance as described in DICOM PS3.4 Annex CC and return appropriate success or failure codes to the Requestor.

> Note: This includes the DICOM requirement to send out notifications of the UPS creation based on subscription settings.

4.80.5 Security Considerations

Local policy should consider what users and systems have permission to create a workitem and configure appropriately.

4.80.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

Modify Query UPS Workitems [RAD-81]

4.81 Query UPS Workitems [RAD-81]

4.81.1 Scope

This transaction is used to find workitems of interest.

The contents of workitems describe both the task to be performed and related information such as references to the input data, the order and accession number with which the task is associated.

Typically, the workitems have been scheduled by the Manager and the querying system intends to then select, claim and perform one or more of the workitems. Workitems on the worklist might include imaging tasks such as computer-aided diagnosis/detection, clinical image analysis/measurement, the generation of 3D views, or a request to read and report on an imaging study.

The querying system might also be a Watcher trying to select workitems of interest to which it will then subscribe for notifications.

This transaction focuses on attributes relevant to filtering/selection. Matching key values are used to perform filtering on the Manager; Return key values can be used to perform additional filtering and sorting on the Requestor. Once a workitem of interest is selected, access to all the workitem details can be obtained using the Get UPS Workitem [RAD-83] transaction.

4.81.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Requestor:
	Query the Manager for Procedure Steps.

Actor(s):	The following actors may play the role of Requestor: Workitem Performer Task Performer Watcher
Role:	Manager: Manage Unified Procedure Steps for workitems; accept query requests for Worklist items, return an appropriately filtered list of workitems.
Actor(s):	The following actors may play the role of Manager: Workitem Manager Task Manager

1885

Transaction text specifies behavior for each role. The behavior of specific actors is only specified when it goes beyond that of the general role.

4.81.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes

1890
- DICOM PS3.3: Unified Procedure Step Information Object

- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.81.4 Messages
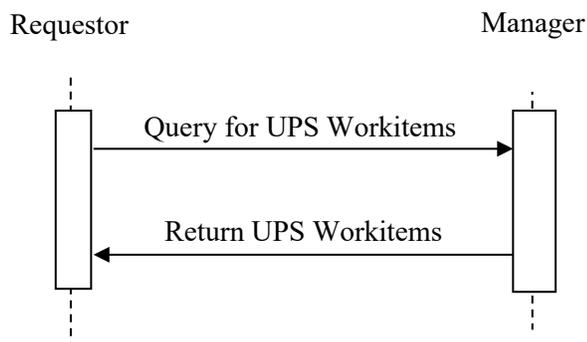
1895

Figure 4.81.4-1: Interaction Diagram

4.81.4.1 Query for UPS Workitems Message

The Requestor queries the Manager for UPS instances representing workitems.

The Manager shall support handling such messages from more than one Requestor. The Requestor may choose to support querying more than one Manager.

4.81.4.1.1 Trigger Events

A user or an automated function on the Requestor wishes to identify workitems of interest and retrieve associated details of the workitems.

4.81.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section 11.9.

DICOM RESTful Message Semantics

The message is a Search~~ForUPS Action~~ **Transaction** of the DICOM UPS-RS Worklist Service. The Requestor is the User~~-~~ Agent, and the Manager is the Origin~~-~~ Server.

DICOM DIMSE Message Semantics

The message is a C-FIND Request of the DICOM UPS Pull SOP Class. The Requestor is the SCU, and the Manager is the SCP.

~~The rest of the message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in~~ **DICOM PS3.18 Section 6.9** ~~.~~

4.81.4.1.2.1 Matching Keys and Return Keys

The profile in which this transaction is used will specify which of the following query types the Requestor must support.

For any of the following query types that the Requestor supports, it shall be capable of performing the query as described below.

> Note: It is likely that various combinations of these queries will be useful to the user or the application. Implementers are advised to consider such combinations.

1) Patient-oriented Query: Query for workitems associated with a specific patient.

The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-1 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

Table 4.81.4.1.2.1-1: UPS Keys for Patient-oriented Workitem Queries

Matching Key Attributes	Tag
Patient's Name	(0010,0010)
Patient ID	(0010,0020)
Issuer of Patient ID	(0010,0021)
Procedure Step State	(0074,1000)

Note: In general, UPS instances are permitted to be created with the Issuer of Patient ID value left blank; however, specific profiles that use this transaction may require that a value be provided. A blank value can be presumed to match the local institution.

The Manager shall identify Workitems with a matching Patient ID and Issuer either inside the Other Patient IDs Sequence (0010,1002) or outside that sequence (i.e., in the "primary" ID) when a query is made using both Patient ID (0010,0020) and Issuer of Patient ID (0010,0021).

2) **Procedure-oriented Query:** Query for workitems associated with a specific procedure instance.

The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-2 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

Sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them.

Table 4.81.4.1.2.1-2: UPS Keys for Procedure-oriented Workitem Queries

Matching Key Attributes	Tag
Referenced Request Sequence	*(0040,A370)*
>Accession Number	(0008,0050)
>Issuer of Accession Number Sequence	*(0008,0051)*
>>Local Namespace Entity ID	(0040,0031)
>>Universal Entity ID	(0040,0032)
>>Universal Entity ID Type	(0040,0033)
>Requested Procedure ID	(0040,1001)
Scheduled Workitem Code Sequence	*(0040,4018)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Procedure Step State	(0074,1000)

3) **Station-oriented Query:** Query for workitems associated with a particular workstation.

The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-3 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

Sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them.

The Code Value of the Scheduled Station Name Code Sequence, if valued, shall be set to the AE Title of the Requestor's UPS SCU.

1955

Table 4.81.4.1.2.1-3: UPS Keys for Station-oriented Workitem Queries

Matching Key Attributes	Tag
Scheduled Station Name Code Sequence	*(0040,4025)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Procedure Step Start DateTime	(0040,4005)
Procedure Step State	(0074,1000)

4) Class-oriented Query: Query for workitems associated with a class of workstations.

The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-4 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

1960 Sequence attributes denoted in the italics are not matching keys on their own but have to be included in a query to convey the value of the attributes contained within them.

Table 4.81.4.1.2.1-4: UPS Keys for Class-oriented Workitem Queries

Matching Key Attributes	Tag
Scheduled Station Class Code Sequence	*(0040,4026)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Scheduled Procedure Step Start DateTime	(0040,4005)
Procedure Step State	(0074,1000)

5) **Task-oriented Query:** Query for workitems to perform a specific type of task.

1965 The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-5 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

Table 4.81.4.1.2.1-5: UPS Keys for Task-oriented Workitem Queries

Matching Key Attributes	Tag
Scheduled Workitem Code Sequence	*(0040,40~~18~~26)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Requested Procedure Code Sequence	*(0032,1064)*

Matching Key Attributes	Tag
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Procedure Step State	(0074,1000)

6) **Staff-oriented Query:** Query for workitems associated with a specific person or organization.

The Requestor shall support all of the matching key attributes listed in Table 4.81.4.1.2.1-6 in a query. Support for the keys individually or in combinations is at the discretion of the Requestor.

Table 4.81.4.1.2.1-6: UPS Keys for Staff-oriented Workitem Queries

Matching Key Attributes	Tag
Human Performer Code Sequence	*(0040,400926)*
>Code Value	(0008,0100)
>Coding Scheme Designator	(0008,0102)
Human Performer's Organization	(0040,4036)

Additional Filtering

Although not mandated, implementers of Requestors are advised to review the full list of available Matching and Return Keys listed in DICOM PS3.4 Table CC.2.5-3 for attributes that would helpful in identifying workitems of interest.

Some possibilities include: Expected Completion DateTime (0040,4011), Expiration DateTime, Scheduled Procedure Step Priority (0074,1200), Procedure Step Label (0074,1204), Worklist Label (0074,1202), Scheduled Station Geographic Location Code Sequence (0040,4027), Scheduled Human Performers Sequence (0040,4034), Patients Birth Date (0010,0030), Patients Sex (0010,0040), Admission ID (0038,0010), Issuer of Admission ID Sequence (0038,0014), Requesting Service (0032,1033), Replaced Procedure Step Sequence (0074,1224), Scheduled Processing Parameters Sequence (0074,1210), Reason for the Requested Procedure (0040,1002), Reason for Requested Procedure Code Sequence (0040,100A).

Worklist Label (0074,1202) may be of particular interest to deployments interested in setting up sub-worklists for various purposes. Each label value effectively defines a sub-worklist. It is, of course, necessary to communicate to the Requestors the labels being used and the purpose of each so Requestors can include them appropriately in queries.

4.81.4.1.2.2 Examples for the Use of Matching Key Attributes

- Scheduled Procedure Step Start DateTime supports a query for tasks scheduled to be performed today.

- Scheduled Workitem Code Sequence supports a query for specific types of computer-aided detection (CAD) tasks.

- Scheduled Station Name Code Sequence supports a query for tasks scheduled for this workstation.

- Human Performer's Organization (inside the Scheduled Human Performers Sequence) supports a query for tasks scheduled for a specific organization, such as a radiology reading group.

- Human Performer Code Sequence (inside the Scheduled Human Performers Sequence) supports a query for tasks scheduled for a specific person.

- Scheduled Procedure Step Start DateTime, Scheduled Workitem Code and Scheduled Station Class Code could be combined to support a query for surface rendering tasks scheduled for today on 3D reconstruction workstations.

- Requesting Service and Expiration DateTime could be combined to support a query for tasks from orthopedics that will expire in the next 8 hours.

Note: Requestors are recommended to append a wildcard "*" at the end of each component of the structured Patient Name to facilitate matching with both structured and unstructured Patient Names.

4.81.4.1.3 Expected Actions

The Manager shall execute the query and send the matching UPS Workitems to the Requestor that originated the query as described in DICOM PS3.4.

4.81.4.2 Return UPS Workitems Message

The Manager returns workitems matching the query.

4.81.4.2.1 Trigger Events

The Manager receives a query for workitems.

4.81.4.2.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a Search ~~ForUPS Message Action~~ **Response Transaction** of the DICOM UPS-RS Worklist Service. The Requestor is the User-Agent, and the Manager is the Origin-Server.

DICOM DIMSE Message Semantics

The message is a set of C-FIND Responses from the DICOM UPS Pull SOP Class. The Requestor is the SCU, and the Manager is the SCP.

The details available in the Responses are intended to facilitate filtering and selection of a workitem for some purpose. The workitem itself contains many additional details that might affect actual performance of the workitem or that might be useful to an observing application. Such details can be obtained using the Get UPS Contents transaction.

4.81.4.2.3 Expected Actions

The Requestor typically provides the worklist to the user to select and start work based on the task details in the selected workitem, or does the selection and processing automatically. The Requestor is permitted to do additional "client-side" filtering prior to presenting the list to the user. Such filtering might be based on the values of Return Keys, access controls or other logic

4.81.5 Security Considerations

4.81.5.1 Security Audit Considerations

Managers that support the ATNA Profile shall audit this transaction.

This transaction corresponds to a Query Information ATNA Trigger Event.

Modify Claim UPS Workitem [RAD-82]

4.82 Claim UPS Workitem [RAD-82]

4.82.1 Scope

This transaction is used to take "ownership" of a selected workitem by telling the managing system to change the state to INPROGRESS. This permits other worklist users to detect that this workitem has been claimed and locks out others from claiming or modifying the workitem.

The workitem is still held by the Manager, but only the "owner" of the workitem is permitted to submit updates to the workitem. In some scenarios a single system might be both the Manager and the Performer of the workitem.

4.82.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Performer:
	Takes ownership of a workitem for the purpose of updating it.

Actor(s):	The following actors may play the role of Performer: Workitem Performer Task Performer
Role:	Manager: Confirms/grants ownership of a workitem to the Performer.
Actor(s):	The following actors may play the role of Manager: Workitem Manager Task Manager

2055 Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.82.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes

- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

2060 - DICOM PS3.18: DICOM UPS-RS Worklist Service

4.82.4 Messages
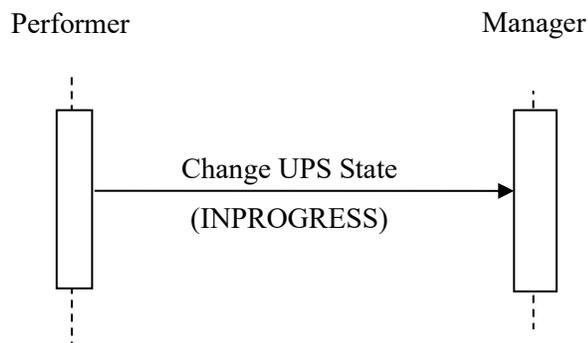
Figure 4.82.4-1: Interaction Diagram

4.82.4.1 Change UPS State Message

2065 The Performer asks the Manager of a UPS instance to change the workitem state to INPROGRESS.

The Manager shall support handling such messages from more than one Performer (although for an individual workitem this message will typically only be received from one Performer). The Performer may choose to support interacting with workitems on multiple Managers.

4.82.4.1.1 Trigger Events

A user or an automated function on the Performer wishes to take control of the workitem to begin work or otherwise modify it.

The Performer shall not claim a workitem if the contents of the assignment related attributes indicate that the workitem was not intended for the Performer. This includes:

- Scheduled Station Name Code Sequence (0040,4025)

- Human Performer's Organization (0040,4036)

- Human Performer Code Sequence (0040,4026)

See Section 4.80.4.1.2.1 for details on populating the Scheduled Station Name Code Sequence.

The Performer shall not claim a workitem for which Input Readiness State has a value of INCOMPLETE. Doing so would prevent the remaining references from being added to the Input Information Sequence.

> Note: If it is useful for the Performer to start working on a workitem with an incomplete list in the Input Information Sequence, it may still use the Get UPS Workitem transaction ([RAD-83]) without claiming the workitem.

The Performer may claim a workitem for which Input Readiness State has a value of UNAVAILABLE; however, the Performer then has the responsibility for determining when the instances in the Input Information Sequence are available.

Once claimed, the Locking UID feature of UPS means that only the Performer that claimed it and the Manager have the key necessary to update the contents or modify the state of the UPS workitem, although other systems can still view the state and the contents.

4.82.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a Change ~~UPS~~ **Workitem** State **Transaction** ~~Action~~ of the DICOM UPS-RS Worklist Service. The Performer is the User Agent, and the Manager is the Origin Server.

DICOM DIMSE Message Semantics

The message is a Change UPS State N-ACTION request of the DICOM UPS Pull SOP Class. The Performer is the SCU, and the Manager is the SCP.

2100 The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section ~~6.9~~ **11.7**.

The Performer shall generate a Locking UID and request that the UPS State be changed to INPROGRESS as described in DICOM PS3.4 Annex CC. The Locking UID is conveyed in the
2105 Transaction UID (0008,1195) attribute.

The Performer shall retain the Locking UID for use in future transactions on this Workitem. Future modification requests for this Workitem will be denied by the Manager (see DICOM PS3.4) if the correct Locking UID is not provided.

By claiming the workitem, the Performer shall take responsibility for the performance of the task
2110 defined by the code contained in the Scheduled Workitem Code Sequence (0040,4018) of the workitem. The Performer shall be configurable to allow sites to map codes to the various tasks the Performer can perform. Performer may perform the task directly or may coordinate performance of the task by another system (e.g., by "sub-contracting" all or part of it or by using a hosted application).

2115 ### 4.82.4.1.3 Expected Actions

The Manager shall handle the N-ACTION state change request as described in DICOM PS3.4 Annex CC and return appropriate success or failure codes to the Performer. This includes the DICOM requirement to send out notifications of the UPS creation based on subscription settings if the Manager support the Send UPS Notification [RAD-87] transaction.

2120 ### 4.82.5 Security Considerations

Local policy should consider what users and systems have permission to claim a workitem and configure appropriately.

4.82.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

2125

> *Modify Get UPS Workitem Contents [RAD-83]*

4.83 Get UPS Workitem Contents [RAD-83]

4.83.1 Scope

This transaction is used to retrieve the contents (i.e., values of a requested list of attributes) from
2130 a workitem.

4.83.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Requestor: Requests details for a workitem.
Actor(s):	The following actors may play the role of Requestor: Task Performer Workitem Performer Watcher
Role:	Manager: Provides the requested details for the requested UPS instance that it manages.
Actor(s):	The following actors may play the role of Manager: Task Manager Workitem Manager

2135

Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.83.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes

2140
- DICOM PS3.3: Unified Procedure Step Information Object

- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.83.4 Messages

Requestor   Manager

Request UPS Contents

Return UPS Contents
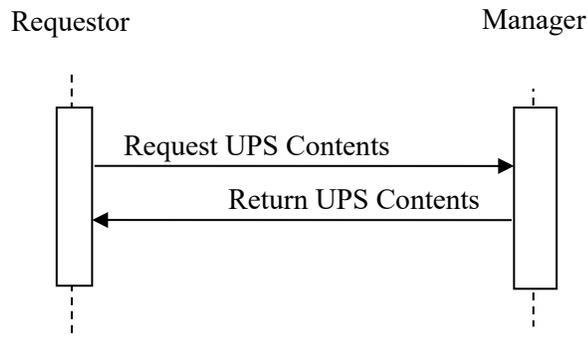
2145   **Figure 4.83.4-1: Interaction Diagram**

4.83.4.1 Request UPS Contents Message

The Requestor sends a request for the Manager of a UPS instance to provide the values for a specific set of attributes for a specific UPS instance.

The Manager shall support handling such messages from more than one Requestor. The
2150 Requestor may choose to support making requests to more than one Manager.

4.83.4.1.1 Trigger Events

A user or an automated function on the Requestor wishes to obtain attribute values for a workitem.

Two typical usages are for:

2155 • a Workitem Performer to get the full contents of a workitem prior to starting to perform it

• a Watcher to get specific details of interest upon notification that the contents of a workitem have changed.

4.83.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE
2160 Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a Retrieve **Workitem Transaction ~~UPS Action~~** of the DICOM UPS-RS Worklist Service. The Requestor is the User Agent, and the Manager is the Origin Server.

2165 **DICOM DIMSE Message Semantics**

The message is an N-GET Request of the DICOM UPS Pull SOP Class (or the DICOM UPS Watch SOP Class). The Requestor is the SCU, and the Manager is the SCP.

Note: The N-GET Request in the two SOP Classes is equivalent. Pay particular attention to the discussion of SOP Class UIDs, Association Negotiation and DIMSE Implications for UPS in DICOM PS3.4.

2170 The ~~rest of the~~ message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section ~~6.9~~ **11.5**.

4.83.4.1.2.1 UPS Attribute Requirements

2175 See ~~RAD TF-3:~~ **RAD TF-2x:** Appendix V ~~(currently in the PAWF Trial Implementation Supplement)~~ for details on the required correspondence between attribute values in UPS instances and associated DICOM objects.

4.83.4.1.3 Expected Actions

The Manager shall handle the request and respond with a Return UPS Contents message.

2180 4.83.4.2 Return UPS Contents Message

The Manager returns the requested values from the specified UPS instance to the Requestor.

4.83.4.2.1 Trigger Events

The Manager receives a Request UPS Contents Message.

4.83.4.2.2 Message Semantics

2185 This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a RetrieveUPS Action Response Message of the DICOM UPS-RS Worklist
2190 Service. The Requestor is the User-Agent, and the Manager is the Origin-Server.

DICOM DIMSE Message Semantics

The message is an N-GET Response Primitive of the DICOM UPS Pull SOP Class (which is equivalent to the N-GET Response Primitive of the DICOM UPS Watch SOP Class). The Requestor is the SCU, and the Manager is the SCP.

2195 The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section 6.9.

4.83.4.2.3 Expected Actions

The Manager shall provide the requested attributes and return appropriate success or failure
2200 codes to the Requestor.

4.83.5 Security Considerations

Local policy should consider what users and systems have permission to retrieve workitem contents and configure appropriately.

4.83.5.1 Security Audit Considerations

2205   This transaction is not associated with an ATNA Trigger Event.

Modify Update UPS Workitem [RAD-84]

4.84 Update UPS Workitem [RAD-84]

4.84.1 Scope

2210   This transaction is used by a Performer to request that the Manager modify the contents of a workitem it manages.

This is generally done to update details describing progress, or to finalize the attribute values prior to completing the workitem.

In the case where a system is also managing a UPS instance that it is performing, it will update
2215   the instance directly rather than use this transaction.

4.84.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Performer:
	Provides updated attribute values for a workitem it is performing.
Actor(s):	The following actors may play the role of Performer: Task Performer Workitem Performer
Role:	Manager: Modifies the attribute values as instructed for a workitem it is managing.
Actor(s):	The following actors may play the role of Manager: Task Manager Workitem Manager

2220

Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.84.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes

2225
- DICOM PS3.3: Unified Procedure Step Information Object

- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.84.4 Messages
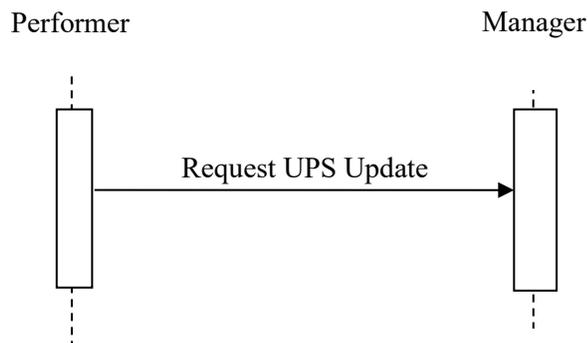
Performer   Manager

2230
Figure 4.84.4-1: Interaction Diagram

4.84.4.1 Request UPS Update Message

The Performer sends a request for the Manager of a UPS instance to update the attribute values.

The Manager shall support handling such messages from more than one Performer. The Performer may choose to support making requests to more than one Manager.

2235 **4.84.4.1.1 Trigger Events**

A user or an automated function on the Performer has updated attribute values for a workitem.

For Post Acquisition Workflow (PAWF) and Radiology Remote Reading (RRR-WF), **u**Upon starting actual work on a workitem, the Performer shall submit a Request UPS Update Message to update the Performed Procedure Step Start DateTime (0040,0244) and the contents 2240 of the Performed Station Name Code Sequence (0040,4028).

In general, the frequency and "timeliness" of other updates is at the discretion of the Performer, unless otherwise specified in the profile. Implementations might find it useful to provide a user configurable parameter for the frequency of updates (e.g., if set to 5 minutes, the information in

2245 the UPS instance is no more than 5 minutes old). This could serve as a useful "heartbeat" mechanism to determine that the Performer is still running.

4.84.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

2250 **DICOM RESTful Message Semantics**

The message is an ~~UpdateUPS Action~~ **Update Workitem Transaction** of the DICOM UPS RS Worklist Service. The Performer is the User Agent, and the Manager is the Origin Server.

DICOM DIMSE Message Semantics

The message is an N-SET Request of the DICOM UPS Pull SOP Class. The Performer is the
2255 SCU, and the Manager is the SCP.

The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section ~~6.9~~**11.6**.

As described in DICOM PS3.4, the Performer needs to have the Locking UID for the UPS
2260 instance; otherwise the Manager will reject the N-SET Request. The Locking UID is conveyed in the Transaction UID (0008,1195) attribute. Generally, the Performer will have generated the Locking UID when it claimed the workitem using [RAD-82]; however, it is possible it might have the Locking UID due to being grouped with another actor, or may have been provided the Locking UID some other way.

2265 ### 4.84.4.1.2.1 UPS Attribute Requirements

In addition to the UPS N-SET requirements described in DICOM PS3.4, the SCU shall comply with the requirements defined here.

The Actual Human Performers Sequence (0040,4035) shall be populated if a human has performed the workitem.

2270 The Performed Station Name Code Sequence (0040,4028) shall be encoded as follows:

The Code Value (0008,0100) shall contain the AE-Title of the **Performer** ~~designated system~~. The Code Meaning (0008,0104) shall contain either the AE-Title of the **Performer** ~~designated system~~ or a human-readable name for the designated system. If the system has multiple AE-Titles, the value should reflect the AE-Title on which Send UPS Notification transactions could
2275 be received (e.g., notifying that a cancelation request has been submitted).

> Note: The Coding Scheme Designator (0008,0102) will likely have a value of "L" or a value beginning with "99". See DICOM PS3.3 Section 8.2.

See **RAD TF-2x:** Appendix V for details on the required correspondence between attribute values in UPS instances and associated DICOM objects.

4.84.4.1.2.2 Examples for the Use of Attributes

Guidance on the use of the Unified Procedure Step Progress Information Module may be found in DICOM PS3.3 C.30.1.

Informative material may be found in DICOM PS3.17 GGG.3.1 on updating workitem contents to reflect partial completion or performance of something that differs from what was requested.

4.84.4.1.3 Expected Actions

The Manager shall attempt to update the UPS instance as requested (and as described in DICOM PS3.4) and return appropriate success or failure codes to the Performer.

4.84.5 Security Considerations

4.84.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

Modify Complete UPS Workitem [RAD-85]

4.85 Complete UPS Workitem [RAD-85]

4.85.1 Scope

This transaction is used by a Performer to tell the Manager that the contents of the selected workitem (e.g., references to result objects, etc.) have been finalized and the state should be changed to a Final State of either COMPLETED or CANCELED. Once in a Final State, further updates to the workitem are not permitted.

Subscribed actors will be notified of the state change and may choose to retrieve further details from the Manager.

4.85.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Performer:
	Finalizes and gives up ownership of a workitem.
Actor(s):	The following actors may play the role of Performer:
	Task Performer Workitem Performer

Role:	Manager:
	Confirms/finalizes the workitem.
Actor(s):	The following actors may play the role of Manager:
	Task Manager
	Workitem Manager

2305

Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.85.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes

2310
- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)

- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.85.4 Messages

Performer   Manager

Change UPS State
(COMPLETED or CANCELED)
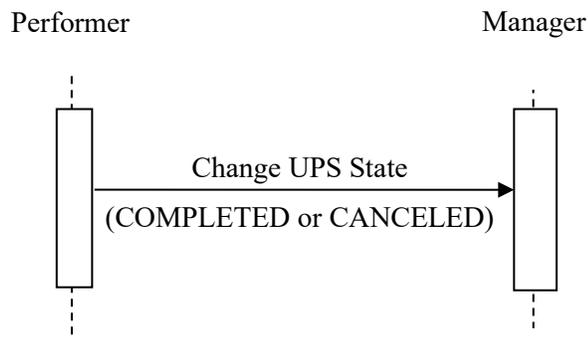
Figure 4.85.4-1: Interaction Diagram

2315 **4.85.4.1 Change UPS State Message**

The Performer informs the Manager of a UPS instance that it has finished working on the workitem, has finished updating the UPS, and that the Manager should change the UPS state to COMPLETED or CANCELED (based on the value provided by the Performer for the Procedure Step State (0074,1000)).

2320 The Manager shall support handling such messages from more than one Performer (although for an individual workitem this message will typically only be received from one Performer). The Performer may choose to support interacting with workitems on multiple Managers.

4.85.4.1.1 Trigger Events

A user or an automated function on the Performer determines that the task represented by the workitem is completed or canceled and the UPS instance has met the final state requirements described in DICOM PS3.4 Table CC.2.5-3.

Since the UPS instance contains references to the generated output objects and where they are available from, and since the contents of a UPS instance cannot be updated after it is completed, it is recommended that the results have been successfully stored before this transaction is triggered.

4.85.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a ~~ChangeUPSState Action~~ **Change Workitem State Transaction** of the DICOM UPS-RS Worklist Service. The Performer is the User Agent, and the Manager is the Origin Server.

DICOM DIMSE Message Semantics

The message is a Change UPS State N-ACTION request of the DICOM UPS Pull SOP Class. The Performer is the SCU, and the Manager is the SCP.

The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section ~~6.9~~**11.7**.

The Performer shall not send the request to change state unless it has already met the Final State requirements, including listing all Instances created, if any, in the Output Information Sequence (0040,4033).

4.85.4.1.3 Expected Actions

The Manager shall handle the state change request as described in DICOM PS3.4 Annex CC and return appropriate success or failure codes to the Performer. This includes the DICOM requirement to send out notifications of the UPS completion based on subscription settings.

If the Manager has internal logic to "override" remaining deletion locks and delete instances that have reached a Final State anyway based on internal logic, it shall be capable of waiting at least 24 hours before such deletions. This capability may be configurable.

4.85.5 Security Considerations

4.85.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

2360 **4.86 Manage UPS Subscription [RAD-86]**

4.86.1 Scope

This transaction is used by an interested actor to subscribe (or unsubscribe) to notifications for one or more UPS workitems.

When an actor becomes subscribed to a workitem, it will be sent [RAD-87] notifications of
2365 events such as changes in the state or contents of the UPS instance that represents the workitem.

In addition to subscribing to specific instances, an actor may subscribe to all instances ("global subscription") managed by another actor. An actor may also place a "deletion lock" on a subscription, which provides time for the subscribing actor to retrieve final details from a UPS instance after it has been moved to the COMPLETED or CANCELED state. See DICOM PS3.4
2370 and PS3.17 for more details.

An actor may also subscribe to all instances that match certain keys ("filtered global subscription"). For example, a Task Performer might subscribe to all instances with the Workitem Code that corresponds to the task it is able to perform. Or a performance auditing Watcher might subscribe to all tasks with a priority of STAT.

2375 ### 4.86.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

Role:	Subscriber:
	Requests to change its subscription status to one or more UPS workitems.
Actor(s):	The following actors may play the role of Subscriber:
	Watcher Task Requestor Task Performer
Role:	Manager:
	Modify subscription record as requested.

Actor(s):	The following actors may play the role of Manager:
	Task Manager Workitem Manager

2380 Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.86.3 Referenced Standards

- DICOM PS3.4: Unified Procedure Step Service and SOP Classes
- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)
2385
- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.86.4 Messages
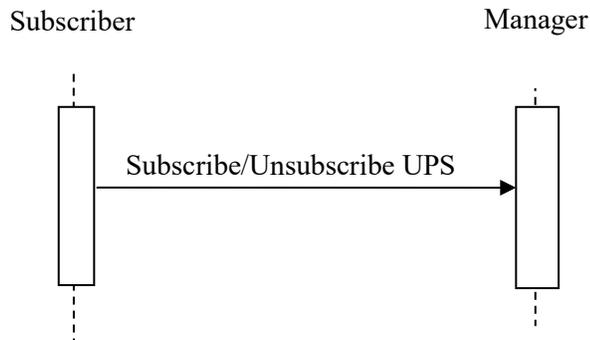
Figure 4.86.4-1: Interaction Diagram

4.86.4.1 Subscribe/Unsubscribe UPS Message

2390 The Subscriber asks the Manager to change the state of the Subscriber's subscription. An active subscription means that the subscriber will receive notification events from the Manager with the associated workitem(s) change state or contents.

The Manager shall support handling such messages from more than one Subscriber. The Subscriber may choose to support interacting with workitems on multiple Managers.

2395 As described in DICOM PS3.4, Subscribers may choose to subscribe (or unsubscribe) from individual workitems or from all workitems managed by the Manager to which the request is sent (see Global Subscriptions in DICOM PS3.4 and PS3.17).

As described in DICOM PS3.4, Subscribers may choose to place a Deletion Lock on workitem(s). Workitems are typically deleted by the Manager when the workitem is

2400 COMPLETED or CANCELED; however, the Manager will attempt to delay deletion of a workitem until Deletion Locks are removed, to allow Subscribers time to retrieve final state details for the workitem.

4.86.4.1.1 Trigger Events

2405 A user or an automated function on the Subscriber determines that it would like to start receiving or stop receiving notifications associated with one or more workitems (UPS Instances).

Also, a user or an automated function on the Subscriber may determine that it would like to place a deletion lock on one or more workitems. For details on deletion locks, refer to DICOM PS3.4.

4.86.4.1.2 Message Semantics

2410 This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is one of three actions of the DICOM UPS-RS Worklist Service. The Subscriber is the User Agent, and the Manager is the Origin Server.

2415 - The ~~CreateSubscription Action~~ **Subscribe Transaction** is used to create a new subscription.

- The Suspend Global Subscription **Transaction** ~~Action~~ is used to stop being **automatically** subscribed to new workitems.

- The ~~DeleteSubscription Action~~ **Unsubscribe Transaction** is used to stop receiving
2420 notifications.

DICOM DIMSE Message Semantics

The message is a Subscribe/Unsubscribe to Receive UPS Event Reports N-ACTION request of the DICOM UPS Watch SOP Class. The Subscriber is the SCU, and the Manager is the SCP.

2425 The message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section 6.9.

The semantics of Deletion Locks and Global Subscriptions are described in DICOM PS3.4 CC.2.3.

2430 The Manager shall support the use of Deletion Locks and Global Subscriptions. Usage of Deletion Locks and Global Subscriptions by the Subscriber will depend on the nature of the application.

For Filtered Global Subscriptions, the Manager shall identify Workitems with a matching Patient ID and Issuer either inside the Other Patient IDs Sequence (0010,1002) or outside that sequence

2435 (i.e., in the "primary" ID) when the filter specifies both Patient ID (0010,0020) and Issuer of Patient ID (0010,0021).

4.86.4.1.3 Expected Actions

The Manager shall respond to the request as described in DICOM PS3.4 and return appropriate success or failure codes to the Subscriber.

4.86.5 Security Considerations

2440 Local policy should consider what users and systems have permission to subscribe to workitem notifications and configure appropriately. More advanced implementations might have logic to identify Subscribers that are requesting unnecessarily broad subscriptions, or whose task targeting is suspicious.

4.86.5.1 Security Audit Considerations

2445 Managers that support the ATNA Profile shall audit this transaction.

This transaction corresponds to a Query Information ATNA Trigger Event.

Modify Send UPS Notification [RAD-87]

4.87 Send UPS Notification [RAD-87]

2450 ### 4.87.1 Scope

This transaction is used to notify systems of the state or contents of a given UPS workitem.

4.87.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors shown here:

2455

Role:	Subscriber:
	Accepts notifications.
Actor(s):	The following actors may play the role of Subscriber:
	Watcher Task Performer Task Requestor Workitem Performer
Role:	Manager:

	Sends notifications about a workitem based on trigger events (such as changes in the state of the workitem).
Actor(s):	The following actors may play the role of Manager: Task Manager Workitem Manager

Transaction text specifies behavior for each role. The behavior of specific actors are only specified when it goes beyond that of the general role.

4.87.3 Referenced Standards

2460
- DICOM PS3.4: Unified Procedure Step Service and SOP Classes
- DICOM PS3.17: Unified Worklist and Procedure Step - UPS (Informative)
- DICOM PS3.18: DICOM UPS-RS Worklist Service

4.87.4 Messages

Subscriber   Manager

Send UPS Notification
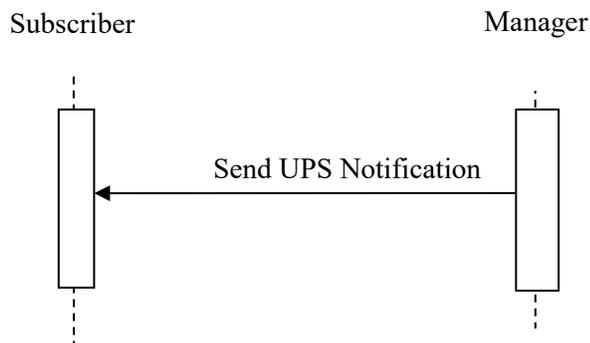
2465   **Figure 4.87.4-1: Interaction Diagram**

4.87.4.1 Send UPS Notification Message

The Manager sends the Subscriber a notification that a given workitem has changed. The notification provides basic state/progress information. For more detail, the Subscriber must retrieve the contents of the UPS instance.

2470 The Manager shall support sending such messages to more than one Subscriber for each workitem instance. The Subscriber shall support receiving such messages from each Manager it is configured to interact with.

As described in DICOM PS3.4, if a Subscriber has a Global Subscription, it shall be prepared to receive notifications for workitems it has not individually subscribed to. The Subscriber may choose to unsubscribe from specific instances as it is notified of their creation.

Similarly, a Subscriber that is also a Task Performer shall be prepared to receive notifications for workitems not individually subscribed to when a new workitem is assigned to the Task Performer, or when there is a cancellation request for a workitem the Task Performer has claimed.

4.87.4.1.1 Trigger Events

Several events may trigger a Send UPS Notification Message

- The state or progress attributes of a workitem is modified by the Manager. See DICOM PS3.4 for a more complete description of the various modifications which require a notification.

- A Subscriber is newly subscribed to a workitem instance (see RAD TF-2: 4.86). The Manager sends an initial notification, which provides the current state of the workitem to the Subscriber. The Subscriber may have subscribed specifically to the workitem instance, it may have a Global Subscription which generated a subscription to the workitem instance, or it may have a Filtered Global Subscription which generated a subscription to the workitem instance because the contents of the workitem either matched the filter initially or the contents were modified resulting in a match to the filter.

- A cancelation request is received for a workitem being performed (see RAD TF-2: 4.88). The Manager notifies subscribers _and the performer of the workitem_ of the cancelation request. This notification of the performer does not depend on the performer having previously subscribed to the workitem.

- A workitem has been assigned to a specific Task Performer (the value of the Scheduled Station Name Code Sequence matches the Task Performer). The Manager notifies the assigned Task Performer. This notification of the Task Performer does not depend on the Task Performer having previously subscribed to the workitem. The notified Task Performer may, but is not mandated to, claim the workitem.

4.87.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE Message Semantics. Profiles using this transaction will specify which semantics actors are required to support.

DICOM RESTful Message Semantics

The message is a **Send Event Report Transaction ~~Action~~** of the DICOM UPS-RS Worklist Service. The Subscriber is the User Agent, and the Manager is the Origin Server.

> Note: The RESTful mechanism used for this message depends on the Subscriber having an open WebSocket channel for the Manager to send the notification over. A Subscriber opens such a channel using [RAD-109].

DICOM DIMSE Message Semantics

The message is a Report a Change in UPS Status N-EVENT-REPORT of the DICOM UPS Event SOP Class. The Subscriber is the SCU, and the Manager is the SCP.

The ~~rest of the~~ message semantics and expected actions in this transaction are stated in terms of DICOM Attributes and DIMSE Services. The requirements also apply to RESTful implementations with the correspondence to RESTful semantics described in DICOM PS3.18 Section **11.136.9**.

4.87.4.1.3 Expected Actions

The Subscriber is not required to take any specific action upon receipt of a notification.

Specifically, in the case of notification of a cancelation request, the Performer of the Workitem is not required to honor the request. See DICOM PS3.4 and PS3.17 for further discussion of UPS cancelation.

The Subscriber may choose to perform a Get UPS Workitem Contents to obtain details beyond the brief set included in the notification event message.

4.87.5 Security Considerations

4.87.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

Modify Section 4.88

4.88 Request UPS Workitem Cancelation [RAD-88]

4.88.1 Scope

This transaction is used by an interested actor to request that a workitem be canceled.

There is no guarantee that the system performing the workitem will be successfully notified of the cancelation request, and there is no obligation for the system performing the workitem to honor the cancelation request.

It is recommended that a system requesting cancelation of a workitem provide as much detail as possible related to the cancelation request. The request itself is asynchronous, so the requesting system is advised to subscribe to the workitem in question if it wishes to know the outcome of the request.

This transaction would not be used by the system performing the workitem since it can simply use the Complete UPS Workitem transaction [RAD-85] to change the workitem to the Canceled state.

4.88.2 Actor Roles

The Roles in this transaction are defined in the following table and may be played by the actors shown here:

| **Role:**	Requestor: Requests cancelation of a UPS workitem.
Actor(s):	The following actors may play the role of Requestor: Workitem Creator Watcher
Role:	Manager: Responds to the request directly if the workitem is not being performed by another system, otherwise notifies the workitem performer of the cancelation request.
Actor(s):	The following actors may play the role of Manager: Workitem Manager

2545   Transaction text specifies behavior for each Role. The behavior of specific Actors are only specified when it goes beyond that of the general Role.

4.88.3 Referenced Standards

DICOM ~~2011~~ PS 3.4: Unified Procedure Step Service and SOP Classes

DICOM ~~2011~~ PS 3.17: Unified Worklist and Procedure Step - UPS (Informative)

2550 **4.88.4 Messages**
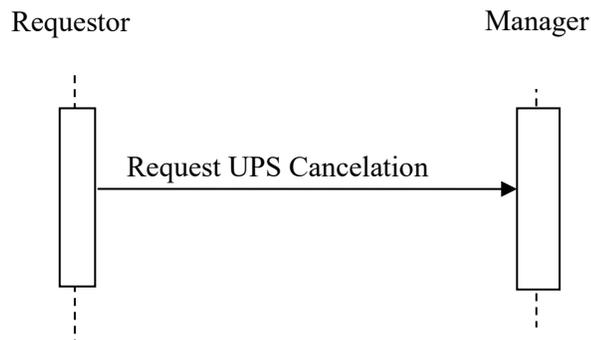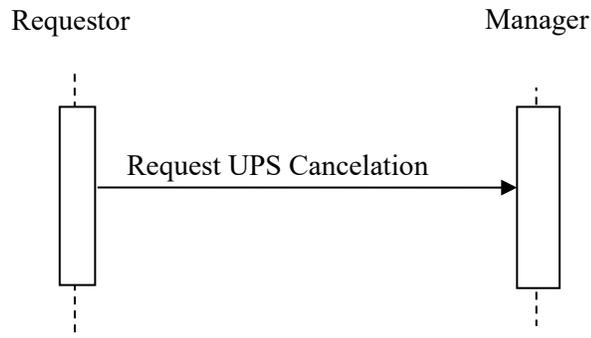
4.88.4.1 Request UPS Cancelation Message

The Requestor sends a request to the Manager of a UPS instance that the workitem be canceled.
2555 The actions will depend on what system (if any) is performing the UPS in question.

For workitems still in the SCHEDULED state, the Manager will handle the cancelation request itself as described in DICOM PS 3.4 Annex CC (i.e., typically it will set the workitem state to IN PROGRESS then to CANCELED with appropriate attribute adjustments; however, it is permitted to ignore the request based on its internal logic).

2560 For workitems that are IN PROGRESS, the Manager will attempt to notify the Performer of the cancelation request using a Send UPS Notification [RAD-87] message to the Performer of the workitem.

For workitems that are already in the CANCELED or COMPLETED state, the Request will fail.

The Requestor does not necessarily know which system is actually performing the workitem.

2565 The Manager shall support handling such messages from more than one Requestor. The Requestor may choose to support interacting with workitems on multiple Managers.

4.88.4.1.1 Trigger Events

A user or an automated function on the Requestor determines that it would like a workitem to be canceled.

2570 ### 4.88.4.1.2 Message Semantics

The message is a Request UPS Cancel N-ACTION request of the DICOM UPS Push SOP Class. The Requestor is the SCU, and the Manager is the SCP.

The successful completion of the message means that the request was received, not that the workitem was necessarily canceled. The workitem might not be canceled, and even if it is
2575 canceled, it might take some time. If the workitem is canceled, the Requestor will receive a report of the cancelation in the form of a Send UPS Notification message (see RAD TF-3: 4.87) if the Requestor is subscribed to the workitem.

4.88.4.1.3 Expected Actions

The Manager shall respond to the N-ACTION request as described in DICOM PS 3.4 CC.2.2.3
2580 and return appropriate success or failure codes to the Requestor.

The Manager shall notify the performer of the Workitem as described in 4.83.

4.88.5 Security Considerations

Local policy should consider what users and systems have permission to cancel a workitem and configure appropriately.

2585 ### 4.88.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

Modify Open Event Channel [RAD-109]

4.109 Open Event Channel [RAD-109]

2590 ### 4.109.1 Scope

This transaction is used to open an event channel that can be used to send back events such as notifications.

4.109.2 Actor Roles

The roles in this transaction are defined in the following table and may be played by the actors
2595 shown here:

Table 4.109.2-1: Actor Roles

Role:	Subscriber: Initiates the channel on which it will receive events.
Actor(s):	The following actors may play the role of Subscriber: Watcher Task Performer **Task Requestor**
Role:	Manager: Keeps the channel open and uses it to send events to the Subscriber.
Actor(s):	The following actor may play the role of Manager: Task Manager

Transaction text specifies behavior for each role. The behavior of specific actors may also be specified when it goes beyond that of the general role.

4.109.3 Referenced Standards

DICOM PS3.18: DICOM UPS-RS Worklist Service

IETF RFC6455: The WebSocket Protocol

4.109.4 Messages

Figure 4.109.4-1: Interaction Diagram

4.109.4.1 Open Event Channel

The Subscriber opens a channel to the Manager over which the Manager may subsequently send events such as notifications.

The Subscriber shall support sending such Open Event Channel messages to more than one
Manager. The Manager shall support receiving such Open Event Channel messages from each
Subscriber it interacts with.

4.109.4.1.1 Trigger Events

Several events may trigger an Open Event Channel Message

- The Subscriber intends to subscribe to events from the Manager (see [RAD-86]).

- The Subscriber needs or expects to receive unsolicited events from the Manager.

- The Subscriber detects that a previously established Event Channel has closed and needs
to be re-opened.

The Manager is not necessarily buffering/queueing events when the channel is not open. It is in
the best interest of the Subscriber that the event channel be opened promptly and maintained. If
the Subscriber suspects it may have missed messages, Query UPS Workitems [RAD-81] or Get
UPS Workitem [RAD-83] can be used to find the current status.

4.109.4.1.2 Message Semantics

This transaction defines both DICOM RESTful Message Semantics and DICOM DIMSE
Message Semantics. Profiles using this transaction will specify which semantics actors are
required to support.

DICOM RESTful Message Semantics

The message is an Open **Notification Connection Transaction** ~~EventChannel Action~~ of the
DICOM UPS-RS Worklist Service. The Subscriber is the User-Agent, and the Manager is the
Origin-Server.

DICOM DIMSE Message Semantics

There are no DICOM DIMSE Message Semantics. An equivalent of this message is not required
before a DIMSE N-EVENT-REPORT message is sent.

For the Manager to be able to associate the correct events with the open channel, it is important
that the Subscriber pass the same AE Title in the Open Event Channel message that is being
passed in the associated transactions, such as Manage UPS Subscription [RAD-86], Create UPS
Workitem [RAD-80] and Claim UPS Workitem [RAD-82].

4.109.4.1.3 Expected Actions

The Manager shall respond to the Open **Notification Connection Transaction** ~~EventChannel
Action~~ as described in DICOM PS3.18 **8.10** ~~6.9.10~~. This involves switching to the WebSocket
protocol and keeping the connection open for use as an event channel.

The Manager shall use the opened channel when sending send subsequent events and
notifications (such as [RAD-87]) to the Subscriber.

4.109.5 Security Considerations

The transaction itself does not inherently verify that the provided AE-Title does, in fact, belong to the application entity (AE) opening the channel to receive events. Implementers are advised to use this transaction in conjunction with ATNA Secure Node/Secure Application or other security features if there is a risk of misuse.

4.109.5.1 Security Audit Considerations

Managers and Subscribers that support the ATNA Profile shall audit this transaction.

This transaction corresponds to an Application Activity ATNA Trigger Event.

2655

Volume 2x – Appendices

The following appendix is included for convenience for the implementors (Unchanged from the Post-Acquisition Workflow (PAWF) Trial Implementation Supplement).

Appendix V: Attribute Consistency between UPS and Resulting Composite IODs

2660　This appendix provides requirements for populating attributes in the result objects generated by Workitem Performers. In particular, it specifies which attributes provided by the UPS shall be used unaltered to populate attributes in objects that result from performing workitems.

The table lists attributes for which requirements or guidance is provided. Attributes for which no guidance is provided are omitted from the table, but that does not imply that missing attributes
2665　should be omitted from the resulting instances.

"Source" indicates the source of the attribute value. "Copy" indicates to which object the attribute value should be copied. If it is not copied from the same row/attribute, the cell will more specifically indicate where it is copied from. "Equal" indicates that both cells in the row are populated by the Workitem Performer and should be populated with the same value. If it is
2670　not equal to the same row/attribute, the cell will more specifically indicate which attribute it is equal to.

Copying attribute values from the UPS Workitem is the defined behavior for most relevant attributes, as shown below. If an attribute is not populated in the source UPS Workitem, implementations may consider copying the corresponding value from an appropriate instance
2675　listed in the Input Information Sequence (0040,4021).

Table V-1: Mapping UPS attributes to Resulting IODs

DICOM attribute	UPS Workitem	Image/Standalone IOD
Patient's Name (0010,0010)	Source	Copy
Patient ID (0010,0020)	Source	Copy
Issuer of Patient ID Macro	Source	Copy
Other Patient IDs Sequence (0010,1002)	Source (See Note 1)	Copy
Patient's Birth Date (0010,0030)	Source	Copy
Patient's Sex (0010,0040)	Source	Copy
Admission ID (0038,0010)	Source	Copy
Issuer of Admission ID Sequence (0038,0014)	Source	Copy
Admitting Diagnoses Description (0008,1080)	Source	Copy
Admitting Diagnoses Code Sequence (0008,1084)	Source	Copy
Study Instance UID (0020,000D)	Source (See Note 2)	Copy

DICOM attribute	UPS Workitem		Image/Standalone IOD	
	Referenced Request Sequence (0040,A370)		Request Attributes Sequence (0040,0275)	
Requested Procedure ID (0040,1001)		Source		Copy
Accession Number (0008,0050)		Source		Copy (See Note 3)
Issuer of Accession Number (0008,0051)		Source		Copy
Study Instance UID (0020,000D)		Source (See Note 2)		Copy
Requested Procedure Description (0032,1060)		Source		Copy
Requested Procedure Code Sequence (0032,1064)		Source		Copy
Reason for Requested Procedure (0040,1002)		Source		Copy
Reason for Requested Procedure Code Sequence (0040,100A)		Source		Copy
Scheduled Procedure Step Description (0040,0007)	n.a.			Copy from: **Procedure Step Label** (0074,1204)
Scheduled Protocol Code Sequence (0040,0008)	n.a.			Copy from: **Scheduled Workitem Code Sequence** (0040,4018)
Procedure Step Label (0074,1204)	Source		n.a.	
Scheduled Workitem Code Sequence (0040,4018)	Source		n.a.	
Performed Procedure Step ID (0040,0253)	n.a.		Leave blank.	
Performed Procedure Step Start DateTime (0040,4050)	Equal (internally generated)		n.a.	
Performed Procedure Step Start Date (0040,0244)	See above		Equal (internally generated) to the Date component of **Performed Procedure Step Start DateTime** (0040,4050)	
Performed Procedure Step Start Time (0040,0245)	See above		Equal (internally generated) to the Time component of **Performed Procedure Step Start DateTime** (0040,4050)	
Performed Procedure Step End DateTime (0040,4051)	(internally generated)		n.a.	
Performed Procedure Step Description (0040,0254)	Equal (internally generated).		Equal (internally generated).	
Performed Workitem Code Sequence (0040,4019)	Equal (internally generated)		n.a.	
Performed Protocol Code Sequence (0040,0260)	n.a.		Equal (internally generated) to **Performed Workitem Code Sequence** (0040,4019).	
Performed Processing Parameters Sequence (0074,1212)	Equal (internally generated)		n.a.	

DICOM attribute	UPS Workitem	Image/Standalone IOD	
Protocol Context Sequence (0040,0440)	n.a.	Equal (internally generated) to **Performed Processing Parameters Sequence** (0074,1212).	
Performed Station Name Code Sequence (0040,4028)	Equal (internally generated)	n.a.	
Actual Human Performers Sequence (0040,4035) **>Human Performer's Name** (0040,4037) **>Human Performer Code Sequence** (0040,4009)	Equal (internally generated) (See Note 5)	n.a.	
Station Name (0008,1010)	n.a.	Contributing Equipment Sequence (0018,A001)	Equal (internally generated) to **Performed Station Name Code Sequence** (0040,4028) (See Note 4)
Operators' Name (0008,1070) **Operator Identification Sequence** (0008,1072) **>Person Identification Code Sequence** (0040,1101)	n.a.		Equal (internally generated) to contents of **Actual Human Performers Sequence** (0040,4035) (See Note 5)
Referenced SOP Class UID (0008,1150)	n.a.	Referenced PPS Sequence (0008,1111)	1.2.840.10008.5.1.4.34.6.1
Referenced SOP Instance UID (0008,1155)	n.a.		Equal to SOP Instance UID of the associated UPS (See Note 6)
Protocol Name (0018,1030)	n.a.	Consider Copying from Performed Procedure Step Description	

Notes: 1. Other Patient IDs (0010,1000) is redundant with Other Patient IDs Sequence (0010,1002) and insufficient as it does not allow the Assigning Authority to be conveyed for each Patient ID. Correspondingly, only Other Patient IDs Sequence (0010,1002) exists in the UPS Workitem instance.

2. Study Instance UID (0020,000D) appears twice in this table. Although both values will be the same in simple cases, they are still permitted to have different values when necessary to support situations such as doing post-processing on a dataset that belongs to an acquisition group case. The value nested within the Referenced Request Sequence is taken from the originating request, if known. The unnested value represents the study to which the result objects were assigned.

3. A Zero Length Accession Number (One of the options proposed by DICOM PS3.17 Annex J) shall be created when no reliable value for this attribute is available. Reliable values are those that can be conveyed by means other than manual data entry such as a value received from the Workitem Manager via a UPS Workitem including an Accession Number, or from the Order Filler via a Modality Worklist, or received through a bar code reader.

4. Map the Code Meaning of the item in the Performed Station Name Code Sequence (0040,4028) into the Station Name (0008,1010)

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5. Although the sequence structure is not identical, the mapping is straightforward.

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6. The SOP Instance UID of the UPS instance is sent in the Affected SOP Instance UID (0000,1000) of the UPS N-Create message and in the Requested SOP Instance UID (0000,1001) for the UPS N-Set or UPS N-GET message. It can also be found in the Referenced SOP Instance UID (0008,1155) of the C-FIND Response Identifier. SOP Instance UID (0008,0018) shall not be used.

The following appendix is included for the convenience of implementors (Unchanged from the Post-Acquisition Workflow (PAWF) Trial Implementation Supplement).

2700 # Appendix W: Populating UPS Workitem Attributes during Creation

This appendix describes how to populate attributes when creating UPS Workitems in several situations:

- Append – the new Workitem represents additional work associated with a prior existing UPS Workitem. Some attribute values in the new workitem are copied from the
2705 associated prior workitem.

- Ad Hoc – the new Workitem represents work associated with an existing study, but not with an existing workitem. Some attribute values in the new workitem are copied from the associated input data.

The following table lists all Type 1 UPS attributes and a number of significant Type 2 attributes.
2710 The blank cells indicate that the value of the attribute is not derived from a value in the source indicated at the top of that column.

Table W-1: Attribute Values in Created Workitems

Attribute Name	Tag	Req. Type N-CREATE (SCU/SCP)	Append	Ad Hoc
(Source of values)			(prior UPS)	(selected data)
Transaction UID	(0008,1195)	2/2 Shall be empty		
Scheduled Procedure Step Priority	(0074,1200)	1/1		
Procedure Step Label	(0074,1204)	1/1		
Scheduled Procedure Step Start DateTime	(0040,4005)	1/1		
Scheduled Workitem Code Sequence	(0040,4018)	2/2	See Note 1	
Input Readiness State	(0040,4041)	1/1	See Note 2	See Note 2
Input Information Sequence	(0040,4021)	2/2	Copy (See Note 3)	Copy (See Note 3)
Study Instance UID	(0020,000D)	1C/2	Copy	Copy (See Note 4)
Patient ID	(0010,0020)	1C/2	Copy	Copy

Attribute Name (Source of values)	Tag	Req. Type N-CREATE (SCU/SCP)	Append (prior UPS)	Ad Hoc (selected data)
Referenced Request Sequence	(0040,A370)	2/2		
>Study Instance UID	(0020,000D)	1/1	Copy	Copy (See Note 4)
>Accession Number	(0008,0050)	2/2	Copy	Copy (See Note 4)
>Issuer of Accession Number Sequence	(0008,0051)	2/2	Copy	Copy
Procedure Step State	(0074,1000)	1/1 Shall be created with a value of "SCHEDULED"		
Unified Procedure Step Performed Procedure Sequence	(0074,1216)	2/2 Shall be created empty		

Notes: 1. If the new Workitem involves repeating the task of the prior UPS or continuing it, or performing it on additional data, it may be appropriate to copy the Scheduled Workitem Code Sequence.

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2. This profile constrains the value of Input Readiness State to be READY at the time of creation.

3. Since the Input Information Sequence is a list of the DICOM instances which were used as input for the workitem, it is technically copied from the Instance UID attributes of the selected/processed data.

4. In general, copying these values will be the reasonable approach; however, there will be cases (such as the Scheduled Workflow Group Case or when an ad hoc task combines inputs from multiple studies) where it will be several possible values to copy. The application should document how it handles such cases (e.g., by asking the operator, by using internal logic such as creating a new study or using the newest of the input studies, or just halting with an exception).

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