IHE Radiology
Technical Framework Supplement

AI Workflow for Imaging
AIW-I

Revision 1.0 – Draft for Public Comment

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Please verify you have the most recent version of this document. See here for Trial Implementation and Final Text versions and here for Public Comment versions.
Foreword

This is a supplement to the IHE Radiology Technical Framework V18.0. 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 March 30, 2020 for public comment. Comments are invited and may be submitted at http://www.ihe.net/Radiology_Public_Comments. In order to be considered in development of the trial implementation version of the supplement, comments must be received by April 29, 2020.

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 bolded or underlined.

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

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 inference tasks on digital image data acquired by an imaging modality.

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

Open Issues and Questions

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<td>Q. Is it appropriate to use a finding code as a procedure code?</td>
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<td>Workitem codes describe the task that a worker is requested to perform. For example the Radlex Playbook procedure codes (which are now incorporated into LOINC) describe radiology procedures. RSNA Clinical Data Elements (radelement.org) includes a large number of useful finding codes which could be used to express something like “the current tumor volume is 143mm^3”. Is it acceptable to send a code like (RDE455,RDE,”Current Tumor Volume”) to also mean “please populate this field”? The alternative is to prepare a set of procedure codes. For example there might be different procedure codes for:</td>
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<td>• Detect whether lung nodules are present. (Y/N)</td>
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<td>• Determine the location of lung nodule(s)</td>
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<td>• Segment the extent of lung nodule(s)</td>
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<td></td>
<td>• Measure the volume/characteristics of lung nodule(s)</td>
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<td>• Grade the lung nodule(s)</td>
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<td>Q. How should results that might influence Reading Worklist Priority be communicated and what details are required?</td>
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<td>In the Concepts section, X.4.1.4 Reading Worklist Priority describes an ORM/OMG-based approach. An alternate approach proposed is using ORU transactions. There are details that are included to provide guidance to include a transaction. Note that deciding how to act on the information is left up to the Reading Worklist Manager and local policies.</td>
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<td>Q. Should the profile explicitly include open workitem assignment of AI Inference Requests?</td>
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Currently the open query use case is not addressed (see PAWF). 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.

Pull Workflow (X.4.2.1) uses a query but 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 yet claimed).

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<th>Q.</th>
<th>Does the profile need to mandate specific deidentification capabilities for specific actors?</th>
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<td>Section X.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.</td>
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<th>Q.</th>
<th>What standards and requirements should be considered for Interactive AI?</th>
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<td>In the Concepts section, X.4.1.7 Interactive AI describes general standards and use cases which may apply to the interactive AI and how UPS-RS can be applied for workflow management. While Interactive AI is not profiled, there is interest in profiling standards-based solutions for subsequent work.</td>
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<th>Q.</th>
<th>What standards and requirements should be considered for AI Services Discovery?</th>
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<td>Task Managers need to know all the different AI Services each Task Performer is capable of performing. Task Requesters should know what AI Services it is realistic to request and what input data to provide. While AI Services Discovery is not being addressed this year (currently left to configuration or other methods), there is interest in profiling standards-based solutions for this in subsequent work.</td>
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<th>Q.</th>
<th>Are additional data transport methods needed? If so, which?</th>
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<td>The Concepts section X.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 X.6 identifies cross-profile considerations which leverage these types and methods.</td>
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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.

8 Q. Is the Proxy-based Inference Workflow sufficient or should the interactions between the Proxy and the AI Model be defined?

The Proxy-base Inference Workflow Section X.4.2.4 specifies a proxy Task Performer for managing stateless single purpose AI Applications. The proxy acts on behalf of the AI Model in these cases. Task Manger is reliant on the Proxy to claim and complete the workitem on behalf of the AI Model.

The interactions between the Proxy and the AI Model, in these cases is left undefined.

9 Q. In Section X.4.2.4 Use Case 4: Push Inference Workflow, is this use case sufficiently optimized for use by AI Models and Orchestrators?

The use case does not follow the triggered pull workflow that includes the Get UPS Workitem from the Task Performer after the Task Performer receives the Create UPS Workflow with the assigned Inference Request. This is because the Create UPS Workitem includes all of the Inference Request details. The Get UPS Workitem is not necessary.

The use case includes a claim UPS workitem, after it is assigned.

The use case separates the Update UPS Workitem from the Compete UPS Workitem transaction.

Closed Issues

1 This Profile uses DICOM UPS-RS for the AI workflow.

With the low level of current reference implementations and development tools with regards to this standard, leveraging UPS is identified as a risk. IHE intentionally optimized the usage with a very minimal approach. The architecture is biased towards performing with a minimal API and dataset.

Note that a Proof of Concept does exist, and support is available in open source libraries.

2 Does this profile adequately address workflow initialization?

Workflow initialization may be triggered by an Acquisition Modality, a PACS, a RIS or any system receiving an IAN.
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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Appendix A – Actor Summary Definitions
There are no new transactions for this profile.

Appendix B – Transaction Summary Definitions
There are no new transactions for this profile.

Glossary

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inference</td>
<td>the process of using trained AI Models or machine learning algorithms to make a prediction</td>
</tr>
</tbody>
</table>
Volume 1 – Profiles

Add new Section X

X AI Workflow for Imaging (AIW-I) Profile

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

Once images are available for inference, a Task Requester sends a request for AI processing to the Task Manager which assigns requests to appropriate Task Performers.

The basic processing steps are:

Step 1: Create Workitem: Requestor prepares the Inference Request

Step 2: Assign Workitem: Manager receives Workitem and assigns

Step 3: Receives Workitem: Performer receives and initiates workitem process using “Push”, “Pull” or “Triggered Pull” method.

Step 4: Retrieves Input Data: Performer retrieves referenced Input data

Step 5: Creates AI Results: Performer creates AI Results

Step 6: Updates Workitem: Performer Updates workitem, Manager notifies Requestor

Step 7: Completes Workitem: Performer Completes Workitem, Manager notifies Requestor

The workflow management transactions are based on the RESTful worklist service defined by DICOM UPS-RS. The Inference Request is defined as a UPS workitem/task.

The means for accessing input non-imaging data for the inference task and distributing the results output are identified using XDS and FHIR. Note that the Transactions are not included for this profile. However, this profile does not preclude use of these transactions.

The data transactions for accessing the inputs image data for the inference task and distributing the AI Results outputs identify the use of RESTful DICOM or Conventional DICOM.

It is important to be clear that this initial profile is focused on a very small set of workflow needs. Many needs are not addressed in this initial release but are anticipated in future releases or other profiles. Items which were considered, but are, currently, out of scope for this profile include:

- 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.
X.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. Both appendices are located at [http://ihe.net/Technical_Frameworks/#GenIntro](http://ihe.net/Technical_Frameworks/#GenIntro)

Figure X.1-1 shows the actors directly involved in the AIW-I Profile and the relevant transactions between them. If needed for context, other actors that may be indirectly involved due to their participation in other related profiles are shown in dotted lines. Actors which have a required grouping are shown in conjoined boxes (see Section X.3).

To see how these transactions are used in sequence, see Section X.4.2.

![Figure X.1-1: AIW-I Actor Diagram](image-url)

Table X.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”).

---

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Template Rev. 10.5
## Table X.1-1: AIW-I Profile - Actors and Transactions

<table>
<thead>
<tr>
<th>Actors</th>
<th>Transactions</th>
<th>Initiator or Responder</th>
<th>Optionality</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Requestor</td>
<td>Instance Availability Notification</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.49</td>
</tr>
<tr>
<td></td>
<td>Create UPS Workitem</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.80</td>
</tr>
<tr>
<td></td>
<td>Get UPS Workitem</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.81</td>
</tr>
<tr>
<td></td>
<td>Manage UPS Subscription</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.86</td>
</tr>
<tr>
<td></td>
<td>Send UPS Notification</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.87</td>
</tr>
<tr>
<td></td>
<td>Open Event Channel</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.109</td>
</tr>
<tr>
<td>Task Manager</td>
<td>Create UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.80</td>
</tr>
<tr>
<td></td>
<td>Create UPS Workitem</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.80</td>
</tr>
<tr>
<td></td>
<td>Query UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.81</td>
</tr>
<tr>
<td></td>
<td>Claim UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.82</td>
</tr>
<tr>
<td></td>
<td>Get UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.83</td>
</tr>
<tr>
<td></td>
<td>Get UPS Workitem</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.83</td>
</tr>
<tr>
<td></td>
<td>Update UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.84</td>
</tr>
<tr>
<td></td>
<td>Complete UPS Workitem</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.85</td>
</tr>
<tr>
<td></td>
<td>Manage UPS Subscription</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.86</td>
</tr>
<tr>
<td></td>
<td>Send UPS Notification</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.87</td>
</tr>
<tr>
<td></td>
<td>Send UPS Notification</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.87</td>
</tr>
<tr>
<td></td>
<td>Open Event Channel</td>
<td>Initiator</td>
<td>R</td>
<td>RAD TF-2: 4.109</td>
</tr>
<tr>
<td></td>
<td>Open Event Channel</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.109</td>
</tr>
<tr>
<td>Task Performer</td>
<td>Retrieve Images</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.16</td>
</tr>
<tr>
<td></td>
<td>Evidence Documents Stored</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.43</td>
</tr>
<tr>
<td></td>
<td>Create UPS Workitem</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.80</td>
</tr>
<tr>
<td></td>
<td>Query UPS Workitem</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.81</td>
</tr>
<tr>
<td></td>
<td>Claim UPS Workitem</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.82</td>
</tr>
<tr>
<td></td>
<td>Get UPS Workitem</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.83</td>
</tr>
<tr>
<td></td>
<td>Get UPS Workitem</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.83</td>
</tr>
<tr>
<td></td>
<td>Update UPS Workitem</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.84</td>
</tr>
<tr>
<td></td>
<td>Complete UPS Workitem</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.85</td>
</tr>
<tr>
<td></td>
<td>Send UPS Notification</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.87</td>
</tr>
<tr>
<td></td>
<td>Send UPS Notification</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.87</td>
</tr>
<tr>
<td></td>
<td>WADO-RS Retrieve</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.107</td>
</tr>
<tr>
<td></td>
<td>Store Instances Over the Web</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.108</td>
</tr>
<tr>
<td></td>
<td>Open Event Channel</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.109</td>
</tr>
<tr>
<td></td>
<td>Open Event Channel</td>
<td>Responder</td>
<td>O</td>
<td>RAD TF-2: 4.109</td>
</tr>
<tr>
<td>Image Manager</td>
<td>Retrieve Images</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.16</td>
</tr>
<tr>
<td></td>
<td>Evidence Documents Stored</td>
<td>Responder</td>
<td>R</td>
<td>RAD TF-2: 4.43</td>
</tr>
<tr>
<td></td>
<td>Instance Availability Notification</td>
<td>Initiator</td>
<td>O</td>
<td>RAD TF-2: 4.49</td>
</tr>
</tbody>
</table>
### X.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.

#### X.1.1.1 Task Requestor

The Task Requestor initiates the AI Inference by creating and populating a UPS workitem. The Task Requestor may be, for example:

- A PACS or workstation.
- An acquisition modality.
- A RIS or Reading Worklist System.

The Task Requestor shall implement the UPS-RS (RESTful Message Semantics) of the transactions listed in Table X.1-1. As a baseline, a Content-Type of application/json shall be supported; application/dicom+xml may additionally be supported.

The Task Requestor shall populate the Scheduled Workitem Code in the UPS Workitem with a code that identifies the inference.

The Task Requestor shall populate the Input Information Sequence (0040,4021) with at least one instance.

The Task shall populate the Destination Output using at least one method for AI Results transfer.

The Task Requestor is responsible for providing References to other relevant input documents (see Table X.4.1.1-1).

The Task Requestor shall include other Inference Request attributes (see Table X.4.1.1-1) as necessary for the requested USP Workitem.

The Task Requestor optionally is a subscriber to workitem for notification updates. The subscription service will provide information about the workitem, including workitem status, including completion and other notable events such as requesting action from the Requestor.

Without the notification subscription, the Task Requester will receive no notifications back from the worklist services.
X.1.1.2 Task Manager

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

- an AI Marketplace/Platform System.

The Task Manager shall implement the DICOM RESTful Message Semantics of the transactions listed in Table X.1-1. As a baseline, a Content-Type of application/json shall be supported; application/dicom+xml may additionally be supported.

The Task Manager shall be capable of modifying workitems by creating new workitems.

X.1.1.3 Task Performer

The Task Performer generates results in response to workitems and input images. The Task Performer may be, for example:

- A hosted software application.
- A stand-alone dedicated AI analysis system, such as for Mammography Screening, either within a host institution or in the cloud.

The Task Performer shall implement the DICOM RESTful Message Semantics of the transactions listed in Table X.1-1. As a baseline, a Content-Type of application/json shall be supported; application/dicom+xml may additionally be supported.

The Task Performer shall implement at least one of the three workflow models described in X.4.1.5, Pull, Triggered Pull and Push Workflow.

The Task Performer may include its own temporary image storage images and results prior to distribution.

Performing System Identification

The Name of the Task Performer providing the inference is identified in the Station Name. Note that [RAD-84] already requires the Performer to update the Performed Station Name Code Sequence to identify itself as described in RAD TF-2: 4.84.4.1.2.1.

X.1.1.4 Image Manager

The Image Manager provides access to input images and receives DICOM results. The Image Manager may be a PACS or VNA but could theoretically also be a CT or MR scanner provided it meets the requirements stated.

The Image Manager shall support DICOMweb and DICOM access or transfer methods for all DICOM instances independent to how the instances were stored.
An Image Manager may be grouped with a Task 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 Performers that are hosted in the cloud).

**X.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 implementing product and is not otherwise mandated in this profile.

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

**X.2 AIW-I Actor Options**

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

<table>
<thead>
<tr>
<th>Actor</th>
<th>Option Name</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Requestor</td>
<td>Instance Availability Option</td>
<td>Section X.2.1</td>
</tr>
<tr>
<td>Task Manager</td>
<td>No options defined</td>
<td>--</td>
</tr>
<tr>
<td>Task Performer</td>
<td>DICOMweb Option (Note)</td>
<td>Section X.2.2</td>
</tr>
<tr>
<td></td>
<td>DICOM Option (Note)</td>
<td>Section X.2.3</td>
</tr>
<tr>
<td>Image Manager</td>
<td>Instance Availability Option</td>
<td>Section X.2.1</td>
</tr>
<tr>
<td>Watcher</td>
<td>No options defined</td>
<td>--</td>
</tr>
</tbody>
</table>

Note: At least one of these two options shall be supported. Both may be supported. A hybrid approach, such as using DICOMweb to get pixel data, and DICOM to store the AI Results is conceivable.

**X.2.1 Instance Availability Option**

This option provides information about study availability in an Image Archive to a Task Requester for use when deciding what inference tasks to schedule and when populating the details of those tasks, such as the list of input data. For example, a centralized Task Requester might use this information to schedule all processing for the hospital in a fully automated fashion.

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

An Image Manager that claims the Instance Availability Option shall implement the Instance Availability Notification [RAD-49] as an Image Manager.
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 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 business logic is 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. Note that multiple notifications may be used to create a single workitem and it is not expected that every notification will create a workitem.

The Task Requestor also populates the Referenced SOP Sequence inside the Input Information Sequence with each of the image instances needed for inference. The Input Information Sequence includes Location End Points and the access method as described in the received message.

Consider grouping the Task Requestor with the Task Manager in this option.

**X.2.2 DICOMweb Option**

This option specifies the ability to use DICOMweb™ as the mechanism for the Task Performer to access the input image data used in the inference task and store the output results.

A Task Performer that claims the DICOMweb Option shall implement the WADO-RS Retrieve [RAD-107] transaction as the Imaging Document Consumer and the Store Instances Over the Web [RAD-108] transaction in the role of Sender.

The Task Performer shall be capable of retrieving any instances identified in the workitem Input Information Sequence with a WADO-RS Retrieval Sequence.

The Task Performer shall be capable of storing AI Results to a DICOMweb STOW-RS server and identifying them in the workitem Output Information Sequence with a WADO-RS Retrieval Sequence.

Note: 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 Image Capture (WIC) Trial Implementation Supplement.

**X.2.3 DICOM Option**

This option specifies the ability to use conventional DIMSE DICOM as the mechanism for the Task Performer to access the data used in the inference task and store the output results.

A Task Performer that claims the DICOM Option shall implement the Retrieve Images [RAD-16] transaction as the Image Display and the Creator Images Stored [RAD-18] transaction as the Evidence Creator.

The Task Performer shall be capable of retrieving any instances identified in the workitem Input Information Sequence with a DICOM Retrieval Sequence.
The Task Performer shall be capable of storing AI Results to a DICOM server and identifying them in the workitem Output Information Sequence with a DICOM Retrieval Sequence.

Note: Task Performers are expected to implement other retrieval transactions, such as Retrieve Presentation States [RAD-17], Retrieve Reports [RAD-27], Retrieve Key Image Notes [RAD-31], Retrieve Evidence Documents [RAD-45], and Retrieve Dose Information [RAD-65], as necessary for the types of inference performed by the AI Model.

**X.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).

<table>
<thead>
<tr>
<th>AIW-I Actor</th>
<th>Actor(s) to be grouped with</th>
<th>Reference</th>
</tr>
</thead>
<tbody>
<tr>
<td>Task Requestor</td>
<td>ITI Consistent Time / Time Client</td>
<td>ITI TF-1: 7</td>
</tr>
<tr>
<td>Task Manager</td>
<td>ITI Consistent Time / Time Client</td>
<td>ITI TF-1: 7</td>
</tr>
<tr>
<td>Task Performer</td>
<td>ITI Consistent Time / Time Client</td>
<td>ITI TF-1: 7</td>
</tr>
<tr>
<td>Image Manager</td>
<td>ITI Consistent Time / Time Client</td>
<td>ITI TF-1: 7</td>
</tr>
<tr>
<td>Watcher</td>
<td>--</td>
<td>--</td>
</tr>
</tbody>
</table>

**X.4 AIW-I Overview**

**X.4.1 Concepts**

**X.4.1.1 Inference Workitem**

The Inference Request is a UPS workitem created by the Task Requestor. Task Performers require sufficient details in the workitem to run inference. The Inference Request attributes are included as part of the UPS Workitem. Table X.4.1.1-1 identifies detailed input values which may be necessary for the inference to be successful.

<table>
<thead>
<tr>
<th>Detail</th>
<th>Corresponding UPS Attribute</th>
</tr>
</thead>
<tbody>
<tr>
<td>Process requested</td>
<td>Scheduled Workitem Code Sequence (0040,4018)</td>
</tr>
<tr>
<td>Patient Age</td>
<td>Patient’s Age (0010,1010)</td>
</tr>
<tr>
<td>Patient Sex</td>
<td>Patient’s Sex (0010,0040)</td>
</tr>
<tr>
<td>Patient Weight</td>
<td>Patient Weight (0010,1030)</td>
</tr>
<tr>
<td>Patient race and ethnicity</td>
<td>Ethnic Group (0010,2160)</td>
</tr>
<tr>
<td>Contrast agent</td>
<td>Scheduled Processing Parameters Sequence (0074,1210)</td>
</tr>
<tr>
<td>Modality (e.g., CT, MR, etc.)</td>
<td>Scheduled Processing Parameters Sequence (0074,1210)</td>
</tr>
<tr>
<td>Disciplines (e.g., NM, Neuro, etc.)</td>
<td>Scheduled Processing Parameters Sequence (0074,1210)</td>
</tr>
<tr>
<td>Detail</td>
<td>Corresponding UPS Attribute</td>
</tr>
<tr>
<td>--------</td>
<td>----------------------------</td>
</tr>
<tr>
<td>Procedure being processed (the &quot;orderable&quot;)</td>
<td>Requested Procedure Code Sequence (0032,1064)</td>
</tr>
<tr>
<td>Body Region/Anatomic Focus</td>
<td>Scheduled Processing Parameters Sequence (0074,1210)</td>
</tr>
<tr>
<td>Expected Completion Date/Time</td>
<td>Expected Completion Date and Time (0040,4011)</td>
</tr>
<tr>
<td>Priority/Urgency</td>
<td>Scheduled Procedure Step Priority (0074,1200)</td>
</tr>
</tbody>
</table>
| 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)  
XDS Retrieval Sequence (0040,E024)  
WADO-RS Retrieval Sequence (0040,E025)  
DICOM Retrieval Sequence (0040,E021)  
FHIR Resource Retrieval Sequence (XXXX,YYYY) |
| 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) |

The onus is on the Task Performer to provide documentation on the input parameters, including values they support. The Task Manager ensures that the required input is populated to create a workitem. The Task Requester is expected to populate the above attributes adequately to properly facilitate appropriate assignment of the task and to facilitate Task Performers being able to efficiently perform the tasks.

If the Request cannot be processed properly by a performer, then the Performer could request cancellation using the Complete UPS Workitem [RAD-85] transaction. The cancellation may include a call back Contact URI requesting more information.

The processing requested is identified by the Scheduled Workitem Code Sequence (0040,4018) which is described in the next section.

### X.4.1.2 Code sets

While this profile does not mandate the use of specific code sets, identifying a common code set 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**

The Scheduled Workitem Code Sequence (0040,4018) contains a code communicating the AI Model Service 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 is purposed for the detection of pneumothorax.

The workitem is created and prioritized on the AI Services Platform and the pneumothorax detection algorithm is performed. The algorithm returns a finding indicating the presence of Pneumothorax and updates the reading 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 services at acrdsi.org. ACR with RSNA has jointly identified the clinical input and the desired outcomes using Common Data Elements (CDE) for Radiology, at the radelement.org website. In this case the Rad Element set for the ACR use case for Pneumothorax Detection uses the Rad Element set.

The RAD Element Set includes inputs and out Data elements. Input images 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 should be included. In the request.

Other sources of standardized code sets which could be utilized for AI Workitem Codes include LOINC and SNOMED CT. Potential usage of these various code sets is illustrated in the table below:

<table>
<thead>
<tr>
<th>Coding Scheme</th>
<th>Code Value</th>
<th>Code Meaning</th>
</tr>
</thead>
<tbody>
<tr>
<td>LOINC</td>
<td>48770-2</td>
<td>Fetal Biophysical profile panel US</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES03</td>
<td>Adrenal Nodule on CT or MR</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES14</td>
<td>Pediatric Bone Age</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES26</td>
<td>Appendicitis Detection</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES39</td>
<td>Midline Shift</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES44</td>
<td>Pneumothorax</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES51</td>
<td>Scoliosis</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES52</td>
<td>Quantification of Myocardial Perfusion</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES73</td>
<td>Pneumonia Detection</td>
</tr>
<tr>
<td>RADElement</td>
<td>RDES75</td>
<td>Breast Density</td>
</tr>
</tbody>
</table>
The requestor would gather as much clinical input data to aid the Manager in the appropriate AI Model selection. The Performed Procedure Step information would include the Procedure Code Sequence (0008,1032) identifying the algorithms performing the analysis.

In such case there may be several AI Models providing analysis on the input images. The Performed Procedure Step information would include the Procedure Code Sequence (0008,1032) identifying the algorithms performing the analysis.

With the workitem codes, the Task Manager may require additional input parameters to successfully assign the workitem. The preferred method is to use the Scheduled Processing Parameter Sequence (0074,1210) in the request. The Task Manager may have other means to populate the input parameters of the workitem.

### Scheduled Processing Parameters Sequence

The Scheduled Processing Parameters Sequence (0074,1210) contains items encoding specific details of the inference task 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 X.4.1.1). Except for those in Table X.4.1.1-1, Processing parameters will be application specific and will need to be configured.

Selection of coded elements should use standard code sets such as LOINC, RAD Elements and SNOMED when possible.

### X.4.1.3 Types and Transfer Methods for Input and Output Data

UPS-RS is a worklist service with the capability of handling multiple input and output data types for clinical data objects. While this profile focuses on medical imaging instances (i.e., DICOM), non-imaging medical data objects such as HL7 CDA and HL7 FHIR resources can be included as well. The key requirement for any object retrieved or stored is the object has an OID.

The Type of Instances (0040,E020) of the Input Information Sequence (0040,4021) may include CDA, DICOM or FHIR resource. The data type methods for retrieval are defined as a sequence and include

- 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)
• FHIR Resource Retrieval Sequence (XXXX,YYYY)

The Output Destination Sequence (0040,4070) identifies where the AI Results are to be stored. The datatypes may include CDA, DICOM or FHIR resource. The data type methods for retrieval are defined as a sequence and include

• DICOM Storage Sequence (0040,4071)
• STOW-RS Storage Sequence (0040,4072)
• XDS Storage Sequence (0040,4074)
• FHIR Resource Storage Sequence (XXXX,YYYY)

The UPS Performed Procedure Sequence (0074,1216) identifies where the AI Results were stored by the Task Performer. This may be different that where the results were requested.

**X.4.1.4 Reading Worklist Priority**

Some AI Model/application may use the inputted image data to directly diagnose the patient providing analysis and/or recommendations to assist a clinician in the diagnosis of a patient. 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. In clinical settings where there are radiologists available, the results could be used to prioritize the reporting and notification to the treating physicians. How the reading worklist is managed against other reading priorities is left open to the institution’s policies and system managing the worklist read priorities.

The typical process flow to convey this worklist priority update request, is to use the HL7 OMI/SC message to a system which manages the read workflow process.

The HL7 ORM or OMI Message as profiled in the Procedure Update [RAD-13] transaction, may be used to recommend the procedure’s priority update. The expected action for the receiving system is to consider updating the worklist read priority. The receiving system will determine how the request will be handled.

Using the Procedure Update [RAD-13] semantics, the worklist priority notification would include:

1. Study Instance UID (IPC-3)
2. AI Model Identified (IPC-7)
4. Priority (TQM1-9)
5. Status Change (ORC-5 =SC)
6. Order Progress (ORC-1=X0)  

7. AI Findings characterized in OBX Segment  

The OBX segment is populated with the finding of the AI result finding to aid in the prioritization process. Note that each finding is encapsulated in a separate OBX segment. 

- OBX-2 Observation Identifier must be a coded data element, such as LOINC or RADelement  
- OBX-3 Observation value for the result should be present.  
- OBX-4 Probability value should be present.  
- OBX-8 Abnormal Flag should be present.  
- OBX-11 Results Status should indicate R  
- OBX-14 should indicate the time of the Inference.  
- OBX-17 Observation Method should identify the AI Model used  
- OBX-18 Equipment Instance Identifier identifies the AI Model Instance  

In cases where a Radiologist may not be present, an alert may be passed on the EMR, such as an ORU^R40 message. Like the ORU^R01, the message provides the findings of the AI result characterizations directly to the clinical care team. 

**X.4.1.5 Pull, Triggered Pull and Push Workflow**  

UPS-RS is a worklist service. It is adaptable to multiple workflow models. Described here are three workflow methods defined in DICOM  

- “Pull” workflow is where a Task Performer queries the Task Manager for relevant tasks and choose which one to start working on. The query targets use cases when the workitem is not assigned by the Task Manager, allowing for systems to choose the item to work on. This workflow is useful when the Task Manager has queued more workitems than available Task Performers. Thus, allowing the next available Task Performer to take the next workitem.  
- An effective usage of the “Pull” workflow for this profile is when a hosted application is launched specifically to perform a workitem. As soon as the algorithm is alive, it would query for assigned tasks using Query UPS Workitem [RAD-82] with the “Station-based Query” to find the assigned workitem.  
- Additional detail is described in Section X.4.2.1 “Use Case 1: Pull Inference Workflow”.  

In a scenario where the Task Performer is always “alive”, a “Triggered-Pull” workflow is appropriate. The “Triggered Pull” Workflow uses assignment notification to trigger the retrieval of the assigned workitem. Rather than query for assignments, the Task Performer receives a notification of the assigned workitem. The notification is received via Send UPS Notification [RAD-87]. In such cases, the Task Manager has responsibility for creating and assigning workitems and the Task Performer has responsibility for performing and updating them. 

Additional detail is described in Section X.4.2.2 “Use Case 2: Triggered Pull Inference Workflow”.
In scenarios where little to no business logic is actually included in the Task Performer, UPS-RS has the capability for a Task Manager to "Push" a workitem (using the UPS-RS POST method as an user-agent) onto the Task Performer (here an origin-server) using Create UPS Workitem [RAD-80]. The “Push” workflow requires the Task Manager to create, assign and update the original requested workitem on behalf of the Task Performer, whereas the Task Performer has responsibility only for performing the workitem. Additional detail is described in Section X.4.2.3 “Use Case 3: Push Inference Workflow”.

Alternately the push workflow could be managed by a Task Performer acting as a proxy to a lightweight AI Model. Additional detail is described in Section X.4.2.4 “Use Case 4: Proxy-Based Inference Workflow”.

**X.4.1.6 Assigning Workitem to Multiple Task Performers**

The Inference Request may require the Task Manager to run multiple inferences for Task Performers to fulfill. The Task Manager may have internal business logic where the various Task Performers run independent of each other or dependent on the output of a preceding Task Performer. In the “Triggered Pull” workflows only, the Task Manager creates and assigns new subtask workitem to each applicable Task Performer and reflects progress of the subtasks into the original workitem.

**X.4.1.7 Interactive AI**

Some implementations may involve “interactive” AI Models in the sense that an operator might choose “on the fly” to invoke one analysis or another based on what they observe in the image, or an operator might provide a needed seed point for a segmentation or select a particular region of an image for analysis, or perhaps there might be several iterative invocations of AI Models with operator feedback in between. The AI Model may trigger CDS hooks in real-time with the Requestor. The AI Model may provide a form to provide additional information. Other possibilities include presenting a display for the user to interact with. The display could be asking for a seed placement on an image for segmentation or confirmation/edit of a segmentation. It may also initiate a FHIRcast session with the Requestor.

Using UPS-RS Update UPS Workitem [RAD-84], the Task Performer could initiate an interactive session while the workitem is in progress. Alternately, it could initiate a new workitem with a Human or another system from the Task Requestor.

**X.4.2 Use Cases**

This profile focuses on use cases for non-interactive AI analysis of post-image acquisition. A clinical example is detection and quantification of pneumothorax in a chest radiograph.

- A patient presents to an ER department.
- The attending physician orders a chest X-ray.
- The patient has a chest x-ray procedure performed.
• After the chest x-ray is acquired, an AI model runs inference 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.

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 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.

X.4.2.1 Use Case 1: Pull Inference Workflow

In “Pull workflow” a Task Performer queries the worklist for relevant tasks and choose which one to start working on.

Typically, 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 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. More information on open query may be found in the Post Acquisition Workflow (PAWF) Profile: RAD TF-1: 30.5.2.

This use case shows the Task Requestor using Open Event Channel to establish a WebSocket for receiving progress notifications. This is not required. The Task Requester could instead use Get UPS Workitem to check the status or could ignore it completely.
Figure X.4.2.1-1: Pull Workflow

- Image Manager
- Task Requestor
- Task Manager
- Task Performer

1. Open Event Channel [RAD-109]
2. Decide images need inference
3. Create Workitem [RAD-80]
4. Assign Workitem X
5. Send UPS Notification [RAD-87] (Workitem X scheduled)
6. Query UPS Workitem [RAD-81]
7. Get UPS Workitem [RAD-83]
8. Claim UPS Workitem [RAD-82]
9. Send UPS Notification [RAD-87] (Workitem X claimed)
10. Retrieve referenced input data using [RAD-107] or [RAD-16]
11. Perform inference
12. Store AI Results with [RAD-108] or [RAD-43]
13. Update UPS Workitem [RAD-84]
14. Send UPS Notification [RAD-87] (Progress Report)
15. Complete UPS Workitem [RAD-85]
16. Send UPS Notification [RAD-87] (Workitem X complete)
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->REQ: Decide images\nneed inference
ORC->REQ: Workitem X UID
ORC->ORC: assign\nWorkitem X
ORC->REQ: Send UPS Notification [RAD-87]\n(Workitem X scheduled)
par Step 3: Pull Workitem
PER->+ORC: Query UPS Workitem [RAD-81]
activate PER
ORC-->-PER: Workitem X UID
PER->+ORC: Get UPS Workitem [RAD-83]
ORC-->PER: Workitem X
PER-->+ ORC: Claim UPS Workitem [RAD-82]
ORC-->PER: Transaction UID
ORC->- REQ: Send UPS Notification [RAD-87]\n(Workitem X 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]
ORC-->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 X complete)
```

### Step 1: Create Workitem

The Task Requester prepares the AI Inference Request by populating the Create UPS Workitem [RAD-80]. The Task Requester 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 Requester specifies the desired endpoint where the AI results are to be stored and the corresponding Study Instance UID.

The Task Manager creates the UPS Workitem as requested and assigns a Workitem UID. The assigned Workitem UID is returned to the Task Requester. This workitem UID can be used to query specifically for the workitem and its status.

### Step 2: Assign Task Performer

The Task Manager assigns the workitem to a specific Task Performer by setting the Station Name attribute in the workitem.
The Task Requester is notified of the workitem status (SCHEDULED) using Send UPS Notification [RAD-87].

710 **Step 3: Pull Workitem**

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].

After retrieving the workitem, the Task Performer claims the workitem assigned to it using the Claim UPS Workitem [RAD-84] to lock the workitem.

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

720 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].

725 **Step 5: Store AI Results**

Once the processing is completed, the Task Performer stores the AI Results using the workitem referenced endpoints with either the WADO-RS method [RAD-108] or the DICOM DIMSE method [RAD-43] as identified in the Output Destination Sequence (0040,4070). Note that the output 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).

730 **Step 6: Update UPS Workitem**

The Task Performer updates the workitem UPS Performed Procedure Information 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 Workitem.

The Task Requestor is notified by a progress report included in Send UPS Notification [RAD-87]. The progress report is an indication that the workitem is updated by the Task Performer. It may also include Procedure step communications URI Sequence (0074,1008) which may require interaction with the Task Performer.

740 **Step 7: Complete UPS Workitem**

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].

**X.4.2.2 Use Case 2: Triggered Pull Inference Workflow**

An alternative to the query in the “Pull Inference Workflow” is the “Triggered Pull Inference Workflow” where the Task Performer is notified of assignments and simply gets the assigned workitem. The Task Performer uses Open Event Channel to establish a WebSocket for receiving notifications.

Otherwise the workflow is the same as that outlined in Section X.4.2.1.

**Figure X.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 X UID
ORC->ORC: assign\nWorkitem X
par Step 3: Triggered Pull
ORC->PER: Send UPS Notification [RAD-87]\n(Workitem X scheduled)
PER-->ORC: Get UPS Workitem [RAD-83]
ORC-->PER: Workitem X
PER-->ORC: Claim UPS Workitem [RAD-82]
ORC-->PER: Transaction UID
ORC->-REQ: Send UPS Notification [RAD-87]\n(Workitem X claimed)
end
note over REQ,PER: Continue with Step 4 Retrieve referenced input data

Step 3: Triggered Pull Workitem

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

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

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

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

X.4.2.3 Use Case 3: Push Inference Workflow

UPS-RS has the capability for a Task Manager to "push" a workitem (using the UPS-RS POST method as a user-agent) onto the Task Performer (here an origin-server) using Create UPS Workitem [RAD-80].
The UML sequence diagram was created using [https://www.websequencediagrams.com/](https://www.websequencediagrams.com/) with the following script:

```
participant Task\nRequestor as REQ
participant Task\nManager as ORC
participant Task\nPerformer as PER
REQ-->ORC: Create Workitem [RAD-80]
ORC-->REQ: workitem UID (X)
ORC-->PER: Create Workitem [RAD-80]
PER-->ORC: workitem UID (Y)
PER-->ORC: Claim UPS Workitem [RAD-82]\n workitem (X)
ORC-->PER: Transaction UID (X)
ORC-->REQ: Send UPS Notification [RAD-87]\n (Workitem X claimed)
deactivate ORC
note over REQ,PER: Continue with Step 4 Retrieve referenced input data
```

The Task Requestor sends the Create UPS Workitem for an Inference Request as usual. The Task Manager creates workitem X and assigns the workitem to a Task Performer.
Step 3: Push Workitem

Once the requested workitem X is assigned, the Task Manager copies the entire contents of workitem X, including the assignment, into a Create UPS Workitem, populating the affected SOP Instance UID (0000,1000) with workitem X.

The Task Performer receives the Create UPS Workitem and creates Workitem Y for the response to the Task Manager. Once created, the Task Performer may complete this workitem at any time.

The purpose was to convey the contents for workitem X.

The Task Performer uses the affected SOP Instance UID (0000,1000) contained in workitem Y to Claim Ups Workitem (workitem X) and receives the Transaction UID (X) from the Task Manager.

X.4.2.4 Use Case 4: Proxy-based Inference Workflow

In today’s environment there are scenarios where AI Models have very limited capabilities. The AI Model may be stateless, providing a single purpose and limited results. There may be multiple simple AI Models which would be required. For this use case the Task Performer acts as a proxy on behalf of the AI Model. This is manageable using a Task Performer to act as a proxy on behalf of the AI Model.

As illustrated below, the Task Performer retrieves the referenced input data and captures the results as a proxy for the AI Model. Note that the Task Performer provides temporarily store the input and results data for the duration of the proxied task.

The example is independent of the type of workflow used by the Task Performer.
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
(AI Model) as PER
participant Proxied
nAI Model as PAM note over ORC,PER: Manage Workitem as usual
PER->+IM: Retrieve Referenced Input Data
using [RAD-107] or [RAD-16]
activate PER
IM-->-PER:
note over PER,PAM: Communicate to exchange input data,
perform inference,
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]
```

805 **X.4.2.5 Use Case 5: Inference Workflow using local Data Cache**

For cloud-based, as well as enterprise systems, Task Performer may not have direct access to the input data or output destination points. There is also the case where there may be multiple Task Performers requiring access to the same data. In these cases, the Task Manager may need to facilitate a local cache on behalf of the Task Performers requiring access to the input data.

810 The Task Manager retrieves the input data as referenced in workitem X. All the content from workitem X is copied into Workitem Y. The referenced input data is redirected to local Cache. The output destination is redirected to the Local Cache.

When the inference steps are complete, the Task Manager stores the results to the output destination identified in workitem X.
Figure X.4.2.5-1: Inference with Local Cache

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

```
participant Task Requestor as REQ
participant Image Manager as IM
participant Task Manager as ORC
participant Data Cache as DC
participant Task Performer (AI Model) as PER

REQ -> ORC: Create Workitem [RAD-80] workitem X
ORC -> IM: Retrieve Referenced Input Data
IM -> ORC: referenced Input data
ORC -> ORC: Create Workitem Y
PER -> ORC: Query [RD-80]/Get [RAD-83]/Claim [RAD-83] UPS Workitem (Y)
activate PER
PER -> ORC: Retrieve Referenced Input Data
ORC -> PER: referenced Input data
PER -> DC: Store Results using referenced endpoints
PER -> ORC: Update [RAD-84]/Complete UPS Workitem [RAD-85]
deactivate PER
ORC -> ORC: Complete Workitem Y
```

https://www.websequencediagrams.com/
X.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 made widely available. Here, the Task Manager is shown facilitating by subdividing Workitem X into two sub-workitems (Workitem Y for the inference step, and Workitem Z for the review step).

Other patterns involving the RIS, PACS or the AI Model are also possible.

The Task Manager copies most of the details from Workitem X into Workitem Y, but to sequester the results, it specifies a different destination (referred to here as the Verification Cache) for the output of the inference step. The Verification Cache has the same functionality as an Image Manager and might be implemented as a component of the Task Manager or could be a feature of the PACS or VNA or could be a standalone system. When the inference step is complete, the Task Manager creates Workitem Z whose inputs are the outputs of Workitem Y in the Verification Cache, and whose output destination is the original Image Manager specified by the Task Requester in Workitem X.

How the results are verified is not specified as part of this use case. Note that the only requirement here is that a Human performs the verification task and the results are stored to their destination.

This example shows the Triggered Pull, other patterns are possible.
Figure X.4.2.6-1: Inference with Verification

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

```plaintext
participant Task\nRequestor as REQ
participant Image\nManager as IDS
participant Task\nManager as ORC
participant Task\nPerformer\n(AI Model) as PER
participant Verification\nCache as IDC
```

The script defines the participants involved in the workflow, including a requestor, image manager, task manager, task performer (AI model), and verification cache. The sequence diagram illustrates the flow of operations, including creation of workitems, send notification, and the verification process. The diagram uses UML notation to represent the interactions and steps involved in the inference and verification processes.
X.5 AIW-I Security Considerations

When managing large numbers of Task Performers, security and access to the source Image Manager is a major concern. Limiting the source Image Manager with transfers only to the Local Image Manager/Cache grouped with the Task Manager as the access point for Task Performers limits the vulnerability of the source Image Manager.

Updates to claimed tasks are limited to systems providing the Transaction UID given to the Task Performer that claimed the task. However, if the Transaction UID is stolen by another malicious system, then potentially it can submit fake results and/or modify the task status to prevent the actual Task Performer from completing the task. A sanity check is for the Task Requester / Task Manager to check if the Transaction UID is used consistently by the same system.

X.5.1 Secure Transport and Data Logging

When storing and accessing the input information and output information as well, it is highly recommended to use HTTPS or DICOM over TLS according to the IHE ITI Audit Trail and Node Authentication (ATNA) Profile.

Logging of access and creation is covered in the ATNA Radiology Audit Trail Option.
X.5.2 Authorization and Access

With the scalability of multiple Requestors and multiple users, the architecture will need to rely on trusted applications. Using OAuth 2.0 authentication layer will help issues regarding consent and access. IHE ITI Internet User Authorization (IUA) Profile incorporates the use of OAuth 2.0 with RESTful services. It is recommended that this profile is incorporated in the overall architecture.

X.5.3 Protected Health Information

In simple usage, the workitem and the referenced data are associated with specific patient and contain the corresponding demographic and clinical metadata which is PHI. In some deployments, performers are part of the clinical IT infrastructure and process PHI directly.
One could imagine deployments where the performers are outside of the hospital IT boundaries. Many inferences do not need for PHI to be included as part of the processing. It is conceivable for a proxy to create a deidentified workitems and datasets which might still allow the performer to complete its processing without accessing PHI and the proxy would put the results back into the correct patient record.
Image data which contains PHI must be protected based on the current regulations and policies regarding the handling of image data with PHI.

X.6 AIW-I Cross Profile Considerations

WIA - Web Image Access
An Imaging Document Consumer in the Web Image Access (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.

MHD - Mobile access to Health Documents
A Document Consumer in the ITI Mobile access to Health Documents (MHD) Profile might be grouped with a Task Requestor to find other relevant data sources for reference in the Input information Sequence.

XDS-I.b - Cross Enterprise Document Sharing for Imaging
An Imaging Document Consumer in the Cross-Enterprise Document Sharing for Imaging (WDS-I.b) 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.

XDS - Cross Enterprise Document Sharing
A Document Consumer in the ITI Cross Enterprise Document Sharing (XDS) Profile might be grouped with a Task Requestor to find other relevant data sources for reference in the Input information Sequence.
mXDE - Mobile Cross Enterprise Document Data Element Extraction

A Clinical Data Consumer in the ITI Mobile Cross Enterprise Document Data Element Extraction (mXDE) Profile might be grouped with a Task Requestor to accesses data elements extracted from shared structured documents for use in the UPS Workitem.

QEDm - Query for Existing Data for Mobile

A Clinical Data Consumer in the PCC Query for Existing Data for Mobile (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.

IDEP - Import and Display of External Priors

An Importer in the Import and Display of External Priors (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.

AIR - AI Results

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

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

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.
Volume 2 – Transactions

Update Section 4.49 for [RAD-49]:
Add Task Requestor as another recipient of Instance Availability Notification.

4.49 Instance Availability Notification [RAD-49]
Modify paragraph


4.49.2 Use Case Roles
Update Diagram with additional actor Task Requestor
Add: Actor & Role

4.49.2 Use Case Roles

... Actor: Task Requestor

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

4.49.4 Messages
Update diagram under 4.49.4 Messages To add Task Requestor

Update Section 49.4.1.2:

4.49.4.1.2 Message Semantics

... “The DSS/Order Filler, Post-Processing Manager, Task Requestor, 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”

Update Section 49.4.1.3:
4.49.4.1.3 Expected Actions

The Department System Scheduler/Order Filler, Post-Processing Manager, Task Requestor, and Report Manager shall act as an Instance Notification SOP Class SCP. 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 corresponding worklist.
- **The Task Requestor creates a notification to create a work item for post-processing by a Task Performer with the available instances and other information taken from the IAN message as input.**

Add Create UPS Workitem [RAD-80]

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.

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.

In an unscheduled or append case, 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 Use Case Roles

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

- 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

990
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 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.

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 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

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 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 11.4.
4.80.4.1.2.1 UPS Attribute Requirements

In addition to the UPS N-CREATE requirements described in DICOM PS3.4, the Requestor shall comply with the following requirements.

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.

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.

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 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.

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

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.

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 available for retrieval.

See Appendix W for details on the correspondence between attribute values in unscheduled UPS instances and associated DICOM objects.

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.
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 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 Workitem for AI Workflow for Imaging

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

Study Instance UID (0020,000D) is provided by the Requestor for use as the Output of the AI Results in DICOM format. Note that the Input Information Sequence could include multiple Study Instances.

4.80.4.1.3 Expected Actions

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.

4.80.4.1.3.1 AI Workflow for Imaging Workitem

The Manager claiming the AI Imaging Profile shall attempt to assign the Task Performer when successfully creating the workitem using the Performer’s AE Title in Scheduled Station Name Code Sequence (0040,4025).

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.

Add 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 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role:</th>
<th>Requestor:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Query the Manager for Procedure Steps.</td>
</tr>
<tr>
<td>Actor(s):</td>
<td>The following actors may play the role of Requestor:</td>
</tr>
<tr>
<td></td>
<td>Workitem Performer</td>
</tr>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
<tr>
<td></td>
<td>Watcher</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role:</th>
<th>Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Manage Unified Procedure Steps for workitems; accept query requests for Worklist items, return an appropriately filtered list of workitems.</td>
</tr>
<tr>
<td>Actor(s):</td>
<td>The following actors may play the role of Manager:</td>
</tr>
<tr>
<td></td>
<td>Workitem Manager</td>
</tr>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
</tbody>
</table>
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
- 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

![Interaction Diagram](image)

**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.
DICOM RESTful Message Semantics

The message is a Search For UPS 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 6.9-11.9.

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>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient's Name</td>
<td>(0010,0010)</td>
</tr>
<tr>
<td>Patient ID</td>
<td>(0010,0020)</td>
</tr>
<tr>
<td>Issuer of Patient ID</td>
<td>(0010,0021)</td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
</tr>
</tbody>
</table>

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.

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

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).
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

<table>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Referenced Request Sequence</td>
<td>(0040,A370)</td>
</tr>
<tr>
<td>&gt;Accession Number</td>
<td>(0008,0050)</td>
</tr>
<tr>
<td>&gt;Issuer of Accession Number Sequence</td>
<td>(0008,0051)</td>
</tr>
<tr>
<td>&gt;&gt;Local Namespace Entity ID</td>
<td>(0040,0031)</td>
</tr>
<tr>
<td>&gt;&gt;Universal Entity ID</td>
<td>(0040,0032)</td>
</tr>
<tr>
<td>&gt;&gt;Universal Entity ID Type</td>
<td>(0040,0033)</td>
</tr>
<tr>
<td>&gt;Requested Procedure ID</td>
<td>(0040,1001)</td>
</tr>
<tr>
<td>Scheduled Workitem Code Sequence</td>
<td>(0040,4018)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
</tr>
</tbody>
</table>

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.

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

<table>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled Station Name Code Sequence</td>
<td>(0040,4025)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Scheduled Procedure Step Start DateTime</td>
<td>(0040,4005)</td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
</tr>
</tbody>
</table>

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. 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

<table>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled Station Class Code Sequence</td>
<td>(0040,4026)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Scheduled Procedure Step Start DateTime</td>
<td>(0040,4005)</td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
</tr>
</tbody>
</table>

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

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

<table>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scheduled Workitem Code Sequence</td>
<td>(0040,4026)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Requested Procedure Code Sequence</td>
<td>(0032,1064)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
</tr>
</tbody>
</table>

### 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

<table>
<thead>
<tr>
<th>Matching Key Attributes</th>
<th>Tag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Human Performer Code Sequence</td>
<td>(0040,4026)</td>
</tr>
<tr>
<td>&gt;Code Value</td>
<td>(0008,0100)</td>
</tr>
<tr>
<td>&gt;Coding Scheme Designator</td>
<td>(0008,0102)</td>
</tr>
<tr>
<td>Human Performer's Organization</td>
<td>(0040,4036)</td>
</tr>
</tbody>
</table>
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 For UPS 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.

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.

4.81.4.2.3 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.
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 IN PROGRESS. 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 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role:</th>
<th>Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Takes ownership of a workitem for the purpose of updating it.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workitem Performer</td>
</tr>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role:</th>
<th>Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Confirms/grants ownership of a workitem to the Performer.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Workitem Manager</td>
</tr>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
</tbody>
</table>

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
4.82.4 Messages

**4.82.4.1 Change UPS State**

The Performer asks the Manager of a UPS instance to change the workitem state to IN PROGRESS.

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.

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 11.7.

The Performer shall generate a Locking UID and request that the UPS State be changed to IN PROGRESS as described in DICOM PS3.4 Annex CC. The Locking UID is conveyed in the 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 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).

**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.
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.

Add 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 a workitem.

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

<table>
<thead>
<tr>
<th>Role: Requestor:</th>
<th>Requests details for a workitem.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s):</td>
<td>The following actors may play the role of Requestor:</td>
</tr>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role: Manager:</th>
<th>Provides the requested details for the requested UPS instance that it manages.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s):</td>
<td>The following actors may play the role of Manager:</td>
</tr>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
</tbody>
</table>

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
- 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

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 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:

- 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 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.

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.

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

See RAD TF-2x: Appendix V 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.

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

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 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.
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.

4.83.4.2.3 Expected Actions

The Manager shall provide the requested attributes and return appropriate success or failure 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

This transaction is not associated with an ATNA Trigger Event.

---

Add Update UPS Workitem [RAD-84]

4.84 Update UPS Workitem [RAD-84]

4.84.1 Scope

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 the instance directly rather than use this transaction.

4.84.2 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role:</th>
<th>Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Provides updated attribute values for a workitem it is performing.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
<tr>
<td></td>
<td>Workitem Performer</td>
</tr>
</tbody>
</table>
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

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
- 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

![Interaction Diagram]

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

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
SCU, and the Manager is the SCP.

As described in DICOM PS3.4, the Performer needs to have the Locking UID for the UPS
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.

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.
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 designated system. The Code Meaning (0008,0104) shall contain either the AE-Title of the 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 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.

4.84.4.1.2.1.1 USP Attribute Requirements for Inference Workitem

In addition to the UPS N-Set requirements specified in Section 4.84.4.1.2.1, The user agent shall comply with the requirements defined here.

The Output Information Sequence (0040,4033) shall be populated, indicating where the AI Results are stored.

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.

Add 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 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role</th>
<th>Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Finalizes and gives up ownership of a workitem.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Performer:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
<tr>
<td></td>
<td>Workitem Performer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role</th>
<th>Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Confirms/finalizes the workitem.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
<tr>
<td></td>
<td>Workitem Manager</td>
</tr>
</tbody>
</table>

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

Figure 4.85.4-1: Interaction Diagram

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)).

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 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 6.911.7.

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.

Add Manage UPS Subscription [RAD-86]

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 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 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.

### 4.86.2 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role:</th>
<th>Subscriber:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Requests to change its subscription status to one or more UPS workitems.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Subscriber:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Watcher</td>
</tr>
<tr>
<td></td>
<td>Task Requester</td>
</tr>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role:</th>
<th>Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Modify subscription record as requested.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Actor(s):</th>
<th>The following actors may play the role of Manager:</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
<tr>
<td></td>
<td>Workitem Manager</td>
</tr>
</tbody>
</table>

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)
- 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

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.

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 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

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

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.

- 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 unsubscribe Transaction Action** is used to stop receiving 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.

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.

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

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 (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

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

Managers that support the ATNA Profile shall audit this transaction.
This transaction corresponds to a Query Information ATNA Trigger Event.

Add Send UPS Notification [RAD-87]

4.87 Send UPS Notification [RAD-87]

4.87.1 Scope

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

4.87.2 Use Case Roles

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

<table>
<thead>
<tr>
<th>Role: Subscriber:</th>
<th>Accepts notifications.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s): The following actors may play the role of Subscriber:</td>
<td></td>
</tr>
<tr>
<td>Watcher</td>
<td></td>
</tr>
<tr>
<td>Task Performer</td>
<td></td>
</tr>
<tr>
<td>Task Requester</td>
<td></td>
</tr>
<tr>
<td>Workitem Performer</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Role: Manager:</th>
<th>Sends notifications about a workitem based on trigger events (such as changes in the state of the workitem).</th>
</tr>
</thead>
<tbody>
<tr>
<td>Actor(s): The following actors may play the role of Manager:</td>
<td></td>
</tr>
<tr>
<td>Task Manager</td>
<td></td>
</tr>
<tr>
<td>Workitem Manager</td>
<td></td>
</tr>
</tbody>
</table>

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

- 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

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.

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 to send a Workitem Event Report. 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.
4.87.4.1.3.1 AIW Expected Actions

If the Task Requestor receives a Progress Report that includes in the Progress Information Sequence (0074,1002) a Procedure Step Communications Sequence (0074,1008) with a Contact URI(0074,100a), the Task Requestor is required to honor the request.

4.87.5 Security Considerations

4.87.5.1 Security Audit Considerations

This transaction is not associated with an ATNA Trigger Event.

Add Open Event Channel [RAD-109]

4.109 Open Event Channel [RAD-109]

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 shown here:

<table>
<thead>
<tr>
<th>Role</th>
<th>Actor(s):</th>
</tr>
</thead>
<tbody>
<tr>
<td>Subscriber:</td>
<td>Initiates the channel on which it will receive events.</td>
</tr>
<tr>
<td></td>
<td>The following actors may play the role of Subscriber:</td>
</tr>
<tr>
<td></td>
<td>Watcher</td>
</tr>
<tr>
<td></td>
<td>Task Performer</td>
</tr>
<tr>
<td></td>
<td>Task Creator</td>
</tr>
<tr>
<td>Manager:</td>
<td>Keeps the channel open and uses it to send events to the Subscriber.</td>
</tr>
<tr>
<td></td>
<td>The following actor may play the role of Manager:</td>
</tr>
<tr>
<td></td>
<td>Task Manager</td>
</tr>
</tbody>
</table>
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

1770 DICOM PS3.18: DICOM UPS-RS Worklist Service
IETF RFC6455: The WebSocket Protocol

### 4.109.4 Messages

**Figure 4.109.4-1: Interaction Diagram**

```
<table>
<thead>
<tr>
<th>Subscriber</th>
<th>Manager</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Open Event Channel</td>
</tr>
</tbody>
</table>
```

#### 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.
Appendices to Volume 2

Add the following new appendix to RAD TF-2x

Appendix V: Attribute Consistency between UPS and Resulting Composite IODs

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 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 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 listed in the Input Information Sequence (0040,4021).

Table V-1: Mapping UPS attributes to Resulting IODs

<table>
<thead>
<tr>
<th>DICOM attribute</th>
<th>UPS Workitem</th>
<th>Image/ Standalone IOD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Patient’s Name (0010,0010)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Patient ID (0010,0020)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Issuer of Patient ID Macro</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Other Patient IDs Sequence (0010,1002)</td>
<td>Source (See Note 1)</td>
<td>Copy</td>
</tr>
<tr>
<td>Patient’s Birth Date (0010,0030)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Patient’s Sex (0010,0040)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Admission ID (0038,0010)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Issuer of Admission ID Sequence (0038,0014)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Admitting Diagnoses Description (0008,1080)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Admitting Diagnoses Code Sequence (0008,1084)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Study Instance UID (0020,000D)</td>
<td>Source (See Note 2)</td>
<td>Copy</td>
</tr>
<tr>
<td>DICOM attribute</td>
<td>UPS Workitem</td>
<td>Image/ Standalone IOD</td>
</tr>
<tr>
<td>------------------------------------------------------</td>
<td>-------------------------------------</td>
<td>-----------------------</td>
</tr>
<tr>
<td>Requested Procedure ID (0040,1001)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Accession Number (0008,0050)</td>
<td>Source</td>
<td>Copy (See Note 3)</td>
</tr>
<tr>
<td>Issuer of Accession Number (0008,0051)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Study Instance UID (0020,000D)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Requested Procedure Description (0032,1060)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Requested Procedure Code Sequence (0032,1064)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Reason for Requested Procedure (0040,1002)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Reason for Requested Procedure Code Sequence (0040,100A)</td>
<td>Source</td>
<td>Copy</td>
</tr>
<tr>
<td>Scheduled Procedure Step Description (0040,0007)</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Scheduled Protocol Code Sequence (0040,0008)</td>
<td>n.a.</td>
<td></td>
</tr>
<tr>
<td>Procedure Step Label (0074,1204)</td>
<td>Source</td>
<td>n.a.</td>
</tr>
<tr>
<td>Scheduled Workitem Code Sequence (0040,4018)</td>
<td>Source</td>
<td>n.a.</td>
</tr>
<tr>
<td>Performed Procedure Step ID (0040,0253)</td>
<td>n.a.</td>
<td>Leave blank.</td>
</tr>
<tr>
<td>Performed Procedure Step Start DateTime (0040,4050)</td>
<td>Equal (internally generated)</td>
<td>n.a.</td>
</tr>
<tr>
<td>Performed Procedure Step Start Date (0040,02444)</td>
<td>See above</td>
<td>Equal (internally generated) to the Date component of Performed Procedure Step Start DateTime (0040,4050)</td>
</tr>
<tr>
<td>Performed Procedure Step Start Time (0040,0245)</td>
<td>See above</td>
<td>Equal (internally generated) to the Time component of Performed Procedure Step Start DateTime (0040,4050)</td>
</tr>
<tr>
<td>Performed Procedure Step End DateTime (0040,4051)</td>
<td>(internally generated)</td>
<td>n.a.</td>
</tr>
<tr>
<td>Performed Procedure Step Description (0040,0254)</td>
<td>Equal (internally generated)</td>
<td>Equal (internally generated).</td>
</tr>
<tr>
<td>Performed Workitem Code Sequence (0040,4019)</td>
<td>Equal (internally generated)</td>
<td>n.a.</td>
</tr>
<tr>
<td>Performed Protocol Code Sequence (0040,0260)</td>
<td>n.a.</td>
<td>Equal (internally generated) to Performed Workitem Code Sequence (0040,4019).</td>
</tr>
</tbody>
</table>
###DICOM attribute | UPS Workitem | Image/ Standalone IOD
--- | --- | ---
Performed Processing Parameters Sequence (0074,1212) | Equal (internally generated) | n.a.
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. | 
Operators' Name (0008,1070) Operator Identification Sequence (0008,1072) >Person Identification Code Sequence (0040,1101) | n.a. | Equal (internally generated) to Contributing Equipment Sequence (0018,A001) Equal (internally generated) to contents of Actual Human Performers Sequence (0040,4035) (See Note 4)
Referenced SOP Class UID (0008,1150) | n.a. | 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 5)
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)

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

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.

Add the following new Appendix

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 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. 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

<table>
<thead>
<tr>
<th>Attribute Name</th>
<th>Tag</th>
<th>Req. Type N-CREATE (SCU/SCP)</th>
<th>Append</th>
<th>Ad Hoc</th>
</tr>
</thead>
<tbody>
<tr>
<td><em>(Source of values)</em></td>
<td></td>
<td><em>(prior UPS)</em></td>
<td><em>(selected data)</em></td>
<td></td>
</tr>
<tr>
<td>Transaction UID</td>
<td>(0008,1195)</td>
<td>2/2</td>
<td>Shall be empty</td>
<td></td>
</tr>
<tr>
<td>Scheduled Procedure Step Priority</td>
<td>(0074,1200)</td>
<td>1/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Procedure Step Label</td>
<td>(0074,1204)</td>
<td>1/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled Procedure Step Start DateTime</td>
<td>(0040,4005)</td>
<td>1/1</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Scheduled Workitem Code Sequence</td>
<td>(0040,4018)</td>
<td>2/2</td>
<td>See Note 1</td>
<td></td>
</tr>
<tr>
<td>Input Readiness State</td>
<td>(0040,4041)</td>
<td>1/1</td>
<td>See Note 2</td>
<td>See Note 2</td>
</tr>
<tr>
<td>Attribute Name</td>
<td>Tag</td>
<td>Req. Type N-CREATE (SCU/SCP)</td>
<td>(prior UPS)</td>
<td>Ad Hoc</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>-----------------</td>
<td>------------------------------</td>
<td>-----------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>(Source of values)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Input Information Sequence</td>
<td>(0040,4021)</td>
<td>2/2</td>
<td>Copy (See Note 3)</td>
<td>Copy (See Note 3)</td>
</tr>
<tr>
<td>Study Instance UID</td>
<td>(0020,000D)</td>
<td>1C/2</td>
<td>Copy</td>
<td>Copy (See Note 4)</td>
</tr>
<tr>
<td>Patient ID</td>
<td>(0010,0020)</td>
<td>1C/2</td>
<td>Copy</td>
<td></td>
</tr>
<tr>
<td>Referenced Request Sequence</td>
<td>(0040,A370)</td>
<td>2/2</td>
<td></td>
<td></td>
</tr>
<tr>
<td>&gt;Study Instance UID</td>
<td>(0020,000D)</td>
<td>1/1</td>
<td>Copy</td>
<td>Copy (See Note 4)</td>
</tr>
<tr>
<td>&gt;Accession Number</td>
<td>(0008,0050)</td>
<td>2/2</td>
<td>Copy</td>
<td>Copy (See Note 4)</td>
</tr>
<tr>
<td>&gt;Issuer of Accession Number</td>
<td>(0008,0051)</td>
<td>2/2</td>
<td>Copy</td>
<td></td>
</tr>
<tr>
<td>Procedure Step State</td>
<td>(0074,1000)</td>
<td>1/1</td>
<td>Shall be created with a value of “SCHEDULED”</td>
<td></td>
</tr>
<tr>
<td>Unified Procedure Step Performed Procedure Sequence</td>
<td>(0074,1216)</td>
<td>2/2</td>
<td>Shall be created empty</td>
<td></td>
</tr>
</tbody>
</table>

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.
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).