Digital Imaging and Communications in Medicine (DICOM)

Supplement NNN: DICOMweb Modality Services

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# Document History

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| --- | --- | --- | --- |
| 2024.08 | Version 00 | JM, DK | Initial version with proposed document structure and content. |
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# Open Issues

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| --- | --- |
| 1 | **Context:** Work Item 2023-10-C states “Add the Modality Worklist and the Modality Performed Procedure Step services to DICOMweb, in principle based on the existing DICOMweb Worklist service (UPS-RS; see [PS3.18, section 11](https://dicom.nema.org/medical/dicom/current/output/html/part18.html#chapter_11)). This would boil down to creating an informative annex and any normative changes needed if gaps are discovered.”  **Issue**: With this statement (creating an informative annex on the mapping and add applicable normative corrections) interoperability is not served, as informative text would give only *a* way of doing the mapping from DIMSE MWL and MPPS to UPS-RS, and other ways for achieving the same would be equally valid.  **Proposal**: Create (mostly) normative text. This way, there would be only one vetted way of doing this mapping, and interoperability would be served. In this, it is proposed to have a section on Modality Services where the high-level structure of other sections in PS3.18 (sections 9-13) is followed as much as possible, to simplify the process of understanding for the reader.  **Decision**: [WGxx: YYYY-MM-DD] None yet. |
| 2 | **Context**: In DIMSE MPPS notifications do not require subscription and can be unsolicited, while the DICOMweb Worklist Service manages notifications by using subscriptions.  **Issue**: One cannot map between these two different kinds of mechanisms.  **Proposal**: Circumvent it the way it has been done for UPS and UPS-RS.  Next to taking the same approach, it would benefit the reader to elaborate on why this is done this way, as to take him or her along.  **Decision**: [WGxx: YYYY-MM-DD] None yet. |
| 3 | **Context**:MPPS notifications can only indicate state changes, see [PS3.4, F.9.2](https://dicom.nema.org/medical/dicom/current/output/chtml/part04/sect_F.9.2.html), while UPS (-RS) notifications allow for many more aspects to be reported on, see [PS3.4, CC.2.4](https://dicom.nema.org/medical/dicom/current/output/chtml/part04/sect_CC.2.4.html).  **Issue**: Due to the difference in what can be reported, it is not possible to make a two-way mapping; therefore, it is impossible to define bi-directional proxies. It is, for instance, not possible to have a UPS-RS origin server notify an MPPS SCU about newly added performed procedure steps, even with a proxy, as such an update does not involve a state change as defined for MPPS.  **Proposal**: Limit the kinds of supported notifications for the DICOMweb Modality Services to actual state changes. These can be mapped back and forth, so it is in principle possible to define bi-directional proxies for such (limited) notifications.  **Decision**: [WGxx: YYYY-MM-DD] None yet. |
| 4 | **Context**: The notified parties of the MPPS notification service as specified in [PS3.4, F.9](https://dicom.nema.org/medical/dicom/current/output/chtml/part04/sect_F.9.html).  **Issue**: This service does not specify how the MPPS Notification SCP knows what SCUs to notify on MPPS changes.  **Proposal**: Do not change the current way this behavior is specified; just add one or more notes to make clear that this aspect is something beyond the standard, and that a conceivable way to achieve this would be configuring the SCP with the SCUs to be notified.  Note that a consequence of this proposal is that Modality Services cannot specify the exact mapping from and to UPS-RS in this respect.  **Decision**: [WGxx: YYYY-MM-DD] None yet. |
| 5 | **Context**: The DIMSE modality services MWL and MPPS distinguish between workitems and modality performed procedure steps; UPS-RS only knows about workitems.  **Issue**: To be able to map DIMSE information onto DICOMweb information, it needs to be completely clear how a UPS-RS workitem can be uniquely identified based on information in the MWL workitem.  **Proposal**: The applicable workitem can be uniquely identified by Study Instance UID, Accession Number, and Scheduled Procedure Step ID.  **Decision**: [WGxx: YYYY-MM-DD] None yet. |
| 6 | **Context**: Discontinue /Cancellation of Workitems.  **Issue**: UPS-RS knows about cancellation of Workitems, while MWL does not. There is the notion of discontinuing performed procedure steps, but that will not cancel a workitem.  **Proposal**: None yet.  **Decision**:[WGxx: YYYY-MM-DD] None yet. |
| 7 | **Context:** Multiplicity of relations between scheduled and performed procedure steps  **Issue:** MWL and MPPS may relate between scheduled and performed procedure steps in an m:n multiplicity (for instance due to the append and group cases), while UPS only allows for 1:1 relations. This makes it impossible to map between these two models.  **Proposal:** None yet.  **Decision:** [WGxx: YYYY-MM-DD] None yet. |

# Closed Issues

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# Scope and Field of Application

The DICOMweb Modality Services are an extension to the existing DICOMweb services, mimicking the Modality Worklist (MWL) and Modality Performed Procedure Step (MPPS) services that are already available in DIMSE. It has been designed such that it is relatively easy to create proxies from/to DIMSE to/from DICOMweb Modality Services.

This supplement describes the way to perform modality services MWL and MPPS based on DICOMweb’s UPS-RS.

**Changes to NEMA Standards Publications PS 3.18**

Add new section X Modality Services and Resources

# X Modality Services and Resources

## X.1 Overview

The Modality Services provide modality-oriented workflow management for user agents. These services correspond to the DIMSE Modality Worklist (MWL) and Modality Performed Procedure Step (MPPS) services as defined in Annexes K and F of PS3.4 respectively and have – where possible – the same semantics.

The Modality Services do not define their own resources but apply the Worklist Service as defined in Section 11. In effect, this defines a mapping from the MWL and MPPS services to the UPS-RS service. Sections B.xx-B.yy show examples of how mapping could be done using proxies.

### X.1.2 Scenarios (Informative)

The scope of the modality services is the management of acquisition modality-oriented workflows. While the Modality Services are not restricted to the scenarios identified in this section, these give a general impression of what can and is meant to be achieved using these services.

#### X.1.2.1 Scheduled Acquisition Workflow

In this workflow, the acquisition modality will query a worklist provider for workitems, each elaborating on what procedure step has been scheduled to perform. The operator of the acquisition modality will select the appropriate workitem and will perform acquisition according to that scheduled procedure step. The acquisition modality will notify the worklist provider when the acquisition of images, waveforms, etc. is starting. It will continue to update the worklist provider on the workitem during the acquisition process until it is done, after which it will mark the workitem as completed.

Figure X.1.2.1-1 shows typical interaction of an acquisition modality with a worklist provider in the context of a scheduled acquisition workflow. Here, the modality would typically play the role of the user agent, while the worklist provider would be the origin server.

Figure X.1.2.1-1. Typical Worklist Provider Interaction in a Scheduled Acquisition Workflow (Informative)

A screenshot of a computer

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#### X.1.2.2 Encounter-Based Acquisition Workflow

While the scheduled acquisition workflow as described in section X.1.2.1 always starts with a workitem including a description of what has been scheduled to be performed, an encounter-based imaging workflow does not have that; acquisition is performed ad-hoc. Hence, when it is wanted to properly record the performed procedure step(s), a workitem needs to be created, after which that workitem can be updated with the applicable information, even in one go, and the worklist provider can be told acquisition for the newly created workitem is done.

Figure X.1.2.2-1 shows typical interaction of an acquisition modality with a worklist provider in the context of an encounter-based acquisition workflow. Here too, as in the scheduled acquisition workflow, the modality would typically play the role of the user agent, while the worklist provider would be the origin server.

Figure X.1.2.2-1. Typical Worklist Provider Interaction in an Encounter-Based Acquisition Workflow (Informative)

A diagram of a workflow

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Naturally, it is also possible to update the created workitem per series instead of in one go.

#### X.1.2.3 Acquisition Workflow Monitoring

When there is a worklist provider serving several acquisition modalities, it can be imagined that there is a need to have an overview of what acquisition is to be performed and what acquisition has been performed in a dashboard fashion. Instead of polling, such a dashboard would need to be notified of events like workitem creation, update, and finalization.

Figure X.1.2.3-1 shows typical interaction of a worklist provider with acquisition modalities and an acquisition workflow dashboard in the context of acquisition workflow monitoring, where each action on a workitem is shown as an update abstractly. Here the modalities and the dashboard would typically play the role of user agents, while the worklist provider would be the origin server.

Figure X.1.2.3-1. Typical Worklist Provider Interaction for Acquisition Workflow Monitoring (Informative)

A diagram of a project

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#### X.1.2.4 Reviewing Workflow

A worklist provider could be responsible for maintaining data related to performed procedure steps. A PACS reviewing workstation may need to display the images for any study viewed. For the PACS to link the images to the study, it may receive a notification whenever a procedure step has been performed. When the PACS receives this notification, it may link the images and the performed procedure step to the study within its internal database or may choose to take no action.

Figure X.1.2.4-1 shows typical interaction of a worklist provider with a PACS in the context of reviewing. In such a configuration the worklist provider is the origin server and the PACS is the user agent.

Figure X.1.2.4-1. Typical Worklist Provider Interaction for Storage and Reviewing Workflow (Informative)

A diagram of a workflow

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### X.1.3 Concepts

There are several conceptual differences between the DIMSE services that are mirrored by the Modality Services and the Worklist Service that is used to supply the Modality Services. These differences are elaborated on below.

#### X.1.3.1 Entities

The DIMSE MWL and MPPS services distinguish between two kinds of entities, namely Worklists (with Workitems, each denoting a Modality Scheduled Procedure Step) and Modality Performed Procedure Steps. Here, Workitems are merely the input of the acquisition process, and Modality Performed Procedure Steps represent the log of what has been done at the modality. The DICOMweb Worklist Service only knows about Workitems, where progress – the non-empty set of performed procedure steps – is an integral part of a Workitem.

An important consequence of using DIMSE MWL and MPPS is that SCUs must copy applicable information from a Workitem to related Modality Performed Procedure Steps, that also need to be created. Using the DICOMweb Worklist Service this is not needed, as all applicable information is present in one object: the Workitem.

There may, however, be differences in the creation of objects depending on the workflow. In the scheduled acquisition workflow as sketched before, there is no need that the acquisition modality creates a Workitem, while the encounter-based acquisition workflow requires such creation, also when utilizing the Worklist Service.

#### X.1.3.2 Notification

While the DIMSE MPPS service utilizes the SCP initiated N-EVENT-REPORT for unsolicited state change notifications (PS3.4, F.9), the Worklist Service has a subscription mechanism for notifying user agents for all kinds of changes (11.10-11.11), based on WebSockets (8.10.4). Here we have three conceptual differences:

1. DIMSE makes the distinction between operations and notifications (compare for instance MPPS sections F.8.2 and F.9.2 of PS3.4) while DICOMweb’s REST interfaces only provides transactions, that can be considered equivalent in behavior to DIMSE operations, namely being client initiated. DICOMweb’s approach for notifications is that of using subscriptions, which will map to actions initiated by the origin server; see section 8.10. An example of how this is used is available in sections 11.10-11.12. Due to this conceptual difference, DIMSE notifications will be mapped to DICOMweb subscription transactions in the mapping tables below.
2. There is a possible mismatch in information, as MPPS notifications can only convey state changes, and UPS-RS notifications can convey much more, for example a newly added performed procedure step. Due to this conceptual difference, the scope of notifications for Modality Services is limited to state changes only, so a proper two-way mapping can be made.
3. In PS3.4, F.9 it is left open how the SCP knows about what SCUs are to be notified at state changes of Workitems (a possible approach to this could be having this as a configuration item of the SCP) while UPS-RS is clear about subscriptions. Due to this conceptual difference, Modality Services leaves this part of the mapping out of scope.

Note Concerning the second difference above, one should be observant regarding the terminology. Workitems – both in MPPS and UPS – have a state attribute. While MPPS only notifies about state changes when this state attribute changes, UPS notifies about all changes to a Workitem and calls this a state change. That can be confusing.

#### X.1.3.3 Discontinue versus Cancellation

To be expanded.

In the Worklist Service it is possible to cancel a workitem (with a Reason For Cancellation and a Procedure Step Discontinuation Reason Code Sequence), while in MPPS one can only discontinue a performed procedure step.

#### X.1.3.4 Relations between Scheduled and Performed Procedure Steps

To be expanded.

MWL and MPPS may relate between scheduled and performed procedure steps in an m:n multiplicity (for instance due to the append and group cases), while UPS only allows for 1:1 relations. This makes it impossible to map between these two models.

## X.2 Conformance

Origin servers conforming to the Modality Services shall support the transactions listed as Required in Table X.2-1.

Table X.2-1. Required and Optional Transactions

| Transaction | Support | Section |
| --- | --- | --- |
| Create Workitem | Required | Section X.4 |
| Claim and Prepare Workitem | Required | Section X.5 |
| Retrieve Workitem | Required | Section X.6 |
| Report Progress on Workitem | Required | Section X.7 |
| Change Workitem State | Required | Section X.8 |
| Get Applicable Workitems | Required | Section X.9 |
| Subscribe to State Changes | Required | Section X.10 |
| Unsubscribe from State Changes | Required | Section X.11 |

Implementations conforming to the Modality Services shall specify their role in their Conformance Statement (see PS3.2): origin server, user agent or both.

In addition, for each supported transaction they shall specify:

* the supported Query Parameters, including optional Attributes, if any;
* the supported DICOM Media Types;
* the supported character sets (if other than UTF-8).

An origin server conforming to the Modality Services shall implement the Retrieve Capabilities Transaction, specifying its role (see Section 8.9 and Annex H).

Implementation-specific warning and error codes shall be included in the Conformance Statement.

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## X.3 Transaction Overview

The Modality Services consist of the transactions shown in Table X.3-1.

Table X.3-1. Modality Services Transactions

| Transaction Name | Method | Payload | | Description |
| --- | --- | --- | --- | --- |
| Request | Success Response |
| Create Workitem | POST | dataset | none | Creates a new, in progress Workitem |
| PUT | none | none |
| Claim and Prepare Workitem | PUT | none | none | Claims a Target Workitem and fills it with the initial information |
| POST | dataset | none |
| Retrieve Workitem | GET | none | dataset | Retrieves the Target Workitem |
| Report Progress on Workitem | POST | dataset | none | Updates the Target Workitem with new information |
| Change Workitem State | PUT | none | none | Changes the state of the Target Workitem |
| Get Applicable Workitems | GET | none | results | Gets applicable Target Workitems |
| Subscribe to State Changes | POST | none | none | Subscribes to state changes of a Workitem |
| Unsubscribe from State Changes | DELETE | none | none | Unsubscribes to state changes of a Workitem |

Each of the Create Workitem and the Claim and Prepare Workitem transactions consist of two methods, due to the mapping from DIMSE Services to the DICOMweb Worklist Service. Table X.3-2 shows how the Modality Services transactions are mapped from the DIMSE MWL and MPPS operations and notifications to Worklist Service transactions.

Table X.3-2. Mapping Modality Services

| MWL and MPPS | | Modality Services | Worklist Service | |
| --- | --- | --- | --- | --- |
| Create | PS3.4, F.7.2.1 | Create Workitem | Create Workitem | 11.4 |
| Change Workitem State | 11.7 |
| Claim and Prepare Workitem | Change Workitem State | 11.7 |
| Update Workitem | 11.6 |
| Get Information | PS3.4, F.8.2.1 | Retrieve Workitem | Retrieve Workitem | 11.5 |
| Set Information | PS3.4, F.7.2.2 | Report Progress on Workitem | Update Workitem | 11.6 |
| Change Workitem State | Change Workitem State | 11.7 |
| Query | PS3.4, K.4 | Get Applicable Workitems | Search | 11.9 |
| Receive Event Notification | PS3.4, F.9.2 | Subscribe to State Changes | Subscribe | 11.10 |
| Provide Event Notification | Unsubscribe from State Changes | Unsubscribe | 11.11 |

Note Table X.3-2 is to be read middle-out. For instance, the Modality Services’ Change Workitem State transaction is mapped from DIMSE’s Set Information operation to the Worklist Service’s Change Workitem State transaction, and the Modality Services’ Claim and Prepare Workitem transaction is mapped from DIMSE’s Create operation to the Worklist Service’s Change Workitem State transaction, while the Modality Services’ Subscribe to State Changes transaction is mapped from DIMSE’s Receive and Provide Event Notifications to the Worklist Service’s Subscribe transaction.

## X.4 Create Workitem Transaction

### X.4.1 Request

See 11.4.1 and 11.7.1.

The Workitem contained in the payload is

### X.4.2 Behavior

The origin server shall create a new Workitem and set it in the IN PROGRESS state, returning a URL referencing the newly created Workitem in the Location header field of the response. A Workitem will only be added to the Worklist once.

The origin server shall create and maintain the Workitem as specified by the SCP behavior defined in Section CC.2.5.3 in PS3.4.

### X.4.3 Response

See 11.4.3.

## X.5 Claim and Prepare Workitem Transaction

### X.5.1 Request

See 11.7.1 and 11.6.1.

### X.5.2 Behavior

### X.5.3 Response

See 11.7.3 and 11.6.3.

## X.6 Retrieve Workitem Transaction

### X.6.1 Request

### X.6.2 Behavior

### X.6.3 Response

## X.7 Report Progress on Workitem Transaction

### X.7.1 Request

### X.7.2 Behavior

### X.7.3 Response

## X.8 Change Workitem State Transaction

### X.8.1 Request

### X.8.2 Behavior

### X.8.3 Response

### X.8.3.1 Status Codes

### X.8.3.2 Response Header Fields

### X.8.3.3 Response Payload

## X.9 Get Applicable Workitems Transaction

### X.9.1 Request

### X.9.2 Behavior

### X.9.3 Response

## X.10 Subscribe to Workitem Changes Transaction

### X.9.1 Request

### X.9.2 Behavior

### X.9.3 Response

## X.11 Unsubscribe to Workitem Changes Transaction

### X.9.1 Request

### X.9.2 Behavior

### X.9.3 Response

Add Sections to Annex B Examples

## B.x1 Example 1

## B.x2 Bi-directional Proxies

The Modality Services may be deployed in a hybrid environment, i.e., an environment in which both DICOMweb and DIMSE are used. In such a hybrid environment, a proxy can broker transactions from one service to the other, allowing a DICOMweb origin server or a DIMSE SCP to support modality services for a mixed set of DICOMweb user agents and DIMSE SCUs. DICOM does not require an implementation of proxies; however, since they would be particularly useful in a hybrid environment, the examples in this section show how this could be done.

Figure B.x2-1 shows how a proxy could facilitate a scheduled acquisition workflow from a DIMSE SCU to a DICOMweb origin server.

Figure B.x2-1. Scheduled Acquisition Workflow DIMSE Proxy for a DICOMweb Origin Server

A white rectangular object with black text

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Adapt section 4 Symbols and Abbreviated Terms

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**JSON** JavaScript Object Notation

**MPPS Modality Performed Procedure Step service. See PS3.4, Annex F.**

**MWL Modality Worklist service (formally defined as the Basic Worklist Management Service. See PS3.4, Annex K.**

**QIDO-RS** Query based on ID for DICOM Objects by RESTful Services

…

**UID** Unique (DICOM) Identifier

**UPS Unified Procedure Step service. See PS3.4, Annex CC.**

**UPS-RS** Unified Procedure Step by RESTful Services

…

**Changes to NEMA Standards Publications PS 3.4**

Update section F.9 with a note of how the SCP know what SCUs to notify about changes

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Note

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1. The terms IS and PACS used in the previous example are provided for clarification purposes only. This document does not define nor constrain the purpose or role of any IS, PACS or acquisition Application Entity conforming to this Service Class Specification.
2. **It is beyond the scope of the specification to define how the SCP knows about what SCUs to notify about changes. A conceivable way would be to make this a configuration item of the SCP.**

…