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## **Digital Imaging and Communications in Medicine (DICOM)**

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### *Supplement 171: Unified Procedure Step by REpresentational State Transfer (REST) Services (UPS-RS)*

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## **Scope and Field of Application**

This Supplement defines a set of REpresentational State Transfer (REST) Services for interfacing with the Unified Procedure Step Services. This could be implemented as a proxy to an existing UPS service or as a web service interacting directly with a worklist manager.

Security is beyond the scope of the RESTful services defined in this supplement. However generic Web security mechanisms are fully compatible. Several security programming recipes are provided for reference.

## TODO List

1	<p>Consider a Whitepaper on how all the pieces/mechanisms of UPS can/should be used to address various challenges.</p> <p>E.g. look at what was done for the Mammo Workflow diagrams and XDW</p> <ul style="list-style-type: none"><li>- be clear that the overall flow is external and is not represented explicitly in any of the individual artifacts</li><li>- the manager might know the overall flow/business logic and create UPS items accordingly</li><li>- the overall flow might be implicit in various UPS items being created in response to events (such as the completion of an antecedent UPS item, or availability of some object)</li><li>- high-level workflow managers should be able to use a (UPS) task manager for the individual task nodes. They might have not separated that clearly, but you could build a proxy client/creator.</li></ul> <p>This is where we could discuss the idea of a “Plan Task X” Task. (Like Plan better than Ordered State)</p> <p>Explain how separate worklists can work (either part of Service – so separate SCPs, or as the attribute in a query) The separate SCPs could be on different boxes or could be different ports/endpoints on the same box.</p>
2	<p>Description of how the interaction between DIMSE and REST should work. For example, a device that supports both DIMSE and REST worklist services should treat Create requests the same whether they are DIMSE or REST and, if it supports notifications, send the same event regardless of which creation method was used.</p>

## OPEN ISSUES

Topic	
1	Is there a better option than WebSocket for notifications?
2	Are any registered WebSocket sub-protocols worth inheriting? See IETF RFC6455, <a href="http://www.iana.org/assignments/websocket/websocket.xhtml">www.iana.org/assignments/websocket/websocket.xhtml</a> . Sub-protocols define additional behavior beyond the generic WebSocket data frame definition. Current definition just uses text data frames with content defined in Annex X.
3	Is it an issue that you need to actively open and upgrade a connection to receive notifications rather than just opening an SCP port?
4	Should ChangeUPSState action have a message body or just use query parameters? See Z.X.5. The message body would contain only two attributes.
5	Do events need additional fields, such as a Datetime? This would be useful if an Origin-Server chooses to buffer responses when connection is down (optional behavior). Currently only uses fields present in DIMSE event messages.
6	Should the supplement contain a more thorough description of how devices that support both DIMSE and RESTful services should operate?
7	Should notification work only using the method used to create the subscription? I.e. could a user-agent use the REST operation to subscribe an Application Entity to receive DIMSE notifications?
8	Should multiple filtered subscriptions be allowed (e.g. by allowing the subscriber to create a "well-known" UID with a subscription)? E.g., the user-agent would submit a request such as: POST {service}/workitems/{SubscriptionUID}/subscriptions/{AETITLE}?{query} where {SubscriptionUID} is a UID created by the user-agent which will be saved by the origin-server and used to manage the Filtered Global Subscription described by {query}. This would involve creating a new N-ACTION type for the DIMSE operation.

## CLOSED ISSUES

Topic	
1	<p>Should query use POST (instead of GET) due to possible URL length limitations?</p> <p><b>A: No.</b> It works OK for QIDO and this is likely to be similar.</p>
2	<p>Should the creation of multiple workitems in a single request be permitted?</p> <p><b>A: No.</b> The DIMSE UPS does not permit this. Although it could be proxied, it would raise additional questions about partial failures. Leave it out for now.</p>
3	<p>Should the Worklist (Label) be exposed in the resource or treated as an attribute?</p> <p><b>A. No</b></p> <p>DICOM treats it as an attribute. It might be convenient to get all workitems in a Worklist via a resource (but you could include as a query parameter) When you are interacting with a UPS instance, you don't really care about the worklist. It's mostly a query/grouping. Hmm. What about Global Subscription to a given worklist? Might be handy but DICOM doesn't support this now (so it would be awkward but possible to proxy)</p>
4	<p>What types of Push Workflow do we consider to be in scope?</p> <p><b>A. All push workflow can be supported.</b></p> <p>There might be implications on what we expect from a web application and/or browser system, etc. If we envisage them being SCPs too.</p>
5	<p>Could we do without Transaction UID in SET and use other mechanisms for identifying claiming system?</p> <p><b>A. Transaction UID works and maps to existing UPS.</b></p> <p>Also, would make it harder to borrow Part 4 text.</p>

6	<p>Should SET use PUT or POST?</p> <p><b>A. PUT.</b></p> <p>Some firewalls and proxies might not support POST for the reverse proxies. But they do support WebDAV (which does? Support POST?) We could GET, fix and PUT a full set of attributes. An advantage of POST is that it communicates the Before as well as the After allowing the SCP to detect blind collisions between two updates. (While PUT would let one unintentionally overwrite the other) JSON has a POST format that might be relevant to this.</p>
7	<p>If we use POST for both CREATE and SET do we need to make sure the SCP is clear? The State will differentiate for the SCP. Differing rules will come into play. During Create it will be SCHEDULED with lots of Scheduled and no Performed and vice versa for IN PROGRESS.</p> <p><b>A. NO</b></p>
8	<p>Does anything about using UPS access locks through a proxy need changing?</p> <p><b>A. NO. Diagram issue to confirm.</b></p>
9	<p>If you have sophisticated business logic managing your workflow, and it is feeding on specific triggers and events like the presence of a certain study or study type in the local image manager, when you spread the workflow across multiple sites, the logic engine might not have access to the same degree of low level triggers from a remote site, thus it is not transparent to having work done “anywhere” across the “affinity domain”. Polling mechanisms could be quite costly. If RWF-UPS is to address cross enterprise reading, these issues come to the fore.</p> <p><b>A. NOT AN ISSUE</b></p>
10	<p>Do we allow Create to omit the UID if the SCU doesn’t want to be able to generate UIDs?</p> <p><b>A. NO</b></p>
11	<p>Do we want to allow Query results to be provided in DICOM Binary? Really shouldn’t DICOM instance information always be available in any of the three representations (Binary, XML, JSON) – although are there implementation loads for the SCP?</p> <p><b>A. NO</b></p> <p>QIDO doesn’t allow this and we are paralleling QIDO. Note that if you can extract the Instance UID, you can still do a GET that requests the Binary. There are some questions about whether there would be a performance gain from getting UPS items sets in Binary. Maybe we should add to both to allow Binary in all the subservices, not just the GETS and PUTS</p>
12	<p>Should Part 10 objects be allowed or just XML / JSON?</p> <p><b>A. NO</b></p>

13	<p>Does using notifications rather than sending of UPS Instances to send a workitem to another device supported by this service?</p> <p><b>A. YES. The workitem performer must set up a subscription (global or filtered) in order to receive notification.</b></p>
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## Changes to NEMA Standards Publication PS 3.4-2013

### Digital Imaging and Communications in Medicine (DICOM)

#### 4: Service Class Specifications

Update Table CC.2.3-1. Subscribe/Unsubscribe to Receive UPS Event Reports - Action Information as follows

Table CC.2.3-1  
Subscribe/Unsubscribe to Receive UPS Event Reports – ACTION INFORMATION

Action Type Name	Action Type ID	Attribute	Tag	Requirement Type SCU/SCP
Subscribe to Receive UPS Event Reports	3	Receiving AE	(0074,1234)	1/1
		Deletion Lock	(0074,1230)	1/1
		<b>Match Keys (see CC.2.3.1)</b>		<b>3/3</b>
Unsubscribe from Receiving UPS Event Reports	4	Receiving AE	(0074,1234)	1/1
Suspend Global Subscription	5	Receiving AE	(0074,1234)	1/1

Update CC.2.3.2 Service Class User Behavior as follows

#### CC.2.3.2 Service Class User Behavior

The SCU subscribing to track the progress and results of the scheduled procedure step may be the system that created the UPS as an SCU of the UPS Push SOP Class, or it may be some other interested observer.

An SCU shall use the N-ACTION primitive to request the SCP to subscribe an AE (usually the requesting SCU) to receive event reports relating to UPS instances managed by the SCP. Since all UPSs are created as instances of the UPS Push SOP Class, the Requested SOP Class UID (0000,0003) in the N-ACTION request shall be the UID of the UPS Push SOP Class. See CC.3.1 for further details.

An SCU shall also use the N-ACTION primitive to request the SCP to unsubscribe an AE to stop receiving event reports relating to UPS instances managed by the SCP. Action Information is specified in Table CC.2.3-1. The SCU shall always provide the AE-TITLE which is to receive (or stop receiving) the N-EVENT-REPORTs.

To subscribe for events relating to *a single specific UPS instance* managed by the SCP, the SCU shall use Action Type ID 3 (Subscribe to Receive UPS Event Reports) and provide the SOP Instance UID of the specific UPS instance in the N-ACTION primitive request. The SCU shall indicate a need for the UPS instance to persist after its state has changed to COMPLETED or CANCELED by setting the value of the Deletion Lock to TRUE. Otherwise the SCU shall set the value of the Deletion Lock to FALSE.

To unsubscribe for events relating to *a single specific UPS instance* managed by the SCP, the SCU shall use Action Type ID 4 (Unsubscribe from Receiving UPS Event Reports) and provide the SOP Instance UID of the specific UPS instance in the N-ACTION primitive request.

To subscribe for events relating to *all current and subsequently created UPS instances* managed by the SCP, the SCU shall use Action Type ID 3 (Subscribe to Receive UPS Event Reports) and provide the well-known UID 1.2.840.10008.5.1.4.34.5 in the N-ACTION primitive request. The SCU shall indicate a need for UPS instances to persist after their states have changed to COMPLETED or CANCELED by setting the value of the Deletion Lock to TRUE. Otherwise the SCU shall set the value of the Deletion Lock to FALSE.

Note: This "global subscription" is useful for SCUs that wish to monitor all activities without having to issue regular C-FINDs to identify new UPS instances.

**To subscribe for events relating to a filtered subset of all current and subsequently created UPS instances (Filtered Global Subscription) managed by the SCP, the SCU shall use Action Type ID 3 (Subscribe to Receive UPS Event Reports) and provide both the well-known UID 1.2.840.10008.5.1.4.xx.x and a set of Matching Keys and values in the N-ACTION primitive request (see CC.2.3.3.1). The SCU shall indicate a need for UPS instances to persist after their states have changed to COMPLETED or CANCELED by setting the value of the Deletion Lock to TRUE. Otherwise the SCU shall set the value of the Deletion Lock to FALSE.**

Note: The well-known UID for a Filtered Global Subscription is distinct from the Global Subscription well-known UID

To unsubscribe for events relating to *all current UPS instances* managed by the SCP and also stop being subscribed to subsequently created UPS instances, the SCU shall use Action Type ID 4 (Unsubscribe from Receiving UPS Event Reports) and provide the well-known UID 1.2.840.10008.5.1.4.34.5 in the N-ACTION primitive request.

Note: This "global unsubscription" is useful for SCUs that wish to stop monitoring all activities and release all deletion locks (if any) placed for this subscriber.

To just stop being subscribed to subsequently created UPS instances, but still continue to receive events for currently subscribed instances managed by the SCP, the SCU shall use Action Type ID 5 (Suspend Global Subscription) and provide the well-known UID 1.2.840.10008.5.1.4.34.5 in the N-ACTION primitive request.

For each UPS instance on which the SCU has placed a deletion lock, either explicitly on the specific instance or implicitly via a global subscription with lock, the SCU shall remove the deletion lock once any needed final state information for the instance has been obtained. The deletion lock may be removed either by unsubscribing or by subscribing with the value of the Deletion Lock set to FALSE.

Note: The SCP will retain COMPLETED or CANCELED UPS Instances until all deletion locks have been released. Failure by SCUs to release the deletion lock may cause problems for the SCP. SCU's which do not have a significant need for the final state information, or who cannot dependably remove deletion locks should not use deletion locks.

The successful N-ACTION Response Status Code indicates that the SCP has received the N-ACTION request and the Subscription State for the AE has been successfully modified.

Note: When subscribing to a specific instance, the SCU can also expect to receive an initial N-EVENT-REPORT containing the current state of the UPS instance. When subscribing globally with the Deletion Lock set to TRUE, the SCU can expect to receive initial N-EVENT-REPORTs for every instance currently managed by the SCP. Initial N-EVENT-REPORTs for newly created instances, received as a result of a global subscription, will appear as transitions to the SCHEDULED state.

A warning N-ACTION Response Status Code of "Deletion Lock not granted", indicates that the AE subscription requested by the SCU was successful, but the deletion lock has not been set.

A failure N-ACTION Response Status Code indicates that the subscription state change requested will not be processed and no subscription states have been changed. The action taken by the SCU upon receiving this status is beyond the scope of this Standard.

At any time after receipt of the N-ACTION-Response, the SCU may release the association on which it sent the N-ACTION-Request.

### **CC.2.3.3 Service Class Provider Behavior**

Upon receipt of the N-ACTION request, the SCP shall attempt to update the Global Subscription State and/or UPS Subscription State of the specified AE with respect to the specified SOP Instance UID as described in Table CC.2.3-2 and then return, via the N-ACTION response primitive, the appropriate N-ACTION Response Status Code.

**The SCP may optionally support allowing an Application Entity to subscribe globally to a filtered set of UPS Instances. In this case, the Application Entity will only be subscribed to UPS Instances that match the search criteria specified by the Matching Keys of the N-ACTION request (see CC.2.3.3.1). If the SCP does not support Filtered Global Subscription it will return a Warning response (see Table CC.2.3-3).**

A success status conveys that the Global Subscription State and/or UPS Subscription State for the AE specified in Receiving AE (0074,1234) was successfully modified by the SCP. The AE-TITLE in Receiving AE (0074,1234) may be different than the AE-TITLE used by the SCU for the association negotiation. The SCP shall use the AE-TITLE specified in Receiving AE (0074,1234). This allows systems to subscribe other systems they know would be interested in events for a certain UPS.

For all UPS instances managed by the SCP, the SCP shall send N-EVENT-REPORTS (as described in CC.2.4.3) to AEs that have a UPS Subscription State of "Subscribed with Lock" or "Subscribed w/o Lock".

Upon successfully processing a subscription action, the SCP shall send initial UPS State Report N-EVENT-REPORTs, as indicated in Table CC.2.3-2, providing the current status of the UPS Instance to the Receiving AE.

The SCP may also refuse both specific and global Subscription requests by returning a failure N-ACTION Response Status Code for “Refused: Not Authorized” if the refusal depends on permissions related to the tasks or the requestor, or “Refused: SCP does not support Event Reports” if the SCP does not support sending the events. The SCP must document in its conformance statement if it might refuse Subscription requests.

The SCP may remove existing Deletion Locks by changing the UPS Subscription State for the AE from “Subscribed with Lock” to “Subscribed w/o Lock” and/or by changing the Global Subscription State for an AE from “Global Subscription with Lock” to “Global Subscription w/o Lock”. This is intended to allow the SCP to deal with SCU malfunctions. The SCP must document in its conformance statement if it might remove a Deletion Lock.

The SCP may also refuse the Deletion Lock portion of a specific or global Subscription request. For example, a request to modify the UPS Subscription State for the AE to “Subscribed with Lock” would instead result in a UPS Subscription State of “Subscribed w/o Lock” and a Warning status (see Table CC.2.3-3) returned to the requesting SCU. This is intended to deal with Security and related policy restrictions. The SCP must document in its conformance statement if it might refuse a Deletion Lock.

Bi-directional Authentication of machines/users/applications is possible at association time (see PS 3.7 and PS 3.15). PS 3.7 provides a “Refused: Not Authorized” error code. Further requiring or documenting authentication and/or authorization features from the SCU or SCP is beyond the scope of this SOP Class.

**CC.2.3.3.1 Filtered Global Subscription**

**An SCP that supports Filtered Global Subscription shall create an instance subscription for each UPS Instance that would match a C-FIND request with the same Matching Keys (see C.C.2.8.3).**

**The SCP shall support filtering by all Unified Procedure Step Instance Attributes in PS 3.4 Table CC.2.5-3 with a Match Key Type value of U, R or \*.**

**Update Table CC.2.5-3. UPS SOP Class N-CREATE/N-SET/N-GET/C-FIND Attributes as follows**

Attribute Name	Tag	Req. Type N-CREATE (SCU/SCP)	Req. Type N-SET (SCU/SCP)	Final State	Req. Type N-GET (SCU/SCP)	Match Key Type	Return Key Type	Remark/ Matching Type
...								
<b>Unified Procedure Step Relationship Module</b>								
...								

Attribute Name	Tag	Req. Type N-CREATE (SCU/SCP)	Req. Type N-SET (SCU/SCP)	Final State	Req. Type N-GET (SCU/SCP)	Match Key Type	Return Key Type	Remark/ Matching Type
Referenced Request Sequence	(0040,A370)	2/2	Not allowed	O	3/2	RO	2	Could be "changed" while SCHEDULED by canceling and re- creating with the "correct" values.
>Study Instance UID	(0020,000D)	1/1	Not allowed	O	-/1	O	1	
...								



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## Changes to NEMA Standards Publication PS 3.18-2013

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### Digital Imaging and Communications in Medicine (DICOM)

#### Part 18: Web Services

6 **Insert into PS 3.18 Section 3 Normative References (in correct order)**

8 IETF RFC6455 The WebSocket Protocol

10 **Insert into PS 3.18 Section 5.2 Symbols and Abbreviated Terms (in correct alphabetical order)**

12 UPS-RS Unified Procedure Step by RESTful Services

14 **Update Section 6.7 QIDO-RS – Search as follows**

#### 6.7.1 QIDO-RS – Search

##### 16 6.7.1.1 Request

The specific resources to be used for the search actions shall be as follows:

18 — Resource

— SearchForStudies

20 — {SERVICE}/studies[?query]

— SearchForSeries

22 — {SERVICE}/studies/{StudyInstanceUID}/series[?query]

— {SERVICE}/series[?query]

24 — SearchForInstances

— {SERVICE}/studies/{StudyInstanceUID}/series/{SeriesInstanceUID}/instances[?query]

26 — {SERVICE}/studies/{StudyInstanceUID}/instances[?query]

— {SERVICE}/instances[?query]

28 where

— {SERVICE} is the base URL for the QIDO RESTful service. This may be a combination of scheme (http or https), host, port, and application.

30 — {StudyInstanceUID} is the unique Study Instance UID for a single study.

- 32 — {SeriesInstanceUID} is the unique Series Instance UID for a single series.
- 34 — Method
  - GET
- 36 — Headers
  - 38 — Accept – The Media Type of the query results. The types allowed for this request header are:
    - multipart/related; type=application/dicom+xml (default)  
Specifies that the results should be DICOM PS3.19 XML (one part per result)
    - application/json  
Specifies that the results should be DICOM JSON
  - A QIDO-RS provider shall support both Accept header values
  - 44 — Cache-control: no-cache (recommended)  
If included, specifies that search results returned should be current and not cached.
- 46 — Query key=value pairs
  - 48 — {attributeID}={value}  
0-n / {attributeID}={value} pairs allowed
  - 50 — includefield={attributeID} | all  
0-n includefield / {attributeID} pairs allowed, where “all” indicates that all available attributes should  
52 be included for each response.
- 54 Each {attributeID} must refer to one of:
  - Patient IE attributes
  - 56 — Study IE attributes
  - Series IE attributes (SearchForSeries or SearchForInstances requests only)
  - 58 — Composite Instance IE attributes (SearchForInstances requests only)
  - Additional Query / Retrieve Attributes (DICOM PS 3.4 C.3.4)
  - 60 — Timezone Offset From UTC (0008,0201)
- 62 **See Section 6.7.1.1.1 for {attributeID} and {value} encoding rules**
- 64 ~~Each {attributeID} query value must be unique unless the associated DICOM Attribute allows UID List matching (see DICOM PS3.4 C.2.2.2), in which case each {value} will be interpreted to be an element of the UID List.~~
- 66 ~~— The acceptable values for {value} are determined by the types of matching allowed by C-FIND for its associated {attributeID} (see PS3.4 C.2.2.2). All characters in {value} that are disallowed for URLs must be URL encoded. See IETF RFC 1738 for details.~~
- 70 ~~— If an {attributeID} is passed as the value of an “includefield” query key this is equivalent to C-FIND Universal matching for the specified attribute (see DICOM PS3.4 C.2.2.2.3).~~
- 72
- 74 — fuzzymatching=true | false
- limit={maximumResults}

76 — offset={skippedResults}

78 **6.7.1.1.1 {attributeID} encoding rules**

80 **Each {attributeID} query value must be unique unless the associated DICOM Attribute allows UID List matching (see DICOM PS3.4 C.2.2.2), in which case each {value} will be interpreted to be an element of the UID List.**

82 **The acceptable values for {value} are determined by the types of matching allowed by C-FIND for its associated {attributeID} (see PS3.4 C.2.2.2). All characters in {value} that are disallowed for URIs must be percent-encoded. See IETF RFC 3986 for details.**

86 **If an {attributeID} is passed as the value of an “includefield” query key this is equivalent to C-FIND Universal matching for the specified attribute (see DICOM PS3.4 C.2.2.3).**

{attributeID} can be one of the following:

- 88 — {dicomTag}
- {dicomKeyword}
- 90 — {dicomTag}.{attributeID}, where {attributeID} is an element of the sequence specified by {dicomTag}
- {dicomKeyword}.{attributeID}, where {attributeID} is an element of the sequence specified
- 92 by {dicomKeyword}

94 {dicomTag} is the eight character hexadecimal string corresponding to the Tag of a DICOM Attribute (see PS3.6 Section 6).

96 {dicomKeyword} is the Keyword of a DICOM Attribute (see PS3.6 Section 6).

Note: Examples of valid values for {attributeID}:

- 98 — 0020000D
- StudyInstanceUID
- 100 — 00101002.00100020
- OtherPatientIDsSequence.PatientID
- 102 — 00101002.00100024.00400032
- OtherPatientIDsSequence.IssuerOfPatientIDQualifiersSequence.UniversalEntityID

104

Note: Examples of valid QIDO-RS URLs:

- 106 — http://dicomrs/studies?PatientID=11235813
- http://dicomrs/studies?PatientID=11235813&StudyDate=20130509
- 108 — http://dicomrs/studies?00100010=SMITH\*&00101002.00100020=11235813&limit=25
- http://dicomrs/studies?00100010=SMITH\*&OtherPatientIDsSequence.00100020=11235813
- 110 — http://dicomrs/studies?PatientID=11235813&includefield=00081048&includefield=00081049
- &includefield=00081060
- 112 — http://dicomrs/studies?PatientID=11235813&StudyDate=20130509-20130510
- http://dicomrs/studies?StudyInstanceUID=1.2.392.200036.9116.2.2.2.2162893313.
- 114 1029997326.94587%2c1.2.392.200036.9116.2.2.2.2162893313.1029997326.94583

116 **Add Section Z.X UPS-RS WORKLIST SERVICE**

**Z.X UPS-RS WORKLIST SERVICE**

118 This DICOM Web Service defines a RESTful interface to the UPS SOP Classes (See PS 3.3 & PS 3.4). It consists of the following action types:

- 120 1. CreateUPS  
 This action requests the creation of a UPS Instance on the Origin-Server. It corresponds to the UPS DIMSE N-CREATE operation.
- 122 2. UpdateUPS  
 124 This action sets the attributes of a UPS Instance managed by the Origin-Server. It corresponds to the UPS DIMSE N-SET operation.
- 126 3. SearchForUPS  
 128 This action searches for UPS Instances known to the Origin-Server. It corresponds to the UPS DIMSE C-FIND operation.
- 130 4. RetrieveUPS  
 This action retrieves a UPS Instances. It corresponds to the UPS DIMSE N-GET operation.
- 132 5. ChangeUPSState  
 This action sets the state of a UPS Instance managed by the Origin-Server. It corresponds to the UPS DIMSE N-ACTION operation.
- 134 6. RequestUPSCancellation  
 136 This action requests the cancellation of a UPS Instance managed by the Origin-Server. It corresponds to the UPS DIMSE N-ACTION operation.
- 138 7. CreateSubscription  
 This action subscribes to a UPS Instance or the Global Worklist managed by the Origin-Server. It corresponds to the UPS DIMSE N-ACTION operation.
- 140 8. SuspendGlobalSubscription  
 142 This action suspends an existing subscription to the Global Worklist managed by the Origin-Server. It corresponds to the UPS DIMSE N-ACTION operation.
- 144 9. DeleteSubscription  
 This action cancels an existing subscription to a UPS Instance or the Global Worklist managed by the Origin-Server. It corresponds to the UPS DIMSE N-ACTION operation.
- 146 10. OpenEventChannel  
 148 This action initiates a WebSocket connection to allow the User-Agent to start receiving Event Report messages.
- 150 11. SendEventReport  
 This action sends an Event Report using an open WebSocket connection. It corresponds to the UPS DIMSE N-EVENT-REPORT operation.

152 An Origin-Server shall support all of the above action types.

154 **Table Z.X-1  
 UPS Restful interface mapping**

Action Type	Section	RESTful Method & Resource
CreateUPS	Z.X.1	POST {SERVICE}/workitems
UpdateUPS	Z.X.2	POST {SERVICE}/workitems/{InstanceUID}[/]?transaction={TransactionUID}

Action Type	Section	RESTful Method & Resource
SearchForUPS	Z.X.3	GET {SERVICE}/workitems[?query]
RetrieveUPS	Z.X.4	GET {SERVICE}/workitems/{UPSInstanceUID}
ChangeUPSState	Z.X.5	PUT {SERVICE}/workitems/{UPSInstanceUID}/state
RequestUPSCancellation	Z.X.6	POST {SERVICE}/workitems/{UPSInstanceUID}/cancelrequest
CreateSubscription	Z.X.7	POST {SERVICE}/workitems/{UPSInstanceUID}/subscribers/{AETITLE}[?deletionlock=true false]  POST {SERVICE}/workitems/1.2.840.10008.5.1.4.XX.X/subscribers/{AETITLE}[?deletionlock=true false&query]
SuspendGlobalSubscription	Z.X.8	POST {SERVICE}/workitems/1.2.840.10008.5.1.4.34.5/subscribers/{AETITLE}/suspend  POST {SERVICE}/workitems/1.2.840.10008.5.1.4.XX.X/subscribers/{AETITLE}/suspend
DeleteSubscription	Z.X.9	DELETE {SERVICE}/workitems/{UPSInstanceUID}/subscribers/{AETITLE}
OpenEventChannel	Z.X.10	GET {WSSERVICE}/subscribers/{AETITLE}
SendEventReport	Z.X.11	N/A

156

158 The Origin-Server shall comply with all requirements placed on the SCP for the corresponding services in PS 3.4 Annex CC (Unified Procedure Step Service and SOP Classes).

160 **Z.X.1 CreateUPS**

This resource allows a User-Agent to instruct an Origin-Server to create a UPS instance.

162 **Z.X.1.1 Request**

The request message shall be formed as follows:

164 — Resource

— {SERVICE}/workitems

166 where

— {SERVICE} is the base URL for the service. This may be a combination of scheme (either HTTP or HTTPS), host, port, and application.

170 — Method

— POST

172

— Headers

- 174 — Content-Type – The representation scheme being posted to the RESTful service. The types  
allowed for this request header are as follows:
- 176 — application/dicom+xml  
Specifies that the post is PS 3.19 XML metadata. See Z.X.1.1.1
- 178 — application/json  
Specifies that the post is PS 3.18 JSON metadata. See Z.X.1.1.1
- 180
- The request body shall convey a single Unified Procedure Step Instance. The instance shall comply  
182 with all requirements in the Req. Type N-CREATE column of PS 3.4 Table CC.2.5-3.

#### 184 **Z.X.1.1.1 Metadata Request Message**

The Metadata Request Message has a single part body.

- 186 — Content-Type:
- application/dicom+xml
- 188 — application/json
- 190 — The request body contains all the metadata to be stored in either DICOM PS 3.19 XML metadata,  
DICOM PS 3.18 JSON metadata. Any binary data contained in the message shall be inline.

192

#### **Z.X.1.2 Behavior**

- 194 The Origin-Server shall create and maintain UPS instances as instructed by CreateUPS requests and as  
specified in PS 3.4 Table CC.2.5-3.
- 196 The Origin-Server shall return the HTTP/1.1 Status Line applicable to the associated request.
- The Origin-Server shall accept POST request primitives only if the value of the Procedure Step State  
198 (0074,1000) Attribute is "SCHEDULED". If the Procedure Step State Attribute has another value, the  
Origin-Server shall fail the CreateUPS request.
- 200 The Origin-Server may modify Attributes of a UPS instance, e.g., to correct invalid Attribute values. A  
description of the modifications the Origin-Server may perform shall be documented in the conformance  
202 statement of the Origin-Server.
- The Origin-Server may also create and maintain UPS instances without receiving a UPS instance N-  
204 CREATE or CreateUPS request, e.g., based on internal logic, operator inputs or HL7 messages. The  
contents of the instance created by the Origin-Server must still comply with the N-CREATE requirements  
206 in Table CC.2.5-3.
- Upon creating a new UPS Instance, the Origin-Server shall update UPS Subscription Status of the  
208 Instance for each AE or User-Agent with a Global Subscription as described in Z.X.7 (HTTP) and PS 3.4  
Section CC.2.3 (DIMSE).
- 210 Upon creating a new UPS Instance, the Origin-Server shall send UPS State Reports (if it supports either  
the WebSocket Event Notification or the UPS Event SOP Class) as described in Z.X.10 (HTTP) or PS 3.4  
212 Section CC.2.4.3 (DIMSE) regardless of whether the creation was based on an N-CREATE, a CreateUPS  
or on internal logic.

214 Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and  
216 PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform authorization.

**Z.X.1.3 Response**

218 The Origin-Server shall return an HTTP/1.1 response message.

**Z.X.1.3.1 Response Status Line**

220 If the Create request is successful, the Origin-Server shall return an HTTP/1.1 "201 - Created" response code.

222 If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table Z.X.1-1.

224

**Table Z.X.1-1  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
201	Created	The UPS instance was created and the new resource can be retrieved at the Content-Location specified in the response
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
409	Conflict	The UID of the posted UPS Instance corresponds to an existing UPS Instance.
503	Busy	Service is unavailable.

226

**Z.X.1.3.2 Response Headers**

228 If the request is successful, the HTTP/1.1 response message shall include the following HTTP/1.1 header:

— Content-Location: {WorkitemURL}

230 Where {WorkitemURL} is the URL from which the created UPS Instance can be retrieved (see Z.X.4 )

232 If the UPS instance was created with modifications, the response message shall include the following HTTP/1.1 header:

234 — Warning: 299 {SERVICE}: The UPS was created with modifications.

### 236 **Z.X.1.3.3 Response Message Body**

The response message body shall be empty.

238

## **Z.X.2 UpdateUPS**

240 This resource supports the modification of attribute values of an existing UPS Instance.

### **Z.X.2.1 Request**

242 The request message shall be formed as follows:

— Resource

244 — {SERVICE}/workitems/{UPSInstanceUID}[?transaction={TransactionUID}]

where

246 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either HTTP or HTTPS), host, port, and application.

248 — {UPSInstanceUID} is the UID of the Unified Procedure Step Instance

— {TransactionUID} is the Transaction UID / Locking UID for the specified Unified Procedure Step Instance

250 If the UPS instance is currently in the SCHEDULED state, the {TransactionUID} shall not be specified.

252 If the UPS instance is currently in the IN PROGRESS state, the {TransactionUID} shall be specified.

254

256 — Method

— POST

258

— Headers

260 — Content-Type – The representation scheme being posted to the RESTful service. The types allowed for this request header are as follows:

262 — application/dicom+xml

Specifies that the post is PS 3.19 XML metadata. See Z.X.2.1.1

264 — application/json

Specifies that the post is PS 3.18 JSON metadata. See Z.X.2.1.1

266

— The request body describes changes to a single Unified Procedure Step Instance. It shall include all Attributes for which Attribute Values are to be set. The changes shall comply with all requirements described in the Req. Type N-SET column of PS 3.4 Table CC.2.5-3.

270

— The request shall be atomic (indivisible) and idempotent (repeat executions have no additional effect). All changes contained in the request shall leave the UPS instance in an internally consistent state.

272

### 274 **Z.X.2.1.1 Metadata Request Message**

The Metadata Request Message has a single part body.

- 276 — Content-Type:  
— application/dicom+xml  
278 — application/json

280 — The request body contains all the metadata to be updated in either DICOM PS 3.19 XML metadata,  
DICOM PS 3.18 JSON metadata. Any binary data contained in the message shall be inline.

282

### **Z.X.2.2 Behavior**

284 The Origin-Server shall support the Attribute changes to the UPS instance specified by the User-Agent in  
the UpdateUPS request as specified in PS 3.4 Table CC.2.5-3.

286 The Origin-Server shall refuse UpdateUPS requests on an IN PROGRESS UPS and not modify the UPS if  
the set request does not include the Transaction UID (0008,1195) Attribute with the same value as  
288 currently recorded in the UPS instance.

The Origin-Server shall refuse UpdateUPS requests on a COMPLETED or CANCELED UPS.

290 The Origin-Server shall use the Specific Character Set (0008,0005) value to appropriately modify its  
internal representation so that subsequent operations reflect the combination of the character sets in use  
292 by the Attributes in this request and those used by Attributes that have not been modified.

The Origin-Server shall return, via the HTTP/1.1 Status applicable to the associated request.

294 The Origin-Server may itself modify any Attributes of a UPS instance independently of an POST request,  
e.g., if the Origin-Server is performing the procedure step itself, if it has been determined that the  
296 performing User-Agent or SCU has been disabled, or if it is necessary to correct Attribute values after  
completion of the procedure in order to carry out reconciliation of the data. A description of the coercions  
298 the Origin-Server may perform shall be documented in the conformance statement of the Origin-Server.

Upon updating a UPS Instance, the Origin-Server shall send UPS State Reports (if it supports either the  
300 WebSocket Event Notification or the UPS Event SOP Class) as described in Z.X.10 (HTTP) or PS 3.4  
Section CC.2.4.3 (DIMSE) regardless of whether the update was based on an N-SET, an UpdateUPS or  
302 on internal logic.

Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and  
304 PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform  
authorization.

### **306 Z.X.2.3 Response**

The Origin-Server shall return an HTTP/1.1 response message.

#### **308 Z.X.2.3.1 Response Status Line**

If the Set request is successful, the Origin-Server shall return an HTTP/1.1 "202 - Accepted" response  
310 code.

If the request fails, the Origin-Server shall return an appropriate failure status line with a response code  
312 from Table Z.X.2-1.

314

**Table Z.X.2-1  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
---------------	---------------	-------------

202	Accepted	The UPS instance was updated
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
409	Conflict	The request cannot be performed for one of the following reasons: — the submitted request is inconsistent with the current state of the UPS Instance — the Transaction UID is missing — the Transaction UID is incorrect
503	Busy	Service is unavailable.

316 **Z.X.2.3.2 Response Headers**

318 If the UPS instance was updated but with modifications made by the Origin-Server, the response message shall include the following HTTP/1.1 header:

- 320 — Warning: 299 {SERVICE}: The UPS was created with modifications.

If optional attributes were rejected, the response message shall include the following HTTP/1.1 header:

- 322 — Warning: 299 {SERVICE}: Requested optional Attributes are not supported.

324 If the request was rejected with an HTTP/1.1 409 status code, the response message shall include one of following HTTP/1.1 headers describing the nature of the conflict:

- 326 — Warning: 299 {SERVICE}: the Transaction UID is missing.
- 328 — Warning: 299 {SERVICE}: the Transaction UID is incorrect.
- 330 — Warning: 299 {SERVICE}: the submitted request is inconsistent with the current state of the UPS Instance.

### **Z.X.2.3.3 Response Message Body**

332 The response message body shall be empty.

### **334 Z.X.3 SearchForUPS**

This resource returns a list of UPS Instances that match specified search query parameters along with  
336 requested attributes for each Instance.

#### **Z.X.3.1 Request**

338 The request message shall be formed as follows:

— Resource

340 — {SERVICE}/workitems/{?query}  
where

342 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either  
HTTP or HTTPS), host, port, and application.

344

— Method

346 — GET

348 — Headers

— Accept – The representation scheme in which the RESTful service is requested to return the  
350 results. The types allowed for this request header are as follows:

— multipart/related; type=application/dicom+xml; boundary={messageBoundary}

352 Specifies that the results should be PS 3.19 XML metadata.

— application/json

354 Specifies that the results should be PS 3.18 JSON metadata.

— Cache-control: no-cache (recommended)

356 If included, specifies that search results returned should be current and not cached.

358 — Query key=value pairs

— {attributeID}={value}

360 0-n / {attributeID}={value} pairs allowed

— includefield={attributeID} | all

362 0-n includefield / {attributeID} pairs allowed, where “all” indicates that all attributes with values  
should be included for each response.

364

Each {attributeID} must refer to an attribute of the Unified Procedure Step IOD (see PS 3.3  
366 B.26.2).

See Section 6.7.1.1.1 for {attributeID} and {value} encoding rules

368

— fuzzymatching=true | false

370 — limit={maximumResults}

— offset={skippedResults}

372

### **Z.X.3.2 Behavior**

374 The Origin-Server shall perform the query indicated in the request.

If the limit query key is not specified or its value exceeds the total number of matching results then  
376 {maximumResults} is the lesser of the number of matching results and the maximum number of results  
supported by the Server.

378 If the offset query key is not specified or its value is less than zero then {skippedResults} is zero.

The first result returned shall be result number ( $\{\text{skippedResults}\} + 1$ ). The last result returned shall be  
380 result number ( $\{\text{skippedResults}\} + \{\text{maximumResults}\}$ ). If ( $\{\text{skippedResults}\} + 1$ ) exceeds  
{maximumResults} then no results are returned.

382 If the number of results exceeds the maximum supported by the server, the server shall return the  
maximum supported results and the response shall include the following HTTP/1.1 Warning header (see  
384 RFC 2616 Section 14.46):

— Warning: 299 {SERVICE}: "The number of results exceeded the maximum supported by the server.  
386 Additional results can be requested.

388 Note: The client can request additional results by specifying a value for the "offset" query key.

390 The server response shall be idempotent so that if the list of results is the same, the response to a request  
with a specific set of parameters shall always be the same, including order. If the complete list of results is  
392 different for subsequent requests the responses may be different. In a situation where results are  
changing due to changes in the server contents, queries using the limit and offset may be inconsistent.

#### **394 Z.X.3.2.1 Matching**

The matching semantics for each attribute are determined by the types of matching allowed by C-FIND  
396 (see PS3.4 C.2.2.2).

Combined Datetime matching shall be performed (see DICOM PS3.4 C.2.2.2.5).

398 Note: If a UPS-RS provider is acting as a proxy for a C-FIND SCP that does not support combined Datetime  
matching the UPS-RS provider will need to perform a C-FIND request using Date only and filter results  
400 outside the time range before returning a UPS-RS response

402 If the TimezoneOffsetFromUTC / 00080201 query key is included in the request, dates and times in the  
request are to be interpreted in the specified time zone.

404 If the "fuzzymatching=true" query key/value is included in the request and it is supported then additional  
fuzzy semantic matching of person names shall be performed in the manner specified in the DICOM  
406 Conformance Statement for the service provider.

If the "fuzzymatching=true" query key/value is included in the request and it is not supported, the response  
408 shall include the following HTTP/1.1 Warning header (see RFC 2616 Section 14.46):

— Warning: 299 {SERVICE}: "The fuzzymatching parameter is not supported. Only literal matching has  
410 been performed."

412 Note: The Warning header is separate from the Status Line and does not affect the returned Status Code.

414 An Origin-Server shall support matching against all Unified Procedure Step Instance Attributes in PS 3.4 Table CC.2.5-3 with a Match Key Type value of U, R or \*.

416

**Z.X.3.3 Response**

418 The Origin-Server shall return an HTTP/1.1 response message.

**Z.X.3.3.1 Response Status Line**

420 If the SearchForUPS request is successful, the Origin-Server shall return an HTTP/1.1 “200 – OK” response code.

422 If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table Z.X.3-3.

424

**Table Z.X.3-1  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
200	OK	The query completed and any matching results are returned in the message body.
206	Partial Content	Only some of the query results were returned and the rest can be requested through the appropriate UPS-RS request.
400	Bad Request	The UPS-RS Origin-Server was unable to perform the query because the Service Provider cannot understand the query component.
401	Unauthorized	The UPS-RS Origin-Server refused to perform the query because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
413	Request entity too large	The query was too broad and a narrower query or paging should be requested.
503	Busy	Service is unavailable.

426

**Z.X.3.3.2 Query Result Attribute**

428 For each matching UPS Instance, the Origin-Server shall return:

- 430 — All Unified Procedure Step Instance Attributes in PS 3.4 Table CC.2.5-3 with a Return Key value of 1 and 2.
- 432 — All Unified Procedure Step Instance Attributes in PS 3.4 Table CC.2.5-3 with a Return Key value of 1C for which the conditional requirements are met.

- 434 — All other Unified Procedure Step Instance Attributes passed as {attributeID} query keys that are supported by the Origin-Server as matching or return attributes
- 436 — All other Unified Procedure Step Instance Attributes passed as “includefield” query values that are supported by the Origin-Server as return attributes.

### 438 **Z.X.3.3.3 Response Message**

The response message body contains the results.

440 The format of the response message body depends on the Accept header specified in the request.

#### **Z.X.3.3.3.1 XML Response Message**

- 442 — Content-Type:
  - multipart/related; type=application/dicom+xml
- 444 — The response is a multipart message body where each part is a DICOM PS 3.19 XML DicomNativeModel element containing the attributes for one matching UPS Instance (see DICOM PS 3.19 Annex A.1).
- 446 — If there are no matching results, the message body will be empty.
- 448 — Each part in the multipart body includes the following HTTP/1.1 headers:
  - Content-Type: application/dicom+xml

450

#### **Z.X.3.3.3.2 JSON Response Message**

- 452 — Content-Type:
  - application/json
- 454 — The response is a DICOM JSON message containing a DICOM JSON property for each matching UPS Instance containing sub-properties describing the matching attributes for each UPS Instance (see 456 F.2).
- If there are no matching results, the JSON message is empty.

458

### 460 **Z.X.4 RetrieveUPS**

This resource supports the retrieval of a UPS Instance.

#### 462 **Z.X.4.1 Request**

The request message shall be formed as follows:

- 464 — Resource
  - {SERVICE}/workitems/{UPSInstanceUID}
  - 466 where
    - {SERVICE} is the base URL for the service. This may be a combination of scheme (either 468 HTTP or HTTPS), host, port, and application.
    - {UPSInstanceUID} is the UID of the Unified Procedure Step Instance
- 470 — Method
- 472 — GET
- 474 — Headers

- 476 — Accept – The representation scheme in which the RESTful service is requested to return the result. The types allowed for this request header are as follows:
  - 478 — application/dicom+xml  
Specifies that the result should be PS 3.19 XML metadata.
  - 480 — application/json  
Specifies that the result should be PS 3.18 JSON metadata.
  - 482 — Cache-control: no-cache (recommended)  
If included, specifies that results returned should be current and not cached.

484 **Z.X.4.2 Behavior**

The Origin-Server shall return, via the HTTP/1.1 response, the indicated Unified Procedure Step Instance to the User-Agent.

488 Note: The requirement for the Origin-Server to respond to GET requests for UPS Instances that have moved to the COMPLETED or CANCELED state is limited. See PS 3.4 Section CC.2.1.3 Service Class Provider Behavior.

492 The User-Agent shall not return the Transaction UID (0008,1195) Attribute. This is necessary to preserve this Attribute's role as an access lock.

494 The User-Agent shall return the HTTP/1.1 Response Status Code applicable to the associated request. A Failure Code shall indicate that the Origin-Server has not returned the SOP Instance.

496 Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform authorization.

498 **Z.X.4.3 Response**

The Origin-Server shall return an HTTP/1.1 response message.

500 **Z.X.4.3.1 Response Status Line**

502 If the Retrieve request is successful, the Origin-Server shall return an HTTP/1.1 "200 – OK" response code.

504 If the request fails, the Origin-Server shall return an appropriate failure status line with a response code from Table Z.X.4-1.

506 **Table Z.X.4-1  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
200	OK	The requested instance is returned.
400	Bad Request	The UPS-RS Origin-Server was unable to perform the query because the Service Provider cannot understand the query component.
401	Unauthorized	The UPS-RS Origin-Server refused to perform the query

		because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
503	Busy	Service is unavailable.

508 **Z.X.4.3.2 Response Message**

The response message body contains the results.

510 The format of the response message body depends on the Accept header specified in the request.

**Z.X.4.3.2.1 XML Response Message**

512 — Content-Type:

— application/dicom+xml

514 — The response contains a DICOM PS 3.19 XML DicomNativeModel element containing the attributes for the requested UPS Instance (see DICOM PS 3.19 Annex A.1).

516

**Z.X.4.3.2.2 JSON Response Message**

518 — Content-Type:

— application/json

520 — The response is a DICOM JSON array containing a DICOM JSON representation of the requested UPS Instance (see F.2).

522

**Z.X.5 ChangeUPSState**

524 This resource supports the modification of the state of an existing UPS Instance.

**Z.X.5.1 Request**

526 The request message shall be formed as follows:

— Resource

528 — {SERVICE}/workitems/{UPSInstanceUID}/state

where:

530 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either HTTP or HTTPS), host, port, and application.

532 — {UPSInstanceUID} is the UID of the Unified Procedure Step Instance

534 — Method

— PUT

536

— Headers

538 — Content-Type – The representation scheme being posted to the RESTful service. The types  
allowed for this request header are as follows:

540 — application/dicom+xml

Specifies that the post is PS 3.19 XML metadata. See Z.X.5.1.1

542 — application/json

Specifies that the post is PS 3.18 JSON metadata. See Z.X.5.1.1

544

— The request body describes a state change to a single Unified Procedure Step Instance. It shall  
546 include all Attributes required for an SCU in PS 3.4 Table CC.2.1-1.

548 **Z.X.5.1.1 Metadata and Bulk Data Request Message**

The Metadata and Bulk Data Request Message has a single part body.

550 — Content-Type:

— application/dicom+xml

552 — application/json

554 — The request body contains DICOM PS 3.19 XML metadata or DICOM PS 3.18 JSON metadata. Any  
binary data contained in the message shall be inline.

556

**Z.X.5.2 Behavior**

558 The Origin-Server shall perform the submitted state change for the identified UPS instance by setting the  
Procedure Step State (0074,1000) to the requested value, or shall report the appropriate failure response  
560 code.

Upon successfully changing the state of a UPS instance to IN PROGRESS, the Origin-Server shall record  
562 the Transaction UID provided by the User-Agent in the Transaction UID (0008,1195) of the UPS instance.

564 Upon completion of the ChangeUPSState request, the Origin-Server shall return the HTTP/1.1 Response  
Line applicable to the associated request.

The Origin-Server shall only perform legal state changes as described in PS 3.4 Table CC.1.1-2.

566 The Origin-Server shall refuse requests to change the state of an IN PROGRESS UPS unless the  
Transaction UID of the UPS instance is provided in the ChangeUPSState request.

568 The Origin-Server shall refuse requests to change the state of an IN PROGRESS UPS to COMPLETED or  
CANCELED if the Final State requirements described in PS 3.4 Table CC.2.5-3 have not been met.

570 After the state of the UPS instance has been changed to COMPLETED or CANCELED, the Origin-Server  
shall not delete the instance until all deletion locks have been removed.

572 Note: See Section Z.X.7 and PS 3.4 CC.2.3.2 for a description of how User-Agents and SCUs place and  
remove deletion locks.

574

The Origin-Server may also modify the Procedure Step State (0074,1000) of a UPS instance  
576 independently of a ChangeUPSState request, e.g., if the Origin-Server is performing the procedure step  
itself, or if it has been determined that the performing SCU or User-Agent has been disabled.

578 Note: If the Origin-Server is not performing the procedure step, this should be done with caution.

580 Upon successfully changing the state of a UPS instance, the Origin-Server shall send UPS State Reports  
 (if it supports either the WebSocket Event Notification or the UPS Event SOP Class) as described in  
 582 Z.X.10 (HTTP) or PS 3.4 Section CC.2.4.3 (DIMSE) regardless of whether the creation was based on an  
 N-ACTION or a CreateUPS request.

584 Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and  
 PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform  
 586 authorization.

**Z.X.5.3 Response**

588 The Origin-Server shall return an HTTP/1.1 response message.

**Z.X.5.3.1 Response Status Line**

590 If the State Change was successful, the Service shall return an HTTP/1.1 "202 - Accepted" response code.

If the State Change fails, the Service shall return an appropriate failure status line with a response code  
 592 from Table Z.X.5-1.

**Table Z.X.5-1  
 STATUS CODES**

594

HTTP/1.1 Code	Reason Phrase	Description
202	Accepted	The UPS instance was updated
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
409	Conflict	The request cannot be performed for one of the following reasons: — the submitted request is inconsistent with the current state of the UPS Instance — the Transaction UID is missing — the Transaction UID is incorrect

503	Busy	Service is unavailable.
-----	------	-------------------------

596 **Z.X.5.3.2 Response Headers**

598 If the User-Agent passes a “state=CANCELED” parameter and the UPS Instance is already in that state,  
the response message shall include the following HTTP/1.1 header:

— Warning: 299 {SERVICE}: The UPS is already in the requested state of CANCELED.

600

602 If the User-Agent passes a “state=COMPLETED” parameter and the UPS Instance is already in that state,  
the response message shall include the following HTTP/1.1 header:

— Warning: 299 {SERVICE}: The UPS is already in the requested state of COMPLETED.

604

606 If the request was rejected with an HTTP/1.1 409 status code, the response message shall include one of  
following HTTP/1.1 headers describing the nature of the conflict:

— Warning: 299 {SERVICE}: the Transaction UID is missing.

608 — Warning: 299 {SERVICE}: the Transaction UID is incorrect.

610 — Warning: 299 {SERVICE}: the submitted request is inconsistent with the current state of the UPS  
Instance.

612 **Z.X.5.3.3 Response Message Body**

The response message body shall be empty.

614

**Z.X.6 RequestUPSCancellation**

616 This resource records a request that the specified UPS Instance be canceled.

**Z.X.6.1 Request**

618 — Resource

— {SERVICE}/workitems/{UPSInstanceUID}/cancelrequest

620 where:

622 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either  
HTTP or HTTPS), host, port, and application.

— {UPSInstanceUID} is the UID of the Unified Procedure Step Instance

624

— Method

626 — POST

628 — Headers

— Content-Type – The representation scheme being posted to the RESTful service. The types  
allowed for this request header are as follows:

630 — application/dicom+xml

632 Specifies that the post is PS 3.19 XML metadata. See Z.X.6.1.1

— application/json

634 Specifies that the post is PS 3.18 JSON metadata. See Z.X.6.1.1

636 — The request body describes a request to cancel a single Unified Procedure Step Instance. The  
 request body shall comply with all attribute requirements described in PS 3.4 Table CC.2.2-1.

638 — The request shall be atomic (indivisible) and idempotent (repeat executions have no additional effect).

640

**Z.X.6.2 Behavior**

642 A User-Agent uses RequestUPSCancellation to request to the Origin-Server that the state of a UPS  
 Instance be changed to CANCELED as shown in PS 3.4 Figure CC.1.1-1.

644 The User-Agent may include a Reason For Cancellation and/or a proposed Procedure Step  
 Discontinuation Reason Code Sequence.

646 The User-Agent may also provide a Contact Display Name and/or a Contact URI for the person with whom  
 the cancel request may be discussed.

648 Note: An HTTP/1.1 Status Code indicating success means that the Request was accepted, not that the UPS  
 has been canceled. The system performing the UPS is not obliged to honor the request to cancel and in  
 650 some scenarios, may not even receive notification of the request. See Section PS 3.4 CC.2.4.

652 To cancel an IN PROGRESS UPS that the User-Agent is itself performing, the User-Agent shall instead  
 use the ChangeUPSState action as described in Section Z.X.5.

654 Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and  
 PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform  
 656 authorization.

**Z.X.6.3 Response**

658 The Origin-Server shall return an HTTP/1.1 response message.

**Z.X.6.2.1 Response Status Line**

660 If the cancel request was accepted, the Service shall return an HTTP/1.1 "202 - Accepted" response code.

If the cancel request was rejected, the Service shall return an appropriate failure status line with a  
 662 response code from Table Z.X.6-1.

**Table Z.X.6-1  
 STATUS CODES**

664

HTTP/1.1 Code	Reason Phrase	Description
202	Accepted	The cancel request was accepted
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server

		understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance does not exist or is not managed by this Origin-Server.
409	Conflict	The cancellation request is inconsistent with the current state of the UPS Instance
503	Busy	Service is unavailable.

666 **Z.X.2.5.2 Response Headers**

If the UPS Instance is already in a canceled state, the response message shall include the following  
668 HTTP/1.1 header:

— Warning: 299 {SERVICE}: The UPS is already in the requested state of CANCELED.  
670

**Z.X.5.2.3 Response Message Body**

672 The response message body shall be empty.

674 **Z.X.7 CreateSubscription**

This resource records subscribers to whom future events associated with the UPS Instance or defined  
676 worklist will be reported.

**Z.X.7.1 Request**

678 The request message shall be formed as follows:

— Resource

680 — {SERVICE}/workitems/{UPSInstanceUID}/subscribers/{AETITLE}[?deletionlock=true|false]

682 — {SERVICE}/workitems/1.2.840.10008.5.1.4.XX.X/subscribers/{AETITLE}  
[?deletionlock=true|false&query]

where

684 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either  
HTTP or HTTPS), host, port, and application.

686 — {UPSInstanceUID} is the UID of the Unified Procedure Step Instance or a well-known UID

688 — {AETITLE} is an Application Entity Title that conforms to the “AE” Value Representation (see  
PS 3.5 Table 6.2-1) and identifies the Application Entity to be subscribed

690 — Method

— POST

692

— Headers

694 — Content-Length: 0

- 696 — Query key=value pairs
  - deletionlock=true | false
- 698 — {attributeID}={value}
- 0-n / {attributeID}={value} pairs allowed

700

Each {attributeID} must refer to an attribute of the Unified Procedure Step IOD (see PS 3.3 B.26.2).

702

See Section 6.7.1.1.1 for {attributeID} and {value} encoding rules

704

- The request body shall be empty.

706

### **Z.X.7.2 Behavior**

708 Upon receipt of the CreateSubscription, SuspendGlobalSubscription or DeleteSubscription request, the Origin-Server shall attempt to update the Global Subscription State. Filtered Global Subscription and/or  
710 UPS Subscription State of the specified Application Entity with respect to the specified SOP Instance UID as described in PS 3.4 Table CC.2.3-2 and then return the appropriate HTTP/1.1 response.

712 The Origin-Server may optionally support allowing an Application Entity to subscribe globally to a filtered set of UPS Instances. In this case, the Application Entity will only be subscribed to UPS Instances that  
714 match the search criteria specified by the query parameters of the HTTP/1.1 request (see Z.X.7.2.1).

A success status conveys that the Global Subscription State and/or UPS Subscription State for the User-Agent was successfully modified by the Origin-Server. The Origin-Server shall use the {AETITLE} for the Application Entity Title, where {AETITLE} is specified by the HTTP/1.1 request. This allows systems to  
716 subscribe other systems they know would be interested in events for a certain UPS.  
718

For all UPS instances managed by the Origin-Server, the Origin-Server shall send UPS State Reports as described in Z.X.10 (HTTP) to User-Agents that have a UPS Subscription State of "Subscribed with Lock" or "Subscribed w/o Lock" and whose WebSocket connections are active (see Z.X.10).

722 Upon successfully processing a subscription action, the Origin-Server shall send initial UPS State Reports, as indicated in PS 3.4 Table CC.2.3-2, providing the current status of the UPS Instance to the Receiving  
724 AE if the WebSocket connection is active (see Z.X.10).

The Origin-Server may remove existing Deletion Locks by changing the UPS Subscription State for the AE from "Subscribed with Lock" to "Subscribed w/o Lock" and/or by changing the Global Subscription State for an AE from "Global Subscription with Lock" to "Global Subscription w/o Lock". This is intended to allow the  
726 Origin-Server to deal with User-Agent malfunctions. The Origin-Server must document in its conformance statement if it might remove a Deletion Lock.  
728

730 The Origin-Server may also refuse the Deletion Lock portion of a specific or global Subscription request. For example, a request to modify the UPS Subscription State for the User-Agent to "Subscribed with Lock" would instead result in a UPS Subscription State of "Subscribed w/o Lock" and a Warning status (see PS  
732 3.4 Table CC.2.3-3) returned to the requesting User-Agent. This is intended to deal with Security and related policy restrictions. The Origin-Server must document in its conformance statement if it might refuse  
734 a Deletion Lock.

736 Bi-directional Authentication of machines/users/applications is possible at association time (see PS3.7 and PS3.15). HTTP/1.1 provides an "Unauthorized" error code. There are no specific requirements to perform  
738 authorization.

**Z.X.7.2.1 Filtered Global Subscriptions**

740 An Origin-Server that supports Filtered Global Subscription shall create an instance subscription for each UPS Instance that would match a C-FIND request with the same Matching Keys (see Z.X.3.2.1).

742 The Origin-Server shall support filtering by all Unified Procedure Step Instance Attributes in PS 3.4 Table CC.2.5-3 with a Match Key Type value of U, R or \*.Origin-Server

**744 Z.X.7.3 Response**

**Z.X.7.3.1 Response Status Line**

746 The Service shall return an HTTP/1.1 status line, including a status code and associated textual phrase.

If the CreateSubscription request was successful, the Service shall return an “HTTP/1.1 204 - Created” response code. The response shall contain a “Content-Location” header of the following format:

— Content-Location: {WSSERVICE}

750 where:

— {WSSERVICE} is the base URL for the WebSocket service. This shall include the WebSocket scheme (either WS or WSS) and may include a combination of host, port, and application.

754 If the subscription fails, the Service shall return an appropriate failure status line with a response code from Table Z.X.7-2.

756

**Table Z.X.7-2  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
201	Created	The subscription was created.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. the Origin-Server does not support global subscription filtering or an authenticated user has insufficient privileges).
404	Not found	The specified UPS Instance or well-known UID does not exist or is not managed by this Origin-Server.
409	Conflict	Specified action not appropriate for specified instance.
503	Busy	Service is unavailable.

758

### **Z.X.7.3.2 Response Headers**

760 If the CreateSubscription request was accepted but the deletion lock was not, the response message shall include the following HTTP/1.1 header:

762 — Warning: 299 {SERVICE}: Deletion Lock not granted.

764 If the request was rejected with an HTTP/1.1 403 status code because Filtered Global Subscription is not supported, the response message shall include one of following HTTP/1.1 headers describing the nature of the conflict:

766 — Warning: 299 {SERVICE}: The Origin-Server does not support Global Subscription Filtering  
768

### **Z.X.7.3.3 Response Message Body**

770 The response message body shall be empty.  
772

## **Z.X.8 SuspendGlobalSubscription**

774 This resource suspends an existing Global Subscription or Filtered Global Subscription. The Origin-Server will no longer automatically subscribe the User-Agent to newly-created UPS Instances. This does not delete any existing subscriptions to specific UPS Instances.  
776

### **Z.X.8.1 Request**

778 The request message shall be formed as follows:

— Resource

780 — {SERVICE}/workitems/1.2.840.10008.5.1.4.34.5/subscribers/{AETITLE}/suspend

— {SERVICE}/workitems/1.2.840.10008.5.1.4.XX.X/subscribers/{AETITLE}/suspend

782 where

784 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either HTTP or HTTPS), host, port, and application.

— {AETITLE} identifies the subscribed Application Entity.

786

— Method

788 — POST

790 — The request body shall be empty.

### **Z.X.8.2 Behavior**

See Z.X.7.2.

### **Z.X.8.3 Response**

#### **Z.X.8.3.1 Response Status Line**

796 The Service shall return an HTTP/1.1 status line, including a status code and associated textual phrase.

798 If the SuspendGlobalSubscription request was successful, the Service shall return an HTTP/1.1 “204 – No Content” response code.

800 If the subscription change fails, the Service shall return an appropriate failure status line with a response code from Table Z.X.8-1.

802 **Table Z.X.7-1**  
**STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
204	No Content	The subscription was suspended.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance or well-known UID does not exist or is not managed by this Origin-Server.
409	Conflict	Specified action not appropriate for specified instance.
503	Busy	Service is unavailable.

804 **Z.X.8.2.2 Response Message Body**

The response message body shall be empty.

806

**Z.X.9 DeleteSubscription**

808 This resource removes existing subscriptions from a UPS Instance or defined worklist.

**Z.X.9.1 Request**

810 The request message shall be formed as follows:

— Resource

812 — {SERVICE}/workitems/{UPSInstanceUID}/subscribers/{AETITLE}

where

814 — {SERVICE} is the base URL for the service. This may be a combination of scheme (either HTTP or HTTPS), host, port, and application.

816 — {UPSInstanceUID} is the UID of the Unified Procedure Step Instance or a well-known UID.

— {AETITLE} identifies the subscribed Application Entity.

818

— Method

820 — DELETE

822 — The request body shall be empty.

824 **Z.X.9.2 Behavior**

See Z.X.7.2.

826 **Z.X.9.3 Response**

**Z.X.9.3.1 Response Status Line**

828 The Service shall return an HTTP/1.1 status line, including a status code and associated textual phrase.

830 If the DeleteSubscription request was successful, the Service shall return an HTTP/1.1 “204 – No Content” response code.

832 If the subscription fails, the Service shall return an appropriate failure status line with a response code from Table Z.X.9-1.

**Table Z.X.7-1  
 STATUS CODES**

834

HTTP/1.1 Code	Reason Phrase	Description
204	No Content	The subscription was removed.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request
401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
404	Not found	The specified UPS Instance or well-known UID does not exist or is not managed by this Origin-Server.
409	Conflict	Specified action not appropriate for specified instance.
503	Busy	Service is unavailable.

836 **Z.X.9.2.2 Response Message Body**

The response message body shall be empty.

838

**Z.X.10 OpenEventChannel**

840 This resource opens a channel that will be used to send Event Reports to the client.

**Z.X.10.1 Request**

842 The request message shall be formed as follows:

— Resource

844 — {WSSERVICE}/subscribers/{AETITLE}

where

846 — {WSSERVICE} is the base URL for the WebSocket service. This shall include the WebSocket scheme (either WS or WSS) and may include a combination of host, port, and application

848 — {AETITLE} identifies the subscribed Application Entity.

850 — Method

— GET

852

854 — If the WebSocket connection is lost at any point it can be re-established by repeating this request. The Origin-Server is not required to queue messages. Existing subscriptions are unaffected by the current state of the WebSocket connection.

856 Note: If an User-Agent wants to receive the initial state of a UPS Instance after creating a subscription, the WebSocket connection should be initiated before creating the subscription

858

**Z.X.10.2 Behavior**

860 The Origin-Server maintains the active WebSocket connection and uses it to send Event Report messages for UPS Instances which have subscriptions association with {AETITLE} (see Z.X.7.2).

**Z.X.10.3 Response**

**Z.X.10.3.1 Response Status Line**

864 The Service shall return an HTTP/1.1 status line, including a status code and associated textual phrase.

866 If the request was successful, the Service shall return an HTTP/1.1 “101 - Switching Protocols” response code. The response shall contain the following HTTP/1.1 headers:

— Connection: Upgrade

868 — Upgrade: WebSocket

870 If the request fails, the Service shall return an appropriate failure status line with a response code from Table Z.X.10-1.

872

**Table Z.X.10-1  
STATUS CODES**

HTTP/1.1 Code	Reason Phrase	Description
101	Switching Protocols	The WebSocket connection was established.
400	Bad Request	The UPS-RS Origin-Server was unable to understand the request

401	Unauthorized	The UPS-RS Origin-Server refused to accept the request because the client is not authenticated.
403	Forbidden	The UPS-RS Origin-Server understood the request, but is refusing to perform the query (e.g. an authenticated user with insufficient privileges).
503	Busy	Service is unavailable.

874

### Z.X.10.2.2 Response Message Body

876 The response message body shall be empty.

The connection remains open and may be used by the server to send Event messages (see Annex X).

878

### Z.X.11 SendEventReport

880 This operation sends an Event Report over an established WebSocket connection.

#### Z.X.11.1 Request

882 The request message shall be formed as follows:

— Resource

884 — N/A

886 — Method

— WebSocket Data Frame transmission

888

— The Event Report shall contain all mandatory attributes described in described in PS 3.4 Table CC.2.4-1 and PS 3.7 Table 10.3-1 for the event type.

890

#### 892 Z.X.11.1.1 Request Message Body

WebSocket Events are encoded as WebSocket data frames with an opcode of "%x1" (text).

894 The frame payload data shall be a DICOM JSON dataset containing the attributes of the Event Report.

Note: Example WebSocket payload:

```
896 {  
    "00000002": [ "1.2.840.10008.5.1.4.34.6.4" ],  
898    "00000100": [ 256 ],  
    "00000110": [ 23 ],  
900    "00001000": [ "1.2.840.10008.5.1.4.34.6.4.2.3.44.22231" ],  
    "00001001": [ 1 ],  
902    "00741238": [ "SCHEDULED" ],  
    "00744041": [ "READY" ]  
904 }
```

906 **Z.X.11.2 Behavior**

PS 3.4 CC.2.4.3 describes the scenarios in which an Origin-Server sends Event Reports to a subscriber  
908 and the content of the Event Report messages.

**Z.X.11.3 Response**

910 None.