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Digital Imaging and Communications in Medicine (DICOM)

Supplement 193: RESTful Notifications

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20 **DICOM Standards Committee, Working Group 27: Web Technologies**
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Rosslyn, Virginia 22209 USA
VERSION: Initial Draft
Developed in accordance with work item 2013-08-B.

25

Closed Issues

#	Description
3	Each Notification Connection should be associated with a Subscriber UUID
4	Be careful to separate the notion of "Complete" vs "Ready to Do Something"
5	Add a general transaction for sending an Event to an origin server, e.g. from a RIS (FHIR Cast integration?) Add a general transaction for sending a notification from an external system.
6	
7	Is a Subscription a resource? Yes.
8	Can a Subscription be transferred to another user agent? No. There is currently no known use case for this functionality
9	What should the queueing model for Notifications be: 1. In order delivery Answer: in order delivery relative to a single subscription, but no order globally. Note no synchronization across subscriptions 2. If Subscriber is offline should the event queue be saved and for how long Ans: origin server discretion but should there be a notification that events have been missed or use sequence numbers. 3. Flow control (too many notifications for sender / receiver to handle) Not now, but maybe a CP later
	Should events have a sequence number? By subscription? No. The mechanism would probably be too complicated.
10	Are subscriptions related to logging? No.
11	Should a subscription be able to specify the events to which the subscription applies? What would be the origin server's responsibility with respect to the request? Maybe later in a CP.
12	Should events have a timestamp? Yes.
13	Should events be logged using ATNA logging? Not required, but if the origin server wants to, it could.
14	
16	Support 'Guest Subscriptions'

Open Issues

#	Description
1	Should we be supporting Workflow Notifications such as: Ready To Read Ready To Re-Read Ready To Post-Process Ready to QC Request for Remote Read Does code exist that are defined externally? SIIM SWIM Should we support (negative) intensions?
3	Can a simple subscription be created with a retention lock? A Subscription Generator? Yes.

4	Should media type be handled in Open Notification Connection or in Create Subscription and Create Subscription Generator.
	No. Use Open Notification Connection.
5	What kinds of notifications should the Studies Service have?
	Instance Availability Notifications / Storage Commit

Commented [JP1]: Use this as a test case.

30

Table of Contents

1   Scope and Field of Application

This supplement defines a generalized abstract API for sending and subscribing to notificationsabout RESTful resources. The Notifications API defines Subscribers, Subscriptions, Events and Event Reports.

- Notifications about Worklist Workitems, already in the Worklist API, but they are modified to conform to the new API.
- Notifications about the state of a Worklist Service.
- Notifications about the existence and state of data resources in the Patient, Study, Series, and Instance hierarchy.

Security is beyond the scope of this supplement. However generic Web security mechanisms are fully compatible.

2   Normative References

Insert the following in Section 2 at the appropriate place:

3   Definitions

Insert the following in Section 2 at the appropriate place:

3.7   DICOM Web Services

Insert the following definitions at the appropriate place in Section 3.7

Event

An Event is a change in the content/state of a resource.

Event Report

An Event Report is a DICOM dataset that is contained in the payload of a Send Event Report Request.

Event Type

An Event Type is a change in the state of a resource defined in the Standard that has a corresponding Event Report. Each Service defines the Event Types and corresponding Event Reports that it supports, e.g. the UPS Assigned Event Type occurs when the value of Scheduled Station Name Code Sequence or Human Performer Code Sequence is populated.

> **Note:**

> **Currently the Storage Commit types don't fit with these Events**

Notification

A Notification is an Event Report message.

Subscriber

A Subscriber is a user agent that has created a Subscription to a resource on an origin server.

Subscription

Commented [JP2]: Kevin: Is it useful to distinguish between an event as a trigger and the payload carried by an event?

Commented [JP3]: Maybe drop this definition

A Subscription is an agreement that an origin server will notify a user agent of Events related to a particular resource.

The Subscription resource is referenced by an *opaque* URL.

Subscription Generator

160   **A Subscription Generator creates subscriptions, on behalf of a Subscriber, for example when new resources are created (each new sub-resource created).**

A Subscription Generator is referenced by a *opaque* URL.

4   Symbols and Abbreviated Terms

165   *Insert the following in Section 4 at the appropriate place:*

5   Conventions

Insert the following in Section 5 at the appropriate place:

170

6   Conformance

Insert the following in Section 6 at the appropriate place:

Insert the following in Section 8.10.1:

175   **8.10.1 Overview**

Some RESTful Services support Notifications.

8.10.1.1   Subscriptions

A Subscription represents an agreement between the origin server creating the Subscription and the user agent (Subscriber) requesting it. The agreement states that when a defined Event Type
180   **happens to the Target Resource, the origin server will send an Event Report to the Subscriber.**

A user agent creates a Subscription to a resource to receive Event Reports, describing changes to that resource. The Event Report is sent from the origin server to the user agent over a Notification Connection.

To create Subscriptions a End-Point must first open a Notification Connection with an origin
185   **server. Then the user agent uses the Subscribe transaction to create Subscriptions.**

A user agent can delete a Subscription using the Delete Subscription transaction.

8.10.1.2   Deletion Locks

A user agent my include a Deletion Lock when it creates the Subscription to indicate to the origin server that the user agent would like the opportunity to inspect the final state of the Target

190 **Resource. For example, this might be useful when a Workitem moves to the completed state (and the user agent is notified) and might otherwise be promptly deleted. The user agent may delete its Subscription, removing the Deletion Lock, to communicate to the origin server that it is no longer interested in the Target Resource.**

Since a resource may have more than one Subscription associated with it, it may also have more
195 **than one Deletion Lock.**

Although it is up to the origin server how long the resource is retained, the intension is that it should not delete the resource until all Retention Locks on that resource have been released.

8.10.1.3   Subscription Generators

While a Subscription provides the Subscriber with notifications related to a resource, a
200 **Subscription Generator is different; it specifies that the origin server should create a Subscription, on the Subscriber's behalf, to each new sub-resource it creates. The Target Resource of a Subscription Generator must be a resource that has contains sub-resources.**

For example, …

For each Subscription Generator, the origin server will continue to create Subscriptions for new
205 **sub-resources as they are created until the Subscriber deletes the Subscription Generator.. See Section ….**

8.10.1.3.1   Filter

When creating a Subscription Generator, the user agent may specify a Filter. The origin server applies the Filter to each newly created sub-resource, and if the Filter is satisfied, the origin server
210 **creates a Subscription to the sub-resource on behalf of the Subscriber. A Filter is a query against resource attribute values. See Section ...**

8.10.1.4   Service Notifications

> **Commented [JP4]:** See PS3.4 CC.2.4.3

Any RESTful Service may implement a Notification sub-service. User agents may subscribe to the Notification sub-service to receive Notifications of Events related to the origin server itself,
215 **rather than the resources it manages. The Service shall specify notifications for the following server related events.**

- **Service shutting down**
- **Service load increasing?**
- **Service low on resources?**
220 - **Service problem?**

> **Commented [JP5]:** Fix this with PS3.4 related events.

A user agent that has opened a Notification Connection with an origin server should be prepared to receive Service Notifications.

> **Commented [JP6]:** Open issue: should you have to subscribe to receive Service notifications. The DIMSE side presumes that there is a Server status resource. SCP Status can have a value of 'restarted' or 'going down'.

An implementation of a Service may extend the set of available service-related notifications. Any
225 **extensions should be documented in the Conformance Statement and in the response to the Retrieve Capabilities request.**

Update Section 8.10.2 as follows:

8.10.2   Conformance

230 An implementation shall document whether or not it supports notifications in the Conformance Statement. If the service supports notification it shall describe how WebSocket connections are opened.

> **Commented [JP7]:** Revisit after things are more stable.

Update PS3.18, Section 8.10.3 as follows

8.10.3 Transaction Overview

235   ~~Any service that supports Notifications shall support the following transactions:~~

The Notification Sub-Service consists of the Transactions in Table 8.10.3-1.

Table 8.10.3-1: Notification Sub-System Transactions

Name	Method	Description
Open Notification Connection	GET	The user agent requests that the origin server create a Notification Connection between them.
Close Notification Connection	~~N/A~~ ws	Closes the Notification Connection. Either the user agent or the origin server may close the connection.
Send Event Report	~~N/A~~ ws	The origin server sends an Event Report to a a user agent
Create Subscription	**POST**	**The user agent requests that the origin server create a Subscription to the Target Resource**
Delete Subscription	**DELETE**	**The user agent requests that the origin server delete a Subscription to the Target Resource**
Create Subscription Generator	**POST**	**The user agent requests that the origin server create a Subscription Generator for sub-resources of the Target Resource**
Delete Subscription Generator	**DELETE**	**The user agent requests that the origin server delete a Subscription Generator for sub-resources of the Target Resource**

~~Where ws is the WebSocket protocol.~~

Commented [JP8]: CP1871

Commented [JP9]: Maybe just add ws to this column

Commented [JP10]: This

Commented [JP11]: Move this to the section that defines Methods.

240   Insert PS3.18 Section 8.10.7 as follows:

8.10.7   Create Subscription Transaction

This transaction creates a Subscription to a Target Resource.

The origin server will report future events associated with the Target Resource to the user agent using the user agent's Notification Connection.

245   #### 8.10.7.1   Request

This request uses the POST method and has the following syntax:

```
POST SP /{/resource}/subscription{?accept}{&deletionlock} SP version CRLF
*(header-field CRLF)
CRLF
```

Commented [JP12]: Note this is different from UPS Subscribe Transaction.

250   The user agent shall create a Notification Connection with the origin server prior to sending any Create Subscription requests.

8.10.7.1.1   Target Resource

The target resource has the following URI template:

```
/{/resource}/subscription
```

255   Where

`{/resource}`   is the resource for which the Subscription is created.

8.10.7.1.2   Query Parameters

The origin server shall support Query Parameters as required in Table 10.4.1-5.

The user agent shall supply in the request Query Parameters as required in Table 10.4.1-5.

260

<div align="center">Table 8.10.7-x</div>

Key	Resource Category	Usage		Section
		User Agent	**Origin Server**	
deletionlock	All	O	M	Section 8.10.7.1.2.1

8.10.7.1.2.1 Deletion Lock

`{?deletionlock} = "retain" "=" "true" / "false"`

If present with a value of "true", it indicates that the user agent is requesting a Retention Lock, which if granted, prevents the resource from being deleted. If the "retain" parameter is not present, its default
265   value is "false", and no Retention Lock will be created.

The Retention Lock may be removed either by deleting the subscription or by creating a new subscription to the resource without the "retain" parameter.

For each resource, which the user agent has acquired a Retention Lock, the user agent shall remove the Retention Lock as soon as it has obtained any needed final state information for the resource.

270   **8.10.7.1.3   Request Header Fields**

The request has no mandatory header fields. See Section 8.4.

8.10.7.1.4   Request Payload

The request has no payload

Ended Editing here on June 6 2019

275   **8.10.7.2   Behavior**

The origin server will create a Subscription to the Target Resource for the user agent.

TODO explain when an origin server has to do notifications.

Upon receipt of the Subscribe request, the origin server shall update the appropriate Subscription state as described in Table CC.2.3-2 in PS3.4.

280   The origin server shall send Notifications for this Subscription over the Notification Connection created by the user agent. The exact Notifications sent shall be determined by the events defined by the Service.

The origin server shall honor any Retention Locks provided to subscriptions.

More than one user agent can request a Retention Lock on the same resource. All Retention Locks associated with a resource must be released before the origin server is free to delete the resource.

285   If the origin server does not have a Notification Connection with the requesting user agent, the origin server shall return a 400 (Bad Request), with a Status Details payload.

8.10.7.3   Response

The response shall have the following format:

Commented [JP13]: Want to incorporate CC.2.3.3

Commented [JP14]: Should the origin server be required to honor Retention Lock requests?

```
      version SP status-code SP reason-phrase CRLF
290   Location: subscription CRLF
      *(header-field CRLF)
      CRLF
      [status-details]
```

Where,

295   subscription   is an opaque URL that references the created subscription resource.

8.10.7.3.1   Status Codes

A success response shall contain a status code of 201 (Created).

A failure response shall contain a status code from Table 8.10.7-2. Table CC.2.1.4.

Table 8.10.7-2: Common Status Codes for the Subscribe Transaction

Status Code	Description
201 (Created)	The subscription was created.
400 (Bad Request)	The origin server was unable to understand the request
404 (Not found)	The specified resource does not exist or is not managed by this origin server.
409 (Conflict)	

300

Table CC.2.3.4: Status Codes for Subscribe

Status	Meaning	Code	
Success	The requested change of subscription state was performed	0000	201
Warning	Retention Lock not granted	B301	207?
Failure	Specified SOP Instance UID does not exist or is not a UPS Instance managed by this SCP	C307	404
	Receiving AE-TITLE is Unknown to this SCP	C308	401
	Refused: Specified action not appropriate for specified instance	C314	409
	Refused: SCP does not support Event Reports	C315	403

Commented [JP15]: Status codes from CC.2.3.4. Should we use them? In general, or just for UPS. Are these status codes defined for All Subscriptions? Modality worklist, UPS, Instance availability Notification

8.10.7.3.2   Response Header Fields

Table 6.1.X-Y: Common Header Fields for Subscribe Request

Name	Value	Usage	Notes
Location	<subscription>	M	An unique and opaque URL, defined by the origin server, that references the Subscription. Required If the request is successful,
Warning	<string>	CM	See below

305   If a Subscription was created but a requested Retention Lock was not granted. The Warning header field shall contain the following string:

```
    Warning: 299 {+service}: Retention Lock not granted.
```

Other required and optional header fields may be specified by the Service.

8.10.7.3.3   Response Payload

310   The success payload, if any, shall be specified by the Service.

A warning or failure payload shall contain a Status Details document.

8.10.8   Delete Subscription Transaction

This transaction removes (deletes) a subscription from the target resource.

315   When a user agent unsubscribes from a resource, its Retention Locks on any resources associated with that subscription are released. The origin server shall not delete a resource until all Retention Locks on the resource have been released.

Upon receipt of the Unsubscribe request, the origin server shall update the appropriate Subscription state as described by the Service.

8.10.8.1   Request

320   The request uses the DELETE method and has the following syntax:

```
DELETE SP {/opaque-url }SP version CRLF
Accept: dicom-media-type CRLF
*(header-field CRLF)
CRLF
```

325   **8.10.8.1.1   Target Resource**

The target resource is a subscription:

```
{/subscription}/subscription = url
```

A subscription is an opaque URL returned in the Location header field of a successful Create Subscription response.

330   **8.10.8.1.2   Query Parameters**

None.

8.10.8.1.3   Request Header Fields

The Service may specify additional Mandatory, Conditionally Mandatory or Optional header fields

Table 8.10.8-1: Common Header Fields for Subscribe Request

Name	Value	Usage	Notes
Accept	media-range	CM	The Acceptable Media Types for a response

335   **8.10.8.1.4   Request Payload**

The request has no payload.

8.10.8.2   Behavior

The target Subscription shall be deleted, and its Retention Lock shall be removed from the resource that it was subscribed to.

340   **8.10.8.3   Response**

The response shall have the following format:

```
version SP status-code SP reason-phrase CRLF
*(header-field CRLF)
CRLF
345   [status-details]
```

8.10.8.3.1 Status Codes

A success response shall contain a status code of 200 (OK), indicating that the target subscription(s) have been suspended or deleted.

A failure response will contain an appropriate status code from Table 8.10.8-2

350

Table 8.10.8.-21. Common Status Codes for Unsubscribe

Status	Meaning	DIMSE Code	Status codes
Success	The requested change of subscription state was performed	0000	200
~~Warning~~	~~Retention Lock not granted~~	~~B301~~	
Failure	Specified SOP Instance UID does not exist or is not a UPS Instance managed by this SCP	C307	404
	Receiving AE-TITLE is Unknown to this SCP	C308	401
	Refused: Specified action not appropriate for specified instance	C314	409
	~~Refused: SCP does not support Event Reports~~	~~C315~~	~~400~~

> **Commented [JP17]:** Status codes from CC.2.1.4. What to do?

> **Commented [JP18]:** Use Warning header field.

8.10.8.3.2 Response Header Fields

The Service may specify additional Mandatory, Conditionally Mandatory or Optional header fields

Table 8.10.8-2: Common Header Fields for Subscribe Request

Name	Value	Usage	Notes
Accept	1#media-range	M	The Acceptable Media Types for a failure response

355   #### 8.10.8.3.3 Response Payload

The success payload, if any, shall be specified by the Service.

A warning or failure payload shall contain a Status Details document.

Insert PS3.18 Section 8.10.7 as follows:

360 ## 8.10.9 Create Subscription Generator Transaction

This transaction creates a Subscription Generator for the Target Resource.

Upon the successful completion of this transaction, whenever the origin server creates a new sub-resource of the Target resource it will also create a Subscription to that new sub-resource for the user agent.

365   ### 8.10.9.1 Request

This request uses the POST method and has the following syntax:

```
POST SP /{/resource}/generator{?accept}{&retain} SP version CRLF
Accept: dicom-media-type CRLF
*(header-field CRLF)
CRLF
```
370

8.10.9.1.1   Target Resource

The target resource has the following URI template:

    /{/resource}/generator

Where

375   {/resource}   is the resource for which the Subscription Generator is created.

8.10.9.1.2   Query Parameters

The query parameters specified below are optional, but if any are supported, they should have the similar defined here.

    {? deletionlock} = " deletionlock" "=" "true" / "false"

380   If present with a value of "true", it indicates that the user agent is requesting a Retention Lock, which if granted, prevents the resource from being deleted. If the "retain" parameter is not present, its default value is "false", and no Retention Lock will be created.

        The Retention Lock may be removed either by deleting the subscription or by creating a new subscription to the resource without the "retain" parameter.

385   More than one user agent can request a Retention Lock on the same resource. All Retention Locks associated with a resource must be released before the origin server is free to delete the resource.

        For each resource, which the user agent has acquired a Retention Lock, the user agent shall remove the Retention Lock as soon as it has obtained any needed final state information for the
390   resource.

    {&filter} = "filter" "=" 1#(attribute "=" values)

        If present, this parameter specifies the attribute/value pairs used to filter the notifications.

        The "filter" parameter specifies a comma-separated list of matching attributes/value pairs that are used as a filter to determine if a new resource should have a subscription. See Section 8.3.1.1
395   for attribute/value pair syntax.

        If a newly created resource has the specified attribute/value pairs then the Filter is satisfied, and the resource will have a Subscription.

        The permissible attributes and values are specified by the Service.

8.10.9.1.3   Request Header Fields

400   **Table 8.10.7-1: Common Header Fields for Subscribe Request**

Name	Value	Usage		Description
		User Agent	Origin Server	
Accept	media-range	M	M	The Acceptable Media Types for the response payload
Accept-Charset	1#charset	O	M	The Acceptable Character Sets of the response payload

See also Section 8.4.

8.10.9.1.4   Request Payload

The request has no payload.

Commented [JP19]: Currently called "deletionlock"

405 **8.10.9.2   Behavior**

The origin server shall create a Subscription Generator to the Target Resource for the user agent.

TODO explain when an origin server has to do notifications.

410 Each time the origin server creates a new UPS instance, the SCP shall send a UPS State Report Event, indicating a change of status to SCHEDULED and the initial value of and Input Readiness State (0040,4041), to all AEs with a Global Subscription State of "Global Subscription with Lock" or "Global Subscription w/o Lock". (see Section CC.2.3)

> **Commented [JP20]:** Edit for correctness

Upon receipt of the Create Subscription Generator request, the origin server shall update the appropriate Subscription state as described in Table CC.2.3-2 in PS3.4.

> **Commented [JP21]:** Review each cell in the table

415 The origin server shall send Notifications for this Subscription over the Notification Connection create by the user agent. The exact Notifications sent shall be determined by the events defined by the Service.

The origin server shall honor any Retention Locks provided to subscriptions.

Upon receipt of a valid Subscribe request, the origin server shall create the subscription(s) specified in the request and then return an appropriate response.

420 **8.10.9.3   Response**

The response shall have the following format:

```
version SP status-code SP reason-phrase CRLF
Location: subscription CRLF
*(header-field CRLF)
425    CRLF
[status-details]
```

Where,

subscription   is an opaque URL that references the created subscription resource.

8.10.9.3.1   Status Codes

430 A success response shall contain a status code of 201 (Created).

A failure response shall contain a status code from Table 8.10.7-2. Table CC.2.1.4.

Table 8.10.7-2: Common Status Codes for the Subscribe Transaction

Status Code	Description
201 (Created)	The subscription was created.
400 (Bad Request)	The origin server was unable to understand the request
404 (Not found)	The specified resource does not exist or is not managed by this origin server.
409 (Conflict)	

Table CC.2.3.4: Status Codes for Subscribe

Status	Meaning	Code	
Success	The requested change of subscription state was performed	0000	201
Warning	Retention Lock not granted	B301	207?
Failure	Specified SOP Instance UID does not exist or is not a UPS Instance managed by this SCP	C307	404

> **Commented [JP22]:** Status codes from CC.2.3.4. Should we use them? In general, or just for UPS. Are these status codes defined for All Subscriptions? Modality worklist, UPS, Instance availability Notification

Receiving AE-TITLE is Unknown to this SCP		C308	401
Refused: Specified action not appropriate for specified instance		C314	409
Refused: SCP does not support Event Reports		C315	403

435   **8.10.9.3.2   Response Header Fields**

Table 6.1.X-Y: Common Header Fields for Subscribe Request

Name	Value	Usage	Notes
Location	<subscription>	M	An unique and opaque URL, defined by the origin server, that references the Subscription. Required If the request is successful,
Warning	<string>	CM	See below

If a Subscription was created but a requested Retention Lock was not granted. The Warning header field shall contain the following string:

440   `Warning: 299 {+service}: Retention Lock not granted.`

Other required and optional header fields may be specified by the Service.

8.10.9.3.3   Response Payload

The success payload, if any, shall be specified by the Service.

A warning or failure payload shall contain a Status Details document.

445   ## 8.10.8   Delete Subscription Generator Transaction

This transaction removes (deletes) a subscription from the target resource.

When a user agent unsubscribes from a resource, its Retention Locks on any resources associated with that subscription are released. The origin server shall not delete a resource until all Retention Locks on the resource have been released.

450   Upon receipt of the Unsubscribe request, the origin server shall update the appropriate Subscription state as described by the Service.

8.10.10.1   Request

The request uses the DELETE method and has the following syntax:

```
      DELETE SP {/subscription}{?existing} SP version CRLF
455   Accept: media-type CRLF
      *(header-field CRLF)
      CRLF
```

8.10.10.1.1   Target Resource

The target resource is a subscription:

460   {/subscription} = url

A subscription is an opaque URL returned in the Location header field of a successful Create Subscription response.

8.10.10.1.2   Query Parameters

The Service may implement the following parameters for this transaction:

465   {?existing} = "existing" "=: "keep" / "delete"

The "existing" parameter is optional. It shall only be present if the target resource is a Collection Subscription. It shall not be present otherwise. The default value is "delete".

8.10.10.1.3   Request Header Fields

The Service may specify additional Mandatory, Conditionally Mandatory or Optional header fields

470   **Table 8.10.8-1: Common Header Fields for Subscribe Request**

Name	Value	Usage	Notes
Accept	media-range	CM	The Acceptable Media Types for a response

8.10.10.1.4   Request Payload

The request has no payload.

8.10.10.2   Behavior

The target Subscription shall be deleted, and its Retention Lock shall be removed from the resource that
475   it was subscribed to.

If the target Subscription is a Collection Subscription, and the value of the "existing" query parameter is
"keep", all existing Instance Subscriptions created by the target Collection Subscription are left in place,
but no more shall be created; otherwise, is the "existing" query parameter is not present or its value is
"delete", all existing Instance Subscriptions created by the target resource are deleted and no more shall
480   be created.

8.10.10.3   Response

The response shall have the following format:

```
version SP status-code SP reason-phrase CRLF
*(header-field CRLF)
485    CRLF
[status-details]
```

8.10.10.3.1   Status Codes

A success response shall contain a status code of 200 (OK), indicating that the target subscription(s)
have been suspended or deleted.

490   A failure response will contain an appropriate status code from Table 8.10.8-2

Table 8.10.10.-21. Common Status Codes for Unsubscribe

Status	Meaning	Code	
Success	The requested change of subscription state was performed	0000	200
Warning	Retention Lock not granted	B301	
Failure	Specified SOP Instance UID does not exist or is not a UPS Instance managed by this SCP	C307	404
	Receiving AE-TITLE is Unknown to this SCP	C308	401
	Refused: Specified action not appropriate for specified instance	C314	409
	Refused: SCP does not support Event Reports	C315	

Commented [JP23]: Status codes from CC.2.1.4. What to do?

8.10.10.3.2   Response Header Fields

The Service may specify additional Mandatory, Conditionally Mandatory or Optional header fields

495

Table 8.10.8-2: Common Header Fields for Subscribe Request

Name	Value	Usage	Notes
Accept	1#media-range	M	The Acceptable Media Types for a failure response

8.10.10.3.3   Response Payload

The success payload, if any, shall be specified by the Service.

A warning or failure payload shall contain a Status Details document.

500 | *Insert the following after PS3.18 Section 10.1.3.*

10.1.4   Studies Notifications

The Studies Notification Sub-Service is used to send Instance Availability Event Reports from the origin server to the user agent. This sub-service corresponds to the Instance Availability Notification Service Class (see PS3.4, Annex R).

505   The Studies Notifications system defines the transactions in Table 10.1.4-1, to conform to the definitions in the corresponding Sections.

Table 10.1.4-1: Standard Notification Transactions

Transaction	Definition
Open Notification Connection	Section 8.10.4
Send Event Report	Section 8.10.5
Close Notification Connection	Section 8.10.6
Subscribe	Section 8.10.7
Unsubscribe	Section 8.10.8

Insert the following after PS3.18 Section 10.1.3.

510

10.7   Instance Availability Event Report

The Instance Availability Event Report Attributes are specified in Table 10.9..

Table 10.9.1-X: Instance Availability Event Report Attributes

Attribute Name	Tag	VR	Type (UA/OS)
Specific Character Set	(0008,0005)	CS	1C/1C*
All other Attributes of the SOP Common Module			3/3
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	2/2
>Referenced SOP Class UID	(0008,1150)	UI	1/1
>Referenced SOP Instance UID	(0008,1155)	UI	1/1
>Performed Workitem Code Sequence	(0040,4019)	CS	2/2

Attribute Name	Tag	VR	Type (UA/OS)
>>Code Value	(0008,0100)	SH	1/1
>>Coding Scheme Designator	(0008,0102)	SH	1/1
>>Code Meaning	(0008,0104)	LO	1/1
>>*All other Attributes of the Performed Workitem Code Sequence*			3/3
Study Instance UID	(0020,000D)	UI	1/1
Referenced Series Sequence	(0008,1115)	SQ	1/1
>Series Instance UID	(0020,000E)	UI	1/1
>Referenced SOP Sequence	(0008,1199)	SQ	1/1
>>Referenced SOP Class UID	(0008,1150)	UI	1/1
>>Reference SOP Instance UID	(0008,1155)	UI	1/1
>>Instance Availability	(0008,0056)	CS	1/1
>>~~Retrieve AE Title~~	~~(0008,0054)~~	~~AE~~	~~1/1~~
>>~~Retrieve Location UID~~	~~(0040,E011)~~	~~UI~~	~~3/3~~
>>~~Retrieve URI~~	~~(0040,E010)~~	~~UR~~	~~3/3~~
>>Retrieve URL	(0008,1190)	UR	~~3/3~~ 1/1
>>~~Storage Media File-Set ID~~	~~(0088,0130)~~		~~3/3~~
>>~~Storage Media File-Set UID~~	~~(0088,0140)~~		~~3/3~~

515   * Required if an extended or replacement character set is used.

10.7.1   Example Instance Notification Event Report for application/json

```
    {
    { "00081111":
      { "vr": "SQ",
        "Value": [
            { "00081150": {"vr": "UI", "Value": [ uid ]},
              "00081155": {"vr": "UI", "Value": [ uid ]},
              "00404019": {"vr": "CS", "Value": [...]},
              "00080100": {"vr": "SH", "Value": [...]},
              "00080102": {"vr": "SH", "Value": [...]},
              "00080104": {"vr": "LO", "Value": [...]}
              ...  ; Other Attributes of Performed Workitem Code Sequence
            }
        ]
    },
    "0020000D": { "vr": "UI", "Value": [ uid ]},
    "00081115": { "vr": "SQ",
                  "Value": [
                    { "0020000E": {"vr": "UI", "Value": [ uid ]},
                      "00081199": {"vr": "SQ",
                                   "Value": [
                                     { "00081150": {"vr": "UI", "Value": [ uid ]},
                                       "00081155": {"vr": "UI", "Value": [ uid ]},
                                       "00080056": {"vr": "CS", "Value": [...]},
                                       "00081190": {"vr": "UR", "Value": [ url ]}
                                     }
                                   ]
                    }
```

515 ... 520 ... 525 ... 530 ... 535 ... 540 (line numbers in left margin)

```
                    . . .
545                 ]
        }
    }
```

10.7.2.　Event Report Format

Events Reports are encoded as WebSocket Data Frames. The Data Frame Type is specified by the
media type of the Event Report.

The Event Report shall contain the attributes in Table 11.4-1.

Table 11.4-1: Event Report Attributes

Tag	Attribute Name	VR
(0000,0002)	Affected SOP Class UID	UI
(0000,0100)	Command Field	US
(0000,0110)	Message ID	US
(0000,1000)	Affected SOP Instance UID	UI
(0000,1001)	Requested SOP Instance UID	UI
(xxxx,yyyy)	Document Type	UR
(0074,1238)	Reason for Cancellation	??
(0074,4041)	Input Readiness State	??

Update PS3.18 Section 11.10 as follows:

11.10　Subscribe Transaction

See Section 8.10.7.

Table 11.10-1. Resources Supporting Subscriptions

Resource	Resource Type	
/worklist	Subscription Generator	
/worklist/{workitem}	Subscription	

Update PS3.18 Section 11.11 as follows:

11.11　Unsubscribe Transaction

See Section 8.10.7.

Update PS3.18 Section 11.11 as follows:

11.12　Send Event Report Transaction

This transaction sends a UPS Event Report from the origin server to the user agent over a Notification
Connection. See Section 6.1.X.5.5.

PS3.4, Section CC.2.4.3 describes the scenarios in which an origin server sends Event Reports to a subscriber and the content of the Event Report messages.

The Event Report shall contain all mandatory attributes described by the Conformance Statement and
570 Capabilities document of the Service for the event type.

6.9.9.1 Notification

The Notification is a Web Socket Data Frame, sent over the Notification Connection. See Section 6.1.X.5.5.

6.9.9.1.1 UPS Event Reports

575 The Notification shall contain an Event Report in one of the formats defined in Tables 6.9-X through 6.9.Y.

Table 6.9-X: Event Report Types

Name	Event Type ID	Description
Workitem State Change	1	A user agent may receive State Change Report either due to a state change to the Workitem, or in response to initial subscription to the Workitem (possibly when the Workitem is initially created). See Section CC.2.3.3.
Cancel Workitem Request	2	If user agent with a Claimed Workitem (In-Progress) and an open Notification Connection may receive a Cancel Request Report if another user agent performs a Request Cancellation transaction. The claiming user agent may, at its own discretion, choose to cancel the Workitem as described above. See Section CC.2.4.3.
Workitem Progress	3	Each time the origin server updates the Procedure Step Progress (0074,1004), the Procedure Step Progress Description (0074,1006), or the contents of the Procedure Step Communications URI Sequence (0074,1008) for a UPS instance, it shall send a UPS Progress Report, with the current contents of the Progress Information Sequence (0074,1002), to subscribed user agents. See Section CC.2.4.3.
Service Status Change	4	Each time the origin server is restarted, it shall send a Status Change Event. The SCP, if it knows it is going down, may send an additional SCP Status Change Event before it is shut down. See Section CC.2.4.3.

Table 10.3-1. N-EVENT-REPORT-RQ Message Fields

Message Field	Tag	VR	VM	Description of Field
Command Group Length	(0000,0000)	UL	1	The even number of bytes from the end of the value field to the beginning of the next group.
Affected SOP Class UID	(0000,0002)	UI	1	SOP Class UID of the SOP Instance for which this event occurred.
Command Field	(0000,0100)	US	1	This field distinguishes the DIMSE-N notification conveyed by this Message. The value of this field shall be set to 0100H for the N-EVENT-REPORT-RQ Message.
Message ID	(0000,0110)	US	1	Implementation-specific value that distinguishes this Message from other Messages.

Message Field	Tag	VR	VM	Description of Field
Command Data Set Type	(0000,0800)	US	1	This field indicates if a Data Set is present in the Message. This field shall be set to the value of 0101H if no Data Set is present; any other value indicates a Data Set is included in the Message.
Affected SOP Instance UID	(0000,1000)	UI	1	Contains the UID of the SOP Instance for which this event occurred.
Event Type ID	(0000,1002)	US	1	Values for this field are application-specific.
Event Information	(no tag)	-	-	Application-specific Data Set containing additional information related to the operation.

580   Note

1. Service Class Specifications contained in PS3.4 defines the values needed for the Event Type ID parameter.

2. Service Class Specifications contained in PS3.4 defines the Data Set needed for the Event Information parameter.

585

Table 6.9-X: UPS Event Report Message Header

Message Field	Tag	VR	VM	Value
Command Group Length	(0000,0000)	UL	1	The length of the message (an even number of bytes)
Affected SOP Class UID	(0000,0002)	UI	1	**"1.2.840.10008.5.1.4.34.6.4"**
Command Field	(0000,0100)	US	1	256 (0100H)
Message ID	(0000,0110)	US	1	origin server controlled number
Command Data Set Type	(0000,0800)	US	1	257 (0101H)
Affected SOP Instance UID	(0000,1000)	UI	1	UID of the Workitem this report is abou.t
Event Type ID	(0000,1002)	US	1	1, 2, 3, or 4. See Table 6.9-X.
Event Information	(no tag)	-	-	Application-specific Data Set containing additional information related to the operation.

The Workitem State Change Event Report shall contain the attributes in Table 6.9.9-

590   **Table 6.9-X: Workitem State Change Event Report (Event Type ID = 1)**

Attribute Name	Tag	Usage
Affected SOP Instance UID	(0000,1000)	-/1
Input Readiness State	(0040,4041)	-/1
Procedure Step State	(0074,1000)	-/1

Attribute Name	Tag	Usage
Procedure Step Discontinuation Reason Code Sequence	(0074,100e)	-/3
>Code Value	(0008,0100)	-/1
>Coding Scheme Designator	(0008,0102)	-/1
>Coding Scheme Version	(0008,0103)	-/1C Required if the value of Coding Scheme Designator (0008,0102) is not sufficient to identify the Code Value (0008,0100) unambiguously
>Code Meaning	(0008,0104)	-/1
Reason For Cancellation	(0074,1238)	-/3

The Cancel Requested Event Report shall contain the attributes in Table 6.9.9-

Table 6.9-X: Cancel Requested Event Report (Event Type ID = 2)

Attribute Name	Tag	Usage
Affected SOP Instance UID	(0000,1000)	-/1
Contact URI	(0074,100a)	-/1C Required if provided in the triggering N-ACTION
Contact Display Name	(0074,100c)	-/1C Required if provided in the triggering N-ACTION
Procedure Step Discontinuation Reason Code Sequence	(0074,100e)	-/1C Required if provided in the triggering N-ACTION
>Code Value	(0008,0100)	-/1
>Coding Scheme Designator	(0008,0102)	-/1
>Coding Scheme Version	(0008,0103)	-/1C Required if the value of Coding Scheme Designator (0008,0102) is not sufficient to identify the Code Value (0008,0100) unambiguously
>Code Meaning	(0008,0104)	-/1
Requesting AE	(0074,1236)	-/1
Reason For Cancellation	(0074,1238)	-/1C Required if provided in the triggering N-ACTION

Commented [JP29]: This needs to be the address and credentials of the User Agent

595   The Workitem Progress Event Report shall contain the attributes in Table 6.9.9-

Table 6.9-X: Workitem Progress Event Report (Event Type ID = 3)

Attribute Name	Tag	Usage
Affected SOP Instance UID	(0000,1000)	-/1
Progress Information Sequence	(0074,1002)	-/1
>Procedure Step Progress	(0074,1004)	-/3
>Procedure Step Progress Description	(0074,1006)	-/3
>Procedure Step Communications URI Sequence	(0074,1008)	-/3

>>Contact URI	(0074,100a)	-/1
>>Contact Display Name	(0074,100c)	-/3

The Origin Server Status Change Event Report shall contain the attributes in Table 6.9.9-

Table 6.9-X: Origin Server Status Change Report (Event Type ID = 4)

Attribute Name	Tag	Usage
Affected SOP Instance UID	(0000,1000)	-/1
SCP Status	(0074,1242)	-/1
Subscription List Status	(0074,1244)	-/1
Unified Procedure Step List Status	(0074,1246)	-/1

600

However, a UPS Service may extend the Event Report with additional attributes.

> **Commented [JP30]:** Is this correct?

The following is an example "application/json" WebSocket payload:

```
{
"00000002": [ "1.2.840.10008.5.1.4.34.6.4" ],
"00000100": [ 256 ],
"00000110": [ 257 ],
"00001000": [ "1.2.840.10008.5.1.4.34.6.4.2.3.44.22231" ],
"00001001": [ 1 ],
"00741238": [ "SCHEDULED" ],
"00744041": [ "READY" ]
} CRLF
```

605

610

> **Commented [JP31]:** Add keywords to examples

6.9.9.2   Behavior

The user agent should take appropriate action when a Notification is received.

6.9.9.3   Notification Acknowledgement

615   The user agent shall send a success or failure Acknowledgement as specified in Section 6.1.X.5.5.3

10.7   Subscribe Transaction

> **Commented [JP32]:** Update Numbering if we keep Close Notification Connection.

This transaction creates a Subscription to a Study resource.

10.7.1.1   Request

620   This request uses the POST method and has the following syntax:

```
POST SP /studies/subscriptions{/study} {?retain} {&filter*} SP version CRLF
*(header-field CRLF)
CRLF
```

10.7.1.1.1   Target Resource

625   There are two different resources that can be subscribed to: the Studies Subscription resource, which creates a Collection Subscription:

```
/studies/subscriptions
```

And the Study Subscription resource, which creates an Instance Subscription:

```
/studies/subscriptions{/study}
```

630   **10.7.1.1.2   Query Parameters**

The standard "retain" and "filter" query parameters are supported. See Section 6.1.X.5.3.1.2.

10.7.1.1.3   Request Header Fields

See Section 6.1.X.5.3.1.3.

10.7.1.1.4   Request Payload

635   The request shall have no payload.

10.7.1.2   Behavior

The origin server shall create a subscription to the target resource, and return a URL reference to the Subscription in the Location header field of the response. See Section 6.1.X.5.3.2 for details.

10.7.1.3   Response

640   The response shall have the following format:

```
version SP status-code SP reason-phrase CRLF
Location: subscription CRLF
*(header-field CRLF)
CRLF
[status-details]
```

645

Where,

subscription   is an opaque URL for the created subscription resource.

10.7.1.3.1   Status Code

A success response shall have a 200 (OK) status code.

650   A failure response shall have an appropriate failure status code. See Section 6.1.X.5.3.3.1.

10.7.1.3.2   Response Header Fields

See Section 6.1.X.5.3.3.2.

10.7.1.3.3   Response Message Body

The response shall have no message body.

655   ## 10.8   Unsubscribe Transaction

10.9   Send Event Report Transaction

This transaction sends an Instance Availability Event Report from the origin server to the user agent over a Notification Connection. See Section 6.1.X.5.5 and PS3.4, Annex R.

660   **10.9.1   Notification**

See Section 6.1.X.5.5.

10.9.1.1   Instance Availability Event Report

The Instance Availability Event Report Attributes are specified in Table 10.9.1-1.

Table 10.9.1-1: Instance Availability Event Report Attributes

Attribute Name	Tag	VR	Type (UA/OS)
Specific Character Set	(0008,0005)	CS	1C/1C*
All other Attributes of the SOP Common Module			3/3
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	2/2
>Referenced SOP Class UID	(0008,1150)	UI	1/1
>Referenced SOP Instance UID	(0008,1155)	UI	1/1
>Performed Workitem Code Sequence	(0040,4019)	CS	2/2
>>Code Value	(0008,0100)	SH	1/1
>>Coding Scheme Designator	(0008,0102)	SH	1/1
>>Code Meaning	(0008,0104)	LO	1/1
>>*All other Attributes of the Performed Workitem Code Sequence*			3/3
Study Instance UID	(0020,000D)	UI	1/1
Referenced Series Sequence	(0008,1115)	SQ	1/1
>Series Instance UID	(0020,000E)	UI	1/1
>Referenced SOP Sequence	(0008,1199)	SQ	1/1
>>Referenced SOP Class UID	(0008,1150)	UI	1/1
>>Reference SOP Instance UID	(0008,1155)	UI	1/1
>>Instance Availability	(0008,0056)	CS	1/1
>>~~Retrieve AE Title~~	~~(0008,0054)~~	~~AE~~	~~1/1~~
>>~~Retrieve Location UID~~	~~(0040,E011)~~	~~UI~~	~~3/3~~
>>~~Retrieve URI~~	~~(0040,E010)~~	~~UR~~	~~3/3~~
>>Retrieve URL	(0008,1190)	UR	~~3/3~~ 1/1
>>~~Storage Media File-Set ID~~	~~(0088,0130)~~		~~3/3~~
>>~~Storage Media File-Set UID~~	~~(0088,0140)~~		~~3/3~~

665   * Required if an extended or replacement character set is used.

10.9.2.1.2   'application/json' Example Instance Notification Event Report

```
      {
        {"00081111": {"vr": "SQ",
                 "Value": [{"00081150": {"vr": "UI", "Value": [ uid ],
670                         "00081155": {"vr": "UI", "Value": [ uid ],
                           "00404019": {"vr": "CS", "Value": [...],
                           "00080100": {"vr": "SH", "Value": [...],
                           "00080102": {"vr": "SH", "Value": [...],
                            "00080104": {"vr": "LO", "Value": [...]
675                          ...  ; Other Attributes of Performed Workitem Code Sequence
                         }
                         ...
                         ],
        "0020000D": {"vr": "UI", "Value": [ uid ],
680        "00081115": {"vr": "SQ",
```

```
            "Value": [{"0020000E": {"vr": "UI", "Value": [ uid ],
                      "00081199": {"vr": "SQ",
                                   "Value": [{"00081150": {"vr": "UI",
                                                           "Value": [ uid ],
                                              "00081155": {"vr": "UI",
                                                           "Value": [ uid ],
                                              "00080056": {"vr": "CS",
                                                           "Value": [...],
                                              "00081190": {"vr": "UR",
                                                           "Value": [ url ]
                                             }
                                   ]
                      }
                      ...
                  ]
        }
   }
```

10.9.2.1.3   Event Report Format

Events Reports are encoded as WebSocket Data Frames. The Data Frame Type is specified by the media type of the Event Report.

The Event Report shall contain the attributes in Table 11.4-1.

Table 11.4-1: Event Report Attributes

Tag	Attribute Name	VR
(0000,0002)	Affected SOP Class UID	UI
(0000,0100)	Command Field	US
(0000,0110)	Message ID	US
(0000,1000)	Affected SOP Instance UID	UI
(0000,1001)	Requested SOP Instance UID	UI
(xxxx,yyyy)	Document Type	UR
(0074,1238)	Reason for Cancellation	??
(0074,4041)	Input Readiness State	??

10.9.2.2   Behavior

The user agent should take appropriate action when a Notification is received.

10.9.2.3   Notification Acknowledgement

The user agent shall send a success or failure Acknowledgement as specified in Section 6.1.X.5.5.3

TODO:

#	Description
1	Look at modality worklist, MPPS, and print notifications
2	Add a section on use cases: For the abstract API For each concrete API Differentiate old use cases from new use cases
3	Difference between N-Create, N-Event….

Commented [JP33]: We need to reference Event Reports in PS3.X.

Commented [JP34]: Is this required or an example?

4	Coordinate with IHE ITI RESTful DSUB whitepaper
5	Follow or parallel N-Event-Report
6	Separable layers: subscription cab be used to generate notifications, which can use <u>messaging</u>. If the End-Point has a Notification Connection open, then the origin server may send Notifications that are not related to a Subscription.
7	Add a section on Server, as opposed to resource, related events

710