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Custom Subscription to Event Notifications
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Abstract

This document defines capabilities and operations for the customized establishment of subscriptions upon a publisher's event streams. Also defined are delivery mechanisms for instances of the resulting events. Effectively this allows a subscriber to request and receive a continuous, custom influx of publisher generated information.

Status of This Memo

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1. Introduction

This document defines capabilities and operations for the customized establishment of subscriptions upon system generated event streams. Also defined are asynchronous delivery mechanisms, where the resulting event instances are placed within notification messages and sent to targeted receivers. Effectively this enables a "Subscribe then Publish" capability where the customized information needs of each target receiver are understood by the publisher before events are marshalled and pushed. The receiver then gets a continuous, custom influx of publisher generated events.

While the functionality defined in this document is transport-agnostic, subscription control plane operations bindings exist for both NETCONF [[RFC6241](#)] and RESTCONF [[RFC8040](#)]. In addition, bindings for the pushed event instances have been defined for protocols such as NETCONF and HTTP2 [[RFC7540](#)]. For specifics on these bindings see [[I-D.ietf-netconf-event-notif](#)] and [[I-D.ietf-netconf-restconf-notif](#)].

The capabilities and operations defined in this document with implemented in conjunction with [[I-D.ietf-netconf-event-notif](#)] are intended to obsolete [[RFC5277](#)].

1.1. Motivation

There are various [[RFC5277](#)] limitations, many of which have been exposed in [[RFC7923](#)] which needed to be solved. Key capabilities supported by this document include:

- o multiple subscriptions on a single transport session
- o support for dynamic and statically configured subscriptions
- o modification of an existing subscription
- o operational counters and instrumentation
- o negotiation of subscription parameters

- o promise theory based interaction model
- o state change notifications (e.g., publisher driven suspension, parameter modification)
- o independence from transport protocol

1.2. Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [RFC 2119](#) [[RFC2119](#)].

Configured subscription: A subscription installed via a configuration interface which persists across reboots.

Dynamic subscription: A subscription agreed between subscriber and publisher created via RPC subscription state signaling messages.

Event: An occurrence of something that may be of interest. (e.g., a configuration change, a fault, a change in status, crossing a threshold, or an external input to the system.)

Event notification: A set of information intended for a Receiver indicating that one or more Event(s) have occurred. Details of the Event(s) may be included within the Notification.

Filter: Evaluation and/or selection criteria, which may be applied against a targeted set of objects or events in a subscription. Information traverses the filter only if specified filter criteria are met.

NACM: NETCONF Access Control Model.

Publisher: An entity responsible for streaming event notifications per the terms of a Subscription.

Receiver: A target to which a publisher pushes event notifications. For dynamic subscriptions, the receiver and subscriber are the same entity.

Stream (also referred to as "event stream"): A continuous ordered set of events grouped under an explicit criteria.

Subscriber: An entity able to request and negotiate a contract for the generation and push of event notifications from a publisher.

Subscription: A contract with a publisher, stipulating which information one or more receivers wish to have pushed from the publisher without the need for further solicitation.

1.3. Solution Overview

This document describes a transport protocol-agnostic mechanism for subscribing to and receiving event notifications from an event publisher. This mechanism is through the use a subscription.

Two types of subscriptions are supported:

1. Dynamic subscriptions, where a subscriber initiates a subscription negotiation with a publisher via RPC. If the publisher wants to serve this request, it accepts it, and then starts pushing event notifications. If the publisher does not wish to serve it as requested, then an error response is returned. This response may include hints at subscription parameters which would have been accepted.
2. Configured subscriptions, which allows the management of subscriptions via a configuration interface so that a publisher can send event notifications to configured receiver(s). Support for this capability is optional.

Additional characteristics differentiating configured from dynamic subscriptions include:

- o The lifetime of a dynamic subscription is bounded by transport session used to establish it. For connection-oriented stateful transport like NETCONF, the loss of the transport session will result in the immediate termination of associated dynamic subscriptions. For connectionless or stateless transports like HTTP, it is the lack of receipt acknowledgement of a sequential set of notification messages and/or keep-alives which will terminate dynamic subscriptions. The lifetime of a configured subscription is driven by relevent configuration being present on the running configuration. This implies configured subscriptions persist across reboots, and persist even when transport is unavailable.
- o Configured subscriptions can be modified by any configuration client with write permission on the configuration of the subscription. Dynamic subscriptions can only be modified via an RPC request made upon the original subscribing transport session.

Note that there is no mixing-and-matching of dynamic and configured subscriptions. Specifically, a configured subscription cannot be

modified or deleted using RPC. Similarly, a subscription established via RPC cannot be modified through configuration operations.

The publisher may decide to terminate a dynamic subscription at any time. Similarly, it may decide to temporarily suspend the sending of event notifications for either configured or dynamic subscriptions. Such termination or suspension may be driven by the publisher running out of resources to serve the subscription, or by internal errors on the publisher.

2. Solution

2.1. Event Streams

An event stream is a named entity on a publisher which exposes a continuously updating set of events. Each event stream is available for subscription. It is out of the scope of this document to identify a) how streams are defined, b) how events are defined/generated, and c) how events are assigned to streams.

There are two standardized event streams within this document: NETCONF and SYSLOG. The NETCONF event stream contains all NETCONF XML event information supported by the publisher, except for where it has been explicitly indicated that this the event must be excluded from the NETCONF stream. The SYSLOG event stream mirrors the discrete set entries which are concurrently being placed into a device's local Syslog. Beyond these two, additional streams can be added via model augmentation.

As events are raised by a system, they may be assigned to one or more streams. The event is distributed to receivers where: (1) a subscription includes the identified stream, and (2) subscription filtering allows the event to traverse.

If access control permissions are in use to secure publisher content, then for notifications to be sent to a receiver, that receiver must be allowed access to all the events on the stream. If permissions change during the lifecycle of the of a subscription, then events must be sent or restricted accordingly. This can be done by re-establishing a subscription with the updated permissions, or by seamlessly updating the permissions of an existing subscription.

2.2. Filters

A publisher implementation MUST support the ability to perform filtering of notification records. Two filtering syntaxes supported are [\[XPath\]](#) and subtree [\[RFC6241\]](#). Events which evaluate to "true", or return a non-null selection as a result of the evaluation by the

An equivalent state machine exists for configured subscriptions. However the transition between states is via configuration operations rather than via RPC.

3. Data Model Trees

```

module: ietf-subscribed-notifications
  +--ro streams
  | +--ro stream*   stream
  +--rw filters
  | +--rw filter* [identifier]
  |   +--rw identifier          filter-id
  |   +--rw (filter-type)?
  |     +--:(event-filter)
  |       +--rw event-filter-type  event-filter-type
  |       +--rw event-filter
  +--rw subscription-config {configured-subscriptions}?
  | +--rw subscription* [identifier]
  |   +--rw identifier          subscription-id
  |   +--rw encoding?          encoding
  |   +--rw (target)
  |     | +--:(event-stream)
  |     | | +--rw stream          stream
  |     +--rw (applied-filter)
  |     | | +--:(by-reference)
  |     | | | +--rw filter-ref      filter-ref
  |     | | +--:(within-subscription)
  |     | | | +--rw (filter-type)?
  |     | | | | +--:(event-filter)
  |     | | | | +--rw event-filter-type  event-filter-type
  |     | | | | +--rw event-filter
  |     +--rw stop-time?        yang:date-and-time
  |     +--rw receivers
  |     | +--rw receiver* [address port]
  |     | | +--rw address      inet:host
  |     | | +--rw port        inet:port-number
  |     | | +--rw protocol?   transport-protocol
  |     +--rw (notification-origin)?
  |     | +--:(interface-originated)
  |     | | +--rw source-interface?  if:interface-ref
  |     | +--:(address-originated)
  |     | | +--rw source-vrf?        string
  |     | | +--rw source-address     inet:ip-address-no-zone
  +--ro subscriptions
  | +--ro subscription* [identifier]
  |   +--ro identifier          subscription-id
  |   +--ro configured-subscription?
  |     |
  |     +--ro empty {configured-subscriptions}?

```



```

+--ro encoding?                encoding
+--ro (target)
| +--:(event-stream)
|   +--ro stream                stream
|   +--ro replay-start-time?    yang:date-and-time {replay}?
+--ro (applied-filter)
| +--:(by-reference)
| | +--ro filter-ref            filter-ref
| +--:(within-subscription)
|   +--ro (filter-type)?
|     +--:(event-filter)
|       +--ro event-filter-type  event-filter-type
|       +--ro event-filter
+--ro stop-time?                yang:date-and-time
+--ro (notification-origin)?
| +--:(interface-originated)
| | +--ro source-interface?      if:interface-ref
| +--:(address-originated)
|   +--ro source-vrf?            string
|   +--ro source-address         inet:ip-address-no-zone
+--ro receivers
  +--ro receiver* [address port]
    +--ro address                inet:host
    +--ro port                    inet:port-number
    +--ro protocol?              transport-protocol
    +--ro pushed-notifications?  yang:counter64
    +--ro excluded-notifications? yang:counter64
    +--ro status                  subscription-status

```

rpcs:

```

+---x establish-subscription
| +---w input
| | +---w encoding?            encoding
| | +---w (target)
| | | +--:(event-stream)
| | |   +---w stream          stream
| | |   +---w replay-start-time? yang:date-and-time {replay}?
| | +---w (applied-filter)
| | | +--:(by-reference)
| | | | +---w filter-ref      filter-ref
| | | +--:(within-subscription)
| | |   +---w (filter-type)?
| | |     +--:(event-filter)
| | |       +---w event-filter-type  event-filter-type
| | |       +---w event-filter
| | +---w stop-time?          yang:date-and-time
| +--ro output
|   +--ro subscription-result    subscription-result

```



```

|     +--ro (result)?
|     +--:(no-success)
|     | +--ro filter-failure?          string
|     | +--ro replay-start-time-hint?  yang:date-and-time
|     +--:(success)
|     +--ro identifier                  subscription-id
+---x modify-subscription
| +---w input
| | +---w identifier?                  subscription-id
| | +---w (applied-filter)
| | | +--:(by-reference)
| | | | +---w filter-ref              filter-ref
| | | +--:(within-subscription)
| | |   +---w (filter-type)?
| | |     +--:(event-filter)
| | |       +---w event-filter-type  event-filter-type
| | |       +---w event-filter
| | +---w stop-time?                  yang:date-and-time
| +--ro output
|   +--ro subscription-result          subscription-result
|   +--ro (result)?
|     +--:(no-success)
|     +--ro filter-failure?            string
+---x delete-subscription
| +---w input
| | +---w identifier                  subscription-id
| +--ro output
|   +--ro subscription-result          subscription-result
+---x kill-subscription
  +---w input
  | +---w identifier                  subscription-id
  +--ro output
    +--ro subscription-result          subscription-result

```

notifications:

```

+---n replay-complete
| +--ro identifier                    subscription-id
+---n notification-complete
| +--ro identifier                    subscription-id
+---n subscription-started
| +--ro identifier                    subscription-id
| +--ro encoding?                     encoding
| +--ro (target)
| | +--:(event-stream)
| |   +--ro stream                    stream
| |   +--ro replay-start-time?        yang:date-and-time {replay}?
| +--ro (applied-filter)
| | +--:(by-reference)

```



```

| | | +--ro filter-ref          filter-ref
| | +--:(within-subscription)
| |   +--ro (filter-type)?
| |     +--:(event-filter)
| |       +--ro event-filter-type  event-filter-type
| |       +--ro event-filter
| +--ro stop-time?                yang:date-and-time
+---n subscription-resumed
| +--ro identifier                subscription-id
+---n subscription-modified
| +--ro identifier                subscription-id
| +--ro encoding?                encoding
| +--ro (target)
| | +--:(event-stream)
| |   +--ro stream                stream
| |   +--ro replay-start-time?    yang:date-and-time {replay}?
| +--ro (applied-filter)
| | +--:(by-reference)
| | | +--ro filter-ref          filter-ref
| | | +--:(within-subscription)
| | |   +--ro (filter-type)?
| | |     +--:(event-filter)
| | |       +--ro event-filter-type  event-filter-type
| | |       +--ro event-filter
| +--ro stop-time?                yang:date-and-time
+---n subscription-terminated
| +--ro identifier                subscription-id
| +--ro error-id                 subscription-errors
| +--ro filter-failure?          string
+---n subscription-suspended
  +--ro identifier                subscription-id
  +--ro error-id                 subscription-errors
  +--ro filter-failure?          string

```

The top-level decompositions of data model are as follows:

- o "Streams" contains a list of event streams that are supported by the publisher and against which subscription is allowed.
- o "Filters" contains a configurable list of filters that can be applied to a subscription. This allows users to reference an existing filter definition as an alternative to defining a filter inline for each subscription.
- o "Subscription-config" contains the configuration of configured subscriptions. The parameters of each configured subscription are a superset of the parameters of a dynamic subscription and use the same groupings. In addition, the configured subscriptions must

also specify intended receivers and may specify the push source from which to send the stream of notification messages.

- o "Subscriptions" contains a list of all subscriptions on a publisher, both configured and dynamic. It can be used to retrieve information about the subscriptions which a publisher is serving.

The data model also contains a number of notifications that allow a publisher to signal information about a subscription. Finally, the data model contains a number of RPC definitions that are used to manage dynamic subscriptions.

4. Dynamic Subscriptions

Dynamic subscriptions are managed via RPC.

4.1. Establishing a Subscription

The <establish-subscription> operation allows a subscriber to request the creation of a subscription via RPC.

The input parameters of the operation are:

- o A stream which identifies the domain of events against which the subscription is applied.
- o A filter which may reduce the set of events pushed.
- o The desired encoding for the returned events. By default, updates are encoded using XML. Other encodings may be supported, such as JSON.
- o An optional stop time for the subscription.
- o An optional start time which indicates that this subscription is requesting a replay push of events previously generated.

If the publisher cannot satisfy the <establish-subscription> request, it sends a negative <subscription-result> element. If the subscriber has no authorization to establish the subscription, the <subscription-result> indicates an authorization error. Optionally, the <subscription-result> may include one or more hints on alternative input parameters and value which would have resulted in an accepted subscription.

Subscription requests must fail if a filter with invalid syntax is provided or if the name of a non-existent stream is provided.

4.1.1. Replay Subscription

Only viable for dynamic subscriptions made on event streams, if the replay feature is supported, a subscription may request that previously generated events be sent. These would then be followed by events generated after the subscription is established.

The presence of a start time is the indicator that there is requested replay for this subscription. The start time must be earlier than the current time. If the start time points earlier than the maintained history of Publisher's event buffer, then the subscription must be rejected. In this case the error response to the <establish-subscription> request should include a start time supportable by the Publisher.

4.2. Modifying a Subscription

The <modify-subscription> operation permits changing the terms of an existing dynamic subscription previously established on that transport session. Subscriptions created by configuration operations cannot be modified via this RPC. Dynamic subscriptions can be modified one or multiple times. If the publisher accepts the requested modifications, it immediately starts sending events based on the new terms, completely ignoring the previous ones. If the publisher rejects the request, the subscription remains as prior to the request. That is, the request has no impact whatsoever. The contents of a such a rejected modification may include one or more hints on alternative input parameters and value which would have resulted in a successfully modified subscription.

Dynamic subscriptions established via RPC can only be modified via RPC using the same transport session used to establish that subscription.

4.3. Deleting a Subscription

The <delete-subscription> operation permits canceling an existing subscription previously established on that transport session. If the publisher accepts the request, it immediately stops sending events for the subscription. If the publisher rejects the request, all subscriptions remain as prior to the request. That is, the request has no impact whatsoever.

Subscriptions established via RPC can only be deleted via RPC using the same transport session used for subscription establishment. Configured subscriptions cannot be deleted using RPCs. Instead, configured subscriptions are deleted as part of regular configuration

operations. Publishers MUST reject any RPC attempt to delete configured subscriptions.

4.4. Killing a Subscription

The <kill-subscription> operation permits an operator to end any dynamic subscription. The publisher must accept the request for any dynamic subscription, and immediately stop sending events.

Configured subscriptions cannot be kill using this RPC. Instead, configured subscriptions are deleted as part of regular configuration operations. Publishers MUST reject any RPC attempt to kill a configured subscription.

5. Configured Subscriptions

A configured subscription is a subscription installed via a configuration interface.

Configured subscriptions persist across reboots, and persist even when transport is unavailable.

Configured subscriptions can be modified by any configuration client with write permissions for the configuration of the subscription. Subscriptions can be modified or terminated via the configuration interface at any point of their lifetime.

Supporting configured subscriptions is optional and advertised using the "configured-subscriptions" feature.

In addition to subscription parameters that apply to dynamic subscriptions, the following additional parameters apply to configured subscriptions:

- o One or more receiver IP addresses (and corresponding ports) intended as the destination for push updates for each subscription. In addition, the transport protocol for each destination may be defined.
- o Optional parameters to identify an egress interface or IP address / VRF where a subscription updates should be pushed from the publisher. Where these are not explicitly included, push updates should egress the publisher's default interface having reachability to a receiver.

5.1. Establishing a Configured Subscription

Configured subscriptions are established using configuration operations against the top-level subtree subscription-config. There are two key differences between RPC and <edit-config> RPC operations for subscription establishment. Firstly, <edit-config> operations install a subscription without question, while RPCs may support negotiation and rejection of requests. Secondly, while RPCs mandate that the subscriber establishing the subscription is the only receiver of the notifications, <edit-config> operations permit specifying receivers independent of any tracked subscriber. Because there is no explicit association with an existing transport session, <edit-config> operations require additional parameters beyond those of dynamic subscriptions to indicate the receivers of the notifications and possibly the source of the notifications such as a specific egress interface.

Immediately after a subscription is successfully established, the publisher sends to identified receivers a control-plane notification stating the subscription has been established (subscription-started).

It is quite possible that upon configuration, reboot, or even steady-state operations, a transport session may not be currently available to the receiver. In this case, when there is something to transport for an active subscription, transport protocol specific call-home operations will be used to establish the connection.

As an example at subscription establishment using <edit-config> over NETCONF, a client may send:


```
<rpc message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0"
  xmlns:nc="urn:ietf:params:xml:ns:netconf:base:1.0">
  <edit-config>
    <target>
      <running/>
    </target>
    <subscription-config
      xmlns="urn:ietf:params:xml:ns:netconf:notification:2.0">
      <subscription>
        <subscription-id>
          1922
        </subscription-id>
        <stream>
          foo
        </stream>
        <receiver>
          <address>
            1.2.3.4
          </address>
          <port>
            1234
          </port>
        </receiver>
      </subscription>
    </subscription-config>
  </edit-config>
</rpc>
```

Figure 2: Configured subscription creation via NETCONF

if the request is accepted, the publisher would reply:

```
<rpc-reply message-id="101"
  xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <ok/>
</rpc-reply>
```

Figure 3: Successful NETCONF configured subscription response

if the request is not accepted because the publisher cannot serve it, the publisher may reply:


```
<rpc-reply xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <rpc-error>
    <error-type>application</error-type>
    <error-tag>resource-denied</error-tag>
    <error-severity>error</error-severity>
    <error-message xml:lang="en">
      Temporarily the publisher cannot serve this
      subscription due to the current workload.
    </error-message>
  </rpc-error>
</rpc-reply>
```

Figure 4: A NETCONF response for a failed configured subscription creation

5.2. Modifying a Configured Subscription

Configured subscriptions can be modified using configuration operations against the top-level subtree `subscription-config`.

Immediately after a subscription is successfully modified, the publisher sends to the existing receivers a control-plane notification stating the subscription has been modified (i.e., `subscription-modified`).

If the modification involved adding and/or removing receivers, those modified receivers are sent control-plane notifications, indicating they have been added (i.e., `subscription-started` to a specific receiver) or removed (i.e., `subscription-terminated` to a specific receiver.)

5.3. Deleting a Configured Subscription

Subscriptions can be deleted using configuration operations against the top-level subtree `subscription-config`. For example, in RESTCONF:

```
DELETE /subscription-config/subscription=1922 HTTP/1.1
Host: example.com

HTTP/1.1 204 No Content
Date: Sun, 24 Jul 2016 11:23:40 GMT
Server: example-server
```

Figure 5: Deleting a configured subscription

Immediately after a subscription is successfully deleted, the publisher sends to all receivers of that subscription a control-plane

notification stating the subscription has been terminated (subscription-terminated).

6. Event (Data Plane) Notifications

Once a subscription has been set up, the publisher streams (asynchronously) notifications per the terms of the subscription. We refer to these as event notifications. For dynamic subscriptions set up via RPC operations, event notifications are sent over the session used to establish the subscription. For configured subscriptions, event notifications are sent over the specified connections.

An event notification is sent to a receiver when something of interest occurs which is able to traverse all specified filtering and access control criteria. At a minimum this event notification must include:

- o a subscription-id element of type uint32 which corresponds to the responsible subscription in the Publisher.
- o a timestamp indicating when event was identified and recorded by the event source. This timestamp must support the indication of time zone. The default timestamp is the eventTime element of type dateTime and compliant to [\[RFC3339\]](#). Additional timestamp elements and formats are outside the scope of this document.
- o the event notification content tagged and provided by a source in the publisher.

Additional header and event bundling capabilities not defined in this document may transparently be included within the event notification.

The following is an example of a compliant event notification. This example extending the example within [\[RFC7950\] section 7.16.3](#) to include the mandatory information described above:

```
<notification
  xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
  <eventTime>2007-09-01T10:00:00Z</eventTime>
  <subscription-id>500</subscription-id>
  <link-failure xmlns="http://acme.example.com/system">
    <if-name>so-1/2/3.0</if-name>
    <if-admin-status>up</if-admin-status>
    <if-oper-status>down</if-oper-status>
  </link-failure>
</notification>
```

Figure 6: Data plane notification

While this extended [\[RFC7950\] section 7.16](#) notification provides a valid method of encapsulating subscribed notifications, other transport encapsulation methods are also viable. Improvements may be achieved in some implementations in the following ways:

- o transport efficiency may be gained by allowing the encapsulation and bundled push of multiple events within the same event notification.
- o identifiers to designate the current and previous event notification can be used to discover duplicated and dropped notifications
- o additional header types can be used to pass relevant metadata.
- o a signature or hash can be included to verify the efficacy of the Publisher

This is being explored in NETMOD Notifications 2.0 [\[I-D.voit-notifications2\]](#).

[7.](#) Subscription State Notifications

In addition to data plane notifications, a publisher may send subscription state notifications to indicate to receivers that an event related to the subscription management has occurred.

Subscription state notifications are unlike other notifications in that they are not general-purpose notifications. They cannot be filtered out, and they are delivered only to directly impacted receiver(s) of a subscription. The definition of subscription state notifications is distinct from other notifications by making use of a YANG extension tagging them as subscription state notification.

Subscription state notifications include indications that a replay of events has been completed, that a subscription is done because an end time has been reached, and that a subscription has started, been modified, been terminated, or been suspended. They are described in the following subsections.

[7.1.](#) subscription-started

This notification indicates that a configured subscription has started and data updates are beginning to be sent. This notification includes the parameters of the subscription, except for the receiver(s) addressing information and push-source information. Note that for RPC-based subscriptions, no such notifications are sent.

7.2. subscription-modified

This notification indicates that a configured subscription has been modified successfully. This notification includes the parameters of the subscription, except for the receiver(s) addressing information and push-source information. Note that for RPC-based subscriptions, no such notifications are sent.

7.3. subscription-terminated

This notification indicates that a subscription has been terminated by the publisher. The notification includes the reason for the termination. The publisher may decide to terminate a subscription when it is running out of resources for serving it, an internal error occurs, etc. Publisher-driven terminations are notified to all receivers. The management plane can also terminate configured subscriptions using configuration operations.

Subscribers can terminate via RPC subscriptions established via a delete-subscription RPC. In such cases, no subscription-terminated notifications are sent. However if a kill-subscription RPC is sent, or some other event results in the end of a subscription, then there must be a notification that the subscription has been ended.

7.4. subscription-suspended

This notification indicates that a publisher has suspended a subscription. The notification includes the reason for the suspension. A possible reason is the lack of resources to serve it. No further data plane notifications will be sent until the subscription resumes. Suspensions are notified to the subscriber (in the case of dynamic subscriptions) and all receivers (in the case of configured subscriptions).

7.5. subscription-resumed

This notification indicates that a previously suspended subscription has been resumed. Data plane notifications generated in the future will be sent after the subscription terms. These notifications go to the subscriber (in the case of dynamic subscriptions) and all receivers (in the case of configured subscriptions).

7.6. notification-complete

This notification is sent to indicate that a subscription, which includes a stop time, has finished passing events.

[7.7.](#) replay-complete

This notification indicates that all of the events prior to the current time have been sent. This includes new events generated since the start of the subscription. This notification must not be sent for any other reason.

If subscription contains no stop time, or has a stop time which has not been reached, then after the replay-complete notification has been sent events will be sent in sequence as they arise naturally within the system.

[8.](#) Administrative Functions

[8.1.](#) Subscription Monitoring

Container "subscriptions" in the YANG module below contains the state of all known subscriptions. This includes subscriptions that were established (and have not yet been deleted) using RPCs, as well as subscriptions that have been configured as part of configuration. Using the <get> operation with NETCONF, or subscribing to this information via [[I-D.ietf-netconf-yang-push](#)] allows the status of subscriptions to be monitored.

Each subscription is represented as a list element. The associated information includes an identifier for the subscription, receiver counter information, the status of the subscription, as well as the various subscription parameters that are in effect. The subscription status indicates the subscription's state with each receiver (e.g., is currently active or suspended). Leaf "configured-subscription" indicates whether the subscription came into being via configuration or via RPC.

Subscriptions that were established by RPC are removed from the list once they expire (reaching stop-time) or when they are terminated. Subscriptions that were established by configuration need to be deleted from the configuration by a configuration editing operation even if the stop time has been passed.

[8.2.](#) Capability Advertisement

Capabilities are advertised in messages sent by each peer during session establishment [[RFC6241](#)]. Publishers supporting the RPCs and Notifications in this document must advertise the capability "urn:ietf:params:netconf:capability:notification:2.0".

If a subscriber only supports [[RFC5277](#)] and not this specification, then they will recognize the capability

"urn:ietf:params:netconf:capability:notification:1.0" and ignore the capability defined in this document.

8.3. Event Stream Discovery

A publisher maintains a list of available event streams as operational data. This list contains both standardized and vendor-specific event streams. A client can retrieve this list like any other YANG-defined data, for example using the <get> operation when using NETCONF.

9. Data Model

```
<CODE BEGINS> file "ietf-subscribed-notifications.yang"
module iETF-subscribed-notifications {
  namespace
    "urn:ietf:params:xml:ns:yang:ietf-subscribed-notifications";

  prefix sn;

  import iETF-yang-types {
    prefix yang;
  }
  import iETF-inet-types {
    prefix inet;
  }
  import iETF-interfaces {
    prefix if;
  }

  organization "IETF";
  contact
    "WG Web: <http://tools.ietf.org/wg/netconf/>
    WG List: <mailto:netconf@ietf.org>

    WG Chair: Mahesh Jethanandani
              <mailto:mjethanandani@gmail.com>

    WG Chair: Mehmet Ersue
              <mailto:mehmet.ersue@nokia.com>

    Editor: Alexander Clemm
            <mailto:ludwig@clemm.org>

    Editor: Eric Voit
            <mailto:evoit@cisco.com>

    Editor: Alberto Gonzalez Prieto
```


<mailto:agonzalezpri@vmware.com>

Editor: Einar Nilsen-Nygaard
<mailto:einarann@cisco.com>

Editor: Ambika Prasad Tripathy
<mailto:ambtripa@cisco.com>";

description

"This module contains conceptual YANG specification for
subscribing to events an receiving event notifications.";

revision 2017-05-31 {

description

"Filtering and stream structures updated, replay a feature.";

reference

["draft-ietf-netconf-subscribed-notifications-03"](#);

}

/*

* FEATURES

*/

feature json {

description

"This feature indicates that JSON encoding of notifications
is supported.";

}

feature configured-subscriptions {

description

"This feature indicates that management plane configuration
of subscription is supported.";

}

feature replay {

description

"This feature indicates that historical event replay is
supported. With replay, it is possible for past events to be
will be streamed in chronological order.";

}

/*

* EXTENSIONS

*/

extension subscription-state-notif {


```
description
  "This statement applies only to notifications. It indicates that
  the notification is a subscription state notification (aka OAM
  notification). Therefore it does not participate in a regular
  event stream and does not need to be specifically subscribed
  in order to receive notifications.";
}

/*
 * IDENTITIES
 */

/* Identities for streams */
identity stream {
  description
    "Base identity to represent a generic stream of event
    notifications exposed for subscription by a system.";
}
identity NETCONF {
  base stream;
  description
    "Default NETCONF event stream, containing events based on
    notifications defined as YANG modules that are supported by the
    system. As a historical reference, this contains the same set
    of events in a default RFC-5277 NETCONF stream.";
}
identity SYSLOG {
  base stream;
  description
    "A stream of events mirroring the discrete set entries
    concurrently being placed into a device's local Syslog.";
}
identity custom-stream {
  base stream;
  description
    "A supported stream not defined via an identity in this model";
}

/* Identities for event filters */

identity event-filter {
  description
    "Evaluation criteria used as a pass/fail test against events.
    If a filter element is specified to look for data of a particular
    value, and the data item is not present within a particular event
    for its value to be checked against, the event will be filtered
    out. For example, if one were to check for 'severity=critical' in
    an event where this object does not exist, then the event would
```



```
    not traverse.";
}
identity subtree-event-filter {
  base event-filter;
  description
    "An RFC-6241 based filter which attempts to select nodes within an
    event. After evaluation, the return of a non-empty node set means
    that the filter is successfully traversed.";
  reference "RFC-6241, #5.1";
}
identity xpath-event-filter {
  base event-filter;
  description
    "A filter applied to an event which follows the syntax specified
    in yang:xpath1.0. Success is indicated by either a positive
    boolean result, or a non-null node selection.";
  reference "XPath: http://www.w3.org/TR/1999/REC-xpath-19991116";
}

/* Identities for subscription results */
identity subscription-result {
  description
    "Base identity for RPC responses and State Change Notifications
    providing information on the creation, modification, deletion of
    subscriptions.";
}
identity ok {
  base subscription-result;
  description
    "OK - RPC was successful and was performed as requested.";
}
identity error {
  base subscription-result;
  description
    "Problem with subscription. Base identity for error return
    codes for RPCs and State Change Notifications.";
}

/* Identities for subscription stream status */
identity subscription-status {
  description
    "Base identity for the status of subscriptions and datastreams.";
}
identity active {
  base subscription-status;
  description
    "Status is active and healthy.";
}
```



```
identity inactive {
  base subscription-status;
  description
    "Status is inactive, for example after the stop time, but not
    yet deleted from the configuration.";
}
identity suspended {
  base subscription-status;
  description
    "The status is suspended, meaning that the publisher is currently
    unable to provide the negotiated updates for the subscription.";
}
identity in-error {
  base subscription-status;
  description
    "The status is in error or degraded, meaning that stream and/or
    subscription is currently unable to provide the negotiated
    notifications.";
}

/* Identities for subscription errors */

identity internal-error {
  base error;
  description
    "Error within publisher prohibits operation.";
}
identity suspension-timeout {
  base error;
  description
    "Termination of previously suspended subscription. The publisher
    has eliminated the subscription as it exceeded a time limit for
    suspension.";
}
identity stream-unavailable {
  base error;
  description
    "Stream does not exist or is not available to the receiver.";
}
identity encoding-unavailable {
  base error;
  description
    "Encoding not supported";
}
identity replay-unsupported {
  base error;
  description
    "Replay cannot be performed for this subscription. The publisher
```



```
    does not provide the requested historic information via replay.";
}
identity history-unavailable {
  base error;
  description
    "Replay request too far into the past. The publisher does store
    historic information for all parts of requested subscription, but
    not back to the requested timestamp.";
}
identity filter-unavailable {
  base error;
  description
    "Referenced filter does not exist";
}
identity filter-type-unsupported {
  base error;
  description
    "Cannot parse syntax within the filter.";
}
identity filter-unsupported {
  base error;
  description
    "Failure can be from a syntax error, or a syntax too complex to be
    processed by the platform. The supplemental info should include
    the invalid part of the filter.";
}
identity namespace-unavailable {
  base error;
  description
    "Referenced namespace doesn't exist or is unavailable
    to the receiver.";
}
identity no-such-subscription {
  base error;
  description
    "Referenced subscription doesn't exist. This may be as a result of
    a non-existent subscription ID, an ID which belongs to another
    subscriber, or an ID for acceptable subscription which has been
    statically configured.";
}
identity error-insufficient-resources {
  base error;
  description
    "The server has insufficient resources to support the
    subscription as requested by an RPC.";
}
identity unsupportable-volume {
  base error;
```



```
    description
      "The publisher cannot support the volume of information intended
      to be sent for an existing subscription.";
  }
  identity error-no-such-option {
    base error;
    description
      "A requested parameter setting is not supported.";
  }

  /* Identities for encodings */
  identity encodings {
    description
      "Base identity to represent data encodings";
  }
  identity encode-xml {
    base encodings;
    description
      "Encode data using XML";
  }
  identity encode-json {
    base encodings;
    description
      "Encode data using JSON";
  }

  /* Identities for transports */
  identity transport {
    description
      "An identity that represents a transport protocol for event
      notifications";
  }
  identity netconf {
    base transport;
    description
      "Netconf notifications as a transport.";
  }
  identity http2 {
    base transport;
    description
      "HTTP2 notifications as a transport";
  }

  /*
   * TYPEDEFS
   */

  typedef subscription-id {
```



```
    type uint32;
    description
        "A type for subscription identifiers.";
}

typedef filter-id {
    type uint32;
    description
        "A type to identify filters which can be associated with a
        subscription.";
}

typedef subscription-result {
    type identityref {
        base subscription-result;
    }
    description
        "The result of a subscription operation";
}

typedef subscription-errors {
    type identityref {
        base error;
    }
    description
        "The reason for the failure of an RPC request or the sending
        of a subscription suspension or termination notification";
}

typedef encoding {
    type identityref {
        base encodings;
    }
    description
        "Specifies a data encoding, e.g. for a data subscription.";
}

typedef event-filter-type {
    type identityref {
        base event-filter;
    }
    description
        "Specifies a known type of event filter.";
}

typedef subscription-status {
    type identityref {
        base subscription-status;
    }
}
```



```
    }
    description
      "Specifies the status of a subscription.";
  }

typedef transport-protocol {
  type identityref {
    base transport;
  }
  description
    "Specifies transport protocol used to send notifications to a
    receiver.";
}

typedef notification-origin {
  type enumeration {
    enum "interface-originated" {
      description
        "Notifications will be sent from a specific interface on a
        publisher";
    }
    enum "address-originated" {
      description
        "Notifications will be sent from a specific address on a
        publisher";
    }
  }
  description
    "Specifies from where notifications will be sourced when
    being sent by the publisher.";
}

typedef stream {
  type identityref {
    base stream;
  }
  description
    "Specifies a system-provided datastream.";
}

typedef filter-ref {
  type leafref {
    path "/sn:filters/sn:filter/sn:identifier";
  }
  description
    "This type is used to reference a filter.";
}
```



```
/*
 * GROUPINGS
 */

grouping base-filter {
  description
    "This grouping defines the base for filters for notification
    events.";
  choice filter-type {
    description
      "A filter needs to be a single filter of a given type. Mixing
      and matching of multiple filters does not occur at the level of
      this grouping.";
    case event-filter {
      leaf event-filter-type {
        type event-filter-type;
        mandatory true;
        description
          "A filter needs to be a known and understood syntax if it is
          to be interpretable by a device.";
      }
      anyxml event-filter {
        mandatory true;
        description
          "Event stream evaluation criteria encoded in a syntax of a
          supported type of filter. If the filter is applied
          against an event stream and there is a non-empty or
          positive result, the event is passed along.";
      }
    }
  }
}

grouping subscription-policy-non-modifiable {
  description
    "This grouping describes the information in a subscription which
    should not change during the life of the subscription.";
  leaf encoding {
    type encoding;
    default "encode-xml";
    description
      "The type of encoding for the subscribed data. Default is XML";
  }
  choice target {
    mandatory true;
    description
      "A filter must be applied against some source of information.
      This identifies the target for the filter.";
  }
}
```



```
    case event-stream {
      leaf stream {
        type stream;
        mandatory true;
        description
          "Indicates a stream of events against which to apply
           a filter.";
      }
    }
  }
}

grouping subscription-policy-modifiable {
  description
    "This grouping describes all objects which may be changed
     in a subscription via an RPC.";
  choice applied-filter {
    mandatory true;
    description
      "A filter must be applied to a subscription.  And that filter
       will come either referenced from a global list, or be provided
       within the subscription itself.";
    case by-reference {
      description
        "Incorporate a filter that has been configured separately.";
      leaf filter-ref {
        type filter-ref;
        mandatory true;
        description
          "References an existing filter which is to be applied to
           the subscription.";
      }
    }
    case within-subscription {
      uses base-filter;
      description
        "Local definition allows a filter to have the same lifecycle
         as the subscription.";
    }
  }
}
leaf stop-time {
  type yang:date-and-time;
  description
    "Identifies a time after which notification events should not
     be sent.  If stop-time is not present, the notifications will
     continue until the subscription is terminated.  If
     replay-start-time exists, stop-time must for a subsequent time.
     If replay-start-time doesn't exist, stop-time must for a future
```



```
        time.";
    }
}

grouping subscription-policy {
  description
    "This grouping describes information concerning a subscription.";
  uses subscription-policy-non-modifiable {
    augment target/event-stream {
      description
        "Adds additional objects which must be set just by RPC.";
      leaf replay-start-time {
        if-feature "replay";
        type yang:date-and-time;
        description
          "Used to trigger the replay feature and indicate that the
          replay should start at the time specified.  If
          replay-start-time is not present, this is not a replay
          subscription and event pushes should start immediately.  It
          is never valid to specify start times that are later than
          or equal to the current time.";
      }
    }
  }
  uses subscription-policy-modifiable;
}

grouping notification-origin-info {
  description
    "Defines the sender source from which notifications for a
    configured subscription are sent.";
  choice notification-origin {
    description
      "Identifies the egress interface on the Publisher from which
      notifications will or are being sent.";
    case interface-originated {
      description
        "When the push source is out of an interface on the
        Publisher established via static configuration.";
      leaf source-interface {
        type if:interface-ref;
        description
          "References the interface for notifications.";
      }
    }
    case address-originated {
      description
        "When the push source is out of an IP address on the
```



```
    Publisher established via static configuration.";
  leaf source-vrf {
    type string;
    description
      "Network instance name for the VRF. This could also have
      been a leafref to draft-ietf-rtgwg-ni-model, but that model
      is not complete, and might not be implemented on a box.";
  }
  leaf source-address {
    type inet:ip-address-no-zone;
    mandatory true;
    description
      "The source address for the notifications.";
  }
}
}
}

grouping receiver-info {
  description
    "Defines where and how to get notifications for a configured
    subscriptions to one or more targeted recipient. This includes
    specifying the destination addressing as well as a transport
    protocol acceptable to the receiver.";
  container receivers {
    description
      "Set of receivers in a subscription.";
    list receiver {
      key "address port";
      min-elements 1;
      description
        "A single host or multipoint address intended as a target
        for the notifications for a subscription.";
      leaf address {
        type inet:host;
        mandatory true;
        description
          "Specifies the address for the traffic to reach a remote
          host. One of the following must be specified: an ipv4
          address, an ipv6 address, or a host name.";
      }
      leaf port {
        type inet:port-number;
        mandatory true;
        description
          "This leaf specifies the port number to use for messages
          destined for a receiver.";
      }
    }
  }
}
```



```
    leaf protocol {
      type transport-protocol;
      default "netconf";
      description
        "This leaf specifies the transport protocol used
        to deliver messages destined for the receiver. Each
        protocol may use the address and port information
        differently as applicable.";
    }
  }
}

grouping error-identifier {
  description
    "A code passed back within an RPC response to describe why the RFC
    has failed, or within a state change notification to describe why
    the change has occurred.";
  leaf error-id {
    type subscription-errors;
    mandatory true;
    description
      "Identifies the subscription error condition.";
  }
}

grouping error-hints {
  description
    "Objects passed back within an RPC response to describe why the
    RFC has failed, or within a state change notification to
    describe why the change has occurred.";
  leaf filter-failure {
    type string;
    description
      "Information describing where and/or why a provided filter was
      unsupportable for a subscription.";
  }
}

grouping subscription-response-with-hints {
  description
    "Defines the output for the establish-subscription and
    modify-subscription RPCs.";
  leaf subscription-result {
    type subscription-result;
    mandatory true;
    description
      "Indicates whether subscription is operational, or if a problem
```



```
        was encountered.";
    }
    choice result {
        description
            "Depending on the subscription result, different data is
            returned.";
        case no-success {
            description
                "This case applies when a subscription request was not
                successful and no subscription was created (or modified) as a
                result. In this case, information MAY be returned that
                indicates suggested parameter settings that would have a
                high likelihood of succeeding in a subsequent establish-
                subscription or modify-subscription request.";
            uses error-hints;
        }
    }
}

/*
 * RPCs
 */

rpc establish-subscription {
    description
        "This RPC allows a subscriber to create (and possibly negotiate)
        a subscription on its own behalf. If successful, the
        subscription remains in effect for the duration of the
        subscriber's association with the publisher, or until the
        subscription is terminated. In case an error (as indicated by
        subscription-result) is returned, the subscription is not
        created. In that case, the RPC output MAY include suggested
        parameter settings that would have a high likelihood of
        succeeding in a subsequent establish-subscription request.";
    input {
        uses subscription-policy;
    }
    output {
        uses subscription-response-with-hints {
            augment "result" {
                description
                    "Allows information to be passed back as part of a
                    successful subscription establishment.";
                case success {
                    description
                        "This case is used when the subscription request was
                        successful.";
                    leaf identifier {
```



```
        type subscription-id;
        mandatory true;
        description
            "Identifier used for this subscription.";
    }
}
}
augment "result/no-success" {
    description
        "Contains establish RPC specific objects which can be
        returned as hints for future attempts.";
    leaf replay-start-time-hint {
        type yang:date-and-time;
        description
            "If a replay has been requested, but the requested replay
            time cannot be honored, this may provide a hint at an
            alternate time which may be supportable.";
    }
}
}
}
}
}

rpc modify-subscription {
    description
        "This RPC allows a subscriber to modify a subscription that was
        previously created using establish-subscription.  If successful,
        the changed subscription remains in effect for the duration of
        the subscriber's association with the publisher, or until the
        subscription is again modified or terminated.  In case an error
        is returned (as indicated by subscription-result), the
        subscription is not modified and the original subscription
        parameters remain in effect.  In that case, the rpc error
        response MAY include suggested parameter hints that would have
        a high likelihood of succeeding in a subsequent
        modify-subscription request.";
    input {
        leaf identifier {
            type subscription-id;
            description
                "Identifier to use for this subscription.";
        }
        uses subscription-policy-modifiable;
    }
    output {
        uses subscription-response-with-hints;
    }
}
```



```
rpc delete-subscription {
  description
    "This RPC allows a subscriber to delete a subscription that
    was previously created from by that same subscriber using the
    establish-subscription RPC.";
  input {
    leaf identifier {
      type subscription-id;
      mandatory true;
      description
        "Identifier of the subscription that is to be deleted.
        Only subscriptions that were created using
        establish-subscription can be deleted via this RPC.";
    }
  }
  output {
    leaf subscription-result {
      type subscription-result;
      mandatory true;
      description
        "Indicates whether subscription has been deleted, or if a
        problem was encountered.";
    }
  }
}

rpc kill-subscription {
  description
    "This RPC allows an operator to delete a dynamic subscription
    without restrictions on the originating subscriber or underlying
    transport session.";
  input {
    leaf identifier {
      type subscription-id;
      mandatory true;
      description
        "Identifier of the subscription that is to be deleted. Only
        subscriptions that were created using establish-subscription
        can be deleted via this RPC.";
    }
  }
  output {
    leaf subscription-result {
      type subscription-result;
      mandatory true;
      description
        "Indicates whether subscription has been killed, or if a
        problem was encountered.";
```



```
    }
  }
}

/*
 * NOTIFICATIONS
 */

notification replay-complete {
  sn:subscription-state-notif;
  description
    "This notification is sent to indicate that all of the replay
    notifications have been sent. It must not be sent for any other
    reason.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
}

notification notification-complete {
  sn:subscription-state-notif;
  description
    "This notification is sent to indicate that a subscription has
    finished passing events.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
}

notification subscription-started {
  sn:subscription-state-notif;
  description
    "This notification indicates that a subscription has started and
    notifications are beginning to be sent. This notification shall
    only be sent to receivers of a subscription; it does not
    constitute a general-purpose notification.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
}
```



```
    uses subscription-policy;
}

notification subscription-resumed {
  sn:subscription-state-notif;
  description
    "This notification indicates that a subscription that had
    previously been suspended has resumed. Notifications will once
    again be sent.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
}

notification subscription-modified {
  sn:subscription-state-notif;
  description
    "This notification indicates that a subscription has been
    modified. Notifications sent from this point on will conform to
    the modified terms of the subscription. For completeness, this
    notification includes both modified and non-modified aspects of
    a subscription ";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
  uses subscription-policy;
}

notification subscription-terminated {
  sn:subscription-state-notif;
  description
    "This notification indicates that a subscription has been
    terminated.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
  uses error-identifier;
  uses error-hints;
}
```



```
notification subscription-suspended {
  sn:subscription-state-notif;
  description
    "This notification indicates that a suspension of the
    subscription by the publisher has occurred. No further
    notifications will be sent until the subscription resumes.
    This notification shall only be sent to receivers of a
    subscription; it does not constitute a general-purpose
    notification.";
  leaf identifier {
    type subscription-id;
    mandatory true;
    description
      "This references the affected subscription.";
  }
  uses error-identifier;
  uses error-hints;
}

/*
 * DATA NODES
 */

container streams {
  config false;
  description
    "This container contains a leaf list of built-in
    streams that are provided by the system.";
  leaf-list stream {
    type stream;
    description
      "Identifies the built-in streams that are supported by the
      system. Built-in streams are associated with their own
      identities, each of which carries a special semantics.
      In case configurable custom streams are supported,
      as indicated by the custom-stream identity, the configuration
      of those custom streams is provided separately.";
  }
}

container filters {
  description
    "This container contains a list of configurable filters
    that can be applied to subscriptions. This facilitates
    the reuse of complex filters once defined.";
  list filter {
    key "identifier";
    description
```



```
    "A list of configurable filters that can be applied to
    subscriptions.";
  leaf identifier {
    type filter-id;
    description
      "An identifier to differentiate between filters.";
  }
  uses base-filter;
}
}
container subscription-config {
  if-feature "configured-subscriptions";
  description
    "Contains the list of subscriptions that are configured,
    as opposed to established via RPC or other means.";
  list subscription {
    key "identifier";
    description
      "Content of a subscription.";
    leaf identifier {
      type subscription-id;
      description
        "Identifier to use for this subscription.";
    }
    uses subscription-policy-non-modifiable;
    uses subscription-policy-modifiable;
    uses receiver-info {
      if-feature "configured-subscriptions";
    }
    uses notification-origin-info {
      if-feature "configured-subscriptions";
    }
  }
}
}
container subscriptions {
  config false;
  description
    "Contains the list of currently active subscriptions, i.e.
    subscriptions that are currently in effect, used for subscription
    management and monitoring purposes. This includes subscriptions
    that have been setup via RPC primitives as well as subscriptions
    that have been established via configuration.";
  list subscription {
    key "identifier";
    config false;
    description
      "Content of a subscription. Subscriptions can be created using
      a control channel or RPC, or be established through
```



```
    configuration.";
  leaf identifier {
    type subscription-id;
    description
      "Identifier of this subscription.";
  }
  leaf configured-subscription {
    if-feature "configured-subscriptions";
    type empty;
    description
      "The presence of this leaf indicates that the subscription
      originated from configuration, not through a control channel
      or RPC.";
  }
  uses subscription-policy;
  uses notification-origin-info {
    if-feature "configured-subscriptions";
  }
  uses receiver-info {
    refine receivers/receiver {
      min-elements "1";
    }
    augment receivers/receiver {
      description
        "include operational data for receivers.";
      leaf pushed-notifications {
        type yang:counter64;
        description
          "Operational data which provides the number of update
          notifications pushed to a receiver.";
      }
      leaf excluded-notifications {
        type yang:counter64;
        description
          "Operational data which provides the number of non-
          datastore update notifications explicitly removed via
          filtering so that they are not sent to a receiver.";
      }
    }
    leaf status {
      type subscription-status;
      mandatory true;
      description
        "The status of the subscription.";
    }
  }
}
}
```



```
}  
<CODE ENDS>
```

10. Considerations

10.1. Implementation Considerations

For a deployment including both configured and dynamic subscriptions, split subscription identifiers into static and dynamic halves. That way there should not be collisions if the configured subscriptions attempt to set a subscription-id which might have already been dynamically allocated. The lower half should be used for configured subscriptions and upper half for dynamic.

The <notification> elements are never sent before the transport layer, including capabilities exchange, has been established.

It is left to an implementation to determine when to transition between active and suspended subscription states. However if a subscription is unable to marshal all intended updates into a transmittable message in multiple successive intervals, the subscription should be suspended with the reason "unsupportable-volume".

10.2. Security Considerations

For dynamic subscriptions the publisher must authenticate and authorize all RPC requests.

Subscriptions could overload a publisher's CPU. For this reason, the publisher must have the ability to decline a dynamic subscription request, and provide the appropriate RPC error response to a subscriber should the proposed subscription overly deplete the publisher's resources.

A publisher needs to be able to suspend an existing dynamic or configured subscription based on capacity constraints. When this occur, the subscription status must be updated accordingly and the receivers notified with subscription state notifications.

If a malicious or buggy subscriber sends an unexpectedly large number of RPCs, this may use up system resources. In such a situation, subscription interactions may be terminated by terminating the transport session.

For both configured and dynamic subscriptions the publisher must authenticate and authorize a receiver via some transport level mechanism before sending any updates.

A secure transport is highly recommended and the publisher must ensure that the user has sufficient authorization to perform the function they are requesting against the specific subset of content involved.

A publisher MUST NOT include any content in a notification for which the user has not been authorized.

With configured subscriptions, one or more publishers could be used to overwhelm a receiver. No push updates should be sent to any receiver which doesn't even support subscriptions. Subscribers that do not want pushed data need only terminate or refuse any transport sessions from the publisher.

The NETCONF Authorization Control Model [[RFC6536bis](#)] SHOULD be used to control and restrict authorization of subscription configuration. This control models permits specifying per-user permissions to receive events from specific streams.

Where NACM is available, the NACM "very-secure" tag should be placed on the <kill-subscription> RPC so that only administrators can access.

One subscription id can be used for two or more receivers of the same configured subscription. But due to the possibility of different access control permissions per receiver, it should not be assumed that each receiver is getting identical updates.

[11.](#) Acknowledgments

For their valuable comments, discussions, and feedback, we wish to acknowledge Andy Bierman, Tim Jenkins, Balazs Lengyel, Sharon Chisholm, Hector Trevino, Susan Hares, Kent Watsen, Michael Scharf, and Guangying Zheng.

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[Appendix A](#). Relationships to other drafts

There are other related drafts which are progressing in the NETCONF WG. This section details the relationship of this draft to those others.

[A.1](#). `ietf-netconf-netconf-event-notif`

The [[I-D.ietf-netconf-event-notif](#)] draft augments this subscribed-notifications specification by defining NETCONF transport specifics. Included are:

- o bindings for RPC communications and Event Notifications over NETCONF.
- o encoded examples

[A.2](#). `ietf-netconf-restconf-notif`

The [[I-D.ietf-netconf-restconf-notif](#)] draft augments this subscribed-notifications specification by defining transport specific guidance where some form of HTTP is used underneath. Included are:

- o bindings for RPC communications over RESTCONF
- o bindings for Event Notifications over HTTP2 and HTTP1.1
- o encoded examples

- o end-to-end deployment guidance for Call Home and TLS Heartbeat

[A.3. ietf-netconf-yang-push](#)

The draft [[I-D.ietf-netconf-yang-push](#)] builds upon this subscribed-notifications specification in order to allow a Publisher to stream YANG datastore objects. In this case, the application of either an on-change or periodic triggers upon a YANG Datastore replace the system generated events within this document.

If you wish to subscribe to a YANG datastore rather than a existing event stream on a publisher, please refer to this specification.

[A.4. voit-notifications2](#)

The draft [[I-D.void-notifications2](#)] is not required to implement this subscribed-notifications specification. Instead it defines data plane notification elements which improve the delivered experience. The following capabilities are specified:

- o Defines common encapsulation headers objects to support functionality such as event severity, message signing, message loss discovery, message de-duplication, originating process identification.
- o Defines how to bundle multiple event records into a single notification message.

These are the enhanced capabilities alluded to in the Event (Data Plane) Notification section above. This draft is not yet adopted by the NETCONF WG.

[Appendix B. Issues that are currently being worked and resolved](#)

(To be removed by RFC editor prior to publication)

Issue #6: Data plane notifications and layered headers

How to allow for seamless integration with non-standard encodings and transports (like GPB/GRPC). Specify requirements encoding and transport must meet, provide examples.

[Appendix C. Changes between revisions](#)

(To be removed by RFC editor prior to publication)

v02 - v03

- o RPCs and Notification support is identified by the Notification 2.0 capability.
- o Updates to filtering identities and text
- o New error type for unsupportable volume of updates
- o Text tweaks.

v01 - v02

- o Subscription status moved under receiver.

v00 - v01

- o Security considerations updated
- o Intro rewrite, as well as scattered text changes
- o Added [Appendix A](#), to help match this to related drafts in progress
- o Updated filtering definitions, and filter types in yang file, and moved to identities for filter types
- o Added Syslog as a stream
- o HTTP2 moved in from YANG-Push as a transport option
- o Replay made an optional feature for events. Won't apply to datastores
- o Enabled notification timestamp to have different formats.
- o Two error codes added.

v01 5277bis - v00 subscribed notifications

- o Kill subscription RPC added.
- o Renamed from 5277bis to Subscribed Notifications.
- o Changed the notification capabilities version from 1.1 to 2.0.
- o Extracted create-subscription and other elements of [RFC5277](#).
- o Error conditions added, and made specific in return codes.
- o Simplified yang model structure for removal of 'basic' grouping.

- o Added a grouping for items which cannot be statically configured.
- o Operational counters per receiver.
- o Subscription-id and filter-id renamed to identifier
- o Section for replay added. Replay now cannot be configured.
- o Control plane notification renamed to subscription state notification
- o Source address: Source-vrf changed to string, default address option added
- o In yang model: 'info' changed to 'policy'
- o Scattered text clarifications

v00 - v01 of 5277bis

- o YANG Model changes. New groupings for subscription info to allow restriction of what is changeable via RPC. Removed notifications for adding and removing receivers of configured subscriptions.
- o Expanded/renamed definitions from event server to publisher, and client to subscriber as applicable. Updated the definitions to include and expand on [RFC 5277](#).
- o Removal of redundancy with other drafts
- o Many other clean-ups of wording and terminology

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