IEC/IEEE 60802
Subscribed Notifications / YANG Push

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Relevant RFCs for Event Notifications

“Old” RFCs
- RFC 5277 “NETCONF Event Notifications”
  - First specification for event notifications
  - Polling required for data store update information
  - Only NETCONF supported
- RFC 7923 “Requirements for Subscriptions to YANG Datastores”
  - New pub/sub service for YANG datastore updates
  - Refinements of RFC 5277

Current RFC
- RFC 8639 “Subscription to YANG Notifications”
  - Describes a transport-agnostic mechanism for subscribing to and receiving content from an event stream in a publisher via a subscription
- RFC 8641 “Subscription to YANG Notifications for Datastore Updates”
  - expands RFC 8639 by a subscription service for datastore updates (YANG-Push)
- RFC 8640 “Dynamic Subscription to YANG Events and Datastores over NETCONF”
Hierarchical Architecture for Configuration
NETCONF Client / Server Relations

Orchestrator

Controller

Network Components

Devices

API based on
Network YANG modules

API based on
Network Element YANG modules

Multiple API locations – all deduced from YANG modules
Hierarchical Architecture for Event Notifications
Publisher / Subscriber Relations

The Event Notification Architecture is similar to the configuration architecture but uses subscriptions.
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Subscribed Notifications (RFC 8639)
NETCONF Protocol Layers

- Client -> Server communication is RPC
- Server -> Client communication is notification

Source: RFC 6241 - NETCONF
Subscribed Notifications (RFC 8639)
Example: Subscribed Notification Message

```
<notification
  xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
  <eventTime>2007-09-01T10:00:00Z</eventTime>
  <link-failure xmlns="https://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 10: Subscribed Notification Message

- Notification Message for a link-failure
- Parameters:
  - if-name
  - if-admin-status
  - if-oper-status
- Complete XML document

Source: RFC 8639 – Subscription to YANG Notifications
**Subscribed Notifications (RFC 8639)**

**Dynamic Subscriptions vs. Configured Subscriptions**

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<th>Configured Subscriptions</th>
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<tr>
<td>• The subscriber initiates a subscription via a NETCONF RPC mechanism</td>
<td>• The subscriptions are configured based on options provided by YANG modules</td>
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<tr>
<td>• If the publisher is able to serve the request, notification messages are sent from the publisher to the subscriber</td>
<td>• The notification messages are sent from the publisher to one or more (!) receivers</td>
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<tr>
<td>• The lifetime of the subscription is bound by the transport session – the loss of the transport session will result in the immediate termination of any associated dynamic subscription if NETCONF is used</td>
<td>• The lifetime of the subscription is driven by configuration being present and persists across reboots and also if the publisher is disconnected from any network</td>
</tr>
<tr>
<td>• Modifications can only be done through an RPC by the original subscriber</td>
<td>• Modifications can be done by any configuration client with write permission</td>
</tr>
<tr>
<td>• This feature is mandatory in RFC 8639</td>
<td>• This feature is optional in RFC 8639 and is advertised via the “configured” YANG feature</td>
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There is no mixing of dynamic and configured operations on a single subscription!
Subscribed Notifications (RFC 8639)
Operations for Dynamic Subscriptions

Following RPC operations are defined for dynamic subscriptions in the “ietf-subscribed-notifications” YANG module:

- establish-subscription
- modify-subscription
- delete-subscription
- kill-subscription
Subscribed Notifications (RFC 8639)
Subscription State Change Notifications

Following state change notifications are defined in the “ietf-subscribed-notifications” YANG module
• subscription-started
• subscription-modified
• subscription-terminated
• subscription-suspended
• subscription-resumed
• subscription-completed
• replay-completed
Subscribed Notifications (RFC 8639)
Publisher’s State Machine for a Dynamic Subscription

Figure 1: Publisher’s State Machine for a Dynamic Subscription

Note: If the connection is terminated, the subscription also will implicitly be killed.
Subscribed Notifications (RFC 8639)
Publisher’s State Machine for a Configured Subscription

Note: Configured subscriptions are independent from any active connection
Notifications have to be defined in YANG models via “notification” statements.

There is no possibility to define new notifications dynamically.
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YANG Push (RFC 8641)
Subscription Model

Enhancements to “Subscribed Notifications”

- **Selection filters** to identify targeted YANG datastore nodes and/or subtrees for which updates are to be pushed
- Update policies
  - Periodic subscriptions
    - period interval
    - anchor-time (reference point in time)
  - on-change subscriptions
    - dampening period (optional) -> refers to update records for the same subscription
    - change-type (created, deleted, value changed)
    - sync-on-start -> sends a complete push-update of all subscribed data at the beginning of a subscription
- Encoding for the contents of push updates
YANG Push (RFC 8641)
Negotiation of Subscription Policies (for Dynamic Subscription Requests)

- The policy is submitted from the subscriber to the publisher at creation or modification of a subscription via RPC.

- If the publisher cannot fulfill the required policy, the subscription should be declined by the publisher.

- To avoid "random guessing of parameters" the publisher should add "hints" to the returned error-message:
  - suggested periodic time intervals
  - acceptable dampening periods
  - size estimates

- There is no guarantee, that a subsequent request that considers the hints will be accepted!
Figure 3: "establish-subscription-datastore-error-info" Tree Diagram
YANG Push (RFC 8641)

On-Change Considerations

On-Change subscriptions

- Are particularly effective for data that changes infrequently and require minimal delay
- More difficult to implement than periodic subscriptions

Thus, they may not be supported by all implementations or for every object!

A publisher may accept on-change subscriptions even when it includes objects for which on-change is not supported!

- Updates are only sent for objects in the scope of the subscription that do support on-change updates, other updates are excluded from update records then
- It is the responsibility of the subscriber to cope with this fact

Alternatively, a publisher may decide to reject such an on-change subscription
YANG Push (RFC 8641)
Data Encoding

Periodic subscriptions
- Streaming through “push-update” notifications
  - An Update record is according to a regular retrieving operation

On-Change subscriptions
- Streaming through
  - “push-update” notifications at the start of a subscription or whenever the publisher chooses to resync
  - “push-change-update” notifications in case of changes
  - The encoding is according to YANG Patch operations (RFC 8072) but not limited to configuration data
There are two possible types of selection filters

- Subtree selection filter
  - It contains the possibility for Namespace Selection, Attribute Match Expressions, Containment Nodes, Selection Nodes and Content Match Nodes
  - This filter is described in detail in RFC 6241 (NETCONF Protocol)

- “XPath” selection filter
  - XPath is a query language for selecting nodes in an XML document
  - It provides powerful filtering constructs

A publisher must support at least one type of selection filter!
YANG Push (RFC 8641)
Receiver Authorization

- A publisher must ensure that no unauthorized data is included in push updates according to NACM
- It must silently remove any unauthorized data from datastore subtrees

-> same mechanism as regular retrieval operation (get)
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Suggested Usage for 60802

Usage and profiling of following RFCs
- RFC 8639 “Subscription to YANG Notifications”
- RFC 8641 “Subscription to YANG Notifications for Datastore Updates”
- RFC 8640 “Dynamic Subscription to YANG Events and Datastores over NETCONF”

Usage of On-change-Subscriptions for
- Change of link-state / MAU-type
- Change of sync-status

Usage of Periodic Time-Aligned Subscriptions for
- Statistic-counters
  - dropped frames
- VLAN specific counters
- PoE, APL, PoDL state changes
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### Questions