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Q. Wu
W. Song
Huawei
P. Liu
China Mobile
Q. Ma
Huawei
W. Wang
China Telecom
Z. Niu
Microsoft
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Adaptive Subscription to YANG Notification
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Abstract

This document defines a YANG data model and associated mechanism enabling the subscriber's adaptive subscriptions to a publisher's event streams with various different period intervals to report updates. Applying these elements allows servers automatically adjust the rate and volume of telemetry traffic sent from a publisher to receivers.

Status of This Memo

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datastore without needing to poll. It defines a mechanism (i.e., update trigger) to determine when an update record needs to be generated. Two types of subscriptions are introduced in [\[RFC8641\]](#), distinguished by how updates are triggered: periodic and on-change.

- * Periodic subscription allows subscribed data to be streamed to the destination at a configured fixed periodic interval;
- * On-change subscription allows update to be triggered whenever a change in the subscribed information is detected.

However in some large scale deployments (e.g., massive data collection for wireless network performance monitoring) where an increased data collection rate is used, it becomes more likely that both clients and servers are temporarily overwhelmed with a burst of streamed data and consumes expensive network resource (e.g., bandwidth resource, radio resource) and computation resource, therefore hard to continuously monitor operational data, especially values that fall outside normal operational ranges. If the rate at which we can collect a stream of data is set too low or chosen to get low priority telemetry data dropped, these telemetry data are not sufficient to detect and diagnose problems and verify correct network behavior.

A client might choose to monitor the operational state and send a request to modify the data collection rate on the server. But how often the client evaluates if the modification of the data collection rate is required highly depends on the current collection rate, collecting a stream of data at a low rate prevents the subscriber from capturing sufficient data for timely decision-making, which may result in service discontinuity. In addition, when tens of thousands of network devices need to be managed, frequent follow-up modification requests are prone to errors.

There is a need for a service to balance between data management cost and real time streaming telemetry. To achieve this, servers can be configured with multiple different period intervals and corresponding subscription update policy which allows servers/publishers automatically switch to different period intervals according to the network condition change without the interaction with the client for policy update instruction, e.g., when the wireless signal strength

falls below a configured threshold, the subscribed data can be streamed at a higher rate to capture potentially important data and events (e.g., continuous service degeneration); while when the wireless signal strength crosses a configured threshold, the subscribed data can be streamed at a lower rate.

This document defines a YANG data model and associated mechanism enabling the subscriber's adaptive subscriptions to a publisher's event streams. Applying these elements allows servers to automatically adjust the rate and volume of telemetry traffic sent from a publisher to receivers.

[1.1.](#) Terminology

The key words "MUST", "MUST NOT", "REQUIRED", "SHALL", "SHALL NOT", "SHOULD", "SHOULD NOT", "RECOMMENDED", "NOT RECOMMENDED", "MAY", and "OPTIONAL" in this document are to be interpreted as described in [BCP 14](#) [[RFC2119](#)] [[RFC8174](#)] when, and only when, they appear in all capitals, as shown here.

The following terms are defined in [[RFC5277](#)] [[RFC7950](#)] [[RFC3198](#)] [[RFC8342](#)] [[RFC8639](#)] [[RFC8641](#)] and are not redefined here:

- * Event
- * Client
- * Configuration
- * Configured subscription
- * Configuration datastore
- * Notification message
- * Publisher
- * Receiver
- * Subscriber

with the creation time of the initial update record.

- * an "xpath-external-eval" represents a standard XPath evaluation expression (See [section 6.4 of \[RFC7950\]](#)) that is applied against the targeted data object, which is used to trigger/control the update interval switching within the server. It follows the rules defined in section 3.4 of [\[XPath1.0\]](#) and contains comparisons of the targeted datastore node with its value to the specific threshold in the XPath format. Different from selection filter defined in [\[RFC8641\]](#),
 - it is applied against a single targeted object rather than a set of target objects.
 - it monitors a specific data object change and evaluates the trigger condition associated with the targeted object to be true or false using XPATH rules and does not influence the event records output generation from a publisher.

How often the XPath expression criterion is evaluated is up to the publisher's implementation. With minimal delay, the expression can be evaluated whenever changes to targeted object occur, or at the end of each high-frequency streaming update period. To reduce the frequency of evaluation, the server can choose to check targeted object change at every multiple (e.g., 2 or 3) high-frequency streaming update periods.

The represented expression defined in "xpath-external-eval" is evaluated in the following XPath context:

- The set of namespace declarations is the set of prefix and namespace pairs for all YANG modules implemented by the server, where the prefix is the YANG module name and the namespace is as defined by the "namespace" statement in the YANG module.
- If the leaf is encoded in XML, all namespace declarations in scope on the "xpath-external-eval" leaf element are added to the set of namespace declarations. If a prefix found in the


```

namespace "urn:ietf:params:xml:ns:yang:ietf-adaptive-subscription";
prefix as;
import ietf-subscribed-notifications {
    prefix sn;
}
import ietf-yang-push {
    prefix yp;
}
import ietf-yang-types {

```

```

    prefix yang;
}

organization
    "IETF NETCONF (Network Configuration) Working Group";
contact
    "";
description
    "NETCONF Protocol Data Types and Protocol Operations.
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    the document authors. All rights reserved.

    Redistribution and use in source and binary forms, with or
    without modification, is permitted pursuant to, and subject
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    set forth in Section 4.c of the IETF Trust's Legal Provisions
    Relating to IETF Documents
    (http://trustee.ietf.org/license-info).

    This version of this YANG module is part of RFC xxxx; see
    the RFC itself for full legal notices.";

revision 2020-02-14 {
    description
        "Initial revision";
    reference
        "RFCxxx Adaptive subscription to YANG notification.";
}

identity adaptive-unsupported {
    base sn:establish-subscription-error;
    description

```

```

        "Adaptive-subscription is not supported for any objects
        that are selectable by the filter.";
    }

    identity xpath-evaluation-unsupported {
        base sn:establish-subscription-error;
        description
            "Unable to parse the xpath evaluation criteria defined in
            'xpath-external-eval' because of a syntax error or some
            XPath 1.0 syntax not supported against the specific object.";
    }

    identity multi-xpath-criteria-conflict {
        base sn:establish-subscription-error;
        base sn:subscription-terminated-reason;
        description

```

```

        "Multiple Xpath evaluation criteria represented by
        'xpath-external-eval' is evaluated as conflict, i.e.,
        more than one condition expressions are evaluated to
        'true'.";
    }

    grouping adaptive-subscription-modifiable {
        description
            "This grouping describes the datastore-specific adaptive subscription
            conditions that can be changed during the lifetime of the
            subscription.";
        choice adaptive-subscription {
            description
                "Defines necessary conditions for sending an event record to
                the subscriber.";
            container adaptive-subscriptions {
                list adaptive-period {
                    key "name";
                    description
                        "Defines necessary conditions to switch update interval for
                        sending an event record to the subscriber. The event record outp
                        generation will not be influenced these conditions.";
                    leaf name {
                        type string {
                            length "1..64";

```

```

    }
    description
    "The name of the condition to be matched. A device MAY further
    restrict the length of this name; space and special
    characters are not allowed.";
  }
  leaf xpath-external-eval {
    type string;
    description
    "A XPath string, representing a logical expression,
    which can contain comparisons of datastore values
    and logical operations in the XPath format.";
  }
  leaf period {
    type yp:centiseconds;
    mandatory true;
    description
    "Duration of time that should occur between periodic
    push updates, in units of 0.01 seconds.";
  }
  leaf anchor-time {
    type yang:date-and-time;
    description

```

```

    "Designates a timestamp before or after which a series
    of periodic push updates are determined. The next
    update will take place at a point in time that is a
    multiple of a period from the 'anchor-time'.
    For example, for an 'anchor-time' that is set for the
    top of a particular minute and a period interval of a
    minute, updates will be sent at the top of every
    minute that this subscription is active.";
  }
}
description
"Container for adaptive subscription.";
}
}

augment "/sn:subscriptions/sn:subscription/yp:update-trigger" {
  description

```



```

|   +--rw packet-unicast-tx-count?      int8
|   +--rw current-max-rate?             int8
|   +--rw overrun-count?                int8
+--rw events
  +--rw event* [name]
    +--rw name                          string
    +--rw disconnection?                enumeration
    +--rw association-failure?          enumeration
    +--rw connection-status?            enumeration

```

[A.1.](#) "example-wifi-mac" YANG Module

```

module example-wifi-network-diagnostic {
  yang-version 1;
  namespace "http://example.com/yang/wifi-network-diagnostic";
  prefix wnd;

  import ietf-yang-types {
    prefix yang;
  }

  container server {
    description
      "Configuration of the WiFi Server logical entity.";
    leaf bssid {
      type yang:mac-address;
      description
        "The MAC address of a wireless access point.";
    }
    leaf security-type {
      type enumeration {
        enum unspecified {
          value 0;
        }
        enum none {
          value 1;
        }
        enum wep {

```

```

        value 2;
    }
    enum wpa {
        value 3;
    }
    enum wpa2 {
        value 4;
    }
    enum wpa3 {
        value 5;
    }
}
description
    "The type of Wi-Fi security used. A value of 0
    indicate that the interface is not currently
    configured or operational.";
}
leaf wifi-version {
    type enumeration {
        enum 80211a {
            value 0;
        }
    }
}

```

```

    enum 80211b {
        value 1;
    }
    enum 80211g {
        value 2;
    }
    enum 80211n {
        value 3;
    }
    enum 80211ac {
        value 4;
    }
    enum 80211ax {
        value 5;
    }
}
description
    "The highest 802.11 standard version usable
    by the Node.";

```

```

}
leaf channel-num {
    type int8;
    description
        "The channel that Wi-Fi communication is currently
        operating on. A value of 0 indicates that the interface
        is not currently configured or operational.";
}
leaf rssi {
    type int8;
    description
        "The RSSI of the Node's Wi-Fi radio in dBm.";
}
leaf beacon-lost-count {
    type int8;
    description
        "The count of the number of missed beacons the
        Node has detected.";
}
leaf beacon-rx-count {
    type int8;
    description
        "The count of the number of received beacons. The
        total number of expected beacons that could have been
        received during the interval since association SHOULD
        match the sum of BeaconRxCount and BeaconLostCount. ";
}
leaf packet-multicast-rx-count {
    type int8;

```

```

    description
        "The number of multicast packets received by
        the Node.";
}
leaf packet-multicast-tx-count {
    type int8;
    description
        "The number of multicast packets transmitted by
        the Node.";
}
leaf packet-unicast-rx-count {
    type int8;

```

```

        description
            "The number of multicast packets received by
            the Node.";
    }
    leaf packet-unicast-tx-count {
        type int8;
        description
            "The number of multicast packets transmitted by
            the Node.";
    }
    leaf current-max-rate {
        type int8;
        description
            "The current maximum PHY rate of transfer of
            data in bytes-per-second.";
    }
    leaf overrun-count {
        type int8;
        description
            "The number of packets dropped either at ingress or
            egress, due to lack of buffer memory to retain all
            packets on the ethernet network interface. The
            OverrunCount attribute SHALL be reset to 0 upon a
            reboot of the Node..";
    }
}
container events {
    description
        "Configuration of WIFI Network Diagnostic events.";
    list event {
        key "name";
        description
            "The list of event sources configured on the
            server.";
        leaf name {
            type string;

```

```

        description
            "The unique name of an event source.";
    }
    leaf disconnection {
        type enumeration {

```

```

        enum de-authenticated {
            value 1;
        }
        enum dis-association {
            value 2;
        }
    }
    description
        "A Node's Wi-Fi connection has been disconnected as a
        result of de-authenticated or dis-association and
        indicates the reason.";
}
leaf association-failure {
    type enumeration {
        enum unknown {
            value 0;
        }
        enum association-failed {
            value 1;
        }
        enum authentication-failed {
            value 2;
        }
        enum ssid-not-found {
            value 3;
        }
    }
    description
        "A Node has attempted to connect, or reconnect, to
        a Wi-Fi access point, but is unable to successfully
        associate or authenticate, after exhausting all
        internal retries of its supplicant.";
}
leaf connection-status {
    type enumeration {
        enum connected {
            value 1;
        }
        enum notconnected {
            value 2;
        }
    }
    description

```

```

    "A Node's connection status to a Wi-Fi network has
      changed. Connected, in this context, SHALL mean that
      a Node acting as a Wi-Fi station is successfully
      associated to a Wi-Fi Access Point.";
  }
}
}
}

```

[Appendix B](#). Adaptive Subscription and Notification Example

The examples within this document use the normative YANG module "ietf-adaptive-subscription" defined in [Section 4](#) and the non-normative example YANG module "example-wifi-network-diagnostic" defined in [Appendix A.1](#).

This section shows some typical adaptive subscription and notification message exchanges.

[B.1](#). "edit-config" Example

The client configures adaptive subscription policy parameters on the server. The adaptive subscription configuration parameters require the server to support two update intervals (i.e., 5 seconds, 60 seconds) and report updates every 60 seconds if the rssi value is greater than or equal to -65dB; If the rssi value is less than -65dB, switch to 5 seconds period value to report updates.

generated and sent to the receivers to inform the receivers that the update interval value is switched to the new value.

```
<notification
  xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0"
  xmlns:yp="urn:ietf:params:xml:ns:yang:ietf-yang-push">
  <eventTime>2016-11-21T13:51:00Z</eventTime>
  <adaptive-period-update
    xmlns="http://example.com/ietf-adaptive-subscription">
    <id>0</id>
    <period>60</period>
    <yp:datastore
      xmlns:ds="urn:ietf:params:xml:ns:yang:ietf-datastores">
      ds:running
    </yp:datastore>
    <yp:datastore-xpath-filter
      xmlns:ex="https://example.com/sample-data/1.0">
      /ex:example-wifi-network-diagnostic
    </yp:datastore-xpath-filter>
    </adaptive-period-update>
  </notification>
```

[B.5.](#) Changes between Revisions

- * Format usage example and change ssid into rssi in the appendix;
- * Use boilerplate and reuse the terms in the terminology section.

Authors' Addresses

Qin Wu
Huawei
101 Software Avenue, Yuhua District
Nanjing
Jiangsu, 210012
China
Email: bill.wu@huawei.com

Wei Song
Huawei
101 Software Avenue, Yuhua District
Nanjing
Jiangsu, 210012
China
Email: songwei80@huawei.com

Peng Liu
China Mobile
32 Xuanwumen West St, Xicheng District
Beijing
Email: liupengyjy@chinamobile.com

Qiufang Ma
Huawei
101 Software Avenue, Yuhua District
Nanjing
Jiangsu, 210012
China
Email: maqiufang1@huawei.com

Wei Wang
China Telecom
32 Xuanwumen West St, Xicheng District
Beijing
Email: wangw36@chinatelecom.cn

Zhixiong Niu
Microsoft
Email: Zhixiong.Niu@microsoft.com

