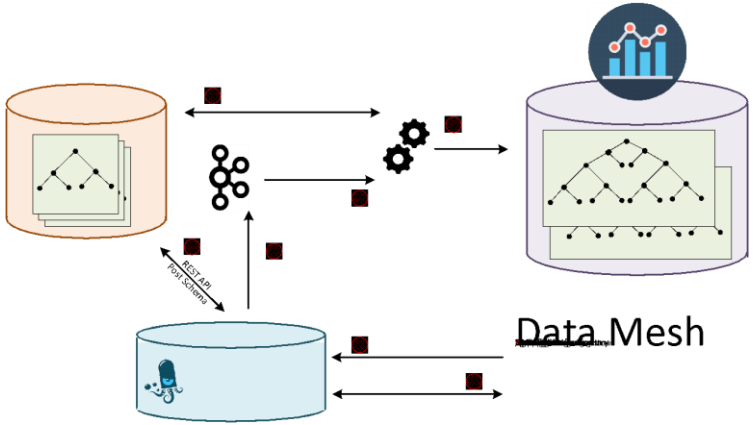
Validate Configured Subscription YANG-Push Publisher Implementations

NETCONF & NMOP WG



IETF 121

November 2-3rd, 2024

Hackathon

Hackathon – Plan and Software

Test Plan

- Validate work in progress vendor YANG-Push publisher implementations.
- Configure RFC 8641 compliant YANG-Push configured subscription.
- Verify output in packet capture before YANG-Push receiver and after transformation.

Development Plan

- MVP 1 – Basic Requirements (9)
- MVP 2 – Scale and Secure (3)
- MVP 3 – Optimizations (2)

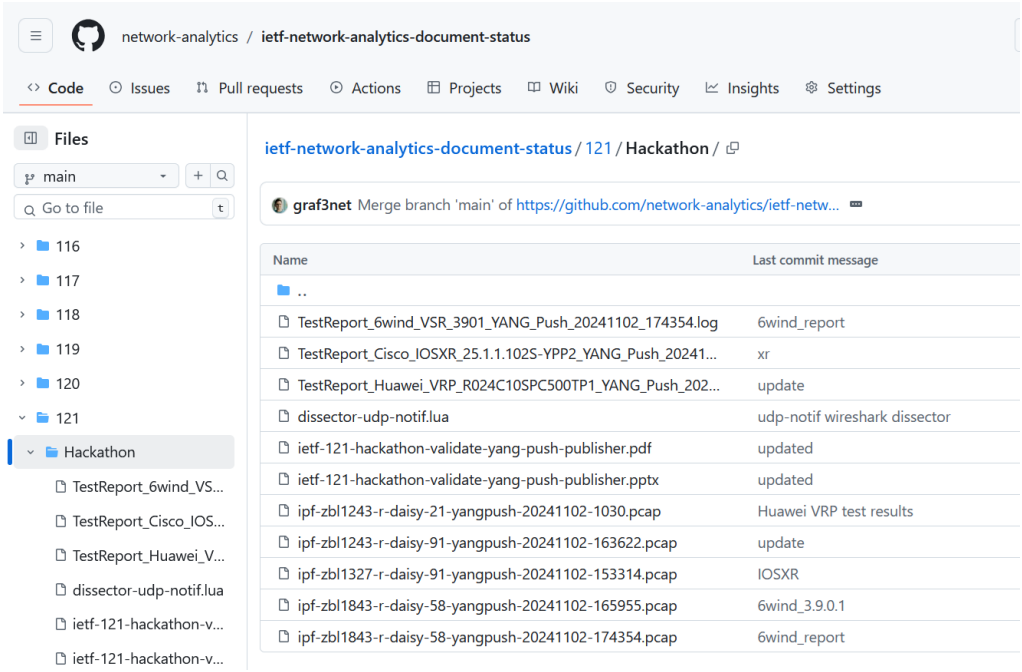
Software

- YANG-Push Publisher - Cisco IOS XR
- YANG-Push Publisher - 6WIND VSR
- YANG-Push Publisher - Huawei VRP
- YANG-Push Receiver – Pmacct
- YANG-Push Receiver – Netgauze
- udp-notif dissector - Wireshark

Hackathon – Repository

Test Repository

- https://github.com/network-analytics/ietf-network-analytics-document-status/tree/main/121/Hackathon
- Contains
  - Packet capture on the wire
  - Netconf RPCs and YANG-Push JSON messages
  - Python script which performed test cases



An Architecture for YANG-Push to Apache Kafka Integration

draft-ietf-nmop-yang-kafka-integration

- Subscription to YANG Notifications
  RFC 8639
- Subscription to YANG Notifications for Datastore Updates
  RFC 8641
- UDP-based Transport for Configured Subscriptions
  draft-ietf-netconf-udp-notif
- Subscription to Distributed Notifications
  draft-ietf-netconf-distributed-notif
- Support of Hostname and Sequencing in YANG Notifications
  draft-tgraf-netconf-notif-sequencing
- Support of Versioning in YANG Notifications Subscription
  draft-ietf-netconf-yang-notifications-versioning
- Support of Network Observation Timestamping in YANG Notifications
  draft-tgraf-netconf-yang-push-observation-time
- YANG Library
  RFC 8525
- Augmented-by Addition into the IETF-YANG-Library
  draft-ietf-netconf-yang-library-augmentation

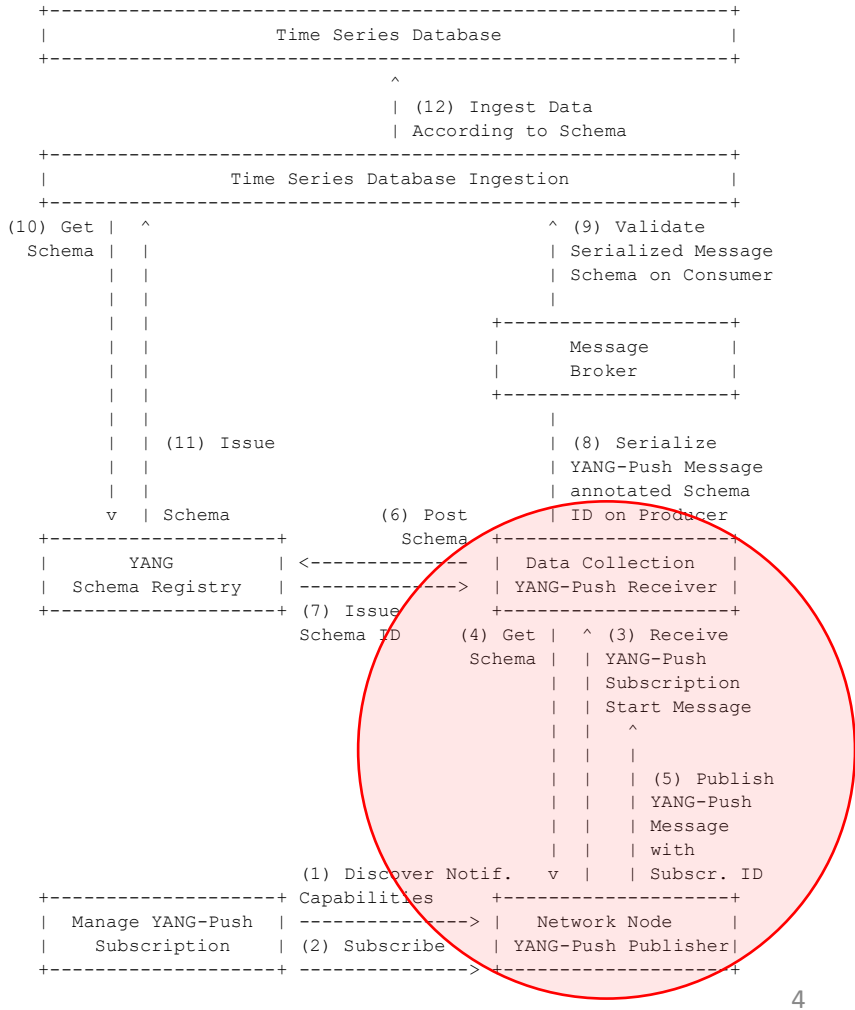


Figure 1: End to End Workflow

Cisco IOS XR – Subscription Notifications

Subscription-Started Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T14:38:22.598Z",
    "ietf-notification:sysName": "ipf-zbl1327-r-daisy-91",
    "ietf-notification:sequenceNumber": 13,
    "ietf-subscribed-notifications:subscription-started": {
      "id": 1,
      "ietf-yang-push:datastore": "IOS-XR",
      "ietf-yang-push:datastore-xpath-filter": "Cisco-IOS-XR-pfi-
im-cmd-oper:interfaces/interface-xr/interface[interface-
name='Loopback13']",
      "transport": "transport",
      "module-version": [
        {
          "module-name": "Cisco-IOS-XR-pfi-im-cmd-oper",
          "revision": "2024-02-29"
        }
      ],
      "encoding": "encode-json",
      "ietf-yang-push:periodic": {
        "period": 4500
      }
    }
  }
}
```


Subscription-Terminated Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T14:43:24.981Z",
    "ietf-notification:sysName": "ipf-zbl1327-r-daisy-91",
    "ietf-notification:sequenceNumber": 21,
    "ietf-subscribed-notifications:subscription-terminated": {
      "id": 1,
      "reason": "no-such-subscription"
    }
  }
}
```

Cisco IOS XR – Push Notifications

Push-Update Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T14:44:30.000Z",
    "ietf-notification:sysName": "ipf-zbl1327-r-daisy-91",
    "ietf-notification:sequenceNumber": 23,
    "ietf-yang-push:push-update": {
      "id": 1,
      "ietf-yp-observation:timestamp": "2024-11-02T14:44:30.000Z",
      "ietf-yp-observation:point-in-time": "current-accounting",
      "datastore-contents": {
        "Cisco-IOS-XR-pfi-im-cmd-oper:interfaces": {
          "interface-xr": {
            "interface": [
              {
                "interface-name": "Loopback13",
                "interface-handle": "Loopback13",
                "interface-type": "IFT_LOOPBACK",
                "hardware-type-string": "Loopback interface(s)",
                "state": "im-state-up",
                "line-state": "im-state-up",
                "encapsulation": "loopback",
                "encapsulation-type-string": "Loopback",
                "mtu": 1500,
```


Push-Change-Update Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T14:54:32.529Z",
    "ietf-notification:sysName": "ipf-zbl1327-r-daisy-91",
    "ietf-notification:sequenceNumber": 1,
    "ietf-yang-push:push-change-update": {
      "id": 1,
      "ietf-yp-observation:timestamp": "2024-11-02T14:54:32.517Z",
      "ietf-yp-observation:point-in-time": "state-changed",
      "datastore-changes": {
        "yang-patch": {
          "patch-id": "TODO - insert patch-id here",
          "edit": [
            {
              "edit-id": "1",
              "operation": "replace",
              "target": "/Cisco-IOS-XR-pfi-im-cmd-oper:interfaces/interface-
xr/interface[interface-name='Loopback13']",
              "value": {
                "Cisco-IOS-XR-pfi-im-cmd-oper:interface": {
                  "interface-name": "Loopback13",
                  "interface-handle": "Loopback13",
                  "interface-type": "IFT_LOOPBACK",
                  "hardware-type-string": "Loopback interface(s)",
                  "state": "im-state-admin-down",
                  "line-state": "im-state-admin-down",
```

Huawei VRP – Push Notifications

Push-Update Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T10:30:52Z",
    "ietf-notification-sequencing:sysName": "ipf-zbl1243-r-daisy-21",
    "ietf-notification-sequencing:sequenceNumber": 5,
    "ietf-yang-push:push-update": {
      "id": 1,
      "ietf-yp-observation:timestamp": "2024-11-02T10:30:52Z",
      "ietf-yp-observation:point-in-time": "current-accounting",
      "ietf-distributed-notif:message-publisher-id": 16974853,
      "datastore-contents": {
        "huawei-ifm:ifm": {
          "interfaces": {
            "interface": [
              {
                "name": "GigabitEthernet0/3/11",
                "mib-statistics": {
                  "receive-byte": "33448478274",
                  "send-byte": "20330971890",
                  "receive-packet": "75363920",
                  "send-packet": "103904697",
                  "receive-unicast-packet": "75340369",
                  "receive-multicast-packet": "23548",
                  "receive-broad-packet": "3",
                  "send-unicast-packet": "103904697",
                  "send-multicast-packet": "0",
                  "send-broad-packet": "0",
```


Push-Change-Update Notification


```
{
  "ietf-notification:notification": {
    "eventTime": "2024-11-02T10:38:52Z",
    "ietf-notification-sequencing:sysName": "ipf-zbl1243-r-daisy-21",
    "ietf-notification-sequencing:sequenceNumber": 69,
    "ietf-yang-push:push-change-update": {
      "id": 5,
      "ietf-yp-observation:timestamp": "2024-11-02T10:38:52Z",
      "ietf-yp-observation:point-in-time": "state-changed",
      "ietf-distributed-notif:message-publisher-id": 16974841,
      "datastore-changes": {
        "yang-patch": {
          "patch-id": 19,
          "edit": [
            {
              "edit-id": "edit1",
              "operation": "merge",
              "target": "/huawei-
ifm:ifm/interfaces/interface[name=GigabitEthernet0/3/9]/dynamic",
              "value": {
                "dynamic": {
                  "link-status": "down"
                }
              }
            },
```

Huawei VRP – YANG Library

RPC <get> Request

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc xmlns="urn:ietf:params:xml:ns:netconf:base:1.0" message-id="2">
  <get>
    <filter type="subtree">
      <yang-library xmlns="urn:ietf:params:xml:ns:yang:ietf-yang-
library" />
    </filter>
  </get>
</rpc>
```

RPC reply

```
<?xml version="1.0" encoding="UTF-8"?>
<rpc-reply message-id="2" xmlns="urn:ietf:params:xml:ns:netconf:base:1.0">
  <data>
    <yang-library xmlns="urn:ietf:params:xml:ns:yang:ietf-yang-library">
      <content-id>3880047851</content-id>
      <module-set>
        <name>config-module</name>
        <module>
          <name>openconfig-acl</name>
          <revision>2017-05-26</revision>
          <namespace>http://openconfig.net/yang/acl</namespace>
          <deviation>huawei-openconfig-acl-deviations-OC-NE-M2K-B</deviation>
        </module>
        <module>
          <name>openconfig-interfaces</name>
          <revision>2021-04-06</revision>
          <namespace>http://openconfig.net/yang/interfaces</namespace>
          <deviation>huawei-openconfig-interfaces-deviations-OC-NE-M2K-B</deviation>
          <augmented-by>huawei-openconfig-qos-ext</augmented-by>
          <augmented-by>openconfig-vlan</augmented-by>
          <augmented-by>openconfig-platform-transceiver</augmented-by>
          <augmented-by>openconfig-platform-port</augmented-by>
          <augmented-by>openconfig-if-tunnel</augmented-by>
          <augmented-by>openconfig-if-ip</augmented-by>
          <augmented-by>openconfig-if-ethernet</augmented-by>
          <augmented-by>openconfig-if-aggregate</augmented-by>
        </module>
```

6WIND VSR – Subscription Notifications

Subscription-Started Notification


```
{
  "ietf-notifications:notification": {
    "eventTime": "2024-11-02T16:20:16.989632098+00:00",
    "ietf-notification-sequencing:sysName": "daisy-ietf-ipf-
zbl1843-r-daisy-58",
    "ietf-notification-sequencing:sequenceNumber": 11008,
    "ietf-subscribed-notifications:subscription-started": {
      "id": 12345678,
      "ietf-yang-push:datastore": "ietf-datastores:operational",
      "ietf-yang-push:datastore-xpath-filter":
"/state/vrf/l3vrf/interface/loopback/enabled",
      "transport": "ietf-udp-notif-transport:udp-notif",
      "encoding": "encode-json",
      "purpose": "send notifications",
      "ietf-distributed-notif:message-publisher-ids": [
        0
      ],
      "ietf-yang-push:on-change": {
        "sync-on-start": true
      },
      "ietf-yang-push-revision:module-version": [
        {
          "module-name": "vrouter-loopback",
          "revision": "2024-04-22"
        }
      ]
    }
  }
}
```


Subscription-Terminated Notification


```
{
  "ietf-notifications:notification": {
    "eventTime": "2024-11-02T16:25:19.639303753+00:00",
    "ietf-notification-sequencing:sysName": "daisy-ietf-ipf-
zbl1843-r-daisy-58",
    "ietf-notification-sequencing:sequenceNumber": 11014,
    "ietf-subscribed-notifications:subscription-terminated": {
      "id": 12345678,
      "reason": "no-such-subscription"
    }
  }
}}
```

6WIND VSR – Push Notifications

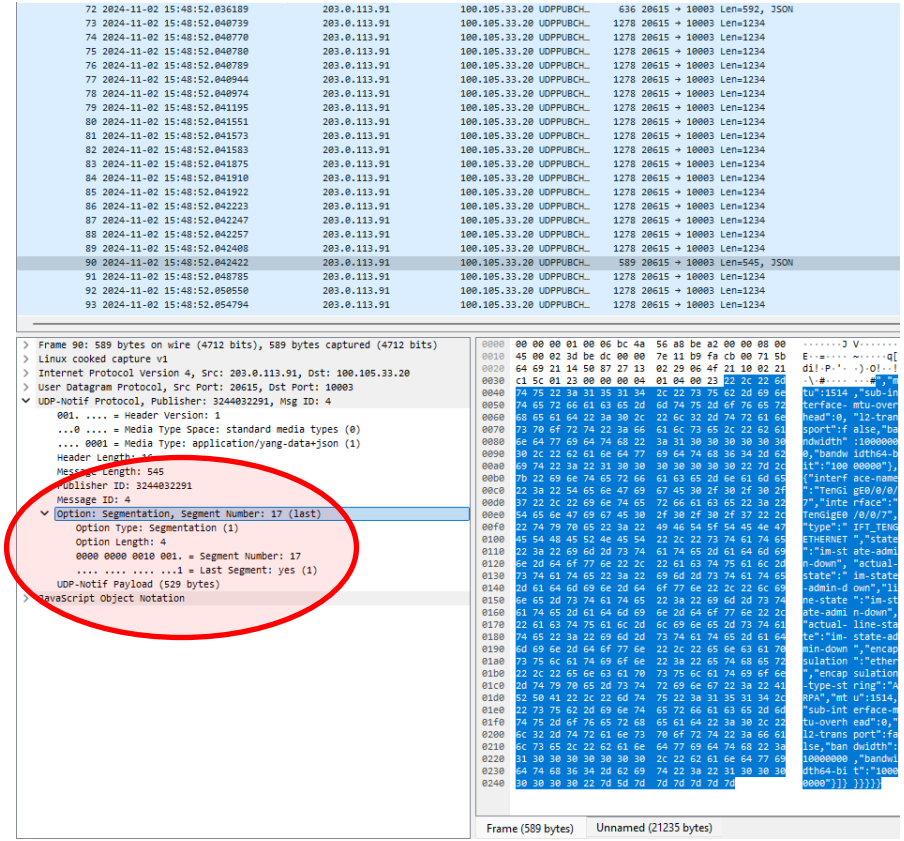
Push-Update Notification


```
{
  "ietf-notifications:notification": {
    "eventTime": "2024-11-02T16:25:20.795276882+00:00",
    "ietf-notification-sequencing:sysName": "daisy-ietf-ipf-zbl1843-r-daisy-58",
    "ietf-notification-sequencing:sequenceNumber": 11016,
    "ietf-yang-push:push-update": {
      "id": 9,
      "datastore-contents": {
        "vrouter:state": {
          "vrf": [
            {
              "name": "main",
              "vrouter-interface:interface": {
                "physical": [
                  {
                    "name": "ens192",
                    "counters": {
                      "in-octets": "68993004950",
                      "in-unicast-pkts": "389889038",
                      "in-discards": "69240",
                      "in-errors": "0",
                      "out-octets": "65180577234",
                      "out-unicast-pkts": "330829342",
                      "out-discards": "0",
                      "out-errors": "0"
                    }}]}}}},
      "ietf-distributed-notif:message-publisher-id": 0,
      "ietf-yp-observation-time:observation-time": "2024-11-02T16:25:20.795814217+00:00",
      "ietf-yp-observation-time:point-in-time": "current-state"
    }
  }
}
```


Push-Change-Update Notification


```
{
  "ietf-notifications:notification": {
    "eventTime": "2024-11-02T16:21:17.889933885+00:00",
    "ietf-notification-sequencing:sysName": "daisy-ietf-ipf-zbl1843-r-daisy-58",
    "ietf-notification-sequencing:sequenceNumber": 11010,
    "ietf-yang-push:push-change-update": {
      "id": 8,
      "datastore-changes": {
        "yang-patch": {
          "patch-id": "patch-1",
          "edit": [
            {
              "edit-id": "edit-1",
              "operation": "replace",
              "target": "/vrouter:state/vrf[name='main']/l3vrf[name='A9']/vrouter-
interface:interface/vrouter-loopback:loopback[name='Loopback-A9']/enabled",
              "value": {
                "vrouter-loopback:enabled": "false"
              }
            }
          ]
        }
      },
      "ietf-distributed-notif:message-publisher-id": 0,
      "ietf-yp-observation-time:observation-time": "2024-11-02T16:21:17.891267251+00:00",
      "ietf-yp-observation-time:point-in-time": "current-state"
    }
}
```

Udp-notif - Segmentation



YANG-Push Publisher

- Huawei VRP
- 6WIND VSR
- Cisco IOS XR

YANG-Push Receiver

- Pmacct
  https://github.com/pmacct/pmacct

- Netgauze
  https://github.com/NetGauze/NetGauze

Tools

- Wireshark dissector
  https://github.com/network-analytics/ietf-network-analytics-document-status/tree/main/121/Hackathon

YANG-Push Implementation Status

IETF 121 – MVP 1

	6WIND VSR	Huawei VRP	Cisco IOS XR	Open-Source
RFC 8639 YANG-Push Subscription	✓	P	P	
RFC 8641 YANG-Push Notification	✓	P	✓	
draft-ietf-netconf-udp-notif	✓	✓	✓	✓
draft-ietf-netconf-yang-notifications-versioning	✓	✓	✓	
draft-tgraf-netconf-notif-sequencing	✓	✓	✓	
draft-tgraf-netconf-yang-push-observation-time	✓	✓	✓	
RFC 7895 YANG Library		✓		
RFC 8525 YANG Library (NMDA)	✓		✓	
draft-ietf-netconf-yang-library-augmentation		P		✓
RFC 9196 System and Notification Capabilities				
draft-netana-netconf-notif-envelope				

Green marked describes new capability at IETF 121. "P" to partially implemented.

YANG-Push Implementation Status

IETF 121 – MVP 2

	6WIND VSR	Huawei VRP	Cisco IOS XR	Open-Source
draft-ietf-netconf-distributed-notif	✓	✓		
RFC 9254 CBOR				
RFC 6347/RFC 9147 DTLS				

Green marked describes new capability at IETF 121. "P" to partially implemented

YANG-Push Implementation Status

IETF 121 – MVP 3

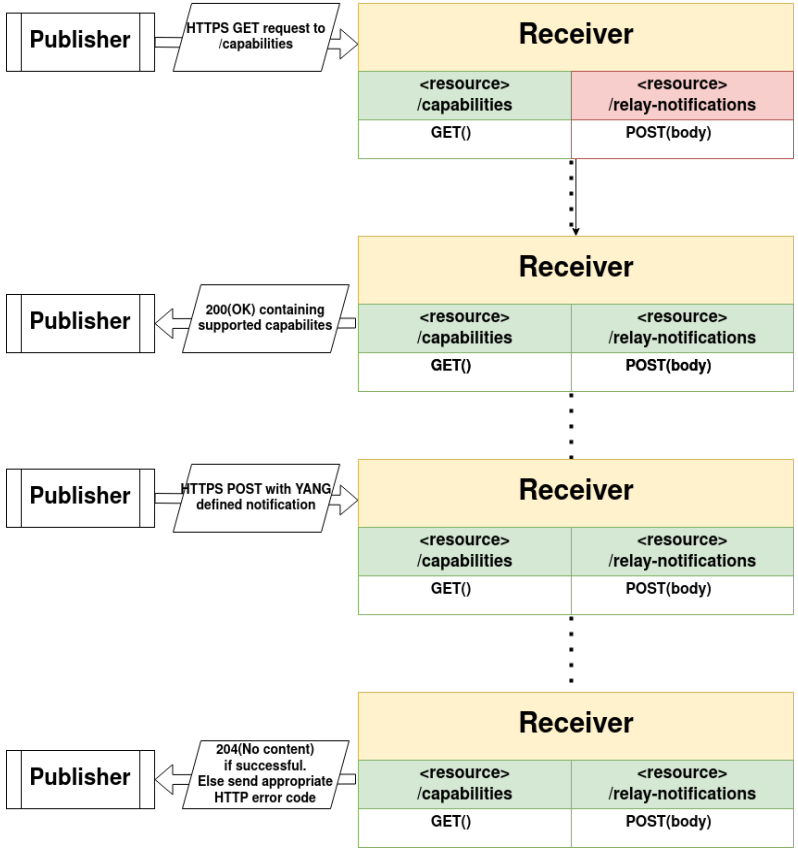
	6WIND VSR	Huawei VRP	Cisco IOS XR	Open-Source
RFC 8641 on-change subscriptions	✓	✓	P	
draft-netana-netconf-yp-transport-capabilities				

Green marked describes new capability at IETF 121. "P" to partially implemented

Implementation of An HTTPS-based Transport for YANG Notifications

draft-ietf-netconf-https-notif-15

- A protocol for **sending asynchronous event notifications** similar to notifications defined in **NETCONF Event Notifications** [RFC5277], but over **HTTPS**.
- Interactions will occur between a publisher which must be a "server" (e.g., a NETCONF or RESTCONF server) and a **receiver** (which **need not** be a NETCONF or RESTCONF server).
- Extended Implementation in C [*] : github link
- Python Implementation : github link
  - Flask : **synchronous** event handler (WSGI)
  - Fast API : **asynchronous** event handler (ASGI)
- Can be made multithreaded using Gunicorn
- Added **validation** for capability data at collector and relay notification from publisher either by integrating with **sysrepo** as a object datastore or using **libyang** for validation
- Added dynamic **response handling** based on request covering **edge cases**
- Team : Siddharth Bhat, Vartika T R, Hayyan A, Bharadwaja Meherrushi Ch, Prof Mohit P T ;Draft authors : Mahesh Jethanandani, Kent Watsen



* Purple marked describes extended implementation originally implemented by **Alex Huang Feng.**
* green marked describes implementation from scratch

Thanks to…

- Rob Wilton – Cisco
- Nick Corran - Cisco
- Emma Rankin – Cisco (remote)
- Mathew Green – Cisco (remote)
- Samuel Gauthier – 6WIND (remote)
- Jérémie Leska – 6WIND (remote)
- Liu Bin – Huawei (remote)
- Benoit Claise – Huawei
- Zhuoyao Lin - Huawei
- Ebben Aries – Juniper
- James Cummings - Nokia
- Paolo Lucente – Pmacct
- Holger Keller – DT
- Daniel Voyer – Bell Canada
- Alex Huang-Feng – INSA Lyon
- Yannick Buchs – Swisscom
- Thomas Graf – Swisscom
- Ahmed Elhassany – Swisscom (remote)
- Uwe Storbeck – Swisscom (remote)