Handling Operational YANG Modelled Data

State of the Union

Nowadays network operators are using **machine and human readable YANG** RFC 7950 to model their configurations and obtain YANG modelled data from their networks.

Network operators organize their data in a Data Mesh where a message broker such as Apache Kafka facilitates the exchange of messages among data processing components.

Today, subscribing to a YANG datastore, publishing a YANG modeled notifications message from the network and viewing the data in a time series database, **manual labor is needed to perform data transformation** to make a message broker and its data processing components with YANG notifications interoperable.

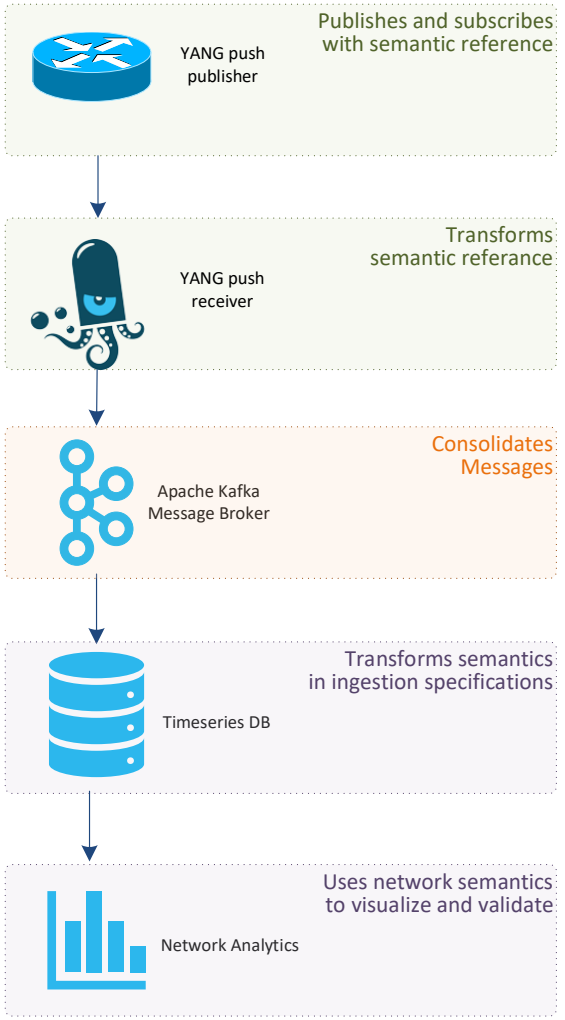
« Even though YANG is intented to ease data management, **this promise has not yet been fulfilled** for Network Telemetry RFC 9232 »

From YANG-Push to Network Analytics

Aiming for an automated data processing pipeline

- **A network operator aims for:**
  - An **automated data processing pipeline** which starts with YANG-Push, consolidates at Data Mesh and ends at Network Analytics.
  - Operational metrics where **IETF defines the semantics.**
  - Analytical metrics where **network operators gain actionable insights.**

- **We achieve this by integrating YANG-Push into Data Mesh to:**
  - Produce metrics from networks **with timestamps when network events were observed.**
  - Hostname, publisher ID and sequence numbers help us to understand **from where metrics were exported and measure its delay and loss.**
  - Forward **metrics unchanged** from networks
  - **Learn semantics** from networks and validate messages.
  - **Control semantic** changes end to end.



IETF YANG-Push Implementations and Next Steps

Where it started…

Starting at IETF 115, In context of a seamless Data Mesh message broker integration described in draft-ietf-nmop-yang-message-broker-integration, **a group of network operators, network vendors and academia have been reviewing currently deployed non-standard YANG notification implementations** of major vendors and compared to IETF YANG-Push defined in RFC 8639 and RFC 8641.

Out of this comparison and the requirements for seamless Data Mesh message broker integration, **several notification, subscription and capability discovery enhancements have been proposed** and discussed at IETF NETCONF and NMOP working groups.

Development on first major vendor implementations started at IETF 118. Throughout IETF 119 and 120, vendor implementation and network operator testing scope and **interest from other vendors and operators steadily grew.** In this process questions on various feature specifications were brought forward. To channelize these discussions, 4 workshops have been organized throughout the last 3 months.

In the workshops we clarified:

- What do you like about IETF YANG-Push?
- What in IETF YANG-Push could have been defined differently and why?
- What prevents IETF YANG-Push for being integrated/used efficiently?
- What in IETF YANG-Push is missing and for which purpose?
- What xpaths do you subscribe to for which Network Analytics use case?
- Which features should be available in which MVP release?
- How to make IETF YANG-Push available to a wider audience?

IETF YANG-Push Implementations and Next Steps

Who we are and what we like…

The group consisting of: **34 colleagues** from Bell Canada, Deutsche Telekom, NTT International, Swisscom, Huawei, Cisco, 6Wind, Ciena Blueplanet, Juniper, Nokia, and INSA Lyon.

The group decided to make the outcome of these workshops **available to the IETF community at NMOP and NEMOPS and continue there these discussions.**

What do you like about IETF YANG-Push?

- Interoperable
- Unified with Netconf and Restconf
- Transport independent
- Push based

What will you never implement nor use in IETF YANG-Push?

- Replay
- Message Bundling
- Dampening

IETF YANG-Push Implementations and Next Steps

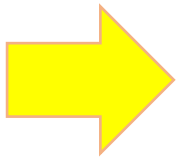
Challenges and how to solve…

What in IETF YANG-Push could have been defined differently and why?

What prevents IETF YANG-Push for being integrated/used efficiently?

What in IETF YANG-Push is missing and for which purpose?

- On-change notification schema different than periodical
- Patch-id in On-Change complex to implement.
- Reduce YANG complexity (example: augmentations, deviations, xpath, lists)
- Each subscribed xpath needs normalization. High effort with many vendor specific YANG modules
- Missing end to end open-source implementations



- Extensible YANG-Push header combing notification and subscription. Separation of header and subscribed content is needed to allow partial parsing of message in binary encoding for data processing chain.
- On-change and periodical notification schema should have identical schema and contain the entire schema tree below subscription and represent current state.
- Common alignment on what should be supported in xpath and what not.
- Agile incremental driven development. Deployment guide describing implementers and operators what is/should be supported at which MVP stage.

IETF YANG-Push

A 22 years journey without at finish line

2002

IAB Workshop

Defines operators' requirements in RFC 3535 to lifecycle CLI and SNMP. YANG, Netconf and Restconf development started.

2010

YANG 1.0

Specified in RFC 6020. 1.1 in RFC 7950.

2015

IETF YANG-Push Specification Started

Development of RFC 8639 and RFC 8641 started at IETF NETCONF.

2017

gNMI

gNMI was proposed to IETF NETCONF and implementations started at major network vendors.

2019

IETF YANG-Push Specification Finished

Development of RFC 8639 and RFC 8641 concluded at IETF NETCONF without any major network vendor implementations.

2022

Data Mesh Integration

Vendor-specific implementations and IETF YANG-Push are hard to manage. New requirements emerged for integrating with the message broker and an automated data processing chain. New specifications are proposed to resolve these challenges.

2024

IETF YANG-Push Major Implementations Started

Questions arise. Proposing a simplified IETF YANG-Push and an Agile Incremental Driven Development.

IETF YANG-Push Today

Requires Agile Incremental Driven Development to Succeed

With **Big Data** capabilities, and **Data Mesh** for organizing data, evolving over the last 20 years, **Network Observability**, the process of observing network behaviors and symptoms based on operational network data **holistically on all 3 network planes**, has gained a lot of traction and is deemed to reduce alert fatigue caused by classical device monitoring. IETF has published with RFC 9232 an overview of Network Telemetry protocols.

What becomes clear now is that IETF developed YANG-Push not according to the network operator's needs, nor network vendors constraints, nor considered where it should integrate to, and most importantly, it lacks an agile incremental driven development process.

With such a process, the user's needs, the requirements and use cases, would be put first and through an iterative process, minimal viable products are being developed and steadily improved. This allows at an early stage to have a working implementation and steadily develop and adapt over time. Applied research should be involved for hypothesis and experiments when new areas are being explored.

Addressing YANG Specification and Integration Gaps

11 documents piling up at NETCONF, NETMOD and NMOP…

YANG-Push Transport Gaps:

- UDP-based Transport for Configured Subscriptions
  draft-ietf-netconf-udp-notif
- Subscription to Distributed Notifications
  draft-ietf-netconf-distributed-notif

YANG-Push Specifications Gaps:

- Extensible YANG model for YANG-Push Notifications
  draft-netana-netconf-notif-envelope
- YANG Notification Transport Capabilities
  draft-netana-netconf-yp-transport-capabilities
- Validating anydata in YANG Library context
  draft-aelhassany-anydata-validation

YANG-Push Integration Gaps and Arch:

- Support of Network Observation Timestamping in YANG Notifications
  draft-tgraf-netconf-yang-push-observation-time
- Support of Versioning in YANG Notifications Subscription
  draft-ietf-netconf-yang-notifications-versioning
- Augmented-by Addition into the IETF-YANG-Library
  draft-ietf-netconf-yang-library-augmentation

YANG-Push Simplification:

- YANG-Push Operational Data Observability Enhancements
  draft-wilton-netconf-yp-observability

YANG-Push Message Broker:

- An Architecture for YANG-Push to Message Broker Integration
  draft-netana-nmop-yang-message-broker-integration