

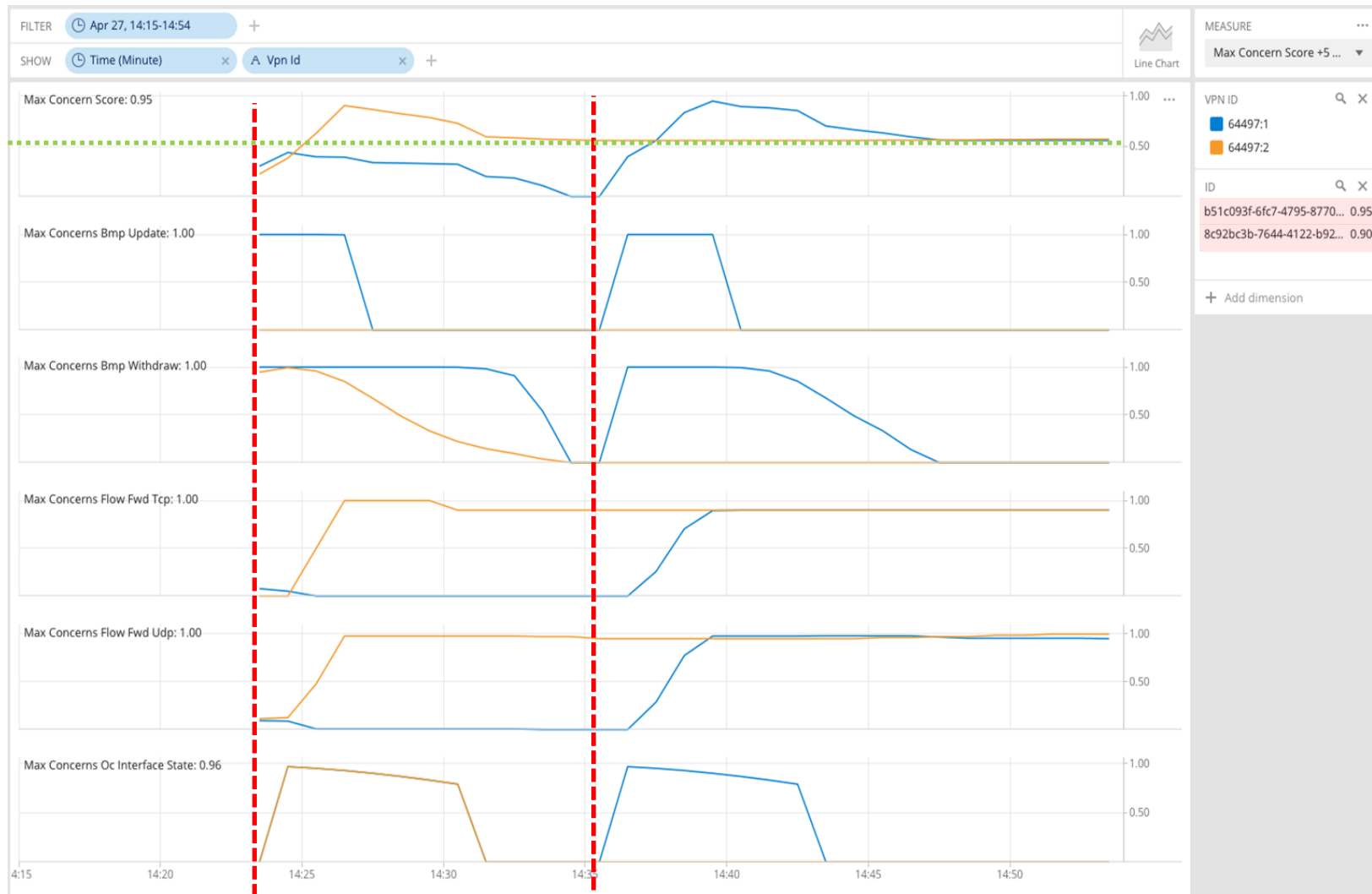
# Network Operator **Challenges** in Network Telemetry Data Mesh **Integration**

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# L3 VPN Network Anomaly Detection

Verify operational changes automatically



## Analytical Perspectives

Monitors the network service and wherever it is congested or not.

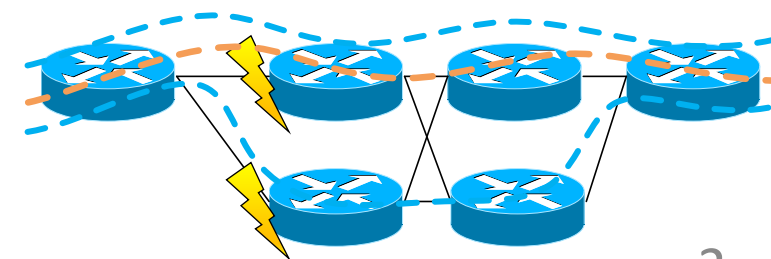
- BGP updates and withdrawals.
- UDP vs. TCP missing traffic.
- Interface state changes.

## Network Events

1. VPN orange lost connectivity.  
VPN blue lost redundancy.
2. VPN blue lost connectivity.

## Key Point

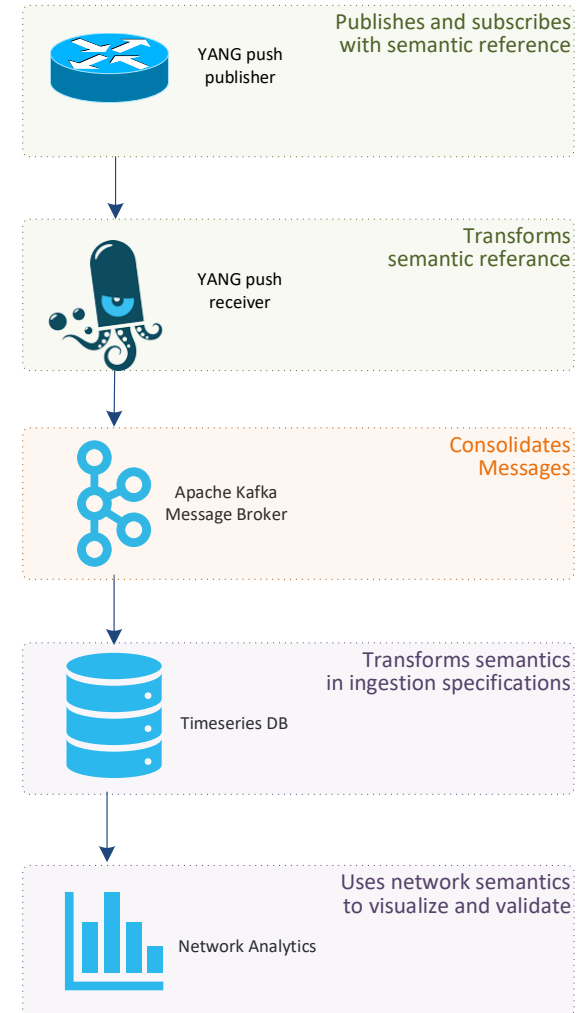
- AI/ML **requires** network intent and network modelled data to deliver dependable results.

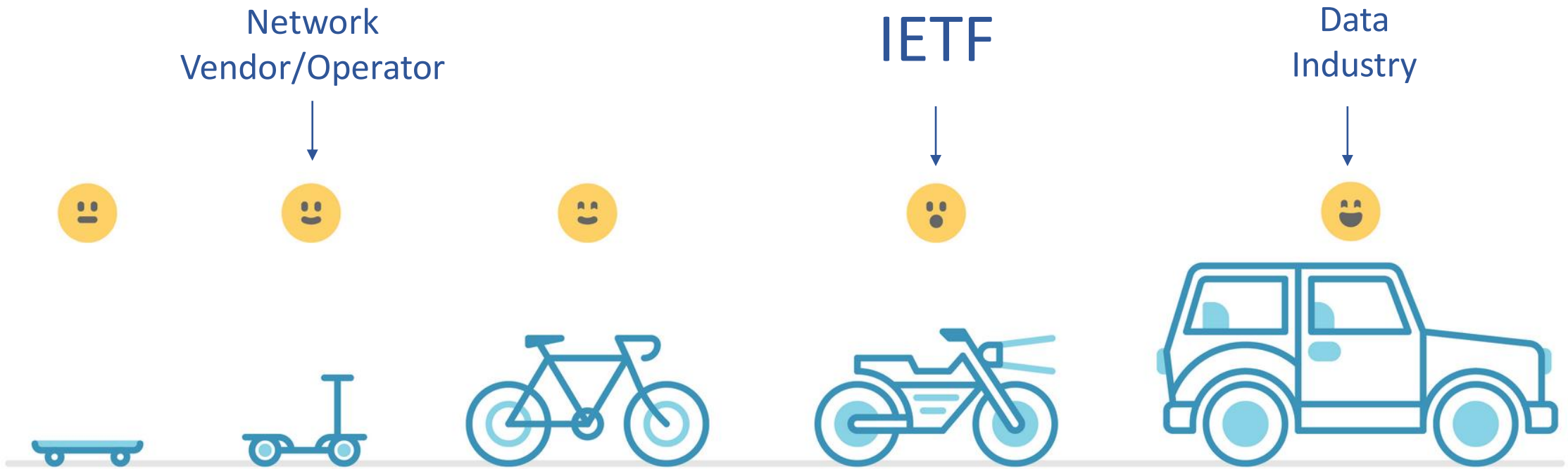


# From Network Telemetry to Analytics

Aiming for an automated processing pipeline

- **A network operator aims for:**
  - An **automated data processing pipeline** which starts with Network Telemetry, 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 Network Telemetry into Data Mesh to:**
  - Forward **metrics unchanged** from networks
  - **Learn semantics** from networks and validate messages.
  - **Control semantic** changes end to end.





State of the Union  
From data **mess** to data **mesh**

# Evolving Big Data Architecture

Domain oriented, like **networks**

**1st Generation**

**Proprietary**  
Enterprise Data Warehouse

**2nd Generation**

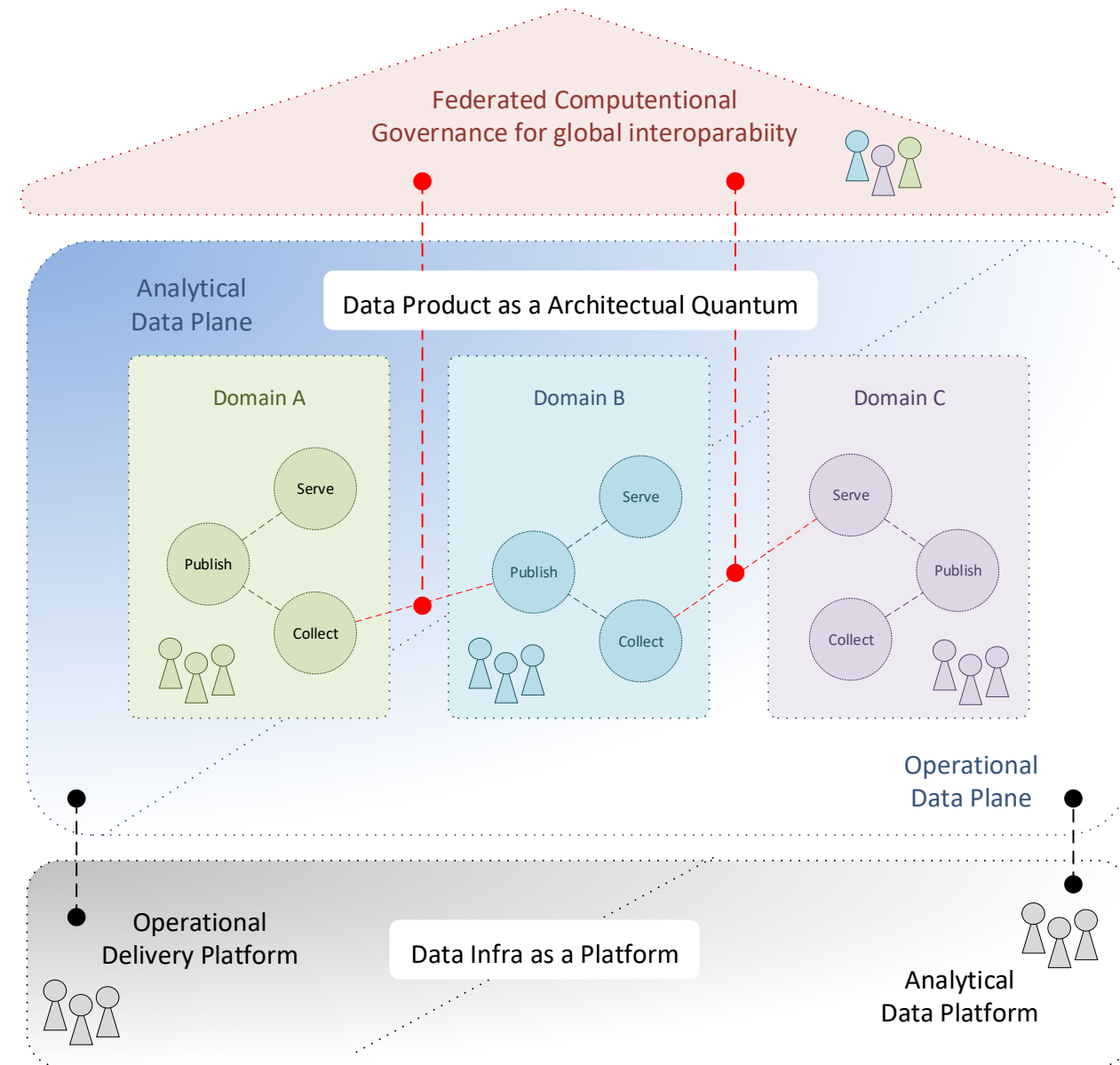
**Data lake**  
Big data ecosystem

**3rd Generation**  
**current**

**Kappa**  
Adds streaming for  
real-time data

**4th Generation**  
**next-step**

**Data Mesh**  
Distributed and organized  
in domains.



From Principles to Logical Architecture

# Evolving YANG Push

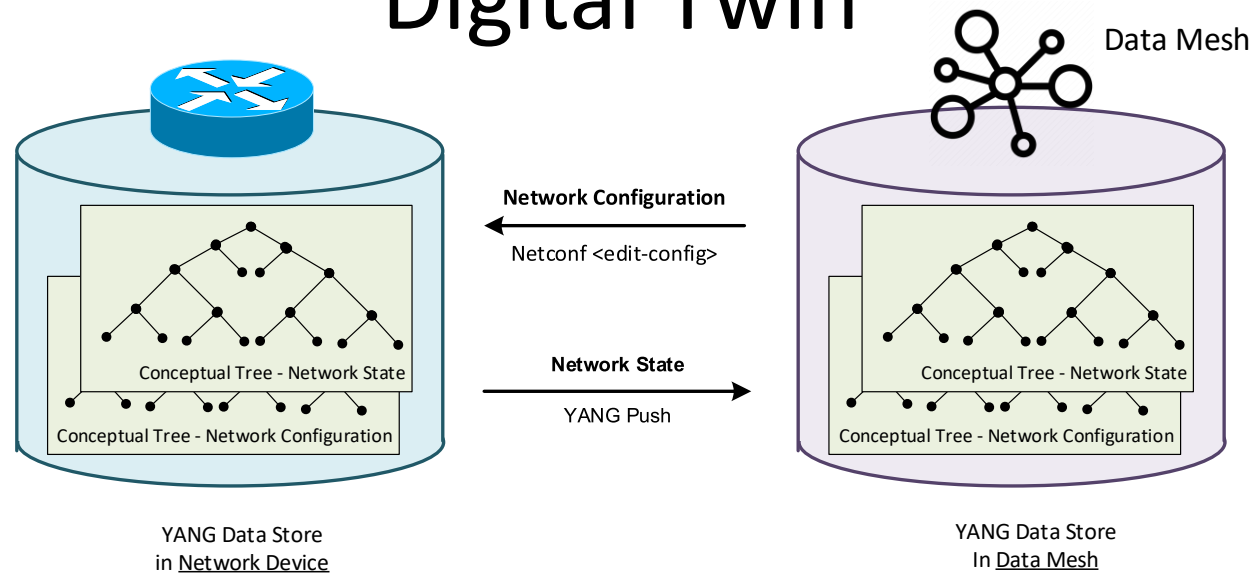
## Missing puzzle pieces

YANG Push	Today at Network Operators	Today at IETF
Transport Protocol	Many and non-standard	netconf-https-notif and netconf-udp-notif in draft status
Encoding	JSON widely adopted. Propriety protobuf in various variants. CBOR not implemented yet.	JSON and XML in RFC8040, CBOR in RFC9254
Subscription	Non-standard, periodical widely adopted. On-change sparse.	RFC8639 and RFC8641
Metadata	Non-standard. Partially among message content.	netconf-yang-notifications-versioning, draft-claise-opsawg-collected-data-manifest, draft-claise-netconf-metadata-for-collection
Versioning	Neither covered in subscription nor in publishing.	netmod-yang-module-versioning
YANG module	Non-standard widely adopted. IETF coverage non-existent.	Many RFC's defined

# YANG datastores enabling Closed Loop Operation

**Automated** data onboarding with bounded context

## Digital Twin



YANG is a data modelling language which will not only transform how we managed our networks; it will transform also how we manage our services.

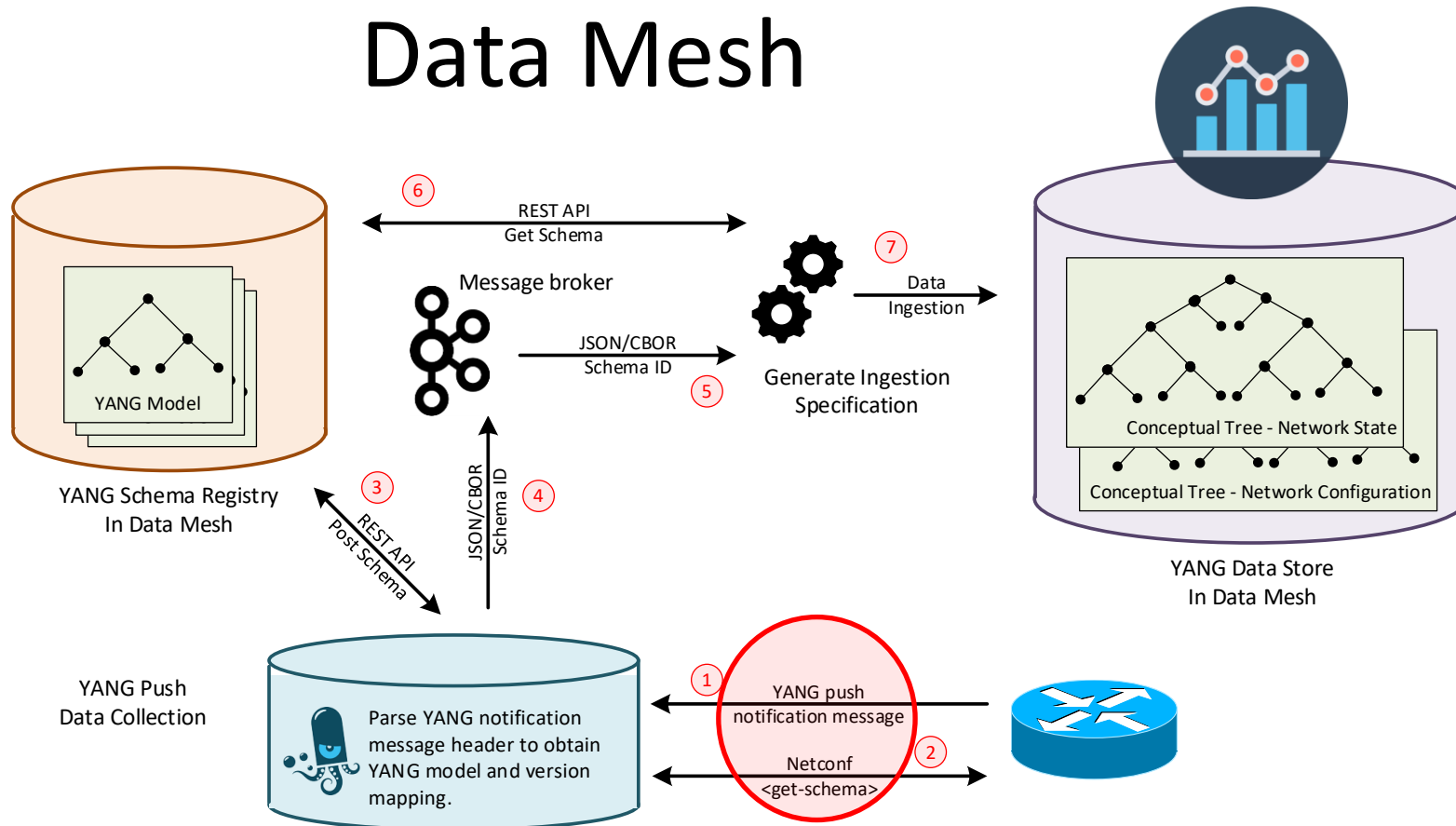
**News: 17 industry leading colleagues** from 4 network operators, 2 network and 3 analytics providers, and 3 universities **commit on a project to integrate YANG and CBOR into data mesh. Starts with IETF 115 public side meeting on Monday November 7<sup>th</sup> 2022 at 13:30.**

**Automated networks can only run with a common data model.** A digital twin YANG data store enables a comparison between intent and reality. Schema preservation enables closed loop operation. **Closed Loop is like an autopilot on an airplane.** We need to understand what the flight envelope is to keep the airplane within. Without, we crash.

# YANG push with semantics reference and versioning

Enabling automated data processing and data mesh integration

## Data Mesh



- **Data Mesh** is a big data architecture where different domains can exchange data with a bounded context. **Same principle as in networks.**
- **Bounded context** relies that data always has semantics and versioning.
- Semantics are needed to describe the data. **A gauge32 is not the same as counter32.** Values can increase or decrease. Needs monotonic increasing counter normalization or not.
- **Versioning and metadata are needed to not only understand that the semantic has changed, but also wherever the new semantic is backward compatible or not. Preventing to break the data processing pipeline.**
- YANG push as defined in RFC8641 is **missing semantics and versioning.** **draft-tgraf-netconf-yang-notifications-versioning** addresses both.



# Extending the Datastore Selection and Notification Message Metadata

## draft-tgraf-netconf-yang-notifications-versioning Introduction

```
module: ietf-yang-push-metadata
```

```
augment /yp:push-update:
  +--ro module?          string
  +--ro namespace?      string
  +--ro revision?       rev:revision-date-or-label
  +--ro revision-label? ysver:version
  +--ro datastore-xpath-filter? yang:xpath1.0 {sn:xpath}?
  +--ro datastore-subtree-filter? <anydata> {sn:subtree}?
augment /yp:push-change-update:
  +--ro module?          string
  +--ro namespace?      string
  +--ro revision?       rev:revision-date-or-label
  +--ro revision-label? ysver:version
  +--ro datastore-xpath-filter? yang:xpath1.0 {sn:xpath}?
  +--ro datastore-subtree-filter? <anydata> {sn:subtree}?
augment /sn:establish-subscription/sn:input/sn:target:
  +-- revision?          rev:revision-date-or-label
  +-- revision-label?    ysver:version
augment /sn:modify-subscription/sn:input/sn:target:
  +-- revision?          rev:revision-date-or-label
  +-- revision-label?    ysver:version
augment /sn:subscription-started/sn:target:
  +-- revision?          rev:revision-date-or-label
  +-- revision-label?    ysver:version
augment /sn:subscription-modified/sn:target:
  +-- revision?          rev:revision-date-or-label
  +-- revision-label?    ysver:version
augment /sn:subscriptions/sn:subscription/sn:target:
  +--rw revision?        rev:revision-date-or-label
  +--rw revision-label? ysver:version
```

- **Network operators need to control semantics in its data processing pipeline. That includes YANG push.**
- This is today only possible during YANG push subscription but not when nodes are being upgraded or messages are being published.
- draft-tgraf-netconf-yang-notifications-versioning extends the YANG push subscription and publishing mechanism defined in RFC8641:
  - **By extending the YANG push header** so that the YANG push receiver learns the semantic reference in the notification message directly.
  - **By adding the ability to subscribe to a specific revision** or latest-compatible-semversion.

# Example Notification Message

In JSON and XML encoding

```
{
  "ietf-notification:notification": {
    "eventTime": "2022-09-02T10:59:55.32Z",
    "ietf-yang-push:push-update": {
      "id": 101, {
        "module": "ietf-interfaces", {
          "namespace": "urn:ietf:params:xml:ns:yang:ietf-interfaces", {
            "revision": "2014-05-08", {
              "revision-label": "1.0.0", {
                "datastore-xpath-filter": "ietf-interfaces:interfaces",
                "datastore-contents": {
                  "ietf-interfaces:interface": {
                    "name": {
                      "eth0": {
                        "oper-status": "up",
                      }
                    }
                  }
                }
              }
            }
          }
        }
      }
    }
  }
}
```

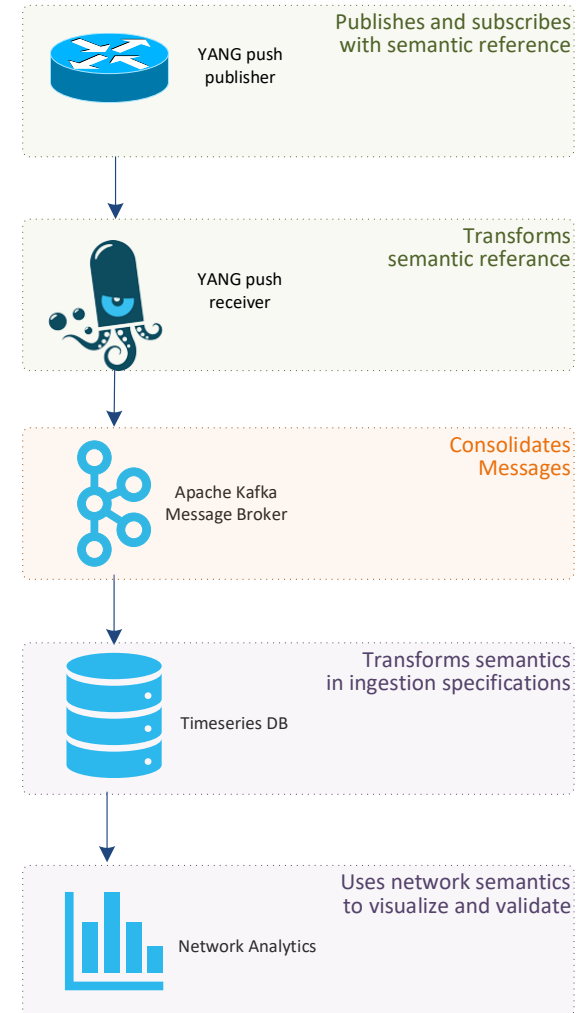
```
<notification xmlns="urn:ietf:params:xml:ns:netconf:notification:1.0">
  <eventTime>2022-09-02T10:59:55.32Z</eventTime>
  <push-update xmlns="urn:ietf:params:xml:ns:yang:ietf-yang-push">
    <id>101</id>
    <module>ietf-interfaces</module>
    <namespace>urn:ietf:params:xml:ns:yang:ietf-interfaces</namespace>
    <revision>2014-05-08</revision>
    <revision-label>1.0.0</revision-label>
    <datastore-xpath-filter>ietf-interfaces:interfaces</datastore-xpath-filter>
    <datastore-contents>
      <interfaces xmlns="urn:ietf:params:xml:ns:yang:ietf-interfaces">
        <interface>
          <name>eth0</name>
          <oper-status>up</oper-status>
        </interface>
      </interfaces>
    </datastore-contents>
  </push-update>
</notification>
```

# From Network Telemetry to Analytics

## Next steps

- **Do you realize the gaps and how it could be resolved?**
  - By adding semantic reference in YANG push and in Data Mesh, an **automated data processing pipeline** which starts with Network Telemetry, consolidates at Data Mesh and ends at Network Analytics would become at reach.
- **Collaborate** with different network operators, network and analytic vendors and universities on bringing YANG semantics into Apache Kafka.
- Adding semantic reference into YANG push at IETF.
- -> **What are your thoughts and comments?**
- -> **Interested to learn more? Join the IETF 115 public side meeting on Monday November 7<sup>th</sup> at 13:30 or look at the project page:**

<https://github.com/graf3net/draft-daisy-kafka-yang-integration/blob/main/draft-daisy-kafka-yang-integration-02.md>



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