The bridge to possible

Experience Telemetry – Driving Insights and Actions

Marisol Palmero, Technical Leader, CPX
Yenu Gobena, Cisco Fellow

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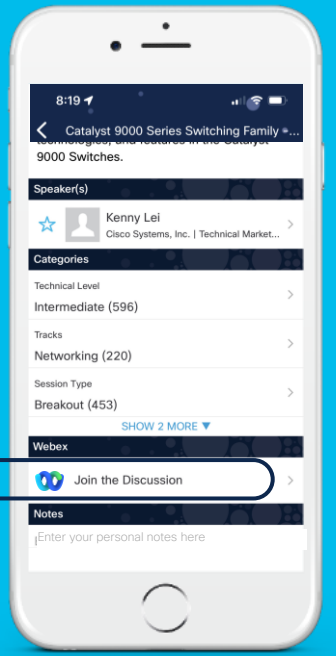

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Abstract

Technologies have long been deployed at scale to improve network reliability. However, they all rely on a technical approach: detecting a failure or thresholds which trigger actions to meet app SLAs.

Experience Telemetry defines a new paradigm – measuring and improving the overall user experience, fuelled by AI/ML, offering many options to accelerate time to value of technology investments.

Come to this session to join in on a fun, engaging, and thought-provoking review of how Experience Telemetry is changing what is possible with networks and apps, both today and tomorrow!

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By Way of Introduction …

I am **Technical Lead** with the Customer and Partner Experience Organization, and have been with Cisco for 24 years.

My area of expertise has been Network Management for many years, with actual focus on Service Delivery Network and Automation Technologies.

Currently leading projects across the company involving different business entities, with a common focus to standardize data ingestion in CX Cloud platform.

I have a special interest in **Telemetry** and during the last 18 months, with special focus on **Sustainability.**

Marisol Palmero
Technical Leader, CPX
mpalmero@cisco.com

By Way of Introduction …

I am currently a Cisco Fellow in the Customer and Partner Experience Organization. I will have been with Cisco for 23 years this summer. I lead an amazing team of global industry recognized Distinguished , Principals and Technical engineering leaders. Our areas of focus are around Large Customer Deployments, Customer Co-innovation, New Technology and Solution incubations.

I also serve as the executive sponsor for our ONEx Organization Senior Technical Talent which stands at 230+ strong.
I have a background in Enterprise and Service Provider networking, cloud and security Solutions. In addition to data and telemetry analytics with an affinity toward driving vertical based outcomes.

Yenu Gobena
VP, Cisco Fellow
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Agenda

- Out with the old, in with the new: Model-Driven Telemetry
- Operational vs. *Experience* Telemetry
- Real-world examples: Experience Telemetry use cases
- Key Takeaways

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Out with the Old, In with the New: Model-Driven Telemetry

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Demystifying the implementation of Model Driven Telemetry with YANG

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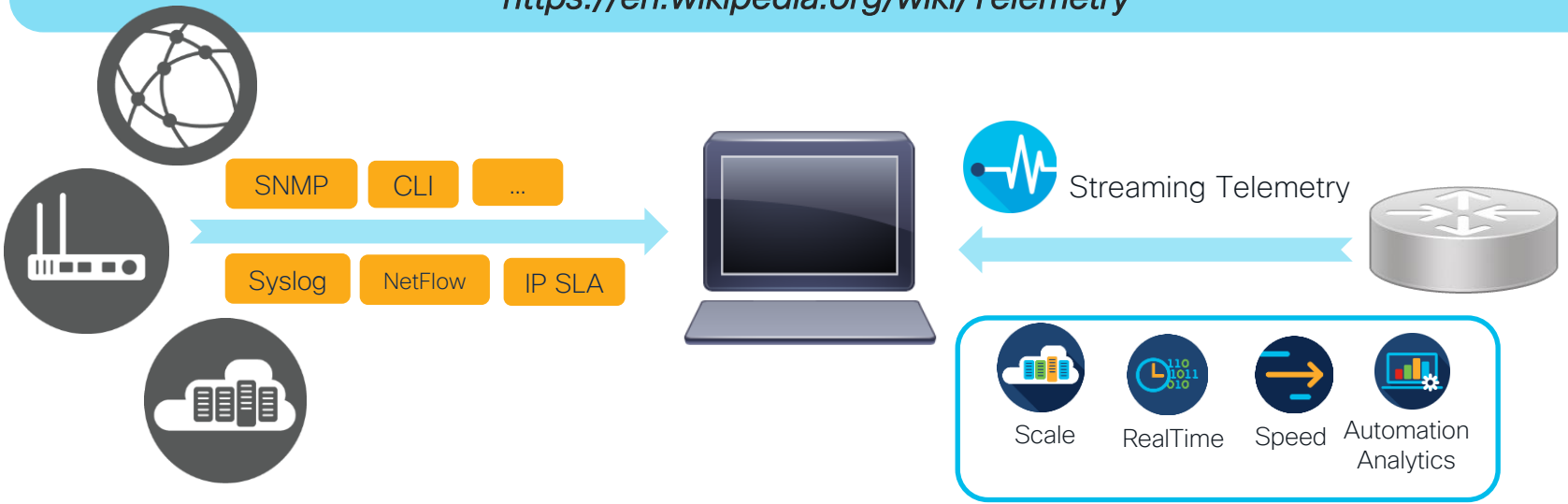
Telemetry

What is it?

Telemetry: An ***automated*** communications ***process*** by which ***measurements*** and other data are ***collected*** at remote or inaccessible points and ***transmitted*** to receiving equipment ***for monitoring***. The word is derived from Greek roots: ***tele = remote,*** and ***metron = measure***.
https://en.wikipedia.org/wiki/Telemetry



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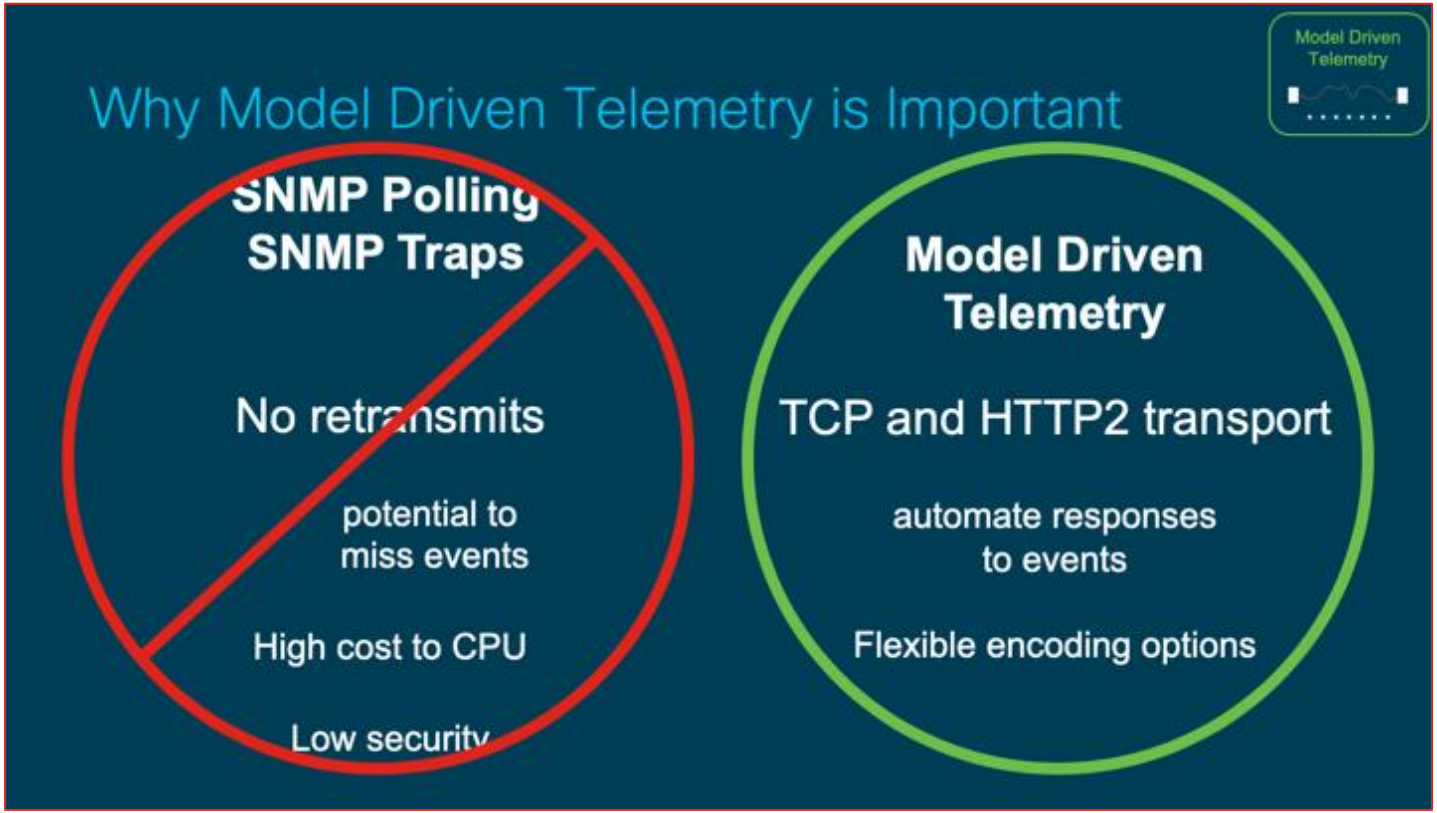
Telemetry History



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What is new about Telemetry?

Model Driven Telemetry (MDT)

- Provides a mechanism to stream data from a model-driven telemetry-capable device to a destination:
  - Push vs Pull
  - Subscriber-based
  - Combines periodic subscriptions with Event-driven
  - Scalability
  - Diversification of manageability

MDT can ensure that those vast quantities of data are truly usable, when they are well structured

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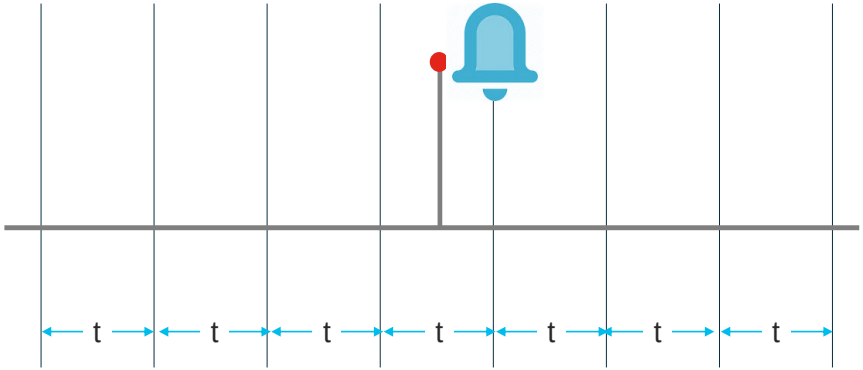
MDT Publication Types

On-Change

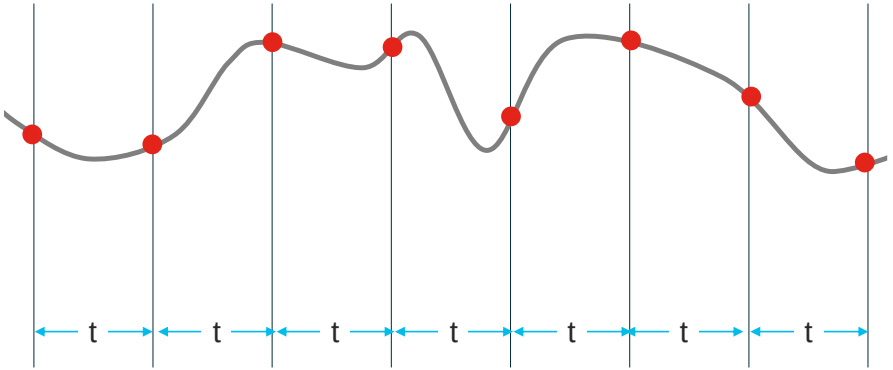


NETCONF-based Notifications

Event Notifications (failed login, etc)

Feature Model **“On-Change” Notifications**

Periodic



Feature Model **“Periodic” Notifications**

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Telemetry Subscriptions

via CLI

```
telemetry ietf subscription 101
encoding encode-kvgpb
filter xpath /memory-ios-xe-oper:
memory-statistics/memory-statistic
stream yang-push
update-policy periodic 6000
source-vrf Mgmt-intf
receiver ip address 10.10.1.45 57555
protocol grpc-tcp
```

via YANG Data Model

```
"mdt-config-data": {
  "mdt-subscription":[ {
     "subscription-id": "102",
     "base": {
        "stream": "yang-push",
        "encoding": "encode-kvgpb",
        "period": "6000",
        "xpath": "/memory-ios-xe-oper:memory-
                  statistics/memory-statistic"
        }
     "mdt-receivers": {
        "address": ”10.10.1.45"
        "port": "57555" }
     }
  ]
}
```


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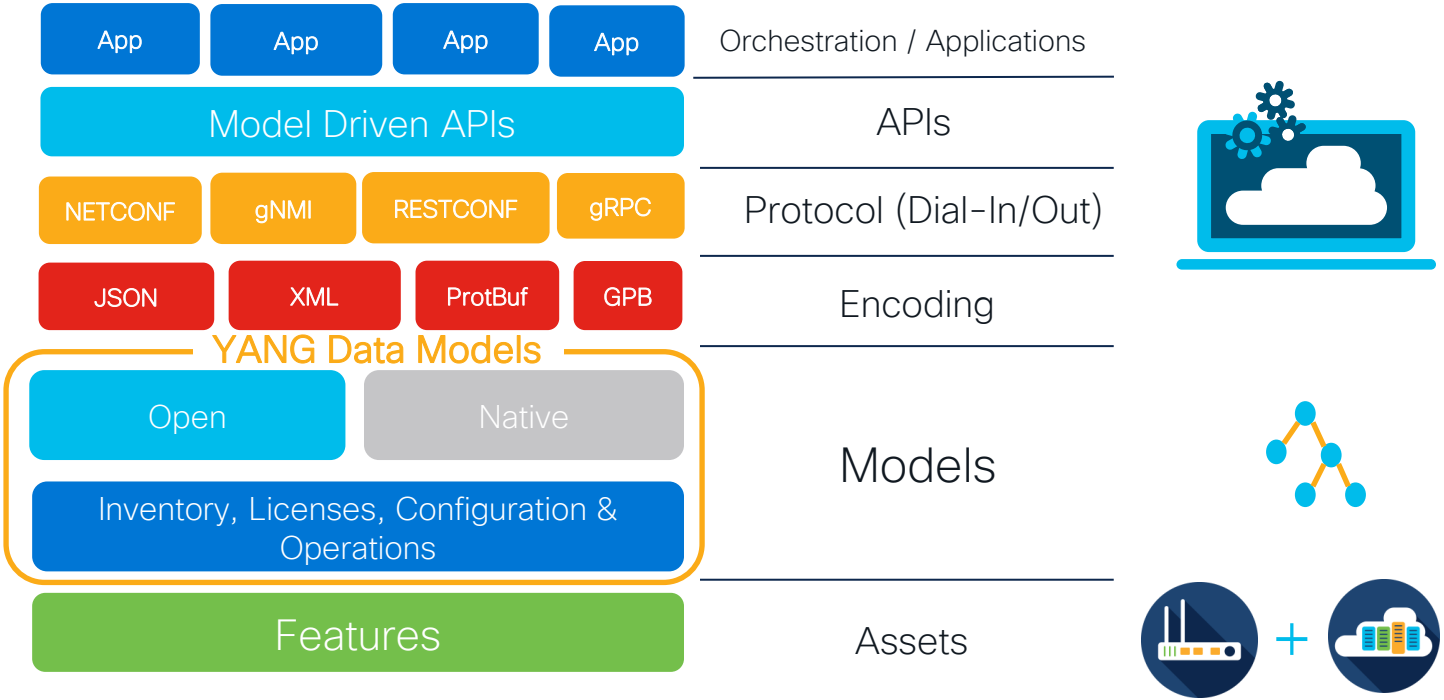
Data Model Driven Telemetry with YANG



YANG Data Models are the foundation of automation Structured, Well-Defined, Programmable Network API

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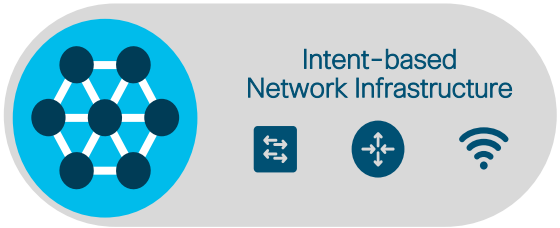
Model Driven Telemetry Interfaces

	NETCONF	gRPC	gNMI
Supported	16.6+	16.10+	16.12+
Method	Dial-In, pull	Dial-Out, push	Dial-In, pull
Configuration	Per session	Configuration based	Per session
Telemetry Receiver	Client	Server	Client
Encoding	XML	JSON + Protobuf	JSON_IETF
Security	SSH + Keys	Plain Text	TLS Certificate
Data Models	YANG	YANG	YANG



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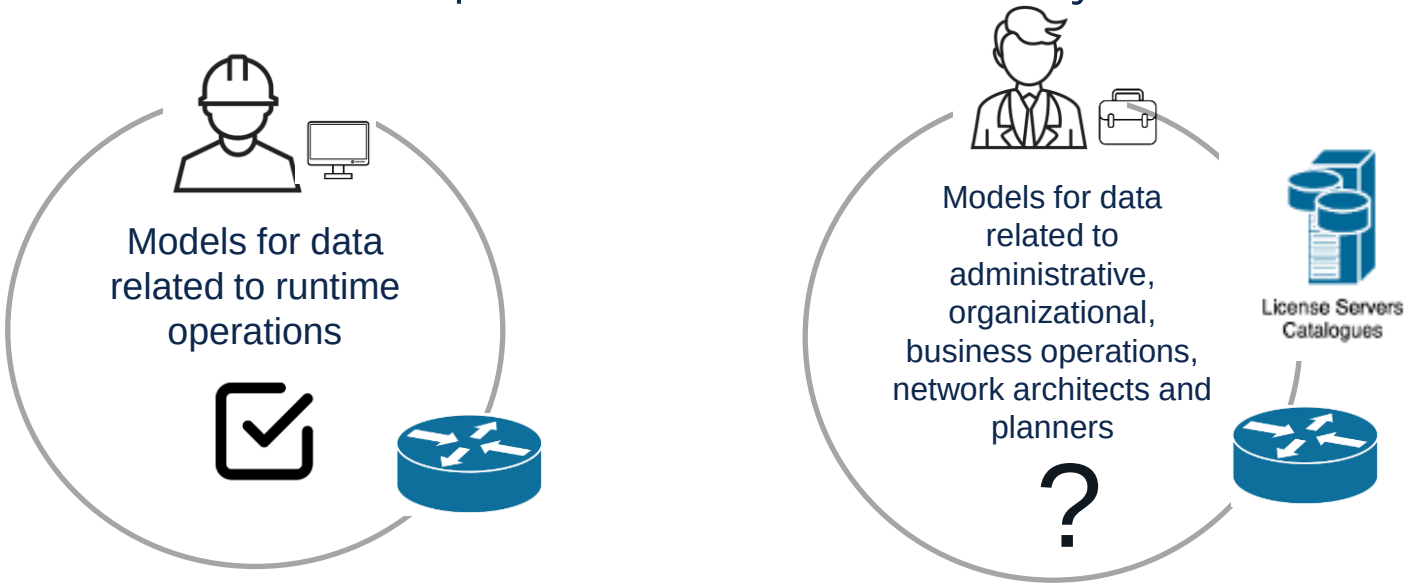
Operational vs. Experience Telemetry

Operational vs. Experience Telemetry



Objective: Enhance & improve the ability to quantify user experience through the use of asset(s), features(s) and/or licences(s).

References:
https://www.ietf.org/live/previous/live104/ietf104-hostser
https://www.claise.be/telemetry-model-driven-telemetry-operational-telemetry-business-telemetry-you-name-it-telemetry/

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How to Classify Telemetry Data?

It depends on who you talk to...

Operational Telemetry

In IT, we often think of telemetry as the mechanism by which we learn about how our networks (or other devices) are *operating* – interface utilization, up/down status, etc.

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How to Classify Telemetry Data?

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Operational Telemetry

In IT, we often think of telemetry as the mechanism by which we learn about how our networks (or other devices) are *operating* – interface utilization, up/down status, etc.

Experience Telemetry

However – telemetry can provide us with valuable data about anything!

Metrics relevant to our business can be just as helpful as metrics about our operations. Business developers and executives talk about business telemetry; at Cisco we refer to this as **Experience Telemetry**.

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What does Experience Telemetry look like?

- Report the business value of a solution, device, or other asset
  - Asset Identification – a unique product, feature, user, …
  - Associated entities / dependencies
  - License – one time purchase, subscription
  - State – (de-)activated
  - Usage - Usage information for the entity, utilization, performance, …

Experience telemetry often uses Operational telemetry objects!

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How to Classify Telemetry Data?

Operational Telemetry

Experience Telemetry

Best practices that apply to Operational Telemetry also apply to Experience Telemetry – such as the importance of **standardizing** and **modeling** your data.

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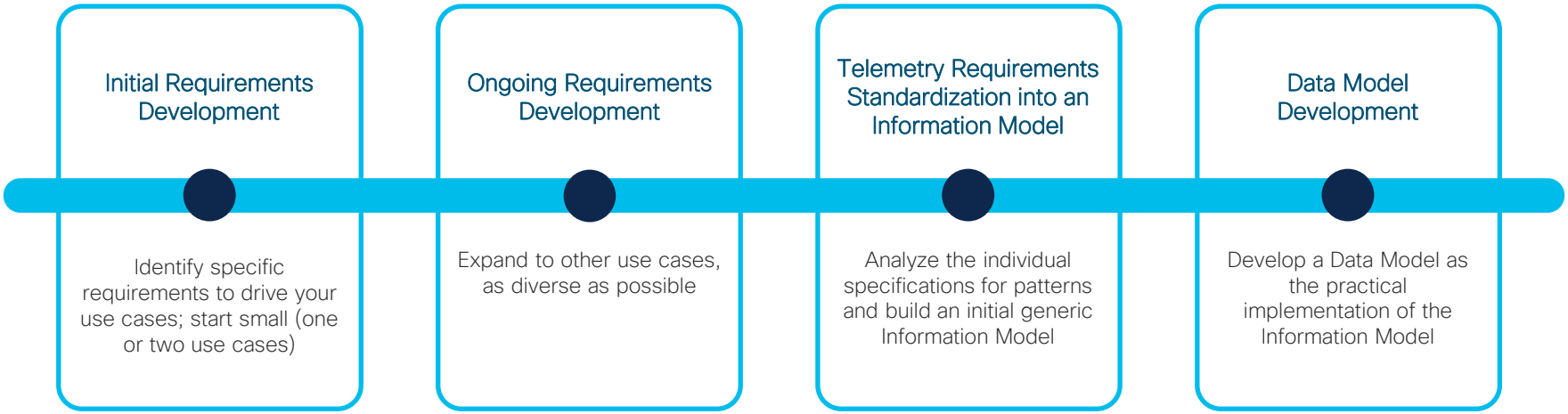
Our Modeling Journey



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Modeling in YANG

FOLDERS

- DMLMO
  - .refcache
  - lmotest111
  - util
  - Archive.zip
  - iana-hardware.yang
  - ietf-geo-location.yang
  - ietf-inet-types.yang
  - ietf-lmo-assets-inventory.yang
  - ietf-lmo-common.yang
  - ietf-lmo-example-mapping-ietf-network-inv
  - ietf-lmo-example-mapping-openconfig-plat
  - ietf-lmo-feature.yang
  - ietf-lmo-incident-management.yang
  - ietf-lmo-licenses.yang
  - ietf-lmo-organization.yang
  - ietf-lmo-usage.yang
  - ietf-lmo-user.yang
  - ietf-lmo.yang
  - ietf-network-inventory@2022-07-11.yang
  - ietf-yang-types.yang
  - createTxtRfc.py
  - createTxtRfc1.py
  - how_to_test_YANG_modules_netsim_NSO.md
  - inventory_ref_standards_drafts.md
  - README.md
  - side_meeting_notes.md

ietf-lmo-assets-inventory.yang

```
identity asset {
  base ietf-lmo-common:lmo-class;
  description
    "An asset can also be physical or virtual";
}
augment /ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:inst {
  when "derived-from-or-self(../ietf-lmo:lmo-class,'ietf-
  description
    "Assets container includes attributes that add the agg
     view";
  leaf role {
    type identityref {
      base ietf-lmo-common:role;
    }
    description
      "What the role of a given device/component is in the
      network. This attribute normally will be configured on
      specific component during setup";
  }
  leaf aggregation {
    type boolean;
    must "../number-of-instances = 1 or current() = 'true'";
    default false;
    description
      "Asset aggregation; e.g., false (default) or true";
  }
  leaf number-of-instances {
    type uint32;
    default 1;
    description
      "Number of instances or endpoints covered by the aggreg
       asset. If different from 1, it should enforce that
       aggregation attribute is set to true";
  }
  leaf platform-dependency-os {
    type identityref {
      base ietf-lmo-common:platform-dependency-os;
    }
    description
      "Operating system for the asset to be deployed.";
  }
  container install-location {
    uses ietf-geo-location:geo-location;
    description
      "Physical installed location of the product. Location i
       provided based on what customer/user configures";
  }
  leaf deployment-mode {
    type identityref {
      base ietf-lmo-common:deployment-mode;
```

ietf-lmo-licenses.yang

```
identity license {
  base ietf-lmo-common:lmo-class;
  description
    "Unique License Identifier";
}
choice all-1-asset{
  description
    "Considering license is linked to all or explicitely a
    one/few assets";
  leaf all-assets {
    type boolean;
    default false;
    description
      "License apply to all assets; e.g., false (default) or
      true";
  }
  container assets {
    description
      "Assets to which this license are attached";
    list asset {
      key "lmo-class id";
      description
        "list of assests";
      leaf lmo-class {
        type leafref {
          path "/ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:lmo-class";
        }
        must "derived-from-or-self(current(), "+
             " 'ietf-lmo-asset:asset')";
        description
          "Asset class to which this license is attached";
      }
      leaf id {
        type leafref {
          path "/ietf-lmo:lmos/ietf-lmo:lmo[ietf-lmo:lmo-class "+
          " = current()/../lmo-class]/ietf-lmo:inst/ietf-lmo:id";
        }
        description
          "Asset to which this license is attached";
      }
    }
```

ietf-lmo-feature.yang

```
  }
  augment /ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:inst {
    when "derived-from-or-self(../ietf-lmo:lmo-class, "+
         " 'ietf-lmo-feature:feature')";
    description
      "feature attributes";

    name {
      type string;
      description
        "Friendly name of the feature";
    }
    leaf summary {
      type string;
      description
        "Brief description of the feature";
    }
    leaf category {
      type string;
      description
        "Feature category or tag list (as applicable to the
        product)";
    }
    leaf entitlement {
      type string;
      description
        "Minimum entitlement level, subscription, or license level
         required for the feature";
    }
    leaf first-available-version {
      type string;
      description
        "The first version in which this feature was enabled";
    }
    container backported-versions {
      config false;
      description
        "software patch or update is taken from a recent software
        version and applied to an older version of the same
        software";
      list backported-version {
        config false;
        description
          "Backport releases to older release";
        leaf version {
          type identityref {
            base ietf-lmo-common:version;
          }
          description
            "version of the backport release";
        }
      }
    }
```

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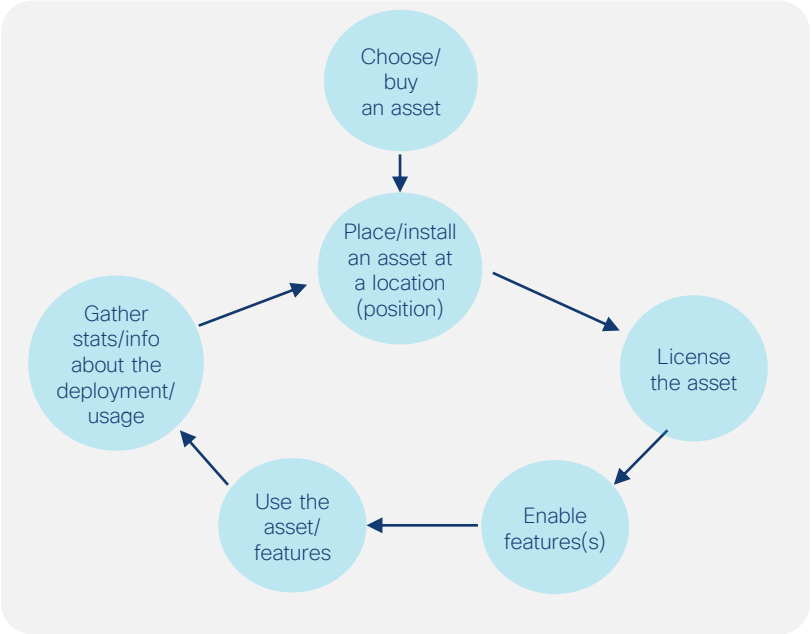
IETF approach
Data Model for Lifecycle Management and Operations

Facilitate the asset lifecycle management from the initial asset selection and positioning, licensing, feature enablement and usage, and beyond renewal to improve the overall user experience

Lifecycle Management and Operations (LMO) data constitutes data needed to measure asset-centric lifecycle metrics including but not limited to:

- asset adoption and usability,
- licensing,
- supported and enabled features and capabilities.



Example Asset Lifecycle Management & Operations

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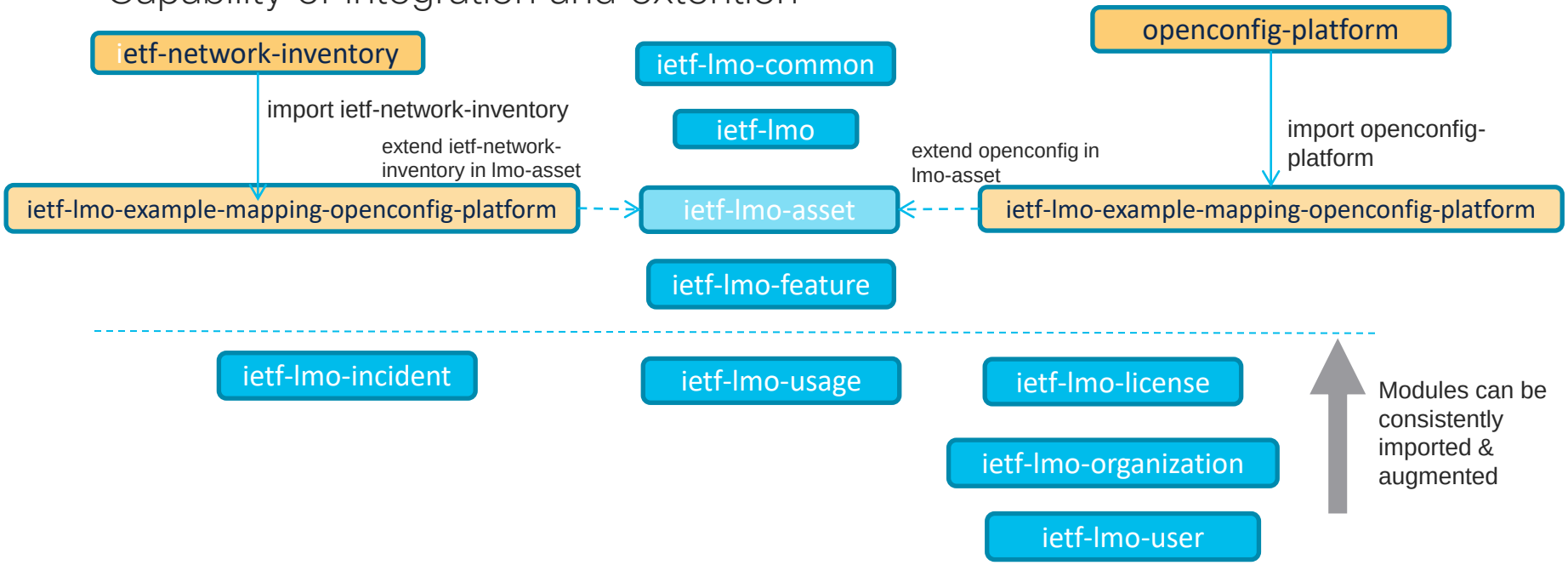
Changes in -09
Flexibility and Consistency to ietf-lmo-asset YANG module

- Capability of integration and extention



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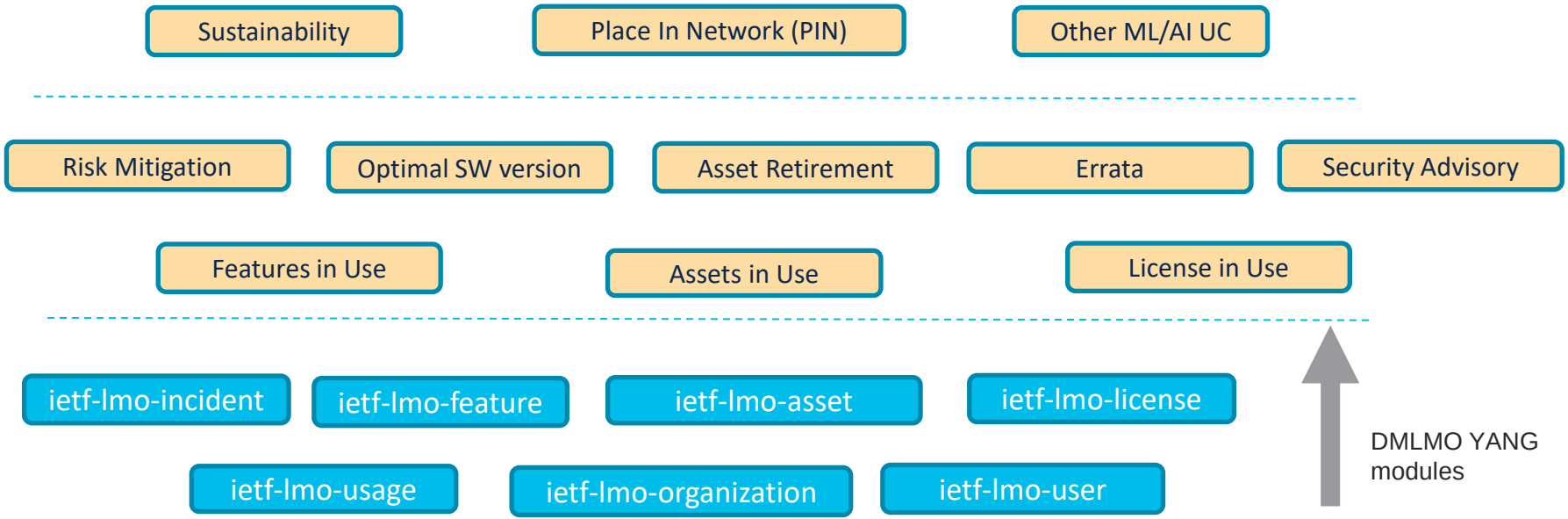
Experience Telemetry
Driving Insights and Actions



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Real-world examples:
Experience Telemetry Use Cases

Moving beyond a “product” or “state”

The Balance to Run your Business

Operational Telemetry

- Error Logs
- Syslogs
- Crash Debugging
- CLI Output
- Configurations
- Software Versions
- Identity
- Inventory
- Product Health Status
- Monitoring

What and how is it being used ?

- User Activity
- Logins
- Page usage
- Behaviour Insights
- Feature Usage
- Licencing Usage
- Licencing types

Is it great ?

- Transaction Times
- Refresh Rate
- Application Availability
- Enhanced Control/Modelling
- Video Quality

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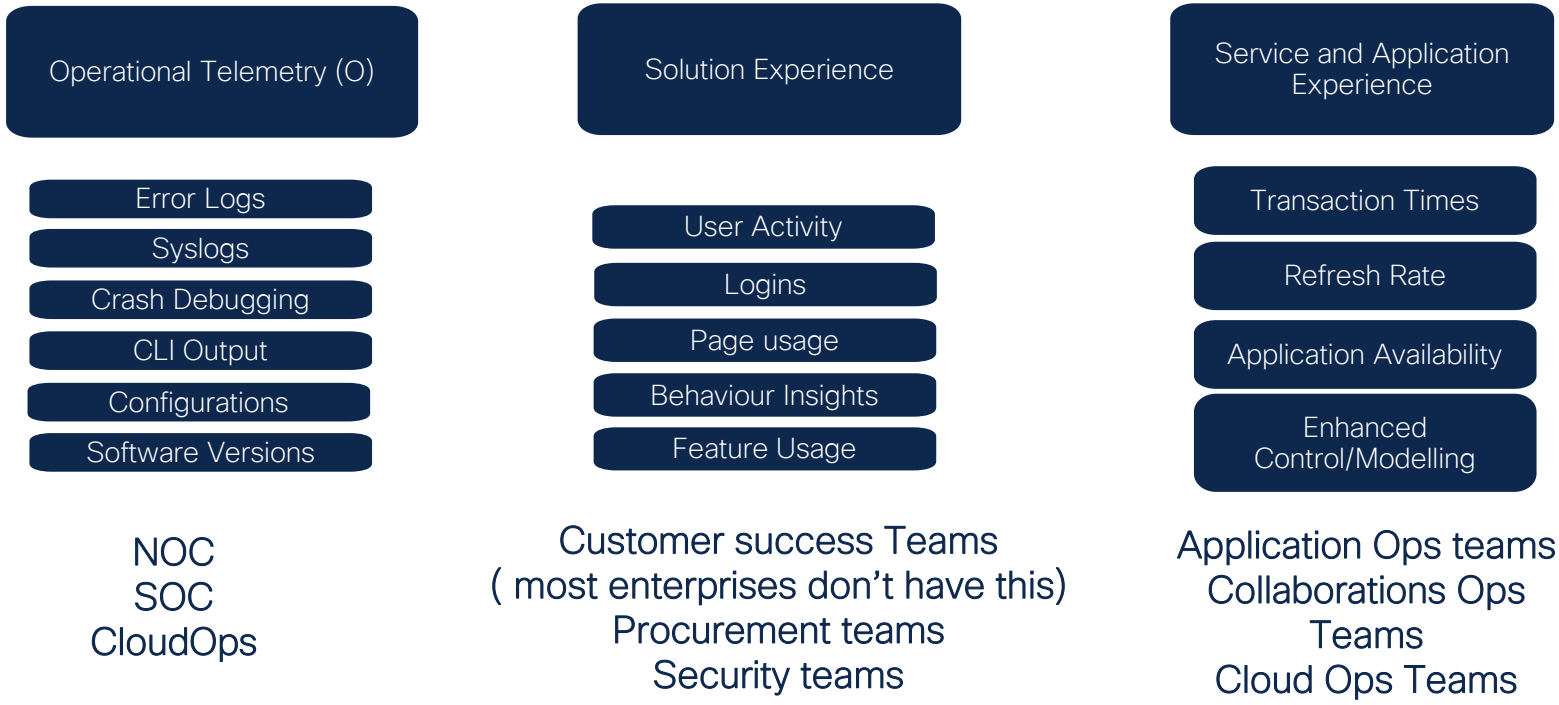
Organizational boundaries – How are our organized, who owns the data ?



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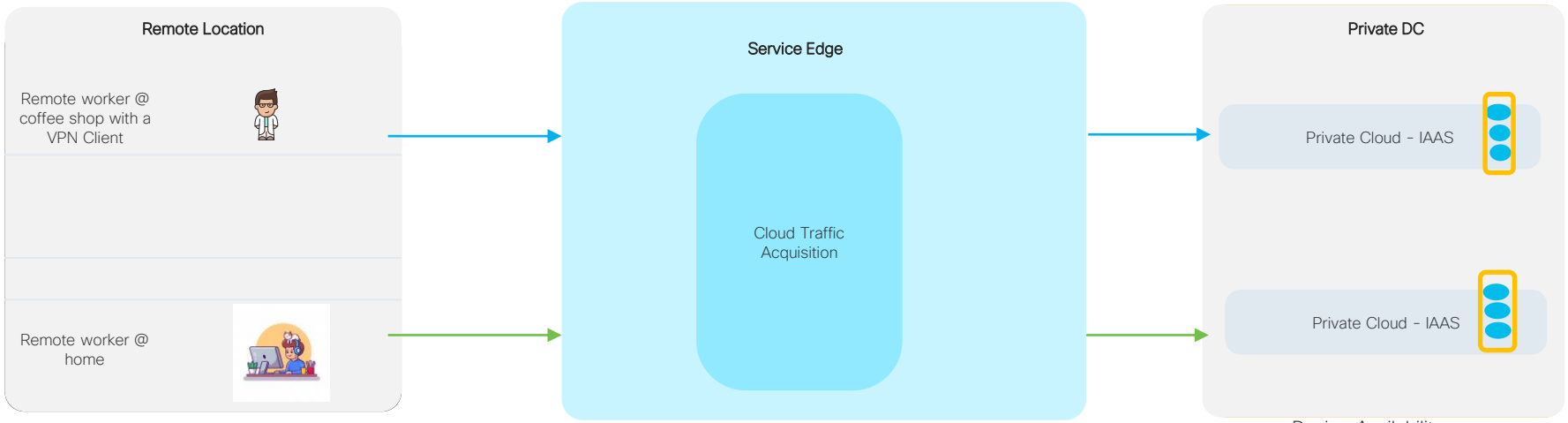
A Health Care Hybrid worker –
Desired Outcome: Wide adoption of a Private Cloud IAAS



Device up/down (O)
Application Probes (E)
VPN or SDWAN User (E)
QOS Queues (O)

Application Probes (E)
Path Probes (O,E)
Service consumed (A)

Device Availability
, Application availability (O)
 CPU % and MEM (O)
Spin up time (E)
# of users (A)
Using self help Guide Links (A)
B/W in and Out over time (A)
# of logins over time (A)
Services in use (A) , License types (A)

End to End Experience – Different data sources

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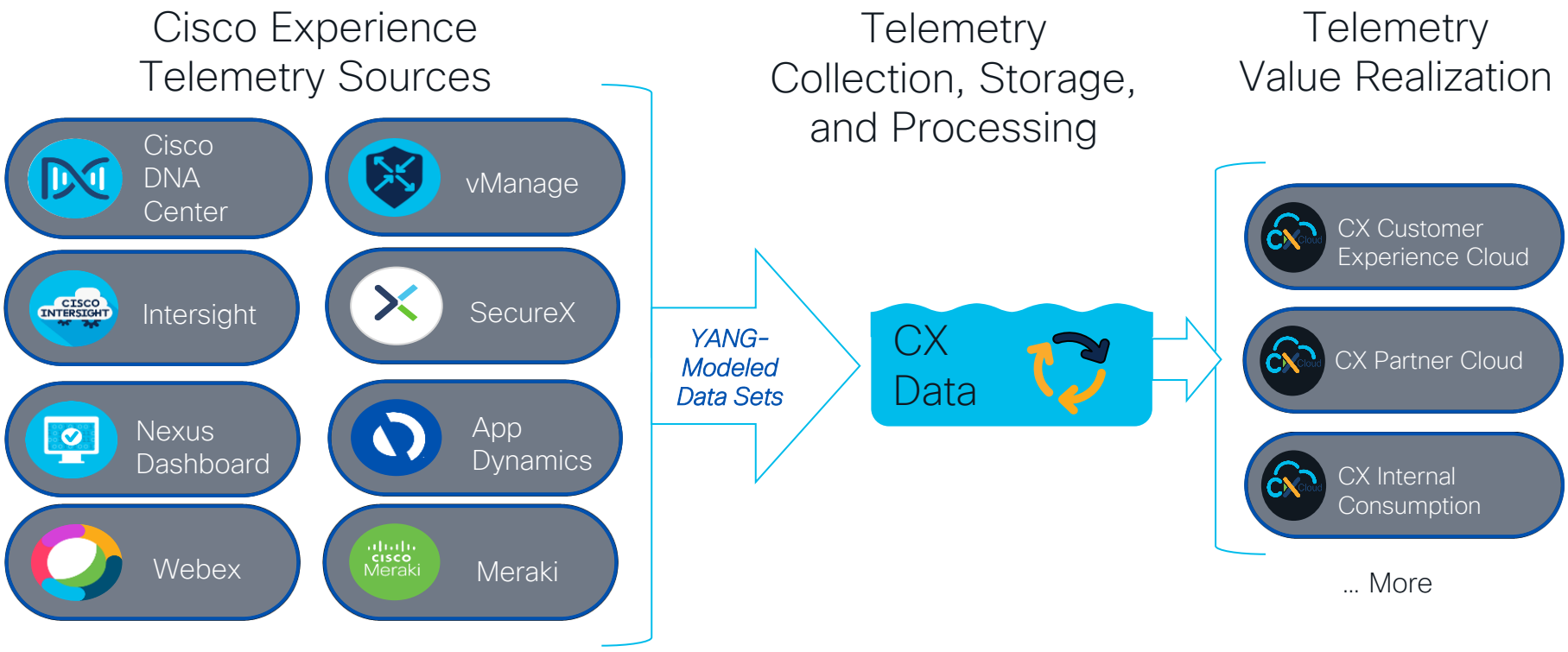
Experience Telemetry

Use in CX Cloud

CX Cloud Telemetry Data Flow



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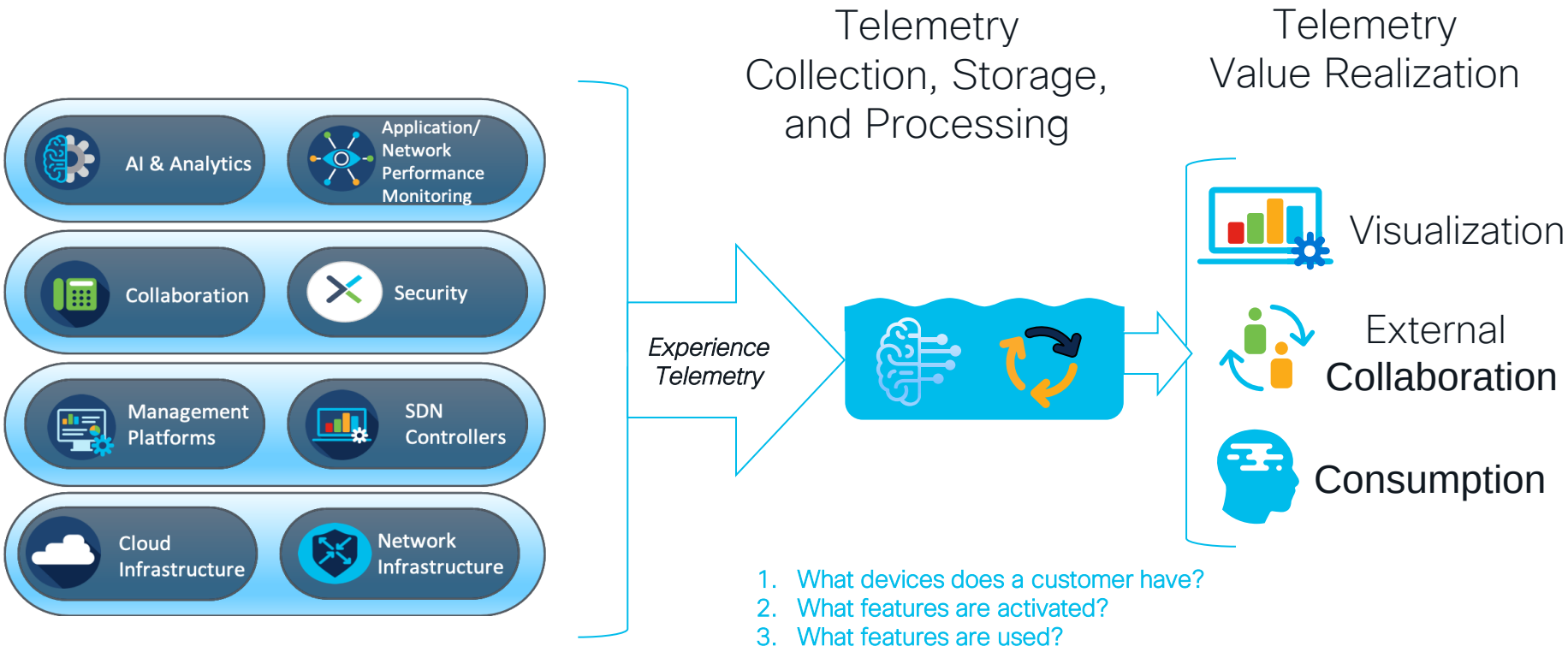
Experience Telemetry – How is Cisco using it ?



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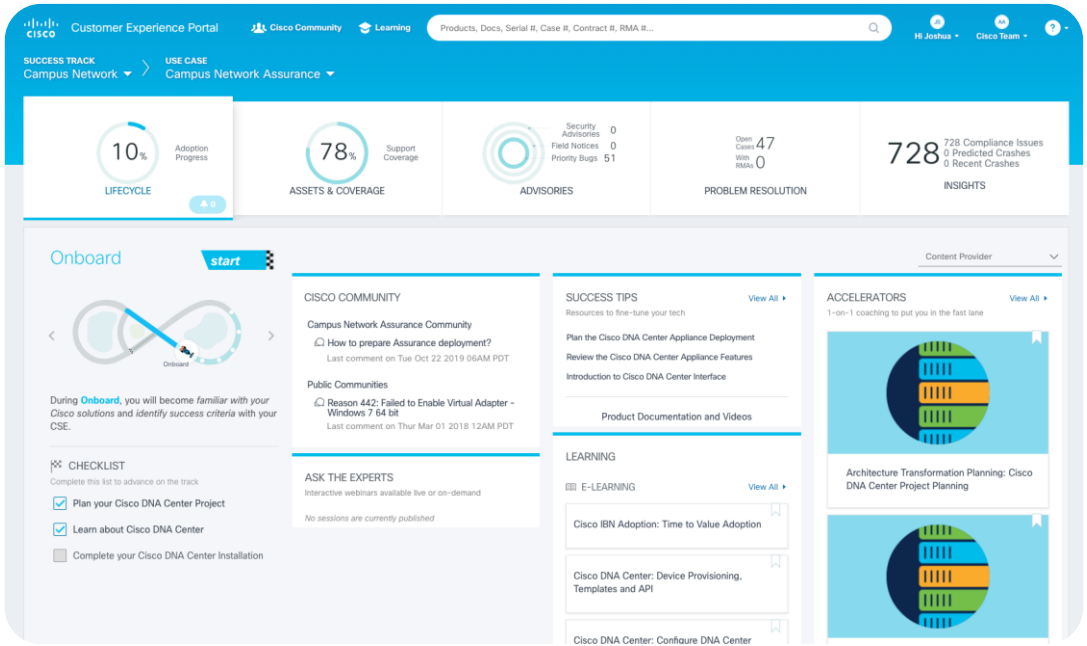
Making it Real: CX Cloud



CX Cloud aggregates information across multiple solutions, product families, etc. to provide collaborative intelligence.

It heavily leverages both Operational and Experience telemetry.

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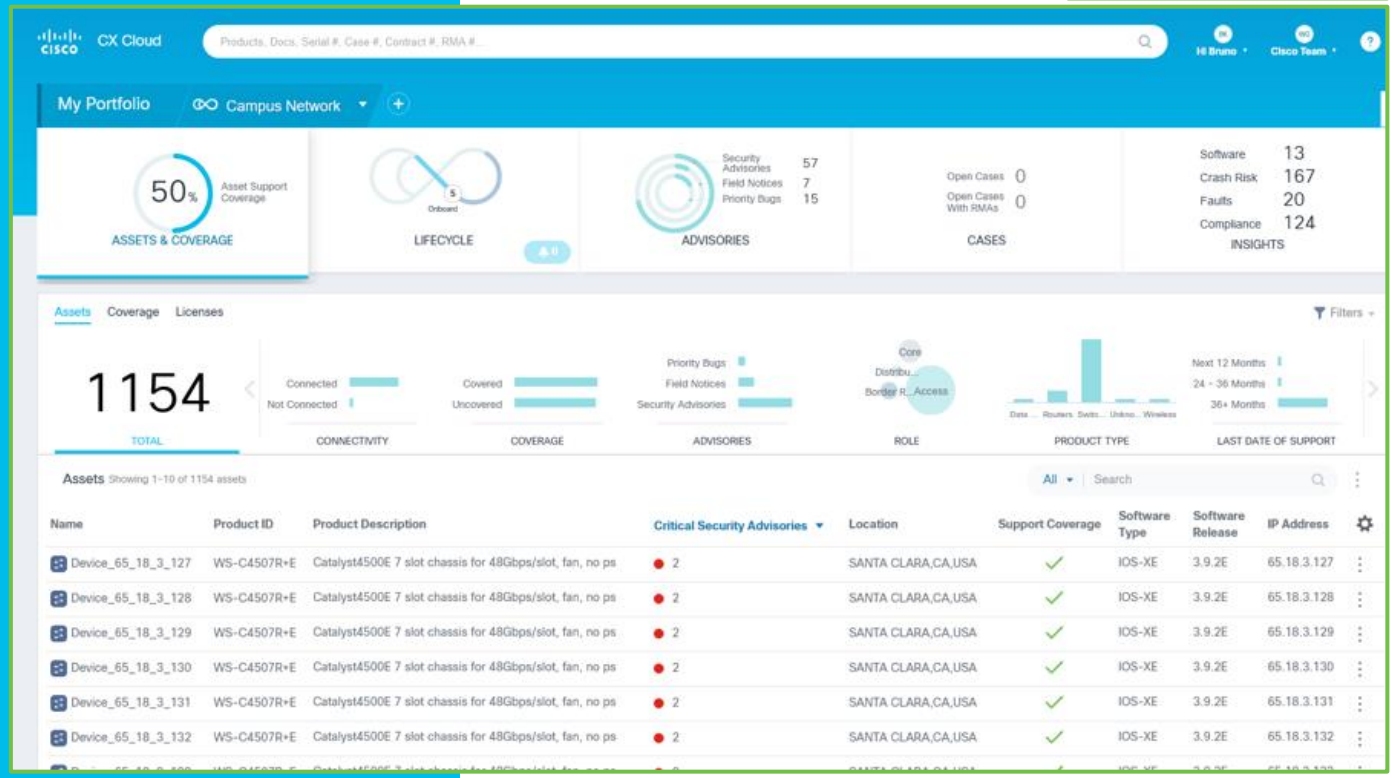
CX Cloud



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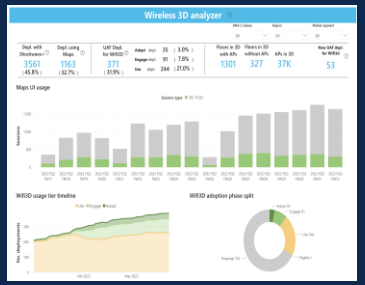
Driving outcomes with Experience Telemetry

Using Feature, Licensing data to ensure adoption and value realization

Universal Adoption Framework

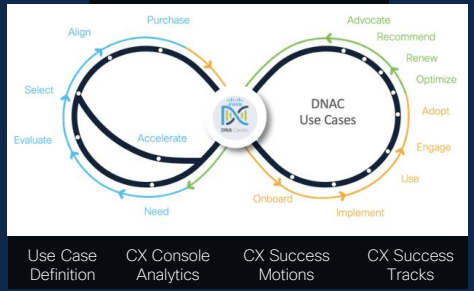
Identify and Accelerate Features, functionality solutions



Telemetry + Adoption Framework

Solution Use Case

Evolve and Accelerate Adoption “Use Cases”



...to achieve higher success and value realization

Customer Journey Map

Prescribe an optimal customer journey for fastest Time to Value

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Experience Telemetry Use Case –

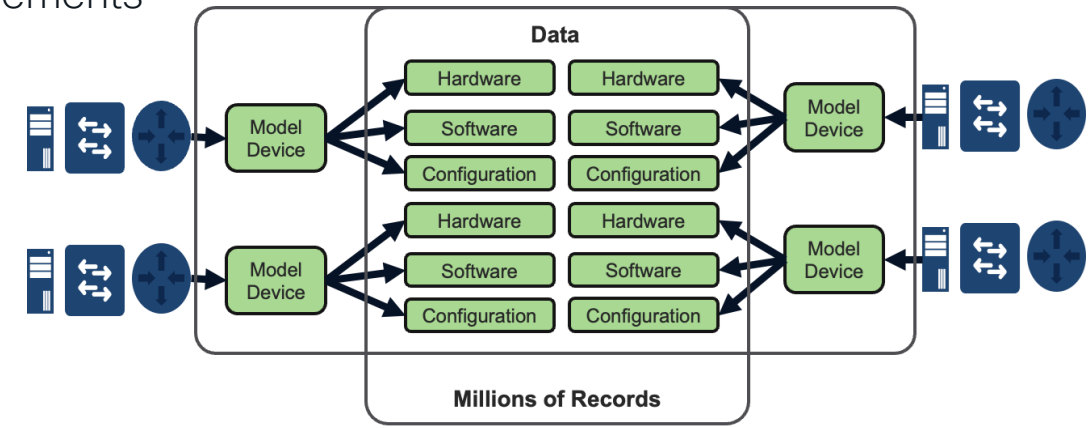
Dynamic Risk Assessment (DRA)

Dynamic Risk Assessment(DRA)

for Network Devices

DRA predicts possibility of crashes in network

- Network consists of 1000's of devices which may crash
- Costly outages
- Help architects/planner in hardening the design around critical network elements



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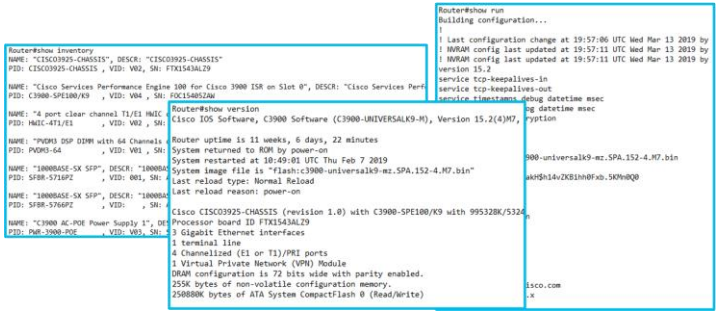
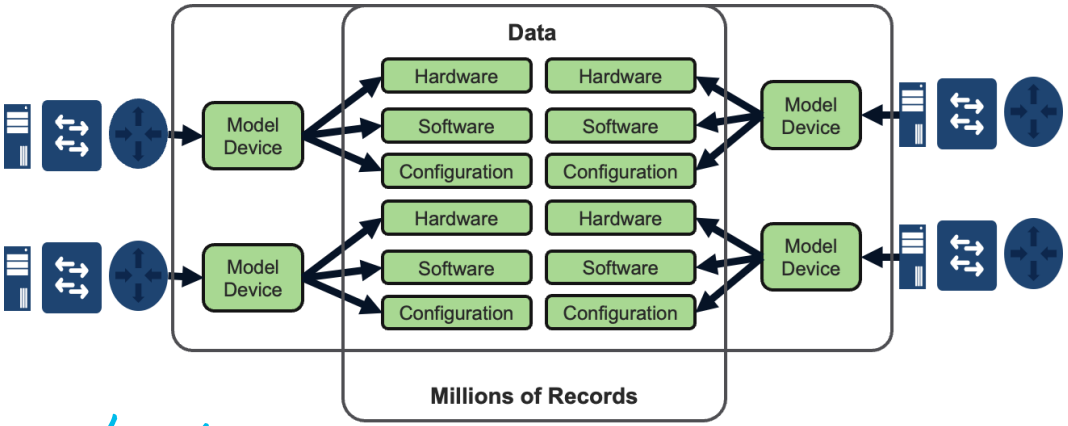
Dynamic Risk Assessment

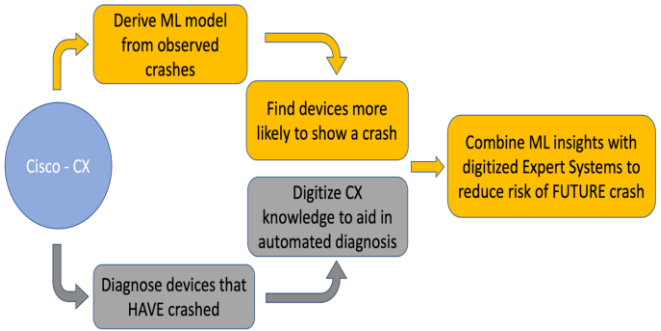
Heterogeneity in implementation





Heterogeneity in:

- network devices
- device information
- methods for collecting information



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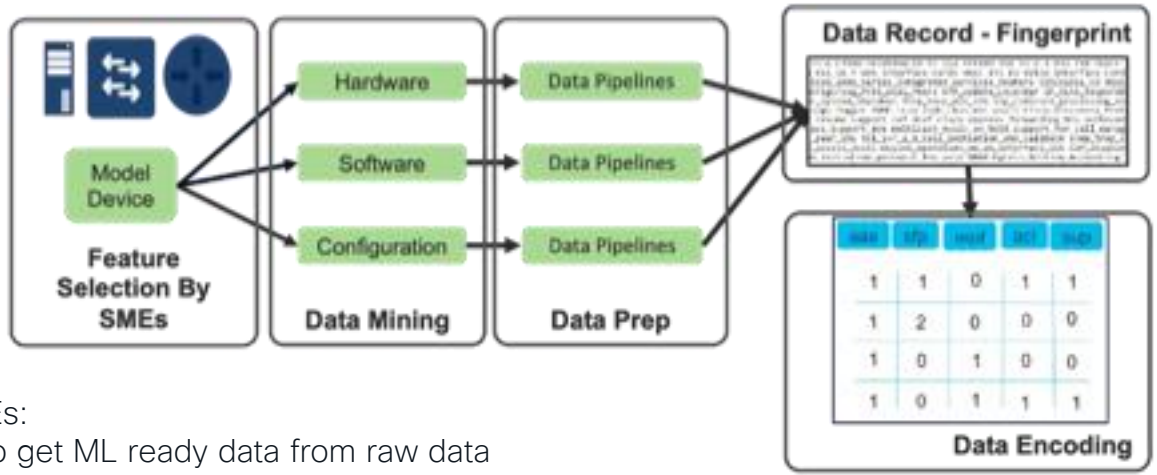
DRA & Experience Telemetry

From Raw Data to ML Ready

By identifying a standard dataset to use across all devices, Experience Telemetry eliminates all challenges related to:

- Feature Selection by SME,
- Data Mining, and
- Data Preparation



Benefit:

Time and Cost Savings for SMEs:

80% of the time is consumed to get ML ready data from raw data

Reference:

https://www.forbes.com/sites/gilpress/2016/03/23/data-preparation-most-time-consuming-least-enjoyable-data-science-task-survey-says/

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Dynamic Risk Assessment & Experience Telemetry
for Network Devices

Challenge

Heterogeneity in:
- network devices
- device information
- methods for collecting information

Networks consist of 1000's of devices which may crash

Outages are costly

Driving Insights and Actions

- Automation (removes expertise to deal with heterogeneity in the network infrastructure)
- Huge time savings in terms of converting raw data to ML ready data
- Easy integration of new data generation points and data consumption points because of the APIs
- Help architects/planner in hardening the design around critical network elements

Solution

The method *uses common data* sets for hardware, software, and feature usage telemetry to identify network elements that may be at risk of crash.
- Observed crashes collected from millions of devices in real networks provide data that is used to train machine learning (ML) models.
- The models are used for predicting the probability of a future device crash.
- Are new purchase/configuration risky for operations
- Is the purchase/configuration being done in an optimal/compliant way

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Experience Telemetry Use Case –

Place In Network (PIN)

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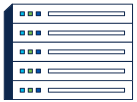
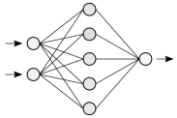
Place In Network (PIN)

Classification for Network Devices





Configurations collected from network devices

SMEs label role of devices

PIN process extracts feature configuration into sequences

Recurrent Neural Network learns patterns of feature usage

Model is capable or predicting role and importance

Weight features based on service dependency and criticality

API exposes model inference based on configuration and telemetry data


```
{
 "device_id": ”9812-3039-3389",
  "device_name": "172.18.87.102",
  "importance": ”critical",
  "product": "ASR 9000 Series
Routers",
  "role": "Core",
  "role_probability": {
          "Access": 0.001,
          "Core": 0.8541,
          "Data Center Access":
0.0001,
          "Distribution": 0.1366,
          "Edge": 0.0039,
          "MPLS": 0.0043
      }
}
```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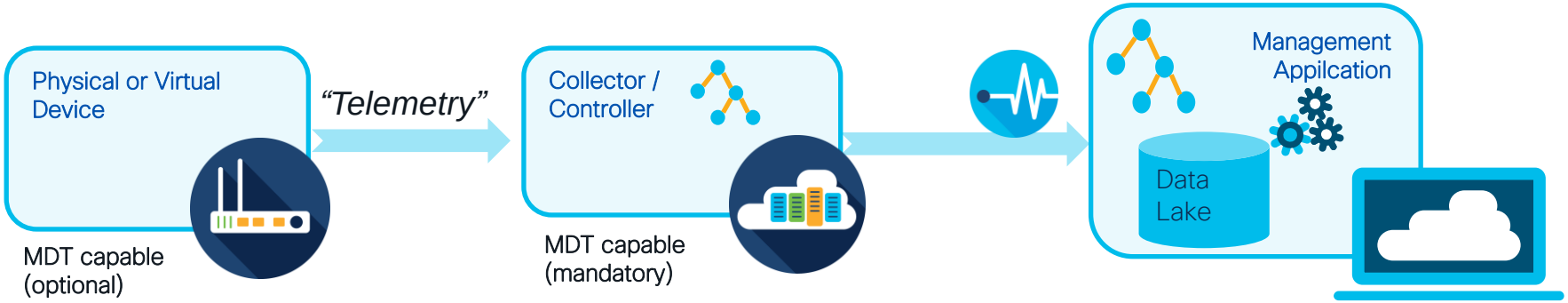
Telemetry
Controller Based for Distributed Intelligence



By modeling data with YANG, MDT can ensure that those vast quantities of data are truly usable

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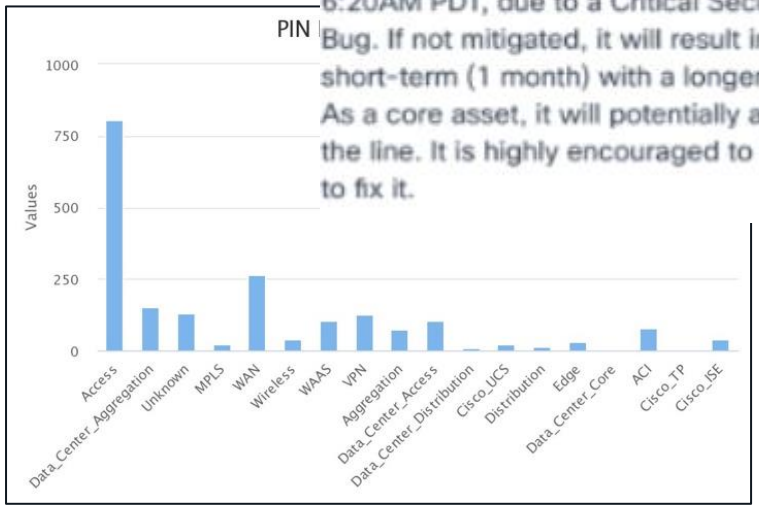
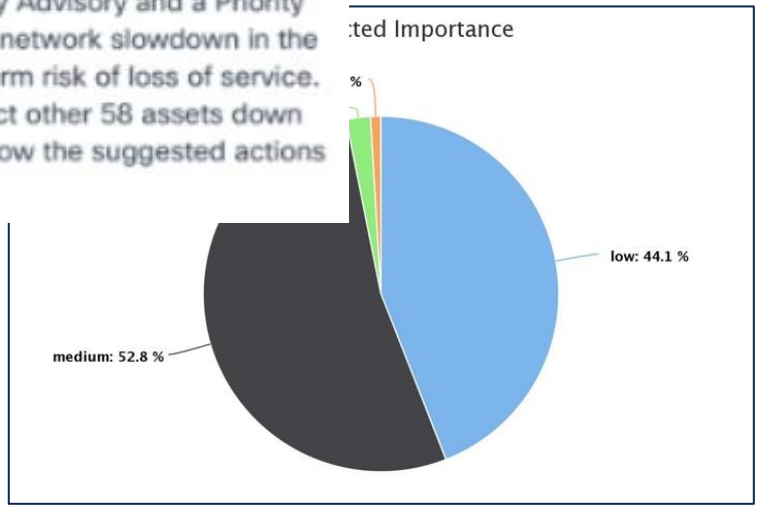
Place In Network (PIN)

Classification for Network Devices

Maching learning capability that predicts the functional role (e.g., “Access” device, “WAN router”, “Data Center Aggregation”, “Route Reflector”, etc.) and business criticality of network devices based upon **Risk**

This Site has been identified with high risk as of Jul 1 2020 6:20AM PDT, due to a Critical Security Advisory and a Priority Bug. If not mitigated, it will result in a network slowdown in the short-term (1 month) with a longer-term risk of loss of service. As a core asset, it will potentially affect other 58 assets down the line. It is highly encouraged to follow the suggested actions to fix it.





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Information Model used by DRA & PIN

```
module: ietf-lmo-assets

  augment /ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:inst:
    +--rw role?                      identityref
    +--rw aggregation?               boolean
    +--rw number-of-instances?       uint32
    +--rw platform-dependency-os?    identityref
    +--rw install-location
    |  +--rw geo-location
    |     +--rw reference-frame
    |     |  +--rw alternate-system?    string {alt
    |     |  +--rw astronomical-body?   string
    |     |  +--rw geodetic-system
    |     |     +--rw geodetic-datum?    string
    |     |     +--rw coord-accuracy?    decimal64
    |     |     +--rw height-accuracy?   decimal64
    |     +--rw (location)?
    |     |  +--:(ellipsoid)
    |     |  |  +--rw latitude?    decimal64
    |     |  |  +--rw longitude?   decimal64
    |     |  |  +--rw height?      decimal64
    |     |  +--:(cartesian)
    |     |     +--rw x?           decimal64
    |     |     +--rw y?           decimal64
    |     |     +--rw z?           decimal64
    |     +--rw velocity
    |     |  +--rw v-north?   decimal64
    |     |  +--rw v-east?    decimal64
    |     |  +--rw v-up?      decimal64
    |     +--rw timestamp?          yang:date-and-ti
    |     +--rw valid-until?        yang:date-and-ti
    +--rw deployment-mode?           identityref
    +--rw activation-date?           yang:date-and-t
    +--rw software-version?          string
    +--ro hotfixes
    |  +--ro hostfix* []
    |     +--ro version?   identityref
    |     +--ro order?     uint8
    +--rw software-type?             string
    +--rw sign-of-life-timestamp?    yang:date-and-time
    +--rw tags?                      string
```

```
module: ietf-lmo-feature

  augment /ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:inst:
    +--rw features
       +--rw feature* [lmo-class id]
          +--rw lmo-class    -> /ietf-lmo:lmos/lmo/lmo-class
          +--rw id           -> /ietf-lmo:lmos/lmo[ietf-lmo:lmo-class =  current()/../lmo-class]/inst/id
  augment /ietf-lmo:lmos/ietf-lmo:lmo/ietf-lmo:inst:
    +--rw name?                      string
    +--rw summary?                   string
    +--rw category?                  string
    +--rw entitlement?               string
    +--rw first-available-version?   string
    +--ro backported-versions
    |  +--ro backported-version* []
    |     +--ro version?   identityref
    +--rw scope?                     identityref
    +--rw config-options* [id]
    |  +--rw id                string
    |  +--rw name?             string
    |  +--rw summary?          string
    |  +--rw characteristic* [id]
    |     +--rw id       string
    |     +--rw name?    string
    |     +--rw value?   string
    +--rw asset
    |  +--rw lmo-class?   -> /ietf-lmo:lmos/lmo/lmo-class
    |  +--rw id?          -> /ietf-lmo:lmos/lmo[ietf-lmo:lmo-class = current()/../lmo-class]/inst/id
    +--rw subfeatures
       +--rw subfeature* [lmo-class id]
          +--rw lmo-class    -> /ietf-lmo:lmos/lmo/lmo-class
          +--rw id           -> /ietf-lmo:lmos/lmo[ietf-lmo:lmo-class =  current()/../lmo-class]/inst/id
```


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Place In Network (PIN)

Classification for Network Devices

Challenge

- Customers have limited capacity for implementing optimizations
- Consultants manually prioritize recommendations based on risk and impact analysis
- Intellectual capital and profiling does not take topology context into account
- Hardware and feature presence alone does not always define business function
- How a feature is configured describes how devices interact with others

Solution

PIN is a machine learning capability that predicts the **functional role** (e.g., “Access” device, “WAN router”, “Data Center Aggregation”, “Route Reflector”, etc.) and **business criticality** of network devices based upon the configured state and utilization of features.

Driving Insights and Actions

- Similar to DRA..., and
- Faster time to understand the devices in a customer’s network
- Recommendations can be prioritized based on impact to the business
- Learns common best practices and configurations for industries and verticals

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Experience Telemetry Use Case –

Sustainability

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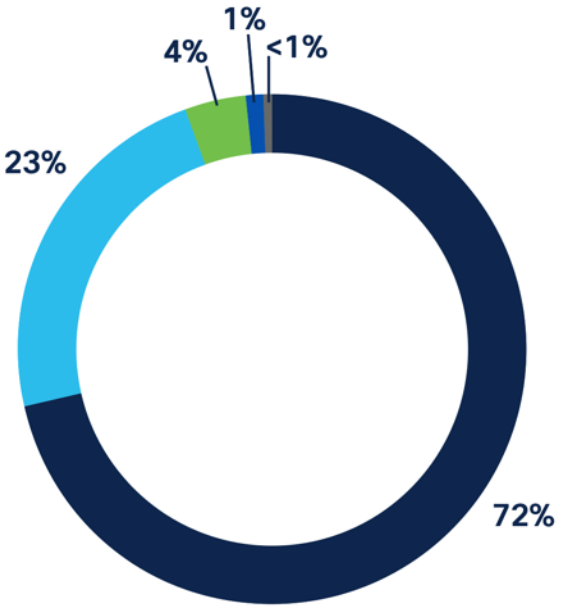
Cisco FY22 Scope 1, 2 and 3 emissions



- **Scope 3:** Use of sold products
- **Scope 3:** Purchased goods and services
- **Scope 3:** Upstream transportation and distribution
- **Scope 1 and 2:** Cisco operations
- **Scope 3:** All other categories

Note: Numbers may not add up to 100 percent due to rounding.

Avoided emissions are emission reductions that occur outside of a product's life cycle or value chain, but as a result of the use of that product. Other terms used to describe avoided emissions include climate positive, net-positive accounting, and Scope 4.[1]

Visit Cisco's ESG Reporting Hub for a detailed breakdown of our Scope 1-3 emissions.

[1] Do We Need a Standard to Calculate "Avoided Emissions"?

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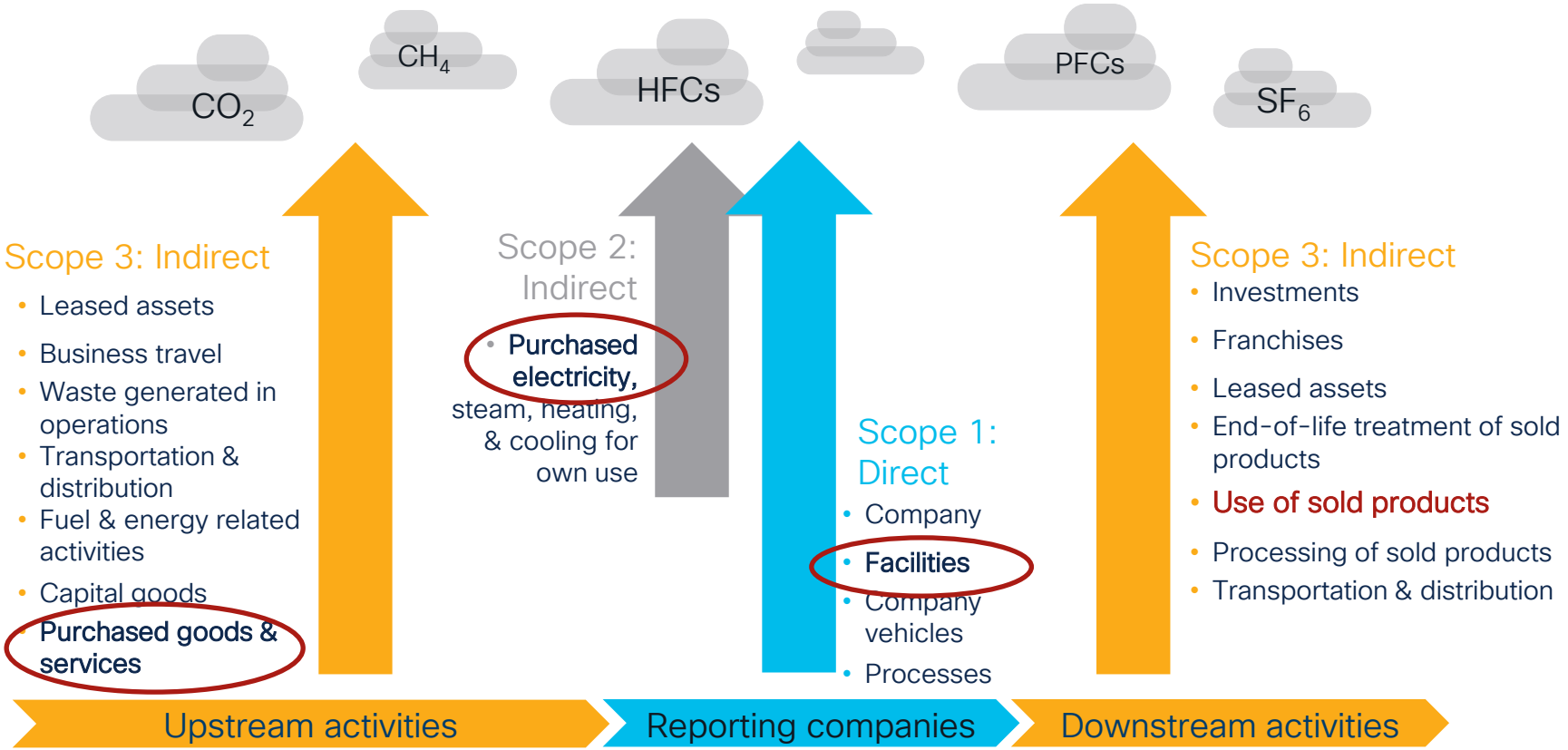
What Is Scope 1, 2 & 3 for Me?



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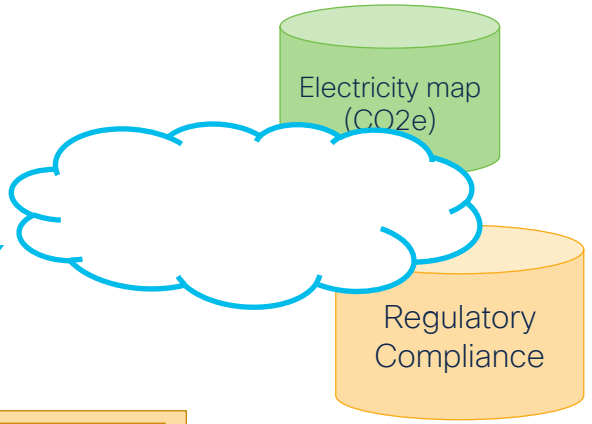
Telemetry Specifications

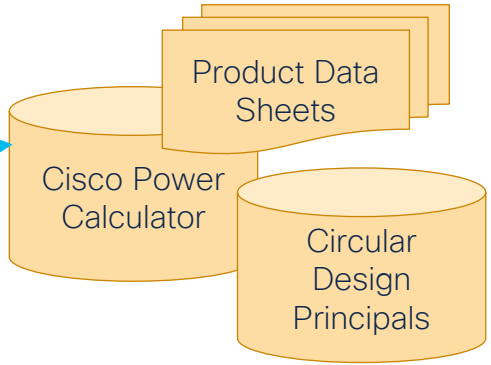
Reference:
https://app.electricitymaps.com/map

" Telemetry" is defined for most of the platforms in different forms:
Show commands, MIBs, YANG modules, ...
different transport mechanisms:
SNMP, RESTConf, NetConf, ...

Business bring us to new needs for Telemetry




```
router#show energy-efficiency
   Input Power(Watt):      1100
   Used Power(Watt):       900
   CO2e(gr CO2eq):         X
   Traffic(Watt/Gbps):     X
   Energy Efficiency:      81%
```



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Sustainability Telemetry Specification
“Real-time” Data

Challenge

" Telemetry" is defined for most of the platforms/systems in:

- different forms: show commands, MIBs, YANG modules, ...
- different transport mechanisms: SNMP, RESTConf, NetConf, ...
- different data storage systems: datasheets, internal and external databases.
- different certifications and regulatory compliances

Solution

Implementing any **Sustainability Solution** at scale with a broad range of Cisco and non-Cisco equipment requires consistently available covering Power Consumption/Energy Efficiency Telemetry.

Telemetry specification benefitsinternal Business Entities, including Corporate Social Responsibility, also customers and partners and even other vendors facilitating consistency and integration.

Driving Insights and Actions

- Cisco CPX Telemetry Specification covering Power Consumption and Energy Efficiency
- Work towards hardware and software platforms, providing CO_2e equivalent
- Enable API access for different data storage systems
- Work to be extended to Circular Design Principals & Sustainability

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Key Takeaways

Key Takeaways

Telemetry is not just for operations – it can provide insights to many other challenging problems

Standardization is important – building an Information Model helps you visualize your data sets, and building a Data Model from that Information Model makes it "real" – regardless of the telemetry type

YANG can be a great option for modeling your data – it provides structure and rigor to standardize your data, but is also readable and easily translated to other languages and for other uses

Think outside the box! How do you use operational or business telemetry in your day-to-day job, and how might it be improved through standardization?

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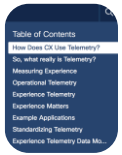
References



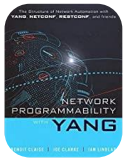
[Experience Telemetry by CX Whitepaper]

IEEE publications:

- [Leveraging Experience Telemetry: Architecture and Data Models]
- [Leveraging Experience Telemetry: Use Cases]

IETF draft:

- [Data Model for Lifecycle Mangement and Operations(DMLMO) v09]



[Network Progammability with YANG]

Just getting started with YANG? Whether for network programmability or other needs like business telemetry, this book is a great place to start.

[Getting Started with Data Modeling]

[IETF RFC 7950: The YANG 1.1 Data Modeling Language]

[Cisco CX Cloud]

Learn more about the use case we highlighted here –
the Cisco CX Cloud portal driven by collaborative intelligence (and lots of telemetry!)

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Networking

Managed Service Operations

START

Feb 6 | 08:30
TECARC-2407
Architecture, Deployments, and Troubleshooting Deep Dive for Catalyst 8000 Series Edge Platforms

Feb 6 | 08:45
TECOPS-2003
Embracing SRE Practices in Infrastructure

Feb 7 | 08:30
BRKOPS-2136
Experience Telemetry - Driving Insights and Actions

Feb 7 | 08:30
BRKOPS-2317
Creating a Network Digital Twin to Leverage Automated Testing with CI/CD Pipelines

Feb 7 | 10:00
BRKOPS-2746
Empower SLA Management for Hybrid Work with ThousandEyes and AppDynamics

Feb 8 | 08:30
BRKENT-2653
All You Need to Know about Forwarding on the Catalyst 8500 and 8500L Platforms

Feb 8 | 10:30
BRKXAR-2003
Extending Enterprise Network into Public Cloud with Cisco Catalyst 8000V Edge Software

Feb 8 | 12:00
BRKENT-2652
Simplify User Experience through Software defined Interconnect and Public cloud

Feb 8 | 14:30
BRKENT-2609
Solving Global WAN Challenges with Multi-Region Fabric

Feb 8 | 14:45
BRKOPS-2040
CiscoLive: Brought To You By Cisco NSO and Cisco Modeling Labs

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Feb 8 | 15:00

BRKOPS-2259

Cisco Full Stack Observability - Solving Problems End-to-End

Feb 9 | 08:30

BRKOPS-2005

Network Wide Visibility in a Unified Dashboard will Change the Way IT Operation Works

Feb 9 | 08:30

LTROPS-1964

Test Automation for everyone using CXTA

Feb 9 | 08:30

LTROPS-2417

Automate your Network Migration

Feb 9 | 08:30

LTROPS-2711

Unified End 2 End Test Automation with CX Test Manager (CXTM)

Feb 9 | 10:15

IBOOPS-1223

An Interactive Conversation on Improving Stability and Network Availability with SW Strategy Framework

Feb 9 | 10:30

BRKOPS-2176

Leveraging Advanced Automation Capabilities in the Fault Management System

Feb 9 | 12:30

BRKENT-2296

Designing On-prem SD-WAN Controllers

Feb 9 | 14:30

BRKOPS-2032

3 Cisco DNA Center and ITSM Workflows: CMDB, Incident Management and SWIM

Feb 9 | 15:45

BRKENT-2126

Three Steps to Gain Actionable Visibility in the Cisco SD-WAN Using ThousandEyes

Feb 10 | 11:00

FINISH

BRKOPS-2766

How to Supercharge your Next-Gen Network with AIOps and Managed Services

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The bridge to possible

Thank you

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ALL IN

Further information

NETCONF Interface

*"NETCONF is **a protocol defined by the IETF** to **install, manipulate**, and delete the **configuration of network devices**"*

V 1.0	V 1.1	Extensions
RFC 4741 Base NETCONF Protocol	RFC 6241 Base NETCONF Protocol	RFC 5277 Notifications
RFC 4742 NETCONF over SSH	RFC 6242 NETCONF over SSH	RFC 5717 Partial Locking
		RFC 6243 With defaults
		RFC 6020 YANG

2006 → 2010 → 2011

Transactional

- Either **all** configuration is applied **or nothing**
- Avoids **inconsistent state**
- Both at **Single Device** and **Network-wide** level

Error Management

- OK or error code

Capability Exchange

Models Download from a Device

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NETCONF Transport – NETCONF over SSH

Client

Client connects to NETCONF SSH sub-system

Server responds with Hello that includes NETCONF supported capabilities

Client responds with supported capabilities

Client issues NETCONF request (rpc/operation/content)

Server issues response / performs operation

Server
SSH port 830

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