



The bridge to possible

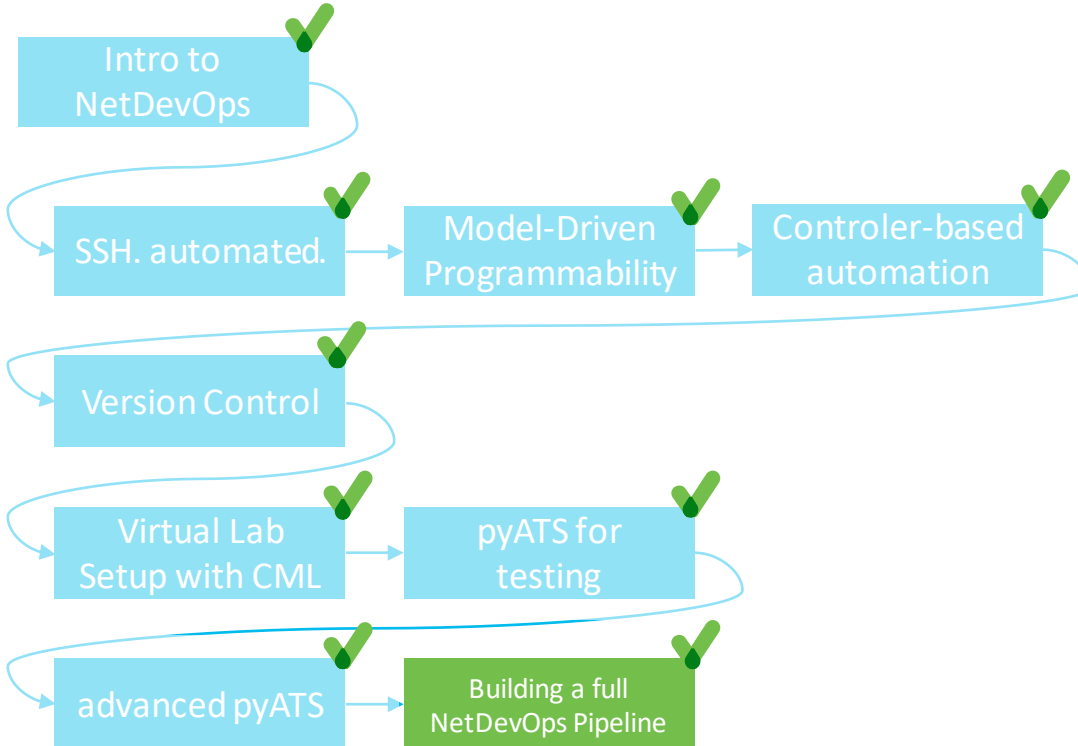
# Monitor your network using programmability and the TIG stack

Marcel Neidinger

Software Solutions Engineer, EMEAR Systems Engineering

14<sup>th</sup> of December, 2021

# Where are we? And where are we going?



What is **NetDevOps**?

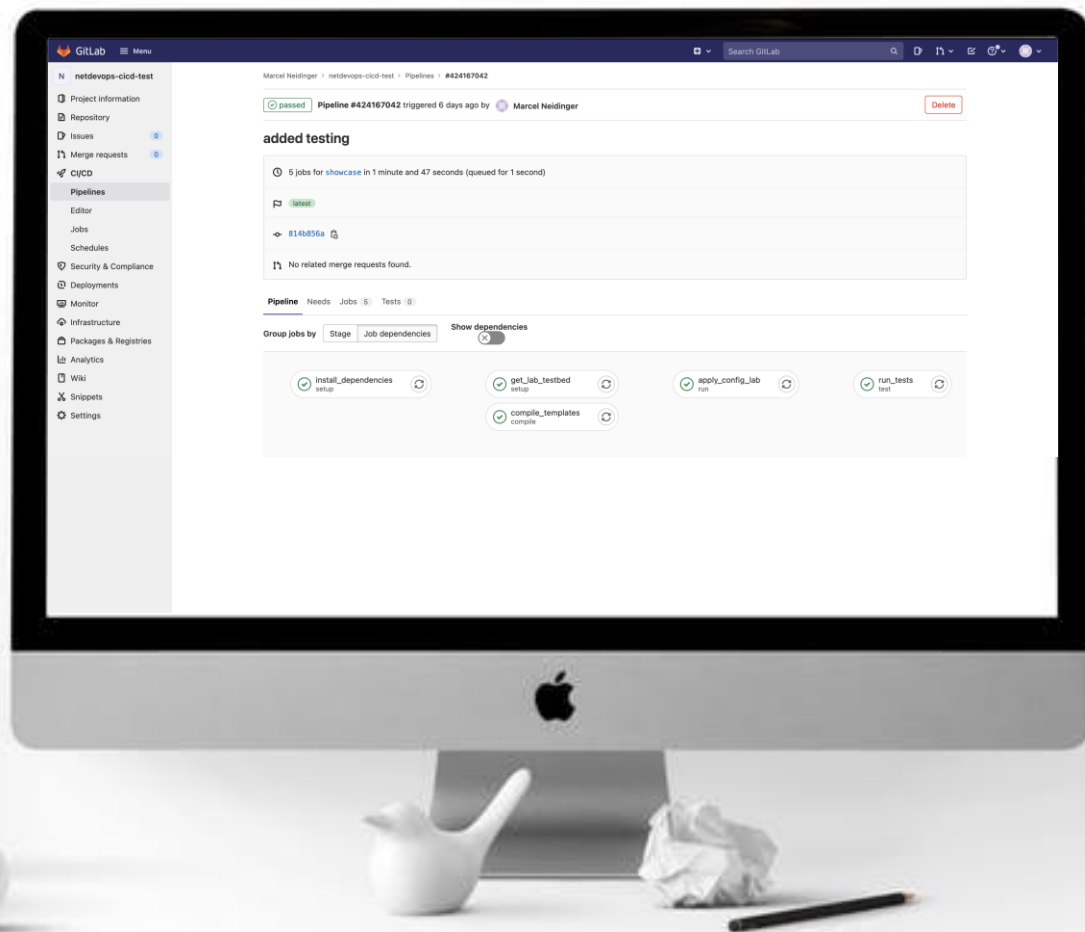
How do we **change**?

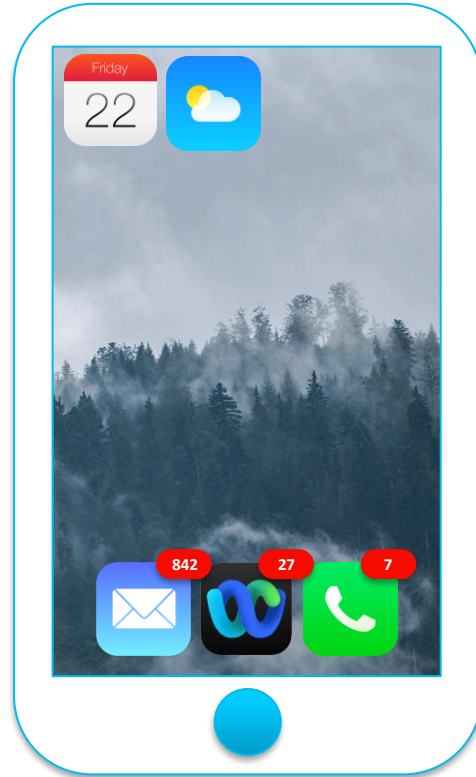
What do we **push**?

How do we **test**?

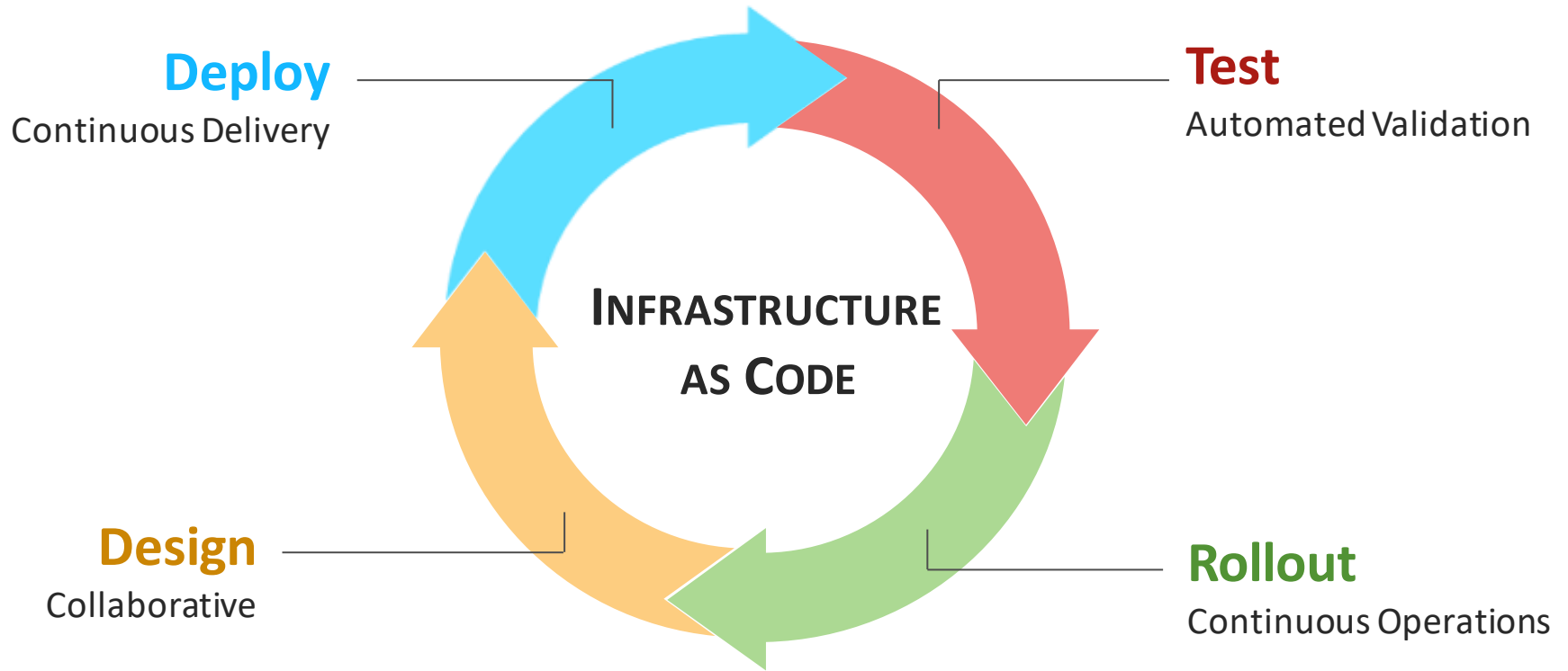
How do we build a **pipeline**?



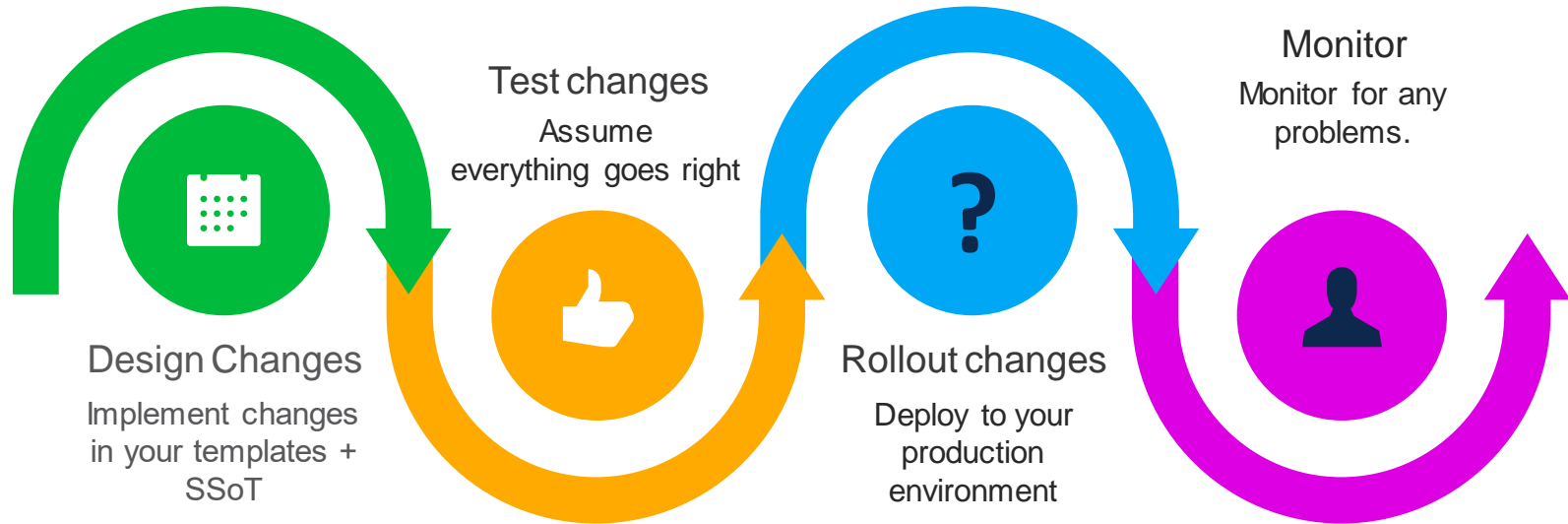




# What is NetDevOps then?



# Steps of a NetDevOps Pipeline



A low-angle photograph of a modern skyscraper with a glass curtain wall. The building's grid of windows is prominent, reflecting the sky. The perspective makes the building appear to rise steeply from the bottom left towards the top right. The sky is a clear, pale blue.

# Single Pane of Glass.



# What do we **want**?



Telegraf  
Telemetry



InfluxDB  
Storage



Grafana  
Visualization

# What do we **want**?



Telegraf  
Telemetry

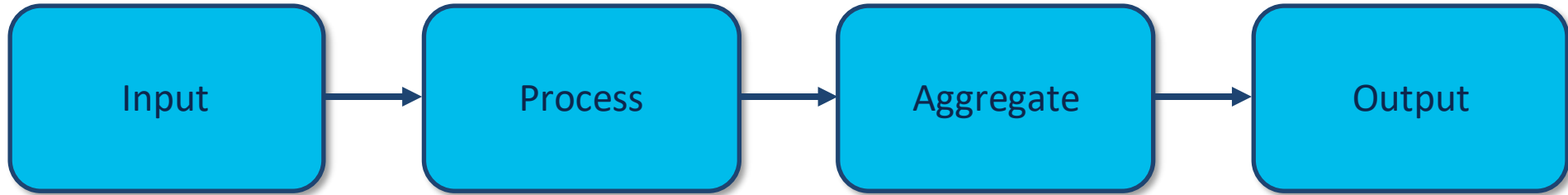


InfluxDB

Storage



Grafana  
Visualization



# What do we **want**?



Telegraf  
Telemetry



InfluxDB

Storage



Grafana  
Visualization

# What do we **want**?



Telegraf  
Telemetry



InfluxDB  
Storage

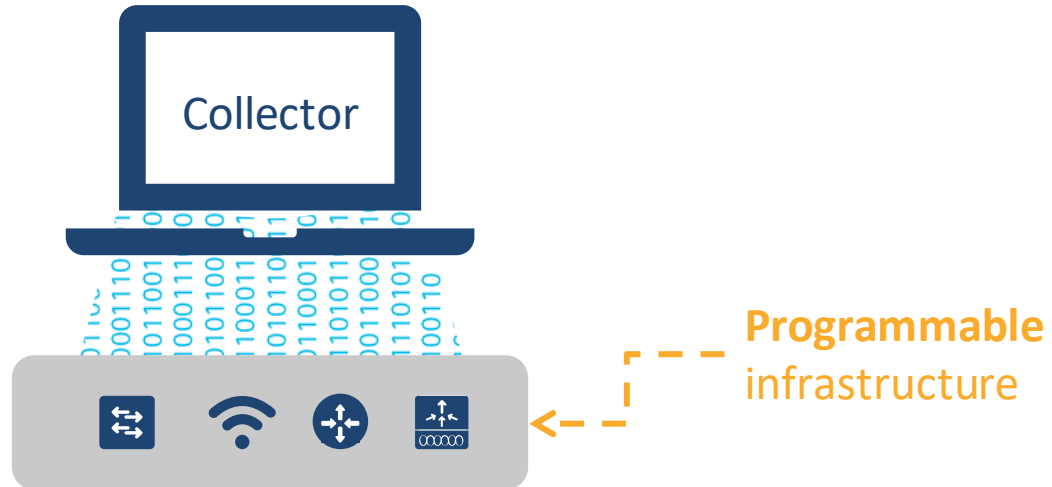


Grafana  
Visualization

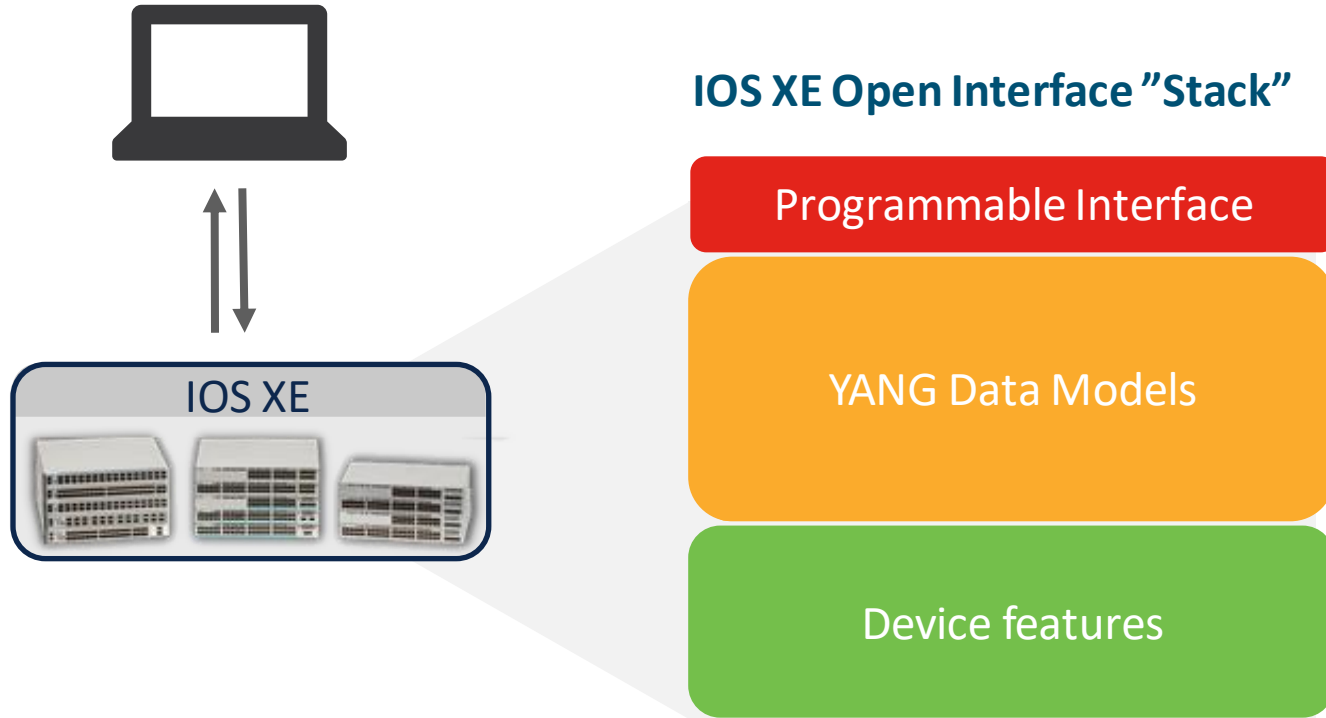
# Streaming telemetry with **IOS XE**

## What is **Streaming Telemetry**?

A mechanism to stream data to a data collector

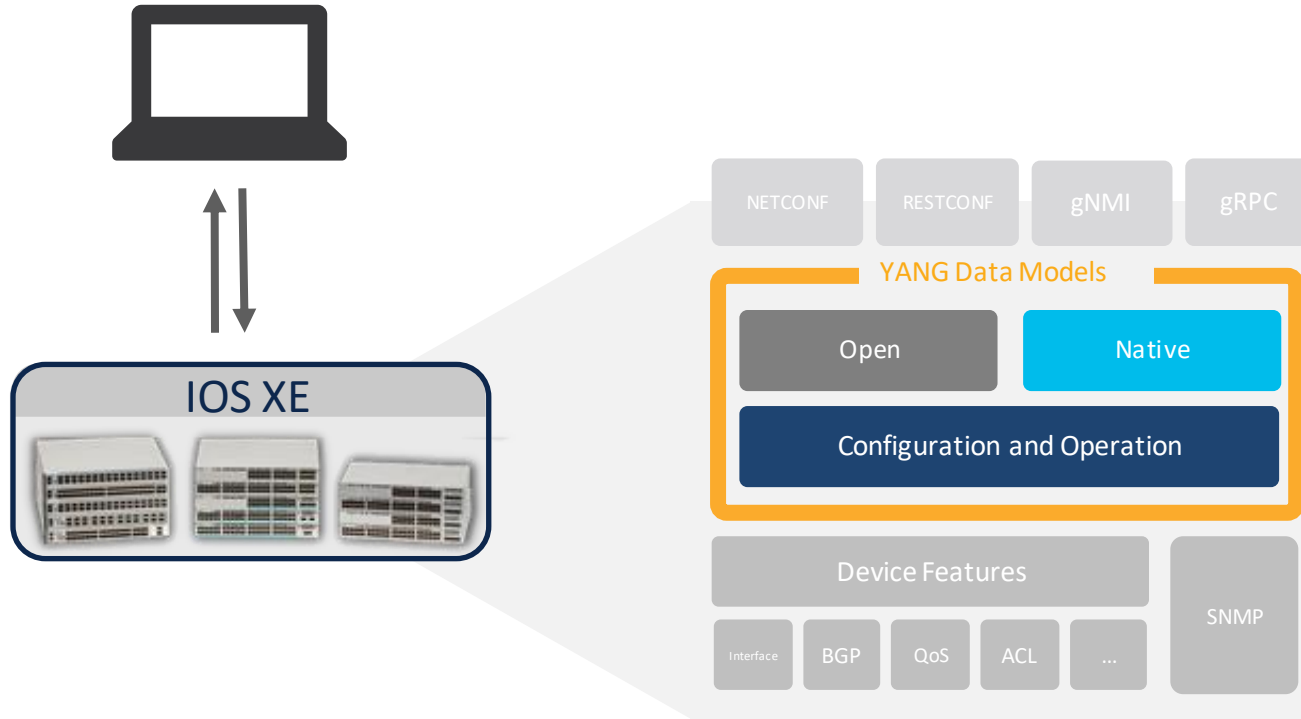


# Model Driven Telemetry on IOS XE





# Data Models

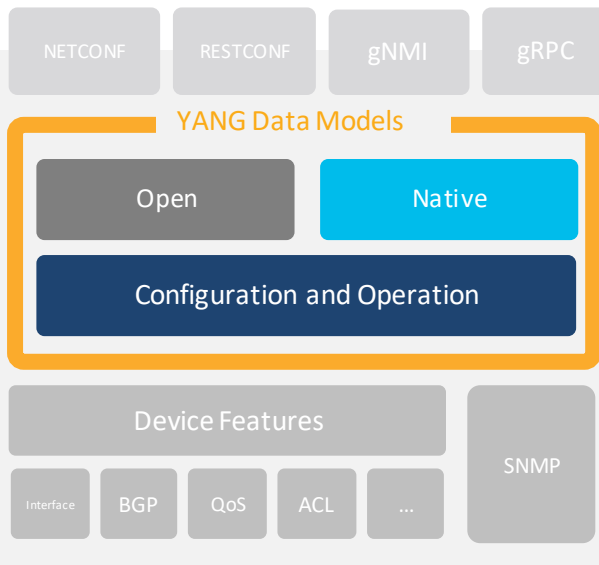


Data Models

# Data Models

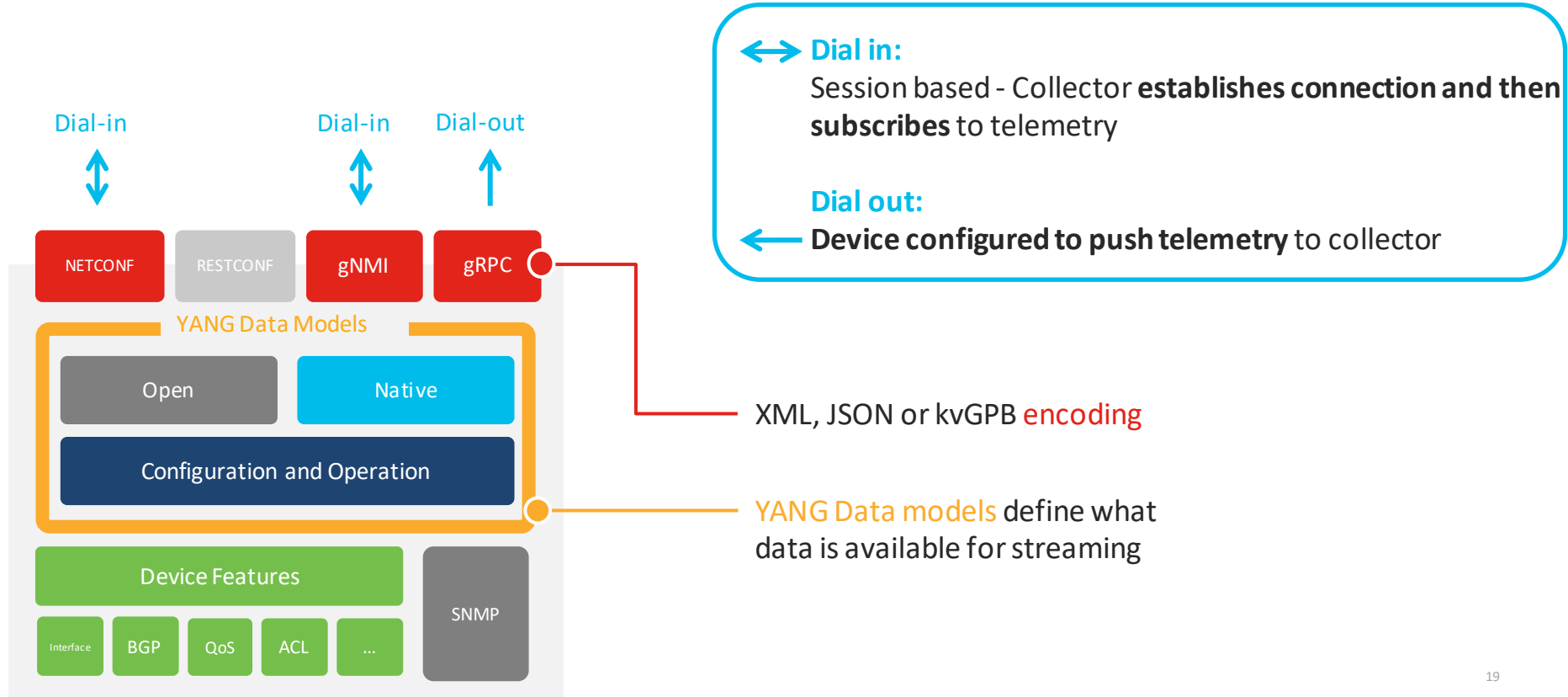
## Structured data

```
module: ietf-interfaces
+--rw interfaces
| +--rw interface* [name]
|   +--rw name          string
|   +--rw description?   string
|   +--rw type           identityref
|   +--rw enabled?       boolean
```

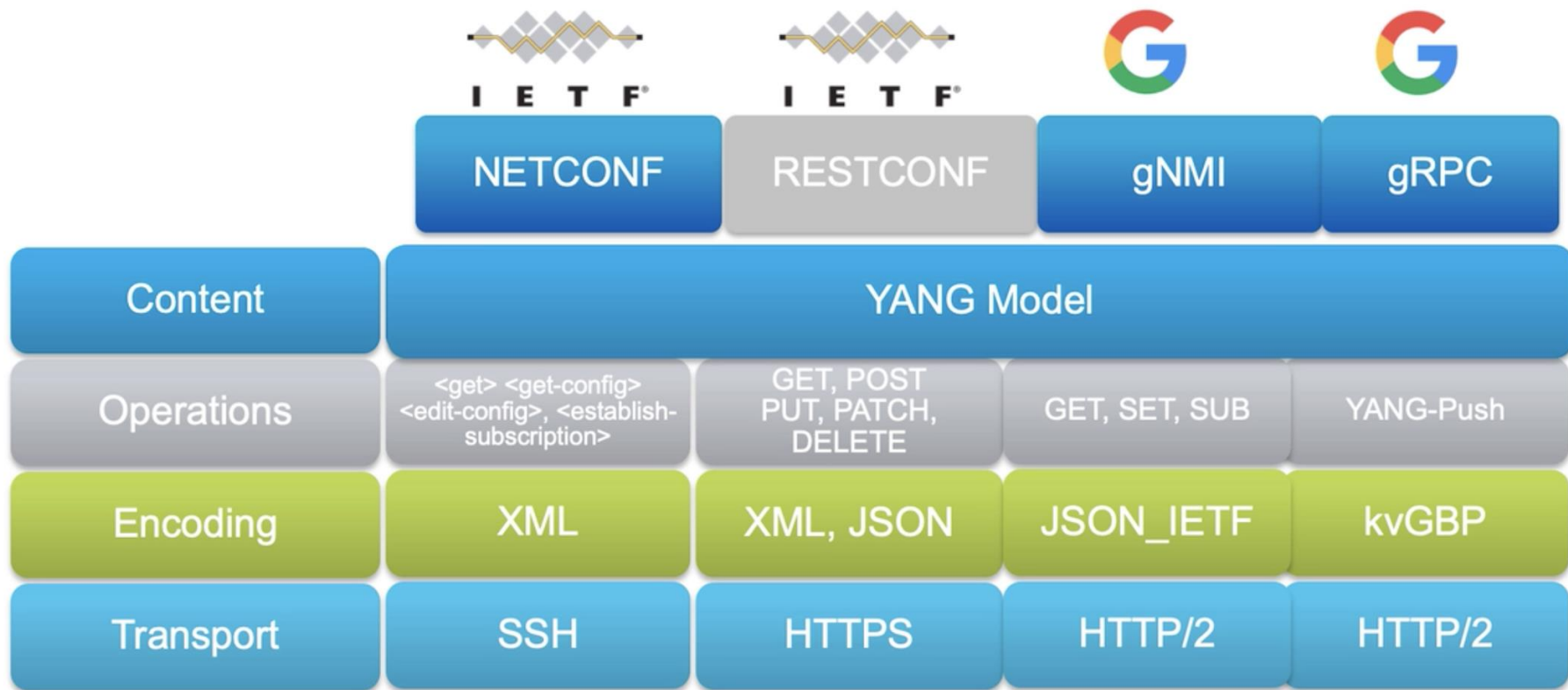


## Data Models

# IOS XE Model Driven Telemetry interfaces



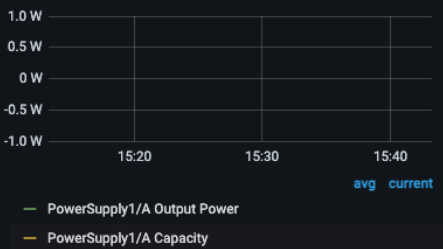
# Telemetry Interfaces



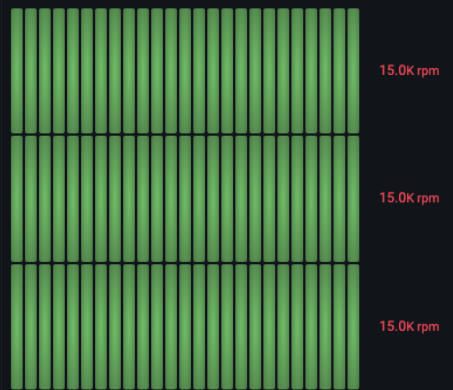
### Last Boot

2020-11-20 03:02:02

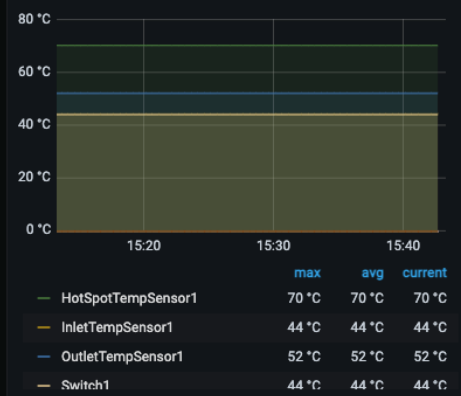
### Power Supply



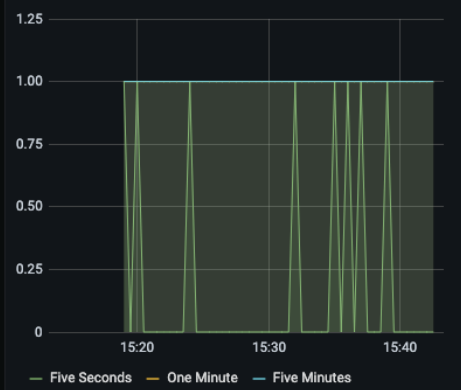
### Fan Speed



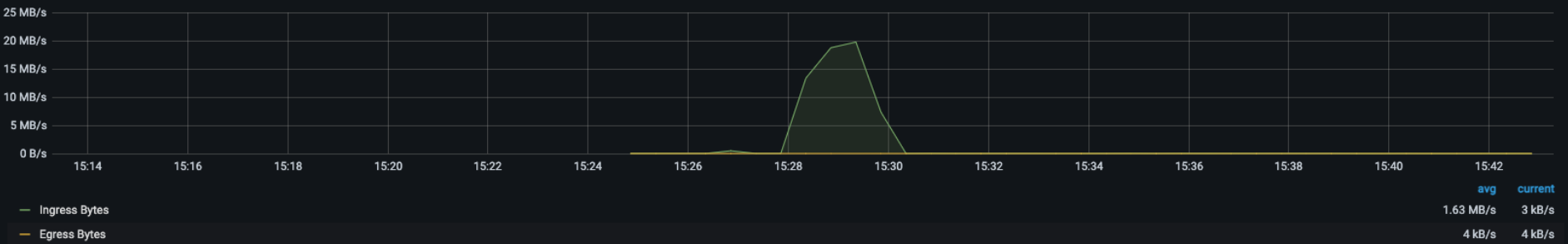
### Temperature



### CPU



### Throughput



### Egress Bytes



### Ingress Bytes



SOURCE All ▼ NAME All ▼ VRF All ▼

## Health

Version

17.3

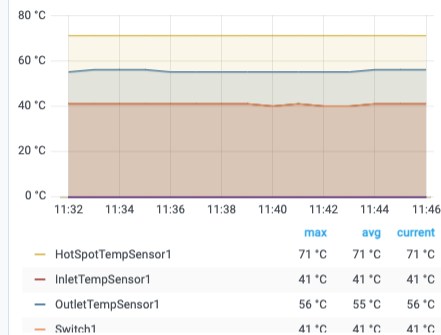
Last Boot

2021-02-16  
12:42:13

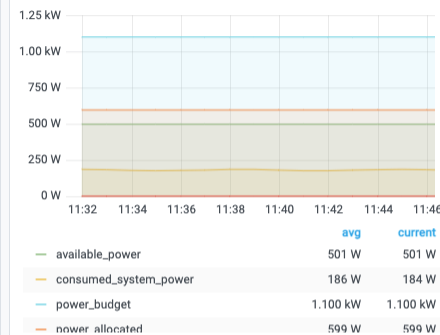
Fan Speed



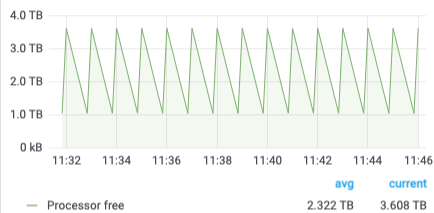
Temperature



Power



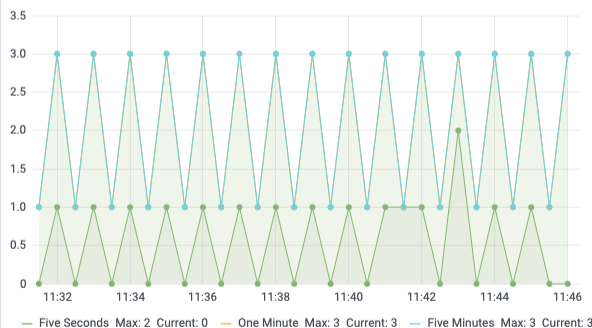
Memory



Memory



CPU



CDP

device_name	ip_address	local_intf_name	mgmt_address	port_id	platform_name
APD478.9B49.26E8	10.1.1.1	TwoGigabitEthernet1/0/3	10.1.1.1	GigabitEthernet0	cisco C9115AXI-B
SKYHAWK	202.54.22.54	TwoGigabitEthernet1/0/1	202.54.22.54	GigabitEthernet0/0/1	cisco ISR4321/K9
RACK3-CAT38-14-Cloud	202.54.22.57	GigabitEthernet0/0/0	202.54.22.57	TenGigabitEthernet1/0/16	cisco WS-C3850-24XS
APD478.9B49.26E8	10.1.1.1	TwoGigabitEthernet1/0/3	10.1.1.1	GigabitEthernet0	cisco C9115AXI-B
SKYHAWK	202.54.22.54	TwoGigabitEthernet1/0/1	202.54.22.54	GigabitEthernet0/0/1	cisco ISR4321/K9
RACK3-CAT38-14-Cloud	202.54.22.57	GigabitEthernet0/0/0	202.54.22.57	TenGigabitEthernet1/0/16	cisco WS-C3850-24XS
APD478.9B49.26E8	10.1.1.1	TwoGigabitEthernet1/0/3	10.1.1.1	GigabitEthernet0	cisco C9115AXI-B
SKYHAWK	202.54.22.54	TwoGigabitEthernet1/0/1	202.54.22.54	GigabitEthernet0/0/1	cisco ISR4321/K9
RACK3-CAT38-14-Cloud	202.54.22.57	GigabitEthernet0/0/0	202.54.22.57	TenGigabitEthernet1/0/16	cisco WS-C3850-24XS

&gt; IP MAC ARP - Client Health (2 panels)

&gt; gRPC MDT Details (1 panel)

&gt; Interface - Cisco Native - Charts (4 panels)

&gt; Interfaces - Cisco Native - Data Table (1 panel)

&gt; IETF Interfaces (3 panels)

# Taa-daa!

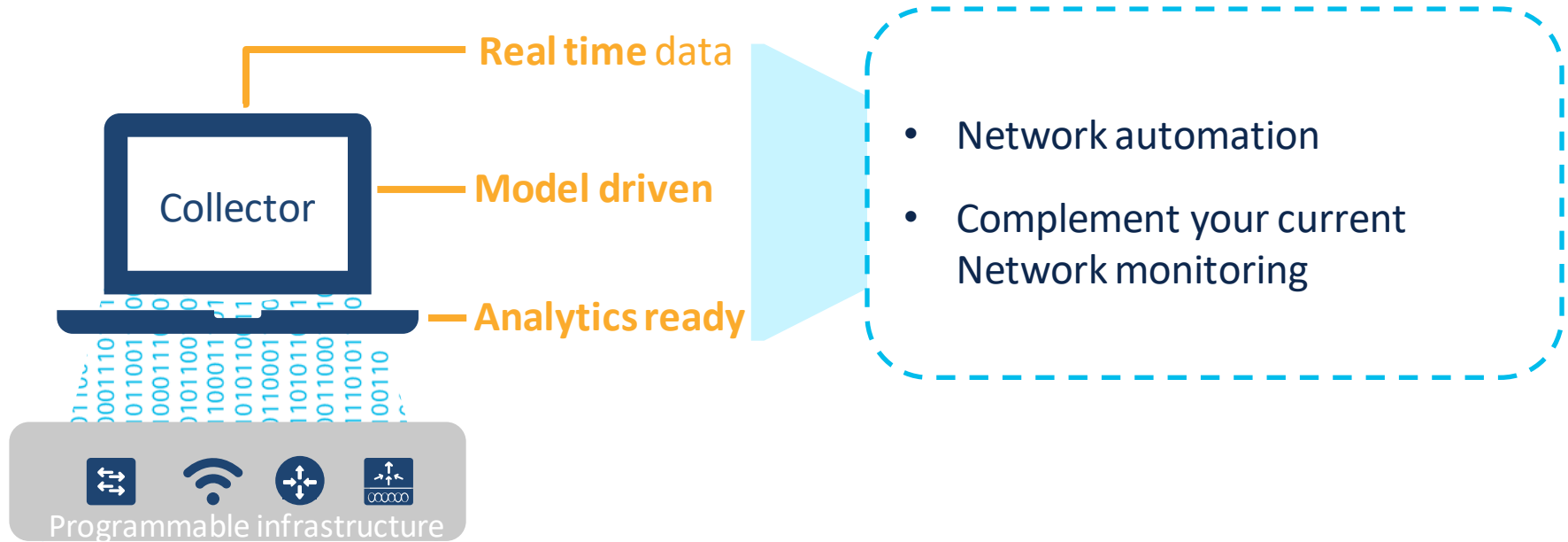


Choose **what** to stream

Choose **how often**

Choose **where to** stream to

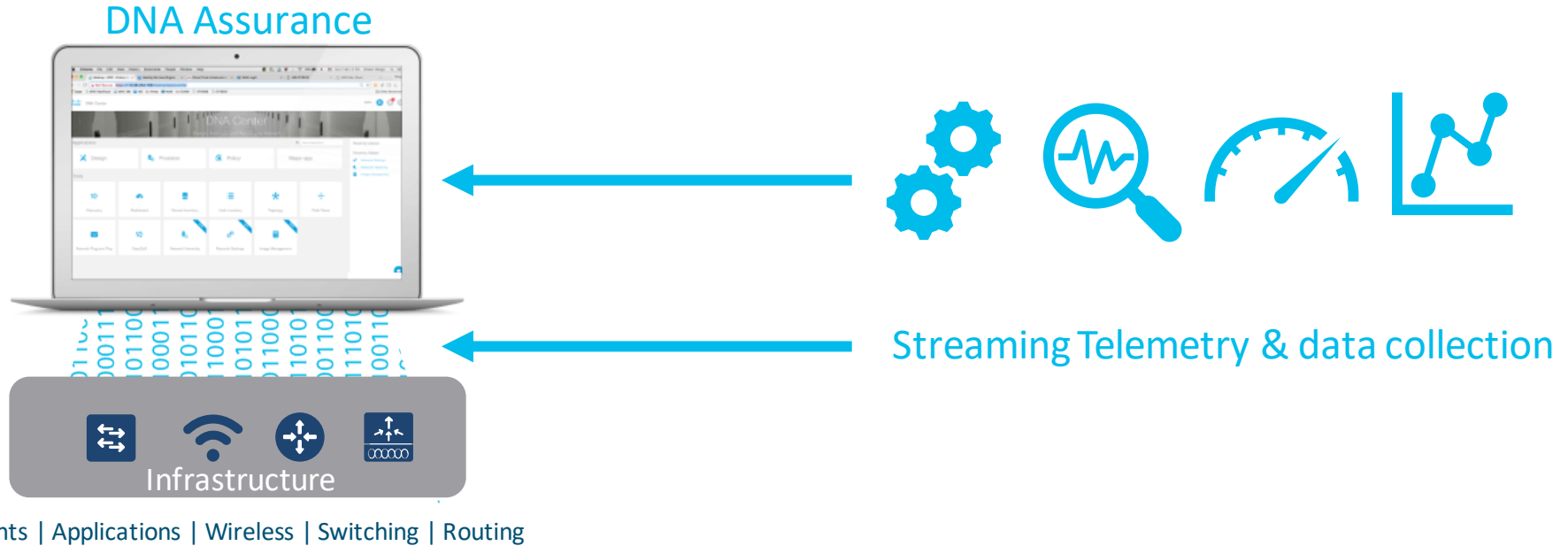
# Why Streaming Telemetry?





What if I have a controller like  
**Cisco DNA Center?**

# From data to **insights** with DNA Assurance

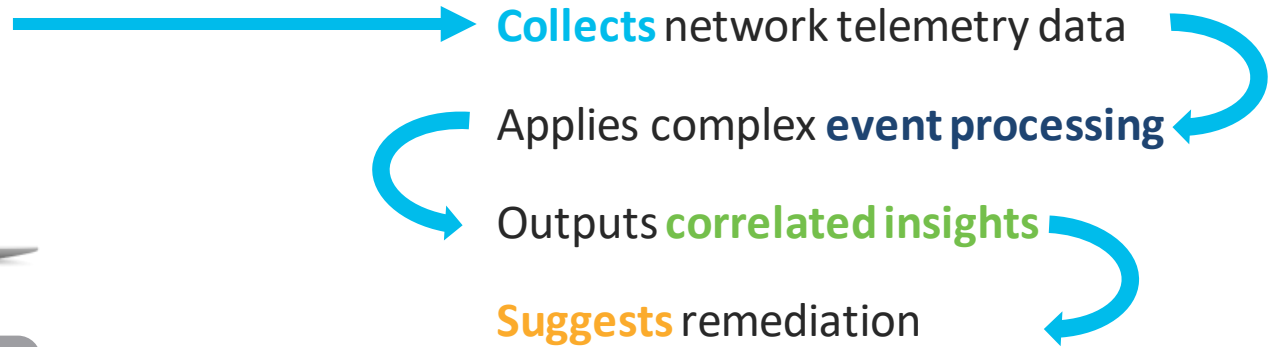


# From data to **insights** with DNA Assurance

## DNA Center Assurance



Clients | Applications | Wireless | Switching | Routing



*Take these insights **anywhere!***

# Take these insights *anywhere!*

## DNA Center Assurance



## Northbound REST APIs

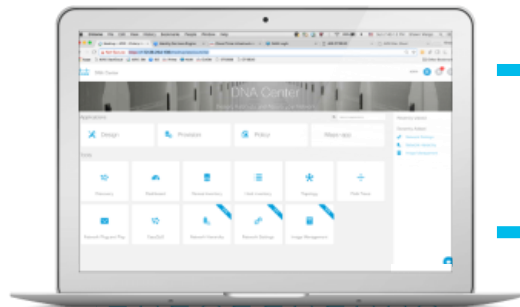
APIs

Authentication	<b>Authentication</b> Authentication APIs provide an authorized token for accessing any REST API. <b>Prerequisite:</b> Add the request header "x-auth-token" with the generated authorized token to get a successful API response.			
> Know Your Network	Method	Name	Description	URL
> Site Management	POST	Authentication API	API to obtain an access token. The token obtained using this API is required to be set as value to the X-Auth-Token HTTP header for all API calls to Cisco DNA.	/auth/token
> Connectivity	<b>Know Your Network</b> Know your Network APIs can be used to discover details about clients, sites, topology and devices. It also provides programmatic REST APIs to add devices to			
> Operational Tasks	<b>Sites</b>			
> Policy	Method	Name	Description	URL
Event Management	POST	Assign Device To Site	Assigns list of devices to a site	/sites/{siteId}/devices
	GET	Get Site Health <sup>Prereq</sup>	Returns Overall Health information for all sites	/site-health
	POST	Create Site <sup>Prereq</sup>	Creates site with area/building/floor with specified hierarchy	/site
	GET	Get Site <sup>Prereq</sup>	Get site with area/building/floor with specified hierarchy	/site
	GET	Get Site Count <sup>Prereq</sup>	API to get site count	/site/count

Clients | Applications | Wireless | Switching | Routing

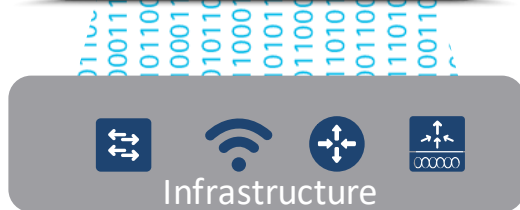
# Take these insights *anywhere!*

## DNA Center Assurance



Subscribe to **events**

Get the **insights**



Clients | Applications | Wireless | Switching | Routing

# Take these insights *anywhere!*

## DNA Center Assurance

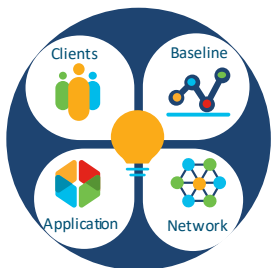


→ **Subscribe to events**

→ **Get the insights**

Clients | Applications | Wireless | Switching | Routing

## Correlated insights



- **WLC Reboot Crash**
- **AP Reboot Crash**
- **Switch Fan Failure**
- **Stack Member Removal**
- ...

## Webhook



```
{
  "id": "E-COMPLIANCE-SWIM-085aed61-9bfc-4545-9008-70a8ee6b8532-1525976460",
  "name": "WLC Reboot Crash",
  "category": "Warn",
  "type": "Network",
  "severity": "P2",
  "status": "New",
  "timestamp": "2018-05-10 22:50:42",
  "workflowIndicator": "Problem",
  "description": "This WLC CAMP1-D2-WLC1 has rebooted due to a hardware or software crash.",
  "domain": "WLC",
  "source": "DNAC Assurance",
  "actualServiceId": "78:da:6e:8a:c6:60",
  "enrichmentInfo": {
    "connectedDevice": [
      {
        "deviceDetails": {
          "type": "Cisco 5508 Wireless LAN Controller",
          "family": "Wireless Controller",
          "inventoryStatusDetail": "<status><general code=\\\"SUCCESS\\\"/></status>",
          "series": "Cisco 5500 Series Wireless LAN Controllers",
          "macAddress": "78:da:6e:8a:c6:60",
```

JSON

## Application REST Endpoint



**webex**  
by **CISCO**  
**Cisco Webex**  
**BOT**



DNAC\_Notification

# Subscribe to Events in Cisco DNA Center

Cisco DNA Center

DESIGN

POLICY

PROVISION

ASSURANCE

PLATFORM

Overview

Manage ▾

Developer Toolkit ▾

Runtime Dashboard

Events

[Subscribe](#)

☐

Event ID ▾

APIs

Integration Flows

Data and Reports

Multivendor Support

Events

Description

☐

NETWORK-DEVICES-2-152

WLC has rebooted due to a hardware or software crash

☐

NETWORK-DEVICES-2-153

[WLC Power Supply Failure](#)

Power supply has failed on this WLC

☐

NETWORK-DEVICES-2-201

[Switch Power Failure](#)

Power supply failure on switch

☐

NETWORK-DEVICES-2-202

[Device Reboot Crash](#)

Device has rebooted due to a hardware or software crash

☐

NETWORK-DEVICES-2-152

[WLC Reboot Crash](#)

☐

NETWORK-DEVICES-2-153

[WLC Power Supply Failure](#)

☐

NETWORK-DEVICES-2-201

[Switch Power Failure](#)

☐

NETWORK-DEVICES-2-202

[Device Reboot Crash](#)

☐

NETWORK-DEVICES-2-204

[Stack Member Running Incompatible](#)

☐

NETWORK-DEVICES-2-205

[Switch Fan Failure](#)

☐

NETWORK-DEVICES-3-103

[AP CPU High Utilization](#)

☐

NETWORK-DEVICES-3-104

[AP Memory High Utilization](#)

☐

NETWORK-DEVICES-3-105

[AP Reboot Crash](#)

☐

NETWORK-DEVICES-3-154

[WLC Memory High Utilization](#)

1

Go to Events and choose event

WLC Reboot Crash

Event Details

Active Subscriptions

GENERAL INFORMATION

Description

WLC has rebooted due to a hardware or software crash

Event Id

NETWORK-DEVICES-2-152

Version

1.0.0

Namespace

ASSURANCE

Domain

Know Your Network

Sub Domain

Devices

Type

NETWORK

Category

ERROR

Severity

2

Cisco DNA

dna/assurance/issueDetails?issuelid=\$instancelid\$

Event link

Note

To programmatically get more info see here -  
<https://<ip-address>/dna/platform/app/consumer-portal/developer-toolkit/apis?apid=8684-39bb-4e89-a6e4>

TAGS

ASSURANCE

wlc\_reboot\_crash\_trigger

MODEL SCHEMA

Details

REST Schema

```
1 {
2   "Type": "$eventSource$",
3   "Assurance Issue Priority": "$priority$",
4   "Assurance Issue Details": "This WLC $wlcName$ has rebooted due to a har",
5   "Device": "$eventInqlid$",
6   "Assurance Issue Category": "$category$",
7   "Assurance Issue Name": "WLC $wlcName$ has rebooted due to a hardware or",
8   "Assurance Issue Status": "$status$"
9 }
```

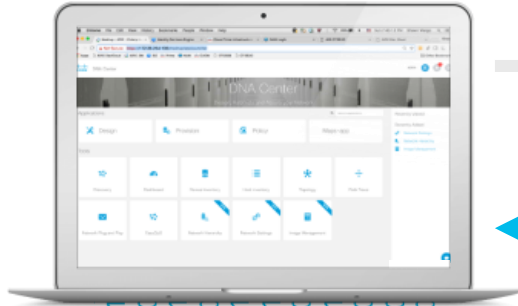
Cancel

Subscribe



# Take these insights *anywhere!*

## DNA Center Assurance



Subscribe to events

Get the insights

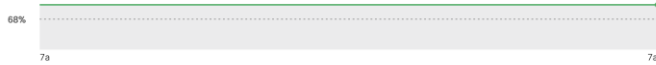


Clients | Applications | Wireless | Switching | Routing

# Client Health

## Wired Clients

LATEST **100%** Healthy CONNECTED: 9



## Wireless Clients

LATEST **83%** Healthy ACTIVE: 6



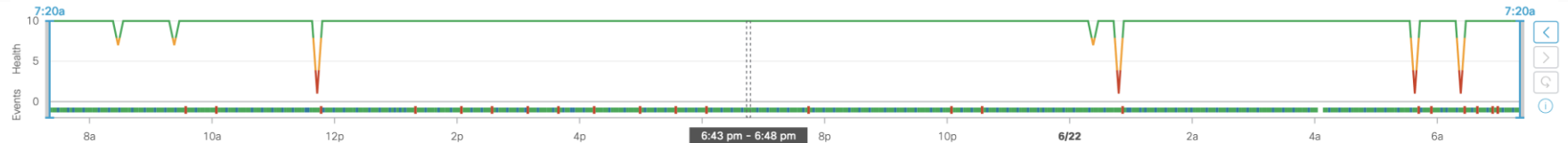
[View Client Health](#)

Monitor and Troubleshoot the Health of All Client Devices

10.100.2.43

24 Hours ▾

[Intelligent Capture](#)



Jun 21, 2021 6:43 PM - 6:48 PM

**Client Health: 10**

\*Only metrics with color code contribute to the Health Score

\* - The KPI is not included for Health Score

### Onboarding

Status Passed

### Connectivity

RSSI -58 dBm  
SNR 36 dB  
Data Rate 400 Mbps  
Tx 891 B  
Rx 626 B  
Retries 0%

### Connection Details

Status Active  
SSID DNAssurance  
AP LAB-8-03  
Channel 100 (40 MHz)  
Band 5 GHz  
Protocol 802.11ac

### Major Events

Intra Roaming 6:47:49 PM  
AP: LAB-8-03  
Onboarding 6:45:54 PM  
Onboarding 6:45:03 PM  
Onboarding 6:43:08 PM

[See Full List](#) (0 Failures, 5 Successes)

# Interactive API Documentation – Developer Toolkit

## Authentication

### Clients

#### ▼ Know Your Network

Sites

Topology

Devices

Clients

Sensors

Users

Applications

Issues

Method	Name	Description	URL
GET	<a href="#">Get Overall Client Health</a> <sup>Intent</sup>	Returns Overall Client Health information by Client type (Wired and Wireless) for any given point of time	/client-health ...
GET	<a href="#">Client Proximity</a> <sup>Intent</sup>	This intent API will provide client proximity information for a specific wireless user. Proximity is defined as presence on the same floor at the same time as...	/client-proximity ...
GET	<a href="#">Get Client Enrichment Details</a> <sup>Intent</sup>	Enriches a given network End User context (a network user-id or end user's device Mac Address) with details about the user, the devices that the user is...	/client-enrichment-details ...
GET	<a href="#">Get Client Detail</a> <sup>Intent</sup>	Returns detailed Client information retrieved by Mac Address for any given point of time.	/client-detail ...

# Interactive API Documentation – Developer Toolkit

≡ Cisco DNA Center

APIs

Integration Flows

Multivendor Support

Events

APIs

Authentication

Know Your Network

Sites

Topology

Devices

Clients

Sensors

Users

Applications

Issues

Clients

Method	Name
GET	Get Overall Client Health <sup>Intent</sup>
GET	Client Proximity <sup>Intent</sup>
GET	Get Client Enrichment Details <sup>Intent</sup>
GET	Get Client Details <sup>Intent</sup>

Get Overall Client Health

DESCRIPTION

Returns Overall Client Health information by Client type (Wired and Wireless) for any given point of time

Method	URL
GET	https://10.101.1.141/dna/intent/apl/v1/client-health

TAGS

API client health

PARAMETERS

Request Query Parameters

Name	Description	DataType	Default Value	Required
timestamp	Epoch time(in milliseconds) when the Client health data is required	string		false

RESPONSES

Response Codes

Code	Message
200	The request was successful. The result is contained in the response body.
400	The client made a request that the server could not understand (for example, the request syntax is incorrect).
401	The client's authentication credentials included with the request are missing or invalid.
404	The client made a request for a resource that does not exist.

Code Preview

Try It

# Take these insights *anywhere!*

## DNA Center Assurance



Clients | Applications | Wireless | Switching | Routing

GET the client health

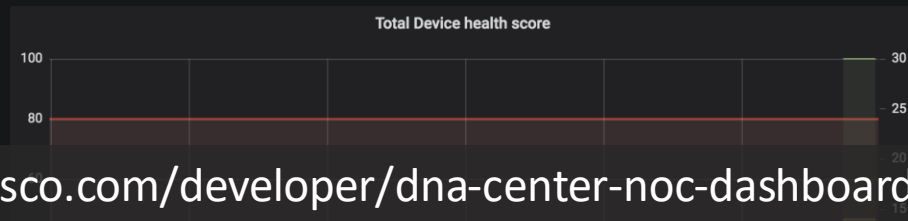
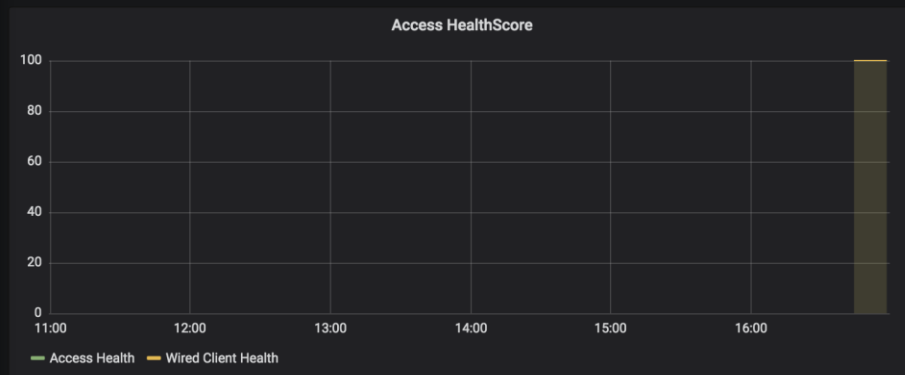
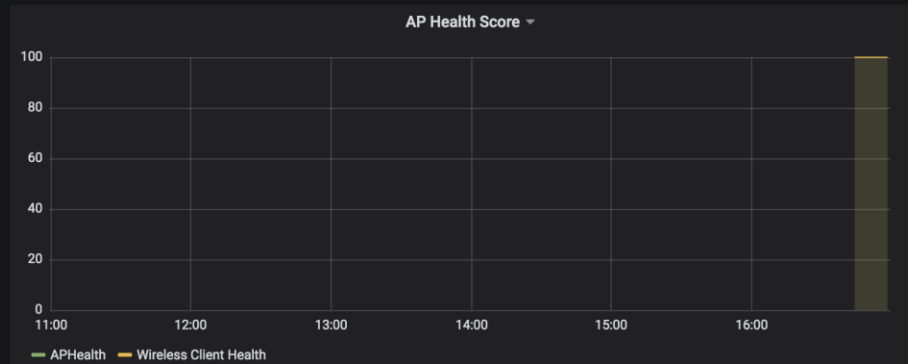
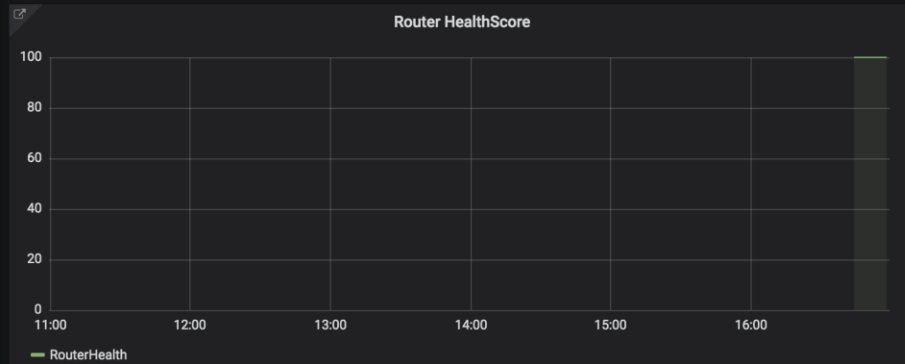
REST API

```
{
  "response": [{
    "siteId": "global",
    "scoreDetail": [{
      "scoreCategory": {
        "scoreCategory": "CLIENT_TYPE",
        "value": "ALL"
      },
      "scoreValue": 86,
      "clientCount": 22,
      "clientUniqueCount": 22,
      "starttime": 1579710960000,
      "endtime": 1579711260000
    }, {
      "scoreCategory": {
        "scoreCategory": "CLIENT_TYPE",
        "value": "WIRED"
      },
      "scoreValue": 94,
      "clientCount": 17,
      "clientUniqueCount": 17,
      "starttime": 1579710960000,
      "endtime": 1579711260000,
      "scoreList": [ { ...
```

JSON

Application  
REST Endpoint

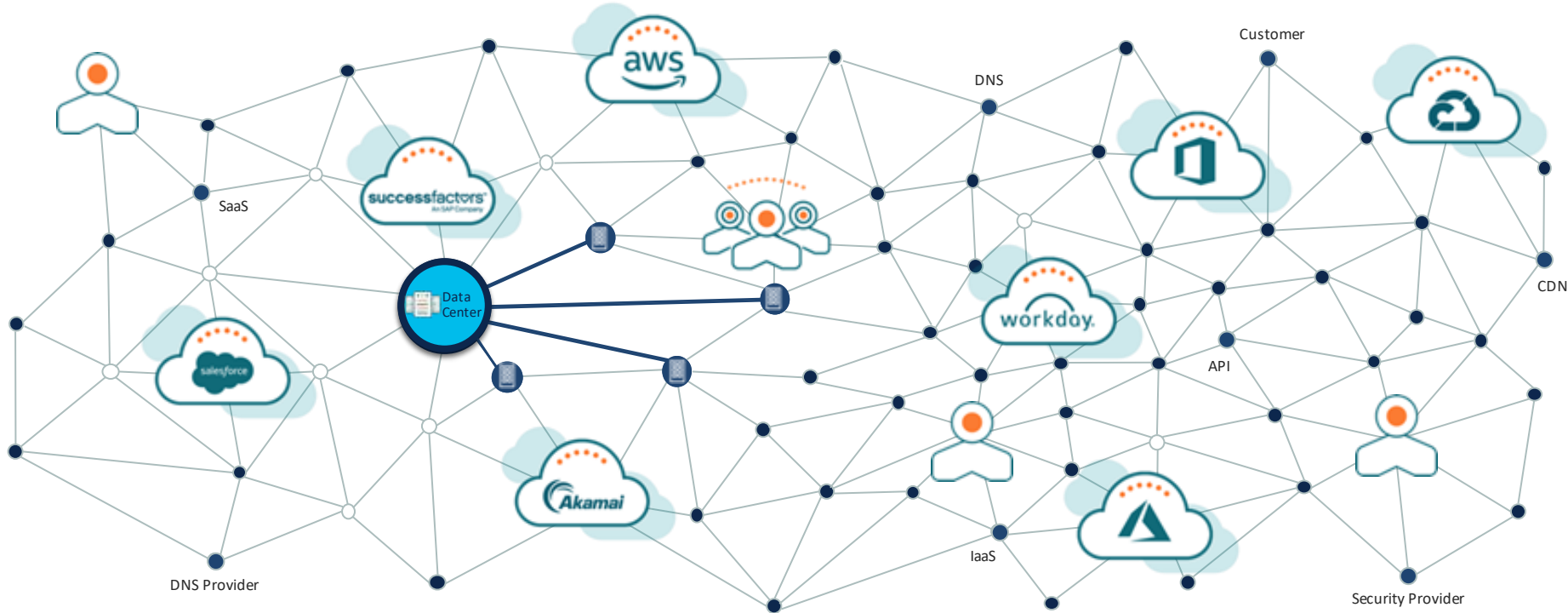
...any other 3<sup>rd</sup> party  
application



View blog at <https://blogs.cisco.com/developer/dna-center-noc-dashboard>

How about **outside of our  
network?**

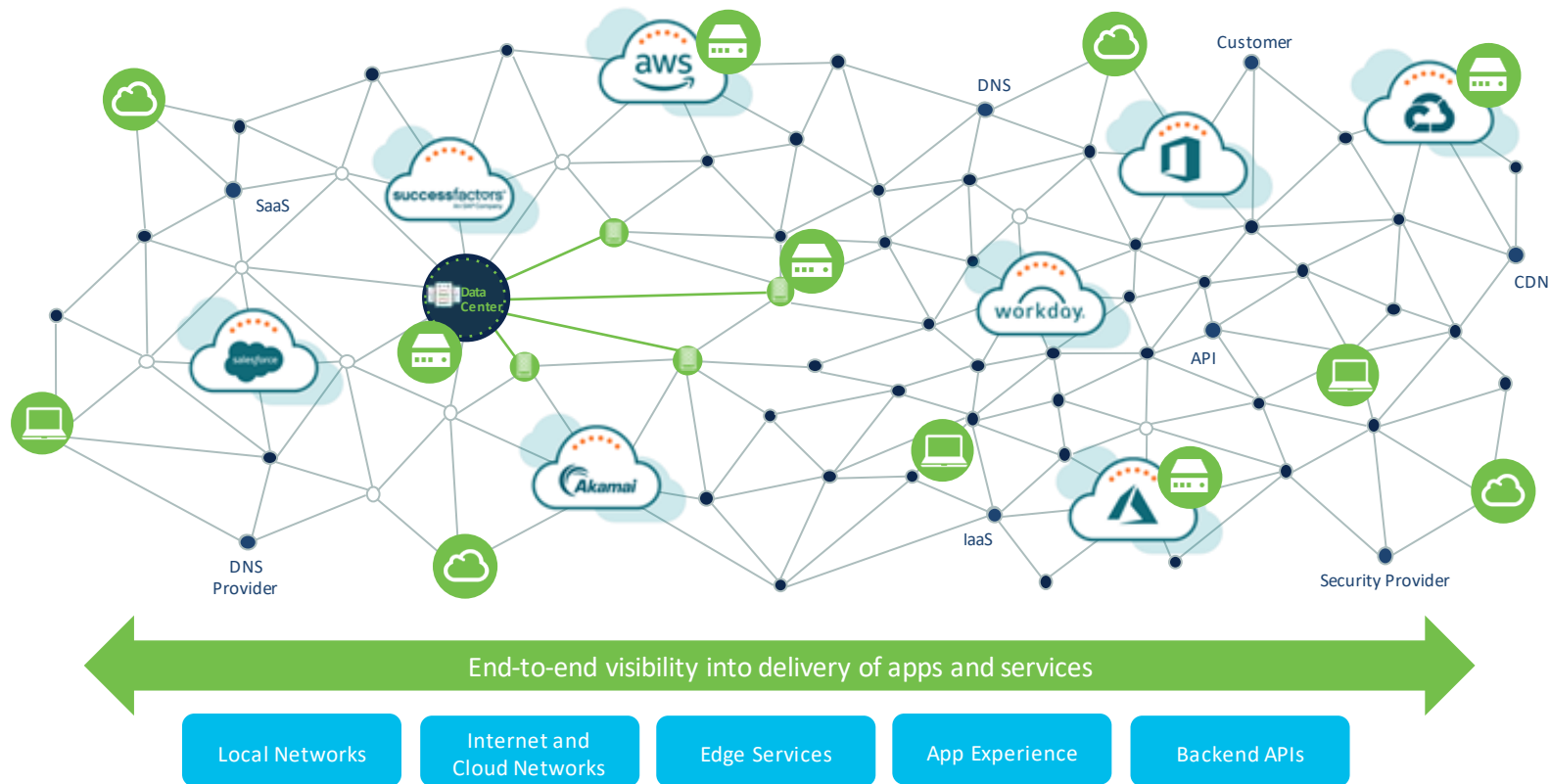
# But Their World Has Changed Dramatically



Internet is the new network | Cloud is the new data center | SaaS is the new application stack



# ThousandEyes enters the picture



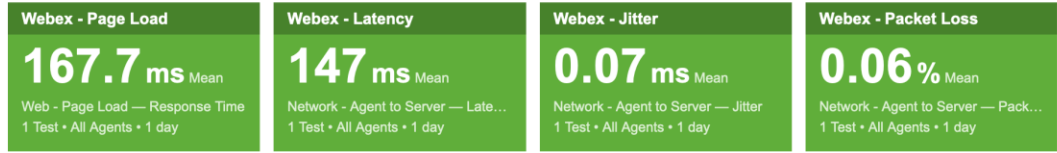
- Cloud & Enterprise Agents >
- Endpoint Agents >
- Devices >
- Internet Insights >
- Dashboards**
- Alerts 2 >
- Reports
- Sharing >
- Account Settings >

Default (CDemo) ▾

Refreshed just now

+ Add Widget ⋮

Webex



Alert List - Webex

1 hour

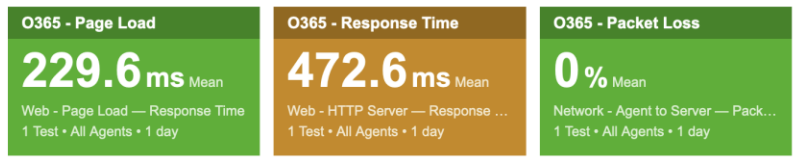
Total Alerts 1 | ● Active Alerts 1

[View All Alerts](#)

↓	Alert Source	Alert Rule	Alert Type	Start Time (UTC)	Duration
●	<a href="https://cisco.webex.com">https://cisco.webex.com</a>	Cloud Latency	Network - Agent to Server	4 days ago	3d 22h 57m 10s

All alerts for the current configuration are visible

O365



I wish this page would...

Current Test

[Settings](#) Agent

[https://cisco.webex.com](#)

Copenhagen, Denmark

Run Now

Save

Share

## Views

### WEB

Page Load

HTTP Server

### NETWORK

Overview

Path Visualization

### ROUTING

BGP Route Visualization

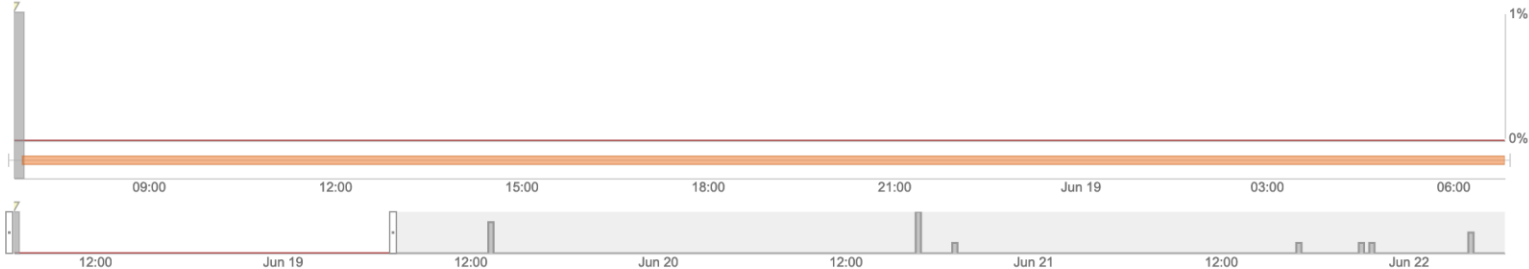
### Target Server

cisco.webex.com:443

Metric

Loss

24h 7d 14d



Showing data from Fri, Jun 18 06:50 - 07:00 UTC (3 days ago)

Latest

## Path Visualization

10 hops

0 hops

Showing: 1 of 1 Test 1 of 1 Agent 1 of 1 Server Hide IP Address labels

Grouping: Agents by Agent Interfaces by IP Address Destinations by Domain

Highlighting: Forwarding Loss > 10 % ( 1 node ) Link Delay > 100 ms ( 0 links )

Selecting: 1 node Alert (1) Info (1) Deselect All

Highlight nodes that match all / any

Search on Network, Country, IP address, Prefix, or Title...



# ThousandEyes Internet and Cloud Intelligence

Real-time  
visualizations

Reports &  
Dashboards

Alerts &  
Notifications

APIs &  
Integrations

**ThousandEyes** 

Cross-correlation & collective intelligence

TESTS

App layer test

Network test

Routing test



**Cloud Agent**

180+ Cities Around the World

ISP | Broadband | Cloud Provider



**Enterprise Agent**

Enterprise Data Centers, Branch Offices & VPCs

Cisco | Docker | JNPR | Linux | MSFT | VMW



**Endpoint Agent**

End-User Laptops and Desktops

Apple | Microsoft

# ThousandEyes APIs



Get the **insights**  
to a 3<sup>rd</sup> party or  
integrate



APIs &  
Integrations

Thousand**Eyes** 

Cross-correlation & collective intelligence



Panel plugin not found: welcome



Install Grafana



Create your first data source



New dashboard



Add users



Explore plugin repository

## Dashboards

Starred dashboards

Recently viewed dashboards

## Latest from the blog



Panel plugin not found: news

View repo at <https://github.com/sttrayno/ASA-TE-Monitoring/>



The bridge to possible