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Day-2 Telemetry

Network Insights for ACI/NX-OS

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Intent Based Networking Group

BRKDCN-2712

cisco Live!
Barcelona | January 27-31, 2020

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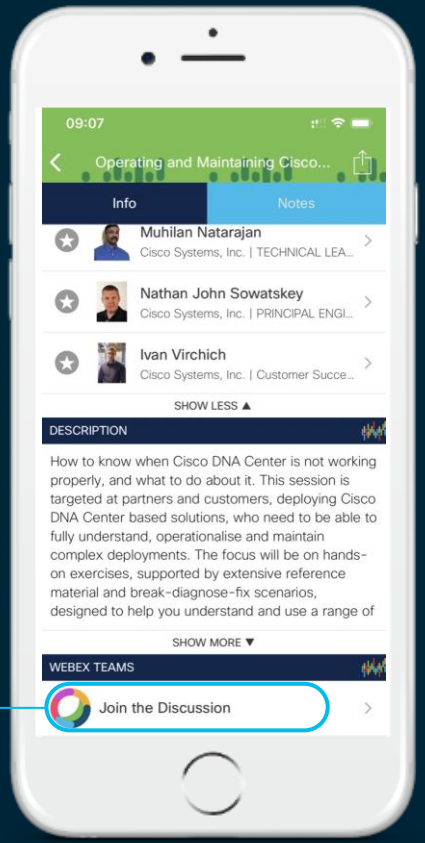

Main Message

“You can't manage what you don’t measure. You can't measure what you don't see”

Session Abstract

The session provides the journey and current state on modern telemetry infrastructure supporting Day 2 operations.

The Cisco's Network Insights offering will provide a common tooling for ACI and NX-OS to efficiently deliver information for Day 2 operations, all built on top of a scale-out micro-services architecture.

In addition to the infrastructure and architecture that enables Network Insights, model based software and hardware telemetry will be put in contrast as well as the various telemetry data consumption models. Where data comes un-throttled from the switches forwarding chip (ASIC), how we receive this mass of information and talk about the benefits, the trade-offs, and challenges across ingestion, retention, correlation, and visualization.
The architecture discussion will be complemented with network telemetry concepts, future directions, and use cases with real-world examples of the concepts, capabilities and key differentiators.

Agenda

- Introduction to Data Center Telemetry
- Operationalizing Telemetry
- Network Insights Use Cases
- Network Insights Resources
- Network Insights Advisor
- Sizing, Demos, Licensing
- Key Takeaways

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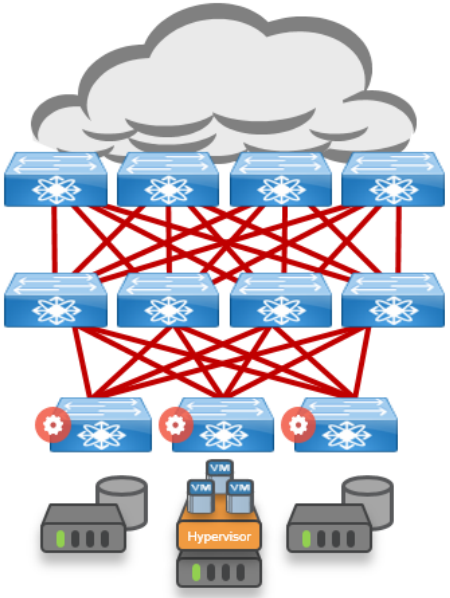
Network Visibility Is Hard



SNMP

Syslog

CLI

- Hard to Operationalize
- Incomplete
- Unstructured
- Device-Specific
- Slow

Why is support asking for access to my setup three times for this issue?

Is my configuration at the supported scale?

If someone else hit this issue and its fixed, why not notify that It could impact me!

How many times do I need to gather these, always rolling over logs to resolve this case?

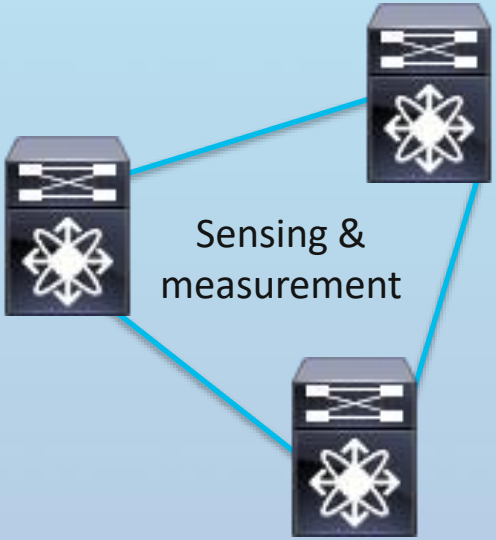
Are my network security patches up to date?

Is the code I'm running since 2016 still recommended?

Are my network resources healthy, underlay/overlay, routing, etc?

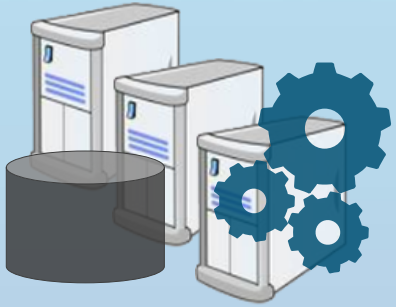
Network Telemetry Frees the Data

Where Data Is Created



As Much Useful Data
As Efficiently as Possible

Where Data Is Useful



Storage &
analysis

Key Telemetry Characteristics

Push not Pull

Efficient Delivery

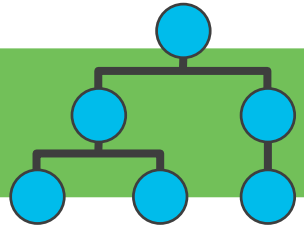
{JSON} JavaScript Object Notation

protobuf Protocol Buffers

GRPC http:// UDP

Analytics-ready Data

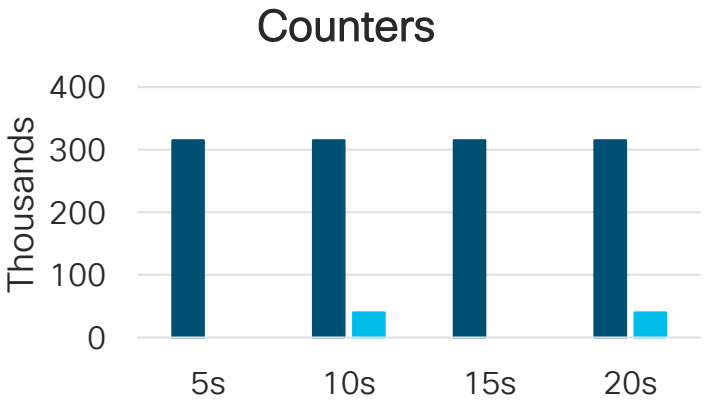
Tool-Chain consumption and Integration

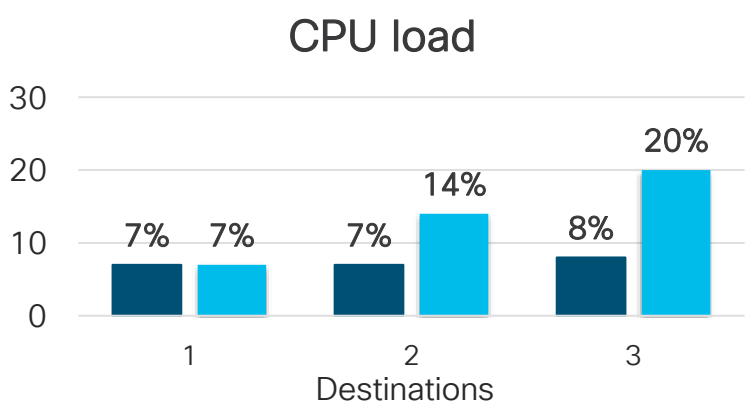


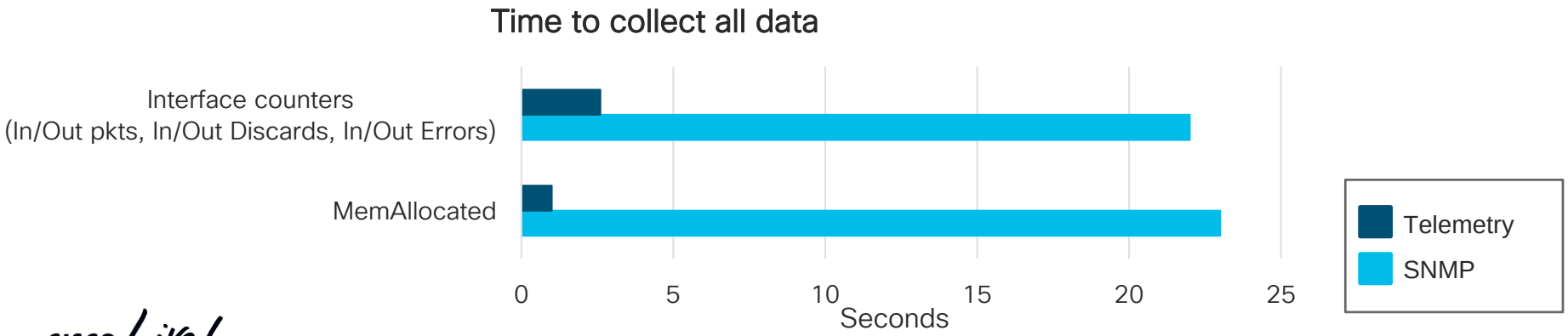
Data-model Driven Consistent format

Structure and Automation

“Pushing” More Data Really Does Work Better







Why This Matters Now

What hasn't changed

Use Cases

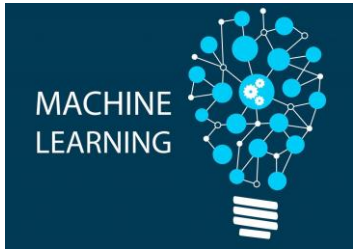
- Network Health
- Anomaly detection
- Troubleshooting / Remediation
- SLAs, Performance Tuning
- Capacity Planning
- Security

What has changed

Trends

- Real time statistics
- Centralized / Software-defined
- Speed
- Scale

Capabilities



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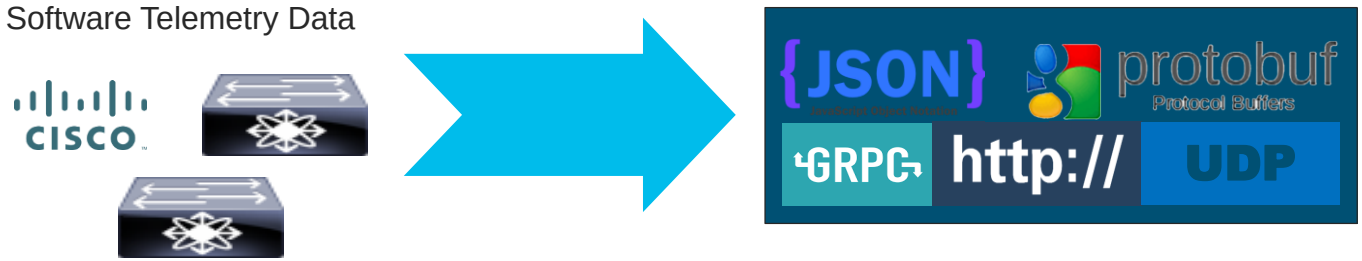
Getting the Information out of the Network

- What are the mechanisms for getting information out of the network? – i.e., “Telemetry Sources”
- This session: Software and Hardware Streaming Telemetry

Nexus Software Telemetry



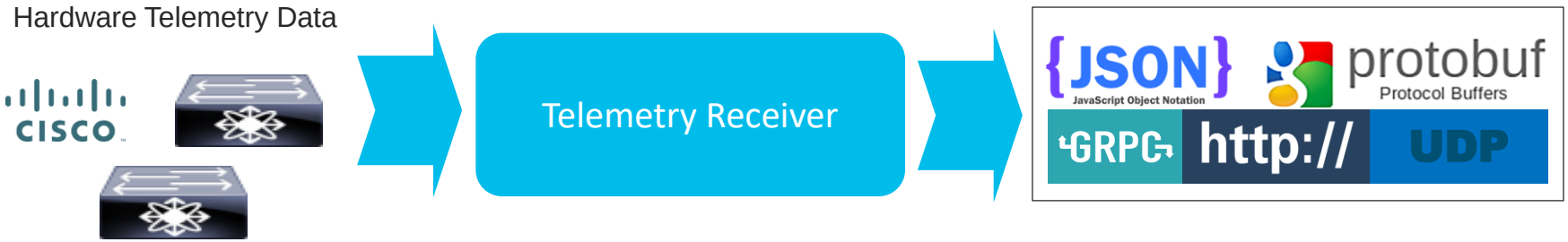
- Provides visibility to control-plane protocol state, environmental info, counters, etc.
- Data retrieved from DME (system object model) or NX-API (structured CLI ouput)
- Limited data-plane visibility, no flow-level visibility
- Not designed for high frequency export

Streaming Software Telemetry Platform Support

Nexus Platform	DME	NX-API	Release
3000 with 8GB+ DRAM	✓	✓	7.0(3)I7(1)
9200/9300	✓	✓	7.0(3)I5(1)
9500	✓	✓	7.0(3)I5(1)
5000/5500/6000	X	X	N/A
7000/7700	X	✓	8.3(1)

ASIC-Specific Telemetry Outputs

- Different ASICs support different hardware telemetry capabilities
- Different hardware telemetry types use different output formats
- No standard in industry (some are evolving)
- Generally requires normalization/conversion into common, structured format for consumption

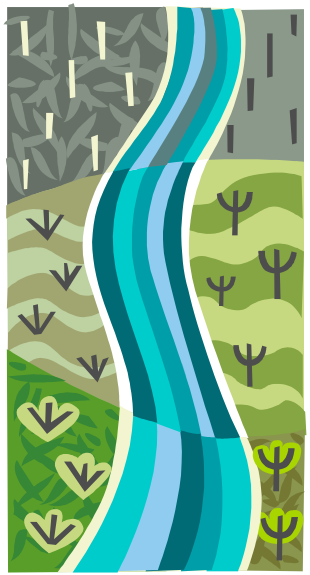


Flow Table (FT)

- Collects full flow information plus metadata
  - 5-tuple flow info
  - Interface/queue info
  - Flow start/stop time
  - Flow latency
- 32K flow table entries per ASIC slice
- Direct hardware export

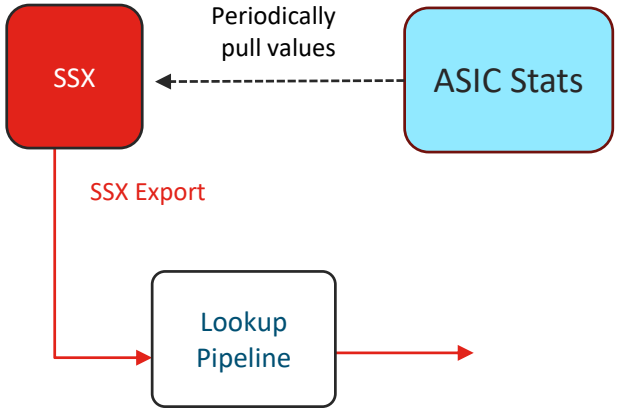
Flow Table Events (FTE)

- Triggers notifications based on criteria / thresholds met by data-plane packet flows
- Collects full flow information plus metadata
  - 5-tuple flow info with timestamp
  - Interface/queue info
  - Buffer drop indication
  - Forwarding drop, ACL drop, policer drop indication
  - Latency/burst threshold exceeded indication
- Direct hardware export, with flow-level and global throttling



Streaming Statistics Export (SSX)

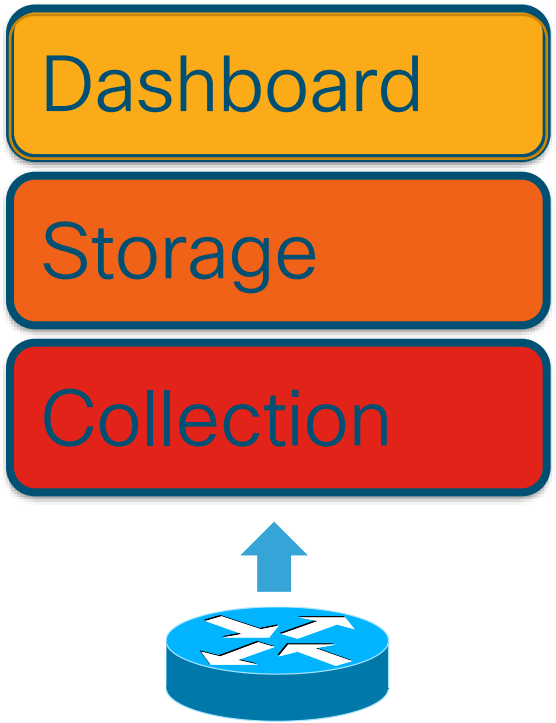
- Streams ASIC statistics at rapid cadence based on user config
  - Interface counters (packets/bytes/drops)
  - Ingress/Egress queue depth
  - Ingress/Egress queue drops
  - Egress queue microbursts
  - Buffer depth
- User defines streaming parameters :
  - which statistics, how often, and to which collector
- Direct export from ASIC to front-panel port



Hardware Telemetry Platform Support

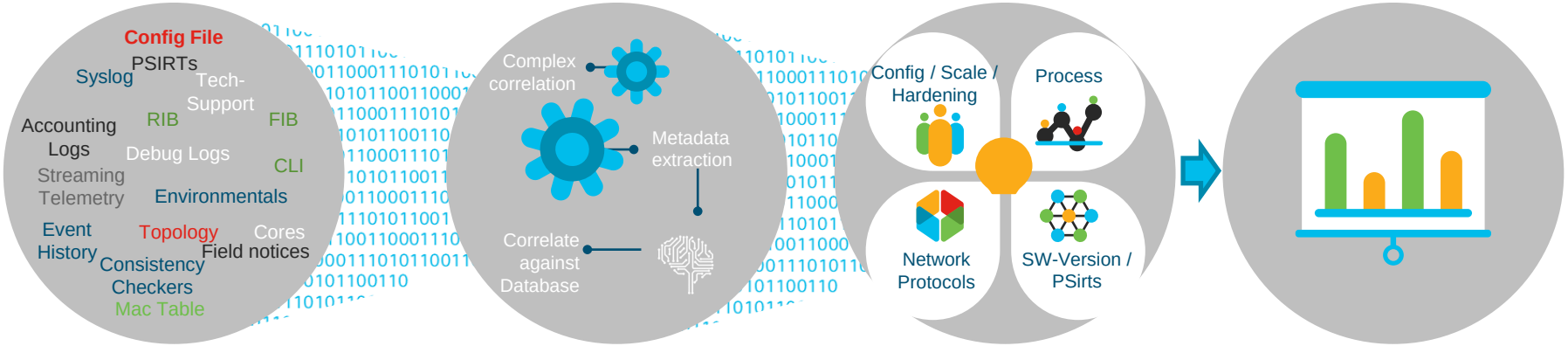
Platform	FT	FTE	SSX
9300/9500-EX	✓	X	X
9300/9500-FX	✓	✓	X
9364C	X	X	✓
9300-FX2	✓	✓	✓
9300-GX	✓	✓	✓

A Very Basic Analytics Platform Architecture



Network Insights – Enabling Proactive Action

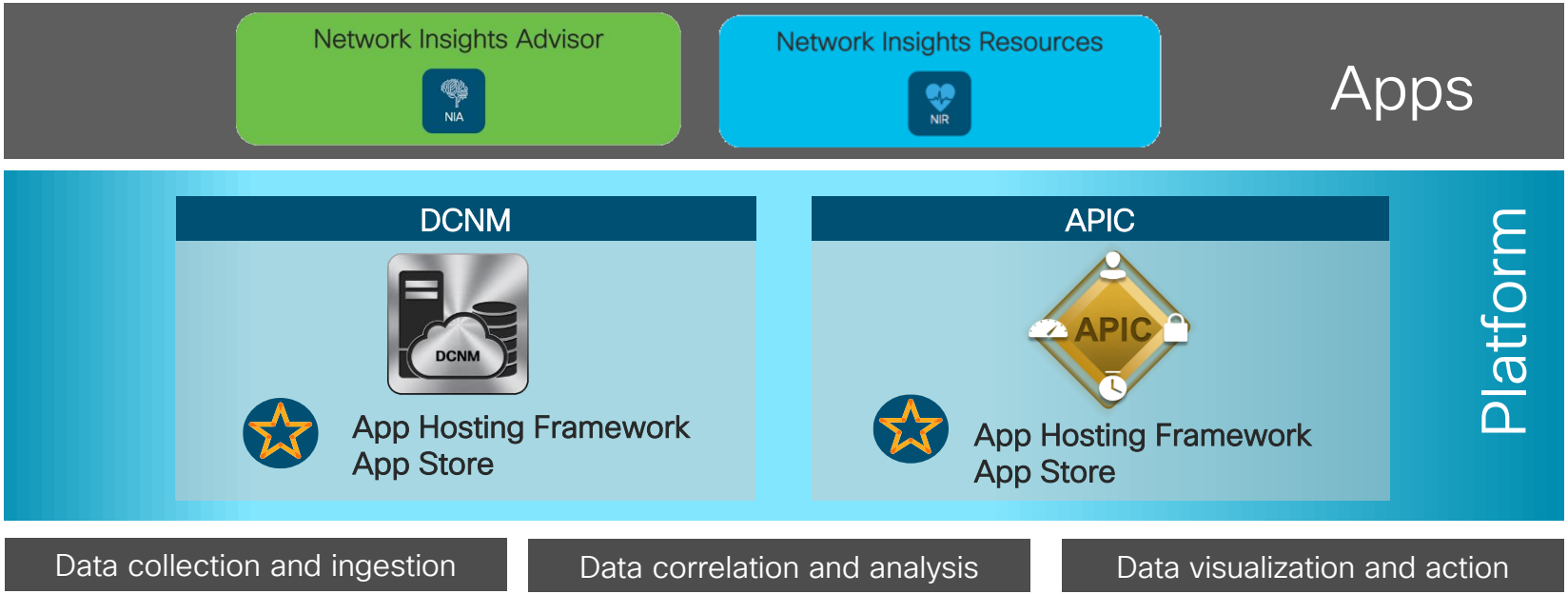
Sources of Telemetry Data | Ingest and Process | Derive Insights | Recommend Action



Increase Availability and Performance

Leverage Knowledge Base of Digitized Known Issues
ACI | NX-OS

Network Insights Applications



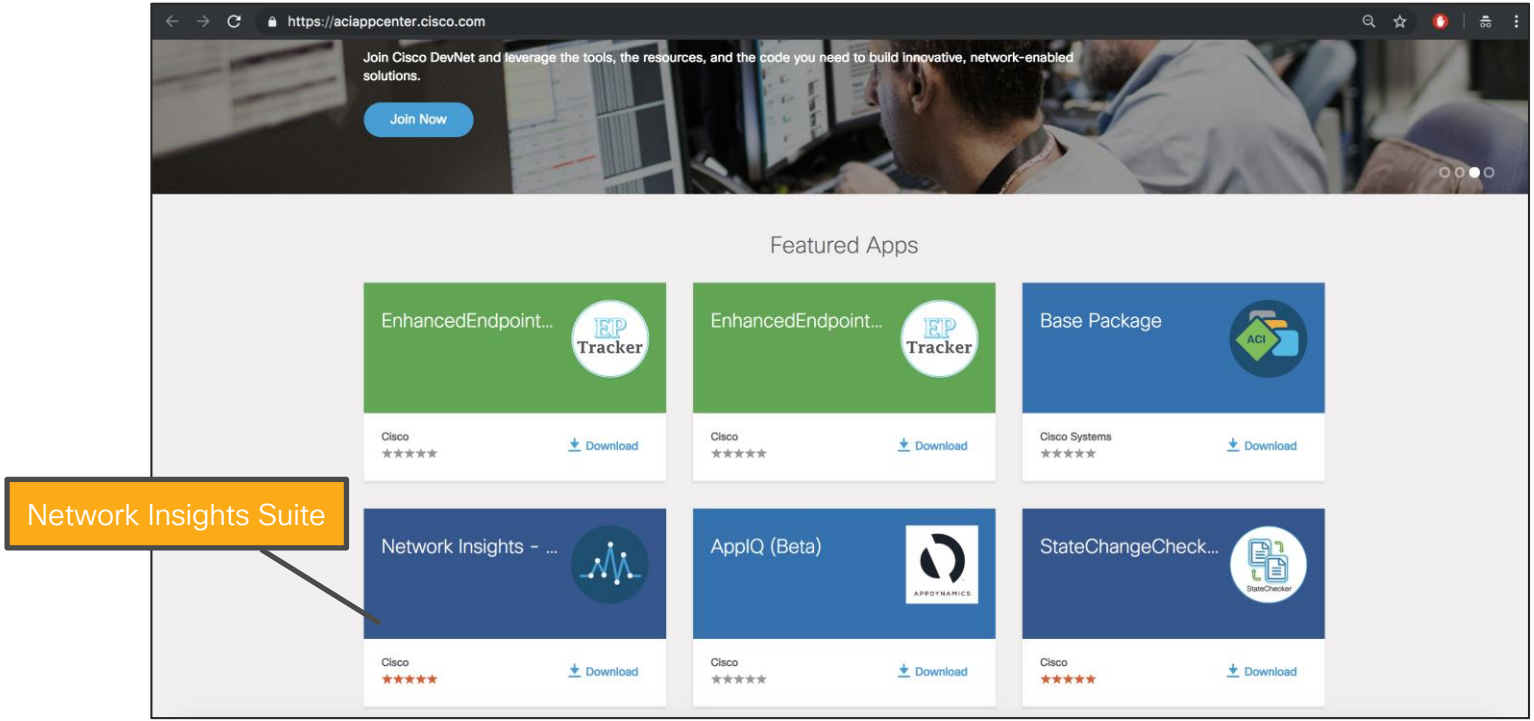
Visibility
Learn from your network and recognize anomalies

Insights
See problems before your end users do

Proactive Troubleshooting
Find root cause faster with granular details

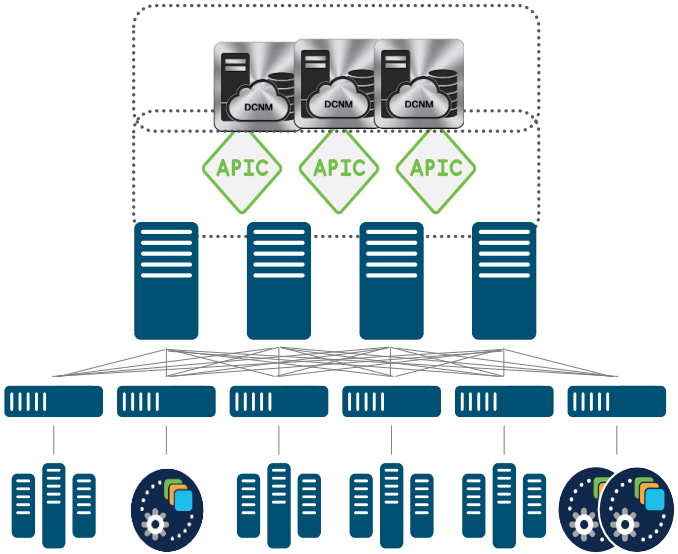
Download application from the App Store

Common App Store for ACI and NXOS – https://dcappcenter.cisco.com/



Network Insights Suite

Day 2 Operations Stack



Network Assurance Engine (NAE)

Network Insights Advisor (NIA)

Network Insights Resources (NIR)

OPSTACK

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Data Center Visibility Use Cases

Network Health

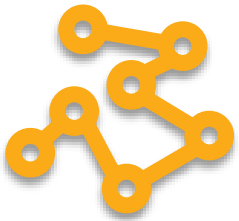
- CPU and memory utilization
- Forwarding table utilization
- Protocol state and events
- Environmental data

Path and Latency Measurement

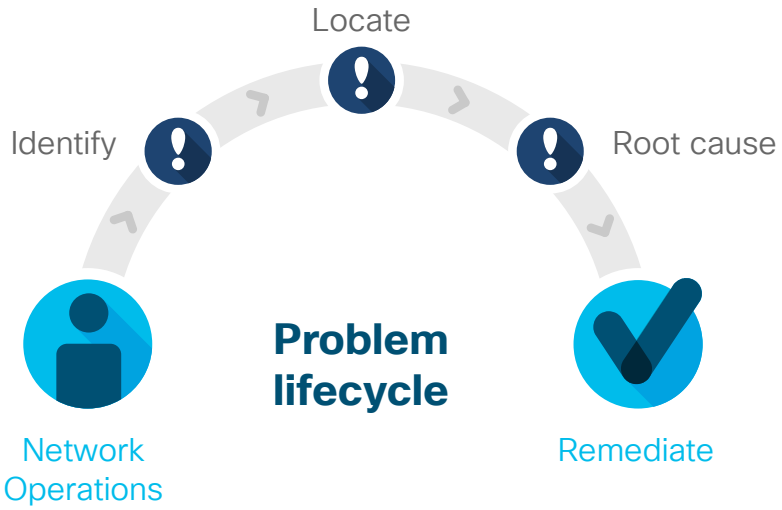
- End-to-end visibility
- Path tracing over time
- Flow latency monitoring

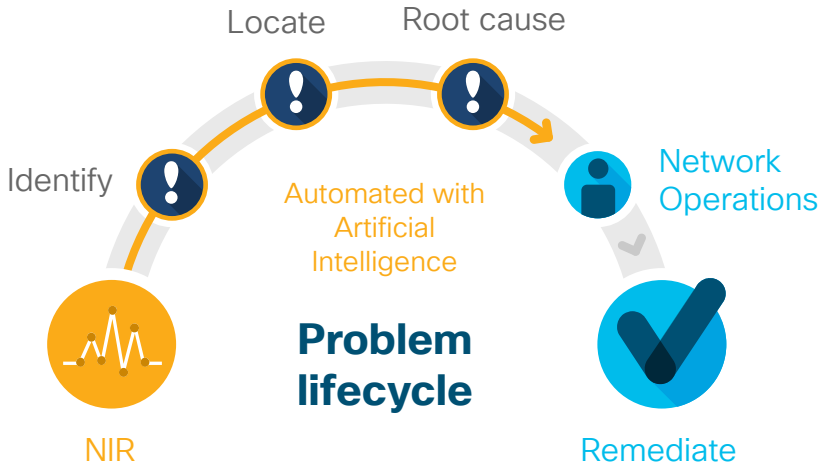
Network Performance

- Interface utilization
- Buffer monitoring
- Microburst detection
- Drop event correlation



Shorten Time to Remediation for Troubleshooting

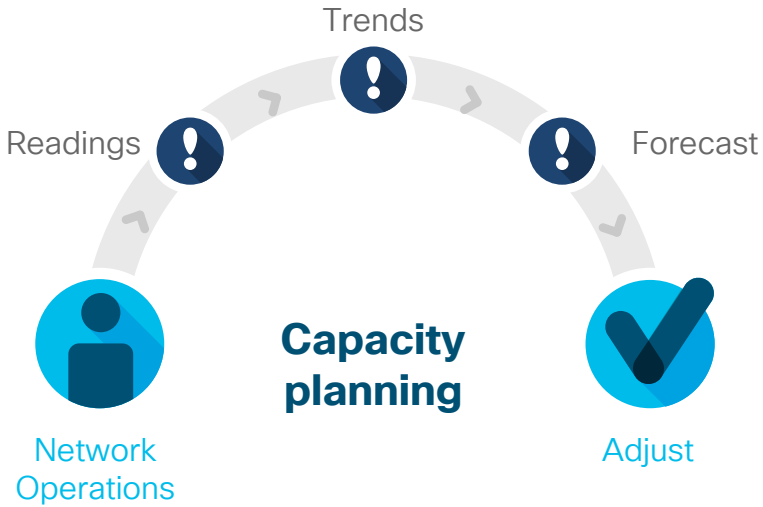


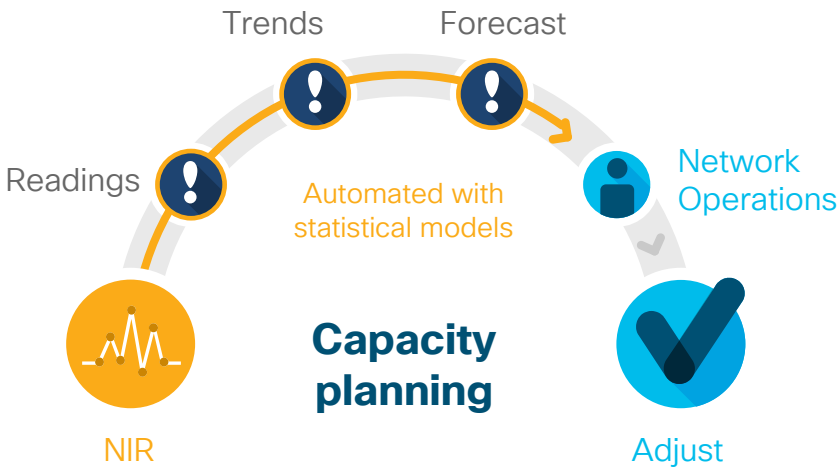


Network Insights:
Resources

Packet drops | Latency | Reachability | Routing | Micro Bursts

Increase Speed and Agility for Capacity Planning

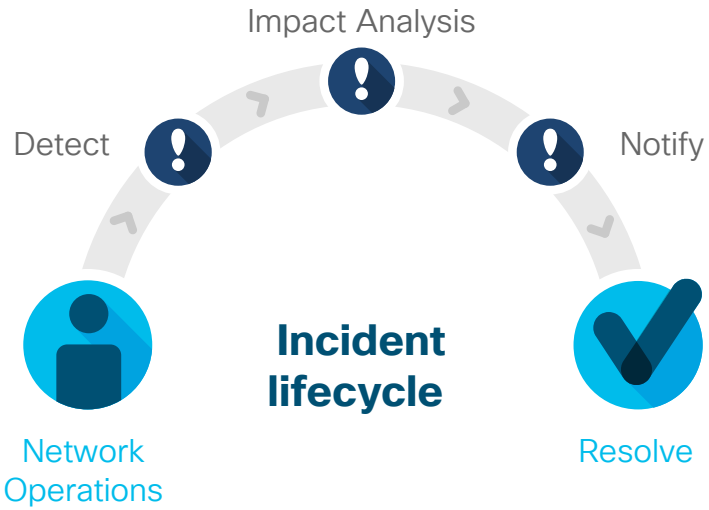


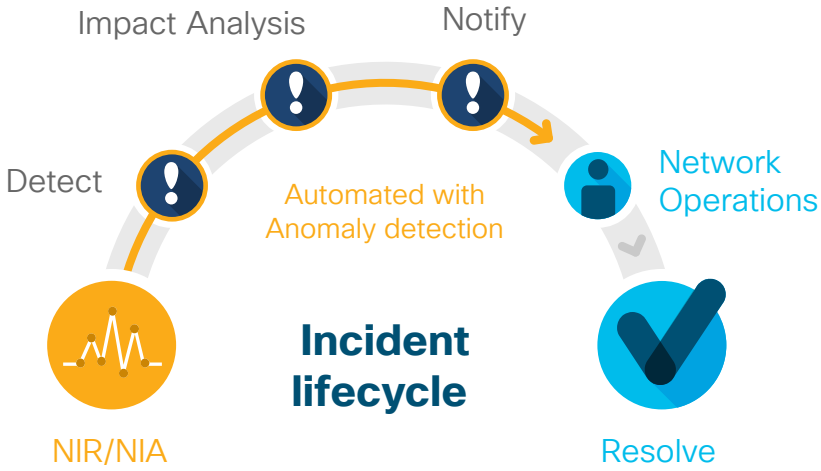


Network Insights:
Resources

Bandwidth | Ports | TCAM | Configuration limits

Empower Your Team with Proactive Monitoring





Network Insights:
Resources and Advisor

Anomaly detection | Pro-active alerts | Predictive failure

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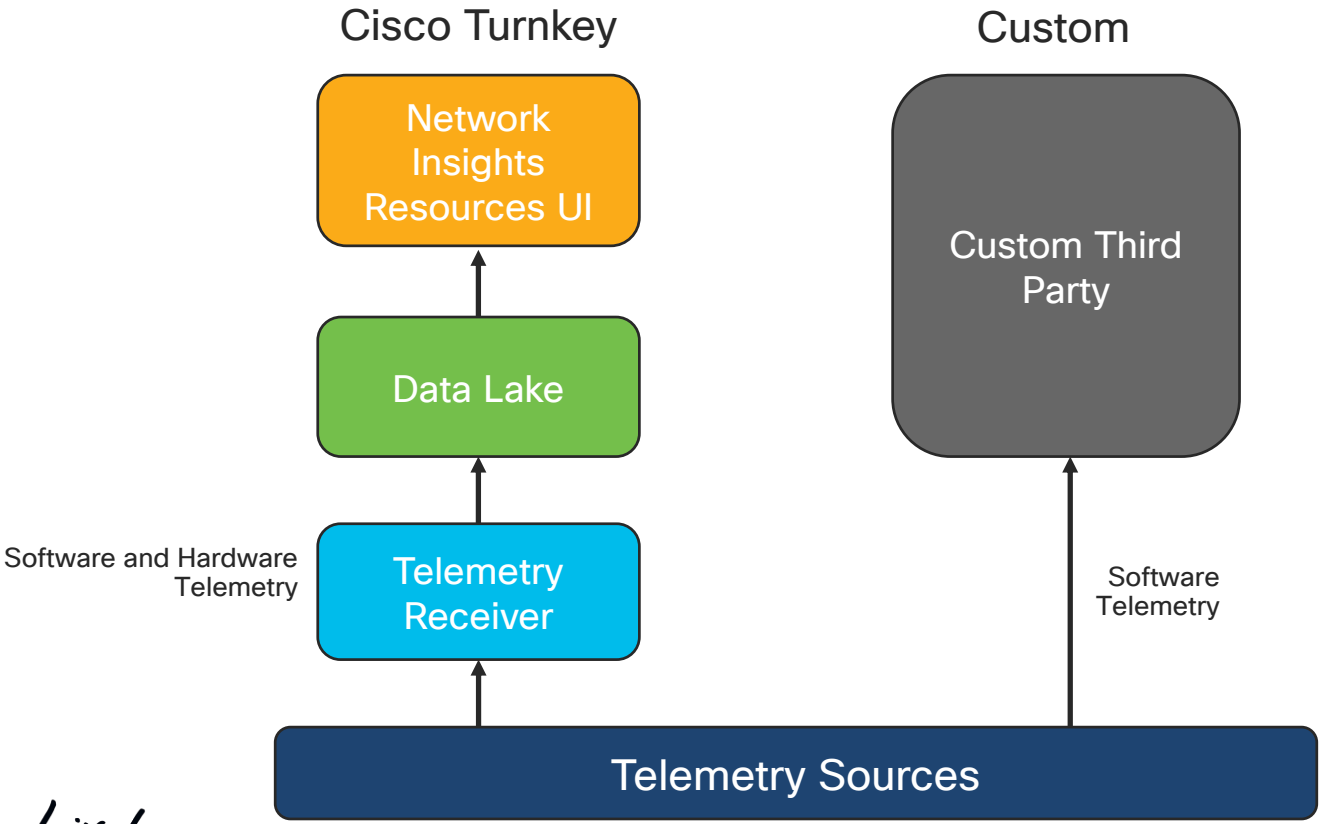
Network Insights Resources

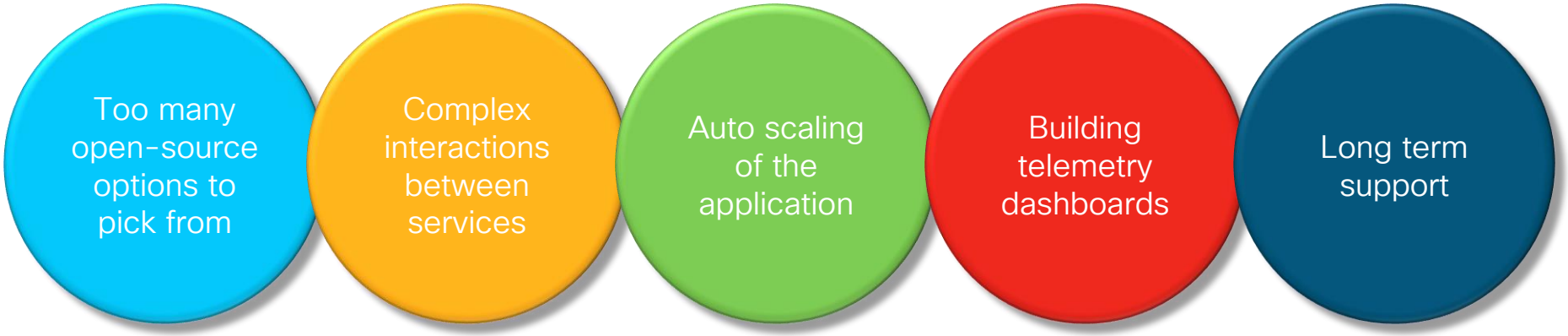
- *Analysis and correlation* of software and hardware telemetry data with focus on Day 2 network operations use-cases
- Focus on *identifying anomalies* and *providing quick drill-down* to specific issues

NIR

Telemetry and Analytics Deployment Models



Complexity of Building a Telemetry Platform



How Can NIR Help with Day 2 Operations?

Resources	Monitor fabric-wide and node-specific resource utilization
Environmental	Track CPU & memory consumption, monitor power and temperature
Statistics	Monitor network bandwidth utilization, packet drops, and network protocol statistics
Flows	Track flow paths, identify applications experiencing high latency or packet drops
Events	Correlate changes to events, identify faults

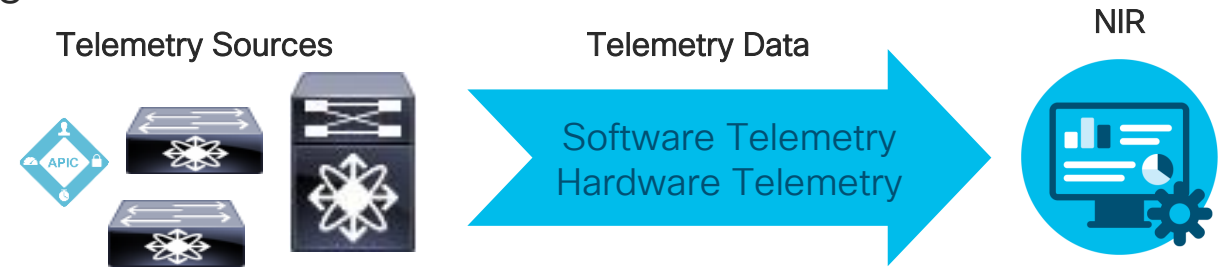
First, We Need Data!

- Software Telemetry
- Provides visibility into:
  - Resource utilization
  - Environmental data
  - Interface counters
  - Control-plane protocol stats & events

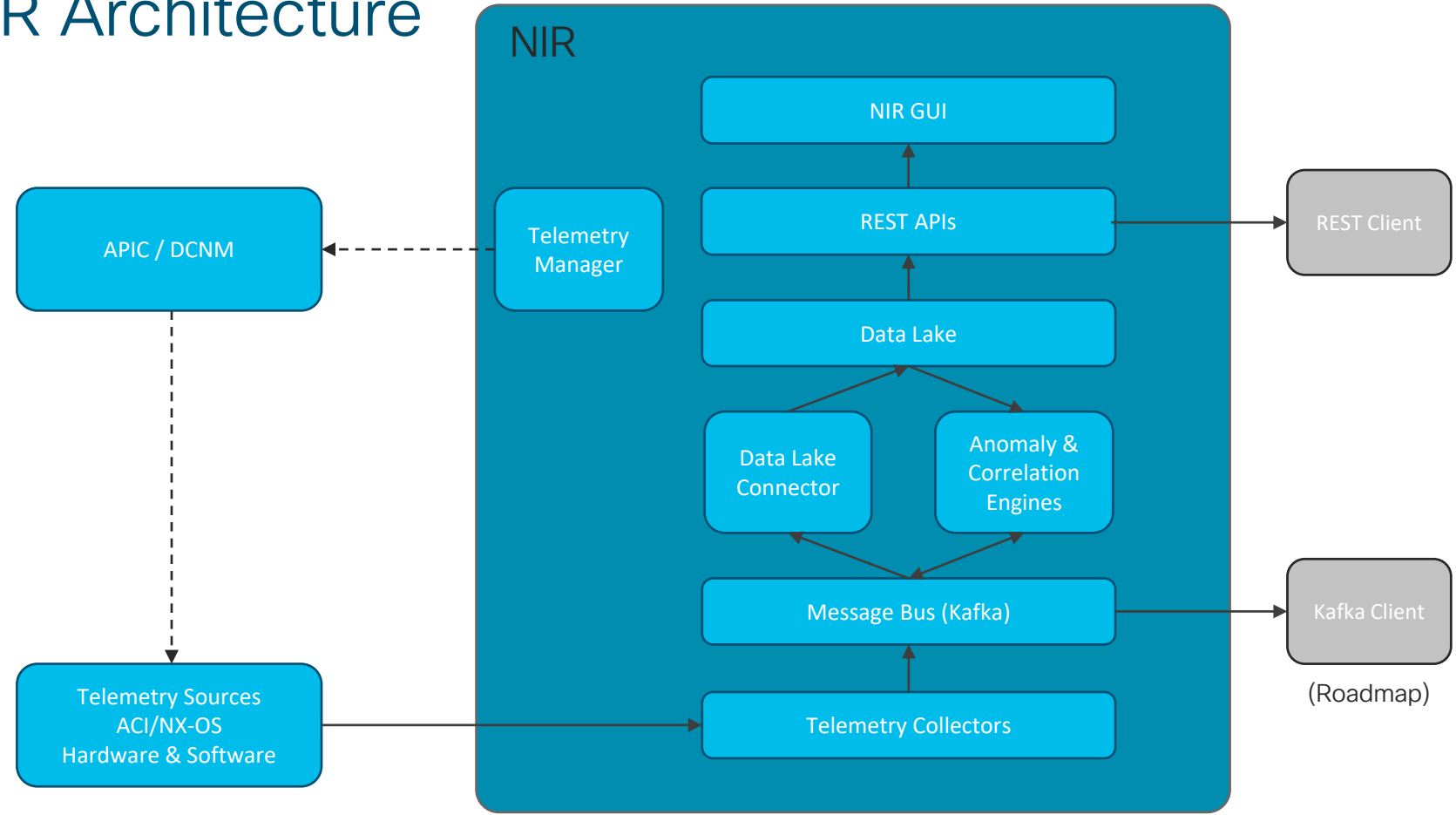
Baseline for Nexus gear

- Hardware Telemetry
- Provides visibility into:
  - Data-plane flow information
  - Flow path data
  - Flow statistics

Hardware dependent



NIR Architecture



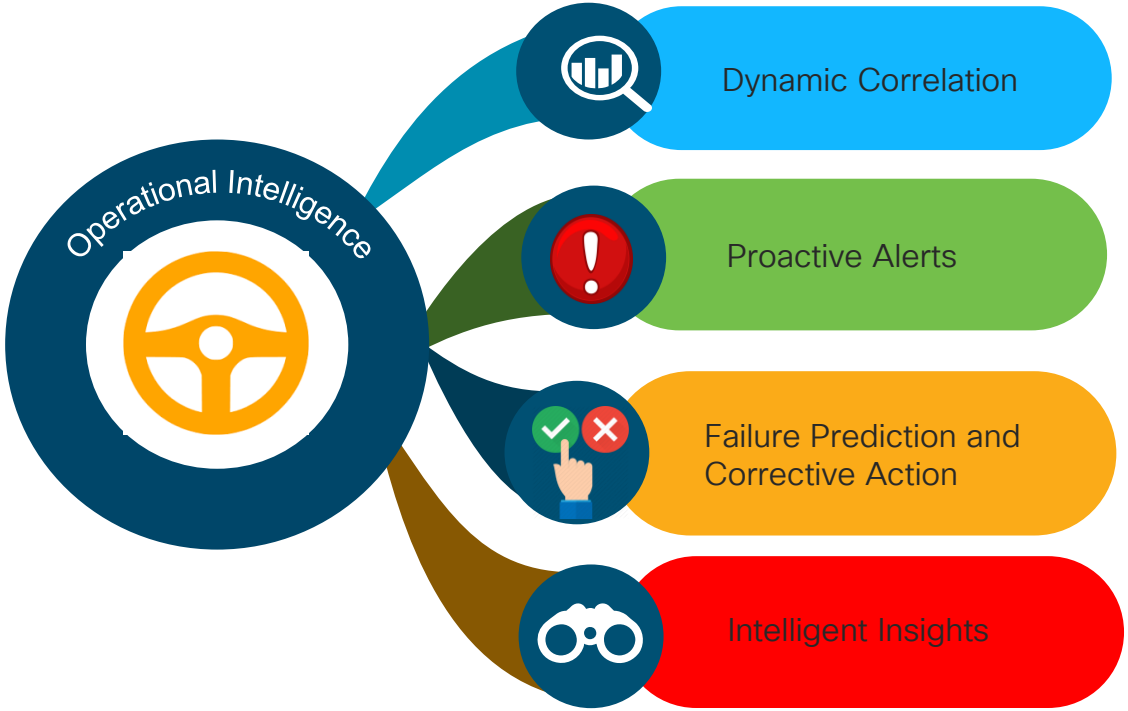
Operational Intelligence Engine for Network Insights

Dynamic Correlation
Correlate information across data sources

Proactive Alerts
See problems before end users do and alert

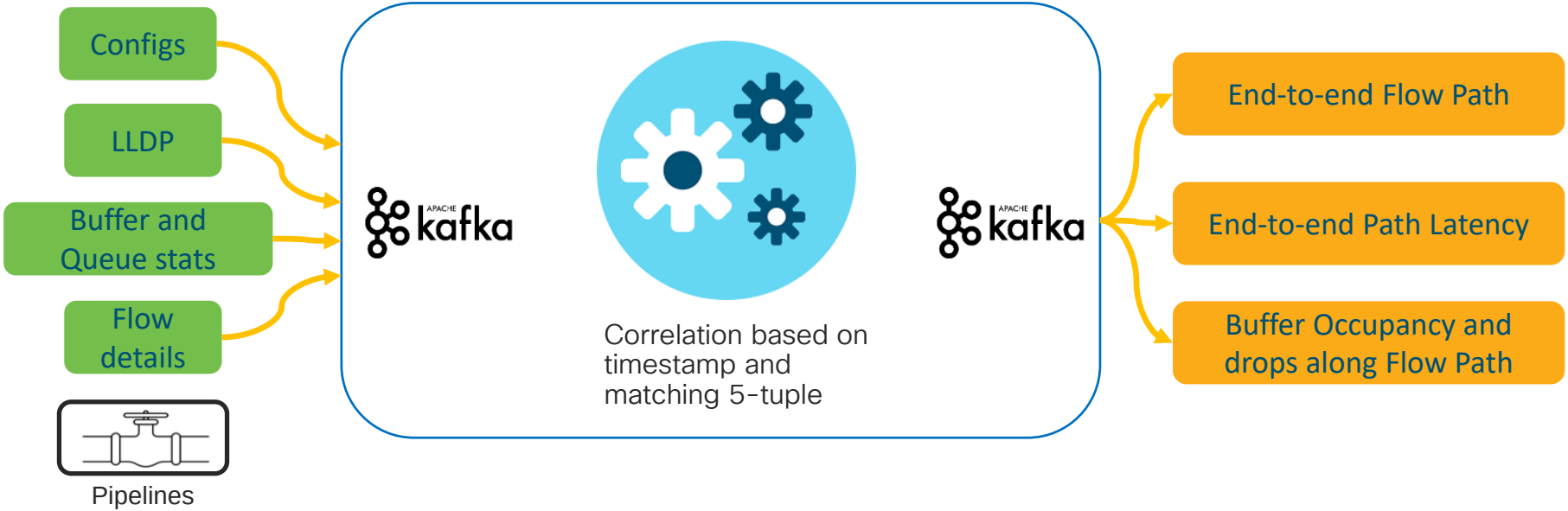
Failure Prediction & Corrective Action
Ability to predict failure and provide corrective action

Intelligent Insights
Ability to discover information with ease



Correlation Engine

Correlate normalized telemetry data streams from Transformation Receiver



NIR Integration with External Systems

REST APIs exposed to provide data to third-party tools

- Anomalies
- Resources
- Events
- Nodes

{ REST }

Kafka topic(s) (Roadmap)

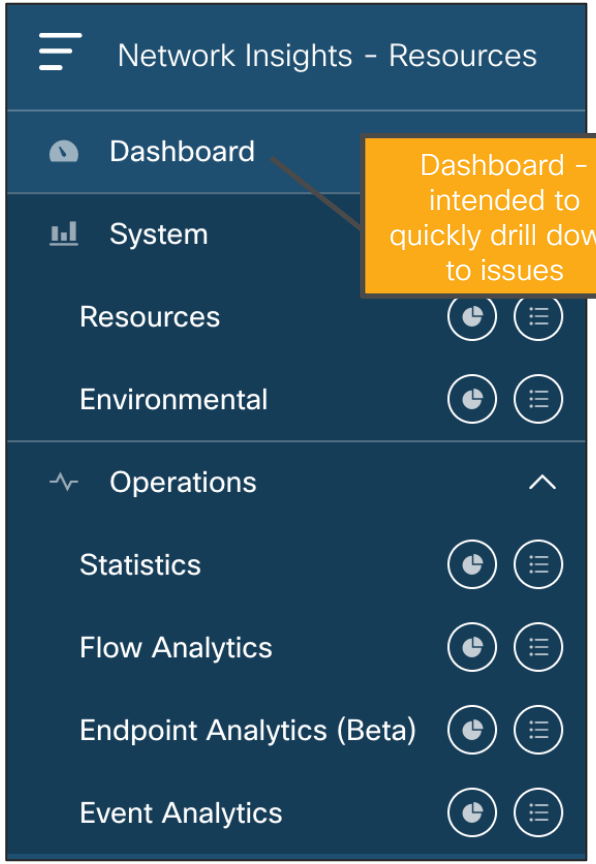
- Normalized pre-correlated data
- Post-correlated data

Forwarding of Anomalies

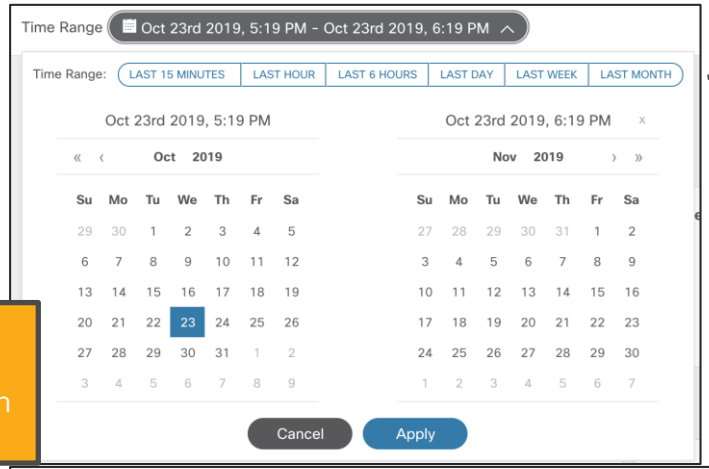
- Every anomaly is treated as a fault
- Every fault is written to Kafka topic
- 3rd party applications (like ServiceNow) can subscribe to these topic to retrieve the faults and process/analyze them further

Let’s start the Day with an Overview

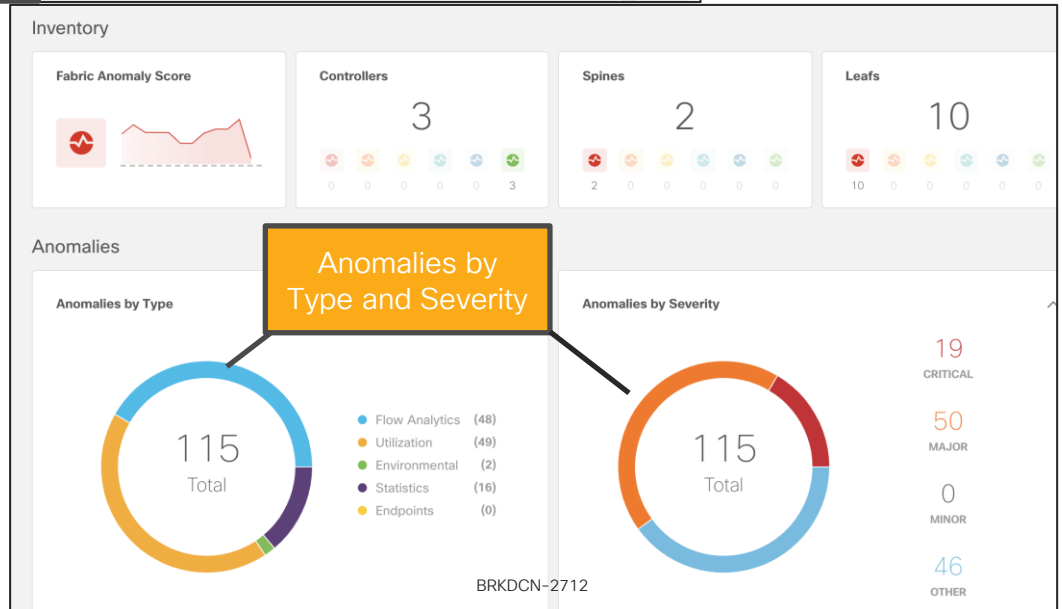
Dashboard view



Dashboard - intended to quickly drill down to issues

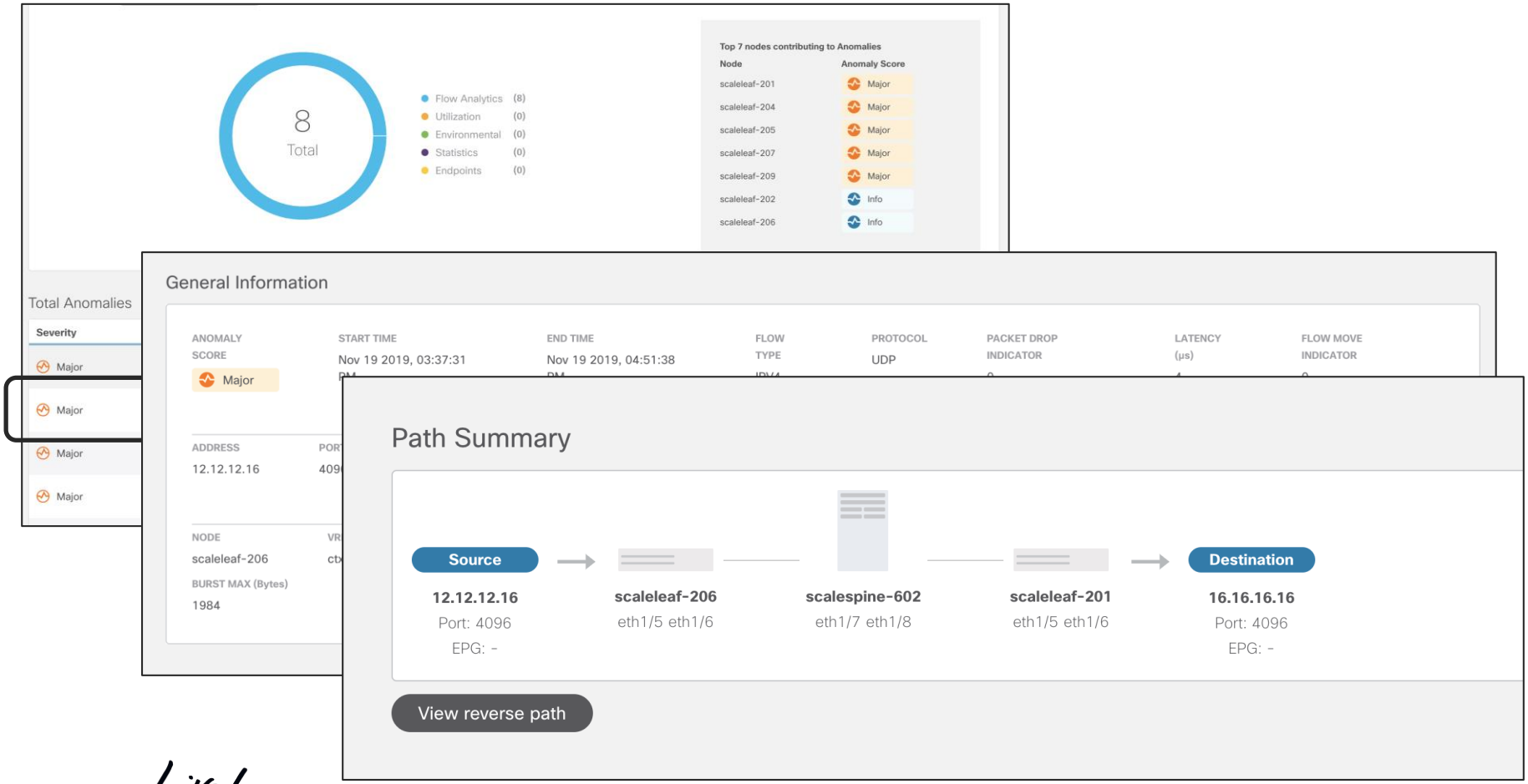


Select time range to retrieve historical data



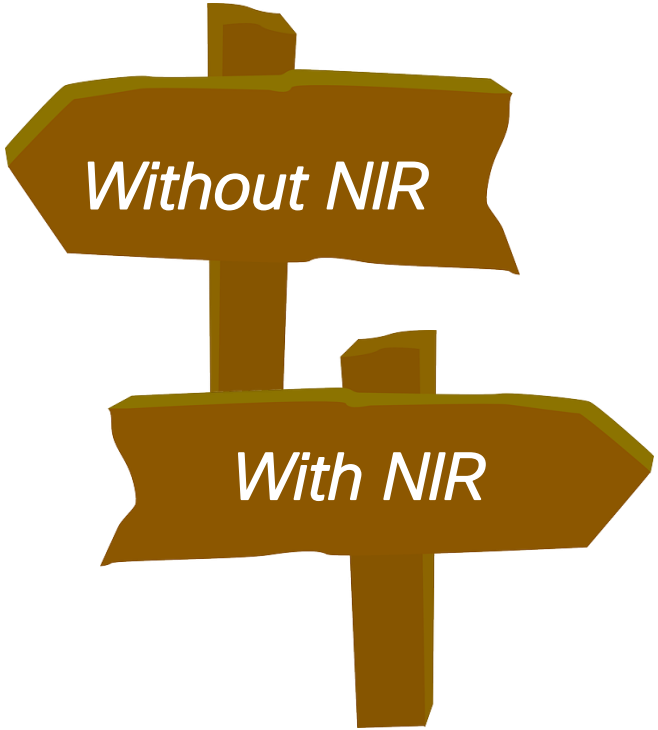
Anomalies by Type and Severity

My Database is/was slow!

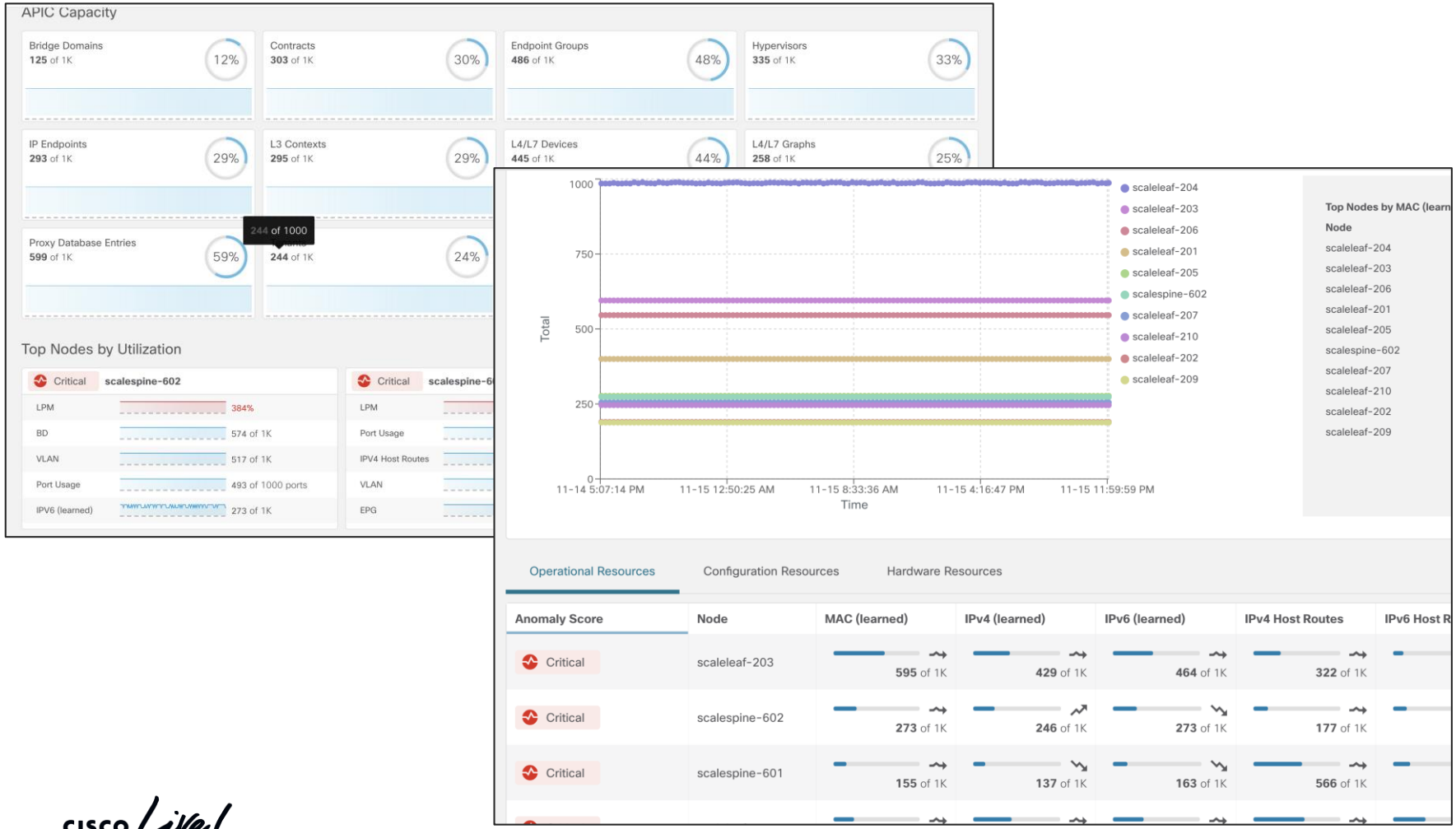


Flow Visibility and Flow Anomalies

Without NIR	With NIR
Shooting in dark using Ping/Traceroute/SPAN	Flows (5-Tuples) visibility using Cisco ASIC's hardware telemetry capabilities
Ping/Traceroute may not take same path as Service flow in Fabric – troubleshooting is not accurate	Correlates and tells you what caused these anomalies – buffer drops, queue drops, QOS drops, policy, ACL, policer, forwarding drops
Does not provide historical data	Keeps historical data and shows path and topology for flows in fabric
Reactive and not proactive	Proactive and not reactive



I need to Capacity Plan



Capacity planning

Stats Collection	Operational, configuration, hardware, environmental resource utilization, interface and routing protocol stats, flow records
Trending	• Baselines statistics and studies pattern to identify ‘normal’ behavior • Provide Trending information
Anomaly Detection	• When Utilization exceeds thresholds • On sudden rate of change in the utilization of these resources

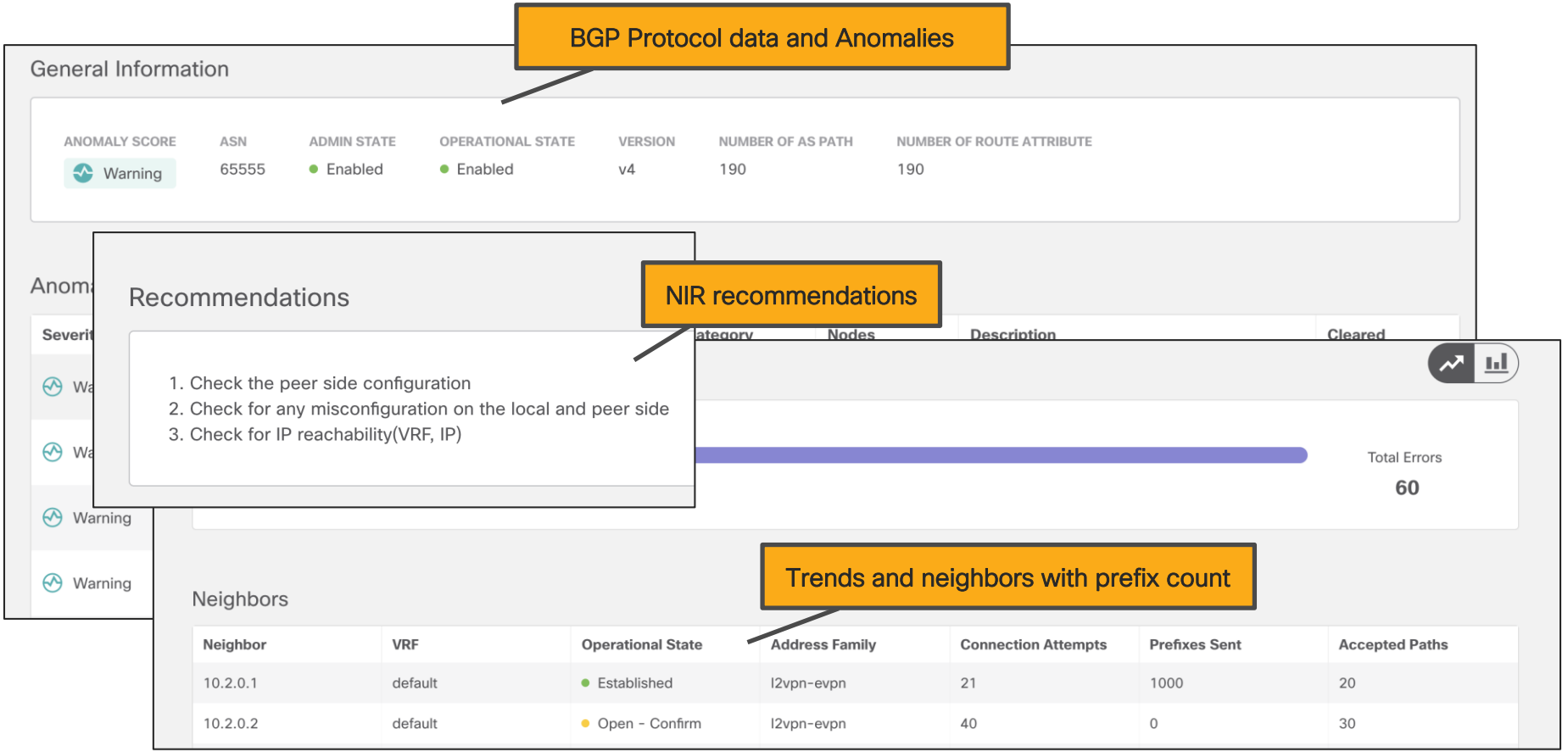
My switch is not forwarding any Traffic to Destination X

BGP statistics

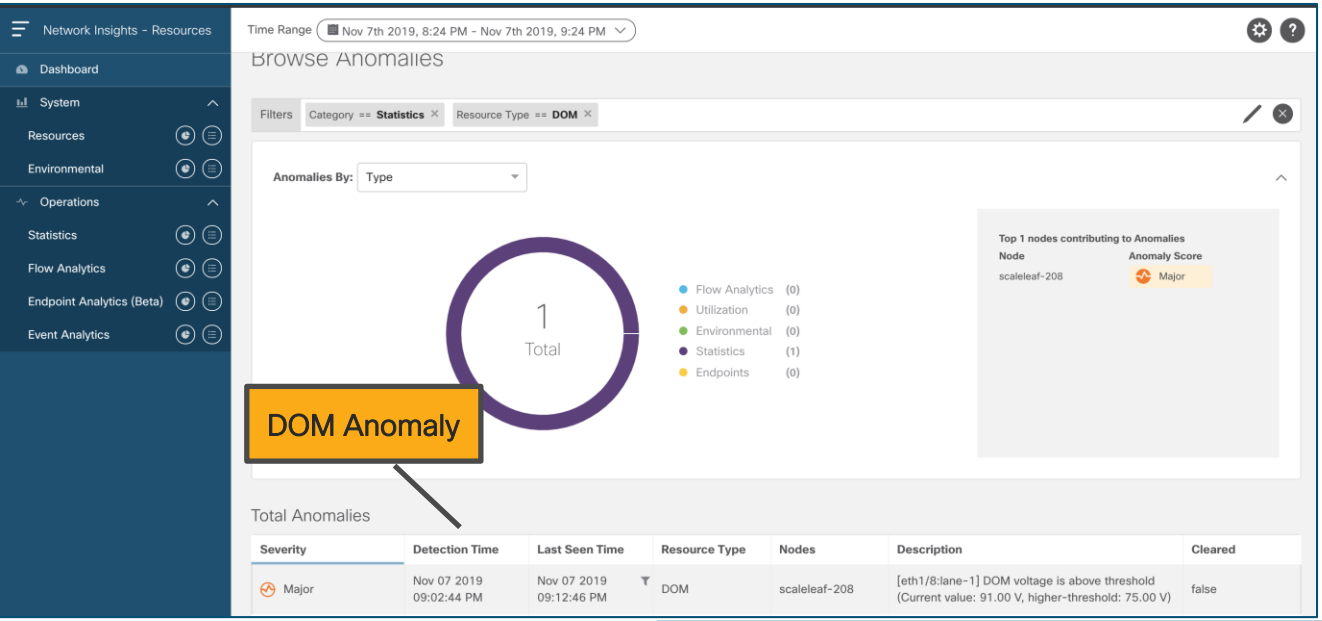
NIR will ingest and correlate BGP data per node which includes –

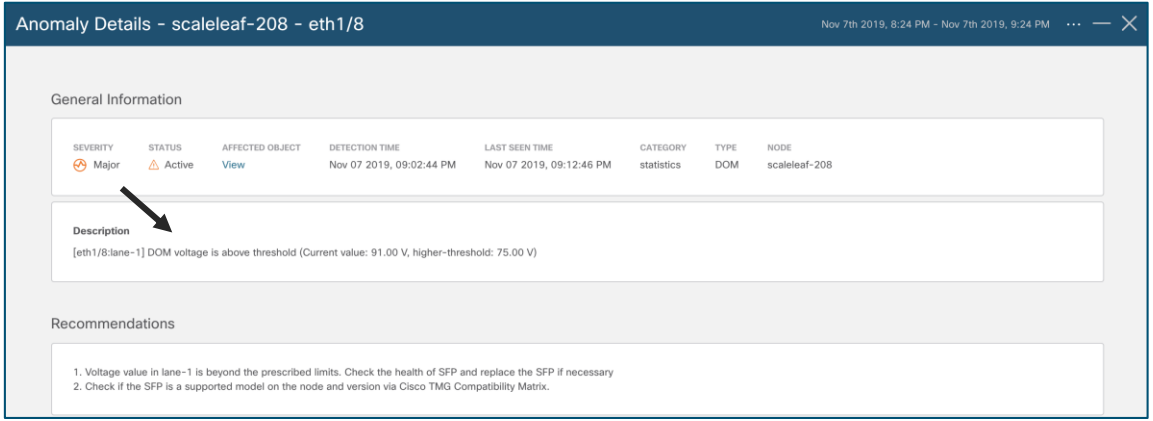
1) Number of BGP Sessions per switch
2) Total number of Neighbors per switch
3) Per Neighbor information on operational state, address family, connection attempts, prefixes sent and accepted paths
4) Anomalies and trends for the above data. Anomalies bubbled up in dashboard for BGP – For example: connection retries and connection drop counts, sudden increase/decrease in prefixes received/sent

BGP Statistics



I see CRC errors on my interface. Could it be because of Interface Optics?


Network Insights - Resources
Time Range
Nov 7th 2019, 8:24 PM - Nov 7th 2019, 9:24 PM
Browse Anomalies
Dashboard
System
Resources
Environmental
Operations
Statistics
Flow Analytics
Endpoint Analytics (Beta)
Event Analytics
Filters
Category == Statistics
Resource Type == DOM
Anomalies By: Type
1
Total
Flow Analytics (0)
Utilization (0)
Environmental (0)
Statistics (1)
Endpoints (0)
Top 1 nodes contributing to Anomalies
Node
Anomaly Score
scaleleaf-208
Major
DOM Anomaly
Total Anomalies
Severity
Detection Time
Last Seen Time
Resource Type
Nodes
Description
Cleared
Major
Nov 07 2019 09:02:44 PM
Nov 07 2019 09:12:46 PM
DOM
scaleleaf-208
[eth1/8:lane-1] DOM voltage is above threshold (Current value: 91.00 V, higher-threshold: 75.00 V)
false


Anomaly Details - scaleleaf-208 - eth1/8
Nov 7th 2019, 8:24 PM - Nov 7th 2019, 9:24 PM
General Information
SEVERITY
STATUS
AFFECTED OBJECT
DETECTION TIME
LAST SEEN TIME
CATEGORY
TYPE
NODE
Major
Active
View
Nov 07 2019, 09:02:44 PM
Nov 07 2019, 09:12:46 PM
statistics
DOM
scaleleaf-208
Description
[eth1/8:lane-1] DOM voltage is above threshold (Current value: 91.00 V, higher-threshold: 75.00 V)
Recommendations
1. Voltage value in lane-1 is beyond the prescribed limits. Check the health of SFP and replace the SFP if necessary
2. Check if the SFP is a supported model on the node and version via Cisco TMG Compatibility Matrix.

Other use cases!

Interface Errors

Stats Collection	• Capture Stats, Errors, Drops, Utilization and Rate of all Interfaces
Anomaly Detection	• Baselines behavior of every interface • Raise anomaly if Interface Utilization exceed thresholds • Anomalies for CRC errors, DOM anomalies, Interface drops, QOS drops
Correlate & Diagnose	• Correlate DOM to CRC errors • Check if Stomped CRC to Fabric receiving CRC errored packets • Correlate Platform counters e to hardware errors • Correlate Flow drops to Interface errors

Monitoring vPC

Stats Collection	• vPC State and stats, vPC Domain State, Peer State, Role, Orphan Ports • Operational state
Anomaly Detection	• vPC configured but peer-link members down • Partially down anomaly if one leg of port-channel is down • Detection of Split-Brain
Correlate & Diagnose	If same EPs are not learnt across vPC legs, this is correlated to vPC inconsistency

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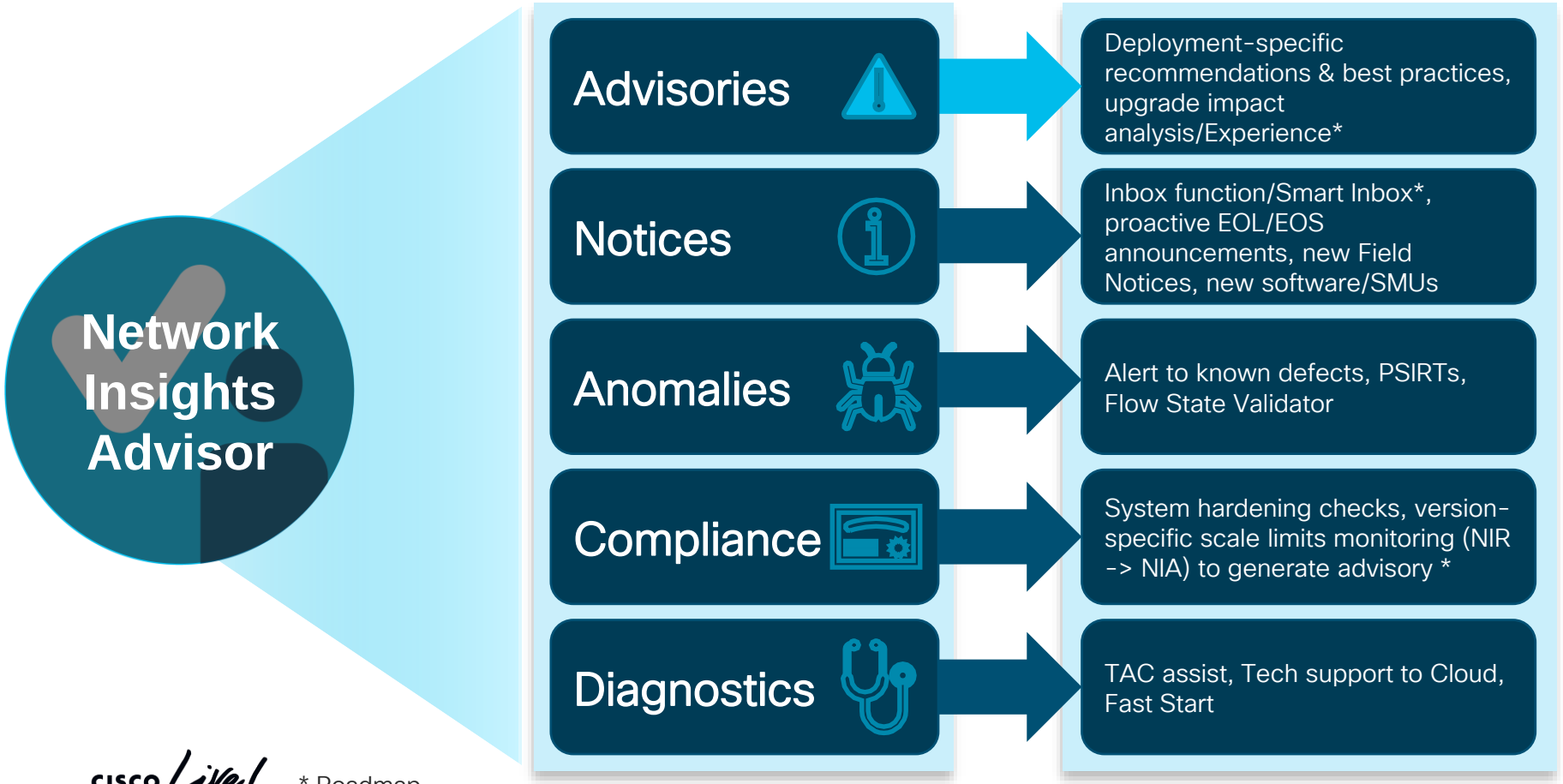
Network Insights Advisor

- Provides *deployment-relevant* supportability information and advisories
- Focus on *actionable recommendations* based on known issues and Cisco best common practices

NIA

How Can NIA Help with Day 2 Operations?



cisco Live!

* Roadmap

First, We Need Data!

Network

On-prem

Provides:

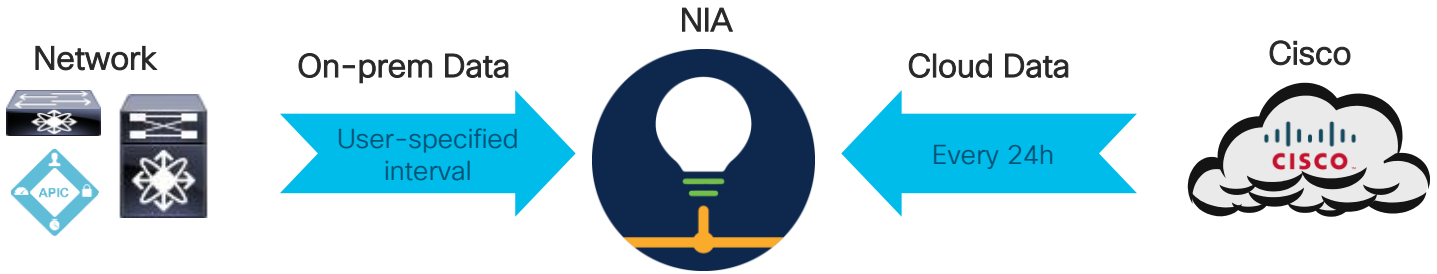
- Running config of all devices
- “show tech” from all devices (including APIC)

Cisco

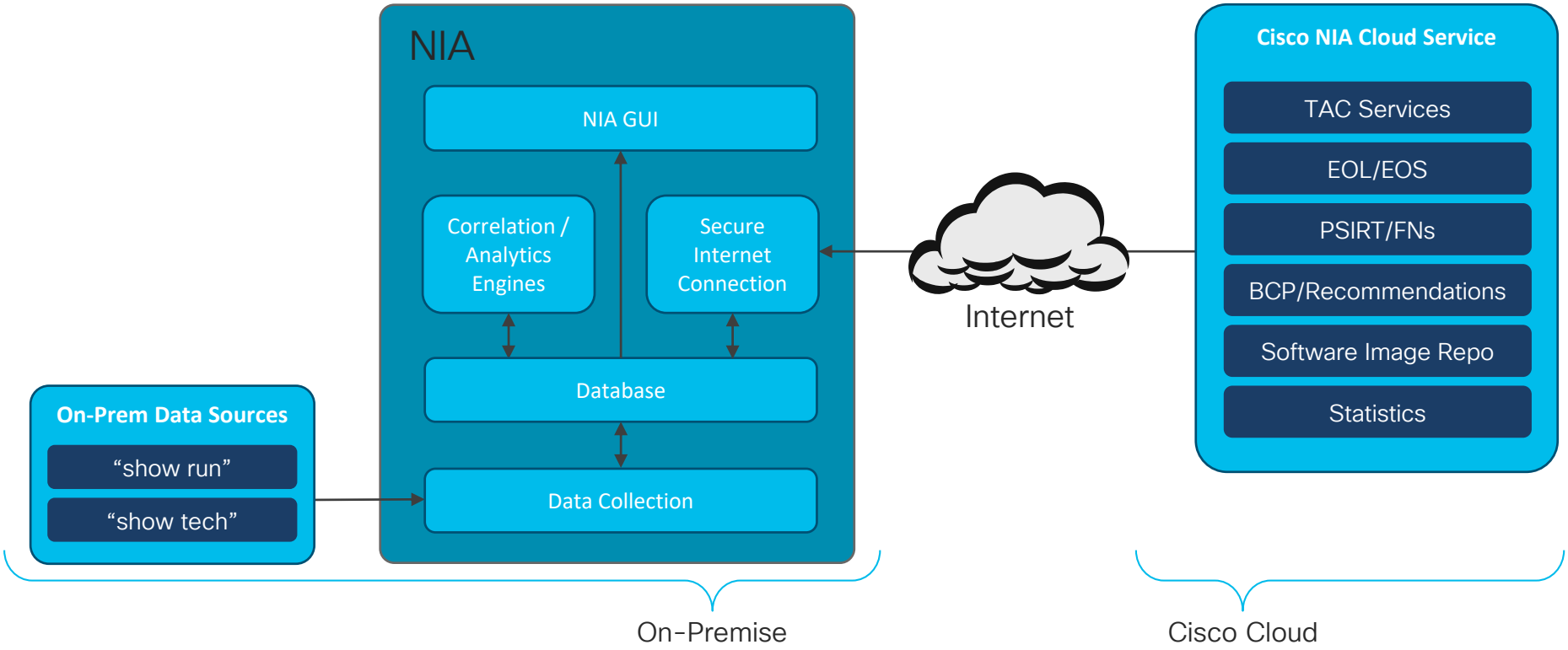
Pulled from the Cloud

Provides:

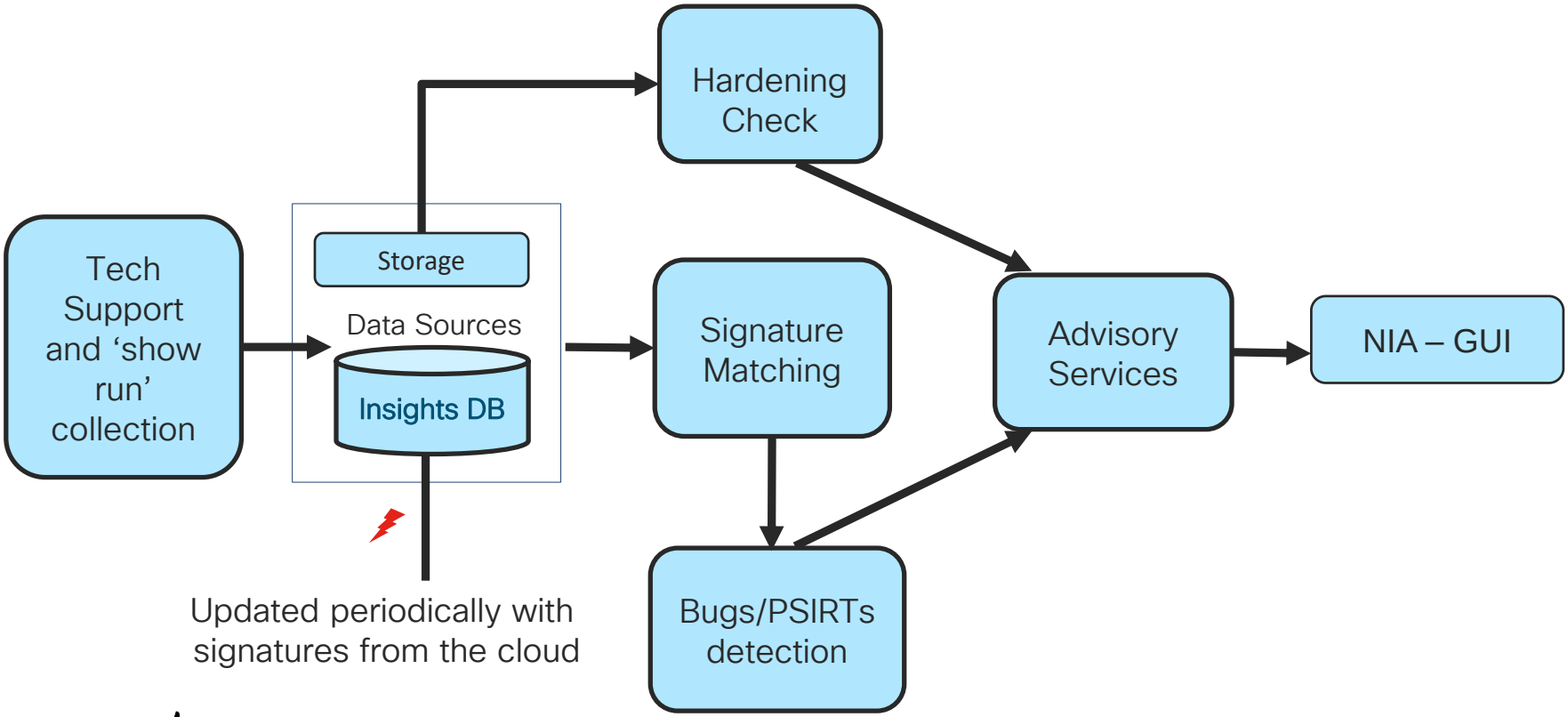
- Best practices updates
- PSIRTs, FNs, EOS/EOL
- Software release notifications
- Digitized signatures of known defects



NIA Architecture



How does NIA detect known issues?

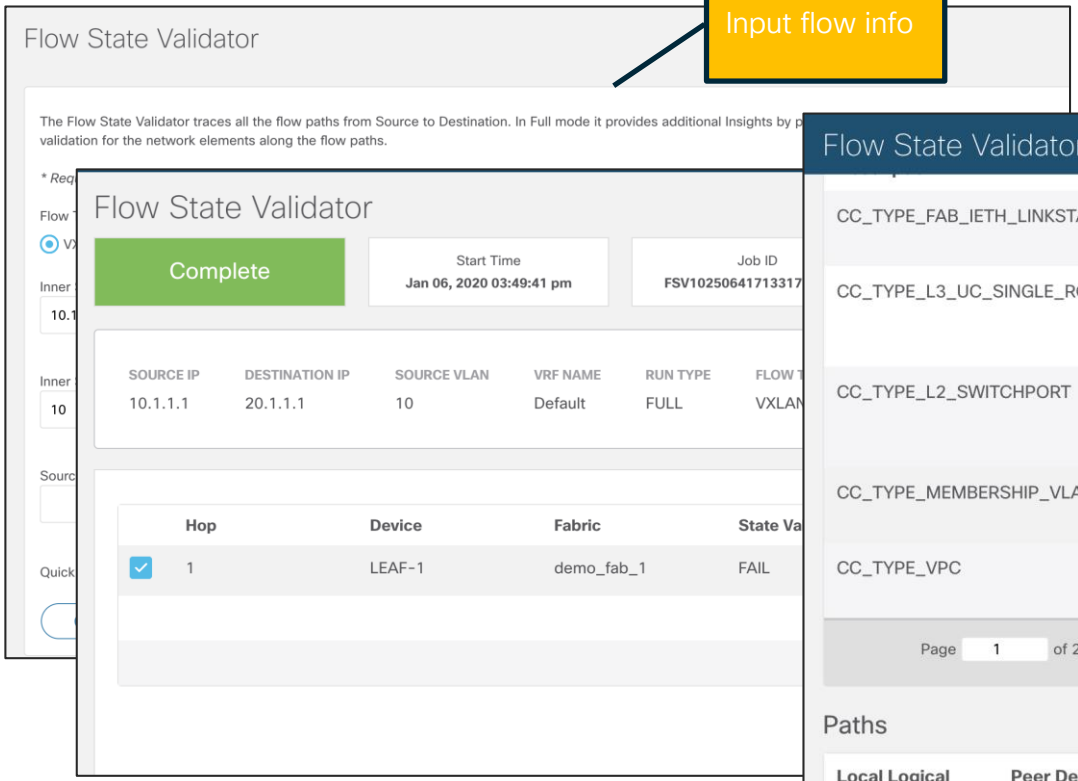


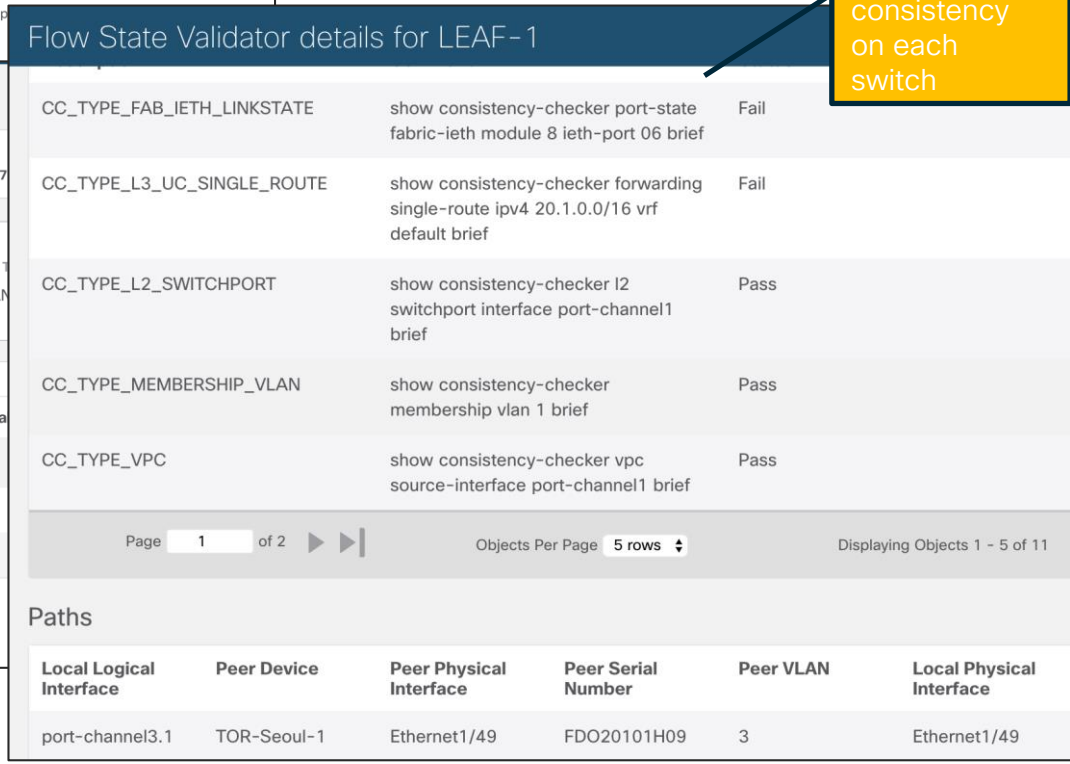
Flow State Validator – SW/HW State Validation for a Flow

NX-OS

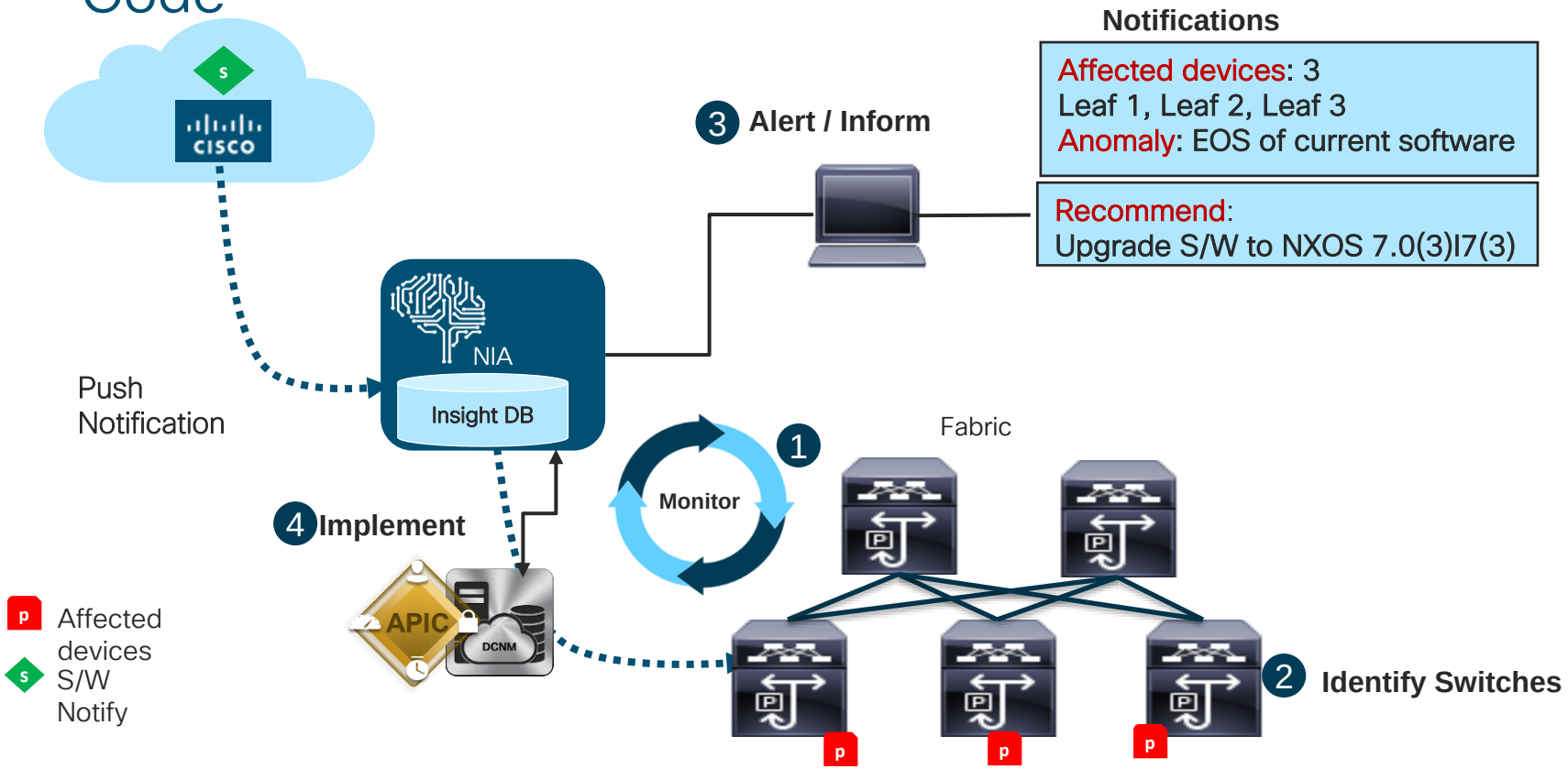
Input flow info

Check Software and hardware consistency on each switch



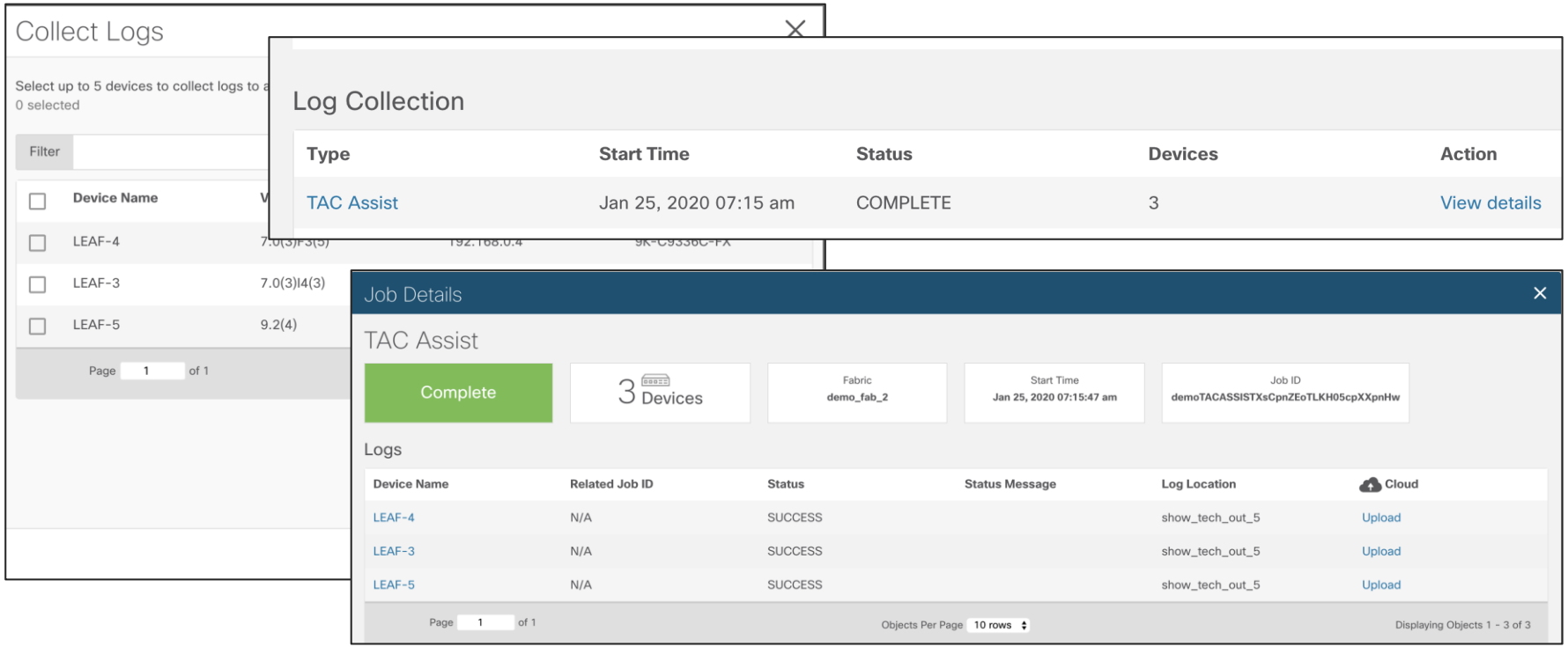


Alert me about Field Notices/EOL/EOS/Recommended Code



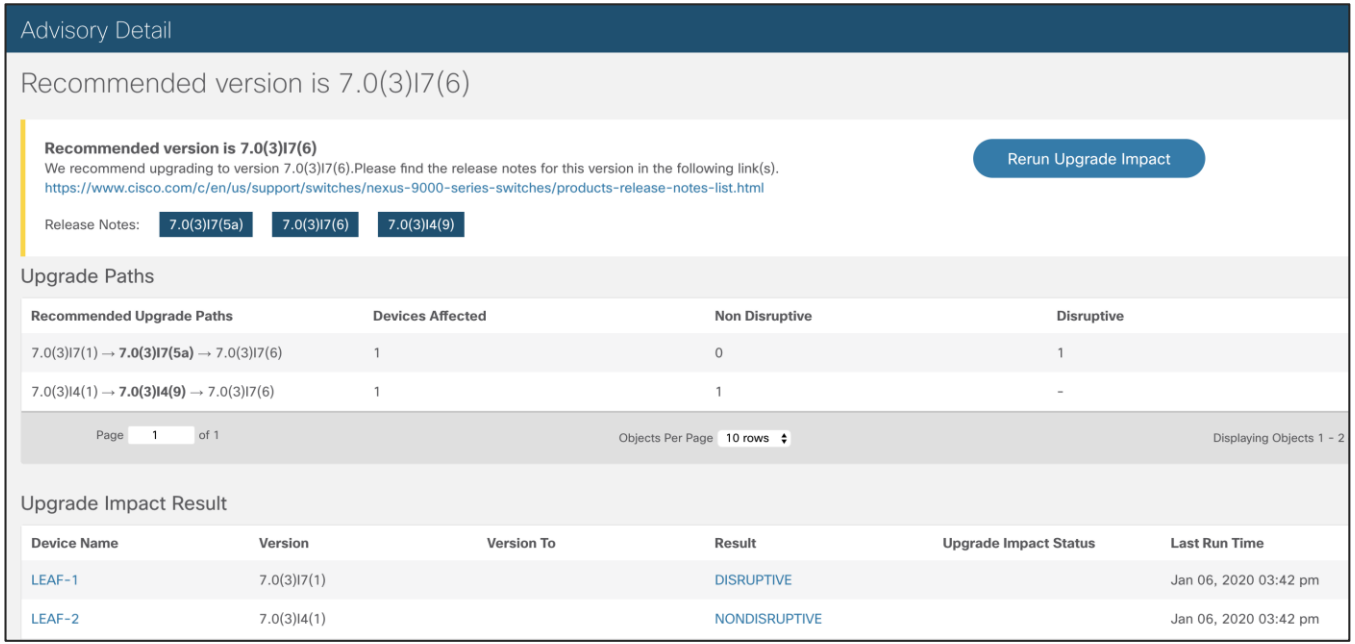
TAC Assist

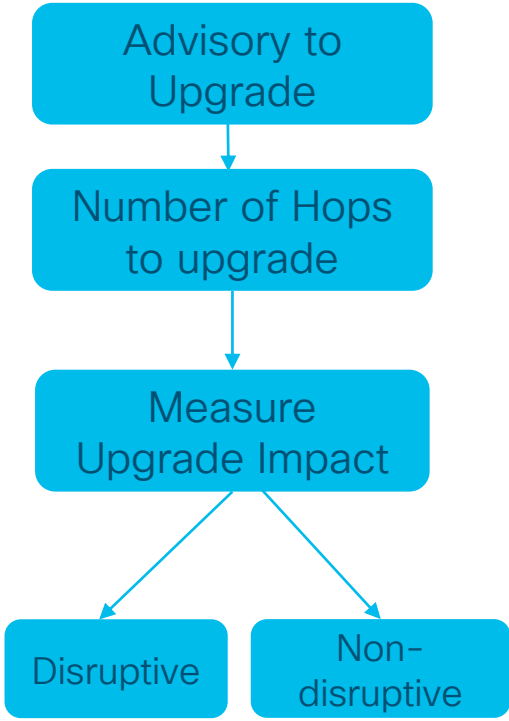
Helps with log collection directly from the app. These logs can then be attached to an SR. Optionally upload to Cloud



Upgrade impact

When a software upgrade advisory is generated, an upgrade impact can be measured from NIA per switch

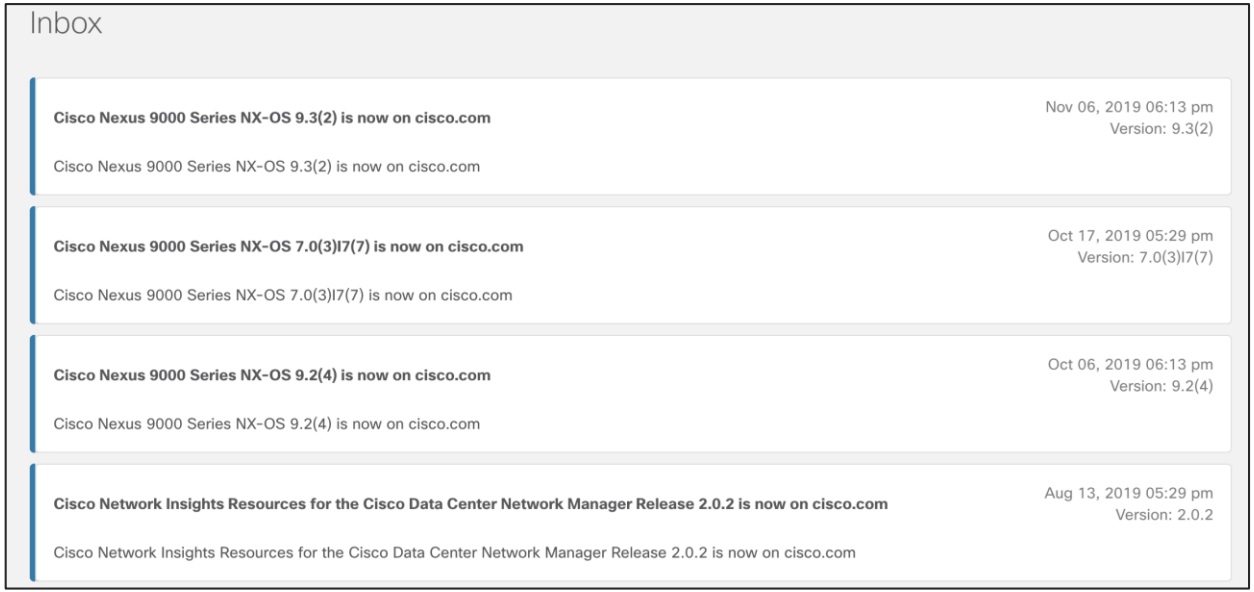




NIA Inbox

Used to send important notifications to end users

- New App Version, new NXOS software, new APIC/DCNM releases
- In future, will be used by Cisco to communicate with customers on best practices, scripts, FAQs



NI Base 2.0.1
ACI 4.2(3), DCNM 11.3(1)

$0

- **Infra details**

Collect basic info about customer Hardware/Software and send to Cisco

- **TAC Assist**

Allows user to collect Tech-Support from NI app for specific or set of nodes

- **Tech Support to Cloud**

Allows user to upload Tech-Support to Cloud. These logs can then be accessed by TAC searchable using Serial #

- **Fast Start**

Enables TAC to pull data from customer premise using NI App. No manual intervention is needed

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DEMOS on NIR/NIA

Scale, Software, Hardware Support

Network Insights Resources Scale – NIR 2.1

Fabrics	Single fabric for ACI (Roadmap for Multiple fabrics – NIR 2.2) Multiple fabric support for NXOS
# of Switches	100 leaf switches (APIC/ACI) 250 switches (DCNM/NX-OS)
Flow Monitoring	10,000 5-tuple flows/second with Services Engine/Cluster of compute nodes
Data Retention	Target 30 days for software telemetry Target 7 days for hardware telemetry

Network Insights Resources 2.1
Software and Hardware Support

Telemetry Type	Nexus 9300 / 9500 1st Gen	Nexus 9300-EX / FX / FX2	Nexus 9364C / 9332C
Software Telemetry	Yes	Yes	Yes
Flow Telemetry	No	Yes	No

ACI Software Version APIC / ACI Release – 4.2(3) / 14.2(3) AND 3.2(8) / 13.2(8)

Standalone Software Versions DCNM release 11.3(1)

7.0(3)I7(6) - [SW Telemetry]

9.3(2) - [SW and HW Telemetry]

Network Insights Advisor 2.0.1
Software, Hardware Support and Scale

	Nexus 9300 / 9500 1st Gen and Cloud Scale – ACI and NXOS	Nexus 3000 (All Models) – NXOS only
Minimum ACI Software Version	APIC / ACI Release - 4.2(3) / 14.2(3)	
Minimum Standalone Software Versions	DCNM release 11.3(1)	NX-OS release 7.0(3)I7(1) or later FSV – 9.3(3) onwards
250 switches – NXOS **100 Nodes – ACI**		

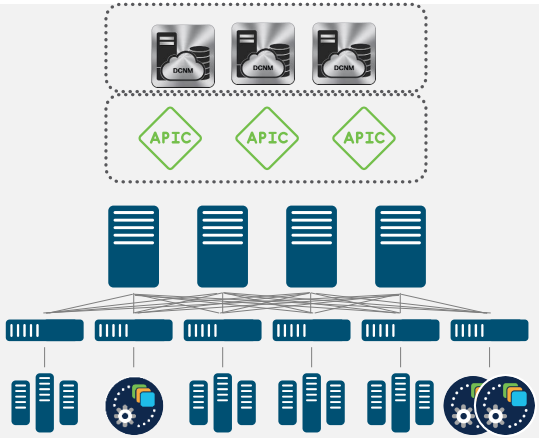
NIA not supported on:
- Cisco Nexus 9500 Series switches with -R line cards
- Cisco Nexus 3600 Series switches

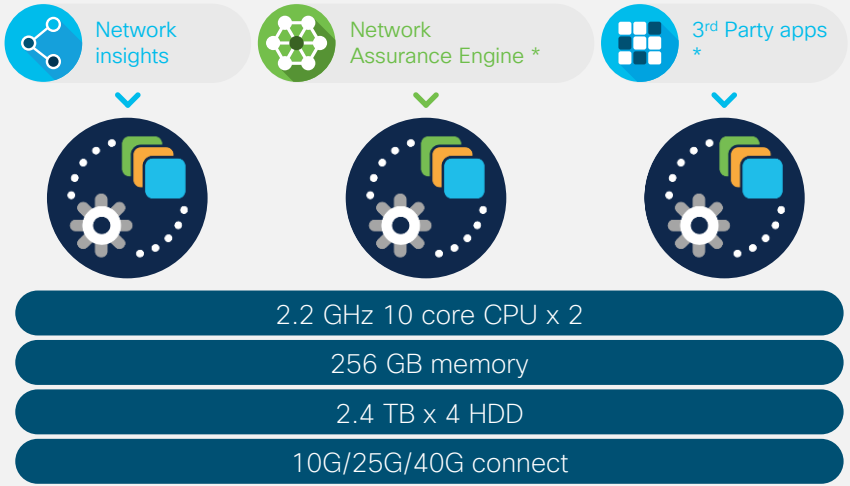
Compute Requirements for NIR/NIA

Cisco Application Services Engine

ACI
DCNM

Modern Scale-out application services stack to host Day-2 Operations applications





Network automation | Scale-out cluster | SE-CL-L3

* In planning

ACI/APIC Compute Requirements for NIR 2.1

Software Telemetry

Existing APIC Cluster (M3/L3)

Software + Flow Analytics

Existing APIC Cluster + 3-Node Services Engine Cluster

ACI/APIC Compute Requirements for NIA 2.0.1

Up to 20 Nodes

Existing APIC Cluster (M3/L3)

21 - 100 Nodes

Existing APIC Cluster + 3-Node Services Engine Cluster

DCNM/NX-OS Compute Requirements for Network Insights

Hardware Recommendations for Deployments up to 80 Switches and 2000 Flows					
Node	**Deployment Mode**	**CPU**	**Memory**	**Storage**	**Network**
Cisco DCNM	OVA/ISO	16 vCPUs	32G	500G HDD	3x NIC
Computes (x3)	OVA/ISO	32 vCPUs	64G	500G HDD	3x NIC

Hardware Recommendations for Deployments from 81 to 250 Switches and 10000 Flows					
Node	**Deployment Mode**	**CPU**	**Memory**	**Storage**	**Network**
Cisco DCNM	OVA/ISO	16 vCPUs	32G	500G HDD	3x NIC
Computes (x3)	ISO/Service Engine	40 vCPUs	256G	2.4TB HDD	3x NIC*

* Network card: Quad-port 10/25G

Licensing

Network Insights and Assurance: Licensing

- Premier Subscription Tier includes NIR/NIA/NAE Licenses + Everything ‘Advantage’ License
- Day2 Ops Subscription bundle includes NIR/NIA/NAE Licenses
- A La Carte Subscription-based Licenses

Day2 Ops bundle info - https://nexus9kaci.cisco.com/subscriptions-licensing#day-2-operations

Network Insights and Assurance: **Licensing**

Premier tier	›	NIR/NIA/NAE license is part of Premier Edition License and separate License is not required
Advantage tier	›	D2 Ops bundle or Add-on Licenses are supported & need to be purchased separately
Essentials tier	›	D2 Ops bundle or Add-on Licenses are supported & need to be purchased separately
License model	›	NIR/NIA is subscription only license and supports per Leaf licensing model for ACI and per node Licensing model for DCNM

Licensing and ordering guide: https://www.cisco.com/c/en/us/td/docs/data-center-analytics/network-insights/1-x/licensing-guide/NIR-NIA-Licensing-Guide-r0.html

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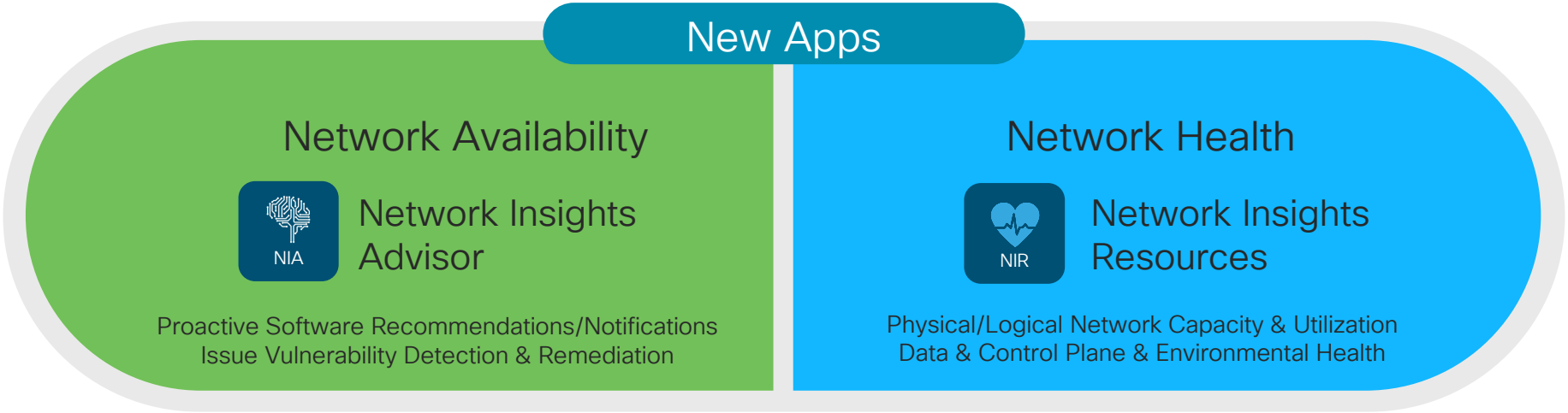
Network Insight Telemetry Applications

Providing Pervasive Network Health Visibility & Enabling Proactive Insights



Enhance Availability, Uptime & Network Wide Visibility

Key Takeaways

- Nexus leads the industry in Telemetry capabilities
- Combination of Software and Hardware streaming provides deepest level of Network Visibility
- Platforms for consuming, analyzing, visualizing Telemetry data available or being developed for both ACI and NX-OS
- Both Cisco turnkey solutions and custom/third-party integrations exist today

Main Message

You can't manage what you don't measure.

You can't measure what you don't see

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