The bridge to possible

Design, Validate and Certify your Wireless Streaming Telemetry Deployment

Rafael Ceara Batlle, Sr Solutions Engineer, 3xCCIE (W,SP,DC)

Salil Prabhu, Principal Engineer, CCIE Wireless

BRKEWN-1108

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How

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4. Enter messages/questions in the Webex space

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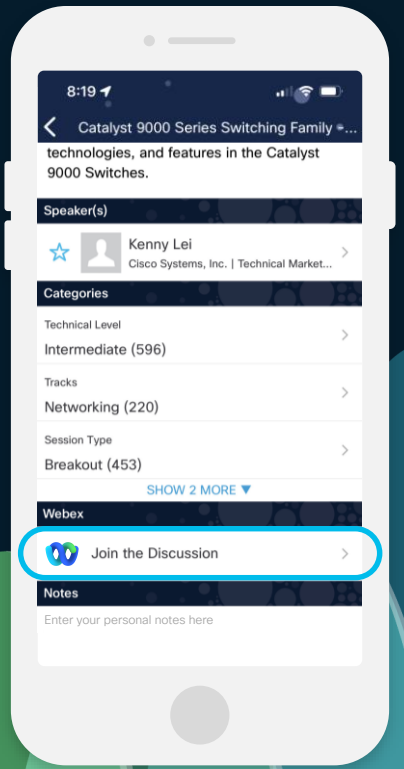

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Agenda

- Why Model Driven Telemetry
- Introduction to MDT
- MDT Connection State Flow
- Design Considerations
- Telemetry Design at Scale
- Performance and Validation
- Real World Scenarios
- A Story
- Takeaways

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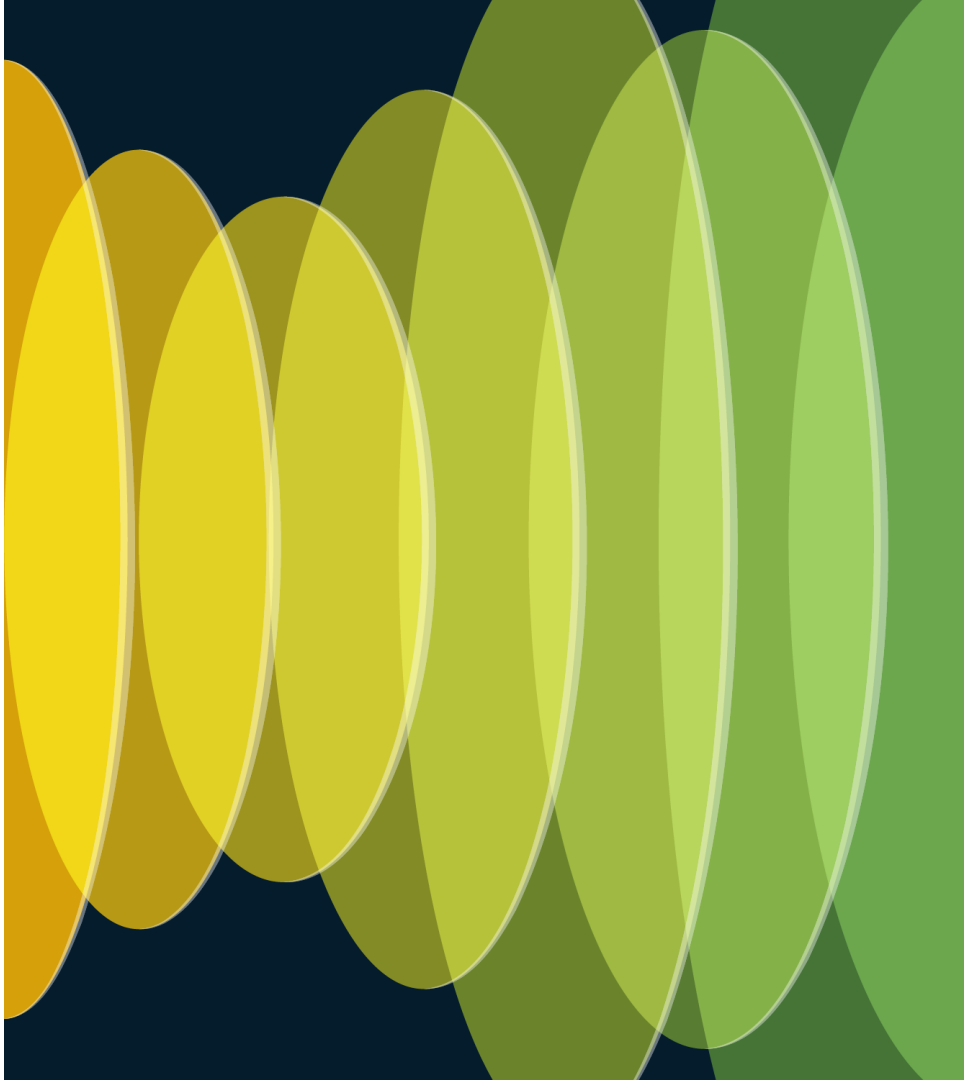
Why Model Driven Telemetry



Why MDT? Monitoring and Telemetry Progression

Good

- CLI
  - Show commands
- Polling
  - SNMP MIBS

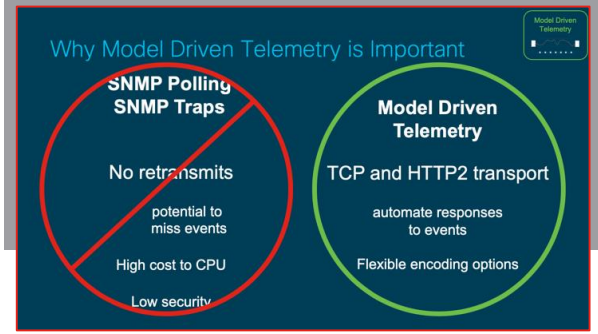
Better

- Telemetry
  - syslog
  - SNMP Traps
  - NETFLOW

Best

- Model Driven Telemetry
  - NETCONF Dial-In
  - gRPC Dial-Out
  - gNMI Dial-In

Not (really) model based



Everything defined in YANG

Consistent Encoding

Reliable Transport

Model Driven Telemetry

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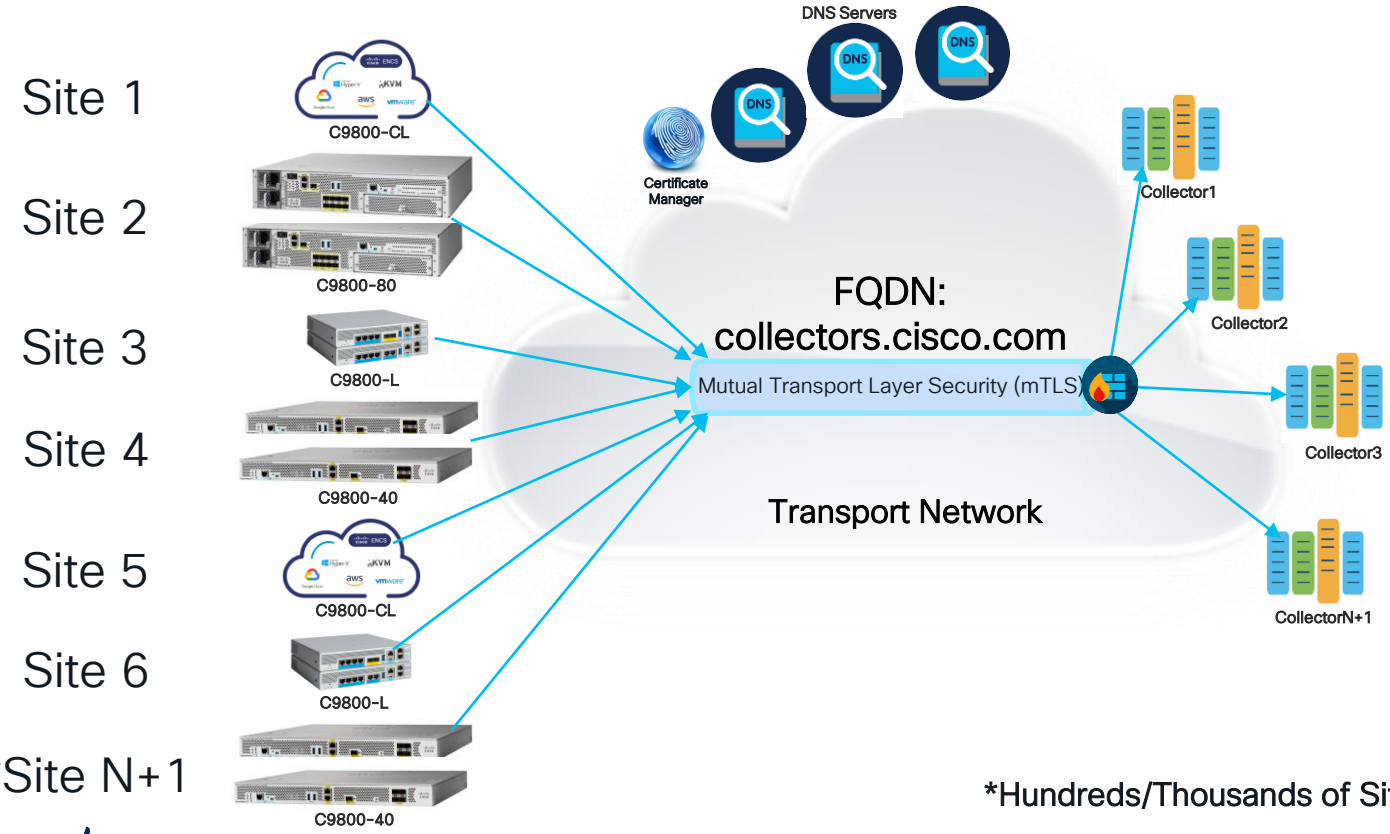
Why Model Driven Telemetry

Scaling your Telemetry deployment for hundreds sites/devices



*Hundreds/Thousands of Sites/Devices to Manage

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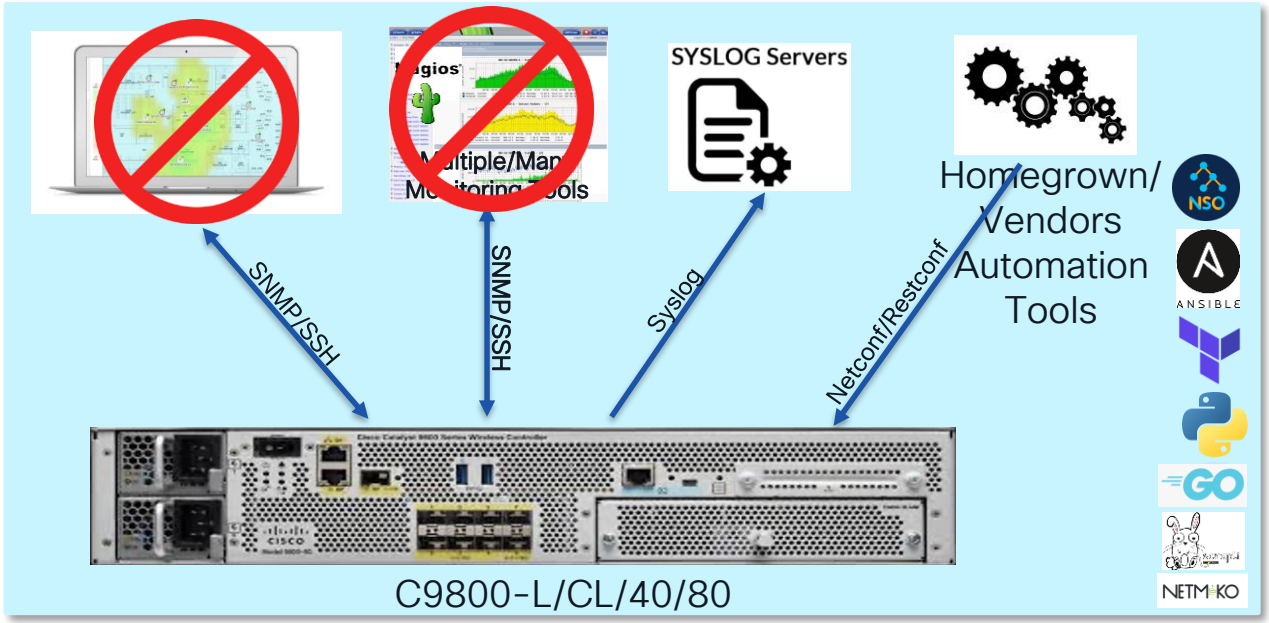
Why Model Driven Telemetry



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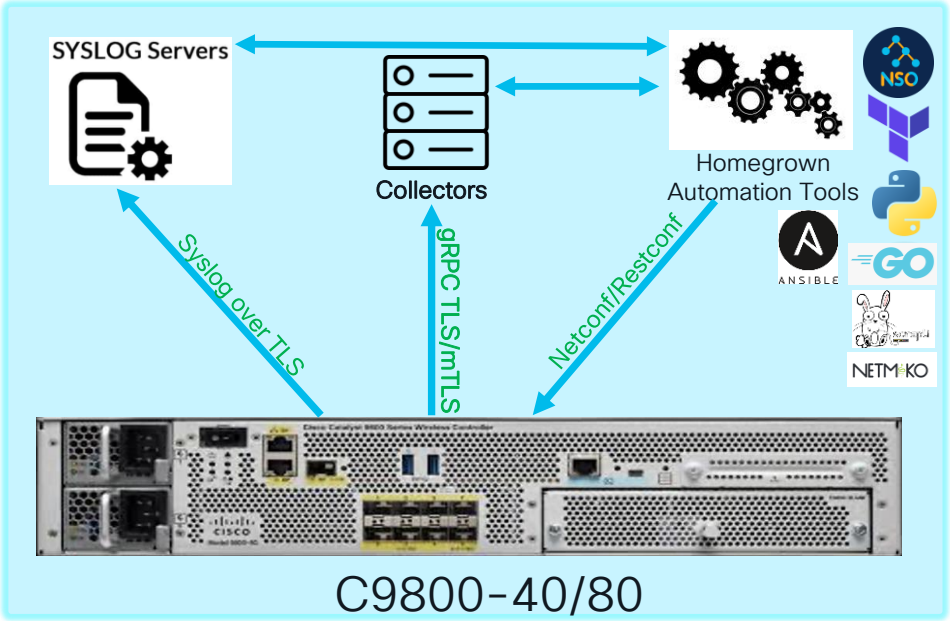
Why Model Driven Telemetry

Customer's Journey toward Streaming Telemetry

NorthStar for Alarming, Monitoring, Automation:



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Why Model Driven Telemetry

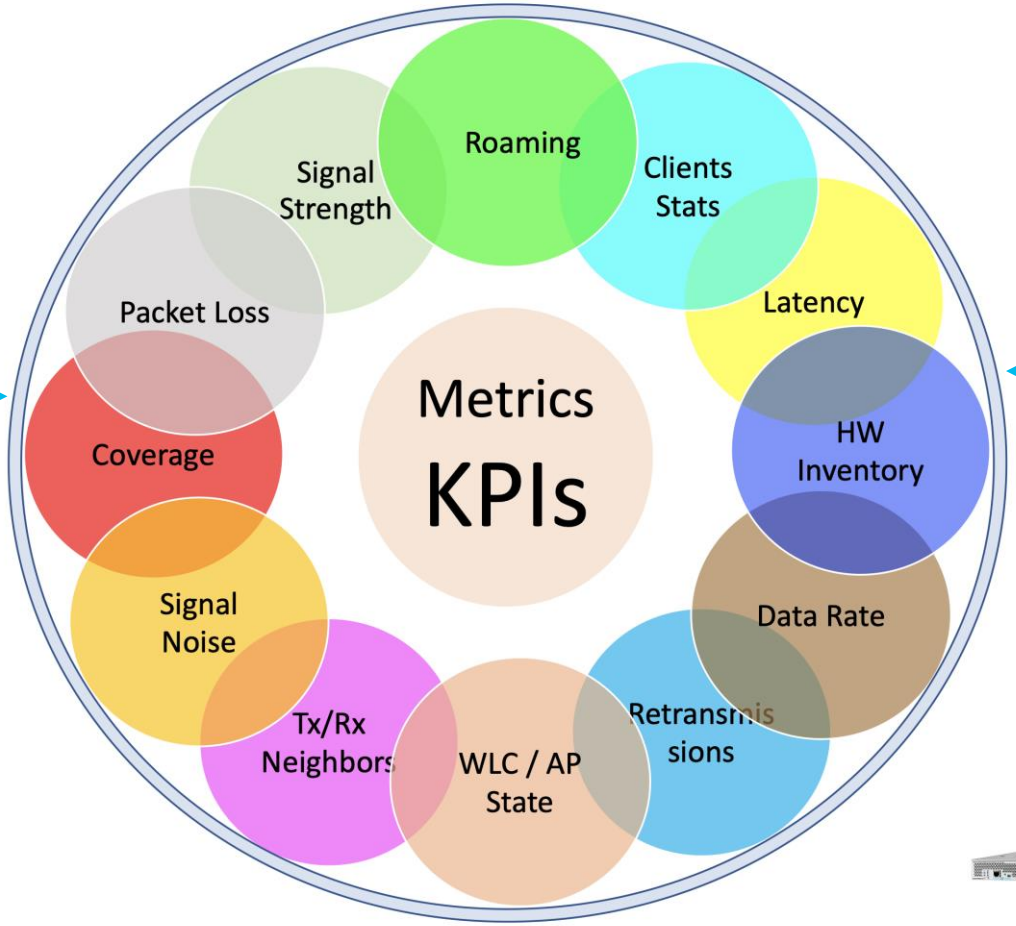
Cloud Reporting Tools

chronograf

Grafana

Monitor Your Infrastructure, Setup Alarms and Notifications

Webhook Webex Teams Kafka emails/pagers Amazon CloudWatch



Homegrown Automation Tools

Push Changes to The Infrastructure Based on Behavior Netconf/Restconf

C9800-CL/L/40/80

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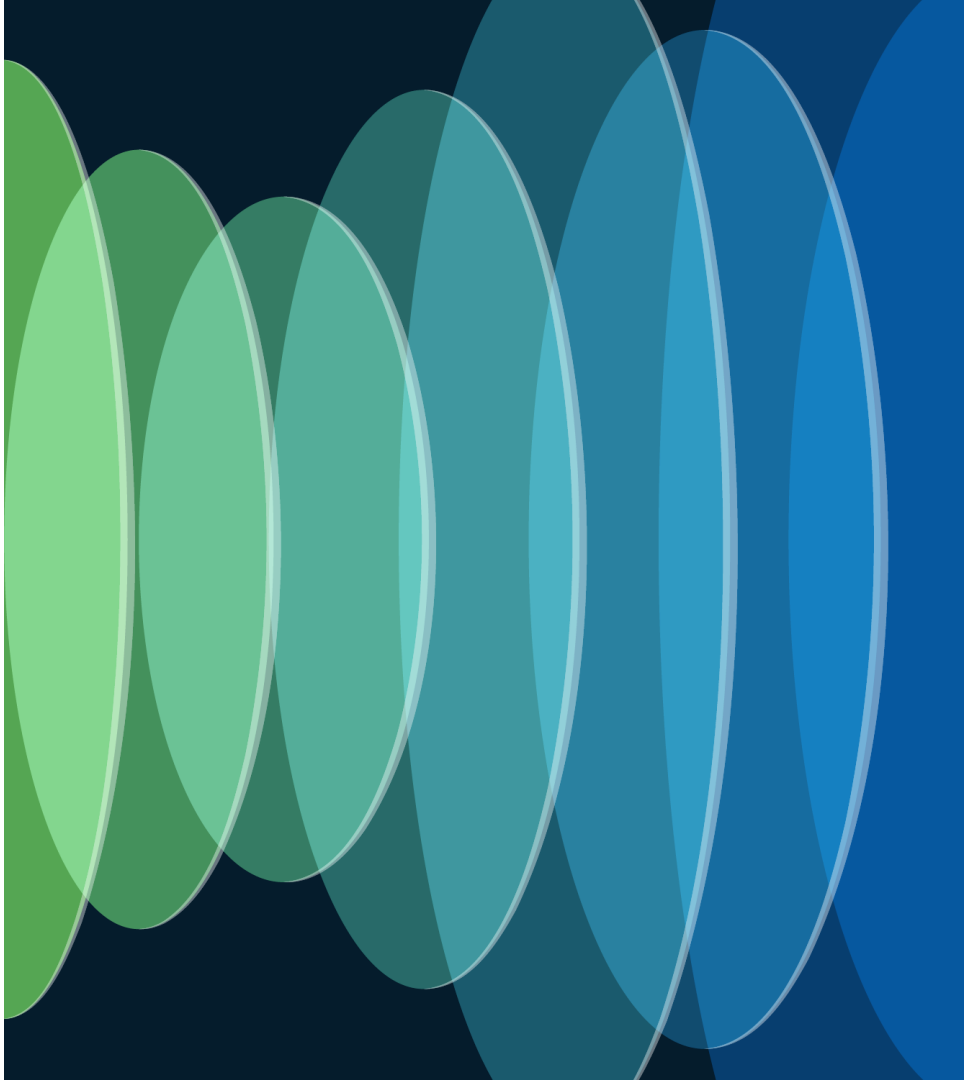
Introduction to MDT



IOS XE API Operations

NETCONF	RESTCONF	gNMI (Dial-Out 17.11)	gRPC
<get-config>, <get>	GET	GET	
<edit-config> (operation="create")	POST	SET	
<edit-config> (operation="replace")	POST, PATCH	SET = update	
<edit-config> (operation="delete")	DELETE	SET = <null>	
<establish-subscription>		SUBSCRIBE	YANG push

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Model Driven Telemetry Overview

gNMI
Dial-in/Dial-out

Network Management Interface

- Network management protocol
- Manage configuration and view operational data of network devices
- Developed by Google
- Modeled using YANG
- IOS XE telemetry + programmability

gRPC
Dial-out

Remote Procedure Call

- low-latency, scalable
- HTTP/2 transport
- IOS XE dial-out telemetry

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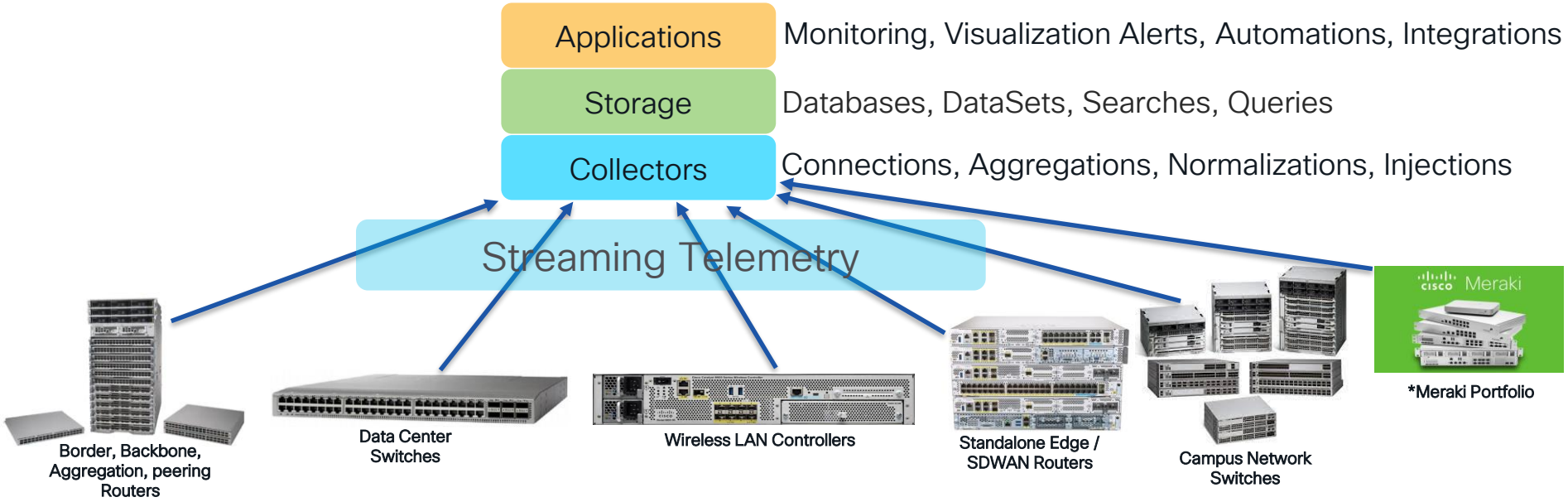
gRPC Concept



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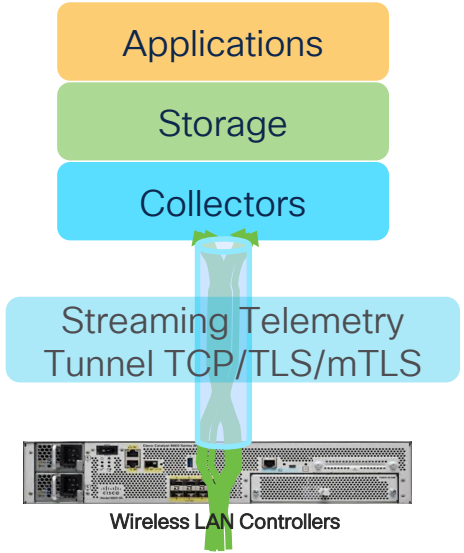
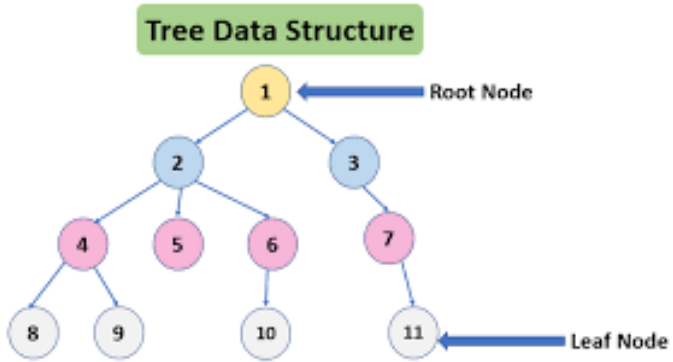
Yang and XPath Concept





Example of Wireless Definition with XPath Subscriptions for:

- Roaming/s Success/Failures
- Client stats
- WLC Health State
- AP Health State

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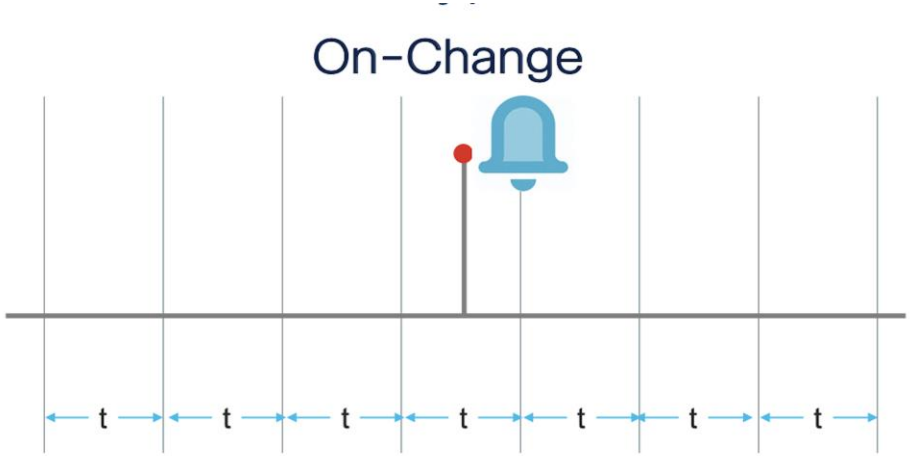
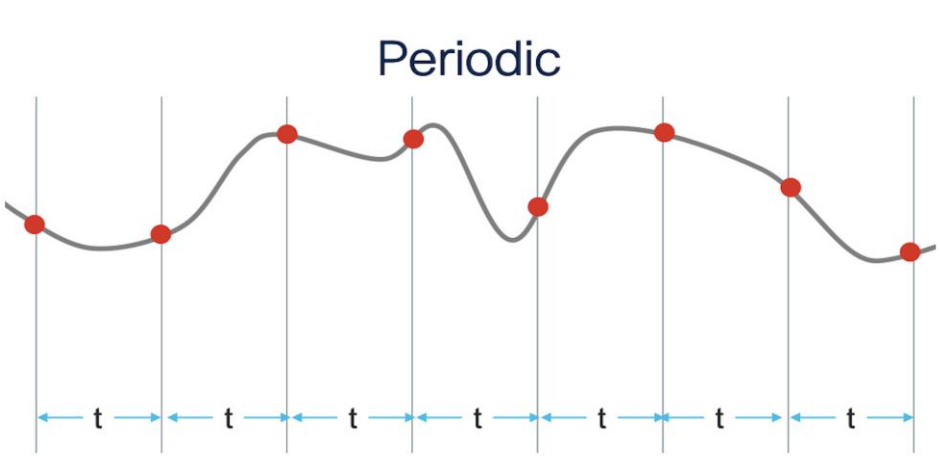
Model Driven Telemetry Publication Types





Config example periodic or on-change

```
wlc1.9840(config)#telemetry ietf subscription 145
wlc1.9840(config-mdt-subs)#update-policy ?
  on-change  Enable on-change updates
  periodic   Enable periodic updates
```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IOS XE Model Driven Telemetry

CLI

...or with...

YANG Models

NSO ANSIBLE pyATS

NETCONF/RESTCONF Dial-In ⇅ gRPC Dial-Out/Configured

Load Balancers → HAPROXY NGINX træfik gobetween

Collector/Receiver
Decodes to text → telegraf

splunk> elastic

Storage
Time Series Database → InfluxDB graphite

Monitoring
and Visualizations → Grafana chronograf

splunk>

Send Alerts/Alarms

Webhook Webex Teams kafka emails/pagers

Visualize data

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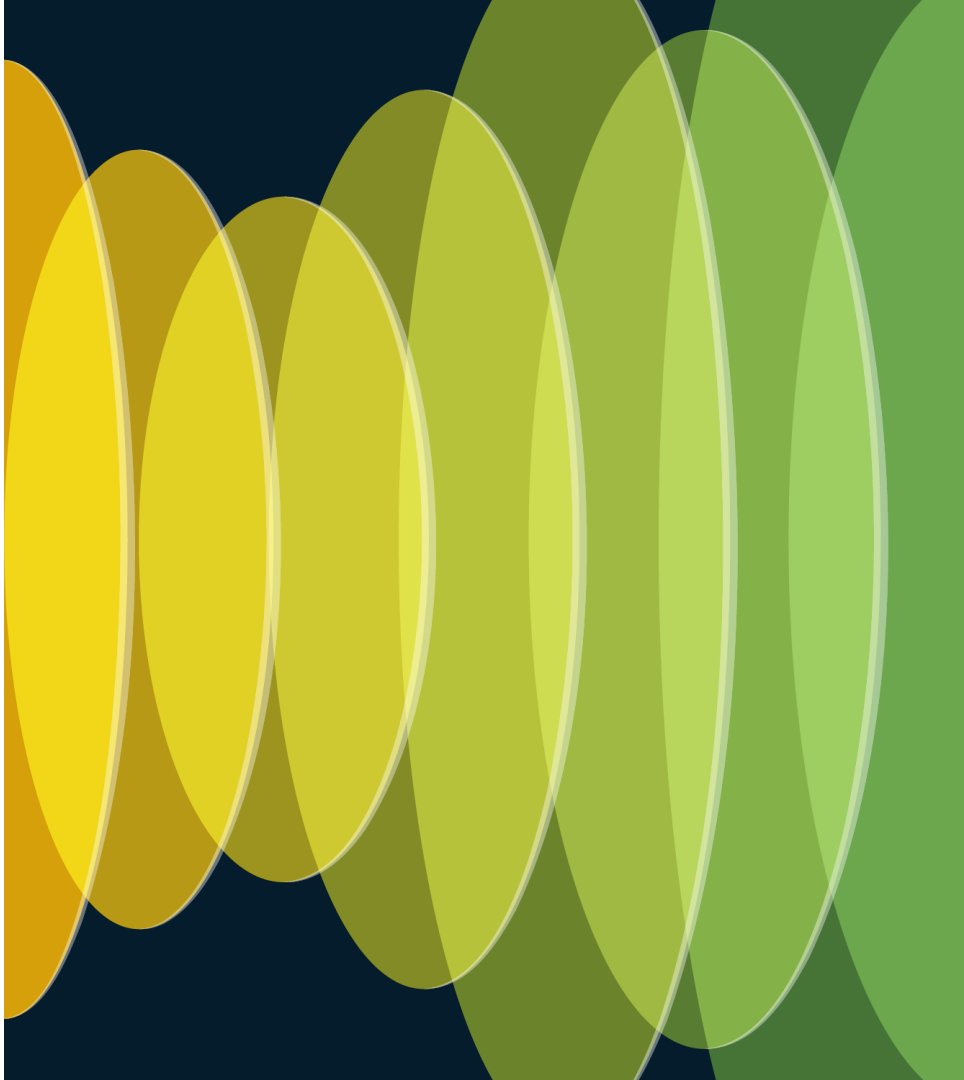
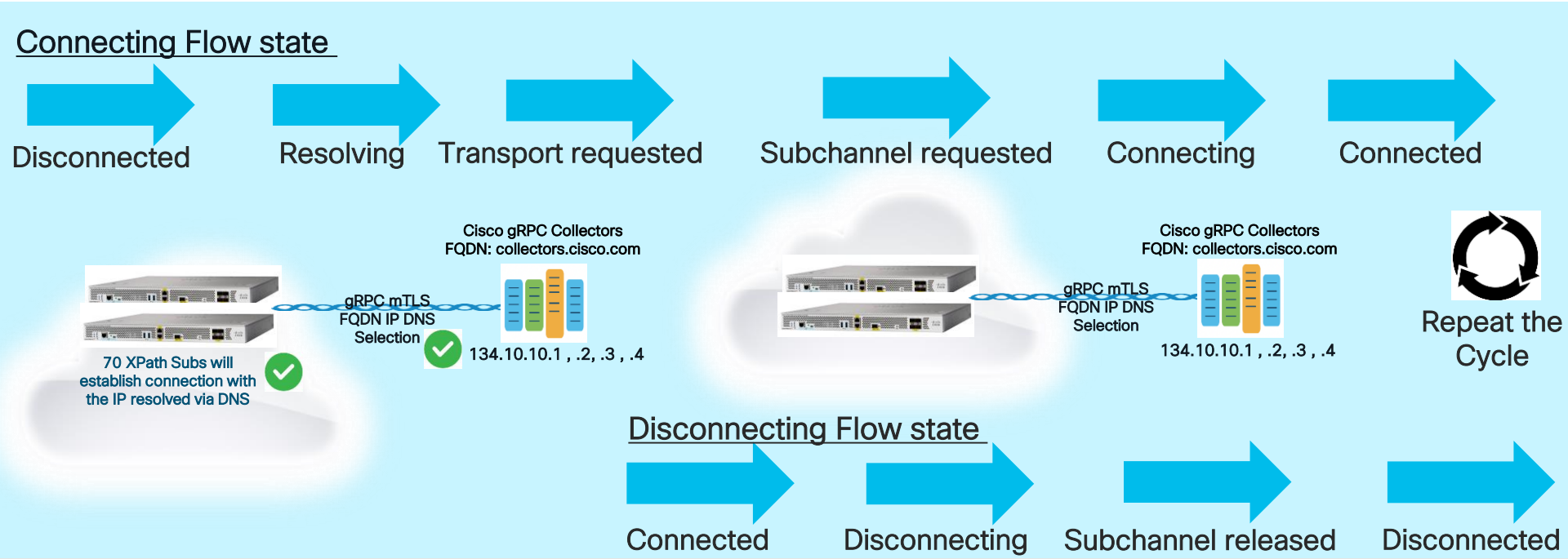
MDT Connection State Flow



gRPC Dial-Out: High Availability Design Considerations



- There is a 15 second delay between Disconnecting and Connecting flow states.
- Flow states are per subscription: each individual subscription follows these workflows
- A single IP is resolved for each FQDN based DNS subscription.
  - If FQDN resolves to multiple IP only 1 will be used for the connection.
  - When multiple subscriptions/XPaths goes to the same FQDN with multiple IP, there will be connections built to each IP provided by DNS.

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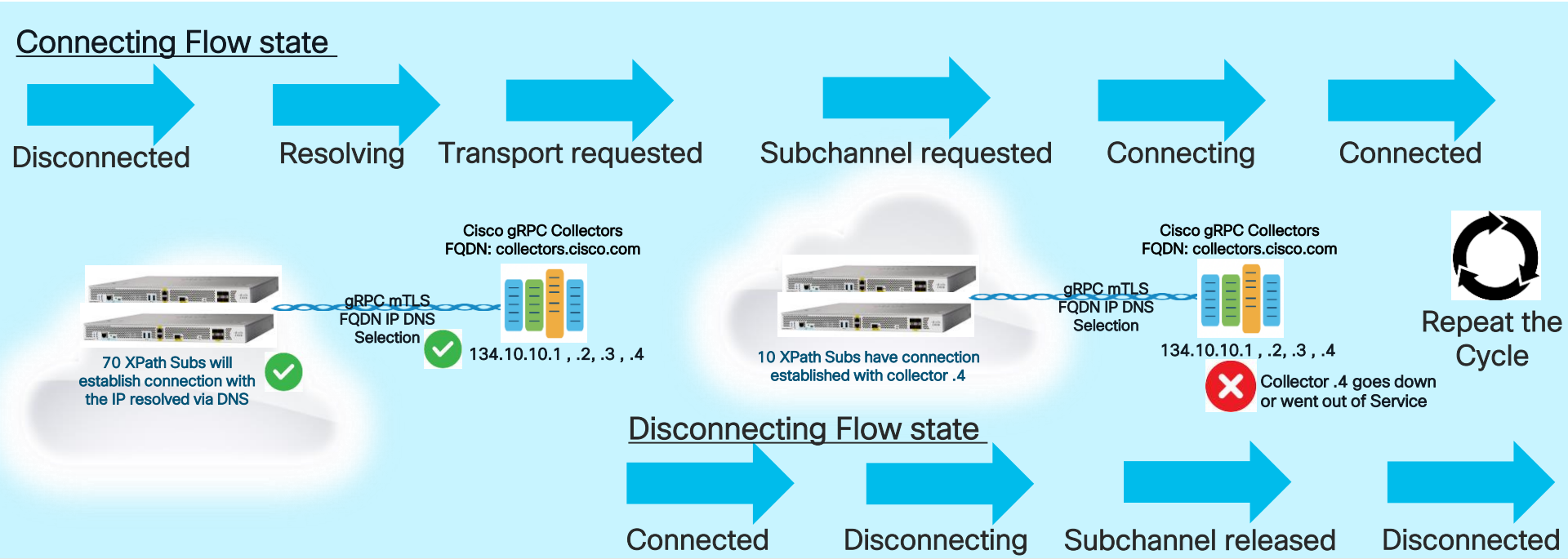

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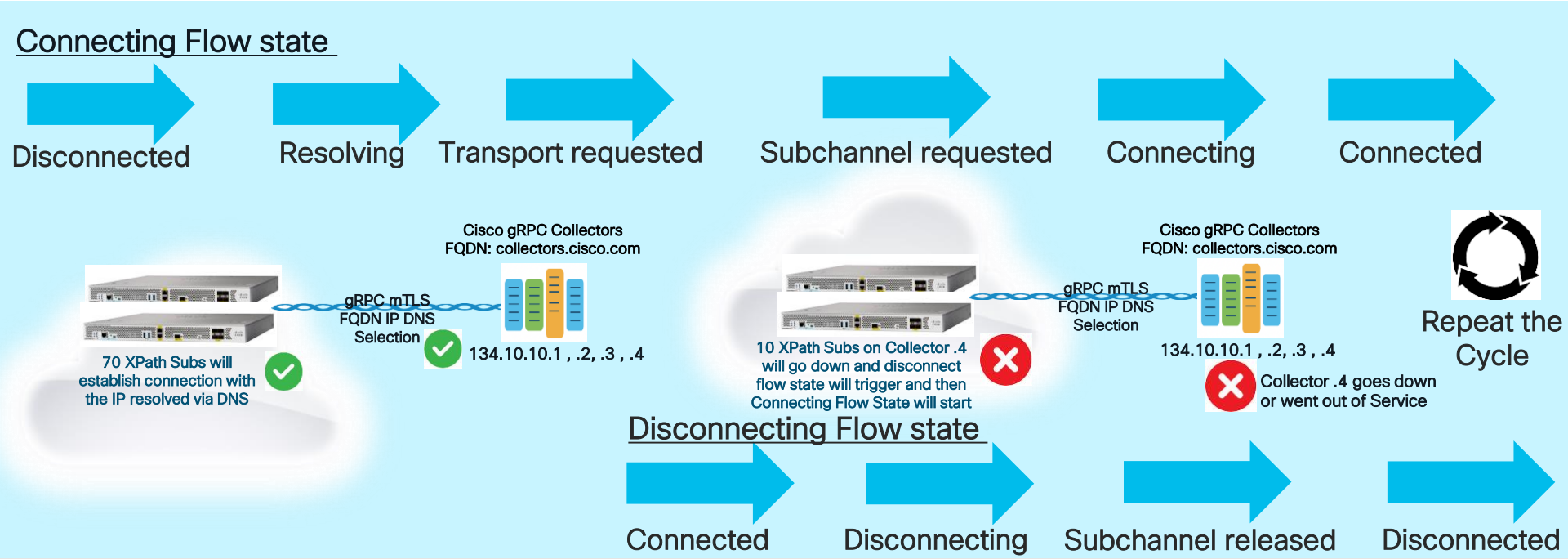

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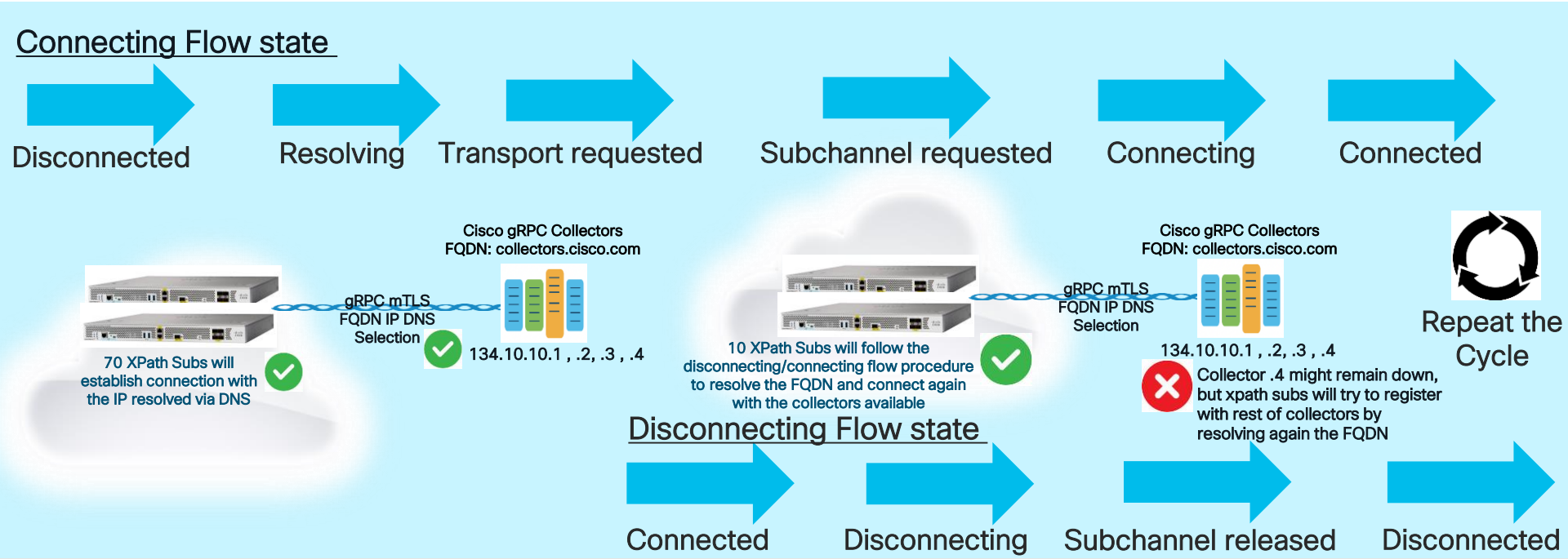

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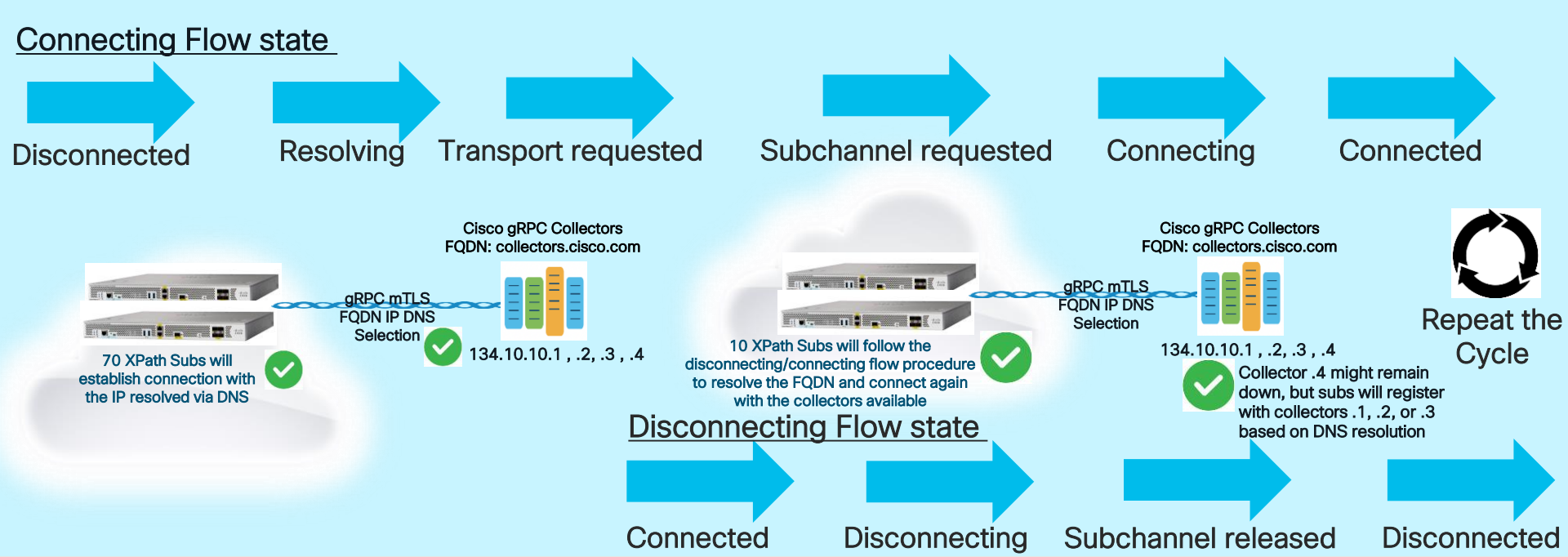

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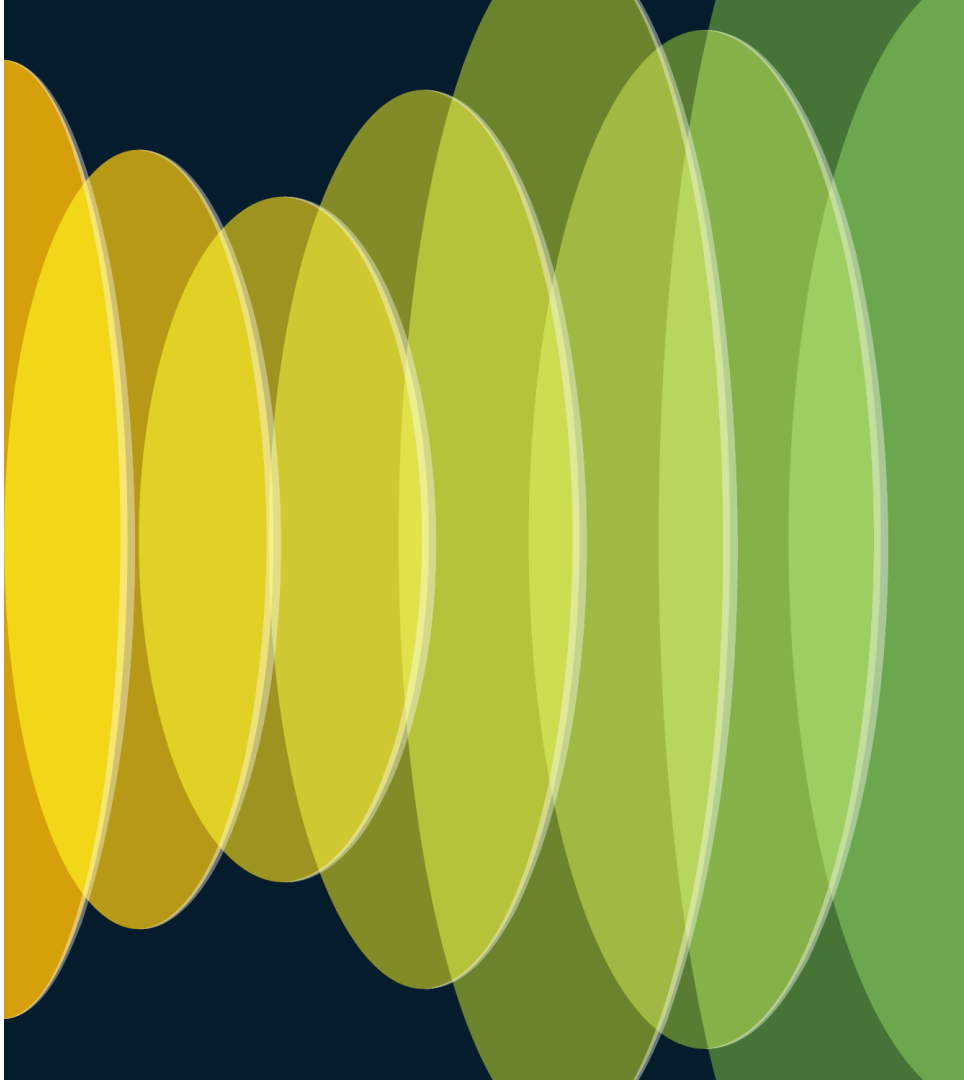
Design Considerations



Scale Design Considerations

- Max Subscriptions on 9800 WLCs- 128
  - Catalyst Center will consume ~85, DNA Spaces ~10-12.
- Subscribe to the closest leaf possible to avoid abundance of streaming data.
- Monitor Pubd process for CPU to balance subscriptions.
  - High Roaming rates or Client joins/dis-joins will impact performance.
- Catalyst Center when used with gRPC mTLS, cert expiry/renewals Keep an eye.

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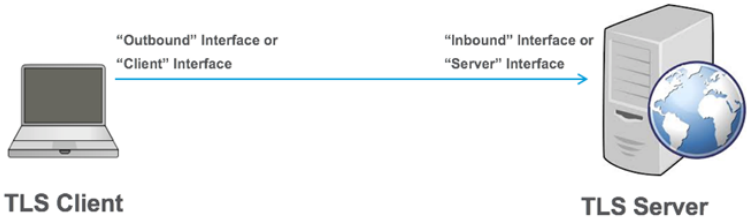
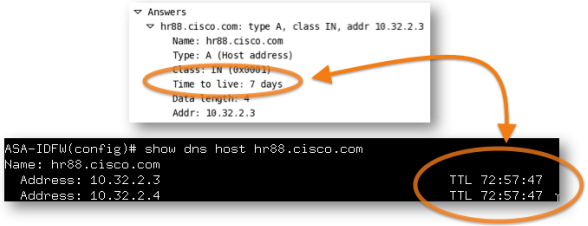
Important Design Considerations



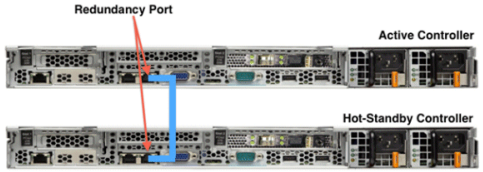
➢ Secure your Transport

Access to information is critical and you want to make sure you are securing your streaming telemetry deployment. Cisco recommendation is to use TLS/mTLS (mutual Transport-Layer Security).



➢ Define your FQDN Strategy

Use an FQDN to host your collectors. It will be better for scalability and fast grow of new VMs/Containers. Setup your DNS per regions, geolocation, weight, etc.



➢ Thing about Redundancy

Make sure each element of your telemetry design is fully redundant for better reliability and availability of the service (Routers, Load-Balancers, Controllers, etc).

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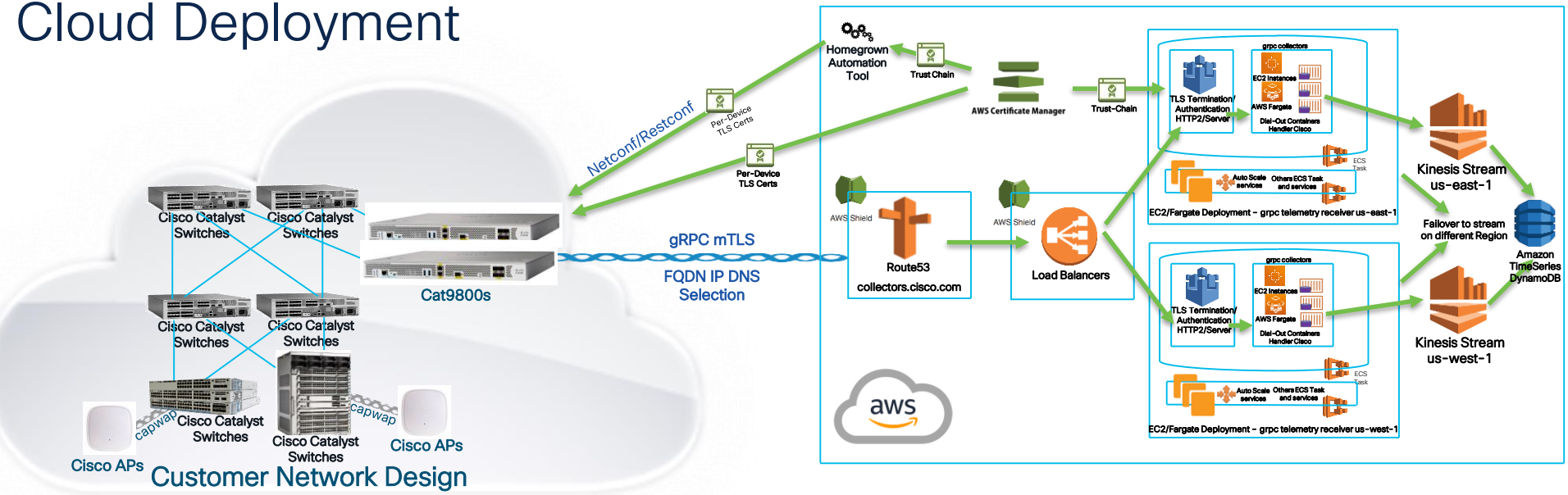
Customer Reference Architecture
Cloud Deployment



- Move away from Multiple SNMP instances/data sources to centralized your streaming monitoring infrastructure.
- Move towards an active telemetry dial-out solution to collect all data in the cloud of preference (AWS, GCP, Azure).
- Secure the transport (mTLS) of the monitored infrastructure.
- Support of FQDN to stream the data to multiple collectors across different regions.
- Configure xPath subscriptions as needed (Support 128 subs on XE release 17.9.1+).
- Build automation based on the KPIs and metrics received in real time.

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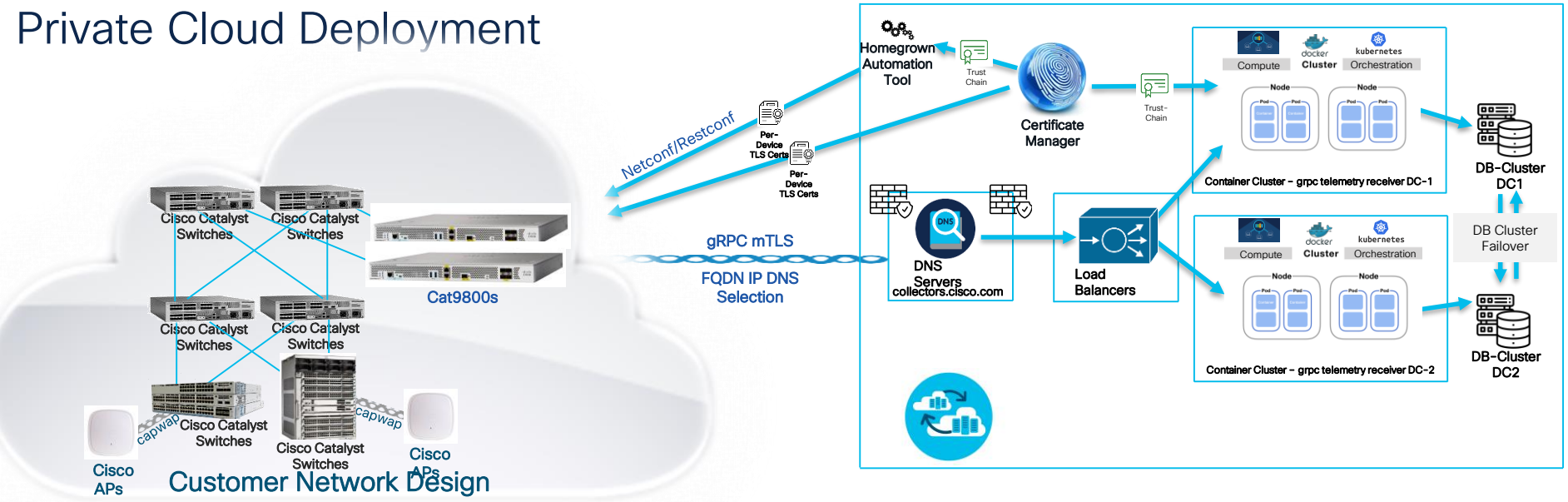
Customer Reference Architecture
Private Cloud Deployment



- Move away from Multiple SNMP instances/data sources to centralized your streaming monitoring infrastructure.
- Move towards an active telemetry dial-out solution to collect all data in the private cloud (Data Centers).
- Secure the transport (mTLS) of the monitored infrastructure.
- Support of FQDN to stream the data to multiple collectors across different locations.
- Configure xPath subscriptions as needed (We support 128 subs on XE release 17.9.1).
- Build automation based on the KPIs and metrics received in real time.

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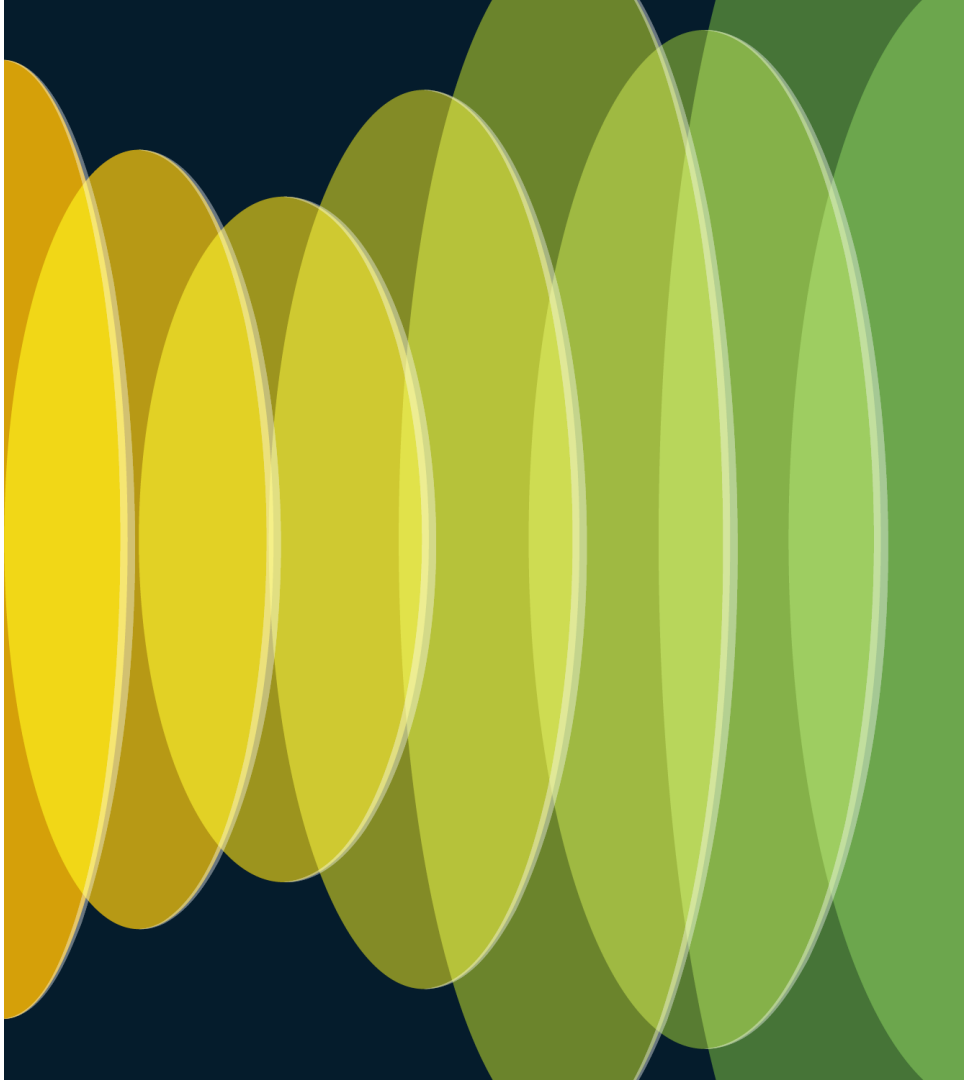
Telemetry Design at Scale



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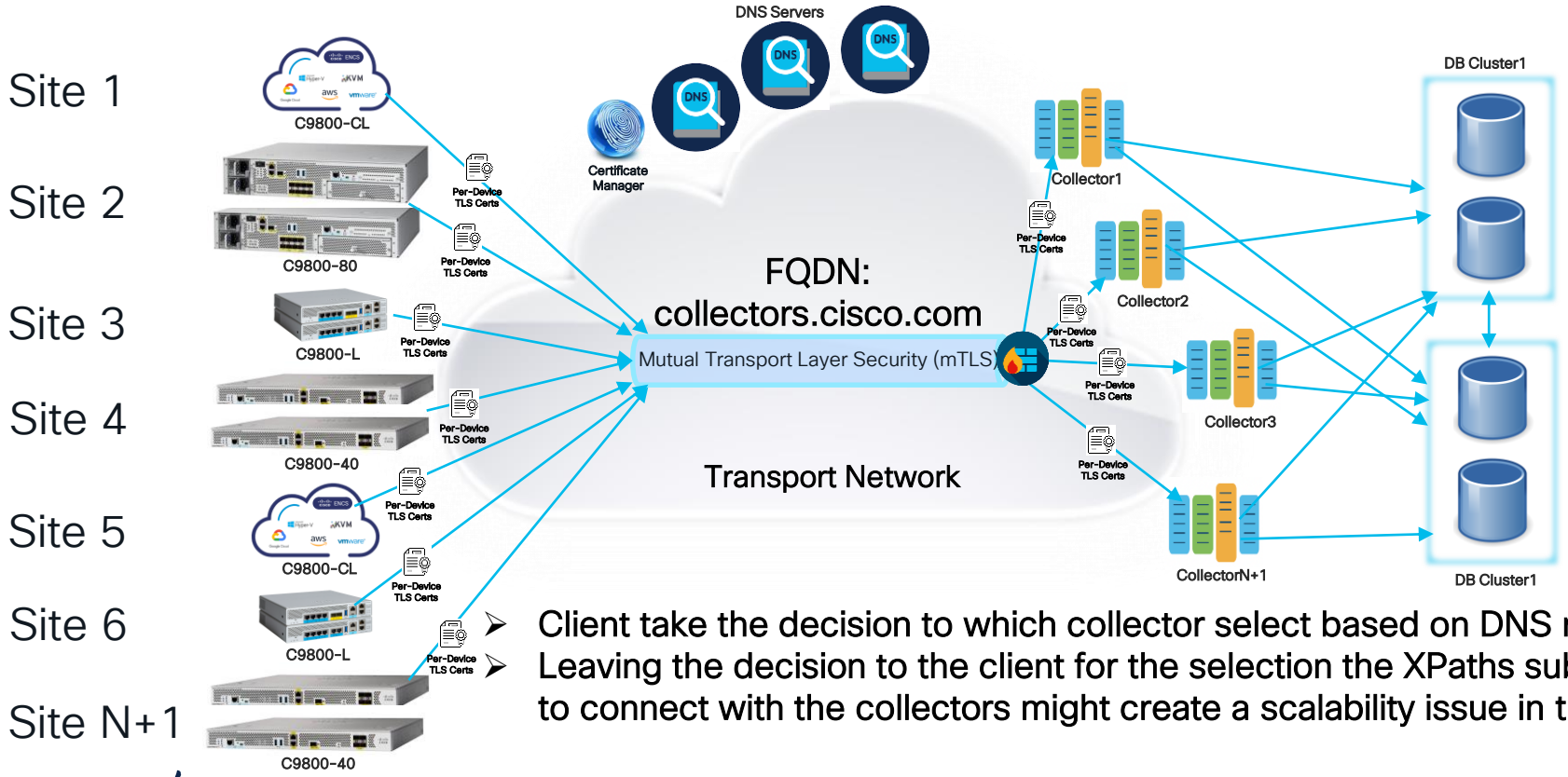
Scaling your Telemetry deployment

Minimum scaling deployment: FQDN with Multiple Collectors



- Client take the decision to which collector select based on DNS resolution.
- Leaving the decision to the client for the selection the XPaths subscriptions to connect with the collectors might create a scalability issue in the future.

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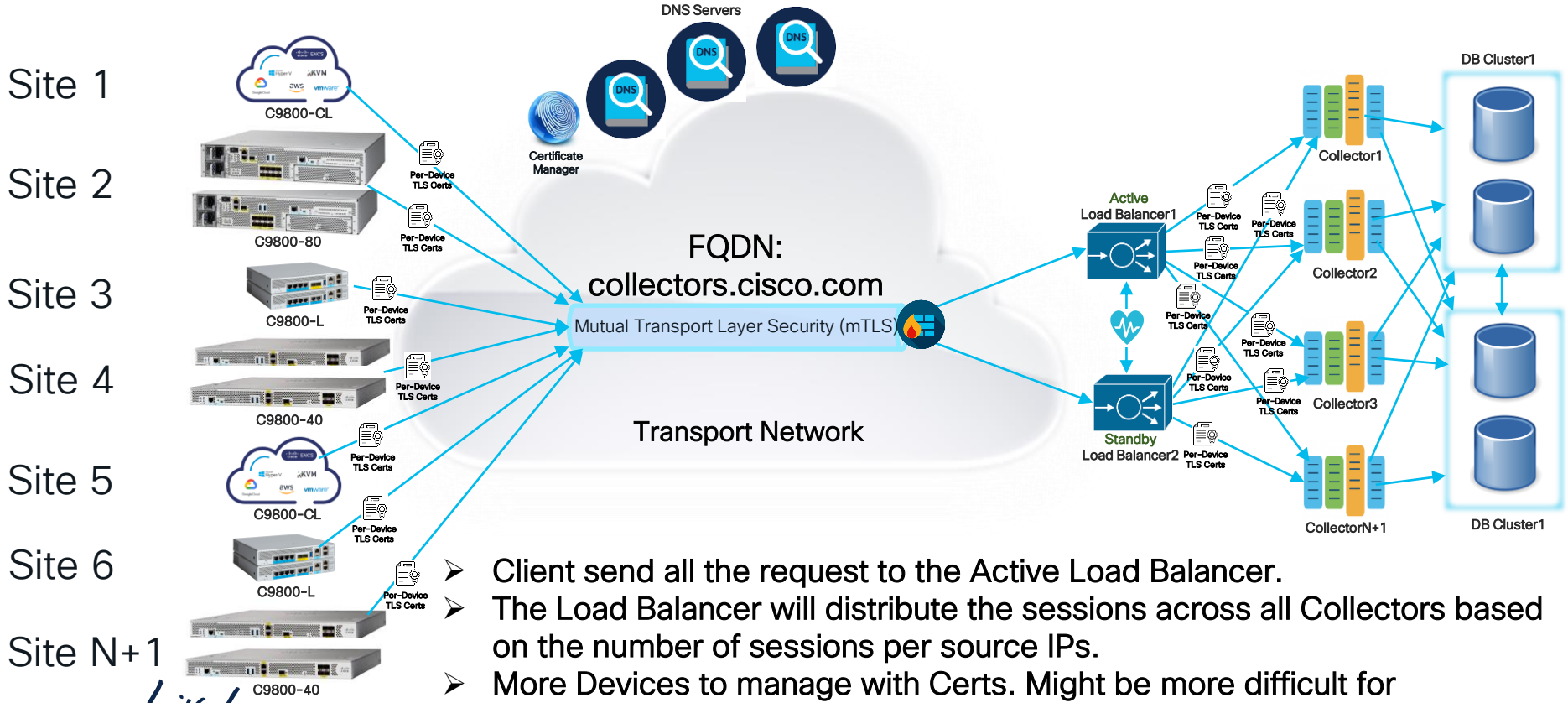
Scaling your Telemetry deployment

Good scaling deployment: Active/Standby mTLS passthrough Multiple Collectors



- Client send all the request to the Active Load Balancer.
- The Load Balancer will distribute the sessions across all Collectors based on the number of sessions per source IPs.
- More Devices to manage with Certs. Might be more difficult for Troubleshoot.

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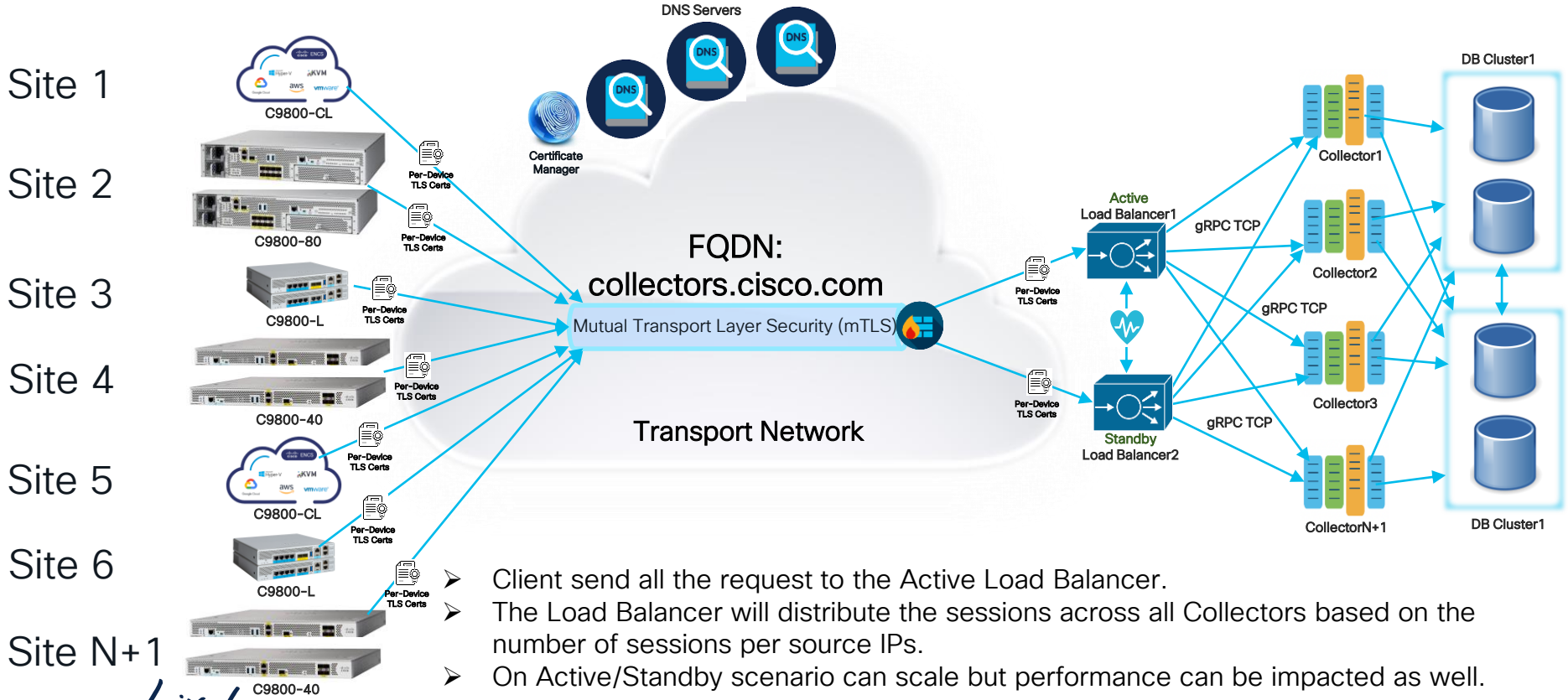
Scaling your Telemetry deployment

Optimal scaling deployment: Active/Standby Load Balances with Multiple Collectors



- Client send all the request to the Active Load Balancer.
- The Load Balancer will distribute the sessions across all Collectors based on the number of sessions per source IPs.
- On Active/Standby scenario can scale but performance can be impacted as well.

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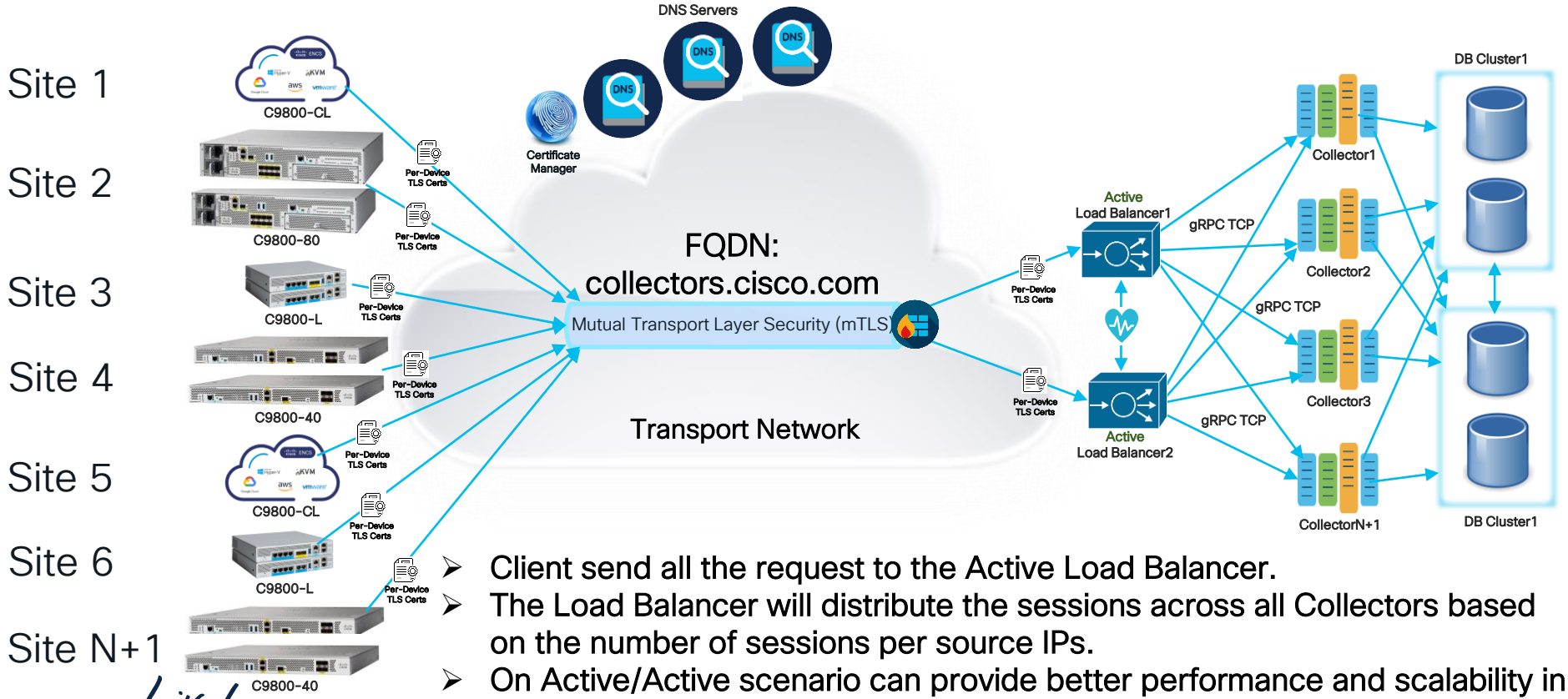
Scaling your Telemetry deployment

Optimal scaling deployment: Active/Active Load Balances with Multiple Collectors



- Client send all the request to the Active Load Balancer.
- The Load Balancer will distribute the sessions across all Collectors based on the number of sessions per source IPs.
- On Active/Active scenario can provide better performance and scalability in the long term.

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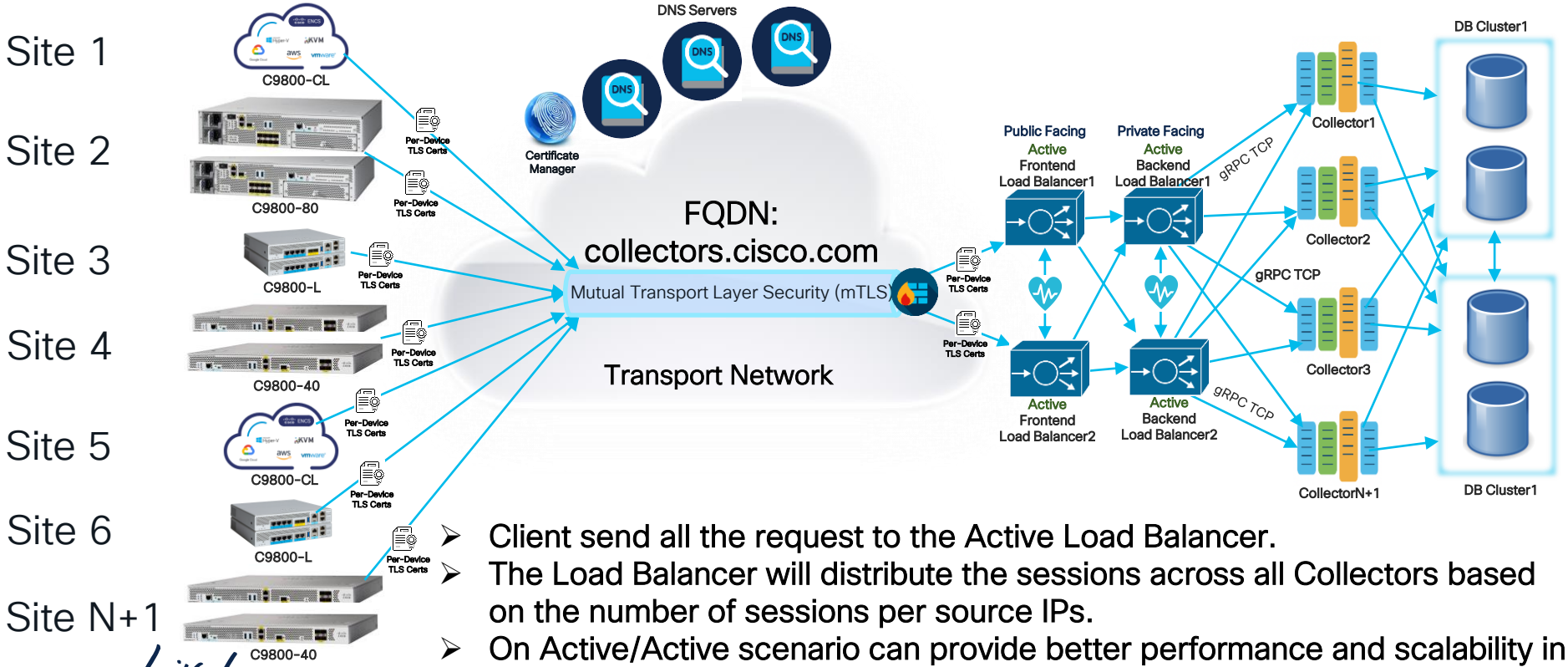
Scaling your Telemetry deployment

Best scaling Deployment: Dual Layer Load Balancers to the Collectors



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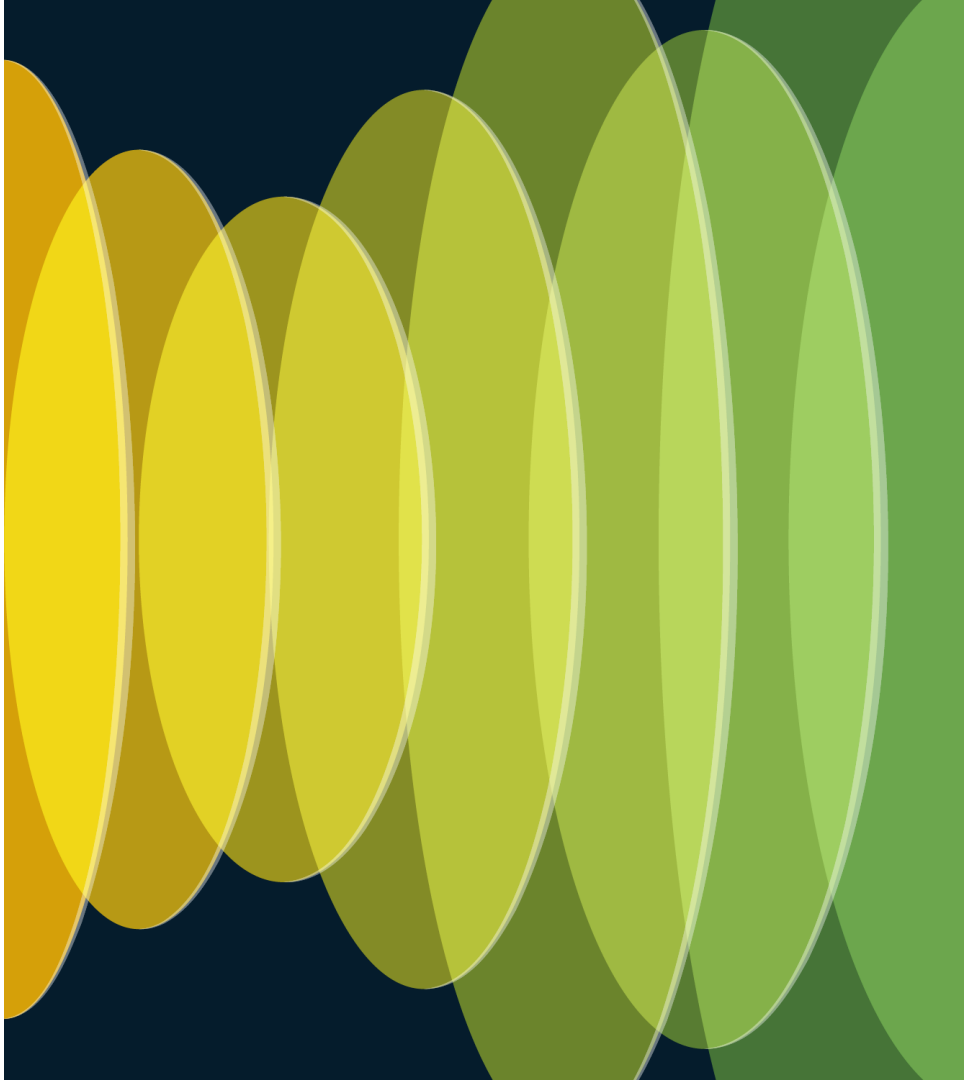
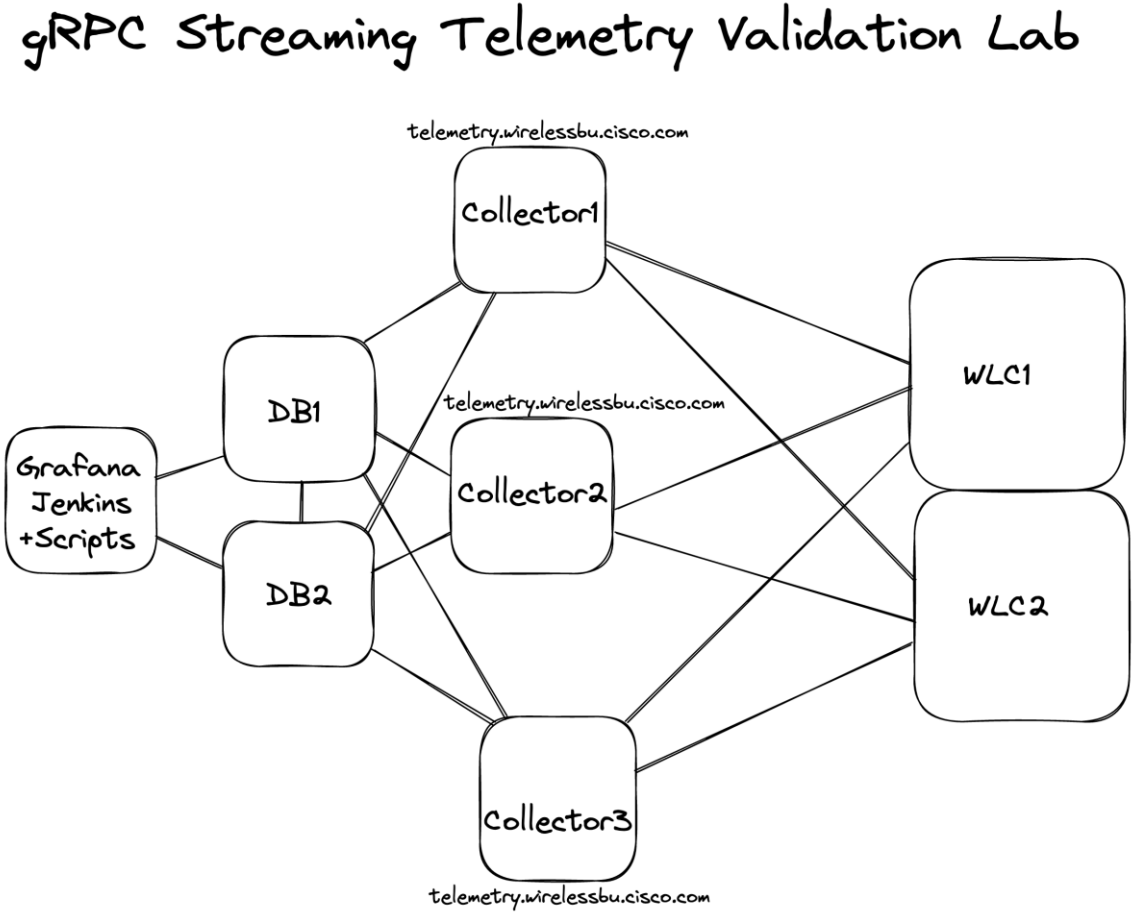
Performance and Validation



Performance and Validation:



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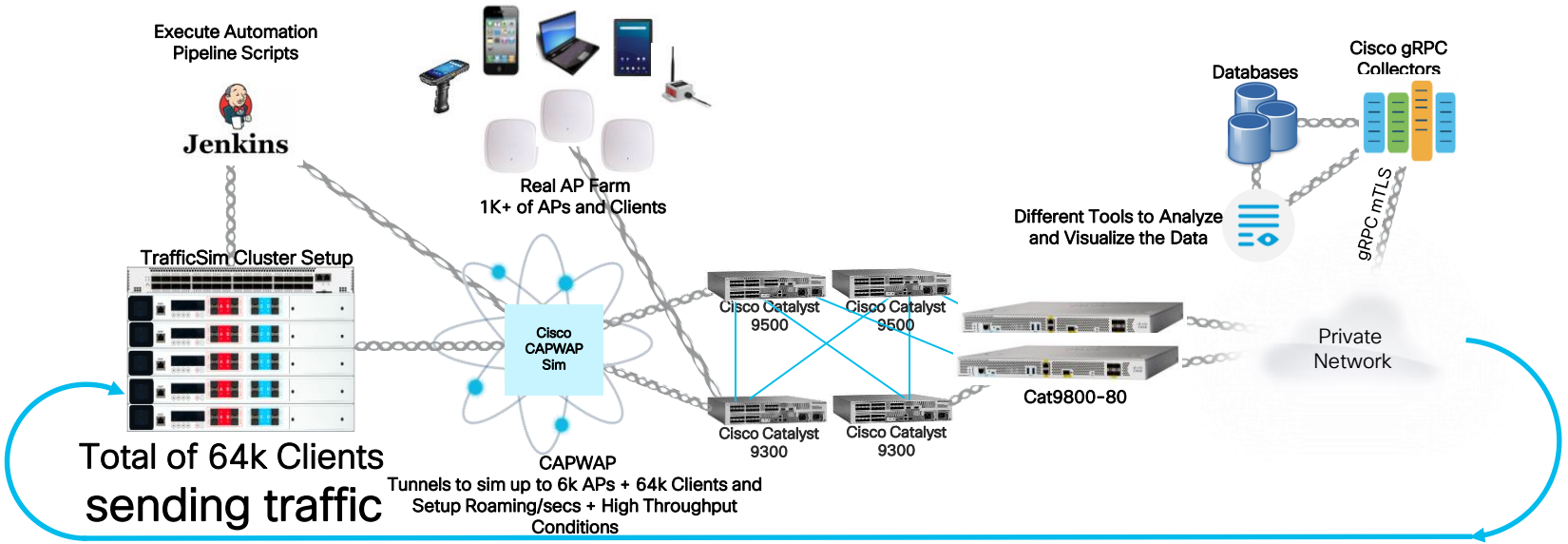
Testing and Validation at Scale with Wireless BU Team



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Testing and Validation at Scale with Wireless BU Team

4k x APs + 15k Clients with ~25+ xPath Subscriptions

```
C9800-80-WLC:sh ap summary
Number of APs: 4002
```

AP Name	Slots	AP Model	Ethernet MAC	Radio MAC	Location	Country	IP Address	State
EWLC-ASIM2-JSATHURA-AP-1	3	C9130AXE-B	002c.3400.02f0	002c.3400.0200	default-location	US	120.1.180.20	Registered
EWLC-ASIM2-JSATHURA-AP-2	3	C9130AXE-B	002c.3400.03f0	002c.3400.0300	default-location	US	120.1.180.21	Registered
EWLC-ASIM2-JSATHURA-AP-3	3	C9130AXE-B	002c.3400.04f0	002c.3400.0400	default-location	US	120.1.180.22	Registered
EWLC-ASIM2-JSATHURA-AP-4	3	C9130AXE-B	002c.3400.05f0	002c.3400.0500	default-location	US	120.1.180.23	Registered
EWLC-ASIM2-JSATHURA-AP-5	3	C9130AXE-B	002c.3400.06f0	002c.3400.0600	default-location	US	120.1.180.24	Registered
EWLC-ASIM2-JSATHURA-AP-6	3	C9130AXE-B	002c.3400.07f0	002c.3400.0700	default-location	US	120.1.180.25	Registered
EWLC-ASIM2-JSATHURA-AP-7	3	C9130AXE-B	002c.3400.08f0	002c.3400.0800	default-location	US	120.1.180.26	Registered

```
C9800-80-WLC:sh wireless client summary
Number of Clients: 15000
```

MAC Address	AP Name	Type	ID	State	Protocol	Method	Role
0000.0134.0001	EWLC-ASIM3-JSATHURA-AP-1	WLAN	13	Run	11a	None	Local
0000.0134.0002	EWLC-ASIM3-JSATHURA-AP-1	WLAN	13	Run	11a	None	Local
0000.0134.0003	EWLC-ASIM3-JSATHURA-AP-1	WLAN	13	Run	11a	None	Local
0000.0134.0004	EWLC-ASIM3-JSATHURA-AP-1	WLAN	13	Run	11a	None	Local
0000.0134.0005	EWLC-ASIM3-JSATHURA-AP-2	WLAN	13	Run	11a	None	Local
0000.0134.0006	EWLC-ASIM3-JSATHURA-AP-2	WLAN	13	Run	11a	None	Local
0000.0134.0007	EWLC-ASIM3-JSATHURA-AP-2	WLAN	13	Run	11a	None	Local
0000.0134.0008	EWLC-ASIM3-JSATHURA-AP-2	WLAN	13	Run	11a	None	Local
0000.0134.0009	EWLC-ASIM3-JSATHURA-AP-3	WLAN	13	Run	11a	None	Local
0000.0134.000a	EWLC-ASIM3-JSATHURA-AP-3	WLAN	13	Run	11a	None	Local
0000.0134.000b	EWLC-ASIM3-JSATHURA-AP-3	WLAN	13	Run	11a	None	Local
0000.0134.000c	EWLC-ASIM3-JSATHURA-AP-3	WLAN	13	Run	11a	None	Local

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Testing and Validation at Scale with Wireless BU Team

4k x APs + 15k Clients with ~25+ XPath Subscriptions and 300 roaming/sec

Client roaming rate

```
C9800-80-WLC:sh wireless stats mobility

Mobility event statistics:
     Joined as
          Local                          : 10000
          Foreign                        : 0
          Export foreign                 : 0
          Export anchor                  : 0
     Delete
          Local                          : 5000
          Remote                         : 0
     Role changes
          Local to anchor                : 0
          Anchor to local                : 0
     Roam stats
          L2 roam count                  : 75
          L3 roam count                  : 0
          Flex client roam count         : 0
          Inter-WNCd roam count          : 75
          Intra-WNCd roam count          : 0
          Remote inter-cntrl roam count  : 0
          Remote WebAuth pending roams   : 0
     Anchor Request
          Sent                           : 0
            Grant received               : 0
            Deny received                : 0
```

Increase of roaming rate

```
C9800-80-WLC:sh wireless stats mobility

Mobility event statistics:
     Joined as
          Local                          : 10000
          Foreign                        : 0
          Export foreign                 : 0
          Export anchor                  : 0
     Delete
          Local                          : 5000
          Remote                         : 0
     Role changes
          Local to anchor                : 0
          Anchor to local                : 0
     Roam stats
          L2 roam count                  : 400
          L3 roam count                  : 0
          Flex client roam count         : 0
          Inter-WNCd roam count          : 400
          Intra-WNCd roam count          : 0
          Remote inter-cntrl roam count  : 0
          Remote WebAuth pending roams   : 0
     Anchor Request
          Sent                           : 0
            Grant received               : 0
            Deny received                : 0
          Received                       : 0
            Grant sent                   : 0
            Deny  sent                   : 0
     Handoff Status Received
          Success                        : 425
          Group mismatch                 : 0
          Client unknown                 : 0
          Client blacklisted             : 0
          SSID mismatch                  : 0
```


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Results of Performance and Validation at Scale

4k x APs + 15k Clients with ~25+ XPath Subscriptions and 300 rc

```
C9800-80-WLC:show telemetry internal subscription all stats
Telemetry subscription stats:
```

Subscription ID	Msgs Sent	Msgs Drop	Bytes Sent	Connection Info
375	7704	0	29627	(9.1.0.3:57666)
374	7640	0	32960	(9.1.0.3:57666)
373	7636	0	33263	(9.1.0.3:57666)
372	7631	0	32960	(9.1.0.3:57666)
371	7638	0	33869	(9.1.0.3:57666)
361	7161	0	32618	(9.1.0.3:57666)
354	7139	0	40999	(9.1.0.3:57666)
353	7150	0	50651	(9.1.0.3:57666)
352	7181	0	51403	(9.1.0.3:57666)
351	7137	0	35508	(9.1.0.3:57666)
341	1463	0	1381034	(9.1.0.3:57666)
331	154	0	713950	(9.1.0.3:57666)
322	21555	0	139335	(9.1.0.3:57666)
321	4366	0	20921	(9.1.0.3:57666)
311	1548	0	13073	(9.1.0.3:57666)
304	2528	0	24864	(9.1.0.3:57666)
303	2528	0	19964	(9.1.0.3:57666)
302	2528	0	26439	(9.1.0.3:57666)
301	2527	0	20489	(9.1.0.3:57666)
171	441705	0	73319656	(9.1.0.3:57666)
170	4620	0	24065	(9.1.0.3:57666)
169	4620	0	25353	(9.1.0.3:57666)
168	4628	0	25905	(9.1.0.3:57666)
167	4625	0	26089	(9.1.0.3:57666)
166	4612	0	26641	(9.1.0.3:57666)
165	441867	0	77322937	(9.1.0.3:57666)
164	4618	0	24801	(9.1.0.3:57666)
163	4619	0	24801	(9.1.0.3:57666)
162	4615	0	24985	(9.1.0.3:57666)
161	4365	0	30073	(9.1.0.3:57666)
160	4364	0	26553	(9.1.0.3:57666)
159	4364	0	25849	(9.1.0.3:57666)
158	1547	0	18257	(9.1.0.3:57666)
157	1547	0	17825	(9.1.0.3:57666)
156	1547	0	19229	(9.1.0.3:57666)
155	1547	0	17177	(9.1.0.3:57666)
154	1547	0	20417	(9.1.0.3:57666)
153	1547	0	16961	(9.1.0.3:57666)
152	139347	0	26352513	(9.1.0.3:57666)
151	1547	0	20201	(9.1.0.3:57666)
150	140261	0	25944894	(9.1.0.3:57666)
149	94	0	14711	(9.1.0.3:57666)
148	138	0	14993	(9.1.0.3:57666)
147	1546	0	17285	(9.1.0.3:57666)
145	1640354	0	317201638	(9.1.0.3:57666)
144	7633	0	79251	(9.1.0.3:57666)
143	2310	0	636290	(9.1.0.3:57666)
142	462	0	186069	(9.1.0.3:57666)
141	462	0	151051	(9.1.0.3:57666)
140	462	0	28621	(9.1.0.3:57666)
139	26681	0	9837471	(9.1.0.3:57666)
138	462	0	36426124	(9.1.0.3:57666)
137	693	0	4009315	(9.1.0.3:57666)
136	693	0	71587	(9.1.0.3:57666)
135	693	0	71587	(9.1.0.3:57666)
134	45045	0	154153819	(9.1.0.3:57666)
133	462	0	57727	(9.1.0.3:57666)
132	462	0	72973	(9.1.0.3:57666)
131	462	0	129106	(9.1.0.3:57666)
130	462	0	1607506	(9.1.0.3:57666)

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For your reference:

Most stable IOS-XE version for gRPC: 17.12.3 and higher

List of recommended Wireless XPath at scale with Time Period:

/wireless-access-point-oper:access-point-oper-data/ethernet-mac-wtp-mac-map	15 mins
/wireless-access-point-oper:access-point-oper-data/capwap-data	15 mins
/wireless-access-point-oper:access-point-oper-data/cdp-cache-data/	15 mins
/wireless-access-point-oper:access-point-oper-data/radio-oper-stats	60 secs
/wireless-access-point-oper:access-point-oper-data/radio-oper-data	180 secs
/wireless-access-point-oper:access-point-oper-data/oper-data	180 secs
/wireless-rrm-oper:rrm-oper-data/rrm-measurement	180 secs
/wireless-client-oper:client-oper-data/dot11-oper-data	180 secs
/wireless-client-oper:client-oper-data/common-oper-data	15 mins
/wireless-client-oper:client-oper-data/policy-data	60 secs
/wireless-client-oper:client-oper-data/sisf-db-mac/ipv4-binding/ip-key/ip-addr	15 mins
/wireless-client-oper:client-oper-data/traffic-stats	180 secs
/lldp-ios-xe-oper:lldp-entries/lldp-state-details	60 secs
/device-hardware-xe-oper:device-hardware-data/device-hardware	15 mins
/wireless-mobility-oper:mobility-oper-data/mobility-node-data/ulink-status	60 secs
/process-cpu-ios-xe-oper:cpu-usage/cpu-utilization/one-minute	60 secs
/platform-sw-ios-xe-oper:cisco-platform-software/control-processes	60 secs
/environment-ios-xe-oper:environment-sensors/environment-sensor	60 secs
/lldp-ios-xe-oper:lldp-entries/lldp-intf-details	60 secs
/interfaces-ios-xe-oper:interfaces/interface	60 secs
/platform-ios-xe-oper:components/component	60 secs
/mdt-oper-v2:mdt-oper-v2-data	60 secs
/wireless-access-point-oper:access-point-oper-data/radio-oper-data/radio-band-info	180 secs
/Cisco-IOS-XE-platform-software-oper	120 secs
/mdns-oper:mdns-oper-data/mdns-global-stats	300 secs
Cisco-IOS-XE-wireless-client-global-oper	300 secs
/aaa-ios-xe-oper:aaa-data/aaa-radius-global-stats	300 secs

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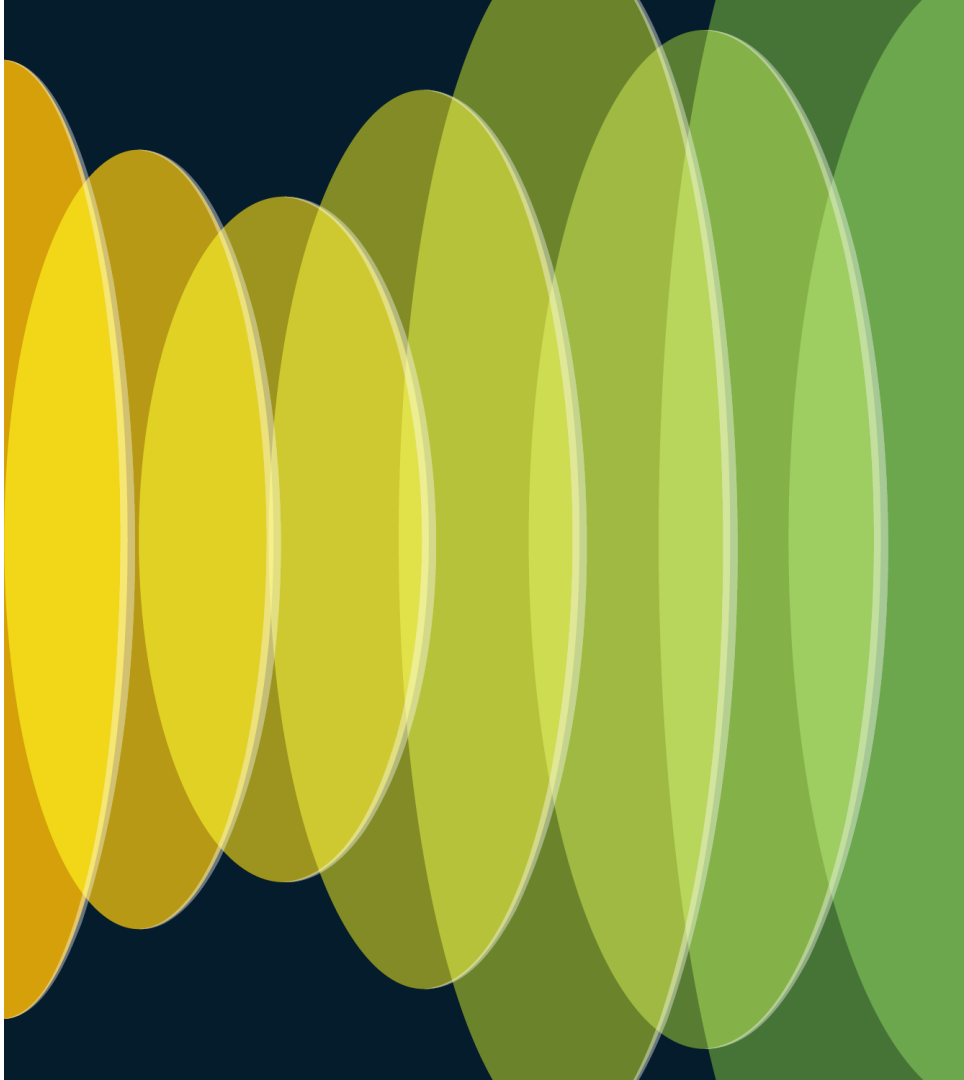
Real World Scenarios

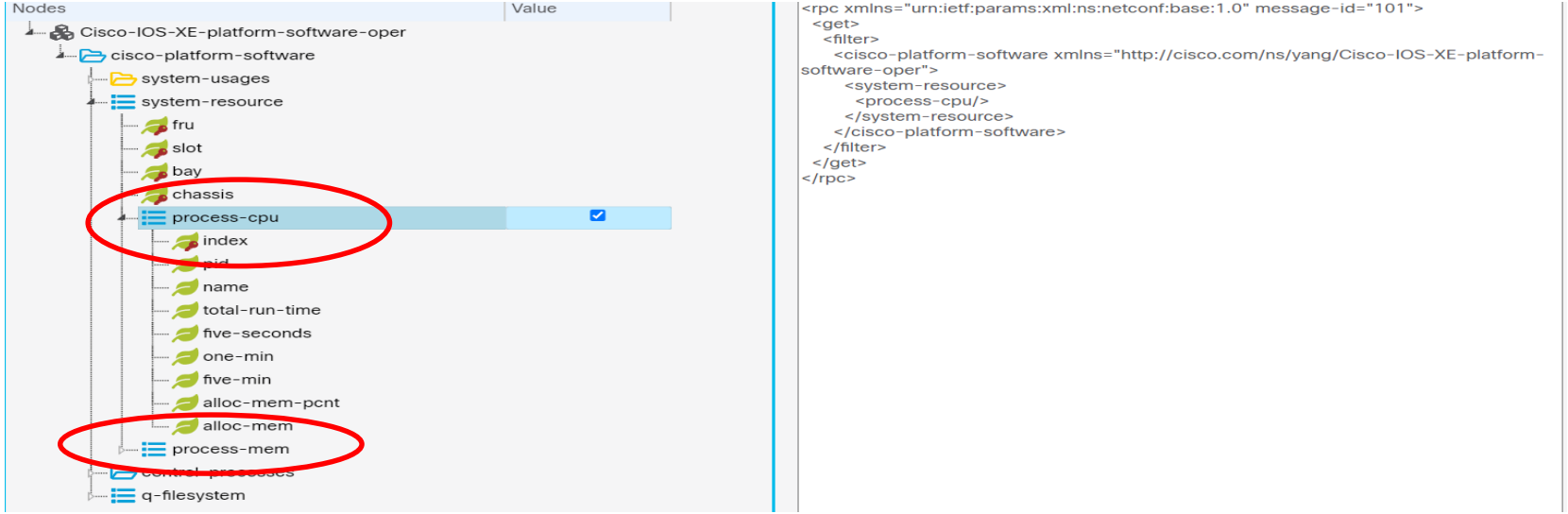


Real World Scenario 1 : Monitor & Track CPU/Memory

Monitor Top 32 Processes for CPU/Memory (WNCD, pubd, SNMP, odm,repm, smand etc)

CLI: show processes cpu platform sorted
show process memory platform sorted

17.14.1 XPath: Cisco-IOS-XE-platform-software-oper



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Monitor & Track CPU/Memory (Our Famous WNCD)

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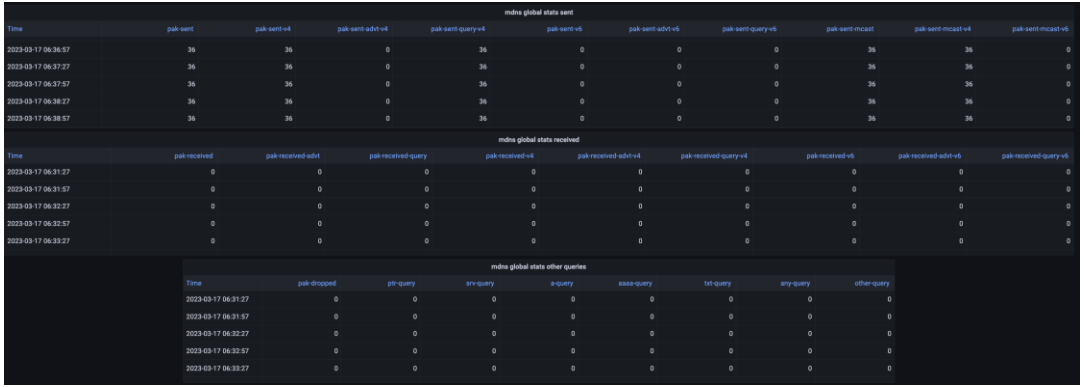
Real World Scenario 2 : Track mDNS Scale (EDU)

Apple Continuity service (mDNS) enabled leading to high WNCD CPU.
9105w APs seeing flood of mDNS from wired network causing sluggishness to Clients
CLI: show mdns-sd statistics
XPath: /mdns-oper:mdns-oper-data/mdns-global-stats



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Real World Scenario 3 : Control Plane Monitoring - WLC

Monitor Client Delete Reasons.

[Delete Reason Codes]

CLI: show wireless stats client detail
XPath: Cisco-IOS-XE-wireless-client-global-oper

```
Total client delete reasons
---------------------------
Controller deletes
---------------------------
---------------------------
Connection timeout                                  : 67
WPA key exchange timeout                            : 286
802.11w MAX SA queries reached                      : 816
Inter instance roam success                         : 16463 --> Good
Due to mobility failure                             : 164
DOT11r pre-authentication failure                   : 1004
SAE authentication failure                          : 1948
DOT11 failure                                       : 4
DOT11 IE validation failed                          : 6
DOT11 group cipher in IE validation failed          : 5
DOT11 invalid AKM                                   : 8
DOT11 received invalid PMKID in the received RSN IE : 19165 --> Result in Failed Roaming. Some failures are expected.
Client EAP ID timeout                               : 661
wrong replay counter                                : 4
MIC validation failed                               : 7
MAC theft                                           : 2
IP theft                                            : 15    --> Problem
Wrong PSK                                           : 37
AAA server unavailable                              : 6
L2-AUTH connection timeout                          : 43
Mobility connection timeout                         : 2
IP-LEARN connection timeout                         : 504
SAE Commit received in Associated State             : 18630  --> Result in Delayed Roaming ~1sec
WPA group key update timeout                        : 543
```


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Real World Scenario 4 : Prevent Radius Server Meltdowns

Monitor high Radius Failures, latency, Accounting updates to Radius Servers

CLI: show aaa servers brief , show aaa servers, show radius stats

XPath: Cisco-IOS-XE-aaa-oper

/aaa-ios-xe-oper:aaa-data/aaa-radius-stats

/aaa-ios-xe-oper:aaa-data/aaa-radius-global-stats

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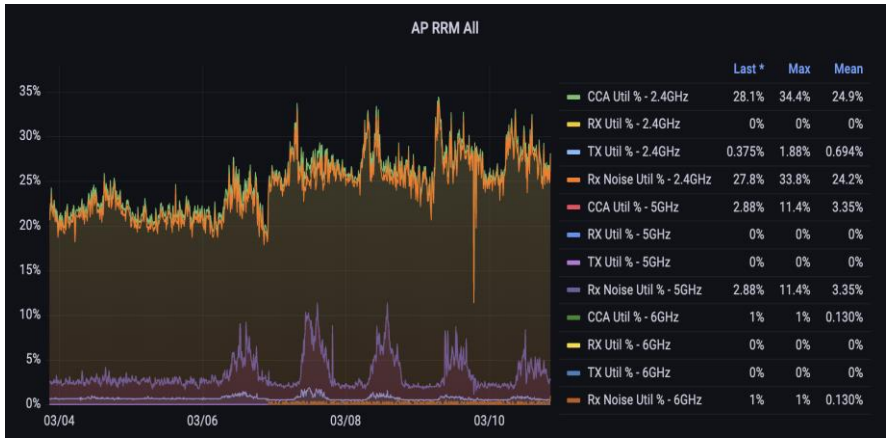
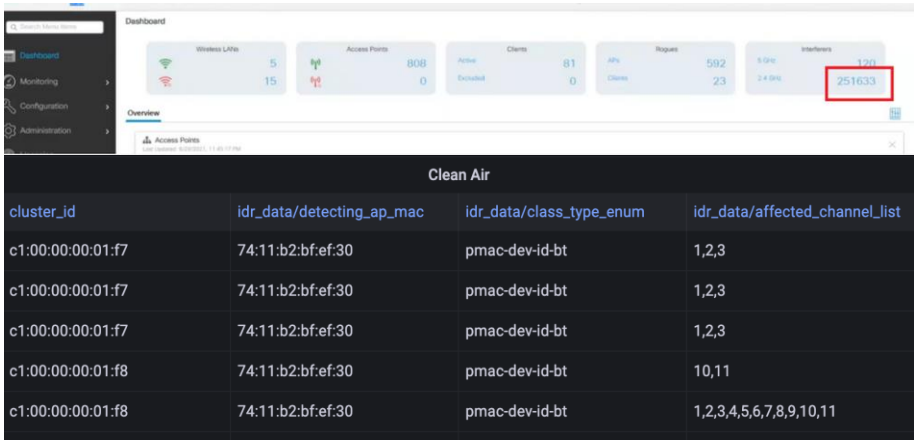
Real World Scenario 4 - High Interferers in 2.4/5 Ghz

WLC Clean air: High Interferers in 2.4Ghz leading to high WNCD CPU:

XPath: /wireless-rrm-oper:rrm-oper-data/rrm-measurement
/wireless-rrm-oper:rrm-oper-data/spectrum-device-table





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Real World Scenario 5: Data Plane Monitoring

CLI:show platform hardware chassis active qfp feature wireless punt statistics
xPath: In-progress

```
WLC#show platform hardware chassis active qfp feature wireless punt statistics
Load for five secs: 2%/0%; one minute: 3%; five minutes: 5%
Time source is NTP, 12:55:43.809 PDT Thu April 30 2024

CPP Wireless Punt stats:

                                    App Tag      Packet Count
                                    -------      ------------
          CAPWAP_PKT_TYPE_DOT11_PROBE_REQ           17631623
               CAPWAP_PKT_TYPE_DOT11_MGMT            5467005
               CAPWAP_PKT_TYPE_DOT11_IAPP           21226789
               CAPWAP_PKT_TYPE_DOT11_RFID                  0
                CAPWAP_PKT_TYPE_DOT11_RRM                  0
              CAPWAP_PKT_TYPE_DOT11_DOT1X             222793
         CAPWAP_PKT_TYPE_CAPWAP_KEEPALIVE            1884742
       CAPWAP_PKT_TYPE_MOBILITY_KEEPALIVE              54977
             CAPWAP_PKT_TYPE_CAPWAP_CNTRL          108411828
              CAPWAP_PKT_TYPE_CAPWAP_DATA                  0
           CAPWAP_PKT_TYPE_CAPWAP_DATA_PAT               1547
            CAPWAP_PKT_TYPE_MOBILITY_CNTRL              31398
                          WLS_SMD_WEBAUTH                   0
                       SISF_PKT_TYPE_ARP              376561
                      SISF_PKT_TYPE_DHCP              107490
                     SISF_PKT_TYPE_DHCP6               80339
                   SISF_PKT_TYPE_IPV6_ND              798456
                SISF_PKT_TYPE_DATA_GLEAN                1936
              SISF_PKT_TYPE_DATA_GLEAN_V6               26450
                 SISF_PKT_TYPE_DHCP_RELAY                   0
                  WLCLIENT_PKT_TYPE_MDNS                    0
          CAPWAP_PKT_TYPE_CAPWAP_RESERVED                   0
```


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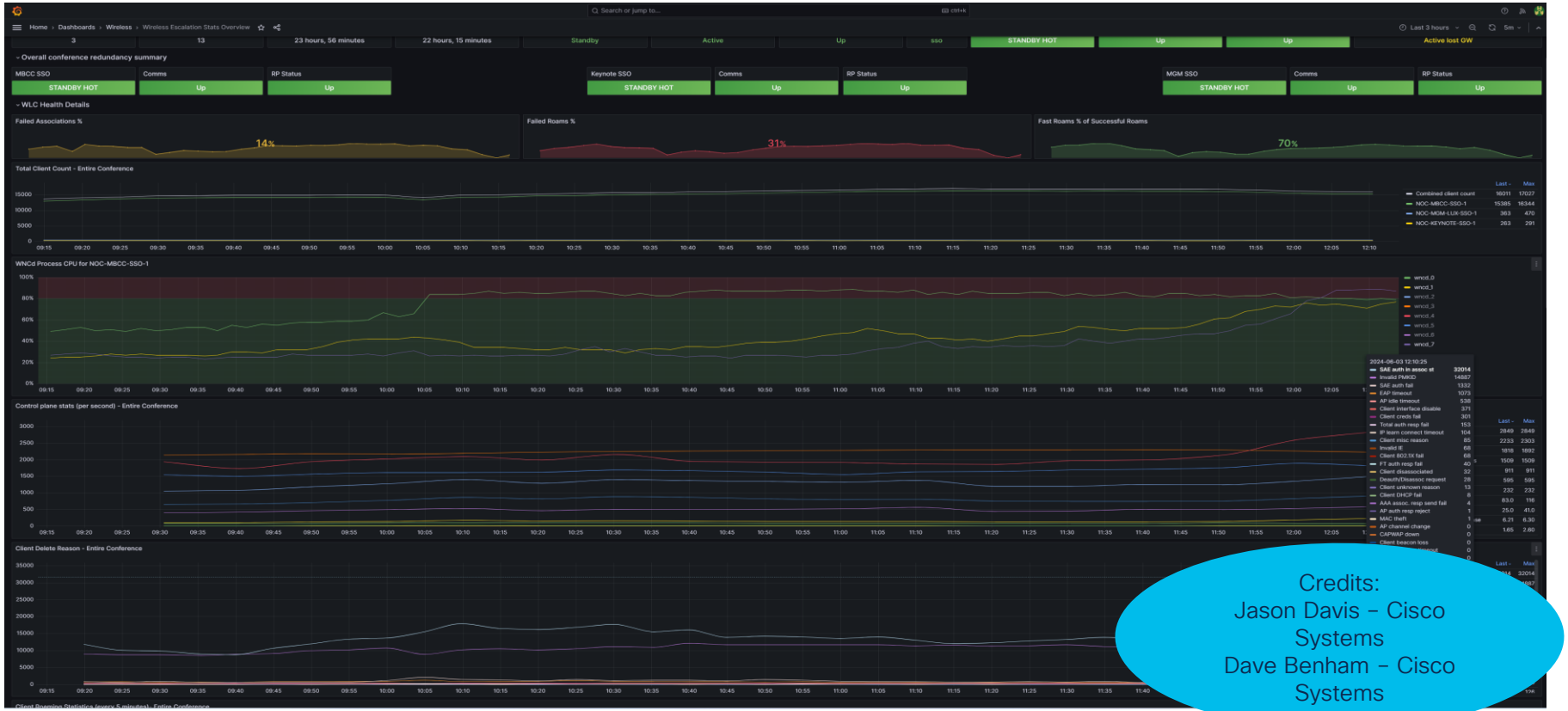
Real World Scenario – Big Picture/Demo



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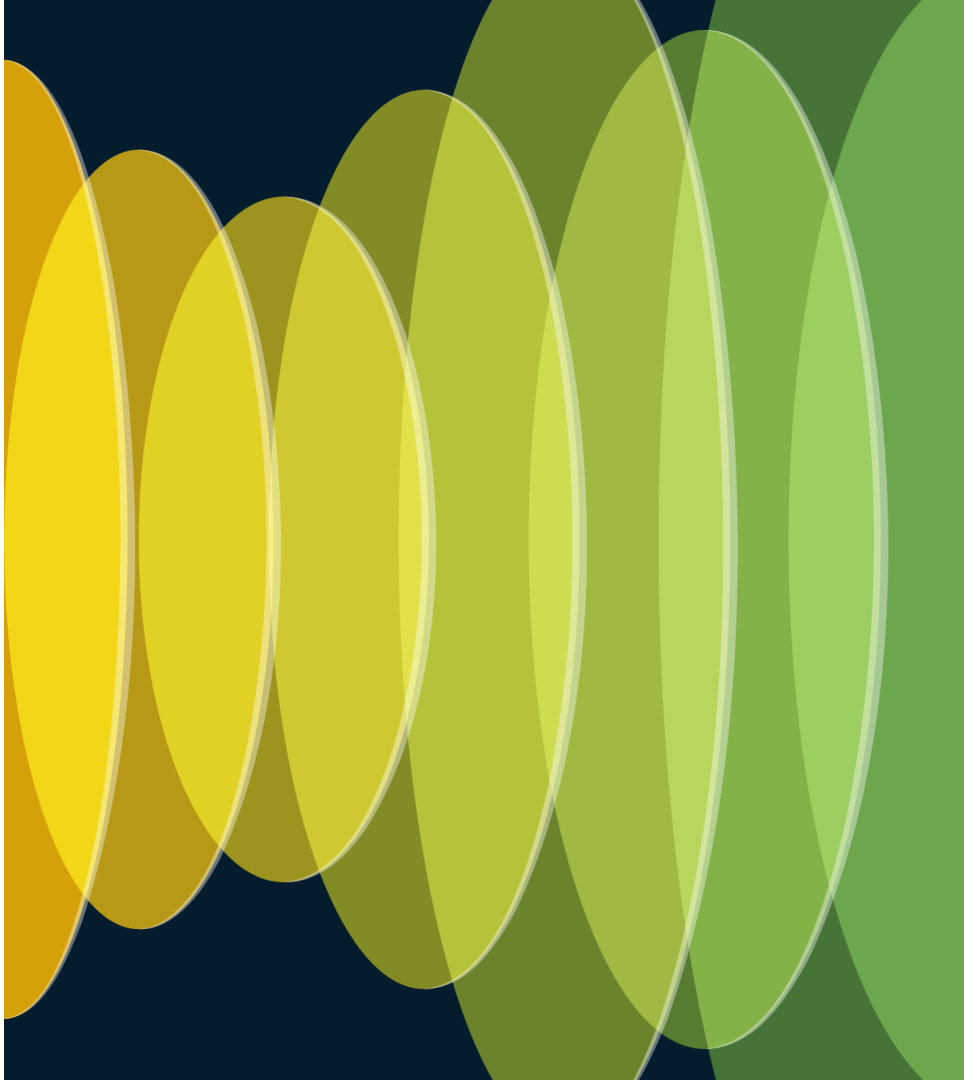
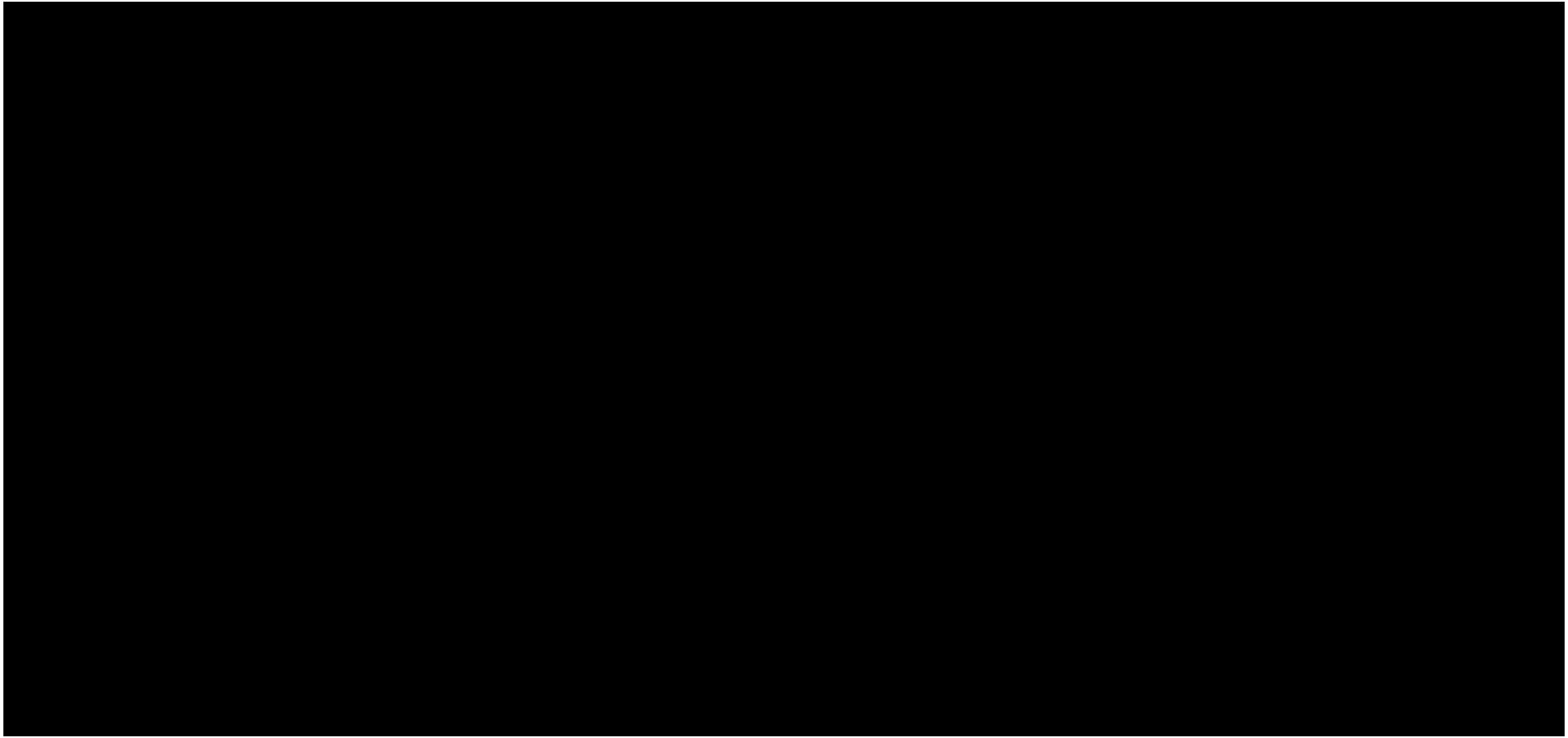
A Story



A Story – Real World



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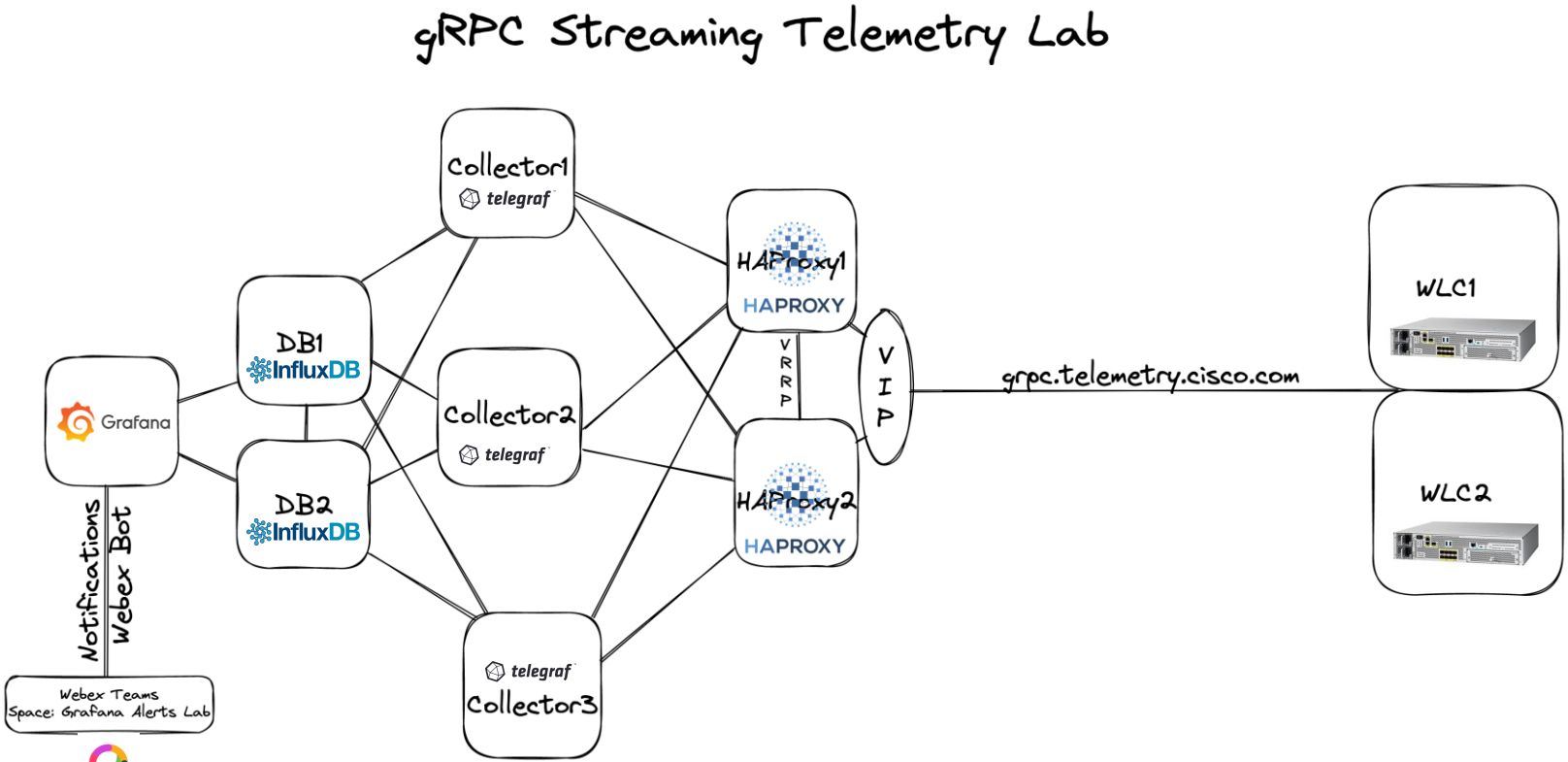
A Story: Demo Architecture Diagram



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Lab Documentation

Try out gRPC in your own lab setup with:

- Setup Telegraf, InfluxDB and Grafana:
https://github.com/rceara/Influx-Telegraf-Grafana

- Setup HAProxy and Keepalived:
https://github.com/rceara/HAProxy-Keepalived-Setup

- Generate the certificates for your gRPC Collectors and WLCs:
https://github.com/rceara/OpenSSL_Certificate_Generation

- Setup your DNS Server for your FQDN collectors:
https://github.com/rceara/BIND-Server-Setup

- Troubleshoot gRPC and MDT:
https://github.com/rceara/gRPCTelemetryTroubleshooting

- Demo Recording:
https://www.youtube.com/watch?v=FPu-Wakh2Oo

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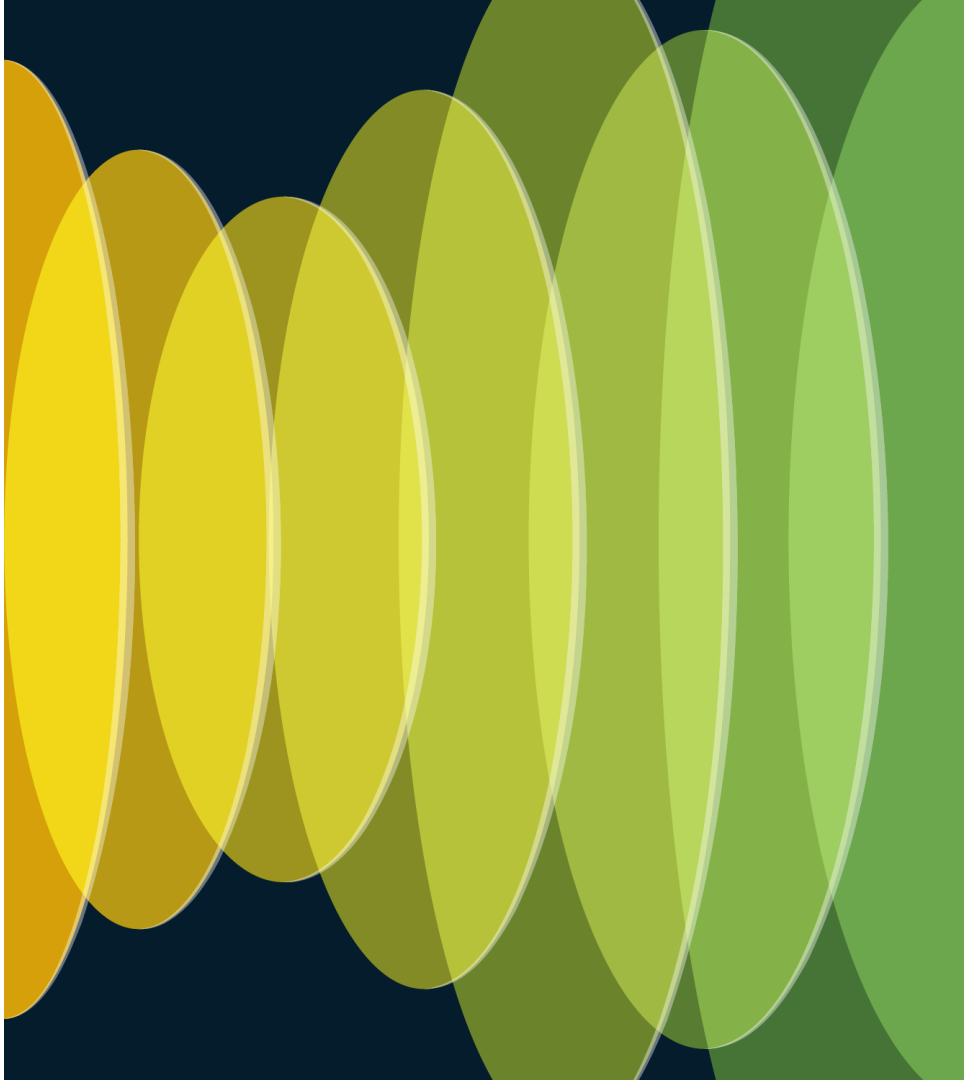
Takeaways



Takeaways

- MDT is becoming the new norm for monitoring and adoption is happening quickly.
- MDT is a solid and scalable solution that has full support from Cisco and there is good online documentation.
- Talk to your Cisco CX and Account team about MDT.
- Get familiar with MDT on DevNet Sandbox:
- https://developer.cisco.com/learning/labs/enabling_telemetry_on_iosxe/enabling-telemetry-on-ios-xe/
- If you want to learn more or need help please reach out to us:
  - Rafael Ceara – rcearaba@cisco.com
  - Salil Prabhu – saprabhu@cisco.com

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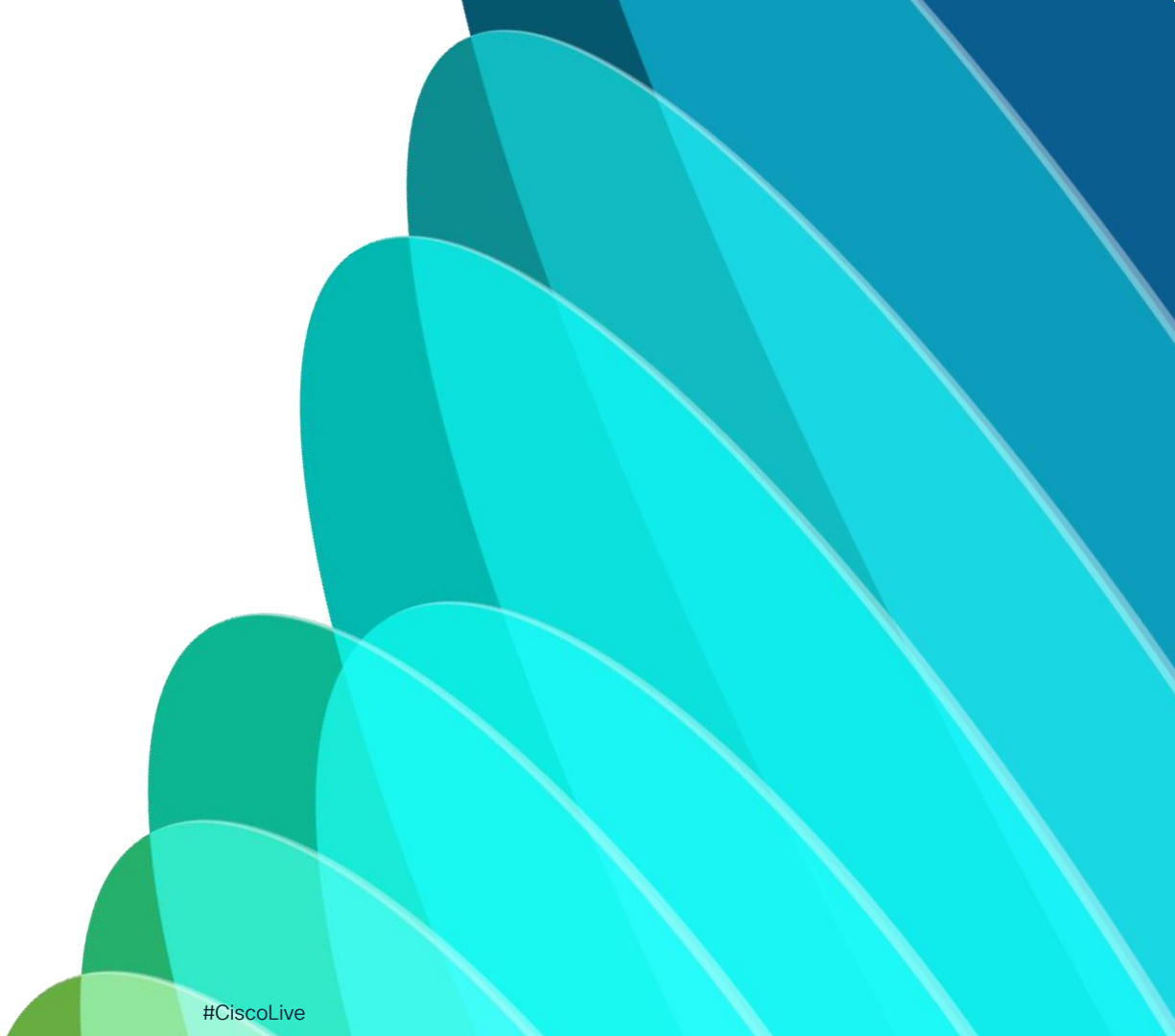
The bridge to possible

Thank you



cisco Live!

Appendix

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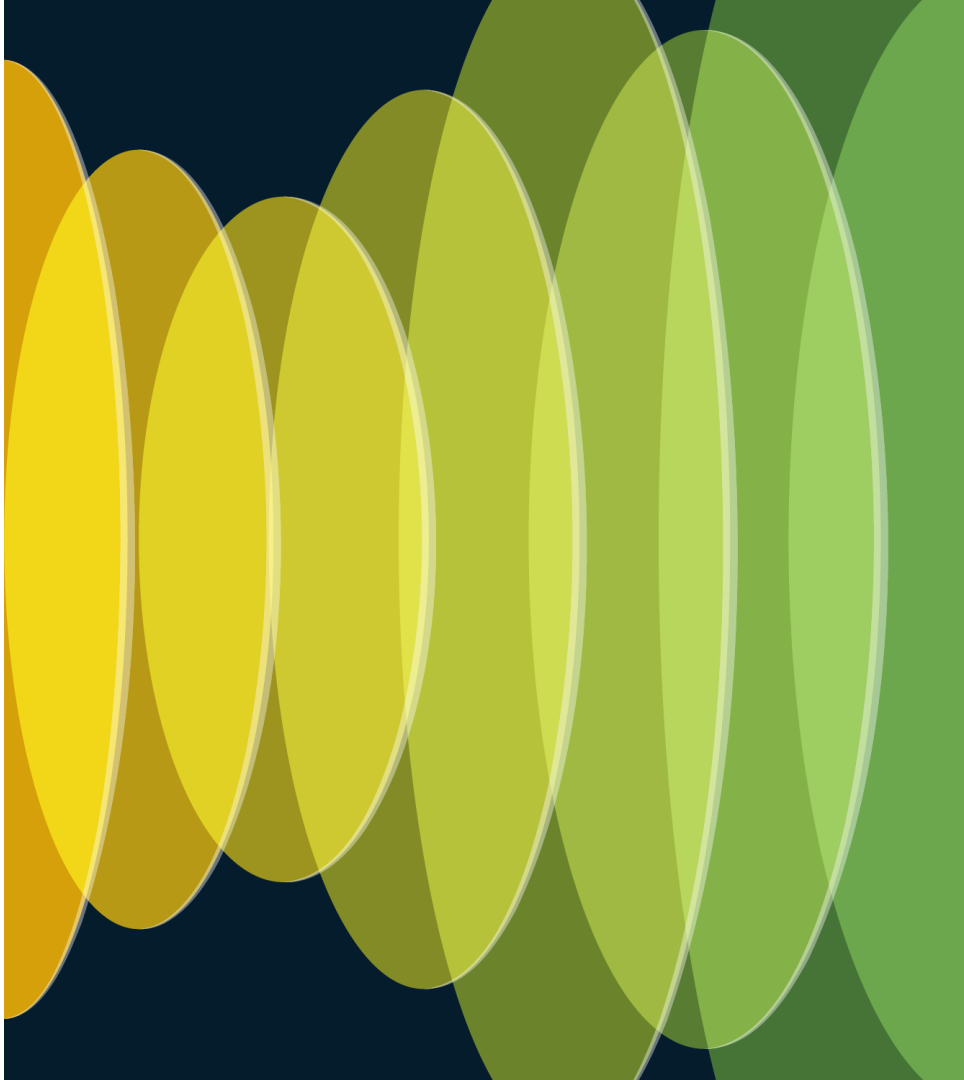
Demo Screenshot Slides



Defining your Telemetry configuration

```
telemetry ietf subscription 101
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/capwap-data/wtp-mac
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 102
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/capwap-data/ap-state/ap-admin-state
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 103
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/cdp-cache-data/cdp-cache-device-id
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 104
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/ssid-counters/num-assoc-clients
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 105
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/oper-data/ap-prime-info/primary-controller-name
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 106
 encoding encode-kvgpb
 filter xpath /access-point-oper-data/capwap-data/country-code
 receiver-type protocol
 source-address 10.93.178.70
 stream yang-push
 update-policy periodic 30000
 receiver name rafa-testing
telemetry ietf subscription 107
 encoding encode-kvgpb
 --More--
```

```
wlc2.9840#show telemetry connection all
Telemetry connections

Index Peer Address              Port  VRF Source Address            State      State Description
----- ------------------------- ----- --- ------------------------- ---------- --------------------
  632 10.93.178.177             57499 0   10.93.178.70              Active     Connection up
  643 10.93.178.174             57499 0   10.93.178.70              Active     Connection up

wlc2.9840#
wlc2.9840#show tele
wlc2.9840#show telemetry conn
wlc2.9840#show telemetry connection 632 de
wlc2.9840#show telemetry connection 632 detail
Index             : 632
Peer Address      : 10.93.178.177
Port              : 57499
VRF               : 0
Source Address    : 10.93.178.70
Type              : PROTOCOL
State             : Active
State Description : Connection up
Peer ID           : (10.93.178.177:57499)
Receiver Name     : rafa-testing3
Transport         : grpc-tls
Use Count         : 20
State Change Time : 03/20/23 05:17:35

wlc2.9840#
wlc2.9840#show telemetry connection 643 detail
Index             : 643
Peer Address      : 10.93.178.174
Port              : 57499
VRF               : 0
Source Address    : 10.93.178.70
Type              : PROTOCOL
State             : Active
State Description : Connection up
Peer ID           : (10.93.178.174:57499)
Receiver Name     : rafa-testing3
Transport         : grpc-tls
Use Count         : 5
State Change Time : 03/20/23 05:28:53
```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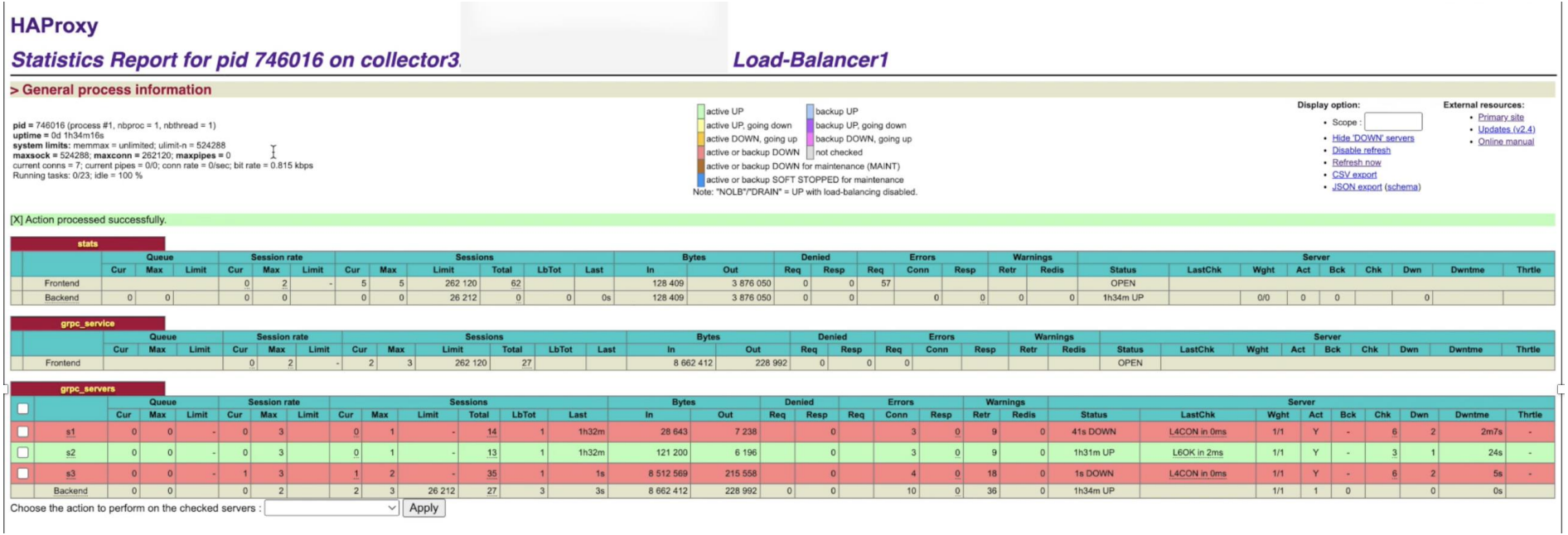
Load balance your grpc traffic to the collectors



HAProxy

Statistics Report for pid 746016 on collector3 — *Load-Balancer1*

> General process information

pid = 746016 (process #1, nbproc = 1, nbthread = 1)
uptime = 0d 1h34m16s
system limits: memmax = unlimited; ulimit-n = 524288
maxsock = 524288; **maxconn =** 262120; **maxpipes =** 0
current conns = 7; current pipes = 0/0; conn rate = 0/sec; bit rate = 0.815 kbps
Running tasks: 0/23; idle = 100 %

active UP
active UP, going down
active DOWN, going up
active or backup DOWN
active or backup DOWN for maintenance (MAINT)
active or backup SOFT STOPPED for maintenance
backup UP
backup UP, going down
backup DOWN, going up
not checked
Note: "NOLB"/"DRAIN" = UP with load-balancing disabled.

Display option:
- Scope :
- Hide 'DOWN' servers
- Disable refresh
- Refresh now
- CSV export
- JSON export (schema)

External resources:
- Primary site
- Updates (v2.4)
- Online manual

[X] Action processed successfully.

stats

	Queue			Session rate			Sessions						Bytes		Denied		Errors			Warnings		Server								
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	Last	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	LastChk	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
Frontend				0	2	-	5	5	262 120	62			128 409	3 876 050	0	0	57					OPEN								
Backend	0	0		0	0		0	0	26 212	0	0	0s	128 409	3 876 050	0	0		0	0	0	0	1h34m UP		0/0	0	0		0		

grpc_service

	Queue			Session rate			Sessions						Bytes		Denied		Errors			Warnings		Server								
	Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	Last	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	LastChk	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
Frontend				0	2	-	2	3	262 120	27			8 662 412	228 992	0	0	0					OPEN								

grpc_servers

		Queue			Session rate			Sessions						Bytes		Denied		Errors			Warnings		Server								
		Cur	Max	Limit	Cur	Max	Limit	Cur	Max	Limit	Total	LbTot	Last	In	Out	Req	Resp	Req	Conn	Resp	Retr	Redis	Status	LastChk	Wght	Act	Bck	Chk	Dwn	Dwntme	Thrtle
☐	s1	0	0	-	0	3		0	1	-	14	1	1h32m	28 643	7 238		0		3	0	9	0	41s DOWN	L4CON in 0ms	1/1	Y	-	6	2	2m7s	-
☐	s2	0	0	-	0	3		0	1	-	13	1	1h32m	121 200	6 196		0		3	0	9	0	1h31m UP	L6OK in 2ms	1/1	Y	-	3	1	24s	-
☐	s3	0	0	-	1	3		1	2	-	35	1	1s	8 512 569	215 558		0		4	0	18	0	1s DOWN	L4CON in 0ms	1/1	Y	-	6	2	5s	-
	Backend	0	0		0	2		2	3	26 212	27	3	3s	8 662 412	228 992	0	0		10	0	36	0	1h34m UP		1/1	1	0		0	0s	

Choose the action to perform on the checked servers : Apply

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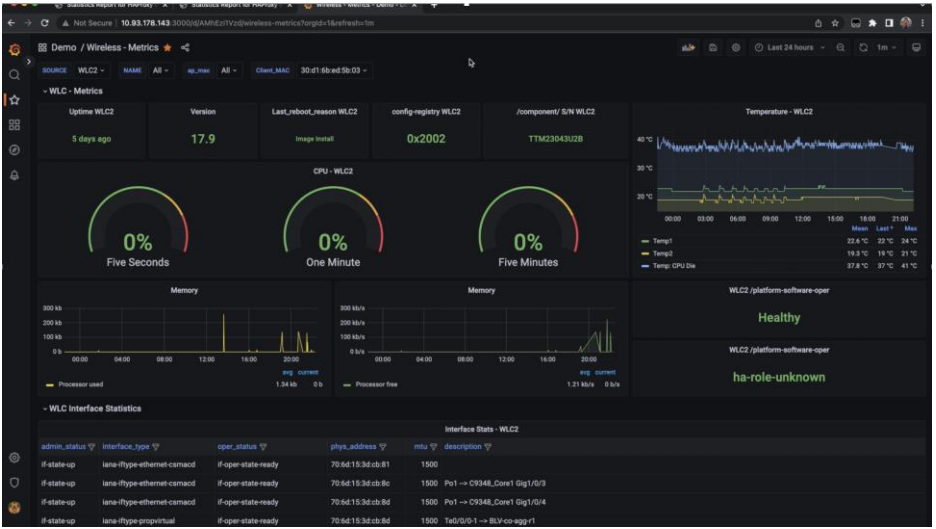
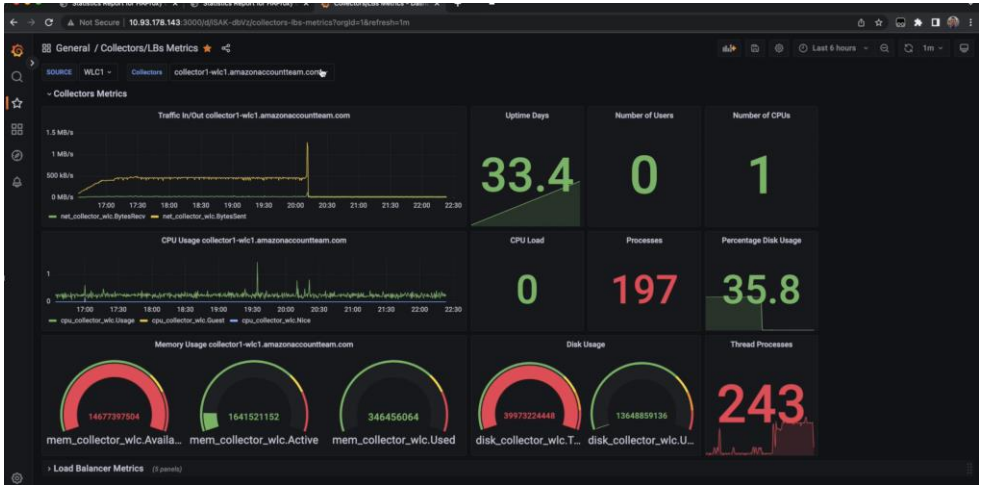
Visualizing and Monitoring your Infrastructure





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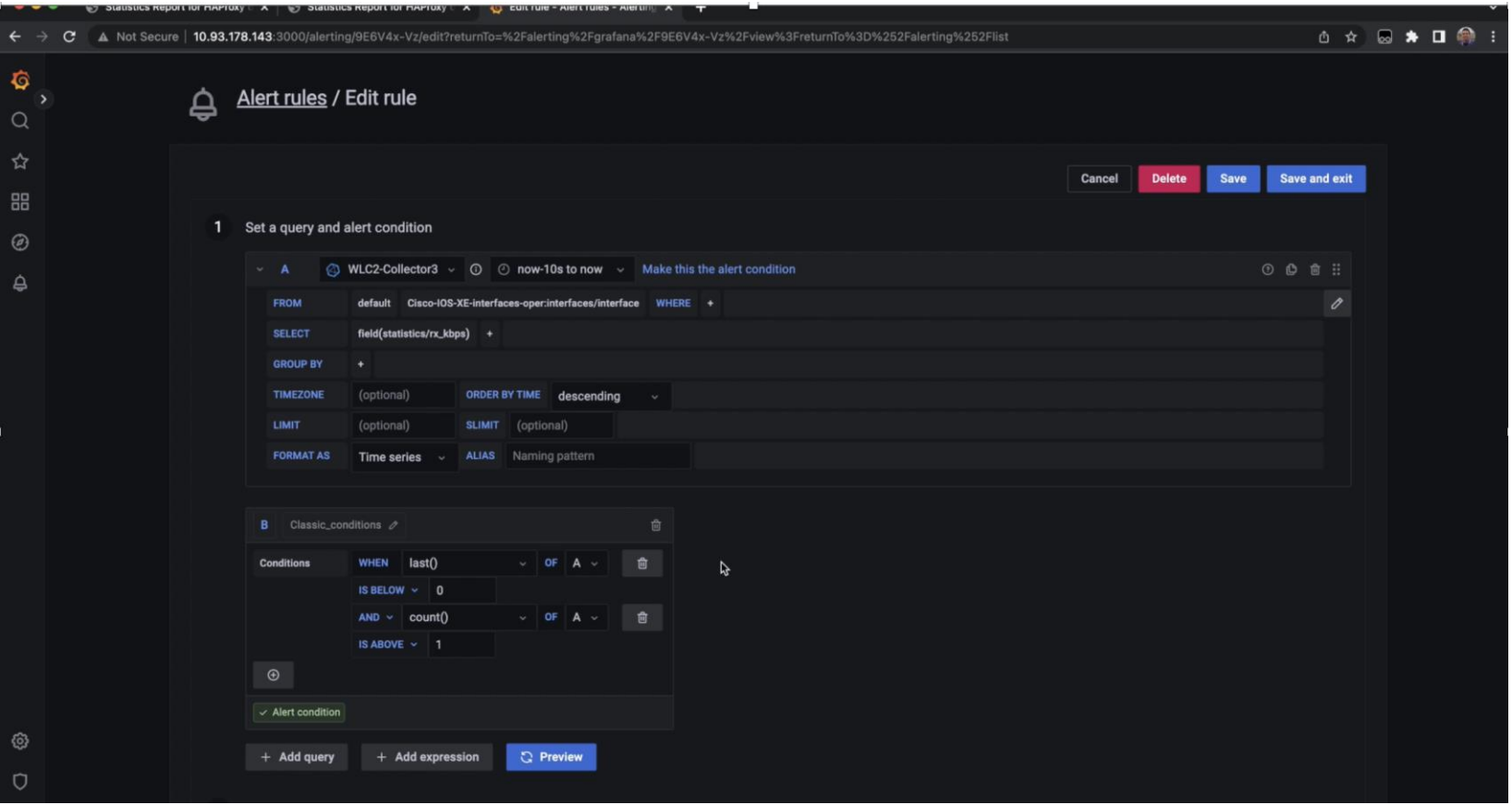
Setting up the Alarms



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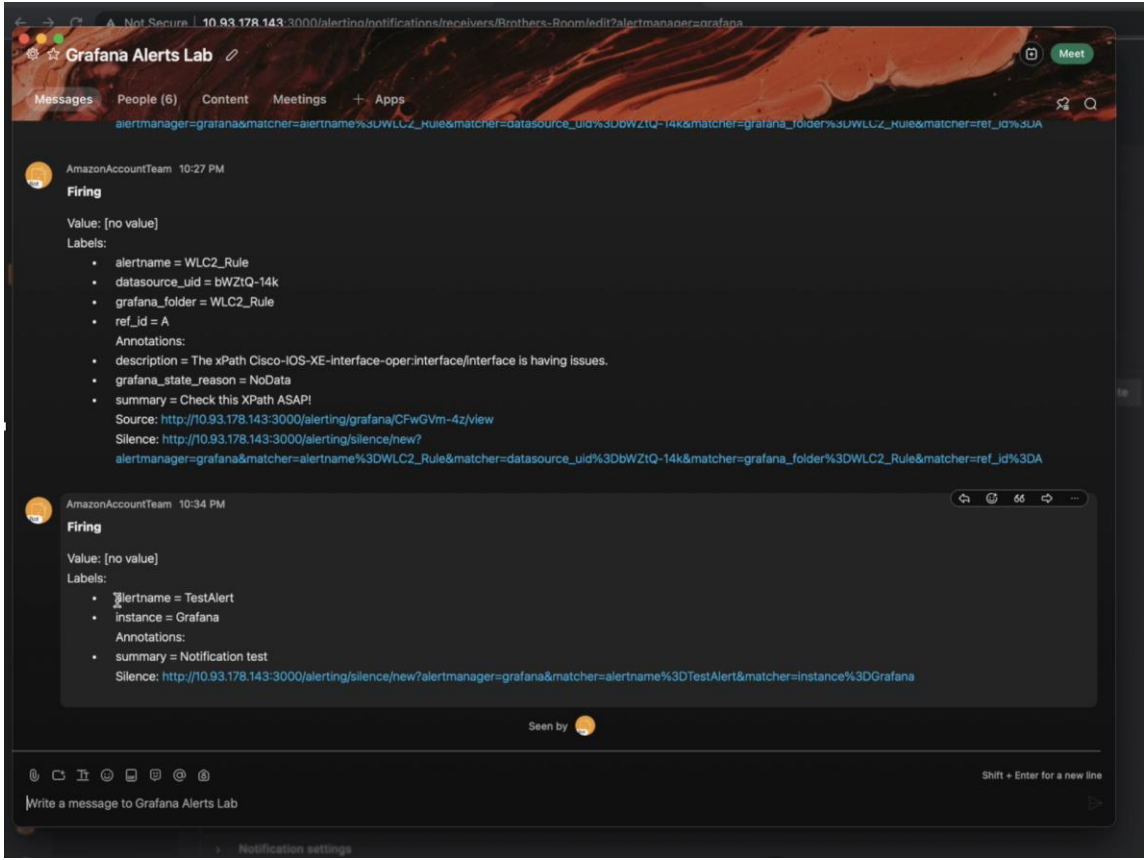
Alarms notifications to Webex Teams



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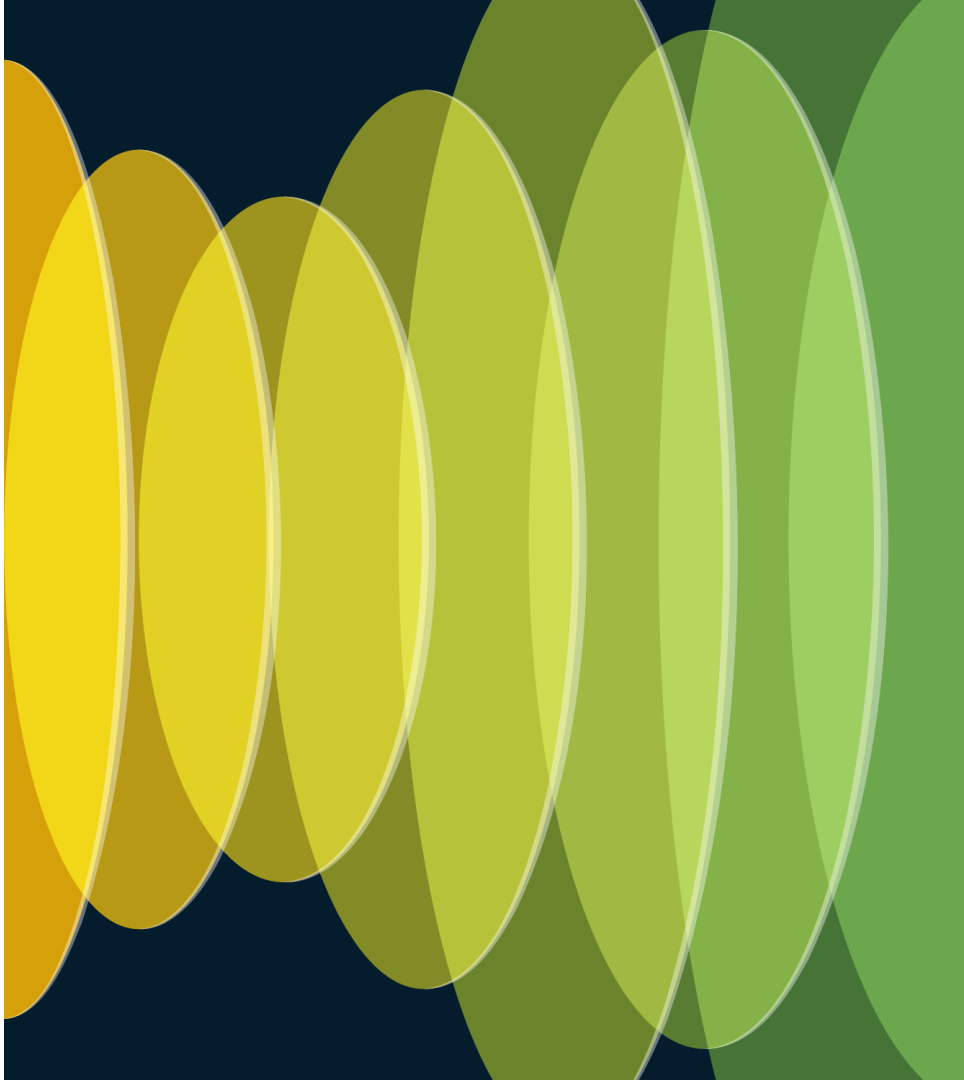
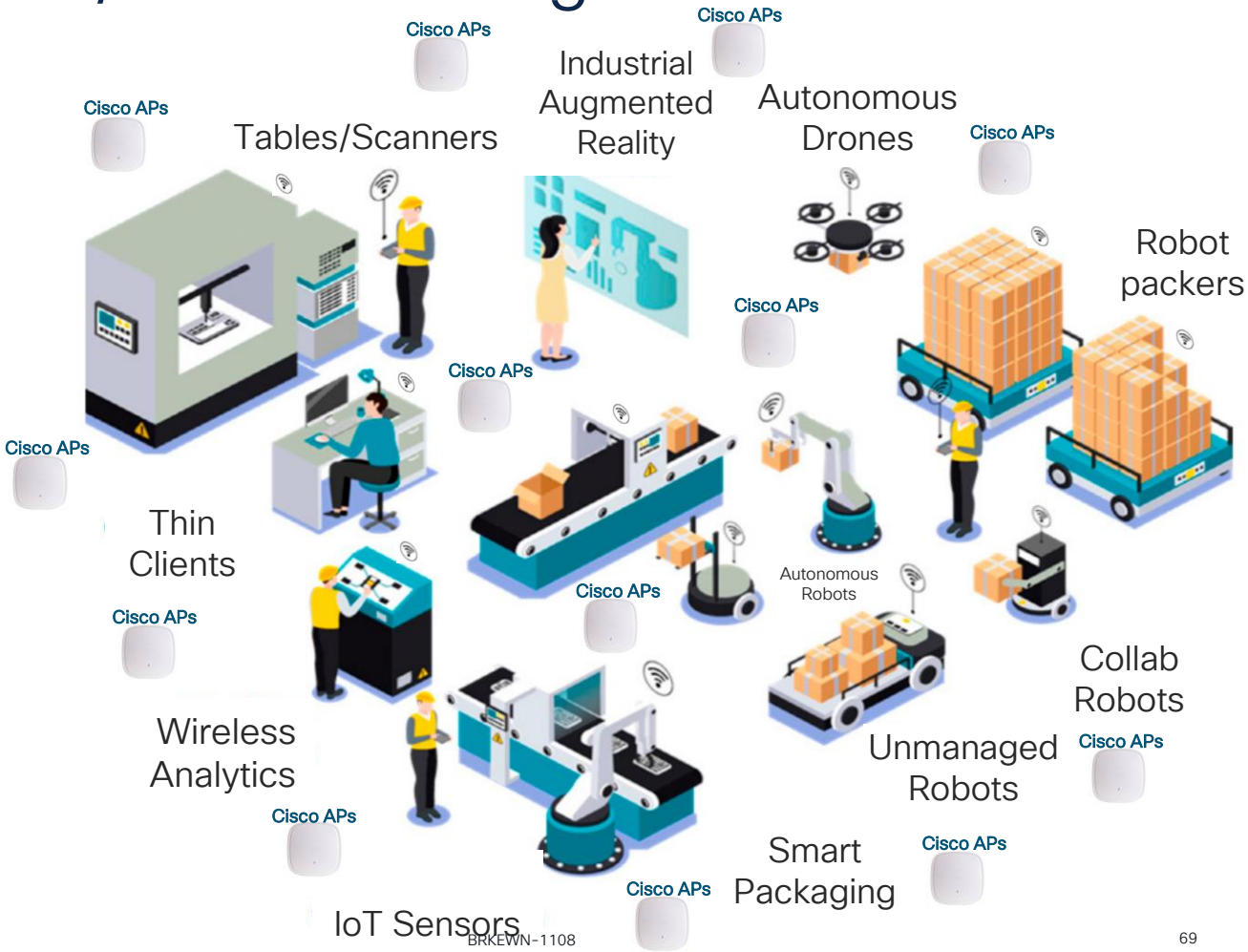
MDT Use-Cases Scenarios



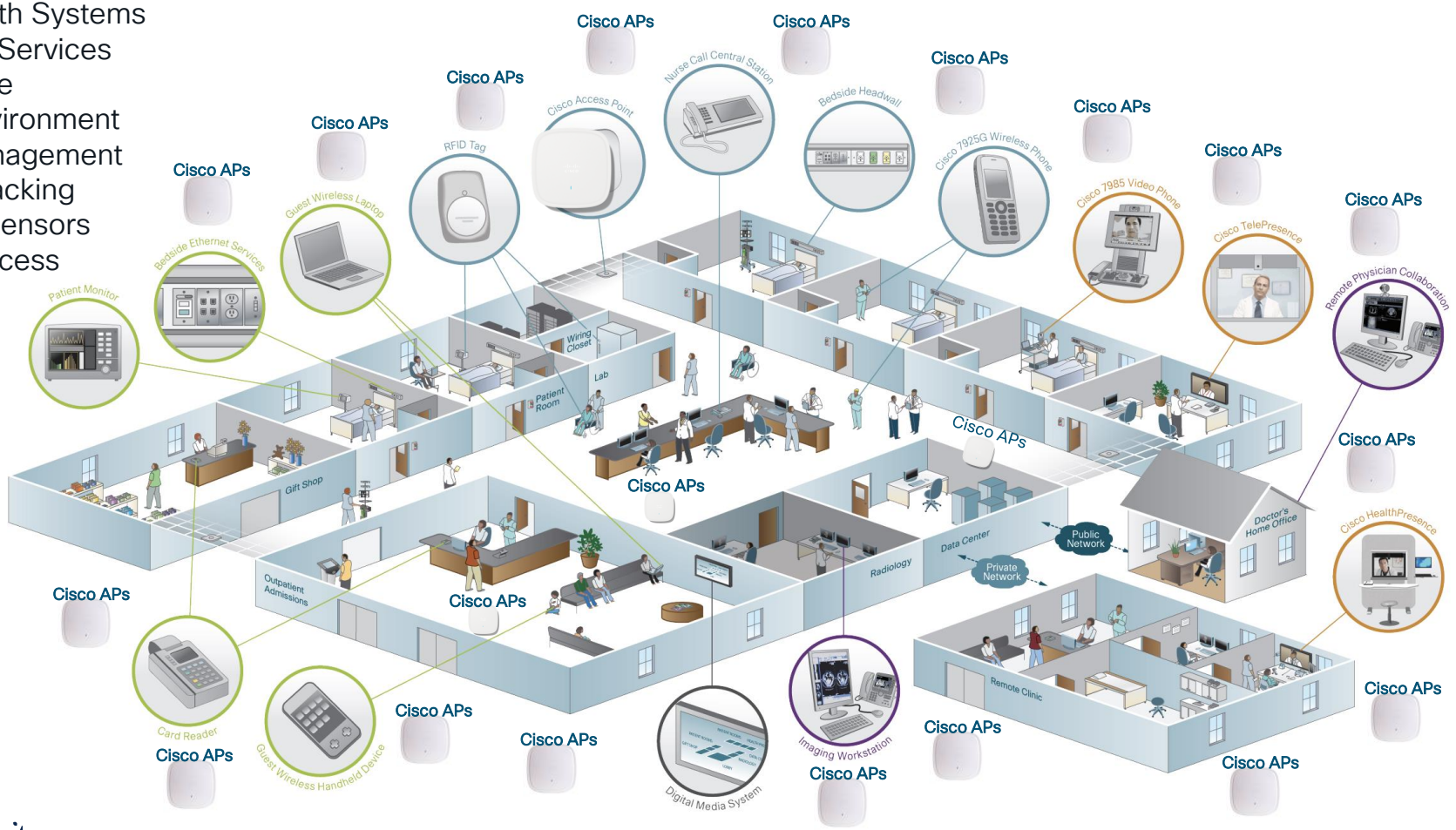
Logistics/Industrial/Manufacturing Services Metrics/KPIs:

- ✓ Inventory picking accuracy
- ✓ Orders Efficiency and Fill Rate
- ✓ Machinery Performance
- ✓ Network operational uptime
- ✓ Backorder rate
- ✓ Order lead times
- ✓ Cost Optimization
- ✓ Stock cycle time



Healthcare Services Metrics/KPIs:

- ✓ Critical Health Systems
- ✓ Emergency Services
- ✓ Nursing Care
- ✓ Hospital Environment
- ✓ Climate Management
- ✓ Location Tracking
- ✓ IoT Health Sensors
- ✓ Services Access
- ✓ Patient care
- ✓ Collab



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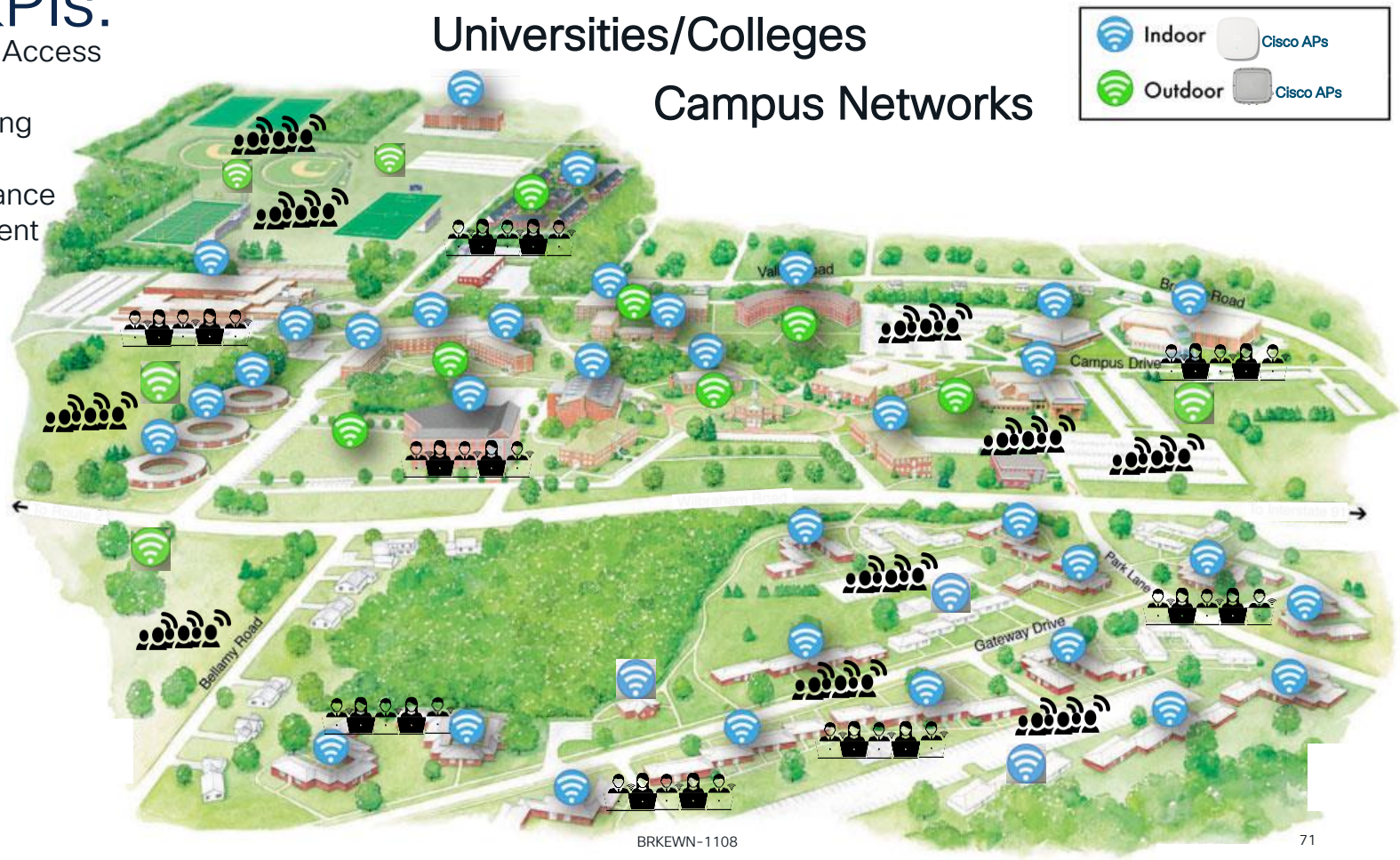
Colleges/Universities Services Metrics/KPIs:

- ✓ Student Services Access
- ✓ Location Tracking
- ✓ Occupancy Sensing
- ✓ EV Charging
- ✓ Buildings Surveillance
- ✓ Assets Management
- ✓ Smart Buildings
- ✓ IoT Sensors