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Let's go

The bridge to possible

Reduce Resolution Time with a Service-Centric Approach to Troubleshooting

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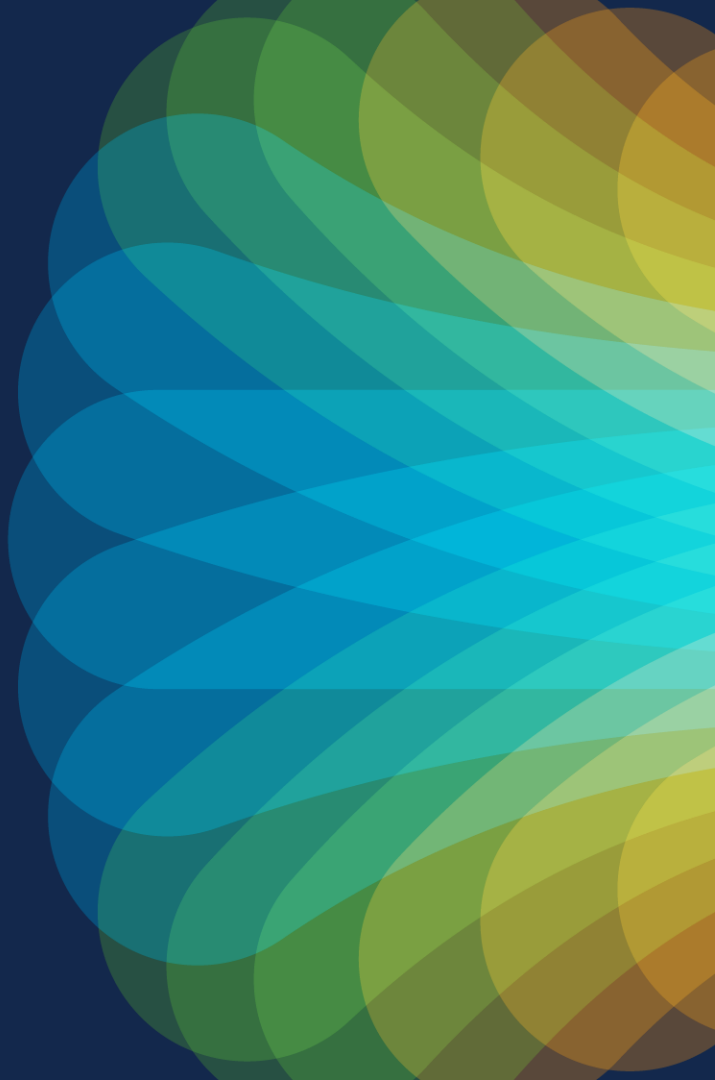
BRKSPG-2474

Agenda

- Today, Operator Challenges
- The Concept of Heuristic Package
- Codify Know How
- Intent Based Networking
- The Operator Experience
- Know How Extension
- Conclusion

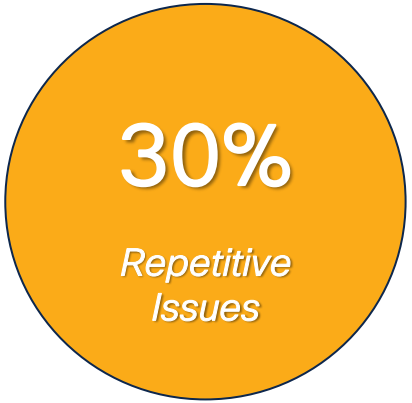
Today, Operator Challenges



Operational Challenges in Numbers

VISIBILITY / AGILITY

CUSTOMER EXPERIENCE



PRODUCTIVITY

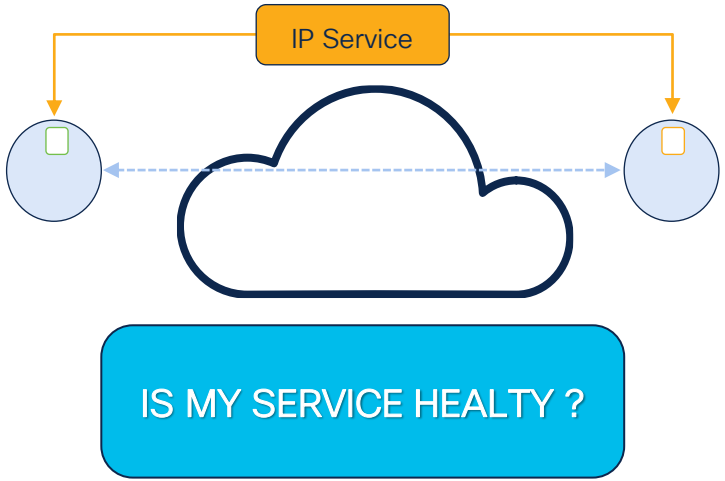
*Forrester Researches

VISIBILITY/ AGILITY Challenge

80%

MTTI/MTTK

VISIBILITY / AGILITY

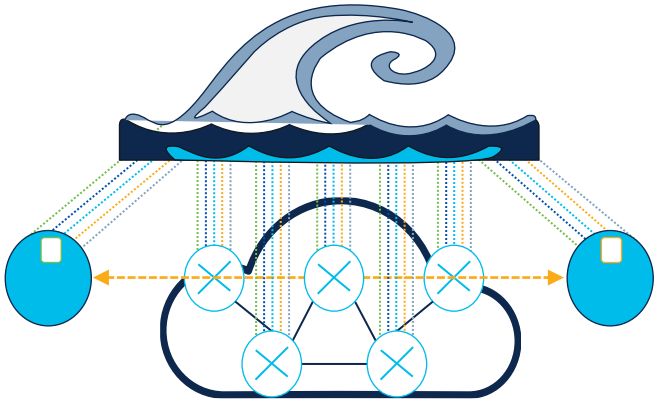


CUSTOMER EXPERIENCE Challenge

74%

Issue found by end-user

CUSTOMER EXPERIENCE



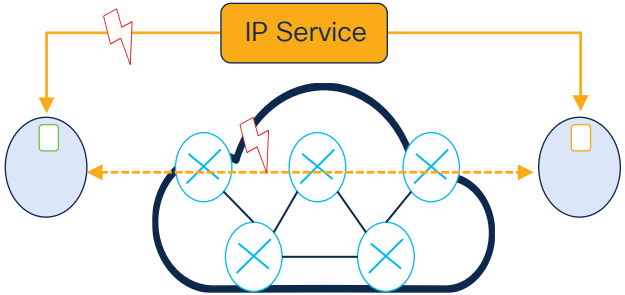
IS MY SERVICE MEETING SLA ?

PRODUCTIVITY Challenge

30%

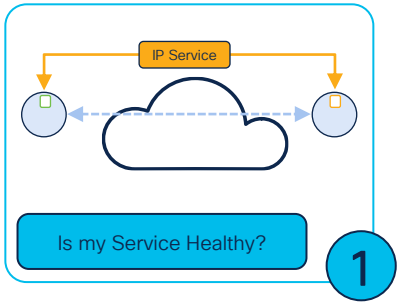
Repetitive Issues

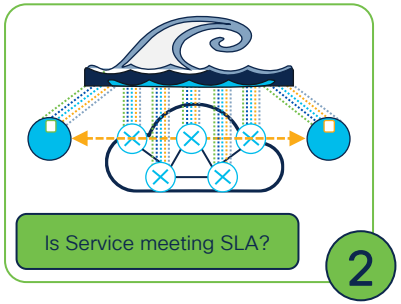
PRODUCTIVITY

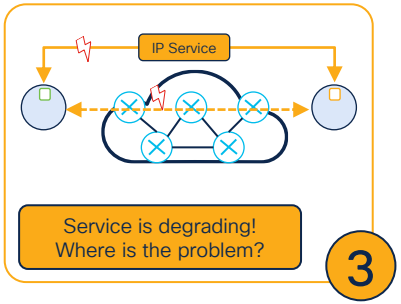


SERVICE IS DEGRADING.
WHERE IS THE PROBLEM ?

A Different Approach is Needed …







Challenge	Requirement	How
1 Visibility	**End-to-end** service visibility	**Intent-based** Networking
2 Insight	**Bridge** customer experience to network health	Dynamically **tie** Intent to telemetry
3 Action	Expedite **MTTI/MTTK**	Capture knowledge to automate troubleshooting

Crosswork Automated Assurance Use Cases

Know your Customer Personas: Role and Know-How its different

QUESTIONS TO ANSWER

AGILITY / VISIBILITY

First Level
Service Operation Center

Is the service **degrading?**

Is the service meeting **SLAs?**

Services & SLA Dashboard

CUSTOMER EXPERIENCE

Second Level
Network Operation Center

Service is DEGRADING!

WHERE is the problem and **WHY**?

I see a congestion in the network, **WHAT** is the cause?

Hierarchical Controller

PRODUCTIVITY

Domain SME

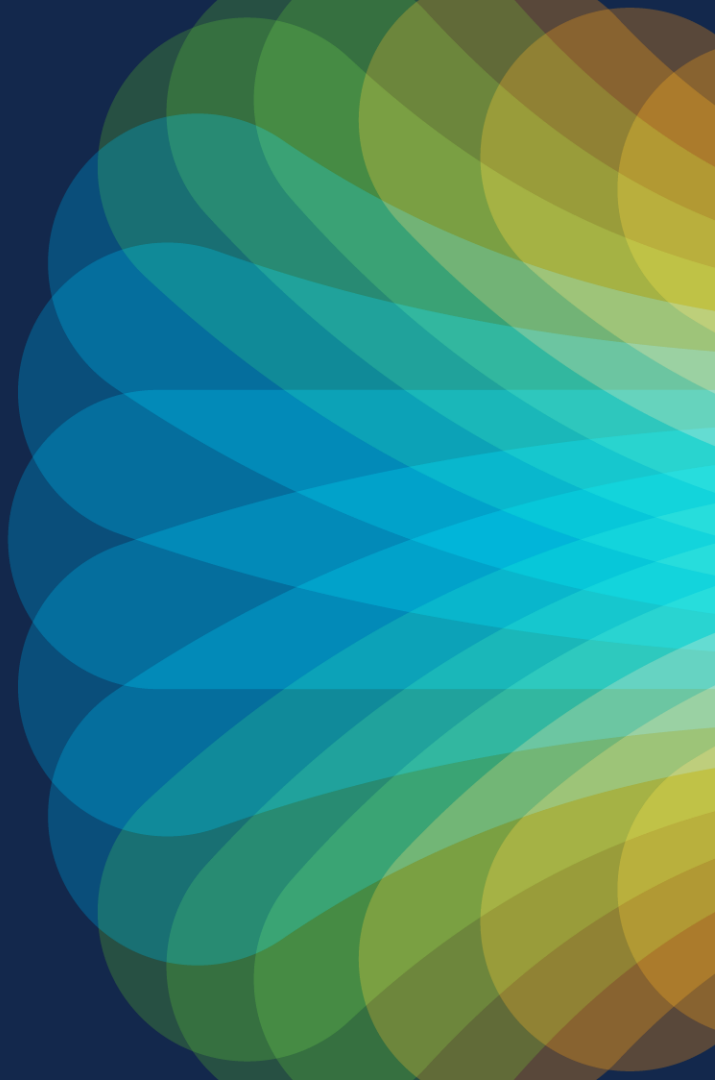
Is the infrastructure **OPERATING** according to planned performance objectives ?

Domain Controller

Domain Controller

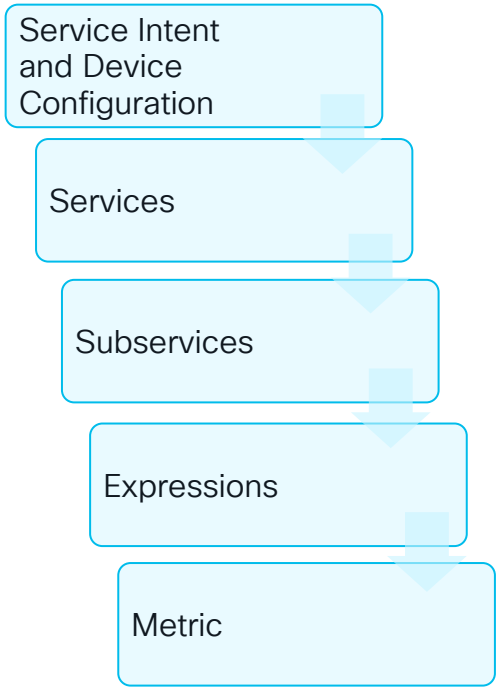
Domain Controller

The Concept of Heuristic Package



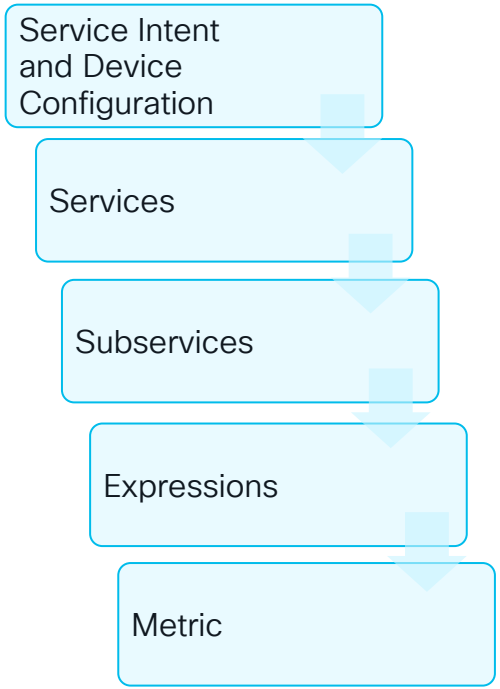
What is the Heuristic Package ?

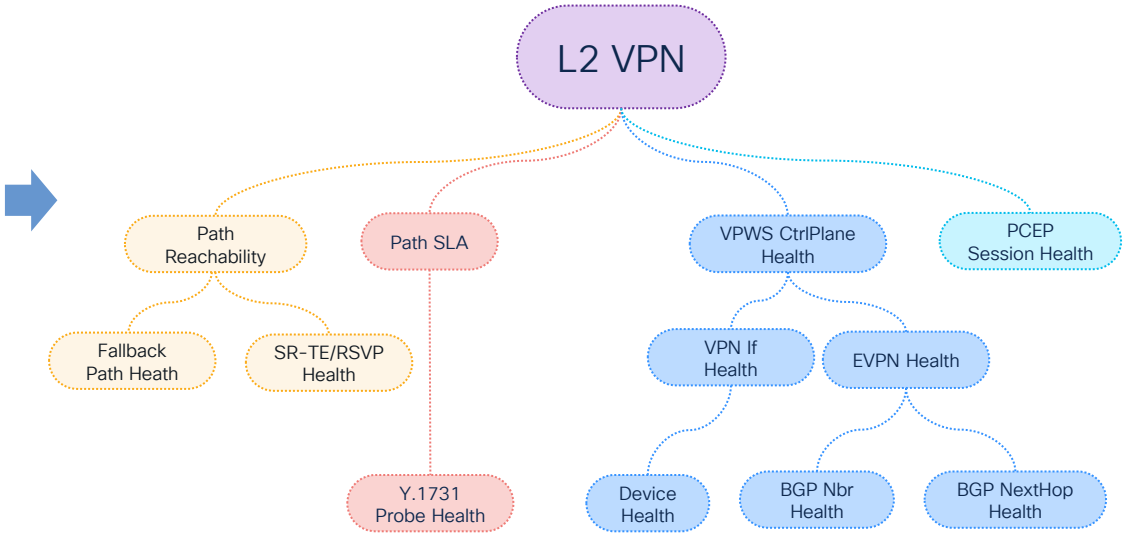
The Heuristic Package tie intent to telemetry



- Heuristic Package matches to a specific service type.
- A subservice focuses on a specific feature or sub-part of the network system.
- Expression encodes logic to deduce the health status of subservice from the collected metrics.
- Each **device-independent metric** used in the sub-services maps to a list of **device-specific metric** implementations (YANG path, SNMP Object or CLI command) that precisely define how to fetch values for that metric.

From Heuristic Package to Assurance Graph





Service Assurance for Intent-Based Networking Architecture

SAIN: IETF RFC 9417

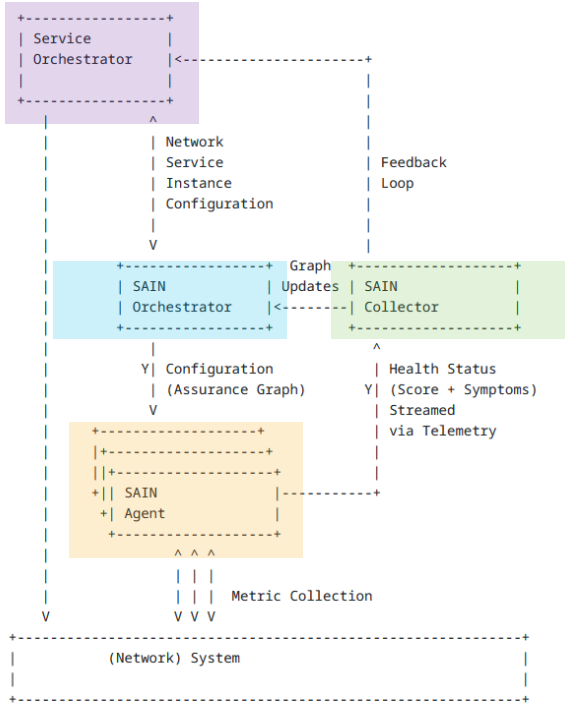


Figure 1: SAIN Architecture

Service Orchestrator is the system that implement the service , i.e. decompose the service, described by an abstract model, into specific network element configuration.

SAIN orchestrator is in charge of fetching the configuration specific to each service instance and converting it into an assurance graph.

SAIN agent communicates with a device, a set of devices, to build an expression graph from a received assurance graph and perform the corresponding computation of the health status and symptoms.

SAIN collector fetches or receives the computer-consumable output of the SAIN agent(s) and process it locally (including displaying it in a user-friendly form).

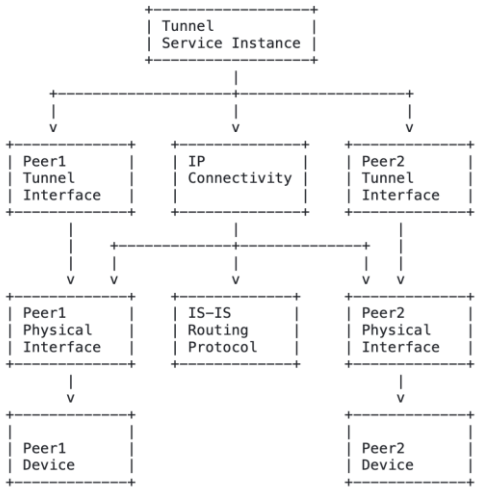
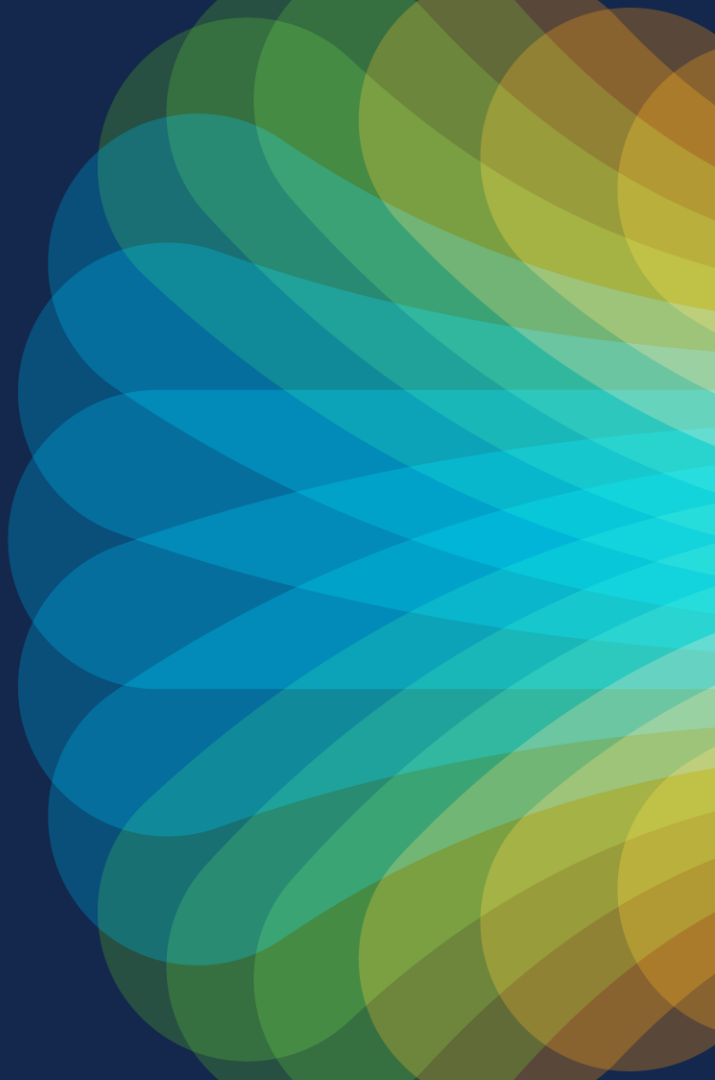
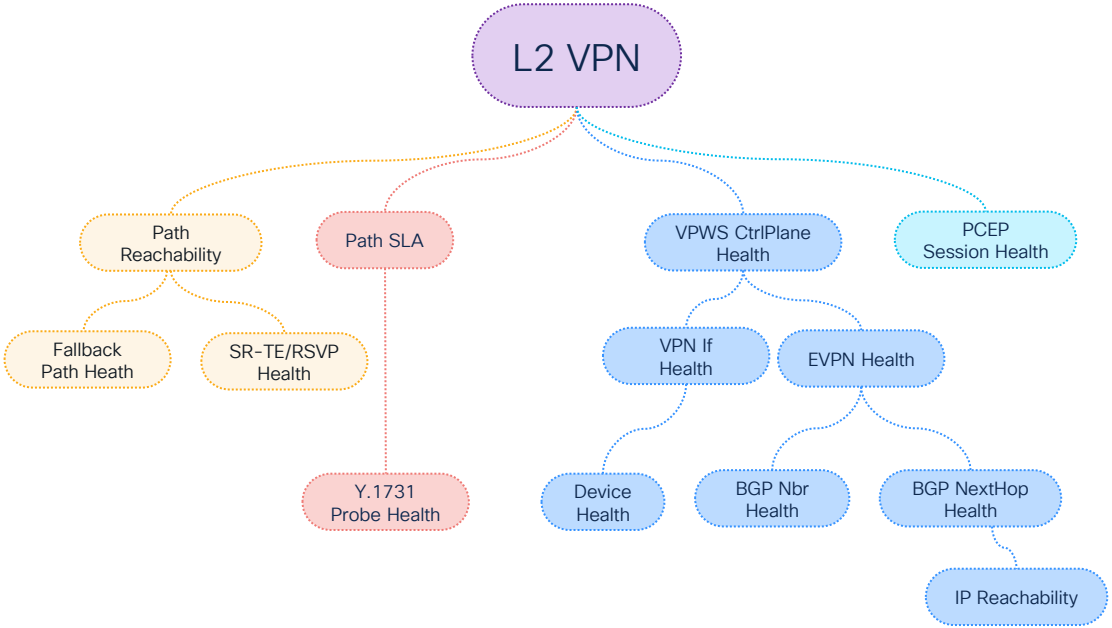


Figure 2: Assurance Graph Example

Codify Know How



Troubleshooting a L2 VPN



Check Service Status

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show l2vpn xconnect
Fri Feb 12 19:10:32.844 EST
Legend: ST = State, UP = Up, DN = Down, AD = Admin Down, UR = Unresolved,
SB = Standby, SR = Standby Ready, (PP) = Partially Programmed
XConnect Segment 1 Segment 2
Group Name ST Description ST Description ST
------------------------------------------------------------------------------
l2vpn-xc-2601 p2p-2601 UP Te0/0/0/2.2601 UP EVPN 2601,2,10.255.255.103 UP
------------------------------------------------------------------------------
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

**This need to be done on both PEs*

If the Status is DOWN *then we need to further check possible causes:*

- *The Attachment Circuit interface could be* DOWN
- *The Control Plane info from remote PE could be* DOWN
- *Possible Crossconnect issues on Local-PE*

Check Attachment Circuit Status

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show int Ten0/0/0/2.2601
Fri Feb 12 19:21:16.351 EST
TenGigE0/0/0/2.2601 is up, line protocol is up
Interface state transitions: 3
Hardware is VLAN sub-interface(s), address is 008a.966e.6808
Description: L2VPN-Dynamic-02
Layer 2 Transport Mode
MTU 1518 bytes, BW 10000000 Kbit (Max: 10000000 Kbit)
reliability Unknown, txload Unknown, rxload Unknown
Encapsulation 802.1Q Virtual LAN,
Outer Match: Dot1Q VLAN 2601
Ethertype Any, MAC Match src any, dest any
loopback not set,
Last link flapped 00:00:14
Last input never, output never
Last clearing of "show interface" counters never
0 packets input, 0 bytes
0 input drops, 0 queue drops, 0 input errors
0 packets output, 0 bytes
0 output drops, 0 queue drops, 0 output errors
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

Check Attachment Circuit sub-interface, and if DOWN *check also the Interface.*

If Interface is DOWN *possible causes are:*

- *Admin shut down*
- *Fiber or Cable issues*
- *Remote switch/optical shut down*

Check EVPN Control Plane

Discover BGP identity

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show bgp l2vpn evpn summary
Fri Feb 12 19:24:35.296 EST
BGP router identifier 10.255.255.102, local AS number 65001
BGP generic scan interval 60 secs
Non-stop routing is enabled
BGP table state: Active
Table ID: 0x0 RD version: 0
BGP main routing table version 819
BGP NSR Initial initsync version 1 (Reached)
BGP NSR/ISSU Sync-Group versions 0/0
BGP scan interval 60 secs
BGP is operating in STANDALONE mode.
Process RcvTblVer bRIB/RIB LabelVer ImportVer SendTblVer StandbyVer
Speaker 819 819 819 819 819 0
Neighbor Status Codes: m - Under graceful maintenance
Neighbor Spk AS MsgRcvd MsgSent TblVer InQ OutQ Up/Down St/PfxRcd
10.255.255.143 0 65001 101083 101065 819 0 0 3d23h 1
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

Possible value for St/PfxRcd*:*

- *Not a number but something like* Active *or* Idle*, then BGP session to the Route Reflector is not* UP*.*
- PfxRcd *is* 0 *(from EVPN Router Reflector) then session is fine, but we did not get any EVPN route. Normally redundant RRs are deployed so we need to get non-zero routes from at-least one RR.*
- PfxRcd *is* ***not*** 0 *then we look at all routes with Route Distinguisher our BGP ID and EVI (EVPN instance ID) specified for this service instance.*

Any neighbors shown, means that there is no single active BGP session to a EVPN Route Reflector.

Data Plane Troubleshooting

Is traffic going via SRTE or IGP path ?

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show l2vpn xconnect detail
Fri Feb 12 19:32:32.803 EST
Group l2vpn-xc-2601, XC p2p-2601, state is up; Interworking none
  AC: TenGigE0/0/0/2.2601, state is up
    Type VLAN; Num Ranges: 1
    Rewrite Tags: []
    VLAN ranges: [2601, 2601]
    MTU 1504; XC ID 0x1; interworking none
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
      drops: illegal VLAN 0, illegal length 0
  EVPN: neighbor 10.255.255.103, PW ID: evi 2601, ac-id 2, state is up ( established )
    XC ID 0xc0000001
    Encapsulation MPLS
    Source address 10.255.255.102
    Encap type Ethernet, control word enabled
    Sequencing not set
    Preferred path Active : SR TE srte_c_2002_ep_10.255.255.103, Statically configured, fallback disabled
    Tunnel : Up
      EVPN         Local                          Remote
      ------------ ------------------------------ ------------------------------
      Label        24011                          24005
      MTU          1504                           1504
      Control word enabled                        Encamp
      AC ID        1                              2
      EVPN type    Ethernet                       Encamp
      ------------ ------------------------------ ------------------------------
    Create time: 12/02/2021 19:04:51 (00:27:41 ago)
    Last time status changed: 12/02/2021 19:21:02 (00:11:30 ago)
    Last time PW went down: 12/02/2021 19:14:58 (00:17:34 ago)
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

The service labels are shown which should be as learned from BGP EVPN in previous step.

Check Statistics

Check Packet counters on the service and service labels

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show l2vpn forwarding interface tenGigE 0/0/0/2.2601  detail  location 0/0/CPU$
Fri Feb 12 19:38:54.984 EST
Local interface: TenGigE0/0/0/2.2601, Xconnect id: 0x1, Status: up
  Segment 1
    AC, TenGigE0/0/0/2.2601, status: Bound
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
      packets dropped: PLU 0, tail 0
      bytes dropped: PLU 0, tail 0
  Segment 2
    MPLS, Tunnel interface: srte_c_2002_ep_10.255.255.103, status: Bound
    Local Pseudowire label: 24011
    Remote Pseudowire label: 24005
    Control word enabled
    Statistics:
      packets: received 0, sent 0
      bytes: received 0, sent 0
      packets dropped: PLU 0, tail 0, out of order 0
      bytes dropped: PLU 0, tail 0, out of order 0
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

Check Packet counters

Check SR-TE Health

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show segment-routing traffic-eng policy name srte_c_2002_ep_10.255.255.103
Fri Feb 12 19:41:01.871 EST

SR-TE policy database
---------------------

Color: 2002, End-point: 10.255.255.103
  Name: srte_c_2002_ep_10.255.255.103
  Status:
    Admin: up  Operational: up for 00:40:51 (since Feb 12 19:00:10.611)
  Candidate-paths:
    Preference: 101 (configuration) (active)
      Name: srte_c_2002_ep_10.255.255.103
      Requested BSID: dynamic
      PCC info:
        Symbolic name: cfg_srte_c_2002_ep_10.255.255.103_discr_101
        PLSP-ID: 1
      Dynamic (pce 10.255.255.141) (valid)
        Metric Type: TE,   Path Accumulated Metric: 30
          24002 [Adjacency-SID, 10.102.141.1 - 10.102.141.2]
          24000 [Adjacency-SID, 10.141.143.1 - 10.141.143.2]
          24000 [Adjacency-SID, 10.103.143.2 - 10.103.143.1]
  Attributes:
    Binding SID: 24010
    Forward Class: Not Configured
    Steering BGP disabled: no
    IPv6 caps enable: yes

RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

Since the service is bound to a SRTE Policy, check the SR TE Policy

Check SR-TE Health

```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show segment-routing traffic-eng forwarding policy name
srte_c_2002_ep_10.255.$
Fri Feb 12 19:42:45.899 EST

SR-TE Policy Forwarding database
--------------------------------
Color: 2002, End-point: 10.255.255.103
  Name: srte_c_2002_ep_10.255.255.103
  Binding SID: 24010
  Active LSP:
    Candidate path:
      Preference: 101 (configuration)
      Name: srte_c_2002_ep_10.255.255.103
    Local label: 24009
    Segment lists:
      SL[0]:
        Name: dynamic
        Packets/Bytes Switched: 0/0
        Paths:
          Path[0]:
            Outgoing Label: 24000
            Outgoing Interface: TenGigE0/0/0/1
            Next Hop: 10.102.141.2
            Switched Packets/Bytes: 0/0
            FRR Pure Backup: No
            ECMP/LFA Backup: No
            Label Stack (Top -> Bottom): { 24000, 24000 }
          Path[1]:
            Outgoing Label: 16141
            Outgoing Interface: TenGigE0/0/0/47
            Next Hop: 10.101.102.1
            Switched Packets/Bytes: 0/0
            FRR Pure Backup: Yes
            ECMP/LFA Backup: No
            Label Stack (Top -> Bottom): { 16141, 24000, 24000 }
  Policy Packets/Bytes Switched: 0/0
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

Check the packet counters on the policy, and verify if it is going through desired path or is it via Loop Free Alternate path (LFA)

Check SR-TE Health

Check Fallback

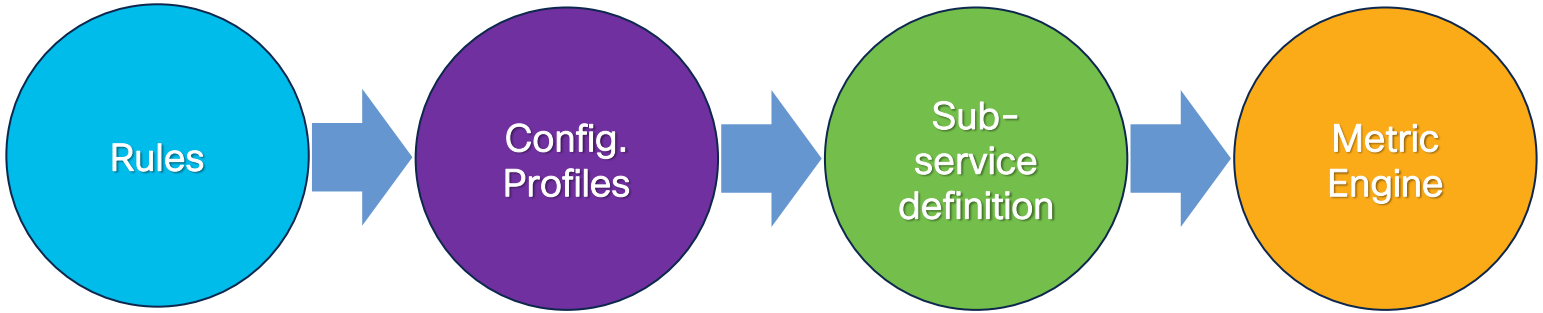
```
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show route 10.255.255.103
Fri Feb 12 19:48:23.330 EST

Routing entry for 10.255.255.103/32
  Known via "isis sitel", distance 115, metric 30, labeled SR, type level-2
  Installed Feb  9 23:00:06.797 for 2d20h
  Routing Descriptor Blocks
    10.101.102.1, from 10.255.255.103, via TenGigE0/0/0/47, Backup (Local-LFA)
      Route metric is 40
    10.102.141.2, from 10.255.255.103, via TenGigE0/0/0/1, Protected
      Route metric is 30
  No advertising protos.
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#show cef 10.255.255.103
Fri Feb 12 19:48:30.033 EST
10.255.255.103/32, version 5610, labeled SR, internal 0x1000001 0x83 (ptr 0x97dbf268) [1], 0x0 (0x97f83f68),
0xa28 (0x98f8e768)
 Updated Feb  9 23:00:06.801
 local adjacency 10.102.141.2
 Prefix Len 32, traffic index 0, precedence n/a, priority 1
   via 10.101.102.1/32, TenGigE0/0/0/47, 16 dependencies, weight 0, class 0, backup (Local-LFA) [flags 0x300]
    path-idx 0 NHID 0x0 [0x98e239b0 0x0]
    next hop 10.101.102.1/32
    local adjacency
     local label 16103      labels imposed {16103}
   via 10.102.141.2/32, TenGigE0/0/0/1, 8 dependencies, weight 0, class 0, protected [flags 0x400]
    path-idx 1 bkup-idx 0 NHID 0x0 [0x9966db30 0x0]
    next hop 10.102.141.2/32
     local label 16103      labels imposed {16103}
RP/0/RP0/CPU0:vtstmesr1-ncs5k-2#
```

If Fallback is enabled Check RIB (Routing information Base) and FIB (forwarding information base)

Heuristic Package = Codify Know-How

Heuristic Package codify the troubleshooting “Know How”.....



..... so that all the manual tasks can be automated !

Heuristic Package = Codify Know-How

Rules: Define “what to monitor”

Rules

Capture the assurance schema that applies to a specific type(s) of services: what are the subservices to be created, their payload and their dependency relationship. This schema gets applied to dynamically discovered service instances to generate their respective *Service Assurance Graphs*.

Rule Example

L2 Point2Point VPN Health Status depends:

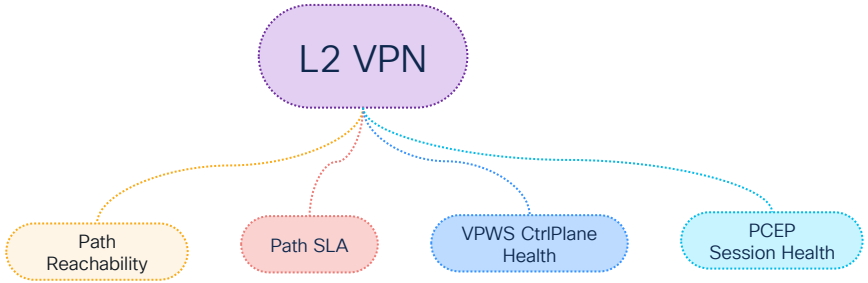
- Connectivity between the VPN endpoints A & B

  Translates to Subservice called `XconnectHealth:A-B`

- Health status of each endpoint devices A & B

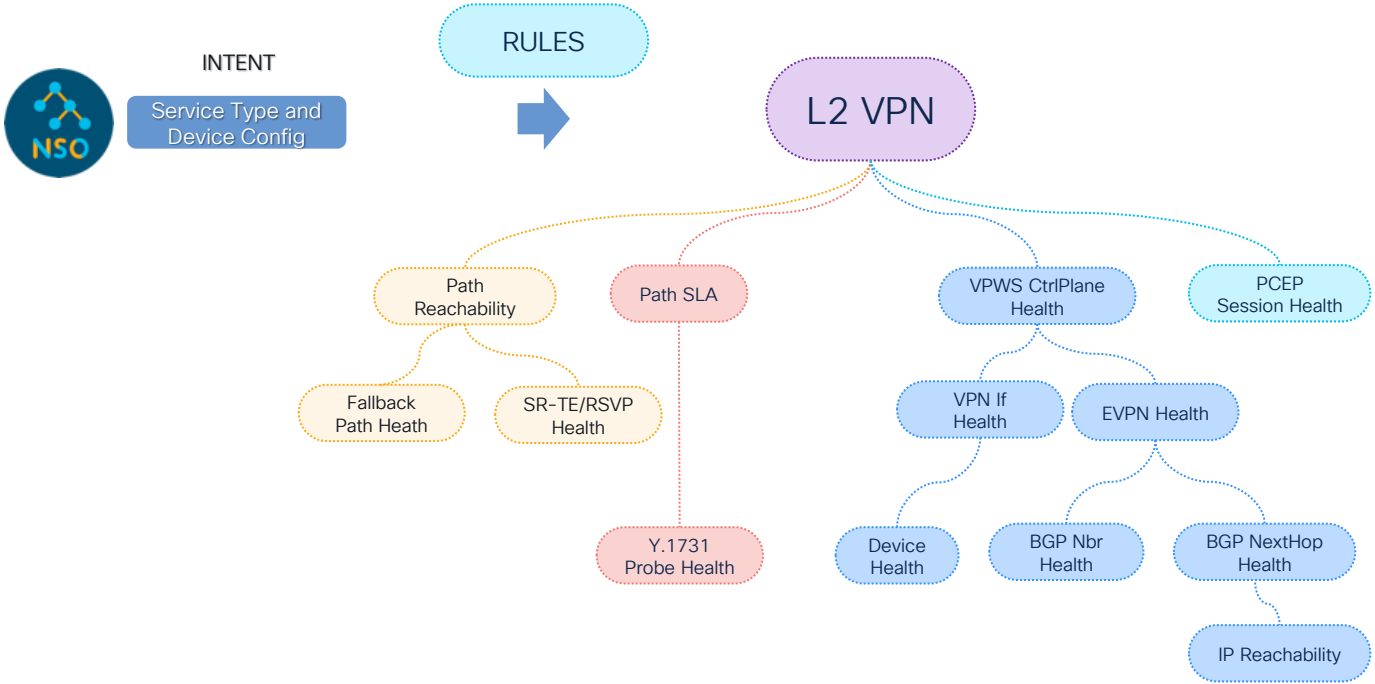
  Translates to 2 Subservices – `DeviceHealthA & DeviceHealthB`

- Payload is Device Name for each end point



Codify Know How = Heuristic Package

Rules: Define “what to monitor” and Model it in an Assurance Graph



Heuristic Package = Codify Know-How

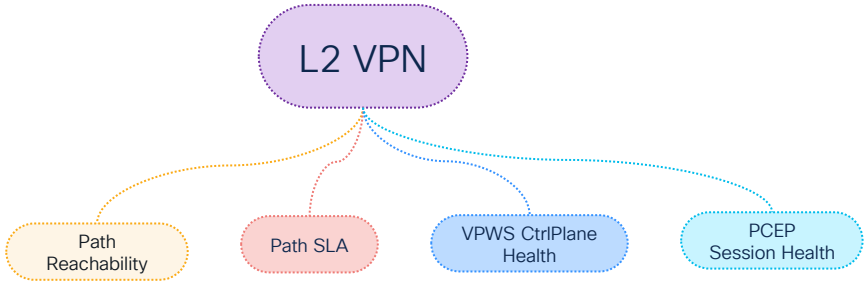
Configuration Profiles: Define Thresholds

Config. Profiles

Capture the thresholds against which I want to monitor the services and sub-services. To the operator we are exposing only the thresholds related to the service intent.

Thresholds Example

```
MEMFREE_THRESHOLD_MIN
Description: Threshold for minimum free memory to be
available on the device
Type: VAL_FLOAT
floatVal {2}
  Unit: GB
  Val: 10
```



Heuristic Package = Codify Know-How

Sub-service definition - Dependencies

Sub-service definition

Subservice definition will specify the underlying Metrics and details about how the health status for that subservice needs to be computed. Subservice Fields includes:

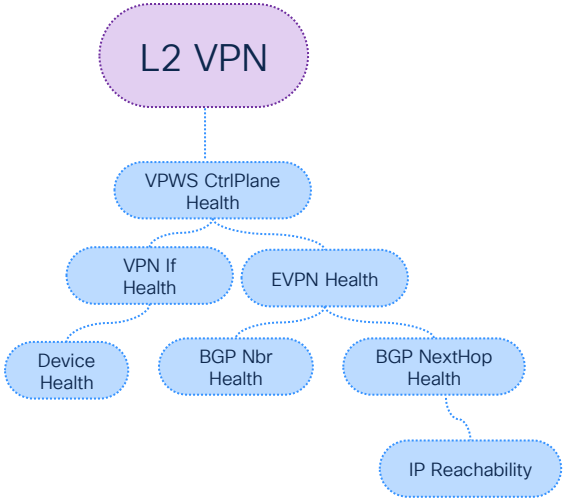
- **Dependencies:** List of Subservices and/or Metric Instances, Soft/Hard Dependency
- **Subservice Eval Expression:** How to derive the health status
- **Symptoms:** Subservice evaluates underlying metrics and subservices and records symptoms when prescribed expression is violated.

Dependencies

`SubserviceClass/subserviceVpwsCpHealth.json :: Checks whether XConnect is up` (Checks for both AC and EVPN segment status)

Supporting Metrics:

- `MetricClass/metricXConnectState.json`
- `MetricClass/metricXConnectAcState.json`
- `MetricClass/metricXConnectEvpnState.json`



Heuristic Package = Codify Know-How

Sub-service definition – Subservices Eval Expression

Sub-service definition

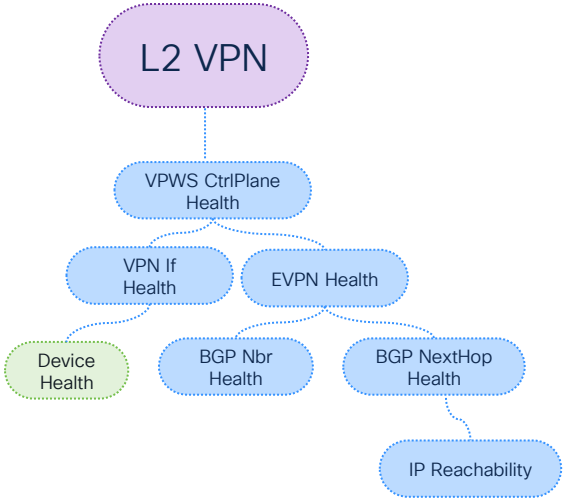
Subservice definition will specify the underlying Metrics and details about how the health status for that subservice needs to be computed. Subservice Fields includes:

- **Dependencies:** List of Subservices and/or Metric Instances, Soft/Hard Dependency
- **Subservice Eval Expression:** How to derive the health status
- **Symptoms:** Subservice evaluates underlying metrics and subservices and records symptoms when prescribed expression is violated.

Eval Expression

```
"rootExpressions": ["cpu_healthy && memory_healthy"],

"dependencies": [
{       "type": "DEP_TYPE_EXPRESSION",
        "label": "cpu_healthy",
        "eval_expression": "cpu_load <= 80" },
{       "type": "DEP_TYPE_EXPRESSION",
        "label": "memory_healthy",
        "eval_expression": "memory_free > 1000" }]
```



Heuristic Package = Codify Know-How

Sub-service definition - Symptoms

Sub-service definition

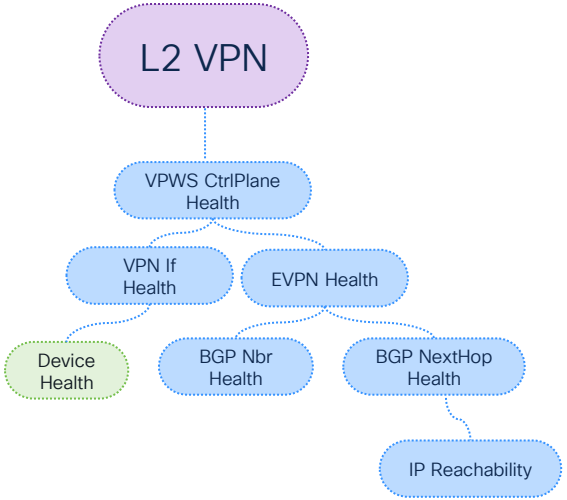
Subservice definition will specify the underlying Metrics and details about how the health status for that subservice needs to be computed. Subservice Fields includes:

- **Dependencies:** List of Subservices and/or Metric Instances, Soft/Hard Dependency
- **Subservice Eval Expression:** How to derive the health status
- **Symptoms:** Subservice evaluates underlying metrics and subservices and records symptoms when prescribed expression is violated.

Symptoms

```
"rootExpressions": ["cpu_healthy && memory_healthy"],

"symptom" : {
    "format_string" : "Heavier than expected resource consumption on
the device.",
    "level" : "DEGRADED"
}
```



Device Health

Symptoms

Eval Expression

Dependencies

```
{
  "name": "subservice.device.health",
  "namespace": "system",
  "params": [ {
      "name": "DEVICE",
      "type": "PARAM_TYPE_NON_LIST" } ],

  "symptom" : {
    "format_string" : "Heavier than expected resource consumption on the device.",
    "level" : "DEGRADED" },

  "rootExpressions": ["cpu_healthy && memory_healthy"],

  "dependencies": [
    { "type": "DEP_TYPE_EXPRESSION",
      "label": "cpu_healthy",
      "eval_expression": "cpu_load <= 80"  },
    { "type": "DEP_TYPE_EXPRESSION",
      "label": "memory_healthy",
      "eval_expression": "memory_free > 1000" },
    {"type": "DEP_TYPE_METRIC",
      "label": "cpu_load",
      "eval_expression": "metric.device.cpu.load",
      "paramMap": { "device": "DEVICE"  } },
    {"type": "DEP_TYPE_METRIC",
      "label": "memory_free",
      "eval_expression": "metric.device.memory.free",
      "paramMap": { "device": "DEVICE" } }
  ]
}
```

Heuristic Package is encoded in human readable format (json) and is designed to be extended in the field by experts to cover variations in service bringing in flexibility to customers.

Codify Know-How: Heuristic Package

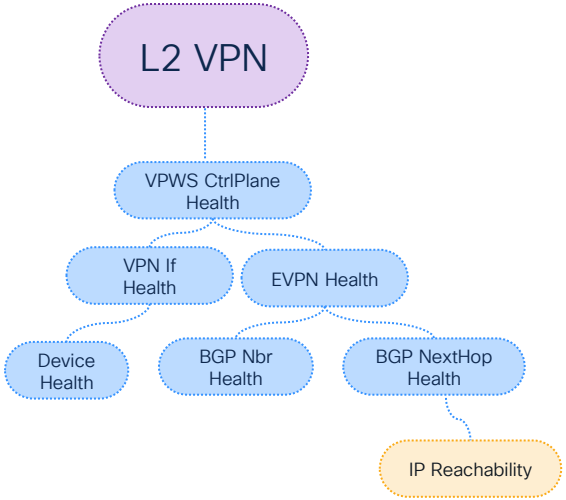
Metric Engine

Metrics Engine

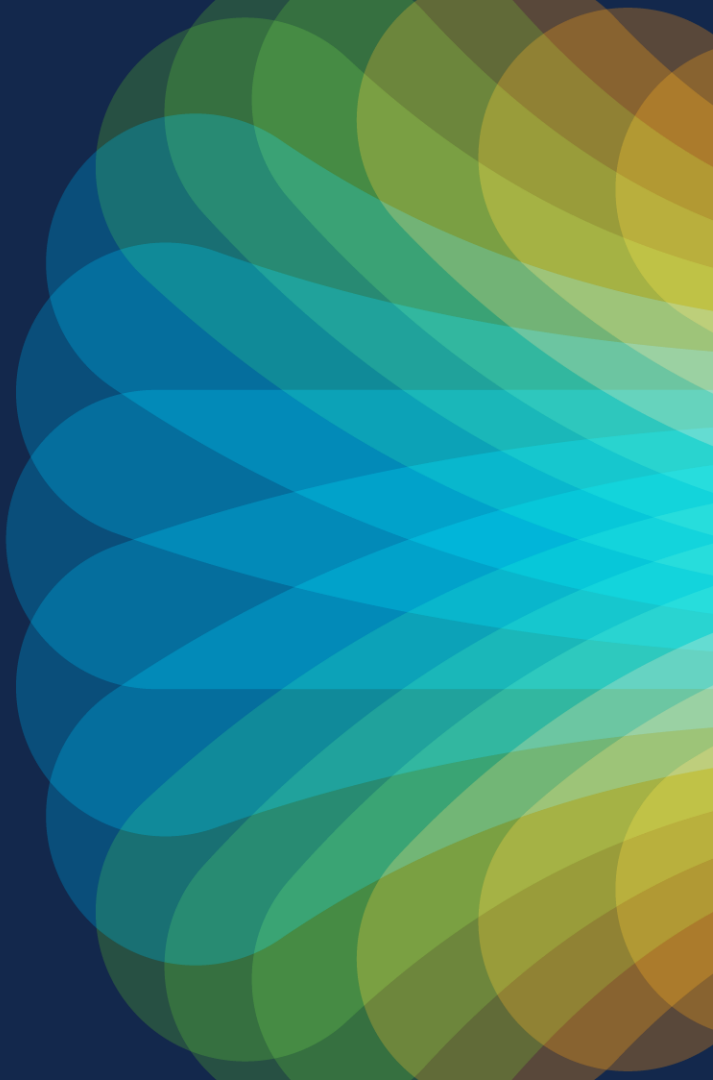
Metric defines the methods to fetch different operational data from different device types. Depending on the platform, different methods may be supported. Each metric definition specifies the different query methods supported for different device platform types.

Metric Mapping

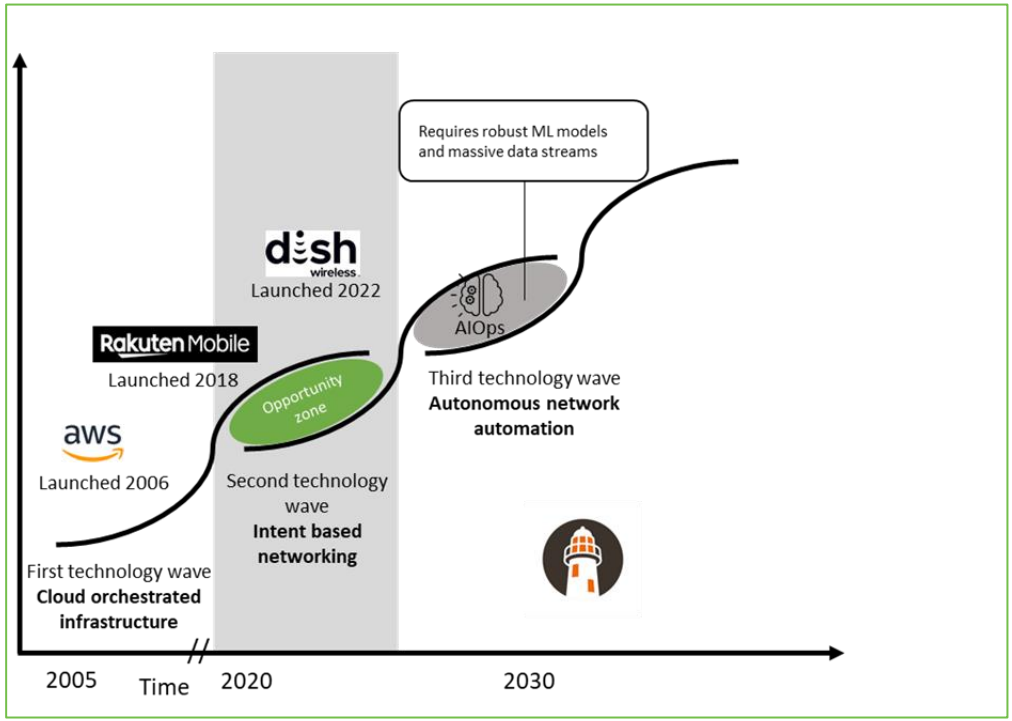
```
implementations": {
  "generic IOS XR": {
    "MDTMetric": {
      "sensor_path": "Cisco-IOS-XR-ifmgr-oper:interface-properties/… /
       interface[interface-name=GigabitEthernet{gigEthIfId}]/state”},
    "precedence": 2  },
  "SNMP IOS XR": {
     "SNMPMetric": {
      "oid": "IF-MIB:ifOperStatus",
      "key": "GigabitEthernet{gigEthIfId}",
      "mapping_oid": "IF-MIB:IF-MIB/ifTable/ifEntry” },
    "precedence": 20  } }
```



Intent Based Networking



Automated Assurance in the Programmable Network



Source: *White Paper by Appledore Research:* *'Intent-based Networking: Automated Assurance Critical Success Factor'*

- Entering 2nd wave of **Intent-based Networking**

> Ability to define a service level and, more importantly, assure that the network can maintain that state regardless of anything that happens in the network

- Cloud & distributed network functions deliver increased scale but also complexity
- Independent technology silos will be replaced with closed loop automation (CLA)

Intent-Based Networking in SDN Transport

Assure Each Layer Independently

Slice health

Slice

Slice Health based on subtending transport service health

Service health

VPN Service

IETF: Service Assurance for Intent Based Networking Architecture
Data Plane Verification through probing

Transport policy health

Transport

Policy verification with SR-PM: a TWAMP based tool

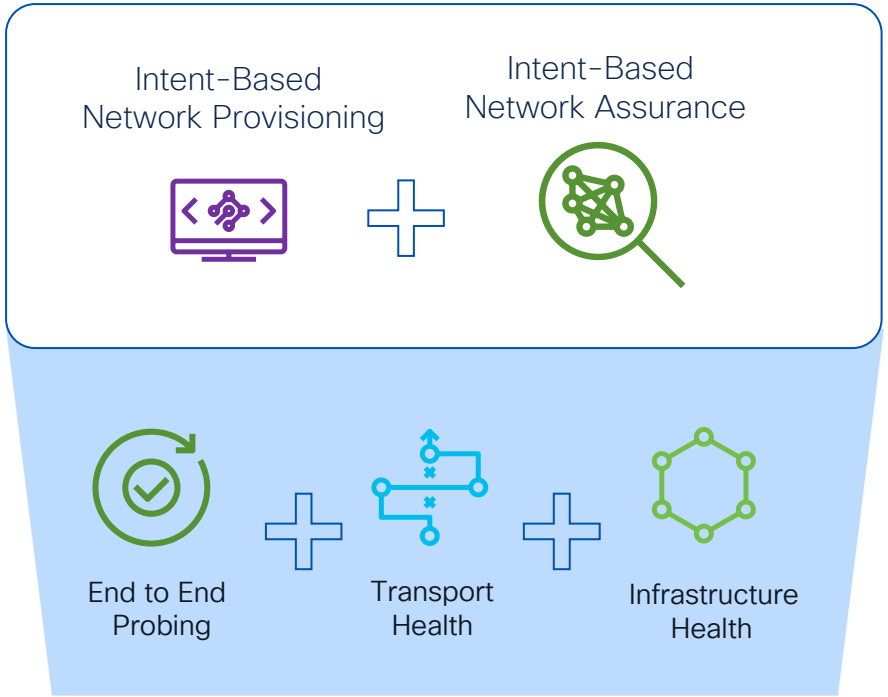
Infrastructure health

Infrastructure

Visibility & Monitoring: Device Inventory, Fault, Performance Metrics
Model Driven Telemetry

Service Health

Intent Based Approach – productization of IETF RFC 9417



Service Centric Approach

Start from the definition of the services and Tie Health across the layers

Dynamically Tie Intent to Telemetry

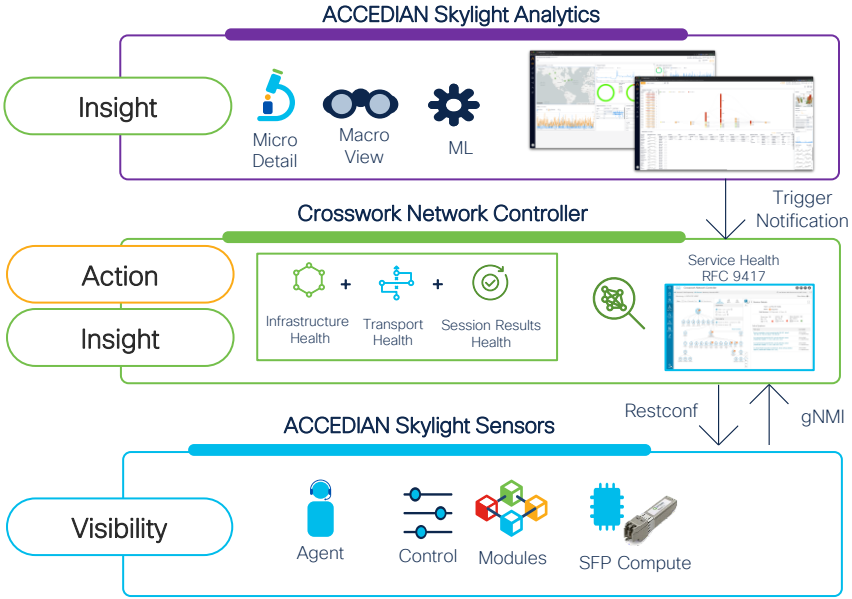
Monitor only network component that can influence the service health state

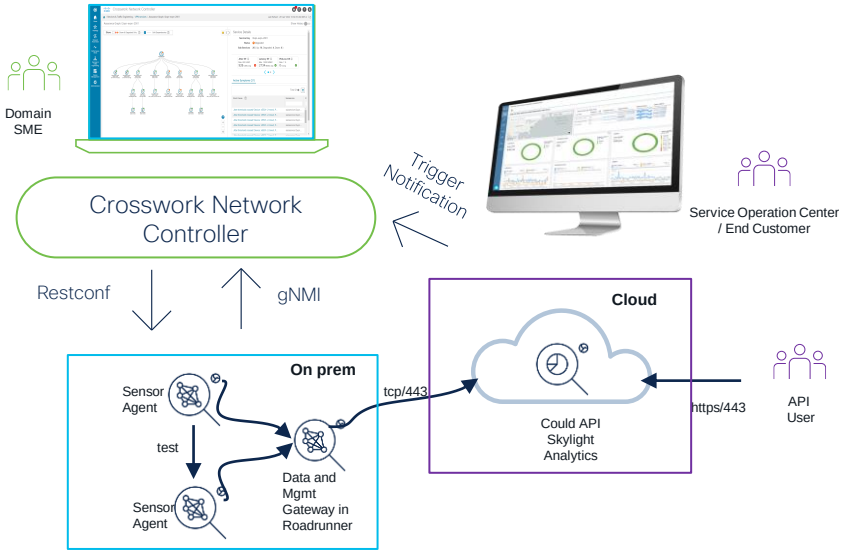
Automate Troubleshooting

Codify networking troubleshooting "Know-How" to automate

Probing

Deliver Your Service with Confidence
External Probe Integration

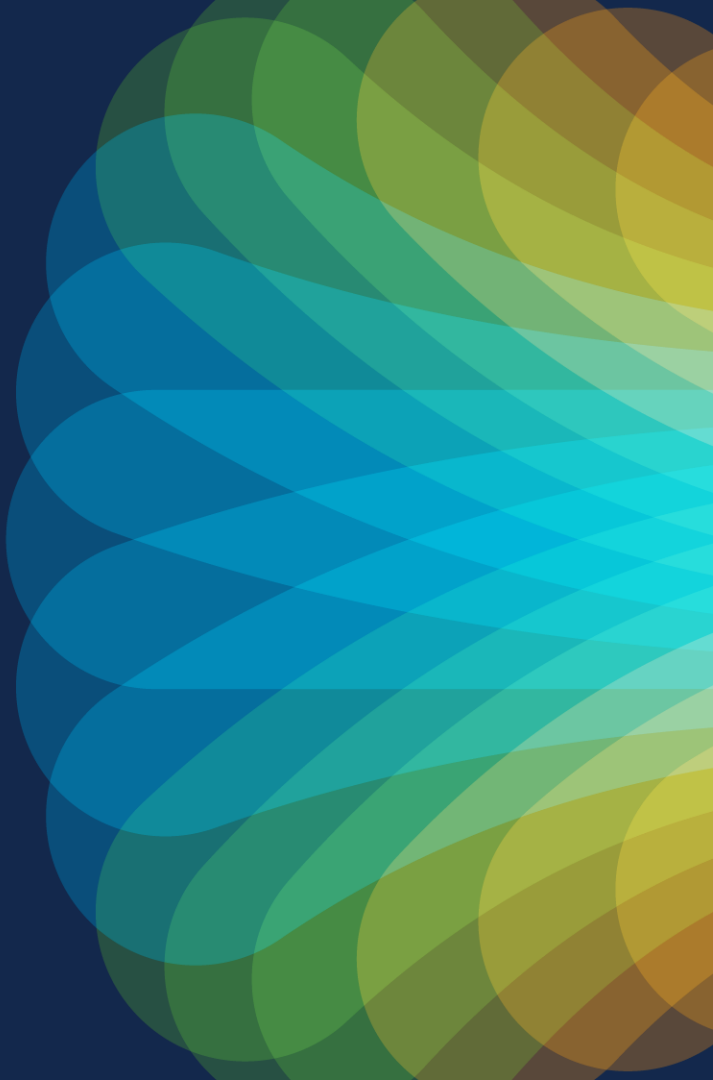




Integration Highlights

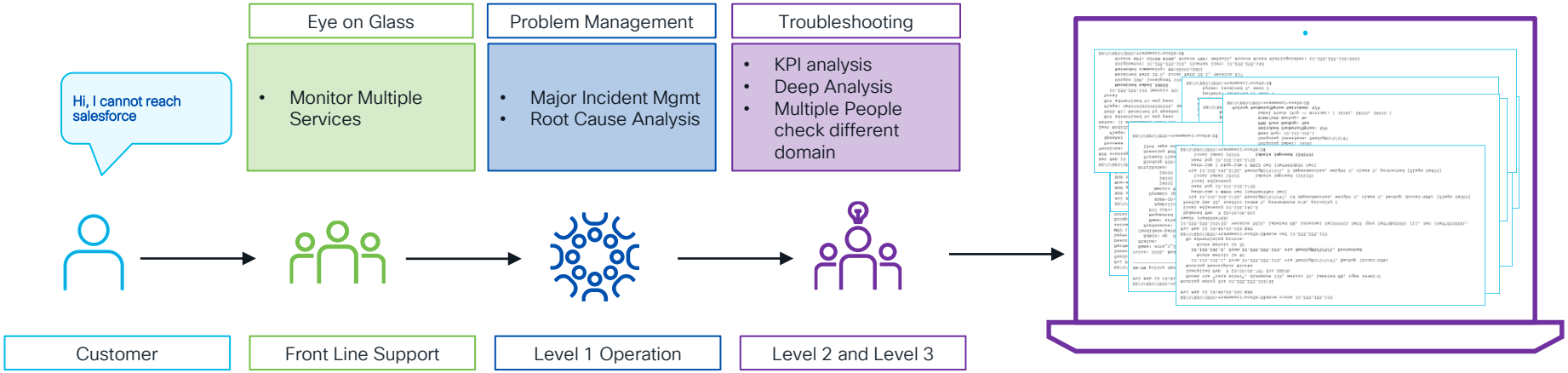
- **Zero Touch Assurance:** Extend service definition (INTENT) to include TWAMP sessions with desired topology
- **Model Driven Telemetry:** Subscribe to Accedian gNMI paths path automatically for the session initiated

The Operator Experience



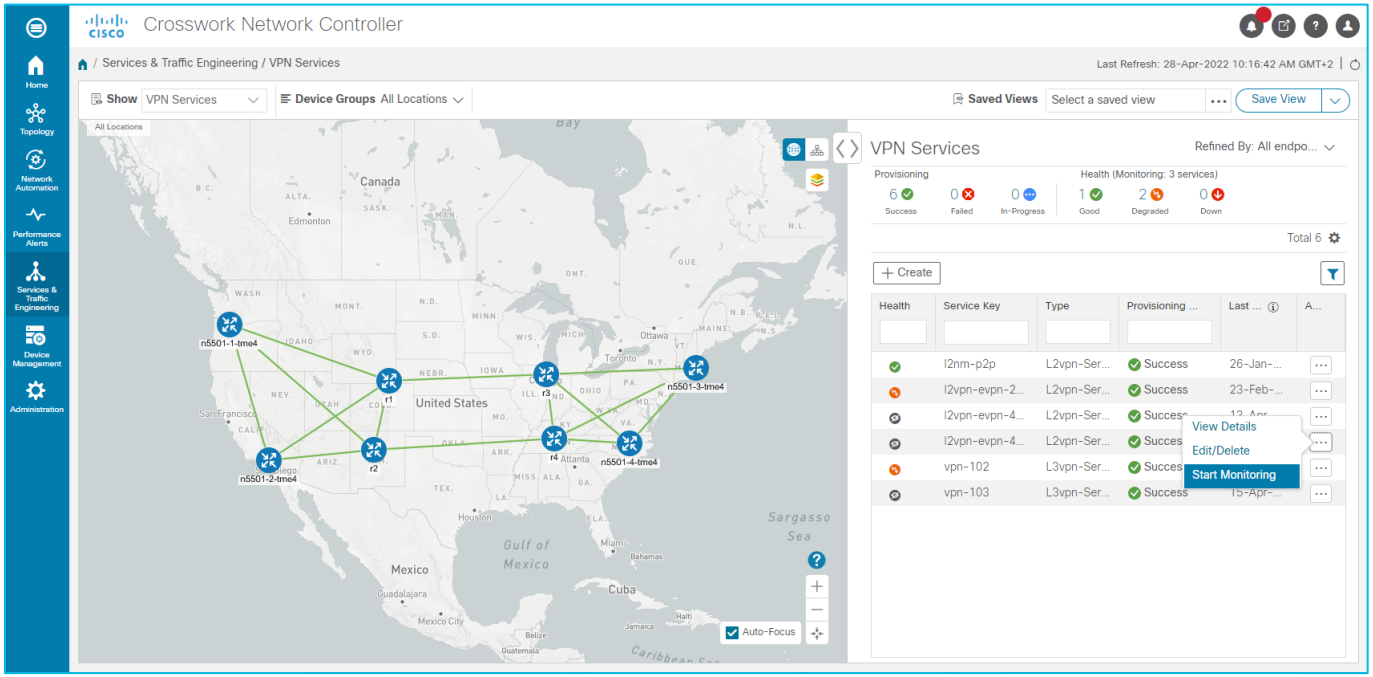
Today Operation Experience ...

MTTI/MTTK



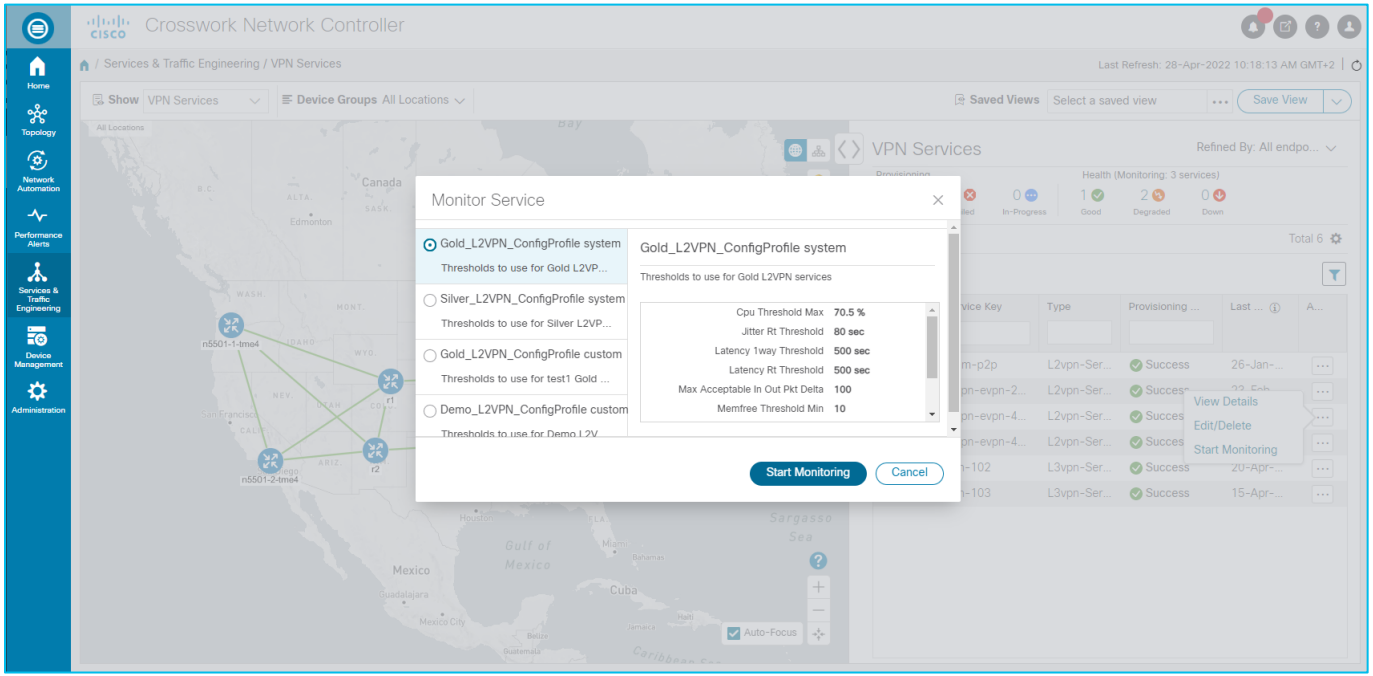
Enable Service Monitoring

Enable for selected service with a specific policy/profile.



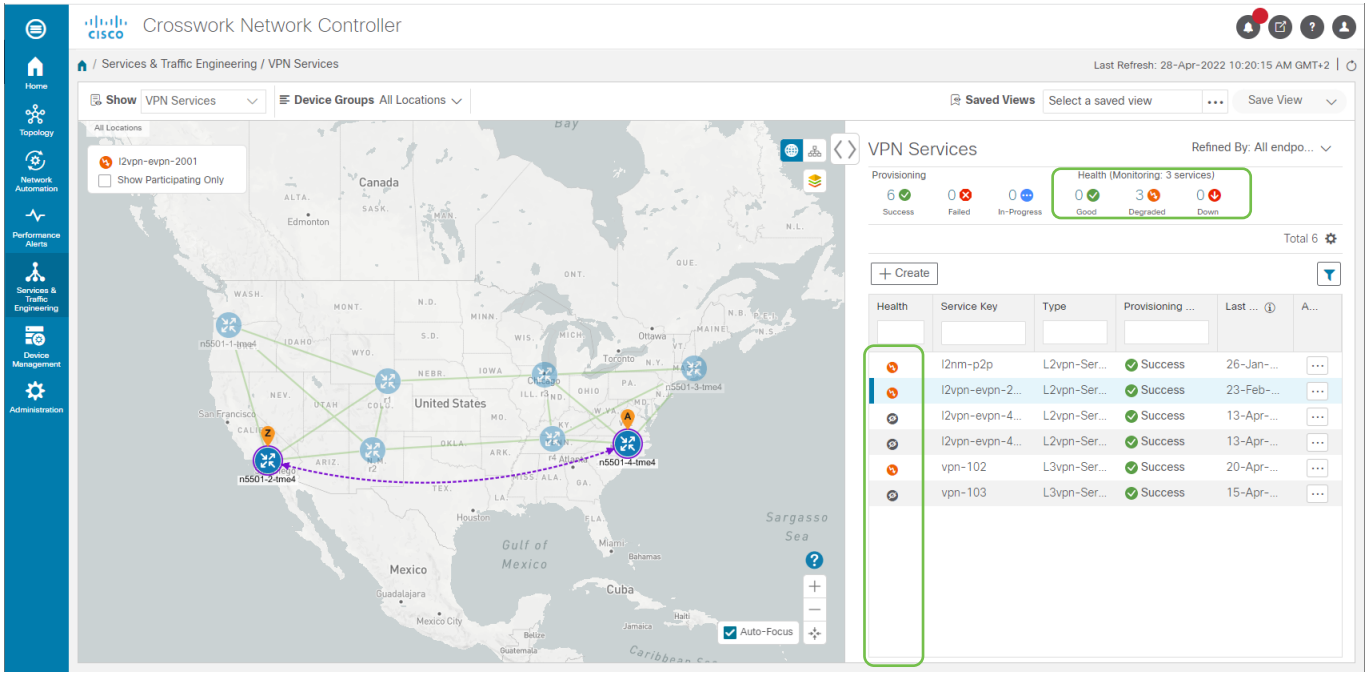
Enable Service Monitoring

Enable for selected service with a specific policy/profile.



Service Health Status reported

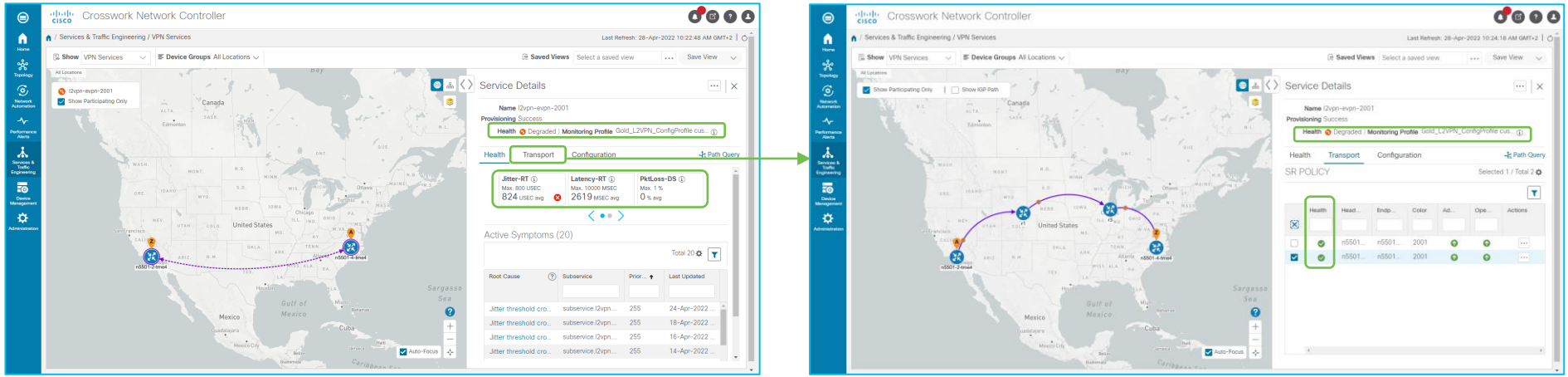
Indication on Service Detailed view



Health

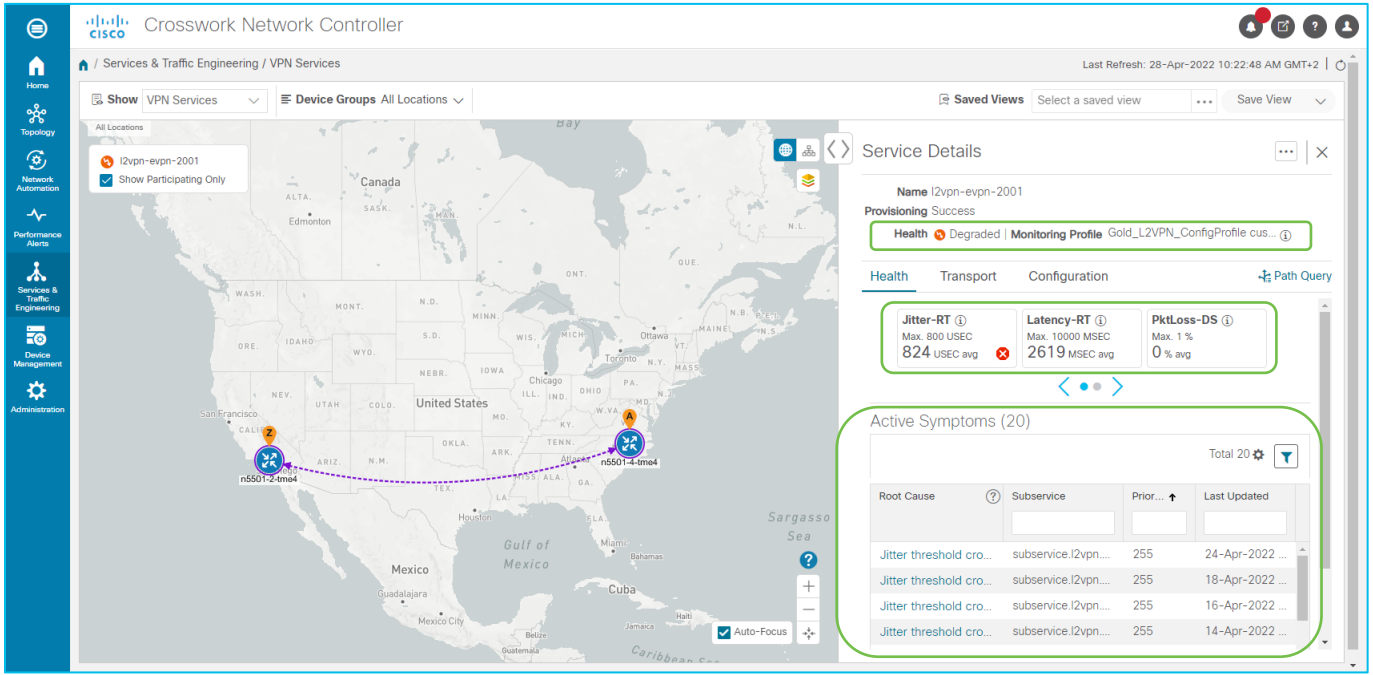
Path Health Status

Tracked as part of the service health details view.



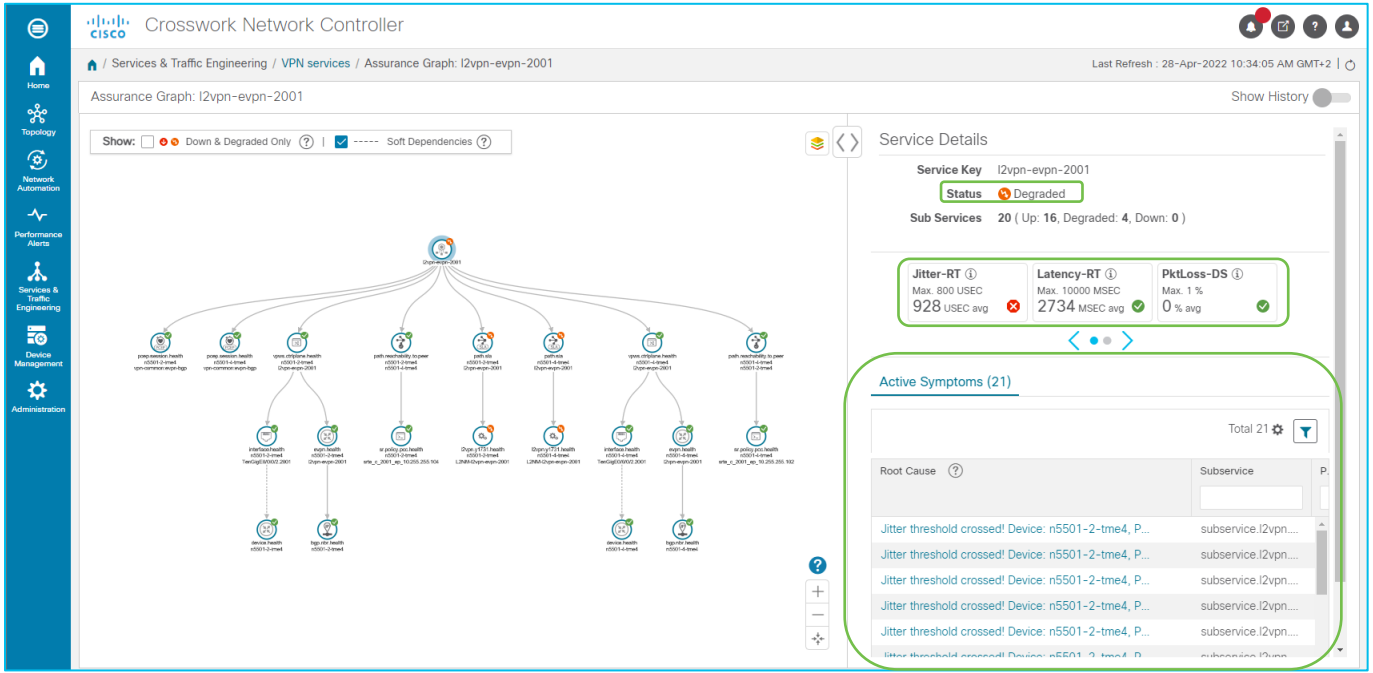
Service details with symptoms

Expedite troubleshooting by pointing to possible symptoms



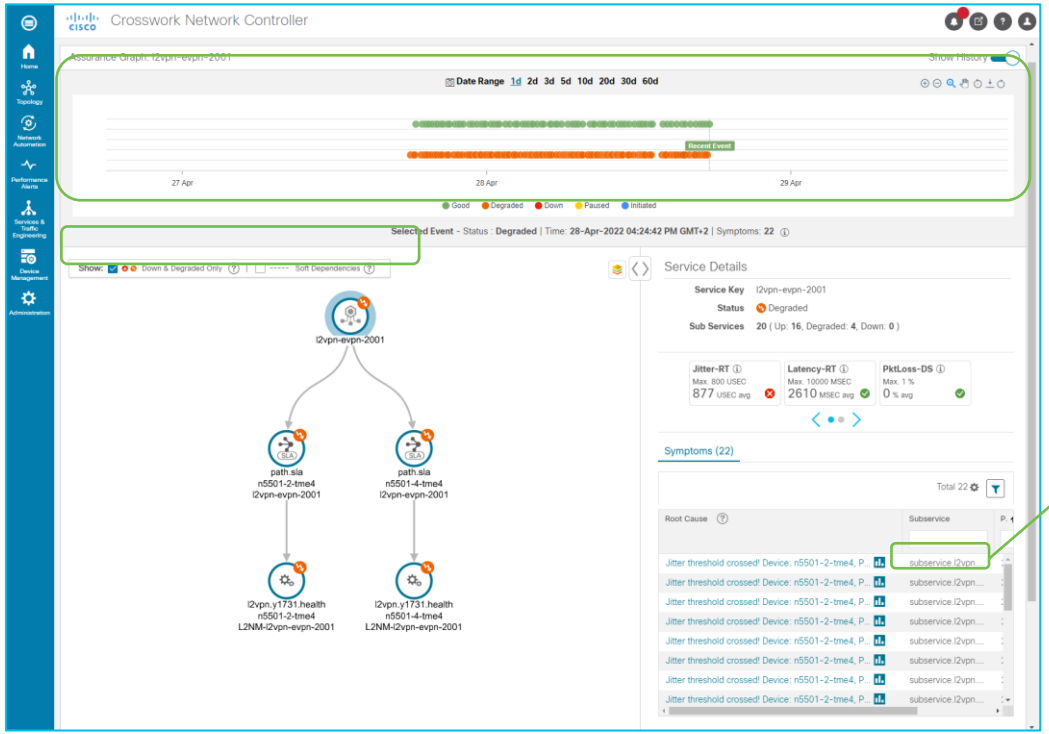
Assurance graph rendering

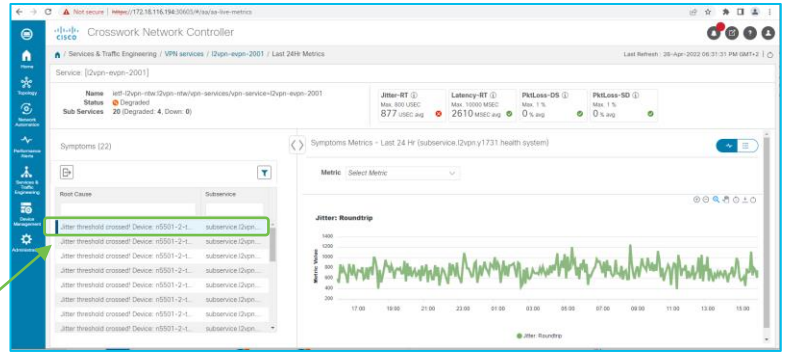
Help in pin-point the sub-services impacting the help of the service



Timeline View

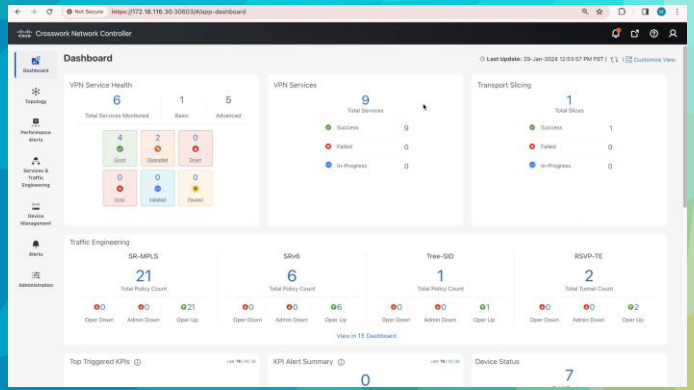
Ability to browse through snapshot of the service/sub-service status across timeline – up to 60 days





Video: Sneak view on Service Health

(Including integration with external probes)

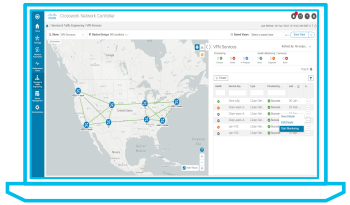


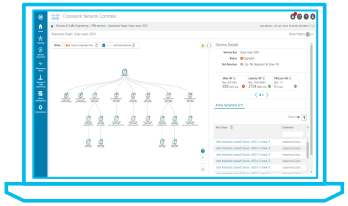
cisco Live!

Tomorrow Operation Experience ...

MTTI/MTTK

End to End View of the services shared across operator and adapted to the operator knowledge.





Eye on Glass

Proactively notify customer with possible causes

Proactive Problem Management

Proactively notify Level 2 and Level 3 and frontline support

Automate Troubleshooting

Extend Heuristic Package with additional subservices.

Hi, cannot reach sales force.

Yes, the device supporting your area is dropping packet.

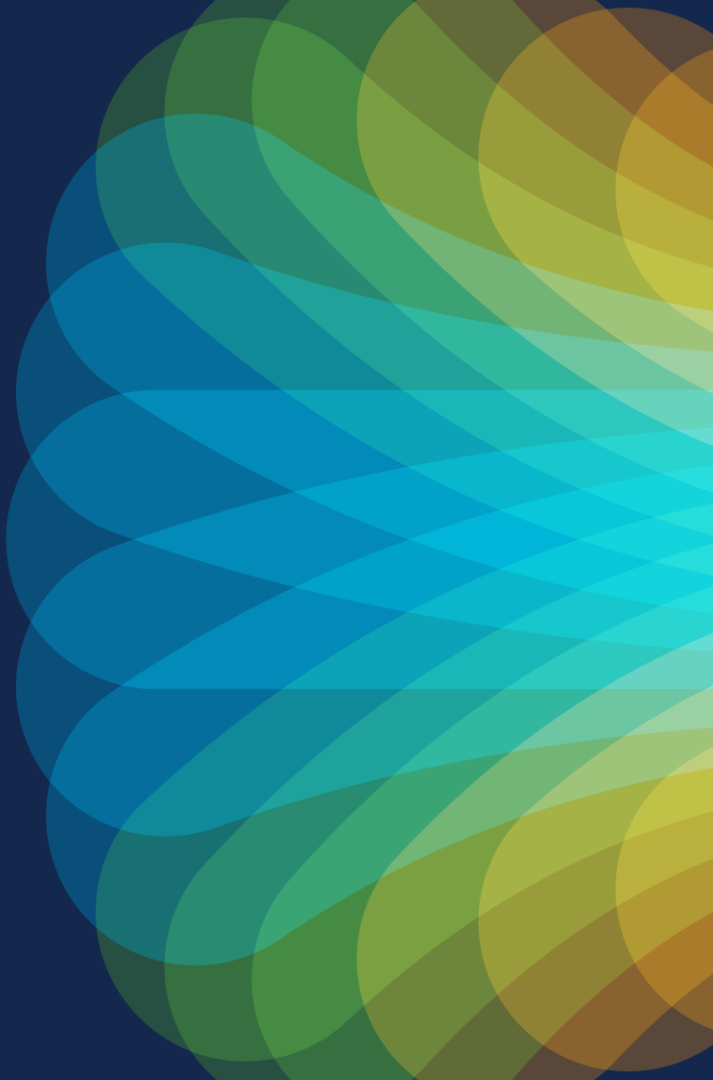
Customer

Front Line Support

Level 1 Operation

Level 2 and Level 3

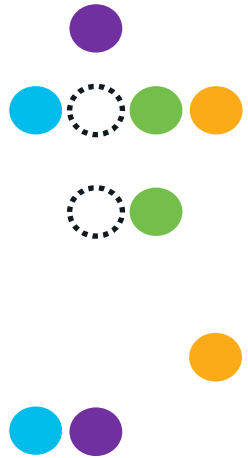
Know How Extension



Know How Extension

Customization and extension for greenfield deployment

- Adjust threshold settings; ex. add a bronze config profile
- Add more metrics to monitor; ex. TWAMP Light metrics for L3VPN, QoS related metrics
- Reduce number of out-of-the-box metrics monitoring to conserve device resource consumption when applicable



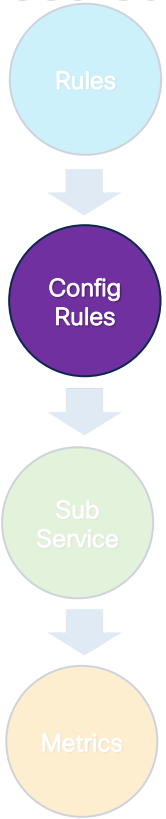
Extension to support additional Cisco and 3rd party platforms

Customization and extension for NSO brownfield deployment

Rules Config Profiles Sub-service definition Metric Engine

Know How Extension

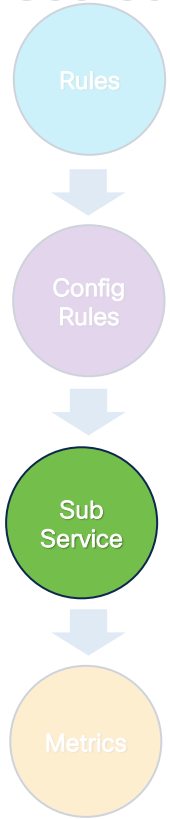
Use Case: Include mtu size for interface health of a l2vpn service.




```
"MTU_SIZE":{
  "description": "MTU Size for Jumbo frames"},
  "type": "VAL_INT"
  "intVal":{
    "unit": "NA",
    "val": 4000
   }
}
```

Know How Extension

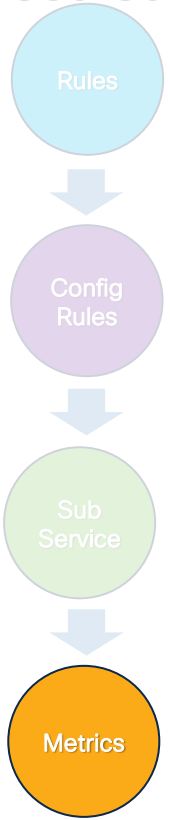
Use Case: Include mtu size for interface health of a l2vpn service.




```
{
  "name": "subservice.interface.health",
  "namespace": "custom",
  "description": "Subservice to reflect interface health",
  "params": [
       { "name": "device" } ,
       { "name": "ifID" }
   ]
 "rootExpressions": [
       { evalExpression":"oper_up && low_in_errors && low_in_discards && low_out_errors &&
         low_out_discards && mtu_size_4K" }
   ],
  "dependencies": [
     { --
     }
     { --
     }
     { "type": "DEP_TYPE_METRIC",
       "label": "mtu_size_4k",
       "eval_expression": "metric.interface.mtu"},
       "paramMap": {
          "device": "device"
          "gigaEthIfId: "ifId" }
        }
      }
  ]
}
```

Know How Extension

Use Case: Include mtu size for interface health of a l2vpn service.




```
{
  "name": "metric.interface.mtu",
  "namespace": "custom",
  "description": "Interface MTU",
  "display label": "ifMTU",
  "parameters": {
    "device": { "description":"Device to which the interface belogs" } ,
    "gigEthIfId": { "description":"Gigabit Ethernet Interface Id. Includes subinterface id." } ,
   }
   "m_type": {
    "int_t": {}
   }
   "implementation ": {
     "SNMP IOS XR": {
     "SNMPMetric": {
      "oidPathConfig": "IF-MIB:IF-MIB/ifTable/ifEntry",
      "oidPathExact": "IF-MIB:IF-MIB/ifTable/ifEntry[ifName={gigEthIfId}]/ifMTU",
      }
    }
   },
  "matches ": {
     "implementation ": "SNMP IOS XR", {
     "conditions": {
      "os_model": {
        "type":"exact_match",
         "match": ["Cisco IOS XR"]
    }
   }
  }
 ]
}
```

CX focus is to match the unique needs of each customer

CX Customization Use Cases

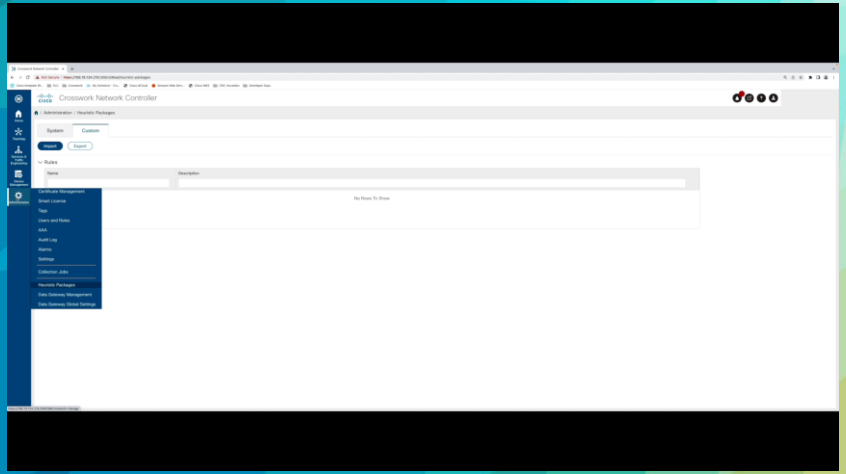
Customization and extension for greenfield deployment

- Adjust threshold settings; ex. add a bronze config profile
- Add more metrics to monitor; ex. TWAMP Light metrics for L3VPN, QoS related metrics
- Reduce number of out-of-the-box metrics monitoring to conserve device resource consumption when applicable

Extension to support additional Cisco and 3rd party platforms

Customization and extension for brownfield deployment

Video: Custom Heuristic Package



Conclusion

Crosswork Automated Assurance Use Cases

Avoid service disruptions with a holistic, **service-centric approach** to mitigating service-impacting issues

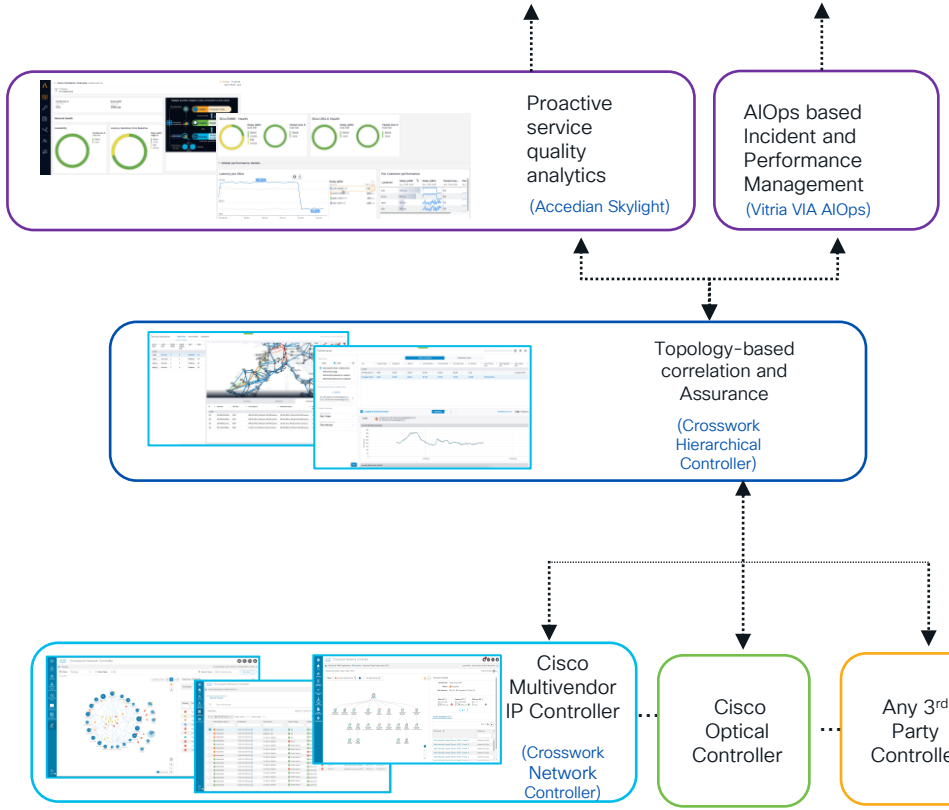
Business Outcome

- Reduction in time-to-detect service issues and remediation
- Improved user experience and operator productivity

Visibility: Expedite troubleshooting by providing deep visibility

Insights: True Service Impact by combining empirical data plane verification with infrastructure health status in a single view

Actions: Codified Assurance Intent and Network "Know-How" enable to automate troubleshooting step.




cisco
The bridge to possible
Thank you
cisco Live!


cisco Live!
Let's go