DATA SHEET

Apstra Operating System AOS®

CHALLENGES

- Network admins manually track and verify thousands of elements, even for a small spine-leaf networks with a handful of devices.

SOLUTION

- **Apstra AOS®**
  A turn-key software that helps networking teams manage data center net-works as a cohesive system.

RESULTS

- From the AOS Server GUI customers can design, build, deploy, and operate a leaf-spine network in days, rather than in months, including racking, stacking, cabling and validating all design intent is met in real-time.

Build and Operate Networks As a Single System — with Breakthrough Simplicity and Agility

Challenges

Enterprises and service providers are transforming their private data centers by building leaf-spine BGP fabrics with EVPN VXLAN. The challenge they face is network admins have to manually track and verify thousands of elements, even for a small spine-leaf networks with a handful of devices. These include logical elements such as ASNs, BGP sessions and routing tables, virtual elements like VNIs, IPs, VXLANs, and physical elements like redundant links, Ethernet interfaces and transceivers. If any one of these components is misconfigured or fails, a cascading effect causes multiple compute, network, and storage nodes to suffer.

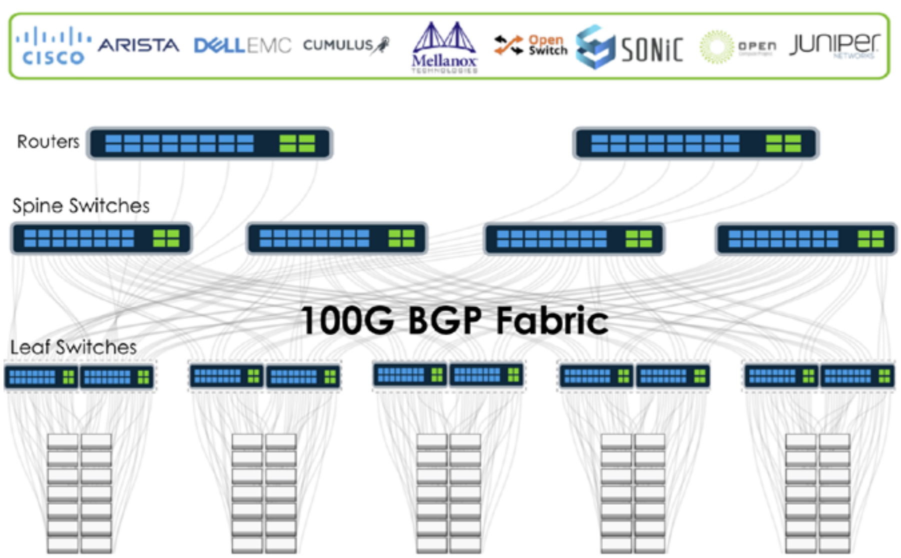

FIGURE 1:

ENORMOUS COMPLEXITIES AND DEPENDENCIES - EVEN IN A SMALL DATA CENTER LEAF-SPINE NETWORK

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In addition, these dependencies are compounded by vendor-specific network operating systems (NOS) and hardware choices, as well as the presence of constant change. Businesses need to move workloads, create a new tenant, or add / delete / update any element. Network admins and IT also need to analyze the changing network state — interface counters, syslogs, memory utilization, and much more.

Solution:

Apstra AOS® is turn-key software that helps networking teams manage data center networks as a cohesive system. Enterprises and service providers are using AOS to declare high-level design intent, which is rendered into low-level device configurations and deployed across their choice of network hardware and NOS. AOS also monitors and analyzes the network operating state to ensure it does not deviate from the intended state. It allows customers to focus on the "what" not the "how," eliminating the need to calculate and correlate low-level dependencies in their head — from BGP EVPN through VXLANs down to Ethernet interfaces.

FIGURE 2:

Apstra Operating System

DESIGN-BUILD-OPERATE LEAF-SPINE BGP FABRIC WITH EVPN VXLAN IN A TOP-DOWN APPROACH

AOS gives every business a turnkey data center network automation solution, with agility and reliability rivaling those from cloud providers, without DIY programming and hardware lock-in.

Unlike traditional network management tools that require operators to write and maintain complex and brittle programs to process raw telemetry — and stare at monitoring stations, AOS is an Intent-Based Networking software with Intent-Based Analytics (IBA) baked-in. Because AOS functions as a distributed operating system that understands the dynamic dependencies of all network elements — the context, it allows operators to use intent as the single source of truth to instantly boil raw data down to actionable insights. This eliminates the need for system operators and integrators to constantly write, integrate and synchronize complex low-level programs.

Unlike Do-It-Yourself (DIY) network automation that requires massive amounts of programming, AOS is a turnkey application that works out-of-the-box for data center leaf-spine networks, with extensibility to support other topologies in the future.

Unlike hardware-specific management software that tightly ties operational life cycles with hardware life cycles, AOS completely decouples management procedures with the underlying hardware life cycles, including vendor choice and arcane specificities -- from day 0 design through day X operations.

AOS gives every business a turnkey data center network automation solution, with agility and reliability rivaling those from cloud providers, without DIY programming and hardware lock-in.

Benefits: Operational Simplicity, Agility and Reliability

Day 0 design

From the AOS Server GUI customers can design, build, deploy, and operate a leaf-spine network in days, rather than in months, including racking, stacking, cabling and validating all design intent is met in real-time.

AOS helps organizations design a Layer 3 BGP underlay fabric, with multi-tenancy EVPN VXLAN overlay networks, using best practices proven by cloud companies and other experts. IT and operation teams can finish design tasks in just a few minutes via a few mouse clicks, such as specifying the oversubscription target, redundancy goal, IP addressing scheme and traffic isolation need, without having to worry about vendor-specific leaf-spine network hardware, or vendor-specific configuration nuances.

The following design examples show how to declare design intent and immediately see rendered topologies:

FIGURE 3:

DECLARATIVE-DESIGN IN MINUTES (EXAMPLE 1)

"I need to connect 500 servers via 10G-leaf via L3 routing, with 1:1 oversubscription."

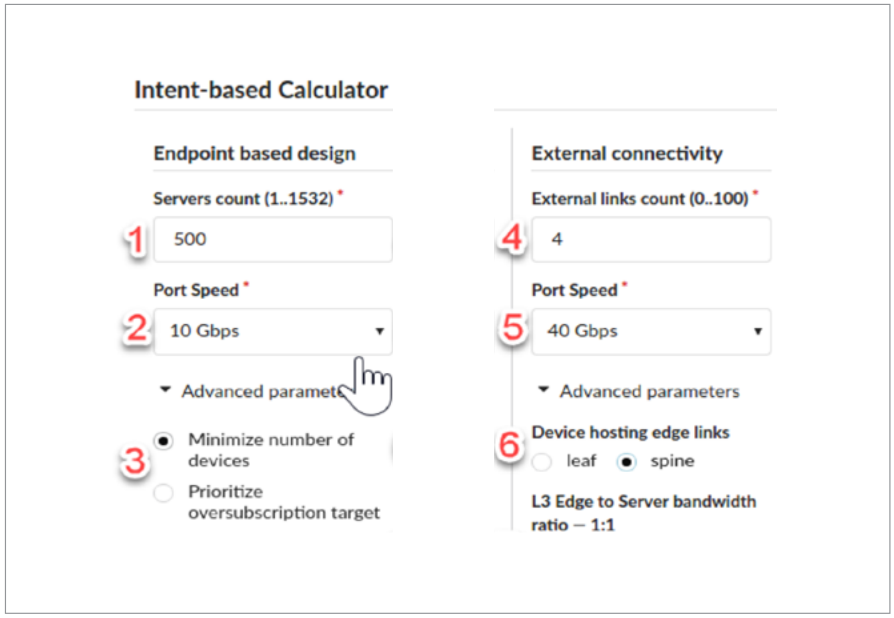


FIGURE 4:

DECLARATIVE-DESIGN IN MINUTES (EXAMPLE 2)

"I need to connect these servers via L3 routing to the host."

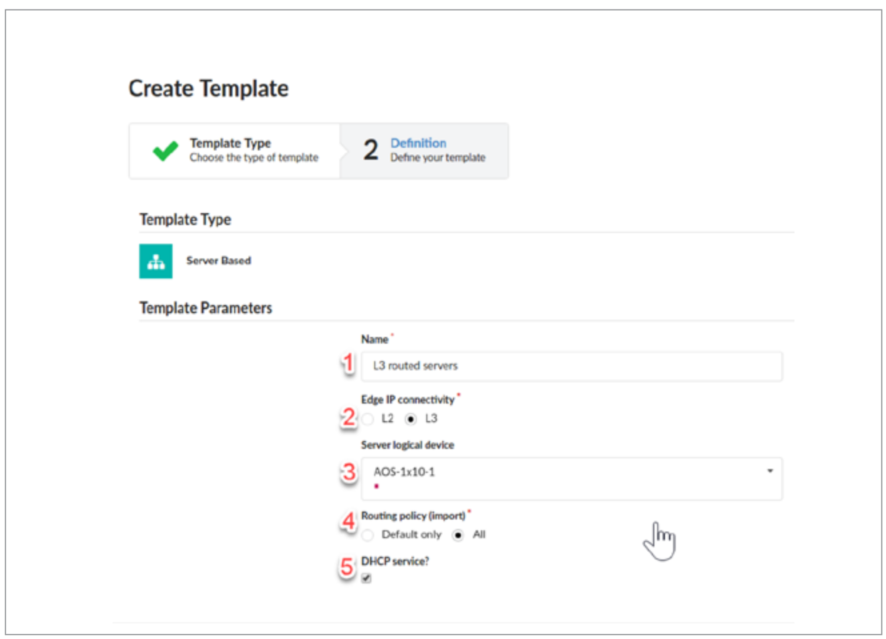
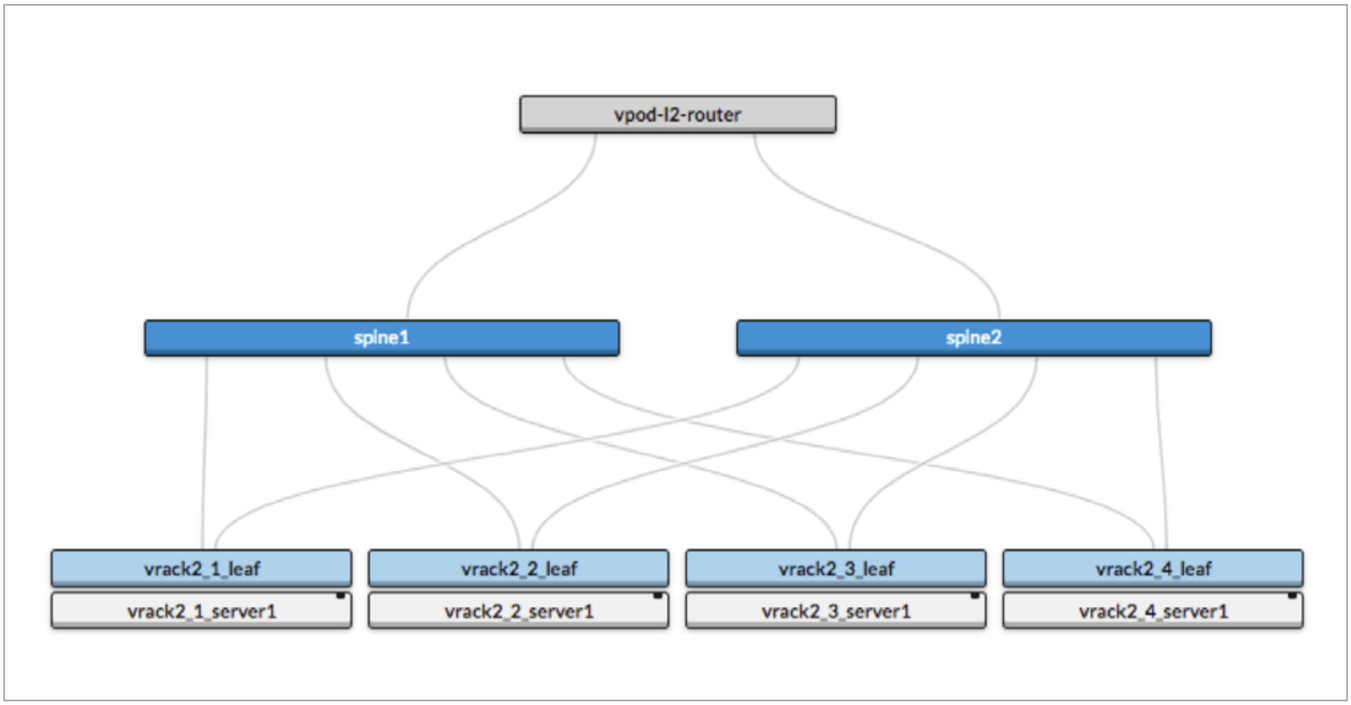


FIGURE 5:
RENDERED-TOPOLOGY IN MINUTES



AOS dynamically updates network documentation and configurations, providing a true single pane of glass for network lifecycle management.

Day 0/1 build and deploy

AOS then renders design intent into a software blueprint in minutes. The blueprint contains detailed configurations for both the underlay BGP fabric and virtual network overlays (EVPN VXLAN), which is validated to work on many vendor's hardware. The blueprint also includes a cabling diagram and cut sheet that show you how to wire up all devices. This make it possible to deploy the blueprint to the chosen hardware in minutes. The following examples show:

- ASN-VNI-IP resource allocation across devices
- Detailed BGP, EVPN and VXLAN configuration
- Redundancy configuration (MLAG and ECMP)

AOS dynamically updates network documentation and configurations, providing a true single pane of glass for network lifecycle management.

FIGURE 5:

BUILD PHYSICAL UNDERLAY NETWORKS WITH RENDERED CONFIGURATIONS AND FULL VALIDATIONS

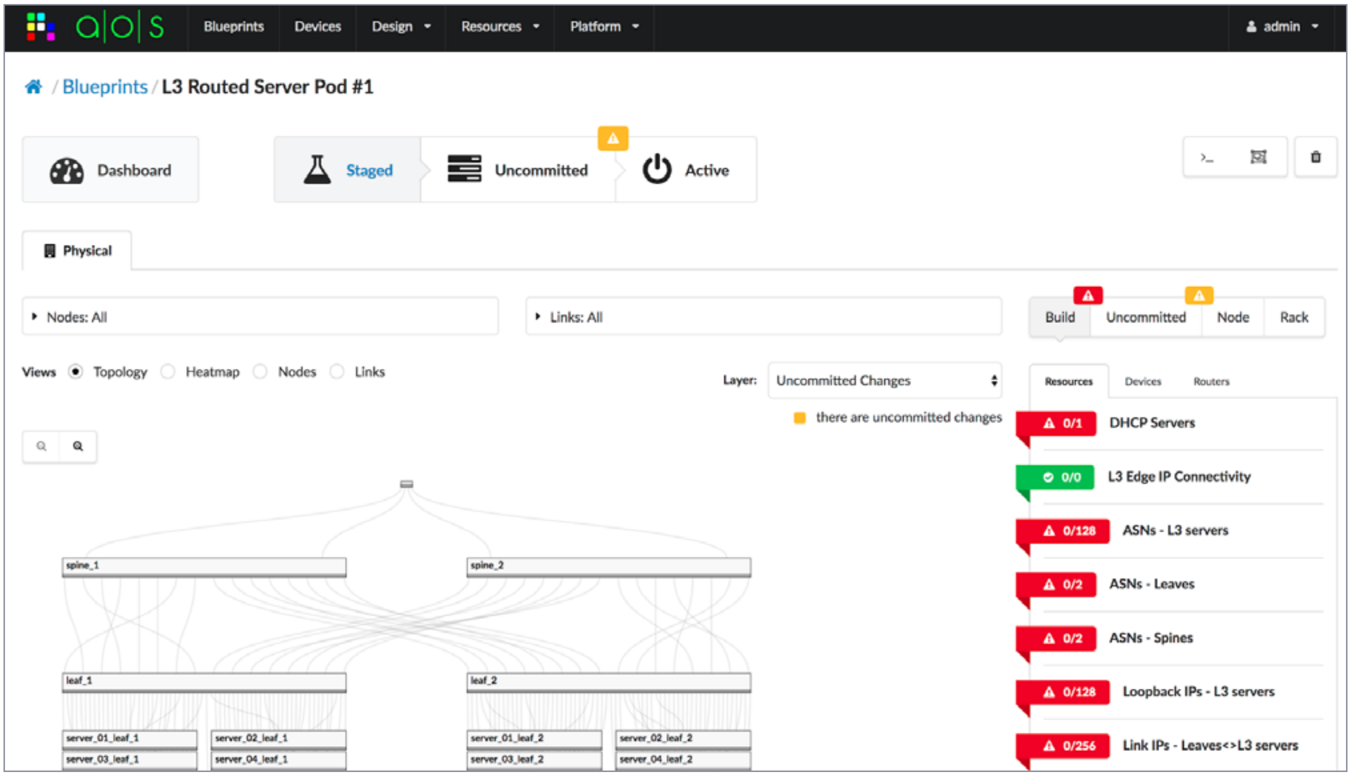


FIGURE 6:

BUILD OVERLAY NETWORKS WITH RENDERED CONFIGURATIONS AND FULL VALIDATIONS

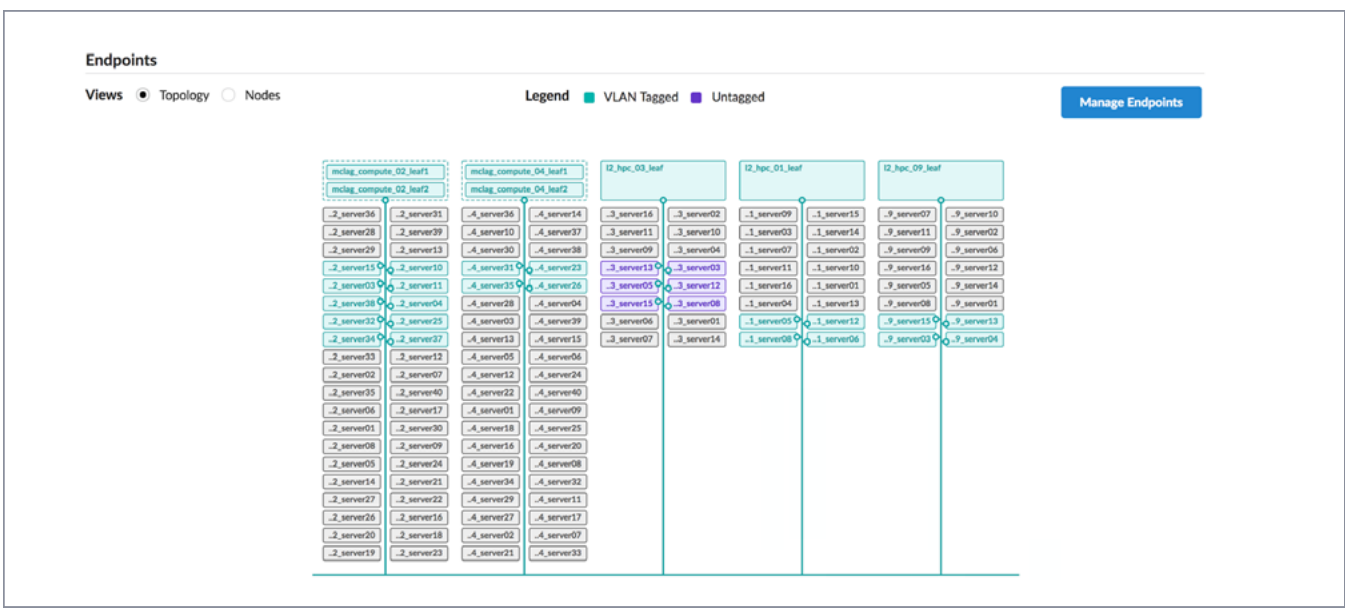
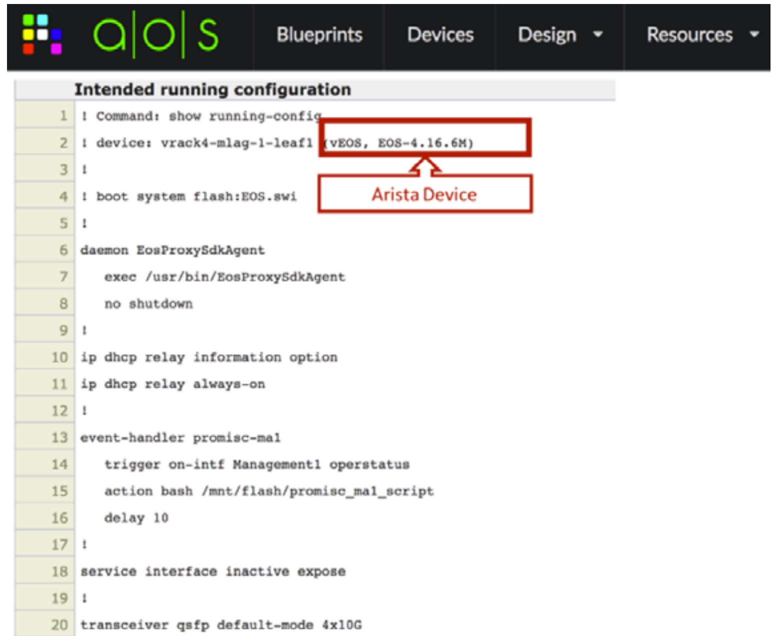


FIGURE 7:

DEPLOY RENDERED VENDOR-SPECIFIC CONFIGURATION DETAILS



Day X operations: Continuous validations with built-in Intent-Based Analytics (IBA) and closed-loop telemetry

Once the blueprint is deployed to the chosen network hardware, AOS continuously validates that the design goals are being met, such as:

- ASN-VNI-IP resources are allocated properly across devices.
- BGP configurations are correct, and routes are populated properly.
- EVPN VRFs are working correctly.
- Redundancy is working properly, including MLAG and ECMP.
- Best practice telemetry is being gathered correctly, and in real-time.

AOS IBA liberates network operators from today's status quo, which is to sift through mountains of raw telemetry, complex and brittle programs, and stare at network visualizations 24/7 to detect unusual patterns. Contrary to the traditional big-data analytics status-quo, AOS IBA relieves network operators from having to write complex low level imperative programs that need to be integrated and constantly kept in sync.

Instead, network operators specify, using a simple, dynamic, declarative interface, exactly how they expect their network to operate - beyond mere connectivity and including traffic patterns, performance, and tolerance for grey failures. AOS then continuously validates the network operators' intent, simply generating anomalies when it detects a deviation. With AOS IBA, network operators can quickly detect and prevent a wide range of service level violations - including security breaches, performance degradations, and traffic imbalances.

Because AOS integrates all management activities and data across design, implementation, and operations, it becomes possible to perform ongoing changes quickly and reliably, such as replacing a leaf switch or adding a virtual network, as well as specify what contextual and actionable alerts are needed to detect and prevent outages and gray failures.

IBA provides 6 categories of intelligent probes out-of-the-box, to allow network admins and operators to quickly set up proactive closed-loop monitoring and actionable alerts for gray failures.

The 6 categories of probes are:

East West Traffic
Calculates East-West Traffic

MLAG Imbalance
Calculates traffic imbalance across members of each MLAG

Headroom
Calculates best and worst case available BW across all possible ECMP paths between 2 endpoints

ECMP Imbalance
Calculates traffic imbalance across all ECMP uplinks

Hot/Cold Fabric Ports
Determine hot or cold interfaces by traffic erros

Interface Flapping
Calculates the number of time an interface op status changes over a period of time

Using the "Headroom" probe as an example, the following screenshots show how to extract the bandwidth consumption insight from raw closed-loop telemetry.

FIGURE 8:

THE BANDWIDTH HEADROOM PROBE WORKS OUT OF THE BOX, ALLOWING OPERATORS TO CONDUCT LIVE, INTERACTIVE QUERY OF THE NETWORK STATE: "DO I HAVE ENOUGH BANDWIDTH HEADROOM BETWEEN THESE TWO PHYSICAL SERVERS?"

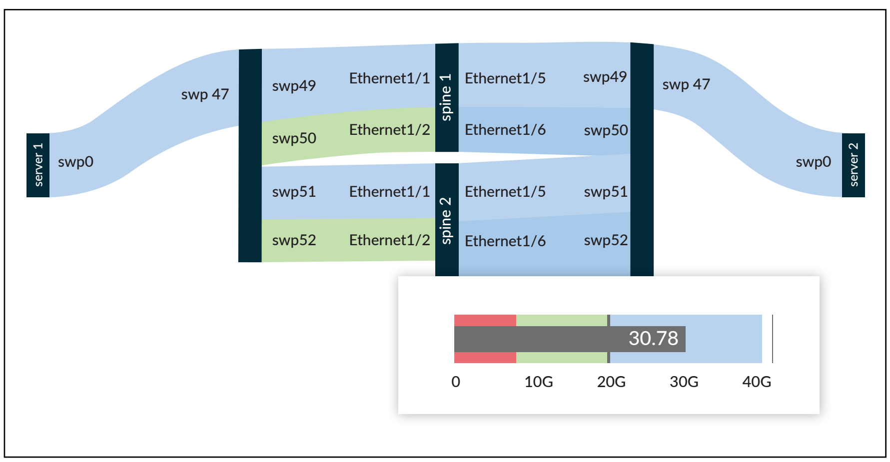


FIGURE 9:

OPERATORS CAN BUILD AND DEPLOY THEIR OWN PROBES INSTANTLY, BY CUSTOMIZING HOW THE BIG DATA PROCESSING PIPELINE WORKS. THE PROBE DYNAMICALLY UPDATES THE REQUIRED RAW STATS.

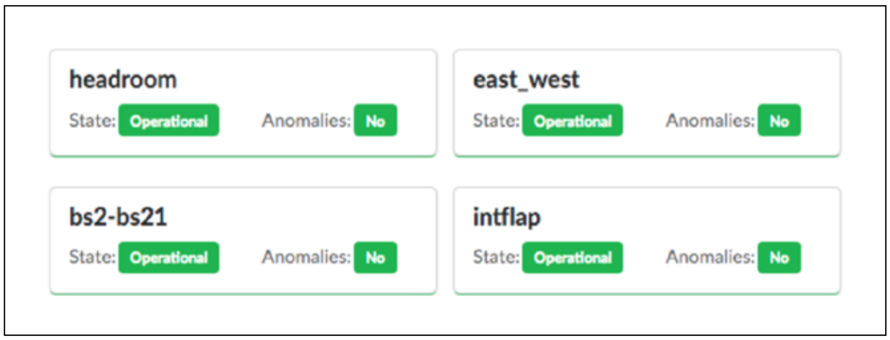


FIGURE 10:

OPERATORS CAN BUILD AND DEPLOY MULTIPLE PROBES INSTANTLY.

FIGURE 11:

IF NEEDED, OPERATORS CAN CHOOSE TO SEE THE TIME-SERIES DATA GATHERED BY A PROBE.

AOS can also be deployed in monitoring mode on existing data center deployments. After automated discovery of the network, AOS offers the same continuous validation and intent-based analytics capabilities in a risk-free, read only fashion.

Summary

AOS® is a turnkey application for data center spine-leaf networks. It enables network engineers and operators to quickly and reliably design-build-operate a spine-leaf network. It applies to any size network, and scales to the largest data centers.

AOS 2.2 Features and Specifications

Services:

- Server-based designer, rack-based designer
- BGP L3 Clos fabric with multi-tenancy EVPN (RFC 7432)*
- Intra-rack (VLAN), or inter-rack (VXLAN)
- L3 VXLAN routing
- L3 server routing with dual attachment*
- L2 server with MLAG/LAG
- IPv6 fabric: No need for IPv4 addresses on fabric links*
- Extensible services (intent, resources, expectations)
- DHCP relay

Telemetry:

- LLDP, BGP, EVPN* config deviation
- Interface counters
- Routing table verification
- Host, transceiver, interface, LAG / MLAG
- MAC & ARP
- Server and devices health
- Intent-based anomaly detection
- Telemetry streaming via protocol buffers
- Extensible telemetry collection

Intent-Based Analytics (IBA)*:

- East-west traffic: Calculates east-west traffic
- MLAG imbalance: Calculates traffic imbalance across members of each MLAG
- Headroom: Calculates high and low bandwidth usage across all possible ECMP paths between 2 endpoints
- ECMP imbalance: Calculates traffic imbalance across all ECMP uplinks
- Hot / cold fabric ports: Determine hot or cold interfaces (by traffic or errors)

Interface flapping: Calculates the number of time an interface status changes over time*An open source catalog of IBA probe configurations is available, to enable an ecosystem with customers, partners, and other third parties*

Device OS:

- Cisco NX-OS and vNX-OS
- Arista EOS and vEOS
- Juniper Junos**
- Cumulus with Free-Range Routing (FRR)*
- Dell OpenSwitch OPX*
- Microsoft SONiC**
- Ubuntu Servers with Free-Range-Routing (FRR)*
- CentOS Servers

Platform:

- Staged/Commit Workflows
- Multi User Authentication
- RBAC with custom roles*
- LDAP and TACACS+*Integration
- Device lifecycle management
- Resource management
- Configlets
- Interactive network visualization
- Extensible on-box or off-box device agents*
- AOS backup / restore
- RESTful APIs
- Graph model and GraphQL/QE API
- HTTPS, AOS server security hardening*
- Headless operation
- Tested capacity: 1,600 devices

AOS 2.2 Features and Specifications (Cont.)

AOS Extensibility Tool For the Community (AOS ETC):

- Zero Touch Provisioning (ZTP) Server
- Demo Tools
- Template Catalog
- 3rd Party Tool Integration
- 3rd Party Big-Data Platform Integration
- Legacy Devices Integration

Maintenance workflows:

- Scale-out Maintenance
- Replacement Maintenance
- Decommission Maintenance
- Addition and deletion of virtual networks and endpoints

* New features introduced in AOS 2.2 ** Technology preview

About Apstra

Apstra pioneered Intent-Based Networking and Intent-Based Analytics™ to eliminate the complexities and inefficiencies that plague data center network operations today. Apstra's core mission is to deliver on the vision of a Self-Operating Network™ that delivers log scale improvements in CapEx, OpEx and capacity. Apstra was founded by leading experts in networking and abstraction (Arista, Juniper), distributed systems and automation (Google, VMware, Stanford). The company is privately funded and based in Menlo Park, California.

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