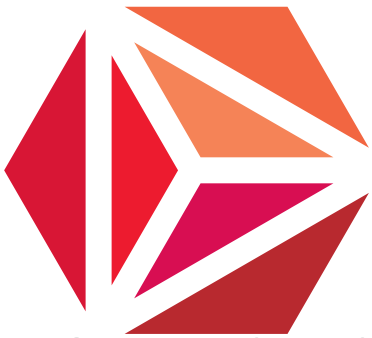
Solving Data Center Pain Points With Intent-Based Networking



A PACKET PUSHERS WHITEPAPER

November 2020

Table of Contents

Introduction

Data center networks are complex beasts. Network engineers approach data center operations and management with caution because even the smallest change can result in unintended outcomes, including performance degradation, security holes, policy violations, and downtime.

Organizations often make changes manually, device by device. This approach slows down the deployment of new applications and hampers agility. It can also create new problems by increasing the likelihood of human error through misconfiguration or keyboarding mistakes. And basic automation techniques such as scripting lack formal validation, which can compound human error.

Intent-based networking (IBN) revolutionizes how data center networks are designed and operated. By aligning business intent with automation and validation that encompasses the full life cycle of data center operations, IBN eliminates the staggering complexity of operating a network.

In particular, IBN resolves persistent data center pain points, including, but not limited to:

1. Resource constraints
2. Lack of agility
3. Poor reliability
4. Slow deployment and troubleshooting
5. Lack of infrastructure choice

Apstra's AOS is an IBN solution that enables data center architects and operators to automate and validate network design and implementation from Day 0 through Day 2 while managing changes quickly and reliably to keep pace with new application and business demands.

Apstra AOS continuously monitors the current operational state of the network, compares it against a single source of truth, and compares the current operational state against the intended state. It also addresses problems and gathers accurate, actionable information to speed troubleshooting.

This white paper provides a brief overview of IBN and Apstra AOS. It also discusses five major data center challenges and explains how Apstra's solution resolves those challenges for network architects and engineers.

A Brief Overview Of IBN and Apstra AOS

I. Understanding Intent-Based Networking

Intent-based networking (IBN) is an emerging technology that evolves network automation. Rather than simply using software to execute common, repeatable tasks, IBN maps an organization's business intent to the network infrastructure.

This means that business-driven outcomes — delivering applications, meeting service level objectives, ensuring performance objectives, and so on — are translated into underlying device configurations. The IBN system then monitors and measures the state of the network and continuously validates outcomes. In short, IBN addresses the full life cycle of data center network operations.

Apstra AOS is a software product that uses software agents to continuously gather configuration data and state information. It then compares that information to the intended state, or "single source of truth," which is held in a data store. Agents also are used to make changes on network devices.

The data store collects and analyzes device telemetry, which enables Apstra to identify anomalies, report on impacts (for example, packet loss or device failure), and identify the root cause of problems. Network engineers can allow Apstra to remediate problems automatically, or to share root cause analysis with engineers to speed up manual remediation.

Apstra can orchestrate changes across multiple devices in the correct sequence to provision services or address problems. Apstra then validates the changes to confirm that the outcome is correct. This validation step closes the loop to ensure the network meets business intent — that is, that the network is delivering services as anticipated.

II. Core Apstra AOS Components

Apstra AOS consists of three major components: device agents, the AOS data store, and a graph database. Let's look at each one in a little more detail.

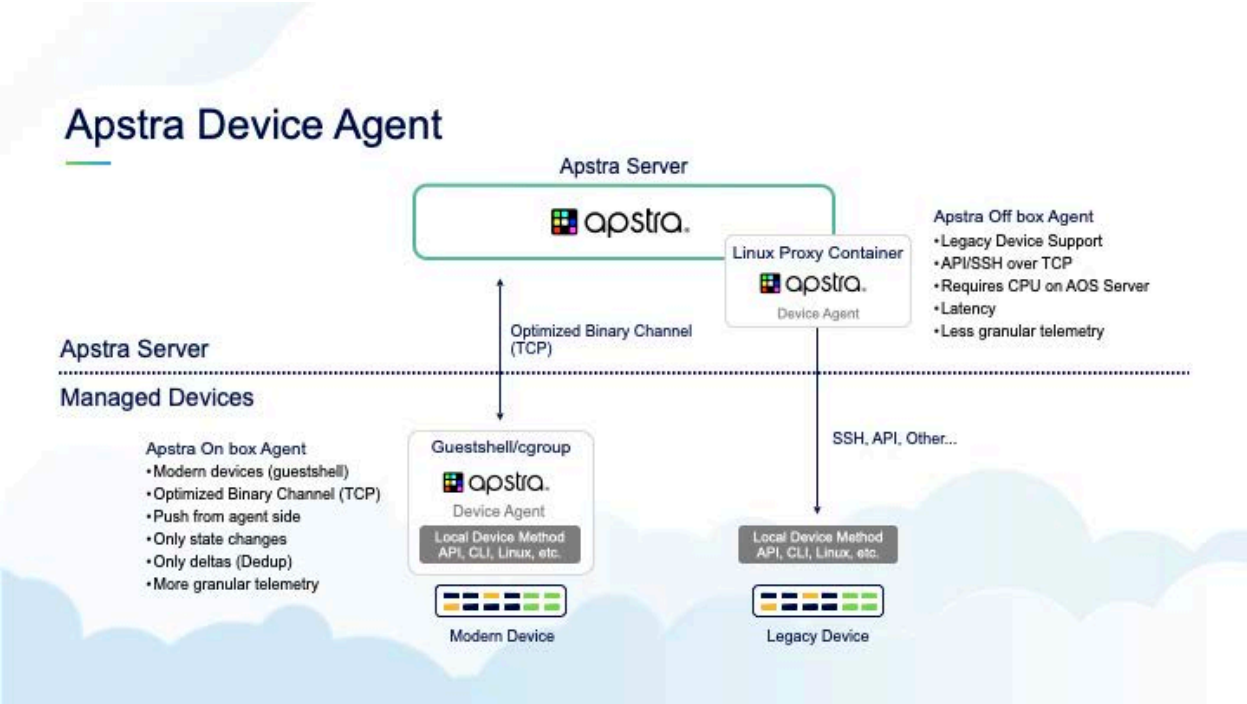
Device Agents

Apstra uses three agent types: interaction agents, application agents, and device agents.

Interaction agents, also called web agents, provide the interface for human operators to AOS. Users input intent into interaction agents, and these agents also provide users with relevant information from the data store.

Application agents perform domain-specific tasks within the Apstra solution. These agents use a pub/sub model to interact with the data store.

Device agents are installed on network devices, whether physical or virtual, including switches, firewalls, load balancers, and servers. Device agents configure devices and stream telemetry back to Apstra. For network devices that do not support local agents, AOS can provide the same functionality off-box.



AOS Data Store

AOS runs on a server or in a virtual machine. How you size the server will depend on the size of your network and the number of network devices AOS is working with.

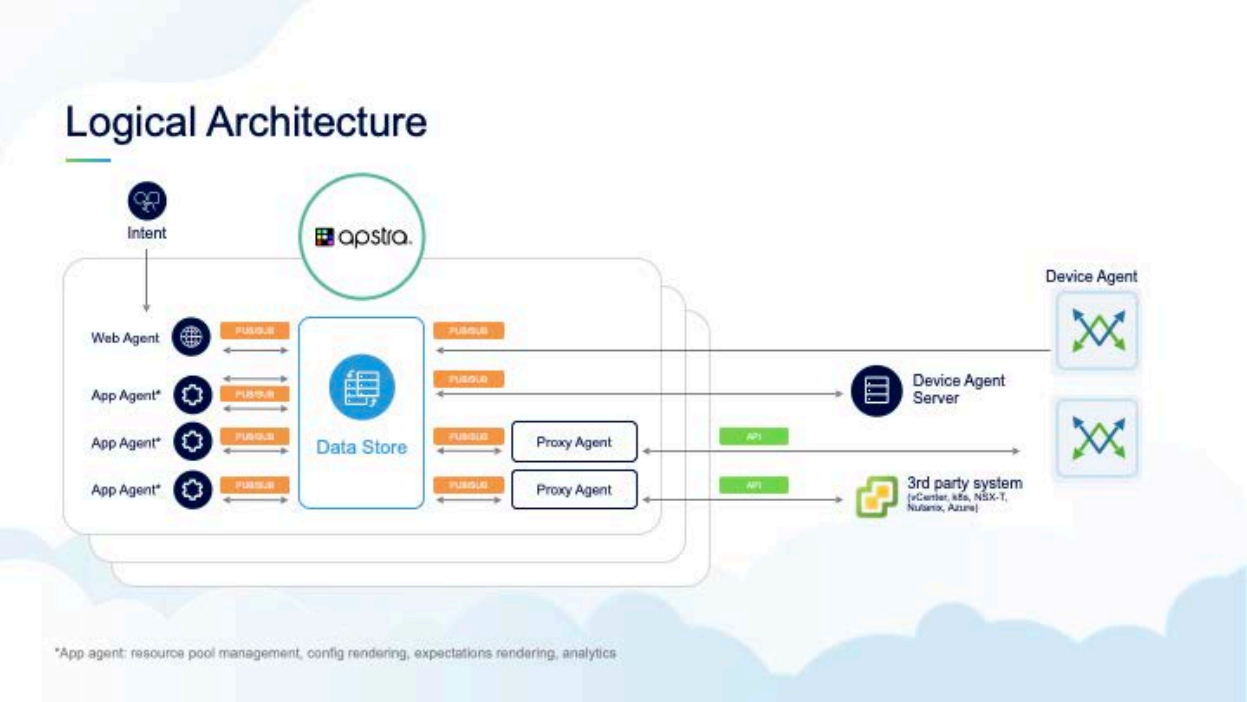
The data store holds a variety of inputs, including device telemetry, user intent, anomalies, design details, and other data. The agents listed above interact with the data store. The data store also holds the graph database.

Graph Database

The graph database is key to AOS. This database creates a structure with which to represent every element or object that makes up the actual data center network. For example, the database will have an object that represents a switch, as well as objects for each interface on that switch. The database also contains network configurations such as BGP, VLANs, IP addresses, and VRFs.

A simple way to think about the graph database is as a model of the network and the relationships between all its elements. But unlike a diagram or chart that quickly falls out of date, this model is continuously updated, which means the database serves as a source of truth for the actual state of the network.

In addition to device and network state, the graph database also stores the operator's intent. AOS continuously compares actual network state against intent to ensure the network aligns with the organization's expressed business outcomes. If there are differences, engineers can be alerted to rectify those differences or the system can make the necessary changes itself.



III. Reference Designs

Apstra AOS uses the concept of reference designs as a template for both the network infrastructure and a way to map intent to that infrastructure. From an infrastructure perspective, the typical AOS reference design is an IP leaf-spine fabric.

From an intent perspective, the reference design ensures that business intent can be fulfilled by the hardware and software components in the network, including enforcement mechanisms to meet performance, security, and compliance policies.

IV. Stateful Orchestration and Intent-Based Analytics

Data center networks are dynamic, with changes occurring both intentionally and due to failures. Apstra handles changes using stateful orchestration and intent-based analytics.

Stateful orchestration ensures that user-driven changes, such as adding or removing a resource or spinning up a new virtual network, happen within the context of existing requirements. The system ensures that the change won't violate policies, makes the requisite configuration changes across the relevant elements, validates the changes, and ensures that the outcome meets expectations. Stateful orchestration is a multi-phase process that draws on Apstra's detailed understanding of high-level business intent and actual network state.

Apstra also performs ongoing analysis of telemetry data, called Intent-based analytics, to monitor for conditions that may indicate problems or issues. Apstra can detect anomalies and diagnose root causes to fix issues automatically or to help engineers troubleshoot problems.

V. Closed-Loop Validation

Configuration and device changes, whether made by an engineer or an automated system, can lead to unintended consequences, such as performance degradation, policy or security violations, and outages. Closed-loop validation, in which the IBN system ensures that a change has produced the appropriate outcome, is an essential component of the solution. Apstra AOS performs closed-loop validation as part of its life cycle for data center network operations.

The Big Five Data Center Challenges

Data center networks support essential applications and services and are critical to business operations. Outages and performance problems can hurt productivity and cause financial losses. At the same time, these networks are fearsomely complex, which presents serious challenges to network engineers and operators who must manage existing applications and support new services.

This intersection of criticality and complexity creates significant pain points for engineers and operators, including resource constraints, lack of agility, poor reliability, inflexible infrastructure, and slow speed.

I. Resource Constraints

Perhaps the greatest pain point is a human one. Engineers and administrators spend most of their time on basic maintenance to ensure the network stays up. Network teams often operate in continual fire-fighting mode, with little time or energy available for innovation.

Many organizations add to the problem by understaffing IT teams and failing to invest in training or tooling. This lack of resources stifles innovation and limits IT's ability to support the business demands.

II. Lack of Agility

Legacy technologies, technical debt, poor visibility and instrumentation, and complex designs make networks brittle. Configuration changes, upgrades, and new services must be rolled out carefully, often passing through several stages of review, to prevent breakage.

The result is that the network is often a drag on new initiatives and deployment of new applications and services. This lack of agility can limit the organization's ability to keep pace with new opportunities or get ahead of competitors.

III. Poor Reliability

While network engineers are rightly proud of their knowledge and skills, the fact is that humans are prone to error. Data center networks that are primarily managed manually run a high risk of misconfigurations and mistakes that can cause serious problems.

In addition, engineers carry a lot of essential details about design decisions, configurations, and settings in their heads, often with little or no documentation shared with or reviewed by other engineers. Every time engineers leave an organization, they take critical knowledge with them, which can hamper operations and affect the network's reliability.

IV. Slow Deployments

Deployment time for new features,applications and services is slowed by legacy designs, technical debt, and the risks of making changes to brittle networks. For example, many changes are only made during designated windows to reduce the risk of related performance degradation or outages However, it drags on the pace of change for the entire organization. For application developers and business leaders eager to iterate, the slow pace of network operations creates friction and slows down the organization.

V. Lack Of Infrastructure Choice

Organizations often are limited to a single vendor when replacing infrastructure components. Vendors may tightly couple hardware and software, tie key features to a specific ASIC or OS, or plan certain customer requirements for a future product revision or upgrade. This vendor entrenchment limits an organization's options and gives the vendor significant leverage in future negotiations.

How IBN Resolves Pain Points

IBN was designed to address the problems that plague data center networks. From relieving engineers of daily firefighting routines to accelerating how quickly the network can change and adapt, IBN enables the data center to match the pace of developers.

I. Efficient Use of Resources

IBN is like a set of power tools; it allows a small team of skilled workers to build things faster and more precisely than a larger group could with traditional hand tools. For example, IBN analytics continuously measures device and network performance, and it can spot anomalies, anticipate problems, and recommend fixes, giving teams a leg up on troubleshooting.

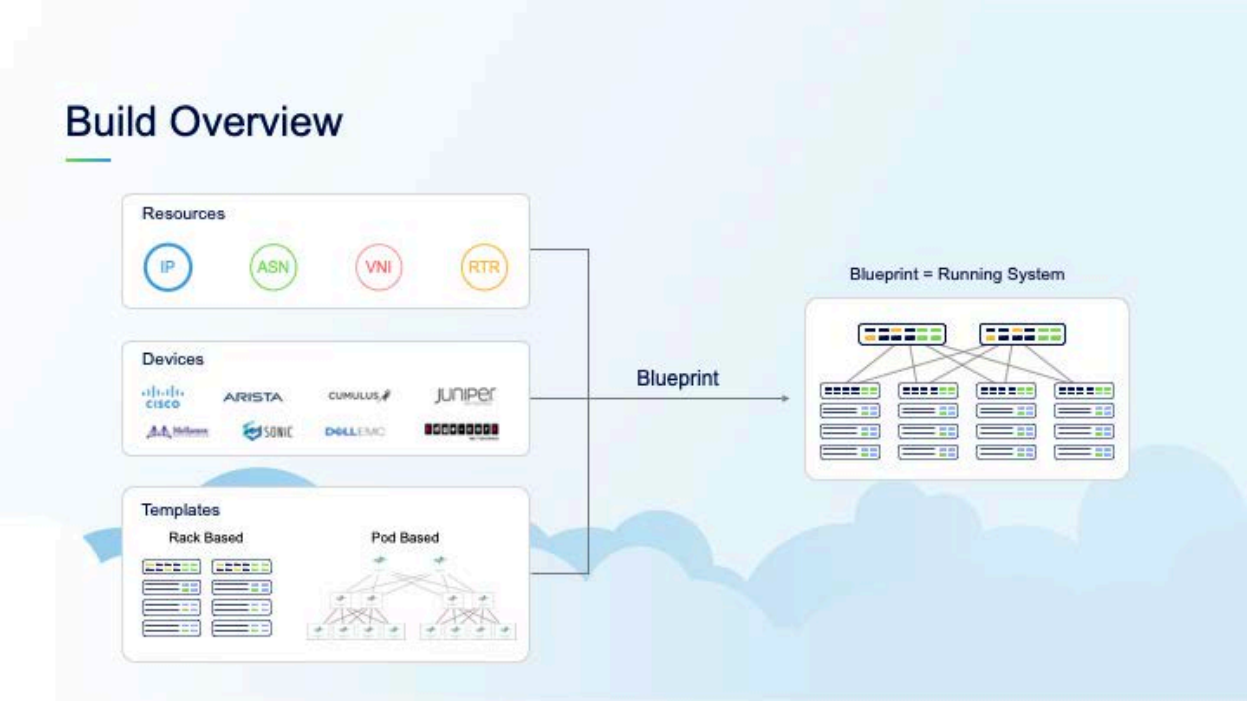
Just as nail guns and power saws speed up construction, IBN capabilities streamline common operational tasks, such as upgrades, changes, and remediation. In turn, IT teams get more time to devote to new business opportunities. IBN also scales up the number of applications and services that data center networks can support — without a commensurate increase in headcount.

II. Increased Agility

Data center networks must be agile enough to keep pace with the increasing frequency of updates to existing applications and the design of new applications and services.

Apstra AOS maintains a constant view of device and network state, so engineers get crystal-clear visibility into how applications and services are connected. This visibility and context is critical to help engineers understand the potential impact of changes. Also, because changes can be orchestrated across multiple devices in the correct sequence and then validated to make sure business intent is being met, engineers can move faster and with greater confidence, which leads to a more agile network.

At the same time, Apstra's reference designs, which are based on Apstra's deep domain expertise, provide practical templates for robust network designs. This allows engineers to quickly stand up new switches with the correct cabling and configurations. Ongoing validation of intent also ensures that today's design decisions or configuration changes don't become tomorrow's technical debt.



III. Reliability

The visibility, analytics, and validation provided by IBN can help reduce human error, which in turn reduces downtime and outages caused by mistakes or unanticipated outcomes caused by configuration changes. IBN analytics measure thousands of data points to spot anomalies and offer precise recommendations for remediation, which improves troubleshooting.

IBN's closed-loop validation ensures that the data center network continuously meets business outcomes. That includes uptime and performance outcomes, as well as security controls, internal policy requirements, and external compliance mandates.

Finally, the IBN system captures the essential details of the network's design and configuration, a more reliable system than depending on the memory of a long-time engineer who keeps the lore of particular configurations and workarounds in his or her head.

IV. Faster Deployment

An agile, reliable network can more quickly update applications and services and support the rollout of new applications. Apstra AOS reduces the time it takes to provision the network infrastructure and services from weeks or days to hours because engineers no longer have to configure devices by hand, wait for change windows, or puzzle out the repercussions of each change.

Activation times decrease because application intent is clearly expressed in AOS, reference designs are available to guide deployments, and engineers can quickly program the network to meet those expressed requirements.

V. Greater Infrastructure Flexibility

Apstra AOS is a vendor-agnostic platform. It integrates with an extensive list of third-party hardware and software from Cisco, Arista, Juniper Networks, Cumulus Networks, Microsoft, and others. This means designers can choose best-of-breed components to meet their needs.

In turn, organizations are not tied to specific vendors, giving them leverage to make the best deals and enjoy more freedom in their designs.

Conclusion

Automation is essential to ensure that data center networks can keep pace with developers while also maintaining uptime and performance, and managing risk. But automation by itself isn't enough.

Network engineers need visibility into and context about the network as a whole, as well as about each hardware and software element. They need analytics to continuously capture, ingest, and make sense of thousands of metrics and events to anticipate problems and assist with remediation. They need orchestration to shepherd automated changes to the right devices in the correct sequence. They need validation to provide assurances that changes were actually made and that the results of those changes deliver the correct outcomes.

The data center network doesn't just exist for its own sake. It's an engine that drives the entire business. This engine must be steered by business outcomes; that is, high-level requirements must guide low-level settings and configurations so that the organization can get where it needs to go.

Intent-based networking integrates all of these components into a unified whole. Apstra AOS, an IBN pioneer, delivers a comprehensive software platform that eliminates common pain points and encompasses the full life cycle of data center operations to help organizations transform their networks.