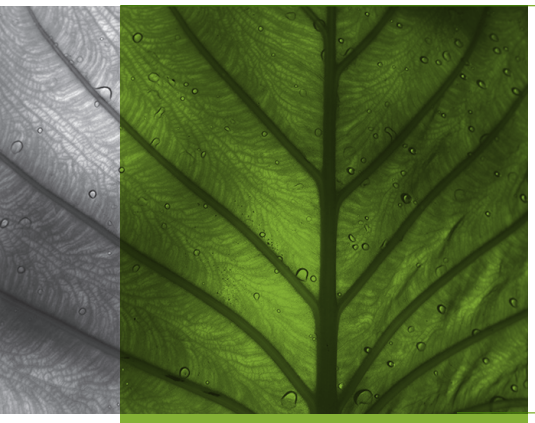

HEALTHBOT

Translate real-time analytics into actionable insights

Challenge

Most network-produced data is unstructured, making it difficult to interpret and correlate. In those rare cases where data is structured, valuable information is difficult to extract and share across organizations, creating silos and hindering problem detection and root cause analysis.

Solution

Combining the strength of streaming telemetry with machine learning, HealthBot offers a highly automated and programmable network diagnostic solution that provides consistent, coherent operational intelligence across networks, delivering a powerful framework that addresses the most complex network issues.

Benefits

- *Translates streaming telemetry into predictive, actionable insights*
- *Provides advanced multidimensional analytics across network elements*
- *Offers intuitive web-based GUI for policy management and easy data consumption*
- *Lowers barrier to entry for telemetry and analytics with open programmability*

Highly distributed cloud-native and consumer applications are generating vast amounts of network data. As a result, streaming telemetry is displacing traditional SNMP as the preferred method for collecting real-time performance information from the network infrastructure.

To date, it has been difficult to correlate multiple sources of network data in order to extract actionable insights. Machine learning is changing all that, transforming network operations and providing real-time visibility into the network. This actionable intelligence augments operational efficiency by providing a multidimensional and predictive view of the network that is critical for root cause analysis, traffic engineering, and AI-powered network operations.

The Challenge

Today's network environment places a premium on a rapid response to changing network conditions and market dynamics. Meanwhile, traffic levels are growing exponentially as new devices and cloud-native applications proliferate. To keep pace, service providers and enterprises need a network analytics solution that provides real-time, actionable intelligence, helping them overcome the challenge of ever-increasing, unpredictable traffic patterns.

Network data analytics play a critical role in building the framework service providers and enterprises need to gain complete end-to-end visibility into specific applications, services, and subscriber endpoints. While telemetry-based techniques have existed for years, the growing number of protocols, data formats, and key performance indicators (KPIs) from diverse networking devices has made data analysis complex and costly. Traditional CLI-based interfaces require specialized skills to extract business value from telemetry data, creating a barrier to entry for network analytics.

Machine learning dramatically simplifies and automates the process of extracting, analyzing, and dissecting network data. Analytics engines can correlate data beyond the abilities of traditional networking devices, providing deeper insights into specific applications and services—essential for traffic engineering and root cause analysis. Advanced algorithms reduce the time spent analyzing traffic and correlating network patterns or behaviors, transforming the process from reactive to proactive and predictive.

The Juniper HealthBot Solution

Juniper® HealthBot is a highly automated and programmable network health and diagnostics solution that provides consistent and coherent operational intelligence across network deployments. Integrated with Junos® Telemetry Interface (JTI) and standards-based OpenConfig telemetry, HealthBot aggregates large volumes of time-sensitive telemetry data, applying machine learning to generate a multidimensional view across network and applications while translating real-time analytics into actionable insights.

HealthBot features a modular design, leveraging a microservices container-based scale-out architecture. Built-in advanced algorithms and machine learning technology correlate data from multiple sources, establishing operational benchmarks and performing historical and predictive analytics, all of which are critical to intent-based networking. Automated analytics simplify network operations, letting service providers and enterprises alike easily monitor and constantly evaluate their network infrastructure—drastically improving operational efficiency and capacity planning.

The HealthBot solution features a programmability-first approach, supporting customized monitoring and diagnostic use cases through programmable playbooks. An intuitive, web-based dashboard eliminates the operational complexity of extracting telemetry data, democratizing the use of network analytics and ultimately encouraging collaboration for business agility and growth. YANG-based health and root-cause analysis modeling allow you to extend and customize the KPIs being analyzed, as well as the business logic required to analyze them.

HealthBot is backed by the Juniper Networks Professional Services organization, which, with deployments in the world's top 100 service providers, offers extensive experience in planning, building, and operating network deployments while minimizing risk and delivering results.

HealthBot offers the following features to gather real-time analytics and deliver actionable information.

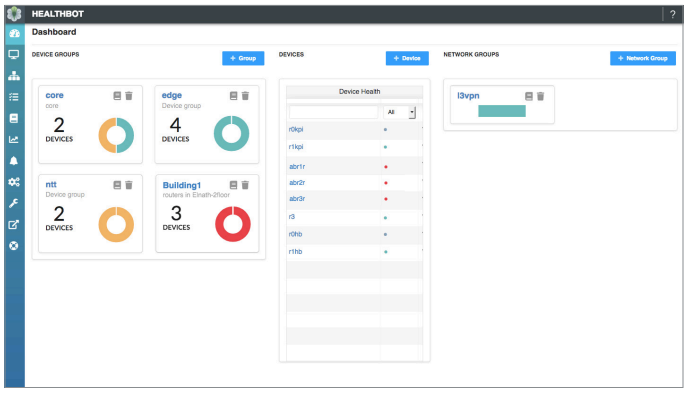

Figure 1: HealthBot dashboard.

Machine Learning

HealthBot uses machine learning to understand the baseline performance of infrastructure elements and network applications. Built-in advanced algorithms identify performance anomalies when real-time metrics deviate from historical trends beyond configured tolerance levels. This creates a monitoring policy which is aware of the dynamic nature of network behavior that causes resource demands to fluctuate over time. Network operators can also leverage this machine learning capability to predict network resource usage based on historical patterns, automate the network planning process, and continually optimize application and infrastructure elements that result in higher asset utilization.

Health Monitoring and Root Cause Analysis

The HealthBot Health Monitoring feature provides an aggregated and abstracted view of network health by correlating raw streaming telemetry data into a multidimensional view that reports current status as well as projected threats to the infrastructure and its workloads. Health status can indicate whether a network resource is currently operating outside a user-defined performance policy, while risk analysis uses historical trends to predict whether a resource may be unhealthy in the future. Health monitoring not only provides a fully customizable view of the current health of network elements, it can also initiate remedial actions based on predefined SLAs. Health profiles are customizable using YANG-based definitions.

Programmability

Built with open programmability at the core, HealthBot supports highly customizable network monitoring and diagnostic workflows. A simple service designer lets service providers and enterprises rapidly create policies and playbooks that intelligently automate service maintenance and sustain overall performance goals. A community-driven library of HealthBot playbooks is also available on the Juniper EngNet. The solution democratizes the adoption of network analytics, breaking down traditional information silos and enhancing business agility and innovation across the entire ecosystem.

Intuitive Graphical User Interface

A web-based dashboard provides an intuitive interface that offers users a visual representation of resource metrics, alarms, health, and reports. The dashboard correlates the relationship between entities (devices, services, hosts, instances), enabling users to apply business logic and required policies.

Streaming Telemetry

HealthBot features Junos Telemetry Interface (JTI) and OpenConfig for real-time streaming telemetry. JTI is a distributed collection engine designed to stream network statistical data, driven by events and in near real time, to data collectors, network controllers, or similar devices for immediate or post analysis. JTI overcomes limitations by relying on a push model to deliver data, asynchronously leveraging popular protocols like MQ Telemetry Transport (MQTT) and JavaScript Object Notation (JSON) to eliminate polling. As a result, JTI is highly scalable and can monitor thousands of objects in a network.

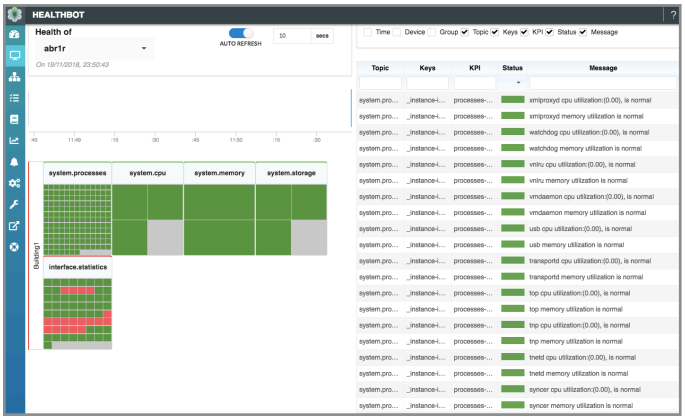

Figure 2: HealthBot health map

Features and Benefits

Greater Network Visibility

HealthBot breaks down the operational barriers associated with traditional monitoring infrastructure, providing advanced multidimensional analytics across network elements and enabling service providers and enterprises to quickly move from a reactive to a highly predictive model that transforms network operations. You get a precise understanding of network behavior to benchmark performance, improve capacity planning, and minimize service downtime.

Closed Loop Automation

HealthBot optimizes the operation of network infrastructures. Identifying the root cause of incidents has always been a tedious and repetitive process, while ongoing maintenance poses its own challenges. Combining the power of fine-grained analytics with workflow automation, HealthBot streamlines diagnostic workflows, automates root cause analysis, and performs remedial actions based on predefined KPIs.

Improved Capital Efficiency

HealthBot reduces overall CapEx. Derived through machine learning and predictive analytics, HealthBot optimizes network utilization, enabling service providers to launch innovative services with better resource planning and traffic engineering.

Reduced Operational Expenditures

HealthBot's machine learning feature correlates multiple data sources, establishes operational benchmarks, and simplifies network operations. Through an intuitive GUI, service providers and enterprises can quickly glean highly customizable business insights, improving operational efficiency, ensuring SLA compliance, and helping you proactively predict and prevent service outages.

Use Cases

Modern networks are complex, often consisting of hundreds or even thousands of different devices. To help network operators better understand how their networks and services are running, many vendors have implemented various data export methods to provide insight into how individual network devices are performing. While these insights are certainly helpful, key issues still remain. For instance:

- How do you monitor the network and all its devices in real time?
- How do you manage all of the data being created?
- How do you filter the data to find what you need and, more importantly, analyze it for meaningful information?

These efforts can quickly become quite overwhelming, especially for those trying to do it manually.

Built to solve these issues, HealthBot automates data collection, filtering, and management of network devices, connections, and services. Once collected and filtered, HealthBot analyzes data to generate actionable insights, which can feed dashboards, reports, and alerts. HealthBot can also communicate insights to other back office systems and work with automation solutions to provide closed-loop remediation without operator intervention.

Device Management

Regardless of their platform type, today's network devices are composed of hardware and software systems, including power supplies, environmental controls, compute resources, memory, optical and electrical interfaces, operating systems, and other software. If any of these components, systems, or sub-systems fail, the impact to the overall system and even the network itself can range from a minor nuisance to a catastrophic failure. Therefore, the ability to know the status of these items in real time is critical for the reliable delivery of network connectivity and services.

HealthBot simplifies the monitoring of network devices by automating the collection, filtering, and analysis of device data using key performance indicators (KPIs), sensors, and rules, which are packaged into templates referred to as playbooks. KPIs are effectively anything on a device that can be measured and monitored, like temperature, power consumption, CPU utilization, memory analytics, and queue depth, among others.

For each KPI, there is a rule which identifies the specific item being measured, as well as the performance level or data value that will trigger an alert. In this example, the KPI we will monitor is Routing Engine CPU utilization. These rules can be grouped into playbooks—in this example, we will refer to it as the system playbook, because it includes rules of KPIs for the CPU and its memory. Rules can be added or removed from playbooks, allowing network operators to customize them so that they can monitor the status of the specific components and systems that are most important to them.

With the playbook defined, HealthBot collects, filters, and analyzes the data coming in from the sensors and displays the status in its dashboards. To simplify the monitoring of hundreds of devices, dashboards organize the KPIs by playbook, device, and device group, such as core routers, edge routers, or data center interconnect routers, making it easier to monitor and manage specific device types and network resources.

If the data for a given KPI exceeds the thresholds specified by the network operator—in this example, 50% and 80% utilization—HealthBot will trigger an alert. Depending on which threshold is exceeded, the alert will either be yellow or red in the dashboard. These triggers can also drive alerts through other notification channels, like e-mail, as well as other systems.

In this use case, HealthBot simplifies the management of multiple performance parameters across hundreds or thousands of devices using automation. The ability to collect component- and system-level performance data and abstract it so that it can be displayed in a visual dashboard enables network operators to identify and remediate issues before they impact the device, entire system, or even the broader network.

Network Service Monitoring

In addition to device management, HealthBot can also monitor and provide actionable insights for network service. The network playbooks in HealthBot leverage the sensors described in the device management use case to compare data ingested for specific KPIs across multiple devices in the network, using this data to determine the health of a path or service running across the network.

In this example, a L3VPN is running between CE1 and CE2. Sensors are configured to track the volume of egress traffic coming out of PE1 and, similarly, the ingress traffic going into PE2. A network playbook is created, which compares the data from the PE1 egress sensor with the PE2 ingress sensor. If the difference of these two values exceeds the defined threshold within a specific time frame, an alert is triggered. We could expand this rule to include P1 ingress and egress data to further isolate issues if they were to occur.

In this use case, network playbooks simplify the monitoring and management of multiple devices within the network to measure service-impacting metrics like packet loss and latency. This helps network operators by simplifying troubleshooting and providing faster remediation when network issues occur.

Machine Learning

HealthBot provides a library of machine learning algorithms, which support anomaly and outlier detection and provide predictive analytics.

- **Anomaly detection**: 3-Sigma, K-means, and Holt-Winters algorithms are used to compare new data points with data points collected from the same device during a specific learning period.
- **Outlier Detection**: Density-Based Spatial Clustering of Applications with Noise (DBSCAN) and K-fold cross-validation using 3-sigma (k-fold 3-sigma) is analyzed from a collection of devices across the network during a specific learning period and compared with real-time data coming in from the network
- **Prediction**: Median Prediction and Holt-Winters algorithms predict future device or network-level behavior during a specified learning period, which is then compared with actual values.

For example, HealthBot can leverage its predictive analytics capability to predict BNG subscriber counts. As HealthBot collects subscriber count data from the BNGs in real-time, its median prediction, ML algorithm, determines what the typical subscriber count should be throughout the day and for each day of the week. As it continues to adjust its model for accuracy, it also analyzes the real-time data with the predicted value. If the actual deviates from the predicted by a specified percentage, a trigger is generated. In this example, the network operator has set two deviation thresholds of 10% and 20%.

When the actual subscriber count exceeds the predicted subscriber count by 12%, an alert is triggered in the dashboard. Setting a deviation threshold against the predicted value, as opposed to setting a static performance threshold, provides multiple benefits, including simplifying the tracking and management of a dynamic KPI like subscriber count and providing insights and alerts when significant deviations occur.

Closed Loop Automation

HealthBot can be used to provide closed-loop automation, working with other scripts, applications, tools, or orchestrators to identify network issues and resolve them without operator intervention. In some situations, HealthBot can do this in a make-before-break fashion.

In this example, a network operator has defined a playbook to monitor a device, which sends its KPI data to HealthBot. As in the BNG subscriber count use case, the playbook running on HealthBot identifies an anomaly using predictive analytics. This triggers a user-defined action to call Juniper Networks NorthStar Controller via its REST API, requesting that the node be put in maintenance mode. NorthStar will calculate alternate paths for the LSPs running through the node having an issue. While a number of steps are required to complete this step, for brevity we will assume that NorthStar is able to identify alternate paths for the LSPs and receives guidance to move the LSPs off the node. Once complete, NorthStar will put that node in maintenance mode.

In this use case, we see how HealthBot uses KPIs to track the status of the network and its devices in real-time to track the health of specific links spanning the network by comparing data between multiple sensors. It then leverages its ML predictive analytics to identify a potential failure in the network. Once identified, a user-defined action triggers remediation in a make-before-break fashion, thanks to its collaboration with NorthStar.

As a result, the network is able to identify and isolate potential error conditions more quickly and usually without any network operator intervention, enabling the network operator to proactively provide a positive customer experience and deliver a higher level of service assurance by diverting traffic off a suspected failing link. This avoids a potential customer outage, which would have impacted customer satisfaction.

Data Center

The available set of Ethernet VPN-Virtual Extensible LAN (EVPN-VXLAN) playbooks contains an exhaustive set of rules covering all aspects of an EVPN-VXLAN fabric, resulting in the collection of more than 130 data points per switch. You can use the prebuilt rules to alert you to problems and speed troubleshooting, improving total network and application uptime. The following scenarios illustrate how HealthBot can help diagnose data center issues.

Duplicate MAC addresses can cause transient errors; sometimes a virtual machine (VM) will be cloned from an existing virtual machine, causing it to have the same MAC as the existing VM. HealthBot's EVPN-VXLAN playbook has a rule which checks for duplicate MACs that appear in the same VLAN, allowing you to identify and remediate the offending VM.

Distributed or microservices-based applications can be highly sensitive to latency. HealthBot has a number of rules that detect input and output errors, as well as bandwidth thresholds that allow the operator to quickly ascertain the cause of latency between different services that make up an application. One can view real-time graphs of interface utilization or create custom notifications and actions to proactively remediate network bandwidth issues—for example, moving VMs or containers that service a particular area of the application based on the performance of the data center network.

HealthBot supports the ability to add custom scripts to act when failure scenarios are detected, which can be very powerful in the data center. Using Python, an operator can write a script that launches when certain conditions are met. If HealthBot detects a particular failure condition, such as BGP peers not being in an established state, and that a commit has recently occurred, a predefined script can be automatically run to perform a commit rollback on the affected device or set of devices.

Summary—HealthBot Simplifies Network Operations

HealthBot revolutionizes network operations by bringing the next level of intelligence and automation. Combining real-time streaming telemetry, advanced algorithms, and machine learning capabilities, HealthBot aggregates large volumes of time-sensitive telemetry data, providing a multidimensional view across the network and applications while correlating analytics to provide predictive insights into network behavior. By focusing on actionable insights, simplified consumption, and a programmable framework supported by an open-sourced data pipeline and collectors, HealthBot democratizes network analytics, breaking down information silos, inspiring collaboration across business units, and enhancing business agility and innovation across the ecosystem.

Next Steps

To learn more about Juniper HealthBot, please visit www.juniper.net or contact your Juniper representative.

About Juniper Networks

Juniper Networks brings simplicity to networking with products, solutions and services that connect the world. Through engineering innovation, we remove the constraints and complexities of networking in the cloud era to solve the toughest challenges our customers and partners face daily. At Juniper Networks, we believe that the network is a resource for sharing knowledge and human advancement that changes the world. We are committed to imagining groundbreaking ways to deliver automated, scalable and secure networks to move at the speed of business.

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