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Predicting Network Congestion in the Era of 5G, Cloud, and SDx

Broadcom Delivers an Industry-First Software to Silicon Solution to Safeguard and Enhance the Customer Experience

Table of Contents

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Executive Summary

Broadcom has long been regarded as an industry leader in semiconductor connectivity solutions. Our status as an industry leader, coupled with our high-scale operations monitoring software offerings, enables us to deliver one of the broadest offerings to support rapidly-expanding and complex modern network architectures. Our leading-edge, end-to-end software to silicon portfolio, fully-realizes our unique hardware and software synergies, driving next-generation software-defined networks and cloud networks, while delivering on the promises of modern 5G infrastructure.

The Challenges Created By the New Hyper-Connected Business

Businesses are now hyper-connected, reliant upon complex infrastructures, multi-cloud environments and billions of devices connected through a mesh of networks. These networks are under tremendous pressure to perform and more prone to failure and outages than ever before.

> "5G networks will carry nearly half of the world's mobile data traffic."

A recent exponential growth of SD-WAN, IoT, and faster networking technologies, such as 5G, which support real-time applications like video processing, analytics, or even self-driving cars, has caused new technologies to now produce more traffic at the edge of data center networks. Traditionally, data computation is done at the core. But, to avoid latency issues that will affect application performance, IoT and 5G require processing and storage that is closer to the edge of the network where this data is being gathered. Additionally, research has shown that by 2025, "5G networks will carry nearly half of the world's mobile data traffic."[1]

> "By 2024, 50% of network operations teams will be required to rearchitect their network monitoring stack, due to the impact of hybrid networking."

This traffic, along with always-on consumer access to digital applications also requires resilient but massive amounts of infrastructure. This is an expensive alternative to an already complex problem and the networks of today are not designed and optimized for this type of high speed access and demand from consumers.

What does all this mean for network operations teams? It means more congestion, more noise, and unfortunately, less visibility to triage the delivery of the modern digital experience.

Gartner agrees and says that, "By 2024, 50% of network operations teams will be required to re-architect their network monitoring stack, due to the impact of hybrid networking, which will be a significant increase from 20% in 2019."[2]

Today's data deluge, resulting from hyper-connectivity, demands an innovative approach to networking and network monitoring to help solve the new congestion issue. Organizations need visibility across current, modern, and edge communication paths to ensure the delivery of a reliable customer experience.

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1 https://www.ericsson.com/en/mobility-report/reports/november-2019/mobile-data-traffic-outlook

2 2020 Market Guide for Network Performance Monitoring and Diagnostics, ID G00463582

Introducing a Software to Silicon Solution Powered by Automation.ai

We are proud to pioneer the latest in next-gen AIOps analytics for the hybrid cloud, SD-WAN, IoT, and 5G powered by Broadcom merchant switch silicon and combined with Open-Source SONiC and Broadview Telemetry. Broadcom agrees with Gartner that this new initiative monitoring solution that captures real-time packet and flow data directly from Broadcom chips and other devices is a differentiator in the industry.[3]
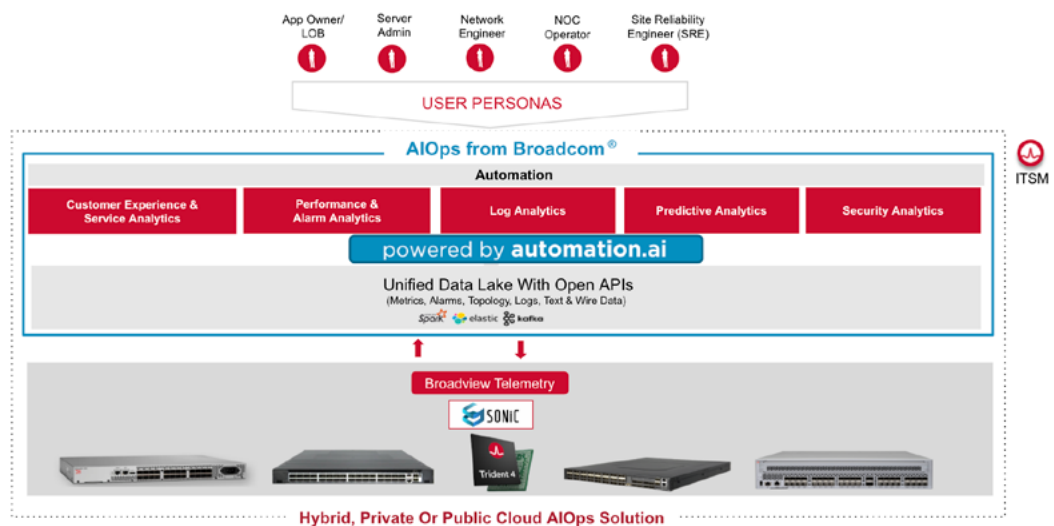
The solution is a one-of-a-kind offering, delivering unparalleled fine-grain, per-packet, and flow-level network monitoring by ingesting rich network data from Broadcom chipsets. Furthermore, the solution enables advanced predictions, correlations, and automated network remediation. The solution also simultaneously analyzes network activity to automate, repair, and tune the network for reduced operational costs and faster triage. Thus, enterprise businesses and service providers can deliver consistent and exceptional digital experiences. AIOps from Broadcom is a core component of our software to silicon capabilities. The solution delivers AI and machine learning, automation, and comprehensive ecosystem observability. AIOps from Broadcom correlates data across users, applications, infrastructure, network and security services.

AIOps is powered by Automation.ai from Broadcom, the industry's first AI-driven software intelligence platform. Automation.ai harnesses the power of advanced AI, machine learning, high-scale operations monitoring and open-source frameworks to transform massive volumes of enterprise data into actionable insights.

The AIOps solution delivers cross-domain contextual intelligence by ingesting and analyzing a diverse data set including metric, topology, text and log data providing customers with the following features:

- Service analytics that expedite root-cause analysis by providing end-to-end visibility across key business or IT services.

- Performance and alarm analytics that reduce false and redundant alerts which reduces MTTR.

- Contextual log analytics that automatically correlates security and application events and performance data.

Figure 1: AIOps network monitoring captures real-time data at the chip level through telemetry, and delivers one-of-a-kind, edge- to-edge, AI-powered triage and visibility.

3 https://www.broadcom.com/company/industry-analyst-report/gartner-has-acknowledged-broadcom-as-representativevendor

- Predictive analytics to identify network bottlenecks before disruption and optimize resources by identifying waste.

- Contextual automation that delivers closed-loop, service driven autonomous remediation.

Software to Silicon Capabilities from Broadcom

AIOps from Broadcom, powered by merchant switch silicon, enables innovation across the entire networking stack and enables new use cases, such as using telemetry to get granular, real-time insights into hop-by-hop latency, packet drops, and network congestion. All of these capabilities are delivered by our silicon technologies:

- Operational visibility into the health of switches and switch fabric topology

- Real-time Broadview congestion altering and queue and congestion analytics for each port

- In-band Flow Analytics (IFA) to view per-hop how applications are impacted by latency introduced during micro-bursts

- Auotmation.ai for deep insights and automated remediation or suggested remediation of SONiC and Broadview control-plane APIs

> "Solving network congestion within nanoseconds has the potential to save millions of dollars for our customers."

These innovative capabilities fuel the following high-scale operations monitoring use cases:

- Easy monitoring of critical operational KPIs in context with alarms and syslog-based events

- A switch topology view with alarms and health indicators

- Real-time Broadview congestion alerting and historical buffer analytics

- Silicon-driven In-band Flow Analytics (IFA) providing real-time information on hop-by-hop latency within switch fabrics

Additionally, silicon-level telemetry enables use cases such as packet path tracing with route change detection alarms, microburst detection with proactive congestion monitoring, and mirror-on-drop, which provides deep visibility into packet drops and elephant flow monitoring.

Silicon-level telemetry could be especially useful to financial sector businesses where seconds can equate to millions of dollars lost or gained, and where low latency trading happens everyday. Low latency trading is the use of algorithmic trading strategies to respond to market events in seconds faster than the competition to increase profitability of trades. Solving network congestion within nanoseconds has the potential to save millions of dollars for our customers.

A Software to Silicon Solution That Delivers On the Promise of 5G and Modern Network Architectures

Autonomous vehicles are one of the most anticipated technologies that will not only require 5G speed but demand low latency network connectivity. The promised capabilities of 5G could enable vehicles to respond 10-100 times faster than over current cellular networks.

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Figure 2: MicroBurst Detection with proactive congestion monitoring across modern technologies, such as 5G, enables visibility down to the nanosecond and is the differentiated AIOps value that we bring to enterprise businesses and service providers.

Compare 4G and 5G latency: Presume a car traveling down the road at 30 miles per hour needs to receive a signal to avoid hitting an object. With current 4G latency at around 100 milliseconds, a car would travel about four feet or 1.2 meters. With 5G latency around 10 milliseconds, the vehicle would only have traveled five inches or 12 centimeters. The difference is significant and could mean life or death.[4]

The software to silicon solution from Broadcom helps deliver on the promise of 5G by enabling network operations to detect, predict, automate, and fine tune these new modern network architectures delivering critical communications and business services.

The solution enables 5G use cases such as dynamic traffic engineering, which requires granular visibility at flow and packet levels in real time. Broadcom combines the Inband Flow Analyzer (IFA), which is a flexible, scalable and real-time monitoring solution that leverages Inband Telemetry, with SONiC NOS metrics and AIOps out-of-band telemetry, to provide a one-of-a-kind, state of the art, network monitoring and intelligent remediation solution for NOC operators and network engineers.

Deployed entirely at the edge of the network to further reduce any network latency, our software to silicon solution captures in real-time the 5G network packets traversing Broadcom chipsets in switching infrastructure. This data is then immediately ingested and analyzed by our AI-driven high-scale operations monitoring solution. This process results in an industry-first packet capture and flow analysis tool. This tool enables enterprise businesses and service providers to predict and minimize any network congestion that could be detrimental to the safety of their customers.

Additionally, wearables, trackers, and sensors will be a big market for the massive IoT supported by 5G networks. This technology will enable billions of devices to operate seamlessly without perceived delays or dropped signals. Consider the implications of a wearable heart monitor sending live data to a hospital but network congestion is causing an interruption or delay in how the data can be interpreted. The software to silicon solution from Broadcom can easily scale to support the IoT and enable uninterrupted application experiences that will be mandated in the era of 5G.

4 **https://www.digi.com/blog/post/5g-applications-and-use-cases**

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Broadcom also offers a broad range of semiconductor solutions that address key 5G design challenges, including speed, latency, density, and capacity. The solutions span wireless, RF, Wi-Fi, fiber optics, broadband, and networking. The highly scalable new series of chips from Broadcom results in a significant reduction in system power and costs, helping our customers reduce their OpEx of building and operating modern network architectures.

The SONiC-based qualified, packaged cloud datacenter solution from Broadcom also provides operations with ease of deployment and operations, a predictable roadmap of enhancements, and a support team of over 200 engineers with deep experience in network operating systems.

> "The highly scalable new series of chips from Broadcom results in a significant reduction in system power and costs."

Conclusion

Software-defined networks, 5G, and edge computing technologies are key enablers for network agility but their dynamic nature introduces unique monitoring challenges, making it more difficult to detect, debug, and remediate problems that degrade service delivery. By building synergies between our hardware, software, and silicon technologies, Broadcom delivers a one-of-a-kind industry solution that easily enables operations to overcome the challenges presented by modern network technologies while helping to reduce the costs usually associated with deploying and managing these architectures. We are proud to deliver the industry-first silicon integrated, AI-driven analytics platform that accelerates network operations decision making and automation while helping to ensure the resiliency of today's modern network architectures.

For more product information, please visit our site at **broadcom.com/aiops**.

About Broadcom
Broadcom Inc. (NASDAQ: AVGO) is a global technology leader that designs, develops and supplies a broad range of semiconductor and infrastructure software solutions. Broadcom's category-leading product portfolio serves critical markets including data center, networking, enterprise software, broadband, wireless, storage and industrial. Our solutions include data center networking and storage, enterprise and mainframe software focused on automation, monitoring and security, smartphone components, telecoms and factory automation. For more information, go to www.broadcom.com.

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