Juniper Networks | Engineering Simplicity

# TECH BRIEF: NETWORK RELIABILITY ENGINEERING AS AN APPROACH TO AUTOMATION

*In a world shaped by technology, automation helps businesses move fast and pivot on a dime. Meanwhile, the foundational value of network operations is steadfast reliability, a condition that is traditionally best during periods of inactivity. "Network reliability engineering" (NRE) is an emerging approach to network automation that stabilizes and improves reliability while achieving the benefits of speed.*

## Automation Drives Business Velocity

The strategic use of technology—not mergers, acquisitions, and entrepreneurship—is the driving force behind many of today's revenue and productivity gains.[1] And in today's competitive business climate, the winners are those who learn and adapt most quickly to technology. As digital plays an increasingly important role in shaping the customer experience and driving innovation, IT is under tremendous pressure to deliver this kind of velocity in the form of agility, acceleration, scale, and reach.

Building on decades of digital transformation experience and discussions about IT methodology, DevOps is ushering in a new culture and a new set of processes that deliver business velocity. DevOps Research and Assessment (DORA) has confirmed the results of several annual studies showing that organizations that have transitioned to DevOps are continuously improving performance, while those that have maintained the IT status quo are not only static, but are falling further behind.

While DevOps focuses on and delivers speed, classic IT dogma maintains that businesses must sacrifice speed to realize other gains like efficiency and, especially, reliability. Through automation, however, many organizations have proven that it's possible to achieve all three benefits simultaneously.

[1] James Besson, Boston University, 2017

## Implementing DevOps Transformation as Reliability Engineering

DevOps defines speed as providing faster feedback and reducing lead times through deliveries with a small-batch cadence. Indeed, this is a proven recipe for continuous improvement, and one that requires automation coupled with an automated pipeline to drive continuous response improvements in system regulation, capacity planning, and feature planning.

DevOps also introduces many cultural principles and practices. In situations where DevOps does not provide job descriptions or implement abstract processes with substantive technology, however, site reliability engineering (SRE) steps in, offering a solution for software delivery and operations teams. As SRE grows in popularity, network operations teams looking to redirect their approach to network automation have assigned a similar moniker to their own processes—network reliability engineering (NRE)—and refer to their people as "network reliability engineers."

Beyond applying SRE behaviors and tools to network operations, it's easy to appreciate why network automators prefer to identify as engineers rather than developers and why they value reliability over speed.

## Automating Reliability First and Speed Second

One important difference between delivering software for business services vs. for network infrastructure services is that networks do not demand as much continual innovation and tweaking. Therefore, in infrastructure—especially the network—reliability is intuitively more important than the advantages of moving fast.

However, when it comes to site reliability engineers and network reliability engineers, it turns out that reliability—while less appealing—must always be prioritized over speed. This is because under some circumstances, without reliability, speed is irrelevant—just like a rocket's escape velocity doesn't matter if it explodes right after launch.

A reliability-first focus ensures that one gets far enough to go fast and sustain that speed. While security and traffic performance may be measurable reliability goals for network engineers, availability is inherently more valuable because, without it, nothing else matters.

## Designing for Reliability

Tony Hoare, a famous computer scientist and Turing award winner, once said that "The price of reliability is the pursuit of the utmost simplicity." This is true in that simplicity in network architecture and automation technology is a prerequisite to automating overall network operations reliability.

For example, large legacy scale-up devices obviously hinder reliability because they are not only single points of failure, they are also very complex and difficult to change. This has led to situations where network devices cannot come offline without disrupting the business, and complex network operating system features require complicated acrobatics to pull off in-service software upgrades.

Scale-out architectures are not only useful for scale, they also promote fault tolerance and hence reliability. Unfortunately, in scale-out networks, which have many smaller interconnected nodes instead of a few large nodes, there will be more node failures. Thankfully, modern network protocols and software automation improve the health of the larger node ecosystem, as well as the overall network. This is true of the Internet, of course, as well as proven, simple, scale-out Clos network architectures. While these architectures were once reserved for large data centers, they are now increasingly found in many other network domains.

A second example of simplicity enabling reliability can be found in automation. Where greater numbers benefit architectural reliability, the opposite is true when it comes to software. When networks include too many different SDN platforms and device operating systems, the diversity of APIs prohibits portability of automation workflows and impedes reliability. Homogenous tools and APIs that can work across many automation use cases greatly simplify human learning, while more testing and hardening improve reliability.

## Measuring Reliability Improves Reliability

Data doesn't just make for good decision making, it helps manage progress. While it's entirely possible to practice continuous improvement by trial and error, it's not very efficient, predictable, or practical. In the early stages of automation learning, trial and error may help one "cut one's teeth" and learn new technologies. For seasoned network reliability engineers, however, measuring reliability serves the purpose of reporting and managing by metrics to guide their own improvement.

Network reliability engineers create goals for their teams called service-level objectives (SLOs) and call their promises to external or up-stack dependents service-level agreements (SLAs). To monitor these objectively, they use automated service-level indicators (SLIs) and track error budgets. This involves higher order integrated systems monitoring layered on top of lower-lever monitoring, logging, troubleshooting, and analytics systems.

By knowing where they stand, network reliability engineers can track improvement and experiment with chaos engineering and fault injection, enabling them to proactively automate around failures rather than waiting for a crisis to occur.

## Approaching Automation as Engineering

While a significant amount of automation can take place on the vendor engineering side, last-mile contextual work is always required to glue together the various customer-specific systems integrated with the network. Every network team has some unique workflows that allow humans to interface with networking systems in order to make changes to provisioned intent and view the operational state.

Approaching these tasks with human technicians is an IT anti-pattern that should be avoided at all costs. In order to improve human accuracy and operational simplicity, the contextual automation engineering that takes place inside network operations must pick up where the vendors leave off.

Forrester recently reported[2] that mainstream enterprises are applying SRE to their IT infrastructure and operations. While NRE is just getting started, one of the positive aspects of this trend for a network automation industry that has focused almost exclusively on technology at the expense of processes is that it applies the rigors and proven processes of software engineering to the automation journey.

For network engineers, learning and applying software engineering skills and processes to network operations is different than application developers doing software engineering by vocation. For most network engineers, their introduction to automation was automating and aggregating traditionally manual operations. Before they could engineer their workflows, they first had to recognize and identify them. Going beyond tribal knowledge and limited documentation is often the first step toward automating routine and repetitive tasks, introducing consistency, accuracy, and reliability. Progressing in this way, over time, more work can be automated.

This type of advancement in workflow automation contributes to learning and productivity, but it does not necessarily transform how people look at network operations. Rethinking operations as a rigorous exercise in software engineering, network reliability engineers consider building, testing, staging, and stressing the boundaries of their network architecture and automation technology. This requires aligning with proven processes like gitOps, automation, and testing with source-code management, infrastructure configurations as code, code reviewing, pre-production pipeline orchestration with continuous integration and delivery (CICD), and other patterns explored in the 5-Step Journey[3] to Automated NetOps.

[2] https://reprints.forrester.com/#/assets/2/157/RES142216/reports
[3] https://www.juniper.net/us/en/solutions/automation/the-automation-journey/

## When It Comes to Automation, Ironically, Humans Are Heroes

Vendors can make the network easier to orchestrate and automate, but they cannot automate network operations.

In automation conversations, it's tempting to put technology front and center, and it will certainly play a role in software-defined, intent-based, and more autonomous networks. However, in the end, network engineers are the heroes when it comes to consuming and delivering automated network operations.

Future narratives that paint a hapless picture by eliminating human operators have it backward. In fact, SRE and NRE are often described as roles ("engineers" instead of "engineering"), placing people at the center of change and garnering them more attention, more responsibility, and greater rewards.

Before long, network engineers will be more technologist than technician. They'll touch a scant amount of device CLI, but it won't be all GUIs, either—they'll shift to APIs that drive higher order workflows and gitOps changes. No matter the provisioning altitude of intent and the amount of autonomous sensors, logic, and actuators in a system, humans will be the key interface that drives change and needs information about the system state in order to make decisions and manage the network services.

Automation technology will reduce the daily toil of repetitive tasks that leads to unintended mistakes. It also provides the guardrails to ensure adherence to SLAs. Network SLAs and reliability are not left to caffeine-powered individual heroics, but are achieved through well-trained automation heroes known as network reliability engineers and the power of NRE.

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