Automation Speeds Software Testing Allowing Cisco to Improve Software Quality and Time to Market

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KEY POINTS:
Description of test lab automation
How Cisco used it to improve software testing and time to market
Components of test lab automation solution

ARTICLE OUTLINE: The test labs of network software developers have made dramatic advances in recent years in automating the configuration of network test gear through the use of scripts that run common tests. The team at Cisco Systems' voice over IP (VoIP) softswitch test lab, though, has taken automation to the next level – and seen dramatic payoffs in lab throughput and return on investment (ROI). The key to Cisco's success is automation of physical layer connectivity.

The Cisco softswitch test group is responsible for feature testing, performance testing, load testing and customer support of the company's advanced BTS 10200 softswitch, an application that provides telephone companies with powerful call-control intelligence for establishing, maintaining, routing, and terminating voice calls in their network.

The Challenges

In 2004, the softswitch test group was part of a team that performed feature and protocol testing of VoIP protocols such as NTTP and SIP. The team automated their tests with scripts, but as a result of the rapid evolution of the VoIP industry, Cisco's test group encountered mounting demands for more testing stemming from a significant increase in features and protocols supported.

"Testing encompassed both line side and protocol testing. As the number of features increased, more and more POTS (Plain Old Telephone Service) lines were required. This caused a dramatic increase in the amount of equipment that needed to be tested and meant more time had to be spent physically connecting devices under test (DUTs) to test equipment," said Orone Laizerovich, a test engineering manager on the team.

Managing the increase in lines, test equipment, patches, and test beds drove the need to seek an automated connectivity solution. The following challenges were the catalysts for the test group's determination to find a solution that would automate their physical test beds:

- Test equipment (NetHawk EAST) and dozens of one- and two-port end user devices needed to be cycled through testing against other devices
- Unwieldy, poorly-labeled patch panels interconnected a mix of interfaces including POTS/analog, RF and Ethernet
- Cabling and troubleshooting connections consumed effective test time
- Fixed test beds dedicated to testing specific features meant more equipment had to be purchased and pushed the limits of available lab space

This situation led the group to become an early pioneer in the automation of physical connections in the lab to reduce the tedious and time-consuming process of manually cabling each test.

The team had a six- to 18-month vision regarding their requirements. They knew what they wanted, but did such a solution exist, and at a price that could be justified? Although several companies offered physical-layer switches that could potentially be used to interconnect the group's devices, front-end software solutions that could manage heterogeneous hardware and automate configuration and test scheduling needs were not widely available.

Making the Case

The chosen solution would have to offer a compelling return on investment (ROI). "Since the team had a good handle on costs and future growth plans, calculating the ROI was a straightforward endeavor," said Laizerovich. The group factored in the cost of test beds they would require in the coming quarters, and the costs associated with lost labor hours from cabling equipment and troubleshooting connections on a quarterly basis. Additional factors, such as how productive a resource is, how long it takes to manually cable a port versus using software, and the tendency for human error, were all taken into account.

They also took into account the fact that automated resource scheduling meant that the test labs could run 24 hours a day, resulting in an exponential increase in the hours of production on a yearly basis. Estimates for the cost of field support due to not finding bugs were also a consideration.

The Solution

The team initiated a search for a solution, considering multiple options that included developing the solution internally. The key features they needed included:

- **Support for heterogeneous interface types found in the lab**. The group needed a solution that would support the POTS, T1, Ethernet, and RF devices involved in their testing. There wasn't one switch that supported all of the required interfaces, so the team considered writing their own scripts to manage multiple switch types. However, the team learned of a hardware-independent software solution that would provide a common front end for multiple third party switches. The team recognized the power of this common set of commands to mask the particulars of the switching infrastructure, a key factor in the efficiency, reusability, and portability of their test scripts. In addition, such a solution allowed them to select switches based on features, performance, port density, quality, and value rather than on a limitation of the lab's deployed management software.
- **An API that enables automated test scripts to incorporate control of the physical infrastructure.** Seamless integration with the lab's existing scripts and script managers was a critical selection factor for the team.
- **A GUI that allows users to easily design, save, organize, and recall an infinite number of test topologies.** Some of the team's tests were manually controlled. For those tests, it was important to have a drag-and-drop user interface that would ease the design and organization of test topologies. The best design would mask the underlying switching infrastructure, while providing troubleshooting capabilities that expose the infrastructure when necessary.
- **A scheduler that manages multiple users contending for lab resources.** The team needed a solution that would allow reservation of lab resources at specific dates and times, as well as prioritized queuing of automated tests so that tests would be run as soon as the appropriate equipment became available. They looked for a scheduler that would automate the process of discovering available devices and assigning them to tests as required, allowing them to define a test topology by describing the types of devices involved and required characteristics of the devices, and have the system find and assign matching and available devices at reservation time.
- **Control over user permissions** -- who can access which devices and test topologies, when, and for how long. With the mix of groups using the lab for different kinds of tests, including local and off-shore users, the team looked for a solution with the ability to fine-tune permissions and priorities on devices, topologies, and scheduling.

After a lengthy search, the group found a commercially available solution from EdenTree Technologies, a company that proposed their software along with a mix of third party physical layer switches. The hardware was all tied together with the company's graphical user interface (GUI) and application programming interface (API) that would allow multiple users to easily and seamlessly control and schedule physical connections.

The proposed lab automation solution included:

- a 4,000-port POTS/analog switching system from Sycamore Networks for switching phones, integrated access devices (IADS), and other analog devices
- a Cytec RF matrix switch for switching banks of multimedia terminal adapters (MTAs) and cable modems to cable modem termination systems (CMTS).
- an Ethernet cross-connect system from MRV for switching Ethernet/IP ports
- and EdenTree Lab Manager software that provided drag and drop topology management (design, save, recall and share), user access controls (role specific privileges, priorities and access control), lab reservation scheduling and job queuing, connection tapping (sends traffic to analyzers and monitors) and test script integration.

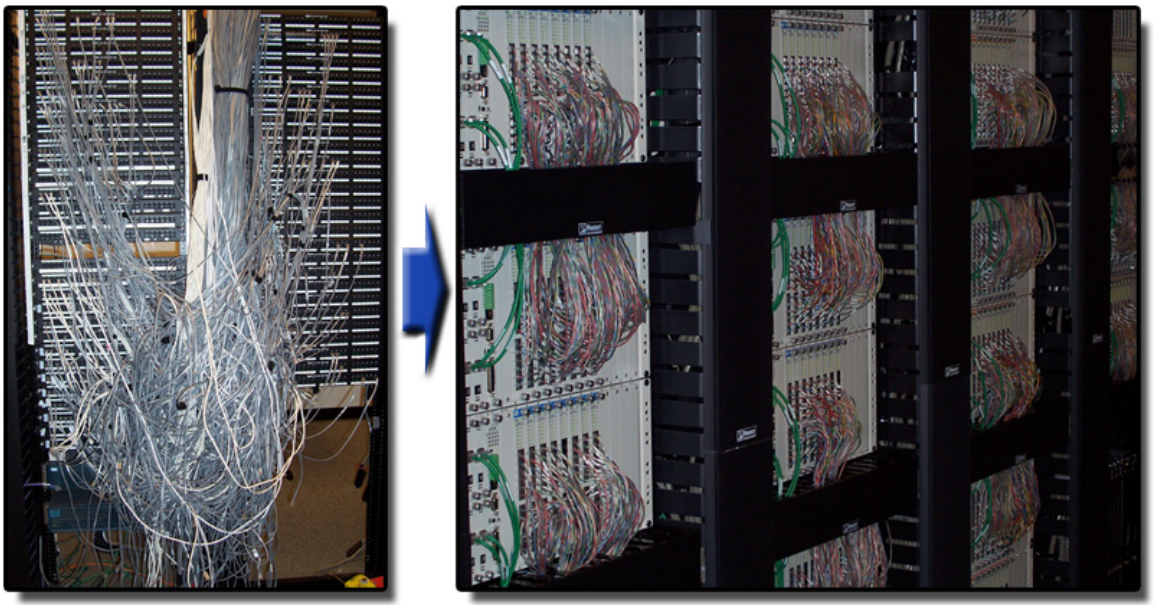

Figure 1: Lab Before and After Layer-One Automation

The ROI analysis for this solution proved that by sharing resources and automating manual processes, an initial payback of approximately 12 months could be realized. Based on the calculated ROI results, Cisco embarked on implementing the lab automation solution.

Results

The test group now had automated software-controlled test beds. For feature testing, the team was able to dynamically configure test beds using the Lab Manager drag-and-drop GUI. For the group's fully automated capacity testing, test beds were controlled by API commands integrated with existing test scripts. In addition to successfully switching large numbers of phone lines without manual re-cabling, the solution also provided the lab with the ability to remotely access resources from home and remote office locations. Debugging time was drastically reduced through the system's ability to tap connections between telephones and the gateway, and they began to realize the benefit of much broader test coverage, resulting in increased product quality and customer satisfaction.

The quantitative results of automation exceeded Cisco's original projections. The group could now run more than 4,000 tests in a weekend; certain test times were reduced from three hours to three minutes; and an estimated six man hours per day of work were eliminated as a result of no longer having to spend time tracking cables and re-cabling configurations. Factoring in savings from productivity gains and the minimization of equipment idle time, the group recalculated their payback to nine months, reducing the original 12-month projection by three months.

Laizerovich says that within the company, the automation project has set an example for other groups – even contributing to an internal quality award. "Other test labs that have not embraced automation are spending thousands of dollars more per test. In addition, the automation solution provides valuable information that helps our group make justifiable decisions about further investments. For example, device utilization reports from the automation system ease the approval process for additional equipment that is needed."

Further Optimizations

The dramatic results of layer-one automation compelled the softswitch test group to seek a solution to eliminate other bottlenecks in the lab. All production processes have bottlenecks and constraints that ultimately affect throughput. Discovering where these constraints are and addressing them leads to maximized test velocity.

In this group, a single softswitch configuration running on four Solaris servers took almost two days to be manually configured, which included both configuring the operating system and loading and configuring the software. With hundreds of combinations of softswitch builds, operating system versions, and other environmental parameters that needed to be tested, the labor-intensive procedure for creating each of these configurations was clearly a significant bottleneck that was hindering the effectiveness of the team's automation efforts.

So, the test group focused on automating computer configurations for the next stage of improving test velocity. "After implementing EdenTree's Configuration Manager software, the team was able to drop configuration times from two days down to 35 minutes, reduce the amount of server hardware needed and eliminate manual involvement in creating the configurations," says Laizerovich. The net result on ROI for the solution was instantaneous, impacting existing and planned on-site and off-shore labs.

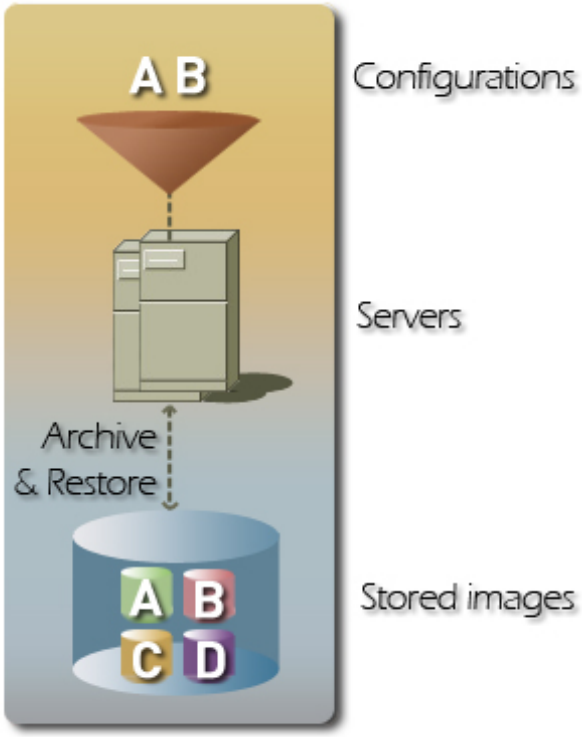

Figure 2: Restoration of Automated Configurations

Conclusion

In an industry where technology and economic stress has amplified the ever-present pressures to do more with less and shorten test cycles, the benefits of lab automation are compelling. Cisco's softswitch test lab shows that the deployment of a completely automated physical layer test lab can pay off with higher quality and better productivity. The solution also opens the lab to off-site and offshore colleagues, partners, or customers who must duplicate the testing infrastructure or wait for on-site personnel to configure the systems. Using a solution with remote capabilities allows for a global deployment and 24x7 test execution.

About the Author

Roberta Gonzalez is a co-founder and vice president of marketing for EdenTree Technologies, Inc. Roberta co-founded EdenTree Technologies in 2002, after holding Vice President and Director level roles in marketing and business development at a range of large and small communications test and measurement equipment companies including Spirent Communications, Hewlett-Packard (Agilent), and Network General. She holds a Bachelor of Science in Engineering from Duke University.