

CASE STUDY: A Leading Service Provider Improves VoIP Robustness, Availability and Security via Service Assurance

The Service Availability Challenge

Service availability is of paramount importance to any provider of real-time services, like Voice over IP (VoIP). One major U.S.-based service provider understands firsthand that the ability to test product robustness, availability and security (RAS) has a direct, measurable impact on the bottom line. This Tier-1 provider offers quad-play services – voice, video, data and wireless -- and serves customers in both the business and consumer markets.

This provider knows that its ability to maintain its edge in these highly competitive businesses hinges on the ability to rapidly develop and deploy innovative revenue-generating services, including hosted VoIP, real-time conferencing, streaming media and other interactive services. But as it pleases customers with hot new services, it must still meet or exceed industry-standard expectations for stability, reliability and availability: 99.999% uptime.

High Cost of Downtime

Achieving the service levels that customers expect means minimizing downtime. There are two types of network downtime:

1. Degradation, when a service is slower than usual, perhaps to the point of being useless, and
2. Outright outage, when a service is unavailable.

The second is usually more serious than the first, but not always. For example, a VoIP phone user may become so frustrated at an unreliable service that s/he leaves in a huff and never returns. This is indeed a loss for the service provider that provides the VoIP service directly or indirectly to this user.

Like other real-time services, downtime in VoIP services incurs several significant costs for a service provider. These costs include:

- lost revenue,
- customer churn,
- avoidable support costs,
- decreased average revenue per user (ARPU).

This leading provider estimates that the average hourly downtime cost is over \$130K, and the **average annual downtime cost is \$23.4M**, sometimes higher than \$100M. It's imperative for this provider to minimize system downtime to avoid customer churn, which improves its bottom line, and maximizes the return on the ever-increasing customer acquisition cost.



CHALLENGE

- Rapidly roll out innovative, revenue-generating VoIP services while ensuring that those services meet the expected service availability and reliability levels;
- Prevent costly service outages and degradation, and reduce customer churn and subscriber support costs;
- Identify potential sources of service quality issues before they impact the customer experience or VoIP infrastructure performance.

SOLUTION

Mu-4000 Analyzer

RESULTS

- Improved service availability for VoIP and unified-communication services, establishing processes to maximize uptime of additional services such as video streaming;
- Reduced customer churn and improved bottom line as a result of significantly improved VoIP service quality;
- Identified a zero-day vulnerability in a session border controller, which was patched prior to service rollout;
- Automated and conducted comprehensive testing of vendor products more efficiently, and streamlined problem resolution process with vendors.

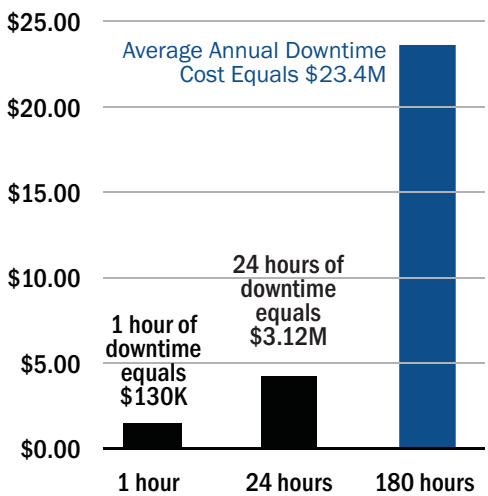


Figure 1. Average Downtime Cost in Millions

Difficulties in Testing VoIP Deployments

Due to these high costs, service providers are quite motivated to reduce network downtime and maintain high service quality. However, achieving this goal in VoIP-based IP communications solutions is a daunting task. VoIP-based networks depend on many hardware and software components and middleware, and each device is itself a complex hardware/software system on its own. As the system complexity increases, implementation mistakes become ever more likely. These device flaws create opportunities for vulnerabilities in VoIP systems, which can degrade service and lead to downtime.

Until now, service providers have not had effective tools to systematically address the root cause of system robustness issues. Existing system testing tools have several major limitations:

- **Depth:** not able to find significant percentage of bugs or vulnerabilities in systems;
- **Agility:** not able to keep up with the pace of product development and deployment;
- **Breadth:** not able to provide thorough coverage.

Improving VoIP Service Quality with Mu

This leading service provider has turned to Mu’s service assurance solution, which is now an integral part of the provider’s world-class testing and certification lab. Service assurance helps determine how vendors’ products will meet its standards for robustness so the service provider knows in advance whether the products will survive in the real-world production network environment.

With the Mu solution, the provider’s architects define purchasing acceptance criteria, so robustness is “designed-in” from the start and baked-in throughout the entire deployment life cycle. Its engineers use the Mu solution to test products throughout the life cycle to proactively identify and address robustness issues that may have caused downtime in a production system. This allows the service provider to take actionable steps toward remediation, before vulnerabilities impact the reliability and security of its VoIP services.

Figure 2 is a simplified network diagram of this service provider’s VoIP architecture. Table 1 summarizes the network elements that the Mu solution analyzes and the benefits for the service providers. Please refer to the “Use Case Details” section for more information.

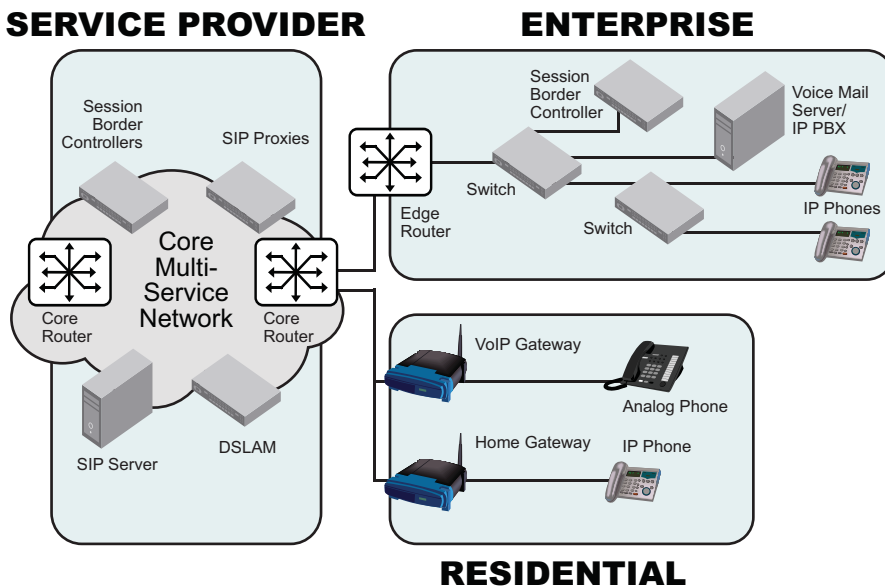


Figure 2. Simplified VoIP Network Architecture Diagram

Business Benefits from Using Mu

After using Mu’s service assurance solution for a year, this provider has achieved significant business benefits. With comprehensive security and robustness testing incorporated into its entire service life cycle, the provider has improved its VoIP service uptime, and has thereby avoided service disruptions that would have otherwise impacted revenues, customer retention rate and overall customer satisfaction.

Key results include:

- Reported a significant reduction in customer churn and SLA penalties as results of improved service availability and quality.
- Uncovered a serious flaw in a session border controller prior to deployment, and thus avoided a service outage.

- Reduced costs in several areas thanks to the proactive approach to problem resolution.

Reducing Total Cost of Ownership (TCO)

Lower total costs contribute to a faster and higher return on investment (ROI) for IP networks. The following are three major cost categories that are key drivers in lowering TCO:

- CapEx,
- OpEx,
- Opportunity costs.

Reducing CapEx

Mu helps this service provider ensure the VoIP devices and applications it purchases are robust, which prevents wasting CapEx on low quality products. Mu provides an integrated analysis approach, so this service provider does not need to buy numerous point solutions that provide only a subset of the analysis capabilities of Mu. Therefore, the provider saves on equipment outlay. Furthermore, Mu's solution platform can be seamlessly integrated with other already-purchased testing tools and homegrown solutions, so that existing capital investments are fully preserved and leveraged.

Reducing OpEx

Mu's solution has helped the service provider to reduce their operating expenses in the following areas:

Layer	Network Elements	Mu Tested	Benefits from Using Mu
Backbone	Router	☑	<ul style="list-style-type: none"> • Harden VoIP infrastructures • Reduce TCO by addressing product vulnerabilities early
	SIP Proxy	☑	
	Firewall	☑	
	IPS/UTM	☑	
Core Services	Core Router	☑	<ul style="list-style-type: none"> • Robust digital dial-tone • Improve audio clarity
	SIP Server	☑	
	Session Border Controller	☑	
	SIP and IMS Endpoints	☑	
	Digital Subscriber Line Access Multiplexer (DSLAM)	☑	
Customer Premises Equipment (CPE)	<i>Enterprise</i>		<ul style="list-style-type: none"> • Minimize voice quality issues such as packet loss, delay, echo, etc. • Characterize system responsiveness to identify problem spots • Secure triple-play control planes
	Switch	☑	
	Edge Router	☑	
	Session Border Controller	☑	
	IP PBX	☑	
	IP Phone	☑	
	<i>Residential</i>		
	VoIP Gateway	☑	
	Home Gateway	☑	
	IP Phone	☑	

Table 1. Comprehensive Testing for VoIP Services

WHERE	HOW
Customer Acquisition Costs	Because customer churn was reduced, the service provider not only improved their bottom line, but also maximized its return on the ever-rising customer acquisition cost.
Avoidable Support Costs (Incident Response)	Mu finds bugs before service rollout and upgrade, so the frequency and severity of downtime has gone down. Therefore, support staff need not spend as much time on resolving downtime-related customer issues.
SLA Penalties	Due to significantly improved service quality and customer satisfaction level, the service provider has reduced cost in SLA-related penalties.
Vendor Problem Resolution	Because of Mu's full range of remediation tools, interactive charts and detailed reports, resolving issues with vendors has become easier and less time-consuming.
System Upgrades & Patches	Mu's regression testing feature enables its testing staff to accurately verify bug fixes from vendors.
Ongoing Operation	Mu's run-to-completion analysis capability does not require human intervention once started, and automatically pinpoints flaws.
Staff Training and Retention	Mu's analysis templates help disseminate scarce security knowledge, and establish service assurance best practices across the entire organization. The provider finds it easier to train new analysts and provide professional development in service assurance for existing staff.

Reducing Opportunity Costs

Opportunity costs, though difficult to measure, are very real. After deploying Mu's solution, this service provider has significantly reduced its opportunities costs. These costs represent lost opportunity for profit resulting from network downtime, inability to deploy new service quickly, application or device failure, etc.

Use Case Details

Thorough Attack Surface Coverage

With the Mu-4000, the service provider is able to methodically identify areas of product weakness that might undermine the service provider's business operations. The service provider's testing team feels that the Mu-4000 provides the only way to get deep, comprehensive attack surface coverage of the protocol implementations across its VoIP system.

The service provider uses the Mu-4000's Dynamic Stateful Fuzzing engine to thoroughly exercise the multi-packet exchanges among complex protocols in all valid and invalid states. VoIP uses the Session Initiation Protocol (SIP) to control communications. Furthermore, SIP leverages many of the mechanisms developed for the HTTP and SMTP/MIME protocols, thus inheriting weaknesses and vulnerabilities. The service provider is painfully aware that SIP is known to have a large number of semi-interoperable implementations and many extensions, which makes it challenging for network equipment manufacturers to ensure robustness and interoperability, especially in multi-vendor deployments as would be found in any real network.

Comprehensive Support for Analyzing VoIP Deployments

With the Mu-4000, engineers at this service provider test millions of unique scenarios and gain better visibility into issues that would affect service availability. For VoIP implementations, the Mu-4000 supports:

- H.323/H225.0/H.245 call signaling,
- SIP (including IMS endpoint functionality),
- MGCP (including NCS profile),
- H.248/Megaco (IMS profile),
- RTP/RTCP, and
- deeply stateful attacks for several dozens other protocols that are necessary for VoIP.

Attacks are delivered over any valid transport, using any valid or appropriate authentication mechanism for the protocol in question.

For example, when testing session border controllers, the engineers at this Tier-1 operator use the Mu-4000 to analyze the SIP implementation on the operational port as well as management protocols including HTTP, SSH, Telnet and FTP. They use similar test methodology across other integral elements of the VoIP infrastructure, including SIP/IMS endpoints, call managers and proxy servers.

In fact, security engineers using the Mu-4000 **uncovered a serious flaw in a session border controller** just prior to deployment. This flaw, in a production network, would have caused service degradation and security issues. With the Mu-4000, the engineers had the benefit of detailed documentation about the vulnerability, which it provided to the vendor to accelerate the remediation process.

Automation Improves Efficiency

With the Mu-4000, engineers cover more test scenarios than would be humanly possible with scripting or manual efforts. They also use the Mu-4000 appliance to automate other toolsets, including the open-source vulnerability analysis tool Nessus. A time-saver is the ability to automatically re-run any test with one-touch regression testing, which allows them to validate that a vendor's patch truly fixes the issue. Another key feature the engineers enjoy is automatic fault isolation. The Mu-4000 continuously manages the analysis process without human intervention, creating checkpoints and isolating faults as they are discovered via the chosen monitor (serial console, syslog, ssh or telnet).

The service provider is also starting to leverage the new DoS module from the Mu-4000. This module enables automatic modeling of stateless traffic – identical to the traffic found in denial-of-service traffic targeted both at the network products and application services. The certification and testing lab is eager to use the DoS module to gain insights into two aspects of the system in a controlled environment – availability during the attack and graceful recovery after the completion of the attack.

Ease of Use

The testing team also appreciates Mu-4000's GUI for ease of use. As a Web-based appliance, the Mu-4000 is easy to install and is intuitive to use. Wizards and templates guide the engineers through the analysis process. Creating and using a template is a simple process that allows the engineers to define attack types, monitor channels and to specify action(s) to be taken in response to events. Test-center staff simply selects any of the Mu's protocols and then configures the comprehensive variety of custom attack parameters in each template. The XML-based templates are also portable using the Mu-4000 for any aspect of the analysis.

Templates further a "Best Practice" approach that is easily shared organization-wide and with the engineers that have complementary skill sets.

Ongoing Service Assurance

By verifying that vulnerable VoIP products are not deployed into production, this Tier-1 service provider avoids most significant problems down the road, including service degradations and downtime. The Mu-4000 is finding its way across the entire deployment lifecycle from the initial product purchase to subsequent upgrades. The service provider began using the Mu for acceptance testing, but now uses it for verification testing of every code revision and application level change.



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