Ribbon SBC SWe
Session Border Controller
Independent Performance Verification

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Contents

1 - Executive Summary

Ribbon Communications (formerly Sonus Networks, Inc.) engaged Miercom to perform an independent performance assessment of its SBC SWe – a virtualized software version of its popular, appliance-based Session Border Controllers.

The virtualized SBC software image ran in a virtual machine environment consisting of 12 CPU Cores (Xeon 2697 V3) and 16GB of memory that was hosted on a standard, off-the-shelf server with no special hardware accelerators. The goal of the testing was primarily to verify the performance of the software in various vocoder, security and call-handling environments. In addition, testing determined the system's resilience in overload and failover situations, as well as to defend against high-volume Denial-of-Service (DoS) attacks.

Key Findings and Conclusions

The software-based Ribbon SBC SWe exhibited remarkable performance and resilience. Among the most noteworthy findings:

- Tests showed that the SBC SWe easily handles a sustained load of up to 20,000 pass-through G.729AB calls, delivering 4.1-MOS call quality, even while performing IPv4-IPv6 or RTP-SRTP interworking or SIP header manipulation.
- Fail-over of redundant SWe nodes occurs near instantaneously on both signaling and media ports with no media interruption nor calls being dropped and maintaining an excellent MOS rating.
- Handling 20,000 calls consumes modest amounts of virtual machine CPU and memory resources, typically less than 20 percent of CPU and about 60 percent of memory. Also, we found that increasing virtual machine memory yields impressive increases in call capacity.
- The SWe successfully fends off long duration and very high loads of various Denial-of-Service (DoS) attacks, with no effect on call quality and no dropped calls. In addition, the SBC successfully handles high call overloads and floods of registration and re-registration requests.
- The Ribbon SBC SWe maintained a full capacity of 256,000 NAT'd registered endpoints and withstood a registration avalanche with no system degradation
- The Ribbon EMS (Element Management System) effectively sustained collection of all call details, even at full call loads.

- Witnessed the same Ribbon SWe version running successfully in VMware, KVM as well as Openstack and Amazon’s (AWS) cloud environments
- The Ribbon SWe achieves reliability and resiliency on par with redundant HW based SBC solutions

The test results confirm that Ribbon’s Session Border Controller SWe delivers impressive, rock-solid performance, running as a Virtual Network Function on an industry-standard server using a hypervisor. With sophisticated call handling, internetworking, transcoding, high availability and immunity from DoS attacks, we are pleased to award the Ribbon SBC SWe the ***Miercom Performance Verified*** certification.

Robert Smithers

CEO

Miercom

2 - About the Product Tested

The Ribbon SBC (Session Border Controller) SWe tested incorporates all the same features, security, resiliency and functions as Ribbon's appliance-based SBC's. In addition, the objective of this testing was to verify the performance and resilience of the Ribbon SBC SWe. In short we set out to verify if the SBC function in software can perform its mission critical role on par or better than legacy HW-based implementations. Thus, many of the SBC's features – high availability, encryption, transcoding, security, policing and so on – were exercised in the many different VoIP traffic-handling environments tested.

The Ribbon SBC SWe is software that runs on industry-standard servers, either in a private data-center environment or as a Virtual Network Function (VNF) on public-cloud or hosted services including Amazon AWS and Openstack. The package runs on VMware 5.0 and higher – it was tested it on VMware ESXi version 5.5.0 – as well as other hypervisor environments including Microsoft Hyper-V and KVM. The management interface for the virtual environment used in our test bed was the vSphere Client v5.5.0.

The Ribbon SBC SWe software release 5.0.1 R2, can be remotely deployed, installed and managed. As it runs on standard servers, the capacity of the system relates directly to the virtual machine allocation of CPU power and memory from the server. In our test bed, the Ribbon SBC SWe was run on a HP DL380 server and allocated 12 CPU cores (2.60-GHz CPU) with 16 GB memory. No special hardware cards nor hardware accelerators were required.

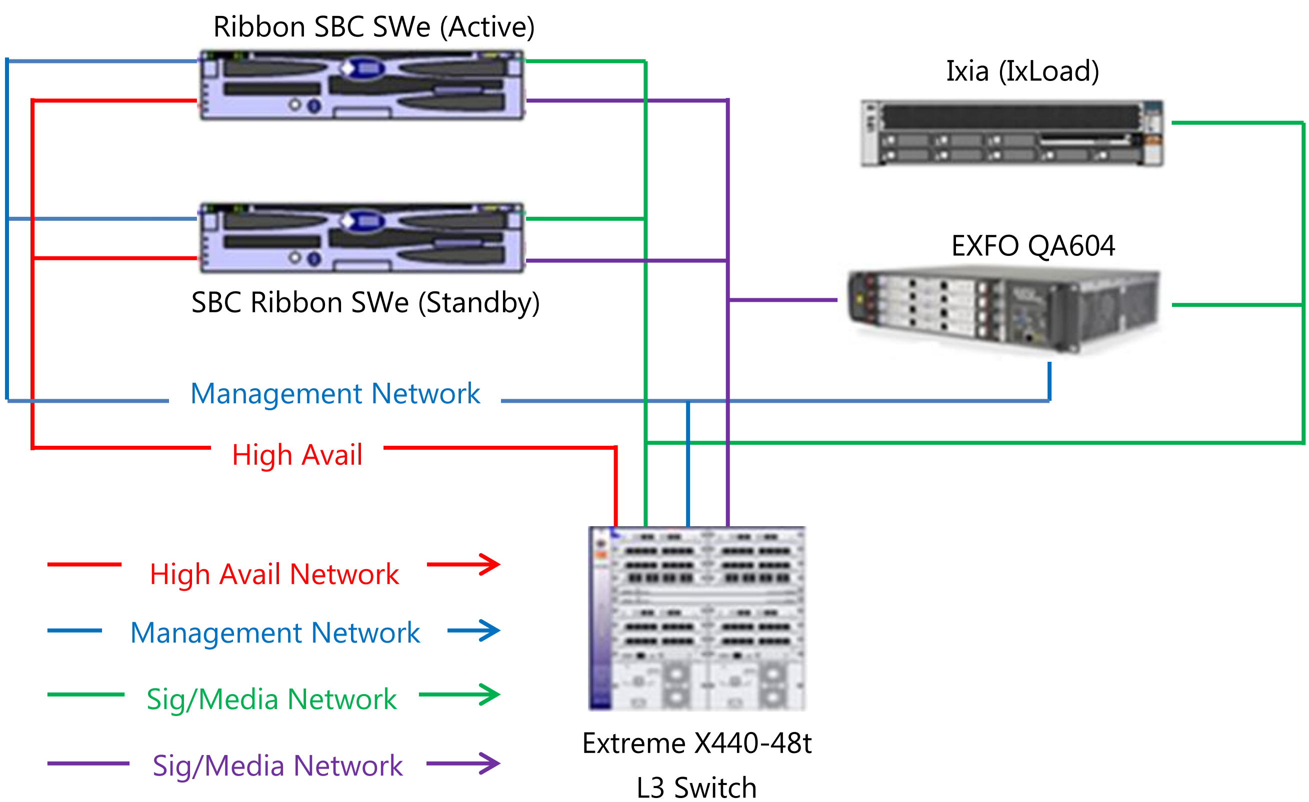
We found that the Ribbon SBC SWe running in this virtual machine configuration had no problem sustaining upwards of 20,000 concurrent sessions with no dropped calls or system degradation, while maintaining an excellent MOS score. Even so, in one of our tests we upped the server's memory 50 percent, from 16 to 24 GB, and found that the resulting platform could readily handle 20 percent more concurrent calls which demonstrates the Ribbon SWe can effectively scale based on increasing underlying system resources.

Indeed, SWe's capacity and resiliency on a reasonably high-powered off-the-shelf server can only be constrained by the server's 1-Gigabit/s network connection – filled with call signaling and pass-through media traffic, as was the case in our test bed.

3 - How We Did It

A straightforward test-bed network was assembled for this study (see below diagram). Equipment-wise, two identical servers were set-up, each running a virtual instance of Ribbon SBC SWe. For later HA (High Availability) fail-over testing, one of the SWe server platforms was configured as the active/primary and the other the "standby"/back-up. Two SBC servers configured for HA stay in sync with each other, monitoring the state of each call in progress. This way the standby SBC server can immediately take over and maintain active calls if the active SBC fails.

Test Bed – Showing Equipment and Connectivity



An EXFO QA604 SIP call generator (www.exfo.com) delivered SIP calls and registration requests to the SBC. As the originator and terminating endpoint of all calls, the EXFO tracked the completed calls, any dropped calls, and calculated the MOS (mean opinion score) quality ratings of calls.

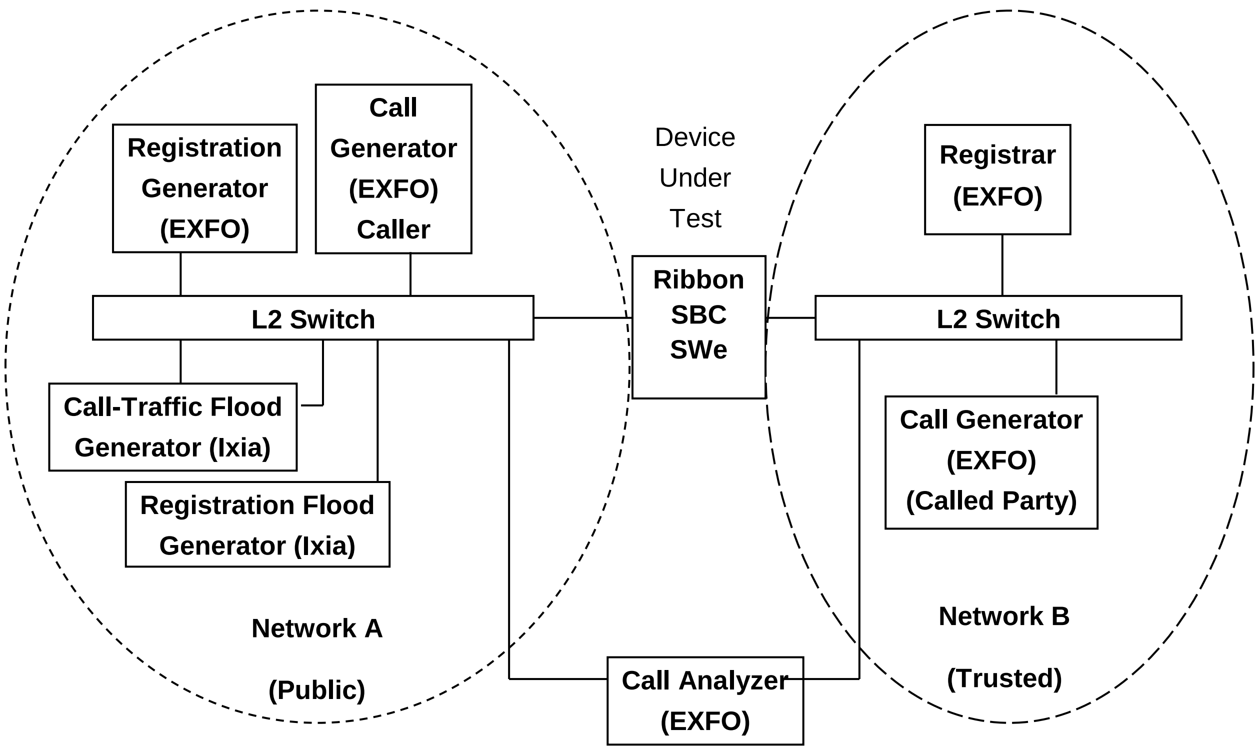
An Ixia test system (www.ixiacom.com), running the IxLoad application, was used to generate the DoS attack packet streams launched at the Ribbon SBC SWe.

Connecting everything in the test bed together was an Extreme X440-48t Layer-3 switch (www.extremenetworks.com). The switch, supporting 48 GE (1-Gigabit/s Ethernet) ports, was configured with separate subnetworks for SIP signaling and media traffic to and from the SBC, management access to all the devices, and separate connections for the HA (High Availability) configuration, enabling the primary Ribbon SBC SWe to fail-over to the back-up.

It is noteworthy that each Ribbon SBC SWe server had only a single 1-Gigabit/s connection for all SIP signaling and media traffic. For most of the tests, the call media was pass-through, meaning that the VoIP streams passed through the Ribbon SBC SWe, but were not otherwise processed (such as for transcoding, or translating between RTP and SRTP). Depending on the vocoder of the media streams (G.711 μ-law required the most bandwidth, G.729AB the least), the 1-Gigabit/s connection in some cases became the bottleneck.

Test Call Flow

The Ribbon SBC SWe, like all hardware based SBCs, provides the interface between an organization's internal network and the WAN, Internet and/or carrier service. The diagram below shows the logical layout of call flows in the test bed. The Ribbon SWe mediates logically between the public network – where calls originated in our testing – and the called party within the organization's trusted network.



The below table summarizes the devices and their roles in this testing.

Device/Equipment	Function	Operating Software
Ribbon SWe SBC software	Device Under Test (DUT)	5.0.1R2 Packaged with OS: VMware ESXI and vSphere Client v5.5.0
HP DL380 Server 2.60 GHz CPU, 12 core E5-2697 V3 16 GB RAM memory 100 GB Disk 1-Gigabit/s Network interface	Virtual machine: Server hardware base for SWe DUT	Debian Linux
EXFO QA604 (generated signaling and media for all calls)	SIP call generator Caller and Called station Call-traffic flood generator Call analyzer Registration generator Registration flood generator Registrar	V9.8
Ixia/IxLoad	DoS traffic generator	
Extreme Layer-3 Switch	1-GE connectivity of all nodes	V12.0.3.16

Test Set-up Notes

Voice packetization sample size was 20 ms in all cases. All sessions were done with the standard seven-message SIP call-signaling flow. The SBC configuration was designed to exercise the product in a carrier peering setting and access deployments using UDP. Egress peers answered calls with no delay (between 180 Ring and 200 OK). The Ribbon SBC SWe acts as a Back-to-Back SIP User Agent, so each call entails two sessions: Caller-SBC SWe and SBC SWe-Called Party.

The Ribbon SBC SWe product is all software and looks, feels and behaves the same as Ribbon's SBC appliances. Signal and media encryption is embedded in the package, along with software-based media transcoding for G.711, G.722, G.723, G.726 and G.729AB, AMR Narrowband and Wideband, EVRC, iLBC, OPUS vocoders. As well as support for RFC2833 and T.38 Fax interworking

All registration scenarios are with a challenge. A default aggregate policer (500 packets/second /flow) was used towards both the trusted and untrusted sides.

4 - Redundancy and Management-Access Tests and Results

Two instances of Ribbon SBC SWe running on different virtualized servers can be configured in a High Availability (HA) configuration. In this configuration, both SBCs are tightly coupled and they remain synchronized with the call state and information on all calls in progress. This way, if the primary, or active, SBC server fails, the back-up SBC can readily assume all operations.

In the first test below, we exercised the fail-over capability of two HA-configured SBC SWe's.

Effect of Fail-Over and Switch-Back on Active G.711 Calls

What's measured: The impact on active calls of two SBC SWe's, in an HA configuration, failing over and then reverting back.

Test set-up: All calls are G.711 µ-law pass-through, with 20-ms packetization. Start traffic and achieve 9,000 sessions. Then simulate a failover from active to standby SBC by issuing a switchover request console command to the active.

Results: The active SBC failed over to the stand-by with no drops of any active in-progress G.711 calls.. During the fail-over, the HA configuration sustained 9,000 G.711 calls and achieved and excellent MOS (4.1) with no media interruption.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
9,000	**0**	**4.1**	**13.35**	**50.0**

The Ribbon SBC SWe is also capable of retaining full call details on each completed call, and then delivering that data when polled by a management system. In the following test we configured an Element Management System (EMS) to poll an SBC SWe sustaining a heavy call load every five minutes and FTP-download the full call details.

FTP Data Retrieval from SBC SWe under High Call Load

What's measured: The ability of an SBC SWe, while supporting a high call load, to regularly deliver complete call statistics to an EMS, with no impact on call traffic.

Test set-up: All calls are G.729AB pass-through, with 20-ms packetization. Start traffic and achieve 20,000 sessions. Then, every five minutes, via an EMS, access and FTP-download all call details from the SBC SWe.

Results: The EMS was able to access and FTP-download full call details from the SBC SWe every five minutes, with no impact on high call load or MOS call-quality ratings.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**16.78**	**60.62**

5 - Media-Handling Tests and Results

The Ribbon SBC SWe was tested with real SIP VoIP calls, delivered by the EXFO call generator. For the most part, the media streams of calls were pass-through – that is, the media streams passed through the virtualized SBC untouched, processed by the SBC's security functionality for full security and policing/protection on relay flows.

In other cases the media streams were processed by the SBC, such as for transcoding or to translate all media packets between RTP (the usual Real-time Transport Protocol used for VoIP media) and SRTP (Secure RTP) which encrypts the payload. In addition, a separate test was conducted where the media stream was passed directly between calling and called endpoints while the call signaling was processed through the Ribbon SBC SWe.

In each test there was no delay between 180 Ringing and 200 OK for call delivery to the called party. After each test the testers ran esxtop on the hypervisor to collect CPU and memory-use statistics.

Sustained Session Load for G.729AB Pass-Through Calls

What's measured: The ability of the Ribbon SBC SWe to handle a sustained session load of 20,000 sessions with an excellent MOS Score. One session equals one complete call between 2 endpoints.

Test set-up: Ingress and egress of all calls is G.729AB, 20-ms packetization. Run the test for 60 minutes.

Results: The Ribbon SBC SWe successfully processed and sustained 20,000 G.729AB pass-through calls (20,000 sessions), with an excellent MOS (4.1) and no packet loss. Additionally, calls were placed by testers between real handsets to confirm the audio quality.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**14.9**	**60.0**

Sustained Session Load for G.711 - G.729A Transcoded Calls

What's measured: The ability of the Ribbon SBC SWe to process and sustain calls transcoded between G.711 µ-law and G.729A vocoders, with an excellent MOS Score and minimal impact on system resources.

Test set-up: Ingress calls are G.729A; egress calls are G.711 µ-law, all 20-ms packetization. Run the test for 60 minutes.

Results: The Ribbon SBC SWe successfully processed and sustained 834 G.729A-G.711 transcoded calls with an excellent MOS (4.09) on par with hardware based transcoding. In addition, ample system resources were available to handle other SBC system functions.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
834	**0**	**4.09**	**22.75**	**44.37**

Sustained G.729AB Load with SRTP – RTP Interworking

What's measured: The ability of Ribbon SBC SWe to interwork and sustain secure, incoming G.729AB calls encrypted using TLS (for signaling) and Secure RTP (for media). Egress calls use conventional, unencrypted SIP and RTP.

Test set-up: Incoming calls use TLS (transport layer security) and media streams encrypted using Secure RTP (SRTP). All calls are G.729AB pass-through, with 20-ms packetization. Run the test for 60 minutes.

Results: The Ribbon SBC SWe successfully interworked and sustained 20,000 pass-through G.729AB calls using TLS and SRTP with no system degradation nor call capacity reduction. An excellent MOS (4.1) was achieved with no calls dropped.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**21.89**	**60.3**

Sustained G.711µ-law Load with SRTP – RTP Interworking

What's measured: The ability of Ribbon SBC SWe to interwork and sustain secure, incoming G.711 µ-law calls, encrypted using TLS for signaling and Secure RTP for media. Egress calls use conventional, unencrypted SIP and RTP.

Test set-up: Ingress calls use TLS and media streams encrypted using SRTP. All calls are G.711 pass-through, with 20-ms packetization. Run the test for 60 minutes.

Results: The SBC SWe successfully interworked and sustained 9,000 pass-through G.711 µ-law calls using TLS and SRTP. An excellent MOS (4.1) was achieved with no calls dropped. This load test completely filled the SBC server's 1-gigabit/s network interface.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
9,000	**0**	**4.1**	**25.7**	**57.56**

Vertical Scalability of SBC SWe Instance for Handling Increased G.729 Call Load

What's measured: The ability to increase the G.729 pass-through call-handling rate of Ribbon SBC SWe by increasing the virtual machine's system memory.

Test set-up: Upgrade the system RAM memory of the virtual machine instance from 16 to 24 GB. All calls are G.729pass-through, with 20-ms packetization. Run the test for 60 minutes.

Results: The SBC SWe successfully processed and sustained 24,000 pass-through G.729 calls – representing a 20-percent increase in sustained call capacity.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
24,000	**0**	**4.1**	**16.28**	**42.91**

6 - Signaling Performance Tests and Results

In the following series of tests, the focus was on the capacity of the Ribbon SBC SWe to efficiently handle SIP messaging. In the first one, the media streams of each call pass directly between calling and called endpoints, and not through the SBC. This is a legitimate SIP option, as long as calling and called parties support the same vocoder and media streams (i.e., G.729 and RTP).

G.729 Call-Handling Capacity with Direct Media

What's measured: The capacity of SBC SWe to handle G.729 calls, with media streams exchanged directly between calling and called parties.

Test set-up: All calls are G.729 with 20-ms packetization. Enable the direct media flags on both ingress and egress trunk groups. Run the test for 60 minutes.

Results: Unlike with pass-through G.729 calls, the media with these direct calls does not pass through the SBC, and subsequently, the server's 1-Gigabit/s network connection does not become a bottleneck. The SBC SWe successfully processed and sustained 20,196 G.729calls (20,196 sessions) with no calls dropped.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,196	**0**	**N/A**	**25.23**	**70.31**

IPv4 – IPv6 Interworking for G.729AB Pass-Through Calls

What's measured: The capacity of SBC SWe to handle the bi-directional conversion of SIP signaling between IPv4 (on ingress side) and IPv6 (on egress side).

Test set-up: All calls are G.729AB pass-through, with 20-ms packetization. Set-up IPv4 on ingress signaling port and IPv6 on egress signaling port. Run the test for 60 minutes.

Results: The SBC SWe successfully processed and sustained 20,000 G.729 calls , while handling the bi-directional translation of all signaling between IPv4 and IPv6.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**16.78**	**60.62**

Message Manipulation on All G.729AB Pass-Through Calls

What's measured: The capacity of Ribbon SBC SWe to perform SIP Message Manipulation (SMM) on SIP messages while processing high volumes of G.729AB pass-through calls.

Test set-up: All calls are G.729AB pass-through, with 20-ms packetization. Configure SMM rules in SIP adaptor profile for ingress and egress zones, respectively. Run the test for 60 minutes.

Results: The SBC SWe successfully processed and sustained 20,000 G.729AB pass-through calls while examining and manipulating SIP message headers to conform to SMM rules.

Summary of Confirmed Results

Sessions sustained	Calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**19.4**	**60.62**

7 - Call-Overload and Registration-Load Tests and Results

In the following test the Ribbon SBC SWe was intentionally over-loaded with calls, to see the impact, if any, on calls in progress and to callers when the SBC was unavailable due to the over-load.

Ribbon SBC SWe Response to Call Over-Load

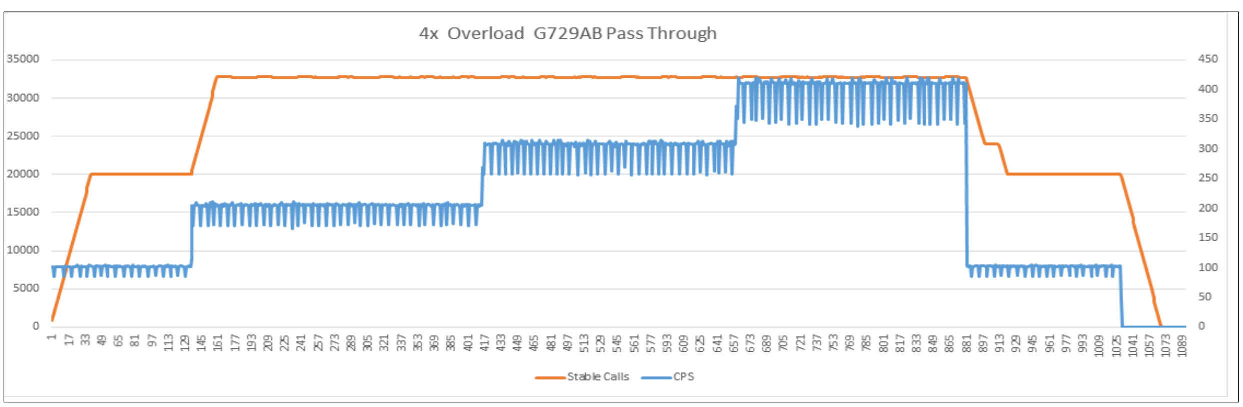
What's measured: The ability of an Ribbon SBC SWe to preserve calls in-progress and respond appropriately while being flooded with increasing high call overloads.

Test set-up: All calls are G.729AB pass-through, with 20-ms packetization. Establish an 100-second Call Hold Time. Start traffic at 100 cps. Then, after observing traffic activity, increase the new-call delivery rate to 200 cps. After observing traffic activity, increase the call-delivery rate to 300 cps, and then again to 400 cps.

Results: The SBC SWe can accept and concurrently sustain 23,895 sessions, delivered at 200 cps. Calls continue to be processed up to that rate, and this sustained level is not reduced by call overloads. In addition, overload calls are properly issued a "503 Service Unavailable" response call.

Summary of Confirmed Results

Calls, call-rate sustained	Call Hold Time (sec)	New calls per sec	Response to overload	Percent CPU utilization	Memory Used percent
200 cps **23,895 concurrent sessions**	**100**	**100, 200, 300, 400**	**503 'Service Unavailable' response code issued for overload calls**	**33.58**	**67.18**



Registration Capacity and Registration Rate Supported

What's measured: The registration capacity of the SBC SWe and the maximum rate at which registrations can be processed. When deployed with SIP endpoints behind a NAT firewall, endpoints must re-register with the SBC periodically so the SBC can update endpoints' addresses.

Test set-up: The EXFO is set to issue 256,000 endpoint registration requests, from simulated endpoints on both the initiating and terminating side. Each endpoint would re-register every 1800 seconds (30 minutes). The SBC SWe is monitored to learn when 256,000 registrations have been accomplished, and that the full capacity of 256,000 is achieved. The test is run for 1 hour.

Results: The SBC SWe can indeed support and maintain 256,000 registered endpoints.

Summary of Confirmed Results

Registration capacity	Re-register refresh time (sec)	Percent CPU utilization	Memory Used percent
256,000	**1800**	**11.65**	**54.37**

8 - DoS Tests and Results

The Ixia tester and application, IxLoad, was used to launch DoS attacks directly to the MAC and IP address, and UDP port, of the SIP signaling interface of the Ribbon SBC SWe on the virtualized HP server. In addition, to bypass simple defense mechanisms designed to blacklist attacking IP addresses, each DoS attack was sent from 100 unique IP addresses.

The DoS attacks were delivered at high volumes, while high volumes of calls were being handled by the Ribbon SBC SWe. During all the attacks, the SBC was maintaining 20,000 sessions with no impact on MOS nor was there any system degradation on available resources. This was done to see if any of the DoS attacks successfully impacted calls in progress. The DoS attacks consisted of 64-byte UDP packets.

SWe Performance with an ARP Flood DoS Attack – Long Duration

What's measured: The impact on Ribbon SBC SWe performance and calls in progress by an ARP Flood Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue an ARP Flood DoS attack, directed at the SIP signaling IP interface of the SBC SWe, to consume 52 percent of the inbound bandwidth of the server's 1-Gigabit/s network connection. The test is run for 15 hours.

Results: There were no calls dropped, of the 20,000 active calls, as a result of the ARP Flood DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**17.91**	**61.87**

SWe Performance with a Fragmented ICMP DoS Attack

What's measured: The impact on SBC SWe performance and calls in progress by a Fragmented ICMP Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue a Fragmented ICMP DoS attack, directed at the SIP signaling IP interface of the SBC SWe, at a rate of 42,961 frames per second. The test is run for 30 minutes.

Results: There were no calls dropped, of the 20,000 active calls as a result of the Fragmented ICMP DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**11.46**	**60.93**

SWe Performance with a Ping of Death DoS Attack

What's measured: The impact on Ribbon SBC SWe performance and calls in progress by a Ping of Death Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue a Ping of Death DoS attack, directed at the SIP signaling IP interface of the SBC SWe, at a rate of 42,961 frames per second. The test is run for 30 minutes.

Results: There were no calls dropped, of the 20,000 active calls, as a result of the "Ping of Death" DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**17.04**	**60.93**

SWe Performance with a Fragmented IP DoS Attack

What's measured: The impact on SBC SWe performance and calls in progress by a Fragmented IP Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue a Fragmented IP DoS attack, directed at the SIP signaling IP interface of the SBC SWe, at a rate of 42,961 frames per second. The test is run for 30 minutes.

Results: There were no calls dropped, of the 20,000 active calls, as a result of the Fragmented IP DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**18.0**	**60.93**

SWe Performance with a SYN Flood DoS Attack

What's measured: The impact on Ribbon SBC SWe performance and calls in progress by a SYN Flood Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue a SYN Flood DoS attack, directed at the SIP signaling IP interface of the SBC SWe, at a rate of 42,600 frames per second. The test is run for one hour.

Results: There were no calls dropped, of the 20,000 active calls, as a result of the SYN Flood DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**15.07**	**60.0**

SWe Performance with a UDP Flood DoS Attack – Long Duration

What's measured: The impact on SBC SWe performance and calls in progress by a UDP Flood Denial-of-Service attack directed at the SIP signaling interface of the SWe.

Test set-up: Calls are all G.729AB pass-through, with 20 ms packetization. The Ixia test system is set to issue a UDP Flood DoS attack, directed at the SIP signaling IP interface of the SBC SWe, at a rate of 42,690 frames per second. The test was run for 15 hours.

Results: There were no calls dropped, of the 20,000 active calls as a result of the UDP Flood DoS attack. MOS call-quality scores remained high and there was no other discernible impact on the operations or performance of the SBC SWe.

Summary of Confirmed Results

Sessions sustained	Active calls dropped	Average MOS	Percent CPU utilization	Memory Used percent
20,000	**0**	**4.1**	**15.73**	**60.62**

9 - About Miercom

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