**Metaswitch Perimeta SBC achieves over 2,300 cps handling capability.**

**Key findings and conclusions:**

- Perimeta software maintained a call rate of over 2,000 calls per second (cps). It also supported 1.4 million concurrent signaling sessions and 50,000 concurrent media sessions on a 1U COTS server.
- Perimeta successfully processed over 54 million calls at a rate of 1,000 cps during a 15-hour DoS attack without dropping any calls.
- In a registration burst test, Perimeta successfully registered more than 1 million endpoints in 6 minutes at a rate of 3,000 registrations per second (rps) while simultaneously processing calls at 1,000 cps.
- Perimeta is scalable – can handle up to 4 million concurrent subscriber registrations depending on hardware capacity.
- While overloaded with 4,000 cps, Perimeta successfully processed calls at a rate of 2,034 cps.

Metaswitch engaged Miercom for an evaluation of the Perimeta Session Border Controller (SBC) for performance, scalability, reliability and security in various usage scenarios and deployment modes. The Perimeta SBC serves as an interconnection point between wireless or wireline peering carriers (Interconnect SBC or I-SBC) or between a carrier’s core infrastructure and the access network (Access SBC or A-SBC). It can be deployed in a next-generation network (NGN) or an IP Multimedia Subsystem (IMS), including VoLTE, IPX and RCS deployments.

The primary functionality of the Perimeta SBC includes security, traffic management and accessibility. Its security functions include network perimeter defense (blacklisting and rate limiting), topology hiding and privacy. Traffic management functions include overload protection and adaptive QoS. Accessibility functions include NAT traversal and protocol repairing.

Perimeta is the first carrier-class SBC tested by Miercom that runs on Commercial Off-the-Shelf (COTS) servers.

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**Figure 1: Metaswitch Perimeta SBC Call Overload Performance in ISC Configuration**

*Source: Miercom, May 2013*
Miercom testing focused on performance, scalability, capacity and security of various deployment models of the Perimeta SBC. It covered both the I-SBC and A-SBC usage scenarios. Specifically, the Perimeta SBC was tested for:

- System throughput — including calls, subscriber registrations and notifications — for SIP traffic
- System capacity for simultaneously active calls, registrations and media sessions
- System high availability (HA) and resilience of operation under overload, various kinds of security attacks and other adverse network conditions

The Perimeta SBC, featuring a software-centric design, runs on general-purpose hardware, including COTS servers and the Metaswitch ATCA appliance. The Perimeta SBC architecture consists of distinct and independently scalable signaling and media processing software elements that can be integrated, co-located or geographically distributed depending on the scale and the topology of the network.

The Perimeta architecture has two distinct components: a Signaling Session Controller (SSC) and a Media Session Controller (MSC), allowing for independent scaling of signaling and media control. Built for distributed operation, the SSC and MSC may be either co-located or geographically dispersed around the network. Combining both SSC and MSC functionality on discrete processor instances, the Perimeta Integrated Session Controller (ISC) provides a consolidated solution for smaller deployments.

The Perimeta SBC was tested in a HA configuration on a pair of Dell R620 servers (64 GB RAM and 2 CPUs 2.9GHz with 16 physical cores) as well as on dedicated Metaswitch ATCA hardware servers functioning in a high-availability 1:1 server pair. The Test Bed Diagram on page 6 shows a high-level view of the test environment — the different tools used, along with the various deployments of Perimeta SBC that were tested.

### Registration Performance

The Perimeta SBC in an A-SBC role is the proxy to the registrar in a SIP network. The SBC is responsible for accepting and maintaining subscriber registrations. The test results of subscriber registration traffic throughput and registration session capacity are summarized in the following subsections.

![Figure 2: Perimeta SBC - Authenticated and Unauthenticated Registrations](source)

**Perimeta SBC subjected to authenticated and unauthenticated subscriber registrations.**

**Registration Throughput**

Three different configurations of the Perimeta SBC were tested for subscriber registration traffic throughput for authenticated and unauthenticated SIP registration requests. Results are shown in the diagram above.

*Table 1* summarizes the test results for various Perimeta platform types. Overall, the system showed high throughput with extremely low latency in response times when handling subscriber registrations.

<table>
<thead>
<tr>
<th>Perimeta Platform Type</th>
<th>Authenticated Regs/Sec</th>
<th>Unauthenticated Regs/Sec</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC COTS</td>
<td>2,800</td>
<td>4,500</td>
</tr>
<tr>
<td>ISC ATCA</td>
<td>950</td>
<td>1,900</td>
</tr>
<tr>
<td>SSC+MSC ATCA</td>
<td>2,000</td>
<td>4,000</td>
</tr>
</tbody>
</table>

Performance for authenticated and unauthenticated registrations on different platforms.

**Registration Capacity and Longevity**

The Perimeta SBC was tested for the number of simultaneous subscriber registration entries the system can hold and maintain successfully over a period of time. The duration of this test was chosen to be long enough so that the system experienced multiple registration refresh cycles.

Notably, in a COTS ISC configuration, Perimeta demonstrated the ability to accept 4 million simultaneously registered subscribers in a longevity...
test that last several hours. Subscribers were accepted and authenticated at a sustained rate of 2,200 rps with refresh occurring every 30 minutes. Table 2 summarizes registration capacities for various Perimeta platform types.

**Table 2: Perimeta Registration Capacity**

<table>
<thead>
<tr>
<th>Perimeta Platform Type</th>
<th>No. of Simulated Regs</th>
<th>Registration Refresh</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC COTS</td>
<td>4,000,000</td>
<td>30 min</td>
</tr>
<tr>
<td>ISC ATCA</td>
<td>200,000</td>
<td>30 min</td>
</tr>
<tr>
<td>SSC+MSC ATCA</td>
<td>1,600,000</td>
<td>30 min</td>
</tr>
</tbody>
</table>

Perimeta registration capacity with refresh rates on different platforms and configuration options.

**Registration Storm**

To investigate Perimeta performance in a realistic stress scenario, Miercom simulated a registration storm after a power outage with 1 million phones coming back online at once and registering with Perimeta. This is a critical test to verify 99.999% reliability. Poor performance in this test could mean a considerable service outage due to circumstances outside the operator’s control.

Perimeta demonstrated exceptional performance. Perimeta took 6 minutes to re-register 1 million subscribers, while processing calls at a constant load of 1,000 cps. This is equivalent to approximately 18,000 SIP messages per second passing through Perimeta.

**Fast Registrations**

The A-SBC deployments of Perimeta typically involve NAT traversal to establish and maintain IP connections when the SBC is subjected to a high volume of registration refresh traffic. The access network's SIP end points rely on frequent registration refreshes (for example, at 30-second intervals) to keep the intermediary NAT pinholes open. The Perimeta was able to successfully handle 1 million registered subscribers while refreshing every 30 seconds.

This is a common topology in real-life access networks. To be a credible choice for a real-life deployment, the SBC must have great support for this topology. Perimeta’s ability to support 1 million subscribers demonstrates that it has been engineered with an operator’s deployment plans in mind.

**Call Performance**

Different hardware configurations of the Perimeta SBC were subjected to various I-SBC and A-SBC call scenarios in a test environment. The following subsections summarize the various call handling performance results.

**Standard SIP Call Performance**

A standard point-to-point SIP call involves seven SIP messages per call leg (a total of 14 SIP messages if both the legs of a SIP B2BUA call are counted) as shown in Figure 3.

![Figure 3: Perimeta SBC Handling Standard SIP Call Flow](source: Miercom, May 2013)

Perimeta SBC handling a standard SIP call flow with seven SIP messages per call leg.

**Table 3: Perimeta Throughput Performance**

<table>
<thead>
<tr>
<th>Platform</th>
<th>Peak Call Rate Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>ATCA ISC</td>
<td>529 calls/second</td>
</tr>
<tr>
<td>ATCA SSC+MSC</td>
<td>1,413 calls/second</td>
</tr>
<tr>
<td>COTS ISC</td>
<td>2,399 calls/second</td>
</tr>
</tbody>
</table>

The Perimeta software running on COTS servers was able to support in excess of 2,000 CPS using this profile.

To test system capacity, the scripts were adjusted so that calls were kept active indefinitely. Results showed that the Perimeta software on COTS servers sustained 1.4 million signaling sessions concurrently.

**Standard SIP Call Overload Performance**

The Perimeta SBC was subjected to a call overload test in which SIP call traffic rates higher than specified capacity were progressively injected into
the system. The graph in Figure 4 shows Perimeta’s gradual tail-off saturation curve. Offered call rates are compared with the successfully handled call rates on various hardware platforms, including COTS-based ISC and ATCA-based ISC.

It is important to note that the Perimeta successfully sustained its rated call-handling throughput even when it was subjected to significant overload conditions. This ability of Perimeta to sustain rated call loads even in an overload state is unusual and allows operators to rely on that level of throughput even in extreme circumstances.

IMS/VoLTE SIP Call Performance

A typical IMS/VoLTE call flow involves 20 SIP messages per call as shown in Figure 5. The Perimeta SBC running as an ISC on COTS hardware demonstrated its linearity by successfully handling IMS/VoLTE calls at 750 cps. Increasing the messages per call has a proportional impact on the cps that can be supported. Linearity is highly useful for traffic engineering planning.

Fragmented SIP INVITE Call-Handling Performance

In the fragmented SIP INVITE test, the size of the SIP message (including the SDP payload) was made large enough so that the INVITE messages were fragmented in the network. The size was typically larger than the network MTU. When subjected to fragmented packets, the Perimeta SBC is responsible for assembling them to construct full SIP messages for further processing. The fact that the Perimeta SBC demonstrated the ability to successfully handle 1,500 CPS when subjected to fragmented SIP INVITEs is

Metaswitch Perimeta software solution and appliance cps handling capability.
noteworthy. Thus, Metaswitch has addressed a traditional issue for SBCs -- the inability to support a high rate of fragmented packets, which can create a potential Denial of Service (DoS) attack vector against a VoIP network.

**Security Testing**

The Perimeta SBC was also subjected to a variety of DoS and DDoS (Distributed Denial of Service) attacks while simultaneously handling normal traffic. As shown in the Security Test Bed Diagram on page 6, the Perimeta was subjected to the following security attacks – spurious invites, ICMP echo packets, junk UDP messages and IP fragment overruns and overlaps, handling loads of up to 849 megabits per second.

The Perimeta SBC demonstrated high resilience against all four security attacks by successfully handling 100% of calls at 1,000 cps.

**Media Capacity and QoS Performance**

The media-handling capacity and QoS performance of the Perimeta ISC were measured using the EXFO QA-604 test tool. As shown in Figure 6, a single SIP/RTP call from EXFO was spiraled 4 times through the Perimeta, thereby quadrupling the media load. The Perimeta successfully handled 50,000 simultaneous G.729 calls with end-to-end media packet loss of, at most, 0.001%.

During the test, the Perimeta SBC had no measurable detrimental effect on the voice quality of the media streams.

The test results verify that the Perimeta SBC has a negligible impact on the media quality since it introduces negligible packet loss or delay into the media stream. Table 4 summarizes the call capacity of various Perimeta configurations.

**Table 4: Perimeta SIP Call Capacity**

<table>
<thead>
<tr>
<th>Perimeta Platform Type</th>
<th>Active Calls</th>
<th>Failed Calls</th>
</tr>
</thead>
<tbody>
<tr>
<td>ISC COTS</td>
<td>50,000</td>
<td>0</td>
</tr>
<tr>
<td>ISC ATCA</td>
<td>15,000</td>
<td>0</td>
</tr>
<tr>
<td>SSC+MSC ATCA</td>
<td>16,000</td>
<td>0</td>
</tr>
</tbody>
</table>

**SIP Message Manipulation Performance**

The Perimeta SBC -- via its Protocol Repairing functionality -- is capable of manipulating SIP headers as SIP call messages are processed. In a test involving SIP call message manipulation, the SBC was configured with the following rules:

- Delete a P-Unused-Header field (a header present in all SIP messages in the test)
- Delete a P-Not-Present field (a header absent in all SIP messages in the test)
- Add a P-Added-Header field with a dummy value
- Replace the value of a P-Replace-Me header with a dummy value
- Replace the value of a P-Also-Replace-Me header with a dummy value

With these manipulation rules in place, the Perimeta SBC did not exhibit any marked difference in normal SIP call-processing performance and successfully handled 2,000 cps. This is a critical result due to the role the SBC plays in normalizing different SIP flows at the edge of the network. Traditionally, SBCs have taken a significant mainline performance hit when performing message manipulation. The Perimeta demonstrated no mainline performance drop, indicating that it is flexible to specific deployment requirements of an operator.

**Bottom Line**

The Metaswitch Perimeta – either as software running on COTS servers or as a complete hardware appliance – offers exceptional scalability, performance and security for service-provider and carrier-class SBC applications.

It maintained resilience and superior performance in two high-duress scenarios, prolonged DoS attack load and when pushed to the limit for call handling and concurrent call load.

Perimeta software running on either COTS servers or as a complete hardware appliance compared well with competitive SBC products Miercom has tested. It achieved higher capacity in many metrics and met performance levels in others.
How We Did It

The Metaswitch Perimeta Session Border Controller was evaluated for performance and security as well as its special features and capabilities. Testing focused on the call capacity, call rate, registration capacity and registration rate. The testing environment included DoS and DDoS to determine the SBC’s effectiveness in thwarting such attacks. Testing was conducted on Perimeta Version 3.4 running on Commercial Off-The-Shelf (COTS) servers and on Version 3.3 running on the Metaswitch Perimeta ATCA appliance.

SIPp, Scapy and Mausezahn are open source tools. Each can be downloaded for free from its Website.

SIPp is a call load-generator tool that is installed onto a server. The SIPp test script can be configured to perform many different types of SIP call traffic. SIPp was used to test the Perimeta’s call capacity and call rate. SIPp was also specifically configured to send INVITE DoS to the Perimeta SBC.

Scapy and Mausezahn also were used in the DoS attacks and message manipulations tests. Scapy is an open-source tool that can interactively manipulate packets. Scapy was used to send fragmented SIP packets out-of-order through the Perimeta to test whether or not the Perimeta could reorder the fragments and reassemble the packets correctly. Scapy attempts to stress the SBC and helps verify the effectiveness of the Perimeta at processing calls while under attack.

Mausezahn generates network traffic load to test network devices for performance and security. Specifically, Mausezahn was used for all DoS and DDoS attacks to determine whether the Perimeta SBC could sustain high levels of INVITE, REGISTERS, ICMP messages and UDP packets.

The EXFO QA-604 VoIP and IMS test tool was used to load SIP media traffic through the Perimeta SBC on COTS and Metaswitch ATCA hardware. The entry level, 2U rack mounted, QA-604 platform provides scalability, stress and emulation performance of more than 2 million IMS subscribers or 1 million subscribers with 128K RTP streams.

The tests in this report are intended to be reproducible for current or prospective customers who wish to recreate them with the appropriate test and measurement equipment. Current or prospective customers interested in repeating these results may contact reviews@miercom.com for details on the configurations applied to the Device Under Test and test tools used in this evaluation. Miercom recommends that current and prospective customers conduct their own needs analysis study and test specifically for the expected environment for product deployment before making a product selection.
Miercom Performance Verified

We are very pleased to present Metaswitch with the Miercom Performance Verified Certification for the Perimeta SBC. Metaswitch Perimeta SBC products demonstrated truly exceptional call-processing performance and capacity based on Miercom hands-on testing validation. Both the hardware and software SBC solutions achieved high call-handling rates and remained stable even while subjected to a wide range of aggressive and realistic DoS and DDoS attacks.

The software solution performed admirably in performance, security and failover tests while running on Dell R620 Commercial Off-The-Shelf servers and the Metaswitch ATCA appliance all-in-one solution.

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Miercom has hundreds of product-comparison analyses published over the years in leading network trade periodicals including Network World, Business Communications Review, Tech Web - NoJitter, Communications News, xchange, Internet Telephony and other leading publications. Miercom’s reputation as the leading, independent product test center is unquestioned.

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