Ericsson Virtual Session Border Controller (vSBC)

Performance Validation

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1.0 Executive Summary

Ericsson engaged Miercom to independently test its virtualized Session Border Controller (vSBC) for performance with different traffic profiles. Testing consisted of SIP handling for virtualized Session Border Gateway (vSBG) and the RTP user plane handling for the virtualized Border Gateway Function (vBGF).

The Ericsson vSBC is a comprehensive solution for real-time voice and video 3GPP IP multimedia services. Its virtual infrastructure for flexible deployment as well as increased speed and efficiency.

This report details performance validation results using real-world network parameters.

Key findings:

- **Supports up to 2.3 million TLS registrations and over 369,000 TLS sessions per VM**
- **Maintains over 24,000 VoLTE sessions at 1,560 sessions per second per VM**
- **Handles 45,200 concurrent G.711 RTP media sessions per HP server with MOS-CQO 4.50 (NB) and 3.22 (SWB) measured audio quality**
- **Handles 60,700 concurrent AMR-NB RTP media sessions per HP server with MOS-CQO 4.43 (NB) and 3.05 (SWB) measured audio quality**
- **Sustains 15,700 concurrent encrypted AMR-NB sessions using a single VM, at 175 sessions per second with MOS-CQO 4.42 (NB) and 3.03 (SWB) measured audio quality**
- **Transcodes up to 8,780 concurrent sessions for G.729 to G.711 media codecs; 4,900 sessions for AMR-WB to G.711; 8,110 sessions for AMR-NB to G.711; and 1,525 sessions for EVS to AMR-NB per HP server**

Based on results of our testing, the Ericsson Virtual Session Border Controller (vSBC) fully supports virtualized network functions to enhance signaling and media communications. The observed performance was impressive and highly scalable, earning the ***Miercom Performance Verified*** certification.

Robert Smithers

CEO

Miercom

2.0 Test Summary

5.1 Signaling	
TLS *Registration capacity: 2.3 million subscriptions* *Registration rate: 2,450 registrations per second (rps)* *Session capacity: 369,410 sessions* *Session rate: 1,400 sessions per second (sps) per 1 VM and 2,800 sps per 2 VMs; 22 vCPU each*	**VoLTE** *Registration rate: 3,100 rps* *Session capacity: 24,000 sessions* *Session rate: 1,560 sps*
5.2 Media	
AMR-NB (per 1 vBGF VM) *Maximum session rate: 454 sps*	**AMR-NB RTP (per 1 vBGF VM)** *Session rate: 177 sps* *Session capacity: 15,700 concurrent sessions* *Packet loss probability (P_{PL}): 0.0000%* *MOS-CQO (NB): 4.44*
G.711 RTP (4 VMs, per HP server) *Session capacity: 45,200 concurrent sessions* *P_{PL}: 0.0006%* *MOS-CQO (NB): 4.50*	**G.711 RTP (per 1 vBGF VM)** *Session capacity: 14,700 concurrent sessions* *P_{PL}: 0.0198%* *MOS-CQO (NB): 4.50*
AMR-NB RTP (4 VMs, per HP server) *Session capacity: 60,700 concurrent sessions* *Forwarding rate: 4.3 Mpps, 8.6 Mpps for Rx-Tx* *Throughput: 3.05 Gbps* *P_{PL}: 0.0008%* *MOS-CQO (NB): 4.43*	**AMR-NB SDES-SRTP (per 1 vBGF VM)** *Session rate: 175 sps* *Session capacity: 15,700 concurrent sessions* *P_{PL}: 0.0873%* *MOS-CQO (NB): 4.42*
5.3 Transcoding	
G.729 to G.711 (6 VMs, per HP server) *Session capacity: 8,780 concurrent sessions* *P_{PL}: 0.0294%* *MOS-CQO (NB): 4.14*	**AMR-WB to G.711 (4 VMs, per HP server)** *Session capacity: 4,900 concurrent sessions* *P_{PL}: 0.0369%* *MOS-CQO (SWB): 3.00*
AMR-NB to G.711 (6 VMs, per HP server) *Session capacity: 8,110 concurrent sessions* *P_{PL}: 0.0366%* *MOS-CQO (NB): 4.29*	**EVS to AMR-NB (4 VMs, per HP server)** *Session capacity: 1,525 concurrent sessions* *P_{PL}: 0.0075%* *MOS-CQO (SWB): 2.84*

Notes:

- *With more vCPU allocated, higher performance values were achieved*
- *Packet Loss Probability (P_{PL}): percentage of measured number of lost packets and packets delayed by more than one millisecond*
- *Mean Opinion Score (MOS) Objective Conversational Quality (CQO): audio quality calculated according to ITU-T G.107*

3.0 Product Overview

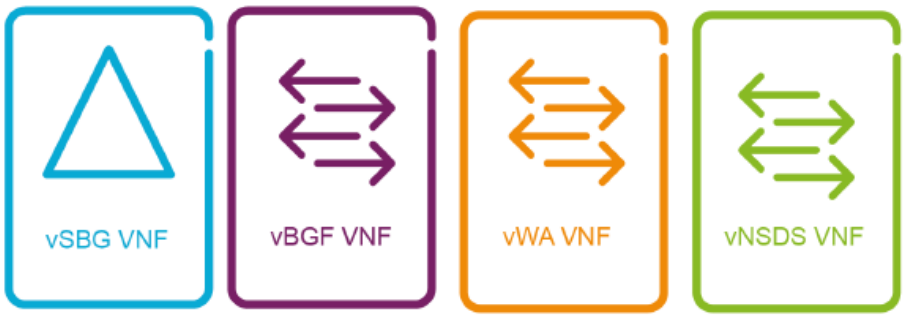
The Ericsson Virtual Session Border Controller (vSBC) handles virtualized communications for commercial networks. It offers SIP trunking and handling of Voice over LTE (VoLTE), Voice over Wi-Fi (VoWiFi), Video over LTE (ViLTE), Rich Communication Services (RCS), Interconnect Fixed VoIP, and Web communication solutions.

This comprehensive solution consists of four components, or Virtual Network Functions (VNFs):

- Virtual Session Border Gateway (vSBG)
- Virtual Border Gateway Function (vBGF)
- Virtual Web Access (vWA)
- Virtual Non-SIM Device Server (vNSDS)

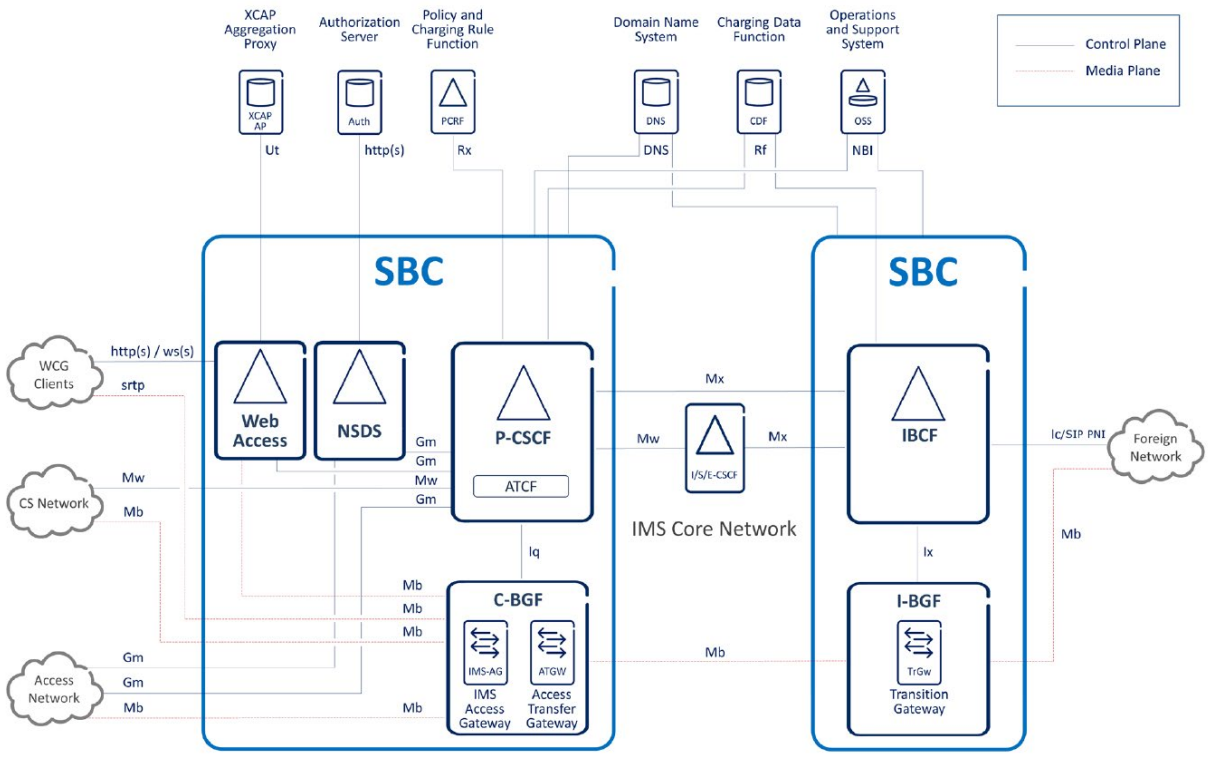
These products are deployable in any environment using virtual cloud infrastructures such as OpenStack or VMware. VNFs allow for easy network adaption, flexibility, speed and efficiency in accordance with 3GPP IP multimedia service. The vSBG provides 1+1 (active/standby VM) redundancy for signal handling; the vBGF provides N+1 (N active/1 standby VM) for user plan handling.

Figure 1: Ericsson vSBC VNF Components



Source: Ericsson

Figure 2: Ericsson vSBC Overview



The Ericsson vSBC communicates between the access (untrusted) and core (trusted) networks. When the client is successfully registered, the call is processed and connected between the access and core networks.

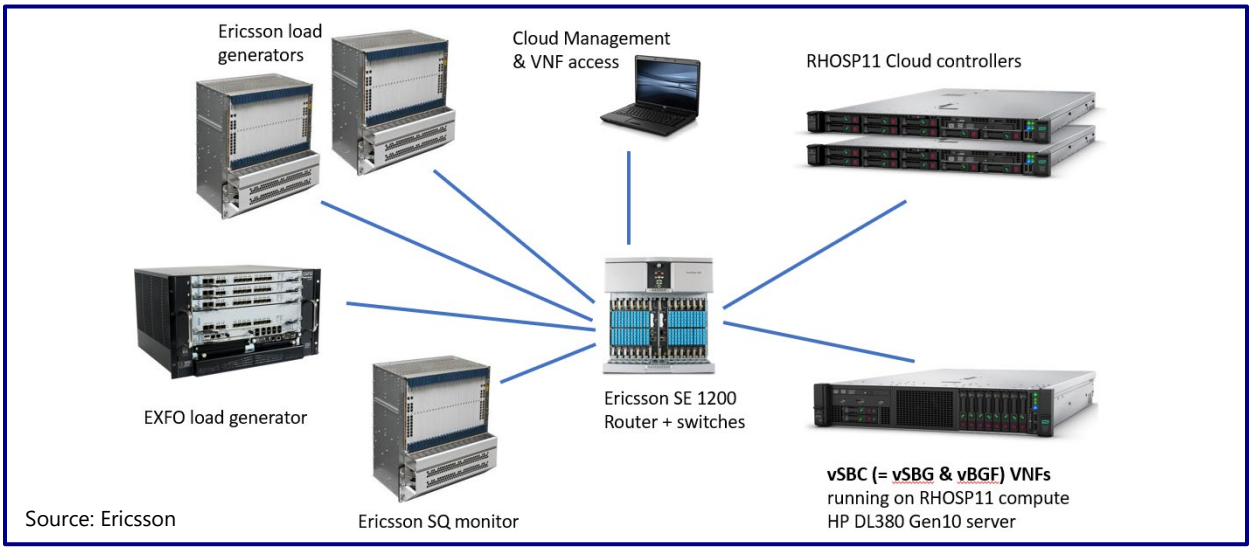
4.0 How We Did It

Cloud Infrastructure Setup

Performance testing was done for each VNF (vSBG and vBGF) separately in two, Miercom approved, test environments. The first environment evaluated the vSBG signaling-only performance using the EXFO call generator and network analytics tool. The second environment assessed the vBGF media performance with the call generator and measurement tool.

Compute Host Configuration Table	
Server	HPE DL380 Gen10
CPU	2 x Intel Xeon Platinum 8168 CPU @2.7 GHz (24 cores) Total 48 cores Total 96 cores with Hyper Threading (HT)
RAM	DDR4, 2666 MHz, 512 GB
Network	Intel Corporation 82599ES 10-Gigabit SFI/SFP+ Network Connection Adapter 3 – HP Ethernet 10 GbE 2-port 560SFP+
Storage	Integrated MU SSD 2x 400 GB 12 Gbps SAS HPE Smart Array P408i-a SR Gen10
Cloud Computing Platform	RedHat OpenStack Platform v11

Test Environment



Source: Ericsson

Test Tools

- Ericsson internal call generation and measurement test tool
- EXFO (version SR1712.2) call generation tool, handling 3GPP SIP loads, including SIP with TLS and IPSec (IMS-AKA)

Traffic Profiles

Different traffic profiles were used to represent a real-world network environment:

Traffic Type	Description
SIP secured by TLS	• Registrations with optimized SIP digest authentication (MD5 or SHA1): REGISTER, 401 Unauth., REGISTER, 200 OK • 7 message SIP calls – Sessions with: INVITE, 100 Trying, 180 Ringing, 200 OK, ACK, BYE, 200 OK • H.248 message request (2x commands): Add request/reply, 2x Modify request/reply, Subtract request/reply • Signaling parameters: TLS, IPv4, TCP, no Rx/Rf signaling • Media parameters: RTP (& SRTP), IPv4, media agnostic (e.g. G.711) / transcoding (e.g. G.711 - G.729)
VoLTE secured by IMS-AKA	• Registrations with optimized SIP digest authentication (MD5 or SHA1): REGISTER, 401 Unauth., REGISTER, 200 OK • 12 message media calls – Sessions with: INVITE, 100 Trying, 183 Session Progress, PRACK, 200 OK, 180 Ringing, PRACK, 200 OK, 200 OK (INVITE), ACK, BYE, 200 OK • H.248 message request (2x commands): Add request/reply, 4x Modify request/reply, Subtract request/reply • Signaling parameters: IPSec, IPv4, UDP, no Rx/Rf signaling, no SIP QoS preconditions • Media parameters: RTP, IPv4, media agnostic (e.g. AMR-WB, EVS) / transcoding (e.g. G.711 - AMR-NB)

In a standard call, one call per session is managed on the originating SBC to connect the calling party to the network. One call per session is managed on the terminating SBC to connect the network to the called party.

During the tests, the Ericsson vSBC, or Device Under Test (DUT), managed both calling and called sides emulated by the load generator. Therefore, the vSBC handled two calls total; one call per session connected the calling party to the network and another call per session connected the network to the called party.

5.0 Performance Testing

Our SBC performance assessment determine capacity, rate, resource usage, and in some cases packet loss, forwarding rate and throughput for signaling, media and transcoding scenarios.

5.1 Signaling performance

The vSBG handled signal handling using one blade made of two processors with 24 cores each. Each core consisted of two virtualized Central Processing Units (vCPUs), for a total of 96 vCPUs per blade. Of the available cores, 36 vCPU Virtual Machines (VMs) were created for Active handling and another 36 vCPU VMs were created for Standby.

5.1.1 Maximum TLS Registration Capacity

Increasing numbers of registrations were generated using MD5 authentication over TLS. We determined the maximum registration capacity that the vSBG VM can successfully handle. Resource usage was also recorded.

Setup: 1 VM (36 vCPU Hyper Threaded (HT), 120 GB RAM)	
Maximum registration capacity	2,300,000 subscriptions
Maximum registration rate	1,900 rps
CPU usage	43%
Memory usage	51% or 61.2 GB

5.1.2 Maximum TLS Registration Rate

An increasing registration rate was generated using MD5 authentication over TLS. The maximum registration rate that the vSBG VM can successfully handle and resource usage were recorded.

Setup: 1 VM (36 vCPU HT, 120 GB RAM)	
Maximum registrations rate	2,450 rps
CPU usage	63%
Memory usage	16% or 19.2 GB

5.1.3 Maximum VoLTE IMS-AKA registrations

Increasing numbers of VoLTE IMS-AKA registrations were generated. We verified the maximum registration rate that the vSBG VM can successfully handle. Resource usage was also recorded.

Setup: 1 VM (36 vCPU HT, 120 GB RAM)	
Maximum registration rate	3,100 rps
CPU usage	70%
Memory usage	10% or 12 GB

5.1.4 Maximum TLS Session Capacity

Increasing numbers of sessions were generated using MD5 authentication over TLS. We determined the maximum registration capacity that the vSBG VM can successfully handle. Resource usage was also recorded.

Setup: 1 VM (36 vCPU HT, 120 GB RAM), 380,000 subscriptions @ 1,100 session rate	
Maximum session capacity	369,410 sessions
CPU usage	38%
Memory usage	54% or 64.8 GB

5.1.5 Maximum TLS Session Rate

An increasing session rate was generated using MD5 authentication over TLS. Using two different setups, the maximum session rate that the vSBG VM can successfully handle and resource usage were recorded. The maximum session rate was recorded for TLS per HP server.

Setup 1: 1 VM (36 vCPU HT, 120 GB RAM)	
Maximum session rate	2,240 sessions per second
CPU usage	99%
Memory usage	4% or 5 GB

Setup 2: 1 VM (22 vCPU HT, 120 GB RAM)	
Maximum session rate	1,400 sessions per second
CPU usage	99%
Memory usage	2.8% or 3.36 GB
Setup 3: 2 VM pairs (each 22 vCPU HT, 120 GB RAM); 1 pair Active, 1 pair Standby	
Maximum session rate	2,800 sessions per second

5.1.6 Maximum VoLTE IMS-AKA Session Rate

An increasing session rate was generated for VoLTE IMS-AKA. We verified the maximum session rate and capacity that the vSBG VM can successfully handle. Resource usage was also recorded.

Setup: 1 VM (36 vCPU HT, 120 GB RAM)	
Maximum session capacity	24,000 subscriptions
Maximum session rate	1,560 sessions per second
CPU usage	97%
Memory usage	3.5% or 4.2 GB

5.2 Media performance

The vBGF handled media handling using one blade made of two processors with 24 cores each. Each core was consisted of two vCPUs, for a total of 96 vCPUs per blade. The number of vCPUs per VM and the number of VMs differed for each test case.

5.2.1 Maximum AMR-NB Session Rate

Increasing numbers of AMR-NB sessions were generated. We determined the maximum session rate that the vBGF VM can successfully handle. Resource usage was also recorded.

Setup: 1 VM (6 vCPU non-HT, 6 GB RAM)	
Maximum session rate	454 sessions per second
CPU usage	82%
Memory usage	75% or 4.5 GB

5.2.2 Maximum AMR-NB RTP Session Capacity

Increasing numbers of AMR-NB RTP sessions were generated. We verified the maximum capacity that the vBGF VM can successfully handle. Session rate, resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 1 VM (6 vCPU, 6 GB RAM)	
Maximum session capacity	15,700 concurrent sessions
Session rate	177 sessions per second
CPU usage	41%
Memory usage	75% or 4.5 GB
Packet Loss Probability	0.0000%
MOS-CQO (measured/maximum)	4.44 (NB) / 4.44 (NB) 3.06 (SWB) / 3.06 (SWB)

5.2.3 Maximum G.711 RTP Session Capacity per HP Server

Increasing numbers of G.711 RTP sessions were generated. We verified the maximum capacity that the vBGF VM can successfully handle. Session rate, forwarding rate, throughput, resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 4 VMs (4x8 vCPU, 6 GB RAM) OVS (12 vCPU HT, 8 on socket 0, 4 on socket 1)	
Maximum session capacity	45,200 concurrent sessions
Session rate	768 sessions per second
Forwarding rate	4.4 Mpps, 8.8 Mpps for Rx-Tx
Throughput	7.7 Gbps
CPU usage	41%
Memory usage	54% or 3.2 GB
Packet Loss Probability	0.0006%
MOS-CQO (measured/maximum)	4.50 (NB) / 4.50 (NB) 3.22 (SWB) / 3.22 (SWB)

5.2.4 Maximum G.711 RTP Session Capacity for Single vBGF VM

Increasing numbers of G.711 RTP sessions were generated. We verified the maximum capacity that the vBGF VM can successfully handle. Session rate, resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 1 VM (6 vCPU, 6 GB RAM)	
Maximum session capacity	14,700 concurrent sessions
Session rate	164 sessions per second
CPU usage	26%
Memory usage	70% or 4.2 GB
Packet Loss Probability	0.0198%
MOS-CQO (measured/maximum)	4.50 (NB) / 4.50 (NB) 3.21 (SWB) / 3.22 (SWB)

5.2.5 Maximum AMR-NB RTP Session Capacity per HP Server

Increasing numbers of AMR-NB RTP sessions were generated. We verified the maximum capacity that the vBGF VM can successfully handle. Session rate, forwarding rate, throughput, resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 4 VMs (4x8 vCPU, 6 GB RAM); OVS (12 vCPU HT, 8 on socket 0, 4 on socket 1)	
Maximum session capacity	60,700 concurrent sessions
Session rate	678 sessions per second
Forwarding rate	4.3 Mpps, 8.6 Mpps for Rx-Tx
Throughput	3.05 Gbps
CPU usage	57%
Memory usage	69% or 4.1 GB
Packet Loss Probability	0.0008%
MOS-CQO (measured/maximum)	4.43 (NB) / 4.44 (NB) 3.05 (SWB) / 3.06 (SWB)

5.2.6 Maximum AMR-NB SRTP Session Rate for Single vBGF VM

Increasing numbers of AMR-NB RTP sessions were generated on the core side and AMR-NB SRTP sessions were generated on the access side. We verified the maximum session rate and session capacity that the vBGF VM can successfully handle. Resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 1 VM (8 vCPU, 6 GB RAM)	
Maximum session rate	175 sessions per second
Maximum session capacity	15,700 concurrent sessions
Session rate	175 sessions per second
CPU usage	78%
Memory usage	49% or 2.9 GB
Packet Loss Probability	0.0873%
MOS-CQO (measured/maximum)	4.42 (NB) / 4.44 (NB) 3.03 (SWB) / 3.06 (SWB)

5.3 Transcoding Media

Transcoding converts codecs of different voice media streams to allow compatibility between calls. Examples include: adding VoLTE access to existing IMS networks with broadband access, or SRVCC transfer where SDP is not compatible with the established VoLTE call.

The vBGF handled media transcoding using one blade made of two processors with 24 cores each. Each core was consisted of two vCPUs, for a total of 96 vCPUs per blade.

Transcoding is handled by the vBGF via the vSBG in accordance with 3GPP TS 24.229. The vSBG adds codecs to the SDP offer when forwarding it to the terminating client side. The following codecs are supported for transcoding: EVS, AMR, AMR-WB, G.722, G.711a, G.711μ and G.729.

5.3.1 Maximum G.729-G.711 Transcoding Sessions per HP Server

Increasing numbers of G.729 to G.711 sessions were generated and transcoded. We verified the maximum session capacity that the vBGF VM can successfully handle. Resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 6 VMs (6x14 vCPU HT, 6 GB RAM)	
Maximum session capacity	8,780 concurrent sessions
CPU usage	93%
Memory usage	38% or 2.3 GB
Packet Loss Probability	0.0294%
MOS-CQO (measured/maximum)	4.14 (NB) / 4.14 (NB) 2.68 (SWB) / 2.68 (SWB)

5.3.2 Maximum AMR-WB-G.711 Transcoding Sessions per HP Server

Increasing numbers of AMR-WB to G.711 sessions were generated and transcoded. We verified the maximum session capacity that the vBGF VM can successfully handle. Resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 4 VMs (4x22 vCPU HT, 6 GB RAM)	
Maximum session capacity	4,900 concurrent sessions
CPU usage	96%
Memory usage	38% or 2.3 GB
Packet Loss Probability	0.0369%
MOS-CQO (measured/maximum)	AMR-WB - G.711 3.00 (SWB) / 3.00 (SWB) G.711 - AMR-WB 2.81 (SWB) / 2.81 (SWB)

5.3.3 Maximum AMR-NB-G.711 Transcoding Sessions per HP Server

Increasing numbers of AMR-NB to G.711 sessions were generated and transcoded. We verified the maximum session capacity that the vBGF VM can successfully handle. Resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 6 VMs (6x14 vCPU HT, 6 GB RAM)	
Maximum session capacity	8,110 concurrent sessions
CPU usage	95%
Memory usage	38% or 2.3 GB
Packet Loss Probability	0.0366%
MOS-CQO (measured/maximum)	4.29 (NB) / 4.29 (NB) 2.84 (SWB) / 2.84 (SWB)

5.3.4 Maximum EVS-AMR-NB Transcoding Sessions per HP Server

Increasing numbers of EVS to AMR-NB sessions were generated and transcoded. We verified the maximum session capacity that the vBGF VM can successfully handle. Resource usage, packet loss probability and MOS-CQO were also recorded.

Setup: 4 VMs (4x22 vCPU HT, 6 GB RAM)	
Maximum session capacity	1,525 concurrent sessions
CPU usage	96%
Memory usage	36% or 2.2 GB
Packet Loss Probability	0.0075%
MOS-CQO (measured/maximum)	EVS - AMR-NB 2.84 (SWB) / 2.84 (SWB) AMR-NB - EVS 2.64 (SWB) / 2.64 (SWB)

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