THE TOLLY GROUP

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Borasys, Inc.

Smart CallGen SIP Version 2.03.116

Call Generator Performance and Functionality Evaluation

TOLLY Up to Spec CERTIFIED Test Summary

Premise: *The Session Initiation Protocol (SIP) is fast becoming the de facto call signaling technology for service providers and network operators to build their Voice over IP networks. Network managers and developers preparing to deploy and test SIP-based VoIP products need to know how those products will behave under variable loads. In such a case, test tools supporting SIP provide users with an effective, scalable means to verify product capabilities.*

BORASYS, Inc. commissioned The Tolly Group/Telecommunications Technology Association (TTA) to evaluate its Smart CallGen SIP, a SIP call generator/analyzer that generates and terminates calls based on the SIP protocol specification and provides additional functions including SIP packet monitoring/analysis and voice call-quality measurements.

Tolly Group engineers cooperated with TTA engineers to perform a battery of feature and performance tests to prove that Borasys Smart CallGen SIP provides an effective, multi-functional test solution to system operators and developers.

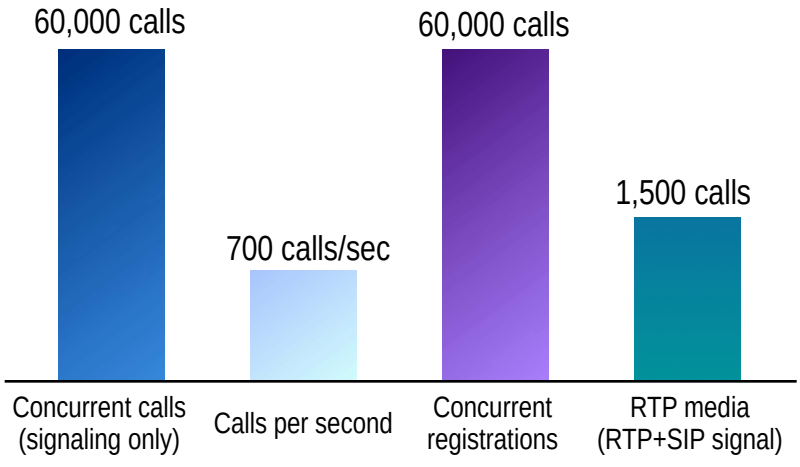
Testing was conducted in June 2007.

Test Highlights

- Generates and terminates simultaneously 1,500 media calls (RTP and SIP signaling) with G.723.1, G.729 and G.711 codecs
- Supports 60,000 concurrent channels of signaling and 60,000 concurrent SIP registration calls
- Generates and terminates 700 calls per second and sustains the rate
- Provides SIP functionality test solutions such as real-time SIP packet monitoring/analysis and configurable message generation
- Measures VoIP call quality including jitter, delay, packet loss, and provides estimated MOS scores using R-factor

Borasys Smart CallGen SIP Performance

as validated by Agilent SART IMS & TNA



Source: TTA/The Tolly Group, June 2007

Figure 1

Executive Summary

The Borasys Smart CallGen SIP delivers important testing functions to SIP-based product developers and users by supporting high-volume stress test and SIP functionality tests.

Voice over IP (VoIP) has become popular largely because of the cost advantage to consumers over traditional telephone networks. With the constant growth of the VoIP market, and the corresponding increase in demand for extra capacity on VoIP devices, VoIP test tool vendors now need to provide cost-effective, high performance and multi-functional VoIP testing solutions.

Tolly Group tests demonstrate that the Borasys Smart CallGen SIP is a user-friendly and high-performance VoIP test tool. Test results show that Smart CallGen SIP generates/terminates 1,500 RTP media calls with SIP signaling, establishes 60,000 concurrent channels of signaling and real-time SIP packet monitoring and analysis, which are all important to developers and network managers. (Smart CallGen SIP is referred to below as "Smart CallGen".)

Borasys Smart CallGen SIP Performance and Feature Validation	
Performance	Stress call test: 700 calls per second
	1,500 simultaneous RTP media calls
Scalability	60,000 concurrent bulk calls
	Max 60,000 terminal registrations
Voice call-quality measurement	Measure jitter, delay, loss, and E-model
Functionality	Real-time VoIP packet monitoring/analysis
	SIP protocol functionality
Note: Figure shows only features validated by The Tolly Group	

Source: TTA/The Tolly Group, June 2007 *Figure 2*

Performance

Engineers validated that the Smart CallGen generates and terminates 1,500 RTP media sessions simultaneously. These sessions include both RTP media and SIP signaling, which are common representations of VoIP traffic in the real world. Engineers also proved that Smart CallGen provides real-time packet monitoring and analysis for the calls at this rate.

Engineers measured the maximum rate of calls generated per second (CPS). In this test, the Smart CallGen proved it is capable of generating and terminating 700 calls per second (SIP signaling only) and maintained the rate for the test duration of 24 hours. The CPS rate indicates how well the VoIP products operate in a scenario where the number of incoming calls increase very rapidly and maintain the rate relatively long. Network managers always need to know the maximum receptive capacity of their systems and have control of the number of subscribers and concurrent calls with the reliable performance information so they can prepare for worst-cast scenarios.

Scalability

Results show that the Smart CallGen supports 60,000 channels of SIP signaling simultaneously. This performance proves that the Smart CallGen can test even high-end, SIP-based VoIP products.

Engineers also tested the number of subscribers to be simultaneously registered by users. The Smart CallGen proved that it supports up to 60,000 registrations simultaneously. This verified the robustness of the SIP servers under the large volume of registration request calls.

Functionality

Engineers verified that the Smart CallGen monitors and analyzes SIP-based packets in real time. Also, the Smart CallGen has SIP protocol test functions to emulate calls including RTP, SDP, etc. The SIP protocol test function is very useful for vendors to develop and test the VoIP products in a lab environment since this can test their conformance to the SIP specifications and guarantee the interoperability in the real VoIP networks.

Call Quality

In this test, engineers verified that the Smart CallGen provides VoIP call quality measurements such as

jitter, delay, packet loss and R-factor/E-model. The Smart CallGen converts R-factor into an estimated representation of MOS score. Engineers also verified that R-factor measured by Smart CallGen is consistent with the R-factor computed by the ITU-T R-factor simulation program.

Test Setup & Methodology

Tolly Group engineers tested the Borasys Smart CallGen SIP call generator running version 2.03.116.

Engineers used Empirix Hammer Protocol Analyzer ver 1.6.1.2 to analyze |inbound and outbound calls which were transmitted or received by the Smart CallGen, and used Agilent SART, TNA and DNA ver 5.30.100.013 to measure the performance and scalability. PacketStorm2600E ver 8.6v1 was used to emulate packet loss and delay.

For all tests, engineers first set up two Smart CallGen units. One generated calls and the other terminated the calls from the transmitter.

For the concurrent call performance test, engineers configured the Smart CallGen to generate 100 signaling calls per second and maintain the rate for 600 seconds so that it could ramp up to 60,000 concurrent calls at the end of test. Next, engineers used the Agilent SART to validate that the Smart CallGen established up to 60,000 channels of signaling simultaneously.

For the RTP media call test, engineers configured the Smart CallGen Tx to set up 1,500 RTP channels with G.723.1, G.729 and G.711 for 400 seconds. Then, engineers generated calls to the Smart CallGen Rx, and used the Agilent SART to verify that the Smart CallGen transmitted 1,500 RTP media calls.

For signal and registration functional test, engineers configured the Smart CallGen to run in concurrent 60,000 calls, 60,000 of registration terminals, 600 seconds of duration, 100 calls per second, 2 ms of registration interval and 240 seconds of registration cycle. Then, engineers attempted to transmit calls to the Smart CallGen Rx, and used an Agilent SART to validate that the Smart CallGen supports up to 60,000 registrations.

For the VoIP call quality measurement test, engineers first configured the Smart CallGen Tx to establish one RTP channel for 100 seconds of call duration. Next, engineers configured the Smart CallGen Rx to terminate the RTP channel. Then, engineers used PacketStorm to emulate the networks with different packet loss and delay values and verified that the Smart CallGen responded to those changes properly. Lastly, engineers compared the values measured by the Smart CallGen to the values computed by R-factor simulation program. ITU-T technical study group 12 provides the simulation program.

For the SIP protocol functional test, engineers first configured the Smart CallGen Tx to run in normal state and to transmit the SIP calls to the Smart CallGen Rx. Second, engineers validated the sequence diagram by using SART. Third, engineers used the Hammer protocol analyzer to verify that the Smart CallGen generated the proper VoIP packets. Figure 3 shows the testbed diagram.

Borasys, Inc.

Smart CallGen SIP

Performance, Scalability, Call Quality Measurement and Functionality Evaluation

TOLLY Up to Spec CERTIFIED

Product Specifications

Vendor-supplied information not necessarily verified by The Tolly Group

Borasys, Inc.
Smart CallGen SIP

- Concurrent 60,000 calls support
- 700 CPS (server)/200 CPS support
- Max 1,500 RTP channels (including G.711, G.723, G.729)
- Network emulation support (Jitter, loss, delay emulation)
- SIP protocol message test (including Refer, Register, Info, Reinvite)
- EarlyMedia, PRAck,P-Preferred, Replace, session timer support
- Real time MOS value announce
- GUI support
- QoS measurement (Jitter, delay, loss, E-model, R-factor
- Real time message tracking
- Performance analysis (CPS, BHCA)
- Statistic of calls transmitted and receipted by each message
- Register, Invite message authorization test support
- RTP path test by RFC2833 DTMF event loop-back
- RFC3261,3262,3264,3265,3311,3325,3515,3842,3881,4028,2671

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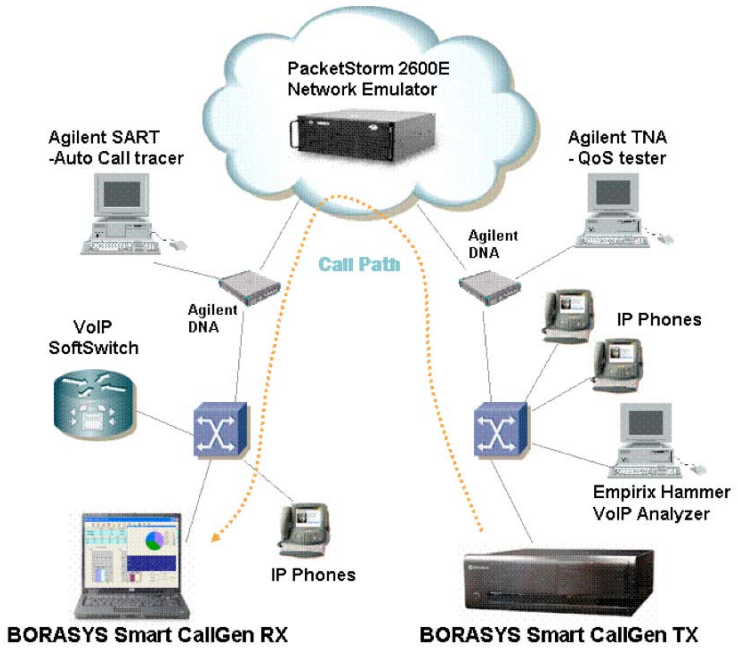
Test Bed Diagram



Source: TTA/The Tolly Group, June 2007

Figure 3

The Tolly Group is a leading global provider of third-party validation services for vendors of IT products, components and services.

The company is based in Boca Raton, FL and can be reached by phone at (561) 391-5610, or via the Internet at: Web: http://www.tolly.com, E-mail: sales@tolly.com

The Telecommunications Technology Association (TTA) is a technology testing and standards organization established and sponsored by the Korean government to provide third-party independent testing and certification services for IT products marketed in Korea.

Test Equipment Summary

The Tolly Group gratefully acknowledges the providers of test equipment used in this project.

Vendor	Product	Web
Agilent Technologies	SART, TNA, DNA (Ver 5.30.100.013)	www.agilent.com
Empirix	Hammer Call Analyzer (Ver 1.6.1.2)	www.empirix.com
PacketStorm Communications	PacketStorm2600E (Ver 8.6v1)	www.packetstorm.com

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