

Cisco Systems SAMI-based CSG2, 7613

Product Profile

Vendor:

Cisco Systems

Product:

**SAMI-based CSG2,
7613**

Target Markets:

The CSG2 is deployed to provide scalable content services for clients near the edge of the network, at an ISP POP or Regional Data Center

Testing Period:

January 2008

Report Released:

February 7, 2008

Software Tested:

**12.2(33)SRB2 for 7600
Latest CSG2 R2
SAMI IP-Base Image
R2**

Features Tested:

- **Packet Switching and Throughput properties of base platform**
- **L4 Throughput**

Executive Summary

Cisco Systems engaged Current Analysis and Iometrix to test and validate the performance of its Content Service Gateway Release 2 (CSG2) when hosted on the largest of the 7600 series routers, the 7613. A typical CSG2 gateway performs multiple functions at the edge of the mobile network such as subscriber access control, firewall generation, IPSEC capabilities, deep packet inspection and content filtering. Cisco's CSG2 is based on the Service Application Module for IP (SAMI) technology, which offers mobile operators a highly scalable approach to meeting network requirements. In order to characterize the SAMI performance, two separate test cases were executed, one to determine the basic packet switching and throughput properties of the base SAMI platform; and a second test to determine the Layer 4 (L4) throughput for an application such as Content Billing using multiple SAMI modules configured as single to multiple (9) CSG2s.

To facilitate the testing, we used the Spirent Avalanche 2900 testers to simulate a range of network traffic loads. The tests were designed to provide intermediate results, as well as aggregate system level results to show that the Cisco CSG2 was able to provide the requisite capacity and scale required by a mobile operator.

The first series of tests were designed to provide visibility into how the SAMI would perform under varying packet sizes such as the CSG2 would encounter as it processed various 2G, 3G and emerging 4G traffic loads. The second series of tests were designed to show how the system would scale as additional SAMIs were added to accommodate incremental growth in network traffic.

The results of the tests identified that each SAMI module was capable of delivering 6 Gbps of L4 throughput when configured at an average packet size of 1024 bytes. The testing also revealed that the CSG2 could be scaled linearly by adding SAMI modules to the 7613 which resulted in a L4 throughput level which ranges from 6 Gbps to 54 Gbps for the fully loaded system. It is important to understand how the CSG2 performs when encountering various types of traffic mixes. The testing verified that the SAMI performs at or above specification for all packet sizes tested, indicating that the CSG2 has the performance to meet any mix of traffic – this is further highlighted by the results of the mixed packet size test. For additional detail refer to the test results section below.

Market Overview and Analysis

The Internet has transformed nearly every facet of telecom; mobile networks are no exception. Where initial analog and 2G wireless networks were designed to provide basic voice services, today's 3G (evolving into 4G) networks deliver a full complement

of voice and broadband data applications. To be sure, we are at a very early stage in the lifecycle of these networks and mobile broadband itself. In fact, there are numerous reasons to believe that mobile broadband traffic will grow at a very strong pace over the next few years.

Why?

- New 3G and 4G technologies – HSPA, HSPA+, WiMAX, LTE, and UMB – are emerging all of which promise to inject new capacity into the mobile Radio Access Network.
- Internet and data applications such as e-mail, instant messaging, online file backup, and even basic web surfing are becoming an integral part of people's lives, driving usage over fixed and mobile networks alike.
- New services such as mobile TV, social networking, and the mobile enterprise (including e-mail and collaboration applications) are driving people to use mobile networks in new ways.
- The proliferation of operator-deployed WiFi networks is delivering high-speed access outside of, and in addition to, 3G coverage and allowing operators to target mobile data users with an inexpensive technology widely available in most laptop PCs.
- The proliferation of multimode devices (2G and 3G, 3G and WiFi) is providing an incentive for users to take advantage of mobile broadband service availability while still promising access to familiar voice services.
- Advanced user interfaces encourage the use of mobile broadband services by making it easier for users to access data applications and services.

In short, demand for Internet and data applications is high, yet still on the rise. Combined with an abundance of mobile broadband networks, some users have come to expect and/or hope for (in some cases rely on) Internet access wherever they go. As more and more people join their ranks, these trends will doubtless have an impact on the data gateways – PDSNs, GGSNs, ASN gateways – linking wireless base stations (and users) into the Internet and other data networks. In particular, a number of gateway features stand out as prerequisites; the first two capabilities are the subject of this testing report.

- **High Capacity.** Gateway capacity – session capacity, application capacity, data throughput – is critical for ensuring that a gateway can keep up with growing traffic demands and that users get access to the applications they want, when they want them. Perhaps more than any other requirements, capacity will be key as mobile data usage ramps up and operators look to conserve on OpEx and CapEx by avoiding the need to purchase and deploy new gateway assets constantly.
- **Scalability.** In the run-up to strong service uptake, a gateway offer must be able to support a high-degree of capacity scalability – evolving from limited capacity up-front to higher capacity as network demands warrant.
- **Reliability.** Gateways must be highly available products in order to provide a consistent user experience as well as consistent revenue flows.
- **User Applications.** Any gateway offer must be able to provide consumer and

enterprise mobile data users with a consistent set of capabilities and applications: network access, firewall generation, IPSEC capabilities, and content filtering.

- **Operator Applications.** Mobile data gateways provide other key functionality such as: billing interfaces, deep packet inspection and content charging tools, lawful intercept, mobility management (including home agent functionality), QoS support including DiffServ marking, and support for a broad set of routing protocols.

Cisco's gateway solution leverages its widely-deployed and market-proven Catalyst platform – including the Cisco 7604, 7606, 7609 and 7613 – with basic session capabilities and application functionality hosted on Cisco SAMI blades: PDSN, GGSN, ASN, Home Agent, content charging, content filtering, etc. Combined with Cisco's broad support for diverse routing protocols and redundancy options, the result is access to a wide array of applications with card-level upgrades promising platform evolution in line with service uptake and market trends.

Objectives

Cisco Systems engaged Current Analysis and Iometrix to create and execute a testing program designed to provide a benchmark for the Cisco CSG2 which is based on Cisco's SAMI technology. In order to characterize the SAMI performance in a 7600 series router, the testing objectives were broken into two separate test cases:

- **Test Case 1** - Determine the Packet Switching and Throughput properties of base SAMI platform.
- **Test Case 2** - Determine the Layer 4 Throughput using 9 SAMI modules configured as 9 CSG2s.

We ran each of the benchmarks using the following conditions to establish the performance of multiple SAMI modules installed in the Cisco 7613 router. To facilitate the testing, four pairs of Spirent Avalanche 2900 test sets were used, four test sets configured as "Clients" and four test sets as "Servers". The tests were designed to provide intermediate results as well as an aggregate system level result to show that the Cisco CSG2 was able to provide the requisite capacity and scale required by a mobile operator.

Test Methodology

Current Analysis and Iometrix developed a test methodology that emulates the typical traffic patterns and loads that a CSG2 would experience in a mobile operator's network. Leveraging the Spirent Avalanche 2900's testing platforms, Current Analysis and Iometrix defined a benchmark that uses simulated TCP/IP and UDP traffic to benchmark the Cisco 7613 SAMI-based CSG2 from a capacity and scale perspective.

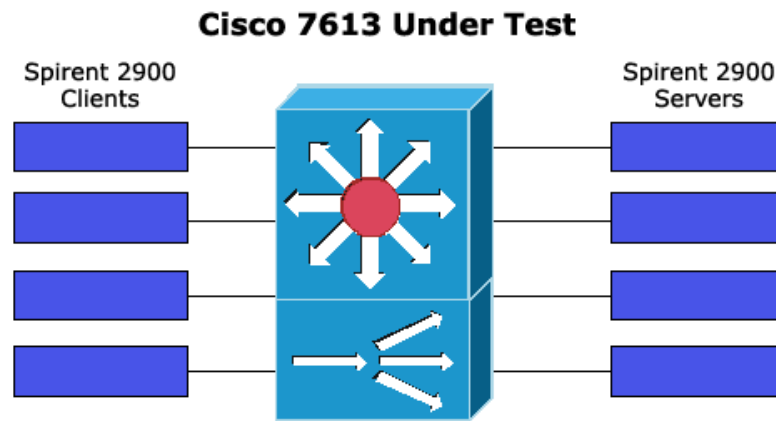
The testing was designed to provide two of the most critical performance metrics noted in the market review section above. This test report addresses the throughput and capacity metrics.

- **For Throughput** – The overall packet switching and throughput properties of the system were tested using various common packet sizes (256, 384, 512, 768, 1024 and 1500 bytes) and the throughput of a mixed packet size stream. Each fixed packet size and the mixed packet size scenarios were then executed on the SAMI cards and the results were recorded. The test provides a metric for the overall throughput and highlights the impact that packet size would have on the overall throughput.
- **For Scalability** – We used a test scenario that simulated the performance of 9 SAMI modules using fixed TCP connections with an average packet size of 1024 bytes. The test sets were configured to assess L4 throughput when configured over 9 servers. To determine the maximum throughput, we increased the rate until the CSG2 began dropping packets. The rate was then lowered, to just below the “drop packet” threshold, and executed for 10 minutes. The overall throughput in Gbps was then recorded and used for the final system test configuration.

The test equipment available for the above tests had the ability to saturate 4 SAMIs. Since the results of the tests showed that the CSG2 scaled linearly by adding SAMI modules, we extrapolated the results for a fully loaded (9 SAMI) 7613 router.

Test Configuration

The following diagram shows the high level test configuration used to the Cisco CSG2 testing program.



Test Suite 1 - Packet Switching and Throughput properties of base platform

This test suite will measure the base hardware platform's packet switching and throughput capabilities.

For this test we configured each processor to route data from one VLAN to another and configured the Spirent Avalanche 2900 test tool to send UDP packets from 4,500 different IP addresses.

We sent packets through the SAMI for 10 minutes and determined the "no drop" packet and throughput rate for the following packet sizes:

- 256 bytes
- 384 bytes
- 512 bytes
- 768 bytes
- 1024 bytes
- 1500 bytes
- Mix: 85:3,171:1,553:1,1419:4

Performance Results Test Suite 1

Test 1.a - For a single SAMI module: determine the no drop throughput rate by sending UDP packets at multiple fixed packet rates and the mixed profile as noted above, results are shown in Figure 1.a below.

Sustained Throughput Rates per Packet Size - Single SAMI

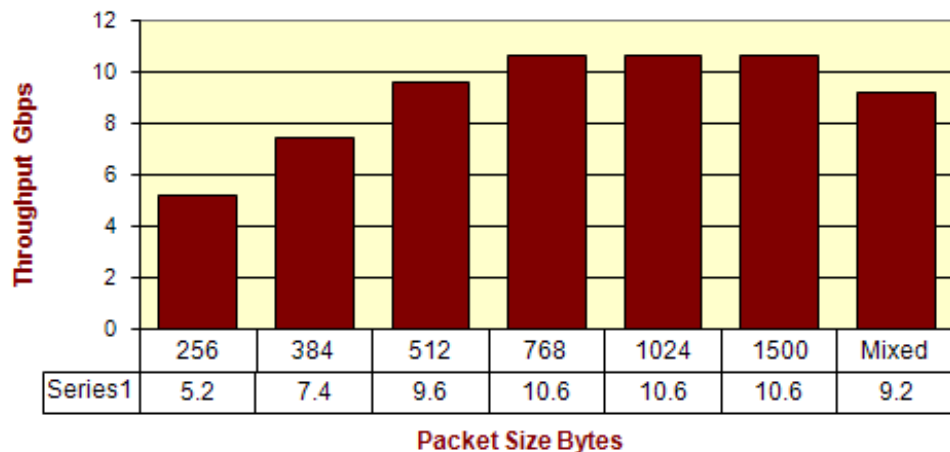


Figure 1.a

Test 1.b - For 4 SAMI modules: determine the no drop throughput rate by sending UDP packets at multiple fixed packet rates and the mixed profile as noted above, results are shown in Figure 1.b below. The measured results verified that as each SAMI module was added, the incremental gain in throughput was nearly linear for all packet sizes tested. For packet sizes, 512, 768, 1024 and 1500 bytes the measured throughput slightly exceeded expectations.

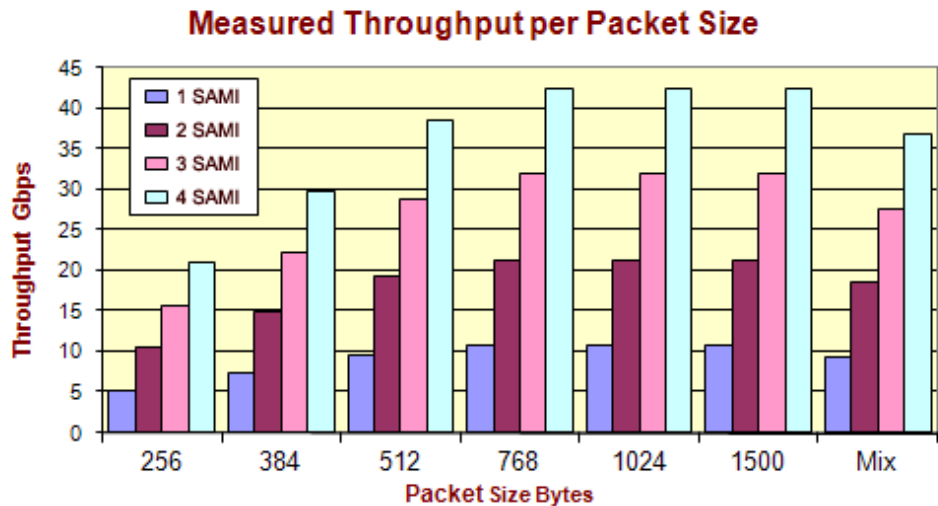


Figure 1.b

Test 1.c – Results for the fully configured system, determined by extrapolating 9 SAMIs at the single SAMI no drop throughput rate for 10 minutes, are shown below in Figure 1.c.

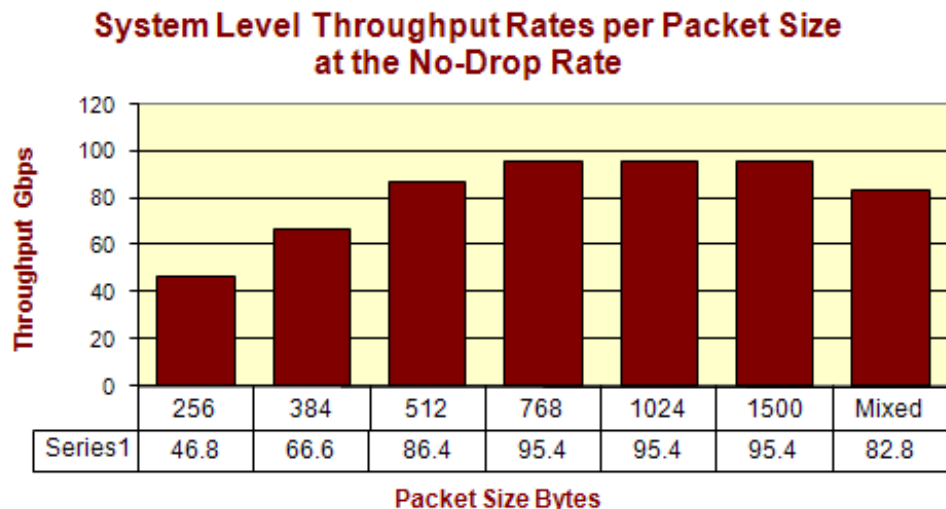


Figure 1.c

Test Suite 2 - Layer 4 Throughput using (9 SAMI modules configured as 9 CSG2s)

The objectives of this test suite is to measure the Layer 4 throughput of the Cisco CSG2 based on the 7613 router. The testing approach is outlined below:

- Use a simple CSG2 configuration with a content parsing “Other/L4” protocol.
- Define TCP connections with an average packet size of 1024 bytes. Traffic mix details: (HTTP Post and Get). HTTP packets: (1100-byte) count for 88% to 90% of the total traffic load, TCP Ack, Syn/Ack and APR packets: (64-byte) count for 10% to 12% of the total traffic load.
- Use the Spirent Avalanche 2900 to execute test at the no drop rate, using HTTP POST and GET traffic, for a sustained period of 10 minutes.
- Gather the resultant throughput (Gbps) for 4 SAMI modules.
- Extrapolate the results for 9 SAMI modules.

Performance Results Test Suite 2

Test 2 – Determine the throughput rate for four SAMI cards using HTTP GET and POST and extrapolate the results for nine SAMI cards to represent a fully configured Cisco CSG2 based on the 7613 router.

Results – Based on an average packet size of 1024 bytes, a sustainable throughput rate was determined. The test used four SAMI modules and provided an aggregate throughput of 24 Gbps where each SAMI contributed 6 Gbps. When this result is extrapolated for 9 SAMI cards, the final throughput for the configuration yielded 54 Gbps. The results are shown in Figure 2 below.

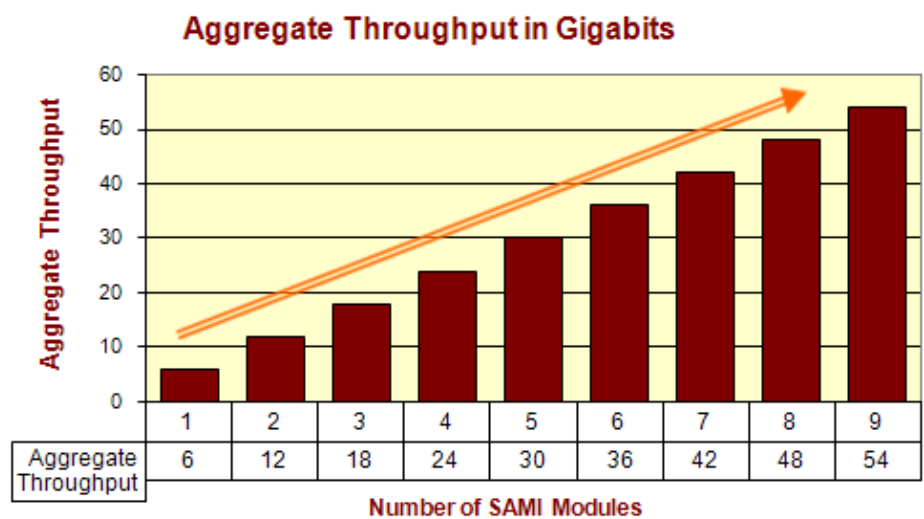


Figure 2

Conclusions

These test results underscore the expected performance, in a mobile operator's network, of a SAMI-based CSG2.

Test 1 identified the performance level of the SAMI under different packet sizes ranging from 256 to 1500 bytes – this shows the mobile operator how well the CSG2 will perform based on varying applications that present different length packet traffic. The most important metric derived in this test regime is that of the mixed traffic type since in real world conditions, the mobile operator's network will most likely experience this type of traffic pattern (text messaging, video/music downloads, voice, web browsing, and others). To establish the performance level of the base system, Test 1 was conducted first with a single SAMI module at the defined packet sizes. As shown in Figure 1.a, at the lowest packet size, 256 bytes, the SAMI throughput was 5.2 Gbps and as expected for larger packet sizes the SAMI throughput increased to a maximum of 10.6 Gbps. To determine the throughput of a multi-module system, we measured the actual throughput of 1 to 4 SAMI modules. The results are shown in Figure 1.b and indicate that as SAMI modules are added, the aggregate throughput grows incrementally. Finally to project a fully loaded system, the results obtained from a single SAMI were extrapolated by taking the single SAMI rate and projecting it over the equivalent of 9 SAMI modules.

Test 2 shows the overall L4 throughput based on the number of SAMI modules. Test 2 determined the actual throughput by adding 1 to 4 SAMI modules. We saw a linear increase in throughput for each SAMI added to the system, indicating that the overall switching and throughput capacity of the Cisco 7613 router is matched to the CSG2 application. The throughput observed was 6.0 Gbps per SAMI which when extrapolated to 9 SAMI modules, yielded an aggregate of 54 Gbps for the fully loaded system.

Lab Testing Mission Statement

Current Analysis and Iometrix share a common vision to develop rigorous, standards-based methodologies essential to the meaningful evaluation of advanced enterprise and carrier networking equipment. Current Analysis and Iometrix collaborate to develop and execute test methodologies that set new standards for quality and relevance in enterprise and carrier networking equipment testing.

Current Analysis and Iometrix perform independent, commissioned product testing to measure and validate relevant, real-world performance of a product from a single vendor. Testing methodologies are designed and executed exclusively by Iometrix and Current Analysis. Current Analysis and Iometrix share the belief that equipment vendors must be held to a higher level of accountability in lab testing engagements, and together we deliver testing methodologies and benchmarks that are credible and relevant to the end user.

Acknowledgements

Current Analysis and Iometrix would like to specifically thank Spirent for providing extensive equipment resources and support throughout the course of this test. Spirent supported the Iometrix lab by supplying us with four pairs of its advanced Avalanche 2900 platforms. The test equipment enabled Current Analysis and Iometrix to develop and execute the testing methodologies described above.

Current Analysis and Iometrix have made every attempt to ensure that all test procedures were conducted with the utmost precision and accuracy, but acknowledge that errors do occur. Neither Current Analysis nor Iometrix shall be held liable for damages which may result from the use of information contained in this document.