THE TOLLY GROUP

No. 199131 October 1999

Sun Microsystems Inc.

Sun Trunking 1.2 Software

Gigabit Ethernet Link Aggregation Competitive Evaluation versus Phobos Corp. PhobosLink Software version 1.0

Test Summary

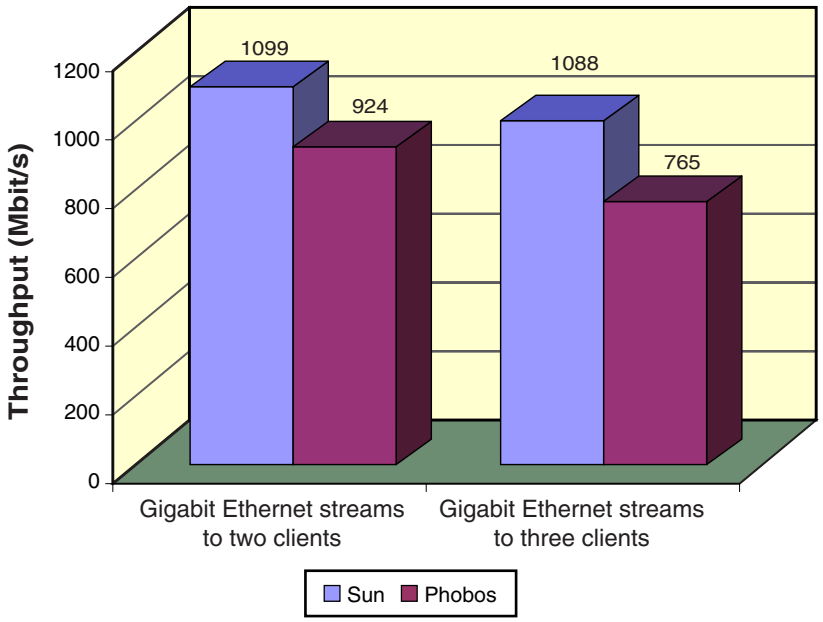
Premise: *By equipping servers with Gigabit Ethernet adapters, buyers are increasing network bandwidth. To further improve the performance of their networks, customers can deploy multiple adapters in one server that function as one. This technology, called link aggregation, or "trunking," not only provides higher throughput, but fault tolerance with near-automatic recovery in the event of a link failure. Trunking software enables two or more physical connections to combine into one logical connection in order to increase adapter's potential throughput.*

Sun Microsystems™, Inc. commissioned The Tolly Group to evaluate its Sun Trunking 1.2 Software paired with a PCI-based Sun Gigabit Ethernet 2.0 multimode fiber adapter against Phobos Corp.'s PhobosLink Software version 1.0. and its P1000 multimode fiber adapter. Results show that the Sun Trunking 1.2 outperformed the PhobosLink software when tested for throughput in both the two- and three-client environments. In addition, the Sun Trunking

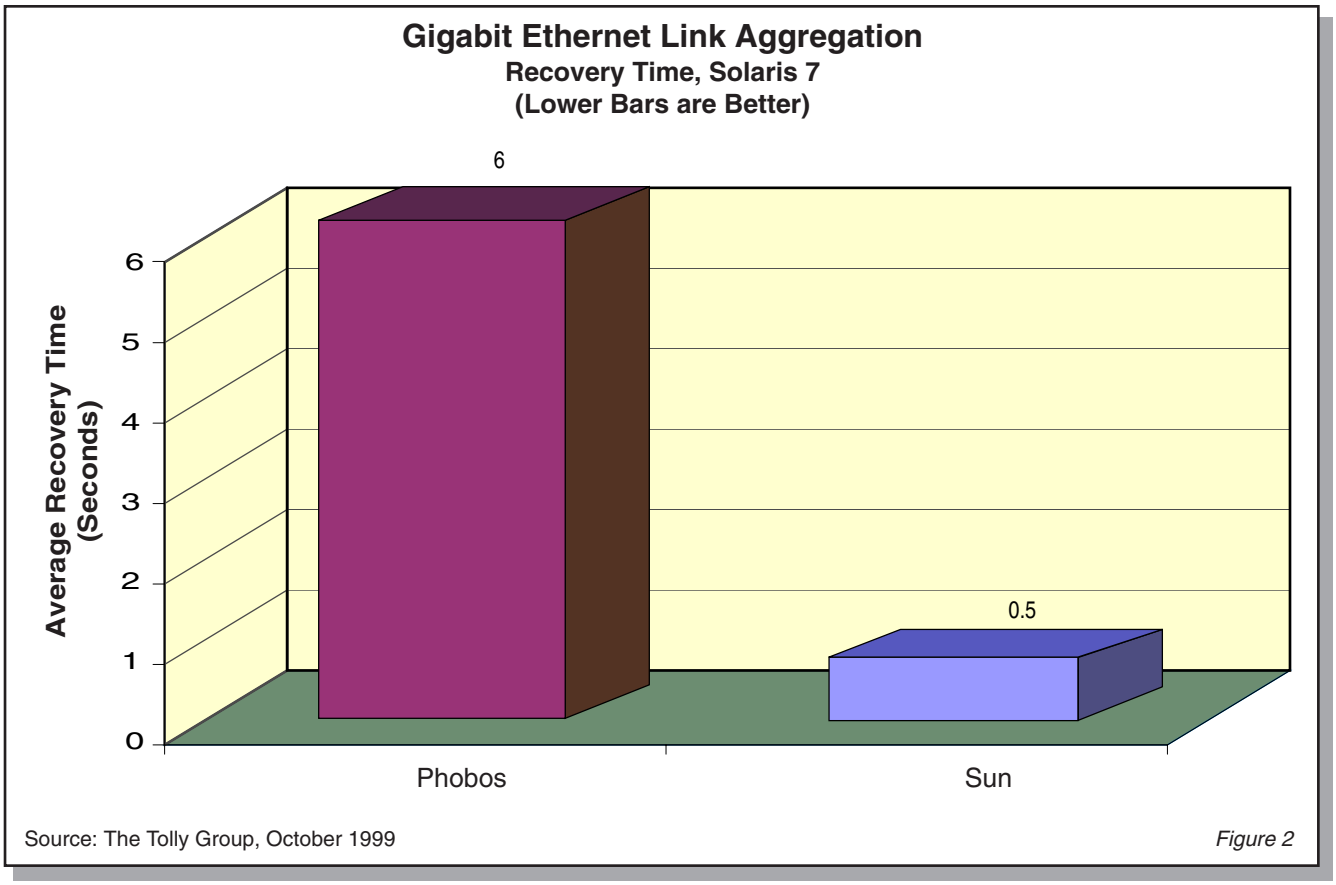
Test Highlights

- Delivers 1088 Mbit/s of aggregate throughput while processing three bidirectional streams, more than 300 Mbit/s faster than its competitor
- Reroutes transaction traffic to backup link within 0.5 seconds when tested in Gigabit Ethernet link aggregation failover tests
- Offers native support for 64-bit Solaris 7

Gigabit Ethernet Link Aggregation Throughput
TTCP Bidirectional 1,518-Byte Packets
Two Full-Duplex Links



Source: The Tolly Group, October 1999 *Figure 1*



Source: The Tolly Group, October 1999

Figure 2

1.2 showed significantly lower recovery times than the PhobosLink software during single-adapter failure tests.

Throughput testing was conducted in a Sun Microsystems 336-MHz Enterprise 6500 Server with 12 processors running Solaris 7. Traffic was generated from a test TCP (TTCP) application from Chesapeake Computer Consultants, Inc., which uses 64-Kbyte packets and other parameters to provide traffic. The trunking software was evaluated using two bidirectional traffic streams and then an additional traffic stream was added to see if the trunk could handle additional traffic streams. The Tolly Group also conducted tests to measure the failover time of the Sun and Phobos software. Testing was performed in July 1999.

Results

Link Aggregation Throughput

Test results show that when both the Sun Trunking 1.2 and PhobosLink software were utilized to aggregate traffic from a pair of full-duplex Gigabit Ethernet adapters into a single logical stream (using bidirectional TTCP traffic of 64-Kbyte packets), the Sun Trunking 1.2 delivered an average throughput of 1,099 Mbit/s to a pair of downstream clients. In the same environment, PhobosLink averaged 924 Mbit/s, or 16% less throughput.

When engineers tested throughput in the same environment using three clients, the Sun Trunking 1.2 averaged slightly lower throughput of 1,088 Mbit/s while PhobosLink 1.0 delivered 765 Mbit/s of throughput, or almost 30% less than Sun Trunking 1.2.[1] See figure 1.

Link Aggregation Failover/Recovery

When testing the link aggregation recovery times of the Sun

[1] Note: Upon reviewing the results, Phobos said that the throughput of its product may have dropped significantly with the addition of the third client due to its Adaptive Load Balancing algorithm. This results in sessions that are bound to a single adapter resulting in uneven load distribution when the number of clients is few and odd. Phobos said that throughput results would be higher if tested with four clients.

Trunking 1.2 and PhobosLink 1.0, engineers averaged the results of six failure/recovery iterations in an environment supporting the Solaris 7 operating system. Sun Trunking 1.2 Software recovered in an average of 0.5 seconds after a transaction failure, while PhobosLink consumed an average of six seconds for recovery. See figure 2.

Analysis

Link Aggregation Throughput

By combining streams from multiple adapters onto a single Gigabit Ethernet trunk with link aggregation software, customers can increase the throughput of their networks by almost 50%. To further increase their investment, customers often choose to utilize "trunking" software that enables them to migrate easily to future higher performance Ethernet technologies and infrastructure investments.

In figure 3, results show single TTCP bidirectional throughput of the Sun Gigabit Ethernet adapter using 1,518-byte packets without link aggregation. When comparing the single throughput to the "trunked" throughput using two clients in figure 1, one can see that the throughput increases. The Sun Trunking 1.2 Software increases the throughput of the Sun adapters by 336 Mbit/s, or 44%.

Link Aggregation Failover/Recovery

Another important advantage to link aggregation is the benefit of a quick recovery during link failures. By "trunking" multiple Gigabit Ethernet adapters together, the throughput not only increases but network sessions will be recovered in the event of a link failure. When using trunking software, one adapter can pick up the traffic sessions of another in the event of a network interface card failure. Sun Trunking 1.2 Software recovered from a simulated failure almost instantaneously. Sun Trunking 1.2 Software proved that it offers the ability to handle failover and recovery in an average 0.5 seconds whether it had two- or three-clients. The result of a faster recovery is reduced downtime and almost guaranteed throughput.

Test Configuration and Methodology

The Tolly Group loaded Sun Gigabit Ethernet 2.0 adapters on the following three Sun Microsystems, Inc. clients: a Sun Microsystems quad-processor 296-MHz UltraSPARC II Enterprise 450 with 512-Mbytes of RAM, acted as client No. 1 in a Solaris 7 configuration; a Sun Microsystems quad-processor 296-MHz UltraSPARC II Enterprise 450 with 1-Gbyte RAM, acted as client No. 2 attached to switch port 19; and a Sun

Sun Microsystems, Inc.

Sun Trunking 1.2 Software

Gigabit Ethernet Link Aggregation Competitive Performance

TOLLY Up to Spec CERTIFIED

Sun Microsystems, Inc.
Sun Trunking 1.2 Software
Product Specifications*

- Bandwidth Aggregation
  - Allows customers to aggregate two Sun Gigabit Ethernet ports
  - Connects up to eight 10/100 Sun Quad Fast Ethernet ports (two Sun Quad Fast Ethernet adapters)
  - Allows customers to increase Ethernet bandwidth and achieve cost savings
- Enhanced Load Balancing
  - Sun Trunking 1.2 has four load-balancing policies: IP destination, source address, MAC hashing and round-robin policies
  - Enables even traffic distribution across the aggregated Ethernet links to increase network efficiency and achieve cost savings
- Failure Recovery
  - Sun Trunking 1.2 automatically redistributes traffic loads across the remaining links in the event of a link failure
  - Results include higher network reliability
- Migration Path to Higher Bandwidth Ethernet Technology
  - Sun Trunking 1.2 aggregates Gigabit Ethernet links and paves the way for future multi-Gigabit Ethernet technology
  - Increases Fast Ethernet bandwidth for customers who are not ready to deploy Gigabit Ethernet connection
- Proven Interoperability with Trunking-Capable Switches
  - Sun Trunking 1.2 interoperates with any trunking-capable switches
  - Offers flexibility and protects customer investment

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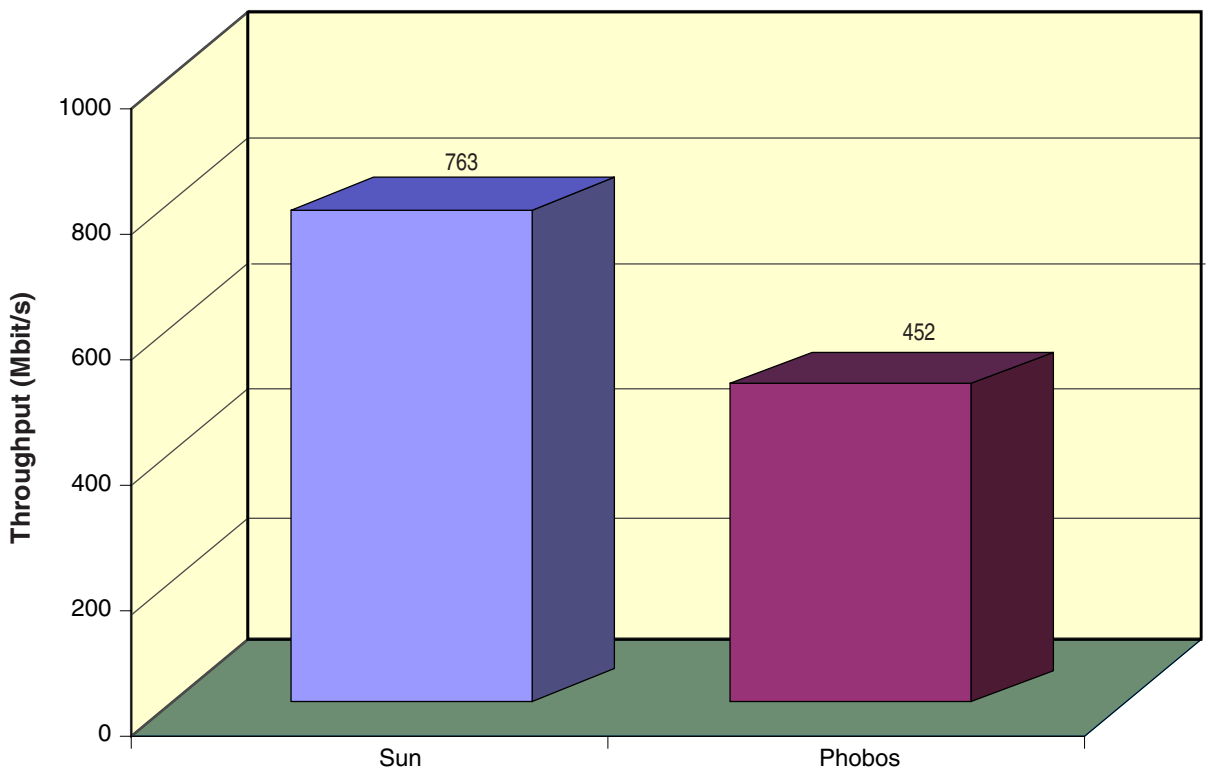
**Vendor-supplied information not verified by The Tolly Group*

Gigabit Ethernet Adapter Performance
Single NIC Baseline with TTCP Bidirectional
1,518-Byte Packets



Source: The Tolly Group, October 1999

Figure 3

Microsystems dual-processor 336-MHz UltraSPARC II Enterprise 3000 with 1-Gbyte of RAM, acted as client No. 3 attached to switch port 21. All clients were running Solaris 7.

Engineers connected all three clients to an Extreme Networks Summit Gigabit Ethernet Switch running software version 2.1.8. The Summit switch, in turn, was connected to a Sun Microsystems 12-processor 336-MHz UltraSPARC II Enterprise 6500 server, with 7-Gbyte of RAM, that hosted all of the following adapter pairs under test: a PCI-based Sun Gigabit Ethernet 2.0 multimode fiber adapter and Phobos Corp. P1000 multimode fiber adapter. The Sun Trunking Software 1.2 and PhobosLink Software version 1.0 were also installed on the server. See figure 4.

Engineers connected a Windows NT 4.0 workstation, Service Pack 3, running Ganymede Software's Chariot 3.1 Console software to the Gigabit Ethernet switch. All three workstations and the server were outfitted to run Ganymede Software's Chariot Endpoint software version 3.1. See figure 5.

To measure the failover/recovery performance of the Gigabit Ethernet trunk pairs consisting of two Gigabit Ethernet adapters under test, engineers configured a SPARCstation server running Sun Solaris 7, equipped with the two adapters under test configured for a trunk pair. The trunk was connected to the Gigabit Ethernet switch. Engineers configured the test application (e.g., TTCP) to support a batch traffic profile for a duration of at least five

Driver Revision Levels Used for Products Tested

Product Name	Driver Version
Sun Gigabit Ethernet adapter	2.0
Phobos P1000 Gigabit Ethernet adapter	1.0

Source: The Tolly Group, October 1999

Figure 4

minutes. The Chariot application was configured for a single pair of the traffic profile to run for three minutes in batch mode.

For tests, engineers initiated the batch traffic and the Chariot test stream. After 30 seconds, engineers disconnected the primary link within the trunk. After another 30 seconds, engineers connected the primary link and waited another 30 seconds before disconnecting the secondary link. After a final 30 seconds, engineers reconnected the secondary link. Engineers verified, via a Shomiti Systems, Inc. Gigabit Analysis Module (GAM), the link over which PINGs and interactive traffic flowed, and disconnected that link.

Testing ceased after another 30 seconds or until it ran to completion. The Tolly Group then recorded either the greater of the maximum single-transaction time, or, the difference between the maximum timing record duration and the average of all timing records exclusive of that maximum. Each test was performed for three iterations and the results were averaged.

Throughput was recorded in Mbit/s for the entire five-minute testing period for all Chariot pairs in the tests. The measurement was only used to determine what traffic traversed the remaining "active" link.

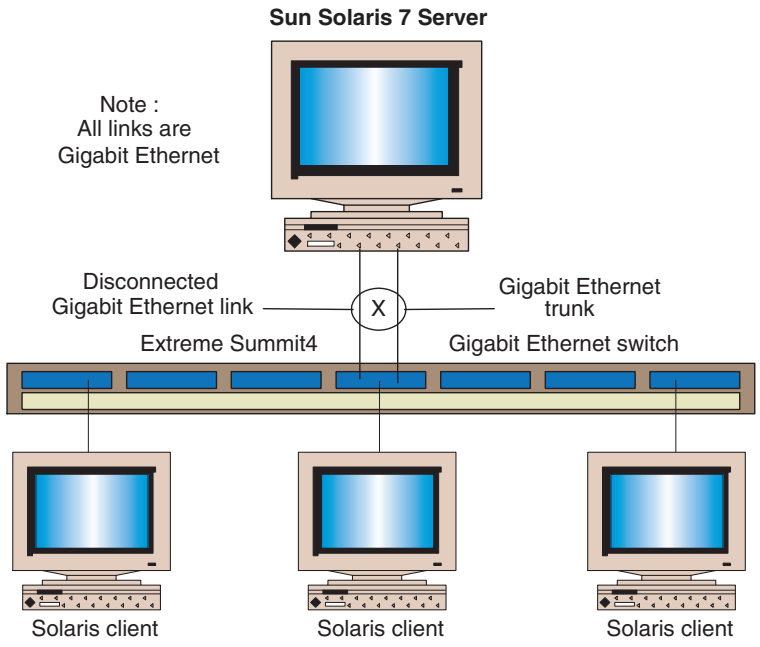
Equipment Acquisition and Support

All competitive products were acquired through normal product distribution channels. The Tolly Group contacted executives at Phobos Corp. and invited them to provide a higher level of support than available through normal channels. Phobos accepted the invitation. The software level was tested as supplied and The Tolly Group relied upon technical phone support to configure/tune the device for the test suites executed.

The Tolly Group verified product release levels and shared test configurations with Phobos in order to give it an opportunity to optimize the device for the tests. Results were shared with the competitive vendor and Phobos acknowledged the accuracy of the test results.

For a more complete understanding of the interaction between The Tolly Group and Phobos Corp., check out the Technical Support Diary for Competitive Products Tested posted on The Tolly Group's World Wide Web site at http://www.tolly.com. See document 199131.

Test Bed



Source: The Tolly Group, October 1999

Figure 5

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

Vendor	Product	Web address
Ganymede Software, Inc.	Chariot	http://www.ganymede.com
Shomiti Systems, Inc.	Gigabit Analysis Module	http://www.shomiti.com

Since its inception, The Tolly Group has produced high-quality tests that meet three overarching criteria: All tests are objective, fully documented and repeatable.

We endeavor to provide complete disclosure of information concerning individual product tests, and multiparty competitive product evaluations.

As an independent organization, The Tolly Group does not accept retainer contracts from vendors, nor does it endorse products or suppliers. This open and honest environment assures vendors they are treated fairly, and with the necessary care to guarantee all parties that the results of these tests are accurate and valid. The Tolly Group has codified this into the Fair Testing Charter, which may be viewed at http://www.tolly.com.

Project Profile

Sponsor: Sun Microsystems, Inc.
Document number: 199131
Product class: Gigabit Ethernet link aggregation software
Products under test:
- Sun Trunking Software
- PhobosLink Software

Software versions tested:
- Version 1.2
- Version 1.0

Testing window: July 1999
Software status:
- Readily available

Additional information available:
- Technical support diary
- Configuration files

For more information on this document, or other services offered by The Tolly Group, visit our World Wide Web site at http://www.tolly.com, send E-mail to info@tolly.com, call (800) 933-1699 or (732) 528-3300.

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