THE TOLLY GROUP

No. 202109A April 200

Telco Systems, Inc.

T4 Routing Switch versus Cisco Systems, Inc. Catalyst 3550-24

Layer 3 Switch Competitive Evaluation

Test Summary

Premise: *Network managers who deploy Fast Ethernet/Gigabit Ethernet switches need to know that the devices can deliver zero-loss throughput with minimal latency to support time-sensitive applications (e.g., VoIP) and network synchronization sensitive applications such as database access. In order to future-proof the network to accommodate deployment of more time-sensitive applications, these switches should be able to sustain low latency at wire-speed throughput across all ports.*

Telco Systems, Inc. commissioned The Tolly Group to evaluate its T4 Routing Switch, a modular stackable hybrid switch that offers 16 10/100 Fast Ethernet copper ports and two Gigabit Ethernet fiber uplinks. Telco Systems also requested The Tolly Group evaluate the T4 Routing Switch against a Cisco Catalyst 3550-24 that offers 24 fixed 10/100 Fast Ethernet copper ports and two fixed Gigabit Ethernet Interface Converter (GBIC)-based 1000BaseX uplink ports. Telco Systems requested The Tolly Group test the Cisco switch with 16 Fast Ethernet ports and two Gigabit ports. Testing was performed in March 2002.

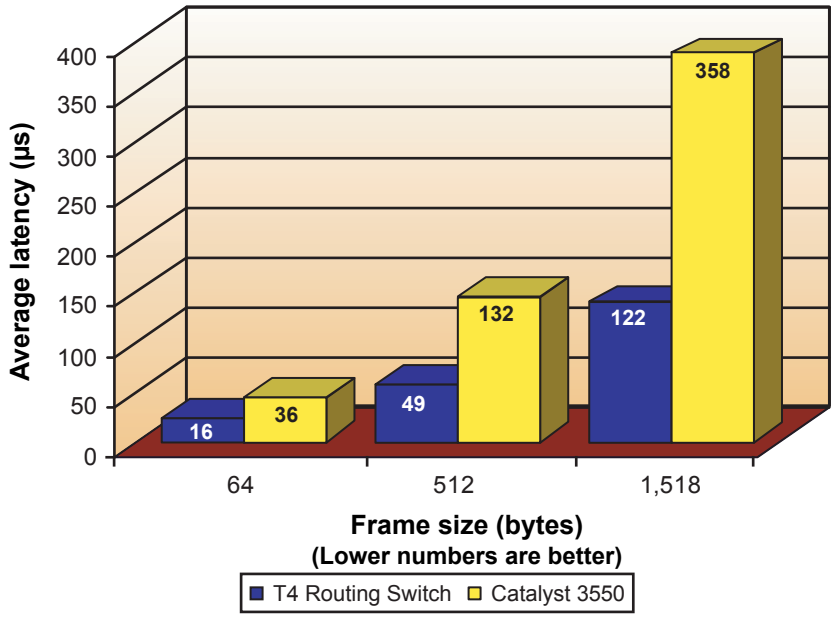
The Tolly Group evaluated the steady state, zero-loss (≤0.001%) bidirec-

Test Highlights

- Demonstrates 2.6X less delay on average than the Catalyst 3550 for all packet sizes tested
- Delivers zero-loss wire-speed throughput in Layer 3 IP tests for all frame sizes tested with or without processor-intensive Layer 4-7 ACL and QoS features enabled
- Supports QoS features designed to improve throughput of higher priority traffic
- Offers price/performance that is 1.5X better than the Catalyst 3550

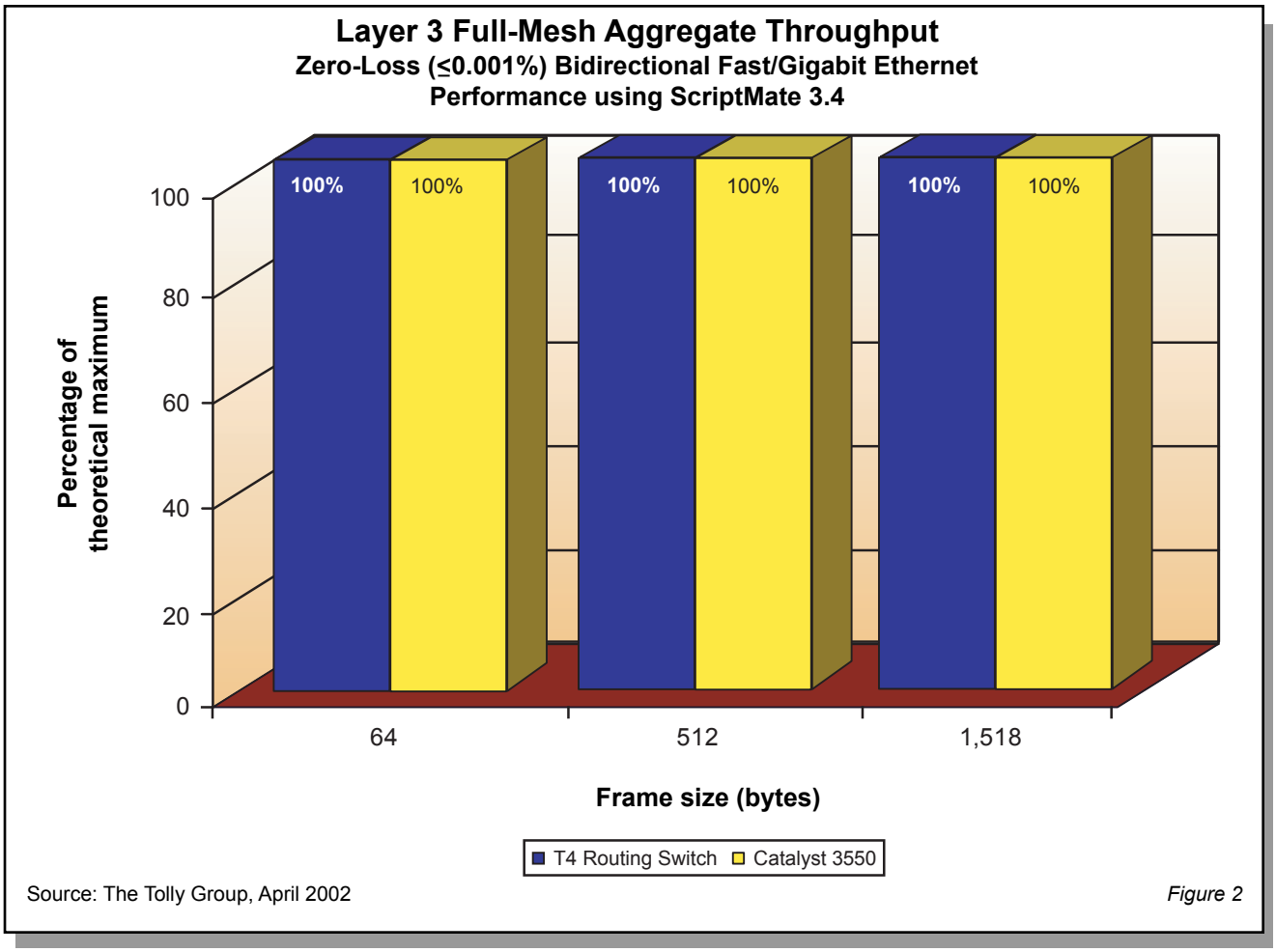
Layer 3 Full-Duplex Latency

Zero-Loss (≤0.001%) Bidirectional Fast/Gigabit Ethernet Performance using ScriptMate 3.4[1]



[1] Ixia's ScriptMate uses a Pair Traffic Pattern for latency tests.

Source: The Tolly Group, April 2002 *Figure 1*



Source: The Tolly Group, April 2002

Figure 2

tional (full-duplex) packet-per-second (pps) throughput and latency of both switches using 64-, 512- and 1,518-byte packets in a full-mesh configuration.

In compliance with The Tolly Group's Fair Testing Charter (FTC), Cisco Systems executives were invited to provide a higher level of technical support for this series of tests. Cisco executives declined to participate. Also in accordance with the FTC, test results were shared with Cisco executives who neither acknowledged nor disputed their accuracy.

Test results show that while both the Telco Systems T4 Routing Switch and the Cisco Catalyst 3550 achieved wire-speed throughput for every packet size tested, latency tests prove that the T4 Routing Switch yielded 2.6 times less delay on average than the Cisco Catalyst 3550.

Results

Latency

Tests demonstrate that at 100% throughput with 1,518-byte frames, the T4 Routing Switch demonstrated average latency of 122 µs while the Catalyst 3550 achieved average latency of 358 µs, which shows that the T4 Routing Switch delivers 2.9 times less delay than the Catalyst 3550. With 512-byte frames, the T4 Routing Switch demonstrated average latency of 49 µs while the Catalyst 3550 demonstrated average latency of 132 µs, proving that the T4 Routing Switch offers 2.7 times less delay than the Catalyst 3550. Finally, with 64-byte frames, the T4 Routing Switch demonstrated average latency of 16 µs, while the average latency for the Cisco switch was 36 µs, proving that the T4 Routing Switch offers 2.2 times less delay than the Catalyst 3550. (See Figure 1.)

Layer 3 Fast Ethernet/Gigabit Ethernet Bidirectional Throughput

Results show that when offered 100% of the theoretical maximum traffic in a Fast Ethernet/Gigabit Ethernet Layer 3 IP environment with 16 ports in a

full-duplex, full-mesh environment, both the T4 Routing Switch and the Catalyst 3550 performed at wire speed. Full mesh represents each port sending traffic to every other port and each port receiving traffic from every other port. Full duplex represents an environment with no collisions so that a single port can transmit and receive traffic simultaneously. Both the T4 Routing Switch and the Catalyst 3550 forwarded 100% of line rate when handling 64-, 512- and 1,518-byte packets, with zero-loss. (See Figure 2.)

Throughput Evaluation with ACL Enabled

Tolly Group engineers subjected the T4 Routing Switch only to steady-state, zero-loss (≤0.001%), bidirectional, packet-per-second throughput tests of 64-, 512- and 1,518-byte frames in a full-mesh configuration with ACL enabled. Results show that the T4 Routing Switch forwarded 100% of the theoretical maximum throughput for all frames tested, with zero-loss.

Telco Systems, Inc.

T4 Routing Switch

Layer 3 Switch Competitive Evaluation

Telco Systems, Inc.
T4 Routing Switch
Product Specifications*

- Standards
  - IEEE 802.1d Spanning Tree Algorithm
  - IEEE 802.1p Priority Queuing
  - IEEE 802.1q VLAN Tagging
  - IEEE 802.3ad Link Aggregation *
  - IEEE 802.3x Flow Control
  - IEEE 802.3 Ethernet
  - IEEE 802.3u Fast Ethernet
  - IEEE 802.3z Gigabit Ethernet
  - RFC 768 UDP
  - RFC 783 TFTP
  - RFC 791 IP
  - RFC 792 ICMP
  - RFC 793 TCP
  - RFC 826 ARP
  - RFC 854 Telnet Client and Server
  - RFC 951 BootP
  - RFC 1058 RIP
  - RFC 1112 IGMP
  - RFC 1122 Host Requirements
  - RFC 1256 Router Discovery Protocol
  - RFC 1305 Network Time Protocol
  - RFC 1519 CIDR (Classless Inter-domain Routing)
  - RFC 1542 Bootstrap Extensions
  - RFC 1587 OSPF NSSA
  - RFC 1723 RIP V2
  - RFC 1812 Requirements for IP Version 4 Routers
  - RFC 1866 HTML
  - RFC 2068 HTTP
  - RFC 2131 BootP/DHCP Relay
  - RFC 2138 RADIUS
  - RFC 2139 RADIUS Accounting*
  - RFC 2178 OSPF
  - RFC 2236 IGMPv2
  - RFC 2328 OSPF V2
  - RFC 2338 VRRP
  - RFC 2362 PIM-SM/DM*
  - RFC 2474 DiffServ Precedence
  - RFC 2475 DiffServ Core and Edge Router Functions*
  - RFC 2597 DiffServ Assured Forwarding*
  - RFC 2598 DiffServ Expedited Forwarding*
  - RFC 2748 COPS Client*
  - Syslog: DVMRP v3*/GMRP/GVRP/RSVP*/SSH2*/PVST*
- Interfaces
  - 10/100BaseT (100m)
  - 10/100/1000BaseT (100m)
  - 100BaseFX Multi Mode (2km)
  - 100BaseFX Single Mode (20km)
  - 1000BaseSX Multi Mode (550m/10km)
  - 1000BaseLX Multi Mode and Single Mode (550m/10km)
  - 1000BaseLX Single Mode (20km, 70Km)
- Switching Characteristics
  - Bridging: IEEE 802.1d Spanning Tree algorithm
  - Address Table: 64K MA- addresses
  - Flow Control: 802.3x for full-duplex and back-pressure for half-duplex transmission
- Routing Characteristics
  - RIP I/RIP II/OSPF
  - Layer 2-4 Switching
  - Address Table: 64K IP-addresses, 17 default gateways
  - Traffic Shaping
- Management
  - SNMP Client
  - MIBs: RFC 1157 SNMP, RFC 1213 MIB II, RFC 1493 Bridge MIB, RFC 1591 DNS, RFC 1643 Ether Like MIB, RFC 1724 RIPv2 MIB, RFC 1757 RMON, RFC 2239 MAU, IETF Dot1p Dot1q MIB, BATM Enterprise MIB
  - TELNET
  - Internet: Java-based Web management
  - Interface: In-band/Out-of-band
  - Command Line Interface: RS-232 console with RJ-45 connector
  - SW Download: Via TFTP
- Management Features
  - VLANs Up to 4k VLANs per 802.1q
  - Bridging: Spanning Tree, aging
  - Class of Service: Four queues per port
  - Monitoring: Single/Multi-port mirroring

** Future*

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

QoS functionality verification

Tolly Group engineers conducted basic verification of the Quality of Service (QoS) functionality of the T4 Routing Switch only. When Tolly Group engineers configured the switch for the Weighted Round Robin Queuing QoS algorithm in a four-to-one port over-subscription configuration exercising four prioritized traffic queues, Tolly Group engineers verified that the appropriate percentages of frames were dropped from each queue.

Analysis

When users purchase an IP switching device, a key desirable factor is speed. One factor that influences a switch's overall performance in terms of speed is latency. The more latency involved, the slower the switch responds to processing packets due to the inherent delay. Ultimately, increased switch latency is a factor that translates into a slower speed switch.

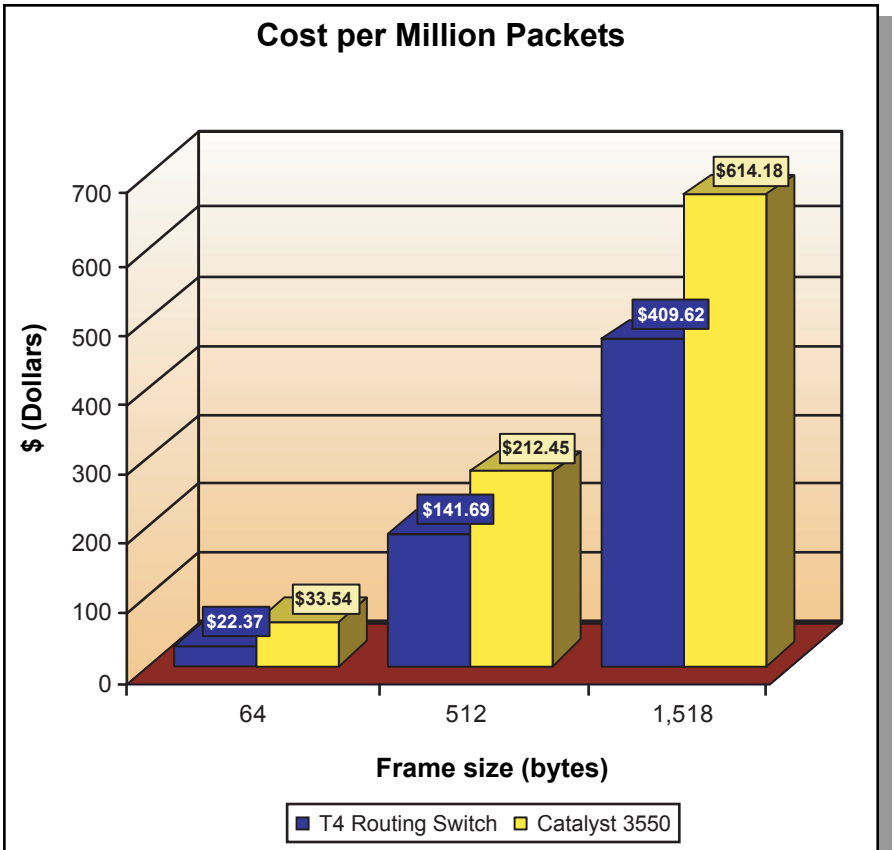
This is a particularly important factor in today's networks with the ever-growing deployment of latency-sensitive applications, such as voice. These latency tests demonstrated that the T4 Routing Switch exhibits latency at levels acceptable even for the most latency-sensitive applications, such as voice. In fact, the T4 Routing Switch outperformed the Catalyst 3550 delivering an average of 2.6 times less delay than the Catalyst 3550 for the packet sizes tested.

Given the rapidly growing bandwidth requirements of today's applications, customers are also looking to design networks with sufficient "headroom" to allow for peak loads approaching 100% network utilization. That requires, in turn, that the switching infrastructure can support heavy traffic loads without packet loss, even when all ports are suddenly deluged with wire-speed traffic. These tests demonstrate that the T4 Routing Switch can support sustained periods of wire-speed traffic on all ports simultaneously across frame sizes in mixed Fast Ethernet/Gigabit Ethernet configurations.

Additional throughput tests configured with an ancillary function enabled, such as ACL enabled, prove that the T4 Routing Switch is capable of high throughput even when handling multiple active services.

On another front, QoS functionality tests assure buyers that the T4 Routing Switch is capable of properly identifying the types of traffic that require higher priority and to dedicate higher bandwidth to such traffic at the expense of lower priority traffic, all while supporting 100% of the theoretical traffic loads.

Lastly, from a price/performance perspective, the T4 Routing Switch operates at 1.5 times less cost than the Cisco switch. The list price for the T4 Routing Switch as configured was $3,995 versus $5,990 for the Catalyst 3550 – $4,995 for the base unit and $500 for each module (see Figure 3).



Source: The Tolly Group, April 2002 *Figure 3*

Test Configuration and Methodology

For performance tests, The Tolly Group tested a Telco Systems, Inc. T4 Routing Switch, version BiNOS v3.5.9.3 against a Cisco Systems, Inc. Catalyst 3550-24, IOS v12.1(6)EA1a. (See Figure 4.)

Both devices were subjected to steady state, zero-loss (≤0.001%), bidirectional, packets-per-second (pps) throughput. Tests used 64-, 512- and 1,518-byte Ethernet frames at a load of 100% utilization, decreasing in 5% increments if the test tool reported greater than 0.001% loss. Engineers also subjected the T4 Routing Switch only to the aforementioned throughput tests with ACL enabled.

For throughput and latency tests, the device under test (DUT) connected to an IXIA 1600 via 16 Fast Ethernet and two Gigabit Ethernet connections. For QoS tests, the DUT connected to a Spirent Communications SmartBits SMB-6000 via 16 Fast Ethernet and two Gigabit Ethernet connections. An Acterna Domino Internetwork Analyzer also tapped into the traffic generator to verify packet content, but was removed before the performance tests commenced.

Engineers configured 16 Fast Ethernet ports on each switch and the two Gigabit Ethernet ports for the link speed each would support and full-duplex operation. The T4 Routing Switch was tested with its full complement of ports; the Catalyst 3550 switch was tested with 16 of its 24 Fast Ethernet ports and two Gigabit ports. Engineers disabled Spanning Tree, flow control and all other ancillary features that would otherwise have an impact on switch performance. Then they configured the traffic generator for the tested frame size, network utilization and test duration. Tests were run in a full-mesh configuration.

Engineers initiated each test and recorded results. If frame loss occurred, they repeated the test procedure and lowered the network utilization as stated until no frame loss occurred.

Ixia's ScriptMate application recorded total transmitted frames and total received frames, plus frame loss, if any. Tests were run for 60 seconds and results averaged.

Engineers conducted latency tests as defined in the RFC2544 test suite. Traffic was generated at 100% of the theoretical maximum for the various frame sizes tested in a port-pair configuration.

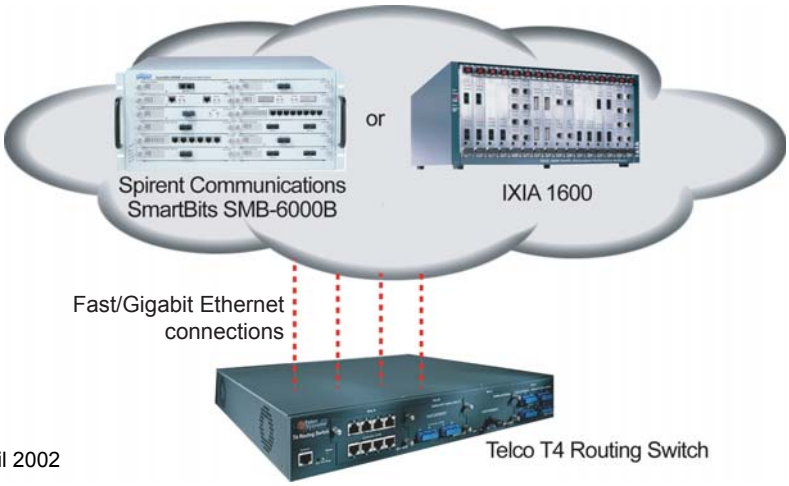
For QoS tests, engineers also configured the T4 Routing Switch for the Weighted Round Robin Queuing algorithm exercising four queues to one.

Equipment Acquisition and Support

The Catalyst 3550-24 was acquired through normal product distribution channels. The Tolly Group contacted executives at Cisco Systems and invited them to provide a higher level of support than available through normal channels. The executives at Cisco Systems declined to support the test. Although technical phone support is available, in fact, Tolly Group engineers did not require any technical assistance to configure the DUT.

The Tolly Group verified product release levels and shared test configurations with executive at Cisco Systems in order to give them an opportunity to optimize their devices for the tests. Results were shared with executives at Cisco Systems who neither acknowledged nor disputed their accuracy. For a more complete understanding of the interaction between The Tolly Group and Cisco Systems, 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 202109a).

Test Bed



Source: The Tolly Group, April 2002

Figure 4

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

Vendor	Product	Web address
Acterna Corp.	Domino DA-350 Internetworking Analyzer	http://www.acterna.com
Ixia	IXIA 1600	http://www.ixiacom.com
Ixia	ScriptMate 3.4	http://www.ixiacom.com
Raritan Computer	MasterConsole MX4	http://www.raritan.com
Spirent Communications	SmartBits 6000	http://www.spirentcom.com
Spirent Communications	SmartWindows	http://www.spirentcom.com

Tolly Group Services

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For info on the Fair Testing Charter, visit: www.tolly.com/About/ftc.asp

Project Profile

Sponsor: Telco Systems, Inc.
Document number: 202109a
Product class: Layer 3 switching
Products under test:
- Telco T4 Routing Switch
- Cisco Catalyst 3550-24

Testing window: March through April 2002
Software versions tested:
- T4 Routing Switch: BiNOS v3.5.9.3
- Catalyst 3550: IOS v12.1(6)EA1a

Software status:
- Generally available

Additional information available:
- Technical Support Diary

For more information on this document, visit our Web site at http://www.tolly.com, send E-mail to info@tolly.com, or call (732) 528-3300.

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