

Nortel, Inc.

Ethernet Routing Switch 2526T & 2550T

Competitive Performance Evaluation vs. Cisco

Catalyst 2960-24T & 48T, and ProCurve Networking 2626 & 2650



Test Summary

Premise: When considering the purchase of fixed-port, standalone Ethernet switches in entry-level enterprise, mid-market, and branch-office networks, IT execs need to know the bidirectional Layer 2 throughput, the device's frame forwarding rate, and its cost-per-Gigabit of throughput delivered.

Nortel commissioned The Tolly Group to evaluate the company's Ethernet Routing Switch (ERS) 2500 switches to determine their frame forwarding rate, throughput, and cost-per-Gigabit of throughput delivered.

Nortel's ERS 2500 series are Layer 2/Layer 3-capable switches, including the 24- and 48-port Fast Ethernet (FE) ERS 2526T and ERS 2550T, each supporting four Gigabit Ethernet (GbE) ports that can be used as uplinks or, for future use, the two ports at the back can be used for stacking.

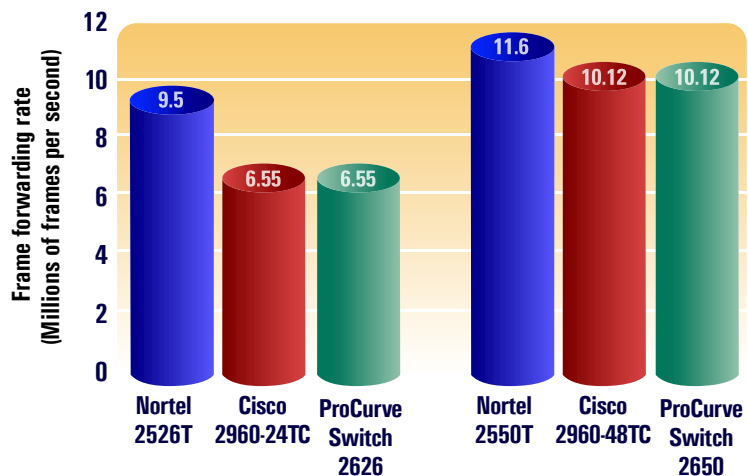
Engineers measured the ERS 2526T and ERS 2550T performance against Cisco Systems, Inc. Catalyst 2960-24TC and 48TC and ProCurve Networking by HP Switch 2626 and 2650 Layer 2/3 switches. Tests were conducted in March 2007.

Test Highlights

- ▶ Delivers superior performance of up to 9.52 and 11.6 million frames per second for 64-byte frames of switching capacity using Nortel's ERS 2526T and ERS 2550T, surpassing frame rates offered by Cisco and HP
- ▶ Offers a lower cost-per-Gigabit of throughput of \$109/\$153 for 24/48 ports, while the ProCurve and the Cisco switches offer \$143/\$159 and \$567/\$661, respectively
- ▶ Achieves wire-speed throughput across 24 FE + 2 GbE ports and 48 FE + 2 GbE ports of Nortel ERS 2500 series

Layer 2 Bidirectional Frame Forwarding Rate of Nortel ERS, Cisco Catalyst and HP ProCurve using 64-Byte Frames

as Reported by Spirent SmartFlow 5.5



Note: 1.) All switches tested with maximum available GbE uplink ports 2) The frame forwarding rate was measured in Layer 2 switching mode and bidirectional traffic was generated in a full-mesh configuration where the same port type was configured as a group.

Source: The Tolly Group, March 2007

Figure 1

Executive Summary

The Nortel ERS 2500 series demonstrated a higher switching capacity than competitors tested with a lower cost-per-Gigabit of throughput.

Enterprise network managers expect high-performance switching from their FE (10/100 Mbps) switching products, especially those that sup-

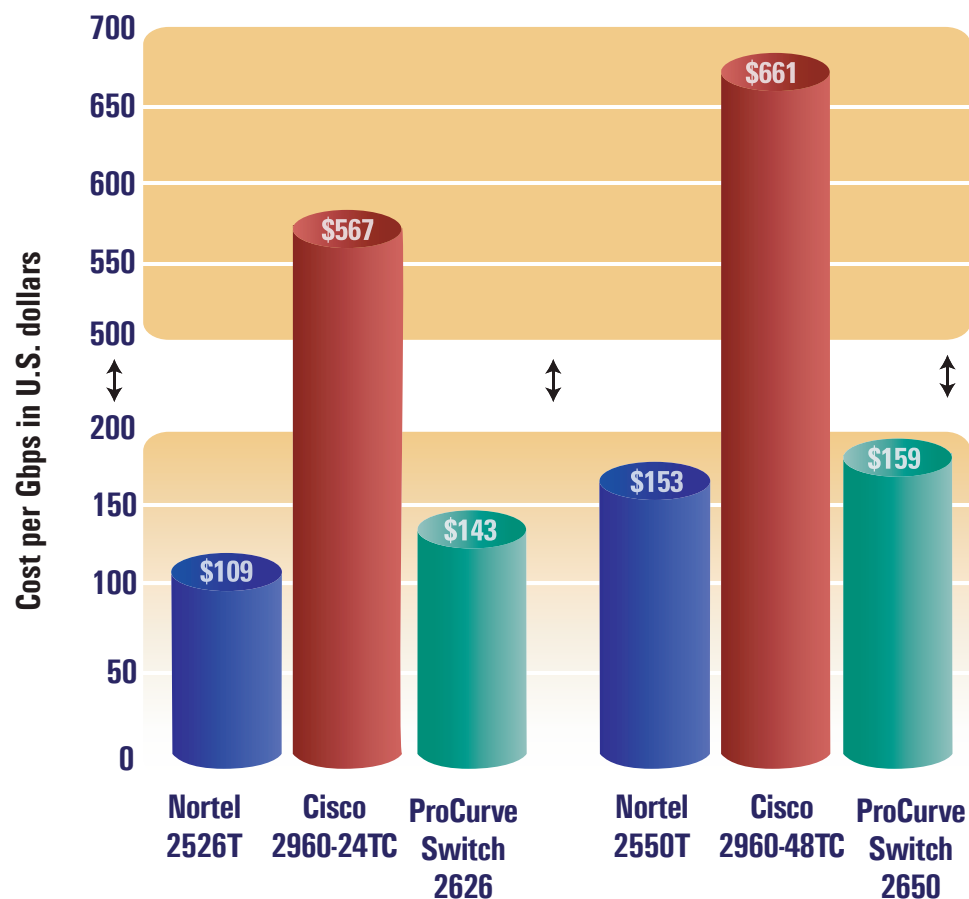
port GbE (10/100/1000 Mbps) in the form of uplinks. Of the switches tested, only the Nortel ERS 2500 series has two extra GbE ports for a total of four GbE ports. This is a very powerful feature when departments or branch offices need to expand their workgroup network to accommodate new employees.

The Nortel ERS switches (with four GbE ports) achieved a higher frame-forwarding rate versus the Cisco Catalyst 2960 series and ProCurve Switch

2600 series, offering 45% greater forwarding performance for the 24-port scenario and 16% greater forwarding for the 48-port test.

To obtain the cost of each switch as a factor of performance, engineers computed a cost-per-Gigabit of throughput. In both the 24-port and 48-port test scenarios, the ERS switches were 4X to 5X less costly than the Cisco switches tested. The ERS switches even offered a better cost-per-Gigabit than the ProCurve switches

Cost per Gigabit of Throughput in a Standalone Configuration



Note: 1.) The MSRP system prices, in U.S. dollars, for all switches was gathered from Unistar-Sparco Computers, Inc., a Cisco Systems certified reseller. Prices were gathered during March 2007 and represent hardware prices only, not including support costs. The metric was obtained by dividing the price of each switch by the throughput achieved in a standalone switch configuration. 2.) All switches tested with maximum GbE uplinks. Nortel ERS switches support four, the others support two ports. 3.) The frame forwarding rate was measured in Layer 2 switching mode and bidirectional traffic was generated in a full-mesh configuration where same port type were configured together as a group.

Source: The Tolly Group, March 2007

Figure 2

tested, though the cost delta was not as significant.

LAYER 2 FRAME FORWARDING RATE

The Nortel 2500 series Layer 2 bidirectional frame forwarding rate using 64-byte frames achieved 9.52 million fps for the 24-port switch scenario (24 FE + 4 GbE ports), versus 6.55 million fps each for the Catalyst 2960 and the ProCurve Switch 2626.

For the 48-port test scenario, the ERS 2550T

achieved frame forwarding of 11.6 million fps, versus 10.12 million fps each for the Catalyst 2960 and the ProCurve Switch 2650. (See Figure 1.)

COST VERSUS THROUGHPUT

For cost-conscious network managers, the switch of choice is one that can perform at a high level while simultaneously keeping the cost low for each Gigabit of throughput delivered.

In terms of switching capacity, the Nortel ERS 2526T offered 6.4 Gbps for 24 FE + 4 GbE ports and the ERS 2550T offered 7.8 Gbps for 48 FE + 4 GbE ports. The Catalyst 2960 and the ProCurve switches each

Nortel, Inc.



ERS 2500 Series

Layer 2 Frame Forwarding Rate, Price-per-Gigabit of Throughput

Product Specifications

Vendor-supplied information not necessarily verified by The Tolly Group

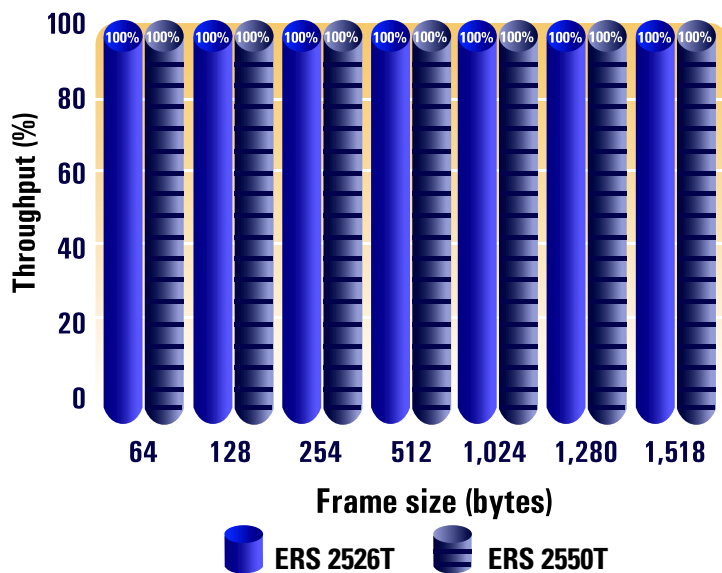
ERS 2526T & 2550T Specifications:

- Height: 4.45 cm (1.75 in)
- Width: 43.82 cm (17.25 in)
- Depth:
 - 2526T/PWR: 30.7 cm (12.13 in)
 - 2550T/PWR: 36.7 cm (14.56 in)
- Switching capacity: 12.8 Gbps for ERS 2526T and 15.6 Gbps for ERS 2550T switches
- Frame forwarding rate max: 9.523 Mpps for ERS 2526T and 11.606 Mpps for ERS 2550T
- Port forwarding performance
 - 10 Mbps: 14,880 pps maximum (64-byte packets)
 - 100 Mbps: 148,810 pps maximum
 - 1000 Mbps: 1,488,100 pps maximum
- Forwarding database size: 16,000 entries
- Frame length
 - 64 to 1,518 bytes (IEEE 802.1q Untagged)
 - 64 to 1,522 bytes (IEEE 802.1q Tagged)
- Multi-Link Trunks (and 802.3ad)
 - Up to six trunks, four link members per trunk VLANs
 - Up to 256 port-based; per VLAN Tagging option
- Multiple Spanning Tree Groups: Up to eight (802.1w/s)
- Interface options: 10BASE-T/100BASE-TX/1000BASE-T RJ-45 (8-pin modular) connectors for Auto MDI/MDI-X interface

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Bidirectional Zero-loss (0.001%) Layer 2 Throughput of Nortel ERS 2526T and ERS 2550T as reported by Spirent SmartFlow 5.50



Note: 1.) All switches were tested with two GbE ports and either 24 or 48 FE ports. 2.) The frame-forwarding rate was measured in Layer 2 switching mode and bidirectional traffic was generated in a full-mesh configuration where the same port type was configured together as a group.

Source: The Tolly Group, March 2007

Figure 3

achieved 4.4 Gbps for 24 FE + 2 GbE ports and 6.8 Gbps for 48 FE + 2 GbE ports.

Tolly Group engineers computed the cost-per-Gigabit of throughput. The ERS 2526T offered the lowest cost among 24-port switches at \$109, 23% less than the ProCurve Switch 2626 and five times less than the Cisco Catalyst 2960. On the 48-port switch side, the ERS 2550T had the lowest cost at \$153 per Gigabit, 4% less than the ProCurve Switch 2650 and more than 4X less than the Cisco Catalyst 2960. (See Figure 2.)

WIRE-SPEED LAYER 2 THROUGHPUT

Tolly Group engineers verified that both the ERS 2526T and ERS 2550T achieved 100% zero-loss throughput in 24- and 48-port FE tests (with two GbE ports). (See Figure 3.)

SMLT vs. RSTP EASE OF CONFIGURATION

Engineers counted the number of CLI commands required to configure either SMLT or RSTP on each vendor's switches in the test bed.

The result showed that Nortel's test bed, consisting of one Nortel ERS 2526T edge switch, one Nortel ERS 2550T edge switch, and two Nortel ERS 8600 core switches running

SMLT, required a total of 60 CLI commands. (See Figure 4.)

In comparison, Cisco's test bed, consisting of a Cisco Catalyst 2960-24T edge switch, one Cisco Catalyst 2960-48T edge switch, and two Cisco Catalyst 6500 core switches, required 156 CLI commands to configure RSTP. That's more than 2.5X the CLI commands needed to configure the Nortel switches.

The ProCurve Networking test bed, consisting of two ProCurve Switch 9300 core switches and two ProCurve switch 2600 series switches, required 96 CLI commands to full configure RSTP, or 60% more commands than were needed to configure the Nortel switches.

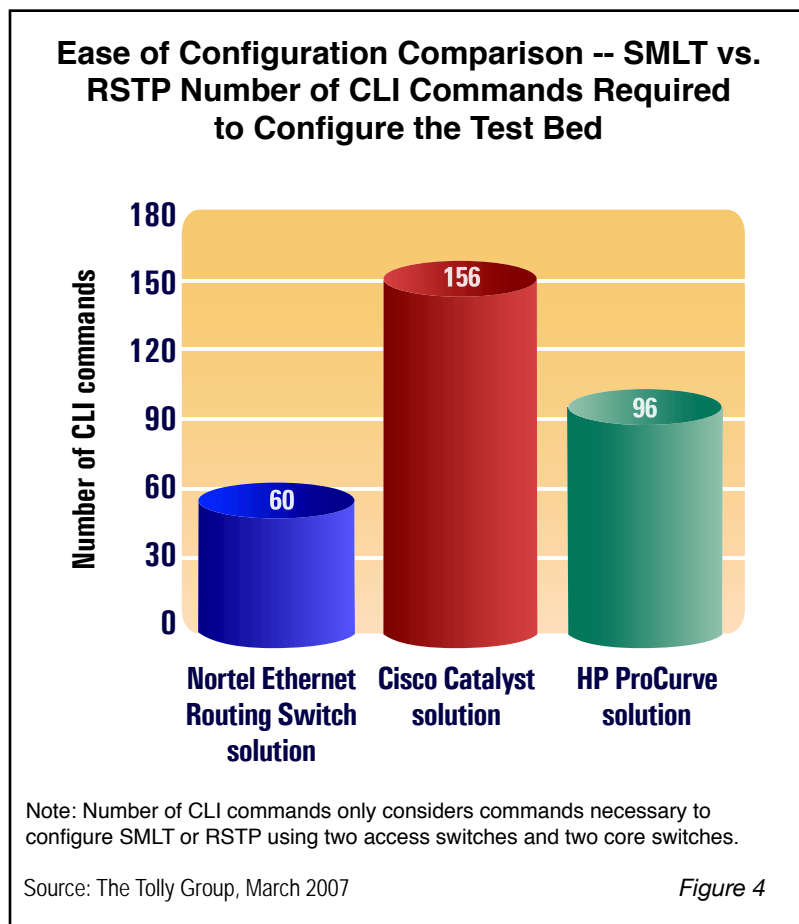
This demonstrates that the Nortel ERS switches required fewer CLI commands for configuration, resulting in greater ease of configuration than other tested devices. This is due to the ERS 2526T and ERS 2550T at the edge to integrate seamlessly into an SMLT core.

Test Setup and Methodology

Tolly Group engineers tested the Nortel ERS 2500 series (2526T and 2550T), Cisco Catalyst 2960 series (24TC and 48TC), and ProCurve Switch 2600 series (2626 and 2650), with switch software version 4.0, 12.2 (25) SEE2, and H.08.98 respectively.

FRAME FORWARDING RATE

For measuring the maximum frame-forwarding rate, engineers used Spirent SmartBits SmartFlow 5.50 to create two groups of full-mesh bidirectional ($\leq 0.001\%$ acceptable frame loss) configuration with a



64-byte frame size. The first group was for all the FE ports and the second group was for all the GbE ports. Tests were run three times for 60 seconds and an average was computed.

COST VERSUS THROUGHPUT

For this test, engineers used frame-forwarding rate results and gathered all the Device Under Test (DUT) MSRP retail prices from Unistar-Sparco Computers, Inc. (a Cisco authorized reseller.) Engineers computed the cost-per-Gigabit by dividing the cost by the throughput.

LAYER 2 THROUGHPUT

For this test, engineers used the same configuration from frame forwarding rate test. Instead of using 64-byte frames only, engineers used RFC 2544 specified frame sizes (64-, 128-, 256-, 512-, 1,024-, 1,280-, 1,518-byte frames.)

All tests were run for three iterations 60 seconds and the results were averaged.

SMLT vs. RSTP EASE OF CONFIGURATION

For this test, engineers created three independent switch solutions for each vendor. The Nortel ERS switch solution consisted of one Nortel ERS 2526T edge switch, one Nortel ERS 2550T edge switch, and two Nortel ERS 8600 core switches. (See Figure 4.)

Engineers configured Nortel switches using

Nortel’s Split Multi-Link Trunking (SMLT) which is an alternative to any Spanning Tree-based protocol (RSTP, MSTP, 802.1D).

For the Cisco Catalyst switch solution, engineers configured all switches with RSTP: one Cisco Catalyst 2960-24T edge switch, one Cisco Catalyst 2960-48T edge switch, and two Cisco Catalyst 6500 core switches. Lastly, for the ProCurve Networking switch solution with RSTP, engineers configured two ProCurve Switch 9300 core switches and did not configure ProCurve Switch 2600s since they have RSTP service enabled by default.

For every edge switch, engineers configured four ports into a VLAN. Of those four ports, a set of two ports was connected to one core switch and another set was connected to another core switch. At the core switches, engineers configured

three VLANs, two VLANs were link to edge switches and another VLAN was used for Trunking between two core switches.

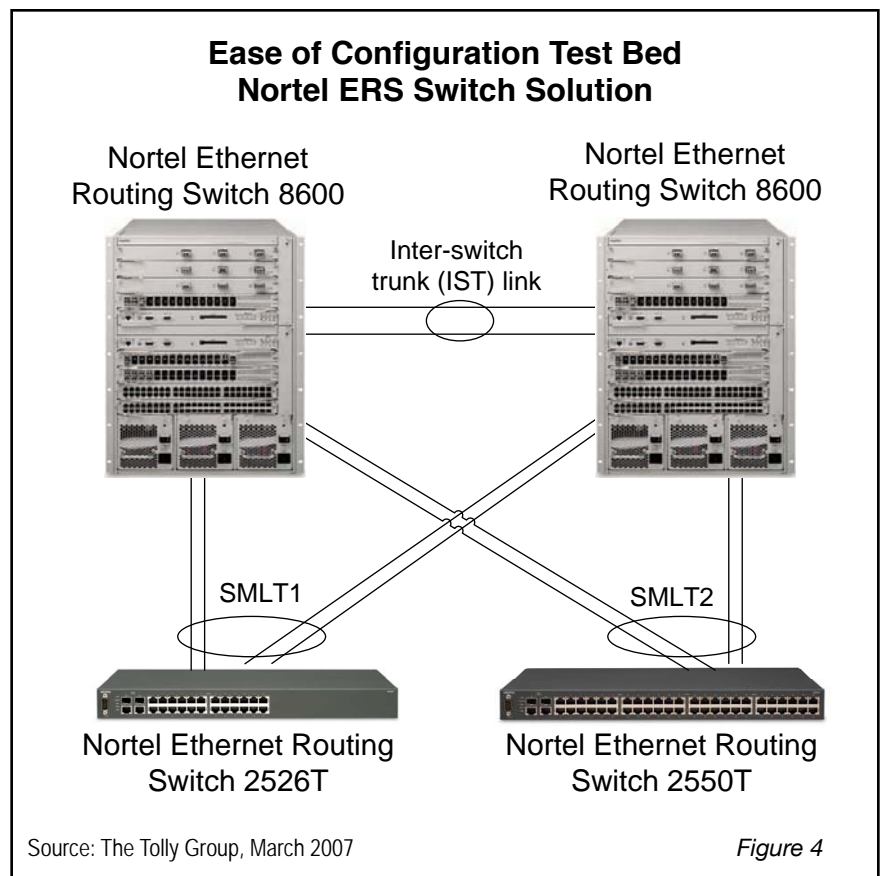
Tolly Group engineers counted the number of CLI commands required to configure the switches in the test bed for SMLT versus RSTP.

VENDOR INTERACTION

The Tolly Group invited Cisco and ProCurve Networking to participate in the testing as per The Tolly Group’s Fair Testing Charter .

Representatives from Cisco did not respond to the invitation while ProCurve participated.

Tolly Group engineers shared test methodology with ProCurve Networking, and implemented the company’s recommendations to ensure the testing of the ProCurve switch was performed



accurately. ProCurve was provided an opportunity to review the test results. ProCurve did not contest the validity of the test results. All switches were supplied by Nortel, which acquired them through normal distribution channels.

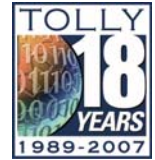


ERS 2526T



ERS 2550T

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



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 Web: <http://www.tolly.com>,
 E-mail: sales@tolly.com

Devices Under Test (DUT)
Nortel ERS Switch 2526T (Software ver. 4.0)
Nortel ERS Switch 2550T (Software ver. 4.0)
Nortel ERS 8600 (Software ver. 4.1)
Cisco Catalyst 2960-24TC (Software ver. 12.2 (25) SEE2)
Cisco Catalyst 2960-48TC (Software ver. 12.2 (25) SEE2)
Cisco Catalyst 6500 (Software ver. 12.2(18) SXD5)
ProCurve Networking Switch 2626 (Software ver. H.08.98)
ProCurve Networking Switch 2650 (Software ver. H.08.98)
ProCurve Networking Routing Switch 9304m Software ver. 07.8.00aT53



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