

Digital Equipment Corporation

Fast Ethernet Switching Competitive Evaluation

Digital Equipment Corporation MultiSwitch 900/VNswitch 900XX –
Cisco Systems Inc. Catalyst 5000 – 3Com Corp. CoreBuilder 5000

Test Summary

Digital Equipment Corporation commissioned The Tolly Group to benchmark the switching throughput of the Digital Equipment Corporation MultiSwitch 900/VNswitch 900 with the Cisco Systems, Inc., Catalyst 5000, and the 3Com Corp. CoreBuilder 5000. The Tolly Group tested multi-stream Fast Ethernet performance. Additionally, for those customers concerned with overload conditions (all switch ports fully saturated), The Tolly Group examined frame loss characteristics under such conditions. Testing focused on inter-module traffic (i.e., across the backplane) since the densities of switching chassis interfaces required by today's enterprise network managers result in high levels of inter-module (backplane) traffic flows. Testing was performed in September of 1997.

Test results show that the MultiSwitch 900 delivered higher aggregate throughput in all test configurations than either the Catalyst 5000 or the CoreBuilder 5000. In saturation testing, the MultiSwitch 900 exhibited significantly less frame loss than either the Catalyst 5000 or the CoreBuilder 5000.

TEST RESULTS

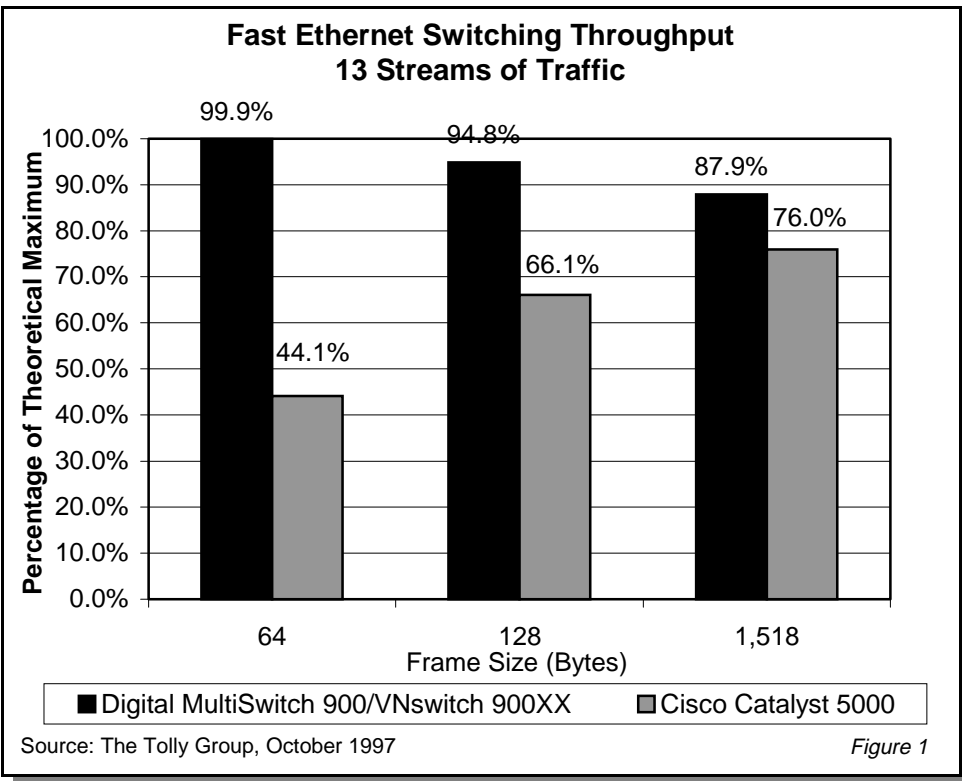
MULTISWITCH 900/VNSWITCH 900XX VS. CATALYST 5000, 13 STREAMS (26 PORTS)

The Tolly Group tested both the MultiSwitch 900 and the Catalyst 5000 for steady-state throughput and for frame loss characteristics when forwarding thirteen simultaneous single-directional Fast Ethernet streams. The streams were primarily inter-module (see Test Configurations section for details).

The MultiSwitch 900 forwarded traffic at 99.9% of wire-speed with 64-Byte frames for an aggregate switching throughput of 0.99 Gbit/s. Using 128-Byte Frames, 94.8% of wire speed (aggregate of 1.07 Gbit/s) was observed, and with 1518-Byte frames 87.9% of wire speed (1.13 Gbit/s) was observed. In contrast, the Catalyst 5000 was limited to a steady state perfor-

Test Highlights

- MultiSwitch 900/VNswitch 900XX provides up to 2.25 times greater Fast Ethernet switching throughput than the Catalyst 5000
- MultiSwitch 900/VNswitch 900XX provides up to 1.9 times greater Fast Ethernet switching throughput than the CoreBuilder 5000
- In 13 Stream overload tests, the MultiSwitch 900/VNswitch 900XX's frame loss ranged from 0.1%-11% while the Catalyst's frame loss ranged from 24% - 56%
- In 4 Stream overload tests, the MultiSwitch 900/VNswitch 900XX's frame loss ranged from 0.1%-6.4% while the CoreBuilder's frame loss ranged 50% - 60%



mance of 44.1% of wire-speed with 64-Byte frames for an aggregate throughput of only 0.44 Gbit/s. When forwarding 128-Byte frames, throughput only reached 66.1% of wire speed

(aggregate of 0.74 Gbit/s). Even with Fast Ethernet's largest frame size (1518 Bytes) throughput only reached 76.0% of wire speed (aggregate of 0.97 Gbit/s). See figure 1.

The MultiSwitch 900 exhibited low frame-loss characteristics as well. In saturation testing, the MultiSwitch 900 exhibited frame loss of less than 0.1% with small frame sizes and less than 10.5% with large frame sizes. The Catalyst 5000, when offered the same load exhibited more than 55.9% frame loss with small frames, and more than 24.0% frame loss with large frames. See figure 3.

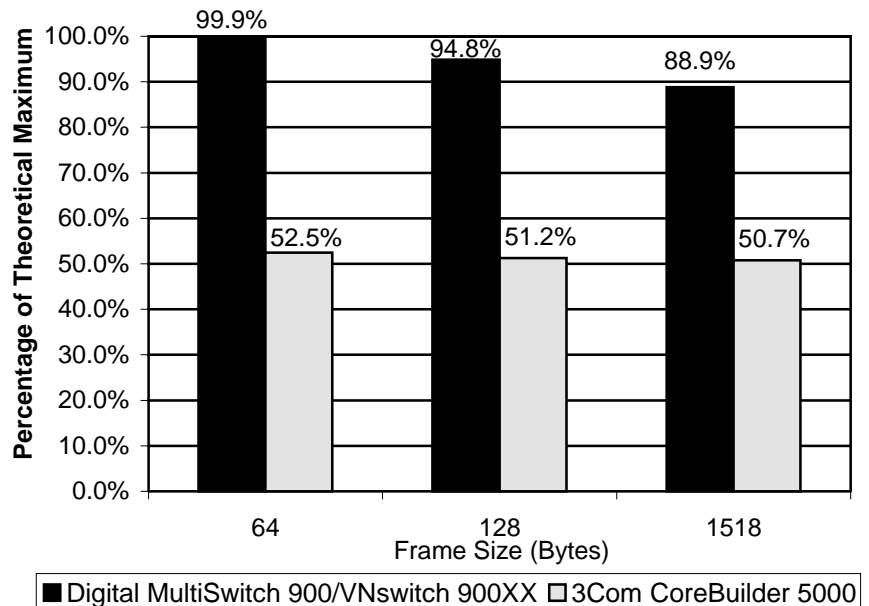
MULTISWITCH 900/VNswitch 900XX vs. COREBUILDER 5000, 4 STREAMS (8PORTS)

The Tolly Group tested both products for steady-state throughput and frame loss characteristics when forwarding four simultaneous single-directional inter-module Fast Ethernet streams. Note: for logistical reasons both systems were tested with only 8 Fast Ethernet ports (2 modules). The CoreBuilder 5000 can support up to 7 modules and the MultiSwitch 900 can support up to 8 modules (see Test Configuration section).

The MultiSwitch 900 exhibited throughput consistent with previous results, forwarding traffic at 99.9% of wire-speed (aggregate of 304.5 Mbit/s) with 64-Byte frames, 94.8% of wire speed (aggregate of 328.1 Mbit/s) with 128-Byte frames, and 88.9% of wire speed (aggregate of 350.8 Mbit/s) with 1518-Byte frames. In contrast the CoreBuilder 5000 was limited to steady-state performance of 52.5% of wire-speed (aggregate of 159.9 Mbit/s) with 64-Byte frames, 51.2% of wire speed (aggregate of 177.3 Mbit/s) with 128-Byte frames, and 50.7% of wire speed (aggregate of 200.3 Mbit/s) with 1518-Byte frames. The results for 3Com are apparently attributable, in part, to a per module throughput limitation of 200 Mbit/s to the backplane. In prototype tests involving only 2 inter-module streams (not shown), the device achieved wire speed throughput. When 4 streams were directed across the backplane (inter-module) the aggregate throughput of the CoreBuilder 5000 remained around 200 Mbit/s or 50% utilization. See figure 2.

The MultiSwitch 900 once again exhibited low frame-loss characteristics in line with previous results. Saturation testing again revealed that the MultiSwitch 900 exhibited frame loss of less than 0.1% for the smallest frame size and less than 5.3% with the largest frame size. The CoreBuilder 5000, when offered the same load exhibited more than 59.8% frame loss with the smallest size frame, and more than 49.8% frame loss with the largest size frame. See figure 4.

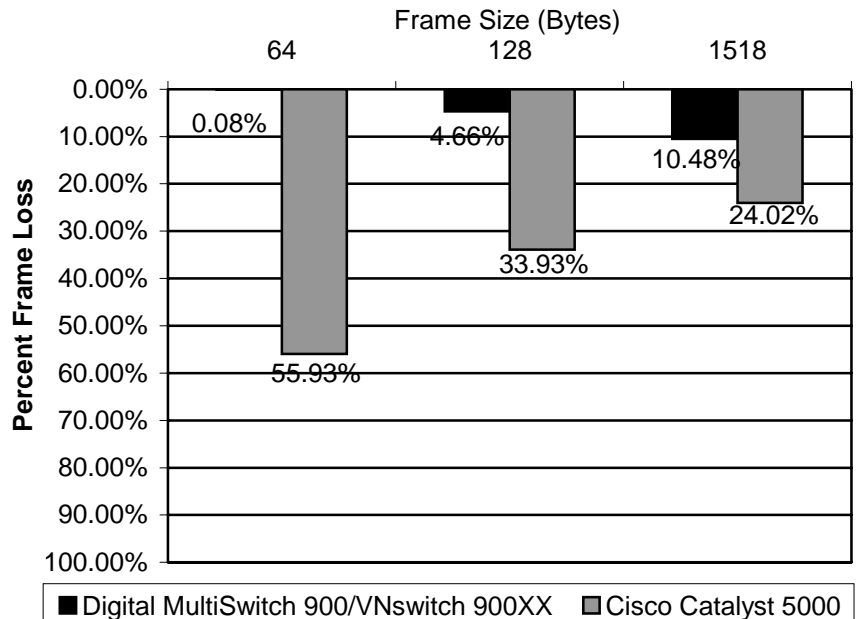
Fast Ethernet Switching Throughput 4 Streams of Traffic



Source: The Tolly Group, October 1997

Figure 2

Aggregate Frame Loss (Offered Load of 100% Bandwidth) 13 Streams of Traffic



Source: The Tolly Group, October 1997

Figure 3

TEST METHODOLOGY

TEST BED

The Tolly Group used two NetCom Systems Inc. SmartBits Advanced Multiport Performance Test/Simulator/Analyzers

consisting of one SMB-1000, and one SMB-10 running firmware version 5.12 and SmartWindows Console version 6.20, and equipped with 26 100 Mbit/s Fast Ethernet modules model SX-7405 (100Base-TX). For Fast Ethernet monitoring and analysis, The Tolly Group used the Smart-

Bits in conjunction with two Wandel & Goltermann DominoFastEthernet Inter-network Analyzers model DA-350 Version BN 9316/01 running software version 2.2 Patch 1.

The Tolly Group connected the "input" ports of the switch under test directly to the traffic generation equipment, and connected the "output" ports directly to the traffic monitoring equipment. Additionally, The Tolly Group connected a DominoFastEthernet "in line" between the switch under test and one of the frame generators. A second DominoFastEthernet was placed between the switch under test and the traffic monitoring equipment.

TEST CONFIGURATIONS

Tests conducted between the MultiSwitch 900 and the Catalyst 5000 for steady-state throughput and for frame loss characteristics utilized thirteen simultaneous single-directional Fast Ethernet streams. Twelve streams were inter-module (i.e., each of the traffic streams exited the device under test through a different module than that through which it entered the device). The thirteenth stream was intra-module (i.e., the traffic stream exited the device under test through the same module through which it entered the device).

The MultiSwitch 900 was configured such that each of six modules would support either four input ports or four output ports, and a seventh module would support one input port and one output port. Each Fast Ethernet switch module (VNswitch 900XX) on the MultiSwitch 900 supports up to 4 Fast Ethernet ports (fully populated, the MultiSwitch 900 supports 32 Fast Ethernet ports).

The Catalyst 5000 was configured such that two of the modules supported either twelve input ports or twelve output ports. The Supervisory Engine Module II (SEM II), which includes two Fast Ethernet ports, supported a single intra-module stream. Each Fast Ethernet switch module (10/100 Fast Ethernet Switching Module – WS-X5213A) supports up to 12 Fast Ethernet ports (fully populated the Catalyst 5000 supports 50 Fast Ethernet ports). Both switches were configured such that input and output ports of any stream were located on adjacent modules. All switch ports were configured to operate in Full Duplex mode and all traffic was uni-directional.

Tests conducted between the MultiSwitch 900 and the CoreBuilder 5000 for steady-state throughput and frame loss

characteristics utilized four simultaneous single-directional inter-module Fast Ethernet streams (i.e., each of the traffic streams exited the device under test through a different module than that through which it entered the device).

The MultiSwitch 900 was configured such that one module would support four input ports and a second module would support four output ports (port density for the MultiSwitch 900 is listed above).

The CoreBuilder 5000 was also configured such that one module would support four input ports, and a second module would support four output ports. Each Fast Ethernet SwitchModule supports up to 4 Fast Ethernet ports (fully populated the CoreBuilder 5000 supports 28 Fast Ethernet ports) Both switches were configured such that input and output ports of inter-module streams were located on adjacent modules. All switch ports were configured to operate in Full Duplex mode and all traffic was uni-directional.

REVISION LEVELS

Digital Equipment Corporation MultiSwitch 900: Model – DMHUB-MB (Note: "–MB" refers to the MultiSwitch 900 with no power supplies, whereas "–AA" refers to the MultiSwitch 900 with 1 power supply); Hardware – REV F; ROM – V1.1.6; Software – V5.2. VNswitch 900XX (Fast Ethernet Module): Part Number – DVNXX-MX; Hardware – REV A02; Software – V1.6-002. Digital states that the VNbus backplane capacity of the MultiSwitch 900 is 1.2 Gbit/s.

Cisco Systems Inc., Catalyst 5000: Model – WS-C5000. Supervisory Engine Module II (SEM II): Model – WS-X5509; McpSW – 2.2(2); NmpSW – 2.2(2); System Bootstrap 2.2(1); Hardware 1.2. 10/100 Mbits Fast Ethernet Switching Module: Model – WS-X5213A; Hardware 1.1; Firmware 1.4; Software 2.2(2). Cisco states that the backplane capacity of the Catalyst 5000 is 1.2 Gbit/s.

3Com Corporation CoreBuilder 5000: Model – 6007CH-AP; Operational – v5.10-H; Boot v1.03. Controller Module: Model – 6000M-ARCTL; Version v1.14. Fast Ethernet SwitchModule: Model – 6604M-TX-A; Version – v2.00. 3Com states that the Packet-Channel backplane capacity of the CoreBuilder 5000 is 2 Gbit/s.

**Digital
Equipment
Corporation**

**MultiSwitch
900**

**Switching
Throughput**



Digital Equipment Corporation MultiSwitch 900/VNswitch 900 Product Specifications*

The DIGITAL VNswitch 900 is a family of multi-layer, multi-technology enterprise class switching products.

- Aggregate switching of 750,000 packet per seconds per module
- 100,000 pps IP routing per module
- Integral SNMP management and telnet support
- Robust industry standard VLAN support
- 8,192 network addresses
- Firmware upgradable via TFTP
- Fully IEEE 802.1d compliant
- Support for Ethernet, Fast Ethernet, FDDI, ATM, and Gigabit Ethernet

The DIGITAL MultiSwitch 900 system is an eight slot, switching chassis with a unique, technology independent backplane which is scalable up to 5.6 Gbit/s.

- 5.6 Gbit/s aggregate backplane bandwidth
- Integral SNMP management agent
- Supports 192 switched 10Base-T ports
- Supports 16 switched ATM ports
- Supports 16 switched DAS FDDI ports
- Will support up to 8 Gigabit uplinks in first half of 1998
- Supports 128 switched Fast Ethernet ports (mid-1998)
- Supports a wide array of local/wide area routers, remote access products, and shared Ethernet/Fast Ethernet hub products
- Fully hot swappable N+1 redundant power

For additional information contact:
Digital Equipment Corp. at
800-457-8211 or 978-692-2562
<http://www.networks.digital.com>

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

TEST PROCEDURE

The Tolly Group first calibrated the test equipment to verify the accuracy of results, then recorded frame sizes and frame rates for each test as they were reported by the SmartBits. The Tolly Group also compared input and output frame sizes and rates as the test proceeded on at least one traffic stream with a DominoFastEthernet.

The Tolly Group began by generating traffic on all streams simultaneously at full bandwidth and recording any differences between the offered and received loads on each stream. The Tolly Group considered the switch to deliver zero-loss performance if the offered load and received loads differed by less than 2% (the margin of error of the test equipment). If the difference was greater than 2% on any stream, The Tolly Group recorded the aggregate frame loss across all streams (as a percentage of offered load) and reduced the offered load on all streams by the same rate until the offered and received streams differed by less than 2%.

TEST CALCULATIONS

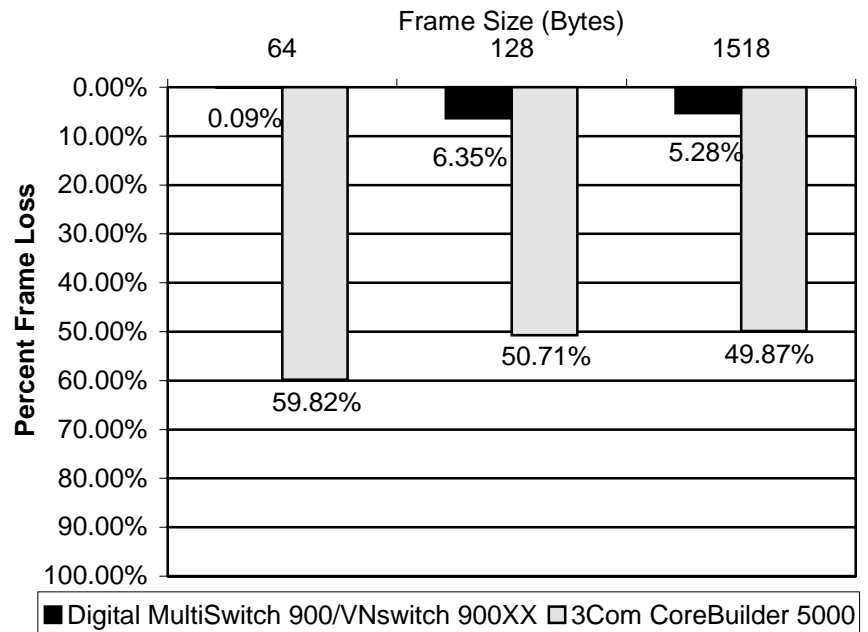
Frame sizes on Fast Ethernet included 4 bytes of CRC. Theoretical maximum fps rates for Fast Ethernet were calculated by adding 20 bytes to each frame size to ac-

count for 0.96 microsecond interframe gap (equivalent to 12 bytes) and preamble (8 bytes). Thus, the maximum Fast Ethernet frame rate in fps for a frame of X bytes is

defined by the following formula:

$$(100,000,000 \text{ Bit/s}) / ((8 \text{ Bits/Byte}) * (X + 20))$$

Aggregate Frame Loss (Offered Load of 100% Bandwidth) 4 Streams of Traffic



Source: The Tolly Group, October 1997

Figure 4

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

Vendor

Wandel & Goltermann

Product

DominoFastEthernet

Web address

<http://www.wg.com>

ABOUT THE TOLLY GROUP

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The Tolly Group is recognized worldwide for its expertise in assessing leading-edge technologies. By combining engineering-caliber test methodologies with informed interpretation, The Tolly Group consistently delivers

meaningful analyses of technology solutions. The Tolly Group has published more than 400 product evaluations, network design features and columns in the industry's most prestigious publications.

Kevin Tolly is President and CEO of The Tolly Group. He is a leading industry analyst and is responsible for guiding the technology decisions of major vendor and end-user organizations. In his consulting work, Tolly has designed enterprise-wide networks for government agencies, banks, retailers, and manufacturers.

For more information on The Tolly Group's services, visit our World Wide Web site at <http://www.tolly.com>, email to info@tolly.com, call 800-933-1699 or 732-528-3300, or fax 732-528-1888.

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