

# Foundry Networks, Inc.

## BigIron 4000

### Layer 2 & Layer 3 Interoperability Evaluation

Test  
Summary



*Premise: Network managers who employ a blend of Fast Ethernet/ Gigabit Ethernet switch brands in their networks need to know the extent that their devices interoperate with one another.*

Foundry Networks Inc. commissioned The Tolly Group to evaluate the Layer 2 and Layer 3 interoperability of the BigIron 4000. The Tolly Group put the BigIron 4000 through a battery of tests designed to reveal the depth of interoperability the switch provides. The Tolly Group tested the BigIron 4000's interoperability as it relates to 11 other switches from six competing vendors. Testing was performed in August 1999.

Tests were broken down into three groups: Layer 2 tests including auto-negotiation, link aggregation and Gigabit Ethernet uplink support; Layer 3 tests including IP routing, IP RIP and IPX RIP support; and support for the virtual router redundancy protocol (VRRP).

#### LAYER 2 RESULTS

##### AUTO-NEGOTIATION

Each pair of switches must properly negotiate the highest speed and duplex settings common to both devices. The Tolly Group tested the BigIron 4000's auto-negotiation against 11 other switches. Tests proved that the BigIron 4000 interoperates with all of the competing brand switches in the test, including Cabletron Systems, Cisco Systems,

### Test Highlights

- Delivers full interoperability with switches participating in Layer 2 tests
- Exchanges RIP tables with other switches that support IP/IPX RIP and IP routing to foster dynamic route configurations
- Supports VRRP to provide and accept hot standby services with other brand switches

### Foundry Networks BigIron 4000 Layer 2 Interoperability Test Results

Devices Tested	Layer 2 Tests Conducted		
	Auto-negotiation	Link Aggregation	Gigabit Uplinks
Cabletron SmartSwitch 6000	✓	✓	✓
Cabletron SmartSwitch Router 8000	✓	✓	✓
Cisco Catalyst 2948G	✓	✓	✓
Cisco Catalyst 8510	✓	✓	✓
HP ProCurve Switch 9304M	✓	✓	✓
HP ProCurve Switch 4000M	✓	✓	✓
IBM 8275 Fast Ethernet Switch	✓	US	US
IBM 8371 Fast Ethernet Switch	✓	✓	US
Lucent Cajun P550 Gigabit Ethernet Switch	✓	✓	✓
Lucent Cajun P120 Workgroup Switch	✓	✓	✓
Nortel Accelar 1200	✓	✓	✓

**Key:** ✓ = Pass    US = The device does not support that feature

Source: The Tolly Group, October 1999

Figure 1

Hewlett-Packard, IBM, Lucent Technologies, and Nortel Networks. See figure 1.

Foundry's successful interoperability of auto-negotiation validates the BigIron 4000's capability to handshake with different brand switches and negotiate a maximum port speed and settings on both sides.

#### LINK AGGREGATION

Each switch pair must interoperate over a single aggregated link consisting of two full-duplex, Fast Ethernet links. The Tolly Group tested the BigIron 4000's support for link aggregation with 11 other switches — submitted by six vendors — that also support link aggregation. The BigIron 4000 passed the link aggregation interoperability test with products from Cabletron, Cisco, HP, Lucent, IBM and Nortel. See figure 1.

The BigIron 4000's successful interoperability in the link aggregation test means the Foundry switch can form a trunk link with different brand switches and transmit data over it.

#### GIGABIT ETHERNET UPLINKS

Each pair of switches must interoperate across a single, full-duplex Gigabit Ethernet (1000Base-SX) uplink. The Tolly Group determined that the BigIron 4000 interoperates with all the switches tested that support Gigabit Ethernet uplinks. See figure 1.

The relevance of this test is that the BigIron 4000 can communicate with other brand switches over a Gigabit Ethernet uplink.

#### LAYER 3 RESULTS

##### IP ROUTING

Each switch pair must exchange routing table information using

### Foundry Networks BigIron 4000 Layer 3 Interoperability Test Results

Devices Tested	Layer 3 Tests Conducted		
	IP Routing	IP RIP (Versions 1 & 2)	IPX RIP
Cabletron SmartSwitch Router 8600			
Cisco Catalyst 8510			
HP ProCurve Switch 9304M			
IBM 8371 Fast Ethernet Switch			
Lucent Cajun P550 Gigabit Ethernet Switch			
Nortel Accelar 1200			

Key: = Pass

Source: The Tolly Group, October 1999

Figure 2

### Foundry Networks BigIron 4000 VRRP Interoperability Test Results

Devices Tested	VRRP
Cabletron SmartSwitch Router 8600	
HP ProCurve Switch 9304M	
IBM 8371 Fast Ethernet Switch	
Lucent Cajun P550 Gigabit Ethernet Switch	
Nortel Accelar 1200	

Key: = Pass

Source: The Tolly Group, October 1999

Figure 3

pure IP routing. The Tolly Group tested the BigIron 4000 with six other switches and determined that the Foundry device successfully exchanges routing table data via IP data streams. See figure 2.

Foundry's successful interoperability in this test means the BigIron 4000 can exchange static route data with other brand switches tested.

#### IP RIP VERSION

##### 1.0 AND 2.0

Each switch pair must exchange IP routing table information in compliance with RIP version 1.0 and, optionally, version 2.0. The Tolly Group tested the BigIron 4000 with six other switches and determined that the Foundry device successfully supports the exchange of IP RIP (both versions 1 and 2) routing table data with the six other switches tested. The upshot is that the BigIron 4000 can create routes dynamically and exchange new routing data on the fly with other devices that passed this test. See figure 2.

#### IPX RIP

Each switch pair must exchange routing table information in compliance with IPX RIP. The Tolly Group tested the BigIron 4000 with six other switches and determined that the Foundry device successfully supports the exchange of IPX RIP routing table data with the six other switches tested. See figure 2.

#### VRRP RESULTS

The virtual router redundancy protocol (VRRP), an emerging industry standard, allows two routers to work in concert to back up one another in the event of an outage. Both switching routers can be configured in such a way

to provide hot standby services for one another, while each device continues to perform its normal duties.

In The Tolly Group's VRRP tests, Foundry's BigIron 4000 interoperated with all the switching router vendors tested who support VRRP. See figure 3. The significance of the test is that the BigIron 4000 can back up other leading brand switching routers in a product-diverse enterprise network. Likewise, the BigIron 4000 can receive hot standby backup from other leading-brand switches, as well.

#### TEST CONFIGURATION AND METHODOLOGY

For Layer 2 tests, The Tolly Group engineers connected Foundry's BigIron 4000 to other switches in a variety of configurations. Layer 2 auto-negotiation tests consisted of the BigIron 4000 connected to the devices under test (one at a time) via a single CAT 5 UTP connection; a Netcom Systems SmartBits SMB-2000 Chassis outfitted with ML-7710 cards also connected to both switches under test. Engineers recorded the speed and the duplex settings reported by each device in the test and then verified that the reported speed and duplex type were correct by generating a 1,518-byte stream of wire-speed traffic between the two devices and verified that no data was lost.

For the Link Aggregation and Gigabit Uplink tests, engineers followed the same methodology except that two links were used for link aggregation and a single Gigabit Ethernet link was used for uplink testing. Again a Netcom SmartBits was used to verify that throughput levels were appropriate for each test conducted (i.e. two aggregated Fast

**Foundry Networks, Inc.**

**BigIron 4000**

**Layer 2 & Layer 3**

**Interoperability Evaluation**



#### Foundry Networks, Inc. BigIron 4000 Product Specifications\*

- Modular, chassis-based switching router for campus, MAN, and LAN/WAN environments
- Supplies 128 Gbit/s of total switching capacity
- Provides hardware-based Layer 2/3/4 switching, multiprotocol routing, 256,000 BGP4 routes and Packet over SONET
- Delivers up to 32 Gigabit Ethernet (fiber or copper) ports and wire-speed switching and routing at 48,000,000 pps
- Modules and power supplies also work in the BigIron 8000 (8-slot) modular chassis delivering up to 64 (fiber or copper) Gigabit Ethernet ports at 96 million pps and 256 Gbit/s of total switching capacity
- Includes policy-based VLANs, four levels of hardware-based QoS, and hardware-based IP multicast support
- Ensures fault tolerance with Server Multi-Homing, multiple instances of Spanning Tree, VRRP, and redundant load-sharing power supplies
- Supports wire-speed Access Control Lists for network control and security
- Supports Gigabit Ethernet links up to 150 Km
- Offers extensive management via HTTP, SNMP, RMON, HP OpenView, and a 'Cisco-like' command line interface
- 10 Gigabit-ready for full investment protection

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

Ethernet links yielded more than 350 Mbit/s of throughput).

Layer 3 tests involved connecting each device under test to a separate client network and to a shared router network. The Tolly Group first asked representative engineers to configure their devices for static IP routes, then for IP RIP (versions 1 and 2) and finally for IPX RIP.

Static route tests consisted of each device under test configured for an IP static route to the accompanying router network. Ganymede Software Chariot Endpoints attached to each router were used to verify that IP traffic was routed properly between interoperating devices.

Dynamic route or RIP tests then ensued, only this time representatives were asked to configure their devices to exchange routing information automatically (for IP tests RIP version 1 and 2 and IPX RIP, as well). Again, Ganymede Software Chariot Endpoints were used to verify that IP traffic was routed properly between vendor devices.

Lastly, engineers conducted the VRRP interoperability tests. This test involved each router in the test connected to two client networks. One network served as the location for a failure of the device under test, while the other network hosted the downstream client. In this test, router 1 (the BigIron 4000) was the

primary or virtual router and the client was configured to use the router's virtual IP address. Engineers then disconnected the primary router's interface and verified that the client communications rolled over to the backup switching routers. Engineers also flip-flopped the scenario to prove that the BigIron 4000 provides reciprocal backup services to other primary switching routers.



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

Vendor	Product	Web address
Ganymede Software, Inc.	Chariot 2.2	<a href="http://www.ganymedesoftware.com">http://www.ganymedesoftware.com</a>
Netcom Systems, Inc.	SmartBits 2000	<a href="http://www.netcomsystems.com">http://www.netcomsystems.com</a>
Network Associates, Inc.	In-line Gigabit Ethernet Analyzer	<a href="http://www.networkassociates.com">http://www.networkassociates.com</a>
Wavetek Wandel Goltermann	WG DominoFastEthernet	<a href="http://www.wg.com">http://www.wg.com</a>



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:** Foundry Networks, Inc.

**Document number:** 199133

**Product class:** Backbone switching router

**Product under test:** BigIron 4000

**Testing window:** July 1999

**Software versions tested:** BigIron software version 5.2

**Software status:**

- BigIron software version BIR05000C8 is readily available.

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