Template for IP Forwarding
Application Level Benchmark Report

Revision 1.3

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Benchmark Number Reporting Requirements

When reporting performance numbers identified as following the NPF IP Forwarding Benchmark IA, the following text must be included:
“[vendor name] achieved a [benchmark metric] of [number] using the NPF IP Forwarding Benchmark employing [number of NPs][NP name]” where bracketed items are filled in. For example “XYZ Corporation achieved a throughput score of 1 Gb/sec using the NPF IP forwarding benchmark employing 3, XYZ45 network processors.”

1 Reference Design Details

The IP forwarding application-level benchmark was run on a reference design with 8 1/100 Mbps Ethernet media interfaces and one PCI control interface. The reference design supports IPv4 and IPv6 protocols. The details of the reference design are given below.

1.1 Block Diagram

![Figure 1: DUT-Traffic Tester Connections](image)

1.2 Component List

- 1 NPF2002 Network Processor
- 64 MB of 133 MHz DDR DRAM organized in 4 banks (Part# DDRnnn)
- 16 MB of 10ns SRAM (Part# SRAMnnn)
- 8 10/100 Mbps Ethernet ports with NPF1008 MAC device.
- 1 32-bit, 33 MHz PCI interface.
- 1 Fabric Interface Chip (Part# NPF-Fabricxxxx)
1.3 Mechanical dimensions
- Standard PCI card

1.4 Media, Fabric and Control interfaces
- Media interfaces: 8 x 10/100 Mbps Ethernet ports
- Control interfaces: 32-bit, 33 MHz, PCI
- Fabric interface: None

1.5 Total Power Consumption
- Idle State Power Consumption
  - 5 Watts

1.6 Control Memory
- IPv4 Control Memory
  - 1 MB SRAM for routing lookup table
  - 256 KB DRAM for next hop forwarding table
- IPv6 Control Memory
  - 3 MB SRAM for routing lookup table
  - 256 KB DRAM for next hop forwarding table

1.7 Test Equipment
- Data plane tester: IXIA 1600
- Control plane tester: PC with NPF IPv4 API software connected via PCI to the reference design

1.8 Forwarding Table and Traffic Details
- Seed used to generate traffic: 2345678
- Type of route table used:
  - IPv4: Unmodified Telestra AS1221
  - IPv6: Unmodified AS4554
- Total Number of forwarding table entries present on the DUT
  - IPv4
    - Across the whole system: 120,000
    - Per DUT Test Port: 15,000
  - IPv6
    - Across the whole system: 400
    - Per DUT Test Port: 50
- Number of route table entries exercised by traffic for all packet sizes are as follows
  - IPv4
    - Across the whole system: 16,000
    - Per DUT Test Port: 2,000
  - IPv6
    - Across the whole system: 400
    - Per DUT Test Port: 50
- Traffic Flow description
  - The Traffic Generator to DUT flows are setup as follows
    - Each DUT Port(i) is connected to Traffic Generator Port(i)
- Each DUT and Traffic Generator port is setup in full duplex mode, and hence and receive and transmit packets at the same time
- The Traffic and route tables are setup as follows
  - All Traffic send in on DUT Port 0 (by Traffic Generator Port 0) is routed to DUT Port 1 (to Traffic Generator Port 1) and vice versa
  - The same is true for DUT Port 2 and 3, 4 and 5, 6 and 7

**Note:** In all tests a separate graph should be included for each traffic combination tested.
2 Data Plane Benchmark Tests

2.1 Forwarding Rate
2.1.1 IPv4 Only Forwarding Rate

![Forwarding Rate Benchmark Measured in pps](image1)

**Figure 2: Results of Forwarding Rate Benchmark Measured in pps**

![Forwarding Rate Benchmark Measured in Mbps](image2)

**Figure 3: Results of Forwarding Rate Benchmark Measured in Mbps**

Forwarding Rate with Internet Mix Traffic = 800 Mbps
2.1.2 IPv6 Only Forwarding Rate

Figure 4: Results of Forwarding Rate Benchmark Measured in pps

Figure 5: Results of Forwarding Rate Benchmark Measured in Mbps

Forwarding Rate with Internet Mix Traffic = 600 Mbps
2.1.3 IPv4 Concurrent with IPv6 (50% IPv4, 50% IPv6) Forwarding Rate

Forwarding Rate with Internet Mix Traffic = 750 Mbps

Note: The min packet size for IPv4 and IPv6 differs. Hence the frame sizes used in that case for IPv4 and IPv6 will not be the same.
2.2 Throughput

2.2.1 IPv4 Only Throughput

Figure 8: Results of Throughput Benchmark Measured in pps

Figure 9: Results of Throughput Benchmark Measured in Mbps

Throughput with Internet Mix Traffic = 800 Mbps

2.2.2 IPv6 Only Throughput
Figure 10: Results of Throughput Benchmark Measured in pps

Throughput with Internet Mix Traffic = 500 Mbps
2.2.3 IPv4 Concurrent with IPv6 Throughput

Figure 12: Results of Throughput Benchmark Measured in pps

Throughput with Internet Mix Traffic = 620 Mbps
2.3 Latency

2.3.1 IPv4 Only Latency

Figure 14: Results of Latency at 100% Throughput

Latency at 100% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 100% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 100% Throughput with Internet Mix Traffic Maximum = 25000 ns
Figure 15: Results of Latency at 95% Throughput

Latency at 95% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 95% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 95% Throughput with Internet Mix Traffic Maximum = 25000 ns

Figure 16: Results of Latency at 90% Throughput

Latency at 90% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 90% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 90% Throughput with Internet Mix Traffic Maximum = 25000 ns

Figure 17: Results of Latency at 50% Throughput

Latency at 50% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 50% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 50% Throughput with Internet Mix Traffic Maximum = 25000 ns

2.3.2 IPv6 Only Latency
Figure 18: Results of Latency at 100% Throughput

Latency at 100% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 100% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 100% Throughput with Internet Mix Traffic Maximum = 25000 ns

Figure 19: Results of Latency at 95% Throughput
Latency at 95% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 95% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 95% Throughput with Internet Mix Traffic Maximum = 25000 ns

**Figure 20: Results of Latency at 90% Throughput**

Latency at 90% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 90% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 90% Throughput with Internet Mix Traffic Maximum = 25000 ns
Latency at 50% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 50% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 50% Throughput with Internet Mix Traffic Maximum = 25000 ns

2.3.3 IPv4 Concurrent with IPv6 Latency

Figure 22: Results of IPv6 Latency at 100% Throughput
Figure 23: Results of IPv4 Latency at 100% Throughput

Latency at 100% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 100% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 100% Throughput with Internet Mix Traffic Maximum = 25000 ns
Figure 24: Results of IPv6 Latency at 95% Throughput

Figure 25: Results of IPv4 Latency at 95% Throughput

Latency at 95% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 95% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 95% Throughput with Internet Mix Traffic Maximum = 25000 ns
Figure 26: Results of IPv6 Latency at 90% Throughput

Figure 27: Results of IPv4 Latency at 90% Throughput

Latency at 90% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 90% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 90% Throughput with Internet Mix Traffic Maximum = 25000 ns
Figure 28: Results of IPv6 Latency at 50% Throughput

Figure 29: Results of IPv4 Latency at 50% Throughput

Latency at 50% Throughput with Internet Mix Traffic Average = 22000 ns
Latency at 50% Throughput with Internet Mix Traffic Minimum = 18000 ns
Latency at 50% Throughput with Internet Mix Traffic Maximum = 25000 ns

2.4 Loss Rate

2.4.1 IPv4 Only Loss Rate

![Figure 30: Results of Loss Rate Benchmark](image1)

2.4.2 IPv6 Only Loss Rate

![Figure 31: Results of Loss Rate Benchmark](image2)
2.4.3 IPv4 Concurrent with IPv6 Loss Rate

![Graph showing IPv4 Concurrent with IPv6 Loss Rate](image_url)

Figure 32: Results of Loss Rate Benchmark
2.5 Overload Forwarding Rate

2.5.1 IPv4 Only Overload Forwarding Rate

![Figure 33: Results of Overload Forwarding Rate Benchmark Measured in pps](image1)

![Figure 34: Results of Overload Forwarding Rate Benchmark Measured in Mbps](image2)

Overload Forwarding Rate with Internet Mix Traffic = 100 Mbps
2.5.1 IPv6 Only Overload Forwarding Rate

Figure 35: Results of Overload Forwarding Rate Benchmark Measured in pps

Figure 36: Results of Overload Forwarding Rate Benchmark Measured in Mbps

Overload Forwarding Rate with Internet Mix Traffic = 100 Mbps
2.5.3 IPv4 Concurrent with IPv6 Overload Forwarding Rate

![Graph showing Overload Forwarding Rate Benchmark Measured in pps](image1)

*Figure 37: Results of Overload Forwarding Rate Benchmark Measured in pps*

![Graph showing Overload Forwarding Rate Benchmark Measured in Mbps](image2)

*Figure 38: Results of Overload Forwarding Rate Benchmark Measured in Mbps*

Overload Forwarding Rate with Internet Mix Traffic = 100 Mbps
2.6 System Power Consumption

Average Power Consumption

- **IPv4**
  - At 100% of throughput rate: 16 Watts
  - At 50% of throughput rate: 12 Watts

- **IPv6**
  - At 100% of throughput rate: 18 Watts
  - At 50% of throughput rate: 14 Watts

- **IPv4 Concurrent with IPv6**
  - At 100% of throughput rate: 17 Watts
  - At 50% of throughput rate: 15 Watts
3 Control Plane Benchmark Tests

3.1 Forwarding Table Update Rate

3.1.1 IPv4 Forwarding Table Update Rate

Figure 39: Results of Forwarding Table Update Rate Benchmark
3.1.2 IPv6 Forwarding Table Update Rate

Figure 40: Results of Forwarding Table Update Rate Benchmark
3.2 Forwarding Rate With Concurrent Forwarding Table Updates

3.2.1 IPv4 Forwarding Rate With Concurrent IPv4 Forwarding Table Updates

![Diagram 1: Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in pps]

![Diagram 2: Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in Mbps]
Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps

![Graph showing forwarding rate with 75% of concurrent forwarding table update rate measured in pps.](image)

**Figure 43: Results of Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate Measured in pps**

![Graph showing forwarding rate with 75% of concurrent forwarding table update rate measured in Mbps.](image)

**Figure 44: Results of Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate Measured in Mbps**

Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 45: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 46: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps

Figure 47: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 48: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in Mbps
3.2.2 IPv6 Forwarding Rate With Concurrent IPv6 Forwarding Table Updates

**Figure 49:** Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in pps

**Figure 50:** Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 53: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 54: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 55: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 56: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
3.2.2 IPv4 Concurrent with IPv6 Forwarding Rate With Concurrent IPv4 and IPv6 Forwarding Table Updates

Figure 57: Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 58: Results of Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 100% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 59: Results of Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 60: Results of Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 75% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 61: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 62: Results of Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 50% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps
Figure 63: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in pps

Figure 64: Results of Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate Measured in Mbps

Forwarding Rate With 25% of Concurrent Forwarding Table Update Rate and Internet Mix Traffic = 800 Mbps