IBM Corporation
8265 Nways® ATM Switch and
8371 Multilayer Ethernet Switch
MPOA Performance Benchmark and
Functionality Verification

Premise: Connecting legacy network technologies to evolving ATM networks requires more than simple physical interfaces. LANE and MPOA soon become concerns and the performance of those technologies can quickly become an issue. Products that provide both LANE and MPOA routing in conjunction with standard Fast Ethernet switching can be of significant benefit in a multilayer network environment.

IBM Corp. commissioned The Tolly Group to evaluate its 8265 Nways ATM Switch and 8371 Multilayer Ethernet Switch. In an extensive suite of tests, IBM’s 8265 ATM switch provided LANE and MPOA backbone services to Fast Ethernet switch ports residing both in standalone IBM 8371 switches, as well as in IBM 8371 switch blades for the 8265. The testing involved Layer 2 and Layer 3 IP throughput, as well as functionality tests of Layer 3 MPOA in mixed environments. Testing was performed in June 1999.

Test results showed that the ATM OC-12 LANE support of the 8265 delivers high throughput when used
as a transport between Fast Ethernet ports. Tests focusing on the Layer 3 IP routing support of the 8371 showed that this device can deliver wire-speed or near wire-speed Fast Ethernet throughput when executing router offload with MPOA. Finally, a battery of functionality tests illustrated the MPOA functionality of the 8371/8265/8210 solution when communicating using the Layer 3 IPX protocol, as well as when communicating with end-stations on token ring and non-MPOA client ports.

**Results**

**8265/8371 OC-12 Performance**

The IBM 8265 demonstrated high performance when transporting Layer 2 Fast Ethernet traffic via an ATM OC-12 (622 Mbit/s) LAN Emulation (LANE) connection. For this test, the 8265 delivered 96% of the maximum throughput across an OC-12 LANE link when tested using 64- and 1,516-byte frames. At 512-byte frames, the IBM 8265 performance improved to 99%. See figure 1.

**8371 Layer 3 IP Throughput with MPOA Router Bypass**

Engineers tested the IBM 8371 Ethernet Switch in a full-mesh configuration of 24 ports, where Layer 3 IP traffic traversed the switch in a paired-port configuration and routing decisions were made by an IBM 8210 Multi-protocol Switched Services (MSS). In these test iterations, the IBM 8371 delivered 90% of wire-speed throughput at 64-byte frames and 100% of wire-speed throughput at 512- and 1,516-byte frames. See figures 2 and 3.

**MPOA Functionality in IPX and Heterogeneous Networks**

The IBM 8371 demonstrated that its implementation of Layer 3 “router bypass” support also extends to the popular Novell NetWare IPX protocol. Returning to Layer 3 IP, the device demonstrated its ability to communicate between MPOA devices located on token ring and Fast Ethernet. Finally, to illustrate its capabilities when inserted into a network that does not have MPOA client capabilities on every device, the 8371 showed that it was able to create a “one-way” shortcut.
using its MPOA capability to accelerate traffic destined to a non-MPOA client.

**Analysis**

8265/8371 OC-12 Performance

When the OC-12 backplane connection was used as the ATM LANE transport, the IBM 8265 was able to achieve 95% or more of the theoretical maximum throughput across the connection. Because of the overhead required in implementing the ATM LANE environment, the actual available bandwidth is somewhat less than 622 Mbit/s. Usable bandwidth is at, or near, the theoretical maximum. This means that customers who invest in the IBM 8265 switch can be assured that it can perform to the maximum bandwidth. Frequently, with new technology, boxes cannot perform up to their rated speeds.

This demonstration of LANE-based frame/cell conversion performance and capacity positions the 8265 as a viable platform for high-density Fast Ethernet concentration at the edge of the ATM network. All LANE processing and segmentation is performed on the 8371 module, so the backplane connection is native ATM. By exploiting the 8265’s non-blocking backplane architecture, IBM says users can put multiple 8371 modules in the 8265 and scale the Ethernet/ATM transport capacity to over 3.6 Gbit/s with up to six 8371 modules. The Tolly Group tested the 8265 with four 8371 modules.

**8371 Layer 3 IP Throughput with MPOA Router Bypass**

By using the sophisticated functions that are built into the MPOA client, routing functionality could be executed locally on the 8371 instead of the 8210. This has several benefits including offloading the network and the MPOA router, and removing the MPOA router as a possible bottleneck and single point-of-failure.

Furthermore, this test illustrates how advanced ATM functionality can be used to improve performance and reliability in a frame-based network. The Tolly Group evaluation illustrates that IBM has created and implemented a high-function, high-performance, MPOA client.

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**IBM Corporation**

**8265 Nways ATM Switch and 8371 Multilayer Ethernet Switch**

**Functionality and Performance**

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*Vendor-supplied information not verified by The Tolly Group*
The IBM 8371 also shows how it can be used to deliver near wire-speed IP routing at the edges of the ATM network. And, by using the MPOA route server, the virtual IP subnet over the ATM backbone simplifies the IP topology of large backbones and allows users to exploit the dynamic routing and topology management of the PNNI-based ATM network.

**MPOA Functionality in IPX and Heterogeneous Networks**

Although the latest version of Novell NetWare supports IP as a client-server protocol, there exists a massive installed base of IPX users. Network managers need to be able to offer Layer 3 services to such users.

These tests conducted of MPOA support for IPX routing, illustrate that the IBM product set does offer these capabilities thus allowing the network manager to extend the life of existing IPX-based clients. Without this capability, networks with IPX clients that require migration to a Layer 3 switching infrastructure for capacity reasons must either be migrated to IP-based NetWare clients, or consolidated onto a single NetWare network ID. The IBM solution eliminates those pre-requisites for migrating IPX to a high-speed ATM network.

This MPOA-based Layer 3 connectivity is a key enabler of token ring-to-Ethernet migration or integration. Previously, the only way to interwork traffic between token ring and Ethernet LANE environments was to use a conventional router for Layer 3 connectivity or translational bridging. Both alternatives created potential performance bottlenecks and cost/complexity. Network managers will now find that IBM’s token ring MPOA capability gives them a solution for either integration or migration.

Given the relative newness of MPOA, it is likely that there will exist devices in the network that are not capable of advanced MPOA functionality. This final test shows that even when the partner device is not capable of setting up MPOA connections, the 8371 can use its integrated MPOA capability to optimize the transport path to the ATM LAN edge switches that lack MPOA client support.

**Test Configuration and Methodology**

**8265/8371 OC-12 Performance**

An IBM 8265 was outfitted with a 16-port Fast Ethernet module and a four-port ATM OC-3 module. The 8265 Fast Ethernet module connected to the backplane of the 8265 via an internal ATM OC-12 connection. Four IBM 8371 Ethernet switches each connected to the 8265 via an OC-3 link. (The four OC-3 connections combine to provide the equivalent of an OC-12 connection to the 8265.) An IBM 8210 MSS provides LAN Emulation and MPOA server functionality. Eight SmartBits Fast Ethernet ports were connected to the Fast Ethernet module of the 8265 and two SmartBits ports were connected to each of the 8371 switches. See figure 4.

Engineers generated Layer 3 IP traffic with SmartBits in this configuration where the first two ports of the SmartBits transmitted and received traffic from the first two ports of the 8371. There were two ports for each 8371. Engineers conducted three iterations of each test for a duration of one minute each, using 64-, 512- and 1,516-byte packets. Results were recorded as reported by SmartBits in the percentage of theoretical maximum for LANE running over an OC-12 link.

**8371 Layer 3 IP Throughput with MPOA Router Bypass**

An IBM 8371 Ethernet switch connected to an 8265 via an ATM OC-3 link. An IBM 8210 MSS provided the MPOA server component and was also connected to the 8265 via an ATM OC-3 link. A Netcom Systems SmartBits was connected to the 8371 and configured to generate Layer 3 traffic across 24-ports. Traffic was configured to flow in a paired-port configuration.

Engineers configured the SmartBits to transmit Layer 3 IP traffic in a bidirectional paired-port configuration. i.e. port one transmitted and received traffic from port two, port three transmitted and
received traffic from port four, etc. Engineers conducted three iterations of each test for a duration of one minute each, using 64-, 512- and 1,516-byte packets. Results were recorded as reported by SmartBits as the percent of theoretical maximum throughput of the Fast Ethernet links. (Although MPOA was used to facilitate the routing process, the traffic flowed across native Fast Ethernet connections and thus did not incur LANE overhead.)

**MPOA Functionality in IPX and Heterogeneous Networks**

When testing MPOA functionality, engineers configured three different test bed configurations. An IBM 8371, an IBM 8271, or an IBM 8270 were interchanged, each connecting to an IBM 8265 via an ATM OC-3 link. An IBM 8210 MSS also was connected to the 8265 to provide router functionality. These tests were measured pass or fail. A pass was recorded if the device under test created shortcuts, and fail was reported if it did not. The actual devices under test report measurements. See figure 3.

Using the above configuration with an IBM 8270 token ring, engineers verified that once traffic was flowing between the 8270 and the 8371, that shortcuts or router bypass mechanisms were implemented. The 8271 Ethernet switch does not support shortcuts. This was a test to verify that shortcuts could be set up with devices that do not support MPOA shortcuts.

A final set of tests was conducted to show a single 8371 where shortcuts were set-up for routing IPX traffic. Engineers created shortcuts using IPX traffic for this test.
The Tolly Group gratefully acknowledges the providers of test equipment used in this project:

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Project Profile

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Products under test:
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- IBM 8371 Multilayer Ethernet Switch version 5 Build 22
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- Readily available

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