Fast Ethernet and Gigabit Ethernet Position Paper

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Version History		
Version 1.0	Jo Harder, George Prado	March 2002

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Introduction

Gigabit Ethernet is an extension of the Ethernet 802.3 standard, known as 802.3z. It will coexist and interoperate with the Ethernet and Fast Ethernet standards. Gigabit Ethernet is generally used for the LAN backbone, although servers with Gigabit Ethernet NICs are sometimes deployed in heavy-traffic environments.

“The initial applications for Gigabit Ethernet are for campuses or buildings requiring greater bandwidth between routers, switches, hubs, repeaters and servers.”

Gigabit Ethernet Accelerating the Standard, Gigabit Ethernet Alliance, 1998

Network Interface Cards and the Impact on Citrix MetaFrame

The Network Interface Card (NIC) is a Data Link (Layer 2) mechanism for transporting frames to and from a network node. Most commonly, Fast Ethernet NICs are installed on MetaFrame servers, with the NIC and switch port manually configured to support full duplex and 100 Mbps. Because auto-negotiation is not well standardized, hard coding these configurations eliminates potential communication errors.

In most instances, a single full duplex Fast Ethernet configuration provides more than adequate throughput to and from a MetaFrame server. This configuration effectively yields to two 100 Mbps pipes for a total throughput of up to 200 Mbps. Moreover, because ICA traffic is compressed, it is generally found that the throughput of a full-duplex Fast Ethernet is underutilized. It is important to note that a single full-duplex Fast Ethernet does not provide redundancy or failover capability since the NIC, cable, and switch port represent single points of failure. If failover and redundancy is desired, consider teaming and aggregating multiple NICs.

The use of a 100 Mbps switch instead of a 100 Mbps hub can drastically improve a NIC's performance. A hub shares its 100 Mbps pipe among its connected stations, is highly susceptible to collisions and retransmissions, and operates in half-duplex mode, resulting to serial communication and degraded performance. On the other hand, a switch provides the optimum performance because each MetaFrame server has two 100 Mbps connections (one in each direction) and collisions are eliminated. For this reason, Citrix strongly recommends the use of switches in MetaFrame environments.

In some cases, traffic is very high on a single Fast Ethernet NIC. Even with the recommended duplex and speed configuration, it is possible that a single NIC becomes overloaded and consequently turns into a bottleneck. This is most often seen where the MetaFrame server must communicate frequently with one or more back-end database servers. If this occurs, the customer should consider the option of adding another Fast Ethernet NIC or replacing the existing Fast Ethernet NIC with a Gigabit Ethernet NIC. If a second NIC is added, it should be teamed. Although multi-homing is supported with MetaFrame XP Feature Release 1, teamed NICs are the preferred configuration.

ICA Traffic

The Citrix ICA Protocol is an adaptive and configurable protocol that is capable of overcoming the bandwidth limitations of a network. It is optimized for slow speed connections; 20 Kbps is the recommended minimum allocated speed, thus the bandwidth capability of the MetaFrame server NIC is generally not fully utilized when used to deliver this type of data to multiple clients. The size of ICA packets on an ICA connection will vary depending upon the ICA connection settings (clipboard, client drive mapping, audio, etc.) used; the kind of application that is utilized (data-intensive or graphic-rich applications); and the type of operation that is performed (data entry, printing, copying files, etc.).

Printing and file copying (on a client mapped drive) are one of the most resource-intensive operations in a MetaFrame environment. These operations consume additional bandwidth and can affect the performance the network and MetaFrame servers. Citrix suggests that performance testing and capacity planning initiatives should include printing and file copying in a MetaFrame environment.

Gigabit Ethernet or Fast Ethernet for Citrix MetaFrame?

MetaFrame is designed and optimized for low-bandwidth and high-latency environments, and it generally works well with Fast Ethernet. Upgrading to Gigabit Ethernet should be evaluated in terms of requirements and cost. There are network environments and applications that are hosted on MetaFrame servers that may require a Gigabit Ethernet solution. These are applications that process volumes of data, perform intensive transaction processing, or require quicker response time such as complex client/server applications or data mining applications.

If the customer perceives that Gigabit Ethernet is required due to network requirements, the network should be analyzed to determine how it could be optimized. For example, segmenting the MetaFrame servers into a smaller subnet may remedy the situation by eliminating unnecessary broadcasts and other traffic.

From the standpoint of eliminating single points of failure, the choice of the Ethernet speed is irrelevant. Teaming or aggregating two same-speed NICs by MAC address (and hence a single IP address) provides redundancy and failover; whereas the failure of one sole NIC results in an inaccessible MetaFrame server. Further, by teaming NICs, higher throughput is obtainable; for example, when each of two Fast Ethernet connections is configured for full-duplex 100 Mbps, up to 400 Mbps of throughput is available.

Migrating to Gigabit Ethernet can be much more expensive compared with the equipment cost of Fast Ethernet. In the table below, a Gigabit Ethernet switch port is more than eight times more expensive than a Fast Ethernet switch port; a Gigabit Ethernet NIC is more than two times more expensive than a Fast Ethernet NIC.

	Fast Ethernet	**Gigabit Ethernet**
Switch	Cisco Catalyst 3512-XL-EN Stackable 12-port 10/100 Switch (Layer 2) @ $1,759.88/unit; $146.66/port **	Cisco Catalyst 4908G 8-port Gigabit Switch (Layer 3) @ $9,919/unit; $1,239.88/port *
Network Interface Card	Compaq NC3123 10/100BASE-TX @ $99.76 **	Compaq NC7131 10/100/1000BASE-TX @ $229.47 **

* The pricing information was taken from www.lanstreet.com, February 2002. Also, the 4908G includes Layer 3 switch capabilities, which are common in a high-speed network,

** The pricing information was taken from www.cdw.com, February 2002.

The switch and NIC are key components for upgrading to Gigabit Ethernet and its overall cost is a function of the number of stations and switches that are supported by the network infrastructure. The total cost of ownership must include all the elements of the network backbone that will be upgraded to Gigabit Ethernet such as routers and other network appliances.

Citrix Position

Although Gigabit Ethernet is supported within MetaFrame environments, the preferred configuration for MetaFrame servers is two or more teamed Fast Ethernet NICs. From the standpoint of throughput, the use of one Fast Ethernet connection in most MetaFrame implementations is generally sufficient. To improve redundancy and failover, as well as to increase throughput, Citrix Systems recommends teaming two or more Fast Ethernet NICs via MAC address.

"Link aggregation can be a cost-effective way to provide higher-speed connections in Ethernet LANs that are reaching saturation with 100 Mbps transmission rates but that won't require gigabit capability, at least in the short term."

Internetworking Technologies Handbook: Link Aggregation, Cisco Systems

Gigabit Ethernet implementations have a higher throughput and subsequently a higher total cost of ownership; however, the throughput capabilities should be weighed against the perceived benefit as required for each MetaFrame implementation.

When using Compaq NICs and Cisco switches, specific instructions are available within Citrix Knowledgebase article CTX434260.

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