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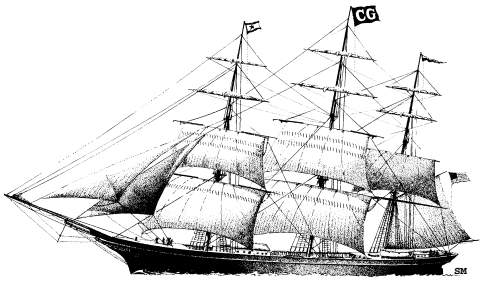

Navigating Information Technology Horizons℠

Published Since 1993 Report #TCG2008041 August 28, 2008

The Future of Virtual I/O in the Data Center is Now

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Management Summary

Providing options to the consumer is nothing new in the automotive industry. From the size of the engine under the hood – for performance, to the interior/exterior color scheme – for esthetics, the DNA of car dealers is geared to providing you with what you need to improve your driving experience. Part of that experience is entertainment, with car radios evolving from a simple AM tuner to AM/FM, then adding a cassette for your driving pleasure. Now, you can upgrade to a CD player and USB/iPod interfaces, even adding the capability to receive hundreds of specialized stations covering music, news, and sports on satellite radio. Can you just imagine what the dashboard would look like, the number of knobs or push buttons that you would require if each unit required its own controls? Fortunately, they do not, as the automotive industry has integrated all of these independent systems into a single unit, with a common communications interface.

Actually, those of us involved in any data center consolidation do not have to imagine what that automobile dashboard would look like; we can see comparable results today as we try to connect a myriad of applications, migrating from physical servers to virtual machines, to a variety of communications and storage networks. Over the past few years, the data center staff has been charged with consolidating a virtual plethora of under-utilized x86 servers onto fewer platforms, in order to better utilize CPU performance and to control energy consumption. These data centers, both enterprise and SMB, have been running a single application on each server, often utilizing only 15% to 20% of the CPU's processing capability. This wastes both CPU cycles and the energy required to run the platform and cool the data center, adding significantly to the total cost of ownership (TCO) of the data center. By virtualizing the servers via *VMware*, *Hyper-V*, *Xen*, or other virtualization utility, the IT staff can deploy multiple applications on that platform, each running in its own virtual environment. In order to continue to provide each application with the data that it needs, the IT staff also virtualizes the storage, consolidating multiple direct-attached storage (DAS) units into storage area network (SAN) arrays, communicating with the virtual machines via a Fibre Channel (FC) or iSCSI protocol. Between consolidating the servers and the storage, the data center has addressed two of three critical areas; they have not, however, addressed the virtualization of the I/O communications between the servers and that storage, or, in fact, between the servers and the outside world.

Multiple communications protocols need to be shared between every application running on a virtualized server. Enterprise applications may run mission-critical processes over high-speed InfiniBand networks, business-critical Internet applications run over an IP band, and even streaming video applications accessing high-speed storage; today they each need to talk via a different protocol to a specialized communications controller. This is an opportunity for simplification by deploying *virtualized I/O* while lowering TCO. NextIO can help you do just that. To learn more about their *Adaptive Connect* products, please read on.

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Data Center Requirements

The IT staff of every enterprise, large or small, is changing the paradigm of server operations in the data center in order to better utilize IT resources. They are also rethinking the way that they deploy new applications in order to reduce the TCO of the IT infrastructure. Significant innovations in microprocessor technology have led to the deployment of multi-socket servers with multi-core, multi-threaded CPUs, enabling the data center to improve server utilization. Usually, the data center no longer can afford to deploy a single application per server, with 15% to 20% CPU utilization, any more than they would allow a virus to infiltrate their network consuming 85% of their compute cycles. Moreover, with the rising cost and decreasing availability of electricity to run and cool the data center, the enterprise cannot afford to waste processing capability. The IT staff has to reduce the TCO of the IT infrastructure. This includes reducing the management complexity in the data center, resulting from the deployment, provisioning, and maintenance of IT resources, gaining access to the storage and networking infrastructure, and conducting an ongoing performance analysis.

In order to improve server utilization and application availability, the data center has virtualized their server and storage environments, enabling multiple applications, as many as ten or more, to share the same processing resources and allow these same applications to share a common storage architecture. In addition, utilities, such as VMware's VMotion, enable the IT staff to migrate an application from one virtual machine to another, in case of a failure from one server to another, or simply to improve overall system response time. Unfortunately, these consolidation and high-availability tactics increase the complexity of the I/O infrastructure, and the enterprise has done little to simplify that, or to virtualize I/O communication, in general, in order to gain access to data or to share information with partners and customers around the globe. I/O complexity remains the same as the data center staff tries to simplify the environment and reduce costs.

Every data center faces a myriad of challenges in order to cope with the requirements of communicating within a consolidated data center, with the mid- to large-sized enterprises experiencing the biggest challenges. On an enterprise level, there is the need to access high-speed interconnects, such as InfiniBand, between servers to share processing, as well as a consolidated access to SANs, both FC and iSCSI, to share data. The introduction of Web 2.0 services places a new emphasis on Internet IP communications. The tremendous advances in the telecommunications industry puts a greater demand on the ability to make thousands of connections to edge devices via T1 and other protocols, and new demands in the media and broadcast arenas places a greater emphasis on the availability of digital HD video access for network broadcasting and cable distribution. New applications, such as IPTV, are creating the need for even more bandwidth. How the data center copes with the deployment and management of all of these communications protocols will determine the complexity of the network infrastructure, the scalability of the environment to accept new protocols into the architecture, the level of management required, and the impact on the TCO. How you implement your physical I/O resources will determine how well your network adapts to a changing enterprise environment.

The IT staff can continue to implement a legacy architecture where a single I/O controller is assigned to a specific slot in a specific server, or to a specific blade, limiting choice, mobility, and scalability, while increasing management complexity. Alternatively, they can change that paradigm and complete the consolidation effort, by continuing to virtualize the entire environment with the virtualization of the I/O infrastructure across multiple servers. In order to facilitate that effort, NextIO has implemented an innovative architecture that will allow the data center to wire the I/O network once and enable an adaptive connect environment in which the enterprise can evolve their communications network in order to meet changing business requirements.

NextIO Adaptive Connect Solutions

In a traditional legacy communication architecture, the data center will insert a specific communications controller into a PCI Express (PCIe) slot in the server. This controller will support any one of a number of communications protocols, IP for queries over the Ethernet, or FC for transactions to the SAN, or even InfiniBand for communication between servers, among a wide assortment of communications options available to the IT staff. Unfortunately, the

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typical 1U or 2U scale-out server has a limited number of PCIe slots available and they are filled quickly in a heterogeneous, virtualized environment. Therefore, even if your four-socket, quad-core processor has sufficient CPU performance and memory to support multiple applications, communications requirements could force the data center to split those applications back onto different servers.

NextIO decided to enable the enterprise to virtualize all server communications, such as FC, Ethernet, SAS, and InfiniBand, through an external managed PCIe switch, supporting all of the mission- and business-critical applications in the data center, as well as enabling future requirements for video, T1, and FCoE, when the IT staff needs to deploy new applications. By removing the physical connection from each server, NextIO enables the IT staff with the capability to virtualize all I/O requirements for any server with a commodity O/S into a single virtualized external communications switch, NextIO's Adaptive Connect, to connect to any I/O protocol. Moreover, NextIO does not require any proprietary, extra-cost software on the server, instead using existing device drivers to communicate with the Adaptive Connect switch through the PCIe slots that come standard with the server.

With 14 PCIe slots available in a basic Adaptive Connect switch, NextIO presents the data center with sufficient scalability to deploy the largest communication network. Each slot in the switch can support two ports and connect to an I/O device or a cable to another Adaptive Connect switch, or in fact, any other already deployed switch such as from Cisco or Brocade, preserving the investment that the enterprise has made in that system. A single NextIO switch can support up to 28 cables, configurable in any way that the IT staff deems appropriate. For example, the data center could attach eight servers to four of the slots and have the remaining ports connect to devices or switches, increasing the scalability, as business needs change. NextIO places a practical limit to the number of servers in the environment to about 100, and the number of slots to about 500. When you factor in server virtualization enabling up to 16 virtual machines on each server, you enable up to 1600 virtual machines sharing a single I/O pool. With up to 10Gbps of bandwidth on a single cable, you can add additional cables, with 10Gbps of bandwidth on each, creating an on-demand solution for adding throughput to the I/O pool.

Large-scale data centers will appreciate the ability of NextIO, through virtualization, to help lower acquisition costs and other capital expenditures, as well as lowering the costs for power, floor space, and administration that all go into the TCO equation. For the mid-sized data center, simplification of the communication network alone is worth its weight in gold as it enables the IT staff to consolidate all management activities onto a single console, enabling one or two IT managers to deploy and manage the entire heterogeneous network with the aid of standard user interfaces and NextIO's end-to-end *nControl* Management Software. Using simple and familiar tools such as SNMP, the IT staff can create easy-to-use, scriptable Command Line Interfaces (CLI) to manage the I/O pool over the Web. The data center can manage the partitioning of the I/O pool and reassign resources as they become available. nControl will also collect statistics from the I/O pool and monitor all errors as they occur.

Conclusion

Two goals that are common to every data center are simplification of the IT environment and lowering of the TCO for the IT infrastructure. The deployment of an NextIO's Adaptive Connect architecture will help you lower capital expenditures by up to 50%, making the decision to virtualize I/O an easy one. The fact that NextIO can lower management costs, as well, improving rack density by 35%, and shrinking both power and cooling costs by 40% make this decision a no-brainer.

Additional value comes from the fact that the data center does not have to over-provision for I/O: it is available when you need it, where you need it. Adaptive Connect provides for the faster deployment of a heterogeneous I/O environment, improving performance via capacity-on-demand, and provides support for a high-availability virtual architecture. If you require a cost-effective, scalable I/O solution, take a look at NextIO's Adaptive Connect.

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