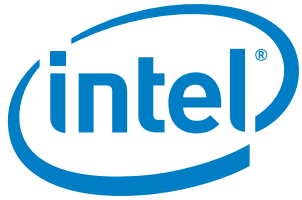


White Paper

Intel® Ethernet Multi-Port Server Adapters

Using Multi-Port Intel® Ethernet Server Adapters to Optimize Server Virtualization

Introduction

As enterprise-class server infrastructures adopt virtualization to improve total cost of ownership (TCO) and simplify IT, they benefit from the growing processor headroom in progressively more powerful platforms based on Intel® architecture. As they use more powerful servers, server consolidation ratios climb, and the number of virtual machines (VMs) running per physical host increases. This trend provides an excellent means of taking advantage of the latest Intel® multi-core technology while continuing to drive up processor utilization.

More VMs per physical host increase the amount of network traffic per host, which necessitates a larger number of physical network ports. That can cause the system to become constrained in terms of the number of PCI Express* slots available to accommodate network interface cards. Quad-port and dual-port Intel® Ethernet Server Adapters are an important means of increasing the number of network ports that servers can support, which makes them an important system component as organizations scale out their virtualization environments.

Intel works together with providers of operating systems, hypervisors, and server and network hardware to help ensure that the full virtualization ecosystem interoperates as smoothly as possible. Beyond simple standards compliance, products from various ecosystem members are pre-validated together to deliver optimal results. End customers benefit from this collaboration as they implement solutions that build value using the latest capabilities:

- **Workload consolidation.** By providing higher network port density and helping to ensure smooth interoperability, multi-port Intel Ethernet Server Adapters enable high server consolidation ratios, for increased hardware value.
- **Live migration.** Intel Ethernet Server Adapters are pre-validated across the ecosystem to support the movement of running VMs from one physical server to another without restarting them, the basis for robust load balancing, automatic failover, and high availability.
- **Robust management.** Pre-validation with industry-leading management software helps ensure that Intel Ethernet Server Adapters are compatible with the latest management capabilities for physical and virtual resources.

Together, these capabilities make multi-port Intel Ethernet Server Adapters ideally suited for use in virtualized environments, regardless of the operating system, virtualization software, or server hardware being used.

Improving IT Efficiency and Reliability with Virtualization

Regardless of the type of industry they work in and the size of their organization, IT managers share the constant challenge to handle expanding business needs while controlling costs. As new applications proliferate, ever-growing numbers of servers create strains from increased management complexity and operating cost, as well as lower reliability and flexibility. Moreover, environments tend to become more heterogeneous, including the need for dedicated servers to support legacy operating systems, which often results in low server utilization and overall inefficiency.

Many organizations have begun to solve these issues using virtualization, reducing TCO through server consolidation and streamlined administration, while at the same time enabling IT to respond more rapidly to changing business requirements. Virtualization reduces server proliferation, simplifies server management, and significantly improves server utilization, network flexibility, and network reliability.

At the heart of this capability is a virtualization software layer, which enables a single physical server to host multiple independent VMs, each of which functions in much the same way as a separate traditional server. For example, each VM can be restarted or shut down independently, and each one can run a separate operating system and applications in isolation from other VMs on the server (Figure 1).

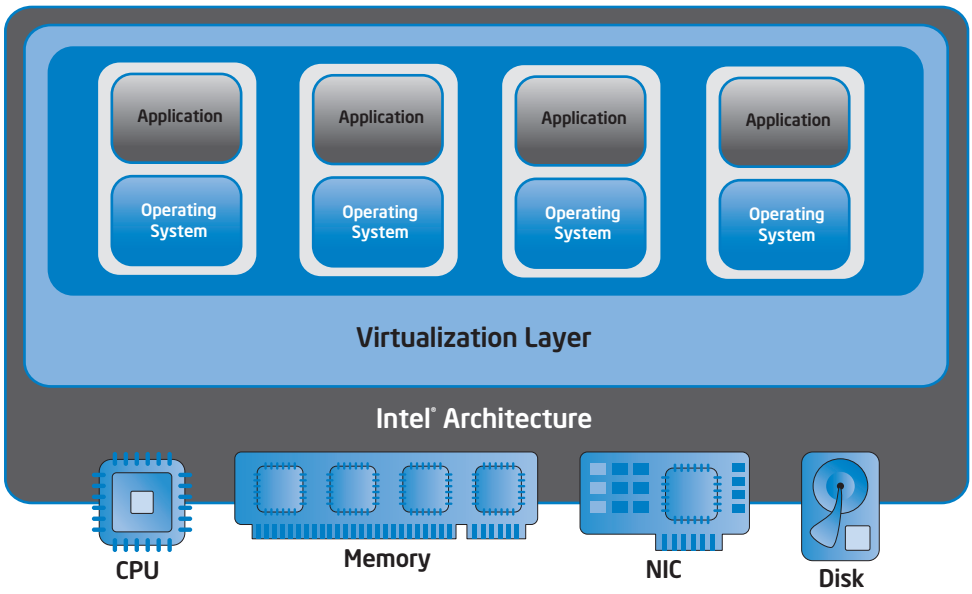


Figure 1. Virtualization enables enterprises to create a virtual infrastructure, which provides a layer of abstraction between the computing, storage, and networking hardware and the software that operates on it. The virtualization layer negotiates the relationship between VMs and physical resources so that each VM sees the CPU, memory, and other resources in the same way as if they were running in the traditional non-virtualized environment.

Having the capability to run multiple VMs simultaneously on one physical server enables enterprises to consolidate workloads from several standalone servers, thereby reducing the number of servers. Unlike physical servers, VMs can be created in a matter of minutes, and they can be moved from one physical server to another without reconfiguring the operating system or applications. As a result, services can be provisioned faster and resources allocated more easily to business units when needed. In addition, virtualization enables IT administrators to proactively manage their systems to help prevent unplanned downtime and increase overall availability.

The increased amount of processing being done on each physical host in a virtualized environment creates additional network traffic. In order to avoid network I/O bottlenecks, multi-port Intel Ethernet Server Adapters allow a greater number of network ports per server.

Building Virtual Infrastructure with a Broad Ecosystem

Intel helps to ensure success for its customers by working with as many makers of virtualization software (generally known as the virtual machine monitor or hypervisor), operating systems, and other virtualization-related technologies as possible, ensuring maximum support across the ecosystem. Some of the key virtualization ecosystem members and open-source projects that Intel collaborates with include the following:

- Citrix
- KVM
- Microsoft
- Novells
- Oracle
- Parallels
- Phoenix Technologies
- Red Hat
- Sun Microsystems
- Virtual Iron
- VMware
- Xen

This breadth helps Intel be responsive to the widest range of customers possible, regardless of what technology providers they prefer. Intel and these ecosystem members collaborate as they develop new products and technologies, which allows for smooth operation and compatibility, while at the same time helping to reduce the systems integration burden on end customers. That interoperability is an important consideration as organizations implement multi-port Intel Ethernet Server Adapters on server hardware from major providers, enabling IT departments to be responsive to business needs while controlling costs.

One important capability provided by all major virtualization environments is the live migration of VMs from one physical server to another without service interruption, making dynamic workload balancing and zero-downtime hardware maintenance possible (Figure 2).

Virtualization-oriented management software enables network administrators to orchestrate the operation of virtual resources in much the same way as they do physical ones, with additional advantages that are specific to the virtualized environment:

- Manage Intel® processor-based hardware as a single logical pool of computing resources
- Streamline server provisioning and management
- Monitor system availability and performance
- Move workloads dynamically across distributed servers without service interruption
- Eliminate scheduled downtime by enabling zero-downtime maintenance
- Secure the environment with robust access control

Increasing Efficiency, Flexibility, and Responsiveness

Virtualization software offers numerous benefits that increase the efficiency, flexibility, and responsiveness of the IT infrastructure:

- **Lower TCO through server consolidation and streamlined systems management.** In a large data center, server consolidation by means of virtualization can enable significant hardware and operating cost savings. In some cases, more than 30 VMs, each with its own operating system and associated applications, can be hosted on one physical server. This approach enables enterprises to consolidate different applications, workloads, and services running on various operating systems onto fewer, and more scalable and reliable enterprise-class servers, including blade servers. As a result, IT managers can streamline data center operations, reduce hardware requirements, and minimize unused capacity while maintaining application service-level agreements by balancing workloads and adjusting the resources dedicated to each VM. The end result is lower cost to acquire, deploy, manage, and operate needed IT resources.

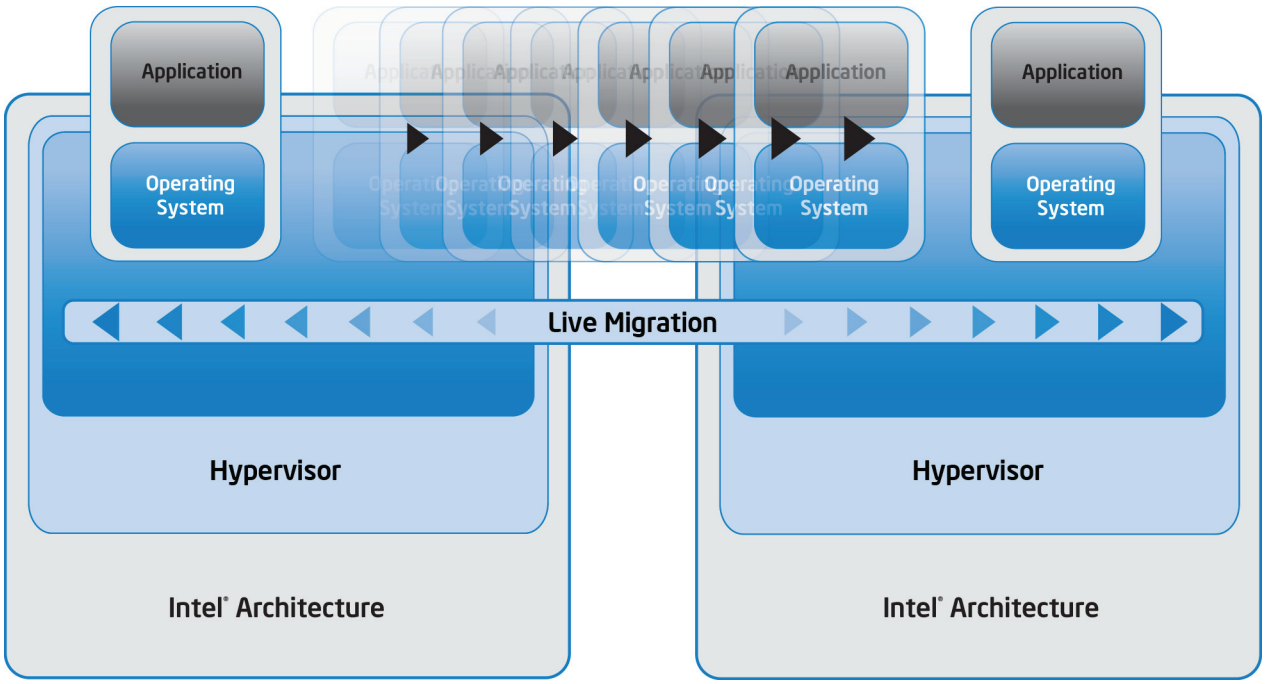


Figure 2. Live migration technology moves live, operating virtual machines from one physical system to another while maintaining continuous service availability. This capability allows fast reconfiguration and optimization of resources across the virtual infrastructure.

- **Respond faster to business needs.** In a virtualized environment, server-provisioning time may be reduced from weeks to minutes. VMs can be added as needed, allowing IT administrators to quickly respond to a variety of situations, including increased demand for capacity, new requests for IT services, and the need for improved performance. Administrators can create server templates to ensure that server configurations for newly added VMs are consistent with departmental policies.
- **Develop and test software more efficiently.** By consolidating multiple test and development servers onto fewer physical servers, IT developers can test new enterprise applications in large-scale test configurations without incurring the cost or resource burden of provisioning and configuring a large number of physical servers.
- **Create cost-effective business continuity and disaster recovery solutions.** Business continuity means maintaining the availability of mission-critical applications in the face of maintenance needs, hardware failures, and adverse events. Live-migration technology allows administrators to move live applications on a VM from one physical server to another before bringing the primary server down for maintenance. In this way, virtualization can dramatically improve application availability and make updates to business-critical servers possible without a disruption in service. In addition, VMs can be clustered to further increase application availability by providing automatic failover.

  Virtualization can also help administrators implement a cost-effective disaster recovery solution. In the event of a disaster, multiple production workloads that were running on VMs can be recovered in minutes simply by copying the VM images to a physical server at the disaster recovery site and then restarting the VMs on that server. Using virtual infrastructure in this way can provide business continuity while eliminating the need to maintain identical hardware at both the production and disaster recovery sites.
- **Migrate legacy and custom applications.** Migrating custom enterprise applications to new operating environments can be time consuming and costly, so many organizations maintain dedicated hardware for legacy systems. Because VMs operate independently of physical hardware and multiple VMs can run on a single physical server, IT administrators can protect critical data and maintain new and old systems simultaneously on the same hardware. This capability is particularly valuable as multi-core servers become more powerful, allowing larger numbers of VMs per physical host.

Intel® Ethernet Server Adapters: Providing the Glue for Virtualization

Often taken for granted in servers, network port capacity can easily become constrained on servers that host large numbers of VMs. As the number of VMs per server increases, utilization of the host CPU resources also increases. In addition, there are more applications competing for the available network hardware resources. Multi-port server adapters provide the foundation for a flexible and reliable virtual infrastructure. They conserve valuable slots while helping to eliminate network bottlenecks in a connection-dense VM environment. For example, a minimum of four network ports might look like this:

- One for the management console
- One to enable dynamic workload balancing
- One for each VM and its application(s)
- One for each VM for redundancy purposes

In fact, however, many industry experts recommend a minimum of six network ports:

- One port for the management console
- One port to enable dynamic workload balancing
- One port for system management
- One port for system heartbeat
- One port for each VM and its application(s)
- One port for redundancy per VM

In practice, virtualized server deployments often exceed this port-count model based on the requirements of the VMs. Multi-port adapters, which support complete network connectivity and redundancy while freeing I/O slots for other purposes, provide an ideal solution.

Multi-port network adapters help IT utilize the potential of virtualization

- **Overcoming slot constraints.** Conserve valuable server I/O slots
- **Segmentation.** Access multiple network segments (security, management, storage, and consolidation and virtualization)
- **High Availability.** Provide added network connections and failover
- **Performance.** Team adapters to improve system throughput
- **Cost Optimization.** Maximize value through reduced per-port cost

This can be challenging if servers are Peripheral Component Interconnect (PCI) slot-constrained, which is often the case with low-profile, rack-mounted servers. As form factors shrink, multi-port server adapters with two or four ports become critical components.

Reliability is critical in a consolidated infrastructure. On a server that is operating multiple applications on multiple VMs, a connection failure can be a costly business interruption. If redundant network connections are desired to enhance the reliability of servers hosting many applications, the issue intensifies—large numbers of network ports per server are highly desirable.

In addition, IT administrators must be able to segment traffic to maintain a flexible and secure network. The flexibility to assign ports to servers and VMs enables administrators to increase performance quickly during peak times. Server workloads are always growing in size as well, which means that enterprises need multiple network connections that provide the throughput required to respond immediately to customer requests for data.

All of these requirements consume server ports. For that reason, dual-port and quad-port Intel Ethernet Server Adapters—available for PCI/PCI-X or PCI Express and optimized for Intel® Xeon® processor-based servers—play an essential role in virtualization, providing the foundation for a flexible and reliable virtual infrastructure.

Multi-port Intel Ethernet Server Adapters conserve valuable PCI slots in servers while helping to eliminate network bottlenecks—especially in connection-dense virtualized environments. The use of extra ports to establish separate physical networks for application production traffic, management, and live VM migration is shown in Figure 3.

Intel Ethernet Server Adapters provide a broad spectrum of advantages to IT organizations of all sizes that make them a solid choice for the virtualized environments of today and tomorrow:

- **High performance.** Multi-port Intel Ethernet Server Adapters can reduce network downtime and optimize utilization of the server's processing capability. Support for PCI Express enables organizations to realize maximum benefit from server virtualization and consolidation by taking advantage of high bandwidth and scalability support. These adapters also include support for advanced server features, including redundant network links for server failover, adaptive load balancing and link aggregation for increased scalability and throughput, and interrupt moderation for significantly enhanced processor utilization.

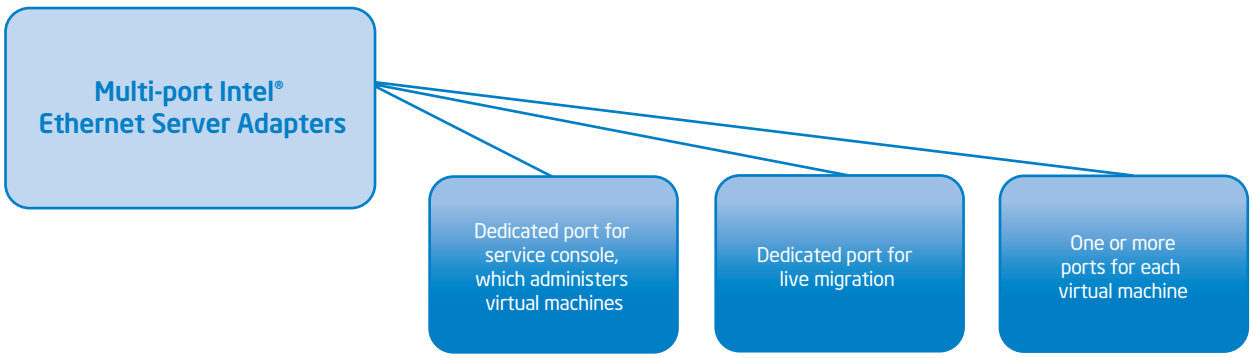


Figure 3. Virtualization best practices recommend the creation of network labels for each virtual network adapter through the hypervisor. Network labels should be global across server farms to support live migration. Virtual machines must have access to the necessary subnets on the target host. Multi-port Intel® Ethernet Server Adapters can provide the necessary port density to help support this topology, in addition to dedicated ports for each virtual machine on a server.

- **Extensive compatibility.** With a flexible design that fits almost any type of PCI slot, multi-port Intel Ethernet Server Adapters include standards-based management features and wide network operating system support to help ensure extensive compatibility with the latest server and networking environments. Intel Ethernet Server Adapters are compatible with full-height and low-profile PCI slots. On select adapters, the standard, full-height bracket can be easily swapped out and replaced by the shorter, low-profile bracket for installation in high-density servers that feature low-profile slots.
- **Increased reliability.** Intel® Advanced Network Services (Intel® ANS) software allows administrators to increase uptime with redundant teamed connections. Switch fault tolerance and test switch configuration features help test compatibility and further increase uptime. Multi-port Intel Ethernet Server Adapters can be configured to automatically switch to a secondary link when a server's primary link fails. Server performance can be further enhanced by teaming connections on adapters with each other, with connections on other Intel Ethernet Server Adapters or with LAN-on-Motherboard components using Intel ANS features to achieve enhanced scalability and redundancy for server failover capability. Advanced cable diagnostics can dynamically test and report network problems, such as interrupts, and automatically compensate for cable issues.
- **Server expandability and business continuity.** Proactively including multi-port Intel Ethernet Server Adapters at the time of server purchase helps to ensure server expandability by helping avoid the cost of taking a server offline to install a new adapter when adding servers or VMs. Multi-port Intel Ethernet Server Adapters also enable business continuity by allowing IT administrators to dedicate ports for remote storage and management, including storage area networks (SANs) and network attached storage (NAS).
- **Network segmentation.** To help ensure that IT organizations can support unpredictable network demands, such as heavy traffic on Web servers and intranets, IT departments are increasingly segmenting enterprise networks. Segmentation helps provide better data security and uptime for each network. Employing multi-port network adapters can provide the platform flexibility to respond to the evolving needs for segmentation and enable the connection to multiple switches to segment traffic on a network.
- **Cabling advantages.** Intel offers dual-port and quad-port adapters with both copper and fiber-optic connections. Both types of adapters use a common driver technology, which helps reduce IT complexity.
- **Centralized remote management.** Dual-port and quad-port Intel Ethernet Server Adapters support standard management protocols to further reduce TCO. These protocols include Wired for Management (WfM), Microsoft Remote Installation Service (RIS), Simple Network Management Protocol (SNMP), and Desktop Management Interface (DMI).

Conclusion

To improve return on investment (ROI) and reduce TCO, organizations need to make the most of what is already in place. Virtual IT infrastructure has become a powerful enabler for consolidating servers, running applications in multiple operating system environments, simplifying administration, and lowering operating costs. Virtualization on Intel Xeon processor-based servers provides a robust virtualization platform, and Intel Ethernet Server Adapters provide the connections to make the virtual IT infrastructure a reality. Together, Intel and the rest of the virtualization ecosystem help IT managers reach a common goal: serving enterprise needs in the most efficient and responsive way possible.

Intel Ethernet controllers and network adapters are optimized to meet the needs of virtualized enterprise data centers. They support a broad range of network operating systems, including Microsoft Windows*, Linux*, and UNIX*, whatever your Ethernet preference:

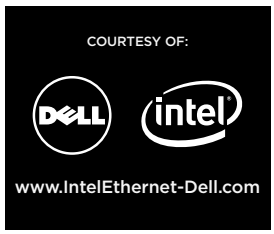
- **Port speeds.** 10/100, 1 Gigabit, and 10 Gigabit
- **Port densities.** Single-, dual-, and quad-port
- **Cabling specifications.** Category 5, 6, 6A; optical fiber; single and multi-mode
- **Bus types.** PCI, PCI-X, PCI Express

Regardless of the long-term requirements an organization faces, Intel Ethernet Server Adapters are an excellent choice. Multi-core optimization ensures efficient use of server processing resources, as well as improved network load balancing across cores, reducing bottlenecks. Network connectivity from multiple VMs can be implemented on a single server, improving operational efficiency. Intel's leadership in the industry, together with collaboration across the virtualization ecosystem, helps simplify IT and gives end customers the confidence they need to face the challenges of implementing new technologies, ensuring ongoing success.

For More Information

Intel® Ethernet Server Adapters are compatibility tested for excellent results across the virtualization ecosystem.

Learn more: www.intel.com/go/ethernet



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