Why Now Is the Time to Consider 10GbE

In This Paper

- Virtualization and cloud are changing enterprise computing, resulting in enterprises rethinking their networking architecture strategies
- Servers are getting faster and more VMs are running on each server; 1 GbE connectivity is no longer enough
- Hardware and software vendors have been designing products to take advantage of 10GbE, offering enterprises a growing 10 GbE ecosystem

ENTERPRISE Networking PLANET

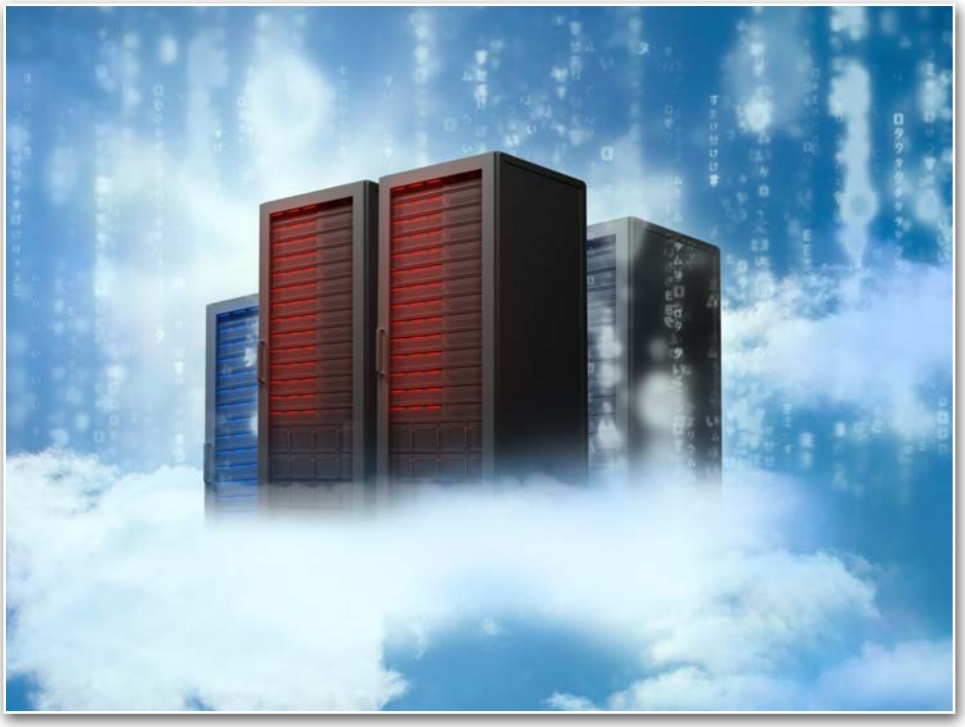
Executive Brief

At one time, data centers were discrete entities consisting of independent silos of computing power and storage bridged together by multiple networks. Servers were consolidated from time to time, but they still used discrete and independent networks such as Token Ring, Ethernet, Infiniband*, and Fibre Channel.

Then along came virtualization and cloud computing. They brought with them a variety of storage technologies and, more recently, software defined networking (SDN). Collectively, these technologies are providing dramatic gains in productivity and cost savings. They are also fundamentally changing enterprise computing and driving a complete rethinking of enterprises´ networking architecture strategies.

As virtualization continues to take hold in data centers, the silos of computing, network, and storage that were once fixtures are increasingly being replaced by resource pools, which enable on-demand scalable performance. Hence, as application needs grow, the infrastructure can respond.

Unfortunately, this is a two-edged sword. Virtualization has increased server utilization, reducing the once-prevalent server sprawl by enabling enterprises to do more with less, and simplifying and maximizing server resources. But it has also driven the demand for networking bandwidth through the roof in complexity and created a major bottleneck in the system.



For some enterprises, server virtualization alone isn't enough and they have deployed a private cloud-based infrastructure within their data center. With this comes the need to not only scale resources for a specific application but also for the data center itself to be able to scale to meet dynamic business needs. This step requires storage and networking resources to move away from the restriction of dedicated hardware and be virtualized as well.

This next step in virtualization is the creation of a virtual network that can be controlled and managed independent of the physical underlying compute, network, and storage infrastructure. Network virtualization and SDN will play a key role, and network performance will ultimately determine success.

Today, discrete data center networks for specific components, such as storage and servers, are no longer appropriate. As companies move to private cloud computing, in which systems are consolidated onto fewer devices, networks must be simpler to deploy, provision, and manage.

Hence, 1GbE connectivity is no longer enough. Think about it: Servers are getting faster, and enterprises are running a growing number of virtual machines (VMs) that compete for existing I/O on each server. An increased amount of data must be processed, analyzed, shared, stored, and backed up due to increased VM density and enterprises' rising storage demands. If this growth is left unmanaged, the network will become even more of a bottleneck, even as server speeds continue to increase.

To truly reap these gains, the network needs to keep up. More bandwidth means faster access to storage and backup, and faster network connections mean lower latency and a minimal bottleneck.

"Although the technology has been around for many years, its adoption has been slow. "

Moving to 10GbE

Despite its recent maturity, 10GbE has had a long journey. Initially ratified by the IEEE in June 2002 as 802.3ae, the standard is a supplement to the 802.3 standard that defines Ethernet.

Officially known as 10 Gigabit Ethernet, 10GbE (also referred to as 10G) operates in only full-duplex mode and supports data transfer rates of 10 gigabits per second for distances up to 300 meters on multimode fiber optic cables and up to 10 kilometers on single-mode fiber optic cables.

Although the technology has been around for many years, its adoption has been slow. After spending nearly a decade building out their 1GbE networks, enterprise have been reluctant to overhaul the resources invested in the network, including adapters, controllers and other devices, and—perhaps most of all—cabling. But as virtualization and cloud operations become core technology components, they are bringing with them changing network requirements, key to which is that the minimum for an advanced dynamic architectures is now 10GbE.

Crehan Research reports that while 17 percent of server Ethernet ports conformed to the 10GbE standard in 2012, the majority—83 percent—still followed the 1GbE standard. In 2013, those numbers remained steady, with 81 percent and 19 percent following the 1GbE and 10GbE standards, respectively. 2014, however, is expected to be a year of change. Crehan Research forecasts that 10GbE usage will increase, with 28 percent of server Ethernet ports adhering to the standard. Inversely, 1GbE installs will decline to 72 percent. This trend is expected to continue through 2018, at which time 79 percent of server Ethernet ports will be using 10GbE and a mere 4 percent 1GbE. The remaining ports will have migrated to 40GbE .

For some time now, hardware vendors have been designing their products—from processors to interconnects and switches—with 10GbE in mind. Software vendors are now well-versed in these needs as well and are designing applications that take advantage of 10GbE. Enterprises are now in effect paying for an optimization for which they may not be reaping the benefits. Fortunately, while this ecosystem around 10GbE has been growing and the speed is now expected if an enterprise is to achieve its desired performance, price points of 10GbE supported products have been dropping.

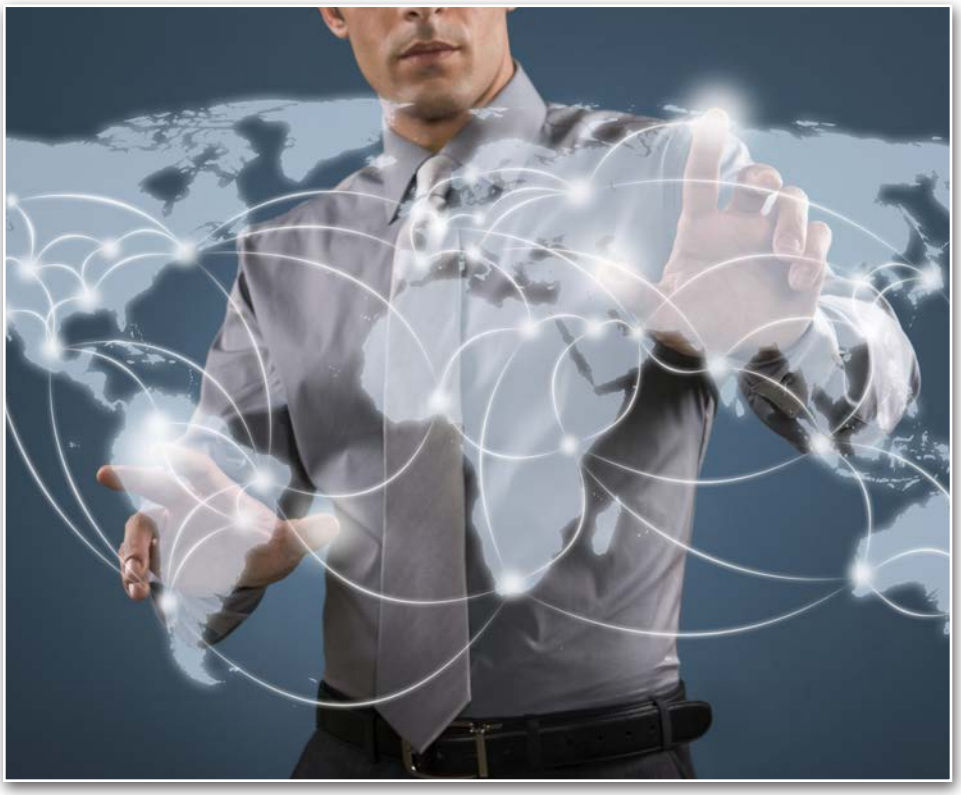
The benefits 10GbE brings to data centers can be classified into three categories:

- Performance
- Simplification
- Unification

Performance, or increased speed, is likely the first enhancement that comes to mind, but performance improvements are not the only advantage 10GbE brings to data centers. It also unifies and simplifies the data center, thus reducing cost and complexities associated with maintaining the network. From the very beginning, simplicity and low cost were goals for Ethernet. And indeed, by unifying the data center storage and network fabrics by adding support for both Fibre Channel or iSCSI technologies over Ethernet and thus a single, low cost, high bandwidth interconnect, 10GbE is able to reduce network costs. In addition, 10GbE simplifies the network infrastructure by reducing power, improving bandwidth, and lessening cabling complexity.

As enticing as these advantages are, few technologies are compelling without a comprehensive ecosystem behind them. Ecosystems for new technologies can sometimes be a chicken and egg cycle, however. Vendors are reluctant to invest resources in building an ecosystem if enterprises aren't buying product, but enterprises are reluctant to buy a new type of product if it lacks an ecosystem. A comprehensive ecosystem is an indicator of a technology's maturity, and 10GbE does not disappoint.

On the market today are a variety of products that support 10GbE, including processors, servers, adapters, switches, and cables. There is also support for multiple media types within 10GbE as well as improved cable technologies.



Getting the Most Out of Popular Technologies

For a technology improvement to be considered worth pursuing, it must facilitate the enterprise in more easily achieving its business goal. In the case of 10GbE, virtualization was the first technology to truly feel its benefits. Virtualization enables enterprises to satisfy a host of business goals from resource maximization to agility. The benefits virtualization brings to enterprises are enhanced and fully realized when the network is migrated to 10GbE.

Virtualization was, in effect, the watershed use case for 10GbE. It offered a way to address the growing complexity and bottlenecks associated with virtualization's need for more network bandwidth. Now, IT could consolidate the ever-growing numbers of 1GbE ports and replace them with 10GbE. The move to 10GbE also enabled IT to unify data center storage and network fabrics, and in some cases I/O virtualization, by adding support for Fibre Channel or iSCSI technologies over Ethernet.

For many enterprises, the next stage after deploying a virtual infrastructure is to add a cloud component. This transition enables enterprises to not only scale resources for a specific application, but also, and more importantly, for the data center to scale to meet dynamic business needs.

For this to be successful, both storage and networking resources must move away from the restrictions endemic to dedicated hardware and be virtualized. This next step creates a virtual infrastructure that can be controlled and managed independent of the physical underlying compute, network, and storage infrastructure in the form of network virtualization and an SDN. For these infrastructures to function, the low latency of 10GbE, and in some cases 40GbE, is required.

Cloud and virtualization are not the only technologies driving 10GbE adoption. Rapidly increasing volumes of data, both structured and unstructured, must be stored and backed up. Being able to scale workloads quickly and efficiently by creating a single storage and data network, and enabling unified resource pools of compute and

storage resources, is critical for the network to function at the speeds and capacities enterprises expect.

10GbE makes this possible.

Why 10GbE from Intel?

The maturity of 10GbE means that enterprises looking to migrate will find no shortage of vendors from which to choose. It is important, however, to find a vendor whose products offer the advantages of simplifying, unifying, and enhancing data center resources.

Intel has a longstanding and trusted reputation when it comes to Ethernet. Much of Intel's business is predicated around Ethernet. For more than 30 years, the company has delivered reliable and trusted Ethernet products that work, no matter how complex the problems they seek to resolve.

Its Ethernet products include controllers, converged network adapters, and switch silicon.. Collectively, Intel's offerings seek to simplify by delivering lower TCO and reduced network complexity, unify with cost-effective LAN and storage networking, and enhance by optimizing the network to achieve maximum utilization levels.

Intel 10GbE Performance

The first step to accommodating growth in network traffic is a move from 1GbE to 10GbE connections. The increased bandwidth enables enterprises to deliver data over the network at a breakneck pace, with consistently stable drivers, high performance, and interoperability.

Intel takes a holistic approach, providing advantages at the component level as well as at the server level. The Intel® Xeon® processor E5-2600 v2, for example, increases I/O bandwidth and thus speed. The Xeon E5-2600 processor family brings a tremendous leap in I/O performance via Intel® Integrated I/O with Intel® Data Direct I/O, which cuts latency by about 30 percent while adding more lanes and higher bandwidth with support for PCIe* 3.0. Increased core counts (up to 12 cores/24 threads) and a 30M cache also contribute to the speed boost, as does support for a larger memory DIMMs up to 64GB, and faster memory.

The E5-2600 v2 is about more than just speed, however. The processor family brings a host of new features to help protect important data: Intel® Secure Key provides faster and more secure encryption, and Intel® OS Guard protects against malware. Advanced Programmable Interrupt Controller virtualization (APICv), designed to improve virtualization performance, is also a key part of the processor.

But 10GbE is really about the network, and Intel's offerings go well beyond the processor. Intel® Ethernet Converged Network Adapters are optimized with Intel® Virtualization Technology, enabling virtualized data centers to not only beat the performance bottle neck, but also to simplify and save by consolidating many 1GbE connections onto fewer 10GbE connectors.

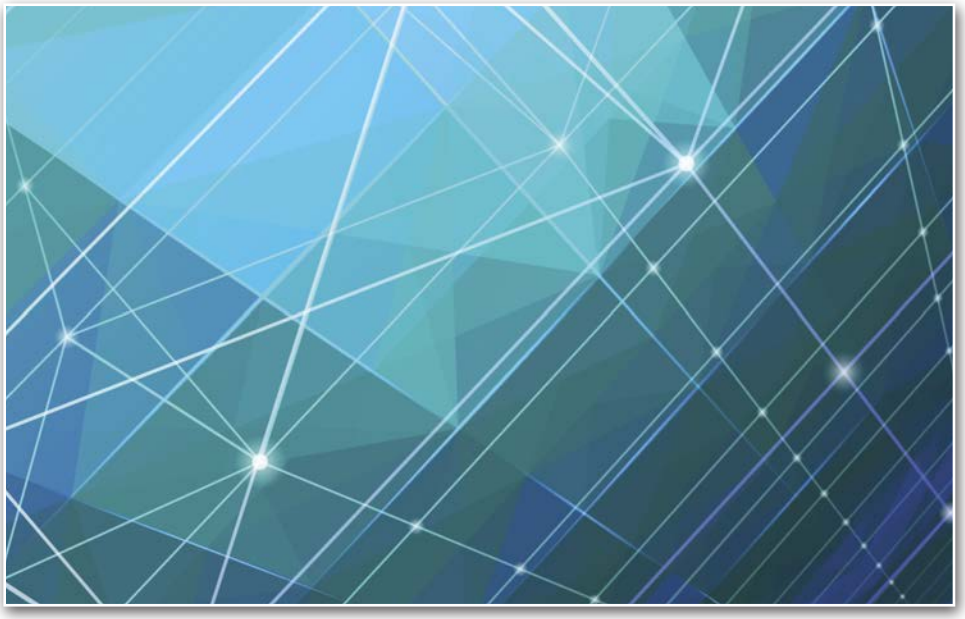
Intel® Ethernet Switch Silicon offers low latency, and rather than fighting the growing interest in SDNs, Intel is making its products compatible with the technology. The company is pioneering SDN as a way to open networks for ultra-high scale, increased flexibility, and control and reduce costs.

Finally, in the area of storage, Intel® Solid-State Drives are considered best in class for performance and latency for both hot and cold storage, which benefit greatly from 10GbE.

While individually each component

"Intel takes a holistic approach, providing advantages at the component level as well as at the server level."

offers many benefits, collectively the benefits increase dramatically. For example, when used together, the Intel Xeon processor E5-2600 v2 and the Intel SSD DC S3700 series, along with Windows Server* 2012, can deliver 3.5 times more VMs than can a legacy server, according to a Principled Technologies Test Report published in September 2013.



Intel 10GbE Simplifies

Moving to a 10GbE network not only increases your bandwidth but also simplifies your data center environment, which results in significant cost savings.

Most IT shops have multiple networks for storage and compute. Maintaining these separate networks brings complexity and added costs. Back in the days before virtualization and cloud computing, when data centers were siloed and consisted of discrete entities, this was necessary. No single network could do it all.

The advent of 10GbE and use of Fibre Channel over Ethernet (FCoE) protocols brought with them enough bandwidth and resiliency to enable enterprises to have a truly unified single network. A single network is easier and less expensive to maintain.

Intel Ethernet Converged Network Adapters simplify the transition to 10GbE by improving the bandwidth per port, thus enabling significant reductions in network hardware and infrastructure costs.

Intel's support for 10GBASE-T also contributes to the easy migration to 10GbE by offering backward compatibility with current GbE networks and allowing the use of existing structured cabling in the data center. No forklift upgrade required here. In addition, Intel's large product family supports a wide range of technologies including, BASE-T, SFP+ and Fibre Optics as well single-, dual- and quad-ports.

The end result is a much simpler network. It is the first traditional Ethernet consolidation that enables a unified fabric that can handle LAN, storage and clustering traffic on the same Ethernet network.

Intel 10GbE Unifies

The advantages of unification go hand in hand with the benefits of simplification. In some cases it is difficult to see a distinction in the benefits offered. Indeed, simplification is one of the major benefits of a unified network. Other benefits are lower TCO inherent with infrastructure consolidation and greater flexibility.

By enabling IT to unify LAN and storage traffic in a single network, Intel simultaneously unifies and simplifies, helping to reduce costs and complexity and enhance the efficiency, particularly when it comes to virtual infrastructure. Enterprises have a choice of traditional Ethernet consolidation or a unified fabric that can handle LAN, storage and Fibre Channel traffic on the same Ethernet network.

Unlike other vendors that have separate network interface cards (NICs) for iSCSI, standard LAN and FCoE, Intel has one NIC that provides full coverage of both the LAN and storage network. It uses 10GbE for FCoE and iSCSI connectivity to storage that utilizes the power of the Intel Xeon processor E5-2600.

Converged networks, with storage and server traffic running across a unified fabric, are simpler to manage while supporting large volumes of traffic. Intel sweetens this concept further by designing its 10Gbe products to be optimized for performance and integration with Intel servers, in particular the E5 and E7 servers, and the technologies they support, such Data Direct I/O Technology (Intel® DDIO) and Intel® Virtualization Technology for Connectivity (Intel® VT-c).

Intel DDIO rearchitects the flow of I/O data into and out of the processor. Introduced with the Intel Xeon processor E5 family as a key feature of Intel Integrated I/O, Intel DDIO was created to enable Intel® Ethernet Controllers and adapters to talk directly with the processor cache of the Intel Xeon processor E5. Intel DDIO makes the processor cache the primary destination and source of I/O data rather than the main memory. This results in increased bandwidth, lower latency and reduced power consumption.

Intel VT-c enables lower CPU utilization, reduced system latency, and improved networking throughput. Intel VT-c is found in Intel Ethernet Controllers. The controllers use the technology to deliver virtualized I/O performance optimizations and quality of service features. These capabilities are designed directly into the controller's silicon.

The importance of virtualization in Intel's approach to 10GbE cannot be overstated. Intel's Ethernet products make it easier for enterprises to get the most out of their virtual infrastructures.

This begins in the migration stage. Intel makes it easy to move to a virtualized environment by reducing the required number of network ports and cables, enabling network programmability, and supporting open network standards. This results in lower TCO and reduced network complexity.

Intel's Ethernet products make it possible for enterprises to scale virtual workloads quickly and efficiently by creating a single storage and data network, and enabling unified resource pools of compute and storage resources. This makes it easier to control and manage network infrastructures. Intel also makes it feasible to fully leverage virtual resource pools by balancing hardware performance and software extensibility, and thus reducing the manpower required to manage the network.

Conclusion

10GbE enables enterprises to boost network performance while simplifying network infrastructure, reducing power, improving bandwidth, and reducing cabling complexity. Unifying different types of traffic onto a single, low-cost, high-bandwidth interconnect further simplifies the network.

The performance improvements and benefits of simplification and unification will be most acutely felt by enterprises deploying a virtual infrastructure. With a virtual infrastructure fast becoming the norm for many enterprises, the importance of a network that can meet performance, maintenance and other usability challenges is critical. In addition to virtualization, 10GbE offers numerous benefits to cloud-based infrastructures and enterprises with heavy storage requirements.

Enterprises that seek to learn more about Intel's offerings around 10GbE will find more information at www.intel.com/go/10GbE. ■