Case Study

Dual-Core Intel® Xeon® Processor–based servers and Intel® PRO/1000 Multi-Port Server Adapters

Global IT

Intel Global IT Group Solves Performance Challenges Using Intel® I/O Acceleration Technology

Dual-Core Intel® Xeon® processor 5100 series–based servers along with Intel® PRO/1000 Multi-Port Gigabit Server Adapters and Intel® I/O Acceleration Technology break through a performance barrier in Intel's enterprise backup and recovery system, saving critical time and driving return on investment savings across the enterprise.

Challenges Several petabytes of data are backed up weekly from Intel's large server and storage infrastructure using Veritas NetBackup* from Symantec. To keep pace with growing business needs and database sizes, the corporate IT group needed to resolve performance bottlenecks in the enterprise backup and recovery system. Previously, this required adding costly server hardware to scale network backup throughput and keep pace with exponentially-growing storage capacity and improved tape performance.

Solutions Intel IT deployed new Dual-Core Intel® Xeon® processor 5160-based servers with Intel® multi-port network adapters and Intel® I/O Acceleration Technology, combining port-teaming features to aggregate multiple Gigabit Ethernet links in the backup and restore servers. With the new configuration, Intel IT demonstrated that it could boost the performance of the backup server by greater than three times that of the installed server platforms.

Benefits Using this new technology, Intel's IT group can now better scale the backup and recovery system to support business growth while reducing capital and operational costs through server consolidation. Intel can reduce the number of NetBackup media servers required in each backup and recovery environment from four to a maximum of three servers per large tape library, cutting acquisition and operational costs by 20 percent to 30 percent.

"We finally broke through the performance barrier, achieving more than 400 MB/s with Veritas NetBackup*. This is a 270 percent increase in server performance."

Barry Spencer
Engineer
Intel IT Server Engineering Group

The Dual-Core Intel® Xeon® processor 5160-based server platform along with Intel® PRO/1000 Multi-Port Network Server Adapters and Intel® I/O Acceleration Technology are ideal for addressing I/O performance bottlenecks in systems such as network backup storage applications.

To support Intel's nearly 100,000 employees across 199 sites in 50 countries, Intel IT designs, deploys, and supports the global compute infrastructure and applications needed to run the core business. One of these crucial applications–enterprise backup and restore (EBaR)–is used to back up all critical data within the company's data centers for rapid recovery in the event of system data loss or site-wide disaster recovery. The system backs up several petabytes of data weekly from Intel's large server and storage infrastructure to prepare for potential data loss and disaster recovery situations.

The Backup and Recovery Performance Barrier

Deploying commercially available equipment and technology, the server engineering group originally designed the EBaR system in 1999 using Veritas NetBackup.* This architecture used Ethernet to pull data from the enterprise servers to NetBackup Media Server, which then leveraged Fibre Channel networks to write the data to tape. The NetBackup software provides complete, automated data protection for enterprise systems, enabling organizations such as Intel to manage all aspects of backup and recovery and maintain consistent backup policies across the enterprise.

However, as the company and data grew and the speed and performance of tape drives increased, the EBaR system was not keeping pace. This system—one of Intel's most highly utilized network applications—was constrained by performance bottlenecks, limiting the maximum throughput per server to 125 MB/s. Figure 1 shows the typical network and server configuration required to drive each tape library and where the bottlenecks occurred. There are more than 100 tape libraries deployed around the world by Intel IT.

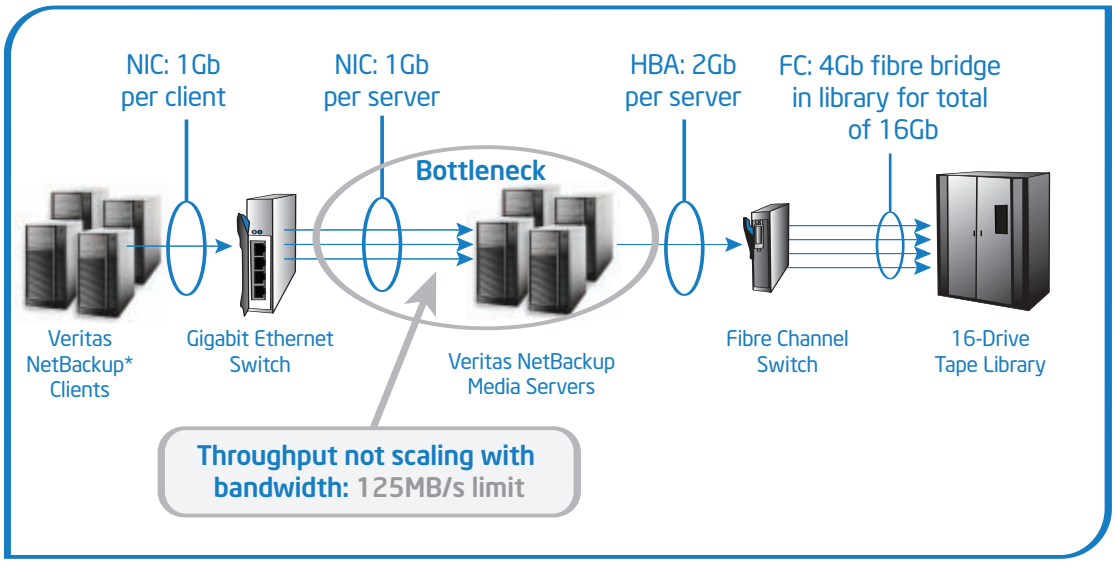
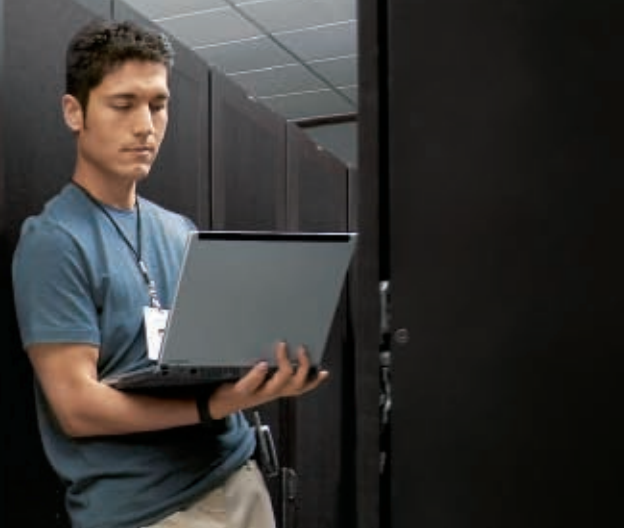


Figure 1. Throughput bottleneck in typical network and server configuration.



Previous Attempts at Solving Performance Challenge Failed

In the original design, each NetBackup media server had a single Gigabit Ethernet port connected to a dedicated backup network switch. In optimal conditions, this switch could handle the throughput to four Quantum SuperDLT* tape drives based on speeds of up to 11-22 MB/s per tape drive. When new higher-speed tape drives were introduced with data rates of up to 72 MB/s per drive, the network performance bottleneck started negatively impacting performance. With a server's single network connection having only a maximum data throughput of 125 MB/s, twice the amount of media servers were needed to drive the same number of tape drives. The challenge was clear: Knowing that the bottleneck was not due to software limitations of the Veritas NetBackup application, Intel IT needed to speed up server I/O. Future tape drives will double the data rate again, with the expectation that rates will continue to double every two years, making the problem even more pronounced as time goes on. The lack of throughput scalability would soon make the initial design obsolete unless a breakthrough was made.

To keep up with demand, servers were added to scale the data backup system—a costly solution. A potential alternative that IT engineering explored was teaming, or aggregating multiple ports of Gigabit network adapters to overcome the I/O performance barrier. Contrary to expectations, initial testing showed that server performance did not increase due to high processor overhead that degraded performance. It was discovered that in the existing server platform design, network interface card (NIC) teaming did not solve the bottleneck problem because network traffic was serviced by only one processor rather than the load being shared by the other processors in the system. The single processor was fully saturated by processing network data, causing the system's network throughput to max out at 125 MB/s.

Then Intel IT became aware of performance-enhancing technologies on the upcoming Dual-Core Intel® Xeon® processor 5100 series–based servers, including Intel® I/O Acceleration Technology (Intel® I/OAT), which could potentially solve the network performance barrier. The group decided to try these technologies in the backup and restore system environment, targeting Intel I/OAT for a severely bandwidth-challenged system.

The Answer: Intel Next-Generation Technology

Working with Intel's networking product experts, the IT engineering team learned the root causes behind the system's I/O performance bottlenecks: lack of scaling across processors, TCP/IP processing inefficiencies, and multiple memory copies. The new Intel-based systems have hardware improvements that solve the processor scaling problem by balancing the network load across multiple cores and processors, enabling NIC port teaming to provide much greater throughput than was previously possible.

Intel system architecture takes advantage of a newly-released Microsoft patch called the Scalable Networking Pack (SNP). The new servers also leverage Intel I/OAT to address other I/O bottlenecks. Intel I/OAT works in conjunction with improvements to the Microsoft Windows* and Linux* operating system network stacks to process TCP/IP network traffic more quickly and reduce system overhead, such as memory copies, by moving data more efficiently through the server platform.

Breaking Through the Barrier with Intel I/OAT

Encouraged to take part in the customer pilot testing process for Intel I/OAT, the Intel IT team began testing the new demonstration servers for the EBaR application in a scaled mockup of a large data center. Intel also invited Symantec to participate in the test, specifically to oversee the testing process and validate the configuration of the NetBackup application.

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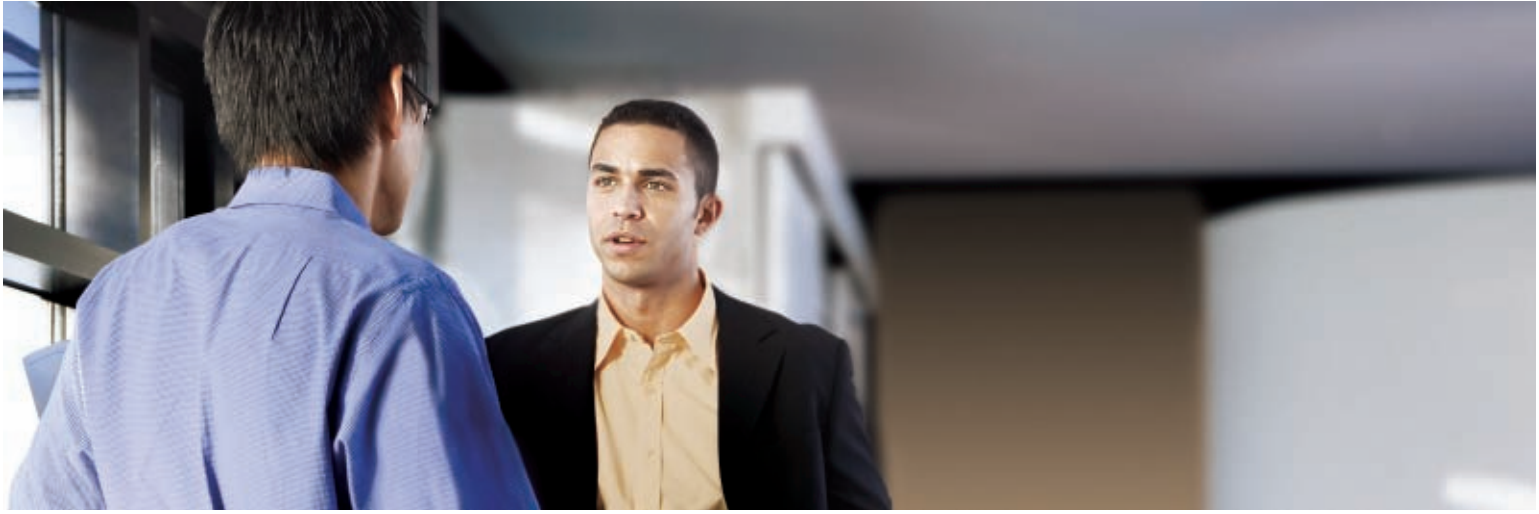

"I was astounded at the Gigabit Ethernet performance Intel was able to achieve—100 percent line rate is amazing. "

Ramon Herrera
Systems Engineer
Symantec

The test was a resounding success. "The new platform with Dual-Core Intel Xeon processor 5160-based servers enabled us to push through the wall. We finally broke through the performance barrier, achieving more than 400 MB/s with Veritas NetBackup*. This is a 270 percent increase in server performance," states Barry Spencer, engineer in Intel IT's server engineering group. Test results also demonstrated improved scalability and reduced processor utilization due to improved network interface teaming thanks to software and hardware improvements.

Ramon Herrera, systems engineer at Symantec, is also pleased with the results: "I was astounded at the Gigabit Ethernet performance Intel was able to achieve—100 percent line rate is amazing. I've never seen this before on a single- or dual-NIC Gigabit Ethernet environment. NetBackup is designed to take advantage of higher speeds, and this test proves that."

Figure 2 shows the actual test results achieved during testing. The first tests were done with a single network interface configured, and the second bar represents the attempt to team the network interface for greater

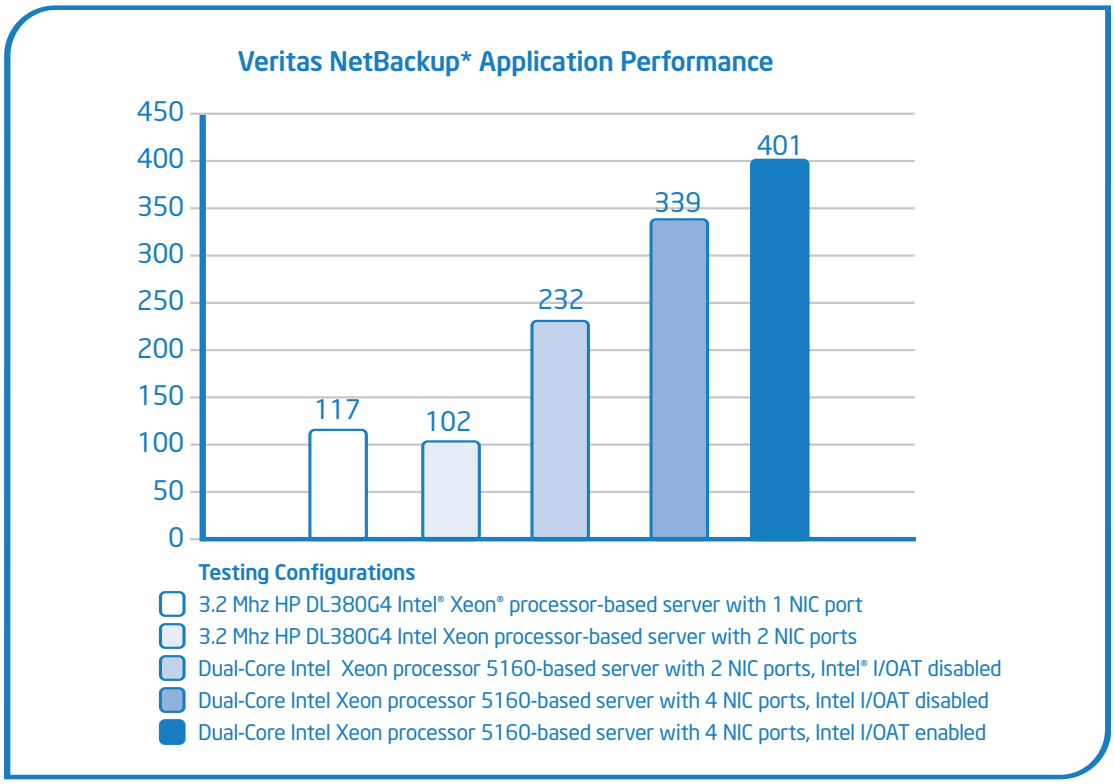

Figure 2. The new Intel® platform achieved much higher thoughput, improving Veritas NetBackup performance*

throughput. High processor utilization caused a drop in throughput when teaming was enabled. In contrast, the new Intel® platform was able to achieve much higher throughput as represented by the third, fourth, and fifth bars.

Prior to Intel I/OAT, the server engineering team was only able to utilize one Gigabit network adapter port with a maximum throughput of 125 MB/s. "We are now able to scale a single server well beyond the 125 MB/s barrier using the combined technology of the Intel® NICs, chipset, and processors," adds Spencer. It is a testament to the product team helping solve a very complex problem with new technology and some tenacious testing."

Combining the Dual-Core Intel Xeon processor 5160-based servers with Intel I/OAT, the Intel IT group can now team up to four or more Gigabit network adapters and retain 400 MB/s or greater backup throughput to a single machine. Adding a dual-port network card essentially takes the place of adding a whole new server. Cost savings are realized by reducing the overall number of servers required for the EBaR environment, providing significant capital and operating cost savings across the entire organization.

Lowering TCO with Anticipated Server Consolidation

With the ability to improve performance and scalability using the new Dual-Core Intel Xeon processor 5160-based server platform together with Intel multi-port network server adapters, Intel I/OAT, and the teaming features of the network adapters, Intel IT expects to be able to significantly reduce the number of servers required for the backup and recovery system. "The return on investment for this application will make a measurable impact to the data center operations, and we can now show great scalability," Spencer says. "The dramatically increased throughput means we can reduce the number of servers required for this responsibility. That stands to offer Intel a major reduction in total cost of ownership when you add up the savings at all of our data centers," explains Spencer.

Chad Sharp, lead engineer for Intel IT Data Management Services, says, "If we use 60 MB/s as an average target speed for the Super DLT 600 tape drives used in our environment, the lab results for Dual-Core Intel Xeon processor 5160-based servers show that we could easily run a tape library of 16 tape drives with three servers instead of four, for a savings of around 25 percent for one group alone within Intel. In some environments, we use six media servers, making the savings even greater."

Sharp adds, "The improvements in this new server platform remove some deeply rooted bottlenecks in our standard data protection architecture. Being able to aggregate several Gigabit Ethernet interfaces into a single virtual interface simplifies the environment, and the performance optimizations in Intel I/OAT allow us to scale up the performance backup architecture without continually adding servers. This improvement delivers on the promise of platform innovation by solving a long-standing real-world problem." Intel IT predicts that with Intel I/OAT and multi-port network adapters being used throughout the backup and recovery system, it can save 20 percent to 30 percent in capital expenditures over a purchasing period, depending upon the particular environment.

Reducing Administrative Overhead

With the performance breakthrough, backup windows will shrink and fewer servers will be necessary to support the data protection application. Intel IT expects the reduction in the number of servers to directly translate into a reduction in operational costs as the cost of managing the servers for patches and updates, as well as the complexity of the environment, are directly proportional to the number of servers in each environment. And because the performance improvement is achieved through server configuration, there is no additional effort on the part of the end user or backup administrator using NetBackup to take advantage of the performance gains.

Keeping Pace with Business Needs

By leveraging the data movement efficiencies of new Intel server platforms, the Intel Global IT group is now able to cost-effectively scale the backup and recovery system as business needs and data sizes continue to expand. "We're anxious to get this new solution into

production and use it for many years to come," explains Spencer. "This will enable our systems to be backed up and recovered much faster, equating to less downtime for critical systems."

The potential for future performance gains are already being discussed within Intel. "If we can scale four NICs, what's to say we can't do more?" Spencer adds. "And as 10 Gigabit networks become more prevalent, we will likely look at similar models to scale since we don't expect the storage expansion to slow down anytime soon. Now we have the tools to keep up."

For more information on Intel® networking solutions, visit www.intel.com/network

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