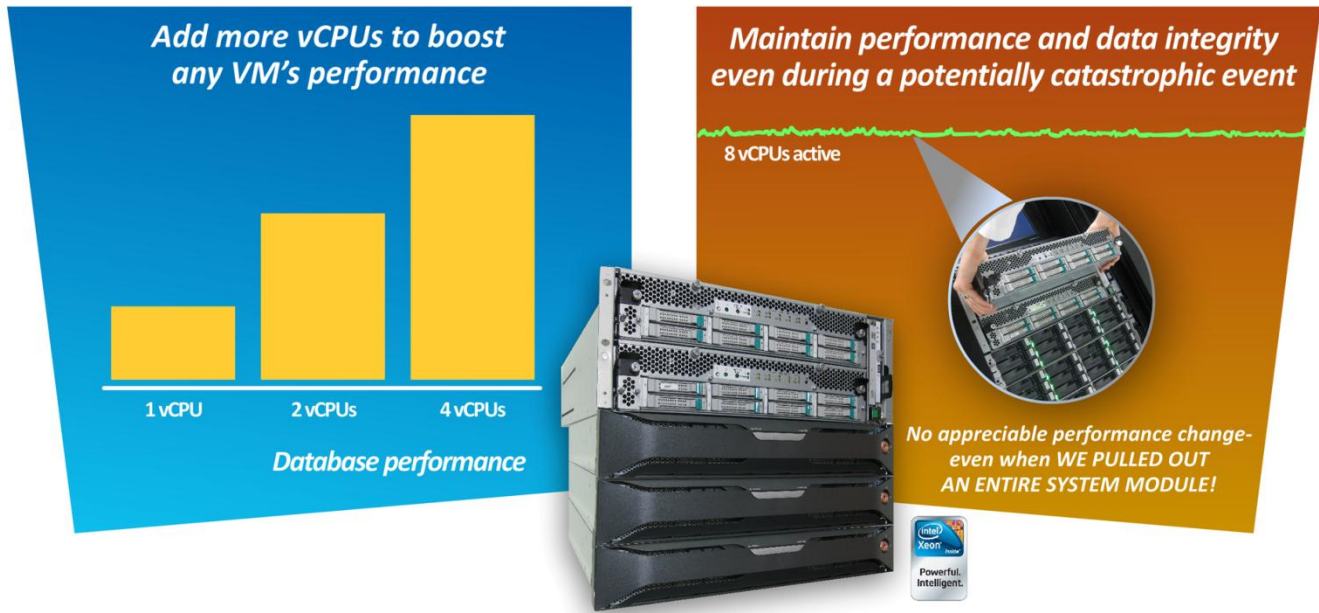


## A Fault-Tolerant Server solution that lets you...



### OUR FINDINGS

Both performance and ultra-high availability are crucial in many virtualized environments. In Principled Technologies' tests in our labs, the Stratus ftServer 6300/NEC Express5800/R320a solution, based on Intel® Xeon® processors, provided out-of-the-box, scalable database performance and fault tolerance to all guest virtual machines (VMs) by supporting multiple virtual CPUs (vCPUs) per VM. It also continued to operate—without data loss and with nearly unchanged database performance on guest VMs—in the face of a potentially catastrophic event more extreme than is likely to ever occur in a real system: we caused one of the lock-stepped CPU/IO enclosures to fail by removing it from the chassis. *Note: The NEC/Stratus fault tolerance solution is hardware-based and thus all guest VMs are immediately fault tolerant. We performed these tests without the use of either*

*the VMware Fault Tolerance or VMware High Availability products.*

### OUR PROCESS

We measured database performance in a single VM with different numbers of vCPUs to see how well the Fault Tolerant Server's performance could scale within a single VM. We also pushed the server to a very high work level (8 vCPUs in one VM) and removed an entire CPU/IO module. We used Microsoft SQL Server 2008 and the open-source DVD Store Version 2 benchmark (DS2) as our example database workload. DS2 takes orders and performs other functions representative of a real-world database application. For complete details on the methodology for this testing, including setup, configuration, and workload, please visit [http://www.stratus.com/pdf/analysts/ftServer\\_Stratus\\_NEC.pdf](http://www.stratus.com/pdf/analysts/ftServer_Stratus_NEC.pdf).

## PROJECT OVERVIEW

Stratus and NEC have worked together for the past 10 years to bring Fault Tolerance to the Intel® Server Architecture (<http://www.stratus.com/news/2005/20051124.htm>). Both firms have commissioned this test to assess the Fault-Tolerant Server’s performance scalability within a VMware VM and its data loss prevention in the face of a potentially catastrophic event.

Our first goal was to gauge the type of scaling the NEC/Stratus solution achieves in a single VM as one adds virtual CPUs (vCPUs). This scaling is important for database applications that require additional processing power beyond the amount a single vCPU can provide. We ran the DVD Store Version 2 benchmark inside a VM, using VMware ESX 4.0 as the hypervisor. We ran Microsoft® Windows Server® 2008 R2 with Microsoft SQL Server® inside the VM. To determine how performance scaled as we added cores, we tested with one, two, and four virtual processors assigned to the VM with a single database.

Our second goal was to gauge the performance level and data integrity of a database application on the Fault Tolerant Server in the face of a potentially catastrophic event. In our example test, we used a single heavily loaded 8vCPU VM – as many vCPUs as the server had physical processors cores. (Note: the Fault Tolerant Server has redundant sets of components, including processors, so there are 16 physical processor cores, but with redundancy, only eight of them are available.) We began the database workload, and then we actually pulled one of the lock-stepped CPU/IO enclosures from the chassis. An enclosure includes both a CPU and I/O element, so removing an enclosure removes half the system’s processor, memory, and I/O capabilities, simulating an event far more catastrophic than one that is likely to occur in a real-world environment.

## WHAT WE FOUND

### Scaling

As Figure 1 shows, database

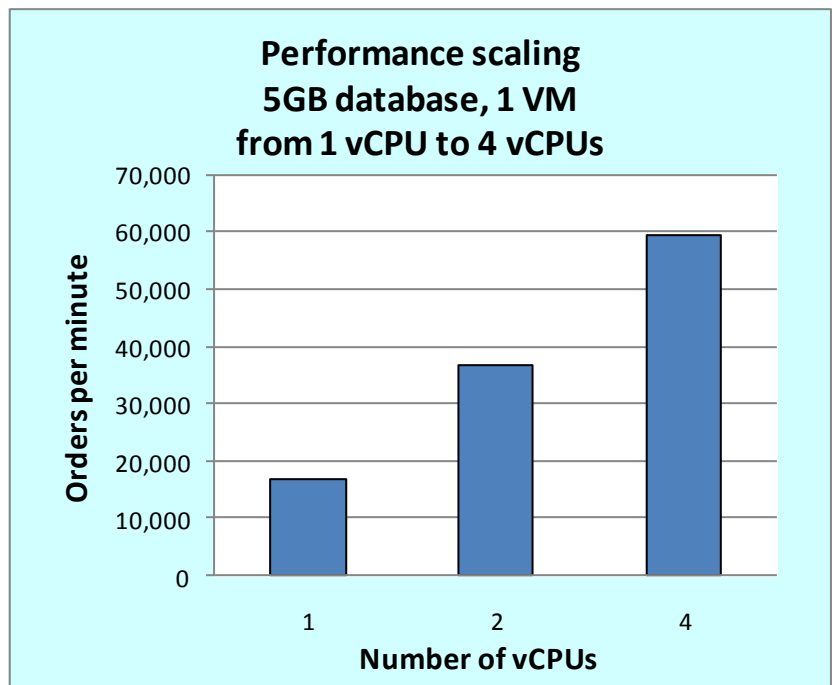


Figure 1: Number of DVD Store Version 2 orders per minute as the number of vCPUs increased from 1 to 4. Higher numbers are better.

performance scaled linearly as the number of vCPUs increased, and memory remained flat at 48GB. This shows that adding virtual processors increased system performance inside the VM with our workload. Figure 2 shows the number of orders per minute and the performance increase, relative to the single-vCPU configuration, for the three configurations we tested. On this and several of our preliminary test runs, the performance scaling from one to two vCPUs was slightly better than linear. This behavior may be due to SQL Server optimizations for multiprocessor architectures.

Number of vCPUs	OPM (higher numbers are better)	OPM increase relative to 1 vCPU (higher numbers are better)
1	16,771	0.0%
2	36,833	119.6%
4	59,409	254.2%

Figure 2: Performance and percentage increase from the median run of DVD Store Version 2 for the three configurations we tested.

### Continued performance and no data loss during a potentially catastrophic event

As we mention in the Project overview, we induced a potentially catastrophic event beyond that which any real-world server environment is likely to experience: We actually pulled a lock-stepped CPU/IO enclosure from the Fault Tolerant Server. We noted the performance before we removed the enclosure. We then observed a slight drop in performance that lasted 12 seconds. After this 12-second period, performance stabilized and began to increase gradually. After 26 seconds, performance returned to the pre-event level. As Figure 3 shows, the lowest performance during this period was 76,010 OPM, which is only 0.16 percent lower than the pre-event level of 76,129 OPM. The server lost no data at all.

Potentially catastrophic event, 5GB database, 1 VM, 8 vCPU	
OPM the server achieved <b>before</b> the potentially catastrophic event occurred	76,129
Lowest OPM the server achieved <b>after</b> the potentially catastrophic event occurred	76,010
Percentage performance drop due to the potentially catastrophic event	0.16%
Seconds from the potentially catastrophic event to the time performance drop ended and performance stabilized	12
Seconds from the time performance stabilized to the time performance returned to pre-event level	26

Figure 3: DVD Store Version 2 performance results for a single VM with 8 vCPU during a potentially catastrophic event. Higher numbers of orders per minute are better.

# ABOUT PRINCIPLED TECHNOLOGIES



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