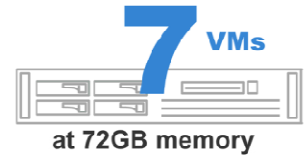
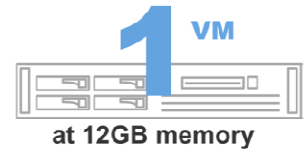
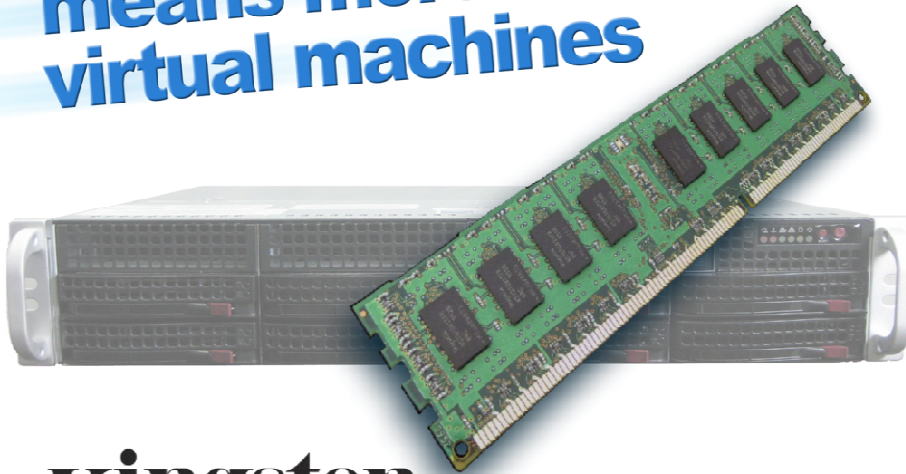


# More Kingston server memory means more database virtual machines



## OUR FINDINGS

Consolidating database servers with virtualization technology allows companies to reduce energy usage, save data center space and lower management costs. In Principled Technologies' tests in our labs, adding Kingston® memory to a server dramatically increased the number of database virtual machines (VMs) the server could support. In fact, the increase in VMs the server could support increased proportionally with the increase in RAM.

## OUR PROCESS

We used the open-source DVD Store benchmark, which provides a workload representative of a real-world database application, to determine how many comparably performing virtual machines a server could run with four different memory configurations. Our server ran VMware® vSphere 4,™ and the VMs ran Microsoft® Windows Server® 2008 R2 Enterprise Edition with Microsoft SQL Server® 2008.



## PROJECT OVERVIEW

This report presents the performance benefit one can expect when adding memory to a server. We tested the virtualized database performance of our server with four memory configurations:

- 12GB of RAM (6 x 2 GB)
- 72GB of RAM (18 x 4 GB)
- 144GB of RAM (18 x 8 GB)
- 192GB of RAM (12 x 16 GB)

The results also suggest that, for maximum potential for future virtual machine growth, companies would do well to select the highest capacity memory modules.

## WORKLOAD

DVD Store Version 2 (DS2) is an accessible, open-source, flexible framework with which we can model a typical online transaction processing (OLTP) database. DS2, which simulates an online e-commerce DVD store, has database components and Web server components, and includes driver programs that put heavy loads on the server. We opted to use the included driver program to stress the database layer directly, and bypassed the Web interface.

The main DS2 metric is orders per minute (OPM), which the driver program calculates and reports via the Windows Performance Monitor utility on the client machines. We chose to collect this OPM metric via the performance monitor counter on each client at 1-second intervals. We ran this workload on the virtual machines for 30 minutes and we report the last OPM score the benchmark reported. We ran one Microsoft SQL Server 2008 instance on each virtual machine (VM), each with an 8GB database.

Each client machine ran a single instance of DS2, with 32 threads, simulating users executing actions within the application. This simulated a heavily loaded environment; the load-generating client VMs ran with 0.5 seconds think time. For more details on DS2, see <http://www.delltechcenter.com/page/DVD+Store>.

Figure 1 shows the settings we used on the test server's virtual machines.

VM specifications	VM settings
vCPU	1
Memory (GB)	10
Virtual NIC type	VMXNET 3
Number of virtual disks	3 (OS, SQL logs, SQL database)

Figure 1: VM configuration used for testing

## MEMORY CONFIGURATION COMPARISON

Figure 2 shows a side-by-side comparison of the memory configurations we tested. We used the same physical server for all configurations.

Memory specifications	12GB configuration	72GB configuration	144GB configuration	192GB configuration
Vendor and model number	Kingston KVR1333D3D8R9S/2G	Kingston KVR1333D3D4R9S/4G	Kingston KVR1333D3D4R9S/8G	Kingston KVR1066D3Q4R7S/16G
Type	PC3-10600R	PC3-10600R	PC3-10600R	PC3-8500R
Speed (MHz)	1,333	1,333	1,333	1,066
Speed running in system (MHz)	1,333	800	800	800
Size (GB)	2	4	8	16
Total memory in system (GB)	12 (6 x 2 GB)	72 (18 x 4 GB)	144 (18 x 8 GB)	192 (12 x 16 GB)

Figure 2: Details of the four memory configurations tested

We configured the two internal hard drives as a RAID 1 and installed vSphere on them. We installed Microsoft Windows Server 2008 R2 and SQL Server 2008 installations inside the virtual machines. We stored all virtual machines on the NetApp FAS960 filer, which we connected to the server via a QLogic QLE2462 dual-port fibre controller.

## WHAT WE FOUND

As Figure 3 shows, the 192GB configuration supported 18 VMs, a 28.5 percent increase over the 144GB configuration, which supported 14 VMs, a 157.1 percent increase over the 72GB configuration, which supported 7 VMs, and a 1,700.0 percent increase over the 12GB configuration, which only supported one

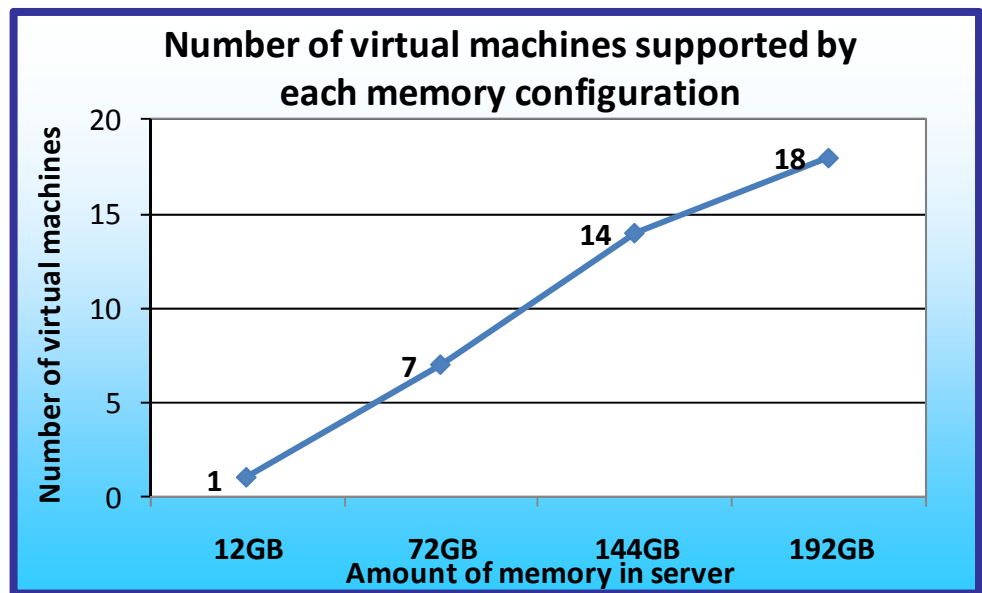


Figure 3: Number of virtual machines for a server with four different memory amounts using DVD Store Version 2. Higher numbers are better.

VM.

As Figure 4 shows, the 192GB configuration achieved a DS2 score of 60,609 OPM, a 23.2 percent increase over the 144GB configuration, which achieved a score of 49,166 OPM, a 134.4 percent increase over the 72GB configuration, which achieved a score of 25,853 OPM, and a 1,520.6 percent increase over the 12GB configuration, which achieved a score of 3,740 OPM.

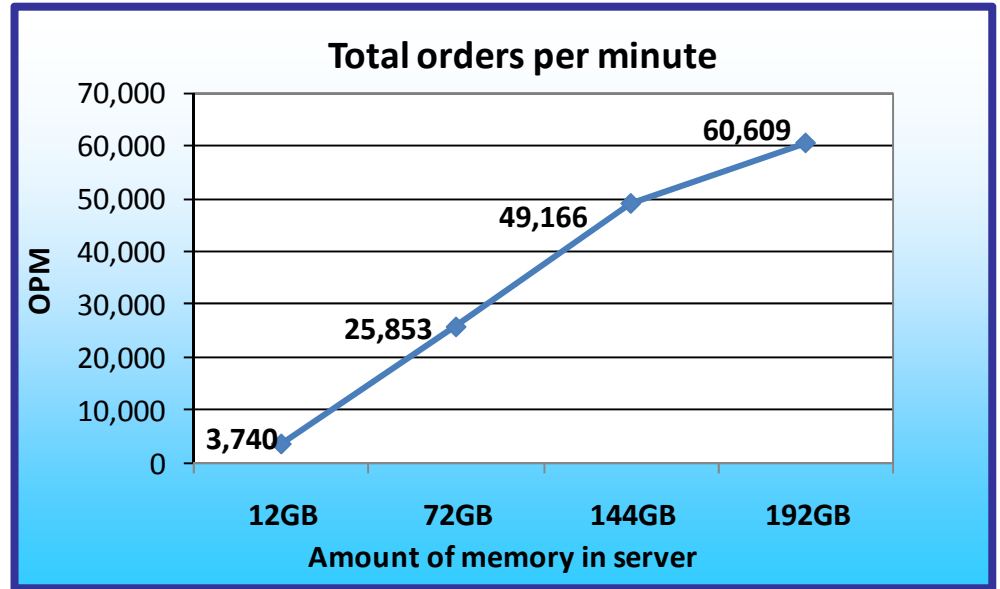


Figure 4: DVD Store Version 2 performance results, in OPM, for a server with four different memory amounts. Higher numbers are better.

For each memory configuration, we used the maximum number of simultaneous virtual machines that could run without oversubscribing memory. We performed three runs at the total number of virtual machines to verify the scores met these standards. We report the median of the three runs.

To read the full results of our tests, see our complete report at [http://principledtechnologies.com/Clients/Reports/Kingston/Database\\_virtualization.pdf](http://principledtechnologies.com/Clients/Reports/Kingston/Database_virtualization.pdf).

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