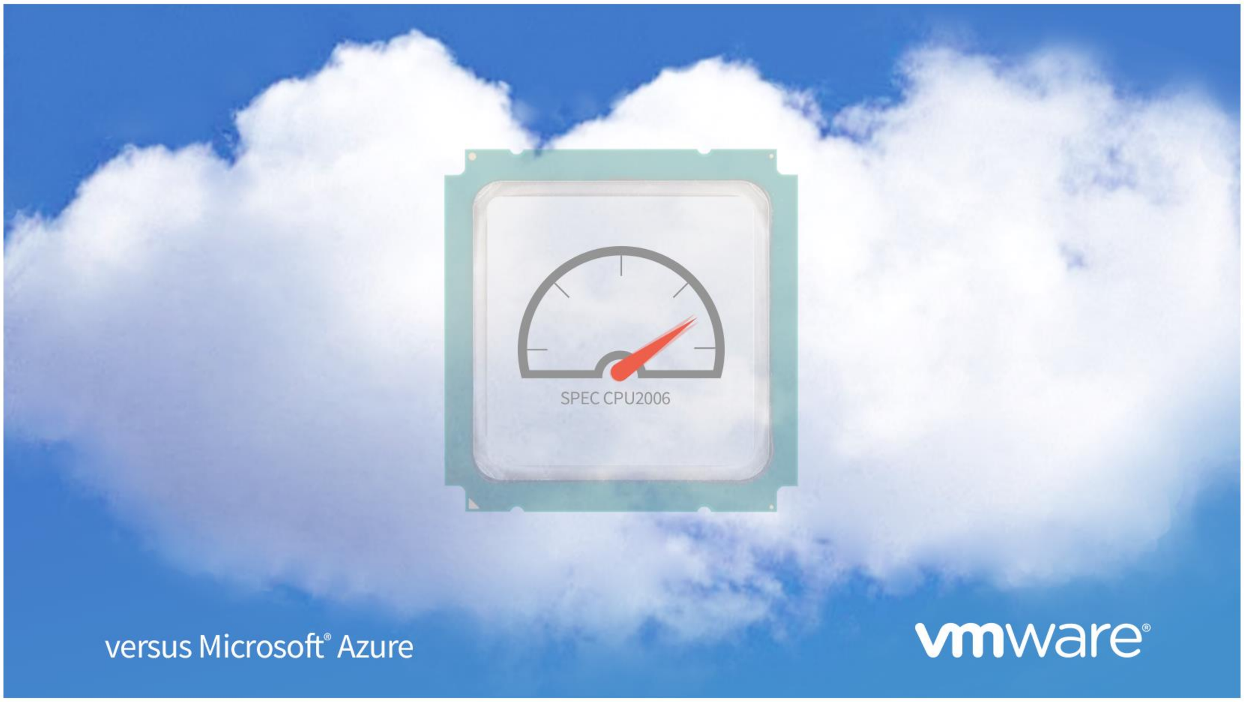
CPU PERFORMANCE COMPARISON OF TWO CLOUD SOLUTIONS: VMWARE VCLOUD HYBRID SERVICE AND MICROSOFT AZURE

VMware® vCloud® Hybrid Service™: up to 2X the CPU performance



Businesses are rapidly transitioning to the public cloud to take advantage of on-demand resources and potential cost savings. Compared to the traditional data center model, where a business purchases and maintains its own physical servers on site, running your virtualized applications off-premises and on Infrastructure-as-a-Service (IaaS) platforms offers enormous flexibility, enhances disaster recover planning, and can save companies in a variety of ways, including management and capital expenditures.

Many public cloud services are available and the performance that they deliver can vary considerably. From the Principled Technologies labs, we tested the compute performance of two public cloud solutions: VMware vCloud Hybrid Service (vCHS) and Microsoft Azure.

Testing the same CentOS version on both platforms, we found that the vCPU performance of our vCHS instances was dramatically greater than that of our Azure instances; in most configurations, the VMware solution delivered twice the performance of the Microsoft solution. This performance advantage means you would need fewer vCPUs to do a given amount of work—and that can translate to savings in your public cloud architecture.

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THE POWER OF THE CLOUD

As discussed, businesses moving to the cloud gain efficiency, cut up-front expenses, and enjoy a number of other advantages. It is the rare business in which computing needs remain constant—demand on servers can fluctuate seasonally, as companies grow, in response to special events, and due to countless other factors. Regardless of the reason, IaaS allows a company to immediately expand and contract their compute resources to meet the needs of that particular moment. This responsiveness means that the company saves money by expanding server resources only when demand requires, not weeks or months or years before. More importantly, this responsiveness means employees, customers, and other users are taken care of right away. The company is able to respond to business needs more quickly and deliver resources more agilely.

Changing from a data center model where companies must budget for capital expenditures to one where virtual machines are a service also means a transition to operating expenses. Because the cloud service provider performs physical server maintenance, including software and security updates, the companies that use them can allocate their IT resources to more productive endeavors.

Cloud-based computing has additional benefits—the fact that server resources are located around the world and accessible from anywhere with an Internet connection aids in collaboration and the ability for workers and customers to connect from anywhere.

BETTER CPU PERFORMANCE

In simple terms, CPU performance is the amount of useful work a computer system accomplishes in terms of the time and resources used. In the case of IaaS cloud services, we can measure the performance of virtual CPUs, or vCPUs, which is a typical method of allocating compute resources to individual virtual machines. vCPU performance is highly dependent on the physical CPU characteristics such as the number of cores and hyperthreading support and can be measured using various benchmark tools.

We compared the performance of vCPUs in the two cloud infrastructure solutions we tested, VMware vCloud Hybrid Service and Microsoft Azure, using the SPEC® CPU2006 benchmark. To do so, we subscribed to the two services and then set up comparable CentOS-based virtual machines. To make sure we were comparing apples to apples, we selected four preset configurations in the Azure solution and then used the VMware solution to create customized instances with the same vCPU counts and similar memory.

As we will discuss in detail below, we found that the vCHS instances scored up to 115 percent higher than the Azure instances on the SPEC CPU2006 benchmark. If a vCPU delivers twice the performance, this means that you could get by with half as many vCPUs and still yield the same performance, an obvious cost-saving benefit.

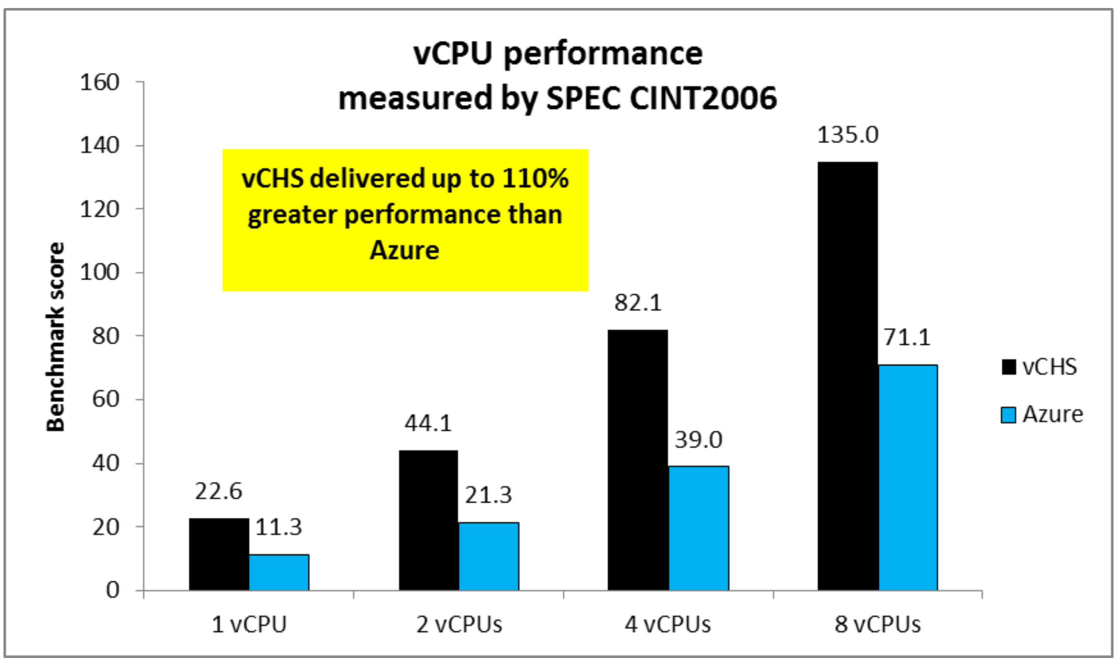
We ran each test three times and report the results from the median run. For detailed system configuration information and test methodology, see Appendix A.

Testing the CPU with SPEC CPU2006

The SPEC CPU2006 benchmark consists of two benchmark suites, each of which focuses on a different aspect of compute-intensive performance. SPEC CINT2006 measures and compares compute-intensive integer performance, while SPEC CFP2006 measures and compares compute-intensive floating-point performance. Figures 1 and 2 show the scores that the systems achieved on both parts of the benchmark. For detailed test results, see Appendix C.

As Figure 1 shows, on the SPEC CINT2006 benchmark, the performance of the vCHS solution exceeded that of the Azure solution at every vCPU count, with wins of up to 110 percent. This means that if you were to use the vCHS infrastructure to host your virtual CPUs, you could expect performance nearly double that of what you would see with Azure.

Figure 1: At all of the vCPU/memory counts we tested, the vCHS solution delivered superior SPEC CINT2006 performance to that of the Azure solution.



Our findings with the SPEC CFP2006 benchmark were similar to those with SPEC CINT2006, with the advantage of the VMware solution over the Microsoft Azure solution even more pronounced. As Figure 2 shows, on the SPEC CFP2006 benchmark, the performance of the vCHS solution again exceeded that of the Azure solution at every vCPU count, with wins of up to 121 percent.

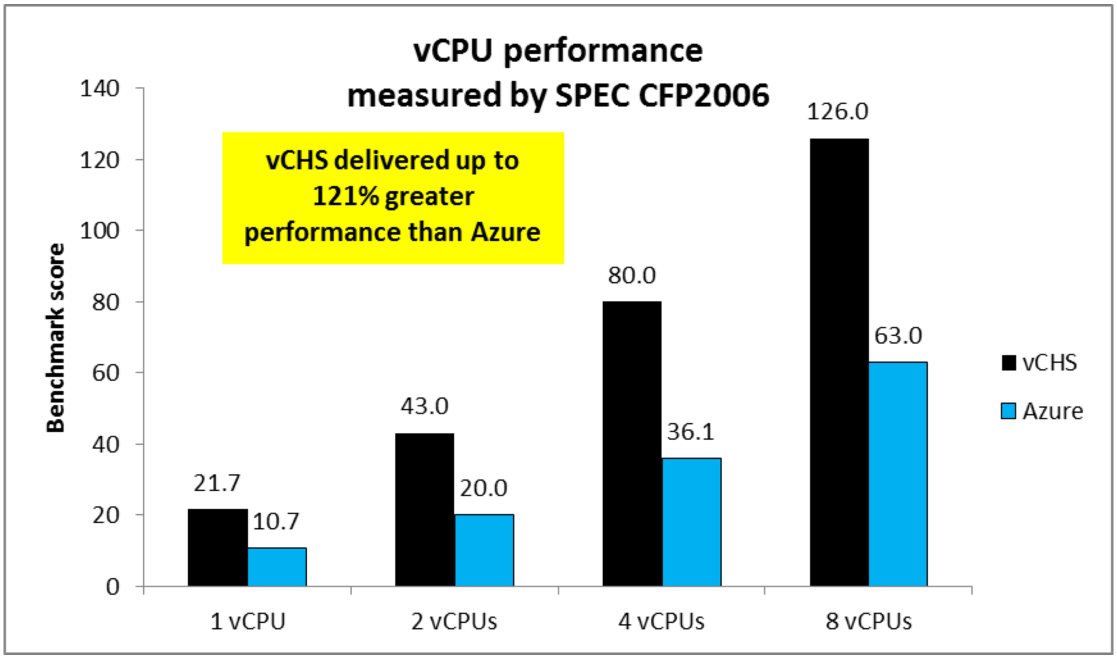


Figure 2: At all of the vCPU/memory counts we tested, the vCHS solution delivered superior SPEC CFP2006 performance to that of the Azure solution.

WHAT WE TESTED

About VMware vCloud Hybrid Service

According to VMware, "vCloud Hybrid Service, built on VMware vSphere®, quickly and seamlessly extends your data center into the cloud using the tools and processes you already have." It is available in three service offerings: Disaster Recovery, Dedicated Cloud, and the Virtual Private Cloud. (We tested the Dedicated Cloud offering with resource reservations found in the Virtual Private Cloud offering.)

For more information about VMware vCloud Hybrid Service, see www.vmware.com/products/vcloud-hybrid-service/.

About Microsoft Azure

According to Microsoft, "Azure is an open and flexible cloud platform that enables you to quickly build, deploy and manage applications across a global network of Microsoft-managed datacenters. You can build applications using any language, tool or framework. And you can integrate your public cloud applications with your existing IT environment."

For more information about Microsoft Azure, see azure.microsoft.com.

About SPEC CPU2006

SPEC CPU2006 is an industry-standard benchmark that uses a CPU-intensive workload to stress a system's processor(s), memory subsystem, and compiler. SPEC CPU2006 encompasses two types of tests: SPEC CINT2006, which reports results in both SPECint_rate2006 and SPECint_rate_base2006 scores. The difference between the two is that SPECint_rate2006 allows for more optimization than SPECint_rate_base2006. Like SPEC CINT2006, SPEC CFP2006 reports results in both SPECfp_rate2006 and SPECfp_rate_base2006 scores. (We report SPECint_rate2006 and SPECfp_rate2006 scores in this report.) These scores help compare a wide range of hardware. For more information about the SPEC CPU2006 benchmark, visit www.spec.org/cpu2006/.

IN CONCLUSION

Business computing is making its way to the cloud in a dramatic fashion. Selecting the right cloud service provider is a pivotal decision that could have a significant effect on how much your company benefits from this move.

Throughout our CPU tests, we found that VMware vCloud Hybrid Service instances performed dramatically better than Microsoft Azure instances in all virtual processor configurations, earning consistently higher SPEC CPU2006 scores.

By choosing a cloud service that can deliver stronger processing performance, you can ensure that you are giving your applications the necessary vCPU resources to perform well and making the most of your investment in the cloud platform.

APPENDIX A – DETAILED TEST METHODOLOGY

For testing, we selected four of the default instances from Azure and then configured similar instances with the same virtual processors from VMware vCloud Hybrid Service. Figure 3 shows the configurations we used from Azure. For each instance, we looked at the /processor/cpuinfo file to see the processor configuration. All Azure instances used the AMD Opteron Processor 4171 HE.

Compute instance	Virtual CPU	Memory (GB)	Storage (GB)	Processor
Small (A1)	1	1.75	60	AMD Opteron Processor 4171 HE
Medium (A2)	2	3.50	60	AMD Opteron Processor 4171 HE
Large (A3)	4	7.00	60	AMD Opteron Processor 4171 HE
Extra Large (A4)	8	14.00	60	AMD Opteron Processor 4171 HE

Figure 3: Azure instance configurations.

Figure 4 shows the similar configurations we used from VMware vCloud Hybrid Service. As with the Azure instances, we looked at the cpuinfo file to confirm the processor used for each instance.

Compute instance	Virtual CPU	Memory (GB)	Storage (GB)	Processor
Small	1	2.00	60	Intel Xeon Processor E5-2660
Medium	2	4.00	60	Intel Xeon Processor E5-2660
Large	4	8.00	60	Intel Xeon Processor E5-2660
Extra Large	8	16.00	60	Intel Xeon Processor E5-2660

Figure 4: VMware vCloud Hybrid Service instance configurations.

We configured the instances using the default templates of CentOS 6.4 and then ran yum update installing all updates. For testing, we used kernel version 2.6.32-431.11.2.el6.x86_64. In addition to the updates, we installed the following packages: glibc.i686 libgcc.i686, libstdc++.i686, libgfortran.x86_64, numactl, sysstat and screen.

We complied SPEC CPU2006 using the configuration file in Appendix B. For each instance we ran SPECint_rate2006 and SPECfp_rate2006. We performed three complete runs of SPEC CPU2006. In between runs, we powered off the instances and then powered them back on. We used the median of the three runs for the comparison.

APPENDIX B – SPEC CPU2006 CONFIGURATIONS FILES

```
####################################################################
# Linux Cloud gcc 4.4 config file
# Config file for CPU2006
#####################################################################
tune          = all
basepeak      = yes
size          = test,train,ref
output_format = asc,cfgfile,csv,html
flagsurl0     = GCC-4.4.7.xml
reportable    = yes
hw_avail      = Dec-9999
verbose       = 6
makeflags     = -j16
license_num   = 3184
#test_sponsor  = Test Sponsor (Optional, defaults to hw_vendor)
tester        = Principled Technologies, Inc.
submit = numactl --localalloc --physcpubind=$SPECCOPYNUM $command
default:
#####################################################################
#
# Compiler selection
#
#####################################################################
# NOTE: The path may be different if you use the compiler from
#       the gnu site.
CC                 = gcc
CXX                = g++
FC                 = gfortran
## HW config
# default sysinfo is expected to write hw_cpu_name, hw_memory, hw_nchips,
# hw_disk
hw_model           =
hw_cpu_char        =
hw_cpu_mhz         =
hw_fpu             =
hw_ncores          =
hw_ncoresperchip   =
hw_nthreadspercore =
hw_ncpuorder       =
hw_pcache          =
hw_scache          =
hw_tcache          =
hw_ocache          =
hw_vendor          =
hw_other           =
## SW config
# default sysinfo is expected to write prepared_by, sw_os, sw_file, sw_state
# Descriptions of the different compilers tested
sw_compiler        = gcc version 4.4.7 20120313 (Red Hat 4.4.7-4) (GCC)
sw_avail           = Nov-2013
sw_other           = None
default=default=cloud.i686:
sw_base_ptrsize    = 32-bit
sw_peak_ptrsize    = 32-bit
```

```
default=default=cloud.x86_64:
sw_base_ptrsize    = 64-bit
sw_peak_ptrsize    = 64-bit
#####################################################################
# Notes
#####################################################################
default:
notes_submit_000 ='numactl' was used to bind copies to the cores.
notes_submit_005 =See the configuration file for details.
notes_os_000 ='ulimit -s unlimited' was used to set environment stack size
#####################################################################
# Optimization
#####################################################################
default=base:
OPTIMIZE      = -O3 -ffast-math -mmmx -msse -msse2 -msse3 -mfpmath=sse
default=base=cloud.i686:
OPTIMIZE     += -m32
default=base=cloud.x86_64:
OPTIMIZE     += -m64
#####################################################################
# 32 bit Portability Flags
#####################################################################
400.perlbench=default=cloud.i686:
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#####################################################################
# 64 bit Portability Flags
#####################################################################
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#####################################################################
# Portability Flags
#####################################################################

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LWs2z9rULxrs1te2dQFxvquVr7pde1931avuavMe0mNKuFjJAB6UAobXflYcWWDxWia84rJEN4+T\
qFwCABOnwIzZOI8o/hFY0zRvaJ3Toz0ZH8xqzLZPCcfQ+Rnsz9S4yuT0DTNnd53Sc8ID4DykSIoO\
voguhSxC+oUhJcgbe1xki+UaY9/ZUiICwMJ0ld4mmPF75gOWFNfFIkqztLg5hBtmoCRL86tRxz9K\
9IM6M3v3pJV3c5jOJEYvUxbvJfvHqQdYUfa7OVjMB+MSvEE=
exemd5=f639e705a1d96ef85782e1b8d885aefb
```

APPENDIX C – SPEC CPU2006 OUTPUT FILES

Below, we show the SPEC CPU2006 output files for both Azure and vCloud Hybrid Service at 1-, 2-, 4- and 8-vCPU configurations. Because the testing was done in the cloud, we do not show the hardware configuration information. We show the instance configuration in Appendix A and show all software and tuning information in the configuration file in Appendix B.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 11.3
SPECint_rate_base2006 = 11.3

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	1	**750**	**13.0**	748	13.1	751	13.0	1	**750**	**13.0**	748	13.1	751	13.0
401.bzip2	1	**1177**	**8.20**	1175	8.21	1198	8.06	1	**1177**	**8.20**	1175	8.21	1198	8.06
403.gcc	1	666	12.1	661	12.2	**663**	**12.1**	1	666	12.1	661	12.2	**663**	**12.1**
429.mcf	1	888	10.3	**889**	**10.3**	890	10.2	1	888	10.3	**889**	**10.3**	890	10.2
445.gobmk	1	896	11.7	**897**	**11.7**	901	11.6	1	896	11.7	**897**	**11.7**	901	11.6
456.hmmer	1	1037	9.00	1045	8.93	**1044**	**8.94**	1	1037	9.00	1045	8.93	**1044**	**8.94**
458.sjeng	1	**1013**	**11.9**	1014	11.9	1012	12.0	1	**1013**	**11.9**	1014	11.9	1012	12.0
462.libquantum	1	1267	16.3	**1266**	**16.4**	1260	16.4	1	1267	16.3	**1266**	**16.4**	1260	16.4
464.h264ref	1	1509	14.7	**1506**	**14.7**	1502	14.7	1	1509	14.7	**1506**	**14.7**	1502	14.7
471.omnetpp	1	581	10.8	575	10.9	**581**	**10.8**	1	581	10.8	575	10.9	**581**	**10.8**
473.astar	1	847	8.28	844	8.32	**844**	**8.31**	1	847	8.28	844	8.32	**844**	**8.31**
483.xalancbmk	1	**545**	**12.7**	546	12.6	544	12.7	1	**545**	**12.7**	546	12.6	544	12.7

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 5: SPEC CINT2006 results for Azure 1-vCPU configuration.

SPEC® CINT2006 Result

System Vendor System Model Name	SPECint®_rate2006 = 21.3 SPECint_rate_base2006 = 21.3

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	2	781	25.0	766	25.5	**770**	**25.4**	2	781	25.0	766	25.5	**770**	**25.4**
401.bzip2	2	1211	15.9	**1202**	**16.1**	1199	16.1	2	1211	15.9	**1202**	**16.1**	1199	16.1
403.gcc	2	724	22.2	713	22.6	**713**	**22.6**	2	724	22.2	713	22.6	**713**	**22.6**
429.mcf	2	963	18.9	954	19.1	**956**	**19.1**	2	963	18.9	954	19.1	**956**	**19.1**
445.gobmk	2	920	22.8	900	23.3	**901**	**23.3**	2	920	22.8	900	23.3	**901**	**23.3**
456.hmmer	2	1044	17.9	1042	17.9	**1042**	**17.9**	2	1044	17.9	1042	17.9	**1042**	**17.9**
458.sjeng	2	1014	23.9	1012	23.9	**1014**	**23.9**	2	1014	23.9	1012	23.9	**1014**	**23.9**
462.libquantum	2	**1558**	**26.6**	1550	26.7	1593	26.0	2	**1558**	**26.6**	1550	26.7	1593	26.0
464.h264ref	2	1517	29.2	**1513**	**29.2**	1507	29.4	2	1517	29.2	**1513**	**29.2**	1507	29.4
471.omnetpp	2	**656**	**19.1**	655	19.1	662	18.9	2	**656**	**19.1**	655	19.1	662	18.9
473.astar	2	**945**	**14.9**	958	14.6	941	14.9	2	**945**	**14.9**	958	14.6	941	14.9
483.xalancbmk	2	606	22.8	**594**	**23.2**	593	23.3	2	606	22.8	**594**	**23.2**	593	23.3

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 6: SPEC CINT2006 results for Azure 2-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 39.0

SPECint_rate_base2006 = 39.0

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	4	796	49.1	784	49.8	**787**	**49.7**	4	796	49.1	784	49.8	**787**	**49.7**
401.bzip2	4	**1275**	**30.3**	1277	30.2	1274	30.3	4	**1275**	**30.3**	1277	30.2	1274	30.3
403.gcc	4	761	42.3	**764**	**42.1**	765	42.1	4	761	42.3	**764**	**42.1**	765	42.1
429.mcf	4	1062	34.3	1064	34.3	**1063**	**34.3**	4	1062	34.3	1064	34.3	**1063**	**34.3**
445.gobmk	4	**903**	**46.5**	903	46.5	904	46.4	4	**903**	**46.5**	903	46.5	904	46.4
456.hmmer	4	1050	35.5	**1049**	**35.6**	1046	35.7	4	1050	35.5	**1049**	**35.6**	1046	35.7
458.sjeng	4	**1015**	**47.7**	1015	47.7	1014	47.7	4	**1015**	**47.7**	1015	47.7	1014	47.7
462.libquantum	4	2254	36.8	2253	36.8	**2254**	**36.8**	4	2254	36.8	2253	36.8	**2254**	**36.8**
464.h264ref	4	1537	57.6	1525	58.1	**1534**	**57.7**	4	1537	57.6	1525	58.1	**1534**	**57.7**
471.omnetpp	4	790	31.6	**792**	**31.6**	792	31.6	4	790	31.6	**792**	**31.6**	792	31.6
473.astar	4	**1043**	**26.9**	1044	26.9	1040	27.0	4	**1043**	**26.9**	1044	26.9	1040	27.0
483.xalancbmk	4	700	39.5	**700**	**39.4**	700	39.4	4	700	39.5	**700**	**39.4**	700	39.4

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 7: SPEC CINT2006 results for Azure 4-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 71.1

SPECint_rate_base2006 = 71.1

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	8	816	95.8	**802**	**97.5**	801	97.6	8	816	95.8	**802**	**97.5**	801	97.6
401.bzip2	8	1352	57.1	1348	57.3	**1351**	**57.1**	8	1352	57.1	1348	57.3	**1351**	**57.1**
403.gcc	8	889	72.5	**863**	**74.7**	856	75.2	8	889	72.5	**863**	**74.7**	856	75.2
429.mcf	8	1283	56.9	1329	54.9	**1294**	**56.4**	8	1283	56.9	1329	54.9	**1294**	**56.4**
445.gobmk	8	**914**	**91.8**	916	91.6	914	91.8	8	**914**	**91.8**	916	91.6	914	91.8
456.hmmer	8	1061	70.4	**1058**	**70.6**	1057	70.6	8	1061	70.4	**1058**	**70.6**	1057	70.6
458.sjeng	8	1058	91.5	1053	92.0	**1055**	**91.7**	8	1058	91.5	1053	92.0	**1055**	**91.7**
462.libquantum	8	2939	56.4	**2813**	**58.9**	2622	63.2	8	2939	56.4	**2813**	**58.9**	2622	63.2
464.h264ref	8	1547	114	1543	115	**1547**	**114**	8	1547	114	1543	115	**1547**	**114**
471.omnetpp	8	960	52.1	942	53.1	**947**	**52.8**	8	960	52.1	942	53.1	**947**	**52.8**
473.astar	8	1113	50.5	**1116**	**50.3**	1116	50.3	8	1113	50.5	**1116**	**50.3**	1116	50.3
483.xalancbmk	8	819	67.4	823	67.1	**819**	**67.4**	8	819	67.4	823	67.1	**819**	**67.4**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 8: SPEC CINT2006 results for Azure 8-vCPU configuration.

SPEC® CFP2006 Result

System Vendor System Model Name	SPECfp®_rate2006 = 10.7 SPECfp_rate_base2006 = 10.7

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	1	2294	5.92	**2292**	**5.93**	2290	5.93	1	2294	5.92	**2292**	**5.93**	2290	5.93
416.gamess	1	1644	11.9	1620	12.1	**1621**	**12.1**	1	1644	11.9	1620	12.1	**1621**	**12.1**
433.milc	1	699	13.1	702	13.1	**702**	**13.1**	1	699	13.1	702	13.1	**702**	**13.1**
434.zeusmp	1	888	10.3	884	10.3	**885**	**10.3**	1	888	10.3	884	10.3	**885**	**10.3**
435.gromacs	1	**951**	**7.51**	949	7.52	951	7.51	1	**951**	**7.51**	949	7.52	951	7.51
436.cactusADM	1	**1404**	**8.51**	1386	8.62	1458	8.19	1	**1404**	**8.51**	1386	8.62	1458	8.19
437.leslie3d	1	824	11.4	820	11.5	**823**	**11.4**	1	824	11.4	820	11.5	**823**	**11.4**
444.namd	1	**829**	**9.67**	829	9.67	830	9.67	1	**829**	**9.67**	829	9.67	830	9.67
447.dealII	1	720	15.9	**720**	**15.9**	719	15.9	1	720	15.9	**720**	**15.9**	719	15.9
450.soplex	1	767	10.9	**745**	**11.2**	743	11.2	1	767	10.9	**745**	**11.2**	743	11.2
453.povray	1	383	13.9	388	13.7	**384**	**13.8**	1	383	13.9	388	13.7	**384**	**13.8**
454.calculix	1	894	9.23	**892**	**9.25**	892	9.25	1	894	9.23	**892**	**9.25**	892	9.25
459.GemsFDTD	1	**1073**	**9.89**	1074	9.88	1069	9.92	1	**1073**	**9.89**	1074	9.88	1069	9.92
465.tonto	1	967	10.2	**968**	**10.2**	969	10.2	1	967	10.2	**968**	**10.2**	969	10.2
470.lbm	1	**929**	**14.8**	931	14.8	928	14.8	1	**929**	**14.8**	931	14.8	928	14.8
481.wrf	1	**1221**	**9.15**	1224	9.13	1221	9.15	1	**1221**	**9.15**	1224	9.13	1221	9.15
482.sphinx3	1	1314	14.8	1309	14.9	**1310**	**14.9**	1	1314	14.8	1309	14.9	**1310**	**14.9**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 9: SPEC CFP2006 results for Azure 1-vCPU configuration.

SPEC® CFP2006 Result

System Vendor
System Model Name

SPECfp®_rate2006 = 20.0
SPECfp_rate_base2006 = 20.0

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	2	2360	11.5	**2372**	**11.5**	2380	11.4	2	2360	11.5	**2372**	**11.5**	2380	11.4
416.gamess	2	**1623**	**24.1**	1622	24.1	1625	24.1	2	**1623**	**24.1**	1622	24.1	1625	24.1
433.milc	2	**817**	**22.5**	818	22.4	814	22.5	2	**817**	**22.5**	818	22.4	814	22.5
434.zeusmp	2	901	20.2	903	20.2	**902**	**20.2**	2	901	20.2	903	20.2	**902**	**20.2**
435.gromacs	2	**955**	**15.0**	956	14.9	954	15.0	2	**955**	**15.0**	956	14.9	954	15.0
436.cactusADM	2	1567	15.3	**1462**	**16.3**	1438	16.6	2	1567	15.3	**1462**	**16.3**	1438	16.6
437.leslie3d	2	941	20.0	945	19.9	**944**	**19.9**	2	941	20.0	945	19.9	**944**	**19.9**
444.namd	2	**831**	**19.3**	831	19.3	828	19.4	2	**831**	**19.3**	831	19.3	828	19.4
447.dealII	2	734	31.2	736	31.1	**736**	**31.1**	2	734	31.2	736	31.1	**736**	**31.1**
450.soplex	2	**861**	**19.4**	870	19.2	860	19.4	2	**861**	**19.4**	870	19.2	860	19.4
453.povray	2	387	27.5	385	27.6	**386**	**27.6**	2	387	27.5	385	27.6	**386**	**27.6**
454.calculix	2	898	18.4	**900**	**18.3**	907	18.2	2	898	18.4	**900**	**18.3**	907	18.2
459.GemsFDTD	2	1178	18.0	**1182**	**18.0**	1194	17.8	2	1178	18.0	**1182**	**18.0**	1194	17.8
465.tonto	2	**992**	**19.8**	994	19.8	988	19.9	2	**992**	**19.8**	994	19.8	988	19.9
470.lbm	2	1223	22.5	1225	22.4	**1224**	**22.5**	2	1223	22.5	1225	22.4	**1224**	**22.5**
481.wrf	2	1272	17.6	**1250**	**17.9**	1246	17.9	2	1272	17.6	**1250**	**17.9**	1246	17.9
482.sphinx3	2	**1535**	**25.4**	1528	25.5	1547	25.2	2	**1535**	**25.4**	1528	25.5	1547	25.2

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 10: SPEC CFP2006 results for Azure 2-vCPU configuration.

SPEC® CFP2006 Result

System Vendor
System Model Name

SPECfp®_rate2006 = 36.1

SPECfp_rate_base2006 = 36.1

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	4	2488	21.9	2481	21.9	**2482**	**21.9**	4	2488	21.9	2481	21.9	**2482**	**21.9**
416.gamess	4	1624	48.2	**1620**	**48.4**	1620	48.4	4	1624	48.2	**1620**	**48.4**	1620	48.4
433.milc	4	1071	34.3	**1072**	**34.3**	1073	34.2	4	1071	34.3	**1072**	**34.3**	1073	34.2
434.zeusmp	4	**935**	**38.9**	936	38.9	935	38.9	4	**935**	**38.9**	936	38.9	935	38.9
435.gromacs	4	**957**	**29.8**	959	29.8	957	29.8	4	**957**	**29.8**	959	29.8	957	29.8
436.cactusADM	4	1535	31.1	1591	30.0	**1545**	**30.9**	4	1535	31.1	1591	30.0	**1545**	**30.9**
437.leslie3d	4	**1202**	**31.3**	1200	31.3	1204	31.2	4	**1202**	**31.3**	1200	31.3	1204	31.2
444.namd	4	**829**	**38.7**	828	38.7	830	38.7	4	**829**	**38.7**	828	38.7	830	38.7
447.dealII	4	761	60.1	767	59.7	**767**	**59.7**	4	761	60.1	767	59.7	**767**	**59.7**
450.soplex	4	**1056**	**31.6**	1058	31.5	1054	31.6	4	**1056**	**31.6**	1058	31.5	1054	31.6
453.povray	4	**385**	**55.3**	385	55.3	384	55.4	4	**385**	**55.3**	385	55.3	384	55.4
454.calculix	4	908	36.3	**909**	**36.3**	909	36.3	4	908	36.3	**909**	**36.3**	909	36.3
459.GemsFDTD	4	1440	29.5	1432	29.6	**1435**	**29.6**	4	1440	29.5	1432	29.6	**1435**	**29.6**
465.tonto	4	1035	38.0	1029	38.3	**1030**	**38.2**	4	1035	38.0	1029	38.3	**1030**	**38.2**
470.lbm	4	1734	31.7	1730	31.8	**1731**	**31.7**	4	1734	31.7	1730	31.8	**1731**	**31.7**
481.wrf	4	1333	33.5	1329	33.6	**1329**	**33.6**	4	1333	33.5	1329	33.6	**1329**	**33.6**
482.sphinx3	4	1828	42.7	1844	42.3	**1830**	**42.6**	4	1828	42.7	1844	42.3	**1830**	**42.6**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 11: SPEC CFP2006 results for Azure 4-vCPU configuration.

SPEC® CFP2006 Result

System Vendor
System Model Name

SPECfp®_rate2006 = 63.0

SPECfp_rate_base2006 = 63.0

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	8	2655	41.0	2833	38.4	**2804**	**38.8**	8	2655	41.0	2833	38.4	**2804**	**38.8**
416.gamess	8	**1633**	**95.9**	1647	95.1	1626	96.3	8	**1633**	**95.9**	1647	95.1	1626	96.3
433.milc	8	1142	64.3	**1489**	**49.3**	1548	47.5	8	1142	64.3	**1489**	**49.3**	1548	47.5
434.zeusmp	8	1000	72.8	**1096**	**66.4**	1110	65.6	8	1000	72.8	**1096**	**66.4**	1110	65.6
435.gromacs	8	975	58.6	**985**	**58.0**	994	57.5	8	975	58.6	**985**	**58.0**	994	57.5
436.cactusADM	8	**1744**	**54.8**	1792	53.3	1715	55.7	8	**1744**	**54.8**	1792	53.3	1715	55.7
437.leslie3d	8	1268	59.3	**1315**	**57.2**	1626	46.3	8	1268	59.3	**1315**	**57.2**	1626	46.3
444.namd	8	834	76.9	**832**	**77.2**	830	77.3	8	834	76.9	**832**	**77.2**	830	77.3
447.dealII	8	807	113	**824**	**111**	840	109	8	807	113	**824**	**111**	840	109
450.soplex	8	1209	55.2	**1352**	**49.4**	1381	48.3	8	1209	55.2	**1352**	**49.4**	1381	48.3
453.povray	8	387	110	**386**	**110**	385	111	8	387	110	**386**	**110**	385	111
454.calculix	8	**924**	**71.4**	928	71.2	921	71.7	8	**924**	**71.4**	928	71.2	921	71.7
459.GemsFDTD	8	1886	45.0	2042	41.6	**2041**	**41.6**	8	1886	45.0	2042	41.6	**2041**	**41.6**
465.tonto	8	**1076**	**73.2**	1081	72.8	1060	74.3	8	**1076**	**73.2**	1081	72.8	1060	74.3
470.lbm	8	2368	46.4	2695	40.8	**2641**	**41.6**	8	2368	46.4	2695	40.8	**2641**	**41.6**
481.wrf	8	1482	60.3	**1494**	**59.8**	1514	59.0	8	1482	60.3	**1494**	**59.8**	1514	59.0
482.sphinx3	8	2223	70.1	2267	68.8	**2260**	**69.0**	8	2223	70.1	2267	68.8	**2260**	**69.0**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 12: SPEC CFP2006 results for Azure 8-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 22.6

SPECint_rate_base2006 = 22.6

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	1	**413**	**23.7**	412	23.7	415	23.6	1	**413**	**23.7**	412	23.7	415	23.6
401.bzip2	1	657	14.7	**638**	**15.1**	633	15.2	1	657	14.7	**638**	**15.1**	633	15.2
403.gcc	1	308	26.2	**317**	**25.4**	323	24.9	1	308	26.2	**317**	**25.4**	323	24.9
429.mcf	1	243	37.6	**244**	**37.3**	250	36.5	1	243	37.6	**244**	**37.3**	250	36.5
445.gobmk	1	546	19.2	**551**	**19.1**	551	19.0	1	546	19.2	**551**	**19.1**	551	19.0
456.hmmer	1	531	17.6	**531**	**17.6**	532	17.5	1	531	17.6	**531**	**17.6**	532	17.5
458.sjeng	1	632	19.2	**629**	**19.2**	623	19.4	1	632	19.2	**629**	**19.2**	623	19.4
462.libquantum	1	515	40.2	**531**	**39.0**	551	37.6	1	515	40.2	**531**	**39.0**	551	37.6
464.h264ref	1	719	30.8	718	30.8	**718**	**30.8**	1	719	30.8	718	30.8	**718**	**30.8**
471.omnetpp	1	338	18.5	**359**	**17.4**	373	16.7	1	338	18.5	**359**	**17.4**	373	16.7
473.astar	1	**465**	**15.1**	456	15.4	465	15.1	1	**465**	**15.1**	456	15.4	465	15.1
483.xalancbmk	1	257	26.9	**264**	**26.1**	267	25.8	1	257	26.9	**264**	**26.1**	267	25.8

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 13: SPEC CINT2006 results for vCHS 1-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 44.1

SPECint_rate_base2006 = 44.1

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	2	413	47.3	420	46.5	**420**	**46.5**	2	413	47.3	420	46.5	**420**	**46.5**
401.bzip2	2	**622**	**31.0**	621	31.1	623	31.0	2	**622**	**31.0**	621	31.1	623	31.0
403.gcc	2	316	50.9	**317**	**50.9**	319	50.4	2	316	50.9	**317**	**50.9**	319	50.4
429.mcf	2	258	70.8	**262**	**69.5**	274	66.5	2	258	70.8	**262**	**69.5**	274	66.5
445.gobmk	2	**556**	**37.7**	556	37.7	555	37.8	2	**556**	**37.7**	556	37.7	555	37.8
456.hmmer	2	532	35.1	**532**	**35.1**	532	35.0	2	532	35.1	**532**	**35.1**	532	35.0
458.sjeng	2	612	39.5	**613**	**39.5**	614	39.4	2	612	39.5	**613**	**39.5**	614	39.4
462.libquantum	2	533	77.7	**546**	**75.9**	558	74.3	2	533	77.7	**546**	**75.9**	558	74.3
464.h264ref	2	736	60.1	**730**	**60.6**	726	61.0	2	736	60.1	**730**	**60.6**	726	61.0
471.omnetpp	2	375	33.3	**382**	**32.7**	389	32.1	2	375	33.3	**382**	**32.7**	389	32.1
473.astar	2	496	28.3	**493**	**28.5**	491	28.6	2	496	28.3	**493**	**28.5**	491	28.6
483.xalancbmk	2	295	46.8	**295**	**46.8**	296	46.6	2	295	46.8	**295**	**46.8**	296	46.6

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 14: SPEC CINT2006 results for vCHS 2-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 82.1

SPECint_rate_base2006 = 82.1

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	4	**437**	**89.4**	437	89.5	437	89.4	4	**437**	**89.4**	437	89.5	437	89.4
401.bzip2	4	655	58.9	652	59.2	**653**	**59.1**	4	655	58.9	652	59.2	**653**	**59.1**
403.gcc	4	338	95.2	**339**	**94.9**	340	94.8	4	338	95.2	**339**	**94.9**	340	94.8
429.mcf	4	303	120	**301**	**121**	301	121	4	303	120	**301**	**121**	301	121
445.gobmk	4	568	73.8	567	74.0	**567**	**74.0**	4	568	73.8	567	74.0	**567**	**74.0**
456.hmmer	4	**551**	**67.7**	550	67.8	552	67.7	4	**551**	**67.7**	550	67.8	552	67.7
458.sjeng	4	624	77.6	627	77.2	**626**	**77.3**	4	624	77.6	627	77.2	**626**	**77.3**
462.libquantum	4	**631**	**131**	630	132	631	131	4	**631**	**131**	630	132	631	131
464.h264ref	4	**741**	**120**	741	120	740	120	4	**741**	**120**	741	120	740	120
471.omnetpp	4	425	58.9	428	58.5	**426**	**58.7**	4	425	58.9	428	58.5	**426**	**58.7**
473.astar	4	529	53.1	527	53.3	**527**	**53.2**	4	529	53.1	527	53.3	**527**	**53.2**
483.xalancbmk	4	337	82.0	**338**	**81.7**	338	81.6	4	337	82.0	**338**	**81.7**	338	81.6

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 15: SPEC CINT2006 results for vCHS 4-vCPU configuration.

SPEC® CINT2006 Result

System Vendor
System Model Name

SPECint®_rate2006 = 135

SPECint_rate_base2006 = 135

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
400.perlbench	8	493	159	**489**	**160**	488	160	8	493	159	**489**	**160**	488	160
401.bzip2	8	763	101	769	100	**767**	**101**	8	763	101	769	100	**767**	**101**
403.gcc	8	398	162	**402**	**160**	411	157	8	398	162	**402**	**160**	411	157
429.mcf	8	409	179	**419**	**174**	427	171	8	409	179	**419**	**174**	427	171
445.gobmk	8	624	134	636	132	**630**	**133**	8	624	134	636	132	**630**	**133**
456.hmmer	8	617	121	628	119	**621**	**120**	8	617	121	628	119	**621**	**120**
458.sjeng	8	697	139	689	141	**695**	**139**	8	697	139	689	141	**695**	**139**
462.libquantum	8	1048	158	**1056**	**157**	1063	156	8	1048	158	**1056**	**157**	1063	156
464.h264ref	8	821	216	825	215	**824**	**215**	8	821	216	825	215	**824**	**215**
471.omnetpp	8	549	91.1	**556**	**90.0**	556	89.9	8	549	91.1	**556**	**90.0**	556	89.9
473.astar	8	621	90.4	**624**	**90.0**	624	89.9	8	621	90.4	**624**	**90.0**	624	89.9
483.xalancbmk	8	419	132	418	132	**418**	**132**	8	419	132	418	132	**418**	**132**

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 16: SPEC CINT2006 results for vCHS 8-vCPU configuration.

SPEC® CFP2006 Result

System Vendor System Model Name	SPECfp®_rate2006 = 21.7 SPECfp_rate_base2006 = 21.7

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	1	584	23.3	578	23.5	**582**	**23.4**	1	584	23.3	578	23.5	**582**	**23.4**
416.gamess	1	**846**	**23.1**	846	23.1	852	23.0	1	**846**	**23.1**	846	23.1	852	23.0
433.milc	1	486	18.9	**487**	**18.8**	489	18.8	1	486	18.9	**487**	**18.8**	489	18.8
434.zeusmp	1	**463**	**19.7**	463	19.6	463	19.7	1	**463**	**19.7**	463	19.6	463	19.7
435.gromacs	1	559	12.8	**560**	**12.8**	567	12.6	1	559	12.8	**560**	**12.8**	567	12.6
436.cactusADM	1	841	14.2	803	14.9	**816**	**14.6**	1	841	14.2	803	14.9	**816**	**14.6**
437.leslie3d	1	394	23.9	**393**	**23.9**	393	23.9	1	394	23.9	**393**	**23.9**	393	23.9
444.namd	1	**482**	**16.6**	481	16.7	483	16.6	1	**482**	**16.6**	481	16.7	483	16.6
447.dealII	1	326	35.1	**327**	**35.0**	328	34.9	1	326	35.1	**327**	**35.0**	328	34.9
450.soplex	1	256	32.6	252	33.0	**255**	**32.7**	1	256	32.6	252	33.0	**255**	**32.7**
453.povray	1	196	27.2	**197**	**27.0**	200	26.6	1	196	27.2	**197**	**27.0**	200	26.6
454.calculix	1	488	16.9	**485**	**17.0**	485	17.0	1	488	16.9	**485**	**17.0**	485	17.0
459.GemsFDTD	1	**431**	**24.6**	433	24.5	429	24.8	1	**431**	**24.6**	433	24.5	429	24.8
465.tonto	1	**542**	**18.2**	542	18.2	543	18.1	1	**542**	**18.2**	542	18.2	543	18.1
470.lbm	1	**454**	**30.2**	453	30.3	455	30.2	1	**454**	**30.2**	453	30.3	455	30.2
481.wrf	1	**614**	**18.2**	614	18.2	615	18.2	1	**614**	**18.2**	614	18.2	615	18.2
482.sphinx3	1	**704**	**27.7**	704	27.7	616	31.7	1	**704**	**27.7**	704	27.7	616	31.7

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 17: SPEC CFP2006 results for vCHS 1-vCPU configuration.

SPEC® CFP2006 Result

System Vendor
System Model Name

SPECfp®_rate2006 = 43.0
SPECfp_rate_base2006 = 43.0

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	2	594	45.8	592	45.9	**594**	**45.8**	2	594	45.8	592	45.9	**594**	**45.8**
416.gamess	2	**838**	**46.7**	835	46.9	839	46.7	2	**838**	**46.7**	835	46.9	839	46.7
433.milc	2	502	36.5	**502**	**36.6**	502	36.6	2	502	36.5	**502**	**36.6**	502	36.6
434.zeusmp	2	**476**	**38.2**	476	38.2	476	38.2	2	**476**	**38.2**	476	38.2	476	38.2
435.gromacs	2	563	25.4	**562**	**25.4**	561	25.5	2	563	25.4	**562**	**25.4**	561	25.5
436.cactusADM	2	758	31.5	723	33.0	**740**	**32.3**	2	758	31.5	723	33.0	**740**	**32.3**
437.leslie3d	2	403	46.7	**403**	**46.7**	402	46.7	2	403	46.7	**403**	**46.7**	402	46.7
444.namd	2	477	33.7	**477**	**33.7**	481	33.4	2	477	33.7	**477**	**33.7**	481	33.4
447.dealII	2	337	67.9	**334**	**68.5**	334	68.6	2	337	67.9	**334**	**68.5**	334	68.6
450.soplex	2	**297**	**56.2**	297	56.2	298	56.0	2	**297**	**56.2**	297	56.2	298	56.0
453.povray	2	**195**	**54.5**	198	53.8	195	54.6	2	**195**	**54.5**	198	53.8	195	54.6
454.calculix	2	**483**	**34.1**	480	34.4	486	34.0	2	**483**	**34.1**	480	34.4	486	34.0
459.GemsFDTD	2	452	46.9	442	48.0	**445**	**47.7**	2	452	46.9	442	48.0	**445**	**47.7**
465.tonto	2	532	37.0	538	36.6	**535**	**36.8**	2	532	37.0	538	36.6	**535**	**36.8**
470.lbm	2	474	58.0	**469**	**58.6**	468	58.7	2	474	58.0	**469**	**58.6**	468	58.7
481.wrf	2	622	35.9	620	36.0	**620**	**36.0**	2	622	35.9	620	36.0	**620**	**36.0**
482.sphinx3	2	684	57.0	**679**	**57.4**	679	57.4	2	684	57.0	**679**	**57.4**	679	57.4

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 18: SPEC CFP2006 results for vCHS 2-vCPU configuration.

SPEC® CFP2006 Result

System Vendor
System Model Name

SPECfp®_rate2006 = 80.0
SPECfp_rate_base2006 = 80.0

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	4	629	86.4	628	86.5	**629**	**86.5**	4	629	86.4	628	86.5	**629**	**86.5**
416.gamess	4	**862**	**90.9**	863	90.8	862	90.9	4	**862**	**90.9**	863	90.8	862	90.9
433.milc	4	545	67.4	546	67.2	**546**	**67.3**	4	545	67.4	546	67.2	**546**	**67.3**
434.zeusmp	4	477	76.3	**477**	**76.3**	480	75.8	4	477	76.3	**477**	**76.3**	480	75.8
435.gromacs	4	574	49.8	**575**	**49.7**	575	49.6	4	574	49.8	**575**	**49.7**	575	49.6
436.cactusADM	4	**904**	**52.9**	905	52.8	903	52.9	4	**904**	**52.9**	905	52.8	903	52.9
437.leslie3d	4	428	87.8	429	87.6	**429**	**87.7**	4	428	87.8	429	87.6	**429**	**87.7**
444.namd	4	**492**	**65.2**	491	65.4	495	64.8	4	**492**	**65.2**	491	65.4	495	64.8
447.dealII	4	343	133	344	133	**344**	**133**	4	343	133	344	133	**344**	**133**
450.soplex	4	345	96.8	**344**	**97.0**	343	97.3	4	345	96.8	**344**	**97.0**	343	97.3
453.povray	4	200	106	201	106	**201**	**106**	4	200	106	201	106	**201**	**106**
454.calculix	4	496	66.6	492	67.1	**495**	**66.7**	4	496	66.6	492	67.1	**495**	**66.7**
459.GemsFDTD	4	497	85.4	**497**	**85.5**	496	85.5	4	497	85.4	**497**	**85.5**	496	85.5
465.tonto	4	547	72.0	**546**	**72.0**	546	72.1	4	547	72.0	**546**	**72.0**	546	72.1
470.lbm	4	598	91.9	599	91.7	**599**	**91.8**	4	598	91.9	599	91.7	**599**	**91.8**
481.wrf	4	635	70.4	639	70.0	**635**	**70.4**	4	635	70.4	639	70.0	**635**	**70.4**
482.sphinx3	4	765	102	**764**	**102**	764	102	4	765	102	**764**	**102**	764	102

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 19: SPEC CFP2006 results for vCHS 4-vCPU configuration.

SPEC® CFP2006 Result

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System Vendor System Model Name	SPECfp®_rate2006 = 126 SPECfp_rate_base2006 = 126

Results Table

Benchmark	Base							Peak						
	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio	Copies	Seconds	Ratio	Seconds	Ratio	Seconds	Ratio
410.bwaves	8	857	127	863	126	**862**	**126**	8	857	127	863	126	**862**	**126**
416.gamess	8	961	163	**963**	**163**	967	162	8	961	163	**963**	**163**	967	162
433.milc	8	**741**	**99.1**	747	98.3	738	99.5	8	**741**	**99.1**	747	98.3	738	99.5
434.zeusmp	8	**548**	**133**	548	133	551	132	8	**548**	**133**	548	133	551	132
435.gromacs	8	**630**	**90.7**	632	90.4	627	91.0	8	**630**	**90.7**	632	90.4	627	91.0
436.cactusADM	8	**1085**	**88.1**	1084	88.2	1090	87.7	8	**1085**	**88.1**	1084	88.2	1090	87.7
437.leslie3d	8	**637**	**118**	633	119	641	117	8	**637**	**118**	633	119	641	117
444.namd	8	545	118	544	118	**545**	**118**	8	545	118	544	118	**545**	**118**
447.dealII	8	385	238	**388**	**236**	394	232	8	385	238	**388**	**236**	394	232
450.soplex	8	511	131	**510**	**131**	507	131	8	511	131	**510**	**131**	507	131
453.povray	8	230	185	223	191	**228**	**186**	8	230	185	223	191	**228**	**186**
454.calculix	8	548	120	**556**	**119**	564	117	8	548	120	**556**	**119**	564	117
459.GemsFDTD	8	789	108	**789**	**108**	793	107	8	789	108	**789**	**108**	793	107
465.tonto	8	**615**	**128**	607	130	620	127	8	**615**	**128**	607	130	620	127
470.lbm	8	**1068**	**103**	1055	104	1072	103	8	**1068**	**103**	1055	104	1072	103
481.wrf	8	720	124	720	124	**720**	**124**	8	720	124	720	124	**720**	**124**
482.sphinx3	8	**1075**	**145**	1086	144	1073	145	8	**1075**	**145**	1086	144	1073	145

Results appear in the order in which they were run. Bold underlined text indicates a median measurement.

Figure 20: SPEC CFP2006 results for vCHS 8-vCPU configuration.

ABOUT PRINCIPLED TECHNOLOGIES

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