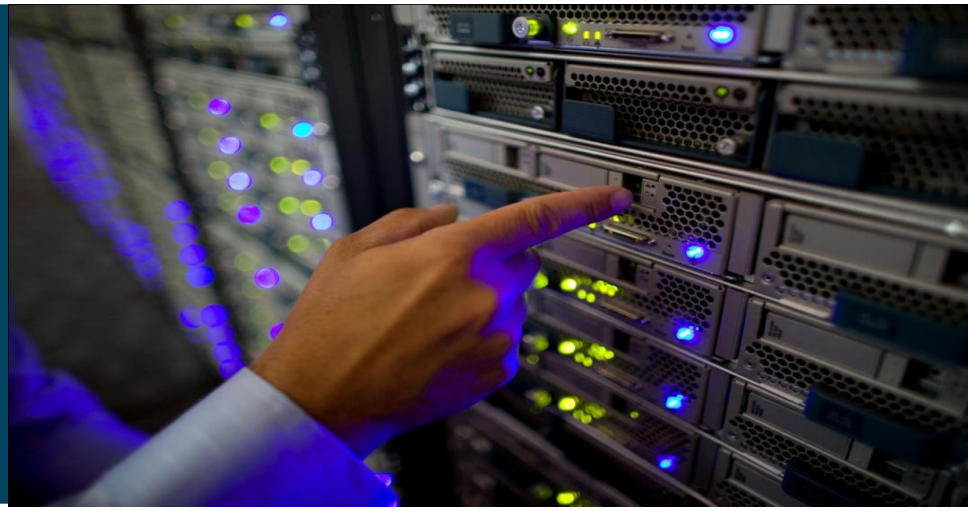
Industry Benchmarks Performance



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Performance history

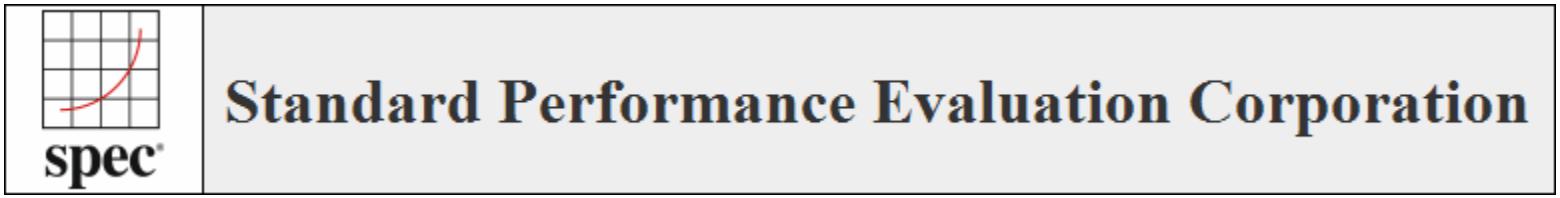
- MIPS (Million Instructions Per Second)
- Whetstone. Floating-point. Was first written in Algol 60 in 1972. Later written in Fortran.
- Dhrystone 1984. Non-floating-point
- FLOPS. Floating-point Operations Per Second
- LINPACK 1970s. Largely replaced by LAPACK. Floating-point. Often used to express performance of HPC systems
- TPC, Transaction Processing Performance Council Business oriented transaction benchmark including a database

MIPS Million Instructions Per Second

Number of instruction retired per clock cycle, AMD = 3
Number of instruction retired per clock cycle, Intel = 4

CPU	GHz	Core / CPU	MIPS
AMD 6140	2.6	8	62.4k
AMD 6172	2.1	12	75.6k
AMD 6176 SE	2.3	12	82.8k
AMD 6180 SE	2.5	12	90.0k
Intel 5570	2.93	4	46.88k
Intel 6550	2.00	8	64.00k
Intel 5675	3.06	6	73.44k
Intel 7560	2.266	8	75.51k
Intel 5680	3.33	6	79.92k
Intel 5690	3.46	6	83.04k
Intel E7-x870	2.4	10	96.90k

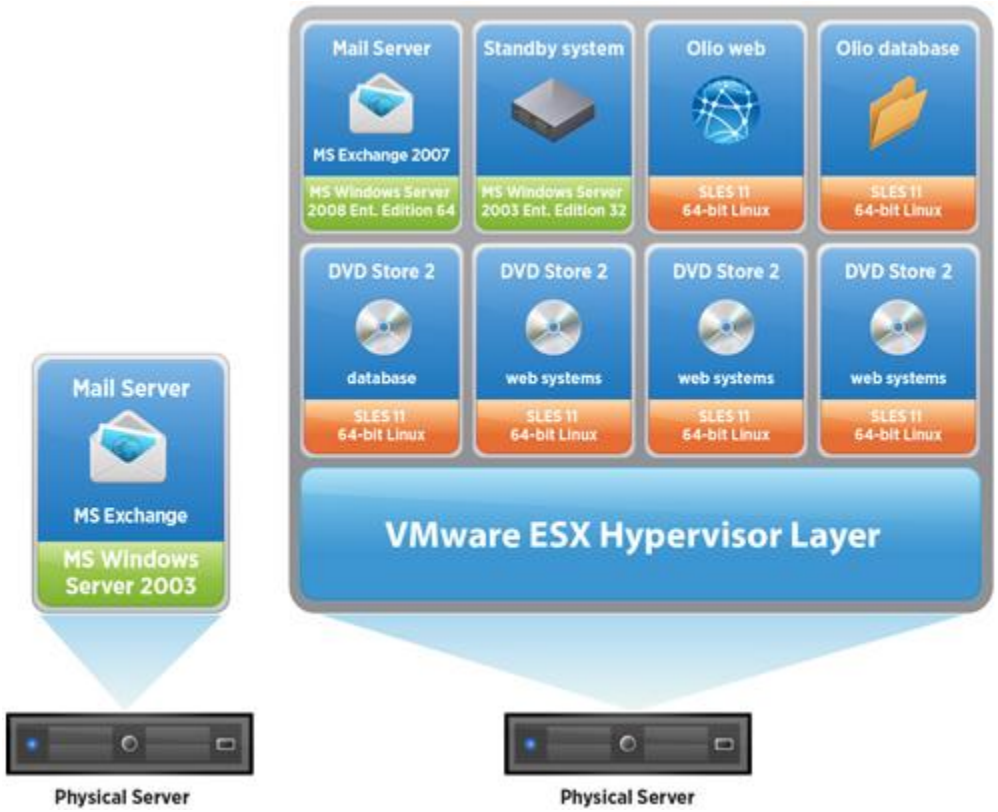
Industry Benchmarks



- SPEC CPU2006; CFP2006 & CINT2006. Designed to provide performance measurements that can be used to compare compute-intensive workloads on different computer systems.
- SPECjbb2005: A benchmark for evaluating the performance of servers running typical Java business applications
- SPECpower_ssj2008 : is the first industry-standard SPEC benchmark that evaluates the power and performance characteristics of volume server class and multi-node class computers.

VMware VMmark 2.0

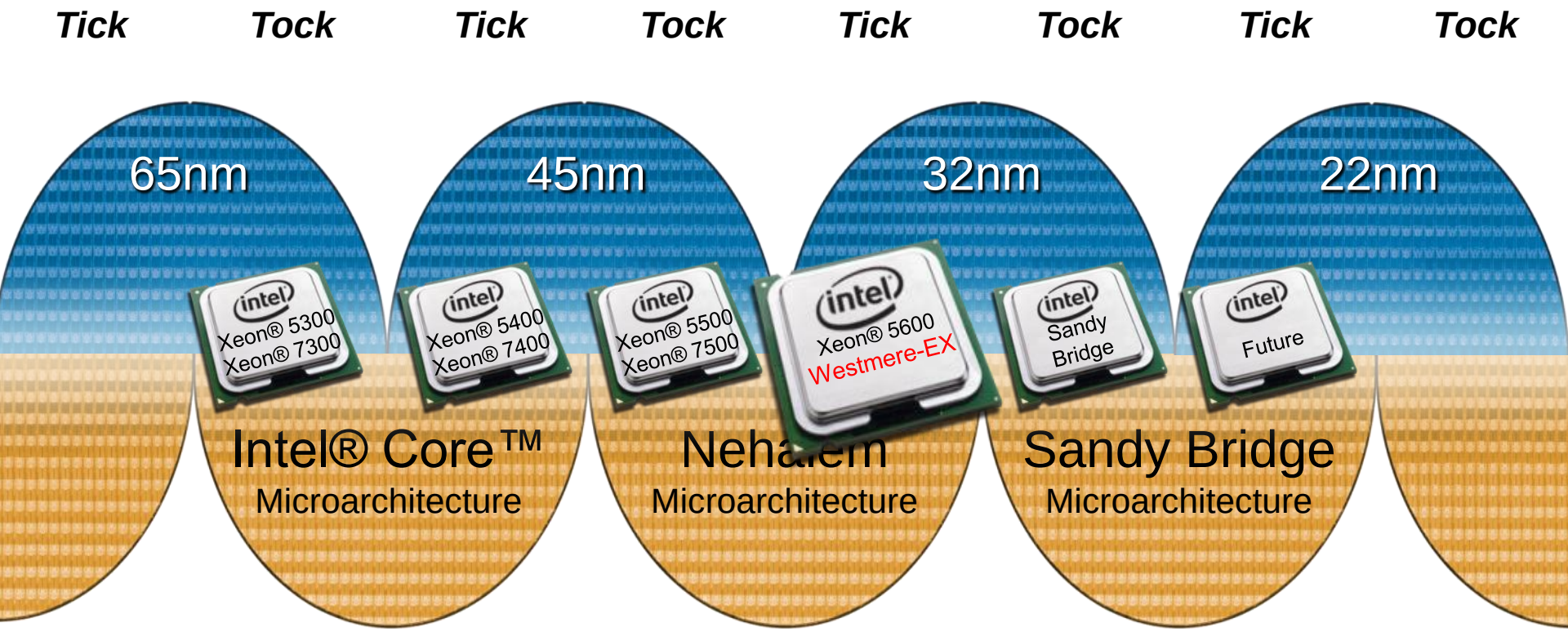
VMmark 2.0 generates a realistic measure of virtualization platform performance by incorporating a variety of platform-level workloads such as dynamic VM relocation (vMotion) and dynamic datastore relocation (storage vMotion), in addition to traditional application-level workloads. The benchmark system in VMmark 2.0 is comprised of a series of “sub-tests” that are derived from commonly used load-generation tools and commonly initiated virtualization administration tasks.



Industry Benchmarks

- Generally comparing SPECint, SPECjbb, VMmark and SAP SD over processors of same generation show same % change as MIPS (increase in clock speed and core)
- SPECint can be used to calculate compute power of old servers to get a good estimate of what to replace them with.

Tick-Tock Development Model



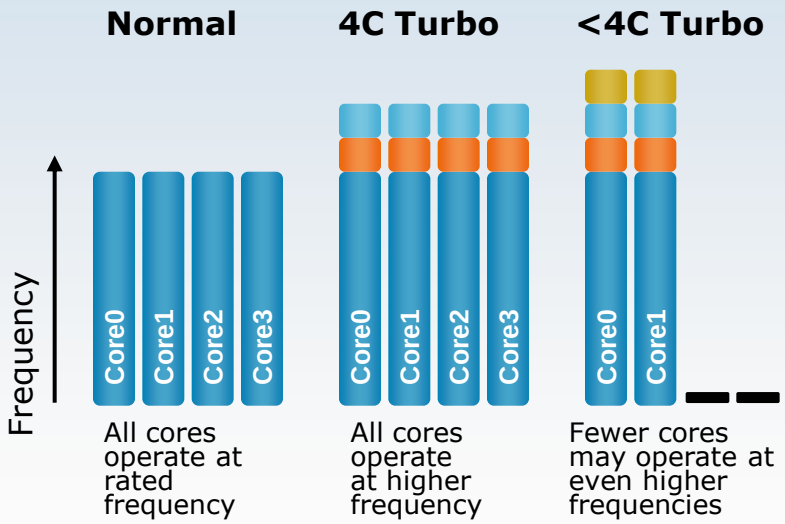
Sustained Xeon® Microprocessor Leadership

Performance Enhancements

Intel® Xeon® 5500/5560 Series Processor (Nehalem-EP)

Intel® Turbo Boost Technology

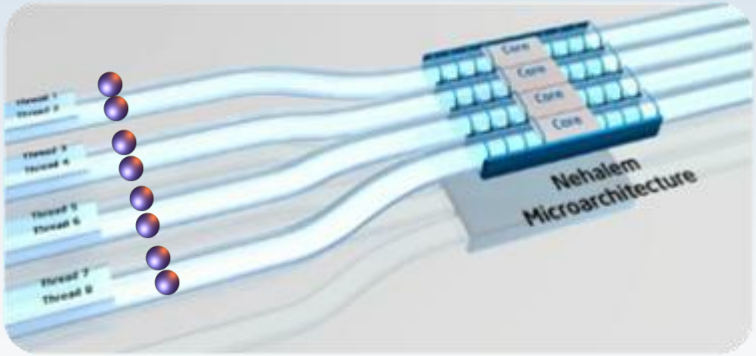
Increases performance by increasing processor frequency and enabling faster speeds when conditions allow



Higher Performance on Demand

Intel® Hyper-threading Technology

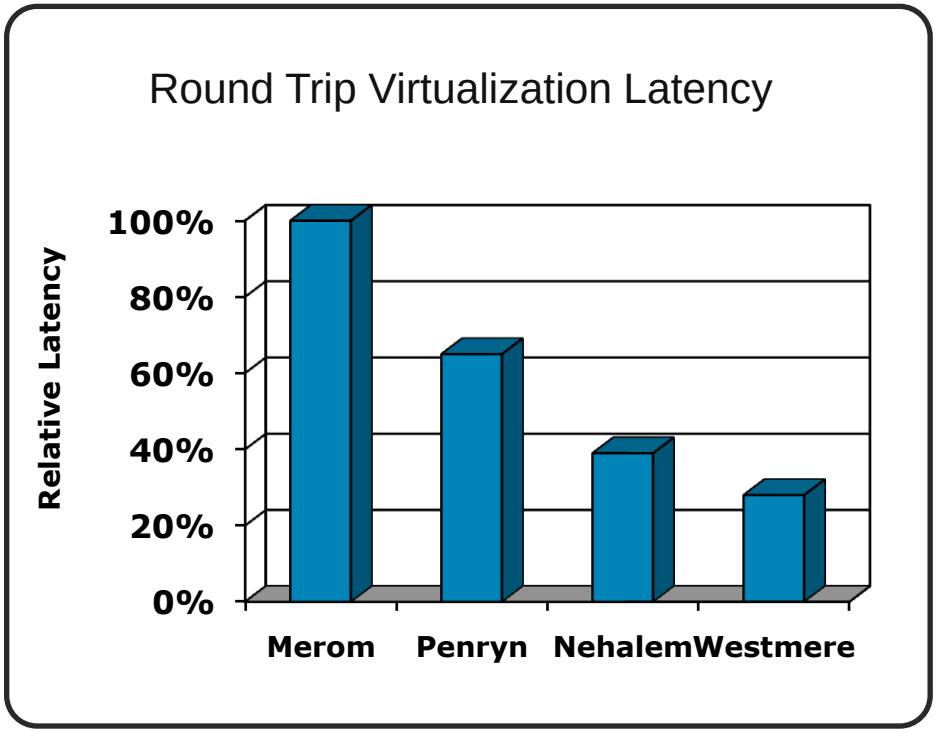
Increases performance for threaded applications delivering greater throughput and responsiveness



Higher Performance For Threaded Workloads

Latency of Virtualization Transitions

- Microarchitectural
  - Huge latency reduction generation over generation
  - Nehalem continues the trend
- Architectural
  - Virtual Processor ID (VPID) added in Intel® Core™ microarchitecture (Nehalem)
  - Removes need to flush TLBs on transitions

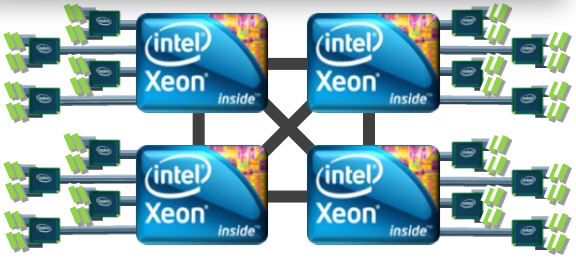


Higher Virtualization Performance Through Lower Transition Latencies

Optimized for Different Usages

Best for *the most demanding* workloads

Xeon 7000 Processor Series



- Largest workloads
- Highly variable workloads
- Maximum consolidation
- Highest availability

Best for general enterprise workloads

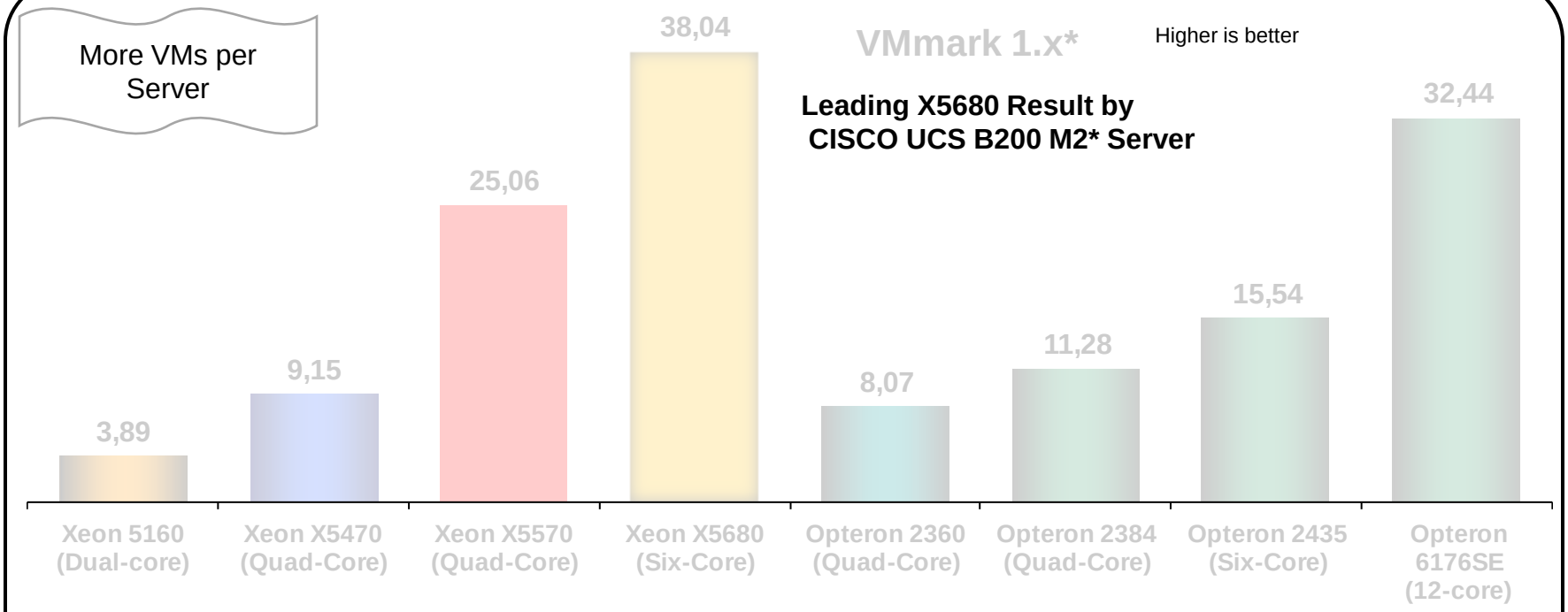
Xeon 5000 Processor Series

- Scale-out workloads
- Infrastructure virtualization
- General purpose workloads
  (e.g. e-mail, web, file/print)

Xeon® 4-socket servers are designed for heavy duty workloads

Intel® Xeon® Processor 5600 series based Server platforms

Virtualization performance on VMware ESX* using VMmark* benchmark 1.1



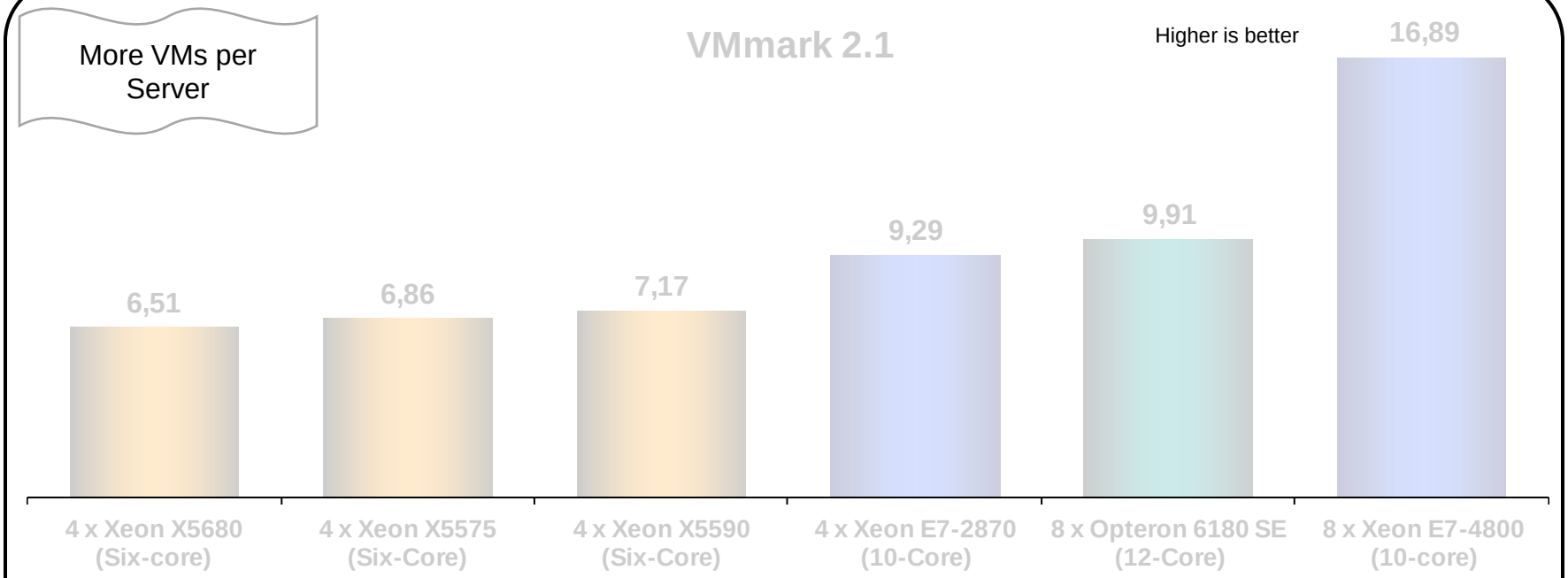
Benchmark Description: VMmark* is designed as a tile-based benchmark consisting of a diverse set of workloads commonly found in the datacenter, The workloads comprising each tile are run simultaneously in separate virtual machines at load levels that are typical of virtualized environments. The performance of each workload is measured and then combined with the other workloads to form the score for the individual tile. Multiple tiles can be run simultaneously to increase the overall score.

A tile is a collection of six diverse workloads concurrently executing specific software. Running on one of two separate operating systems (Windows or Linux), each workload runs in its own virtual machine and executes specific applications. Included in a single tile are a web server, file server, mail server, database, Java server, as well as an idle machine. Results are posted at http://www.vmware.com/products/vmmark/results.html

Up to 42% gain on VMmark* over Xeon 5570

Intel® Xeon® Processor 5600 / E7 series based Server platforms

Virtualization performance on VMware ESX* using VMmark* benchmark 2.1



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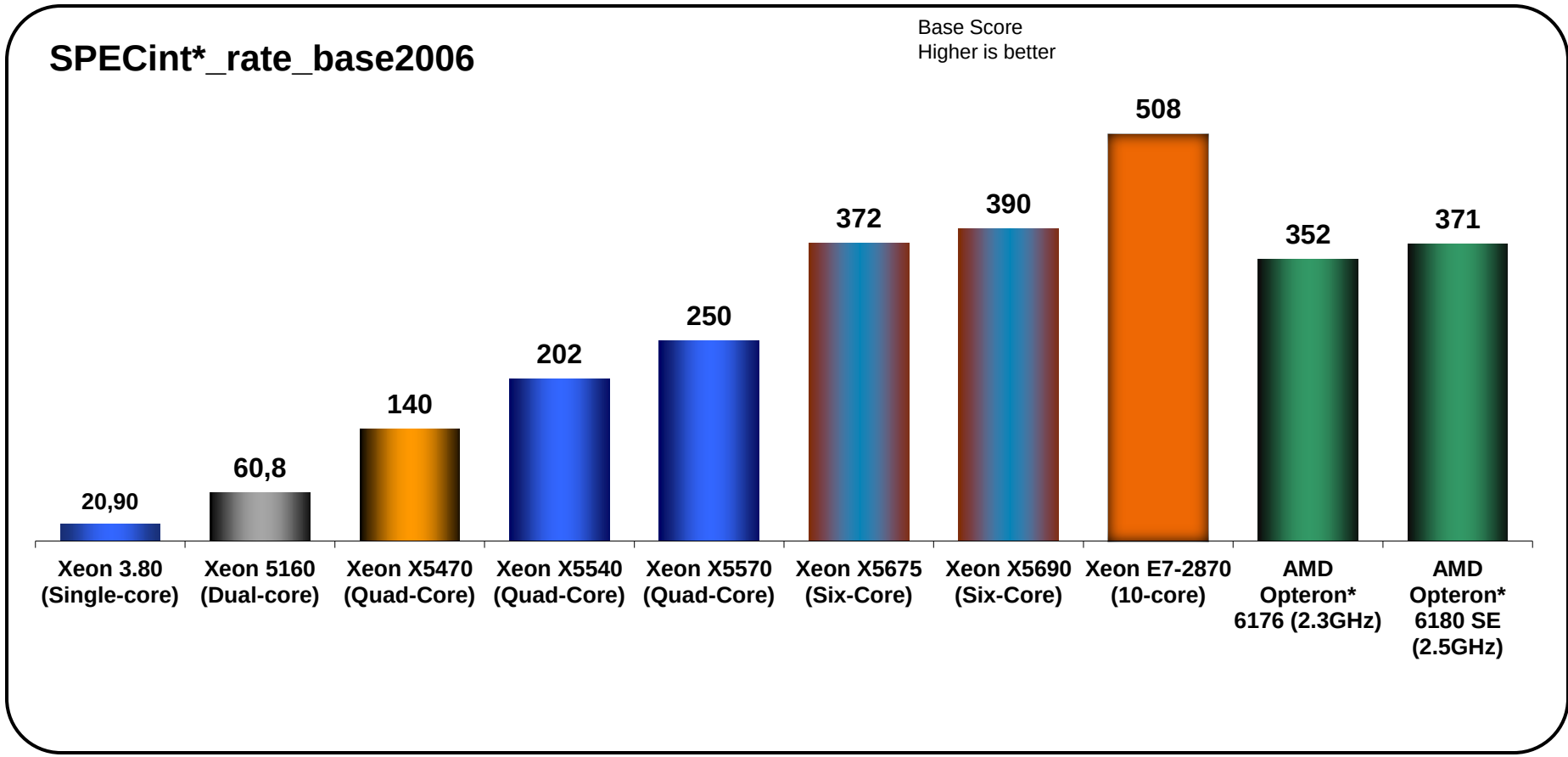
Intel® Xeon® Processor 5600 series based Server platforms

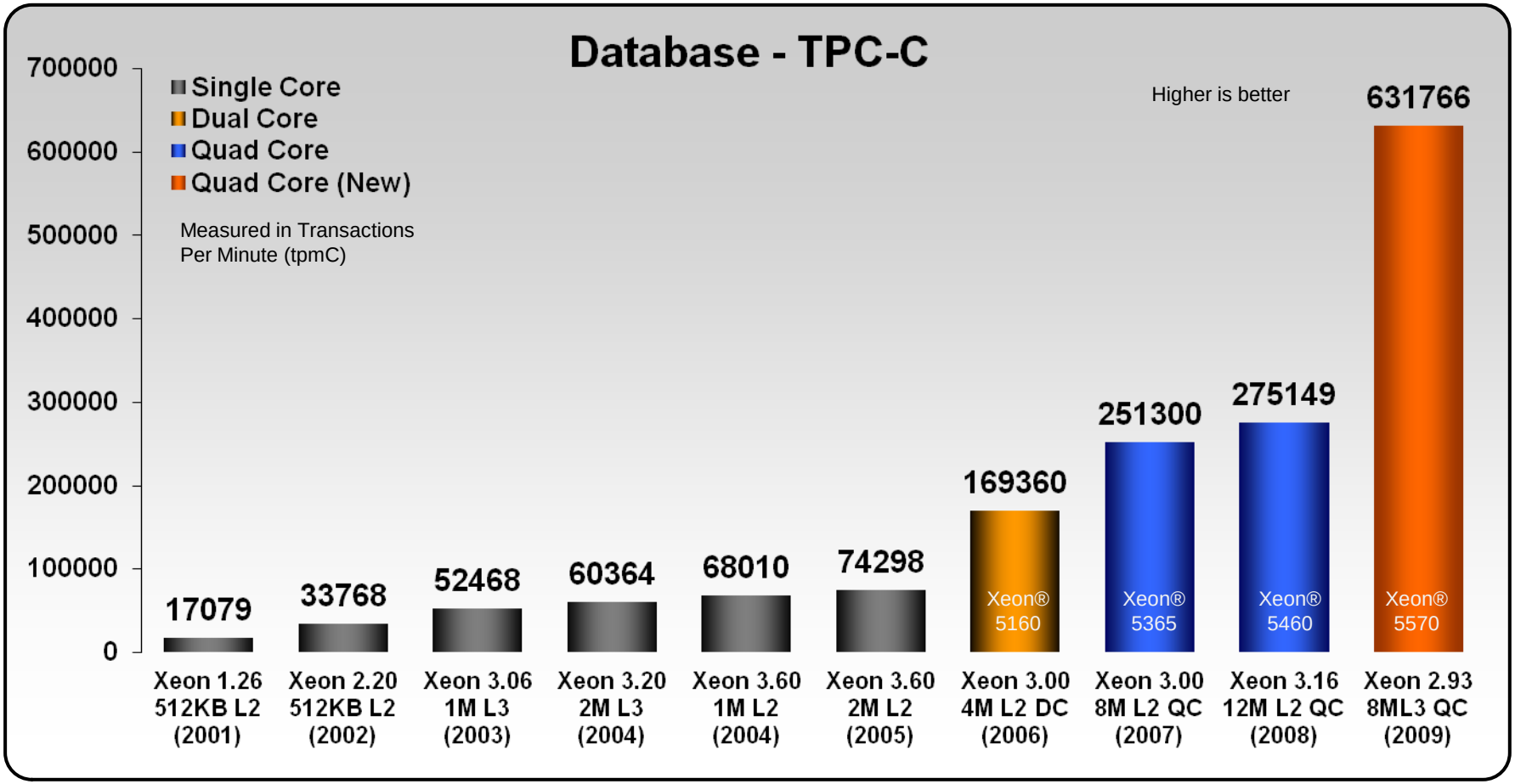
Integer Throughput performance on SPECint*_rate_base2006



Better Performance on General Purpose Computing Applications

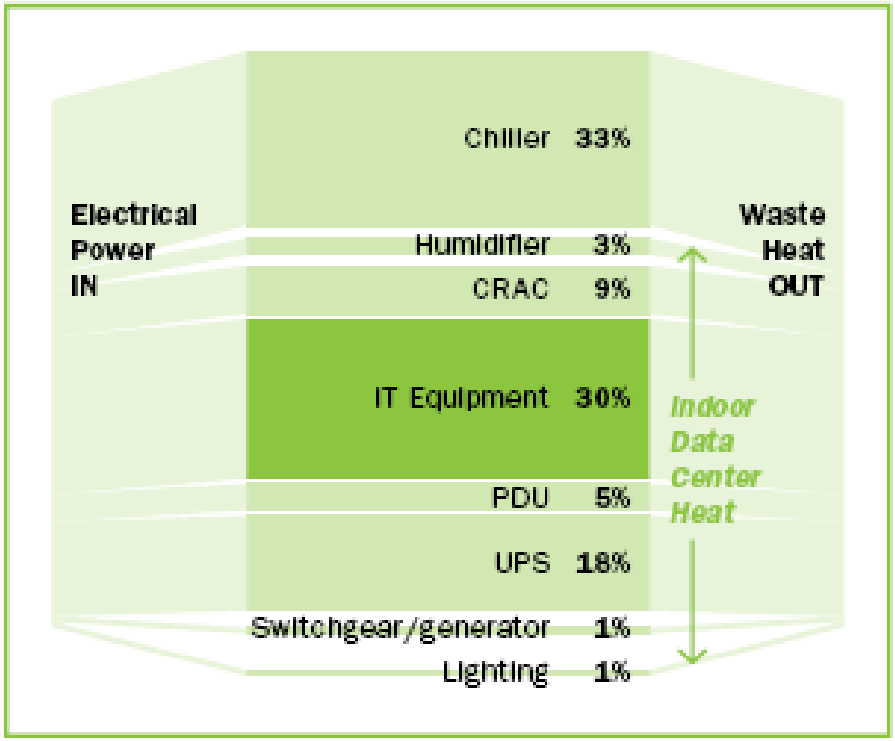
Xeon 3.80 – Intel® Xeon® Processor 3.80 2M L2 (“Irwindale 3.80GHz”, Single-Core)
Xeon 5160 – Intel® Xeon® Processor 5160 (“Woodcrest 3.0GHz”, Dual-Core)
Xeon 5470 – Intel® Xeon® Processor X5470 (“Harpertown 3.33GHz”, Quad-Core)
Xeon 5570 – Intel® Xeon® Processor X5570 (“Nehalem-EP 2.93GHz”, Quad-Core)
Xeon 5680 – Intel® Xeon® Processor X5680 (“Westmere-EP 3.33 GHz”, Six-Core
Magny Cours – AMD Opteron 6176 SE 2.3GHz

Intel® Xeon® Processor 5500 series based Server platforms
Database performance on TPC*-C



Consolidate your IT infrastructure with Xeon 5500 series

Typical power usage in an older Data Center



Picture taken from Green Grid

Picture shows typical use of electrical power in an older (5 years or older) Data Center

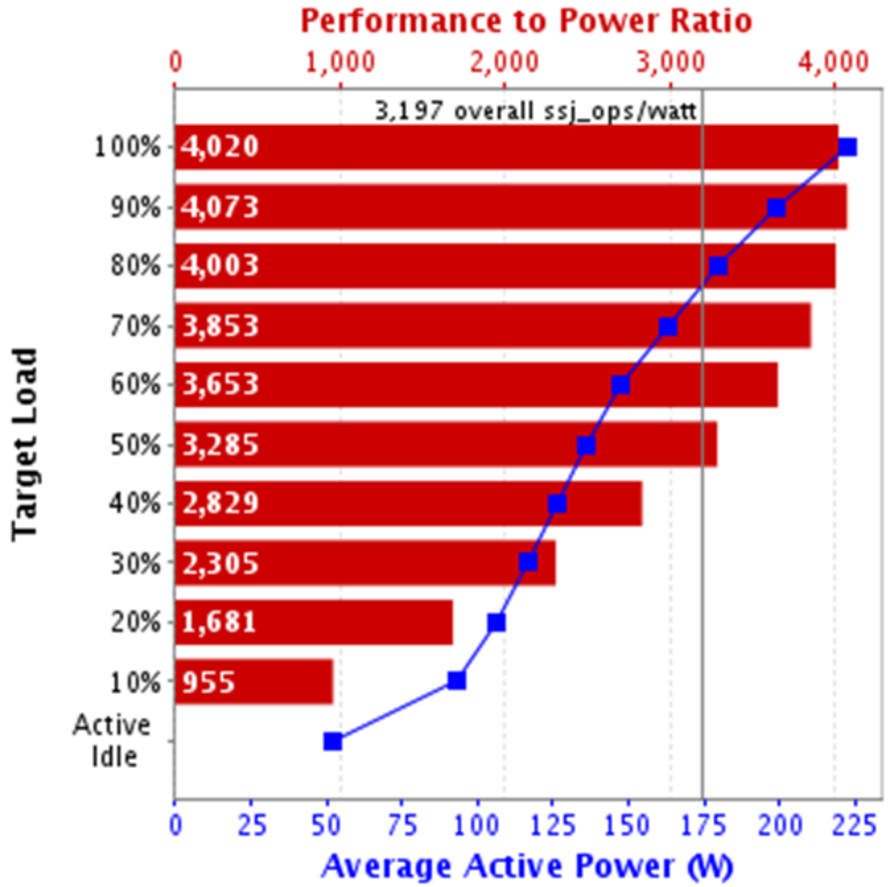
Green Grid defines Power Usage Effectiveness (PUE) as total power consumed in DC divided by power consumed by IT equipment

The lower PUE the less power used by non-IT equipment

PUE of picture: 3.33

SPECpower_ssj2008

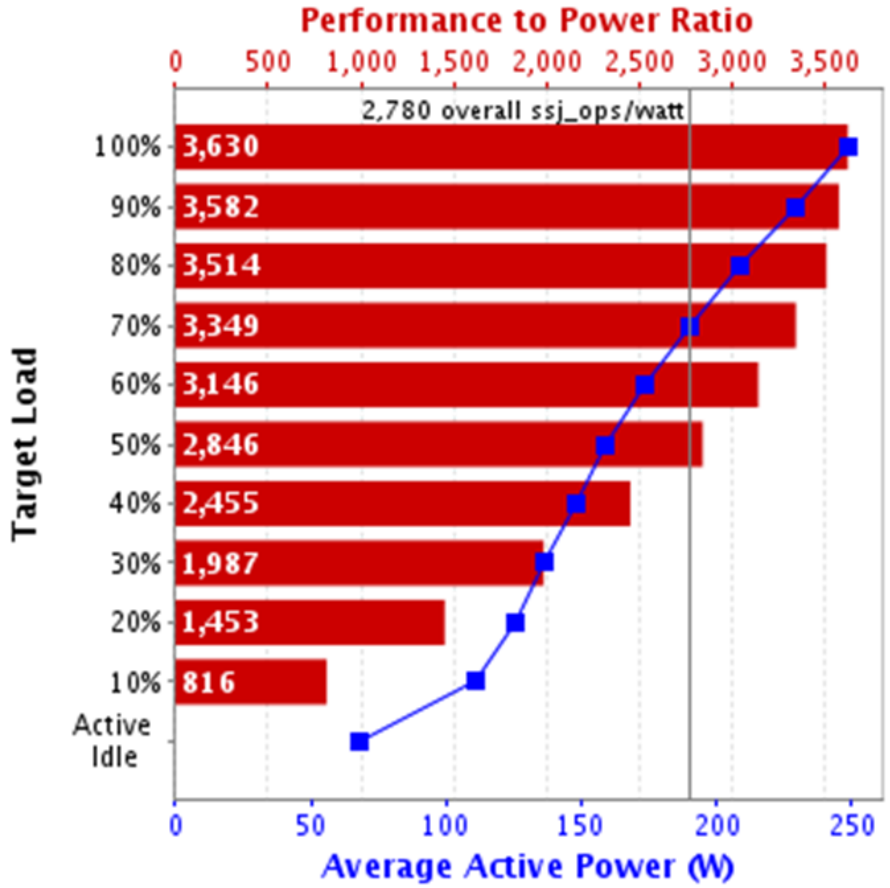
- HP ProLiant DL380 G7, 2 x Intel Xeon X5675, 3.07GHz 6 core pr CPU / 4 x 4GB / 120GB SSD



SPECint: 367
100% Watt: 222
Idle: 52

SPECpower_ssj2008

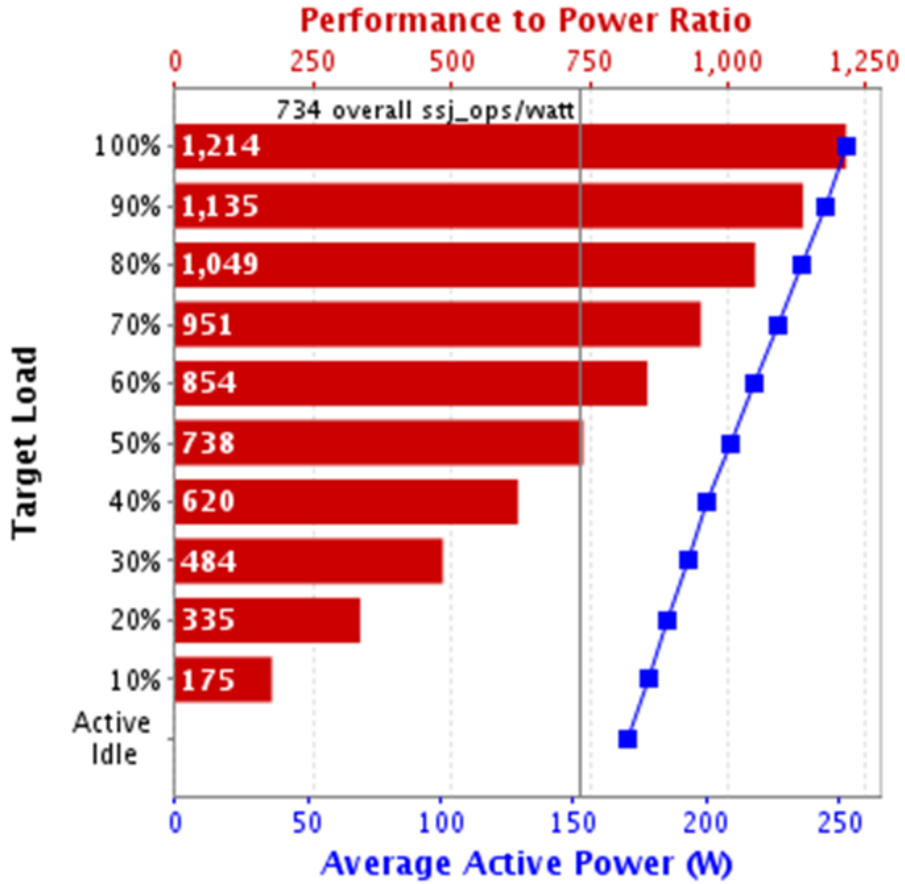
- HP ProLiant DL380 G6, 2 x Intel Xeon X5670, 2.93GHz 6 core pr CPU / 4 x 4GB / 60GB SSD



SPECint: 331
100% Watt: 249
Idle: 68

SPECpower_ssj2008

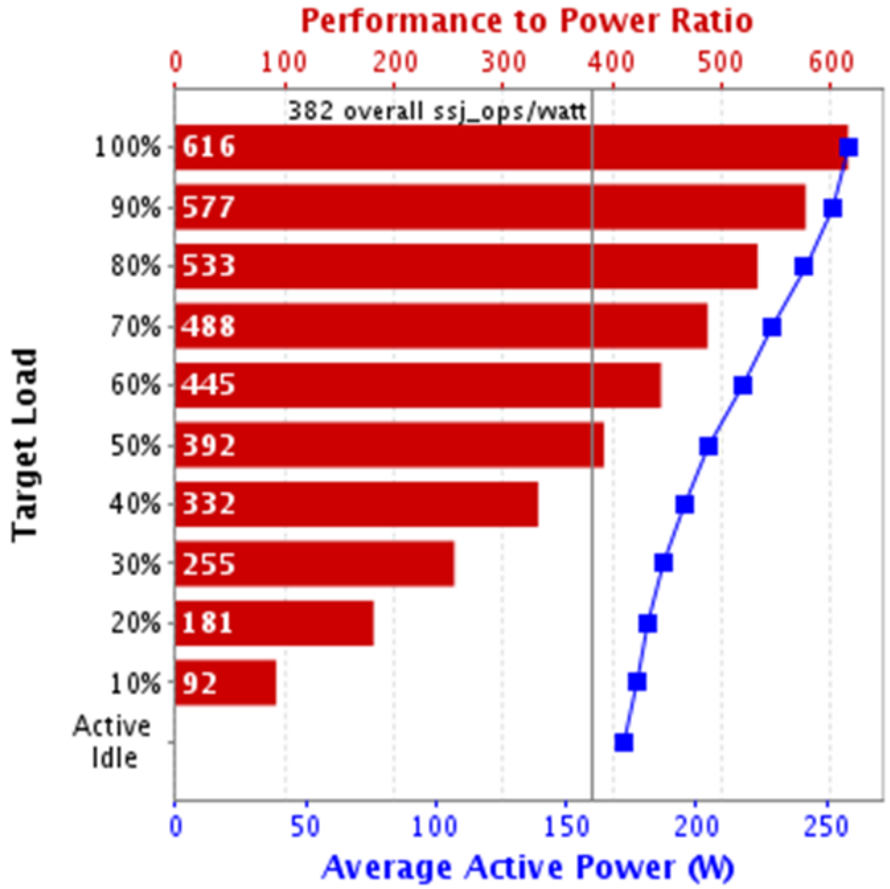
- HP ProLiant DL380 G5, 2 x Intel Xeon L5430, 2.67GHz 4 core pr CPU / 2 x 4GB / 36GB 10K PRM SAS



SPECint: 120
100% Watt: 253
Idle: 170

SPECpower_ssj2008

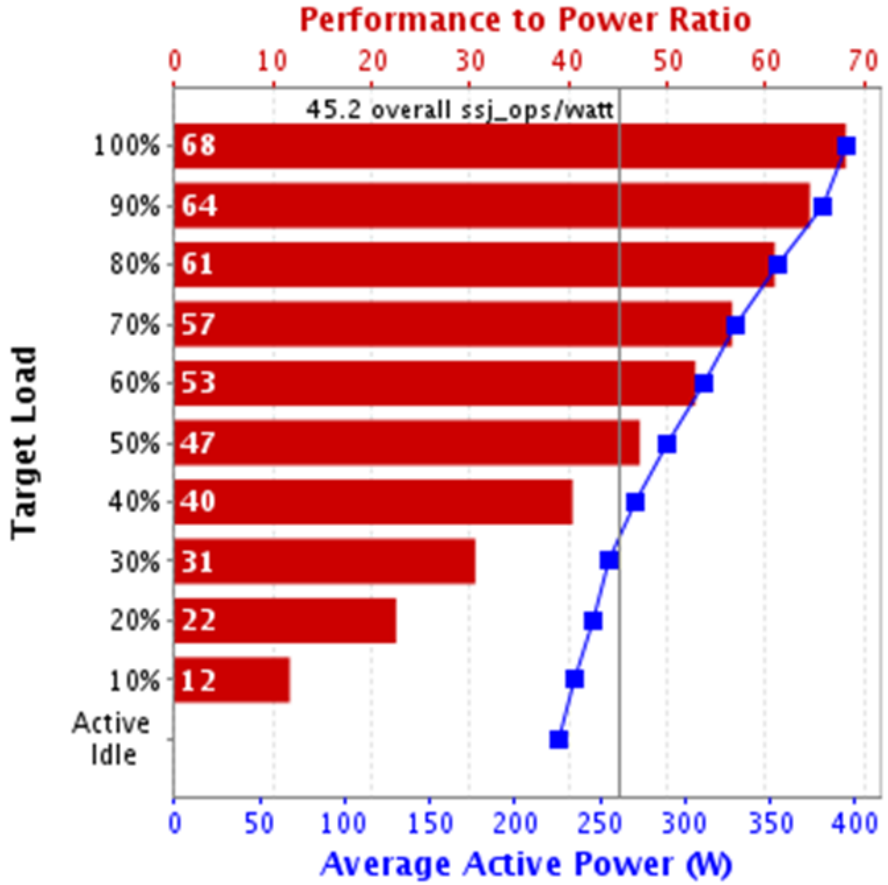
- HP ProLiant DL380 G5, 2 x Intel Xeon 5160, 3,0GHz 4 core pr CPU / 2 x 4GB / 36GB 10K PRM SAS



SPECint: 61
100% Watt: 258
Idle: 172

SPECpower_ssj2008

- HP ProLiant DL380 G4, 2 x Intel Xeon 3.8GHz
  1 core pr CPU / 4 x 2GB / 1 x 36 GB 15K RPM SCSI



SPECint: 21
100% Watt: 394
Idle: 226

MIPS Million Instructions Per Second

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AMD 6140	2.6	8	62.4k
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CPU	GHz	Core / CPU	MIPS	SPECint
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AMD 6172	2.1	12	75.6k	328
AMD 6176 SE	2.3	12	82.8k	352
AMD 6180 SE	2.5	12	90.0k	369
Intel 5570	2.93	4	46.88k	250
Intel 6550	2.00	8	64.00k	320
Intel 5675	3.06	6	73.44k	372
Intel 7560	2.266	8	75.51k	363
Intel 5680	3.33	6	79.92k	355
Intel 5690	3.46	6	83.04k	388
Intel E7-x870	2.4	10	96.90k	480


CISCO