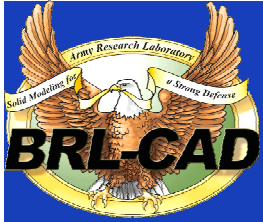# *Benchmarking Results on Different Architectures*

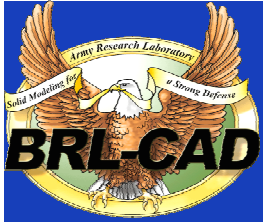Charles M. Kennedy

<kermit@arl.army.mil>

The BRL-CAD Benchmark

- Ray tracing (RT) runs of candidate models
- Rays / second are measured (RTFM)
- Compared with reference to VAX-11/780 running 4.3 BSD
- Run time performance is compared to reference platform
- Benchmark also checks for correctness of resultant image!

The BRL-CAD Benchmark

- Benchmark is included in source distribution only
- Not installed as part of compilation and installation process
- Benchmark lives in "bench" directory
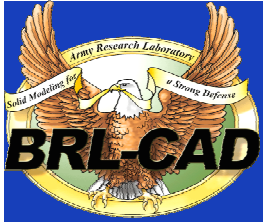- No installation is required, just compile and run the benchmark script "run.sh"

Sample Benchmark Run

```
[pbook:~/brlcad/bench] chuck% ./run.sh
B R L - C A D   B E N C H M A R K
================================
Looking for RT...
...checking for NFS or local build...
...found NFS build
Looking for geometry database directory...
...checking for NFS or local build...
...found NFS build
Checking for pixel comparison utility...
...checking for NFS of local build...
...found NFS build
Using [../.rt.pmac/rt] for RT
Using [../.db.pmac] for DB
Using [../.bench.pmac/pixcmp] for CMP


+++++ moss

real    0m5.553s
user    0m3.720s
sys     0m0.740s
pixcmp bytes:   786432 matching,        0 off by 1,       0 off by many
moss.pix: answers are RIGHT
+++++ world
.
.
.
```

Sample Benchmark Summary

```
[pbook:~/brlcad/bench] chuck%
[pbook:~/brlcad/bench] chuck% tail summary
Abs      pbook.arl.army.mil        80968.78        45168.73        45159.48
38982.21  48499.04 69153.97         54655.36        Thu Oct 17 23:57:33 EDT 2002
*vgr     pbook.arl.mil       590.96  673.55  805.41  730.55  686.08  4.66    581.86  -P1
Abs      pbook.arl.army.mil        80786.00        45295.96        45688.43
39071.31  48284.60 69044.37         54695.11        Thu Oct 17 23:58:54 EDT 2002
*vgr     pbook.arl.army.mil        589.63  675.45  814.84  732.22  683.04  4.65    583.30
-P1
Abs      pbook.arl.army.mil        80786.00        45042.20        45094.22
38982.21  48499.04 69044.37         54574.67        Fri Oct 18 00:00:13 EDT 2002
*vgr     pbook.arl.army.mil        589.63  671.67  804.24  730.55  686.08  4.65    581.13
-P1
Abs      pbook.arl.army.mil        80968.78        44749.72        45290.57
38893.52  48427.35 69044.37         54562.38        Fri Oct 18 00:01:28 EDT 2002
*vgr     pbook.arl.army.mil        590.96  667.30  807.75  728.88  685.06  4.65    580.76
-P1
Abs      pbook.arl.army.mil        80968.78        45084.30        45290.57
39026.71  48499.04 69080.87         54658.37        Fri Oct 18 00:02:41 EDT 2002
*vgr     pbook.arl.army.mil        590.96  672.29  807.75  731.38  686.08  4.66    582.18
-P1
[pbook:~/brlcad/bench] chuck%
```
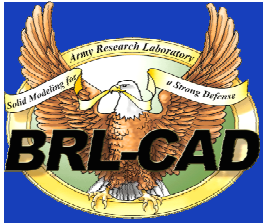
Reference Images
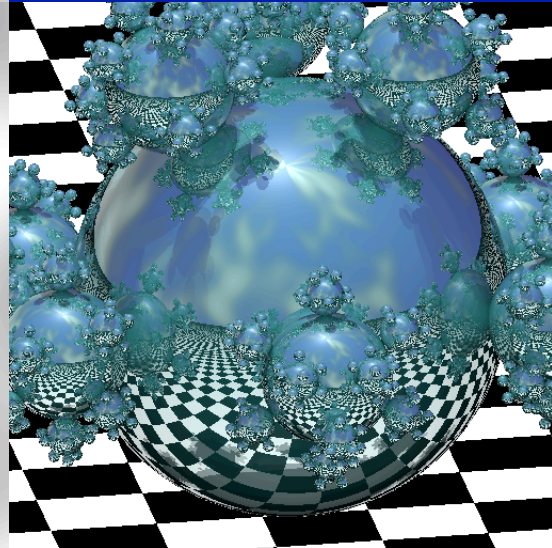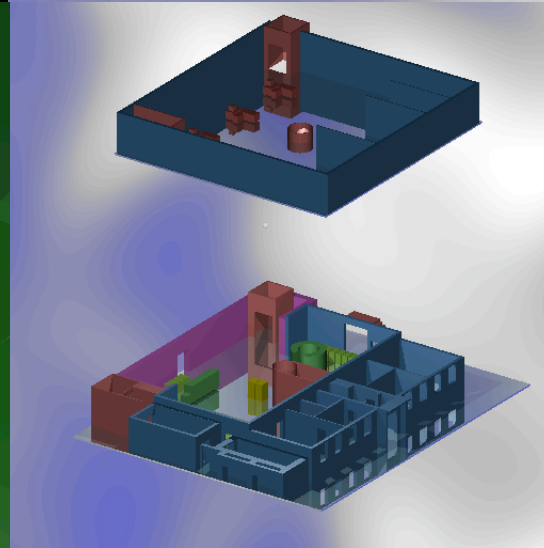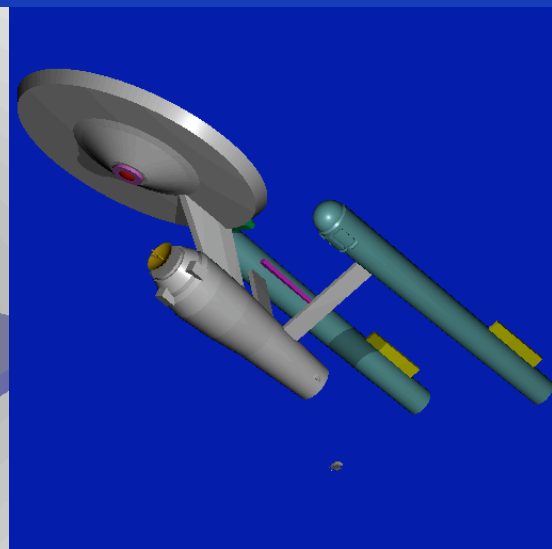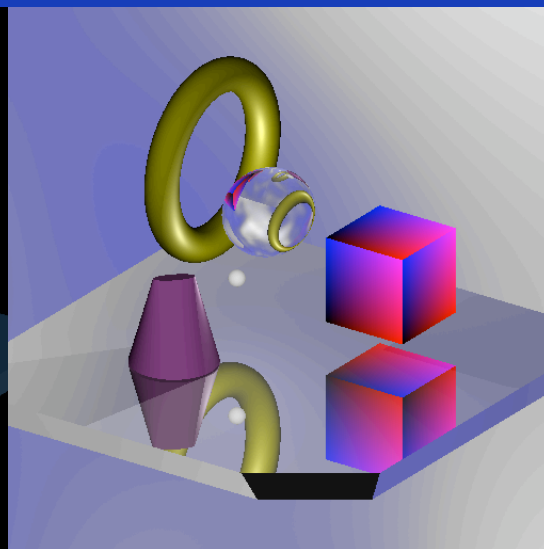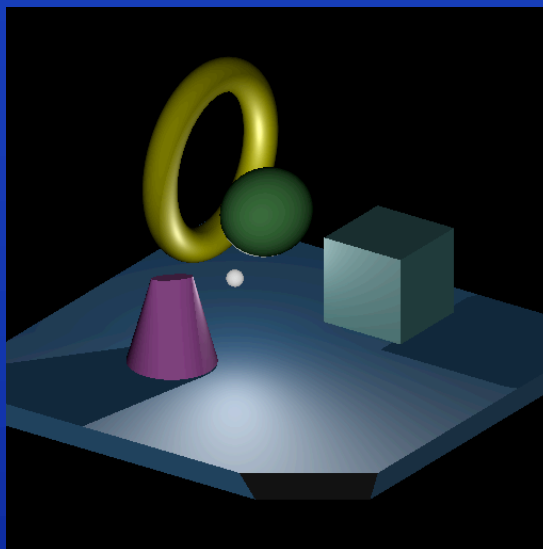
The BRL-CAD Benchmark

- Previous releases used four, then later, five reference images

- Reference runs on VAX-11/780 named VGR used for comparison

- Sphflake reference image added

- After 17 years, reference VAX-11/780 suffered disk controller P/S failure
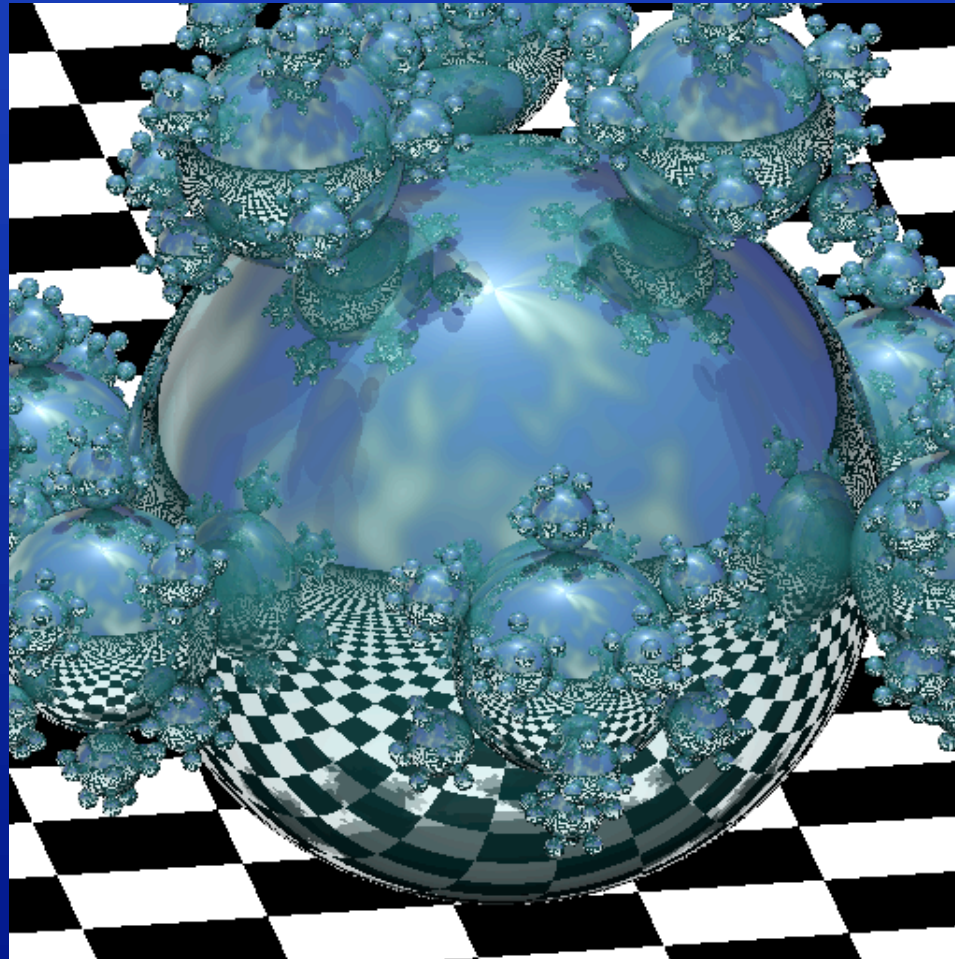
- Sphflake generated on a different machine

The BRL-CAD Benchmark

- Result was sphflake reference run is not normalized with respect to other runs
- Not harmful
- Effect is to report lower relative performance for sphflake compared to other five references
- Lower average performance is also reported
- Should renormalize someday!

Reference Sphflake Image

The BRL-CAD Benchmark

- Methodology for benchmark results
  - Benchmark was run on unloaded machine whenever feasible
  - Target machine running multi-user with networking support operational
  - Five benchmark runs are averaged
- Exceptions to methodology noted
  - Some HPC machines were loaded when benchmark was run
  - Dedicated time needed for HPC machines

SGI Indy

- 180MHz R5000
- 32K instruction cache
- 32K data cache
- 512K secondary cache
- 256MB memory
- IRIX 5.3
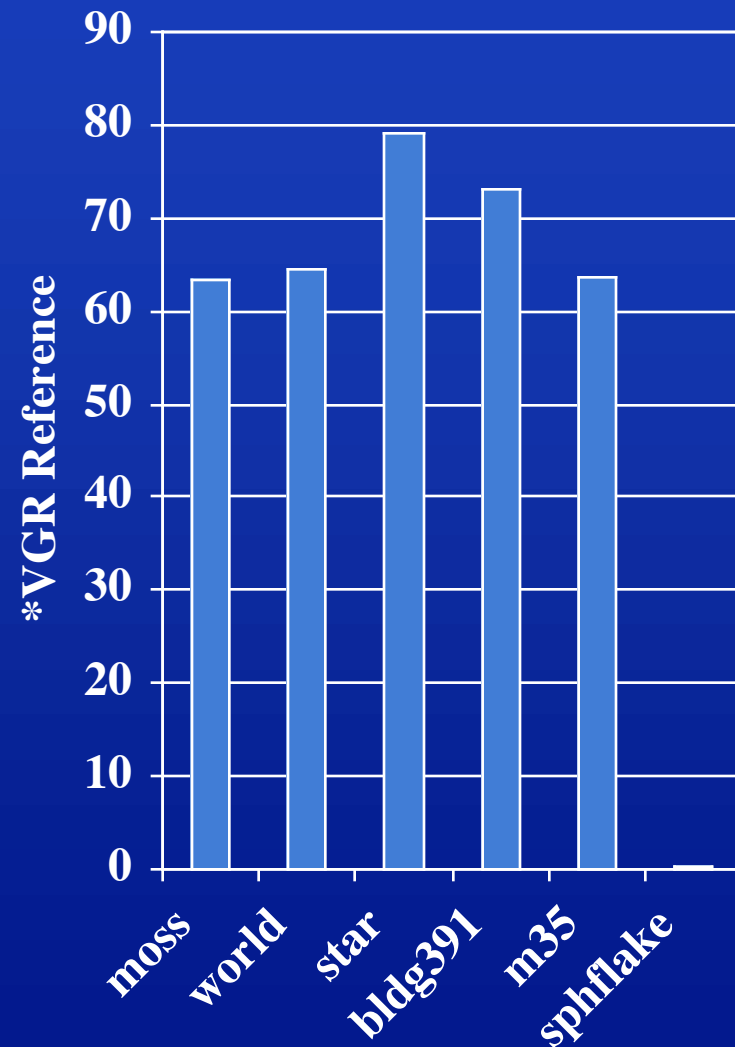
SGI O2

- 200MHz R5000

- 32K instruction cache

- 32K data cache

- 1MB secondary cache

- 512MB memory

- IRIX 6.5.15m
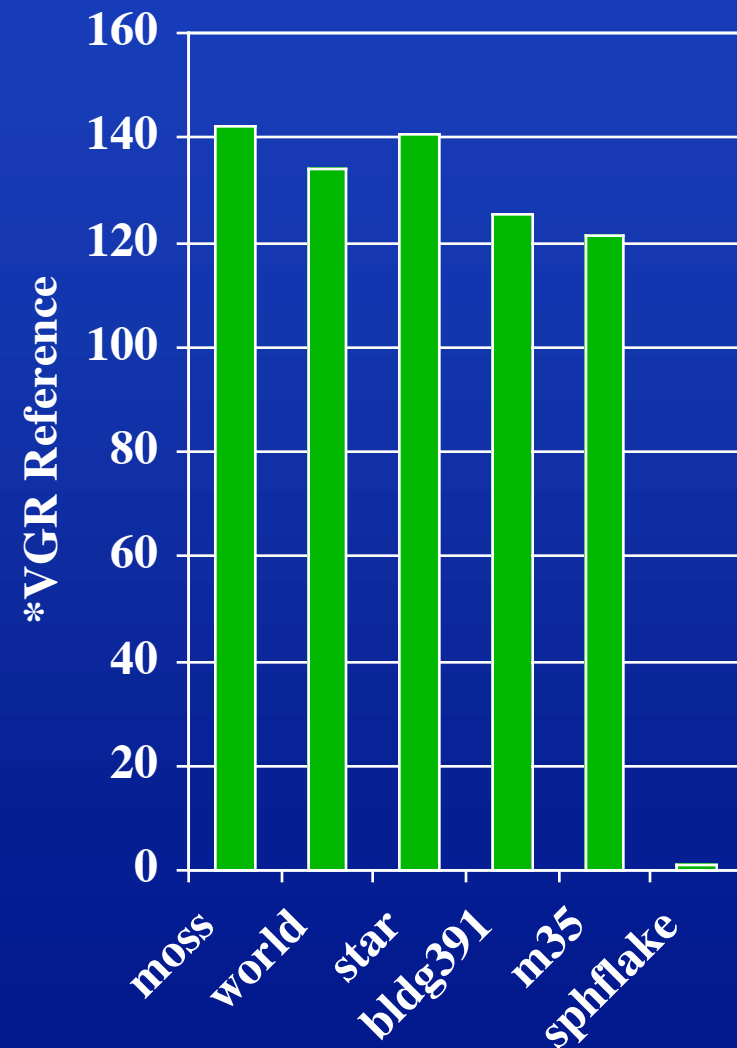
Dell Inspiron 7000 Laptop

- 366MHz Pentium II
- 256K cache
- 128MB memory
- Linux RedHat 7.0
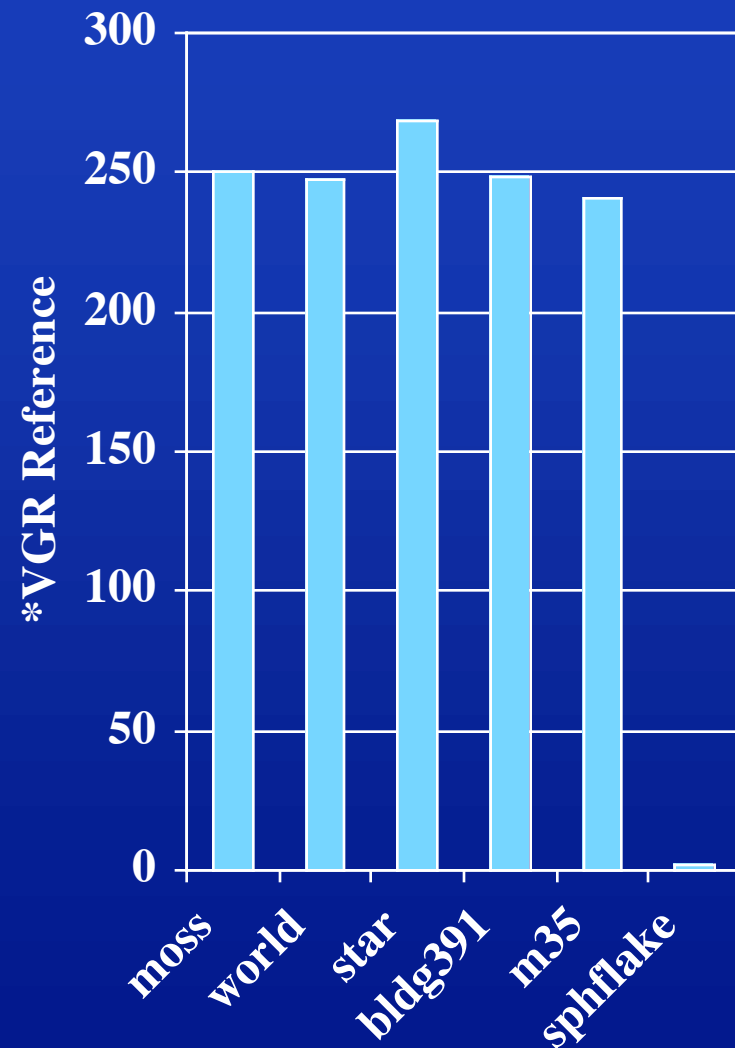
Dell Dimension XPS T500

- 500MHz Pentium III

- 512K cache
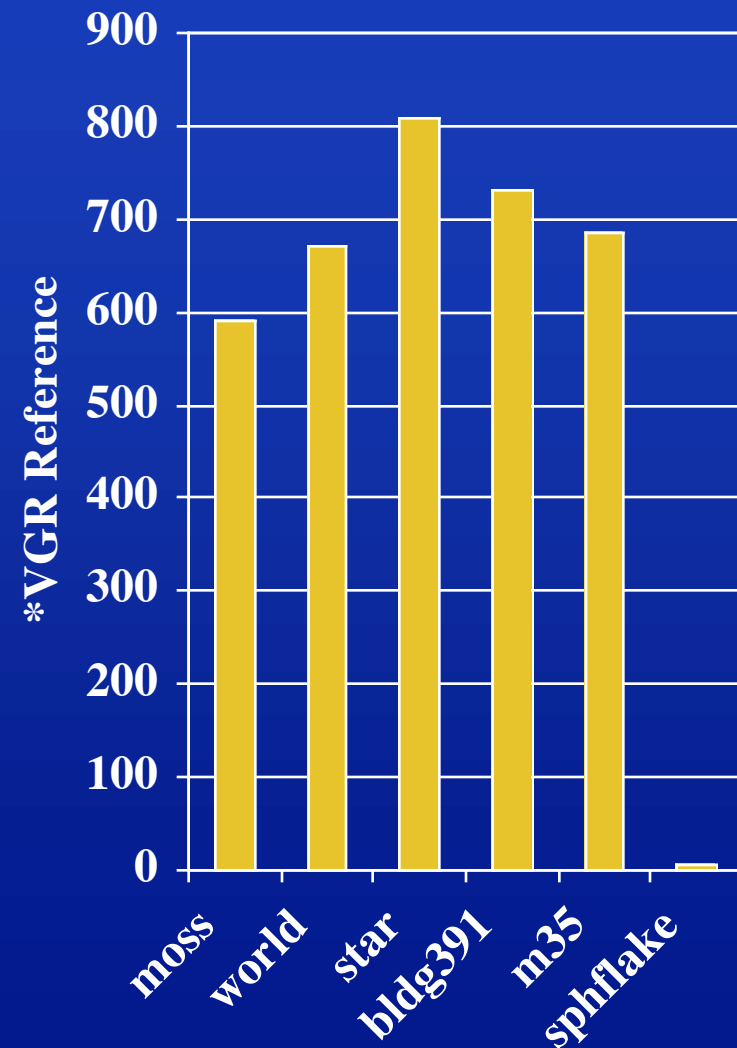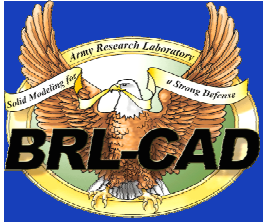
- 256MB memory

- Linux RedHat 7.1
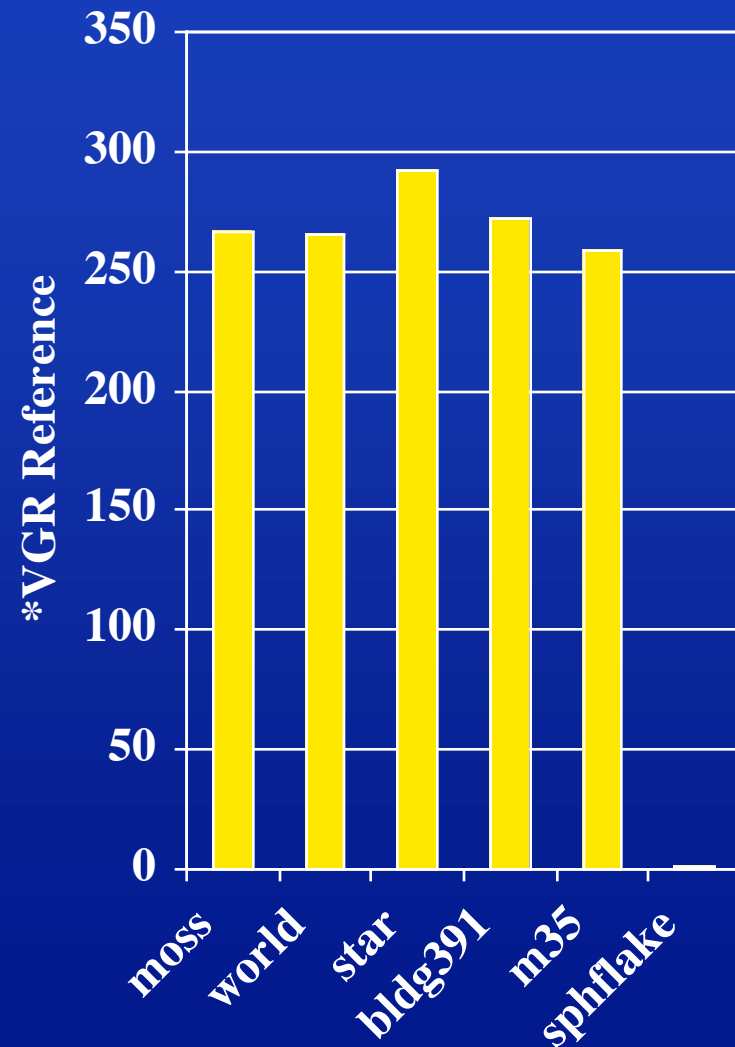
Dell Dimension 4100

- 866MHz Pentium III
- 256K cache
- 512MB memory
- Linux RedHat 7.3
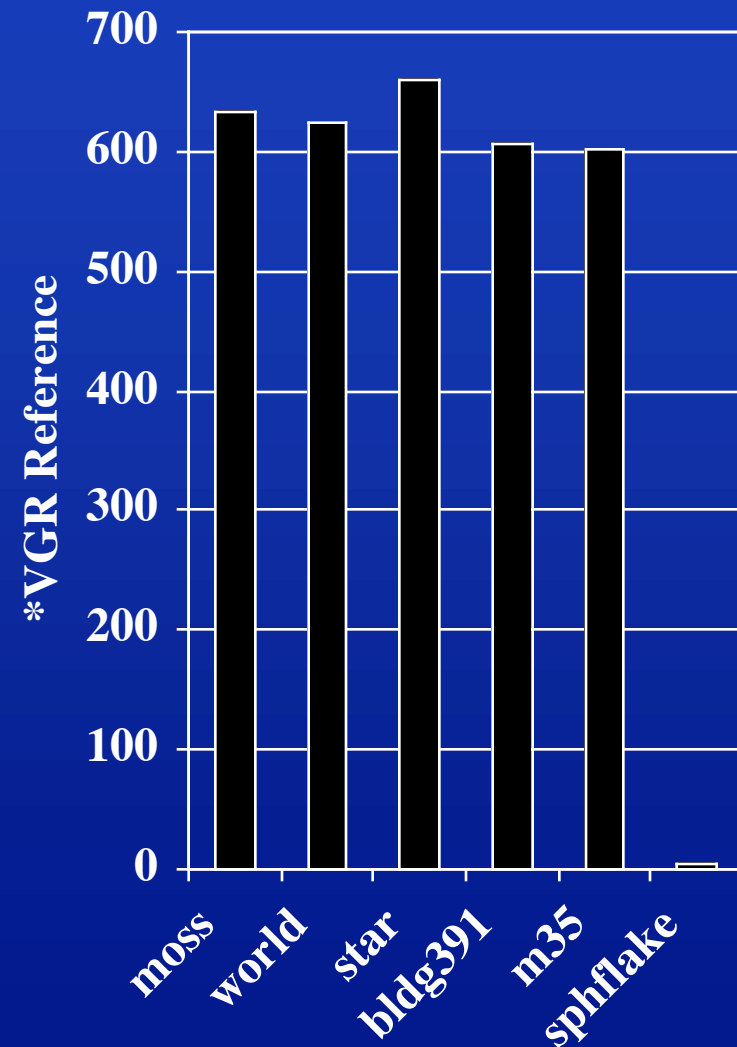
Apple PowerBook G4

- 800MHz PowerPC G4
- 256K L2 cache
- 1MB L3 cache
- 1024MB memory
- Mac OS X v10.2
- Low power setting available

Apple PowerBook G4

- 800MHz PowerPC G4

- 256K L2 cache

- 1MB L3 cache

- 1024MB memory

- Mac OS X v10.2

- Low power setting reduces performance by about 20 percent

- Results shown are for low power setting
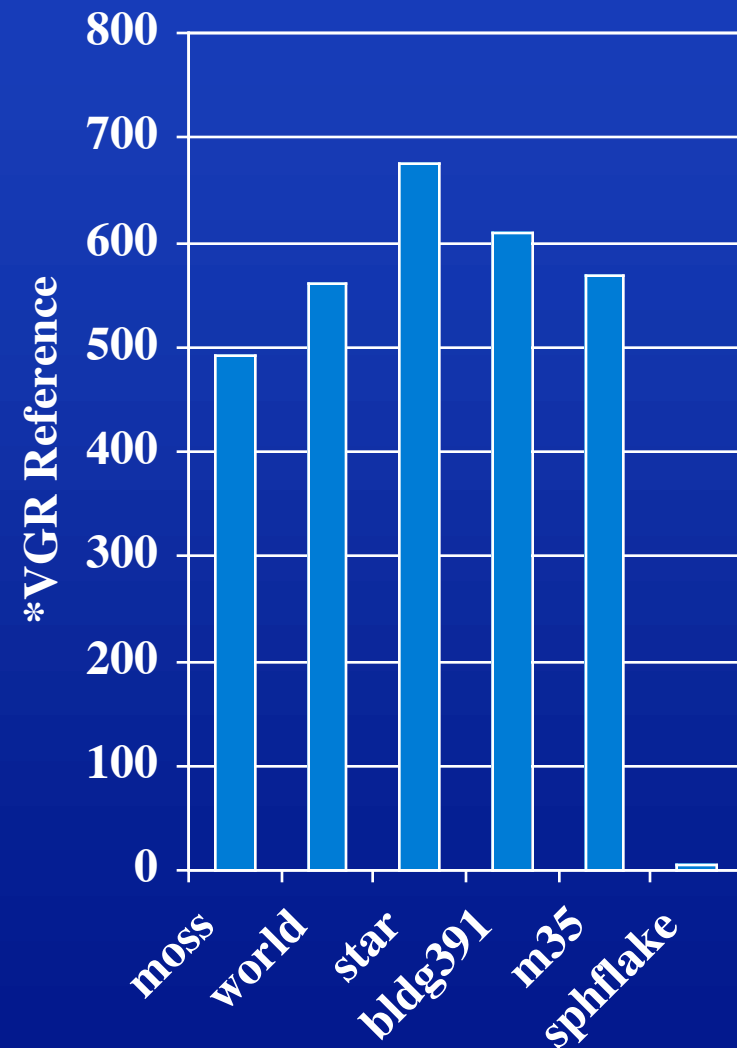
Apple PowerBook G4

- 800MHz PowerPC G4
- 256K L2 cache
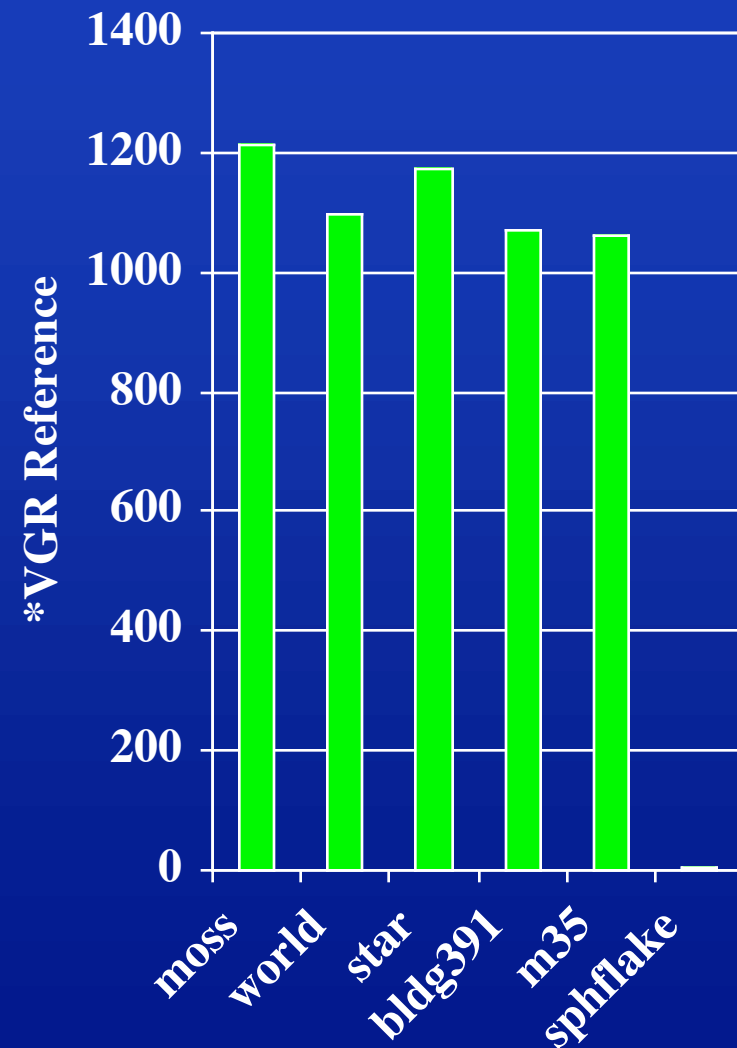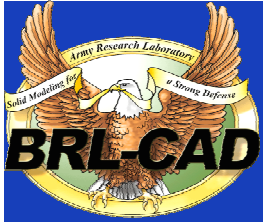- 1MB L3 cache
- 1024MB memory
- Linux Yellow Dog 2.3
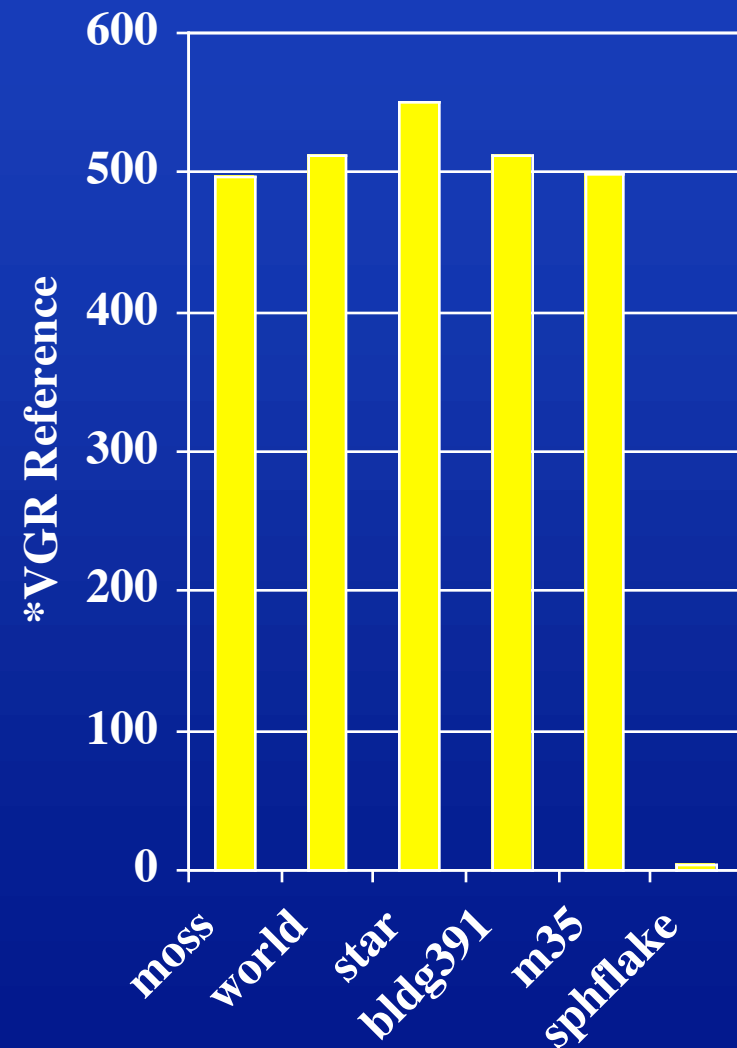
Apple Power Mac G4

- Dual CPU system
- 500MHz PowerPC G4
- 1MB L2 cache/CPU
- 2048MB memory
- Mac OS X v10.2
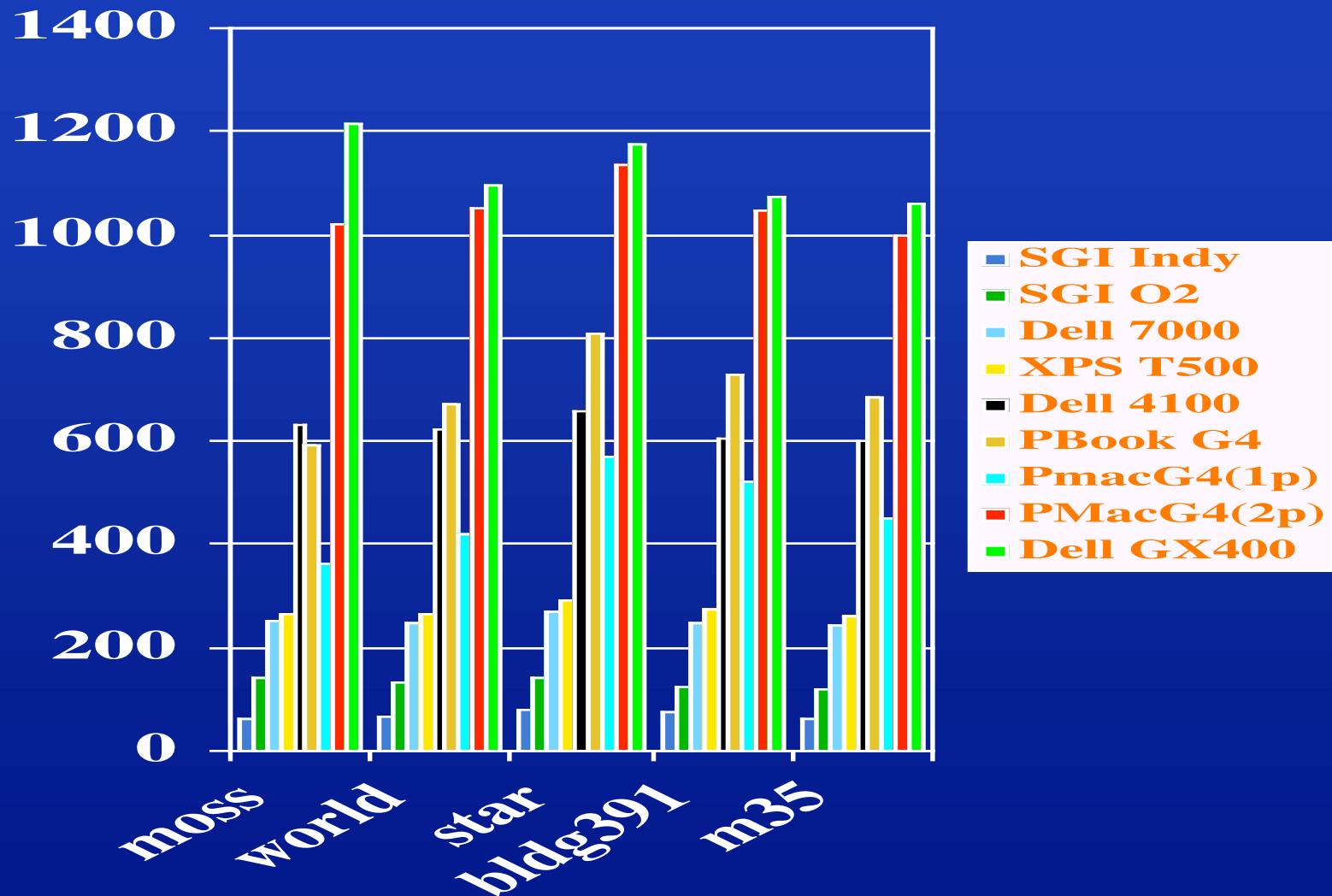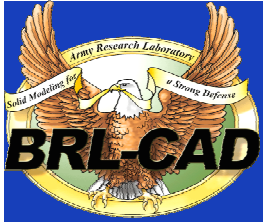- Single and dual CPU results on SMP shown
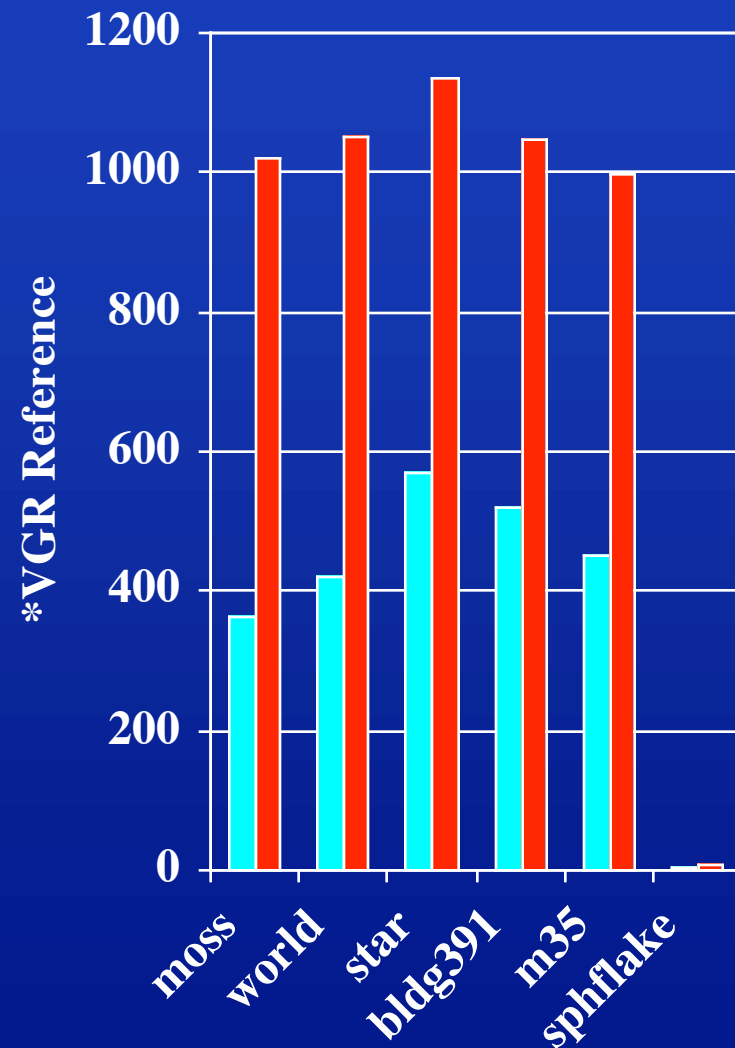
Dell OptiPlex GX400

- 1.8GHz Pentium 4
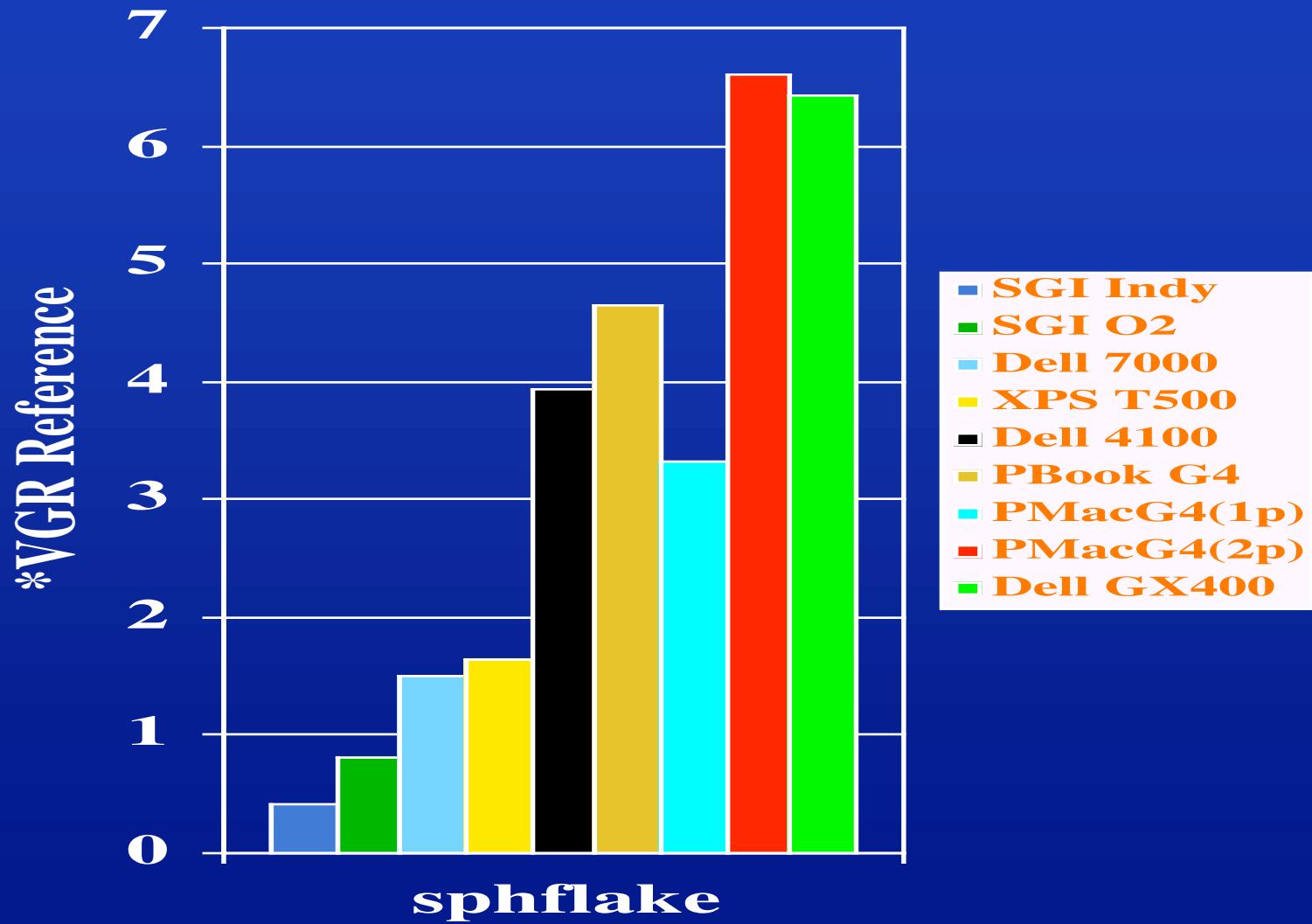- 256K L2 cache
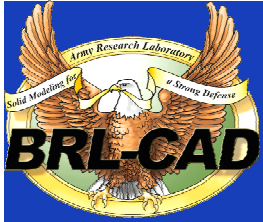- 1024MB memory
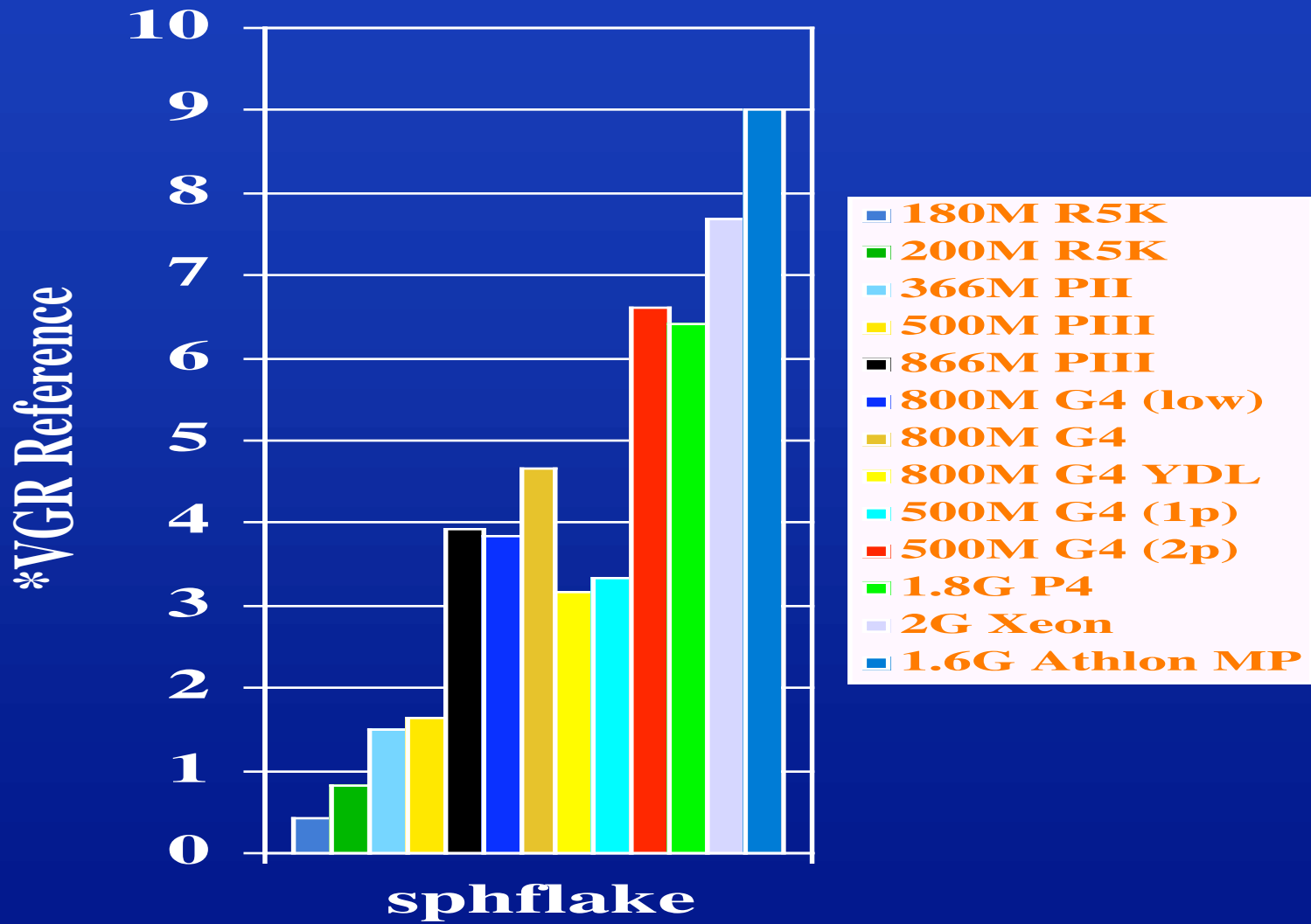- Linux RedHat 7.3

Desktop Comparison
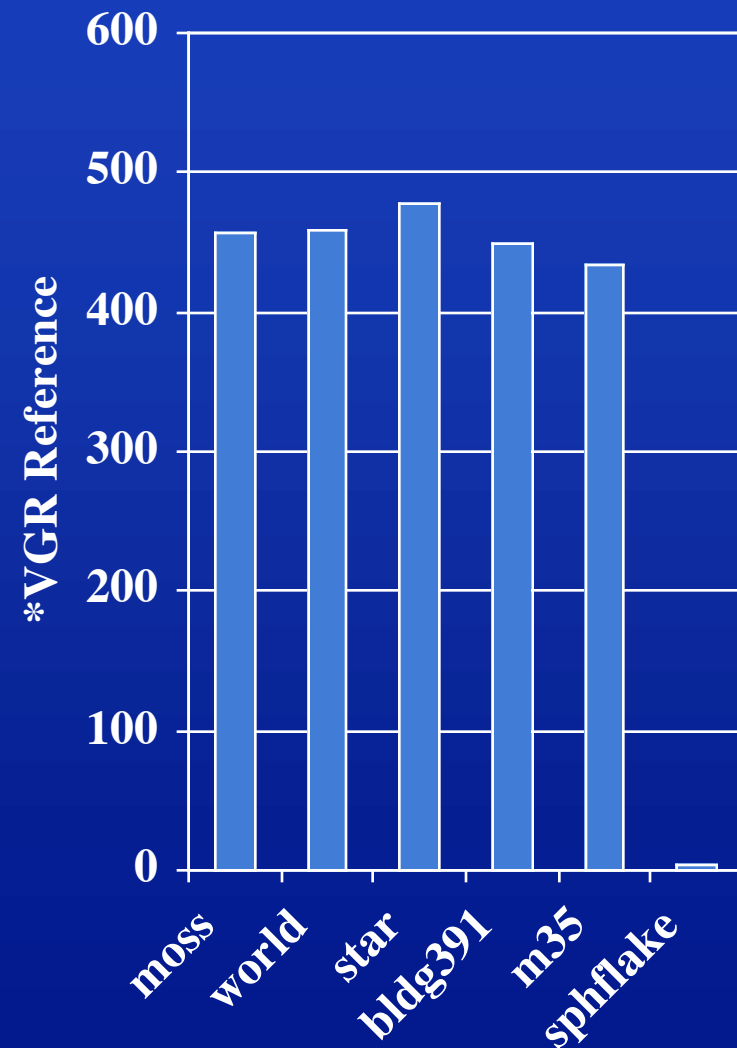
Desktop Comparison - Sphflake
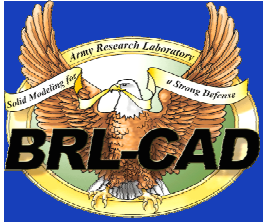
Desktop Comparison - Sphflake
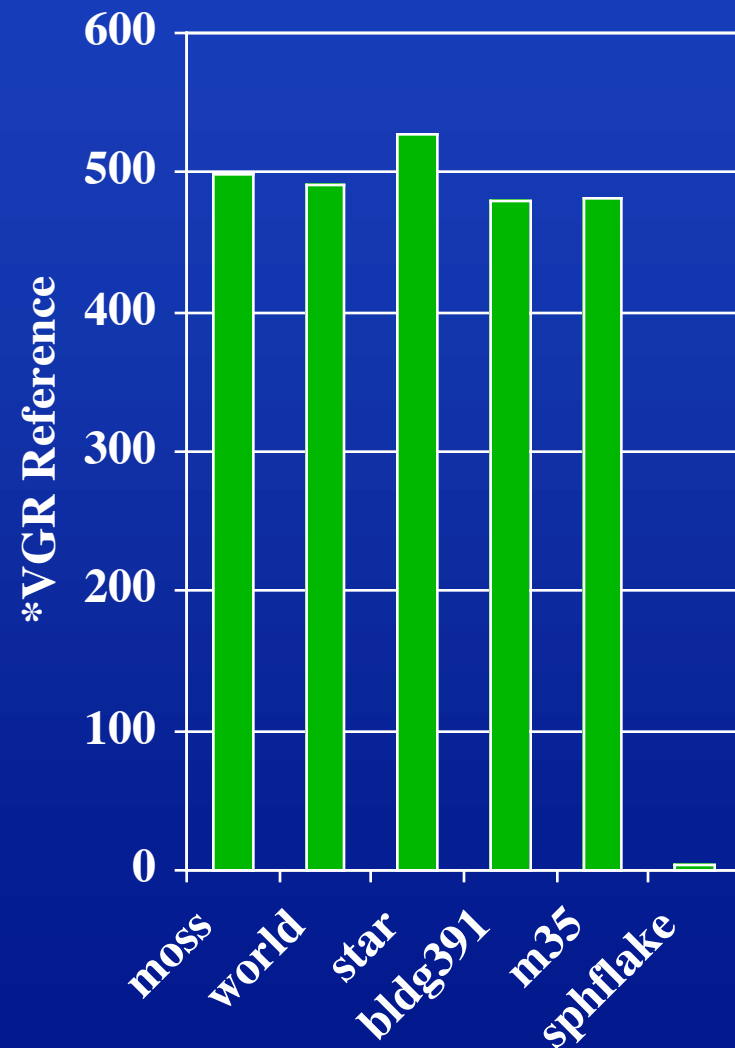
Dell PowerEdge 2450

- Dual CPU system
- 660MHz Pentium III
- 256K cache/CPU
- 512MB memory
- FreeBSD 4.6
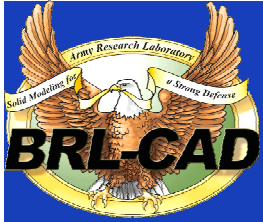- Single CPU results on SMP shown
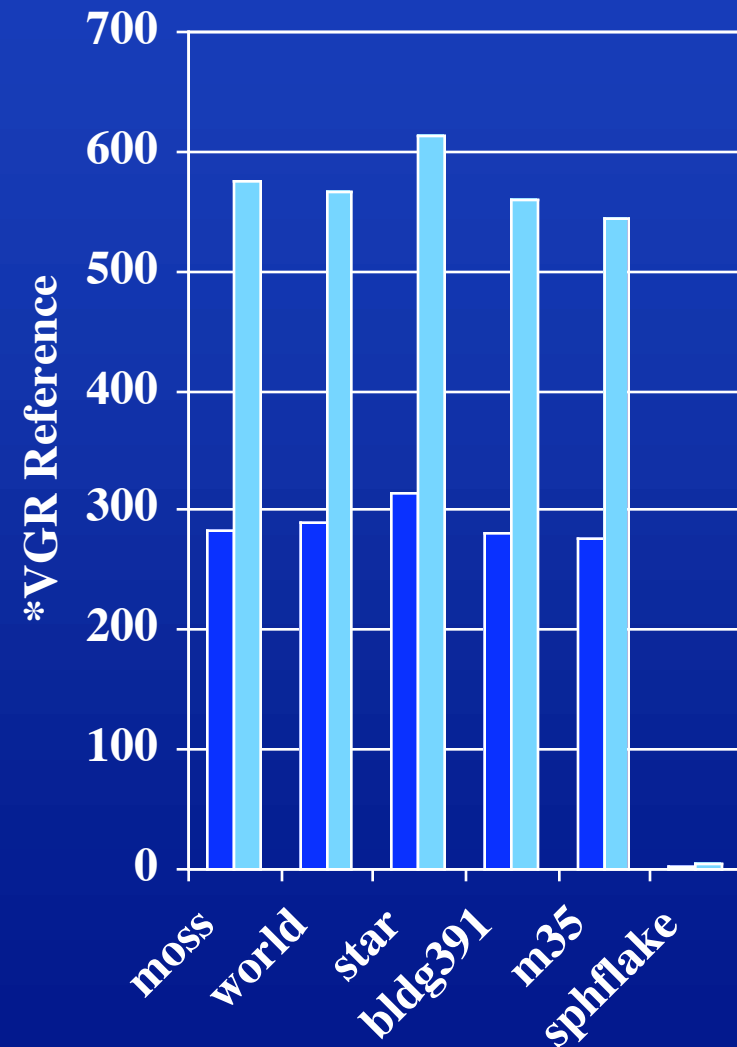
Dell PowerEdge 2450

- Dual CPU system
- 660MHz Pentium III
- 256K cache/CPU
- 512MB memory
- Linux RedHat 7.3
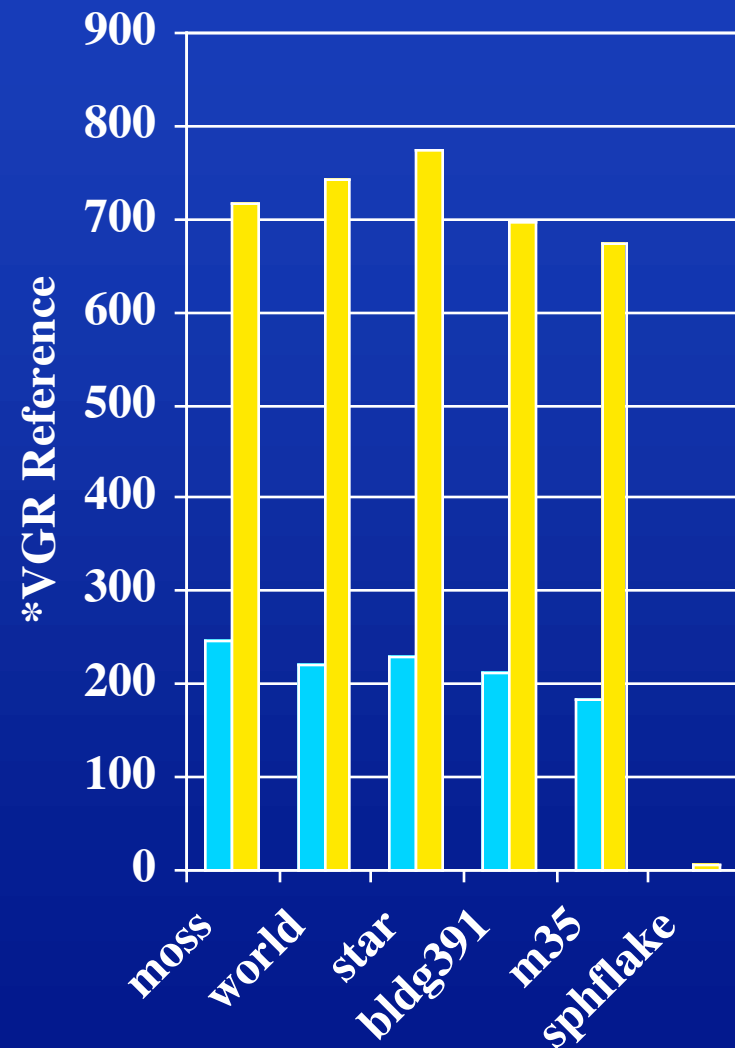- Single CPU results on SMP shown

Sun Enterprise 420R

- Dual CPU system
- 450MHz UltraSPARC-II
- 4MB cache/CPU
- 2048MB memory
- SunOS 5.8
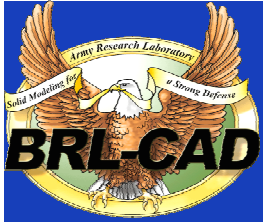- Single and dual CPU results on SMP shown
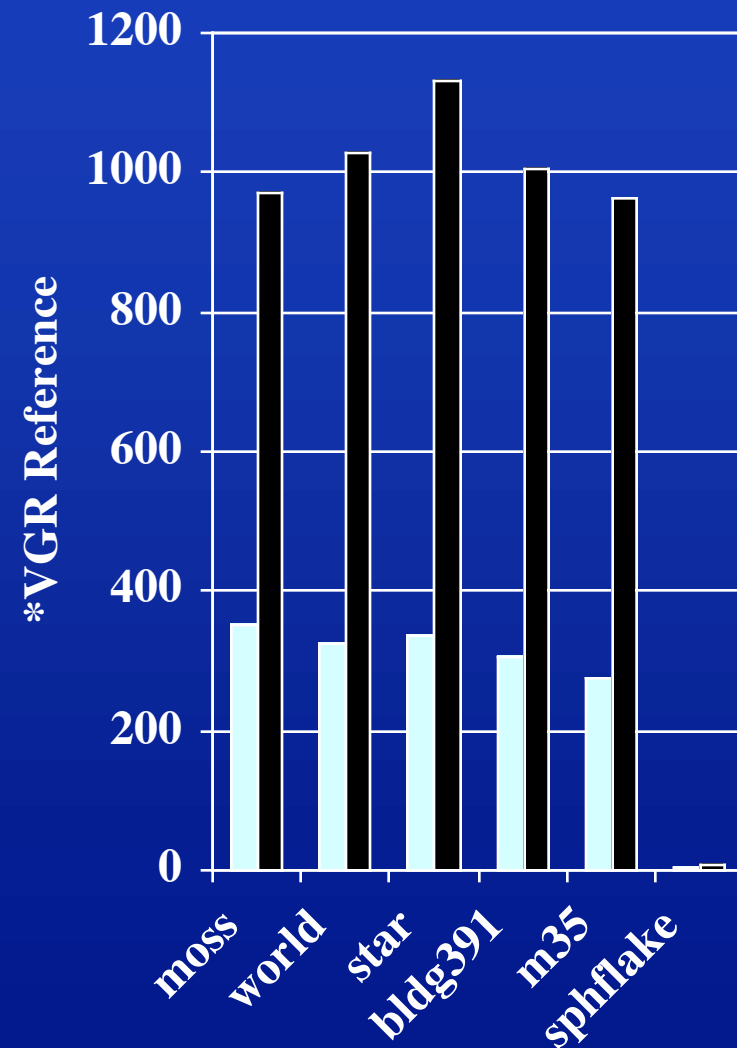
SGI Origin 200

- Quad CPU system
- 180MHz R10000
- On two CPUs
  - 1MB L2 cache/CPU
- On two CPUs
  - 2MB L2 cache/CPU
- 1024MB memory
- IRIX 6.5.14f
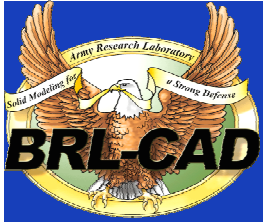- Single and quad CPU results on SMP shown
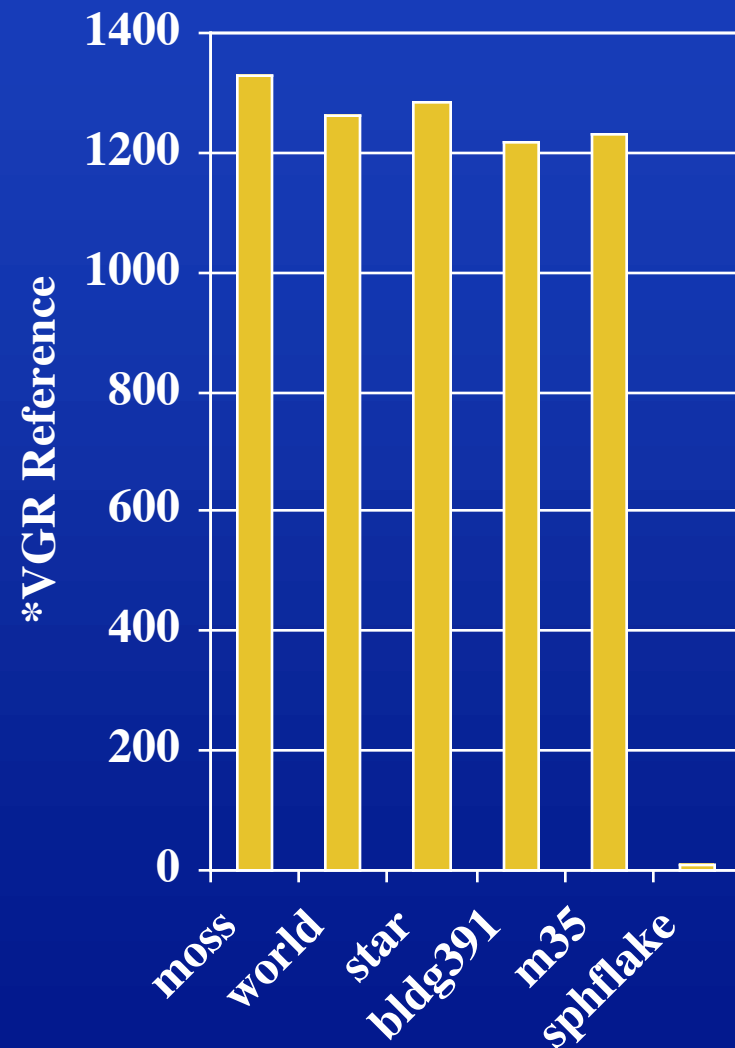
SGI Origin 2000

- Quad CPU system
- 250MHz R10000
- 4MB L2 cache/CPU
- 2048MB memory
- IRIX 6.5.16m
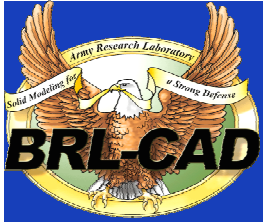- Single and quad CPU results on SMP shown
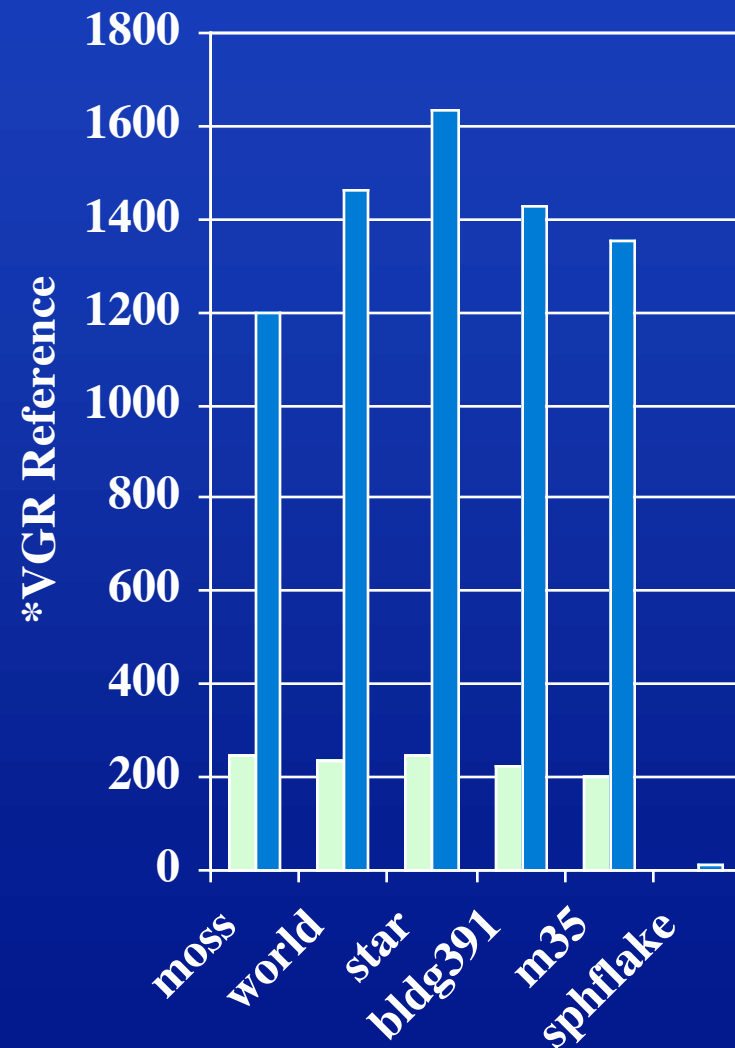
Dell PowerEdge 4600

- Dual CPU system
- 2.00GHz Xeon
- 512K cache/CPU
- 4096MB memory
- Linux RedHat 8.0
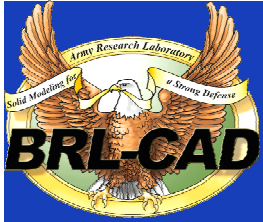- Single CPU results on SMP shown
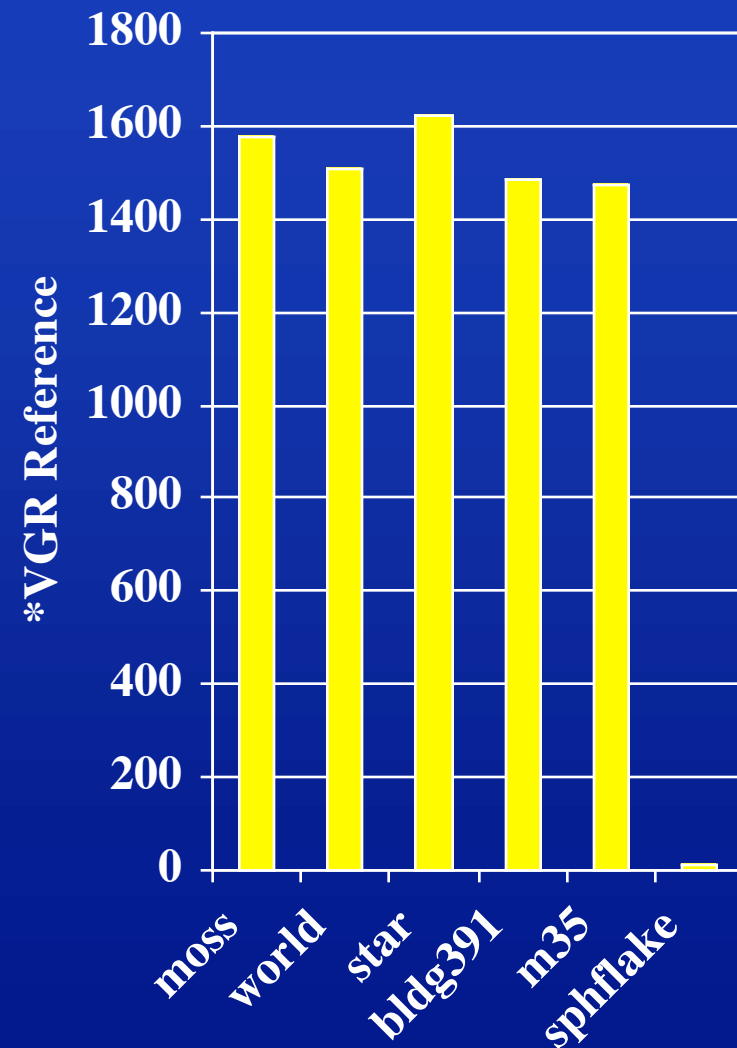
SGI Origin 2000

- Eight CPU system
- 195MHz R10000
- 4MB L2 cache/CPU
- 3904MB memory
- IRIX 6.5.16m
- Single and eight CPU results on SMP shown
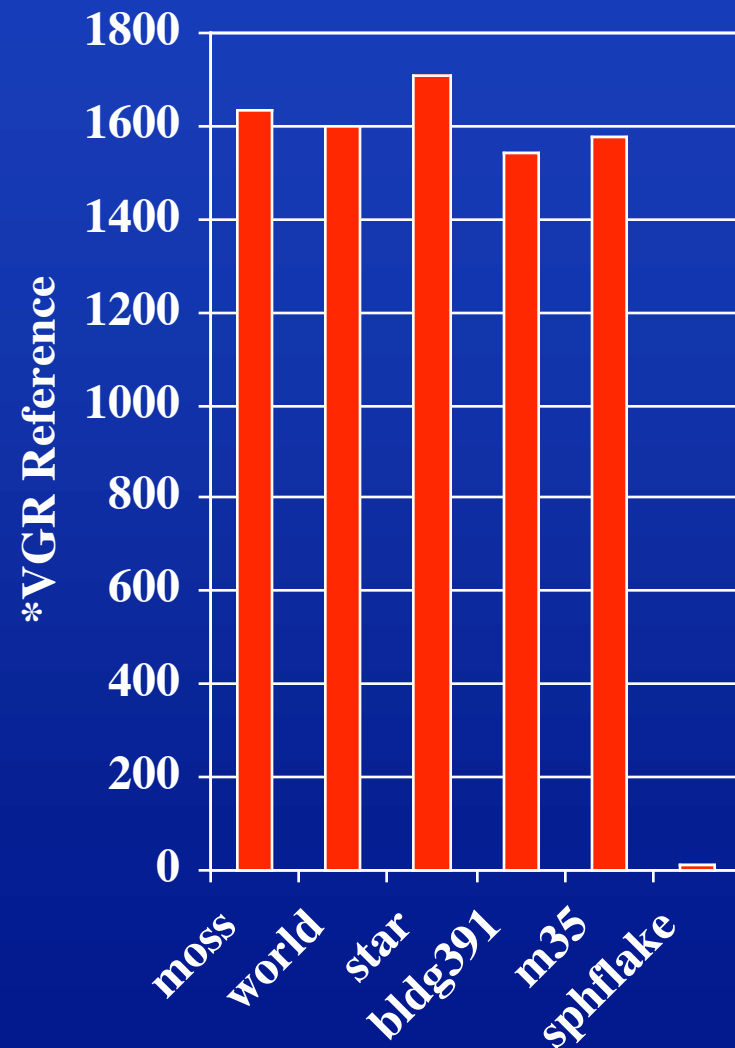
Boxx AMD Athlon MP 2000+

- Dual CPU system
- 1.66GHz Athlon MP 2000+
- 256K L2 cache/CPU
- 1024MB PC1600 memory
- Tyan Thunder K7
- Linux RedHat 7.3
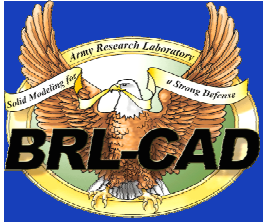- Single CPU results on SMP shown
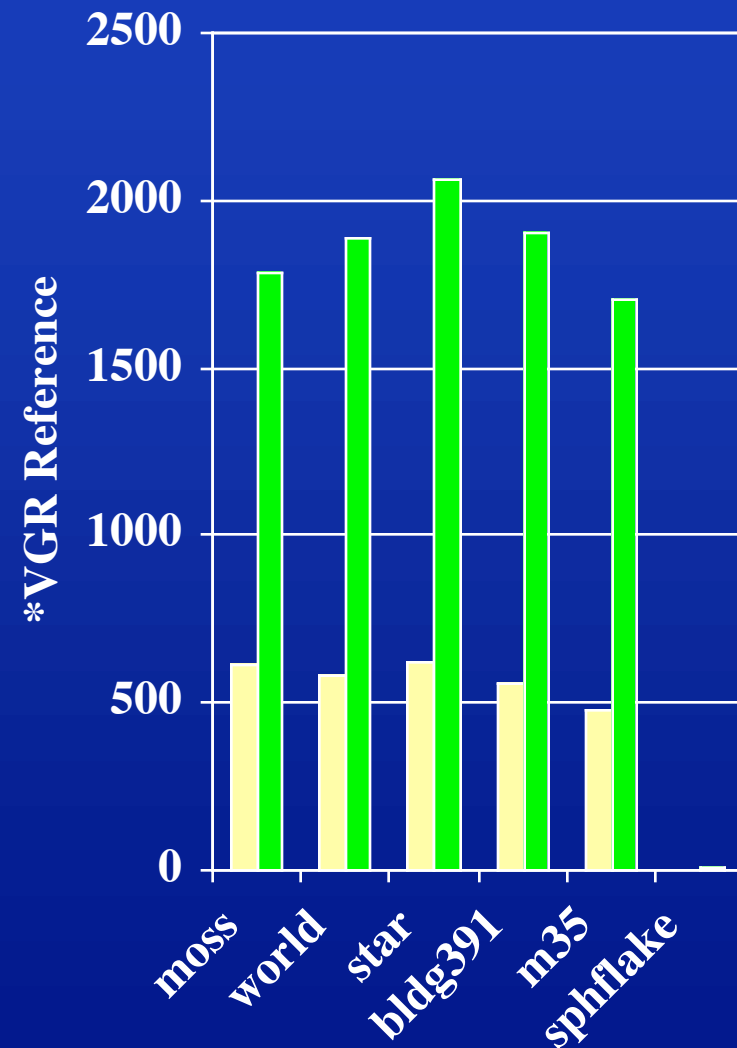
Athlon MP 2000+ / A7M266-D

- Dual CPU system
- 1.66GHz Athlon MP 2000+
- 256K L2 cache/CPU
- 1024MB PC2100 memory
- Asus A7M266-D
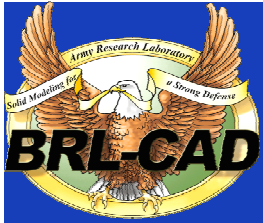- Linux RedHat 8.0
- Single CPU results on SMP shown
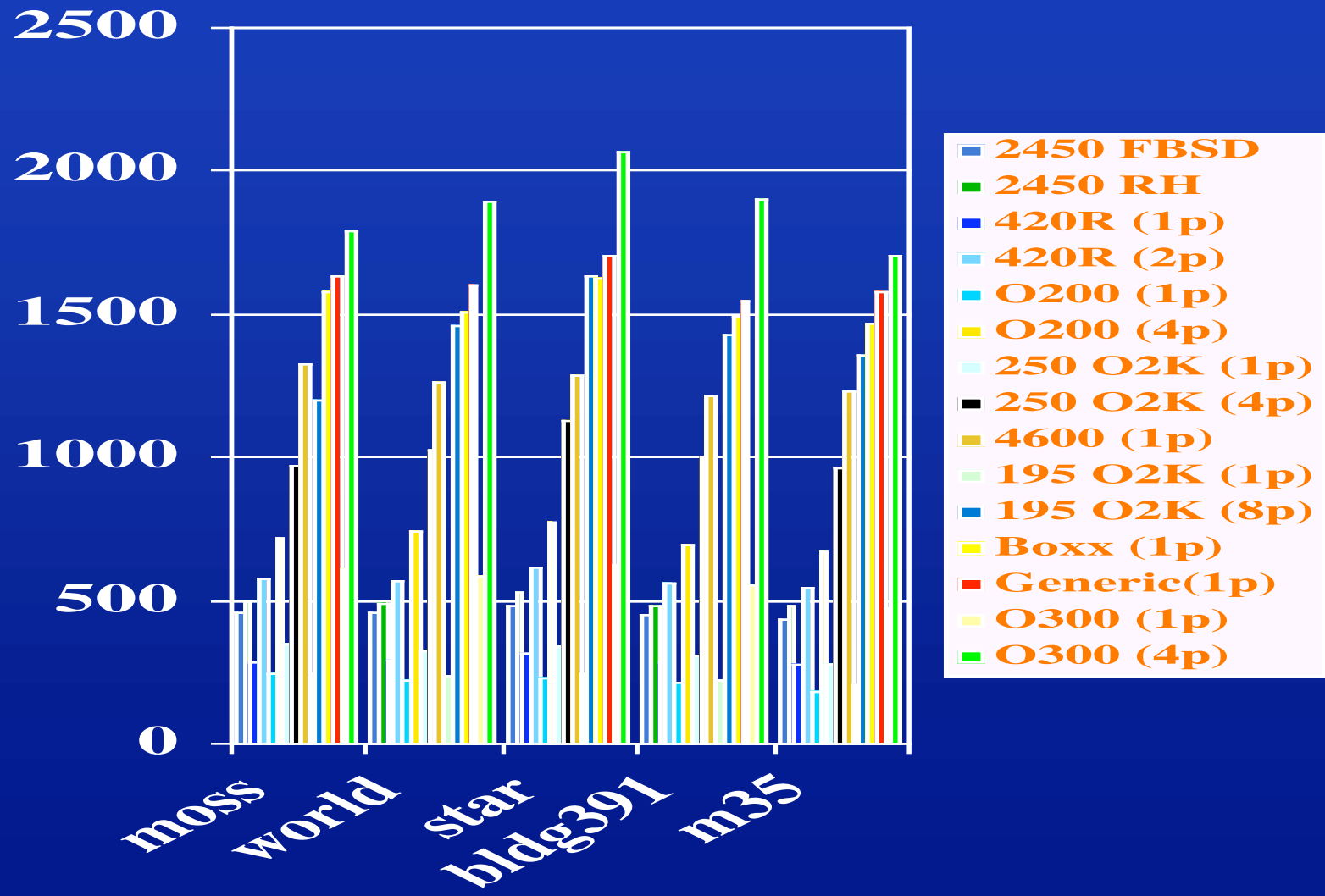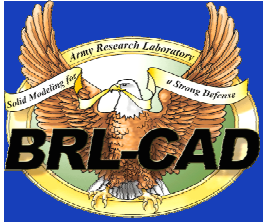
SGI Origin 300

- Quad CPU system
- 500MHz R14000
- 2MB L2 cache/CPU
- 1024MB memory
- IRIX 6.5.17m
- Single and quad CPU results on SMP shown
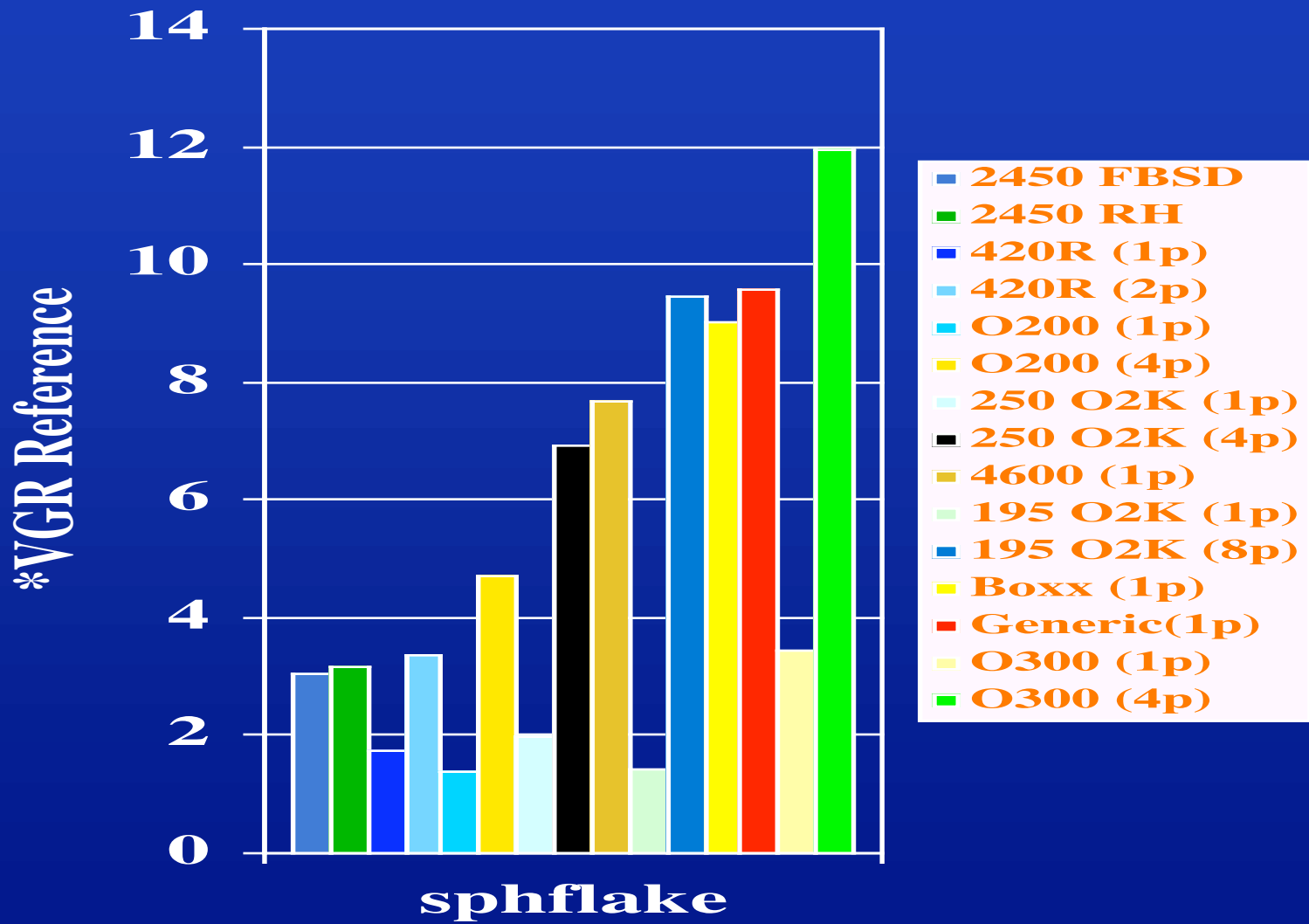
Server Comparison

Server Comparison -Sphflake

IBM SP3

- **512 CPU system**
- **375MHz Power3**
- **16 CPUs/node**
- **16GB memory/node**
- **AIX 4.3**
- **Single and dual CPU results on SMP shown**
- **Tests not completed for 16 CPU node**
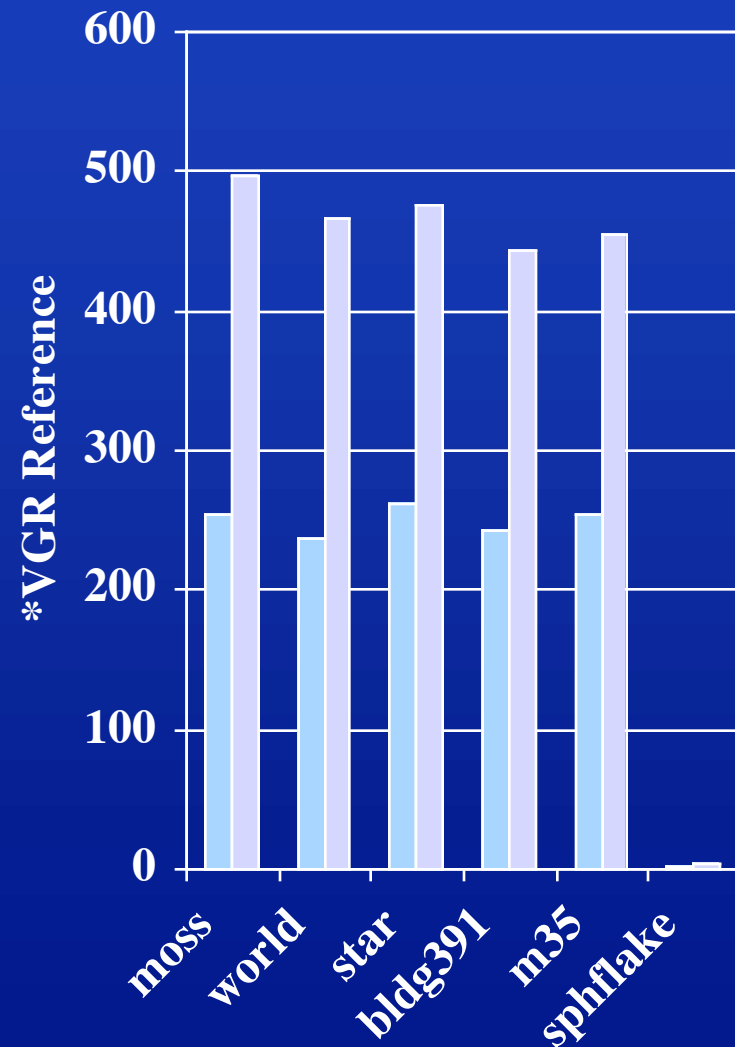
Sun Enterprise 10000

- 40 CPU system
- 400MHz UltraSPARC-II
- 8MB cache/CPU
- 40GB memory
- SunOS 5.8
- 40 CPU results on SMP shown
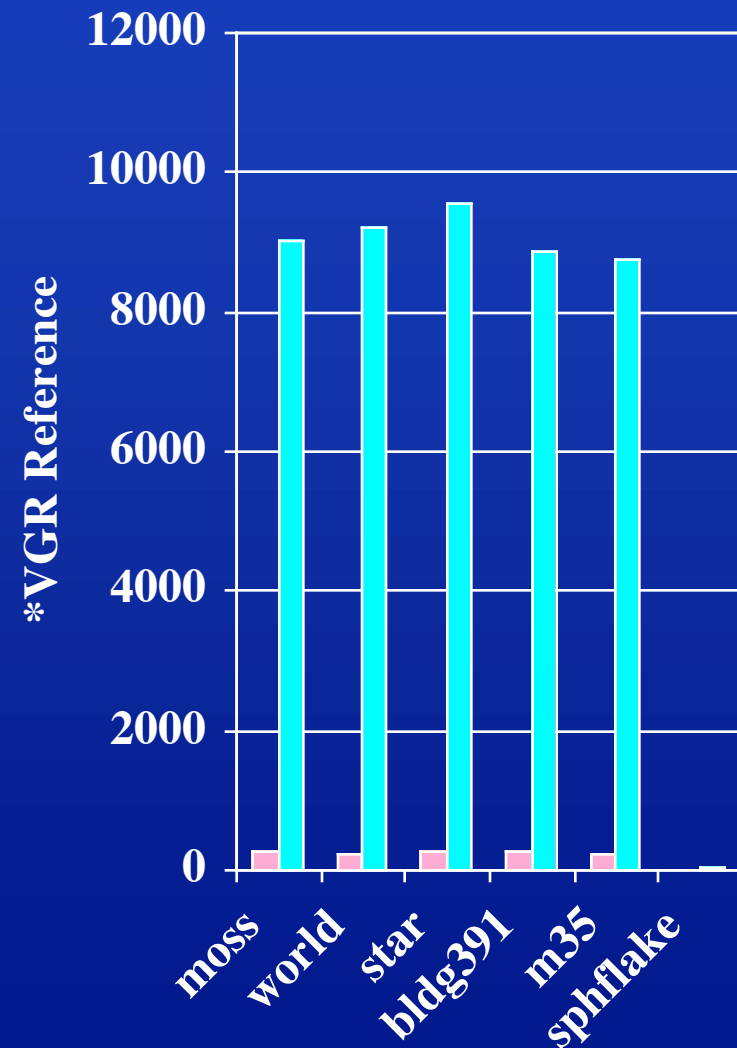
IBM SP4

- 64 CPU system
- 1.3GHz Power4
- 8 CPUs/node
- 16GB memory/node
- AIX 5.1
- Single and eight CPU results on SMP shown
- 32 CPUs/node configuration available
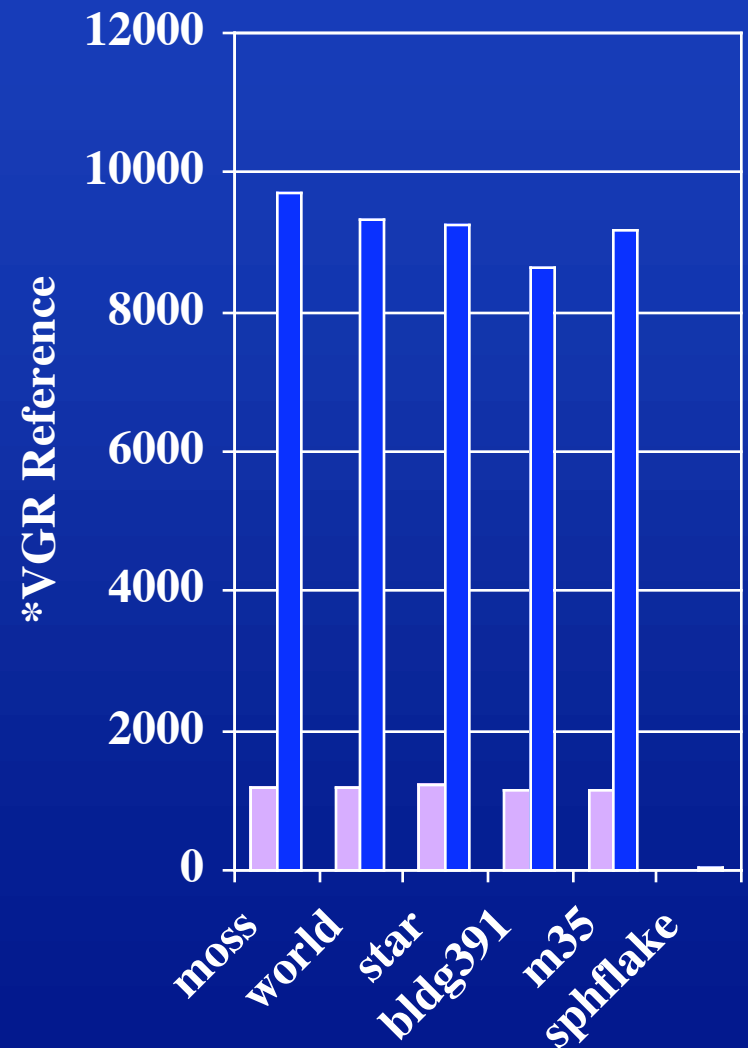
SGI Origin 2000

- 128 CPU system
- 400MHz R12000
- 8MB L2 cache/CPU
- 128GB memory
- IRIX 6.5.16m
- Single and 128 CPU results on SMP shown
- Machine was loaded during runs
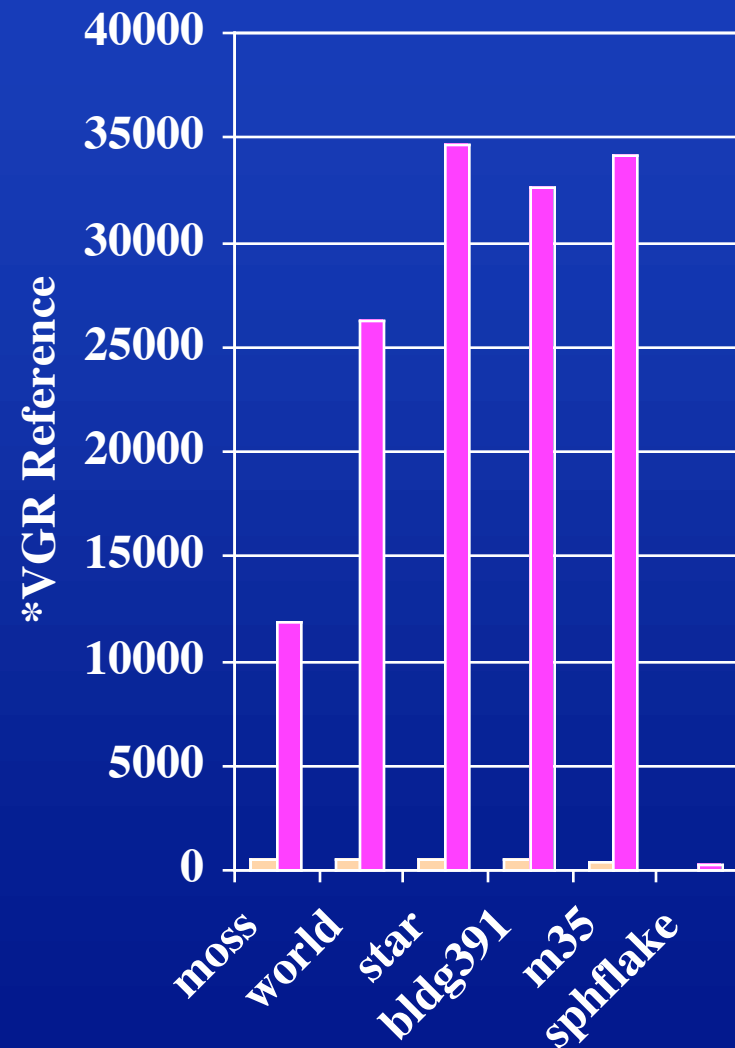
SGI Origin 3800

- 512 CPU system
- 400MHz R12000
- 8MB L2 cache/CPU
- 384GB memory
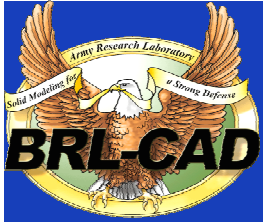- IRIX 6.5.16m
- Single and 512 CPU results on SMP shown
- Machine was loaded
- Single 512 CPU run

*VGR Reference chart with categories: moss, world, star, bldg391, m35, sphflake. Y-axis values 0 to 160000.

HPC Comparison

Legend:
- SP3 (1p)
- SP3 (2p)
- E10K (1p)
- E10K (40p)
- SP4 (1p)
- SP4 (8p)
- 400 O2K (1p)
- 400 O2K (128p)
- O3K (1p)
- O3K (512p)

X-axis categories: moss, star, m35

Y-axis: 0, 20000, 40000, 60000, 80000, 100000, 120000, 140000, 160000

HPC Comparison - Sphflake

Legend:
- SP3 (1p)
- SP3 (2p)
- E10K (1p)
- E10K (40p)
- SP4 (1p)
- SP4 (8p)
- 400 O2K (1p)
- 400 O2K (128p)
- O3K (1p)
- O3K (512p)

sphflake

Average VGR Reference Time

Legend:
- 2450 FBSD
- 2450 RH
- 420R (1p)
- 420R (2p)
- O200 (1p)
- O200 (4p)
- 250 O2K (1p)
- 250 O2K (4p)
- 4600 (1p)
- 195 O2K (1p)
- 195 O2K (8p)
- Boxx (1p)
- Generic(1p)
- O300 (1p)
- O300 (4p)
- SP3 (1p)
- SP3 (2p)
- E10K (1p)
- E10K (40p)
- SP4 (1p)
- SP4 (8p)
- 400 O2K (1p)
- 400 O2K (128p)
- O3K (1p)
- O3K (512p)

The BRL-CAD Benchmark

- Other scripts available
  - "try.sh" runs benchmark with output to current framebuffer instead of saving to a file
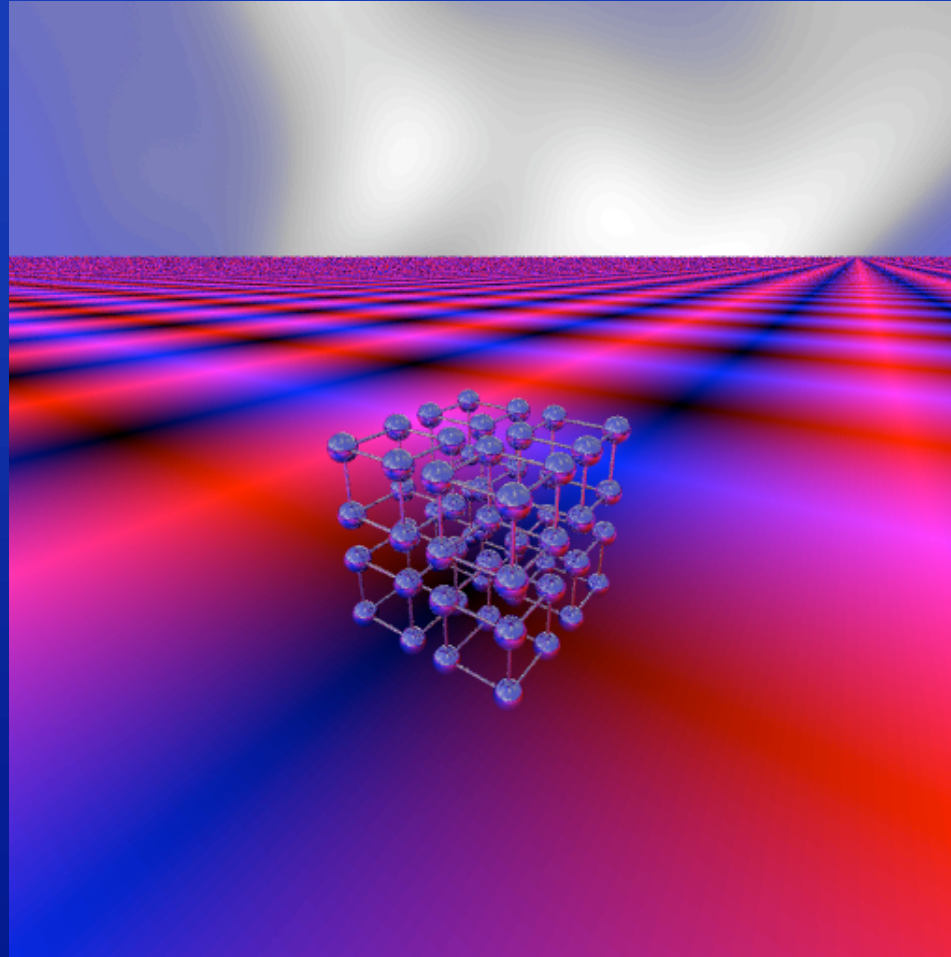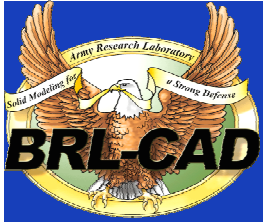 - "recheck.sh" runs pixdiff on most recent results with output to current framebuffer so any differences can be examined
  - "pretty.sh" produces image of mirrored balls arranged in a cubic array against an interesting background using benchmark style run

Pretty.sh Cube Image

The BRL-CAD Benchmark

- Need more difficult benchmarks
  - Fastest single CPU machines now run the entire benchmark in under 30 seconds
  - Parallel machines need consideration
- Need to strike delicate balance
  - Runs can't take days on older machines
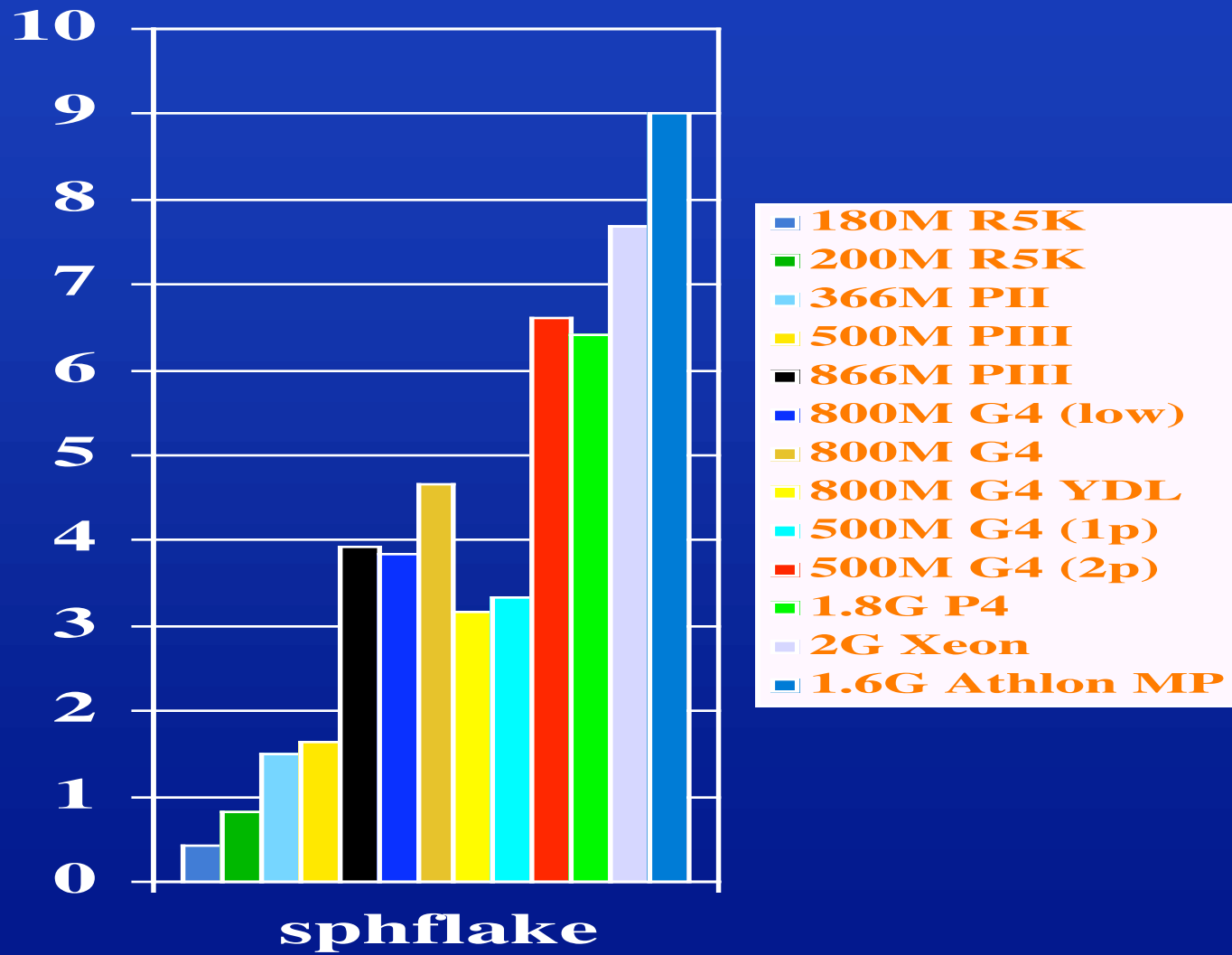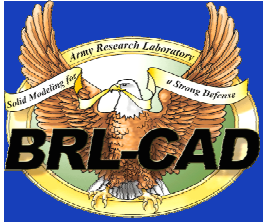 - Runs need to provide challenge for newer machines and future machines

Acknowledgements

- **Christopher Sean Morrison**
  - PowerBook G4 Linux Yellow Dog results
  - Power Mac G4 results / configuration
- **Lee Butler**
  - Boxx Linux RedHat 7.3 results / configuration
- **Mike Busse & Steve Leatherman**
  - AMD Athlon MP 2000+ on ASUS A7M266-D access and configuration
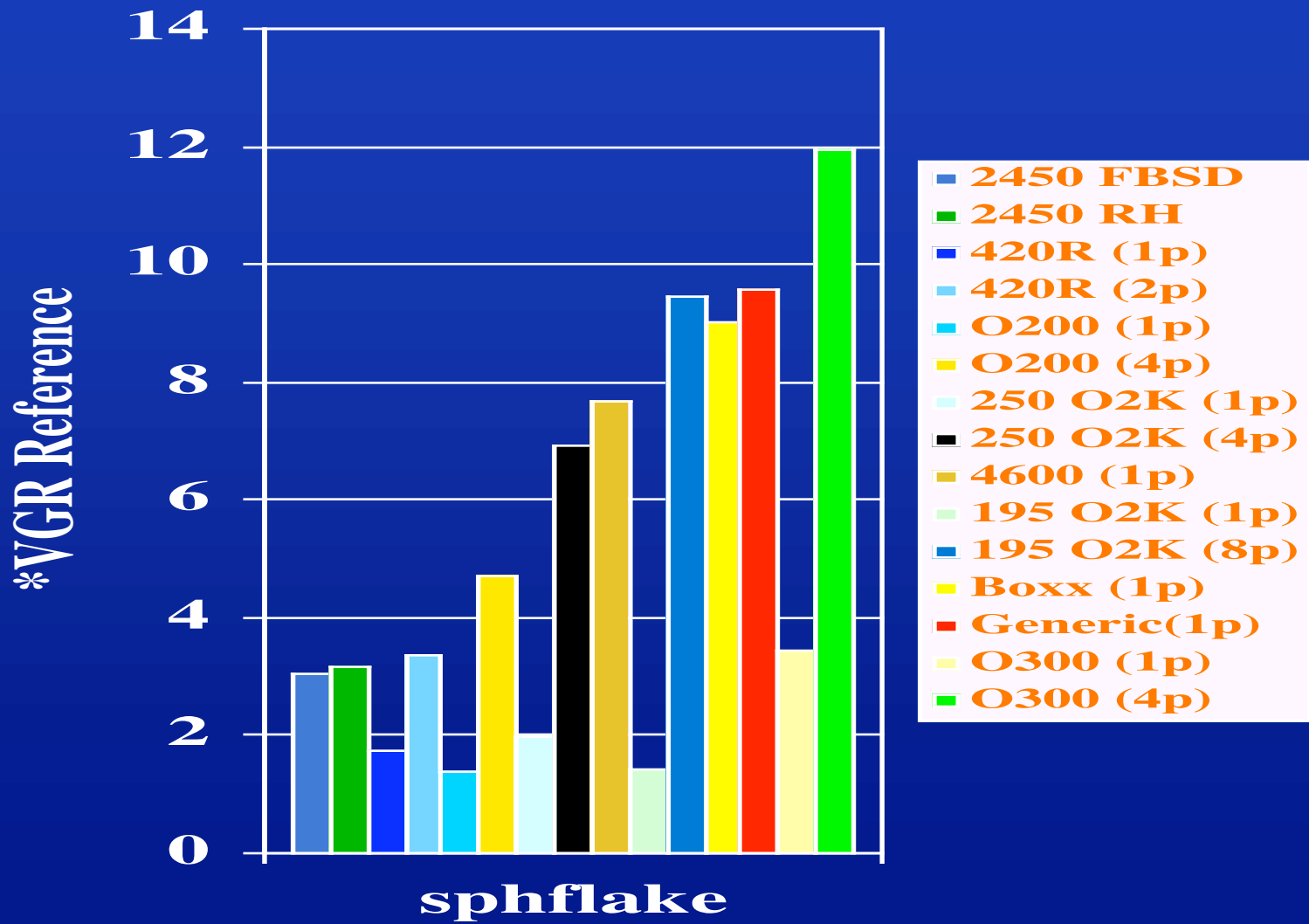- **Thomas Kendall**
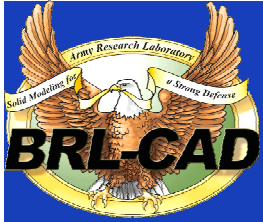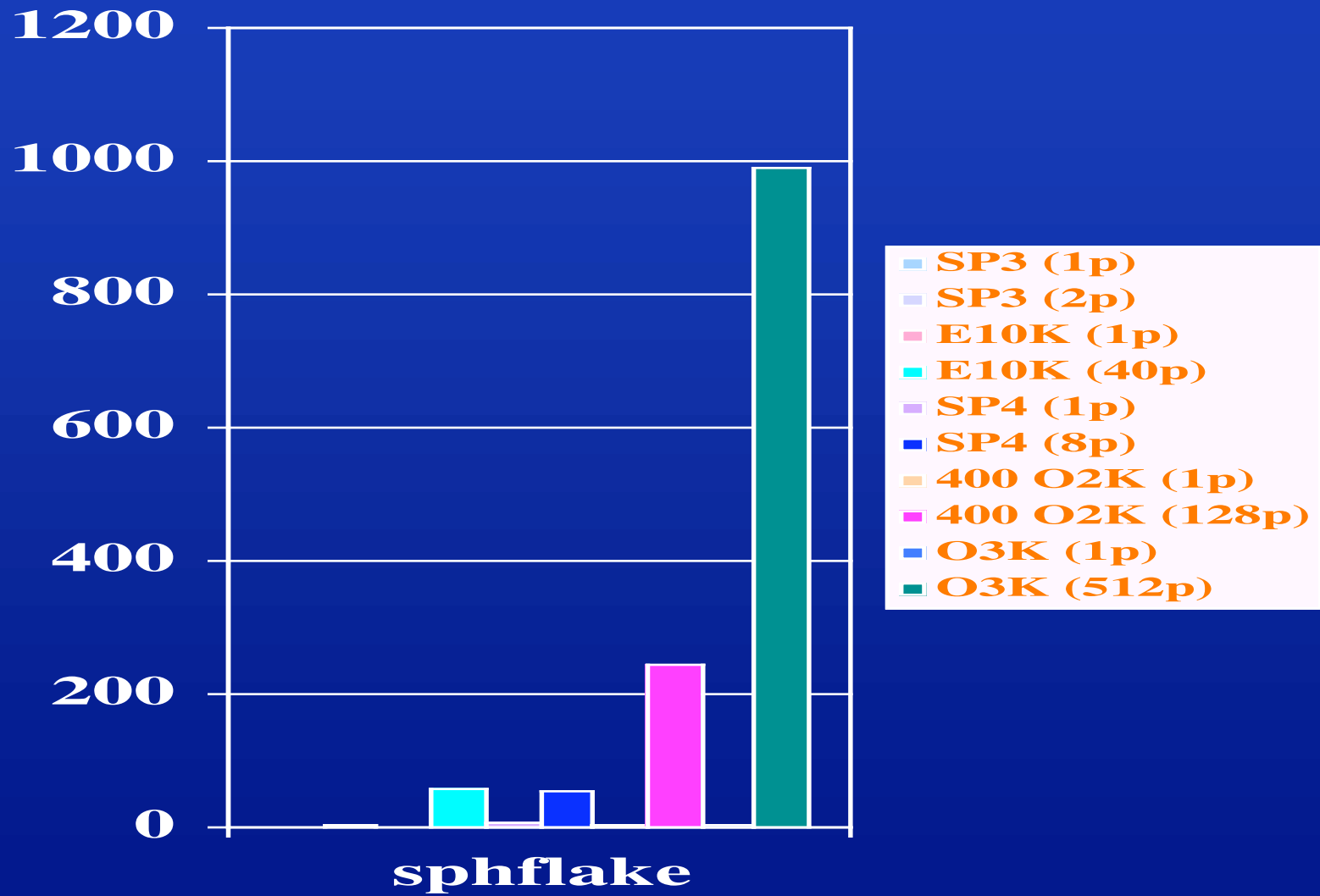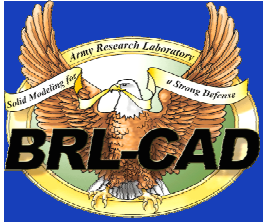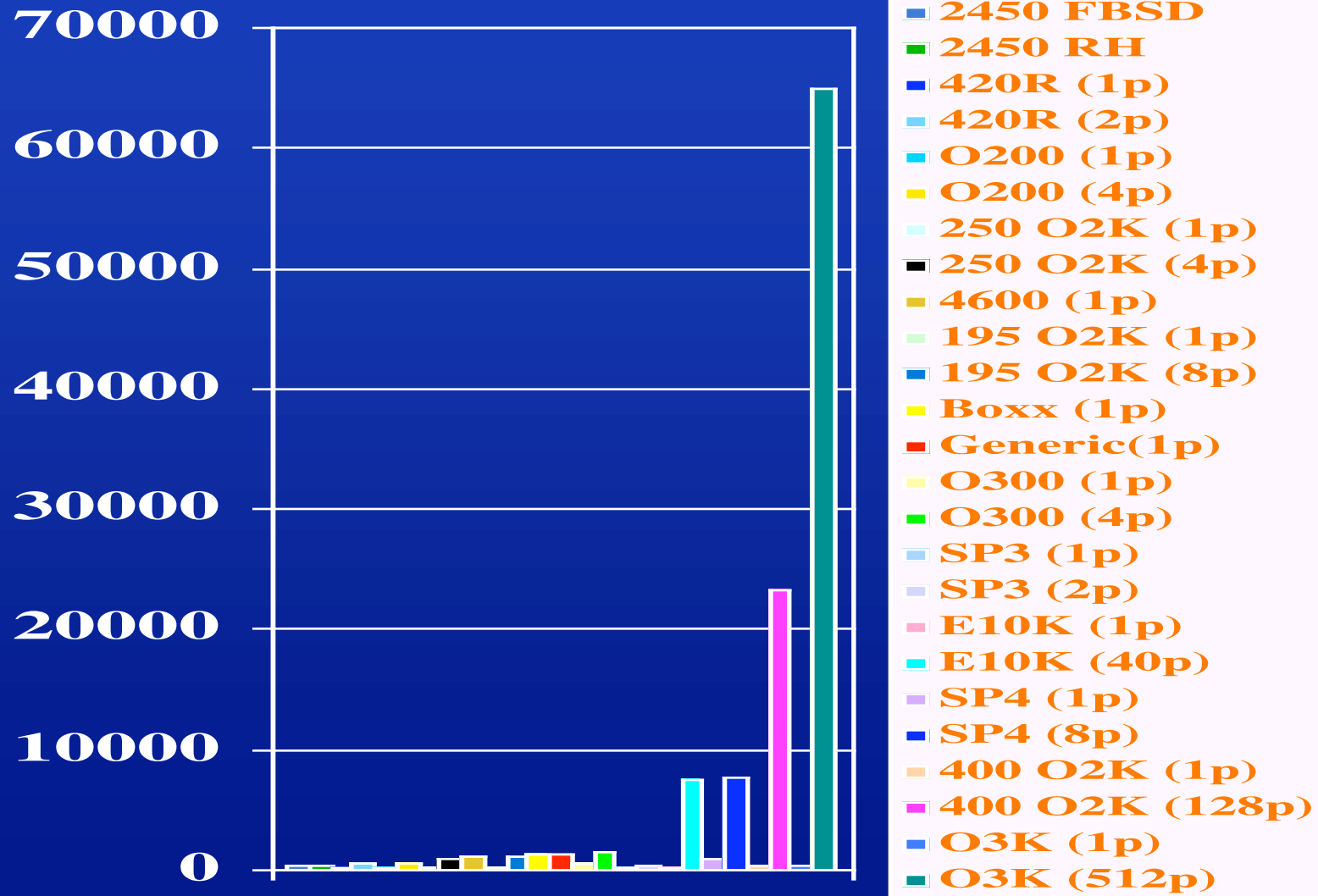 - MSRC IBM configuration

Desktop Comparison - Sphflake

Server Comparison -Sphflake

HPC Comparison - Sphflake

Legend:
- SP3 (1p)
- SP3 (2p)
- E10K (1p)
- E10K (40p)
- SP4 (1p)
- SP4 (8p)
- 400 O2K (1p)
- 400 O2K (128p)
- O3K (1p)
- O3K (512p)

sphflake

Average VGR Reference Time

Legend:
- 2450 FBSD
- 2450 RH
- 420R (1p)
- 420R (2p)
- O200 (1p)
- O200 (4p)
- 250 O2K (1p)
- 250 O2K (4p)
- 4600 (1p)
- 195 O2K (1p)
- 195 O2K (8p)
- Boxx (1p)
- Generic(1p)
- O300 (1p)
- O300 (4p)
- SP3 (1p)
- SP3 (2p)
- E10K (1p)
- E10K (40p)
- SP4 (1p)
- SP4 (8p)
- 400 O2K (1p)
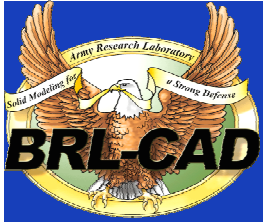- 400 O2K (128p)
- O3K (1p)
- O3K (512p)

The BRL-CAD Benchmark

Thanks for your attention!

Questions?

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The BRL-CAD Benchmark