Sun Grid Engine
From download to production

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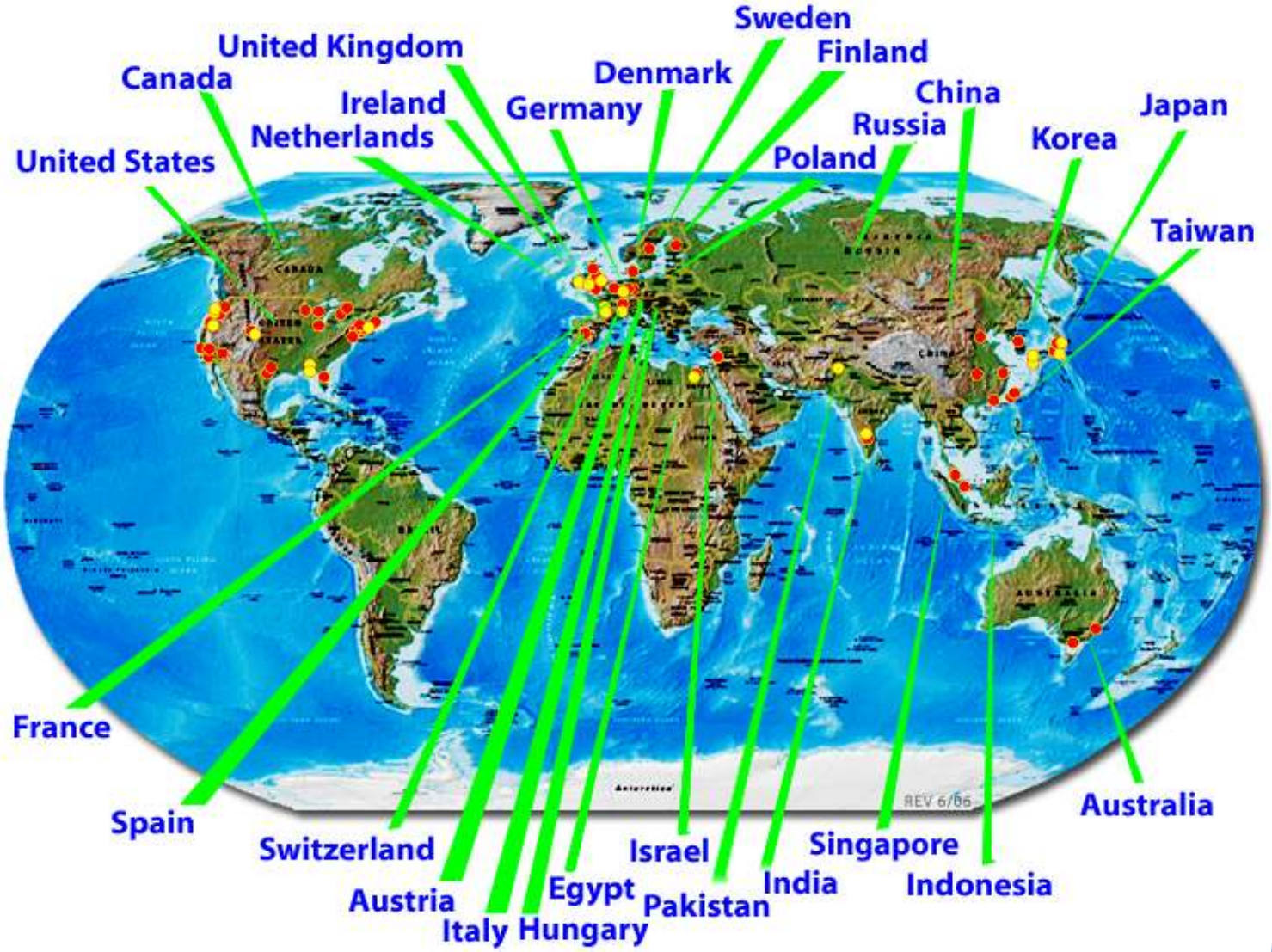
Computing challenges



More challenges

- Product engineering at multiple sites
- Development teams own their hardware
- Multiplatform – Solaris, Linux, Windows, HPUX, AIX
- WAN issues
- IT Skill level varies from novice to expert
- A savvy user community, that often knows more about computing than the IT staff at many locations.

Simple beginnings…

- From a pilot with open-source grid engine and one engineering team, into production in a blink…
  - Once the pilot team saw their test time drop from 13 hours to 45 minutes, many other groups wanted to take advantage of the technology.
- Currently ~25 million jobs per month, with 250+ users, at 11 sites with 16 grids containing ~2,000 cores running Sun Grid Engine.

“Standard” Grid environment

- Grids are local to a site, with no connection to other sites
- Standard installation environment, canned for local site IT team
- “Core” functionality available at all sites
  - Extendable for specific engineering needs

“Standard” Grid Policy

- Default job runtime of 4 hours
- Error check grid jobs at submission
- Default priority of -100
- Custom prolog/epilog
- Local spool directories
- Fairshare scheduling, without sharetree
- Max scheduling – Dedicated grid masters
- Classic Spooling / Shadow Masters
- Honor-based system – Peer pressure works!

Installation

- Heavily documented sge_qmaster installation process, with standardized default configuration
- Push-button execution host installation
- Configuration information is stored outside of SGE, with the ability to put hosts in groups based on configuration needs

- Typically more issues with site infrastructure than with grid engine itself
  - NIS, DNS, Storage, Networking

Grid execution host startup

- Custom startup scripts on execution hosts
  - Updates grid configuration & complexes
  - Starts sge_execd
  - Starts grid process monitor
  - Optionally starts distccd

- Grid configuration is updated every time a system boots and/or starts grid. Sets complex, queue, and exec host information.

Complexes & Queues

- Standard complexes defined consistently across all grids, with the ability to have additional complexes on a per-site basis
  - Operating System, Applications SW, & CPU information, …
- Many sites simply use “all.q” with complexes to identify resources
  - “short.q” is starting to become common, for low h_rt jobs

gridq - See grid systems and their status

```
HOST         OS           CPU    /BT  P/MHZ /MEM     STA SLT SIU  LOAD GROUP
-------------------------------------------------------------------------------
apl          hpux11       parisc/64  2/0875/16G      au   2   0       csd
heptain      hpux11       parisc/64  2/0875/8G            2   1  0.42 rdft
hpccf01      hpux11       parisc/64  2/0552/4G            3   3  0.94 bit
ablt         hpux11i      parisc/64  4/1000/1022M         1   0  0.00 sv
hyrx         redhat2.1       ipf/64  2/0900/6G            2   2  0.94 rdft
al4way2      redhat3      x86-64/64  4/1792/2G            4   1  0.62 rdft
aster        redhat3         x86/32  4/2992/4G            4   0  0.00 bit
grdil2       redhat3         ipf/64  2/1300/4G            3   2  1.02 bit
hpal         redhat3         x86/64  2/3400/8G            2   0  0.08 bit
lxqa1        redhat3         x86/32  1/2784/2G            1   0  0.02 sv
stinger      redhat3      x86-64/64  4/2193/15G           4   3  0.22 bit
lxqa3        redhat4         x86/32  1/1483/503M      D   1   0  0.00 sv
mitel01      redhat4      x86-64/64  4/2586/31G           4   1  0.13 rdft
sunlnx08     redhat7.2       x86/32  2/1396/3G            3   0  0.01 bit
glaxy        sles9        x86-64/64  2/2792/16G           2   0  0.33 bit
betha        solaris10    usparc/64  8/1200/16G       d  10   0  0.91 bit
solqa3       solaris10    usparc/64  1/1062/1G            1   1  0.82 sv
tarier       solaris7     usparc/64  4/0400/8G            2   1  0.27 bit
ssbb25       solaris8     usparc/64  1/1280/4G            1   0  0.12 bit
fussy1       solaris8     usparc/64  2/0900/1G        d   2   0  0.00 sv
slqa8        solaris9     usparc/64  1/0900/1G            1   0  0.39 sv
uduck        solaris9     usparc/64 11/1200/22G          11   7  0.75 bit
...
-------------------------------------------------------------------------------
Total number of hosts:  287
Total number of processors:  638
```

gridqinfo - See grid jobs and their status

```
Grid queue information at ...
-------------------------------------------------------------------------------
Running    jobs:        304
Queued     jobs:       7525
Xfering    jobs:          6
-------------------------------------------------------------------------------
User                                                          RunningJob
rlee                                                     :          85
banst                                                    :          56
qsharma                                                  :          90
thomas                                                   :          73
-------------------------------------------------------------------------------
User                                                          QueuedJobs
qsharma                                                  :          24
thomas                                                   :        7442
-------------------------------------------------------------------------------
Arch                                                              Jobs
hp11                                                     :         120
lx24-amd64                                               :          28
lx24-x86                                                 :        2581
lx24-x86|lx24-amd64|sol-sparc64|hp11                     :           3
sol-sparc64                                              :        4804
-------------------------------------------------------------------------------
Misc                                                              Jobs
cb=64                                                    :        4754
cm=ipf                                                   :        2581
cm=parisc                                                :         120
cm=usparc                                                :        4804
cm=usparc|parisc|x86*                                    :           3
cm=x86-64                                                :          28
```

Job status

- qacct performance isn't acceptable to find job exit/resource information
  - Started with a custom epilog to cache information
  - Now using reporting file (we don't use ARCO)

$ time qacct –j 2581013

36.611 seconds

$ time grid_getjobstatus 2581013

0.004 seconds

Gridsuspend/Gridalter

- Users want the ability to disable grid on systems
  - Benchmarking, “failing” systems, …

Implemented as a wrapper around qmod -e/-d

$ gridsuspend -cab -s badboy 6

- Users sometimes need to alter the priority of their jobs after submission

Implemented as a wrapper around qalter

$ gridalter –p 50

Paging/Alerting

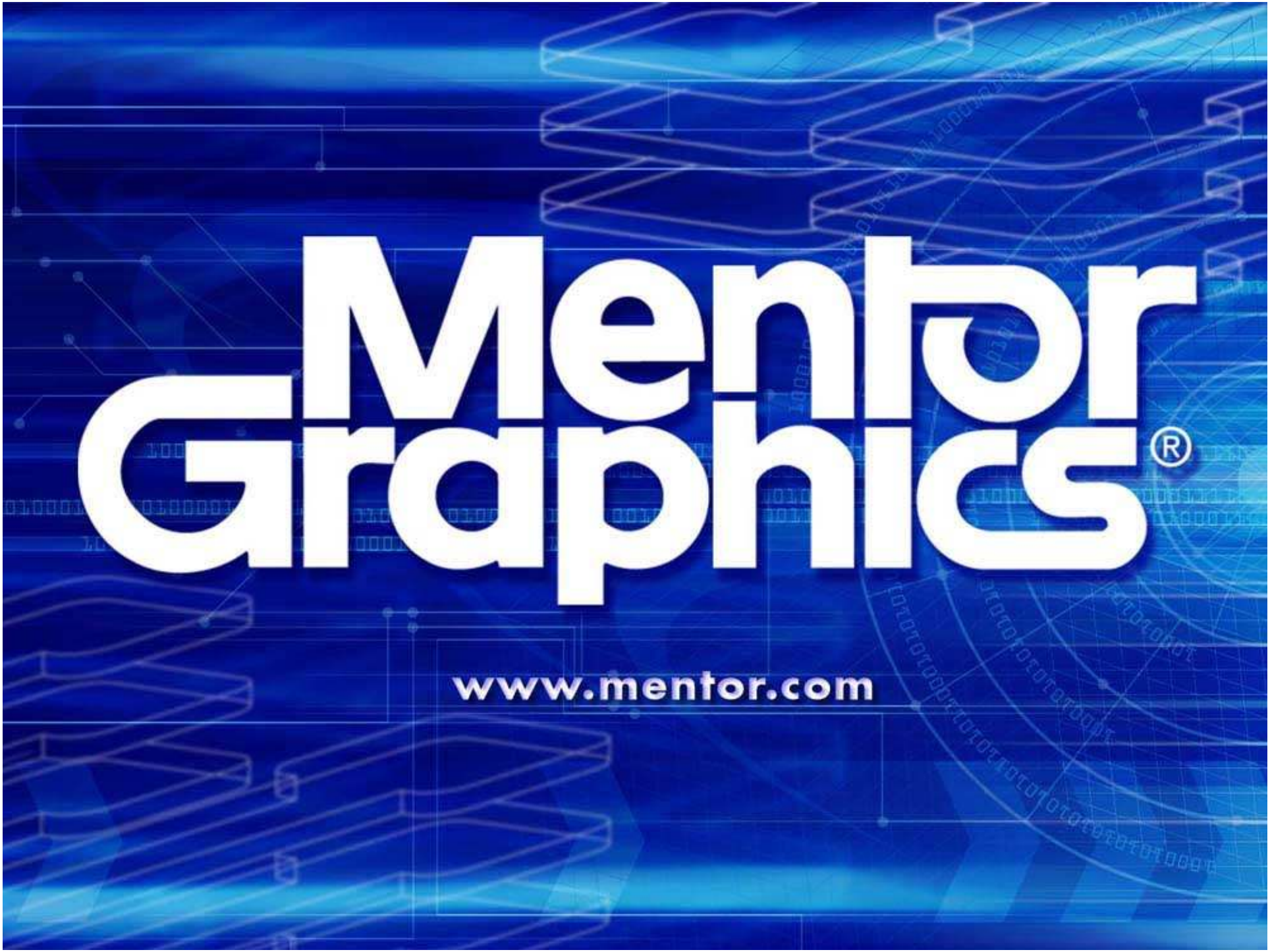
Test	STATUS	Info	Last Run ***
NETSTAT	GREEN	-	0:04
DISKSPACE	GREEN	62	0:04
QPING	GREEN	1	0:04
QLOAD	GREEN	1.59	0:04
QHOSTT	GREEN	1	0:04
QSCHEDULER	GREEN	wvgrida	0:04
EXDOWN	GREEN	1 (0%)	0:04
RJOBS	GREEN	269/79155	0:04
QSIZE	GREEN	79223	0:04
QSUBTIME	GREEN	0	0:04
GMEMORY	GREEN	4544640	0:04
GHEALTHMON	GREEN	2 mins	0:04

Other Useful Stuff

- A wrapper that sources settings.sh, and then calls a grid command, for cron jobs
- Monitor for jobs & queues in the error state
- Monitor qmaster messages file, to disable failing hosts automatically
- Reporting tools
- X windows display server

General lifesavers

- Caching data saves grids
  - qstat
  - Job status information
- Any grid master can be crushed by a user
- Grid resources are never infinite
- Automatic job rescheduling can help, or hurt…
- “Smoke Tests” before major job submission
- Scaling matters
- Write temporary data in $TMPDIR
- Array jobs, and “Caboose” jobs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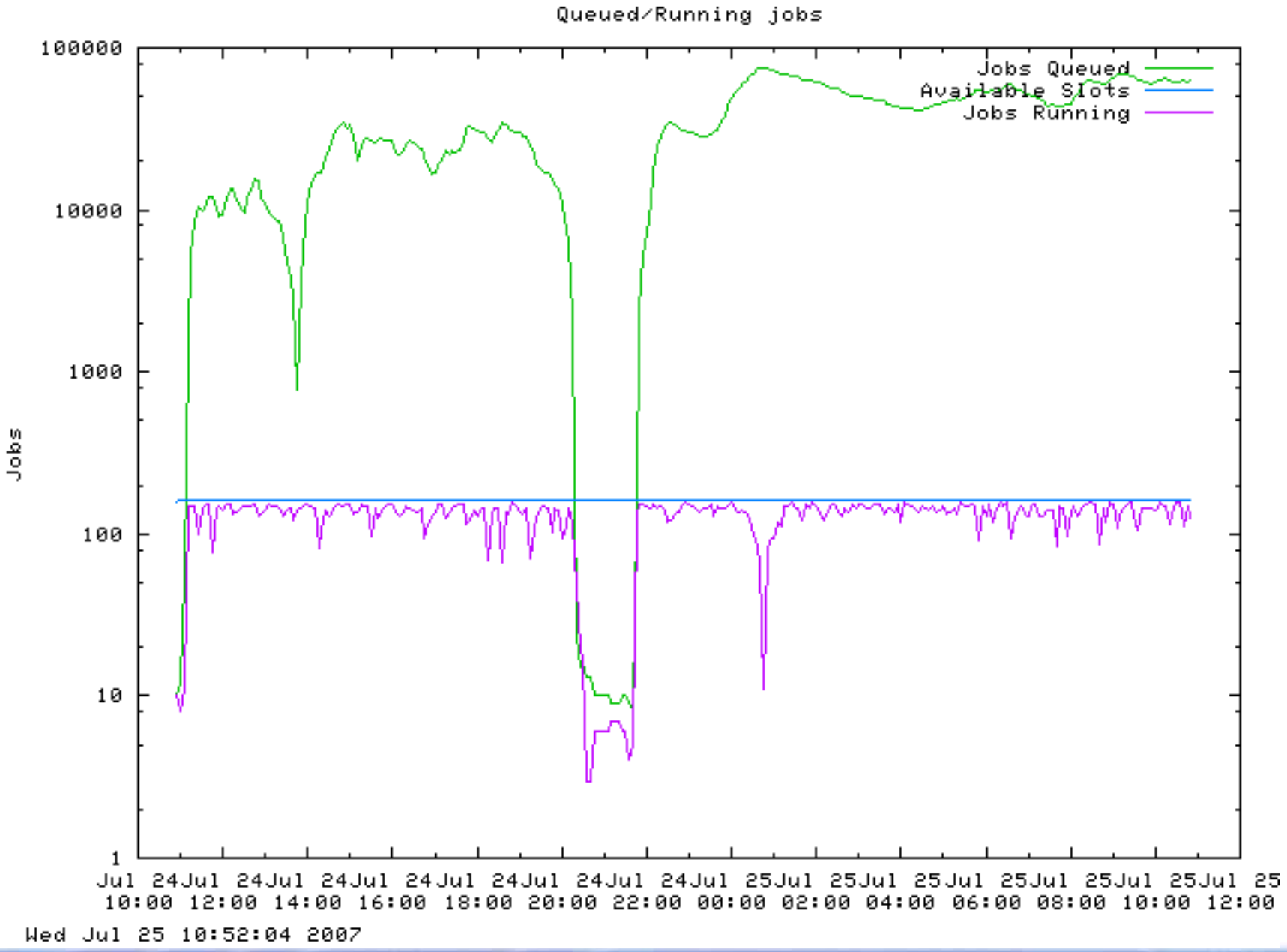
Backup Slides


Grid Monitor - Windows Internet Explorer
Fri Aug 17 2007 03:00:01 I
Grid: /w/grid/mgs6u5
Test STATUS Info Last Run ***
NETSTAT GREEN 0:00
DISKSPACE GREEN 83 0:10
QPING GREEN 0 0:10
QLOAD GREEN 0.88 0:09
QHOSTT GREEN 1 0:09
QSCHEDULER GREEN wvgrida 0:09
EXDOWN GREEN 3 |13| 0:09
RJOBS GREEN 107/8210 0:09
QSIZE GREEN 8317 0:09
QSUBTIME GREEN 0 0:09
GMEMORY GREEN 39985720 0:09
GHEALTHMON GREEN 13 mins 0:09
Fri Aug 17 15:01:02 PDT 2007: Total system count: 251
Legend
Error
Calendar
gridsuspend
Down
Alarm
Full
Partial
Empty
??
Done
Internet
100%


Queued/Running jobs
Jobs Queued
Available Slots
Jobs Running
Jobs
100000
10000
1000
100
10
1
Jul 24 10:00
Jul 24 12:00
Jul 24 14:00
Jul 24 16:00
Jul 24 18:00
Jul 24 20:00
Jul 24 22:00
Jul 25 00:00
Jul 25 02:00
Jul 25 04:00
Jul 25 06:00
Jul 25 08:00
Jul 25 10:00
Jul 25 12:00
Wed Jul 25 10:52:04 2007