



Performance Analysis

Help! My system is slow!

- ❑ http://people.freebsd.org/~kris/scaling/Help_my_system_is_slow.pdf

What you can do to improve performance

- Memory size has a major influence on performance
- Correct the problems of usage
- Load balance appliance
- Organize the system's hard disks and filesystems
- Monitoring your networks
- ...

Factors that affect Performance

❑ Four major resources

- CPU Time
- Memory
- Hard disk I/O bandwidth
- Network I/O bandwidth

❑ Where is the real bottleneck

- **Not CPU, hard disk bandwidth it is !!**
- When memory is not enough, system will do swap, so memory and disk bandwidth are the major suspects

System Performance Checkup – Analyzing CPU usage (1)

❑ Three information of CPU

- Overall utilization
 - Help to identify whether the CPU resource is the system bottleneck
- Load average
- Per-process consumption
 - Identify specific process's CPU utilization

System Performance Checkup – Analyzing CPU usage (2)

❑ vmstat command

- Report kernel statistics about process, memory, cpu, ..
- Usage: % `vmstat -c 2 -w 1`
 - us: user time
 - High us means high computation
 - sy: system time
 - High sy means process are making lots of system call or performing I/O
 - id: cpu idle
- us and sy time should half-half
- Monitoring interval should not be too small

```
tytsai@u3:/var/log> vmstat -c 2 -w 5
```

procs			memory		page				disks		faults			cpu				
r	b	w	avm	fre	flt	re	pi	po	fr	sr	da0	da1	in	sy	cs	us	sy	id
3	2	0	50364	1587316	3	0	0	0	3	0	0	0	931	786	181	0	0	100
0	2	0	50368	1587312	5	0	0	0	0	0	0	0	250	91	23	0	0	99

System Performance Checkup – Analyzing CPU usage (3)

- faults (average per second over last 5 seconds)
 - in: device interrupt per interval
 - sy: system calls per interval
 - cs: cpu context switch rate

Nothing to do Server

```
tytsai@u3:/var/log> vmstat -c 2 -w 5
```

procs			memory		page				disks			faults			cpu			
r	b	w	avm	fre	flt	re	pi	po	fr	sr	da0	da1	in	sy	cs	us	sy	id
3	2	0	50364	1587316	3	0	0	0	3	0	0	0	931	786	181	0	0	100
0	2	0	50368	1587312	5	0	0	0	0	0	0	0	250	91	23	0	0	99

High load, busy http server

```
tytsai@ccbsd3:~> vmstat -c 5 -w 5
```

procs			memory		page				disk		faults		cpu				
r	b	w	avm	fre	flt	re	pi	po	fr	sr	ad0	in	sy	cs	us	sy	id
0	0	0	231320	68792	320	4	0	0	264	7	0	2273	3381	952	16	4	80
0	0	0	232984	67100	558	0	0	0	386	0	1	1958	3285	551	11	5	84
1	0	0	228252	69272	192	2	0	0	292	0	5	2787	2626	681	23	4	73
1	0	0	221564	72048	102	0	0	0	229	0	0	1395	556	184	1	2	97
0	0	0	209624	76684	96	0	0	0	306	0	0	1350	935	279	0	2	97

System Performance Checkup – Analyzing CPU usage (4)

❑ Load average

- The average number of runnable processes
 - Including processes waiting for disk or network I/O

❑ uptime command

- Show how long system has been running and the load average of the system over the last 1, 5, and 15 minutes
- Usage: % uptime

```
{tytsai@mgate2}~> uptime  
8:22AM up 6 days, 22:13, 2 users, load averages: 0.06, 0.02, 0.00
```

System Performance Checkup – Analyzing CPU usage (5)

- ❑ top command
 - Display and update information about the top cpu processes
- ❑ ps command
 - Show process status
- ❑ renice command
 - `renice -n increment -p pid`
 - `renice +1 987 -u daemon root -p 32`

System Performance Checkup – Analyzing memory usage (1)

- ❑ When memory is not enough ...
 - Memory page has to be “swapped out” to the disk block
 - LRU (Least Recently Used) algorithm
 - Bad situation – “desperation swapping”
 - Kernel forcibly swaps out runnable process
 - Extreme memory shortage

- ❑ Two numbers that quantify memory activity
 - Total amount of active virtual memory
 - Tell you the total demand for memory
 - Page rate
 - suggest the proportion of actively used memory

System Performance Checkup – Analyzing memory usage (2)

- ❑ To see amount of swap space in use
 - `pstat -s` or `swapinfo -k` (FreeBSD)
 - `swapon -s` (Linux)
 - `swap -l` (Solaris)

- ❑ `pstat` command

- `% pstat -s`

```
csduty[~] -chiahung- pstat -s
```

Device	1K-blocks	Used	Avail	Capacity
/dev/label/swap-0	1048572	0	1048572	0%
/dev/label/swap-1	1048572	0	1048572	0%
Total	2097144	0	2097144	0%

System Performance Checkup – Analyzing memory usage (3)

❑ vmstat command

- procs
 - r: in run queue
 - b: blocked for resource
 - w: runnable or short sleeper but swapped
- memory
 - avm: active virtual pages
 - fre: size of the free list
- page (averaged each five seconds, given in units per second)
 - flt: total number of page faults
 - pi: pages paged in
 - po: pages paged out
 - 50 page-out cause about 1 seconds latency
 - fr: pages freed per second

```
csws1[~] -chiahung- vmstat -c 3 -w 5
```

procs			memory		page				disks			
r	b	w	avm	fre	flt	re	pi	po	fr	sr	da0	da1
0	3	0	1427M	1196M	224	0	0	0	312	0	0	0
0	3	0	1427M	1196M	3	0	0	0	169	0	12	12
0	3	0	1427M	1196M	3	0	0	0	110	0	15	15

System Performance Checkup – Analyzing disk I/O

❑ iostat command

- Report I/O statistics
- Usage: `iostat -w 1 -c 5`
 - tin/tout: characters read from /write to terminal
 - KB/t: kilobytes per transfer
 - tps: transfers per second
 - MB/s: megabytes per second

```
FreeBSD:~ -lwshsu- iostat da0 -w 1
      tty          da0          cpu
tin tout  KB/t    tps  MB/s  us ni sy in id
0 258   59.78  253  14.77  3 0 4 0 94
0 127   63.13  501  30.89  3 0 4 0 93
0 43    62.58  346  21.14  5 0 5 0 90
0 42    62.40  289  17.63  3 0 5 0 92
0 43    61.19  720  43.02  1 0 2 0 97
```

System Performance Checkup – Analyzing network

❑ The four most common uses of netstat

- Monitoring the status of network connections
 - netstat -a
- Inspecting interface configuration information
 - netstat -i

```
derek[~] -chiahung- netstat -I
Name      Mtu Network      Address      Ipkts      Ierrs      Opkts      Oerrs      Coll
bge0      1500 140.113.240.0 derek        2256736153 -        3709378394 -        -
bge0      1500 192.168.7.0   192.168.7.1 1744582    -        49144622  -        -
lo0       16384 your-net      localhost    433424     -        433424   -        -
```

- Examining the routing table
 - netstat -r -n
- Viewing operational statistics for network protocols

systat

☐ display system statistics

```

                /0 /1 /2 /3 /4 /5 /6 /7 /8 /9 /10
Load Average  ||

Interface      Traffic          Peak            Total
  lo0 in    0.000 KB/s    0.000 KB/s    319.574 MB
       out    0.000 KB/s    0.000 KB/s    319.574 MB

  em0 in    231.623 KB/s  281.986 KB/s   42.270 GB
       out    689.802 KB/s  923.680 KB/s  215.311 GB
    
```

systat -ifstat

systat -vmstat

```

22 users      Load 0.87  0.51  0.42                      Dec 28 21:41

Mem:KB        REAL                VIRTUAL                VN PAGER      SWAP PAGER
              Tot   Share      Tot   Share   Free            in  out       in  out
Act 888500    15268  3578016  28204  581224          3
All 1985880   138664 1077786k  340176                3
Proc:
   r  p  d  s  w  Csw Trp  Sys  Int  Sof  Flt  631 cow  17709 total
   1          468    19k 1878   14k 1709 1069 1353  317 zfod    atkbd0 1
                    ozfod    51 atapci0 19
5.9%Sys   0.3%Intr  2.5%User  0.0%Nice 91.3%Idle    %ozfod  778 ahc0 irq24
| | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
====>                                         764 prcfr  2000 cpu0: time
                                         18391 totfr  876 em0 irq256
Namei      Name-cache    Dir-cache    450000 desvn    react    4 em1 irq257
   Calls    hits  %    hits  %    395311 numvn    pdwak  2000 cpu1: time
  154838  144273  93            25000 frevn    pdpgs  2000 cpu2: time
                                         intrn  2000 cpu3: time

Disks      ad4  ad6  ad8  ad10  da0 pass0    3917836 wire  2000 cpu5: time
KB/t       104 0.00 107 0.00 61.70 0.00    4763576 act  2000 cpu7: time
tps        22  0    31  0    775  0    2908320 inact 2000 cpu4: time
MB/s       2.24 0.00 3.24 0.00 46.71 0.00    109544 cache 2000 cpu6: time
%busy      2    0    3    0    82  0    471700 free
                                         327552 buf
    
```

*stat commands

```
lucky7:/bin -lwhsu- ls -al {,/usr}{/bin,/sbin}/*stat
-r-xr-xr-x 1 root wheel - 49976 Jan 2 18:52 /sbin/ipfstat*
-r-xr-xr-x 1 root wheel - 7264 Jan 2 18:52 /sbin/kldstat*
-r-xr-sr-x 1 root kmem - 11872 Jan 2 18:53 /usr/bin/btsockstat*
-r-xr-sr-x 1 root kmem - 20432 Jan 2 18:53 /usr/bin/fstat*
-r-xr-sr-x 1 root kmem - 144208 Jan 2 18:53 /usr/bin/netstat*
-r-xr-xr-x 1 root wheel - 12352 Jan 2 18:53 /usr/bin/nfsstat*
-r-xr-xr-x 1 root wheel - 16912 Jan 2 18:53 /usr/bin/procstat*
-r-xr-xr-x 1 root wheel - 15696 Jan 2 18:53 /usr/bin/sockstat*
-r-xr-xr-x 2 root wheel - 15560 Jan 2 18:53 /usr/bin/stat*
-r-xr-xr-x 1 root wheel - 82424 Jan 2 18:53 /usr/bin/systat*
-r-xr-xr-x 1 root wheel - 25552 Jan 2 18:53 /usr/bin/vmstat*
-r-xr-xr-x 1 root wheel - 15760 Jan 2 18:53 /usr/sbin/gstat*
lrwxr-xr-x 1 root wheel - 21 Jan 2 18:53 /usr/sbin/hoststat@ ->
                                                    /usr/sbin/mailwrapper
-r-xr-x--- 1 root wheel - 11504 Jan 2 18:53 /usr/sbin/ifmcstat*
-r-xr-xr-x 1 root wheel - 19808 Jan 2 18:53 /usr/sbin/iostat*
-r-xr-xr-x 1 root wheel - 39376 Jan 2 18:53 /usr/sbin/pmcstat*
-r-xr-xr-x 2 root wheel - 13040 Jan 2 18:53 /usr/sbin/pstat*
lrwxr-xr-x 1 root wheel - 21 Jan 2 18:53 /usr/sbin/purgestat@ ->
                                                    /usr/sbin/mailwrapper
-r-xr-xr-x 1 root wheel - 10048 Jan 2 18:53 /usr/sbin/slstat*
```

top

top -m cpu (default)

```

last pid: 61540;  load averages:  0.30,  0.31,  0.32                up 17+09:57:18  13:57:14
242 processes: 1 running, 241 sleeping
CPU states:      % user,      % nice,      % system,      % interrupt,      % idle
Mem: 2195M Active, 7466M Inact, 1574M Wired, 21M Cache, 214M Buf, 619M Free
Swap: 2048M Total, 140K Used, 2048M Free

  PID USERNAME      THR PRI NICE   SIZE   RES STATE  C   TIME   WCPU COMMAND
26091 squid            17  44   0   414M   384M ucond  1  35:51  0.00% squid
11945 bind             11  44   0 71696K 59544K select 1  32:06  0.00% named
11375 root               1  58   0 20960K 3144K select 1   9:35  0.00% sshd
68517 nobody           1  44   0 24472K 14716K select 3   8:00  0.00% rsync

```

top -m io

```

last pid: 9347;  load averages:  0.21,  0.29,  0.32                up 17+09:58:20  13:58:16
243 processes: 1 running, 242 sleeping
CPU states:  0.5% user,  0.0% nice,  1.2% system,  0.0% interrupt, 98.3% idle
Mem: 2200M Active, 7484M Inact, 1604M Wired, 25M Cache, 214M Buf, 562M Free
Swap: 2048M Total, 140K Used, 2048M Free

  PID USERNAME      VCSW  IVCSW  READ  WRITE  FAULT  TOTAL PERCENT COMMAND
18107 cvsup             0     0     0     0     0     0   0.00% cvsupd
26091 squid            34     0     0     0     0     0   0.00% squid
11945 bind              9     3     0     0     0     0   0.00% named
11375 root               4     0     0     0     0     0   0.00% sshd

```

gstat

L (q)	ops/s	r/s	kBps	ms/r	w/s	kBps	ms/w	%busy	Name
0	0	0	0	0.0	0	0	0.0	0.0	acd0
5	218	218	15756	9.3	0	0	0.0	94.0	da0
0	111	2	214	5.0	107	933	4.3	23.4	ad4
0	113	0	0	0.0	111	933	4.3	24.1	ad5
0	111	2	214	5.0	107	933	4.3	23.5	ad4s1
0	113	0	0	0.0	111	933	4.3	24.1	ad5s1
0	0	0	0	0.0	0	0	0.0	0.0	ad6
0	5	0	0	0.0	5	40	0.6	0.3	ad4s1a
0	0	0	0	0.0	0	0	0.0	0.0	ad4s1b
0	0	0	0	0.0	0	0	0.0	0.0	ad4s1c
0	106	2	214	5.0	102	893	4.7	23.4	ad4s1d
0	0	0	0	0.0	0	0	0.0	0.0	ad7
0	5	0	0	0.0	5	40	0.3	0.1	ad5s1a
0	0	0	0	0.0	0	0	0.0	0.0	ad5s1b
0	0	0	0	0.0	0	0	0.0	0.0	ad5s1c
0	108	0	0	0.0	106	893	4.7	24.1	ad5s1d
0	4	0	0	0.0	4	40	0.8	0.3	mirror/gm0s1a