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:~ -lwhsu- 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  count              3
All 1985880  138664 1077786k   340176         pages              3
Proc:                                                          Interrupts
  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
|    |    |    |    |    |    |    |    |    |        daefr       ahc1 irq25
===>                                                 764 prcfr  2000 cpu0: time
                                        29 dtbuf    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
```