

lxtx - Introduction

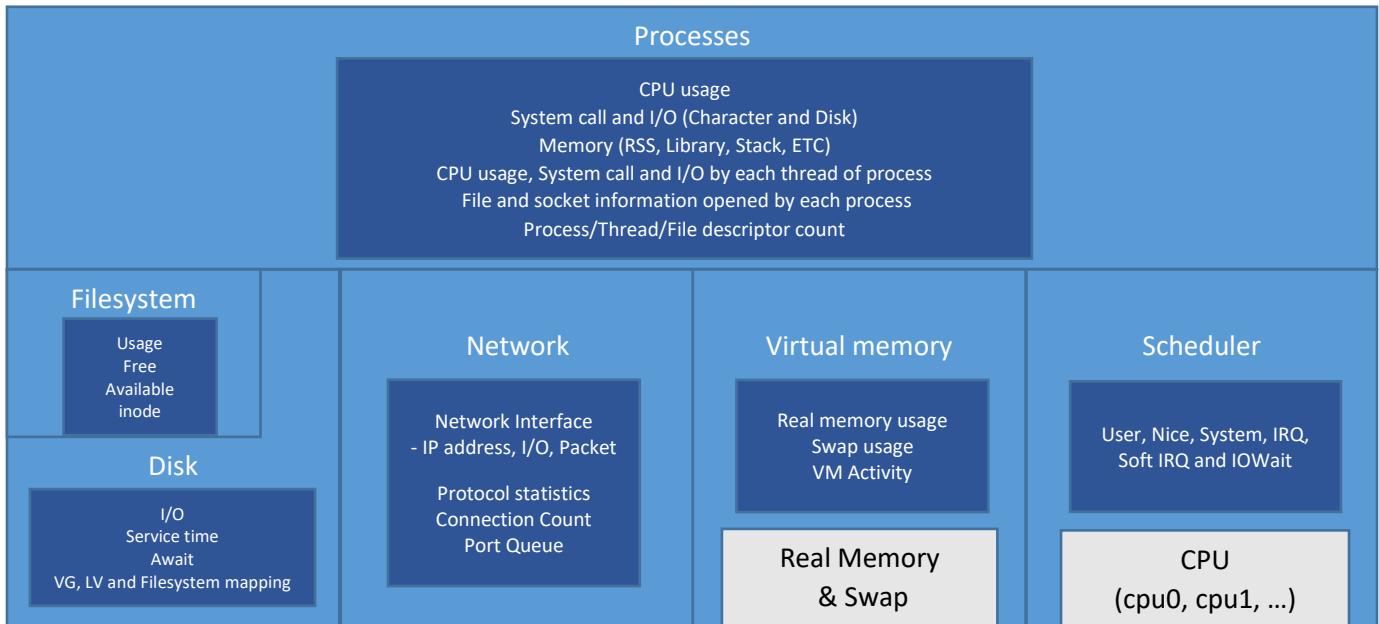
1. lxtx is,

A simple command line program, like vmstat, sar, or iostat.

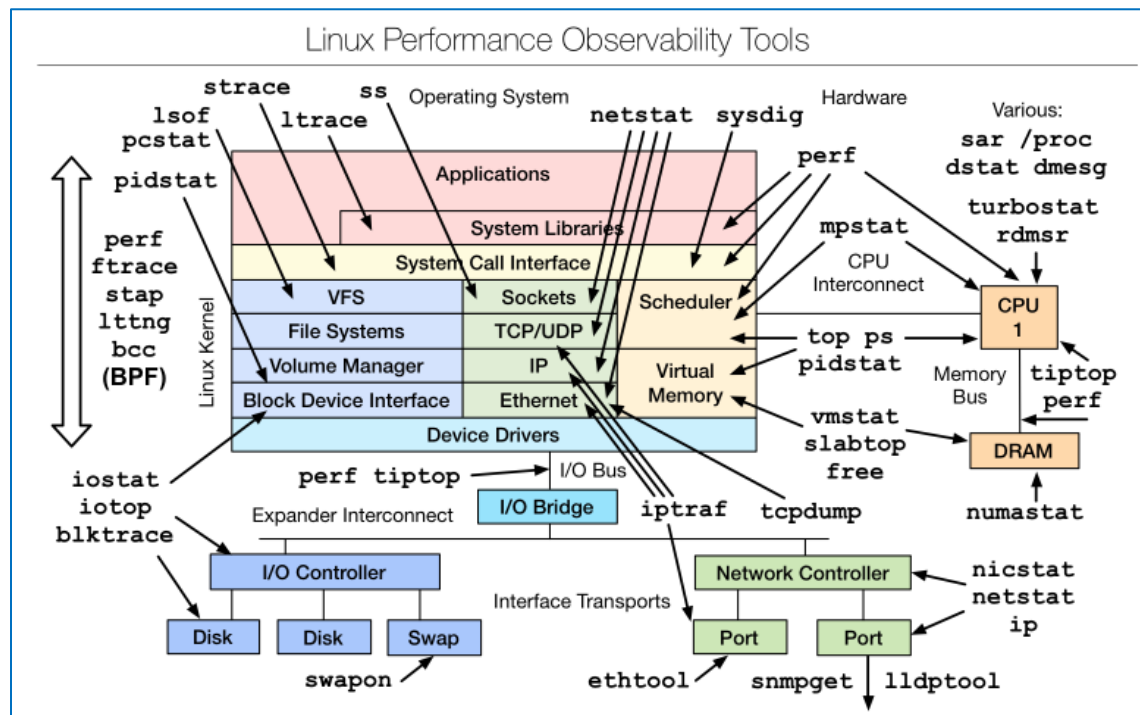
lxtx is free-to-use, and may be downloaded at <http://ontune.us>

lxtx was developed to streamline an integrated monitoring of Linux servers.

lxtx replaces vmstat, sar, iostat, nmon, ps, lsof and other Linux monitoring programs, described below:



- Above features might cover the image below except trace or hardware level.



2. lxtx advantages

- Several commands or tools are usually needed to monitor performance items in Linux;

Using lxtx reduces the inconvenience, troubles, and errors that come with using several commands or tools, and their various options, because it covers the entire performance monitoring range.

- lxtx shows the differential file position when a process issues file I/O. This file position delta value can generally represent file I/O in the case of sequential read or write. The owner process information must of course be included with it.

- lxtx shows current active port queue length. A port can generally be considered as a path for an application service. Since network I/O happens via port queue, port queue activity can be used to monitor application activity. lxtx shows owner process information together with inode mapping throughout.

* High network I/O doesn't mean high queue length, because speedy system can complete I/O requests before making a long queue. However, high queue length should be considered as a symptom of a big load in a network performance.

- lxtx shows protocol items' activity via netstat delta, by which users may identify TCP/IP activities.

- lxtx shows mapping information of each disk for the case of Disk performance data. Via translation of multipath, pvs, and mount, lxtx shows the mounted filesystem, logical volume name, or volume group name, that each disk belongs to.

- lxtx shows filesystem's usage delta, such as how much free size(or inode usage, etc) of each filesystem is increased/decreased.

* "Differential" is used the same as "Delta"; eg. Differential File Position = File Position Delta

3. How to run lxtx

CPU & Memory Utilization(Basic performance items) : `./lxtx -b`

Each process performance information : `./lxtx -p 24` (24 is the maximum process entry count to display.)

Differential file position : `./lxtx -p 24 -f`

(-f shows entries with detected position change, and -F shows every file entry.)

Socket list : `./lxtx -p 24 -S` (Every socket owned by each process is displayed.)

Newly created or terminated process : `./lxtx -p 24 -k`

Network interface performance : `./lxtx -n 8` (8 is the maximum network interface entry count to display.)

Disk performance : `./lxtx -v -d 16` (16 is the maximum disk entry count to display.) -v option shows LV / VG entries.

Port Queue Length : `./lxtx -o 8` (8 is the maximum port entry count to display.)

Differential Filesystem Status(Filesystem delta) : `./lxtx -m` (shown when change is detected.)

Differential protocol statistics(netstat delta) : `./lxtx -t` (shown when change is detected.)

Monitoring interval : `-s 2` (2 second interval) Or `-i 500` (500ms interval). 2 second interval is applied when interval is not defined.

Monitoring count : `-c "Count"`. Infinite count is applied when count is not defined.

`./lxtx -a` : -a option applies below:

→ `./lxtx -b -p 24 -f -k -o 4 -n 4 -d 8`

Basic items such as CPU/Memory, Each process(Differential File position and process creation/termination included), Port Queue, Network interface, and Disk monitoring are applied.

4. Resource usage comparison

* Command option for a test. [Monitoring interval is 1 second]

- nmon : `nmon -f -t -s 1 -c 86400`

- lxtx as nmon : `./lxtx -b -d 1000 -p 1000 -n 1000 -T 0 -s 1 -c 86400`

- lxtx full option : `./lxtx -T 0 -b -p 1000 -d 1000 -n 1000 -o 1000 -f -m -t -s 1 -c 86400`

* System specifications : All are guest linux servers with Intel i7 4 cores and 4GB Memory of VMware 12 pro.

CentOS 5.8	nmon 16f	lxtx (as nmon)	lxtx full option
CPU	0.4%	1.0%	1.2%
Memory(RSS)	1.0MB	9.0MB	12.3MB

CentOS 6.7	nmon 16f	lxtx (as nmon)	lxtx full option
CPU	1.0%	1.4%	3.1%
Memory(RSS)	1.1MB	12.7MB	21.6MB

CentOS 7.1	nmon 16f	lxtx (as nmon)	lxtx full option
CPU	1.9%	3.0%	4.9%
Memory(RSS)	1.3MB	15.4MB	24.7MB

5. Functional comparison

	Nmon 16f	ltx 1.1.12	Additional description
CPU Utilization	User / Sys / Wait / Idle / Steal. Sys includes IRQ and Soft IRQ.	User / SYSall / Wait / Idle / Steal / SYS / IRQ / Soft IRQ.	SYSall is similar to Sys in nmon. ltx breaks down SYSall to IRQ, Soft IRQ, and SYS separately.
Memory and Virtual Memory Activity	High/low memory status, as well as many individual VM items are collected.	Current status without high/low in memory data. VM items are narrowed from general perspective according to order of importance. Additionally, ltx shows VM Efficiency.	VM Efficiency : Near 100% means stealing pages is achieved easily; while low efficiency means stealing pages is strenuous for memory demands. 0% means no additional memory demands beyond current usage.
Proc(or Kernel)	Runnable,Blocked,pswitch,syscall,read, write,fork,exec,sem,msg. Actually, syscall/read/write/exec/sem/msg are not collected despite the definition.	same modality as nmon.	No related information in /proc regarding syscall/read/write/exec/sem/msg.
Each Process	CPU%,Size,ResSet/Text/Data,SharedLibrary,Minor/MajorFault.	In addition to nmon's modality, character I/O, Read/Write SysCall, Read/Write Bytes and process start time are added.	Ltx shows VmSize, VmPin, VmRSS, VmData, VmStack, VmLib, and VmSwap, instead of nmon's process memory items.
Differential File Position		ltx shows the differential file position owned by each process.	Differential file position usually can represent how much sequential read or write happens in the file.
Number of Processes and more		ltx shows the number of processes, threads, sockets, pipes, files, and read/write system calls by current processes.	
Number of Ports		ltx shows the number of each port status.	Port status consists of established, listen, syn_sent, syn_recv, fin_wait1/2, time_wait, close, close_wait, closing, and last_ack.
Network Interface	Read/Write KBytes and transfers per second.	In addition to nmon's modality, each network interface is shown with its IP address.	
Port Queue Length		Queue length of opened port is shown with owner process.	
Differential Protocol Statistics		ltx shows activities of protocol by showing extent increase of each protocol statistics.	
Differential Filesystem Usage		ltx shows differential filesystem usage, such as increased/decreased free size; available size; and total size, including i-node.	
Disk	Read/Write KBytes and transfers per a second, busy, and Block size. -g option provides user define disk group. Inclusion with service time.	In addition to nmon's modality except -g option, await, service time, and queue length are added. In place of block size excluded, logical volume name, filesystem or volume group, are displayed together.	Since ltx can recognize multipath, a member disk can be mapped to logical volume, or volume group.

6. Examples

1) “./lctx -a” Sample screen shot during downloading test via sftp

/vg/vg02/lvol2/dummy1.dat file is being downloaded via sftp.

sftp-server process is causing 2.67M file position delta,

and its parent process is causing 2.22M of TX queue length of local 22 port.

2.83MBPS writing(transmitting) is on-going via eth0. (IP is 192.168.29.66)

Disk read is on-going by 2.63MBPS at sdc, sdc2, and dm-5.

sdc is partitioned to sdc2, which is belonging to vg02 as volume group.

dm-5 is mapped to a logical volume to be used to mount at /vg/vg02/lvol2.

Differential file position(Delta Rate) is 2.67M, and this file is owned by sftp-server process[PID : 122025 / PPID : 122018]

Port queue length shows that TX Queue Length(TCP local 22 port) is 2.22M, and owner process is sshd[PID : 122018]

Network interface shows 4MBPS traffic is on-going via eth0 (192.168.29.66)

Disk shows 2.63MBPS read is on-going from sdc, sdc2 and dm-5. sdc2 is a partition of sdc, belonging to vg02(Volume Group). dm-5 is used to mount at /vg/vg02/lvol2 as logical volume. * Downloading file is /vg/vg02/lvol2/dummy1.dat

2) Process Count, Port Count, and Differential Protocol Statistics

Number of processes, and more

Number of ports

Differential protocol statistics : Activities of protocol showing extent of increase for each protocol statistics.

3) Instead of vmstat: ./lxtx -b -s 2

* -b : Basic performance data

* -s 2 : 2 second interval (2 second interval applied if not defined.)

```
-----
TIME : 16.11.22 13:30:52.122 [1479839452/#4]
USER SYSall  SYS      IRQ  S-IRQ  WAIT  IDLE  STEAL    RUN  BLOCK    FORK    INTR    CTXT
0.12% 0.50% 0.50% 0% 0% 0% 99.38% 0 1 0 0 166.9 70.46
MEM MEMUSE  BUFFS  CACHE  SWAP SWPUSE SWPHOT  PgIn  PgOut  SwpIn  SwpOut  PgFree  Rotate  VmEff%  ScanK  ScanD  StealK  StealD  MajFlt
0.96G 39.05% 4.56% 45.57% 1.94G 3.30% 3.12% 0 0 0 0 1.60K 0 0 0 0 0 0 0

-----
TIME : 16.11.22 13:30:54.123 [1479839454/#5]
USER SYSall  SYS      IRQ  S-IRQ  WAIT  IDLE  STEAL    RUN  BLOCK    FORK    INTR    CTXT
0% 0.50% 0.50% 0% 0% 0% 99.50% 0 1 0 0 103.4 59.97
MEM MEMUSE  BUFFS  CACHE  SWAP SWPUSE SWPHOT  PgIn  PgOut  SwpIn  SwpOut  PgFree  Rotate  VmEff%  ScanK  ScanD  StealK  StealD  MajFlt
0.96G 39.05% 4.56% 45.57% 1.94G 3.30% 3.12% 0 0 0 0 1.53K 0 0 0 0 0 0 0

-----
TIME : 16.11.22 13:30:56.124 [1479839456/#6]
USER SYSall  SYS      IRQ  S-IRQ  WAIT  IDLE  STEAL    RUN  BLOCK    FORK    INTR    CTXT
0.12% 0.38% 0.38% 0% 0% 0% 99.50% 0 1 0 0 99.95 63.97
MEM MEMUSE  BUFFS  CACHE  SWAP SWPUSE SWPHOT  PgIn  PgOut  SwpIn  SwpOut  PgFree  Rotate  VmEff%  ScanK  ScanD  StealK  StealD  MajFlt
0.96G 39.05% 4.56% 45.57% 1.94G 3.30% 3.12% 0 0 0 0 1.52K 0 0 0 0 0 0 0
```

4) Instead of iostat: ./lxtx -v -d 4

* -d 4 : At most, top 4 disks are displayed

* -v : Disk data is followed by VG and LV data

```
-----
TIME : 16.11.22 15:12:54.550 [1483992774/#23]

Name      Busy  RBytes  WBytes  Rxfers  Wxfers  Rawait  Wawait  Await  SVC-tm  AVG-Q  [VG][LV][FS]
Total     0.15  0 4.00K  0 1.00  0 3.00  3.00  1.50  0.00
sda       0.15  0 4.00K  0 1.00  0 3.00  3.00  1.50  0.00  [[]]
sda2      0.15  0 4.00K  0 1.00  0 3.00  3.00  1.50  0.00  [vg_centos6][[]]
dm-0      0.15  0 4.00K  0 1.00  0 3.00  3.00  1.50  0.00  [[][vg_centos6/lv_root][/]
VG       0.15  0 4.00K  0 1.00  0 3.00  3.00 1.50 0.00  vg_centos6
LV       0.15  0 4.00K  0 1.00  0 3.00  3.00 1.50 0.00  [vg_centos6] [lv_root] [/]

-----
TIME : 16.11.22 15:12:56.552 [1483992776/#24]

Name      Busy  RBytes  WBytes  Rxfers  Wxfers  Rawait  Wawait  Await  SVC-tm  AVG-Q  [VG][LV][FS]
Total     13.69  0 189.8K  0 2.00  0 68.75  68.75  68.50  0.14
sda       13.69  0 189.8K  0 2.00  0 68.75  68.75  68.50  0.14  [[]]
sda2      13.69  0 189.8K  0 2.00  0 68.75  68.75  68.50  0.14  [vg_centos6][[]]
dm-0      13.24  0 19.98K  0 5.00  0 28.00  28.00  26.50  0.14  [[][vg_centos6/lv_root][/]
dm-1      0.45  0 169.8K  0 42.46  0 4.69  4.69  0.11  0.20  [[][vg_centos6/lv_swap][/]
VG       13.69  0 189.8K  0 2.00  0 68.75 68.75 68.50 0.14  vg_centos6
LV       13.24  0 19.98K  0 5.00  0 28.00 28.00 26.50 0.14  [vg_centos6] [lv_root] [/]
LV       0.45  0 169.8K  0 42.46  0 4.69 4.69 0.11 0.20  [vg_centos6] [lv_swap] []

-----
TIME : 16.11.22 15:12:58.553 [1483992778/#25]

Name      Busy  RBytes  WBytes  Rxfers  Wxfers  Rawait  Wawait  Await  SVC-tm  AVG-Q  [VG][LV][FS]
Total     0.30  0 83.96K  0 1.00  0 3.00  3.00  3.00  0.00
sda       0.30  0 83.96K  0 1.00  0 3.00  3.00  3.00  0.00  [[]]
sda2      0.30  0 83.96K  0 1.00  0 3.00  3.00  3.00  0.00  [vg_centos6][[]]
dm-1      0.30  0 83.96K  0 20.99  0 3.00  3.00  0.14  0.06  [[][vg_centos6/lv_swap][/]
VG       0.30  0 83.96K  0 1.00  0 3.00 3.00 3.00 0.00  vg_centos6
LV       0.30  0 83.96K  0 20.99  0 3.00 3.00 0.14 0.06  [vg_centos6] [lv_swap] []
```

5) Process list replacing ps and lsof

lxtx can replace ps and lsof.

“./lxtx -P ps” shows a process list.

```
root@centos-6:/usr/new
[root@centos-6.6 /usr/new]# ./lxtx -P ps
Copyright (c) 2016 Teemstone LLC.
Version : 1.1.12

  Command      PID      PPID      USER S  THRD [CommandLine]
  -----
    init         1         0      root S    1 /sbin/init
  kthreadd       2         0      root S    1 kthreadd
migration/0     3         2      root S    1 migration/0
ksoftirqd/0     4         2      root S    1 ksoftirqd/0
stopper/0       5         2      root S    1 stopper/0
watchdog/0      6         2      root S    1 watchdog/0
migration/1     7         2      root S    1 migration/1
stopper/1       8         2      root S    1 stopper/1
ksoftirqd/1     9         2      root S    1 ksoftirqd/1
watchdog/1     10        2      root S    1 watchdog/1
migration/2    11         2      root S    1 migration/2
stopper/2     12         2      root S    1 stopper/2
ksoftirqd/2    13         2      root S    1 ksoftirqd/2
watchdog/2     14         2      root S    1 watchdog/2
migration/3    15         2      root S    1 migration/3
stopper/3     16         2      root S    1 stopper/3
ksoftirqd/3    17         2      root S    1 ksoftirqd/3
watchdog/3     18         2      root S    1 watchdog/3
events/0       19         2      root S    1 events/0
events/1       20         2      root S    1 events/1
events/2       21         2      root S    1 events/2
events/3       22         2      root S    1 events/3
cgroupp        23         2      root S    1 cgroupp
```

“./lxtx -P ps,time,mem -F -S” lists process entries with process start time and memory allocated.

```
root@centos-6:/usr/new
[root@centos-6.6 /usr/new]# ./lxtx -P ps,mem,time |egrep "Command|usr"
  Command      PID      PPID      USER S  THRD START_TIME-yyymmdd  Size  RSS  Swap [CommandLine]
  -----
modem-manager 1519      1      root S    1 16.12.12 09:50:04 56.77M 1.57M 248.0K /usr/sbin/modem-manager
wpa_supplicant 1553      1      root S    1 16.12.12 09:50:04 43.93M 324.0K 272.0K /usr/sbin/wpa_supplicant -c /etc/wpa_supplicant/wpa_supplicant.c...
acpid         1615      1      root S    1 16.12.12 09:50:04 3.98M 456.0K 108.0K /usr/sbin/acpid
sshd          1732      1      root S    1 16.12.12 09:50:06 65.12M 496.0K 652.0K /usr/sbin/sshd
abrttd        1784      1      root S    1 16.12.12 09:50:07 112.0M 720.0K 172.0K /usr/sbin/abrttd
atd           1809      1      root S    1 16.12.12 09:50:08 21.07M 296.0K 196.0K /usr/sbin/atd
sh            1830      1      root S    1 16.12.12 09:50:08 105.7M 680.0K 224.0K /bin/sh /usr/ontune/ontune.sh /usr/ontune
certmonger    1881      1      root S    1 16.12.12 09:50:08 63.19M 608.0K 572.0K /usr/sbin/certmonger -S -p /var/run/certmonger.pid
gdm-binary    1932      1      root S    2 16.12.12 09:50:09 130.9M 1.63M 132.0K /usr/sbin/gdm-binary -nodaemon
gdm-simple-slav 2023    1932    root S    2 16.12.12 09:50:08 161.0M 1.66M 812.0K /usr/libexec/gdm-simple-slave --display-id /org/gnome/DisplayMan...
Xorg          2040    2023    root S    1 16.12.12 09:50:08 158.3M 33.15M 5.17M /usr/bin/Xorg :0 -br -verbose -audit 4 -auth /var/run/gdm/auth-f...
console-kit-dae 2057      1      root S    64 16.12.12 09:50:09 1.99G 1.97M 1.23M /usr/sbin/console-kit-daemon --no-daemon
dbus-launch   2127      1      gdm S    1 16.12.12 09:50:09 19.57M 336.0K 236.0K /usr/bin/dbus-launch --exit-with-session
devkit-power-da 2133      1      root S    1 16.12.12 09:50:09 48.82M 1.86M 344.0K /usr/libexec/devkit-power-daemon
polkitd       2199      1      root S    1 16.12.12 09:50:09 51.54M 2.58M 748.0K /usr/libexec/polkit-1/polkitd
rtkit-daemon  2213      1      rtkit S    3 16.12.12 09:50:09 164.5M 924.0K 160.0K /usr/libexec/rtkit-daemon
gnome-keyring-d 2316      1      root S    3 16.12.12 09:50:20 223.8M 2.16M 308.0K /usr/bin/gnome-keyring-daemon --daemonize --login
gconfd-2      2405      1      root S    1 16.12.12 09:50:20 130.5M 3.18M 1.93M /usr/libexec/gconfd-2
gnome-settings-da 2412      1      root S    2 16.12.12 09:50:20 503.1M 12.83M 976.0K /usr/libexec/gnome-settings-daemon
gvfsd         2421      1      root S    1 16.12.12 09:50:20 134.2M 1.50M 152.0K /usr/libexec/gvfsd
gvfs-fuse-daemo 2434      1      root S    5 16.12.12 09:50:20 342.5M 3.68M 500.0K /usr/libexec/gvfs-fuse-daemon /root/.gvfs
bonobo-activati 2452      1      root S    2 16.12.12 09:50:21 680.0M 4.22M 164.0K /usr/libexec/bonobo-activation-server --ac-activate --ior-output...
wnck-applet   2459      1      root S    1 16.12.12 09:50:21 329.6M 6.80M 0 /usr/libexec/wnck-applet --oaf-activate-iiid=OAFIID:GNOME_Wncklet...
trashapplet   2460      1      root S    1 16.12.12 09:50:21 315.9M 5.71M 0 /usr/libexec/trashapplet --oaf-activate-iiid=OAFIID:GNOME_Panel_T...
gvfs-gdu-volume 2463      1      root S    1 16.12.12 09:50:21 291.1M 2.64M 0 /usr/libexec/gvfs-gdu-volume-monitor
udisks-daemon 2472      1      root S    2 16.12.12 09:50:21 56.57M 2.51M 0 /usr/libexec/udisks-daemon
```

-F and -S are provided to check files and sockets opened by each process.

“-F” shows file fd, inode and filename opened by each process, and “-S” shows either socket inode or port information.

* Sample of “./lxtx -P ps -F -S”

```
root@centos-6:/usr/new
ontuned      2136    2031    root S    9 ./ontuned -c -x -m teemstone
ontuned      2136    2031    root S    9 FILE: 0 4418 /dev/null
ontuned      2136    2031    root S    9 FILE: 1 4418 /dev/null
ontuned      2136    2031    root S    9 FILE: 2 791769 /usr/ontune/agentd.log
ontuned      2136    2031    root S    9 SOCK: 3 15093 Port 0/0 192.168.29.156:41533 -> 192.168.29.106:18893 ESTABLISH
console-kit-dae 2195      1      root S    64 /usr/sbin/console-kit-daemon --no-daemon
console-kit-dae 2195      1      root S    64 FILE: 0 4418 /dev/null
console-kit-dae 2195      1      root S    64 FILE: 1 4418 /dev/null
console-kit-dae 2195      1      root S    64 FILE: 2 4418 /dev/null
console-kit-dae 2195      1      root S    64 FILE: 4 4418 /dev/null
console-kit-dae 2195      1      root S    64 SOCK: 8 15327 Not found in TCP/UDP
console-kit-dae 2195      1      root S    64 FILE: 9 912295 /var/log/ConsoleKit/history
console-kit-dae 2195      1      root S    64 SOCK: 10 15354 Not found in TCP/UDP
console-kit-dae 2195      1      root S    64 FILE: 11 6127 /dev/tty0
dbus-launch    2265      1      gdm S    1 /usr/bin/dbus-launch --exit-with-session
dbus-launch    2265      1      gdm S    1 FILE: 0 4418 /dev/null
dbus-launch    2265      1      gdm S    1 FILE: 1 4418 /dev/null
dbus-launch    2265      1      gdm S    1 FILE: 2 4418 /dev/null
dbus-launch    2265      1      gdm S    1 SOCK: 3 15501 Not found in TCP/UDP
```

Port information is displayed if socket inode is found in TCP/UDP entry

Fd, inode and filename are displayed

6) System Information

lxtx shows the system information when it starts.

```
Program      : lxtx
Version      : 1.1.12
Hostname     : centos-6.6
OS           : Linux 2.6.32-504.el6.x86_64 x86_64
Distributor  : CentOS
Description   : CentOS release 6.6 (Final)
Release      : 6.6
Model        : VMware Virtual Platform
Serial       : VMware-56 4d 2e fd 6d 6a ad 70-2c b3 66 95 f2 d0 f8 be
Logical Core : 4
Clock(MHz)   : 3198
CPU Model    : Intel(R) Core(TM) i7-4790S CPU @ 3.20GHz
H/T          : N
Sibling/Core : 1
Memory(MB)   : 4192
Swap(MB)     : 1983
CurrentTime  : 11/22/2016 14:10:39, 1479841839
Boot Time    : 10/11/2016 15:09:26, 1476212966
Uptime       : 42 day(s) 00:01:13
Timezone     : -5 hour(s)
PageSize     : 4096
ClockTick    : 100
```

Network Interface	Address	Netmask	Broadcast
lo	127.0.0.1	255.0.0.0	
eth0	192.168.29.66	255.255.255.0	192.168.29.255

“./lxtx -e” also shows above.

7. How to collect data

lxtx collects data from /proc files as below:

CPU/Memory : /proc/stat, /proc/meminfo

VM activity : /proc/vmstat

Process, Thread : /proc/[PID]/stat, /proc/[PID]/status, /proc/[PID]/io, /proc/[PID]/cmdline, /proc/[PID]/fd, /proc/[PID]/fdinfo, /proc/[PID]/task/[TID]/stat, /proc/[PID]/task[TID]/io

Network interface : /proc/net/dev

TCP/UDP port queue length : /proc/net/tcp, /proc/net/udp

Differential protocol statistics(netstat delta) : /proc/net/snmp, /proc/net/netstat

Disk : /proc/diskstats

Filesystem : /etc/mtab