Use Case S2 : System Call Interface

Time Measurement:
● **Measure the execution time for each command to assess their performance.**
System Interaction Identification:
● **Identify which system stack (e.g., file system, network) each command interacts with during execution.**
Syscall Time Breakdown:
● **Break down the total execution time of each command into time per system call to understand their resource consumption.**
Performance Evaluation:
● **Analyze the results to determine which command performs better than the other based on execution time, system interaction, and syscall breakdown.**

System Interaction Identification:

$ strace -c -e trace=$Stack$ <cmd>

Time Measurement:

$ time <cmd>

Syscall Time Breakdown:

$ strace -c <cmd>

Performance Evaluation

ls vs. find

Time Measurement:

$ time ls

```
real      0m0.015s
user      0m0.000s
sys       0m0.007s
```

$ time find

```
real      0m0.815s
user      0m0.140s
sys       0m0.258s
```

Syscall Time Breakdown:

$ strace -c ls

```
 time    seconds  usecs/ca            syscall
----- ---------- --------- --------- --------- ----------------
20.35   0.000023        11         2           getdents64
15.04   0.000017         2         8           write
13.27   0.000015         2         7           read
13.27   0.000015         7         2         2 statfs
10.62   0.000012         1        11           close
 9.73   0.000011         0        29        20 openat
 6.19   0.000007         0        10           fstat
 3.54   0.000004         1         3           brk
 2.65   0.000003         0        27           mmap
 2.65   0.000003         1         2           ioctl
 2.65   0.000003         1         2         2 access
 0.00   0.000000         0        16        15 stat
 0.00   0.000000         0         8           mprotect
 0.00   0.000000         0         1           munmap
 0.00   0.000000         0         2           rt_sigaction
 0.00   0.000000         0         1           rt_sigprocmask
 0.00   0.000000         0         8           pread64
 0.00   0.000000         0         1           execve
 0.00   0.000000         0         2         1 arch_prctl
 0.00   0.000000         0         1           set_tid_address
 0.00   0.000000         0         1           set_robust_list
 0.00   0.000000         0         1           prlimit64
----- ---------- --------- --------- --------- ----------------
00.00   0.000113                 145        40 total
ami@linux:~$
```

$ strace -c find

```
% time     seconds  usecs              s syscall
----- ----------- -----             --------- ----------------
50.07   0.356304         1    211489           write
12.53   0.089191         2     32523           getdents64
11.90   0.084684         1     80087           fcntl
10.78   0.076718         1     64366           close
 7.47   0.053176         1     32418           newfstatat
 4.45   0.031694         1     16728        33 openat
 2.64   0.018818         1     16695           fstat
 0.12   0.000847         4       178           brk
 0.00   0.000030         3        10           read
 0.00   0.000024         0        35           mmap
 0.00   0.000024         8         3           munmap
 0.00   0.000022         2         9           mprotect
 0.00   0.000014         7         2         2 statfs
 0.00   0.000012        12         1           sysinfo
 0.00   0.000005         2         2           ioctl
 0.00   0.000003         3         1           fstatfs
 0.00   0.000002         1         2           rt_sigaction
 0.00   0.000002         1         2         2 access
 0.00   0.000002         2         1           set_tid_address
 0.00   0.000001         1         1           rt_sigprocmask
 0.00   0.000001         1         1           uname
 0.00   0.000001         1         1           fchdir
 0.00   0.000001         0         2         1 arch_prctl
 0.00   0.000001         1         1           futex
 0.00   0.000001         1         1           set_robust_list
 0.00   0.000001         1         1           prlimit64
 0.00   0.000000         0        16        15 stat
 0.00   0.000000         0         8           pread64
 0.00   0.000000         0         1           execve
----- ----------- -----             --------- ----------------
100.00   0.711579               454585        53 total
sami@linux:~$
```
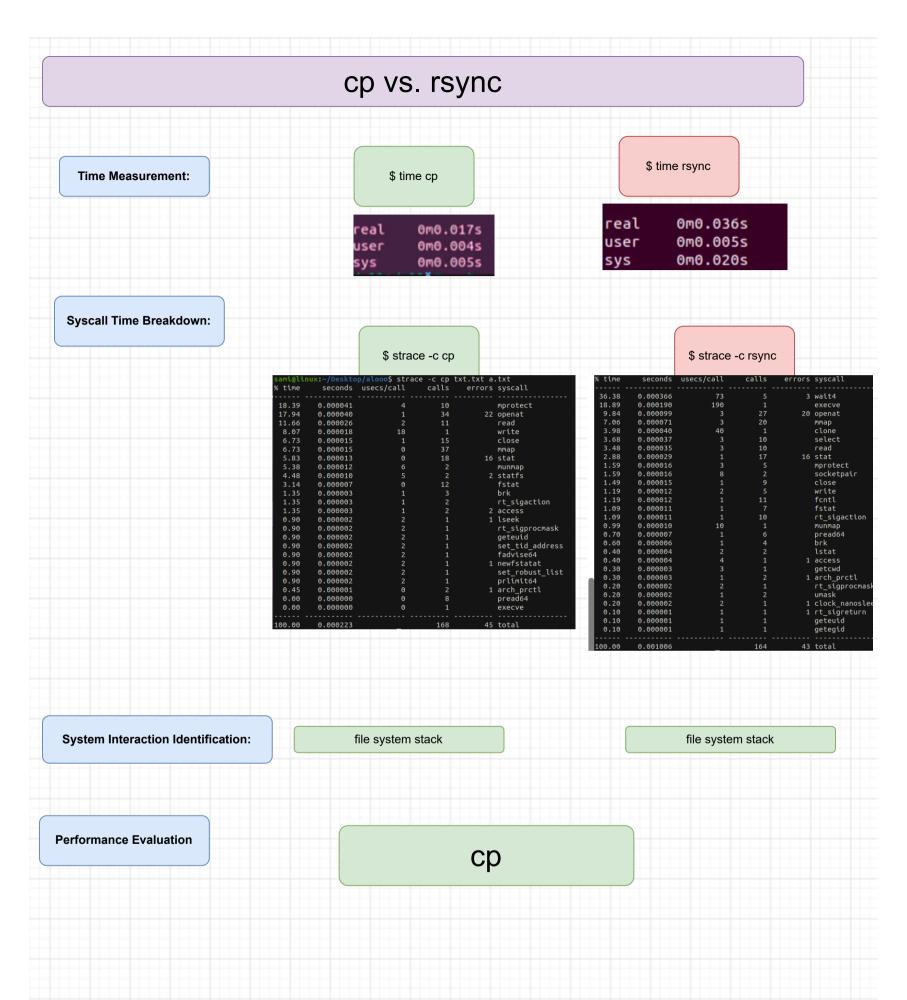
System Interaction Identification:

file system stack

file system stack

Performance Evaluation

ls

cp vs. rsync

Time Measurement:

$ time cp

```
real      0m0.017s
user      0m0.004s
sys       0m0.005s
```

$ time rsync

```
real      0m0.036s
user      0m0.005s
sys       0m0.020s
```

Syscall Time Breakdown:

$ strace -c cp

```
sami@linux:~/Desktop/alooo$ strace -c cp txt.txt a.txt
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 18.39    0.000041           4        10           mprotect
 17.94    0.000040           1        34        22 openat
 11.66    0.000026           2        11           read
  8.07    0.000018          18         1           write
  6.73    0.000015           1        15           close
  6.73    0.000015           0        37           mmap
  5.83    0.000013           0        18        16 stat
  5.38    0.000012           6         2           munmap
  4.48    0.000010           5         2         2 statfs
  3.14    0.000007           0        12           fstat
  1.35    0.000003           1         3           brk
  1.35    0.000003           1         2           rt_sigaction
  1.35    0.000003           1         2         2 access
  0.90    0.000002           2         1         1 lseek
  0.90    0.000002           2         1           rt_sigprocmask
  0.90    0.000002           2         1           geteuid
  0.90    0.000002           2         1           set_tid_address
  0.90    0.000002           2         1           fadvise64
  0.90    0.000002           2         1         1 newfstatat
  0.90    0.000002           2         1           set_robust_list
  0.90    0.000002           2         1           prlimit64
  0.45    0.000001           0         2         1 arch_prctl
  0.00    0.000000           0         8           pread64
  0.00    0.000000           0         1           execve
------ ----------- ----------- --------- --------- ----------------
100.00    0.000223                   168        45 total
```

$ strace -c rsync

```
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 36.38    0.000366          73         5         3 wait4
 18.89    0.000190         190         1           execve
  9.84    0.000099           3        27        20 openat
  7.06    0.000071           3        20           mmap
  3.98    0.000040          40         1           clone
  3.68    0.000037           3        10           select
  3.48    0.000035           3        10           read
  2.88    0.000029           1        17        16 stat
  1.59    0.000016           3         5           mprotect
  1.59    0.000016           8         2           socketpair
  1.49    0.000015           1         9           close
  1.19    0.000012           2         5           write
  1.19    0.000012           1        11           fcntl
  1.09    0.000011           1         7           fstat
  1.09    0.000011           1        10           rt_sigaction
  0.99    0.000010          10         1           munmap
  0.70    0.000007           1         6           pread64
  0.60    0.000006           1         4           brk
  0.40    0.000004           2         2           lstat
  0.40    0.000004           4         1         1 access
  0.30    0.000003           3         1           getcwd
  0.30    0.000003           1         2         1 arch_prctl
  0.20    0.000002           2         1           rt_sigprocmask
  0.20    0.000002           1         2           umask
  0.20    0.000002           2         1         1 clock_nanoslee
  0.10    0.000001           1         1         1 rt_sigreturn
  0.10    0.000001           1         1           geteuid
  0.10    0.000001           1         1           getegid
------ ----------- ----------- --------- --------- ----------------
100.00    0.001006                   164        43 total
```

System Interaction Identification:

file system stack

file system stack

Performance Evaluation

cp

diff vs. cmp

Time Measurement:

$ time diff

```
4c4
< HELLOO LINUX `asdASDASDAS
---
> asdASDASDAS

real    0m0.001s
user    0m0.001s
sys     0m0.000s
```

$ time cmp

```
sami@linux:~/Desktop/alooo$ time cmp txt.txt a.txt
txt.txt a.txt differ: byte 36, line 4

real    0m0.003s
user    0m0.000s
sys     0m0.001s
sami@linux:~/Desktop/alooo$
```

Syscall Time Breakdown:

$ strace -c diff

```
mina@mina-VirtualBox:~$ strace -c diff
diff: missing operand after 'diff'
diff: Try 'diff --help' for more information.
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 25.27    0.000162           9        17        12 openat
 22.78    0.000146          14        10           mmap
  6.86    0.000044           8         5           read
  6.71    0.000043          10         4           mprotect
  6.55    0.000042           7         6           write
  4.68    0.000030          15         2           munmap
  4.37    0.000028           5         5           close
  4.37    0.000028           7         4           pread64
  4.21    0.000027           6         4           newfstatat
  2.34    0.000015           5         3           brk
  2.18    0.000014           4         3           fcntl
  1.72    0.000011           5         2           rt_sigaction
  1.25    0.000008           8         1         1 access
  0.94    0.000006           6         1           lseek
  0.94    0.000006           6         1           sigaltstack
  0.94    0.000006           6         1           getrandom
  0.78    0.000005           2         2         1 arch_prctl
  0.78    0.000005           5         1           set_tid_address
  0.78    0.000005           5         1           set_robust_list
  0.78    0.000005           5         1           prlimit64
  0.78    0.000005           5         1           rseq
  0.00    0.000000           0         1           execve
------ ----------- ----------- --------- --------- ----------------
100.00    0.000641           8        76        14 total
```

$ strace -c rsync

```
dell@dell-Inspiron-5570:~$ strace -c cmp
cmp: missing operand after 'cmp'
cmp: Try 'cmp --help' for more information.
% time     seconds  usecs/call     calls    errors syscall
------ ----------- ----------- --------- --------- ----------------
 45.37    0.000642         642         1           execve
 15.27    0.000216          12        17        12 openat
 11.38    0.000161          16        10           mmap
  5.02    0.000071          17         4           mprotect
  4.24    0.000060          30         2           munmap
  4.17    0.000059          11         5           read
  3.25    0.000046           7         6           write
  1.98    0.000028           7         4           newfstatat
  1.70    0.000024           4         5           close
  1.55    0.000022           7         3           brk
  1.06    0.000015           3         4           pread64
  0.85    0.000012          12         1           prlimit64
  0.71    0.000010          10         1         1 access
  0.71    0.000010           3         3           fcntl
  0.64    0.000009           4         2         1 arch_prctl
  0.49    0.000007           3         2           rt_sigaction
  0.35    0.000005           5         1           getrandom
  0.28    0.000004           4         1           lseek
  0.28    0.000004           4         1           sigaltstack
  0.28    0.000004           4         1           set_robust_list
  0.21    0.000003           3         1           set_tid_address
  0.21    0.000003           3         1           rseq
------ ----------- ----------- --------- --------- ----------------
100.00    0.001415          18        76        14 total
dell@dell-Inspiron-5570:~$
```

System Interaction Identification:

file system stack

file system stack

Performance Evaluation

diff