

Performance report on Squeue Driver and its
tester application
CS598 : Embedded System Programming
Assignement 1

Brahmesh Jain
St Id: 1207654522

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Chapter 1

Profiling using linux perf tool

1.1 Introduction

As a part of this assignment, I have run the linux 'perf' tool to evaluate the performance of the softwares. perf tool is a terminal based tool that records all the information and events from the software and could be used to generate the report out of it. In this assignement, I have run this tool to collect simple information like CPU cycles, number of instructions executed in kernel and user space, and memory profile of the software. The tool was made to run on two different configurations of the software. One uses the dynamic memory allocation for the message buffers, whereas the other uses the static memory allocation. This has been done to understand the difference it makes on the performance of the software.

1.2 CPU cycles

perf tool can give the number of cpu cycles that was consumed during the run of a program. It can also give the number of cycles that was taken by kernel and user spaces separately. This will help us to differentiate the CPU usage of the kernel driver and its application.

1.2.1 CPU cycles on the driver with dynamic allocation of memory

By default dynamic memory allocation is done by the driver and printing of received messages is done by the application. So no change in the source code is required.

Total CPU cycles consumed by the program is calculate using this command

```
sudo perf stat -e cycles:uk ./SqTester.o
```



```

Rid-3 <- Sid-2      MsgId=5325      AccTime=45659 us
Rid-3 <- Sid-2      MsgId=5328      AccTime=27785 us
Rid-3 <- Sid-1      MsgId=5327      AccTime=3278 us
Rid-2 <- Sid-3      MsgId=5326      AccTime=56129 us
Rid-2 <- Sid-1      MsgId=5331      AccTime=24244 us
Rid-2 <- Sid-3      MsgId=5332      AccTime=23379 us
Rid-1 <- Sid-3      MsgId=5330      AccTime=79645 us
Rid-1 <- Sid-2      MsgId=5329      AccTime=45297 us
Rid-1 <- Sid-2      MsgId=5333      AccTime=43882 us
Rid-1 <- Sid-2      MsgId=5337      AccTime=15689 us
Rid-1 <- Sid-3      MsgId=5335      AccTime=11386 us
Rid-3 <- Sid-2      MsgId=5336      AccTime=48485 us
Rid-3 <- Sid-1      MsgId=5334      AccTime=38982 us
Rid-3 <- Sid-3      MsgId=5340      AccTime=53368 us
Rid-3 <- Sid-2      MsgId=5338      AccTime=48484 us
Rid-3 <- Sid-3      MsgId=5341      AccTime=41458 us
Rid-1 <- Sid-1      MsgId=5339      AccTime=77586 us
Rid-1 <- Sid-1      MsgId=5342      AccTime=42683 us

Rid-1 <- Sid-3      MsgId=5345      AccTime=11480 us
Rid-2 <- Sid-3      MsgId=5344      AccTime=61925 us
Rid-3 <- Sid-2      MsgId=5343      AccTime=53369 us

Waiting for Sender1 to stop sending message
Rid-2 <- Sid-1      MsgId=5346      AccTime=68814 us
Rid-2 <- Sid-2      MsgId=5347      AccTime=29126 us
Rid-1 <- Sid-3      MsgId=5349      AccTime=27879 us

Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Rid-3 <- Sid-1      MsgId=5348      AccTime=34875 us

Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop receiving message
Waiting for Receiver2 to stop receiving message
Waiting for Receiver3 to stop receiving message
Main thread Ended

Performance counter stats for './SqTester.o':

    283,188,213 cycles:k
    10.018056347 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution5$ sudo perf stat -e cycles:k ./SqTester.o

```

Figure 1.2: CPU cycles consumed by the kernel only in dynamic mode

```

Rid-2 <- Sid-3      MsgId=5291      AccTime=37518 us
Rid-2 <- Sid-3      MsgId=5294      AccTime=25887 us
Rid-3 <- Sid-1      MsgId=5292      AccTime=56682 us
Rid-3 <- Sid-2      MsgId=5299      AccTime=40878 us
Rid-1 <- Sid-2      MsgId=5296      AccTime=56188 us
Rid-1 <- Sid-1      MsgId=5298      AccTime=49841 us
Rid-1 <- Sid-3      MsgId=5297      AccTime=42686 us
Rid-1 <- Sid-3      MsgId=5302      AccTime=58376 us
Rid-1 <- Sid-1      MsgId=5301      AccTime=59288 us
Rid-1 <- Sid-1      MsgId=5303      AccTime=28846 us
Rid-1 <- Sid-2      MsgId=5305      AccTime=27339 us
Rid-2 <- Sid-1      MsgId=5308      AccTime=46263 us
Rid-2 <- Sid-3      MsgId=5304      AccTime=42623 us
Rid-3 <- Sid-3      MsgId=5306      AccTime=41819 us
Rid-3 <- Sid-2      MsgId=5308      AccTime=21829 us
Rid-1 <- Sid-3      MsgId=5309      AccTime=21379 us
Rid-2 <- Sid-1      MsgId=5307      AccTime=26849 us
Rid-2 <- Sid-2      MsgId=5310      AccTime=38923 us
Rid-2 <- Sid-1      MsgId=5312      AccTime=14436 us
Rid-3 <- Sid-3      MsgId=5311      AccTime=34803 us
Rid-3 <- Sid-1      MsgId=5315      AccTime=35364 us
Rid-2 <- Sid-3      MsgId=5313      AccTime=54857 us
Rid-1 <- Sid-2      MsgId=5314      AccTime=25954 us
Rid-1 <- Sid-3      MsgId=5317      AccTime=6651 us
Rid-2 <- Sid-2      MsgId=5318      AccTime=51244 us
Rid-2 <- Sid-1      MsgId=5316      AccTime=58511 us

Waiting for Sender1 to stop sending message
Rid-2 <- Sid-1      MsgId=5321      AccTime=31252 us
Rid-3 <- Sid-3      MsgId=5319      AccTime=60122 us
Rid-3 <- Sid-2      MsgId=5320      AccTime=35594 us

Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop receiving message
Waiting for Receiver2 to stop receiving message
Waiting for Receiver3 to stop receiving message
Main thread Ended

Performance counter stats for './SqTester.o':

    77,760,548 cycles:u
    10.020964120 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution5$ sudo perf stat -e cycles:u ./SqTester.o

```

Figure 1.3: CPU cycles consumed by the user application only in dynamic mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo insmod Squeue.ko
brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cycles:uk ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
    377,897,518 cycles:uk
    10.016004896 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cycles:uk ./SqTester.o

```

Figure 1.4: Total CPU cycles in Static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cycles:k ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
    293,497,045 cycles:k
    10.015349230 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.5: CPU cycles consumed by the kernel only in static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cycles:u ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
      103,155,139 cycles:u
      10.016928829 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.6: CPU cycles consumed by the user application only in static mode

CPU cycles consumed only by the user application(SqTester) program is calculated using the below command

```
sudo perf stat -e cycles:u ./SqTester.o
```

1.3 Instructions

Number of instructions executed for a 10seconds run of the program can be calculated using the perf commands as shown below.

1.3.1 Number of instructions executed for Dynamic memory allocation

As mentioned in the CPU cycles sections, there is no need to recompile the source in dynamic case. Just run the program with the perf tool using below commands

Total instructions executed by the program is calculate using the below command

```
sudo perf stat -e instructions:uk ./SqTester.o
```

Number of instructions executed by the program in kernel space is calculated using the below command

```
sudo perf stat -e instructions:k ./SqTester.o
```



```

Rtd-1 <- Sld-2 MsgId=5335 Acctine=36666 us Msg=UUVYGVWPCSLIXO
Rtd-1 <- Sld-2 MsgId=5338 Acctine=14552 us Msg=RRSVDSIXNDSIXNDS
Rtd-1 <- Sld-3 MsgId=5339 Acctine=26671 us Msg=DOMDLOCAQKVTKSEVTQYKCAWFQIMJRD
Rtd-1 <- Sld-1 MsgId=5337 Acctine=18645 us Msg=DOBGUJXMBPESHVKNYCQFTIMLADRGUJXMBPESHVKNYCQFTIMLADRGUJXMBPESHVKN
Rtd-3 <- Sld-1 MsgId=5342 Acctine=59375 us Msg=TOPHMMWMSJZKCAKAYVTLCKQDSHEIBULTEACQIRULTUQSHEYLSBZACDGNAPQH
Rtd-3 <- Sld-3 MsgId=5341 Acctine=37140 us Msg=LLMPHMSYFLRXEKQNDJPCVCIQUBHNTAGRS
Rtd-3 <- Sld-2 MsgId=5343 Acctine=30955 us Msg=CQHSXJHSQCGLJNLPN
Rtd-3 <- Sld-1 MsgId=5344 Acctine=20915 us Msg=MLKGGJGRPHWJALBNDRNRBDQSYLCKSDXHECPAEVGGKTVRSEKOGYCAFVHVIVPO
Rtd-3 <- Sld-3 MsgId=5345 Acctine=19762 us Msg=B7BDITRGKLGHOYNEBFGBRRCPJPMQADIT
Rtd-1 <- Sld-2 MsgId=5340 Acctine=84190 us Msg=DPKPIDKA0BSLGFUB
Rtd-3 <- Sld-3 MsgId=5348 Acctine=41932 us Msg=ESVYDUFRIKKEIARNNHSMXILUKQEFPCS
Rtd-2 <- Sld-1 MsgId=5347 Acctine=23333 us Msg=KHUEFFLSIOCLMSSBHUJEPLLTANWKEELYLJMIQPDMMNMUTHQNJ3RQENHKGZONT
Rtd-1 <- Sld-2 MsgId=5346 Acctine=77265 us Msg=BCFWCOUIQIYNNRPSM
Rtd-1 <- Sld-3 MsgId=5349 Acctine=50667 us Msg=THRBVITCQATTCUEXMGADIMBUVNLATXNGK
Rtd-1 <- Sld-3 MsgId=5352 Acctine=28354 us Msg=P2JMTJPLASTOQVRSYBUSODJLQFYXJMHG
Rtd-2 <- Sld-1 MsgId=5351 Acctine=65110 us Msg=GMAHIGNDOMOEIKAGEG
Rtd-2 <- Sld-1 MsgId=5350 Acctine=62568 us Msg=OKRPMMSGOMPSRQVHLBHHIRLGENTHPMKRNGFEPTJPJKNHCYAJJMFWTBQJCBKKTATORL
Rtd-2 <- Sld-2 MsgId=5353 Acctine=20227 us Msg=XKXKBRBINEQVPIYHNGU
Rtd-2 <- Sld-2 MsgId=5358 Acctine=9262 us Msg=XXYCJYICTHJUSWMSNEQY
Rtd-3 <- Sld-3 MsgId=5355 Acctine=48810 us Msg=MQATINVHVQVJLEQETNPVAMNMLMQAUVJSMCJ
Rtd-3 <- Sld-1 MsgId=5354 Acctine=48842 us Msg=QMFHQBIXERYFPJAGECQKRMVJSGOVANUPCYLQNMWHLISIVYEAKLYBQHMIGIST
Rtd-1 <- Sld-1 MsgId=5357 Acctine=14122 us Msg=DLXLSIOXGXUHQIDITCCAKKPRQWYKCGTYFDIXEVBPHLLEULXGCYKXKXINHAQYVI
Rtd-1 <- Sld-3 MsgId=5356 Acctine=50522 us Msg=ACHSQATYIYJPPDFMHPPIHFCXJXJMSGHCMLAJ
Rtd-1 <- Sld-3 MsgId=5361 Acctine=25854 us Msg=VEHAKXHDJERTKSVOBVBXSNCKNMSCHSNPLIA
Rtd-3 <- Sld-2 MsgId=5360 Acctine=52603 us Msg=HQPQAPKPCFCQDQTHQNMQ
Rtd-3 <- Sld-1 MsgId=5359 Acctine=48199 us Msg=RVLCAWURPKKHFCAMURPKKHFCAMROJGBXSPKHCTQLIDARJXSHMBVPKEYSNHCVKFYTNIC
Rtd-3 <- Sld-2 MsgId=5362 Acctine=40549 us Msg=GRNLFHFDYKUSQNKIGECAX

Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread

Waiting for Receiver1 to stop Receiving message
Rtd-3 <- Sld-1 MsgId=5365 Acctine=52737 us Msg=FLYDOHLMTJPDHSPQVJPDHSPQVJPDHSPQVJNBFOHLMRFJMBKIHINBFUECBCHUYKMTSTYM
Rtd-1 <- Sld-2 MsgId=5365 Acctine=84357 us Msg=R3TPIUUVGVCPRIIGXOWOVUN

Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
136,871,949 instructions:k
10.018434394 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution5$ sudo perf stat -e instructions:k ./SqTester.o

```

Figure 1.8: Number of instructions executed in kernel space in Dynamic mode

```

Rtd-1 <- Sld-2 MsgId=5298 Acctine=50572 us Msg=R3TPIUUVGVCPRIIGXOWOVUNAABELBHMCMCLIDTCEASFFGJQ
Rtd-2 <- Sld-2 MsgId=5300 Acctine=38283 us Msg=PMUSCVNUJXKATILSHRQVILHJHJOYITIMILQBVKDMSXNNYHQ
Rtd-1 <- Sld-3 MsgId=5302 Acctine=44495 us Msg=DDPJAKJHGHATKEORLKLXKJISDPOPCPYMRQBPATKXUSPONDQIESOLIHIPJAKGDYAHBRAVSPQ
Rtd-1 <- Sld-1 MsgId=5301 Acctine=34910 us Msg=OTFDGDNQGLNVMHQWQFPR
Rtd-1 <- Sld-2 MsgId=5304 Acctine=17305 us Msg=UNAXUNXRCINWMSGEBTEXMOTUBOOLEKYDIRJHFFCUHDTXDMENAA
Rtd-3 <- Sld-1 MsgId=5305 Acctine=45950 us Msg=TRJZYVNMKJXPLDNQAKKQ
Rtd-3 <- Sld-3 MsgId=5303 Acctine=25361 us Msg=LXSECYUNBUIUMDSYMPXBAABFQJAKGAPWVODHROLGYLMRDOLFAPSVDOUGEDGGOIYEXMSIQJW
Rtd-1 <- Sld-3 MsgId=5308 Acctine=59835 us Msg=MTQFNPLEQORLXNLSECYTKSQUJVVMAHMQDSJHEVPAPAVOBBCFPCIXDOMJEUDEFBGTGKHRH
Rtd-2 <- Sld-2 MsgId=5306 Acctine=16664 us Msg=THUIKPMETAJDRSRMYUNVNPUCNNBVNSRMYREVCQATERPIMNPG
Rtd-2 <- Sld-2 MsgId=5311 Acctine=16664 us Msg=TFDYQATHJNLVRECKPATIKQNTG
Rtd-1 <- Sld-1 MsgId=5312 Acctine=10866 us Msg=BNVYVUSQWIKGCAKPRMLJ
Rtd-3 <- Sld-1 MsgId=5305 Acctine=46682 us Msg=EIRLJENHVAJDRVFNBJJHOF
Rtd-3 <- Sld-3 MsgId=5309 Acctine=59776 us Msg=VFJXHEXMYQJUILQBQWQBXSHLTKQEFINXTLUNAYVQGSJQEFINYNVPCBYTJNVHTIKNTFBTEKX
Rtd-1 <- Sld-1 MsgId=5315 Acctine=34300 us Msg=PPQTBQWGAAML1BNJAIXADIRJPM
Rtd-3 <- Sld-1 MsgId=5318 Acctine=24571 us Msg=MNHLFQDITRLUOUBDJHBPKNKYITJ
Rtd-3 <- Sld-2 MsgId=5316 Acctine=24188 us Msg=QMFLSIOVLRFBUEOKXTANJPDYFSQIEXKTGTGCPCLXHTHDPOLYUHQDQ
Rtd-3 <- Sld-3 MsgId=5317 Acctine=15688 us Msg=LRKXNQEUODHJLHAEENBMYQBMMPTDTCQROJSLISCVESQLYUNUEXGUUVQAPVDPJROHICPO
Rtd-2 <- Sld-2 MsgId=5314 Acctine=60824 us Msg=OSGAGONMGPFRIGANMGPJNLKYDCVYIRGTWQFYIRGFDYCBPJCQOP
Rtd-2 <- Sld-3 MsgId=5313 Acctine=51873 us Msg=JKNURQEDCYI1RVNXPAPVNSECLNQLNQLVQVFMFS1SRMDJSMQDQYVPVJHCQUAHVYCHQICJ1KJGMD0I
Rtd-1 <- Sld-2 MsgId=5320 Acctine=39759 us Msg=RWBKESPKTGHDQFNFYKBCQUPYSBIMJGCGJCOAQRNMDVEFIBYOGCJYVH
Rtd-1 <- Sld-1 MsgId=5319 Acctine=13926 us Msg=AEHNRNCLSEJAJYMPCTEVXXNNNOJ

Waiting for Sender1 to stop sending message
Rtd-1 <- Sld-3 MsgId=5322 Acctine=23730 us Msg=CXQYQBMLIDPPQPOJATPEINUGATROBBXSCNNVBOBMLHVMMQRUXWRANLEINUCACEBRROJRB
QOO
Rtd-1 <- Sld-1 MsgId=5323 Acctine=14733 us Msg=VCPRRNBDDYMOOKXAAVOQNFHIBDIJ
Rtd-3 <- Sld-2 MsgId=5321 Acctine=24398 us Msg=RDBXKCNACHJAAVBVEASGHRFLVSYV1ISOYHGWFGBRJLWNAJUKIKKE

Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
26,792,365 instructions:u
10.021162116 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution5$ sudo perf stat -e instructions:u ./SqTester.o

```

Figure 1.9: Number of instructions executed in user space in Dynamic mode


```
brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e instructions:uk ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
      185,378,125 instructions:uk
      10.019992835 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$
```

Figure 1.10: Total number of instructions executed in static mode

```
brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e instructions:k ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
      82,550,312 instructions:k
      10.022133681 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$
```

Figure 1.11: Number of instructions executed in kernel space in static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e instructions:u ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
      23,142,875 instructions:u
      10.017216707 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.12: Number of instructions executed in user space in static mode

1.4 Memory

Some of the memory related performance can also be tested using perf tool. For example : cache-misses, cache-references, mem-loads, mem-stores. etc

To measure these parameters use the below command :

```
sudo perf stat -e <one of the above parameter> ./SqTester.o
```

1.5 Profiling

perf also supports profiling a program where we can check the calling sequences. A call graph can be got by running the below command :

```
sudo perf report --call-graph --stdio
```

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cache-misses ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
      7,042,267 cache-misses
    10.025278979 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.13: cache-misses in the static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e cache-references ./SqTester.o
[sudo] password for brahmesh:
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
    9,202,007 cache-references
    10.012911207 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.14: cache-references in the static mode

```

Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
    0 cpu/mem-loads/
    10.013696850 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e mem-stores ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':
    20,283,401 cpu/mem-stores/
    10.022385742 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.15: mem-load/mem-stores in the static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat -e mem-stores ./SqTester.o
Invalid or unsupported event: 'mem-st'
Run 'perf list' for a list of valid events

usage: perf stat [<options>] [<command>]

-e, --event <event>  event selector, use 'perf list' to list available events
brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf stat ./SqTester.o
Sender1 Task thread Created
Sender2 Task thread Created
Sender3 Task thread Created
BusDaemon Task thread Created
Receiver1 Task thread Created
Receiver2 Task thread Created
Receiver3 Task thread Created

Parent thread is going to sleep for 10secs now
Waiting for Sender1 to stop sending message
Waiting for Sender2 to stop sending message
Waiting for Sender3 to stop sending message
Waiting for BusDaemon to finish its thread
Waiting for Receiver1 to stop Receiving message
Waiting for Receiver2 to stop Receiving message
Waiting for Receiver3 to stop Receiving message
Main thread Ended

Performance counter stats for './SqTester.o':

    384,128,144 task-clock (msec)          #    0.038 CPUs utilized
      12,487 context-switches             #    0.033 M/sec
         49 cpu-migrations                #    0.128 K/sec
        193 page-faults                  #    0.502 K/sec
    473,669,805 cycles                    #    1.233 GHz
<not supported> stalled-cycles-frontend
    126,000,587 instructions              #    0.27 insns per cycle
    22,049,651 branches                   #   57.402 M/sec
    2,610,339 branch-misses               #   11.87% of all branches

    10.018706187 seconds time elapsed

brahmesh@brahmesh-Lenovo-IdeaPad-Z510:~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$

```

Figure 1.16: General statistics in the static mode

```

brahmesh@brahmesh-Lenovo-IdeaPad-Z510: ~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution
[ perf record: Woken up 1 times to write data ]
[ perf record: Captured and wrote 0.491 MB perf.data (-21470 samples) ]
[ Queue] with build id 1f17fb02b95e9ad56ba0954b73bea31117a57d35 not found, continuing without symbols
brahmesh@brahmesh-Lenovo-IdeaPad-Z510: ~/CS598-Embedded_System_Programming/assignments/ESPAssignment1/Solution$ sudo perf report --call-graph --stdio
# =====
# captured on: Sun Sep 21 17:25:16 2014
# hostname : brahmesh-Lenovo-IdeaPad-Z510
# os release : 3.13.0-35-generic
# perf version : 3.13.11.6
# arch : x86_64
# nr_cpus online : 4
# nr_cpus avail : 4
# cpudesc : Intel(R) Core(TM) i5-4200M CPU @ 2.50GHz
# cpuid : GenuineIntel,6,60,3
# total memory : 8086872 kB
# cmdline : /usr/lib/linux-tools-3.13.0-35/perf record -g ./SqTester.o
# event : name = cycles, type = 0, config = 0x0, config1 = 0xb0, config2 = 0x0, excl_usr = 0, excl_kern = 0, excl_host = 0, excl_guest = 1, precise_ip = 0, attr_map2 = 0, attr_map = 1
# HEADER_CPU_TOPOLOGY info available, use -I to display
# HEADER_NUMA_TOPOLOGY info available, use -I to display
# pmu mappings: cpu = 4, software = 1, tracepoint = 2, breakpoint = 5
# =====
# Samples: 3K of event 'cycles'
# Event count (approx.): 438525613
#
# Overhead      Command      Shared Object      Symbol
# .....
#
# 0.89%  SqTester.o  libc-2.19.so      [.] vfprintf
#      |
#      |--- vfprintf
#      |   |--- _IO_vfprintf
#      |   |   |--- 0x3d64495220203e2d
#      |   |   |--- 0x3d64695320202d3c
#      |   |   |--- 0x3d64495320202d3c
#      |   |--- printf
#      |   |--- start_thread
#      |   |--- 0x3d64495320202d3c
#      |   |--- 0x3d64495220203e2d
#
# 5.86%  SqTester.o  [kernel.kallsyms]  [k] read_hpet
#      |
#      |--- read_hpet

```

Figure 1.17: A call-graph generated with perf tool

Bibliography

- [1] Performance Profiling Analysis using perf
- [2] Perf wiki page