

Submission Details:

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Git Commit ID:

commit df8ba95c572a187ed2aa7403e97a7a7f58c01f00

2) Note whether or not you used a larger count of exits between outputs (1000 or 2000 exits vs the suggested 500)

Answer:

I am displaying the statistics information for every 1000 total exits

3) Include a sample of your print output from dmesg from “with ept” and “without ept”.

Sample Output with EPT (with EPT = 1) :

```
ept=1 (~/) - gedit
Open  Save
[ 3170.428173] Smitha:*****Start Exit Reasons Report*****
[ 3170.428175] Smitha:Total number of exits = 687000
[ 3170.428176] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI      No. of exits:11      Min CPU Cycle: 333      Max CPU cycle: 168755      Avg CPU cycle: 46048
[ 3170.428177] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT  No. of exits:2138    Min CPU Cycle: 19      Max CPU cycle: 3315      Avg CPU cycle: 320
[ 3170.428178] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT    No. of exits:345     Min CPU Cycle: 1130    Max CPU cycle: 96935     Avg CPU cycle: 1989
[ 3170.428179] Smitha:Exit Reason: EXIT_REASON_CPUID                No. of exits:381     Min CPU Cycle: 4090    Max CPU cycle: 40492     Avg CPU cycle: 576
[ 3170.428180] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS             No. of exits:1       Min CPU Cycle: 5630    Max CPU cycle: 5630      Avg CPU cycle: 4477
[ 3170.428180] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS             No. of exits:8088     Min CPU Cycle: 10708   Max CPU cycle: 131073    Avg CPU cycle: 84
[ 3170.428181] Smitha:Exit Reason: EXIT_REASON_ID_INSTRUCTION      No. of exits:674202  Min CPU Cycle: 5200    Max CPU cycle: 6706402   Avg CPU cycle: 1
[ 3170.428181] Smitha:Exit Reason: EXIT_REASON_MSR_READ           No. of exits:4       Min CPU Cycle: 4510    Max CPU cycle: 8875      Avg CPU cycle: 25698
[ 3170.428181] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE          No. of exits:62      Min CPU Cycle: 4885    Max CPU cycle: 9912      Avg CPU cycle: 72
[ 3170.428182] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION  No. of exits:7       Min CPU Cycle: 5701    Max CPU cycle: 8086      Avg CPU cycle: 635
[ 3170.428182] Smitha:Exit Reason: EXIT_REASON_EPT_VIOLATION       No. of exits:926     Min CPU Cycle: 6542    Max CPU cycle: 129338810 Avg CPU cycle: 717
[ 3170.428183] Smitha:Exit Reason: EXIT_REASON_EPT_MISCONFIG      No. of exits:833     Min CPU Cycle: 16421   Max CPU cycle: 568034    Avg CPU cycle: 19
[ 3170.428183] Smitha:Exit Reason: EXIT_REASON_WBINVD            No. of exits:2       Min CPU Cycle: 7226    Max CPU cycle: 7369      Avg CPU cycle: 7899
[ 3170.428184] Smitha:Total CPU cycles = 11195
```

Sample Output without EPT (EPT = 0) :

```
ept=0 (-/) - gedit
[ 3514.765270] Smitha:*****Start Exit Reasons Report*****
[ 3514.765272] Smitha:Total number of exits = 2584800
[ 3514.765273] Smitha:Exit Reason: EXIT_REASON_EXCEPTION_NMI      No. of exits:1165858      Min CPU Cycle: 82      Max CPU cycle: 72461467      Avg CPU cycle: 2
[ 3514.765274] Smitha:Exit Reason: EXIT_REASON_EXTERNAL_INTERRUPT No. of exits:102982      Min CPU Cycle: 19      Max CPU cycle: 193264      Avg CPU cycle: 24
[ 3514.765275] Smitha:Exit Reason: EXIT_REASON_PENDING_INTERRUPT  No. of exits:18198      Min CPU Cycle: 1029    Max CPU cycle: 818757      Avg CPU cycle: 137
[ 3514.765275] Smitha:Exit Reason: EXIT_REASON_CPUID              No. of exits:10873      Min CPU Cycle: 4272    Max CPU cycle: 596589      Avg CPU cycle: 230
[ 3514.765276] Smitha:Exit Reason: EXIT_REASON_HLT               No. of exits:9209       Min CPU Cycle: 6017    Max CPU cycle: 756160      Avg CPU cycle: 271
[ 3514.765276] Smitha:Exit Reason: EXIT_REASON_INVLPG           No. of exits:122767     Min CPU Cycle: 6092    Max CPU cycle: 6878687     Avg CPU cycle: 20
[ 3514.765277] Smitha:Exit Reason: EXIT_REASON_CR_ACCESS         No. of exits:81386      Min CPU Cycle: 6419    Max CPU cycle: 18488870    Avg CPU cycle: 30
[ 3514.765277] Smitha:Exit Reason: EXIT_REASON_DR_ACCESS         No. of exits:2          Min CPU Cycle: 45937   Max CPU cycle: 55493      Avg CPU cycle: 342975
[ 3514.765278] Smitha:Exit Reason: EXIT_REASON_IO_INSTRUCTION       No. of exits:921287     Min CPU Cycle: 5767    Max CPU cycle: 6816076     Avg CPU cycle: 2
[ 3514.765278] Smitha:Exit Reason: EXIT_REASON_MSR_READ          No. of exits:358        Min CPU Cycle: 105     Max CPU cycle: 902953      Avg CPU cycle: 6948
[ 3514.765279] Smitha:Exit Reason: EXIT_REASON_MSR_WRITE          No. of exits:53342      Min CPU Cycle: 5489    Max CPU cycle: 5470187     Avg CPU cycle: 46
[ 3514.765279] Smitha:Exit Reason: EXIT_REASON_PAUSE_INSTRUCTION No. of exits:8          No. of exits:18350     Min CPU Cycle: 5440     Max CPU cycle: 7949593     Avg CPU cycle: 136
[ 3514.765280] Smitha:Exit Reason: EXIT_REASON_WBINVD           No. of exits:8          Min CPU Cycle: 5525    Max CPU cycle: 8506      Avg CPU cycle: 85780
[ 3514.765280] Smitha:Exit Reason: EXIT_REASON_XSETBV           No. of exits:3          Min CPU Cycle: 8412    Max CPU cycle: 18370      Avg CPU cycle: 228651
[ 3514.765281] Smitha:Total CPU Cycles = 7480
```

4) What did you learn from the count of exits? Was the count what you expected? If not, why not?

Answer

The total count of exits show how frequently there is a switch between guest VM and the Hypervisor.

Most of the VM exits happen due to EXIT_REASON_IO_INSTRUCTION which has maximum number of exits and exits like EXIT_REASON_MSR_READ, EXIT_REASON_MSR_WRITE, EXIT_REASON_HLT, EXIT_REASON_EXCEPTION_NMI are comparatively less but still a considerable amount and these counts are expected to be higher in number.

The guest VM cannot execute these because it may change all the contents of memory which it is not supposed to access. So whenever these instructions are encountered, VM exit occurs and the Hypervisor handles it.

Also when nested page table is disabled (with ept=0) the number of exits increases as shadow paging creates more exits and the overhead is more.

5) What changed between two runs (ept vs no-ept) ?

Answer:

With EPT enabled:

No. of exits are less when EPT is enabled

With EPT disabled (ept = 0):

No. of exits are greater when EPT is disabled.