

## KVM虚拟机与特定CPU的绑定

实验过程：

查看当前内核启动时的命令参数：cat /proc/cmdline

修改内核启动参数：

查看宿主机是否隔离成功和当前各个cpu上运行的线程信息：

启动一个拥有俩个VCPU的客户机，并将其VCPU绑定到宿主机的CPU2-3上：

启动客户机：

查看客户机的VCPU线程：

查看并改变客户机VCPU的处理器亲和性：

实验结果：

CPU绑定之后的内核时延：

不同组合测试时延的频数统计

# KVM虚拟机与特定CPU的绑定

## 实验过程：

**查看当前内核启动时的命令参数：cat /proc/cmdline**

**修改内核启动参数：**

使用vim编辑器以root身份打开/etc/default/grub配置文件

在文件中找到以GRUB\_CMDLINE\_LINUX开头的行，在后面增加参数：isolcpus=2,3

保存并退出编辑

使用编辑后的默认文件重新生成GRUB2配置：

grub2-mkconfig -o /boot/grub2/grub.cfg

然后重启计算机

查看本次内核启动时的参数：cat /proc/cmdline

**查看宿主机是否隔离成功和当前各个cpu上运行的线程信息：**

```
ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==3) print $0}'
ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==2) print $0}'
ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==1) print $0}'
ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==0) print $0}'
ps -eLo psr | grep -e "^[[:blank:]]0$" | wc -l
ps -eLo psr | grep -e "^[[:blank:]]1$" | wc -l
ps -eLo psr | grep -e "^[[:blank:]]2$" | wc -l
ps -eLo psr | grep -e "^[[:blank:]]3$" | wc -l
```

```
gpf@rt-base:~  
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)  
[gpf@rt-base ~]$ uname -a  
Linux rt-base 4.18.16-rt9 #1 SMP PREEMPT RT Thu Oct 8 11:52:01 CST 2020 x86_64 x86_64 GNU/Linux  
[gpf@rt-base ~]$ cat /proc/cmdline  
BOOT_IMAGE=(hd0,msdos1)/vmlinuz-4.18.16-rt9 root=/dev/mapper/cl-root ro crashkernel=auto resume=/dev/mapper/cl-swap rd.lvm.lv=cl/root rd.lvm.lv=cl/  
swap rhgb quiet isolcpus=2,3  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*3$" | wc -l  
13  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*2$" | wc -l  
15  
[gpf@rt-base ~]$ ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==3) print $0}'  
root      37      2      37      3 [cpuhp/3]  
root      38      2      38      3 [watchdog/3]  
root      39      2      39      3 [migration/3]  
root      40      2      40      3 [posixcpumr/3]  
root      41      2      41      3 [rcuc/3]  
root      42      2      42      3 [ktimersoftd/3]  
root      43      2      43      3 [ksoftirqd/3]  
root      44      2      44      3 [kworker/3:0-mm_percpu_wq]  
root      45      2      45      3 [kworker/3:0H-events_highpri]  
root      67      2      67      3 [kworker/3:1-mm_percpu_wq]  
root     131      2     131      3 [irq/26-PCIe PME]  
root     137      2     137      3 [irq/20-ehci_hcd]  
root     1390      2    1390      3 [kworker/3:1H-events_highpri]  
[gpf@rt-base ~]$ ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==2) print $0}'  
root      28      2      28      2 [cpuhp/2]  
root      29      2      29      2 [watchdog/2]  
root      30      2      30      2 [migration/2]  
root      31      2      31      2 [posixcpumr/2]  
root      32      2      32      2 [rcuc/2]  
root      33      2      33      2 [ktimersoftd/2]  
root      34      2      34      2 [ksoftirqd/2]  
root      35      2      35      2 [kworker/2:0-mm_percpu_wq]  
root      36      2      36      2 [kworker/2:0H-events_highpri]  
root      66      2      66      2 [kworker/2:1-mm_percpu_wq]  
root     130      2     130      2 [irq/25-PCIe PME]  
root     133      2     133      2 [irq/28-PCIe PME]  
root     140      2     140      2 [irq/8-rtc0]  
root     1119      2    1119      2 [irq/36-enp2s0]  
root     1389      2    1389      2 [kworker/2:1H-events_highpri]  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*1$" | wc -l  
346  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*0$" | wc -l  
292
```

```
gpf@rt-base:~  
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)  
root     1119      2    1119      2 [irq/36-enp2s0]  
root     1389      2    1389      2 [kworker/2:1H-events_highpri]  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*1$" | wc -l  
346  
[gpf@rt-base ~]$ ps -eLo psr | grep -e "^[[:blank:]]*0$" | wc -l  
292  
[gpf@rt-base ~]$ ps -eLo ruser,pid,ppid,lwp,psr,args | awk '{if ($5==1) print $0}'  
root      11      2      11      1 [rcu_preempt]  
root      12      2      12      1 [rcu_sched]  
root      14      2      14      1 [kswork]  
root      19      2      19      1 [cpuhp/1]  
root      20      2      20      1 [watchdog/1]  
root      21      2      21      1 [migration/1]  
root      22      2      22      1 [posixcpumr/1]  
root      23      2      23      1 [rcuc/1]  
root      24      2      24      1 [ktimersoftd/1]  
root      25      2      25      1 [ksoftirqd/1]  
root      26      2      26      1 [kworker/1:0-mm_percpu_wq]  
root      27      2      27      1 [kworker/1:0H-kblockd]  
root      47      2      47      1 [kdevtmpfs]  
root      48      2      48      1 [netns]  
root      53      2      53      1 [kworker/1:1-events_freezable_power_]  
root      55      2      55      1 [oom_reaper]  
root      56      2      56      1 [writeback]  
root      60      2      60      1 [kintegrityd]  
root      62      2      62      1 [irq/9-acpi]  
root      63      2      63      1 [md]  
root      64      2      64      1 [edac-poller]  
root      78      2      78      1 [kswapd0]  
root      97      2      97      1 [kworker/u8:1-events_unbound]  
root     129      2     129      1 [kthrotld]  
root     132      2     132      1 [irq/27-PCIe PME]  
root     134      2     134      1 [acpi_thermal_pm]  
root     135      2     135      1 [kmpath_rdacd]  
root     142      2     142      1 [kstrp]  
root     201      2     201      1 [kworker/1:2-events]  
root     202      2     202      1 [kworker/1:3-events_freezable_power_]  
root     375      2     375      1 [kworker/1:4-mm_percpu_wq]  
root     392      2     392      1 [kworker/u8:2-events_unbound]  
root     395      2     395      1 [scsi_tmf_0]  
root     396      2     396      1 [usb-storage]  
root     422      2     422      1 [ata_sff]  
root     426      2     426      1 [irq/30-ahci.000]
```

根据输出信息可以看到cpu3-2上运行的进程和线程信息，分别有

migration线程：用于进程在不同CPU间迁移；

kworker线程：用于处理workqueues；

ksoftirqd线程：用于调度CPU软中断的进程；

watchdog:

cpuhp:

posixcpumr:

这些进程都是内核对各个CPU的守护进程。没有其他的普通进程在CPU2-3上运行，说明隔离是有效的。

启动一个拥有俩个VCPU的客户机，并将其VCPU绑定到宿主机的CPU2-3上：

启动客户机：

```
gpf@rt-base:~/centos
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)
qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos.img -boot d
```

查看客户机的VCPU线程：

```
localhost:5900 (QEMU (guest)) - VNC Viewer
compat_monitor0 console
c/QEMU 2.12.0 monitor - type 'help' for more information
c/(qemu) info cpus
c/* CPU #0: thread_id=2866
c/ CPU #1: thread_id=2867
c/(qemu) █
```

查看并改变客户机VCPU的处理器亲和性：

```
gpf@rt-base:~
文件(F) 编辑(E) 查看(V) 搜索(S) 终端(T) 帮助(H)
[gpf@rt-base ~]$ ps -eLo ruser,pid,ppid,lwp,psr,args | grep qemu | grep -v grep
gpf      2860      2859      2860      0 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2861      1 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2865      0 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2866      1 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2867      0 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2869      0 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      3103      0 qemu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
[gpf@rt-base ~]$ taskset -pc 3 2860
pid 2860 的当前亲和列表: 0,1
pid 2860 的新亲和列表: 3
[gpf@rt-base ~]$ taskset -pc 3 2866
pid 2866 的当前亲和列表: 0,1
pid 2866 的新亲和列表: 3
[gpf@rt-base ~]$ taskset -pc 2 2867
pid 2867 的当前亲和列表: 0,1
pid 2867 的新亲和列表: 2
[gpf@rt-base ~]$ ps -eLo ruser,pid,ppid,lwp,psr,args | grep qemu | grep -v grep
gpf      2860      2859      2860      3 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2861      1 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2865      0 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2866      3 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2867      2 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      2869      1 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
gpf      2860      2859      3188      3 emu-kvm -m 4096 -enable-kvm -smp 2 -name guest -hda centos2.img -boot d
[gpf@rt-base ~]$ █
```

```
ps -eLo ruser,pid,ppid,lwp,psr,args | grep qemu | grep -v grep
```

其中，

-e:显示所有进程

L: 显示所有线程

-o:以用户自定义的格式输出

ruser:运行进程的用户名

pid:进程id

ppid:父进程id

lwp:线程的id

psr: 系统当前分配给进程运行的处理器编号

args:运行的命令及其参数

实验结果：

## CPU绑定之后的内核时延:

GP-GP:

```
localhost:5900 (QEMU (guest)) - VNC Viewer
T: 0 ( 1398) P:80 I:10000 C: 10000 Min:      7 Act:   13 Avg:   39 Max:   399
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.02 0.00 1/120 1417

T: 0 ( 1417) P:80 I:10000 C: 10000 Min:      5 Act:   49 Avg:   49 Max:   440
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.01 0.00 1/120 1421

T: 0 ( 1421) P:80 I:10000 C: 10000 Min:     12 Act:   22 Avg:   52 Max:   226
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/116 1428

T: 0 ( 1427) P:80 I:10000 C: 10000 Min:      6 Act:   59 Avg:   52 Max:   158
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.03 0.01 0.00 1/116 1434

T: 0 ( 1432) P:80 I:10000 C: 10000 Min:      6 Act:   48 Avg:   51 Max:   238
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/116 1439

T: 0 ( 1439) P:80 I:10000 C: 10000 Min:      6 Act:   26 Avg:   47 Max:   333
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/116 1445

T: 0 ( 1443) P:80 I:10000 C: 10000 Min:      7 Act:   55 Avg:   31 Max:   205
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/116 1450

T: 0 ( 1450) P:80 I:10000 C: 10000 Min:      6 Act:   65 Avg:   49 Max:   334
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
[sudo] password for gpf:
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/117 1466

T: 0 ( 1462) P:80 I:10000 C: 10000 Min:      7 Act:   53 Avg:   50 Max:   131
[gpf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.04 0.01 0.00 1/118 1485

T: 0 ( 1483) P:80 I:10000 C: 10000 Min:      6 Act:   44 Avg:   50 Max:   162
[gpf@localhost rt-tests]$
```

GP-RT:

```
11/1/2018 10:21
localhost:5900 (QEMU (guest)) - VNC Viewer x

T: 0 ( 1186) P:80 I:10000 C: 10000 Min:    7 Act:  151 Avg:  124 Max:   474
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.24 0.15 0.09 1/134 1197

T: 0 ( 1195) P:80 I:10000 C: 10000 Min:    7 Act:   24 Avg:  126 Max:   242
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.56 0.25 0.13 1/133 1201

T: 0 ( 1201) P:80 I:10000 C: 10000 Min:    5 Act:   12 Avg:   68 Max:   232
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.24 0.20 0.12 1/132 1208

T: 0 ( 1207) P:80 I:10000 C: 10000 Min:    5 Act:  122 Avg:  142 Max:   258
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.39 0.26 0.15 1/132 1212

T: 0 ( 1212) P:80 I:10000 C: 10000 Min:    6 Act:  159 Avg:  134 Max:   231
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.38 0.27 0.17 1/132 1217

T: 0 ( 1216) P:80 I:10000 C: 10000 Min:    6 Act:  123 Avg:  131 Max:   187
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.37 0.26 0.17 1/132 1223

T: 0 ( 1221) P:80 I:10000 C: 10000 Min:    4 Act:  162 Avg:  133 Max:   363
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.52 0.33 0.21 1/132 1227

T: 0 ( 1227) P:80 I:10000 C: 10000 Min:    7 Act:  151 Avg:  122 Max:   294
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.41 0.34 0.23 1/132 1232

T: 0 ( 1231) P:80 I:10000 C: 10000 Min:    6 Act:  124 Avg:  129 Max:   521
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.42 0.35 0.24 1/132 1236

T: 0 ( 1236) P:80 I:10000 C: 10000 Min:    4 Act:  162 Avg:  120 Max:   242
[gppf@localhost rt-tests]$
```

RT-GP:

```
T: 0 ( 1387) P:80 I:10000 C: 10000 Min: 12 Act: 50 Avg: 54 Max: 95
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.01 0.00 1/119 1396

T: 0 ( 1396) P:80 I:10000 C: 10000 Min: 14 Act: 57 Avg: 48 Max: 86
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.01 0.00 1/117 1405

T: 0 ( 1404) P:80 I:10000 C: 10000 Min: 8 Act: 52 Avg: 51 Max: 115
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/118 1415

T: 0 ( 1409) P:80 I:10000 C: 10000 Min: 7 Act: 10 Avg: 49 Max: 84
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/118 1419

T: 0 ( 1419) P:80 I:10000 C: 10000 Min: 8 Act: 14 Avg: 52 Max: 222
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/118 1425

T: 0 ( 1423) P:80 I:10000 C: 10000 Min: 7 Act: 44 Avg: 51 Max: 107
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/117 1431

T: 0 ( 1429) P:80 I:10000 C: 10000 Min: 6 Act: 51 Avg: 43 Max: 385
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/117 1435

T: 0 ( 1435) P:80 I:10000 C: 10000 Min: 6 Act: 35 Avg: 50 Max: 256
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.00 0.00 0.00 1/117 1439

T: 0 ( 1439) P:80 I:10000 C: 10000 Min: 6 Act: 38 Avg: 44 Max: 243
[gppf@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.01 0.01 0.00 1/117 1445

T: 0 ( 1443) P:80 I:10000 C: 10000 Min: 8 Act: 46 Avg: 55 Max: 136
[gppf@localhost rt-tests]$ _
```

RT-RT:

localhost:5900 (QEMU (guest)) - VNC Viewer

```
T: 0 ( 1207) P:80 I:10000 C: 10000 Min:      6 Act:   54 Avg:   56 Max:   277
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.43 0.25 0.15 1/134 1218

T: 0 ( 1216) P:80 I:10000 C: 10000 Min:      7 Act:   56 Avg:   55 Max:   205
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.47 0.30 0.18 1/131 1222

T: 0 ( 1222) P:80 I:10000 C: 10000 Min:     24 Act:   54 Avg:   54 Max:   232
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.41 0.30 0.20 1/132 1228

T: 0 ( 1227) P:80 I:10000 C: 10000 Min:      7 Act:   56 Avg:   49 Max:   232
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.23 0.25 0.18 1/132 1234

T: 0 ( 1234) P:80 I:10000 C: 10000 Min:      8 Act:   56 Avg:   50 Max:   211
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.29 0.28 0.20 1/132 1244

T: 0 ( 1238) P:80 I:10000 C: 10000 Min:      6 Act:   57 Avg:   48 Max:   140
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.32 0.30 0.21 1/132 1248

T: 0 ( 1248) P:80 I:10000 C: 10000 Min:      9 Act:   60 Avg:   56 Max:   259
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.51 0.37 0.25 1/133 1265

T: 0 ( 1252) P:80 I:10000 C: 10000 Min:      8 Act:   33 Avg:   56 Max:   158
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.28 0.34 0.25 1/133 1271

T: 0 ( 1269) P:80 I:10000 C: 10000 Min:      7 Act:   48 Avg:   52 Max:   275
[gprof@localhost rt-tests]$ sudo ./cyclicttest -t 1 -p 80 -n -i 10000 -l 10000
# /dev/cpu_dma_latency set to 0us
policy: fifo: loadavg: 0.24 0.28 0.24 1/133 1275

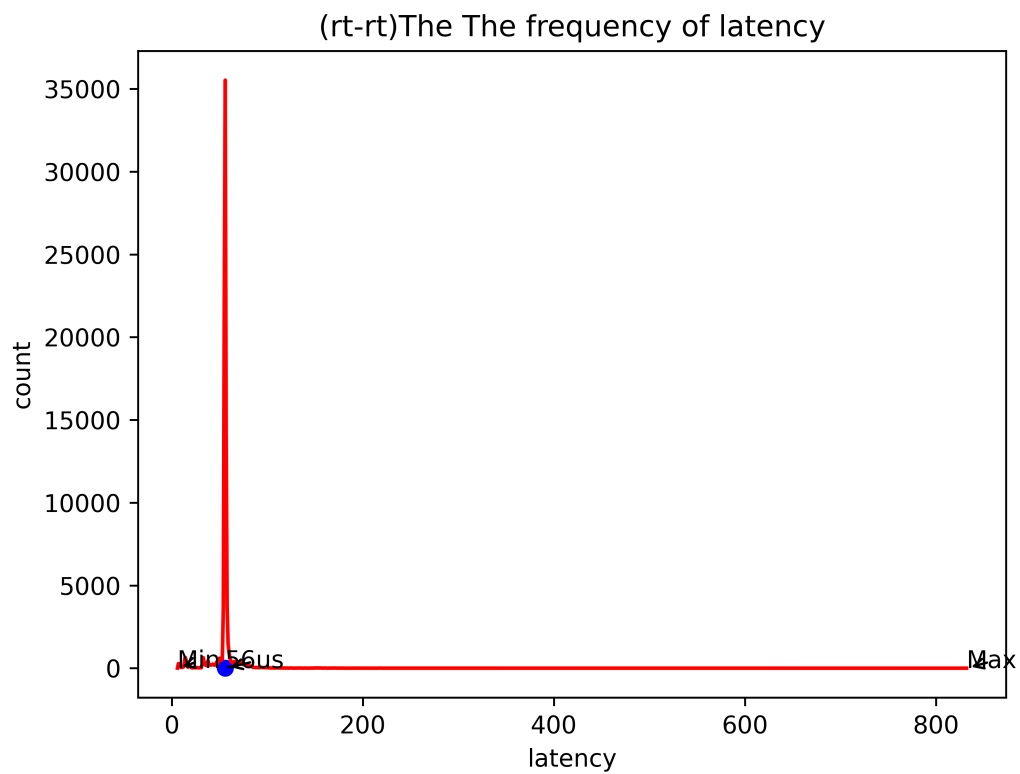
T: 0 ( 1275) P:80 I:10000 C: 10000 Min:      7 Act:   51 Avg:   56 Max:   202
[gprof@localhost rt-tests]$ _
```

不同组合内核时延统计：

| 宿主机<br>\客户机 | GP  | RT   |
|-------------|---|--|
| GP          | 717、399、448、226、158、238、<br>333、205、334、131、162 | 474、242、232、258、231、187、<br>363、294、521、242、 |
| RT          | 95、86、115、84、222、107、385、<br>256、243、136        | 277、205、232、232、211、148、<br>259、158、275、202  |

## 不同组合测试时延的频数统计

- RT-RT

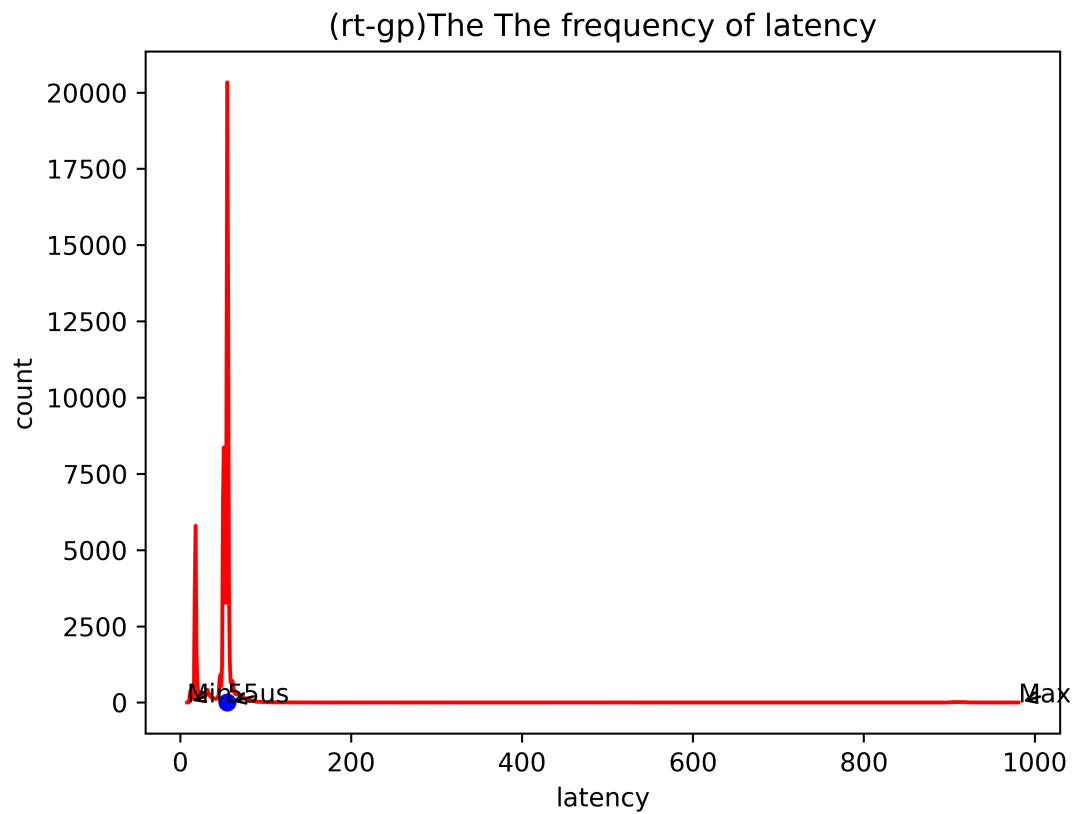


出现频率最高的时延是55us，一共出现了35522次。

```
(torch) [gpf@legion 20201201 (master X)]$ python show_freq.py ./kvm/ans.txt rt-r  
t  
35522  
The most frequency lactency is 56. It appeared 35522 times
```

- RT-GP

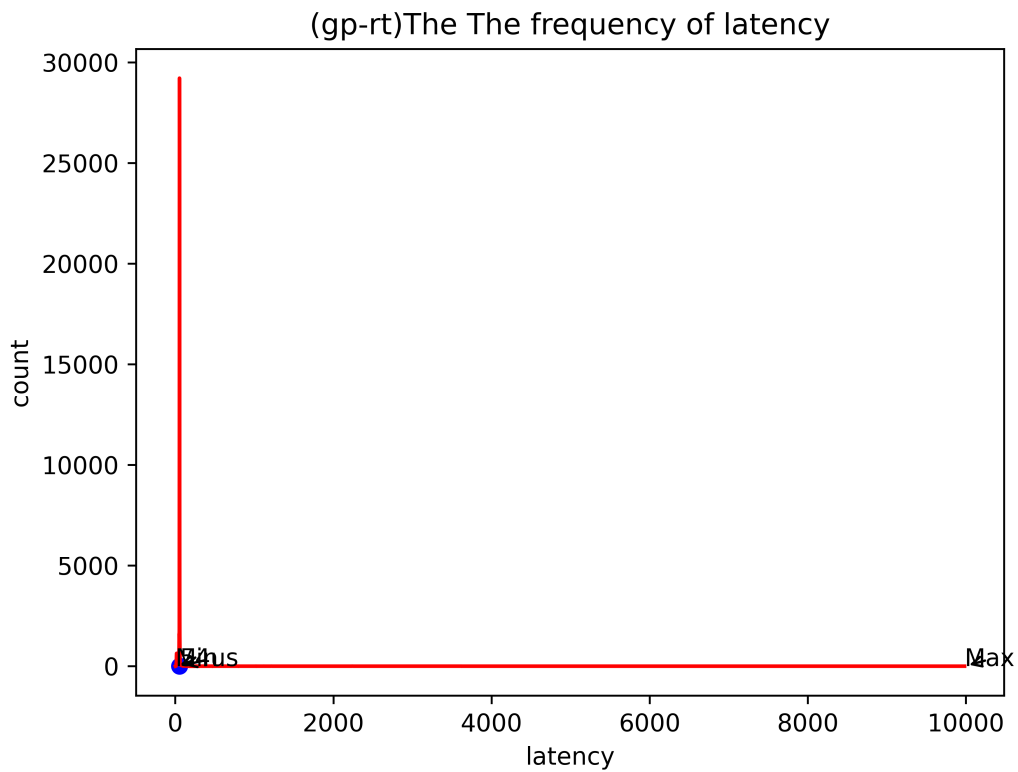




出现频率最高的时延是55us，一共出现了20334次。

```
(torch) [gpf@legion 20201201 (master X)]$ python show_freq.py ./kvm/ans2.txt rt-gp
20334    No packages published
The most frequency lactency is 55. It appeared 20334 times
```

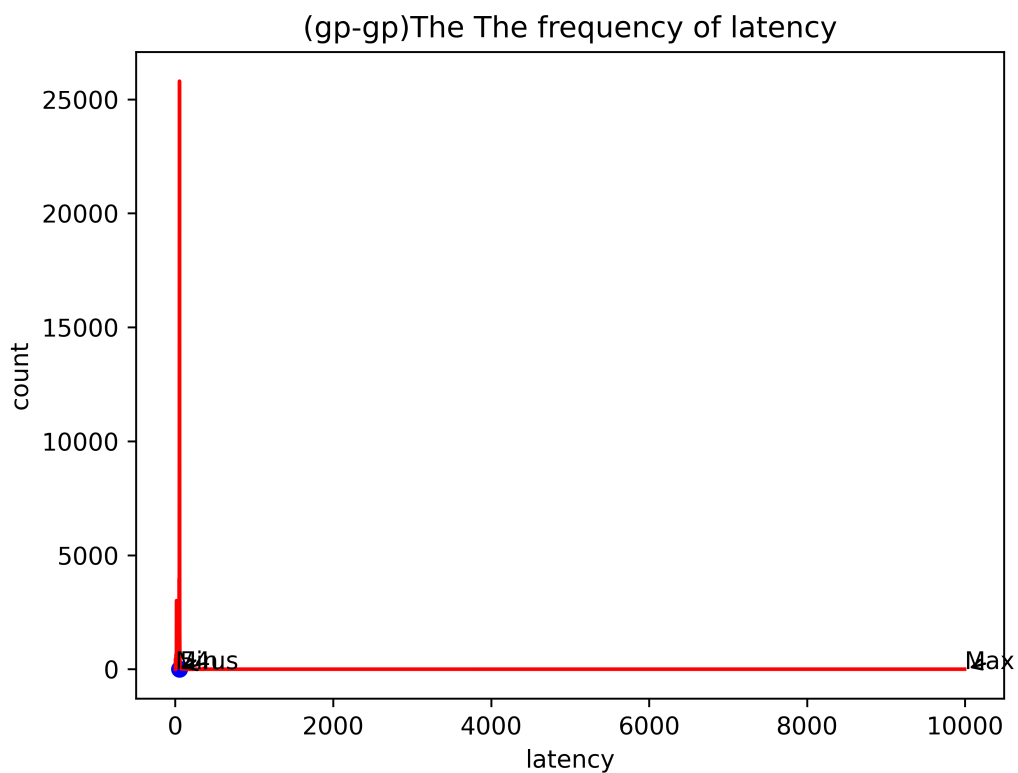
- GP-RT



出现频率最高的时延是54us，一共出现了29215次。

```
(torch) [gpf@legion 20201201 (master X)]$ python show_freq.py ./kvm/ans3.txt gp-rt
29215      6000      8000      10000
The most frequency lactory is 54. It appeared 29215 times
```

- GP-GP



出现频率最高的时延是54us，一共出现了25795次。

```
(torch) [gpf@legion 20201201 (master X)]$ python show_freq.py ./kvm/gp-gp.txt gp  
-gp  
25795  
The most frequency lactency is 54. It appeared 25795 times
```