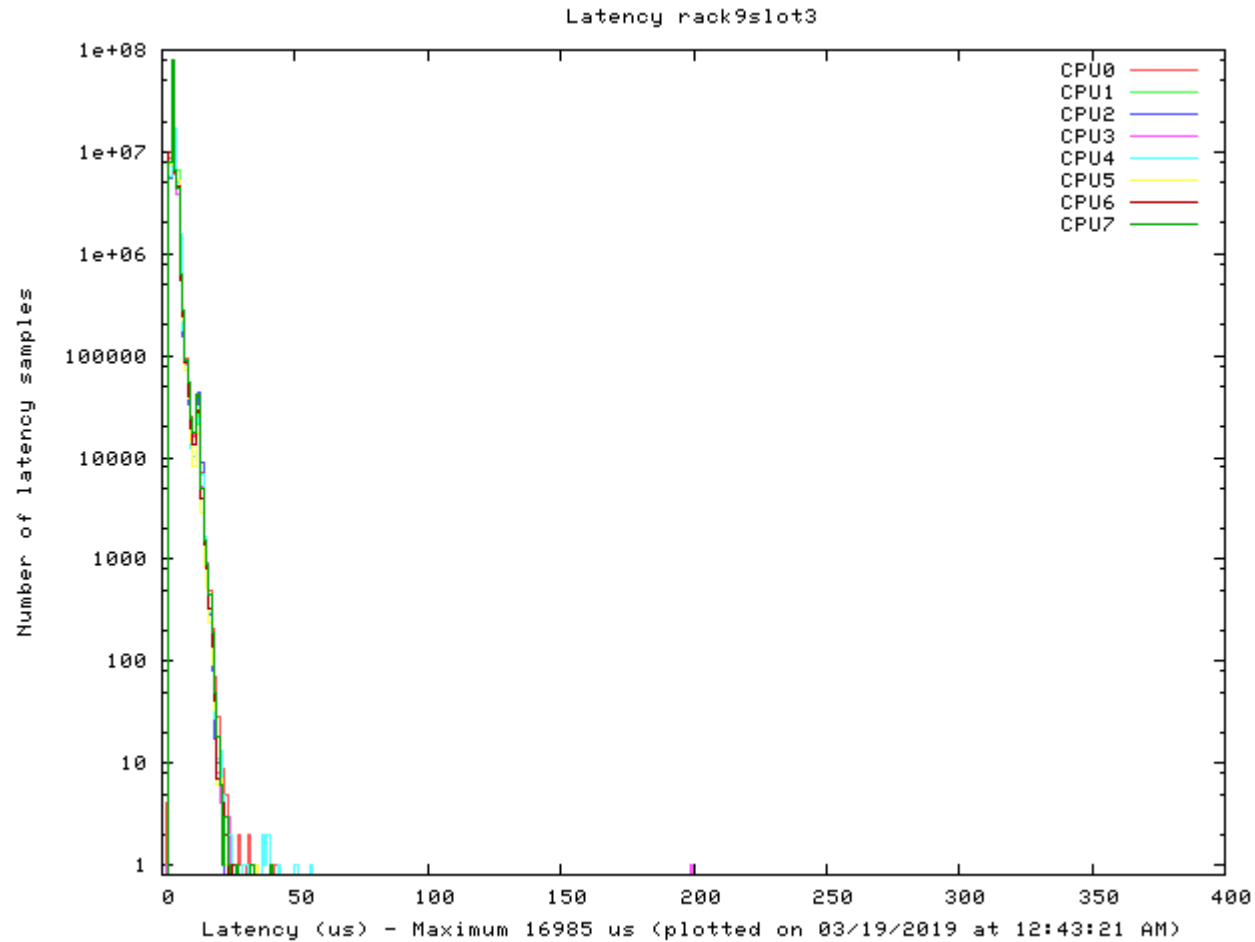


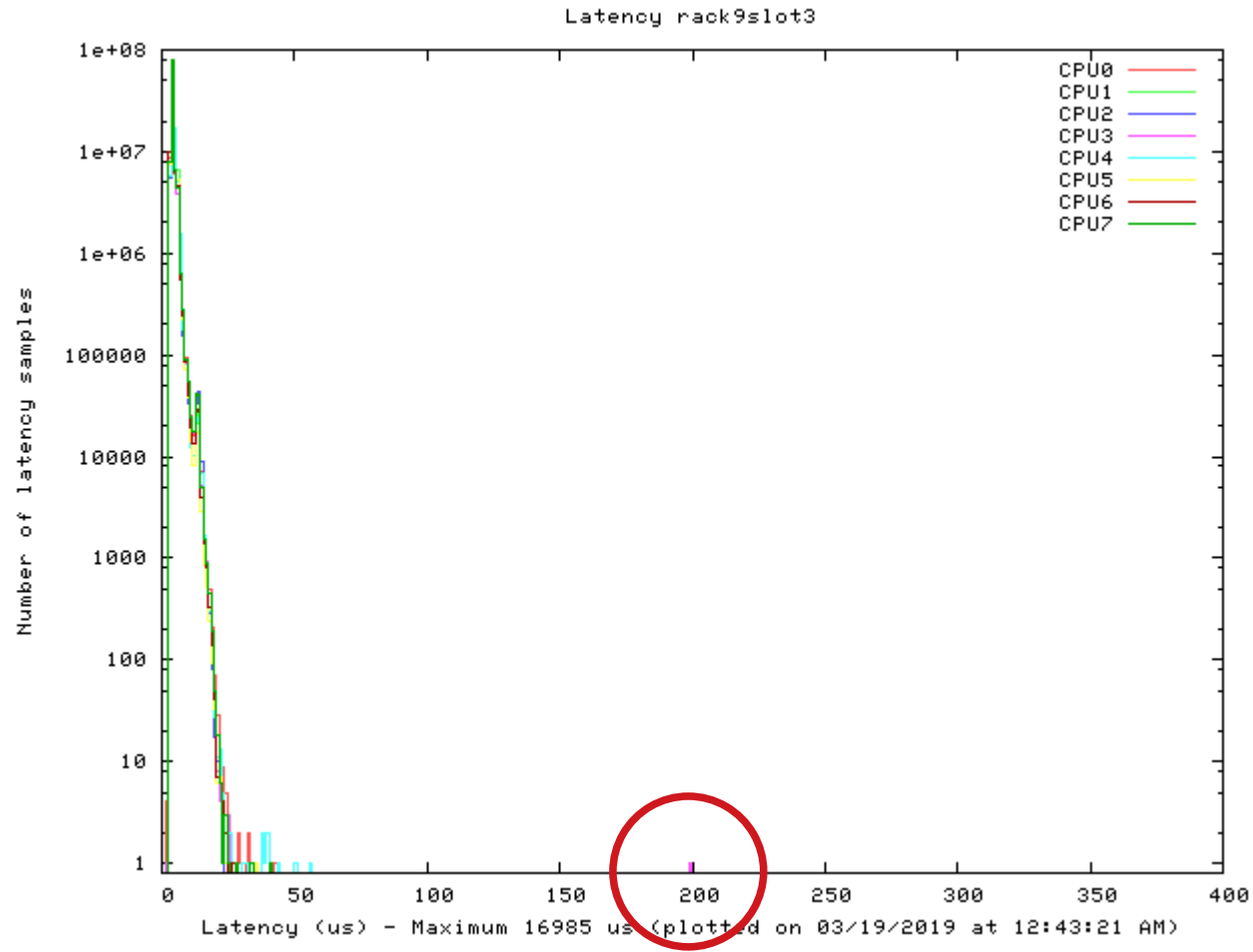
Open Source in Industry: Linux tracing and debugging/ Trouble shooting of real-time Linux

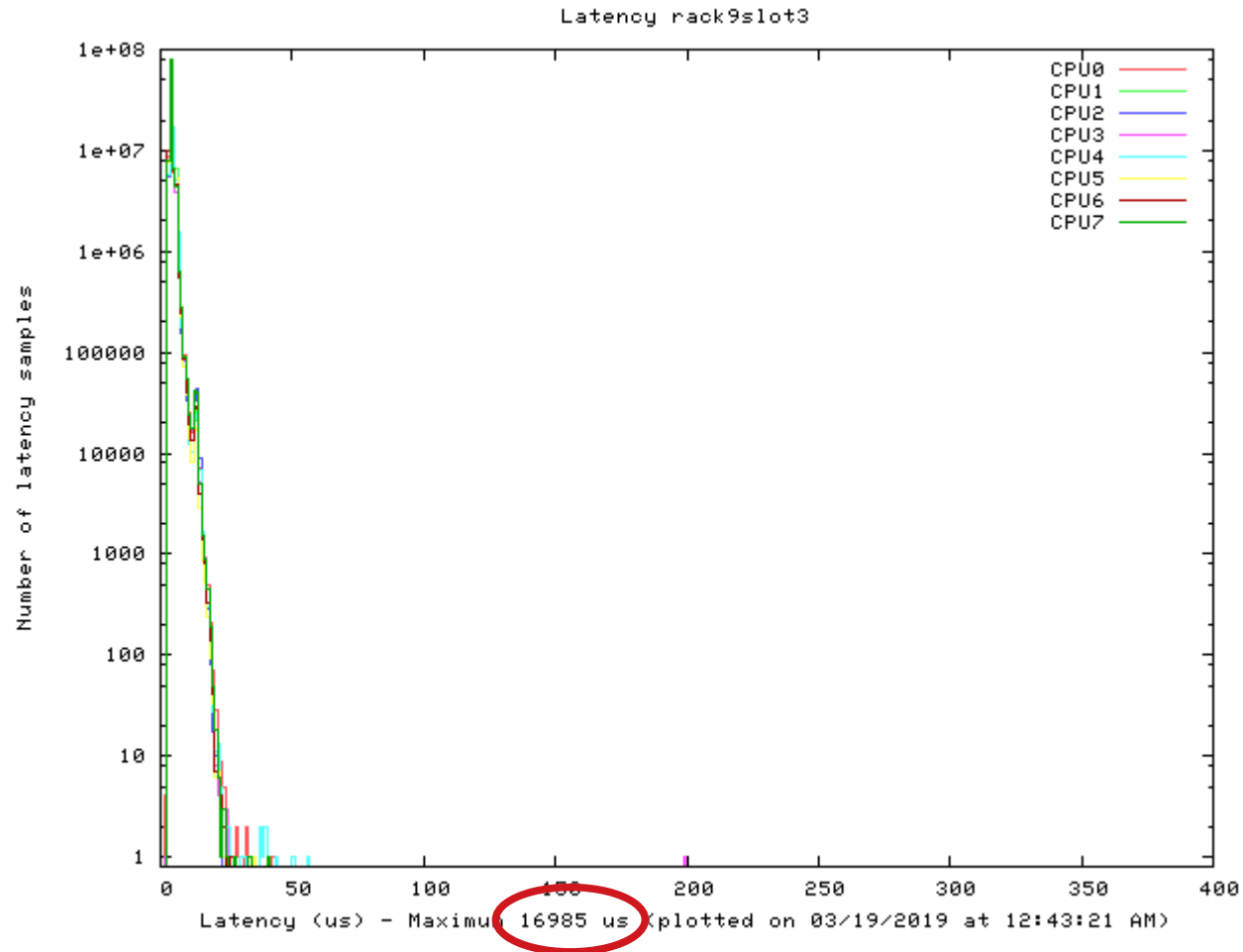
Technical Heidelberg OSADL Talks, Online Session

Latency fighting

Latency fighting case #1







Culprit/victim table

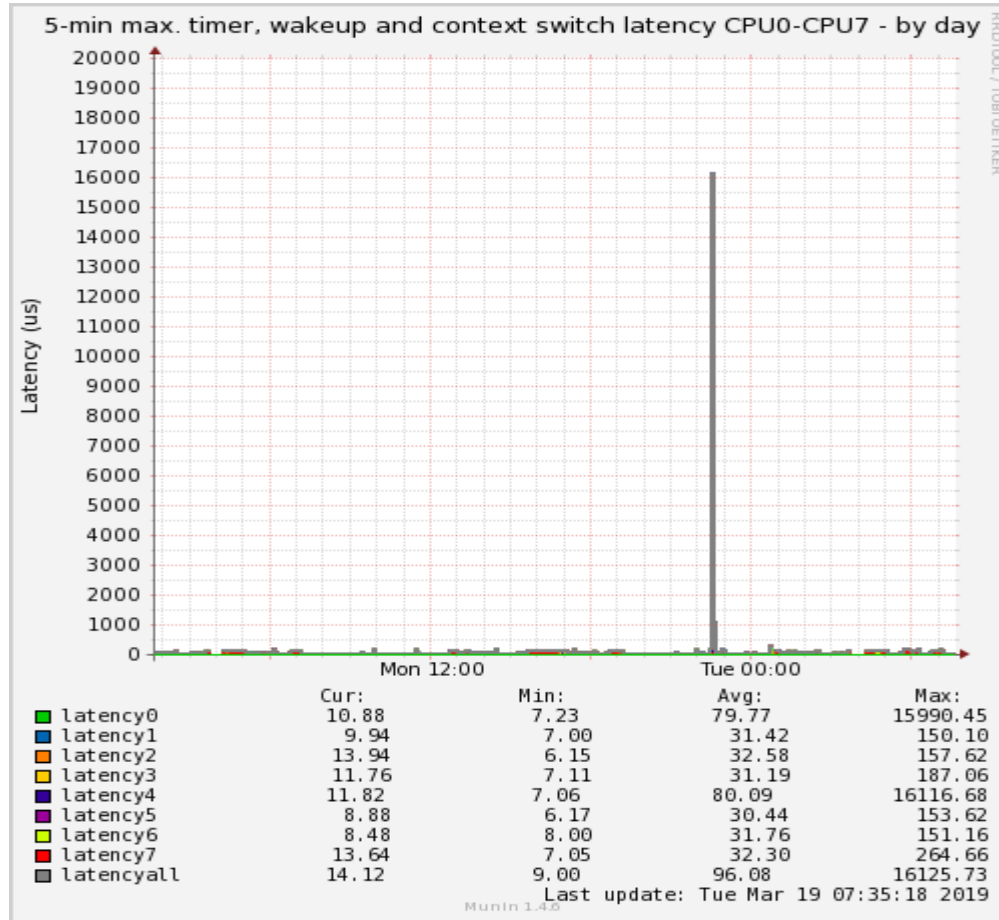
| Characteristics of the 20 highest latencies: System rack9slot3.osadl.org (updated Tue Mar 19, 2019 00:43:28) | | | | | | | | | |
|---|------|--------------------|-----------------------|-----------|--------------------|------|------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 9952 | 99 | 16981 | 0,16980 | cyclctest | 25744 | -21 | modprobe | 22:34:26 | 4 |
| 9948 | 99 | 16848 | 0,16846 | cyclctest | 25744 | -21 | modprobe | 22:34:26 | 0 |
| 9951 | 99 | 196 | 194,1 | cyclctest | 28093 | -21 | cat | 22:27:59 | 3 |
| 13655 | 2 | 156 | 0,1 | sleep1 | 3657 | -21 | runrttasks | 22:51:09 | 1 |
| 28522 | 2 | 154 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 21:59:59 | 6 |
| 22371 | 2 | 137 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 22:59:58 | 1 |
| 9742 | 2 | 94 | 49,15 | sleep2 | 0 | -21 | swapper/2 | 19:07:55 | 2 |
| 9640 | 2 | 90 | 49,34 | sleep3 | 0 | -21 | swapper/3 | 19:06:28 | 3 |
| 9856 | 2 | 81 | 48,25 | sleep4 | 0 | -21 | swapper/4 | 19:09:34 | 4 |
| 9800 | 2 | 73 | 53,13 | sleep6 | 0 | -21 | swapper/6 | 19:08:48 | 6 |
| 9601 | 2 | 73 | 51,15 | sleep0 | 0 | -21 | swapper/0 | 19:05:53 | 0 |
| 9866 | 2 | 72 | 51,14 | sleep5 | 0 | -21 | swapper/5 | 19:09:43 | 5 |
| 9653 | 2 | 72 | 51,14 | sleep7 | 0 | -21 | swapper/7 | 19:06:40 | 7 |
| 9629 | 2 | 72 | 50,15 | sleep1 | 0 | -21 | swapper/1 | 19:06:18 | 1 |
| 9952 | 99 | 53 | 0,52 | cyclctest | 0 | -21 | swapper/4 | 21:14:56 | 4 |
| 9115 | 2 | 36 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 22:47:40 | 1 |
| 5127 | 2 | 36 | 0,0 | sleep7 | 0 | -21 | swapper/7 | 00:10:03 | 7 |
| 11408 | 2 | 36 | 0,0 | sleep5 | 0 | -21 | swapper/5 | 23:46:36 | 5 |
| 30046 | 2 | 34 | 0,1 | sleep0 | 30048 | -21 | sh | 22:37:29 | 0 |
| 3665 | 2 | 33 | 0,1 | sleep1 | 0 | -21 | swapper/1 | 22:05:23 | 1 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot3.osadl.org (updated Tue Mar 19, 2019 00:43:28) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 9952 | 99 | 16981 | 0,16980 | cyclicttest | 25744 | -21 | modprobe | 22:34:26 | 4 |
| 9948 | 99 | 16848 | 0,16846 | cyclicttest | 25744 | -21 | modprobe | 22:34:26 | 0 |
| 9951 | 99 | 196 | 194,1 | cyclicttest | 28093 | -21 | cat | 22:27:59 | 3 |
| 13655 | 2 | 156 | 0,1 | sleep1 | 3657 | -21 | runrttasks | 22:51:09 | 1 |
| 28522 | 2 | 154 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 21:59:59 | 6 |
| 22371 | 2 | 137 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 22:59:58 | 1 |
| 9742 | 2 | 94 | 49,15 | sleep2 | 0 | -21 | swapper/2 | 19:07:55 | 2 |
| 9640 | 2 | 90 | 49,34 | sleep3 | 0 | -21 | swapper/3 | 19:06:28 | 3 |
| 9856 | 2 | 81 | 48,25 | sleep4 | 0 | -21 | swapper/4 | 19:09:34 | 4 |
| 9800 | 2 | 73 | 53,13 | sleep6 | 0 | -21 | swapper/6 | 19:08:48 | 6 |
| 9601 | 2 | 73 | 51,15 | sleep0 | 0 | -21 | swapper/0 | 19:05:53 | 0 |
| 9866 | 2 | 72 | 51,14 | sleep5 | 0 | -21 | swapper/5 | 19:09:43 | 5 |
| 9653 | 2 | 72 | 51,14 | sleep7 | 0 | -21 | swapper/7 | 19:06:40 | 7 |
| 9629 | 2 | 72 | 50,15 | sleep1 | 0 | -21 | swapper/1 | 19:06:18 | 1 |
| 9952 | 99 | 53 | 0,52 | cyclicttest | 0 | -21 | swapper/4 | 21:14:56 | 4 |
| 9115 | 2 | 36 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 22:47:40 | 1 |
| 5127 | 2 | 36 | 0,0 | sleep7 | 0 | -21 | swapper/7 | 00:10:03 | 7 |
| 11408 | 2 | 36 | 0,0 | sleep5 | 0 | -21 | swapper/5 | 23:46:36 | 5 |
| 30046 | 2 | 34 | 0,1 | sleep0 | 30048 | -21 | sh | 22:37:29 | 0 |
| 3665 | 2 | 33 | 0,1 | sleep1 | 0 | -21 | swapper/1 | 22:05:23 | 1 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)



Let's have a look at dmesg

```
# dmesg | tail -11
```

```
[7216.176506] CPU3: Core temperature above threshold, cpu clock throttled (total events = 1)
[7216.176507] CPU7: Core temperature above threshold, cpu clock throttled (total events = 1)
[7216.176509] CPU5: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176510] CPU1: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176512] CPU6: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176514] CPU4: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176515] CPU2: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176516] CPU0: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176517] CPU7: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176518] CPU3: Package temperature above threshold, cpu clock throttled (total events = 1)
[7216.176532] mce: [Hardware Error]: Machine check events logged
```

At the time of the latency, a new module appeared

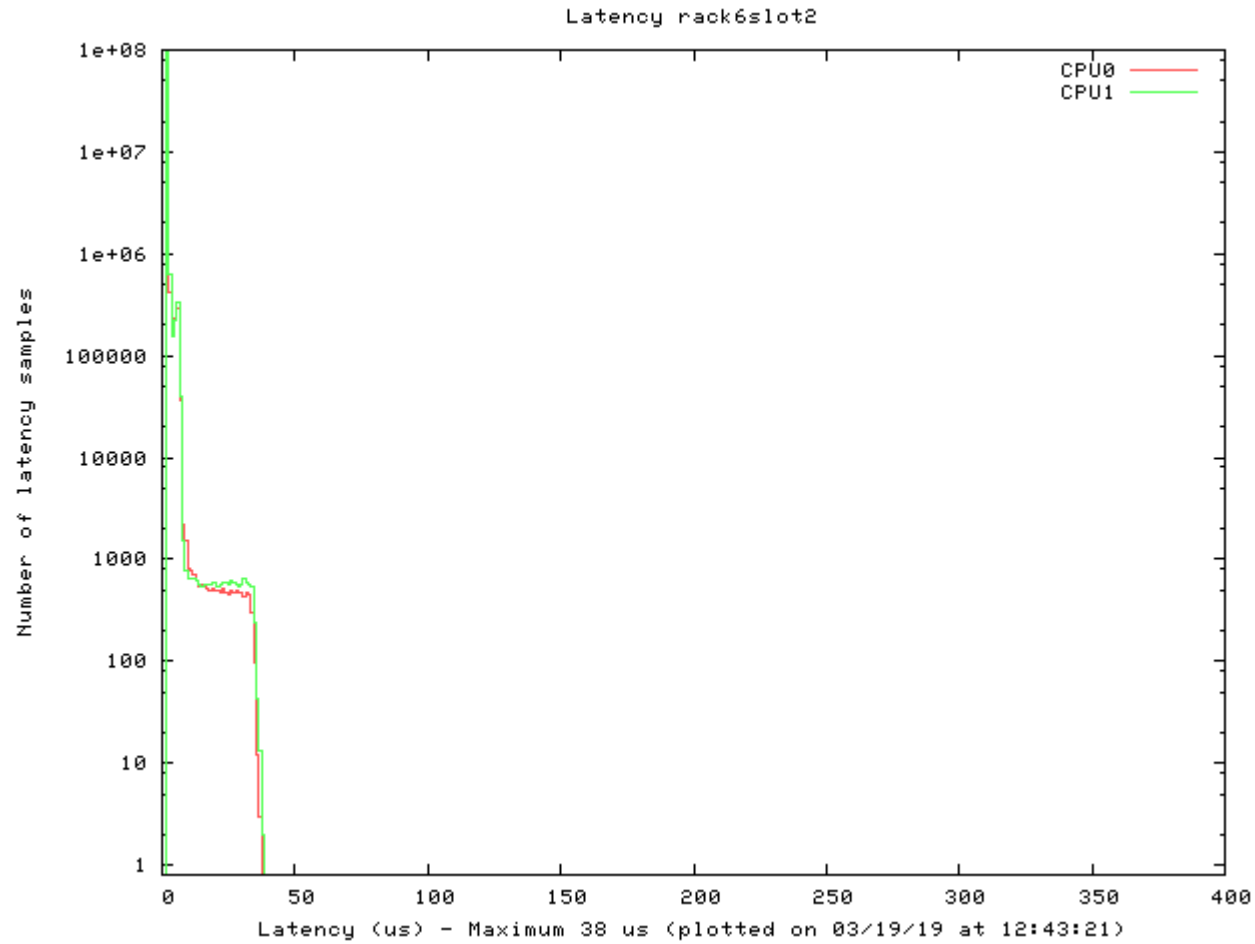
```
# lsmod | head
```

| Module | Size | Used by |
|------------|--------------|-----------------|
| msr | 16384 | 16 |
| eeeprom | 16384 | 0 |
| nfsv4 | 409600 | 2 |
| ppdev | 16384 | 0 |
| bnep | 20480 | 2 |
| lp | 20480 | 0 |
| rfcomm | 36864 | 0 |
| bluetooth | 299008 | 10 bnep, rfcomm |
| rfkill | 20480 | 2 bluetooth |

Countermeasures

- Quick fix
 - Load the *msr* module immediately after the system was booted
- Better
 - File a bug
- Even better
 - Fix it yourself
 - ✓ Analyze the init part of *msr*.
 - ✓ Search for busy loops or similar while preemption and/or interrupts are disabled.
 - ✓ Alternatively, use *cyclictest*'s breaktrace feature and function tracing to pinpoint the culprit.
 - ✓ Shorten the busy loop, allow intermittent interrupt execution and preemption.

Latency fighting case #2



Culprit/victim table

| Characteristics of the 20 highest latencies: System rack6slot2.osadl.org (updated Mon Mar 18, 2019 00:43:27) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|-----------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 5528 | 2 | 114 | 0,1 | sleep1 | 21 | -21 | rcuc/1 | 19:31:47 | 1 |
| 18185 | 2 | 61 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 21:32:02 | 1 |
| 28116 | 2 | 43 | 8,8 | sleep1 | 0 | -21 | swapper/1 | 19:05:18 | 1 |
| 28316 | 99 | 39 | 32,6 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:36:47 | 1 |
| 28316 | 99 | 38 | 33,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:41:45 | 1 |
| 28316 | 99 | 38 | 32,5 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 00:11:50 | 1 |
| 28316 | 99 | 38 | 31,6 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 22:54:36 | 1 |
| 28316 | 99 | 37 | 34,2 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:13:03 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:43:28 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:06:47 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:56:53 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 19:26:50 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 19:12:46 | 1 |
| 28316 | 99 | 37 | 31,5 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:52:05 | 1 |
| 28316 | 99 | 36 | 33,2 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 22:20:44 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:41:50 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:26:47 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:45:53 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:35:53 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:03:54 | 1 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

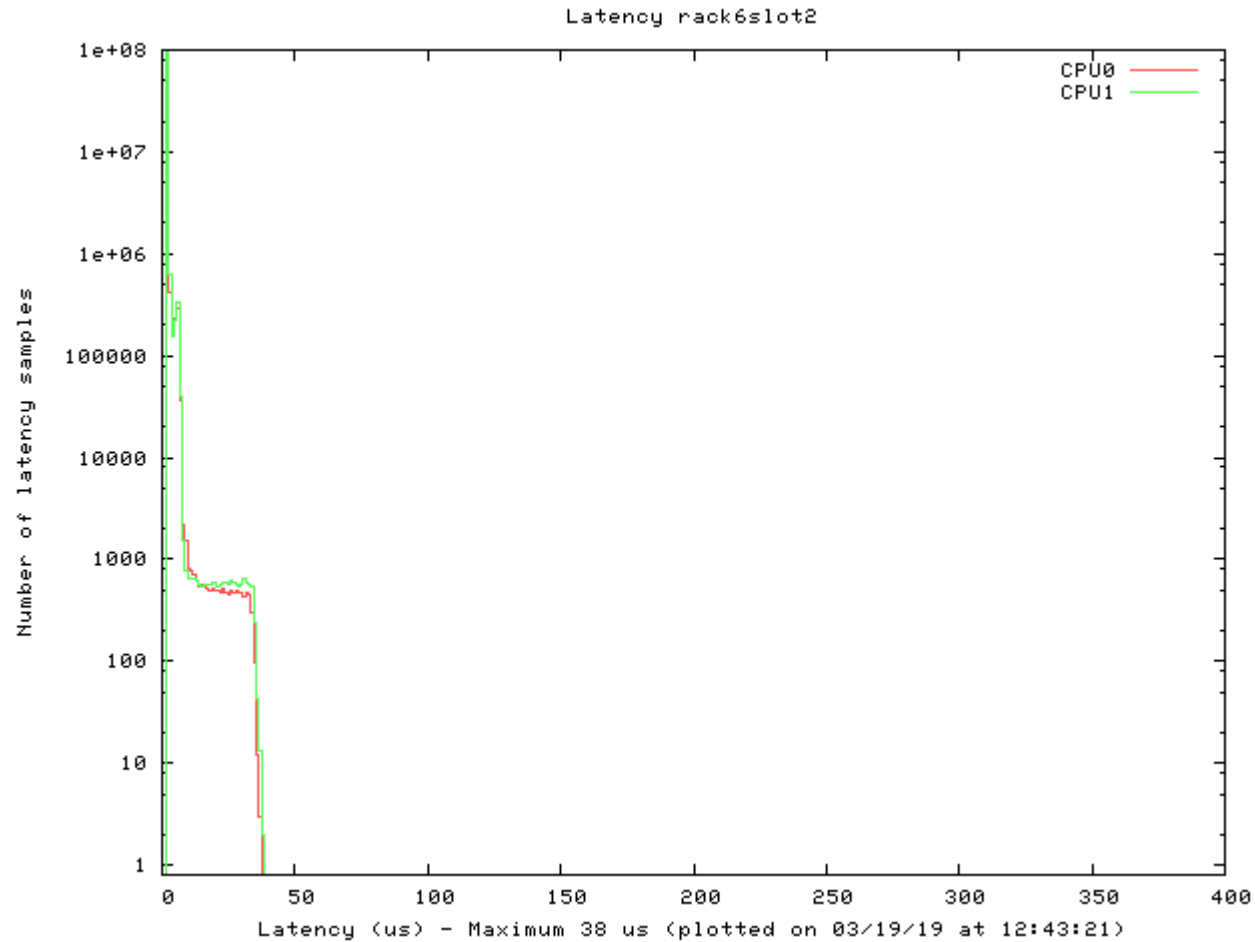
| Characteristics of the 20 highest latencies: System rack6slot2.osadl.org (updated Mon Mar 18, 2019 00:43:27) | | | | | | | | | |
|---|------|--------------------|-----------------------|--------------------|------|------|-----------------|-----------|-----|
| Delayed (victim) | | | | Switcher (culprit) | | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 5528 | 2 | 114 | 0,1 | sleep1 | 21 | -21 | rcuc/1 | 19:31:47 | 1 |
| 18185 | 2 | 61 | 0,0 | sleep1 | 0 | -21 | swapper/1 | 21:32:02 | 1 |
| 28116 | 2 | 43 | 8,8 | sleep1 | 0 | -21 | swapper/1 | 19:05:18 | 1 |
| 28316 | 99 | 39 | 32,6 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:36:47 | 1 |
| 28316 | 99 | 38 | 33,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:41:45 | 1 |
| 28316 | 99 | 38 | 32,5 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 00:11:50 | 1 |
| 28316 | 99 | 38 | 31,6 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 22:54:36 | 1 |
| 28316 | 99 | 37 | 34,2 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:13:03 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:43:28 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:06:47 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:56:53 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 19:26:50 | 1 |
| 28316 | 99 | 37 | 32,4 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 19:12:46 | 1 |
| 28316 | 99 | 37 | 31,5 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:52:05 | 1 |
| 28316 | 99 | 36 | 33,2 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 22:20:44 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:41:50 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 23:26:47 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:45:53 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 21:35:53 | 1 |
| 28316 | 99 | 36 | 32,3 | cyclicttest | 2408 | 50 | irq/16-enp2s0f0 | 20:03:54 | 1 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

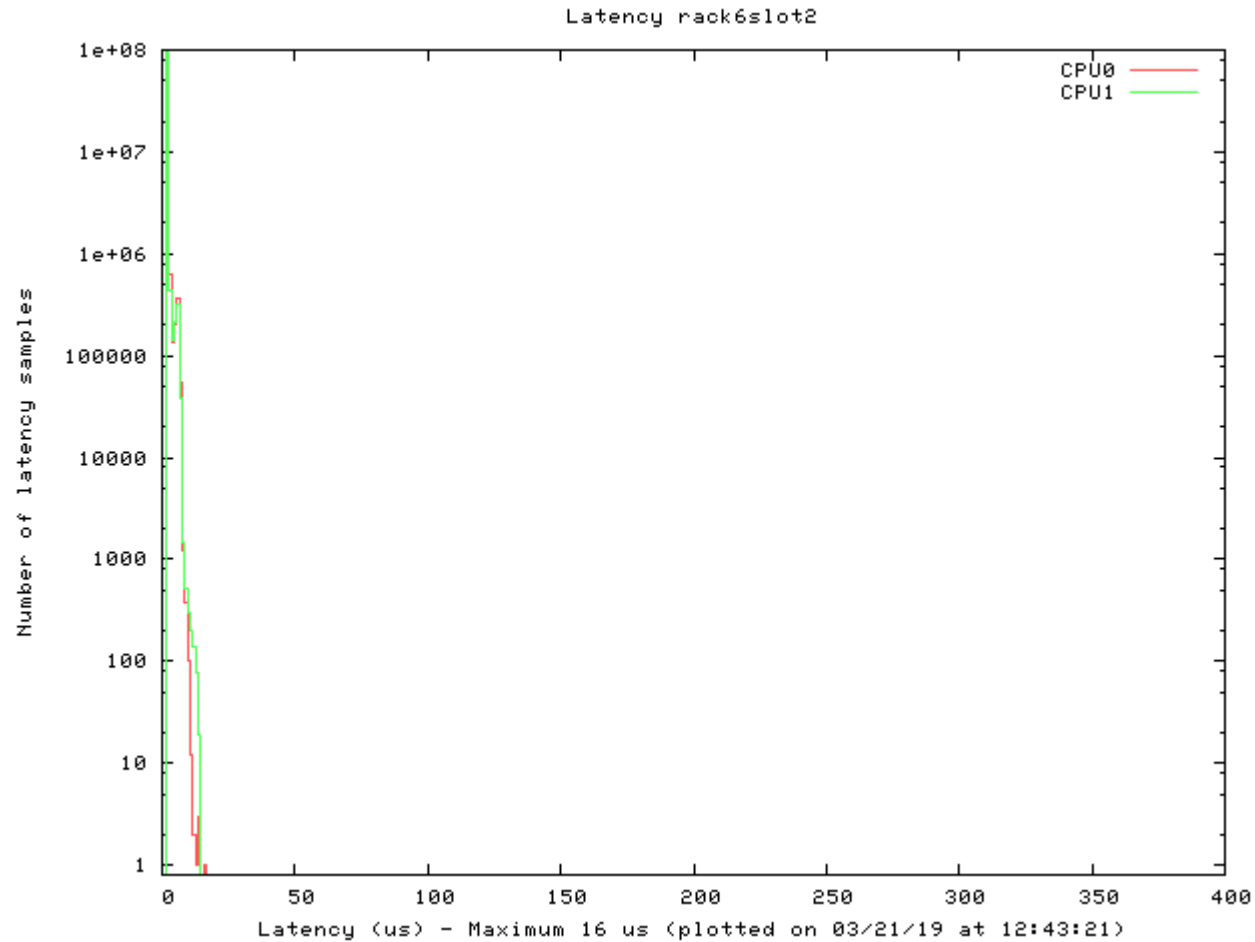
Countermeasures

- Quick fix
 - Uninstall Broadcom Limited NetLink BCM57785 Gigabit Ethernet PCIe network device and unload driver *tg3*.
 - Install another, for example USB, Ethernet controller and reconfigure the system to no longer use IRQ 16 handler of network device *enp2s0f0*.
- Better
 - File a bug
- Even better
 - Fix it yourself
 - ✓ Analyze the source code of *drivers/net/ethernet/broadcom/tg3.c*.
 - ✓ Search for busy loops or similar while preemption and/or interrupts are disabled.
 - ✓ Alternatively, use *cyclictest*'s breaktrace feature and function tracing to pinpoint the culprit.
 - ✓ Shorten the busy loop, allow intermittent interrupt execution and preemption.

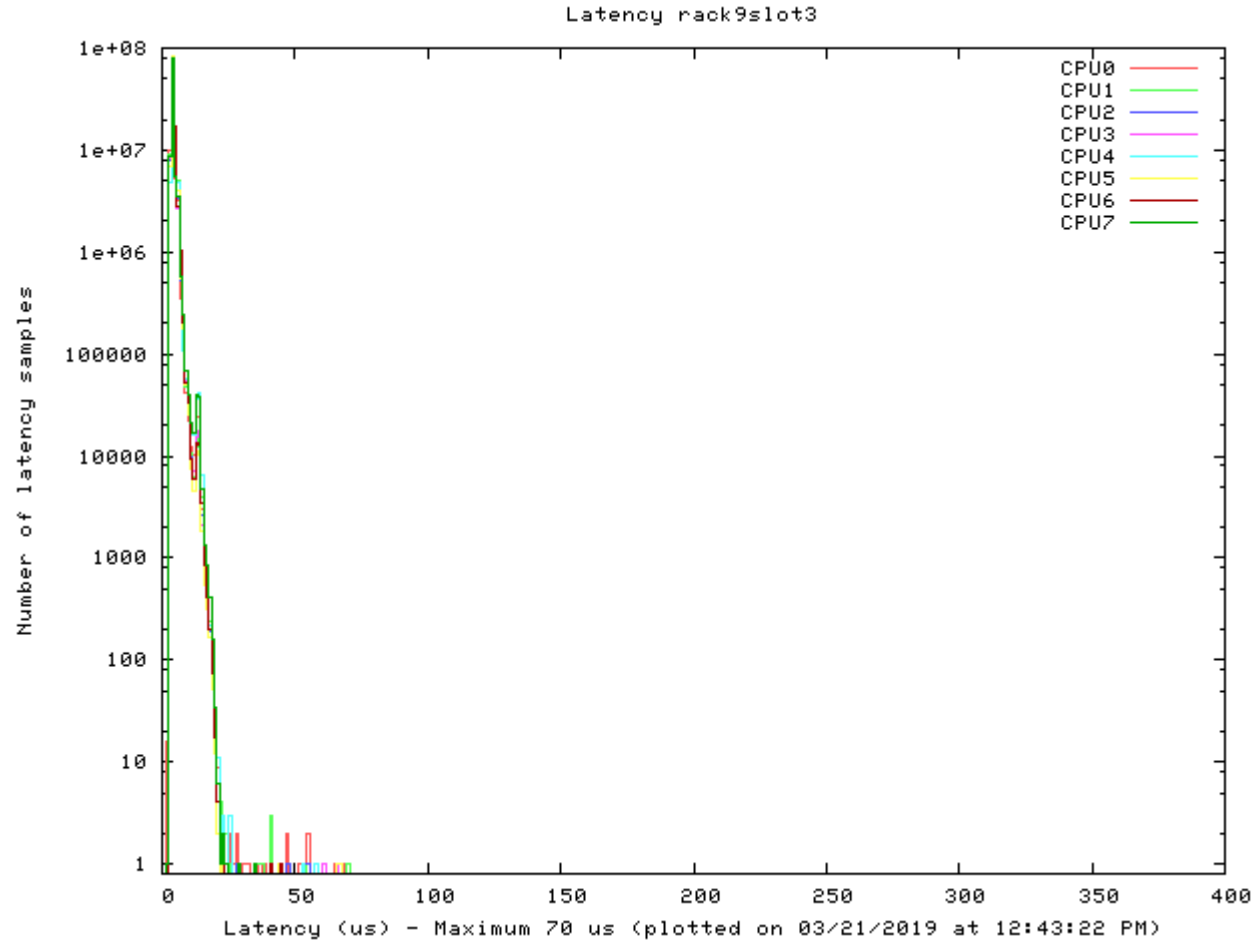
Before



After



Latency fighting case #3



Culprit/victim table

| Characteristics of the 50 highest latencies: System rack9slot3.osadl.org (updated Thu Mar 21, 2019 12:43:28) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|---------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(,W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 3053 | 99 | 67 | 65,1 | cyclicttest | 914 | -21 | meminfo | 11:35:15 | 1 |
| 3052 | 99 | 66 | 63,2 | cyclicttest | 7422 | -21 | meminfo | 10:15:13 | 0 |
| 3057 | 99 | 64 | 62,1 | cyclicttest | 11143 | -21 | meminfo | 08:30:12 | 5 |
| 3055 | 99 | 64 | 61,2 | cyclicttest | 29980 | -21 | meminfo | 10:35:14 | 3 |
| 3053 | 99 | 64 | 62,1 | cyclicttest | 7460 | -21 | meminfo | 07:15:13 | 1 |
| 3057 | 99 | 62 | 59,2 | cyclicttest | 26677 | -21 | meminfo | 07:55:14 | 5 |
| 3052 | 99 | 62 | 60,1 | cyclicttest | 19536 | -21 | meminfo | 07:40:17 | 0 |
| 3055 | 99 | 57 | 54,2 | cyclicttest | 13529 | -21 | meminfo | 08:35:13 | 3 |
| 3056 | 99 | 55 | 53,1 | cyclicttest | 23084 | -21 | meminfo | 08:55:16 | 4 |
| 3052 | 99 | 53 | 51,1 | cyclicttest | 32180 | -21 | meminfo | 09:40:13 | 0 |
| 3053 | 99 | 52 | 50,1 | cyclicttest | 3954 | -21 | meminfo | 08:15:15 | 1 |
| 3054 | 99 | 51 | 49,1 | cyclicttest | 24304 | -21 | meminfo | 07:50:16 | 2 |
| 3054 | 99 | 51 | 48,2 | cyclicttest | 25223 | -21 | meminfo | 12:25:15 | 2 |
| 3052 | 99 | 51 | 49,1 | cyclicttest | 15098 | -21 | meminfo | 09:25:12 | 0 |
| 3056 | 99 | 49 | 46,2 | cyclicttest | 25476 | -21 | meminfo | 09:00:14 | 4 |
| 3052 | 99 | 49 | 47,1 | cyclicttest | 5060 | -21 | meminfo | 11:10:15 | 0 |
| 3054 | 99 | 44 | 42,1 | cyclicttest | 26094 | -21 | meminfo | 11:00:12 | 2 |
| 3054 | 99 | 44 | 41,2 | cyclicttest | 6368 | -21 | meminfo | 08:20:12 | 2 |
| 3052 | 99 | 44 | 42,1 | cyclicttest | 27854 | -21 | meminfo | 09:05:12 | 0 |
| 3052 | 99 | 44 | 42,1 | cyclicttest | 20412 | -21 | meminfo | 10:55:13 | 0 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

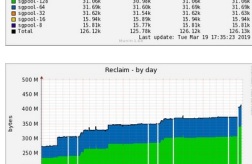
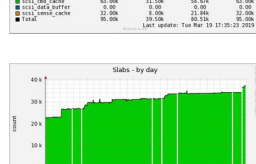
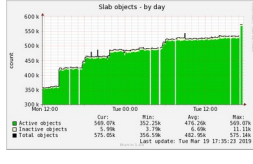
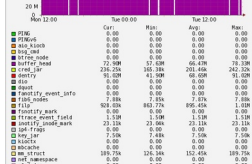
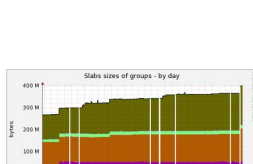
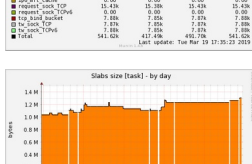
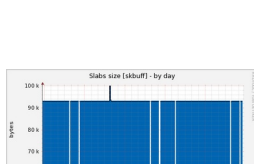
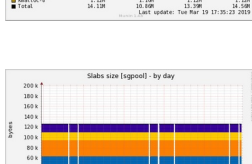
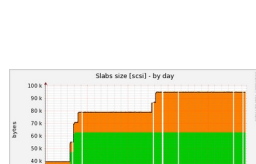
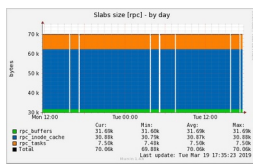
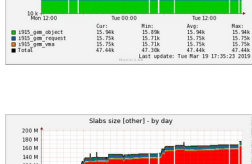
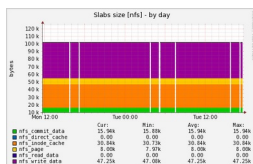
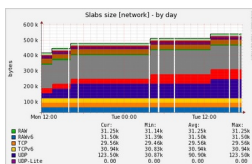
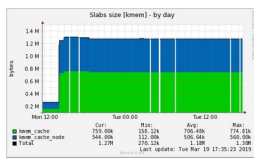
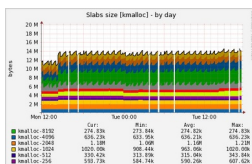
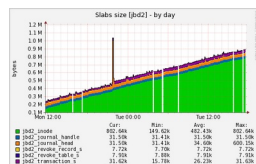
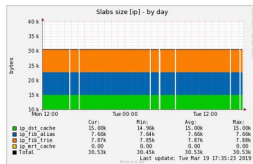
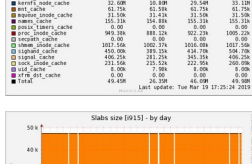
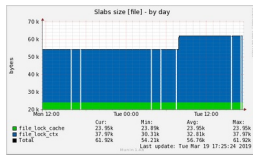
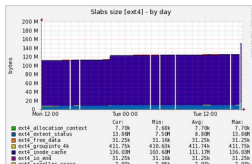
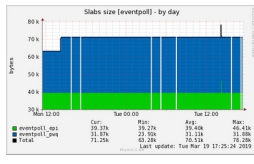
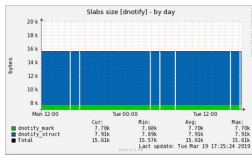
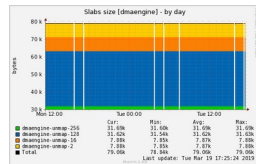
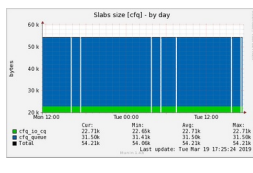
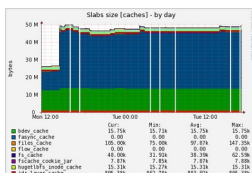
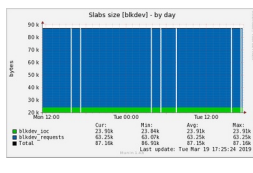
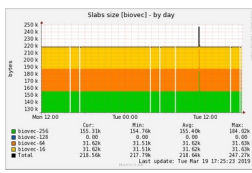
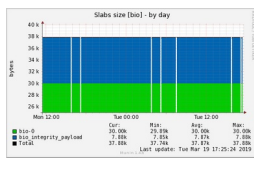
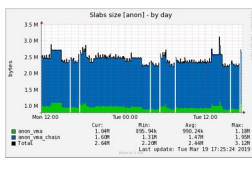
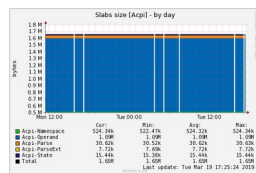
Culprit/victim table

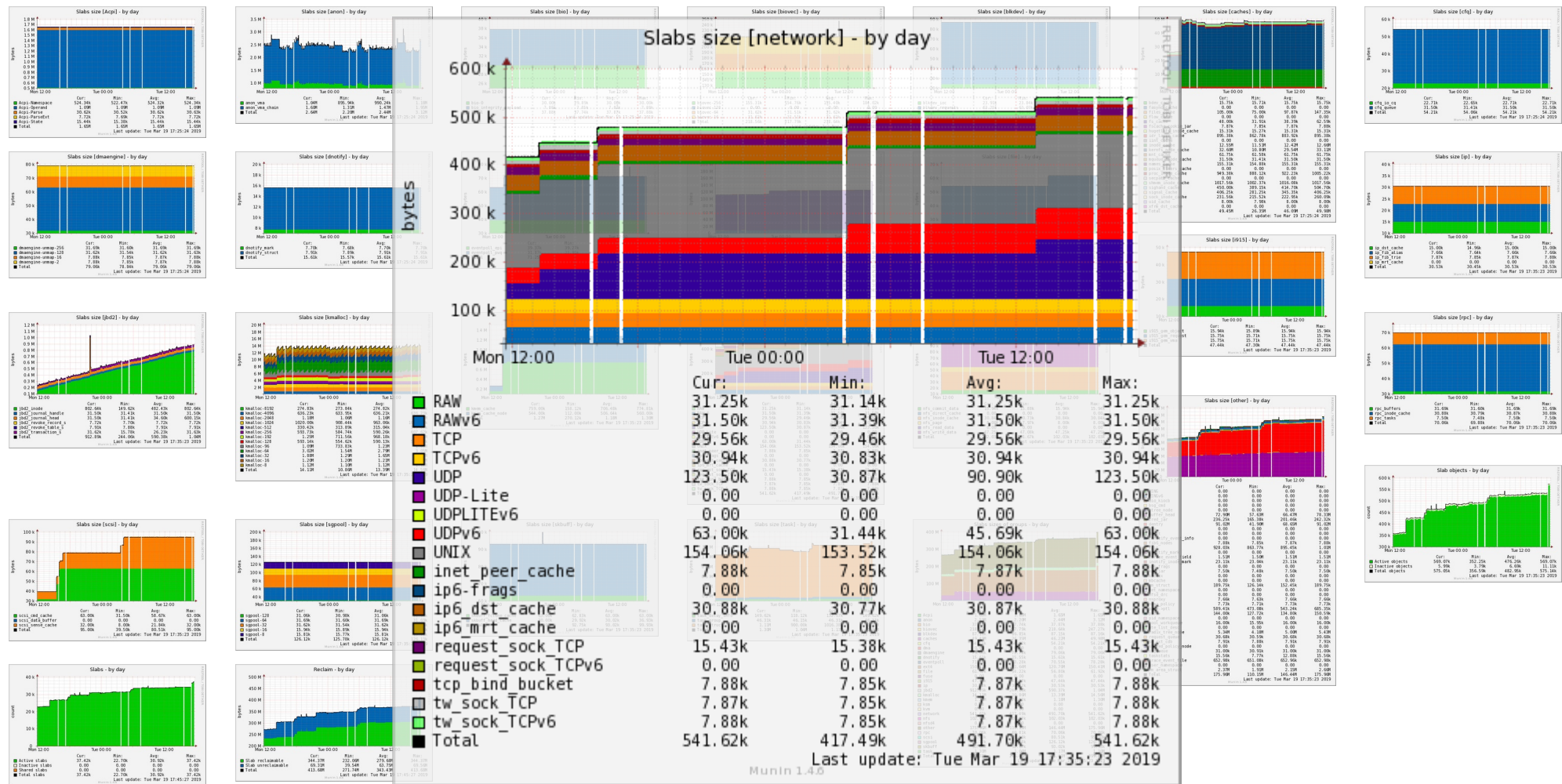
| Characteristics of the 50 highest latencies: System rack9slot3.osadl.org (updated Thu Mar 21, 2019 12:43:28) | | | | | | | | | |
|---|------|--------------------|----------------------|-------------|--------------------|------|---------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 3053 | 99 | 67 | 65,1 | cyclicttest | 914 | -21 | meminfo | 11:35:15 | 1 |
| 3052 | 99 | 66 | 63,2 | cyclicttest | 7422 | -21 | meminfo | 10:15:13 | 0 |
| 3057 | 99 | 64 | 62,1 | cyclicttest | 11143 | -21 | meminfo | 08:30:12 | 5 |
| 3055 | 99 | 64 | 61,2 | cyclicttest | 29980 | -21 | meminfo | 10:35:14 | 3 |
| 3053 | 99 | 64 | 62,1 | cyclicttest | 7460 | -21 | meminfo | 07:15:13 | 1 |
| 3057 | 99 | 62 | 59,2 | cyclicttest | 26677 | -21 | meminfo | 07:55:14 | 5 |
| 3052 | 99 | 62 | 60,1 | cyclicttest | 19536 | -21 | meminfo | 07:40:17 | 0 |
| 3055 | 99 | 57 | 54,2 | cyclicttest | 13529 | -21 | meminfo | 08:35:13 | 3 |
| 3056 | 99 | 55 | 53,1 | cyclicttest | 23084 | -21 | meminfo | 08:55:16 | 4 |
| 3052 | 99 | 53 | 51,1 | cyclicttest | 32180 | -21 | meminfo | 09:40:13 | 0 |
| 3053 | 99 | 52 | 50,1 | cyclicttest | 3954 | -21 | meminfo | 08:15:15 | 1 |
| 3054 | 99 | 51 | 49,1 | cyclicttest | 24304 | -21 | meminfo | 07:50:16 | 2 |
| 3054 | 99 | 51 | 48,2 | cyclicttest | 25223 | -21 | meminfo | 12:25:15 | 2 |
| 3052 | 99 | 51 | 49,1 | cyclicttest | 15098 | -21 | meminfo | 09:25:12 | 0 |
| 3056 | 99 | 49 | 46,2 | cyclicttest | 25476 | -21 | meminfo | 09:00:14 | 4 |
| 3052 | 99 | 49 | 47,1 | cyclicttest | 5060 | -21 | meminfo | 11:10:15 | 0 |
| 3054 | 99 | 44 | 42,1 | cyclicttest | 26094 | -21 | meminfo | 11:00:12 | 2 |
| 3054 | 99 | 44 | 41,2 | cyclicttest | 6368 | -21 | meminfo | 08:20:12 | 2 |
| 3052 | 99 | 44 | 42,1 | cyclicttest | 27854 | -21 | meminfo | 09:05:12 | 0 |
| 3052 | 99 | 44 | 42,1 | cyclicttest | 20412 | -21 | meminfo | 10:55:13 | 0 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Analysis

- The script *meminfo* is a *Munin* plugin that provides a detailed snapshot of memory allocation and usage.
- It may report an in-depth analysis of the *slub* allocator, if the related debug configuration is enabled. If so, *slub* data can be inspected through the */proc/slabinfo* interface.





Countermeasure #1 (quick fix)

```
--- .config.old 2019-03-17 12:49:05.216088137 +0100
+++ .config 2019-03-17 13:08:18.013949211 +0100
@@ -5649,8 +5649,8 @@
# CONFIG_PAGE_POISONING is not set
# CONFIG_DEBUG_PAGE_REF is not set
# CONFIG_DEBUG_OBJECTS is not set
-CONFIG_SLUB_DEBUG_ON=y
-CONFIG_SLUB_STATS=y
+# CONFIG_SLUB_DEBUG_ON is not set
+# CONFIG_SLUB_STATS is not set
CONFIG_HAVE_DEBUG_KMEMLEAK=y
# CONFIG_DEBUG_KMEMLEAK is not set
# CONFIG_DEBUG_STACK_USAGE is not set
```

Countermeasure #2 (provide patch)

Subject: Reading /proc/slabinfo may cause large latencies

From: Carsten Emde <C.Emde@osadl.org>

Date: Sat, 29 Jun 2013 15:28:27 +0100

Reading /proc/slabinfo may cause large latencies of up to several milliseconds. This is due to a mutex lock that spans over the entire readout period and, thus, may prevent a higher-priority process from allocating memory during this amount of time.

This patch shortens the mutex lock to the data accumulation of a single item. It still guarantees coherence of a single output line but not across items which probably is a minor disadvantage compared to the otherwise fatal effect on the system's real-time capabilities.

Signed-off-by: Carsten Emde <C.Emde@osadl.org>

```
--  
mm/slab_common.c | 4 +--  
1 file changed, 2 insertions(+), 2 deletions(-)
```

Index: linux-3.12.0-rt1/mm/slab_common.c

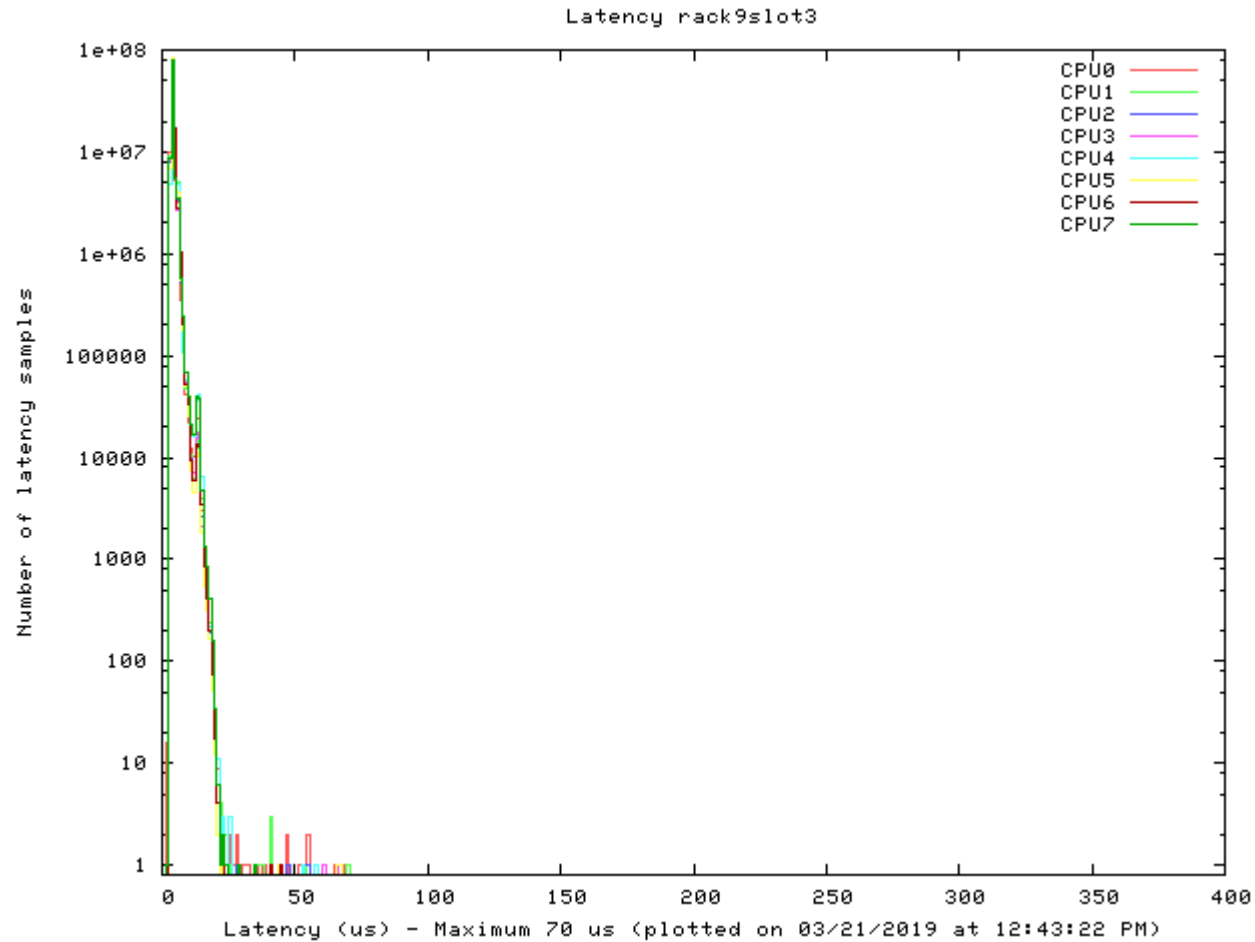
```
=====
```

--- linux-3.12.0-rt1.orig/mm/slab_common.c
+++ linux-3.12.0-rt1/mm/slab_common.c

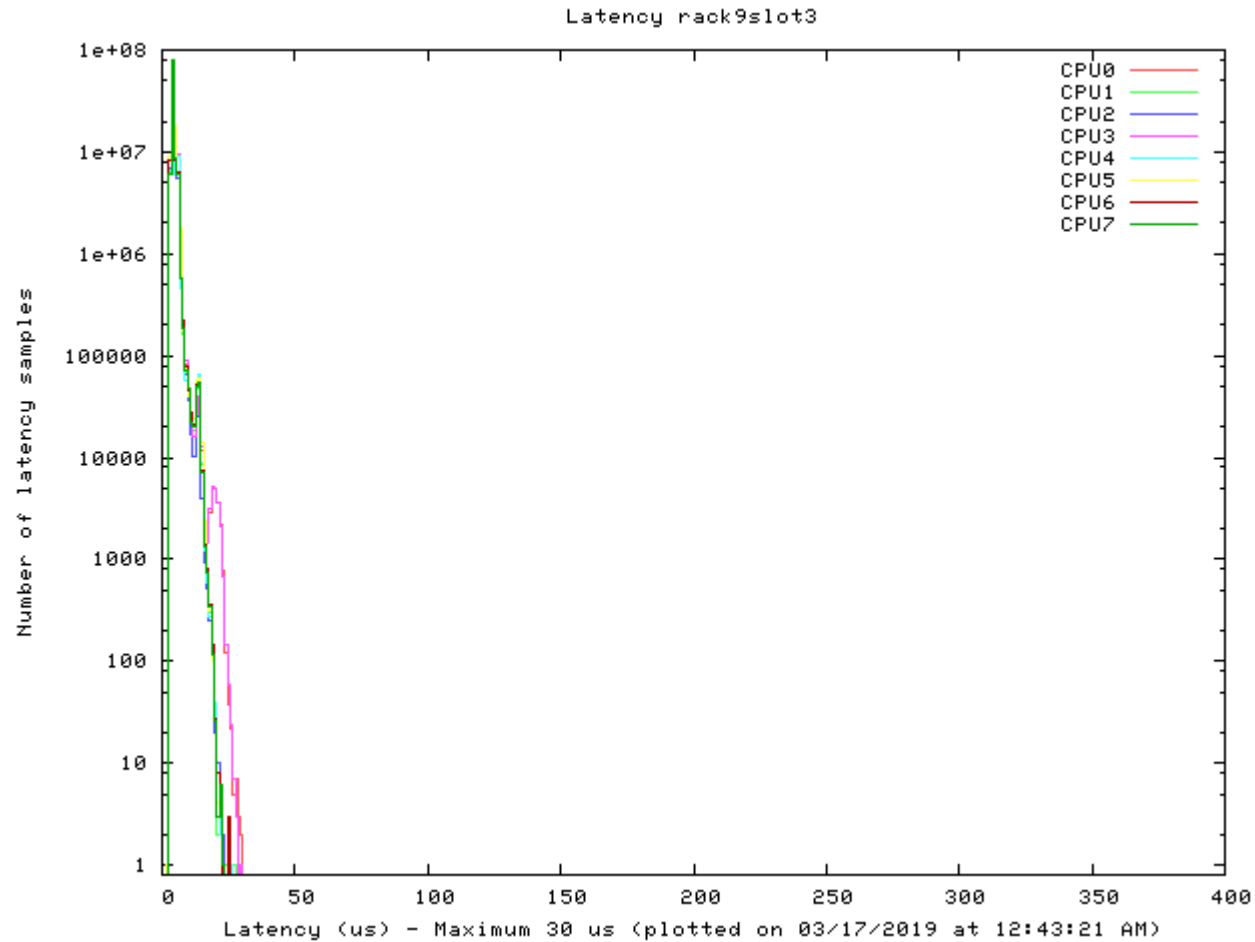
```
@@ -543,7 +543,6 @@ static void *s_start(struct seq_file *m,  
{  
    loff_t n = *pos;  
  
-    mutex_lock(&slab_mutex);  
    if (!n)  
        print_slabinfo_header(m);  
  
@@ -557,7 +556,6 @@ void *slab_next(struct seq_file *m, void  
  
void slab_stop(struct seq_file *m, void *p)  
{  
-    mutex_unlock(&slab_mutex);  
}  
  
static void  
@@ -570,6 +568,7 @@ memcg_accumulate_slabinfo(struct kmem_ca  
    if (!is_root_cache(s))  
        return;  
  
+    mutex_lock(&slab_mutex);  
    for_each_memcg_cache_index(i) {  
        c = cache_from_memcg(s, i);  
        if (!c)
```

```
@@ -584,6 +583,7 @@ memcg_accumulate_slabinfo(struct kmem_ca  
        info->active_objs += sinfo.active_objs;  
        info->num_objs += sinfo.num_objs;  
    }  
+    mutex_unlock(&slab_mutex);  
}  
  
int cache_show(struct kmem_cache *s, struct seq_file *m)
```

Before



After



Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot3.osadl.org (updated Sun Mar 17, 2019 00:43:25) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|---------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(,W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 26221 | 2 | 95 | 50,15 | sleep1 | 0 | -21 | swapper/1 | 18:52:07 | 1 |
| 26102 | 2 | 92 | 49,35 | sleep3 | 0 | -21 | swapper/3 | 18:50:24 | 3 |
| 26059 | 2 | 91 | 47,14 | sleep7 | 0 | -21 | swapper/7 | 18:49:48 | 7 |
| 26206 | 2 | 90 | 48,35 | sleep4 | 0 | -21 | swapper/4 | 18:51:54 | 4 |
| 26198 | 2 | 90 | 48,35 | sleep5 | 0 | -21 | swapper/5 | 18:51:47 | 5 |
| 26032 | 2 | 90 | 47,14 | sleep0 | 0 | -21 | swapper/0 | 18:49:25 | 0 |
| 25252 | 2 | 73 | 0,0 | sleep0 | 0 | -21 | swapper/0 | 19:52:43 | 0 |
| 1094 | 2 | 72 | 0,0 | sleep2 | 30 | 1 | ktimersoftd/2 | 23:26:17 | 2 |
| 31196 | 2 | 71 | 0,1 | sleep5 | 4203 | -21 | runrttasks | 20:07:38 | 5 |
| 25955 | 2 | 71 | 50,14 | sleep6 | 0 | -21 | swapper/6 | 18:48:19 | 6 |
| 25949 | 2 | 70 | 48,15 | sleep2 | 0 | -21 | swapper/2 | 18:48:15 | 2 |
| 13130 | 2 | 64 | 0,0 | sleep7 | 0 | -21 | swapper/7 | 23:37:03 | 7 |
| 27566 | 2 | 61 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 21:55:28 | 6 |
| 26321 | 99 | 27 | 0,11 | cyclicttest | 0 | -21 | swapper/3 | 21:42:11 | 3 |
| 26318 | 99 | 27 | 0,4 | cyclicttest | 0 | -21 | swapper/0 | 00:13:03 | 0 |
| 26318 | 99 | 27 | 0,21 | cyclicttest | 0 | -21 | swapper/0 | 21:00:39 | 0 |
| 26318 | 99 | 26 | 0,19 | cyclicttest | 0 | -21 | swapper/0 | 22:24:27 | 0 |
| 26321 | 99 | 25 | 0,11 | cyclicttest | 0 | -21 | swapper/3 | 22:10:52 | 3 |
| 26318 | 99 | 25 | 9,2 | cyclicttest | 0 | -21 | swapper/0 | 23:18:58 | 0 |
| 26318 | 99 | 25 | 8,2 | cyclicttest | 0 | -21 | swapper/0 | 23:54:25 | 0 |

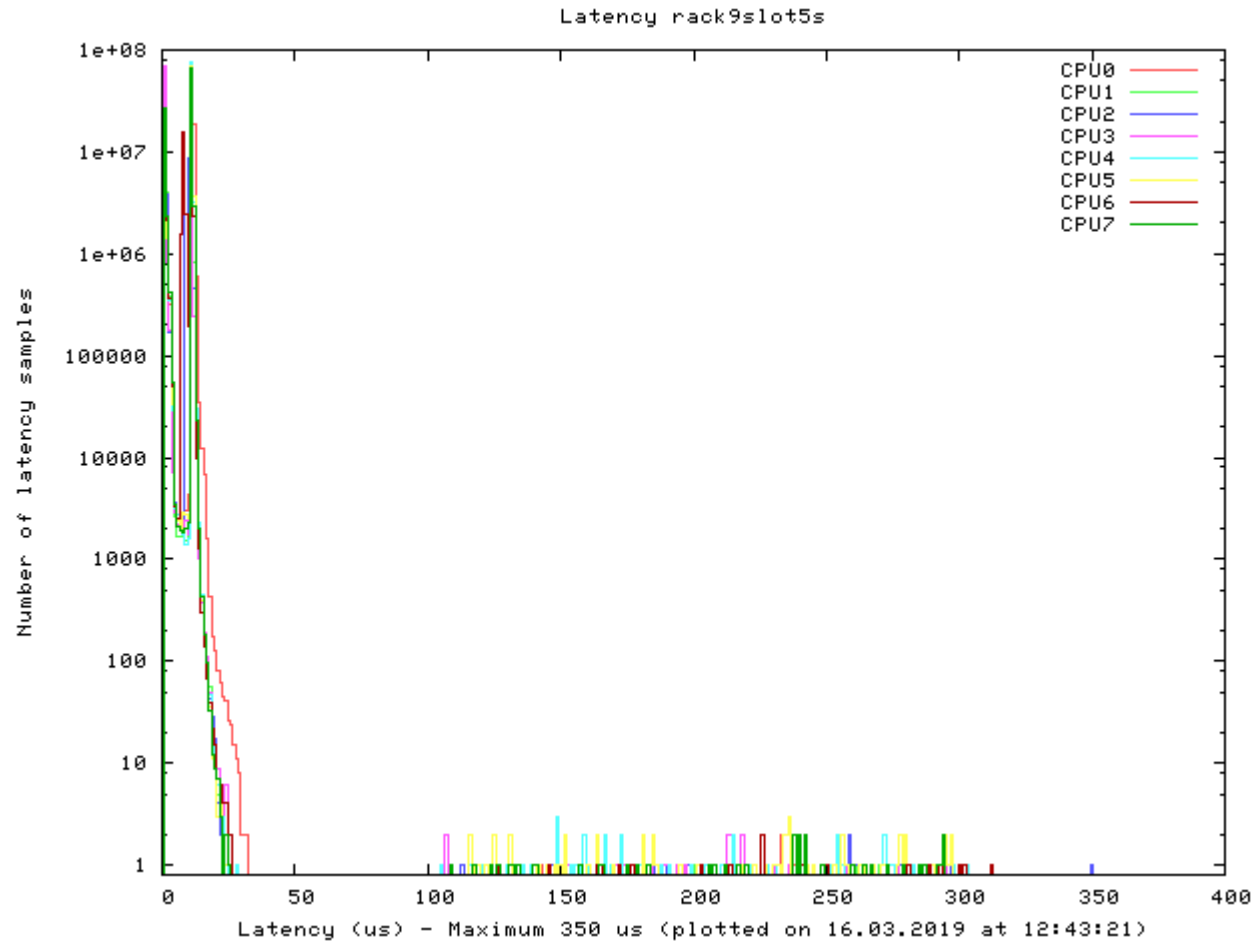
*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot3.osadl.org (updated Sun Mar 17, 2019 00:43:25) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|---------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 26221 | 2 | 95 | 50,15 | sleep1 | 0 | -21 | swapper/1 | 18:52:07 | 1 |
| 26102 | 2 | 92 | 49,35 | sleep3 | 0 | -21 | swapper/3 | 18:50:24 | 3 |
| 26059 | 2 | 91 | 47,14 | sleep7 | 0 | -21 | swapper/7 | 18:49:48 | 7 |
| 26206 | 2 | 90 | 48,35 | sleep4 | 0 | -21 | swapper/4 | 18:51:54 | 4 |
| 26198 | 2 | 90 | 48,35 | sleep5 | 0 | -21 | swapper/5 | 18:51:47 | 5 |
| 26032 | 2 | 90 | 47,14 | sleep0 | 0 | -21 | swapper/0 | 18:49:25 | 0 |
| 25252 | 2 | 73 | 0,0 | sleep0 | 0 | -21 | swapper/0 | 19:52:43 | 0 |
| 1094 | 2 | 72 | 0,0 | sleep2 | 30 | 1 | ktimersoftd/2 | 23:26:17 | 2 |
| 31196 | 2 | 71 | 0,1 | sleep5 | 4203 | -21 | runrttasks | 20:07:38 | 5 |
| 25955 | 2 | 71 | 50,14 | sleep6 | 0 | -21 | swapper/6 | 18:48:19 | 6 |
| 25949 | 2 | 70 | 48,15 | sleep2 | 0 | -21 | swapper/2 | 18:48:15 | 2 |
| 13130 | 2 | 64 | 0,0 | sleep7 | 0 | -21 | swapper/7 | 23:37:03 | 7 |
| 27566 | 2 | 61 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 21:55:28 | 6 |
| 26321 | 99 | 27 | 0,11 | cyclicttest | 0 | -21 | swapper/3 | 21:42:11 | 3 |
| 26318 | 99 | 27 | 0,4 | cyclicttest | 0 | -21 | swapper/0 | 00:13:03 | 0 |
| 26318 | 99 | 27 | 0,21 | cyclicttest | 0 | -21 | swapper/0 | 21:00:39 | 0 |
| 26318 | 99 | 26 | 0,19 | cyclicttest | 0 | -21 | swapper/0 | 22:24:27 | 0 |
| 26321 | 99 | 25 | 0,11 | cyclicttest | 0 | -21 | swapper/3 | 22:10:52 | 3 |
| 26318 | 99 | 25 | 9,2 | cyclicttest | 0 | -21 | swapper/0 | 23:18:58 | 0 |
| 26318 | 99 | 25 | 8,2 | cyclicttest | 0 | -21 | swapper/0 | 23:54:25 | 0 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Latency fighting case #4



Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot5s.osadl.org (updated Sat Mar 16, 2019 12:46:13) | | | | | | | | | |
|--|------|--------------------|-----------------------|-------------|--------------------|------|------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 7787 | 99 | 346 | 343,0 | cyclicttest | 2337 | -21 | kerneloops | 08:54:20 | 2 |
| 7791 | 99 | 309 | 307,0 | cyclicttest | 2337 | -21 | kerneloops | 09:54:09 | 6 |
| 7791 | 99 | 299 | 299,0 | cyclicttest | 2337 | -21 | kerneloops | 10:42:46 | 6 |
| 7787 | 99 | 299 | 297,0 | cyclicttest | 2337 | -21 | kerneloops | 07:49:38 | 2 |
| 7791 | 99 | 296 | 296,0 | cyclicttest | 2337 | -21 | kerneloops | 10:33:43 | 6 |
| 7789 | 99 | 296 | 294,0 | cyclicttest | 2337 | -21 | kerneloops | 10:04:18 | 4 |
| 7790 | 99 | 294 | 294,0 | cyclicttest | 2337 | -21 | kerneloops | 12:15:52 | 5 |
| 7790 | 99 | 294 | 292,0 | cyclicttest | 2337 | -21 | kerneloops | 10:23:32 | 5 |
| 7787 | 99 | 294 | 293,0 | cyclicttest | 2337 | -21 | kerneloops | 07:37:29 | 2 |
| 7790 | 99 | 293 | 293,0 | cyclicttest | 2337 | -21 | kerneloops | 07:48:38 | 5 |
| 7790 | 99 | 292 | 292,0 | cyclicttest | 2337 | -21 | kerneloops | 09:41:58 | 5 |
| 7790 | 99 | 292 | 290,0 | cyclicttest | 2337 | -21 | kerneloops | 09:53:07 | 5 |
| 7792 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 11:33:20 | 7 |
| 7792 | 99 | 291 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 10:57:55 | 7 |
| 7790 | 99 | 291 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 09:02:28 | 5 |
| 7789 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 11:07:02 | 4 |
| 7788 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 09:10:35 | 3 |
| 7790 | 99 | 290 | 290,0 | cyclicttest | 2337 | -21 | kerneloops | 08:58:24 | 5 |
| 7792 | 99 | 289 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 10:45:48 | 7 |
| 7792 | 99 | 289 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 09:32:52 | 7 |
| *Timer **Wakeup (latency=timer+wakeup+contextswitch) | | | | | | | | | |

Culprit/victim table

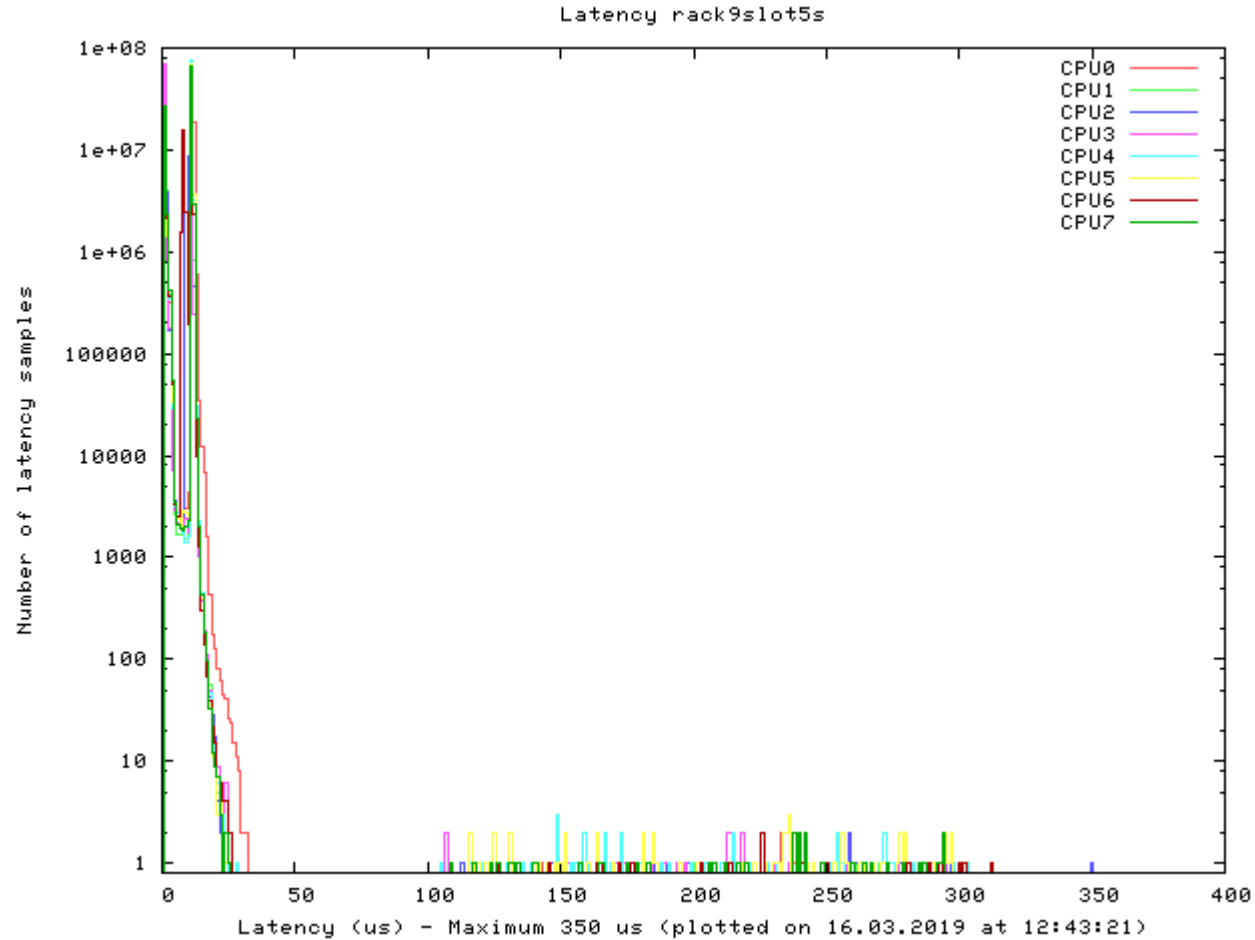
| Characteristics of the 20 highest latencies: System rack9slot5s.osadl.org (updated Sat Mar 16, 2019 12:46:13) | | | | | | | | | |
|--|------|--------------------|-----------------------|-------------|--------------------|------|------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(,W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 7787 | 99 | 346 | 343,0 | cyclicttest | 2337 | -21 | kerneloops | 08:54:20 | 2 |
| 7791 | 99 | 309 | 307,0 | cyclicttest | 2337 | -21 | kerneloops | 09:54:09 | 6 |
| 7791 | 99 | 299 | 299,0 | cyclicttest | 2337 | -21 | kerneloops | 10:42:46 | 6 |
| 7787 | 99 | 299 | 297,0 | cyclicttest | 2337 | -21 | kerneloops | 07:49:38 | 2 |
| 7791 | 99 | 296 | 296,0 | cyclicttest | 2337 | -21 | kerneloops | 10:33:43 | 6 |
| 7789 | 99 | 296 | 294,0 | cyclicttest | 2337 | -21 | kerneloops | 10:04:18 | 4 |
| 7790 | 99 | 294 | 294,0 | cyclicttest | 2337 | -21 | kerneloops | 12:15:52 | 5 |
| 7790 | 99 | 294 | 292,0 | cyclicttest | 2337 | -21 | kerneloops | 10:23:32 | 5 |
| 7787 | 99 | 294 | 293,0 | cyclicttest | 2337 | -21 | kerneloops | 07:37:29 | 2 |
| 7790 | 99 | 293 | 293,0 | cyclicttest | 2337 | -21 | kerneloops | 07:48:38 | 5 |
| 7790 | 99 | 292 | 292,0 | cyclicttest | 2337 | -21 | kerneloops | 09:41:58 | 5 |
| 7790 | 99 | 292 | 290,0 | cyclicttest | 2337 | -21 | kerneloops | 09:53:07 | 5 |
| 7792 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 11:33:20 | 7 |
| 7792 | 99 | 291 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 10:57:55 | 7 |
| 7790 | 99 | 291 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 09:02:28 | 5 |
| 7789 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 11:07:02 | 4 |
| 7788 | 99 | 291 | 291,0 | cyclicttest | 2337 | -21 | kerneloops | 09:10:35 | 3 |
| 7790 | 99 | 290 | 290,0 | cyclicttest | 2337 | -21 | kerneloops | 08:58:24 | 5 |
| 7792 | 99 | 289 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 10:45:48 | 7 |
| 7792 | 99 | 289 | 289,0 | cyclicttest | 2337 | -21 | kerneloops | 09:32:52 | 7 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

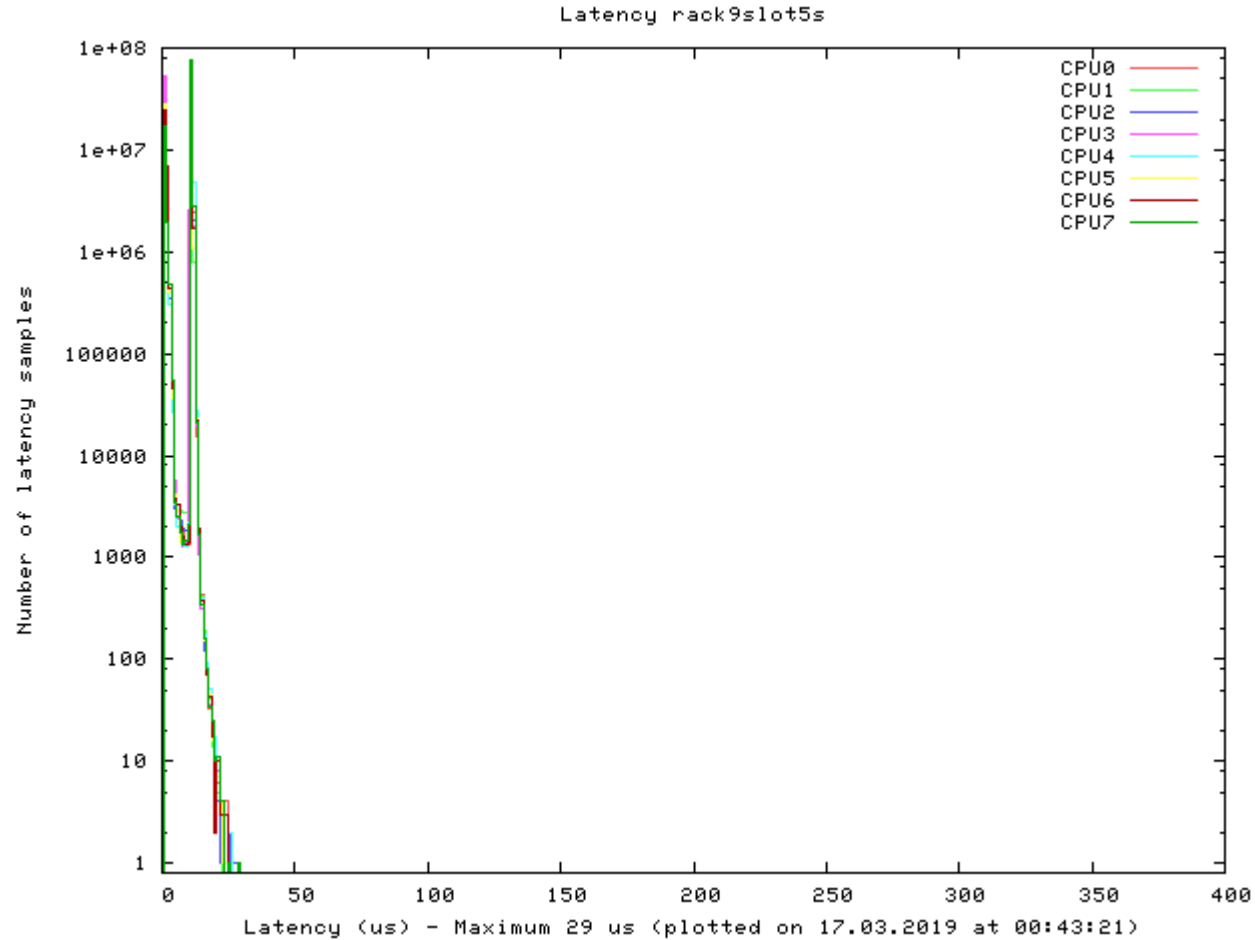
Countermeasures

- Quick fix
 - `# systemctl stop kerneloops`
 - `# systemctl disable kerneloops`
- Better
 - File a bug
- Even better
 - Fix it yourself and provide a patch

Before



After



Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot5s.osadl.org (updated Sun Mar 17, 2019 00:46:14) | | | | | | | | | |
|--|------|--------------------|----------------------|-------------|--------------------|------|-------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 31028 | 2 | 41 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 00:38:07 | 6 |
| 31398 | 2 | 31 | 0,0 | sleep2 | 0 | -21 | swapper/2 | 23:39:26 | 2 |
| 8339 | 99 | 27 | 27,0 | cyclicttest | 0 | -21 | swapper/2 | 22:05:45 | 2 |
| 8339 | 99 | 26 | 26,0 | cyclicttest | 0 | -21 | swapper/2 | 20:55:05 | 2 |
| 8339 | 99 | 25 | 21,2 | cyclicttest | 19866 | -21 | munin-node | 21:31:14 | 2 |
| 8337 | 99 | 24 | 24,0 | cyclicttest | 0 | -21 | swapper/0 | 21:44:53 | 0 |
| 29650 | 2 | 24 | 10,0 | sleep6 | 0 | -21 | swapper/6 | 22:38:00 | 6 |
| 8341 | 99 | 23 | 10,6 | cyclicttest | 0 | -21 | swapper/4 | 20:55:03 | 4 |
| 8344 | 99 | 22 | 10,5 | cyclicttest | 0 | -21 | swapper/7 | 21:45:03 | 7 |
| 8339 | 99 | 22 | 10,3 | cyclicttest | 0 | -21 | swapper/2 | 19:35:03 | 2 |
| 4357 | 2 | 22 | 10,1 | sleep1 | 0 | -21 | swapper/1 | 23:14:45 | 1 |
| 8343 | 99 | 21 | 10,5 | cyclicttest | 0 | -21 | swapper/6 | 20:25:03 | 6 |
| 8342 | 99 | 21 | 21,0 | cyclicttest | 0 | -21 | swapper/5 | 21:54:42 | 5 |
| 8340 | 99 | 21 | 9,8 | cyclicttest | 41 | -21 | ksoftirqd/3 | 23:05:04 | 3 |
| 792 | 2 | 21 | 10,0 | sleep5 | 0 | -21 | swapper/5 | 21:41:29 | 5 |
| 3929 | 2 | 21 | 10,0 | sleep3 | 0 | -21 | swapper/3 | 00:13:16 | 3 |
| 12612 | 2 | 21 | 10,0 | sleep1 | 0 | -21 | swapper/1 | 21:23:17 | 1 |
| 9635 | 2 | 20 | 10,0 | sleep0 | 0 | -21 | swapper/0 | 20:25:04 | 0 |
| 9025 | 2 | 20 | 10,0 | sleep4 | 0 | -21 | swapper/4 | 21:20:07 | 4 |
| 8710 | 2 | 20 | 10,0 | sleep6 | 0 | -21 | swapper/6 | 22:19:18 | 6 |

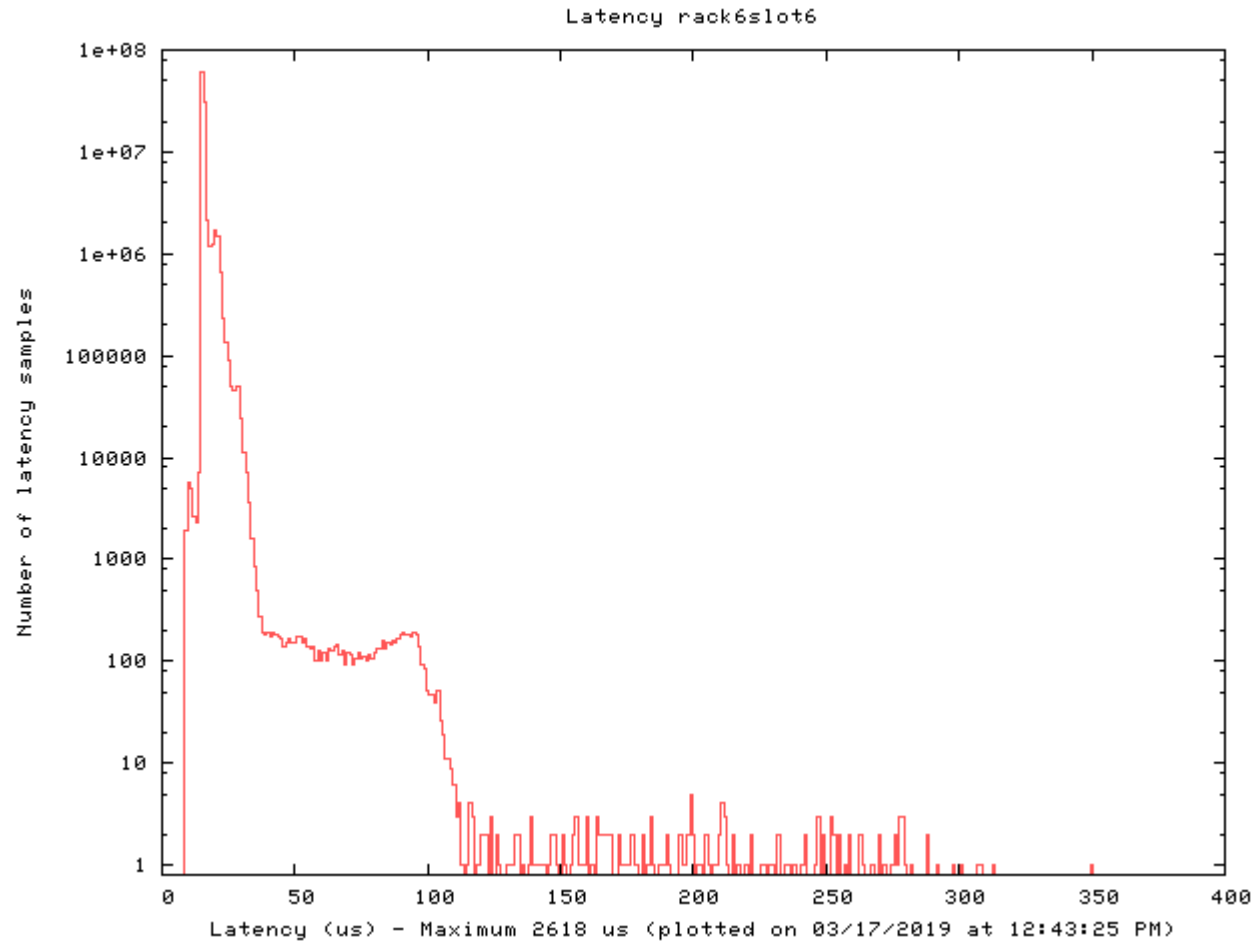
*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

| Characteristics of the 20 highest latencies: System rack9slot5s.osadl.org (updated Sun Mar 17, 2019 00:46:14) | | | | | | | | | |
|--|------|--------------------|----------------------|-------------|--------------------|------|-------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 31028 | 2 | 41 | 0,0 | sleep6 | 0 | -21 | swapper/6 | 00:38:07 | 6 |
| 31398 | 2 | 31 | 0,0 | sleep2 | 0 | -21 | swapper/2 | 23:39:26 | 2 |
| 8339 | 99 | 27 | 27,0 | cyclicttest | 0 | -21 | swapper/2 | 22:05:45 | 2 |
| 8339 | 99 | 26 | 26,0 | cyclicttest | 0 | -21 | swapper/2 | 20:55:05 | 2 |
| 8339 | 99 | 25 | 21,2 | cyclicttest | 19866 | -21 | munin-node | 21:31:14 | 2 |
| 8337 | 99 | 24 | 24,0 | cyclicttest | 0 | -21 | swapper/0 | 21:44:53 | 0 |
| 29650 | 2 | 24 | 10,0 | sleep6 | 0 | -21 | swapper/6 | 22:38:00 | 6 |
| 8341 | 99 | 23 | 10,6 | cyclicttest | 0 | -21 | swapper/4 | 20:55:03 | 4 |
| 8344 | 99 | 22 | 10,5 | cyclicttest | 0 | -21 | swapper/7 | 21:45:03 | 7 |
| 8339 | 99 | 22 | 10,3 | cyclicttest | 0 | -21 | swapper/2 | 19:35:03 | 2 |
| 4357 | 2 | 22 | 10,1 | sleep1 | 0 | -21 | swapper/1 | 23:14:45 | 1 |
| 8343 | 99 | 21 | 10,5 | cyclicttest | 0 | -21 | swapper/6 | 20:25:03 | 6 |
| 8342 | 99 | 21 | 21,0 | cyclicttest | 0 | -21 | swapper/5 | 21:54:42 | 5 |
| 8340 | 99 | 21 | 9,8 | cyclicttest | 41 | -21 | ksoftirqd/3 | 23:05:04 | 3 |
| 792 | 2 | 21 | 10,0 | sleep5 | 0 | -21 | swapper/5 | 21:41:29 | 5 |
| 3929 | 2 | 21 | 10,0 | sleep3 | 0 | -21 | swapper/3 | 00:13:16 | 3 |
| 12612 | 2 | 21 | 10,0 | sleep1 | 0 | -21 | swapper/1 | 21:23:17 | 1 |
| 9635 | 2 | 20 | 10,0 | sleep0 | 0 | -21 | swapper/0 | 20:25:04 | 0 |
| 9025 | 2 | 20 | 10,0 | sleep4 | 0 | -21 | swapper/4 | 21:20:07 | 4 |
| 8710 | 2 | 20 | 10,0 | sleep6 | 0 | -21 | swapper/6 | 22:19:18 | 6 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Latency fighting case #5



Culprit/victim table

| Characteristics of the 20 highest latencies: System rack6slot6.osadl.org (updated Sun Mar 17, 2019 12:43:25) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------|--------------------|------|------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 6409 | 99 | 2612 | 2597,13 | cyclicttest | 1802 | -21 | hald | 03:46:17 | 0 |
| 6409 | 99 | 682 | 666,14 | cyclicttest | 728 | -21 | sensors | 04:06:29 | 0 |
| 6409 | 99 | 673 | 653,18 | cyclicttest | 15095 | -21 | sensors | 05:56:26 | 0 |
| 6409 | 99 | 655 | 8,618 | cyclicttest | 26624 | -21 | ssh | 05:27:37 | 0 |
| 6409 | 99 | 652 | 11,6 | cyclicttest | 19597 | -21 | sh | 03:47:27 | 0 |
| 6409 | 99 | 650 | 7,620 | cyclicttest | 0 | -21 | swapper | 05:14:53 | 0 |
| 6409 | 99 | 649 | 7,640 | cyclicttest | 0 | -21 | swapper | 05:46:42 | 0 |
| 6409 | 99 | 647 | 7,5 | cyclicttest | 0 | -21 | swapper | 02:44:19 | 0 |
| 6409 | 99 | 645 | 7,636 | cyclicttest | 0 | -21 | swapper | 06:28:54 | 0 |
| 6409 | 99 | 644 | 7,5 | cyclicttest | 0 | -21 | swapper | 04:47:15 | 0 |
| 6409 | 99 | 644 | 7,4 | cyclicttest | 0 | -21 | swapper | 02:35:16 | 0 |
| 6409 | 99 | 643 | 7,615 | cyclicttest | 0 | -21 | swapper | 01:34:38 | 0 |
| 6409 | 99 | 643 | 617,23 | cyclicttest | 1406 | 50 | irq/9-eth0 | 05:01:19 | 0 |
| 6409 | 99 | 641 | 7,632 | cyclicttest | 0 | -21 | swapper | 06:14:00 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclicttest | 0 | -21 | swapper | 06:23:23 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclicttest | 0 | -21 | swapper | 05:58:46 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclicttest | 0 | -21 | swapper | 04:15:46 | 0 |
| 6409 | 99 | 640 | 7,630 | cyclicttest | 21458 | -21 | expr | 03:06:15 | 0 |
| 6409 | 99 | 639 | 7,5 | cyclicttest | 0 | -21 | swapper | 04:24:08 | 0 |
| 6409 | 99 | 639 | 619,18 | cyclicttest | 30600 | -21 | sh | 05:33:08 | 0 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

| Characteristics of the 20 highest latencies: System rack6slot6.osadl.org (updated Sun Mar 17, 2019 12:43:25) | | | | | | | | | |
|---|------|--------------------|-----------------------|-------------------|--------------------|------|-------------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(.W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 6409 | 99 | 2612 | 2597,13 | cyclictest | 1802 | -21 | hald | 03:46:17 | 0 |
| 6409 | 99 | 682 | 666,14 | cyclictest | 728 | -21 | sensors | 04:06:29 | 0 |
| 6409 | 99 | 673 | 653,18 | cyclictest | 15095 | -21 | sensors | 05:56:26 | 0 |
| 6409 | 99 | 655 | 8,618 | cyclictest | 26624 | -21 | ssh | 05:27:37 | 0 |
| 6409 | 99 | 652 | 11,6 | cyclictest | 19597 | -21 | sh | 03:47:27 | 0 |
| 6409 | 99 | 650 | 7,620 | cyclictest | 0 | -21 | swapper | 05:14:53 | 0 |
| 6409 | 99 | 649 | 7,640 | cyclictest | 0 | -21 | swapper | 05:46:42 | 0 |
| 6409 | 99 | 647 | 7,5 | cyclictest | 0 | -21 | swapper | 02:44:19 | 0 |
| 6409 | 99 | 645 | 7,636 | cyclictest | 0 | -21 | swapper | 06:28:54 | 0 |
| 6409 | 99 | 644 | 7,5 | cyclictest | 0 | -21 | swapper | 04:47:15 | 0 |
| 6409 | 99 | 644 | 7,4 | cyclictest | 0 | -21 | swapper | 02:35:16 | 0 |
| 6409 | 99 | 643 | 7,615 | cyclictest | 0 | -21 | swapper | 01:34:38 | 0 |
| 6409 | 99 | 643 | 617,23 | cyclictest | 1406 | 50 | irq/9-eth0 | 05:01:19 | 0 |
| 6409 | 99 | 641 | 7,632 | cyclictest | 0 | -21 | swapper | 06:14:00 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclictest | 0 | -21 | swapper | 06:23:23 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclictest | 0 | -21 | swapper | 05:58:46 | 0 |
| 6409 | 99 | 640 | 7,631 | cyclictest | 0 | -21 | swapper | 04:15:46 | 0 |
| 6409 | 99 | 640 | 7,630 | cyclictest | 21458 | -21 | expr | 03:06:15 | 0 |
| 6409 | 99 | 639 | 7,5 | cyclictest | 0 | -21 | swapper | 04:24:08 | 0 |
| 6409 | 99 | 639 | 619,18 | cyclictest | 30600 | -21 | sh | 05:33:08 | 0 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Output of "hwlatdetect --duration=30m" on 03/17/2019 at 03:45:

tracer: hwlat

#

entries-in-buffer/entries-written: 89/89 #P:1

#

#

#

#

#

#

#

#

#

#

#

```

          -----> irqsoft
          /_-----> need-resched
          || /_-----> need-resched_lazy
          ||| /_-----> hardirq/softirq
          ||| /_-----> preempt-depth
          |||| /_-----> preempt-lazy-depth
          ||||| /_-----> migrate-disable
          ||||| /_-----> delay
TASK-PID  CPU#  |||||  TIMESTAMP  FUNCTION
<...>-16302 [000] d..... 4877473.400363: #1    inner/outer(us): 614/0    ts:1552790720.782088594
<...>-16302 [000] d..... 4877479.517988: #2    inner/outer(us): 0/612    ts:1552790730.901208053
<...>-16302 [000] d..... 4877484.911291: #3    inner/outer(us): 0/608    ts:1552790740.981327040
<...>-16302 [000] d..... 4877490.348623: #4    inner/outer(us): 0/613    ts:1552790751.061446017
<...>-16302 [000] d..... 4877495.760501: #5    inner/outer(us): 0/607    ts:1552790761.141564983
<...>-16302 [000] d..... 4877501.162081: #6    inner/outer(us): 0/611    ts:1552790771.221683938
<...>-16302 [000] d..... 4877506.570170: #7    inner/outer(us): 0/607    ts:1552790781.301802883
<...>-16302 [000] d..... 4877511.961434: #8    inner/outer(us): 0/608    ts:1552790791.381921818
<...>-16302 [000] d..... 4877587.256690: #9    inner/outer(us): 0/609    ts:1552790931.581574965
<...>-16302 [000] d..... 4877592.666464: #10   inner/outer(us): 0/613    ts:1552790941.677693936
<...>-16302 [000] d..... 4877598.068932: #11   inner/outer(us): 574/0    ts:1552790951.765812804
<...>-16302 [000] d..... 4877603.480017: #12   inner/outer(us): 0/608    ts:1552790961.861931755
<...>-16302 [000] d..... 4877608.870198: #13   inner/outer(us): 612/0    ts:1552790971.942050509
<...>-16302 [000] d..... 4877614.278978: #14   inner/outer(us): 607/0    ts:1552790982.021169240
<...>-16302 [000] d..... 4877619.688860: #15   inner/outer(us): 0/614    ts:1552790992.109288068
<...>-16302 [000] d..... 4877625.125405: #16   inner/outer(us): 0/607    ts:1552791002.197406885
<...>-16302 [000] d..... 4877693.388482: #17   inner/outer(us): 614/0    ts:1552791122.517823263
<...>-16302 [000] d..... 4877698.787595: #18   inner/outer(us): 0/606    ts:1552791132.605941955
<...>-16302 [000] d..... 4877704.205377: #19   inner/outer(us): 610/0    ts:1552791142.702060731
<...>-16302 [000] d..... 4877709.602221: #20   inner/outer(us): 0/616    ts:1552791152.790179404
<...>-16302 [000] d..... 4877715.012943: #21   inner/outer(us): 0/609    ts:1552791162.869297962
<...>-16302 [000] d..... 4877720.422802: #22   inner/outer(us): 0/607    ts:1552791172.957416616
<...>-16302 [000] d..... 4877725.967553: #23   inner/outer(us): 0/613    ts:1552791183.053535355
<...>-16302 [000] d..... 4877731.361344: #24   inner/outer(us): 609/0    ts:1552791193.133653896
<...>-16302 [000] d..... 4877736.768349: #25   inner/outer(us): 611/0    ts:1552791203.213772428
<...>-16302 [000] d..... 4877742.162564: #26   inner/outer(us): 0/607    ts:1552791213.293890950
<...>-16302 [000] d..... 4877747.568916: #27   inner/outer(us): 608/0    ts:1552791223.374009462
<...>-16302 [000] d..... 4877752.971246: #28   inner/outer(us): 611/0    ts:1552791233.454127966
<...>-16302 [000] d..... 4877758.393812: #29   inner/outer(us): 608/0    ts:1552791243.533246448
```

Output of "hwlatdetect --duration=30m" on 03/17/2019 at 03:45:

tracer: hwlat

#

entries-in-buffer/entries-written: 89/89 #P:1

#

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#

#

#

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#

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#

#

#

#

```

          _-----> irqsoft
          /_-----> need-resched
          ||_-----> need-resched_lazy
          |||_-----> hardirq/softirq
          ||||_-----> preempt-depth
          |||||_-----> preempt-lazy-depth
          |||||_-----> migrate-disable
          |||||_-----> delay
TASK-PID  CPU#  |||||  TIMESTAMP  FUNCTION
<...>-16302 [000] d..... 4877473.400363: #1 inner/outer(us): 614/0 ts:1552790720.782088594
<...>-16302 [000] d..... 4877479.517988: #2 inner/outer(us): 0/612 ts:1552790730.901208053
<...>-16302 [000] d..... 4877484.911291: #3 inner/outer(us): 0/608 ts:1552790740.981327040
<...>-16302 [000] d..... 4877490.348623: #4 inner/outer(us): 0/613 ts:1552790751.061446017
<...>-16302 [000] d..... 4877495.760501: #5 inner/outer(us): 0/607 ts:1552790761.141564983
<...>-16302 [000] d..... 4877501.162081: #6 inner/outer(us): 0/611 ts:1552790771.221683938
<...>-16302 [000] d..... 4877506.570170: #7 inner/outer(us): 0/607 ts:1552790781.301802883
<...>-16302 [000] d..... 4877511.961434: #8 inner/outer(us): 0/608 ts:1552790791.381921818
<...>-16302 [000] d..... 4877587.256690: #9 inner/outer(us): 0/609 ts:1552790931.581574965
<...>-16302 [000] d..... 4877592.666464: #10 inner/outer(us): 0/613 ts:1552790941.677693936
<...>-16302 [000] d..... 4877598.068932: #11 inner/outer(us): 574/0 ts:1552790951.765812804
<...>-16302 [000] d..... 4877603.480017: #12 inner/outer(us): 0/608 ts:1552790961.861931755
<...>-16302 [000] d..... 4877608.870198: #13 inner/outer(us): 612/0 ts:1552790971.942050509
<...>-16302 [000] d..... 4877614.278978: #14 inner/outer(us): 607/0 ts:1552790982.021169240
<...>-16302 [000] d..... 4877619.688860: #15 inner/outer(us): 0/614 ts:1552790992.109288068
<...>-16302 [000] d..... 4877625.125405: #16 inner/outer(us): 0/607 ts:1552791002.197406885
<...>-16302 [000] d..... 4877693.388482: #17 inner/outer(us): 614/0 ts:1552791122.517823263
<...>-16302 [000] d..... 4877698.787595: #18 inner/outer(us): 0/606 ts:1552791132.605941955
<...>-16302 [000] d..... 4877704.205377: #19 inner/outer(us): 610/0 ts:1552791142.702060731
<...>-16302 [000] d..... 4877709.602221: #20 inner/outer(us): 0/616 ts:1552791152.790179404
<...>-16302 [000] d..... 4877715.012943: #21 inner/outer(us): 0/609 ts:1552791162.869297962
<...>-16302 [000] d..... 4877720.422802: #22 inner/outer(us): 0/607 ts:1552791172.957416616
<...>-16302 [000] d..... 4877725.967553: #23 inner/outer(us): 0/613 ts:1552791183.053535355
<...>-16302 [000] d..... 4877731.361344: #24 inner/outer(us): 609/0 ts:1552791193.133653896
<...>-16302 [000] d..... 4877736.768349: #25 inner/outer(us): 611/0 ts:1552791203.213772428
<...>-16302 [000] d..... 4877742.162564: #26 inner/outer(us): 0/607 ts:1552791213.293890950
<...>-16302 [000] d..... 4877747.568916: #27 inner/outer(us): 608/0 ts:1552791223.374009462
<...>-16302 [000] d..... 4877752.971246: #28 inner/outer(us): 611/0 ts:1552791233.454127966
<...>-16302 [000] d..... 4877758.393812: #29 inner/outer(us): 608/0 ts:1552791243.533246448
```

```

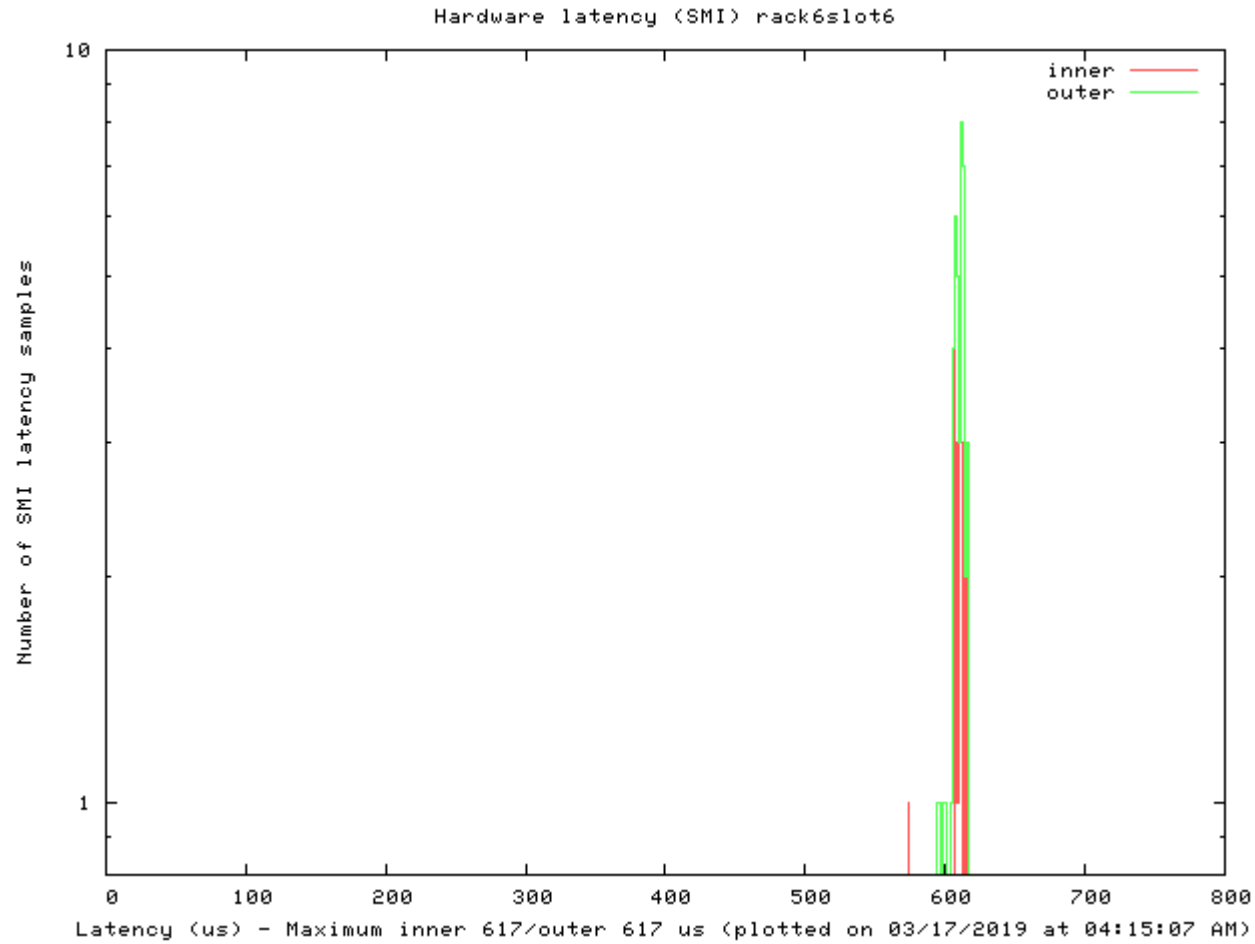
<...>-16302 [000] d..... 4877804.630851: #30 inner/outer(us): 608/0 ts:1552791323.597187292
<...>-16302 [000] d..... 4877810.339991: #31 inner/outer(us): 0/617 ts:1552791333.733306362
<...>-16302 [000] d..... 4877815.749037: #32 inner/outer(us): 0/613 ts:1552791343.813424765
<...>-16302 [000] d..... 4877821.153488: #33 inner/outer(us): 0/610 ts:1552791353.901543253
<...>-16302 [000] d..... 4877826.582131: #34 inner/outer(us): 0/611 ts:1552791364.013662014
<...>-16302 [000] d..... 4877831.975550: #35 inner/outer(us): 0/605 ts:1552791374.093780390
<...>-16302 [000] d..... 4877837.380887: #36 inner/outer(us): 607/0 ts:1552791384.173898756
<...>-16302 [000] d..... 4877842.779632: #37 inner/outer(us): 0/612 ts:1552791394.262017208
<...>-16302 [000] d..... 4877923.496708: #38 inner/outer(us): 0/612 ts:1552791544.541780701
<...>-16302 [000] d..... 4877928.894798: #39 inner/outer(us): 610/0 ts:1552791554.629899013
<...>-16302 [000] d..... 4877934.300006: #40 inner/outer(us): 616/0 ts:1552791564.718017316
<...>-16302 [000] d..... 4877939.697218: #41 inner/outer(us): 0/608 ts:1552791574.806135611
<...>-16302 [000] d..... 4877945.106890: #42 inner/outer(us): 612/0 ts:1552791584.885253792
<...>-16302 [000] d..... 4877950.511634: #43 inner/outer(us): 611/0 ts:1552791594.973372070
<...>-16302 [000] d..... 4877956.425184: #44 inner/outer(us): 611/0 ts:1552791605.093490714
<...>-16302 [000] d..... 4878029.559309: #45 inner/outer(us): 0/610 ts:1552791735.446018845
<...>-16302 [000] d..... 4878034.969977: #46 inner/outer(us): 0/595 ts:1552791745.526137006
<...>-16302 [000] d..... 4878040.364004: #47 inner/outer(us): 0/614 ts:1552791755.605255147
<...>-16302 [000] d..... 4878045.769635: #48 inner/outer(us): 0/606 ts:1552791765.685373291
<...>-16302 [000] d..... 4878051.193046: #49 inner/outer(us): 0/608 ts:1552791775.773491521
<...>-16302 [000] d..... 4878056.738801: #50 inner/outer(us): 610/0 ts:1552791785.885610024
<...>-16302 [000] d..... 4878062.132220: #51 inner/outer(us): 610/0 ts:1552791795.965728144
<...>-16302 [000] d..... 4878067.541579: #52 inner/outer(us): 0/613 ts:1552791806.053846349
<...>-16302 [000] d..... 4878072.937369: #53 inner/outer(us): 0/611 ts:1552791816.141964546
<...>-16302 [000] d..... 4878078.345181: #54 inner/outer(us): 0/611 ts:1552791826.222082641
<...>-16302 [000] d..... 4878083.751705: #55 inner/outer(us): 0/606 ts:1552791836.309200810
<...>-16302 [000] d..... 4878089.166895: #56 inner/outer(us): 0/615 ts:1552791846.389318889
<...>-16302 [000] d..... 4878094.560043: #57 inner/outer(us): 0/611 ts:1552791856.469436959
<...>-16302 [000] d..... 4878099.968019: #58 inner/outer(us): 0/612 ts:1552791866.549555021
<...>-16302 [000] d..... 4878146.515204: #59 inner/outer(us): 0/613 ts:1552791946.445490511

```

```

<...>-16302 [000] d..... 4878151.921186: #60 inner/outer(us): 611/0 ts:1552791956.525608502
<...>-16302 [000] d..... 4878157.340646: #61 inner/outer(us): 0/606 ts:1552791966.613726579
<...>-16302 [000] d..... 4878162.734473: #62 inner/outer(us): 607/0 ts:1552791976.693844554
<...>-16302 [000] d..... 4878168.143763: #63 inner/outer(us): 0/599 ts:1552791986.781962615
<...>-16302 [000] d..... 4878173.541694: #64 inner/outer(us): 0/612 ts:1552791996.870080668
<...>-16302 [000] d..... 4878178.950005: #65 inner/outer(us): 611/0 ts:1552792006.957198702
<...>-16302 [000] d..... 4878184.370113: #66 inner/outer(us): 0/616 ts:1552792017.045316740
<...>-16302 [000] d..... 4878189.795701: #67 inner/outer(us): 0/612 ts:1552792027.149434956
<...>-16302 [000] d..... 4878195.188437: #68 inner/outer(us): 617/0 ts:1552792037.229552885
<...>-16302 [000] d..... 4878200.590301: #69 inner/outer(us): 0/610 ts:1552792047.309670805
<...>-16302 [000] d..... 4878205.991221: #70 inner/outer(us): 0/612 ts:1552792057.389788718
<...>-16302 [000] d..... 4878211.396720: #71 inner/outer(us): 0/596 ts:1552792067.469906623
<...>-16302 [000] d..... 4878216.798039: #72 inner/outer(us): 0/609 ts:1552792077.550024520
<...>-16302 [000] d..... 4878295.026662: #73 inner/outer(us): 0/607 ts:1552792217.877665008
<...>-16302 [000] d..... 4878301.310293: #74 inner/outer(us): 0/601 ts:1552792228.069784102
<...>-16302 [000] d..... 4878306.721636: #75 inner/outer(us): 0/609 ts:1552792238.165902066
<...>-16302 [000] d..... 4878312.146302: #76 inner/outer(us): 610/0 ts:1552792248.246019836
<...>-16302 [000] d..... 4878317.542008: #77 inner/outer(us): 0/609 ts:1552792258.326137598
<...>-16302 [000] d..... 4878322.971584: #78 inner/outer(us): 0/615 ts:1552792268.405255342
<...>-16302 [000] d..... 4878328.367607: #79 inner/outer(us): 616/0 ts:1552792278.493373183
<...>-16302 [000] d..... 4878333.761087: #80 inner/outer(us): 0/614 ts:1552792288.573490923
<...>-16302 [000] d..... 4878403.657367: #81 inner/outer(us): 607/0 ts:1552792418.718010425
<...>-16302 [000] d..... 4878409.071895: #82 inner/outer(us): 607/0 ts:1552792428.798128066
<...>-16302 [000] d..... 4878414.462985: #83 inner/outer(us): 0/600 ts:1552792438.877245688
<...>-16302 [000] d..... 4878419.897597: #84 inner/outer(us): 617/0 ts:1552792448.973363502
<...>-16302 [000] d..... 4878425.295041: #85 inner/outer(us): 0/608 ts:1552792459.053481121
<...>-16302 [000] d..... 4878430.685993: #86 inner/outer(us): 0/616 ts:1552792469.133598734
<...>-16302 [000] d..... 4878436.092827: #87 inner/outer(us): 0/613 ts:1552792479.213716340
<...>-16302 [000] d..... 4878441.501407: #88 inner/outer(us): 0/612 ts:1552792489.293833938
<...>-16302 [000] d..... 4878446.898398: #89 inner/outer(us): 612/0 ts:1552792499.373951530

```

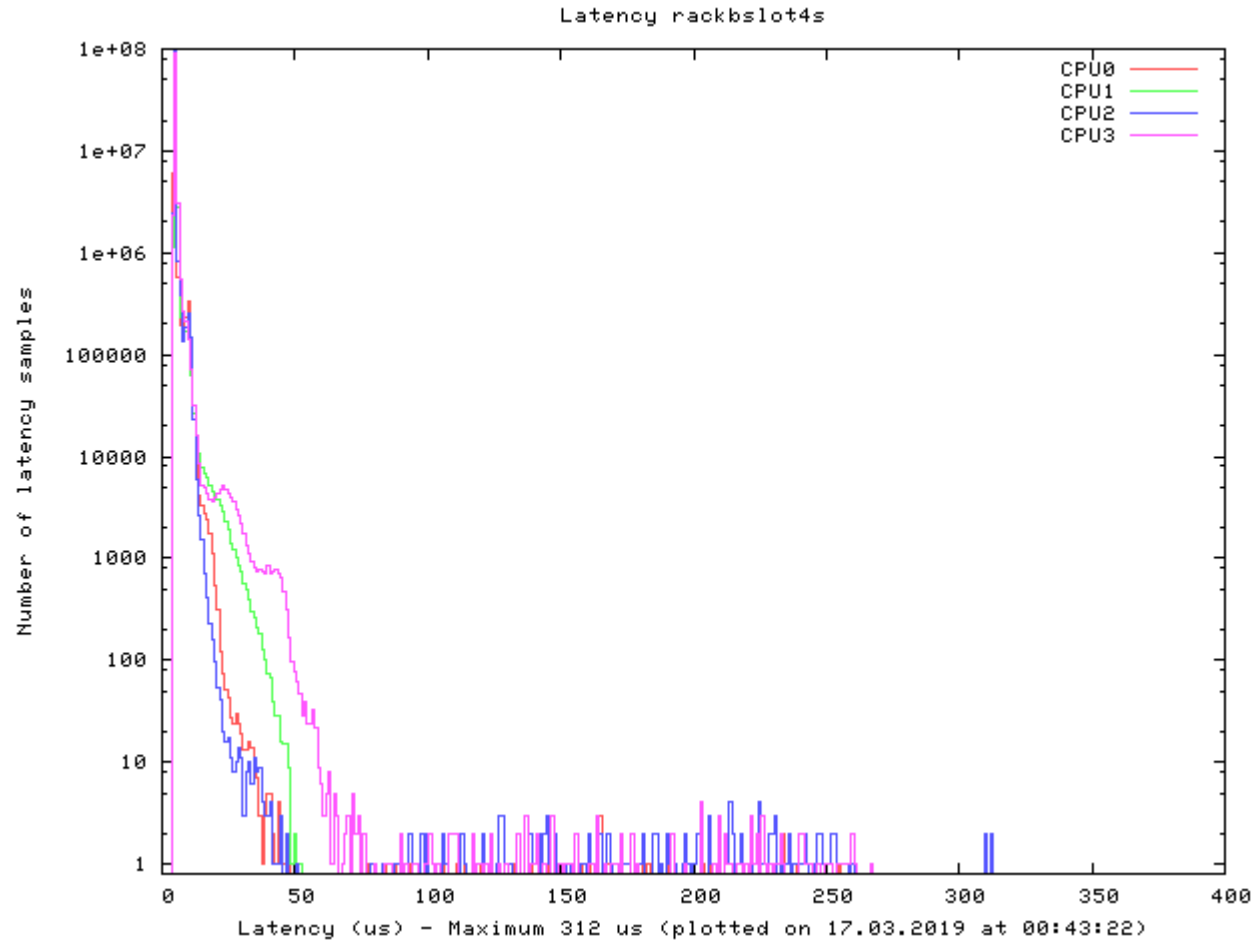
Countermeasure

- Run the following process:

```
int timeout = bios_fixed = success = 0;

install_timeout_handler(&timeout);
while (!bios_fixed && !timeout)
    return_hardware_to_vendor(&bios_fixed);
if (timeout) {
    ask_osadl();
    docs = osadl_mkdocs(qafarm);
    success = osadl_convince_vendor(docs);
    if (!success)
        remove_feature_from_hardware(rt);
}
```

Latency fighting case #6



Culprit/victim table

| Characteristics of the 20 highest latencies: System rackbslot4s.osadl.org (updated Sun Mar 17, 2019 00:43:30) | | | | | | | | | |
|--|------|--------------------|-----------------------|-------------|--------------------|------|--------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(,W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 27884 | 99 | 308 | 305,2 | cyclicttest | 25156 | -21 | kworker/u8:1 | 22:20:02 | 2 |
| 27885 | 99 | 261 | 245,12 | cyclicttest | 1724 | -21 | gnome-shell | 22:03:00 | 3 |
| 11961 | 99 | 261 | 247,11 | cyclicttest | 1724 | -21 | gnome-shell | 09:01:59 | 0 |
| 11962 | 99 | 254 | 249,3 | cyclicttest | 1724 | -21 | gnome-shell | 10:35:58 | 1 |
| 27884 | 99 | 253 | 249,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:59:59 | 2 |
| 27884 | 99 | 245 | 241,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:43:00 | 2 |
| 27884 | 99 | 243 | 237,3 | cyclicttest | 1724 | -21 | gnome-shell | 23:51:00 | 2 |
| 27884 | 99 | 235 | 222,10 | cyclicttest | 1724 | -21 | gnome-shell | 23:34:59 | 2 |
| 27882 | 99 | 225 | 212,10 | cyclicttest | 1724 | -21 | gnome-shell | 00:15:00 | 0 |
| 27884 | 99 | 220 | 215,3 | cyclicttest | 1724 | -21 | gnome-shell | 23:49:00 | 2 |
| 27882 | 99 | 204 | 190,11 | cyclicttest | 1724 | -21 | gnome-shell | 00:03:00 | 0 |
| 27882 | 99 | 198 | 182,13 | cyclicttest | 1724 | -21 | gnome-shell | 00:09:00 | 0 |
| 27884 | 99 | 167 | 163,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:37:00 | 2 |
| 27885 | 99 | 166 | 161,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:35:59 | 3 |
| 27885 | 99 | 124 | 119,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:55:00 | 3 |
| 27885 | 99 | 85 | 81,2 | cyclicttest | 1724 | -21 | gnome-shell | 23:33:59 | 3 |
| 27884 | 99 | 84 | 81,1 | cyclicttest | 1724 | -21 | gnome-shell | 00:00:59 | 2 |
| 27885 | 99 | 55 | 24,4 | cyclicttest | 41 | -21 | ksoftirqd/3 | 00:15:07 | 3 |
| 27885 | 99 | 54 | 29,5 | cyclicttest | 41 | -21 | ksoftirqd/3 | 00:00:00 | 3 |
| 27885 | 99 | 53 | 28,8 | cyclicttest | 41 | -21 | ksoftirqd/3 | 23:45:14 | 3 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

Culprit/victim table

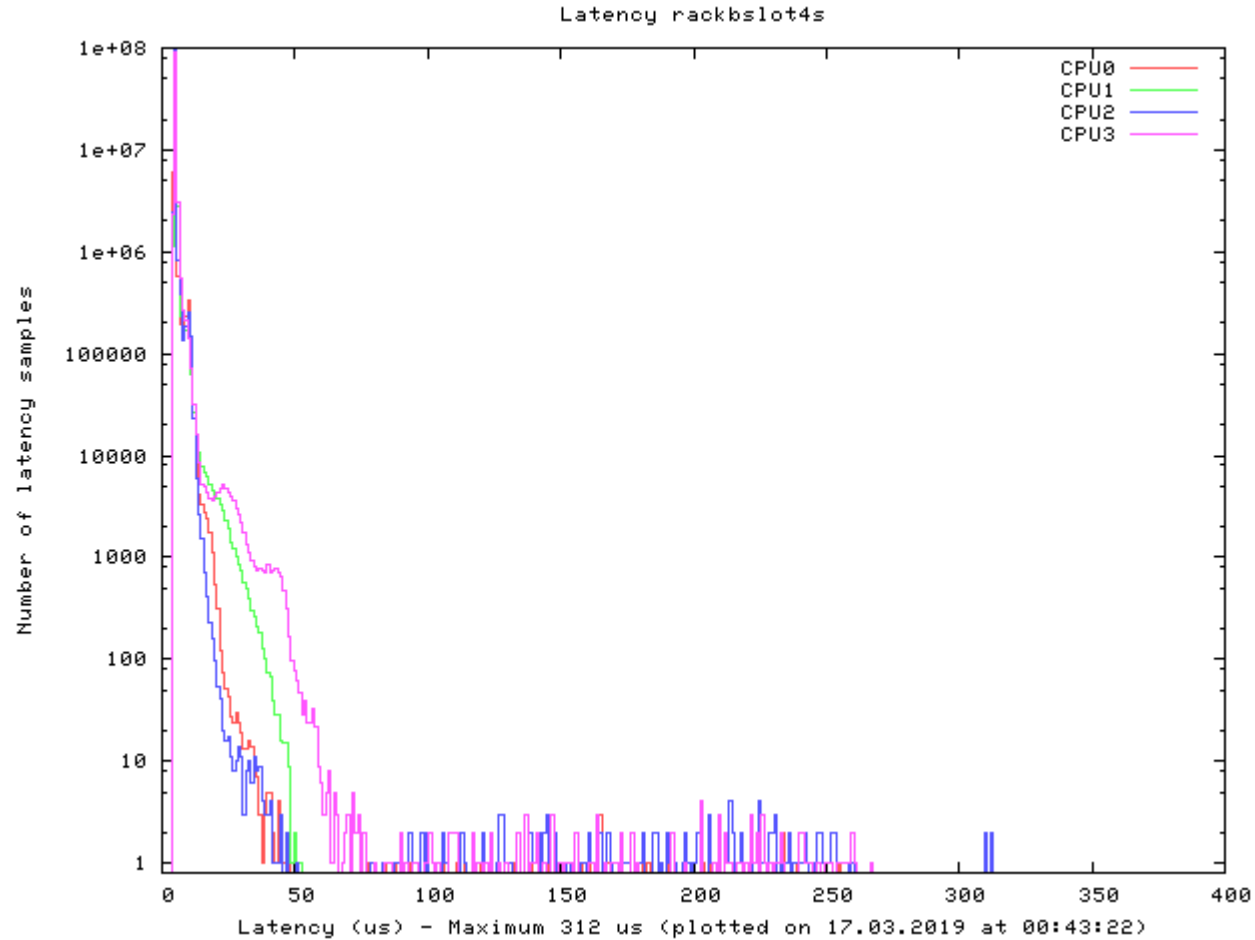
| Characteristics of the 20 highest latencies: System rackbslot4s.osadl.org (updated Sun Mar 17, 2019 00:43:30) | | | | | | | | | |
|--|------|--------------------|-----------------------|------------|--------------------|------|--------------|-----------|-----|
| Delayed (victim) | | | | | Switcher (culprit) | | | Timestamp | CPU |
| PID | Prio | Total latency (µs) | T*(,W**) latency (µs) | Cmd | PID | Prio | Cmd | | |
| 27884 | 99 | 308 | 305,2 | cyclictest | 25156 | -21 | kworker/u8:1 | 22:20:02 | 2 |
| 27885 | 99 | 261 | 245,12 | cyclictest | 1724 | -21 | gnome-shell | 22:03:00 | 3 |
| 11961 | 99 | 261 | 247,11 | cyclictest | 1724 | -21 | gnome-shell | 09:01:59 | 0 |
| 11962 | 99 | 254 | 249,3 | cyclictest | 1724 | -21 | gnome-shell | 10:35:58 | 1 |
| 27884 | 99 | 253 | 249,2 | cyclictest | 1724 | -21 | gnome-shell | 23:59:59 | 2 |
| 27884 | 99 | 245 | 241,2 | cyclictest | 1724 | -21 | gnome-shell | 23:43:00 | 2 |
| 27884 | 99 | 243 | 237,3 | cyclictest | 1724 | -21 | gnome-shell | 23:51:00 | 2 |
| 27884 | 99 | 235 | 222,10 | cyclictest | 1724 | -21 | gnome-shell | 23:34:59 | 2 |
| 27882 | 99 | 225 | 212,10 | cyclictest | 1724 | -21 | gnome-shell | 00:15:00 | 0 |
| 27884 | 99 | 220 | 215,3 | cyclictest | 1724 | -21 | gnome-shell | 23:49:00 | 2 |
| 27882 | 99 | 204 | 190,11 | cyclictest | 1724 | -21 | gnome-shell | 00:03:00 | 0 |
| 27882 | 99 | 198 | 182,13 | cyclictest | 1724 | -21 | gnome-shell | 00:09:00 | 0 |
| 27884 | 99 | 167 | 163,2 | cyclictest | 1724 | -21 | gnome-shell | 23:37:00 | 2 |
| 27885 | 99 | 166 | 161,2 | cyclictest | 1724 | -21 | gnome-shell | 23:35:59 | 3 |
| 27885 | 99 | 124 | 119,2 | cyclictest | 1724 | -21 | gnome-shell | 23:55:00 | 3 |
| 27885 | 99 | 85 | 81,2 | cyclictest | 1724 | -21 | gnome-shell | 23:33:59 | 3 |
| 27884 | 99 | 84 | 81,1 | cyclictest | 1724 | -21 | gnome-shell | 00:00:59 | 2 |
| 27885 | 99 | 55 | 24,4 | cyclictest | 41 | -21 | ksoftirqd/3 | 00:15:07 | 3 |
| 27885 | 99 | 54 | 29,5 | cyclictest | 41 | -21 | ksoftirqd/3 | 00:00:00 | 3 |
| 27885 | 99 | 53 | 28,8 | cyclictest | 41 | -21 | ksoftirqd/3 | 23:45:14 | 3 |

*Timer **Wakeup (latency=timer+wakeup+contextswitch)

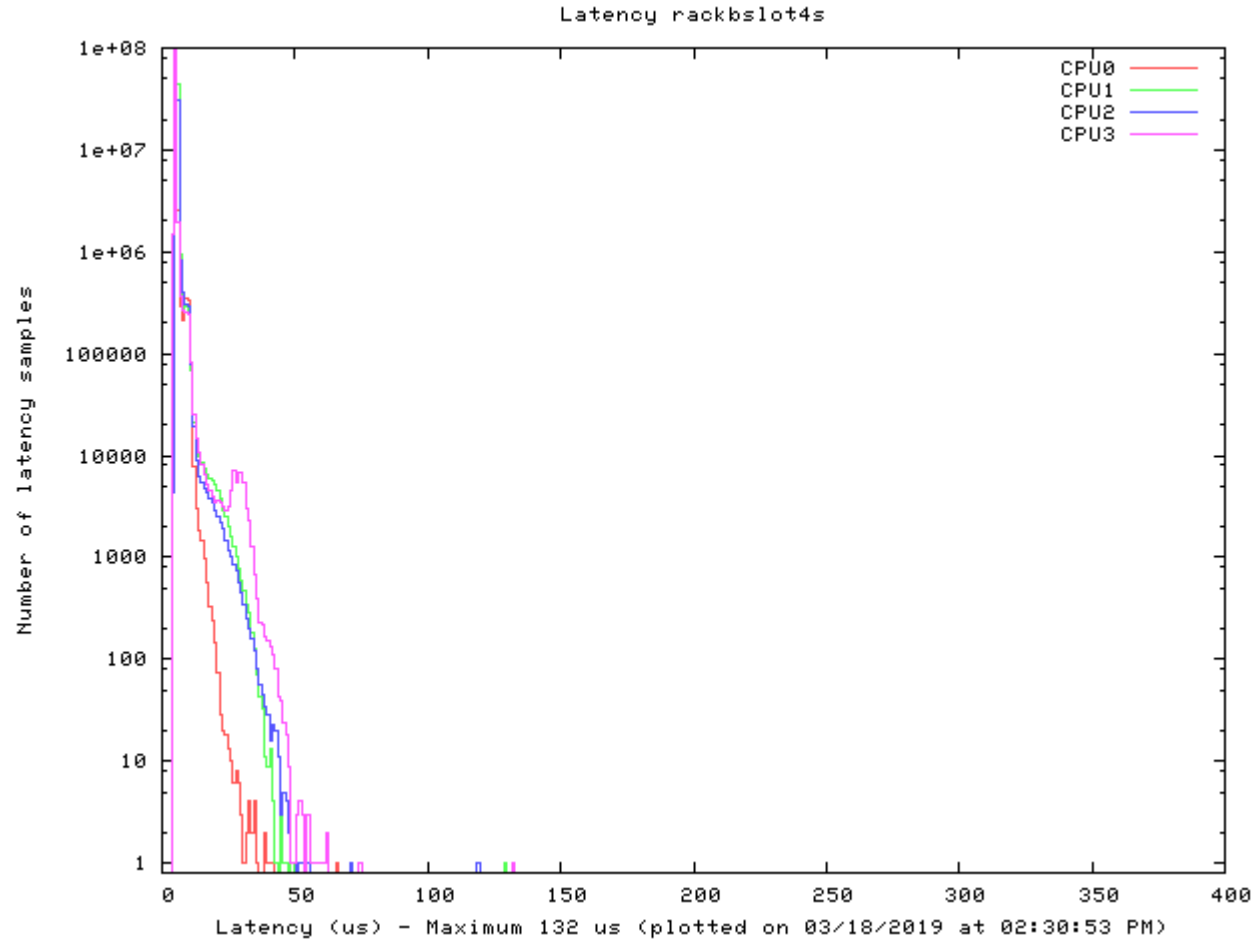
Countermeasures

- Quick fix for testing
 - `# systemctl isolate multi-user`
 - `# systemctl set-default multi-user`
- Fix with considerable impact on graphics performance
 - Additional kernel parameter: `nomodeset`
 - Use frame buffer graphics
- Better
 - There is nothing better
- Even better
 - No, you can't fix it yourself.

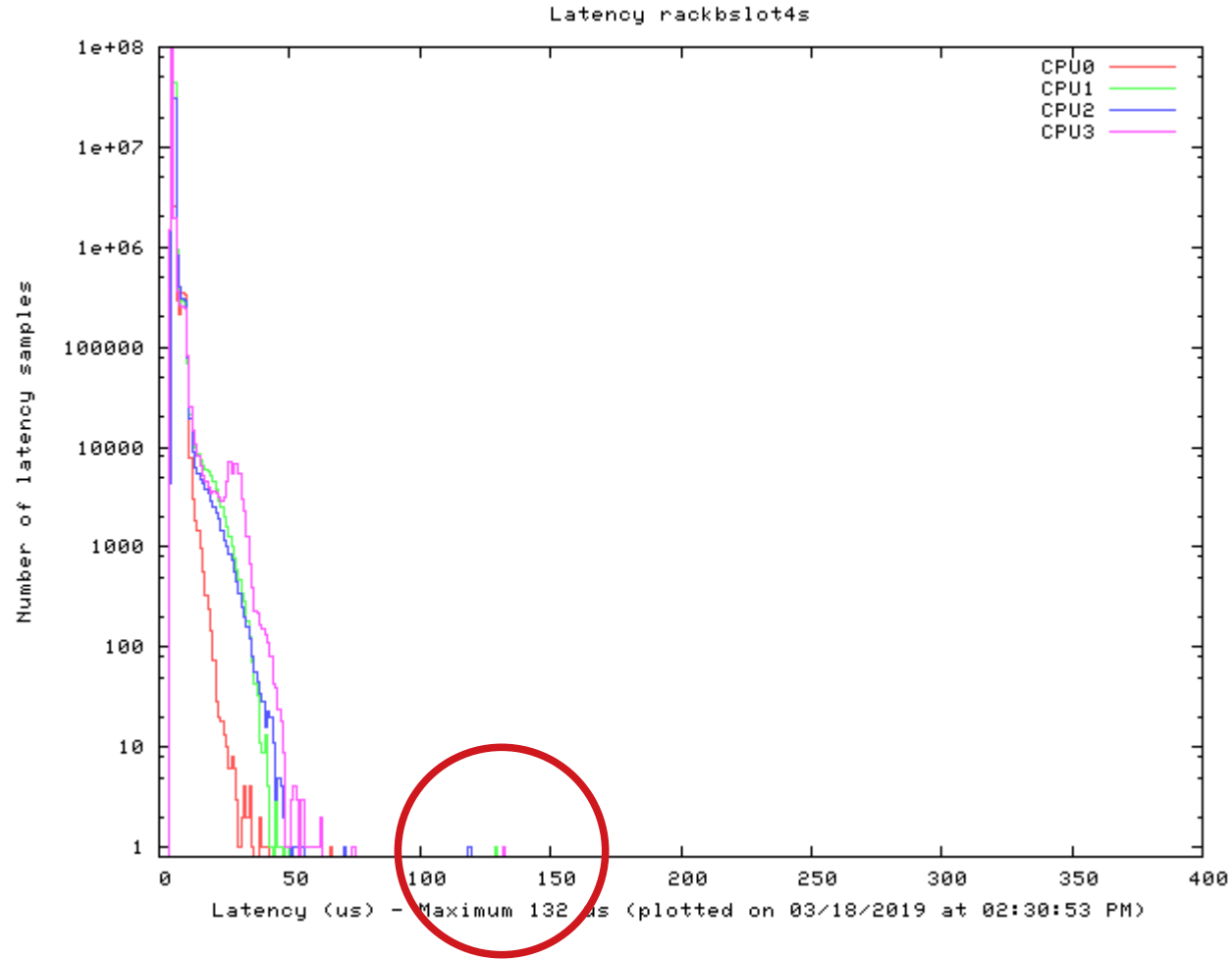
Before



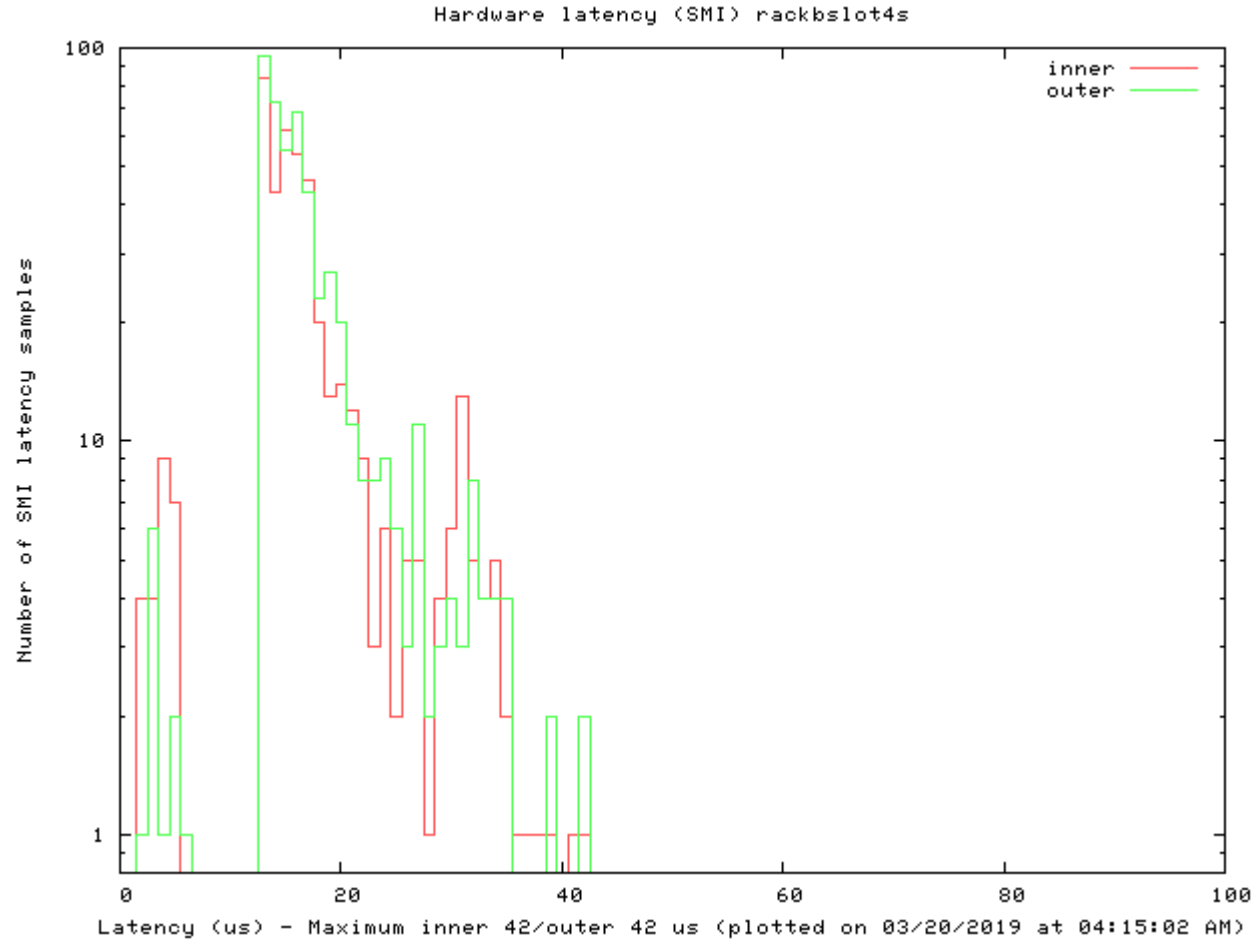
After



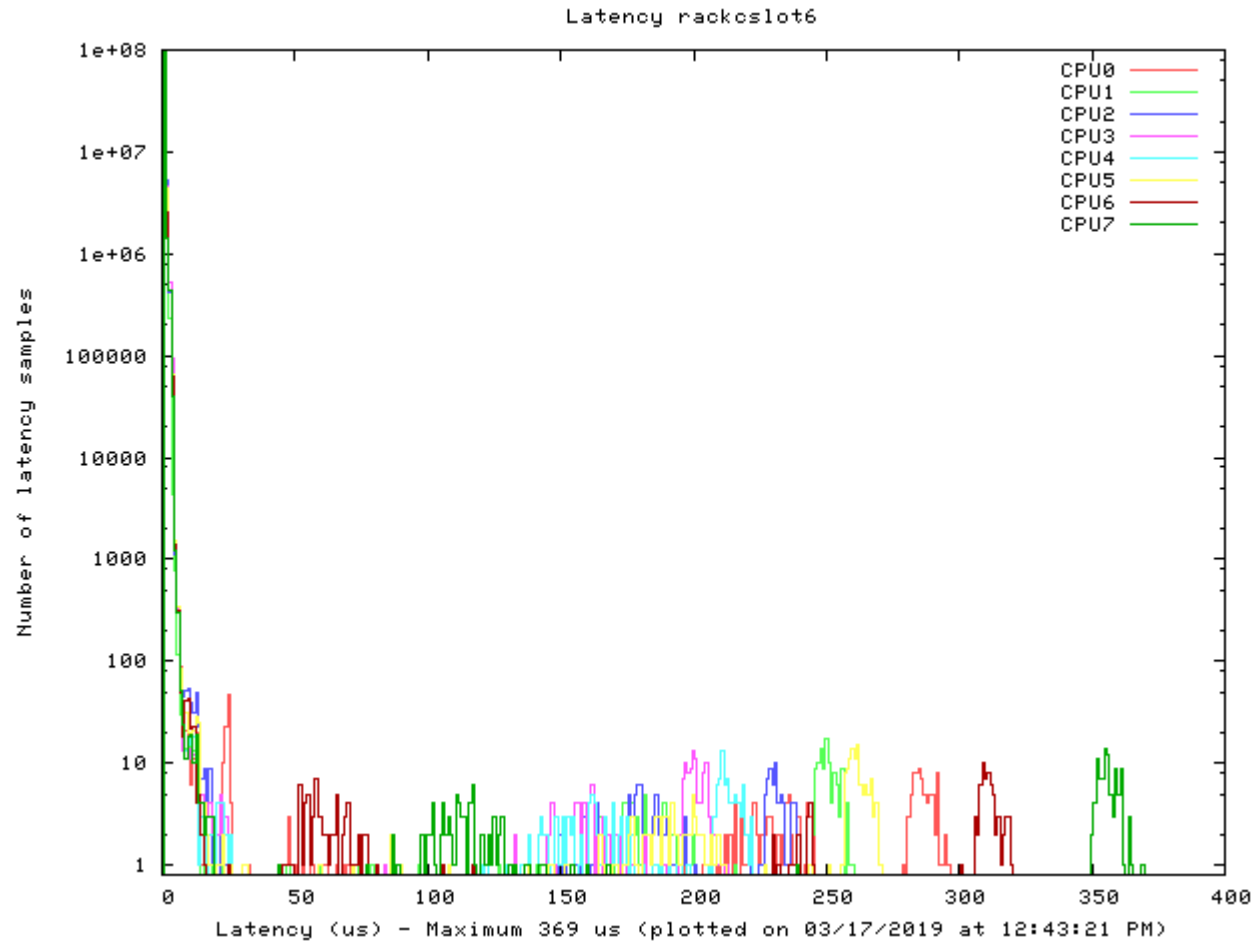
After

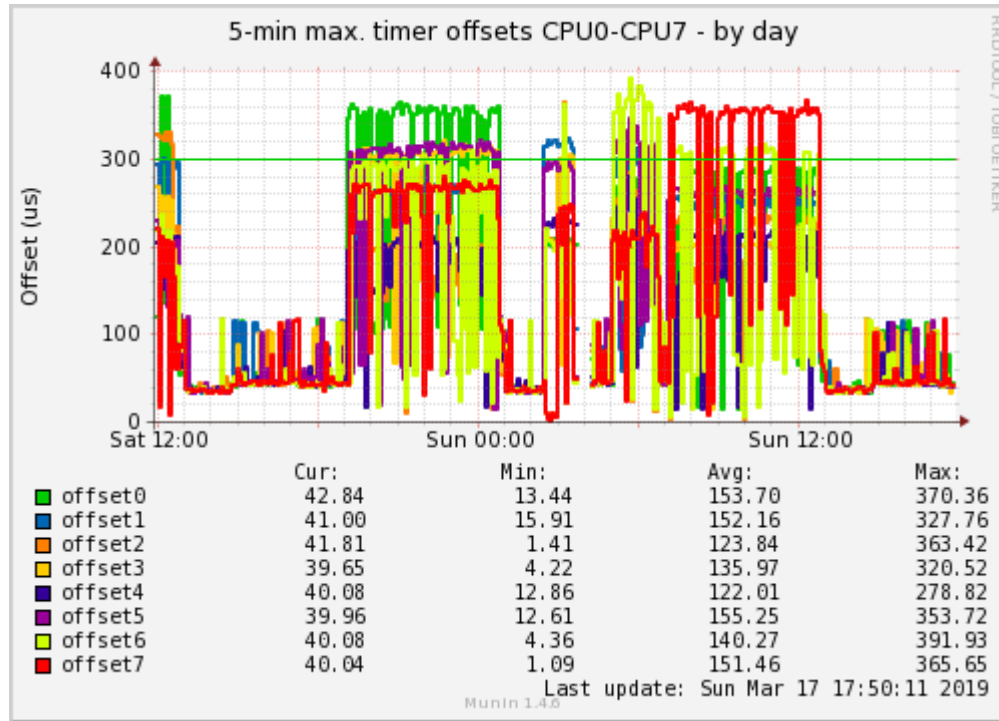


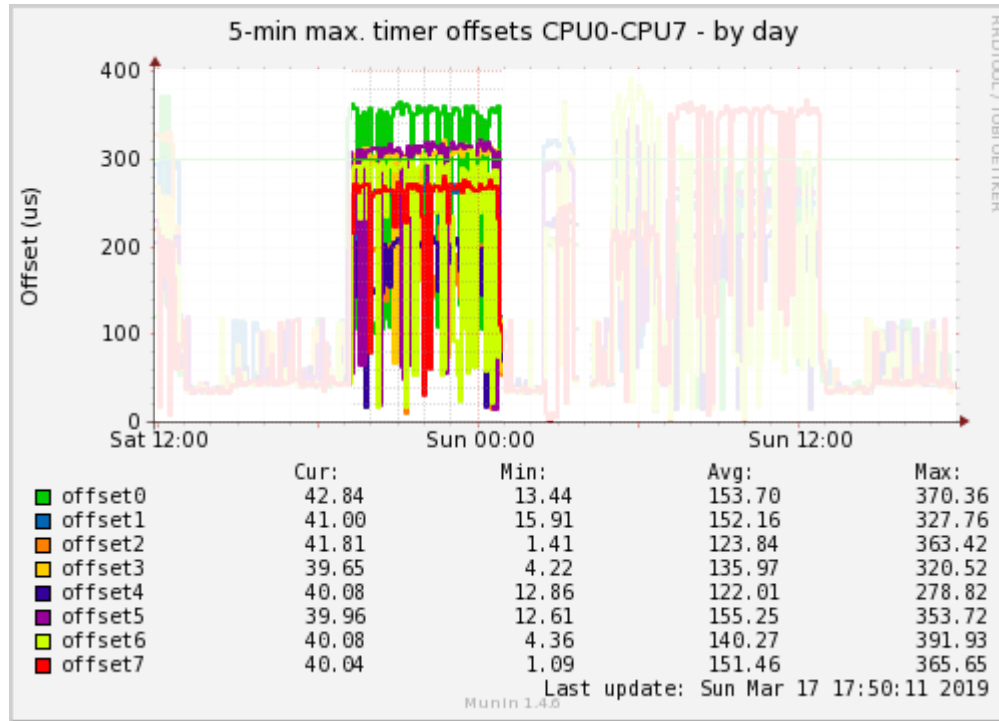
SMIs hidden behind other latency

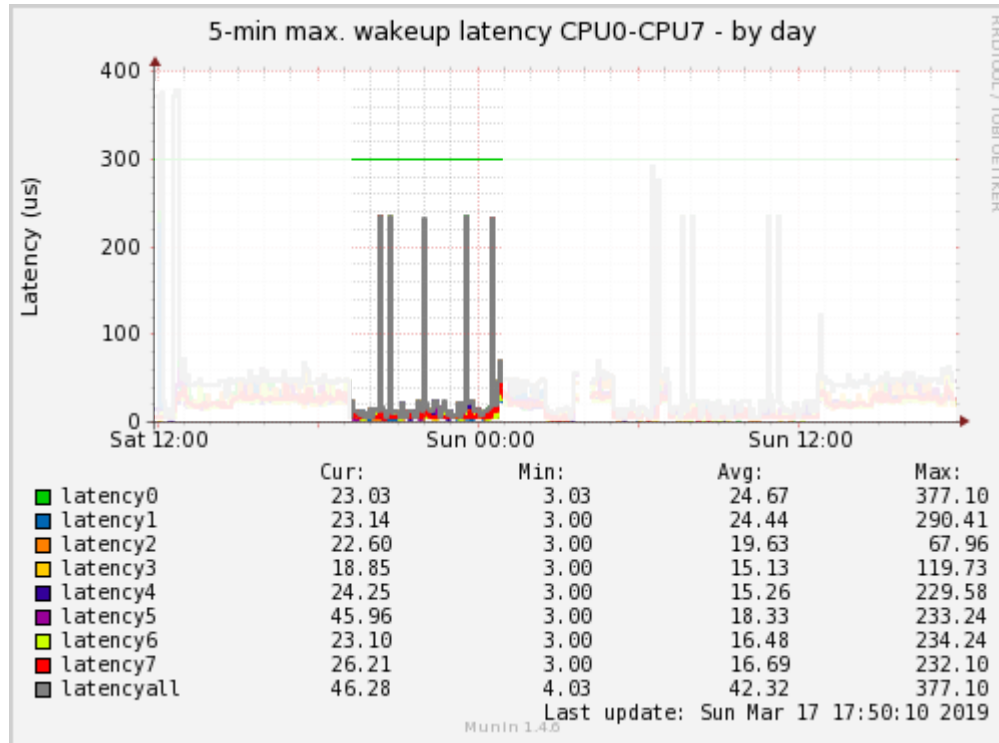


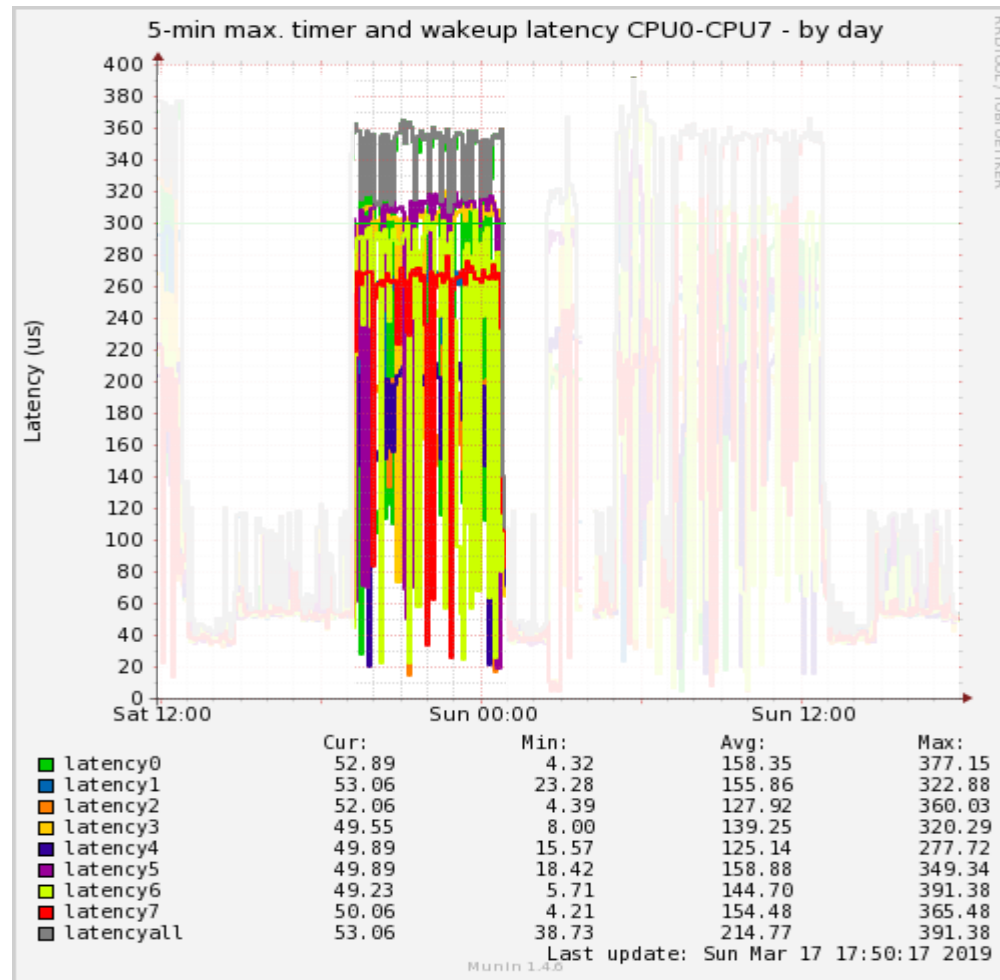
Latency fighting case #7

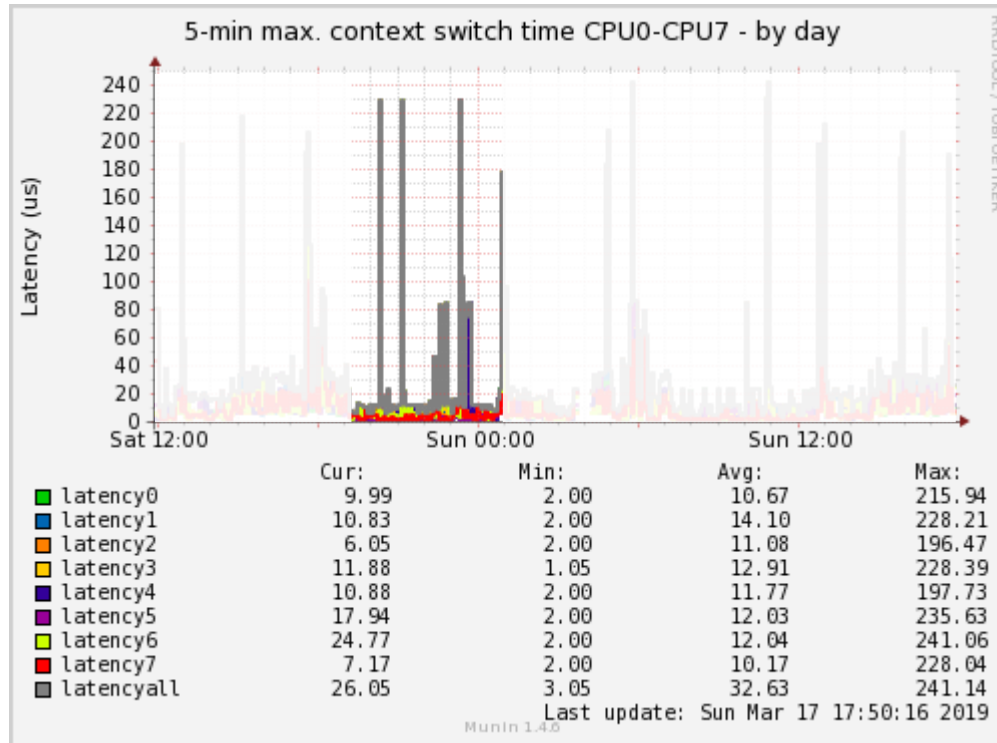


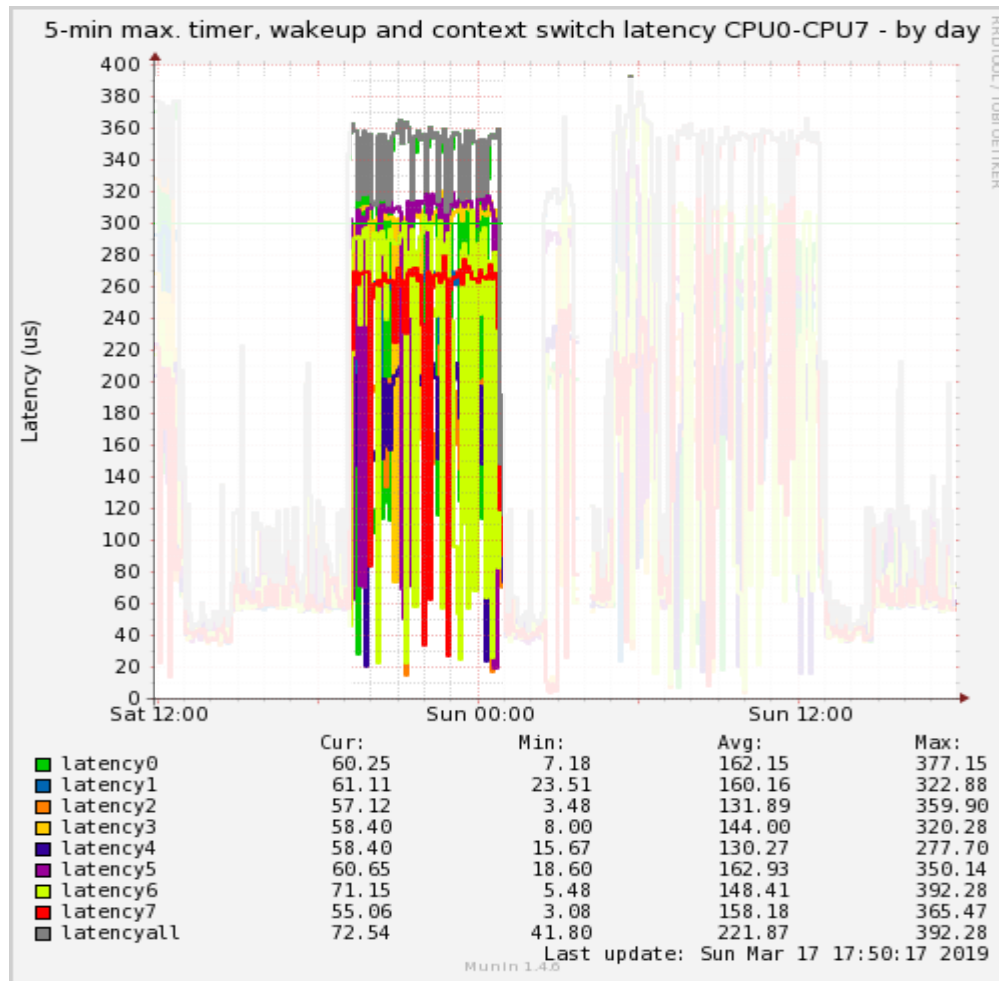


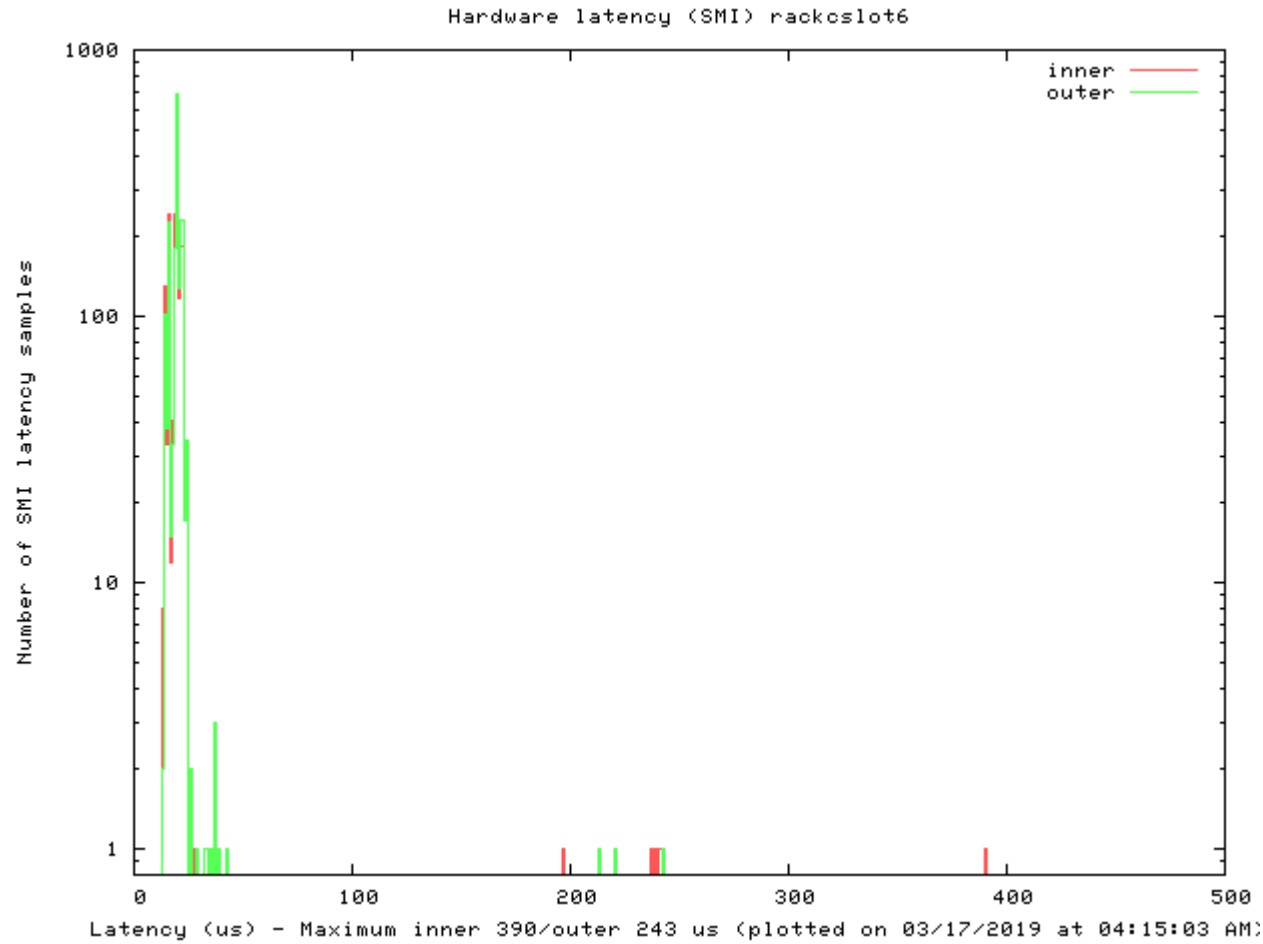








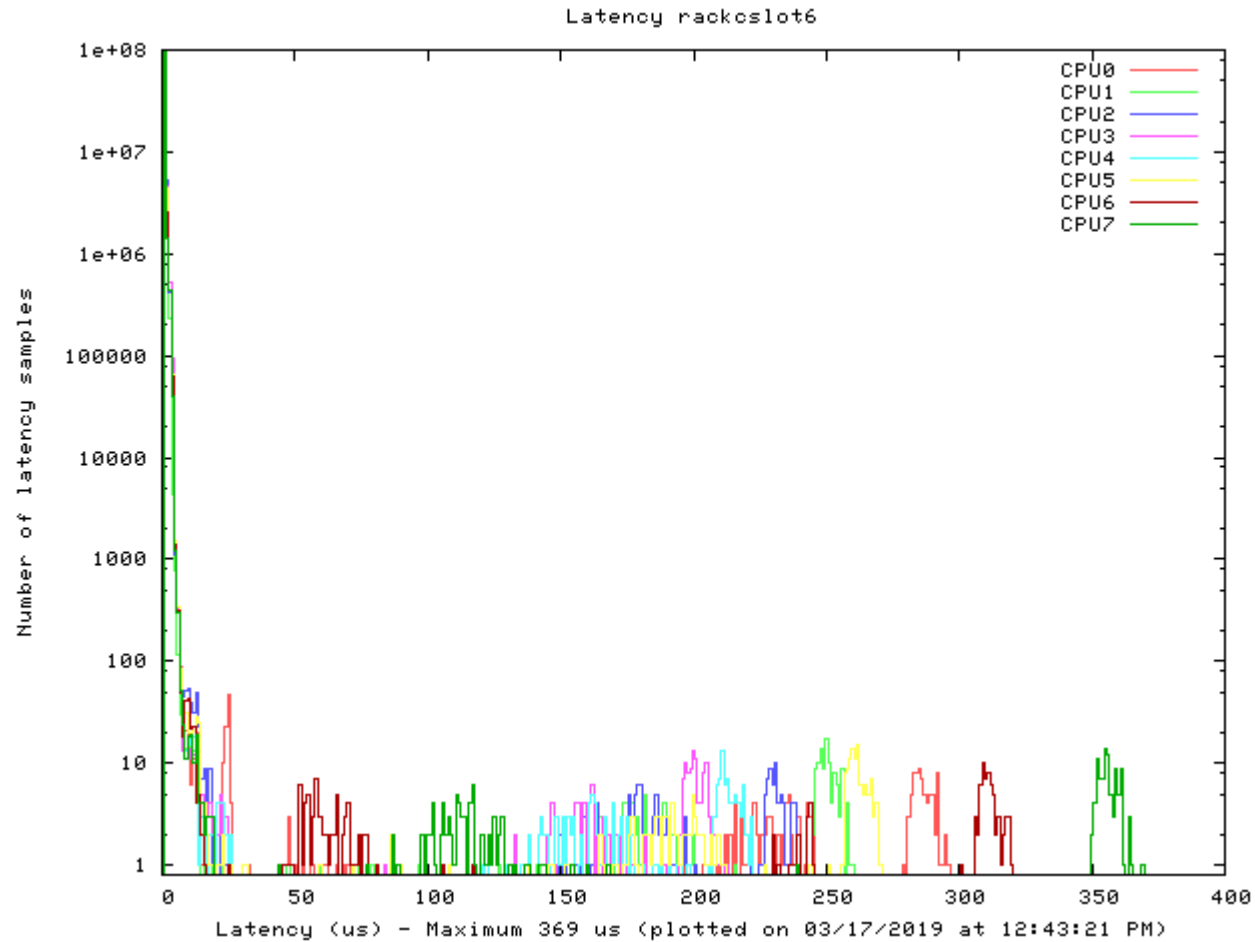




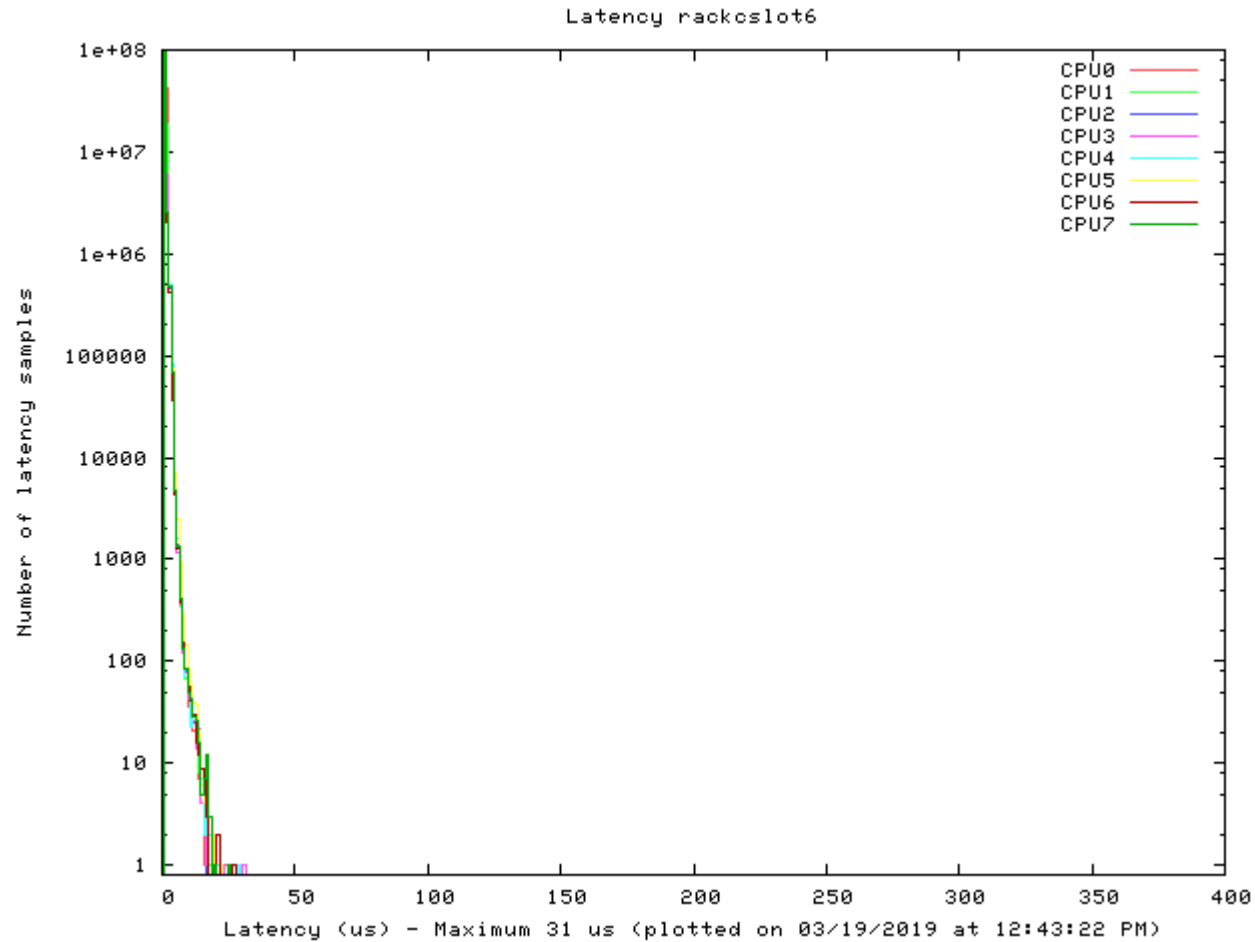
Countermeasures

- Quick fix for testing
 - `# systemctl isolate multi-user`
 - `# systemctl set-default multi-user`
- Fix with considerable impact on graphics performance
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- Better
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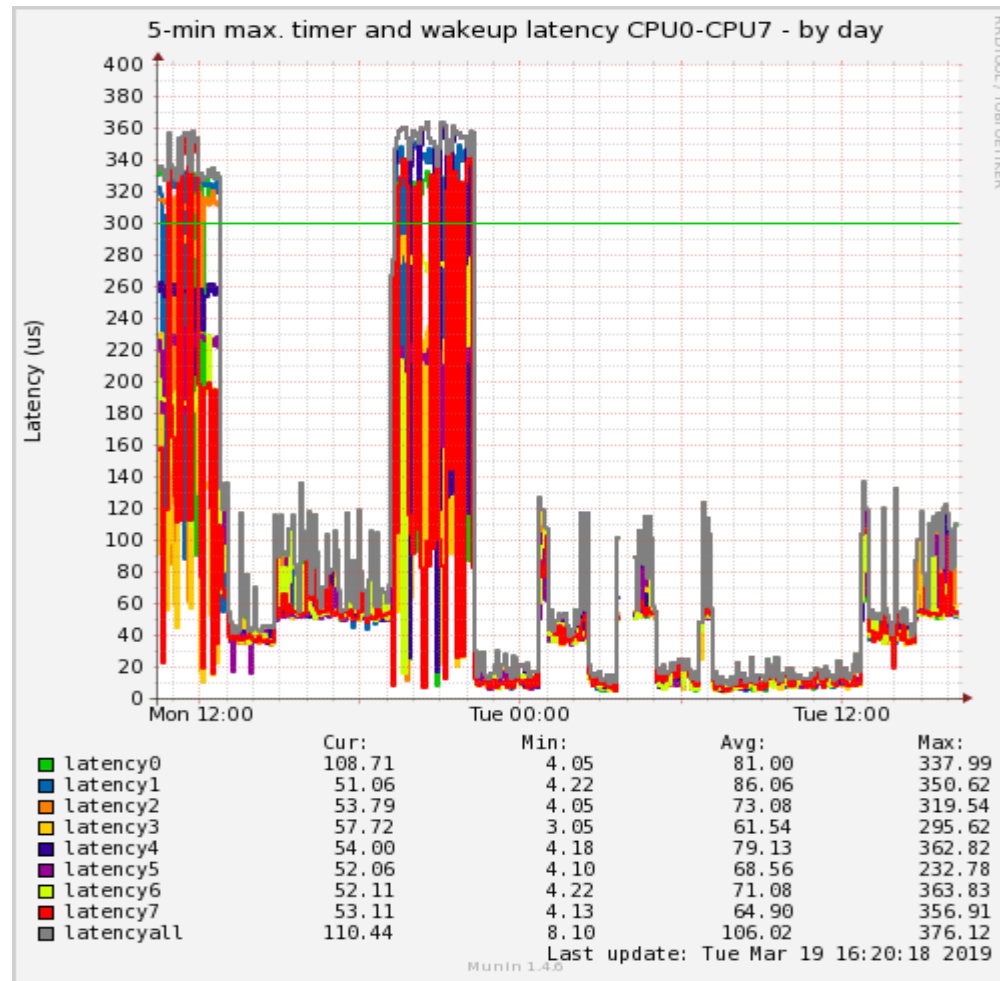
Before



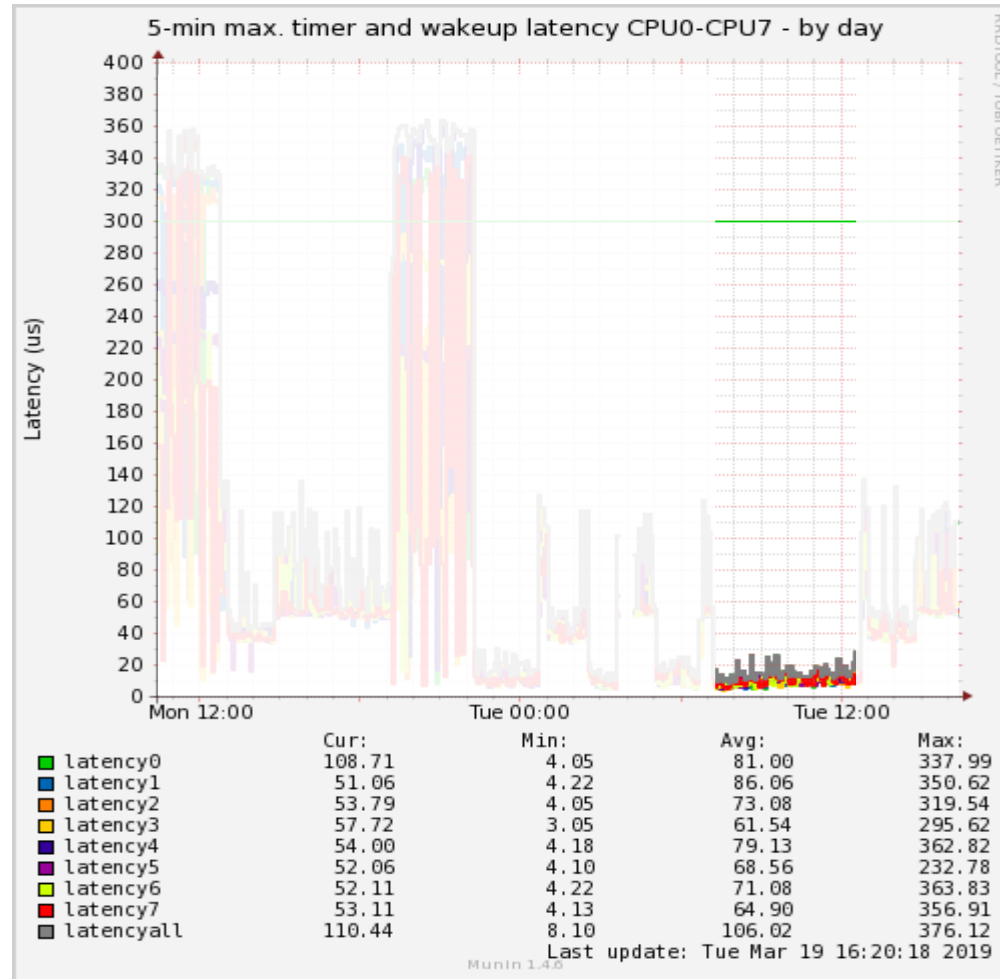
After



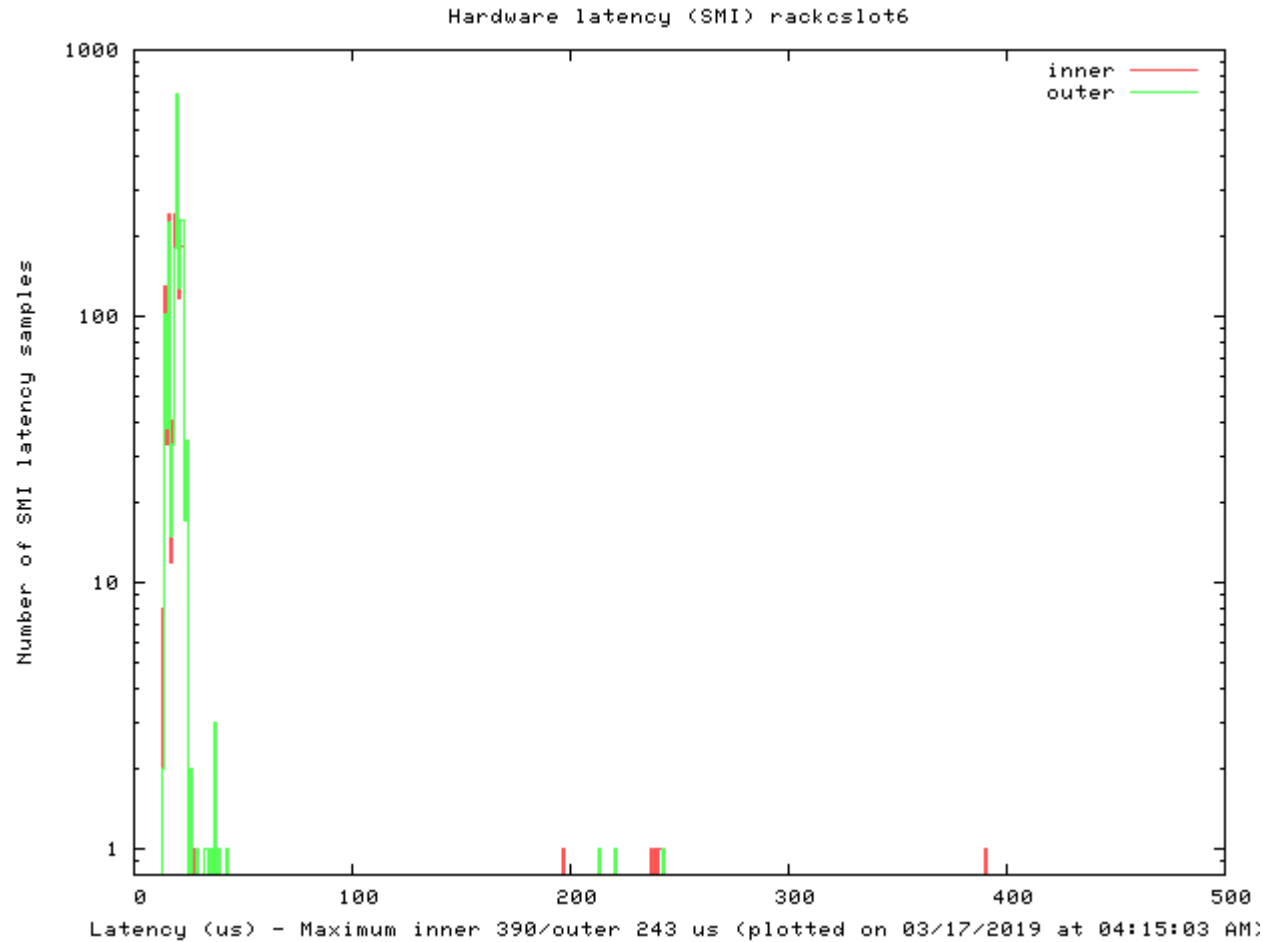
Before
and
after



Before
and
after



Before



After

