Ftrace
Linux Kernel Tracing

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Who am I?

What is Ftrace?

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- Traces the internal operations of the kernel

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- Traces the internal operations of the kernel
  - Static tracepoints within the kernel (event tracing)
    - scheduling
    - interrupts
    - file systems
    - virtual guest connections with host

What is Ftrace?

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  - Dynamic kernel function tracing

What is Ftrace?

- Traces the internal operations of the kernel
  - Dynamic kernel function tracing
    - trace all functions within the kernel
    - pick and choose what functions to trace
      - less functions == less overhead
    - call graphs
    - stack usage

What is Ftrace?

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  - Latency tracers

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  - Latency tracers
    - how long interrupts are disabled
    - how long preemption is disabled
    - how long interrupts and/or preemption is disabled

What is Ftrace?

- Traces the internal operations of the kernel
  - Latency tracers
    - how long interrupts are disabled
    - how long preemption is disabled
    - how long interrupts and/or preemption is disabled
  - Wake up latency
    - how long it takes a process to run after it is woken
      - All tasks
      - Just RT tasks

The Debugfs

- Officially mounted at
  - /sys/kernel/debug
- I prefer
  - mkdir /debug
  - mount -t debugfs nodev /debug
  - This presentation will use /debug
- Do what you want

The Tracing Directory

```
# ls /debug/tracing
available_events              printk_formats     trace
available_filter_functions    README             trace_clock
available_tracers             saved_cmdlines     trace_marker
buffer_size_kb                set_event          trace_options
current_tracer                set_ftrace_filter  trace_pipe
dyn_ftrace_total_info         set_ftrace_notrace trace_stat
events                        set_ftrace_pid
tracing_cpumask               failures
set_graph_function            tracing_enabled
function_profile_enabled      stack_max_size
tracing_max_latency           options            stack_trace
tracing_on                    per_cpu
tracing_thresh
```

Tracer Plugins

- Found in available_tracers
  - function
  - function_graph
  - wakeup and wakeup_rt
  - irqsoff, preemptoff, preemtirqsoff
  - mmiotrace
  - sched_switch
  - nop

The Function Tracer

```
[root@frodo tracing]# echo function > current_tracer
[root@frodo tracing]# cat trace | head -15
# tracer: function
#
#           TASK-PID    CPU#    TIMESTAMP  FUNCTION
#              | |       |          |         |
   simpress.bin-2792  [000]   634.280032: unix_poll <-sock_poll
   simpress.bin-2792  [000]   634.280033: sock_poll_wait <-unix_poll
   simpress.bin-2792  [000]   634.280033: fput <-do_sys_poll
   simpress.bin-2792  [000]   634.280034: fget_light <-do_sys_poll
   simpress.bin-2792  [000]   634.280035: sock_poll <-do_sys_poll
   simpress.bin-2792  [000]   634.280035: unix_poll <-sock_poll
   simpress.bin-2792  [000]   634.280036: sock_poll_wait <-unix_poll
   simpress.bin-2792  [000]   634.280037: fput <-do_sys_poll
   simpress.bin-2792  [000]   634.280038: fget_light <-do_sys_poll
   simpress.bin-2792  [000]   634.280038: sock_poll <-do_sys_poll
   simpress.bin-2792  [000]   634.280039: unix_poll <-sock_poll
```

set_ftrace_filter

```
[root@frodo tracing]# echo schedule > set_ftrace_filter
[root@frodo tracing]# cat set_ftrace_filter
schedule
[root@frodo tracing]# echo function > current_tracer
[root@frodo tracing]# cat trace | head -15
# tracer: function
#
#           TASK-PID    CPU#    TIMESTAMP  FUNCTION
#              | |       |          |         |
            Xorg-1849  [001]   883.657737: schedule <-schedule_hrtimeout_range
          <idle>-0     [001]   883.658534: schedule <-cpu_idle
            Xorg-1849  [001]   883.658612: schedule <-__cond_resched
     kondemand/1-1239  [001]   883.658632: schedule <-worker_thread
            Xorg-1849  [001]   883.659384: schedule <-sysret_careful
            Xorg-1849  [001]   883.659479: schedule <-schedule_hrtimeout_range
  gnome-terminal-2112  [001]   883.660053: schedule <-schedule_hrtimeout_range
            Xorg-1849  [001]   883.660281: schedule <-schedule_hrtimeout_range
            Xorg-1849  [001]   883.660293: schedule <-schedule_hrtimeout_range
  gnome-terminal-2112  [001]   883.660409: schedule <-schedule_hrtimeout_range
            Xorg-1849  [001]   883.660458: schedule <-sysret_careful
```

set_ftrace_filter (Continued)

```
[root@frodo tracing]# echo schedule_tail >> set_ftrace_filter
[root@frodo tracing]# cat set_ftrace_filter
schedule_tail
schedule
[root@frodo tracing]# echo 'sched*' > set_ftrace_filter
[root@frodo tracing]# cat set_ftrace_filter | head -10
sched_avg_update
sched_group_shares
sched_group_rt_runtime
sched_group_rt_period
sched_slice
sched_rt_can_attach
sched_feat_open
sched_debug_open
sched_feat_show
sched_feat_write
```

Acceptable Globs

- match*
  - Selects all functions starting with “match”
- *match
  - Selects all functions ending with “match”
- *match*
  - Selects all functions with “match” in its name

set_ftrace_notrace

```
[root@frodo tracing]# echo > set_ftrace_filter
[root@frodo tracing]# echo '*lock*' > set_ftrace_notrace
[root@frodo tracing]# cat set_ftrace_notrace | head -10
xen_pte_unlock
alternatives_smp_unlock
user_enable_block_step
__acpi_release_global_lock
__acpi_acquire_global_lock
unlock_vector_lock
lock_vector_lock
parse_no_kvmclock
kvm_set_wallclock
kvm_register_clock
```

The Function Graph Tracer

```
[root@frodo tracing]# echo function_graph > current_tracer
[root@frodo tracing]# cat trace | head -20
# tracer: function_graph
#
# CPU  DURATION                  FUNCTION CALLS
# |     |   |                     |   |   |   |
 1)               |  down_read_trylock() {
 1)   0.487 us    |    _spin_lock_irqsave();
 1)   0.409 us    |    _spin_unlock_irqrestore();
 1)   2.519 us    |  }
 1)   0.420 us    |  __might_sleep();
 1)   0.415 us    |  _cond_resched();
 1)   0.415 us    |  find_vma();
 1)               |  handle_mm_fault() {
 1)   0.421 us    |    pud_alloc();
 1)   0.409 us    |    pmd_alloc();
 1)               |    __do_fault() {
 1)               |      filemap_fault() {
 1)               |        find_get_page() {
 1)   0.571 us    |          page_cache_get_speculative();
 1)   1.630 us    |        }
 1)               |        lock_page() {
```

What Does That Function Call?

```
[root@frodo tracing]# echo sys_read > set_graph_function
[root@frodo tracing]# cat trace | head -20
# tracer: function_graph
#
# CPU  DURATION                  FUNCTION CALLS
# |     |   |                     |   |   |   |
 1)   1.888 us    |        fsnotify();
 1) + 10.016 us   |      }
 1) ! 116.994 us  |    }
 1)   0.920 us    |    fput_light();
 1) ! 122.158 us  |  }
 1)               |  sys_read() {
 1)   1.149 us    |    fget_light();
 1)               |    vfs_read() {
 1)               |      rw_verify_area() {
 1)               |        security_file_permission() {
 1)               |          selinux_file_permission() {
 1)   0.781 us    |            avc_policy_seqno();
 1)   2.435 us    |          }
 1)   4.046 us    |        }
 1)   5.675 us    |      }
 1)               |      tty_read() {
```

Latency Tracers

```
[root@frodo tracing]# echo irqsoff > current_tracer
[root@frodo tracing]# cat trace
# tracer: irqsoff
#
# irqsoff latency trace v1.1.5 on 2.6.31-git
# --------------------------------------------------------------------
# latency: 366 us, #82/82, CPU#1 | (M:desktop VP:0, KP:0, SP:0 HP:0 #P:2)
#    -----------------
#    | task: -13867 (uid:500 nice:0 policy:0 rt_prio:0)
#    -----------------
#  => started at: save_args
#  => ended at:   call_softirq
#
#
#                  _------=> CPU#
#                 / _-----=> irqs-off
#                | / _----=> need-resched
#                || / _---=> hardirq/softirq
#                ||| / _--=> preempt-depth
#                |||| /_--=> lock-depth
#                |||||/     delay
#  cmd     pid   |||||| time  |   caller
#     \   /      ||||||   \   |   /
     cc1-13867   1d....    0us : trace_hardirqs_off_thunk <-save_args
     cc1-13867   1d....    0us : smp_apic_timer_interrupt <-apic_timer_interrupt
     cc1-13867   1d....    1us : apic_write <-smp_apic_timer_interrupt
     cc1-13867   1d....    1us : native_apic_mem_write <-apic_write
     cc1-13867   1d....    1us : exit_idle <-smp_apic_timer_interrupt
     cc1-13867   1d....    2us : irq_enter <-smp_apic_timer_interrupt
[...]
     cc1-13867   1dN...  365us : do_softirq <-irq_exit
     cc1-13867   1dN...  365us : __do_softirq <-call_softirq
     cc1-13867   1dN...  366us : __local_bh_disable <-__do_softirq
     cc1-13867   1dNs..  366us : __do_softirq <-call_softirq
     cc1-13867   1dNs..  367us : trace_hardirqs_on <-call_softirq
```

Trace Events

```
[root@frodo tracing]# ls events
block   ext4    header_event  irq   kmem  kvmmmu  sched   syscalls
enable  ftrace  header_page   jbd2  kvm   module  skb     workqueue

[root@frodo tracing]# ls events/sched/
enable                  sched_process_exit  sched_stat_iowait  sched_wakeup
filter                  sched_process_fork  sched_stat_sleep
sched_wakeup_new
sched_kthread_stop      sched_process_free  sched_stat_wait
sched_kthread_stop_ret  sched_process_wait  sched_switch
sched_migrate_task      sched_signal_send   sched_wait_task

[root@frodo tracing]# ls events/sched/sched_wakeup
enable  filter  format  id
```

Enable a Single Event

```
[root@frodo tracing]# echo 1 > events/sched/sched_wakeup/enable
[root@frodo tracing]# cat trace | head -10
# tracer: nop
#
#         TASK-PID    CPU#   TIMESTAMP  FUNCTION
#            | |       |         |         |
          bash-2613  [001]  425.078164: sched_wakeup: task bash:2613 [120] success=0 [001]
          bash-2613  [001]  425.078184: sched_wakeup: task bash:2613 [120] success=0 [001]
          bash-2613  [001]  425.078572: sched_wakeup: task bash:2613 [120] success=0 [001]
          bash-2613  [001]  425.078660: sched_wakeup: task bash:2613 [120] success=0 [001]
        <idle>-0     [001]  425.078930: sched_wakeup: task events/1:10 [120] success=1 [001]
      events/1-10    [001]  425.078941: sched_wakeup: task gnome-terminal:2162 [120]
success=1 [001]
```

Enable All Subsystem Events

```
[root@frodo tracing]# echo 1 > events/sched/enable
[root@frodo tracing]# cat trace | head -10
# tracer: nop
#
#       TASK-PID    CPU#    TIMESTAMP  FUNCTION
#         | |       |           |         |
    events/0-9     [000]   638.042792: sched_switch: task events/0:9 [120] (S) ==> kondemand/0:1305 [120]
 kondemand/0-1305  [000]   638.042796: sched_stat_wait: task: restorecond:1395 wait: 15023 [ns]
 kondemand/0-1305  [000]   638.042797: sched_switch: task kondemand/0:1305 [120] (S) ==> restorecond:1395 [120]
 restorecond-1395  [000]   638.051758: sched_stat_wait: task: restorecond:1395 wait: 0 [ns]
 restorecond-1395  [000]   638.052758: sched_stat_sleep: task: kondemand/0:1305 sleep: 9966692 [ns]
 restorecond-1395  [000]   638.052760: sched_wakeup: task kondemand/0:1305 [120] success=1 [000]
```

Enable All Events

```
[root@frodo tracing]# echo 1 > events/enable
[root@frodo tracing]# cat trace | head -10
# tracer: nop
#
#           TASK-PID    CPU#    TIMESTAMP  FUNCTION
#              | |       |          |         |
           acpid-1470  [001]   794.947181: kfree: call_site=ffffffff810c996d
ptr=(null)
           acpid-1470  [001]   794.947182: sys_read -> 0x1
           acpid-1470  [001]   794.947183: sys_exit: NR 0 = 1
           acpid-1470  [001]   794.947184: sys_read(fd: 3, buf: 7f4ebb32ac50,
count: 1)
           acpid-1470  [001]   794.947185: sys_enter: NR 0 (3, 7f4ebb32ac50,
1, 8, 40, 101010101010101)
           acpid-1470  [001]   794.947186: kfree: call_site=ffffffff810c996d
ptr=(null)
```

Enable Multiple Events

```
[root@frodo tracing]# echo 1 > events/sched/sched_wakeup/enable
[root@frodo tracing]# echo 1 > events/sched/sched_wakeup_new/enable
[root@frodo tracing]# echo 1 > events/sched/sched_switch/enable
[root@frodo tracing]# cat trace | head -15
# tracer: nop
#
#           TASK-PID    CPU#    TIMESTAMP  FUNCTION
#              | |       |          |         |
            bash-2913  [001]   574.988228: sched_wakeup: task bash:2913 [120] success=0 [001]
            bash-2913  [001]   574.988264: sched_wakeup: task bash:2913 [120] success=0 [001]
            bash-2913  [001]   574.988425: sched_wakeup: task bash:2913 [120] success=0 [001]
            bash-2913  [001]   574.988440: sched_switch: task bash:2913 [120] (S) ==> swapper:0 [140]
          <idle>-0     [001]   574.988744: sched_wakeup: task events/1:10 [120] success=1 [001]
          <idle>-0     [001]   574.988754: sched_switch: task swapper:0 [140] (R) ==> events/1:10 [120]
        events/1-10    [001]   574.988760: sched_wakeup: task gnome-terminal:2158 [120] success=1 [001]
        events/1-10    [001]   574.988764: sched_switch: task events/1:10 [120] (S) ==> gnome-terminal:2158
[120]
  gnome-terminal-2158  [001]   574.988855: sched_switch: task gnome-terminal:2158 [120] (S) ==> swapper:0
[140]
          <idle>-0     [000]   574.991204: sched_wakeup: task phy0:1041 [120] success=1 [000]
          <idle>-0     [000]   574.991211: sched_switch: task swapper:0 [140] (R) ==> phy0:1041 [120]
```

tracing_on

```
[root@frodo tracing]# echo 0 > tracing_on
```

```
[root@frodo tracing]# echo 1 > tracing_on
```

```
[root@frodo tracing]# echo 0> tracing_on
```

```
[root@frodo tracing]# echo 1 > tracing_on; run_test; echo 0 > tracing_on
```

stack_trace

- echo 1 > /proc/sys/kernel/stack_tracer_enabled
- kernel command line “stacktrace”

stack_trace

```
[root@frodo tracing]# cat stack_trace
        Depth    Size   Location    (45 entries)
        -----    ----   ---------
  0)     4048     112   ftrace_call+0x5/0x2b
  1)     3936      64   update_curr+0x10a/0x12b
  2)     3872      64   enqueue_entity+0x31/0x20f
  3)     3808      48   enqueue_task_fair+0x3d/0x98
  4)     3760      48   enqueue_task+0x6b/0x8d
[...]
 28)     1936      96   sr_test_unit_ready+0x72/0xec
 29)     1840     144   sr_media_change+0x57/0x264
 30)     1696      64   media_changed+0x63/0xb2
 31)     1632      32   cdrom_media_changed+0x44/0x5e
 32)     1600      32   sr_block_media_changed+0x2c/0x42
 33)     1568      48   check_disk_change+0x3c/0x85
 34)     1520     512   cdrom_open+0x8d9/0x96b
 35)     1008      80   sr_block_open+0x9f/0xd2
 36)      928     112   __blkdev_get+0xde/0x37c
 37)      816      32   blkdev_get+0x23/0x39
 38)      784      64   blkdev_open+0x85/0xd1
 39)      720      96   __dentry_open+0x14b/0x28f
 40)      624      48   nameidata_to_filp+0x51/0x76
 41)      576     320   do_filp_open+0x514/0x9bc
 42)      256      96   do_sys_open+0x71/0x131
 43)      160      32   sys_open+0x33/0x49
 44)      128     128   system_call_fastpath+0x16/0x1b
```

trace-cmd

- Version 1.1-rc1

git://git.kernel.org/pub/scm/linux/kernel/git/rostedt/trace-cmd.git

trace-cmd

- binary tool to read Ftrace's buffers
  - Records into a trace.dat file for later reads
  - Reads the trace.dat file
    - Can record on big endian, read in little, and vice versa
  - Reads the raw buffers using splice
  - Will automatically mount debugfs if it is not mounted
    - Must have root access (sudo)

trace-cmd record

- Default, writes to “trace.dat”

```
[root@frodo ~]# trace-cmd record -e sched ls -ltr /usr > /dev/null
disable all
enable sched
offset=2f2000
offset=2f4000
[root@frodo ~]# trace-cmd record -o func.dat -p function ls -ltr /usr > /dev/null
  plugin function
disable all
offset=2f2000
offset=412000
[root@frodo ~]# trace-cmd record -o fgraph.dat -p function_graph ls -ltr /usr \
   > /dev/null
  plugin function_graph
disable all
offset=2f2000
offset=460000
[root@frodo ~]# trace-cmd record -o fgraph-events.dat -e sched -p function_graph \
    ls -ltr /usr > /dev/null
  plugin function_graph
disable all
enable sched
offset=2f2000
offset=461000
```

Filters, and Options

```
[root@frodo ~]# trace-cmd record -e sched_switch -f 'prev_prio < 100'

[root@frodo ~]# trace-cmd record -p function_graph -O nograph-time

[root@frodo ~]# trace-cmd record -p function_graph -g sys_read

[root@frodo ~]# trace-cmd record -p function_graph -l do_IRQ -l timer_interrupt

[root@frodo ~]# trace-cmd record -p function_graph -n '*lock*'
```

- -f : filter
- -O : option
- -g : same as echoing into set_graph_function
- -l : same as echoing into set_ftrace_filter
- -n : same as echoing into set_ftrace_notrace

trace-cmd report

- Default, reads from “trace.dat”

```
[root@frodo ~]# trace-cmd report | head -15
version = 6
cpus=2
       trace-cmd-6157  [000]    83.713584: sched_stat_runtime:   task: trace-cmd:61
       trace-cmd-6157  [000]    83.713591: sched_switch:         6157:120:S ==> 0:1
          <idle>-0     [000]    83.713646: sched_stat_wait:      task: trace-cmd:61
          <idle>-0     [000]    83.713648: sched_switch:         0:120:R ==> 6158:1
              ls-6158  [001]    83.713934: sched_wakeup:         6158:?:? +   5900:
              ls-6158  [001]    83.713935: sched_stat_runtime:   task: trace-cmd:61
              ls-6158  [001]    83.713937: sched_stat_runtime:   task: trace-cmd:61
              ls-6158  [001]    83.713938: sched_switch:         6158:120:R ==> 590
     migration/1-5900  [001]    83.713941: sched_stat_wait:      task: trace-cmd:61
     migration/1-5900  [001]    83.713942: sched_migrate_task:   task trace-cmd:615
     migration/1-5900  [001]    83.713947: sched_switch:         5900:0:S ==> 0:120
              ls-6158  [000]    83.714067: sched_stat_runtime:   task: ls:6158 runt
              ls-6158  [000]    83.714636: sched_stat_runtime:   task: ls:6158 runt
```

trace-cmd report (continued)

```
[root@frodo ~]# trace-cmd report -i func.dat | head -15
version = 6
cpus=2
         ls-6178  [000]   137.259033: function:   fsnotify_modify <-- vfs_write
         ls-6178  [000]   137.259035: function:   inotify_inode_queue_event <-- fsn
         ls-6178  [000]   137.259035: function:   fsnotify_parent <-- fsnotify_modi
         ls-6178  [000]   137.259035: function:   __fsnotify_parent <-- fsnotify_pa
         ls-6178  [000]   137.259036: function:   inotify_dentry_parent_queue_event
         ls-6178  [000]   137.259036: function:   fsnotify <-- fsnotify_modify
         ls-6178  [000]   137.259036: function:   fput_light <-- sys_write
         ls-6178  [000]   137.259037: function:   audit_syscall_exit <-- sysret_aud
         ls-6178  [000]   137.259037: function:   audit_get_context <-- audit_sysca
         ls-6178  [000]   137.259037: function:   audit_free_names <-- audit_syscal
         ls-6178  [000]   137.259038: function:   path_put <-- audit_free_names
         ls-6178  [000]   137.259038: function:   dput <-- path_put
         ls-6178  [000]   137.259038: function:   mntput <-- path_put
```

trace-cmd report (continued)

```
[root@frodo ~]# trace-cmd report -i fgraph.dat | head -15 | cut -c32-43 --complement
version = 6
cpus=2
       ls-6186  [000]   funcgraph_entry:                |  fsnotify_modify() {
       ls-6186  [000]   funcgraph_entry: 0.709 us       |    inotify_inode_queue_event();
       ls-6186  [000]   funcgraph_entry:                |    fsnotify_parent() {
       ls-6186  [000]   funcgraph_entry: 0.397 us       |      __fsnotify_parent();
       ls-6186  [000]   funcgraph_entry: 0.385 us       |      inotify_dentry_parent_queu
       ls-6186  [000]   funcgraph_exit:  1.942 us       |    }
       ls-6186  [000]   funcgraph_entry: 0.390 us       |    fsnotify();
       ls-6186  [000]   funcgraph_exit:  7.064 us       |  }
       ls-6186  [000]   funcgraph_entry: 0.403 us       |  fput_light();
       ls-6186  [000]   funcgraph_entry:                |  audit_syscall_exit() {
       ls-6186  [000]   funcgraph_entry: 0.396 us       |    audit_get_context();
       ls-6186  [000]   funcgraph_entry:                |    audit_free_names() {
       ls-6186  [000]   funcgraph_entry:                |      path_put() {
```

trace-cmd start

- Using start is like echoing into debugfs
  - trace-cmd start -e all
    - same as “echo 1 > events/enable”
- Uses the same options as trace-cmd record

  -
    ```
    trace-cmd start -p function_graph
    ```

  -
    ```
    trace-cmd start -p function -e sched_switch
    ```

trace-cmd stop / extract

- trace-cmd stop
  - stops the tracer from writing:
    - same as “echo 0 > tracing_on”
- trace-cmd extract -o output.dat
  - Makes a “dat” file that trace-cmd report can use
  - Without “-o ...” will create “trace.dat”

trace-cmd reset

- trace-cmd stop does not stop the overhead of tracing
- trace-cmd reset disables all tracing
  - `trace-cmd reset`
- Removes trace data from kernel
  - Do the extract before doing the reset

trace-cmd list

- See the trace options, events or plugins
  - trace-cmd list -o
    - shows list of trace options
    - these options are used by trace-cmd record -O option
  - trace-cmd list -p
    - available plugins
  - trace-cmd list -e
    - available events

trace-cmd split

- Split by time, events, CPU
  - trace-cmd split 258.121328
    - splits from timestamp to end of file
  - trace-cmd split -e 1000
    - splits out the first 1000 events
  - trace-cmd split -m 1 -r 258.121328 259.000000
    - split 1 millisecond starting at first timestamp to second timestamp repeatedly
      - trace.dat.1, trace.dat.2, ...

trace-cmd listen

- listen for connections from other boxes
  - `trace-cmd listen -p 5678 -d`
- Record can now send to that box
  - `trace-cmd record -N host:5678 -e all`
  - use “-t” to force TCP otherwise trace data is sent via UDP

A cute little trick

- Finding high latency interrupts

```
[root@frodo ~]# trace-cmd record -p function_graph -l do_IRQ \
   -e irq_handler_entry
  plugin function_graph
disable all
enable irq_handler_entry
path = /debug/tracing/events/irq_handler_entry/enable
path = /debug/tracing/events/*/irq_handler_entry/enable
Hit Ctrl^C to stop recording
```

A cute little trick

- Finding high latency interrupts

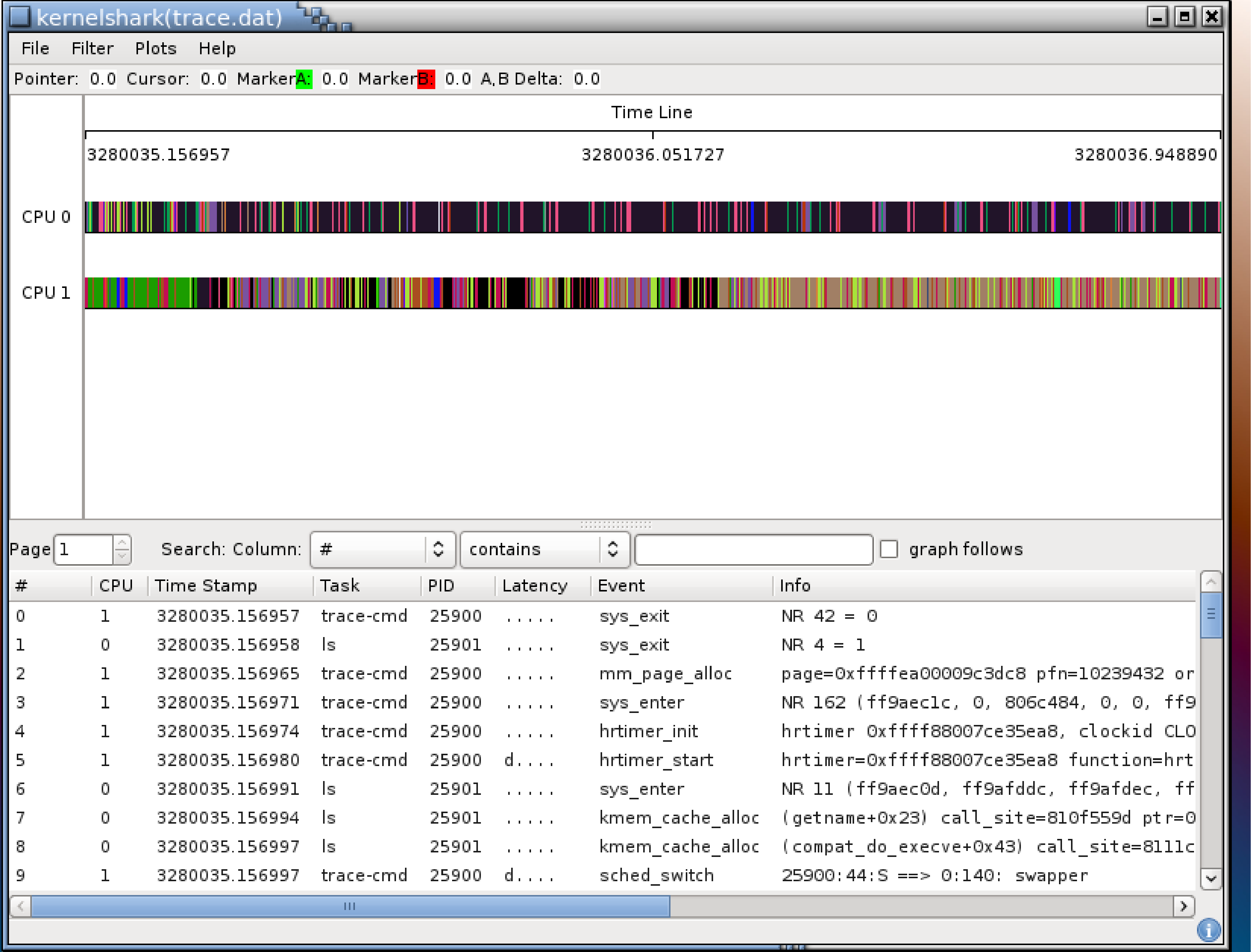
```
[root@frodo ~]# trace-cmd report |  cut -c32-43  --complement
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=0 handler=timer
          <idle>-0     [000]   funcgraph_exit:       + 29.013 us   |  }
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=30 handler=iwl3945
          <idle>-0     [000]   funcgraph_entry:                    |    do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=30 handler=iwl3945
          <idle>-0     [000]   funcgraph_exit:       + 22.580 us   |    }
          <idle>-0     [000]   funcgraph_exit:       ! 175.404 us  |  }
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=0 handler=timer
          <idle>-0     [000]   funcgraph_exit:       + 27.239 us   |  }
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=0 handler=timer
          <idle>-0     [000]   funcgraph_exit:       + 28.537 us   |  }
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=0 handler=timer
          <idle>-0     [000]   funcgraph_exit:       + 29.157 us   |  }
          <idle>-0     [000]   funcgraph_entry:                    |  do_IRQ() {
          <idle>-0     [000]   irq_handler_entry:    irq=0 handler=timer
          <idle>-0     [000]   funcgraph_exit:       + 21.522 us   |  }
```

KernelShark

- A front end reader of the trace-cmd trace.dat file
- Graph view
- List view
- Simple and Advance filtering
- Still in Beta (for now)

  In trace-cmd git repo (make gui)

  http://rostedt.homelinux.com/kernelshark [help menu]



Pointer: 0.0 Cursor: 0.0 MarkerA: 0.0 MarkerB: 0.0 A,B Delta: 0.0

Page 1 Search: Column: # contains □ graph follows

#	CPU	Time Stamp	Task	PID	Latency	Event	Info
0	1	3280035.156957	trace-cmd	25900	.....	sys_exit	NR 42 = 0
1	0	3280035.156958	ls	25901	.....	sys_exit	NR 4 = 1
2	1	3280035.156965	trace-cmd	25900	.....	mm_page_alloc	page=0xffffea00009c3dc8 pfn=10239432 or
3	1	3280035.156971	trace-cmd	25900	.....	sys_enter	NR 162 (ff9aec1c, 0, 806c484, 0, 0, ff9
4	1	3280035.156974	trace-cmd	25900	.....	hrtimer_init	hrtimer 0xffff88007ce35ea8, clockid CLO
5	1	3280035.156980	trace-cmd	25900	d....	hrtimer_start	hrtimer=0xffff88007ce35ea8 function=hrt
6	0	3280035.156991	ls	25901	.....	sys_enter	NR 11 (ff9aec0d, ff9afddc, ff9afdec, ff
7	0	3280035.156994	ls	25901	.....	kmem_cache_alloc	(getname+0x23) call_site=810f559d ptr=0
8	0	3280035.156997	ls	25901	.....	kmem_cache_alloc	(compat_do_execve+0x43) call_site=8111c
9	1	3280035.156997	trace-cmd	25900	d....	sched_switch	25900:44:S ==> 0:140: swapper

Kernel Shark

Demo!

Questions?

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