Improving scheduling latency with SCHED_IDLE task

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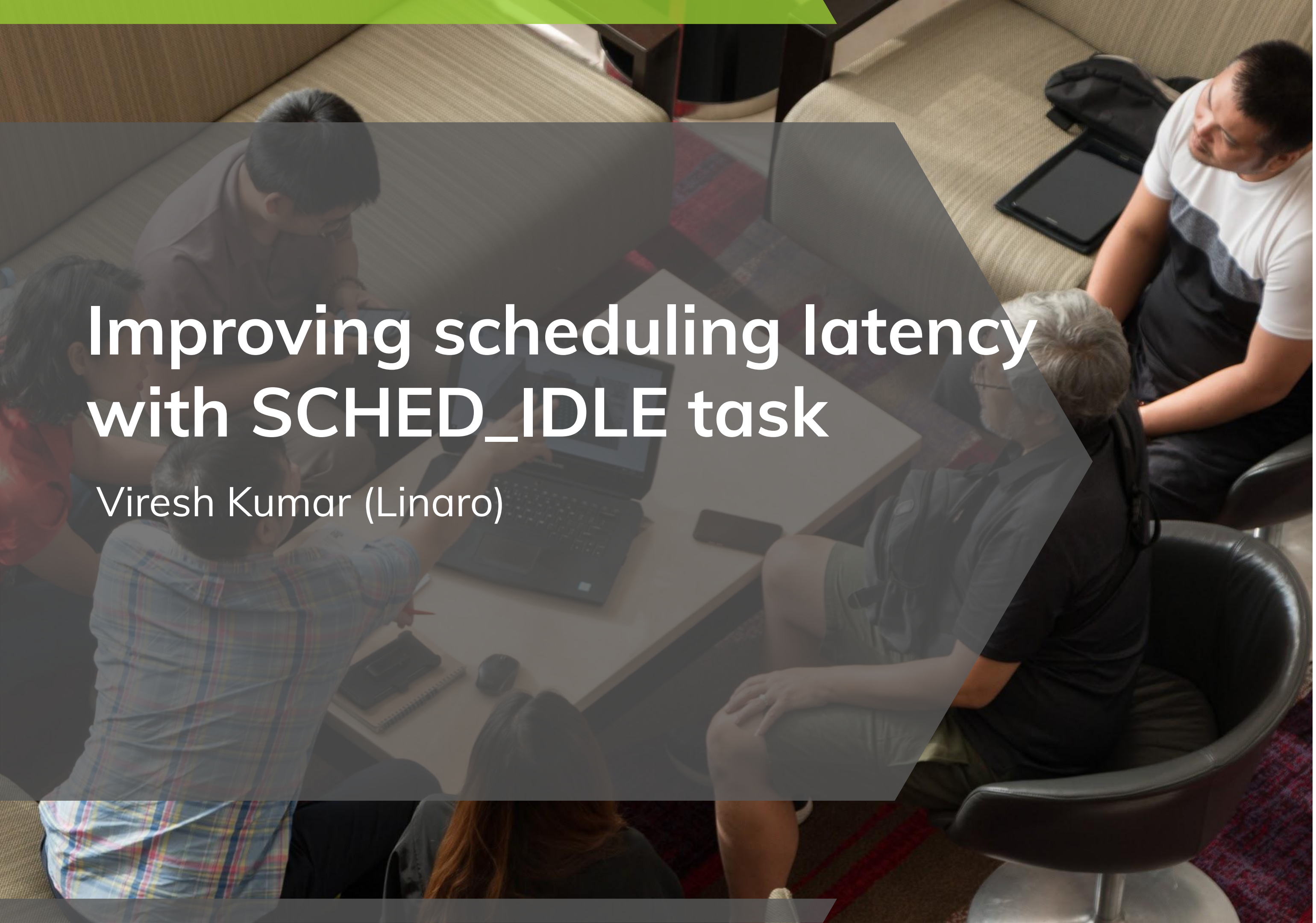

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Scheduling classes and policies (recap)

- Stop
  - No policy
- Deadline
  - SCHED_DEADLINE
- Real Time
  - SCHED_FIFO
  - SCHED_RR
- Fair (CFS)
  - SCHED_NORMAL
  - SCHED_BATCH
  - SCHED_IDLE
- Idle
  - No policy

SCHED_IDLE scheduling policy

- One of the scheduling policies available in CFS.
- Nice range -20 to +19, where +19 means lowest priority.
- Priority of SCHED_IDLE tasks is lower than tasks with +19 nice.
- Useful for background tasks with lowest priority in system.
- Any non-idle task can preempt a running SCHED_IDLE task.
- It is still not a real idle time scheduler and still gets a chance to run on a fully busy system to avoid priority inversion.
- Not widely used currently. That needs to change.

What’s new ?

Before:

- Special handling only in ->check_preempt_curr() in fair.c
    - A SCHED_OTHER task will preempt a SCHED_IDLE task.

Now (Merged in 5.4-rc1):

- Special handling added in ->select_task_rq() in fair.c
    - Both fast and slow paths updated
    - CPU running only SCHED_IDLE tasks considered as idle
        - Will immediately get preempted by a SCHED_NORMAL task.
    - Improves scheduling latency for the SCHED_OTHER task
        - Even better than running on an idle-cpu as we don’t need to wake-up the CPU.

rt-app json, 8 normal and 5 sched-idle threads

```
{
    "tasks" : {
        "cfs_thread" : {
            "instance" : 8,
            "run" :   5333,
            "timer" : { "ref" : "unique", "period" : 7777 },
            "policy" : "SCHED_OTHER"
        },
        "idle_thread" : {
            "instance" : 5,
            "run" :   3000,
            "policy" : "SCHED_IDLE"
        }
    },
    "global" : {
        "duration" : 5,
        "calibration" : "CPU0",
        "default_policy" : "SCHED_OTHER",
        "pi_enabled" : false,
        (more unrelated settings...)
        "gnuplot" : false
    }
}
```

Wu-latency (usec) from rt-app for CFS tasks

Hardware: Octa core cortex A7

Without the patchset:

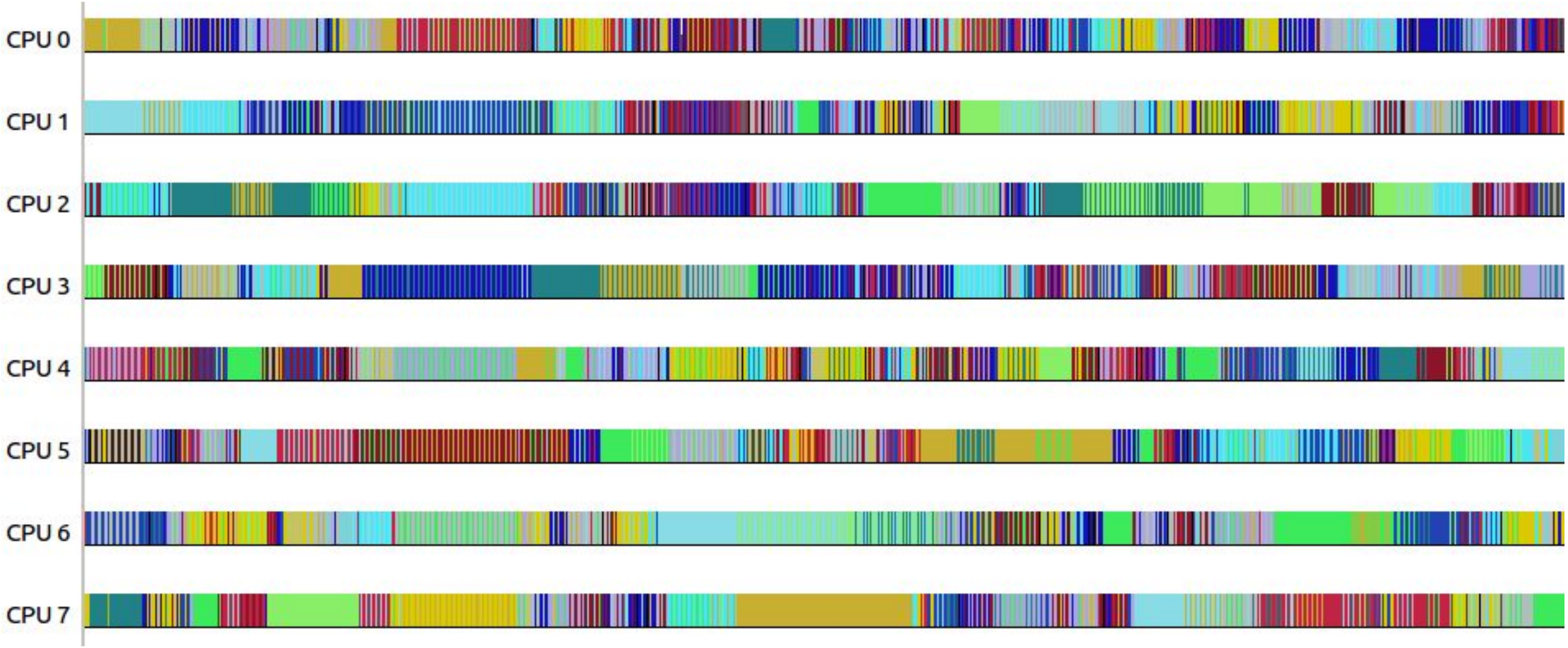
N	min	max	sum	mean	stddev
4710	0	67664	5.25956e+06	1116.68	2315.09

With the patchset:

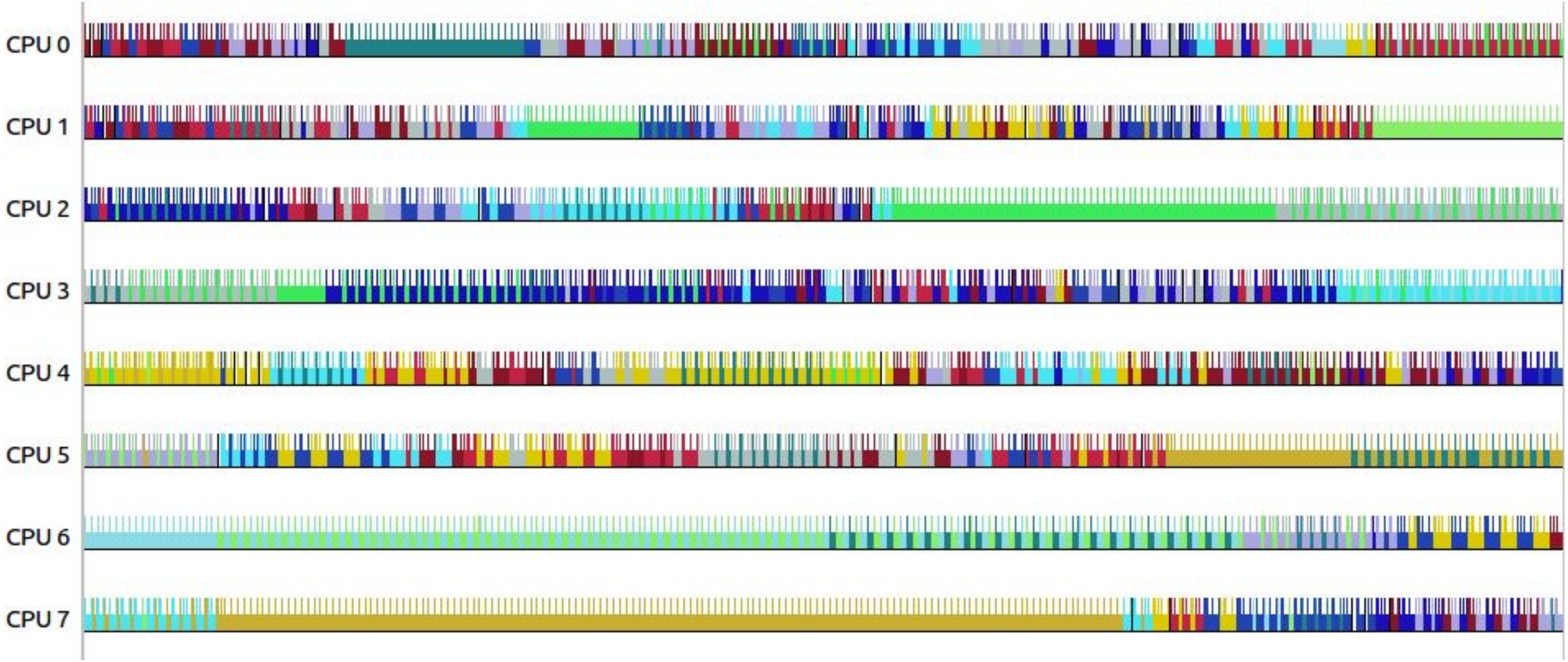
N	min	max	sum	mean	stddev
5095	0	7773	523170	102.683	475.482

mean latency dropped by 90% and stddev dropped by 75%

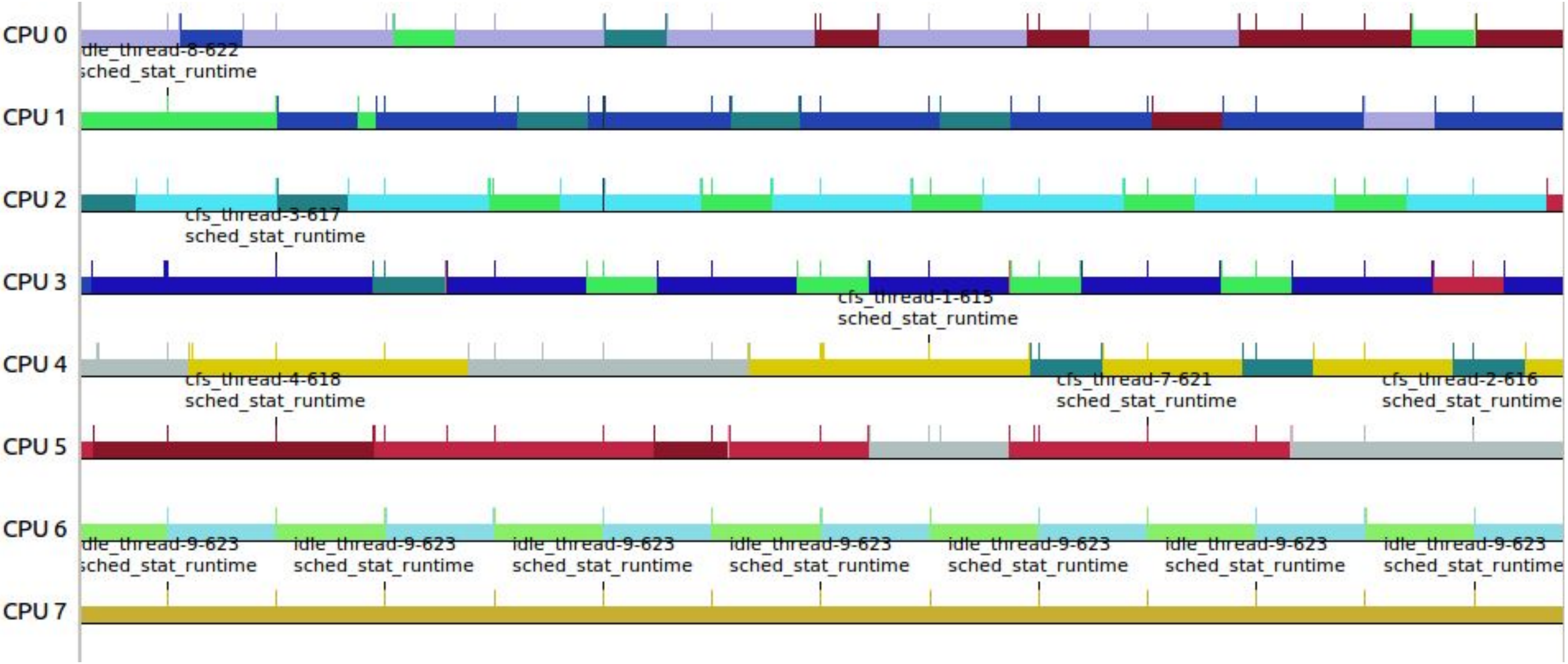
Kernelshark without sched-idle modifications



Kernelshark without sched-idle modifications ...



Kernelshark without sched-idle modifications ...



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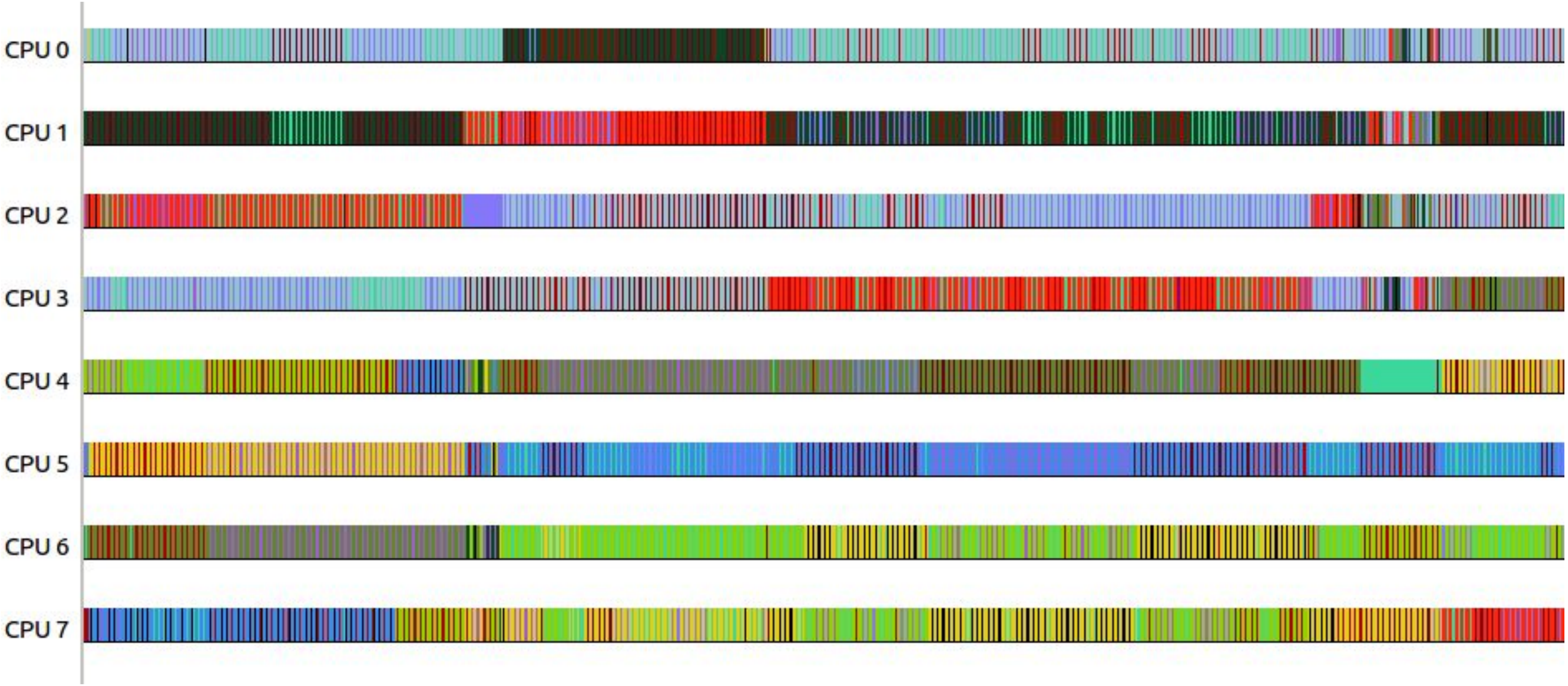
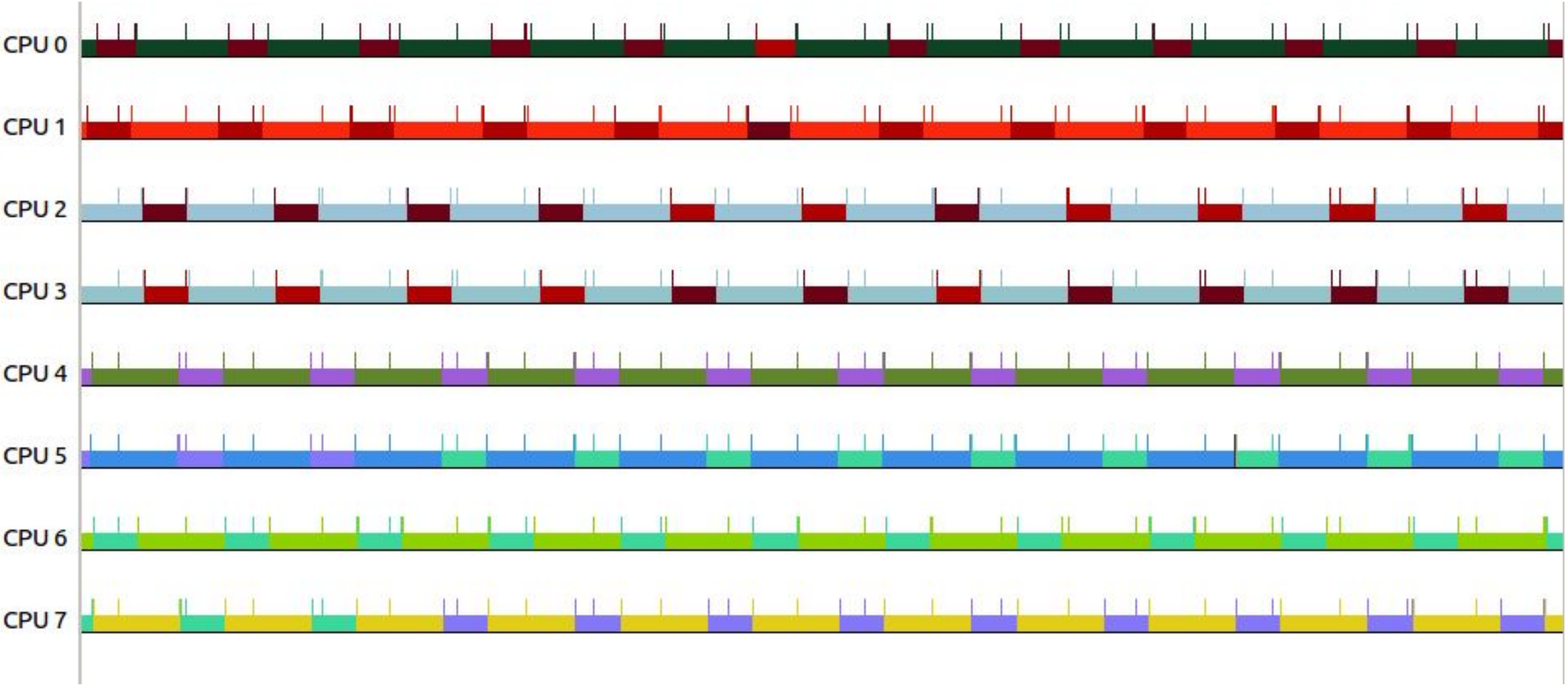
Kernelshark with sched-idle modifications



Kernelshark with sched-idle modifications



Who should use SCHED_IDLE policy ?

- SCHED_IDLE policy isn’t widely used currently.
- Can be used for most of background tasks which aren’t time critical.

- Google is interested in using SCHED_IDLE policy for background Android tasks, like dex2oat (compiles dex files).

- Facebook’s use-case involves using spare CPU cycles on servers (running latency sensitive workloads) to run side jobs like video encoding but that interferes with main workload. Making the side jobs SCHED_IDLE has proven to be very useful.

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