oomd2 and beyond: a year of improvements

Daniel Xu

Facebook

Overview

- Motivations & past development
- Present state
- Future plans
- Q&A

Motivations & past developments

Resource control @ FB

- Goal: resource isolation across applications
- Active area of development
- Use cases:
  - Protecting the workload
  - Side-loading batch workloads (eg transcoding)
- Deployed to several internal machine pools
- oomd steps in when kernel resource isolation breaks down

What is oomd?

- Out-of-memory killing in userspace
- Faster, more accurate
- Uses cgroup2, PSI, other system stats
- https://github.com/facebookincubator/oomd
  - GPL2

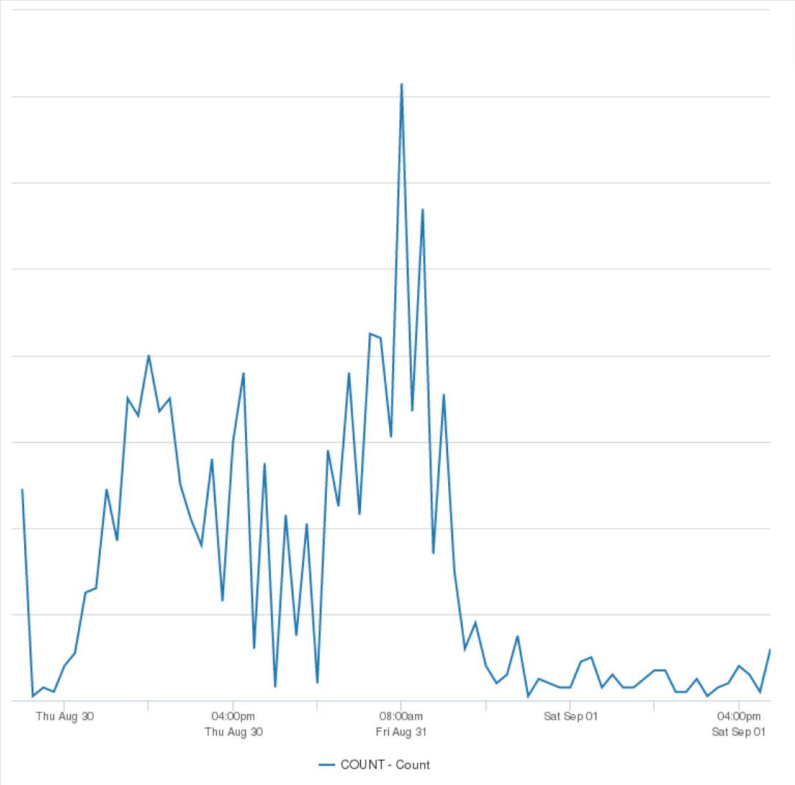
Why oomd?

- Configuration not very intuitive (what's with all the numbers?)
  - /proc/[pid]/oom_adj
  - /proc/[pid]/oom_score
  - /proc/[pid]/oom_score_adj
  - /proc/sys/vm/oom_kill_allocating_task
  - /proc/sys/vm/panic_on_oom
- Slow to act; often it's already too late by the time the kernel reacts
- Tries to protect kernel health; user-space could be livelocked but the kernel could still be happily churning pages in and out

Why oomd? (cont.)

- Little context on logical composition of system
  - What should be killed together, what shouldn't be, etc.
- No way to customize kill action (modulo OOM eventfd; still slow though)
  - For some processes, a SIGTERM/SIGKILL is fine. Other might want a song and dance
    - Eg. a persistent process that manages containers
- Non-deterministic (Or at least really hard to get deterministic)

oomd deployment



panic_on_oom rate before and after oomd rollout

Present State

oomd2

- Essentially a rule engine
- What we unsuccessfully tried
  - Monolithic config was not flexible enough
  - Plugin-only was too much work
- “Core plugins” was just right

oomd2

- Gotcha-free configurations
  - Of course, you can still make mistakes. But it should be clear they're *your* mistakes
  - Plugins inherently encode domain knowledge
- Example: `swap_free` plugin
  - `/proc/swaps` and `/proc/meminfo` present slightly different information when draining swap

oomd2 config example

```
{
    "rulesets": [
        ...,
        {
            "name": "user session protection",
            "detectors": [
                [
                    "user pressure above 60 for 30s",
                    {
                        "name": "pressure_above",
                        "args": {
                            "cgroup": "user.slice,workload.slice,www.slice",
                            "resource": "memory",
                            "threshold": "60",
                            "duration": "30"
                        }
                    },
                    {
                        "name": "memory_reclaim",
                        "args": {
                            "cgroup": "user.slice,workload.slice,www.slice",
                            "duration": "10"
                        }
                    }
                ],
                [
                    "system pressure above 80 for 60s",
                    {
                        "name": "pressure_above",
                        "args": {
                            "cgroup": "system.slice",
                            "resource": "memory",
                            "threshold": "80",
                            "duration": "60"
                        }
                    },
                    {
                        "name": "memory_reclaim",
                        "args": {
                            "cgroup": "system.slice",
                            "duration": "10"
                        }
                    }
                ]
            ],
            "actions": [
                {
                    "name": "kill_by_memory_size_or_growth",
                    "args": {
                        "cgroup": "user.slice/user-*.slice/session-*.scope,user.slice/user-*.slice/user@*.service/*,system.slice/*,workload.slice/*,www.slice/*"
                    }
                }
            ]
        },
        ...,
    ]
}
```

oomd2 config example (simplified)

```
1  {
2      "rulesets": [
3          ...,
4          {
5              "name": "user session protection",
6              "detectors": [
7                  <FIRE IF USER.SLICE, WORKLOAD.SLICE, or WWW.SLICE SLOWS BY OVER 60%>
8                  <FIRE IF SYSTEM.SLICE SLOWS BY OVER 80%>
9              ],
10             "actions": [
11                 <KILL THE LARGEST MEMORY HOG ON THE SYSTEM>
12             ]
13         },
14         ...,
15     ]
16 }
```

pseudocode

Drop-in configurations

- Alters base configuration settings without having to modify base
- Useful for when containers can move on and off hosts
- Containers can carry around specialized oomd configuration
- Path not taken: in-container oomd

Lessons learned

- Most people (speaker included) are hazy on memory management internals
  - Thus it’s important that someone does it right and the work can be reused
- OOMing not a widely solved problem
- Lots of things can trigger an OOM
  - Understandable diagnostics are crucial

Future improvements

- epoll(2)-able pressure files
  - O(1) memory.stat access
- iocost
- systemd-oomd?
  - systemd is possibly in a good position to do sane autoconfiguration

Q&A