Container tracing: challenges and mechanisms

Progress Report Meeting
December 7, 2017

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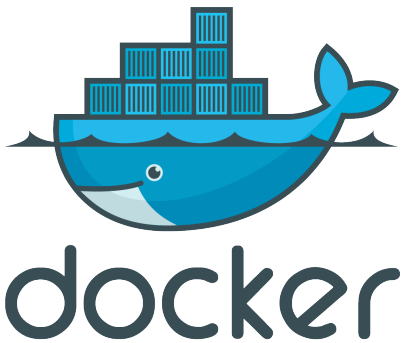
DORSAL Lab
École polytechnique de Montréal

Context



- Containers tend to partially replace virtual machines
- Runtime level: Docker, LXC
- Orchestration level: Kubernetes, Amazon ECS, Docker Swarm

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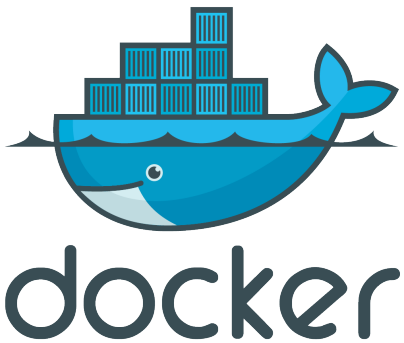

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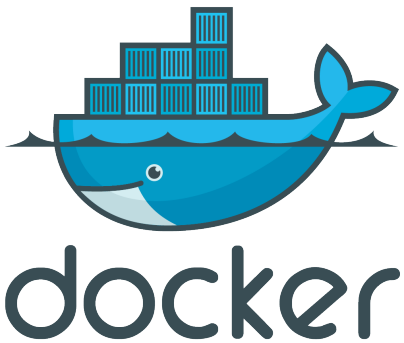

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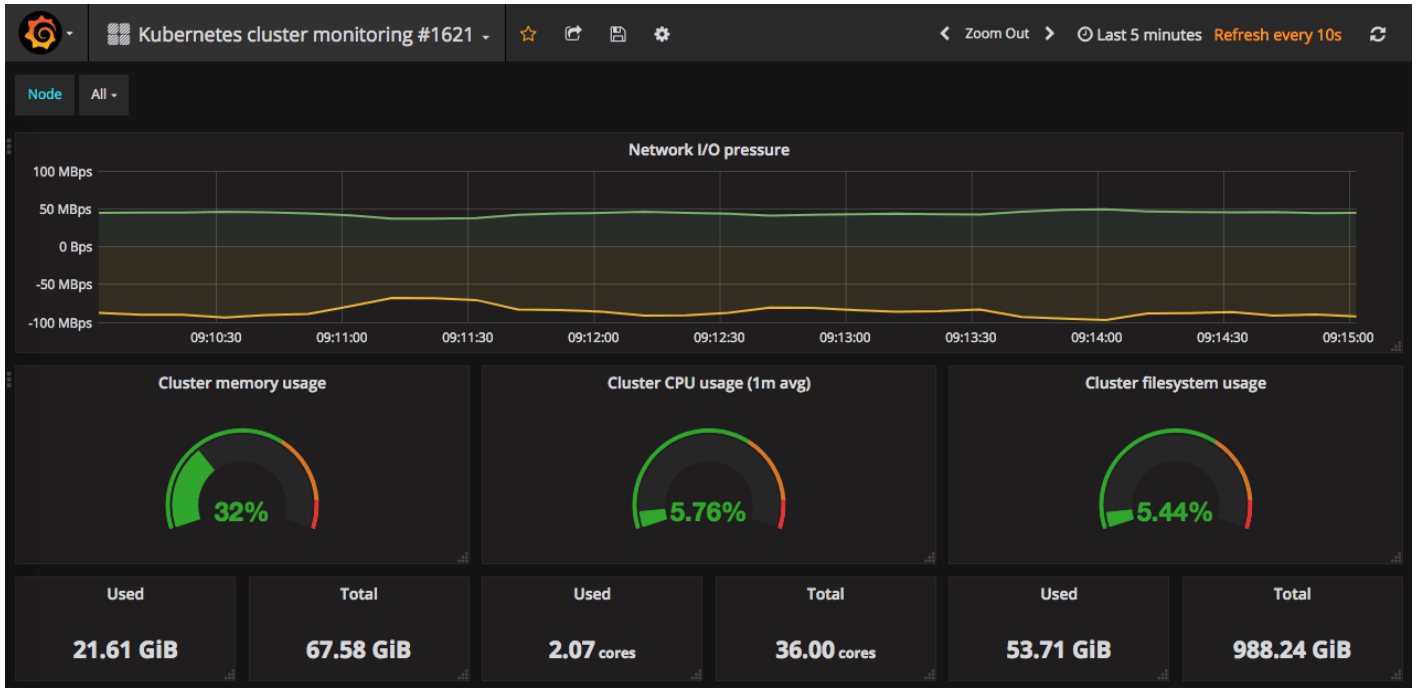
Container analysis landscape

Monitoring at the cluster level by querying



Kubernetes cluster monitoring with Grafana and Prometheus

Source: blog.lwolf.org

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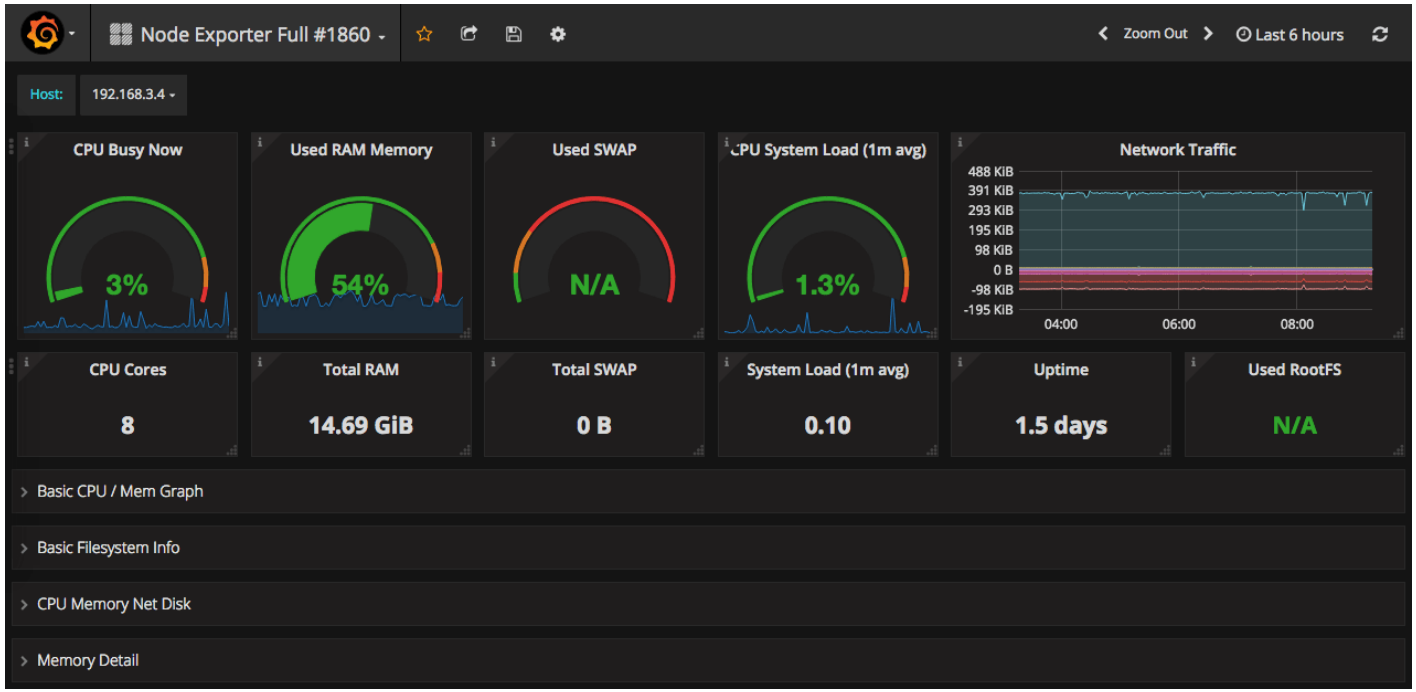

Kubernetes node monitoring with Grafana and Prometheus

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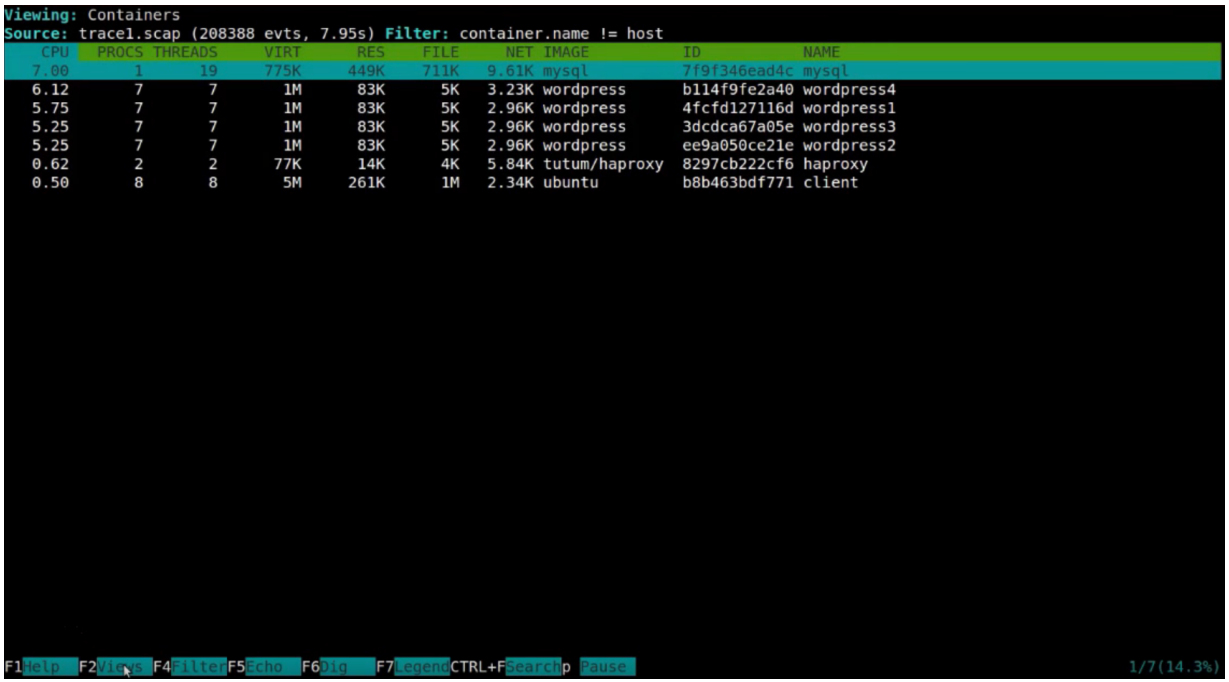
Container analysis landscape

Monitoring at the host level by sampling



System containers monitoring with Sysdig and its UI Csysdig

Source: sysdig.org

Containers are not lightweight virtual machines

Handy shortcut to view containers as lightweight virtual machines...

- Similar isolation features from a user level
- Can be easily deployed, backed up, frozen or migrated

...yet their architecture is very different:

- A container shares the same OS kernel as the rest of the system
- A process running in a container is handled just as any other process in the system
- Containers are basically a combination of two Linux kernel features: control groups and namespaces

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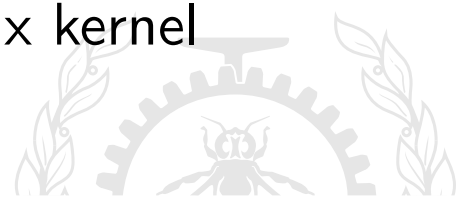

Linux cgroups and namespaces

- **cgroups:** Allows to account for or limit resources (cpu, memory, ...) usage for user-defined sets of processes
  → *how much I can use*
- **namespaces:** Allows to isolate resources (PIDs, filesystems, ...) for user-defined sets of processes
  → *what I can use / see*

Running a container is about running normal processes that **belong to given cgroups and namespaces**...

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Project roadmap

- Instrument the kernel to get **cgroups and namespaces** trace information (ongoing!)
- Use this information to build **container-specific views** of a system
- Design **useful analyses** for containers at the runtime level
- **Scale up** to the orchestration level

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Analyses ideas

- Understand why a process in a container is being throttled back (cgroup limitations or system overload?)
- Understand why access to some resources from a container fail (namespace isolation?)
- "What if"-like analysis: what if I change my container resources? What impact on the critical path length?

Suggestions and use cases are welcome throughout the project!

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Thank you!

Questions?

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