

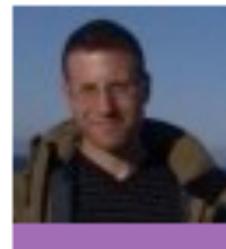
Apache Mesos at Twitter

#TXLF 2014



Chris Aniszczyk
Head of Open Source
@cra

Hi, I'm @cra & run the @TwitterOSS office!



Chris Aniszczyk

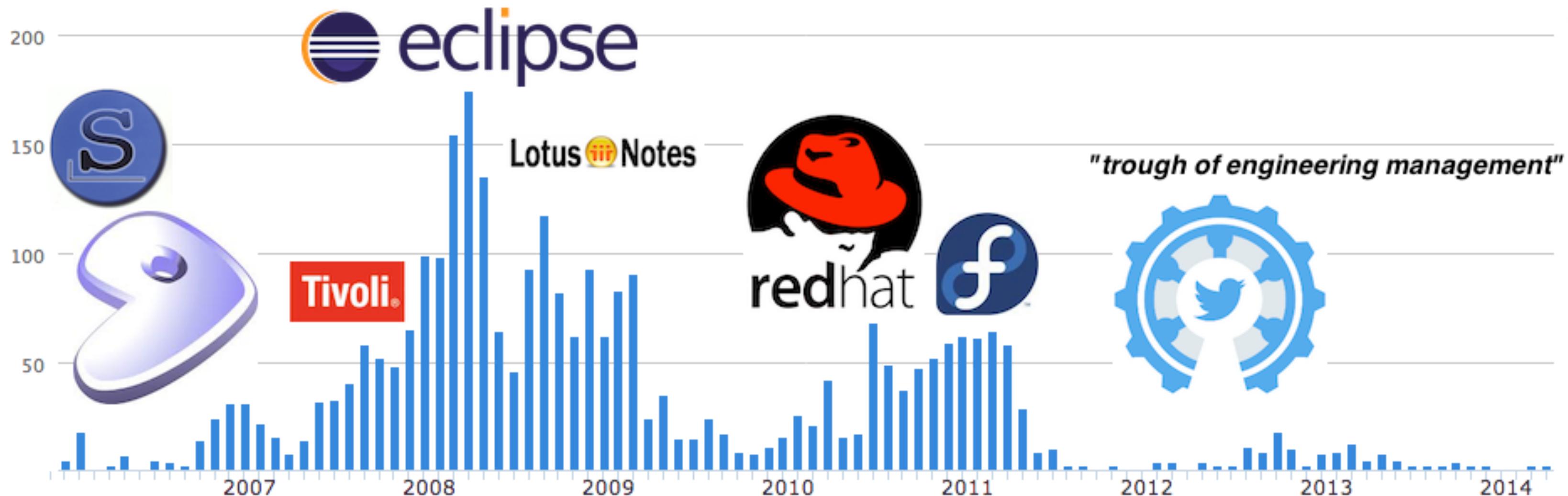
Austin, TX, USA

<http://aniszczyk.org>

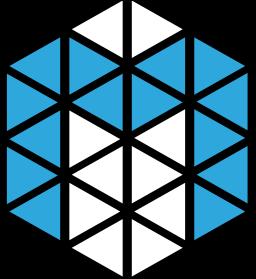


Contributions

Analyzed about 1 hour ago



Twitter is Built on Open Source...



Agenda

- Introduction
- How does Mesos work?
- Mesos Ecosystem
- Conclusion
- Q&A



Twitter Scale...

255M+

Active users

100TB+

compressed data per day

500M+

Tweets per day

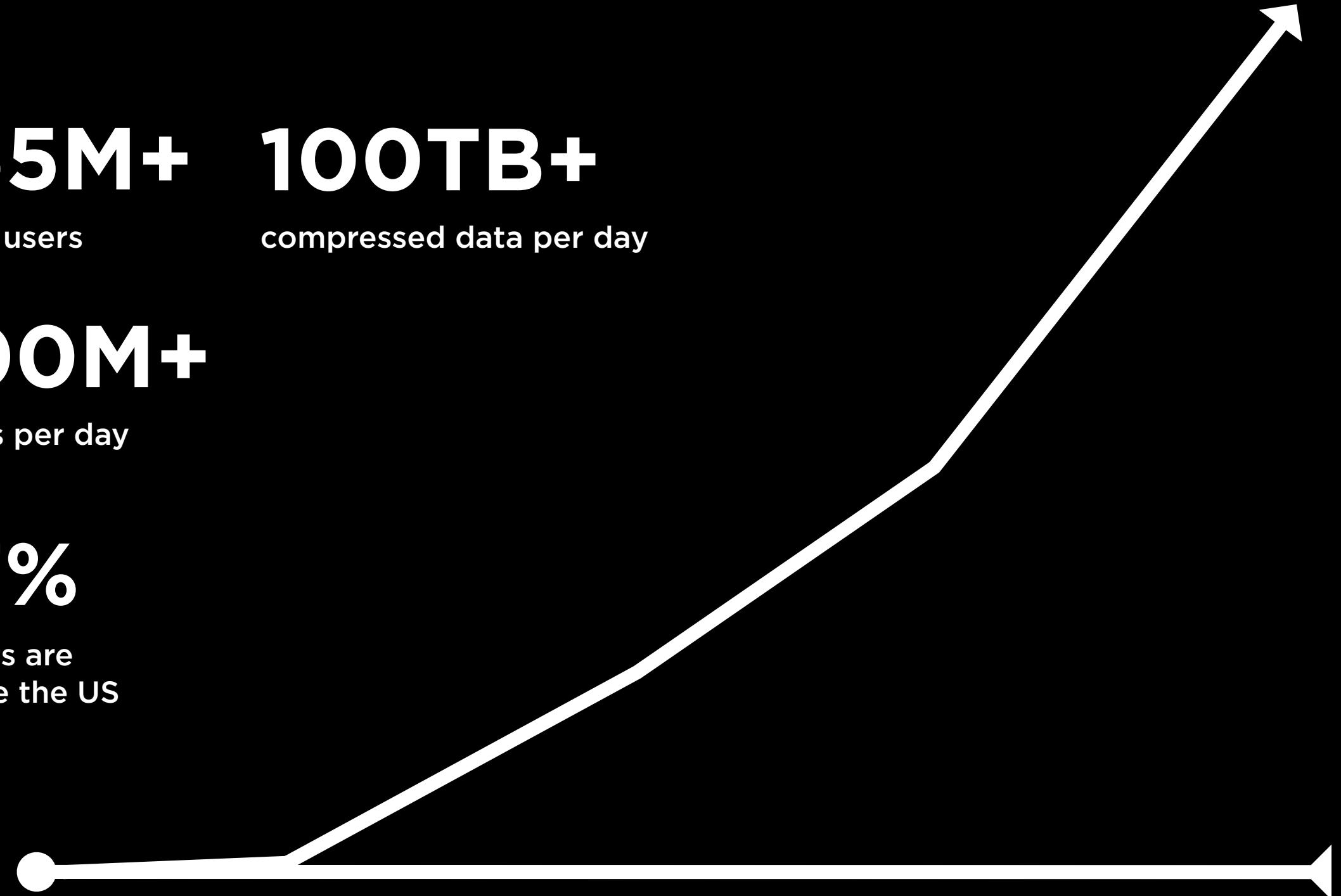
77%

of users are
outside the US

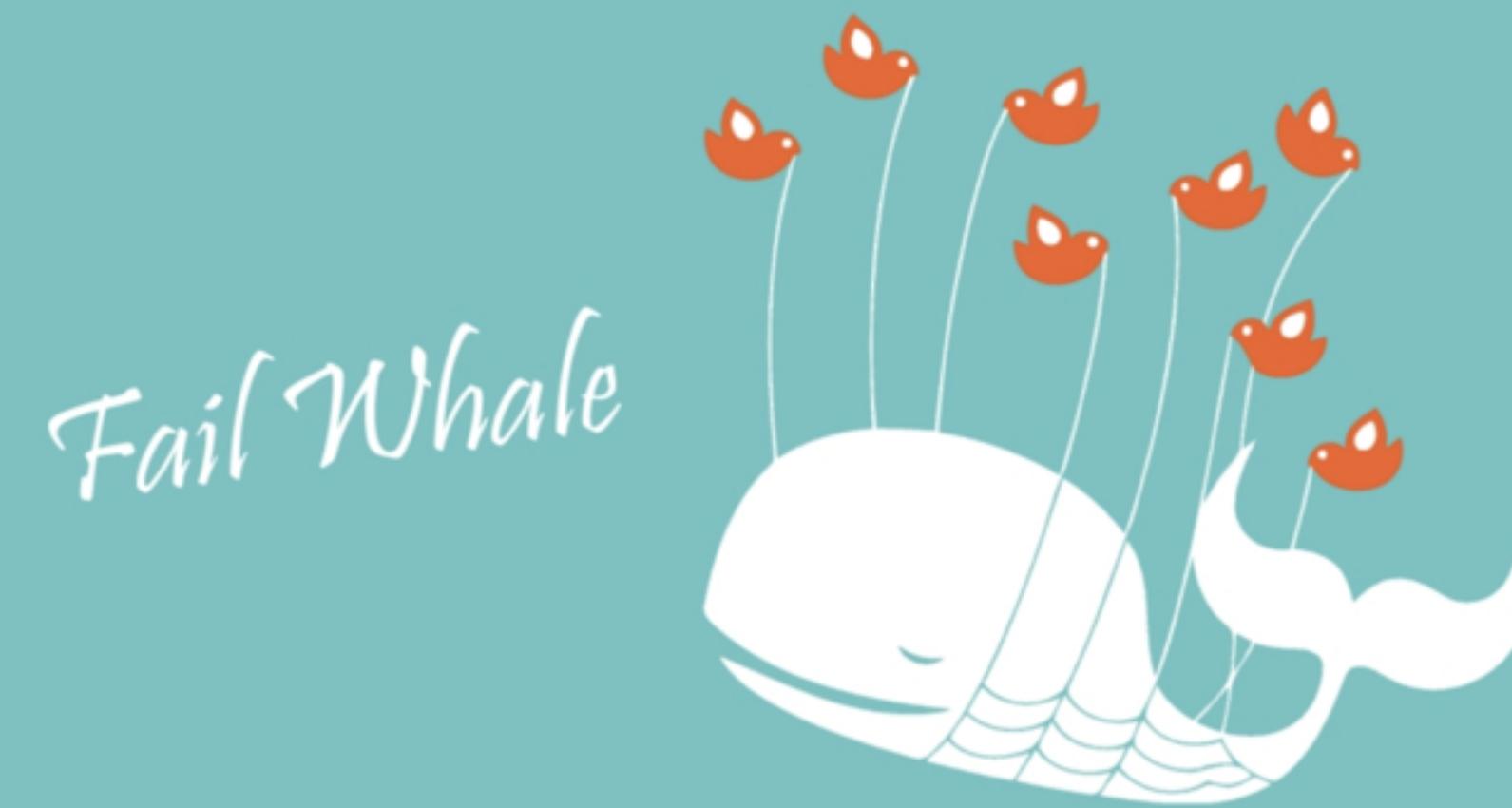


2006

2014



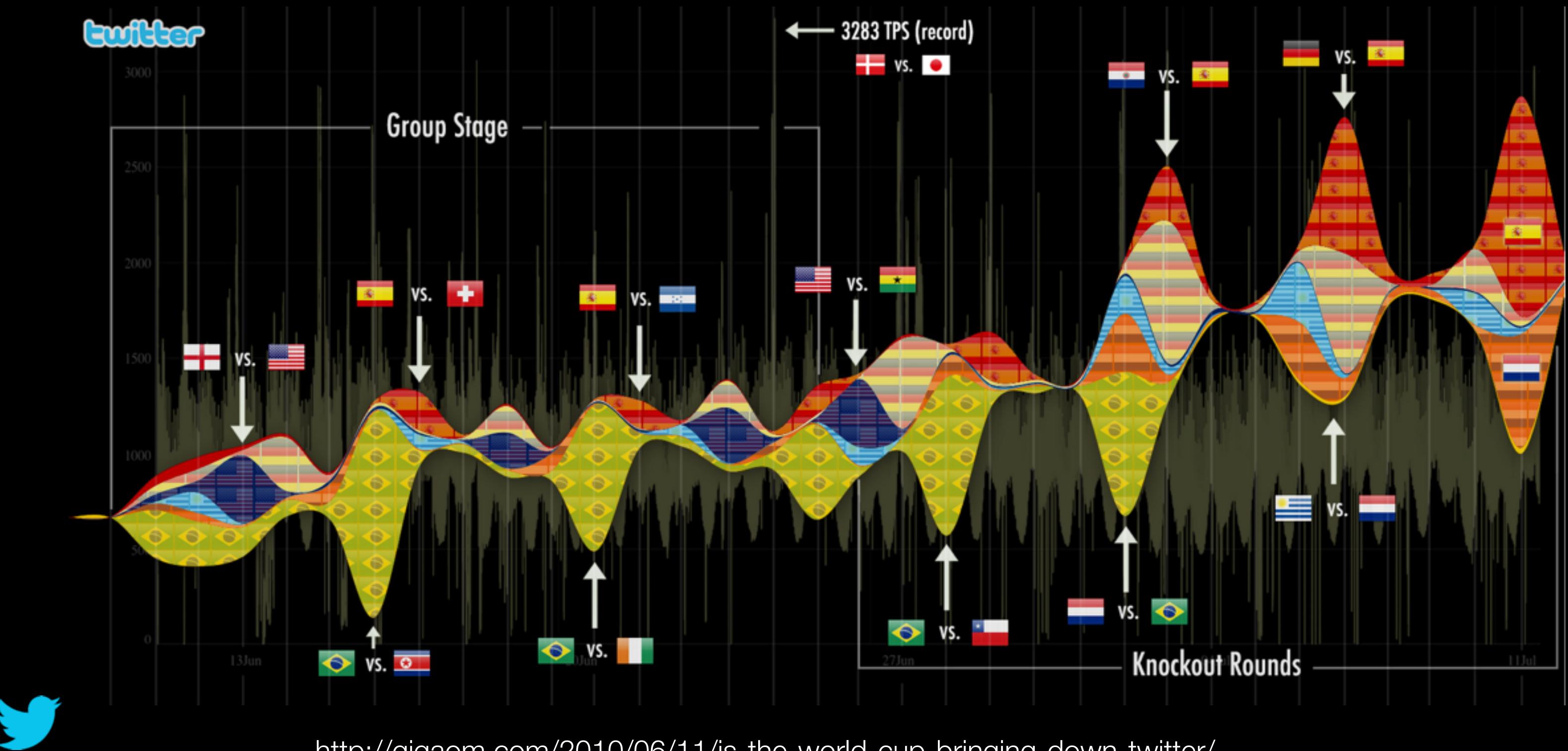
Growth challenges... sad times... remember the fail whale?



Fail Whale



Ups and Downs... remember World Cup 2010?



<http://gigaom.com/2010/06/11/is-the-world-cup-bringing-down-twitter/>

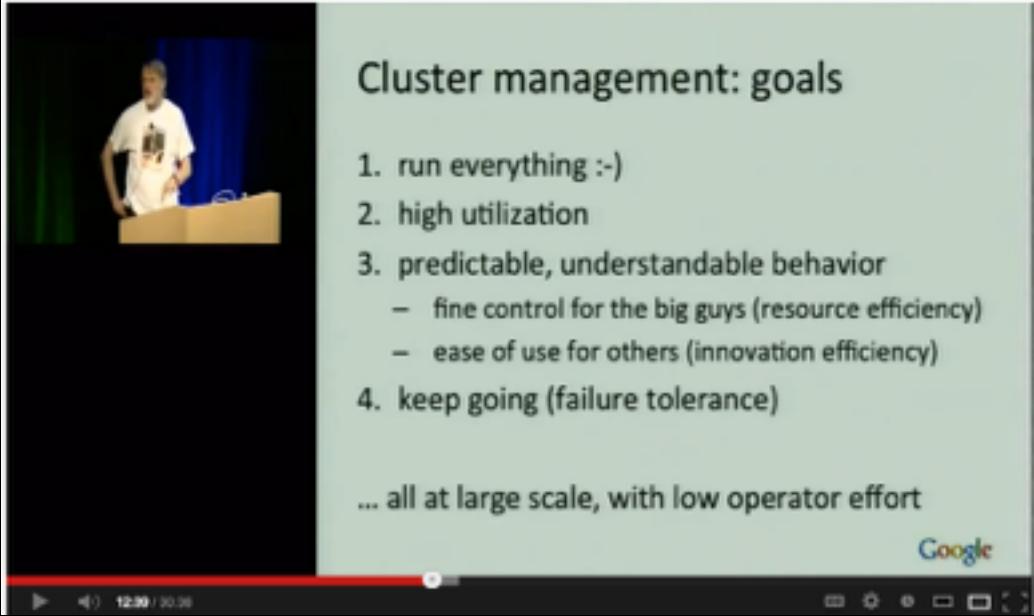
Easy solution!? Lets add machines... but...

- Can get expensive... even with commodity hardware...
- Hard to fully utilize machines (e.g., 72 GB RAM and 24 CPUs)
- Hard to deal with failures...
- What else could we do...?

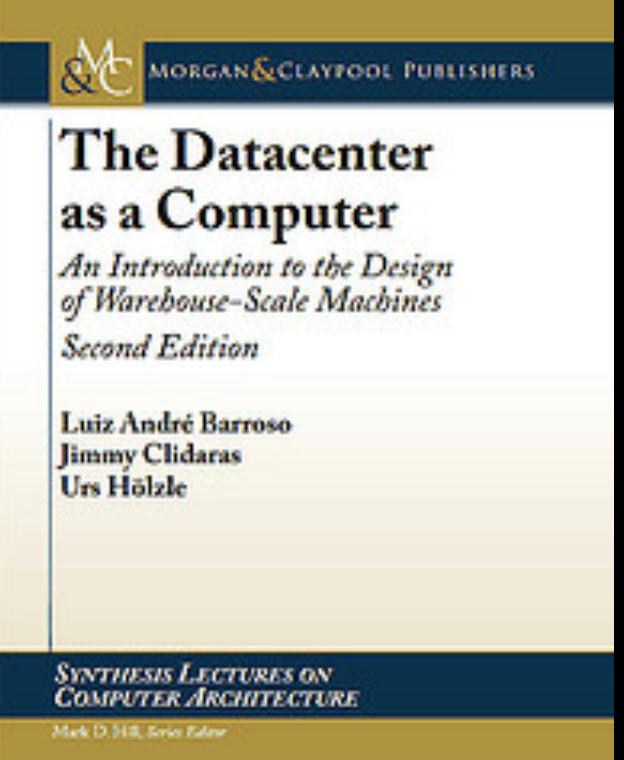


Evaluate industry...

- Google was ahead of the game of managing warehouse scale computing: <http://research.google.com/pubs/pub35290.html>



- Google hit a lot of these problems before many other companies and came up with interesting solutions:
<http://youtube.com/watch?v=0ZFMlO98Jkc>



Evaluate research at universities...

- Universities (wooooo PhDs) were doing research in this area, we decided to partner and hire researchers:
<https://amplab.cs.berkeley.edu/tag/mesos/>
- “Return of the Borg: How Twitter Rebuilt Google’s Secret Weapon: <http://www.wired.com/2013/03/google-borg-twitter-mesos>



– amplab The amplab logo consists of the word "amplab" in a lowercase, sans-serif font. A thin, yellow wavy line starts from the top of the letter "a" and extends to the right, ending near the letter "b".

Enter Apache Mesos

- We took university research and spun into an open source project at the Apache Foundation: <https://blog.twitter.com/2012/incubating-apache-mesos>

- <https://twitter.com/ApacheMesos/statuses/360039441500340224>

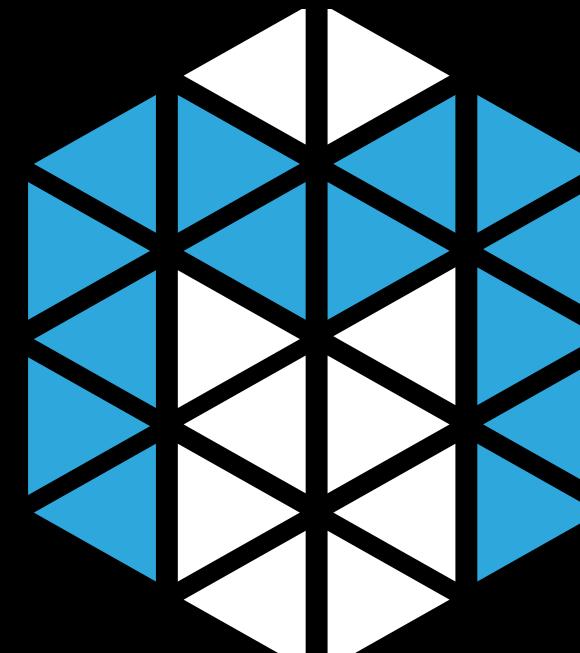


Apache Mesos
@ApacheMesos

we've become a Top-Level Project at [#Apache!](https://blogs.apache.org/foundation/entry/apache-mesos-reaches-top-level-project)
[blogs.apache.org/foundation/ent... #mesos](https://blogs.apache.org/foundation/entry/apache-mesos-reaches-top-level-project)

9:11 AM - 24 Jul 2013

34 RETWEETS 20 FAVORITES



Engineering Blog All Twitter Blogs

View Edit Revisions

Incubating Apache Mesos

Thursday, May 10, 2012 | By Chris Aniszczyk (@cra) [16:27 UTC]

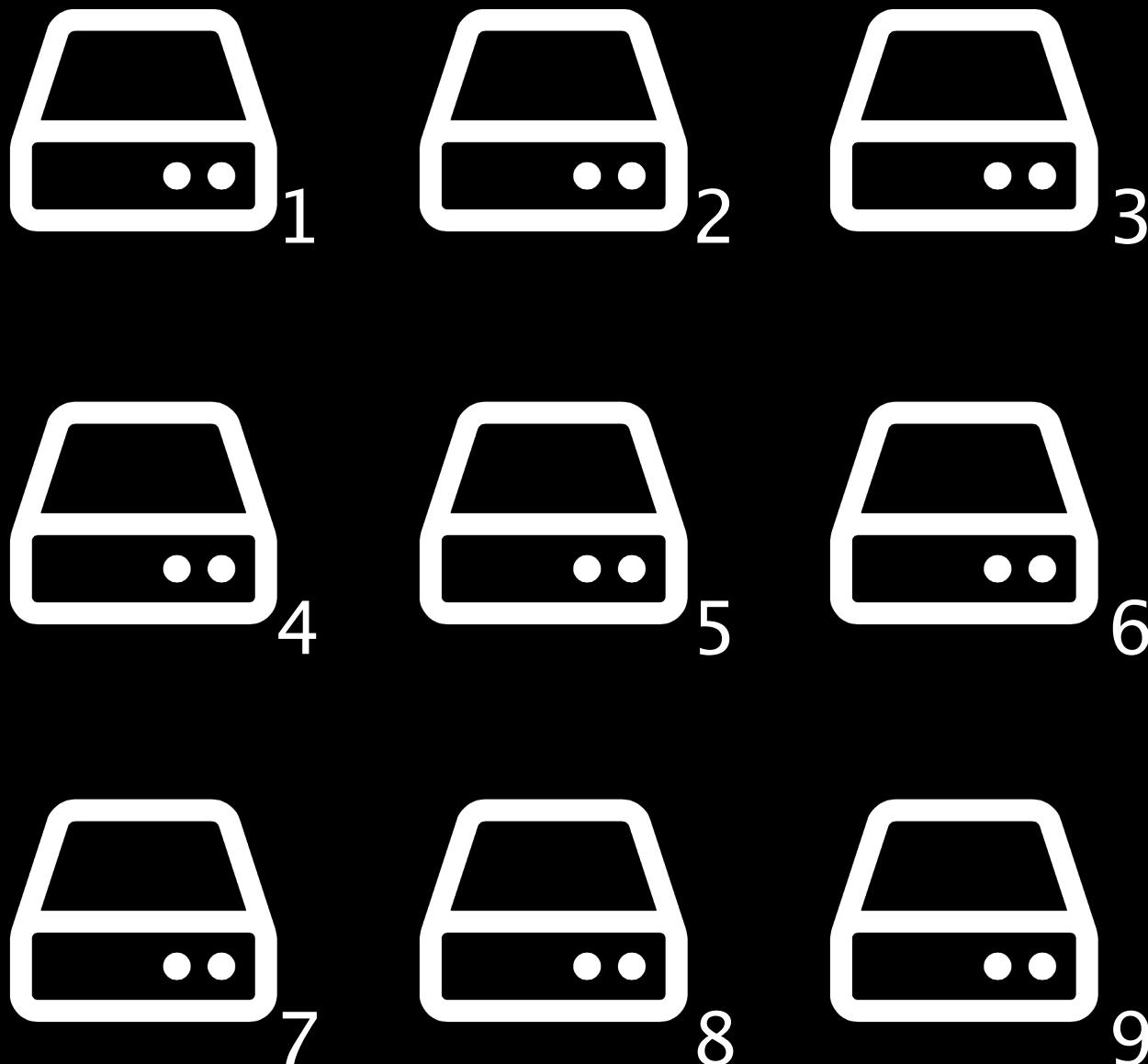
Tweet

At Twitter, Apache Mesos runs on hundreds of production machines and makes it easier to execute jobs that do everything from running services to handling our analytics workload. For those not familiar with it, the Mesos project originally started as a UC Berkeley research effort. It is now being developed at the Apache Software Foundation (ASF), where it just reached its first release inside the Apache Incubator.

What is exactly is Mesos?

- Mesos is an open source project with a healthy independent community: <http://mesos.apache.org>
- Mesos is a distributed system to build and run distributed systems
- Mesos provides fine-grained resource sharing and isolation
- Mesos enables high-availability and fault-tolerance for your cluster

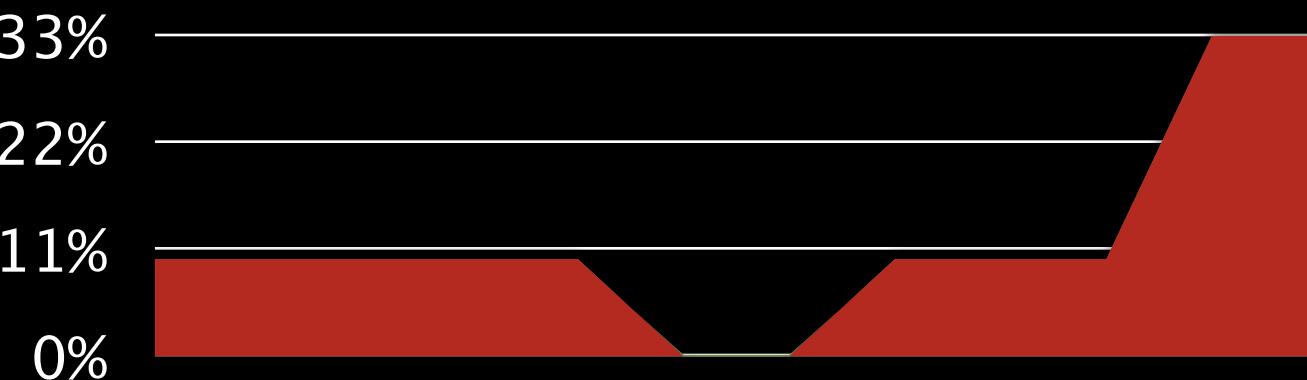
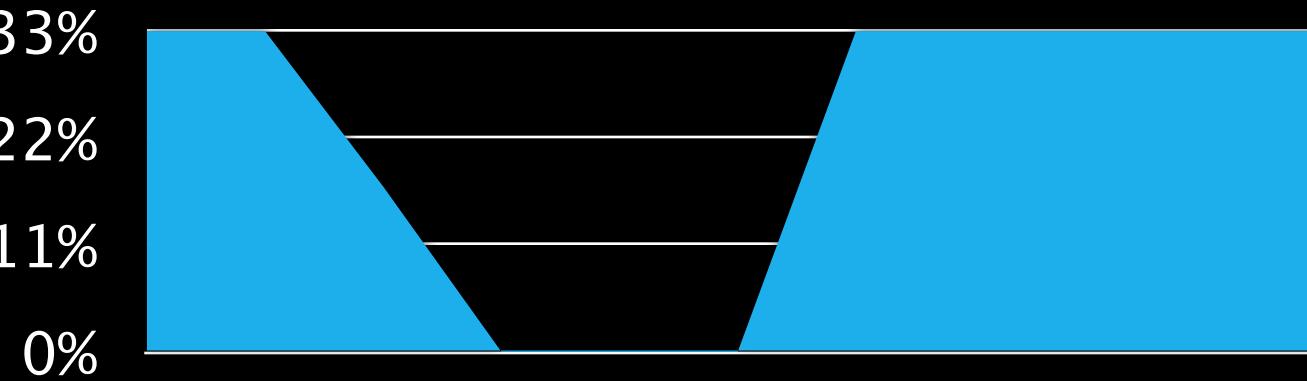
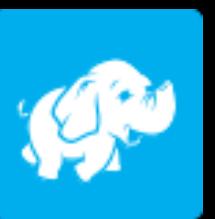
This is your typical data center



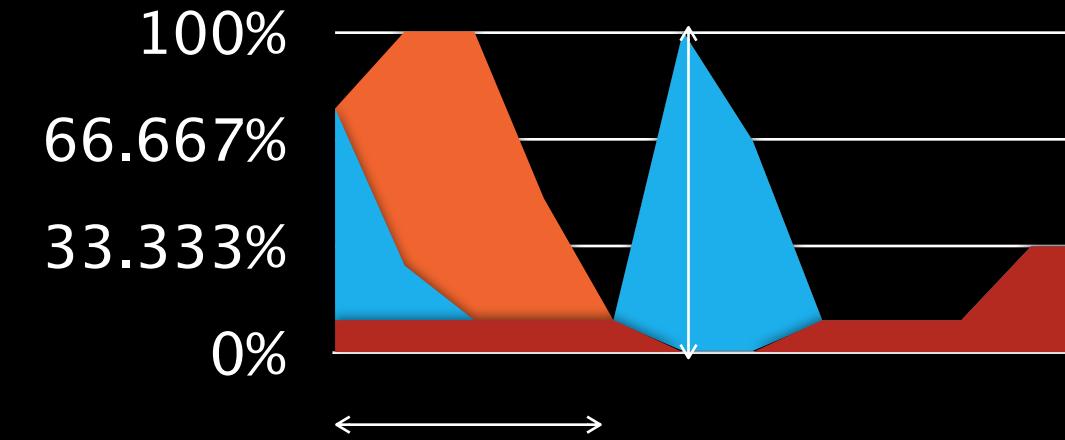
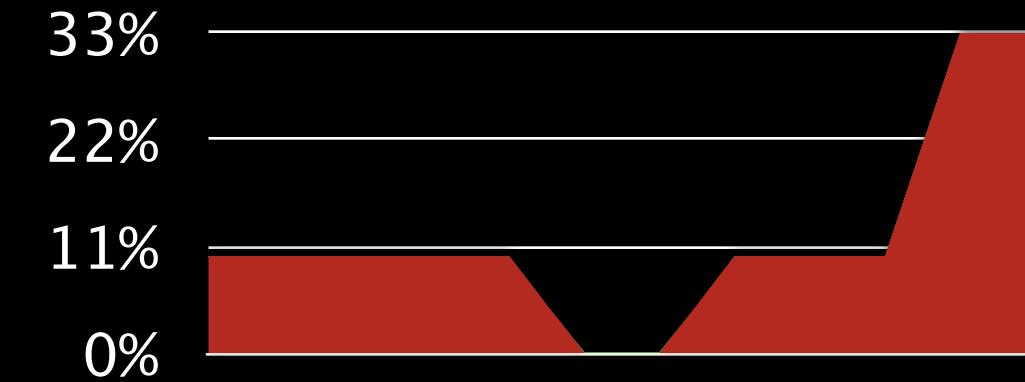
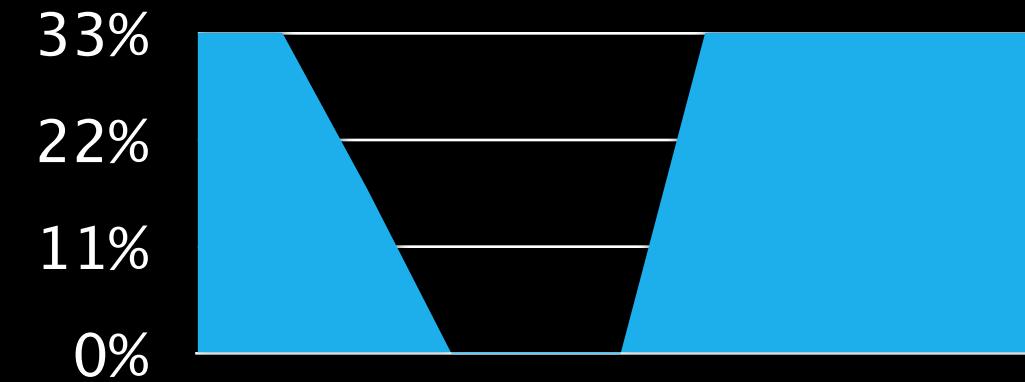
This is your typical data center with static partitioned apps



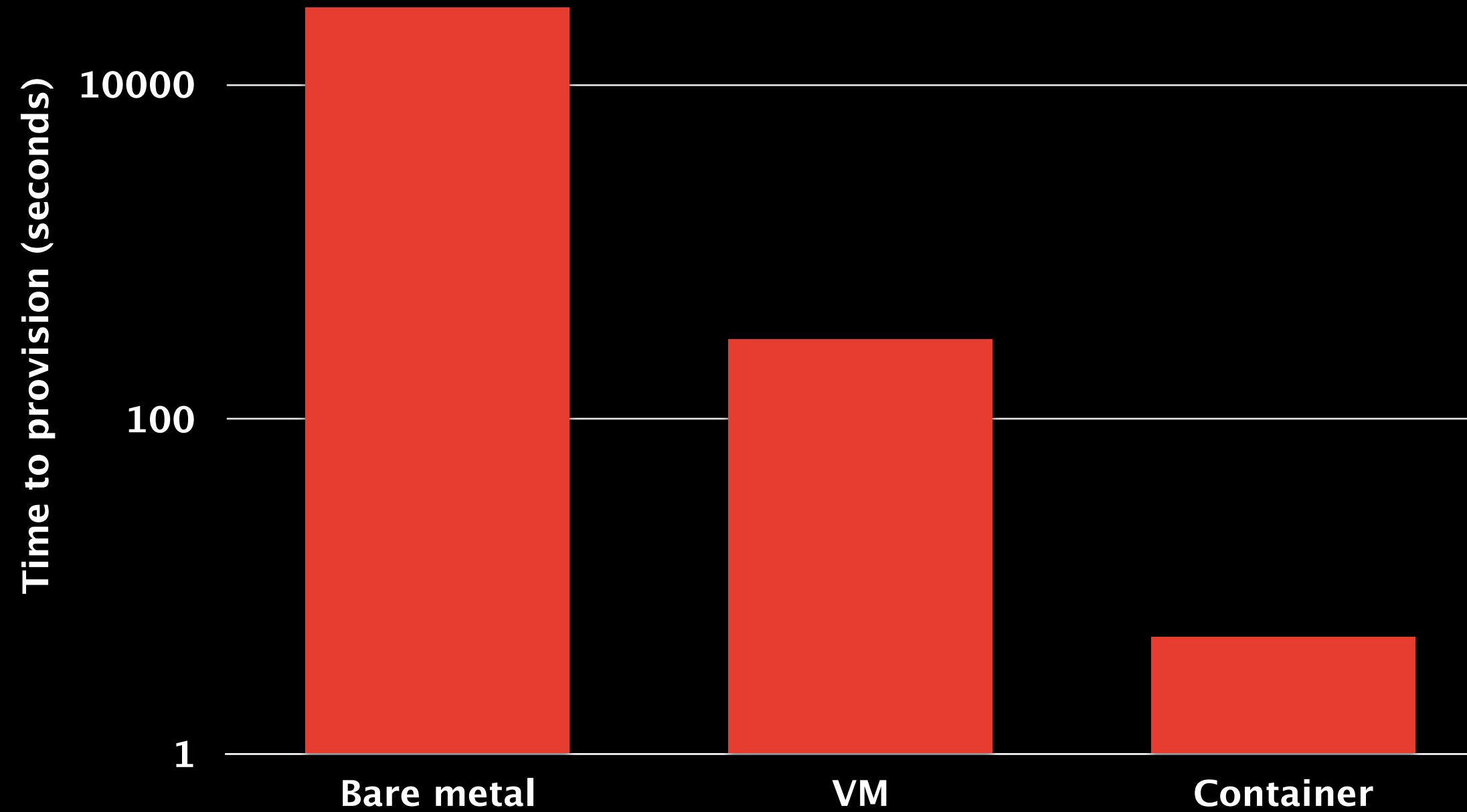
Not sharing wastes resources



Resource sharing increases throughput and utilization



Running at the container level improves performance...



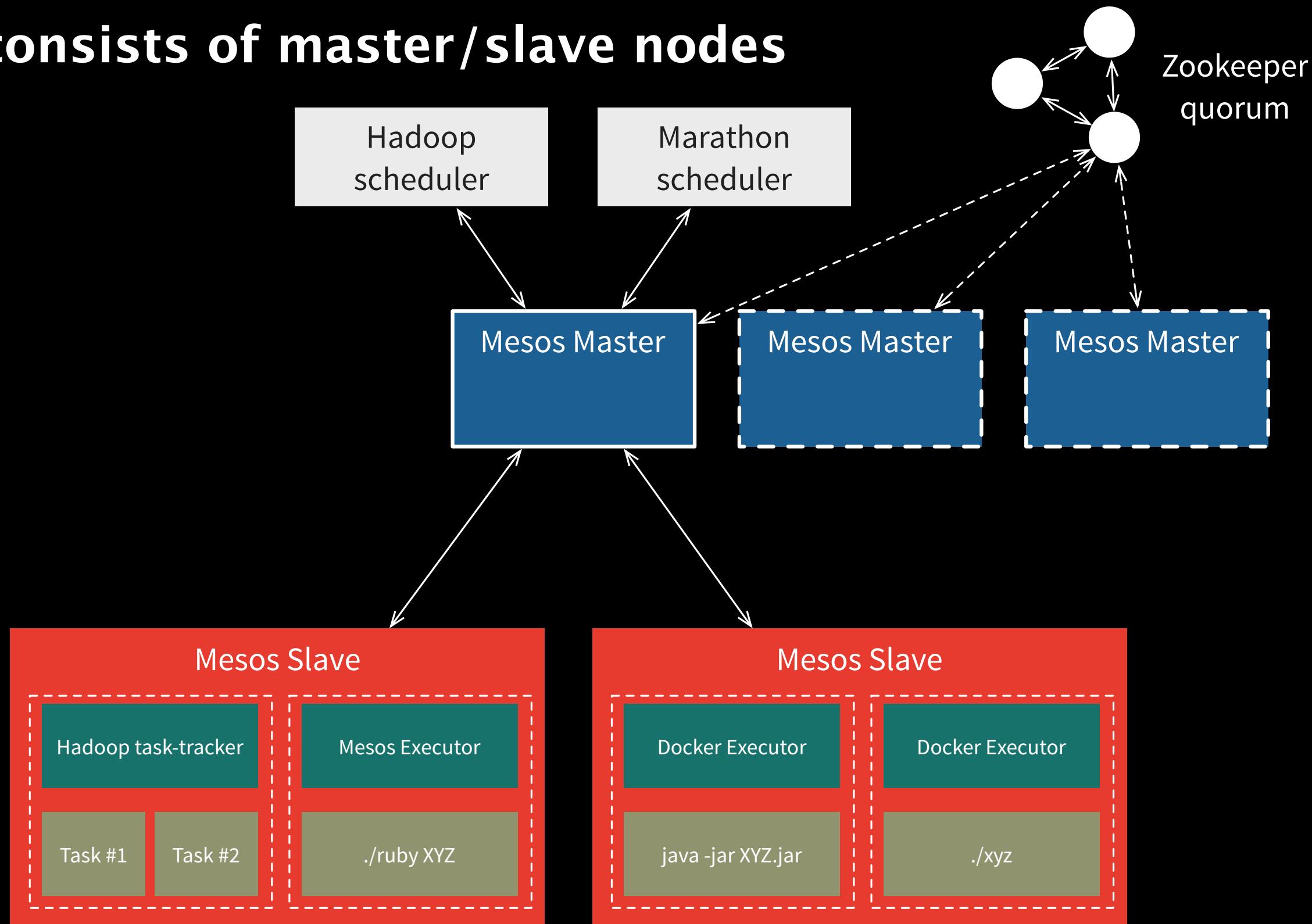
Inspired by Tomas Barton's Mesos talk at InstallFest in Prague

Agenda

- Introduction
- **How does Mesos work?**
- Mesos Ecosystem
- Conclusion
- Q&A

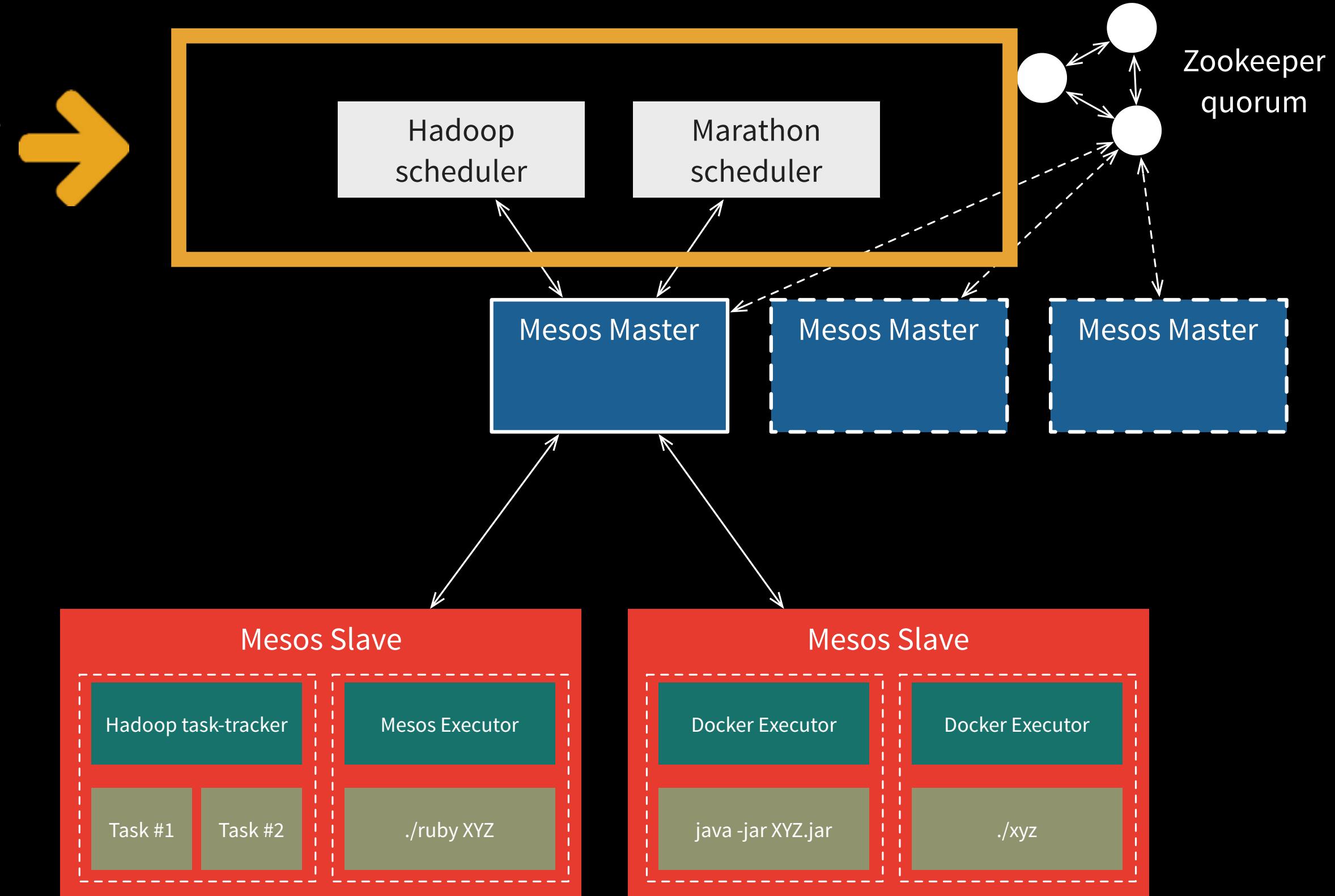


Mesos consists of master/slave nodes

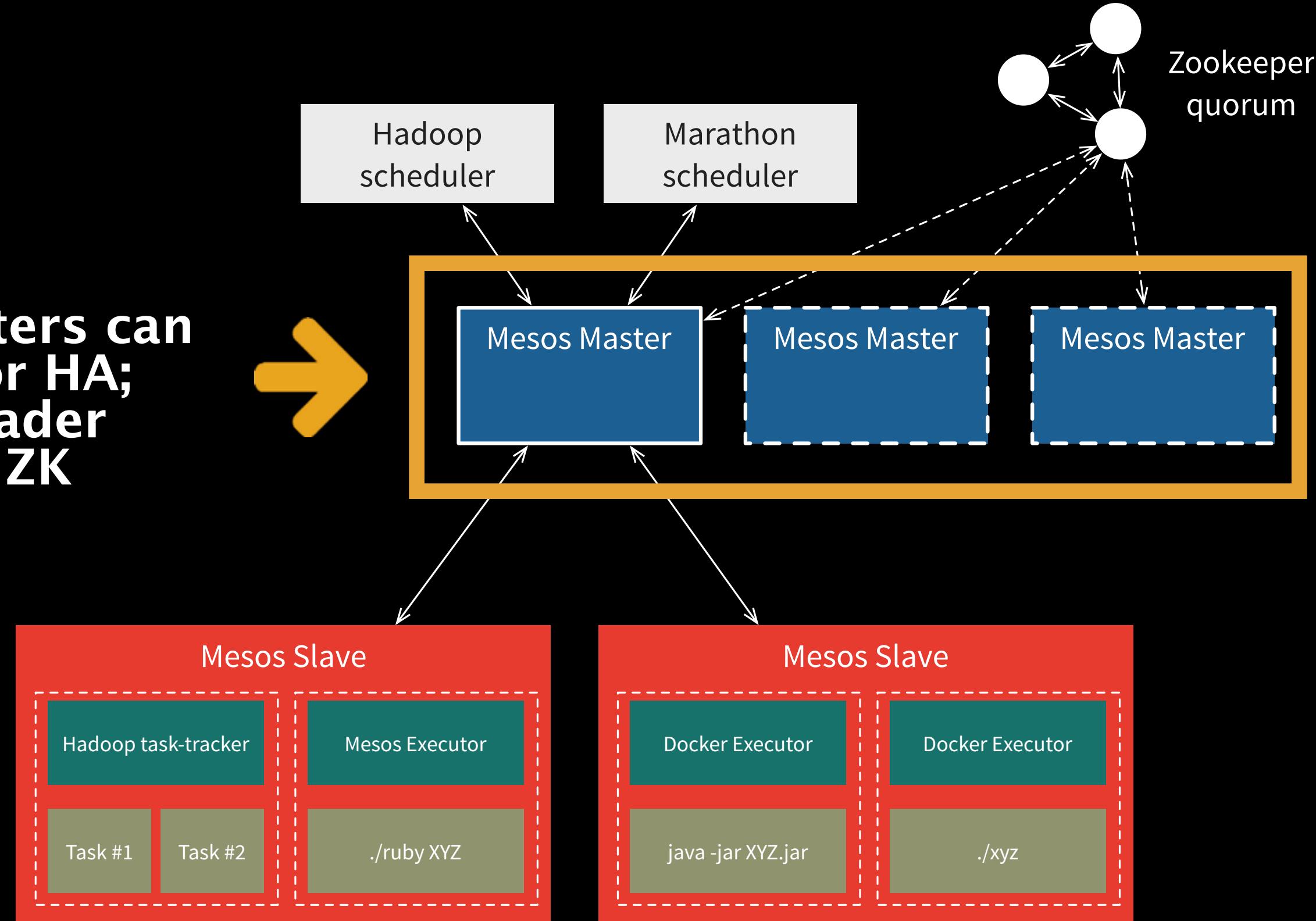


*Thank you to Niklas Nielsen and Adam Borlen for the following diagrams explaining Mesos
<https://www.youtube.com/watch?v=EI0R0kf0vks>

**applications
are known as
frameworks
in Mesos,
they interact
with master**

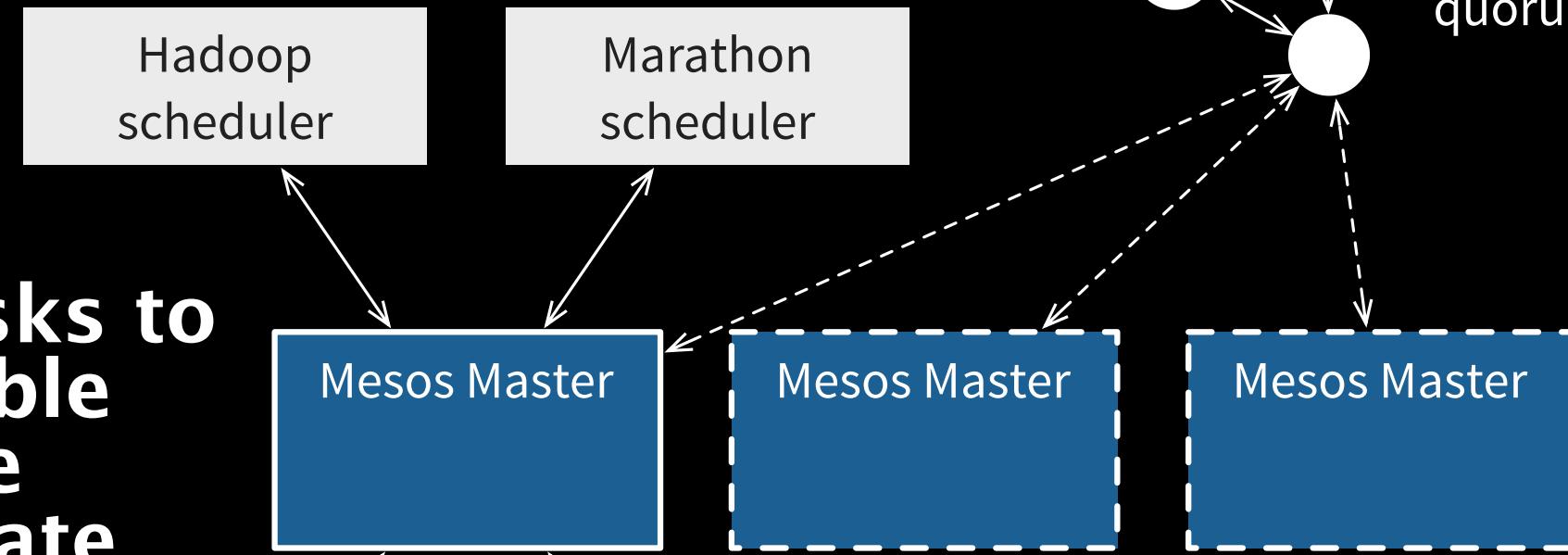
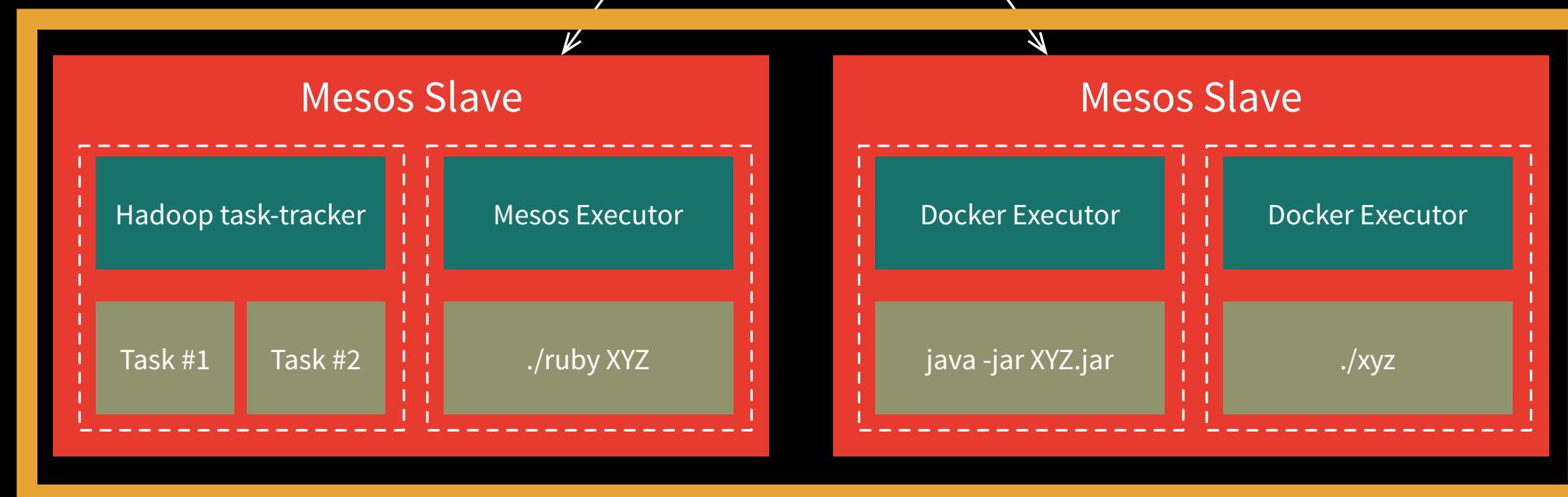


**Multiple masters can
be in place for HA;
coordinate leader
election with ZK**

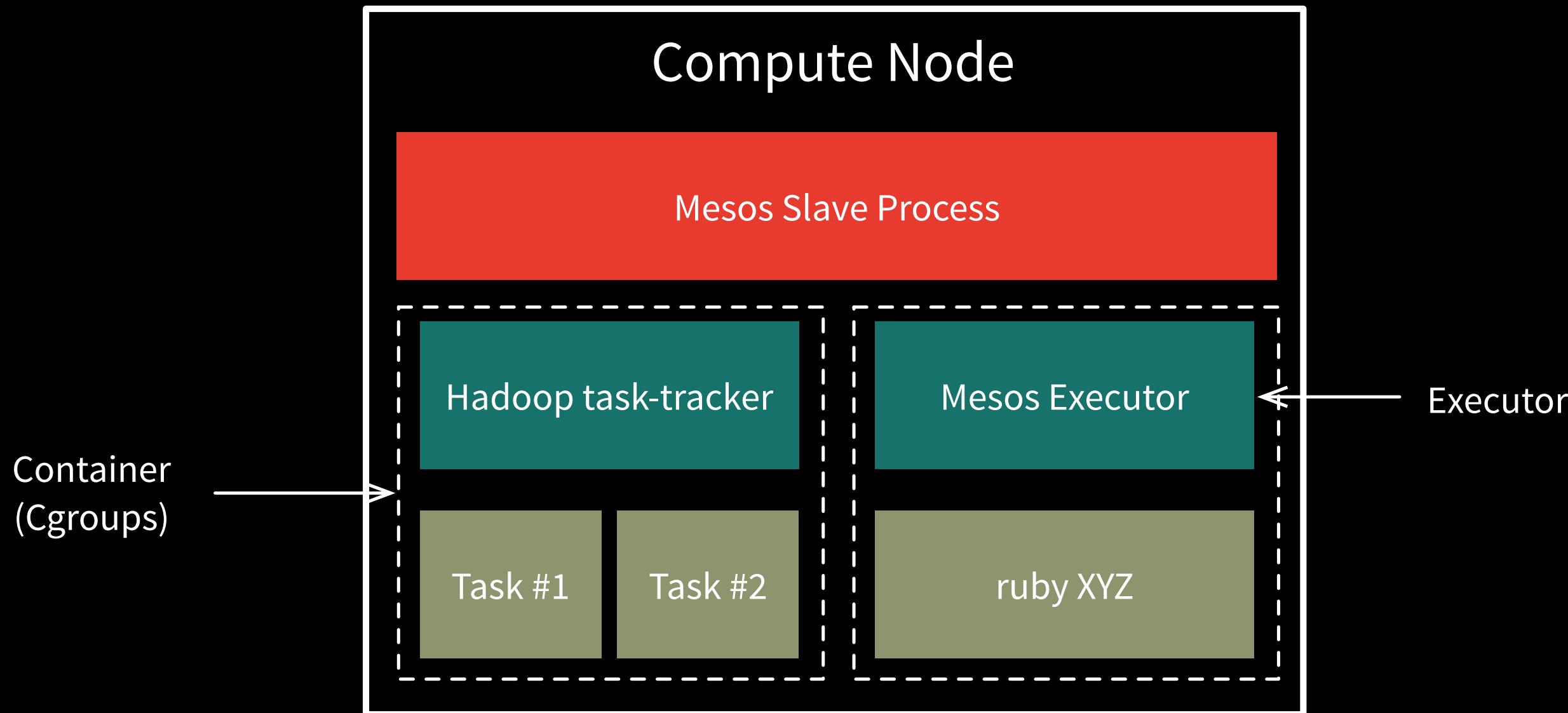


Master schedules tasks to run on slaves' available resources; slaves use executors to coordinate execution of tasks

Tasks are the unit of execution

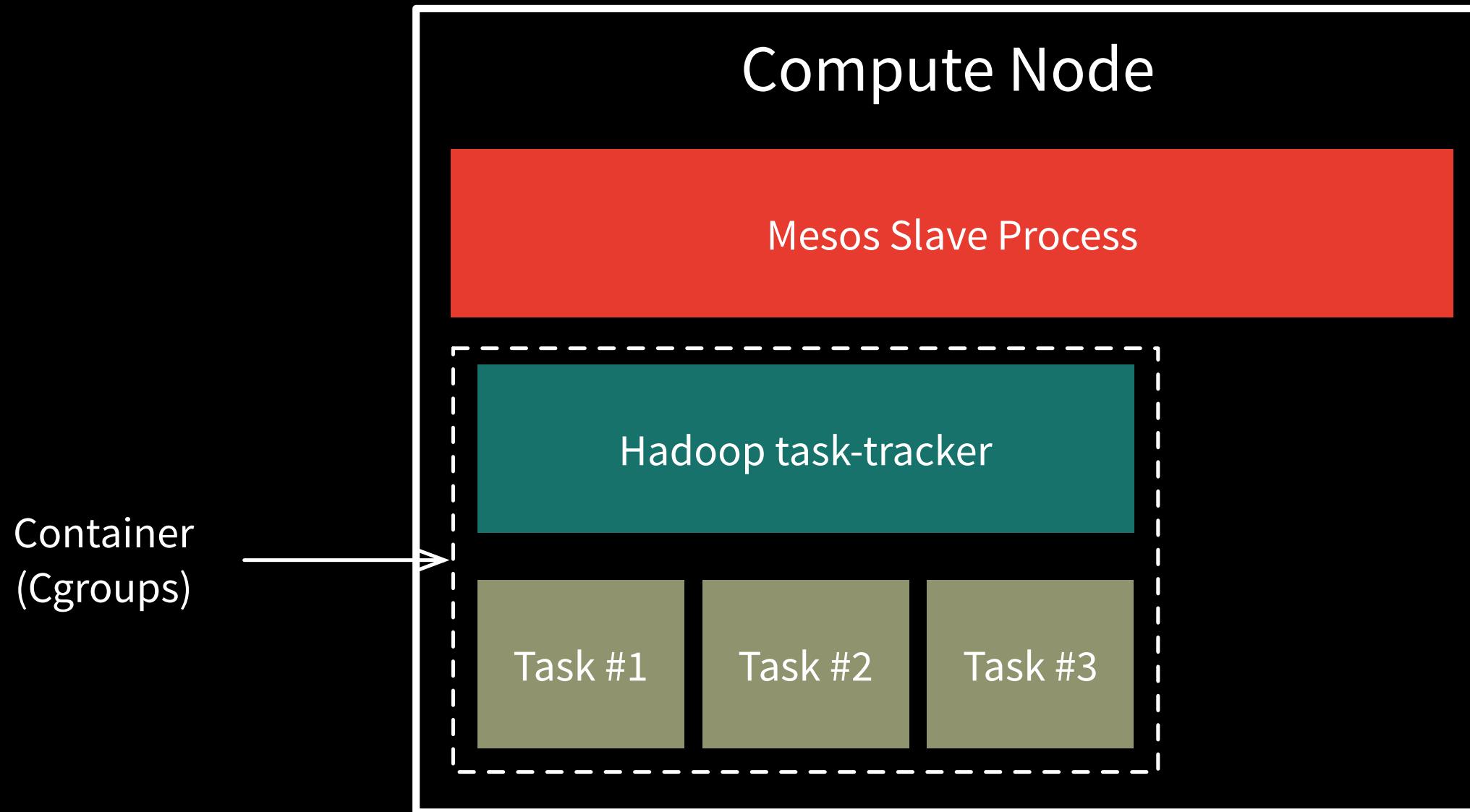


Mesos provides fine-grained resource isolation (via cgroups)



Slaves isolate executors and tasks via containers (dotted line)

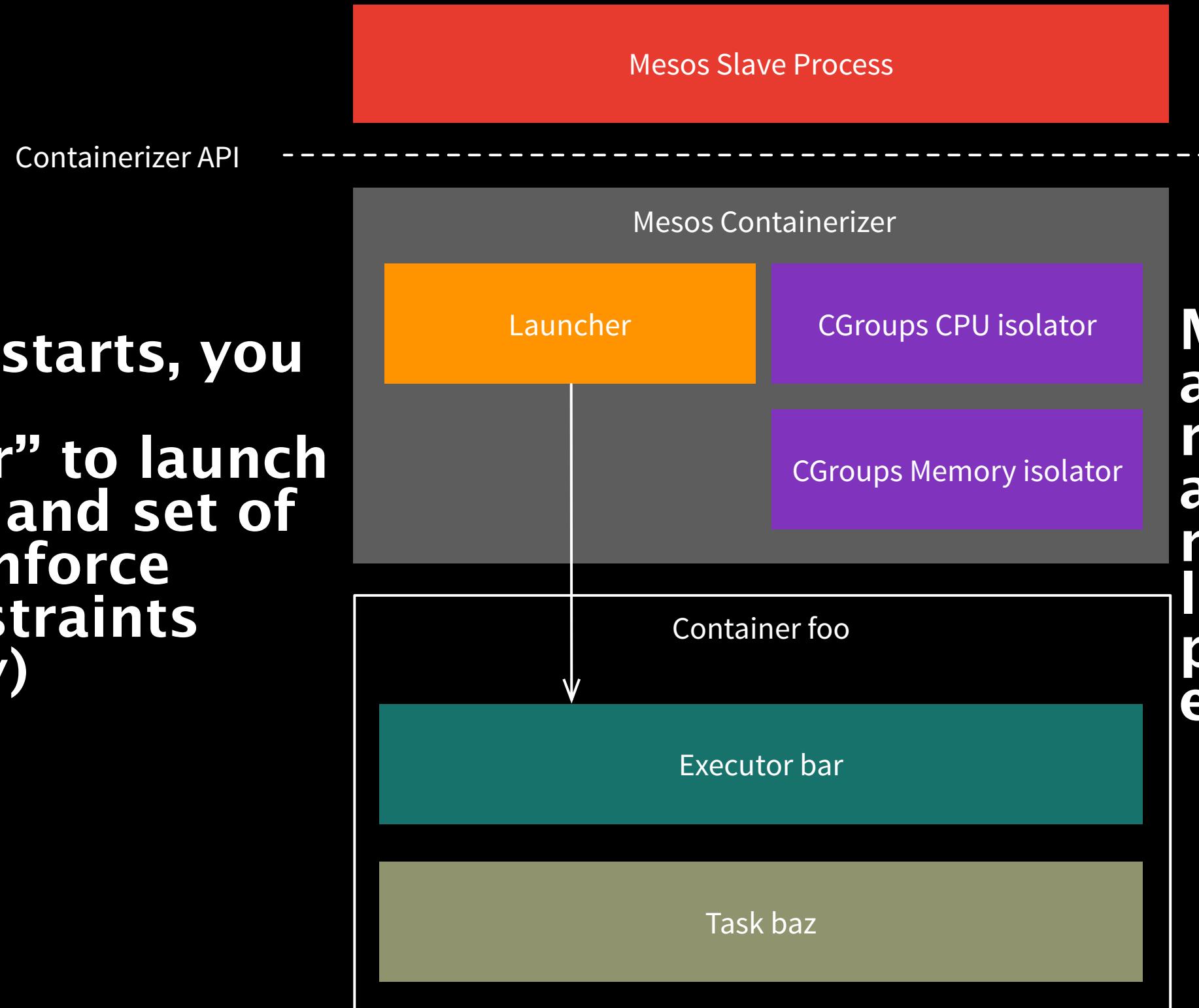
Mesos provides fine-grained resource isolation (via cgroups)



Containers can GROW AND SHRINK as tasks run and complete

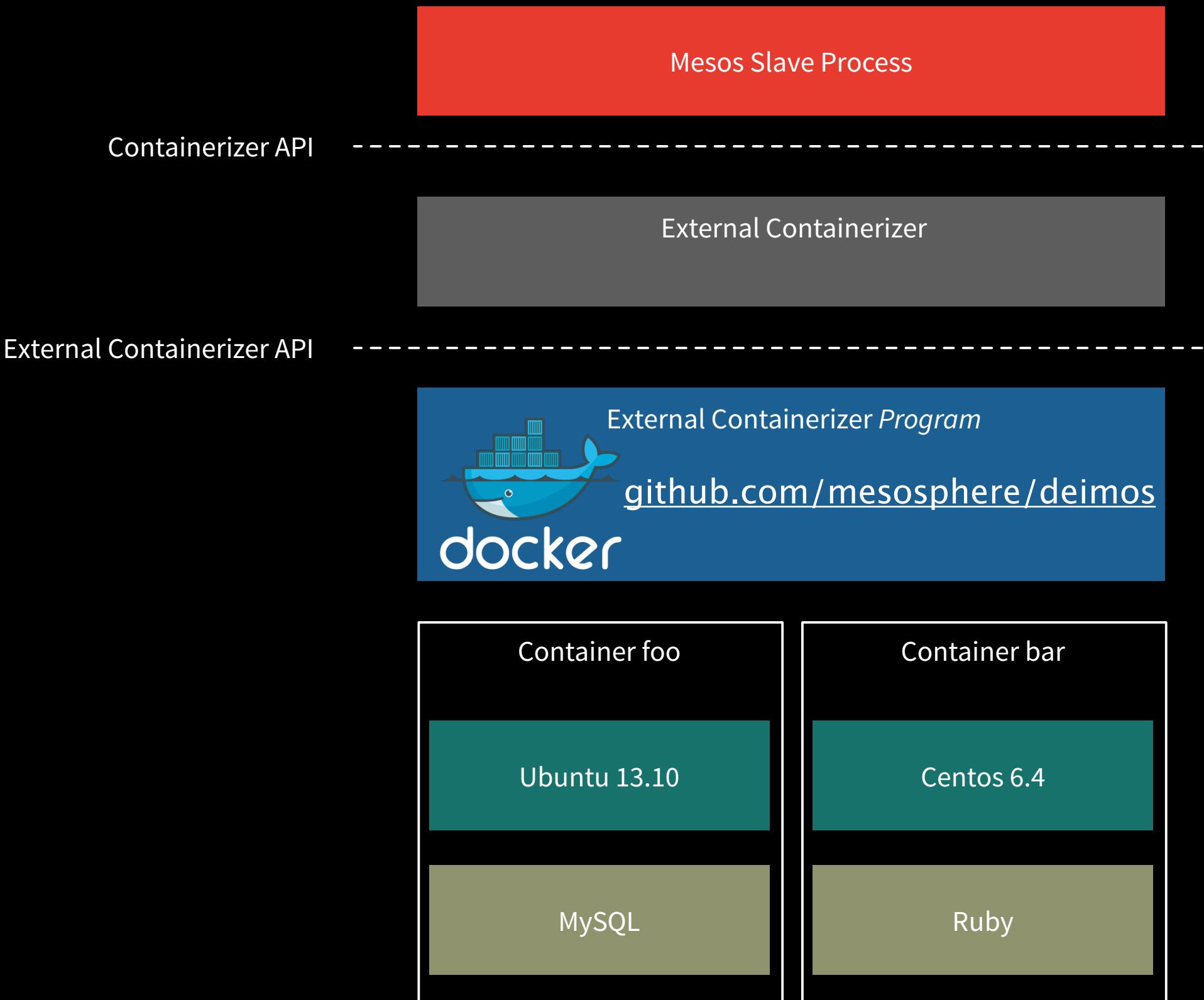
Mesos provides componentized resource isolation

When a slave starts, you can specify a “containerizer” to launch the container and set of isolators to enforce resource constraints (CPU/memory)



Mesos can track and allocate more resource types, allowing you to manage resources like ip-addresses, ports, disk space and even GPUs!

Mesos provides pluggable resource isolation (e.g., Docker)

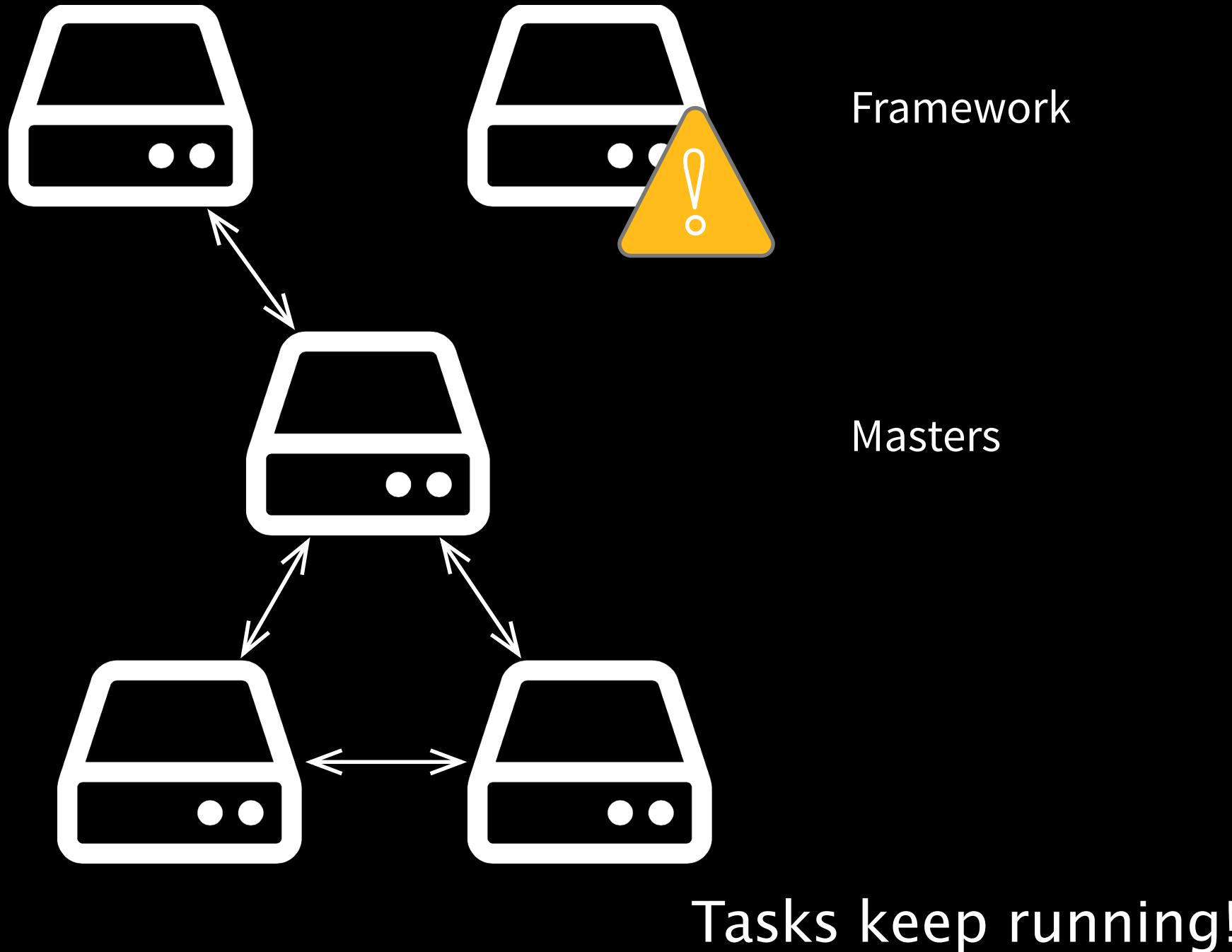


“

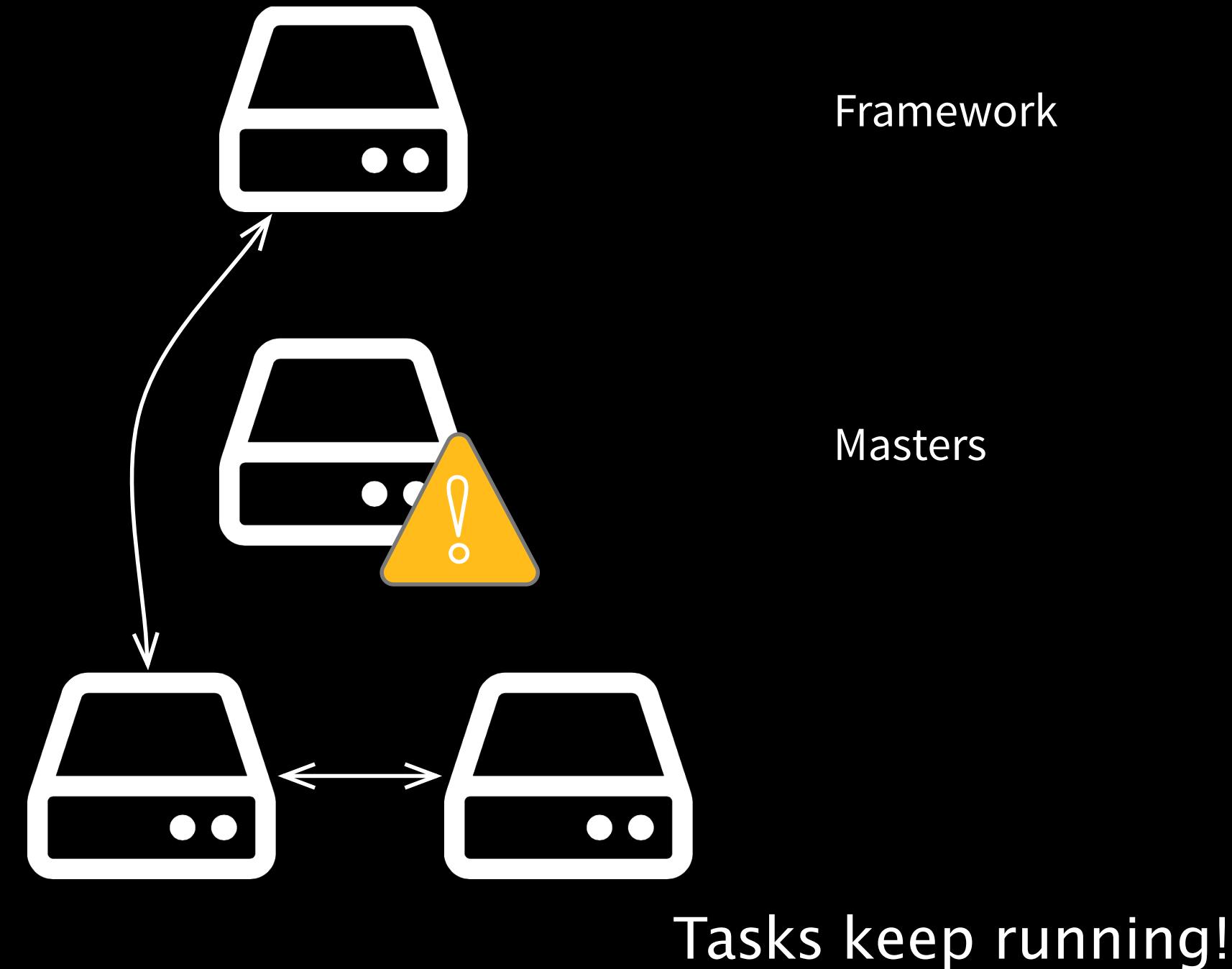
Everything fails all the time”

Werner Vogels (Amazon CTO)

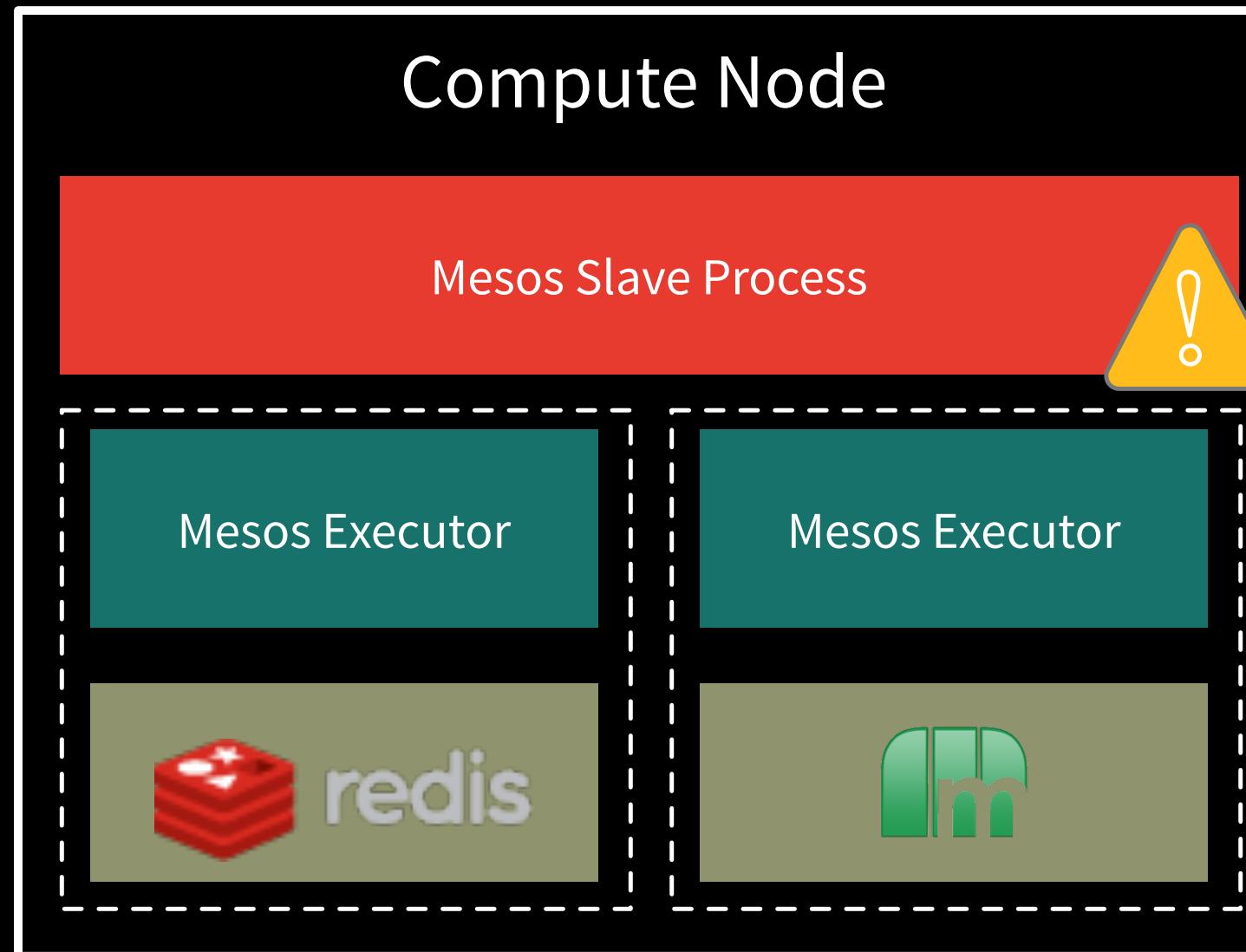
Mesos has no single point of failure (master keeps monitoring tasks and waits for a node to reconnect, master will update the framework with any tasks that were completed while it was gone)



Master node can fail-over (ZK quorum will elect a new leader)

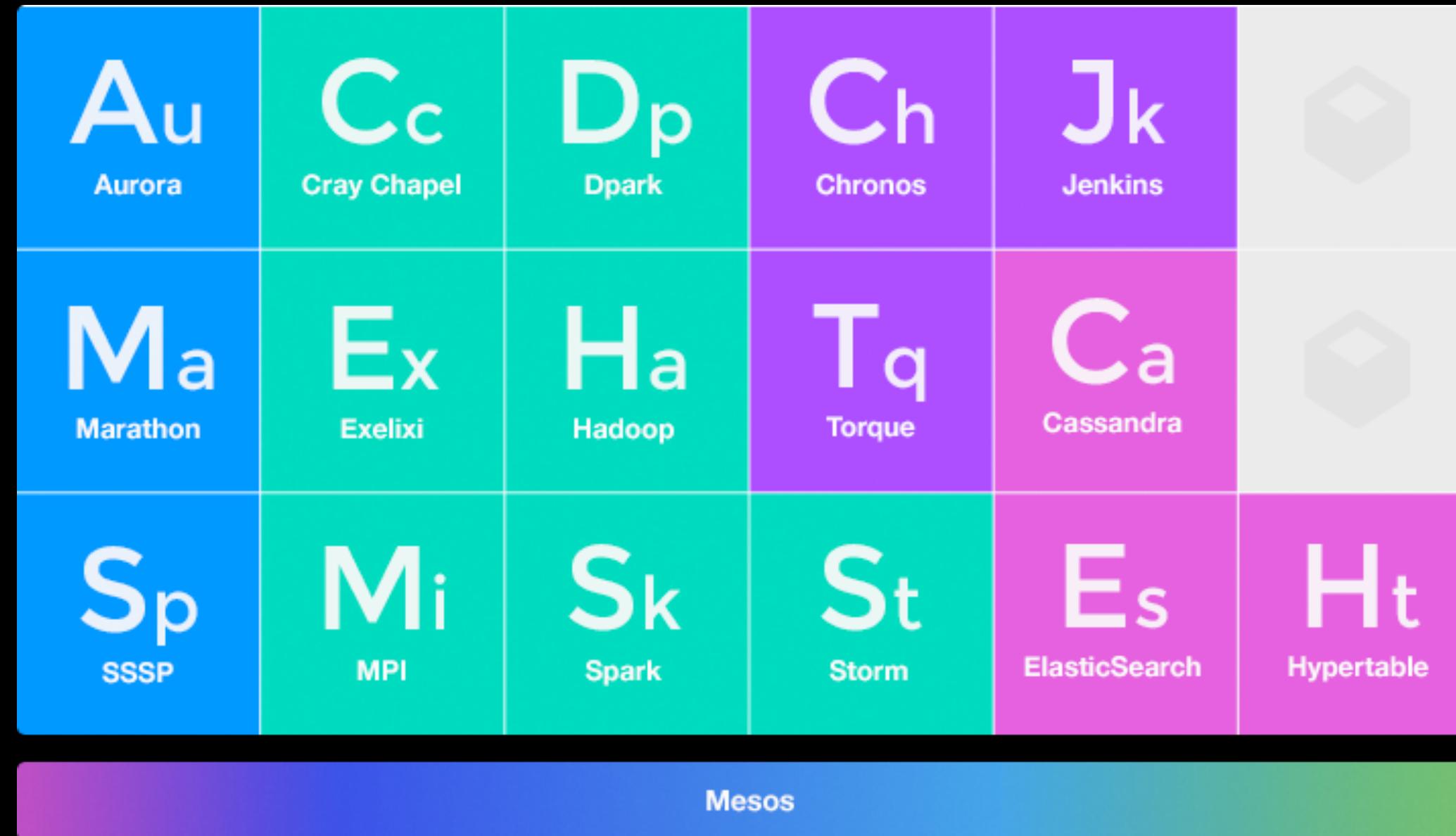


Slave processes can fail over (loads check pointed state to learn what pods to reconnect for reach task and re-registers with the master)



Tasks keep running!

The Mesos ecosystem is growing, frameworks everywhere)



<http://mesos.apache.org/documentation/latest/mesos-frameworks/>

Chronos: Distributed cron with dependencies

<https://github.com/airbnb/chronos>

The screenshot displays the Chronos web interface. On the left, a summary bar shows 256 total jobs and 16 failed jobs. Below this are buttons for 'Dependency Graph' and 'New Job'. The main area is a table listing various jobs with their names and status (all marked as 'success'). On the right, a modal dialog is open for creating a new job named 'Steve_Jobs' with the command 'echo 'FOO' >> /tmp/steve.txt'. It includes fields for 'PARENTS' (set to 'Choose parents...'), 'OWNER' ('ateam@airbnb.com'), and a 'SCHEDULE' section. The schedule is set to run daily at 11:44:03 on the executor '/custom/executor' with an epsilon of PT15M. A calendar for March 2013 shows the 15th as the selected run date. The modal also has tabs for 'NAME' and 'COMMAND'.

NAME	LAST
create_airbed_dump_table_hostings	success
create_airbed3_dump_table-hostings_first...	success
create_airbed_dump_table_hostings_with_...	success
create_airbed_dump_table_collection_host...	success
create_omg_table-affiliate_events_hostings	success
hostings_summary	success
daily_gibson-import_airbed3_hostings	success
db_export-airbed_hostings	success
hostings_summary_2_quality_score	success
hostings_summary_1_pre	success
hostings_impressions_normalize	success
hostings_impressions_normalize_prepare	success
daily-update_hostings_summary_history	success
hostings_earnings_summary#async	success
daily-create_hostings_history	success
daily-update_hostings_history	success
daily-create hostings summary history	success

Marathon: init.d for your data center

<https://github.com/mesosphere/marathon>

The screenshot shows the Marathon web interface. On the left, there's a sidebar with a dropdown menu labeled "ID ▾". In the center, a modal window titled "New Application" is open. The modal contains fields for defining the application: "ID" set to "Hello", "COMMAND" set to "./Hello-* /bin/hello -Dhttp.port=\$PORT", "CPUS" set to "1", "MEMORY (MB)" set to "512", "INSTANCES" set to "1", and "URIS" set to "http://downloads.mesosphere.io/tutorials/PlayHello.zip". At the bottom of the modal are two buttons: "CANCEL" and "CREATE". To the right of the modal, there are tabs for "CPUUs" and "Instances", and a button labeled "+NEW".

Aurora: Advanced scheduler used by Twitter in production

<http://aurora.incubator.apache.org>



The Apache Aurora logo features a circular arrangement of blue and teal triangles forming a hexagonal pattern.

Apache TM
AURORA

Documentation Download Community

Apache Software Foundation • Apache Incubator • Apache Aurora

Apache Aurora is a service scheduler that runs on top of Mesos, enabling you to run long-running services that take advantage of Mesos' scalability, fault-tolerance, and resource isolation. Apache Aurora is currently part of the [Apache Incubator](#).

Aurora Features

- Deployment and scheduling of jobs
- The abstraction a "job" to bundle and manage Mesos tasks
- A rich DSL to define services
- Health checking
- Failure domain diversity
- Instant provisioning

You can also build your own framework...



STANDARD



Agenda

- Introduction
- How does Mesos work?
- **Mesos Ecosystem**
- Conclusion
- Q&A



#PoweredByMesos (public)



airbnb™

NETFLIX

vimeo®

mesosphere

ebay

HubSpot



OpenTable

ignidata
igniting business with data

xogito
...radical thinking...

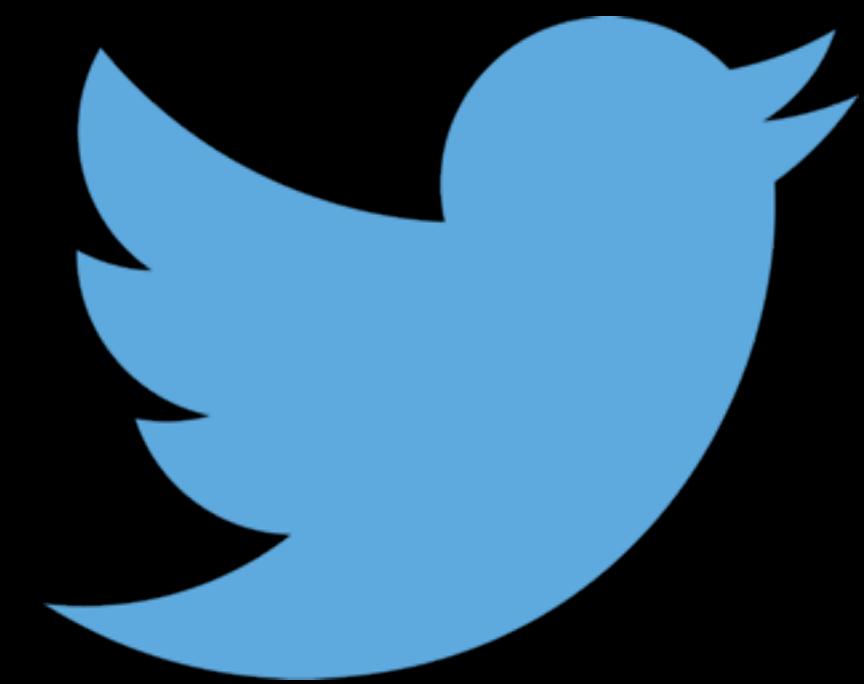
PayPal™

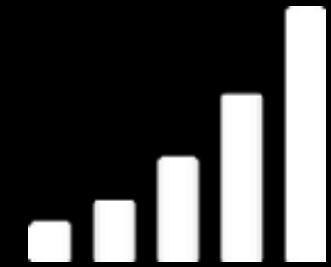
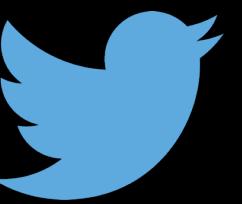
DueDil

Atlassian

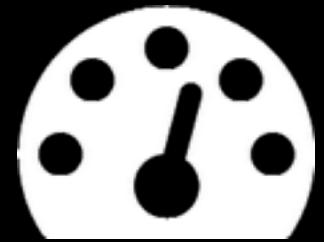
CLOUD PHYSICS

device scape™

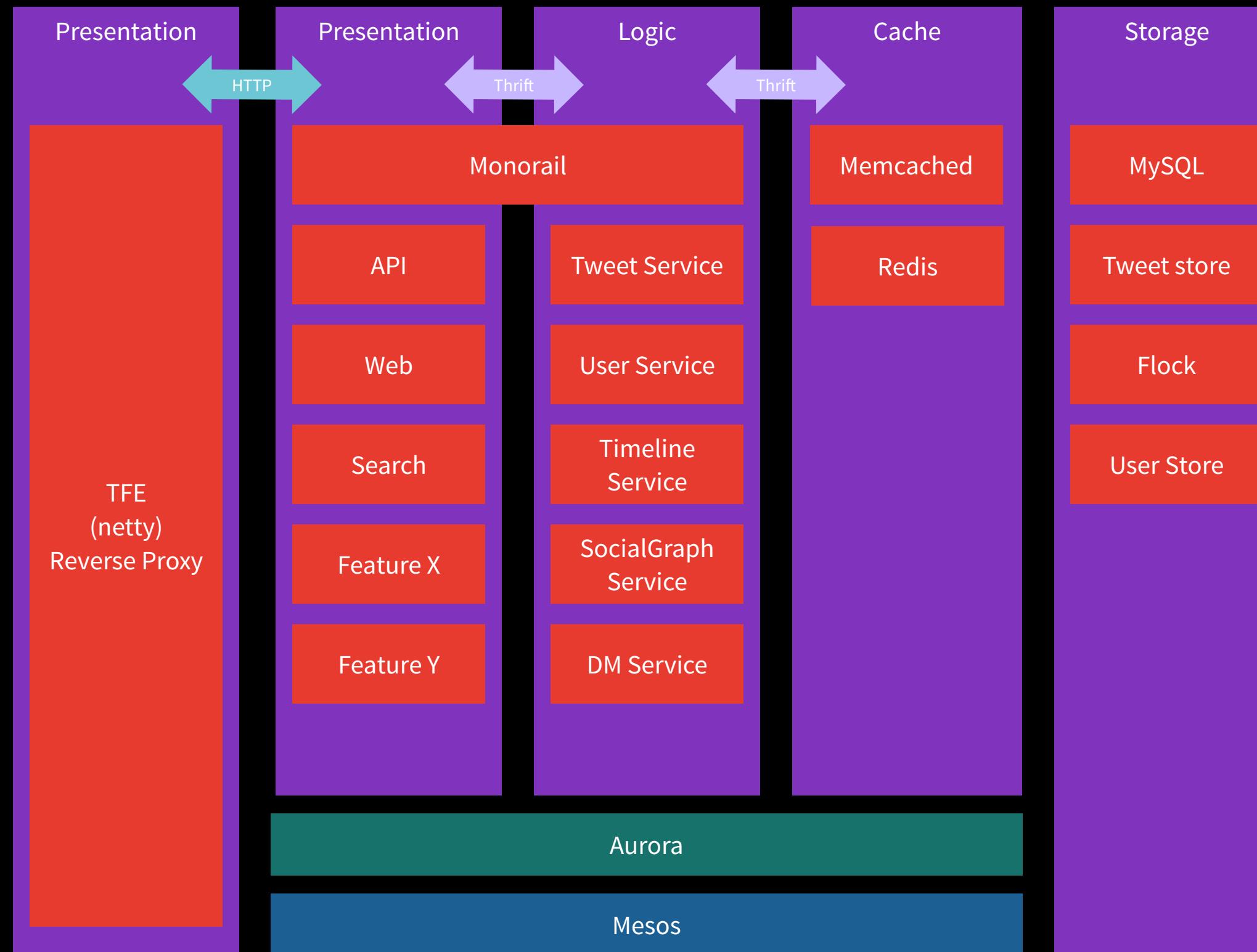
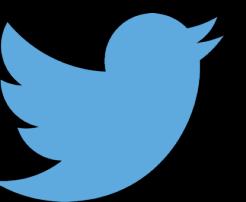




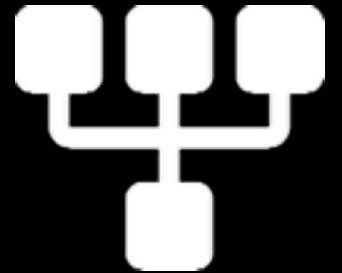
Mesos allow services to scale



Engineers think about resources, not machines







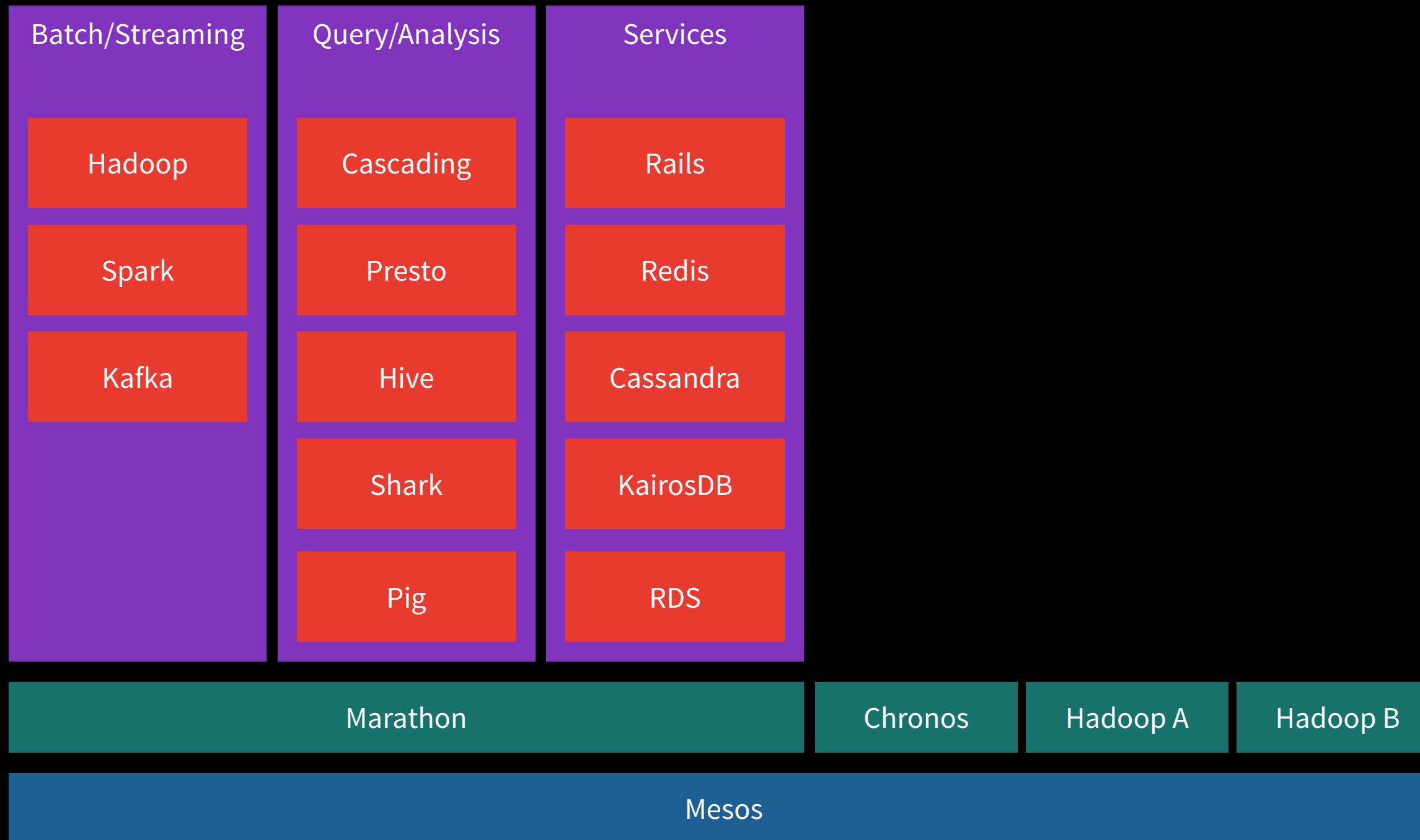
Mesos enables multi-tenant clusters



Small teams can move fast



AWS-based infrastructure
beyond just Hadoop



Agenda

- Introduction
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Conclusion

- Mesos is a distributed system to build and run distributed systems (think datacenter OS)
- Mesos enables resource sharing, high-availability and fault-tolerance for your data centers
- Mesos is an open source project with a healthy independent community: <http://mesos.apache.org>
- So please check it out, use it or contribute back if you can to make it better!



Launch an Apache Mesos Cluster in

3

2

1

3 Choose a cluster size

6 instances

12 vCPUs
45 GiB memory

\$1.44 per hour¹

Perfect for trying out Apache Mesos

18 instances

36 vCPUs
135 GiB memory

\$4.32 per hour¹

Unleash the data-cruncher

2 Enter your credentials

1 Choose where to receive notifications

Launch

<https://elastic.mesosphere.io>

Open Source Support from the Mesos Community



Apache
MESOS

Getting Started Documentation Downloads Community

Contribute

Mesos Adopters

User Groups

Committers

About the Community

Apache Mesos is an open source community that's organized by its members, including you! Whether you're running or writing a framework, or hacking the core, there are opportunities for you to get in touch and ask questions, get involved locally, and contribute back. If you're interested in who is using Mesos, check out our growing [Powered By Mesos](#) list.

Get Involved

Local User Groups

Mesos User Groups organize local Mesos events in different cities. Join one in your city, or learn how to start your own.

Contribute

Report or track a bug

New bugs can be reported on our [issue tracker](#). In order to create a new issue, you'll need to signup for

Get In Touch

Mailing Lists

Users: [Subscribe](#) | [Unsubscribe](#) | [Archives](#)
Developers: [Subscribe](#) | [Unsubscribe](#) | [Archives](#)

IRC Channel

Developers and users chat in the #mesos channel on irc.freenode.net.

If you are new to IRC, you can use a [web-based client](#).

<http://mesos.apache.org>

Learn more via Mesos User Groups



Getting Started Documentation Downloads Community

Contribute

Mesos
Adopters

User Groups

Committers

Mesos User Groups

Mesos User Groups (MUGs) are responsible for organizing local meetups, hackathons, and other events to foster the adoption of Mesos and support its community.

Local Groups

USA

- [Atlanta, GA](#)
- [Los Angeles / Santa Monica, CA](#)
- [New York, NY](#)
- [San Francisco, CA](#)

Start Your Own MUG

It's easy. If you're interested in organizing a MUG in your city, share your interest on the user mailing list (user@mesos.apache.org) and we'll add you to our list. MUGs typically use Meetup.com or Twitter to coordinate. We encourage groups to be organized by at least two organizations, and share responsibility for hosting and organizing

<http://mesos.apache.org/community/user-groups/>

Commercial Support from Mesosphere

The image shows a screenshot of the Mesosphere website. At the top, there is a navigation bar with links: Get Started (highlighted in purple), Tutorials, Apps, Tools, and Developer Resources. Below the navigation bar, the main heading is "Start using Apache Mesos". Underneath this, there is a three-step guide: 1. Install pre-reqs, 2. Install Mesos Package, and 3. Reboot! Each step has a circular arrow icon to its right. Below the steps is a "Choose an OS" dropdown menu and a "Get Started" button. In the bottom left corner, there is a screenshot of the Mesos UI interface, which includes tabs for Mesos, Dashboard, Frameworks, and Slaves. The Mesos tab is active, showing a master ID and some cluster details. The Frameworks tab is also visible. In the bottom right corner, there is a tutorial card for "Apache Spark on Mesos". The card features the Spark logo, a duration of 30 minutes, 17 steps, and a description: "Spark is a fast and general-purpose cluster computing system which makes parallel jobs easy to write. This tutorial shows you how to run Spark on Mesos." It also lists requirements: "You'll need: A Mesos Cluster, Spark, Apache Mesos".

<http://mesosphere.io/learn>

First #MesosCon to coincide with LinuxCon 2014!

The screenshot shows the Linux Foundation website with a banner for the first #MesosCon coinciding with LinuxCon 2014. The banner features a speaker on stage and the text '#MesosCon' in large white letters. Below the banner, there are navigation links for Home, Program, Attend, and Sponsor. The event details are as follows:

- #mesoscon**
- Sheraton Chicago**
- Chicago, IL**
- August 21 - 22, 2014**

Social media sharing icons for Twitter, Facebook, LinkedIn, and Google+ are present. A green 'REGISTER (\$99)' button is visible. At the bottom, sponsor logos for Twitter (Organizing Sponsor), Atlassian (Platinum Sponsor), and ebay inc. (Gold Sponsors) are displayed.

Navigation menu:

- HOME
- TRAINING
- EVENTS
- COLLABORATIVE PROJECTS

Footer links:

- View Events
- Sponsor
- Event Management Services
- CFP
- Contact Us

Social media icons:

-
-
-
-

Sponsor logos:

- Organizing Sponsor:
- Platinum Sponsor: mesosphere
- Gold Sponsors: ebay inc.

<http://mesoscon.org>

Thank you for listening!

Chris Aniszczyk (@cra)

zx@twitter.com

<http://opensource.twitter.com>

<http://mesos.apache.org>

email: {user,dev}@mesos.apache.org



Also thanks to Niklas Nielsen and Adam Borlen for their slides explaining Mesos from ApacheCon 2014
<https://www.youtube.com/watch?v=EI0ROkf0vks>

Resources

<http://mesos.apache.org>

<http://mesosphere.io/learn/>

<http://wired.com/wiredenterprise/2013/03/google-borg-twitter-mesos>

<http://mesosphere.io/2013/09/26/docker-on-mesos/>

<http://typesafe.com/blog/play-framework-grid-deployment-with-mesos>

<http://research.google.com/pubs/pub35290.html>

<http://nerds.airbnb.com/hadoop-on-mesos/>

<https://blog.twitter.com/2013/mesos-graduates-from-apache-incubation>

<http://www.ebaytechblog.com/2014/04/04/delivering-ebays-ci-solution-with-apache-mesos-part-i/>

<https://www.youtube.com/watch?v=ElOROkf0vks>

