Docker for fun + profit

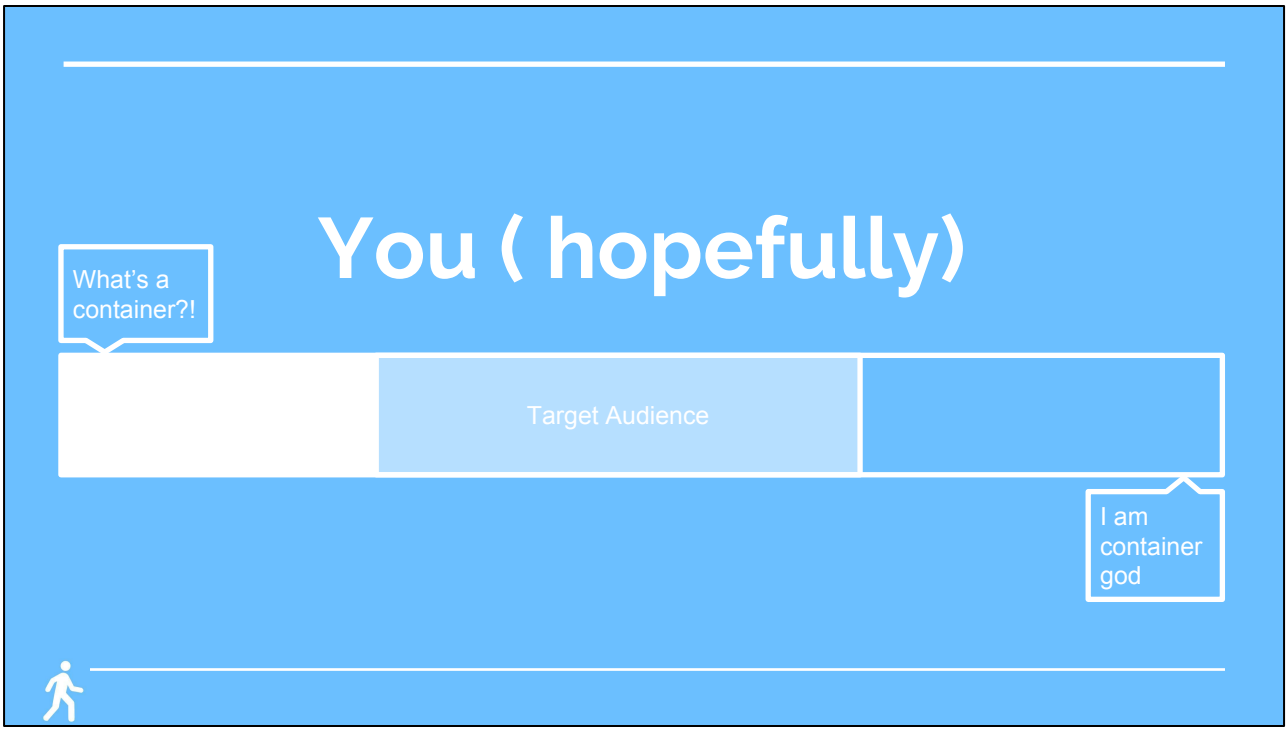
A story about (more generally) deploying and managing containers in prod

So who's used containers

Speaker Notes

Interactive instructions

- Hands up if you have used docker before?
- Keep them up if you use them in dev
- Keep them up if you use them in prod
- Keep them up if you use Kubernetes
- Keep them up if you homebrew your own clusters? (You're going to be bored here)



Speaker Notes

- 0 should be like “I have kind of used Linux but I don’t really know what this container lark is about”
- 3 (audience start) should be like “I have used containers! I created a docker compose.”
- 7 (audience end) is like “I have shipped things to Kubernetes/Swarm/Whatever and they’re facing traffic”
- 10 is like home brewing clusters with kubeadm, handling storage abstractions and so fourth.

Please Interrupt.

Speaker Notes

Action Required

- Put up the “raise questions” URL.

Talking Points

- The presentation is a guide. We might finish it, or we might not - it doesn’t matter. Please ask questions
- The goal of this is to spark interest, not really to answer all questions. Please, ask them -- but also don’t worry too much if you don’t get it; the slides will be sent around, and they mostly have links where you can learn more.

Speaker Notes

Talking Points

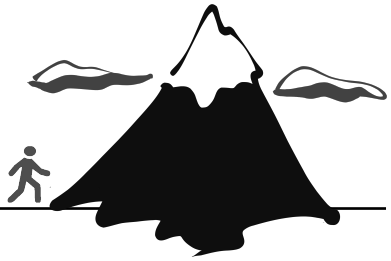
- I know some things. But not all things.
- If you know things (or if your knowledge contradicts mine) please voice it! We're all a collaborative team here.

The problem

Speaker Notes

- Skip these. This. Finish on the slide with the giant mountain.

Building a server is hard



Speaker Notes

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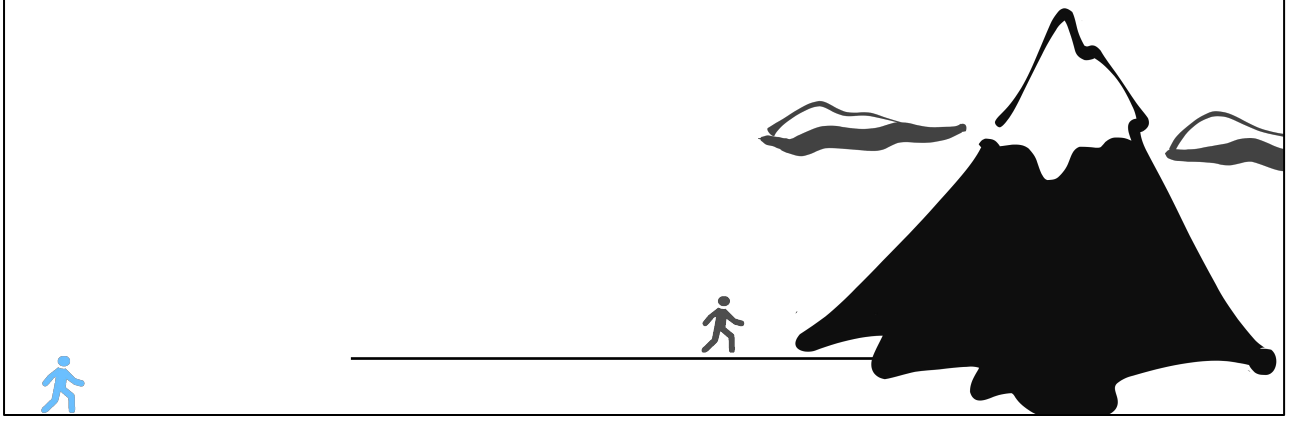
Maintaining servers is super hard



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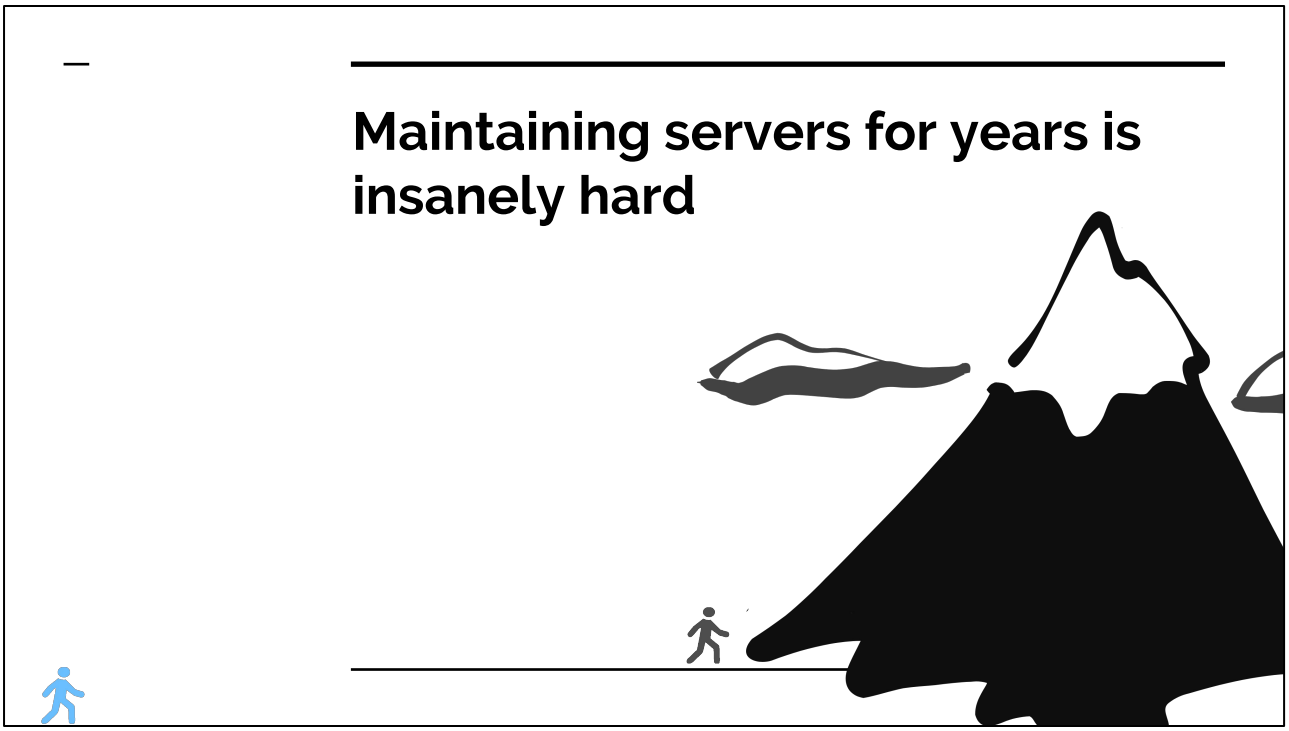

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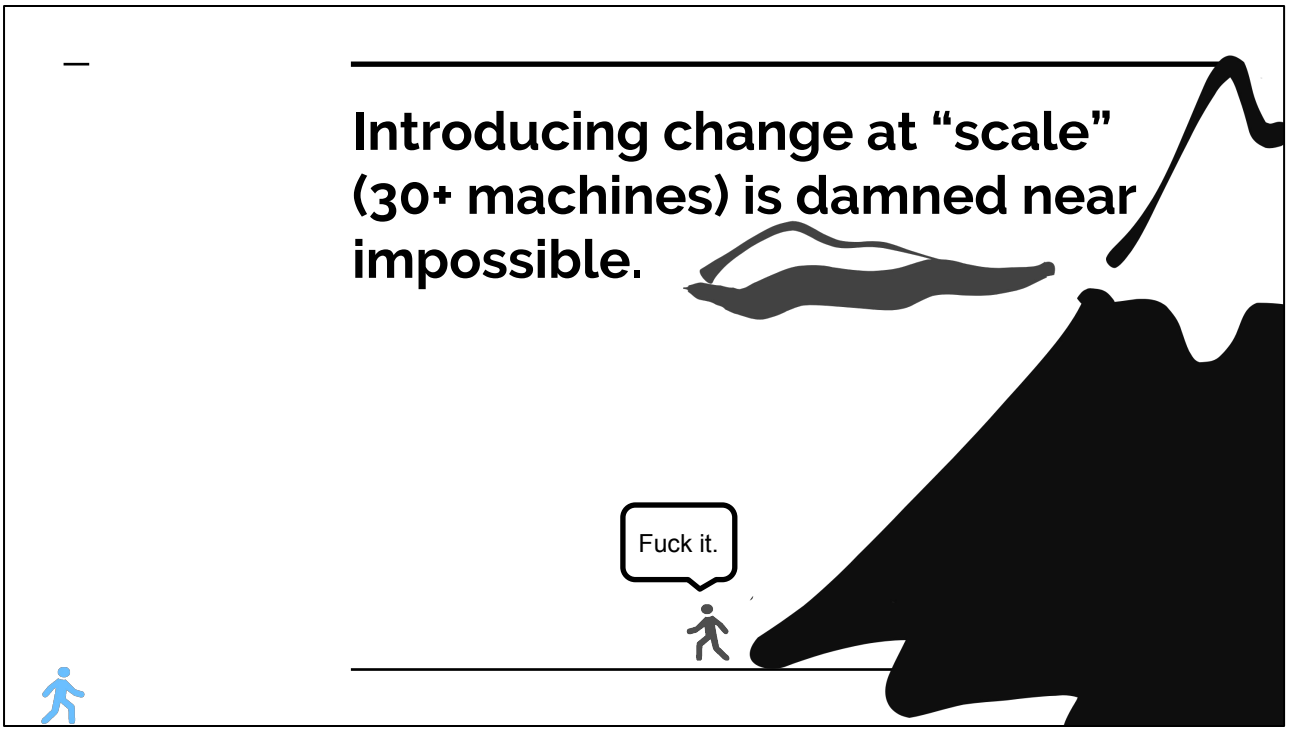


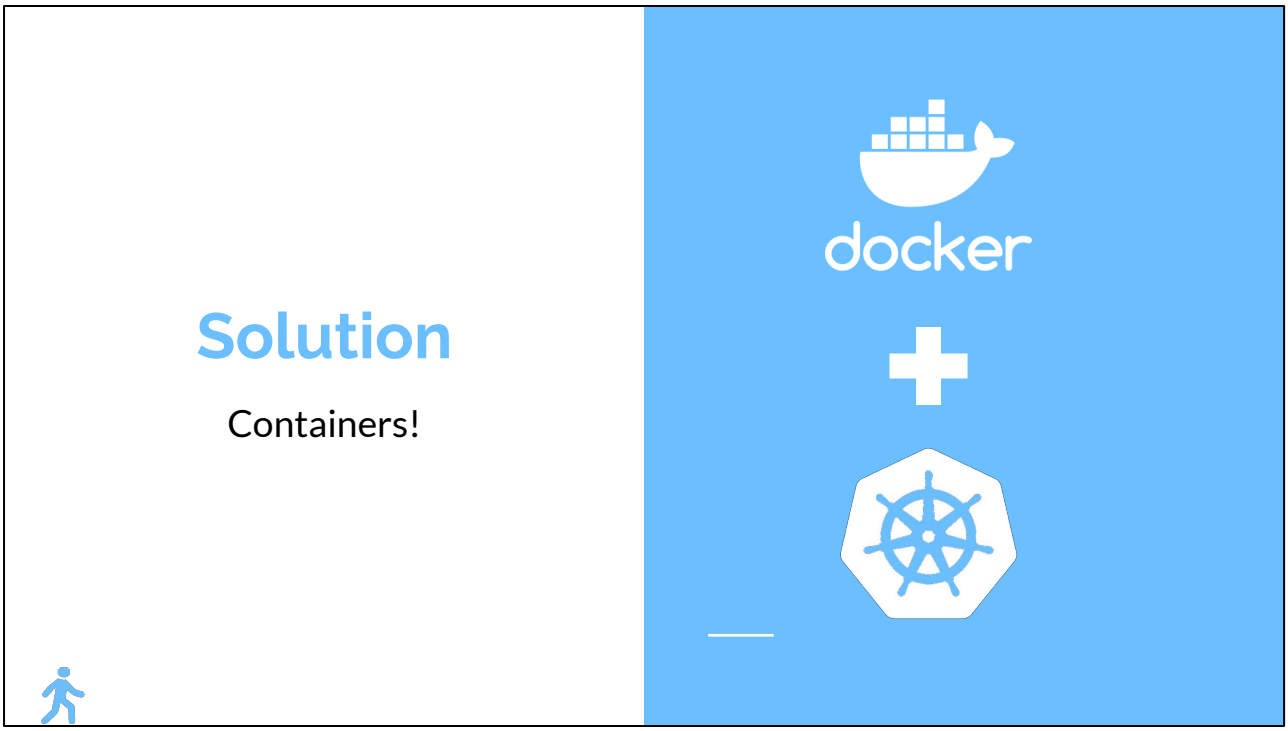
Speaker Notes

Talking Points

- Running Linux machines finds problems other software eng has solved:
  - Version Control
  - Code Review
  - Collaboration
  - Change Management

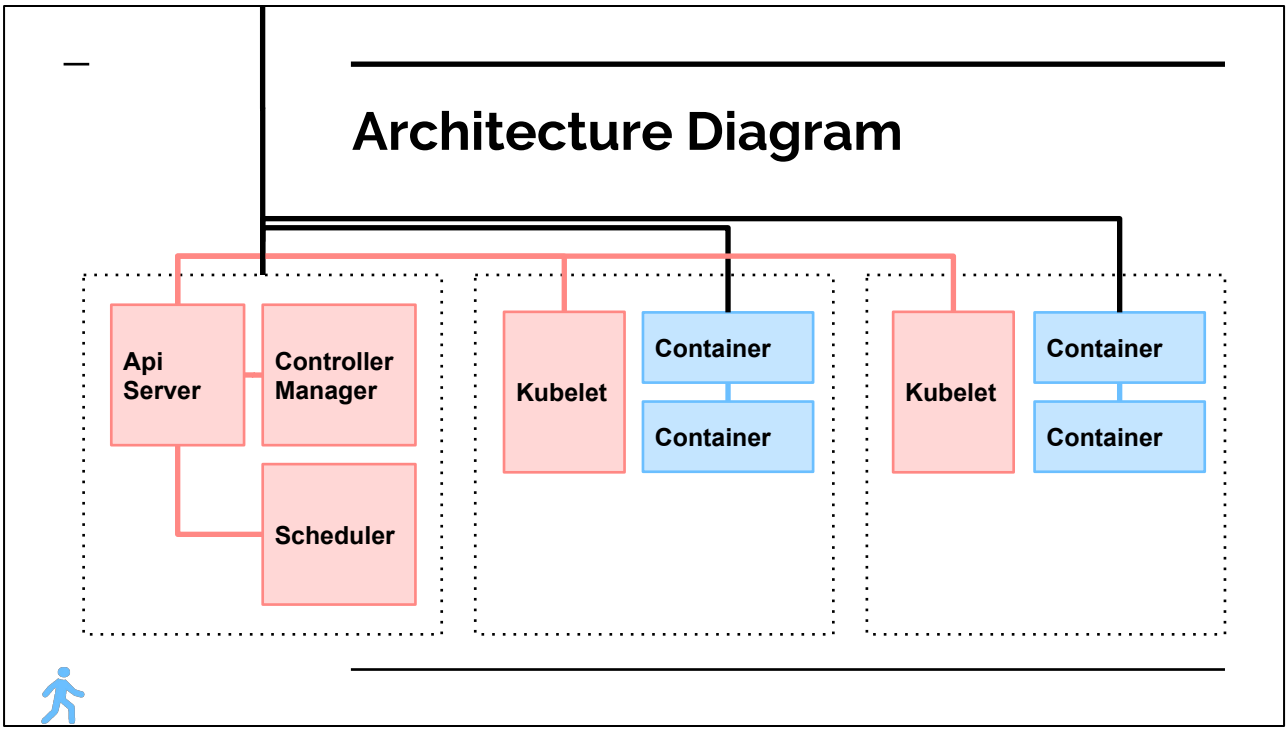
Further Reading

- https://www.safaribooksonline.com/library/view/site-reliability-engineering/9781491929117/ch05.html



Further Reading

- https://www.opencontainers.org/



Speaking Notes

- We're going to cover containers, then Kubernetes. The blue, then the pink
- We'll cover how to use them, how they work and any other questions you might have
- Don't worry about the terms just yet.

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Pray to the live demo gods

Speaker Notes

- $ helm install stable/${SOFTWARE}.

Containers

namespaces + cgroups

Speaker Notes

- Build once
- Deploy anywhere

Speaker Notes

- Docker is most popular, and well supported. There are also others! But perhaps the most important thing to know is there is a standard format for them, and they're interchangeable.

Further Reading

- https://www.docker.com/
- https://github.com/coreos/rkt
- https://linuxcontainers.org/
- https://github.com/opencontainers

Who has played snake

Speaker Notes

- Hands up who’s played snake?
- Keep them up if you played it on a nokia 3310
- Let’s all go back to nokia 3310’s

Fun!

Build

Locally, or in CI build an “image” - a deployable container

Push

Push the image to a “registry” - a place to put these containers until they’re deployed

Deploy

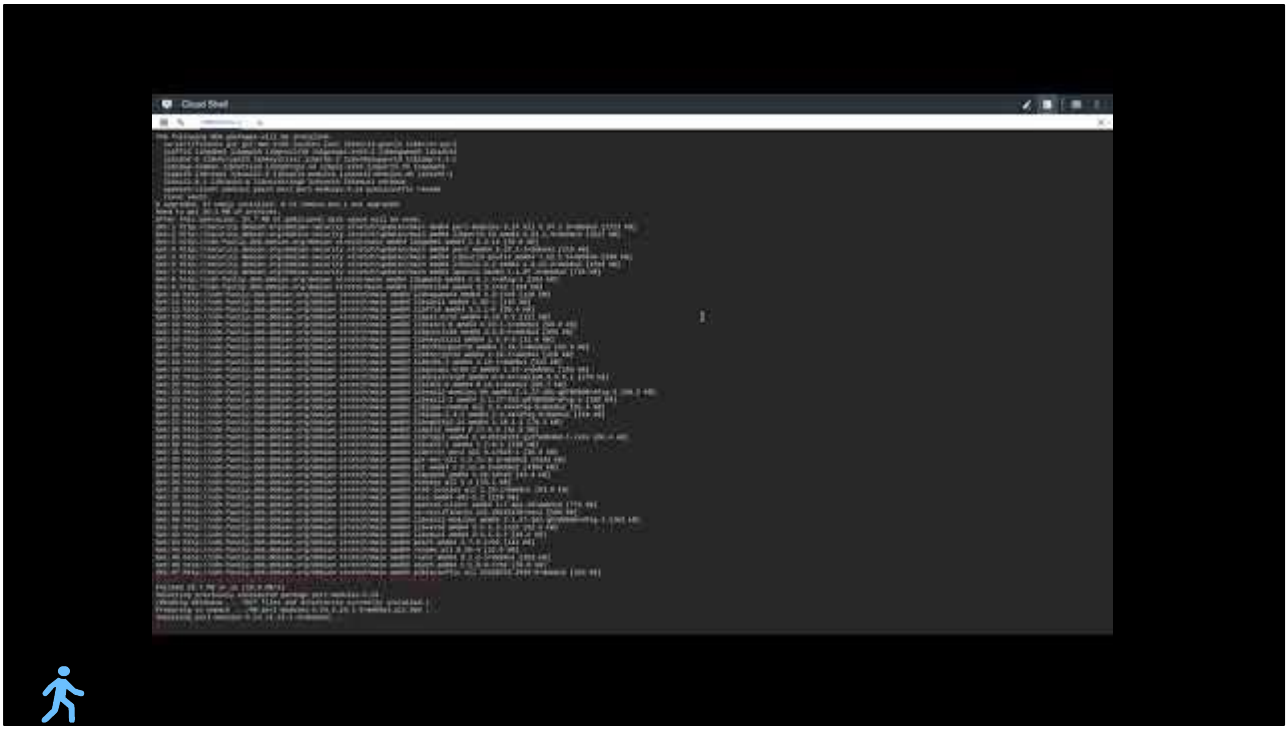
Update the deployment configuration so it uses the new container

Speaker Notes

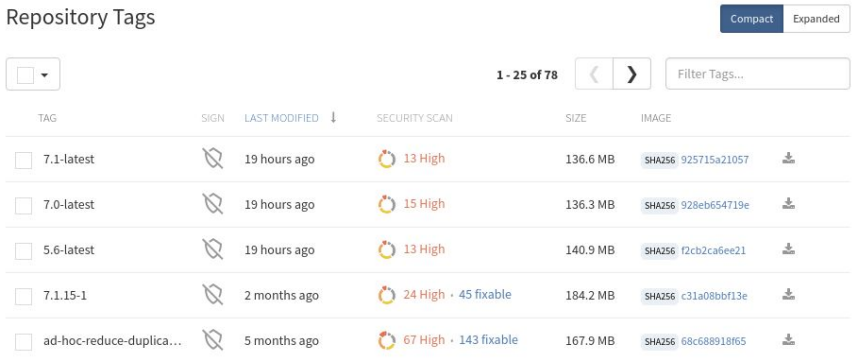
- This process lends itself extremely well to automation.
- Mostly, developers won’t do this -- they’ll simply mark their code as deployable, and it’ll be deployed.

Build

```
FROM nginx:latest

# Define the snake repo in a handy environment variable for easy replacement
ENV SNAKE_REPO="https://github.com/PKief/Snake.git"

# Install git so we can download the snake repo
RUN apt-get update && \
    apt-get install --yes \
        git

# Clone the repo to a directory that NGINX can access
RUN git clone ${SNAKE_REPO} /var/www/snake

# Modify NGINX configuration to serve our snake game
RUN sed --in-place 's/usr\/share\/nginx\/html/var\/www\/snake/' /etc/nginx/conf.d/default.conf
```


Cloud Shell

Push


Repository Tags
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15 High
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SHA256 928eb654719e
5.6-latest
19 hours ago
13 High
140.9 MB
SHA256 f2cb2ca6ee21
7.1.15-1
2 months ago
24 High · 45 fixable
184.2 MB
SHA256 c31a08bbf13e
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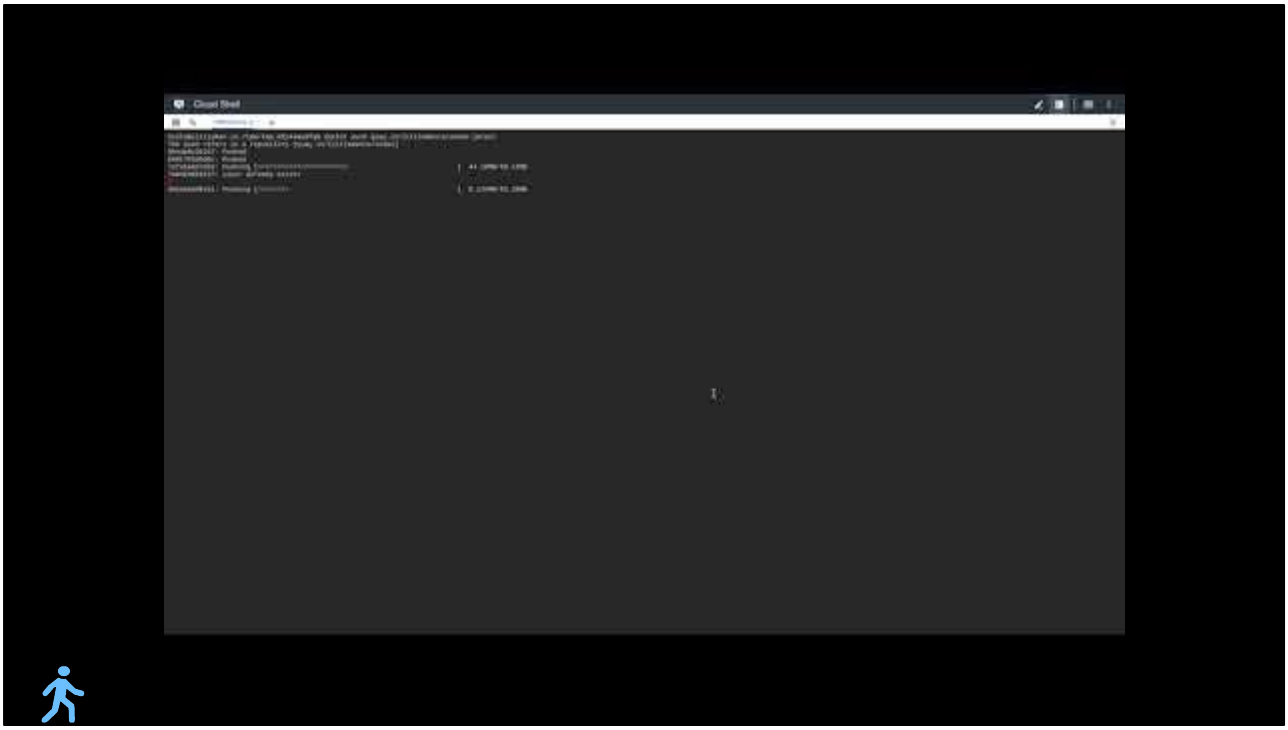
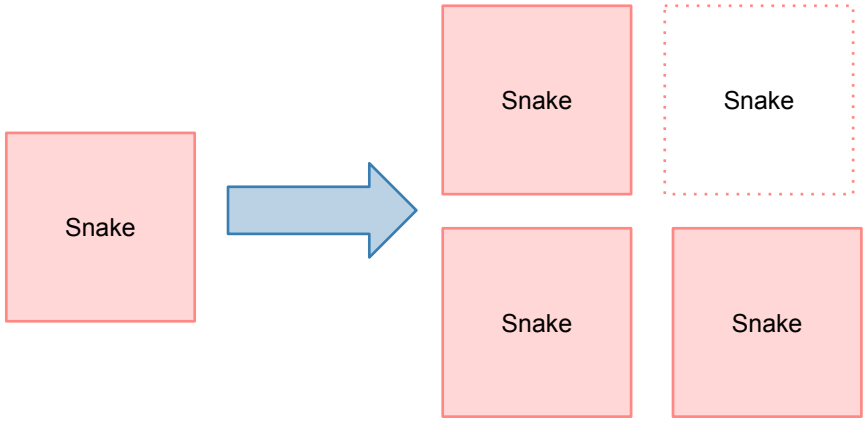
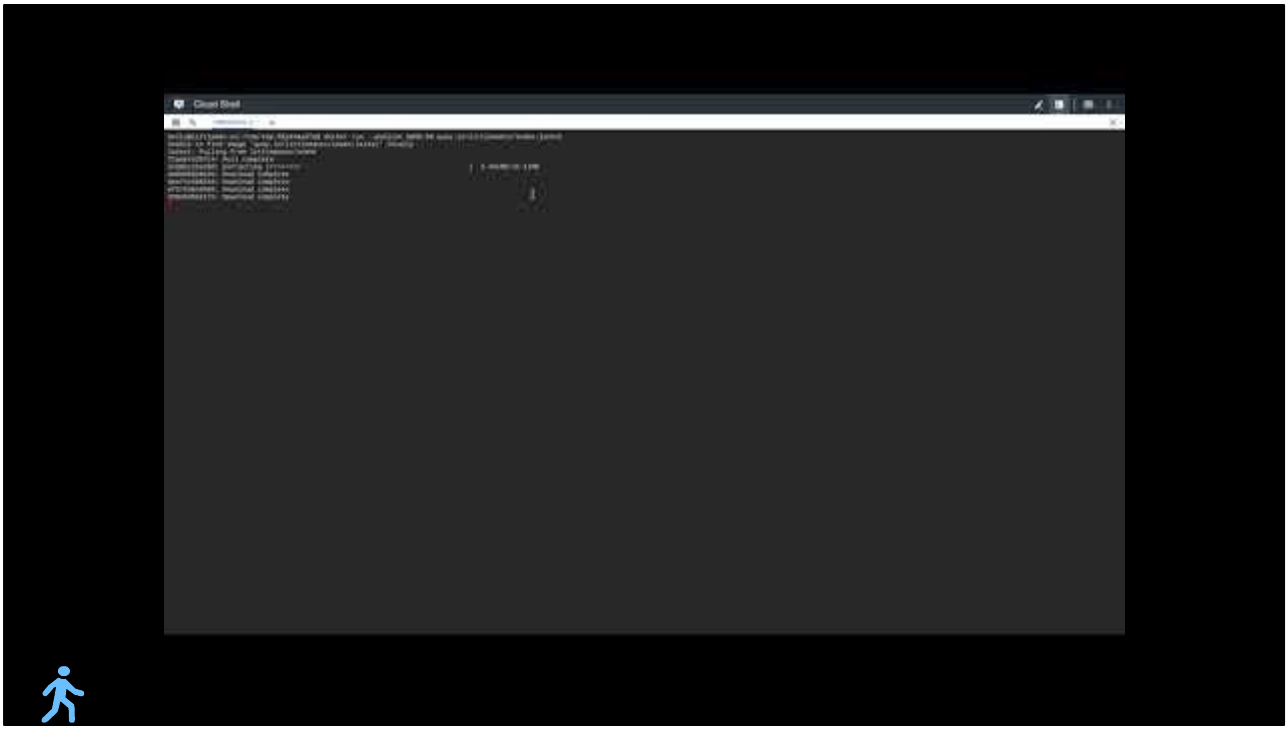
5 months ago
67 High · 143 fixable
167.9 MB
SHA256 68c688918f65


Cloud Shell

Deploy




Cloud Shell

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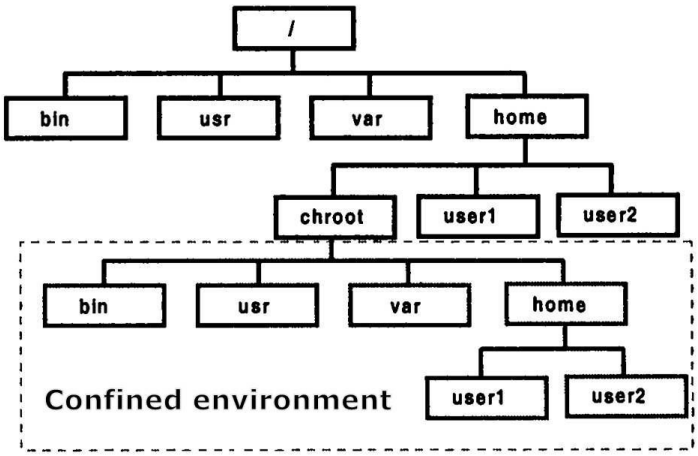
How does that work?!

mount namespace (~chroot)



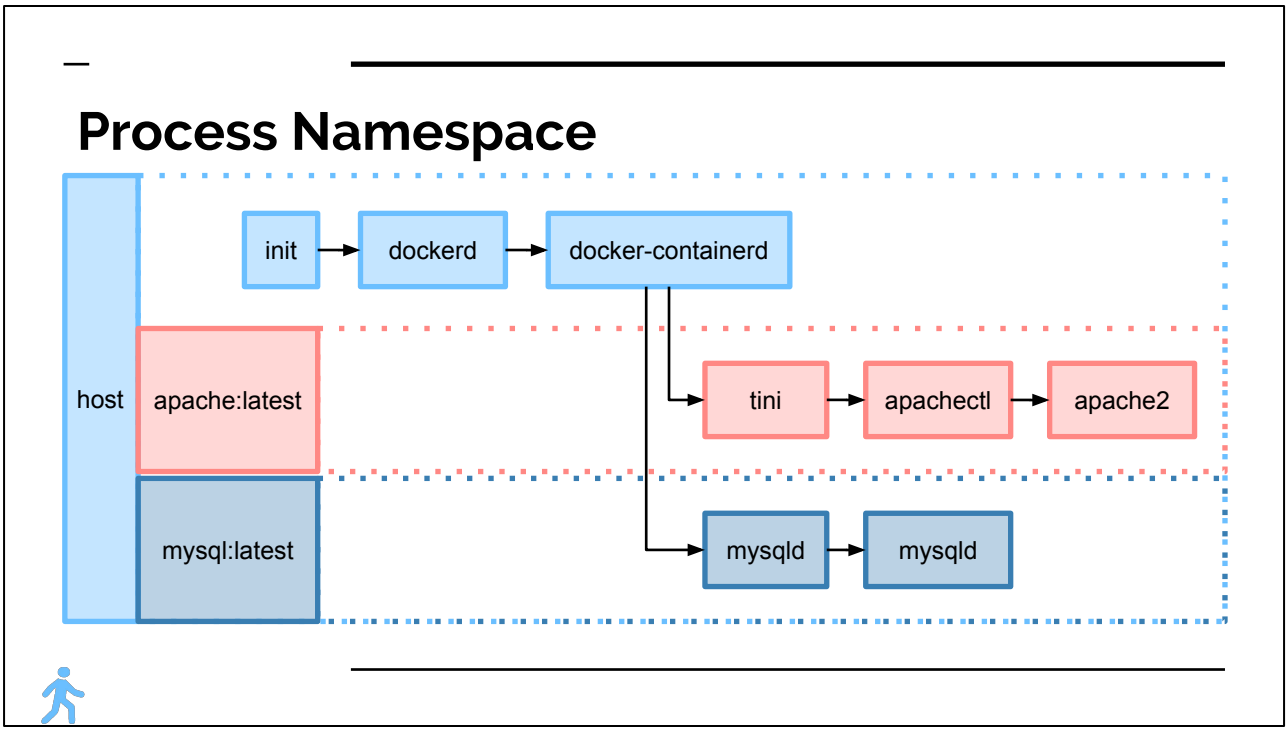
Speaker Notes

Explanation

- chroot → ch**ange** root
- It's a root file system within a file system
- Traditionally used for jailing in shared hosting, but also used in docker.

Further Reading

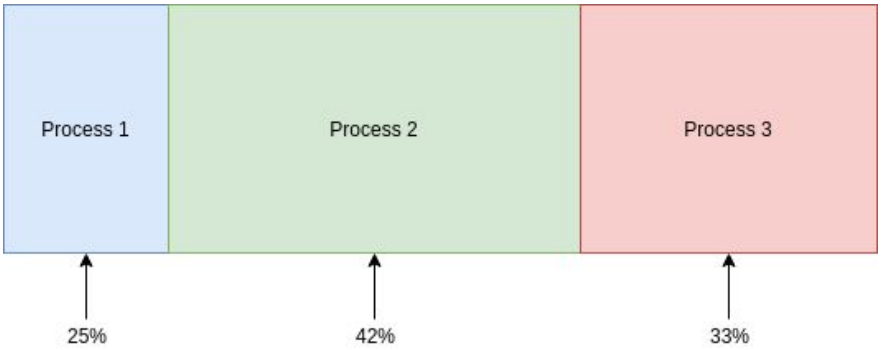
- https://en.wikipedia.org/wiki/Operating-system-level_virtualization
- http://queue.acm.org/detail.cfm?id=2898444
- http://crosbymichael.com/creating-containers-part-1.html



Speaker Notes

- All namespaces provide some level of isolation from the other namespaces
- The above namespace is a “process” namespace
- The host can see processes in containers. Containers can’t see process on the host, or in other containers.
- All namespaces work with a variation of this flavour.

Control Group



Speaker Notes

- This can be CPU, Memory or a bunch of other things

Design Notes

- I need to add notes here. Memory or whatever.

Further Reading

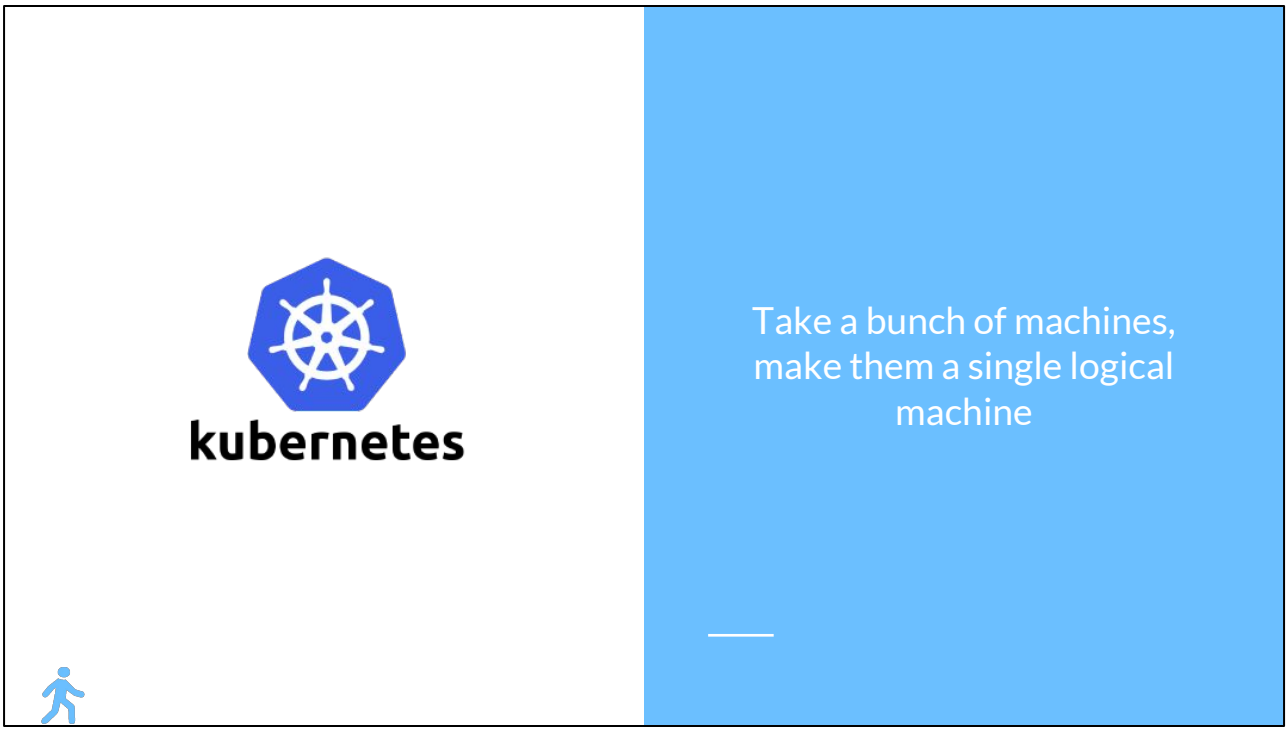
- https://en.wikipedia.org/wiki/Cgroups

Deploy to what?

Speaker Notes

- Containers require a runtime, the most common of which is Docker. However, once that is there you can run it wherever;
  - VM (EC2, Google Cloud, Rackspace, 1und1, Whatever)
  - AWS container service
  - Docker Swarm
  - App engine
- Once we have containers though, we can do some tremendously cool things with Automation
- All of those cool things have already been done with Kubernetes.

We don't have to use Kubernetes to use containers. But it's there, and it makes our lives fundamentally easier -- why not?



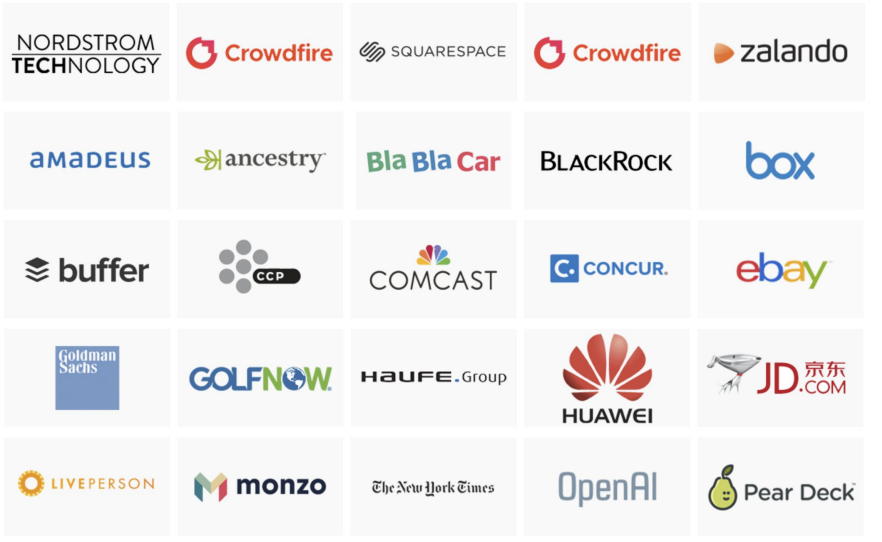
Speaker Notes

- It would be worth adopting containers to get Kubernetes
- It makes operations much, much simpler and more reliable

Further Reading

- https://kubernetes.io/docs/concepts/overview/what-is-kubernetes/
- https://www.linux.com/news/learn/chapter/Intro-to-Kubernetes/2017/3/what-kubernetes
- https://cloudplatform.googleblog.com/2016/09/bringing-Pokemon-GO-to-life-on-Google-Cloud.html
- https://kubernetes.io/case-studies/

Who Uses It?

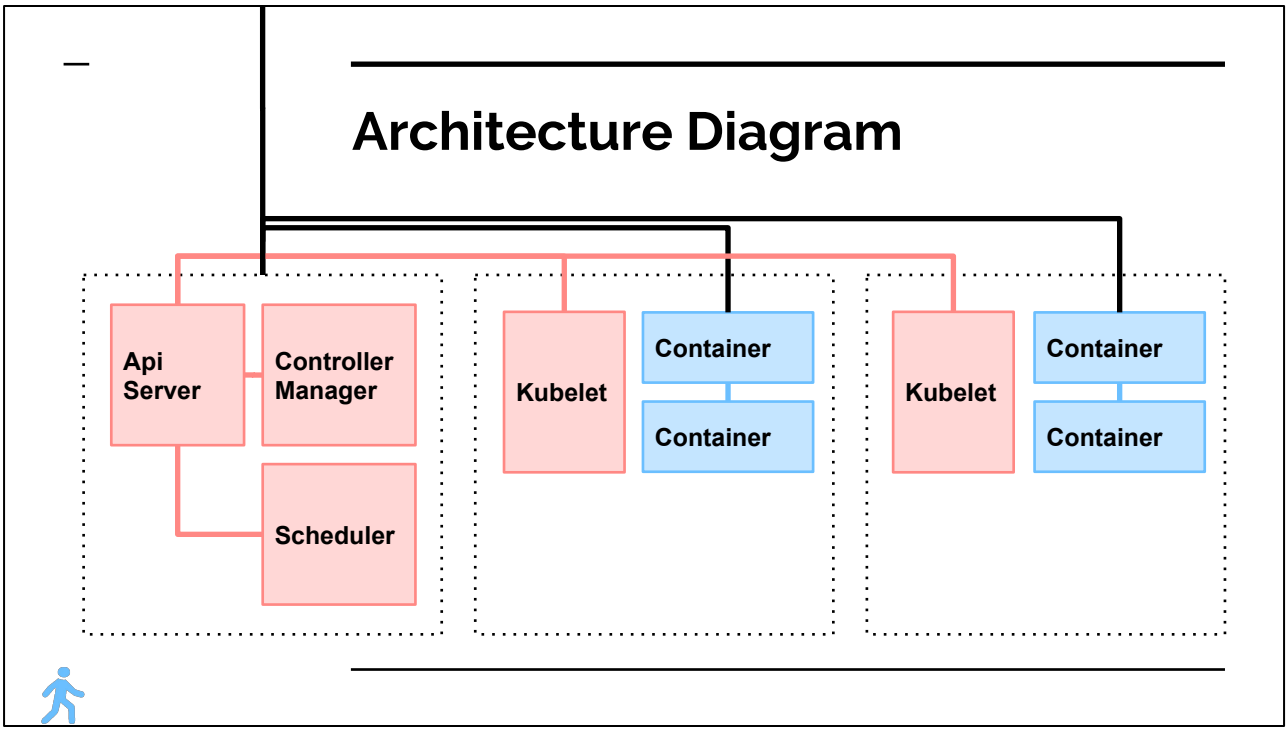


Speaker Notes

- Basically Everyone

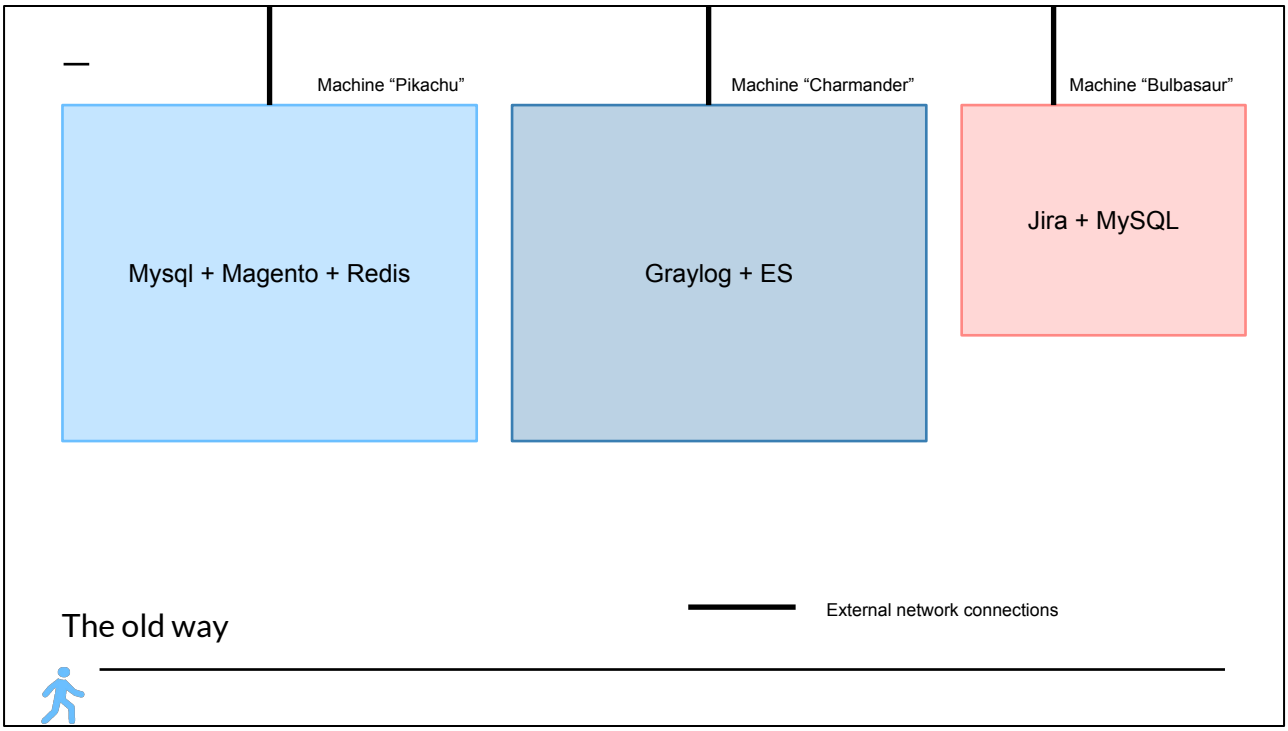
Further Reading

- https://kubernetes.io/case-studies/



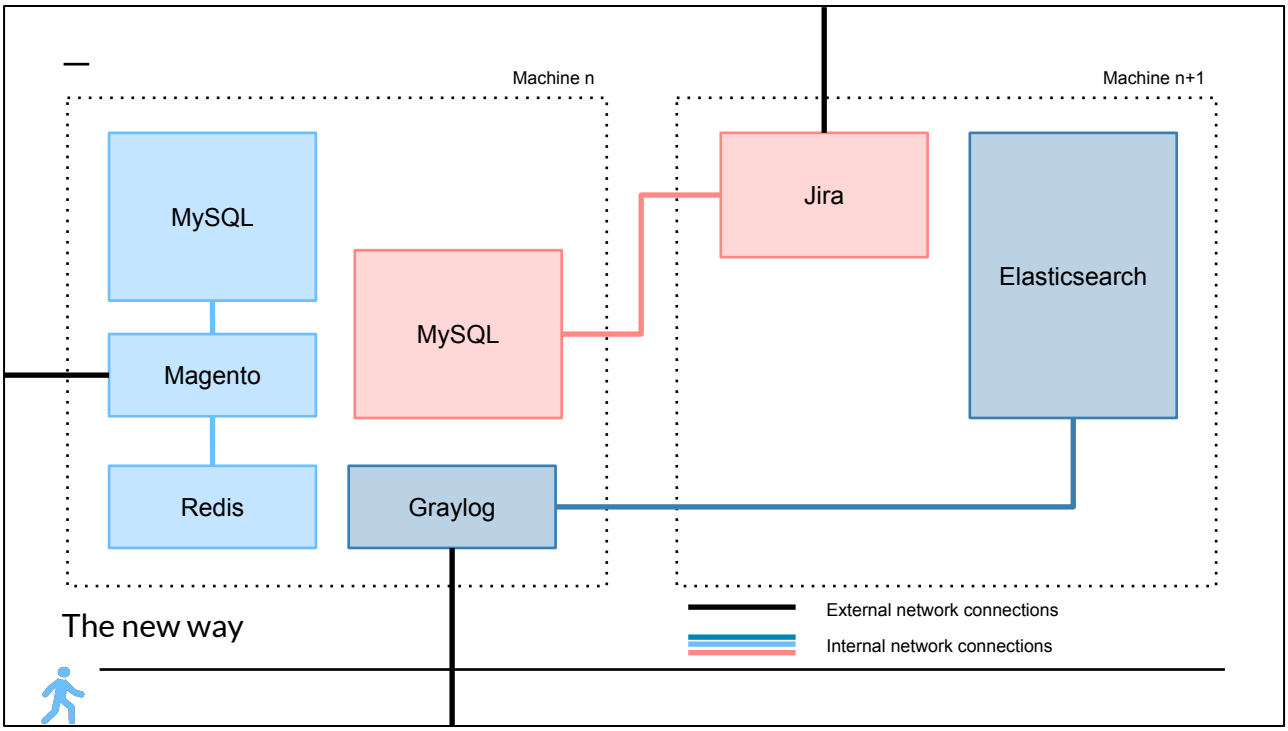
Speaker Notes

- The blue bits are containers, usually docker
- The pink bits are Kubernetes



Speaker Notes

- Basically we have no really good way of being accurate about how much resources each application requires
- We usually just bundle everything onto the one machine and give it enough power until it doesn’t break
- Efficient?



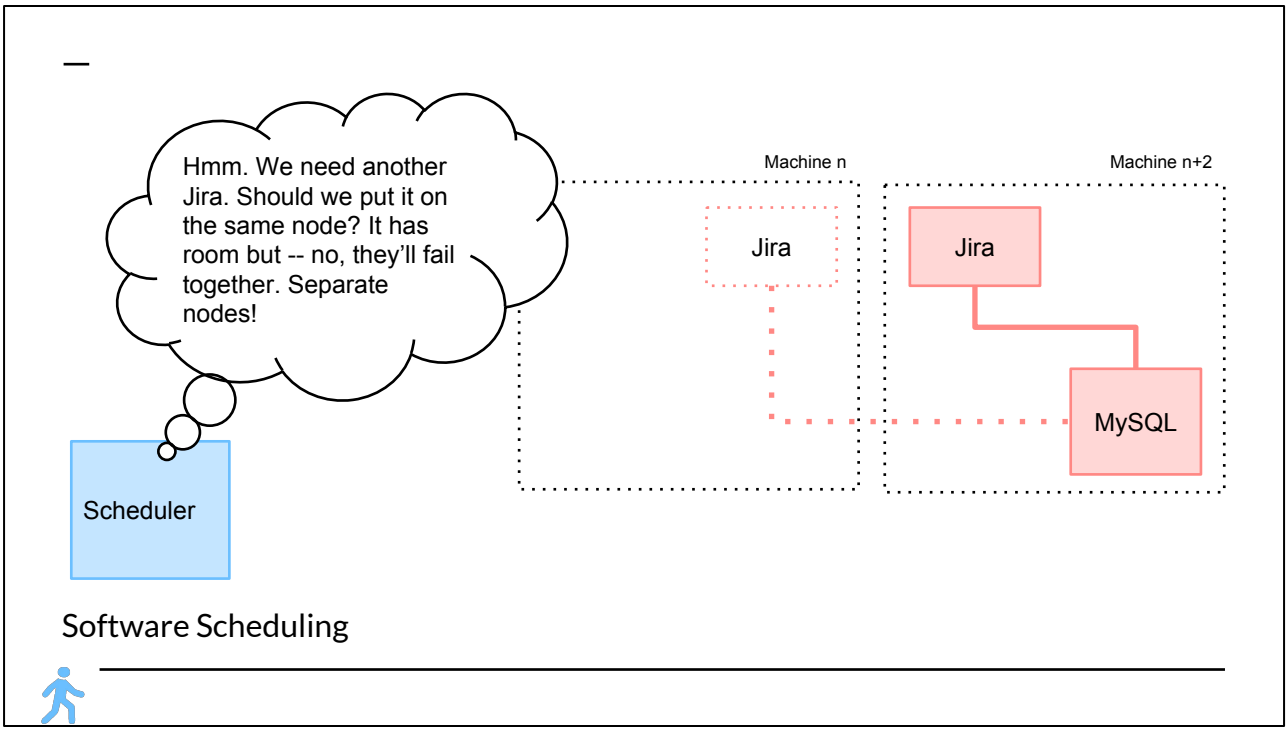
Speaker Notes

- Kubernetes decouples applications entirely from what host they run on. They run … somewhere, within an arbitrary set of nodes. Where doesn't matter.
- Each application "reserves" how much it will **usually** need (and we'll come back to why "usually" is important)
- We already get wins here from automation, but this automation is strictly possible with plain EC2 + AWS. It is, however, much harder.
- This also means we can pack staging environments in with prod ones. It doesn't matter -- the isolation is pretty good, and we can make more efficient use of compute this way
- It also means developers can be reasonably self service about what they provision.

Great! But what does this buy us?

Speaker Notes

- Lots of complexity there. What do we get for our complexity purchase?

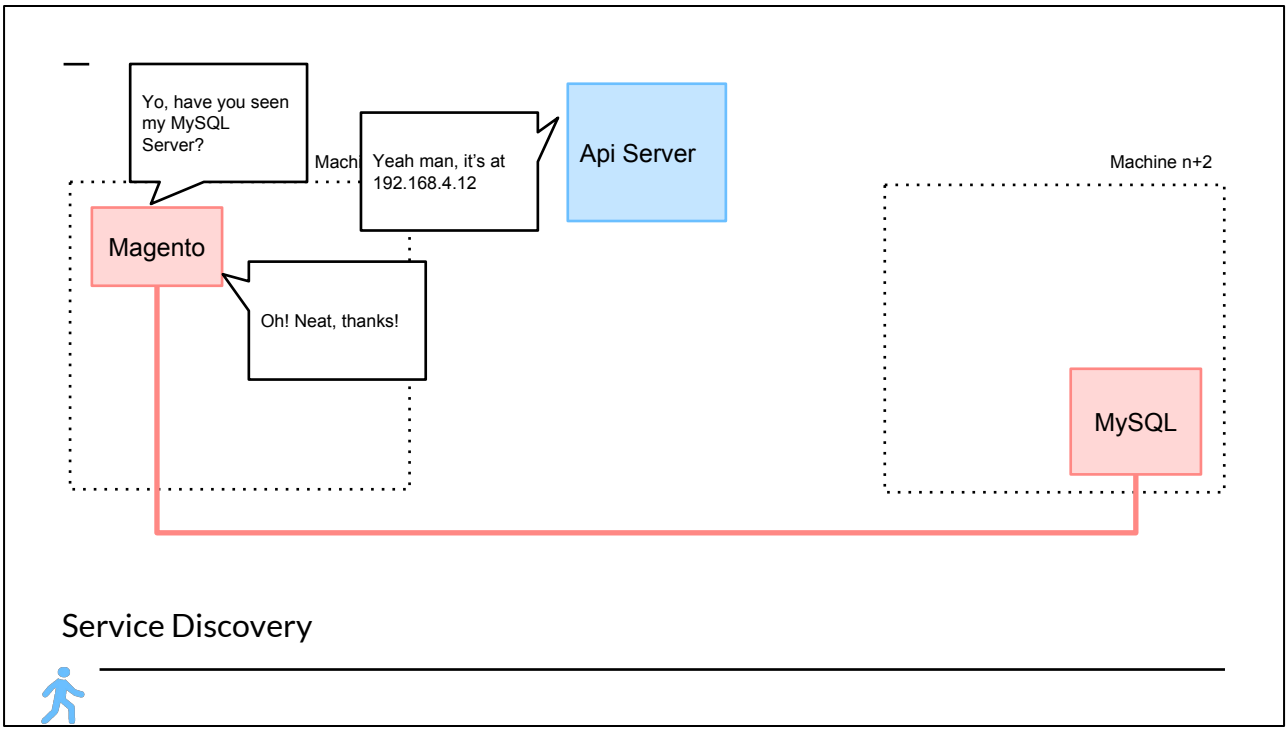


Speaker Notes

- We no longer decide exactly where to place our software
- But something does
- That thing is actually pretty good at making these decisions
- Among other things, it checks:
  - Whether there are disk conflicts on that machine
  - Whether there is enough CPU / Memory available on that machine
  - Whether ports are free on that machine
  - Whether the pod prefers a given machine
- It then ranks the machines based on a bunch of other criteria and picks the best
- If, for some reason, you're not happy with the default scheduler you can write your own

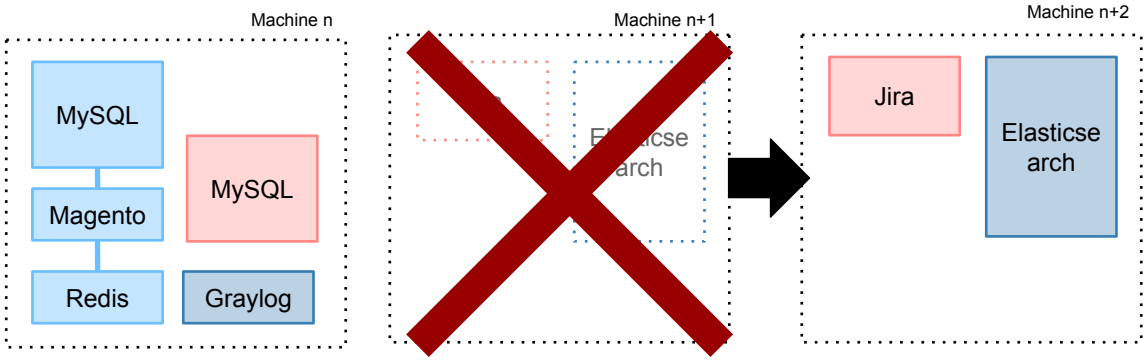
Further Reading

- https://jvns.ca/blog/2017/07/27/how-does-the-kubernetes-scheduler-work/



Speaker Notes

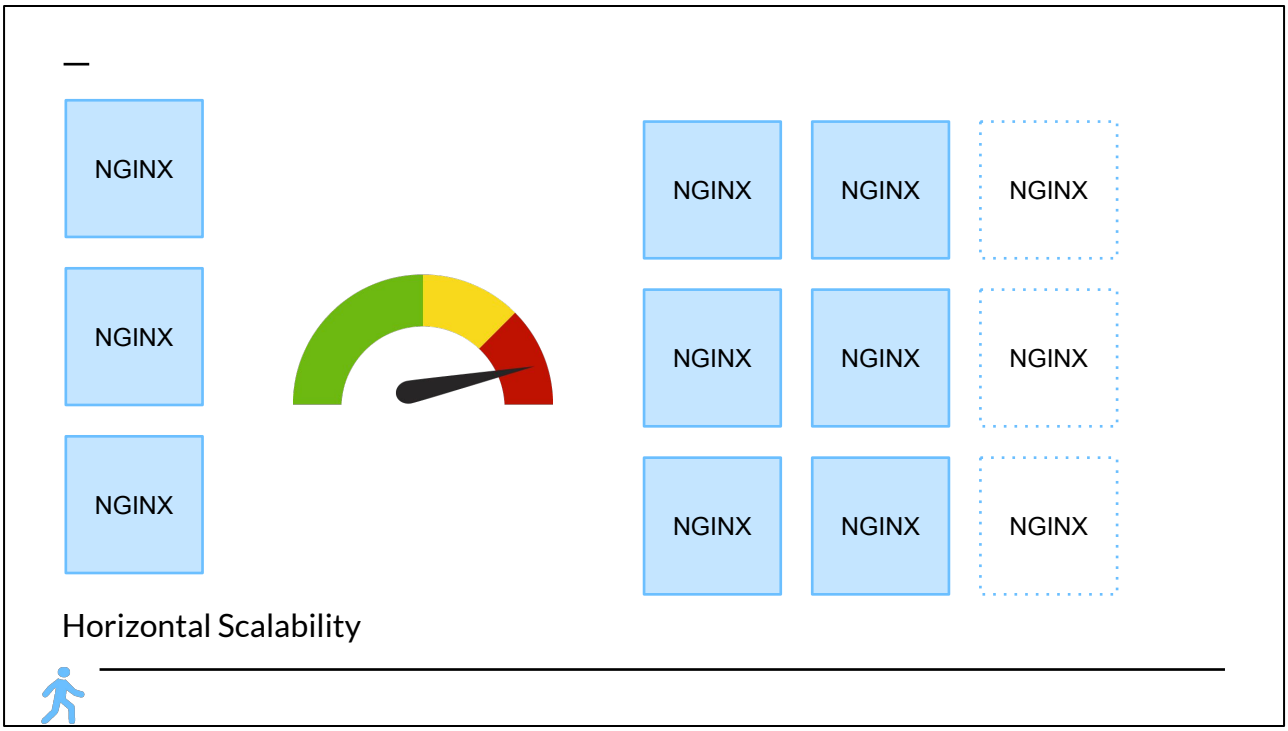
- Kubernetes allows us to create “services”; a kind of load balancer for pods
- Service discovery operates via several mechanisms, but the easiest is simply DNS.



Automated Failure Recovery

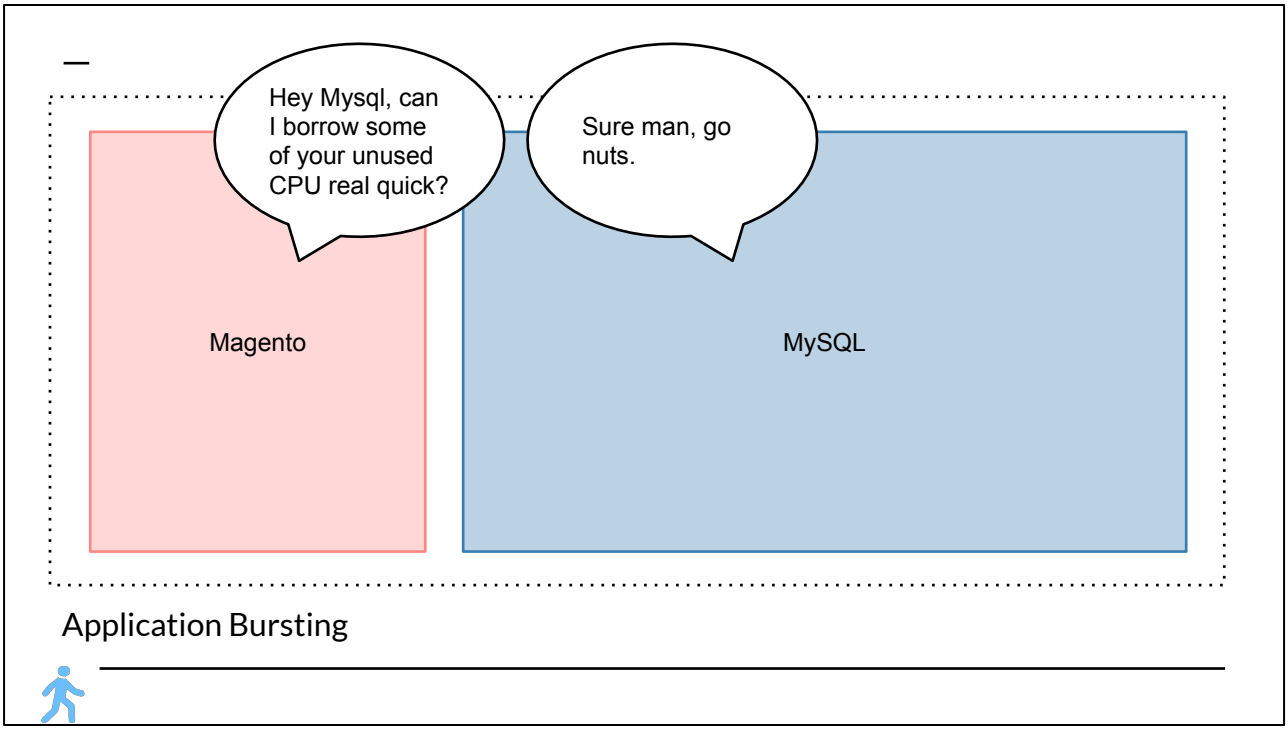
Speaker Notes

- Kubernetes works in a control loop (covered later)
- If something breaks, it'll try and fix it



Speaker Notes

- This applies to both stateless services *as well as* nodes
- Additionally, we can autoscale based on arbitrary metrics.

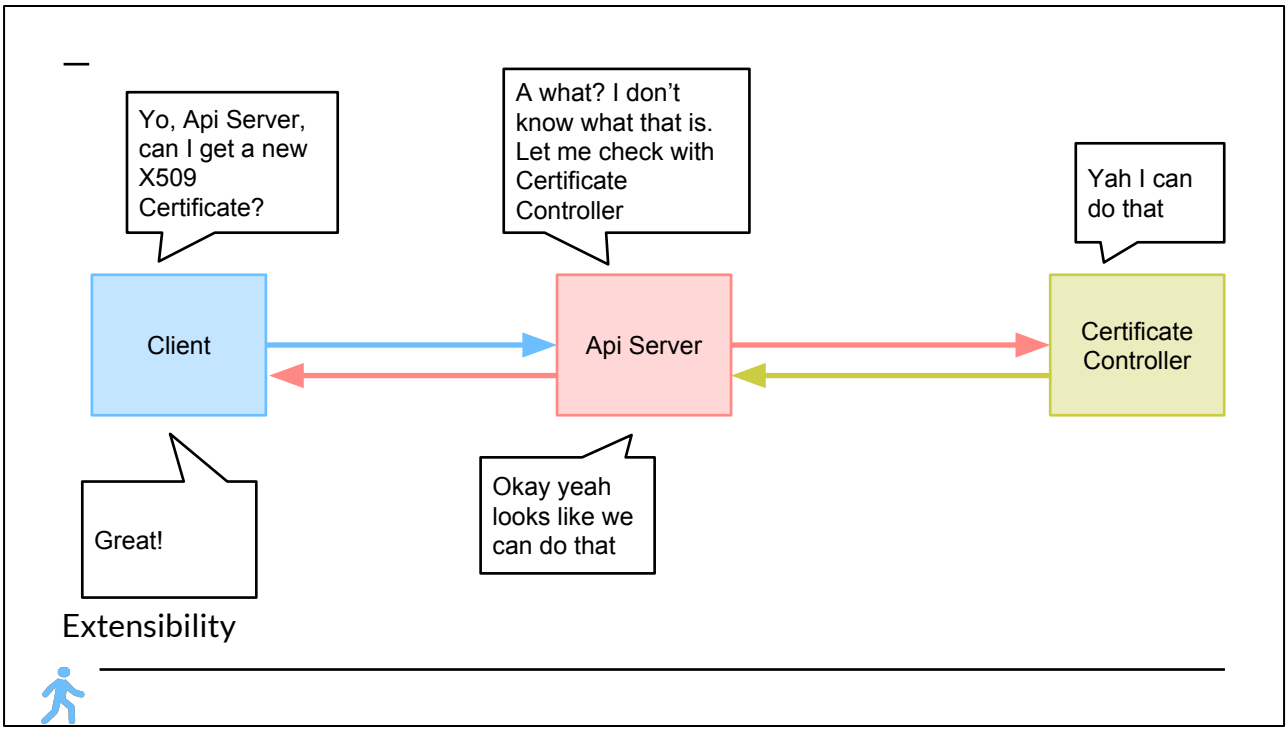


Speaker Notes

- Kubernetes allows applications to burst beyond their existing memory / CPU requirements if those requirements are otherwise unused.
- It will kill applications if memory get too dicey, much like the linux kernel does today.
- It prioritises certain applications according to a QoS policy

Further Reading

- https://www.ibm.com/developerworks/library/l-completely-fair-scheduler/
- https://kubernetes.io/docs/concepts/configuration/manage-compute-resources-container/



Speaker Notes

- We can also extend and modify the APIs behaviour, implementing our own feedback loops
- We can additionally extend the root APIs with our own “annotations” to modify their behaviour

Speaker Notes

- Kubernetes does a hilarious amount of stuff. It will take (literally) years to use it effectively.
- It's also highly extensible. It allows us to build out our own processes on top of it. For example, mark disks as "backup-able".

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Ahhm how does this happen?

—

Controller-manager

Looks at the what the cluster is now, and what it should be, and makes changes so that what it is becomes what it should be.

Scheduler

Decides which workloads should be run on which machine.

Kubelet

Runs and reports on workloads.

Apiserver

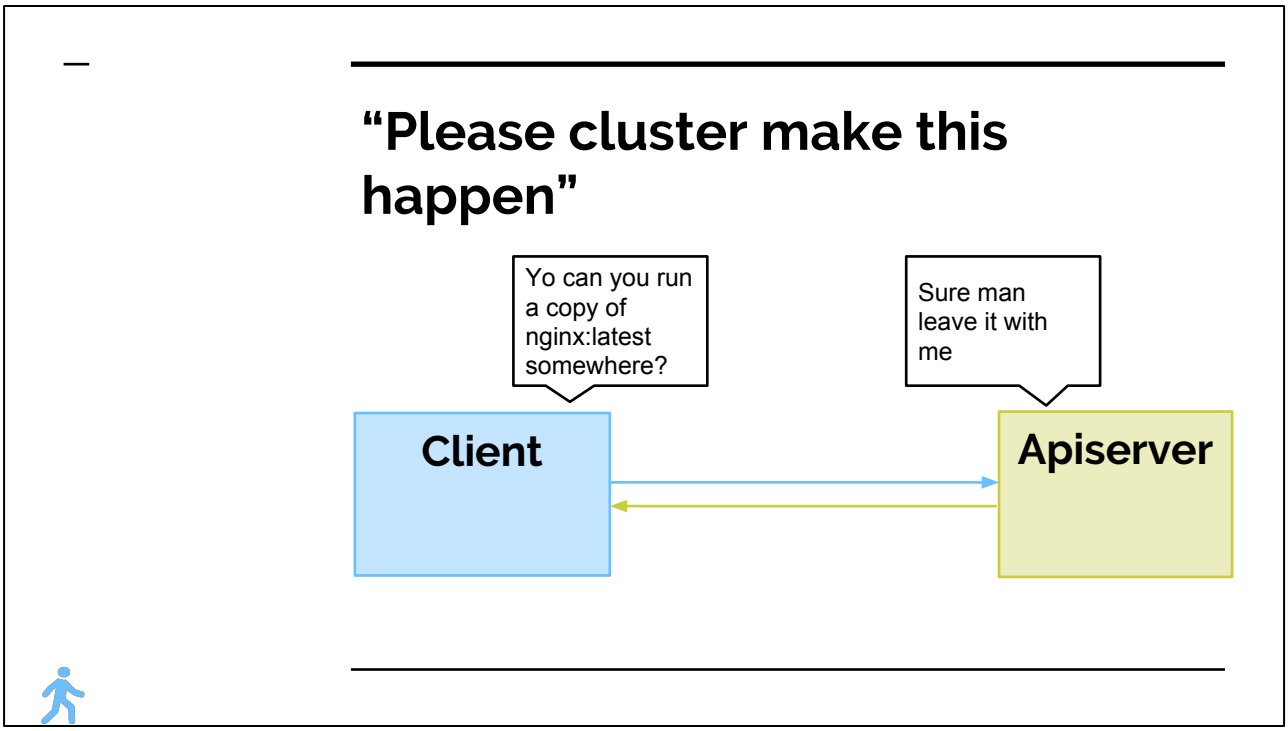
Handles communications between the various pieces

Speaker Notes

- Doing the previous stuff seems pretty magical. But it's backed by a reasonably simple architecture. (explain above)
- Everything is stateless. It's backed by an etcd cluster, which handles state. etcd is a highly available, multi-master key value store with a particularly excellent reputation for distributed consensus.
- There is also the master. It's pretty dumb -- it basically reads and writes to etcd, and it's what other stuff queries to find out the cluster state.

Further Reading

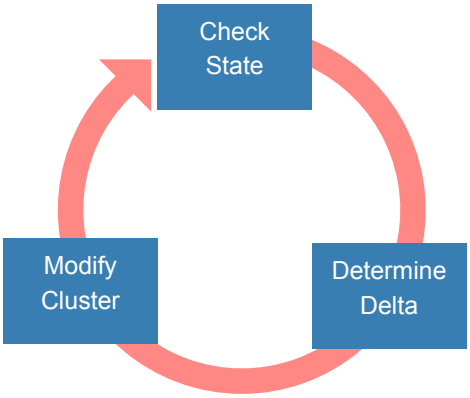
- https://kubernetes.io/docs/admin/



Speaker Notes

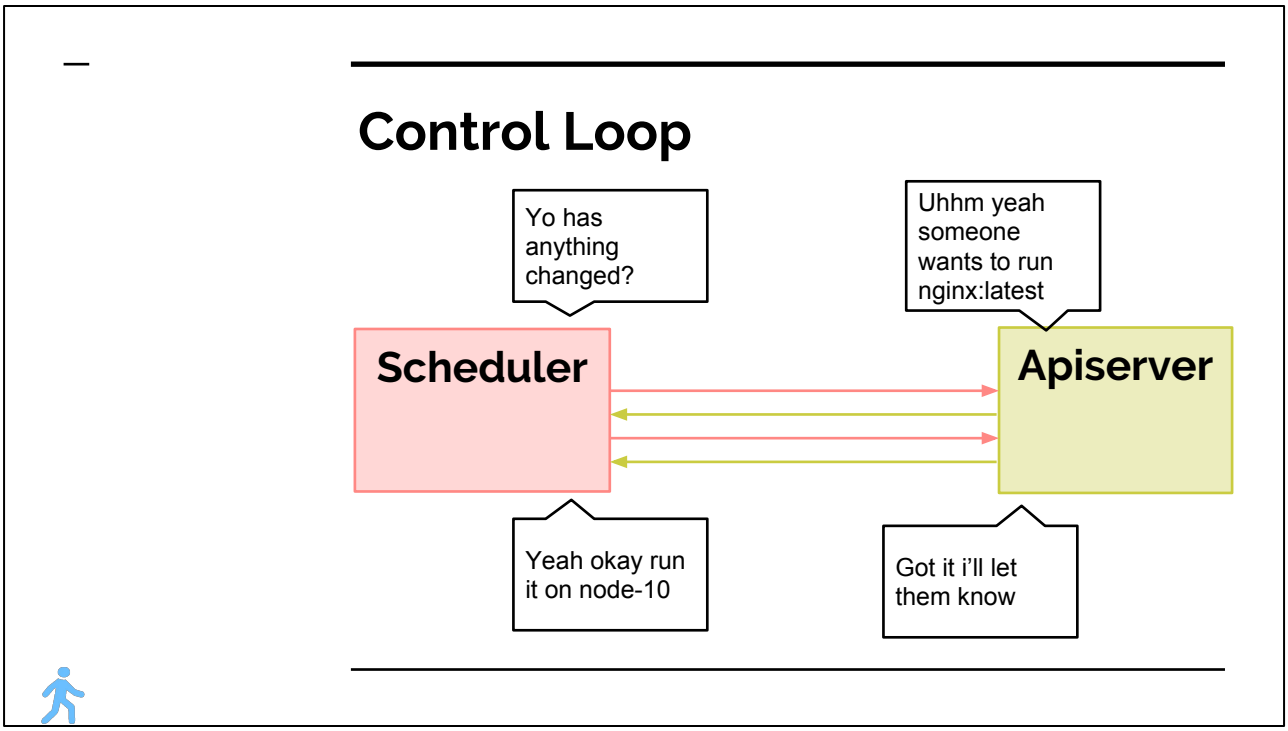
- Kubernetes is entirely declarative; you indicate to the cluster “this is what I think should be” and the cluster itself decides how to do make that happen
- This also means the cluster is self-healing; when something goes wrong (such as a machine does) Kubernetes will rearrange itself to be as close to spec as it can manage
- In our case, that probably means everything will just come good as we autoscale worker nodes.
- This lends itself **extremely** well to automation, such as CI/CD

Control Loop



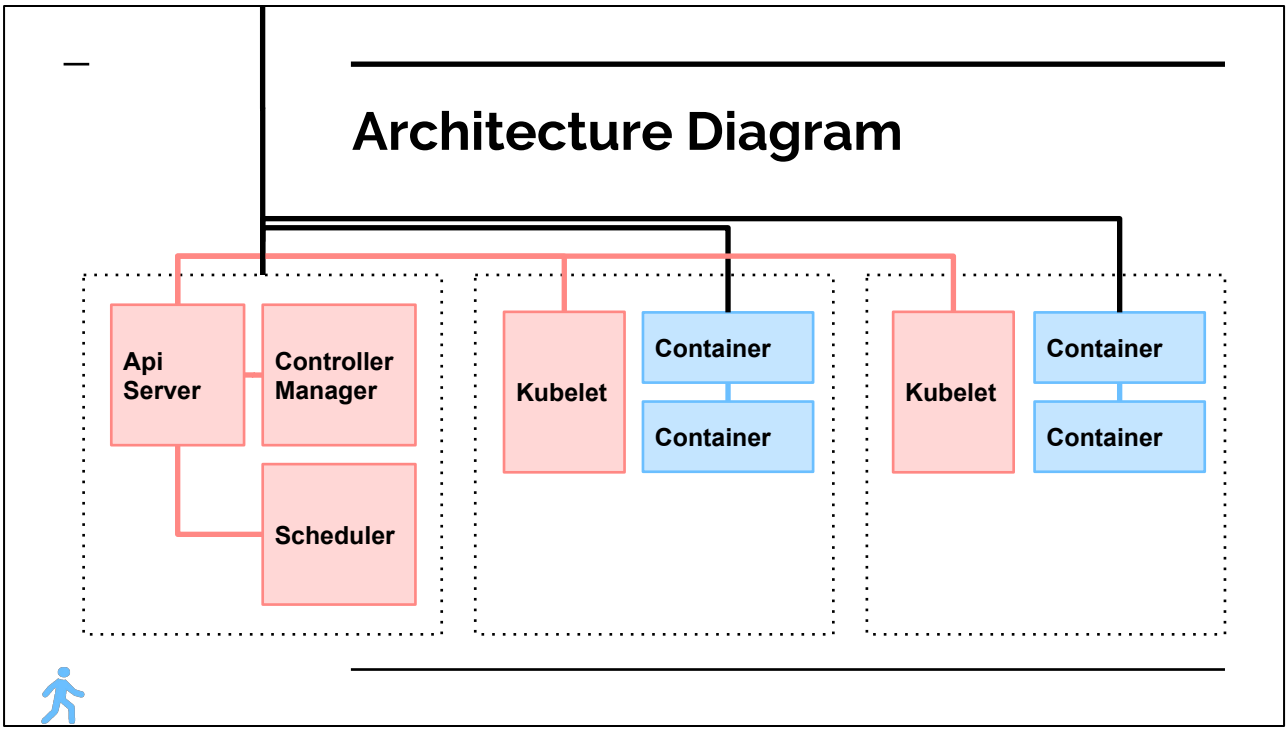
Speaker Notes

- A control loop is kind of like climate control.
  - House gets colder →heat comes on.
  - House gets hotter →cold comes on.
  - House perfect →check again in a few seconds.
- There are lots of control loops in Kubernetes, but they all tend to follow this pattern.



Speaker Notes

- Placing a container is a control loop



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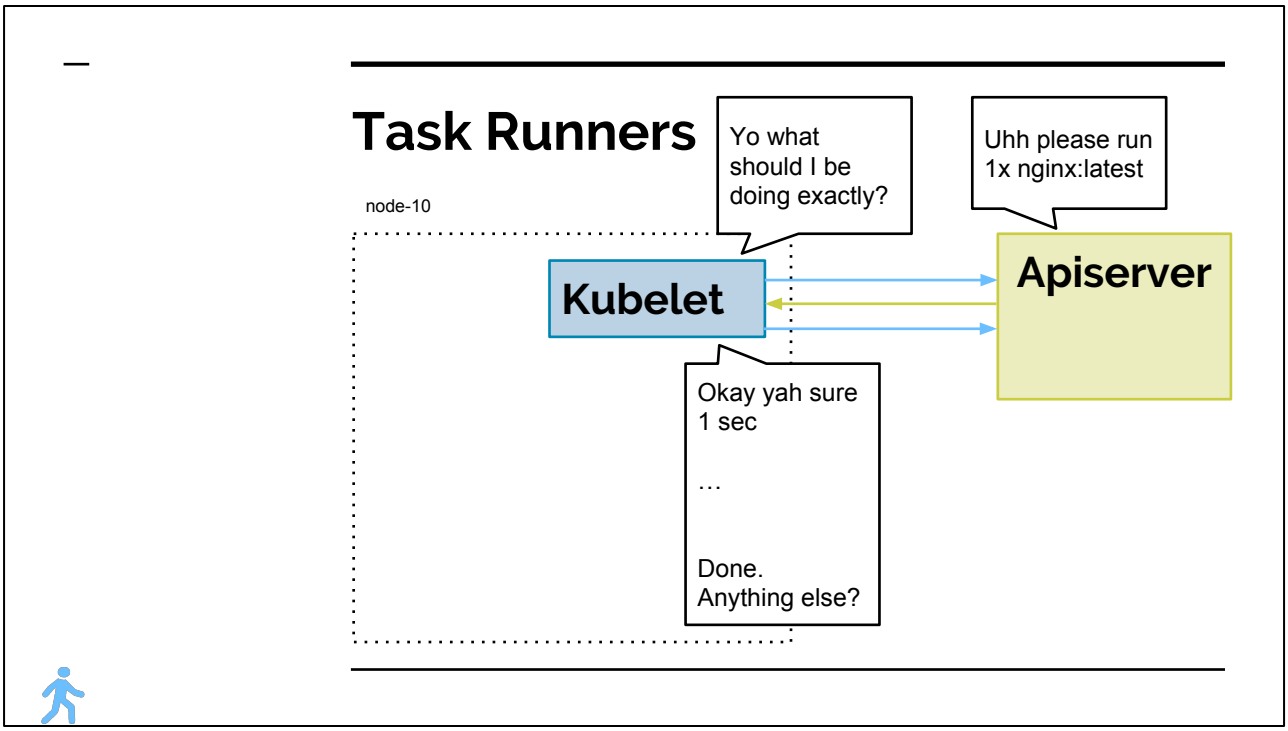
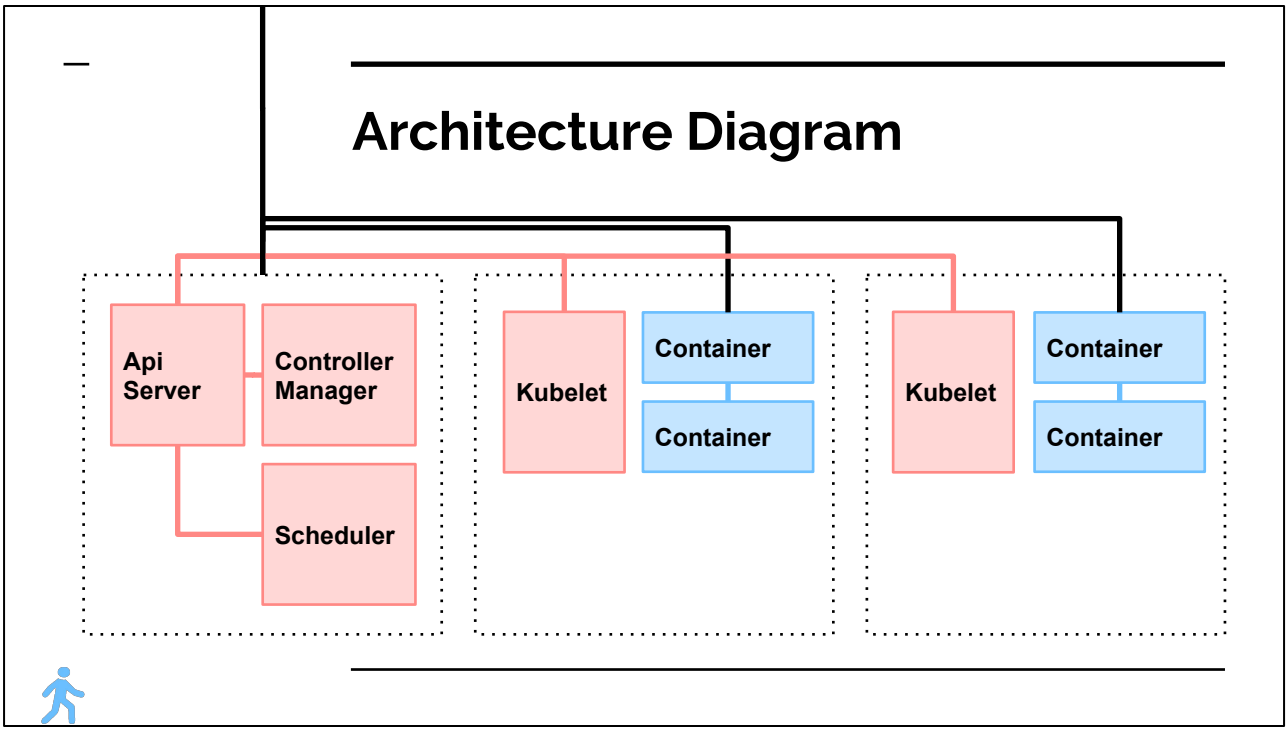


Speaker Notes

- The task runner is stupid. It just runs tasks. Hooray!
- Reads what it should do from the API
- Also here but not mentioned is the kube-proxy. It’s basically the same thing, but for network



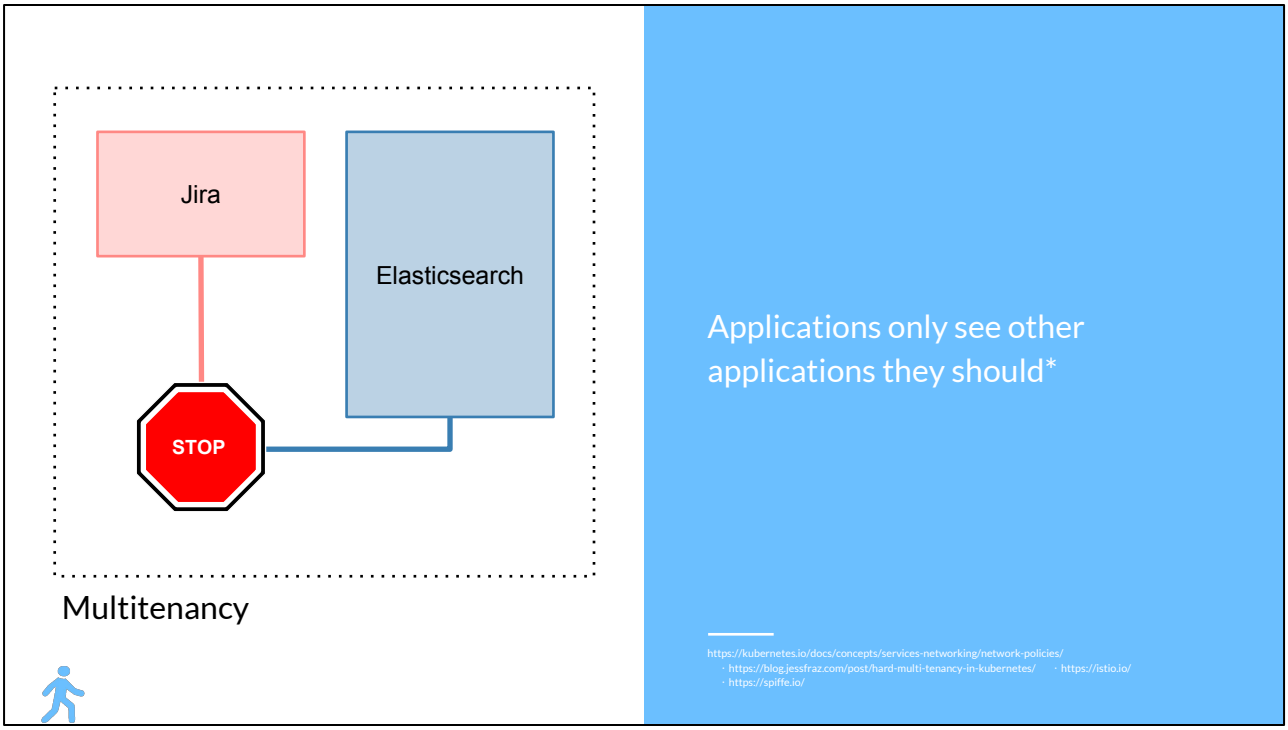
Speaker Notes

- Now we can see where each bit lives

Security Implications

-- SPEAKER NOTES --

- Yes, yes it was. However there are some ways to mitigate that complexity.



-- SPEAKER NOTES --

- The docker isolation is pretty good. But, networks gonna network
- Giant caveats:
  - Network policy needs to be correctly configured
  - There are still some loopholes where applications directly access the Kubernetse API
  - See the Istio project, and SPIFFE

Tools for the road to production

Helm

A tool for managing pre-configured Kubernetes resources.

Kind of like apt-get or yum for Kubernetes. It makes the complexity manageable.

https://github.com/kubernetes/helm · https://github.com/kubernetes/charts · https://kubeapps.com/

-- SPEAKER NOTES --

- Just like as currently exists in every major linux distribution, there are people who specialise in packaging software. They expose a limited number of knobs for the consumer to play with.
- For 99% of people in Sitewards, this is Kubernetes.
- There are already quite a number of deployable applications. Checkout the charts repo to see what's available.

GKE

Google Kubernetes Engine

Kubernetes as a service, on top of the already brilliant Google Cloud platform.

Speaker Notes

- GKE will give you $300.00 and a year to go play with Kubernetes; this is enough to run small workloads for most of that year. It's pretty cheap.
- Be patient. GKE is by far the easiest way of getting started, but it will still take some time to get used to.

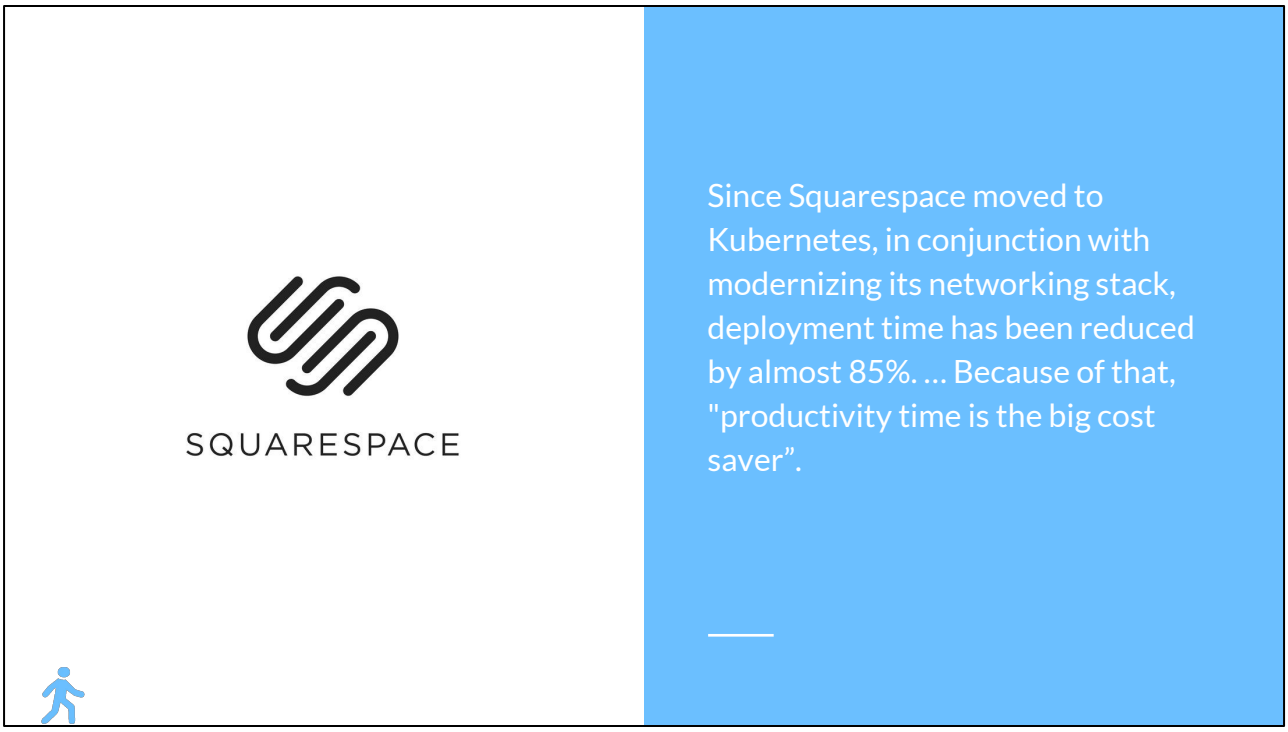
Further Reading

- https://cloud.google.com/kubernetes-engine/

Profit?

Speaker Notes

- Or, “how to sell this to managers”



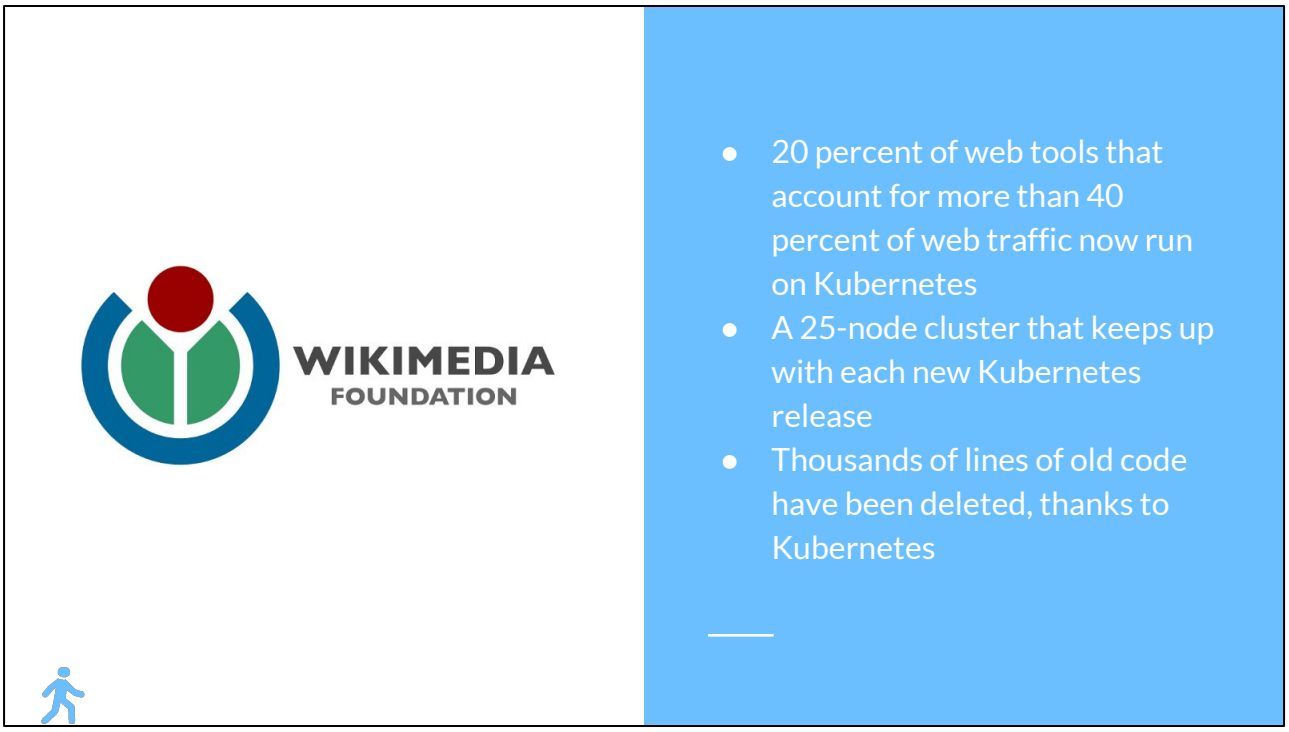
Further Reading

- https://kubernetes.io/case-studies/squarespace/

The impact has been considerable: With Kubernetes, the company has experienced a 90% cost savings on Elastic Load Balancer, which is now only used for their public, user-facing services. Their EC2 operating expenses have been decreased by as much as 50%.

Further Reading

- https://kubernetes.io/case-studies/crowdfire/



Further Reading

- https://kubernetes.io/case-studies/wikimedia/

In summary

- Containers are good
- Kubernetes is good
- They're pretty complex
- It's worth learning
- Get a Google Cloud account and start using Kubernetes engine

Needs moar info

Jess Frazelle

Keyser Söze of containers

Tim Hockin

Principal SW Engineer, Kubernetes

Kelsey Hightower

Minimalist

Carter Morgan

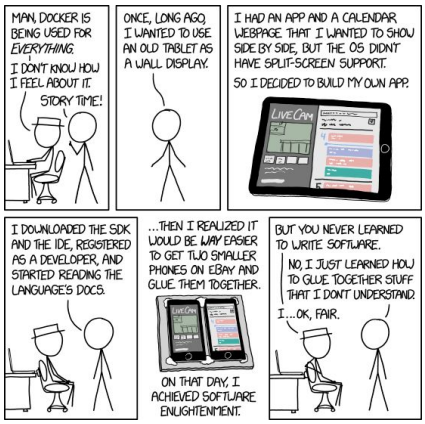
Developer Programs Engineer at Google

See slides for additional notes

Further Reading

- Pets versus Cattle: https://blog.engineyard.com/2014/pets-vs-cattle
- Udacity Course: https://www.udacity.com/course/scalable-microservices-with-kubernetes--ud615 (Free!)
- The Docker Book: https://www.dockerbook.com/
- Infrastructure as Code book: http://shop.oreilly.com/product/0636920039297.do
- Site Reliability Engineering book: https://landing.google.com/sre/book/index.html (Free!)

Questions?



https://xkcd.com/1988/

Everything is available at the following link:

https://github.com/andrewhowdencom/talk-using-docker-for-fun-and-profit

Find the rest of my contact information at

https://www.andrewhowden.com/

Speaker Notes

- Warn people that “<joke>Conference speakers are professional enthusiasts!</joke>”. We need a way to follow up as “the rubber hits the road”, or we start putting theory into practice
- Also ask for feedback on this talk.

Thanks

My dev colleagues · Kristoff Ringleff · Kelsey Hightower · Jessie Frazelle · Joe Beda · Many others

Design Notes

- Tell them what you're gonna tell them, then repeat a bunch
- Control groups -- did that well; there is an example. Can the other bits be supported with examples? Namespaces, chroot
- Recorded terminal -> thumbs_up. Probably needs to be bigger (font size), or shorter if possible.
- Persist the example through the rest of the Kubernetes talk. Maybe make it Magento only? Or vary it for specific talks.