Shaping Applications for Docker, CoreOS, Kubernetes and Co

thomas@endocode.com

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HI!

Thomas Fricke

thomas@endocode.com

CTO Endocode

- System Automation
- DevOps
- Cloud, Database and Software Architect

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- high-quality software solutions
- best software engineering practices: test driven
- well known open source projects: https://github.com/endocode
- diverse range of technologies
- decades of experience
  - software development,
  - team management
  - 100000s of server years in public and private clouds
- **Be it web, mobile, server or desktop we use: open source meet any challenge**

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F.E. A FEW DAYS AGO: FIXING A BUG

- Bug hunt in fleet
- Found the bug in a Go library:
  https://golang.org/pkg/crypto/
- Fixed!!!
  https://go-review.googlesource.com/#/c/20687/

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MORE BUGFIX EXAMPLES

- Application breaks
- **systemd problem**
- **NO! journald problem**
- analysis: application writes a log line
  longer than the kernel buffer used by journald
- **FIX: enlarge the kernel buffer**
- **Push fix to the upstream kernel**

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AGENDA

Containers or Virtualization

Kubernetes

CoreOS

Starting point

Migration

Case Study: immmr

Success, challenges, 'what is missing'

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CONTAINER OR VIRTUALIZATION

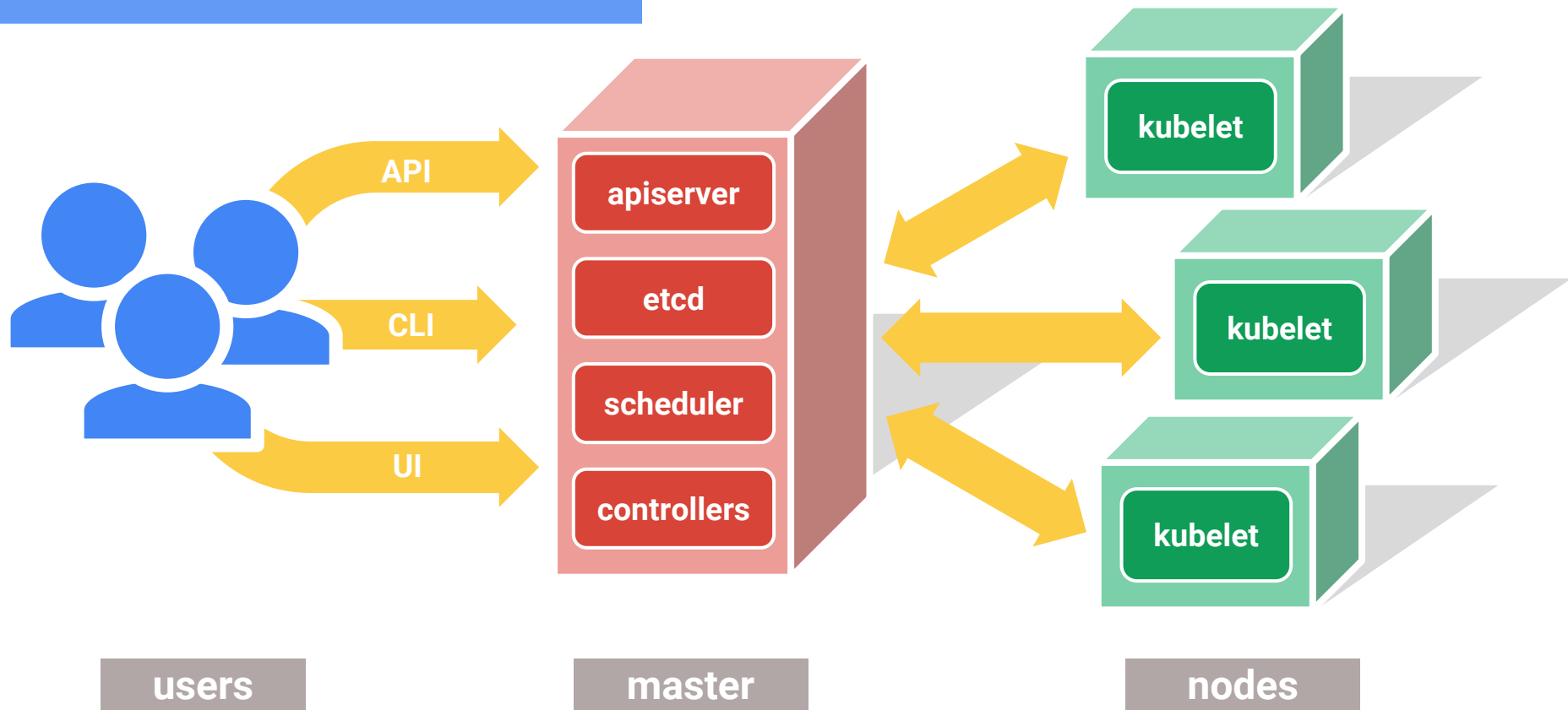| Topic	Container	Virtualisation	
Isolation	OS Level, OS namespaces	CPU Level: Ring 0/Ring 3	
foreign CPU	no	yes, with emulation	
foreign kernels, OS	no	yes	kernel is common
emulated devices	no	yes	security
host devices	direct	virtio driver	security
CPU performance	100%	95%	
IO performance	100%	<<100%	
root isolation	yes	yes	USER directive
CPU cache attacks	easy	possible	PoC ?

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Kubernetes

Greek for *"Helmsman"*; also the root of the words *"governor"* and *"cybernetic"*

- Runs and manages containers
- Inspired and informed by Google's experiences and internal systems
- Supports multiple cloud and bare-metal environments
- Supports multiple container runtimes
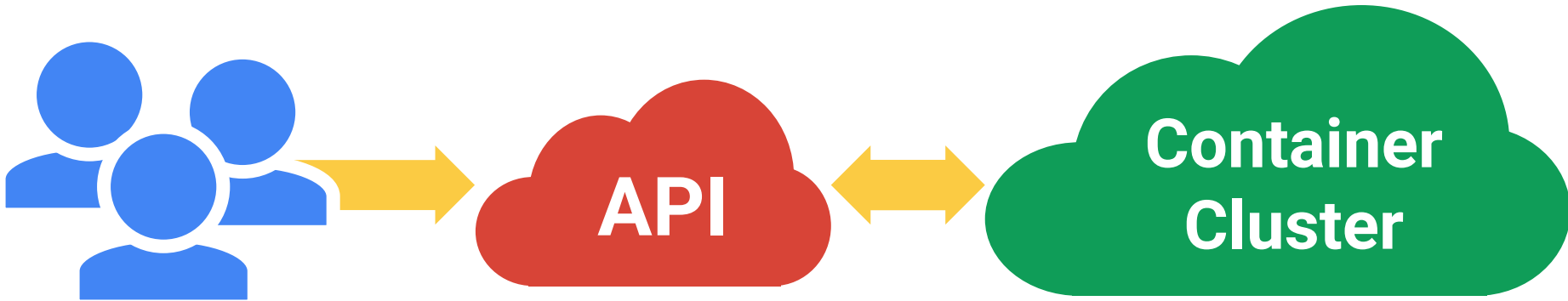- **100% Open source**, written in Go

Manage <u>applications</u>, not machines

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The 10000 foot view

API

CLI

UI

users

apiserver

etcd

scheduler

controllers

master

kubelet

kubelet

kubelet

nodes

Google Cloud Platform

All you really care about

API

Container Cluster

CoreOS

CoreOS trusted computing

|	
Cluster access	**Kubernetes**
Container Integrity	**rkt**
OS Integrity	**CoreOS Linux**
Hardware	**Firmware TPM**

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ECOSYSTEM

STARTING POINT - ARCHITECTURE

WE NEVER START FROM SCRATCH

- Almost no project starts from a green field
- Technical debt
- environments not made for microservices

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- strict layered architecture
  - separation of stateless
  - and persistent data
- inside the pods
  - developers are free to use what they want
  - contract is binding to the outside

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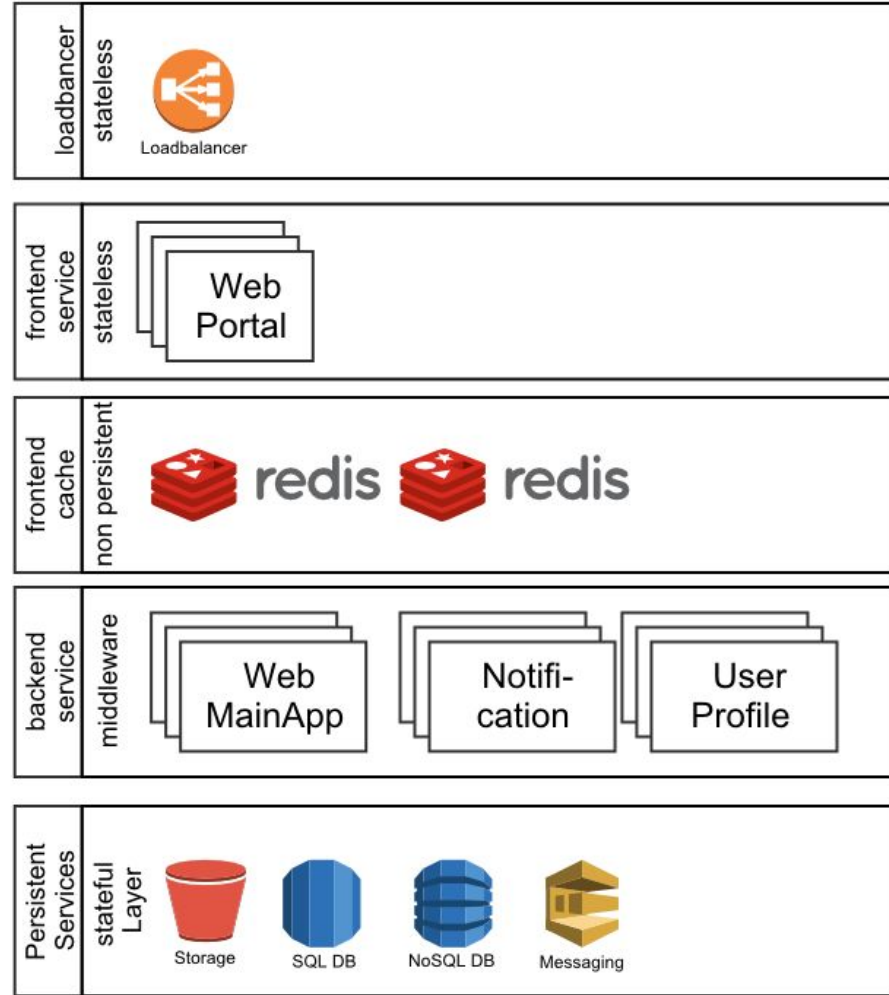
EXISTING HETEROGENEOUS ENVIRONMENT

- Programming languages and their runtimes
- Various databases from various generations
  - SQL
  - NoSQL
- Local and sessions storage
- Message queueing

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SEMI-AUTOMATED DEPLOYMENT

- Deployment chain automation
- Knowledge about staging and release processes typically implicit and critical

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VM CLUSTER BASED ARCHITECTURES

- Assumes complete OS
- Package management
- Configuration management (at runtime)

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MIGRATION

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FROM VMs TO PODS

OS instances ⟹ microservices in Pods

- pods are containers sharing the same fate
    - created together
    - running on same node
    - terminationg together
    - one network address
    - shared volumes

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FROM VMs TO PODS

VM cluster ⟹ Pods running on Kubernetes

- cattle: stateless containers
- pets: databases

configuration management ⟹ separation of build time and run time

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STEP 1: STATELESS AND STATEFUL SERVICES

- where to keep state? A trade-off
    - provider → lock-in
    - self-managed → overhead
- cattle, no pets
- mindset: ephemeral deployment units

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STEP 2: FRONT END AND BUSINESS LOGIC

- Migrate frontend to a stateless, load-balanced Kubernetes service
- Make everything explicit
    - Firewall and load-balancer
    - front-ends
        - web
        - mobile
        - native
        - embedded
        - IoT
        - TV
    - caching
    - cusiness logic
    - persistence

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STEP 3: STANDARDISED DEPLOYMENT PIPELINE

- dev/test/prod, more stages possible (QA, …)
    - Services, labels
- parametrization
    - etcd
    - environment variables
    - secrets in kubernetes
- logging (rsyslog, ELK, splunk)
    - not every utility needs to be container specific
- measurements
    - f.e. prometheus metrics (easy to integrate in apps and services)

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STEP 3: FRONT END AND BUSINESS LOGIC

- Avoid privileged 'special' applications
    - application server
    - LAMP stack
- separating concerns
    - web Interface
    - application service
    - scalable through parallelism

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ARCHITECTURE WRAP UP

- Desired Architecture
- Cleanups
- Ready to Rock

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CASE STUDY

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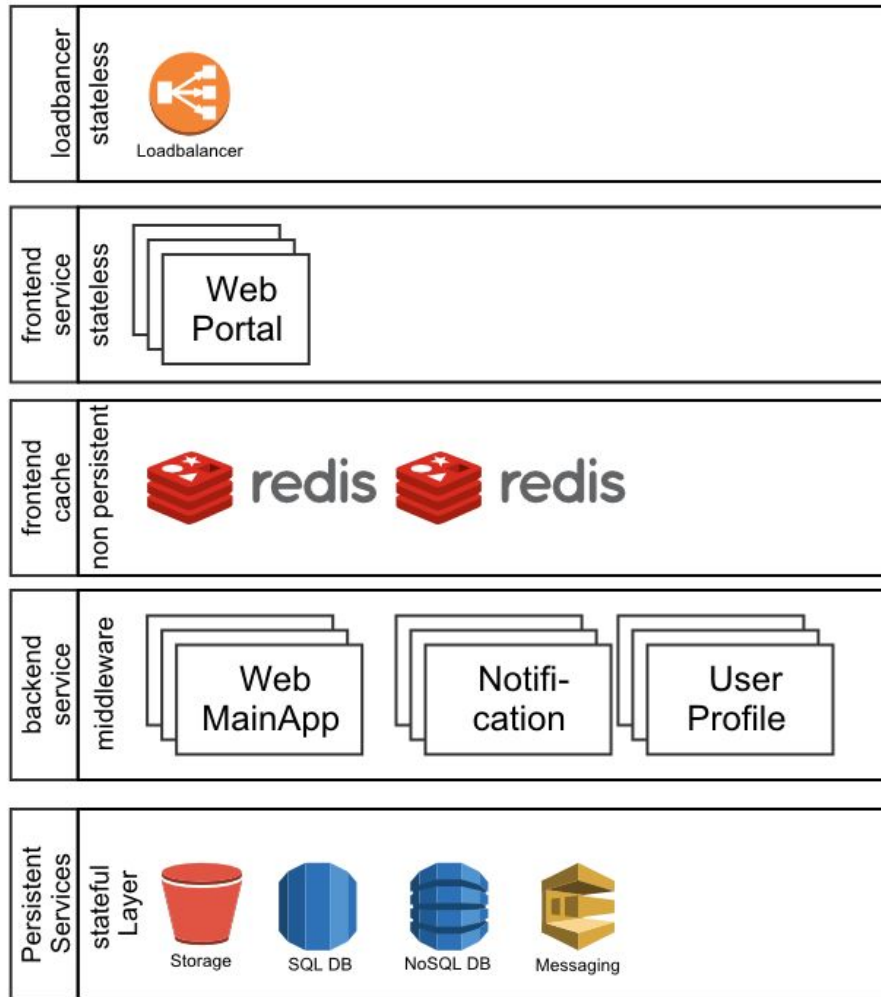
immmr - one number for every need

immmr combines the best of Internet base communication with the advantages of mobile communication

immmr makes it possible to use a single mobile number from any device

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immmr - one number for every need

Coming later in 2016:

Launch as an independent, open communications service for voice, messaging and video telephony in the second half of 2016.

The service developed by immmr GmbH, a subsidiary of Deutsche Telekom in Berlin, is currently being tested in selected European countries.

http://www.immmr.com/

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FROM THE TRENCHES

- Easy:
    - Java with SpringBoot
    - Python
- Hard:
    - Ruby Gems
        - Separation
            - **build**
            - **deployment**
    - no compiler in production
    - change to a static Ruby binary **traveling ruby**
    - adapt to database supported by your cloud provider
    - ruby hersion hell: rvh^hm

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FROM THE TRENCHES

- Lessons learned preparing for a **security audit:**
- this needed to be done anyway
- separation of stateless and persistent services is
  a good idea anyway and with containers really important
  - Dockerfiles need careful design to be fast
  - private registry for images recommended (same region)
  - quay.io
    - container life cycle monitoring
    - CVE database

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RESULTS AND EXPERIENCES

- Scalable, kubified application
    - Service architecture as it always should have been :-)
- Reduced technical debt and implicit knowledge
- Standardised processes and APIs for services management
    - Previously, practises varied between projects
- Pod as deployment unit, single process per container
    - Pods are containers sharint the same fate
- Service as load-balanced entry point
    - external service
    - no LB cluster hassle
- smaller deployments

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BUSINESS VALUE

- faster deployments:
    - faster time to market
    - more and faster testing
    - more teams possible
        - faster deployment
        - better quality
- less maintenance in operations
    - less load
    - simpler deployments

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RESULTS AND EXPERIENCES

Separation of build-time and run-time

- PODs should require only minimal parametrization for being deployed
    - Secrets
    - Environment variables
- Ongoing debate on role of configuration management, our assumption:
    - Configuration management is a build-time issue
    - It should not be deployed with the container

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CONTAINER LIFECYCLE MANAGEMENT

Part 1: Build-time related

- Audits, scanning of container content in the registry
- Management of ephemeral configuration
  (as in regular scheduled updates of keys, …)
  - Stop-gap: rebuild container often, deploy new versions
- Leaner containers
  - immutable containers on immutable CoreOS
  - incredibly shrinking deployments

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CONTAINER LIFECYCLE MANAGEMENT

Part 2: Runtime related
- Monitoring of pods, containers and apps/processes
- Lifecycle management
- Cleanup of nodes (minions) after POD end-of-live
  - Issue with multi-tenant readiness
  - Clean-up, ... - issue of isolation beyond individual process (in container)

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BEST PRACTISES & SIDE EFFECTS

Best practice for deployment pipelines/continuous delivery

- The last thing that is still mostly hand-made for each project
- Often violates 'infrastructure is code' paradigm

Side effects of rolling updates

- Database migrations
- Difficult to roll back, structural changes stay behind or require global lock
- Solutions are being developed (e.g. crate.io)

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CONTAINERIZING APPLICATIONS

- Baggage:
    - runtimes of existing program environments (Java, Rails, ...)
    - package management: gems, eggs, npm, external jars
      this is not specific to containers
- Trade-off between maintenance and migrating to container-focused languages like Go

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DOES IT SCALE IN REAL LIFE?

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YES

- scaling by country
- or single-tenant and multi-tenant use cases
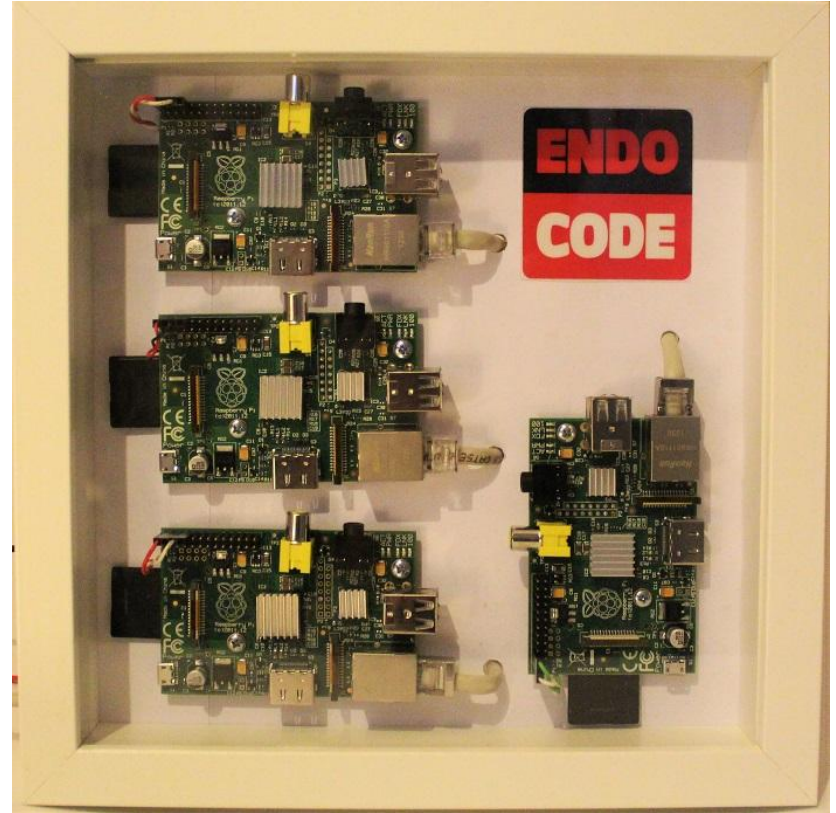- surprisingly, quite often VMs provide underlying isolation

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YOUR PRIVATE KUBERNETES DATACENTER

You need providers for:

- Storage
- Network
- Firewalls

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- https://endocode.com/trainings-overview/
- Visit us on GitHub
  https://github.com/endocode

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Dive into Kubernetes!

Watch our Webinar 'Dive into Kubernetes' on our YouTube Channel

https://youtu.be/8694GGJlpZ8

Register for a free Google Cloud Platform Trial with $300 Google Cloud Platform Credits

https://goo.gl/dUzDWi

Use another $200 partner credits

https://goo.gl/eYldnT

QUESTIONS?