Launching Applications with Docker, CoreOS, Kubernetes and Co

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HI!

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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**

AGENDA

Containers or Virtualization

Kubernetes

CoreOS

Starting point

Migration

Case Study: immmr

Success, challenges, ‘what is missing’

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http://www.commitstrip.com/en/2016/06/24/how-to-host-a-coder-dinner-party/

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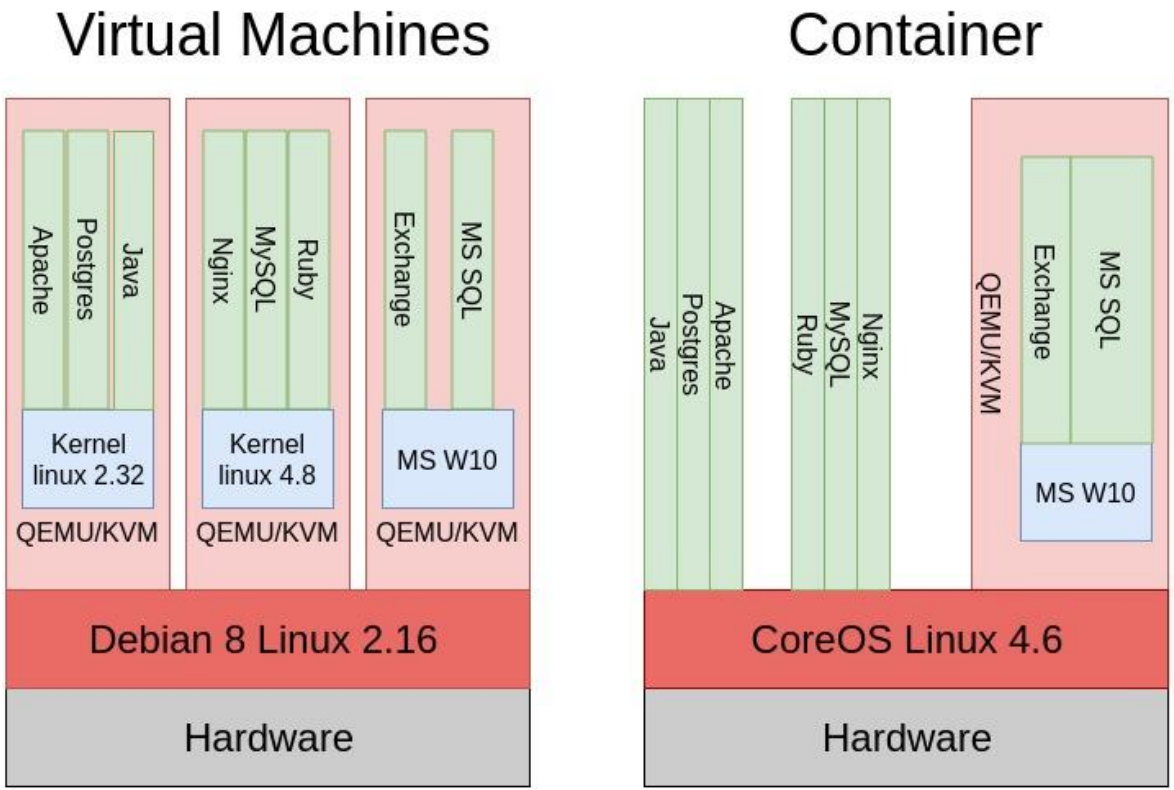
CONTAINER OR VIRTUALIZATION

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 ?

LAYOUT



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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 applications, not machines

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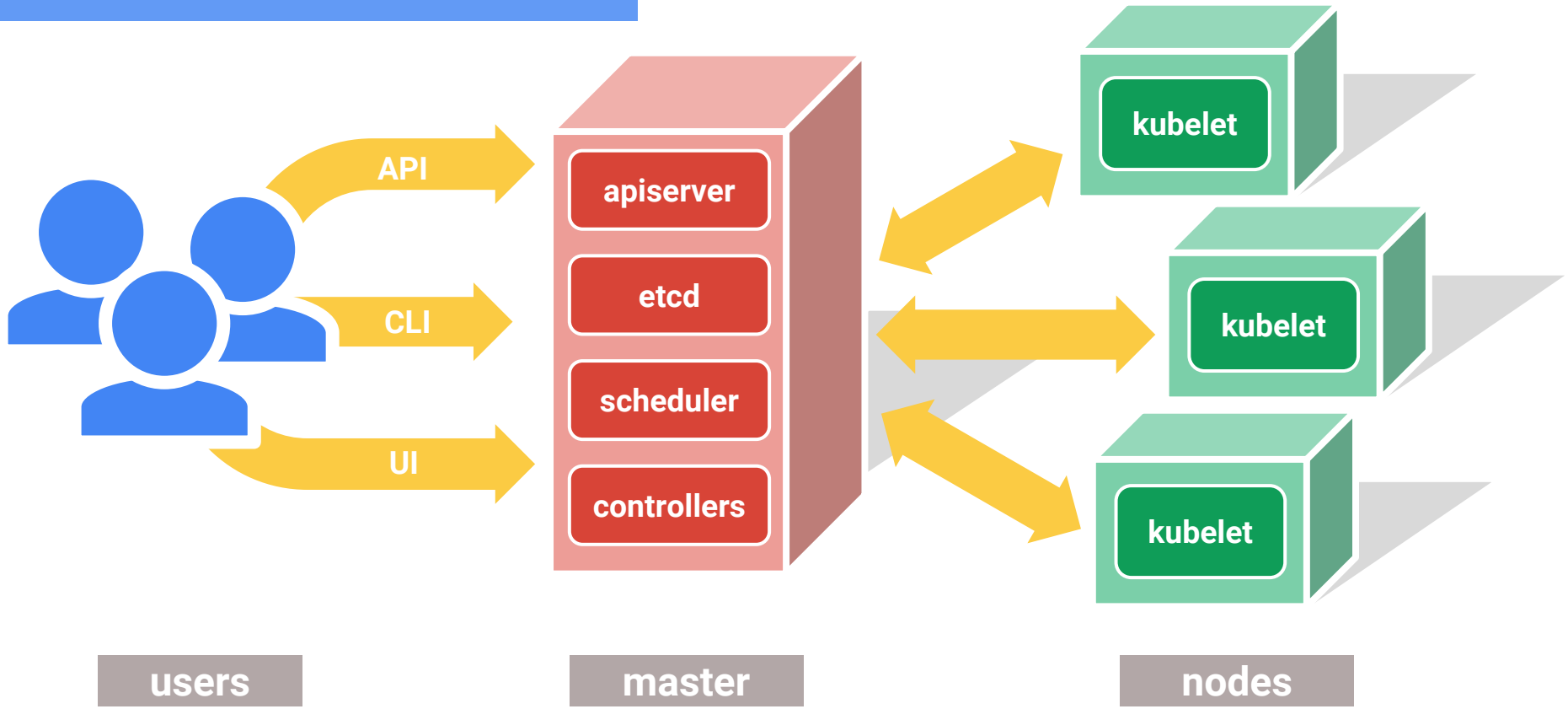
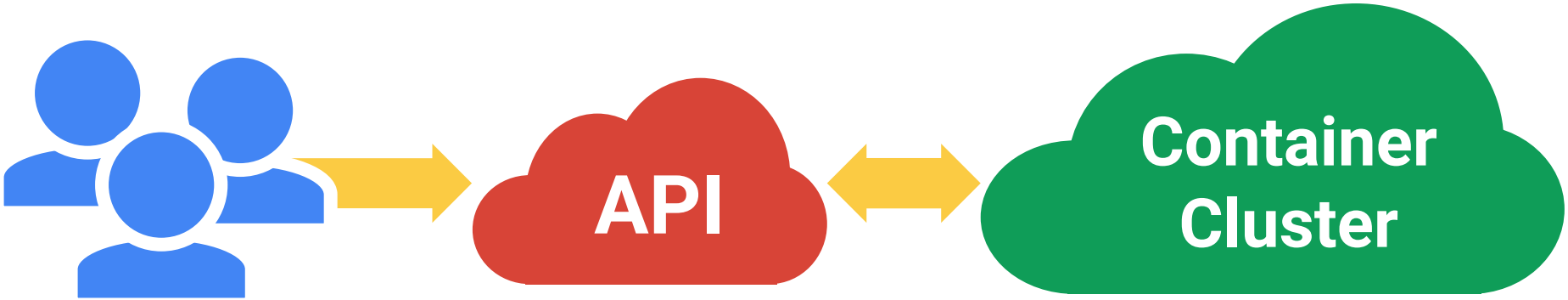
The 10000 foot view



All you really care about



CoreOS

CoreOS

CoreOS trusted computing

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

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ECOSYSTEM

CoreOS

clair

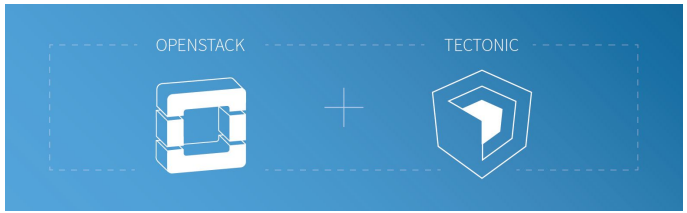
canal

PROJECT CALICO + flannel

rkt

etcd

Torus



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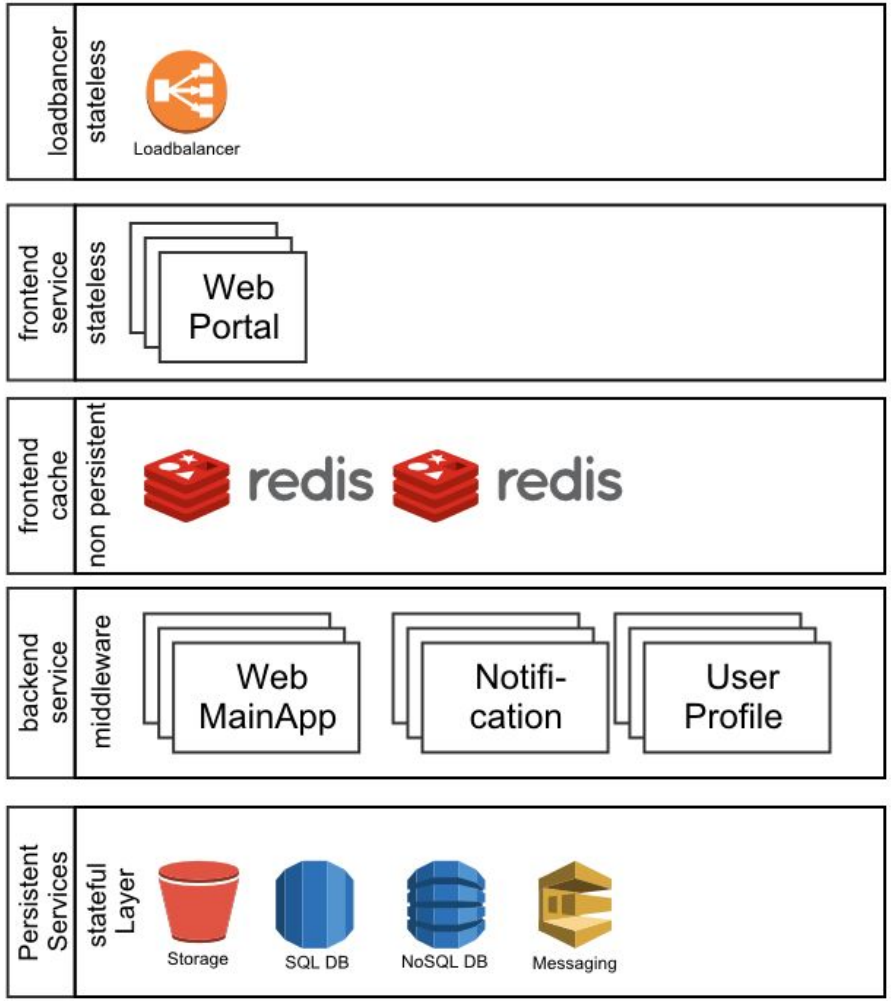
STARTING POINT - ARCHITECTURE

WE NEVER START FROM SCRATCH

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

- 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

SEMI-AUTOMATED DEPLOYMENT

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

VM CLUSTER BASED ARCHITECTURES

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

MIGRATION

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

FROM VMs TO PODS

VM cluster ⇨ Pods running on Kubernetes

- cattle: stateless containers
- pets: databases

configuration management ⇨ separation of build time and run time

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

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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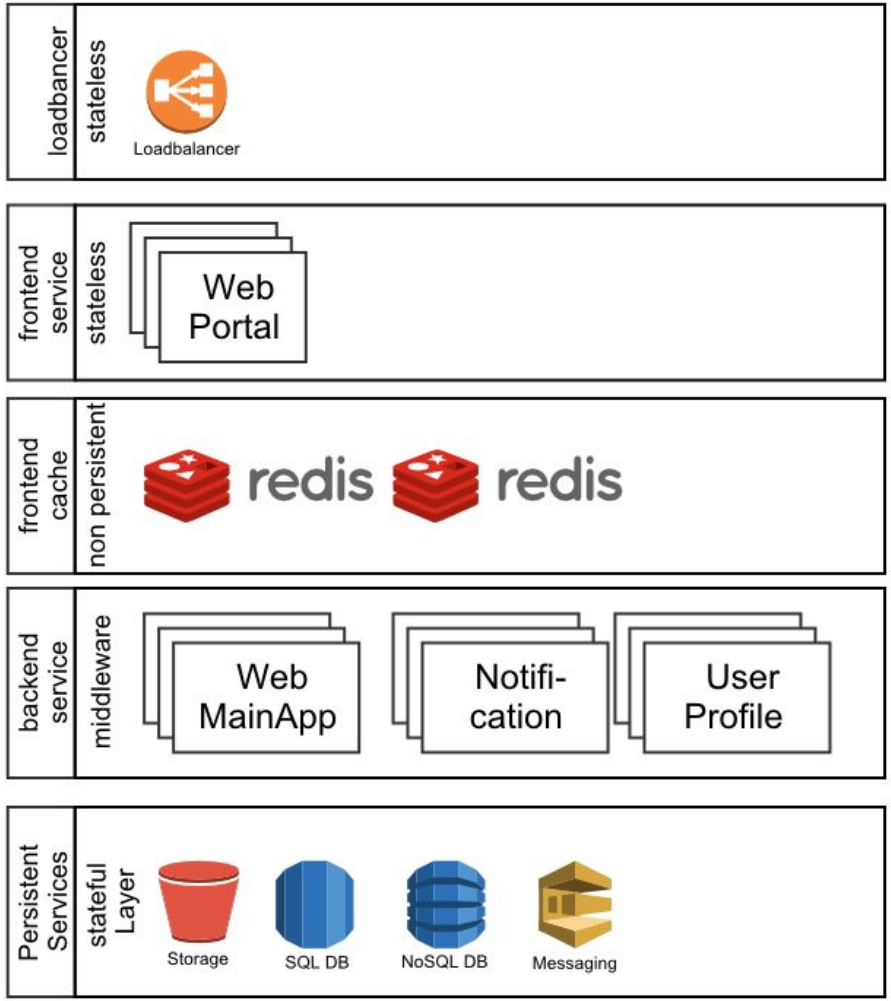
ARCHITECTURE WRAP UP

- 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/

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

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

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

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

SUCCESS, CHALLENGES, ‘WHAT IS MISSING’

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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)

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

DOES IT SCALE IN REAL LIFE?

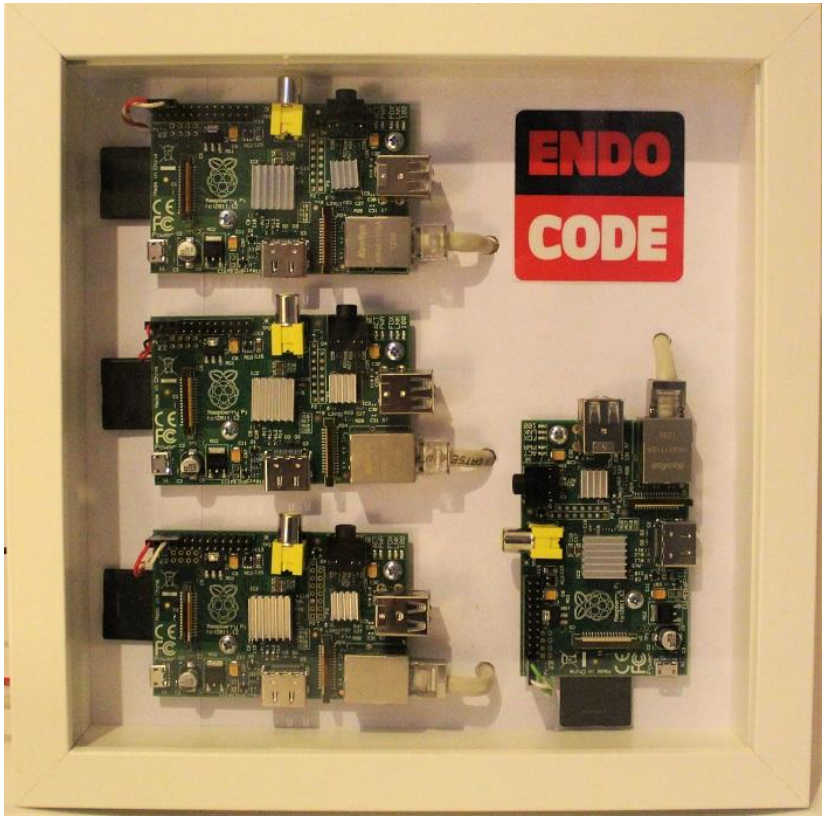
YES

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

YOUR PRIVATE KUBERNETES DATACENTER

You need providers for:

- Storage
- Network
- Firewalls



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QUESTIONS?