RSAConference2019

San Francisco | March 4–8 | Moscone Center

BETTER.

SESSION ID: ASD-W10

Practical Approaches to Cloud Native Security

Karthik Gaekwad

Principal Engineer
Oracle Inc
@iteration1

RSAConference2019

Slides are here:

http://bitly.com/cloudnative-rsa

Hello

- I'm Karthik Gaekwad
- NOT a DBA

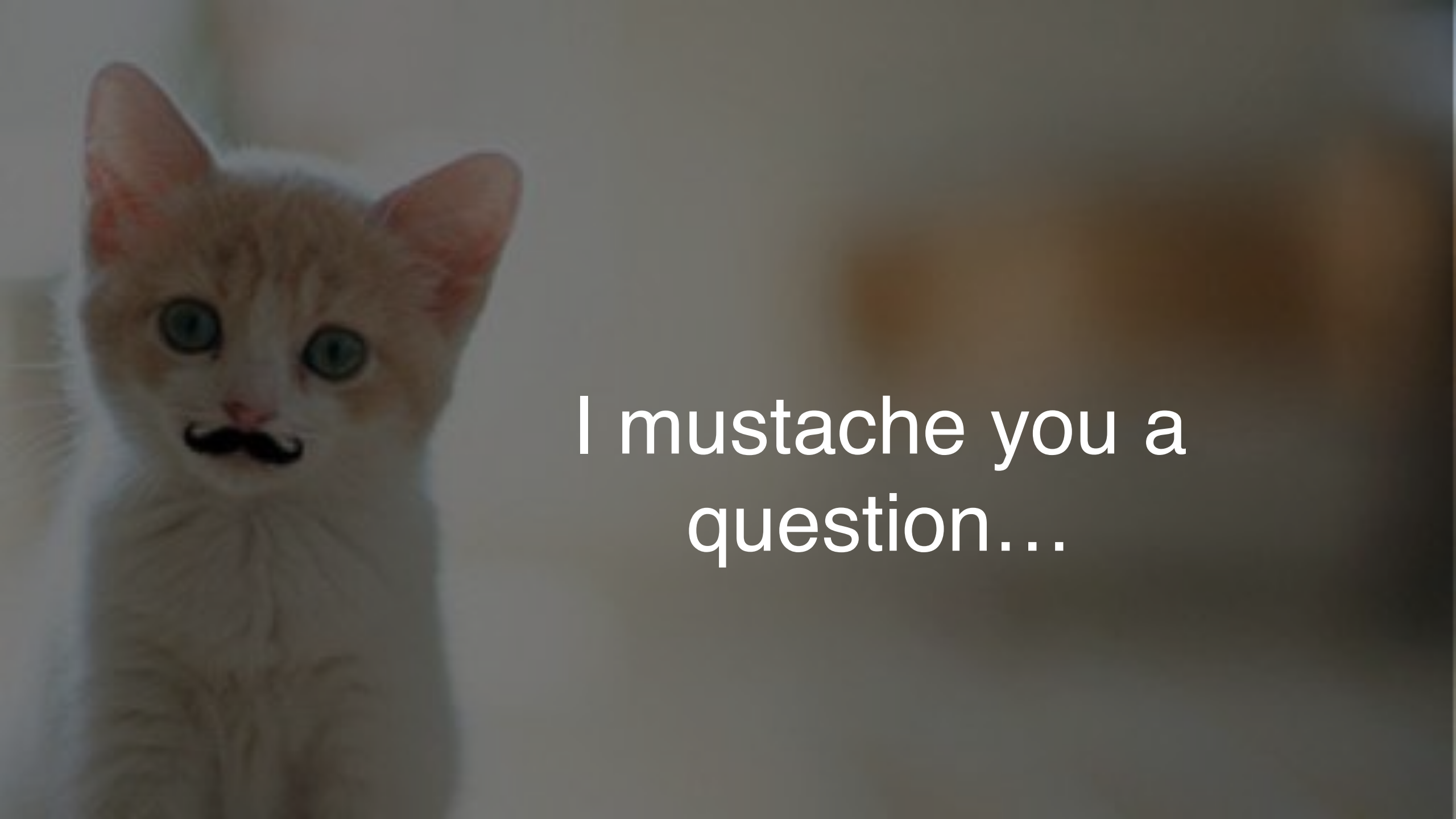
ORACLE
Cloud Native Labs

- https://cloudnative.oracle.com/
- Cloud Native Evangelist at Oracle Cloud
- Past: Developer on the Oracle Managed Kubernetes Team

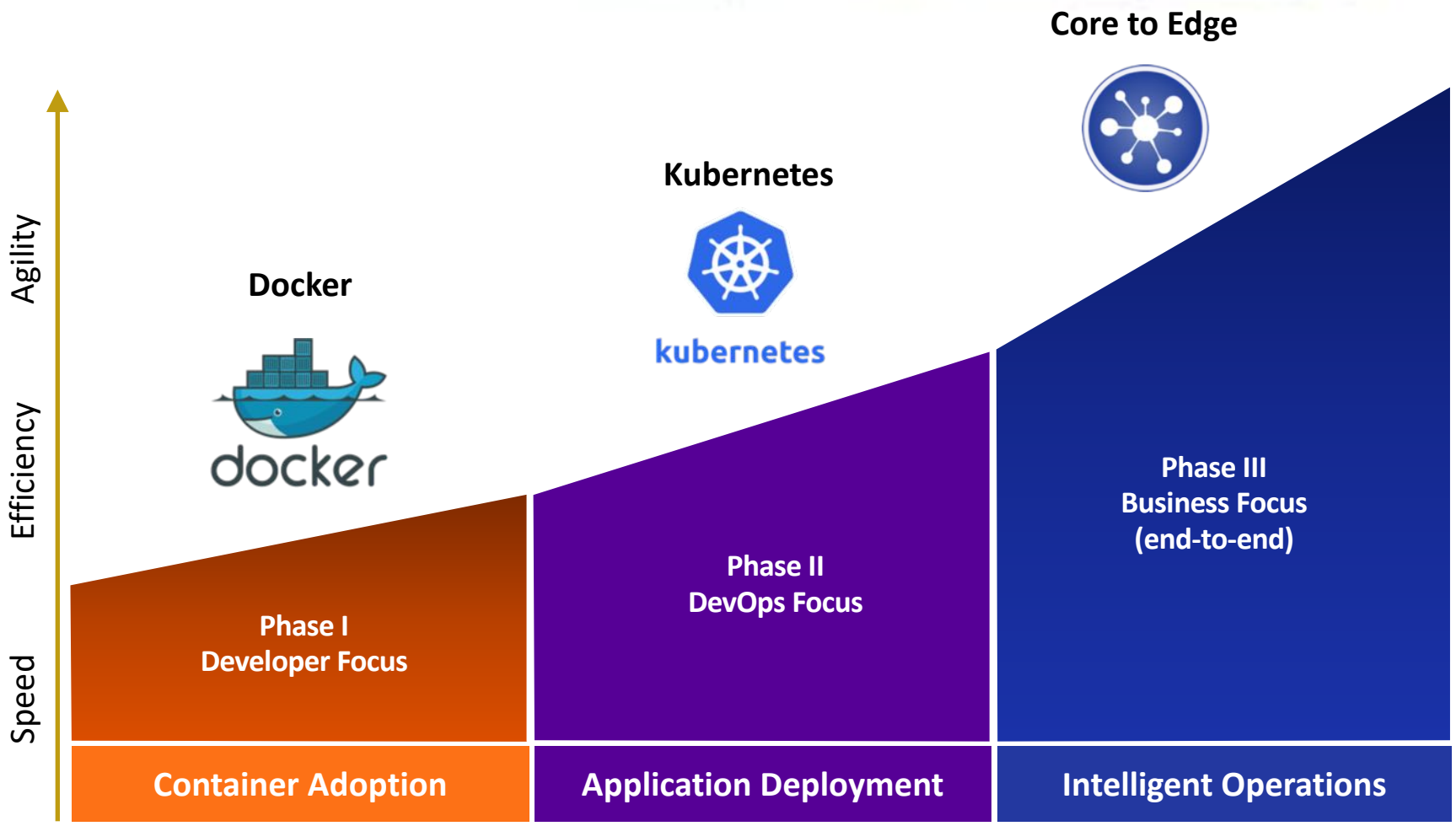
@iteration1

Hello

- Been in Industry for 15 years.
- In general, I like building stuff with friends.
  - Maintainer for Gauntlt- Open source security scanner.
- Love Teaching and building community.
  - Run Devopsdays Austin, Container Days, Cloud Austin.
  - Chair All Day Devops Cloud Native track.
  - LinkedIn Learning Author for Learning Kubernetes (and more).


I mustache you a question...

The Cloud Native Journey



Focus
Applications
Automation
Community

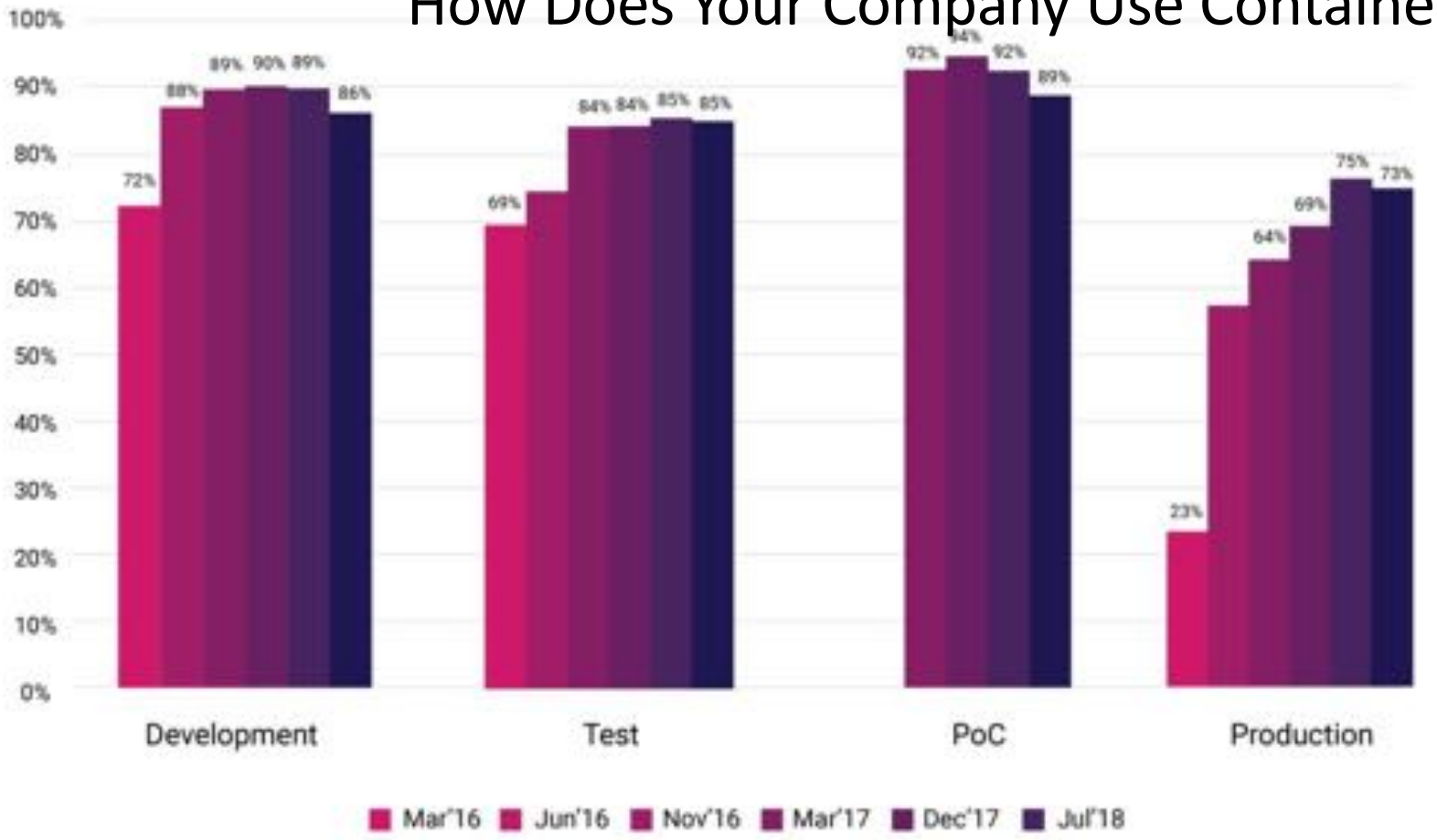
Developer adoption
Dev/Test apps
Simple orchestration
Individual developers

DevOps deployment
Production apps
Advanced orchestration
Teams & lines of business

End-to-end integration
Digital business apps
Serverless, DevSecOps, & ML
Cloud native enterprises

CNCF Survey: August 2018

How Does Your Company Use Containers and Where?



Lots of adoption on dev/staging

Continued production increase

CNCF Survey: August 2018

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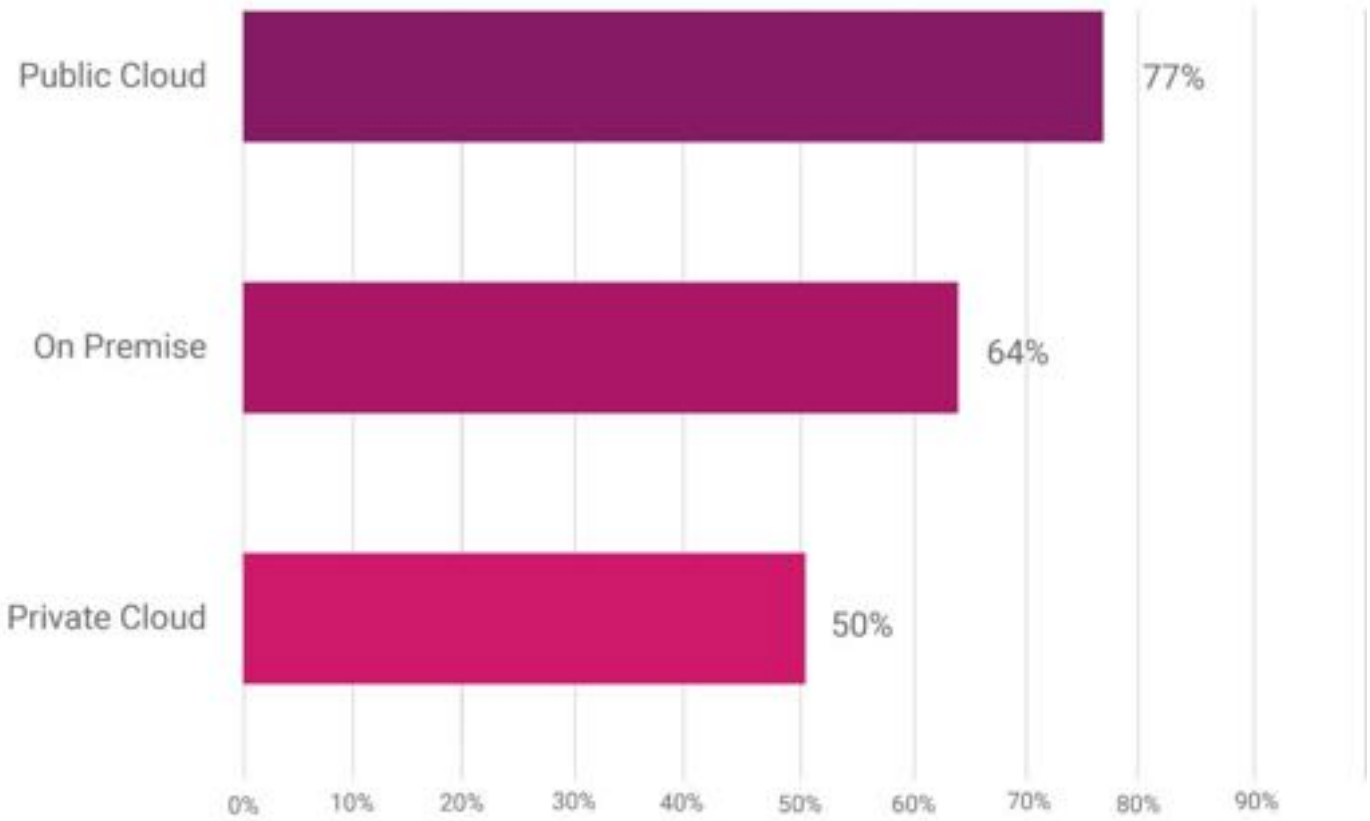
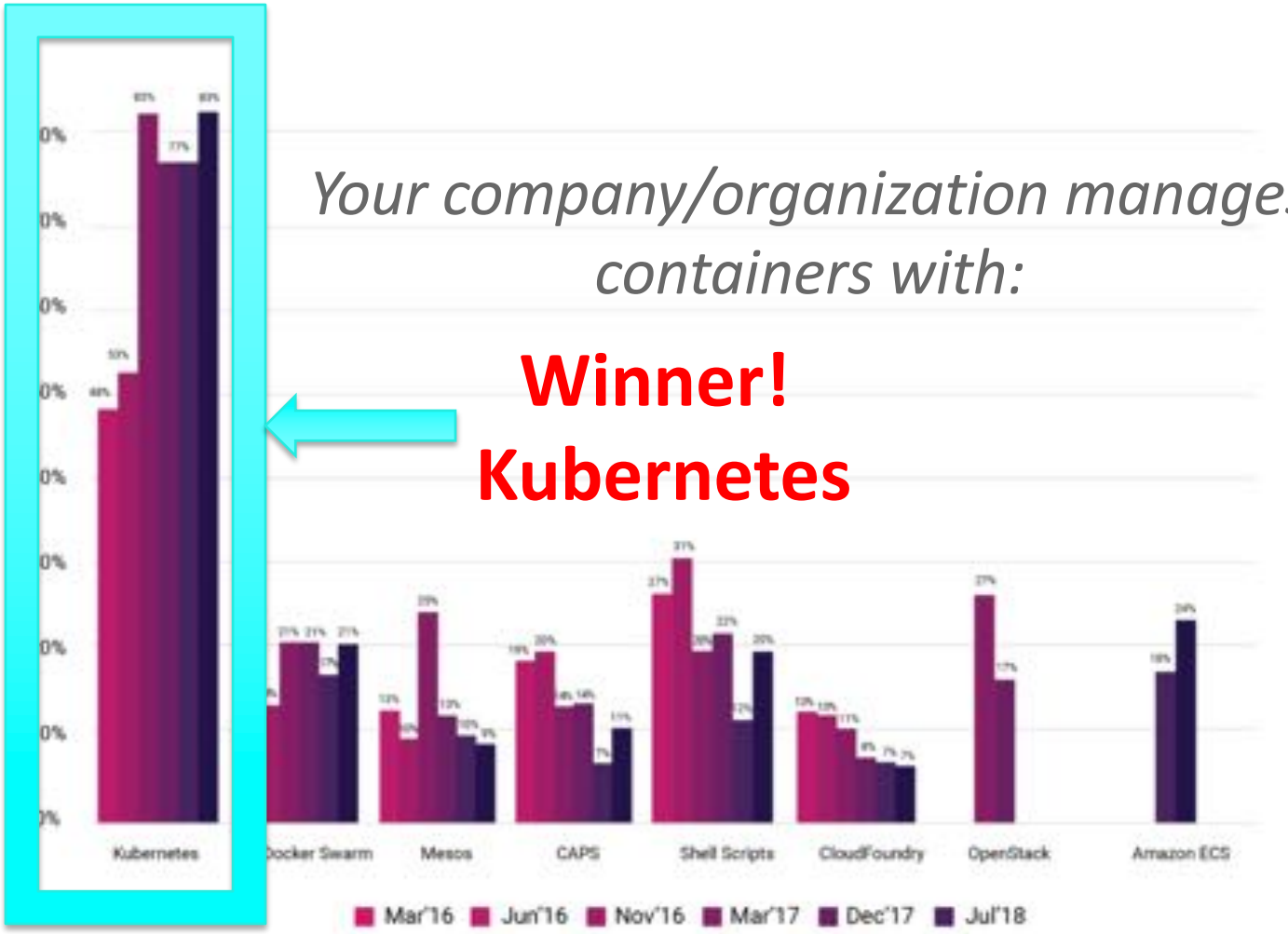


Adoption over public and on-prem

Kubernetes Dominates Container Management



Your company/organization manages containers with:

Winner!
Kubernetes

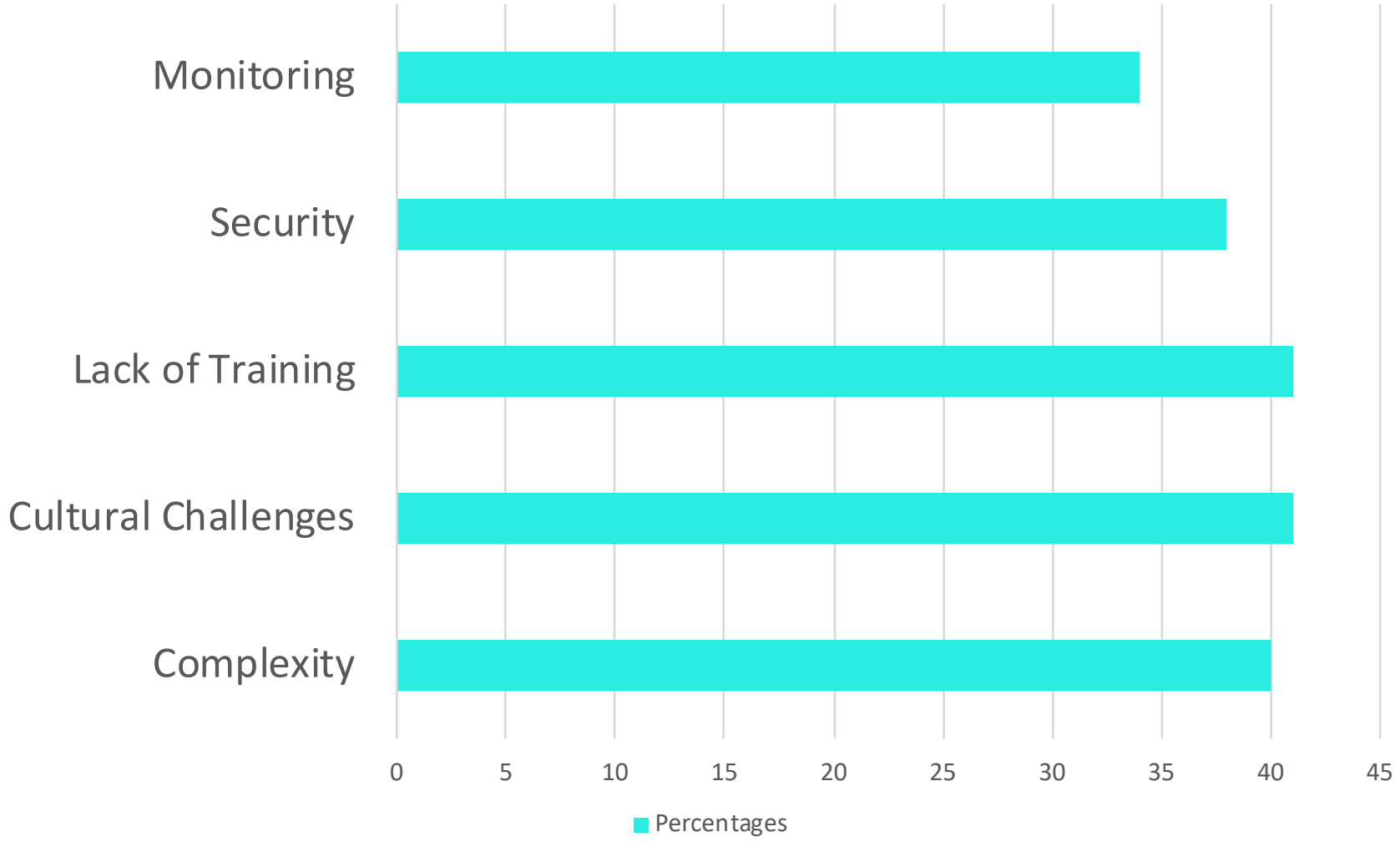
Good News, Bad News…

Many Projects…

Good usage in dev/prod

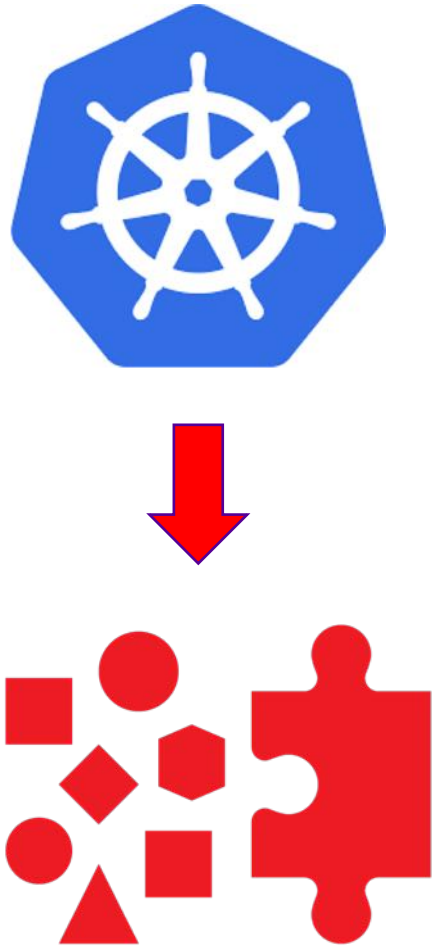
But…

Top 5 challenges to cloud native adoption…



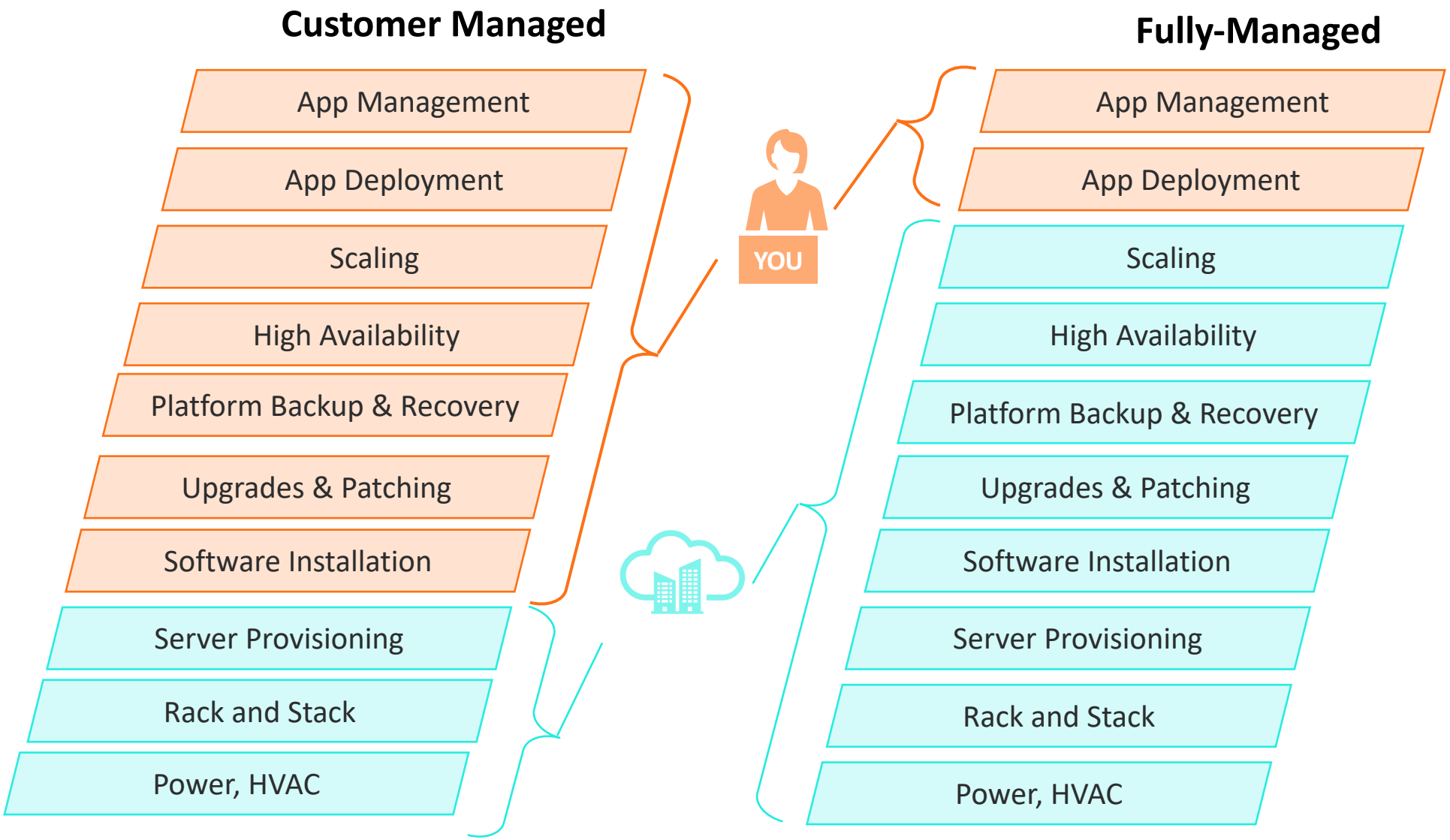
Kubernetes & Cloud Native Challenges

- Managing, maintaining, upgrading Kubernetes Control Plane
  - API Server, etcd, scheduler etc….
- Managing, maintaining, upgrading Kubernetes Data Plane
  - In place upgrades, deploy parallel cluster etc….
- Figuring out container networking & storage
  - Overlays, persistent storage etc… - it should just work
- Managing Teams
  - How do I manage & control team access to my clusters?
- Security, security, security



Source: Oracle Customer Survey 2018

How Are Teams Addressing Complexity, Training Issues?



Benefits

- ✓ Faster Time to Deploy
- ✓ Lower Risk
- ✓ Accelerate Innovation

Which brings us to security…

Where no news, is good news!

Unsecured K8s dashboards

< Back

Research

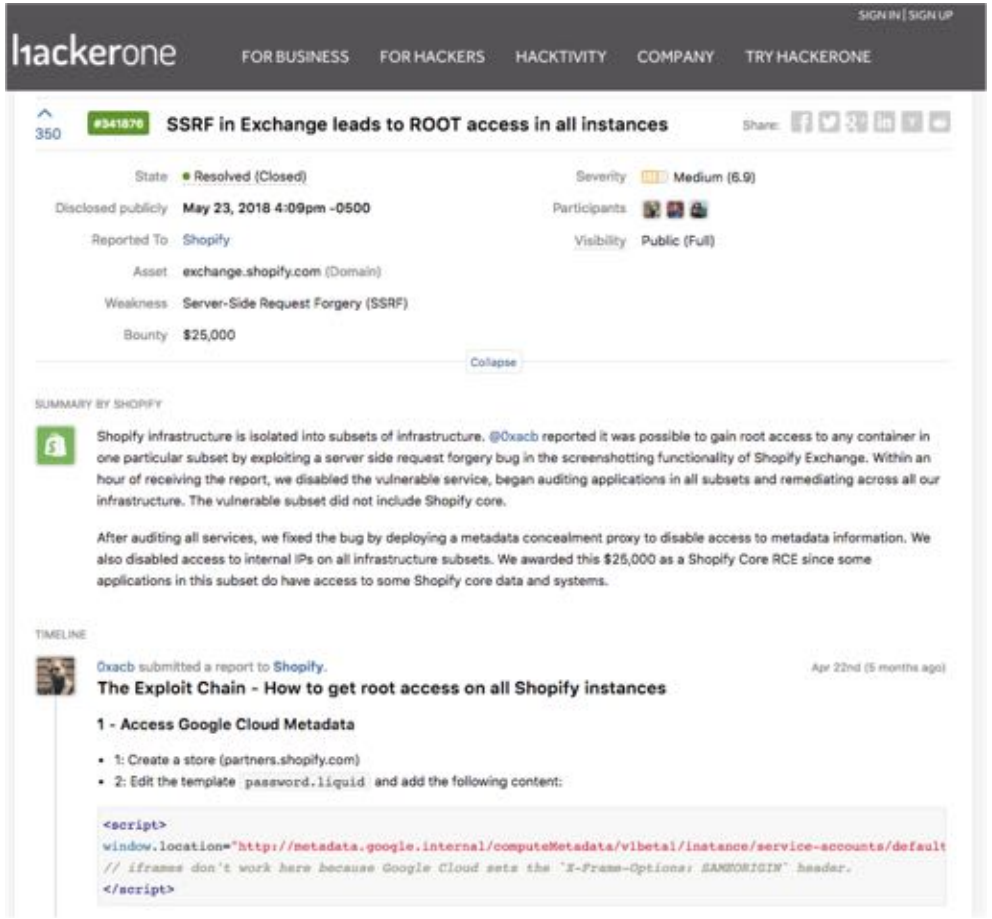
Lessons from the Cryptojacking Attack at Tesla

by RedLock CSI Team | 02.20.18, 6:00 AM

- Unsecured Kubernetes Dashboard with account creds.
- Used this to mine cryptocurrency.
- 2017: Aviva
- 2018: Tesla, Weight Watchers

- https://redlock.io/blog/cryptojacking-tesla

Kubelet credentials hack



hackerone FOR BUSINESS FOR HACKERS HACKTIVITY COMPANY TRY HACKERONE SIGN IN | SIGN UP

350 #341876 **SSRF in Exchange leads to ROOT access in all instances** Share:

State • Resolved (Closed)
Disclosed publicly May 23, 2018 4:09pm -0500
Reported To Shopify
Asset exchange.shopify.com (Domain)
Weakness Server-Side Request Forgery (SSRF)
Bounty $25,000

Severity Medium (6.9)
Participants
Visibility Public (Full)

Collapse

SUMMARY BY SHOPIFY

Shopify infrastructure is isolated into subsets of infrastructure. @0xacb reported it was possible to gain root access to any container in one particular subset by exploiting a server side request forgery bug in the screenshotting functionality of Shopify Exchange. Within an hour of receiving the report, we disabled the vulnerable service, began auditing applications in all subsets and remediating across all our infrastructure. The vulnerable subset did not include Shopify core.

After auditing all services, we fixed the bug by deploying a metadata concealment proxy to disable access to metadata information. We also disabled access to internal IPs on all infrastructure subsets. We awarded this $25,000 as a Shopify Core RCE since some applications in this subset do have access to some Shopify core data and systems.

TIMELINE

0xacb submitted a report to Shopify. Apr 22nd (5 months ago)

The Exploit Chain - How to get root access on all Shopify instances

1 - Access Google Cloud Metadata

- 1: Create a store (partners.shopify.com)
- 2: Edit the template `password.liquid` and add the following content:

```
<script>
window.location="http://metadata.google.internal/computeMetadata/v1beta1/instance/service-accounts/default
// iframes don't work here because Google Cloud sets the `X-Frame-Options: SAMEORIGIN` header.
</script>
```

- Shopify: Server Side request Forgery
- Get kubelet certs/private key
- Root access to any container in part of infrastructure.
- https://hackerone.com/reports/341876

CVE's Happen…

In a Nutshell, Kubernetes…

… has had 70,892 commits made by 2,241 contributors
representing 1,537,561 lines of code

In a Nutshell, docker…

… has had 257,984 commits made by 11,382 contributors
representing 9,236,254 lines of code

Even more relevant with increased production usage of containers…

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Privilege Escalation

CVE-2018-1002105: proxy request handling in kube-apiserver can leave vulnerable TCP connections #71411

Container Escaping

DOCKER SECURITY UPDATE: CVE-2019-5736 AND CONTAINER SECURITY BEST PRACTICES

https://www.shodan.io/search?query=port%3A%2379%+product%3A%etcd%

SHODAN port:"2379" product:"etcd"

Explore | Downloads | Reports | Developer Pricing | Enterprise Access

Exploits | Maps | Share Search | Download Results | Create Report

TOTAL RESULTS

2,367

TOP COUNTRIES

China	933
United States	662
Germany	153
France	110
Singapore	67

TOP ORGANIZATIONS

Amazon.com	323
Hangzhou Alibaba Advertising Co.,Ltd.	276
Tencent cloud computing	207
Hetzner Online GmbH	70
Digital Ocean	70

TOP OPERATING SYSTEMS

Linux 3.x	1

TOP VERSIONS

3.3.2	299
3.2.19	138
3.3.9	128
3.2.22	123
3.2.17	82

[redacted]
Tencent cloud computing
Added on 2018-09-26 19:13:25 GMT
China
Details

etcd
Name: etcd_10.0.128.13
Version: 3.3.2
Uptime: 79h38m33.2321030055s
Peers: http://10.0.128.13:2380

[redacted]
Amazon Corporate Services Pty
Added on 2018-09-26 19:08:40 GMT
Australia, Sydney
Details

etcd
Name: MFR-50nodeap-southeast-2002
Version: 3.3.2
Uptime: 54h22m1.357953836s
Peers: http://13.236.207.66:2380

[redacted]
Spectrum Business
Added on 2018-09-26 18:02:04 GMT
United States, Flower Mound
Details

etcd
Name: core2
Version: 2.2.5
Uptime: 5h38m59.4021755996s
Peers: http://10.11.36.2:2380, http://10.11.36.2:7001

[redacted]
Red Hat
Added on 2018-09-26 18:48:03 GMT
United States
Details

etcd
Name: rdocloud-devstack4.rdocloud
Version: 3.2.17
Uptime: 633h2m38.382059797s
Peers: http://192.168.4.6:2380

[redacted]
Amazon.com
Added on 2018-09-26 18:40:20 GMT
United States, Ashburn

etcd
Name: master-0
Version: 3.2.18
Uptime: [illegible]

SHODAN port:"2379" product:"etcd"

Explore | Downloads | Reports | Developer Pricing | Enterprise Access

Maps | Share Search | Download Results | Create Report

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Sydney

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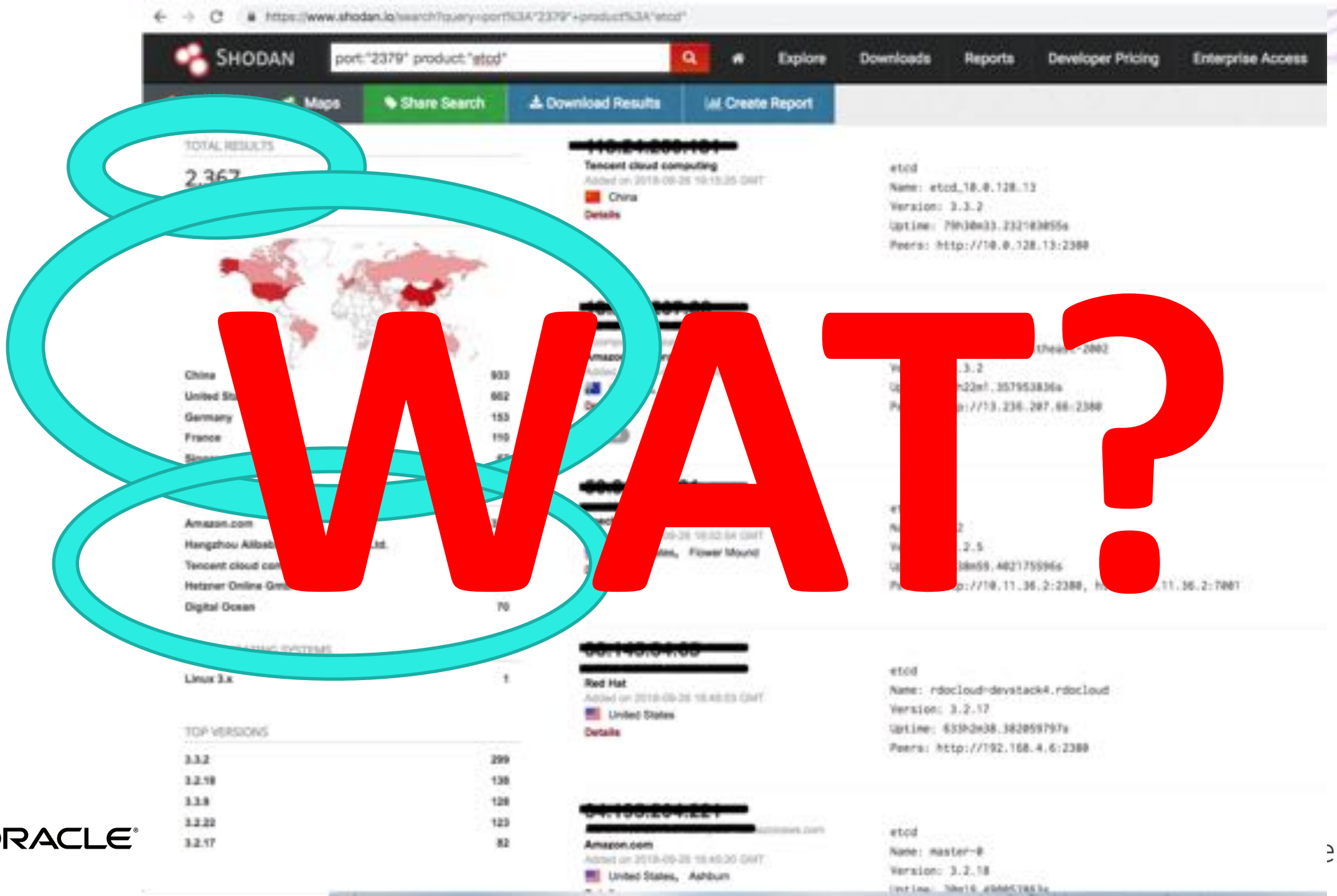
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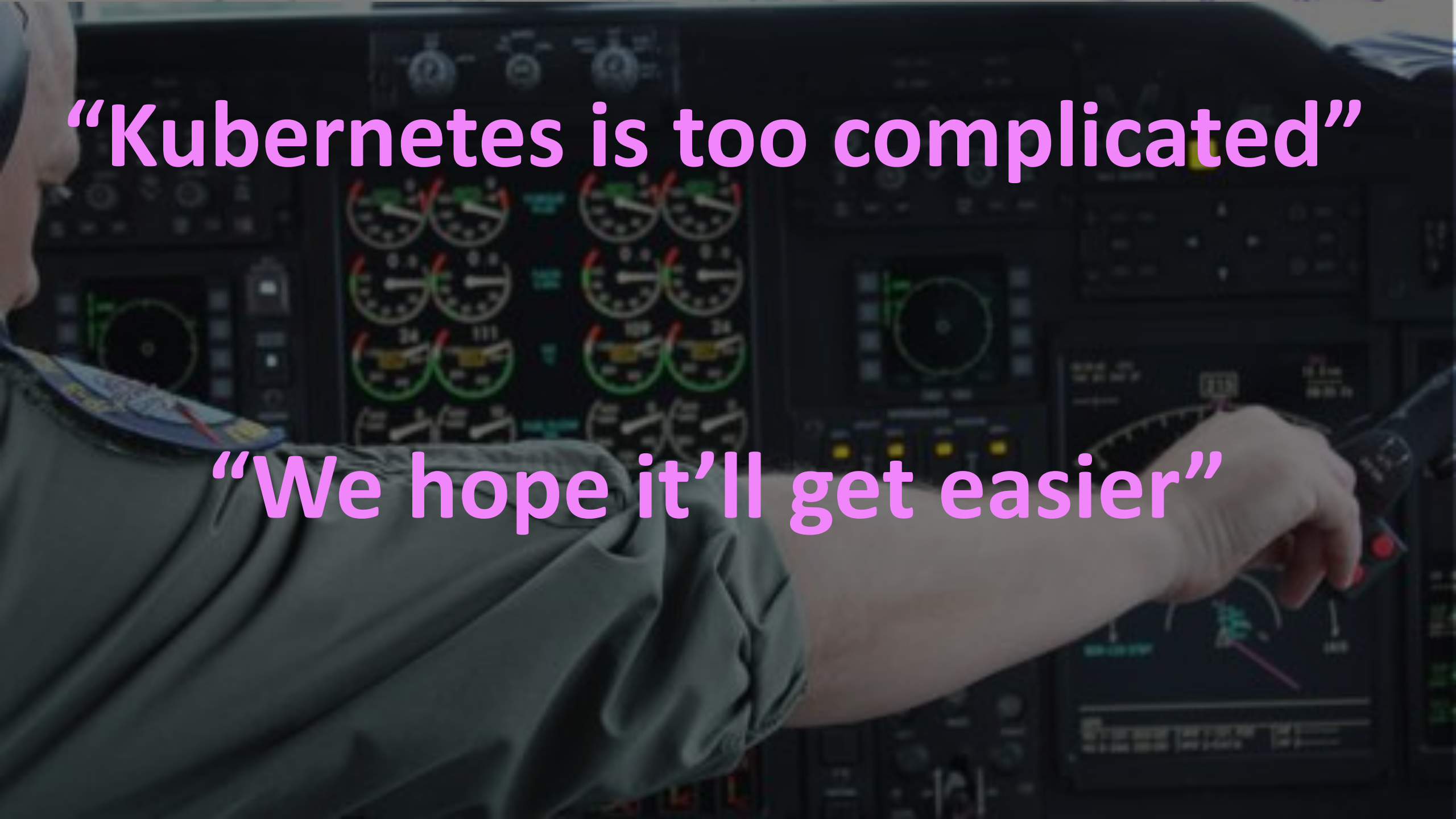
WAT?

How did we get here?

“Kubernetes is too complicated”


“Kubernetes is too complicated”
“We hope it’ll get easier”

I want to get better!
But where to start?

Let’s look at:

- Attack Surface
  - More importantly, how to limit damage
- Security related features in K8s
  - The more you know, the better you build
- Opensource Tooling to help
  - Because we all need help

Attack Surface

Attack Surface

Goal: Reduce the attack surface

- Analysis for:
  - Host(s)
  - Container (Images and running)
  - Kubernetes Cluster

Attack Surface: Host

- These are the machines you're running Kubernetes on.
- Age old principles of Linux still apply:
  - Enable SELinux
  - AppArmor
  - Seccomp
  - Hardened Images
- Goal: Minimize privilege to applications running on the host

- *Good news*: Already a wealth of information on this subject!
  - http://lmgtfy.com/?q=how+to+reduce+attack+surface+linux

Attack Surface: Container Images

GOAL: Know your base image when building containers

Attack Surface: Container Images

GOAL: Know your base image when building containers

karthequian/ruby
public

500K+
PULLS

PUBLIC REPOSITORY

karthequian/ruby

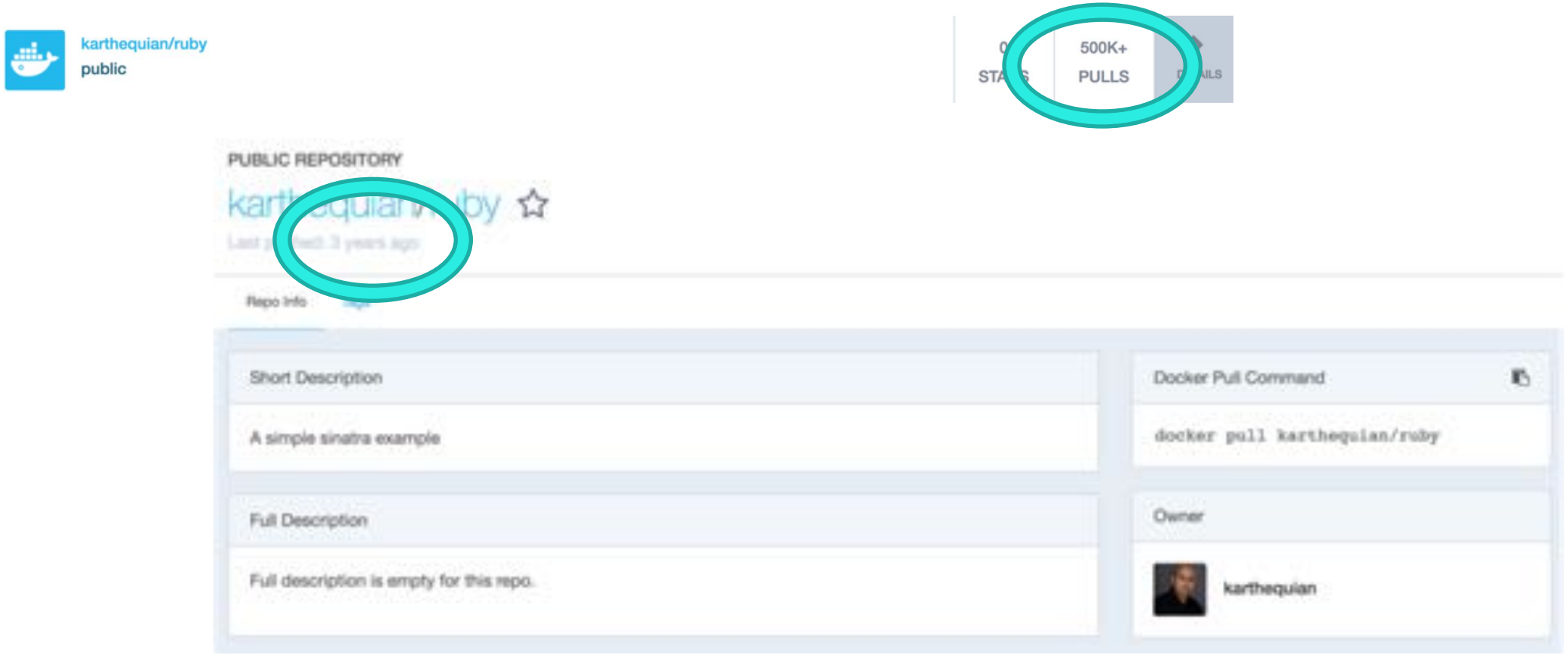
Repo Info | Tags

Short Description	Docker Pull Command
A simple sinatra example	docker pull karthequian/ruby
Full Description	Owner
Full description is empty for this repo.	karthequian

**BTW, this is just a ruby helloworld app

Attack Surface: Container Images

GOAL: Know your base image when building containers



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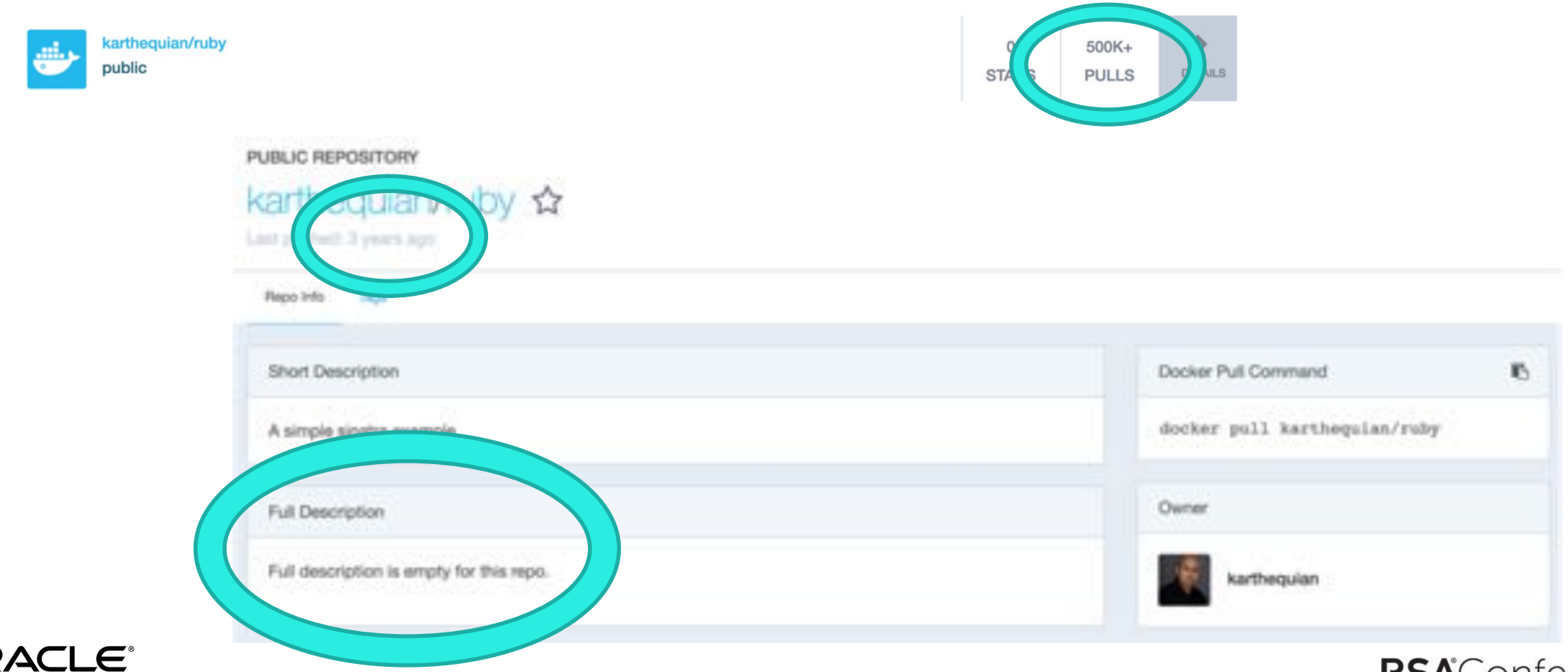
Attack Surface: Container Images

GOAL: Know your base image when building containers

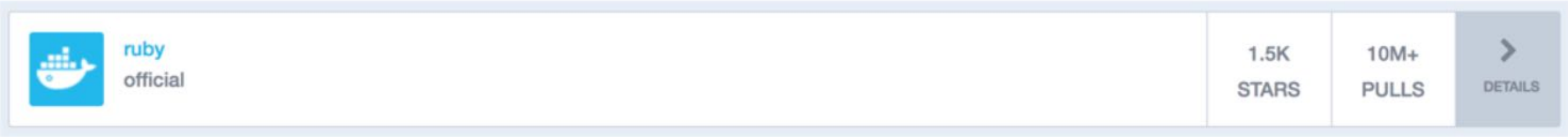


Full disclosure: I'm karthequian; I created this as a ruby 101 container for learning purposes only

Attack Surface: Container Images

GOAL: Know your base image when building containers

- When in doubt, stick to an official images!



- Or start from a sane base image (example: alpine linux)

Attack Surface: Container Images

GOAL: Smaller the image, the better

- Less things for an attacker to exploit.
- Quicker to push, quicker to pull.

Attack Surface: Container Images

GOAL: Don’t rely on :latest tag

- :latest image yesterday might not be :latest image tomorrow
- Instead, you’d want to know what specific version you’re operating with.

- Side benefit: If there is a new vulnerability announced for OS version x.y.z, you know immediately whether you’re running that version!

Attack Surface: Container Images

GOAL: Check for vulnerabilities periodically

- Plenty of ways to do this in registries. We'll cover more in the tooling section

Attack Surface: Running Containers

GOAL: Don’t run as root

- Containers running as root might be completely unnecessary for the actual application.
- If compromised, attacker can do a lot more things..
- Pod security policies can help (we’ll see how later).

Attack Surface: Running Containers

GOAL: Limit host mounts

- Be wary of images that require broad access to paths on the host
- Limit your host mount to a smaller subset of directories
- Reduces blast radius on compromise

Attack Surface: Kubernetes Cluster

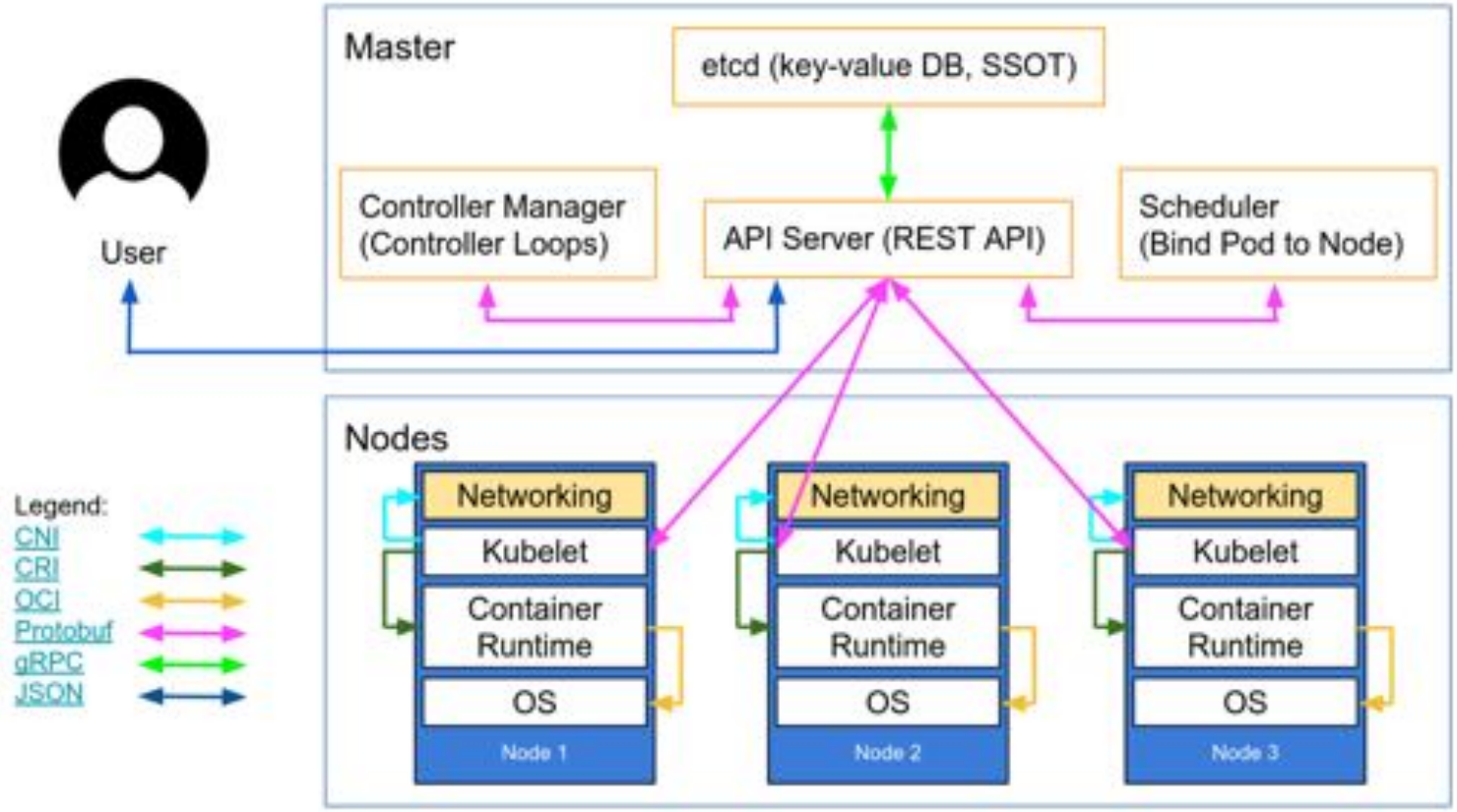
Kubernetes Cluster- TLS

TLS ALL THE THINGS

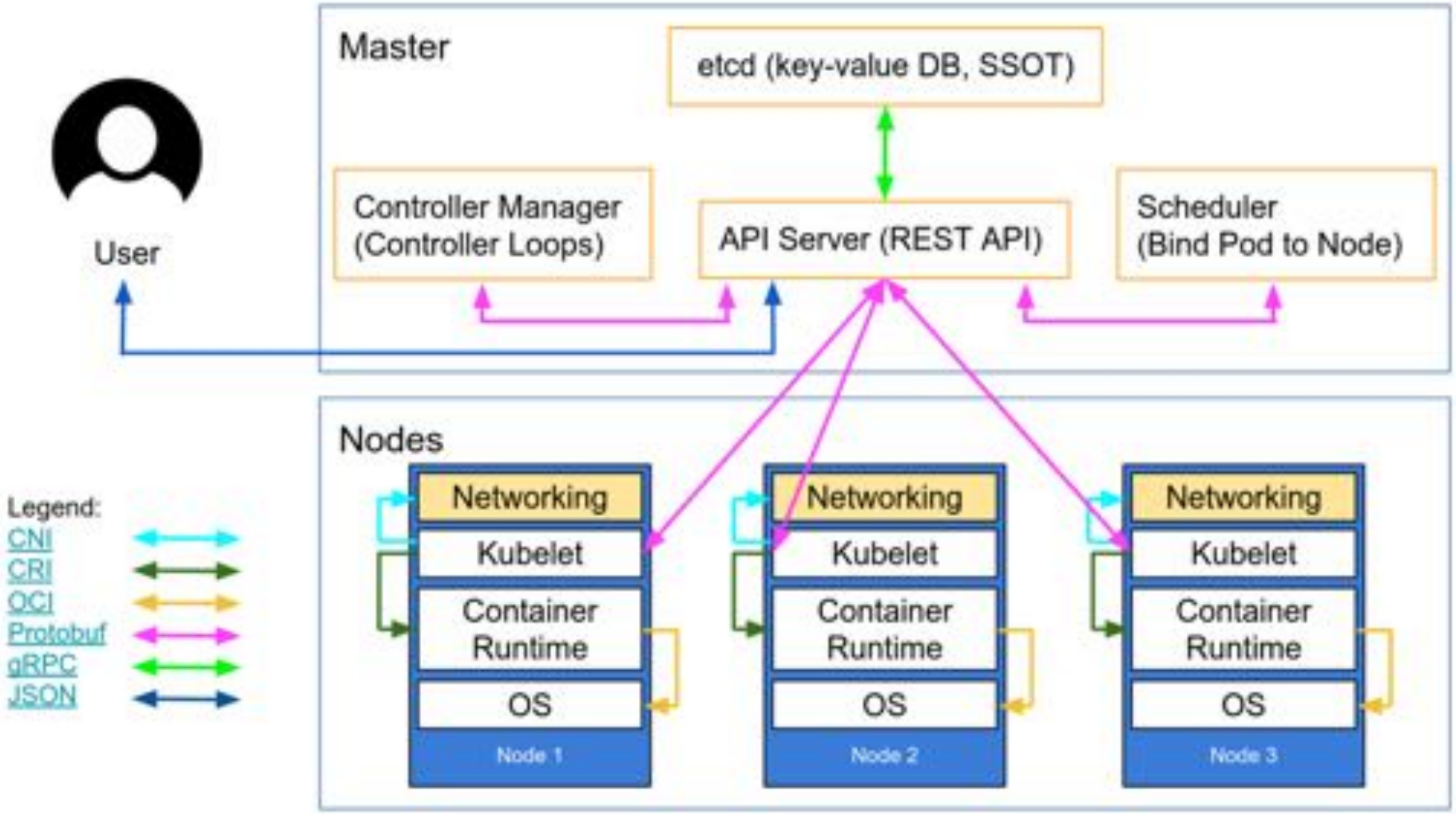
Kubernetes Cluster- TLS

- TLS Checklist:

1. Nodes and Master
2. User and Master
3. Everything etcd
4. Kubelet to API Server



Kubernetes Cluster- TLS



Kubernetes Cluster- TLS

- TLS Checklist:

1. User and Master
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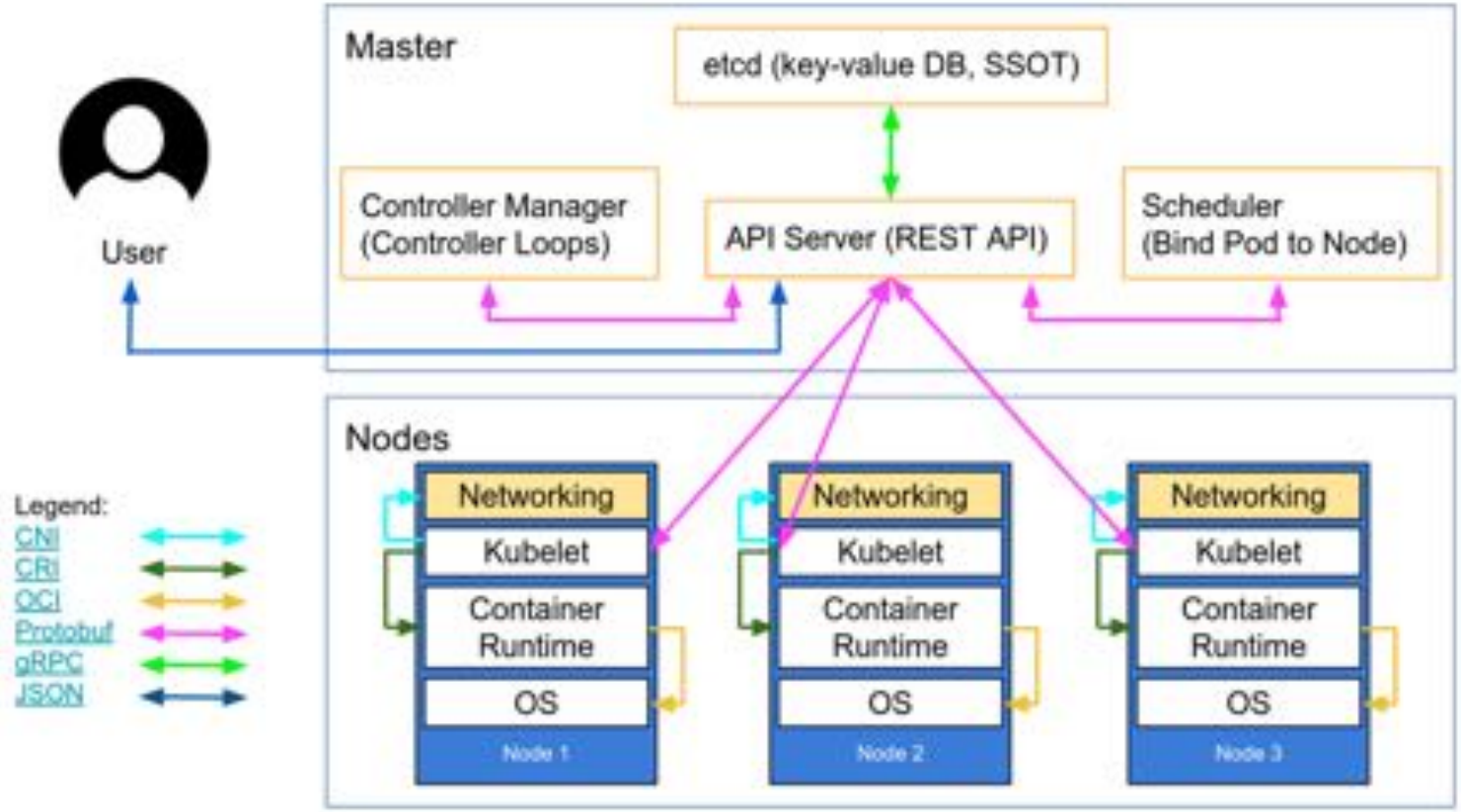


CVE's

GOAL: Have an upgrade strategy

- Because…CVE's are fixed in new minor versions.
- Don't treat K8s as "install once, run all the time".
- Make your K8s install repeatable for different versions.

- ..Or use a Managed Provider.
  - Either automatically patch for you, or tell you what to do.

We're a little
better off now.
But what else to do?

K8s Features

How can the platform help me make secure choices?

K8s Features

- Kubernetes Secrets
- Authentication
- Authorization
- Audit Logging
- Network Policies
- Pod security policies

Kubernetes Secrets

- **GOAL: Use Kubernetes secrets to store sensitive data instead of config maps.**

- Also look at: secrets encryption provider.
  - Controls how etcd encrypts API data
  - **--experimental-encryption-provider-config**
- https://kubernetes.io/docs/tasks/administer-cluster/encrypt-data/

Authentication and Authorization

- Do you know how you are authenticating with Kubernetes?

- Many ways to Authenticate
  - Client Certs
  - Static token file
  - Service Account tokens
  - OpenID
  - Webhook Mode
  - And more (https://kubernetes.io/docs/reference/access-authn-authz/authentication/)

Goal: Pick a strategy that fits your use case
Whatever you do, DO NOT YOLO!

If you DO NOT YOLO…
You can pick an authz strategy..

Authentication and Authorization

Authorization Modules

- **Node** - A special-purpose authorizer that grants permissions to kubelets based on the pods they are scheduled to run. To learn more about using the Node authorization mode, see Node Authorization.
- **ABAC** - Attribute-based access control (ABAC) defines an access control paradigm whereby access rights are granted to users through the use of policies which combine attributes together. The policies can use any type of attributes (user attributes, resource attributes, object, environment attributes, etc). To learn more about using the ABAC mode, see ABAC Mode.
- **RBAC** - Role-based access control (RBAC) is a method of regulating access to computer or network resources based on the roles of individual users within an enterprise. In this context, access is the ability of an individual user to perform a specific task, such as view, create, or modify a file. To learn more about using the RBAC mode, see RBAC Mode
  - When specified RBAC (Role-Based Access Control) uses the `rbac.authorization.k8s.io` API group to drive authorization decisions, allowing admins to dynamically configure permission policies through the Kubernetes API.
  - To enable RBAC, start the apiserver with `--authorization-mode=RBAC`.
- **Webhook** - A WebHook is an HTTP callback: an HTTP POST that occurs when something happens; a simple event-notification via HTTP POST. A web application implementing WebHooks will POST a message to a URL when certain things happen. To learn more about using the Webhook mode, see Webhook Mode.

https://kubernetes.io/docs/reference/access-authn-authz/authorization/

Authentication and Authorization

- Pro tip: Nobody uses ABAC anymore. Don't be that guy….
- RBAC is the defacto standard
  - Based on roles and role bindings
  - Good set of defaults: https://github.com/uruddarraju/kubernetes-rbac-policies
- Can use multiple authorizers together, but can get confusing.
  - 1st authorizer to authorize passes authz

Kubernetes Cluster- Audit Logs

- Wat?
- “Kubernetes auditing provides a security-relevant chronological set of records documenting the sequence of activities that have affected system by individual users, administrators or other components of the system.”
- Answers: What/when/who/where information on security events.

- **Your job:** Periodically watch Kubernetes Audit logs
- https://kubernetes.io/docs/tasks/debug-application-cluster/audit/

See, you know how to take the reservation, you just don't know how to hold the reservation and that's really the most important part of the reservation, the holding. Anybody can just take them.

— Jerry Seinfeld —

AZ QUOTES

Kubernetes Cluster- Network Policies

- Consider adding a network policy to the cluster…

- Default Policy: All pods can talk to all other pods.
- Consider limiting this with a Network Policy
- https://kubernetes.io/docs/concepts/services-networking/network-policies/

Kubernetes Cluster- Pod Security Policies

- Consider adding Pod Security policies

- PodSecurityPolicy: A Defined set of conditions a pod must run with.
- Think of this as authorization for pods.

Kubernetes Cluster: Pod Security Policies

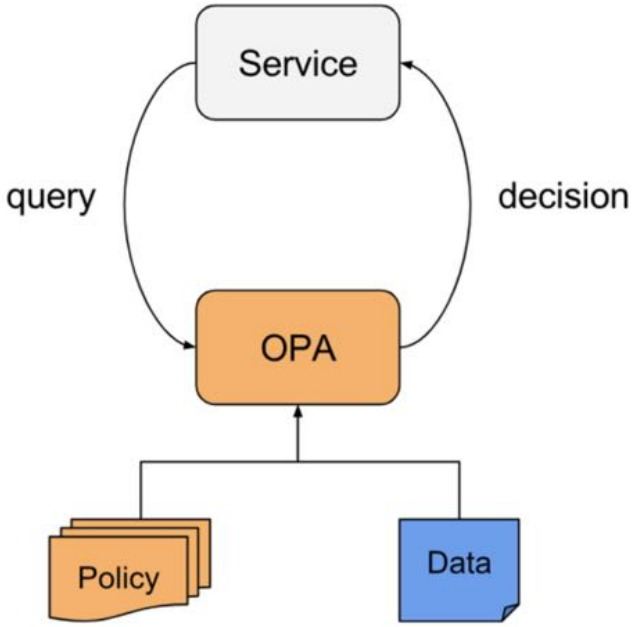
Capability for an admin to control specific actions

Control Aspect	Field Names
Running of privileged containers	`privileged`
Usage of host namespaces	`hostPID`, `hostIPC`
Usage of host networking and ports	`hostNetwork`, `hostPorts`
Usage of volume types	`volumes`
Usage of the host filesystem	`allowedHostPaths`
White list of Flexvolume drivers	`allowedFlexVolumes`
Allocating an FSGroup that owns the pod's volumes	`fsGroup`
Requiring the use of a read only root file system	`readOnlyRootFilesystem`
The user and group IDs of the container	`runAsUser`, `supplementalGroups`
Restricting escalation to root privileges	`allowPrivilegeEscalation`, `defaultAllowPrivilegeEscalation`
Linux capabilities	`defaultAddCapabilities`, `requiredDropCapabilities`, `allowedCapabilities`
The SELinux context of the container	`seLinux`
The AppArmor profile used by containers	annotations
The seccomp profile used by containers	annotations
The sysctl profile used by containers	annotations

https://kubernetes.io/docs/concepts/policy/pod-security-policy/#what-is-a-pod-security-policy

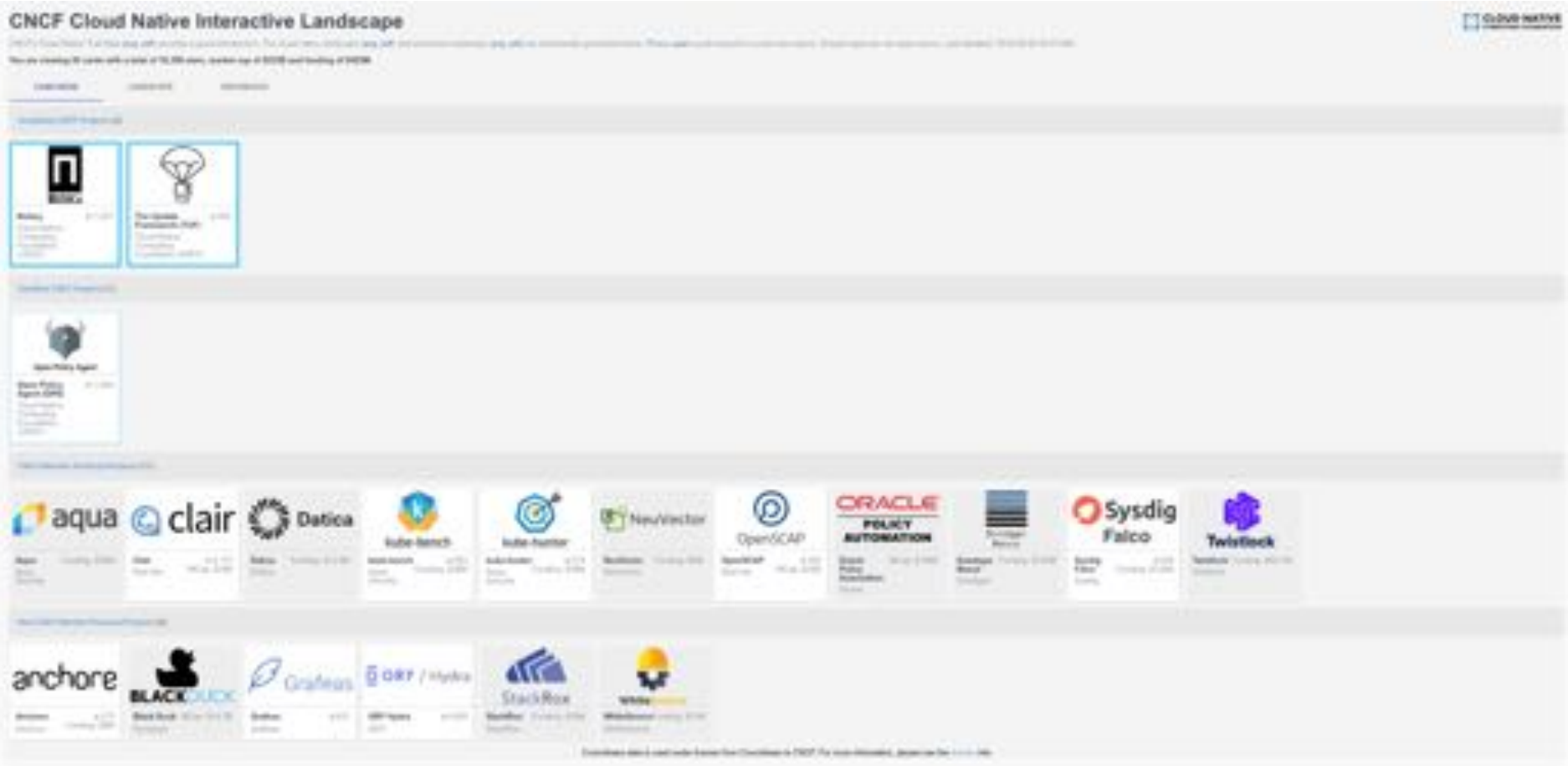
Open Policy Agent

- Policy based control for your whole environment.
- Full featured Policy Engine to offload policy decisions from each application/service.
  - Deploy OPA alongside your service
  - Add policy data to OPA's store
  - Query OPA on decisions.
- Great idea, still early, watch this space..
- Standardize policies for all clusters
- https://www.openpolicyagent.org/



Opensource Tooling

Keep tabs on the CNCF Security landscape



https://landscape.cncf.io/landscape=security-complia

CNCF Projects

- "The Update Framework"
- Is a framework or a methodology.
- Used for secure software updates.
- Based on ideas surrounding trust and integrity.

- Is a project.
- Based on TUF.
- A solution to secure software updates and distribution.
- Used in Docker Trusted Registry.

Clair

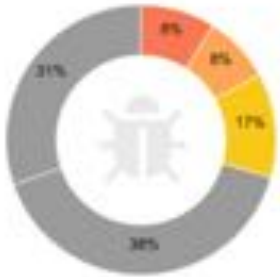
- Open source project for the static analysis of vulnerabilities in containers.
- Find vulnerable images in your repo.
- Built into quay.io, but you can add to your own repo.

- https://github.com/coreos/clair

QUAY Repositories Tutorial Docs Blog jakedt

example/repository

56c0fa71e47b



Quay Security Scanner has detected **13** vulnerabilities.

Patches are available for **4** vulnerabilities.

- **1** High-level vulnerabilities.
- **1** Medium-level vulnerabilities.
- **2** Low-level vulnerabilities.
- **5** Negligible-level vulnerabilities.
- **4** Unknown-level vulnerabilities.

Image Vulnerabilities

Filter vulnerabilities... Only show fixable

CVE	SEVERITY	PACKAGE	CURRENT VERSION	FIXED IN VERSION	INTRODUCED IN IMAGE
CVE-2013-7445	High	linux	3.16.7-ckt20-1+deb8u3		RUN apt-get up.
CVE-2015-5276	Medium	gcc-4.9	4.9.2-10		ADD file:b5391.
CVE-2016-2856	Low	glibc	2.19-18+deb8u3		ADD file:b5391.
CVE-2016-0823	Low	linux	3.16.7-ckt20-1+deb8u3		RUN apt-get up.
CVE-2005-3660	Negligible *	linux	3.16.7-ckt20-1+deb8u3		RUN apt-get up.
CVE-2015-4003	Negligible *	linux	3.16.7-ckt20-1+deb8u3		RUN apt-get up.
CVE-2008-4108	Negligible *	python-defaults	2.7.9-1		RUN apt-get up.
CVE-2015-8830	Negligible	linux	3.16.7-ckt20-1+deb8u3	3.16.7-ckt20-1+deb8u4	RUN apt-get up.
CVE-2013-4392	Negligible *	systemd	215-17+deb8u3		ADD file:b5391.
CVE-2015-7515	Unknown	linux	3.16.7-ckt20-1+deb8u3		RUN apt-get up.
CVE-2015-8816	Unknown	linux	3.16.7-ckt20-1+deb8u3	3.16.7-ckt20-1+deb8u4	RUN apt-get up.
CVE-2016-2547	Unknown	linux	3.16.7-ckt20-1+deb8u3	3.16.7-ckt20-1+deb8u4	RUN apt-get up.
CVE-2016-2545	Unknown	linux	3.16.7-ckt20-1+deb8u3	3.16.7-ckt20-1+deb8u4	RUN apt-get up.

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CoreOS

Harbor

- Newer! CNCF Project
- Registry product
- Supports vulnerability scanning, image signing and identity control
- Scope is larger than clair

Harbor

Harbor | Search Harbor... | English | About

< Projects < Repositories < thomas/postgres

thomas/postgres:alpine

Author	anonymity
Architecture	amd64
OS	linux
Docker Version	17.06.2-ce
Scan Completed	Nov 3, 2018

- 0 High Level Vulnerabilities
- 1 Medium Level Vulnerabilities
- 0 Low Level Vulnerabilities
- 0 Unknown Level Vulnerabilities

SCAN

Vulnerability	Severity	Package	Current version	Fixed in version
CVE-2018-9251	Low	libxml2	2.9.8-r0	2.9.8-r1
CVE-2018-14404	Medium	libxml2	2.9.8-r0	2.9.8-r1
CVE-2018-14567	Medium	libxml2	2.9.8-r0	2.9.8-r1

1 - 3 of 3 items

Kube-bench

- Checks whether a Kubernetes cluster is deployed according to security best practices.
- Run this after creating your K8s cluster.
- https://github.com/aquasecurity/kube-bench
- Defined by the CIS Benchmarks Docs: https://www.cisecurity.org/cis-benchmarks/
- Run it against your Kubernetes Master, or Kubernetes node.

Kube-bench example

```
~$ kubectl logs kube-bench-node
[INFO] 2 Worker Node Security Configuration
[INFO] 2.1 Kubelet
[FAIL] 2.1.1 Ensure that the --allow-privileged argument is set to false (Scored)
[PASS] 2.1.2 Ensure that the --anonymous-auth argument is set to false (Scored)
[PASS] 2.1.3 Ensure that the --authorization-mode argument is not set to AlwaysAllow (Scored)
[PASS] 2.1.4 Ensure that the --client-ca-file argument is set as appropriate (Scored)
[PASS] 2.1.5 Ensure that the --read-only-port argument is set to 0 (Scored)
[FAIL] 2.1.6 Ensure that the --streaming-connection-idle-timeout argument is not set to 0 (Scored)
[FAIL] 2.1.7 Ensure that the --protect-kernel-defaults argument is set to true (Scored)
[FAIL] 2.1.8 Ensure that the --make-iptables-util-chains argument is set to true (Scored)
[FAIL] 2.1.9 Ensure that the --keep-terminated-pod-volumes argument is set to false (Scored)
[FAIL] 2.1.10 Ensure that the --hostname-override argument is not set (Scored)
[FAIL] 2.1.11 Ensure that the --event-qps argument is set to 0 (Scored)
[PASS] 2.1.12 Ensure that the --tls-cert-file and --tls-private-key-file arguments are set as appropriate (Scored)
[PASS] 2.1.13 Ensure that the --cadvisor-port argument is set to 0 (Scored)
[FAIL] 2.1.14 Ensure that the RotateKubeletClientCertificate argument is set to true
[FAIL] 2.1.15 Ensure that the RotateKubeletServerCertificate argument is set to true
[INFO] 2.2 Configuration Files
[FAIL] 2.2.1 Ensure that the kubelet.conf file permissions are set to 644 or more restrictive (Scored)
[FAIL] 2.2.2 Ensure that the kubelet.conf file ownership is set to root:root (Scored)
[FAIL] 2.2.3 Ensure that the kubelet service file permissions are set to 644 or more restrictive (Scored)
[FAIL] 2.2.4 2.2.4 Ensure that the kubelet service file ownership is set to root:root (Scored)
[FAIL] 2.2.5 Ensure that the proxy kubeconfig file permissions are set to 644 or more restrictive (Scored)
[FAIL] 2.2.6 Ensure that the proxy kubeconfig file ownership is set to root:root (Scored)
[WARN] 2.2.7 Ensure that the certificate authorities file permissions are set to 644 or more restrictive (Scored)
[WARN] 2.2.8 Ensure that the client certificate authorities file ownership is set to root:root
```

Kube-hunter

- Penetration Testing tool for Kubernetes clusters.
- Looks for weaknesses in your cluster.
- 2 ways to run:
  - External to cluster (what an attacker sees)
  - Internal to cluster (install as a pod)
- Active and Passive mode.
  - Active mode changes stuff (probably don't use in Prod)
- Read more: https://kube-hunter.aquasec.com/

- **ONLY RUN ON YOUR OWN CLUSTER.**

Kube-hunter

172.17.0.1
Node / Master

6 vulnerabilities

SEVERITY	CATEGORY	VULNERABILITY	DESCRIPTION	EVIDENCE
High	Remote Code Execution	Dashboard Exposed	All oprations on the cluster are exposed	nodes: minikube
High	Remote Code Execution	Anonymous Authentication	The kubelet is misconfigured, potentially allowing secure access to all requests on the kubelet, without the need to authenticate	
Medium	Information Disclosure	K8s Version Disclosure	The kubernetes version could be obtained from logs in the /metrics endpoint	v1.10.0
Medium	Information Disclosure	Cluster Health Disclosure	By accessing the open /healthz handler, an attacker could get the cluster health state without authenticating	status: ok
Medium	Information Disclosure	Exposed Pods	An attacker could view sensitive information about pods that are bound to a Node using the /pods endpoint	count: 10
Low	Access Risk	Privileged Container	A Privileged container exist on a node, could expose the node/cluster to unwanted root operations	pod: kube-proxy-w8z8b, container: kube-proxy

Kubesec

- Helps you quantify risk for Kubernetes resources.
- Run against your K8s applications (deployments/pods/daemonsets etc)
- https://kubesec.io/ from controlplane

- Can be used standalone, or as a kubectl plugin (https://github.com/stefanprodan/kubectl-kubesec)

Kubesec example

```
~$ kubectl -n kube-system plugin scan deployment/kubernetes-dashboard
scanning deployment kubernetes-dashboard
deployment/kubernetes-dashboard kubesec.io score 3
-----------------
Advise
1. containers[] .securityContext .runAsNonRoot == true
Force the running image to run as a non-root user to ensure least privilege
2. containers[] .securityContext .capabilities .drop
Reducing kernel capabilities available to a container limits its attack surface
3. containers[] .securityContext .readOnlyRootFilesystem == true
An immutable root filesystem can prevent malicious binaries being added to PATH and increase attack cost
4. containers[] .securityContext .runAsUser > 10000
Run as a high-UID user to avoid conflicts with the host's user table
5. containers[] .securityContext .capabilities .drop | index("ALL")
Drop all capabilities and add only those required to reduce syscall attack surface
~$
```

Kubeaudit

- Opensourced from Shopify.
- Auditing your applications in your K8s cluster.
- https://github.com/Shopify/kubeaudit
- Little more targeted than Kubesec.

```
kubeaudit is a program that will help you audit
your Kubernetes clusters. Specify -l to run kubeaudit using ~/.kube/config
otherwise it will attempt to create an in-cluster client.

#patcheswelcome

Usage:
  kubeaudit [command]

Available Commands:
  allowpe     Audit containers that allow privilege escalation
  caps        Audit container for capabilities
  help        Help about any command
  image       Audit container images
  nonroot     Audit containers running as root
  np          Audit namespace network policies
  priv        Audit containers running as root
  rootfs      Audit containers with read only root filesystems
  sat         Audit automountServiceAccountToken = true pods against an empty (default) service account
  version     Print the version number of kubeaudit

Flags:
  -a, --allPods             Audit againsts pods in all the phases (default Running Phase)
  -h, --help                help for kubeaudit
  -j, --json                Enable json logging
  -c, --kubeconfig string   config file (default is $HOME/.kube/config
  -l, --local               Local mode, uses ~/.kube/config as configuration
  -f, --manifest string     yaml configuration to audit
  -v, --verbose string      Set the debug level (default "INFO")

Use "kubeaudit [command] --help" for more information about a command.
```

Kubeaudit example

```
-$ /Users/karthik/Downloads/kubeaudit_0.2.0_darwin_amd64/kubeaudit allowpe -c /Users/karthik/.kube/config
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=dotnetworld Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=javademo Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=prom-demo-prometheus-alertmanager Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=prom-demo-prometheus-kube-state-metrics Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=prom-demo-prometheus-pushgateway Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=prom-demo-prometheus-server Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=wishlist-deployment Namespace=default
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=contour Namespace=heptio-contour
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=kube-dns Namespace=kube-system
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=kube-dns-autoscaler Namespace=kube-system
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=kubernetes-dashboard Namespace=kube-system
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=oci-volume-provisioner Namespace=kube-system
ERRO[0003] SecurityContext not set, please set it!        KubeType=deployment Name=tiller-deploy Namespace=kube-system
ERRO[0003] SecurityContext not set, please set it!        KubeType=daemonSet Name=prom-demo-prometheus-node-exporter Namespace=default
ERRO[0003] AllowPrivilegeEscalation not set which allows privilege escalation, please set to false  KubeType=daemonSet Name=kube-flannel-ds Namespace=kube-system
ERRO[0003] AllowPrivilegeEscalation not set which allows privilege escalation, please set to false  KubeType=daemonSet Name=kube-proxy Namespace=kube-system
```

Sonobuoy by Heptio

- Sonobuoy is a diagnostic tool.
- Tells you whether your cluster is built correctly per best practices.
- vendor-agnostic conformance tests to let you test the cluster.
- End to End tests test that APIs required for your deployment are supported by the cluster.
- Can take a long time to finish (1-3 hours).
- https://scanner.heptio.com/

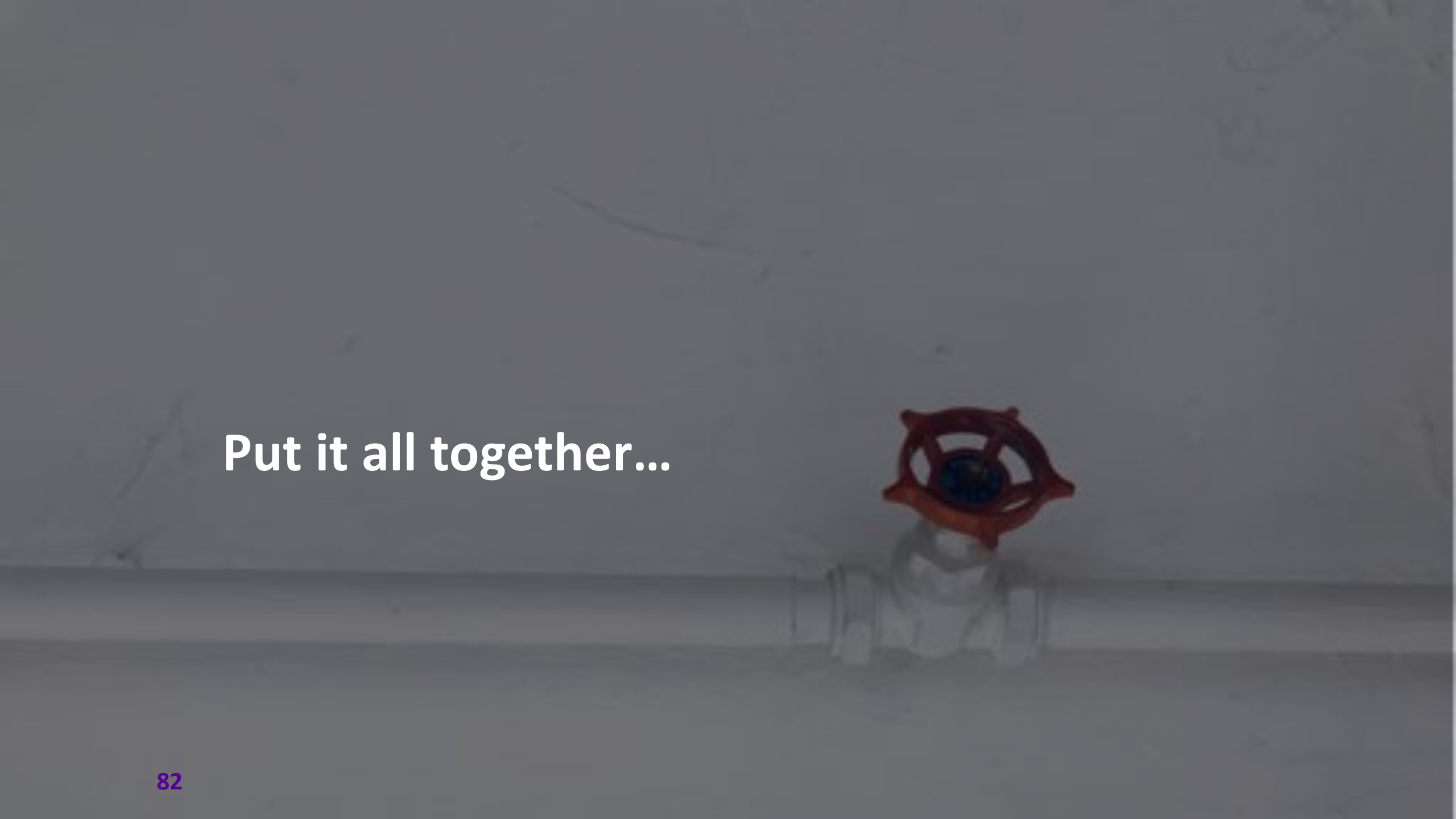
Test Output summary

- Stored in a file called e2e.log

GitHub, Inc. [US] | https://github.com/cncf/k8s-conformance/blob/master/v1.11/oke/e2e.log

```
7630  ------------------------------
7631  Sep 19 21:22:51.543: INFO: Running AfterSuite actions on all node
7632  Sep 19 21:22:51.543: INFO: Running AfterSuite actions on node 1
7633  Sep 19 21:22:51.543: INFO: Skipping dumping logs from cluster
7634
7635  Ran 143 of 996 Specs in 5025.706 seconds
7636  SUCCESS! -- 143 Passed | 0 Failed | 0 Pending | 853 Skipped PASS
7637
7638  Ginkgo ran 1 suite in 1h23m46.684104996s
7639  Test Suite Passed
```

Put it all together…



Apply It!

- **Day 1:**
- Know what version of Docker and Kubernetes you use.
- Understand if your control and data plane nodes are hardened.
- Understand how your Docker containers are built.
- Find out how you authenticate and authorize for your clusters.

Apply It!

- **Week 1:**
- Build an Automation Pipeline:
  - To build Docker images on code pushes
  - Versioning strategy for code
  - To build your Kubernetes clusters

Apply It!

- **1st Month**
- Sanitize your code:
  - Know your base images
  - Implement versioning for your containers
  - Invest in a registry (or tooling) that does vulnerability scanning
- Kubernetes:
  - Have an upgrade strategy in place
  - Analyze secrets/sensitive cluster data
  - Turn on audit logging

Apply It!

- **3 Months:**
- Continuously Monitor
  - Tooling like sonobuoy/Kubesec/Kube-audit/kube-hunter//
- Plan how to address vulnerabilities/CVE's
- K8s:
  - Strategy for Pod Security Policies
  - Strategy for Network Policies
  - Run scans (like kube-bench) on cluster creation

Apply It!

- **6 Months:**
- Re-ask day 1 questions.
- Review strategies- is it working? What needs tweaking?
- Review tooling- are there new tools that help? Are existing tools working?
- Review CVE's

Couple more resources to look at:

- 11 ways not to get hacked: https://kubernetes.io/blog/2018/07/18/11-ways-not-to-get-hacked

- K8s security (from Image Hygiene to Network Policy): https://speakerdeck.com/mhausenblas/kubernetes-security-from-image-hygiene-to-network-policies

KEEP CALM AND KUBE ON

@iteration1