


KubeCon | CloudNativeCon

Europe 2020

Virtual

Help! My Cluster Is On The Internet!

Container Security Fundamentals

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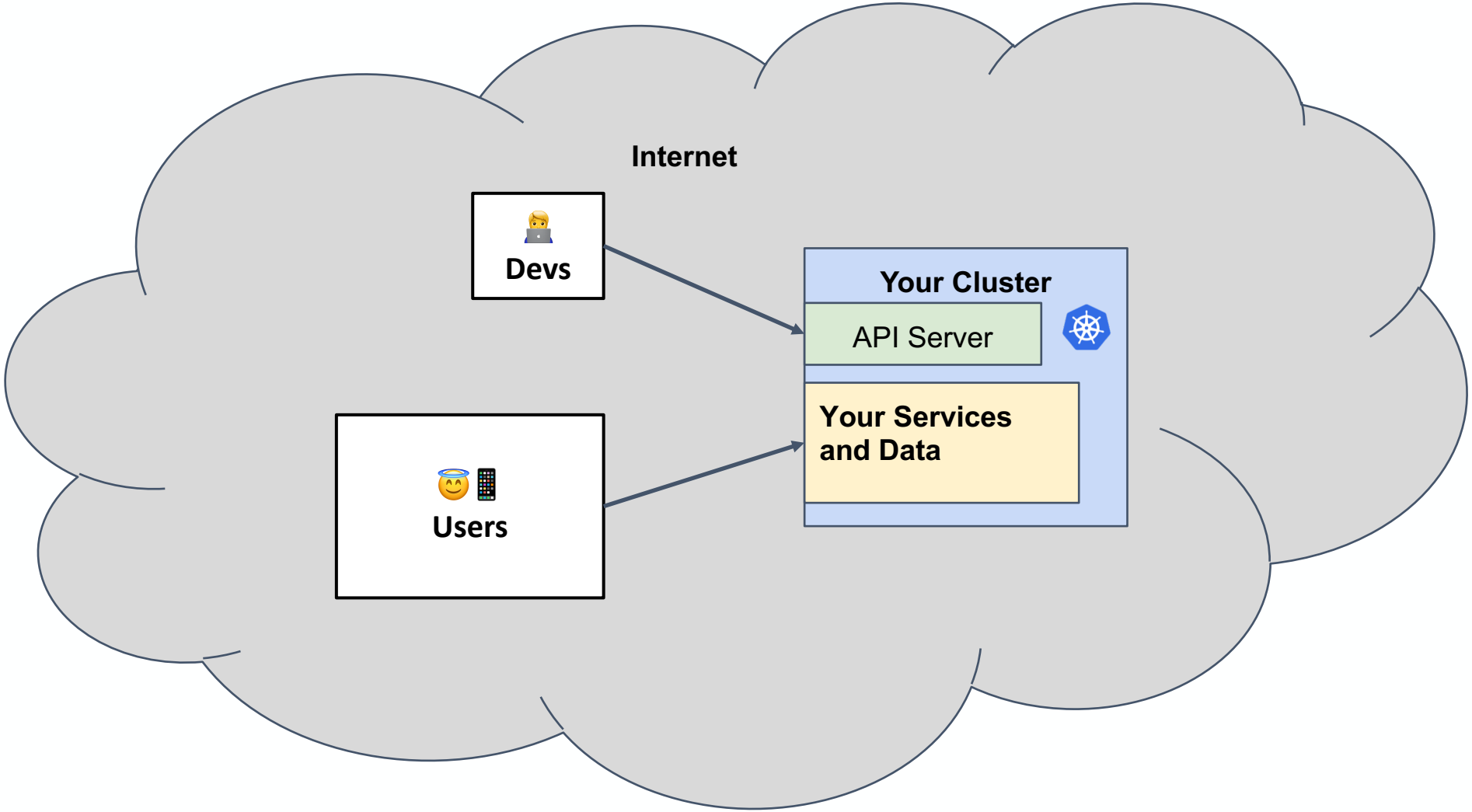
About Me

Samuel Davidson

Google Kubernetes Engine (GKE) Security for 2.5 years.

A lot of identity and authorization work for GKE.

Help! My Cluster Is On The Internet!



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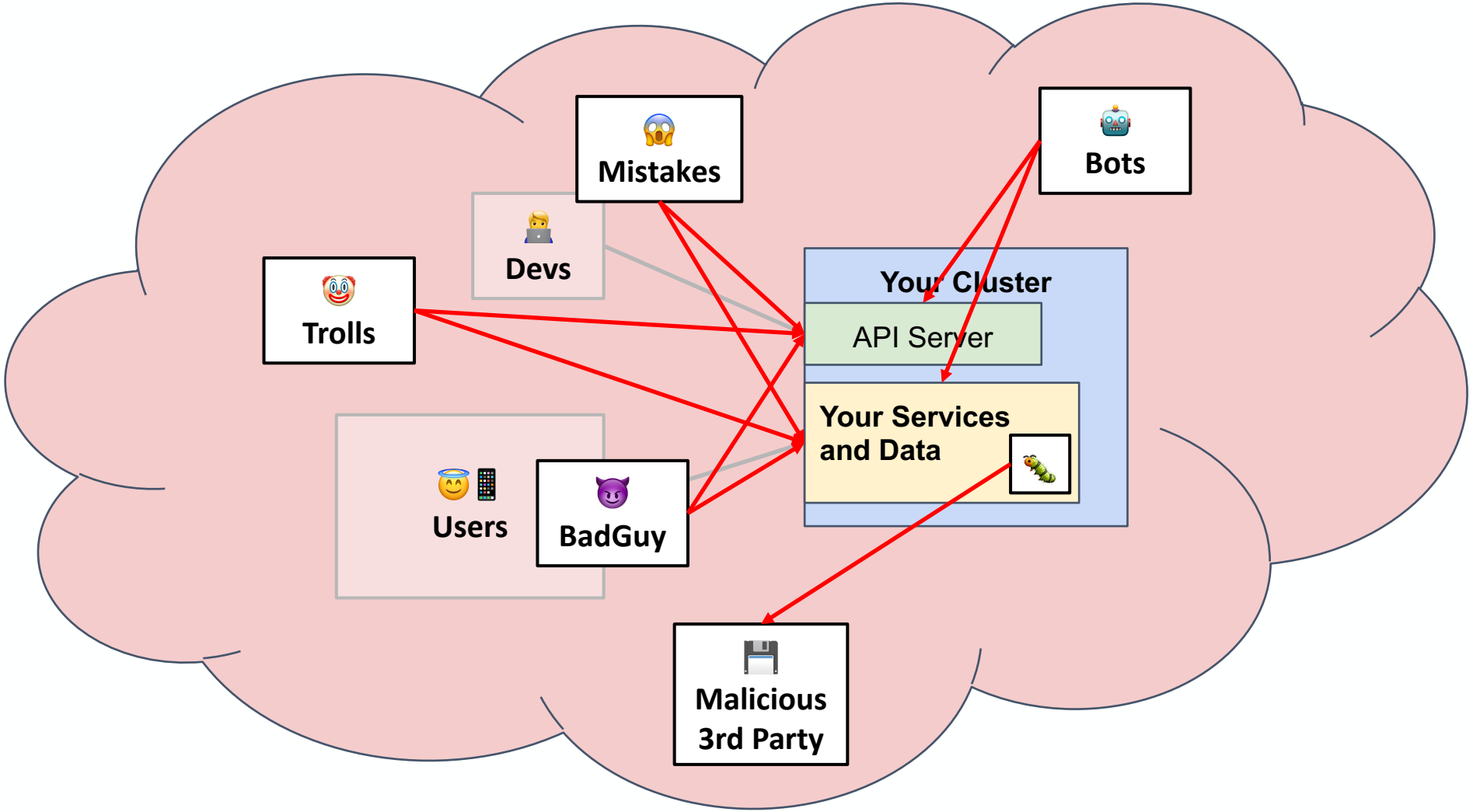
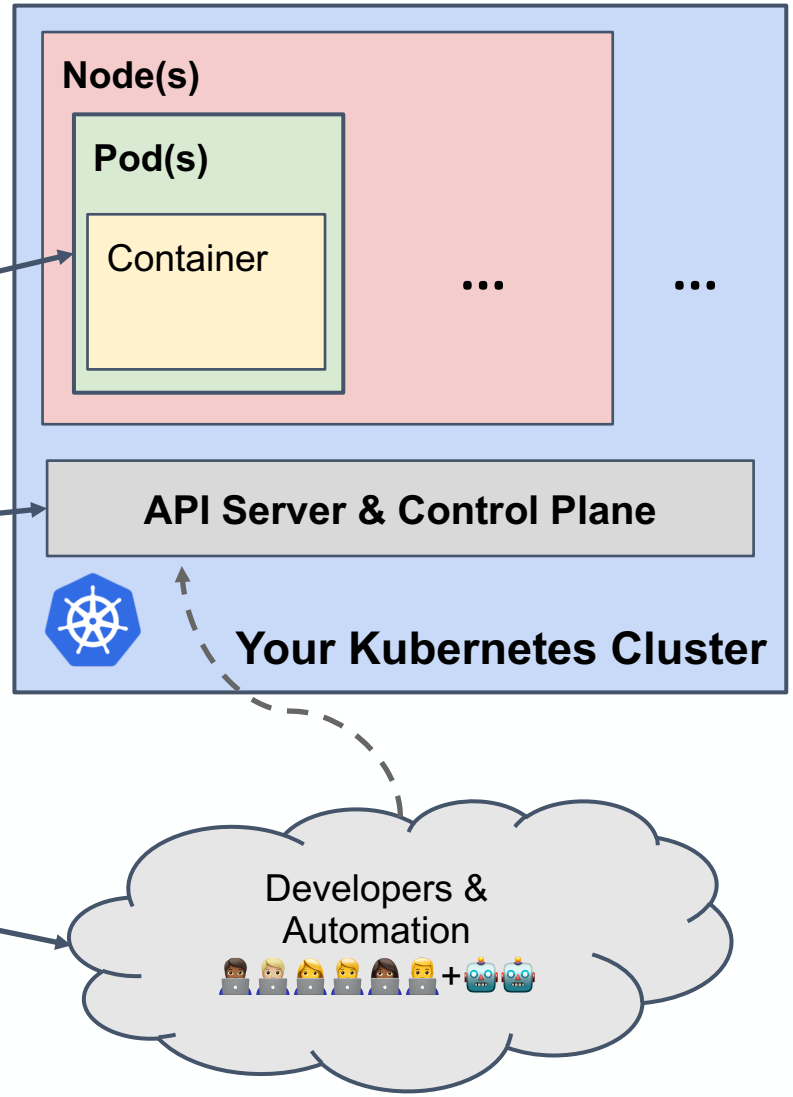
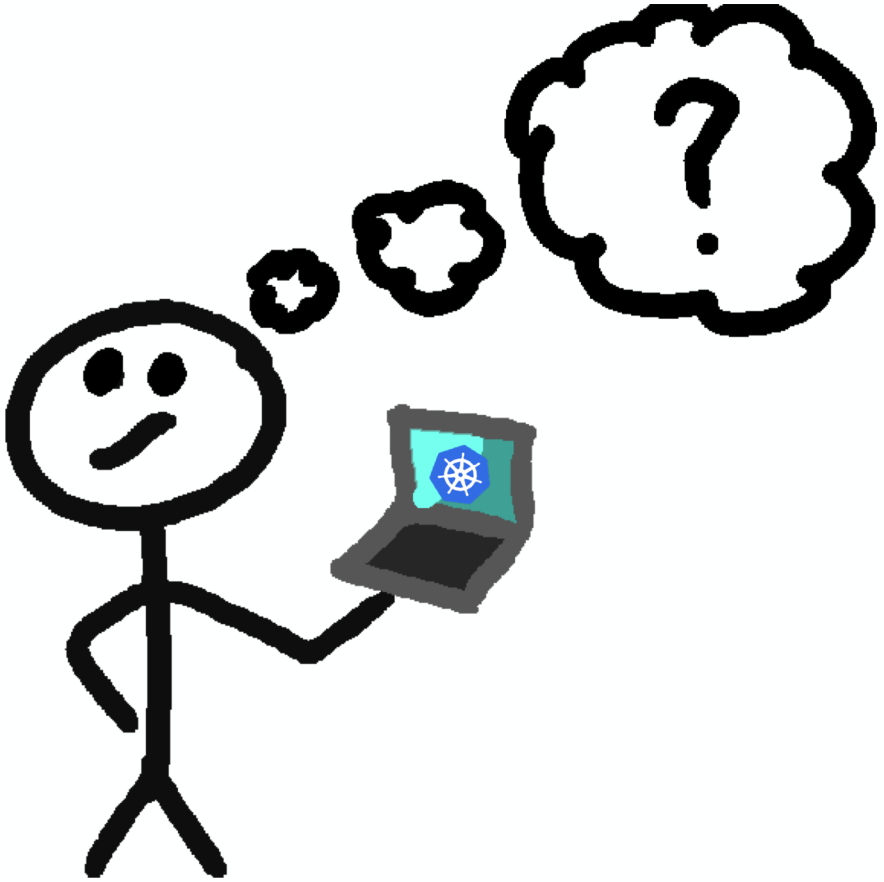


Structure Of This Talk

1. Workload Security
2. Cluster Security
3. User Security

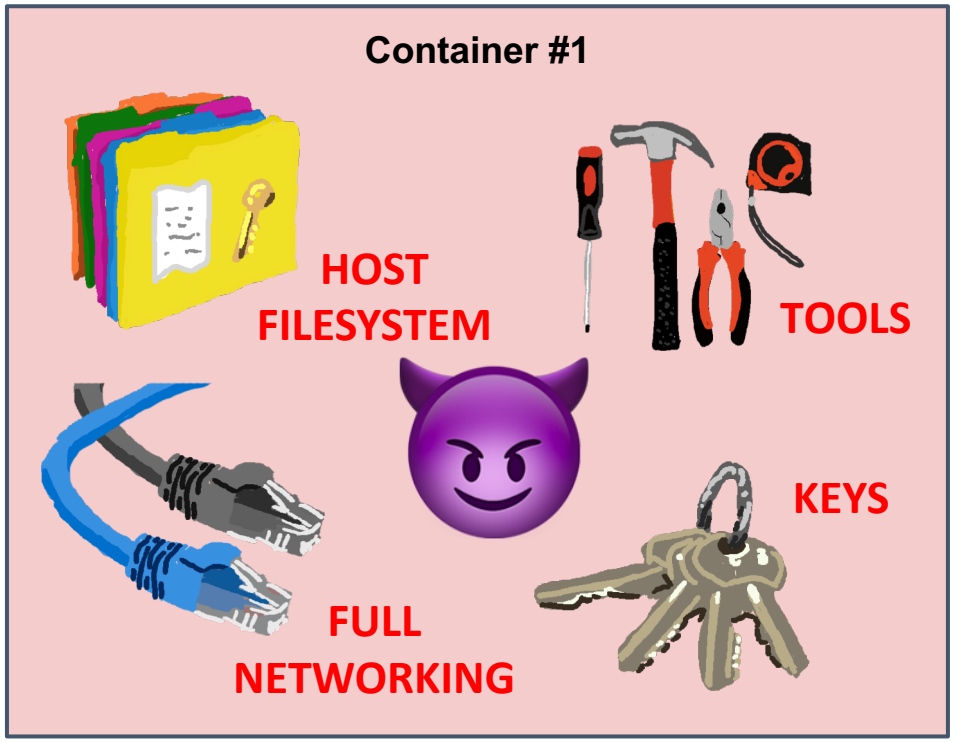


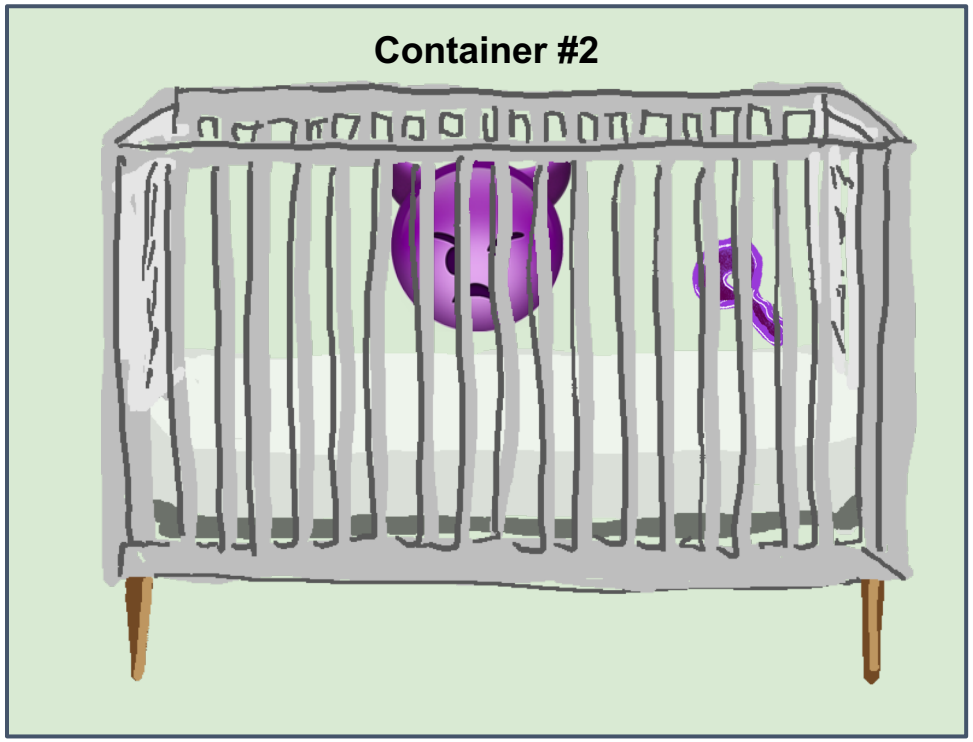
1. Workload Security



1. Workload Security - Containers

#1 - Assume that you will be OWNED.





1. Workload Security - Containers

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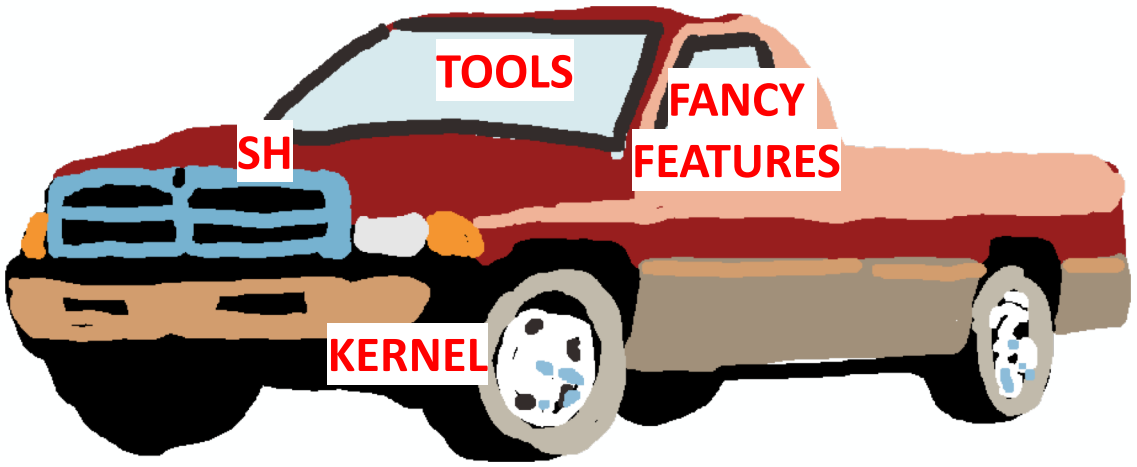
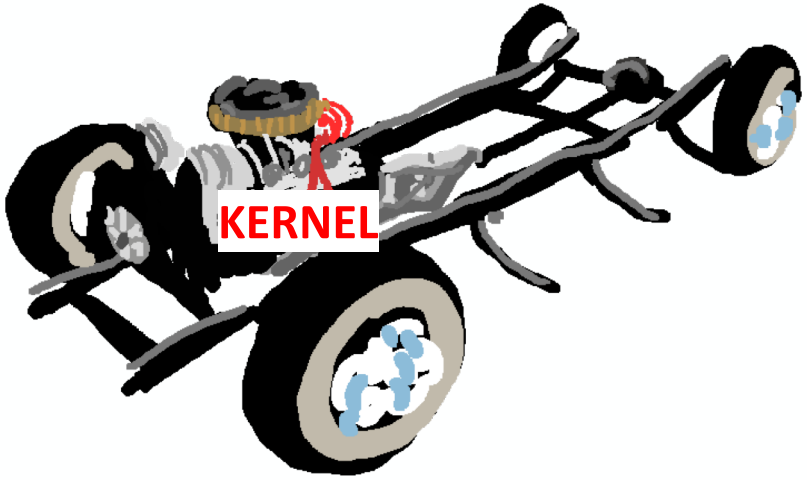
#2 - Use a *distroless* base image.



Debian10



Distroless Debian10

1. Workload Security - Containers

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#2 - Use a *distroless* base image.

```
FROM golang:1.13-buster as builder
WORKDIR /go/src/app
ADD . /go/src/app

RUN go get -d -v ./...

RUN go build -o /go/bin/app

# Now copy it into our base image.
FROM debian:10
COPY --from=build /go/bin/app /
CMD ["/app"]
```

```
FROM golang:1.13-buster as builder
WORKDIR /go/src/app
ADD . /go/src/app

RUN go get -d -v ./...

RUN go build -o /go/bin/app

# Now copy it into our base image.
FROM gcr.io/distroless/base-debian10
COPY --from=build /go/bin/app /
CMD ["/app"]
```

1. Workload Security - Containers

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#2 - Use a *distroless* base image.

https://github.com/GoogleContainerTools/distroless
(bit.ly/39lU5i7)
or just search "distroless"

1. Workload Security - Containers

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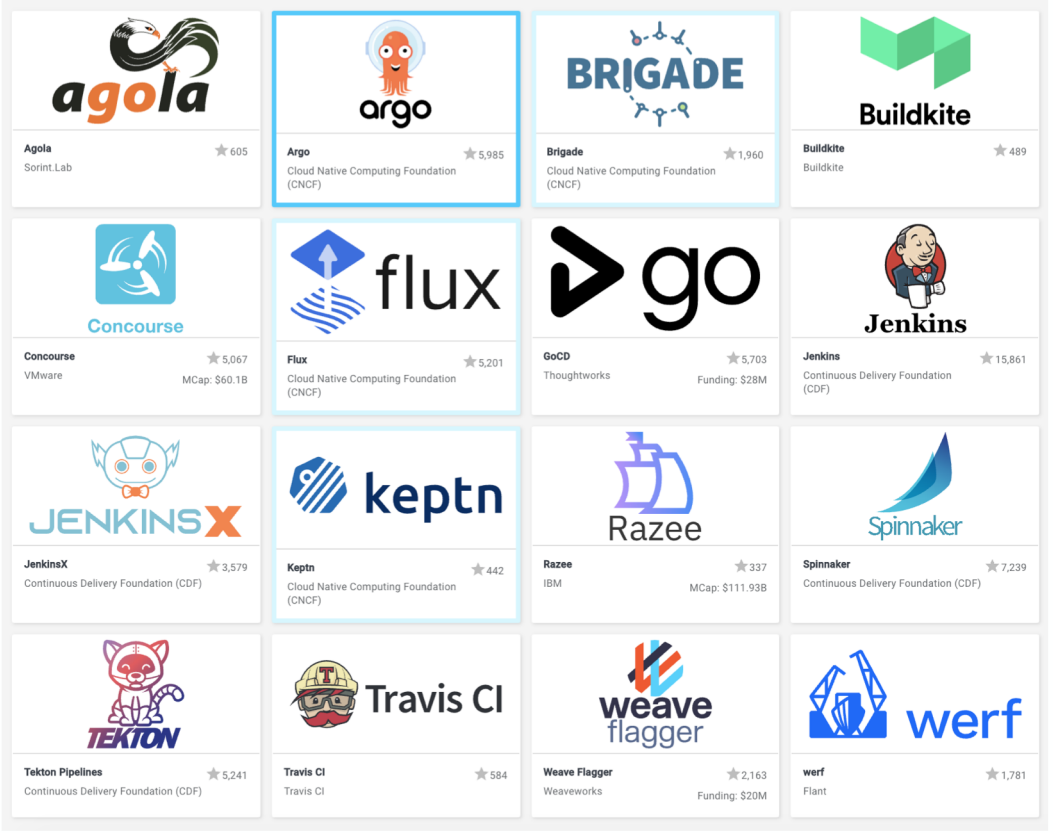
#3 - Containers are easy rebuild and deploy.

HELP! 😱 I've got a critical vulnerability in my container!!

Just bump your dependencies and redeploy. 😄



landscape.cncf.io

1. Workload Security - Containers

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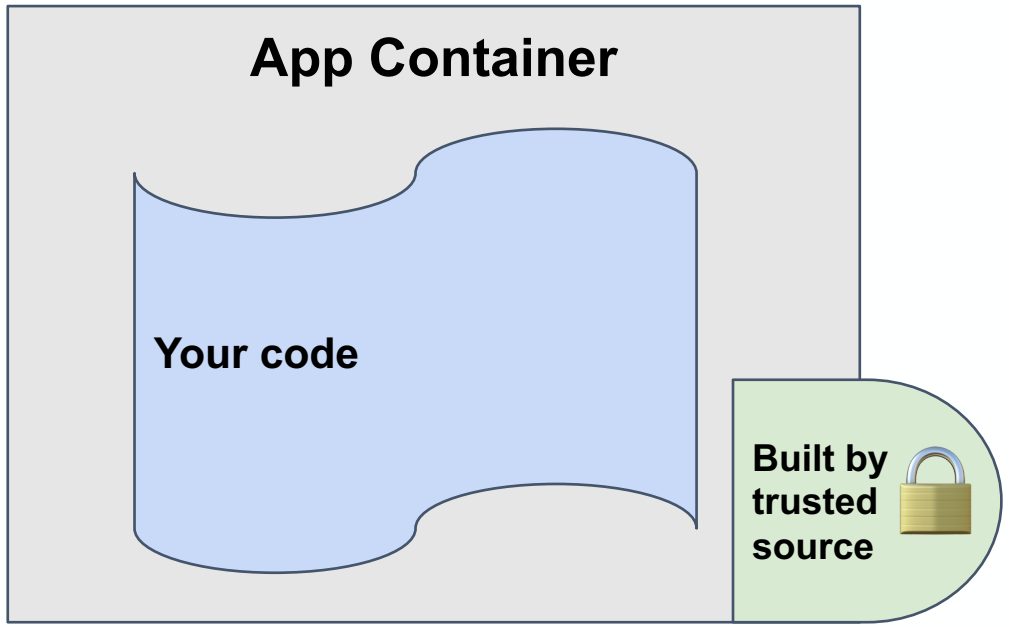
#4 - Trust your containers with **signatures!**



A.K.A:

Binary Authorization
Signed Containers
Image Signing
Binary Attestation
Content Trust

1. Workload Security - Containers

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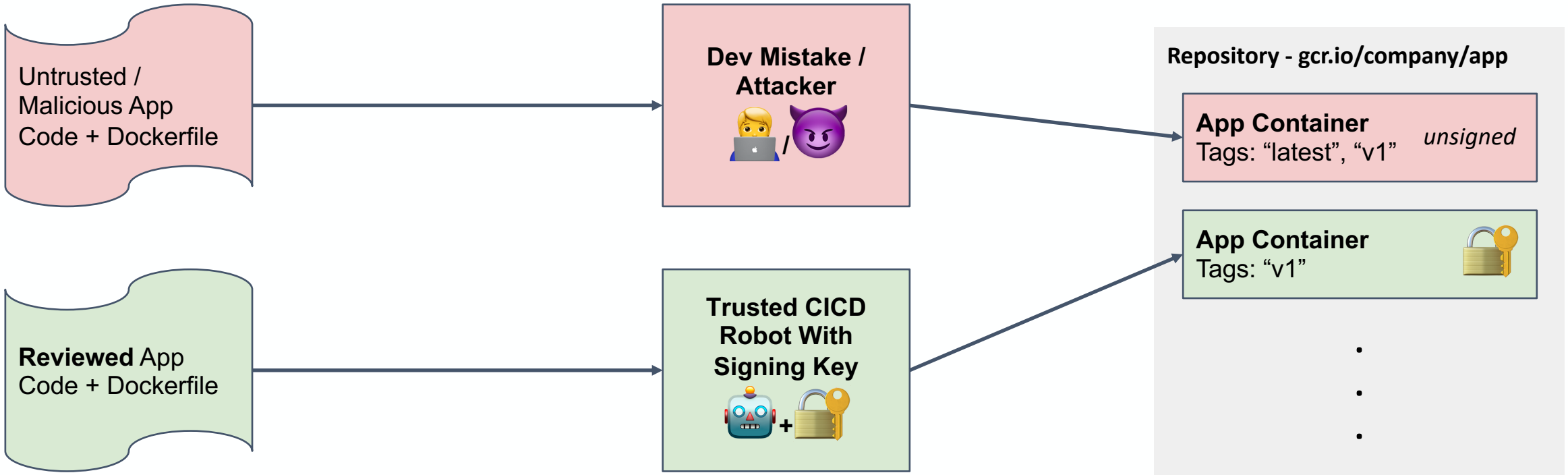
#4 - Trust your containers with **signatures!**



1. Workload Security - Containers

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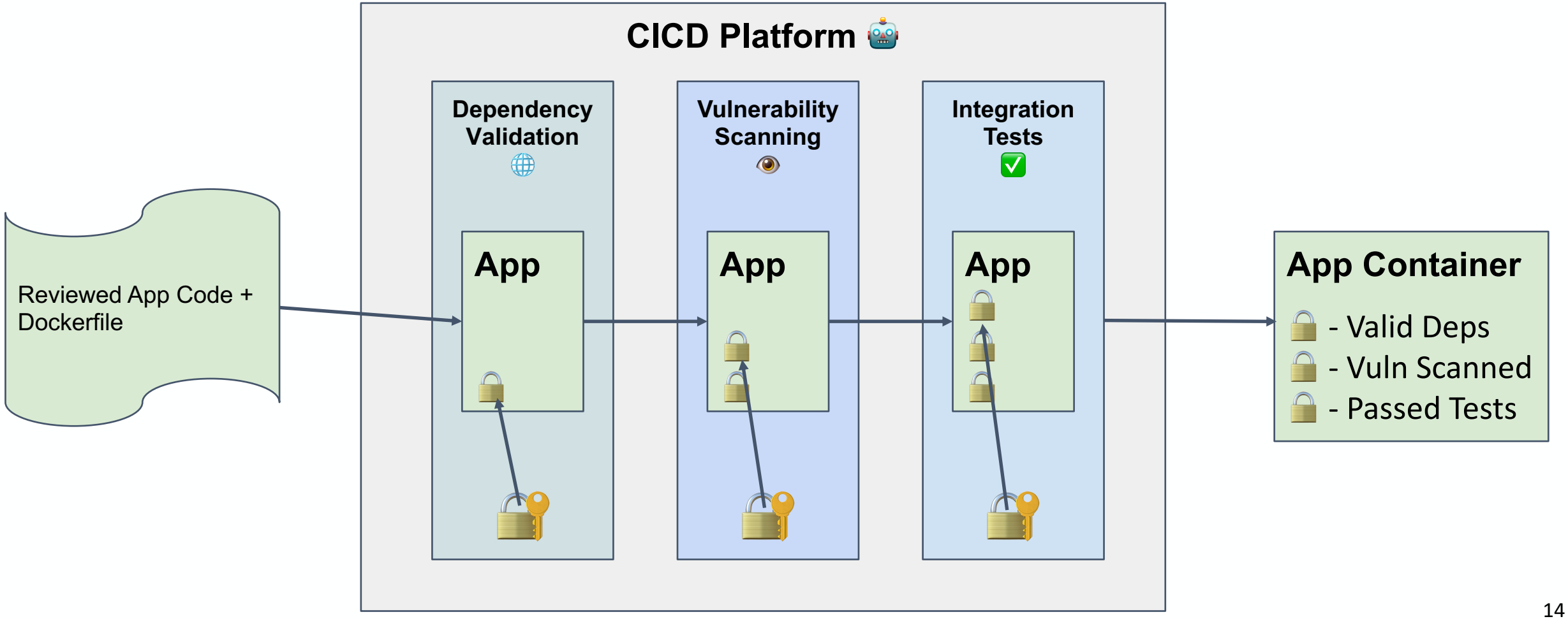
#4 - Trust your containers with **signatures!**



1. Workload Security - Containers

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#4 - Trust your containers with **signatures!**

App Container

unsigned

❌

App Container

🔒 - Valid Deps
🔒 - Vuln Scanned
🔒 - Passed Tests

✅

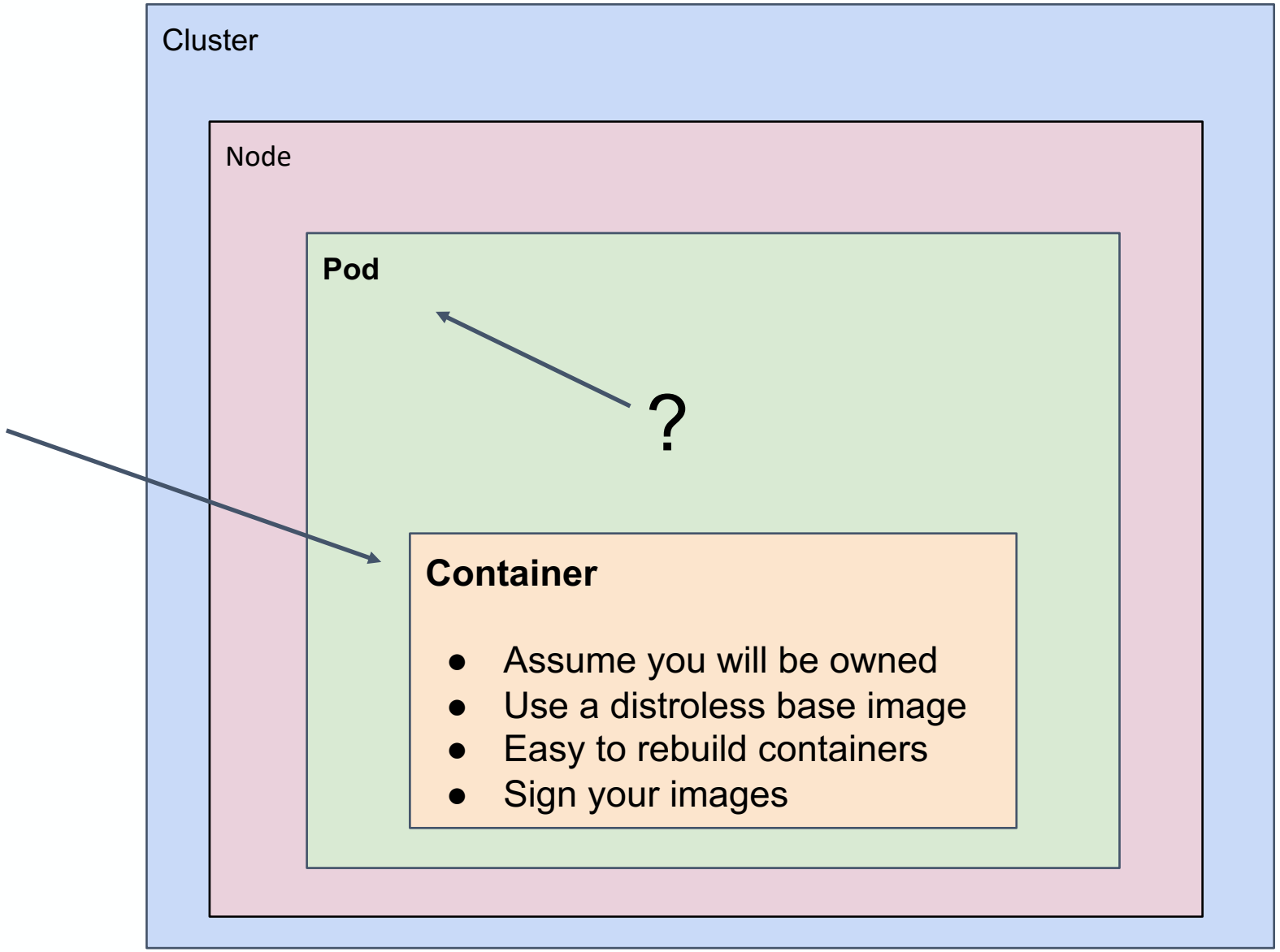
Your Kubernetes Cluster

```
SOME-POLICY-ENGINE:
          RequireSignedContainers: true
          SignedContainerKeys: [...]
```

Pst.. we will talk more about how to do this later.

1. Workload Security

Recap:



1. Workload Security - Pods

This concerns PodSpec configs *everywhere*.

- **`Pods`**
- **`DaemonSets`**
- **`Jobs`**
- **`CronJobs`**
- **`ReplicaSet`**
- **`StatefulSet`**
- **`etc...`**

PodSpec API Reference

https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.18/#podspec-v1-core

(bit.ly/2CUsKHM)

1. Workload Security - Pods

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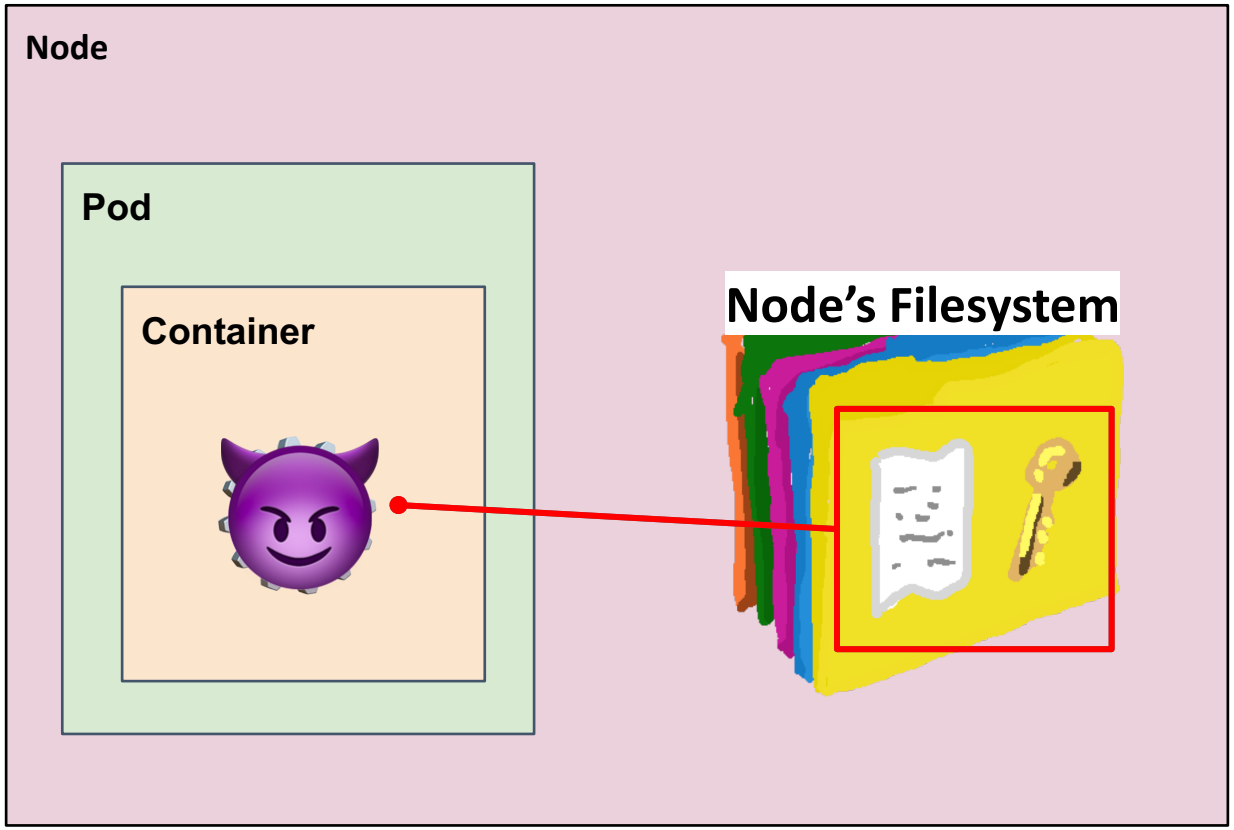
#1 - Don’t use **hostPath**.



1. Workload Security - Pods

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#1 - Don't use **hostPath**.

`.volumes.hostPath`

example:

```
apiVersion: v1
kind: Pod
metadata:
        name: example
spec:
  containers:
  - image: gcr.io/org/app
    name: example
    volumeMounts:
    - mouthPath: /keys
      name: keys-volume
  volumes:
    - name: keys-volume
      hostPath: /etc/pod_data/
```

*Sure, maybe there is nothing scary in **/etc/pod_data** right now…*
But what about a year from now?
Do all devs know the danger of this folder?

1. Workload Security - Pods

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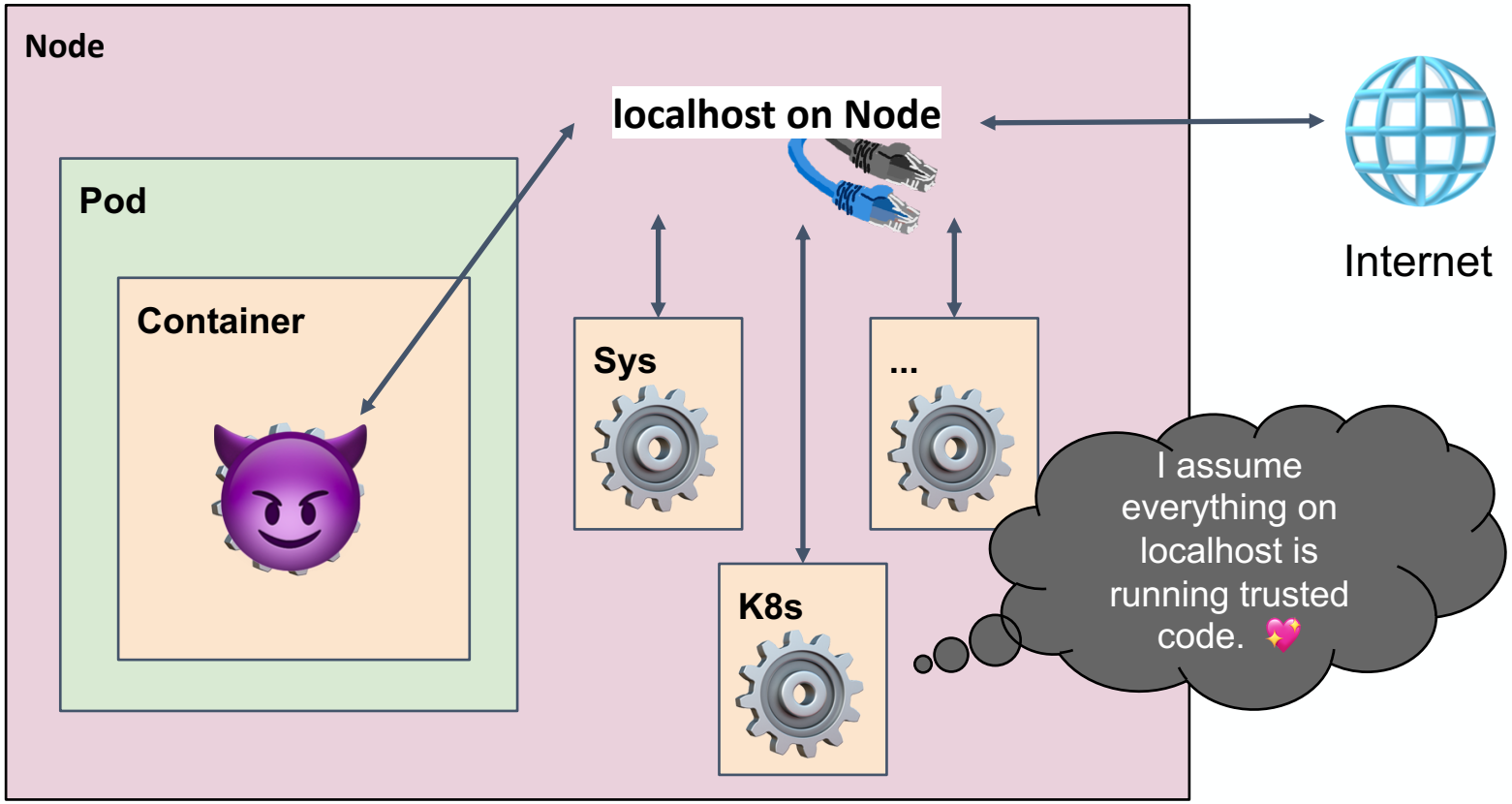
#2 - Don't use **hostNetwork**.



1. Workload Security - Pods

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#2 - Don’t use **hostNetwork**.

`.hostNetwork`

example:

```
apiVersion: v1
kind: Pod
metadata:
  name: example
spec:
  containers:
  - image: gcr.io/org/app
    name: example
    ports:
    - 4444
  hostNetwork: true
```

just don’t include this line

1. Workload Security - Pods

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#3 - Be conscious of your pod's Service Account.

simple pod spec:

```
apiVersion: v1
kind: Pod
metadata:
  name: simple
spec:
  containers:
  - image: gcr.io/org/app
    name: simple
```

Are there any SA credentials bound to this pod?

Actually yes! Every pod is bound to a SA.

If no SA is specified the SA named "default" is used.

Pod is in "default" namespace so the SA loaded is:
/api/v1/namespaces/default/serviceaccounts/default

Mounted at:
`/var/run/secrets/kubernetes.io/serviceaccount/`

1. Workload Security - Pods

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#3 - Be conscious of your pod's Service Account.

Some easy recommendations:

- Bind a different SA, that is unique to its use-case.
- Put the pod in a different namespace.
- Set `automountServiceAccountToken` to false.

If your workload doesn't need Kubernetes API server access, just do this!

```
apiVersion: v1
kind: Pod
metadata:
  name: simple
spec:
  automountServiceAccountToken: false
  containers:
  - image: gcr.io/org/app
    name: simple
```

1. Workload Security - Pods

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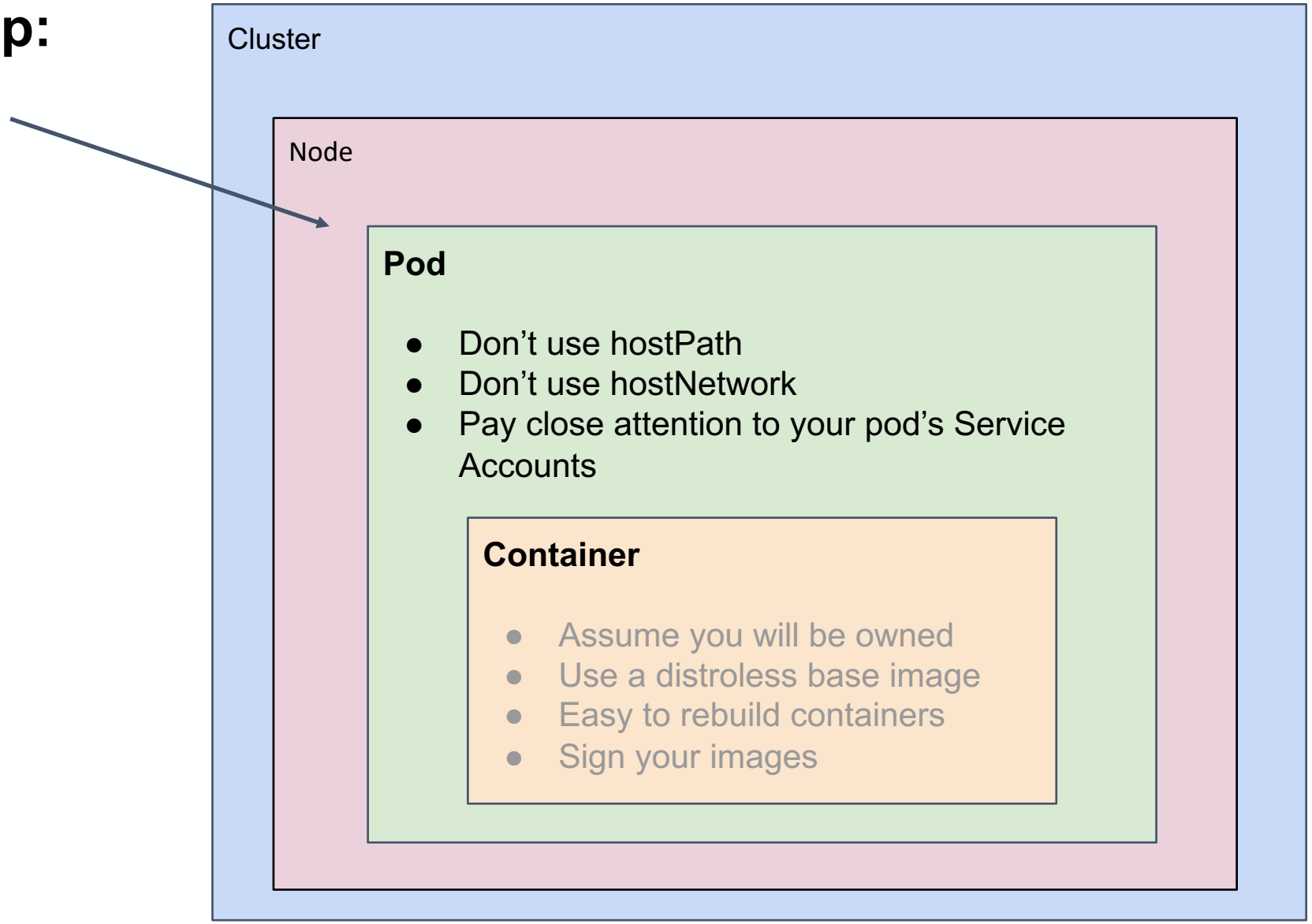
#3 - Be conscious of your pod's Service Account.

Learn More!

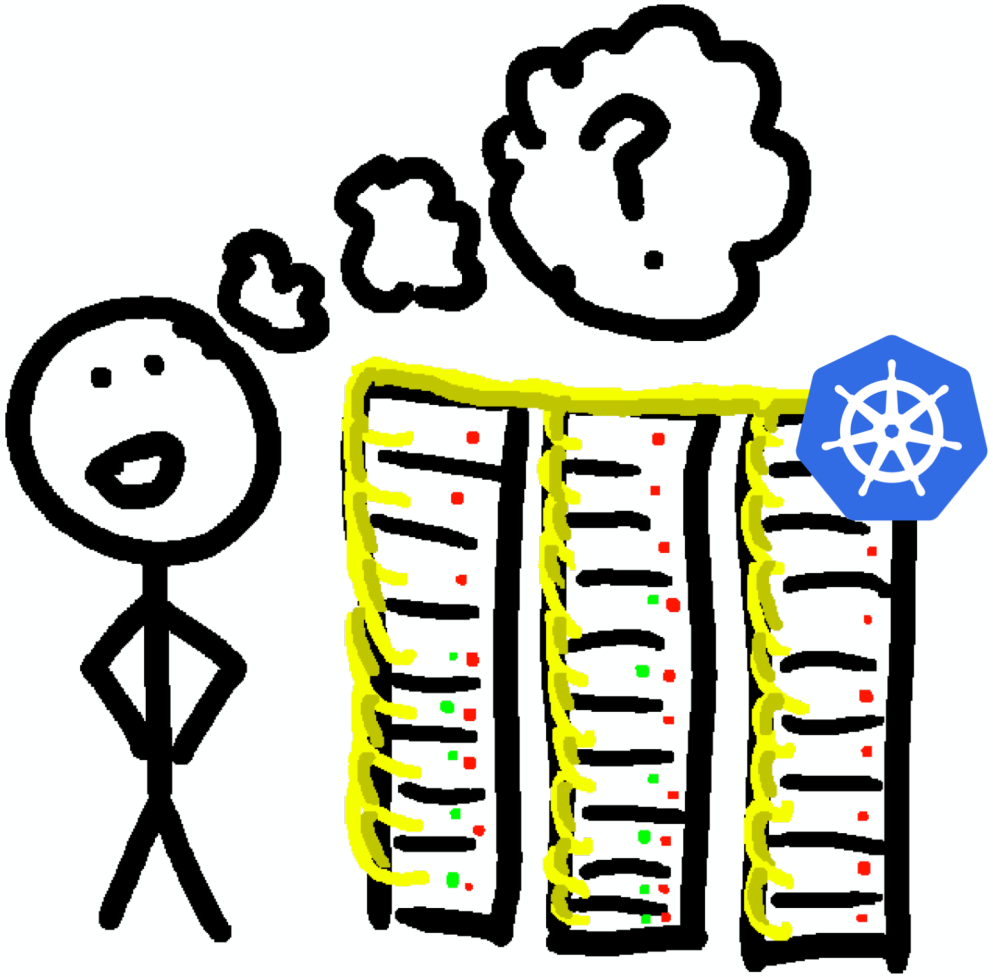
Kubernetes Docs on Service Accounts
https://kubernetes.io/docs/tasks/configure-pod-container/configure-service-account/
(bit.ly/30C3rIP)

1. Workload Security

Recap:



2. Cluster Security



2. Cluster Security

#1 - Keep your cluster up to date.

Bugs and vulnerabilities are fixed all the time!

github 1.16 post-release bugfix PRs
https://bit.ly/2OPsoVA

Their Cluster
v1.16.0

v1.16.0 has been working just fine for us, I don't want to rock the boat.

Consider this! Since 1.16.0 there have been **174 bugfix PRs** into the release branch. The latest patch version is **1.16.14**.*

* as of 7/29/2020

2. Cluster Security

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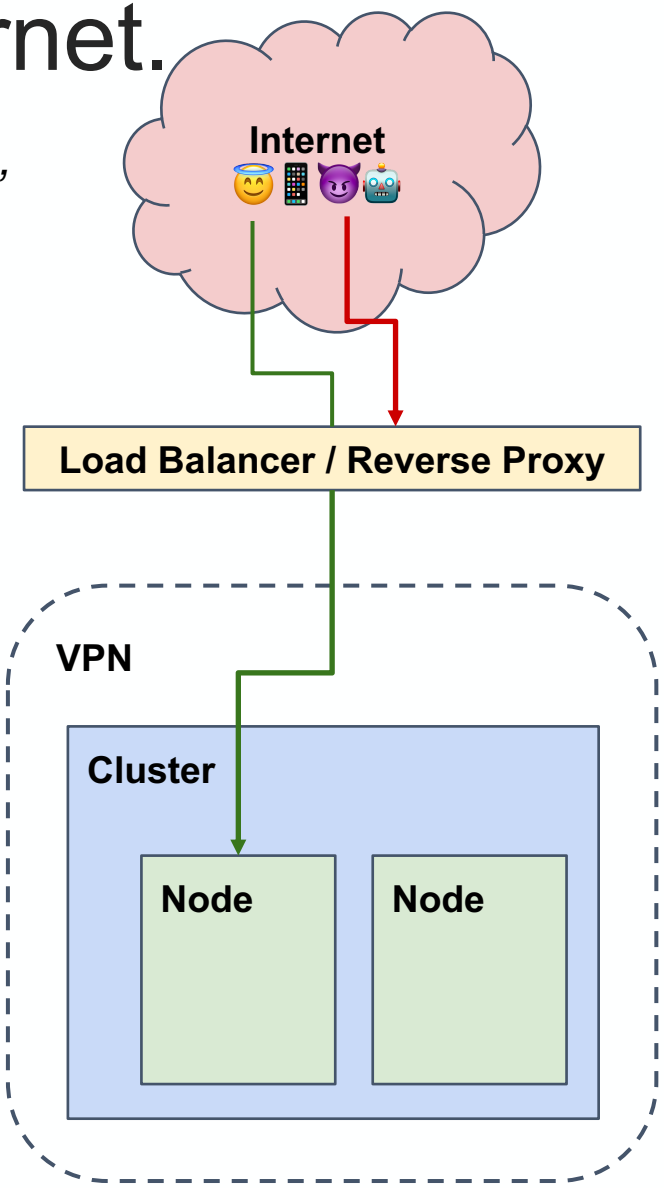
#2 - Isolate your cluster from the internet.

"Help! My Cluster Is On The Internet!"

- Ideally **the entire cluster** is in a private network (VPN, auth-proxy, etc).
  - No public IPs for any cluster VMs.
- Solutions to common needs:
  - Devs/bots need API access?
    - Log them into the network
  - Users on internet need access to services/pods?
    - External load balancer that can forward traffic to nodes
  - Cluster needs internet access?
    - Egress only internet access from private network.



2. Cluster Security

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#3 - For your secrets use Secrets.

- Great for Access Keys, Passwords, Tokens, etc.
- Stored in memory, never saved to a node.
- Only loaded as-needed by pods.
- Easy authorization policy with RBAC.
- Not great for non-sensitive or lengthy configs, documents, large files.
  - Use ConfigMaps or other storage.

Kubernetes Docs on Secrets

https://kubernetes.io/docs/concepts/configuration/secret/
(bit.ly/3064n2E)

2. Cluster Security

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#3 - For your secrets use Secrets.

Some namespace for the workload.

```
$ kubectl create secret generic sensitive-key --from-file=./sensitive.key --namespace=app-sensitive
```

```
apiVersion: v1
kind: Secret
metadata:
  name: sensitive-key
  namespace: app-sensitive
type: Opaque
data:
  sensitive.key: ...BASE64...
```

2. Cluster Security

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#3 - For your secrets use Secrets.

```
apiVersion: v1
kind: Secret
metadata:
  name: sensitive-key
  namespace: app-sensitive
type: Opaque
data:
  sensitive.key: ...BASE64...
```

```
apiVersion: v1
kind: Pod
metadata:
  name: pod-with-secret
  namespace: app-sensitive
spec:
  containers:
  - image: gcr.io/org/app
    name: app-with-secret
  volumeMounts:
    - name: keys
      mountPath: "/etc/key"
      readOnly: true
  volumes:
  - name: keys
    secret:
      secretName: sensitive-key
```

2. Cluster Security

Recap:

Cluster

- Keep your cluster up to date
- Isolate your cluster from the internet
- Use Secrets

Node

- *Isolate your nodes from the internet*

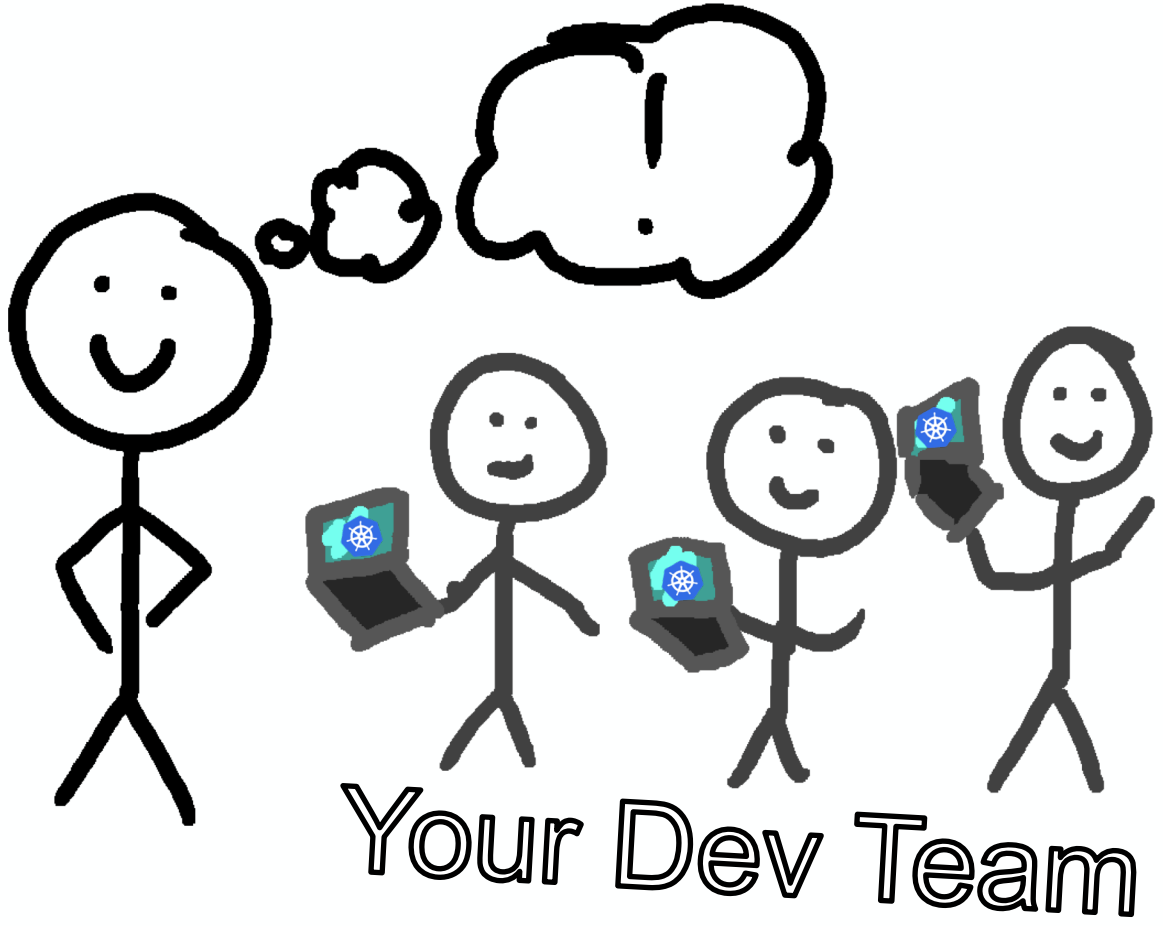
Pod

- Don't use hostPath
- Don't use hostNetwork
- Pay close attention to your pod's Service Accounts

Container

- Assume you will be owned
- Use a distroless base image
- Easy to rebuild containers
- Sign your images

3. User Security



3. User Security

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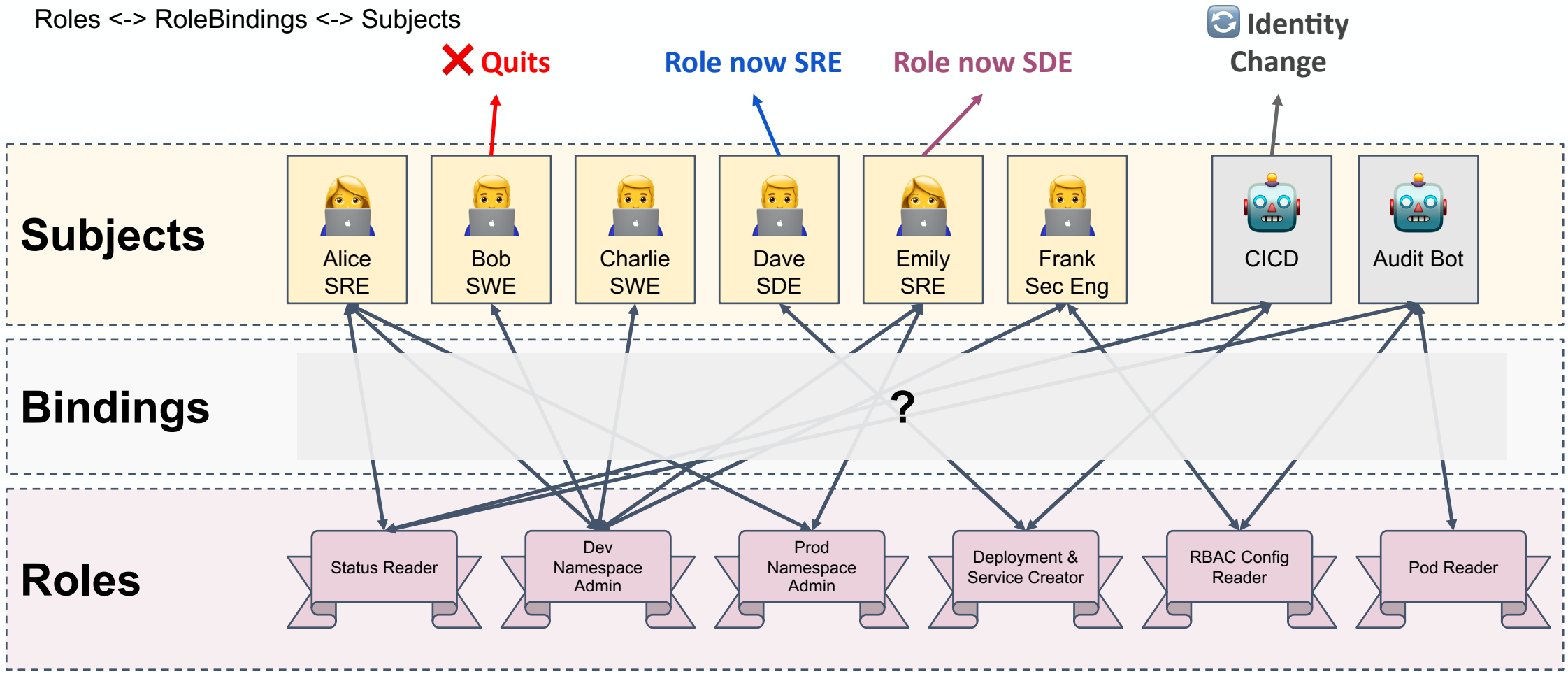
#1 - Use RBAC and groups.

"Role Based Access Control":
Roles <-> RoleBindings <-> Subjects



3. User Security

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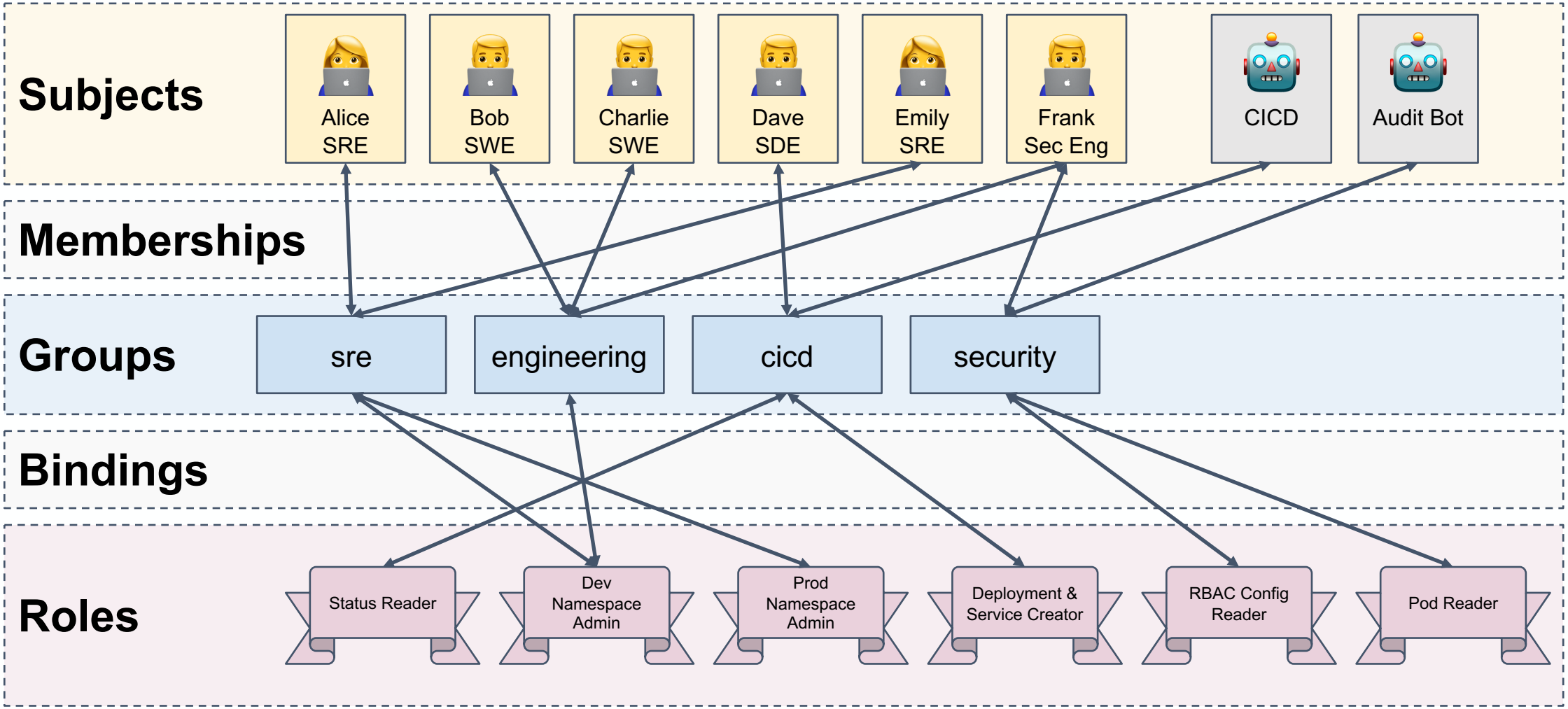
#1 - Use RBAC and groups.



3. User Security

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#1 - Use RBAC and groups.

RBAC Docs

https://kubernetes.io/docs/reference/access-authn-authz/rbac/
(bit.ly/30GcGRR)

RBAC API

https://kubernetes.io/docs/reference/generated/kubernetes-api/v1.18/#role-v1-rbac-authorization-k8s-io
(bit.ly/3hrhAJj)

3. User Security

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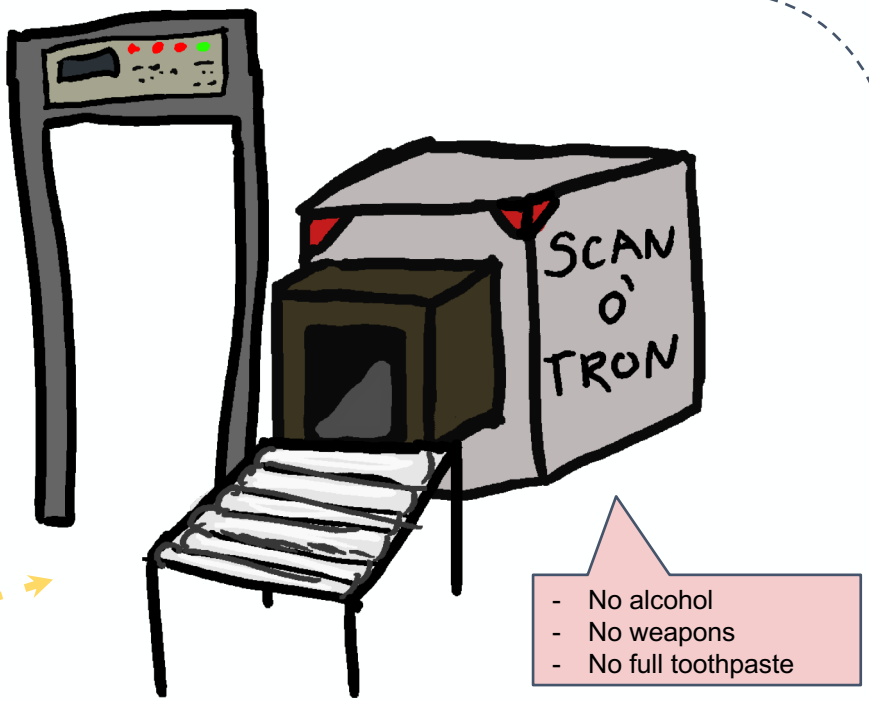
#2 - Use a policy agent to protect you cluster.

- Typically a Kubernetes *AdmissionController* which selectively allows/denies Kubernetes resource requests based on rules (or policies).

RBAC



Admission Controllers

3. User Security

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#2 - Use a policy agent to protect you cluster.

- Can enforce all kinds of best practices at runtime
  - No **hostPath**, **hostNetwork**
  - Default SAs
  - Allow/block images
  - Signatures
  - No Keys
  - RBAC
  - Labels (owner)
  - … plus much, MUCH more
- Audits of existing resources

3. User Security

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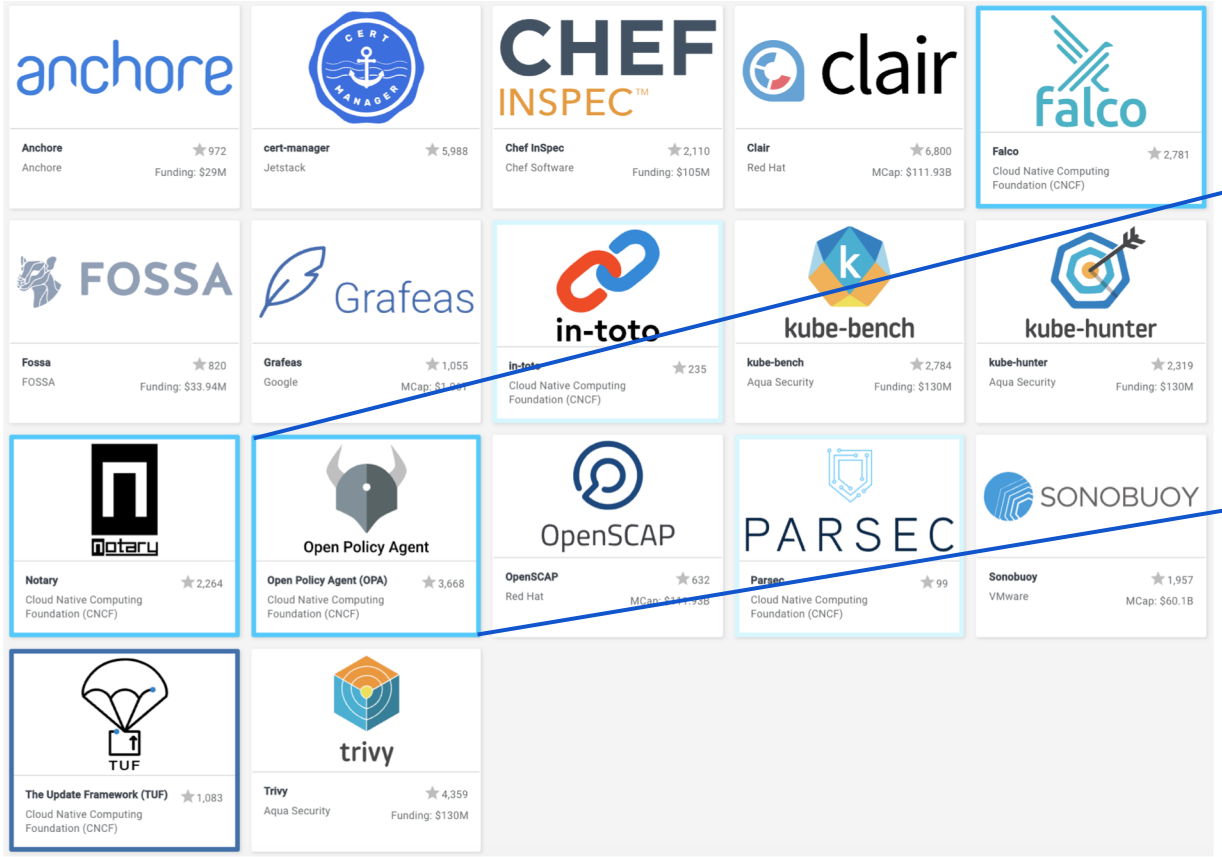
#2 - Use a policy agent to protect you cluster.



Open Policy Agent

Gatekeeper

https://github.com/open-policy-agent/gatekeeper
(bit.ly/2WNlEM3)

landscape.cncf.io

3. User Security

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#2 - Use a policy agent to protect you cluster.

App Container

unsigned

❌

App Container

🔒 - Valid Deps
🔒 - Vuln Scanned
🔒 - Passed Tests

✅

Your Kubernetes Cluster

```
SOME-POLICY-ENGINE:
          RequireSignedContainers: true
          SignedContainerKeys: [...]
```

Pst.. we will talk more about how to do this later.

3. User Security

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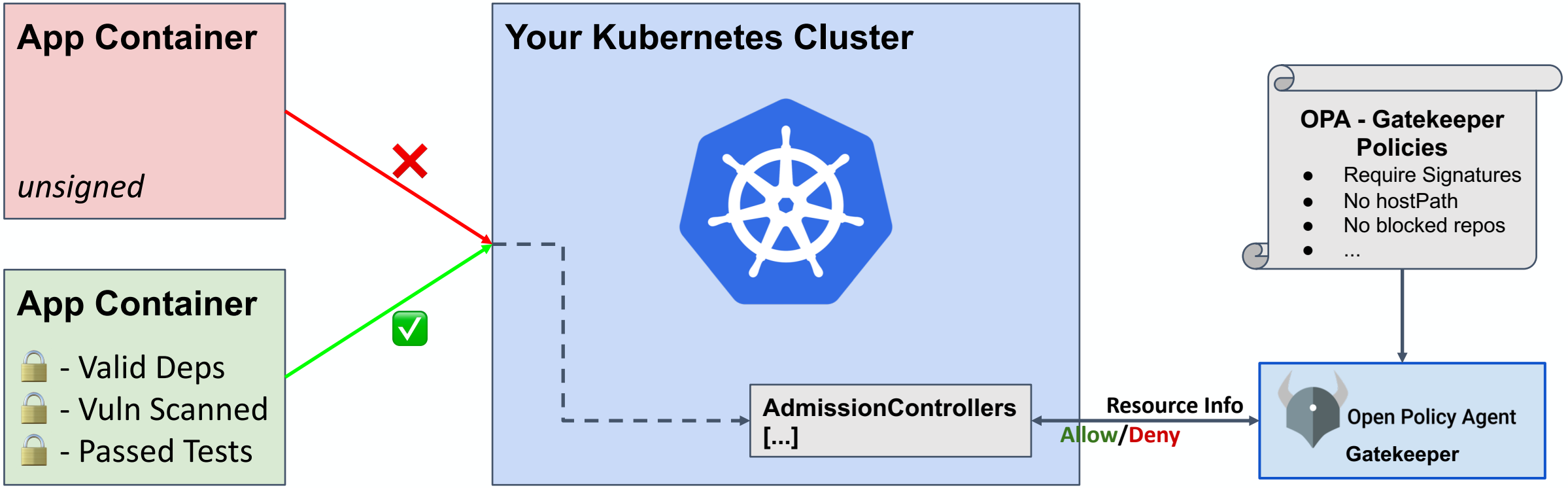
#2 - Use a policy agent to protect you cluster.



3. User Security

Recap:

Developers & Automation

- Use RBAC and groups
- Use a policy agent

Cluster

- Keep your cluster up to date
- Isolate your cluster from the internet
- Use Secrets
- Don't use Basic Auth

Node

- *Isolate your nodes from the internet*

Pod

- Don't use hostPath
- Don't use hostNetwork
- Pay close attention to your pod's Service Accounts

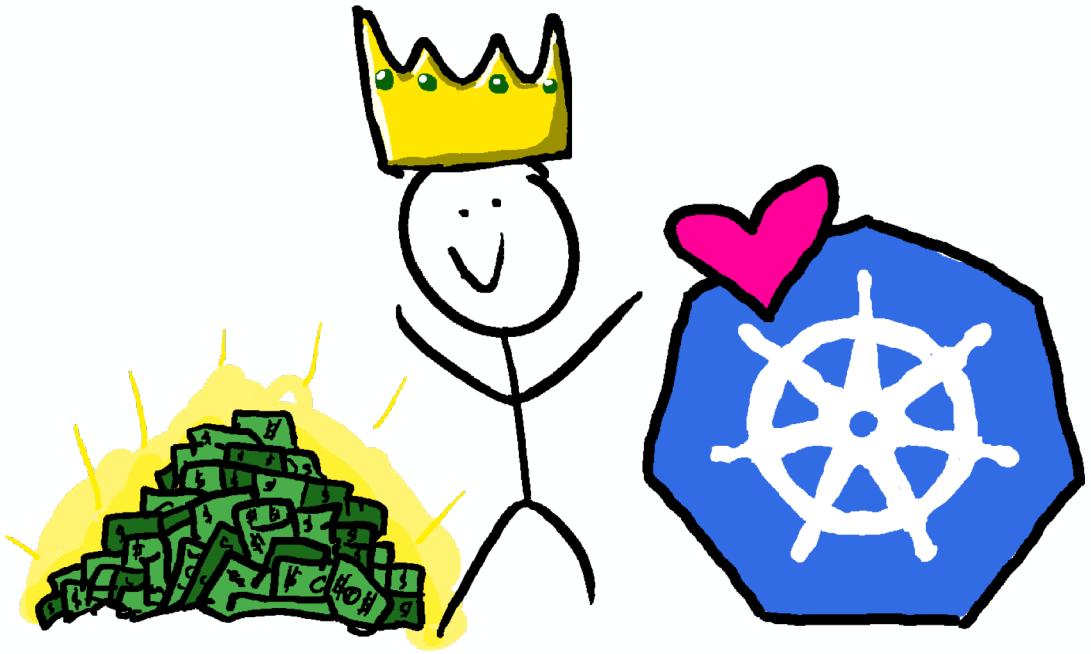
Container

- Assume you will be owned
- Use a distroless base image
- Easy to rebuild containers
- Sign your images

3. Cluster Security

Your workloads, cluster, and developers enjoy a much more secure Kubernetes experience. You are recognized for your efforts and compensated handsomely. You are filled with a sense of satisfaction.

:)



4. Epilogue

I can’t remember all that!!

I made a doc!

- All the tips and tricks
- Lots of links and reading
- Plus other stuff not covered
  - *Don’t run pods as root*
  - *Trusting your nodes*
  - *Disable basic auth*
  - *Namespace isolation*
  - *Identity developers and robots*
  - *Other authorization engines*
  - *Pod security policy (PSP)*

bit.ly/SamK8sSec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