

# Approaching Kubernetes Security

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# \$whoami

Over 15 years of experience in information technology and security. He has spoken at ISSA, ISC2, OWASP, DEFCON, RSA Conference, Hackmiami, DerbyCon, Splunk .CONF, Black Hat, BSides, Underground Economy and also been featured in Rolling Stone Magazine, Pentest Magazine, Univision, BBC, Forbes, VICE, Fox News and CNN.

Rod Soto was the winner of the 2012 BlackHat Las Vegas CTF competition and is the founder and lead developer of the **Kommand & KonTroll/NOQRTRCTF** competitive hacking Tournament series.

Secretary of the board of Hackmiami %27, Co-founder of Pacific Hackers Silicon Valley meetup. Founder & President Pacific Hackers Conference [www.phack.org](http://www.phack.org).



# Kubernetes

Open-source container-orchestration system for automating application deployment, scaling, and management. It was originally designed by Google, and is now maintained by the Cloud Native Computing Foundation.

Known also as K8s

*\*Kubernetes (κυβερνήτης, Greek for "governor", "helmsman" or "captain")*

# Kubernetes Objects

## Pod

A pod consists of one or more containers that are guaranteed to be co-located on the host machine and can share resources.

## Replica sets

Replica Sets<sup>[22]</sup> are a grouping mechanism that lets Kubernetes maintain the number of instances that have been declared for a given pod.

## Services

A Kubernetes service is a set of pods that work together, such as one tier of a [multi-tier](#) application.

# Kubernetes Objects

## Volumes

Filesystems in the Kubernetes container provide ephemeral storage, by default. A Kubernetes Volume<sup>[25]</sup> provides persistent storage that exists for the lifetime of the pod itself. This storage can also be used as shared disk space for containers within the pod.

## Namespaces

They are intended for use in environments with many users spread across multiple teams, or projects, or even separating environments like development, test, and production

# Kubernetes Objects

## **ConfigMaps and Secrets**

A common application challenge is deciding where to store and manage configuration information, some of which may contain sensitive data. Configuration data can be anything as fine-grained as individual properties or coarse-grained information like entire configuration files or JSON / XML documents.

**Secrets** ---> Example of use = Reference password for DB → (Base64 encoding decoded before passing it to the pod)

**ConfigMaps** → Referenced in yaml application deployment files, not good for storing sensitive information as they are in plain text. Example of use = Files mapped to a volume within a pod

# Kubernetes Objects

## **Deployment**

Sets of Identical Pods. Pod templates define how to run pods. Pod definitions describe the pods including their state.(i.e number of pods)

## **StatefulSet**

A type of Kubernetes controller used to manage and maintain Pods. StatefulSets assign unique identifiers to Pods. This enables tracking which pod is used by which client. Use for applications that need unique network identifiers or stable persistent storage (i.e a database).

# Kubernetes Objects

## DaemonSets

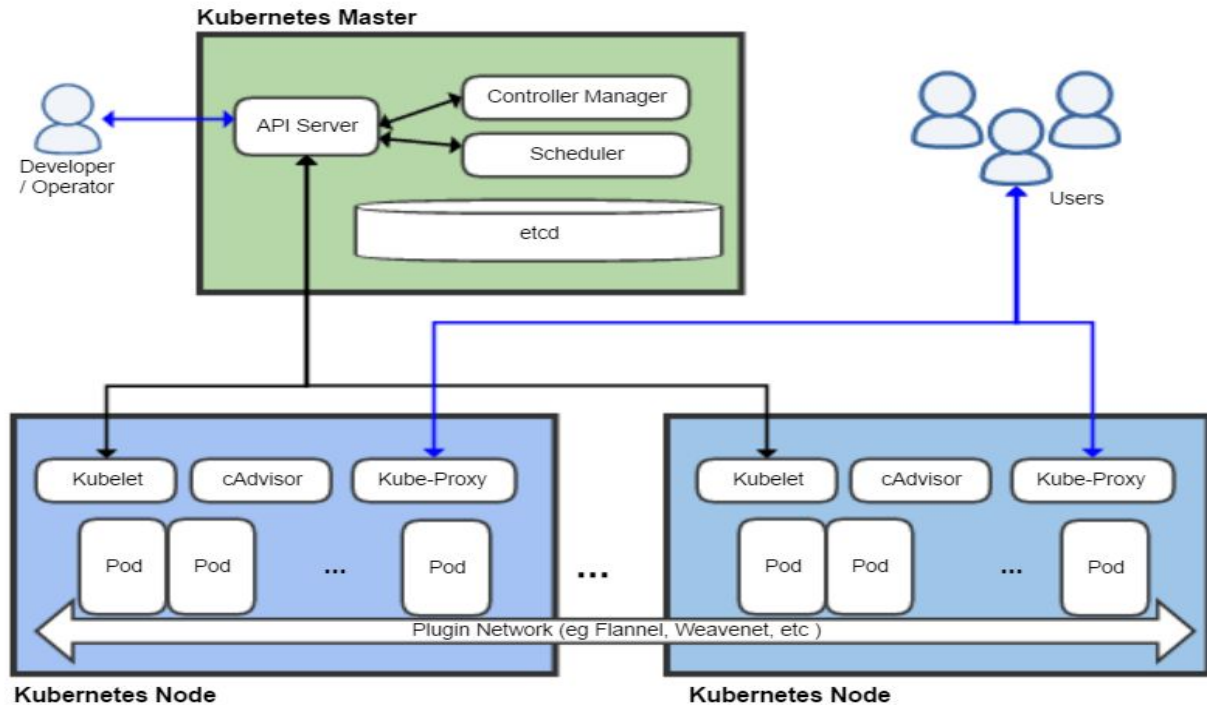
Like other workload objects, **DaemonSets** manage groups of replicated [Pods](#). However, DaemonSets attempt to adhere to a one-Pod-per-node model, either across the entire cluster or a subset of nodes. As you add nodes to a [node pool](#), DaemonSets automatically add Pods to the new nodes as needed. (Example: fluentd, logstash)

## Job

Kubernetes create pods and run them until application completes a workload. Specifications are in a configuration file, includes specifications about the container to use and what command to run.



# Kubernetes Cluster



# Kubernetes Cluster

**Api-Server** - The API server is a key component and serves the Kubernetes [API](#) using [JSON](#) over [HTTP](#), which provides both the internal and external interface to Kubernetes.

**Controller Manager** - Control loops that watch the state of your cluster. A cluster has at least one worker node and at least one master node. , then make or request changes where needed.

**Scheduler** - The scheduler tracks resource use on each node to ensure that workload is not scheduled in excess of available resources.

**Etcd** - Stores the entire state of the cluster: its configuration, specifications, and the statuses of the running workloads.

# Kubernetes Cluster

**Kubelet** - Primary “node agent” that runs on each node

**CAdvisor** - Open source container resource usage collector (Web Interface)

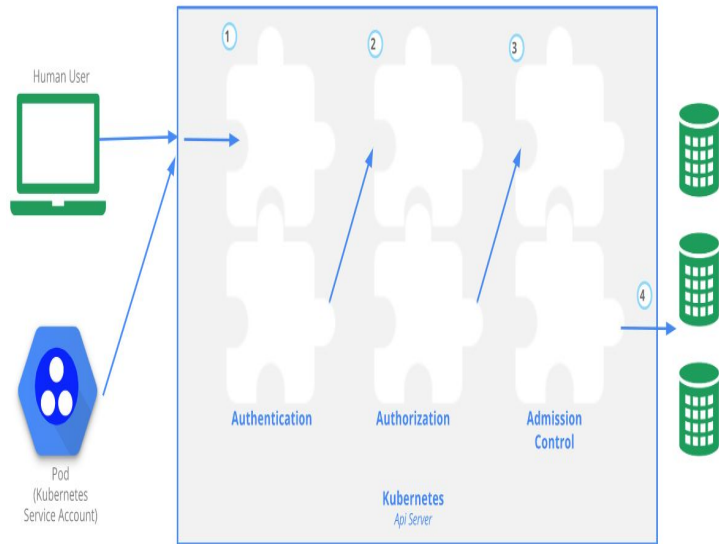
**Kube-Proxy** - Network proxy that runs on each node in your cluster, implementing part of the Kubernetes service concept. Reflects services as defined in the Kubernetes API on each node and can do simple TCP, UDP, and SCTP stream forwarding or round robin TCP, UDP, and SCTP forwarding across a set of backends.

**Kube-Node** - A node is a worker machine in Kubernetes, previously known as a `minion`. A node may be a VM or physical machine, depending on the cluster. Each node contains the services necessary to run `pods` and is managed by the master components. The services on a node include the `container runtime`, kubelet and kube-proxy.

# Accessing Kubernetes

Users **access the API** using `kubectl`, client libraries, or by making REST requests. Both human users and **Kubernetes service accounts** can be authorized for API access. When a request reaches the API, it goes through several stages, illustrated in the following diagram

A request must include the username of the requester, the requested action, and the object affected by the action.



# Accessing Kubernetes

- **Transport Security** - (API 6443)
- **Authentication** - Client Certificates, Password, and Plain Tokens, Bootstrap Tokens, and JWT Tokens (used for service accounts)
- **Authorization** - ABAC mode, RBAC Mode, and Webhook
- **Admission Control** - Admission Control Modules are software modules that can modify or reject requests. They act on objects being created, deleted, updated or connected (proxy).
- **API Server Ports and IPs** - (8080, 6443, 443)

# Kubernetes - The CI/CD - Devops attack surface

- Source Code repository: github, gitlab, S3, SVN
- CI/CD Platform: Jenkins, CircleCI, TravisCI
- Container Repository: Docker, Vagrant
- IaaS Provider: Kubernetes flavor, Microsoft EKS, Amazon AKS
- IaC: Ansible, Terraform, Cloudformation, Chef

# Kubernetes attack vectors

## Internal VS External

Inside Cluster	-	Outside Cluster
CI/CD Devops attack surface (Accounts, Pods, Nodes)	-	Exposed API
Application Vulns(CVE-2019-16276)	-	Exposed Kubelet
Container Implantation (Mitre T1147)	-	Information disclosure
	-	Exposed Management GUI
	-	Denial of Service

# Vulnerability / Attack TTPs references

- Mitre ATT&CK <https://attack.mitre.org/>
- Mitre Cloud ATT&CK <https://attack.mitre.org/matrices/enterprise/cloud/>
- OWASP TOP 10 [https://owasp.org/www-project-top-ten/OWASP\\_Top\\_Ten\\_2017/](https://owasp.org/www-project-top-ten/OWASP_Top_Ten_2017/)
- OWASP TOP 10 API <https://www2.owasp.org/www-project-api-security/>
- Mitre CWE <https://cwe.mitre.org/>
- NIST <https://nvd.nist.gov/>
- Mitre CVE <https://cve.mitre.org/>
- Mitre CAPEC <https://capec.mitre.org/>
- Cloud Security Alliance Egregious 11  
<https://cloudsecurityalliance.org/press-releases/2019/08/09/csa-releases-new-research-top-threats-to-cloud-computing-egregious-eleven/>
- CVSS Score <https://www.first.org/cvss/specification-document>



# Kubernetes attack vectors

- **Cloud API** - Mitre Cloud ATT&CK T1522 Example: CVE-2018-1002105, CVE-2019-11253 (Improper input validation in the Kubernetes API )
- **Misconfiguration** - Mitre Cloud ATT&CK T1190 OWASP A6-Security Misconfiguration - Example: Tesla Hack
- **Information Disclosure** - OWASP A3-Sensitive Data Exposure - Exposed API, Kubelets.
- **CSA Abuse and nefarious use of cloud services** - Mitre ATT&CK T1496 (CryptoMining, DDoS)
- **CWE-59: Improper Link Resolution Before File Access** - CVE-2017-1002101
- **Application Vulnerability** - CVE-2019-16276 (Bypass authentication using HTTP request smuggling)
- **CVE-2019-9512/CVE-2019-9514** - HTTP/2 Ping Flood Mitre ATT&CK T1498

# Tools to assess Kubernetes Security

ShodanDevelopersMonitorView All...

SHODANkubernetes

ExploitsMapsLike 5Download ResultsCreate Report


Show API KeyTry out the new beta website!Help Center

My Account

TOTAL RESULTS

17,863

TOP COUNTRIES



United States	9,723
Germany	2,721
Ireland	2,203
Singapore	646
United Kingdom	398

TOP SERVICES

HTTPS	17,505
HTTP	73
HTTPS (8443)	69
49153	60
Minecraft	22

TOP ORGANIZATIONS

Amazon.com	13,026
Amazon Data Services Ireland Limited	994
A100 ROW GmbH	797
Amazon	630
Google Cloud	376

TOP OPERATING SYSTEMS

New Service: Keep track of what you have connected to the Internet. Check out [Shodan Monitor](#)

18.228.242.199

ec2-18-228-242-199.sa-east-1.compute.amazonaws.com

Amazon.com

Added on 2020-01-20 02:59:02 GMT

Brazil, Sao Paulo

cloud

SSL Certificate

Issued By:

Common Name: **kubernetes**

Issued To:

Common Name: **kubernetes-master**

Supported SSL Versions

TLsv1.2

HTTP/1.1 401 Unauthorized

Content-Type: application/json

Www-Authenticate: Basic realm="**kubernetes-master**"

Date: Mon, 20 Jan 2020 02:59:02 GMT

Content-Length: 165

52.220.241.58

ec2-52-220-241-58.ap-southeast-1.compute.amazonaws.com

Amazon.com

Added on 2020-01-20 02:57:02 GMT

Singapore, Singapore

cloud

SSL Certificate

Issued By:

Common Name: **kubernetes**

Issued To:

Common Name: **kubernetes-master**

Supported SSL Versions

TLsv1.2

HTTP/1.1 401 Unauthorized

Content-Type: application/json

Www-Authenticate: Basic realm="**kubernetes-master**"

Date: Mon, 20 Jan 2020 02:52:02 GMT

Content-Length: 165

54.255.173.129

ec2-54-255-173-129.ap-southeast-1.compute.amazonaws.com

Amazon.com

Added on 2020-01-20 02:59:33 GMT

Singapore, Singapore

cloud

SSL Certificate

Issued By:

Common Name: **kubernetes**

Issued To:

Common Name: **kubernetes-master**

Supported SSL Versions

TLsv1.2

HTTP/1.1 401 Unauthorized

Content-Type: application/json

Www-Authenticate: Basic realm="**kubernetes-master**"

Date: Mon, 20 Jan 2020 02:54:33 GMT

Content-Length: 165


54.219.173.195

ec2-54-219-173-195.us-west-

SSL Certificate

HTTP/1.1 401 Unauthorized

# Sshgit - <https://sshgit.darkport.co.uk/>















sshgit **live!** v0.3

25 matches 0 filters ✕





- High entropy string 7
- Username and password in URI 6
- Environment configuration file 3
- Google Cloud API Key 3
- Log file 2
- Potential private key (.pem) 2
- NPM configuration file 1
- PHP configuration file 1
- Potential private key (.p21) 1
- 1Password password manager 1
- Amazon MWS Auth Token
- Apache httpasswd file

☒ Interesting file extensions ☒ High entropy strings ☐ Notify on match

 [@darkp0rt](#) [blog](#) Connected

Found	Signature Name	Matches	File	★
 9:25:35 AM	Username and password in URI 	<code>https://gitlab-ci-token:testTokenHere1234@gitlab.example.com/test/test-project.git"</code>	<a href="#">/network/gitlab_test.go</a>	-1
 9:25:34 AM	Username and password in URI 	<code>https://user:password@gitlab.com/gitlab?key=value#fragment"</code>	<a href="#">/helpers/url/clean_url_test.go</a>	-1
 9:25:32 AM	Potential private key (.p21)	<code>http://%s:%s@127.0.0.1:%s"%(config['rpcuser'],</code>	<a href="#">/share/certs/ionomy_untrusted_gitianuser.p12</a>	-1
 9:25:32 AM	Potential private key (.pem)	<code>http://%s:%s@127.0.0.1:%s"%(config['rpcuser'],</code>	<a href="#">/share/certs/BitcoinFoundation_Comodo_Cert.pem</a>	-1
 9:25:32 AM	Potential private key (.pem)	<code>http://%s:%s@127.0.0.1:%s"%(config['rpcuser'],</code>	<a href="#">/share/certs/BitcoinFoundation_Apple_Cert.pem</a>	-1
 9:25:29 AM	High entropy string 	<code>helper_image = "my.registry.local/gitlab/gitlab-runner-helper:x86_64-\${CI_RUNNER_REVISION}"</code>	<a href="#">/docs/configuration/advanced-configuration.md</a>	-1
 9:25:29 AM	Username and password in URI 	<code>http://gitlab-ci-token:s3cr3tt0k3n@192.168.1.23/namespace/project.git`.</code>	<a href="#">/docs/configuration/advanced-configuration.md</a>	-1

# Tools to assess Kubernetes Security

 "k8s.%.com"  Pull requests Issues Marketplace Explore  

Repositories 0

Code 1K

Commits 21

Issues 0

Packages 3

Marketplace 0

Topics 1

Wikis 325

Users 0


Languages

Go	2,895
Markdown	1,605
YAML	478
HTML	478
Scala	313
Java	177
Shell	171
Python	142
JSON	107
Text	106

Advanced search Cheat sheet


1,539 code results 

Sort: Best match ▾

 siddu117/docker-k8s  
complex/k8s/certificate.yaml

```
1  apiVersion: certmanager.k8s.io/v1alpha1
2  kind: Certificate
3  metadata:
4    name: k8s-multi-com-tls
5  spec:
6    secretName: k8s-multi-com
7    issuerRef:
8      name: letsencrypt-prod
9      kind: ClusterIssuer
```

● YAML Showing the top two matches Last indexed on Feb 17, 2019

 mikeringrose/laughing-waffle  
k8s/certificate.yaml

```
1  apiVersion: certmanager.k8s.io/v1alpha1
2  kind: Certificate
3  metadata:
4    name: k8s-mikeringrose-com-tls
5  spec:
6    secretName: k8s-mikeringrose-com
7    issuerRef:
8      name: letsencrypt-prod
9      kind: ClusterIssuer
10   commonName: k8s.mikeringrose.com
11   dnsNames:
12     - k8s.mikeringrose.com
13     - www.k8s.mikeringrose.com
14   acme:
15     config:
16       - http01:
17         ingressClass: nginx
```

# Common Kubernetes ports

Port	Process	Description
443/TCP	kube-apiserver	Kuberntes API port
2379/TCP	etcd	
6666/TCP	etcd	etcd
4194/TCP	cAdvisor	Contrainer metrics
6443/TCP	kube-apiserver	Kubernetes API port
8443/TCP	kube-apiserver	Minikube API port
8080/TCP	kube-apiserver	Insecure API port
10250/TCP	kubelet	HTTPS API which allows full node access
10255/TCP	kubelet	Unauthenticated read-only HTTP port: pods, runningpods and node state
10256/TCP	kube-proxy	Kube Proxy health check server
9099/TCP	calico-felix	Health check server for Calico
6782-4/TCP	weave	Metrics and endpoints

# Tools to assess Kubernetes Security

Trivy <https://github.com/aquasecurity/trivy>

```
[rsoto@rsoto-mbp-1ecaa] ~/Desktop
# trivy wordpress
2020-02-27T00:15:25.429-0500 WARN You should avoid using the :latest tag as it is cached. You need to specify '--clear-cache' option when :latest image is changed
2020-02-27T00:15:42.474-0500 INFO Detecting Debian vulnerabilities...
2020-02-27T00:15:42.515-0500 INFO Detecting npm vulnerabilities...
2020-02-27T00:15:42.515-0500 INFO Detecting npm vulnerabilities...

wordpress (debian 10.2)
=====
Total: 763 (UNKNOWN: 1, Low: 83, Medium: 563, High: 106, Critical: 10)
```

LIBRARY	VULNERABILITY ID	SEVERITY	INSTALLED VERSION	FIXED VERSION	TITLE
apache2	CVE-2007-0986	HIGH	2.4.38-3+deb10u3		** DISPUTED ** The Apache HTTP Server, when accessed through a...
	CVE-2003-1307	MEDIUM			** DISPUTED ** The mod_php module for the Apache HTTP Server...
	CVE-2003-1580				The Apache HTTP Server 2.0.44, when DNS resolution is enabled for client...
	CVE-2007-1743				suexec in Apache HTTP Server (httpd) 2.2.3 does not verify combinations of...
	CVE-2007-3303				Apache httpd 2.0.59 and 2.2.4, with the Prefork MPM module, allows local...
	CVE-2008-0455				CVE-2012-2687 CVE-2008-0455 httpd: mod_negotiation XSS via untrusted file names in directories with...
	CVE-2001-1534	LOW			mod_usertrack in Apache 1.3.11 through 1.3.20 generates session ID's using predictable information...
	CVE-2003-1581				httpd: Injection of arbitrary text into log files when DNS resolution is...
apache2-bin	CVE-2008-0456				httpd: mod_negotiation CRLF injection via untrusted file names in directories with MultiViews...
	CVE-2007-0986	HIGH			** DISPUTED ** The Apache HTTP Server, when accessed through a...
	CVE-2003-1307	MEDIUM			** DISPUTED ** The mod_php module for the Apache HTTP Server...

# Tools to assess Kubernetes Security

Kube-Bench <https://github.com/aquasecurity/kube-bench>

```
trajan@x-dre:~/kube-bench$ kubectl logs kube-bench-9q8d6
[INFO] 2 Worker Node Security Configuration
[INFO] 2.1 Kubelet
[PASS] 2.1.1 Ensure that the --anonymous-auth argument is set to false (Scored)
[PASS] 2.1.2 Ensure that the --authorization-mode argument is not set to AlwaysAllow (Scored)
[PASS] 2.1.3 Ensure that the --client-ca-file argument is set as appropriate (Scored)
[FAIL] 2.1.4 Ensure that the --read-only-port argument is set to 0 (Scored)
[PASS] 2.1.5 Ensure that the --streaming-connection-idle-timeout argument is not set to 0 (Scored)
[FAIL] 2.1.6 Ensure that the --protect-kernel-defaults argument is set to true (Scored)
[PASS] 2.1.7 Ensure that the --make-iptables-util-chains argument is set to true (Scored)
[PASS] 2.1.8 Ensure that the --hostname-override argument is not set (Scored)
[FAIL] 2.1.9 Ensure that the --event-qps argument is set to 0 (Scored)
[FAIL] 2.1.10 Ensure that the --tls-cert-file and --tls-private-key-file arguments are set as appropriate (Scored)
[INFO] 2.1.11 [DEPRECATED] Ensure that the --cadvisor-port argument is set to 0
[PASS] 2.1.12 Ensure that the --rotate-certificates argument is not set to false (Scored)
[PASS] 2.1.13 Ensure that the RotateKubeletServerCertificate argument is set to true (Scored)
[PASS] 2.1.14 Ensure that the Kubelet only makes use of Strong Cryptographic Ciphers (Not Scored)
[INFO] 2.2 Configuration Files
[PASS] 2.2.1 Ensure that the kubelet.conf file permissions are set to 644 or more restrictive (Scored)
[PASS] 2.2.2 Ensure that the kubelet.conf file ownership is set to root:root (Scored)
[PASS] 2.2.3 Ensure that the kubelet service file permissions are set to 644 or more restrictive (Scored)
[PASS] 2.2.4 Ensure that the kubelet service file ownership is set to root:root (Scored)
[PASS] 2.2.5 Ensure that the proxy kubeconfig file permissions are set to 644 or more restrictive (Scored)
[PASS] 2.2.6 Ensure that the proxy kubeconfig file ownership is set to root:root (Scored)
[PASS] 2.2.7 Ensure that the certificate authorities file permissions are set to 644 or more restrictive (Scored)
[PASS] 2.2.8 Ensure that the client certificate authorities file ownership is set to root:root (Scored)
[PASS] 2.2.9 Ensure that the kubelet configuration file ownership is set to root:root (Scored)
[PASS] 2.2.10 Ensure that the kubelet configuration file has permissions set to 644 or more restrictive (Scored)

== Remediations ==
2.1.4 If using a Kubelet config file, edit the file to set readOnlyPort to 0 .
If using command line arguments, edit the kubelet service file
/etc/systemd/system/kubelet.service on each worker node and
set the below parameter in KUBELET_SYSTEM_PODS_ARGS variable.
--read-only-port=0
Based on your system, restart the kubelet service. For example:
```



# Tools to assess Kubernetes Security

Kube-Hunter <https://github.com/aquasecurity/kube-hunter>

```
trajan@x-dre:~/kube-hunter$ ./kube-hunter.py
Choose one of the options below:
1. Remote scanning      (scans one or more specific IPs or DNS names)
2. Interface scanning   (scans subnets on all local network interfaces)
3. IP range scanning    (scans a given IP range)
Your choice: 1
Remotes (separated by a ','): 18.228.242.199

Nodes
+-----+-----+
| TYPE           | LOCATION           |
+-----+-----+
| Node/Master    | 18.228.242.199    |
+-----+-----+

Detected Services
+-----+-----+-----+
| SERVICE           | LOCATION           | DESCRIPTION           |
+-----+-----+-----+
| Unrecognized K8s API | 18.228.242.199:443 | A Kubernetes API     |
|                   |                   | service               |
+-----+-----+-----+

No vulnerabilities were found
```



# Tools to assess Kubernetes Security

Kubeaudit - <https://github.com/Shopify/kubeaudit/releases/tag/v0.7.0>

```
trajan@x-dre:~/Downloads$ ./kubeaudit priv
INFO[0000] Not running inside cluster, using local config
ERRO[0001] Privileged set to true! Please change it to false! Container=aws-node KubeType=daemonSet Name=aws-node Namespace=kube-sys
ERRO[0001] Privileged set to true! Please change it to false! Container=kube-proxy KubeType=daemonSet Name=kube-proxy Namespace=kube
tem
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=coredns KubeType=deployment Name=
dns Namespace=kube-system
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=guestbook KubeType=pod Name=guest
-2dgvv Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=guestbook KubeType=pod Name=guest
-76rw2 Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=guestbook KubeType=pod Name=guest
-qqpwf Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=kube-bench KubeType=pod Name=kube
ch-9q8d6 Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=redis-master KubeType=pod Name=re
master-9lzld Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=redis-slave KubeType=pod Name=red
lave-4ktzs Namespace=default
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=redis-slave KubeType=pod Name=red
lave-rzfxl Namespace=default
ERRO[0001] Privileged set to true! Please change it to false! Container=aws-node KubeType=pod Name=aws-node-g2nxs Namespace=kube-sys
ERRO[0001] Privileged set to true! Please change it to false! Container=aws-node KubeType=pod Name=aws-node-nm948 Namespace=kube-sys
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=coredns KubeType=pod Name=coredns
d858ddc-4j8lm Namespace=kube-system
WARN[0001] Privileged defaults to false, which results in non privileged, which is okay. Container=coredns KubeType=pod Name=coredns
d858ddc-nlhht Namespace=kube-system
ERRO[0001] Privileged set to true! Please change it to false! Container=kube-proxy KubeType=pod Name=kube-proxy-xm78l Namespace=kube
tem
ERRO[0001] Privileged set to true! Please change it to false! Container=kube-proxy KubeType=pod Name=kube-proxy-xp97d Namespace=kube
```

# Tools to assess Kubernetes Security

Rhino Labs CCat <https://github.com/RhinoSecurityLabs/ccat>

```
nv) trajan@x-dre:~/ccat/data$ cat ecr_enum_repos_data.json
{
  "count": 1,
  "payload": {
    "aws_regions": [
      "us-east-1"
    ],
    "repositories_by_region": {
      "us-east-1": [
        {
          "repositoryArn": "arn:aws:ecr:us-east-1:748344480667:repository/rodtest",
          "registryId": "748344480667",
          "repositoryName": "rodtest",
          "repositoryUri": "748344480667.dkr.ecr.us-east-1.amazonaws.com/rodtest",
          "createdAt": "2020-01-19 22:52:09-05:00",
          "imageTagMutability": "MUTABLE",
          "imageScanningConfiguration": {
            "scanOnPush": false
          }
        }
      ]
    }
  }
}

nv) trajan@x-dre:~/ccat/data$

What do you want to do? (Use arrow keys)
= AWS (None) =
> Enumerate ECR
List Enumerated ECR Repos
Pull Repos from ECR
Push Repos to ECR
Swap AWS Profile
= GCP =
Enumerate GCR
List Enumerated GCR Repos
Pull Repos from GCR
Push Repos to GCR
Swap GCP Credentials
= Docker =
Docker Backdoor
-----
Exit
```

# CyberArk KubiScan <https://github.com/cyberark/KubiScan>

```
-ossss+::/+ssssssssssssssss+::/+ssss-  
:ssssssssssssssssssssssssssssssssss/  
`+ssssssssssssssssssssssssssssss+`  
-osssssssssssssssssssssssssssss-  
`/ssssssssssssssssssssssss/`
```

KubiScan version 1.5  
Author: Eviatar Gerzi

```
/usr/local/lib/python3.6/dist-packages/urllib3/connectionpool.py:847: InsecureRequestWarning: Unverified HTTPS request is being made. Adding certificate verification is strongly advised.  
.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings  
InsecureRequestWarning)  
/usr/local/lib/python3.6/dist-packages/urllib3/connectionpool.py:847: InsecureRequestWarning: Unverified HTTPS request is being made. Adding certificate verification is strongly advised.  
.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings  
InsecureRequestWarning)  
/usr/local/lib/python3.6/dist-packages/urllib3/connectionpool.py:847: InsecureRequestWarning: Unverified HTTPS request is being made. Adding certificate verification is strongly advised.  
.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings  
InsecureRequestWarning)  
/usr/local/lib/python3.6/dist-packages/urllib3/connectionpool.py:847: InsecureRequestWarning: Unverified HTTPS request is being made. Adding certificate verification is strongly advised.  
.readthedocs.io/en/latest/advanced-usage.html#ssl-warnings  
InsecureRequestWarning)
```

-----  
[Risky Users]

Priority	Kind	Namespace	Name
CRITICAL	Group	None	system:masters
CRITICAL	ServiceAccount	default	kubiscan-sa
CRITICAL	ServiceAccount	kube-system	clusterrole-aggregation-controller
HIGH	ServiceAccount	kube-system	cronjob-controller
HIGH	ServiceAccount	kube-system	daemon-set-controller
HIGH	ServiceAccount	kube-system	deployment-controller
CRITICAL	ServiceAccount	kube-system	expand-controller
CRITICAL	ServiceAccount	kube-system	generic-garbage-collector
CRITICAL	ServiceAccount	kube-system	horizontal-pod-autoscaler
HIGH	ServiceAccount	kube-system	job-controller
CRITICAL	ServiceAccount	kube-system	namespace-controller
CRITICAL	ServiceAccount	kube-system	persistent-volume-binder
HIGH	ServiceAccount	kube-system	replicaset-controller
HIGH	ServiceAccount	kube-system	replication-controller
CRITICAL	ServiceAccount	kube-system	resourcequota-controller
HIGH	ServiceAccount	kube-system	statefulset-controller
CRITICAL	User	None	system:kube-controller-manager
HIGH	ServiceAccount	kube-system	metrics-server
CRITICAL	ServiceAccount	kube-system	bootstrap-signer
HIGH	ServiceAccount	kube-system	heapster
CRITICAL	ServiceAccount	kube-system	token-cleaner

# SonarQube.org Code analysis

The screenshot shows the SonarQube web interface. At the top is a browser address bar with the URL `localhost:9000/dashboard?id=testguessbook`. Below the browser is a navigation bar with tabs for 'sonarqube', 'Projects', 'Issues', 'Rules', 'Quality Profiles', 'Quality Gates', and 'Administration'. A search bar is on the right of the navigation bar. The main content area is for the 'testguessbook' project, with a sub-tab for 'master'. A yellow banner at the top right of the main area states 'Last analysis had 1 warning' on February 8, 2020, at 6:14 PM, with the version 'not provided'. The 'Quality Gate' section shows a 'Failed' status. Two metrics are displayed: 'Reliability Rating on New Code' is 'C' (worse than A), and 'Coverage on New Code' is '0.0%' (less than 80.0%). The 'Reliability' section shows 13 bugs, with a chart indicating 'New code: since February 8, 2020 started 5 minutes ago' and '13 New Bugs'. The 'Security' section shows 0 vulnerabilities and 34 security hotspots, with a chart indicating 'New code: since February 8, 2020 started 5 minutes ago' and '0 New Vulnerabilities' and '34 New Security Hotspots'. The right sidebar contains 'About This Project' (No tags, 2k Lines of Code, 1.9k PHP, 53 CSS) and 'Project Activity' (February 8, 2020, not provided, Quality Gate: Red (was Green), Project Analyzed, Show More).

localhost:9000/dashboard?id=testguessbook

Apps Now I wanna sniff s... hostapd-compatibl... play a bigger role i... (6) Underground D... Pacific Hackers Me... woj-ciech/Daily-do... Pentest Tips and Tr...

sonarqube Projects Issues Rules Quality Profiles Quality Gates Administration ? Search for projects and files... + A

testguessbook master

Last analysis had 1 warning February 8, 2020, 6:14 PM Version not provided

Overview Issues Measures Code Activity Administration

Quality Gate **Failed**

Reliability Rating on New Code is worse than A

Coverage on New Code is less than 80.0%

0.0%

Reliability Measures

13 Bugs started 5 minutes ago

New code: since February 8, 2020 started 5 minutes ago

13 New Bugs

Security Measures

0 Vulnerabilities

34 Security Hotspots

New code: since February 8, 2020 started 5 minutes ago

0 New Vulnerabilities

34 New Security Hotspots

About This Project

No tags

2k Lines of Code

PHP 1.9k

CSS 53

Project Activity

February 8, 2020

not provided

Quality Gate: Red (was Green)

February 8, 2020

Project Analyzed

Show More

# SonarQube.org Code analysis

←

→

↺

localhost:9000/project/issues?id=testguessbook&resolved=false&types=SECURITY\_HOTSPOT

☆

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⋮

Apps

Now I wanna sniff s...

NK hostapd-compatibl...

play a bigger role i...

(6) Underground D...

Pacific Hackers Me...

woj-ciech/Daily-do...

Pentest Tips and Tr...

»

sonarqube

Projects

Issues

Rules

Quality Profiles

Quality Gates

Administration

?

Search for projects and files...

+

A

testguessbook

master

Last analysis had 1 warning

February 8, 2020, 6:14 PM

Version not provided

Overview

Issues

Measures

Code

Activity

Administration

My Issues

All

Filters

Clear All Filters

Type

SECURITY HOTSPOT

Clear

Bug

13

Vulnerability

0

Code Smell

117

Security Hotspot

34

NEW Security Hotspots

×

Security Hotspots aren't necessarily issues, but they need to be reviewed to make sure they aren't vulnerabilities.

Learn More

+ click to add to selection

> Severity

> Resolution

> Status

Bulk Change

↑

↓

to select issues

←

→

to navigate

↺

1 / 34 issues

3h 5min effort

gbook182/gbook.php

☐

Make sure that hashing data is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L58

🔗

🔽

cwe, owasp-a3, owasp-a6, sans-top2...

☐

Make sure that hashing data is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L59

🔗

🔽

cwe, owasp-a3, owasp-a6, sans-top2...

☐

Make sure that hashing data is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L60

🔗

🔽

cwe, owasp-a3, owasp-a6, sans-top2...

☐

Make sure that hashing data is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L61

🔗

🔽

cwe, owasp-a3, owasp-a6, sans-top2...

☐

Make sure that using a regular expression is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L445

🔗

🔽

cwe, owasp-a1

☐

Make sure that using a regular expression is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L447

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🔽

cwe, owasp-a1

☐

Make sure that using a regular expression is safe here.

See Rule

Security Hotspot

To Review

Not assigned

Comment

2 minutes ago

L722

🔗

🔽

# How to harden & defend K8s

## - **Control access to API**

- Use TLS
- API Authentication / Authorization (RBAC)

## - **Control access to Kubelet (Authentication)**

## - **Runtime variables**

- Apply policies and controls limit by use case how those objects act on the cluster, themselves, and other resources. (Resource usage/limits/ranges)

- Limit privileges that containers run

- Prevent containers from loading unwanted kernel modules (be careful what AMIs you chose)

-

# How to harden and defend K8s

- Restrict network access
- Restrict cloud metadata API access
- Control which Pods nodes may access
- Protect Cluster from compromise
  - Restrict access to etcd
  - Enable audit logging
  - Restrict access to alpha/beta features
  - Rotate infrastructure credentials
  - Review third party integrations
  - Encrypt secrets at rest/transit
  - Update and patch per alerts and vulnerability advisories



# How to harden & defend k8s

- User cloud security assessment tools like CS Suite <https://github.com/SecurityFTW/cs-suite>
- Watch specifically for risky permissions ([Eviatar Gerzi](#))
  - Listing secrets (potentially view all the secrets in a specific namespace)
  - Create pods
  - Impersonation of privilege accounts
  - Reading secrets (full secret's name may not get all secrets but may help in brute forcing)
  - Privilege Rolebindings (allows account to add any user to high privilege roles) Watch specifically accounts with ClusterRole\*
- Use tools such as SonarQube.org to harden CI/CD pipeline



# How to harden & defend k8s

## Watch for container scape

- *Cap\_sys\_admin*
  - Perform a range of system administration operations
- *Cap\_sys\_module*
  - Load and unload kernel modules
- *Cap\_sys\_boot*
  - Use `reboot(2)` and `kexec_load(2)`

\*<http://man7.org/linux/man-pages/man7/capabilities.7.html>

# Resources

- <https://kubernetes.io/docs/tasks/administer-cluster/securing-a-cluster/#controlling-access-to-the-kubernetes-api>
- <https://sysdig.com/blog/33-kubernetes-security-tools/>
- <https://www.cisecurity.org/blog/new-cis-benchmark-for-google-cloud-computing-platform/>
- <https://www.slideshare.net/Lacework/practical-guide-to-securing-kubernetes>
- <https://cloudsecurityalliance.org/press-releases/2019/08/09/csa-releases-new-research-top-threats-to-cloud-computing-egregious-eleven/>
- <https://rhinosecuritylabs.com/aws/cloud-container-attack-tool/>
- <https://github.com/rsfl/researchdocs/blob/master/Using%20Splunk%20ELK%20for%20Auditing%20AWS%20GCP%20Azure%20Security%20posture%20-%20defcon27.pptx>
- [https://www.amazon.com/Google-Cloud-Certified-Associate-Engineer/dp/1119564417/ref=sr\\_1\\_1?crid=2TGT6926CWROE&keywords=official+google+cloud+certified+associate+cloud+engineer+study+guide&qid=1580317660&srefix=associate+engineer+%2Caps%2C194&sr=8-1](https://www.amazon.com/Google-Cloud-Certified-Associate-Engineer/dp/1119564417/ref=sr_1_1?crid=2TGT6926CWROE&keywords=official+google+cloud+certified+associate+cloud+engineer+study+guide&qid=1580317660&srefix=associate+engineer+%2Caps%2C194&sr=8-1)

# Resources

<https://www.cyberark.com/threat-research-blog/kubernetes-pentest-methodology-part-2/>  
<https://github.com/calinah/learn-by-hacking-kccn/blob/master/Learn%20by%20Hacking.pdf>  
<https://www.cyberark.com/threat-research-blog/securing-kubernetes-clusters-by-eliminating-risky-permissions/>  
<https://kubernetes.io/docs/reference/access-authn-authz/controlling-access/#authentication>  
<https://www.cyberark.com/threat-research-blog/kubernetes-pentest-methodology-part-1/>  
<https://www.cyberark.com/threat-research-blog/kubernetes-pentest-methodology-part-3/>  
[https://github.com/calinah/learn-by-hacking-kccn/blob/master/k8s\\_cheatsheet.md](https://github.com/calinah/learn-by-hacking-kccn/blob/master/k8s_cheatsheet.md)  
<https://kubernetes.io/docs/concepts/policy/pod-security-policy/>  
<https://github.com/kelseyhightower/kubernetes-the-hard-way>  
<https://github.com/hardening-kubernetes/from-scratch>  
<https://jwt.io>  
<https://capsule8.com/blog/practical-container-escape-exercise/>  
<https://bustakube.com>

# Q & A

Thank you

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