DEFENDING CONTAINERS LIKE A NINJA:
A WALK THROUGH THE ADVANCED SECURITY FEATURES OF DOCKER AND KUBERNETES

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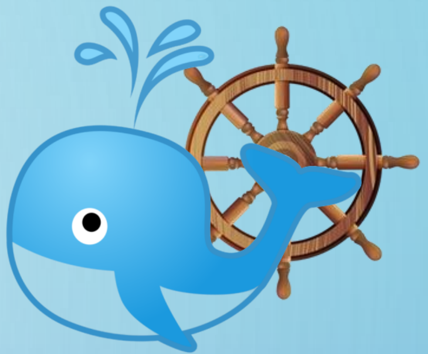
Dreamlab Technologies



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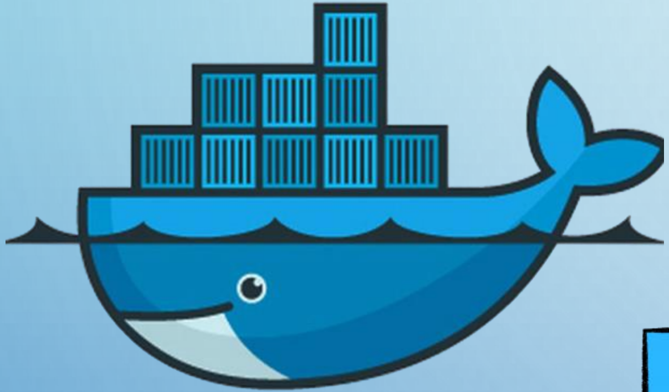
WHO AM I?

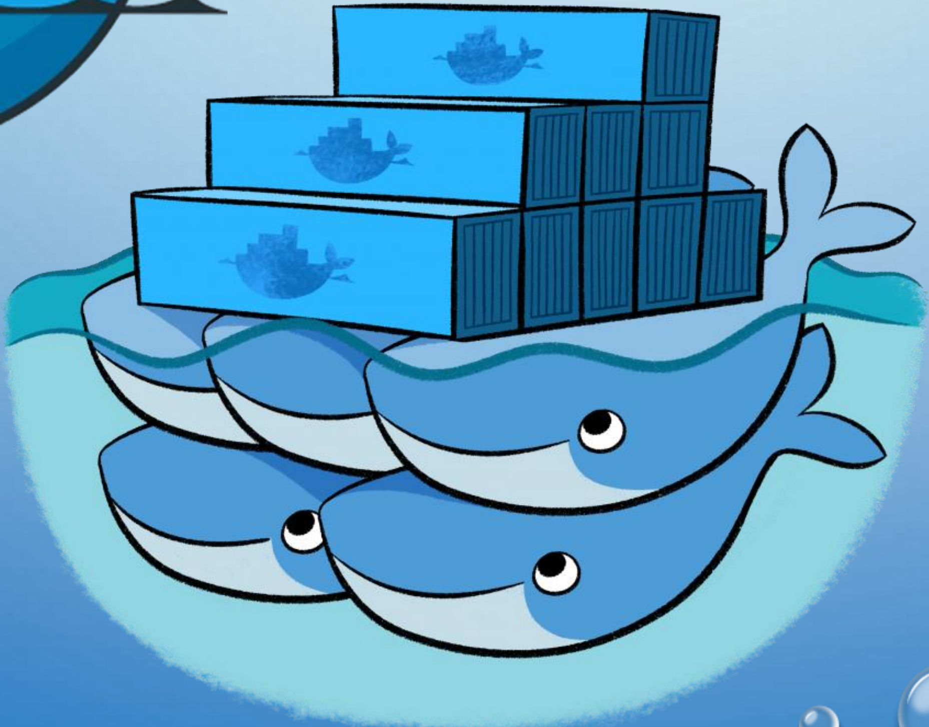
Sheila A. Berta - @UnaPibaGeek
Head of Research at Dreamlab Technologies

A little bit more:

- Developer in ASM (Microcontrollers & Microprocessors x86/x64), C/C++, Go & Python.
- Speaker at Black Hat (x3), DEF CON (x2), Ekoparty (x4), HITB, SCSD, IEEE… & more.
- Docker Captain! (DCA Certified)

COMPLEXITY IS THE WORST ENEMY OF SECURITY...





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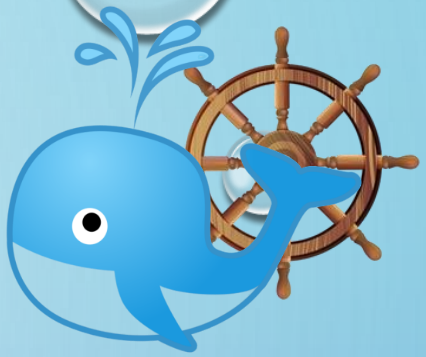
SECURING DOCKER DAEMON AND CORE COMPONENTS



DAEMON ROOTLESS MODE

Prerequisites: https://docs.docker.com/engine/security/rootless/#distribution-specific-hint

Step 1:

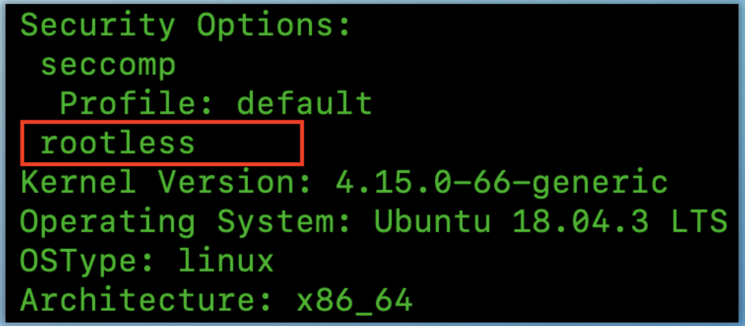
```
$ curl -fsSL https://get.docker.com/rootless | sh
```

Step 2:

```
export XDG_RUNTIME_DIR=/tmp/docker-1000
export PATH=/home/<user>/bin:$PATH
export DOCKER_HOST=unix:///tmp/docker-1000/docker.sock
```

Step 3:

```
$ /home/<user>/bin/dockerd-rootless.sh --experimental --storage-driver vfs &
```

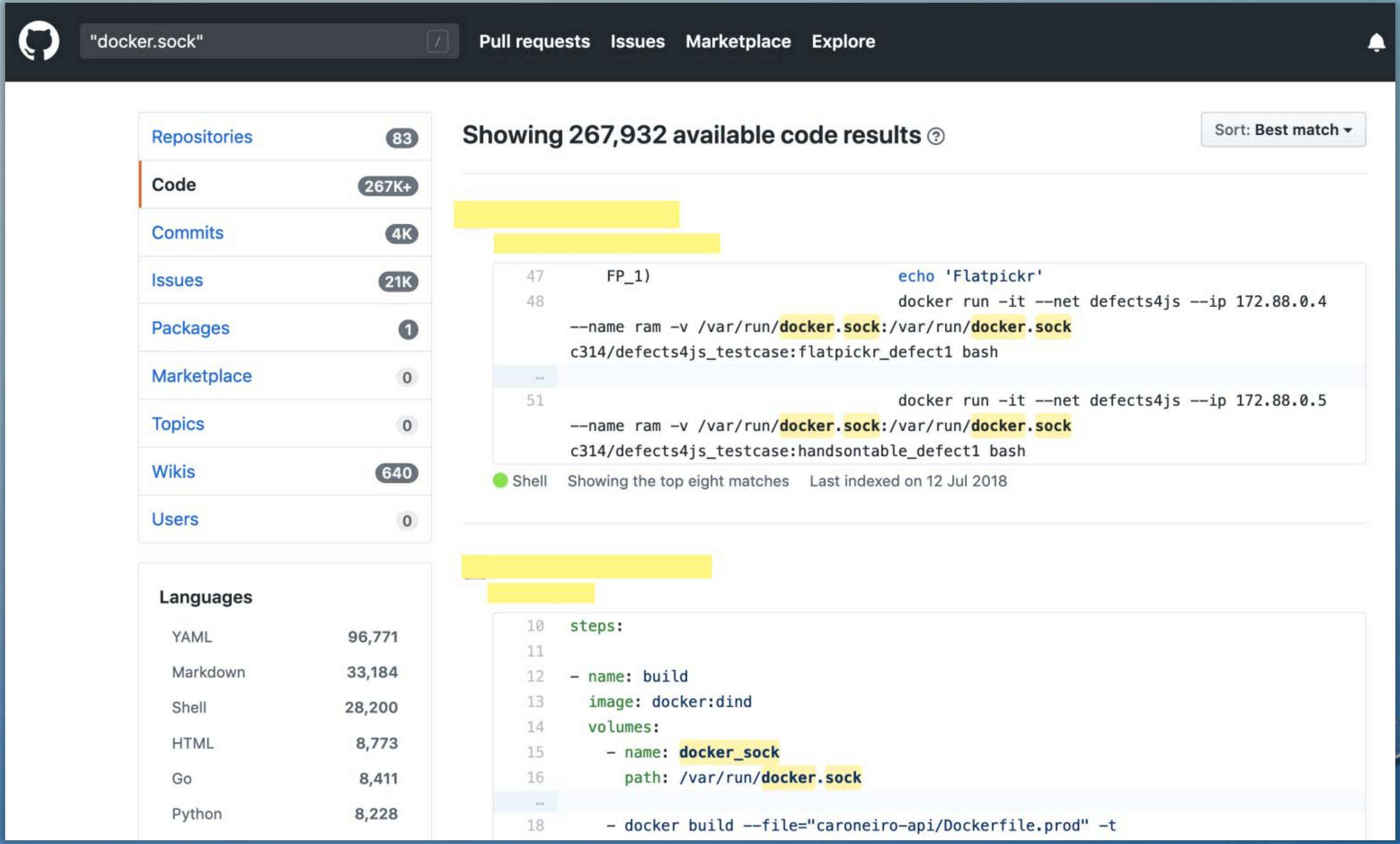


```
Security Options:
 seccomp
  Profile: default
 rootless
Kernel Version: 4.15.0-66-generic
Operating System: Ubuntu 18.04.3 LTS
OSType: linux
Architecture: x86_64
```

DOCKER SOCKET

- ❑ UNIX
- ❑ TCP
- ❑ FD

UNIX socket
/var/run/docker.sock



"docker.sock" Pull requests Issues Marketplace Explore

Repositories	83
Code	267K+
Commits	4K
Issues	21K
Packages	1
Marketplace	0
Topics	0
Wikis	640
Users	0

Languages

YAML	96,771
Markdown	33,184
Shell	28,200
HTML	8,773
Go	8,411
Python	8,228

Showing 267,932 available code results

Sort: Best match

```
    FP_1)                           echo 'Flatpickr'
                                    docker run -it --net defects4js --ip 172.88.0.4
--name ram -v /var/run/docker.sock:/var/run/docker.sock
c314/defects4js_testcase:flatpickr_defect1 bash
...
                                    docker run -it --net defects4js --ip 172.88.0.5
--name ram -v /var/run/docker.sock:/var/run/docker.sock
c314/defects4js_testcase:handsontable_defect1 bash
```

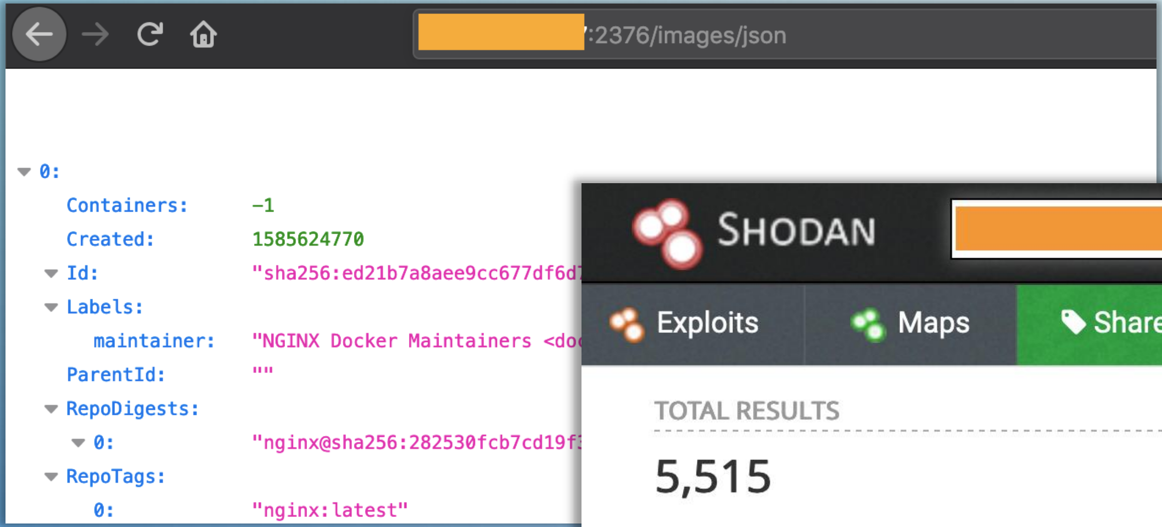
● Shell Showing the top eight matches Last indexed on 12 Jul 2018

```
steps:

- name: build
  image: docker:dind
  volumes:
    - name: docker_sock
      path: /var/run/docker.sock
...
    - docker build --file="caroneiro-api/Dockerfile.prod" -t
```

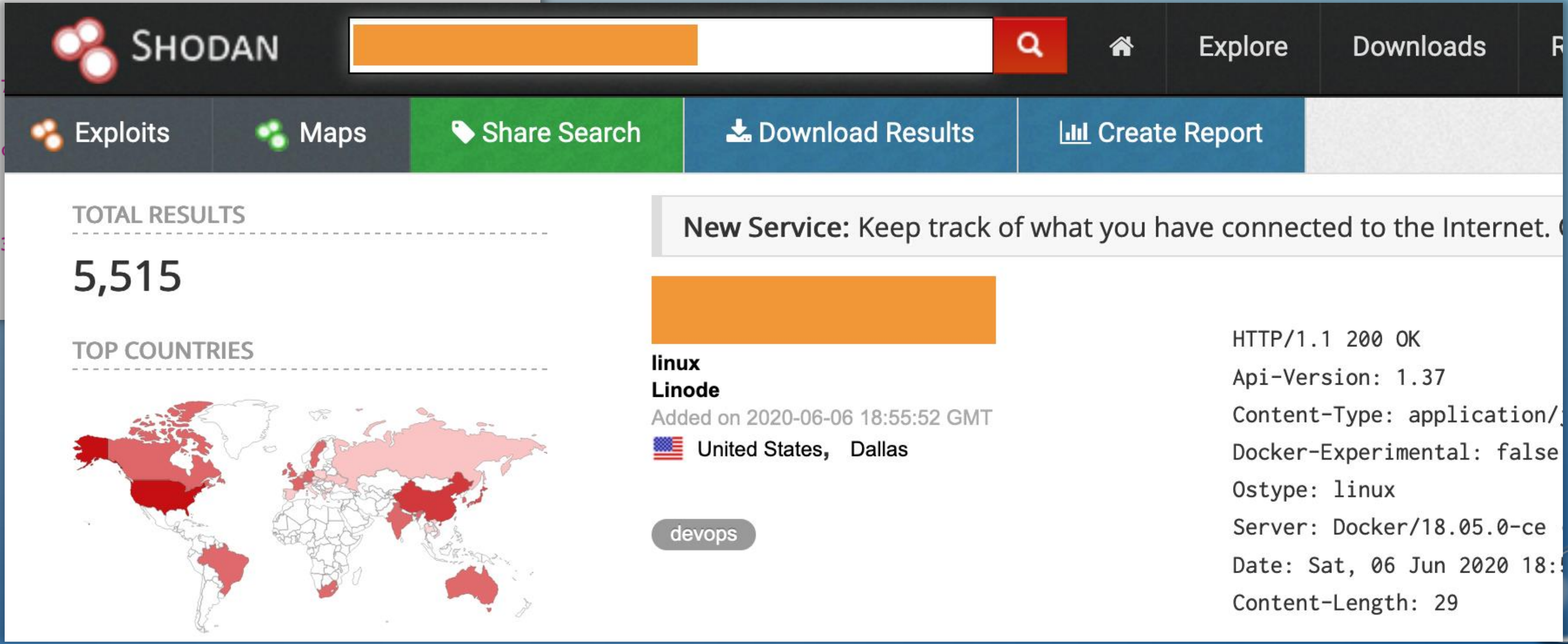
DOCKER SOCKET

TCP socket



[redacted]:2376/images/json

```
▼ 0:
    Containers:      -1
    Created:         1585624770
  ▼ Id:              "sha256:ed21b7a8aee9cc677df6d
  ▼ Labels:
      maintainer:    "NGINX Docker Maintainers <do
    ParentId:        ""
  ▼ RepoDigests:
    ▼ 0:             "nginx@sha256:282530fcb7cd19f
  ▼ RepoTags:
      0:             "nginx:latest"
```



[redacted]

TOTAL RESULTS

5,515

TOP COUNTRIES

New Service: Keep track of what you have connected to the Internet.

[redacted]

linux
Linode
Added on 2020-06-06 18:55:52 GMT
United States, Dallas

devops

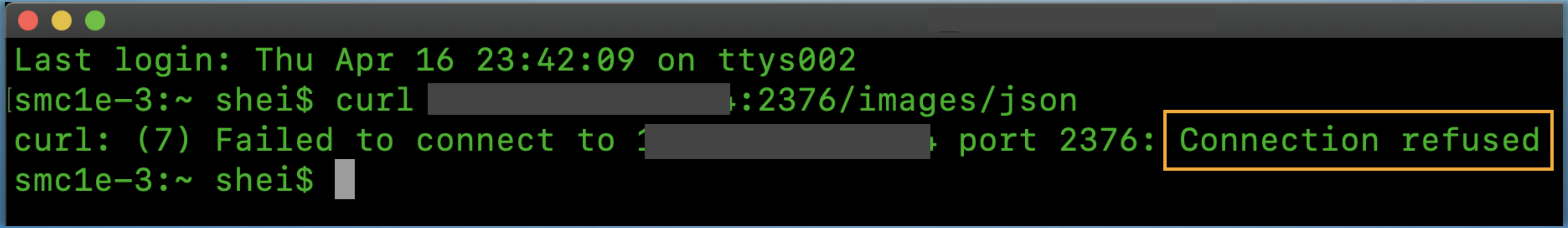
```
HTTP/1.1 200 OK
Api-Version: 1.37
Content-Type: application/
Docker-Experimental: false
Ostype: linux
Server: Docker/18.05.0-ce
Date: Sat, 06 Jun 2020 18:
Content-Length: 29
```

DOCKER SOCKET

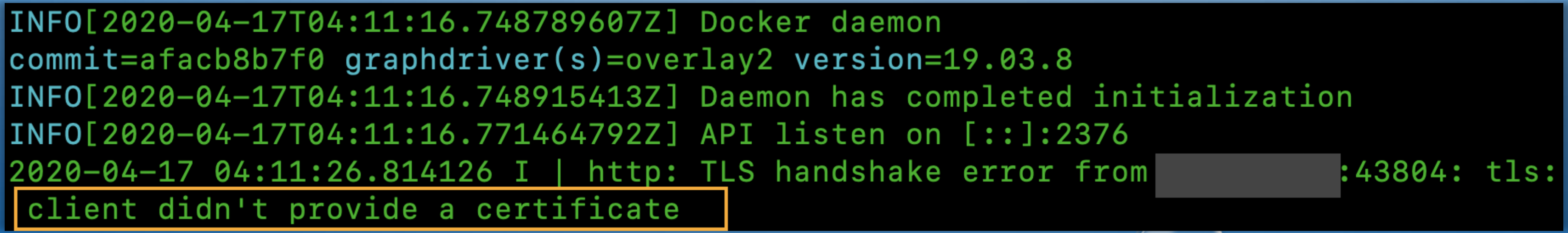
TCP socket – Built-in HTTPS encrypted socket

- ❑ Create a CA and server keys using OpenSSL
- ❑ Run the Docker daemon with the TLS certificates.

```
$ dockerd --tlsverify --tlscacert=ca.pem --tlscert=server-cert.pem --tlskey=server-key.pem -H=0.0.0.0:2376
```



```
Last login: Thu Apr 16 23:42:09 on ttys002
smc1e-3:~ shei$ curl [redacted]:2376/images/json
curl: (7) Failed to connect to [redacted] port 2376: Connection refused
smc1e-3:~ shei$
```



```
INFO[2020-04-17T04:11:16.748789607Z] Docker daemon
commit=afacb8b7f0 graphdriver(s)=overlay2 version=19.03.8
INFO[2020-04-17T04:11:16.748915413Z] Daemon has completed initialization
INFO[2020-04-17T04:11:16.771464792Z] API listen on [::]:2376
2020-04-17 04:11:26.814126 I | http: TLS handshake error from [redacted]:43804: tls:
client didn't provide a certificate
```

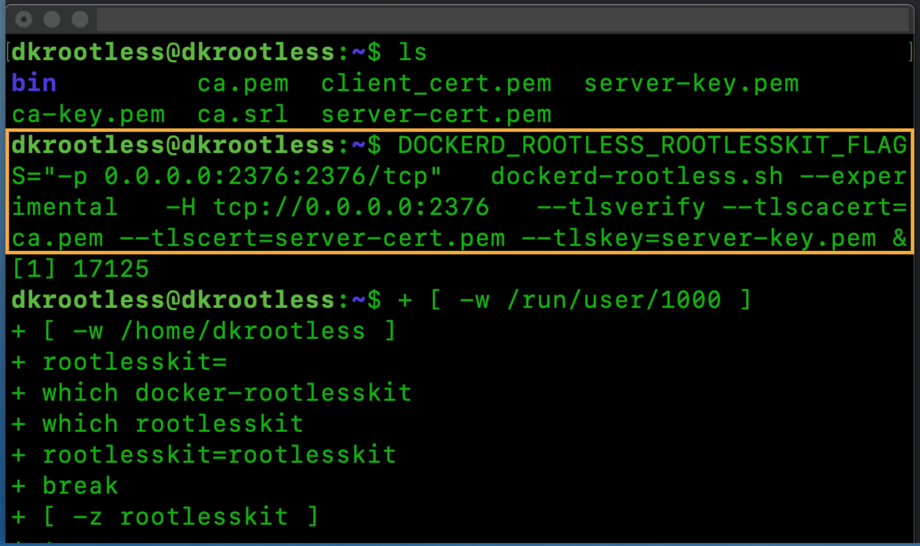
API ENDPOINT – CLIENT AUTHENTICATION

- ❑ Create the client TLS certificates and sign them with the CA.
- ❑ Connect to the remote API endpoint providing the certificates.

$ docker --tlsverify --tlscacert=ca.pem --tlscert=client-cert.pem --tlskey=client-key.pem -H=<host>:2376 version

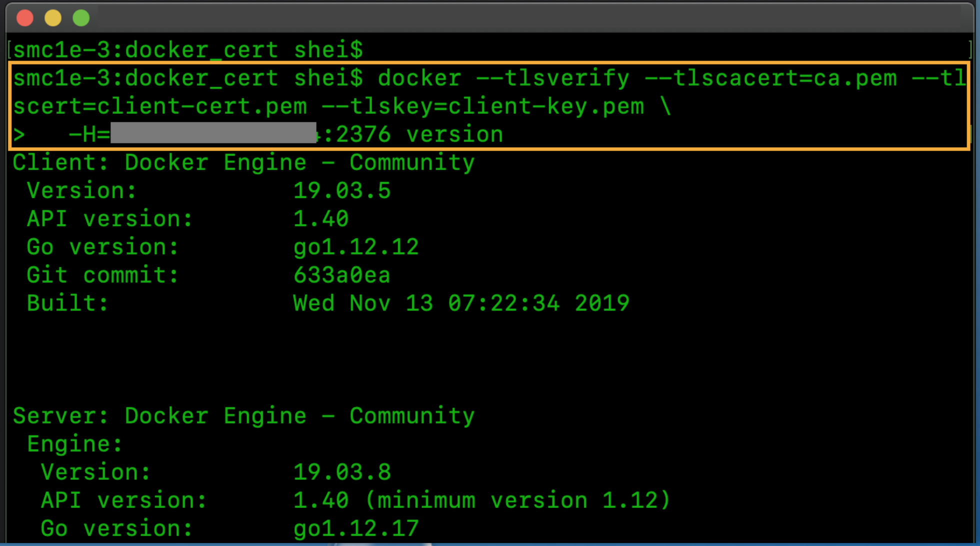
$ export DOCKER_HOST=tcp://<host>:2376 DOCKER_TLS_VERIFY=1

DOCKER DAEMON'S HOST



```
dkrootless@dkrootless:~$ ls
bin            ca.pem  client_cert.pem  server-key.pem
ca-key.pem   ca.srl  server-cert.pem
dkrootless@dkrootless:~$ DOCKERD_ROOTLESS_ROOTLESSKIT_FLAG
S="-p 0.0.0.0:2376:2376/tcp"   dockerd-rootless.sh --exper
imental   -H tcp://0.0.0.0:2376   --tlsverify --tlscacert=
ca.pem --tlscert=server-cert.pem --tlskey=server-key.pem &
[1] 17125
dkrootless@dkrootless:~$ + [ -w /run/user/1000 ]
+ [ -w /home/dkrootless ]
+ rootlesskit=
+ which docker-rootlesskit
+ which rootlesskit
+ rootlesskit=rootlesskit
+ break
+ [ -z rootlesskit ]
```

CLIENT'S MACHINE



```
smc1e-3:docker_cert shei$
smc1e-3:docker_cert shei$ docker --tlsverify --tlscacert=ca.pem --tl
scert=client-cert.pem --tlskey=client-key.pem \
>    -H=[redacted]:2376 version
Client: Docker Engine - Community
 Version:           19.03.5
 API version:       1.40
 Go version:        go1.12.12
 Git commit:        633a0ea
 Built:             Wed Nov 13 07:22:34 2019


Server: Docker Engine - Community
 Engine:
  Version:          19.03.8
  API version:      1.40 (minimum version 1.12)
  Go version:       go1.12.17
```

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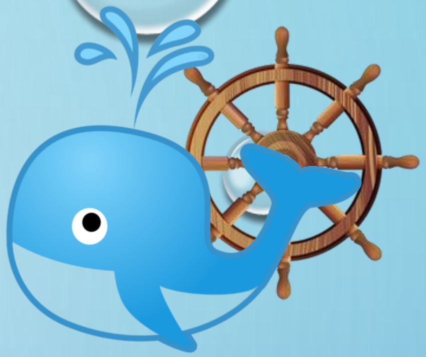
SECURING DOCKER CONTAINERS



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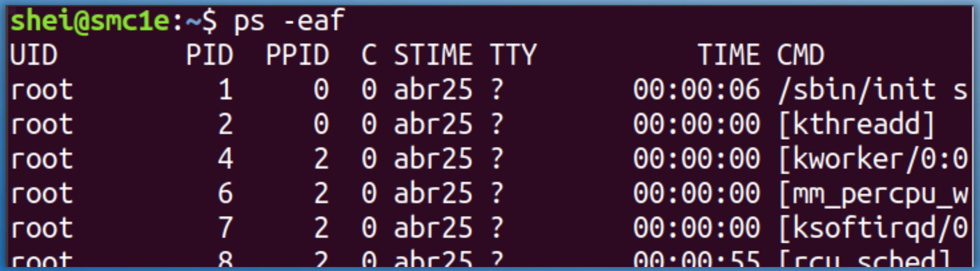
KERNEL NAMESPACES

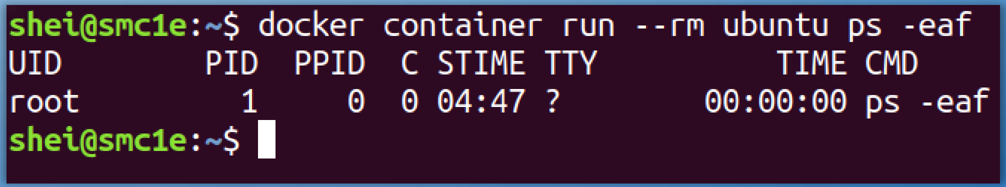
- ❑ UTS namespace: isolates system identifiers.
- ❑ PID namespace: isolates the PID space.
- ❑ IPC namespace: isolates IPC resources.
- ❑ NET namespace: isolates network interfaces.
- ❑ USER namespace: isolates user and group ID spaces (disabled by default).
- ❑ Mount namespace: isolates the set of filesystem mount points.

Docker Host



```
shei@smc1e:~$ ps -eaf
UID        PID  PPID  C STIME TTY          TIME CMD
root         1     0  0 abr25 ?        00:00:06 /sbin/init s
root         2     0  0 abr25 ?        00:00:00 [kthreadd]
root         4     2  0 abr25 ?        00:00:00 [kworker/0:0
root         6     2  0 abr25 ?        00:00:00 [mm_percpu_w
root         7     2  0 abr25 ?        00:00:00 [ksoftirqd/0
root         8     2  0 abr25 ?        00:00:55 [rcu_sched]
```

Docker Container



```
shei@smc1e:~$ docker container run --rm ubuntu ps -eaf
UID        PID  PPID  C STIME TTY          TIME CMD
root         1     0  0 04:47 ?        00:00:00 ps -eaf
shei@smc1e:~$ 
```

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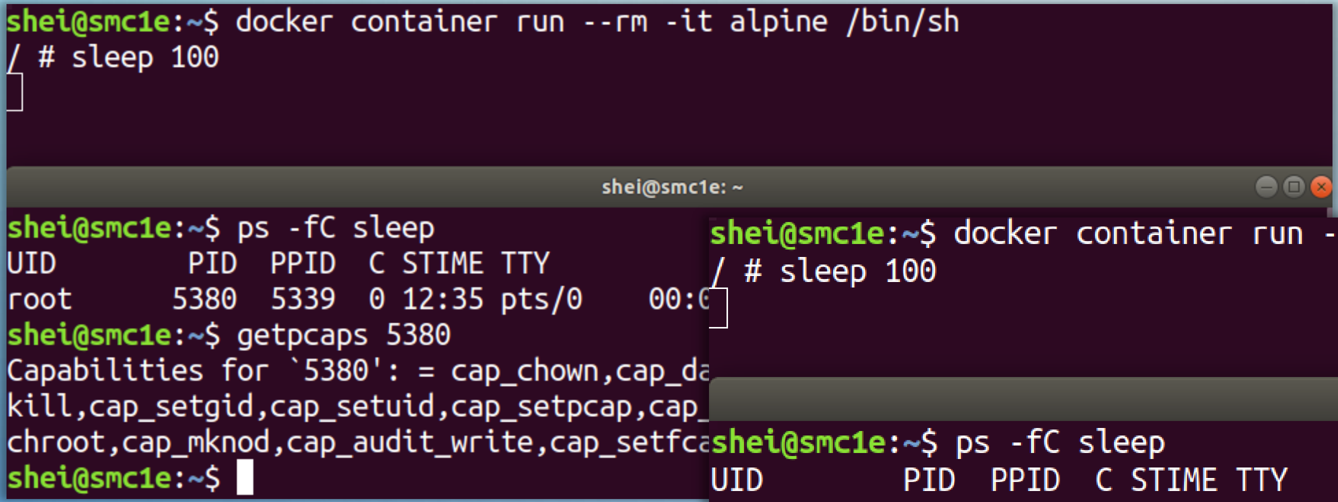
KERNEL CAPABILITIES

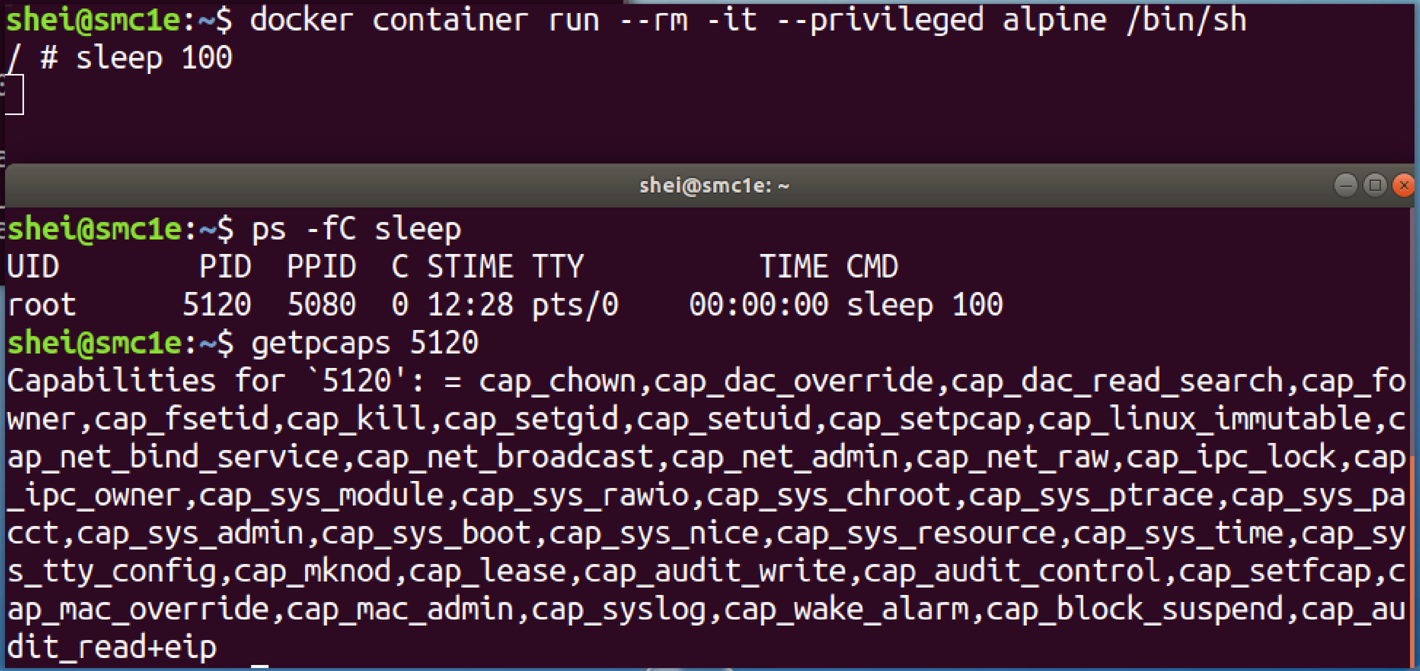
Default Capabilities: https://github.com/moby/moby/blob/master/oci/caps/defaults.go



```
shei@smc1e:~$ docker container run --rm -it alpine /bin/sh
/ # sleep 100
```

shei@smc1e: ~

```
shei@smc1e:~$ ps -fC sleep
UID         PID  PPID  C STIME TTY          00:0
root       5380  5339  0 12:35 pts/0
shei@smc1e:~$ getpcaps 5380
Capabilities for `5380': = cap_chown,cap_da
kill,cap_setgid,cap_setuid,cap_setpcap,cap_
chroot,cap_mknod,cap_audit_write,cap_setfca
shei@smc1e:~$
```



```
shei@smc1e:~$ docker container run --rm -it --privileged alpine /bin/sh
/ # sleep 100
```

shei@smc1e: ~

```
shei@smc1e:~$ ps -fC sleep
UID         PID  PPID  C STIME TTY          TIME CMD
root       5120  5080  0 12:28 pts/0    00:00:00 sleep 100
shei@smc1e:~$ getpcaps 5120
Capabilities for `5120': = cap_chown,cap_dac_override,cap_dac_read_search,cap_fo
wner,cap_fsetid,cap_kill,cap_setgid,cap_setuid,cap_setpcap,cap_linux_immutable,c
ap_net_bind_service,cap_net_broadcast,cap_net_admin,cap_net_raw,cap_ipc_lock,cap
_ipc_owner,cap_sys_module,cap_sys_rawio,cap_sys_chroot,cap_sys_ptrace,cap_sys_pa
cct,cap_sys_admin,cap_sys_boot,cap_sys_nice,cap_sys_resource,cap_sys_time,cap_sy
s_tty_config,cap_mknod,cap_lease,cap_audit_write,cap_audit_control,cap_setfcap,c
ap_mac_override,cap_mac_admin,cap_syslog,cap_wake_alarm,cap_block_suspend,cap_au
dit_read+eip
```

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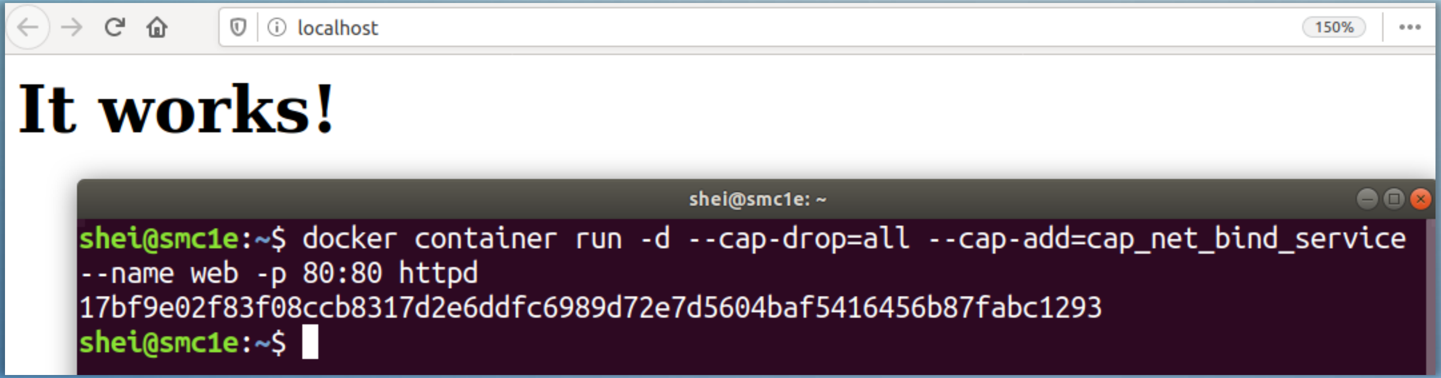
KERNEL CAPABILITIES

Fine-grained access control system

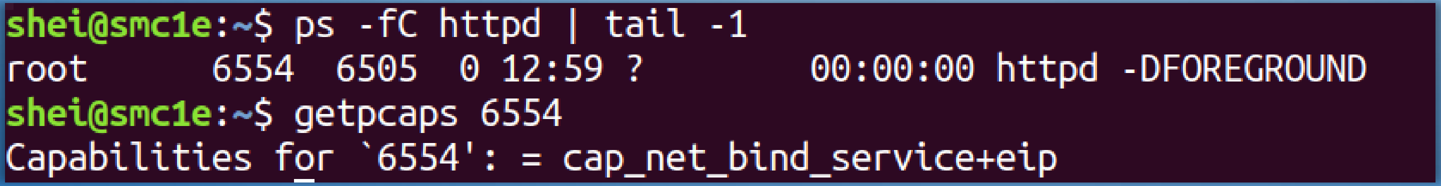
```
$ docker container run --cap-drop=all --cap-add=cap_net_bind_service -p 80:80 httpd
```



localhost

It works!

```
shei@smc1e:~$ docker container run -d --cap-drop=all --cap-add=cap_net_bind_service
--name web -p 80:80 httpd
17bf9e02f83f08ccb8317d2e6ddfc6989d72e7d5604baf5416456b87fabc1293
shei@smc1e:~$
```



```
shei@smc1e:~$ ps -fC httpd | tail -1
root      6554  6505  0 12:59 ?        00:00:00 httpd -DFOREGROUND
shei@smc1e:~$ getpcaps 6554
Capabilities for `6554': = cap_net_bind_service+eip
```

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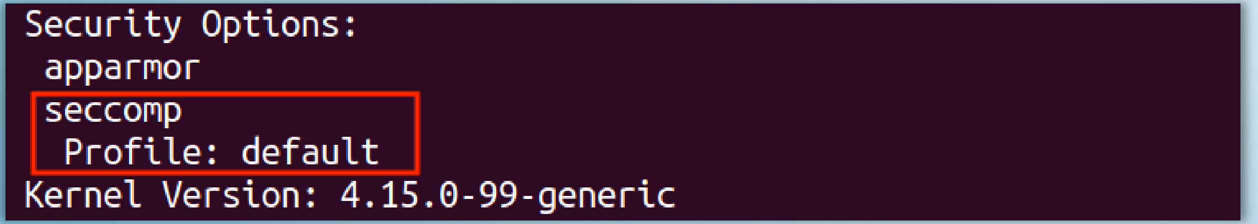
SYSTEM CALLS RESTRICTION

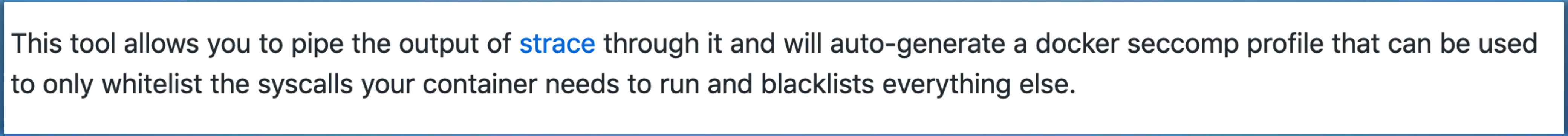
Seccomp Profiles



```
Security Options:
 apparmor
 seccomp
  Profile: default
Kernel Version: 4.15.0-99-generic
```

$ docker container run --security-opt seccomp=/path/to/seccomp/profile.json myapp

https://github.com/blacktop/seccomp-gen



This tool allows you to pipe the output of strace through it and will auto-generate a docker seccomp profile that can be used to only whitelist the syscalls your container needs to run and blacklists everything else.

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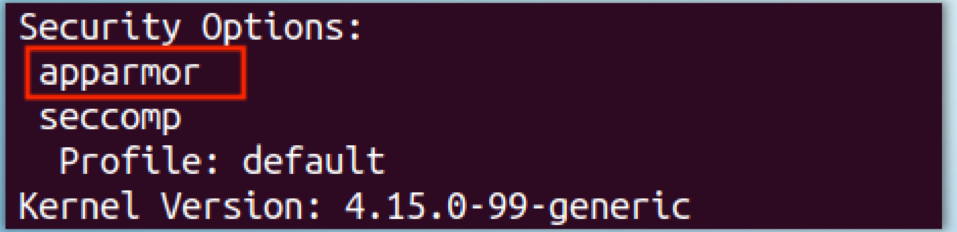
MANDATORY ACCESS CONTROL

AppArmor / SELinux Profiles

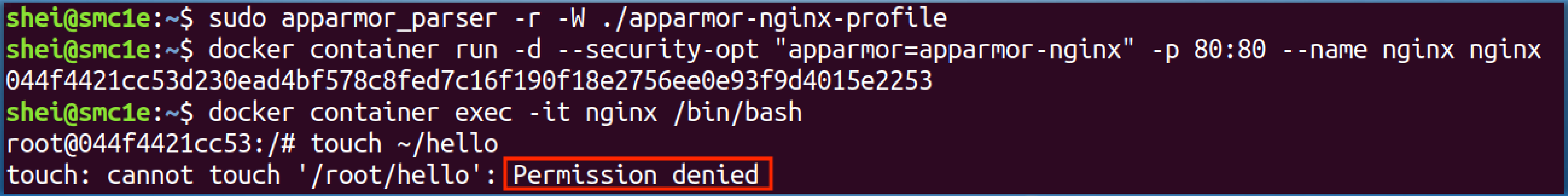


```
Security Options:
 apparmor
 seccomp
  Profile: default
Kernel Version: 4.15.0-99-generic
```

https://github.com/genuinetools/bane

$ sudo apparmor_parser -r -W /path/to/your/apparmor-nginx-profile

$ docker run -d --security-opt "apparmor=apparmor-profile-name" -p 80:80 nginx



```
shei@smc1e:~$ sudo apparmor_parser -r -W ./apparmor-nginx-profile
shei@smc1e:~$ docker container run -d --security-opt "apparmor=apparmor-nginx" -p 80:80 --name nginx nginx
044f4421cc53d230ead4bf578c8fed7c16f190f18e2756ee0e93f9d4015e2253
shei@smc1e:~$ docker container exec -it nginx /bin/bash
root@044f4421cc53:/# touch ~/hello
touch: cannot touch '/root/hello': Permission denied
```

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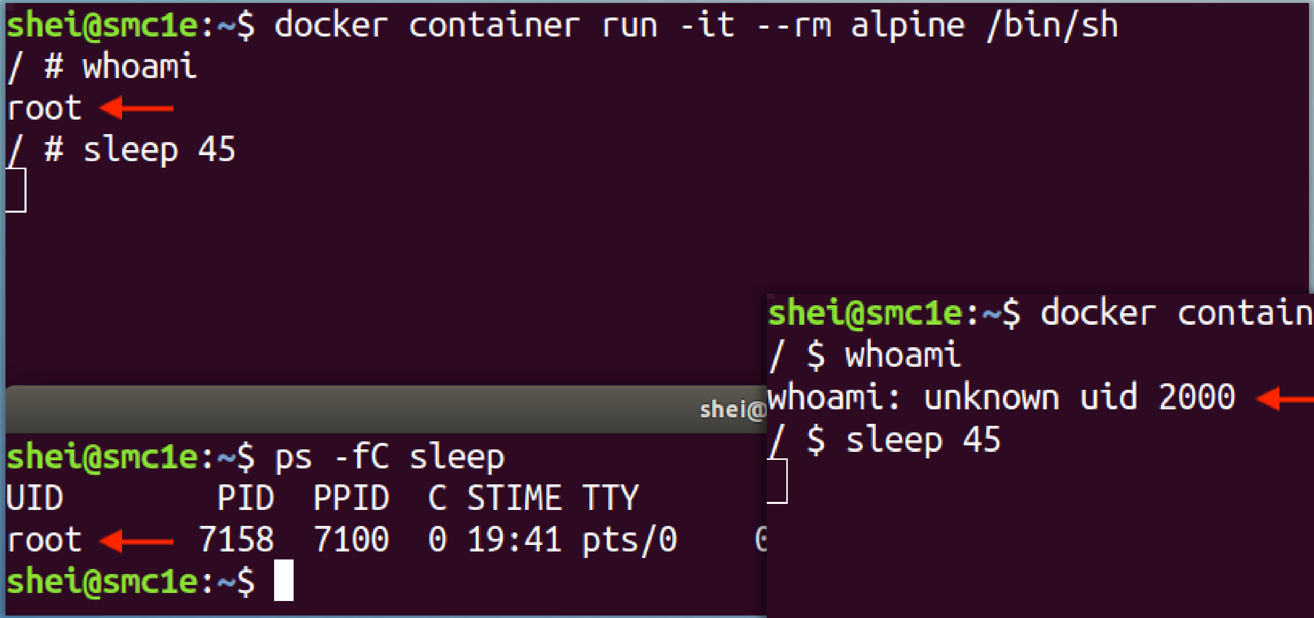
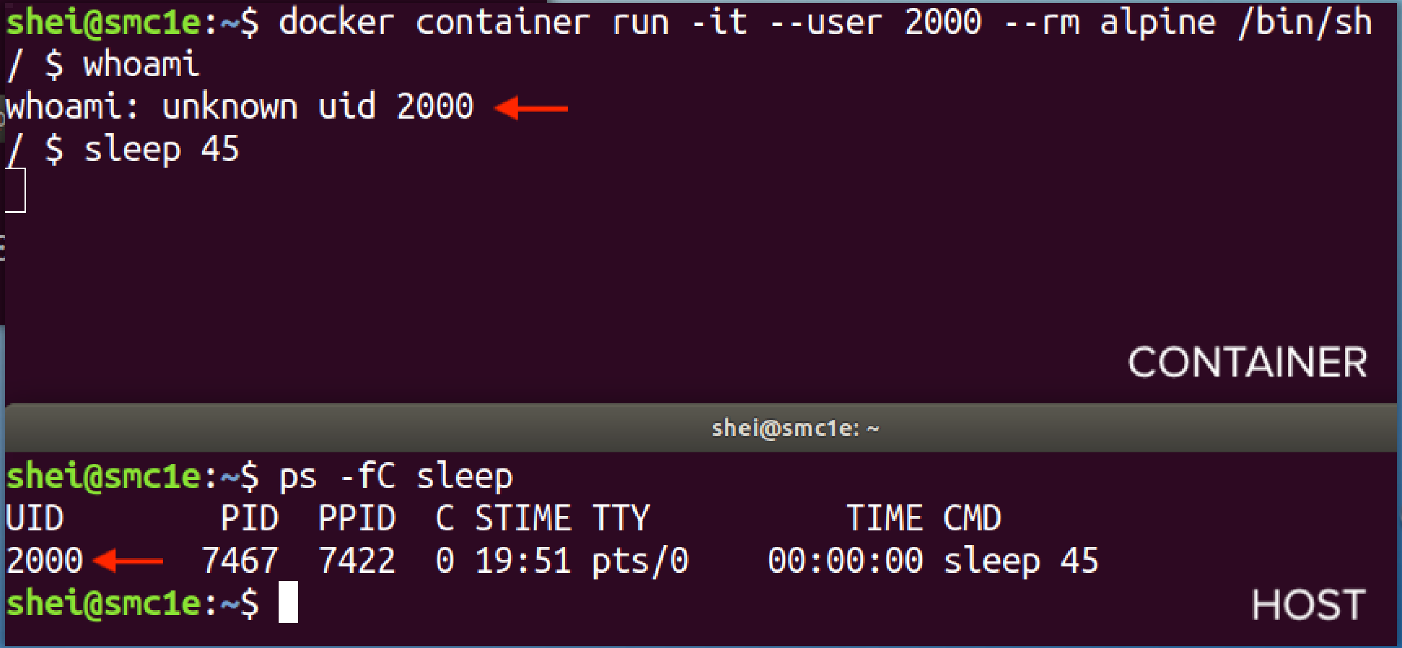
CONTAINER UID & GID MANAGEMENT



```
shei@smc1e:~$ docker container run -it --rm alpine /bin/sh
/ # whoami
root
/ # sleep 45
```

```
shei@smc1e:~$ ps -fC sleep
UID          PID  PPID  C STIME TTY
root        7158  7100  0 19:41 pts/0
shei@smc1e:~$
```



```
shei@smc1e:~$ docker container run -it --user 2000 --rm alpine /bin/sh
/ $ whoami
whoami: unknown uid 2000
/ $ sleep 45
```

CONTAINER

shei@smc1e: ~

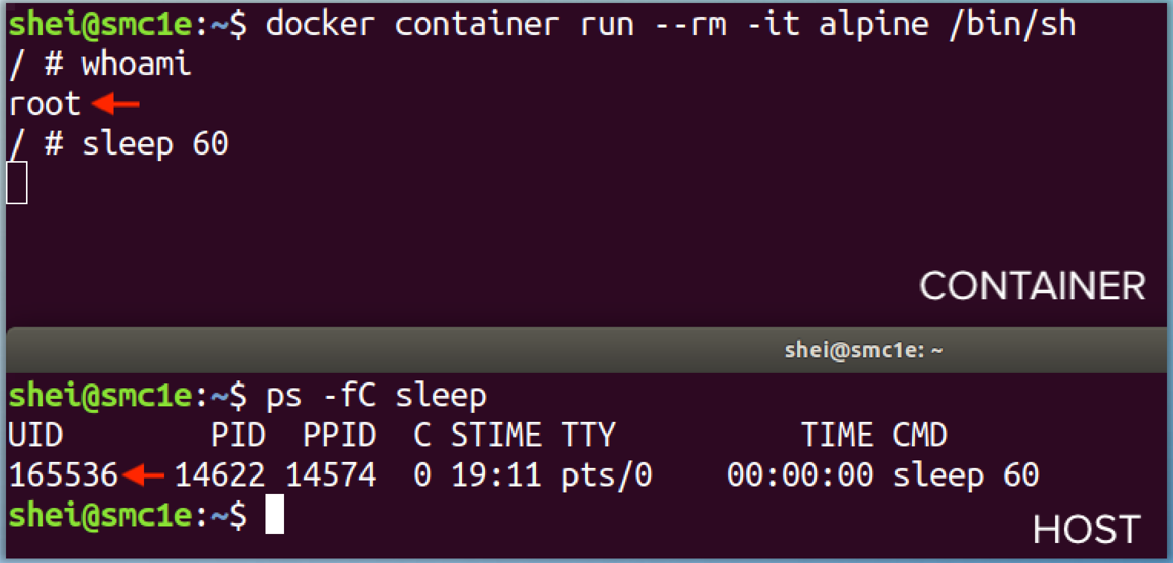
```
shei@smc1e:~$ ps -fC sleep
UID          PID  PPID  C STIME TTY          TIME CMD
2000        7467  7422  0 19:51 pts/0    00:00:00 sleep 45
shei@smc1e:~$
```

HOST

USER NAMESPACE REMAP

```
/etc/docker/daemon.json

{
  "userns-remap": "default"
}
```



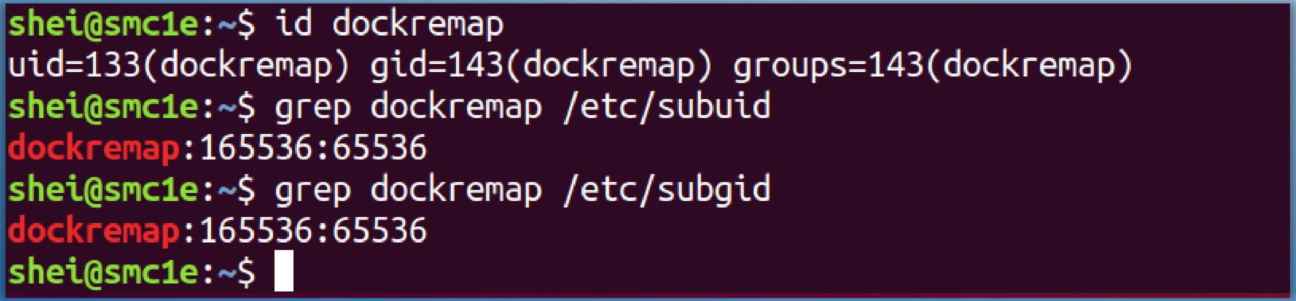
```
shei@smc1e:~$ docker container run --rm -it alpine /bin/sh
/ # whoami
root
/ # sleep 60
```

CONTAINER

shei@smc1e: ~

```
shei@smc1e:~$ ps -fC sleep
UID          PID  PPID  C STIME TTY          TIME CMD
165536     14622 14574  0 19:11 pts/0    00:00:00 sleep 60
shei@smc1e:~$
```

HOST



```
shei@smc1e:~$ id dockremap
uid=133(dockremap) gid=143(dockremap) groups=143(dockremap)
shei@smc1e:~$ grep dockremap /etc/subuid
dockremap:165536:65536
shei@smc1e:~$ grep dockremap /etc/subgid
dockremap:165536:65536
shei@smc1e:~$
```

DEMO TIME!

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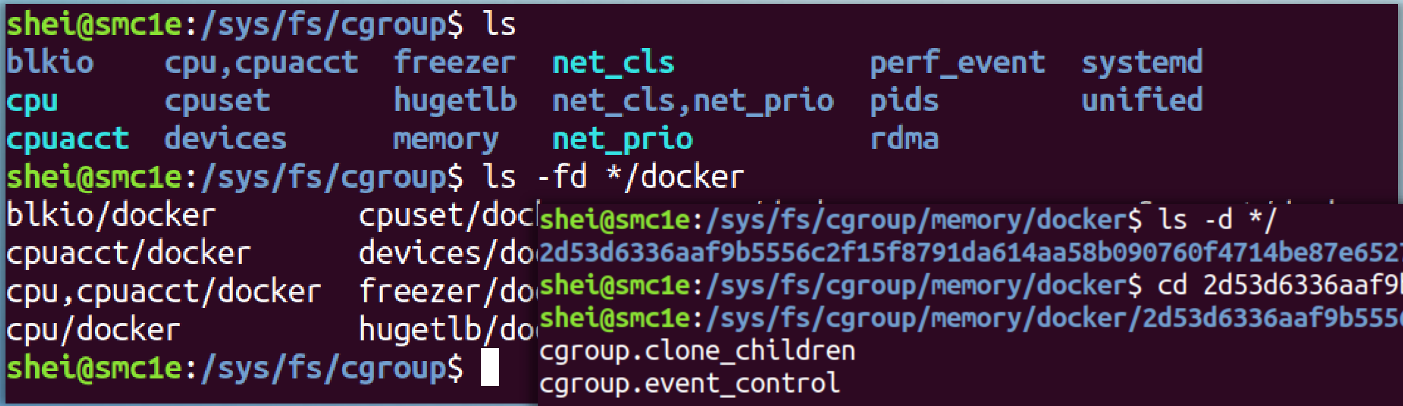
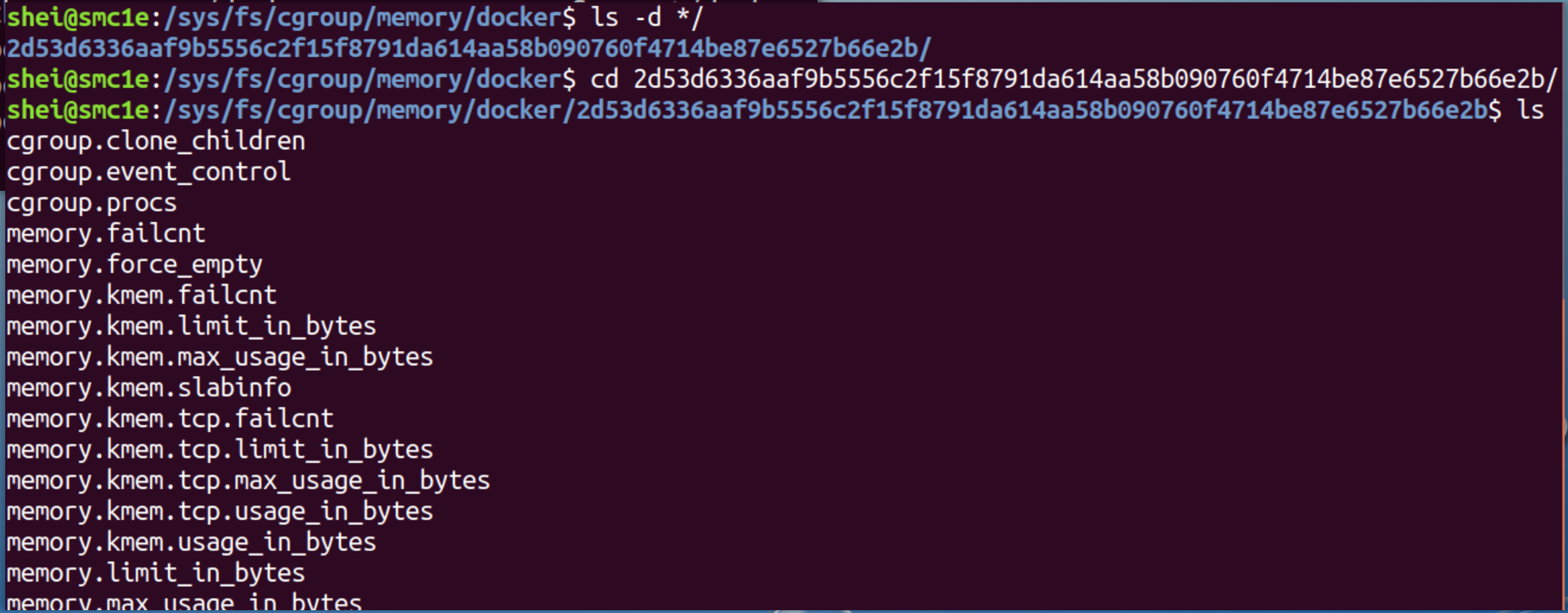
CONTROL GROUPS – RESOURCE LIMITATION

❑ CPU ❑ Disk I/O ❑ Memory ❑ Hardware Resources

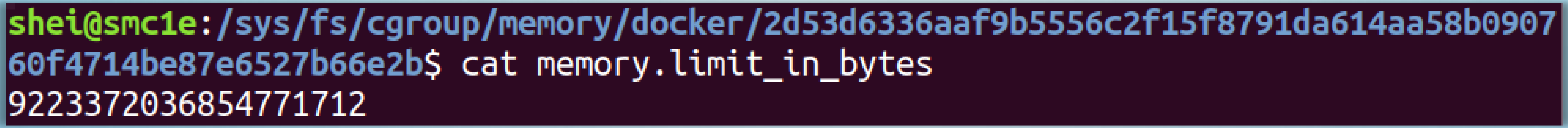


```
shei@smc1e:/sys/fs/cgroup$ ls
blkio    cpu,cpuacct  freezer  net_cls           perf_event  systemd
cpu      cpuset       hugetlb  net_cls,net_prio  pids        unified
cpuacct  devices      memory   net_prio          rdma
shei@smc1e:/sys/fs/cgroup$ ls -fd */docker
blkio/docker         cpuset/doc
cpuacct/docker       devices/do
cpu,cpuacct/docker   freezer/do
cpu/docker           hugetlb/do
shei@smc1e:/sys/fs/cgroup$ 
```



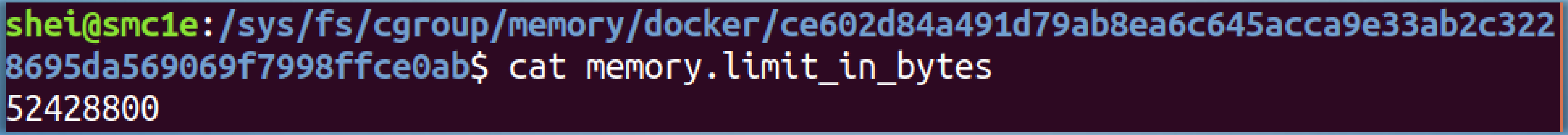
```
shei@smc1e:/sys/fs/cgroup/memory/docker$ ls -d */
2d53d6336aaf9b5556c2f15f8791da614aa58b090760f4714be87e6527b66e2b/
shei@smc1e:/sys/fs/cgroup/memory/docker$ cd 2d53d6336aaf9b5556c2f15f8791da614aa58b090760f4714be87e6527b66e2b/
shei@smc1e:/sys/fs/cgroup/memory/docker/2d53d6336aaf9b5556c2f15f8791da614aa58b090760f4714be87e6527b66e2b$ ls
cgroup.clone_children
cgroup.event_control
cgroup.procs
memory.failcnt
memory.force_empty
memory.kmem.failcnt
memory.kmem.limit_in_bytes
memory.kmem.max_usage_in_bytes
memory.kmem.slabinfo
memory.kmem.tcp.failcnt
memory.kmem.tcp.limit_in_bytes
memory.kmem.tcp.max_usage_in_bytes
memory.kmem.tcp.usage_in_bytes
memory.kmem.usage_in_bytes
memory.limit_in_bytes
memory.max_usage_in_bytes
```

CONTROL GROUPS – RESOURCE LIMITATION



```
shei@smc1e:/sys/fs/cgroup/memory/docker/2d53d6336aaf9b5556c2f15f8791da614aa58b0907
60f4714be87e6527b66e2b$ cat memory.limit_in_bytes
9223372036854771712
```

```
$ docker container run --rm --memory 50M -it alpine /bin/sh
```

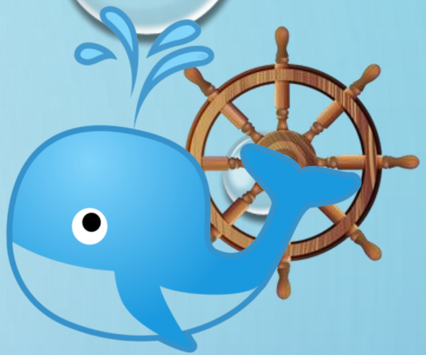


```
shei@smc1e:/sys/fs/cgroup/memory/docker/ce602d84a491d79ab8ea6c645acca9e33ab2c322
8695da569069f7998ffce0ab$ cat memory.limit_in_bytes
52428800
```

--memory-swap	--cpu-quota
--cpus	--cpu-period

https://docs.docker.com/engine/reference/commandline/run/

SECURING DOCKER IMAGES



DISTROLESS – MULTI-STAGE BUILDS

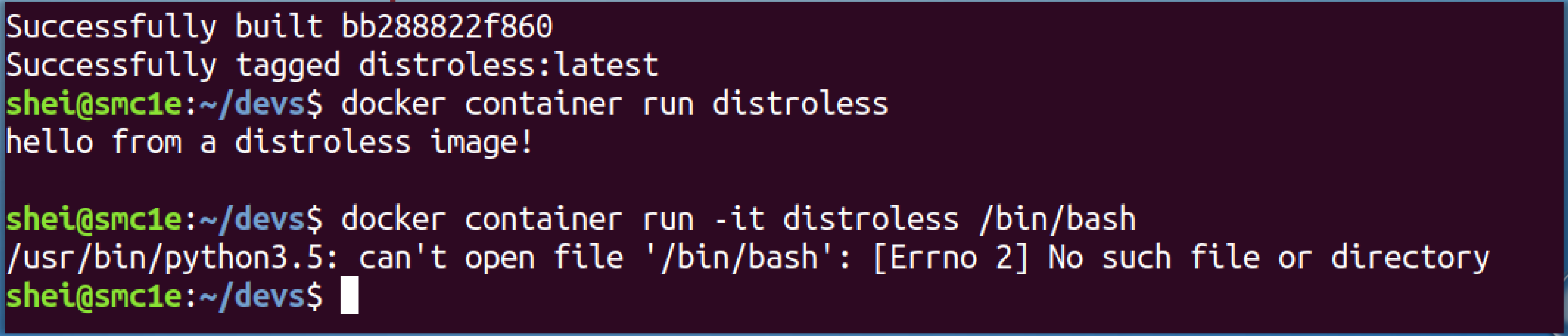
DISTROLESS BASE IMAGES AND MULTI-STAGE BUILDS

```
FROM python:3-slim AS build-env
ADD . /app
WORKDIR /app
```

Build Stage

```
FROM gcr.io/distroless/python3
COPY --from=build-env /app /app
WORKDIR /app
CMD ["hello.py"]
```

Final Image



```
Successfully built bb288822f860
Successfully tagged distroless:latest
shei@smc1e:~/devs$ docker container run distroless
hello from a distroless image!

shei@smc1e:~/devs$ docker container run -it distroless /bin/bash
/usr/bin/python3.5: can't open file '/bin/bash': [Errno 2] No such file or directory
shei@smc1e:~/devs$
```

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DOCKER CONTENT TRUST

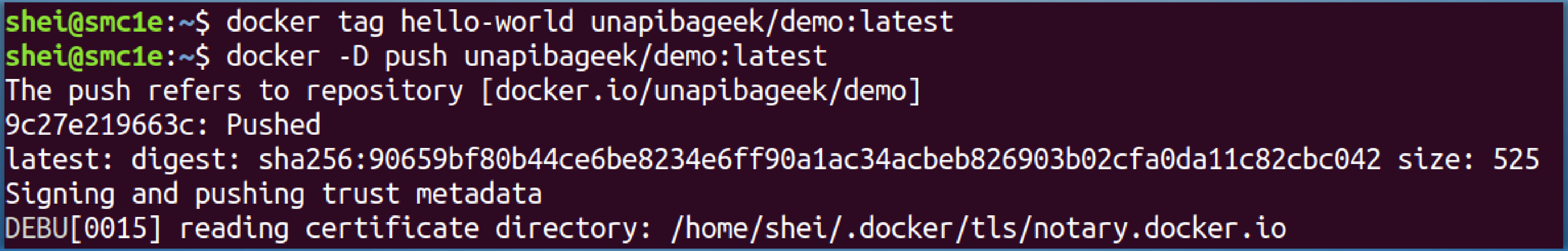
DOCKER CONTENT TRUST – SIGNED IMAGES

Image Publisher side:

Step 1: $ DOCKER_CONTENT_TRUST=1

Step 2: $ docker trust key generate <your_name>

Step 3: $ docker trust signer add --key <your-key.pub> <your-name> <your-repo>



```
shei@smc1e:~$ docker tag hello-world unapibageek/demo:latest
shei@smc1e:~$ docker -D push unapibageek/demo:latest
The push refers to repository [docker.io/unapibageek/demo]
9c27e219663c: Pushed
latest: digest: sha256:90659bf80b44ce6be8234e6ff90a1ac34acbeb826903b02cfa0da11c82cbc042 size: 525
Signing and pushing trust metadata
DEBU[0015] reading certificate directory: /home/shei/.docker/tls/notary.docker.io
```

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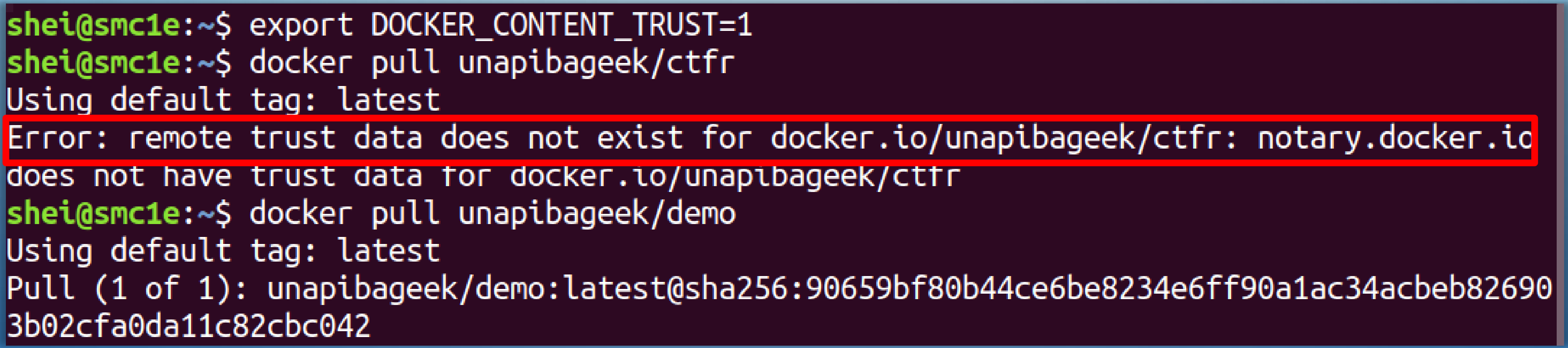
DOCKER CONTENT TRUST

DOCKER CONTENT TRUST – SIGNED IMAGES

Image Consumer side:

$ DOCKER_CONTENT_TRUST=1



```
shei@smc1e:~$ export DOCKER_CONTENT_TRUST=1
shei@smc1e:~$ docker pull unapibageek/ctfr
Using default tag: latest
Error: remote trust data does not exist for docker.io/unapibageek/ctfr: notary.docker.io
does not have trust data for docker.io/unapibageek/ctfr
shei@smc1e:~$ docker pull unapibageek/demo
Using default tag: latest
Pull (1 of 1): unapibageek/demo:latest@sha256:90659bf80b44ce6be8234e6ff90a1ac34acbeb82690
3b02cfa0da11c82cbc042
```

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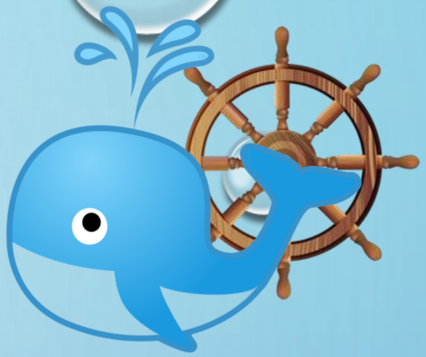
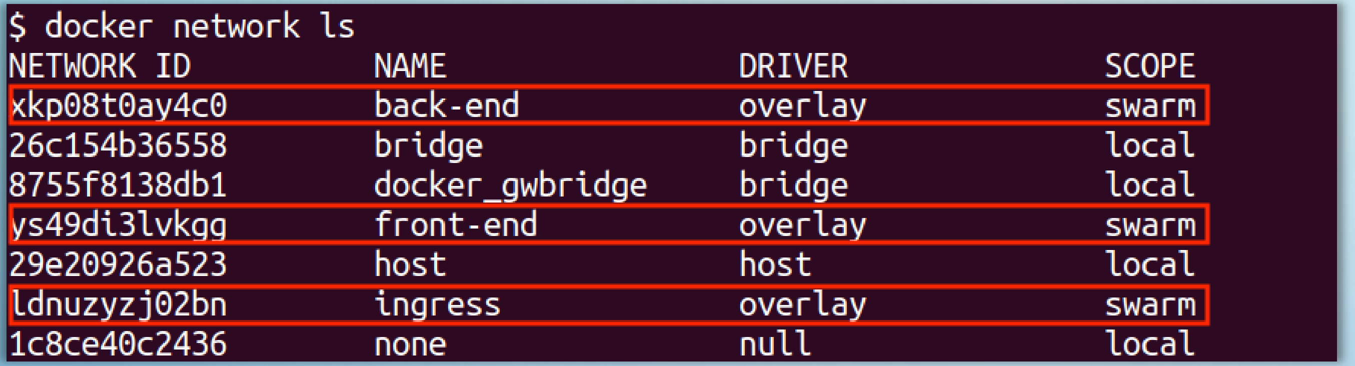
SECURING DOCKER SWARM ENVIRONMENTS



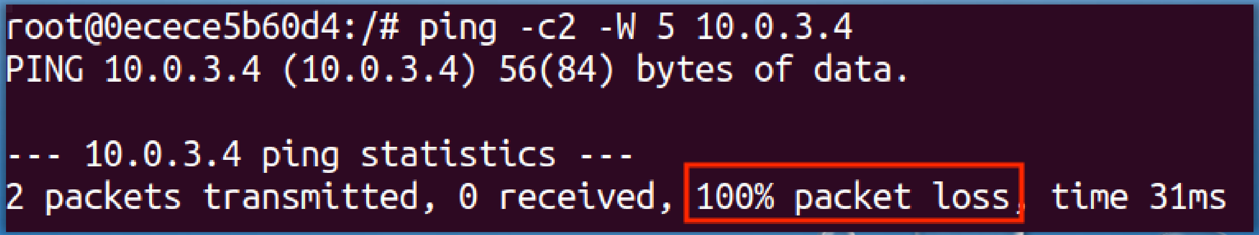
NETWORK ISOLATION



```
$ docker network ls
NETWORK ID          NAME                DRIVER              SCOPE
xkp08t0ay4c0        back-end            overlay             swarm
26c154b36558        bridge              bridge              local
8755f8138db1        docker_gwbridge     bridge              local
ys49di3lvkgg        front-end           overlay             swarm
29e20926a523        host                host                local
ldnuzyzj02bn        ingress             overlay             swarm
1c8ce40c2436        none                null                local
```

```
$ docker network create -d overlay back-end
$ docker network create -d overlay front-end
```

```
$ docker service create -d --network back-end --name redis redis
$ docker service create -d --network front-end --name nginx nginx
```



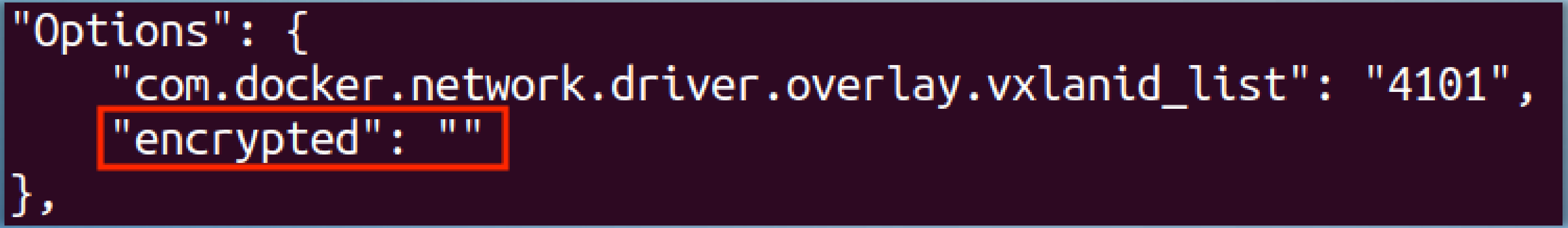
```
root@0ecece5b60d4:/# ping -c2 -W 5 10.0.3.4
PING 10.0.3.4 (10.0.3.4) 56(84) bytes of data.

--- 10.0.3.4 ping statistics ---
2 packets transmitted, 0 received, 100% packet loss, time 31ms
```

COMMUNICATION ENCRYPTION

$ docker network create -d overlay --opt encrypted encrypted-net

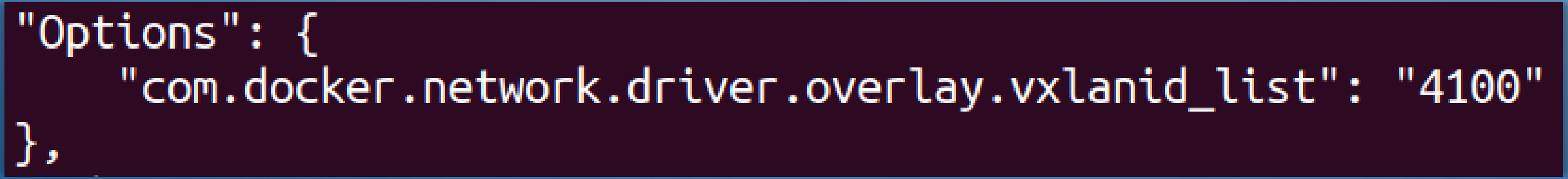
$ docker network inspect encrypted-net

Encrypted network:



```
"Options": {
    "com.docker.network.driver.overlay.vxlanid_list": "4101",
    "encrypted": ""
},
```

Non-encrypted network:

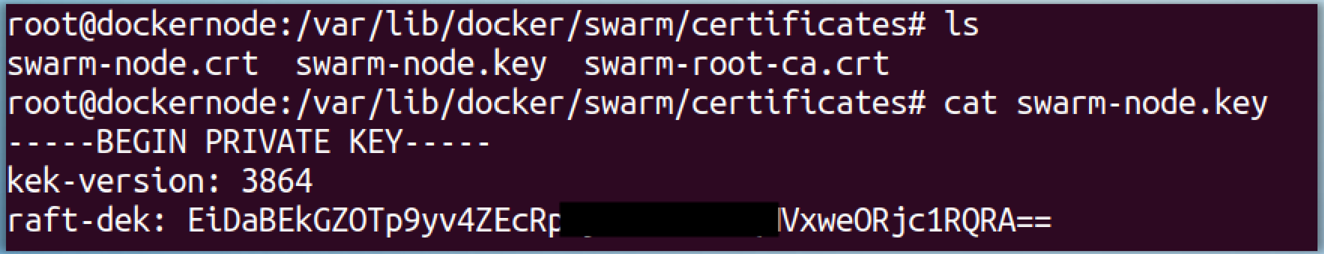


```
"Options": {
    "com.docker.network.driver.overlay.vxlanid_list": "4100"
},
```

RAFT-LOGS KEY ENCRYPTION

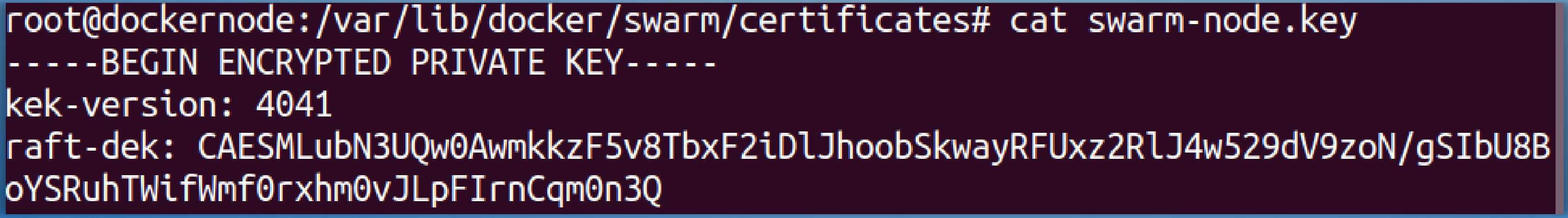
/var/lib/docker/swarm/raft/

/var/lib/docker/swarm/certificates/swarm-node.key



```
root@dockernode:/var/lib/docker/swarm/certificates# ls
swarm-node.crt  swarm-node.key  swarm-root-ca.crt
root@dockernode:/var/lib/docker/swarm/certificates# cat swarm-node.key
-----BEGIN PRIVATE KEY-----
kek-version: 3864
raft-dek: EiDaBEkGZOTp9yv4ZEcRp[redacted]VxweORjc1RQRA==
```

$ docker swarm update --autolock=true



```
root@dockernode:/var/lib/docker/swarm/certificates# cat swarm-node.key
-----BEGIN ENCRYPTED PRIVATE KEY-----
kek-version: 4041
raft-dek: CAESMLubN3UQw0AwmkkzF5v8TbxF2iDlJhoobSkwayRFUxz2RlJ4w529dV9zoN/gSIbU8B
oYSRuhTWifWmf0rxhm0vJLpFIrnCqm0n3Q
```

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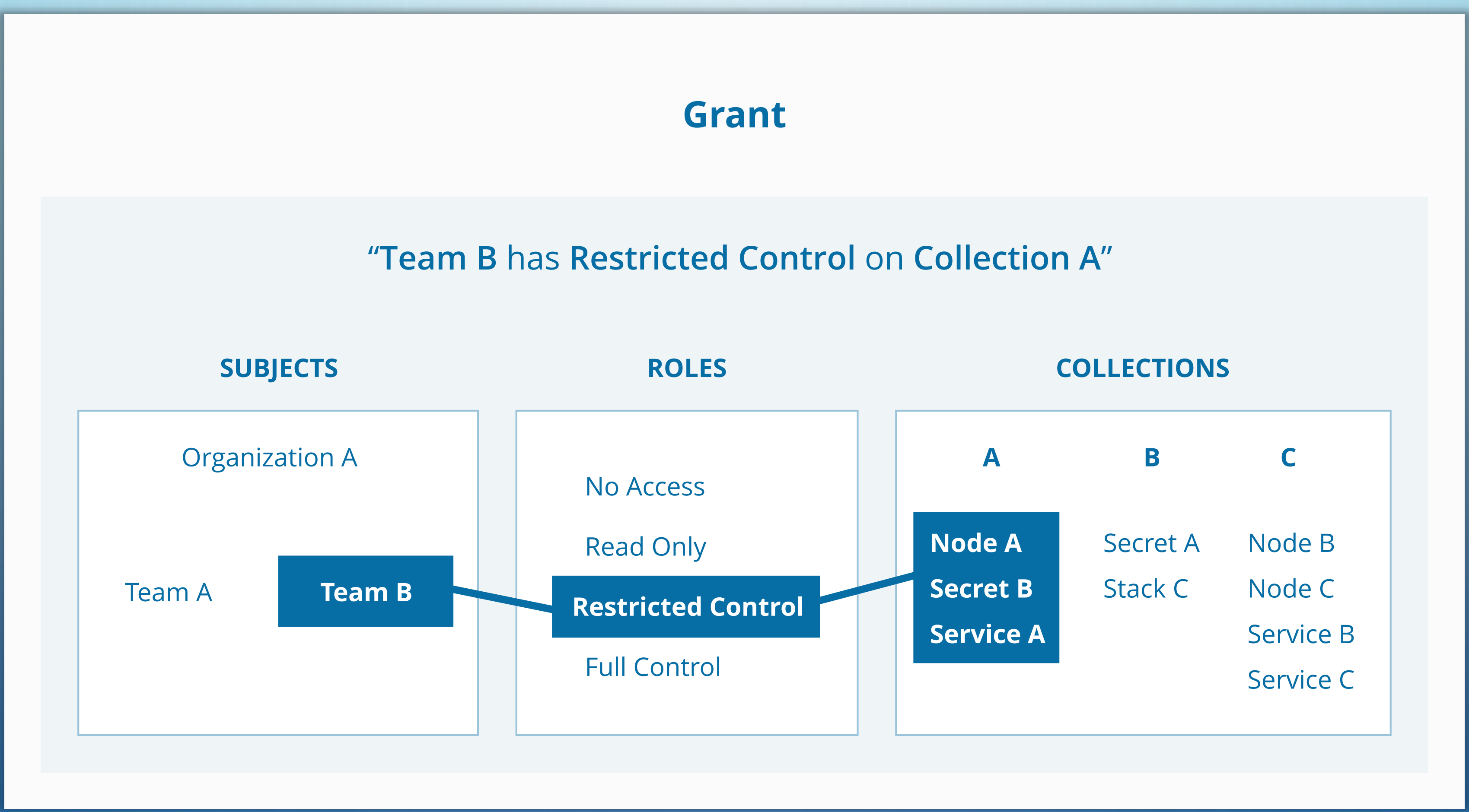
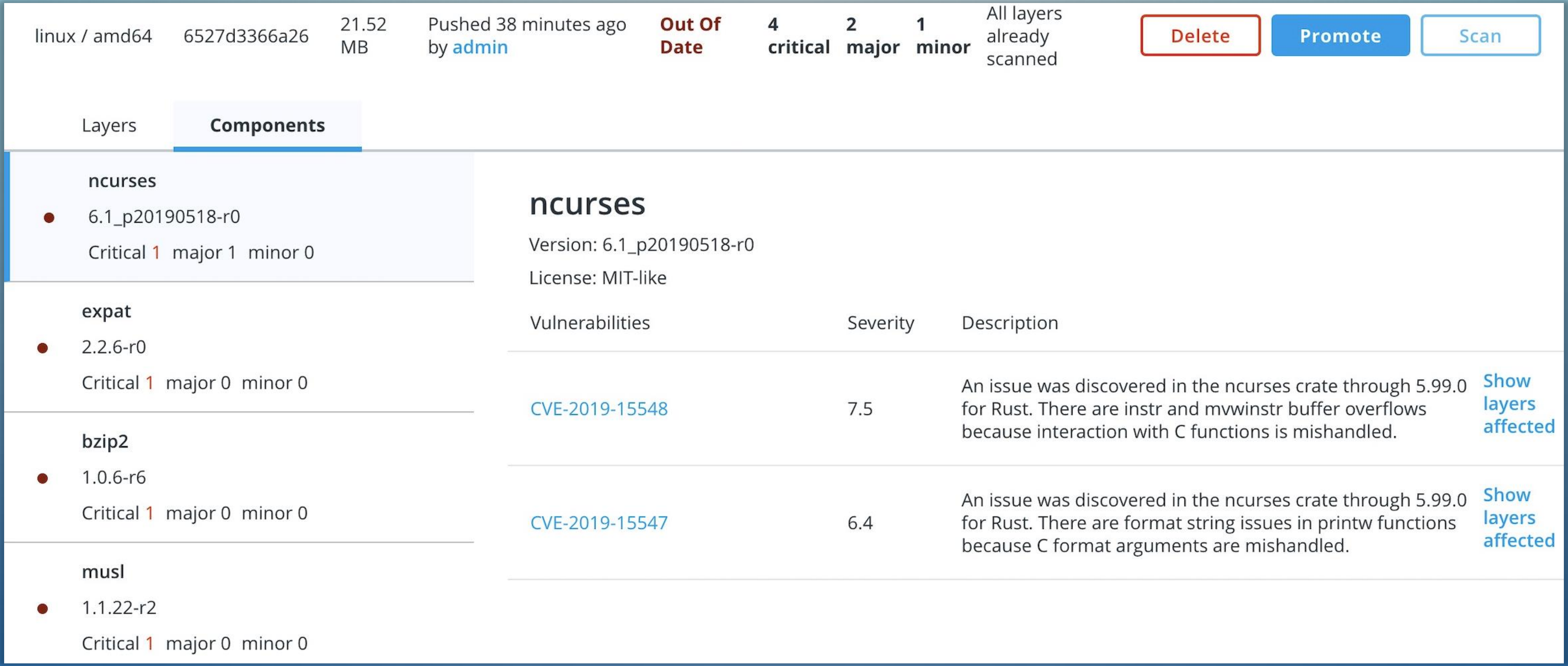
UCP SECURITY – RBAC



DTR SECURITY



linux / amd64 | 6527d3366a26 | 21.52 MB | Pushed 38 minutes ago by admin | Out Of Date | 4 critical | 2 major | 1 minor | All layers already scanned

● **ncurses** 6.1_p20190518-r0 Critical 1 major 1 minor 0

● **expat** 2.2.6-r0 Critical 1 major 0 minor 0

● **bzip2** 1.0.6-r6 Critical 1 major 0 minor 0

● **musl** 1.1.22-r2 Critical 1 major 0 minor 0

ncurses

Version: 6.1_p20190518-r0

License: MIT-like

Vulnerabilities	Severity	Description	
CVE-2019-15548	7.5	An issue was discovered in the ncurses crate through 5.99.0 for Rust. There are instr and mvwinstr buffer overflows because interaction with C functions is mishandled.	Show layers affected
CVE-2019-15547	6.4	An issue was discovered in the ncurses crate through 5.99.0 for Rust. There are format string issues in printw functions because C format arguments are mishandled.	Show layers affected

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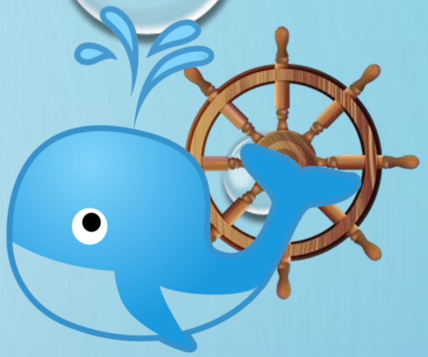
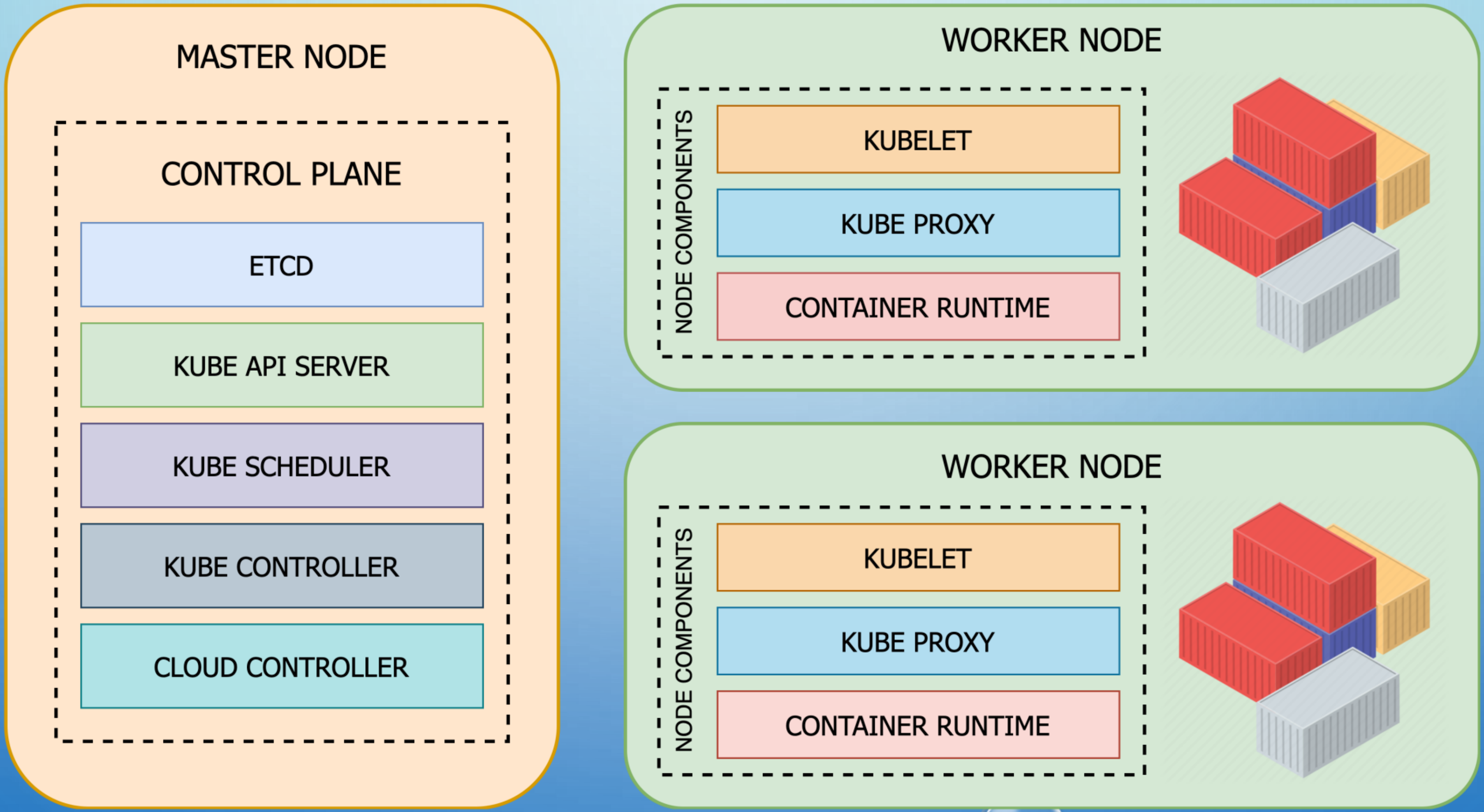
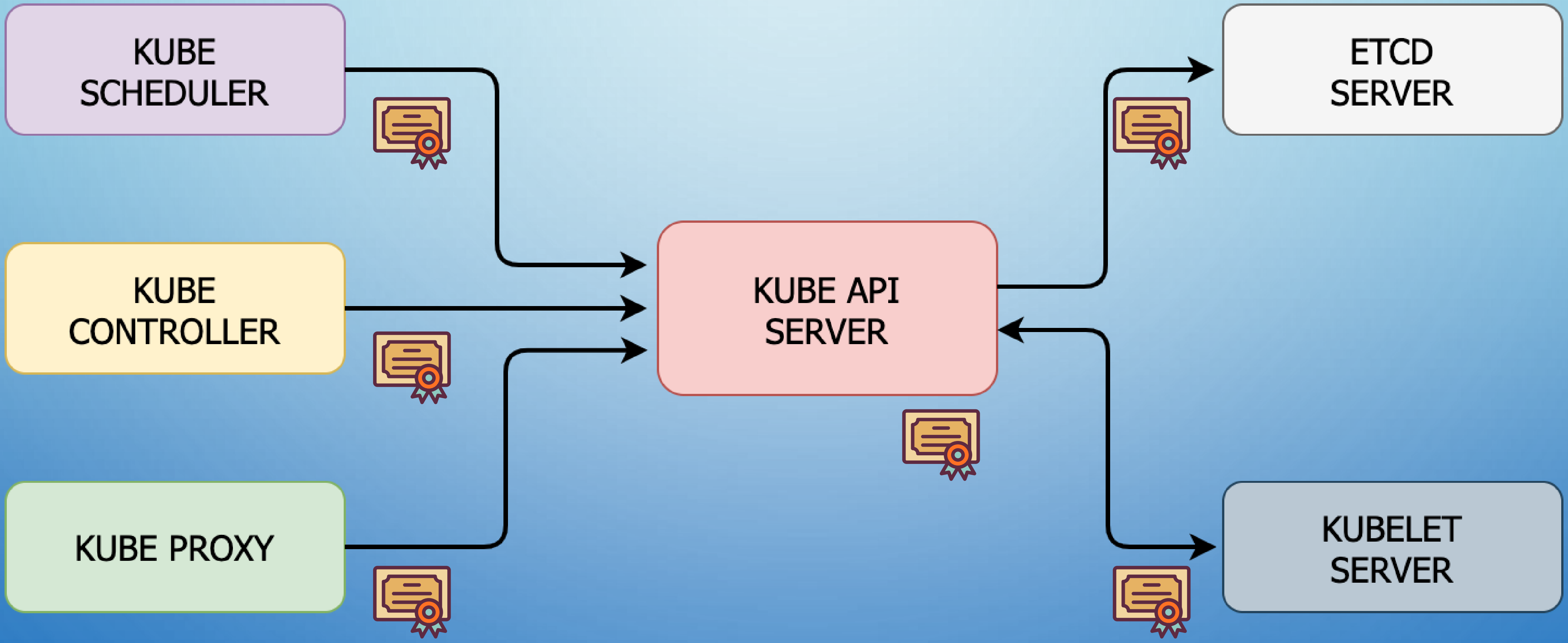
SECURING KUBERNETES ENVIRONMENTS



KUBERNETES ARCHITECTURE



SECURING COMPONENTS COMMUNICATION



SECURING COMPONENTS COMMUNICATION

Kubernetes cluster's CAs:

- ❑ Etcd CA
- ❑ Kubernetes CA

Server Certificates:

- ❑ Etcd
- ❑ Kube-API server
- ❑ Kubelet

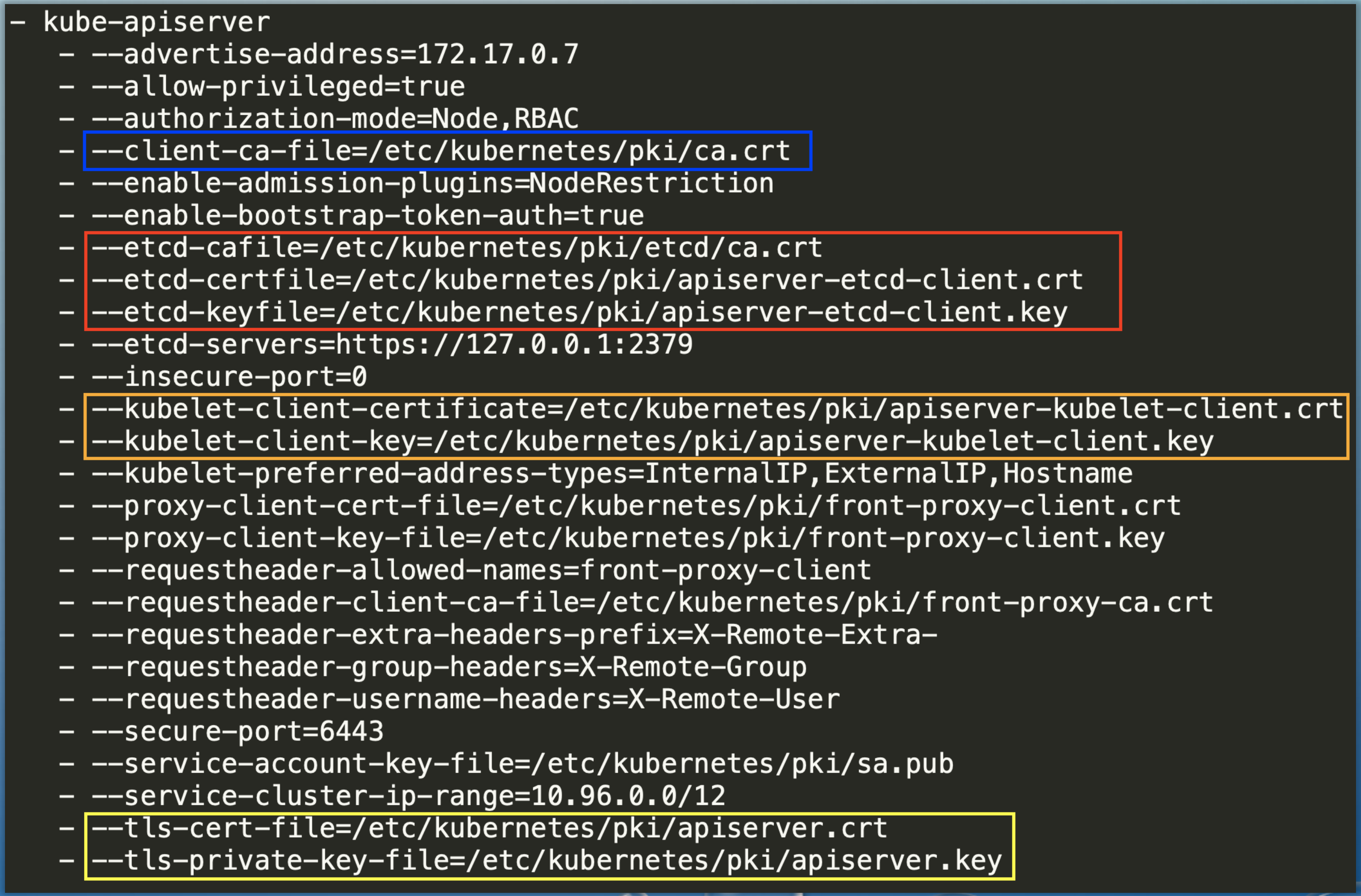
Client Certificates:

- ❑ Kube-scheduler
- ❑ Kube-controller
- ❑ Kube-proxy
- ❑ Kube-API server (etcd client)
- ❑ Kube-API server (kubelet client)
- ❑ Kubelet (API server client)

SECURING COMPONENTS COMMUNICATION

Kube-API Certificates:

- ❑ Etcd client
- ❑ Kubelet client
- ❑ Kube-api server



```
- kube-apiserver
    - --advertise-address=172.17.0.7
    - --allow-privileged=true
    - --authorization-mode=Node,RBAC
    - --client-ca-file=/etc/kubernetes/pki/ca.crt
    - --enable-admission-plugins=NodeRestriction
    - --enable-bootstrap-token-auth=true
    - --etcd-cafile=/etc/kubernetes/pki/etcd/ca.crt
    - --etcd-certfile=/etc/kubernetes/pki/apiserver-etcd-client.crt
    - --etcd-keyfile=/etc/kubernetes/pki/apiserver-etcd-client.key
    - --etcd-servers=https://127.0.0.1:2379
    - --insecure-port=0
    - --kubelet-client-certificate=/etc/kubernetes/pki/apiserver-kubelet-client.crt
    - --kubelet-client-key=/etc/kubernetes/pki/apiserver-kubelet-client.key
    - --kubelet-preferred-address-types=InternalIP,ExternalIP,Hostname
    - --proxy-client-cert-file=/etc/kubernetes/pki/front-proxy-client.crt
    - --proxy-client-key-file=/etc/kubernetes/pki/front-proxy-client.key
    - --requestheader-allowed-names=front-proxy-client
    - --requestheader-client-ca-file=/etc/kubernetes/pki/front-proxy-ca.crt
    - --requestheader-extra-headers-prefix=X-Remote-Extra-
    - --requestheader-group-headers=X-Remote-Group
    - --requestheader-username-headers=X-Remote-User
    - --secure-port=6443
    - --service-account-key-file=/etc/kubernetes/pki/sa.pub
    - --service-cluster-ip-range=10.96.0.0/12
    - --tls-cert-file=/etc/kubernetes/pki/apiserver.crt
    - --tls-private-key-file=/etc/kubernetes/pki/apiserver.key
```

API AUTHENTICATION

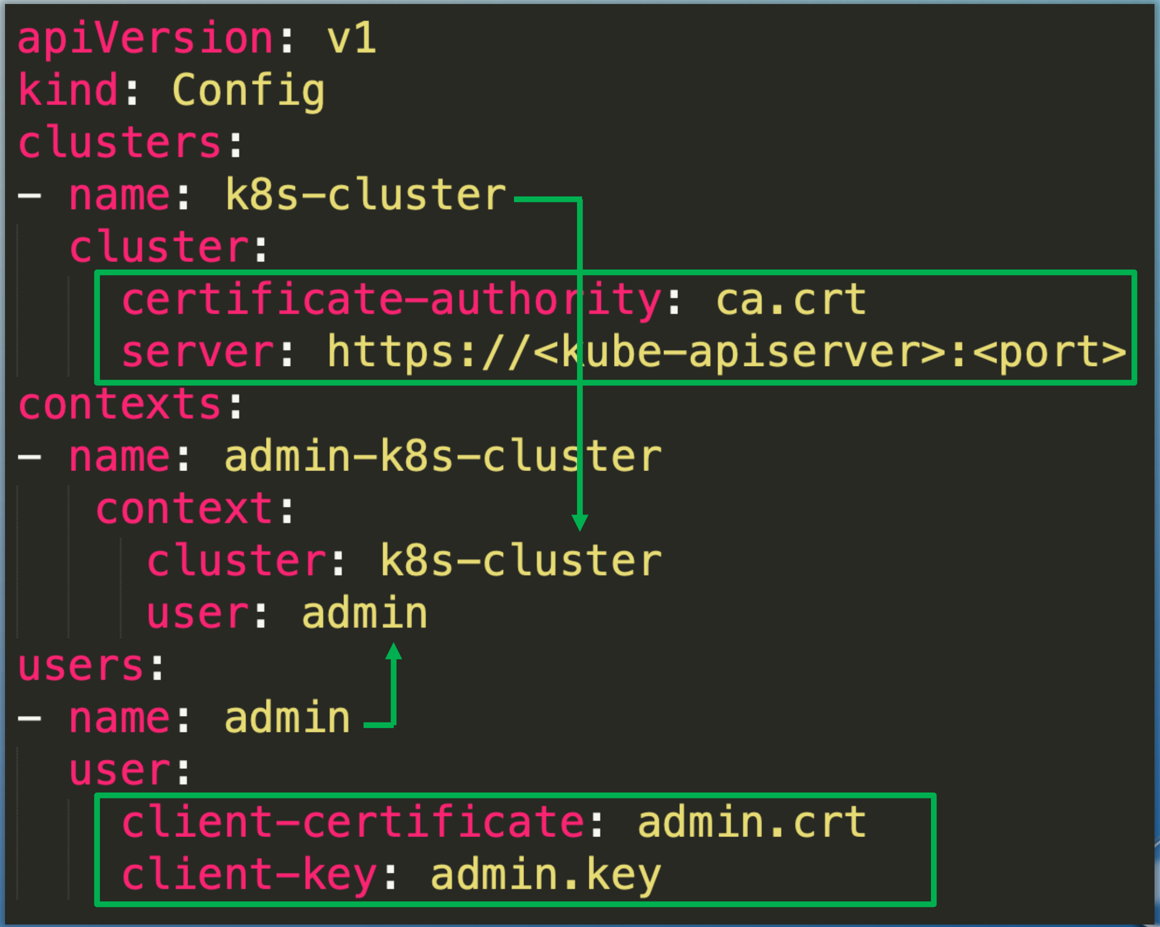
Kubernetes authentication mechanisms:

- ❑ Basic (user/password or token).
- ❑ TLS Certificates.
- ❑ LDAP, Kerberos, etc.

```
$ openssl genrsa -out admin.key 2048

$ openssl req -new -key admin.key -subj
"CN=admin/O=system:masters" \ -out
admin.csr
$ openssl x509 -req -in admin.csr -CA ca.crt \
-CAkey ca.key -out admin.crt
```

$HOME/.kube/config



```
apiVersion: v1
kind: Config
clusters:
- name: k8s-cluster
  cluster:
    certificate-authority: ca.crt
    server: https://<kube-apiserver>:<port>
contexts:
- name: admin-k8s-cluster
   context:
     cluster: k8s-cluster
     user: admin
users:
- name: admin
  user:
    client-certificate: admin.crt
    client-key: admin.key
```

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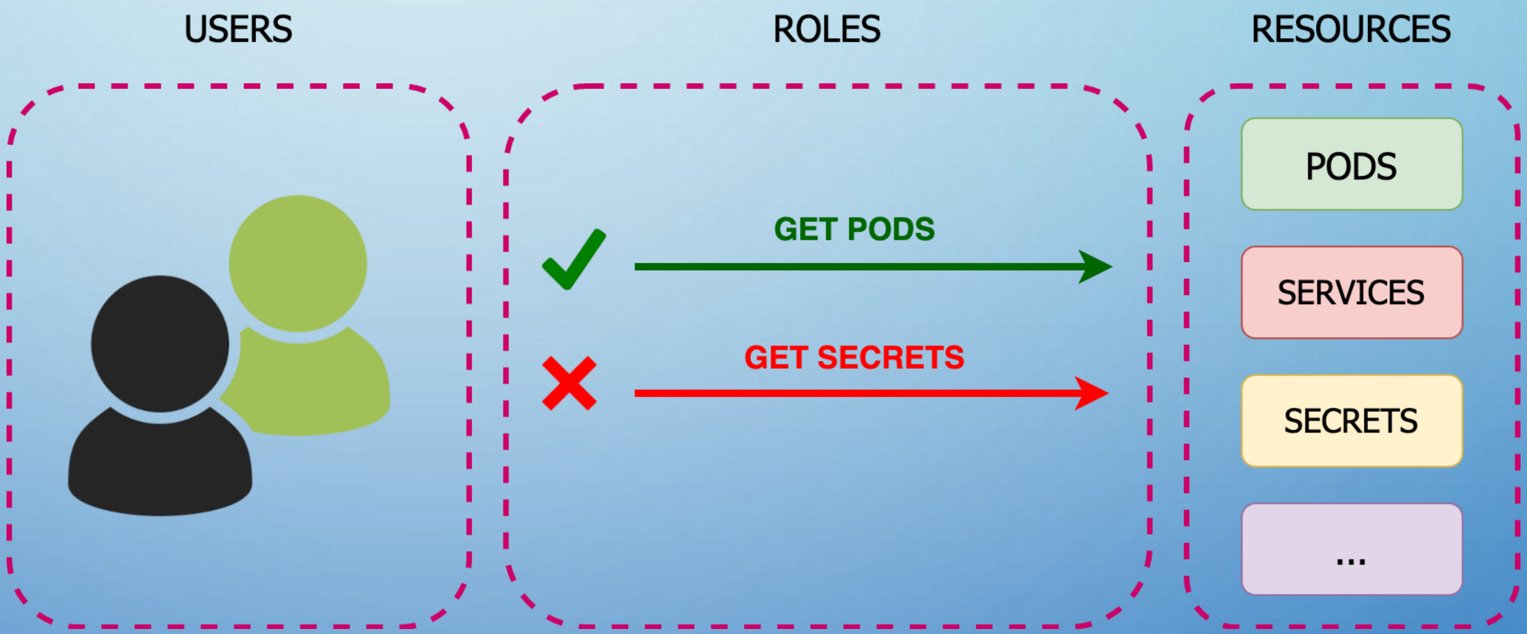
API AUTHORIZATION

Kubernetes authorization mechanisms:

- ❑ Node
- ❑ ABAC
- ❑ RBAC
- ❑ WebHook

RBAC objects:

- ❑ Role
- ❑ Role Binding
- ❑ Cluster Role
- ❑ Cluster Role Binding



API AUTHORIZATION – RBAC

Role & Role Binding example

role-definition.yaml

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: Role
metadata:
  name: pod-reader-role
  namespace: backend
rules:
  - apiGroups: [""]
  resources: ["pods"]
  verbs: ["get", "list"]
```

role-binding-definition.yaml

```yaml
apiVersion: rbac.authorization.k8s.io/v1
kind: RoleBinding
metadata:
  name: pod-reader-binding
  namespace: backend
subjects:
- kind: ServiceAccount
  name: sa-token
  apiGroup: rbac.authorization.k8s.io
roleRef:
  kind: Role
  name: pod-reader-role
  apiGroup: rbac.authorization.k8s.io
```

DEMO TIME!

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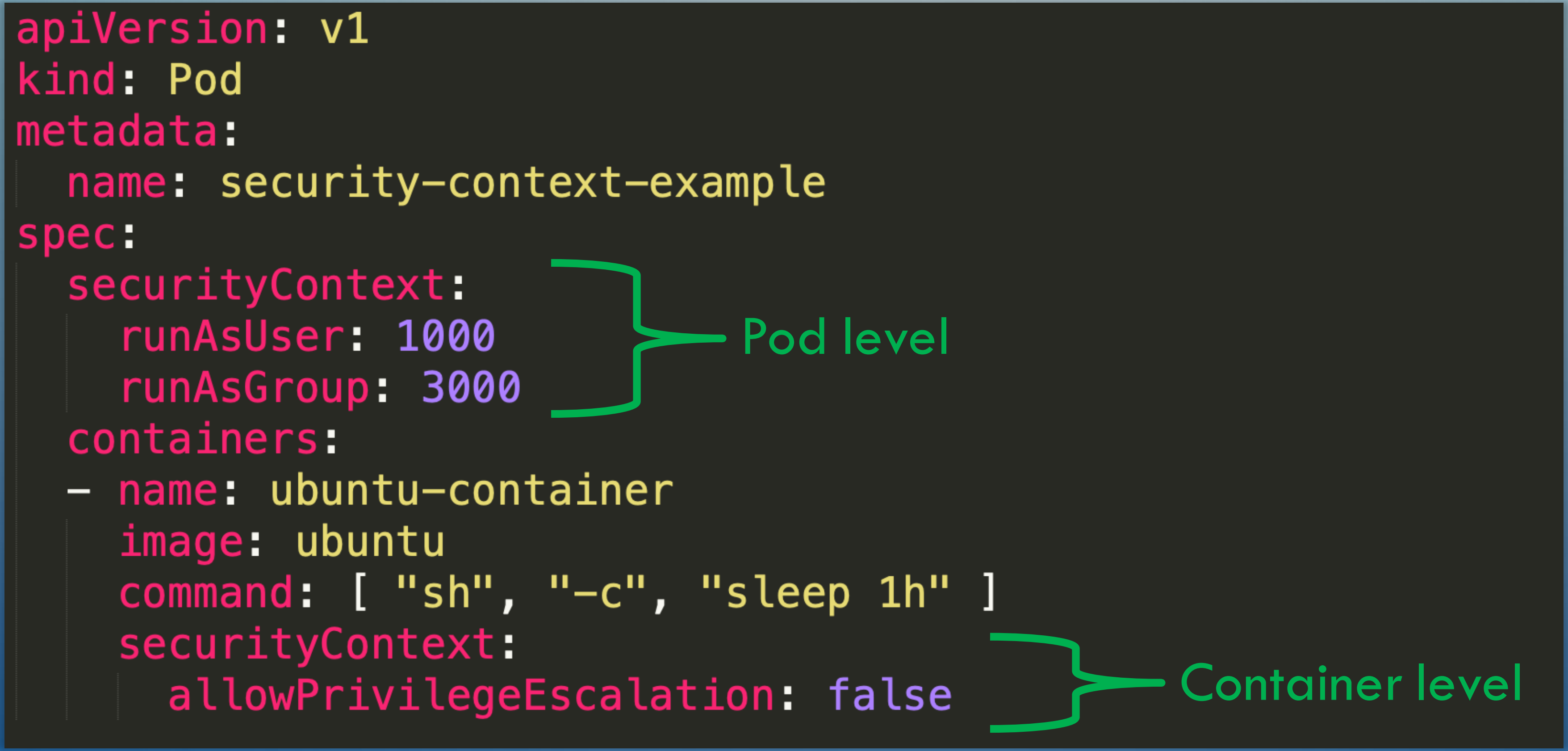
SECURITY CONTEXT

Security Context example



```
apiVersion: v1
kind: Pod
metadata:
  name: security-context-example
spec:
  securityContext:
    runAsUser: 1000
    runAsGroup: 3000
  containers:
  - name: ubuntu-container
    image: ubuntu
    command: [ "sh", "-c", "sleep 1h" ]
    securityContext:
      allowPrivilegeEscalation: false
```

NETWORK POLICIES

Network Policies examples

default-deny-all.yaml

```yaml
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: default-deny-all
spec:
  podSelector: {}
  policyTypes:
  - Ingress
  - Egress
```

namespace-isolation.yaml

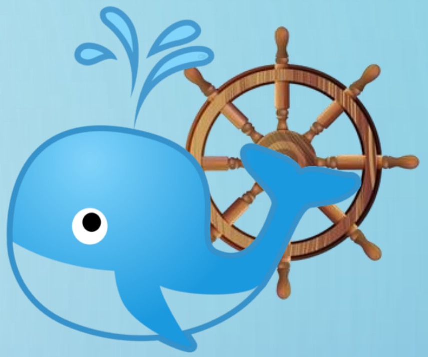
```yaml
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: allow-same-namespace
  namespace: backend
spec:
  podSelector: {}
  ingress:
    - from:
      - namespaceSelector:
          matchLabels:
            name: backend
  egress:
    - to:
      - namespaceSelector:
          matchLabels:
            name: backend
```

WHITE PAPERS DOWNLOAD

Defending Docker, Swarm and Kubernetes white papers:

https://dreamlab.net/blackhat-whitepapers

- docs.docker.com
- kubernetes.io/docs



THANK YOU!

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