Pentesting Lab

Privilege Escalation - Containers

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26.04.2026

Summer 2026, www.isec.tugraz.at/ptl

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Recap

Recap: What is privilege escalation?

- ”Privilege Escalation consists of techniques that adversaries use to gain higher-level permissions on a system or network.” - MITRE Framework
- ”Privilege Escalation is the act of exploiting a bug, a design flaw, or a configuration oversight in an operating system or software application to gain elevated access to resources that are normally protected from an application or user.” - Wikipedia
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Recap: How does Linux enforce Privileges?

- Uid/gid for setting which groups and users are allowed to use binaries
- RWX bits for whether the user is allowed to read, write, and execute the binary
- Capabilities define what the process is allowed to do.

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Background

The DotCom Era

- Everyone wants to cut costs
  - ...on Staff
  - ...on Maintenance
  - ...on Power
- It's easier to deal with dependencies if we can define a known state and work from there
- ...full-blown virtualisation is cumbersome.
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- Namespaces govern what we can see and what we can access
- Capabilities govern how we can see and access the devices!
- Highly recommended Course by Michael Kerrisk, if you want to know more!
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Namespaces

- Kernel namespaces make it possible to sandbox environments
  - The Kernel provides a separate environment for all applications
  - The Kernel guaranties that the processes are only allowed to access their own sandbox and specific interfaces
  - This allows for the separation of entire process hierarchies from each other (containerization)

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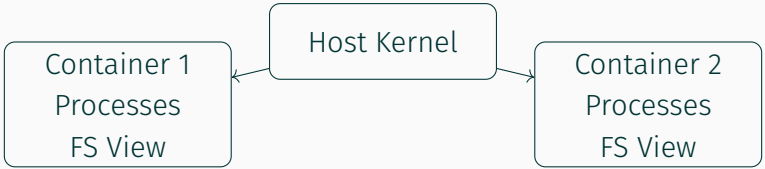
Host Kernel
Container 1
Processes
FS View
Container 2
Processes
FS View

Kernel Namespaces Cont.

- 6 Main Namespaces
  - uid namespaces
  - pid namespaces
  - network namespaces
  - mount namespaces
  - cgroup namespaces
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- Within a namespace, you can only see other resources in the same namespace.
- Try it out yourself!
- `sudo lsns`
- Run any Docker container with some namespacing
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```
Usage:
 unshare [options] [<program> [<argument>...]]
Run a program with some namespaces unshared from the parent.
Options:
 -m, --mount[=<file>]      unshare mounts namespace
 -r, --map-root-user       map current user to root (implies
     --user)
 -n, --net[=<file>]        unshare network namespace
 -p, --pid[=<file>]        unshare pid namespace
 -U, --user[=<file>]       unshare user namespace
 -C, --cgroup[=<file>]     unshare cgroup namespace

```

- Requires the `unshare` syscall
- This syscall is restricted by default but often disabled due to misconfiguration (e.g. –security-opt seccomp=unconfined)
- `unshare -Urm`
- Root?!
- Now we have full capabilities?!

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```
testuser@dfb1a3e93014:/$ id
uid=1000(testuser) gid=1000(testuser) groups=1000(testuser)
testuser@dfb1a3e93014:/$ cat /proc/self/status | grep Cap
CapInh: 0000000000000000
CapPrm: 0000000000000000
CapEff: 0000000000000000
CapBnd: 00000000a80425fb
CapAmb: 0000000000000000
testuser@dfb1a3e93014:/$ unshare -Urm
# id
uid=0(root) gid=0(root) groups=0(root)
# cat /proc/self/status | grep Cap
CapInh: 0000000000000000
CapPrm: 000001fffffffff
CapEff: 000001fffffffff
CapBnd: 000001fffffffff
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```

Surely nobody disables Seccomp in production ...right?

```
<builds/esp-ws2023/students/espws23-a3-system-test$ unshare -UrmCpf bash
unshare -UrmCpf bash
whoami
root
id
uid=0(root) gid=0(root) groups=0(root)
hostname
runner-p66fnvl-project-35613-concurrent-0
^[[B
```

Capabilities

Capabilities

- refresher from Unix PrivEsc: A subset of root privileges on:
  - Processes
  - Binaries
  - Users
  - Environment / Containers
  - Services
- Today: Our focus!
- Command capsh

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Checking process capabilities

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- Allows root to debug all processes or user processes to debug processes running under the same user
- Debian specific: Any user can ptrace any other user process, regardless of the owner (except root). - WTF?!
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- CAP_DAC_READ_SEARCH
  - Bypasses read file permissions
  - Allows reading directories as well
  - Directory traversal and reading any file is possible
- CAP_DAC_OVERRIDE
  - Bypasses **any** file permission checks
  - Allows writing arbitrary files
  - E.g. append malicious user to /etc/sudoers

Many more capabilities, check out hacktricks

Container Runtime abuses

- It's 2013: Docker is released
- 2 core components:
- **dockerd** (docker deamon)
  - Communicates with the kernel and provides functionality such as creating containers, etc.
  - We expose the API via a simple file (docker.socket), and every user in the `docker` group can access this file
- docker
  - Docker as a CLI tool for interacting with the Docker daemon
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- Surely nobody does this...

```
version: "2.4" # optional since v1.27.0
services:
  testsystem:
    image: *redacted*_testsystem
    ...
    volumes:
      - /var/run/docker.sock:/var/run/docker.sock
      - ...
```

: Surely nobody does this...

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8       - ...
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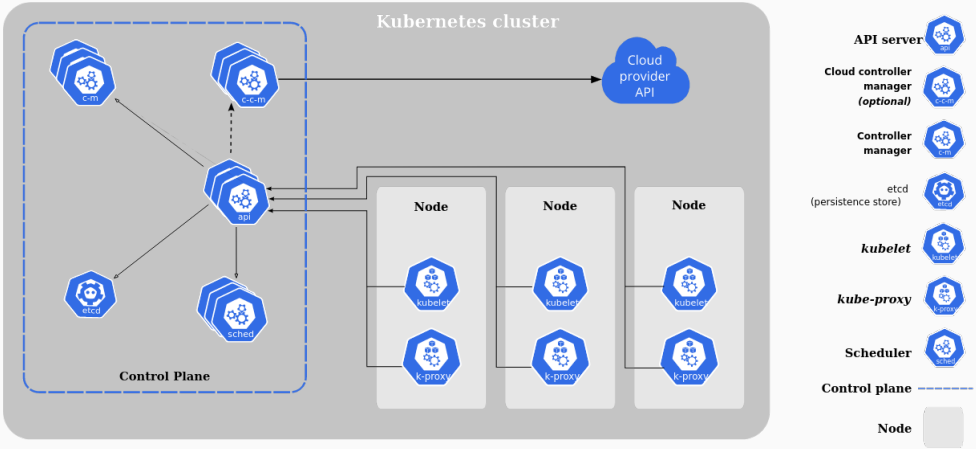
Demo Docker Escape


Kubernetes cluster
c-m
c-c-m
Cloud provider API
api
etcd
sched
Control Plane
Node
kubelet
k-proxy
Node
kubelet
k-proxy
Node
kubelet
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API server
Cloud controller manager (optional)
Controller manager
etcd (persistence store)
kubelet
kube-proxy
Scheduler
Control plane
Node

- Kubernetes consists of the following Components:
  - Control plane
    - manages the overall Kubernetes cluster
    - schedules workloads on the nodes hosts the Kubernetes API server
  - Nodes
    - represents the physical hardware
    - schedules pods on the hardware
  - pods
    - Are the actual containers
    - ...run the actual applications

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- Kubernetes utilises an RBAC model for governing access to the resources
- each User, Service, Pod has an Account and gets a **Service-Token**
- Namespaces describe a partition of resources from the Cluster
- **Roles**:
  - roles describe what kind of access is allowed for an account
  - e.g.: An account might be allowed to create Pods in the Namespace default
- **Policies**:
  - policies govern the relationships between resources
  - e.G. pod foo can access pod bar in Namespace default

Common scenarios

- outside the pod:
  - you acquire a token
- inside the pod:
  - you have an RCE inside the pod
  - you run as some user

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Outside the Pod

- ...Somehow, you get a service token
- Questions
  - What can we do with the token?
  - What kind of access do we have on the cluster?
  - What kind of roles do we have?
- kubectl and kdigger to the rescue!
- badpods for spawning privileged pods

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kubectl auth can-i <action>
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- ...internal APIs etc.
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#enumeration with kdigger
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Questions?

Now it’s your turn!