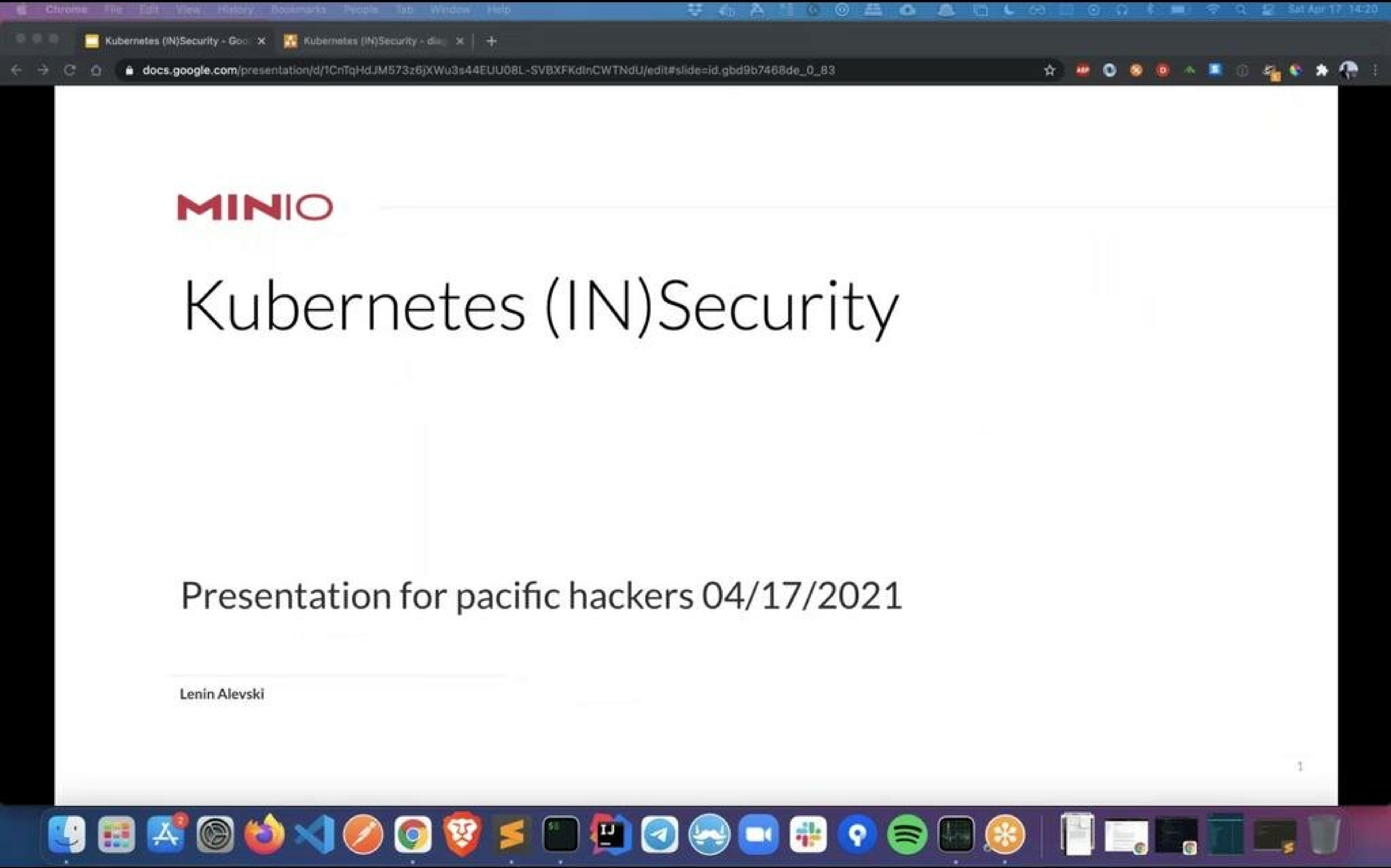
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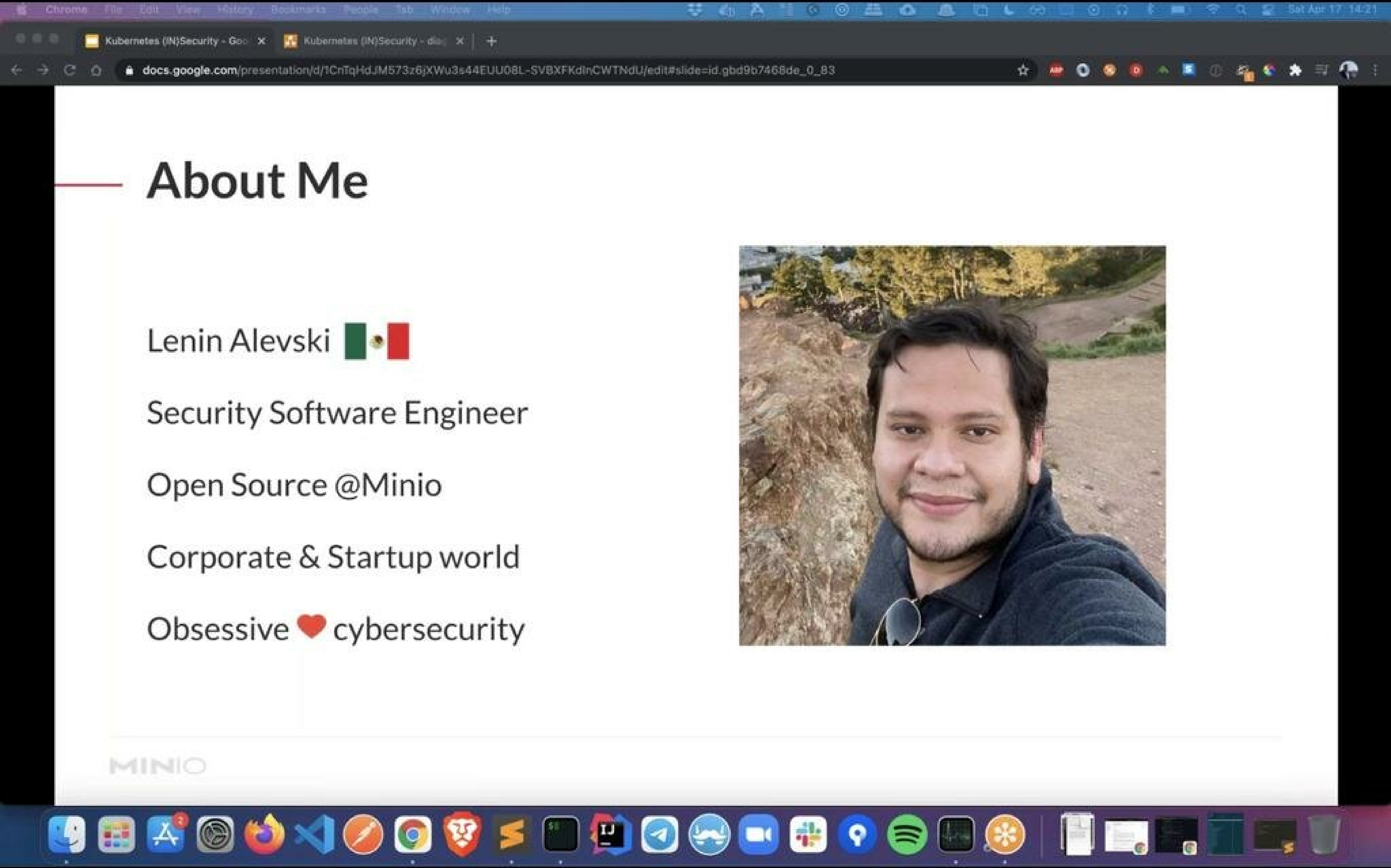
Kubernetes (IN)Security

Presentation for pacific hackers 04/17/2021

Lenin Alevski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About Me

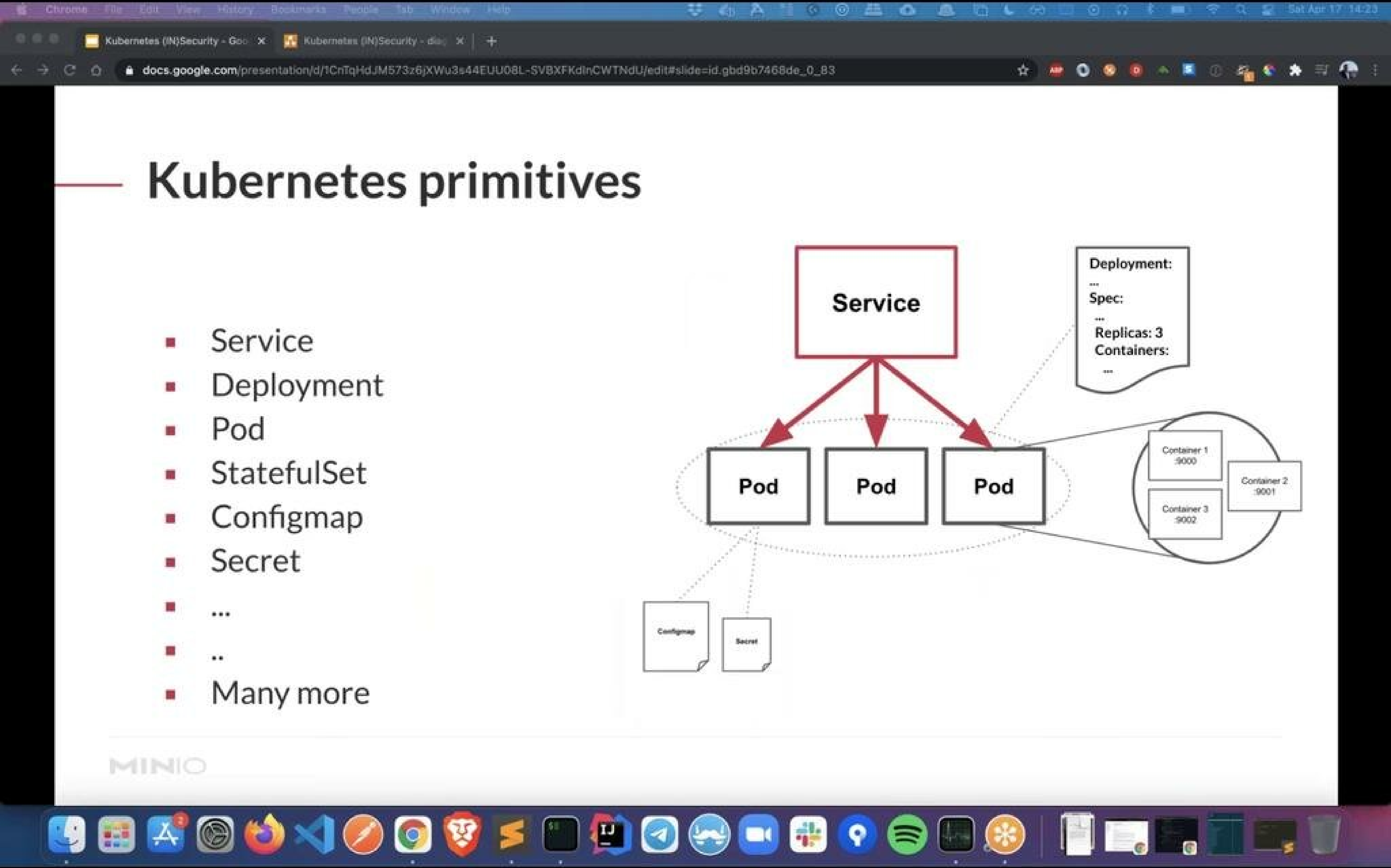
Lenin Alevski 🇲🇽

Security Software Engineer

Open Source @Minio

Corporate & Startup world

Obsessive ❤ cybersecurity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Kubernetes primitives

- Service
- Deployment
- Pod
- StatefulSet
- Configmap
- Secret
- ...
- ..
- Many more

Deployment:
...
Spec:
...
Replicas: 3
Containers:
...

Service
Pod
Pod
Pod
Container 1
:9000
Container 2
:9001
Container 3
:9002
Configmap
Secret

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Kubernetes Components

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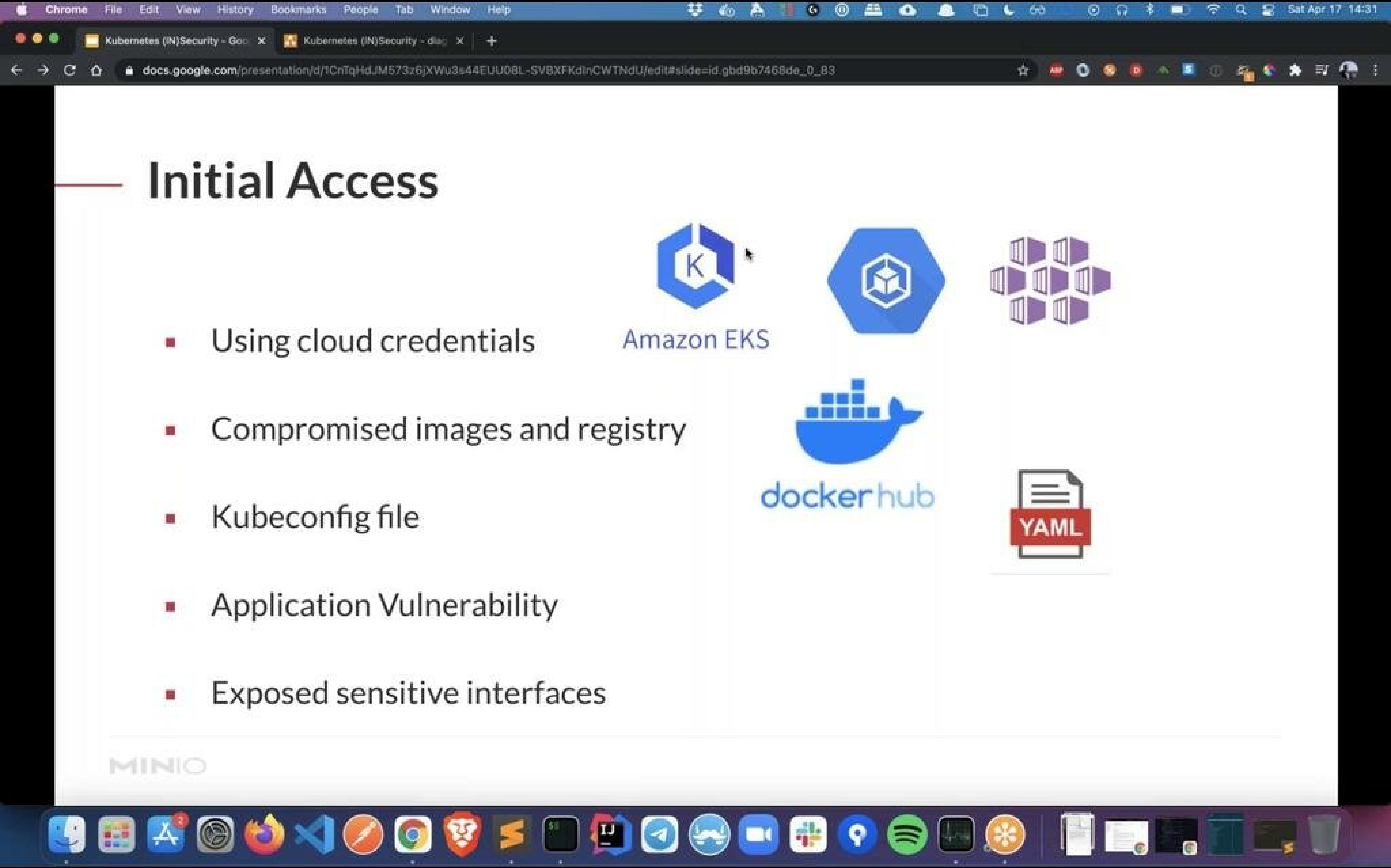
Kubernetes most common attack techniques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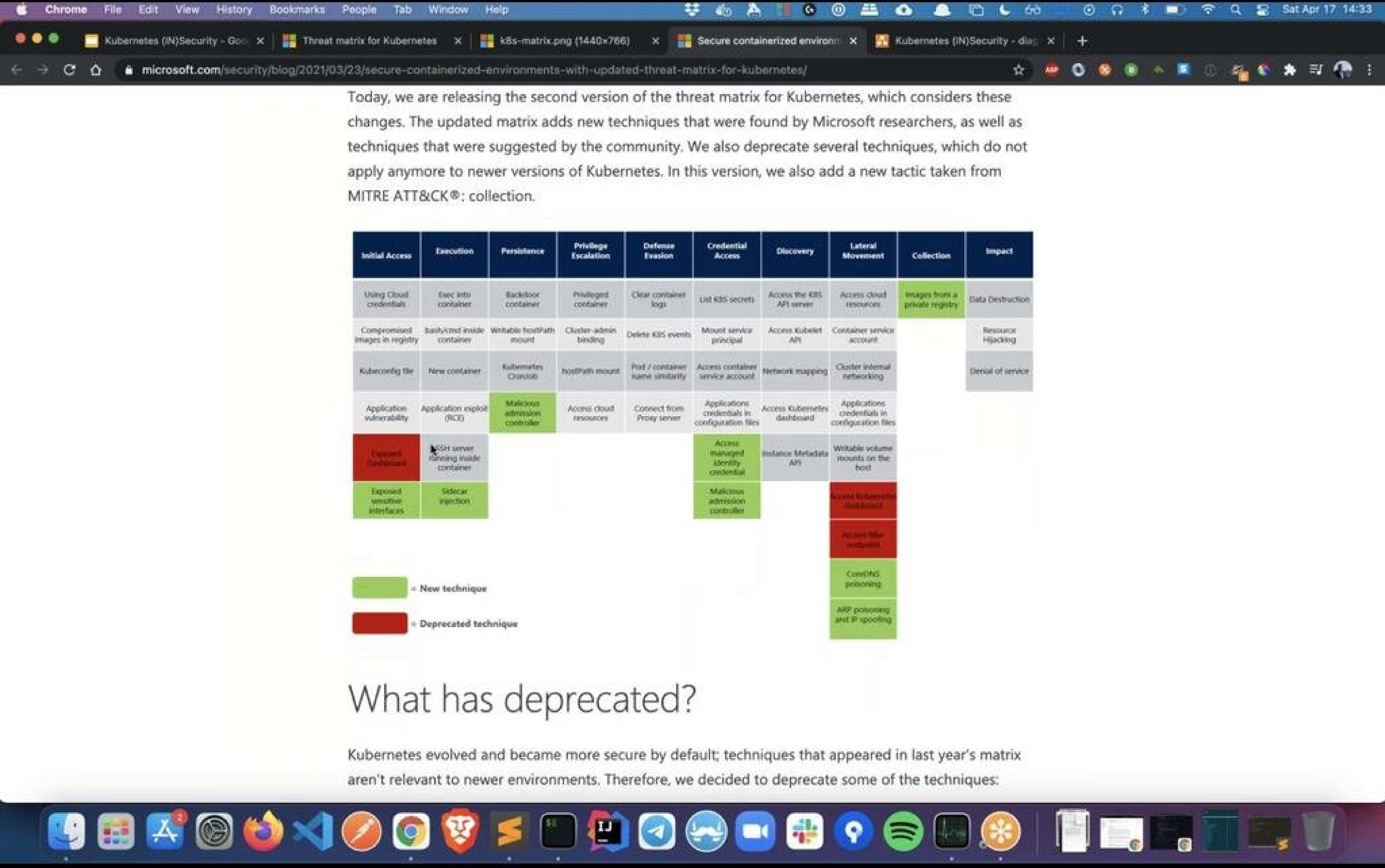
Initial Access

- Using cloud credentials
- Compromised images and registry
- Kubeconfig file
- Application Vulnerability
- Exposed sensitive interfaces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Threat matrix for Kubernetes
k8s-matrix.png (1440×766)
Secure containerized environm
Kubernetes (IN)Security - dia
microsoft.com/security/blog/2021/03/23/secure-containerized-environments-with-updated-threat-matrix-for-kubernetes/

Today, we are releasing the second version of the threat matrix for Kubernetes, which considers these changes. The updated matrix adds new techniques that were found by Microsoft researchers, as well as techniques that were suggested by the community. We also deprecate several techniques, which do not apply anymore to newer versions of Kubernetes. In this version, we also add a new tactic taken from MITRE ATT&CK®: collection.

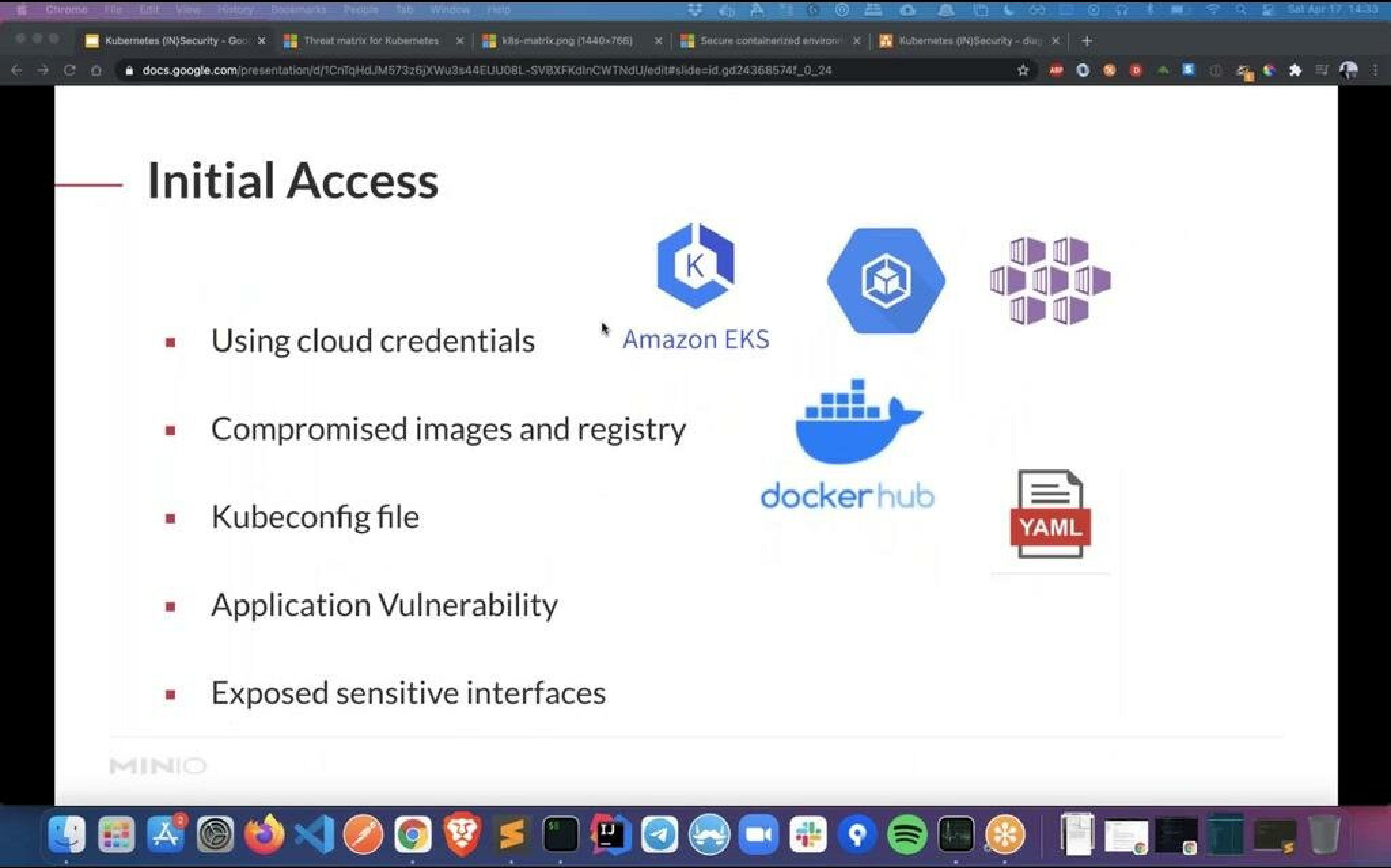
Initial Access	Execution	Persistence	Privilege Escalation	Defense Evasion	Credential Access	Discovery	Lateral Movement	Collection	Impact
Using Cloud credentials	Exec into container	Backdoor container	Privileged container	Clear container logs	List K8S secrets	Access the K8S API server	Access cloud resources	Images from a private registry	Data Destruction
Compromised images in registry	bash/cmd inside container	Writable hostPath mount	Cluster-admin binding	Delete K8S events	Mount service principal	Access Kubelet API	Container service account		Resource Hijacking
Kubeconfig file	New container	Kubernetes CronJob	hostPath mount	Pod / container name similarity	Access container service account	Network mapping	Cluster internal networking		Denial of service
Application vulnerability	Application exploit (RCE)	Malicious admission controller	Access cloud resources	Connect from Proxy server	Applications credentials in configuration files	Access Kubernetes dashboard	Applications credentials in configuration files		
Exposed Dashboard	SSH server running inside container				Access managed identity credential	Instance Metadata API	Writable volume mounts on the host		
Exposed sensitive interfaces	Sidecar injection				Malicious admission controller		Access Kubernetes dashboard		
							Access tiller endpoint		
							CoreDNS poisoning		
							ARP poisoning and IP spoofing		

🟩 = New technique

🟥 = Deprecated technique

What has deprecated?

Kubernetes evolved and became more secure by default; techniques that appeared in last year's matrix aren't relevant to newer environments. Therefore, we decided to deprecate some of the techniques: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Initial Access

- Using cloud credentials
- Compromised images and registry
- Kubeconfig file
- Application Vulnerability
- Exposed sensitive interfaces

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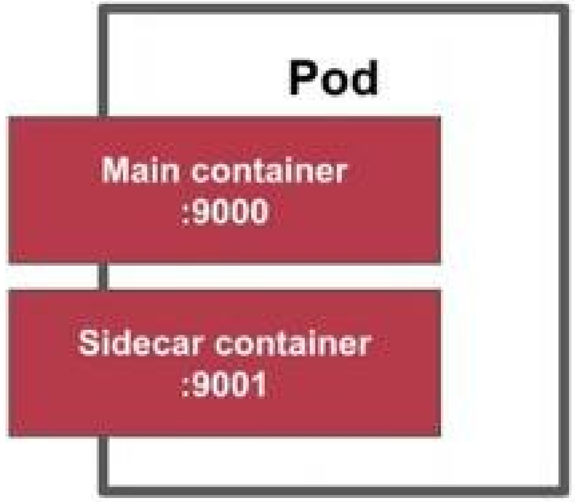
Execution

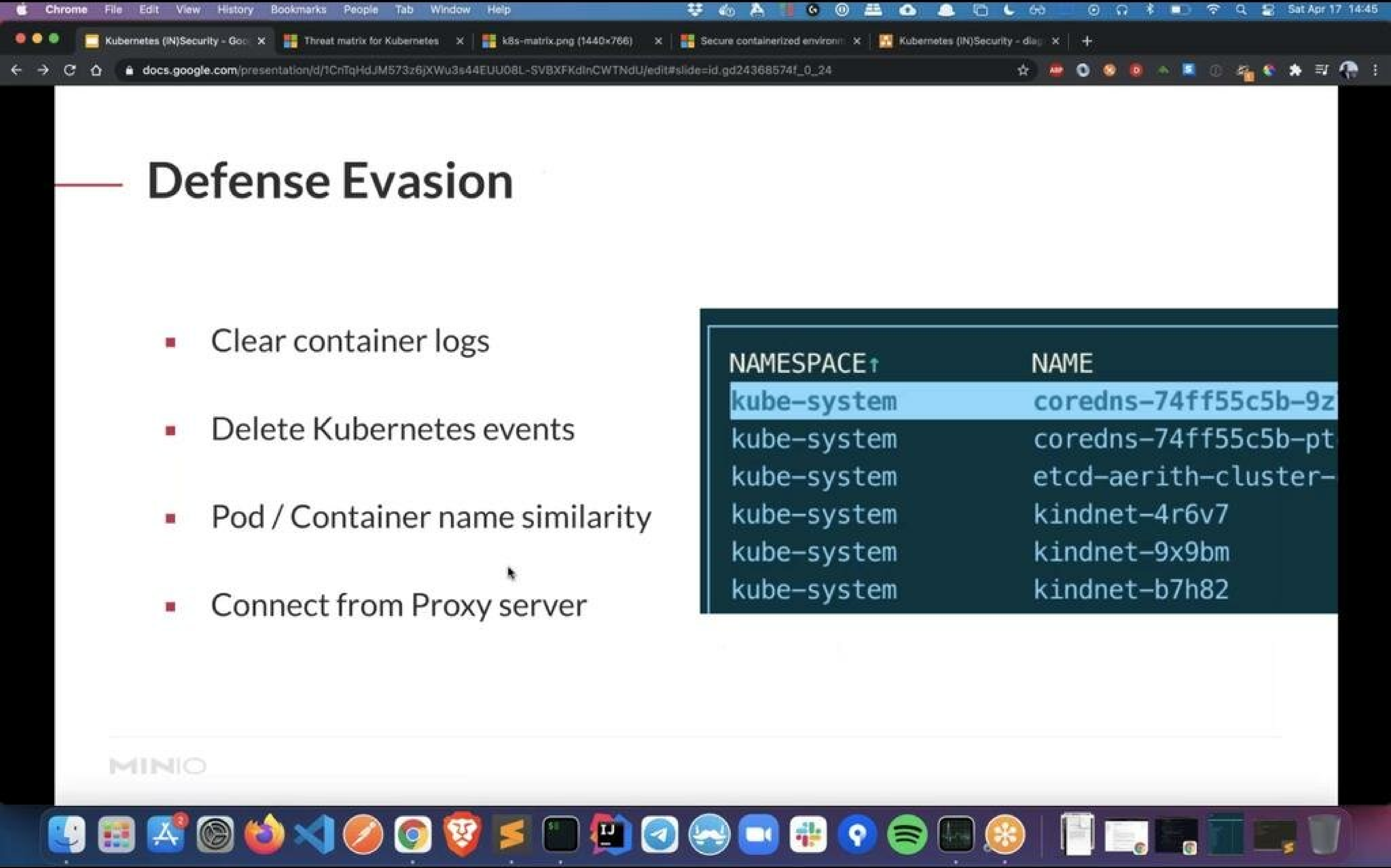
- Exec into container
- New container
- Application exploit (RCE)
- SSH server running inside container
- Sidecar Injection



Pod

Main container
:9000

Sidecar container
:9001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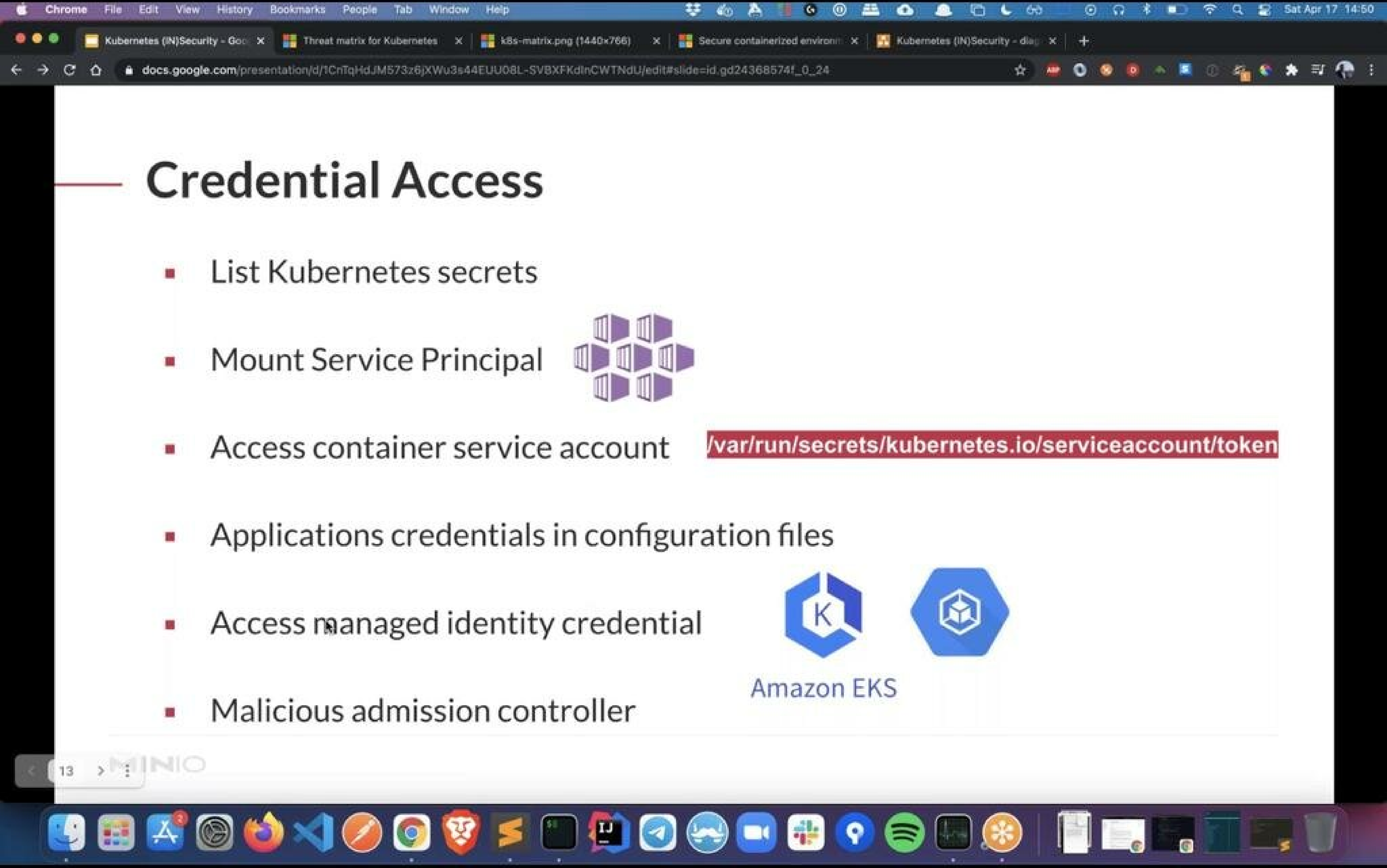
Defense Evasion

- Clear container logs
- Delete Kubernetes events
- Pod / Container name similarity
- Connect from Proxy server

```
NAMESPACE↑          NAME
kube-system         coredns-74ff55c5b-9z
kube-system         coredns-74ff55c5b-pt
kube-system         etcd-aerith-cluster-
kube-system         kindnet-4r6v7
kube-system         kindnet-9x9bm
kube-system         kindnet-b7h82
```



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Amazon EKS
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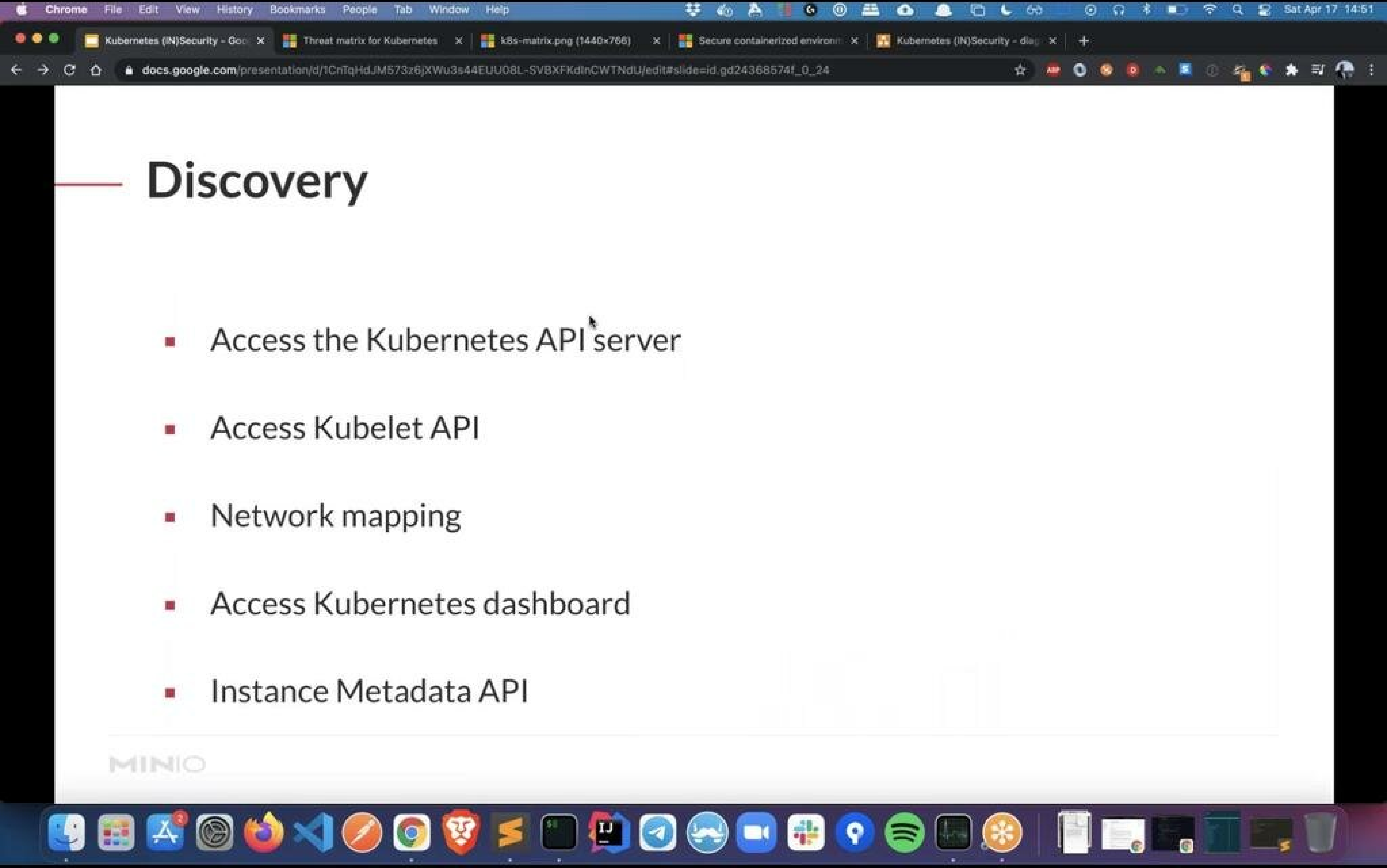
13

Credential Access

- List Kubernetes secrets
- Mount Service Principal
- Access container service account /var/run/secrets/kubernetes.io/serviceaccount/token
- Applications credentials in configuration files
- Access managed identity credential
- Malicious admission controller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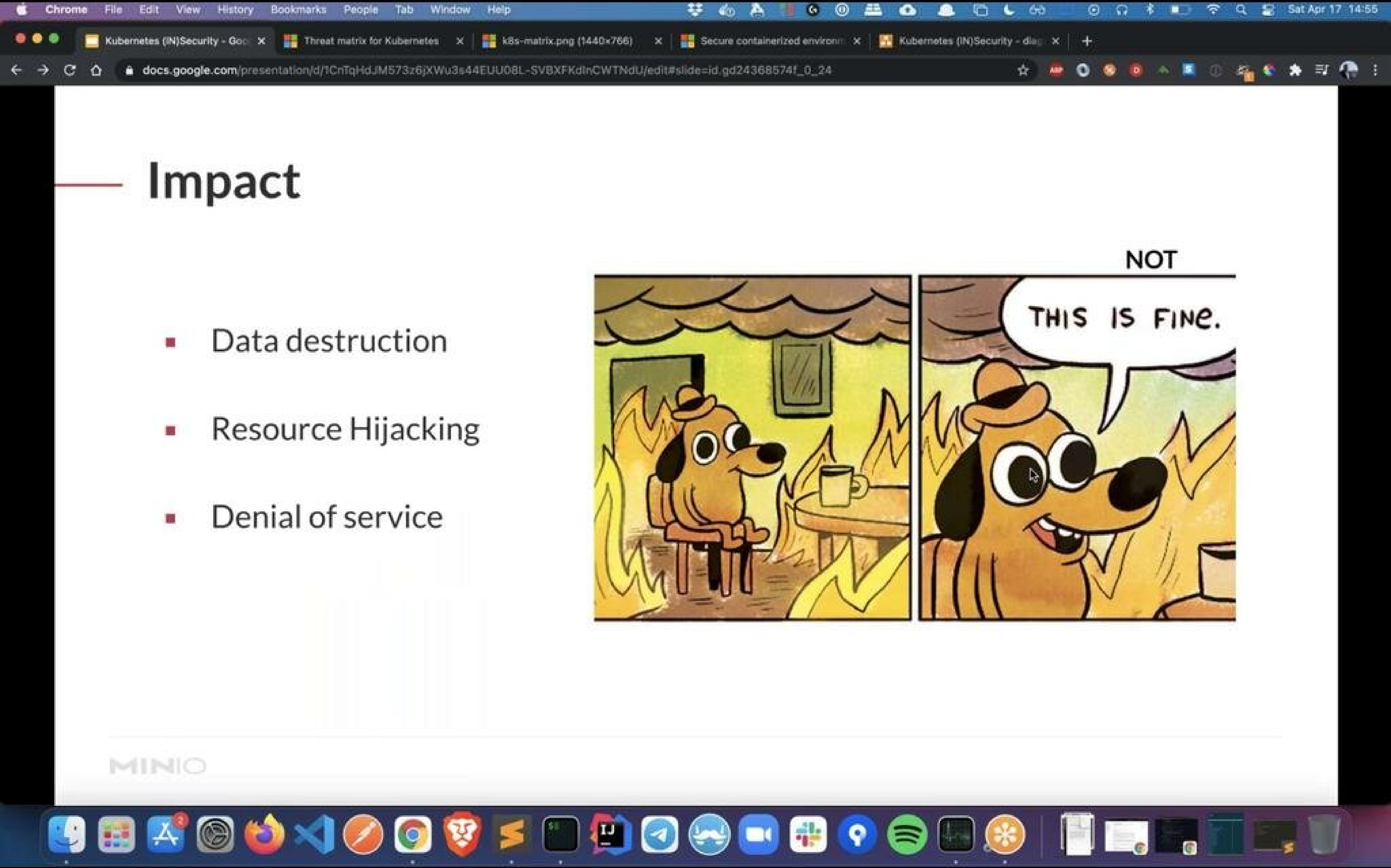
Discovery

- Access the Kubernetes API server
- Access Kubelet API
- Network mapping
- Access Kubernetes dashboard
- Instance Metadata API



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Impact

- Data destruction
- Resource Hijacking
- Denial of service

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Threat matrix for Kubernetes
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Kubernetes build-in defences

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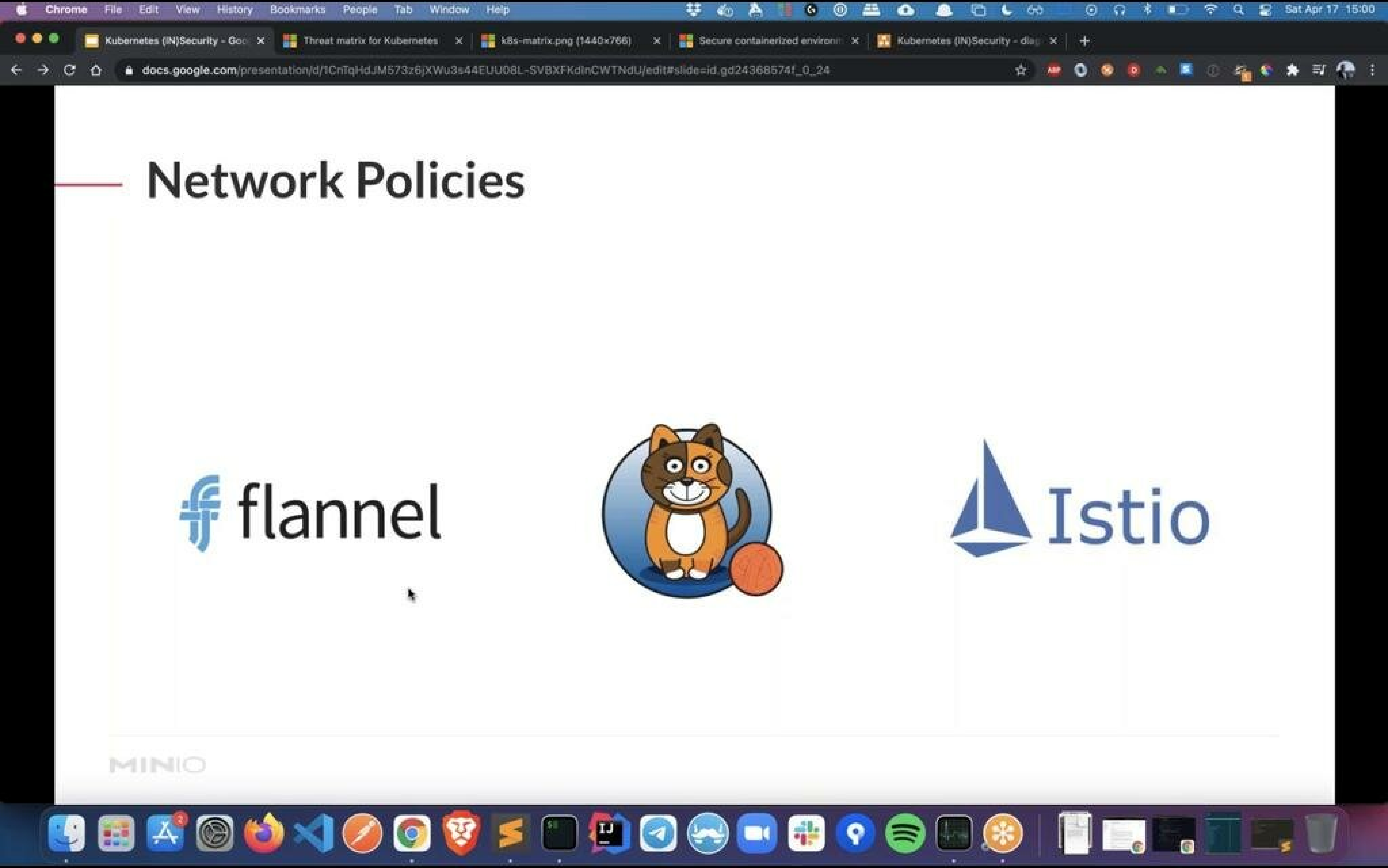
Security Context for Pods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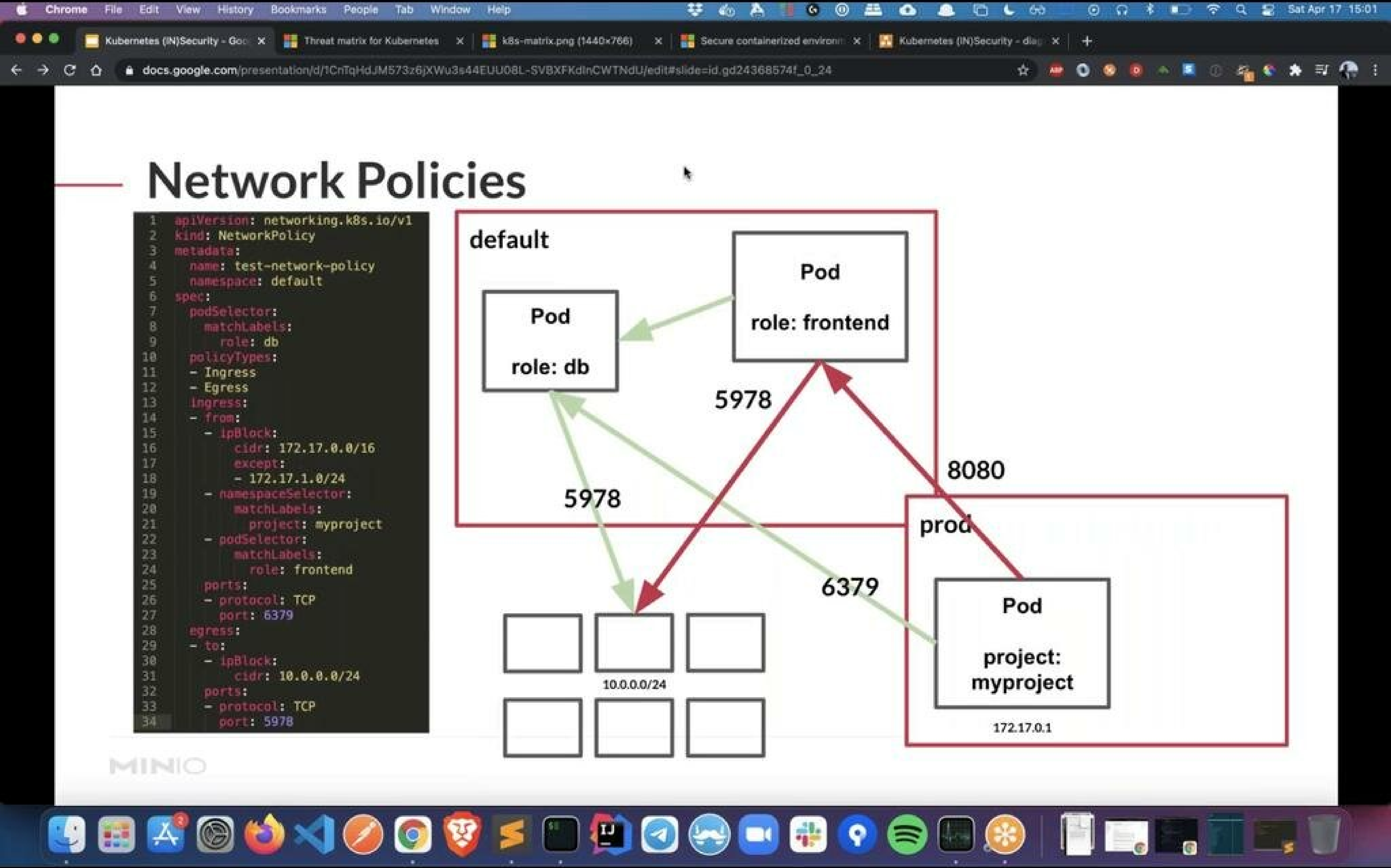
Network Policies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Network Policies

```
apiVersion: networking.k8s.io/v1
kind: NetworkPolicy
metadata:
  name: test-network-policy
  namespace: default
spec:
  podSelector:
    matchLabels:
      role: db
  policyTypes:
  - Ingress
  - Egress
  ingress:
  - from:
    - ipBlock:
        cidr: 172.17.0.0/16
        except:
        - 172.17.1.0/24
    - namespaceSelector:
        matchLabels:
          project: myproject
    - podSelector:
        matchLabels:
          role: frontend
    ports:
    - protocol: TCP
      port: 6379
  egress:
  - to:
    - ipBlock:
        cidr: 10.0.0.0/24
    ports:
    - protocol: TCP
      port: 5978
```

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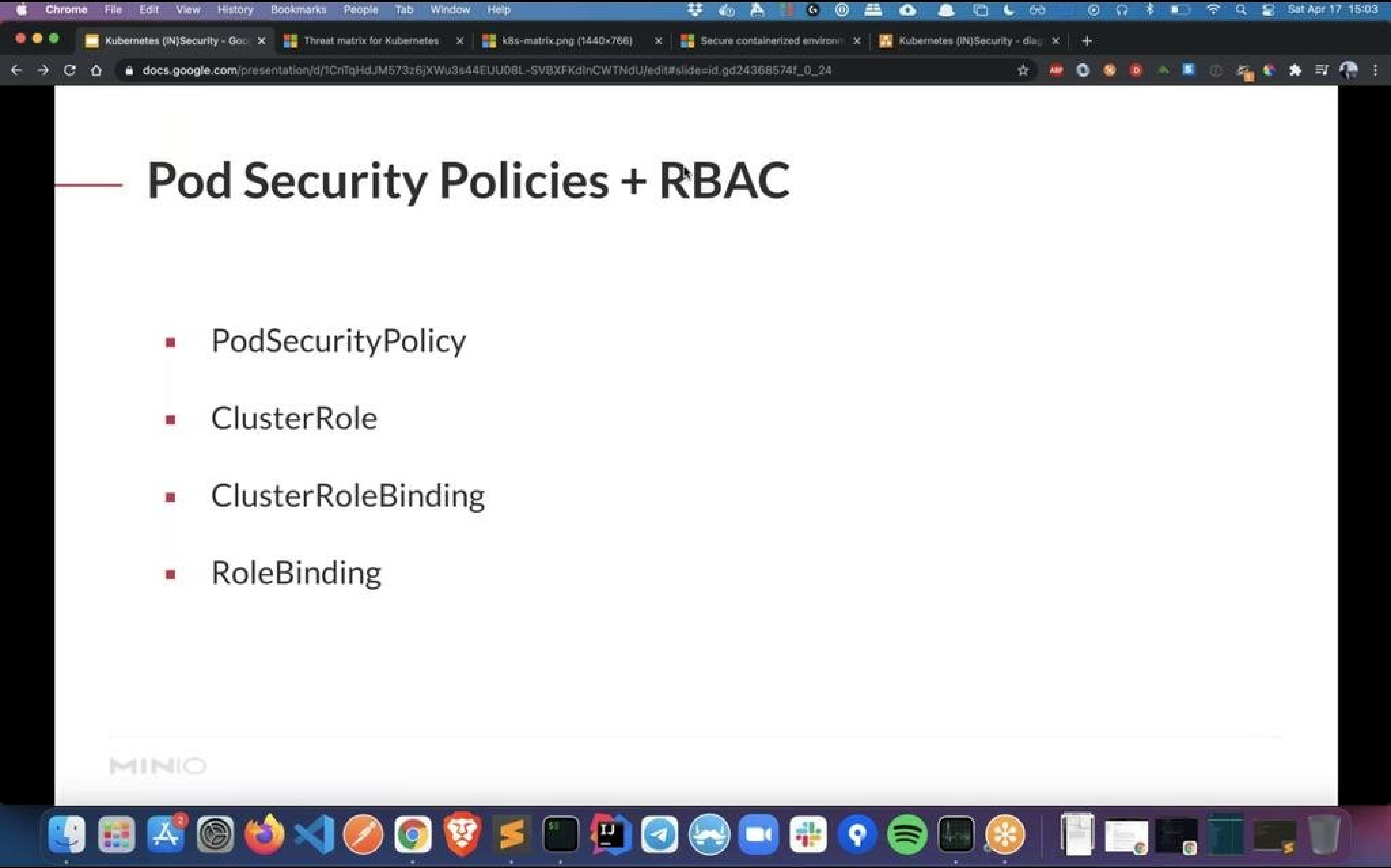
Pod Security Policies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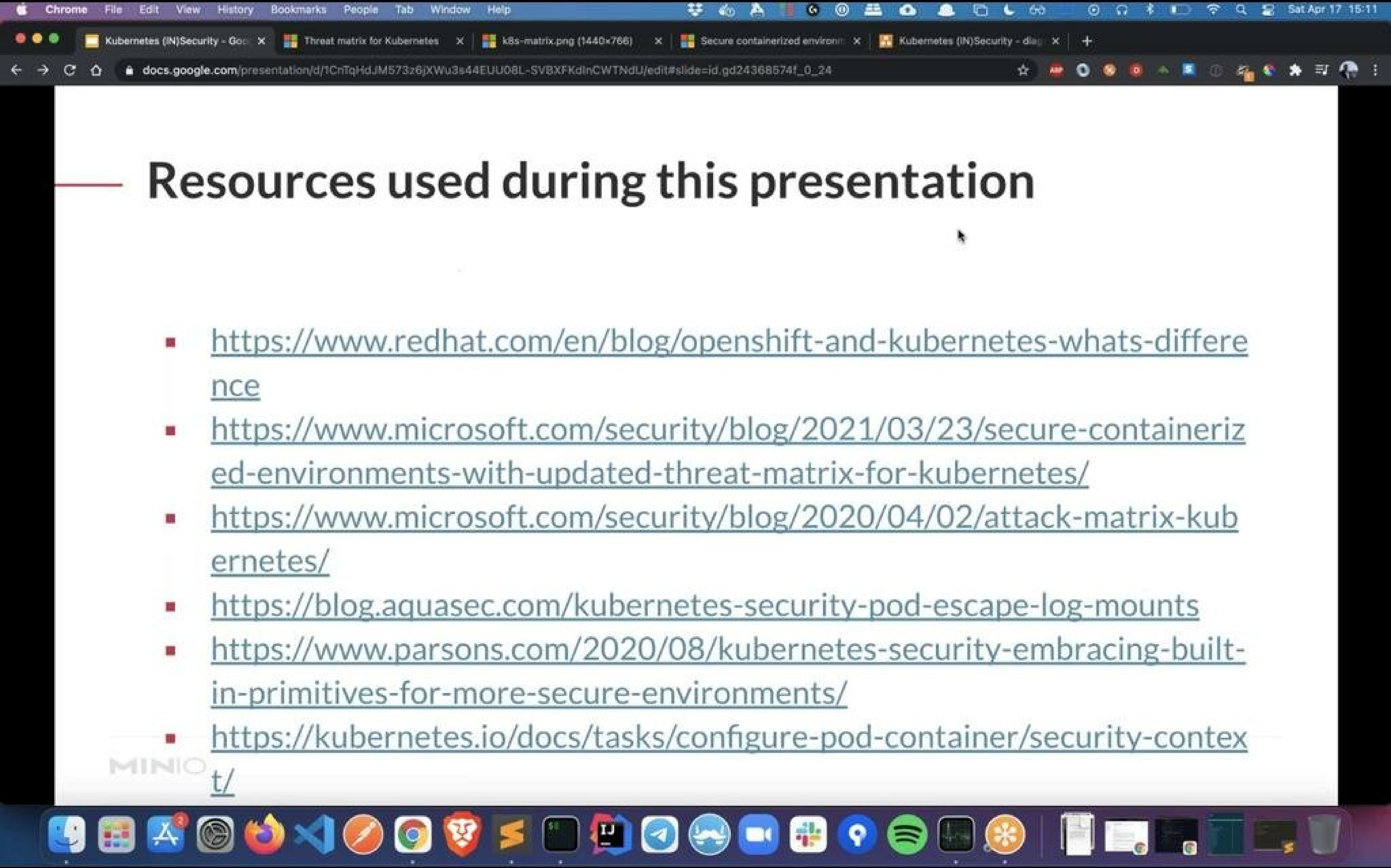
Pod Security Policies + RBAC

- PodSecurityPolicy
- ClusterRole
- ClusterRoleBinding
- RoleBinding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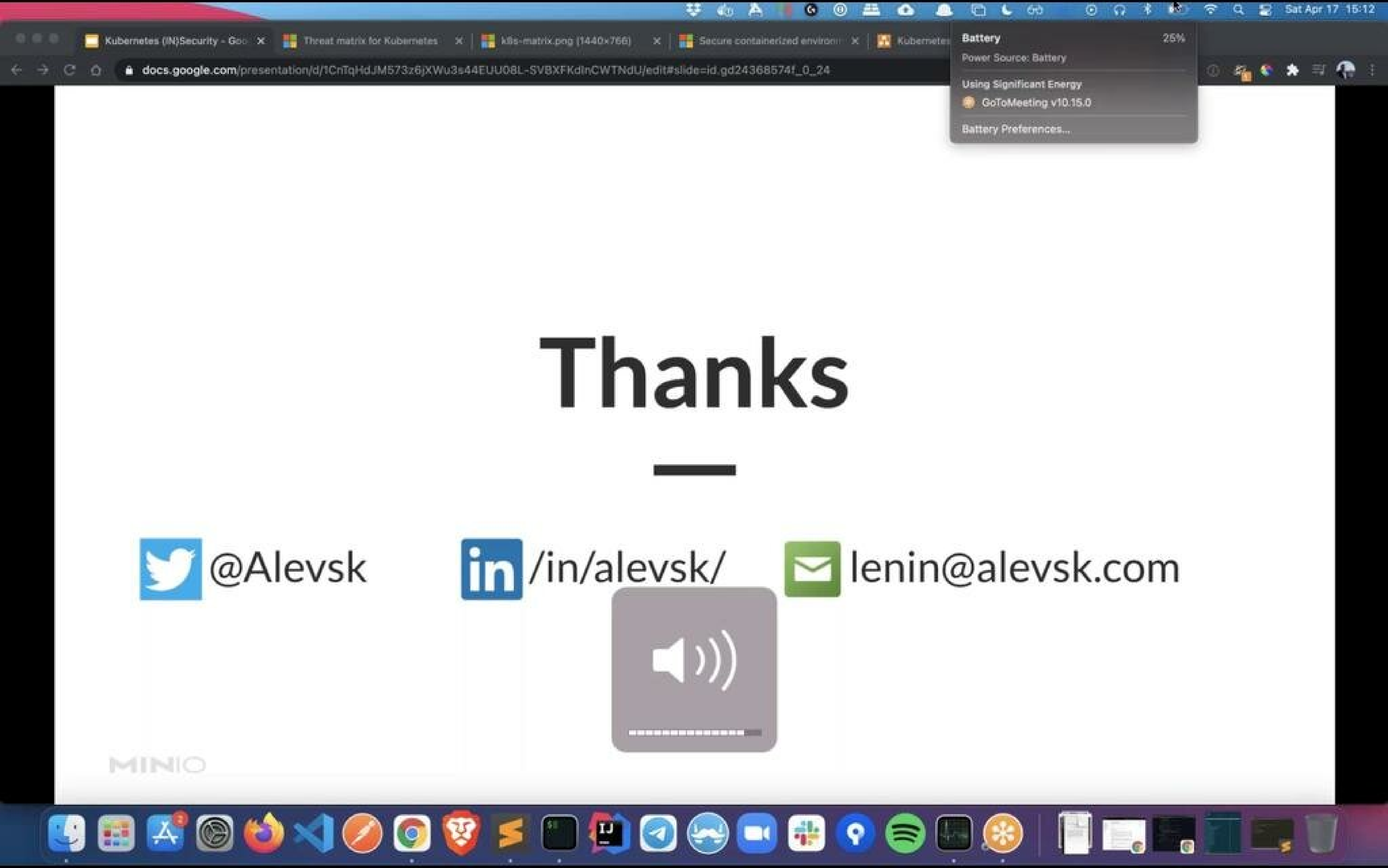
Resources used during this presentation

- https://www.redhat.com/en/blog/openshift-and-kubernetes-whats-difference
- https://www.microsoft.com/security/blog/2021/03/23/secure-containerized-environments-with-updated-threat-matrix-for-kubernetes/
- https://www.microsoft.com/security/blog/2020/04/02/attack-matrix-kubernetes/
- https://blog.aquasec.com/kubernetes-security-pod-escape-log-mounts
- https://www.parsons.com/2020/08/kubernetes-security-embracing-built-in-primitives-for-more-secure-environments/
- https://kubernetes.io/docs/tasks/configure-pod-container/security-context/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Kubernetes
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Battery 25%
Power Source: Battery
Using Significant Energy
GoToMeeting v10.15.0
Battery Preferences...
MINIO

Thanks

@Alevsk

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lenin@alevsk.com