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Kubernetes Namespace Breakout using Insecure Host Path Volume — Part 1

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This is Part 1 of a 2 part series on security implications of insecure hostPath

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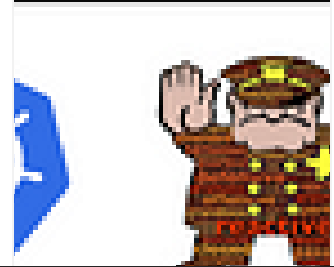
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Part 2 deals with the mitigation

Prevent hostPath based Kubernetes attacks with Pod Security Policies

Mitigation for insecure hostPath volume mounts using pod security policies

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This ability can in turn be leveraged to eventually gain maximum privileges in

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Abusing hostPath volume mounts for a Pod namespace escape Video

```
→ research export KUBECONFIG=./developer-kubeconfig
→ research
→ research kubectl auth can-i create pods
no
→ research kubectl auth can-i list secrets -n kube-system
no
→ research kubectl auth can-i create pods --namespace=developers
yes
```

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```
# Create kubeconfig for service account
```

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The config above creates a Namespace `developers` , a Service Account `developer-sa` and binds Role to allow CRUD on Pod resource to `developer-sa` but restricted only to the `developers` Namespace.

Attacker Starting Point

As attacker in the scenario, we will start by having access to the cluster using the *kubeconfig* generated for `developer-sa` above. This is equivalent to having

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Our objective is to breakout of this namespace restriction and gain access to
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Namespace Escape Steps

We will use hostPath volume feature of Kubernetes to deploy a Pod in *developers* namespace but with the underlying Node's / (root filesystem) mounted inside our Pod at */host*. We will also use additional features of Pod such as *hostIPC*, *hostPID*, *hostNetwork* to allow us access to all processes in the underlying Node. Our *PodSpec* (*pod-to-node.yml*) that we use in the exampe below is available [here](#).

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At this point we can access all Docker Containers running in the node

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```
root@pool-qt7kkl8wt-zn6c:/# docker ps
```

CONTAINER ID	IMAGE	COMMAND	CREATED	STATUS
622b9f408fde	ubuntu	"/bin/sh -c 'sleep i..."	8 minutes ago	Up 8 minutes
k8s_attacker-pod_attacker-pod_developers_d261db9d-84e4-4b73-83fb-dbf42444e4d4_0				
e329436b98dc	k8s_gcr.io/pause:3.1			

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to. In addition to this, we can use `nodeName` or `nodeSelector` in `PodSpec` to

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Privilege Escalation

We have gained an attack primitive where we can deploy a Pod, which is scheduled in arbitrary Node by Kubernetes. Through the Pod, we are able to access the Node's *Docker daemon* and in turn have full access to any container running on the Node.

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We can use the same config to list ALL Pods in the cluster

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```
root@pool-qt7kkl8wt-zn6c:/# kubectl \
--kubeconfig=/etc/kubernetes/kubelet.kubeconfig get pods -A
```

This lists all Pods in the cluster

NAMESPACE	NAME	READY
-----------	------	-------

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```
cat /var/run/secrets/kubernetes.io/serviceaccount/ca.crt
```

The above information can be used, along with `cluster-info` to generate a `kubeconfig` using which an attacker can interact with the API server. Refer to [our script](#) for generating `kubeconfig`

Mitigation

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assurance for withstanding real world attackers by getting us to do a black box pen test.

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We run a hands-on training course “Attacking and Auditing Kubernetes Clusters” for cluster operators and pentesters.

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Written by Abhisek Datta

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