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Mitigating Privilege Escalation in Multi-tenant Argo CD

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Agenda

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- What is Privilege escalation ?
- Privilege escalation in Argo CD
- Multi tenant security controls in Argo CD
- Mitigation approaches
  - Policy enforced AppProjects (Classic)
  - App Sync with Impersonation Feature (Recommended way)
- Summary & Key takeaways

What is Privilege Escalation

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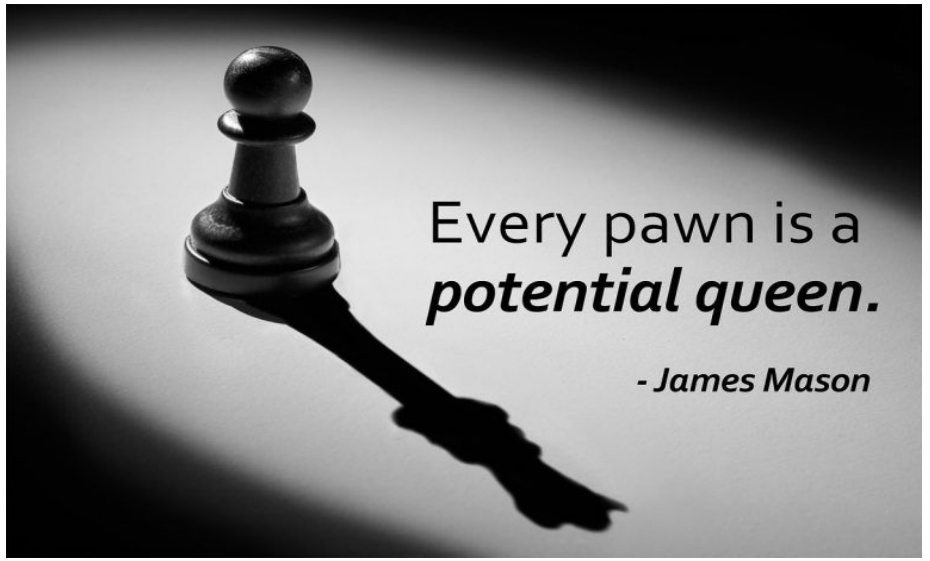
- Consists of techniques that **adversaries** use to gain **higher-level permissions** on a **system or network**.
- Adversaries can often enter and explore a network with **unprivileged access** but acquire **elevated permissions**.
- Common approaches are to take advantage of **system weaknesses, misconfigurations, and vulnerabilities**.
- Examples of elevated access include:
  - SYSTEM/root level
  - local administrator
  - user account with admin-like access



Types of Privilege Escalation

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Vertical
a cybersecurity attack where an attacker exploits vulnerabilities to gain **higher-level privileges** on a system, moving from a lower to a higher access level, like a standard user to an administrator.

Horizontal
occurs when an attacker gains access to resources or data belonging to **another user** with the **same privilege level,** rather than escalating to higher privileges

Multi tenant Security Controls

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RBAC

Includes both Argo CD and Kubernetes Role based access control.

Projects

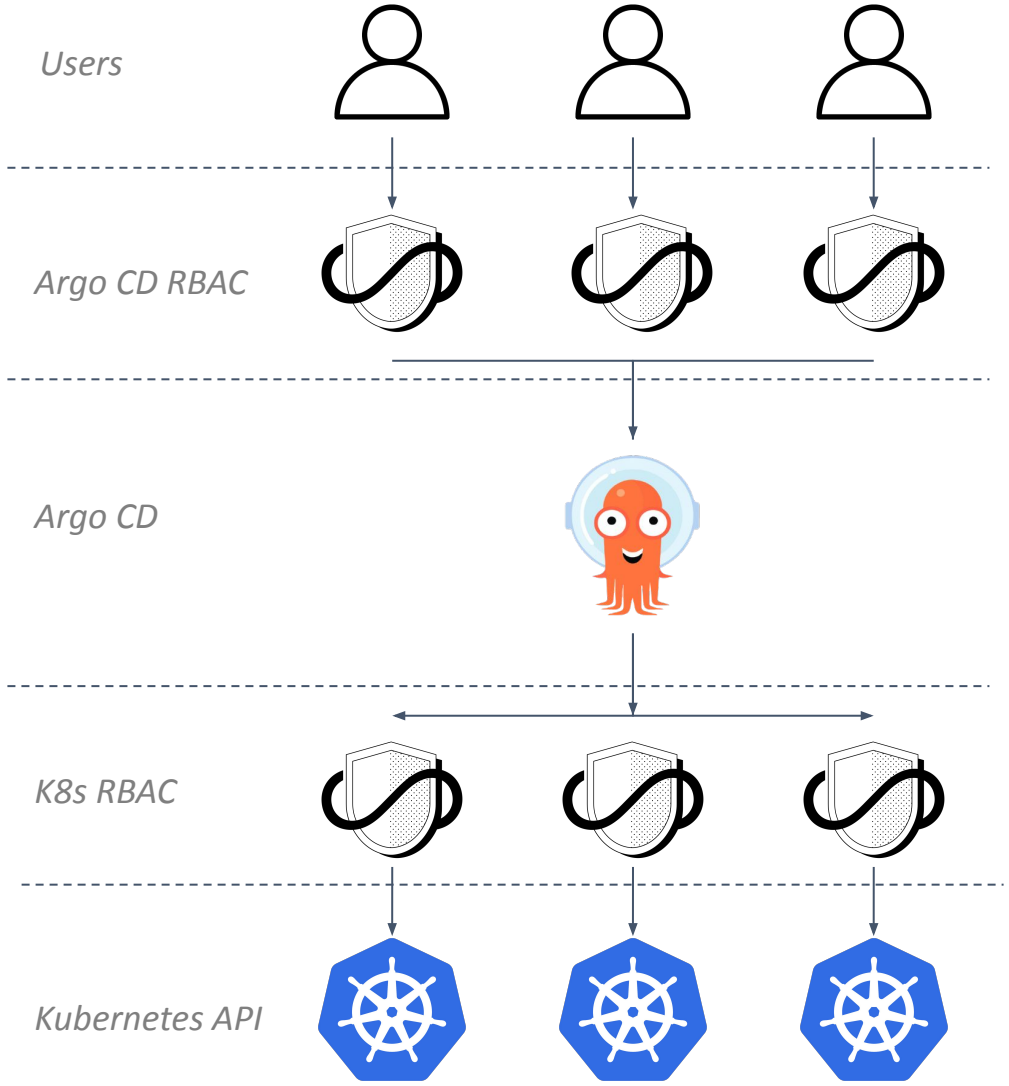
Logical grouping of applications. Often organized along tenant boundaries.

Scope

Scope of Argo CD installation - Cluster or Namespace scoped.

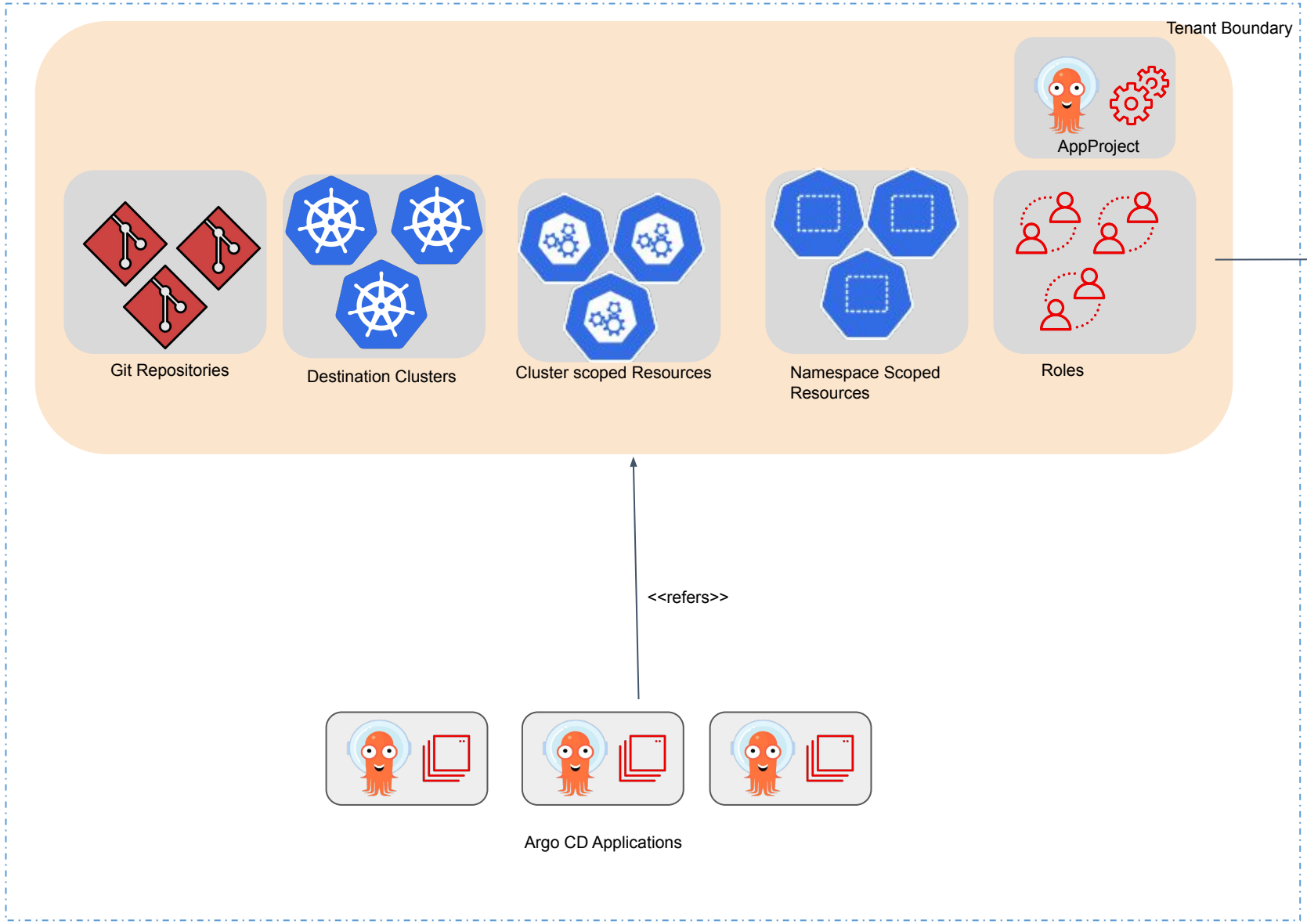
Privilege escalation in Argo CD

- Tenants accessing the same cluster use the **same** Kubernetes **Service Account** for the **sync** operation.
- Different use cases often require vastly **different permissions**
- Argo CD does not support using **different Service Accounts** to the same cluster (*)

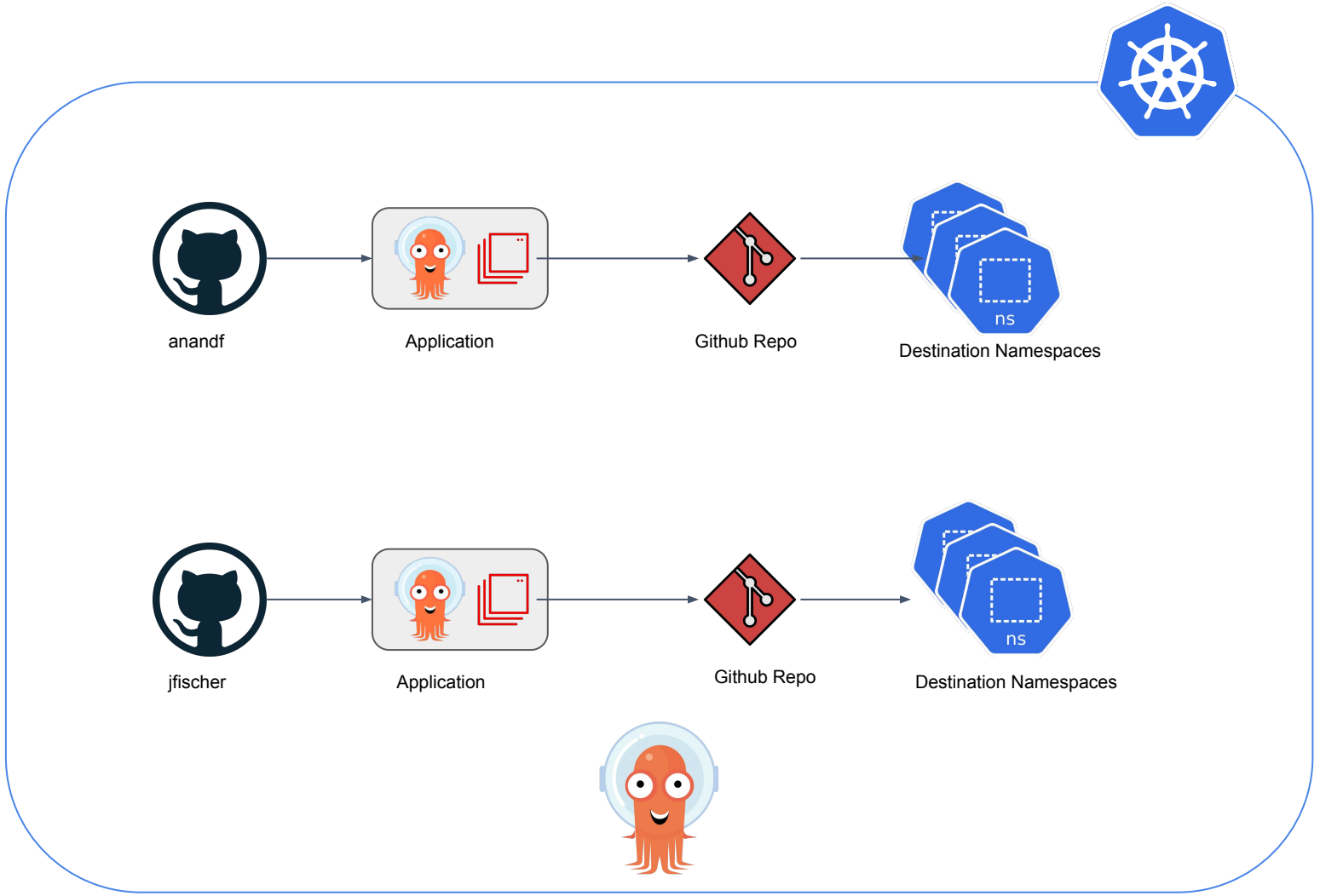


TLDR; Service Account must have privileges that meet the needs of all tenants use cases!

Argo CD Projects



Use Case - Argo CD



Approach 1 : Policy enforced AppProjects

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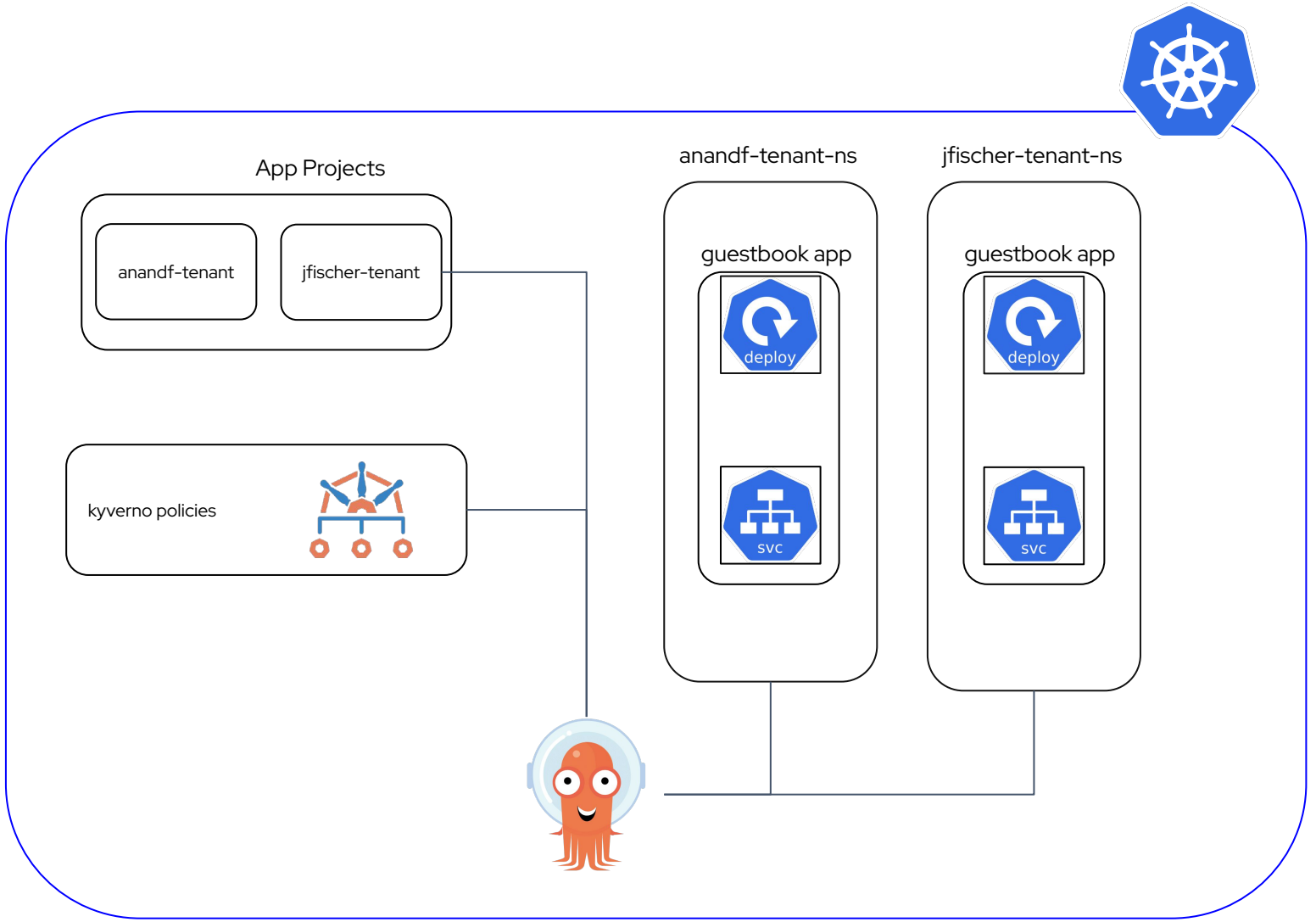
- In this approach we ensure that all the security posture remains same between AppProjects and k8s RBAC.

- Kyverno (or) Open Policy Agent (OPA) can be used for enforcing policies.

- Some of the policies
  - Do not refer the ***default*** AppProject in any Application.
  - Enforce all AppProjects inherit from the ***global*** AppProject.
  - Enforce all AppProjects are bound to only its tenant's namespace.
  - Enforce all AppProjects allow destinations that are allowed for its tenant.
  - Keep every resources **blacklisted** and **whitelist** it explicitly per tenant.

Demo Setup

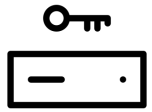

App Projects
anandf-tenant
jfischer-tenant
kyverno policies
anandf-tenant-ns
guestbook app
deploy
svc
jfischer-tenant-ns
guestbook app
deploy
svc

Approach 2: App Sync with Impersonation

New enhancement
introduced in Argo CD v2.13

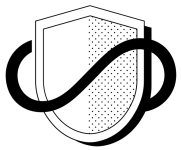
Aimed for improving
multi-tenancy user experience in
Argo CD

Experimental feature
Maturity : Alpha

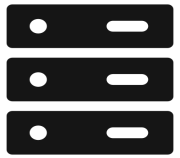


Only Administrators can
configure the service account to
be used for the sync operation

Disabled by default.
Can be enabled by setting
`application.sync.impersonation.enabled: true`



Improves the security posture of
Argo CD



Can only be enabled/disabled at
system level and not per application
or project

How to use this feature

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- Enable the feature by running the following command

```
kubectl patch configmap argocd-cm -n argocd \
 -p '{"data": {"application.sync.impersonation.enabled": "true"}}'
```

- (Optional) Add support for apps in any namespace by running the following command.

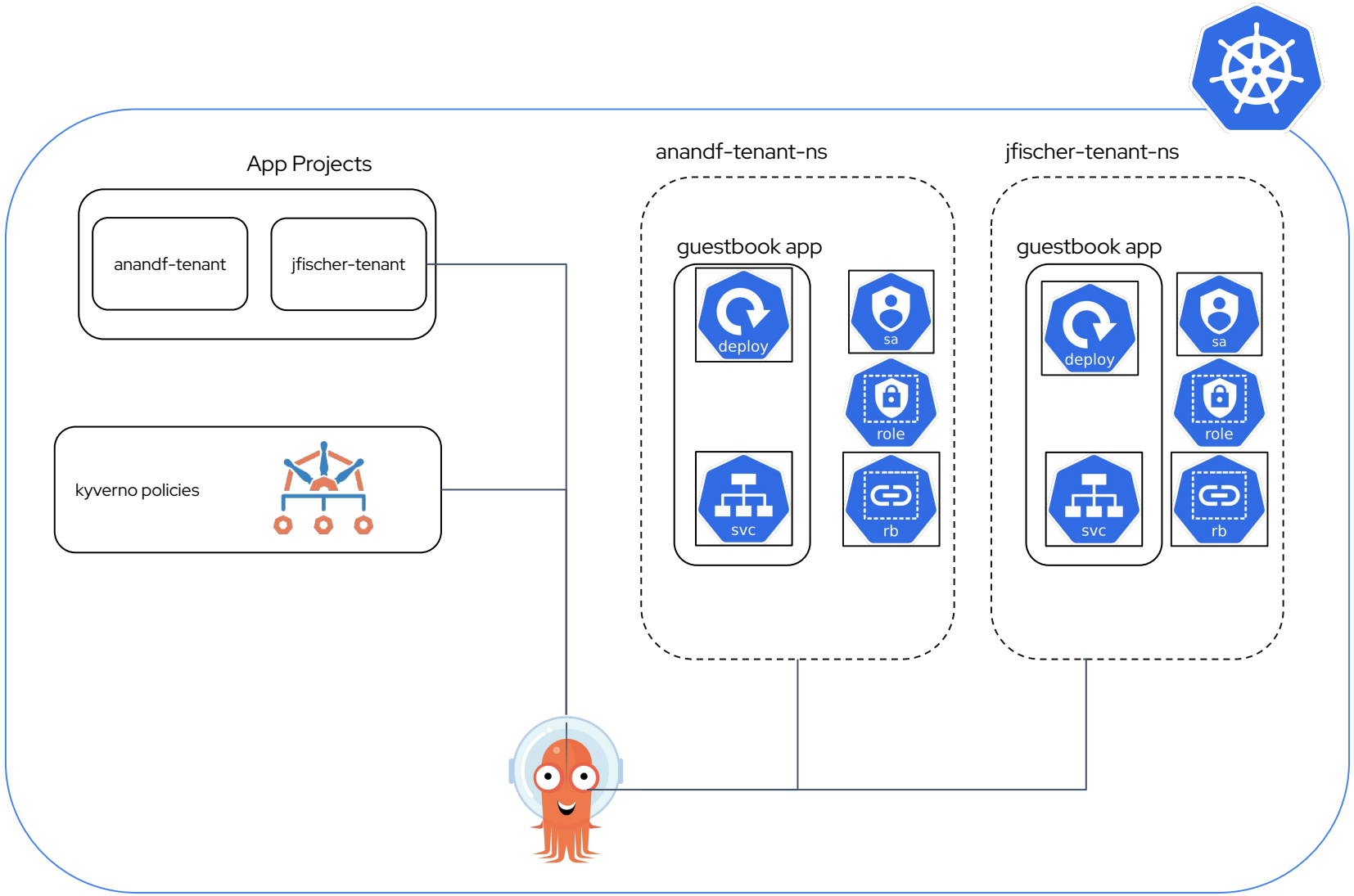
```
kubectl patch cm argocd-cmd-params-cm -n argocd \
  -p '{"data": {"application.namespaces": "tenant-*"}}'
```

- Destination service accounts can be added to the AppProject under .spec.destinationServiceAccounts

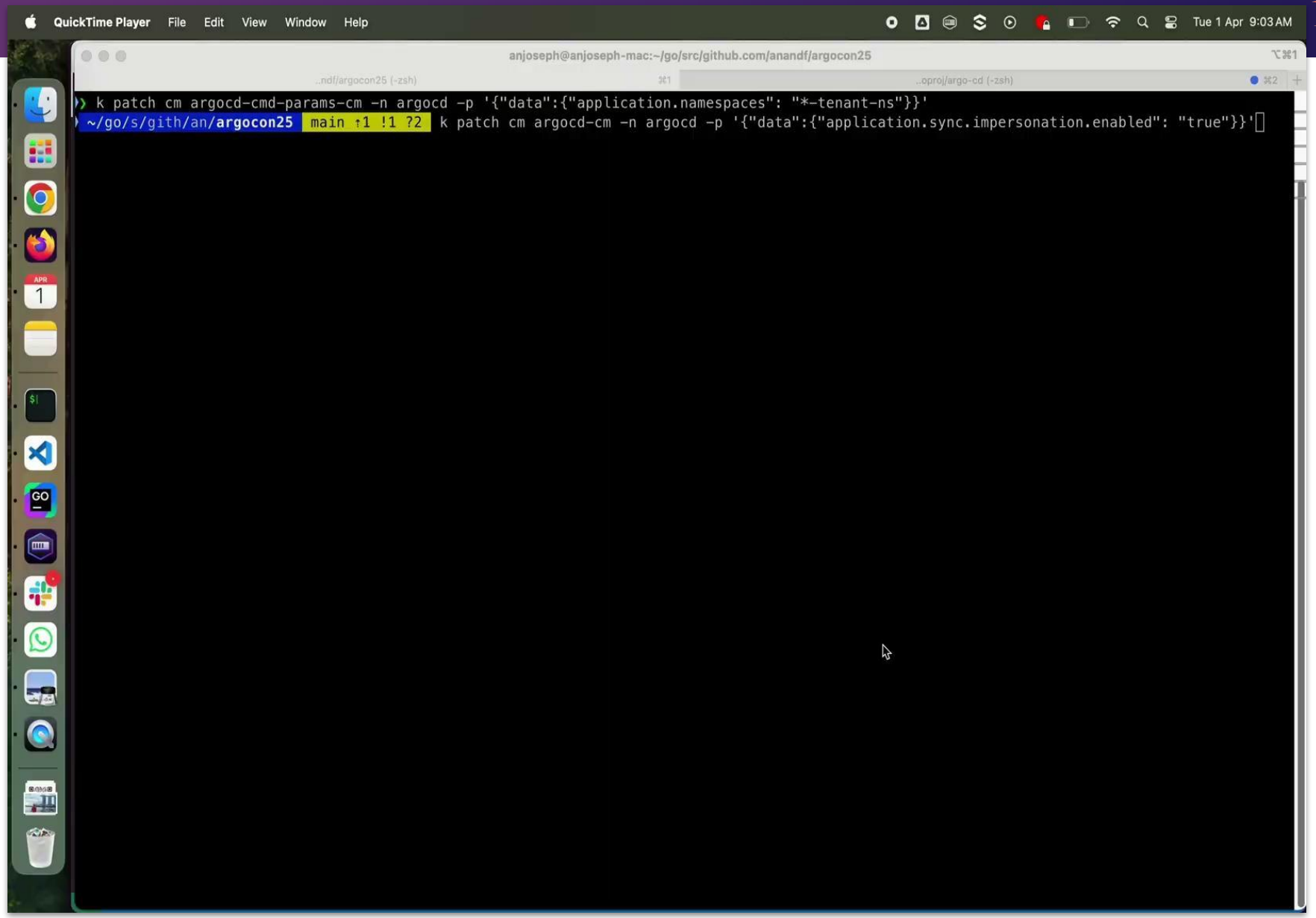
- One or more Destination ServiceAccounts can be configured in an AppProject, each pointing to target server and namespace combination

```
destinationServiceAccounts:
 - server: https://kubernetes.default.svc
   namespace: guestbook
   defaultServiceAccount: guestbook-deployer
 - server: https://kubernetes.default.svc
   namespace: guestbook-dev
   defaultServiceAccount: guestbook-dev-deployer
 - server: https://kubernetes.default.svc
```

Demo Setup


App Projects
anandf-tenant
jfischer-tenant
kyverno policies
anandf-tenant-ns
guestbook app
deploy
sa
role
svc
rb
jfischer-tenant-ns
guestbook app
deploy
sa
role
svc
rb

Demo


QuickTime Player File Edit View Window Help
Tue 1 Apr 9:03 AM
anjoseph@anjoseph-mac:~/go/src/github.com/anandf/argocon25
k patch cm argocd-cmd-params-cm -n argocd -p '{"data":{"application.namespaces": "*-tenant-ns"}}'
~/go/s/gith/an/argocon25 main ↑1 !1 ?2 k patch cm argocd-cm -n argocd -p '{"data":{"application.sync.impersonation.enabled": "true"}}'

Benefits

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- Prevent privilege escalation (issue#9606)
- Possibility of having multiple destination clusters with same server URL (issue#15027).
- Support for avoiding accidental deletion of resources (issue#11227) (Work In progress)

Additional Resources

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Feature Documentation

- https://argo-cd.readthedocs.io/en/stable/operator-manual/app-sync-using-impersonation/
- https://argo-cd.readthedocs.io/en/stable/proposals/decouple-application-sync-user-using-impersonation/

Demo Materials

https://github.com/anandf/ArgoConEU2025

Summary & Key Takeaway

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- App sync with impersonation is a powerful feature to use existing Kubernetes RBAC to decouple the sync process for multiple tenants.
- It allows platform admins to follow the principle of assigning least privileges that is required for each tenant.
- It works directly with k8s RBAC and can avoid privilege escalations caused due to misconfigurations.
- Having policies to enforce the best practices can greatly improve the security posture of Argo CD.