

KCD Seoul 2025

ArgoCD와 함께하는 Multi-Cluster 운영

김태지 | Technical Architect

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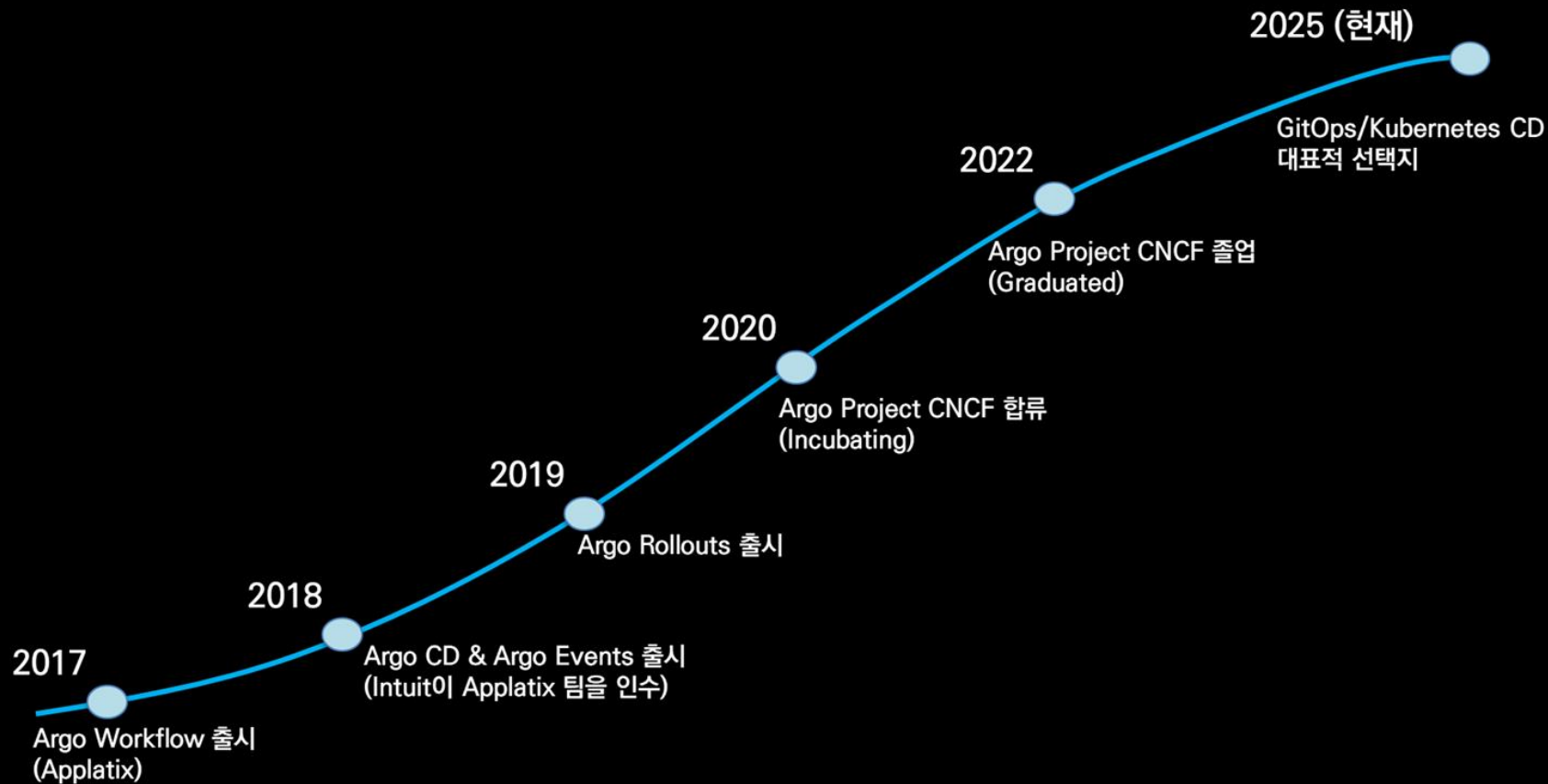
<https://kkamji.net> (Blog)

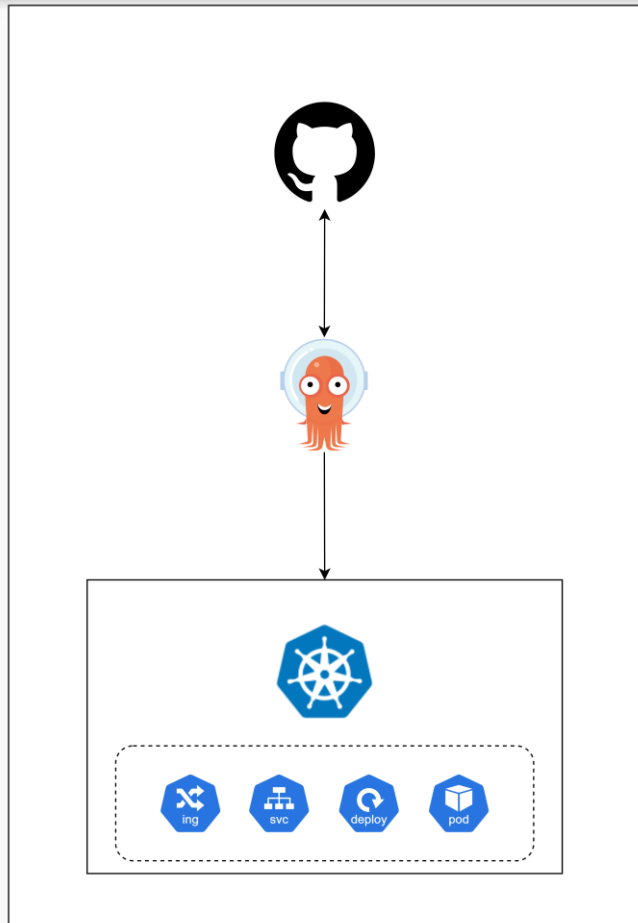


Background



Argo Project History





GitOps 기반 지속적 배포(CD) 도구

- **Pull 기반 재조정(Reconciliation)**
Git을 단일 기준 저장소로 삼아 주기적 동기화, 커밋 기준 롤백
- **선언적 구성 지원**
Helm, Kustomize, YAML, Jsonnet 등 표준 도구를 그대로 사용
- **드리프트 감지와 자동 복구**
Diff/Health 확인, Auto-Prune와 Self-Heal로 원하는 상태 유지
- **커밋 단위 롤백과 감사 추적**
Git History 기반으로 특정 시점으로 롤백 및 변경 기록 보존
- **멀티클러스터 & 멀티테넌시**
ApplicationSet과 Projects, RBAC으로 대규모 환경을 일관적으로 운영

GitOps Principles

v1.0.0

1 Declarative

A **system** managed by GitOps must have its desired state expressed **declaratively**.

2 Versioned and Immutable

Desired state is **stored** in a way that enforces immutability, versioning and retains a complete version history.

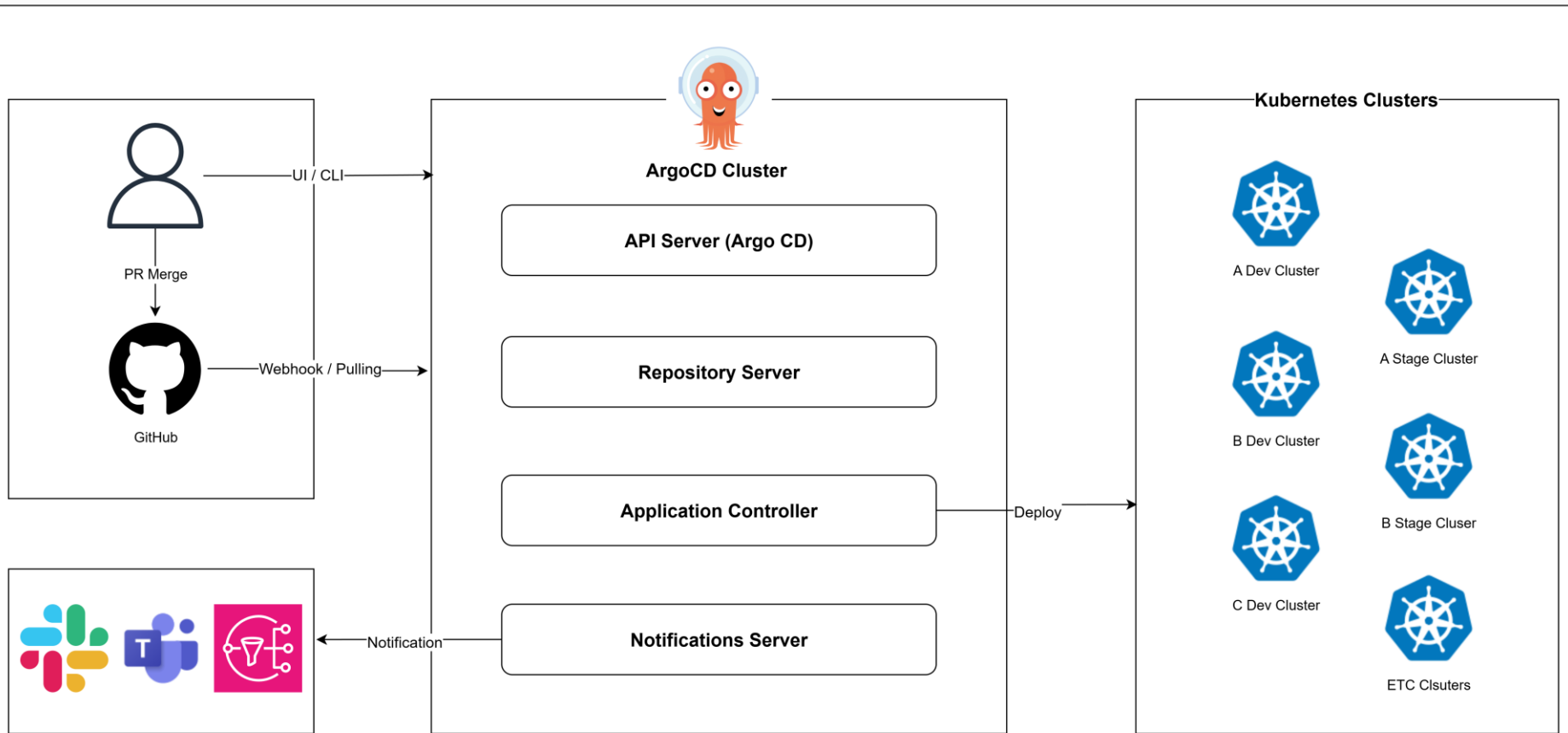
3 Pulled Automatically

Software agents automatically pull the desired state declarations from the source.

4 Continuously Reconciled

Software agents **continuously** observe actual system state and **attempt to apply** the desired state.

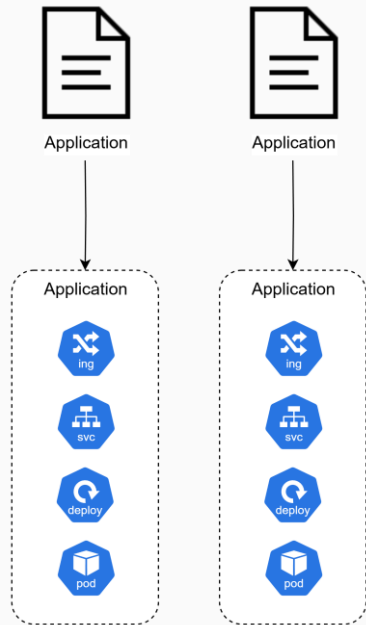
Argo CD 배포 과정



Preview

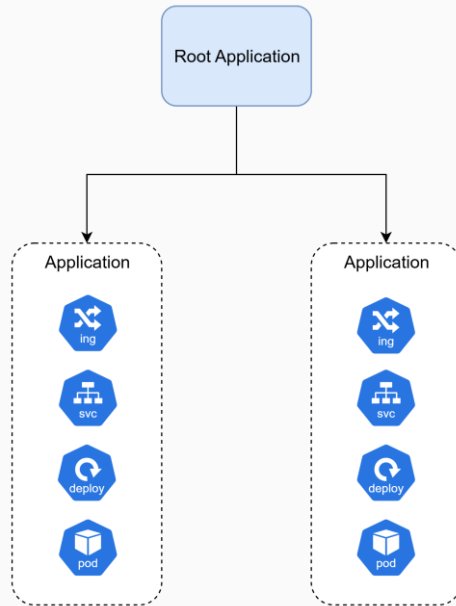
선언적으로 Application 생성

One Manifest = One Application
(1:1)



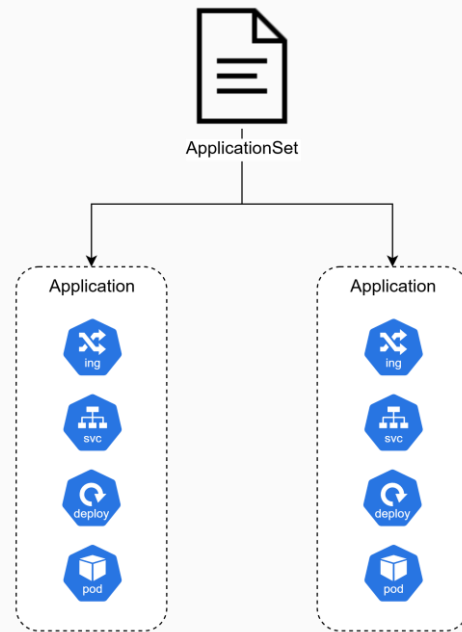
App of Apps Pattern

One Root App = Many Applications
(1:N)



ApplicationSet

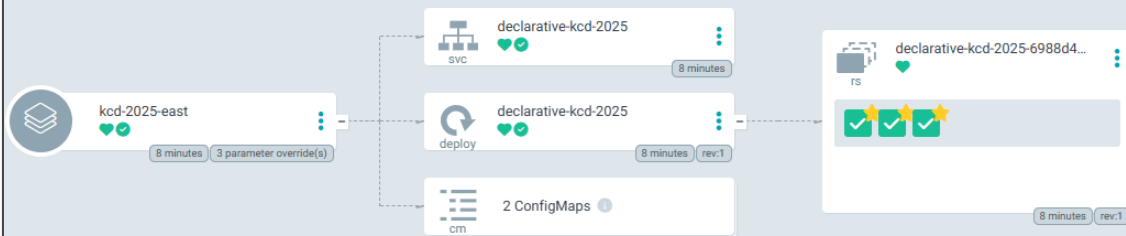
One Manifest = Many Applications
(1:N)



Application 선언적으로 생성하기

```
1  apiVersion: argoproj.io/v1alpha1
2  kind: Application
3  metadata:
4    name: kcd-2025-east
5    namespace: argocd
6  spec:
7    project: kcd-2025
8    source:
9      repoURL: https://github.com/KKamJi98/kcd-2025.git
10     path: helm
11     targetRevision: HEAD
12     helm:
13       releaseName: declarative
14       parameters:
15         - name: prefix
16           value: kcd
17         - name: region
18           value: east
19         - name: replicaCount
20           value: "3"
21     destination:
22       name: kcd-east
23       namespace: kcd
24     syncPolicy:
25       automated:
26         prune: true
27         selfHeal: true
28       syncOptions:
29         - CreateNamespace=true
30         - ServerSideApply=true
31         - PrunePropagationPolicy=foreground
32         - PruneLast=true
```

어디에 있는 어떤 Application을? 어떤 클러스터에? 어떤 옵션으로?

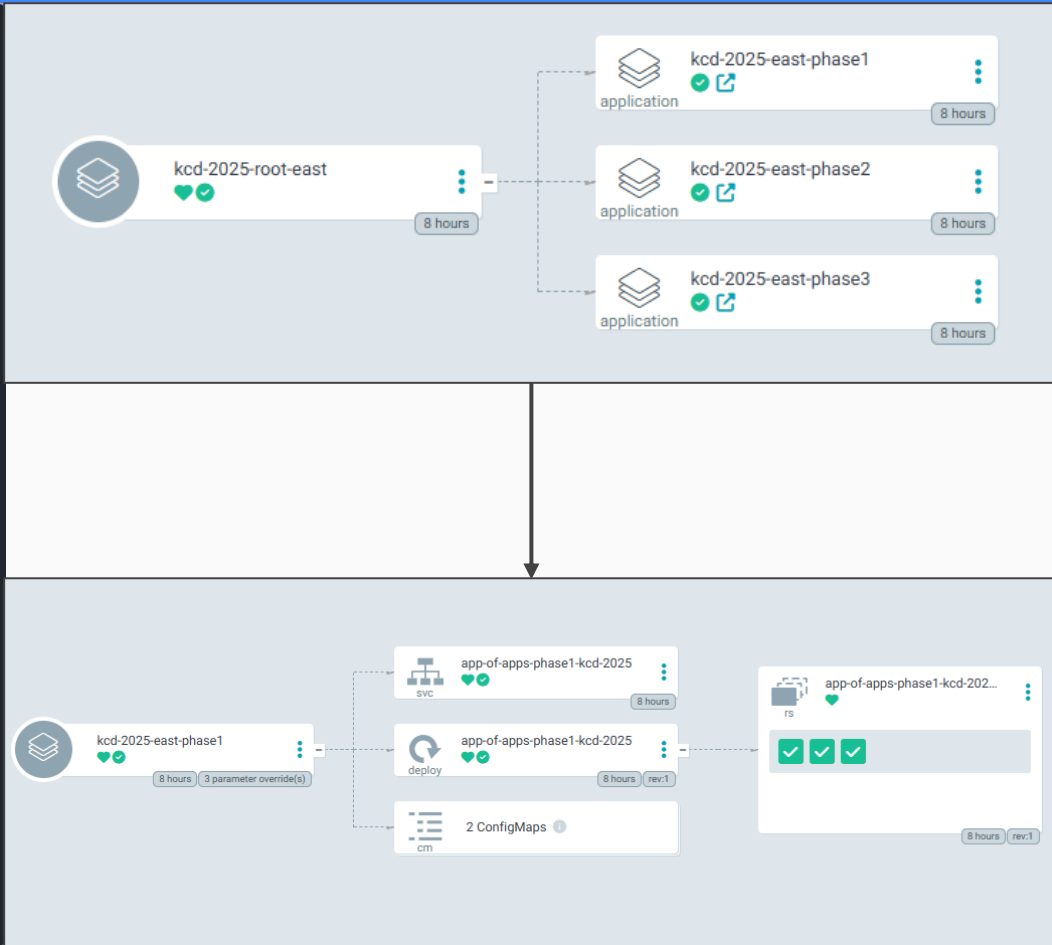


REPO URL	https://github.com/KKamJi98/kcd-2025.git
TARGET REVISION	HEAD
PATH	helm
SYNC OPTIONS	<input checked="" type="checkbox"/> CreateNamespace <input checked="" type="checkbox"/> ServerSideApply <input type="checkbox"/> PrunePropagationPolicy=foreground <input checked="" type="checkbox"/> PruneLast

App of Apps Pattern

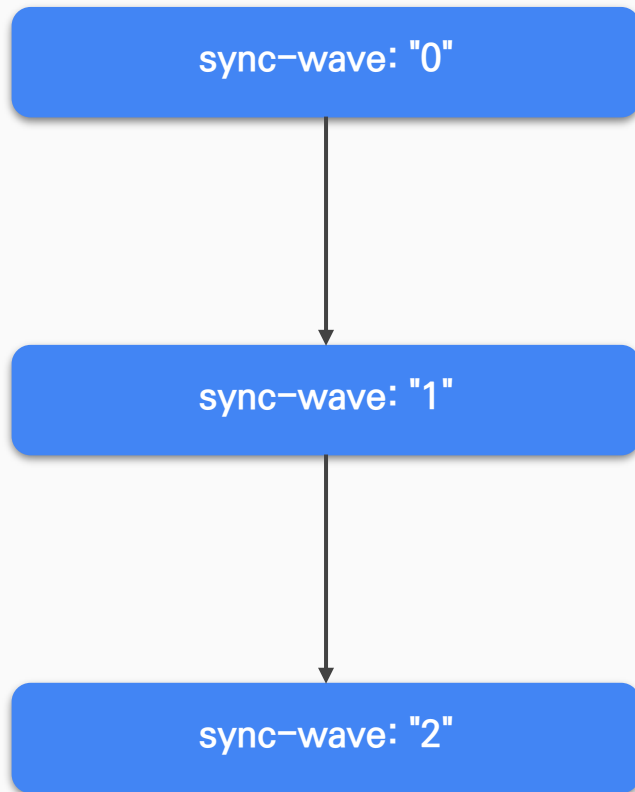


```
1  apiVersion: argoproj.io/v1alpha1
2  kind: Application
3  metadata:
4    name: kcd-2025-root-east
5    namespace: argocd
6    finalizers:
7      - resources-finalizer.argocd.argoproj.io
8  spec:
9    project: kcd-2025
10   source:
11     repoURL: https://github.com/KKamJi98/kcd-2025.git
12     targetRevision: HEAD
13     path: argocd/app-of-apps/east
14     directory:
15       recurse: true
16   destination:
17     server: https://kubernetes.default.svc
18     namespace: argocd
19   syncPolicy:
20     automated:
21       prune: true
22       selfHeal: true
23     syncOptions:
24       - CreateNamespace=true
25       - ServerSideApply=true
26       - PrunePropagationPolicy=foreground
27       - PruneLast=true
```



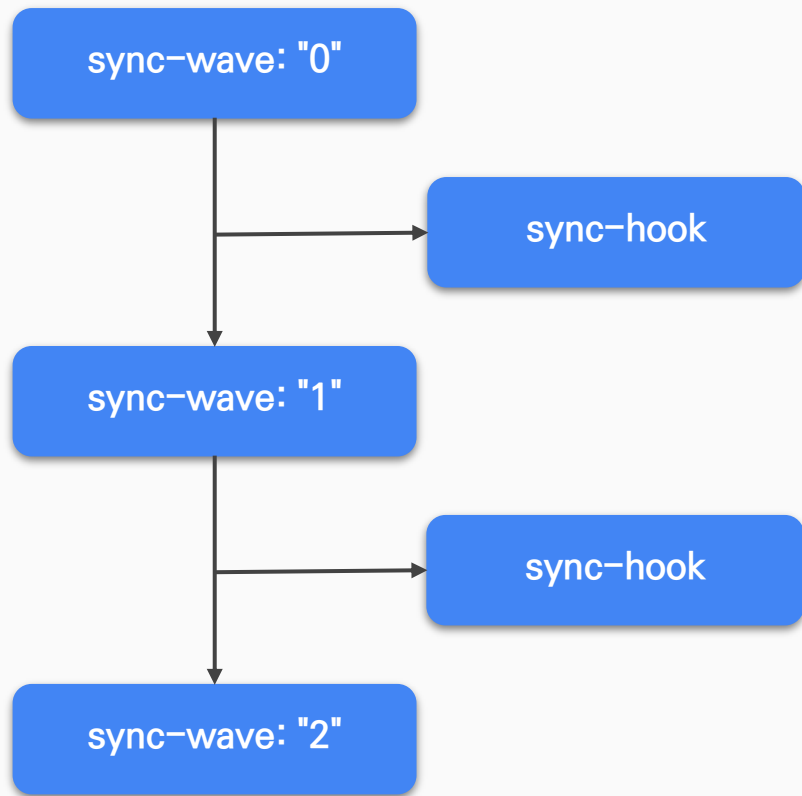
App of Apps Pattern – Sync Wave

```
1  apiVersion: argoproj.io/v1alpha1
2  kind: Application
3  metadata:
4    name: kcd-2025-east-phase1
5    namespace: argocd
6    annotations:
7      argocd.argoproj.io/sync-wave: "0"
8    finalizers:
9      - resources-finalizer.argocd.argoproj.io
10 spec:
11   project: kcd-2025
12   source:
13     repoURL: https://github.com/KKamJi98/kcd-2025.git
14     path: helm
15     targetRevision: HEAD
16     helm:
17       releaseName: app-of-apps-phase1
18       parameters:
19         - name: prefix
20           value: kcd
21         - name: region
22           value: east
23         - name: replicaCount
24           value: "3"
25   destination:
26     name: kcd-east
27     namespace: kcd
28   syncPolicy:
29     automated:
30       prune: true
31       selfHeal: true
32     syncOptions:
33       - CreateNamespace=true
34       - ServerSideApply=true
35       - PrunePropagationPolicy=foreground
36       - PruneLast=true
```





App of Apps Pattern – Sync Hook

```
1  apiVersion: batch/v1
2  kind: Job
3  metadata:
4    name: east-wave0-delay
5    namespace: argocd
6    annotations:
7      argocd.argoproj.io/hook: Sync
8      argocd.argoproj.io/hook-delete-policy: HookSucceeded
9      argocd.argoproj.io/sync-wave: "0"
10 spec:
11   backoffLimit: 0
12   template:
13     spec:
14       restartPolicy: Never
15       containers:
16       - name: sleep
17         image: busybox:1.36
18         imagePullPolicy: IfNotPresent
19         command: ["sh", "-c", "sleep 10"]
20 ---
21 apiVersion: batch/v1
22 kind: Job
23 metadata:
24   name: east-wave1-delay
25   namespace: argocd
26   annotations:
27     argocd.argoproj.io/hook: Sync
28     argocd.argoproj.io/hook-delete-policy: HookSucceeded
29     argocd.argoproj.io/sync-wave: "1"
30 spec:
31   backoffLimit: 0
32   template:
33     spec:
34       restartPolicy: Never
35       containers:
36       - name: sleep
37         image: busybox:1.36
38         imagePullPolicy: IfNotPresent
39         command: ["sh", "-c", "sleep 10"]
```





ApplicationSet (하나의 선언으로 N개의 Application을 생성)

```
1 apiVersion: argoproj.io/v1alpha1
2 kind: ApplicationSet
3 metadata:
4   name: kcd-2025-appset-list
5   namespace: argocd
6 spec:
7   goTemplate: true
8   goTemplateOptions: ["missingkey=error"]
9   generators:
10    - list:
11      elements:
12        - region: east
13        - region: west
14   template:
15     metadata:
16       name: 'kcd-2025-appset-{{ .region }}'
17     finalizers:
18       - resources-finalizer.argocd.argoproj.io
19     spec:
20       project: kcd-2025
21       source:
22         repoURL: https://github.com/KKamJi98/kcd-2025.git
23         targetRevision: HEAD
24         path: helm
25         helm:
26           releaseName: 'baseline'
27           parameters:
28             - name: prefix
29               value: kcd
30             - name: region
31               value: '{{ .region }}'
32             - name: replicaCount
33               value: "3"
34       destination:
35         name: 'kcd-{{ .region }}'
36         namespace: kcd
37     syncPolicy:
38       automated:
39         prune: true
40         selfHeal: true
41       syncOptions:
42         - CreateNamespace=true
43         - ServerSideApply=true
44         - PrunePropagationPolicy=foreground
45         - PruneLast=true
```

 **kcd-2025-appset-east** 

Project: kcd-2025

Labels:

Status:  Healthy  Synced

Repository: <https://github.com/KKamJi98/kcd-2025.git>

Target Rev... HEAD




Path: helm



Destination: kcd-east

Namespa... kcd

Created At: 09/09/2025 01:22:41 (a minute ago)



Last Sync: 09/09/2025 01:22:42 (a minute ago)

 SYNC  REFRESH  DELETE

 **kcd-2025-appset-west** 

Project: kcd-2025

Labels:

Status:  Healthy  Synced

Repository: <https://github.com/KKamJi98/kcd-2025.git>

Target Rev... HEAD




Path: helm

Destination: kcd-west

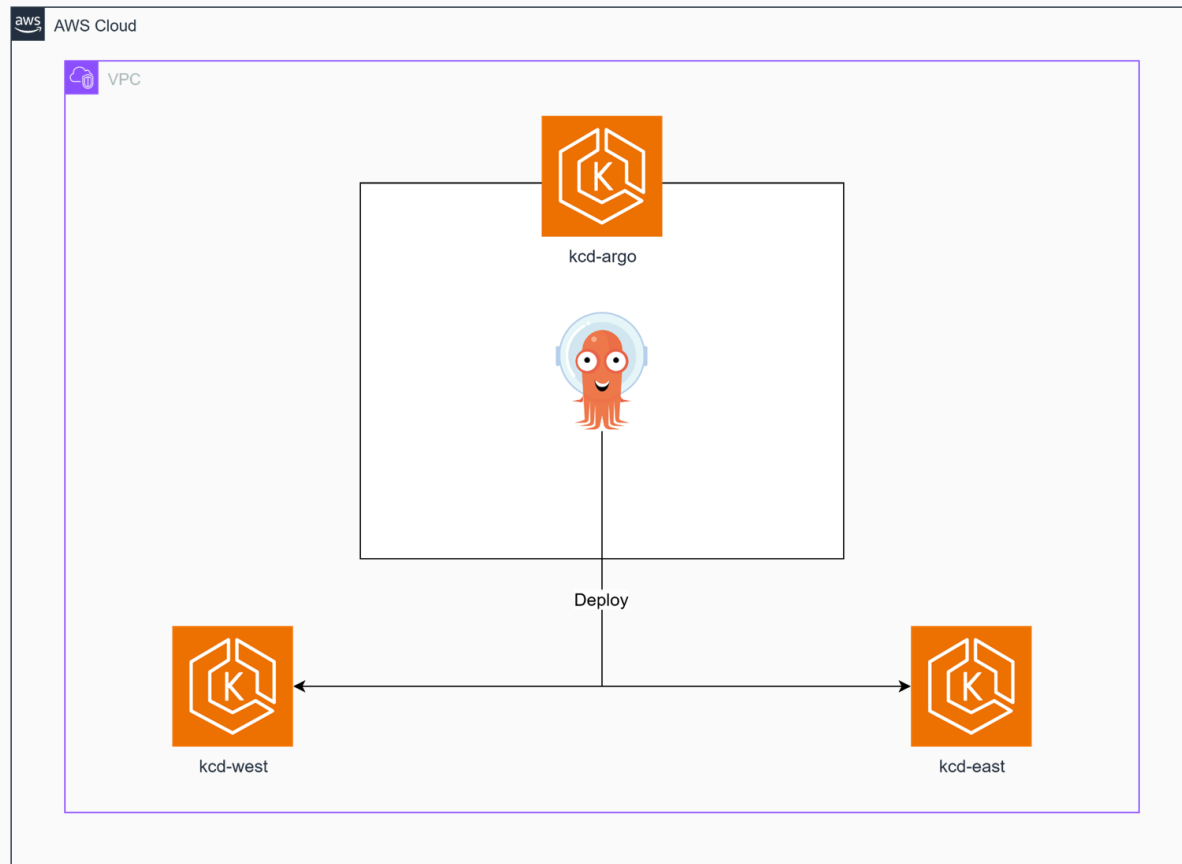
Namespa... kcd

Created At: 09/09/2025 01:22:41 (a minute ago)

Last Sync: 09/09/2025 01:22:42 (a minute ago)

 SYNC  REFRESH  DELETE

Demo 환경 소개



Demo

<https://github.com/KKamJi98/kcd-2025>

- **GitOps의 네 가지 핵심 원칙**
선언적 구성 · Git 버전관리 · 자동 Pull · 지속적 동기화
- **Argo CD 배포 과정**
Git 저장소 → Repo Server → Application Controller → 대상 클러스터
- **Application 선언적으로 구성**
YAML Manifest로 원하는 상태를 정의하고 GitOps로 관리
- **App of Apps Pattern**
Root Application으로 여러 애플리케이션을 그룹화, Sync Wave 및 Sync Hook을 통한 배포 순서 제어
- **ApplicationSet**
하나의 Manifest로 멀티 클러스터/멀티 앱 자동 생성 및 일관성 유지

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