Hands-on Crossplane with Argo CD: Multi-cloud Kubernetes Deployment

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Abstract:
Focuses on a practical assignment report detailing the utilization of Crossplane and Argo CD for multi-cloud Kubernetes deployment. Cover the integration of these tools to provision infrastructure across Azure, AWS, GCP, and YC while adhering to GitOps principles for continuous delivery.

Table of content:

1. Before start

- Kubernetes Cluster: Ensure you have a Kubernetes cluster deployed on your preferred cloud provider (Azure, AWS, GCP) or on-premises.
- CLI: Kubectl, helm
- Argo CD Installation:

`kubectl create namespace argocd`
`kubectl apply -n argocd -f` https://raw.githubusercontent.com/argoproj/argo-cd/stable/manifests/install.yaml

Install Crossplane in ArgoCD:

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: crossplane
  namespace: argocd
  finalizers: []
spec:
  destination:
    name: ''
    namespace: crossplane-system
    server: 'https://kubernetes.default.svc'
  source:
    path: ''
    repoURL: 'https://charts.crossplane.io/stable'
    targetRevision: 1.15.2
    chart: crossplane
  sources: []
  project: default
  syncPolicy:
    automated:
      prune: true
      selfHeal: true
    syncOptions:
      - CreateNamespace=true
```

Then manage it such as another ArgoCD app

2. Building Kubernetes Cluster on Azure:

2.1 Prerequisite

To authenticate with crossplane, you need to provide a secret which will allow you authenticate to Azure. To do that, you can authen via AzCli:

az ad sp create-for-rbac

--sdk-auth

--role Owner

--scopes <subscriptionId>

Then store it as a json file, for example `azure-credentials.json`

Then, create secrets with kubectl, this one will be used to mapping to ProviderRef later:
for example:
`kubectl create secret generic azure-secret -n crossplane-system --from-file=creds=azure-credentials.json`

Then, later you can create Provider config:

```
:
apiVersion: azure.upbound.io/v1beta1
kind: ProviderConfig
metadata:
  name: azure-provider
  annotations:
    argocd.argoproj.io/sync-wave: "2"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  credentials:
    source: Secret
    secretRef:
      namespace: crossplane-system
      name: azure-secrets
      key: creds
```

2.2 Configuration:

Provider:

```
apiVersion: pkg.crossplane.io/v1
kind: Provider
metadata:
  name: provider-azure-network
  annotations:
    argocd.argoproj.io/sync-wave: "0"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  package: xpkg.upbound.io/upbound/provider-azure-network:v0.42.1
```

And

```
apiVersion: pkg.crossplane.io/v1
kind: Provider
metadata:
  name: provider-azure-containerservice
  annotations:
    argocd.argoproj.io/sync-wave: "6"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  package: xpkg.upbound.io/upbound/provider-azure-containerservice:v1.0.1
```

Reference, read further:

https://marketplace.upbound.io/providers/upbound/provider-azure-network/v1.1.0

https://marketplace.upbound.io/providers/upbound/provider-azure-containerservice/v1.1.0

Application:

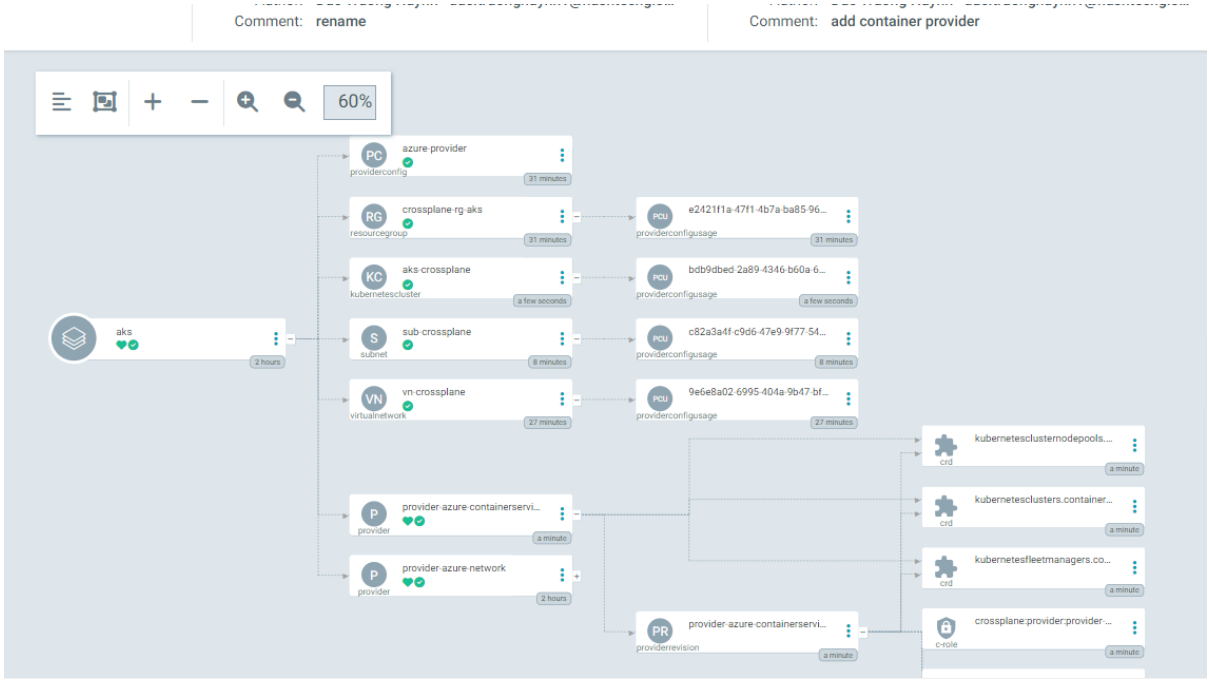
Reference to github: https://github.com/huynhduc0/argo-demo/tree/master/aks/crossplane

With application:

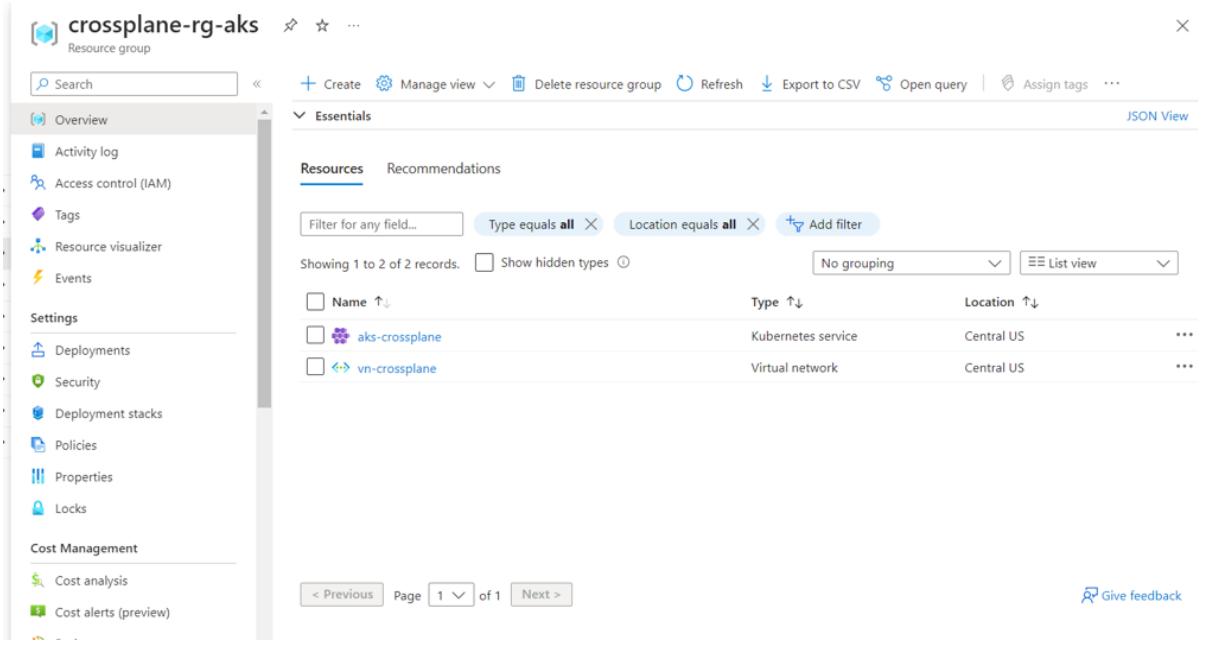
```yaml
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: aks
  namespace: argocd
spec:
  destination:
    name: ''
    namespace: dev
    server: 'https://kubernetes.default.svc'
  source:
    path: aks/crossplane
    repoURL: 'https://github.com/huynhduc0'
    targetRevision: HEAD
  sources: []
  project: default
  syncPolicy:
    automated:
      prune: true
      selfHeal: true
    syncOptions:
      - CreateNamespace=true
```

2.3 Result

After run, we can see our AKS infrastructure as application struct below:



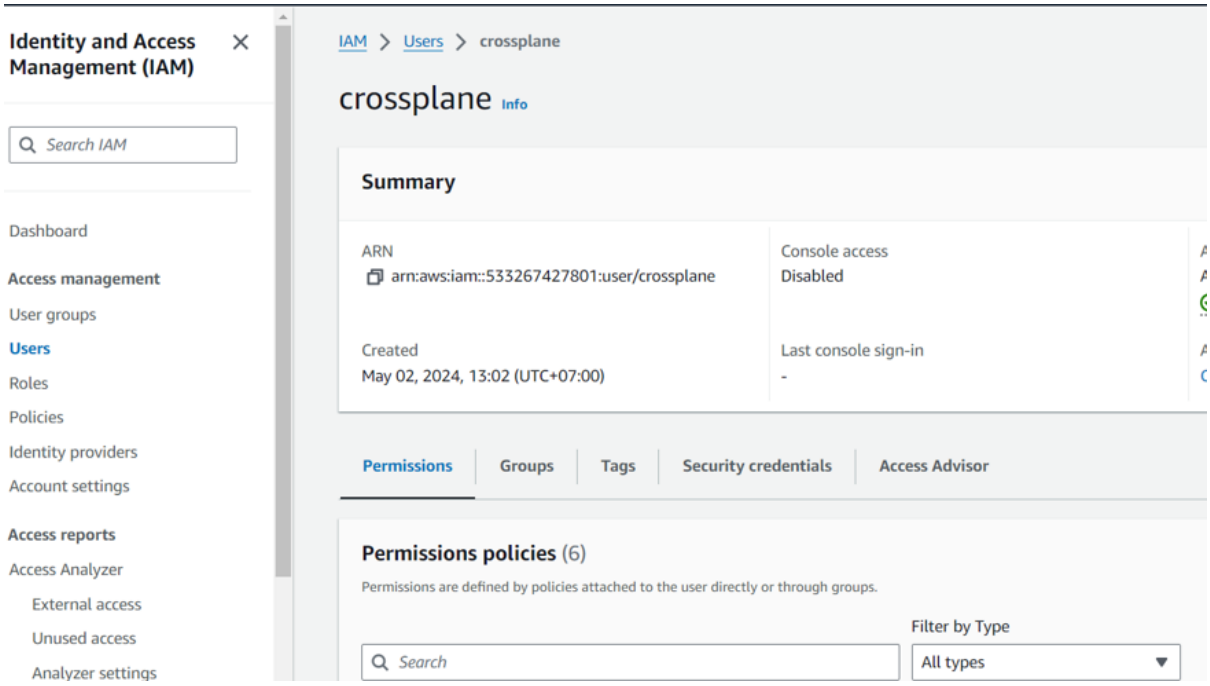
And Resource created on Azure:



2. Building Kubernetes Cluster on AWS:

2.1 Prerequisite

Same to Azure, we also need create a secrets, however, json format will not be use. Login to your AWS account and get AWS_ACCESS_KEY_ID and AWS_SECRET_ACCESS_KEY, grant nessesary permission such as EKS, VPC...



then create a file, such as `aws-credentials.txt`:
AWS_ACCESS_KEY_ID=<your key>

AWS_SECRET_ACCESS_KEY= <your key>
then, create with kubectl:

```
kubectl create secret generic aws-secret -n crossplane-system --from-file=creds=aws-credentials.txt
```

And your provider can be:

```yaml
apiVersion: aws.upbound.io/v1beta1
kind: ProviderConfig
metadata:
  name: aws-provider
  annotations:
    argocd.argoproj.io/sync-wave: "1"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  credentials:
    source: Secret
    secretRef:
      namespace: crossplane-system
      name: aws-creds
      key: creds
```

2.2 Configuration:

Provider needed, use also use another once for each service, or for all:

```yaml
apiVersion: pkg.crossplane.io/v1
kind: Configuration
metadata:
  name: configuration-aws-eks
  annotations:
    argocd.argoproj.io/sync-wave: "0"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  package: xpkg.upbound.io/upbound/configuration-aws-eks:v0.7.0
```

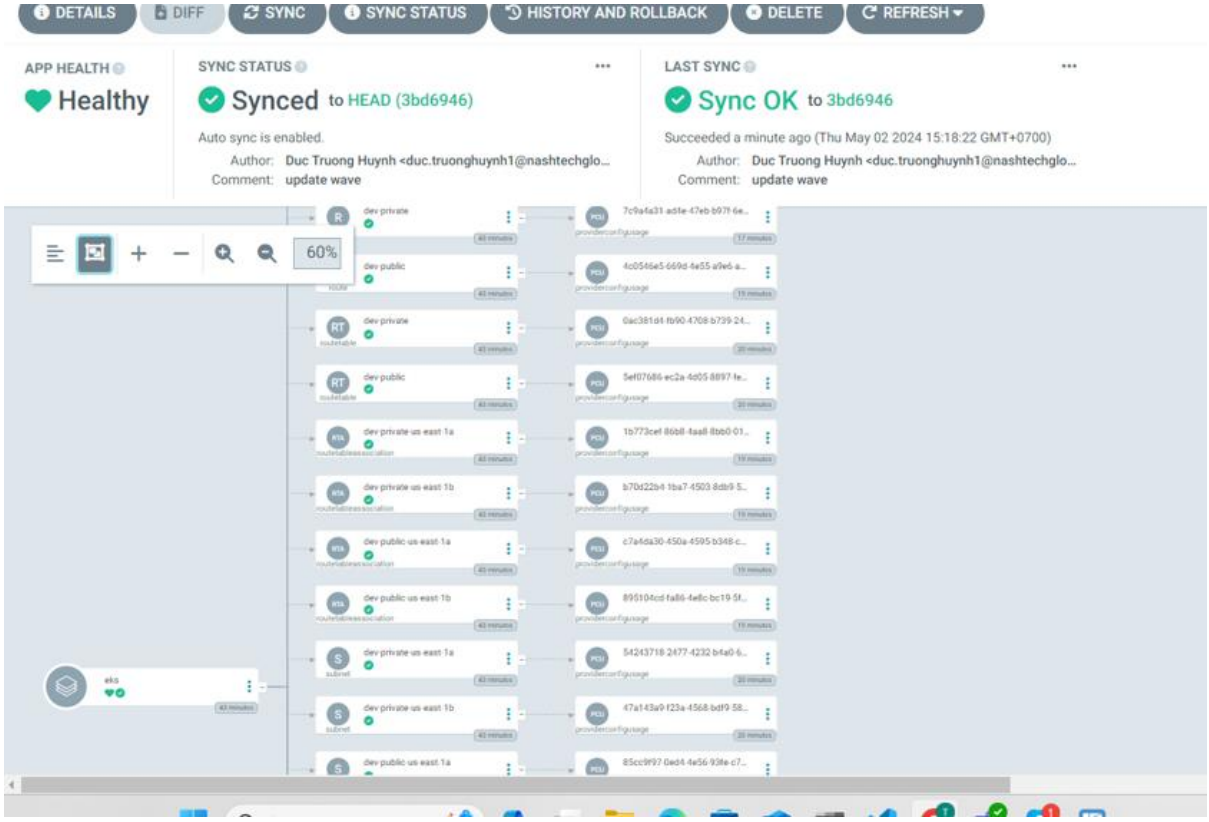
Reference to github: https://github.com/huynhduc0/argo-demo/tree/master/eks/crossplane

With application:

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: eks
  namespace: argocd
spec:
  destination:
    name: ''
    namespace: dev
    server: 'https://kubernetes.default.svc'
  source:
    path: eks/crossplane
    repoURL: 'https://github.com/huynhduc0'
    targetRevision: HEAD
  sources: []
  project: default
  syncPolicy:
    automated:
      prune: true
      selfHeal: false
    syncOptions:
      - CreateNamespace=true
```

2.3 Result

Then you can see infrastructure:

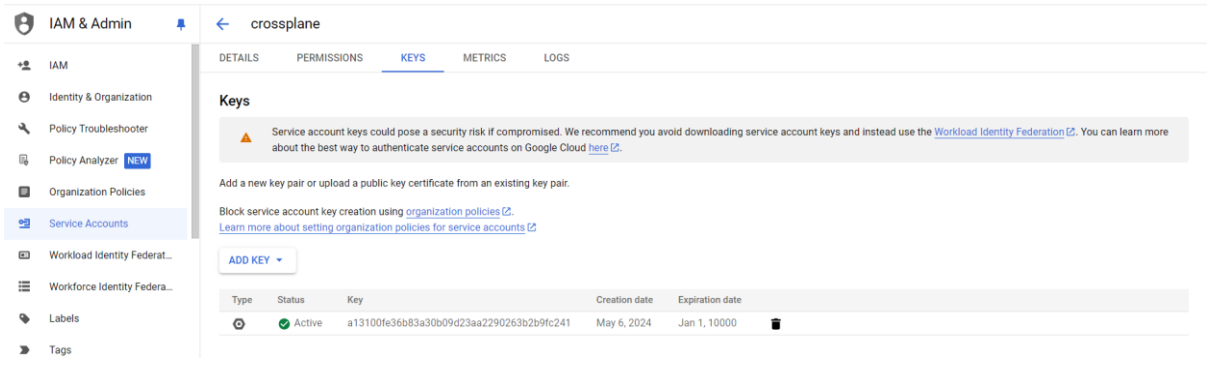


3. Building Kubernetes Cluster on GCP:

3.1 Prerequisite

Create a Service Accout with GKE permission,

Then create key and download secrets:



Then run:

```
kubectl create secret generic gcp-secret -n crossplane-system --from-file=creds=<downloaded file.json>
```

Then, later you can create Provider config:

```
:
apiVersion: gcp.upbound.io/v1beta1
kind: ProviderConfig
metadata:
  name: {{.Values.provider.name}}
  annotations:
    argocd.argoproj.io/sync-wave: "1"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  projectID: arcane-geode-422508-p4
  credentials:
    source: Secret
    secretRef:
      namespace: crossplane-system
      name: gcp-secret
      key: creds
```

3.2 Configuration:

Provider:

```
apiVersion: pkg.crossplane.io/v1
kind: Provider
metadata:
  annotations:
    argocd.argoproj.io/sync-wave: "0"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
  name: provider-gcp-compute
spec:
  package: xpkg.upbound.io/upbound/provider-gcp-compute:v1.1.0
---
apiVersion: pkg.crossplane.io/v1
kind: Provider
metadata:
  annotations:
    argocd.argoproj.io/sync-wave: "0"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
  name: provider-gcp-container
spec:
  package: xpkg.upbound.io/upbound/provider-gcp-container:v1.1.0
```

Reference, read further:

https://marketplace.upbound.io/providers/upbound/provider-gcp-compute/v1.1.0

https://marketplace.upbound.io/providers/upbound/provider-gcp-container/v1.1.0

Application:

Reference to github:

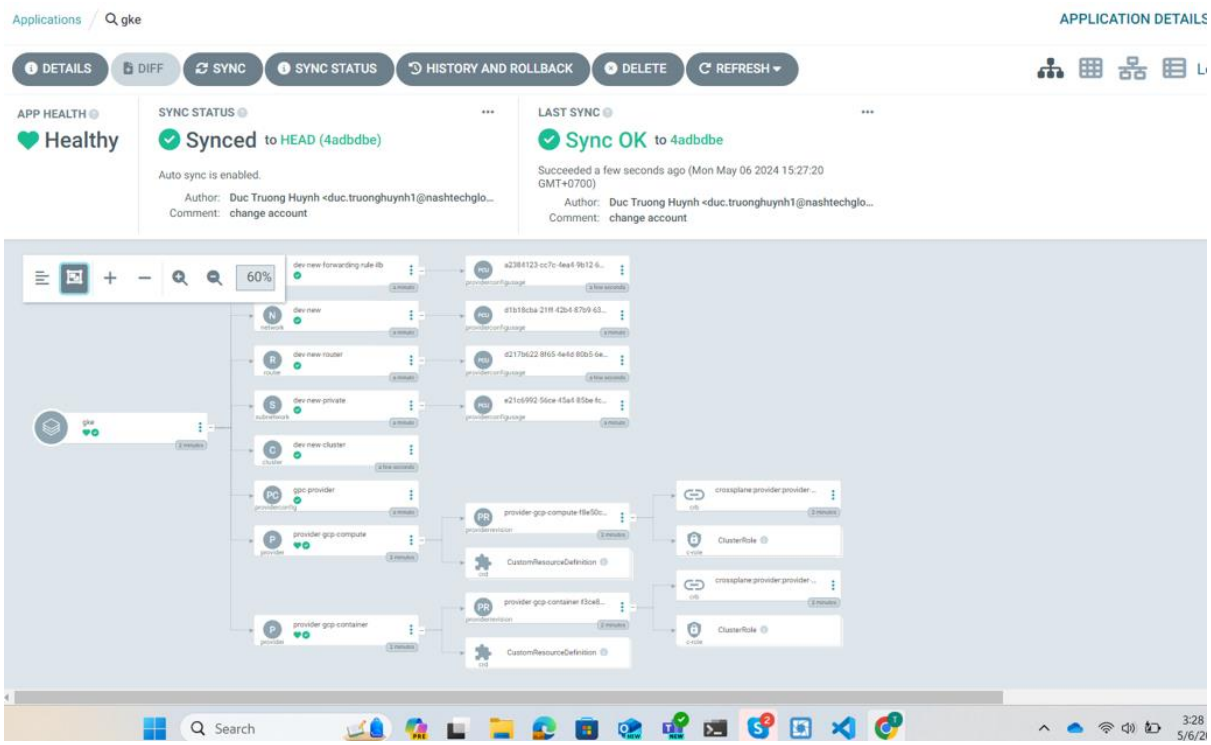
https://github.com/huynhduc0/argo-demo/tree/master/gke/crossplane

With application:

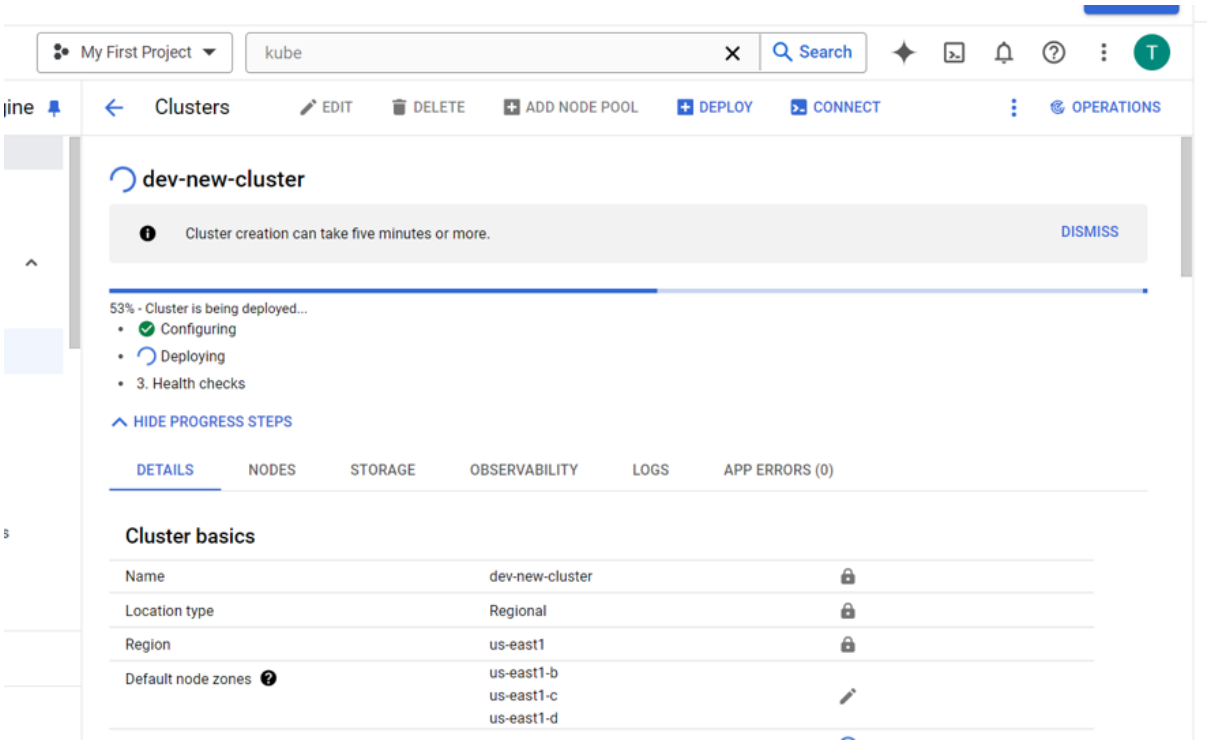
```yaml
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: gke
  namespace: argocd
spec:
  destination:
    name: ''
    namespace: dev3
    server: 'https://kubernetes.default.svc'
  source:
    path: gke/crossplane
    repoURL: 'https://github.com/huynhduc0/argo-demo/'
    targetRevision: HEAD
    helm:
      valueFiles:
        - values.yaml
  sources: []
  project: default
  syncPolicy:
    automated:
      prune: true
      selfHeal: true
    syncOptions:
      - CreateNamespace=true
```

3.3 Result:

Then you can see infrastructure:



And on Google Cloud Console:

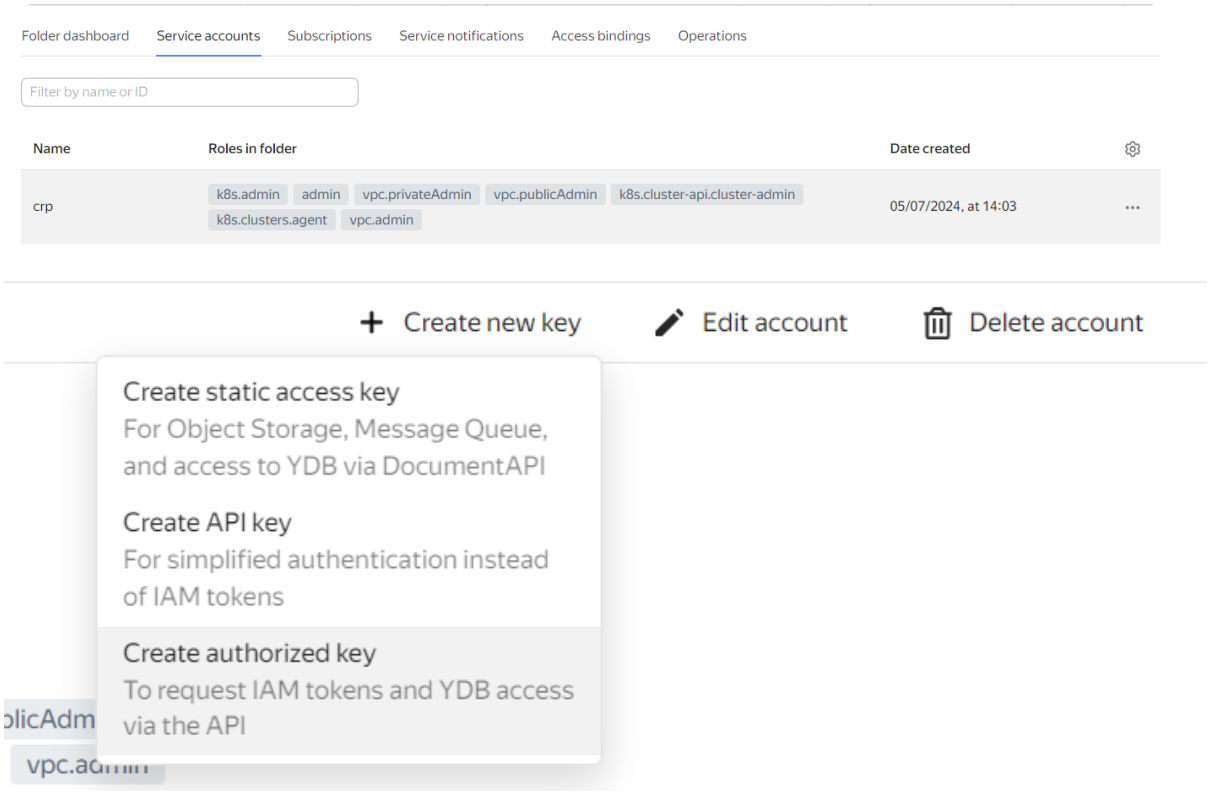


4. Building Kubernetes Cluster on YC:

4.1 Prerequisite

Create a Service Account with MKS (Manage Kubenertes Service) permission,

Then create key and download secrets:



Then run:

```
kubectl create secret generic yc-secret -n crossplane-system --from-file=creds=<downloaded file.json>
```

Then, later you can create Provider config:

```
:
apiVersion: yandex-cloud.upjet.crossplane.io/v1beta1
kind: ProviderConfig
metadata:
  name: yc-provider
  annotations:
    argocd.argoproj.io/sync-wave: "1"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
spec:
  credentials:
    source: Secret
    secretRef:
      namespace: crossplane-system
      name: yc-secret
      key: creds
```

4.2 Configuration:

Provider:

```yaml
apiVersion: pkg.crossplane.io/v1
kind: Provider
metadata:
  annotations:
    argocd.argoproj.io/sync-wave: "0"
    argocd.argoproj.io/sync-options: "SkipDryRunOnMissingResource=true"
  name: provider-upjet-yc
spec:
  package: xpkg.upbound.io/tages/provider-upjet-yc:v1.1.0
```

Reference, read further:

https://marketplace.upbound.io/providers/tages/provider-upjet-yc/v1.1.0

Application:

Reference to github:

https://github.com/huynhduc0/argo-demo/tree/master/yck/crossplane

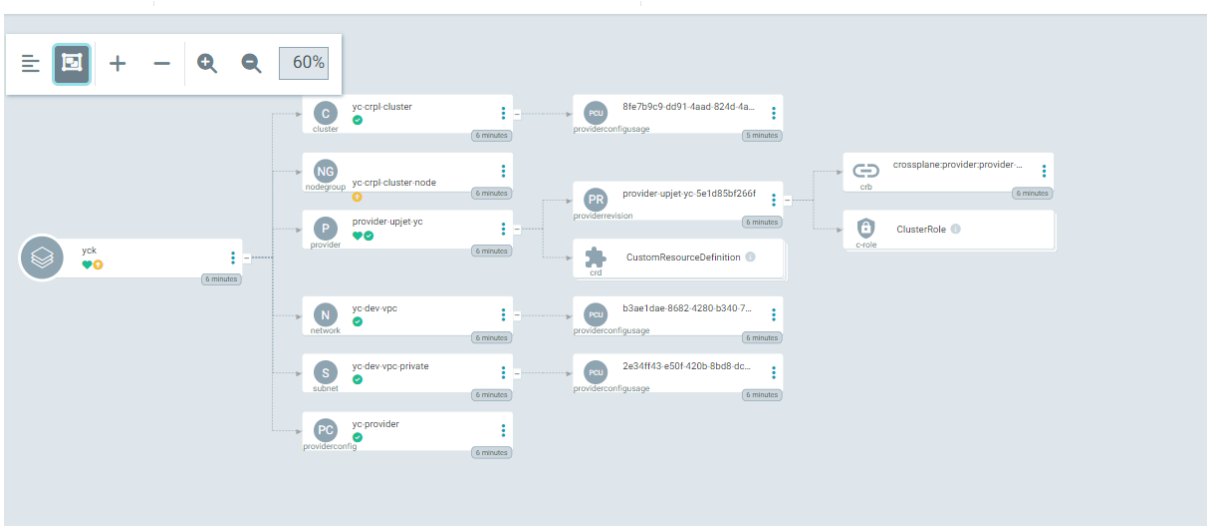
With application:

```yaml
apiVersion: argoproj.io/v1alpha1
kind: Application
metadata:
  name: yck
  namespace: argocd
spec:
  destination:
    name: ''
    namespace: dev3
    server: 'https://kubernetes.default.svc'
  source:
    path: yck/crossplane
    repoURL: 'https://github.com/huynhduc0/argo-demo/'
    targetRevision: HEAD
    helm:
      valueFiles:
        - values.yaml
  sources: []
  project: default
  syncPolicy:
```

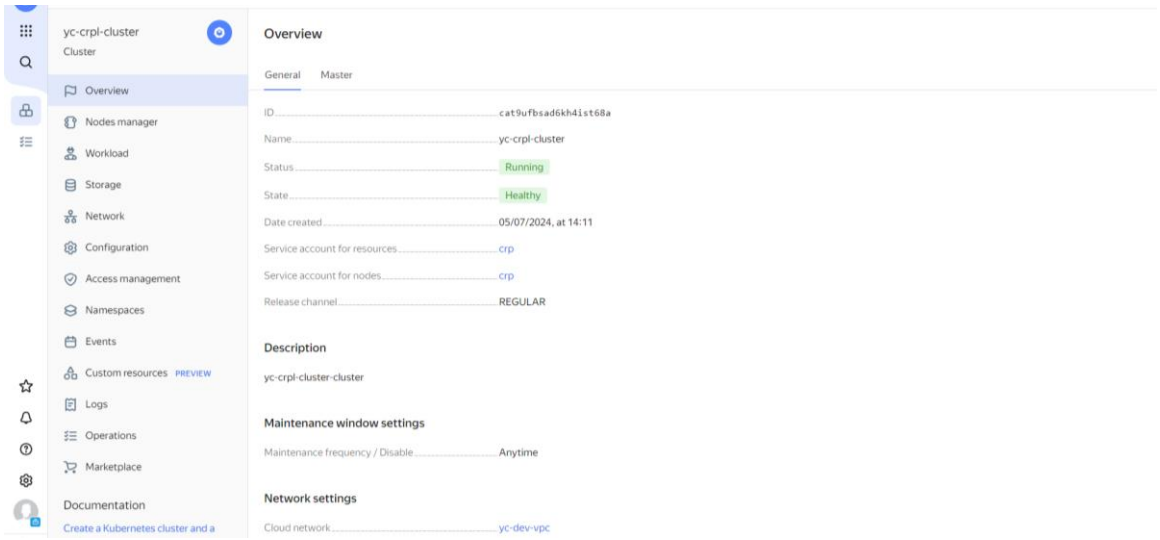
```
    automated:
      prune: true
      selfHeal: true
    syncOptions:
      - CreateNamespace=true
```

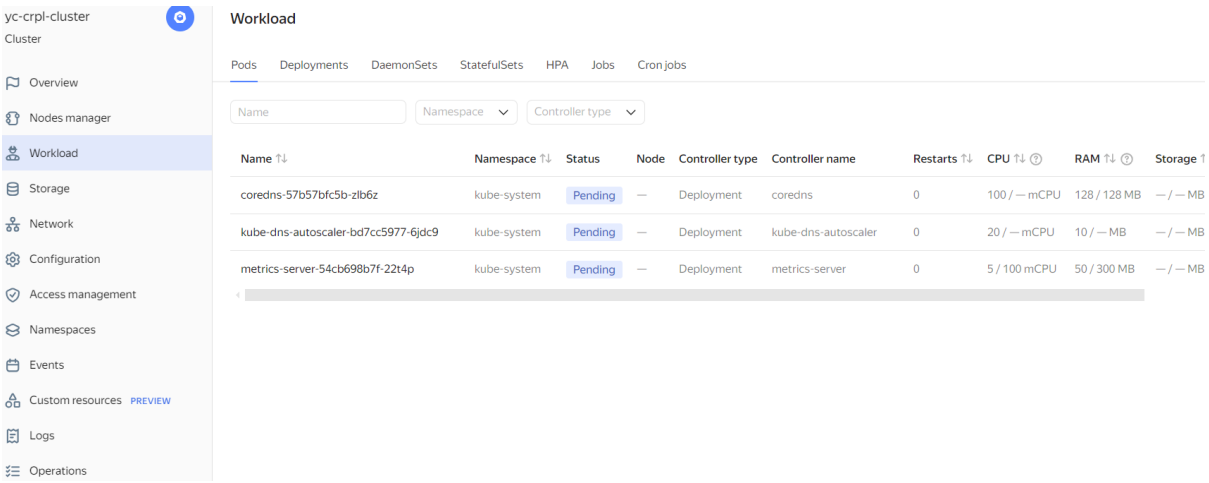
4.3 Result:

Then you can see infrastructure:



And on Yandex Cloud Console:




yc-crpl-cluster
Cluster
Overview
Nodes manager
Workload
Storage
Network
Configuration
Access management
Namespaces
Events
Custom resources
PREVIEW
Logs
Operations
Workload
Pods
Deployments
DaemonSets
StatefulSets
HPA
Jobs
Cron jobs
Name
Namespace
Controller type
Name
Namespace
Status
Node
Controller type
Controller name
Restarts
CPU
RAM
Storage
coredns-57b57bfc5b-zlb6z
kube-system
Pending
—
Deployment
coredns
0
100 / — mCPU
128 / 128 MB
— / — MB
kube-dns-autoscaler-bd7cc5977-6jdc9
kube-system
Pending
—
Deployment
kube-dns-autoscaler
0
20 / — mCPU
10 / — MB
— / — MB
metrics-server-54cb698b7f-22t4p
kube-system
Pending
—
Deployment
metrics-server
0
5 / 100 mCPU
50 / 300 MB
— / — MB

FIN.