Mobility of Virtual Machines in Kubernetes clusters

Cross-Cluster Live Migration and **Storage** Live Migration

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Let's talk

- Storage Live Migration

- Cross-Cluster Live Migration

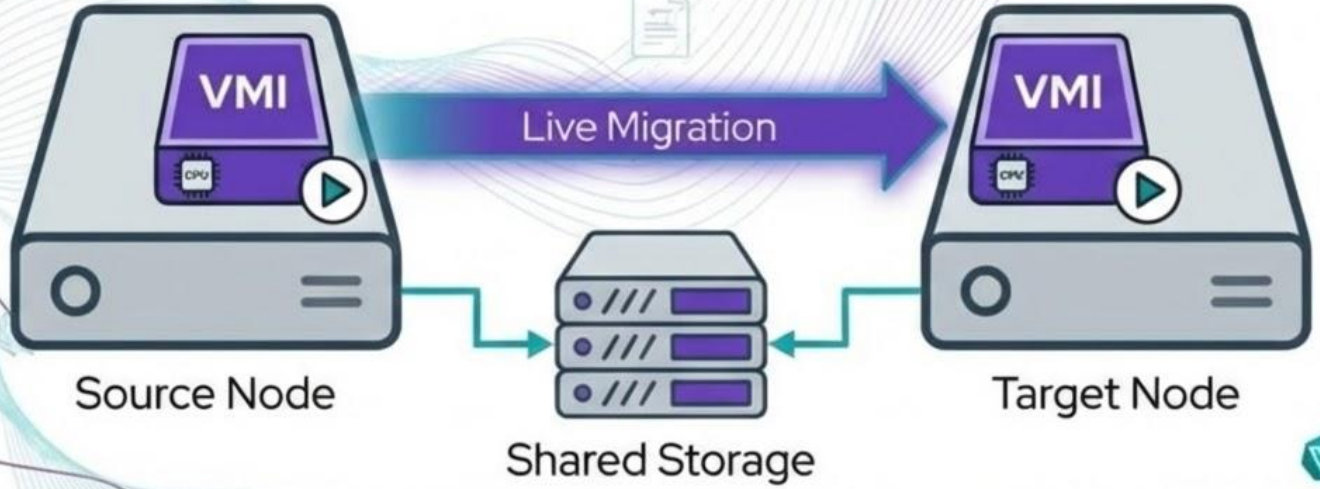
- "Why" and "how"
- Features, requirements, limitations
- Demo

KubeVirt

Compute Live Migration

VM remains **Running**

while VMI moves to another node



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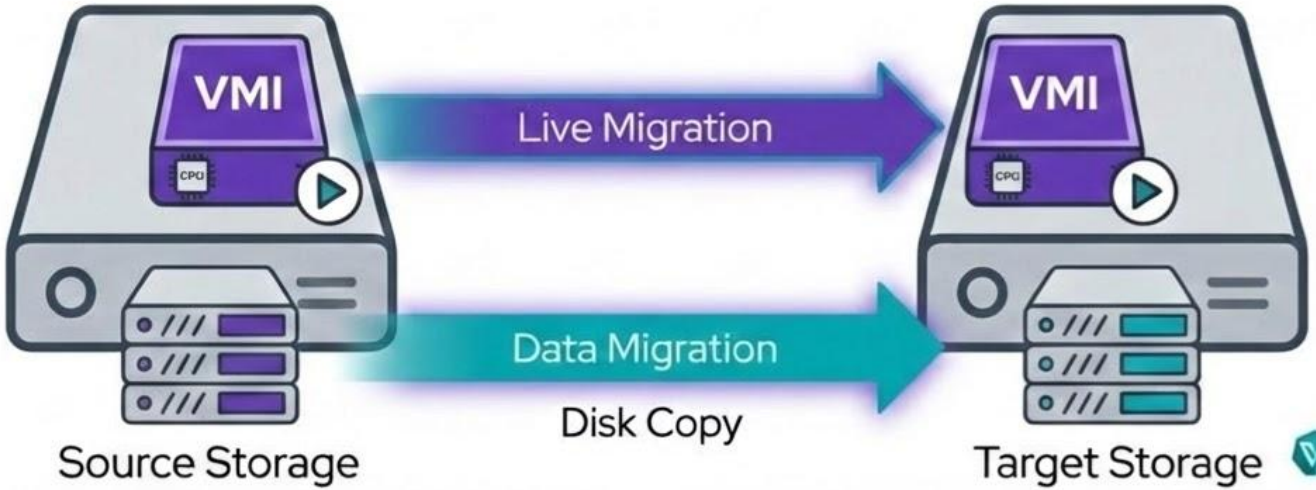
Storage Live Migration

VM remains **Running**

VMI and disk data moves



Features

Storage Live Migration

- **ReadWriteOnce** included!
  - any **access mode** + **volume mode** combination
  - RWO | RWX, Block | Filesystem

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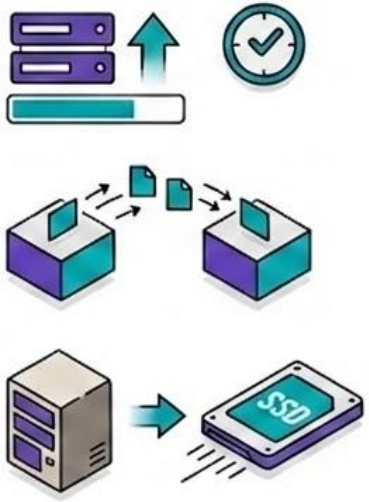
The "why"

- Upgrade infrastructure with no downtime
- Rebalancing storage
- Adopting new storage classes



Storage Live Migration: try it!

- User guide: https://kubevirt.io/user-guide/storage/volume_migration
- Add to the KubeVirt CR:

```yaml
apiVersion: kubevirt.io/v1
kind: KubeVirt
spec:
  configuration:
    vmRolloutStrategy: LiveUpdate
  workloadUpdateStrategy:
    workloadUpdateMethods:
    - LiveMigrate
```

- Create destination DataVolume with
  - `spec.source.blank: {}`
  - `spec.storageClassName: <new_storage_class>`
- Watch VirtualMachineInstanceMigration
- Update VM spec

```
 apiVersion: kubevirt.io/v1
 kind: VirtualMachine
     kubevirt.io/vm: vm-dv
   name: vm-dv
 spec:
+  updateVolumesStrategy: Migration
   dataVolumeTemplates:
   - metadata:
-      name: src-pvc
+      name: dst-dv

       volumes:
       - dataVolume:
-          name: src-pvc
+          name: dst-dv
         name: datavolumedisk1
```

Storage Live Migration

Bulk VM Migration Orchestrator

- Available in kubevirt!

kubevirt/kubevirt-migration-controller

kubevirt/kubevirt-migration-operator

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Bulk VM migration orchestrator

- Create a MigrationPlan

```
apiVersion: migrations.kubevirt.io/v1alpha1
kind: MultiNamespaceVirtualMachineStorageMigrationPlan
metadata:
  name: multi-mig-plan
spec:
  namespaces:
  - name: default
    virtualMachines:
    - name: vm-fedora-datavolume
      targetMigrationPVCs:
      - volumeName: datavolumedisk1
        destinationPVC: {}
    - name: testvmi-w57rg
      targetMigrationPVCs:
      - volumeName: disk0
        destinationPVC:
          name: dv-alpine
```

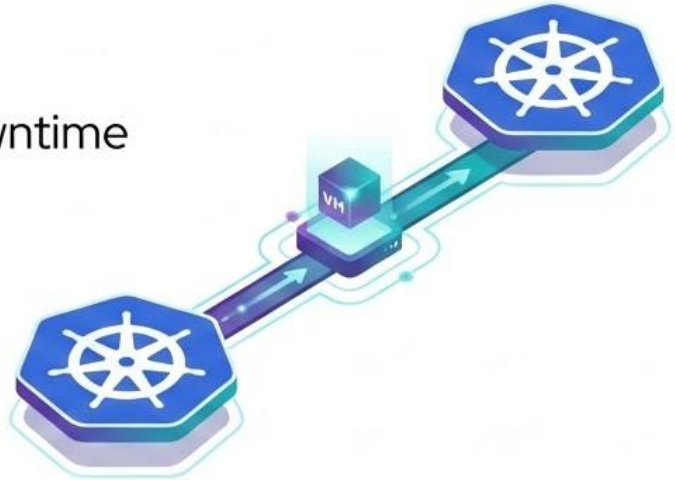
- Create a Migration

```
apiVersion: migrations.kubevirt.io/v1alpha1
kind: MultiNamespaceVirtualMachineStorageMigration
metadata:
  name: multi-mig-migration
spec:
  multiNamespaceVirtualMachineStorageMigrationPlanRef:
    name: "multi-mig-plan"
```

Cross-Cluster Live Migration

The “why”

- Upgrade infrastructure with no downtime
- Load balancing
- Maintenance operations
- Infrastructure consolidation



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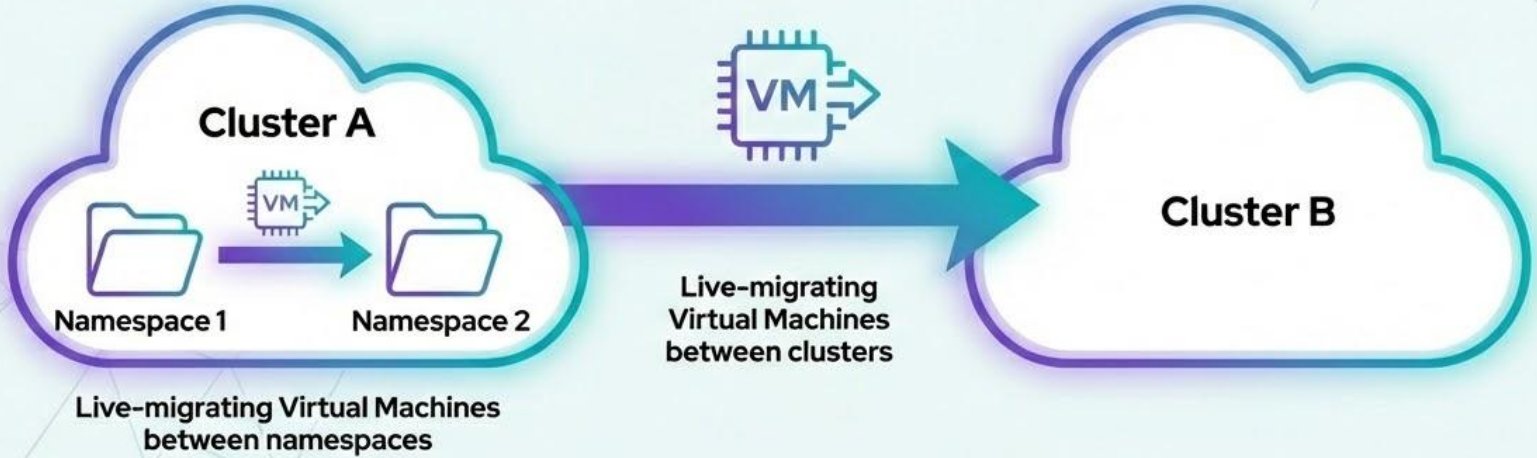
Cross-Cluster Live Migration

Variation of **Storage** Live Migration



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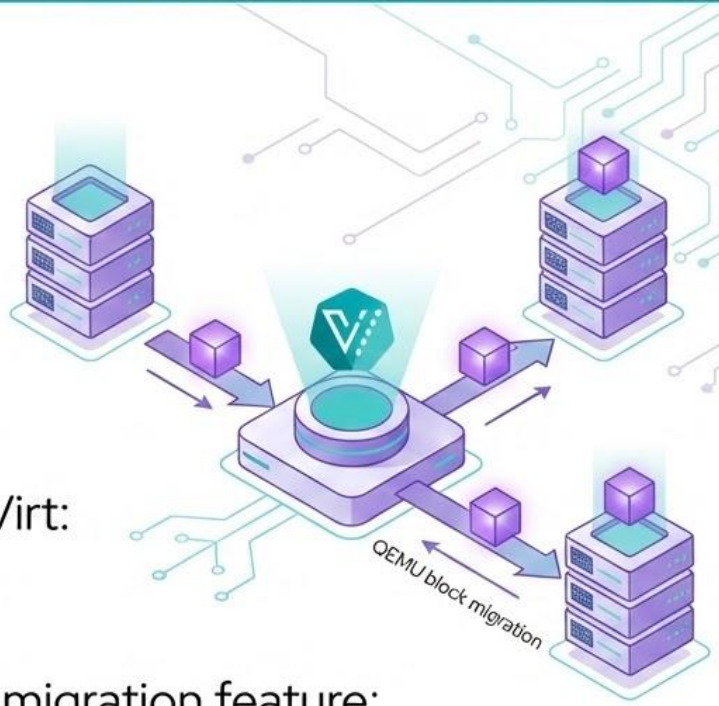
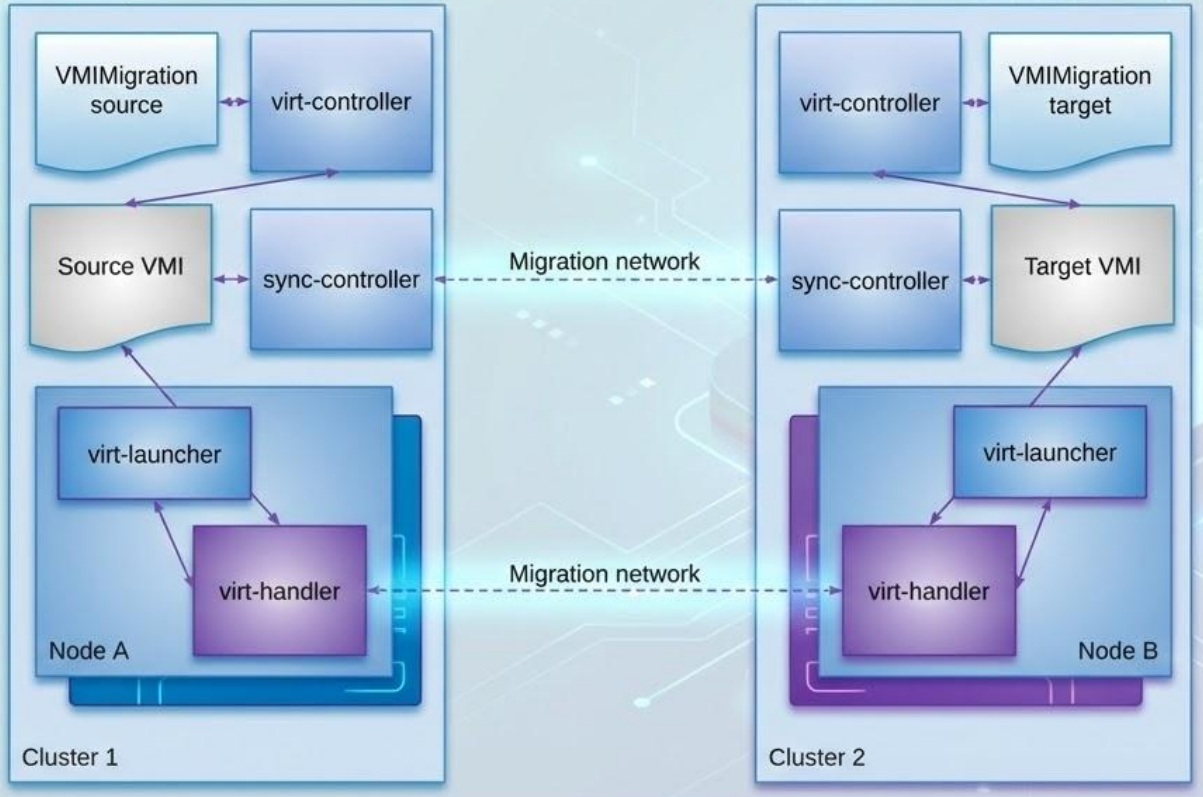
The “how”



- Orchestrated by libvirt and KubeVirt: https://libvirt.org/migration.html
- Migration through QEMU's block migration feature: https://www.qemu.org/docs/master/devel/migration

Cross-Cluster Live Migration: try it!

- **Decentralized Live Migration:**
  - two VirtualMachineInstances
  - two VirtualMachineInstanceMigrations



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Cross-Cluster Live Migration: try it!

- User guide: https://kubevirt.io/user-guide/compute/decentralized_live_migration

- In both clusters in KubeVirt CR:
  - activate **DecentralizedLiveMigration** featureGate
  - set spec.configuration.migrations.network

```
spec:
  certificateRotateStrategy: {}
  configuration:
    developerConfiguration:
      featureGates:
      - DecentralizedLiveMigration
    migrations:
      network: migration-evpn
```

- Wait for virt-synch pods:

```
virt-synchronization-controller-784d9fd5f9-tfhnz   1/1   Running   0   43s
virt-synchronization-controller-784d9fd5f9-x6rkb   1/1   Running   0   43s
```

- Wait for virt-handler pods to get updated

Cross-Cluster Live Migration: try it!

- Create **target** VirtualMachine
  - Copy source VM spec
  - Replace network, disk(s), etc. to match the target
  - Set `runStrategy: WaitAsReceiver`
  - Add annotation: `kubevirt.io/restore-run-strategy: Always`
    - [Always / RerunOnFailure / Manual]

Cross-Cluster Live Migration: try it!

- Create **target** VirtualMachineInstanceMigration

```
apiVersion: kubevirt.io/v1
kind: VirtualMachineInstanceMigration
metadata:
  name: example-target-migration
  namespace: <same namespace as target vm>
spec:
  receive:
    migrationID: <unique identifier>
  vmiName: <name of the vmi that is created from target vm>
```

Cross-Cluster Live Migration: try it!

- Create **source** VirtualMachineInstanceMigration

```yaml
apiVersion: kubevirt.io/v1
kind: VirtualMachineInstanceMigration
metadata:
  name: example-source-migration
spec:
  sendTo:
    connectURL: "<synchronization address>"
    migrationID: <unique identifier, same as target migration resource migrationID>
  vmiName: <name of the source vmi>
```

Get **connectURL** from KubeVirt CR **status.synchronizationAddresses** or
After **target VMIM** created, its status will contain a **synchronizationAddresses** field

Cross-Cluster Live Migration

Requirements

Clusters connected via L2 or L3 network

Synchronization controllers and virt-handler pods should be able to communicate

Compatible node architectures

The target cluster/namespace must have all resources for the VM to operate (Secrets, ConfigMaps etc.)

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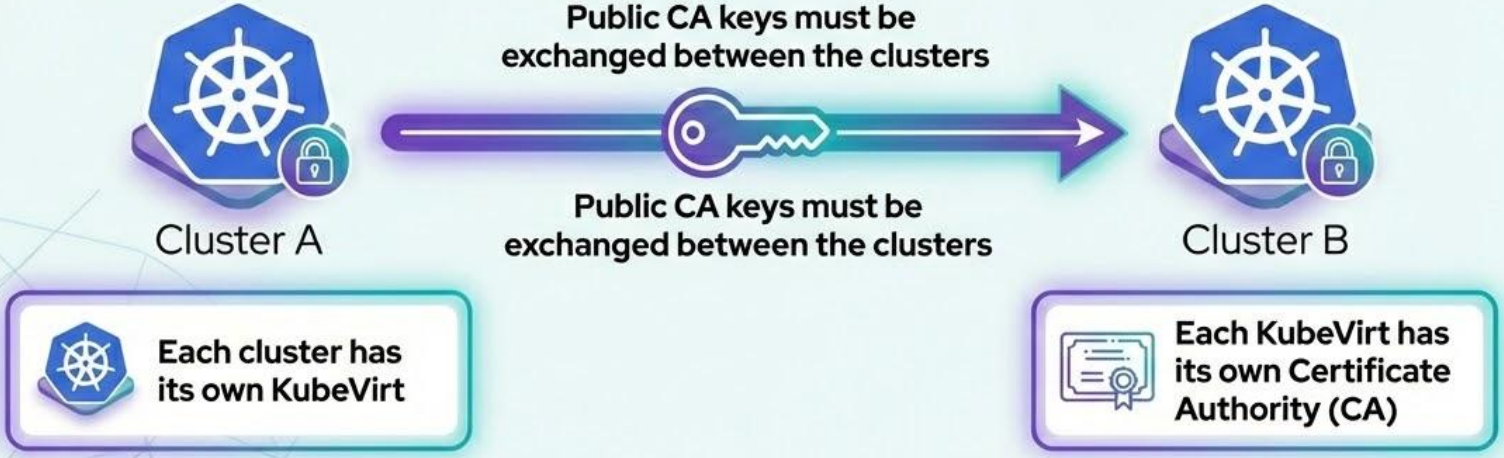
Configuring KubeVirt CA



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Limitations

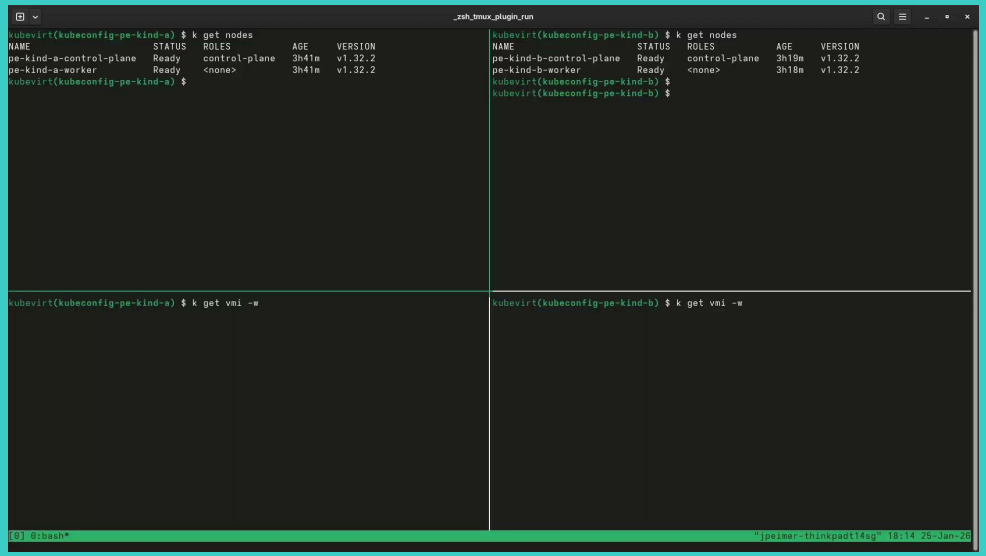
Shareable disks are not supported

filesystems devices (`vm.spec.domain.devices.filesystems`) are not supported, as virtio-fs does not currently support live migration

LUN disks are not supported

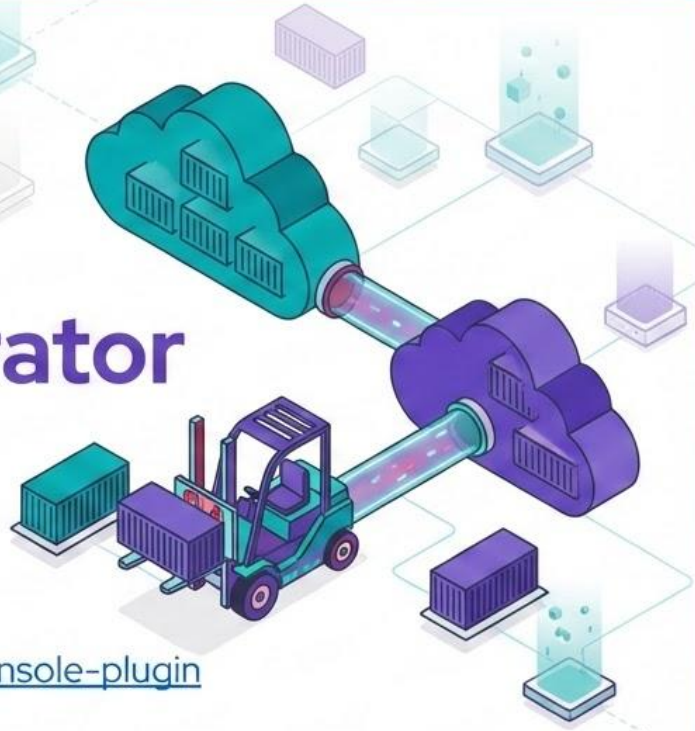
Mobility of Virtual Machines in Kubernetes clusters

Demo



Cross-Cluster Live Migration

Bulk CCLM Orchestrator



- Available and open-sourced
  - https://github.com/kubev2v/forklift
  - UI: https://github.com/kubev2v/forklift-console-plugin

KubeVirt

Mobility of Virtual Machines in Kubernetes clusters

Credits:

Storage Live Migration:
Alice Frosi, Alexander Wels, Alex Kalenyuk

Cross-cluster Live Migration:
Alexander Wels, Sam Lucidi

\+ KubeVirt community 💜

Thanks for help with Demo setup:
Miguel Duarte (OpenPERouter)

Thank you

Join us:

https://kubevirt.io