KNF Orchestration: Kubernetes Functions, Helm and Juju Bundles

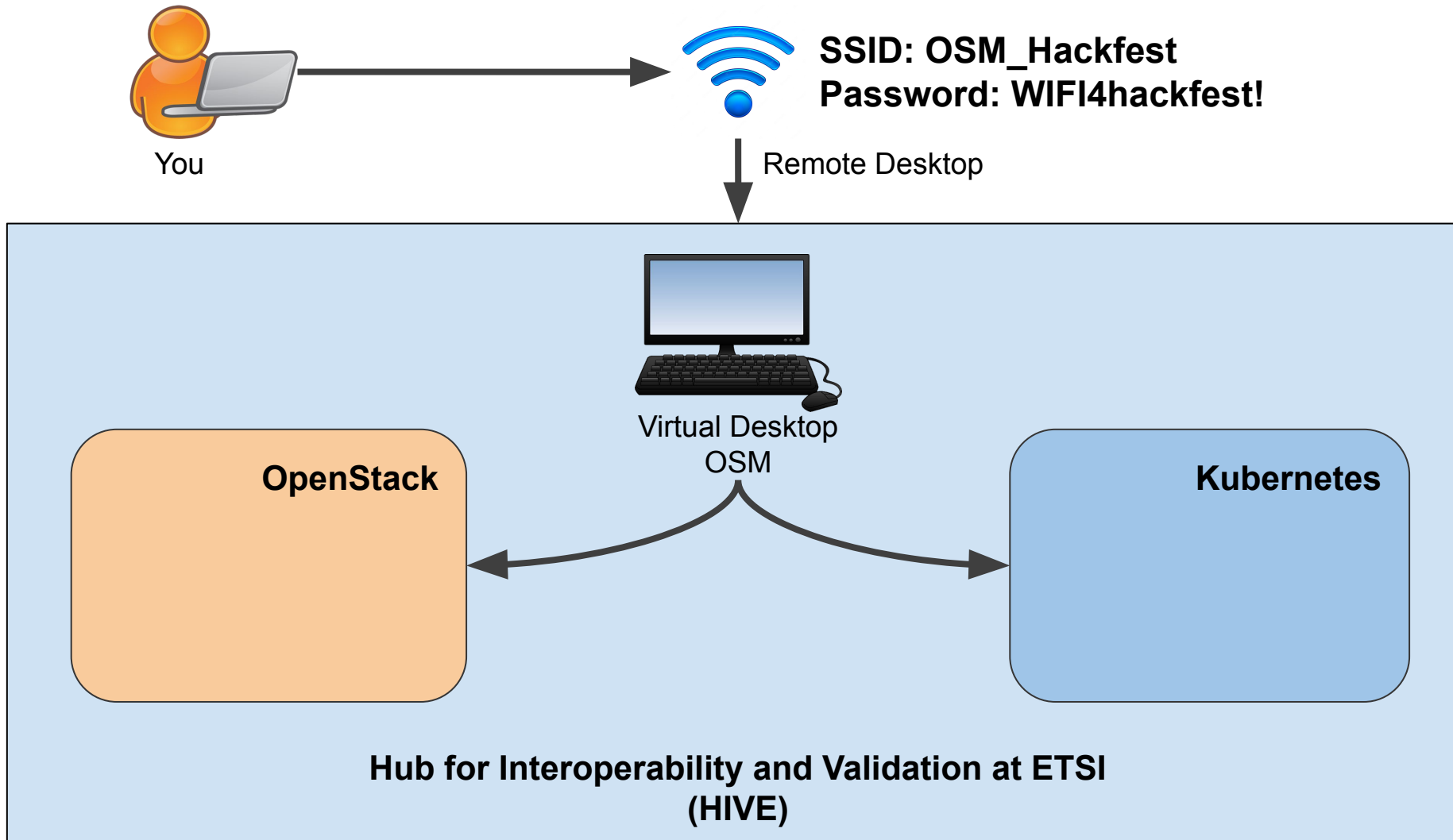Gülsüm Atıcı (Canonical, OSM RO MDL)

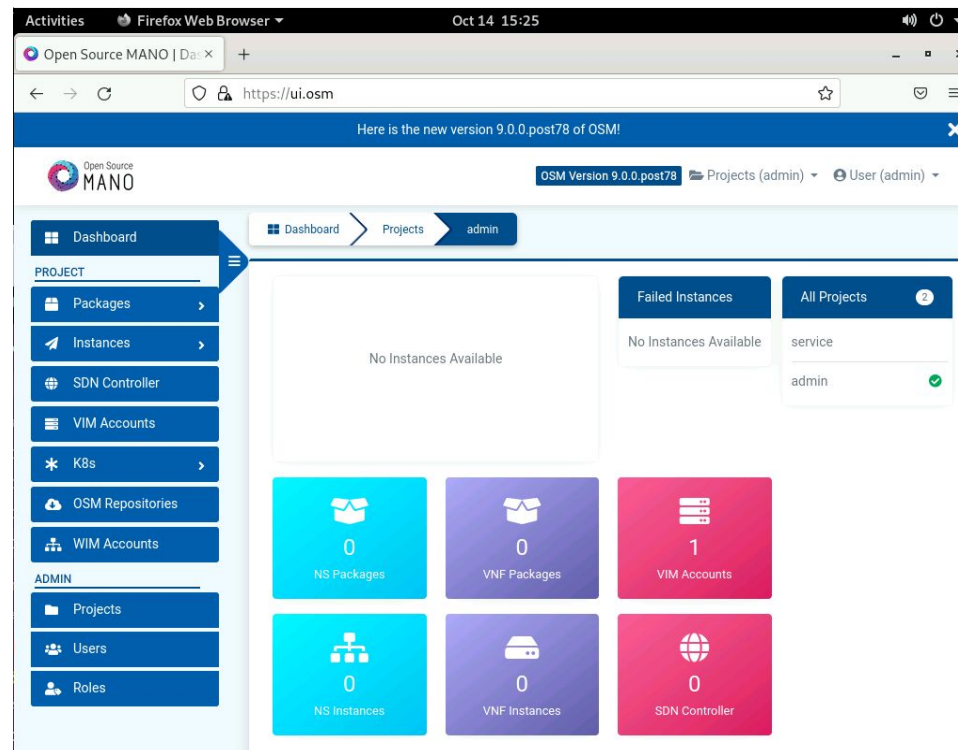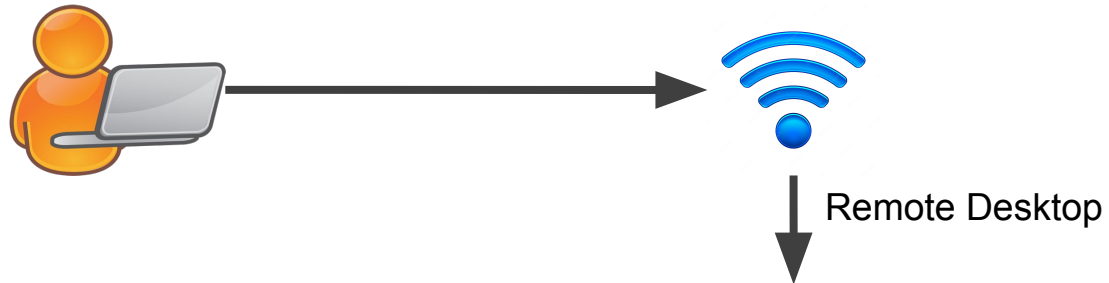October 19, 2022

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Welcome to the Hackfest

Agenda

- Hackfest Environment

- OSM Overview

- Use Case: Magma Orchestration

- Hands On Session: Deployment of Network Services

- Kubernetes Functions

- Hands On Session: Running Day 2 Actions

Hackfest Environment

You

SSID: OSM_Hackfest
Password: WIFI4hackfest!

Remote Desktop

Virtual Desktop
OSM

OpenStack

Kubernetes

**Hub for Interoperability and Validation at ETSI
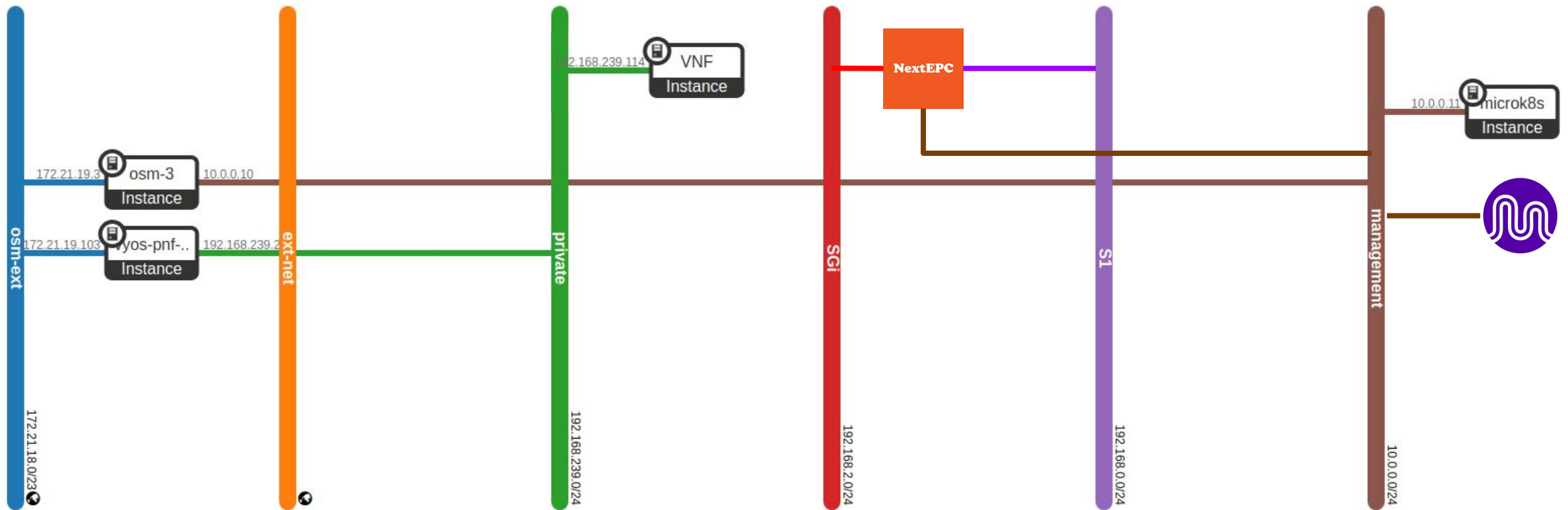(HIVE)**

Logging Into OSM

Remote Desktop

firefox https://ui.osm

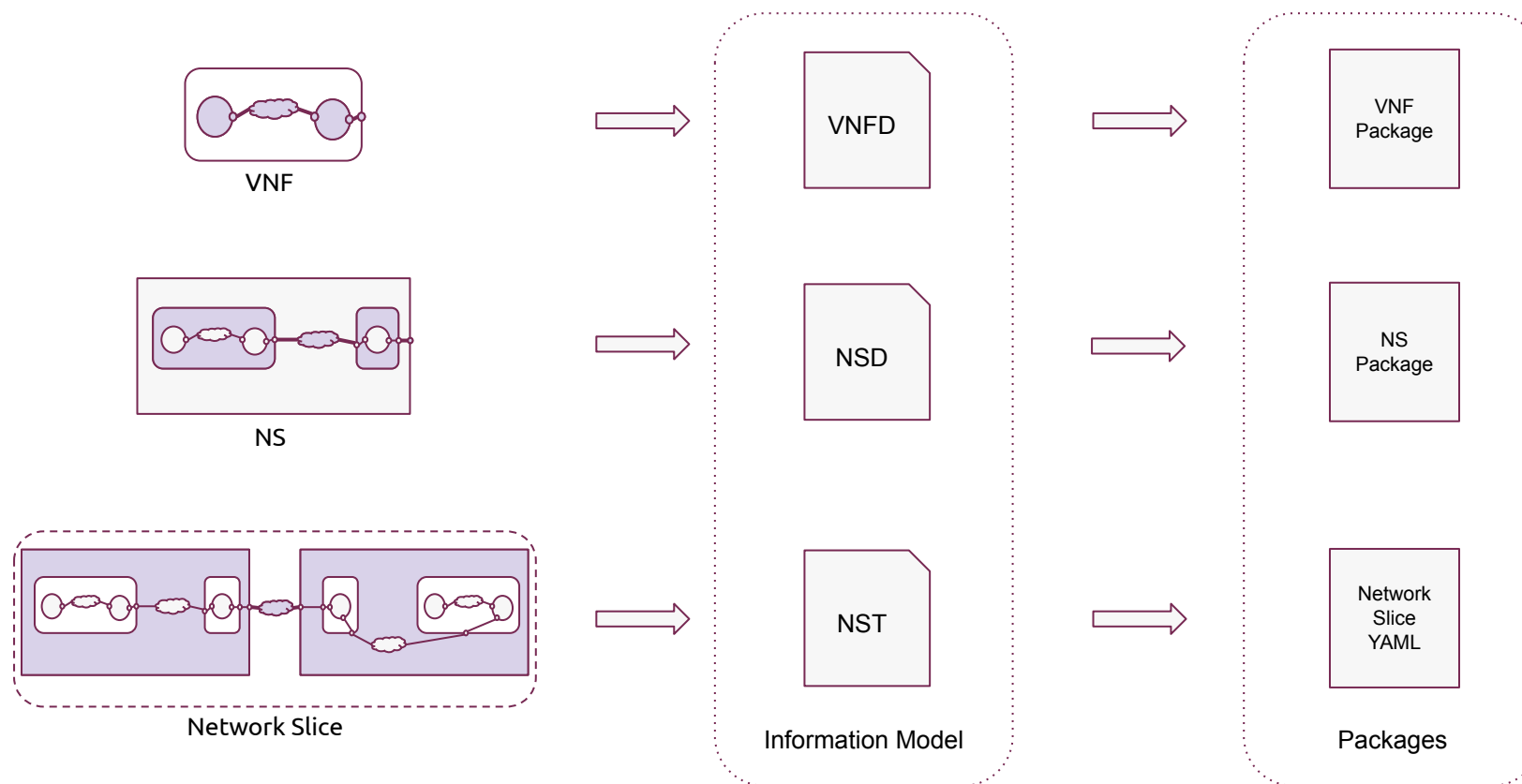Username: admin
Password: hackfest

Your Openstack Tenant

OSM Overview

OSM Concepts

- VNF/PNF/KNF

- VNFd, NSd

- Network Service

OSM Concepts: Information Model & Packages

OSM IM reference link: https://osm.etsi.org/docs/user-guide/latest/11-osm-im.html
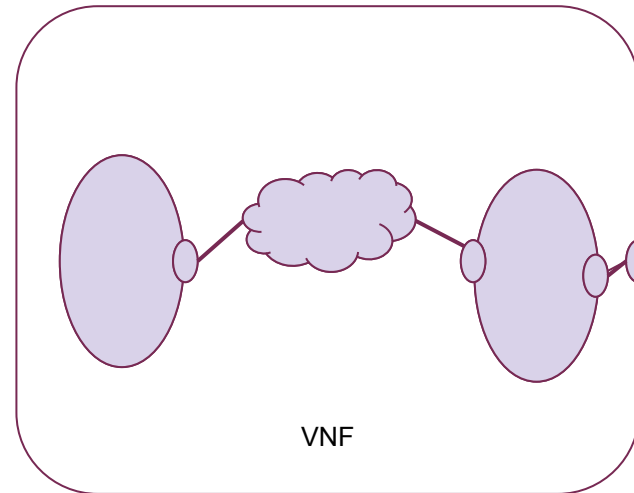
OSM Concepts: VNF

Virtual Network Function

- One or more Deployment Units

- Internal networks

- Internal connection points (interfaces)

- Mapping VDU connections to the networks

- External connection points

VDU: Virtual Deployment Unit
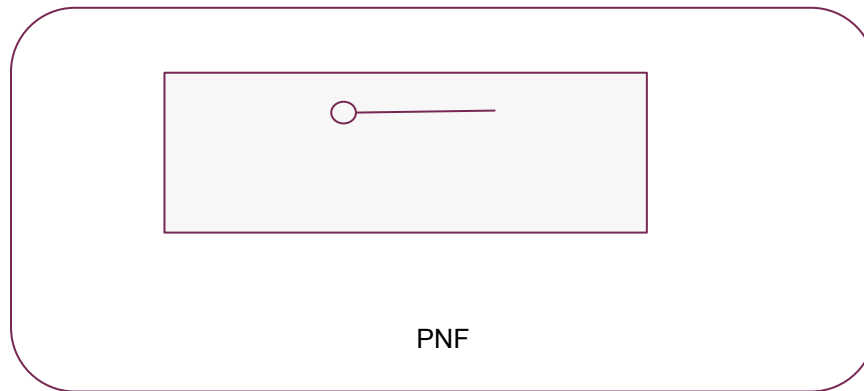
- Virtual Machines

- OSM models vCPUs, RAM, Storage, Interfaces, Performance Capabilities (SR-IOV, EPA)

VNF

OSM Concepts: PNF

Physical Network Function

- Models an already existing physical application.

- It uses the same concepts as the VNF

PDU: Physical Deployment Unit

- Already existing application

- No control over the Lifecycle

- Perform operations on it

PNF

OSM Concepts: KNF

Kubernetes Network Function

Composed of one or more KDUs and the connection points to communicate with other

KNFs/VNFs/PNFs.

Specify the networks that need to be already present in the K8s cluster.

KDU: Kubernetes Deployment Unit

- Kubernetes applications

- A KDU represents a Helm Chart or a Juju Bundle

KNF

OSM Concepts: VNFd

Metadata ← DECLARATIVE

Operations Package - "Charm"

- Lifecycle
- Configuration
- Operation
- Integration

← CODE

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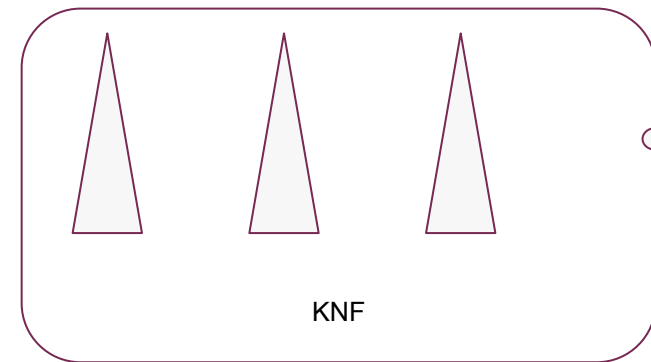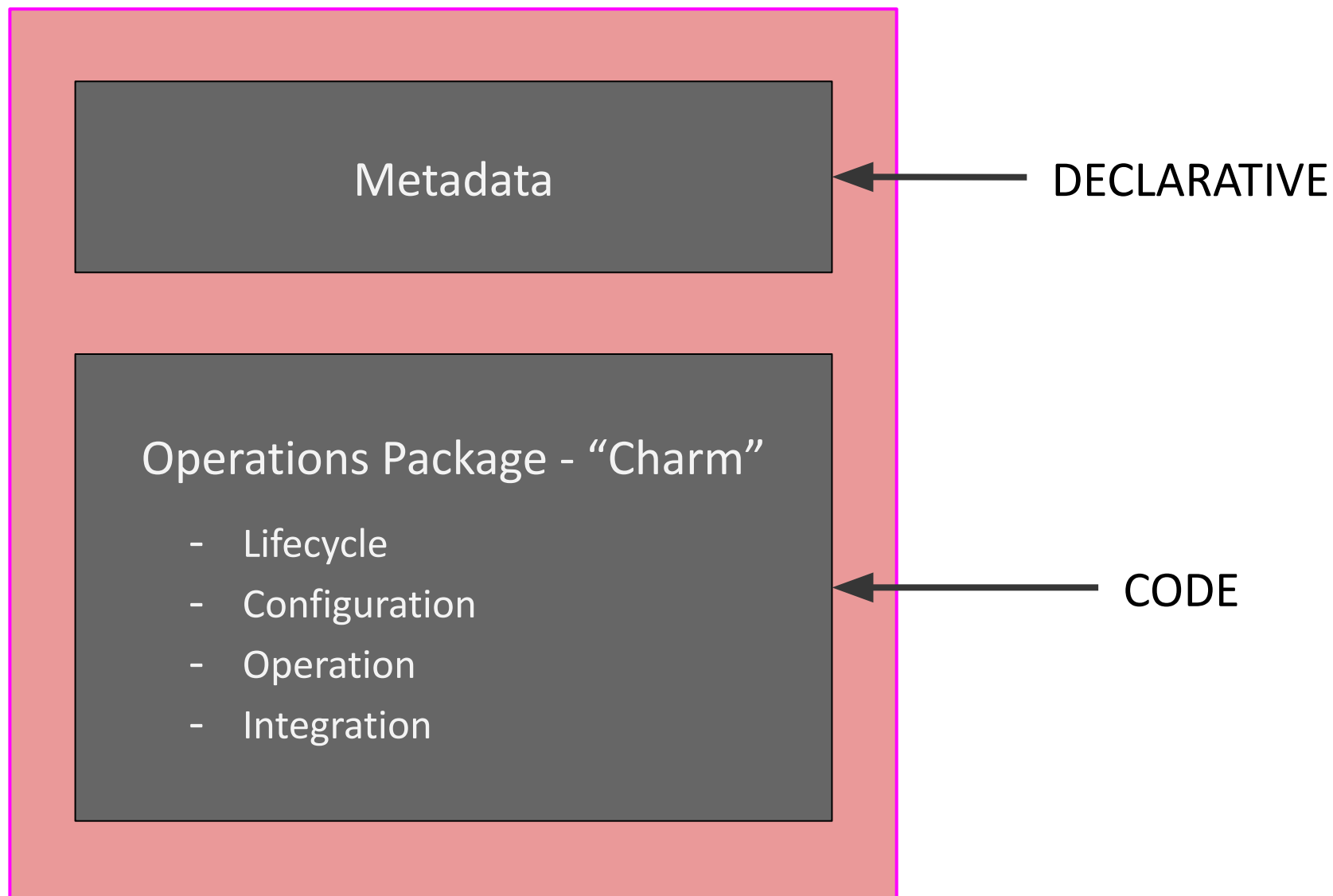
OSM Concepts: Network Service

- One or more xNFs

- Networks

- Mapping xNF connections to the networks

- Network Service level connection points

NS
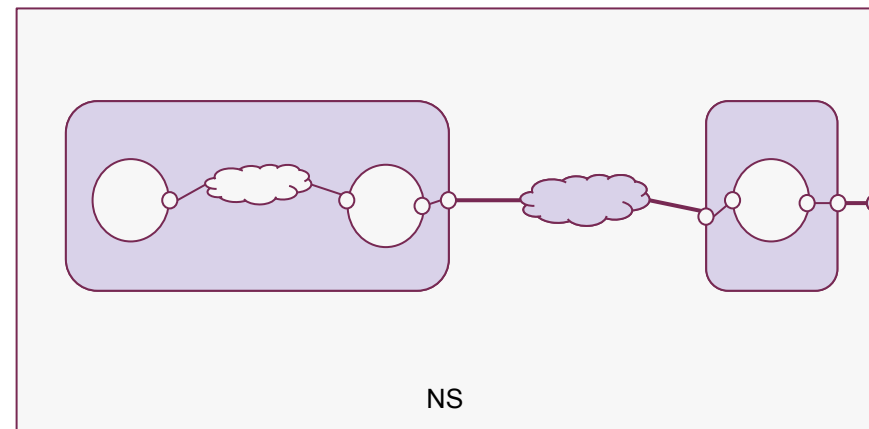
OSM Primitives

OSM Primitives are actions exposed by the Charm

- Backup

- Monitor

- Debug

- Add users, policies, rules, etc.

- Manage certificates, keys, etc.

- Rotate logs

Each ' primitive' is a **charm action**
that takes parameters and produces output.

VCA coordinates all OSM Primitives

VNFds map OSM Primitives to Charm Actions

VNFd

```
primitives:
 - restore:
       mariadb:restore
 - copy:
       mediawiki:zzz
```

"Mariadb"

```
actions:
 - restore
 - backup
```

"Mediawiki"

```
actions:
 - yyy
 - copy
```

Charm Model
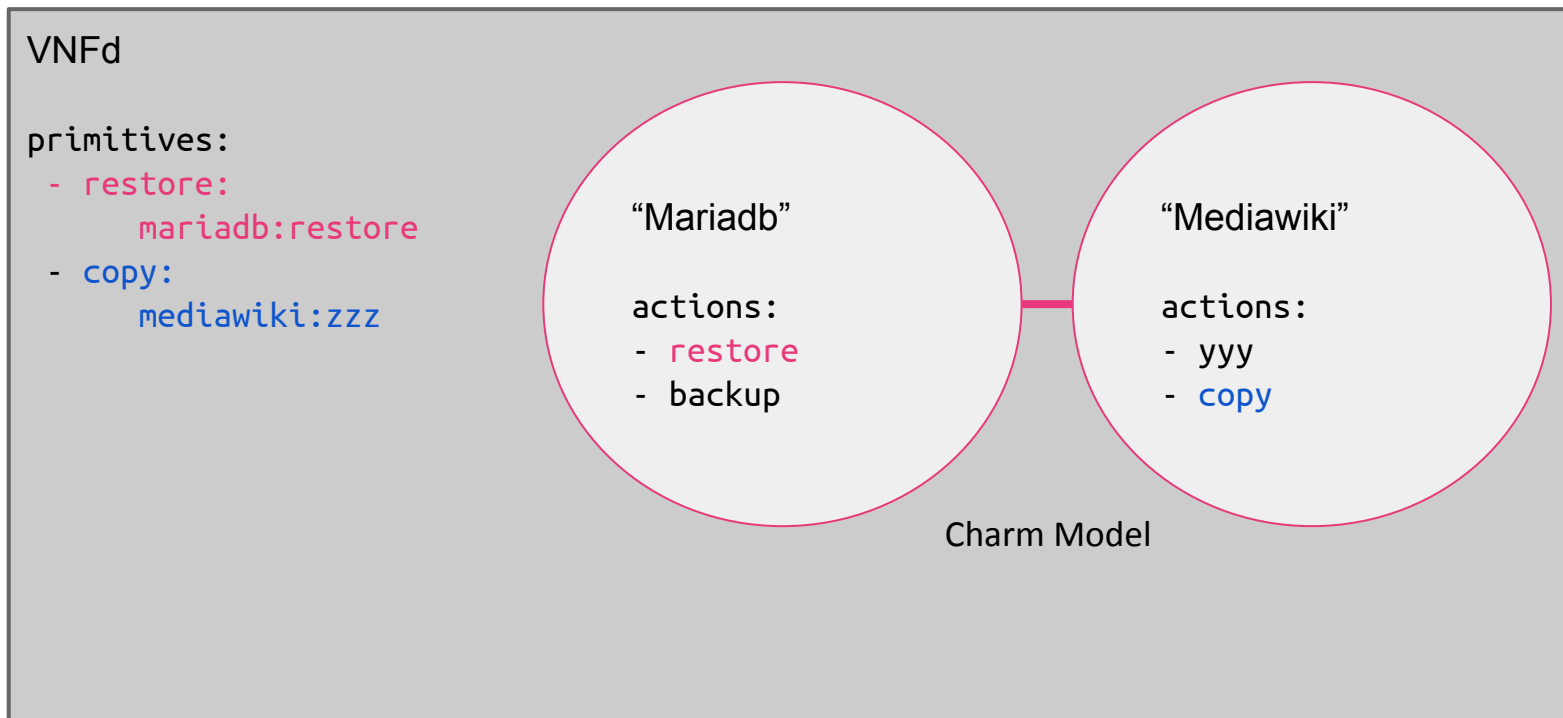
VCA uses multiple models for Scenario
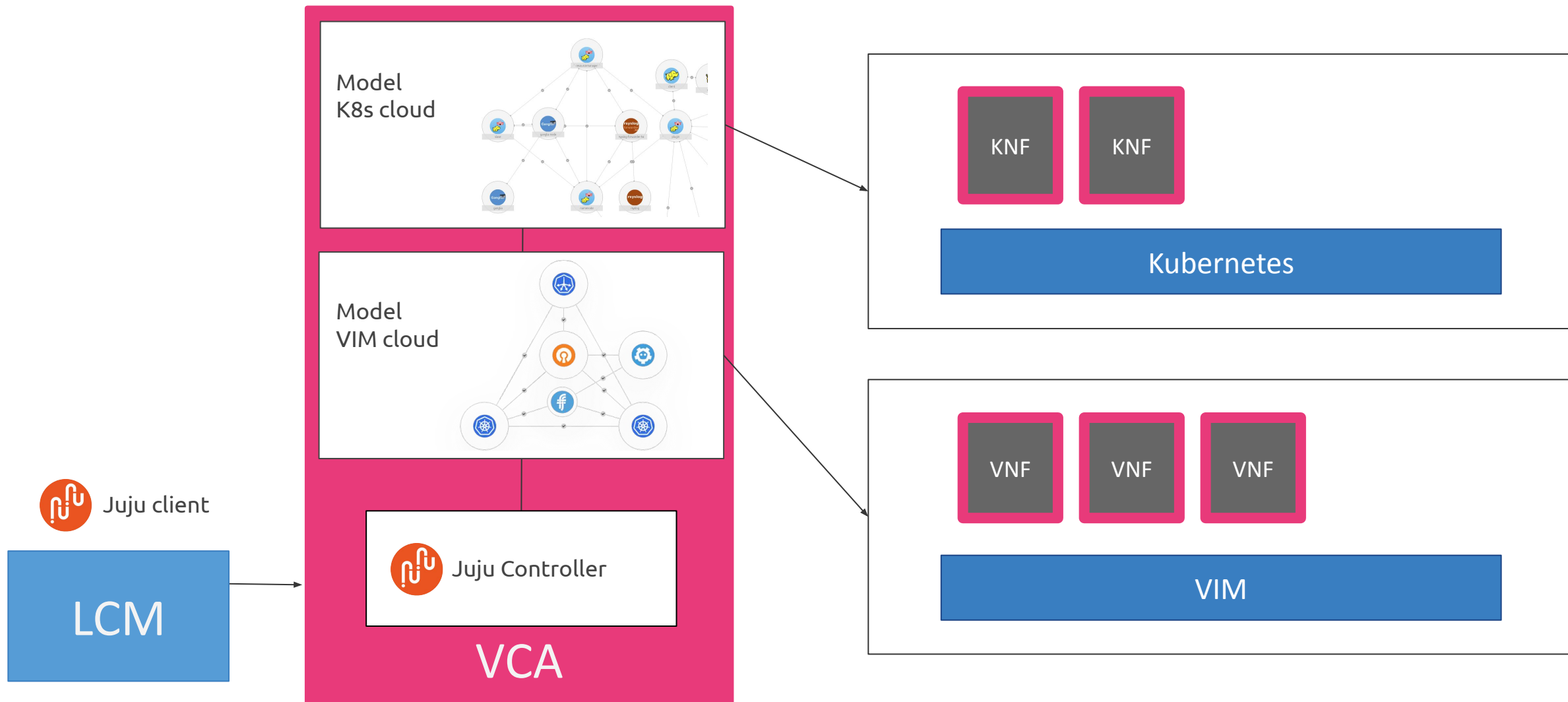
Perform the operations on VNF/PNF/CNF instances by using actions
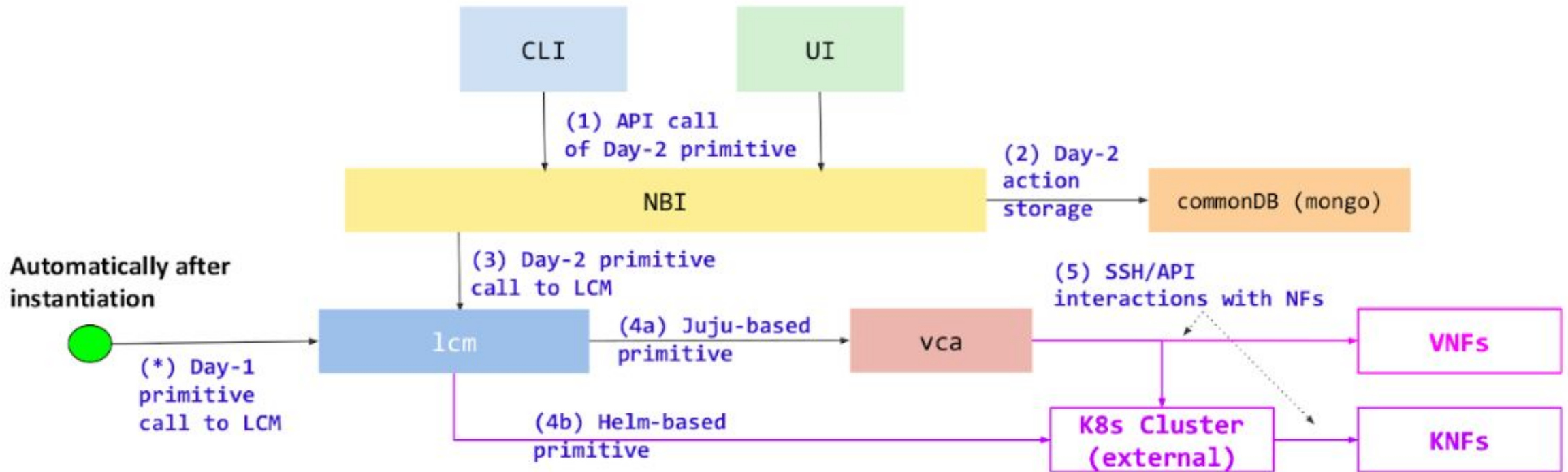
Charms

What is a charm?

A charm is a set of scripts for deploying and operating application

- Built-in event handling

- Organized by layers → Helps reusing code

- Provide/require interfaces to exchange data with other charms

- Utilizes Juju to deploy across multiple substrates

wordpress   mysql

mysql-interface

Provides
mysql-interface

Requires
mysql-interface
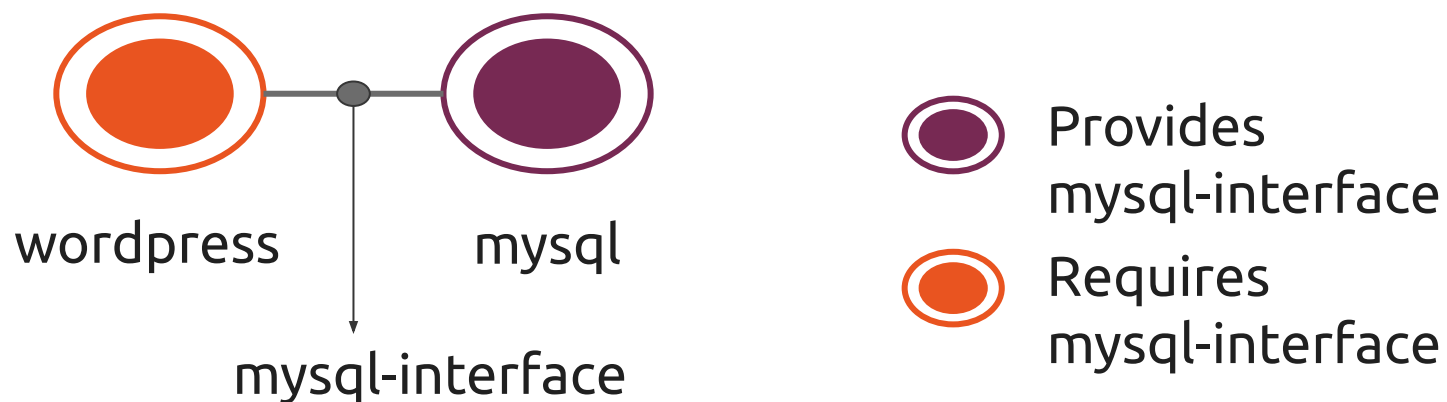
Charms are packages of scripts to drive apps

Lifecycle Scripts

- install
- config
- update
- remove
- scale

Integration Scripts

- relate-mysql
- relate-ldap
- relate-proxy
- relate-...

"Action" Scripts are OSM Primitives

"action: backup"
"action: restore"
"action: scan-viruses"
"action: health-check"
"action: add-repo"
"action: ..."
"action: ..."
"action: ..."
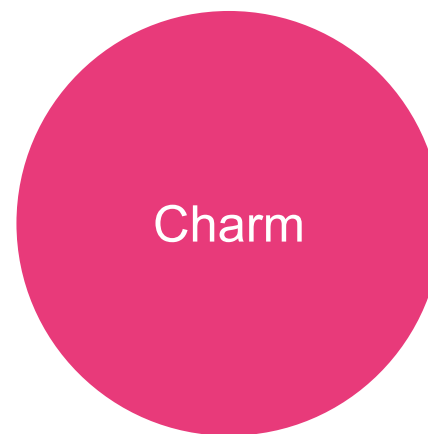
These are your operation primitives.

Charm

APACHE kafka®

Native Charm Approach

OSM

Native Charm

Workload
VNF/KNF

Workloads optimised for OSM

Workloads have the charm that drives itself directly
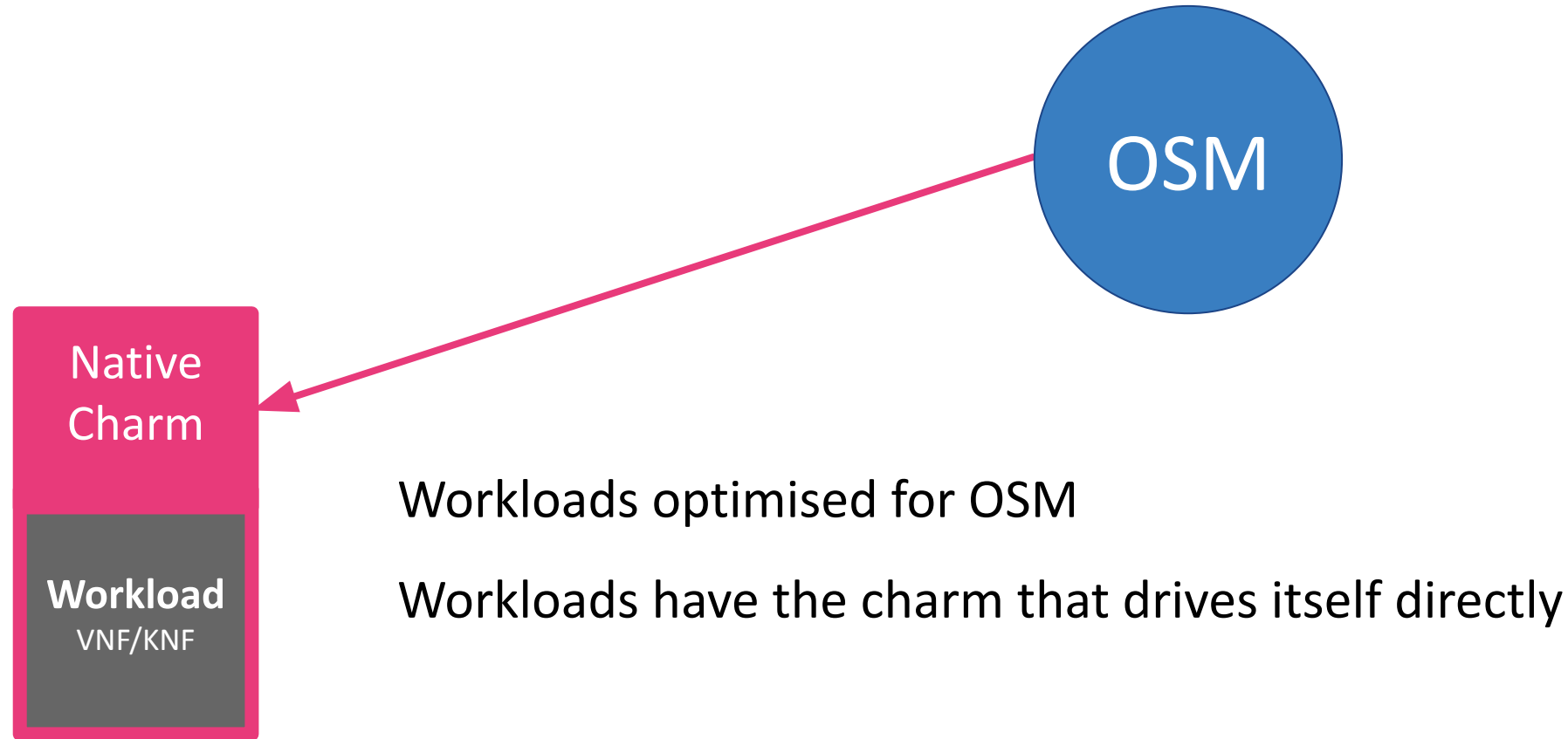
Proxy Charm Approach

LXD Operators   K8s Operators

'Operator' instance

Proxy Charm

OSM

Workload
PNF/VNF/KNF
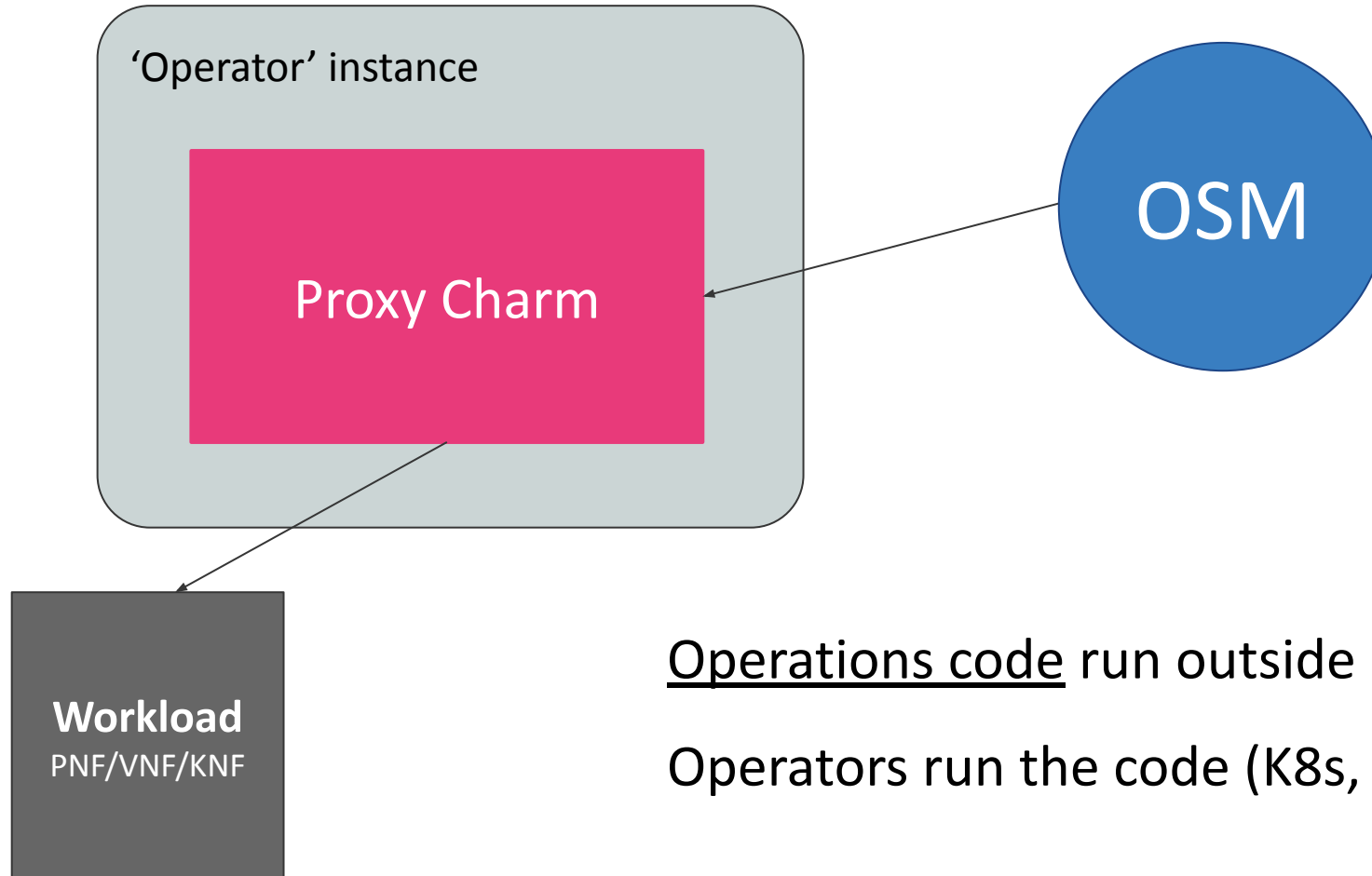
Operations code run outside of the workload

Operators run the code (K8s, LXD)

What can we do by using Charms ?

Configuration

Open Source MANO

Configure

```
https_proxy: xxx
ca_cert: yyyy
...
```

Charm

LCM → VCA

Workload
PNF/VNF/KNF

Actions

Add user!

Do backup!

Charm

LCM

VCA

Workload
PNF/VNF/KNF

Integration

Integrate!

LCM → VCA

Charm, Charm, Charm, Charm, Charm, Charm

PNF VNF KNF
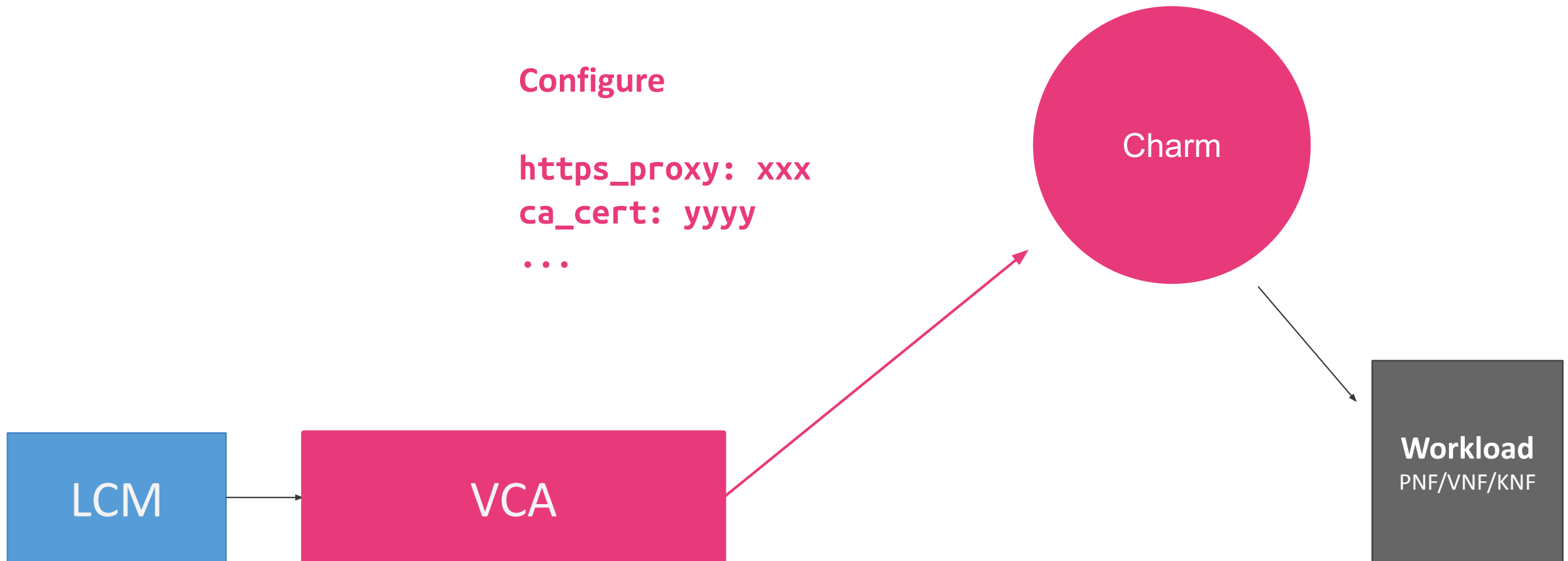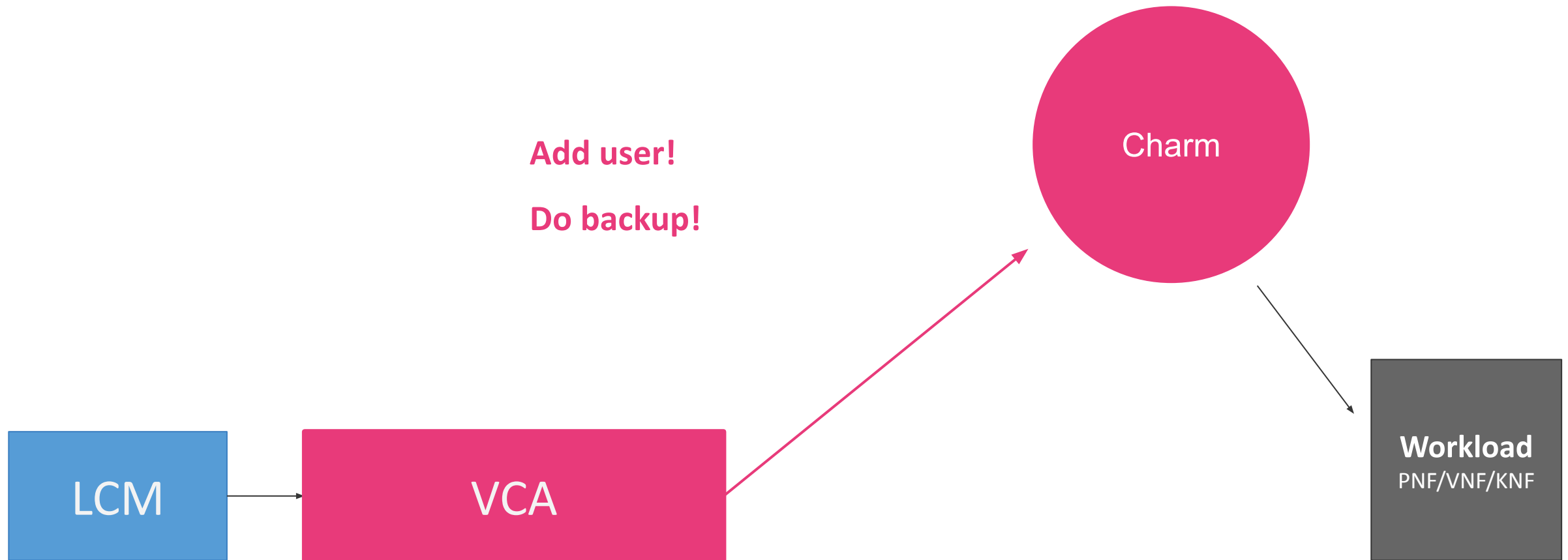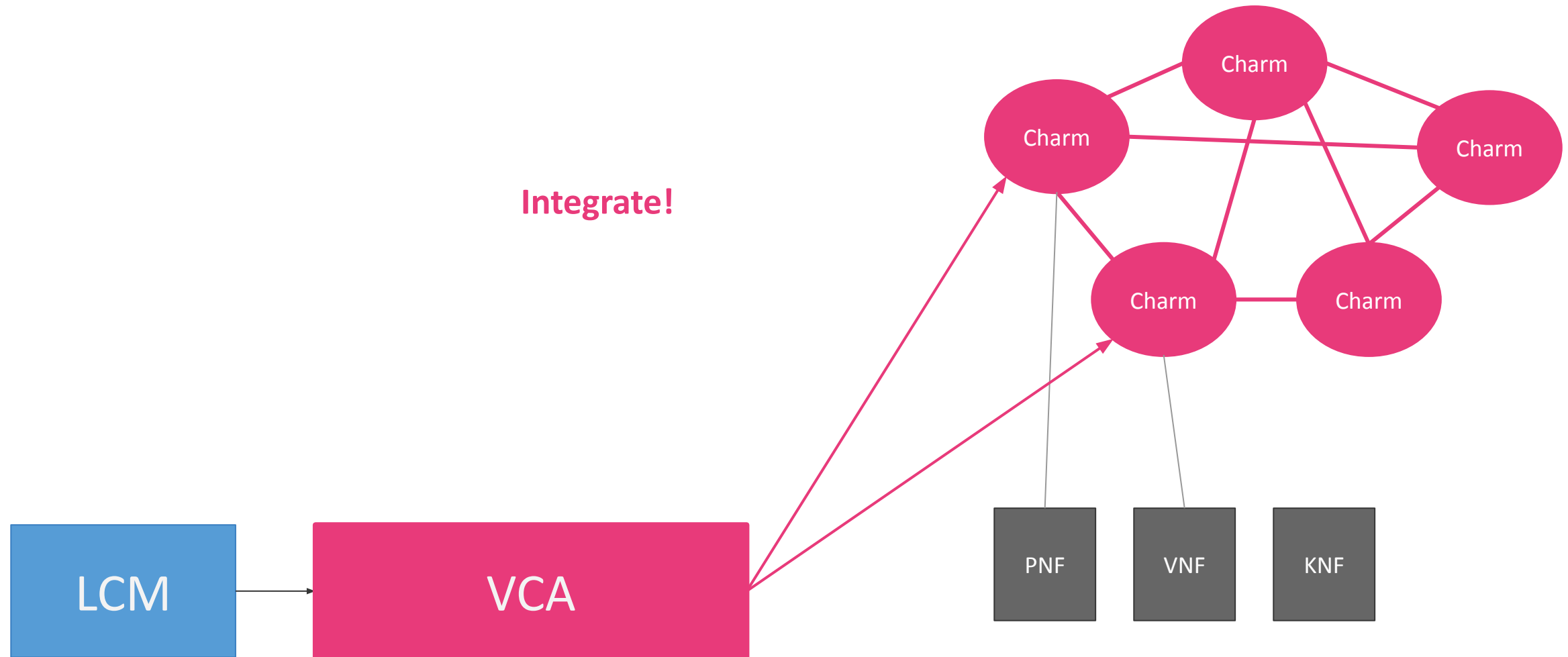
VNFds can describe Complex Integrations
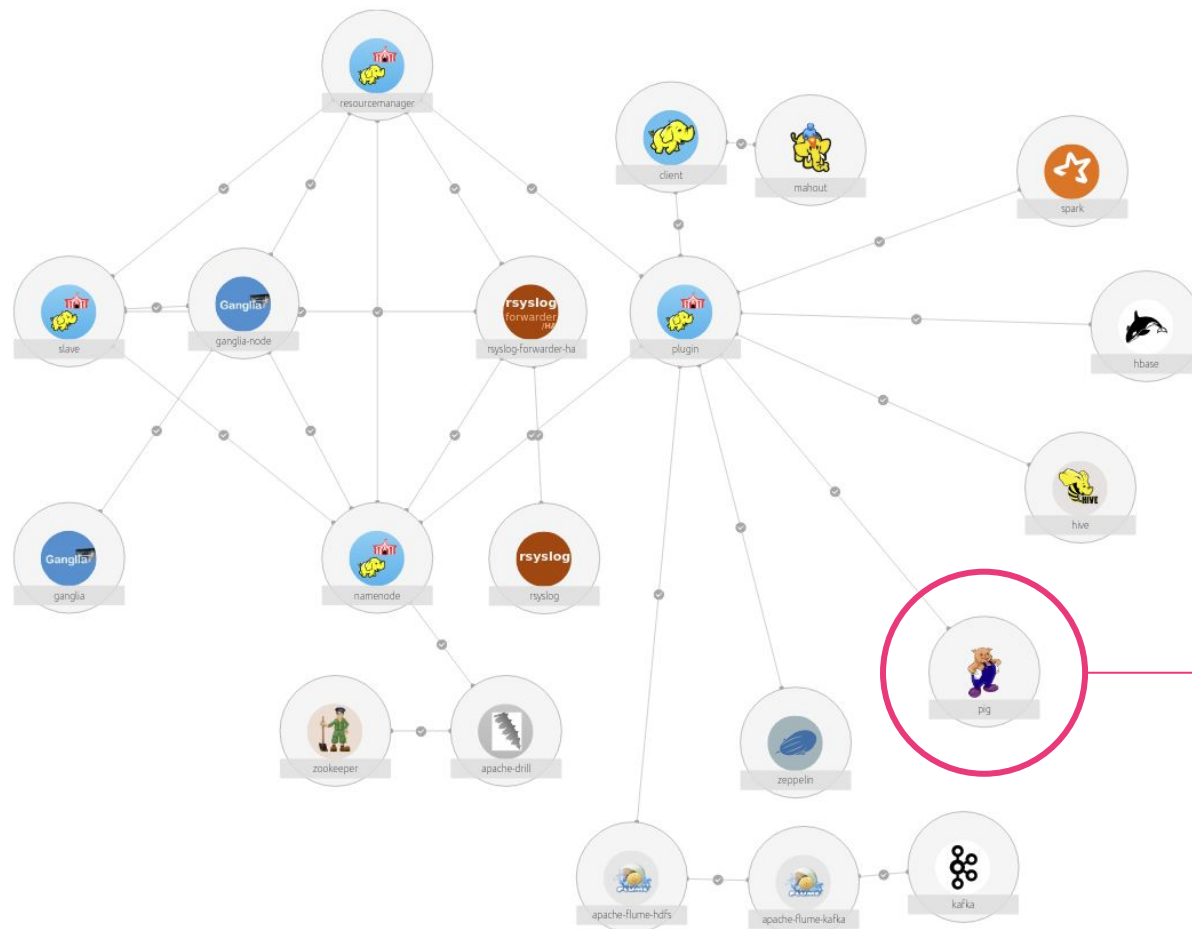
Lifecycle scripts
Config scripts
Integration scripts
Action scripts

Relations

Matching integration points can be related

Lines of integration between matching integration points on different charms
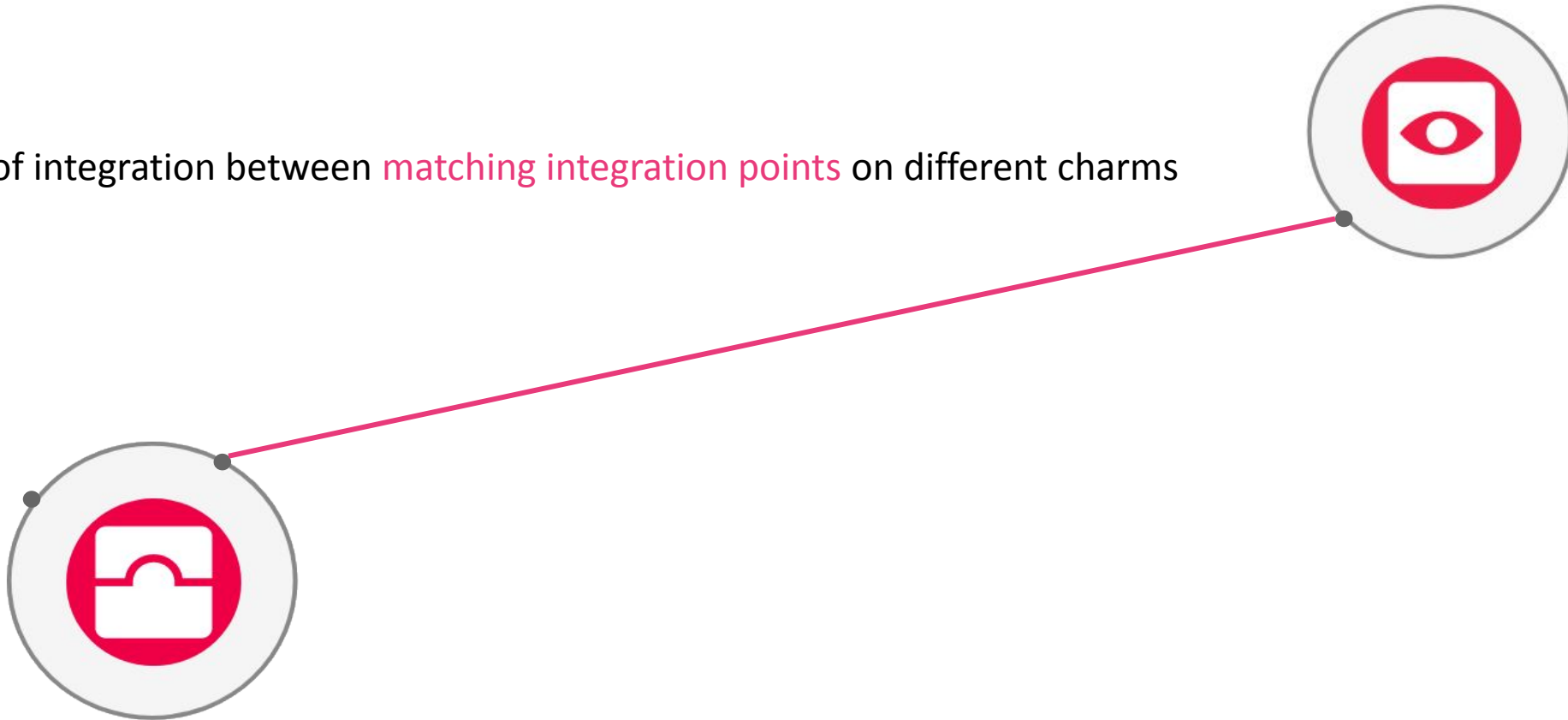
Magma Orchestration Use Case

Magma: A Free Wireless Mobile Core Network
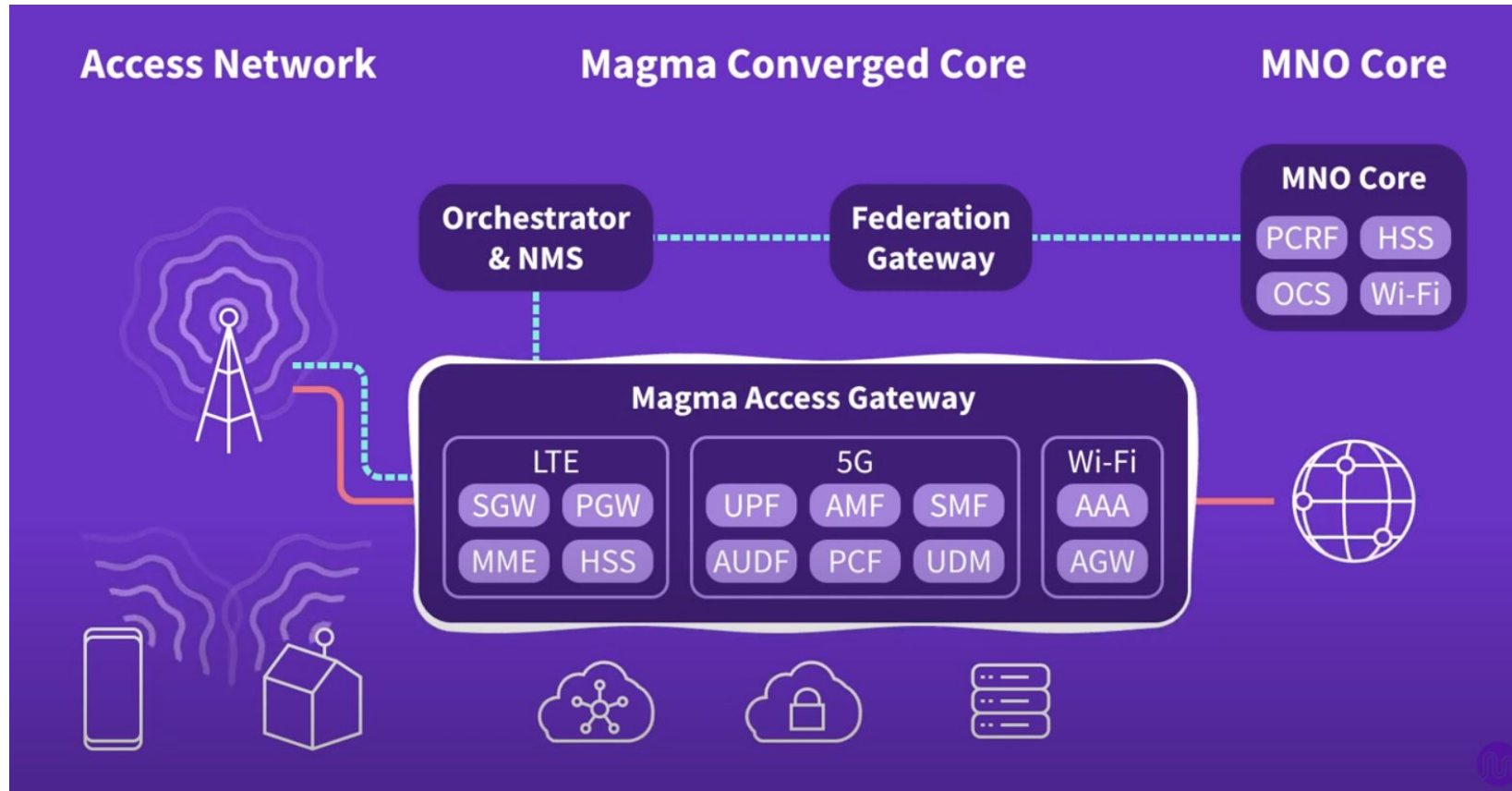
Learn more on www.magmacore.org

Magma Components

Access Gateway

- Contains core network elements
- In an LTE network:
  - Evolved Packet Core (EPC)
  - Connectivity with EnodeB's

Orchestrator

- Cloud service
- Allows user to configure and monitor the wireless network
- Allows management of multiple Access Gateways
- Web UI

Federation Gateway

- Cloud service
- Integration with Mobile Network Operator
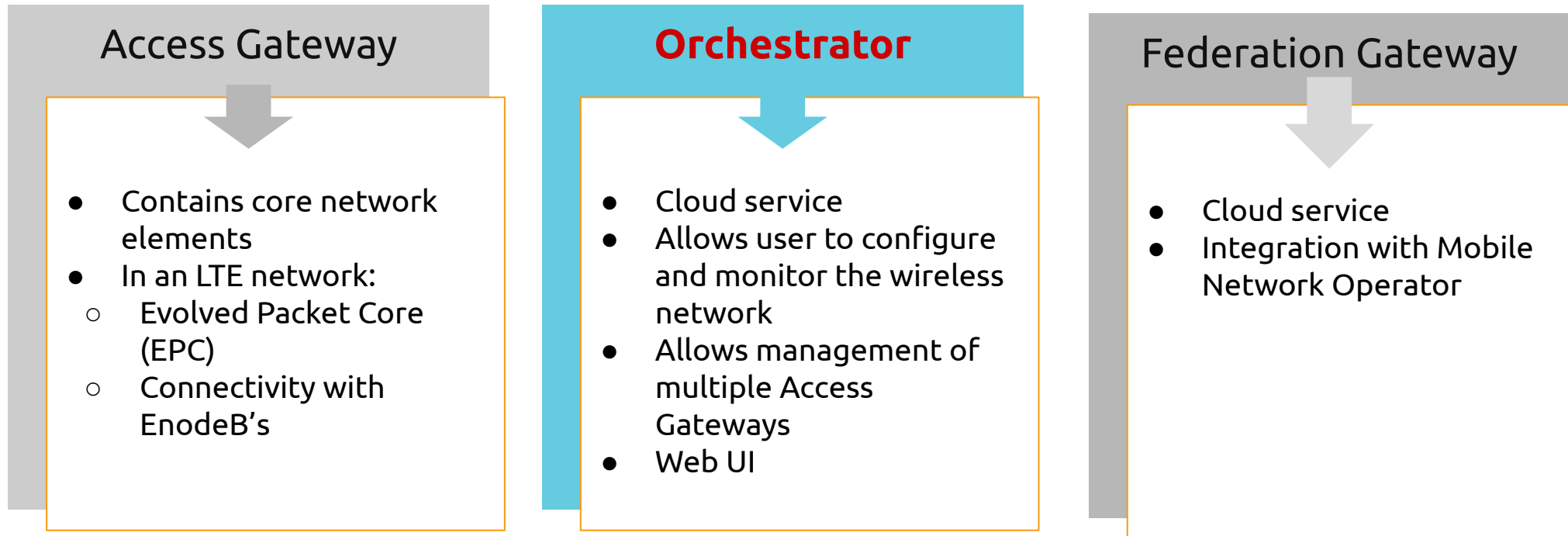
Magma is an Evolved Packet Core that runs on K8s

Onboarding Scenario

Access Orc8r GUI

magma
Orchestrator

Name Resolution

POWERDNS
DNS Server

K8s Cluster

Onboarding Scenario

© ETSI
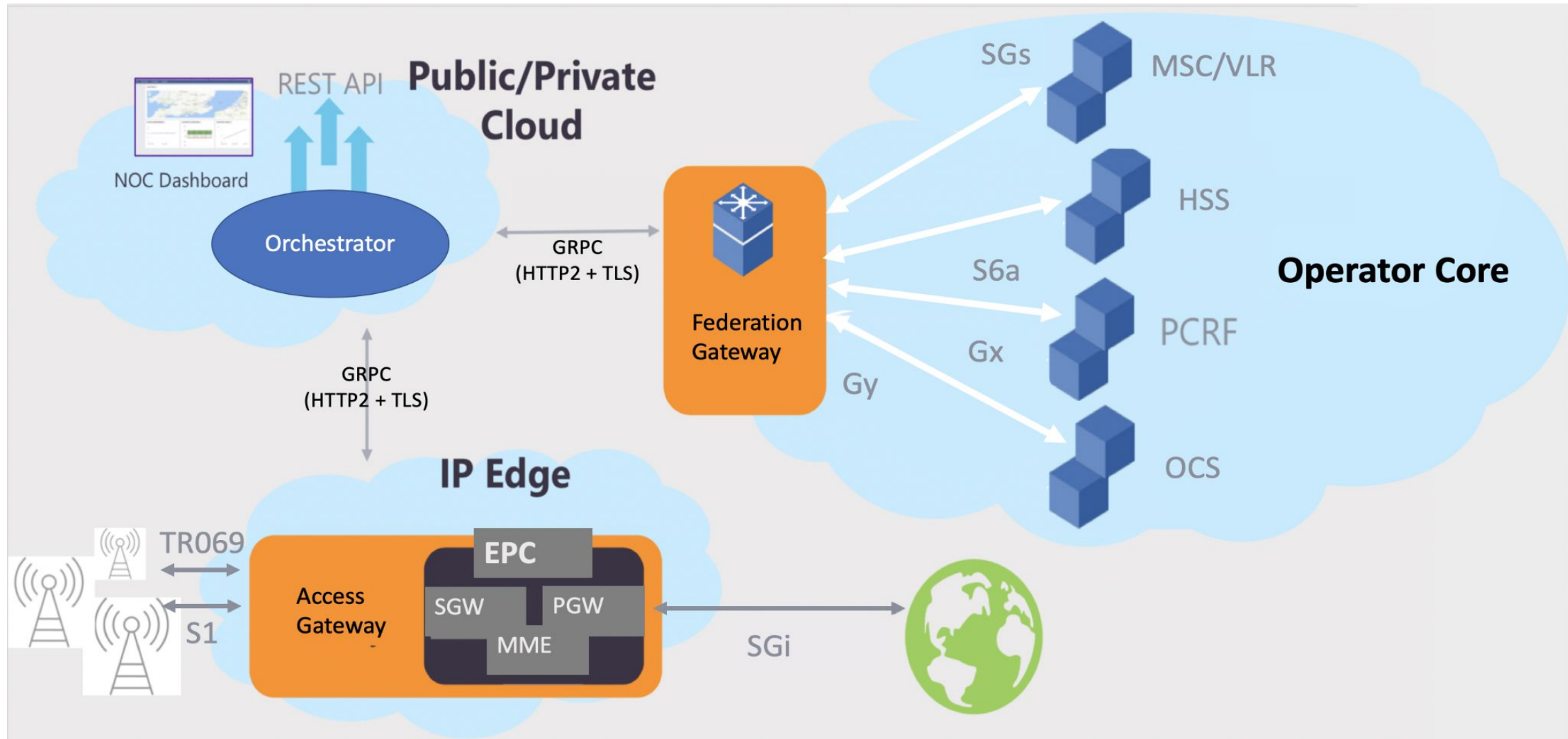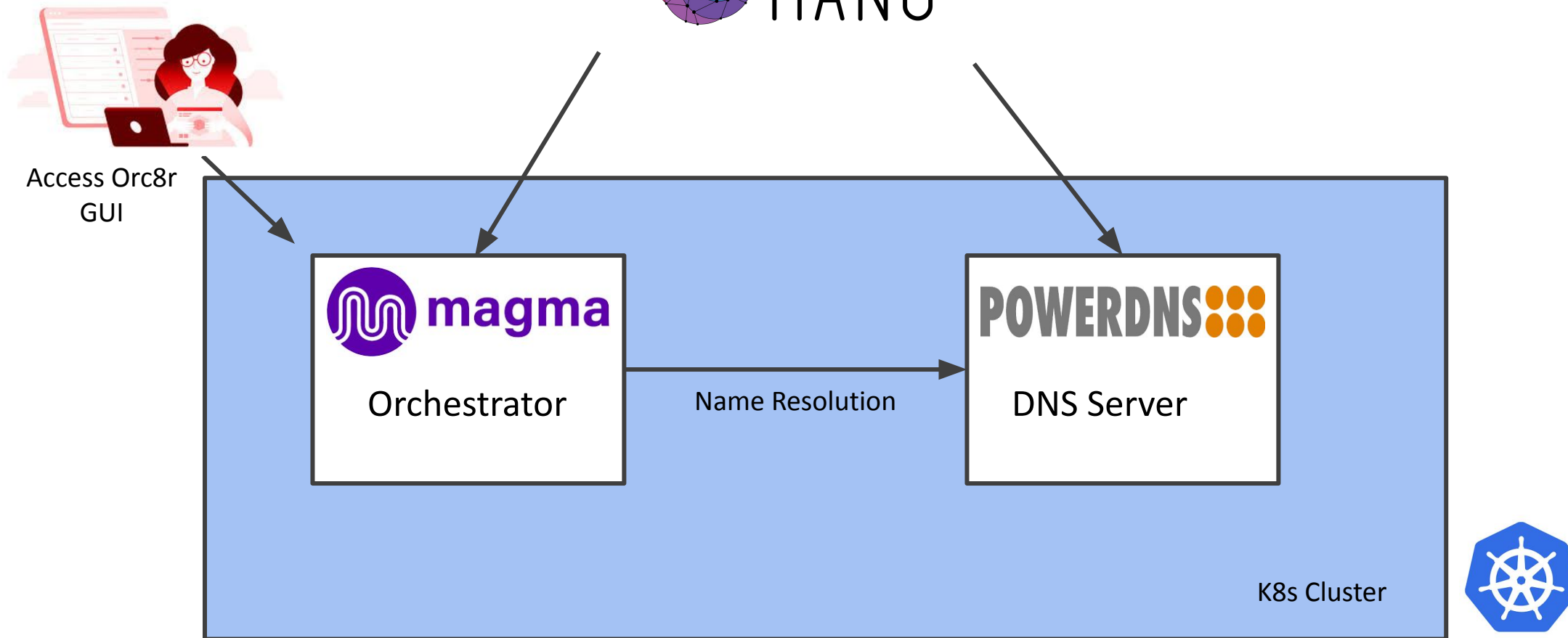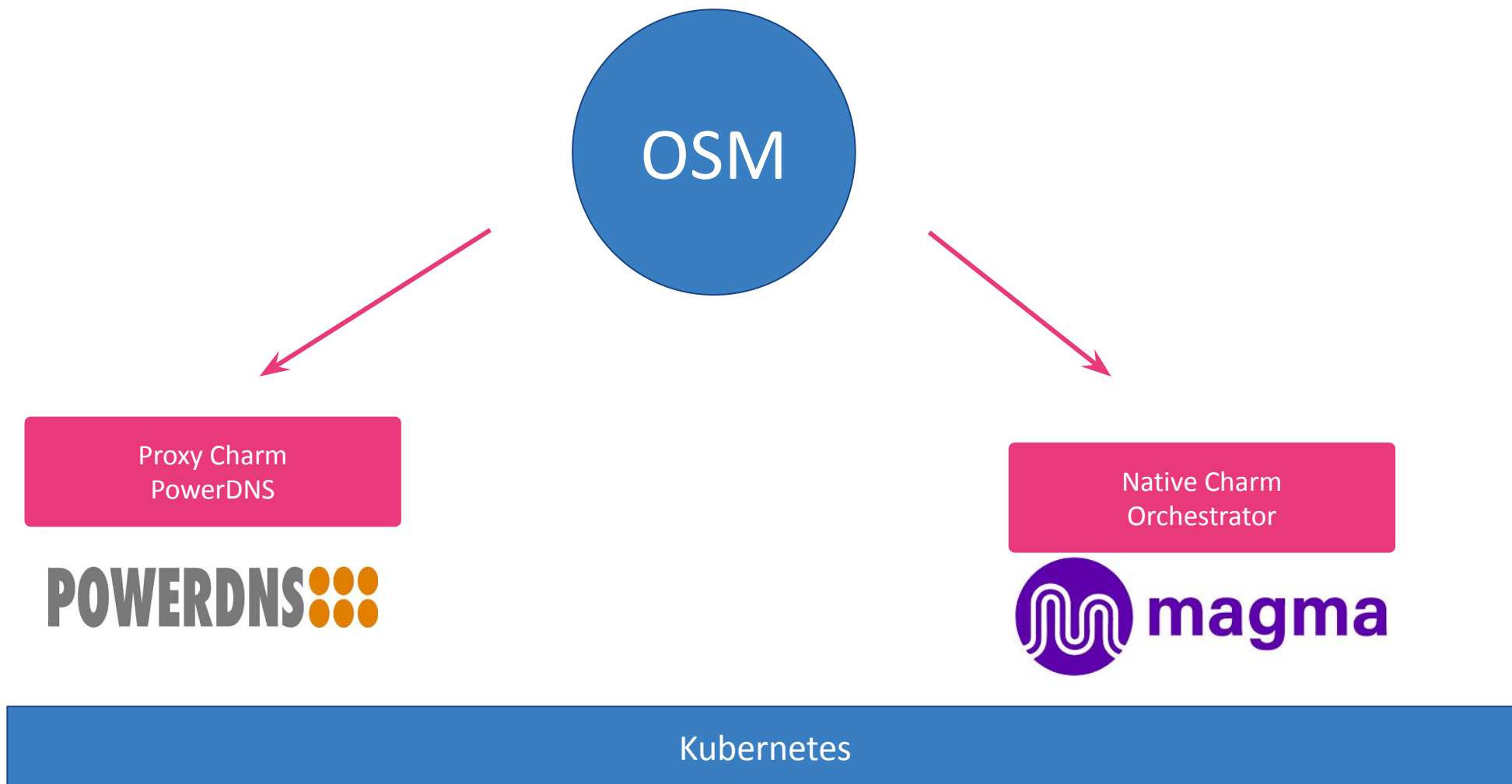
Magma Orchestrator as a Juju bundle

NS Diagram

NS

NS: magma_orc8r_ns

VL: mgmtnet

CP: mgmtnet-ext

KNF

NF: magma_orc8r_cnf

KNF Diagram

KNF

External CP: mgmt-ext

NF: magma_orc8r_cnf

KDU: orc8r
- juju-bundle: bundle.yaml

KDU

KNF Diagram: K8s Cluster Requirements

Open Source MANO

Net 1: mgmtnet

K8s Cluster is already deployed and ready to use.

K8s cluster
- Version: 1.23

External CP: mgmtnet-ext

KNF
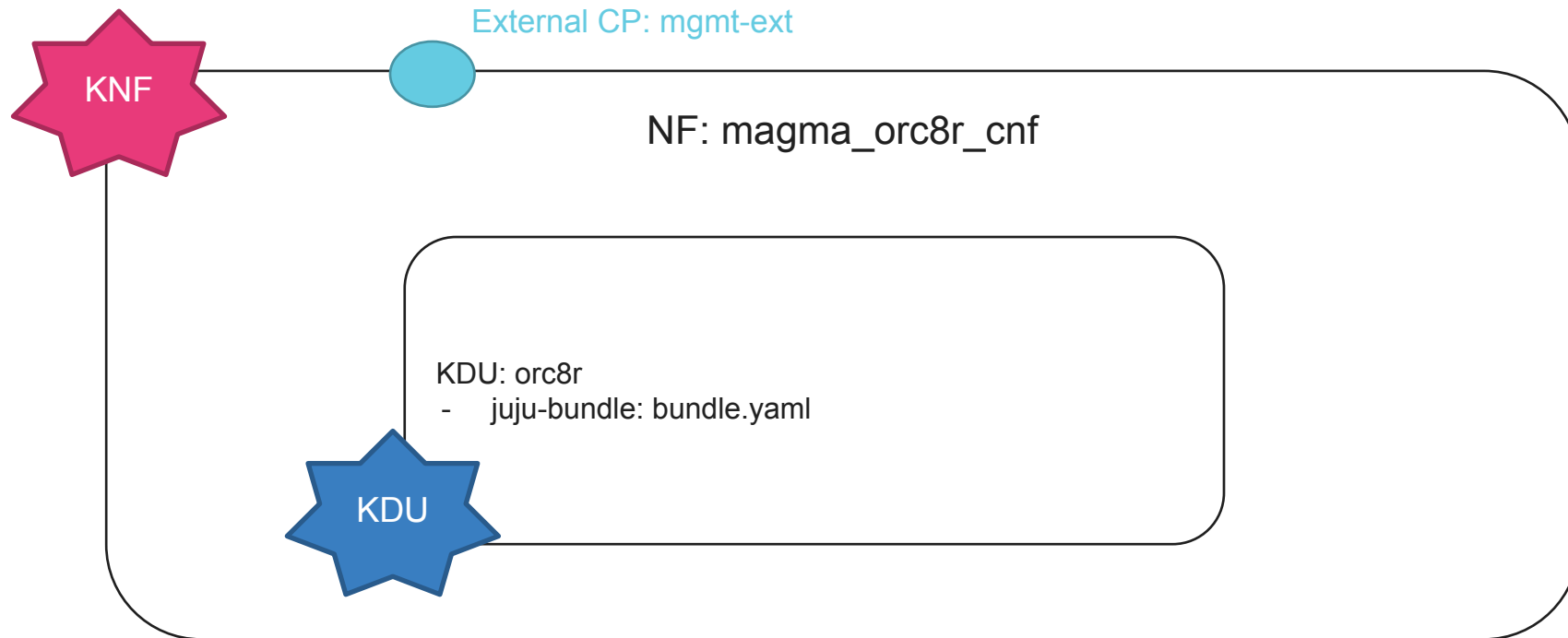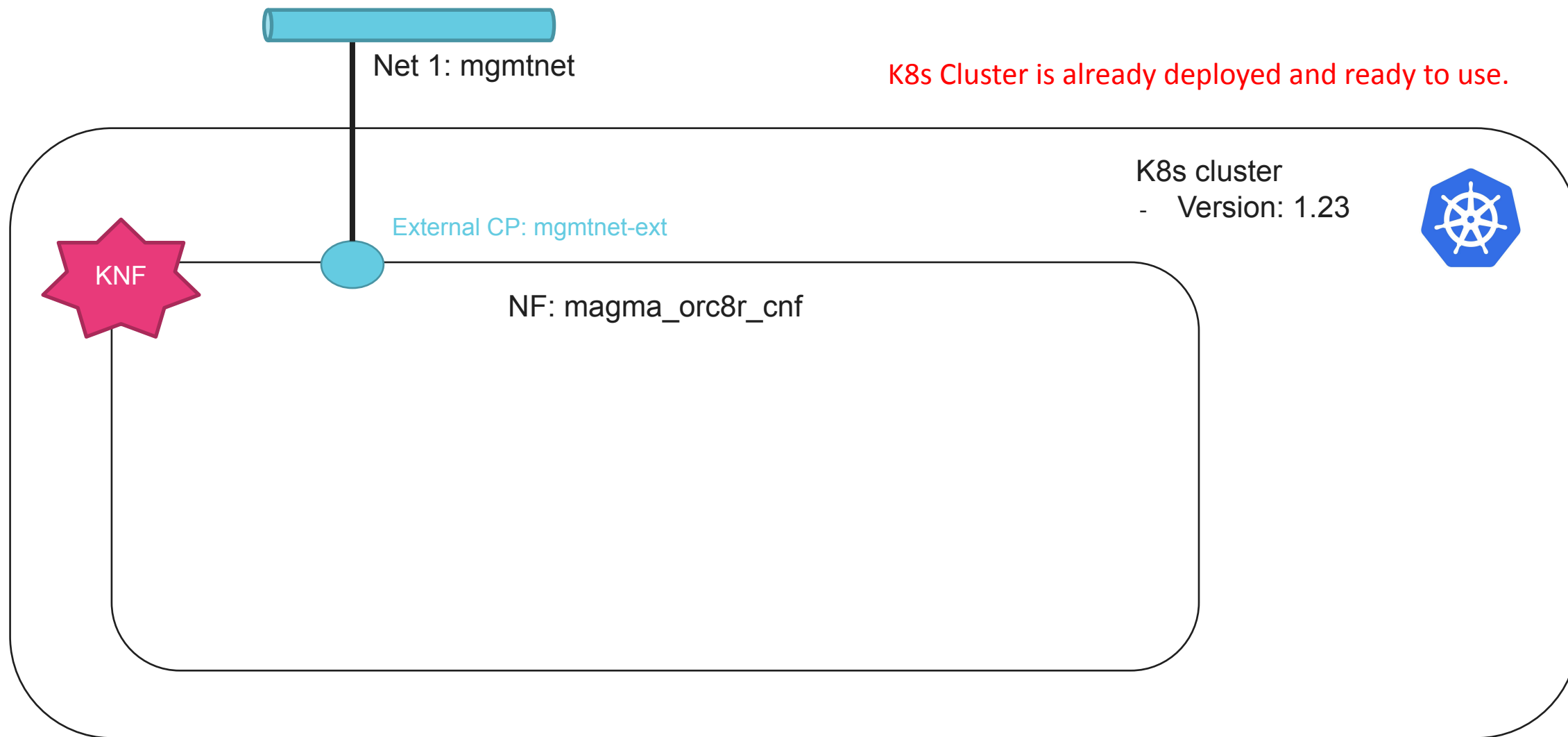
NF: magma_orc8r_cnf

Referencing the Juju-Bundle (VNFD)

```
vnfd:
  [...]
  kdu:
  - name: magma-orc-kdu
    juju-bundle: bundle.yaml
```

juju-bundles/bundle.yaml (VNFD)

```yaml
bundle: kubernetes
applications:
  nms-magmalte:
    charm: magma-nms-magmalte
  # ...
  orc8r-certifier:
    charm: magma-orc8r-certifier
    channel: edge
    scale: 1
    trust: true
    options:
      domain: osm.magma.com
  # ...
relations:
- - nms-magmalte:magma-orc8r-certifier
  - orc8r-certifier:magma-orc8r-certifier
```

```
vnfd:
  description: K8s container deployment of Magma Orchestrator
  df:
  - id: default-df
    lcm-operations-configuration:
      operate-vnf-op-config:
        day1-2:
          - id: magma-orc-kdu
            config-primitive:
              - name: get-master-admin-credentials
            parameter:
                  - name: application-name
                    data-type: STRING
                    default-value: nms-magmalte
          [...]
```

Hands On Session

Deploying Magma Orchestrator (Juju Bundle)

Download osm-packages

```
git clone --recurse-submodules -j8
https://osm.etsi.org/gitlab/vnf-onboarding/osm-packages.git

cd osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/magma-orc-scripts
```

Onboard the Magma Orc8r Packages

Run the following script under **magma-orc-scripts**

```
./1-onboard-packages.sh
```

Check the status of onboarded packages:

```
osm vnfd-list
osm nsd-list
```

Instantiate Magma Orc8r NS

Run the following script under **magma-orc-scripts**

```
./2-onboard-ns.sh
```

Check the status of NS using the command:

```
osm ns-list
```

Deployment takes around 15-20 minutes.

```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/magma-orc-scripts$ osm ns-list
+-------------------+--------------------------------------+---------------------+----------+-----------------------------------------------+---------------+
| ns instance name  | id                                   | date                | ns state | current operation                             | error details |
+-------------------+--------------------------------------+---------------------+----------+-----------------------------------------------+---------------+
| magma_orc_ns      | 0c58fe6e-f730-4497-9271-44897179b162 | 2022-10-17T11:57:41 | BUILDING | INSTANTIATING (fa434e7b-b1c0-4898-bcf6-c7b99679f1c1) | N/A           |
+-------------------+--------------------------------------+---------------------+----------+-----------------------------------------------+---------------+
```

Hands On Session

Deploying PowerDNS (Helm Chart)

NS Diagram

NS: powerdns_ns

VL: mgmtnet

CP: mgmt-ext

NF: powerdns_knf

KNF Diagram

Open Source MANO

External CP: mgmt-ext

KNF

NF: powerdns_knf

KDU: powerdns
- helm-chart: osm-helm/powerdns

KDU

KNF Diagram: K8s Cluster Requirements

Open Source MANO

Net 1: mgmtnet

K8s cluster
- Version: 1.23

External CP: mgmt-ext

KNF

NF: magma_orc8r_cnf
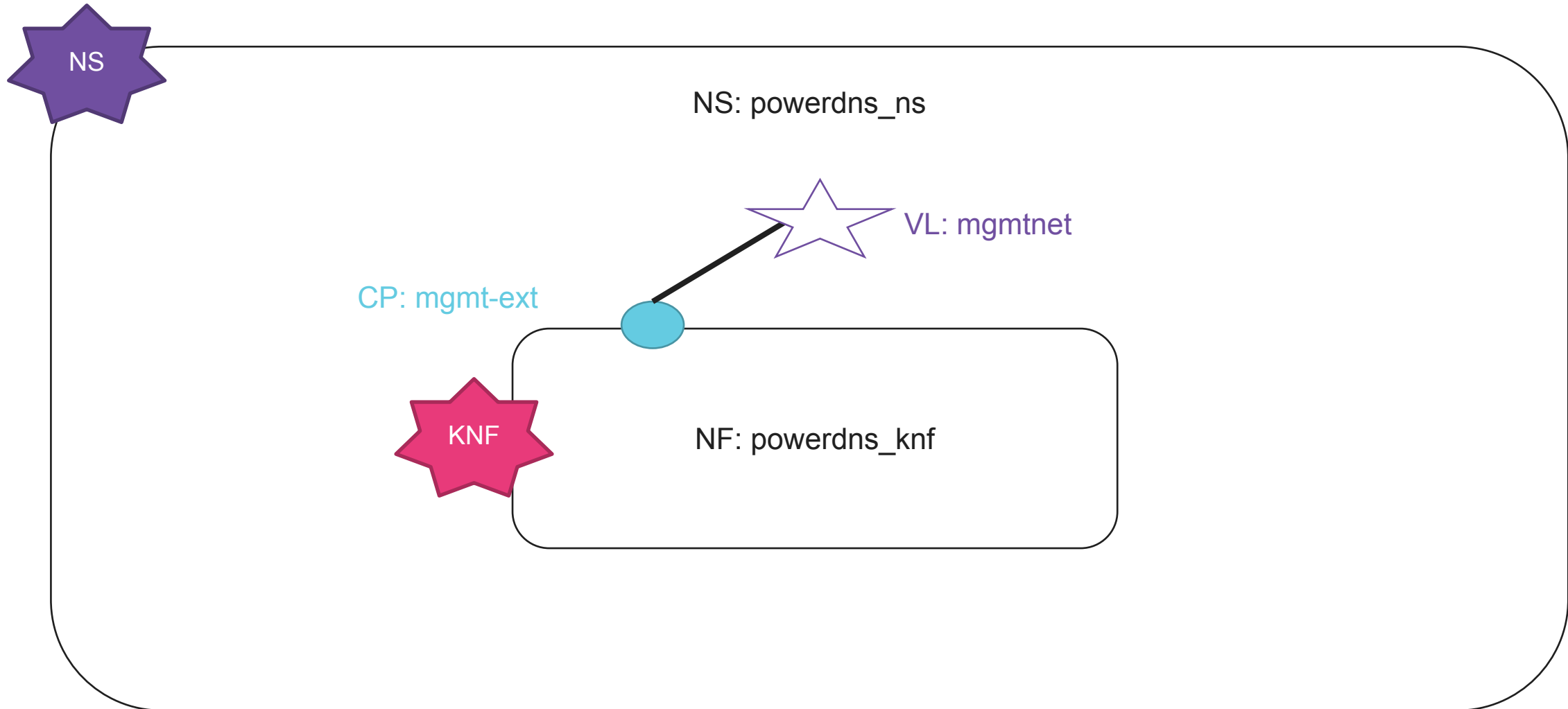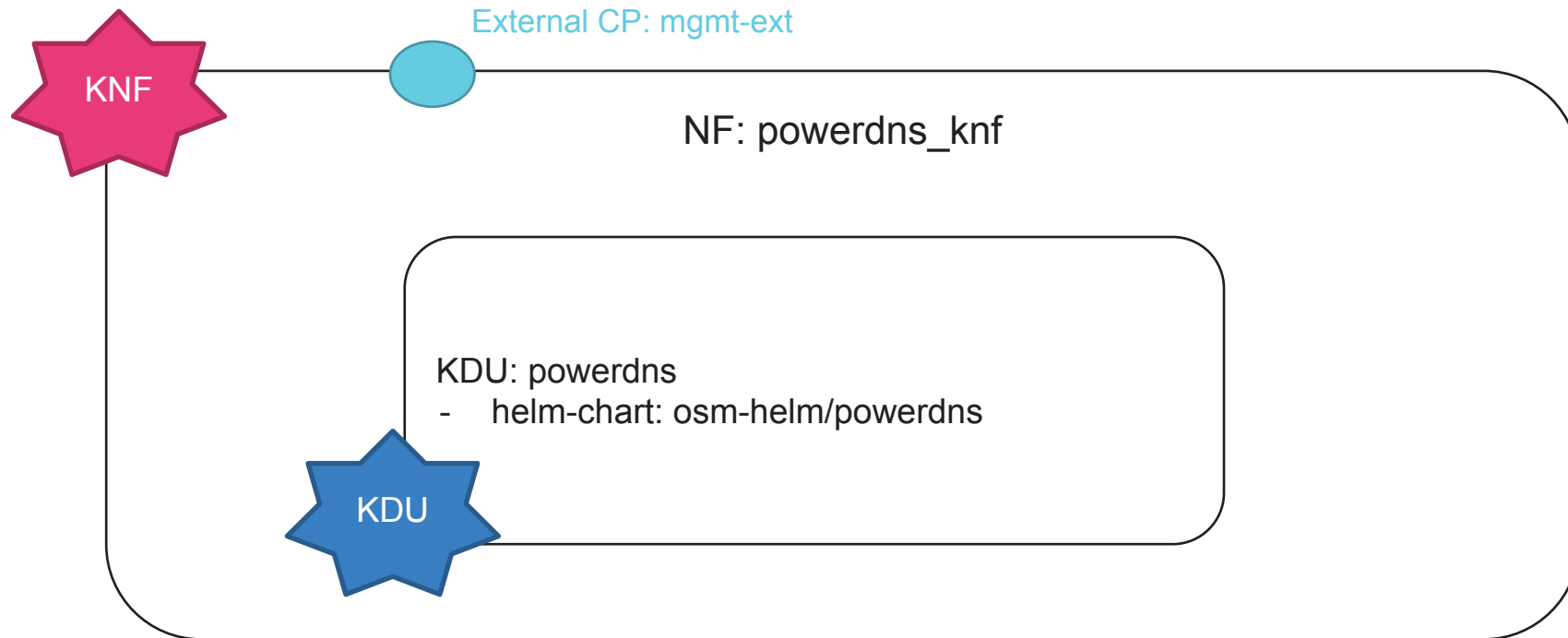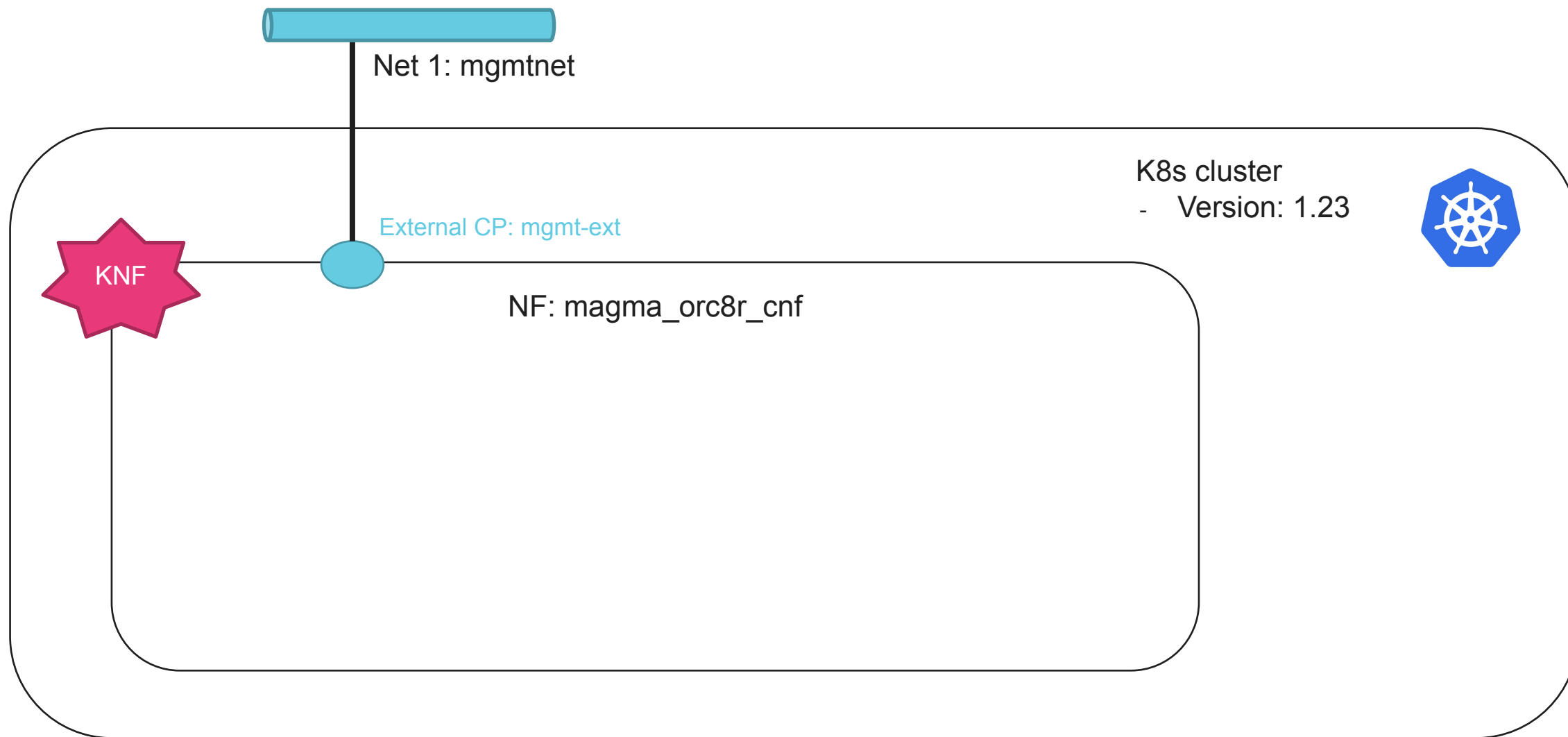
Referencing the Helm Chart (VNFD)

```
vnfd:
  [...]
  kdu:
  - name: powerdns
    helm-chart: osm-helm/powerdns
    service:
    - name: webserver-osm-helm-powerdns
```

helm-chart/Chart.yaml (VNFD)

```yaml
apiVersion: v2
appVersion: v4.3.1
dependencies:
- condition: postgresql.enabled
  name: postgresql
  repository:
https://charts.bitnami.com/bitnami
  version: 10.16.2
- condition: mariadb.enabled
  name: mariadb
  repository:
https://charts.bitnami.com/bitnami
  version: 10.5.1
name: powerdns
sources:
- http://www.github.com/PowerDNS/
version: 5.0.0
```

helm-chart/values.yaml (VNFD)

```yaml
replicaCount: 1
image:
  repository: naps/powerdns
  tag: 4.3.1
  pullPolicy: Always
serviceAccount:
  create: true
service:
  externalTrafficPolicy: ""
  type: LoadBalancer
postgresql:
  enabled: true
  postgresqlUsername: pdns
  postgresqlPassword: pdnspass
  postgresqlPostgresPassword: pdnsadminpass
  postgresqlDatabase: pdns
```

```
vnfd:
  description:
  df:
  - id: default-df
    lcm-operations-configuration:
      operate-vnf-op-config:
        day1-2:
            config-primitive:
            - name: add-zone
              execution-environment-ref: powerdns-ee
              parameter:
              - name: zone_name
                data-type: STRING
                default-value: ""
            [...]
```

Add Helm Repository

Go to the **powerdns-scripts** path:

```
cd ~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts
```

Run the script:

```
./1-add-helm-repo.sh
```

Check the repository:

```
osm repo-list
```

```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ osm repo-list
+----------+--------------------------------------+------------+-----------------------------------+--------------------------------+
| Name     | Id                                   | Type       | URI                               | Description                    |
+----------+--------------------------------------+------------+-----------------------------------+--------------------------------+
| osm-helm | 95603bdf-8aad-432b-8d68-d0ea5764bee1 | helm-chart | https://gatici.github.io/helm-repo/ | Repository for Powerdns helm Chart |
+----------+--------------------------------------+------------+-----------------------------------+--------------------------------+
```

Onboard PowerDNS Packages

Run the following script under **powerdns-scripts**

```
./2-onboard-packages.sh
```

Check the status of onboarded packages:

```
osm vnfd-list
osm nsd-list
```

```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ osm vnfd-list
+----------------+--------------------------------------+-----------+
| nfpkg name     | id                                   | desc type |
+----------------+--------------------------------------+-----------+
| magma_orc_cnf  | 4caca484-f68f-4d37-8c52-fefe71a877c0 | sol006    |
| powerdns_knf   | 5b989246-4fa1-49ec-b7cf-c71f099942f0 | sol006    |
+----------------+--------------------------------------+-----------+
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ osm nsd-list
+------------------+--------------------------------------+
| nsd name         | id                                   |
+------------------+--------------------------------------+
| magma_orc_cnf_ns | 6b011ebd-e48d-48bd-b4bd-f53fccef67ab |
| powerdns_ns      | 33c1a232-f1db-4e79-8485-beb000346979 |
+------------------+--------------------------------------+
```

Instantiate PowerDNS NS

Run the following script under **powerdns-scripts**

```
./3-instantiate-ns.sh
```

Check the status of NS using the command:

```
osm ns-list
```

Check the status of Network Services

WAIT TILL BOTH NS STATUS BECOME READY!

Check the status of NS using the command:

```
osm ns-list
```



```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ osm ns-list
+------------------+--------------------------------------+---------------------+----------+-----------------------------------------------------+---------------+
| ns instance name | id                                   | date                | ns state | current operation                                   | error details |
+------------------+--------------------------------------+---------------------+----------+-----------------------------------------------------+---------------+
| magma_orc_ns     | 0c58fe6e-f730-4497-9271-44897179b162 | 2022-10-17T11:57:41 | BUILDING | INSTANTIATING (fa434e7b-b1c0-4898-bcf6-c7b99679f1c1) | N/A           |
| powerdns_ns      | c0501d24-0422-4aba-b744-47d9c0753df6 | 2022-10-17T12:02:20 | BUILDING | INSTANTIATING (d84234e1-8a74-4736-86dc-5a8b2ed6adef) | N/A           |
+------------------+--------------------------------------+---------------------+----------+-----------------------------------------------------+---------------+
```

Kubernetes Functions

Why using K8s in OSM?

- Applications based in micro-services

- OSM is, in fact, already running in K8s, both [distros](#) and [community installer](#)

- Upcoming NFV use cases: 5G Core, uCPE/SD-WAN...

- K8s apps and clusters are essential ingredients for many Edge use cases

How K8s-based apps are modelled ?

K8s provides a huge number of high-level service objects,

which are the core of its functionality:

- Pod sets*: deployments (+replicasets), statefulsets
- Services: clusterIP, NodePort, Load Balancer
- Storage: persistent volumes, persistent volume claims
- more...

2 ways to deploy a K8s app:

- **Helm Charts**: packaged format + indirect call to the K8s API via Helm
- **Juju Charms and Bundles**: packaged format + indirect call to the K8s API via Juju
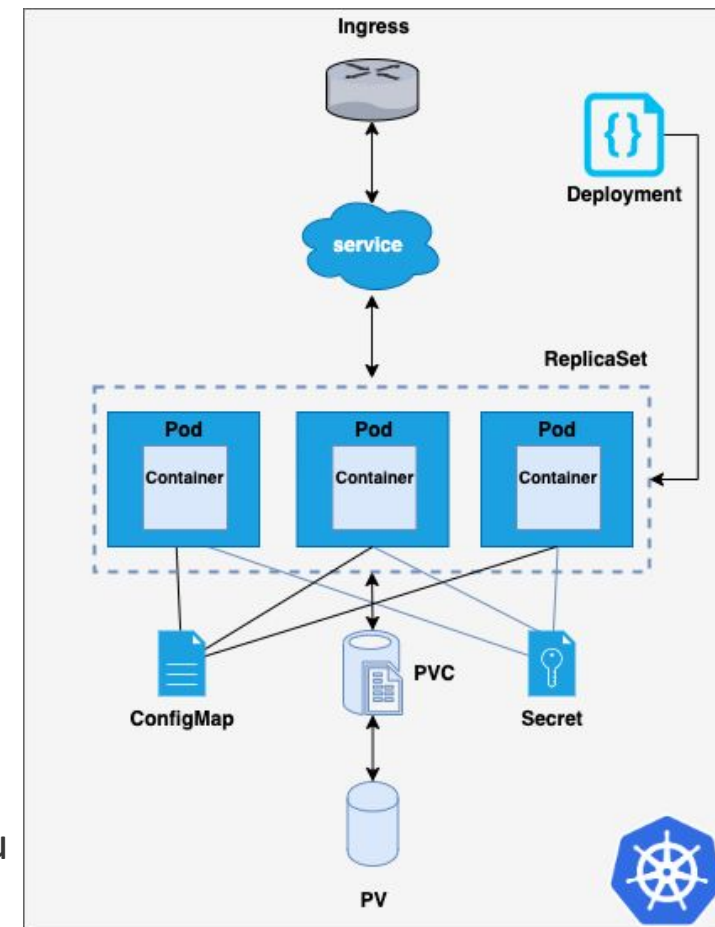
What is Helm?

● Helm is the package manager

● Helm manages charts, releases and versions

© ETSI
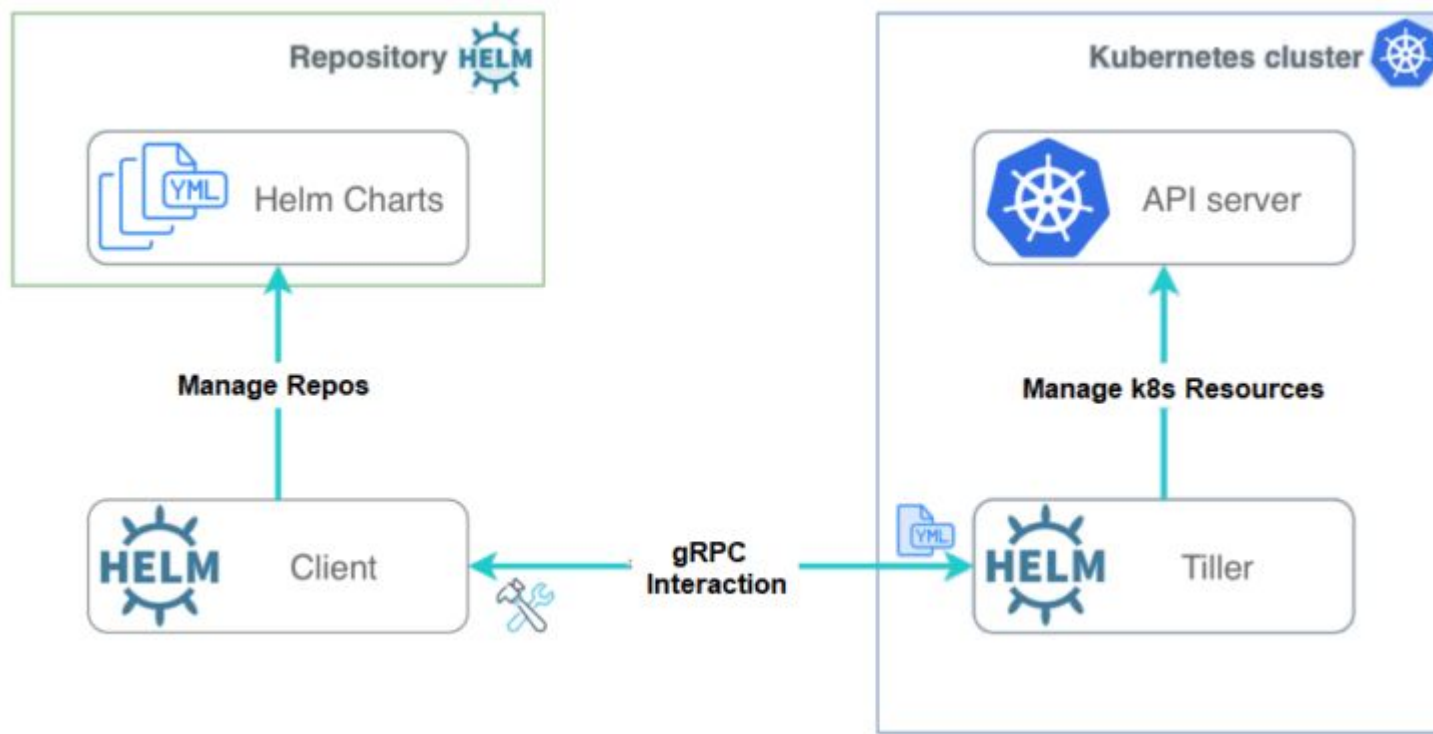
What are Helm Charts?

- Helm chart describes any Kubernetes resources such as deployment, services etc.

- Uses a rich templating system for making charts generic and highly customizable

- Organized as a collection of files inside a directory

- Charts are versioned

  - **appVersion** -> version of app

  - **kubeVersion** -> define constraints on supported Kubernetes versions

```
.
├── Chart.lock
├── charts
│   ├── mariadb
│   └── postgresql
├── Chart.yaml
├── powerdns-5.0.0.tgz
│
README_CONFIG.md.gotmpl
├── README.md
├── templates
│   ├── configmap.yaml
│   ├── deployment.yaml
│   ├── _helpers.tpl
│   ├── NOTES.txt
│   ├── secret.yaml
│   ├── serviceaccount.yaml
│   └── service.yaml
└── values.yaml
```
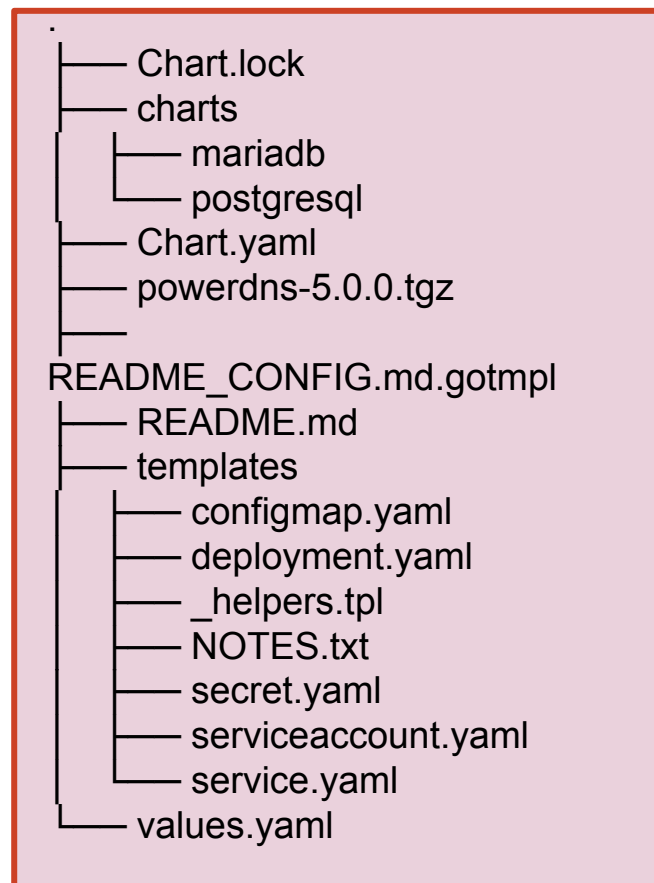
What are Juju Bundles?

- Bundles are collections of charms.

- They represent an entire model, rather than a single application.

- A bundle is a YAML file

Charms + Config + Relations →

```
bundle: kubernetes
applications:
  mariadb-k8s:
    charm: cs:~juju/mariadb-k8s-2
    scale: 1
  mediawiki-k8s:
    charm: cs:~juju/mediawiki-k8s-3
    scale: 1
    options:
      debug: true
relations:
- - mariadb-k8s:server
  - mediawiki-k8s:db
```

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Requirements of K8s-based Applications

- The K8s cluster

  - Can be created in different ways:

  - Standalone: Openshift, Charmed K8s, Kubeadm

  - As part of a VIM: VMware Cloud PKS, AWS, GCP etc.

  - Can run on Bare Metal, on VMs running in a VIM or runs as a service of platform such as EKS, AKS, GKE.

  - Once created, each cluster provides an identical K8s API depending on version, irrespective of the way it was created.

- Specific versions of K8s or CNI plugins might be required
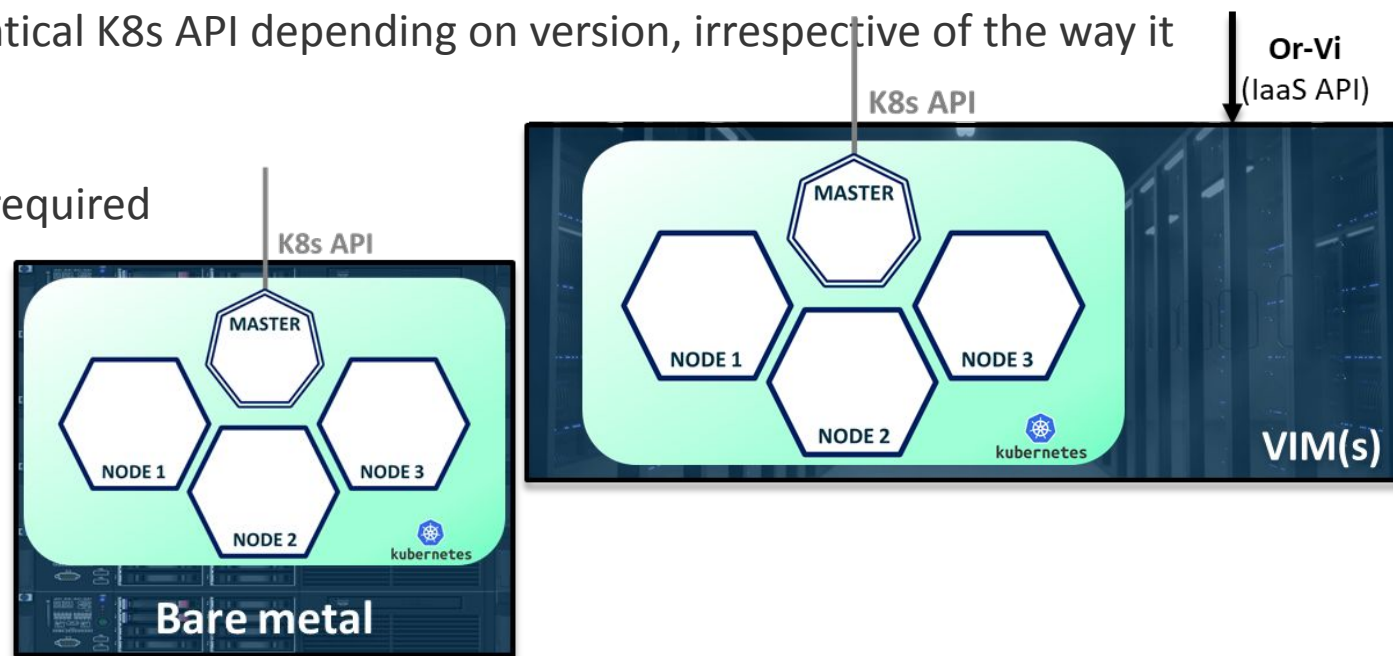
Modelling KNFs

NF composition specified in the VNF descriptor using deployment units:

- Virtual (VDU) = VM

- Physical (PDU) = Physical Node

- Kubernetes (KDU) = K8s app
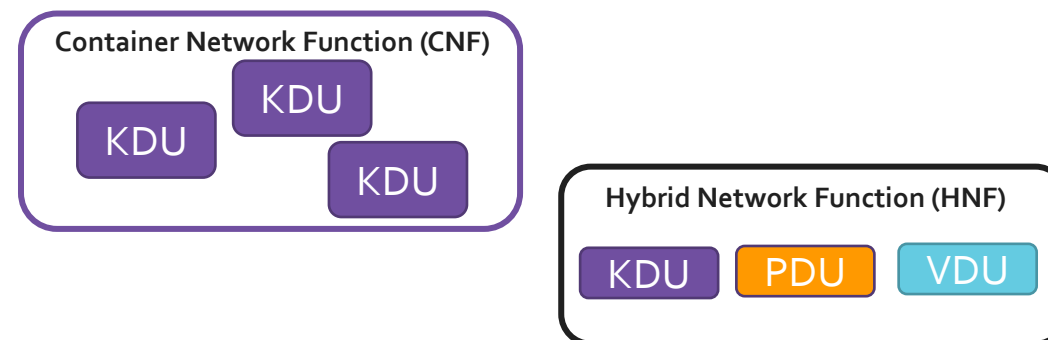
Modelling in the VNF descriptor

KDU based on helm charts or juju bundles

```
+--rw kdu:kdu* [name]
|  +--rw kdu:name              string
|  +--rw kdu:description?       string
|  +--rw (kdu:kdu-model)?
|  |  +--:(kdu:helm-chart)
|  |  |  +--rw kdu:helm-chart?     string
|  |  |  +--rw kdu:helm-version?   enumeration
|  |  +--:(kdu:juju-bundle)
|  |     +--rw kdu:juju-bundle?    string
|  +--rw kdu:service* [name]
|     +--rw kdu:name                       string
|     +--rw kdu:external-connection-point-ref?  string
```

K8s cluster requirements

```
+--rw kdu:k8s-cluster
|  +--rw kdu:version*   string
|  +--rw kdu:cni*       enumeration
|  +--rw kdu:nets* [id]
|     +--rw kdu:id     string
```

Life Cycle Management of KDU

OSM NBI abstracts the operations required to manage the life cycle of KDU **in the context of a NS**

OSM operations:
- NS instantiate
- NS primitive
- NS termination

Full K8s app lifecycle operations:
- install
- upgrade
- rollback
- delete

OSS/BSS

NF Packages (VNF, PNF, HNF)

NS Package

Mgmt Procedures

Resource Description

K8s Deployment Model(s)

Mgmt Procedures

Topology

NBI

Open Source MANO

Or-Vi
(IaaS API)

K8s API

NS instance

MASTER

NODE 1

NODE 2

NODE 3

kubernetes

VIM(s)
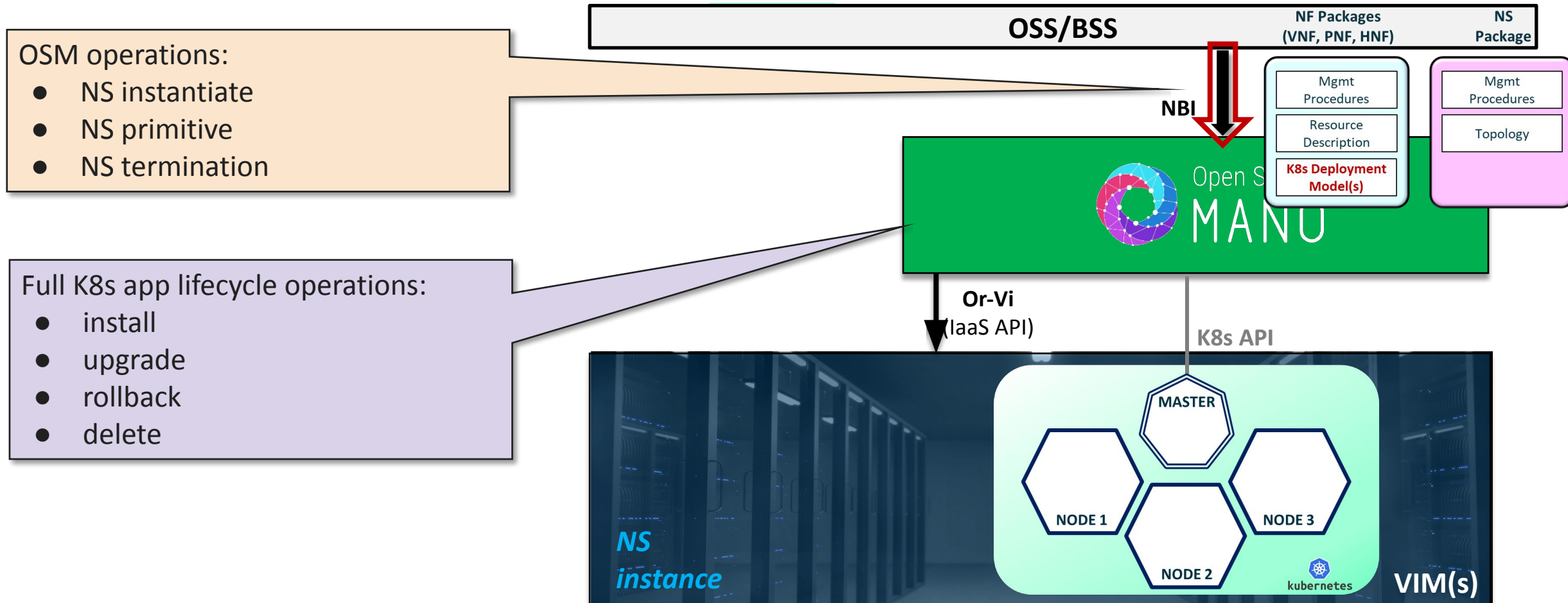
CNF operator runs in a Kubernetes Pod

- A CNF Charm is almost identical to the charms for VNF and PNF workloads

- Runs in a standalone pod if it's proxy charm

- Runs in the same pod as different container if it's native charm

VCA

Charm

Operator Container

Workload Containers

Kubernetes
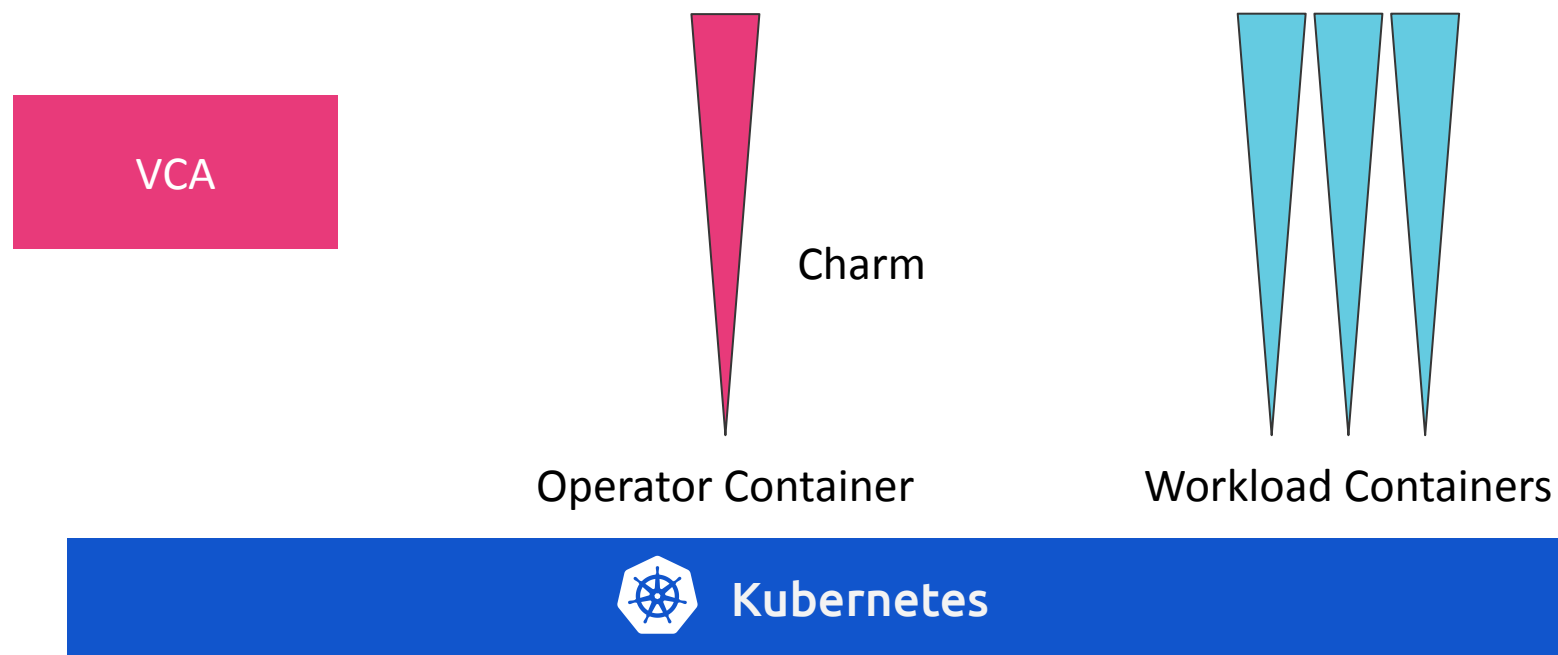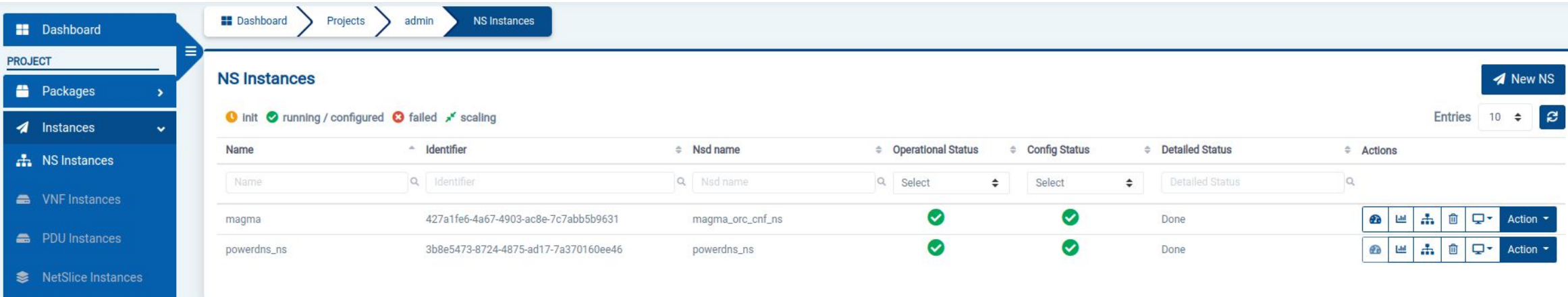
Hands On Session

- Registering Magma Services using PowerDNS

- Accessing Magma Orchestrator GUI

Check the status of Network Services

Check the status of NS using the command:

```
osm ns-list
```

Check the Operational Dashboard

Run Day 2 Actions

Set DNS server in OSM machine

Run the following script under **<u>powerdns-scripts:</u>**

```
./4-setting-dns-server.sh
```

Run the following command to check:

```
cat /etc/resolv.conf |  head -1
```

```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ cat /etc/resolv.conf  | head -1
nameserver 10.0.0.202
```

Download admin operator https certificate

Run the following script under **magma-orc-scripts**

```
./3-download-admin-operator-cert.sh
```

admin_operator.pfx file appears in your current working directory.

```
ls |  grep *.pfx
```

Run get-pfx-package-password action

Run the following script under **magma-orc-scripts**

```
./4-get-admin-operator-credential.sh
```

pfx_package pass appears in the operation output, please save it.

Run get-master-admin-credentials action

Run the following script under **magma-orc-scripts**

```
./5-get-magma-orc-gui-credential.sh
```

admin-password and admin-username appear in the operation output, please save it.

Run get-load-balancer-services action

Run the following script under **magma-orc-scripts**

```
./6-get-loadbalancer-services.sh
```

Load Balancer service names and External IP's are visible in the action output as following:

echo "Load Balancer service names and External IP's are visible in the action output."
echo "'nginx-proxy':   <nginx-proxy External IP>   ->   master.nms.osm.magma.com"
echo "'orc8r-bootstrap-nginx':   <orc8r-bootstrap-nginx External IP>   ->   bootstrapper-controller.osm.magma.com"
echo "'orc8r-clientcert-nginx': <orc8r-clientcert-nginx External IP> ->   controller.osm.magma.com"
echo "'orc8r-nginx-proxy':   <orc8r-nginx-proxy External IP>   ->   api.osm.magma.com"

Save the output to be used in the next steps.

```
ubuntu@osm-1:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/magma-orc-scripts$ ./6-get-loadbalancer-services.sh
=================================================================
Getting Loadbalancer services
=================================================================
detailed-status: In progress
detailed-status: {'nginx-proxy': '10.0.0.204', 'orc8r-bootstrap-nginx': '10.0.0.206', 'orc8r-clientcert-nginx': '10.0.0.207', 'orc8r-nginx-proxy': '10.0.0.205', 'return-code': 0}
```

Run add-zone action

Run the following script under **powerdns-scripts**:

```
./5-add-zone-action.sh
```

When script asks you the zone, enter the following input:

osm.magma.com.

Output of add-zone action

```
+----------------------+--------------------------------------------------------------------------+
| field                | value                                                                    |
+----------------------+--------------------------------------------------------------------------+
| _id                  | "be4b48b3-8e95-4d9c-9788-6fadd873dcc0"                                    |
| id                   | "be4b48b3-8e95-4d9c-9788-6fadd873dcc0"                                    |
| operationState       | "PROCESSING"                                                              |
| queuePosition        | null                                                                     |
| stage                | null                                                                     |
| errorMessage         | null                                                                     |
| detailedStatus       | null                                                                     |
| statusEnteredTime    | 1666010788.9984512                                                       |
| nsInstanceId         | "c0501d24-0422-4aba-b744-47d9c0753df6"                                   |
| lcmOperationType     | "action"                                                                 |
| startTime            | 1666010788.9984512                                                       |
| isAutomaticInvocation| false                                                                    |
| operationParams      | {                                                                        |
|                      |    "member_vnf_index": "powerdns",                                       |
|                      |    "kdu_name": "powerdns",                                               |
|                      |    "primitive": "add-zone",                                              |
|                      |    "primitive_params": "{\"zone_name\": \"osm.magma.com.\"}",            |
|                      |    "lcmOperationType": "action",                                         |
|                      |    "nsInstanceId": "c0501d24-0422-4aba-b744-47d9c0753df6"                |
|                      | }                                                                        |
| isCancelPending      | false                                                                    |
| links                | {                                                                        |
|                      |    "self": "/osm/nslcm/v1/ns_lcm_op_occs/be4b48b3-8e95-4d9c-9788-6fadd873dcc0", |
|                      |    "nsInstance": "/osm/nslcm/v1/ns_instances/c0501d24-0422-4aba-b744-47d9c0753df6" |
|                      | }                                                                        |
| _admin               | {                                                                        |
|                      |    "created": 1666010788.9984758,                                        |
|                      |    "modified": 1666010788.9984758,                                       |
|                      |    "projects_read": [                                                    |
|                      |       "25cb60c47886454cbbaee79d524001d7"                                 |
|                      |    ],                                                                    |
|                      |    "projects_write": [                                                   |
|                      |       "25cb60c47886454cbbaee79d524001d7"                                 |
|                      |    ],                                                                    |
|                      |    "worker": "13a684de697c"                                              |
|                      | }                                                                        |
+----------------------+--------------------------------------------------------------------------+
```

Run add-domain action

Run the following script under powerdns-scripts:

```
./6-add-domain-action.sh
```

Use the output of get-load-balancer-services action.

Replace the <External IP> with the exact service IP:

<nginx-proxy External IP>   ->   master.nms.osm.magma.com
<orc8r-bootstrap-nginx External IP>   ->   bootstrapper-controller.osm.magma.com
<orc8r-clientcert-nginx External IP>   ->   controller.osm.magma.com
<orc8r-nginx-proxy External IP>   ->   api.osm.magma.com

Run add-domain action

When script asks you the inputs, register domain name by entering inputs zone, domain and ip.
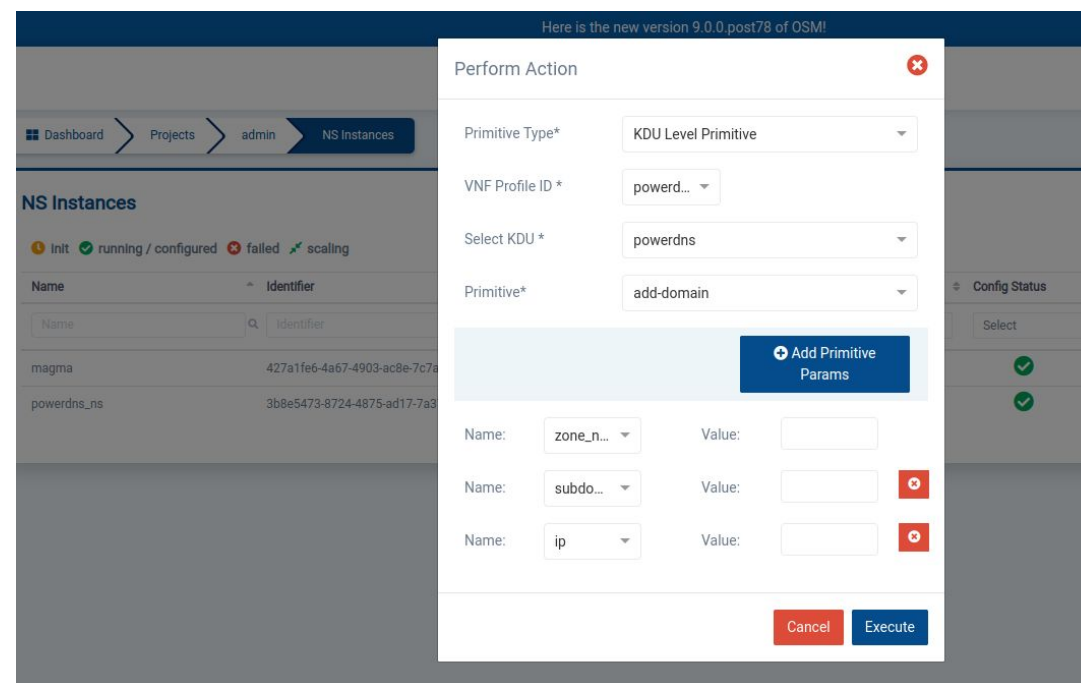
Run the action 4 times to register all domain names.

Sample domain name registration using action:

api.osm.magma.com
ZONE=osm.magma.com.
DOMAIN=api.
IP=<orc8r-nginx-proxy External IP>

Output of add-domain action

```
+---------------------+-----------------------------------------------------------------------------+
| field               | value                                                                       |
+---------------------+-----------------------------------------------------------------------------+
| _id                 | "ca247fb6-8faa-46ee-b396-19efb2998131"                                      |
| id                  | "ca247fb6-8faa-46ee-b396-19efb2998131"                                      |
| operationState      | "PROCESSING"                                                                |
| queuePosition       | null                                                                        |
| stage               | null                                                                        |
| errorMessage        | null                                                                        |
| detailedStatus      | null                                                                        |
| statusEnteredTime   | 1666011765.8786762                                                          |
| nsInstanceId        | "c0501d24-0422-4aba-b744-47d9c0753df6"                                     |
| lcmOperationType    | "action"                                                                    |
| startTime           | 1666011765.8786762                                                          |
| isAutomaticInvocation | false                                                                     |
| operationParams     | {                                                                           |
|                     |     "member_vnf_index": "powerdns",                                         |
|                     |     "kdu_name": "powerdns",                                                  |
|                     |     "primitive": "add-domain",                                              |
|                     |     "primitive_params": "{\"zone_name\": \"osm.magma.com.\", \"subdomain\": \"master.nms.\", \"ip\": |
|                     | \"10.0.0.204\"}",                                                           |
|                     |     "lcmOperationType": "action",                                           |
|                     |     "nsInstanceId": "c0501d24-0422-4aba-b744-47d9c0753df6"                  |
|                     | }                                                                           |
| isCancelPending     | false                                                                       |
| links               | {                                                                           |
|                     |     "self": "/osm/nslcm/v1/ns_lcm_op_occs/ca247fb6-8faa-46ee-b396-19efb2998131", |
|                     |     "nsInstance": "/osm/nslcm/v1/ns_instances/c0501d24-0422-4aba-b744-47d9c0753df6" |
|                     | }                                                                           |
| _admin              | {                                                                           |
|                     |     "created": 1666011765.8787055,                                          |
|                     |     "modified": 1666011765.8787055,                                         |
|                     |     "projects_read": [                                                       |
|                     |         "25cb60c47886454cbbaee79d524001d7"                                  |
|                     |     ],                                                                       |
|                     |     "projects_write": [                                                      |
|                     |         "25cb60c47886454cbbaee79d524001d7"                                  |
|                     |     ],                                                                       |
|                     |     "worker": "13a684de697c"                                                |
|                     | }                                                                           |
+---------------------+-----------------------------------------------------------------------------+
```

Test domain name resolution

Run the following script under powerdns-scripts:

```
./7-test-dns-record.sh
```

When script asks you the input, add domain names registered at previous step.

Run the script 4 times to check all domain names.

Sample input:

master.nms.osm.magma.com

Output of domain name resolution test

Access Magma Orc8r GUI

Firefox browser is already installed in your remote machine.
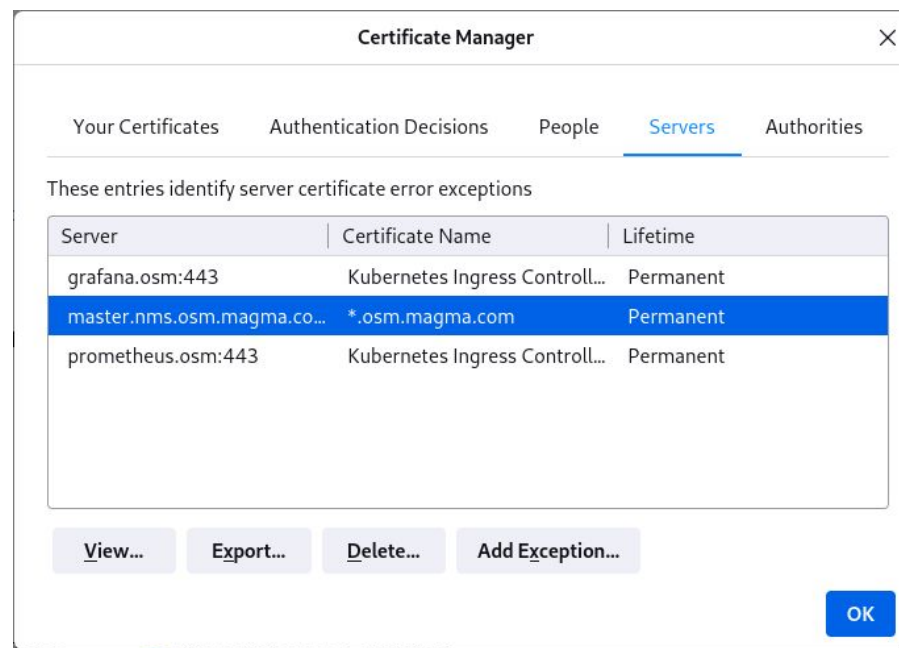
Open the browser and import the admin_operator.pfx using certificate import.

When it asks you a password, please enter pfx_package pass.

Try to reach following URL using your browser: https://master.nms.osm.magma.com.
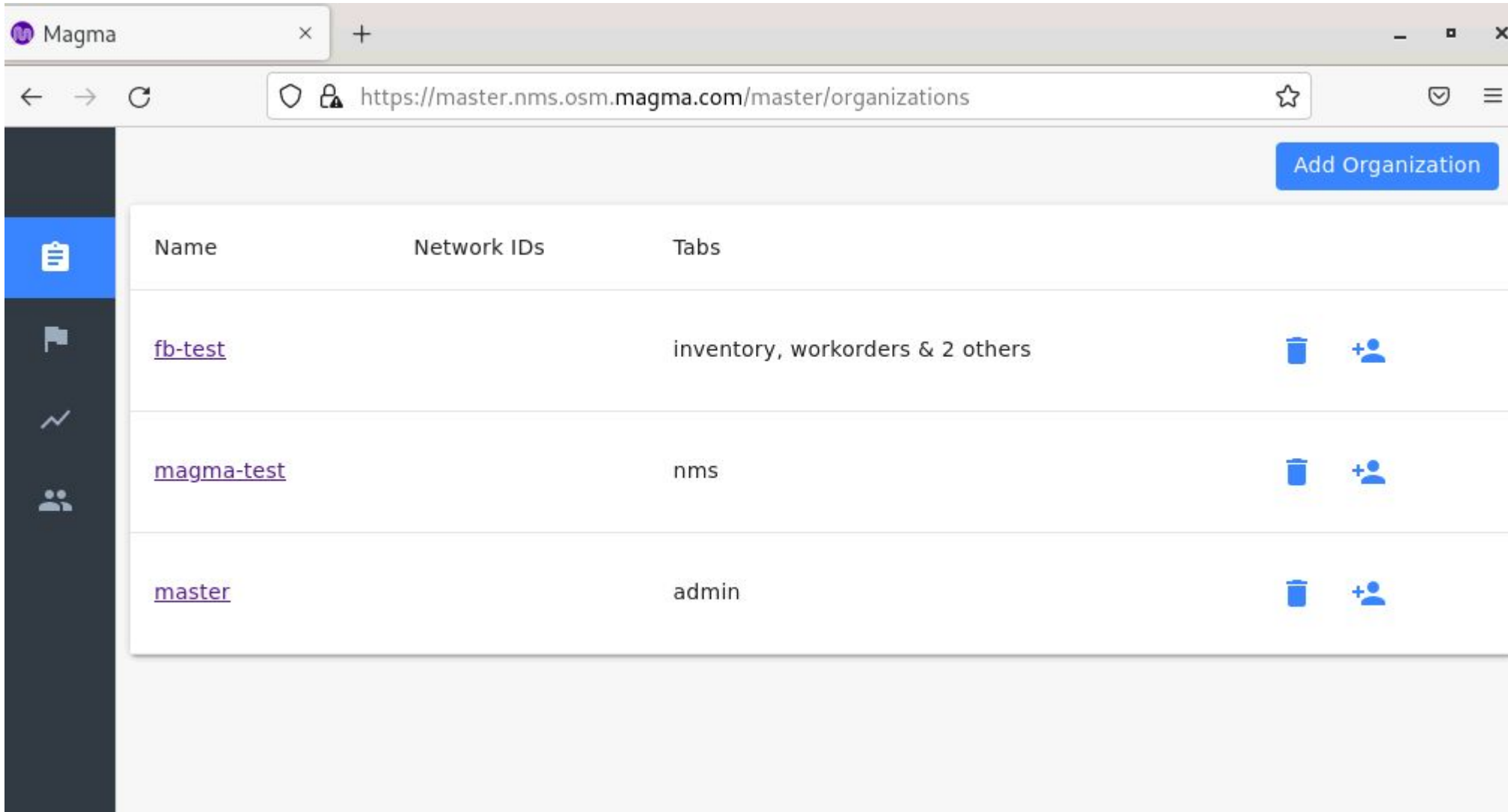
Use the admin-username and admin-password to login.

Import certificate by following steps in your browser:

Firefox settings -> Privacy & Security -> Certificates

Access Magma Orc8r GUI

Run scale out/scale in actions

Run the following script under powerdns-scripts:

```
./12-scale-out.sh
```

```
ubuntu@osm-10:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ ./11-scale-out.sh
Enter replicaCount number to scale as number greater than 1:3
You entered NUM 3 ================================================================
Scaling out
================================================================
================================================================
Showing action status
Check the action status using osm ns-op-show 1d7abe3d-c6be-4ddf-bf65-8ff081935128 --literal | yq .operationState
================================================================
PROCESSING
================================================================
Showing replicaCount number
Check the replicaCount using osm vnf-show 812a7f40-abee-4e63-9ddb-7d180e0e5030 --kdu powerdns | yq .config.replicaCount
ubuntu@osm-10:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ osm vnf-show 812a7f40-abee-4e63-9ddb-7d180e0e5030 --kdu powerdns | yq .config.replicaCount
3
```

```
./12-scale-in.sh
```

```
ubuntu@osm-10:~/osm-packages/Hackfest_Demos/OSM-MR13/2.1-KNF/powerdns-scripts$ ./12-scale-in.sh
================================================================
Rolling back
================================================================
================================================================
Showing action status
Check the action status using osm ns-op-show e1ccf1b4-0518-438f-a57b-770003ef3e2a
================================================================
PROCESSING
================================================================
Showing replicaCount number
Check the replicatCount number using osm vnf-show 812a7f40-abee-4e63-9ddb-7d180e0e5030 --kdu powerdns | yq .config.replicaCount
================================================================
1
```
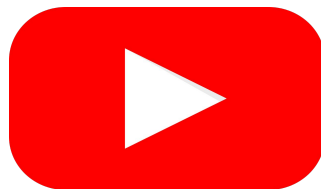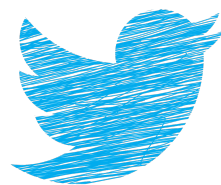
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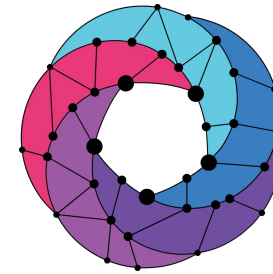
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