LF NETWORKING
Developer & Testing Forum

Cross Community Collaboration

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PTL – ONAP SO, ORAN-SC SMO

https://lfnetworking.org

Problem Statement

- Unification of the Brown & Green zones
- LCM of xNFs / applications Seamlessly
- Sharable Persistency layer (for Heterogenous workloads)
- Service Assurance
- Easy to Integrate/ Extend /Audit

Frankfurt

ONAP

OPEN NETWORK AUTOMATION PLATFORM

OSS / BSS / Other

NBI

Legend: Design | Orchestration & Management | Operations | Deprecated

Honolulu

ONAP

OPEN NETWORK AUTOMATION PLATFORM

Design-Time

Run-Time

Manage ONAP

ONAP Operations Manager (OOM)

VNF Validation | VVP | VNF SDK

Portal | O&M Dashboard (VID) | Use-Case UI | External APIs | CLI | Interfaces

Service Design & Creation (SDC)

- Service/xNF Design
- xNF Onboarding
- Workflow Designer
- Controller Design Studio
- DCAE Design Studio
- Catalog

(...)

Control Loop Automation (CLAMP)

Policy Framework

Service Orchestration (SO)

Active & Available Inventory (AAI)

External System Register (ESR)

Microservice Bus (MSB)

Message & Data Routers (DMaaP)

DCAE

- Correlation Engine (Holmes)
- Collectors

Infrastructure Adaptation (Multi-VIM/ Cloud)

Controller Design Studio (CDS)

SDN Controller (SDNC)

Application Controller (APPC)

Virtual Function Controller (VFC)

Shared Services

- AuthN/AuthZ (AAF)
- Optimization (OOF)
- Logging
- Audit (POMBA)
- Multi-Site State (MUSIC)
- CPS

ONAP Shared Utilities

- CCSDK
- Model Utilities
- TOSCA Parser

External Systems | Third Party Controllers | sVNFM | EMS

Network Function Layer | VNFs ... | PNFs

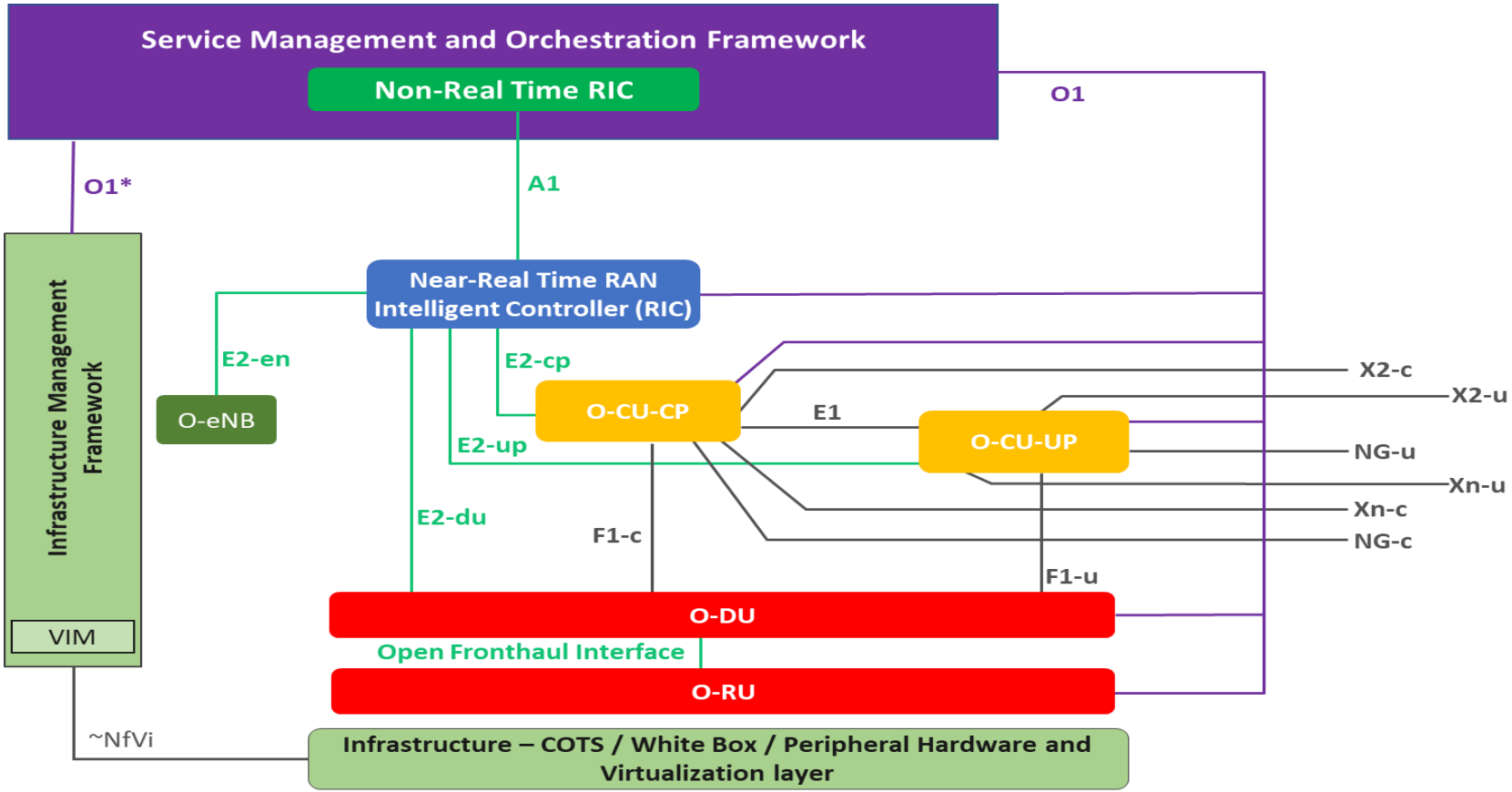
Hypervisor / OS Layer | OpenStack | Commercial VIM | Kubernetes | Public Cloud

Private Edge Cloud — MPLS — Private DC Cloud — IP — Public Cloud

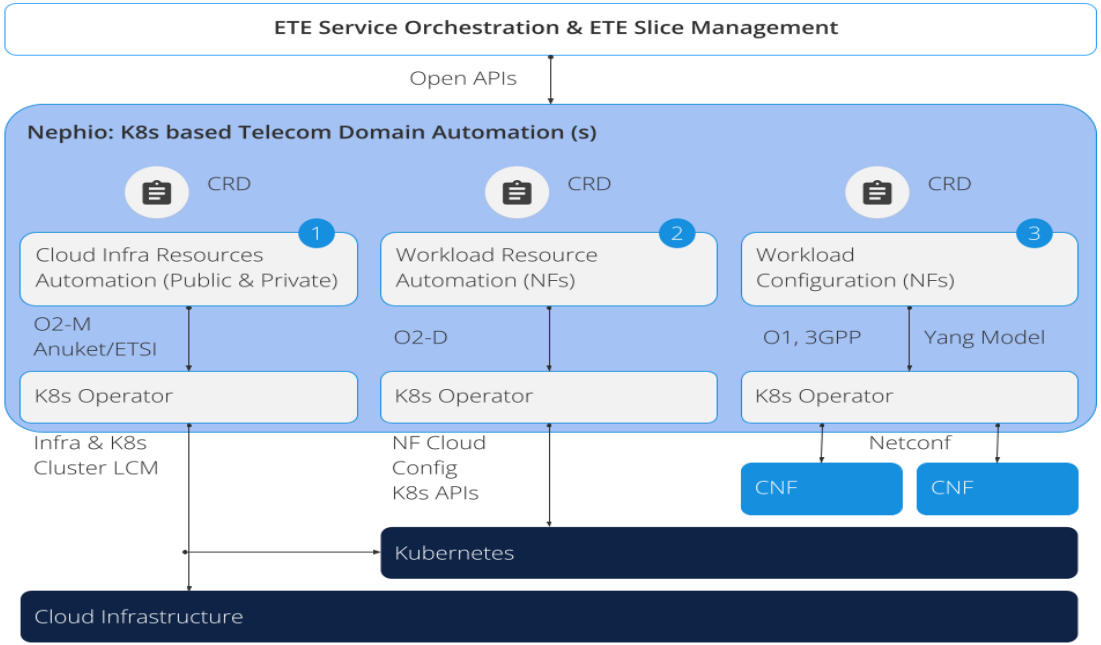
Managed Environment

Honolulu-R8

ORAN Architecture



How Nephio Works



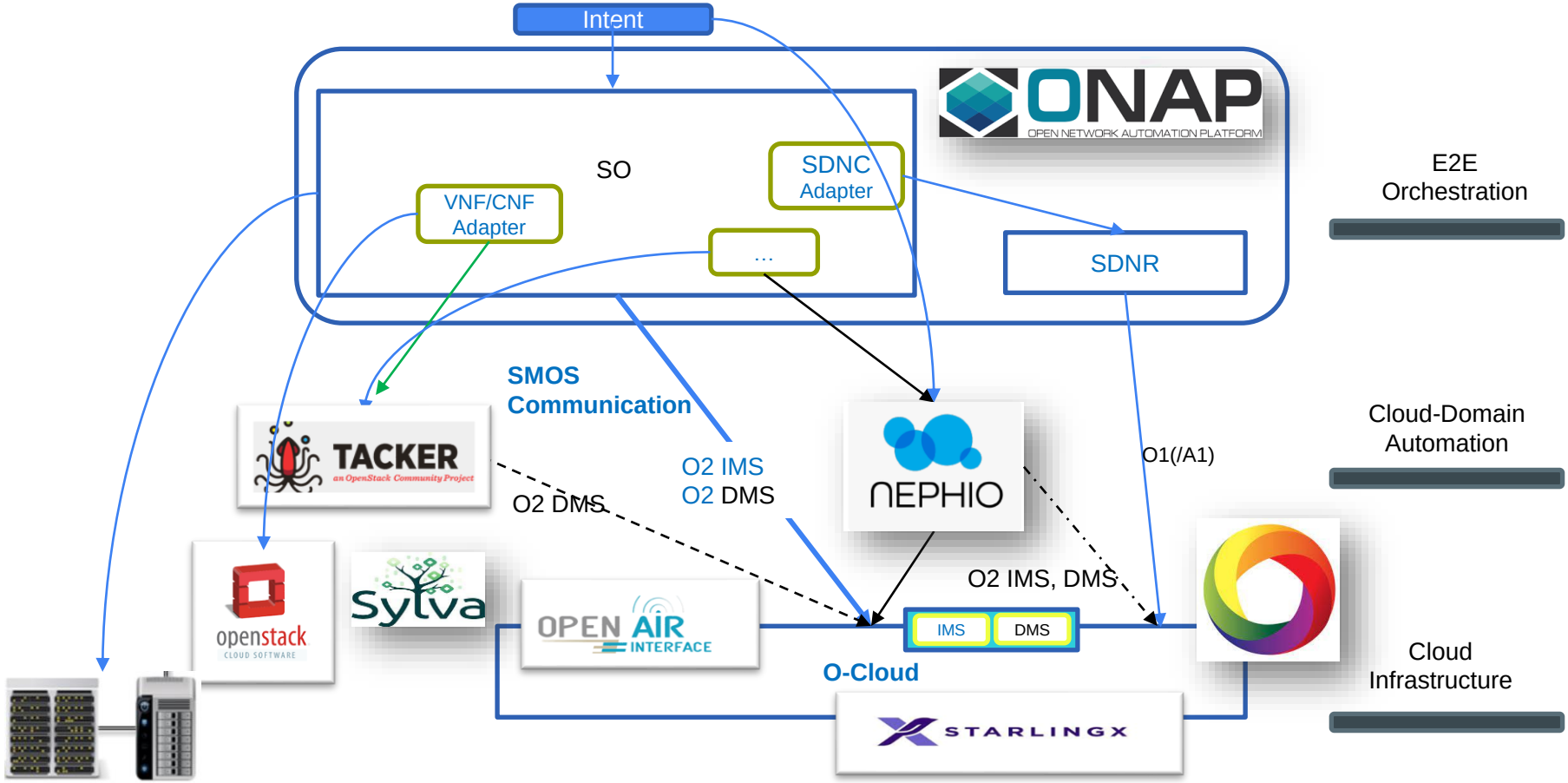
Utilizing Kubernetes as the automation control plane at each layer of the stack simplifies the overall automation and enables declarative management with active reconciliation for the entire stack.

We can broadly think of three layers in the stack,

1) cloud infrastructure,
2) workload (network function) resources, and
3) workload (network function) configuration.

Nephio is establishing open, extensible Kubernetes Custom Resource Definition (CRD) models for each layer of the stack, in conformance to the **3GPP & O-RAN standard.**

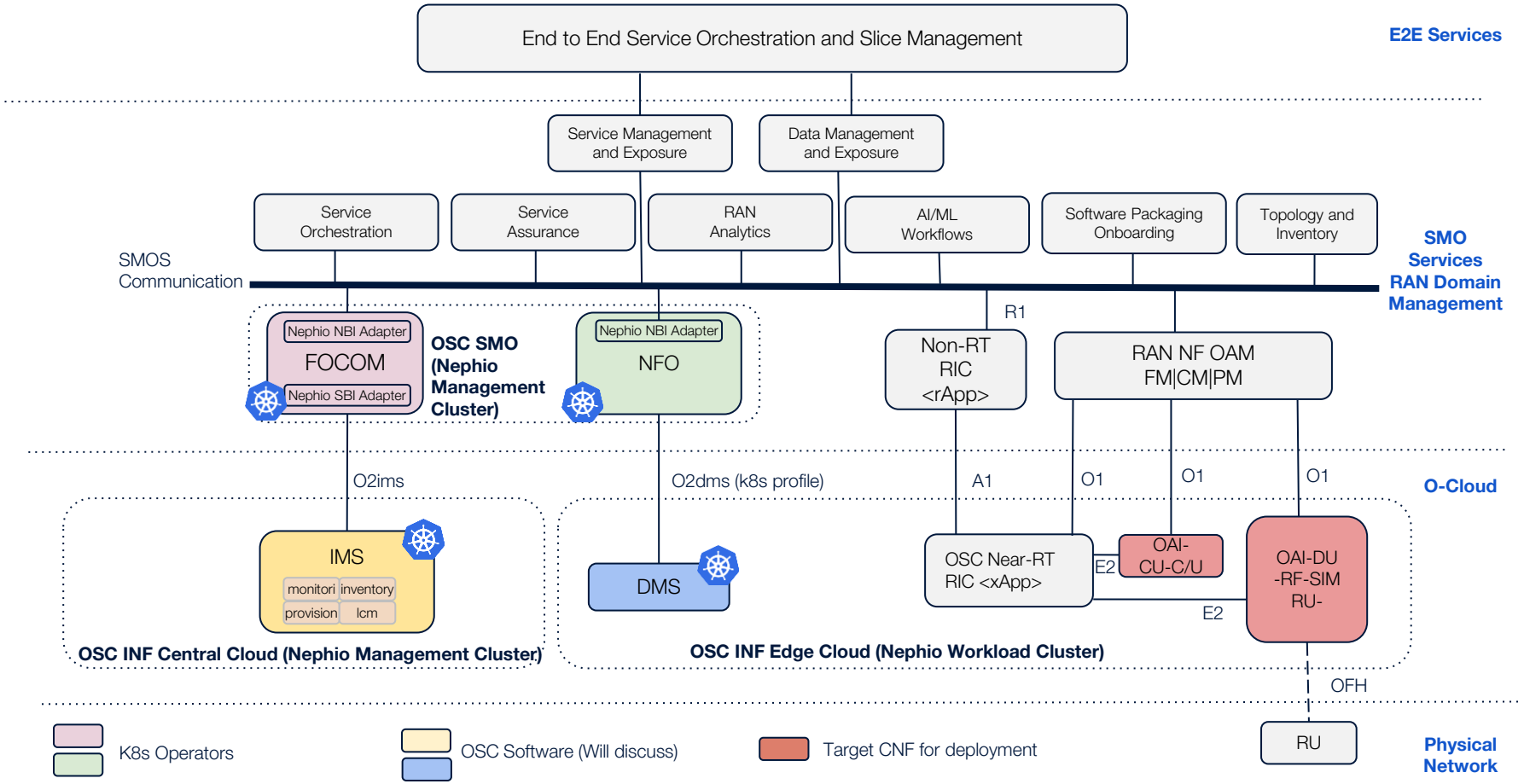
Possible Integrations



Where We are

NF Orchestration Using SMO (Architecture) - Integrations

O-RAN Network Function Deployment Instantiation Using SMO



Further Details of OSC I and Nephio 3 releases

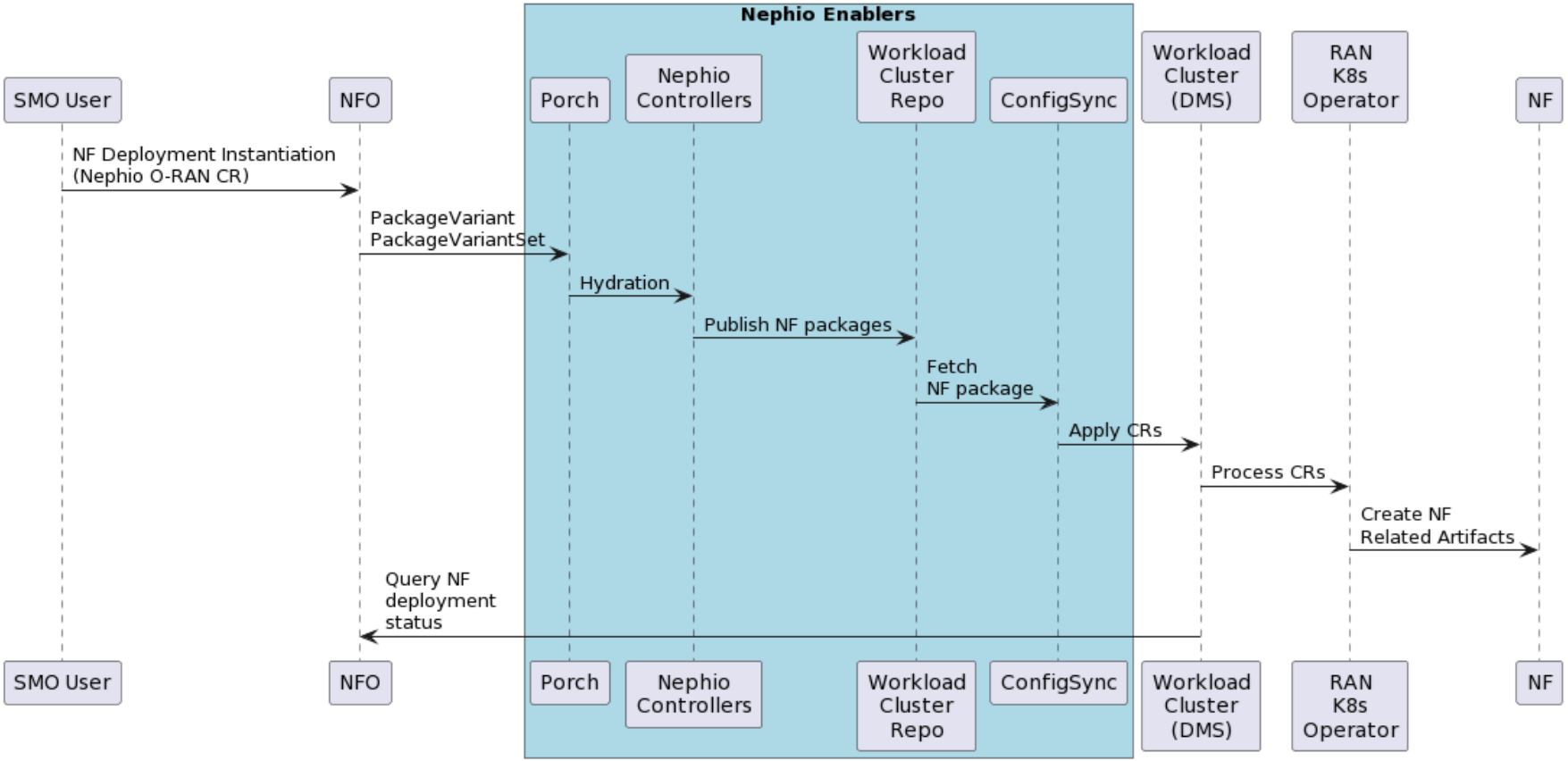
Scope and Priority

1. Deployment of OAI-DU, OAI-CU-CP/UP
    a. (Current OSC mechanism) Via Helm Charts
    b. (Extension of Nephio R2) Via KPT packages. Prerequisite: We will require Nephio RAN K8s operator to be deployed by FOCOM. Re-use of R2 RAN packages.
2. **Stretch**: Delete RAN NF Deployment
3. Update and modify of NF Deployment is not in scope
4. Timeline: Targeted for O-RAN J release and Nephio R3

Needed Software Development

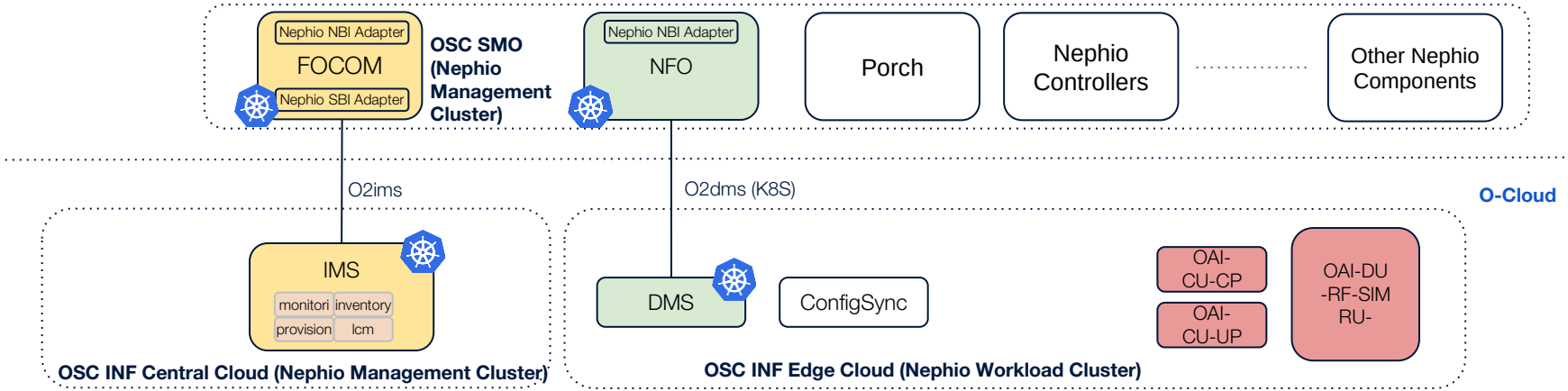
1. Development of NFO
    a. Development of NFO service logic adapted to deployment of OSC K8S profile (NFs packaged as Helm Charts) **NOTE**: No Nephio enablers will be used at this step
    b. Adapting the NFO service logic to deploy RAN NFs via Nephio Enablers (Nephio O-RAN CR).
    c. NFO source code will be hosted in OSC Gerrit
2. Development and re-use of DMS, OSC Components (SMO, INF(IMS & DMS), OAM, RIC, Integration)
3. Re-use of helm-charts of OAI (DU, CU-C/U) - OSC
4. Re-Use of the Nephio RAN K8s Operator and KPT Packages

Sequence Flow Diagram (with Nephio Enablers)



Component Architecture

NFO in Nephio Management Cluster



K8s Operators

Target CNF for deployment

NF Orchestration use case : Gap Analysis and Potential Enhancements for R4

R3 Assumptions

- FOCOM doesn’t have inventory state of the Physica/Virtual or K8S Cluster resources
- Currently, the use case assumes O-Cloud/IMS registers with the FOCOM, and FOCOM queries the O-Cloud/IMS for DMS-id (kubeconfig) information
- There is no assumption on prior execution of O-Cloud Registration or Create Cluster Use cases

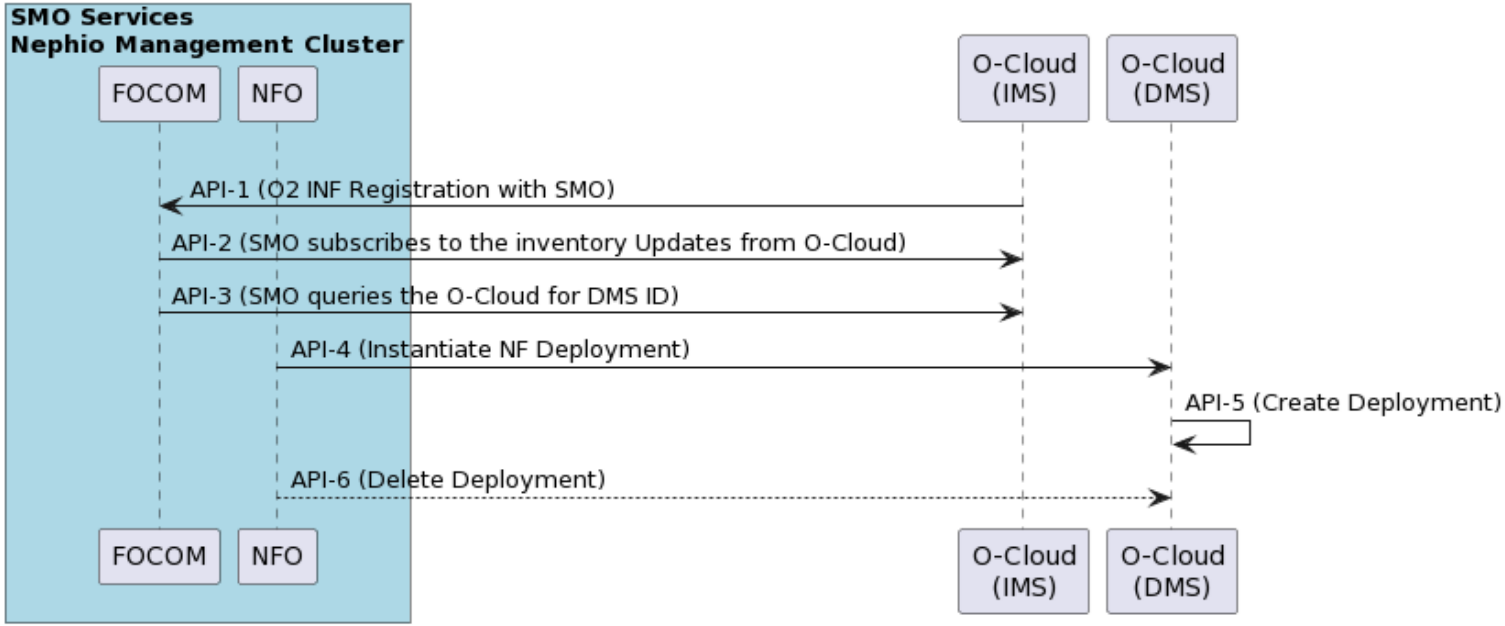
R4 Enhancements

- O-Cloud Resource Inventory DB in FOCOM, after executing the O-Cloud Register use case
- O-Cloud Cluster information in the FOCOM DB, after executing the O-Cloud Create Cluster use case
- NF Orchestration CR will trigger DMS to query FOCOM Inventory DB for the Cluster information based on the Site/Location intent in the CR

Appendix

Sequence Flow Diagram (APIs in the Appendix Section)

Dependencies and O-RAN Deployment Flow



E2E test environment (Nephio)

1. Prerequisite
    a. SMO (FOCOM, NFO) and OSC components are deployed on the management cluster.
    b. FOCOM creates the K8s edge cloud (workload cluster) and DMS(k8S api) is brought up in this process
    c. FOCOM installs the necessary CRDs and Operators required to handle the NF Deployment in the desired K8S Cluster
    d. Cluster registration (DMS will register its information in IMS DB)
    e. Nf deployment Kpt Packages/Helm-charts or other dependent artifacts should be available and accessible via NFO
2. Deployment:
    a. NFO should fetch DMS information
    b. NFO will receive the request for CU-CP deployment and will bring up CU-CP
    c. NFO will receive the request for CU-UP and DU deployment and will bring up CU-UP and DU
    d. We will use the KPT packages based deployment if and when ready. (Nephio)
3. This will be first implemented in OSC and then ported to the Nephio.
4. Integration test
    a. The trigger to deploy would be initiated as a Nephio O-RAN CR/REST call to NFO (for the time being).
    b. Stretch: Deploy NR-UE (Emulated package used in Nephio R2 and can be deployed via NFO because they are expressed as helm-charts) and make an end to end call

API Details/Design

API 1: O2 Registration, Provisioning INF platform with SMO endpoint configuration

- Configure INF platform with SMO endpoint address. This provisioning of INF O2 service will make a request from INF O2 service to SMO, that make SMO know the O2 service is working.

  It needs SMO to have an API like "*http(s)://SMO_HOST:SMO_PORT/registration*", which can accept JSON format data.

```
curl -X 'POST' \
  'http://'${IP}':30205/provision/v1/smo-endpoint' \
  -H 'accept: application/json' \
  -H 'Content-Type: application/json' \
  -d '{
  "endpoint": "http://<SMO_HOST>:<SMO_PORT>/registration"
 }'
```

API Details/Design

API-2 : O2 Inventory Subscription, create subscription in the INF O2 IMS

```
curl -X 'POST' \
  "http://${IP}:30205/o2ims_infrastructureInventory/v1/subscriptions" \
  -H 'accept: application/json' \
  -H 'Content-Type: application/json' \
  -d '{
  "callback": "http://SMO/address/to/callback",
  "consumerSubscriptionId": "<ConsumerIdHelpSmoToIdentify>",
  "filter": "<ResourceTypeNameSplitByComma,EmptyToGetAll>"
 }'
```

API Details/Design

API 3: Orchestrate CNF in helm chart , get the DMS Id in the INF O2 service

```
curl --location --request GET
"http://${IP}:30205/o2ims_infrastructureInventory/v1/deploymentManagers"

export dmsId=`curl --location --request GET
"http://${OAM_IP}:30205/o2ims_infrastructureInventory/v1/deploymentManagers"
2>/dev/null | jq     .[].deploymentManagerId | xargs echo

echo ${dmsId}
```

API Details/Design

API 4: Create NfDeploymentDescriptor on the INF O2 DMS

```
curl --location --request POST "http://${IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeploymentDescriptor" \

--header 'Content-Type: application/json' \

--data-raw '{

  "name": "cfwdesc1",

  "description": "demo nf deployment descriptor",

  "artifactRepoUrl": "http://'${NODE_IP}':30330",

  "artifactName": "firewall-host-netdevice",

  "inputParams":

  "{\n  \"image\": {\n    \"repository\": \"ubuntu\",\n    \"tag\": 18.04,\n    \"pullPolicy\": \"IfNotPresent\"\n
},\n  \"resources\": {\n    \"cpu\": 2,\n    \"memory\": \"2Gi\",\n    \"hugepage\": \"0Mi\",\n
\"unprotectedNetPortVpg\": \"veth11\",\n    \"unprotectedNetPortVfw\": \"veth12\",\n    \"unprotectedNetCidr\":
\"10.10.1.0/24\",\n    \"unprotectedNetGwIp\": \"10.10.1.1\",\n    \"protectedNetPortVfw\": \"veth21\",\n
\"protectedNetPortVsn\": \"veth22\",\n    \"protectedNetCidr\": \"10.10.2.0/24\",\n    \"protectedNetGwIp\":
\"10.10.2.1\",\n    \"vfwPrivateIp0\": \"10.10.1.1\",\n    \"vfwPrivateIp1\": \"10.10.2.1\",\n    \"vpgPrivateIp0\":
\"10.10.1.2\",\n    \"vsnPrivateIp0\": \"10.10.2.2\"\n  }\n}",

  "outputParams": "{\"output1\": 100}"

}'
```

API Details/Design

```
curl --location --request GET
"http://${OAM_IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeploymentDescriptor"

export descId=` curl -X 'GET'
"http://${OAM_IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeploymentDescriptor"   -H
'accept: application/json'   -H 'X-Fields: id' 2>/dev/null | jq .[].id | xargs echo`

echo ${descId} (are these part of API-4?)
```

API-5: Create NfDeployment on the INF O2 DMS: This will trigger an event inside of the IMS/DMS, and use the K8S API to create a real pod

```
      POST "http://${OAM_IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeployment"
\
         --header 'Content-Type: application/json' \
         --data-raw '{
           "name": "cfw100",
           "description": "demo nf deployment",
           "descriptorId": "'${descId}'",
           "parentDeploymentId": ""
         }'
```

https://docs.o-ran-sc.org/projects/o-ran-sc-pti-o2/en/e-release/user-guide.html

API Details/Design

API-6: Delete the deployment (Stretch)

```
        export NfDeploymentId=`curl --location --request GET
"http://${OAM_IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeployment" 2>/dev/null
|
        jq .[].id | xargs echo`
        echo ${NfDeploymentId} # Check the exported deployment id
        curl --location --request DELETE
"http://${OAM_IP}:30205/o2dms/${dmsId}/O2dms_DeploymentLifecycle/NfDeployment/${NfDeployme
ntId}"
```