

Release I: rApp Manager

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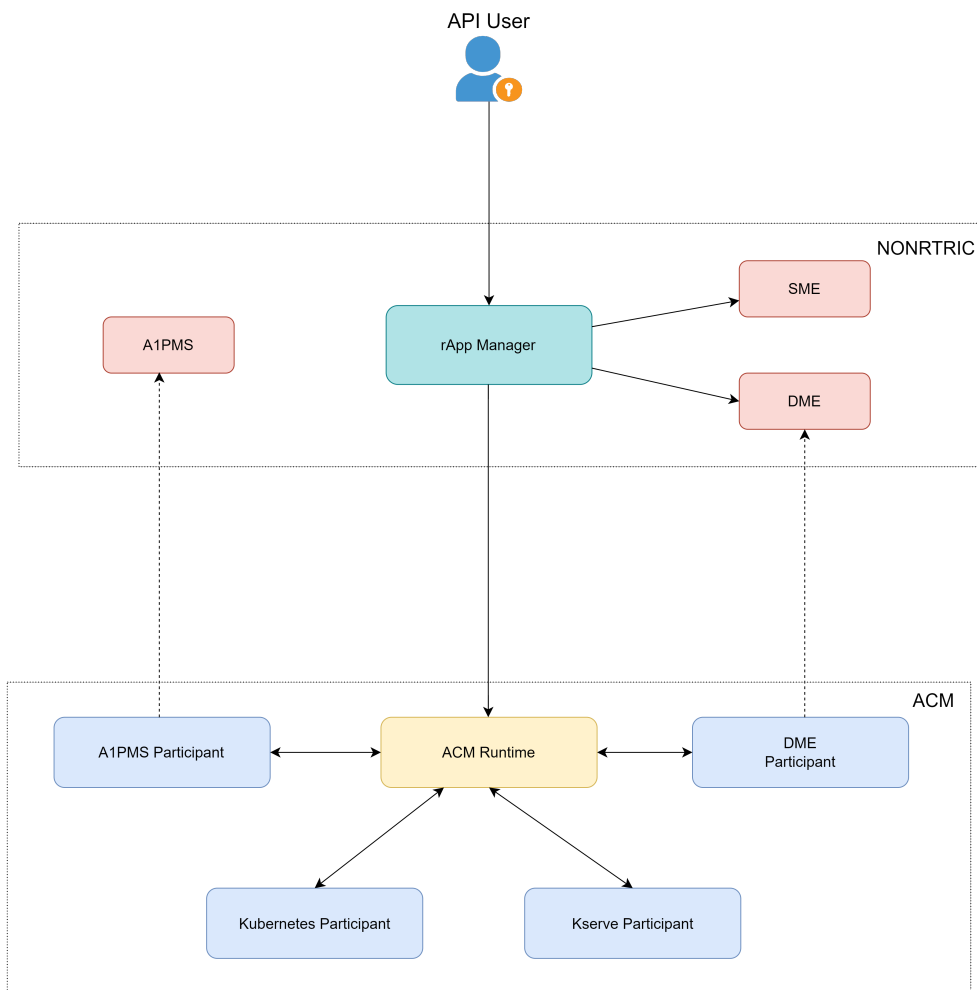
Introduction

The rApp Manager is a lifecycle management service for rApps. It gets the rApp as an ASD formatted package and lifecycle manages it based on its instance configuration. It uses ONAP ACM for lifecycle management operations and it integrates with other components for managing the rApp.

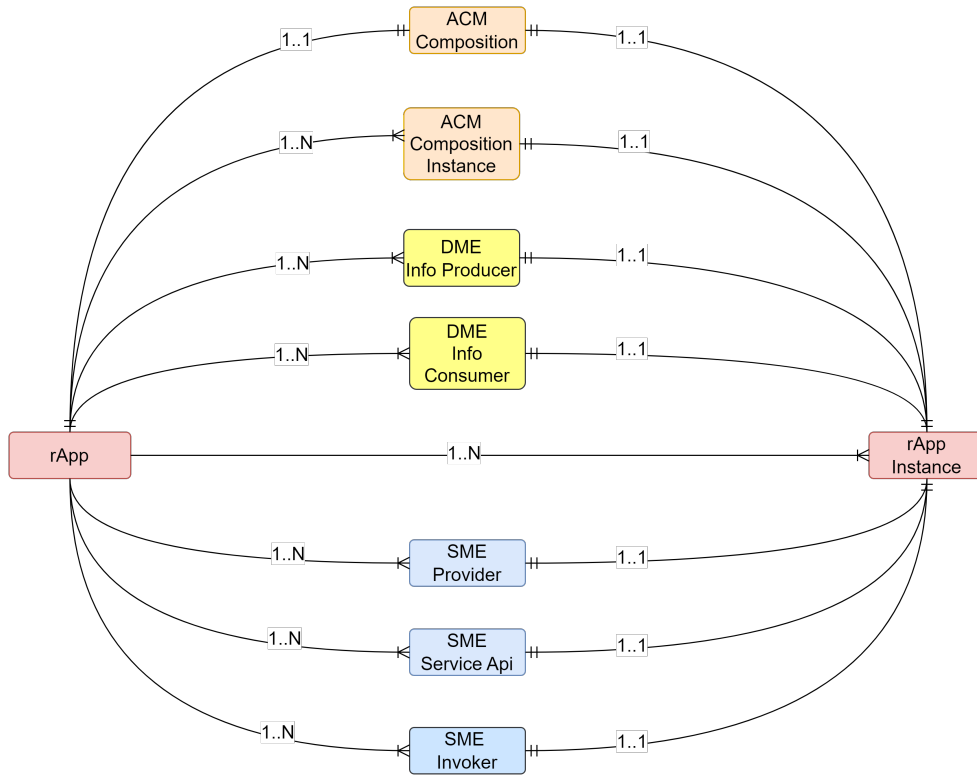
The ASD package contains the details required to create and integrate the required services/components. Each ASD package contains only one rApp and one rApp can have any number of rApp instances.

Source code repository : <https://gerrit.o-ran-sc.org/r/gitweb?p=nonrtric%2Fplt%2Frapppmanager.git;a=summary>

Architecture



rApp Data Model



Integrations

The rApp Manager is integrated with the following components to support lifecycle managing the rApp.

ACM

Automation Composition Management (ACM) is a framework that supports Life Cycle Management of Automation Compositions. It supports deployment, monitoring, update and removal of Automation Compositions en-bloc, allowing users to manage their features, services, and capabilities as single logical units. More details about ACM can be found [here](#).

ACM-R has the ability to support an unlimited number of participants and all the participants can be configured through the configuration in the rApp package.

List of participants used by rApp manager sample rApp.

- A1PMS Participant - It interacts with A1PMS of NONRTRIC. It is capable of lifecycle managing A1PMS service.
- Kserve Participant - It interacts with Kserve. It is capable of lifecycle managing Kserve inference service.
- Kubernetes Participant - It interacts with Helm/Kubernetes. It is capable of lifecycle managing Helm charts. It expects the helm charts to be available in the mentioned repository as it doesn't handle the helm chart creation in the chart repository.
- DME Participant - It interacts with DME(ICS) of NONRTRIC. It is capable of lifecycle managing DME entities.

ACM composition and instance details can be provided as part of the rApp package and the package structure can be found [here](#).

DME

The DME(Information Coordination Service (ICS)) is a generic service that maintains data subscriptions. Its main purpose is to decouple data consumers and data producers in a multi vendor environment. A data consumer does not need to know anything about the producers of the data. More details about DME can be found [here](#).

It is integrated with rApp manager to enable the rApp to produce/consume specific type of data(Information Type in DME terms).

Information type, and Data producer/consumer information can be provided as part of rApp package and the package structure can be found [here](#).

SME

The CAPIF stands for Common API framework and it was developed by 3GPP to enable a unified Northbound API framework across 3GPP network functions, and to ensure that there is a single and harmonized approach for API development. More details about SME can be found [here](#).

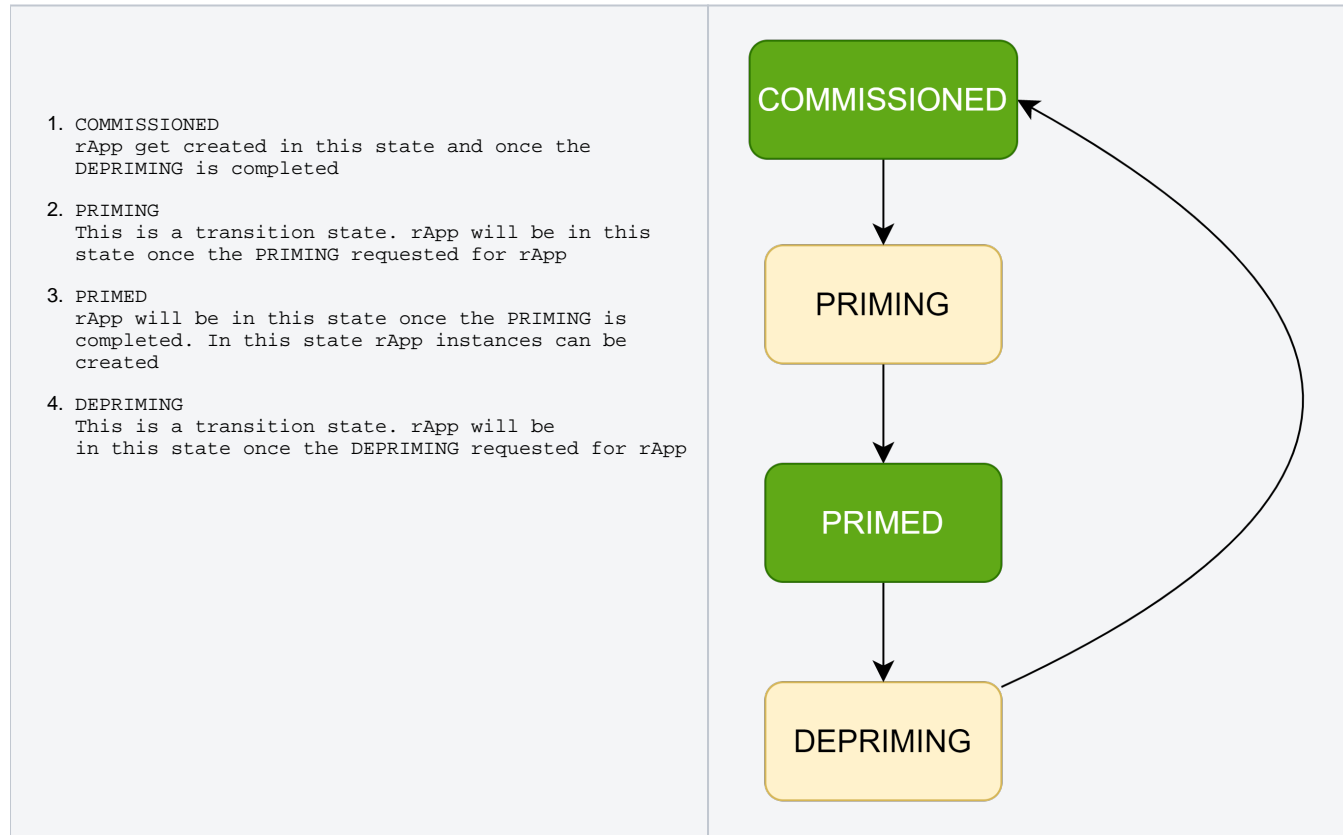
It is integrated with rApp manager to enable the rApp to expose/access/discover endpoints.

Service exposure/access related configurations can be provided as part of rApp package and the package structure can be found [here](#).

State Transitions

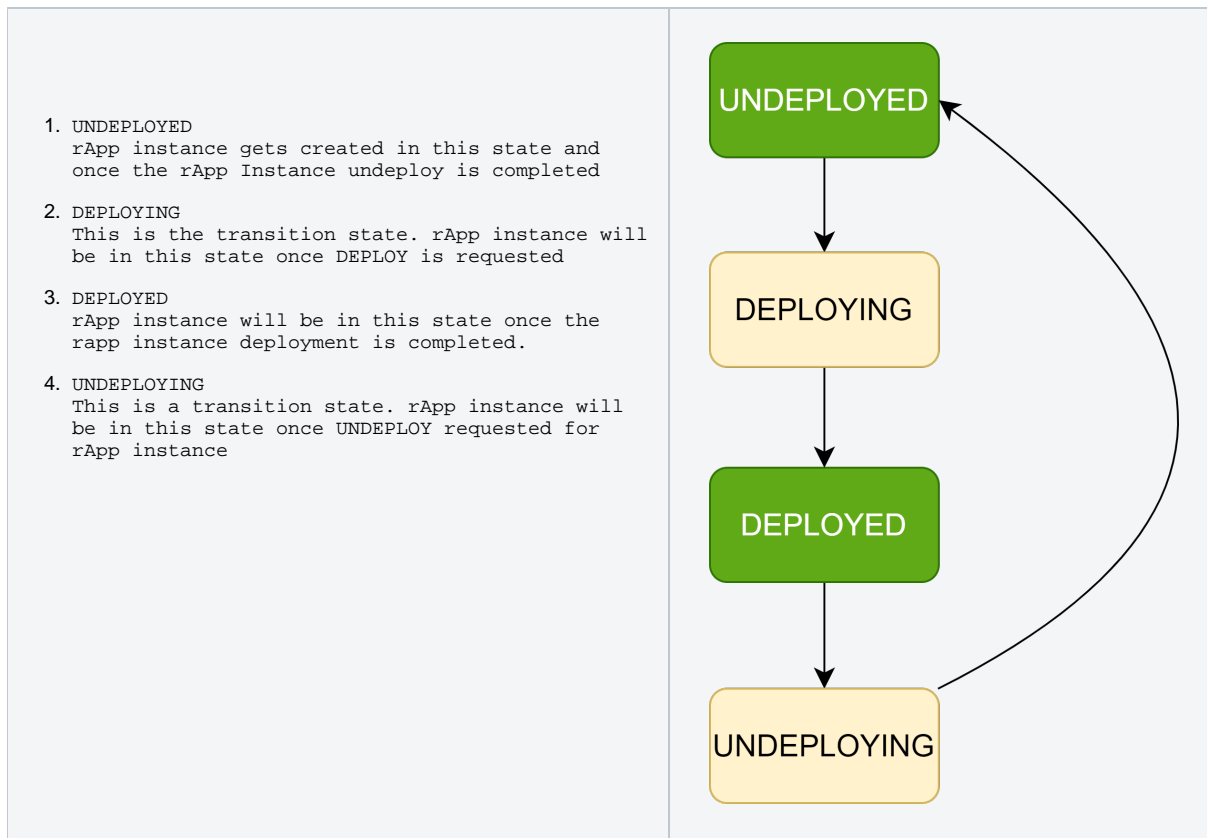
rApp States

The rApp lifecycle contains 4 states. The state and transitions are as follows,



rApp Instance States

The rApp Instance lifecycle contains 4 states. The state and transitions are as follows,

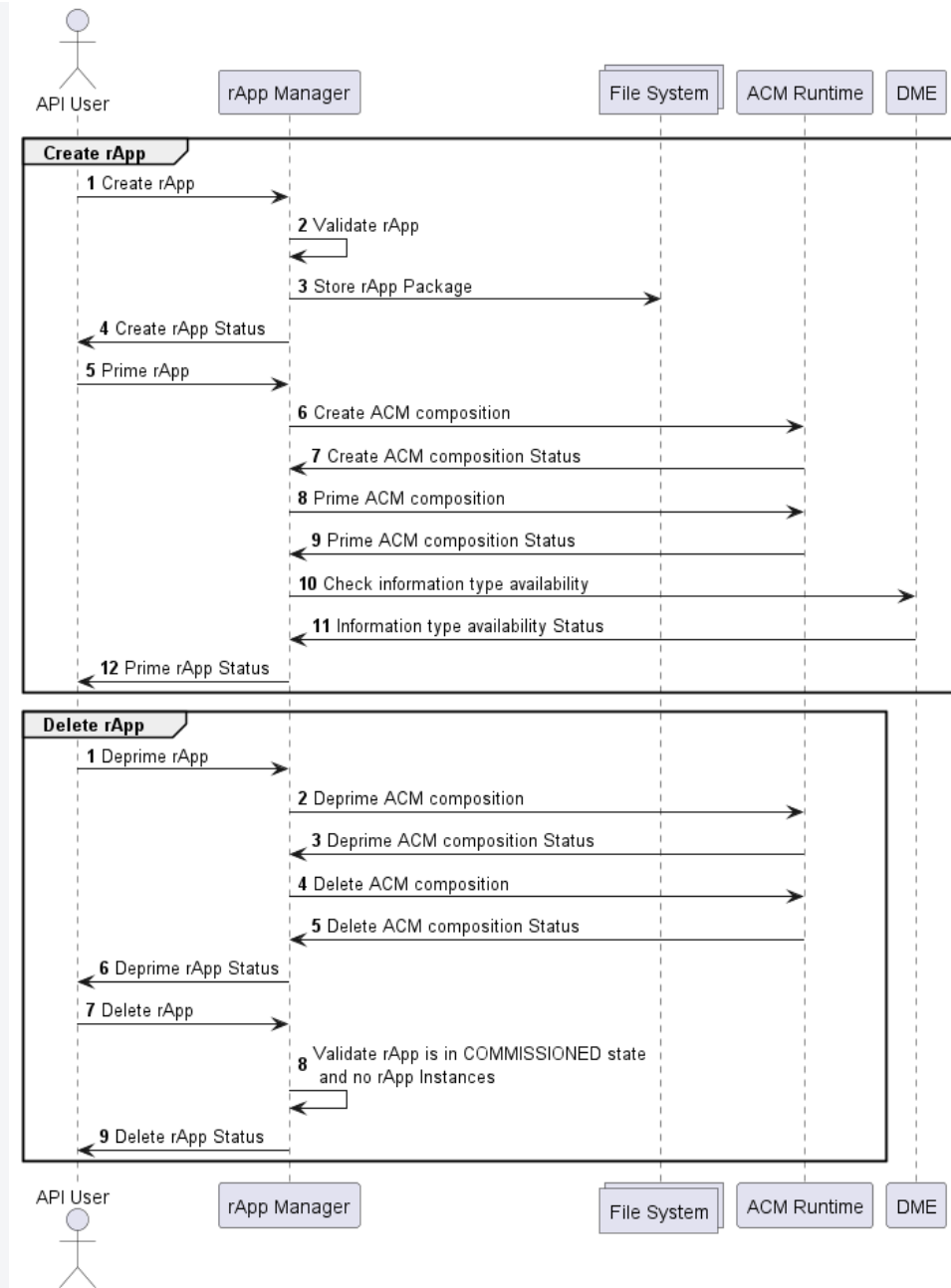


Flows

rApp flow

Create rApp	
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1. API user creates rApp by sending rApp package
2. rApp Manager validates the rApp
3. rApp Manager stores the rApp in the file system if the rApp is valid
4. API user provided with the status of rApp creation.
5. API user request to Prime the rApp
6. rApp Manager fetches the ACM composition from rApp package and creates the ACM composition in ACM-R
7. rApp Manager gets the ACM composition creation status from ACM-R
8. rApp Manager request ACM-R to prime the ACM composition
9. rApp Manager gets the ACM composition priming status from ACM-R
10. rApp Manager checks with DME for the unknown information type from rApp package
11. rApp Manager get the information type availability from DME
12. API user provided with the status of rApp priming



Delete rApp

<ol style="list-style-type: none"> 1. API user request to Deprime rApp 2. rApp Manager request ACM-R to deprime the ACM composition 3. rApp Manager get the status of ACM composition depriming. 4. rApp Manager requests ACM-R to delete the ACM composition 5. rApp Manager gets the status of ACM composition deletion 6. API user provided with the deprime rApp status. 7. API user request to delete the rApp 8. rApp Manager validates that the rApp is in COMMISSIONED state and there is no rApp Instances are available. 9. API User provided with delete rApp status 	
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rApp Instance flow

<p>Create rApp Instance</p>	
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1. API user request to create rApp Instance with the resource details from rApp package

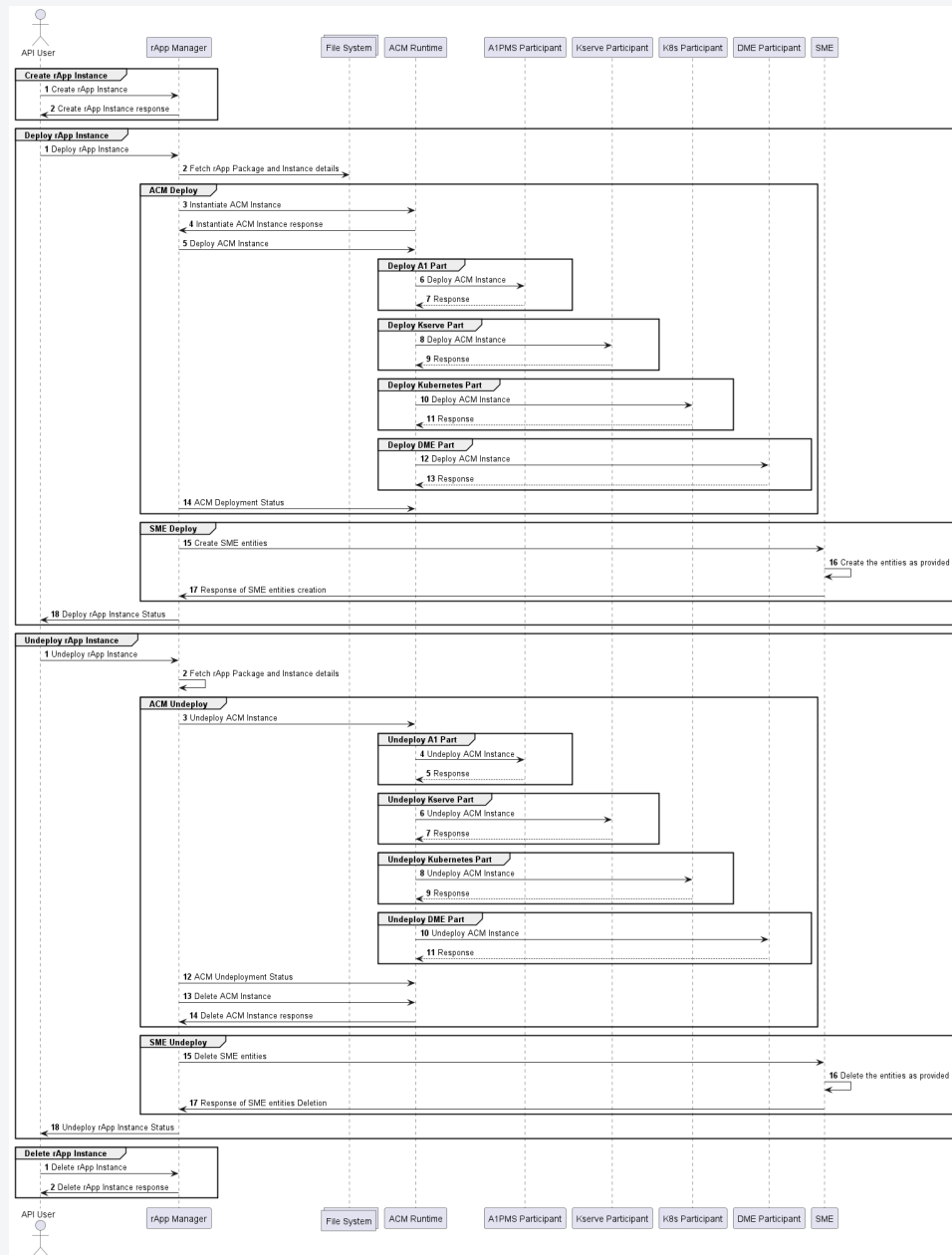
2. API user get the rApp instance creation response

Deploy rApp Instance

1. API user request to deploy rApp instance

2. rApp Manager fetches the rApp package from file system and fetches the resources mentioned in the rApp instance.

3. rApp Manager request ACM-R with the necessary details from rApp package to instantiate ACM instance



4. rApp
Manager
gets
instant
iate
ACM
instanc
e
response
5. rApp
Manager
request
ACM-R
to
deploy
ACM
instance
6. ACM-R
deploys
the
AlPMS
instanc
e if
it is
configu
red in
the
ACM
instance
7. ACM-R
gets
the
AlPMS
deploym
ent
status
8. ACM-R
deploys
the
Kserve
instanc
e if
it is
configu
red in
the
ACM
instance
9. ACM-R
gets
the
Kserve
deploym
ent
status
10. ACM-R
deploys
the
Kuberne
tes
instanc
e if
it is
configu
red in
the
ACM
instance
11. ACM-R
gets
the
Kuberne
tes
deploym
ent
status

12. ACM-R
deploys
the
DME
instanc
e if
it is
configu
red in
the
ACM
instance
13. ACM-R
gets
the
DME
deploym
ent
status
14. rApp
Manager
gets
ACM
deploym
ent
status
15. rApp
Manager
request
SME to
create
the
entitie
s in
rApp
instance
16. SME
creates
the
entitie
s
provide
d by
rApp
Manager
17. rApp
manager
get
the
respons
e of
SME
entitie
s
creation

18. API user provides with the status of rApp instance deployment. rApp Manager combines the status of ACM deployment and SME deployment to provide the rApp instance status.

Undeploy rApp Instance

1. API user request to undeploy rApp instance
2. rApp Manager fetches the rApp and rApp instance details
3. rApp Manager request ACM-R to undeploy the ACM instance
4. ACM-R undeploy the ALPMS instance if it is already deployed


5. ACM-R
gets
the
ALPMS
undeplo
y
status
6. ACM-R
undeplo
y the
Kserve
instanc
e if
it is
already
deployed
7. ACM-R
gets
the
Kserve
undeplo
y
status
8. ACM-R
undeplo
y the
Kuberne
tes
instanc
e if
it is
already
deployed
9. ACM-R
gets
the
Kuberne
tes
undeplo
y
status
10. ACM-R
undeplo
y the
DME
instanc
e if
it is
already
deployed
11. ACM-R
gets
the
DME
undeplo
y
status
12. rApp
Manager
get
ACM
undeplo
y
status
13. rApp
Manager
request
ACM-R
to
delete
the
ACM
instance

14. rApp
Manager
get
respons
e of
ACM
instanc
e
deletion
15. rApp
Manager
request
SME to
delete
SME
entities
16. SME
deletes
the
entitie
s
created
as
part
of rApp
17. rApp
Manager
get
the
respons
e of
SME
entitie
s
deletion
18. API
user
get
the
status
of
undeplo
y rApp
instance

Delete rApp Instance

1. API
user
request
rApp
Manager
to
delete
rApp
Instance
2. API
user
gets
delete
rApp
instanc
e
response

Sample rApp package structure

 This packaging structure is a prototype and subject to change

The sample rApp package structure shown below and the location of relevant files for each integration is provided.

<div><h3>ACM (Files /Acm)</h3><ul style="list-style-type: none">• Definition<ul style="list-style-type: none">- Files/Acm/Definition (Only one file)• Instances<ul style="list-style-type: none">- Files/Acm/instances</div> <div><h3>DME (Files /Dme)</h3><ul style="list-style-type: none">• Consumer Information Types<ul style="list-style-type: none">- Files/Dme/consumerinfotypes• Producer information Types<ul style="list-style-type: none">- Files/Dme/producerinfotypes• Information Consumers<ul style="list-style-type: none">- Files/Dme/infoconsumers• Information Producers<ul style="list-style-type: none">- Files/Dme/infoproducers</div> <div><h3>SME (Files /Sme)</h3><ul style="list-style-type: none">• Providers Functions<ul style="list-style-type: none">- Files/Sme/providers• Service Api<ul style="list-style-type: none">- Files/Sme/serviceapis• Invokers<ul style="list-style-type: none">- Files/Sme/invokers</div>	<div><ul style="list-style-type: none">> Definitions✓ Files<ul style="list-style-type: none">✓ Acme<ul style="list-style-type: none">definition<ul style="list-style-type: none">compositions.jsoninstances<ul style="list-style-type: none">a1pms-instance.jsonall-instance.jsonk8s-instance.jsonkserve-instance.json✓ Dme<ul style="list-style-type: none">consumerinfotypes<ul style="list-style-type: none">json-file-data-from-filestore.jsonxml-file-data-from-filestore.jsoninfoconsumers<ul style="list-style-type: none">json-file-consumer.jsonxml-file-consumer.jsoninfoproducers<ul style="list-style-type: none">json-file-data-producer.jsonxml-file-data-producer.jsonproducerinfotypes<ul style="list-style-type: none">json-file-data-from-filestore.jsonxml-file-data-from-filestore.json> Events> Guides> Measurements> rapp1</div>	<div><ul style="list-style-type: none">> Scripts✓ Sme<ul style="list-style-type: none">invokers<ul style="list-style-type: none">invoker-app1.jsoninvoker-app2.jsonproviders<ul style="list-style-type: none">provider-function-1.jsonprovider-function-2.jsonprovider-function-3.jsonserviceapis<ul style="list-style-type: none">api-set-1.jsonapi-set-2.json> Yang_module<ul style="list-style-type: none">ChangeLog.txt> HELM> TOSCA-Metadata<ul style="list-style-type: none">asd.mf</div>
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CSAR File Generation

CSAR file generator is available in the rAppmanager repository [here \(i-release\)](#).

"rappmanager/csar-generator/resources" folder contains the resources to build the rApp package.

The contents of the "resources" directory can be modified as required and the package can be generated as shown below,

Linux: Generate rApp package

```
> ./generate.sh
```

Windows: Generate rApp package

```
> ./generate.bat
```

This will generate a package named "rapp.csar". It can be renamed as required.

This generated package can be used with rApp Manager to create rApp.

Deployment Instructions

The scripts for the deployments of rApp Manager and its dependent components are available [here \(i-release\)](#).



These scripts are specifically designed for a fresh environment. Some tweaks may be required to run these in an environment where there are some existing installations

Pre-requisites

- Kubernetes Cluster (V1.24.6)
- GIT

Environment setup

The installation scripts shown [here](#) installs all the required components.

ACM components should be configured with couple of other components for the participants to work.

In case some of the installation is already setup or not set by the installation scripts, the below environment variables can be used to set the configurations ACM through installation scripts.



Ignore the below variables if the entire environment is being setup by the following installation scripts

Variable Name	Description	Default Value
AlPMS_HOST	Address of the AlPMS. It will be accessed from AlPMS participant.	http://policymanagementservice.nonrtric:9080
CHART_REPO_HOST	Address of the chart repository. It will be used by Kubernetes participant.	http://IP_ADDRESS:8879/charts IP_ADDRESS: IP of the host in which the installation scripts are running.

Installation

All components can be installed using the command below,

```
>./install-all.sh
```

Individual components can be installed using the commands below,

To install the tools required for other installer scripts.

```
>./install-base.sh
```

To install the ACM, and it's related components.

```
>./install-acm.sh
```

To install the Kserve, and it's related components.

```
>./install-kserve.sh
```

To install the NONRTRIC components.

```
>./install-nonrtric.sh
```

Installed Components

The below components should be up and running for the rApp Manager integrations to work properly.

Istio components

```
root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get all -n istio-system
```

NAME	READY	STATUS	RESTARTS	AGE
pod/istiod-74657777df-69lpc	1/1	Running	0	33m

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
service/istiod	ClusterIP	10.233.37.0	<none>	15010/TCP,15012/TCP,443/TCP,15014/TCP	33m

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
deployment.apps/istiod	1/1	1	1	33m

NAME	DESIRED	CURRENT	READY	AGE
replicaset.apps/istiod-74657777df	1	1	1	33m

NAME	REFERENCE	TARGETS	MINPODS	MAXPODS	REPLICAS	AGE
horizontalpodautoscaler.autoscaling/istiod	Deployment/istiod	<unknown>/80%	1	5	1	33m

Cert Manager components


```

root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get all -n cert-manager
NAME                                READY    STATUS    RESTARTS   AGE
pod/cert-manager-7c869867bf-xjb7v  1/1      Running   0           31m
pod/cert-manager-cainjector-54c9d9b775-ndrhv  1/1      Running   0           31m
pod/cert-manager-webhook-7f7469bdb7-2rwtk  1/1      Running   0           31m

NAME                                TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)    AGE
service/cert-manager                ClusterIP      10.233.18.26   <none>          9402/TCP    31m
service/cert-manager-webhook        ClusterIP      10.233.53.169  <none>          443/TCP     31m

NAME                                READY    UP-TO-DATE    AVAILABLE    AGE
deployment.apps/cert-manager        1/1      1              1            31m
deployment.apps/cert-manager-cainjector  1/1      1              1            31m
deployment.apps/cert-manager-webhook  1/1      1              1            31m

NAME                                DESIRED    CURRENT    READY    AGE
replicaset.apps/cert-manager-7c869867bf  1          1          1        31m
replicaset.apps/cert-manager-cainjector-54c9d9b775  1          1          1        31m
replicaset.apps/cert-manager-webhook-7f7469bdb7  1          1          1        31m

```

Kserve components

```

root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get all -n kserve
NAME                                READY    STATUS    RESTARTS   AGE
pod/kserve-controller-manager-78c74d5b75-bqtls  2/2      Running   2 (95s ago)  28m

NAME                                TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)    AGE
service/kserve-controller-manager-metrics-service  ClusterIP      10.233.56.191  <none>          8443/TCP    28m
service/kserve-controller-manager-service          ClusterIP      10.233.50.7    <none>          8443/TCP    28m
service/kserve-webhook-server-service              ClusterIP      10.233.22.190  <none>          443/TCP     28m

NAME                                READY    UP-TO-DATE    AVAILABLE    AGE
deployment.apps/kserve-controller-manager  1/1      1              1            28m

NAME                                DESIRED    CURRENT    READY    AGE
replicaset.apps/kserve-controller-manager-78c74d5b75  1          1          1        28m

```

ACM Components

```
root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get all -n default
```

NAME	READY	STATUS	RESTARTS	AGE
pod/mariadb-galera-0	1/1	Running	0	35m
pod/policy-clamp-ac-alpms-ppnt-5db94f4c89-4mdk4	1/1	Running	0	35m
pod/policy-clamp-ac-k8s-ppnt-587499d668-fsnnl	1/1	Running	0	35m
pod/policy-clamp-ac-kserve-ppnt-6dd9d49968-j7qjs	1/1	Running	0	35m
pod/policy-clamp-runtime-acm-84569dc946-67fn6	1/1	Running	0	35m
pod/policy-galera-config-vcvcw	0/1	Completed	0	35m
pod/policy-galera-init-hrxbf	0/1	Completed	0	35m
pod/policy-models-simulator-788fbd465f-wr7wj	1/1	Running	0	35m

NAME	TYPE	CLUSTER-IP	EXTERNAL-IP	PORT(S)	AGE
service/aai-sim	ClusterIP	10.233.16.82	<none>	6666/TCP	35m
service/grpc-sim	ClusterIP	10.233.60.235	<none>	6680/TCP	35m
service/kubernetes	ClusterIP	10.233.0.1	<none>	443/TCP	78d
service/mariadb-galera	ClusterIP	10.233.18.204	<none>	3306/TCP	35m
service/mariadb-galera-headless	ClusterIP	None	<none>	4567/TCP, 4568/TCP, 4444/TCP	35m
service/message-router	ClusterIP	10.233.47.23	<none>	3904/TCP	35m
service/policy-clamp-ac-alpms-ppnt	ClusterIP	10.233.38.44	<none>	8086/TCP	35m
service/policy-clamp-ac-k8s-ppnt	NodePort	10.233.28.192	<none>	8083:30443/TCP	35m
service/policy-clamp-ac-kserve-ppnt	ClusterIP	10.233.33.99	<none>	8087/TCP	35m
service/policy-clamp-runtime-acm	NodePort	10.233.46.213	<none>	6969:30442/TCP	35m
service/sdnc-sim	ClusterIP	10.233.30.76	<none>	6668/TCP	35m
service/so-sim	ClusterIP	10.233.25.224	<none>	6669/TCP	35m
service/vfc-sim	ClusterIP	10.233.36.42	<none>	6670/TCP	35m

NAME	READY	UP-TO-DATE	AVAILABLE	AGE
deployment.apps/policy-clamp-ac-alpms-ppnt	1/1	1	1	35m
deployment.apps/policy-clamp-ac-k8s-ppnt	1/1	1	1	35m
deployment.apps/policy-clamp-ac-kserve-ppnt	1/1	1	1	35m
deployment.apps/policy-clamp-runtime-acm	1/1	1	1	35m
deployment.apps/policy-models-simulator	1/1	1	1	35m

NAME	DESIRED	CURRENT	READY	AGE
replicaset.apps/policy-clamp-ac-alpms-ppnt-5db94f4c89	1	1	1	35m
replicaset.apps/policy-clamp-ac-k8s-ppnt-587499d668	1	1	1	35m
replicaset.apps/policy-clamp-ac-kserve-ppnt-6dd9d49968	1	1	1	35m
replicaset.apps/policy-clamp-runtime-acm-84569dc946	1	1	1	35m
replicaset.apps/policy-models-simulator-788fbd465f	1	1	1	35m

NAME	READY	AGE
statefulset.apps/mariadb-galera	1/1	35m

NAME	COMPLETIONS	DURATION	AGE
job.batch/policy-galera-config	1/1	2m2s	35m
job.batch/policy-galera-init	1/1	66s	35m

NONRTRIC Components

```

root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get all -n nontritic
NAME                                READY    STATUS    RESTARTS   AGE
pod/al-sim-osc-0                    1/1     Running   0           33m
pod/al-sim-osc-1                    1/1     Running   0           32m
pod/al-sim-std-0                    1/1     Running   0           33m
pod/al-sim-std-1                    1/1     Running   0           32m
pod/al-sim-std2-0                   1/1     Running   0           33m
pod/al-sim-std2-1                   1/1     Running   0           32m
pod/alcontroller-558776cc7b-7v44h  1/1     Running   0           33m
pod/capifcore-54c465899c-247md     1/1     Running   0           33m
pod/db-75c5789d97-7d2v4           1/1     Running   0           33m
pod/dmeparticipant-6d4d5f9f98-xlgw4 1/1     Running   0           33m
pod/informationsservice-0          1/1     Running   0           33m
pod/policymanagementservice-0      1/1     Running   0           33m
pod/rappmanager-0                  1/1     Running   0           33m

NAME                                TYPE          CLUSTER-IP    EXTERNAL-IP    PORT(S)          AGE
service/al-sim                      ClusterIP      None           <none>          8085/TCP,8185/TCP 33m
service/alcontroller                 ClusterIP      10.233.35.135  <none>          8282/TCP,8383/TCP 33m
service/capifcore                    ClusterIP      10.233.46.221  <none>          8090/TCP          33m
service/dbhost                       ClusterIP      10.233.10.92   <none>          3306/TCP          33m
service/dmeparticipant               ClusterIP      10.233.48.158  <none>          8080/TCP          33m
service/informationsservice           ClusterIP      10.233.43.62   <none>          9082/TCP,9083/TCP 33m
service/policymanagementservice       ClusterIP      10.233.62.226  <none>          9080/TCP,9081/TCP 33m
service/rappmanager                  ClusterIP      10.233.44.126  <none>          8080/TCP          33m
service/sdnctldb01                   ClusterIP      10.233.56.62   <none>          3306/TCP          33m

NAME                                READY    UP-TO-DATE    AVAILABLE    AGE
deployment.apps/alcontroller         1/1      1              1            33m
deployment.apps/capifcore            1/1      1              1            33m
deployment.apps/db                   1/1      1              1            33m
deployment.apps/dmeparticipant       1/1      1              1            33m

NAME                                DESIRED    CURRENT    READY    AGE
replicaset.apps/alcontroller-558776cc7b 1          1          1        33m
replicaset.apps/capifcore-54c465899c    1          1          1        33m
replicaset.apps/db-75c5789d97            1          1          1        33m
replicaset.apps/dmeparticipant-6d4d5f9f98 1          1          1        33m

NAME                                READY    AGE
statefulset.apps/al-sim-osc          2/2      33m
statefulset.apps/al-sim-std          2/2      33m
statefulset.apps/al-sim-std2         2/2      33m
statefulset.apps/informationsservice 1/1      33m
statefulset.apps/policymanagementservice 1/1      33m
statefulset.apps/rappmanager         1/1      33m

```

Troubleshooting

1. If Kserve installation failed or end up in the below state after "install-all.sh", Try run "patch-kserve.sh" script after "install-all.sh"

```

Validating webhook configuration: admissionregistration.k8s.io/trainedmodel.serving.kserve.io created
Error from server (InternalError): error when creating "https://github.com/kserve/kserve/releases/download/v0.10.0/kserve.yaml": Internal error occurred: failed calling webhook
"webhook.cert-manager.io": failed to call webhook: Post "https://cert-manager-webhook.cert-manager.svc:443/mutate?timeout=10s": x509: certificate signed by unknown authority
Error from server (InternalError): error when creating "https://github.com/kserve/kserve/releases/download/v0.10.0/kserve.yaml": Internal error occurred: failed calling webhook
"webhook.cert-manager.io": failed to call webhook: Post "https://cert-manager-webhook.cert-manager.svc:443/mutate?timeout=10s": x509: certificate signed by unknown authority
clusterservingruntime.serving.kserve.io/kserve-lbserver created
clusterservingruntime.serving.kserve.io/kserve-mlserver created

```

```

root@est-selfservice-booking194-k8s-master-0:/home/infra/rappmanager/scripts/install# kubectl get po -n kserve
NAME                                READY    STATUS    RESTARTS   AGE
kserve-controller-manager-78c74d5b75-9b4ph 0/2     ContainerCreating   0           21m

```

Uninstallation

To uninstall all the components

```
> ./uninstall-all.sh
```