Red Hat OpenShift Data Foundation 4.12

Configuring OpenShift Data Foundation Disaster Recovery for OpenShift Workloads

Red Hat OpenShift Data Foundation Metro-DR feature with Red Hat Advanced Cluster Management for Kubernetes 2.7 is General Available now and the Regional-DR solution for both Blocks and Files is offered as Technology Preview and is subject to Technology Preview support limitations.

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Abstract

The intent of this solution guide is to detail the steps necessary to deploy OpenShift Data Foundation for disaster recovery with Advanced Cluster Management to achieve a highly available storage infrastructure.

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MAKING OPEN SOURCE MORE INCLUSIVE

Red Hat is committed to replacing problematic language in our code, documentation, and web properties. We are beginning with these four terms: master, slave, blacklist, and whitelist. Because of the enormity of this endeavor, these changes will be implemented gradually over several upcoming releases. For more details, see our CTO Chris Wright’s message .

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CHAPTER 1. INTRODUCTION TO OPENSHIFT DATA FOUNDATION DISASTER RECOVERY

Disaster recovery (DR) is the ability to recover and continue business critical applications from natural or human created disasters. It is a component of the overall business continuance strategy of any major organization as designed to preserve the continuity of business operations during major adverse events.

The OpenShift Data Foundation DR capability enables DR across multiple Red Hat OpenShift Container Platform clusters, and is categorized as follows:

- **Metro-DR**
  Metro-DR ensures business continuity during the unavailability of a data center with no data loss. In the public cloud these would be similar to protecting from an Availability Zone failure.

- **Regional-DR**
  Regional-DR ensures business continuity during the unavailability of a geographical region, accepting some loss of data in a predictable amount. In the public cloud this would be similar to protecting from a region failure.

Zone failure in Metro-DR and region failure in Regional-DR is usually expressed using the terms, **Recovery Point Objective (RPO)** and **Recovery Time Objective (RTO)**.

- **RPO** is a measure of how frequently you take backups or snapshots of persistent data. In practice, the RPO indicates the amount of data that will be lost or need to be reentered after an outage.

- **RTO** is the amount of downtime a business can tolerate. The RTO answers the question, “How long can it take for our system to recover after we are notified of a business disruption?”

The intent of this guide is to detail the Disaster Recovery steps and commands necessary to be able to failover an application from one OpenShift Container Platform cluster to another and then relocate the same application to the original primary cluster.

CHAPTER 2. DISASTER RECOVERY SUBSCRIPTION REQUIREMENT

Disaster Recovery features supported by Red Hat OpenShift Data Foundation require all of the following prerequisites to successfully implement a disaster recovery solution:

- A valid Red Hat OpenShift Data Foundation Advanced entitlement
- A valid Red Hat Advanced Cluster Management for Kubernetes subscription

Any Red Hat OpenShift Data Foundation Cluster containing PVs participating in active replication either as a source or destination requires OpenShift Data Foundation Advanced entitlement. This subscription should be active on both source and destination clusters.

To know how subscriptions for OpenShift Data Foundation work, see knowledgebase article on OpenShift Data Foundation subscriptions.

CHAPTER 3. METRO-DR SOLUTION FOR OPENSHIFT DATA FOUNDATION

The section of the guide provides details of the Metro Disaster Recovery (Metro DR) steps and commands necessary to be able to failover an application from one OpenShift Container Platform cluster to another and then failback the same application to the original primary cluster. In this case the OpenShift Container Platform clusters will be created or imported using Red Hat Advanced Cluster Management (RHACM) and have distance limitations between the OpenShift Container Platform clusters of less than 10ms RTT latency.

The persistent storage for applications is provided by an external Red Hat Ceph Storage (RHCS) cluster stretched between the two locations with the OpenShift Container Platform instances connected to this storage cluster. An arbiter node with a storage monitor service is required at a third location (different location than where OpenShift Container Platform instances are deployed) to establish quorum for the RHCS cluster in the case of a site outage. This third location can be in the range of ~100ms RTT from the storage cluster connected to the OpenShift Container Platform instances.

This is a general overview of the Metro DR steps required to configure and execute OpenShift Disaster Recovery (ODR) capabilities using OpenShift Data Foundation and RHACM across two distinct OpenShift Container Platform clusters separated by distance. In addition to these two clusters called managed clusters, a third OpenShift Container Platform cluster is required that will be the Red Hat Advanced Cluster Management (RHACM) hub cluster.

3.1. COMPONENTS OF METRO-DR SOLUTION

Metro-DR is composed of Red Hat Advanced Cluster Management for Kubernetes, Red Hat Ceph Storage and OpenShift Data Foundation components to provide application and data mobility across OpenShift Container Platform clusters.

Red Hat Advanced Cluster Management for Kubernetes

Red Hat Advanced Cluster Management (RHACM) provides the ability to manage multiple clusters and application lifecycles. Hence, it serves as a control plane in a multi-cluster environment.

RHACM is split into two parts:

- RHACM Hub: components that run on the multi-cluster control plane
- Managed clusters: components that run on the clusters that are managed

For more information about this product, see RHACM documentation and the RHACM “Manage Applications” documentation.

Red Hat Ceph Storage

Red Hat Ceph Storage is a massively scalable, open, software-defined storage platform that combines the most stable version of the Ceph storage system with a Ceph management platform, deployment utilities, and support services. It significantly lowers the cost of storing enterprise data and helps organizations manage exponential data growth. The software is a robust and modern petabyte-scale storage platform for public or private cloud deployments.

For more product information, see Red Hat Ceph Storage .

OpenShift Data Foundation

OpenShift Data Foundation provides the ability to provision and manage storage for stateful applications in an OpenShift Container Platform cluster. It is backed by Ceph as the storage provider, whose lifecycle is managed by Rook in the OpenShift Data Foundation component stack and Ceph-CSI provides the provisioning and management of Persistent Volumes for stateful applications.

OpenShift DR

OpenShift DR is a disaster recovery orchestrator for stateful applications across a set of peer OpenShift clusters which are deployed and managed using RHACM and provides cloud-native interfaces to orchestrate the life-cycle of an application's state on Persistent Volumes. These include:

- Protecting an application and its state relationship across OpenShift clusters
- Failing over an application and its state to a peer cluster
- Relocate an application and its state to the previously deployed cluster

OpenShift DR is split into three components:

- **ODF Multicluster Orchestrator**: Installed on the multi-cluster control plane (RHACM Hub), it orchestrates configuration and peering of OpenShift Data Foundation clusters for Metro and Regional DR relationships.
- **OpenShift DR Hub Operator**: Automatically installed as part of ODF Multicluster Orchestrator installation on the hub cluster to orchestrate failover or relocation of DR enabled applications.
- **OpenShift DR Cluster Operator**: Automatically installed on each managed cluster that is part of a Metro and Regional DR relationship to manage the lifecycle of all PVCs of an application.

3.2. METRO-DR DEPLOYMENT WORKFLOW

This section provides an overview of the steps required to configure and deploy Metro-DR capabilities using the latest versions of Red Hat OpenShift Data Foundation, Red Hat Ceph Storage (RHCS) and Red Hat Advanced Cluster Management for Kubernetes (RHACM) version 2.7 or later, across two distinct OpenShift Container Platform clusters. In addition to two managed clusters, a third OpenShift Container Platform cluster will be required to deploy the Advanced Cluster Management.

To configure your infrastructure, perform the below steps in the order given:

1. Ensure requirements across the Hub, Primary and Secondary Openshift Container Platform clusters that are part of the DR solution are met. See Requirements for enabling Metro-DR.
2. Ensure you meet the requirements for deploying Red Hat Ceph Storage stretch cluster with arbiter. See Requirements for deploying Red Hat Ceph Storage .
3. Deploy and configure Red Hat Ceph Storage stretch mode. For instructions on enabling Ceph cluster on two different data centers using stretched mode functionality, see Deploying Red Hat Ceph Storage.
4. Install OpenShift Data Foundation operator and create a storage system on Primary and Secondary managed clusters. See Installing OpenShift Data Foundation on managed clusters .
5. Install the ODF Multicluster Orchestrator on the Hub cluster. See Installing ODF Multicluster Orchestrator on Hub cluster.
6. Configure SSL access between the Hub, Primary and Secondary clusters. See Configuring SSL access across clusters.

7. Create a DRPolicy resource for use with applications requiring DR protection across the Primary and Secondary clusters. See Creating Disaster Recovery Policy on Hub cluster .

> **NOTE**
>
> There can be more than a single policy.

For testing your disaster recovery solution:

- Create a sample application using RHACM console. See Creating sample application.
- Test failover and relocate operations using the sample application between managed clusters. See application failover and relocating an application.

3.3. REQUIREMENTS FOR ENABLING METRO-DR

Disaster Recovery features supported by Red Hat OpenShift Data Foundation require all of the following prerequisites in order to successfully implement a Disaster Recovery solution:

- You must have the following OpenShift clusters that have network reachability between them:
    - **Hub cluster** where Red Hat Advanced Cluster Management for Kubernetes (RHACM operator) is installed.
    - **Primary managed cluster** where OpenShift Data Foundation is installed.
    - **Secondary managed cluster** where OpenShift Data Foundation is installed.
- Ensure that RHACM operator and MultiClusterHub is installed on the Hub cluster. See RHACM installation guide for instructions.
    - Login to the RHACM console using your OpenShift credentials.
    - Find the Route that has been created for the RHACM console:

      ```
      $ oc get route multicloud-console -n open-cluster-management -o jsonpath --
      template="https://{.spec.host}/multicloud/clusters{'\n'}"
      ```

      Example Output:

      ```
      https://multicloud-console.apps.perf3.example.com/multicloud/clusters
      ```

    - Open your output link in a browser to login with OpenShift credentials. You should now see your local-cluster imported.

> **IMPORTANT**
>
> It is the user's responsibility to ensure that application traffic routing and redirection are configured appropriately. Configuration and updates to the application traffic routes are currently not supported.

- Ensure that you either import or create the **Primary managed cluster** and the **Secondary managed cluster** using the RHACM console. Choose the appropriate options for your environment. After the managed clusters are successfully created or imported, you can see the list of clusters that were imported or created on the console. For instructions, see Creating a cluster and Importing a target managed cluster to the hub cluster .

WARNING

There are distance limitations between the locations where the OpenShift Container Platform managed clusters reside as well as the RHCS nodes. The network latency between the sites must be below 10 milliseconds round-trip time (RTT).

3.4. REQUIREMENTS FOR DEPLOYING RED HAT CEPH STORAGE STRETCH CLUSTER WITH ARBITER

Red Hat Ceph Storage is an open-source enterprise platform that provides unified software-defined storage on standard, economical servers and disks. With block, object, and file storage combined into one platform, Red Hat Ceph Storage efficiently and automatically manages all your data, so you can focus on the applications and workloads that use it.

This section provides a basic overview of the Red Hat Ceph Storage deployment. For more complex deployment, refer to the official documentation guide for Red Hat Ceph Storage 5 .

NOTE

Only Flash media is supported since it runs with **min_size=1** when degraded. Use stretch mode only with all-flash OSDs. Using all-flash OSDs minimizes the time needed to recover once connectivity is restored, thus minimizing the potential for data loss.

IMPORTANT

Erasure coded pools cannot be used with stretch mode.

3.4.1. Hardware requirements

For information on minimum hardware requirements for deploying Red Hat Ceph Storage, see Minimum hardware recommendations for containerized Ceph.

Table 3.1. Physical server locations and Ceph component layout for Red Hat Ceph Storage cluster deployment:

Node name	Datacenter	Ceph components
ceph1	DC1	OSD+MON+MGR
ceph2	DC1	OSD+MON
ceph3	DC1	OSD+MDS+RGW

Node name	Datacenter	Ceph components
ceph4	DC2	OSD+MON+MGR
ceph5	DC2	OSD+MON
ceph6	DC2	OSD+MDS+RGW
ceph7	DC3	MON

3.4.2. Software requirements

Use the latest software version of **Red Hat Ceph Storage 5**

For more information on the supported Operating System versions for Red Hat Ceph Storage, see knowledgebase article on Red Hat Ceph Storage: Supported configurations .

3.4.3. Network configuration requirements

The recommended Red Hat Ceph Storage configuration is as follows:

- You must have two separate networks, one public network and one private network.
- You must have three different datacenters that support VLANS and subnets for Cephs private and public network for all datacenters.

  NOTE

  You can use different subnets for each of the datacenters.

- The latencies between the two datacenters running the Red Hat Ceph Storage Object Storage Devices (OSDs) cannot exceed 10 ms RTT. For the **arbiter** datacenter, this was tested with values as high up to 100 ms RTT to the other two OSD datacenters.

Here is an example of a basic network configuration that we have used in this guide:

- **DC1: Ceph public/private network:** 10.0.40.0/24
- **DC2: Ceph public/private network:** 10.0.40.0/24
- **DC3: Ceph public/private network:** 10.0.40.0/24

For more information on the required network environment, see Ceph network configuration .

3.5. DEPLOYING RED HAT CEPH STORAGE

3.5.1. Node pre-deployment steps

Before installing the Red Hat Ceph Storage Ceph cluster, perform the following steps to fulfill all the requirements needed.

1. Register all the nodes to the Red Hat Network or Red Hat Satellite and subscribe to a valid pool:

```
subscription-manager register
subscription-manager subscribe --pool=8a8XXXXXX9e0
```

2. Enable access for all the nodes in the Ceph cluster for the following repositories:

   - **rhel-8-for-x86_64-baseos-rpms**
   - **rhel-8-for-x86_64-appstream-rpms**

   ```
   subscription-manager repos --disable="*" --enable="rhel-8-for-x86_64-baseos-rpms" --
   enable="rhel-8-for-x86_64-appstream-rpms"
   ```

3. Update the operating system RPMs to the latest version and reboot if needed:

```
dnf update -y
reboot
```

4. Select a node from the cluster to be your bootstrap node. **ceph1** is our bootstrap node in this example going forward.
   Only on the bootstrap node **ceph1**, enable the **ansible-2.9-for-rhel-8-x86_64-rpms** and **rhceph-5-tools-for-rhel-8-x86_64-rpms** repositories:

```
subscription-manager repos --enable="ansible-2.9-for-rhel-8-x86_64-rpms" --
enable="rhceph-5-tools-for-rhel-8-x86_64-rpms"
```

5. Configure the **hostname** using the bare/short hostname in all the hosts.

```
hostnamectl set-hostname <short_name>
```

6. Verify the hostname configuration for deploying Red Hat Ceph Storage with cephadm.

```
$ hostname
```

   Example output:

```
ceph1
```

7. Modify /etc/hosts file and add the fqdn entry to the 127.0.0.1 IP by setting the DOMAIN variable with our DNS domain name.

```
DOMAIN="example.domain.com"

cat <<EOF >/etc/hosts
127.0.0.1 $(hostname).${DOMAIN} $(hostname) localhost localhost.localdomain localhost4
localhost4.localdomain4
::1       $(hostname).${DOMAIN} $(hostname) localhost6 localhost6.localdomain6
EOF
```

8. Check the long hostname with the **fqdn** using the **hostname -f** option.

```
$ hostname -f
```

Example output:

```
ceph1.example.domain.com
```

Note: To know more about why these changes are required, see Fully Qualified Domain Names vs Bare Host Names.

9. Run the following steps on bootstrap node. In our example, the bootstrap node is **ceph1**.

    a. Install the **cephadm-ansible** RPM package:

    ```
    $ sudo dnf install -y cephadm-ansible
    ```

    IMPORTANT

    To run the ansible playbooks, you must have **ssh** passwordless access to all the nodes that are configured to the Red Hat Ceph Storage cluster. Ensure that the configured user (for example, **deployment-user**) has root privileges to invoke the **sudo** command without needing a password.

    b. To use a custom key, configure the selected user (for example, **deployment-user**) ssh config file to specify the id/key that will be used for connecting to the nodes via ssh:

    ```
    cat <<EOF > ~/.ssh/config
    Host ceph*
      User deployment-user
      IdentityFile ~/.ssh/ceph.pem
    EOF
    ```

    c. Build the ansible inventory

    ```
    cat <<EOF > /usr/share/cephadm-ansible/inventory
    ceph1
    ceph2
    ceph3
    ceph4
    ceph5
    ceph6
    ceph7
    [admin]
    ceph1
    ceph4
    EOF
    ```

    NOTE

    Here, the Hosts (**Ceph1** and **Ceph4**) belonging to two different data centers are configured as part of the [admin] group on the inventory file and are tagged as **_admin** by **cephadm**. Each of these admin nodes receive the admin ceph keyring during the bootstrap process so that when one data center is down, we can check using the other available admin node.

d. Verify that **ansible** can access all nodes using ping module before running the pre-flight playbook.

```
$ ansible -i /usr/share/cephadm-ansible/inventory -m ping all -b
```

Example output:

```
ceph6 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph4 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph3 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph2 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph5 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph1 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
ceph7 | SUCCESS => {
    "ansible_facts": {
        "discovered_interpreter_python": "/usr/libexec/platform-python"
    },
    "changed": false,
    "ping": "pong"
}
```

–

e. Navigate to the **/usr/share/cephadm-ansible** directory.

f. Run ansible-playbook with relative file paths.

```
$ ansible-playbook -i /usr/share/cephadm-ansible/inventory /usr/share/cephadm-
ansible/cephadm-preflight.yml --extra-vars "ceph_origin=rhcs"
```

The preflight playbook Ansible playbook configures the RHCS **dnf** repository and prepares the storage cluster for bootstrapping. It also installs podman, lvm2, chronyd, and cephadm. The default location for **cephadm-ansible** and **cephadm-preflight.yml** is **/usr/share/cephadm-ansible**. For additional information, see Running the preflight playbook

3.5.2. Cluster bootstrapping and service deployment with Cephadm

The cephadm utility installs and starts a single Ceph Monitor daemon and a Ceph Manager daemon for a new Red Hat Ceph Storage cluster on the local node where the cephadm bootstrap command is run.

In this guide we are going to bootstrap the cluster and deploy all the needed Red Hat Ceph Storage services in one step using a cluster specification yaml file.

If you find issues during the deployment, it may be easier to troubleshoot the errors by dividing the deployment into two steps:

1. Bootstrap
2. Service deployment

NOTE

For additional information on the bootstrapping process, see Bootstrapping a new storage cluster.

Procedure

1. Create json file to authenticate against the container registry using a json file as follows:

```
$ cat <<EOF > /root/registry.json
{
 "url":"registry.redhat.io",
 "username":"User",
 "password":"Pass"
}
EOF
```

2. Create a **cluster-spec.yaml** that adds the nodes to the Red Hat Ceph Storage cluster and also sets specific labels for where the services should run following table 3.1.

```
cat <<EOF > /root/cluster-spec.yaml
service_type: host
addr: 10.0.40.78  ## <XXX.XXX.XXX.XXX>
hostname: ceph1   ##  <ceph-hostname-1>
location:
  root: default
  datacenter: DC1
labels:
  - osd
  - mon
  - mgr
---
service_type: host
addr: 10.0.40.35
hostname: ceph2
location:
  datacenter: DC1
labels:
  - osd
  - mon
---
service_type: host
addr: 10.0.40.24
hostname: ceph3
location:
  datacenter: DC1
labels:
  - osd
  - mds
  - rgw
---
service_type: host
addr: 10.0.40.185
hostname: ceph4
location:
  root: default
  datacenter: DC2
labels:
  - osd
  - mon
  - mgr
---
service_type: host
addr: 10.0.40.88
hostname: ceph5
location:
  datacenter: DC2
labels:
  - osd
  - mon
---
service_type: host
addr: 10.0.40.66
hostname: ceph6
location:
  datacenter: DC2
labels:
  - osd
  - mds
  - rgw
---
service_type: host
```

```
addr: 10.0.40.221
hostname: ceph7
labels:
  - mon
---
service_type: mon
placement:
  label: "mon"
---
service_type: mds
service_id: cephfs
placement:
  label: "mds"
---
service_type: mgr
service_name: mgr
placement:
  label: "mgr"
---
service_type: osd
service_id: all-available-devices
service_name: osd.all-available-devices
placement:
  label: "osd"
spec:
  data_devices:
    all: true
---
service_type: rgw
service_id: objectgw
service_name: rgw.objectgw
placement:
  count: 2
  label: "rgw"
spec:
  rgw_frontend_port: 8080
EOF
```

3. Retrieve the IP for the NIC with the Red Hat Ceph Storage public network configured from the bootstrap node. After substituting **10.0.40.0** with the subnet that you have defined in your ceph public network, execute the following command.

   ```
   $ ip a | grep 10.0.40
   ```

   Example output:

   ```
   10.0.40.78
   ```

4. Run the **Cephadm** bootstrap command as the **root** user on the node that will be the initial Monitor node in the cluster. The **IP_ADDRESS** option is the node's IP address that you are using to run the **cephadm bootstrap** command.

NOTE

If you have configured a different user instead of **root** for passwordless SSH access, then use the **--ssh-user=** flag with the **cepadm bootstrap** command.

If you are using non default/id_rsa ssh key names, then use **--ssh-private-key** and **--ssh-public-key** options with **cephadm** command.

```
$ cephadm  bootstrap --ssh-user=deployment-user --mon-ip 10.0.40.78 --apply-spec
/root/cluster-spec.yaml --registry-json /root/registry.json
```

IMPORTANT

If the local node uses fully-qualified domain names (FQDN), then add the **--allow-fqdn-hostname** option to **cephadm bootstrap** on the command line.

Once the bootstrap finishes, you will see the following output from the previous cephadm bootstrap command:

```
You can access the Ceph CLI with:

 sudo /usr/sbin/cephadm shell --fsid dd77f050-9afe-11ec-a56c-029f8148ea14 -c
/etc/ceph/ceph.conf -k /etc/ceph/ceph.client.admin.keyring

Please consider enabling telemetry to help improve Ceph:

 ceph telemetry on

For more information see:

 https://docs.ceph.com/docs/pacific/mgr/telemetry/
```

5. Verify the status of Red Hat Ceph Storage cluster deployment using the Ceph CLI client from ceph1:

```
$ ceph -s
```

Example output:

```
cluster:
  id:     3a801754-e01f-11ec-b7ab-005056838602
  health: HEALTH_OK

services:
  mon: 5 daemons, quorum ceph1,ceph2,ceph4,ceph5,ceph7 (age 4m)
  mgr: ceph1.khuuot(active, since 5m), standbys: ceph4.zotfsp
  osd: 12 osds: 12 up (since 3m), 12 in (since 4m)
  rgw: 2 daemons active (2 hosts, 1 zones)

data:
  pools:   5 pools, 107 pgs
```

```
    objects: 191 objects, 5.3 KiB
    usage:   105 MiB used, 600 GiB / 600 GiB avail
             105 active+clean
```

NOTE

It may take several minutes for all the services to start.

It is normal to get a global recovery event while you don't have any osds configured.

You can use **ceph orch ps** and **ceph orch ls** to further check the status of the services.

6. Verify if all the nodes are part of the **cephadm** cluster.

```
$ ceph orch host ls
```

Example output:

```
HOST   ADDR         LABELS  STATUS
ceph1  10.0.40.78    _admin osd mon mgr
ceph2  10.0.40.35    osd mon
ceph3  10.0.40.24    osd mds rgw
ceph4  10.0.40.185   osd mon mgr
ceph5  10.0.40.88    osd mon
ceph6  10.0.40.66    osd mds rgw
ceph7  10.0.40.221   mon
```

NOTE

You can run Ceph commands directly from the host because **ceph1** was configured in the **cephadm-ansible** inventory as part of the [admin] group. The Ceph admin keys were copied to the host during the **cephadm bootstrap** process.

7. Check the current placement of the Ceph monitor services on the datacenters.

```
$ ceph orch ps | grep mon | awk '{print $1 " " $2}'
```

Example output:

```
mon.ceph1 ceph1
mon.ceph2 ceph2
mon.ceph4 ceph4
mon.ceph5 ceph5
mon.ceph7 ceph7
```

8. Check the current placement of the Ceph manager services on the datacenters.

```
$ ceph orch ps | grep mgr | awk '{print $1 " " $2}'
```

Example output:

```
mgr.ceph2.ycgwyz ceph2
mgr.ceph5.kremtt ceph5
```

9. Check the ceph osd crush map layout to ensure that each host has one OSD configured and its status is **UP**. Also, double-check that each node is under the right datacenter bucket as specified in table 3.1

   ```
   $ ceph osd tree
   ```

   Example output:

   ```
   ID   CLASS  WEIGHT   TYPE NAME          STATUS  REWEIGHT  PRI-AFF
   -1          0.87900  root default
   -16         0.43950      datacenter DC1
   -11         0.14650          host ceph1
     2    ssd  0.14650              osd.2      up   1.00000  1.00000
    -3         0.14650          host ceph2
     3    ssd  0.14650              osd.3      up   1.00000  1.00000
   -13         0.14650          host ceph3
     4    ssd  0.14650              osd.4      up   1.00000  1.00000
   -17         0.43950      datacenter DC2
    -5         0.14650          host ceph4
     0    ssd  0.14650              osd.0      up   1.00000  1.00000
    -9         0.14650          host ceph5
     1    ssd  0.14650              osd.1      up   1.00000  1.00000
    -7         0.14650          host ceph6
     5    ssd  0.14650              osd.5      up   1.00000  1.00000
   ```

10. Create and enable a new RDB block pool.

    ```
    $ ceph osd pool create rbdpool 32 32
    $ ceph osd pool application enable rbdpool rbd
    ```

    NOTE

    The number 32 at the end of the command is the number of PGs assigned to this pool. The number of PGs can vary depending on several factors like the number of OSDs in the cluster, expected % used of the pool, etc. You can use the following calculator to determine the number of PGs needed: Ceph Placement Groups (PGs) per Pool Calculator.

11. Verify that the RBD pool has been created.

    ```
    $ ceph osd lspools | grep rbdpool
    ```

    Example output:

    ```
     3 rbdpool
    ```

12. Verify that MDS services are active and has located one service on each datacenter.

```
$ ceph orch ps | grep mds
```

Example output:

```
mds.cephfs.ceph3.cjpbqo    ceph3           running (17m)   117s ago  17m    16.1M       -
16.2.9
mds.cephfs.ceph6.lqmgqt    ceph6           running (17m)   117s ago  17m    16.1M       -
16.2.9
```

13. Create the CephFS volume.

```
$ ceph fs volume create cephfs
```

NOTE

The **ceph fs volume create** command also creates the needed data and meta CephFS pools. For more information, see Configuring and Mounting Ceph File Systems.

14. Check the **Ceph** status to verify how the MDS daemons have been deployed. Ensure that the state is active where **ceph6** is the primary MDS for this filesystem and **ceph3** is the secondary MDS.

```
$ ceph fs status
```

Example output:

```
cephfs - 0 clients
======
RANK  STATE         MDS           ACTIVITY     DNS    INOS   DIRS   CAPS
 0    active  cephfs.ceph6.ggjywj  Reqs:    0 /s    10     13     12      0
       POOL           TYPE     USED  AVAIL
cephfs.cephfs.meta  metadata  96.0k   284G
cephfs.cephfs.data    data       0    284G
    STANDBY MDS
cephfs.ceph3.ogcqkl
```

15. Verify that RGW services are active.

```
$ ceph orch ps | grep rgw
```

Example output:

```
rgw.objectgw.ceph3.kkmxgb  ceph3  *:8080      running (7m)     3m ago   7m    52.7M       -
16.2.9
rgw.objectgw.ceph6.xmnpah  ceph6  *:8080      running (7m)     3m ago   7m    53.3M       -
16.2.9
```

3.5.3. Configuring Red Hat Ceph Storage stretch mode

Once the Red Hat Ceph Storage cluster is fully deployed using **cephadm**, use the following procedure to configure the stretch cluster mode. The new stretch mode is designed to handle the 2-site case.

Procedure

1. Check the current election strategy being used by the monitors with the ceph mon dump command. By default in a ceph cluster, the connectivity is set to classic.

   ```
   ceph mon dump | grep election_strategy
   ```

   Example output:

   ```
   dumped monmap epoch 9
   election_strategy: 1
   ```

2. Change the monitor election to connectivity.

   ```
   ceph mon set election_strategy connectivity
   ```

3. Run the previous ceph mon dump command again to verify the election_strategy value.

   ```
   $ ceph mon dump | grep election_strategy
   ```

   Example output:

   ```
   dumped monmap epoch 10
   election_strategy: 3
   ```

   To know more about the different election strategies, see Configuring monitor election strategy.

4. Set the location for all our Ceph monitors:

   ```
   ceph mon set_location ceph1 datacenter=DC1
   ceph mon set_location ceph2 datacenter=DC1
   ceph mon set_location ceph4 datacenter=DC2
   ceph mon set_location ceph5 datacenter=DC2
   ceph mon set_location ceph7 datacenter=DC3
   ```

5. Verify that each monitor has its appropriate location.

   ```
   $ ceph mon dump
   ```

   Example output:

   ```
   epoch 17
   fsid dd77f050-9afe-11ec-a56c-029f8148ea14
   last_changed 2022-03-04T07:17:26.913330+0000
   created 2022-03-03T14:33:22.957190+0000
   min_mon_release 16 (pacific)
   election_strategy: 3
   0: [v2:10.0.143.78:3300/0,v1:10.0.143.78:6789/0] mon.ceph1; crush_location
   {datacenter=DC1}
   1: [v2:10.0.155.185:3300/0,v1:10.0.155.185:6789/0] mon.ceph4; crush_location
   {datacenter=DC2}
   2: [v2:10.0.139.88:3300/0,v1:10.0.139.88:6789/0] mon.ceph5; crush_location
   ```

```
{datacenter=DC2}
3: [v2:10.0.150.221:3300/0,v1:10.0.150.221:6789/0] mon.ceph7; crush_location
{datacenter=DC3}
4: [v2:10.0.155.35:3300/0,v1:10.0.155.35:6789/0] mon.ceph2; crush_location
{datacenter=DC1}
```

6. Create a CRUSH rule that makes use of this OSD crush topology by installing the **ceph-base** RPM package in order to use the **crushtool** command:

   ```
   $ dnf -y install ceph-base
   ```

   To know more about CRUSH ruleset, see Ceph CRUSH ruleset.

7. Get the compiled CRUSH map from the cluster:

   ```
   $ ceph osd getcrushmap > /etc/ceph/crushmap.bin
   ```

8. Decompile the CRUSH map and convert it to a text file in order to be able to edit it:

   ```
   $ crushtool -d /etc/ceph/crushmap.bin -o /etc/ceph/crushmap.txt
   ```

9. Add the following rule to the CRUSH map by editing the text file **/etc/ceph/crushmap.txt** at the end of the file.

   ```
   $ vim /etc/ceph/crushmap.txt
   ```

   ```
   rule stretch_rule {
           id 1
           type replicated
           min_size 1
           max_size 10
           step take default
           step choose firstn 0 type datacenter
           step chooseleaf firstn 2 type host
           step emit
   }
   # end crush map
   ```

   This example is applicable for active applications in both OpenShift Container Platform clusters.

   NOTE

   The rule **id** has to be unique. In the example, we only have one more crush rule with id 0 hence we are using id 1. If your deployment has more rules created, then use the next free id.

   The CRUSH rule declared contains the following information:

   - **Rule name**
     - Description: A unique whole name for identifying the rule.
     - Value: **stretch_rule**

- **id**
  - Description: A unique whole number for identifying the rule.
  - Value: **1**
- **type**
  - Description: Describes a rule for either a storage drive replicated or erasure-coded.
  - Value: **replicated**
- **min_size**
  - Description: If a pool makes fewer replicas than this number, CRUSH will not select this rule.
  - Value: 1
- **max_size**
  - Description: If a pool makes more replicas than this number, CRUSH will not select this rule.
  - Value: 10
- **step take default**
  - Description: Takes the root bucket called **default**, and begins iterating down the tree.
- **step choose firstn 0 type datacenter**
  - Description: Selects the datacenter bucket, and goes into it's subtrees.
- **step chooseleaf firstn 2 type host**
  - Description: Selects the number of buckets of the given type. In this case, it is two different hosts located in the datacenter it entered at the previous level.
- **step emit**
  - Description: Outputs the current value and empties the stack. Typically used at the end of a rule, but may also be used to pick from different trees in the same rule.

10. Compile the new CRUSH map from the file **/etc/ceph/crushmap.txt** and convert it to a binary file called **/etc/ceph/crushmap2.bin**:

    ```
    $ crushtool -c /etc/ceph/crushmap.txt -o /etc/ceph/crushmap2.bin
    ```

11. Inject the new crushmap we created back into the cluster:

    ```
    $ ceph osd setcrushmap -i /etc/ceph/crushmap2.bin
    ```

    Example output:

    ```
    17
    ```

NOTE

The number 17 is a counter and it will increase (18,19, and so on) depending on the changes you make to the crush map.

12. Verify that the stretched rule created is now available for use.

    ```
    ceph osd crush rule ls
    ```

    Example output:

    ```
    replicated_rule
    stretch_rule
    ```

13. Enable the stretch cluster mode.

    ```
    $ ceph mon enable_stretch_mode ceph7 stretch_rule datacenter
    ```

    In this example, **ceph7** is the arbiter node, **stretch_rule** is the crush rule we created in the previous step and **datacenter** is the dividing bucket.

14. Verify all our pools are using the **stretch_rule** CRUSH rule we have created in our Ceph cluster:

    ```
    $ for pool in $(rados lspools);do echo -n "Pool: ${pool}; ";ceph osd pool get ${pool}
    crush_rule;done
    ```

    Example output:

    ```
    Pool: device_health_metrics; crush_rule: stretch_rule
    Pool: cephfs.cephfs.meta; crush_rule: stretch_rule
    Pool: cephfs.cephfs.data; crush_rule: stretch_rule
    Pool: .rgw.root; crush_rule: stretch_rule
    Pool: default.rgw.log; crush_rule: stretch_rule
    Pool: default.rgw.control; crush_rule: stretch_rule
    Pool: default.rgw.meta; crush_rule: stretch_rule
    Pool: rbdpool; crush_rule: stretch_rule
    ```

    This indicates that a working Red Hat Ceph Storage stretched cluster with arbiter mode is now available.

3.6. INSTALLING OPENSHIFT DATA FOUNDATION ON MANAGED CLUSTERS

In order to configure storage replication between the two OpenShift Container Platform clusters, OpenShift Data Foundation operator must be installed first on each managed cluster as follows:

Prerequisites

- Ensure that you have met the hardware requirements for OpenShift Data Foundation external deployments. For a detailed description of the hardware requirements, see External mode requirements.

NOTE

Refer to OpenShift Data Foundation deployment guides and instructions that are specific to your infrastructure (AWS, VMware, BM, Azure, etc.).

Procedure

1. Install and configure the latest **OpenShift Data Foundation** cluster on each of the managed clusters.

2. After installing the operator, create a StorageSystem using the option **Full deployment** type and **Connect with external storage platform** where your **Backing storage type** is **Red Hat Ceph Storage**.
   For detailed instructions, refer to Deploying OpenShift Data Foundation in external mode .

   - At a minimum, you must use the following three flags with the **ceph-external-cluster-details-exporter.py script**:

     --rbd-data-pool-name

     With the name of the RBD pool that was created during RHCS deployment for OpenShift Container Platform. For example, the pool can be called **rbdpool**.

     --rgw-endpoint

     Provide the endpoint in the format **<ip_address>:<port>**. It is the RGW IP of the RGW daemon running on the same site as the OpenShift Container Platform cluster that you are configuring.

     --run-as-user

     With a different client name for each site.

     The following flags are **optional** if default values were used during the RHCS deployment:

     --cephfs-filesystem-name

     With the name of the CephFS filesystem we created during RHCS deployment for OpenShift Container Platform, the default filesystem name is **cephfs**.

     --cephfs-data-pool-name

     With the name of the CephFS data pool we created during RHCS deployment for OpenShift Container Platform, the default pool is called **cephfs.data**.

     --cephfs-metadata-pool-name

     With the name of the CephFS metadata pool we created during RHCS deployment for OpenShift Container Platform, the default pool is called **cephfs.meta**.

   - Run the following command on the bootstrap node, ceph1, to get the IP for the RGW endpoints in datacenter1 and datacenter2:

     ```
     ceph orch ps | grep rgw.objectgw
     ```

     Example output:

     ```
     rgw.objectgw.ceph3.mecpzm  ceph3  *:8080      running (5d)    31s ago   7w    204M
     -  16.2.7-112.el8cp
     rgw.objectgw.ceph6.mecpzm  ceph6  *:8080      running (5d)    31s ago   7w    204M
     -  16.2.7-112.el8cp
     ```

```
host ceph3
host ceph6
```

Example output:

```
ceph3.example.com has address 10.0.40.24
ceph6.example.com has address 10.0.40.66
```

- Execute the ceph-external-cluster-details-exporter.py with the parameters configured for our first ocp managed cluster cluster1.

  ```
  python3 ceph-external-cluster-details-exporter.py --rbd-data-pool-name rbdpool --cephfs-filesystem-name cephfs --cephfs-data-pool-name cephfs.cephfs.data  --cephfs-metadata-pool-name cephfs.cephfs.meta --rgw-endpoint 10.0.40.24:8080 --run-as-user client.odf.cluster1 > ocp-cluster1.json
  ```

- Execute the ceph-external-cluster-details-exporter.py with the parameters configured for our first ocp managed cluster cluster2

  ```
  python3 ceph-external-cluster-details-exporter.py --rbd-data-pool-name rbdpool --cephfs-filesystem-name cephfs --cephfs-data-pool-name cephfs.cephfs.data  --cephfs-metadata-pool-name cephfs.cephfs.meta --rgw-endpoint 10.0.40.66:8080 --run-as-user client.odf.cluster2 > ocp-cluster2.json
  ```

- Save the two files generated in the bootstrap cluster (ceph1) **ocp-cluster1.json** and **ocp-cluster2.json** to your local machine.
- Use the contents of file **ocp-cluster1.json** on the OCP console on **cluster1** where external ODF is being deployed.
- Use the contents of file **ocp-cluster2.json** on the OCP console on **cluster2** where external ODF is being deployed.

3. Review the settings and then select **Create StorageSystem**.

4. Validate the successful deployment of OpenShift Data Foundation on each managed cluster with the following command:

   ```
   $ oc get storagecluster -n openshift-storage ocs-external-storagecluster -o jsonpath='{.status.phase}{"\n"}'
   ```

   For the Multicloud Gateway (MCG):

   ```
   $ oc get noobaa -n openshift-storage noobaa -o jsonpath='{.status.phase}{"\n"}'
   ```

   If the status result is **Ready** for both queries on the **Primary managed cluster** and the **Secondary managed cluster**, then continue with the next step.

NOTE

In the OpenShift Web Console, navigate to **Installed Operators → OpenShift Data Foundation → Storage System → ocs-storagecluster-storagesystem → Resources** and verify that **Status** of **StorageCluster** is **Ready** and has a green tick mark next to it.

3.7. INSTALLING OPENSHIFT DATA FOUNDATION MULTICLUSTER ORCHESTRATOR OPERATOR

OpenShift Data Foundation Multicluster Orchestrator is a controller that is installed from OpenShift Container Platform’s OperatorHub on the Hub cluster.

Procedure

1. On the **Hub cluster**, navigate to **OperatorHub** and use the keyword filter to search for **ODF Multicluster Orchestrator**.
2. Click **ODF Multicluster Orchestrator** tile.
3. Keep all default settings and click **Install**.
   Ensure that the operator resources are installed in **openshift-operators** project and available to all namespaces.

   NOTE

   The **ODF Multicluster Orchestrator** also installs the **Openshift DR Hub Operator** on the RHACM hub cluster as a dependency.

4. Verify that the operator **Pods** are in a **Running** state. The **OpenShift DR Hub operator** is also installed at the same time in **openshift-operators** namespace.

```
$ oc get pods -n openshift-operators
```

   Example output:

```
NAME                                        READY   UP-TO-DATE   AVAILABLE   AGE
odf-multicluster-console-6845b795b9-blxrn   1/1     Running      0           4d20h
odfmo-controller-manager-f9d9dfb59-jbrsd    1/1     Running      0           4d20h
ramen-hub-operator-6fb887f885-fss4w         2/2     Running      0           4d20h
```

3.8. CONFIGURING SSL ACCESS ACROSS CLUSTERS

Configure network (SSL) access between the **primary and secondary clusters** so that metadata can be stored on the alternate cluster in a Multicloud Gateway (MCG) **object bucket** using a secure transport protocol and in the **Hub cluster** for verifying access to the object buckets.

NOTE

If all of your OpenShift clusters are deployed using a signed and valid set of certificates for your environment then this section can be skipped.

Procedure

1. Extract the ingress certificate for the Primary managed cluster and save the output to **primary.crt**.

```
$ oc get cm default-ingress-cert -n openshift-config-managed -o jsonpath="{['data']['ca-bundle\.crt']}" > primary.crt
```

2. Extract the ingress certificate for the Secondary managed cluster and save the output to **secondary.crt**.

```
$ oc get cm default-ingress-cert -n openshift-config-managed -o jsonpath="{['data']['ca-
bundle\.crt']}" > secondary.crt
```

3. Create a new **ConfigMap** file to hold the remote cluster's certificate bundle with filename **cm-clusters-crt.yaml**.

NOTE

There could be more or less than three certificates for each cluster as shown in this example file. Also, ensure that the certificate contents are correctly indented after you copy and paste from the **primary.crt** and **secondary.crt** files that were created before.

```
apiVersion: v1
data:
  ca-bundle.crt: |
    -----BEGIN CERTIFICATE-----
    <copy contents of cert1 from primary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert2 from primary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert3 primary.crt here>
    -----END CERTIFICATE----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert1 from secondary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert2 from secondary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert3 from secondary.crt here>
    -----END CERTIFICATE-----
kind: ConfigMap
metadata:
  name: user-ca-bundle
  namespace: openshift-config
```

4. Create the **ConfigMap** on the **Primary managed cluster**, **Secondary managed cluster**, and the **Hub cluster**.

```
$ oc create -f cm-clusters-crt.yaml
```

Example output:

```
configmap/user-ca-bundle created
```

5. Patch default proxy resource on the **Primary managed cluster**, **Secondary managed cluster**, and the **Hub cluster**.

```
$ oc patch proxy cluster --type=merge  --patch='{"spec":{"trustedCA":{"name":"user-ca-bundle"}}}'
```

Example output:

```
proxy.config.openshift.io/cluster patched
```

3.9. CREATING DISASTER RECOVERY POLICY ON HUB CLUSTER

Openshift Disaster Recovery Policy (DRPolicy) resource specifies OpenShift Container Platform clusters participating in the disaster recovery solution and the desired replication interval. DRPolicy is a cluster scoped resource that users can apply to applications that require Disaster Recovery solution.

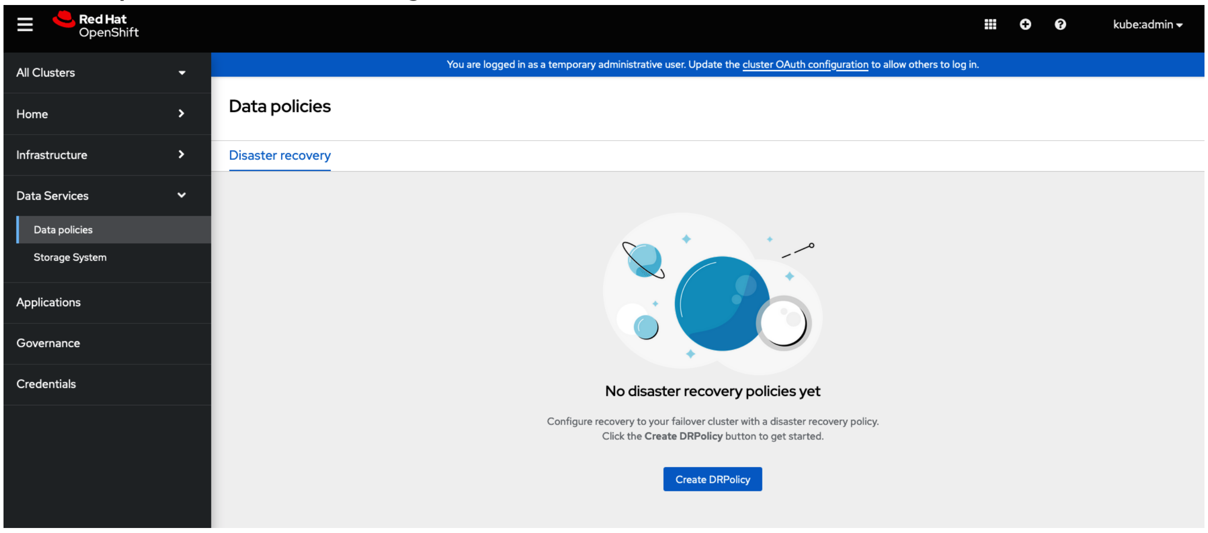
The **ODF MultiCluster Orchestrator** Operator facilitates the creation of each **DRPolicy** and the corresponding **DRClusters** through the **Multicluster Web console**.

Prerequisites

- Ensure that there is a minimum set of two managed clusters.

Procedure

1. On the **OpenShift console**, navigate to **All Clusters**.



You are logged in as a temporary administrative user. Update the cluster OAuth configuration to allow others to log in.

No disaster recovery policies yet

Configure recovery to your failover cluster with a disaster recovery policy.
Click the **Create DRPolicy** button to get started.

2. Navigate to **Data Services** and click **Data policies**.

3. Click **Create DRPolicy**.

4. Enter **Policy name**. Ensure that each DRPolicy has a unique name (for example: **ocp4perf1-ocp4perf2**).

5. Select two clusters from the list of managed clusters to which this new policy will be associated with.

6. **Replication policy** is automatically set to **sync** based on the OpenShift clusters selected.

7. Click **Create**.

8. Verify that the **DRPolicy** is created successfully. Run this command on the **Hub cluster** for each of the DRPolicy resources created.

   NOTE

   Replace <drpolicy_name> with your unique name.

   ```
   $ oc get drpolicy <drpolicy_name> -o jsonpath='{.status.conditions[].reason}{"\n"}'
   ```

   Example output:

   ```
   Succeeded
   ```

   NOTE

   When a DRPolicy is created, along with it, two DRCluster resources are also created. It could take up to 10 minutes for all three resources to be validated and for the status to show as **Succeeded**.

9. Verify the object bucket access from the **Hub cluster** to both the **Primary managed cluster** and the **Secondary managed cluster**.

   a. Get the names of the **DRClusters** on the Hub cluster.

      ```
      $ oc get drclusters
      ```

      Example output:

      ```
      NAME        AGE
      ocp4perf1   4m42s
      ocp4perf2   4m42s
      ```

   b. Check S3 access to each bucket created on each managed cluster using this **DRCluster** validation command.

      NOTE

      Replace <drcluster_name> with your unique name.

      ```
      $ oc get drcluster <drcluster_name> -o jsonpath='{.status.conditions[2].reason}{"\n"}'
      ```

      Example output:

      ```
      Succeeded
      ```

NOTE

Make sure to run command for both **DRClusters** on the **Hub cluster**.

10. Verify that the **OpenShift DR Cluster operator** installation was successful on the **Primary managed cluster** and the **Secondary managed cluster**.

```
$ oc get csv,pod -n openshift-dr-system
```

Example output:

```
NAME                                                                    DISPLAY                    VERSION
REPLACES   PHASE
clusterserviceversion.operators.coreos.com/odr-cluster-operator.v4.11.0   Openshift DR
Cluster Operator   4.11.0              Succeeded

NAME                                             READY   STATUS    RESTARTS   AGE
pod/ramen-dr-cluster-operator-5564f9d669-f6lbc   2/2     Running   0          5m32s
```

You can also verify that **OpenShift DR Cluster Operator** is installed successfully on the **OperatorHub** of each managed clusters.

3.10. CONFIGURE DRCLUSTERS FOR FENCING AUTOMATION

This configuration is required for enabling fencing prior to application failover. In order to prevent writes to the persistent volume from the cluster which is hit by a disaster, OpenShift DR instructs Red Hat Ceph Storage (RHCS) to fence the nodes of the cluster from the RHCS external storage. This section guides you on how to add the IPs or the IP Ranges for the nodes of the DRCluster.

3.10.1. Add node IP addresses to DRClusters

1. Find the **IP addresses** for all of the OpenShift nodes in the managed clusters by running this command in the **Primary managed cluster** and the **Secondary managed cluster**.

```
$ oc get nodes -o jsonpath='{range .items[*]}{.status.addresses[?
(@.type=="ExternalIP")].address}{"\n"}{end}'
```

Example output:

```
10.70.56.118
10.70.56.193
10.70.56.154
10.70.56.242
10.70.56.136
10.70.56.99
```

Once you have the **IP addresses** then the **DRCluster** resources can be modified for each managed cluster.

2. Find the **DRCluster** names on the Hub Cluster.

```
$ oc get drcluster
```

Example output:

```
NAME        AGE
ocp4perf1   5m35s
ocp4perf2   5m35s
```

3. Edit each **DRCluster** to add your unique IP addresses after replacing **<drcluster_name>** with your unique name.

```
$ oc edit drcluster <drcluster_name>
```

```
apiVersion: ramendr.openshift.io/v1alpha1
kind: DRCluster
metadata:
[...]
spec:
  s3ProfileName: s3profile-<drcluster_name>-ocs-external-storagecluster
  ## Add this section
  cidrs:
    -  <IP_Address1>/32
    -  <IP_Address2>/32
    -  <IP_Address3>/32
    -  <IP_Address4>/32
    -  <IP_Address5>/32
    -  <IP_Address6>/32
[...]
```

Example output:

```
drcluster.ramendr.openshift.io/ocp4perf1 edited
```

NOTE

There could be more than six IP addresses.

Modify this **DRCluster** configuration also for **IP addresses** on the **Secondary managed clusters** in the peer DRCluster resource (e.g., ocp4perf2).

3.10.2. Add fencing annotations to DRClusters

Add the following annotations to all the DRCluster resources. These annotations include details needed for the **NetworkFence** resource created later in these instructions (prior to testing application failover).

NOTE

Replace *<drcluster_name>* with your unique name.

```
$ oc edit drcluster <drcluster_name>
```

```
apiVersion: ramendr.openshift.io/v1alpha1
kind: DRCluster
```

```
metadata:
 ## Add this section
 annotations:
  drcluster.ramendr.openshift.io/storage-clusterid: openshift-storage
  drcluster.ramendr.openshift.io/storage-driver: openshift-storage.rbd.csi.ceph.com
  drcluster.ramendr.openshift.io/storage-secret-name: rook-csi-rbd-provisioner
  drcluster.ramendr.openshift.io/storage-secret-namespace: openshift-storage
[...]
```

Example output:

```
drcluster.ramendr.openshift.io/ocp4perf1 edited
```

Make sure to add these annotations for both **DRCluster** resources (for example: **ocp4perf1** and **ocp4perf2**).

3.11. CREATE SAMPLE APPLICATION FOR TESTING DISASTER RECOVERY SOLUTION

OpenShift Data Foundation disaster recovery (DR) solution supports disaster recovery for applications that are managed by RHACM. See Managing Applications for more details.

NOTE

OpenShift Data Foundation DR solution does not support ApplicationSet, which is required for applications that are deployed via ArgoCD.

This solution orchestrates RHACM application placement, using the PlacementRule, when an application is moved between clusters in a DRPolicy for failover or relocation requirements. The following sections detail how to apply a **DRPolicy** to an application and how to manage the applications placement life-cycle during and after cluster unavailability.

NOTE

OpenShift users that do not have cluster-admin permissions, see the Knowledge Article on how to assign necessary permissions to an application user for executing disaster recovery actions.

3.11.1. Creating a sample application

In order to test **failover** from the **Primary managed cluster** to the **Secondary managed cluster** and **relocate**, we need a sample application.

Prerequisites

- When creating an application for general consumption, ensure that the application is deployed to ONLY one cluster.
- Use the sample application called **busybox** as an example.
- Ensure all external routes of the application are configured using either Global Traffic Manager (GTM) or Global Server Load Balancing (GLSB) service for traffic redirection when the application fails over or is relocated.

- As a best practice, group Red Hat Advanced Cluster Management (RHACM) subscriptions, that belong together, to refer to a single Placement Rule to DR protect them as a group. Further create them as a single application for a logical grouping of the subscriptions for future DR actions like failover and relocate.

NOTE

If unrelated subscriptions refer to the same Placement Rule for placement actions, they will also be DR protected as the DR workflow controls all subscriptions that references the Placement Rule.

Procedure

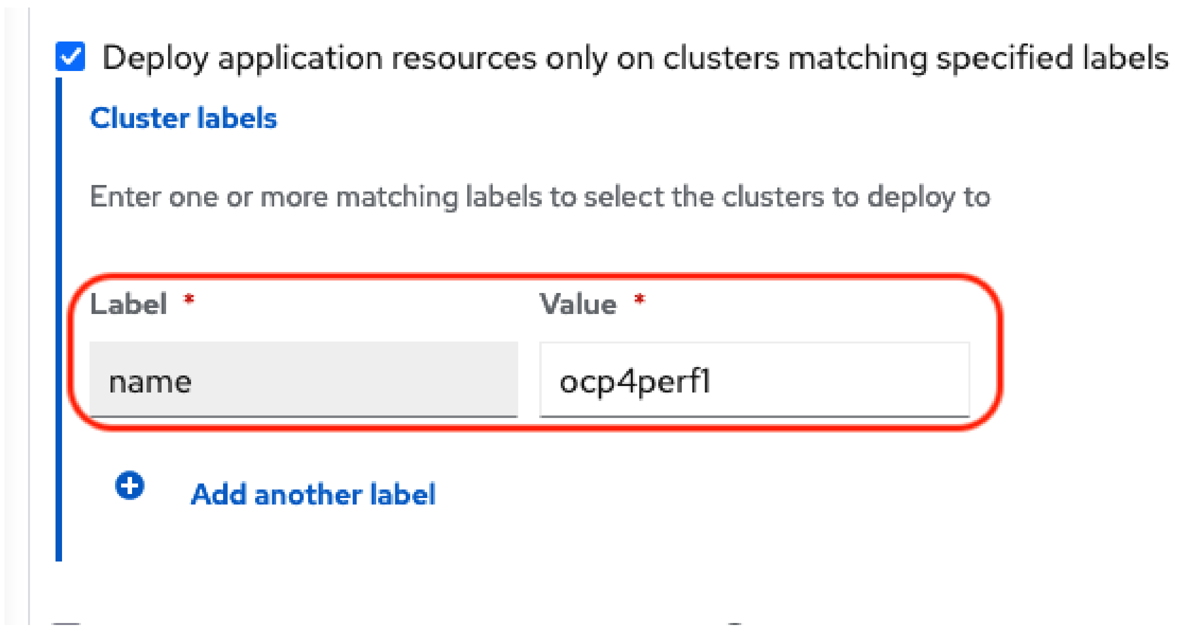
1. Log in to the RHACM console using your OpenShift credentials if not already logged in.

```
$ oc get route multicloud-console -n open-cluster-management -o jsonpath --
template="https://{.spec.host}/multicloud/applications{'\n'}"
```

   Example Output:

```
https://multicloud-console.apps.perf3.example.com/multicloud/applications
```

2. Navigate to **Applications** and click **Create application**.
3. Select type as **Subscription**.
4. Enter your application **Name** (for example, **busybox**) and **Namespace** (for example, **busybox-sample**).
5. In the Repository location for resources section, select **Repository type Git**.
6. Enter the Git repository URL for the sample application, the github **Branch** and **Path** where the resources **busybox** Pod and PVC will be created.
   Use the sample application repository as **https://github.com/red-hat-storage/ocm-ramen-samples** where the **Branch** is **release-4.12** and **Path** is **busybox-odr-metro**.
7. Scroll down in the form until you see **Deploy application resources only on clusters matching specified labels** and then add a label with its value set to the **Primary managed cluster** name in **RHACM** cluster list view.


☑ Deploy application resources only on clusters matching specified labels

Cluster labels

Enter one or more matching labels to select the clusters to deploy to

Label * name

Value * ocp4perf1

8. Click **Create** which is at the top right hand corner.
   On the follow-on screen go to the **Topology** tab. You should see that there are all Green checkmarks on the application topology.

   NOTE

   To get more information, click on any of the topology elements and a window will appear on the right of the topology view.

9. Validating the sample application deployment.
   Now that the **busybox** application has been deployed to your preferred Cluster, the deployment can be validated.

   Login to your managed cluster where **busybox** was deployed by RHACM.

   ```
   $ oc get pods,pvc -n busybox-sample
   ```

   Example output:

   ```
   NAME                          READY   STATUS    RESTARTS   AGE
   pod/busybox-67bf494b9-zl5tr   1/1     Running   0          77s


   NAME                                STATUS   VOLUME                                     CAPACITY   ACCESS
   MODES   STORAGECLASS                  AGE
   persistentvolumeclaim/busybox-pvc   Bound    pvc-c732e5fe-daaf-4c4d-99dd-462e04c18412
   5Gi        RWO            ocs-storagecluster-ceph-rbd   77s
   ```

3.11.2. Apply DRPolicy to sample application

Prerequisites

- Ensure that both managed clusters referenced in the DRPolicy are reachable. If not, the application will not be DR protected till both clusters are online.

Procedure

1. On the Hub cluster go back to the Multicluster Web console, navigate to **All Clusters**.
2. Login to all the clusters listed under **All Clusters**.
3. Navigate to **Data Services** and then click **Data policies**.
4. Click the Actions menu at the end of DRPolicy to view the list of available actions.
5. Click **Apply DRPolicy**.
6. When the **Apply DRPolicy** modal is displayed, select **busybox** application and enter **PVC label** as **appname=busybox**.

   NOTE

   When multiple placements rules under the same application or more than one application are selected, all PVCs within the application's namespace will be protected by default.

7. Click **Apply**.
8. Verify that a **DRPlacementControl** or **DRPC** was created in the **busybox-sample** namespace on the **Hub cluster** and that it's **CURRENTSTATE** shows as **Deployed**. This resource is used for both failover and relocate actions for this application.

   ```
   $ oc get drpc -n busybox-sample
   ```

   Example output:

   ```
   NAME                    AGE     PREFERREDCLUSTER   FAILOVERCLUSTER
   DESIREDSTATE   CURRENTSTATE
   busybox-placement-1-drpc   6m59s   ocp4perf1                               Deployed
   ```

3.11.3. Deleting sample application

You can delete the sample application **busybox** using the RHACM console.

NOTE

The instructions to delete the sample application should not be executed until the failover and relocate testing is completed and the application is ready to be removed from RHACM and the managed clusters.

Procedure

1. On the RHACM console, navigate to **Applications**.
2. Search for the sample application to be deleted (for example, **busybox**).
3. Click the Action Menu **(⋮)** next to the application you want to delete.
4. Click **Delete application**.

When the **Delete application** is selected a new screen will appear asking if the application related resources should also be deleted.

5. Select **Remove application related resources** checkbox to delete the Subscription and PlacementRule.
6. Click **Delete**. This will delete the busybox application on the Primary managed cluster (or whatever cluster the application was running on).
7. In addition to the resources deleted using the RHACM console, the **DRPlacementControl** must also be deleted after deleting the **busybox** application.
    a. Login to the OpenShift Web console for the Hub cluster and navigate to Installed Operators for the project **busybox-sample**.
    b. Click **OpenShift DR Hub Operator** and then click **DRPlacementControl** tab.
    c. Click the Action Menu **(⋮)** next to the **busybox** application DRPlacementControl that you want to delete.
    d. Click **Delete DRPlacementControl**.
    e. Click **Delete**.

NOTE

This process can be used to delete any application with a **DRPlacementControl** resource.

3.12. APPLICATION FAILOVER BETWEEN MANAGED CLUSTERS

Perform a failover when a managed cluster becomes unavailable, due to any reason. This failover method is application based.

Prerequisites

- [Optional] If your setup has active and passive RHACM hub clusters,
    - Install the multi cluster orchestrator (MCO) operator on the passive RHACM hub prior to the restore. For instructions to restore your RHACM hub, see Preparing the new hub cluster .
    - Once the MCO operator is installed, to restore the backup, see Restoring a hub cluster from backup.
    - Wait till DRPolicy validation succeeds.

NOTE

Recovering a failed hub to its passive instance will only restore applications and their DR protected state as of the last scheduled backup. Any application that was DR protected post the last scheduled backup would need to be protected again on the new hub.

- [Optional] When the primary cluster is in a state other than **Ready**, the actual status on the RHACM console → Infrastructure → Clusters → Cluster list tab might take some time to update. Make sure to check the status of both the managed clusters individually before performing failover operation. However, failover operation can still be performed.

- In order to failover the OpenShift cluster where the application is currently running all applications must be fenced from communicating with the external OpenShift Data Foundation external storage cluster. This is required to prevent simultaneous writes to the same persistent volume from both managed clusters. The OpenShift cluster to **Fence** is the one where the applications are currently running.

Procedure

1. Enable fencing on the **Hub cluster**.

   a. Open CLI terminal and edit the **DRCluster resource**.

   CAUTION

   Once the managed cluster is fenced, **all** communication from applications to the OpenShift Data Foundation external storage cluster will fail and some **Pods** will be in an unhealthy state (for example: **CreateContainerError**, **CrashLoopBackOff**) on the cluster that is now fenced.

   NOTE

   Replace *<drcluster_name>* with your unique name.

   ```
   $ oc edit drcluster <drcluster_name>
   ```

   ```
   apiVersion: ramendr.openshift.io/v1alpha1
   kind: DRCluster
   metadata:
   [...]
   spec:
     ## Add this line
     clusterFence: Fenced
     cidrs:
     [...]
   [...]
   ```

   Example output:

   ```
   drcluster.ramendr.openshift.io/ocp4perf1 edited
   ```

   b. Verify the fencing status on the **Hub cluster** for the **Primary managed cluster**.

   NOTE

   Replace *<drcluster_name>* with your unique name.

   ```
   $ oc get drcluster.ramendr.openshift.io <drcluster_name> -o jsonpath='{.status.phase}
   {"\n"}'
   ```

   Example output:

   ```
   Fenced
   ```

2. On the Hub cluster, navigate to **Applications**.
3. Click the **Actions** menu at the end of application row to view the list of available actions.
4. Click **Failover application**.
5. When the **Failover application** popup is shown, select **policy** and **target cluster** to which the associated application will failover in case of a disaster.
6. By default, the subscription group that will replicate the application resources is selected. Click the **Select subscription group** dropdown to verify the default selection or modify this setting.
7. Check the status of the **Failover readiness**.
   - If the status is **Ready** with a green tick, it indicates that the target cluster is ready for failover to start. Proceed to step 7.
   - If the status is **Unknown** or **Not ready**, then wait until the status changes to **Ready**.
8. Click **Initiate**. The busybox resources are now created on the target cluster.
9. Close the modal window and track the status using the **Data policy** column on the Applications page.
10. Verify that the activity status shows as **FailedOver** for the application.
    a. Navigate to the **Applications** → **Overview** tab.
    b. In the **Data policy** column, click the **policy** link for the application you applied the policy to.
    c. On the **Data Policies** modal page, click the **View more details** link.

3.13. RELOCATING AN APPLICATION BETWEEN MANAGED CLUSTERS

Relocate an application to its preferred location when all managed clusters are available.

Prerequisite

- [Optional] If your setup has active and passive RHACM hub clusters, and if you have restored the data in the new hub, then
  - Wait for both managed clusters to be **Ready** in the RHACM console. For more information, see Restoring imported managed clusters .
  - Ensure that S3 profile is added to the configmap **ramen-hub-operator-config** in the **openshift-operators** namespace on the hub cluster.
  - Before relocation to preferred cluster,
    - Check the PROGRESSION status. If it is stuck at **Cleaning Up**, then manually clean up the applications in the preferred cluster.

```
$ oc get drpc  -n busybox -owide
```

```
NAME                      AGE   PREFERREDCLUSTER   FAILOVERCLUSTER
DESIREDSTATE   CURRENTSTATE   PROGRESSION   START TIME
```

```
DURATION   PEER READY
busybox-placement-1-drpc        10h   ocp4perf1        ocp4perf2       Failover
FailedOver     Cleaning Up   2023-03-07T05:10:39Z            False
```

- Delete the orphaned **AppliedManifestWork** in the preferred cluster. You can find the orphaned **AppliedManifestWork** by looking at the leading **sha256** value.

  ```
  $ echo -n "https://api.ocp4perf-hub.qe.rh-ocs.com:6443" | sha256sum
  ```

  Example output:

  ```
  7044ffd168d05a6d28d2f6ac5a99ad8693c
  ```

  In this case, the server url for the old hub is https://api.ocp4perf-hub.qe.rh-ocs.com:6443 and the **AppliedManfiestWork** that must be deleted is **7044ffd168d05a6d28d2f6ac5a99ad8693c-busybox-sample-subscription**

  ```
  $ oc delete AppliedManifestWork 7044ffd168d05a6d28d2f6ac5a99ad8693c-
  busybox-sample-subscription
  ```

- Verify that your application have been deleted in the preferred cluster before proceeding with the relocation.

NOTE

Recovering a failed hub to its passive instance will only restore applications and their DR protected state as of the last scheduled backup. Any application that was DR protected post the last scheduled backup would need to be protected again on the new hub.

- To ensure that the primary cluster where workloads are running is in **Ready** state, navigate to RHACM console → Infrastructure → Clusters → Cluster list tab. When the primary cluster is in a state other than **Ready**, then the actual status update might take some time to reflect on the RHACM console. Since relocate can only be performed when both primary and preferred clusters are up and running, make sure to check the status of both the managed clusters individually before performing relocate operation.

Procedure

1. Disable fencing on the Hub cluster.

   a. Edit the **DRCluster resource** for this cluster.

      NOTE

      Replace *<drcluster_name>* with your unique name.

      ```
      $ oc edit drcluster <drcluster_name>
      ```

      ```
      apiVersion: ramendr.openshift.io/v1alpha1
      kind: DRCluster
      metadata:
      [...]
      ```

```
spec:
  cidrs:
  [...]
  ## Modify this line
  clusterFence: Unfenced
  [...]
[...]
```

Example output:

```
drcluster.ramendr.openshift.io/ocp4perf1 edited
```

b. Gracefully reboot OpenShift Container Platform nodes that were **Fenced**. A reboot is required to resume the I/O operations after unfencing to avoid any further recovery orchestration failures. Reboot all nodes of the cluster by following the steps in the procedure, Rebooting a node gracefully.

NOTE

Make sure that all the nodes are initially cordoned and drained before you reboot and perform uncordon operations on the nodes.

c. After all OpenShift nodes are rebooted and are in a **Ready** status, verify that all Pods are in a healthy state by running this command on the Primary managed cluster (or whatever cluster has been Unfenced).

```
oc get pods -A | egrep -v 'Running|Completed'
```

Example output:

```
NAMESPACE                              NAME
READY   STATUS      RESTARTS      AGE
```

The output for this query should be zero Pods before proceeding to the next step.

IMPORTANT

If there are Pods still in an unhealthy status because of severed storage communication, troubleshoot and resolve before continuing. Because the storage cluster is external to OpenShift, it also has to be properly recovered after a site outage for OpenShift applications to be healthy.

Alternatively, you can use the OpenShift Web Console dashboards and Overview tab to assess the health of applications and the external ODF storage cluster. The detailed OpenShift Data Foundation dashboard is found by navigating to **Storage → Data Foundation**.

d. Verify that the **Unfenced** cluster is in a healthy state. Validate the fencing status in the Hub cluster for the Primary managed cluster.

NOTE

Replace *<drcluster_name>* with your unique name.

```
$ oc get drcluster.ramendr.openshift.io <drcluster_name> -o jsonpath='{.status.phase}
{"\n"}'
```

Example output:

```
Unfenced
```

2. On the Hub cluster, navigate to **Applications**.
3. Click the **Actions** menu at the end of application row to view the list of available actions.
4. Click **Relocate application**.
5. When the **Relocate application** popup is shown, select **policy** and **target cluster** to which the associated application will relocate to in case of a disaster.
6. By default, the subscription group that will deploy the application resources is selected. Click the **Select subscription group** dropdown to verify the default selection or modify this setting.
7. Check the status of the **Relocation readiness**.
   - If the status is **Ready** with a green tick, it indicates that the target cluster is ready for relocation to start. Proceed to step 7.
   - If the status is **Unknown** or **Not ready**, then wait until the status changes to **Ready**.
8. Click **Initiate**. The busybox resources are now created on the target cluster.
9. Close the modal window and track the status using the **Data policy** column on the Applications page.
10. Verify that the activity status shows as **Relocated** for the application.
    a. Navigate to the **Applications** → **Overview** tab.
    b. In the **Data policy** column, click the **policy** link for the application you applied the policy to.
    c. On the **Data Policies** modal page, click the **View more details** link.

CHAPTER 4. REGIONAL-DR SOLUTION FOR OPENSHIFT DATA FOUNDATION [TECHNOLOGY PREVIEW]

IMPORTANT

Configuring OpenShift Data Foundation for Regional-DR with Advanced Cluster Management is a Technology Preview feature and is subject to Technology Preview support limitations. Technology Preview features are not supported with Red Hat production service level agreements (SLAs) and might not be functionally complete. Red Hat does not recommend using them in production. These features provide early access to upcoming product features, enabling customers to test functionality and provide feedback during the development process.

For more information, see Technology Preview Features Support Scope .

4.1. COMPONENTS OF REGIONAL-DR SOLUTION

Regional-DR is composed of Red Hat Advanced Cluster Management for Kubernetes and OpenShift Data Foundation components to provide application and data mobility across Red Hat OpenShift Container Platform clusters.

Red Hat Advanced Cluster Management for Kubernetes

Red Hat Advanced Cluster Management (RHACM))provides the ability to manage multiple clusters and application lifecycles. Hence, it serves as a control plane in a multi-cluster environment.

RHACM is split into two parts:

- RHACM Hub: includes components that run on the multi-cluster control plane.
- Managed clusters: includes components that run on the clusters that are managed.

For more information about this product, see RHACM documentation and the RHACM “Manage Applications” documentation.

OpenShift Data Foundation

OpenShift Data Foundation provides the ability to provision and manage storage for stateful applications in an OpenShift Container Platform cluster.

OpenShift Data Foundation is backed by Ceph as the storage provider, whose lifecycle is managed by Rook in the OpenShift Data Foundation component stack. Ceph-CSI provides the provisioning and management of Persistent Volumes for stateful applications.

OpenShift Data Foundation stack is now enhanced with the following abilities for disaster recovery:

- Enable RBD block pools for mirroring across OpenShift Data Foundation instances (clusters)
- Ability to mirror specific images within an RBD block pool
- Provides csi-addons to manage per Persistent Volume Claim (PVC) mirroring

OpenShift DR

OpenShift DR is a set of orchestrators to configure and manage stateful applications across a set of peer OpenShift clusters which are managed using RHACM and provides cloud-native interfaces to orchestrate the life-cycle of an application's state on Persistent Volumes. These include:

- Protecting an application and its state relationship across OpenShift clusters
- Failing over an application and its state to a peer cluster
- Relocate an application and its state to the previously deployed cluster

OpenShift DR is split into three components:

- **ODF Multicluster Orchestrator**: Installed on the multi-cluster control plane (RHACM Hub), it orchestrates configuration and peering of OpenShift Data Foundation clusters for Metro and Regional DR relationships
- **OpenShift DR Hub Operator**: Automatically installed as part of ODF Multicluster Orchestrator installation on the hub cluster to orchestrate failover or relocation of DR enabled applications.
- **OpenShift DR Cluster Operator**: Automatically installed on each managed cluster that is part of a Metro and Regional DR relationship to manage the lifecycle of all PVCs of an application.

4.2. REGIONAL-DR DEPLOYMENT WORKFLOW

This section provides an overview of the steps required to configure and deploy Regional-DR capabilities using latest version of Red Hat OpenShift Data Foundation across two distinct OpenShift Container Platform clusters. In addition to two managed clusters, a third OpenShift Container Platform cluster will be required to deploy the Red Hat Advanced Cluster Management (RHACM).

To configure your infrastructure, perform the below steps in the order given:

1. Ensure requirements across the three: Hub, Primary and Secondary Openshift Container Platform clusters that are part of the DR solution are met. See Requirements for enabling Regional-DR.
2. Install OpenShift Data Foundation operator and create a storage system on Primary and Secondary managed clusters. See Creating OpenShift Data Foundation cluster on managed clusters.
3. Install the ODF Multicluster Orchestrator on the Hub cluster. See Installing ODF Multicluster Orchestrator on Hub cluster.
4. Configure SSL access between the Hub, Primary and Secondary clusters. See Configuring SSL access across clusters.
5. Create a DRPolicy resource for use with applications requiring DR protection across the Primary and Secondary clusters. See Creating Disaster Recovery Policy on Hub cluster .

   NOTE

   There can be more than a single policy.

For testing your disaster recovery solution:

- Create a sample application using RHACM console. See Creating sample application .

- Test failover and relocate operations using the sample application between managed clusters. See application failover and relocating an application.

4.3. REQUIREMENTS FOR ENABLING REGIONAL-DR

Disaster Recovery features supported by Red Hat OpenShift Data Foundation require all of the following prerequisites in order to successfully implement a Disaster Recovery solution:

- You must have three OpenShift clusters that have network reachability between them:
    - **Hub cluster** where Red Hat Advanced Cluster Management for Kubernetes (RHACM operator) is installed.
    - **Primary managed cluster** where OpenShift Data Foundation is installed.
    - **Secondary managed cluster** where OpenShift Data Foundation is installed.
- Ensure that RHACM operator and MultiClusterHub is installed on the Hub cluster. See RHACM installation guide for instructions.
    - Login to the RHACM console using your OpenShift credentials.
    - Find the Route that has been created for the RHACM console:

      ```
      $ oc get route multicloud-console -n open-cluster-management -o jsonpath --
      template="https://{.spec.host}/multicloud/clusters{'\n'}"
      ```

      Example Output:

      ```
      https://multicloud-console.apps.perf3.example.com/multicloud/clusters
      ```

    - Open your output link in a browser to login with OpenShift credentials. You should now see your local-cluster imported.

IMPORTANT

It is the user's responsibility to ensure that application traffic routing and redirection are configured appropriately. Configuration and updates to the application traffic routes are currently not supported.

- Ensure that you have either imported or created the **Primary managed cluster** and the **Secondary managed cluster** using the RHACM console. For instructions, see Creating a cluster and Importing a target managed cluster to the hub cluster .
- The managed clusters must have non-overlapping networks.
  To connect the managed OpenShift cluster and service networks using the Submariner add-ons, you need to validate that the two clusters have non-overlapping networks by running the following commands for each of the managed clusters.

  ```
  $ oc get networks.config.openshift.io cluster -o json | jq .spec
  ```

  Example output for Primary cluster:

  ```
  {
  ```

```
  "clusterNetwork": [
    {
      "cidr": "10.5.0.0/16",
      "hostPrefix": 23
    }
  ],
  "externalIP": {
    "policy": {}
  },
  "networkType": "OpenShiftSDN",
  "serviceNetwork": [
    "10.15.0.0/16"
  ]
}
```

Example output for Secondary cluster:

```
{
  "clusterNetwork": [
    {
      "cidr": "10.6.0.0/16",
      "hostPrefix": 23
    }
  ],
  "externalIP": {
    "policy": {}
  },
  "networkType": "OpenShiftSDN",
  "serviceNetwork": [
    "10.16.0.0/16"
  ]
}
```

For more information, see Submariner add-ons documentation.

- Ensure that the Managed clusters can connect using **Submariner add-ons**. After identifying and ensuring that the cluster and service networks have non-overlapping ranges, install the **Submariner add-ons** for each managed cluster using the RHACM console and **Cluster sets**. For instructions, see Submariner documentation.

CAUTION

Do not select **Enable Globalnet** because of overlapping cluster and service networks for the managed clusters. Using **Globalnet** is not supported with Regional Disaster Recovery currently. Ensure that cluster and service networks are non-overlapping before proceeding.

4.4. CREATING AN OPENSHIFT DATA FOUNDATION CLUSTER ON MANAGED CLUSTERS

In order to configure storage replication between the two OpenShift Container Platform clusters, create an OpenShift Data Foundation storage system after you install the OpenShift Data Foundation operator.

NOTE

Refer to OpenShift Data Foundation deployment guides and instructions that are specific to your infrastructure (AWS, VMware, BM, Azure, etc.).

Procedure

1. Install and configure the latest **OpenShift Data Foundation** cluster on each of the managed clusters.
   For information about the OpenShift Data Foundation deployment, refer to your infrastructure specific deployment guides (for example, AWS, VMware, Bare metal, Azure).

2. Validate the successful deployment of OpenShift Data Foundation on each managed cluster with the following command:

   ```
   $ oc get storagecluster -n openshift-storage ocs-storagecluster -o jsonpath='{.status.phase}
   {"\n"}'
   ```

   For the Multicloud Gateway (MCG):

   ```
   $ oc get noobaa -n openshift-storage noobaa -o jsonpath='{.status.phase}{"\n"}'
   ```

   If the status result is **Ready** for both queries on the **Primary managed cluster** and the **Secondary managed cluster**, then continue with the next step.

NOTE

In the OpenShift Web Console, navigate to **Installed Operators → OpenShift Data Foundation → Storage System → ocs-storagecluster-storagesystem → Resources** and verify that **Status** of **StorageCluster** is **Ready** and has a green tick mark next to it.

4.5. INSTALLING OPENSHIFT DATA FOUNDATION MULTICLUSTER ORCHESTRATOR OPERATOR

OpenShift Data Foundation Multicluster Orchestrator is a controller that is installed from OpenShift Container Platform's OperatorHub on the Hub cluster.

Procedure

1. On the **Hub cluster**, navigate to **OperatorHub** and use the keyword filter to search for **ODF Multicluster Orchestrator**.

2. Click **ODF Multicluster Orchestrator** tile.

3. Keep all default settings and click **Install**.
   Ensure that the operator resources are installed in **openshift-operators** project and available to all namespaces.

   NOTE

   The **ODF Multicluster Orchestrator** also installs the **Openshift DR Hub Operator** on the RHACM hub cluster as a dependency.

4. Verify that the operator **Pods** are in a **Running** state. The **OpenShift DR Hub operator** is also installed at the same time in **openshift-operators** namespace.

```
$ oc get pods -n openshift-operators
```

Example output:

```
NAME                                        READY   UP-TO-DATE   AVAILABLE   AGE
odf-multicluster-console-6845b795b9-blxrn   1/1     Running      0           4d20h
odfmo-controller-manager-f9d9dfb59-jbrsd    1/1     Running      0           4d20h
ramen-hub-operator-6fb887f885-fss4w         2/2     Running      0           4d20h
```

4.6. CONFIGURING SSL ACCESS ACROSS CLUSTERS

Configure network (SSL) access between the **primary and secondary clusters** so that metadata can be stored on the alternate cluster in a Multicloud Gateway (MCG) **object bucket** using a secure transport protocol and in the **Hub cluster** for verifying access to the object buckets.

NOTE

If all of your OpenShift clusters are deployed using a signed and valid set of certificates for your environment then this section can be skipped.

Procedure

1. Extract the ingress certificate for the Primary managed cluster and save the output to **primary.crt**.

```
$ oc get cm default-ingress-cert -n openshift-config-managed -o jsonpath="{['data']['ca-bundle\.crt']}" > primary.crt
```

2. Extract the ingress certificate for the Secondary managed cluster and save the output to **secondary.crt**.

```
$ oc get cm default-ingress-cert -n openshift-config-managed -o jsonpath="{['data']['ca-bundle\.crt']}" > secondary.crt
```

3. Create a new **ConfigMap** file to hold the remote cluster's certificate bundle with filename **cm-clusters-crt.yaml**.

NOTE

There could be more or less than three certificates for each cluster as shown in this example file. Also, ensure that the certificate contents are correctly indented after you copy and paste from the **primary.crt** and **secondary.crt** files that were created before.

```
apiVersion: v1
data:
  ca-bundle.crt: |
    -----BEGIN CERTIFICATE-----
    <copy contents of cert1 from primary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert2 from primary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert3 primary.crt here>
    -----END CERTIFICATE----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert1 from secondary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert2 from secondary.crt here>
    -----END CERTIFICATE-----

    -----BEGIN CERTIFICATE-----
    <copy contents of cert3 from secondary.crt here>
    -----END CERTIFICATE-----
kind: ConfigMap
metadata:
  name: user-ca-bundle
  namespace: openshift-config
```

4. Create the **ConfigMap** on the **Primary managed cluster**, **Secondary managed cluster**, and the **Hub cluster**.

```
$ oc create -f cm-clusters-crt.yaml
```

Example output:

```
configmap/user-ca-bundle created
```

5. Patch default proxy resource on the **Primary managed cluster**, **Secondary managed cluster**, and the **Hub cluster**.

```
$ oc patch proxy cluster --type=merge  --patch='{"spec":{"trustedCA":{"name":"user-ca-bundle"}}}'
```

Example output:

```
proxy.config.openshift.io/cluster patched
```

4.7. CREATING DISASTER RECOVERY POLICY ON HUB CLUSTER

Openshift Disaster Recovery Policy (DRPolicy) resource specifies OpenShift Container Platform clusters participating in the disaster recovery solution and the desired replication interval. DRPolicy is a cluster scoped resource that users can apply to applications that require Disaster Recovery solution.

The **ODF MultiCluster Orchestrator** Operator facilitates the creation of each **DRPolicy** and the corresponding **DRClusters** through the **Multicluster Web console**.

NOTE

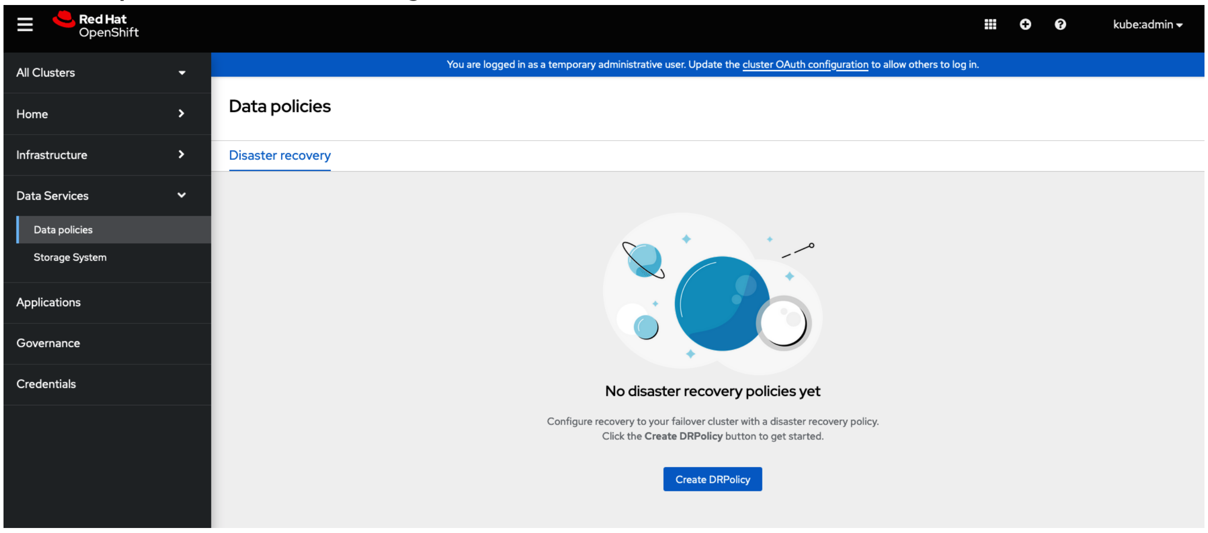
On the initial run, VolSync operator is installed automatically. VolSync is used to setup volume replication between two clusters to protect CephFs-based PVCs. The replication feature is enabled by default.

Prerequisites

- Ensure that there is a minimum set of two managed clusters.

Procedure

1. On the **OpenShift console**, navigate to **All Clusters**.



You are logged in as a temporary administrative user. Update the cluster OAuth configuration to allow others to log in.

Data policies

Disaster recovery

No disaster recovery policies yet

Configure recovery to your failover cluster with a disaster recovery policy.
Click the **Create DRPolicy** button to get started.

2. Navigate to **Data Services** and click **Data policies**.

3. Click **Create DRPolicy**.

4. Enter **Policy name**. Ensure that each DRPolicy has a unique name (for example: **ocp4bos1-ocp4bos2-5m**).

5. Select two clusters from the list of managed clusters to which this new policy will be associated with.

6. **Replication policy** is automaticaly set to **Asynchronous**(async) based on the OpenShift clusters selected and a **Sync schedule** option will become available.

7. Set **Sync schedule**.

    IMPORTANT

    For every desired replication interval a new **DRPolicy** must be created with a unique name (such as: **ocp4bos1-ocp4bos2-10m**). The same clusters can be selected but the **Sync schedule** can be configured with a different replication interval in minutes/hours/days. The minimum is one minute.

8. Click **Create**.

9. Verify that the **DRPolicy** is created successfully. Run this command on the **Hub cluster** for each of the DRPolicy resources created.

NOTE

Replace <drpolicy_name> with your unique name.

```
$ oc get drpolicy <drpolicy_name> -o jsonpath='{.status.conditions[].reason}{"\n"}'
```

Example output:

```
Succeeded
```

NOTE

When a DRPolicy is created, along with it, two DRCluster resources are also created. It could take up to 10 minutes for all three resources to be validated and for the status to show as **Succeeded**.

10. Verify the object bucket access from the **Hub cluster** to both the **Primary managed cluster** and the **Secondary managed cluster**.

    a. Get the names of the **DRClusters** on the Hub cluster.

    ```
    $ oc get drclusters
    ```

    Example output:

    ```
    NAME      AGE
    ocp4bos1  4m42s
    ocp4bos2  4m42s
    ```

    b. Check S3 access to each bucket created on each managed cluster using this **DRCluster** validation command.

    NOTE

    Replace <drcluster_name> with your unique name.

    ```
    $ oc get drcluster <drcluster_name> -o jsonpath='{.status.conditions[2].reason}{"\n"}'
    ```

    Example output:

    ```
    Succeeded
    ```

    NOTE

    Make sure to run command for both **DRClusters** on the **Hub cluster**.

11. Verify that the **OpenShift DR Cluster operator** installation was successful on the **Primary managed cluster** and the **Secondary managed cluster**.

```
$ oc get csv,pod -n openshift-dr-system
```

Example output:

```
NAME                                                                    DISPLAY                    VERSION
REPLACES   PHASE
clusterserviceversion.operators.coreos.com/odr-cluster-operator.v4.11.0   Openshift DR
Cluster Operator   4.11.0              Succeeded

NAME                                         READY   STATUS    RESTARTS   AGE
pod/ramen-dr-cluster-operator-5564f9d669-f6lbc   2/2     Running   0          5m32s
```

You can also verify that **OpenShift DR Cluster Operator** is installed successfully on the **OperatorHub** of each managed clusters.

12. Verify that the status of the ODF mirroring **daemon** health on the **Primary managed cluster** and the **Secondary managed cluster**.

```
$ oc get cephblockpool ocs-storagecluster-cephblockpool -n openshift-storage -o
jsonpath='{.status.mirroringStatus.summary}{"\n"}'
```

Example output:

```
{"daemon_health":"OK","health":"OK","image_health":"OK","states":{}}
```

CAUTION

It could take up to 10 minutes for the **daemon_health** and **health** to go from **Warning** to **OK**. If the status does not become **OK** eventually then use the RHACM console to verify that the Submariner connection between managed clusters is still in a healthy state. Do not proceed until all values are **OK**.

13. When using **VolSync** to protect CephFs-based PVCs, then configure the **VolSync** copy method. The default copy method is to use snapshot. A snapshot is taken at the source and synced to the temporary destination PVC. Once the syncronization is complete, another snapshot is taken from this temporary PVC and saved on the destination cluster. On failover, the application PVC is restored from the latest snapshot found on the cluster.
Using a snapshot as a copy method may not be desirable when using PVCs that contain thousands of files as CephFS will take a long time to create a writable PVC from snapshot. Furthermore, when using the copy method as snapshot, after a failover or replication, the entire PVC must be syncronized to the other side. This is a very expensive operation on high latency network and big PVC size.

To avoid these issues, a "direct" copy method can be used instead. This method is preferred as synchronization is done directly to the application PVC, and a snapshot is also saved in case manual restoration is required.

a. You can configure the copy method "direct" as follows:

```
$ oc edit cm -n openshift-operators ramen-hub-operator-config
```

b. Add the following to **spec.data.ramen_manager_config.yaml** section:

```
   volsync:
     destinationCopyMethod: Direct
```

4.8. CREATE SAMPLE APPLICATION FOR TESTING DISASTER RECOVERY SOLUTION

OpenShift Data Foundation disaster recovery (DR) solution supports disaster recovery for applications that are managed by RHACM. See Managing Applications for more details.

NOTE

OpenShift Data Foundation DR solution does not support ApplicationSet, which is required for applications that are deployed via ArgoCD.

ODF DR orchestrates RHACM application placement, using the PlacementRule, when an application is moved between clusters in a DRPolicy for failover or relocation requirements. The following sections detail how to apply a **DRPolicy** to an application and how to manage the applications placement life-cycle during and after cluster unavailability.

NOTE

OpenShift users that do not have cluster-admin permissions, see the Knowledge Article on how to assign necessary permissions to an application user for executing disaster recovery actions.

4.8.1. Creating a sample application

In order to test **failover** from the **Primary managed cluster** to the **Secondary managed cluster** and **relocate**, we need a sample application.

Prerequisites

- When creating an application for general consumption, ensure that the application is deployed to ONLY one cluster.
- Use the sample application called **busybox** as an example.
- Ensure all external routes of the application are configured using either Global Traffic Manager (GTM) or Global Server Load Balancing (GLSB) service for traffic redirection when the application fails over or is relocated.
- As a best practice, group Red Hat Advanced Cluster Management (RHACM) subscriptions, that belong together, to refer to a single Placement Rule to DR protect them as a group. Further create them as a single application for a logical grouping of the subscriptions for future DR actions like failover and relocate.

  NOTE

  If unrelated subscriptions refer to the same Placement Rule for placement actions, they will also be DR protected as the DR workflow controls all subscriptions that references the Placement Rule.

Procedure

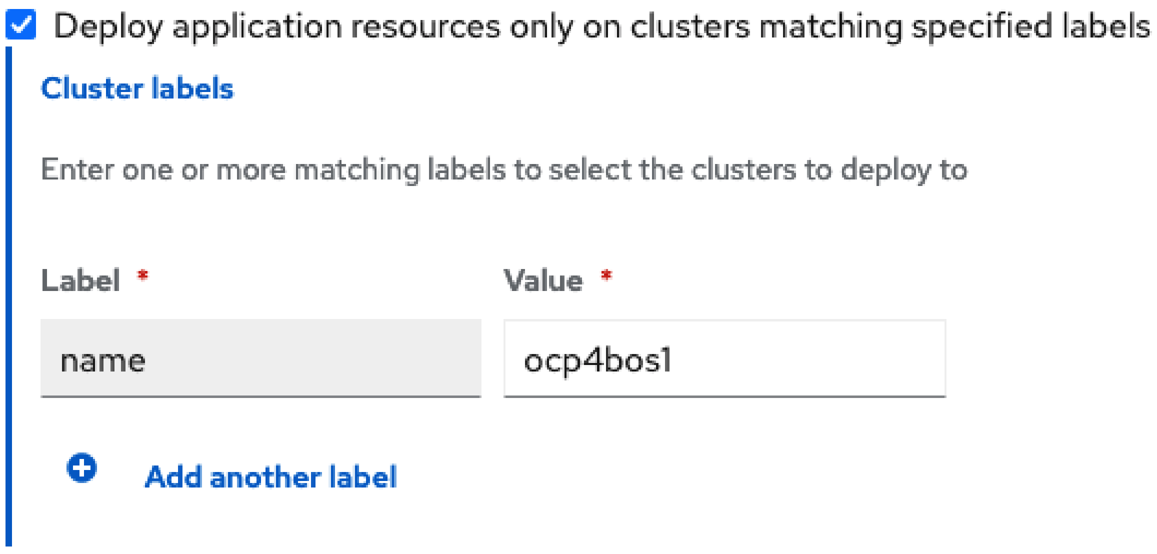
1. Log in to the RHACM console using your OpenShift credentials if not already logged in.

```
$ oc get route multicloud-console -n open-cluster-management -o jsonpath --
template="https://{.spec.host}/multicloud/applications{'\n'}"
```

Example Output:

```
https://multicloud-console.apps.perf3.example.com/multicloud/applications
```

2. Navigate to **Applications** and click **Create application**.
3. Select type as **Subscription**.
4. Enter your application **Name** (for example, **busybox**) and **Namespace** (for example, **busybox-sample**).
5. In the Repository location for resources section, select **Repository type Git**.
6. Enter the Git repository URL for the sample application, the github **Branch** and **Path** where the resources **busybox** Pod and PVC will be created.
    - Use the sample application repository as **https://github.com/red-hat-storage/ocm-ramen-samples**
    - Select **Branch** as **release-4.12**.
    - Choose one of the following **Path**
        - **busybox-odr** to use RBD Regional-DR.
        - **busybox-odr-cephfs** to use CephFS Regional-DR.
7. Scroll down in the form until you see **Deploy application resources only on clusters matching specified labels** and then add a label with its value set to the **Primary managed cluster** name in **RHACM** cluster list view.



☑ Deploy application resources only on clusters matching specified labels

Cluster labels

Enter one or more matching labels to select the clusters to deploy to

Label *	Value *
name	ocp4bos1

8. Click **Create** which is at the top right hand corner.
   On the follow-on screen go to the **Topology** tab. You should see that there are all Green checkmarks on the application topology.

NOTE

To get more information, click on any of the topology elements and a window will appear on the right of the topology view.

9. Validating the sample application deployment.
   Now that the **busybox** application has been deployed to your preferred Cluster, the deployment can be validated.

   Login to your managed cluster where **busybox** was deployed by RHACM.

```
$ oc get pods,pvc -n busybox-sample
```

   Example output:

```
NAME                          READY   STATUS    RESTARTS   AGE
pod/busybox-67bf494b9-zl5tr   1/1     Running   0          77s


NAME                                STATUS   VOLUME                                     CAPACITY   ACCESS
MODES   STORAGECLASS                AGE
persistentvolumeclaim/busybox-pvc   Bound    pvc-c732e5fe-daaf-4c4d-99dd-462e04c18412
5Gi        RWO            ocs-storagecluster-ceph-rbd   77s
```

10. [Optional] Verify Rados block device (RBD) **volumereplication** and **volumereplicationgroup** on the primary cluster.

```
$ oc get volumereplications.replication.storage.openshift.io
```

   Example output:

```
NAME           AGE     VOLUMEREPLICATIONCLASS                  PVCNAME
DESIREDSTATE   CURRENTSTATE
busybox-pvc    2d16h   rbd-volumereplicationclass-1625360775   busybox-pvc      primary
Primary
```

```
$ oc get volumereplicationgroups.ramendr.openshift.io
```

   Example output:

```
NAME           DESIREDSTATE   CURRENTSTATE
busybox-drpc   primary        Primary
```

11. [Optional] Verify CephFS volsync replication source has been setup successfully in the primary cluster and VolSync ReplicationDestination has been setup in the failover cluster.

```
$ oc get replicationsource -n busybox-sample
```

   Example output:

```
NAME          SOURCE        LAST SYNC             DURATION        NEXT SYNC
busybox-pvc   busybox-pvc   2022-12-20T08:46:07Z  1m7.794661104s  2022-12-
20T08:50:00Z
```

```
$ oc get replicationdestination -n busybox-sample
```

Example output:

```
NAME          LAST SYNC             DURATION        NEXT SYNC
busybox-pvc   2022-12-20T08:46:32Z  4m39.52261108s
```

4.8.2. Apply DRPolicy to sample application

Prerequisites

- Ensure that both managed clusters referenced in the DRPolicy are reachable. If not, the application will not be DR protected till both clusters are online.

Procedure

1. On the Hub cluster go back to the Multicluster Web console, navigate to **All Clusters**.
2. Login to all the clusters listed under **All Clusters**.
3. Navigate to **Data Services** and then click **Data policies**.
4. Click the Actions menu at the end of DRPolicy to view the list of available actions.
5. Click **Apply DRPolicy**.
6. When the **Apply DRPolicy** modal is displayed, select **busybox** application and enter **PVC label** as **appname=busybox**.

   NOTE

   When multiple placements rules under the same application or more than one application are selected, all PVCs within the application's namespace will be protected by default.

7. Click **Apply**.
8. Verify that a **DRPlacementControl** or **DRPC** was created in the **busybox-sample** namespace on the **Hub cluster** and that it's **CURRENTSTATE** shows as **Deployed**. This resource is used for both failover and relocate actions for this application.

```
$ oc get drpc -n busybox-sample
```

Example output:

```
NAME                        AGE    PREFERREDCLUSTER   FAILOVERCLUSTER
DESIREDSTATE   CURRENTSTATE
busybox-placement-1-drpc   6m59s   ocp4bos1                               Deployed
```

4.8.3. Deleting sample application

You can delete the sample application **busybox** using the RHACM console.

NOTE

The instructions to delete the sample application should not be executed until the failover and relocate testing is completed and the application is ready to be removed from RHACM and the managed clusters.

Procedure

1. On the RHACM console, navigate to **Applications**.
2. Search for the sample application to be deleted (for example, **busybox**).
3. Click the Action Menu **(⋮)** next to the application you want to delete.
4. Click **Delete application**.
   When the **Delete application** is selected a new screen will appear asking if the application related resources should also be deleted.
5. Select **Remove application related resources** checkbox to delete the Subscription and PlacementRule.
6. Click **Delete**. This will delete the busybox application on the Primary managed cluster (or whatever cluster the application was running on).
7. In addition to the resources deleted using the RHACM console, the **DRPlacementControl** must also be deleted after deleting the **busybox** application.
   a. Login to the OpenShift Web console for the Hub cluster and navigate to Installed Operators for the project **busybox-sample**.
   b. Click **OpenShift DR Hub Operator** and then click **DRPlacementControl** tab.
   c. Click the Action Menu **(⋮)** next to the **busybox** application DRPlacementControl that you want to delete.
   d. Click **Delete DRPlacementControl**.
   e. Click **Delete**.

NOTE

This process can be used to delete any application with a **DRPlacementControl** resource.

4.9. APPLICATION FAILOVER BETWEEN MANAGED CLUSTERS

Perform a failover when a managed cluster becomes unavailable, due to any reason. This failover method is application based.

Prerequisites

- [Optional] When the primary cluster is in a state other than **Ready**, the actual status on the

RHACM console → Infrastructure → Clusters → Cluster list tab might take some time to update. Make sure to check the status of both the managed clusters individually before performing failover operation. However, failover operation can still be performed.

Procedure

1. On the Hub cluster, navigate to **Applications**.
2. Click the **Actions** menu at the end of application row to view the list of available actions.
3. Click **Failover application**.
4. When the **Failover application** popup is shown, select **policy** and **target cluster** to which the associated application will failover in case of a disaster.
5. By default, the subscription group that will replicate the application resources is selected. Click the **Select subscription group** dropdown to verify the default selection or modify this setting.
6. Check the status of the **Failover readiness**.
    - If the status is **Ready** with a green tick, it indicates that the target cluster is ready for failover to start. Proceed to step 7.
    - If the status is **Unknown** or **Not ready**, then wait until the status changes to **Ready**.
7. Click **Initiate**. The busybox resources are now created on the target cluster.
8. Close the modal window and track the status using the **Data policy** column on the Applications page.
9. Verify that the activity status shows as **FailedOver** for the application.
    a. Navigate to the **Applications** → **Overview** tab.
    b. In the **Data policy** column, click the **policy** link for the application you applied the policy to.
    c. On the **Data Policies** modal page, click the **View more details** link.
    d. Verify that you can see one or more policy names and the ongoing activities (Last sync time and Activity status) associated with the policy in use with the application.

4.10. RELOCATING AN APPLICATION BETWEEN MANAGED CLUSTERS

Relocate an application to its preferred location when all managed clusters are available.

Prerequisite

- To ensure that the primary cluster where workloads are running is in **Ready** state, navigate to RHACM console → Infrastructure → Clusters → Cluster list tab. When the primary cluster is in a state other than **Ready**, then the actual status update might take some time to reflect on the RHACM console. Since relocate can only be performed when both primary and preferred clusters are up and running, make sure to check the status of both the managed clusters individually before performing relocate operation.

- Relocate performed when last sync time is closer to current time would be preferred as the time taken to relocate would be lower, considering amount of data changed between last sync time and now is proportionally smaller.

Procedure

1. On the Hub cluster, navigate to **Applications**.
2. Click the **Actions** menu at the end of application row to view the list of available actions.
3. Click **Relocate application**.
4. When the **Relocate application** popup is shown, select **policy** and **target cluster** to which the associated application will relocate to in case of a disaster.
5. By default, the subscription group that will deploy the application resources is selected. Click the **Select subscription group** dropdown to verify the default selection or modify this setting.
6. Check the status of the **Relocation readiness**.
   - If the status is **Ready** with a green tick, it indicates that the target cluster is ready for relocation to start. Proceed to step 7.
   - If the status is **Unknown** or **Not ready**, then wait until the status changes to **Ready**.
7. Click **Initiate**. The busybox resources are now created on the target cluster.
8. Close the modal window and track the status using the **Data policy** column on the Applications page.
9. Verify that the activity status shows as **Relocated** for the application.
   a. Navigate to the **Applications** → **Overview** tab.
   b. In the **Data policy** column, click the **policy** link for the application you applied the policy to.
   c. On the **Data Policies** modal page, click the **View more details** link.
   d. Verify that you can see one or more policy names and the ongoing activities (Last sync time and Activity status) associated with the policy in use with the application.

4.11. VIEWING RECOVERY POINT OBJECTIVE VALUES FOR DISASTER RECOVERY ENABLED APPLICATIONS

Recovery Point Objective (RPO) value is the most recent sync time of persistent data from the cluster where the application is currently active to its peer. This sync time helps determine duration of data lost during failover.

NOTE

This RPO value is applicable only for Regional-DR during failover. Relocation ensures there is no data loss during the operation, as all peer clusters are available.

You can view the Recovery Point Objective (RPO) value of all the protected volumes for their workload on the Hub cluster.

Procedure

1. On the Hub cluster, navigate to **Applications → Overview** tab.

2. In the **Data policy** column, click the **policy** link for the application you applied the policy to.
   A **Data Policies** modal page appears with the number of disaster recovery policies applied to each application along with failover and relocation status.

3. On the **Data Policies** modal page, click the **View more details** link.
   A detailed **Data Policies** modal page is displayed that shows the policy names and the ongoing activities (Last sync, Activity status) associated with the policy that is applied to the application.

   The **Last sync time** reported in the modal page, represents the most recent sync time of all volumes that are DR protected for the application.

CHAPTER 5. TROUBLESHOOTING DISASTER RECOVERY

5.1. TROUBLESHOOTING METRO-DR

5.1.1. A statefulset application stuck after failover

Problem

While relocating to a preferred cluster, DRPlacementControl is stuck reporting PROGRESSION as "MovingToSecondary".
Previously, before Kubernetes v1.23, the Kubernetes control plane never cleaned up the PVCs created for StatefulSets. This activity was left to the cluster administrator or a software operator managing the StatefulSets. Due to this, the PVCs of the StatefulSets were left untouched when their Pods are deleted. This prevents Ramen from relocating an application to its preferred cluster.

Resolution

1. If the workload uses StatefulSets, and relocation is stuck with PROGRESSION as "MovingToSecondary", then run:

   ```
   $ oc get pvc -n <namespace>
   ```

2. For each bounded PVC for that namespace that belongs to the StatefulSet, run

   ```
   $ oc delete pvc <pvcname> -n namespace
   ```

   Once all PVCs are deleted, Volume Replication Group (VRG) transitions to secondary, and then gets deleted.

3. Run the following command

   ```
   $ oc get drpc -n <namespace> -o wide
   ```

   After a few seconds to a few minutes, the PROGRESSION reports "Completed" and relocation is complete.

Result

The workload is relocated to the preferred cluster

BZ reference: [2118270]

5.1.2. DR policies protect all applications in the same namespace

Problem

While only single application is selected to be used by a DR policy, all applications in the same namespace will be protected. This results in PVCs, that match the **DRPlacementControl spec.pvcSelector** across multiple workloads or if the selector is missing across all workloads, replication management to potentially manage each PVC multiple times and cause data corruption or invalid operations based on individual **DRPlacementControl** actions.

Resolution

Label PVCs that belong to a workload uniquely, and use the selected label as the DRPlacementControl **spec.pvcSelector** to disambiguate which DRPlacementControl protects and manages which subset of PVCs within a namespace. It is not possible to specify the **spec.pvcSelector** field for the DRPlacementControl using the user interface, hence the DRPlacementControl for such applications must be deleted and created using the command line.

BZ reference: [2111163]

5.1.3. During failback of an application stuck in Relocating state

Problem

This issue might occur after performing failover and failback of an application (all nodes or cluster are up). When performing failback application stuck in the **Relocating** state with a message of **Waiting** for PV restore to complete.

Resolution

Use S3 client or equivalent to clean up the duplicate PV objects from the s3 store. Keep only the one that has a timestamp closer to the failover or relocate time.

BZ reference: [2120201]

5.2. TROUBLESHOOTING REGIONAL-DR

5.2.1. RBD mirroring scheduling is getting stopped for some images

Problem

There are a few common causes for RBD mirroring scheduling getting stopped for some images. After marking the applications for mirroring, for some reason, if it is not replicated, use the toolbox pod and run the following command to see which image scheduling is stopped.

```
$ rbd snap ls <poolname/imagename> –all
```

Resolution

- Restart the manager daemon on the primary cluster
- Disable and immediately re-enable mirroring on the affected images on the primary cluster

BZ reference: [2067095 and 2121514]

5.2.2. rbd-mirror daemon health is in warning state

Problem

There appears to be numerous cases where WARNING gets reported if mirror service **::get_mirror_service_status** calls **Ceph** monitor to get service status for **rbd-mirror**. Following a network disconnection, **rbd-mirror** daemon health is in the **warning** state while the connectivity between both the managed clusters is fine.

Resolution

Run the following command in the toolbox and look for **leader:false**

```
rbd mirror pool status --verbose ocs-storagecluster-cephblockpool | grep 'leader:'
```

If you see the following in the output:

leader: false	It indicates that there is a daemon startup issue and the most likely root cause could be due to problems reliably connecting to the secondary cluster. Workaround: Move the **rbd-mirror** pod to a different node by simply deleting the pod and verify that it has been rescheduled on another node.
leader: true or no output	Contact Red Hat Support

BZ reference: [2118627]

5.2.3. A statefulset application stuck after failover

Problem

While relocating to a preferred cluster, DRPlacementControl is stuck reporting PROGRESSION as "MovingToSecondary".
Previously, before Kubernetes v1.23, the Kubernetes control plane never cleaned up the PVCs created for StatefulSets. This activity was left to the cluster administrator or a software operator managing the StatefulSets. Due to this, the PVCs of the StatefulSets were left untouched when their Pods are deleted. This prevents Ramen from relocating an application to its preferred cluster.

Resolution

1. If the workload uses StatefulSets, and relocation is stuck with PROGRESSION as "MovingToSecondary", then run:

   ```
   $ oc get pvc -n <namespace>
   ```

2. For each bounded PVC for that namespace that belongs to the StatefulSet, run

   ```
   $ oc delete pvc <pvcname> -n namespace
   ```

   Once all PVCs are deleted, Volume Replication Group (VRG) transitions to secondary, and then gets deleted.

3. Run the following command

   ```
   $ oc get drpc -n <namespace> -o wide
   ```

   After a few seconds to a few minutes, the PROGRESSION reports "Completed" and relocation is complete.

Result

The workload is relocated to the preferred cluster

BZ reference: [2118270]

5.2.4. Application is not running after failover

Problem

After failing over an application, workload pods do not reach running state with errors **MountVolume.MountDevice failed for volume <PV name> : rpc error: code = Internal desc = fail to check rbd image status:** ***(cannot map image <image description> it is not primary)***

> **NOTE**
>
> Execute these steps on the cluster where the workload is being failed over to.

Resolution

1. Scale down the RBD mirror daemon deployment to **0** until the application pods can recover from the above error.

   ```
   $ oc scale deployment rook-ceph-rbd-mirror-a -n openshift-storage --replicas=0
   ```

2. Post recovery, scale the RBD mirror daemon deployment back to **1**.

   ```
   $ oc scale deployment rook-ceph-rbd-mirror-a -n openshift-storage --replicas=1
   ```

BZ reference: [2134936]

5.2.5. volsync-rsync-src pods are in error state

Problem

volsync-rsync-src pods are in error state as they are unable to connect to **volsync-rsync-dst**. The **VolSync** source pod logs might exhibit persistent error messages over an extended duration similar to the log snippet.
Run the following command to check the logs.

```
$ oc logs volsync-rsync-src-<app pvc name>-<suffix>
```

Example output

```
VolSync rsync container version: ACM-0.6.0-ce9a280
Syncing data to volsync-rsync-dst-busybox-pvc-9.busybox-workloads-1.svc.clusterset.local:22
Syncronization failed. Retrying in 2 seconds. Retry 1/5.
rsync: connection unexpectedly closed (7 bytes received so far) [sender]
rsync error: unexplained error (code 255) at io.c(226) [sender=3.1.3]
```

Resolution

You can reconfigure the Maximum Transmission Unit (MTU) size to fix this issue using the following steps:

1. Annotate the nodes which have submariner gateway labels.

   ```
   $ oc annotate node -l submariner.io/gateway submariner.io/tcp-clamp-mss=1340 --
   overwrite
   ```

Example output

```
node/compute-0 annotated
node/compute-2 annotated
```

2. Delete submariner route agent pods.

```
$ oc delete pods -n submariner-operator -l app=submariner-routeagent
```

Example output

```
pod "submariner-routeagent-4r66z" deleted
pod "submariner-routeagent-4tn6d" deleted
pod "submariner-routeagent-9r42l" deleted
pod "submariner-routeagent-bg5wq" deleted
pod "submariner-routeagent-gzqdj" deleted
pod "submariner-routeagent-j77jq" deleted
```

3. Check for any error in the **vol-sync-src pod**.

```
$ oc logs volsync-rsync-src-dd-io-pvc-3-nwn8h
```

Example output

```
VolSync rsync container version: ACM-0.6.0-ce9a280
Syncing data to volsync-rsync-dst-dd-io-pvc-3.busybox-workloads-
8.svc.clusterset.local:22 …
.d..tp..... ./
<f+++++++++ 07-12-2022_13-03-04-dd-io-3-5d6b4b84df-v9bhc
```

BZ reference: [2136864]

5.2.6. volsync-rsync-src pod is in error state as it is unable to resolve the destination hostname

Problem

VolSync source pod is unable to resolve the hostname of the VolSync destination pod. The log of the VolSync Pod consistently shows an error message over an extended period of time similar to the following log snippet.

```
$ oc logs -n busybox-workloads-3-2 volsync-rsync-src-dd-io-pvc-1-p25rz
```

Example output

```
VolSync rsync container version: ACM-0.6.0-ce9a280
Syncing data to volsync-rsync-dst-dd-io-pvc-1.busybox-workloads-3-2.svc.clusterset.local:22 ...
ssh: Could not resolve hostname volsync-rsync-dst-dd-io-pvc-1.busybox-workloads-3-
2.svc.clusterset.local: Name or service not known
```

Resolution

Restart **submariner-lighthouse-agent** on both nodes.

```
$ oc delete pod -l app=submariner-lighthouse-agent -n submariner-operator
```