Red Hat Ansible Automation Platform Automation Mesh for operator-based installations

Thank you for your interest in Red Hat Ansible Automation Platform. Ansible Automation Platform is a commercial offering that helps teams manage complex multi-tier deployments by adding control, knowledge, and delegation to Ansible-powered environments.

This guide helps you to understand the requirements and processes behind setting up an automation mesh on a operator-based installation of Red Hat Ansible Automation Platform. This document has been updated to include information for the latest release of Ansible Automation Platform.

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.

Providing feedback on Red Hat documentation

If you have a suggestion to improve this documentation, or find an error, please contact technical support at https://access.redhat.com to create an issue on the Ansible Automation Platform Jira project using the **docs-product** component.

1. Planning for automation mesh in your operator-based Red Hat Ansible Automation Platform environment

The following topics contain information to help plan an automation mesh deployment in your operator-based Red Hat Ansible Automation Platform environment. The document covers the setting up of automation mesh on operator-based deployments, such as OpenShift Container Platform and Ansible Automation Platform on Microsoft Azure managed application.

1.1. About automation mesh

Automation mesh is an overlay network intended to ease the distribution of work across a large and dispersed collection of workers through nodes that establish peer-to-peer connections with each other using existing networks.

Red Hat Ansible Automation Platform 2 replaces Ansible Tower and isolated nodes with automation controller and automation hub. Automation controller provides the control plane for automation through its UI, RESTful API, RBAC, workflows and CI/CD integration, while automation mesh can be used for setting up, discovering, changing or modifying the nodes that form the control and execution layers. Automation mesh is useful for:

- traversing difficult network topologies
- bringing execution capabilities (the machine running `ansible-playbook`) closer to your target hosts

The nodes (control, hop, and execution instances) are interconnected through a receptor mesh, forming a virtual mesh.

Automation mesh uses TLS encryption for communication, so traffic that traverses external networks (the internet or other) is encrypted in transit.

Automation mesh introduces:

- Dynamic cluster capacity that scales independently, enabling you to create, register, group, ungroup and deregister nodes with minimal downtime.
- Control and execution plane separation that enables you to scale playbook execution capacity independently from control plane capacity.
- Deployment choices that are resilient to latency, reconfigurable without outage, and that dynamically re-reroute to choose a different path when outages occur.
- Connectivity that includes bi-directional, multi-hopped mesh communication possibilities which are *Federal Information Processing Standards* (FIPS) compliant.

1.2. Control and execution planes

Instances make up the network of devices that communicate with one another. They are the building blocks of an automation mesh. These building blocks serve as nodes in a mesh topology. Automation mesh makes use of unique node types to create both the **control** and **execution** plane. Learn more about the control and execution plane and their node types before designing your automation mesh topology

1.2.1. Control plane

Instances in the control plane run persistent automation controller services such as the web server and task dispatcher, in addition to project updates, and management jobs. However, in the operator-based model, there are no hybrid or control nodes. There are container groups, which make up containers running on the Kubernetes cluster. That comprises the control plane. That control plane is local to the kubernetes cluster in which Red Hat Ansible Automation Platform is deployed.

1.2.2. Execution plane

The **execution plane** consists of execution nodes that execute automation on behalf of the control plane and have no control functions. Hop nodes serve to communicate. Nodes in the **execution plane** only run user-space jobs, and may be geographically separated, with high latency, from the control plane.

- **Execution nodes** - Execution nodes run jobs under `ansible-runner` with `podman` isolation. This node type is similar to isolated nodes. This is the default node type for execution plane nodes.
- **Hop nodes** - similar to a jump host, hop nodes route traffic to other execution nodes. Hop nodes cannot execute automation.

2. Automation mesh for operator-based Red Hat Ansible Automation Platform

Scaling your automation mesh is available on Openshift deployments of Red Hat Ansible Automation Platform and is possible through adding or removing nodes from your cluster dynamically, using the **Instances** resource of the automation controller UI, without running the installation script.

Instances serve as nodes in your mesh topology. Automation mesh enables you to extend the footprint of your automation. The location where you launch a job can be different from the location where the ansible-playbook runs.

To manage instances from the automation controller UI, you must have System Administrator or System Auditor permissions.

In general, the more processor cores (CPU) and memory (RAM) a node has, the more jobs that can be scheduled to run on that node at once.

For more information, see Automation controller capacity determination and job impact.

2.1. Prerequisites

The automation mesh is dependent on hop and execution nodes running on Red Hat Enterprise Linux (RHEL). Your Red Hat Ansible Automation Platform subscription grants you ten Red Hat Enterprise Linux licenses that can be used for running components of Ansible Automation Platform. The following steps prepare the RHEL instances for deployment of the automation mesh.

1. You require a Red Hat Enterprise Linux operating system. This machine requires a static IP address, or a resolvable DNS hostname that automation controller can access.
2. Ensure that you have the minimum requirements for the RHEL virtual machine before proceeding. For more information, see the Red Hat Ansible Automation Platform system requirements.

3. Deploy the RHEL instances within the remote networks where communication is required. For information about creating virtual machines, see Creating Virtual Machines in the *Red Hat Enterprise Linux* documentation. Remember to scale the capacity of your virtual machines sufficiently so that your proposed tasks can run on them.
   - RHEL ISOs can be obtained from access.redhat.com.
   - RHEL cloud images can be built using Image Builder from console.redhat.com.

2.2. Setting up Virtual Machines for use in an automation mesh

Procedure

1. SSH into each of the RHEL instances and perform the following steps. Depending on your network access and controls, SSH proxies or other access models might be required.

   Use the following command:

   ```
   ssh [username]@[host_ip_address]
   ```

   For example, for an Ansible Automation Platform instance running on Amazon Web Services.

   ```
   ssh ec2-user@10.0.0.6
   ```

2. Create or copy an SSH key that can be used to connect from the hop node to the execution node in later steps. This can be a temporary key used just for the automation mesh configuration, or a long-lived key. The SSH user and key are used in later steps.
3. Enable your RHEL subscription with `baseos` and `appstream` repositories. Ansible Automation Platform RPM repositories are only available through subscription-manager, not the *Red Hat Update Infrastructure* (RHUI). If you attempt to use any other Linux footprint, including RHEL with RHUI, this causes errors.

   ```
   sudo subscription-manager register --auto-attach
   ```

   If Simple Content Access is enabled for your account, use:

   ```
   sudo subscription-manager register
   ```

   For more information about Simple Content Access, see Simple Content Access.

4. Enable Ansible Automation Platform subscriptions and the proper Red Hat Ansible Automation Platform channel:

   ```
   # subscription-manager repos --enable ansible-automation-platform-2.4-for-rhel-8-
   ```

```
x86_64-rpms for RHEL 8

# subscription-manager repos --enable ansible-automation-platform-2.4-for-rhel-9-
x86_64-rpms for RHEL 9
```

5. Ensure the packages are up to date:

```
sudo dnf upgrade -y
```

6. Install the ansible-core packages:

```
sudo dnf install -y ansible-core
```

2.3. Defining automation mesh node types

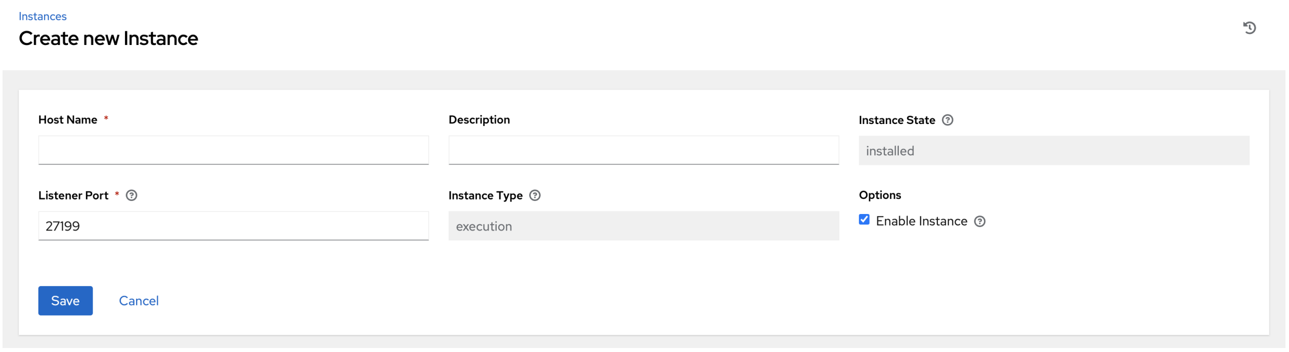
To expand job capacity, create a standalone **execution node** that can be added to run alongside a deployment of automation controller. These execution nodes are not part of the automation controller Kubernetes cluster. The control nodes run in the cluster connect and submit work to the execution nodes through Receptor. These execution nodes are registered in automation controller as type `execution` instances, meaning they are only used to run jobs, not dispatch work or handle web requests as control nodes do.

Hop nodes can be added to sit between the control plane of automation controller and standalone execution nodes. These hop nodes are not part of the Kubernetes cluster and are registered in automation controller as an instance of type `hop`, meaning they only handle inbound and outbound traffic for otherwise unreachable nodes in different or more strict networks.

The following procedure demonstrates how to set the node type for the hosts.

Procedure

1. From the navigation panel of automation controller, select **Instances**.
2. On the **Instances** list page, click **[Add]**. The **Create new Instance** window opens.


Instances
Create new Instance

Host Name *
Description
Instance State: installed
Listener Port *: 27199
Instance Type: execution
Options: ☑ Enable Instance

An instance requires the following attributes:

- **Host Name**: (required) Enter a fully qualified domain name (public DNS) or IP address for your instance. This field is equivalent to `hostname` for installer-based deployments.

NOTE If the instance uses private DNS that cannot be resolved from the control cluster, DNS lookup routing fails, and the generated SSL certificates is invalid. Use the IP address instead.

- Optional: **Description**: Enter a description for the instance.
- **Instance State**: This field is auto-populated, indicating that it is being installed, and cannot be modified.
- **Listener Port**: This port is used for the receptor to listen on for incoming connections. You can set the port to one that is appropriate for your configuration. This field is equivalent to `listener_port` in the API. The default value is 27199, though you can set your own port value.
- **Instance Type**: Only `execution` and `hop` nodes can be created. Operator based deployments do not support Control or Hybrid nodes.

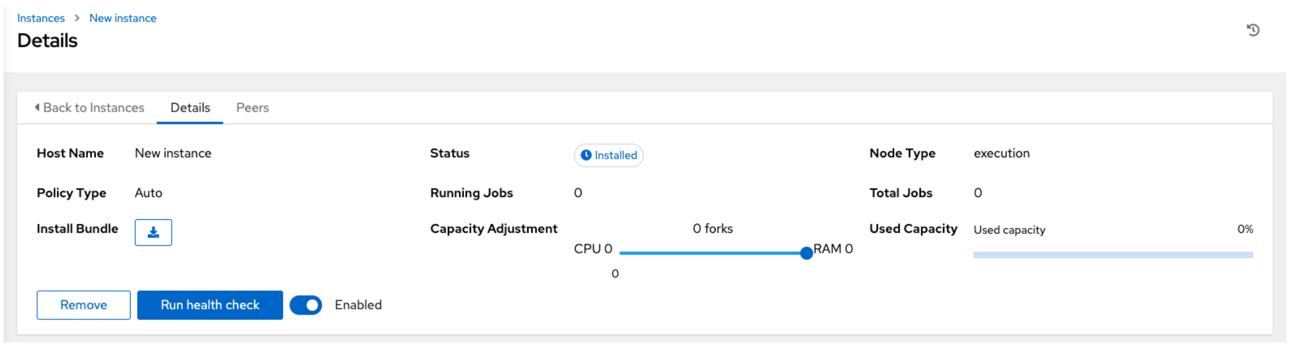
  Options:

  - **Enable Instance**: Check this box to make it available for jobs to run on an execution node.
  - Check the **Managed by Policy** box to enable policy to dictate how the instance is assigned.
  - Check the **Peers from control nodes** box to enable control nodes to peer to this instance automatically. For hop nodes, check the **Peers from Control** nodes box to create a direct communication link between the hop node and automation controller. For execution nodes that communicate with hop nodes, do not check this box.
  - To peer an execution node with a hop node, click the 🔍 icon next to the **Peers** field.

    The Select Peers window is displayed.

    Peer the execution node to the hop node.

3. Click **[Save]**.


Instances > New instance

Details

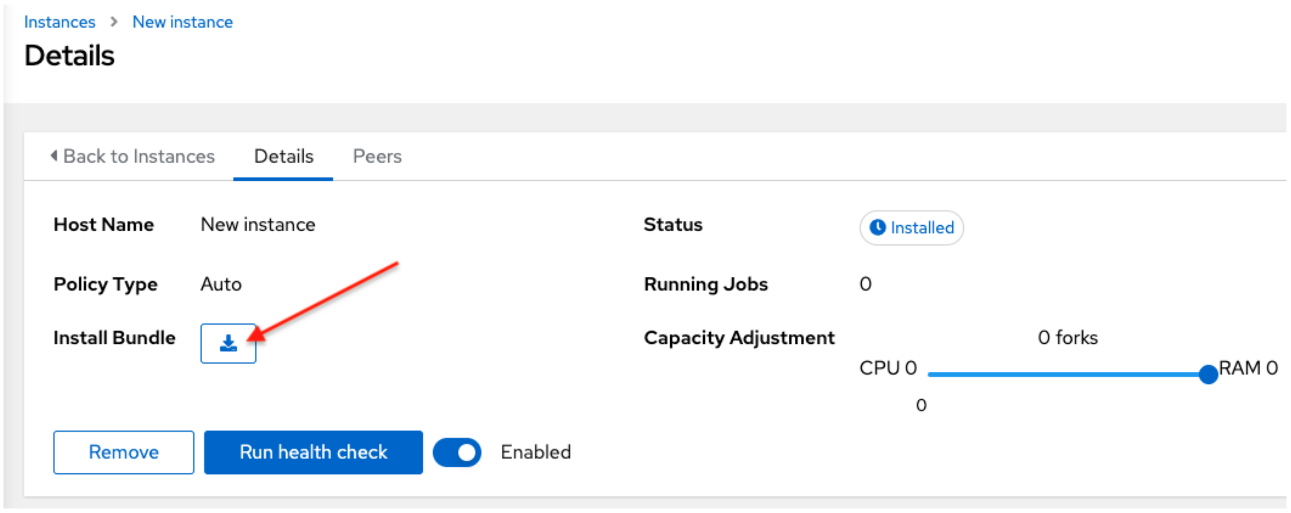
Back to Instances | Details | Peers

Host Name	New instance	Status	Installed	Node Type	execution
Policy Type	Auto	Running Jobs	0	Total Jobs	0
Install Bundle		Capacity Adjustment	0 forks CPU 0 RAM 0 0	Used Capacity	Used capacity 0%

4. To view a graphical representation of your updated topology, see Topology viewer.

NOTE Execute the following steps from any computer that has SSH access to the newly created instance.

5. Click the ⬇ icon next to **Install Bundle** to download the tar file that includes this new instance and the files necessary to install the created node into the automation mesh.



The install bundle contains TLS certificates and keys, a certificate authority, and a proper Receptor configuration file.

```
receptor-ca.crt
work-public-key.pem
receptor.key
install_receptor.yml
inventory.yml
group_vars/all.yml
requirements.yml
```

6. Extract the downloaded `tar.gz` Install Bundle from the location where you downloaded it. To ensure that these files are in the correct location on the remote machine, the install bundle includes the `install_receptor.yml` playbook. The playbook requires the Receptor collection. Run the following command to download the collection:

```
ansible-galaxy collection install -r requirements.yml
```

7. Before running the `ansible-playbook` command, edit the following fields in the `inventory.yml` file:

```
all:
  hosts:
    remote-execution:
      ansible_host: 10.0.0.6
      ansible_user: <username> # user provided
  ansible_ssh_private_key_file: ~/.ssh/<id_rsa>
```

   - Ensure `ansible_host` is set to the IP address or DNS of the node.
   - Set `ansible_user` to the username running the installation.
   - Set `ansible_ssh_private_key_file` to contain the filename of the private key used to connect to the instance.

    - The content of the `inventory.yml` file serves as a template and contains variables for roles that are applied during the installation and configuration of a receptor node in a mesh topology. You can modify some of the other fields, or replace the file in its entirety for advanced scenarios. For more information, see Role Variables.

8. For a node that uses a private DNS, add the following line to `inventory.yml`:

   ```
   ansible_ssh_common_args: <your ssh ProxyCommand setting>
   ```

   This instructs the `install-receptor.yml` playbook to use the proxy command to connect through the local DNS node to the private node.

9. When the attributes are configured, click **[Save]**. The **Details** page of the created instance opens.
10. Save the file to continue.
11. The system that is going to run the install bundle to setup the remote node and run `ansible-playbook` requires the `ansible.receptor` collection to be installed:

    ```
    ansible-galaxy collection install ansible.receptor
    ```

    or

    ```
    ansible-galaxy install -r requirements.yml
    ```

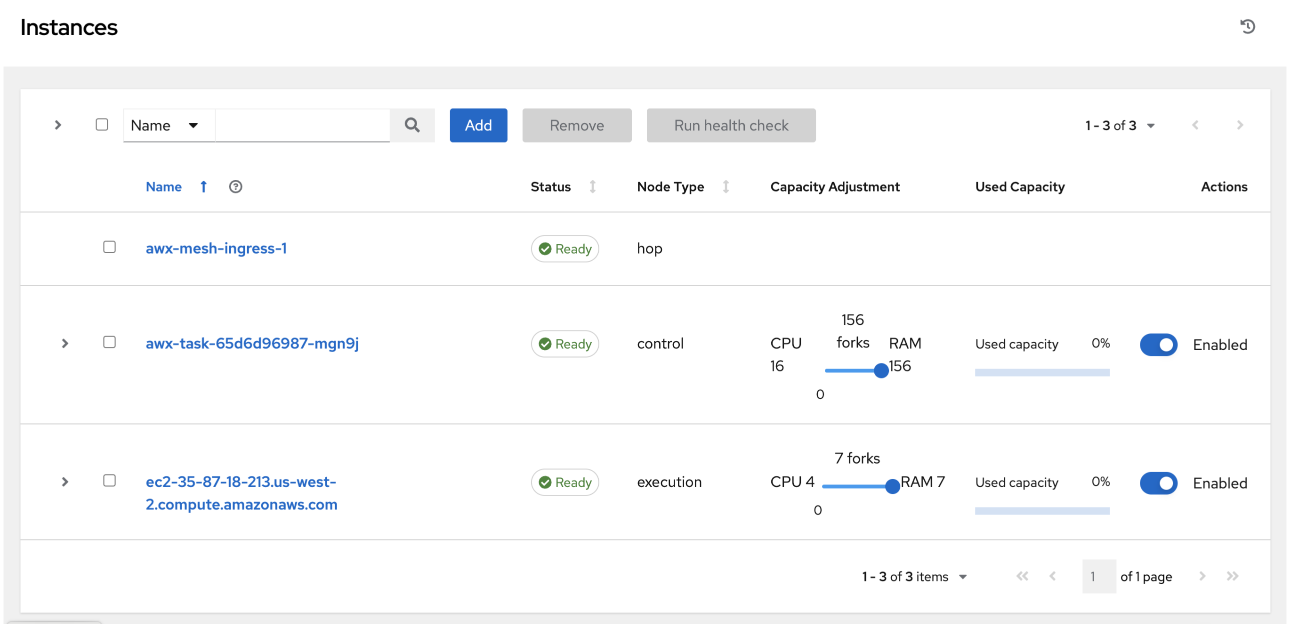
    - Installing the receptor collection dependency from the `requirements.yml` file consistently retrieves the receptor version specified there. Additionally, it retrieves any other collection dependencies that might be needed in the future.
    - Install the receptor collection on all nodes where your playbook will run, otherwise an error occurs.
12. If receptor_listener_port is defined, the machine also requires an available open port on which to establish inbound TCP connections, for example, 27199. Run the following command to open port 27199 for receptor communication:

    ```
    sudo firewall-cmd --permanent --zone=public --add-port=27199/tcp
    ```

13. Run the following playbook on the machine where you want to update your automation mesh:

    ```
    ansible-playbook -i inventory.yml install_receptor.yml
    ```

    After this playbook runs, your automation mesh is configured.



Name	Status	Node Type	Capacity Adjustment	Used Capacity	Actions
awx-mesh-ingress-1	Ready	hop			
awx-task-65d6d96987-mgn9j	Ready	control	CPU 16, 156 forks, RAM 156, 0	Used capacity 0%	Enabled
ec2-35-87-18-213.us-west-2.compute.amazonaws.com	Ready	execution	CPU 4, 7 forks, RAM 7, 0	Used capacity 0%	Enabled

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2.3.1. Removing Instances

From the **Add Instances page**, you can add, remove or run health checks on your nodes.

NOTE You must follow the procedures for installing RHEL packages for any additional nodes you create. If you peer this additional node to an existing hop node, you must also install the Install Bundle on each node.

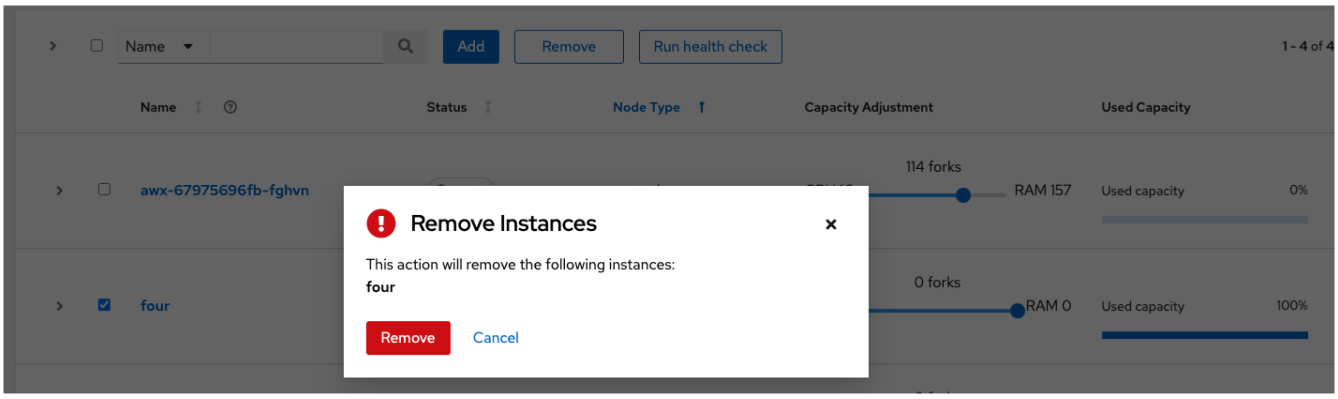
Use the check boxes next to an instance to select it to remove or run a health check against it.

NOTE

- If a node is removed using the UI, then the node is "removed" and does not show a status. If you delete the VM of the node before it is removed in the UI, it will show an error.
- You only need to reinstall the Install Bundle if the topology changes the communication pattern, that is, hop nodes change or you add nodes.

When a button is disabled, you do not have permission for that particular action. Contact your Administrator to grant you the required level of access.

If you are able to remove an instance, you receive a prompt for confirmation.



Remove Instances

This action will remove the following instances:
four

NOTE You can still remove an instance even if it is active and jobs are running on it.

Automation controller waits for jobs running on this node to complete before removing it.

2.4. Creating an instance group

Use the following procedure to create a new instance group.

Procedure

1. From the navigation panel, select **Administration › Instance Groups**.
2. Click **Add › Add instance group**.
3. Enter the appropriate details into the following fields:
   - **Name**: Names must be unique and must not be named "controller".
   - **Policy instance minimum**: Enter the minimum number of instances to automatically assign to this group when new instances come online.
   - **Policy instance percentage**: Use the slider to select a minimum percentage of instances to automatically assign to this group when new instances come online.

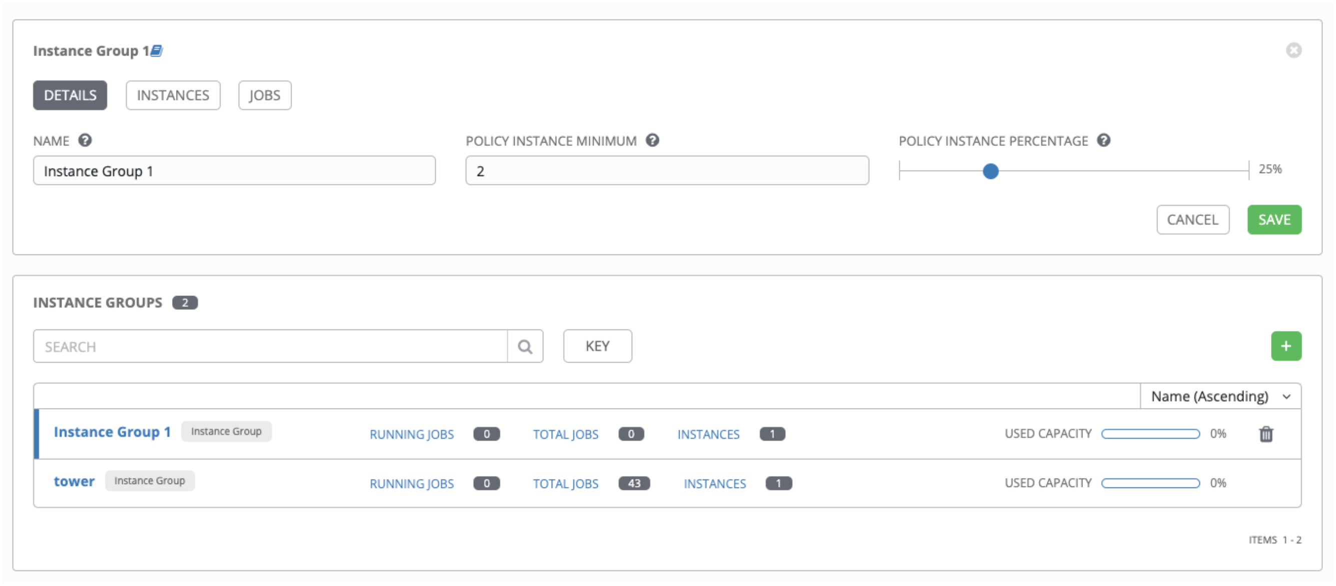
     NOTE Policy instance fields are not required to create a new instance group. If you do not specify values, then the **Policy instance minimum** and **Policy instance percentage** default to 0.

   - **Max concurrent jobs**: Specify the maximum number of forks that can be run for any given job.
   - **Max forks**: Specify the maximum number of concurrent jobs that can be run for any given job.

     NOTE The default value of 0 for **Max concurrent jobs** and **Max forks** denotes no limit. For more information, see Instance group capacity limits in the *Automation controller Administration Guide*.

4. Click **[Save]**.

When you have successfully created the instance group the **Details** tab of the newly created instance group remains, enabling you to review and edit your instance group information. This is the same screen that opens when you click the Edit ✎ icon from the **Instance Groups** list view. You can also edit **Instances** and review **Jobs** associated with this instance group:


Instance Group 1

NAME: Instance Group 1
POLICY INSTANCE MINIMUM: 2
POLICY INSTANCE PERCENTAGE: 25%

INSTANCE GROUPS 2

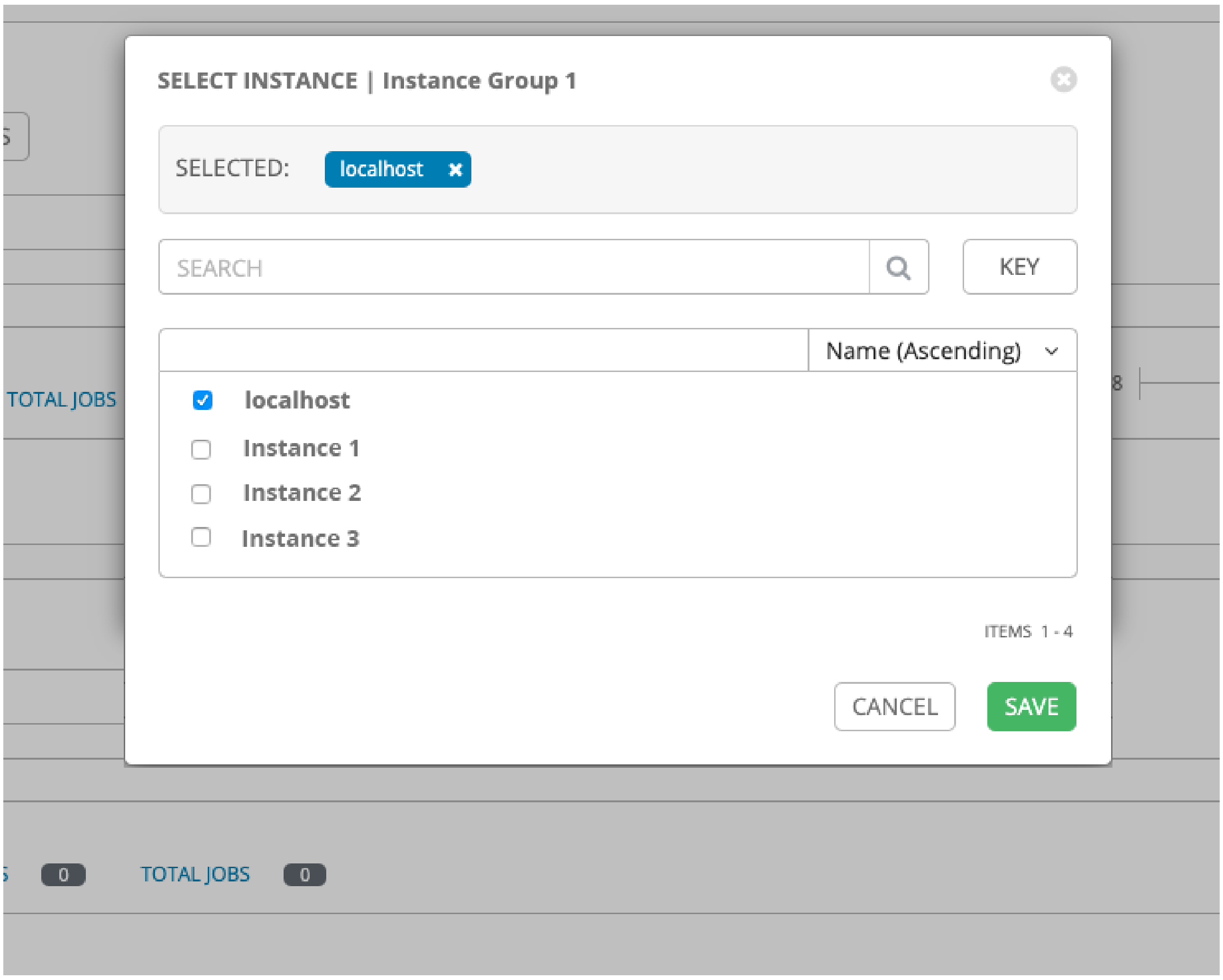
Instance Group 1	Instance Group	RUNNING JOBS 0	TOTAL JOBS 0	INSTANCES 1	USED CAPACITY 0%
tower	Instance Group	RUNNING JOBS 0	TOTAL JOBS 43	INSTANCES 1	USED CAPACITY 0%

ITEMS 1 - 2

2.5. Associating instances to an instance group

Procedure

1. Select the **Instances** tab of the **Instance Groups** window.
2. Click **[Associate]**.
3. Click the checkbox next to one or more available instances from the list to select the instances you want to associate with the instance group:

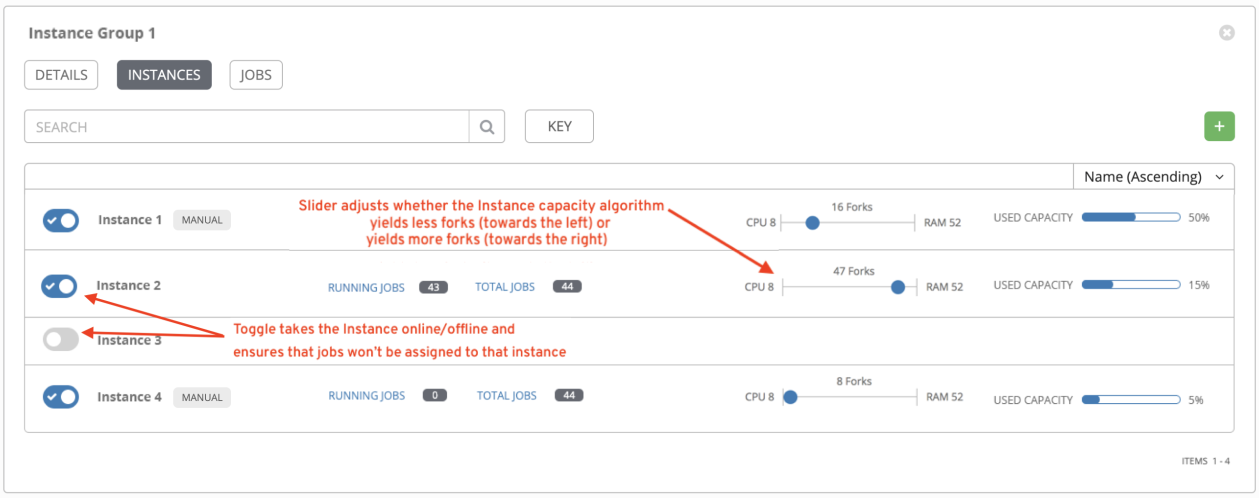

SELECT INSTANCE | Instance Group 1

SELECTED: localhost

- [✓] localhost
- [ ] Instance 1
- [ ] Instance 2
- [ ] Instance 3

ITEMS 1 - 4

4. In the following example, the instances added to the instance group displays along with information about their capacity:


Instance Group 1

Instance 1	MANUAL			CPU 8 — 16 Forks — RAM 52	USED CAPACITY 50%
Instance 2		RUNNING JOBS 43	TOTAL JOBS 44	CPU 8 — 47 Forks — RAM 52	USED CAPACITY 15%
Instance 3					
Instance 4	MANUAL	RUNNING JOBS 0	TOTAL JOBS 44	CPU 8 — 8 Forks — RAM 52	USED CAPACITY 5%

Slider adjusts whether the Instance capacity algorithm yields less forks (towards the left) or yields more forks (towards the right)

Toggle takes the Instance online/offline and ensures that jobs won't be assigned to that instance

ITEMS 1 - 4

2.6. Running jobs on execution nodes

You must specify where jobs are run, or they default to running in the control cluster.

To do this, set up a Job Template.

For more information on Job Templates, see Job Templates in the *Automation controller User Guide*.

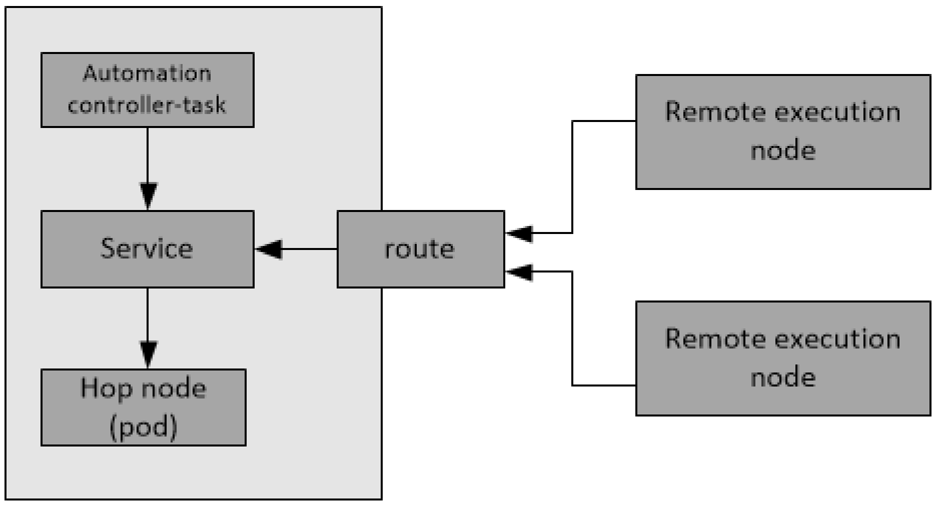
Procedure

1. The **Templates** list view shows job templates that are currently available. From this screen you can launch 🚀, edit ✎, and copy ❐ a workflow job template.
2. Select the job you want and click the 🚀 icon.
3. Select the **Instance Group** on which you want to run the job. Note that a System Administrator must grant you or your team permissions to be able to use an instance group in a job template. If you select multiple jobs templates, the order in which you select them sets the execution precedence.
4. Click **[Next]**.
5. Click **[Launch]**.

2.7. Connecting nodes through mesh ingress

If you are using a network which restricts or does not permit inbound connections, using an instance to set up a hop node peered to the control plane can cause problems. Creating a hop node instance also requires that the hop node has a 'listener_port' set up for internal connections. There is, however, an alternative method of setting up an automation mesh, using *mesh ingress*.

When you instantiate mesh ingress you set up a pod, or receptor hop node inside the kubernetes control cluster, registered to the database through the operator. It also creates a service, and a route URL that is used by the control plane to connect to the hop node, and automation controller.



Prerequisites

- Create node instances within the remote networks for execution nodes in the automation mesh.

Use the following procedure to set up mesh nodes.

Procedure

1. Create a YAML file to set up the mesh ingress node.

   The file resembles the following:

   ```
   apiVersion:
   kind: AutomationControllerMeshIngress
   ```

```
metadata:
    name:
    namespace:
spec:
    deployment name:
```

Where:

- **apiVersion**: defines the versioned schema of this representation of an object. Servers should convert recognized schemas to the latest internal value, and might reject unrecognized values.
- **kind**: Is the type of node to create. Set the value to `AutomationControllerMeshIngress`. `AutomationControllerMeshIngress` controls the deployment and configuration of mesh ingress on automation controller.
- **name**: is the name of the mesh ingress node
- **namespace**: is which Kubernetes namespace to deploy the mesh ingress into. This must be in the same namespace as the automation controller that the mesh is connected to
- **deployment_name**: You can find the deployment name by using:

  ```
  oc get ansible-automation-platform.
  ```

2. Apply this YAML file using:

   ```
   oc apply -f oc_meshingress.yml
   ```

   This runs the playbook associated with `AutomationControllerMeshIngress`, and creates the hop node called `<name>`.

3. When the MeshIngress instance has been created, it appears in the Instances page.

2.8. Pulling the secret for OpenShift Container Platform deployments

NOTE This does not apply to Ansible Automation Platform on Microsoft Azure.

If you are using the default execution environment provided with automation controller to run on remote execution nodes, you must add a pull secret in automation controller that contains the credential for pulling the execution environment image.

To do this, create a pull secret on the automation controller namespace and configure the `ee_pull_credentials_secret parameter in the Operator as follows:

Procedure

1. Create a secret using the following command:

```
oc create secret generic ee-pull-secret \
     --from-literal=username=<username> \
     --from-literal=password=<password> \
     --from-literal=url=registry.redhat.io

oc edit automationcontrollers <instance name>
```

2. Add `ee_pull_credentials_secret` and `ee-pull-secret` to the specification using:

```
spec.ee_pull_credentials_secret=ee-pull-secret
```

3. To manage instances from the automation controller UI, you must have System Administrator or System Auditor permissions.