



OpenShift Container Platform 4.7

Windows Container Support for OpenShift

Red Hat OpenShift for Windows Containers Guide

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Abstract

Red Hat OpenShift for Windows Containers provides built-in support for running Microsoft Windows Server containers on OpenShift Container Platform. This guide provides all the details.

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CHAPTER 1. RED HAT OPENSIFT SUPPORT FOR WINDOWS CONTAINERS OVERVIEW

Red Hat OpenShift support for Windows Containers is a feature providing the ability to run Windows compute nodes in an OpenShift Container Platform cluster. This is possible by using the Red Hat Windows Machine Config Operator (WMCO) to install and manage Windows nodes. With a Red Hat subscription, you can get support for running Windows workloads in OpenShift Container Platform. For more information, see the [release notes](#).

For workloads including both Linux and Windows, OpenShift Container Platform allows you to deploy Windows workloads running on Windows Server containers while also providing traditional Linux workloads hosted on Red Hat Enterprise Linux CoreOS (RHCOS) or Red Hat Enterprise Linux (RHEL). For more information, see [getting started with Windows container workloads](#).

You need the WMCO to run Windows workloads in your cluster. The WMCO orchestrates the process of deploying and managing Windows workloads on a cluster. For more information, see [how to enable Windows container workloads](#).

You can create a Windows **MachineSet** object to create infrastructure Windows machine sets and related machines so that you can move supported Windows workloads to the new Windows machines. You can create a Windows **MachineSet** object on multiple platforms.

You can [schedule Windows workloads](#) to Windows compute nodes.

You can [perform Windows Machine Config Operator upgrades](#) to ensure that your Windows nodes have the latest updates.

You can [remove a Windows node](#) by deleting a specific machine.

You can [disable Windows container workloads](#) by performing the following:

- Uninstalling the Windows Machine Config Operator
- Deleting the Windows Machine Config Operator namespace

CHAPTER 2. WINDOWS CONTAINER SUPPORT FOR RED HAT OPENSIFT RELEASE NOTES

2.1. ABOUT WINDOWS CONTAINER SUPPORT FOR RED HAT OPENSIFT

Red Hat OpenShift support for Windows Containers enables running Windows compute nodes in an OpenShift Container Platform cluster. Running Windows workloads is possible by using the Red Hat Windows Machine Config Operator (WMCO) to install and manage Windows nodes. With Windows nodes available, you can run Windows container workloads in OpenShift Container Platform.

The release notes for Red Hat OpenShift support for Windows Containers tracks the development of the WMCO, which provides all Windows container workload capabilities in OpenShift Container Platform.

2.2. GETTING SUPPORT

Windows Container Support for Red Hat OpenShift is provided and available as an optional, installable component. Windows Container Support for Red Hat OpenShift is not part of the OpenShift Container Platform subscription. It requires an additional Red Hat subscription and is supported according to the [Scope of coverage](#) and [Service level agreements](#).

You must have a separate subscription to receive support for Windows Container Support for Red Hat OpenShift. Without this additional Red Hat subscription, deploying Windows container workloads in production clusters is not supported. You can request support through the [Red Hat Customer Portal](#).

For more information, see the Red Hat OpenShift Container Platform Life Cycle Policy document for [Red Hat OpenShift support for Windows Containers](#).

If you do not have this additional Red Hat subscription, you can use the Community Windows Machine Config Operator, which is a distribution that lacks official support.

2.3. WINDOWS MACHINE CONFIG OPERATOR PREREQUISITES

The following information details the supported cloud provider versions, Windows Server versions, and networking configurations for the Windows Machine Config Operator. See the vSphere documentation for any information that is relevant to only that platform.

2.3.1. Supported cloud providers based on OpenShift Container Platform and WMCO versions

Cloud provider	Supported OpenShift Container Platform version	Supported WMCO version
Amazon Web Services (AWS)	4.6+	WMCO 1.0+
Microsoft Azure	4.6+	WMCO 1.0+
VMware vSphere	4.7+	WMCO 2.0+

2.3.2. Supported Windows Server versions

The following table lists the supported [Windows Server version](#) based on the applicable cloud provider. Any unlisted Windows Server version is not supported and will cause errors. To prevent these errors, only use the appropriate version according to the cloud provider in use.

Cloud provider	Supported Windows Server version
Amazon Web Services (AWS)	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
Microsoft Azure	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
VMware vSphere	Windows Server Semi-Annual Channel (SAC): Windows Server 20H2

2.3.3. Supported networking

Hybrid networking with OVN-Kubernetes is the only supported networking configuration. See the additional resources below for more information on this functionality. The following tables outline the type of networking configuration and Windows Server versions to use based on your cloud provider. You must specify the network configuration when you install the cluster. Be aware that OpenShift SDN networking is the default network for OpenShift Container Platform clusters. However, OpenShift SDN is not supported by WMCO.

Table 2.1. Cloud provider networking support

Cloud provider	Supported networking
Amazon Web Services (AWS)	Hybrid networking with OVN-Kubernetes
Microsoft Azure	Hybrid networking with OVN-Kubernetes
VMware vSphere	Hybrid networking with OVN-Kubernetes with a custom VXLAN port

Table 2.2. Hybrid OVN-Kubernetes Windows Server support

Hybrid networking with OVN-Kubernetes	Supported Windows Server version
Default VXLAN port	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
Custom VXLAN port	Windows Server Semi-Annual Channel (SAC): Windows Server 20H2

2.3.4. Supported installation method

The installer-provisioned infrastructure installation method is the only supported installation method. This is consistent across all supported cloud providers. User-provisioned infrastructure installation method is not supported.

2.4. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.5

Issued: 2022-05-02

The WMCO 2.0.5 is now available with bug fixes. The components of the WMCO were released in link:[RHSA-2022:93074](#).

2.5. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.4

Issued: 2022-02-16

The WMCO 2.0.4 is now available with bug fixes. The components of the WMCO were released in [RHBA-2022:0241](#).

2.5.1. Bug fixes

- For clusters installed on VMware vSphere, the WMCO ignored the **Deleting** phase notification event, leaving incorrect node information in the **windows-exporter** metrics endpoint. This resulted in an invalid mapping for the Prometheus metrics endpoint. This bug has been fixed; the WMCO now recognizes the **Deleting** phase notification event and maps the Prometheus metrics endpoint appropriately. ([BZ#1995340](#))

2.6. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.3

Issued: 2021-07-28

The WMCO 2.0.3 is now available with bug fixes. The components of the WMCO were released in [RHBA-2021:2926](#).

2.6.1. Bug fixes

- This WMCO release fixes a bug that prevented users from upgrading to WMCO 3.0.0. Users should upgrade to WMCO 2.0.3 before upgrading to OpenShift Container Platform 4.8, which only supports WMCO 3.0.0. ([BZ#1985349](#))

2.7. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.2

Issued: 2021-07-08

The WMCO 2.0.2 is now available with bug fixes. The components of the WMCO were released in [RHBA-2021:2671](#).



IMPORTANT

Users who are running a version of WMCO prior to 2.0.3 should first upgrade to WMCO 2.0.3 prior to upgrading to WMCO 3.0.0. ([BZ#1983153](#))

2.7.1. Bug fixes

- OpenShift Container Platform 4.8 enables the **BoundServiceAccountTokenVolume** option by default. This option attaches the projected volumes to all of the pods. In addition, OpenShift Container Platform 4.8 adds the **RunAsUser** option to the **SecurityContext**. This combination results in Windows pods being stuck in the **ContainerCreating** status. To work around this issue, you should upgrade to WMCO 2.0.2 before upgrading your cluster to OpenShift Container Platform 4.8. ([BZ#1975553](#))

2.8. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.1

Issued: 2021-06-23

The WMCO 2.0.1 is now available with bug fixes. The components of the WMCO were released in [RHSA-2021:2130](#).

2.8.1. New features and improvements

This release adds the following new features and improvements.

2.8.1.1. Increased image pull time-out duration

Image pull time-out has been increased to 30 minutes.

2.8.1.2. Autoscaling for Windows instances

Cluster autoscaling is now supported for Windows instances. You can complete the following actions for Windows nodes:

- Define and deploy a [cluster autoscaler](#).
- Create a Windows node using a [Windows machine set](#).
- Define and deploy a [machine autoscaler](#), referencing a Windows machine set.

2.8.2. Bug fixes

- Previously, when using the Windows kube-proxy component on an AWS installation, when you created a LoadBalancer service, packets would be misrouted and reached an unintended destination. Now, packets are no longer wrongly routed to unintended destinations. ([BZ#1946538](#))
- Previously, Windows nodes were not reporting some key node-level metrics via telemetry monitoring. The **windows_exporter** reports various metrics as **windows_*** instead of the **node_exporter** equivalent of **node_***. Now, the telemetry results cover all of the expected metrics. ([BZ#1955319](#))

- Previously, when the WMCO configured Windows instances, if the hybrid-overlay or kube-proxy components failed, the node might report itself as **Ready**. Now, the error is detected and the node reports itself as **NotReady**. ([BZ#1956412](#))
- Previously, the kube-proxy service would terminate unexpectedly after the load balancer is created if you created the load balancer after the Windows pods begin running. Now, the kube-proxy service does not crash when recreating the load balancer service. ([BZ#1939968](#))

2.8.3. RHSA-2021:2130 - Windows Container support for OpenShift Container Platform security update

As part of the previously noted bug fix ([BZ#1946538](#)), an update for Windows kube-proxy is now available for Red Hat Windows Machine Config Operator 2.0.1. Details of the update are documented in the [RHSA-2021:2130](#) advisory.

2.9. RELEASE NOTES FOR RED HAT WINDOWS MACHINE CONFIG OPERATOR 2.0.0

This release of the WMCO provides bug fixes and enhancements for running Windows compute nodes in an OpenShift Container Platform cluster. The components of the WMCO 2.0.0 were released in [RHBA-2021:0440](#).



IMPORTANT

Running Windows container workloads is not supported for clusters in a restricted network or disconnected environment.

Version 2.x of the WMCO is only compatible with OpenShift Container Platform 4.7.

2.9.1. New features and improvements

This release adds the following new features and improvements.

2.9.1.1. Support for clusters running on VMware vSphere

You can now run Windows nodes on a cluster installed on VMware vSphere version 6.5, 6.7, or 7.0. You can create a Windows **MachineSet** object on vSphere to host Windows Server compute nodes. For more information, see [Creating a Windows MachineSet object on vSphere](#).

2.9.1.2. Enhanced Windows node monitoring

Windows nodes are now fully integrated with most of the monitoring capabilities provided by the web console. However, it is not possible to view workload graphs for pods running on Windows nodes in this release.

2.10. KNOWN ISSUES

- When you create Windows pods with **RunAsUserName** set in its "SecurityContext" with a projected volume associated with these pods, the file ownership permissions for the projected entities are ignored, resulting in incorrectly configured ownership permissions.

- The filesystem graphs available in the web console do not display for Windows nodes. This is caused by changes in the filesystem queries. This will be fixed in a future release of WMCO. ([BZ#1930347](#))
- The Prometheus windows_exporter used by the WMCO currently collects metrics through HTTP, so it is considered unsafe. You must ensure that only trusted users can retrieve metrics from the endpoint. The windows_exporter feature recently added support for HTTPS configuration, but this configuration has not been implemented for WMCO. Support for HTTPS configuration in the WMCO will be added in a future release.
- When the **RunAsUser** permission is set in the security context of a Linux-based pod, the projected files have the correct permissions set, including container user ownership. However, when the Windows equivalent **RunAsUsername** permission is set in a Windows pod, the kubelet is prevented from setting correct ownership on the files in the projected volume. This problem can get exacerbated when used in conjunction with a [hostPath volume](#) where best practices are not followed. For example, giving a pod access to the **C:\var\lib\kubelet\pods** folder results in that pod being able to access service account tokens from other pods. By default, the projected files will have the following ownership, as shown in this example Windows projected volume file:

```
Path :
Microsoft.PowerShell.Core\FileSystem::C:\var\run\secrets\kubernetes.io\serviceaccount\..2021_
08_31_22_22_18.318230061\ca.crt
Owner : BUILTIN\Administrators
Group : NT AUTHORITY\SYSTEM
Access : NT AUTHORITY\SYSTEM Allow FullControl
        BUILTIN\Administrators Allow FullControl
        BUILTIN\Users Allow ReadAndExecute, Synchronize
Audit :
Sddl : O:BAG:SYD:AI(A;ID;FA;;;SY)(A;ID;FA;;;BA)(A;ID;0x1200a9;;;BU)
```

This indicates all administrator users, such as someone with the **ContainerAdministrator** role, have read, write, and execute access, while non-administrator users have read and execute access.



IMPORTANT

OpenShift Container Platform applies the **RunAsUser** security context to all pods irrespective of its operating system. This means Windows pods automatically have the **RunAsUser** permission applied to its security context.

In addition, if a Windows pod is created with a projected volume with the default **RunAsUser** permission set, the pod remains in the **ContainerCreating** phase.

To handle these issues, OpenShift Container Platform forces the file permission handling in projected service account volumes set in the security context of the pod to not be honored for projected volumes on Windows. Note that this behavior for Windows pods is how file permission handling used to work for all pod types prior to OpenShift Container Platform 4.7. ([BZ#1971745](#))

2.11. KNOWN LIMITATIONS

Note the following limitations when working with Windows nodes managed by the WMCO (Windows nodes):

- The following OpenShift Container Platform features are not supported on Windows nodes:
 - Red Hat OpenShift Developer CLI (odo)
 - Image builds
 - OpenShift Pipelines
 - OpenShift Service Mesh
 - OpenShift monitoring of user-defined projects
 - OpenShift Serverless
 - Horizontal Pod Autoscaling
 - Vertical Pod Autoscaling
- The following Red Hat features are not supported on Windows nodes:
 - [Red Hat cost management](#)
 - [Red Hat OpenShift Local](#)
- Windows nodes do not support pulling container images from private registries. You can use images from public registries or pre-pull the images.
- Windows nodes do not support workloads created by using deployment configs. You can use a deployment or other method to deploy workloads.
- Windows nodes are not supported in clusters that use a cluster-wide proxy. This is because the WMCO is not able to route traffic through the proxy connection for the workloads.
- Windows nodes are not supported in clusters that are in a disconnected environment.
- Red Hat OpenShift support for Windows Containers supports only in-tree storage drivers for all cloud providers.
- Kubernetes has identified the following [node feature limitations](#) :
 - Huge pages are not supported for Windows containers.
 - Privileged containers are not supported for Windows containers.
 - Pod termination grace periods require the containerd container runtime to be installed on the Windows node.
- Kubernetes has identified [several API compatibility issues](#) .

CHAPTER 3. UNDERSTANDING WINDOWS CONTAINER WORKLOADS

Red Hat OpenShift support for Windows Containers provides built-in support for running Microsoft Windows Server containers on OpenShift Container Platform. For those that administer heterogeneous environments with a mix of Linux and Windows workloads, OpenShift Container Platform allows you to deploy Windows workloads running on Windows Server containers while also providing traditional Linux workloads hosted on Red Hat Enterprise Linux CoreOS (RHCOS) or Red Hat Enterprise Linux (RHEL).



NOTE

Multi-tenancy for clusters that have Windows nodes is not supported. Hostile multi-tenant usage introduces security concerns in all Kubernetes environments. Additional security features like [pod security policies](#), or more fine-grained role-based access control (RBAC) for nodes, make exploits more difficult. However, if you choose to run hostile multi-tenant workloads, a hypervisor is the only security option you should use. The security domain for Kubernetes encompasses the entire cluster, not an individual node. For these types of hostile multi-tenant workloads, you should use physically isolated clusters.

Windows Server Containers provide resource isolation using a shared kernel but are not intended to be used in hostile multitenancy scenarios. Scenarios that involve hostile multitenancy should use Hyper-V Isolated Containers to strongly isolate tenants.

3.1. WINDOWS MACHINE CONFIG OPERATOR PREREQUISITES

The following information details the supported cloud provider versions, Windows Server versions, and networking configurations for the Windows Machine Config Operator. See the vSphere documentation for any information that is relevant to only that platform.

3.1.1. Supported cloud providers based on OpenShift Container Platform and WMCO versions

Cloud provider	Supported OpenShift Container Platform version	Supported WMCO version
Amazon Web Services (AWS)	4.6+	WMCO 1.0+
Microsoft Azure	4.6+	WMCO 1.0+
VMware vSphere	4.7+	WMCO 2.0+

3.1.2. Supported Windows Server versions

The following table lists the supported [Windows Server version](#) based on the applicable cloud provider. Any unlisted Windows Server version is not supported and will cause errors. To prevent these errors, only use the appropriate version according to the cloud provider in use.

Cloud provider	Supported Windows Server version
Amazon Web Services (AWS)	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
Microsoft Azure	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
VMware vSphere	Windows Server Semi-Annual Channel (SAC): Windows Server 20H2

3.1.3. Supported networking

Hybrid networking with OVN-Kubernetes is the only supported networking configuration. See the additional resources below for more information on this functionality. The following tables outline the type of networking configuration and Windows Server versions to use based on your cloud provider. You must specify the network configuration when you install the cluster. Be aware that OpenShift SDN networking is the default network for OpenShift Container Platform clusters. However, OpenShift SDN is not supported by WMCO.

Table 3.1. Cloud provider networking support

Cloud provider	Supported networking
Amazon Web Services (AWS)	Hybrid networking with OVN-Kubernetes
Microsoft Azure	Hybrid networking with OVN-Kubernetes
VMware vSphere	Hybrid networking with OVN-Kubernetes with a custom VXLAN port

Table 3.2. Hybrid OVN-Kubernetes Windows Server support

Hybrid networking with OVN-Kubernetes	Supported Windows Server version
Default VXLAN port	Windows Server Long-Term Servicing Channel (LTSC): Windows Server 2019
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3.1.4. Supported installation method

The installer-provisioned infrastructure installation method is the only supported installation method. This is consistent across all supported cloud providers. User-provisioned infrastructure installation method is not supported.

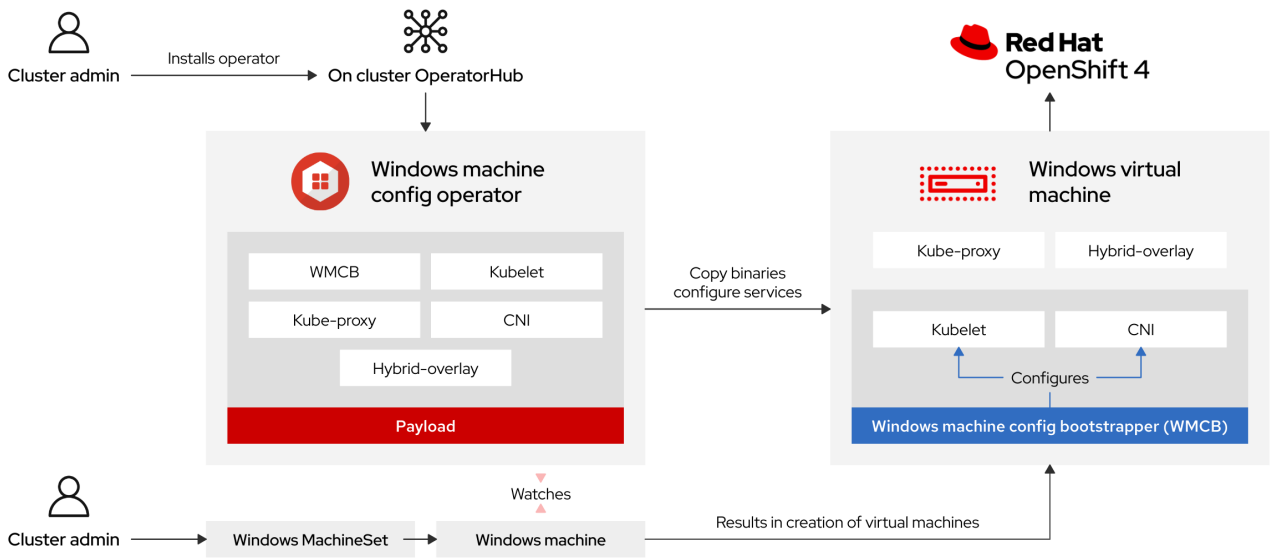
Additional resources

- See [Configuring hybrid networking with OVN-Kubernetes](#)

3.2. WINDOWS WORKLOAD MANAGEMENT

To run Windows workloads in your cluster, you must first install the Windows Machine Config Operator (WMCO). The WMCO is a Linux-based Operator that runs on Linux-based control plane and compute nodes. The WMCO orchestrates the process of deploying and managing Windows workloads on a cluster.

Figure 3.1. WMCO design



Before deploying Windows workloads, you must create a Windows compute node and have it join the cluster. The Windows node hosts the Windows workloads in a cluster, and can run alongside other Linux-based compute nodes. You can create a Windows compute node by creating a Windows machine set to host Windows Server compute machines. You must apply a Windows-specific label to the machine set that specifies a Windows OS image that has the Docker-formatted container runtime add-on enabled.

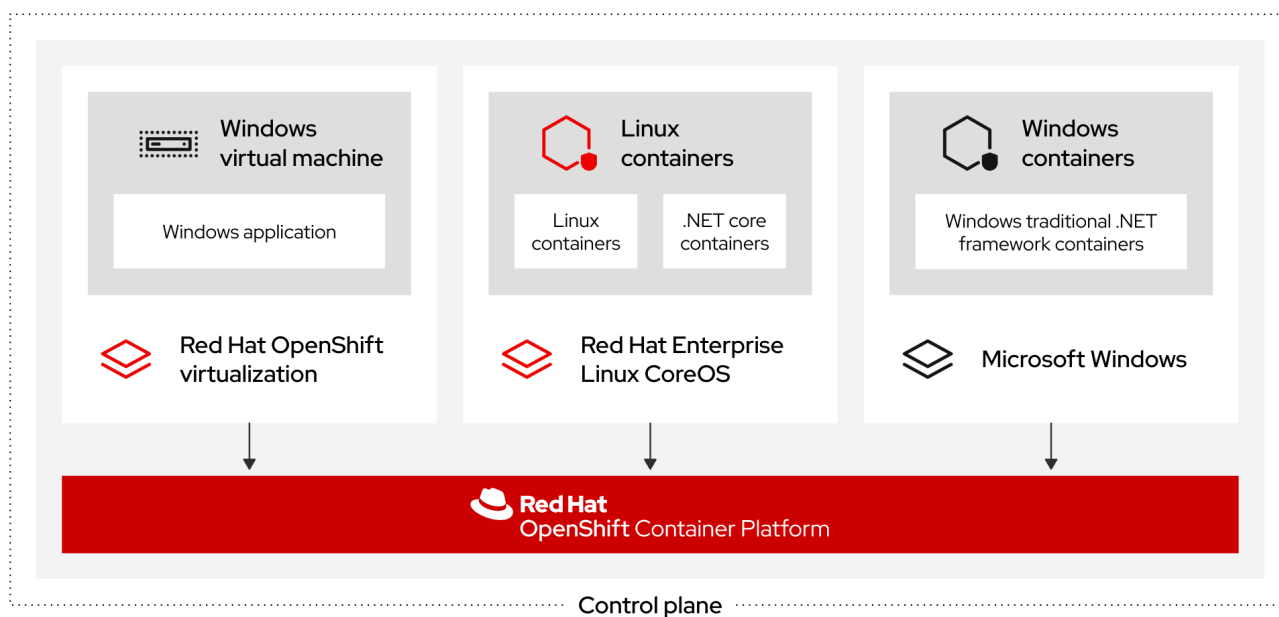


IMPORTANT

Currently, the Docker-formatted container runtime is used in Windows nodes. Kubernetes is deprecating Docker as a container runtime; you can reference the Kubernetes documentation for more information in [Docker deprecation](#). Containerd will be the new supported container runtime for Windows nodes in a future release of Kubernetes.

The WMCO watches for machines with the Windows label. After a Windows machine set is detected and its respective machines are provisioned, the WMCO configures the underlying Windows virtual machine (VM) so that it can join the cluster as a compute node.

Figure 3.2. Mixed Windows and Linux workloads



The WMCO expects a predetermined secret in its namespace containing a private key that is used to interact with the Windows instance. WMCO checks for this secret during boot up time and creates a user data secret which you must reference in the Windows **MachineSet** object that you created. Then the WMCO populates the user data secret with a public key that corresponds to the private key. With this data in place, the cluster can connect to the Windows VM using an SSH connection.

After the cluster establishes a connection with the Windows VM, you can manage the Windows node using similar practices as you would a Linux-based node.



NOTE

The OpenShift Container Platform web console provides most of the same monitoring capabilities for Windows nodes that are available for Linux nodes. However, the ability to monitor workload graphs for pods running on Windows nodes is not available at this time.

Scheduling Windows workloads to a Windows node can be done with typical pod scheduling practices like taints, tolerations, and node selectors; alternatively, you can differentiate your Windows workloads from Linux workloads and other Windows-versioned workloads by using a **RuntimeClass** object.

3.3. WINDOWS NODE SERVICES

The following Windows-specific services are installed on each Windows node:

Service	Description
kubelet	Registers the Windows node and manages its status.
Container Network Interface (CNI) plug-ins	Exposes networking for Windows nodes.
Windows Machine Config Bootstrapper (WMCB)	Configures the kubelet and CNI plug-ins.

Service	Description
Windows Exporter	Exports Prometheus metrics from Windows nodes
hybrid-overlay	Creates the OpenShift Container Platform Host Network Service (HNS) .
kube-proxy	Maintains network rules on nodes allowing outside communication.

3.4. KNOWN LIMITATIONS

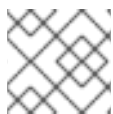
Note the following limitations when working with Windows nodes managed by the WMCO (Windows nodes):

- The following OpenShift Container Platform features are not supported on Windows nodes:
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 - OpenShift Pipelines
 - OpenShift Service Mesh
 - OpenShift monitoring of user-defined projects
 - OpenShift Serverless
 - Horizontal Pod Autoscaling
 - Vertical Pod Autoscaling
- The following Red Hat features are not supported on Windows nodes:
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- Windows nodes do not support workloads created by using deployment configs. You can use a deployment or other method to deploy workloads.
- Windows nodes are not supported in clusters that use a cluster-wide proxy. This is because the WMCO is not able to route traffic through the proxy connection for the workloads.
- Windows nodes are not supported in clusters that are in a disconnected environment.
- Red Hat OpenShift support for Windows Containers supports only in-tree storage drivers for all cloud providers.
- Kubernetes has identified the following [node feature limitations](#) :
 - Huge pages are not supported for Windows containers.

- Privileged containers are not supported for Windows containers.
- Pod termination grace periods require the containerd container runtime to be installed on the Windows node.
- Kubernetes has identified [several API compatibility issues](#).

CHAPTER 4. ENABLING WINDOWS CONTAINER WORKLOADS

Before adding Windows workloads to your cluster, you must install the Windows Machine Config Operator (WMCO), which is available in the OpenShift Container Platform OperatorHub. The WMCO orchestrates the process of deploying and managing Windows workloads on a cluster.



NOTE

Dual NIC is not supported on WMCO-managed Windows instances.

Prerequisites

- You have access to an OpenShift Container Platform cluster using an account with **cluster-admin** permissions.
- You have installed the OpenShift CLI (**oc**).
- You have installed your cluster using installer-provisioned infrastructure. Clusters installed with user-provisioned infrastructure are not supported for Windows container workloads.
- You have configured hybrid networking with OVN-Kubernetes for your cluster. This must be completed during the installation of your cluster. For more information, see [Configuring hybrid networking](#).
- You are running an OpenShift Container Platform cluster version 4.6.8 or later.



NOTE

The WMCO is not supported in clusters that use a [cluster-wide proxy](#) because the WMCO is not able to route traffic through the proxy connection for the workloads.

Additional resources

- For the comprehensive prerequisites for the Windows Machine Config Operator, see [Understanding Windows container workloads](#).

4.1. INSTALLING THE WINDOWS MACHINE CONFIG OPERATOR

You can install the Windows Machine Config Operator using either the web console or OpenShift CLI (**oc**).

4.1.1. Installing the Windows Machine Config Operator using the web console

You can use the OpenShift Container Platform web console to install the Windows Machine Config Operator (WMCO).



NOTE

Dual NIC is not supported on WMCO-managed Windows instances.

Procedure

1. From the **Administrator** perspective in the OpenShift Container Platform web console, navigate to the **Operators → OperatorHub** page.
2. Use the **Filter by keyword** box to search for **Windows Machine Config Operator** in the catalog. Click the **Windows Machine Config Operator** tile.
3. Review the information about the Operator and click **Install**.
4. On the **Install Operator** page:
 - a. Select the **stable** channel as the **Update Channel**. The **stable** channel enables the latest stable release of the WMCO to be installed.
 - b. The **Installation Mode** is preconfigured because the WMCO must be available in a single namespace only.
 - c. Choose the **Installed Namespace** for the WMCO. The default Operator recommended namespace is **openshift-windows-machine-config-operator**.
 - d. Click the **Enable Operator recommended cluster monitoring on the Namespace** checkbox to enable cluster monitoring for the WMCO.
 - e. Select an **Approval Strategy**.
 - The **Automatic** strategy allows Operator Lifecycle Manager (OLM) to automatically update the Operator when a new version is available.
 - The **Manual** strategy requires a user with appropriate credentials to approve the Operator update.
1. Click **Install**. The WMCO is now listed on the **Installed Operators** page.

**NOTE**

The WMCO is installed automatically into the namespace you defined, like **openshift-windows-machine-config-operator**.

2. Verify that the **Status** shows **Succeeded** to confirm successful installation of the WMCO.

4.1.2. Installing the Windows Machine Config Operator using the CLI

You can use the OpenShift CLI (**oc**) to install the Windows Machine Config Operator (WMCO).

**NOTE**

Dual NIC is not supported on WMCO-managed Windows instances.

Procedure

1. Create a namespace for the WMCO.
 - a. Create a **Namespace** object YAML file for the WMCO. For example, **wmco-namespace.yaml**:

```
apiVersion: v1
kind: Namespace
```

```

metadata:
  name: openshift-windows-machine-config-operator 1
  labels:
    openshift.io/cluster-monitoring: "true" 2

```

- 1** It is recommended to deploy the WMCO in the **openshift-windows-machine-config-operator** namespace.
- 2** This label is required for enabling cluster monitoring for the WMCO.

b. Create the namespace:

```
$ oc create -f <file-name>.yaml
```

For example:

```
$ oc create -f wmco-namespace.yaml
```

2. Create the Operator group for the WMCO.

a. Create an **OperatorGroup** object YAML file. For example, **wmco-og.yaml**:

```

apiVersion: operators.coreos.com/v1
kind: OperatorGroup
metadata:
  name: windows-machine-config-operator
  namespace: openshift-windows-machine-config-operator
spec:
  targetNamespaces:
    - openshift-windows-machine-config-operator

```

b. Create the Operator group:

```
$ oc create -f <file-name>.yaml
```

For example:

```
$ oc create -f wmco-og.yaml
```

3. Subscribe the namespace to the WMCO.

a. Create a **Subscription** object YAML file. For example, **wmco-sub.yaml**:

```

apiVersion: operators.coreos.com/v1alpha1
kind: Subscription
metadata:
  name: windows-machine-config-operator
  namespace: openshift-windows-machine-config-operator
spec:
  channel: "stable" 1
  installPlanApproval: "Automatic" 2

```



```
name: "windows-machine-config-operator"
source: "redhat-operators" 3
sourceNamespace: "openshift-marketplace" 4
```

- 1 Specify **stable** as the channel.
- 2 Set an approval strategy. You can set **Automatic** or **Manual**.
- 3 Specify the **redhat-operators** catalog source, which contains the **windows-machine-config-operator** package manifests. If your OpenShift Container Platform is installed on a restricted network, also known as a disconnected cluster, specify the name of the **CatalogSource** object you created when you configured the Operator Lifecycle Manager (OLM).
- 4 Namespace of the catalog source. Use **openshift-marketplace** for the default OperatorHub catalog sources.

b. Create the subscription:

```
$ oc create -f <file-name>.yaml
```

For example:

```
$ oc create -f wmco-sub.yaml
```

The WMCO is now installed to the **openshift-windows-machine-config-operator**.

4. Verify the WMCO installation:

```
$ oc get csv -n openshift-windows-machine-config-operator
```

Example output

```
NAME                                DISPLAY                                VERSION REPLACES PHASE
windows-machine-config-operator.2.0.0  Windows Machine Config Operator  2.0.0
Succeeded
```

4.2. CONFIGURING A SECRET FOR THE WINDOWS MACHINE CONFIG OPERATOR

To run the Windows Machine Config Operator (WMCO), you must create a secret in the WMCO namespace containing a private key. This is required to allow the WMCO to communicate with the Windows virtual machine (VM).

Prerequisites

- You installed the Windows Machine Config Operator (WMCO) using Operator Lifecycle Manager (OLM).
- You created a PEM-encoded file containing an RSA key.

Procedure

- Define the secret required to access the Windows VMs:

```
$ oc create secret generic cloud-private-key --from-file=private-  
key.pem=${HOME}/.ssh/<key> \  
-n openshift-windows-machine-config-operator 1
```

- 1** You must create the private key in the WMCO namespace, like **openshift-windows-machine-config-operator**.

It is recommended to use a different private key than the one used when installing the cluster.

4.3. ADDITIONAL RESOURCES

- [Generating an SSH private key and adding it to the agent](#)
- [Adding Operators to a cluster](#).

CHAPTER 5. CREATING WINDOWS MACHINESET OBJECTS

5.1. CREATING A WINDOWS MACHINESET OBJECT ON AWS

You can create a Windows **MachineSet** object to serve a specific purpose in your OpenShift Container Platform cluster on Amazon Web Services (AWS). For example, you might create infrastructure Windows machine sets and related machines so that you can move supporting Windows workloads to the new Windows machines.

Prerequisites

- You installed the Windows Machine Config Operator (WMCO) using Operator Lifecycle Manager (OLM).
- You are using a supported Windows Server as the operating system image with the Docker-formatted container runtime add-on enabled.

Use the following **aws** command to query valid AMI images:

```
$ aws ec2 describe-images --region <aws region name> --filters
"Name=name,Values=Windows_Server-2019*English*Full*Containers*" "Name=is-
public,Values=true" --query "reverse(sort_by(Images, &CreationDate))[*].{name: Name, id:
ImageId}" --output table
```



IMPORTANT

Currently, the Docker-formatted container runtime is used in Windows nodes. Kubernetes is deprecating Docker as a container runtime; you can reference the Kubernetes documentation for more information in [Docker deprecation](#). Containerd will be the new supported container runtime for Windows nodes in a future release of Kubernetes.

5.1.1. Machine API overview

The Machine API is a combination of primary resources that are based on the upstream Cluster API project and custom OpenShift Container Platform resources.

For OpenShift Container Platform 4.7 clusters, the Machine API performs all node host provisioning management actions after the cluster installation finishes. Because of this system, OpenShift Container Platform 4.7 offers an elastic, dynamic provisioning method on top of public or private cloud infrastructure.

The two primary resources are:

Machines

A fundamental unit that describes the host for a node. A machine has a **providerSpec** specification, which describes the types of compute nodes that are offered for different cloud platforms. For example, a machine type for a worker node on Amazon Web Services (AWS) might define a specific machine type and required metadata.

Machine sets

MachineSet resources are groups of machines. Machine sets are to machines as replica sets are to pods. If you need more machines or must scale them down, you change the **replicas** field on the machine set to meet your compute need.

**WARNING**

Control plane machines cannot be managed by machine sets.

The following custom resources add more capabilities to your cluster:

Machine autoscaler

The **MachineAutoscaler** resource automatically scales machines in a cloud. You can set the minimum and maximum scaling boundaries for nodes in a specified machine set, and the machine autoscaler maintains that range of nodes. The **MachineAutoscaler** object takes effect after a **ClusterAutoscaler** object exists. Both **ClusterAutoscaler** and **MachineAutoscaler** resources are made available by the **ClusterAutoscalerOperator** object.

Cluster autoscaler

This resource is based on the upstream cluster autoscaler project. In the OpenShift Container Platform implementation, it is integrated with the Machine API by extending the machine set API. You can set cluster-wide scaling limits for resources such as cores, nodes, memory, GPU, and so on. You can set the priority so that the cluster prioritizes pods so that new nodes are not brought online for less important pods. You can also set the scaling policy so that you can scale up nodes but not scale them down.

Machine health check

The **MachineHealthCheck** resource detects when a machine is unhealthy, deletes it, and, on supported platforms, makes a new machine.

In OpenShift Container Platform version 3.11, you could not roll out a multi-zone architecture easily because the cluster did not manage machine provisioning. Beginning with OpenShift Container Platform version 4.1, this process is easier. Each machine set is scoped to a single zone, so the installation program sends out machine sets across availability zones on your behalf. And then because your compute is dynamic, and in the face of a zone failure, you always have a zone for when you must rebalance your machines. The autoscaler provides best-effort balancing over the life of a cluster.

5.1.2. Sample YAML for a Windows MachineSet object on AWS

This sample YAML defines a Windows **MachineSet** object running on Amazon Web Services (AWS) that the Windows Machine Config Operator (WMCO) can react upon.

```
apiVersion: machine.openshift.io/v1beta1
kind: MachineSet
metadata:
  labels:
    machine.openshift.io/cluster-api-cluster: <infrastructure_id> 1
  name: <infrastructure_id>-windows-worker-<zone> 2
  namespace: openshift-machine-api
spec:
  replicas: 1
  selector:
    matchLabels:
      machine.openshift.io/cluster-api-cluster: <infrastructure_id> 3
      machine.openshift.io/cluster-api-machineset: <infrastructure_id>-windows-worker-<zone> 4
```

```

template:
  metadata:
    labels:
      machine.openshift.io/cluster-api-cluster: <infrastructure_id> 5
      machine.openshift.io/cluster-api-machine-role: worker
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: <infrastructure_id>-windows-worker-<zone> 6
      machine.openshift.io/os-id: Windows 7
  spec:
    metadata:
      labels:
        node-role.kubernetes.io/worker: "" 8
    providerSpec:
      value:
        ami:
          id: <windows_container_ami> 9
        apiVersion: awsproviderconfig.openshift.io/v1beta1
        blockDevices:
          - ebs:
              iops: 0
              volumeSize: 120
              volumeType: gp2
        credentialsSecret:
          name: aws-cloud-credentials
        deviceIndex: 0
        iamInstanceProfile:
          id: <infrastructure_id>-worker-profile 10
        instanceType: m5a.large
        kind: AWSMachineProviderConfig
        placement:
          availabilityZone: <zone> 11
          region: <region> 12
        securityGroups:
          - filters:
              - name: tag:Name
                values:
                  - <infrastructure_id>-worker-sg 13
        subnet:
          filters:
            - name: tag:Name
              values:
                - <infrastructure_id>-private-<zone> 14
        tags:
          - name: kubernetes.io/cluster/<infrastructure_id> 15
            value: owned
        userDataSecret:
          name: windows-user-data 16
        namespace: openshift-machine-api

```

1 3 5 10 13 14 15 Specify the infrastructure ID that is based on the cluster ID that you set when you provisioned the cluster. You can obtain the infrastructure ID by running the following command:

```
$ oc get -o jsonpath='{.status.infrastructureName}' infrastructure cluster
```

- 2 4 6 Specify the infrastructure ID, worker label, and zone.
- 7 Configure the machine set as a Windows machine.
- 8 Configure the Windows node as a compute machine.
- 9 Specify the AMI ID of a Windows image with a container runtime installed. You must use Windows Server 2019.
- 11 Specify the AWS zone, like **us-east-1a**.
- 12 Specify the AWS region, like **us-east-1**.
- 16 Created by the WMCO when it is configuring the first Windows machine. After that, the **windows-user-data** is available for all subsequent machine sets to consume.

5.1.3. Creating a machine set

In addition to the ones created by the installation program, you can create your own machine sets to dynamically manage the machine compute resources for specific workloads of your choice.

Prerequisites

- Deploy an OpenShift Container Platform cluster.
- Install the OpenShift CLI (**oc**).
- Log in to **oc** as a user with **cluster-admin** permission.

Procedure

1. Create a new YAML file that contains the machine set custom resource (CR) sample and is named **<file_name>.yaml**.

Ensure that you set the **<clusterID>** and **<role>** parameter values.

- a. If you are not sure which value to set for a specific field, you can check an existing machine set from your cluster:

```
$ oc get machinesets -n openshift-machine-api
```

Example output

```
NAME                                DESIRED  CURRENT  READY  AVAILABLE  AGE
agl030519-vplxk-worker-us-east-1a  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1b  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1c  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1d  0        0        0      0          55m
agl030519-vplxk-worker-us-east-1e  0        0        0      0          55m
agl030519-vplxk-worker-us-east-1f  0        0        0      0          55m
```

- b. Check values of a specific machine set:

```
$ oc get machineset <machineset_name> -n \
  openshift-machine-api -o yaml
```

-

Example output

```
...
template:
  metadata:
    labels:
      machine.openshift.io/cluster-api-cluster: agl030519-vplxk 1
      machine.openshift.io/cluster-api-machine-role: worker 2
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: agl030519-vplxk-worker-us-east-1a
```

- 1** The cluster ID.
- 2** A default node label.

2. Create the new **MachineSet** CR:

```
$ oc create -f <file_name>.yaml
```

3. View the list of machine sets:

```
$ oc get machineset -n openshift-machine-api
```

Example output

NAME	DESIRED	CURRENT	READY	AVAILABLE	AGE
agl030519-vplxk-windows-worker-us-east-1a	1	1	1	1	11m
agl030519-vplxk-worker-us-east-1a	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1b	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1c	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1d	0	0			55m
agl030519-vplxk-worker-us-east-1e	0	0			55m
agl030519-vplxk-worker-us-east-1f	0	0			55m

When the new machine set is available, the **DESIRED** and **CURRENT** values match. If the machine set is not available, wait a few minutes and run the command again.

5.1.4. Additional resources

- For more information on managing machine sets, see the *Machine management* section.

5.2. CREATING A WINDOWS MACHINESSET OBJECT ON AZURE

You can create a Windows **MachineSet** object to serve a specific purpose in your OpenShift Container Platform cluster on Microsoft Azure. For example, you might create infrastructure Windows machine sets and related machines so that you can move supporting Windows workloads to the new Windows machines.

Prerequisites

- You installed the Windows Machine Config Operator (WMCO) using Operator Lifecycle Manager (OLM).
- You are using a supported Windows Server as the operating system image with the Docker-formatted container runtime add-on enabled.



IMPORTANT

Currently, the Docker-formatted container runtime is used in Windows nodes. Kubernetes is deprecating Docker as a container runtime; you can reference the Kubernetes documentation for more information in [Docker deprecation](#). Containerd will be the new supported container runtime for Windows nodes in a future release of Kubernetes.

5.2.1. Machine API overview

The Machine API is a combination of primary resources that are based on the upstream Cluster API project and custom OpenShift Container Platform resources.

For OpenShift Container Platform 4.7 clusters, the Machine API performs all node host provisioning management actions after the cluster installation finishes. Because of this system, OpenShift Container Platform 4.7 offers an elastic, dynamic provisioning method on top of public or private cloud infrastructure.

The two primary resources are:

Machines

A fundamental unit that describes the host for a node. A machine has a **providerSpec** specification, which describes the types of compute nodes that are offered for different cloud platforms. For example, a machine type for a worker node on Amazon Web Services (AWS) might define a specific machine type and required metadata.

Machine sets

MachineSet resources are groups of machines. Machine sets are to machines as replica sets are to pods. If you need more machines or must scale them down, you change the **replicas** field on the machine set to meet your compute need.



WARNING

Control plane machines cannot be managed by machine sets.

The following custom resources add more capabilities to your cluster:

Machine autoscaler

The **MachineAutoscaler** resource automatically scales machines in a cloud. You can set the minimum and maximum scaling boundaries for nodes in a specified machine set, and the machine autoscaler maintains that range of nodes. The **MachineAutoscaler** object takes effect after a **ClusterAutoscaler** object exists. Both **ClusterAutoscaler** and **MachineAutoscaler** resources are made available by the **ClusterAutoscalerOperator** object.

Cluster autoscaler

This resource is based on the upstream cluster autoscaler project. In the OpenShift Container Platform implementation, it is integrated with the Machine API by extending the machine set API. You can set cluster-wide scaling limits for resources such as cores, nodes, memory, GPU, and so on. You can set the priority so that the cluster prioritizes pods so that new nodes are not brought online for less important pods. You can also set the scaling policy so that you can scale up nodes but not scale them down.

Machine health check

The **MachineHealthCheck** resource detects when a machine is unhealthy, deletes it, and, on supported platforms, makes a new machine.

In OpenShift Container Platform version 3.11, you could not roll out a multi-zone architecture easily because the cluster did not manage machine provisioning. Beginning with OpenShift Container Platform version 4.1, this process is easier. Each machine set is scoped to a single zone, so the installation program sends out machine sets across availability zones on your behalf. And then because your compute is dynamic, and in the face of a zone failure, you always have a zone for when you must rebalance your machines. The autoscaler provides best-effort balancing over the life of a cluster.

5.2.2. Sample YAML for a Windows MachineSet object on Azure

This sample YAML defines a Windows **MachineSet** object running on Microsoft Azure that the Windows Machine Config Operator (WMCO) can react upon.

```

apiVersion: machine.openshift.io/v1beta1
kind: MachineSet
metadata:
  labels:
    machine.openshift.io/cluster-api-cluster: <infrastructure_id> 1
  name: <windows_machine_set_name> 2
  namespace: openshift-machine-api
spec:
  replicas: 1
  selector:
    matchLabels:
      machine.openshift.io/cluster-api-cluster: <infrastructure_id> 3
      machine.openshift.io/cluster-api-machineset: <windows_machine_set_name> 4
  template:
    metadata:
      labels:
        machine.openshift.io/cluster-api-cluster: <infrastructure_id> 5
        machine.openshift.io/cluster-api-machine-role: worker
        machine.openshift.io/cluster-api-machine-type: worker
        machine.openshift.io/cluster-api-machineset: <windows_machine_set_name> 6
        machine.openshift.io/os-id: Windows 7
    spec:
      metadata:
        labels:
          node-role.kubernetes.io/worker: "" 8
      providerSpec:
        value:
          apiVersion: azureproviderconfig.openshift.io/v1beta1
          credentialsSecret:
            name: azure-cloud-credentials
            namespace: openshift-machine-api
          image: 9

```

```

offer: WindowsServer
publisher: MicrosoftWindowsServer
resourceID: ""
sku: 2019-Datacenter-with-Containers
version: latest
kind: AzureMachineProviderSpec
location: <location> 10
managedIdentity: <infrastructure_id>-identity 11
networkResourceGroup: <infrastructure_id>-rg 12
osDisk:
  diskSizeGB: 128
  managedDisk:
    storageAccountType: Premium_LRS
  osType: Windows
publicIP: false
resourceGroup: <infrastructure_id>-rg 13
subnet: <infrastructure_id>-worker-subnet
userDataSecret:
  name: windows-user-data 14
  namespace: openshift-machine-api
vmSize: Standard_D2s_v3
vnet: <infrastructure_id>-vnet 15
zone: "<zone>" 16

```

- 1 3 5 11 12 13 15** Specify the infrastructure ID that is based on the cluster ID that you set when you provisioned the cluster. You can obtain the infrastructure ID by running the following command:

```
$ oc get -o jsonpath='{.status.infrastructureName}' infrastructure cluster
```

- 2 4 6** Specify the Windows machine set name. Windows machine names on Azure cannot be more than 15 characters long. Therefore, the machine set name cannot be more than 9 characters long, due to the way machine names are generated from it.
- 7** Configure the machine set as a Windows machine.
- 8** Configure the Windows node as a compute machine.
- 9** Specify a **WindowsServer** image offering that defines the **2019-Datacenter-with-Containers** SKU.
- 10** Specify the Azure region, like **centralus**.
- 14** Created by the WMCO when it is configuring the first Windows machine. After that, the **windows-user-data** is available for all subsequent machine sets to consume.
- 16** Specify the zone within your region to place machines on. Be sure that your region supports the zone that you specify.

5.2.3. Creating a machine set

In addition to the ones created by the installation program, you can create your own machine sets to dynamically manage the machine compute resources for specific workloads of your choice.

Prerequisites

- Deploy an OpenShift Container Platform cluster.
- Install the OpenShift CLI (**oc**).
- Log in to **oc** as a user with **cluster-admin** permission.

Procedure

1. Create a new YAML file that contains the machine set custom resource (CR) sample and is named **<file_name>.yaml**.

Ensure that you set the **<clusterID>** and **<role>** parameter values.

- a. If you are not sure which value to set for a specific field, you can check an existing machine set from your cluster:

```
$ oc get machinesets -n openshift-machine-api
```

Example output

NAME	DESIRED	CURRENT	READY	AVAILABLE	AGE
agl030519-vplxk-worker-us-east-1a	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1b	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1c	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1d	0	0			55m
agl030519-vplxk-worker-us-east-1e	0	0			55m
agl030519-vplxk-worker-us-east-1f	0	0			55m

- b. Check values of a specific machine set:

```
$ oc get machineset <machineset_name> -n \
  openshift-machine-api -o yaml
```

Example output

```
...
template:
  metadata:
    labels:
      machine.openshift.io/cluster-api-cluster: agl030519-vplxk 1
      machine.openshift.io/cluster-api-machine-role: worker 2
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: agl030519-vplxk-worker-us-east-1a
```

1 The cluster ID.

2 A default node label.

2. Create the new **MachineSet** CR:

```
$ oc create -f <file_name>.yaml
```

- View the list of machine sets:

```
$ oc get machineset -n openshift-machine-api
```

Example output

NAME	DESIRED	CURRENT	READY	AVAILABLE	AGE
agl030519-vplxk-windows-worker-us-east-1a	1	1	1	1	11m
agl030519-vplxk-worker-us-east-1a	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1b	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1c	1	1	1	1	55m
agl030519-vplxk-worker-us-east-1d	0	0		55m	
agl030519-vplxk-worker-us-east-1e	0	0		55m	
agl030519-vplxk-worker-us-east-1f	0	0		55m	

When the new machine set is available, the **DESIRED** and **CURRENT** values match. If the machine set is not available, wait a few minutes and run the command again.

5.2.4. Additional resources

- For more information on managing machine sets, see the *Machine management* section.

5.3. CREATING A WINDOWS MACHINESSET OBJECT ON VSPHERE

You can create a Windows **MachineSet** object to serve a specific purpose in your OpenShift Container Platform cluster on VMware vSphere. For example, you might create infrastructure Windows machine sets and related machines so that you can move supporting Windows workloads to the new Windows machines.

Prerequisites

- You installed the Windows Machine Config Operator (WMCO) using Operator Lifecycle Manager (OLM).
- You are using a supported Windows Server as the operating system image with the Docker-formatted container runtime add-on enabled.



IMPORTANT

Currently, the Docker-formatted container runtime is used in Windows nodes. Kubernetes is deprecating Docker as a container runtime; you can reference the Kubernetes documentation for more information on [Docker deprecation](#). Containerd will be the new supported container runtime for Windows nodes in a future release of Kubernetes.

5.3.1. Machine API overview

The Machine API is a combination of primary resources that are based on the upstream Cluster API project and custom OpenShift Container Platform resources.

For OpenShift Container Platform 4.7 clusters, the Machine API performs all node host provisioning management actions after the cluster installation finishes. Because of this system, OpenShift Container Platform 4.7 offers an elastic, dynamic provisioning method on top of public or private cloud infrastructure.

The two primary resources are:

Machines

A fundamental unit that describes the host for a node. A machine has a **providerSpec** specification, which describes the types of compute nodes that are offered for different cloud platforms. For example, a machine type for a worker node on Amazon Web Services (AWS) might define a specific machine type and required metadata.

Machine sets

MachineSet resources are groups of machines. Machine sets are to machines as replica sets are to pods. If you need more machines or must scale them down, you change the **replicas** field on the machine set to meet your compute need.



WARNING

Control plane machines cannot be managed by machine sets.

The following custom resources add more capabilities to your cluster:

Machine autoscaler

The **MachineAutoscaler** resource automatically scales machines in a cloud. You can set the minimum and maximum scaling boundaries for nodes in a specified machine set, and the machine autoscaler maintains that range of nodes. The **MachineAutoscaler** object takes effect after a **ClusterAutoscaler** object exists. Both **ClusterAutoscaler** and **MachineAutoscaler** resources are made available by the **ClusterAutoscalerOperator** object.

Cluster autoscaler

This resource is based on the upstream cluster autoscaler project. In the OpenShift Container Platform implementation, it is integrated with the Machine API by extending the machine set API. You can set cluster-wide scaling limits for resources such as cores, nodes, memory, GPU, and so on. You can set the priority so that the cluster prioritizes pods so that new nodes are not brought online for less important pods. You can also set the scaling policy so that you can scale up nodes but not scale them down.

Machine health check

The **MachineHealthCheck** resource detects when a machine is unhealthy, deletes it, and, on supported platforms, makes a new machine.

In OpenShift Container Platform version 3.11, you could not roll out a multi-zone architecture easily because the cluster did not manage machine provisioning. Beginning with OpenShift Container Platform version 4.1, this process is easier. Each machine set is scoped to a single zone, so the installation program sends out machine sets across availability zones on your behalf. And then because your compute is dynamic, and in the face of a zone failure, you always have a zone for when you must rebalance your machines. The autoscaler provides best-effort balancing over the life of a cluster.

5.3.2. Preparing your vSphere environment for Windows container workloads

You must prepare your vSphere environment for Windows container workloads by creating the vSphere Windows VM golden image and enabling communication with the internal API server for the WMCO.

5.3.2.1. Creating the vSphere Windows VM golden image

Create a vSphere Windows virtual machine (VM) golden image.

Prerequisites

- You have created a private/public key pair, which is used to configure key-based authentication in the OpenSSH server. The private key must also be configured in the Windows Machine Config Operator (WMCO) namespace. This is required to allow the WMCO to communicate with the Windows VM. See the "Configuring a secret for the Windows Machine Config Operator" section for more details.



NOTE

You must use [Microsoft PowerShell](#) commands in several cases when creating your Windows VM. PowerShell commands in this guide are distinguished by the **PS C:\>** prefix.

Procedure

- Create a new VM in the vSphere client using the Windows Server Semi-Annual Channel (SAC): Windows Server 20H2 ISO image that includes the [Microsoft patch KB4565351](#). This patch is required to set the VXLAN UDP port, which is required for clusters installed on vSphere. See the [VMware documentation](#) for more information.
- Install and configure VMware Tools version 11.0.6 or greater on the Windows VM. See the [VMware Tools documentation](#) for more information.
- After installing VMware Tools on the Windows VM, verify the following:

- The **C:\ProgramData\VMware\VMware Tools\tools.conf** file exists with the following entry:

```
exclude-nics=
```

If the **tools.conf** file does not exist, create it with the **exclude-nics** option uncommented and set as an empty value.

This entry ensures the cloned vNIC generated on the Windows VM by the hybrid-overlay is not ignored.

- The Windows VM has a valid IP address in vCenter:

```
C:\> ipconfig
```

- The VMTools Windows service is running:

```
PS C:\> Get-Service -Name VMTools | Select Status, StartType
```

- Install and configure the OpenSSH Server on the Windows VM. See Microsoft's documentation on [installing OpenSSH](#) for more details.
- Set up SSH access for an administrative user. See Microsoft's documentation on the [Administrative user](#) to do this.



IMPORTANT

The public key used in the instructions must correspond to the private key you create later in the WMCO namespace that holds your secret. See the "Configuring a secret for the Windows Machine Config Operator" section for more details.

6. Install the **docker** container runtime on your Windows VM following the [Microsoft documentation](#).
7. You must create a new firewall rule in the Windows VM that allows incoming connections for container logs. Run the following PowerShell command to create the firewall rule on TCP port 10250:

```
PS C:\> New-NetFirewallRule -DisplayName "ContainerLogsPort" -LocalPort 10250 -
Enabled True -Direction Inbound -Protocol TCP -Action Allow -EdgeTraversalPolicy Allow
```

8. Clone the Windows VM so it is a reusable image. Follow the VMware documentation on how to [clone an existing virtual machine](#) for more details.
9. In the cloned Windows VM, run the [Windows Sysprep tool](#):

```
C:\> C:\Windows\System32\Sysprep\sysprep.exe /generalize /oobe /shutdown /unattend:
<path_to_unattend.xml> 1
```

- 1 Specify the path to your **unattend.xml** file.



NOTE

There is a limit on how many times you can run the **sysprep** command on a Windows image. Consult Microsoft's [documentation](#) for more information.

An example **unattend.xml** is provided, which maintains all the changes needed for the WMCO. You must modify this example; it cannot be used directly.

Example 5.1. Example unattend.xml

```
<?xml version="1.0" encoding="UTF-8"?>
<unattend xmlns="urn:schemas-microsoft-com:unattend">
  <settings pass="specialize">
    <component xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" name="Microsoft-Windows-
International-Core" processorArchitecture="amd64"
publicKeyToken="31bf3856ad364e35" language="neutral" versionScope="nonSxS">
      <InputLocale>0409:00000409</InputLocale>
      <SystemLocale>en-US</SystemLocale>
      <UILanguage>en-US</UILanguage>
      <UILanguageFallback>en-US</UILanguageFallback>
      <UserLocale>en-US</UserLocale>
    </component>
    <component xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" name="Microsoft-Windows-
Security-SPP-UX" processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35"
```

```

language="neutral" versionScope="nonSxS">
  <SkipAutoActivation>true</SkipAutoActivation>
</component>
  <component xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" name="Microsoft-Windows-
SQMApi" processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35"
language="neutral" versionScope="nonSxS">
  <CEIPEEnabled>0</CEIPEEnabled>
</component>
  <component xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" name="Microsoft-Windows-
Shell-Setup" processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35"
language="neutral" versionScope="nonSxS">
  <ComputerName>winhost</ComputerName> 1
</component>
</settings>
<settings pass="oobeSystem">
  <component xmlns:wcm="http://schemas.microsoft.com/WMIConfig/2002/State"
xmlns:xsi="http://www.w3.org/2001/XMLSchema-instance" name="Microsoft-Windows-
Shell-Setup" processorArchitecture="amd64" publicKeyToken="31bf3856ad364e35"
language="neutral" versionScope="nonSxS">
  <AutoLogon>
    <Enabled>>false</Enabled> 2
  </AutoLogon>
  <OOBE>
    <HideEULAPage>>true</HideEULAPage>
    <HideLocalAccountScreen>true</HideLocalAccountScreen>
    <HideOEMRegistrationScreen>true</HideOEMRegistrationScreen>
    <HideOnlineAccountScreens>true</HideOnlineAccountScreens>
    <HideWirelessSetupInOOBE>true</HideWirelessSetupInOOBE>
    <NetworkLocation>Work</NetworkLocation>
    <ProtectYourPC>1</ProtectYourPC>
    <SkipMachineOOBE>true</SkipMachineOOBE>
    <SkipUserOOBE>true</SkipUserOOBE>
  </OOBE>
  <RegisteredOrganization>Organization</RegisteredOrganization>
  <RegisteredOwner>Owner</RegisteredOwner>
  <DisableAutoDaylightTimeSet>>false</DisableAutoDaylightTimeSet>
  <TimeZone>Eastern Standard Time</TimeZone>
  <UserAccounts>
    <AdministratorPassword>
      <Value>MyPassword</Value> 3
      <PlainText>true</PlainText>
    </AdministratorPassword>
  </UserAccounts>
</component>
</settings>
</unattend>

```

- 1 Specify the **ComputerName**, which must follow the [Kubernetes' names specification](#). These specifications also apply to Guest OS customization performed on the resulting template while creating new VMs.
- 2 Disable the automatic logon to avoid the security issue of leaving an open terminal with Administrator privileges at boot. This is the default value and must not be changed.

- 3 Replace the **MyPassword** placeholder with the password for the Administrator account. This prevents the built-in Administrator account from having a blank password

After the Sysprep tool has completed, the Windows VM will power off. You must not use or power on this VM anymore.

10. Convert the Windows VM to [a template in vCenter](#).

5.3.2.1.1. Additional resources

- [Configuring a secret for the Windows Machine Config Operator](#)

5.3.2.2. Enabling communication with the internal API server for the WMCO on vSphere

The Windows Machine Config Operator (WMCO) downloads the Ignition config files from the internal API server endpoint. You must enable communication with the internal API server so that your Windows virtual machine (VM) can download the Ignition config files, and the kubelet on the configured VM can only communicate with the internal API server.

Prerequisites

- You have installed a cluster on vSphere.

Procedure

- Add a new DNS entry for **api-int.<cluster_name>.<base_domain>** that points to the external API server URL **api.<cluster_name>.<base_domain>**. This can be a CNAME or an additional A record.



NOTE

The external API endpoint was already created as part of the initial cluster installation on vSphere.

5.3.3. Sample YAML for a Windows MachineSet object on vSphere

This sample YAML defines a Windows **MachineSet** object running on VMware vSphere that the Windows Machine Config Operator (WMCO) can react upon.

```
apiVersion: machine.openshift.io/v1beta1
kind: MachineSet
metadata:
  labels:
    machine.openshift.io/cluster-api-cluster: <infrastructure_id> 1
  name: <windows_machine_set_name> 2
  namespace: openshift-machine-api
spec:
  replicas: 1
  selector:
    matchLabels:
      machine.openshift.io/cluster-api-cluster: <infrastructure_id> 3
      machine.openshift.io/cluster-api-machineset: <windows_machine_set_name> 4
```

```

template:
  metadata:
    labels:
      machine.openshift.io/cluster-api-cluster: <infrastructure_id> 5
      machine.openshift.io/cluster-api-machine-role: worker
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: <windows_machine_set_name> 6
      machine.openshift.io/os-id: Windows 7
  spec:
    metadata:
      labels:
        node-role.kubernetes.io/worker: "" 8
    providerSpec:
      value:
        apiVersion: vsphereprovider.openshift.io/v1beta1
        credentialsSecret:
          name: vsphere-cloud-credentials
        diskGiB: 128 9
        kind: VSphereMachineProviderSpec
        memoryMiB: 16384
        network:
          devices:
            - networkName: "<vm_network_name>" 10
        numCPUs: 4
        numCoresPerSocket: 1
        snapshot: ""
        template: <windows_vm_template_name> 11
        userDataSecret:
          name: windows-user-data 12
        workspace:
          datacenter: <vcenter_datacenter_name> 13
          datastore: <vcenter_datastore_name> 14
          folder: <vcenter_vm_folder_path> 15
          resourcePool: <vsphere_resource_pool> 16
          server: <vcenter_server_ip> 17

```

- 1 3 5** Specify the infrastructure ID that is based on the cluster ID that you set when you provisioned the cluster. You can obtain the infrastructure ID by running the following command:

```
$ oc get -o jsonpath='{.status.infrastructureName}' infrastructure cluster
```

- 2 4 6** Specify the Windows machine set name. The machine set name cannot be more than 9 characters long, due to the way machine names are generated in vSphere.
- 7** Configure the machine set as a Windows machine.
- 8** Configure the Windows node as a compute machine.
- 9** Specify the size of the vSphere Virtual Machine Disk (VMDK).

**NOTE**

This parameter does not set the size of the Windows partition. You can resize the Windows partition by using the **unattend.xml** file or by creating the vSphere Windows virtual machine (VM) golden image with the required disk size.

- 10 Specify the vSphere VM network to deploy the machine set to. This VM network must be where other Linux compute machines reside in the cluster.
- 11 Specify the full path of the Windows vSphere VM template to use, such as **golden-images/windows-server-template**. The name must be unique.

**IMPORTANT**

Do not specify the original VM template. The VM template must remain off and must be cloned for new Windows machines. Starting the VM template configures the VM template as a VM on the platform, which prevents it from being used as a template that machine sets can apply configurations to.

- 12 The **windows-user-data** is created by the WMCO when the first Windows machine is configured. After that, the **windows-user-data** is available for all subsequent machine sets to consume.
- 13 Specify the vCenter Datacenter to deploy the machine set on.
- 14 Specify the vCenter Datastore to deploy the machine set on.
- 15 Specify the path to the vSphere VM folder in vCenter, such as **/dc1/vm/user-inst-5ddjd**.
- 16 Optional: Specify the vSphere resource pool for your Windows VMs.
- 17 Specify the vCenter server IP or fully qualified domain name.

5.3.4. Creating a machine set

In addition to the ones created by the installation program, you can create your own machine sets to dynamically manage the machine compute resources for specific workloads of your choice.

Prerequisites

- Deploy an OpenShift Container Platform cluster.
- Install the OpenShift CLI (**oc**).
- Log in to **oc** as a user with **cluster-admin** permission.

Procedure

1. Create a new YAML file that contains the machine set custom resource (CR) sample and is named **<file_name>.yaml**.
Ensure that you set the **<clusterID>** and **<role>** parameter values.
 - a. If you are not sure which value to set for a specific field, you can check an existing machine set from your cluster:

```
$ oc get machinesets -n openshift-machine-api
```

Example output

```
NAME                                DESIRED  CURRENT  READY  AVAILABLE  AGE
agl030519-vplxk-worker-us-east-1a  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1b  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1c  1        1        1      1          55m
agl030519-vplxk-worker-us-east-1d  0        0                55m
agl030519-vplxk-worker-us-east-1e  0        0                55m
agl030519-vplxk-worker-us-east-1f  0        0                55m
```

- b. Check values of a specific machine set:

```
$ oc get machineset <machineset_name> -n \
  openshift-machine-api -o yaml
```

Example output

```
...
template:
  metadata:
    labels:
      machine.openshift.io/cluster-api-cluster: agl030519-vplxk 1
      machine.openshift.io/cluster-api-machine-role: worker 2
      machine.openshift.io/cluster-api-machine-type: worker
      machine.openshift.io/cluster-api-machineset: agl030519-vplxk-worker-us-east-1a
```

1 The cluster ID.

2 A default node label.

2. Create the new **MachineSet** CR:

```
$ oc create -f <file_name>.yaml
```

3. View the list of machine sets:

```
$ oc get machineset -n openshift-machine-api
```

Example output

```
NAME                                DESIRED  CURRENT  READY  AVAILABLE  AGE
agl030519-vplxk-windows-worker-us-east-1a  1        1        1      1          11m
agl030519-vplxk-worker-us-east-1a         1        1        1      1          55m
agl030519-vplxk-worker-us-east-1b         1        1        1      1          55m
agl030519-vplxk-worker-us-east-1c         1        1        1      1          55m
agl030519-vplxk-worker-us-east-1d         0        0                55m
agl030519-vplxk-worker-us-east-1e         0        0                55m
agl030519-vplxk-worker-us-east-1f         0        0                55m
```

When the new machine set is available, the **DESIRED** and **CURRENT** values match. If the machine set is not available, wait a few minutes and run the command again.

5.3.5. Additional resources

- For more information on managing machine sets, see the *Machine management* section.

CHAPTER 6. SCHEDULING WINDOWS CONTAINER WORKLOADS

You can schedule Windows workloads to Windows compute nodes.



NOTE

The WMCO is not supported in clusters that use a [cluster-wide proxy](#) because the WMCO is not able to route traffic through the proxy connection for the workloads.

Prerequisites

- You installed the Windows Machine Config Operator (WMCO) using Operator Lifecycle Manager (OLM).
- You are using a Windows container as the OS image with the Docker-formatted container runtime add-on enabled.
- You have created a Windows machine set.



IMPORTANT

Currently, the Docker-formatted container runtime is used in Windows nodes. Kubernetes is deprecating Docker as a container runtime; you can reference the Kubernetes documentation for more information in [Docker deprecation](#). Containerd will be the new supported container runtime for Windows nodes in a future release of Kubernetes.

6.1. WINDOWS POD PLACEMENT

Before deploying your Windows workloads to the cluster, you must configure your Windows node scheduling so pods are assigned correctly. Since you have a machine hosting your Windows node, it is managed the same as a Linux-based node. Likewise, scheduling a Windows pod to the appropriate Windows node is completed similarly, using mechanisms like taints, tolerations, and node selectors.

With multiple operating systems, and the ability to run multiple Windows OS variants in the same cluster, you must map your Windows pods to a base Windows OS variant by using a **RuntimeClass** object. For example, if you have multiple Windows nodes running on different Windows Server container versions, the cluster could schedule your Windows pods to an incompatible Windows OS variant. You must have **RuntimeClass** objects configured for each Windows OS variant on your cluster. Using a **RuntimeClass** object is also recommended if you have only one Windows OS variant available in your cluster.

For more information, see Microsoft's documentation on [Host and container version compatibility](#).



IMPORTANT

The container base image must be the same Windows OS version and build number that is running on the node where the container is to be scheduled.

Also, if you upgrade the Windows nodes from one version to another, for example going from 20H2 to 2022, you must upgrade your container base image to match the new version. For more information, see [Windows container version compatibility](#).

Additional resources

- [Controlling pod placement using the scheduler](#)
- [Controlling pod placement using node taints](#)
- [Placing pods on specific nodes using node selectors](#)

6.2. CREATING A RUNTIMECLASS OBJECT TO ENCAPSULATE SCHEDULING MECHANISMS

Using a **RuntimeClass** object simplifies the use of scheduling mechanisms like taints and tolerations; you deploy a runtime class that encapsulates your taints and tolerations and then apply it to your pods to schedule them to the appropriate node. Creating a runtime class is also necessary in clusters that support multiple operating system variants.

Procedure

1. Create a **RuntimeClass** object YAML file. For example, **runtime-class.yaml**:

```
apiVersion: node.k8s.io/v1beta1
kind: RuntimeClass
metadata:
  name: <runtime_class_name> 1
handler: 'docker'
scheduling:
  nodeSelector: 2
    kubernetes.io/os: 'windows'
    kubernetes.io/arch: 'amd64'
    node.kubernetes.io/windows-build: '10.0.17763'
  tolerations: 3
    - effect: NoSchedule
      key: os
      operator: Equal
      value: "Windows"
```

- 1 Specify the **RuntimeClass** object name, which is defined in the pods you want to be managed by this runtime class.
- 2 Specify labels that must be present on nodes that support this runtime class. Pods using this runtime class can only be scheduled to a node matched by this selector. The node selector of the runtime class is merged with the existing node selector of the pod. Any conflicts prevent the pod from being scheduled to the node.
- 3 Specify tolerations to append to pods, excluding duplicates, running with this runtime class during admission. This combines the set of nodes tolerated by the pod and the runtime class.

2. Create the **RuntimeClass** object:

```
$ oc create -f <file-name>.yaml
```

For example:

```
$ oc create -f runtime-class.yaml
```

3. Apply the **RuntimeClass** object to your pod to ensure it is scheduled to the appropriate operating system variant:

```

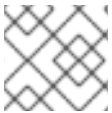
apiVersion: v1
kind: Pod
metadata:
  name: my-windows-pod
spec:
  runtimeClassName: <runtime_class_name> 1
  ...

```

- 1 Specify the runtime class to manage the scheduling of your pod.

6.3. SAMPLE WINDOWS CONTAINER WORKLOAD DEPLOYMENT

You can deploy Windows container workloads to your cluster once you have a Windows compute node available.



NOTE

This sample deployment is provided for reference only.

Example Service object

```

apiVersion: v1
kind: Service
metadata:
  name: win-webserver
labels:
  app: win-webserver
spec:
  ports:
    # the port that this service should serve on
    - port: 80
      targetPort: 80
  selector:
    app: win-webserver
  type: LoadBalancer

```

Example Deployment object

```

apiVersion: apps/v1
kind: Deployment
metadata:
  labels:
    app: win-webserver
  name: win-webserver
spec:
  selector:
    matchLabels:
      app: win-webserver
  replicas: 1

```



```

template:
  metadata:
    labels:
      app: win-webserver
      name: win-webserver
  spec:
    tolerations:
      - key: "os"
        value: "Windows"
        Effect: "NoSchedule"
    containers:
      - name: windowswebserver
        image: mcr.microsoft.com/windows/servercore:ltsc2019
        imagePullPolicy: IfNotPresent
        command:
          - powershell.exe
          - -command
            - $listener = New-Object System.Net.HttpListener; $listener.Prefixes.Add("http://*:80/");
              $listener.Start();Write-Host('Listening at http://*:80/'); while ($listener.IsListening) { $context =
                $listener.GetContext(); $response = $context.Response; $content='<html><body><H1>Red Hat
                OpenShift + Windows Container Workloads</H1></body></html>'; $buffer =
                [System.Text.Encoding]::UTF8.GetBytes($content); $response.ContentLength64 = $buffer.Length;
                $response.OutputStream.Write($buffer, 0, $buffer.Length); $response.Close(); };
        securityContext:
          runAsNonRoot: false
          windowsOptions:
            runAsUserName: "ContainerAdministrator"
        nodeSelector:
          kubernetes.io/os: windows

```



NOTE

When using the **mcr.microsoft.com/powershell:<tag>** container image, you must define the command as **pwsh.exe**. If you are using the **mcr.microsoft.com/windows/servercore:<tag>** container image, you must define the command as **powershell.exe**. For more information, see Microsoft's documentation.

6.4. SCALING A MACHINE SET MANUALLY

To add or remove an instance of a machine in a machine set, you can manually scale the machine set.

This guidance is relevant to fully automated, installer-provisioned infrastructure installations. Customized, user-provisioned infrastructure installations do not have machine sets.

Prerequisites

- Install an OpenShift Container Platform cluster and the **oc** command line.
- Log in to **oc** as a user with **cluster-admin** permission.

Procedure

1. View the machine sets that are in the cluster:

```
$ oc get machinesets -n openshift-machine-api
```

The machine sets are listed in the form of **<clusterid>-worker-<aws-region-az>**.

2. View the machines that are in the cluster:

```
$ oc get machine -n openshift-machine-api
```

3. Set the annotation on the machine that you want to delete:

```
$ oc annotate machine/<machine_name> -n openshift-machine-api  
machine.openshift.io/cluster-api-delete-machine="true"
```

4. Cordon and drain the node that you want to delete:

```
$ oc adm cordon <node_name>  
$ oc adm drain <node_name>
```

5. Scale the machine set:

```
$ oc scale --replicas=2 machineset <machineset> -n openshift-machine-api
```

Or:

```
$ oc edit machineset <machineset> -n openshift-machine-api
```

You can scale the machine set up or down. It takes several minutes for the new machines to be available.

Verification

- Verify the deletion of the intended machine:

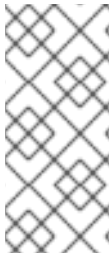
```
$ oc get machines
```

CHAPTER 7. WINDOWS NODE UPGRADES

You can ensure your Windows nodes have the latest updates by upgrading the Windows Machine Config Operator (WMCO).

7.1. WINDOWS MACHINE CONFIG OPERATOR UPGRADES

When a new version of the Windows Machine Config Operator (WMCO) is released that is compatible with the current cluster version, the Operator is upgraded based on the upgrade channel and subscription approval strategy it was installed with when using the Operator Lifecycle Manager (OLM). The WMCO upgrade results in the Kubernetes components in the Windows machine being upgraded.



NOTE

If you are upgrading to a new version of the WMCO and want to use cluster monitoring, you must have the **openshift.io/cluster-monitoring=true** label present in the WMCO namespace. If you add the label to a pre-existing WMCO namespace, and there are already Windows nodes configured, restart the WMCO pod to allow monitoring graphs to display.

For a non-disruptive upgrade, the WMCO terminates the Windows machines configured by the previous version of the WMCO and recreates them using the current version. This is done by deleting the **Machine** object, which results in the drain and deletion of the Windows node. To facilitate an upgrade, the WMCO adds a version annotation to all the configured nodes. During an upgrade, a mismatch in version annotation results in the deletion and recreation of a Windows machine. To have minimal service disruptions during an upgrade, the WMCO only updates one Windows machine at a time.



IMPORTANT

The WMCO is only responsible for updating Kubernetes components, not for Windows operating system updates. You provide the Windows image when creating the VMs; therefore, you are responsible for providing an updated image. You can provide an updated Windows image by changing the image configuration in the **MachineSet** spec.

For more information on Operator upgrades using the Operator Lifecycle Manager (OLM), see [Upgrading installed Operators](#).

CHAPTER 8. REMOVING WINDOWS NODES

You can remove a Windows node by deleting its host Windows machine.

8.1. DELETING A SPECIFIC MACHINE

You can delete a specific machine.



NOTE

You cannot delete a control plane machine.

Prerequisites

- Install an OpenShift Container Platform cluster.
- Install the OpenShift CLI (**oc**).
- Log in to **oc** as a user with **cluster-admin** permission.

Procedure

1. View the machines that are in the cluster and identify the one to delete:

```
$ oc get machine -n openshift-machine-api
```

The command output contains a list of machines in the **<clusterid>-worker-<cloud_region>** format.

2. Delete the machine:

```
$ oc delete machine <machine> -n openshift-machine-api
```



IMPORTANT

By default, the machine controller tries to drain the node that is backed by the machine until it succeeds. In some situations, such as with a misconfigured pod disruption budget, the drain operation might not be able to succeed in preventing the machine from being deleted. You can skip draining the node by annotating "machine.openshift.io/exclude-node-draining" in a specific machine. If the machine being deleted belongs to a machine set, a new machine is immediately created to satisfy the specified number of replicas.

CHAPTER 9. DISABLING WINDOWS CONTAINER WORKLOADS

You can disable the capability to run Windows container workloads by uninstalling the Windows Machine Config Operator (WMCO) and deleting the namespace that was added by default when you installed the WMCO.

9.1. UNINSTALLING THE WINDOWS MACHINE CONFIG OPERATOR

You can uninstall the Windows Machine Config Operator (WMCO) from your cluster.

Prerequisites

- Delete the Windows **Machine** objects hosting your Windows workloads.

Procedure

1. From the **Operators → OperatorHub** page, use the **Filter by keyword** box to search for **Red Hat Windows Machine Config Operator**.
2. Click the **Red Hat Windows Machine Config Operator** tile. The Operator tile indicates it is installed.
3. In the **Windows Machine Config Operator** descriptor page, click **Uninstall**.

9.2. DELETING THE WINDOWS MACHINE CONFIG OPERATOR NAMESPACE

You can delete the namespace that was generated for the Windows Machine Config Operator (WMCO) by default.

Prerequisites

- The WMCO is removed from your cluster.

Procedure

1. Remove all Windows workloads that were created in the **openshift-windows-machine-config-operator** namespace:

```
$ oc delete --all pods --namespace=openshift-windows-machine-config-operator
```

2. Verify that all pods in the **openshift-windows-machine-config-operator** namespace are deleted or are reporting a terminating state:

```
$ oc get pods --namespace openshift-windows-machine-config-operator
```

3. Delete the **openshift-windows-machine-config-operator** namespace:

```
$ oc delete namespace openshift-windows-machine-config-operator
```

Additional resources

- [Deleting Operators from a cluster](#)
- [Removing Windows nodes.](#)