VMware vSphere Integrated Containers Engine Installation

vSphere Integrated Containers Engine 0.7.0

vmware

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vSphere Integrated Containers Engine Installation

vSphere Integrated Containers Engine Installation provides information about how to install and configure VMware vSphere® Integrated Containers™ Engine.

Product version: 0.7.0

NOTE This book is a work in progress.

Intended Audience

This information is intended for anyone who wants to install, configure, and get started with using vSphere Integrated Containers Engine. The information is written for experienced VMware vSphere® administrators who are familiar with virtual machine technology and datacenter operations. Knowledge of container technology and Docker is assumed.

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Overview of vSphere Integrated Containers Engine for vSphere Administrators

vSphere Integrated Containers Engine provides developers the portability, speed, and agility of using enterprise-class containers, and provide IT Ops the management, security, and visibility they require to run workloads in production.

vSphere Integrated Containers Engine enables IT teams to run traditional and container workloads side-by-side on existing infrastructure seamlessly.

Using constructs from the Open Container Initiative to map Docker containers to vSphere infrastructure, vSphere Integrated Containers Engine containers are provisioned as virtual machines, offering the same security and functionality of virtual machines in VMware ESXi™ hosts or VMware vCenter Server® instances.

A virtual container host is compatible with standard Docker client tools and backed by a pool of resources to accommodate applications.

From a developer's perspective, vSphere Integrated Containers Engine is a seamless Docker interface for containers with a vSphere back end. Developers can deploy, test, and run container processes faster in the same environment as traditional applications.

You install vSphere Integrated Containers Engine by using a command line installer, `vic-machine`, that deploys virtual container hosts to ESXi hosts or vCenter Server. You connect Docker clients to the virtual container hosts and use the Docker clients to work with containers. You use your vSphere environment to manage the container VMs and container images.

Comparing vSphere Integrated Containers Engine and Traditional Container Hosts

vSphere Integrated Containers Engine provisions containers as virtual machines, rather than in virtual machines.

Traditional Container Host

A traditional container host is a virtual machine running a Linux OS with the necessary libraries, kernel version, and daemon installed. The container host has a fixed amount of memory and vCPU resource used by the containers provisioned into it.

The hypervisor provides hardware virtualization of the entire container host VM, one or more VMDKs providing local disk for the OS, one or more vNICs to provide network connectivity for the OS and possibly paravirtualization capabilities allowing the containers to directly access hypervisor infrastructure.

vSphere Integrated Containers Engine Virtual Container Host

vSphere Integrated Containers Engine containers run as virtual machines. The virtual container host is not a VM, but a vApp, which is a kind of resource pool. It is an abstract dynamic resource boundary defined and controlled by vSphere into which you can provision container VMs. The virtual container host can be a subset of a physical host or a subset of a cluster of hosts.

A one to one coupling exists between a container and a virtual machine. A container image is attached to the VM as a disk, the VM is either booted or forked from the kernel ISO, then the containerVM chroots into the container filesystem, effectively becoming the container.

Virtual Container Host Deployment and Management

vSphere Integrated Containers Engine provides a command-line utility, `vic-machine`, that you use to deploy and manage virtual container hosts. The different commands of the vic-machine utility allow you to perform the following actions:

- Deploy virtual container hosts in configurations that are tailored to your vSphere and container development environments.
- List the virtual container hosts that are running on a particular ESXi host or vCenter Server instance.
- Inspect, delete, debug, and upgrade running virtual container hosts.

The Port Layer

The port layer augments the vSphere API with low level, platform-specific primitives to allow you to implement a simple container engine:

- Port Layer Execution: Handles container management, such as create, start, and stop.
- Port Layer Interaction: Handles interaction with a running container.
- Port Layer Networking: Handles specific vSphere network mappings into the Docker network namespace as well as mapping existing network entities such as database servers into the Docker container namespace with defined aliases.
- Port Layer Storage: Provides storage manipulation, including container image storage, layering with volume creation and manipulation. imagec, the docker registry client library, uses this component to translate registry images into a layered format that VMDK disk chains can use directly.

Tether Process

The tether process is a minimal agent in the container VM that starts and stops processes and provides monitoring statistics.

Contents of the vSphere Integrated Containers Engine Binaries

After you download and unpack a vSphere Integrated Containers Engine binary bundle, you obtain following files:

File	Description
`appliance.iso`	The ISO from which a virtual container host appliance boots.
`bootstrap.iso`	A Photon OS kernel from which container VMs boot.
`ui/`	A folder that contains the files and scripts for the deployment of the vSphere Web Client Plug-in for vSphere Integrated Containers Engine.
`vic-machine-darwin`	The Mac OS command line utility for the installation and management of virtual container hosts.
`vic-machine-linux`	The Linux command line utility for the installation and management of virtual container hosts.
`vic-machine-windows.exe`	The Windows command line utility for the installation and management of virtual container hosts.
`vic-ui-darwin`	The Mac OS executable for the deployment of the vSphere Web Client Plug-in for vSphere Integrated Containers Engine. **NOTE**: Do not run this executable directly.(1)
`vic-ui-linux`	The Linux executable for the deployment of the vSphere Web Client Plug-in for vSphere Integrated Containers Engine. **NOTE**: Do not run this executable directly.(1)
`vic-ui-windows.exe`	The Windows executable for the deployment of the vSphere Web Client Plug-in for vSphere Integrated Containers Engine. **NOTE**: Do not run this executable directly.(1)
`README`	Contains a link to the vSphere Integrated Containers Engine repository on GitHub.
`LICENSE`	The license file for vSphere Integrated Containers Engine

If you build the vSphere Integrated Containers Engine binaries manually, you find the ISO files and the `vic_machine` utility in the `<git_installation_dir>/vic/bin` folder.

(1) For information about how to install the vSphere Integrated Containers Engine client plug-in, see Installing the vSphere Web Client Plug-in for vSphere Integrated Containers Engine.

Environment Prerequisites for vSphere Integrated Containers Engine Installation

Before you install vSphere Integrated Containers Engine, you must ensure that your infrastructure meets certain requirements.

Supported Platforms for `vic-machine`

The vSphere Integrated Containers Engine installation and management utility, `vic-machine`, has been tested and verified on the following 64-bit OS, Windows, Mac OS, and Photon OS systems.

Platform	Supported Versions
Windows	7, 10
Mac OS X	10.11 (El Capitan)
Linux	Ubuntu 16.04 LTS

Other recent 64-bit OS versions should work but are untested.

Supported vSphere Configurations

You can install vSphere Integrated Containers Engine in the following vSphere setups:

- Standalone ESXi 6.0 host that is not managed by a vCenter Server instance.
- vCenter Server 6.0, managing one or more standalone ESXi 6.0 hosts.
- vCenter Server 6.0, managing a cluster of ESXi 6.0 hosts, with VMware vSphere Distributed Resource Scheduler™ (DRS) enabled.

Caveats and limitations:

- Deploying vSphere Integrated Containers Engine to vSphere 5.5 environments works but is unsupported.
- Deploying vSphere Integrated Containers Engine to a nested ESXi host, namely ESXi running in a virtual machine, is not supported in production environments. Deploying vSphere Integrated Containers Engine to a nested ESXi host is acceptable for testing purposes only.
- Deploying vSphere Integrated Containers Engine to a vCenter Server instance that is running in Enhanced Linked Mode is fully supported.

ESXi Host Requirements

To be valid targets for virtual container hosts and container VMs, standalone ESXi hosts and all ESXi hosts in vCenter Server clusters must meet the following criteria:

- In vCenter Server clusters, at least two ESXi hosts must be attached to shared storage for use as container stores, image stores, and volume stores. Using non-shared datastores is possible, but limits the use of vSphere features such as DRS and High Availability. The use of VMware vSAN™ datastores is fully supported.
- The firewall on all ESXi hosts must be configured to allow connections on the back channel and to allow outbound connections on port 2377. For instruction about how to open port 2377 on ESXi hosts, see VCH Deployment Fails with Firewall Validation Error.

- All ESXi hosts must be attached to the distributed virtual switch for the bridge network in vCenter Server. For more information about distributed virtual switches, see Network Requirements below.
- All ESXi hosts must be attached to any mapped vSphere networks.

During deployment of virtual container hosts, the `vic-machine` utilty checks that the target ESXi hosts meet the requirements, and issues warnings if they do not.

License Requirements

The type of license that vSphere Integrated Containers Engine requires depends on the way in which you deploy the software.

Type of Installation	vSphere Feature Used	Required License
ESXi host	Network Serial Port	vSphere Enterprise
vCenter Server	Distributed Virtual Switch	vSphere Enterprise Plus

All of the ESXi hosts in a cluster require an appropriate license. Installation fails if your environment includes one or more ESXi hosts that have inadequate licenses.

Role and Permissions Requirements

You must use an account with the vSphere Administrator role when you install vSphere Integrated Containers Engine.

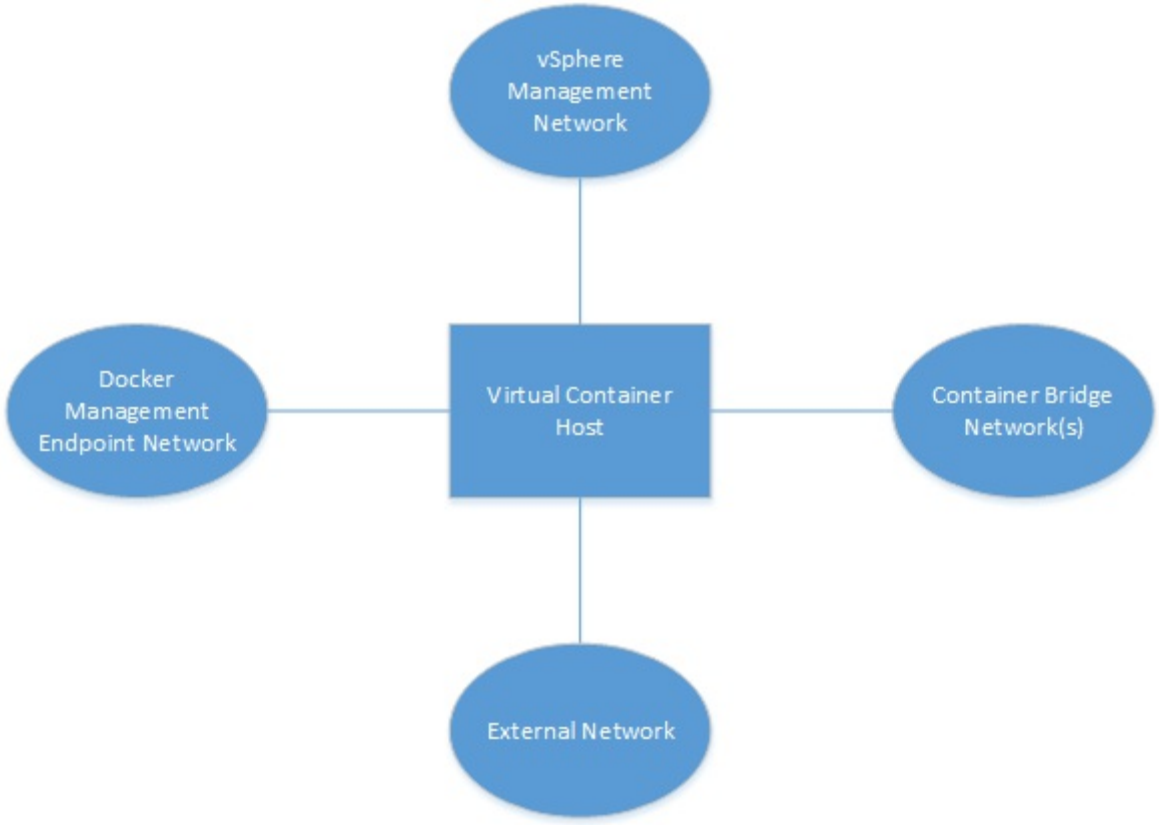
Network Requirements

- Use a trusted network for the deployment and use of vSphere Integrated Containers Engine.
- Use a trusted network for connections between Docker clients and the virtual container hosts.
- Each virtual container host requires the following network configuration:
  - An IP address that can be either static or obtained by DHCP.
  - A network for use as the external network. You can share this network between multiple virtual container hosts.
- In vCenter Server environment, before you deploy a virtual container host, you must create a bridge network for use by container VMs.
  - Create a distributed virtual switch with a distributed port group for each virtual container host, for use as the bridge network. You can create multiple port groups on the same distributed virtual switch, but each virtual container host requires its own port group. For information about how to create a distributed virtual switch and a distributed port group, see Create a vSphere Distributed Switch in the vSphere 6.0 documentation.
  - Add the target ESXi host or hosts to the distributed virtual switch. For information about how to add hosts to a distributed virtual switch, see Add Hosts to a vSphere Distributed Switch in the vSphere 6.0 documentation.
  - If you are not using private VLANs, assign a VLAN ID to the port group, to ensure that the bridge network is isolated. For information about how to assign a VLAN ID to a port group, see VMware KB 1003825. For more information about private VLAN, see VMware KB 1010691.

Networks Used by vSphere Integrated Containers Engine

You can configure networks that are tied into the vSphere infrastructure. Pre-configured networks available to a virtual container host are determined by the networks that you define when you configure the virtual container host.

Virtual container hosts connect to different types of network.



This topic provides an overview of the different network types.

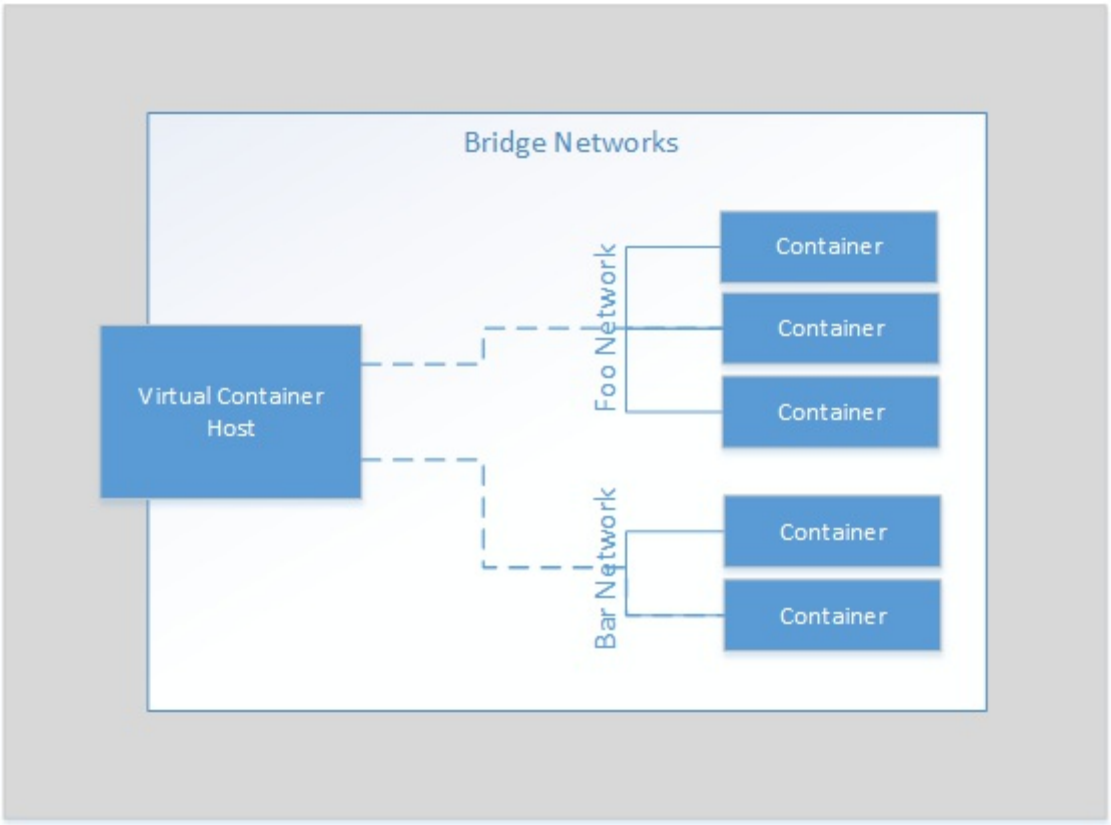
IMPORTANT: A virtual container host supports a maximum of 3 distinct networks. Because the bridge and container networks require their own distributed port groups, at least two of the external, client, and management networks must share a network.

Container Bridge Networks

The network or networks that container VMs use to communicate with each other. Each virtual container host requires a unique bridge network.

You define the bridge networks by setting the `bridge-network` option when you run `vic-machine create`. For more detailed information about bridge networks, see the section on the `bridge-network` option in Virtual Container Host Deployment Options.

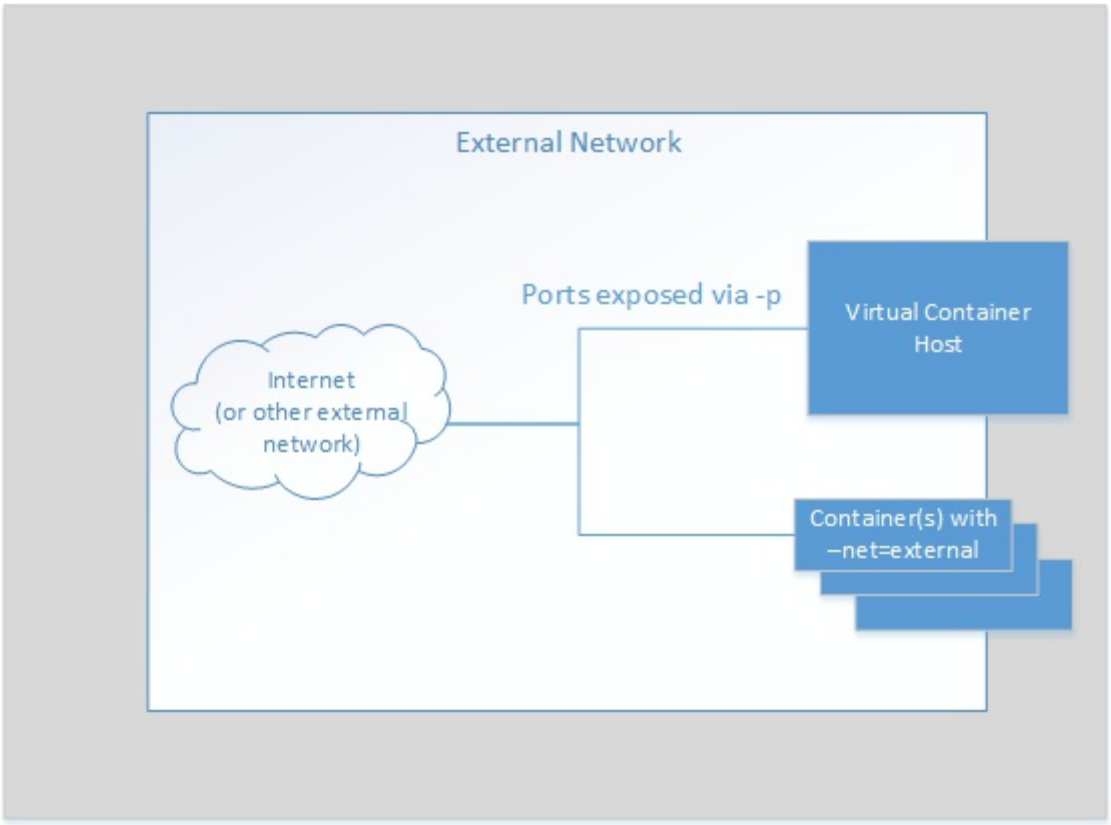
Container application developers can also use `docker network create` to create additional bridge networks. You can define a range of IP addresses that additional bridge networks can use by defining the `bridge-network-range` option when you run `vic-machine create`. For more detailed information about how to set bridge network ranges, see the section on the `bridge-network-range` option.



External Network

The network that container VMs use to connect to the internet. Containers can use this external network to publish network services. After defining the external network, you can deploy containers directly on the external interface.

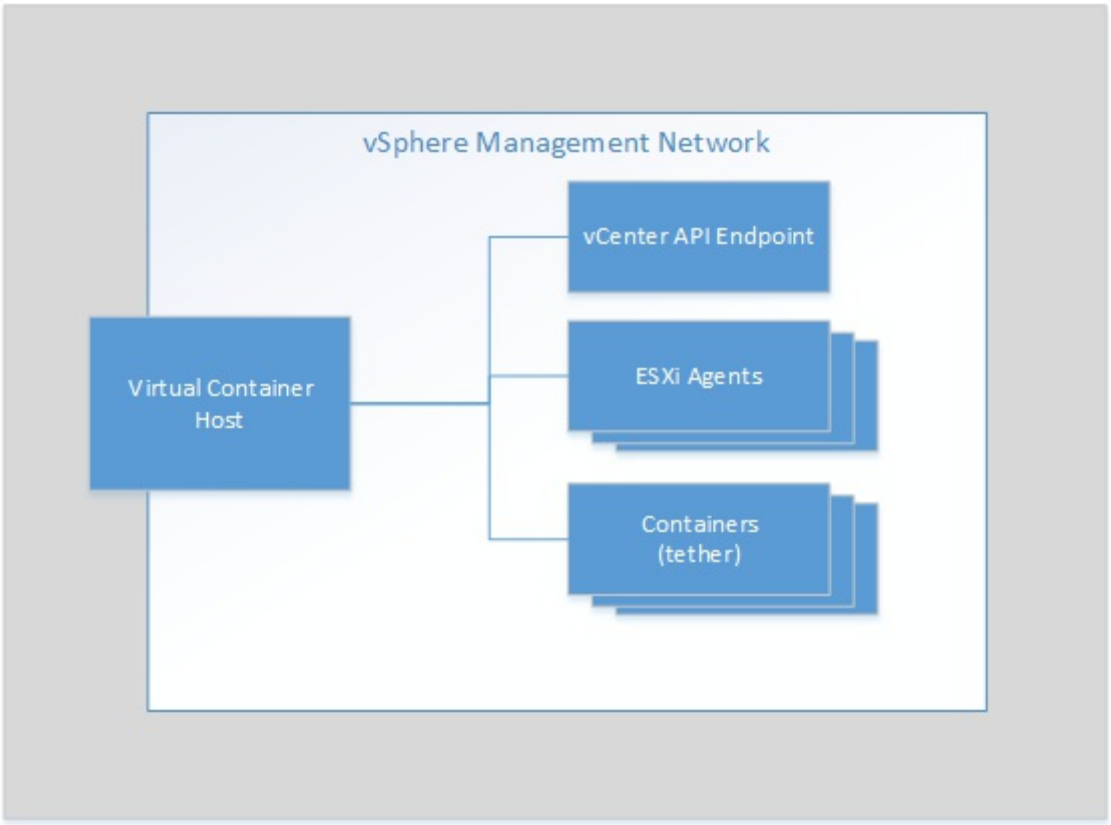
You define the external network by setting the `external-network` option when you run `vic-machine create`. For more detailed information about management networks, see the section on the `external-network` option in Virtual Container Host Deployment Options.



vSphere Management Network

The network for communication between the virtual container host and vCenter Server and ESXi hosts. This network also serves as a tether within container VMs for communication with the virtual container host.

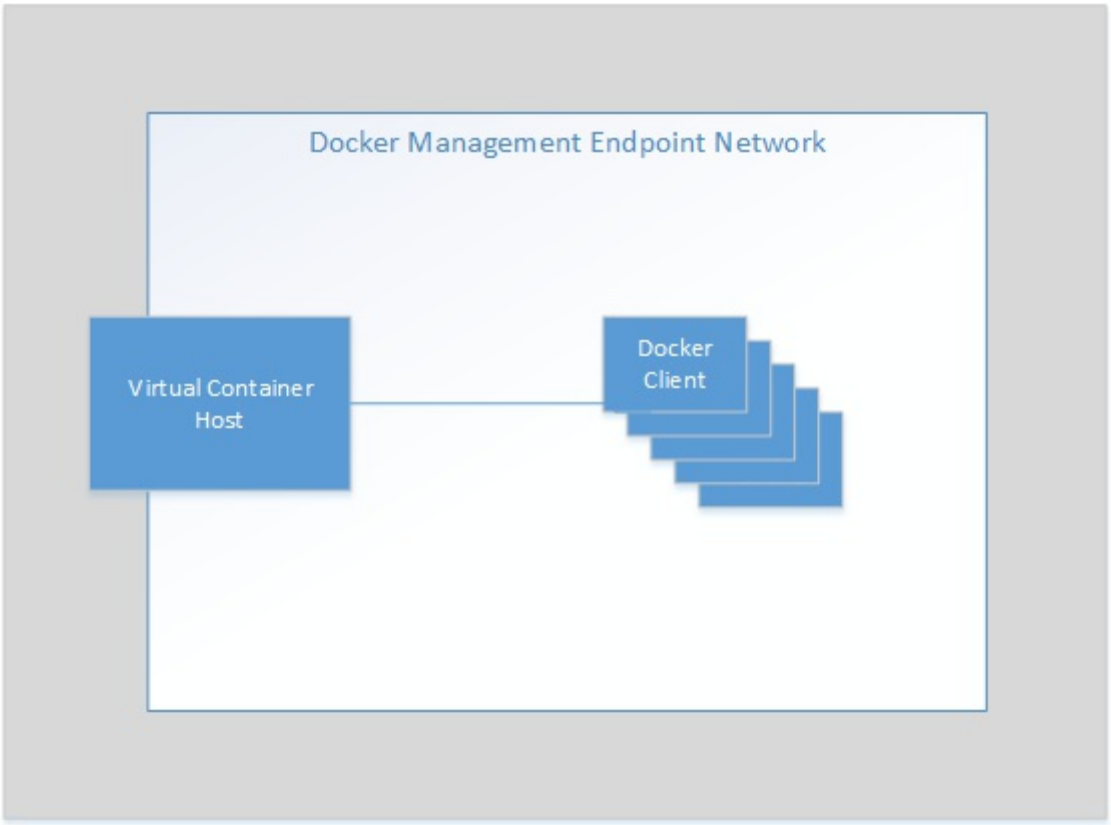
You define the management network by setting the `management-network` option when you run `vic-machine create`. For more detailed information about management networks, see the section on the `management-network` option in Virtual Container Host Deployment Options.



Docker Management Endpoint Network

Connects virtual container hosts to Docker clients and isolates the Docker endpoints from the more public external network.

You define the Docker management endpoint network by setting the `client-network` option when you run `vic-machine create`. For more detailed information about Docker management endpoint networks, see the section on the `client-network` option in Virtual Container Host Deployment Options.



Container Networks

Networks for container VMs to use for external communication when container developers run `docker run` or `docker create` with the `--net` option. For more detailed information about setting up container networks, see the sections on the `container-network-xxx` options in Virtual Container Host Deployment Options.

Deploy a Virtual Container Host

You install vSphere Integrated Containers Engine by deploying a vSphere Integrated Containers Engine virtual container host. You use the `vic-machine create` command to deploy a virtual container host.

The `vic-machine` utility can deploy a virtual container host in one of the following setups:

- vCenter Server with a cluster
- vCenter Server with one or more standalone ESXi hosts
- A standalone ESXi host

When you deploy a virtual container host, `vic-machine` registers the virtual container host as a vSphere extension. Authentication between the virtual container host and vSphere is handled via key pair authentication against the vSphere extension.

The virtual container host allows you to use an ESXi host or vCenter Server instance as the Docker endpoint for a Docker client. The containers that you pull or create by using your Docker client are stored and managed in the vSphere environment.

Prerequisites

- Verify that your vSphere infrastructure meets the requirements in Environment Prerequisites for vSphere Integrated Containers Engine Installation.
- In a vCenter Server environment, before you deploy a virtual container host, you must create a distributed virtual switch and a distributed port group for use as the bridge network for container VMs. For information about how to create a distributed virtual switch and port group, see *Network Requirements* in Environment Prerequisites for vSphere Integrated Containers Engine Installation.
- Obtain either a verified build, the latest daily build, or the source code of vSphere Integrated Containers Engine:
  - Download the most recent verified build of vSphere Integrated Containers Engine from https://github.com/vmware/vic/releases and unpack it. This version has been tested and approved, but it does not reflect the most up-to-date version of the code.
  - Download the latest daily build of vSphere Integrated Containers Engine from https://bintray.com/vmware/vic-repo/build/view#files and unpack it. This version reflects the version of the code as it was at the last daily build. It has not been tested or approved.
  - For the very latest version, for example to include changes that you have made since the last daily build, build the vSphere Integrated Containers Engine binaries from the source code.
- Add the folder that contains the vSphere Integrated Containers Engine binaries to the `PATH` environment variable on the machine on which you are running `vic-machine`.
- Familiarize yourself with the vSphere Integrated Containers Engine binaries, as described in Contents of the vSphere Integrated Containers Engine Binaries.
- Familiarize yourself with the options of the `create` command of the `vic-machine` utility described in Virtual Container Host Deployment Options.
- For examples of commands to deploy a virtual container host in various vSphere configurations, see Examples of Deploying a Virtual Container Host.

Procedure

1. Open a terminal on the system on which you downloaded and unpacked the vSphere Integrated Containers Engine binary bundle.
2. Navigate to the directory that contains the `vic-machine` utility:
   - If you downloaded the most recent verified build or the latest daily build, go to the location in which you unpacked the vSphere Integrated Containers Engine bundle.
   - If you built the vSphere Integrated Containers Engine binaries, go to `installation_dir/vic/bin`.

3. Run the `create` command of the `vic-machine` utility.

   The following examples include the fewest possible options for installation in a simple vCenter Server environment with a cluster. For simplicity, these examples assume that the vSphere environment uses trusted certificates signed by a known Certificate Authority (CA), so the `--thumbprint option` is not specified, and verification of client TLS certificates is disabled.

   Deploy a virtual container host from a Mac OS system:

   ```
   $ vic-machine-darwin create
   --target vcenter_server_address
   --image-store datastore_name
   --user username
   --bridge-network network_name
   --no-tlsverify
   ```

   Deploy a virtual container host from a Linux OS system:

   ```
   $ vic-machine-linux create
   --target vcenter_server_address
   --image-store datastore_name
   --user username
   --bridge-network network_name
   --no-tlsverify
   ```

   Deploy a virtual container host from a Windows system:

   ```
   $ vic-machine-windows create
   --target vcenter_server_address
   --image-store datastore_name
   --user username
   --bridge-network network_name
   --no-tlsverify
   ```

Result

At the end of a successful installation, `vic-machine` displays information about the new virtual container host:

```
Initialization of appliance successful
vic-admin portal:
https://vch_address:2378
Published ports can be reached at:
vch_address
Docker environment variables:
DOCKER_HOST=vch_address:2376
Environment saved in vch_name/vch_name.env
Connect to docker:
docker -H vch_address:2376 --tls info
Installer completed successfully
```

What to Do Next

If you did not explicitly disable TLS certificate generation by using the `no-tls` option, and if your Docker client is not on the same system as the one that you used to run `vic-machine`, you must copy all of the generated `*.pem` certificate files to the Docker client system.

To test your virtual container host, see Verify the Deployment of a Virtual Container Host.

Virtual Container Host Deployment Options

The command line utility for vSphere Integrated Containers Engine, `vic-machine`, provides a `create` command with options that allow you to customize the deployment of virtual container hosts to correspond to your vSphere environment.

- vSphere Target Options
- Security Options
- Datastore Options
- Networking Options
- Appliance Deployment Options

To allow you to fine-tune the deployment of virtual container hosts, `vic-machine create` provides Advanced Options.

- Advanced Security Options
- Options for Specifying a Static IP Address for the Virtual Container Host Endpoint VM
- Options for Configuring a Non-DHCP Network for Container Traffic
- Options to Configure Virtual Container Hosts to Use Proxy Servers
- Advanced Resource Management Options
- Other Advanced Options

vSphere Target Options

The `create` command of the `vic-machine` utility requires you to provide information about where in your vSphere environment to deploy the virtual container host and the vCenter Server or ESXi user account to use.

`--target`

Short name: `-t`

The IPv4 address, fully qualified domain name (FQDN), or URL of the ESXi host or vCenter Server instance on which you are deploying a virtual container host. This option is always **mandatory**.

To facilitate IP address changes in your infrastructure, provide an FQDN whenever possible, rather than an IP address.

- If the target ESXi host is not managed by vCenter Server, provide the address of the ESXi host.

  ```
  --target esxi_host_address
  ```

- If the target ESXi host is managed by vCenter Server, or if you are deploying to a cluster, provide the address of vCenter Server.

  ```
  --target vcenter_server_address
  ```

- You can include the user name and password in the target URL.

  ```
  --target vcenter_or_esxi_username:password@vcenter_or_esxi_address
  ```

  Wrap the user name or password in single quotes (Linux or Mac OS) or double quotes (Windows) if they include special characters.

```
'vcenter_or_esxi_usern@me':'p@ssword'@vcenter_or_esxi_address
```

If you do not include the user name in the target URL, you must specify the `user` option. If you do not specify the `password` option or include the password in the target URL, `vic-machine create` prompts you to enter the password.

- If you are deploying a virtual container host on a vCenter Server instance that includes more than one datacenter, include the datacenter name in the target URL. If you include an invalid datacenter name, `vic-machine create` fails and suggests the available datacenters that you can specify.

  ```
  --target vcenter_server_address/datacenter_name
  ```

  Wrap the datacenter name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

  ```
  --target vcenter_server_address/'datacenter name'
  ```

`--user`

Short name: `-u`

The username for the ESXi host or vCenter Server instance on which you are deploying a virtual container host.

If you are deploying a virtual container host on vCenter Server, specify a username for an account that has the Administrator role on that vCenter Server instance.

```
--user esxi_or_vcenter_server_username
```

Wrap the user name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes special characters.

```
--user 'esxi_or_vcenter_server_usern@me'
```

You can also specify the username in the URL that you pass to `vic-machine create` in the `target` option, in which case the `user` option is not required.

`--password`

Short name: `-p`

The password for the user account on the vCenter Server on which you are deploying the virtual container host, or the password for the ESXi host if you are deploying directly to an ESXi host. If not specified, `vic-machine` prompts you to enter the password during deployment.

```
--password esxi_host_or_vcenter_server_password
```

Wrap the password in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes special characters.

```
--password 'esxi_host_or_vcenter_server_p@ssword'
```

You can also specify the username and password in the URL that you pass to `vic-machine create` in the `target` option, in which case the `password` option is not required.

`--compute-resource`

Short name: `-r`

The relative path to the host, cluster, or resource pool in which to deploy the virtual container host.

If the vCenter Server instance on which you are deploying a virtual container host only includes a single instance of a standalone host or cluster, `vic-machine create` automatically detects and uses those resources. If you are deploying to an ESXi host that has no resource pools, `vic-machine create` automatically uses the default resource pool. In these cases, you do not need to specify a compute resource when you run `vic-machine create`.

You specify the `compute-resource` option in the following circumstances:

- A vCenter Server instance includes multiple instances of standalone hosts or clusters, or a mixture of standalone hosts and clusters.
- An ESXi host includes multiple resource pools.
- You want to deploy the virtual container host to a specific resource pool in your environment.

If you do not specify the `compute-resource` option and multiple possible resources exist, `vic-machine create` fails and suggests valid targets for `compute-resource` in the failure message.

- To deploy to a specific resource pool on an ESXi host, specify the name of the resource pool:

  ```
  --compute-resource  resource_pool_name
  ```

- To deploy to a vCenter Server instance that has more than one standalone host that are not part of a cluster, specify the IPv4 address or fully qualified domain name (FQDN) of the target host:

  ```
  --compute-resource host_address
  ```

- To deploy to a vCenter Server with more than one cluster, specify the name of the target cluster:

  ```
  --compute-resource cluster_name
  ```

- To deploy to a specific resource pool on a standalone host that is managed by vCenter Server, specify the IPv4 address or FQDN of the target host and name of the resource pool:

  ```
  --compute-resource host_name/resource_pool_name
  ```

- To deploy to a specific resource pool in a cluster, specify the names of the target cluster and the resource pool:

  ```
  --compute-resource cluster_name/resource_pool_name
  ```

- Wrap the resource names in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if they include spaces:

  ```
  --compute-resource 'cluster name'/'resource pool name'
  ```

`--thumbprint`

Short name: None

The thumbprint of the vCenter Server or ESXi host certificate. Specify this option if your vSphere environment uses untrusted, self-signed certificates. If your vSphere environment uses trusted certificates that are signed by a known Certificate Authority (CA), you do not need to specify the `--thumbprint` option.

NOTE If your vSphere environment uses untrusted, self-signed certificates, you can run `vic-machine create` without the `--thumbprint` option by using the `--force` option. However, running `vic-machine create` with the `--force` option rather than providing the certificate thumbprint is not recommended, because it permits man-in-the-middle attacks to go undetected.

To obtain the thumbprint of the vCenter Server or ESXi host certificate, run `vic-machine create` without the specifying the `--thumbprint` or `--force` options. The deployment of the virtual container host fails, but the resulting error message includes the required certificate thumbprint. You can copy the thumbprint from the error message and run vic-machine create again, including the `thumbprint` option.

```
--thumbprint certificate_thumbprint
```

Security Options

When you deploy a virtual container host, you must specify the type of authentication to use when Docker clients connect to that virtual container host. <!--

- Two-way authentication with trusted auto-generated TLS certificates that are signed by a Certificate Authority (CA). Specify the `tls-cname` option when you deploy the virtual container host.
- Server-side authentication with auto-generated, untrusted TLS certificates that are not signed by a CA, with no client-side verification. Specify the `no-tlsverify` option when you deploy the virtual container host.
- Authentication with trusted custom TLS certificates that are signed by a CA. Specify the `cert` and `key` advanced options when you deploy the virtual container host.
- No TLS authentication. Any Docker client can connect to the virtual container host. Specify the `no-tls` advanced option when you deploy the virtual container host.

For more information about the possible security configurations for virtual container hosts, see Securing Virtual Container Host Connections.

IMPORTANT: If you assign a static IP address to a virtual container host on the client network and you do not specify any authentication options, `vic-machine` behaves in the same way as if you set the `--tls-cname` option. If you do not set a static IP address on the virtual container host, it is **mandatory** to specify an authentication option when you deploy a virtual container host. For information about setting a static IP address on a virtual container host, see Options for Specifying a Static IP Address for the Virtual Container Host Endpoint VM in Advanced Options. --> The security options also allow you to configure virtual container hosts to connect to insecure registries and download container images by setting the `--insecure-registry` option.

`--tls-cname`

Short name: None

The Common Name to use in an auto-generated CAcertificate if you require two-way, trusted TLS certificate authentication when connecting Docker clients to the virtual container host.

The `--tls-cname` option is the minimum option that you must specify when using auto-generated trusted TLS certificates. For information about further options that you can specify when using auto-generated trusted certificates, see the descriptions of the `--tls-ca`, `--certificate-key-size`, and `--organization` options in Advanced Security Options.

If you specify a static IP address for the virtual container host on the client network by setting the `--client-network-ip` and `--client-network-gateway` options, `vic-machine create` uses this address as the Common Name when it creates auto-generated trusted certificates. In this case, you do not need to specify `--tls-cname` or any other authentication options. For information about setting a static IP address on a virtual container host, see Options for Specifying a Static IP Address for the Virtual Container Host Endpoint VM in Advanced Options.

When you specify the `--tls-cname` option, and potentially other options for auto-generating trusted TLS certificates, `vic-machine create` performs the following actions during the deployment of the virtual container host.

- Creates a folder with the same name as the virtual container host in the location in which you run `vic-machine create`.
- Creates trusted CA, server, and client certificate/key pairs in the newly created folder:
  - `ca.pem`
  - `ca-key.pem`
  - `cert.pem`
  - `key.pem`
  - `server-cert.pem`
  - `server-key.pem`
- Creates a browser-friendly PFX client certificate, `cert.pfx`, to use to authenticate connections to the VCH Admin portal for the virtual container host.

Running `vic-machine create` with the `--tls-cname` option also creates an environment file named `vch_name.env`, that contains Docker environment variables that container developers can use to configure their Docker client environment:

- Activates TLS client verification.

  ```
  DOCKER_TLS_VERIFY=1
  ```

- The path to the client certificates.

  ```
  DOCKER_CERT_PATH=path_to_certs
  ```

- The address of the virtual container host.

  ```
  DOCKER_HOST=vch_address:2376
  ```

You must provide copies of the certificate files and the environment file to container developers so that they can connect Docker clients to the virtual container host.

If you use trusted certificates, container developers run Docker commands with the `--tlsverify`, `--tlscacert`, `--tlscert`, and `--tlskey` options.

When you specify the `--tls-cname` option, you must provide an FQDN for the virtual container host or the name of the domain to which the virtual container host will belong. The system on which you run `vic-machine create` and the remote vCenter Server system must agree on the vCenter Server system's FQDN or domain. As a consequence, to use the `--tls-cname` option, you must have a DNS service running on the client network that the virtual container host uses. You cannot specify an IP address in the `--tls-cname` option. If you do not have a DNS service on the client network, you can still implement full TLS authentication with trusted certificates by either specifying a static IP address or by using the `--cert` and `--key` options to upload custom certificates.

```
--tls-cname vch-name.example.org
```

```
--tls-cname *.example.org
```

`--no-tlsverify`

Short name: `--kv`

Authentication of the virtual container host with auto-generated TLS certificates that are not signed by a CA, with no client-side verification. The `vic-machine create` command still generates certificates, but these are untrusted, self-signed certificates.

If you configure the virtual container host for untrusted TLS certificate authentication, clients are not verified. Consequently, container developers do not require copies of the certificate and key files.

When you specify the `--no-tlsverify` option, `vic-machine create` performs the following actions during the deployment of the virtual container host.

- Creates a folder with the same name as the virtual container host in the location in which you run `vic-machine create`.
- Creates an environment file named `vch_name.env`, that contains the `DOCKER_HOST=vch_address` environment variable, that you can provide to container developers to use to set up their Docker client environment.

If you use untrusted certificates, container developers run Docker commands with the `--tls` option. The `--no-tlsverify` option takes no arguments.

```
--no-tlsverify
```

`--insecure-registry`

Short name: `--dir`

If your Docker environment stores Docker images in an insecure private registry server, you must configure virtual container hosts to connect to this private registry server when you deploy them. An insecure private registry server is a private registry server that is secured by self-signed certificates rather than by TLS. You authorize connections from a virtual container host to an insecure private registry server by setting the URL of a registry server in the `insecure-registry` option. If the registry server listens on a specific port, add the port number to the URL.

You can specify `insecure-registry` multiple times to allow connections from the virtual container host to multiple insecure private registry servers.

```
--insecure-registry registry_URL_1
--insecure-registry registry_URL_2:port_number
```

NOTE: The current builds of vSphere Integrated Containers do not yet support private registry servers that you secure by using TLS certificates.

Datastore Options

The `vic-machine` utility allows you to specify the datastore in which to store container image files, container VM files, and the files for the virtual container host appliance. You can also specify datastores in which to create container volumes.

- vSphere Integrated Containers Engine fully supports VMware vSAN datastores.

- vSphere Integrated Containers Engine supports all alphanumeric characters, hyphens, and underscores in datastore paths and datastore names, but no other special characters.
- If you specify different datastores in the different datastore options, and if no single host in a cluster can access all of those datastores, `vic-machine create` fails with an error.

  ```
  No single host can access all of the requested datastores.
  Installation cannot continue.
  ```

- If you specify different datastores in the different datastore options, and if only one host in a cluster can access all of them, `vic-machine create` succeeds with a warning.

  ```
  Only one host can access all of the image/container/volume datastores.
  This may be a point of contention/performance degradation and HA/DRS
  may not work as intended.
  ```

`--image-store`

Short name: `-i`

The datastore in which to store container image files, container VM files, and the files for the virtual container host appliance. The `--image-store` option is **mandatory** if there is more than one datastore in your vSphere environment. If there is only one datastore in your vSphere environment, the `--image-store` option is not required.

If you are deploying the virtual container host to a vCenter Server cluster, the datastore that you designate in the `image-store` option must be shared by at least two ESXi hosts in the cluster. Using non-shared datastores is possible, but limits the use of vSphere features such as vSphere vMotion® and VMware vSphere Distributed Resource Scheduler™ (DRS).

When you deploy a virtual container host, `vic-machine` creates a set of folders in the target datastore:

- A folder with the same name as the virtual container host, at the top level of the datastore. This folder contains the VM files for the virtual container host appliance.
- A folder named `VIC` inside the virtual container host folder. The `VIC` folder contains a folder that uses the UUID of the virtual container host endpoint VM as its name. The `VIC/vch_uuid` folder contains a subfolder named `images`, in which to store all of the container images that you pull into the virtual container host.

You can specify a datastore folder to use as the image store in the format `datastore_name/path`. If the path to the folder that you specify does not already exist, `vic-machine create` creates it. In this case, `vic-machine` still creates the folder for the files of the virtual container host appliance at the top level of the datastore. However, `vic-machine create` creates the `VIC` folder inside the `datastore_name/path` folder, rather than in the same folder as the virtual container host files.

By specifying the path to a datastore folder in the `--image-store` option, you can designate the same datastore folder as the image store for multiple virtual container hosts. In this way, `vic-machine create` creates only one `VIC` folder in the datastore, at the path that you specify. The `VIC` folder contains one `vch_uuid/images` folder for each virtual container host that you deploy. By creating one `vch_uuid/images` folder for each virtual container host, vSphere Integrated Containers Engine limits the potential for conflicts of image use between virtual container hosts, even if you share the same image store folder between multiple hosts.

NOTE: In the current builds of vSphere Integrated Containers Engine, sharing an image store folder between multiple virtual container hosts can lead to inconsistent behavior. Designate a different folder for the image store for each virtual container host, or omit the datastore folder from the `--image-store` option.

When container developers create containers, vSphere Integrated Containers Engine stores the files for container VMs at the top level of the image store, in folders that have the same name as the containers.

vSphere Integrated Containers Engine supports all alphanumeric characters, hyphens, and underscores in datastore paths and datastore names, but no other special characters.

- Specify a datastore as the image store:

  ```
  --image-store datastore_name
  ```

- Specify a datastore folder as the image store:

  ```
  --image-store datastore_name/path
  ```

- Wrap the datastore name and path in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if they include spaces:

  ```
  --image-store 'datastore name'/'datastore path'
  ```

If you specify an invalid datastore name, `vic-machine create` fails and suggests valid datastores.

`--volume-store`

Short name: `--vs`

The datastore in which to create volumes when container developers use the `docker volume create` or `docker create -v` commands. When you specify the `volume-store` option, you provide the name of the target datastore and a label for the volume store. You can optionally provide a path to a specific folder in the datastore in which to create the volume store. If the folders that you specify in the path do not already exist on the datastore, `vic-machine create` creates the appropriate folder structure. If you specify an invalid datastore name, `vic-machine create` fails and suggests valid datastores.

IMPORTANT: If multiple virtual container hosts will use the same datastore for their volume stores, specify a different datastore folder for each virtual container host. Do not designate the same datastore folder as the volume store for multiple virtual container hosts.

If you are deploying the virtual container host to a vCenter Server cluster, the datastore that you designate in the `volume-store` option should be shared by at least two ESXi hosts in the cluster. Using non-shared datastores is possible and `vic-machine create` succeeds, but it issues a warning that this configuration limits the use of vSphere features such as vSphere vMotion and DRS.

The label that you specify is the volume store name that Docker uses. For example, the volume store label appears in the information for a virtual container host when container developers run `docker info`. Container developers specify the volume store label in the `docker volume create --opt VolumeStore=volume_store_label` option when they create a volume.

IMPORTANT If you do not specify the `volume-store` option, no volume store is created and container developers cannot use the `docker volume create` or `docker create -v` commands.

- If you only require one volume store, you can set the volume store label to `default`. If you set the volume store label to `default`, container developers do not need to specify the `--opt VolumeStore=volume_store_label` option when they run `docker volume create`.

  NOTE: If container developers intend to use `docker create -v` to create containers that are attached to anonymous or named volumes, you must create a volume store with a label of `default`.

  ```
  --volume-store datastore_name:default
  ```

- If you specify the target datastore and the volume store label, `vic-machine create` creates a folder named `VIC/volumes` at the top level of the target datastore. Any volumes that container developers create will appear in the `VIC/volumes` folder.

  ```
  --volume-store datastore_name:volume_store_label
  ```

- If you specify the target datastore, a datastore path, and the volume store label, `vic-machine create` creates a folder named `volumes` in the location that you specify in the datastore path. Any volumes that container developers create will appear in the `path/volumes` folder.

  ```
  --volume-store datastore_name/datastore_path:volume_store_label
  ```

- Wrap the datastore name and path in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if they include spaces. The volume store label cannot include spaces.

  ```
  --volume-store 'datastore name'/'datastore path':volume_store_label
  ```

- You can specify the `volume-store` option multiple times, to create multiple volume stores for the virtual container host.

  ```
  --volume-store datastore_name/path:volume_store_label_1
  --volume-store datastore_name/path:volume_store_label_2
  [...]
  --volume-store datastore_name/path:volume_store_label_n
  ```

Networking Options

The `vic-machine create` utility allows you to specify different networks for the different types of traffic between containers, the virtual container host, the external internet, and your vSphere environment. For information about the different networks that virtual container hosts use, see Networks Used by vSphere Integrated Containers Engine.

IMPORTANT: A virtual container host supports a maximum of 3 distinct networks. Because the bridge and container networks require their own distributed port groups, at least two of the external, client, and management networks must share a network.

By default, `vic-machine create` obtains IP addresses for virtual container host endpoint VMs by using DHCP. For information about how to specify a static IP address for the virtual container host endpoint VM on the client, external, and management networks, see Specify a Static IP Address for the Virtual Container Host Endpoint VM in Advanced Options.

If your network access is controlled by a proxy server, see Options to Configure Virtual Container Hosts to Use Proxy Servers in Advanced Options.

`--bridge-network`

Short name: `-b`

A distributed port group that container VMs use to communicate with each other.

The `bridge-network` option is **mandatory** if you are deploying a virtual container host to vCenter Server.

In a vCenter Server environment, before you run `vic-machine create`, you must create a distributed virtual switch and a distributed port group. You must add the target ESXi host or hosts to the distributed virtual switch, and assign a VLAN ID to the port group, to ensure that the bridge network is isolated. For information about how to create a distributed virtual switch and port group, see *Network Requirements* in Environment Prerequisites for vSphere Integrated Containers Engine Installation.

You pass the name of the distributed port group to the `bridge-network` option. Each virtual container host requires its own distributed port group.

IMPORTANT

- Do not assign the same `bridge-network` distributed port group to multiple virtual container hosts. Sharing a distributed port group between virtual container hosts might result in multiple container VMs being assigned the same IP address.
- Do not use the `bridge-network` distributed port group as the target for any of the other `vic-machine create` networking options.

If you specify an invalid network name, `vic-machine create` fails and suggests valid networks.

The `bridge-network` option is **optional** when you are deploying a virtual container host to an ESXi host with no vCenter Server. In this case, if you do not specify `bridge-network`, `vic-machine` creates a virtual switch and a port group that each have the same name as the virtual container host. You can optionally specify this option to assign an existing port group for use as the bridge network for container VMs. You can also optionally specify this option to create a new virtual switch and port group that have a different name to the virtual container host.

```
--bridge-network distributed_port_group_name
```

Wrap the distributed port group name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

```
--bridge-network 'distributed port group name'
```

For information about how to specify a range of IP addresses for additional bridge networks, see `bridge-network-range` in Advanced Networking Options.

`--client-network`

Short name: `--cln`

The network that the virtual container host uses to generate the Docker API. The Docker API only uses this network.

If not specified, the virtual container host uses the external network for client traffic. If you specify an invalid network name, `vic-machine create` fails and suggests valid networks.

```
--client-network network_name
```

Wrap the network name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

```
--client-network 'network name'
```

`--external-network`

Short name: `--en`

The network for containers to use to connect to the Internet. Virtual container hosts use the external network to pull container images, for example from https://hub.docker.com/. Container VMs use the external network to publish network services. If you define the external network, you can deploy containers directly on the external interface.

If not specified, containers use the default VM Network for external traffic. If you specify an invalid network name, `vic-machine create` fails and suggests valid networks.

```
--external-network network_name
```

Wrap the network name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

```
--external-network 'network name'
```

`--management-network`

Short name: `--mn`

The network that the virtual container host uses to communicate with vCenter Server and ESXi hosts. Container VMs use this network to communicate with the virtual container host.

If not specified, the virtual container host uses the external network for management traffic. If you specify an invalid network name, `vic-machine create` fails and suggests valid networks.

```
--management-network network_name
```

Wrap the network name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

```
--management-network 'network name'
```

`--container-network`

Short name: `--cn`

Anetwork for container VMs to use for external communication when container developers run `docker run` or `docker create` with the `--net` option.

To specify a container network, you provide the name of a distributed port group for the container VMs to use, and an optional descriptive name for the container network for use by Docker. If you do not specify a descriptive name, Docker uses the vSphere network name. If you specify an invalid network name, `vic-machine create` fails and suggests valid networks.

- You can specify a vSphere network as the container network.
- The distributed port group must exist before you run `vic-machine create`.
- You cannot use the same distributed port group as you use for the bridge network.
- You can create the distributed port group on the same distributed virtual switch as the distributed port group that you use for the bridge network.
- If the network that you specify in the `container-network` option does not support DHCP, see Options for Configuring a Non-DHCP Network for Container Traffic in Advanced Options.
- The descriptive name appears under `Networks` when you run `docker info` on the deployed virtual container

host.
- Container developers use the descriptive name in the `--net` option when they run `docker run` or `docker create`.

If you do not specify the `container-network` option, or if container developers run `docker run` or `docker create` without specifying `--net`, container VMs use the bridge network.

```
--container-network distributed_port_group_name:container_network_name
```

Wrap the distributed port group name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces. The descriptive name cannot include spaces.

```
--container-network 'distributed port group name':container_network_name
```

Appliance Deployment Options

The `vic-machine` utility provides options to customize the virtual container host appliance.

`--name`

Short name: `-n`

Aname for the virtual container host appliance. If not specified, `vic-machine` sets the name of the virtual container host to `virtual-container-host`. If a virtual container host of the same name exists on the ESXi host or in the vCenter Server inventory, or if a folder of the same name exists in the target datastore, the deployment of the virtual container host fails.

```
--name vch_appliance_name
```

Wrap the appliance name in single quotes (') on Mac OS and Linux and in double quotes (") on Windows if it includes spaces.

```
--name 'vch appliance name'
```

`--memory`

Short name: `--mem`

Limit the amount of memory that is available for use by the virtual container host appliance and container VMs. Specify the memory limit value in MB. If not specified, `vic-machine create` sets the limit to 0 (unlimited).

```
--memory 1024
```

`--cpu`

Short name: None

Limit the amount of CPU capacity that is available for use by the virtual container host appliance and container VMs. Specify the CPU limit value in MHz. If not specified, `vic-machine create` sets the limit to 0 (unlimited).

```
--cpu 1024
```

`--force`

Short name: `-f`

Forces `vic-machine create` to ignore warnings and non-fatal errors and continue with the deployment of a virtual container host. Errors such as an incorrect compute resource still cause the installation to fail.

If your vSphere environment uses untrusted, self-signed certificates, you can use the `--force` option to deploy a virtual container host without providing the thumbprint of the vCenter Server or ESXi host in the `thumbprint` option.

IMPORTANT Running `vic-machine create` with the `--force` option rather than providing the certificate thumbprint is not recommended, because it permits man-in-the-middle attacks to go undetected.

```
--force
```

`--timeout`

Short name: none

The timeout period for uploading the vSphere Integrated Containers Engine appliance and container images to the ESXi host, and for powering on the appliance. Specify a value in the format `XmYs` if the default timeout of 3m0s is insufficient.

```
--timeout 5m0s
```

Advanced Options

The options in this section are exposed in the `vic-machine create` help if you run `vic-machine-darwin-linux-windows create --extended-help`, or `vic-machine-darwin-linux-windows create -x`.

Advanced Security Options

The advanced security options allow you to customize the authentication of connections from Docker clients to virtual container hosts.

- Add optional information to auto-generated trusted TLS certificates by specifying the `--tls-ca`, `--certificate-key-size`, and `--organization` options.
- Use custom trusted TLS certificates by using the `--cert` and `--key` options.
- Disable TLS authentication completely by using the `--no-tls` option.

`--tls-ca`

Short name: `--ca`

Certificate Authority (CA) files to use to verify Docker client certificates. Specify the `--tls-ca` option if your certificates are validated by a CA that is not commonly recognized. Specify the `--tls-ca` option multiple times to specify multiple CA files.

```
--tls-ca path_to_ca_file
```

`--certificate-key-size`

Short name: `--ksz`

The size of the key for `vic-machine create` to use when it creates auto-generated trusted certificates. If not specified, `vic-machine create` creates keys with default size of 2048 bits. It is not recommended to use key sizes of less than 2048 bits.

```
--certificate-key-size 3072
```

`--organization`

Short name: None

A list of identifiers to record in auto-generated trusted certificates. If not specified, `vic-machine create` uses the name of the virtual container host as the organization value. It also uses the IP address or FQND of the virtual container host as the organization if you set a static IP address by using the `--client-network-ip` and `--client-network-gateway` options.

```
--organization organization_name
```

`--cert`

Short name: none

The path to a custom X.509 certificate that has been signed by a CA, for the Docker API to use to authenticate the virtual container host with a Docker client.

- This option is mandatory if you use custom TLS certificates, rather than auto-generated certificates, to authenticate connections between Docker clients and the virtual container hosts.
- Use this option in combination with the `key` option, that provides the path to the private key file for the custom certificate.
- Include the names of the certificate and key files in the paths.
- If you use trusted custom certificates, container developers run Docker commands with the `--tlsverify`, `--tlscacert`, `--tlscert`, and `--tlskey` options.

```
--cert path_to_certificate_file/certificate_file_name.pem
--key path_to_key_file/key_file_name.pem
```

Wrap the folder names in the paths in single quotes (Linux or Mac OS) or double quotes (Windows) if they include spaces.

```
--cert 'path to certificate file'/certificate_file_name.pem
--key 'path to key file'/key_file_name.pem
```

`--key`

Short name: none

The path to the private key file to use with a custom CA certificate. This option is mandatory if you specify the `cert` option, that provides the path to a custom X.509 certificate file. Include the names of the certificate and key files in the paths.

```
--cert path_to_certificate_file/certificate_file_name.pem
--key path_to_key_file/key_file_name.pem
```

Wrap the folder names in the paths in single quotes (Linux or Mac OS) or double quotes (Windows) if they include spaces.

```
--cert 'path to certificate file'/certificate_file_name.pem
--key 'path to key file'/key_file_name.pem
```

`--no-tls`

Short name: `-k`

Disables TLS authentication of connections between the Docker client and the virtual container host.

Set the `no-tls` option if you do not require TLS authentication between the virtual container host and the Docker client. Any Docker client can connect to the virtual container host if you disable TLS authentication.

If you use the `no-tls` option, container developers connect Docker clients to the virtual container host via port 2375, instead of via port 2376.

```
--no-tls
```

Options for Specifying a Static IP Address for the Virtual Container Host Endpoint VM

You can specify a static IP address for the virtual container host endpoint VM on each of the client, external, and management networks. DHCP is used for the endpoint VM for any network on which you do not specify a static IP address.

If you specify static IP addresses, you can only specify one static IP address on a given port group. If more than one of the client, external, or management networks shares a port group, you can only specify an IP address for one of those networks. The same address is then used for all of the networks that share that port group.

Assigning the same subnet to multiple port groups can cause routing problems. If `vic-machine create` detects that you have assigned the same subnet to multiple port groups, it issues a warning.

To specify a static IP address for the endpoint VM, you provide an IP address, and a gateway address. You can also optionally specify one or more DNS server addresses.

IMPORTANT: If you assign a static IP address to a virtual container host on the client network by setting the `--client-network-ip` and `--client-network-gateway` options, `vic-machine create` uses this address to auto-generate trusted CA certificates. In this case, two-way TLS authentication with trusted certificates is implemented by default, and you do not need to perform any additional TLS configuration when you deploy the virtual container host. If you assign a static IP to a virtual container host on the client network, `vic-machine create` creates the same certificate and environment variable files as described in the `--tls-cname` option.

`--dns-server`

Short name: None

ADNS server to use if you specify static IP addresses for the virtual container host on the client, external, and management networks. You can specify `dns-server` multiple times, to configure multiple DNS servers.

If you specify `dns-server` but you do not specify a static IP address for one or more of the client, external, and management networks, `vic-machine create` ignores the `dns-server` setting for that network and uses the DNS servers that are provided by DHCP.

If you use a mixture of static and DHCP addresses for the virtual container host on the different networks, the virtual container host uses the DNS servers that you specify in `dns-server` and those that DHCP provides.

If you specify static IP address for the virtual container host on any of the client, external, and management networks and you do not specify `dns-server`, the DNS server defaults to 8.8.8.8 and 8.8.4.4.

```
--dns-server=172.16.10.10
--dns-server=172.16.10.11
```

`--client-network-ip`, `--external-network-ip`, `--management-network-ip`

Short name: None

Astatic IP address for the virtual container host on the client, external, or management network. If you specify an IP address by using `client/external/management-network-ip`, you must also specify a corresponding gateway address by using `client/external/management-network-gateway`. If you specify neither a gateway nor an IP address for a given network, `vic-machine create` uses DHCP to obtain an IP address for the virtual container host endpoint VM on that network.

You can specify IP addresses in CIDR format.

```
--external-network-ip 192.168.X.N/24
--management-network-ip 192.168.Y.N/24
--client-network-ip 192.168.Z.N/24
```

You can also specify IP addresses as resolvable FQDNs. If you specify an FQDN, `vic-machine create` uses the netmask from the gateway.

```
--external-network-ip=vch27-team-a.internal.domain.com
--management-network-ip=vch27-team-b.internal.domain.com
--client-network-ip=vch27-team-c.internal.domain.com
```

`--client-network-gateway`, `--external-network-gateway`, `--management-network-gateway`

Short name: None

The gateway to use if you specify a static IP address for the virtual container host on the client, external, or management network. If you specify a gateway address by using `client/external/management-network-gateway`, you must also specify a corresponding IP address by using `client/external/management-network-ip`. If you specify neither a gateway nor an IP address for a given network, `vic-machine create` uses DHCP to obtain an IP address for the virtual container host endpoint VM on that network.

You specify gateway addresses in CIDR format.

```
--external-network-gateway 192.168.X.1/24
--management-network-gateway 192.168.Y.1/24
--client-network-gateway 192.168.Z.1/24
```

Options for Configuring a Non-DHCP Network for Container Traffic

If the network that you specify in the `container-network` option does not support DHCP, you must specify the `container-network-gateway` option. You can optionally specify one or more DNS servers and a range of IP addresses for container VMs on the container network.

For information about the container network, see the section on the `container-network` option.

`--container-network-gateway`

Short name: `--cng`

The gateway for the subnet of the container network. This option is required if the network that you specify in the `container-network` option does not support DHCP. Specify the gateway in the format `container_network:subnet`. If you specify this option, it is recommended that you also specify the `container-network-dns` option.

When you specify the container network gateway, you must use the distributed port group that you specify in the `container-network` option. If you specify `container-network-gateway` but you do not specify `container-network`, or if you specify a different distributed port group to the one that you specify in `container-network`, `vic-machine create` fails with an error.

```
--container-network-gateway distributed_port_group_name:gateway_ip_address/subnet_mask
```

Wrap the distributed port group name in single quotes (Linux or Mac OS) or double quotes (Windows) if it includes spaces.

```
--container-network-gateway 'distributed port group name':gateway_ip_address/subnet_mask
```

`--container-network-dns`

Short name: `--cnd`

The address of the DNS server for the container network. This option is recommended if the network that you specify in the `container-network` option does not support DHCP.

When you specify the container network DNS server, you must use the distributed port group that you specify in the `container-network` option. You can specify `container-network-dns` multiple times, to configure multiple DNS servers. If you specify `container-network-dns` but you do not specify `container-network`, or if you specify a different distributed port group to the one that you specify in `container-network`, `vic-machine create` fails with an error.

```
--container-network-dns distributed_port_group_name:8.8.8.8
```

Wrap the distributed port group name in single quotes (Linux or Mac OS) or double quotes (Windows) if it includes spaces.

```
--container-network-dns 'distributed port group name':8.8.8.8
```

--container-network-ip-range

Short name: `--cnr`

The range of IP addresses that container VMs can use if the network that you specify in the `container-network` option does not support DHCP. If you specify `--container-network-ip-range`, virtual container hosts manage the addresses for containers within that range. The range that you specify must not be used by other computers or VMs on the network. If you specify `container-network-gateway` but do not specify `--container-network-ip-range`, the IP range for container VMs is the entire subnet that you specify in `container-network-gateway`.

When you specify the container network IP range, you must use the distributed port group that you specify in the `container-network` option. If you specify `container-network-ip-range` but you do not specify `container-network`, or if you specify a different distributed port group to the one that you specify in `container-network`, `vic-machine create` fails with an error.

```
--container-network-ip-range distributed_port_group_name:192.168.100.2-192.168.100.254
```

You can also specify the IP range as a CIDR.

```
--container-network-ip-range distributed_port_group_name:192.168.100.0/24
```

Wrap the distributed port group name in single quotes (Linux or Mac OS) or double quotes (Windows) if it includes spaces.

```
--container-network-ip-range 'distributed port group name':192.168.100.0/24
```

Options to Configure Virtual Container Hosts to Use Proxy Servers

If your network access is controlled by a proxy server, you must configure a virtual container host to connect to the proxy server when you deploy it.

IMPORTANT: Configuring a virtual container host to use a proxy server does not configure proxy support on the containers that this virtual container host runs. Container developers must configure proxy servers on containers when they create them.

--http-proxy

Short name: `--hproxy`

The address of the HTTP proxy server through which the virtual container host accesses the network. Specify the address of the proxy server as either an FQDN or an IP address.

```
--http-proxy http://proxy_server_address:port
```

--https-proxy

Short name: `--sproxy`

The address of the HTTPS proxy server through which the virtual container host accesses the network. Specify the address of the proxy server as either an FQDN or an IP address.

```
--https-proxy https://proxy_server_address:port
```

Advanced Resource Management Options

`--memory-reservation`

Short name: `--memr`

Reserve a quantity of memory for use by the virtual container host appliance and container VMs. Specify the memory reservation value in MB. If not specified, `vic-machine create` sets the reservation to 1.

```
--memory-reservation 1024
```

`--memory-shares`

Short name: `--mems`

Set memory shares on the virtual container host appliance. Specify the share value as a level or a number, for example `high`, `normal`, `low`, or `163840`. If not specified, `vic-machine create` sets the share to `normal`.

```
--memory-shares low
```

`--cpu-reservation`

Short name: `--cpur`

Reserve a quantity of CPU capacity for use by the virtual container host appliance and container VMs. Specify the CPU reservation value in MHz. If not specified, `vic-machine create` sets the reservation to 1.

```
--cpu-reservation 1024
```

`--cpu-shares`

Short name: `--cpus`

Set CPU shares on the virtual container host appliance. Specify the share value as a level or a number, for example `high`, `normal`, `low`, or `163840`. If not specified, `vic-machine create` sets the share to `normal`.

```
--cpu-shares low
```

`--appliance-cpu`

Short name: none

The number of virtual CPUs for the virtual container host endpoint VM. The default is 1. Set this option to increase the number of CPUs in the virtual container host VM, for example if the virtual container host will handle large volumes of containers, or containers that require a lot of processing power.

NOTE Use the `--cpu` option instead of the `--appliance-cpu` option. The `--appliance-cpu` option is mainly intended for use by VMware Support.

```
--appliance-cpu number_of_CPUs
```

`--appliance-memory`

Short name: none

The amount of memory for the virtual container host endpoint VM. The default is 2048MB. Set this option to increase the amount of memory in the virtual container host VM, for example if the virtual container host will handle large volumes of containers, or containers that consume a lot of memory.

NOTE Use the `--memory` option instead of the `--appliance-memory` option. The `--appliance-memory` option is mainly intended for use by VMware Support.

```
--appliance-memory amount_of_memory
```

Other Advanced Options

`--bridge-network-range`

Short name: `--bnr`

The range of IP addresses that additional bridge networks can use when container application developers use `docker network create` to create new bridge networks. If you do not specify the `bridge-network-range` option, the IP range for bridge networks is 172.16.0.0/12.

When you specify the bridge network IP range, you specify the IP range as a CIDR.

```
--bridge-network-range 192.168.100.0/24
```

`--base-image-size`

Short name: None

The size of the base image from which to create other images. You should not normally need to use this option. Specify the size in `GB` or `MB`. The default is 8GB.

```
--base-image-size 4GB
```

`--container-store`

Short name: `--cs`

The `container-store` option is not enabled. Container VM files are stored in the datastore that you designate as the image store.

--appliance-iso

Short name: `--ai`

The path to the ISO image from which the virtual container host appliance boots. Set this option if you have moved the `appliance.iso` file to a folder that is not the folder that contains the `vic-machine` binary or is not the folder from which you are running `vic-machine`. Include the name of the ISO file in the path.

NOTE: Do not use the `--appliance-iso` option to point `vic-machine` to an `--appliance-iso` file that is of a different version to the version of `vic-machine` that you are running.

```
--appliance-iso path_to_ISO_file/appliance.iso
```

Wrap the folder names in the path in single quotes (Linux or Mac OS) or double quotes (Windows) if they include spaces.

```
--appliance-iso 'path to ISO file'/appliance.iso
```

--bootstrap-iso

Short name: `--bi`

The path to the ISO image from which to boot container VMs. Set this option if you have moved the `bootstrap.iso` file to a folder that is not the folder that contains the `vic-machine` binary or is not the folder from which you are running `vic-machine`. Include the name of the ISO file in the path.

NOTE: Do not use the `--bootstrap-iso` option to point `vic-machine` to a `--bootstrap-iso` file that is of a different version to the version of `vic-machine` that you are running.

```
--bootstrap-iso path_to_ISO_file/bootstrap.iso
```

Wrap the folder names in the path in single quotes (Linux or Mac OS) or double quotes (Windows) if they include spaces.

```
--bootstrap-iso 'path to ISO file'/bootstrap.iso
```

--use-rp

Short name: none

Deploy the virtual container host appliance to a resource pool on vCenter Server rather than to a vApp. If you specify this option, `vic-machine create` creates a resource pool with the same name as the virtual container host.

```
--use-rp
```

--debug

Short name: `-v`

Provide verbose logging output, for troubleshooting purposes when running `vic-machine create`. If not specified, the `debug` value is set to 0 and verbose logging is disabled. Provide a value of 1 or greater to increase the verbosity of the logging. Note that setting debug to a value greater than 1 can affect the behavior of `vic-machine create`.

```
--debug 1
```

Examples of Deploying a Virtual Container Host

This topic provides examples of the options of the `vic-machine create` command to use when deploying virtual container hosts in different vSphere configurations.

For simplicity, unless stated otherwise, these examples assume that the vSphere environment uses trusted certificates signed by a known Certificate Authority (CA), so the `--thumbprint` option is not specified.

For detailed descriptions of all of the `vic-machine create` options, see Virtual Container Host Deployment Options.

Deploy to an ESXi Host with no Resource Pools and a Single Datastore

You can deploy a virtual container host directly on an ESXi host that is not managed by a vCenter Server instance. This example provides the minimum options required to deploy a virtual container host, namely the `--target` and `--user` options and an authentication option. The `vic-machine create` command prompts you for the password for the ESXi host and deploys a virtual container host with the default name `virtual-container-host`. If there is only one datastore on the host and there are no resource pools, you do not need to specify the `--image-store` or `--compute-resource` options. When deploying to an ESXi host, `vic-machine create` creates a standard virtual switch and a distributed port group, so you do not need to specify any network options if you do not have specific network requirements. The example uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target esxi_host_address
--user root
--no-tlsverify
```

Deploy to a vCenter Server Cluster

If vCenter Server has more than one datacenter, you specify the datacenter in the `--target` option.

If vCenter Server manages more than one cluster, you use the `--compute-resource` option to specify the cluster on which to deploy the virtual container host.

When deploying a virtual container host to vCenter Server, you must use the `--bridge-network` option to specify an existing distributed port group for container VMs to use to communicate with each other. For information about how to create a distributed virtual switch and port group, see *Network Requirements* in Environment Prerequisites for vSphere Integrated Containers Engine Installation.

This example deploys a virtual container host with the following configuration:

- Provides the vCenter Single Sign-On user and password in the `--target` option. Note that the user name is wrapped in quotes, because it contains the `@` character. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Deploys a virtual container host named `vch1` to the cluster `cluster1` in datacenter `dc1`.
- Uses a distributed port group named `vic-bridge` for the bridge network.
- Designates `datastore1` as the datastore in which to store container images, the files for the virtual container host appliance, and container VMs.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--name vch1
--no-tlsverify
```

Specify External, Management, Client, and Container Networks

In addition to the mandatory bridge network, if your vCenter Server environment includes multiple networks, you can direct different types of traffic to different networks.

- You can direct the traffic between the virtual container host, container VMs, and the internet to a specific network by specifying the `external-network` option. If you do not specify the `external-network` option, the virtual container host uses the default VM Network for external traffic.
- You can direct traffic between ESXi hosts, vCenter Server, and the virtual container host to a specific network by specifying the `--management-network` option. If you do not specify the `--management-network` option, the virtual container host uses the external network for management traffic.
- You can designate a specific network for use by the Docker API by specifying the `--client-network` option. If you do not specify the `--client-network` option, the Docker API uses the external network.
- You can designate a specific network for container VMs to use by specifying the `--container-network` option. Containers use this network if the container developer runs `docker run` or `docker create` with the `--net` option when they run or create a container. This option requires a distributed port group that must exist before you run `vic-machine create`. You cannot use the same distributed port group that you use for the bridge network. You can provide a descriptive name for the network, for use by Docker. If you do not specify a descriptive name, Docker uses the vSphere network name. For example, the descriptive name appears as an available network in the output of `docker info`.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, datacenter, cluster, image store, bridge network, and name for the virtual container host.
- Directs external, management, and Docker API traffic to network 1, network 2, and network 3 respectively. Note that the network names are wrapped in quotes, because they contain spaces. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Designates a distributed port group named `vic-containers` for use by container VMs that are run with the `--net` option.
- Gives the container network the name `vic-container-network`, for use by Docker.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--external-network 'network 1'
--management-network 'network 2'
--client-network 'network 3'
--container-network vic-containers:vic-container-network
--name vch1
--no-tlsverify
```

For more information about the networking options, see the Networking Options section in Virtual Container Host Deployment Options.

Configure a Non-DHCP Container Network

If the network that you designate as the container network in the `--container-network` option does not support DHCP, you can configure the gateway, DNS server, and a range of IP addresses for container VMs to use.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, datacenter, cluster, image store, bridge network, and name for the virtual container host.
- Uses the default VM Network for the external, management, and client networks.
- Designates a distributed port group named `vic-containers` for use by container VMs that are run with the `--net` option.
- Gives the container network the name `vic-container-network`, for use by Docker.
- Specifies the gateway, two DNS servers, and a range of IP addresses on the container network for container VMs to use.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--container-network vic-containers:vic-container-network
--container-network-gateway vic-containers:gateway_ip_address/255.255.255.0
--container-network-dns vic-containers:dns1_ip_address
--container-network-dns vic-containers:dns2_ip_address
--container-network-ip-range vic-containers:192.168.100.0/24
--name vch1
--no-tlsverify
```

For more information about the container network options, see the container network section in Virtual Container Host Deployment Options.

Set a Static IP Address on the Different Networks

If you specify networks for any or all of the external, management, and client networks, you can deploy the virtual container host so that the virtual container host endpoint VM has a static IP address on those networks.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, datacenter, cluster, image store, bridge network, and name for the virtual container host.
- Directs external, management, and Docker API traffic to network 1, network 2, and network 3 respectively. Note that the network names are wrapped in quotes, because they contain spaces. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Sets a DNS server for use by the virtual container host.
- Sets a static IP address for the virtual container host endpoint VM on each of the external, management, and client networks.

NOTE: When you specify a static IP address for the virtual container host on the client network, `vic-machine create` uses this address as the Common Name with which to create auto-generated trusted certificates. In this case, full TLS authentication is implemented by default and you do not need to specify any authentication options.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--external-network 'network 1'
--external-network-gateway 192.168.1.1/24
--external-network-ip 192.168.1.10/24
--management-network 'network 2'
--management-network-gateway 192.168.2.1/24
--management-network-ip 192.168.2.10/24
--client-network 'network 3'
--client-network-gateway 192.168.3.1/24
--client-network-ip 192.168.3.10/24
--dns-server dns_server_address
--name vch1
--no-tlsverify
```

For more information about the networking options, see the Options for Specifying a Static IP Address for the Virtual Container Host Endpoint VM in Virtual Container Host Deployment Options.

Specify One or More Volume Stores

If container application developers will use the `docker volume create` command to create containers that use volumes, you must create volume stores when you deploy virtual container hosts. You specify volume stores in the `--volume-store` option. You can specify `--volume-store` multiple times to create multiple volume stores.

When you create a volume store, you specify the name of the datastore to use and an optional path to a folder on that datastore. You also specify a descriptive name for that volume store for use by Docker.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, datacenter, cluster, bridge network, and name for the virtual container host.
- Specifies the `volumes` folder on `datastore 1` as the default volume store. Creating a volume store named `default` allows container application developers to create anonymous or named volumes by using `docker create -v`.
- Specifies a second volume store named `volume_store_2` in the `volumes` folder on `datastore 2`.
- Note that the datastore names are wrapped in quotes, because they contain spaces. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--bridge-network vic-bridge
--image-store 'datastore 1'
--volume-store 'datastore 1'/volumes:default
--volume-store 'datastore 2'/volumes:volume_store_2
--name vch1
--no-tlsverify
```

For more information about volume stores, see the volume-store section in Virtual Container Host Deployment Options.

Deploy to a Standalone Host in vCenter Server

If vCenter Server manages multiple standalone ESXi hosts that are not part of a cluster, you use the `--compute-resource` option to specify the address of the ESXi host to which to deploy the virtual container host.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, bridge network, and name for the virtual container host.
- Deploys the virtual container host on the ESXi host with the FQDN `esxihost1.organization.company.com` in the datacenter `dc1`. You can also specify an IP address.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--image-store datastore1
--bridge-network vic-bridge
--compute-resource esxihost1.organization.company.com
--name vch1
--no-tlsverify
```

Deploy to a Resource Pool on an ESXi Host

To deploy a virtual container host in a specific resource pool on an ESXi host that is not managed by vCenter Server, you specify the resource pool name in the `--compute-resource` option.

This example deploys a virtual container host with the following configuration:

- Specifies the user name and password, and a name for the virtual container host.
- Designates `rp 1` as the resource pool in which to place the virtual container host. Note that the resource pool name is wrapped in quotes, because it contains a space. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target root:password@esxi_host_address
--compute-resource 'rp 1'
--name vch1
--no-tlsverify
```

Deploy to a Resource Pool in a vCenter Server Cluster

To deploy a virtual container host in a resource pool in a vCenter Server cluster, you specify the names of the cluster and resource pool in the `compute-resource` option.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, datacenter, image store, bridge network, and name for the virtual container host.
- Designates `rp 1` in cluster `cluster 1` as the resource pool in which to place the virtual container host. Note that the resource pool and cluster names are wrapped in quotes, because they contain spaces. Use single quotes if you are using `vic-machine` on a Linux or Mac OS system and double quotes on a Windows system.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource 'cluster 1'/'rp 1'
--image-store datastore1
--bridge-network vic-bridge
--name vch1
--no-tlsverify
```

Use Auto-Generated Trusted CA Certificates

You can deploy a virtual container host that implements two-way authentication with trusted auto-generated TLS certificates that are signed by a Certificate Authority (CA). To automatically generate a trusted CA certificate, you provide information that `vic-machine create` uses to populate the fields of a certificate request. At a minimum, you must specify the FQDN or the name of the domain in which the virtual container host will run in the `--tls-cname` option. `vic-machine create` uses the name as the Common Name in the certificate request. You can also optionally specify a CA file, an organization name, and a size for the certificate key.

NOTE: Because the `--tls-cname` option requires an FQDN or domain name, you must have a DNS service running on the client network on which you deploy the virtual container host. However, if you specify a static IP address for the virtual container host endpoint VM on the client network, `vic-machine create` uses this address as the Common Name with which to create an auto-generated trusted certificate. In this case, full TLS authentication is implemented by default and you do not need to specify any authentication options, and DNS is not required on the client network.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, cluster, bridge network, and name for the virtual container host.
- Provides `vch1.example.org` as the FQDN for the virtual container host, for use as the Common Name in the

certificate.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--tls-cname vch1.example.org
--name vch1
```

For more information about using auto-generated CA certificates, see the Security Options section in Virtual Container Host Deployment Options.

Use Custom Trusted CA Certificates

If your development environment uses custom CA certificates to authenticate connections between Docker clients and virtual container hosts, use the `--cert` and `--key` options to provide the paths to a custom X.509 certificate and its key when you deploy a virtual container host. The paths to the certificate and key files must be relative to the location from which you are running `vic-machine create`.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, cluster, bridge network, and name for the virtual container host.
- Provides the paths relative to the current location of the `*.pem` files for the custom CA certificate and key files.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--cert ../some/relative/path/certificate_file.pem
--key ../some/relative/path/key_file.pem
--name vch1
```

For more information about using custom CA certificates, see the Advanced Security Options section in Virtual Container Host Deployment Options.

Limit Resource Use

To limit the amount of system resources that the container VMs in a virtual container host can use, you can set resource limits on the virtual container host vApp.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, cluster, bridge network, and name for the virtual container host.
- Sets resource limits on the virtual container host by imposing memory and CPU reservations, limits, and shares.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--memory 1024
--memory-reservation 1024
--memory-shares low
--cpu 1024
--cpu-reservation 1024
--cpu-shares low
--name vch1
--no-tlsverify
```

For more information about setting resource use limitations on virtual container hosts, see the vApp Deployment Options and Advanced Resource Management Options sections in Virtual Container Host Deployment Options.

Authorize Access to an Insecure Private Registry Server

An insecure private registry server is a private registry server for Docker images that is secured by self-signed certificates rather than by TLS. To authorize connections from a virtual container host to an insecure private registry server, set the `insecure-registry` option. You can specify `insecure-registry` multiple times to allow connections from the virtual container host to multiple insecure private registry servers.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, cluster, bridge network, and name for the virtual container host.
- Authorizes the virtual container host to pull Docker images from the insecure private registry servers located at the URLs *registry_URL_1* and *registry_URL_2*.
- The registry server at *registry_URL_2* listens for connections on port 5000.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--insecure-registry registry_URL_1
--insecure-registry registry_URL_2:5000
--name vch1
--no-tlsverify
```

For more information about configuring virtual container hosts to connect to insecure private registry servers, see the section on the `insecure-registry` option in Virtual Container Host Deployment Options.

NOTE: The current builds of vSphere Integrated Containers do not yet support private registry servers that you secure by using TLS certificates.

Configure a Proxy Server

If your network access is controlled by a proxy server, you must configure a virtual container host to connect to the proxy server when you deploy it.

This example deploys a virtual container host with the following configuration:

- Specifies the user name, password, image store, cluster, bridge network, and name for the virtual container host.
- Configures the virtual container host to access the network via an HTTPS proxy server.
- Uses the `--no-tlsverify` option to implement TLS authentication with self-signed untrusted certificates, with no client verification.

```
vic-machine-darwin-linux-windows create
--target 'Administrator@vsphere.local':password@vcenter_server_address/dc1
--compute-resource cluster1
--image-store datastore1
--bridge-network vic-bridge
--https-proxy https://proxy_server_address:port
--name vch1
--no-tlsverify
```

Verify the Deployment of a Virtual Container Host

After you have deployed a virtual container host, you can verify the deployment by connecting a Docker client to the virtual container host and running Docker operations. You can check the results in the vSphere Client or vSphere Web Client.

IMPORTANT: Do not use the vSphere Client or vSphere Web Client to perform operations on virtual container host appliances or container VMs. Specifically, using the vSphere Client or vSphere Web Client to power off, power on, or delete virtual container host appliances or container VMs can cause vSphere Integrated Containers Engine to not function correctly. Always use `vic-machine` to perform operations on virtual container hosts. Always use Docker commands to perform operations on containers.

Prerequisites

- You used `vic-machine create` to deploy a virtual container host to either a vCenter Server instance or an ESXi host. For information about running `vic-machine`, see Deploy a Virtual Container Host and Virtual Container Host Deployment Options.
- You have installed a Docker client.
- Configure your Docker client according to the type of authentication that the virtual container host uses:
  - If you deployed the virtual container host with either of the `--no-tlsverify` or `--no-tls` options, disable TLS in the Docker client.

    ```
    set DOCKER_TLS_VERIFY=0
    ```

  - If you deployed the virtual container host with full TLS autentication with trusted certificates, enable TLS in the Docker client.

    ```
    set DOCKER_TLS_VERIFY=1
    ```

  - If you deployed the virtual container host with full TLS autentication with trusted certificates, and if you are not running the Docker client in the same location as the one on which you ran `vic-machine`, copy the `*.pem` certificate files to the system on which you you are running the Docker client. Copy the certificate files either to the folder in which you run Docker commands, or to the `~/.docker` folder.
- If you deployed the virtual container host to vCenter Server, connect a vSphere Web Client to that vCenter Server instance.
- If you deployed the virtual container host to an ESXi host, connect a vSphere Client to that host.

Procedure

1. View the virtual container host appliance in the vSphere Web Client or vSphere Client.
   - vCenter Server: Go to **Hosts and Clusters** in the vSphere Web Client and select the cluster or host on which you deployed the virtual container host. You should see a vApp with the name that you set for the virtual container host.
   - ESXi host: Go to **Inventory** in the vSphere Client and select the host on which you deployed the virtual container host. You should see a resource pool with the name that you set for the virtual container host.

   The vApp or resource pool contains the virtual container host endpoint VM.
2. In your Docker client terminal, run the `docker info` command to confirm that you can connect to the virtual container host.

   How you run Docker commands depends on the level of authentication that the virtual container host requires:

- Full TLS authentication with trusted CA certificates:

```
docker -H vch_address:2376 --tlsverify --tlscacert=ca.pem --tlscert=./cert.pem --
```

- TLS authentication with untrusted self-signed certificates:

```
docker -H vch_address:2376 --tls info
```

- With no TLS authentication:

```
$ docker -H vch_address:2375 info
```

You should see confirmation that the Storage Driver is `vSphere Integrated Containers Backend Engine`. If the connection fails with a Docker API version error, see Docker Commands Fail with a Docker API Version Error.

3. Pull a Docker container image into the virtual container host, for example, the `BusyBox` container.
   - Full TLS authentication with trusted CA certificates:

```
docker -H vch_address:2376 --tlsverify --tlscacert=ca.pem --tlscert=./cert.pem --
```

   - TLS authentication with untrusted self-signed certificates:

```
docker -H vch_address:2376 --tls pull busybox:latest
```

   - With no TLS authentication:

```
$ docker -H vch_address:2375 pull busybox:latest
```

4. View the container image files in the vSphere Web Client or vSphere Client.
   - vCenter Server: Go to **Storage**, select the datastore that you designated as the image store, and click **Manage** > **Files**.
   - ESXi host: Click the **Summary** tab for the ESXi host, right-click the datastore that you designated as the image store, and select **Browse Datastore**.

   vSphere Integrated Containers Engine creates a folder named `VIC` in which to store container image files.
   - If you specified a specific datastore folder as the image store when you deployed the virtual container host, the `VIC` folder appears inside that folder.
   - If you did not specify a specific datastore folder as the image store when you deployed the virtual container host, the `VIC` folder appears in a folder that has the same name as the virtual container host.

   Expand the `VIC` folder to navigate to the `images` folder. The `images` folder contains a folder for every container image that you pull into the virtual container host. The folders contain the container image files.
5. In your Docker client, run the Docker container that you pulled into the virtual container host.
   - Full TLS authentication with trusted CA certificates:

```
docker -H vch_address:2376 --tlscacert --tlscert=path --tlskey=path run --name te
```

   - TLS authentication with untrusted self-signed certificates:

```
docker -H vch_address:2376 --tls run --name test busybox
```

- With no TLS authentication:

```
$ docker -H vch_address:2375 run --name test busybox
```

6. View the container VMs in the vSphere Web Client or vSphere Client.
   - vCenter Server: Go to **Hosts and Clusters** and expand the virtual container host vApp.
   - ESXi host: Go to **Inventory** and expand the virtual container host resource pool.

   You should see a VM for every container that you run, including a VM named `test`.
7. View the container VM files in the vSphere Web Client or vSphere Client.
   - vCenter Server: Go to **Storage** and select the datastore that you designated as the image store.
   - ESXi host: Click the **Summary** tab for the ESXi host, right-click the datastore that you designated as the image store, and select **Browse Datastore**.

   At the top-level of the datastore, you should see a folder for every container that you run. The folders contain the container VM files.

Installing the vSphere Web Client Plug-In for vSphere Integrated Containers Engine

You can install a plug-in that adds information about virtual container hosts and container VMs in the vSphere Web Client.

You can install the plug-in for vSphere Integrated Containers Engine either on a vCenter Server instance that runs on Windows, or on a vCenter Server Appliance.

Information about virtual container hosts and container VMs appears in the **Summary** tabs for those VMs.

- Install the vSphere Integrated Containers Engine Plug-In on vCenter Server For Windows by Using a Web Server
- Install the vSphere Integrated Containers Engine Plug-In on vCenter Server For Windows Without Access to a Web Server
- Install the vSphere Integrated Containers Engine Plug-In on a vCenter Server Appliance by Using a Web Server
- Install the vSphere Integrated Containers Engine Plug-In on a vCenter Server Appliance Without Access to a Web Server
- Verify the Deployment of the vSphere Integrated Containers Engine Plug-In

Install the vSphere Integrated Containers Engine Plug-In on vCenter Server For Windows by Using a Web Server

If your vCenter Server instance runs on Windows, you can use a Web server to host the vSphere Web Client plug-in for vSphere Integrated Containers Engine.

Prerequisites

- You deployed at least one virtual container host to a vCenter Server instance that runs on Windows.
- You are running a Web server that your vCenter Server instance can access.
- You must use a Windows system to run the script to install the plug-in on a vCenter Server that runs on Windows. If you used a Linux or Mac OS system to deploy the virtual container host, download and unpack the vSphere Integrated Containers Engine package on a Windows system. For example, download the package to the system on which vCenter Server is running.

Procedure

1. On the Windows system on which you have downloaded and unpacked vSphere Integrated Containers Engine, navigate to the folder that contains the `vic-machine` utility and open the `ui` folder.
2. Upload the plug-in bundle to your Web server.

   ```
   vic_unpack_dir\vic\ui\vsphere-client-serenity\com.vmware.vicui.Vicui-version.zip
   ```

3. On the `vic-machine` system, open the `vic_unpack_dir\vic\ui\vCenterForWindows\configs` file in a text editor.
4. Enter the IPv4 address or FQDN of the vCenter Server instance on which to install the plug-in.

   ```
   SET target_vcenter_ip=vcenter_server_address
   ```

5. Enter the path to the folder on your Web server that contains the `com.vmware.vicui.Vicui-version.zip` file.

   ```
   SET vic_ui_host_url="vicui_zip_location"
   ```

6. (Optional) If you used an HTTPS address in `vic_ui_host_url`, provide the SHA-1 thumbprint of the Web server.

   ```
   SET vic_ui_host_thumbprint="thumbprint"
   ```

7. Save and close the `configs` file.
8. Open a command prompt, navigate to `vic_unpack_dir\vic\ui\vCenterForWindows`, and run the installer.

   ```
   install.bat
   ```

9. Enter the user name and password for the vCenter Server administrator account.
10. When installation finishes, if you are logged into the vSphere Web Client, log out then log back in again.

What to Do Next Check that the deployment has succeeded by following the procedure in Verify the Deployment of the vSphere Integrated Containers Engine Plug-In.

Install the vSphere Integrated Containers Engine Plug-In on vCenter Server for Windows Without Access to a Web Server

You can install the vSphere Web Client plug-in for vSphere Integrated Containers Engine on a vCenter Server instance for Windows that does not have access to a Web Server.

Prerequisites

- You deployed at least one virtual container host to a vCenter Server instance that runs on Windows.
- You must use a Windows system to run the script to install the plug-in on a vCenter Server that runs on Windows. If you used a Linux or Mac OS system to deploy the virtual container host, download and unpack the vSphere Integrated Containers Engine package on a Windows system. For example, download the package to the system on which vCenter Server is running.

Procedure

1. On the Windows system on which you have downloaded and unpacked vSphere Integrated Containers Engine, navigate to the folder that contains the `vic-machine` utility and open the `ui` folder.
2. Copy the `com.vmware.vicui.Vicui-version` folder into the folder on the vCenter Server system that contains the vSphere Web Client packages.
   - Source location on `vic-machine` system:

     ```
     vic_unpack_dir\vic\ui\vsphere-client-serenity
     ```

   - Destination location on vCenter Server Windows system:

     ```
     instl_dir\vCenterServer\cfg\vsphere-client\vc-packages\vsphere-client-serenity
     ```

     `instl_dir` is the location in which vCenter Server is installed. If the `vc-packages\vsphere-client-serenity` folders do not exist under the `vsphere-client` folder, create them manually.
3. On the `vic-machine` system, open the `vic_unpack_dir\vic\ui\vCenterForWindows\configs` file in a text editor.
4. Enter the IPv4 address or FQDN of the vCenter Server instance on which to install the plug-in.

   ```
   SET target_vcenter_ip=vcenter_server_address
   ```

5. Save and close the `configs` file.
6. Open a command prompt, navigate to `vic_unpack_dir\vic\ui\vCenterForWindows`, and run the installer.

   ```
   install.bat
   ```

7. Enter the user name and password for the vCenter Server administrator account.
8. When installation finishes, if you are logged into the vSphere Web Client, log out then log back in again.

What to Do Next Check that the deployment has succeeded by following the procedure in Verify the Deployment of the vSphere Integrated Containers Engine Plug-In.

Install the vSphere Integrated Containers Engine Plug-In on a vCenter Server Appliance by Using a Web Server

If you are running the vCenter Server Appliance, you can use a Web server to host the vSphere Web Client plug-in for vSphere Integrated Containers Engine.

Prerequisites

- You deployed at least one virtual container host to a vCenter Server Appliance instance.
- You are running a Web server that the vCenter Server Appliance can access.

Procedure

1. On the system on which you run `vic-machine`, navigate to the folder that contains the `vic-machine` utility and open the `ui` folder.
2. Upload the plug-in bundle to your Web server.

   ```
   vic_unpack_dir/vic/ui/vsphere-client-serenity/com.vmware.vicui.Vicui-version.zip
   ```

3. Open the `vic_unpack_dir/vic/ui/VCSA/configs` file in a text editor.
4. Enter the IPv4 address or FQDN of the vCenter Server instance on which to install the plug-in.

   ```
   VCENTER_IP="vcenter_server_address"
   ```

5. Enter the path to the folder on your Web server that contains the `com.vmware.vicui.Vicui-version.zip` file.

   ```
   VIC_UI_HOST_URL="vicui_zip_location"
   ```

6. (Optional) If you used an HTTPS address in `VIC_UI_HOST_URL`, provide the SHA-1 thumbprint of the Web server.

   ```
   VIC_UI_HOST_THUMBPRINT="thumbprint"
   ```

7. (Optional) If you are deploying the plug-in to a vCenter Server 5.5 instance, change the value of `IS_VCENTER_5_5` from 0 to 1.

   IMPORTANT: Deploying vSphere Integrated Containers Engine to vSphere 5.5 environments works but is not officially supported.

   ```
   IS_VCENTER_5_5=1
   ```

8. Save and close the `configs` file.
9. (Optional) If you run `vic-machine` on a Windows system, open the `vic_unpack_dir/vic/ui/VCSA/install.sh` file in a text editor and point `PLUGIN_MANAGER_BIN` to the Windows UI executable.
   - Before:

     ```
     if [[ $(echo $OS | grep -i "darwin") ]] ; then
     PLUGIN_MANAGER_BIN="../../vic-ui-darwin"
     else
     PLUGIN_MANAGER_BIN="../../vic-ui-linux"
     ```

- After:

```
if [[ $(echo $OS | grep -i "darwin") ]] ; then
PLUGIN_MANAGER_BIN="../../vic-ui-darwin"
else
PLUGIN_MANAGER_BIN="../../vic-ui-windows"
```

10. Open a command prompt, navigate to `vic_unpack_dir/vic/ui/VCSA`, and run the installer.

```
./install.sh
```

    - Make sure that `install.sh` is executable by running `chmod` before you run it.
    - On Windows systems, run `install.sh` in a UNIX shell that supports SSH and SCP, for example Cygwyn or Git Bash. Do not use Windows 10 native Bash.
11. Enter the user name and password for the vCenter Server administrator account.
12. When installation finishes, if you are logged into the vSphere Web Client, log out then log back in again.

What to Do Next Check that the deployment has succeeded by following the procedure in Verify the Deployment of the vSphere Integrated Containers Engine Plug-In.

Install the vSphere Integrated Containers Engine Plug-In on a vCenter Server Appliance Without Access to a Web Server

If you are running the vCenter Server Appliance and you do not have access to a Web server, you can manually install the vSphere Web Client plug-in for vSphere Integrated Containers Engine.

Prerequisites

You deployed at least one virtual container host to a vCenter Server Appliance instance.

Procedure

1. On the system on which you run `vic-machine`, open the `vic_unpack_dir/vic/ui/VCSA/configs` file in a text editor.
2. Enter the IPv4 address or FQDN of the vCenter Server instance on which to install the plug-in.

   ```
   VCENTER_IP="vcenter_server_address"
   ```

3. (Optional) If you are deploying the plug-in to a vCenter Server 5.5 instance, change the value of `IS_VCENTER_5_5` from 0 to 1.

   IMPORTANT: Deploying vSphere Integrated Containers Engine to vSphere 5.5 environments works but is not officially supported.

   ```
   IS_VCENTER_5_5=1
   ```

4. Save and close the `configs` file.
5. (Optional) If you run `vic-machine` on a Windows system, open the `vic_unpack_dir/vic/ui/VCSA/install.sh` file in a text editor and point `PLUGIN_MANAGER_BIN` to the Windows UI executable.
   - Before:

     ```
     if [[ $(echo $OS | grep -i "darwin") ]] ; then
     PLUGIN_MANAGER_BIN="../../vic-ui-darwin"
     else
     PLUGIN_MANAGER_BIN="../../vic-ui-linux"
     ```

   - After:

     ```
     if [[ $(echo $OS | grep -i "darwin") ]] ; then
     PLUGIN_MANAGER_BIN="../../vic-ui-darwin"
     else
     PLUGIN_MANAGER_BIN="../../vic-ui-windows"
     ```

6. Open a command prompt, navigate to `vic_unpack_dir/vic/ui/VCSA`, and run the installer.

   ```
   ./install.sh
   ```

   - Make sure that `install.sh` is executable by running `chmod` before you run it.
   - On Windows systems, run `install.sh` in a UNIX shell that supports SSH and SCP, for example Cygwyn or Git Bash. Do not use Windows 10 native Bash.

7. Enter the user name and password for the vCenter Server administrator account.
8. Enter the root password for the vCenter Server Appliance.

   The installer requires the root password of the vCenter Server Appliance three times:

   - Once to check whether the Bash shell is enabled on the vCenter Server Appliance. If the Bash shell is not enabled, the installation fails and the installer provides remedial instructions.
   - Once to copy the files to the appliance over SSH.
   - Once to set the correct ownership on the files and folders.
9. When installation finishes, if you are logged into the vSphere Web Client, log out then log back in again.

What to Do Next Check that the deployment has succeeded by following the procedure in Verify the Deployment of the vSphere Integrated Containers Engine Plug-In.

Verify the Deployment of the vSphere Integrated Containers Engine Plug-In

After you have installed or upgraded the vSphere Web Client plug-in for vSphere Integrated Containers Engine, verify the deployment of the plug-in in the vSphere Web Client.

Prerequisites

- You deployed a virtual container host.
- You installed or upgraded the vSphere Web Client plug-in for vSphere Integrated Containers Engine.
- You logged out of the vSphere Web Client after deploying the plug-in, and logged back in.

Procedure

1. In the vSphere Web Client Home page, select **Hosts and Clusters**.
2. Expand the hierarchy of vCenter Server objects to navigate to the virtual container host vApp.
3. Expand the virtual container host vApp and select the virtual container host endpoint VM.
4. Click the **Summary** tab for the virtual container host endpoint VM and scroll down to the Virtual Container Host portlet.

Result

Information about the virtual container host appears in the Virtual Container Host portlet in the **Summary** tab:

- The address of the Docker API endpoint for this virtual container host
- A link to the vic-admin portal for the virtual container host, from which you can obtain health information and download log bundles for the virtual container host.

What to Do Next

If the Virtual Container Host portlet still does not appear in the **Summary** tab for the virtual container host endpoint VM, restart the vSphere Web Client service. For instructions about how to restart the vSphere Web Client service, see vSphere Integrated Containers Engine Plug-In Does Not Appear in the vSphere Web Client.

Troubleshooting vSphere Integrated Containers Engine Installation

This information provides solutions for common problems that you might encounter when deploying virtual container hosts.

VCH Deployment Fails with Resource Pool Creation Error

When you use `vic-machine create` to deploy a virtual container host directly on an ESXi host, the installation fails with a resource pool creation error.

Problem

Deployment on an ESXi host fails during the validation of the configuration that you provided:

```
Creating resource pool failed with ServerFaultCode:
Access to resource settings on the host is restricted to the server
that is managing it: vcenter_server_address.
Exiting ...
```

Cause

You set the `target` option to the address of an ESXi host that is managed by a vCenter Server instance.

Solution

- Set the `target` option to the address of the vCenter Server instance that manages the ESXi host.
- Disassociate the ESXi host from the vCenter Server instance.
- Set the `target` option to a different ESXi host.

VCH Deployment Fails with Unknown or Non-Specified Argument Error or Incorrect User Name Error

When you use the command line installer to deploy a virtual container host, the deployment fails with an error about unknown CLI arguments, unspecified mandatory options, or an invalid user name and password.

Problem

Deployment fails during the validation of the configuration that you provided, even if you did specify the options cited as missing or incorrect. For example:

```
Image datastore path must be specified; use format datastore/path
```

```
Unknown argument: argument
vic-machine failed: invalid CLI arguments
```

```
vic-machine failed: Failed to log in to vcenter_server_or_esxi_host_address:
ServerFaultCode: Cannot complete login due to an incorrect user name or password
```

Cause

String values that you provided for certain options contain spaces, or the user name and password contain special characters.

Solution

Wrap any arguments that contain spaces or special characters in single quotation marks (') on Mac OS and Linux and in double quotation (") marks on Windows.

Option arguments that might require quotation marks include the following:

- User names and passwords in `target`, or in `user` and `password`
- Datacenter names in `target`
- Virtual container host names in `name`
- Datastore names and paths in `image-store`, `container-store`, and `volume-store`
- Network and distributed port group names in all networking options.
- Cluster and resource pool names in `compute-resource`
- Folder names in the paths for `cert`, `key`, `appliance-iso`, and `bootstrap-iso`

For information about when to use quotation marks for different options, see the descriptions of those options in Virtual Container Host Deployment Options.

VCH Deployment Fails with Firewall Validation Error

When you use `vic-machine create` to deploy a virtual container host, deployment fails because firewall port 2377 is not open on the target ESXi host or hosts.

Problem

Deployment fails with a firewall error during the validation phase:

```
Firewall must permit 2377/tcp outbound to use VIC.
```

Cause

ESXi hosts communicate with the virtual container hosts through port 2377 via Serial Over LAN. For deployment of a virtual container host to succeed, port 2377 must be open for outgoing connections on all ESXi hosts before you run `vic-machine create`. Opening port 2377 for outgoing connections on ESXi hosts opens port 2377 for inbound connections on the virtual container hosts.

Solution

Set a firewall ruleset on the ESXi host or hosts. In test environments, you can disable the firewall on the hosts.

Set a Firewall Ruleset Manually

In production environments, if you are deploying to a standalone ESXi host, set a firewall ruleset on that ESXi host. If you are deploying to a cluster, set the firewall ruleset on all of the ESXi hosts in the cluster.

IMPORTANT: Firewall rulesets that you set manually are not persistent. If you reboot the ESXi hosts, any firewall rules that you set are lost. You must recreate firewall rules each time you reboot a host.

1. Use SSH to log in to each ESXi host as `root` user.
2. Follow the instructions in VMware KB 2008226 to add the following rule after the last rule in the file `/etc/vmware/firewall/service.xml`.

   ```
   <service id='id_number'>
   <id>vicoutgoing</id>
   <rule id='0000'>
    <direction>outbound</direction>
    <protocol>tcp</protocol>
    <port type='dst'>2377</port>
   </rule>
   <enabled>true</enabled>
   <required>true</required>
   </service>
   ```

In this example, *id_number* is the number of the preceding ruleset in `service.xml`, incremented by 1.

Disable the Firewall

In test environments, you can disable the firewalls on the ESXi hosts instead of opening port 2377.

1. Use SSH to log in to each ESXi host as `root` user.
2. Run the following command:

```
$ esxcli network firewall set --enabled false
```

vSphere Integrated Containers Engine Plug-In Does Not Appear in the vSphere Web Client

After you have installed or upgraded the vSphere Web Client plug-in for vSphere Integrated Containers Engine, the plug-in does not appear in the vSphere Web Client, or the upgraded version does not appear.

Problem

The UI plug-in installer reported success, but the Virtual Container Host portlet, or its upgraded version, does not appear in the **Summary** tab for the virtual container host endpoint VM. Logging out of the vSphere Web Client and logging back in again does not resolve the issue.

Cause

- If a previous attempt at installing the vSphere Integrated Containers Engine plug-in failed, the failed installation state is retained in the vSphere Web Client cache.
- You installed a new version of the vSphere Integrated Containers Engine plug-in that has the same version number as the previous version, for example a hot patch.

Solution

Restart the vSphere Web Client service.

vCenter Server on Windows

1. Open Server Manager on the Windows system on which vCenter Server is running.
2. Select **Configuration** > **Services**.
3. Select **VMware vSphere Web Client** and click **Restart**.

vCenter Server Appliance

1. Use SSH to log in to the vCenter Server Appliance as root.
2. Stop the vSphere Web Client service by running the following command:

   ```
   service vsphere-client stop
   ```

3. Restart the vSphere Web Client service by running the following command:

   ```
   service vsphere-client start
   ```

Docker Commands Fail with a Docker API Version Error

After a successful deployment of a vSphere Integrated Containers Engine virtual container host, attempting to run a Docker command fails with a Docker version error.

Problem

When you attempt to run a Docker command from a Docker client that is connecting to a virtual container host, the command fails with the error `Error response from daemon: client is newer than server (client API version: 1.24, server API version: 1.23)`.

Cause

vSphere Integrated Containers Engine supports Docker 1.11, that includes version 1.23 of the Docker API. You are using version 1.12 of the Docker client, that uses version 1.24 of the Docker API, which is incompatible.

Solution

1. Open a Docker client terminal.
2. Set the Docker client API to the same version as is used by vSphere Integrated Containers Engine.

   ```
   export DOCKER_API_VERSION=1.23
   ```

3. Check that your Docker client can now connect to the virtual container host by running a Docker command.

   ```
   docker -H virtual_container_host_address:2376 --tls info
   ```

   The `docker info` command should succeed and you should see information about the virtual container host.