Installing the Controller in Oracle Cloud Infrastructure

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Cisco Catalyst Wireless Controller for Cloud on Oracle Cloud Infrastructure

The IOS XE based Cisco Catalyst Wireless Controller for Cloud (C9800-CL) sets the standard for Infrastructure as a Service (IaaS) secure wireless network services with Oracle Cloud Infrastructure (OCI). C9800-CL combines the advantages and flexibility of an OCI public cloud with the customization and feature-richness that customers usually experience on-prem deployments.

Scalability

C9800-CL scales up to x Access Points and y clients with features like Zero Touch AP provisioning, High Availability, Application Visibility and Control, and more. Here, x and y values depend on the capacity of the instance.

The following are the scale values for small, medium, and large instances:

Small: 1000 APs and 10,000 clients

Medium: 3000 APs and 32,000 clients

Large: 6000 APs and 64,000 clients

OCI Compute Instances

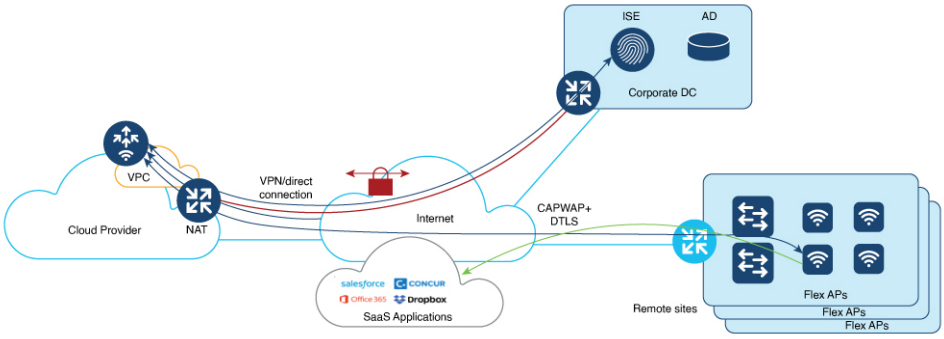
OCI Compute service helps you provision and control the compute hosts, referred to as instances. You can create instances according to your specific compute and application needs.

When you create an instance, you can

- securely connect to it from your own computer
- reboot it
- connect and disconnect storage volumes, and
- shut it down permanently when it is no longer needed.

Any changes made to the local drives of the instances are lost when you terminate it. Any saved changes to volumes attached to the instance are retained.

Figure 1: OCI Networking



Supported Cloud Deployment Scenarios

The Cisco Catalyst Wireless Controller for Cloud supports the following deployment scenario:

- Virtual Private Network (VPN) between the AP locations and the Public Cloud
- Connect directly to the Public IP of the controller in the cloud

Guidelines and Limitations

- Cisco Catalyst 9800 Wireless Controller for Cloud - Ultra-Low Profile is not supported on public cloud.
- Only a single interface (single VNIC) is supported
- Only FlexConnect mode (Local Switching) is supported.
- The following operations will lock you out of the OCI instance, without a possible recovery:
  - Deleting SSH credentials
  - Providing incorrect SSH credentials
  - Deleting interface configuration

- Providing incorrect interface configuration
- Configuring **write erase**

Virtual Cloud Network

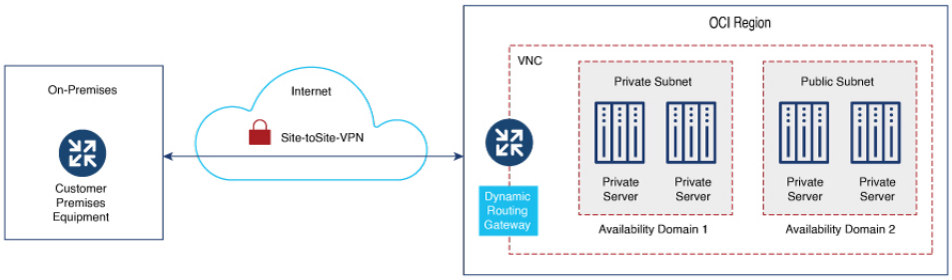
The Virtual Cloud Network (VCN) in Oracle Cloud Infrastructure (OCI) serves as the foundational networking layer, like the Virtual Private Cloud (VPC) offered by other cloud services. A VCN is similar to a physical network which is virtualized within OCI.

With a VCN you can

- establish a tailored and isolated network within Oracle's cloud environment
- define the IP address space
- set up subnetworks, and
- manage traffic flow by configuring route tables and gateways, both within the VCN and to external destinations.

In OCI you can either create and assign a new VCN or use an existing VCN.

Figure 2: OCI Virtual Cloud Network



Creating a New VCN

You can create a VCN that is used by instances, load balancers, and other resources to connect to each other and to the internet. Create a new VCN manually or with the help of the VCN Wizard. The wizard maps default subnets and gateways for the VCN. If you use the manual option, you must manually create subnets and gateways, else you can use the defaults.

Create VCN using VCN Wizard

Step 1 Choose **OCI console** > **Networking** > **Virtual Cloud Networks**.

Step 2 Click **Start VCN Wizard**.

Step 3 Click one of the following options:

- **Create VCN with Internet Connectivity**: Creates a VCN with a public subnet that is connected through the Internet. It also creates a private subnet that connects to the Internet through the NAT gateway, and privately connects to the Oracle Services Network.
- **Add Internet Connectivity and Site-to-Site VPN to a VCN**: Adds a site-to-site VPN between your on-premise network and a VCN you have selected.

Step 4 In the **Configuration** section, enter the **VCN name**.

Step 5 Map the VCN to the correct **Compartment**.

Step 6 In the **Configure VCN** section, enter the **VCN IPv4 CIDR block.**

Note If you plan to peer this VCN with another VCN, the VCNs must not have overlapping CIDR blocks.

Step 7 Enter the **IPv4 CIDR block** for public and private subnets.

Step 8 In the **Review and create** window, verify the configuration details of the subnet and click **Review and create**. Internet, NAT, and Service Gateways are created for the VCN. Default security lists and route tables are used. The rules added to the default security lists and the route tables are also displayed, which can be modified later.

Create a VCN Manually

Before you begin

For a manually created VCN, ensure that the following components or resources are availabe for Internet connectivity or connectivity to on-premise network:

- Subnets – Private and Public
- Internet Gateway
- Security Lists
- Route Tables
- NAT Gateway
- Service Gateway

Step 1 Choose **OCI console** > **Networking** > **Virtual Cloud Networks**.

Step 2 Click **Create VCN**.

Step 3 In the **Create a Virtual Cloud Network** window, in the **IPv4 CIDR Blocks** field, enter the IPv4 CIDR block for the VCN.

Step 4 Click **Create VCN**.

What to do next

- Create a public and private subnet
- Create a security list
- Create an internet gateway

- Create a route table
- Create a NAT gateway
- Create a service gateway

Create Public and Private Subnets

Public Subnet

Create a public subnet in the **Subnet Access** option to allow all public IP addresses for instances deployed with this subnet.

Create a Public Subnet

For information and detailed steps about creating a public subnet, refer to Create a Public Subnet.

Private Subnet

Create a private subnet in the **Subnet Access** option to prohibit all public IP addresses for instances deployed with this subnet.

Create a Private Subnet

For information and detailed steps about creating a private subnet, refer to Create a Private Subnet.

Create a Security List

Security Lists

Security lists are virtual firewalls for the instances for which you can define ingress and egress rules that apply to all the VNICs in the subnet.

Create a Security List

For information and detailed steps about creating a security list, see Create a Security List.

Note You can restrict access to your instance using the security lists, for security reasons. For example, if you want to permit only CAPWAP from a certain IP range, so that only those APs register with the controller, you must enable inbound and outbound rules for CAPWAP.

The following table lists the ports and protocols that may be enabled on the controller:

Ports	Protocols
UDP 5246/5247/5248	CAPWAP
TCP 22	SSH, SCP
TCP 21	FTP
ICMP	Ping

Ports	Protocols
UDP 161, 162	SNMP/SNMP traps
TCP 443/80	HTTPs/HTTP
TCP/UDP 49	TACACS+
UDP 53	DNS Server
UDP 1812/1645/1813/1646	Radius
UDP 123	NTP Server
UDP 514	Syslog

Create an Internet Gateway

Internet Gateway

An internet gateway is an optional gateway you can add to your VCN to enable direct connectivity to the internet. The gateway supports connections initiated from within the VCN (egress) and connections initiated from the internet (ingress). Resources that need to use the gateway for internet access must be in a public subnet and have public IP addresses. Resources that have private IP addresses can use a NAT gateway to initiate connections to the internet.

Create an Internet Gateway

For information and detailed steps about creating an internet gateway, refer to Create an Internet Gateway.

Create a Route Table

Route tables are lookup tables for the VCN to send traffic to the internet, the on-prem network, or to a peered VCN. They are like network routes. Intra-VCN within the subnets are handles by the local-routing of the VCNs. Route tables contain rules that have a certain priority for each. In case of overlapping ones, the prior one is chosen. For traffic that do not match any route, rules are dropped.

Create a Route Table

For information and detailed steps about creating a route table, see Create a Route Table.

Create a NAT Gateway

NAT Gateway

You can add a NAT gateway to your VCN to give instances in a private subnet access to the internet. Instances in a private subnet do not have public IP addresses. With the NAT gateway, they can initiate connections to the internet and receive responses, but not accept inbound connections initiated from the internet.

Create a NAT Gateway

For information and detailed steps about creating a NAT gateway, see Create a NAT Gateway.

Create a Service Gateway

Oracle Cloud Infrastructure (OCI) Service Gateway provides private and secure access to multiple Oracle cloud services simultaneously from within a virtual cloud network (VCN) or an on-premise network through a single gateway, without traversing the internet. Services accessed through their public IP address are routed through OCI Service Gateway rather than an internet gateway when exiting a VCN.

Create a Service Gateway

For information and detailed steps about creating a service gateway, refer to Create a Service Gateway.

Create a VPC Instance

Step 1 Navigate to the OCI console and choose **Compute** > **Instances**.

Step 2 Click **Create Instance**.

Step 3 Enter the name of the instance.

Step 4 In the **Create in compartment** field, scroll and select the required compartment.

Step 5 In the **Placement** section, select the **Availability domain**.

Step 6 In the **Image and shape** section, choose the desired image for the instance.

Step 7 Click **Select image**.

Step 8 In the **Browse all shapes** section, select the **Instance type** and the **Shape series**.

Note The shape series includes the processors, OCPUs, and the memory for the instance.

Step 9 Click **Select shape**.

Step 10 In the **Primary VNIC information** section, choose the **Primary network**.

Step 11 Choose public or private subnets.

Step 12 In the **Primary VNIC IP addresses** section, assign private and public IPv4 addresses.

Note VNIC private and public IPV4 addresses can be either assigned automatically or manually.

Step 13 In the **Add SSH keys** section, select one of the following:

- **Generate a key pair for me**
- **Upload public key files (.pub)**
- **Paste public keys**
- **No SSH keys**

Step 14 Click either the **Save private key** or the **Save public key** button to download the keys for SSH access to the controller instance.

The instance moves to the **Provisioning** state and then moves to the **Running** state. When the instance comes up, go to the console details and select **Console connection** and create a local connection with the SSH keys.

Initial Setup of Controller Using a Wizard (GUI)

You can access the controller GUI by using the public IP of the VCN assigned in the NAT gateway. Since the instance is not configured, when you log in, you are redirected to the Day 0 window.

Step 1 In the **Configuration Setup Wizard**, under the **General Settings** window, add and verify the following:

a) Change the **Hostname**, if required, as the hostname from the initial configuration appears.
b) Configure the correct **Country, Date,** and **Time/Timezone**.
c) Add **NTP/AAA severs**, if required.
d) Within the sub-section **Wireless Management Settings,** verify if the interface is mapped with the correct private IP address, same as that of the instance.

Step 2 In the **Wireless Network Settings** window, add a WLAN network.

Step 3 In the **Advanced Settings** window, complete the RF parameters such as the **Client Density**, **RF Group Name**, **Traffic Type**, and the **Virtual IP Address**.

Step 4 In the **AP Certificate** section, complete the following:

a) In the **General Certificate** toggle field, choose **YES**.
b) From the **RSA Key-Size** drop-down list, choose the required key-size.
c) From the **Signature Algorithm** drop-down list, choose the required algorithm.
d) In the **Password** field, set the AP certificate password for the APs to join the wireless controller.

Note These parameters will be used to create a self-signed certificate on the wireless controller.

Step 5 Click **Summary** to review the configuration details.

Step 6 Click **Finish**.

The configuration and trust point are pushed to the device. The C9800-CL controller will not reboot. After 60 seconds, log in again, by entering the same credentials. The C9800-CL controller GUI **Dashboard** is displayed, where you can view the WLAN details.

Initial Setup of Controller

Step 1 Connect to the controller console when the instance is provisioned and running.
The prompt for the initial configuration of the controller is displayed.

Step 2 Configure the Management Setup and the Wireless Setup through the initial configuration of the controller.

Step 3 Enable the credentials for the WebUI and HTTP, to access the GUI of the controller.

Enabling Public IP on the Controller

The controller has two types of IPs — Private IP and Public IP.

To enable the Wireless Management Interface with Public IP, complete the following:

Procedure

	Command or Action	Purpose
Step 1	**configure terminal** **Example:** `Device# configure terminal`	Enters global configuration mode.
Step 2	**wireless management interface** *interface-type interface-number* **Example:** `Device(config)# wireless management interface gigabit 1`	Defines the management interface. Here, • *interface-type*—Refers to the Gigabit interface. • *interface-number*—The interface number is 1. **Note** The Public cloud VM supports only the following: • Gigabit as the interface-type. • 1 as the interface-number.
Step 3	**public-ip** *external-public-ip* **Example:** `Device(config-mgmt-interface)# public-ip x.x.x.x.`	Defines the external Public IP (x.x.x.x).
Step 4	**end** **Example:** `Device(config-mgmt-interface)# end`	Returns to privileged EXEC mode.

Enabling CAPWAP Discovery to Respond Only with Public or Private IP

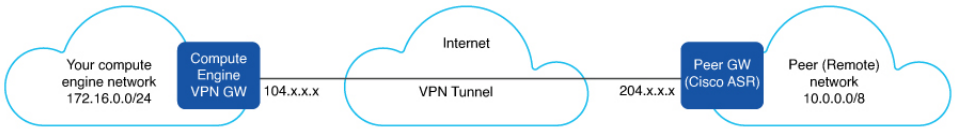
By default, the CAPWAP discovery response covers both private and public IP.

- To enable the controller to respond only with a private or public IP, see the Configuring CAPWAP Discovery to Respond Only with Public or Private IP (CLI) section in *Cisco Catalyst 9800 Series Wireless Controller Software Configuration Guide*.

VPN Tunnel

With the help of the VPN tunnel, the APs can reach the wireless controller instance without exposing the network to internet.

Figure 3: VPN Tunnel



Create a VPC-VPN Connection

The wizard sets up Site-to-Site VPN between your on-premises network and the Oracle VCN. To provide a VPN access to a VPC instance using Site-to-Site VPN, the following elements are required:

1. VCN with a private or public subnet
2. Dynamic Routing Gateway (DRG) to be attached with the VCN
3. Internet Gateway (IG)
4. Security Lists
5. Subnets to be mapped to the VPN
6. Customer-Premises Equipment (CPE)

Step 1 On the OCI Console, choose **Networking** > **Customer connectivity** > **Site-to-Site VPN**.

Step 2 Click the **Start VPN Wizard** button to create the Site-to-Site VPN.

Note Click the **Start VPN Wizard** button to create the Site-to-Site VPN, or, click the **Create IPSec connection** button to do it manually.

Step 3 In the **Create Site-to-Site VPN** window, complete the following:

a) **Compartment**: Choose the appropriate compartment VCN to which the Site-to-Site VPN should be mapped. Select a default compartment for all new resources.
b) **Virtual cloud network**: Choose an existing VCN for this connection.
c) **Dynamic routing gateway**: Create a new DRG or choose and existing DRG. To access your on-premises network, the VCN must be connected to a DRG.
d) **Internet gateway**: Choose an already existing internet gateway. An internet gateway helps you to quickly connect to an instance in a public subnet in your VCN.

Step 4 Click **Next**.
The **Subnets and security** window is displayed.

Step 5 In the **Subnets and security** window,

- **Select existing security list**: Choose the security list for each subnet you choose.
- **Create new security list**: Create a new security list which contains the new security rules.

Step 6 Choose the subnets from the list and click **Next**.

Step 7 In the **Site-to-Site VPN** window, choose one **Routing type**.

- **BGP dynamic routing**: The available routes are learned dynamically through BGP.

- **Static routing**: Static routing requires you to manually provide the static routes for subnets in your on-premises network.
- **Policy based routing**: The routes are static and not learned dynamically.

Step 8 In the **Routes to your on-premises network** field, add the IP addresses. This is necessary for the establishment of the VPN tunnel.
Tunnel 1 and Tunnel 2 are created, based on the IKE version and a **Shared secret**, the Oracle side and the CPE.

Note Ensure that the tunnels are in the UP state, for the VPC-VPN connection to work.

Step 9 Click **Next**.
The **Customer-premises equipment** window is displayed.

Step 10 In the **Customer-premises equipment** window, select an existing CPE by choosing the **Select existing** option, or, create a new CPE by choosing the **Create new** option.

Step 11 Enter the **CPE name** and **IP address**.

Step 12 In the **CPE vendor information** section, choose the vendor and the platform or the version.

Step 13 Click **Next**.
The **Review and create** window is displayed.

Step 14 In the **Review and create** window, review the details.

Step 15 Click the **Create VPN** button.
The **Provision successful** message is displayed.

You can view the VPN solution summary after provisioning.

Step 16 In the **CPE Configuration Helper** window, enter the **IPSec connection** details or leave it as optional.

Step 17 Click **Create Content** to get the configurations of the CPE.
You can view the VPN details in the **VPN Solution Summary**. The IPSec connection will be established after the CPE is configured correctly.

Troubleshooting - Controller on the Oracle Cloud Infrastructure

- When the instance is launched, it would take around 8 - 9 minutes before it becomes reachable. Check the status of all the components of the VCN and the ensure that the instance is in **Running** state.
- **Configuration Issues**:
  - The memory allocated for the instance should be equivalent to the required minimum for the instance to be provisioned properly.
  - Upload the bootable custom images properly to the OCI console for the instance to use it.
- **System Reachability Issues**:
  - Correct use of key-pair for SSH or VCN access.
  - Controller misconfiguration.
  - Verify the rules in the Security Lists of the VCN. Use **ssh -w** to debug the SSH access to the controller.

- **AP Join Issues**:
  - Reachability of APs to the public or private IP of the controller instance.
  - Wrong auth-token.
  - Generation of the management trust points for the controller.
- **VPC-VPN Issues**:
  - Wrong shared secret.
  - Misconfiguration of the on-premises router.
  - Configuration of wrong route rules.