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Overview of Cisco CSR 1000v on Google Cloud Platform

The Cisco Cloud Services Router (CSR) 1000v is a virtual router running Cisco IOS XE. Most Cisco IOS XE features are available on the Cisco CSR 1000v.

You can choose to deploy Cisco CSR 1000v software on new or existing infrastructure, such as a VPC network.

The following VPN features are supported on the Cisco CSR 1000v: IPsec, DMVPN, FlexVPN, Easy VPN, and SSLVPN. You can use dynamic routing protocols, such as EIGRP, OSPF, and BGP.

You can secure, inspect, and audit network traffic with the application-aware Zone-Based Firewall. You can also use IP SLA and Application Visibility and Control (AVC) to detect performance issues, fingerprint application flows, and export detailed flow data.

Prerequisites for Deploying Cisco CSR 1000v on Google Cloud Platform

The following are prerequisites when deploying a Cisco CSR 1000v on Google Cloud Platform (GCP):

- You must have a user account or subscription with Google Cloud Platform.
- Several resources must be deployed before, or during, the deployment of the Cisco CSR 1000v.
- To obtain full traffic throughpput, you must obtain a software license for the Cisco CSR 1000v. Otherwise, throughput is limited to 1 Mbps.
Google Cloud Platform Resources

To deploy a Cisco CSR 1000v on Google Cloud Platform (GCP), you must create a project with the following resources: virtual machines, interfaces, VPC networks, routes, public IP addresses, firewall rules, and storage. Resources that exist in different projects can only connect through an external network. For more information on projects, see The Project resource, and Creating and Managing Projects in the Google Cloud Platform (GCP) resource hierarchy.

The following list is a summary of some of the resources that are used by a project for the Cisco CSR 1000v on Google Cloud Platform:

- Virtual Private Cloud (VPC) network—connects VM instances and has subnets with defined IP addresses.
- VM instance—created from a boot disk image. For example, n1-standard-2 (2 vCPUs, 7.5 GB RAM, 2 virtual Network Interface Cards (vNICs)).
- Subnet—includes a subnet route, which is the next hop IP address. The next hop IP address defines a communication path to and from the resources for the subnet.
- Firewall rules—security rules for the VPC network.
- Routes—a route maps an IP address range to a destination. This route allows the VPC network to send packets to the correct destination for an IP address. For more information, see Routes Overview.
- Storage—persistence disk storage that is used to hold disk or container images for VM instances. For more information, see Storage Options.
- Interfaces—You can assign a public IP address to each network interfaces of a Cisco CSR 1000v VM. (Usually, a public IP address is assigned to the first interface.) All Cisco CSR 1000v VM interfaces are in a private subnet. You can assign the IP address of each private interface using the `ip dhcp address` command in the interface configuration. Alternatively, you can assign a static IP address using the `ip address` command (for example, `ip address 1.1.1.1 255.255.255.0`). If you use a static IP address, ensure that the IP address is the same as the IP address assigned by GCP. Later, to view some details about the interface, use the `show ip interface brief` command.

Cisco CSR 1000v with Two Network Interfaces—Example

This example shows a topology diagram that results after deploying a Cisco CSR 1000v on GCP.

The Cisco CSR 1000v VM was created from image "n1-Standard-2" and has two interfaces and two vCPUs. This Cisco CSR 1000v has a public IP address of 40.121.148.7 for the interface of the first subnet (NIC0). The firewall rule "csr-firewallrule-1" is assigned to this interface.

Note
Create a firewall rule to allow traffic to pass in a custom VPC network. (Without a firewall rule, by default, all traffic is blocked.)
Licensing for a Cisco CSR 1000v on Google Cloud Platform

The Cisco CSR 1000v on GCP supports the following license model:

Bring Your Own License Model

The Bring Your Own License (BYOL) licensing model, for the Cisco CSR 1000v on GCP, supports the following two types of license:

- Cisco Software License (CSL)—uses a traditional Product Authorization Key (PAK) licensing model. For further information on using a PAK, see Cisco Software Licensing (CSL).

- Cisco Smart Licensing—assigns a license to Cisco CSR1000v instances dynamically. This allows you to manage licenses across different CSR1000v instances without having to lock each license to a specific CSR1000v UDI serial number. For more information on Cisco Smart Licensing, see Smart Licensing.

The cost of licensing using BYOL in GCP, includes the cost of a GCP instance and the cost of a Cisco CSR 1000v license.
Create an SSH Key

To create an SSH key, which is required to access a Cisco CSR 1000v VM instance, perform the following steps. Enter the commands at a terminal server.

**Step 1**

Execute `ssh-keygen -t rsa -f ~/.ssh/keyfile [ -C username ]`

* -C username - Username, which is added as a comment. This variable is optional.

Two key files are created; a private key and a public key in the .ssh directory. For example, mykey and mykey.pub.

For more information on creating an SSH key, see Creating a new SSH key in the Google Cloud Platform documentation. See also Managing SSH keys in Metadata.

**Example:**

```
ssh-keygen -t rsa -f /users/joe/.ssh/mykey -C joe
```

**Step 2**

`cat ~/.ssh/[keyfile_pub]`

* keyfile_pub specifies the public key; for example, mykey.pub.

**Example:**

```
Example: cat /users/joe/.ssh/mykey.pub
```
Create a VPC Network

Before you begin
To learn about VPC networks, see: Virtual Private Cloud (VPC) Network Overview and Using VPC Networks.

Step 1
From the navigation pane in the Google Cloud Platform console, scroll down to VPC network and select VPC networks.
Step 2
Click Create VPC Network.
Step 3
Enter a Name for the network. CREATE VPC NETWORK.
Step 4
Enter a Description for the network.
Step 5
Select Subnets > Add Subnet.
Step 6
In the New Subnet dialog box, Enter a Name for the subnet. For example, csrnet1.
Step 7
Select the appropriate option in the Region field.
Step 8
Enter an IP address range. For example, enter 10.10.1.0/24 for the subnet address.
Step 9
Click Done to create the subnet.
To create multiple subnets for the VPC network, repeat steps 5 to 9.
Step 10
Click Create to create the VPN Network.

Create an External IP Address

To create an external IP address, you reserve an IP address by performing the following steps. You can later use the IP address to connect to a VM instance using an SSH session.

Step 1
From the navigation menu in the Google Cloud Platform Console, scroll down to "VPC network" and select "External IP Addresses".
For more information about IP addresses, see: IP Addresses.
Step 2
Click Reserve static address.
These are the field names and permissible values:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Enter a name (in lowercase) for this address.</td>
</tr>
<tr>
<td>Description</td>
<td>Enter a description for this address.</td>
</tr>
</tbody>
</table>
The premium tier gives a higher performance than the standard tier.

**Network Service Tier**

- premium
  - The premium tier gives a higher performance than the standard tier.

**IP Version**

- IPv4

**Type**

- Regional

**Region**

- Select a location.
  - Example: "us-east2".

---

**Step 3**

Click **Reserve**.

Reserves this IP address.

---

## Create Firewall Rules

To enable traffic to pass to a VM instance, you must create a firewall rule by performing the following steps. For more information on firewall rules, refer to "Firewalls" in VPC Networking and Firewalls.

**Note**

After creating a firewall rule, you can change only some of its values. The following properties cannot be changed: "Network" (that is, the network to which the rule originally applied), "Priority", "Direction of traffic," and "Action on match". Therefore, in future you may need to delete the original rule and replace it with a new rule.

---

**Step 1**

From the navigation menu in the Google Cloud Platform Console, scroll down to "VPC network" and select "Firewall Rules".

**Step 2**

Click "CREATE FIREWALL RULE".

Enter the specified values for the following fields:

**Table 2: Firewall Rules Fields**

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network</td>
<td>Default.</td>
</tr>
<tr>
<td>Priority</td>
<td>1000</td>
</tr>
<tr>
<td></td>
<td>Values: 0–65535. Default: 1000. A lower value results in a higher priority being assigned to this rule.</td>
</tr>
<tr>
<td>Traffic Direction</td>
<td>Ingress.</td>
</tr>
<tr>
<td></td>
<td>Values: Ingress, Egress.</td>
</tr>
</tbody>
</table>
### Create a VM Instance

Perform the following steps to deploy a Cisco CSR 1000v VM instance on Google Cloud Platform.

For more information, see: Creating and Starting a VM Instance.

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Click <strong>Compute Engine</strong> and <strong>VM Instances</strong>.</td>
</tr>
<tr>
<td>2</td>
<td>Click <strong>CREATE INSTANCE</strong>. Select a boot disk to create a new CSR 1000v VM instance (from &quot;OS Images&quot; or custom images) and enter values for the following fields.</td>
</tr>
<tr>
<td>3</td>
<td>Specify the name for your VM in the <strong>Name</strong> field. You can name for your VM, using only lowercase letters. Example: &quot;newtestvm&quot;.</td>
</tr>
<tr>
<td>4</td>
<td>Specify the <strong>Region</strong>.</td>
</tr>
<tr>
<td>5</td>
<td>Specify the <strong>Zone</strong>. The zone is often a data center with a region.</td>
</tr>
<tr>
<td>6</td>
<td>Select the <strong>Machine type</strong>. Select one of the following options from the drop-down list: n1-standard-2, n1-standard-4, n1-standard-8. The machine type is associated with an image filename. For example, the 2vCPUs machine type for the Cisco CSR 1000v has an image filename of &quot;n1-standard-2&quot;.</td>
</tr>
</tbody>
</table>
Step 7  
(Optional) Click **Customize** to select the number of cores (vCPUs), memory size, and GPUs.

Step 8  
In the **Boot disk** section, click **Change**.

Step 9  
Select a Cisco CSR 1000v image. See the **Marketplace** to select the CSR 1000v image.

Step 10  
In the **Boot Disk** window, for the **Boot disk** type, select **SSD persistent disk**.

Step 11  
Click **Select**.

In the **Create an Instance** window, the name of the previously selected image appears in the **Boot disk** section.

**Note**  
In the **Identity and API Access** section, do not change the value of the **Service account**.

Step 12  
Select **Allow default access**.

Step 13  
In the **Firewall** section, select either: **Allow HTTP traffic** or **Allow HTTPS traffic**.

Step 14  
Click **Management, disks, networking, SSH keys**.

Step 15  
Click **Networking**.

Step 16  
Click **Add interface**.

Step 17  
In the Networking Interfaces dialog box, select the default interface. For example, the default security group is 10.142.0.0/20.

Step 18  
In the Networking Interface window, select the first default interface.

Step 19  
Set **IP Forwarding** to **On**. This setting prevents the traffic from being blocked.

Step 20  
Set **Primary internal IP** to **Ephemeral (automatic)**. This private IP address is obtained automatically from the selected subnet.

Step 21  
Set **External IP** to **Ephemeral (automatic)**.

Specify **Ephemeral (automatic)**. Later, you can use this public IP address when you start an SSH session from a terminal server. You may also choose to specify this External IP address as static. The external IP address of each interface is either ephemeral or static.

Step 22  
Click **Done**.

Step 23  
(Optional) Click **Add network interface** to add a second interface.

This step is optional. If you do not want to add a second interface, go to step 31 "SSH Keys".

Step 24  
Enter **Name** to specify the name of the second interface.

Step 25  
Select a **Network**.

Step 26  
Select a **Subnetwork**.

Step 27  
For the primary internal IP, select **Ephemeral (automatic)**. The private IP address is obtained automatically from the selected subnet.

Step 28  
For the external IP, select **None**.

For the second interface, you can select **None**. You do not need a public IP address on this interface as you previously set an external IP address on the first interface.

Step 29  
Click **Done**.

Step 30  
In the **SSH Keys** section, paste the SSH key from the public key that you created earlier in the **Create an SSH Key, on page 5** section.

The SSH key is an instance-wide SSH key. The settings are applicable only to this VM instance, and not to the whole project.

Step 31  
Click **Create**.
The newly created Cisco CSR 1000v VM instance boots up, and may take 5 to 10 minutes. To check whether the VM instance is up, click the Cisco CSR 1000v name and under Logs, click Serial Port. If you see, for example, "Adding eth0 entry", it indicates that the instance is still booting up.

Create Routes

Perform the following steps to create each route for traffic in the VPC network.

**Step 1**  
Under "VPC Network", select Routes. 
The "Route details" window opens.

**Step 2**  
Click CREATE ROUTE. 
Enter the specified values for the fields:

<table>
<thead>
<tr>
<th>Field</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name</td>
<td>Enter a name (in lowercase) for this address.</td>
</tr>
<tr>
<td></td>
<td>Example: &quot;northboundtosouthbound&quot;.</td>
</tr>
<tr>
<td>Description</td>
<td>Enter a description for this address.</td>
</tr>
<tr>
<td></td>
<td>Example: &quot;Route to Linux&quot;.</td>
</tr>
<tr>
<td>Network</td>
<td>Name of the VPC network.</td>
</tr>
<tr>
<td></td>
<td>Example: &quot;csrnet220&quot;.</td>
</tr>
<tr>
<td>Destination IP range</td>
<td>Example: 10.12.1.0/24.</td>
</tr>
<tr>
<td>Next hop</td>
<td>Enter a value for the &quot;Next hop&quot; destination, using one of the following fields: Instance, Gateway, or IP address.</td>
</tr>
<tr>
<td></td>
<td>Example (IP address): 10.11.1.2.</td>
</tr>
</tbody>
</table>

**Step 3**  
Click Create.  
Creates a route.

Access the Cisco CSR 1000v CLI

This task describes how to access the CLI of the Cisco CSR 1000v VM using SSH and how to increase the speed of the interfaces.
Before you begin

Before accessing the Cisco CSR 1000v VM instance using an SSH session, the Cisco CSR 1000v VM instance must be up.

---

**Note**

In the "VM instances" window, the SSH tab is not enabled for a Cisco CSR 1000v VM. You must, therefore, set up an SSH using CLI commands, which are described in the table at the Procedure section.

---

### Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Command or Action</th>
<th>Purpose</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>In a terminal server, enter the following command: <code>ssh -i ~/.ssh/[keyfile] username@ instance-external-IP</code>. <strong>Example:</strong> <code>ssh -i /users/joe/.ssh/mykey.pub joe@10.0.0.2</code></td>
<td>Logs into the Cisco CSR 1000v using an SSH session. <code>~/.ssh/keyfile</code> represents the path and filename of the public key. After logging in, you can enter Cisco IOS XE commands using the CLI.</td>
</tr>
<tr>
<td>2</td>
<td><code>interface interface-name</code> <strong>Example:</strong> <code>Router(config)# interface GigabitEthernet1</code></td>
<td>Enters interface configuration mode. (The following steps are recommended in order to increase the speed to 10 Gbps for each interface.).</td>
</tr>
<tr>
<td>3</td>
<td><code>ip address dhcp</code> <strong>Example:</strong> <code>Router(config-if)# ip address dhcp</code></td>
<td>Acquires an IP address on an interface from DHCP.</td>
</tr>
<tr>
<td>4</td>
<td><code>speed 10000</code> <strong>Example:</strong> <code>Router(config-if)# speed 10000</code></td>
<td>Set speed to 10 Gbps.</td>
</tr>
<tr>
<td>5</td>
<td><code>no negotiation auto</code> <strong>Example:</strong> <code>Router(config-if)# no negotiation auto</code></td>
<td>Disables autonegotiation.</td>
</tr>
<tr>
<td>6</td>
<td><code>exit</code> <strong>Example:</strong> <code>Router(config-if)# exit</code></td>
<td>Exits interface configuration mode.</td>
</tr>
<tr>
<td>7</td>
<td>Repeat steps 2 to 6 to increase the speed for the second interface of the Cisco CSR 1000v.</td>
<td></td>
</tr>
</tbody>
</table>

---

### Configuring IPsec VPN for a Cisco CSR 1000v on Google Cloud Platform

This example shows the configuration of an IPsec VPN on a Cisco CSR 1000v on GCP.
crypto isakmp policy 1
  encr aes
  hash sha256
  authentication pre-share
  group 14
crypto isakmp key cisco123 address 0.0.0.0
crypto ipsec transform-set T1 esp-3des esp-md5-hmac
  mode transport
  crypto ipsec profile P1
    set transform-set T1
interface Tunnel0
  ip address 10.0.0.2 255.255.255.0
  tunnel source GigabitEthernet1
  tunnel mode ipsec ipv4
  tunnel destination 198.51.100.253
  tunnel protection ipsec profile P1
end
ip route 6.6.6.6 255.255.255.255 Tunnel0
Deploy a CSR 1000v by Using a Solution Template

You can deploy a CSR 1000v router in Google Cloud Platform (GCP) in two ways: by using a VM instance, or by using a solution template. This chapter specifies how you can deploy a CSR 1000v solution template and the configuration of the associated resources in the service provider’s cloud.

- Create an SSH Key, on page 13
- Create a VPC Network, on page 14
- Deploy the CSR Solution Template, on page 14

Create an SSH Key

To create an SSH key, which is required to access a Cisco CSR 1000v VM instance, perform the following steps. Enter the commands at a terminal server.

**Step 1**

Execute `ssh-keygen -t rsa -f ~/.ssh/keyfile [-C username]`

`~/.ssh/keyfile` - Directory path and filename of the key. Example: `/users/joe/.ssh/mykey`

`-C username` - Username, which is added as a comment. This variable is optional.

Two key files are created; a private key and a public key in the .ssh directory. For example, `mykey` and `mykey.pub`.

For more information on creating an SSH key, see Creating a new SSH key in the Google Cloud Platform documentation.

See also Managing SSH keys in Metadata.

**Example:**

```bash
ssh-keygen -t rsa -f /users/joe/.ssh/mykey -C joe
```

**Step 2**

`cat ~/.ssh/[keyfile_pub]`

`keyfile_pub` specifies the public key; for example, `mykey.pub`.

**Example:**

```bash
cat /users/joe/.ssh/mykey.pub
```

The system displays the contents of the public key. You will need this public key to Create a VM Instance, on page 8.
Create a VPC Network

Before you begin

To learn about VPC networks, see: Virtual Private Cloud (VPC) Network Overview and Using VPC Networks.

Step 1
From the navigation pane in the Google Cloud Platform console, scroll down to VPC network and select VPC networks.

Step 2
Click Create VPC Network.

Step 3
Enter a Name for the network. CREATE VPC NETWORK.

Step 4
Enter a Description for the network.

Step 5
Select Subnets > Add Subnet.

Step 6
In the New Subnet dialog box, Enter a Name for the subnet. For example, csrnet1.

Step 7
Select the appropriate option in the Region field.

Step 8
Enter an IP address range. For example, enter 10.10.1.0/24 for the subnet address.

Step 9
Click Done to create the subnet.

To create multiple subnets for the VPC network, repeat steps 5 to 9.

Step 10
Click Create to create the VPN Network.

Deploy the CSR Solution Template

Step 1
Go to the Google Marketplace and search for Cisco CSR100v. Select the CSR Template.
Figure 1: Select CSR Deployment Template
Step 2  Click **Launch On Compute Engine**.

Step 3  In the New Cisco 1000v Deployment screen, provide the following details:

a) **Deployment name**: This field is filled by default, and displays the cisco-csr1000v-'deployment number'

b) **Instance Name**: The name of the CSR 1000v instance in text format. You must follow the GCP naming pattern for successful deployment. The name of the instance must be a combination of regex '^[a-zA-Z0-9]{1,61}$'

c) **Username**: Specify the username that is used to access the CSR 1000v instance.

d) **Instance SSH Key**: Specify the public key to be used for SSHing into the instance. To know how to create an ssh-key, see **SSH-Key**.

e) **Zone**: Select the zone where the CSR 1000v is deployed from the drop-down list.

f) **Machine Type**: Select the size of the CSR 1000v that you want to deploy. For more information on CSR 1000v sizes, see **MachineTypes**.

Bootdisk

h) **Boot disk size in GB**: The default value is 10 GB. Cisco recommends that you use the default Boot disk size.

Networking

i) **Network (VPC)**: Select the network in the region where you want to deploy the CSR 1000v instance. You must create the Network (VPC) before you create the CSR 1000v instance. Ensure that at least one subnet is associated to that Network (VPC). For more information about VPC networks, see Virtual Private Cloud Network Overview and Using VPC Networks.

j) **Subnetwork**: Select the subnet that is associated with the selected Network (VPC). This subnet acts as the first Network Interface (nic0) of the CSR instance.

k) **ExternalIP**: The public IP address that you must use to SSH into the CSR 1000v instance. This can be static, Ephemeral (Dynamic) and None. For more information about IP addresses, see **IP Addresses**.

l) **Firewall**: The firewall wall rule associated to the VPC Network. With the current Solution Template, you can use TCP ports 21, 22, 80. You can also create additional Firewall rules. For more information on firewall rules, see Firewalls in VPC Networking and Firewalls.

**Note**  You can also specify source ranges for firewalls rules.

m) **IP Forwarding**: The default value to allow traffic between interfaces on the CSR 1000v instance. By default, the value for IP Forwarding is ON.
Deploy a CSR 1000v by Using a Solution Template

Figure 2: New CSR 1000v Deployment Screen
n) **Additional Network Interfaces**: Configure this field if you want to configure additional interfaces. By default, the value of this field is 0. To add additional interfaces, specify additional interfaces that are needed for the CSR 1000v instance. Select the additional network interfaces based on the machine type. For more information on deployment of instance with multiple interfaces in GCP, see Creating Instances With Multiple Network Interfaces.
Figure 3: Additional Network Interfaces
For the deployment to be successful, even if you do not require all the additional interfaces, you must select the Additional Network Interfaces option. This is a known issue where Google brings up to 8 interfaces, and you must fill in all the eight interfaces.

For example, in the following image, even though two additional NICs were selected, note that the 7 additional interfaces are configured with the networks and subnets present in region where the CSR 1000v instance is deployed.

After successful deployment, the system displays a message that the CSR instance has been deployed.
Deploy a CSR 1000v by Using a Solution Template

Verify successful deployment

- Cisco CSR 1000v-2 has been deployed

Overview - cisco-csr-1000v-2

- cisco-csr-1000v
  - cisco-csr-1000v.jinja
    - instance vm instance
  - cisco-csr-1000v-2-tcp-22 firewall
  - cisco-csr-1000v-2-tcp-80 firewall

More about the software

Get started with cisco-csr-1000v

Suggested next steps

- Request a license
  This is a BYOL solution which requires a valid license to use
  [license](#)

- Open TCP port 21 traffic
  This firewall rule is not enabled. To allow specific network traffic from the Internet, create a firewall rule to open TCP port 21 traffic for VMP instance `1000v-2-tcp-21`. Learn more [here](#)
  If you are using Google Cloud SDK, type the following command:
  ```
  gcloud --project=cryptic-net-198518 compute firewall-rules create open-tcp
  ```

- Assign a static external IP address to your VM instance
  An ephemeral external IP address has been assigned to the CSR VM. This requires a static external IP address, you may promote the address using:
  [Learn more](#)

Documentation

- CSR 1000V Configuration Guides
- CSR 1000V Home Page
- CSR 1000V Youtube Channel
Deploy the CSR Solution Template
Deploying a Cisco CSR 1000v VM Using Custom Data

Deploying a Cisco CSR 1000v VM using a custom data is supported on Cisco IOS XE Gibraltar 16.12.1 or later releases.

When you deploy a Cisco CSR 1000v VM instance on Google Cloud Platform, you can optionally choose to use the Startup Script section on the VM creation console to provide custom data, or use the CLI to access the custom data to achieve a variety of automation goals. The custom data in GCP allows you to run Cisco IOS XE configuration commands, install Python packages in guestshell on Day0, run scripts in guestshell on Day0, and provide licensing information to boot the CSR 1000v instance with a desired technology package.

To launch a CSR 1000v instance with Day 0 configuration, perform the following steps:

• Editing the Custom Data, on page 23
• Accessing the Custom Data, on page 26
• Verifying the Custom Data Configuration, on page 28

Editing the Custom Data

To edit the custom data, configure the following properties: IOS Configuration, Scripts, Script credentials, Python package, and Licensing. The properties can be placed in a file in any order. Dependencies between the properties are noted in each of the following property descriptions. See the example bootstrap files at: https://github.com/csr1000v/customdata-examples.

After you have defined the custom data properties, you can access the startup script or the custom data file using the CLI as described in the Accessing the Custom Data section.

Configuring the IOS Configuration Property

If you want to bootstrap certain IOS configuration on Day0, configure the “IOS Configuration” property. See the following example:

```
Section: IOS configuration
hostname CSR1
interface GigabitEthernet1
description “static IP address config”
```
ip address 10.0.0.1 255.255.255.0
interface GigabitEthernet2
description "DHCP based IP address config"
ip address dhcp

After the first line that reads Section: IOS configuration, you can enter a list of Cisco IOS XE configuration commands to be run on the Cisco CSR 1000v router.

When you run this command, the above mentioned IOS configuration is applied to the CSR 1000v router on Day0.

Configuring the Scripts Property

Scripts property helps you to automate your deployment and achieve other automation goals. If you want to run a python or a bash script on Day0 under the guestshell context, you can achieve the same by providing the public URL and arguments of the python or the bash script in Scripts property.

A script must include a piece of code that includes the shebang (!) character in the first line of the script. This line tells Cisco IOS-XE which script interpreter (Python or Bash) must be used to parse the script code. For example, the first line of a python script can contain `#!/usr/bin/env python`, while the first line of a bash script can contain `#!/bin/bash`. This line allows the Python or Bash script to run as executable code in a Linux environment.

When you execute the script, the script runs in the guestshell container of the Cisco CSR 1000v instance. To access the guestshell container, use the guestshell EXEC mode command. For more information on guestshell command, see the Programmability Configuration Guide.

To configure the Scripts property, follow the format given below:

```
Section: scripts
public_url <arg1> <arg2>
```

In this script, the first line of the property should read Section: Scripts.

In the second line of the property, enter the URL of the script and the script's arguments. The script can be either a python or a bash script. The script is run in guestshell in the first boot when the custom data file is uploaded when you create the CSR1000v instance.

To view more examples of the scripts, see "scripts" at: https://github.com/csr1000v/customdata-examples. Also refer to the following two examples:

**Example 1**

```
Section: Script
```

The two lines in the scripts property retrieve the smartLicensingConfigurator.py script from the customdata-examples repository at the specified URL. The script runs in the guestshell container of the Cisco CSR 1000v with the arguments idtoken and throughput.

**Example 2**

```
Section: Scripts
ftp://10.11.0.4/dir1/dir2/script.py -a arg1 -s arg2
```

These two lines in the Scripts property retrieve the script.py script from the ftp server with the IP address 10.11.0.4, and runs the script with the `./script.py -a arg1 -s arg2` bash command in the guestshell container of the Cisco CSR 1000v instance using arguments arg1 and arg2.
If a script in the Scripts property requires a Python package that is not included in the standard CentOS Linux release (the CentOS Linux release that is currently used by the guestshell is CentOS Linux release 7.1.1503), you must include information about the Python package in the Python package property. For more information, see: Configuring the Python package Property, on page 25.

Note

Before you access the custom data and run the bash or python script, Cisco recommends that you test the URL that you intend to use in the Scripts property. You can test ftp://10.11.0.4/dir1/dir2/script.py -a arg1 -s arg2 by first running the curl software tool to download the script file. In the guestshell, enter the curl command, as shown in the following example:

curl -m 30 --retry 5 --user username:password
ftp://10.11.0.4/dir1/dir2/script_needs_credentials.py.

If the curl command is successful, a copy of the python script is downloaded, which verifies whether the URL is correct.

Configuring the Script Credentials Property

If you have specified an FTP server in the Script property, and the server requires a username and password credentials, specify the credentials using the Script credentials property. If the FTP server can be accessed anonymously, you need not use the Script credentials property.

Configure the Scripts property with a URL and parameters that match those in the Script credentials property. To configure the Script credentials property, follow the format given below:

Section: Script credentials
public_url <username> <password>

Example 1

Section: Script credentials
ftp://10.11.0.4/dir1/dir2/script1.py userfoo foospass

The second line in the Script credentials property specifies the values of the username (userfoo) and password (foospass) credentials for the python script script1.py.

Include the name of the FTP server that is also in the Scripts property. An example line in the Scripts property is: ftp://10.11.0.4/dir1/dir2/script1.py -a arg1 -s arg2. See example 2 in Configuring the Scripts Property, on page 24.

Configuring the Python package Property

If a Python package is required by a script in the Scripts property and it is not part of the standard CentOS Linux release 7.1.1503, you must include information about the package in the Python package property. By including the Python package property in the bootstrap file, you ensure that the Cisco CSR 1000v downloads and installs the required Python package before the custom data file that you specified in the Scripts property.

To configure the Python package property, follow the format as specified below:

Section: Python package

The arguments: version, sudo, and pip_arg1 to pip_arg9 are optional. You must put the arguments to the pip command between “{“ and “}” braces.
If the `version` argument is specified, a specific version number is downloaded.

If the `sudo` argument is specified, the package is downloaded as a sudo user.

**Example 1**

In this example, the second line of the Python package property specifies that the `package_name` is "ncclient" and the `version` is "0.5.2". When the bootstrap file is uploaded, version 0.5.2 of the ncclient package is installed in the guestshell container of the Cisco CSR 1000v.

```
Section: Python package
ncclient 0.5.2
```

**Example 2**

In this example, the second line of the Python package property specifies that the `package_name` is "csr_gcp_ha" and the `version` is "3.0.0". When the bootstrap file is uploaded, version 3.0.0 of the csr_gcp_ha package is installed in the guestshell container of the Cisco CSR 1000v. The following command is executed as a sudo user:

```
pip install csr_gcp_ha=3.0.0 --user
```

**Configuring the License property**

Configure the license property to specify the license technology level for the Cisco CSR 1000v.

Enter the first line of the property: `Section: License`. Enter the second line of the property, which specifies the tech level of the license, using the following format: `TechPackage:tech_level`. (Note: There must be no spaces between "TechPackage:" and the `tech_level`. `tech_level` values: `ax`, `security`, `appx`, or `ipbase`).

`tech_level`—must be in lowercase.

**Example 1**

```
Section: License
TechPackage:security
```

**Accessing the Custom Data**

To run the custom data as a file by using the CLI, execute the following script:

**Accessing the custom data file using the CLI**

To run the custom data as a file by using the CLI, execute the following script:

```
gcloud compute instances create <vm_name> --metadata-from-file=startup-script=Customdata.txt --image <image_name>
```

When you execute this command, a Cisco CSR 1000v VM is created. The router is configured using the commands in the file: "Customdata.txt".
Accessing the custom data from the console

To access the custom data from the console, log in to the GCP console. Click Compute Engine, and select Create an Instance.

On the New VM instance screen, click Management > Startup Script.

The startup script specified in this field runs everytime you bootup or restart your CSR 1000v instance.
Verifying the Custom Data Configuration

After you run the custom data script, the VM is created and the configuration commands are executed. Perform the following commands to verify the configuration commands of each property.

To help determine if the license property worked, in Cisco IOS XE CLI on the CSR 1000v, enter the `show version` command. For example, you should see a reference to the security license.

To see if errors occurred after running commands in the scripts property, look at the `customdata.log` file in the `/bootflash/<cloud>/` directory. The `scriptname.log` file stores any output that is sent to STDOUT by the script.

To verify whether the Python property worked, enter the `pip freeze | grep <package-name>` command from the Guestshell to view the currently installed python packages. Here, `package-name` refers to the package that you are specifically searching for.

To verify the Cisco IOS XE commands in the IOS Configuration property, run the `show running-configuration` command.
Usage Guidelines for Custom Routes

- Introduction to Custom Routes, on page 29
- Custom Routes in the Same VPC Network, on page 29
- Routing Between VPC Networks or On-Premises Networks, on page 29

Introduction to Custom Routes

When a Cisco CSR 1000v is deployed in a VPC network, a route is created for each subnet to which the Cisco CSR 1000v is connected. For example, if you deploy a Cisco CSR 1000v in GCP with two subnets, then each subnet has an associated route.

Custom Routes in the Same VPC Network

By default, the GCP network infrastructure provides a basic routing service which interconnects all the subnets within a VPC network. By default, packets are blocked between subnets, unless firewall rules are changed to allow them to pass.

Routing Between VPC Networks or On-Premises Networks

To connect two VPC networks or to connect a VPC network to an on-premises network, you must create a route to specify the Cisco CSR 1000v as the next hop router to each remote network. To force traffic through the Cisco CSR 1000v, add a route (default route or specific destination route) that points to the Cisco CSR 1000v.

For example, the following route was added with a destination IP address pointing to the Cisco CSR 1000v. The "Next hop" refers to the Cisco CSR 1000v VM instance "cefcsr".
Routing Between VPC Networks or On-Premises Networks

Usage Guidelines for Custom Routes

### celsiusx1tolinux2

**Network**
celsiusx1

**Destination IP address range**
10.100.2.0/24

**Priority**
1000

**Instance tags**
This route applies to all instances within the specified network

**Next hop**
celsiusx1 (Zone us-central1-a)

**Equivalent REST**
Differences Between CSR 1000v Deployments

The differences between deploying Cisco CSR 1000v on Microsoft Azure, Amazon Web Services (AWS), and Google Cloud Platform (GCP) are shown in the following table:

<table>
<thead>
<tr>
<th>Function</th>
<th>Microsoft Azure</th>
<th>Amazon Web Services</th>
<th>Google Cloud Platform</th>
</tr>
</thead>
<tbody>
<tr>
<td>Number of Interfaces</td>
<td>1, 2, 4, or 8.</td>
<td>3 or more.</td>
<td>1, 2, 4, or 8.</td>
</tr>
<tr>
<td>Multiple IP addresses</td>
<td>Multiple IP addresses per vNIC.</td>
<td>Multiple IP addresses per vNIC.</td>
<td>Multiple IP addresses per vNIC.</td>
</tr>
<tr>
<td>GRE tunnel</td>
<td>Not Supported.</td>
<td>Supported.</td>
<td>Not Supported.</td>
</tr>
<tr>
<td>Routing Redundancy</td>
<td>Supported.</td>
<td>Supported through two CSR instances.</td>
<td>Not Supported.</td>
</tr>
<tr>
<td>Attachment or Detachment of an interface on the running Cisco CSR 1000v.</td>
<td>Not Supported</td>
<td>Supported</td>
<td>Not supported</td>
</tr>
</tbody>
</table>
Best Practices and Caveats

1. When a Cisco CSR 1000v VM is deleted, not all the resources for the VM are deleted. When you create a new Cisco CSR 1000v with the same name as before, the previous resources may be reused. If you do not want to reuse these resources, manually remove these individual resources or create a new Cisco CSR 1000v with a different name.

Other Related Resources

The Cisco CSR 1000v on Microsoft Azure supports DMVPN, AWS, and GCP. For further information on DMVPN, see the Cisco Dynamic Multipoint VPN Configuration Guide.