CSR1000v HA Redundancy Deployment Guide on Amazon AWS

Contents

Introduction

This document describes the configuration guide on how to deploy CSR1000v routers for High Availability on Amazon AWS cloud. It is aimed to give users practical knowledge of HA and the ability to deploy a fully functional testbed.

For more in depth background about AWS and HA, *refer to* the section.

Prerequisites

Requirements

Cisco recommends that you have knowledge of these topics:

- An Amazon AWS account
- 2 CSR1000v and 1 Linux/Windows AMIs in the same region
- HA version 1 is supported on Cisco IOS-XE® versions 16.5 to 16.9. From 16.11 and on, use HA version 3.

Components Used

The information in this document is based on Cisco IOS-XE® Denali 16.7.1.

The information in this document was created from the devices in a specific lab environment. All of the devices used in this document started with a cleared (default) configuration. If your network is live, ensure that you understand the potential impact of any command.

Goal

In a multiple Availability Zone environment, simulate continuous traffic from the private datacenter (VM) to the internet. Simulate an HA failover and observe that HA succeeds as the routing table switches traffic from CSRHA to CSRHA1's private interface is confirmed.

Topology

Before the configuration starts, it is important to understand the topology and design completely. This helps to troubleshoot any potential issues later on.

There are various scenarios of HA deployment based on the network requirements. For this example, HA redundancy is configured with these settings:

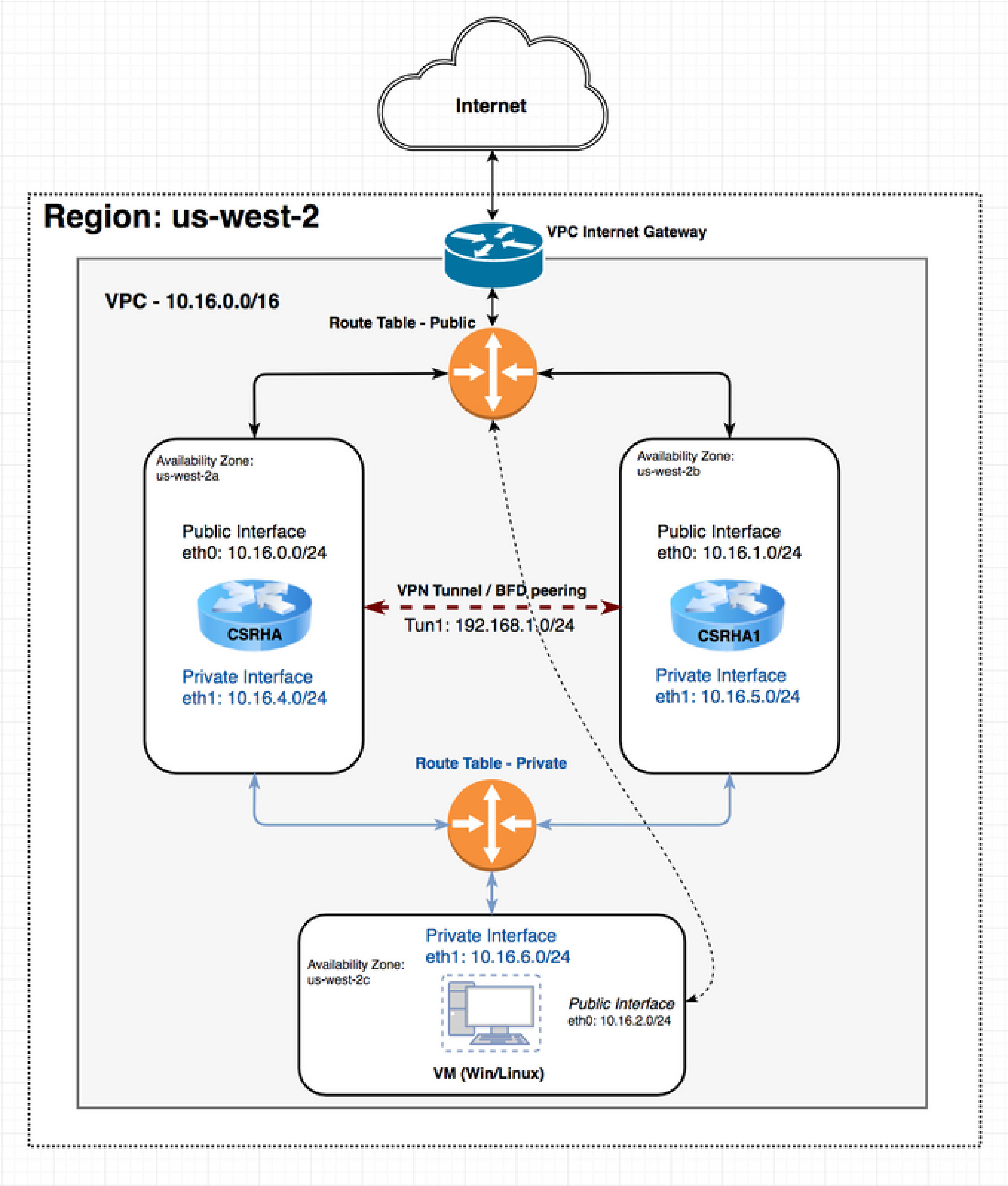
- 1x - Region
- 1x - VPC
- 3x - Availability Zones
- 6x - Network Interfaces/Subnets (3x Public Facing/3x Private Facing)
- 2x - Route Tables (Public & Private)
- 2x - CSR1000v routers (Cisco IOS-XE® Denali 16.3.1a or later)
- 1x - VM (Linux/Windows)

There are 2x CSR1000v routers in an HA pair, in two different availability zones. Think of each availability zone as a separate datacenter for additional hardware resiliency.

The third zone is a VM, which simulates a device in a private datacenter. For now, internet access is enabled through the public interface on so that you can access and configure the VM. Generally, all normal traffic should flow through the private route table.

Ping the VM's private interface private route table CSRHA   8.8.8.8 for Traffic simulation. In a failover scenario, observe the private route table has switched the route to point to CSRHA1's private interface.

Network Diagram



Terminology

RTB - The route table ID.

CIDR - Destination address for the route to be updated in the route table.

ENI - The network interface ID of the CSR 1000v gigabit interface to which traffic is routed.
For Example, if CSRHA fails then CSRHA1 takes over and updates the route in the AWS route table to point to its own ENI.

REGION - The AWS region of CSR 1000v.

Restrictions

- For private subnets, do not use the IP address 10.0.3.0/24—this is used internally on the Cisco CSR 1000v for High Availability. The Cisco CSR 1000v needs to have public internet accessibility to make REST API calls that change the AWS route table.

- Do not put the CSR1000v's gig1 interface inside a VRF. HA does not work otherwise.

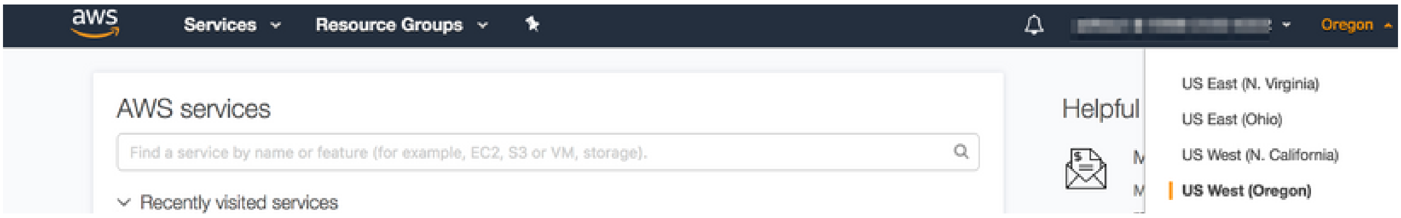
Configuration

The general flow of configuration is to start at the top most encompassing feature (Region/VPC) and move your way down to the most specific (Interface/subnet). However, there is no specific order of configuration. Before you start, it is important to understand the topology first .

> **Tip**: Give names to all your settings (VPC, Interface, Subnet, Route Tables, etc).

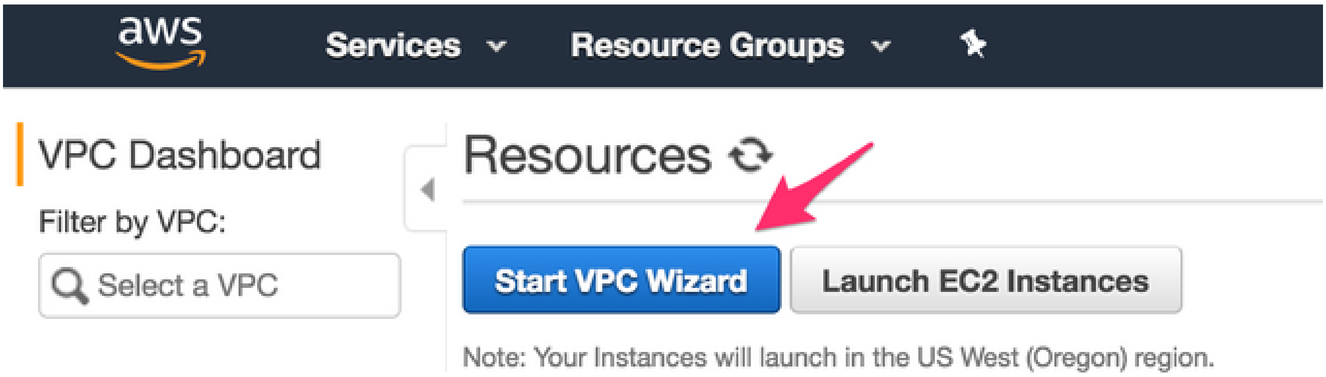
Step 1. Choose a Region.

This example uses US West (Oregon).



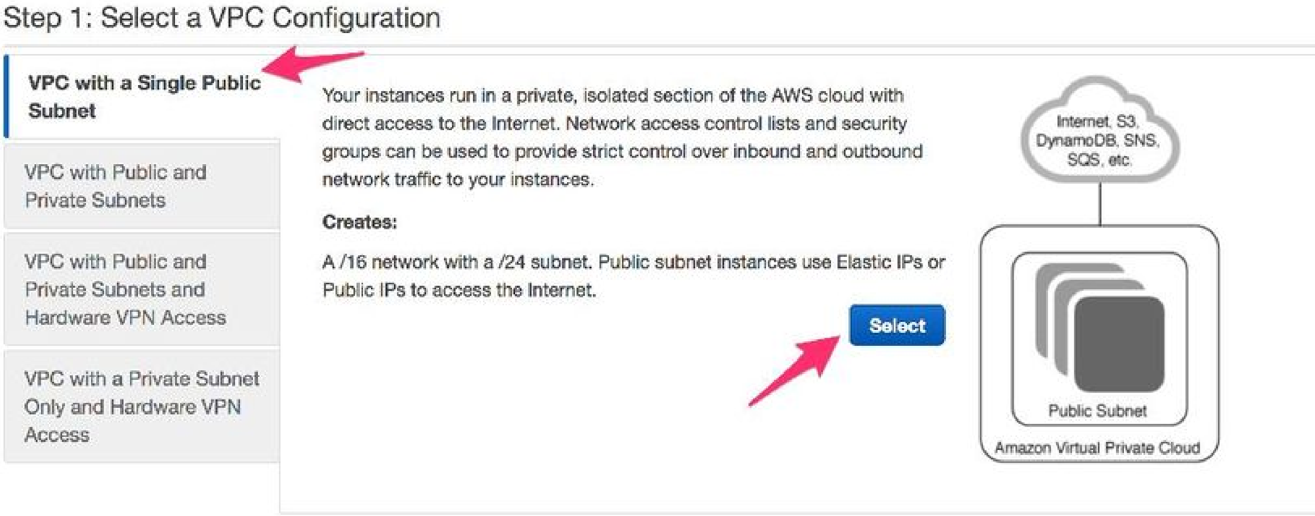
Step 2. Create a VPC.

1. On the AWS Console, navigate to **VPC > VPC Dashboard > Start VPC Wizard**.



Note: Your Instances will launch in the US West (Oregon) region.

2. Choose VPC with a Single Public Subnet.


Step 1: Select a VPC Configuration
VPC with a Single Public Subnet
VPC with Public and Private Subnets
VPC with Public and Private Subnets and Hardware VPN Access
VPC with a Private Subnet Only and Hardware VPN Access
Select
Internet, S3, DynamoDB, SNS, SQS, etc.
Public Subnet
Amazon Virtual Private Cloud

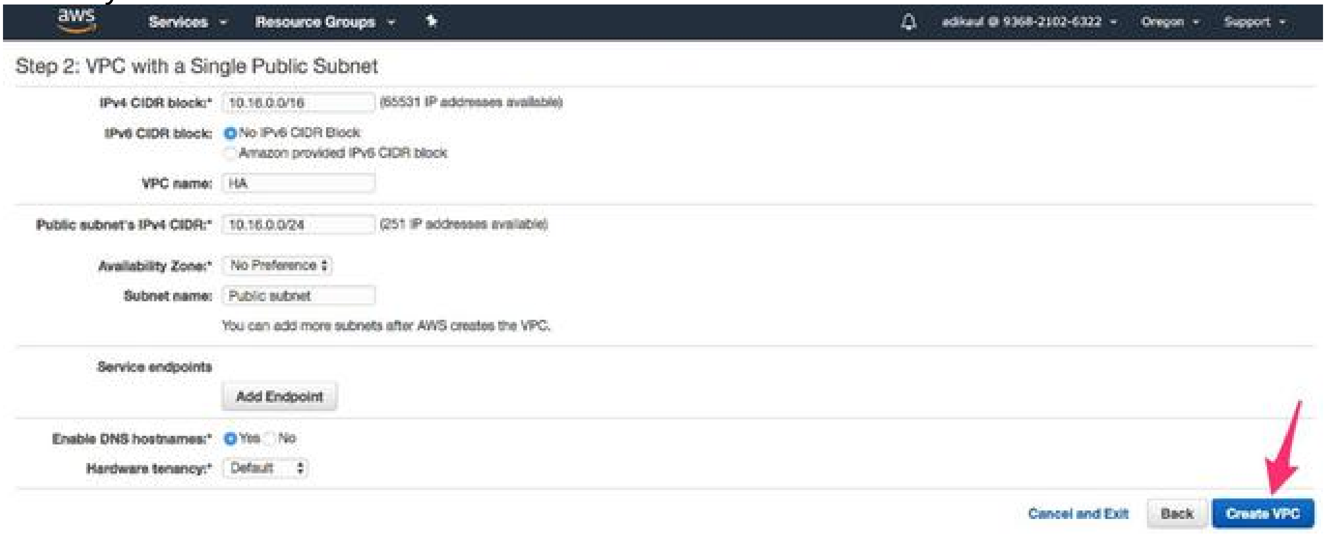
Your instances run in a private, isolated section of the AWS cloud with direct access to the Internet. Network access control lists and security groups can be used to provide strict control over inbound and outbound network traffic to your instances.

Creates:

A /16 network with a /24 subnet. Public subnet instances use Elastic IPs or Public IPs to access the Internet.

3. When you create a VPC, you are assigned a /16 network to use as you please.

4. You are also assigned a /24 public subnet. Public subnet instances use Elastic IPs or Public IPs for your devices to access the Internet.



Step 2: VPC with a Single Public Subnet

IPv4 CIDR block:* 10.16.0.0/16 (65531 IP addresses available)

IPv6 CIDR block: ● No IPv6 CIDR Block ○ Amazon provided IPv6 CIDR block

VPC name: HA

Public subnet's IPv4 CIDR:* 10.16.0.0/24 (251 IP addresses available)

Availability Zone:* No Preference

Subnet name: Public subnet

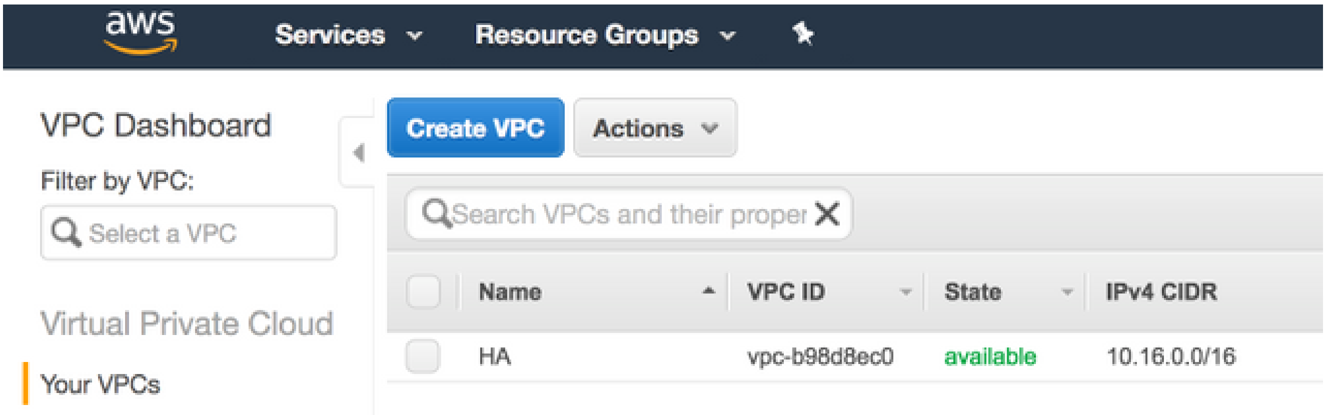
You can add more subnets after AWS creates the VPC.

Service endpoints

Enable DNS hostnames:* ● Yes ○ No

Hardware tenancy:* Default

5. vpc-b98d8ec0 is created.

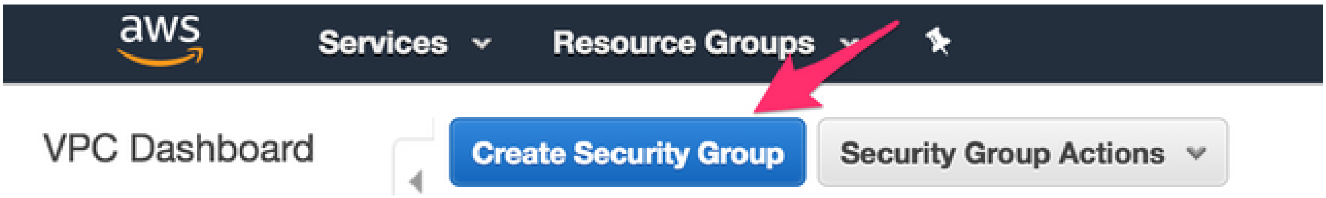


Name	VPC ID	State	IPv4 CIDR
HA	vpc-b98d8ec0	available	10.16.0.0/16

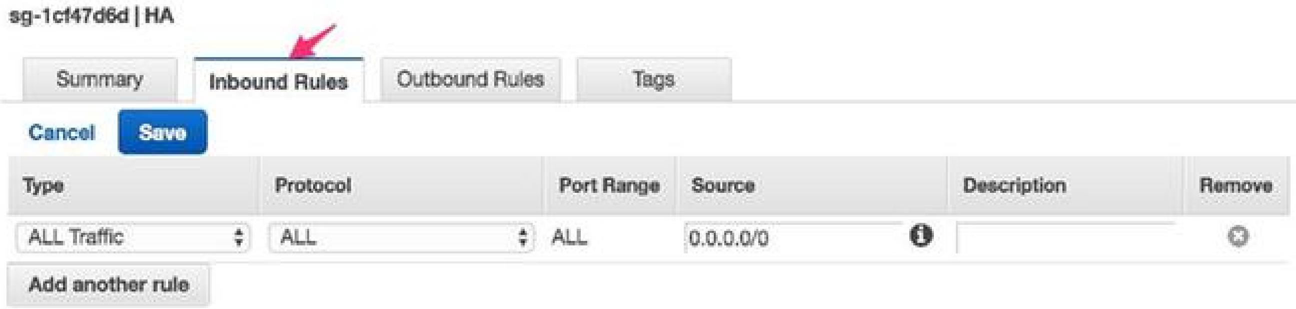
Step 3. Create a Security Group for the VPC.

Security Groups are like ACLs to permit or deny traffic.

1. Under Security, click on **Security Groups** and **Create your Security Group** associated with the above created VPC named HA.



2. Under Inbound Rules, define what traffic do you wish to allow for sg-1cf47d6d. For this example, you allow All Traffic.



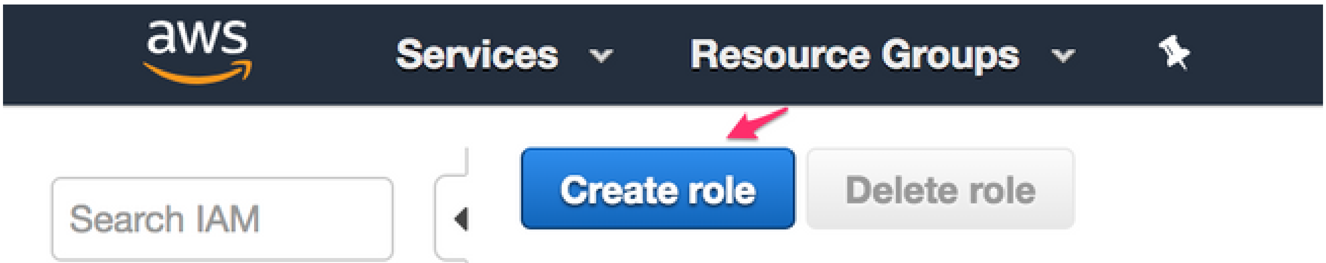
Type	Protocol	Port Range	Source	Description	Remove
ALL Traffic	ALL	ALL	0.0.0.0/0		

Step 4. Create an IAM role with a Policy and associate it to the VPC.

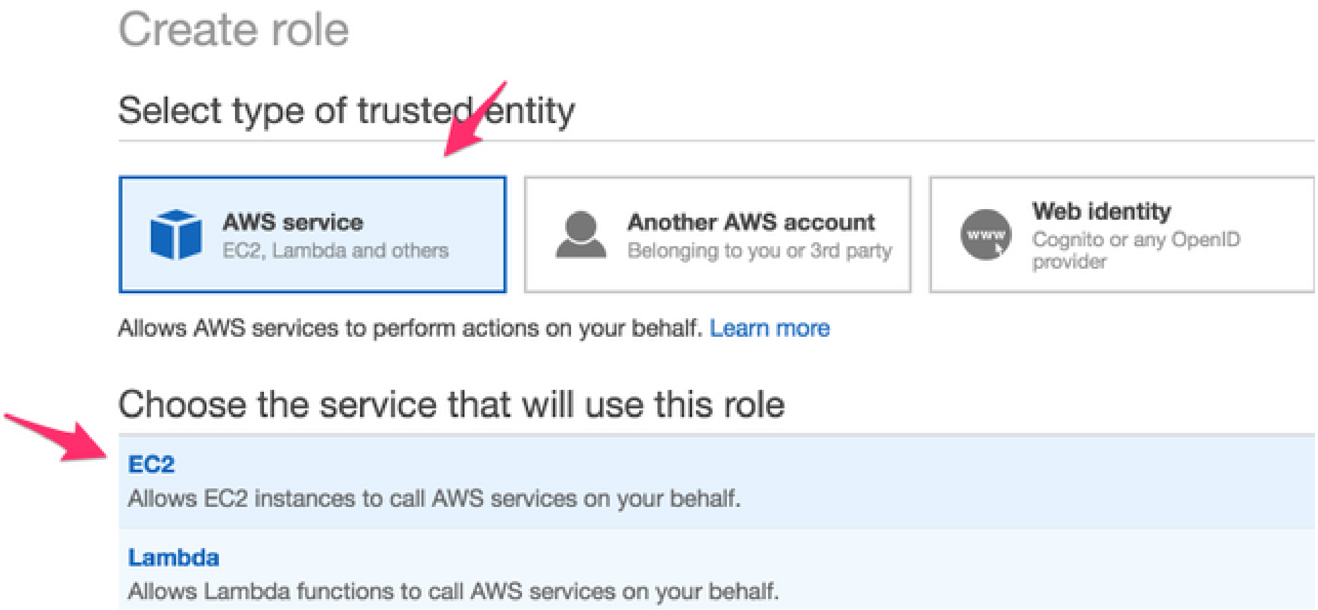
IAM grants your CSR access to Amazon APIs.

The CSR1000v is used as a proxy to call AWS API commands to modify the route table. By default, AMI's are not allowed access to APIs. This procedure creates an IAM role and this role is used during the launch of a CSR instance. IAM provides the access credentials for CSRs to use and modify AWS APIs.

1. Create IAM role. Browse to the IAM dashboard, and navigate to **Roles > Create Role**, as shown in the image.



2. As shown in the image, allow EC2 instance to call AWS on your behalf.



Create role

Select type of trusted entity

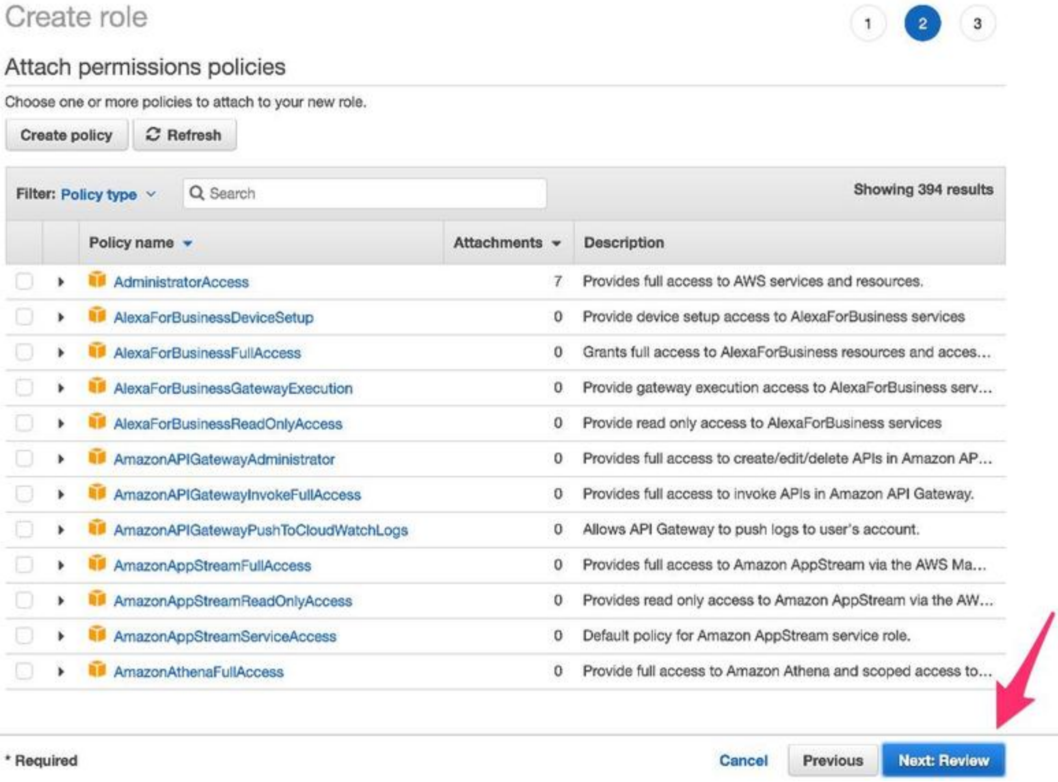
Allows AWS services to perform actions on your behalf. Learn more

Choose the service that will use this role

EC2
Allows EC2 instances to call AWS services on your behalf.

Lambda
Allows Lambda functions to call AWS services on your behalf.

3. Create a Role and click on **Next: Review**, as shown in the image.



Create role

Attach permissions policies

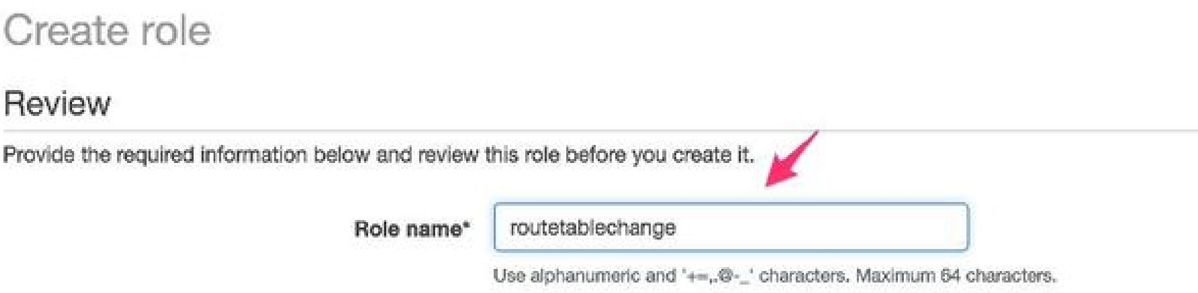
Choose one or more policies to attach to your new role.

Showing 394 results

	Policy name	Attachments	Description
□	AdministratorAccess	7	Provides full access to AWS services and resources.
□	AlexaForBusinessDeviceSetup	0	Provide device setup access to AlexaForBusiness services
□	AlexaForBusinessFullAccess	0	Grants full access to AlexaForBusiness resources and acces...
□	AlexaForBusinessGatewayExecution	0	Provide gateway execution access to AlexaForBusiness serv...
□	AlexaForBusinessReadOnlyAccess	0	Provide read only access to AlexaForBusiness services
□	AmazonAPIGatewayAdministrator	0	Provides full access to create/edit/delete APIs in Amazon AP...
□	AmazonAPIGatewayInvokeFullAccess	0	Provides full access to invoke APIs in Amazon API Gateway.
□	AmazonAPIGatewayPushToCloudWatchLogs	0	Allows API Gateway to push logs to user's account.
□	AmazonAppStreamFullAccess	0	Provides full access to Amazon AppStream via the AWS Ma...
□	AmazonAppStreamReadOnlyAccess	0	Provides read only access to Amazon AppStream via the AW...
□	AmazonAppStreamServiceAccess	0	Default policy for Amazon AppStream service role.
□	AmazonAthenaFullAccess	0	Provide full access to Amazon Athena and scoped access to...

* Required

4. Give it a Role Name. For this Example, as shown in the image, the Role Name is **routetablechange**.



Create role

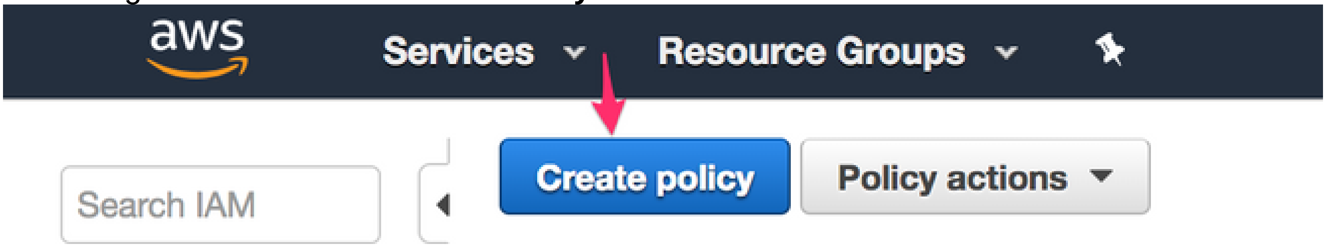
Review

Provide the required information below and review this role before you create it.

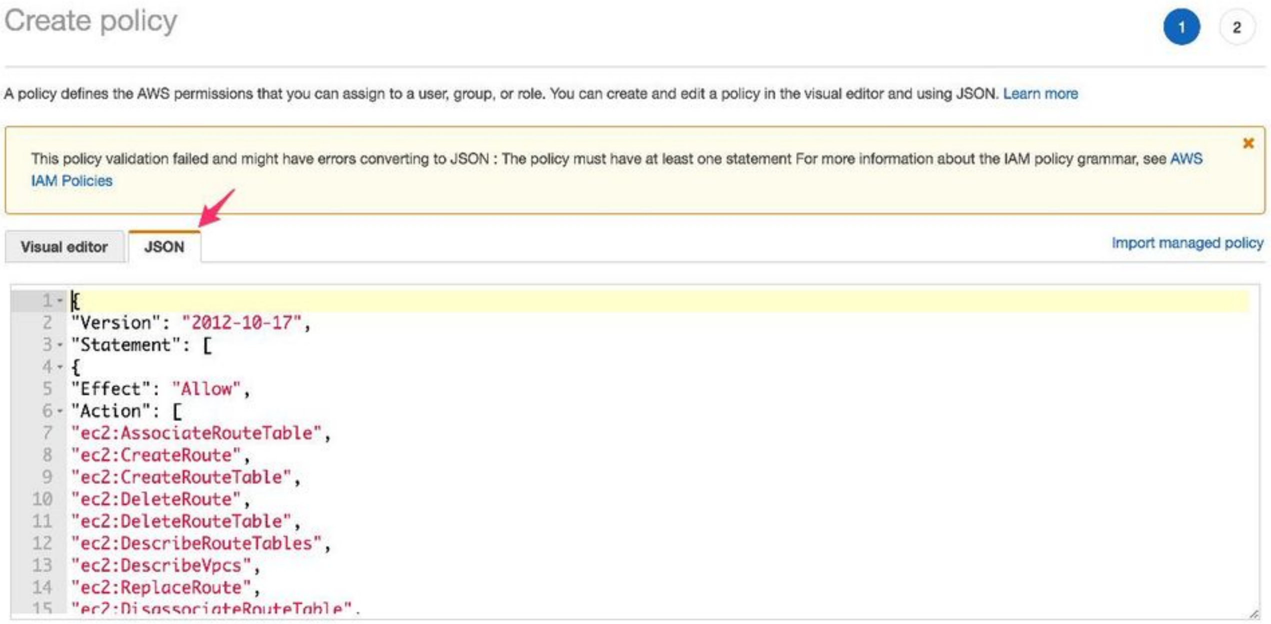
Role name* routetablechange

Use alphanumeric and '+=,.@-_' characters. Maximum 64 characters.

5. Next, you need to create a policy and attach it to the role you created above. IAM dashboard, and navigate to **Policies > Create Policy**.



```
{
"Version": "2012-10-17",
"Statement": [
{
"Effect": "Allow",
"Action": [
"ec2:AssociateRouteTable",
"ec2:CreateRoute",
"ec2:CreateRouteTable",
"ec2:DeleteRoute",
"ec2:DeleteRouteTable",
"ec2:DescribeRouteTables",
"ec2:DescribeVpcs",
"ec2:ReplaceRoute",
"ec2:DisassociateRouteTable",
"ec2:ReplaceRouteTableAssociation"
],
"Resource": "*"
}
]
}
```



Create policy

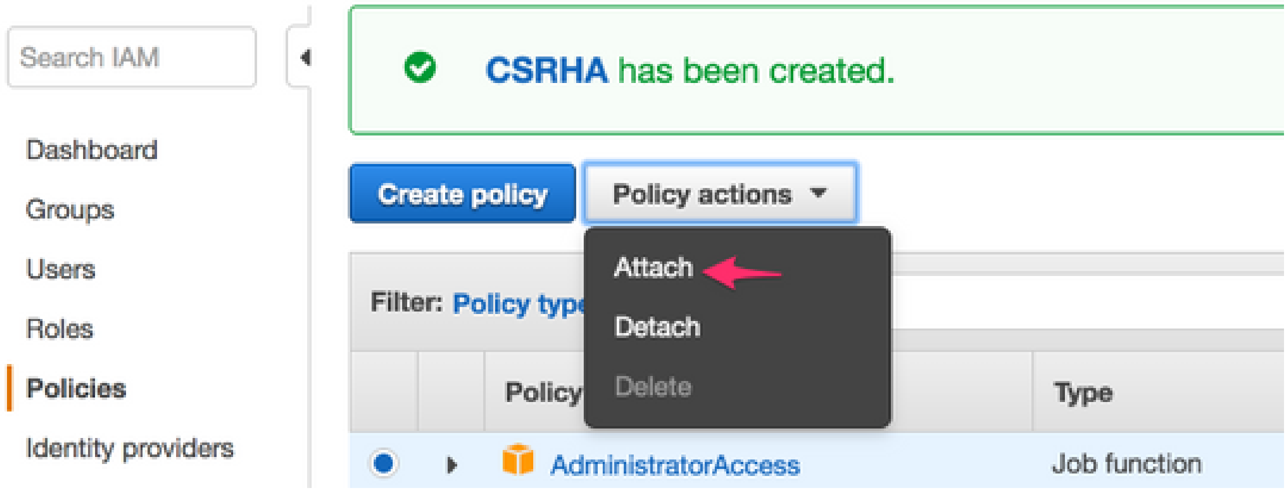
A policy defines the AWS permissions that you can assign to a user, group, or role. You can create and edit a policy in the visual editor and using JSON. Learn more

This policy validation failed and might have errors converting to JSON : The policy must have at least one statement For more information about the IAM policy grammar, see AWS IAM Policies

```
{
"Version": "2012-10-17",
"Statement": [
{
"Effect": "Allow",
"Action": [
"ec2:AssociateRouteTable",
"ec2:CreateRoute",
"ec2:CreateRouteTable",
"ec2:DeleteRoute",
"ec2:DeleteRouteTable",
"ec2:DescribeRouteTables",
"ec2:DescribeVpcs",
"ec2:ReplaceRoute",
"ec2:DisassociateRouteTable",
```

6. Give it a policy name and attach it to the Role you created. For this example, the policy name

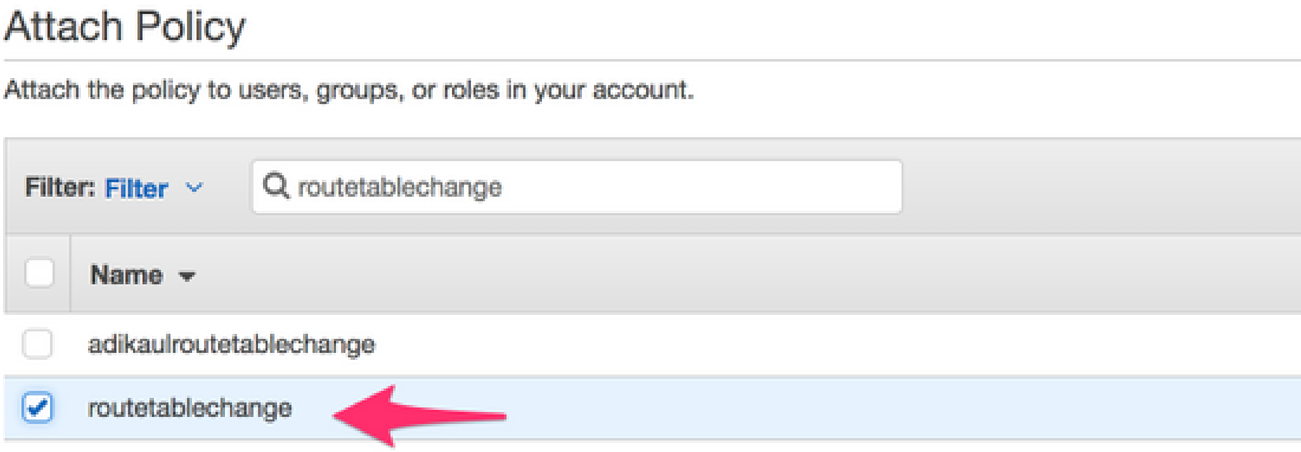
is called CSRHA with Administrator Access, as shown in the image.



CSRHA has been created.

Policy	Type
AdministratorAccess	Job function

7. As shown in the image, attach the policy to the role you created called **routetablechange**.



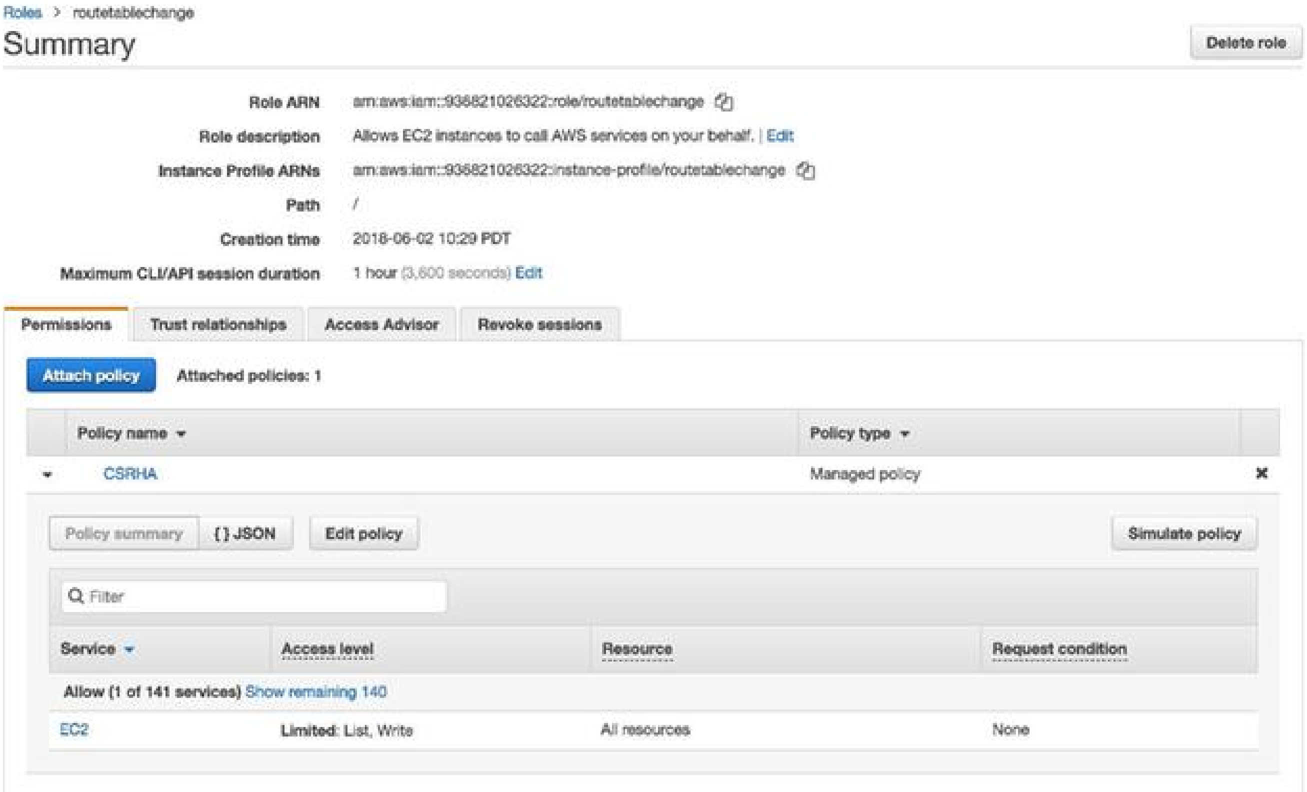
Attach Policy

Attach the policy to users, groups, or roles in your account.

🔍 routetablechange

	Name
□	adikaulroutetablechange
☑	routetablechange

8. Summary.



Summary

Role ARN	arn:aws:iam::936821026322:role/routetablechange
Role description	Allows EC2 instances to call AWS services on your behalf. | Edit
Instance Profile ARNs	arn:aws:iam::936821026322:instance-profile/routetablechange
Path	/
Creation time	2018-06-02 10:29 PDT
Maximum CLI/API session duration	1 hour (3,600 seconds) Edit

Attached policies: 1

Policy name	Policy type
CSRHA	Managed policy

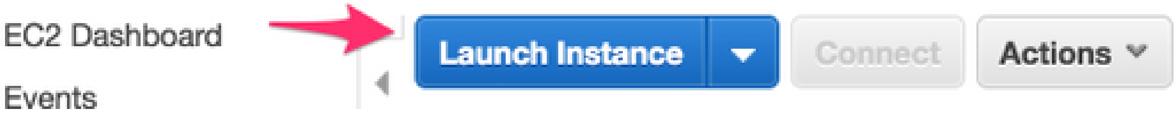
Allow (1 of 141 services) Show remaining 140

Service	Access level	Resource	Request condition
EC2	Limited: List, Write	All resources	None

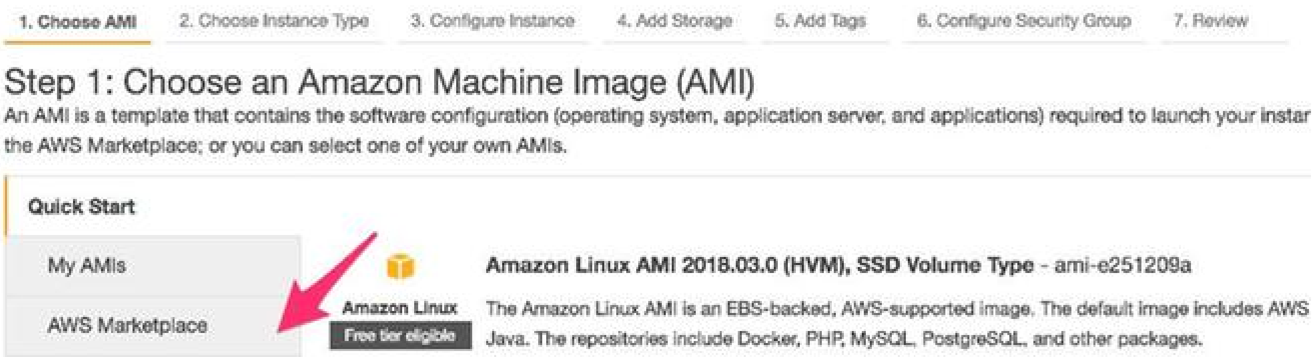
Step 5. Launch the CSR1000v's with the AMI role you Created and Associate the Public/Private Subnets.

Each CSR1000v router has 2 interfaces (1 public, 1 private) and is in its own Availability Zone. You can think of each CSR as being in separate datacenters.

1. On AWS console, select **EC2** and then click on **Launch Instance**.



2. Select AWS Marketplace.



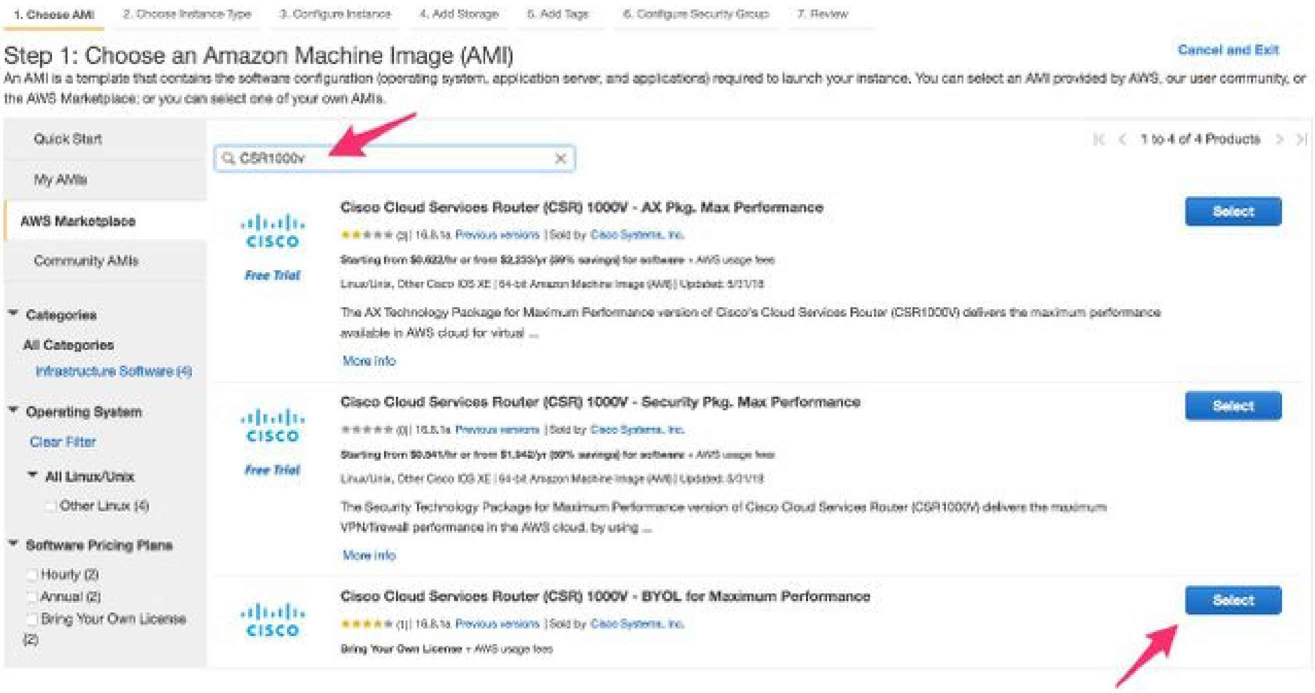
Step 1: Choose an Amazon Machine Image (AMI)

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instar the AWS Marketplace; or you can select one of your own AMIs.

Amazon Linux AMI 2018.03.0 (HVM), SSD Volume Type - ami-e251209a

The Amazon Linux AMI is an EBS-backed, AWS-supported image. The default image includes AWS Java. The repositories include Docker, PHP, MySQL, PostgreSQL, and other packages.

3. Enter CSR1000v and for this example you use Cisco Cloud Services Router (CSR) 1000V - BYOL for Maximum Performance.



Step 1: Choose an Amazon Machine Image (AMI)

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. You can select an AMI provided by AWS, our user community, or the AWS Marketplace; or you can select one of your own AMIs.

CSR1000v

Cisco Cloud Services Router (CSR) 1000V - AX Pkg. Max Performance

★★★★★ (3) | 16.8.1a Previous versions | Sold by Cisco Systems, Inc.

Starting from $0.622/hr or from $2,235/yr (99% savings) for software + AWS usage fees

Linux/Unix, Other Cisco IOS XE | 64-bit Amazon Machine Image (AMI) | Updated: 5/31/18

The AX Technology Package for Maximum Performance version of Cisco's Cloud Services Router (CSR1000V) delivers the maximum performance available in AWS cloud for virtual ...

More info

Cisco Cloud Services Router (CSR) 1000V - Security Pkg. Max Performance

★★★★★ (0) | 16.8.1a Previous versions | Sold by Cisco Systems, Inc.

Starting from $0.941/hr or from $1,942/yr (99% savings) for software + AWS usage fees

Linux/Unix, Other Cisco IOS XE | 64-bit Amazon Machine Image (AMI) | Updated: 5/31/18

The Security Technology Package for Maximum Performance version of Cisco Cloud Services Router (CSR1000V) delivers the maximum VPN/firewall performance in the AWS cloud, by using ...

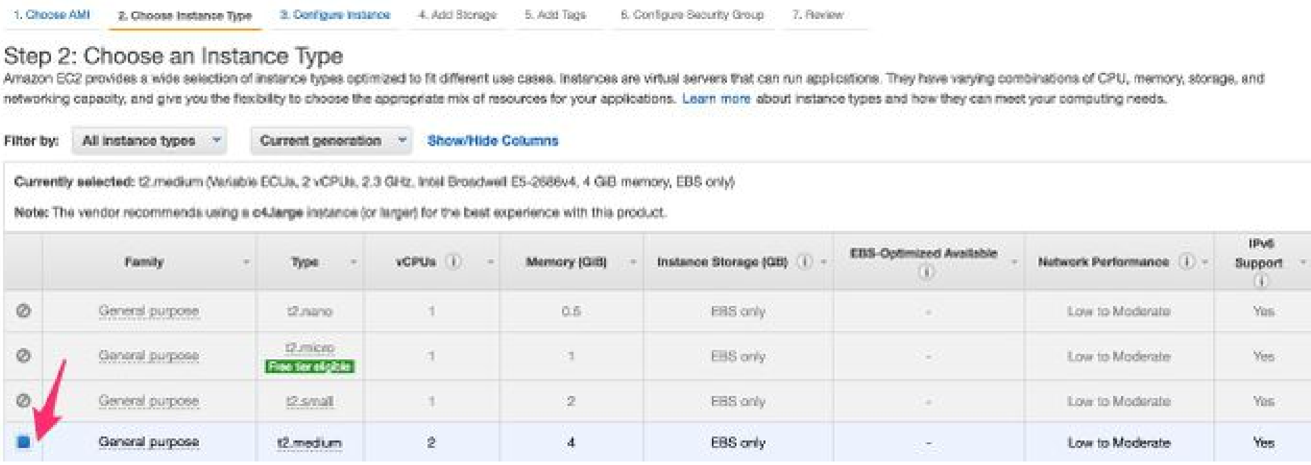
More info

Cisco Cloud Services Router (CSR) 1000V - BYOL for Maximum Performance

★★★★★ (1) | 16.8.1a Previous versions | Sold by Cisco Systems, Inc.

Bring Your Own License + AWS usage fees

4. Choose an Instance Type. For this example, the type selected is **t2.medium**.



Step 2: Choose an Instance Type

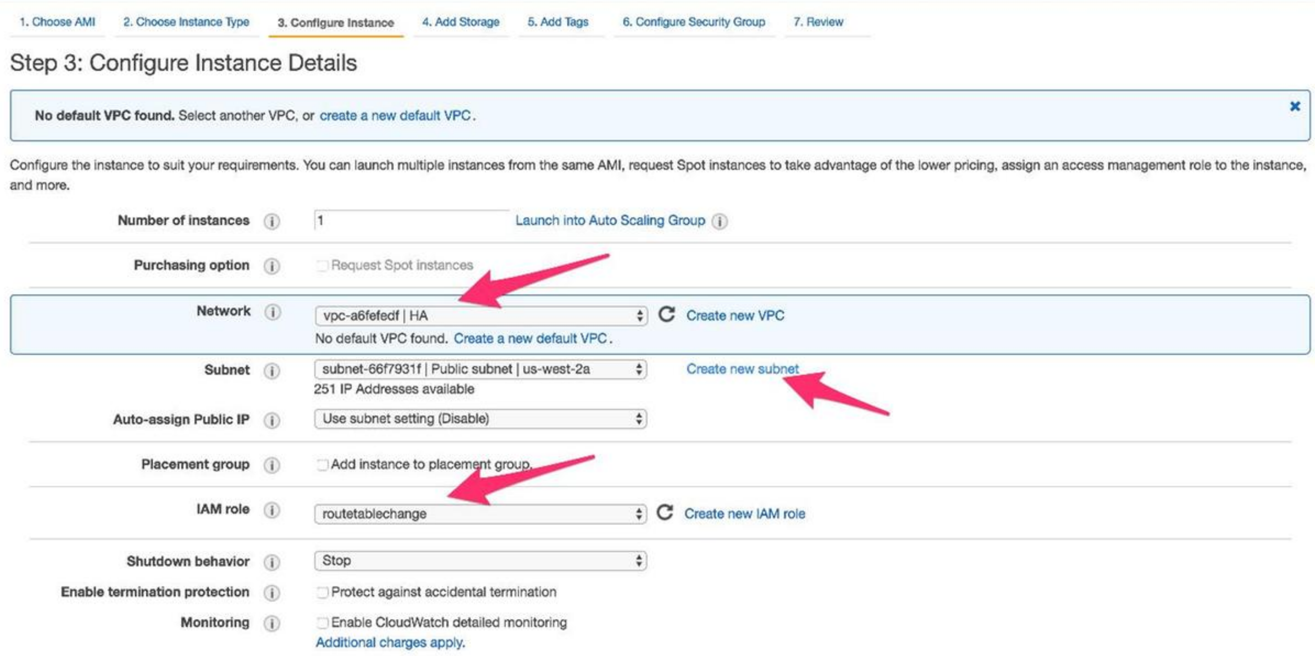
Amazon EC2 provides a wide selection of instance types optimized to fit different use cases. Instances are virtual servers that can run applications. They have varying combinations of CPU, memory, storage, and networking capacity, and give you the flexibility to choose the appropriate mix of resources for your applications. Learn more about instance types and how they can meet your computing needs.

Currently selected: t2.medium (Variable ECUs, 2 vCPUs, 2.3 GHz, Intel Broadwell E5-2686v4, 4 GiB memory, EBS only)

Note: The vendor recommends using a **c4.large** instance (or larger) for the best experience with this product.

	Family	Type	vCPUs	Memory (GiB)	Instance Storage (GB)	EBS-Optimized Available	Network Performance	IPv6 Support
⊘	General purpose	t2.nano	1	0.5	EBS only	-	Low to Moderate	Yes
⊘	General purpose	t2.micro Free tier eligible	1	1	EBS only	-	Low to Moderate	Yes
⊘	General purpose	t2.small	1	2	EBS only	-	Low to Moderate	Yes
■	General purpose	t2.medium	2	4	EBS only	-	Low to Moderate	Yes

5. While the Instance is configured, you need to make sure to select the VPC you created above along with the IAM role above. Additionally, create a Private Subnet which you associate to the private facing interface.



1. Choose AMI | 2. Choose Instance Type | 3. Configure Instance | 4. Add Storage | 5. Add Tags | 6. Configure Security Group | 7. Review

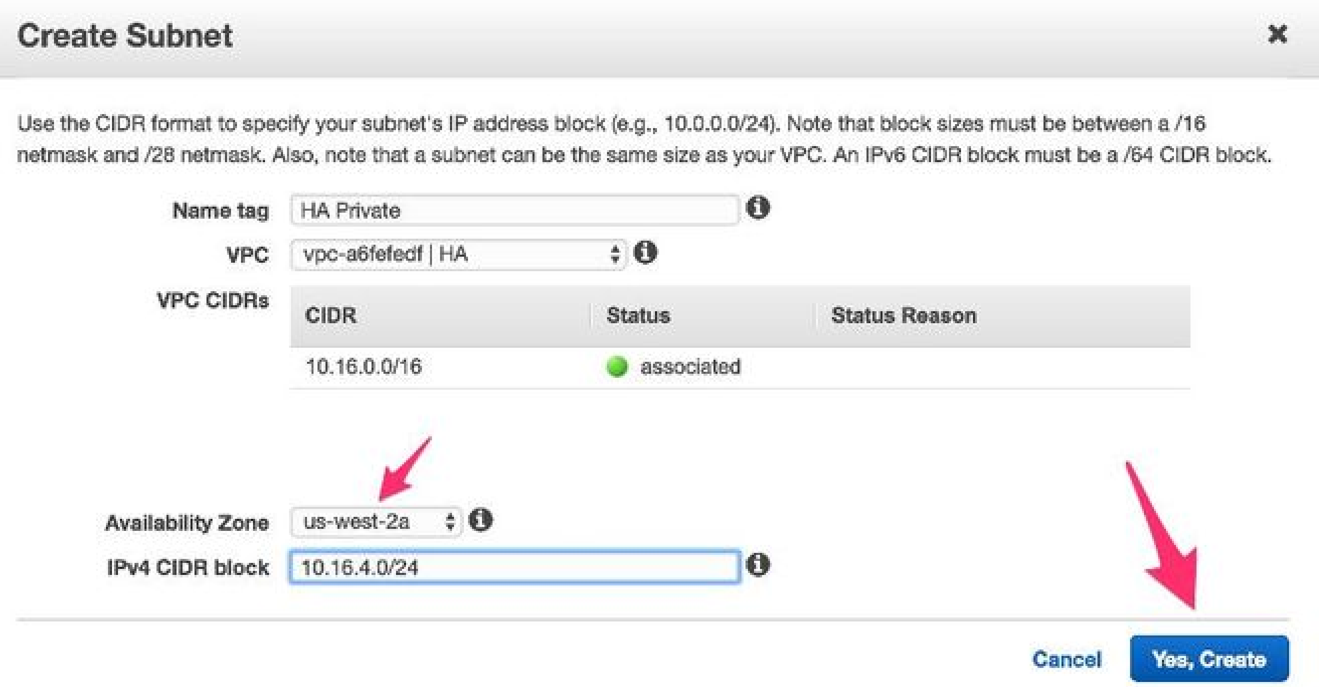
Step 3: Configure Instance Details

No default VPC found. Select another VPC, or create a new default VPC.

Configure the instance to suit your requirements. You can launch multiple instances from the same AMI, request Spot instances to take advantage of the lower pricing, assign an access management role to the instance, and more.

Number of instances	1	Launch into Auto Scaling Group
Purchasing option	□ Request Spot instances	
Network	vpc-a6fefedf | HA No default VPC found. Create a new default VPC.	Create new VPC
Subnet	subnet-66f7931f | Public subnet | us-west-2a 251 IP Addresses available	Create new subnet
Auto-assign Public IP	Use subnet setting (Disable)	
Placement group	□ Add instance to placement group.	
IAM role	routetablechange	Create new IAM role
Shutdown behavior	Stop	
Enable termination protection	□ Protect against accidental termination	
Monitoring	□ Enable CloudWatch detailed monitoring Additional charges apply.	

6. Click on Create new Subnet for Private Subnet. For this example, the Name tag is HA Private. Ensure that it is in the same Availability Zone as the Public Subnet.



Create Subnet

Use the CIDR format to specify your subnet's IP address block (e.g., 10.0.0.0/24). Note that block sizes must be between a /16 netmask and /28 netmask. Also, note that a subnet can be the same size as your VPC. An IPv6 CIDR block must be a /64 CIDR block.

Name tag: HA Private

VPC: vpc-a6fefedf | HA

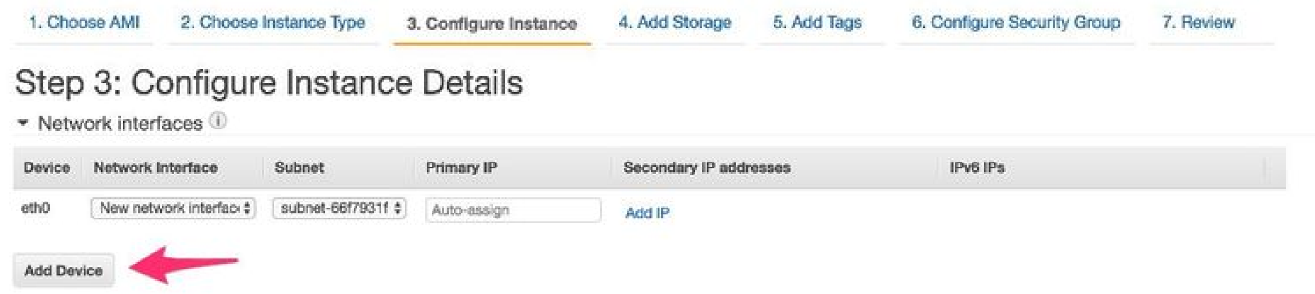
VPC CIDRs:

CIDR	Status	Status Reason
10.16.0.0/16	● associated	

Availability Zone: us-west-2a

IPv4 CIDR block: 10.16.4.0/24

7. Scroll down and under Configure Instance Details, click on **Add Device**, as shown in the image.



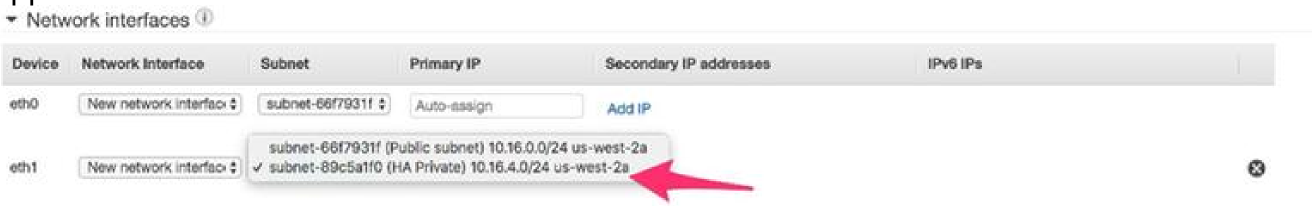
1. Choose AMI | 2. Choose Instance Type | 3. Configure Instance | 4. Add Storage | 5. Add Tags | 6. Configure Security Group | 7. Review

Step 3: Configure Instance Details

Network interfaces

Device	Network Interface	Subnet	Primary IP	Secondary IP addresses	IPv6 IPs
eth0	New network interfac	subnet-66f7931f	Auto-assign	Add IP	

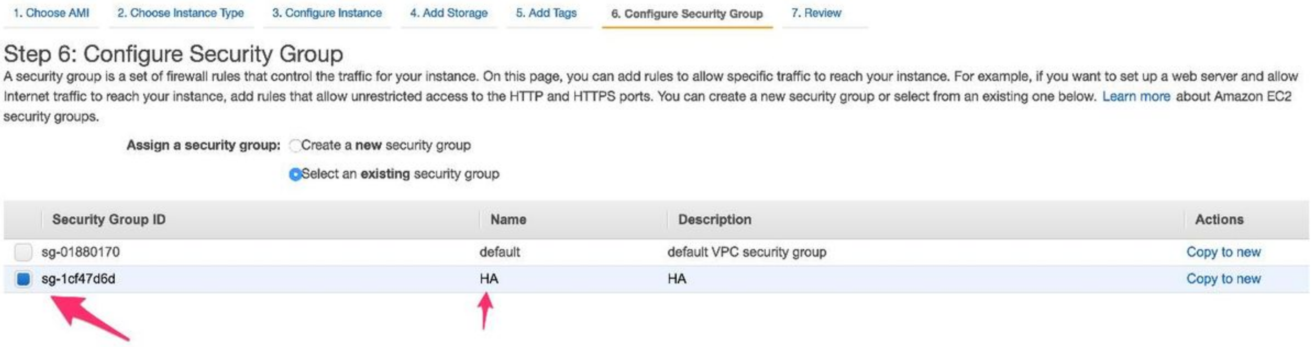
8. After the secondary interface is added, associate the private subnet you created called HA Private. Eth0 is the public facing and Eth1 is the private facing interface. **Note**: The subnet created in the previous step may not appear in this drop down. You may need to refresh or cancel the page and start again for the subnet to appear.



Network interfaces

Device	Network Interface	Subnet	Primary IP	Secondary IP addresses	IPv6 IPs
eth0	New network interfac	subnet-66f7931f	Auto-assign	Add IP	
eth1	New network interfac	subnet-66f7931f (Public subnet) 10.16.0.0/24 us-west-2a ✓ subnet-89c5a1f0 (HA Private) 10.16.4.0/24 us-west-2a			

9. Select the Security Group you created under VPC and ensure that the rules are properly defined.



Step 6: Configure Security Group

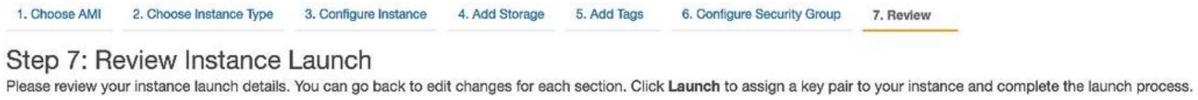
A security group is a set of firewall rules that control the traffic for your instance. On this page, you can add rules to allow specific traffic to reach your instance. For example, if you want to set up a web server and allow Internet traffic to reach your instance, add rules that allow unrestricted access to the HTTP and HTTPS ports. You can create a new security group or select from an existing one below. Learn more about Amazon EC2 security groups.

Assign a security group: ○ Create a **new** security group

● Select an **existing** security group

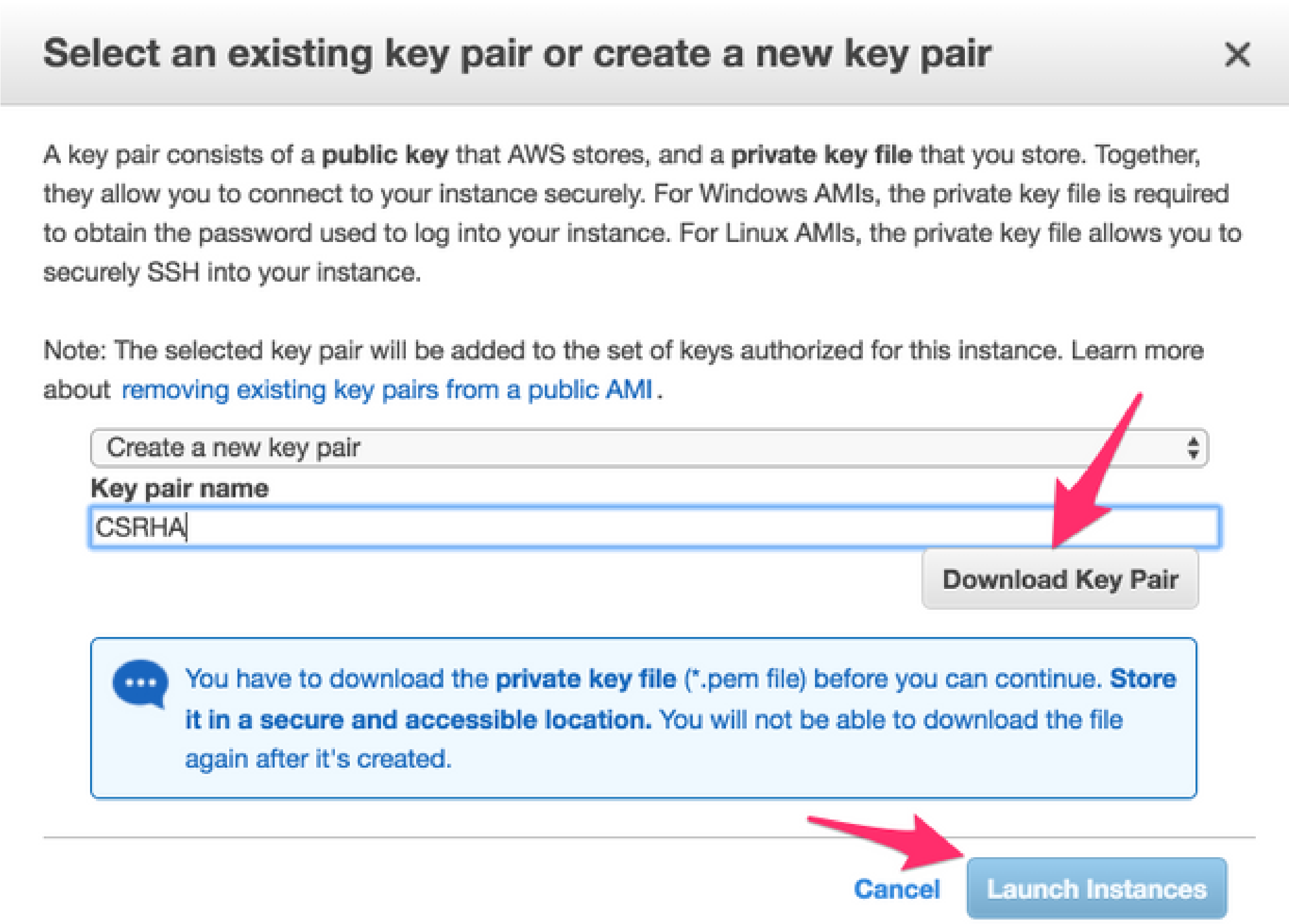
	Security Group ID	Name	Description	Actions
□	sg-01880170	default	default VPC security group	Copy to new
■	sg-1cf47d6d	HA	HA	Copy to new

10. Create a new key pair and ensure to download your private key. You can reuse one key for every device. **Note**: If you lose your private key, you cannot login to your CSR's again. There is no method to recover keys.



Step 7: Review Instance Launch

Please review your instance launch details. You can go back to edit changes for each section. Click **Launch** to assign a key pair to your instance and complete the launch process.



Select an existing key pair or create a new key pair

A key pair consists of a **public key** that AWS stores, and a **private key file** that you store. Together, they allow you to connect to your instance securely. For Windows AMIs, the private key file is required to obtain the password used to log into your instance. For Linux AMIs, the private key file allows you to securely SSH into your instance.

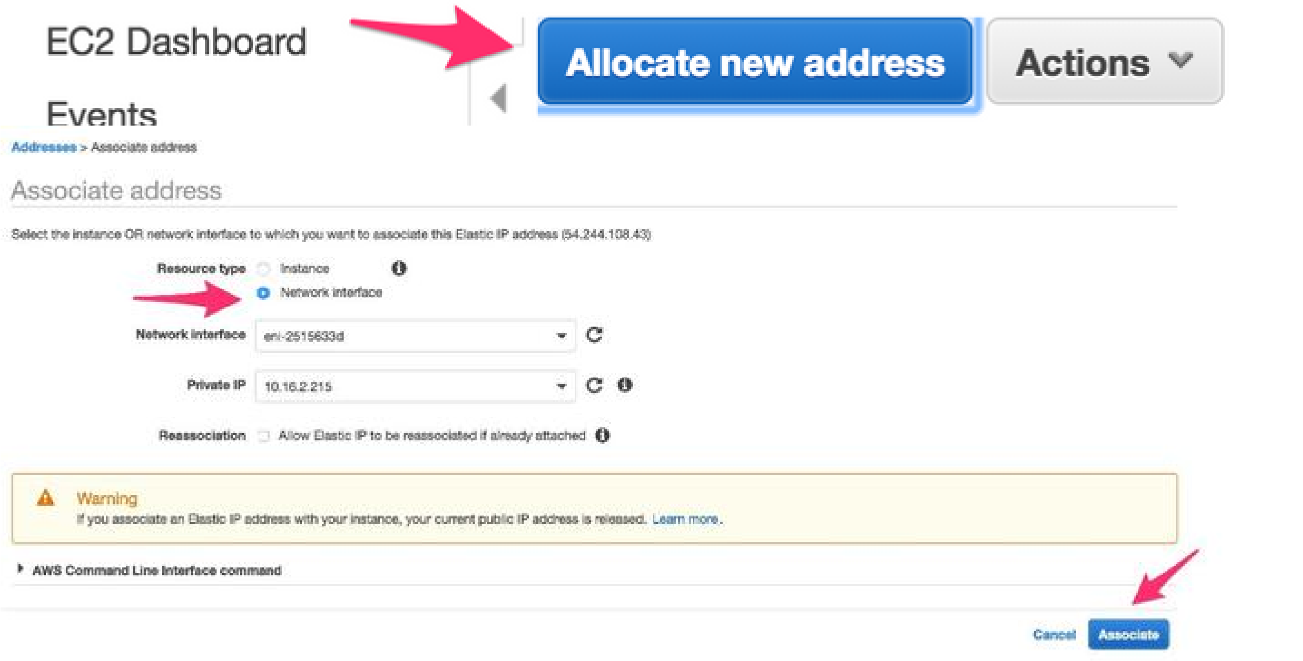
Note: The selected key pair will be added to the set of keys authorized for this instance. Learn more about removing existing key pairs from a public AMI.

Create a new key pair

Key pair name: CSRHA

You have to download the **private key file** (*.pem file) before you can continue. **Store it in a secure and accessible location.** You will not be able to download the file again after it's created.

11. Associate the Elastic IP with the ENI of Public Interface for the instance you created and navigate to **AWS console > EC2 Management > Network Security > Elastic IP's**. **Note**: Public/private terminology may confuse you here. For the purposes of this example, definition of a public interface is Eth0 which is the internet facing interface. From the point of view of AWS, our public interface is their private ip.



Addresses > Associate address

Associate address

Select the instance OR network interface to which you want to associate this Elastic IP address (54.244.108.43)

Resource type: ○ Instance ● Network interface

Network interface: eni-2515633d

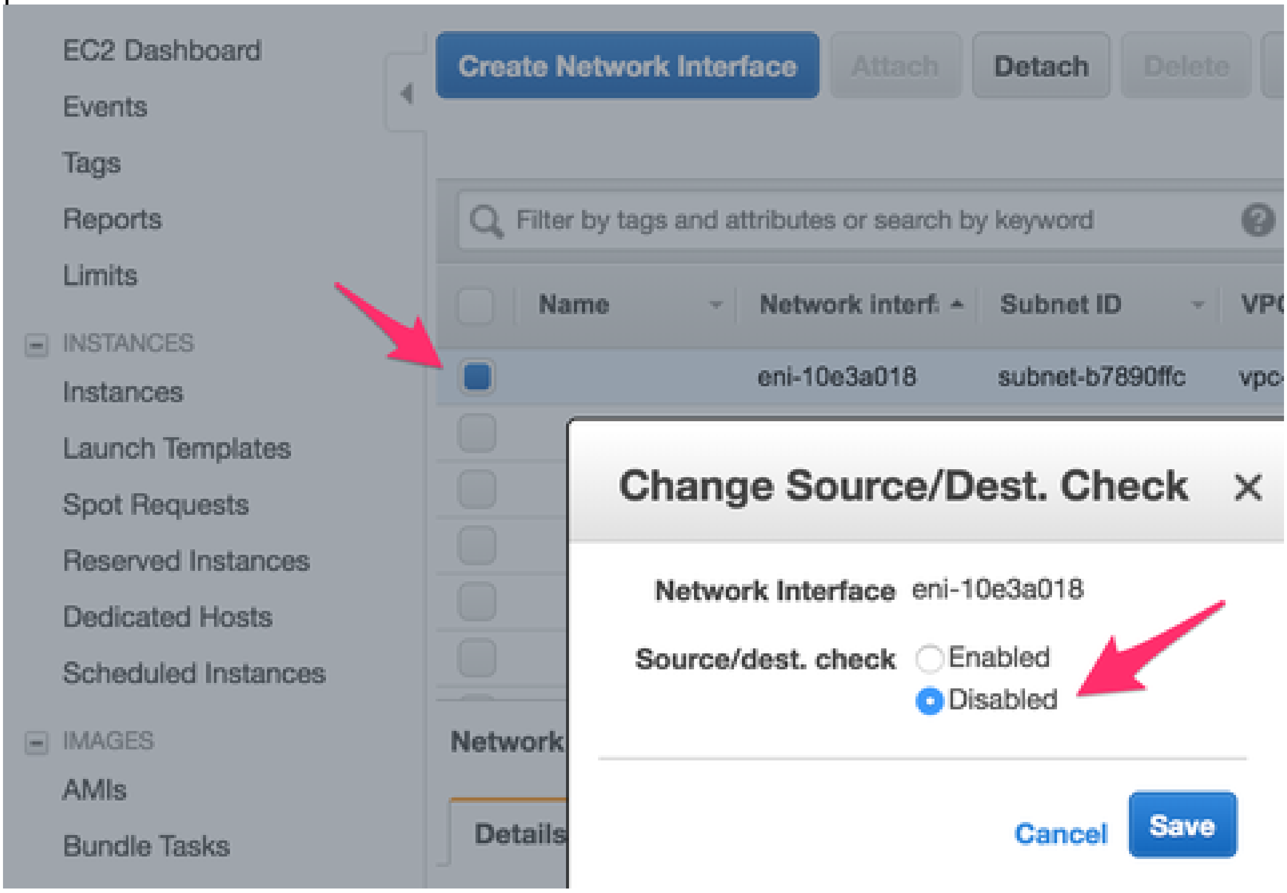
Private IP: 10.16.2.215

Reassociation: □ Allow Elastic IP to be reassociated if already attached

Warning
If you associate an Elastic IP address with your instance, your current public IP address is released. Learn more.

12. Disable Source/Dest Check as you navigate to **EC2 > Network Interfaces**. Verify each ENI for Source/Dest check. By default, all ENIs come with this Source/Dest check enabled. An anti-spoofing feature meant to avoid letting an ENI get overrun with traffic that is not really

intended for it by verifying that the ENI is the destination of the traffic before forwarding it. The router is rarely the actual destination of a packet. This feature must be disabled on all CSR transit ENIs or it cannot forward packets.

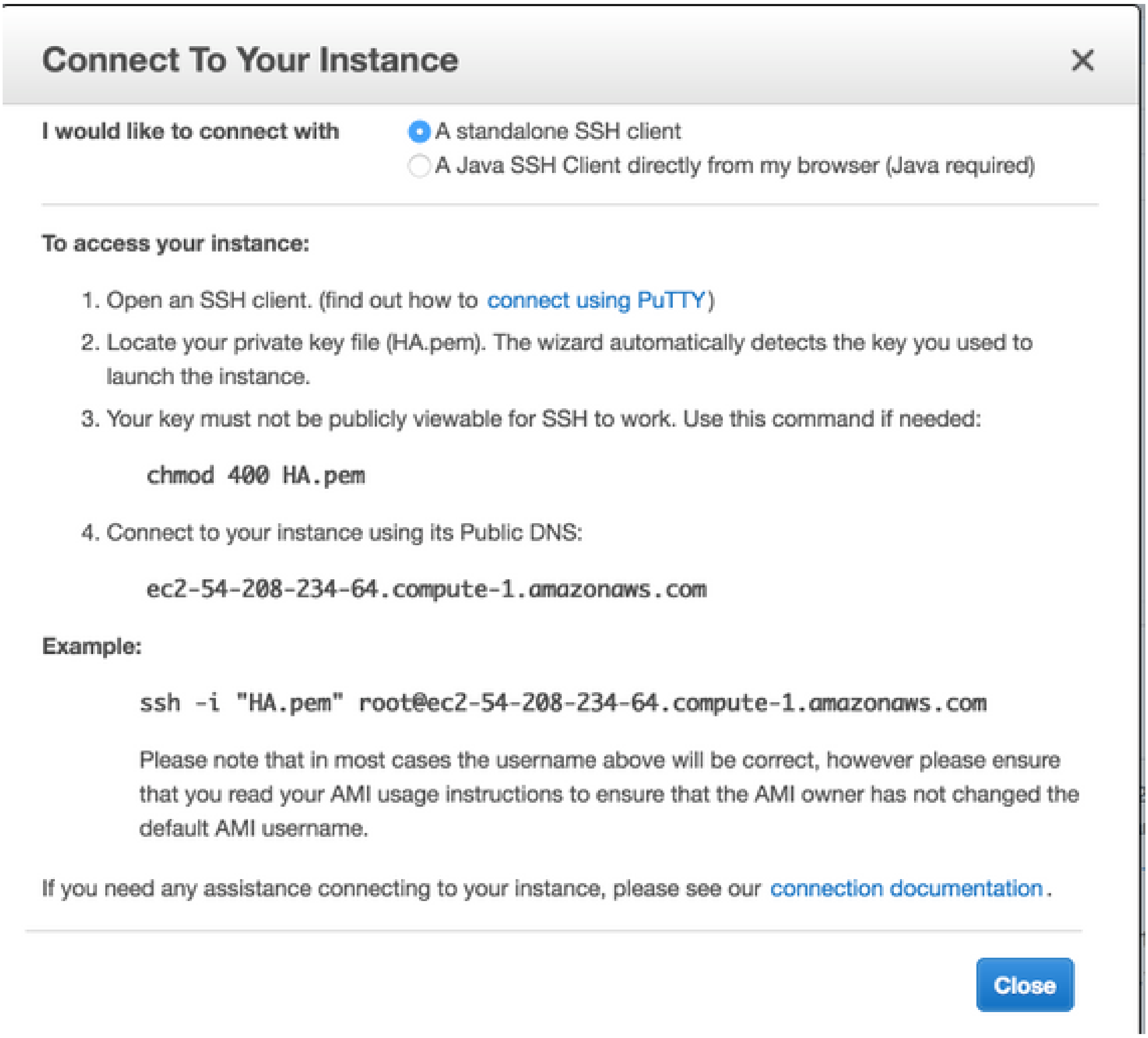


Change Source/Dest. Check

Network Interface eni-10e3a018

Source/dest. check ○ Enabled ● Disabled

13. Connect to your CSR1000v. **Note**: The username provided by AWS to SSH into the CSR1000v may be incorrectly listed as root. Change this to ec2-user if necessary.**Note**: You must be able to ping the DNS address to SSH in. Here it is ec2-54-208-234-64.compute-1.amazonaws.com. Check that the router's public subnet/eni is associated with the Public Route Table. Briefly go to Step 8 on how to associate the subnet to the Route Table.



Connect To Your Instance

I would like to connect with ● A standalone SSH client
○ A Java SSH Client directly from my browser (Java required)

To access your instance:

1. Open an SSH client. (find out how to connect using PuTTY)
2. Locate your private key file (HA.pem). The wizard automatically detects the key you used to launch the instance.
3. Your key must not be publicly viewable for SSH to work. Use this command if needed:

```
chmod 400 HA.pem
```

4. Connect to your instance using its Public DNS:

```
ec2-54-208-234-64.compute-1.amazonaws.com
```

Example:

```
ssh -i "HA.pem" root@ec2-54-208-234-64.compute-1.amazonaws.com
```

Please note that in most cases the username above will be correct, however please ensure that you read your AMI usage instructions to ensure that the AMI owner has not changed the default AMI username.

If you need any assistance connecting to your instance, please see our connection documentation.

Step 6. Repeat Step 5 and Create the Second CSR1000v Instance for HA.

Public Subnet: 10.16.1.0/24

Private Subnet: 10.16.5.0/24

If you are unable to ping the elastic ip address of this new AMI, briefly go to Step 8 and ensure that the public subnet is associated with the public route table.

Step 7. Repeat Step 5 and Create a VM(Linux/Windows) from the AMI Marketplace.

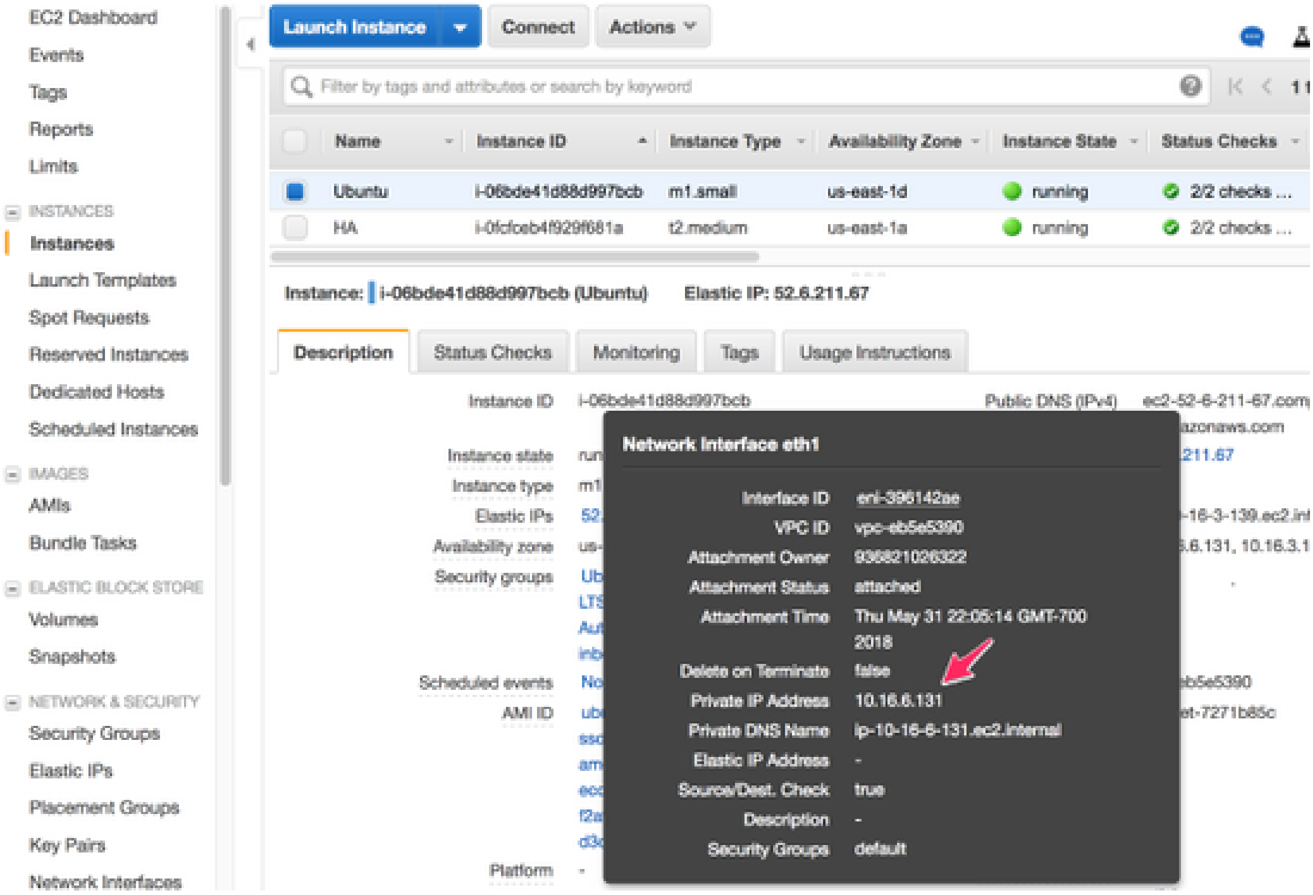
For this example, use Ubuntu Server 14.04 LTS on the marketplace.

Public Subnet: 10.16.2.0/24

Private Subnet: 10.16.6.0/24

If you are unable to ping the elastic ip address of this new AMI, briefly go to Step 8 and ensure that the public subnet is associated with the public route table.

1. Eth0 is created by default for the public interface. Create a second interface called eth1 for the private subnet.



Name	Instance ID	Instance Type	Availability Zone	Instance State	Status Checks
Ubuntu	i-06bde41d88d997bcb	m1.small	us-east-1d	running	2/2 checks ...
HA	i-0fcfceb4f929f681a	t2.medium	us-east-1a	running	2/2 checks ...

Instance: i-06bde41d88d997bcb (Ubuntu) Elastic IP: 52.6.211.67

Instance ID i-06bde41d88d997bcb Public DNS (IPv4) ec2-52-6-211-67.com

Network Interface eth1

Interface ID	eni-396142ae
VPC ID	vpc-eb5e5390
Attachment Owner	936821026322
Attachment Status	attached
Attachment Time	Thu May 31 22:05:14 GMT-700 2018
Delete on Terminate	false
Private IP Address	10.16.6.131
Private DNS Name	ip-10-16-6-131.ec2.internal
Elastic IP Address	-
Source/Dest. Check	true
Description	-
Security Groups	default

2. The IP address you configure in Ubuntu is the eth1 private interface assigned by AWS.

```
ubuntu@ip-10-16-2-139:~$ cd /etc/network/interfaces.d/

ubuntu@ip-10-16-2-139:/etc/network/interfaces.d$ sudo vi eth1.cfg

auto eth1
iface eth1 inet static
  address 10.16.6.131
  netmask 255.255.255.0
  network 10.16.6.0
  up route add -host 8.8.8.8 gw 10.16.6.1 dev eth1
```

3. Flap the interface or reboot the VM.

```
ubuntu@ip-10-16-2-139:/etc/network/interfaces.d$ sudo ifdown eth1 && sudo ifup eth1
ubuntu@ip-10-16-2-139:/etc/network/interfaces.d$ sudo reboot
```

4. Ping 8.8.8.8 for the test. Ensure that the 8.8.8.8 route has been added per step 7.

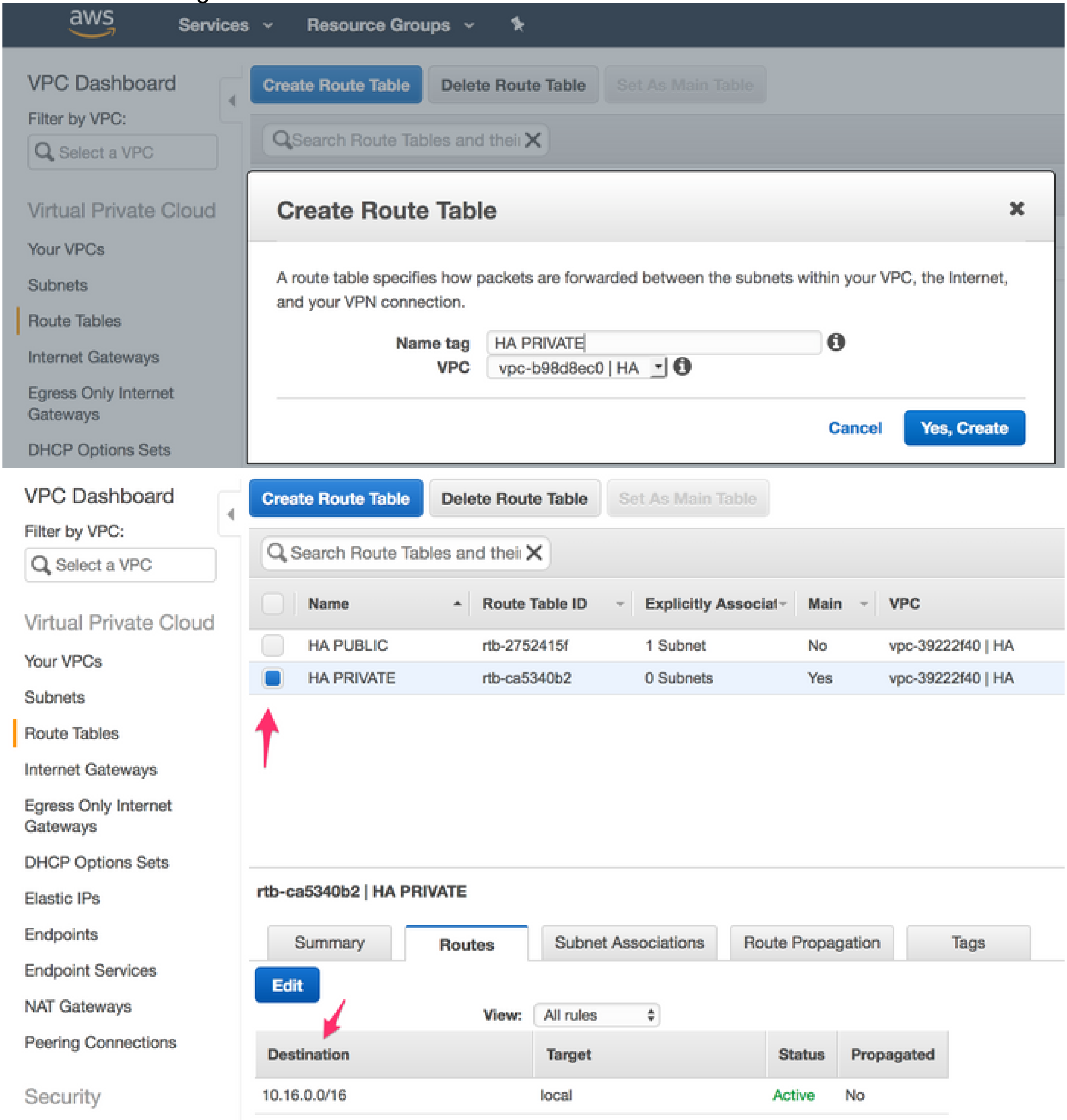
```
ubuntu@ip-10-16-2-139:~$ route -n
Kernel IP routing table
Destination Gateway Genmask Flags Metric Ref Use Iface
0.0.0.0 10.16.2.1 0.0.0.0 UG 0 0 0 eth0
8.8.8.8 10.16.6.1 255.255.255.255 UGH 0 0 0 eth1     <---------------
10.16.3.0 0.0.0.0 255.255.255.0 U 0 0 0 eth0
10.16.6.0 0.0.0.0 255.255.255.0 U 0 0 0 eth1
```

If 8.8.8.8 is not listed in the table, add it manually:

```
ubuntu@ip-10-16-2-139:~$ sudo route add -host 8.8.8.8 gw 10.16.6.1 dev eth1
```

Step 8. Configure the Private and Public Route Tables.

1. When a VPC through the wizard in Step 2 is created, two route tables are automatically created. If there is only one Route Table, create another one for your private subnets, as shown in the image.



Create Route Table

A route table specifies how packets are forwarded between the subnets within your VPC, the Internet, and your VPN connection.

Name tag: HA PRIVATE

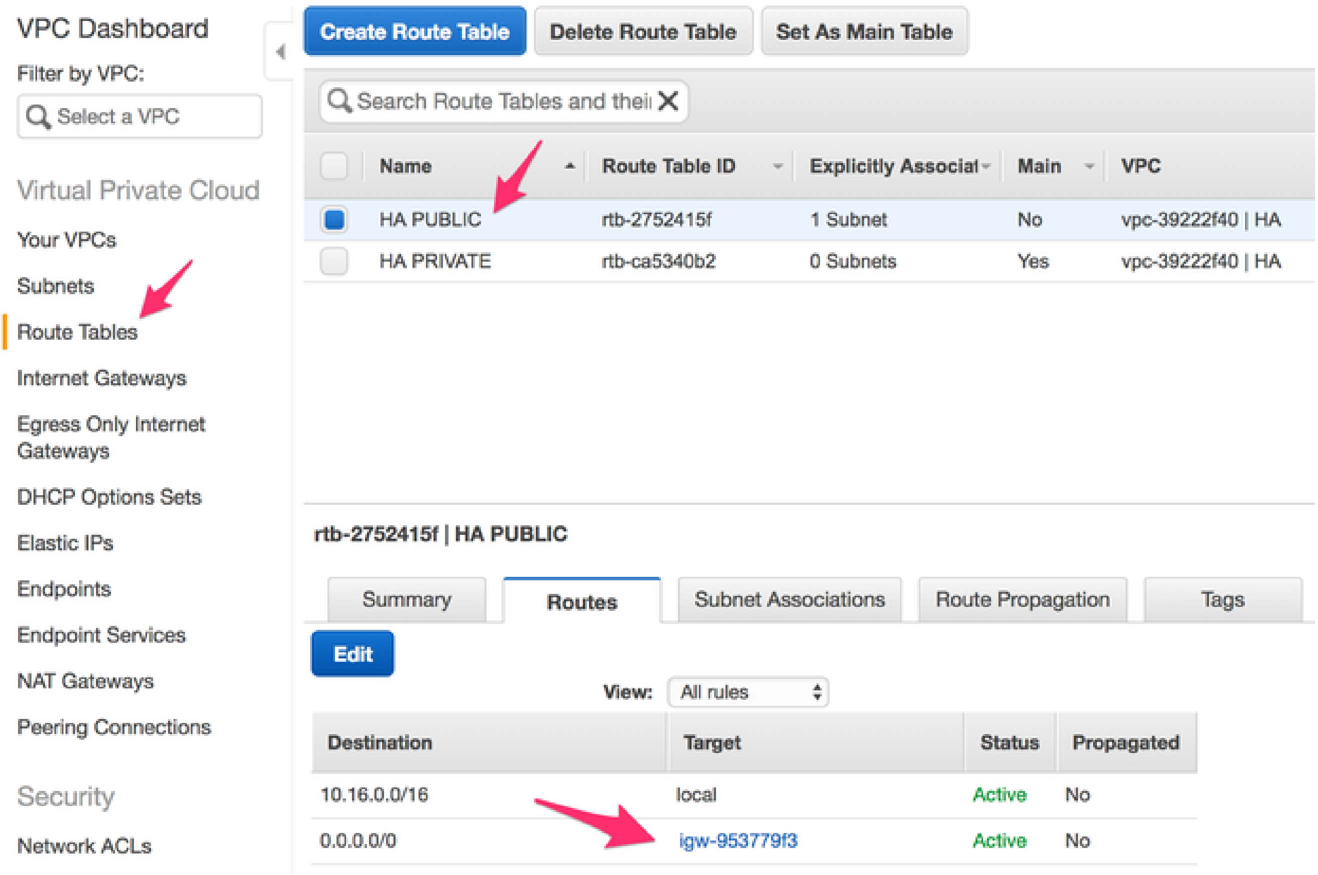
VPC: vpc-b98d8ec0 | HA

	Name	Route Table ID	Explicitly Associat	Main	VPC
□	HA PUBLIC	rtb-2752415f	1 Subnet	No	vpc-39222f40 | HA
■	HA PRIVATE	rtb-ca5340b2	0 Subnets	Yes	vpc-39222f40 | HA

rtb-ca5340b2 | HA PRIVATE

Destination	Target	Status	Propagated
10.16.0.0/16	local	Active	No

2. Here is a view of the two Route Tables. The PUBLIC Route Table has the Internet Gateway (igw-95377973) automatically attached. Label these two tables accordingly. The PRIVATE table should NOT have this route.

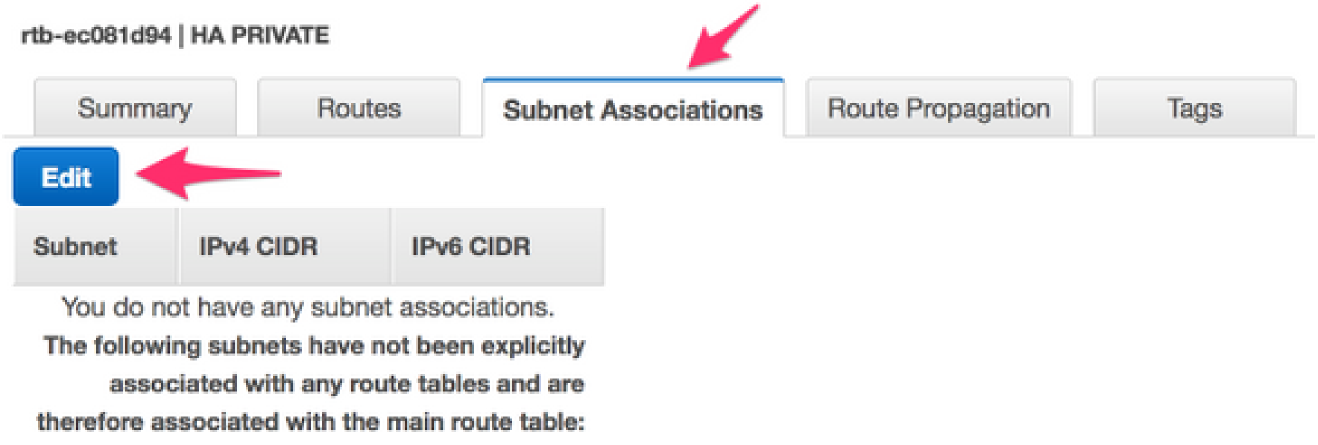


	Name	Route Table ID	Explicitly Associat	Main	VPC
☑	HA PUBLIC	rtb-2752415f	1 Subnet	No	vpc-39222f40 | HA
□	HA PRIVATE	rtb-ca5340b2	0 Subnets	Yes	vpc-39222f40 | HA

rtb-2752415f | HA PUBLIC

Destination	Target	Status	Propagated
10.16.0.0/16	local	Active	No
0.0.0.0/0	igw-953779f3	Active	No

3. Associate all 6 subnets to the proper Route Table 3 Public interfaces are associated with the Public Route Table:Public Subnets: 10.16.0.0/24, 10.16.1.0/24, 10.16.2.0/24 3 Private interfaces are associated with the Private Route Table:Private Subnets: 10.16.4.0/24, 10.16.5.0/24,
10.16.6.0/24



rtb-ec081d94 | HA PRIVATE

Subnet	IPv4 CIDR	IPv6 CIDR

You do not have any subnet associations.

The following subnets have not been explicitly associated with any route tables and are therefore associated with the main route table:

Step 9. Configure Network Address Transaltion (NAT) and GRE Tunnel with BFD, and any Routing Protocol.

Configure the Generic Routing Encapsulation (GRE) tunnel through the Elastic IPs of the CSR 1000v's (recommended to avoid DHCP lease renewal issues, which detect false failures.)
The Biderection Forwarding Detection (BFD) values can be configured to be more aggressive than those shown in this example, if faster convergence is required. However, this can lead to BFD peer down events during intermittent connectivity. The values in this example detects peer failure within 1.5 seconds. There is a variable delay of about a few seconds between the time when the AWS API command is executed and when the VPC routing table changes go into effect.

- Configuration on CSRHA

  GRE and BFD - Used to observe conditions for HA failover

```
interface Tunnel1
  ip address 192.168.1.1 255.255.255.0
  bfd interval 500 min_rx 500 multiplier 3
  tunnel source GigabitEthernet1
  tunnel destination 52.10.183.185 /* Elastic IP of the peer CSR */
!
router eigrp 1
  bfd interface Tunnel1
  network 192.168.1.0
  passive-interface GigabitEthernet1
```

  NAT and Routing - Used for VM internet reachability through the private interface

```
interface GigabitEthernet1
  ip address dhcp
  ip nat outside
  no shutdown
!
interface GigabitEthernet2
  ip address dhcp
  ip nat inside
  no shutdown
!
ip nat inside source list 10 interface GigabitEthernet1 overload
!
access-list 10 permit 10.16.6.0 0.0.0.255
!
ip route 10.16.6.0 255.255.255.0 GigabitEthernet2 10.16.4.1
```

- Configuration on CSRHA1

  GRE and BFD - Used to observe conditions for HA failover

```
interface Tunnel1
  ip address 192.168.1.2 255.255.255.0
  bfd interval 500 min_rx 500 multiplier 3
  tunnel source GigabitEthernet1
  tunnel destination 50.112.227.77 /* Elastic IP of the peer CSR */
!
router eigrp 1
  bfd interface Tunnel1
  network 192.168.1.0
  passive-interface GigabitEthernet1
```

  NAT and Routing - Used for VM internet reachability through the private interface

```
interface GigabitEthernet1
  ip address dhcp
  ip nat outside
  no shutdown
!
interface GigabitEthernet2
  ip address dhcp
  ip nat inside
  no shutdown
```

```
!
ip nat inside source list 10 interface GigabitEthernet1 overload
!
access-list 10 permit 10.16.6.0 0.0.0.255
!
ip route 10.16.6.0 255.255.255.0 GigabitEthernet2 10.16.5.1
```

Step 10. Configure High Availability (Cisco IOS XE Denali 16.3.1a or later).

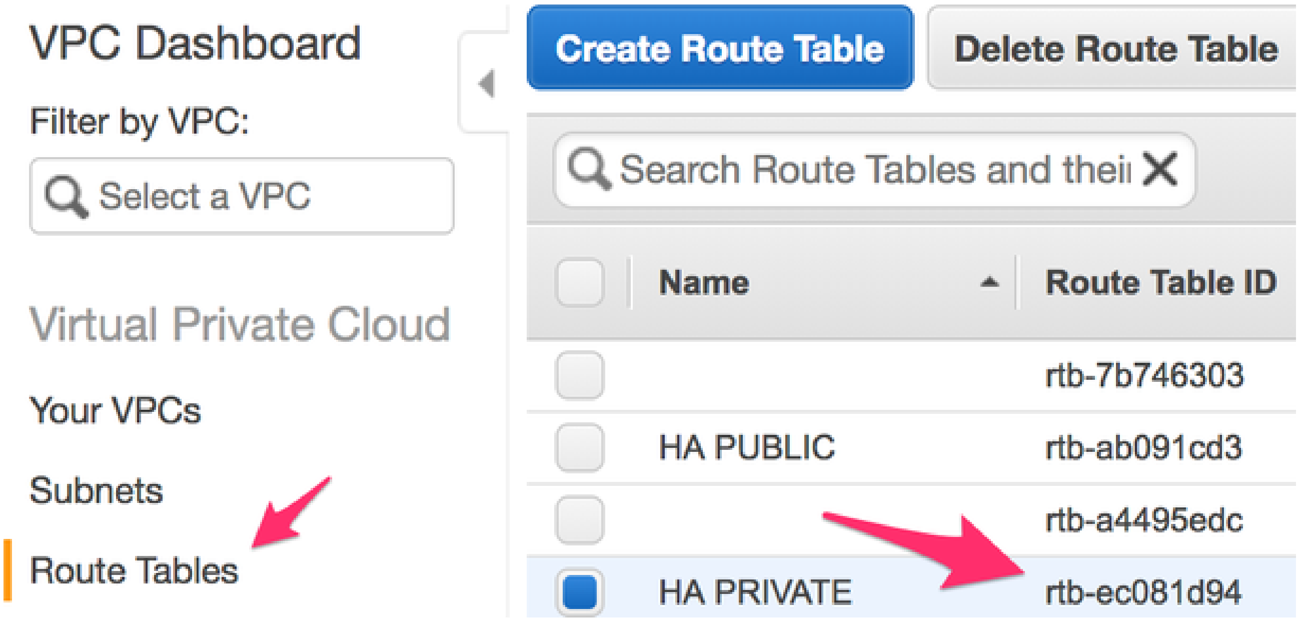
Monitor BFD peer down events by configuring each CSR 1000v using the cloud provider aws command specified below. Use this command to define the routing changes to (VPC) Route-table-id, Network-interface-id and CIDR after an AWS HA error such as BFD peer down, is detected.

```
CSR(config)# redundancy
CSR(config-red)# cloud provider [aws | azure] node-id
# bfd peer ipaddr
# route-table table-name
# cidr ip ipaddr/prefix
# eni elastic-network-intf-name
# region region-name
```

1. The #bfd peer ipaddr is the peer Tunnel ip address.

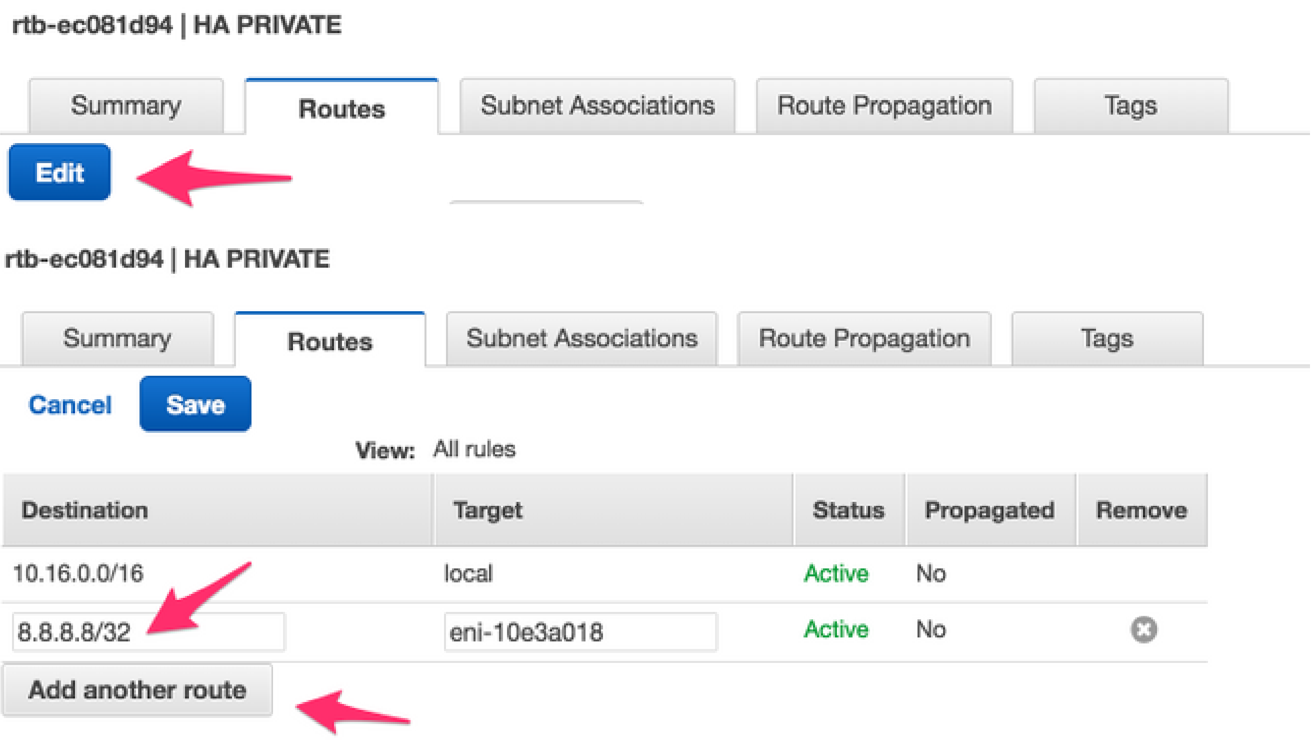
   ```
   CSRHA#show bfd neighbors

   IPv4 Sessions
   NeighAddr LD/RD RH/RS State Int
   192.168.1.2 4097/4097 Up Up Tu1
   ```

2. The #route-table table-name is found under AWS console, navigate to **VPC > Route Tables**. This action alters the Private Route Table.



	Name	Route Table ID
□		rtb-7b746303
□	HA PUBLIC	rtb-ab091cd3
□		rtb-a4495edc
☑	HA PRIVATE	rtb-ec081d94

3. The #cidr ip ipaddr/prefix is the destination address for the route to be updated in the route table. Under AWS console, navigate to **VPC > Route Tables**. Scroll down, click **Edit** and then on **Add another route**. Add our test destination address of 8.8.8.8 and CSRHA's private ENI.



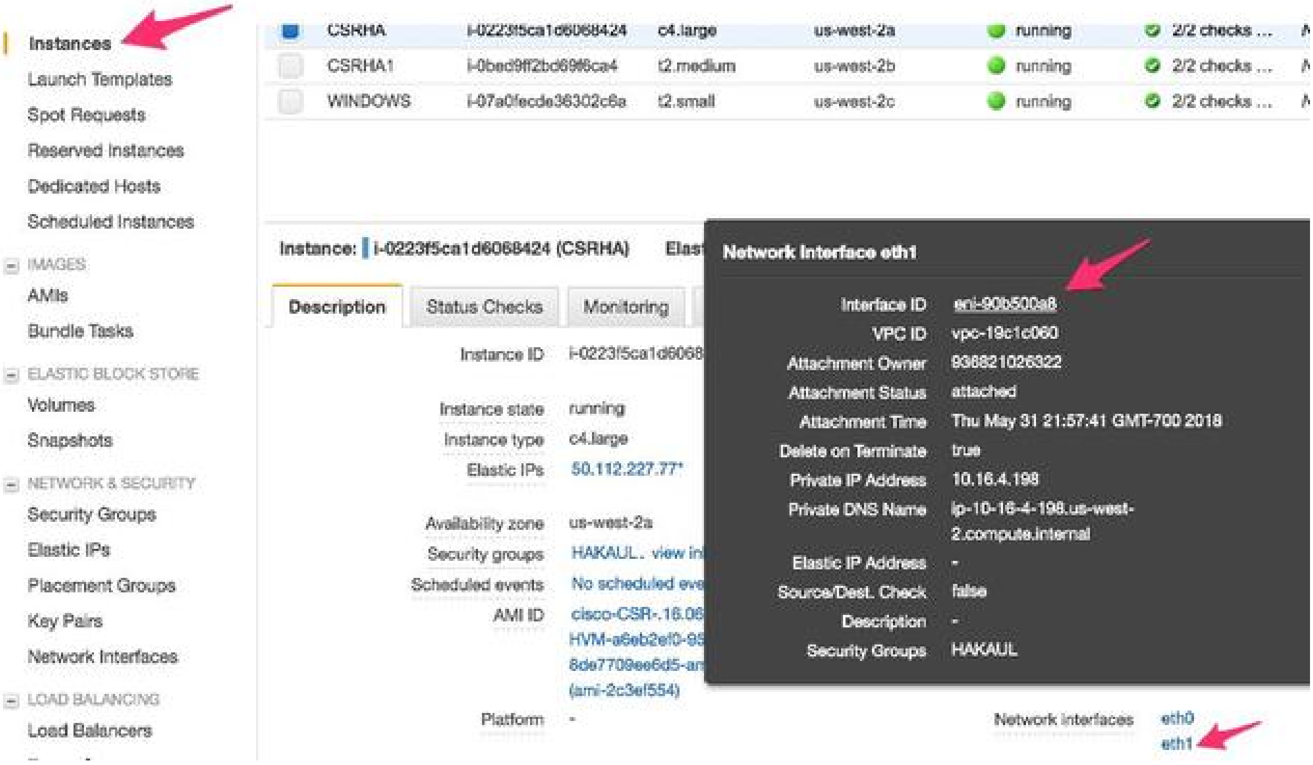
rtb-ec081d94 | HA PRIVATE

rtb-ec081d94 | HA PRIVATE

View: All rules

Destination	Target	Status	Propagated	Remove
10.16.0.0/16	local	Active	No	
8.8.8.8/32	eni-10e3a018	Active	No	⊗

4. The #eni elastic-network-intf-name is found in your EC2 instance. Click on your Private facing interface eth1 for each of the corresponding CSR's and use the Interface ID.



■	CSRHA	i-0223f5ca1d6068424	c4.large	us-west-2a	● running	✓ 2/2 checks ...
□	CSRHA1	i-0bed9ff2bd69f6ca4	t2.medium	us-west-2b	● running	✓ 2/2 checks ...
□	WINDOWS	i-07a0fecde36302c6a	t2.small	us-west-2c	● running	✓ 2/2 checks ...

Instance: i-0223f5ca1d6068424 (CSRHA) Elas

Instance ID i-0223f5ca1d6068

Instance state running

Instance type c4.large

Elastic IPs 50.112.227.77*

Availability zone us-west-2a

Security groups HAKAUL. view in

Scheduled events No scheduled eve

AMI ID cisco-CSR-.16.06 HVM-a6eb2ef0-9 8de7709ee6d5-am (ami-2c3ef554)

Platform -

Network interfaces eth0 eth1

Network Interface eth1

Interface ID eni-90b500a8

VPC ID vpc-19c1c060

Attachment Owner 936821026322

Attachment Status attached

Attachment Time Thu May 31 21:57:41 GMT-700 2018

Delete on Terminate true

Private IP Address 10.16.4.198

Private DNS Name ip-10-16-4-198.us-west-2.compute.internal

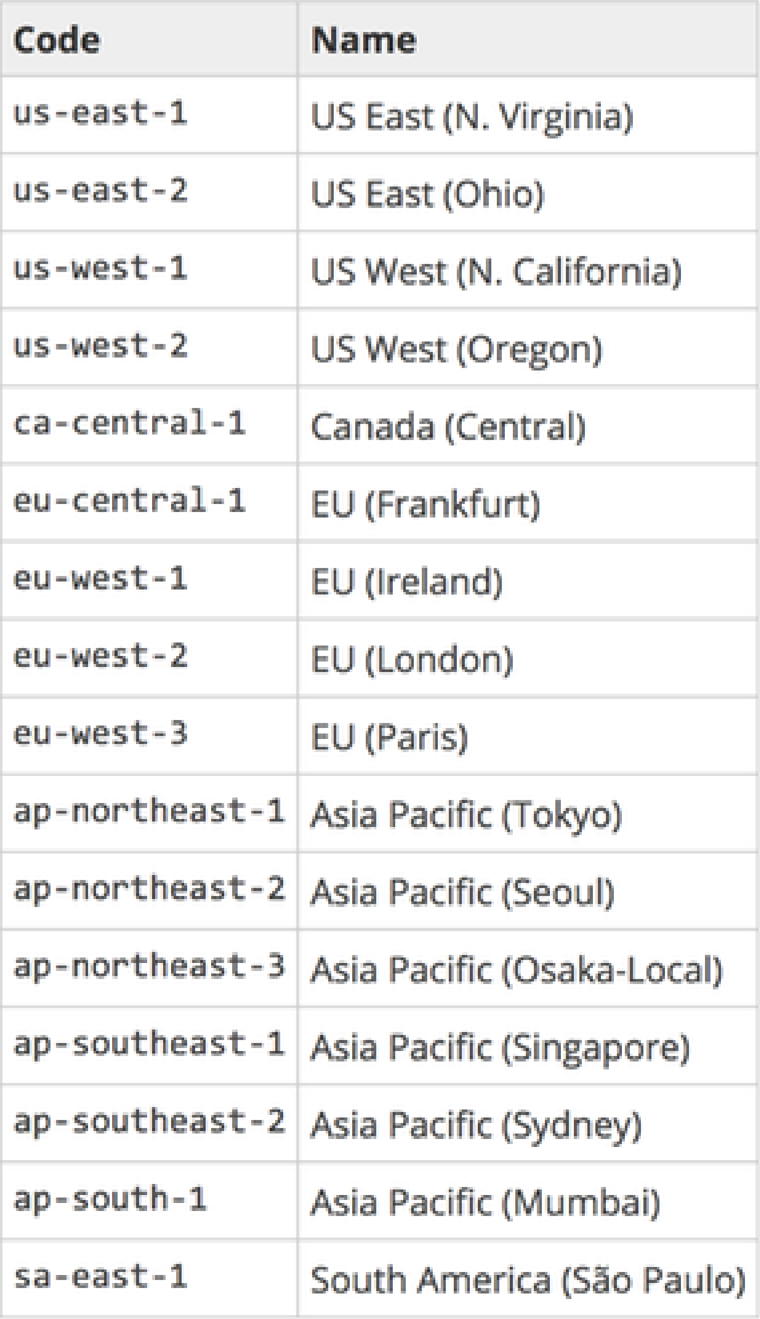
Elastic IP Address -

Source/Dest. Check false

Description -

Security Groups HAKAUL

5. The #region name is the code name found in the AWS document. This list may change or grow. To find the latest updates, visit Amazon's Region and Availability Zones document.



Code	Name
us-east-1	US East (N. Virginia)
us-east-2	US East (Ohio)
us-west-1	US West (N. California)
us-west-2	US West (Oregon)
ca-central-1	Canada (Central)
eu-central-1	EU (Frankfurt)
eu-west-1	EU (Ireland)
eu-west-2	EU (London)
eu-west-3	EU (Paris)
ap-northeast-1	Asia Pacific (Tokyo)
ap-northeast-2	Asia Pacific (Seoul)
ap-northeast-3	Asia Pacific (Osaka-Local)
ap-southeast-1	Asia Pacific (Singapore)
ap-southeast-2	Asia Pacific (Sydney)
ap-south-1	Asia Pacific (Mumbai)
sa-east-1	South America (São Paulo)

Redundancy Configuration Example on CSRHA

```
redundancy
cloud provider aws 1
  bfd peer 192.168.1.2
  route-table rtb-ec081d94
  cidr ip 8.8.8.8/32
  eni eni-90b500a8
  region us-west-2
```

Redundancy Configuration Example on CSRHA1

```
redundancy
cloud provider aws 1
  bfd peer 192.168.1.1
  route-table rtb-ec081d94
  cidr ip 8.8.8.8/32
  eni eni-10e3a018
  region us-west-2
```

Verify High Availability

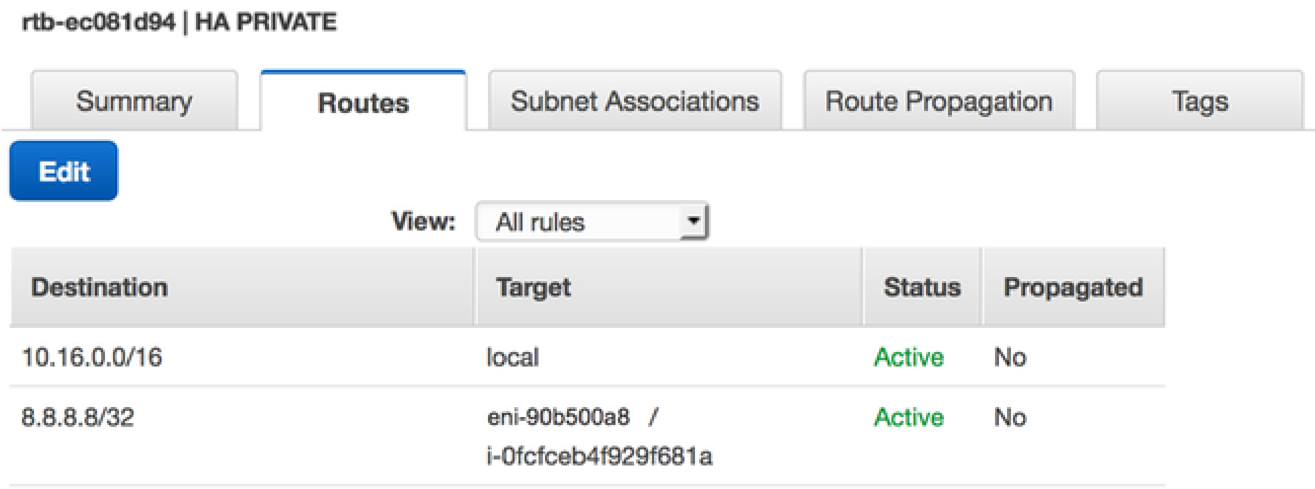
1. Check BFD and cloud configurations.

```
CSRHA#show bfd nei

IPv4 Sessions
NeighAddr LD/RD RH/RS State Int
192.168.1.2 4097/4097 Up Up Tu1


CSRHA#show ip eigrp neighbors
EIGRP-IPv4 Neighbors for AS(1)
H Address Interface Hold Uptime SRTT RTO Q Seq
(sec) (ms) Cnt Num
0 192.168.1.2 Tu1 12 00:11:57 1 1470 0 2


CSRHA#show redundancy cloud provider aws 1

Cloud HA: work_in_progress=FALSE
Provider : AWS node 1
State : idle
BFD peer      = 192.168.1.2
BFD intf      = Tunnel1
route-table   = rtb-ec081d94
cidr          = 8.8.8.8/32
eni           = eni-90b500a8
region        = us-west-2
```

2. Run a continuous ping from the VM to the destination. Ensure the ping is through the private eth1 interface.

```
ubuntu@ip-10-16-3-139:~$ ping -I eth1 8.8.8.8
PING 8.8.8.8 (8.8.8.8) from 10.16.6.131 eth1: 56(84) bytes of data.
64 bytes from 8.8.8.8: icmp_seq=1 ttl=50 time=1.60 ms
64 bytes from 8.8.8.8: icmp_seq=2 ttl=50 time=1.62 ms
64 bytes from 8.8.8.8: icmp_seq=3 ttl=50 time=1.57 ms
```

3. Check the Private Route Table. The eni is currently the private interface of CSRHA where this is the traffic.



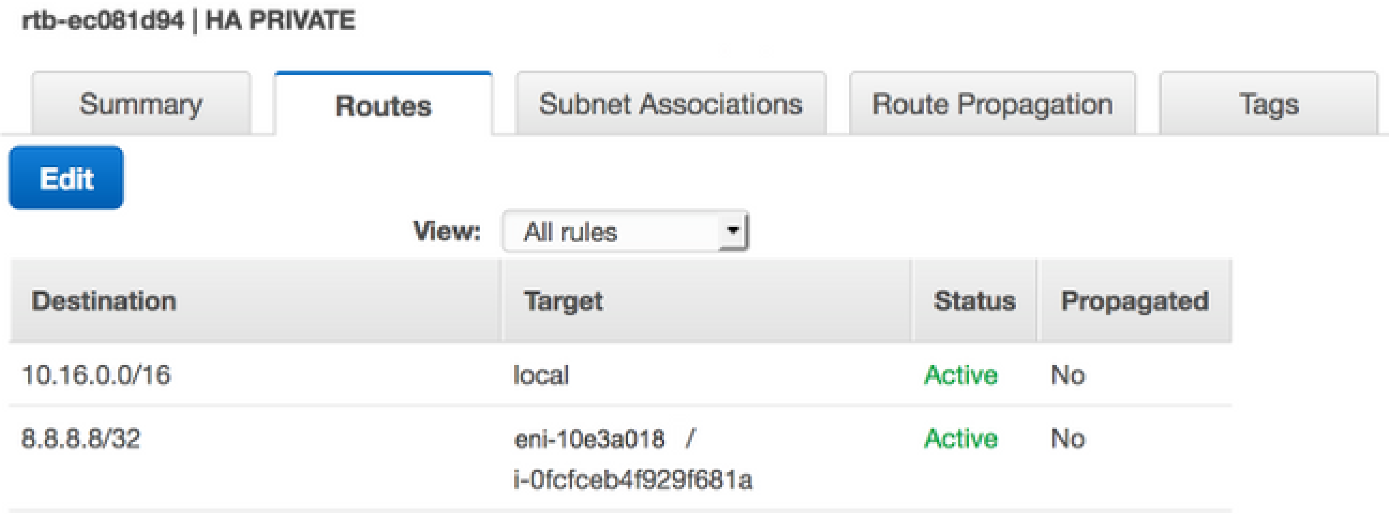
rtb-ec081d94 | HA PRIVATE

Destination	Target	Status	Propagated
10.16.0.0/16	local	Active	No
8.8.8.8/32	eni-90b500a8 / i-0fcfceb4f929f681a	Active	No

4. Shut down Tunnel1 of CSRHA to simulate an HA Failover.

```
CSRHA(config)#int Tun1
CSRHA(config-if)#shut
```

5. Observe that the Route Table points to the new ENI which is the private interface of CSRHA1.



Destination	Target	Status	Propagated
10.16.0.0/16	local	Active	No
8.8.8.8/32	eni-10e3a018 / i-0fcfceb4f929f681a	Active	No

Troubleshoot

- Ensure resources are associated. When creating VPC, Subnets, Interfaces, Route Tables, etc, many of these are not associated with each other automatically. They have no knowledge of each other.
- Ensure that the Elastic IP and any Private IP is associated with the correct Interfaces, with the right subnets, added to the correct Route Table, connected to the correct router and the correct VPC and Zone, linked with the IAM Role and security groups.

- Disable Source/Dest check per ENI.

- For Cisco IOS XE 16.3.1a or later, this is the additional verification commands available.

```
show redundancy cloud provider [aws | azure] node-id
debug redundancy cloud [all | trace | detail | error]
debug ip http all
```

- Here are common failures seen in debugs:

Problem: httpc_send_request failed

Resolution: Http is used to send the API call from the CSR to AWS. Ensure DNS can resolve the DNS name listed in your instance. Ensure http traffic is not blocked.

```
*May 30 20:08:06.922: %VXE_CLOUD_HA-3-FAILED: VXE Cloud HA BFD state transitioned, AWS node 1
event httpc_send_request failed
*May 30 20:08:06.922: CLOUD-HA : AWS node 1 httpc_send_request failed (0x12)
URL=http://ec2.us-east-2b.amazonaws.com
```

Problem: route table rtb-9c0000f4 and interface eni-32791318 belong to different networks

Resolution: Region name and ENI are incorrectly configured in different networks. Region and ENI should be in the same zone as the router.

```
*May 30 23:38:09.141: CLOUD-HA : res content iov_len=284 iov_base=<?xml version="1.0"
encoding="UTF-8"?>
<Response><Errors><Error><Code>InvalidParameterValue</Code><Message>route table rtb-9c0000f4 and
interface eni-32791318 belong to different
networks</Message></Error></Errors><RequestID>af3f228c-d5d8-4b23-b22c-
f6ad999e70bd</RequestID></Response>
```

Problem: You are not authorized to perform this operation. Encoded authorization failure message.

Resolution: IAM JSON role/policy created incorrectly or not applied to the CSR. IAM role authorizes the CSR to make API calls.

```
*May 30 22:22:46.437: CLOUD-HA : res content iov_len=895 iov_base=<?xml version="1.0"
encoding="UTF-8"?>
<Response><Errors><Error><Code>UnauthorizedOperation</Code><Message>You are not authorized to
perform this operation. Encoded
authorization failure message: qYvEB4MUdOB8m2itSteRgnOuslAaxhAbDph5qGRJkjJbrESajbmF5HWUR-
MmHYeRAlpKZ3Jg_y-
_tMlYel5l_ws8Jd9q2W8YDXBl3uXQqfW_cjjrgy9jhnGY0nOaNu65aLpfqui8kS_4RPOpm5grRFfo99-
8uv_N3mYaBqKFPn3vUcSYKBmxFIIkJKcjY9esOeLIOWDcnYGGu6AGGMoMxWDtk0K8nwk4IjLDcnd2cDXeENS45w1PqzKGPsH
v3wD28TS5xRjIrPXYrT18UpV6lLA_09Oh4737VncQKfzbz4tPpnAkoW0mJLQ1vDpPmNvHUpEng8KrGWYNfbfemoDtWqIdABf
aLLLmh4saNtnQ_OMBoTi4toBLEb2BNdMkl1UVBIxqTqdFUVRS**MSG 00041 TRUNCATED** **MSG 00041
CONTINUATION
#01**qLosAb5Yx0DrOsLSQwzS95VGvQM_n87LBHYbAWWhqWj3UfP_zmiak7dlm9P41mFCucEB3Cs4FRsFtb-
9q44VtyQJaS2sU2nhGe3x4uGEsl7F1pNv5vhVeYOZB3tbOfbV1_Y4trZwYPFgLKgBShZp-WNmUKUJsKc1-
6KGqmp7519imvh66JgwgmU9DT_qAZ-jEjkqWjBrxg6krw</Message></Error></Errors><RequestID>4cf31249-
2a6e-4414-ae8d-6fb825b0f398</RequestID></Response>
```

Related Information

- VPC Gateway Redundancy - Cisco
- Cisco CSR 1000v Series Cloud Services Router Deployment Guide for Amazon Web Services
- Instance types breakdown
- EC2 and VPCs
- Elastic Network Interfaces, from EC2 User Guide, includes # of ENIs per instance type
- Enhanced Networking on Linux how-to, useful background info
- Dedicated Instances/tenancy Explanation and How-to
- General EC2 Documentation
- General VPC Documentation
- Regions and Availability Zones
- CSR1000v High Availability version 3