😊 Route 53 Resolver Endpoints

Amazon Route 53 Resolver is a scalable and highly available DNS (Domain Name System) service in Amazon Web Services (AWS). It is part of the Route 53 service, which is AWS's domain name system (DNS) web service. The Route 53 Resolver acts as a DNS resolver for Amazon VPCs (Virtual Private Clouds), allowing resources within your VPC to resolve domain names to IP addresses and vice versa.

Key Features of Route 53 Resolver

1. **DNS Resolution:**
    - The Route 53 Resolver provides DNS resolution for both forward (resolving domain names to IP addresses) and reverse (resolving IP addresses to domain names) lookups within your VPC.
2. **Hybrid DNS:**
    - Route 53 Resolver supports hybrid cloud scenarios by enabling DNS resolution between on-premises networks and AWS VPCs. This is done through the use of inbound and outbound endpoints.
    - **Inbound Endpoints:** Allow on-premises systems to resolve domain names for AWS resources.
    - **Outbound Endpoints:** Allow AWS resources to resolve domain names hosted in on-premises networks or another cloud provider.
3. **Private DNS for VPCs:**
    - Route 53 Resolver allows you to use private DNS for resources within your VPC, enabling the use of custom domain names within your private network.
4. **Resolver Rules:**
    - You can create resolver rules to define how DNS queries should be handled. For example, you can specify that queries for certain domain names should be forwarded to specific IP addresses or DNS servers.
5. **Security:**
    - Route 53 Resolver integrates with AWS Identity and Access Management (IAM) and AWS CloudTrail, allowing you to manage access and monitor DNS queries.
6. **Scalability and High Availability:**
    - Route 53 Resolver is designed to be highly available and can scale to handle DNS queries efficiently across multiple VPCs and regions.

Use Cases

- **Hybrid Cloud DNS Resolution:** Connecting on-premises environments with AWS, enabling seamless DNS resolution between the two.
- **Private DNS Management:** Providing DNS resolution for internal domain names within a VPC, without exposing DNS queries to the public internet.
- **Custom DNS Routing:** Directing specific DNS queries to custom DNS servers or endpoints, allowing for customized DNS behavior.

How It Works

1. **DNS Queries from VPC:** When an AWS resource within a VPC needs to resolve a domain name, it sends a DNS query to the Route 53 Resolver.
2. **Resolver Rules:** The resolver uses the rules you have defined to determine how to handle the query, whether to resolve it within the VPC, forward it to another DNS server, or respond with a custom IP address.
3. **Inbound and Outbound Endpoints:** Depending on the configuration, queries may be routed to on-premises DNS servers (via outbound endpoints) or received from on-premises systems (via inbound endpoints).

In summary, Route 53 Resolver is an essential component for managing DNS resolution within AWS environments, supporting both internal and hybrid cloud scenarios with flexibility and security.

🤔 What are we doing in this Lab?

In this lab, you're setting up a hybrid DNS resolution system between two AWS regions (Ohio and Frankfurt) using Amazon Route 53 Resolver. The goal is to enable seamless communication and DNS name resolution between resources in different regions, simulating an on-premises and cloud hybrid environment.

Summary of Steps:

1. **Setup CloudFormation Stacks:**
    - Deploy templates in the Ohio and Frankfurt regions to create necessary infrastructure, including VPCs, EC2 instances, and a DNS zone.
2. **Establish VPC Peering:**
    - Create a VPC peering connection between the VPCs in the Ohio and Frankfurt regions to allow network communication.
3. **DNS Resolution Setup:**
    - Create **Route 53 Resolver inbound endpoints** in the Ohio region to allow DNS queries from Frankfurt.
    - Update DNS server configurations in the Frankfurt region to use these endpoints.

- Configure **Route 53 Resolver outbound endpoints** in the Ohio region to forward DNS queries for a custom domain.

4. **Verification:**
   - Verify that instances in both regions can communicate and resolve DNS queries correctly.
5. **Cleanup:**
   - Delete the created infrastructure and configurations to avoid ongoing costs.

End Goal:

The end goal is to demonstrate how to set up cross-region, hybrid DNS resolution between AWS regions. This setup allows instances in different regions to resolve each other's DNS names securely and privately as if they were within the same network. This is useful for hybrid cloud scenarios where seamless and secure communication is required between on-premises systems and AWS cloud resources.

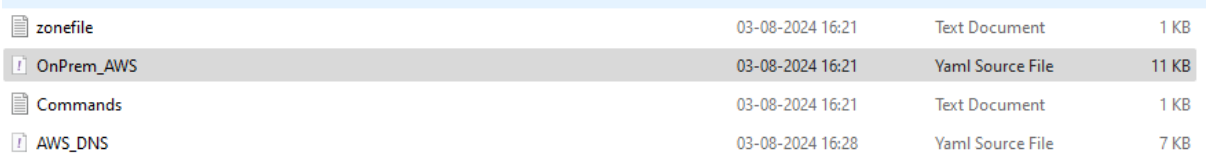
😄 To begin with the Lab:

😁 Step 1: Creating Environment

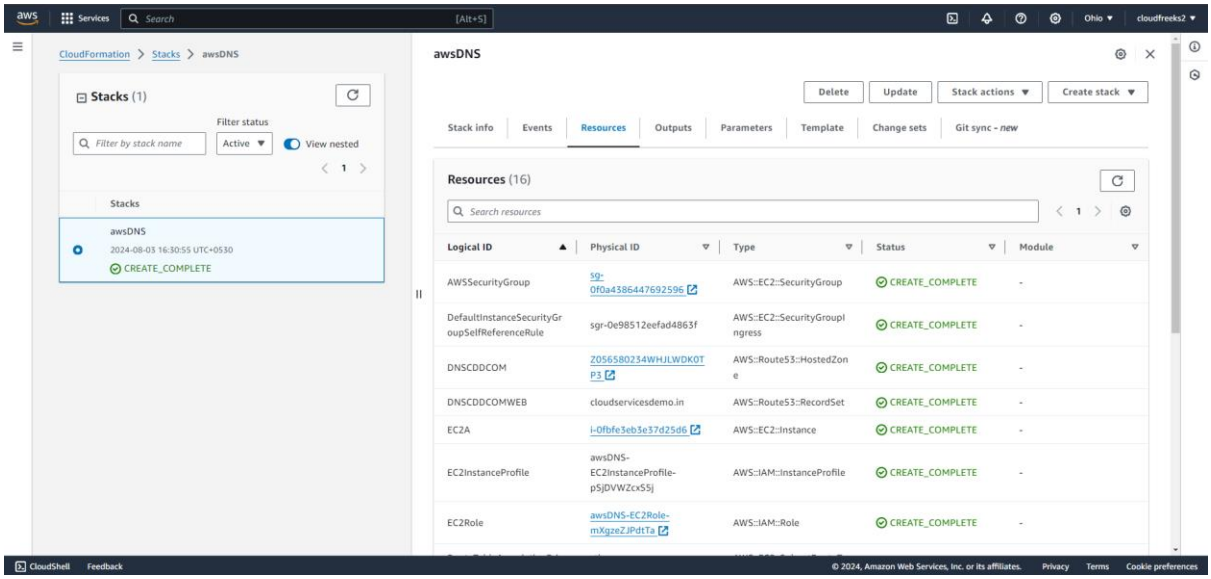
1. In this lab you need to download these 4 files shown below from GitHub.
2. Now you can see that two files are in YAML format because they are going to be used as templates in Cloud formation.
3. So, in your AWS Console go to cloud formation in the Ohio Region, then upload your template and create your stack. The template you have to use in the Ohio Region is AWS_DNS.

Also, it would help if you had a domain name from any provider with you. Then open the AWS_DNS file and update the name of your domain here. Then you have to upload the template.

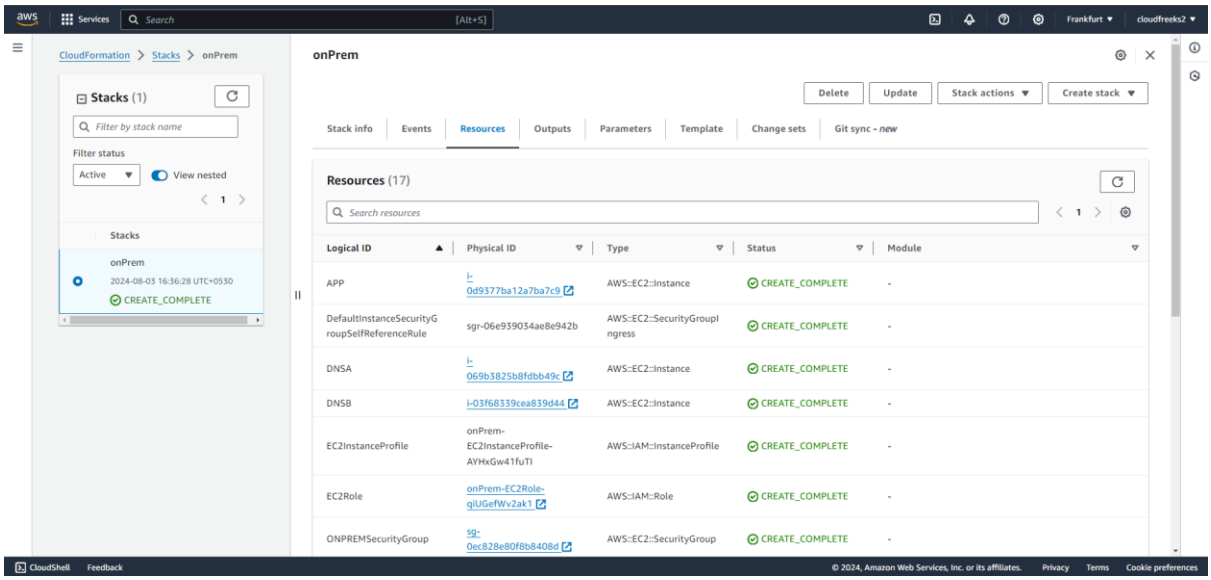
4. Similarly, you have to go to the Frankfurt region and go to cloud formation then you need to upload the template OnPrem_AWS and create your stack.



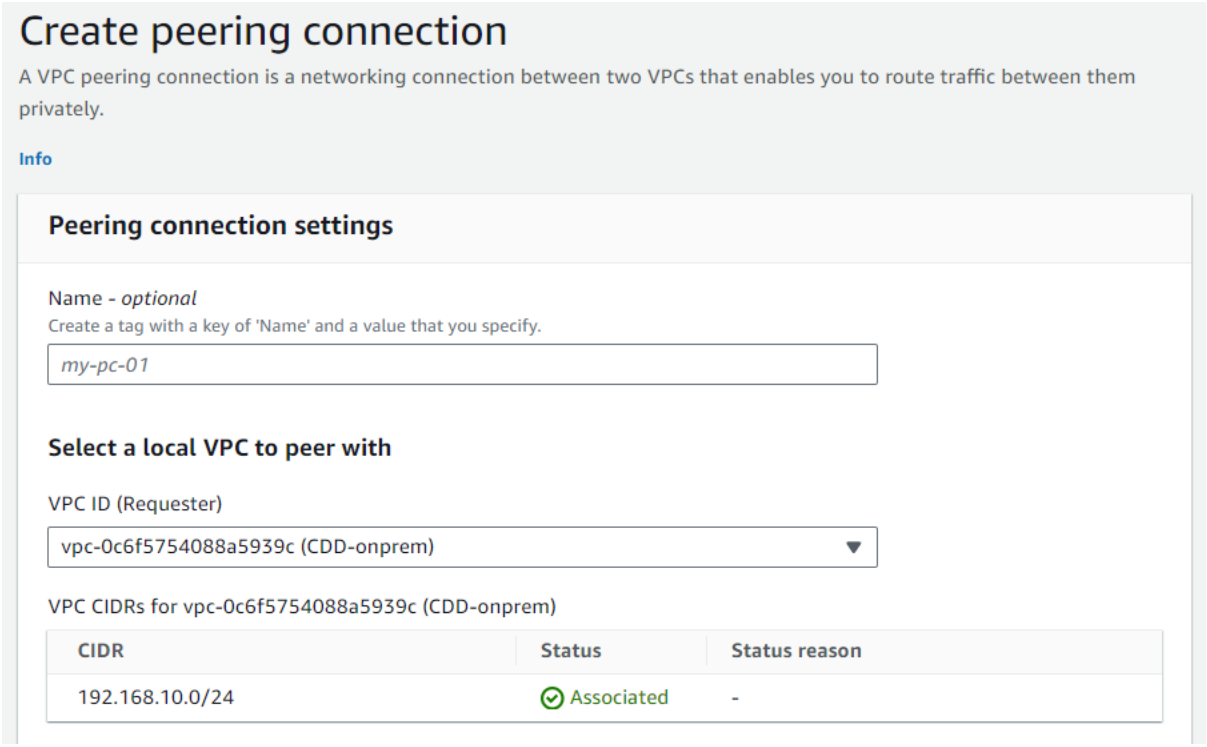
5. Below you can see that our template has been created in the Ohio region and here you can see the resources that have been created. So, here this template has created a VPC, an EC2 instance, and a DNS zone in Route 53.



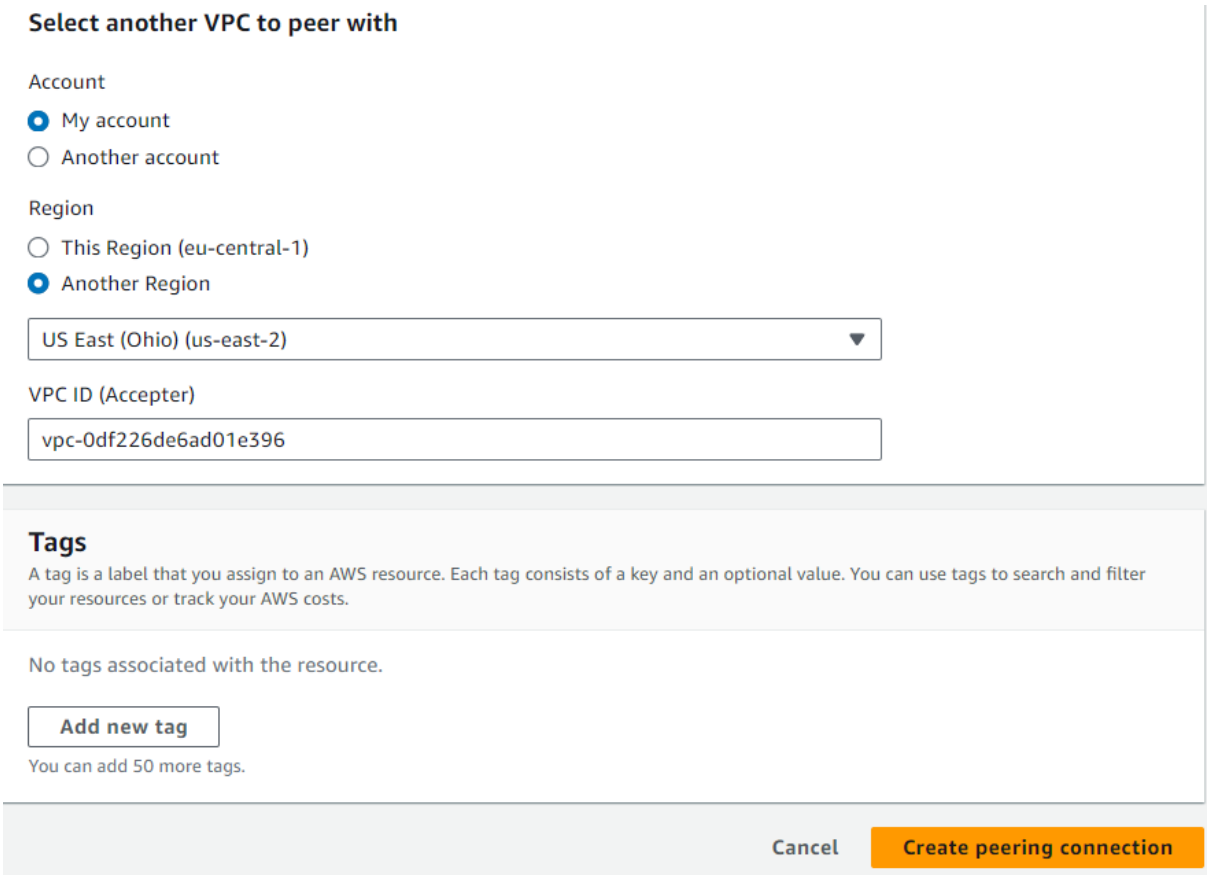
6. Below you can see that our template in the Frankfurt region has also been created. Here we have created a VPC, 3 EC2 instances.



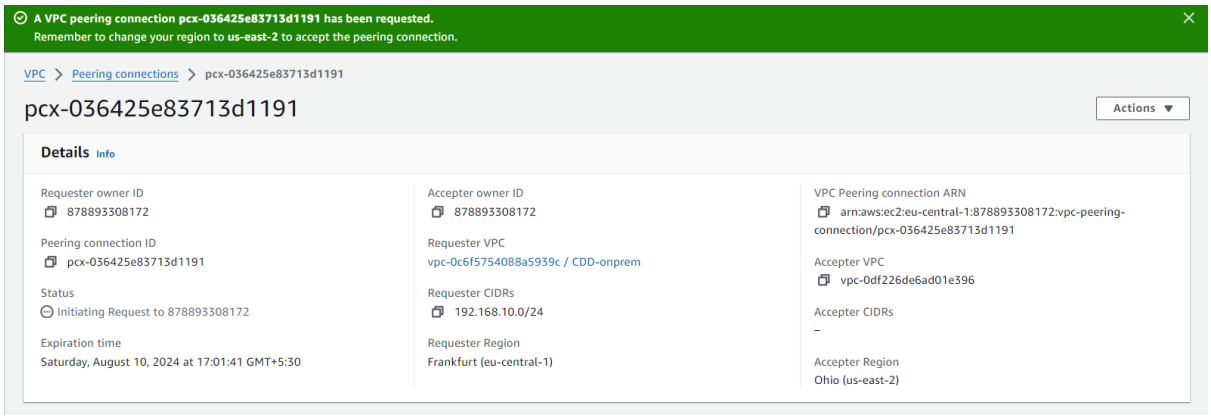
7. Now we are going to create a peering connection from the Frankfurt region to the Ohio region. For that in the search bar search for Peering Connection or go to VPC then navigate to there.
8. Here you need to click on Create. Then you need to choose the Requester which is on-prem and scroll down.



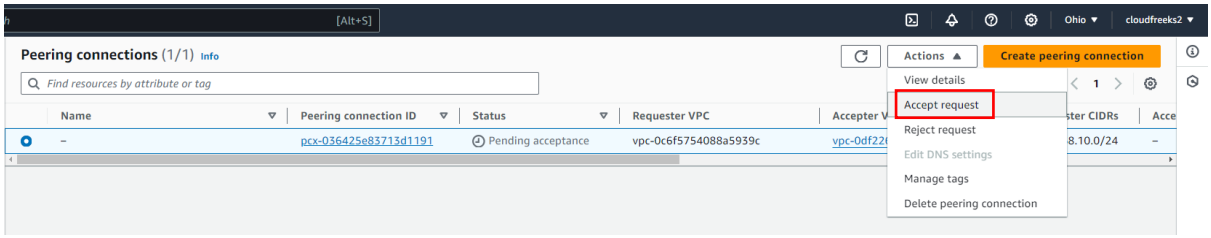
9. After that you need to choose My account, then in the region choose Another region and mention the VPC ID of the Ohio region VPC.
10. Then click on Create peering connection.



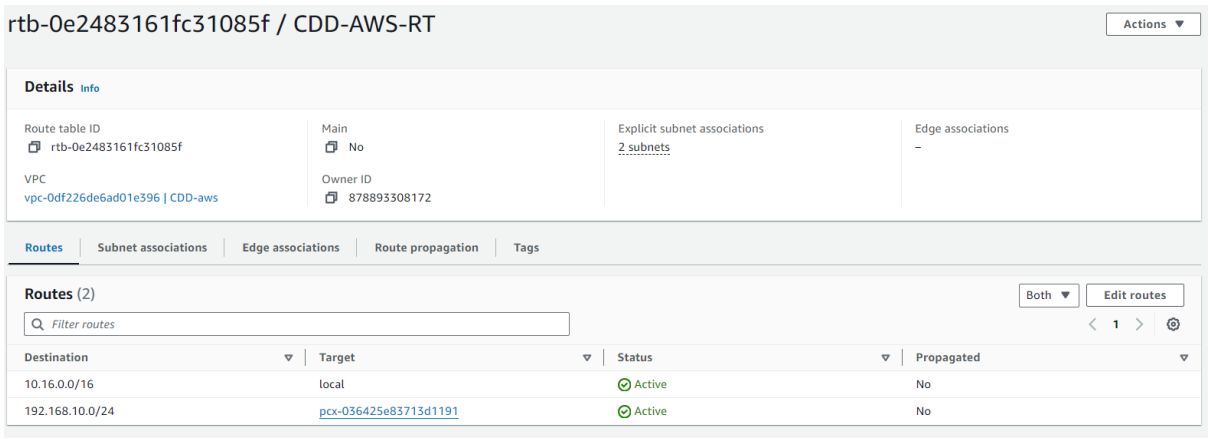
11. Then a request will be sent to the Ohio region VPC to accept the Peering connection request.

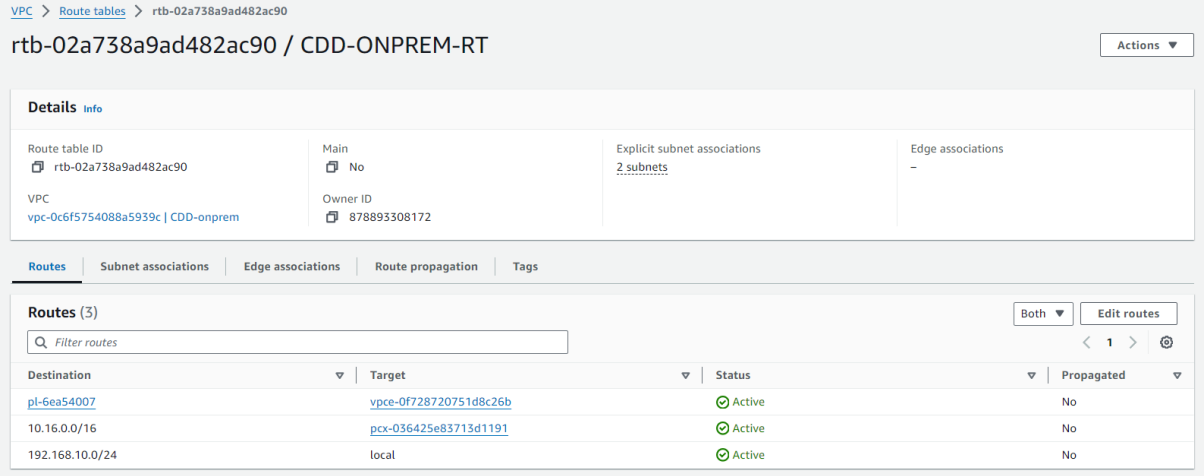


12. Now go to Peering connection in the Ohio region, here you will see the status as Pending Acceptance. Then choose it and click on action then click on accept request.

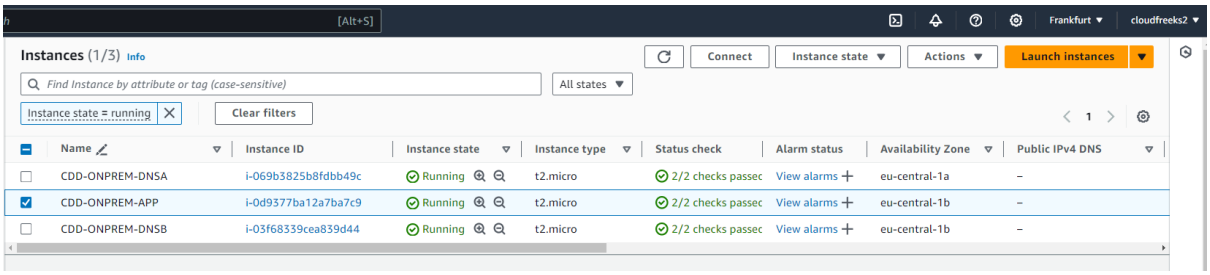


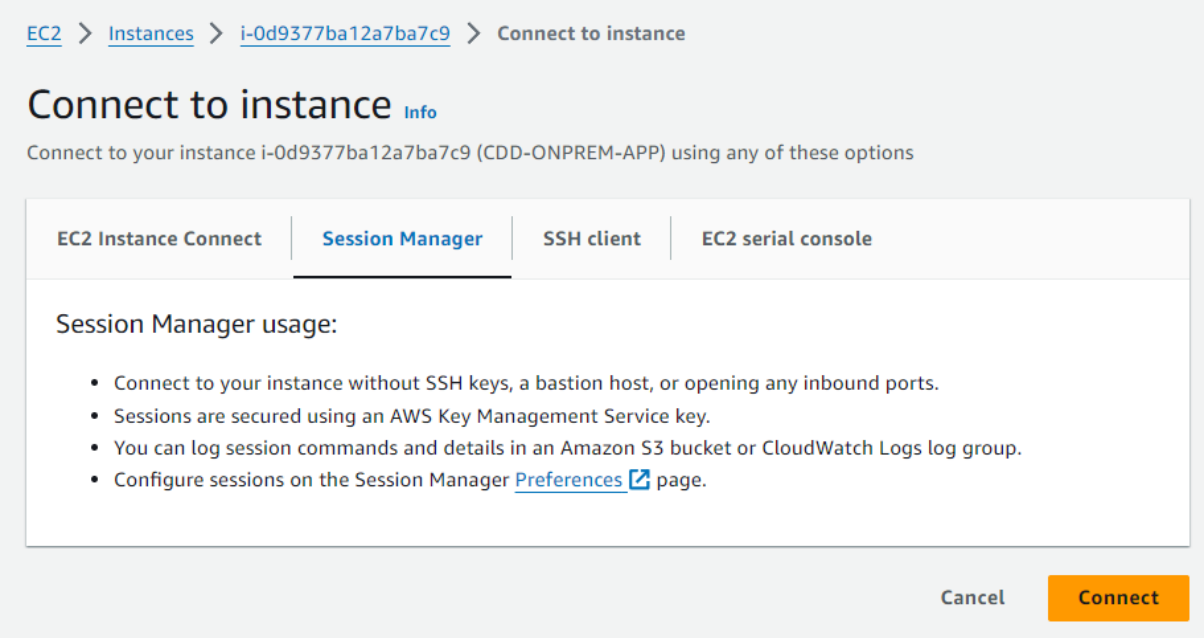
13. Then you need to go to route tables in both of the regions and add a route for both where the destination is CIDR blocks, and the target is Peering connection.





14. Now we are going to connect to our ON PREM APP instance in the Frankfurt region and try to ping the EC2 instance in the Ohio region. So, choose your instance and click on connect. Then choose Session Manager to connect with your instance.





15. Then you need to copy the Private IP address of your EC2 instance in Ohio and then try to ping that in Session Manager as shown below. Here you can see that we are able to make the connection with our instance.

Session ID: root-ipqbuba25ofgnpbe24zfcpj6ii Instance ID: i-0d9377ba12a7ba7c9

```
sh-4.2$ ping 10.16.45.114
PING 10.16.45.114 (10.16.45.114) 56(84) bytes of data.
64 bytes from 10.16.45.114: icmp_seq=1 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=2 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=3 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=4 ttl=255 time=99.9 ms
64 bytes from 10.16.45.114: icmp_seq=5 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=6 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=7 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=8 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=9 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=10 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=11 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=12 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=13 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=14 ttl=255 time=99.8 ms
64 bytes from 10.16.45.114: icmp_seq=15 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=16 ttl=255 time=99.7 ms
64 bytes from 10.16.45.114: icmp_seq=17 ttl=255 time=99.7 ms
^C
--- 10.16.45.114 ping statistics ---
17 packets transmitted, 17 received, 0% packet loss, time 16020ms
rtt min/avg/max/mdev = 99.712/99.814/99.908/0.422 ms
sh-4.2$
```

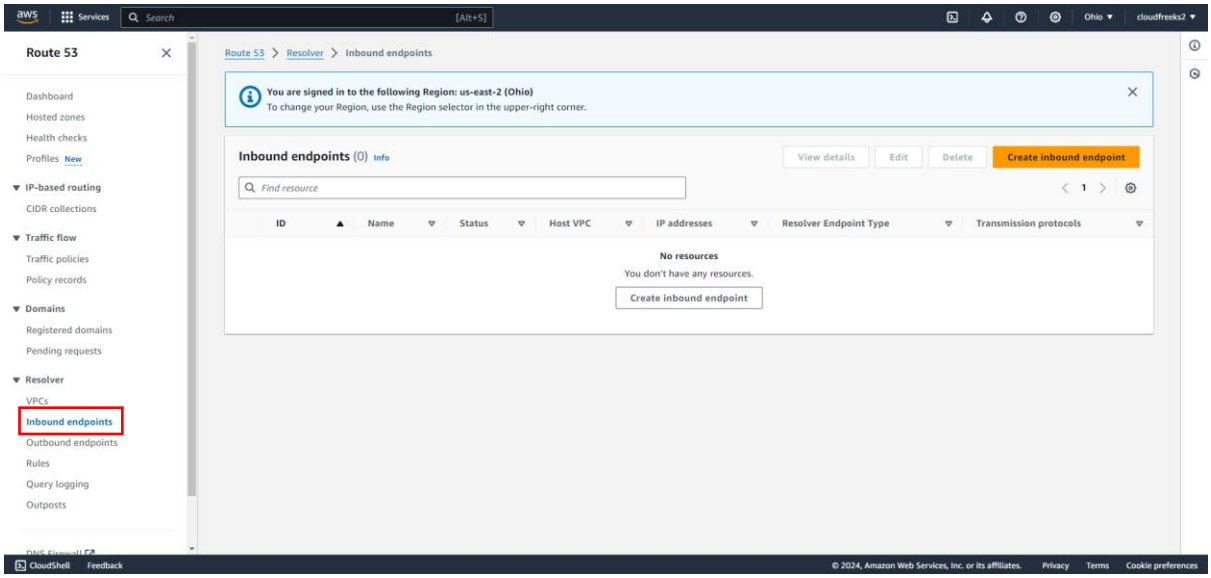
16. And here if we try to ping our DNS server then it is saying that Name or service not known.

```
sh-4.2$ ping cloudservicesdemo.in
ping: cloudservicesdemo.in: Name or service not known
sh-4.2$
```

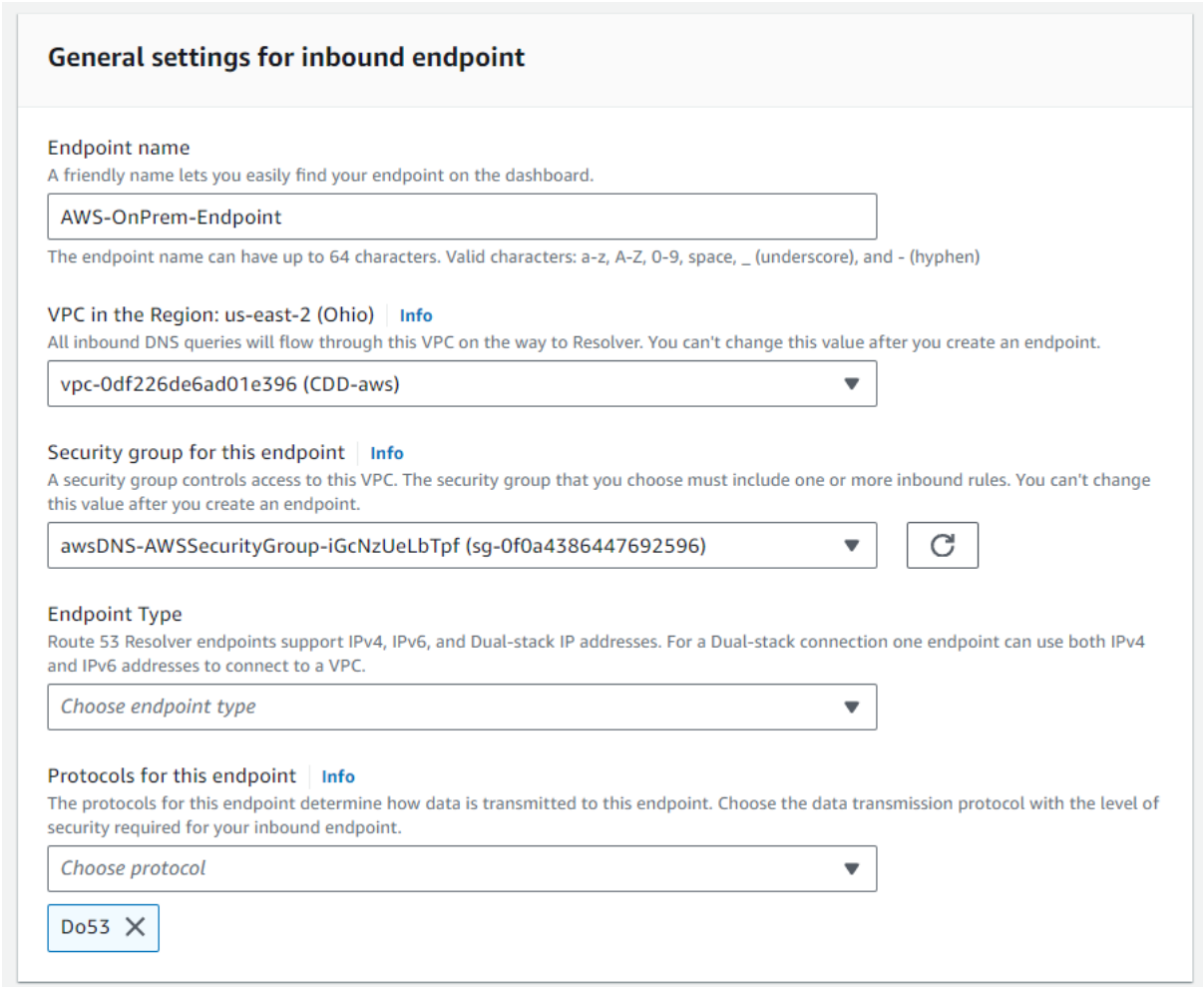
17. So, currently we have created our environment and in it our instances can talk to each other, but they cannot resolve the DNS name of each other.

😁 Step 2: Create Inbound Endpoints

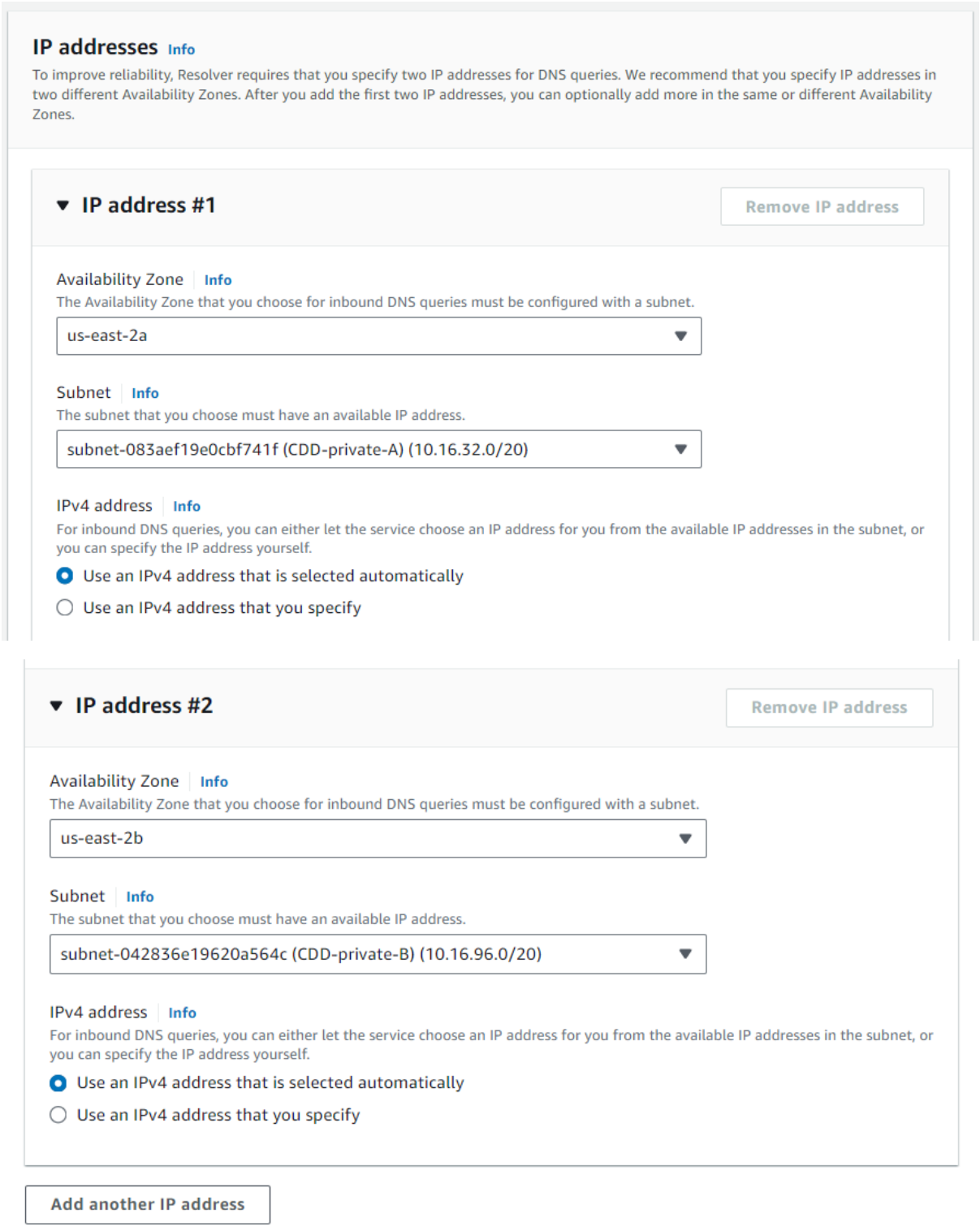
1. Now we will create two Route 53 resolver Endpoints and then update our DNS and App servers.
2. Now you need to go to Route 53 in Ohio region because here our DNS zone has been hosted and go to Inbound endpoints under Resolver as shown in the snapshot below. Click on create inbound endpoints.



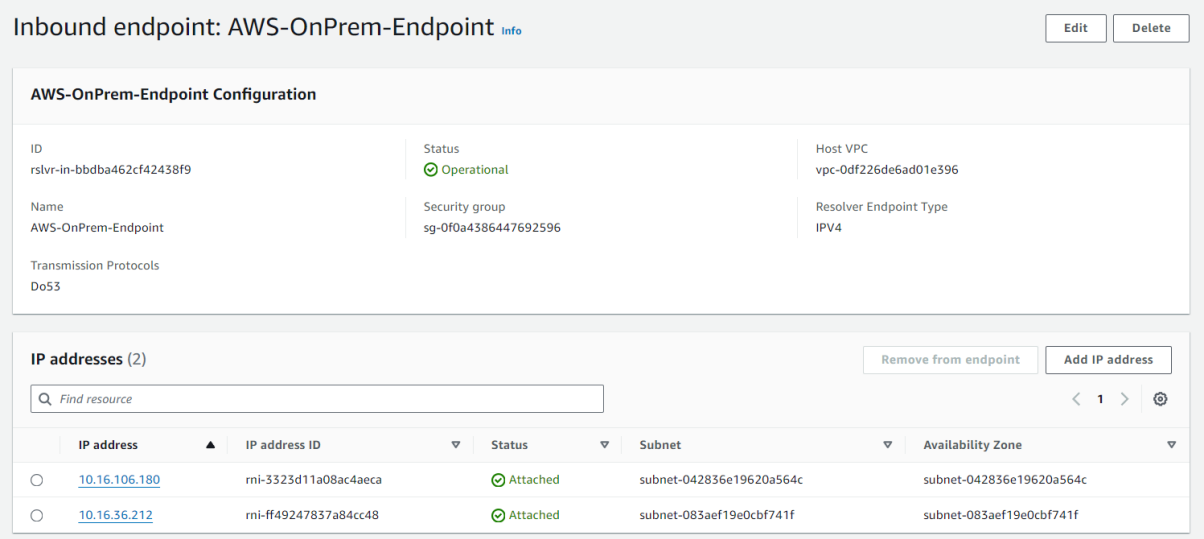
3. Here you need to give it an endpoint name of your choice, then choose the VPC, after that, you need to choose the same Security group as shown below and in the Endpoint, type Choose IPv4 and scroll down.



4. Then in the IP address 1 you have to choose the availability zone, so choose us-east-2a and the subnet, similarly in the IP address 2 choose AZ as us-east-2b and the subnet. Then click on create endpoint.



5. Here it has created an inbound endpoint and two IP addresses in different Az. You need to copy these IP addresses and paste them in your notepad for later use.



6. Now we are going to update the zone in our EC2 instance DNS A which is in Frankfurt. By using the zone file that you have seen at the start.
7. So, inside the DNS server you are going to update this file in you need to paste the IP address in place of inbound endpoint IP1 and IP2.

```
zone "aws.clouddeepdive.org" {
  type forward;
  forward only;
  forwarders { INBOUND_ENDPOINT_IP1; INBOUND_ENDPOINT_IP2; };
};
```

8. Now connect with your instance and run some commands. Below you can see the commands. First, you need to enter the first command and then enter the second command to add some data in your configuration file.
9. After entering the second command you need to update the zone file now so copy the content from the file and paste it here as you can see below. After that just save it and then run the restart command.

cd /etc
sudo nano /etc/named.conf
sudo service named restart

Session ID: root-xdsamhfnv7ip457yigqdnufxdi Instance ID: i-069b3825b8fdbb49c

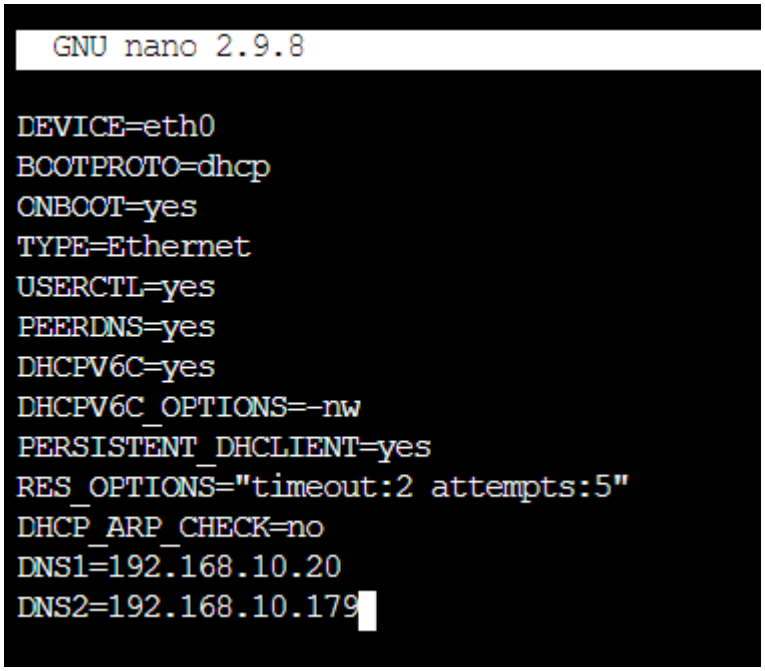
```
  GNU nano 2.9.8

options {
  directory "/var/named";
  dump-file "/var/named/data/cache_dump.db";
  statistics-file "/var/named/data/named_stats.txt";
  memstatistics-file "/var/named/data/named_mem_stats.txt";
  allow-query { any; };
  allow-transfer     { localhost; 192.168.10.179; };
  recursion yes;
  forward first;
  forwarders {
    192.168.10.2;
  };
  dnssec-enable yes;
  dnssec-validation yes;
  dnssec-lookaside auto;
  /* Path to ISC DLV key */
  bindkeys-file "/etc/named.iscdlv.key";
  managed-keys-directory "/var/named/dynamic";
};
zone "corp.clouddeepdive.org" IN {
    type master;
    file "corp.clouddeepdive.org.zone";
    allow-update { none; };
};
zone "aws.clouddeepdive.org" {
  type forward;
  forward only;
  forwarders { 10.16.106.180; 10.16.36.212; };
};
```

10. Now we need to go to the EC2 instance App server which is running in the Frankfurt region. In this server also we are going to update a file. So, open the session manager and run this command

    sudo nano /etc/sysconfig/network-scripts/ifcfg-eth0

11. Then you will be in this type of window inside your instance, now you need to update the DNS server in your App server for that go to bottom and write the private IP address of your 2 DNS servers which you can find in Frankfurt region. Now just save it.
12. In the end you need to reboot your server for that run this command

    sudo reboot



13. Similarly, you need to update your DNS B server also, like you did with your DNS A server
14. After doing that you need to connect with your App Server.
15. So, below you can see that when we try to ping the private IP of our EC2 instance in the Ohio region then we are getting a response but this time we also get the response from the DNS zone.
16. This time it could resolve the DNS query.

Session ID: root-tvypgsrzarpv4vmzdlnltlfxyy Instance ID: i-0d9377ba12a7ba7c9

```
sh-4.2$ ping 10.16.45.114
PING 10.16.45.114 (10.16.45.114) 56(84) bytes of data.
64 bytes from 10.16.45.114: icmp_seq=1 ttl=255 time=101 ms
64 bytes from 10.16.45.114: icmp_seq=2 ttl=255 time=101 ms
64 bytes from 10.16.45.114: icmp_seq=3 ttl=255 time=101 ms
64 bytes from 10.16.45.114: icmp_seq=4 ttl=255 time=101 ms
64 bytes from 10.16.45.114: icmp_seq=5 ttl=255 time=101 ms
64 bytes from 10.16.45.114: icmp_seq=6 ttl=255 time=101 ms
^C
--- 10.16.45.114 ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5008ms
rtt min/avg/max/mdev = 101.655/101.713/101.809/0.266 ms
sh-4.2$ ping cloudservicesdemo.in
PING cloudservicesdemo.in (10.16.45.114) 56(84) bytes of data.
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=1 ttl=255 time=101 ms
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=2 ttl=255 time=101 ms
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=3 ttl=255 time=101 ms
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=4 ttl=255 time=101 ms
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=5 ttl=255 time=101 ms
64 bytes from 10.16.45.114 (10.16.45.114): icmp_seq=6 ttl=255 time=101 ms
^C
--- cloudservicesdemo.in ping statistics ---
6 packets transmitted, 6 received, 0% packet loss, time 5009ms
rtt min/avg/max/mdev = 101.629/101.692/101.758/0.263 ms
sh-4.2$
```

😁 Step 3: Create Outbound Endpoint

1. Now go to route 53 and under resolver you will find outbound endpoints click on it and create it.
2. We created an inbound endpoint earlier, similarly, we need to create these. Follow the snapshots below.

General settings for outbound endpoint

Endpoint name
A friendly name lets you easily find your endpoint on the dashboard.

OnPrem-Outbound-EP

The endpoint name can have up to 64 characters. Valid characters: a-z, A-Z, 0-9, space, _ (underscore), and - (hyphen)

VPC in the Region: us-east-2 (Ohio) | Info
All outbound DNS queries will flow through this VPC on the way from other VPCs. You can't change this value after you create an endpoint.

vpc-0df226de6ad01e396 (CDD-aws)

Security group for this endpoint | Info
A security group controls access to this VPC. The security group that you choose must include one or more outbound rules. You can't change this value after you create an endpoint.

awsDNS-AWSSecurityGroup-iGcNzUeLbTpf (sg-0f0a4386447692596)

Endpoint Type
Route 53 Resolver endpoints support IPv4, IPv6, and Dual-stack IP addresses. For a Dual-stack connection one endpoint can use both IPv4 and IPv6 addresses to connect to a VPC.

IPv4

Protocols for this endpoint | Info
The protocols for this endpoint determine how data is transmitted to this endpoint. Choose the data transmission protocol with the level of security required for your outbound endpoint.

Choose protocol

Do53 ×

IP addresses Info

To improve reliability, Resolver requires that you specify two IP addresses for DNS queries. We recommend that you specify IP addresses in two different Availability Zones. After you add the first two IP addresses, you can optionally add more in the same or different Availability Zones.

▼ IP address #1

Remove IP address

Availability Zone | Info
The Availability Zone that you choose for outbound DNS queries must be configured with a subnet.

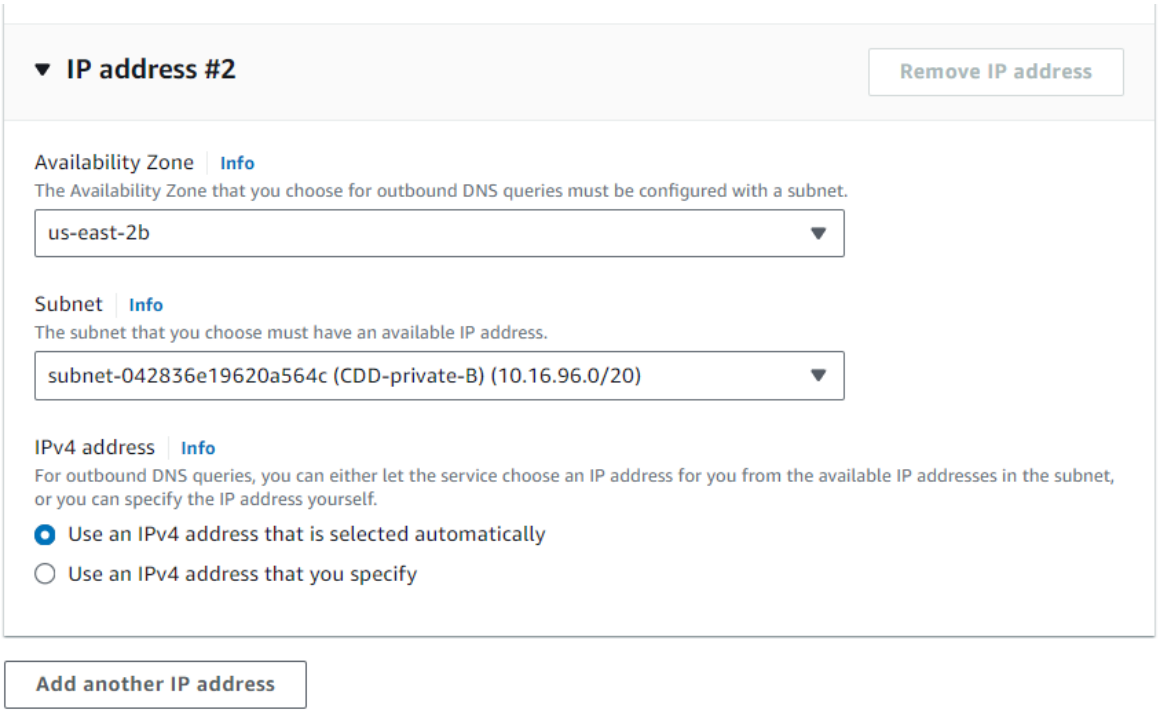
us-east-2a

Subnet | Info
The subnet that you choose must have an available IP address.

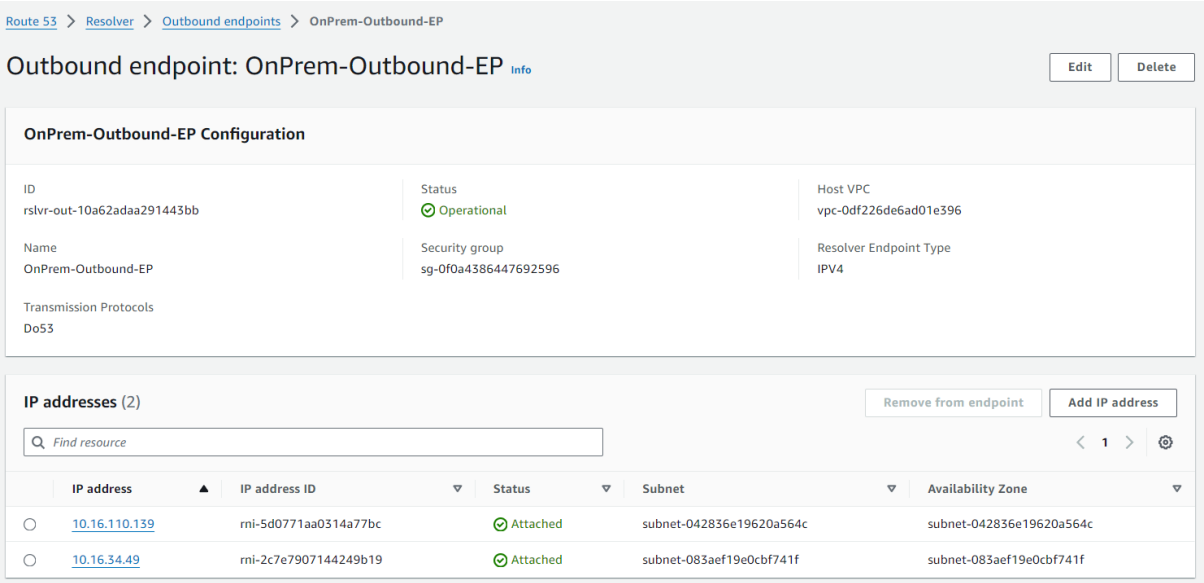
subnet-083aef19e0cbf741f (CDD-private-A) (10.16.32.0/20)

IPv4 address | Info
For outbound DNS queries, you can either let the service choose an IP address for you from the available IP addresses in the subnet, or you can specify the IP address yourself.

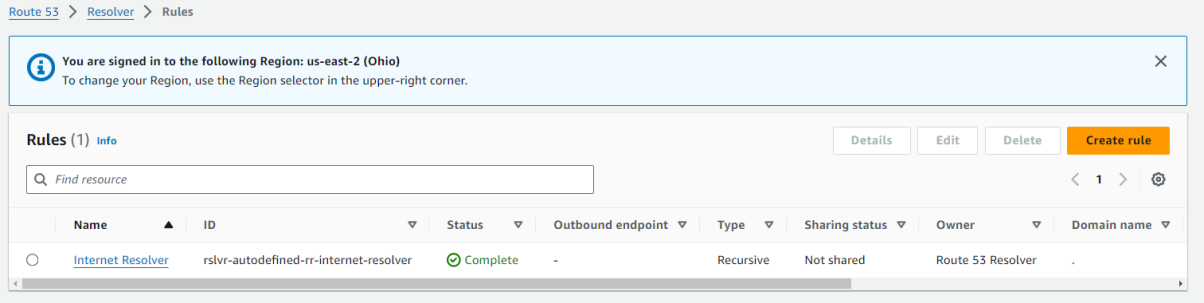
- (•) Use an IPv4 address that is selected automatically
- ( ) Use an IPv4 address that you specify



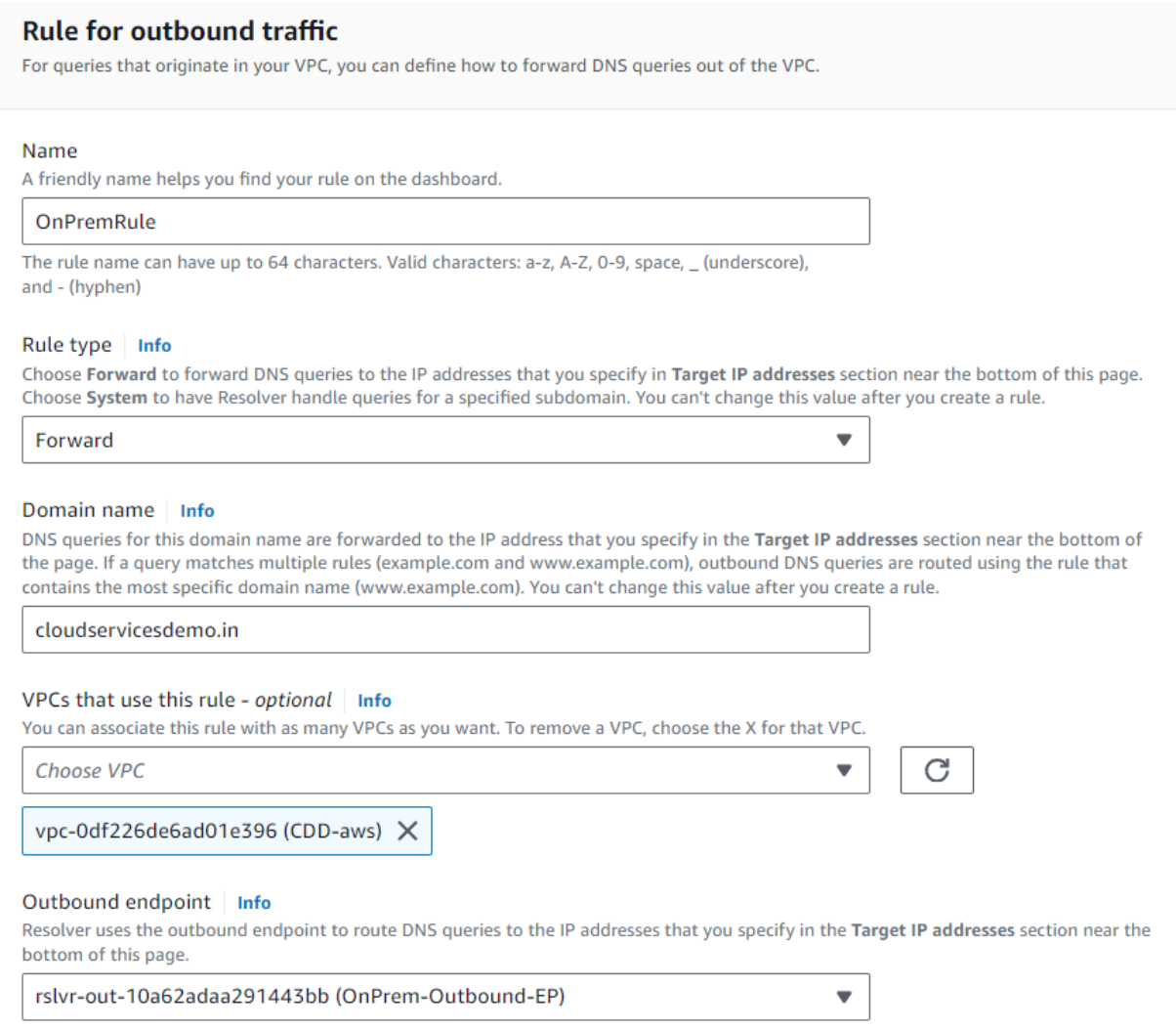
3. Once it is created then you will see that an outbound endpoint has been created with two IP addresses attached to it in different AZs.



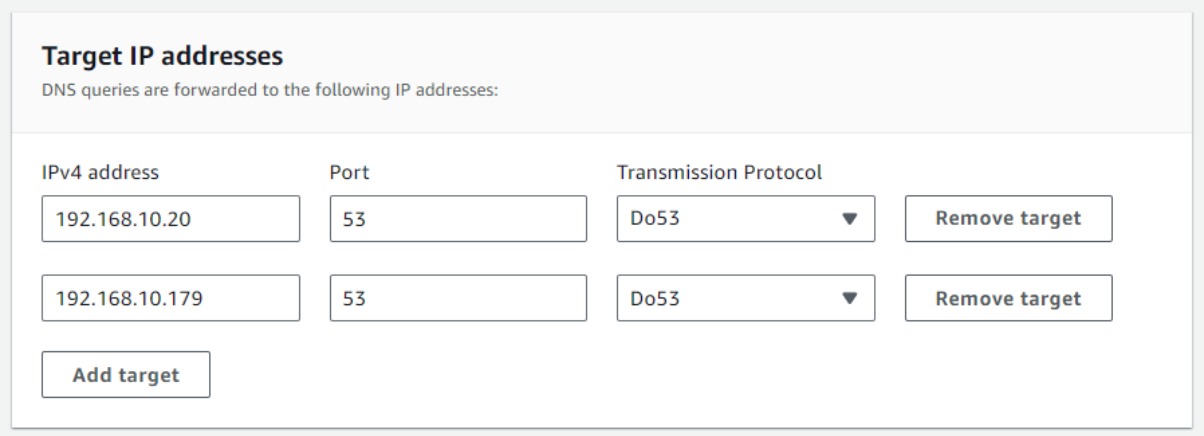
4. After that you are going to create rules. For that under the outbound endpoint you will see an option for rules click on it and click on create.



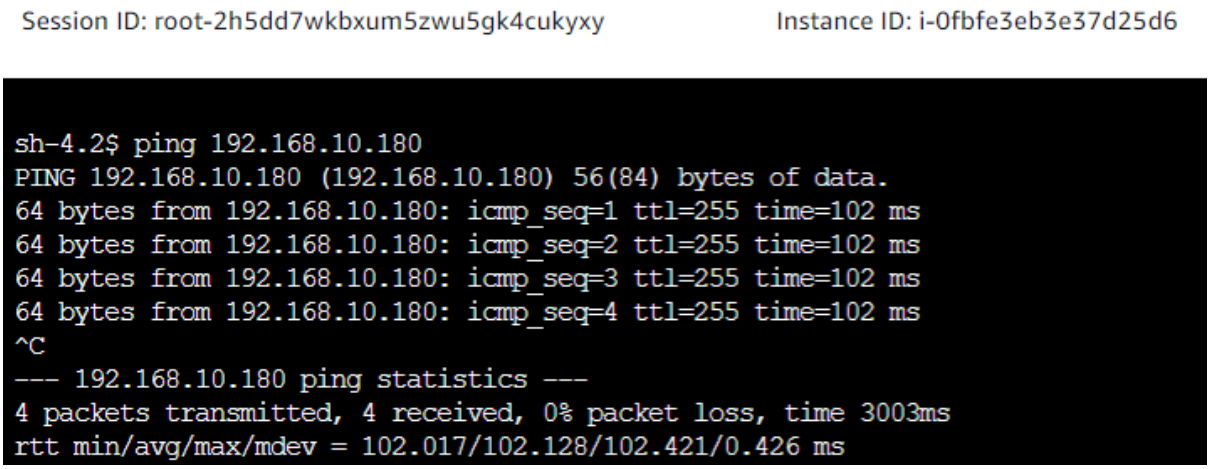
5. Here you need to give it a name then choose rule type as forward and put your domain name. After that choose VPC and then choose your outbound endpoint.



6. Then in the target IP address put the Private IP addresses of your DNS server instances and click on create rule.



7. So, this rule will help us to resolve the DNS query for our EC2 instance in the Ohio region.
8. So, now you need to connect with your EC2 instance in your Ohio region and you will see that it is able to connect with your App server instance.
9. Now try the DNS name and you will see that it is able to resolve the DNS query.



To delete the environment first delete the rule, inbound and outbound endpoint from your route 53. Then you need to go and delete the peering connection, after that just delete your cloud formation stack.