AWS Partner Network (APN) Blog

Using AWS PrivateLink for Amazon S3 for Private Connectivity Between Snowflake and Amazon S3

by Maxwell Moon and Bosco Albuquerque | on 08 DEC 2021 | in Advanced (300), Amazon Simple Storage Service (S3), AWS Partner Network, AWS PrivateLink, Customer Solutions, Networking & Content Delivery, Technical How-To | Permalink | Comments | Share

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Snowflake

Amazon Web Services (AWS) customers running on-premises workloads that leverage Amazon Simple Storage Service (Amazon S3) previously needed to set up proxies running on Amazon Elastic Compute Cloud (Amazon EC2) to access S3 gateway endpoints.

This creates additional complexity for operations and considerations for bandwidth to S3, which becomes more complex when adding another service that support AWS PrivateLink for Amazon S3 such as Snowflake.

With AWS PrivateLink for Amazon S3, you can provision interface VPC endpoints (interface endpoints) in your virtual private cloud (VPC).

These endpoints are directly accessible from applications that are on-premises over virtual private network (VPN) and AWS Direct Connect, or in a different AWS region over VPC peering.

You can use AWS PrivateLink for Amazon S3 to connect to a software-as-a-service (SaaS) provider such as Snowflake, which allows users to ingest data from their own S3 buckets into Snowflake-managed S3 buckets.

In this post, you'll learn how to set up AWS PrivateLink for Amazon S3 using Snowflake-provided S3 PrivateLink endpoints. We'll walk through verifying connectivity over AWS PrivateLink to Snowflake's staging buckets via an Amazon EC2 instance.

Snowflake is an AWS Partner with the Data and Analytics Competency and AWS PrivateLink Service Ready designation. Snowflake has reinvented the data warehouse, building a new enterprise-class SQL data warehouse designed from the ground up for the cloud and today's data.

Solution Overview

Previously, VPC endpoints only supported gateway endpoints for Amazon S3. This works well for workloads already operating on AWS, but for workloads operating on-premises a set of proxy EC2 instances needed to be set up to allow for connectivity between the data center and S3 using gateway endpoints.

Interface endpoints use private IP addresses within your VPC to access Amazon S3. This allows workloads operating on-premises or connected by either AWS Direct Connect or AWS Site-to-Site VPN to connect to S3 without the need for proxy servers.

The architecture demonstrated in this post should only be used in test VPCs and VPCs that are used to connect resources running on-premises to AWS. It requires making changes to domain name system (DNS) that may impact your ability to connect to other S3 buckets in the same AWS region.

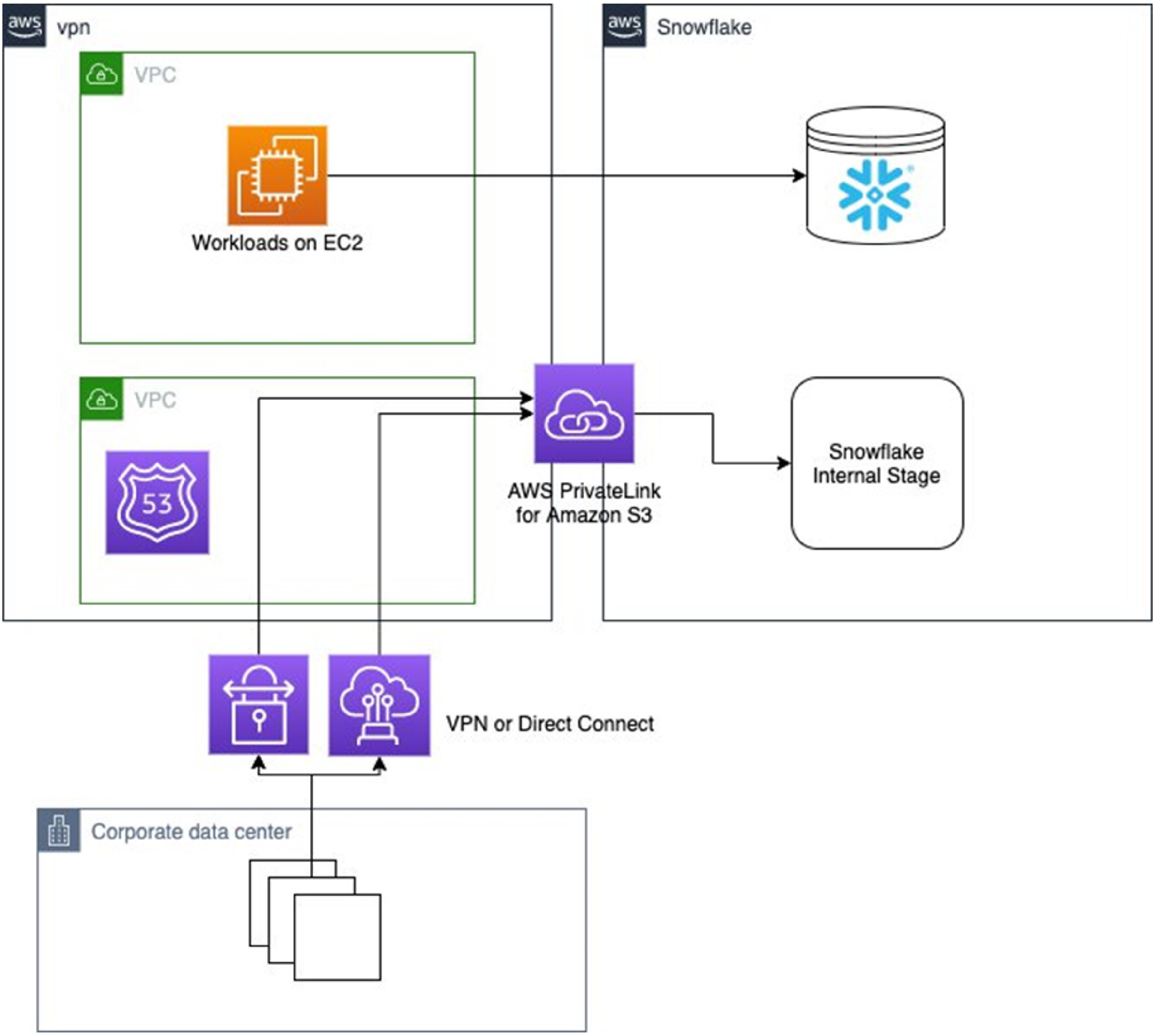


Figure 1 – On-premises workloads connecting to AWS using Direct Connect or AWS VPN can leverage AWS PrivateLink for S3 to connect to Snowflake.

If you're interested in learning more about using AWS PrivateLink for Amazon S3 with resources in your VPC, examples are provided in the S3 documentation for the AWS Command Line Interface (CLI) and software development kits (SDKs).

Prerequisites

To complete this solution, you need the following:

- AWS account
- Snowflake account

- Snowflake database and table
- Snowflake warehouse
- Sufficient AWS Identity and Access Management (IAM) privileges to create VPC endpoints, route tables, security groups, and Amazon Route 53 hosted zones and resource record sets

Walkthrough

We'll start in Snowflake to retrieve the Amazon S3 URL for the Snowflake stage. Once this step is complete, all other steps will be performed on AWS.

This post assumes you have the permissions required on AWS to create VPC endpoints and Amazon Route 53 private hosted zones, as well as EC2 instances for testing connectivity.

Retrieve the Configuration for the S3 Stage in Snowflake

First, retrieve the S3 URL that will be used when creating the VPC endpoint that will use AWS PrivateLink for Amazon S3.

From Snowflake, execute the following select statement:

```
select key, value from
table(flatten(input=>parse_json(system$get_privatelink_config())));
```

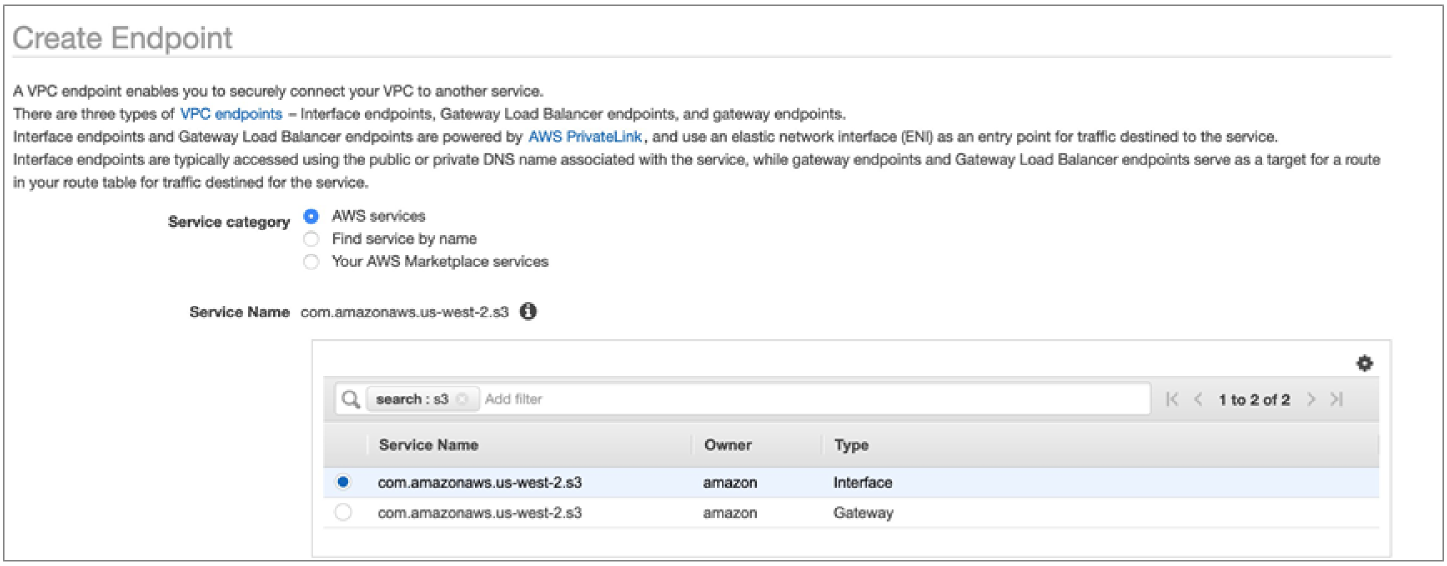
This command will output a table containing several rows. Retrieve the value for `privatelink-internal-stage`. This value is required later when creating the Amazon Route 53 internal hosted zone. Copy it and paste it in the text editor of your choice temporarily.

Create a VPC Endpoint for AWS PrivateLink for Amazon S3

Next, we'll set up the VPC endpoint that will allow us to use AWS PrivateLink for Amazon S3 to connect to Snowflake stages.

Navigate to the VPC Menu in the AWS Management Console, and then select **Endpoints** from the left panel.

Select **Create Endpoint** in the top left corner, leave the radio icon for **AWS Services** selected for **Service category**, and then search for **S3** in the **Service name field**.



Create Endpoint

A VPC endpoint enables you to securely connect your VPC to another service.
There are three types of VPC endpoints – Interface endpoints, Gateway Load Balancer endpoints, and gateway endpoints.
Interface endpoints and Gateway Load Balancer endpoints are powered by AWS PrivateLink, and use an elastic network interface (ENI) as an entry point for traffic destined to the service.
Interface endpoints are typically accessed using the public or private DNS name associated with the service, while gateway endpoints and Gateway Load Balancer endpoints serve as a target for a route in your route table for traffic destined for the service.

Service category ● AWS services
○ Find service by name
○ Your AWS Marketplace services

Service Name com.amazonaws.us-west-2.s3

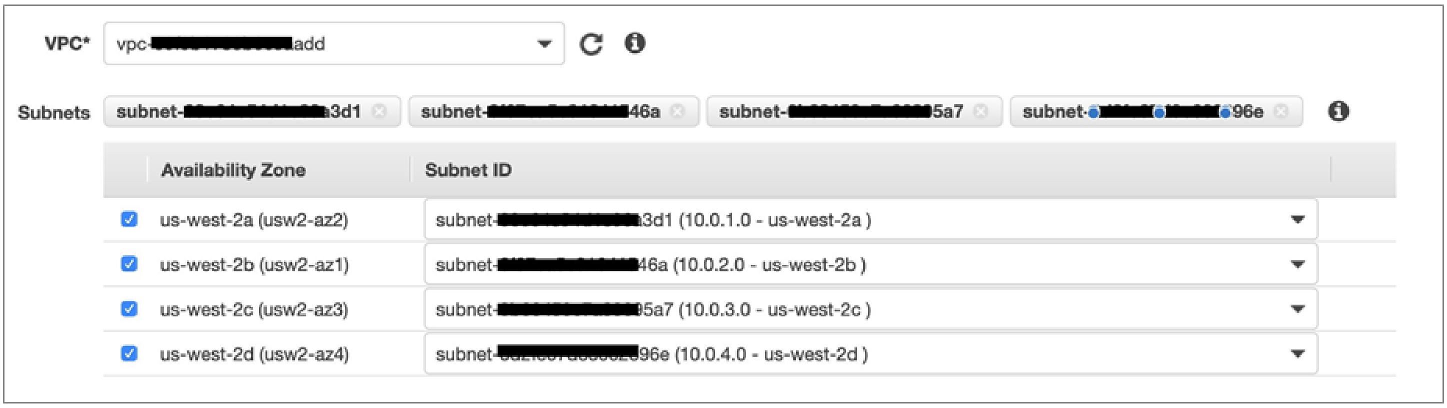
search : s3 Add filter 1 to 2 of 2

	Service Name	Owner	Type
●	com.amazonaws.us-west-2.s3	amazon	Interface
○	com.amazonaws.us-west-2.s3	amazon	Gateway

Figure 2 – Options for S3 endpoints; for PrivateLink select the Interface type.

Next, from the **VPC** drop-down, select the VPC in which the endpoint will be deployed. After selecting the VPC, a series of dropdowns for Subnets will be automatically populated per AWS Availability Zone in the region (in us-west-2, for example, there are four AZs so there are four drop-downs).

Select the subnets in which you would like the endpoint to be available.



VPC* vpc-[redacted]add

Subnets subnet-[redacted]3d1 subnet-[redacted]46a subnet-[redacted]5a7 subnet-[redacted]96e

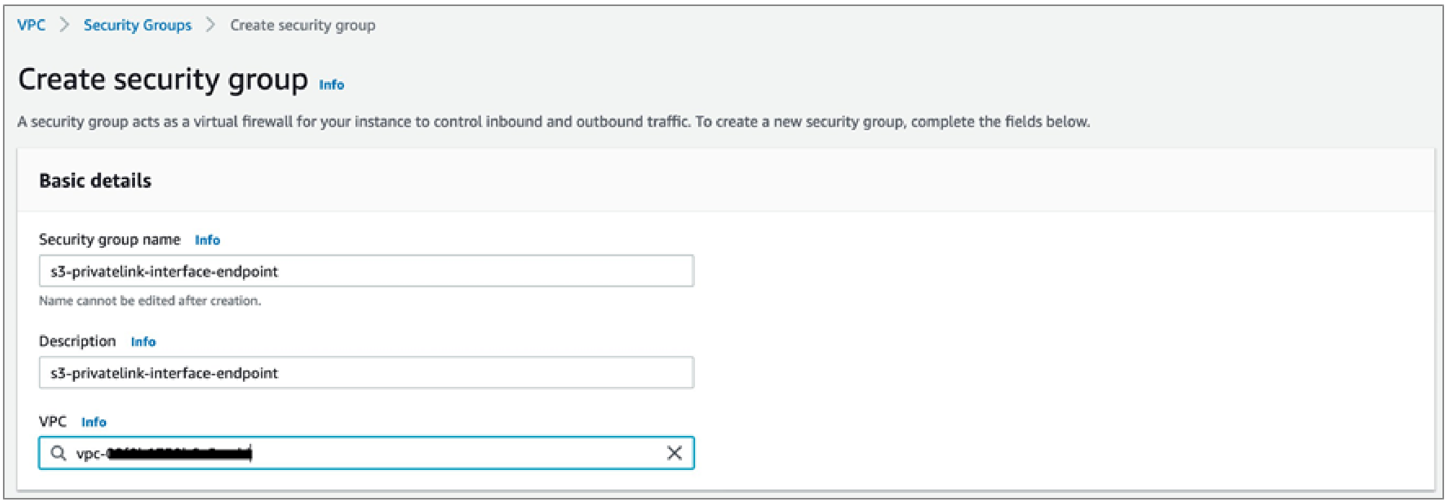
	Availability Zone	Subnet ID
☑	us-west-2a (usw2-az2)	subnet-[redacted]3d1 (10.0.1.0 - us-west-2a)
☑	us-west-2b (usw2-az1)	subnet-[redacted]46a (10.0.2.0 - us-west-2b)
☑	us-west-2c (usw2-az3)	subnet-[redacted]5a7 (10.0.3.0 - us-west-2c)
☑	us-west-2d (usw2-az4)	subnet-[redacted]96e (10.0.4.0 - us-west-2d)

Figure 3 – Associating subnets from a VPC with the PrivateLink endpoint.

For **security group**, create a new security group that will allow access to the endpoint. Select **create a new security group**, which will automatically redirect you in a new tab to the Security Groups menu in the AWS console.

Select **create security group** in the upper right corner, and give your security group a name and description that you'll remember; for example, *s3-privatelink-interface-endpoint*.

For now, don't create any inbound rules and leave the default outbound rules.



VPC > Security Groups > Create security group

Create security group Info

A security group acts as a virtual firewall for your instance to control inbound and outbound traffic. To create a new security group, complete the fields below.

Basic details

Security group name Info
s3-privatelink-interface-endpoint
Name cannot be edited after creation.

Description Info
s3-privatelink-interface-endpoint

VPC Info
vpc-[redacted]

Figure 4 – Creating a new security group for the PrivateLink for S3 endpoint.

Select the **create security group** button in the lower right corner. You'll be automatically redirected to the details menu for the security group. Copy the value for **Security group ID**.

Switch back to the tab where you are creating the VPC endpoint and paste the value of **Security group ID** in the input field of the **Security group** section. Once the search results populate, select the security group by clicking the box on the left side of the row. Be sure to remove any security groups that were added automatically, if present (such as the default security group).

Leave the policy section as-is for full access.

An **optional** step is to select **Add Tag** to add tags, if required by your organization for asset tracking or cost attribution. We won't be adding tags in this post.

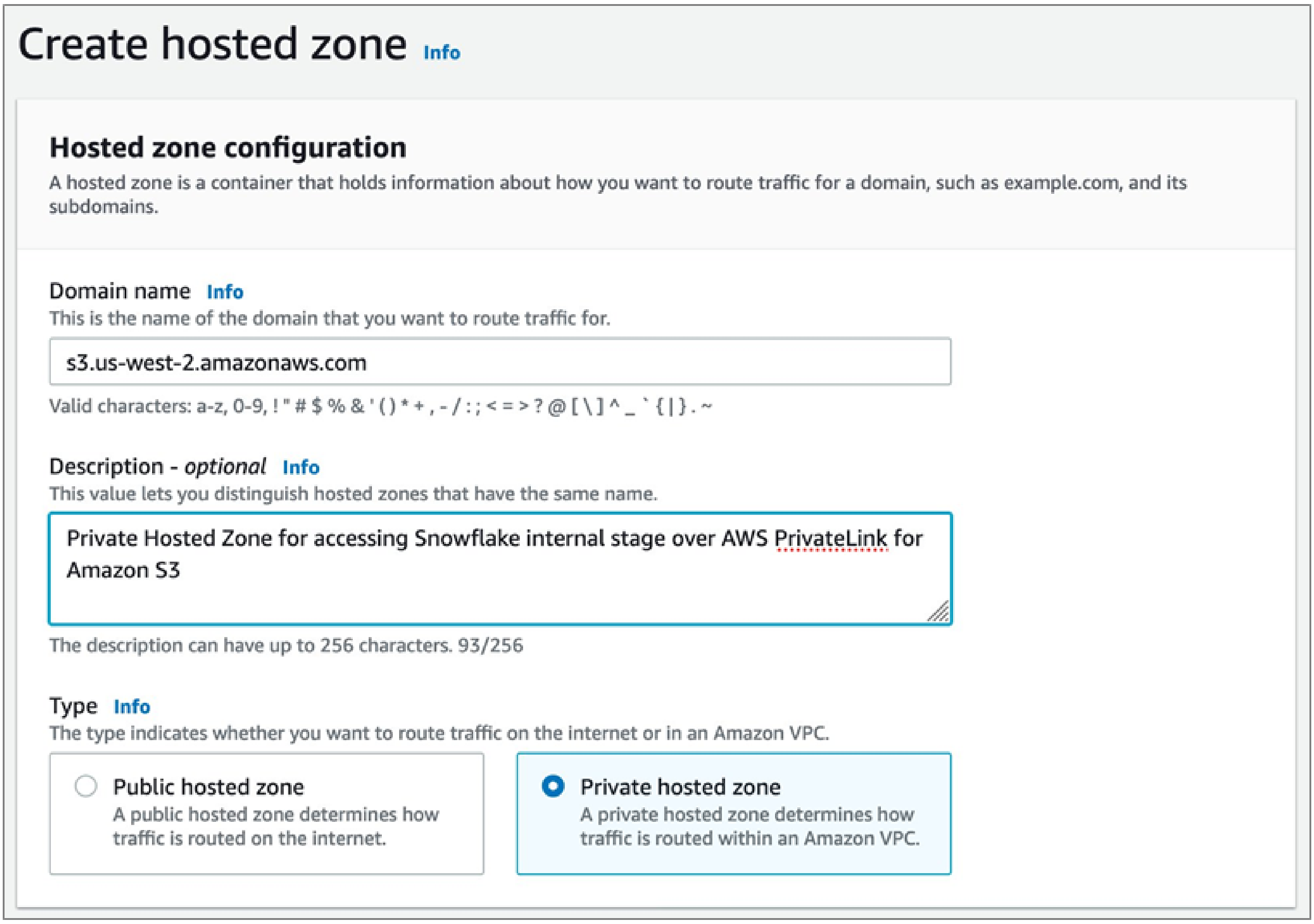
Next, select the **Create endpoint** button in the bottom right. Once created, take note of the VPC endpoint ID, which will be displayed in a green box stating the VPC endpoint was created successfully, and then select **close**.

Create an Amazon Route 53 Private Hosted Zone

In this section, we'll cover the steps required to resolve DNS to the Snowflake internal stage S3 bucket. This requires the use of Amazon Route 53 private hosted zones to create a CNAME record for the S3 URL for `host` value of the `stage` that points to our newly-created VPC endpoint.

Navigate to the Amazon Route 53 console and select **Hosted zones** from the left panel. Choose **Create hosted zone**, and in the domain name input enter `s3.<region>.amazonaws.com`. In this post, we are deploying the solution in us -west-2, so we enter `s3.us-west-2.amazonaws.com`.

Select the radio icon for **Private hosted zone**.



Create hosted zone Info

Hosted zone configuration

A hosted zone is a container that holds information about how you want to route traffic for a domain, such as example.com, and its subdomains.

Domain name Info

This is the name of the domain that you want to route traffic for.

s3.us-west-2.amazonaws.com

Valid characters: a-z, 0-9, ! " # $ % & ' ( ) * + , - / : ; < = > ? @ [\ ] ^ _ ` { | } . ~

Description - *optional* Info

This value lets you distinguish hosted zones that have the same name.

Private Hosted Zone for accessing Snowflake internal stage over AWS PrivateLink for Amazon S3

The description can have up to 256 characters. 93/256

Type Info

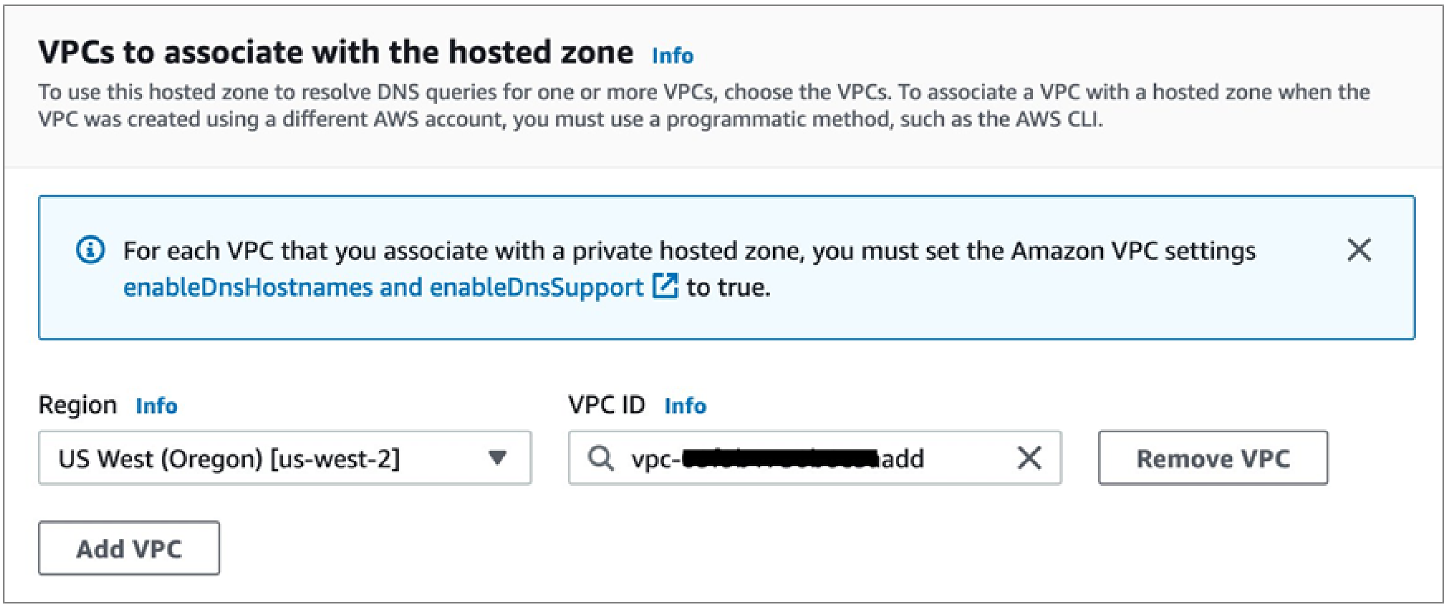
The type indicates whether you want to route traffic on the internet or in an Amazon VPC.

○ Public hosted zone
A public hosted zone determines how traffic is routed on the internet.

● Private hosted zone
A private hosted zone determines how traffic is routed within an Amazon VPC.

Figure 5 – Creating a private hosted zone in Amazon Route 53.

In the **VPCs to associate with the hosted zone** section, select the region and VPC in which the VPC endpoint was created. For example, us-west-2, and vpc-xxxxxxxxxx.



VPCs to associate with the hosted zone Info

To use this hosted zone to resolve DNS queries for one or more VPCs, choose the VPCs. To associate a VPC with a hosted zone when the VPC was created using a different AWS account, you must use a programmatic method, such as the AWS CLI.

For each VPC that you associate with a private hosted zone, you must set the Amazon VPC settings enableDnsHostnames and enableDnsSupport to true.

Region: US West (Oregon) [us-west-2]

VPC ID: vpc-[redacted]add

Figure 6 – Associating a VPC with a private hosted zone.

An optional step here is to select **Add Tag** to add tags, if required by your organization for asset tracking or cost attribution.

Select the **Create hosted zone** button in the bottom right.

Next, we'll create a CNAME record in the private hosted zone that will point the URL for `host` value of the Snowflake `stage` S3 bucket to the VPC Endpoint created above.

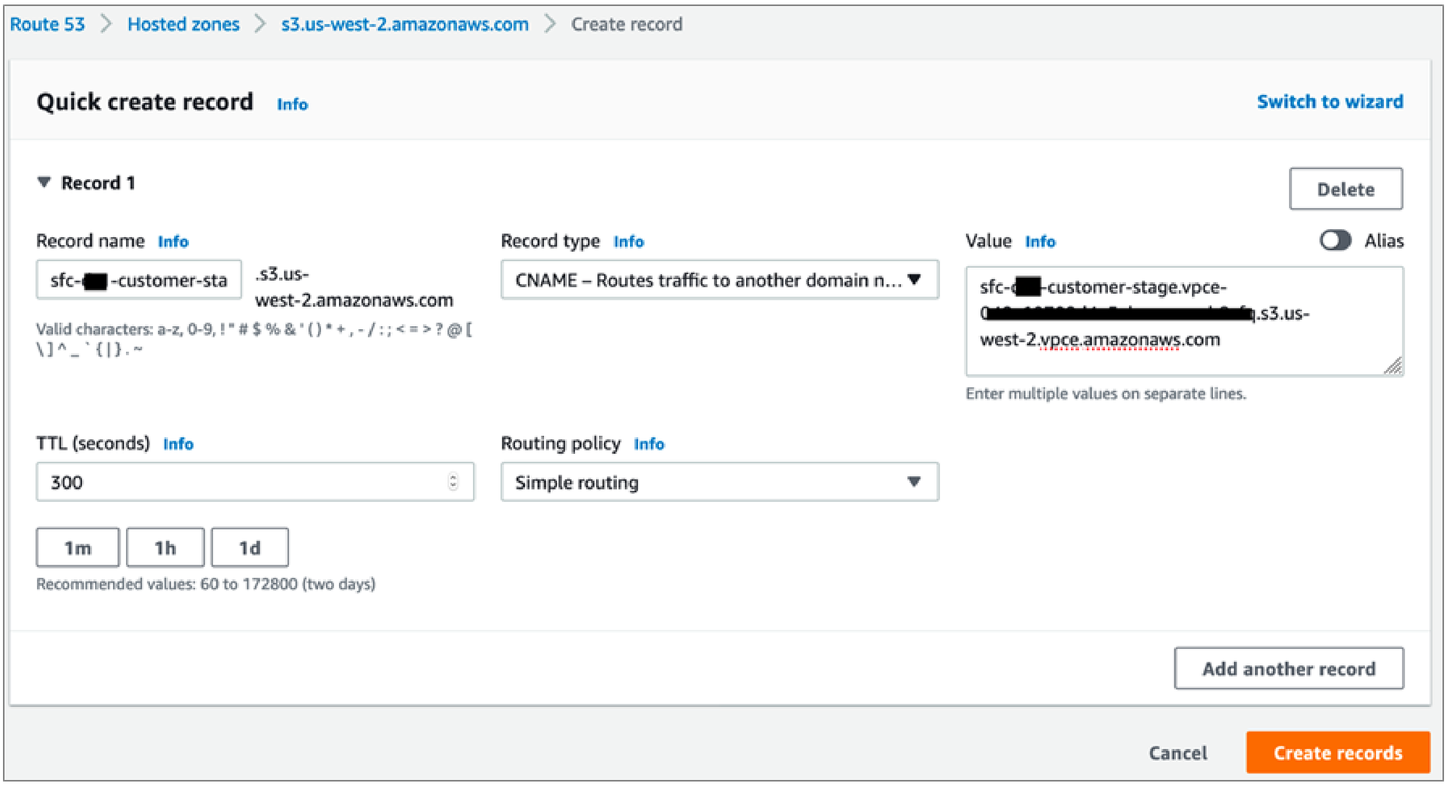
Select the private hosted zone you just created from the list of hosted zones. Click the **Create record** button in the records section.

For the **Record name**, use the value preceding the first period in the `host` value for the Snowflake `stage` which should start with `sfc` and end with `customers-stage`.

For the **Record type**, select CNAME from the drop-down.

For the **Value**, retrieve the DNS record from the VPC endpoint for the region (it does not a have zonal letter as the suffix). This should be the topmost value in the **DNS names** section of the VPC endpoint (such as *.vpce-xxxxxxxx-xxxxxxxx.s3.us-west-2.vpce.amazonaws.com).

Replace the asterisk in the DNS name for the VPC endpoint with the name of the S3 bucket in the `host` value for the Snowflake `stage`. This will reduce the potential impact of accessing other S3 buckets, outside of the Snowflake stage.



Route 53 > Hosted zones > s3.us-west-2.amazonaws.com > Create record

Quick create record Info

▼ Record 1

Record name: sfc-[redacted]-customer-sta .s3.us-west-2.amazonaws.com

Valid characters: a-z, 0-9, ! " # $ % & ' ( ) * + , - / : ; < = > ? @ [\ ] ^ _ ` { | } . ~

Record type: CNAME – Routes traffic to another domain n...

Value: sfc-[redacted]-customer-stage.vpce-[redacted].s3.us-west-2.vpce.amazonaws.com

Enter multiple values on separate lines.

TTL (seconds): 300

Recommended values: 60 to 172800 (two days)

Routing policy: Simple routing

Figure 7 – Creating a DNS record for AWS PrivateLink for Amazon S3 endpoint.

Finally, select the **Create records** button in the bottom right.

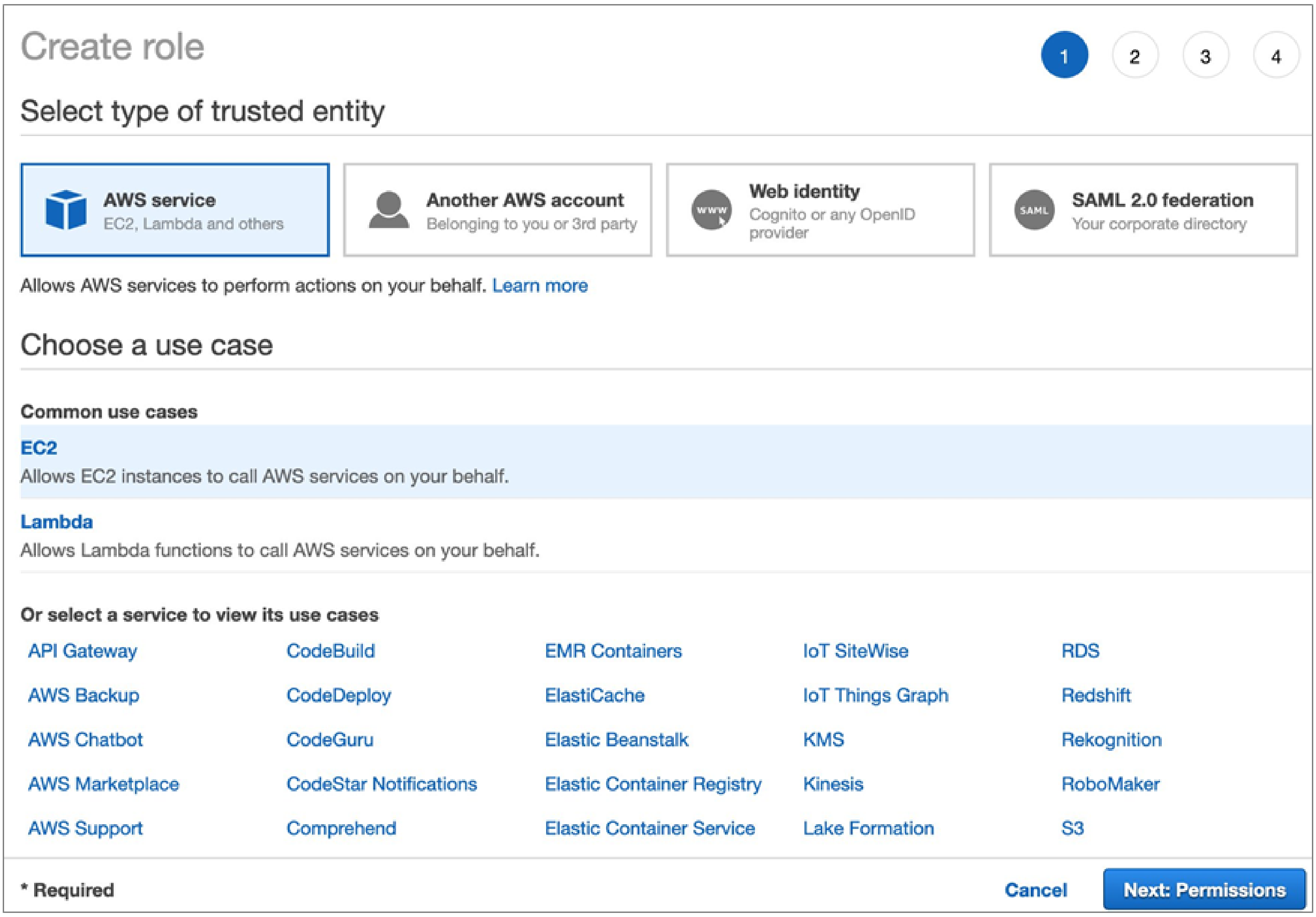
Verify Private Connectivity to the Snowflake Stage

In this section, we'll cover testing private connectivity to the Snowflake internal stage. This requires you to spin up an EC2 instance in the VPC in which the VPC endpoint to S3 was created.

Once created, we'll access get shell access to the EC2 instance using AWS Systems Manager Session Manager.

First, we'll create an IAM role that allows us to connect to the EC2 instance via AWS Systems Manager Session Manager.

Navigate to the IAM menu in the AWS console, select **Roles** from the left panel, and then select **Create role**. Leave the box for **AWS Service** selected as the trusted entity, select **EC2** in the common use cases section, and then select **Next: Permissions** in the bottom right corner.



Create role

Select type of trusted entity

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

Choose a use case

Common use cases

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

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

Or select a service to view its use cases

Figure 8 – Create role page showing EC2 selected for trusted entity.

Next, search for `AmazonSSMManagedInstanceCore` in **Filter policies**. This is an AWS managed policy that allows an instance to use AWS Systems Manager service core functionality, including connecting to the instance using Session Manager. For more information, see Create an IAM instance profile for Systems Manager.

Select **Next: Tags**. Optionally, you can apply tags and select **Next: Review**.

Give the role a name you will remember. For example, `snowflake-s3-privatelink-ssm-role`. Then, click **Create role** in the bottom right corner.

Next, we'll launch an Amazon EC2 instance in the same VPC as the VPC endpoint. To get started, navigate to the EC2 menu in the AWS console and select **Launch instances** in the top right corner.

Choose **Select** for the latest Amazon Linux 2 AMI. It should be the top-most result. Then, choose the **t2.micro** instance type, which is free tier eligible, and select **Next: Configure Instance Details**.

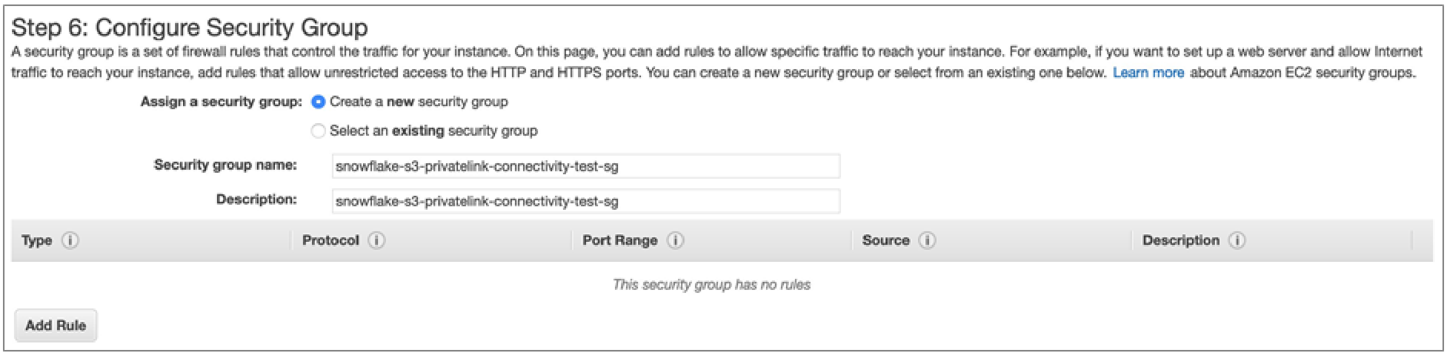
In the Configure Instance Details menu, select a VPC and subnet in which there is a VPC endpoint for S3 PrivateLink from the **Network** and **Subnet** drop-downs. Then, select the IAM role `snowflake-s3-privatelink-ssm-role` from the **IAM role** drop-down.

Select **Next: Add storage**, leave the default 8GiB GP2 volume configuration, and then select **Next: Add Tags**.

Select **Add Tag** using `Name` as the Key and `snowflake-s3-privatelink-connectivity-test` as the value. Click on **Next: Configure Security Group**.

Leave the radio icon for **Create a new security group** selected. Enter a name and description you will remember; for example, `snowflake-s3-privatelink-connectivity-test-sg`.

Remove the default SSH rule, since we'll use AWS Systems Manager Session Manager to connect to the instance. We need no other ingress rules for this test.



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 name: snowflake-s3-privatelink-connectivity-test-sg

Description: snowflake-s3-privatelink-connectivity-test-sg

Type	Protocol	Port Range	Source	Description

This security group has no rules

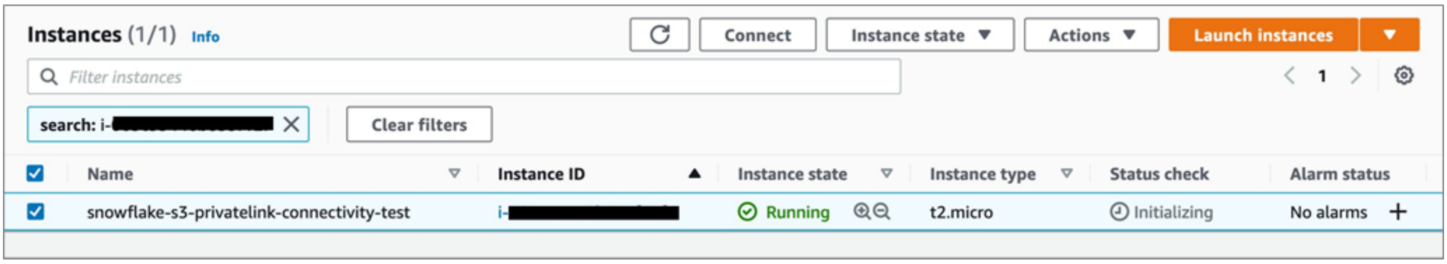
Figure 9 – Creating a new security group.

Select **Review and Launch** to review the configuration, and then select **Launch**.

When prompted to select an existing key pair or create a new key pair, select **proceed without a key pair** from the drop-down. You don't need a key pair for the instance when using AWS Systems Manager Session Manager to connect.

Select the checkbox acknowledging that without a key pair you will only be able to connect to this instance by using EC2 instance connect.

Click on **Launch instances** and you'll be redirected to a success screen that shows the instance ID of the instance. Select the instance ID, which will take you to the EC2 menu.



☑	Name	Instance ID	Instance state	Instance type	Status check	Alarm status
☑	snowflake-s3-privatelink-connectivity-test	i-[redacted]	Running	t2.micro	Initializing	No alarms

Figure 10 – Amazon EC2 console with running EC2 instance.

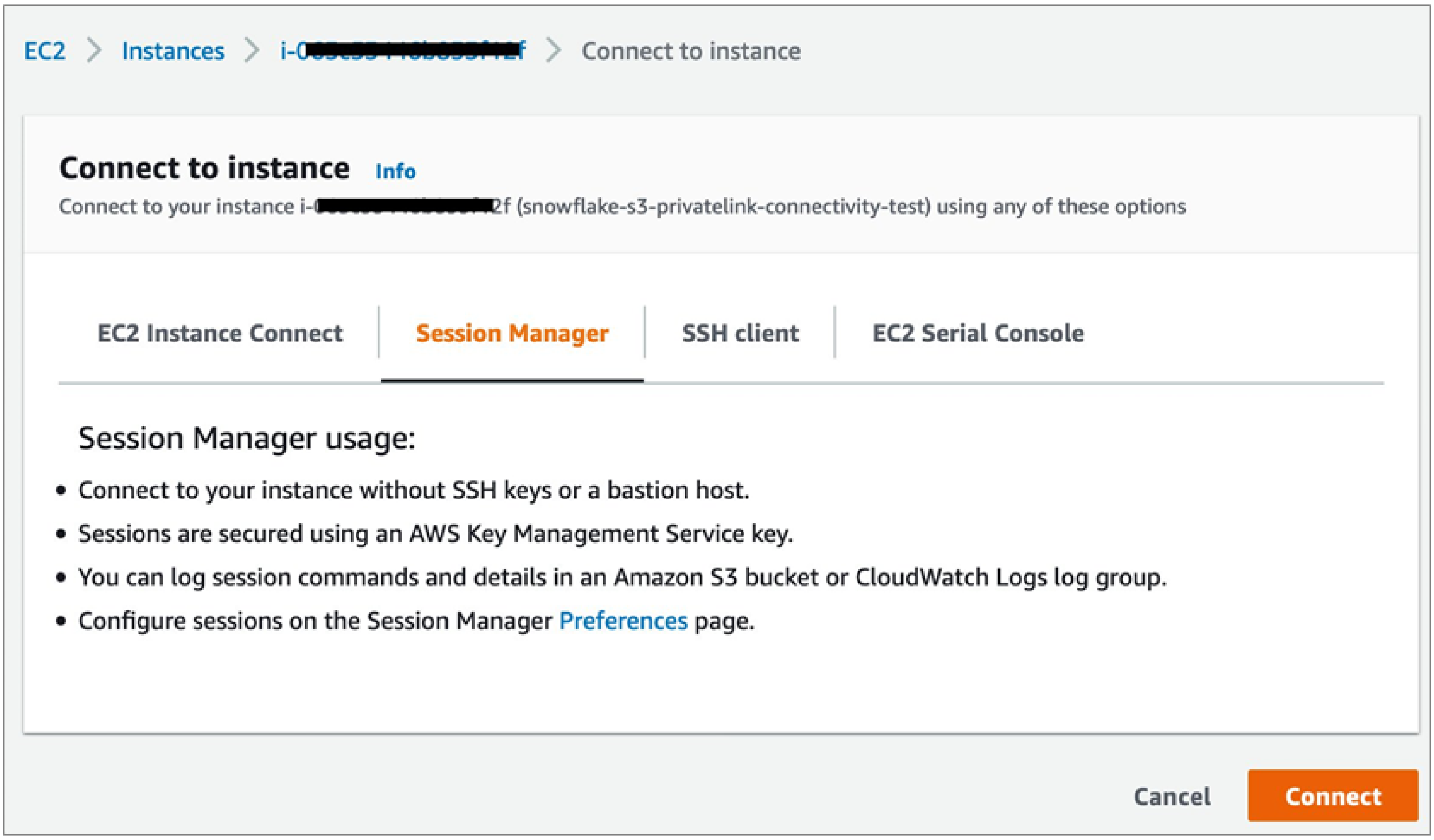
Next, we need to modify the security group for the S3 interface endpoint to allow for traffic over HTTPS from the security group assigned to the EC2 instance.

Navigate to the Security Group menu in the AWS console, and select the security group you created for the S3 interface endpoint. Add an inbound rule for HTTPS from the security group that was created for the EC2 instances, and then save the changes.

Now, we'll connect to the EC2 instance using AWS Systems Manager Session manager to test connectivity to Snowflake over AWS PrivateLink for Amazon S3.

If you're following the steps, you will already be in the EC2 menu with the newly-launched EC2 instance selected. If not, navigate to the EC2 menu in the AWS console.

Select **Connect** from top menu. You'll be navigated to a page that outlines Session Manager usage, and select the **connect** button in the bottom right.



Connect to your instance i-[redacted] (snowflake-s3-privatelink-connectivity-test) using any of these options

Session Manager usage:

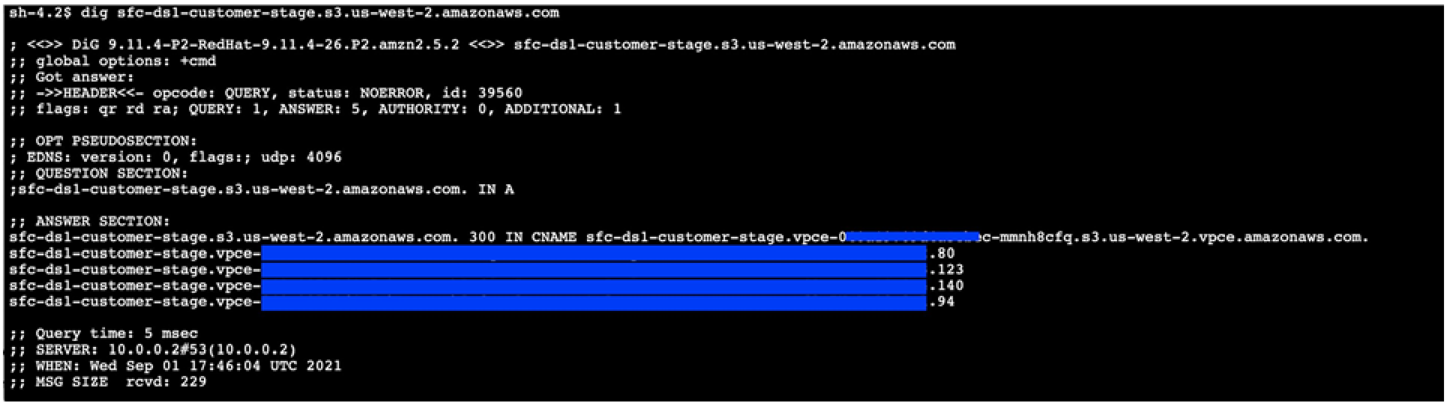
- Connect to your instance without SSH keys or a bastion host.
- Sessions are secured using an AWS Key Management Service key.
- You can log session commands and details in an Amazon S3 bucket or CloudWatch Logs log group.
- Configure sessions on the Session Manager Preferences page.

Figure 11 – Options to connect to an EC2 instance.

Click on **Connect**, which opens a new tab in your browser that allows shell access to the EC2 instance.

Finally, we'll test connectivity to the instance. We will run dig for the S3 URL for the internal stage to ensure it returns private IP address for the VPC endpoint, rather than a public IP address.

```
#!/bin/bash
# Replace <internal stage bucket> with the name of the Snowflake in
dig <internal stage bucket>.s3.us-west-2.amazonaws.com
```



```
sh-4.2$ dig sfc-dsl-customer-stage.s3.us-west-2.amazonaws.com

; <<>> DiG 9.11.4-P2-RedHat-9.11.4-26.P2.amzn2.5.2 <<>> sfc-dsl-customer-stage.s3.us-west-2.amazonaws.com
;; global options: +cmd
;; Got answer:
;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 39560
;; flags: qr rd ra; QUERY: 1, ANSWER: 5, AUTHORITY: 0, ADDITIONAL: 1

;; OPT PSEUDOSECTION:
; EDNS: version: 0, flags:; udp: 4096
;; QUESTION SECTION:
;sfc-dsl-customer-stage.s3.us-west-2.amazonaws.com. IN A

;; ANSWER SECTION:
sfc-dsl-customer-stage.s3.us-west-2.amazonaws.com. 300 IN CNAME sfc-dsl-customer-stage.vpce-0[redacted]c-mmnh8cfq.s3.us-west-2.vpce.amazonaws.com.
sfc-dsl-customer-stage.vpce-[redacted].80
sfc-dsl-customer-stage.vpce-[redacted].123
sfc-dsl-customer-stage.vpce-[redacted].140
sfc-dsl-customer-stage.vpce-[redacted].94

;; Query time: 5 msec
;; SERVER: 10.0.0.2#53(10.0.0.2)
;; WHEN: Wed Sep 01 17:46:04 UTC 2021
;; MSG SIZE  rcvd: 229
```

Figure 12 – DNS answers for Snowflake internal stage S3 bucket.

Cleaning Up

If your work with AWS PrivateLink for Amazon S3 and Snowflake is complete, shut down the resources created in this post to avoid incurring additional fees:

- Amazon Route 53 internal hosted zone and CNAME record.
- Interface VPC endpoint for S3.
- EC2 instance that was launched for the connectivity test.
- IAM role that was created for EC2 instance.

Conclusion

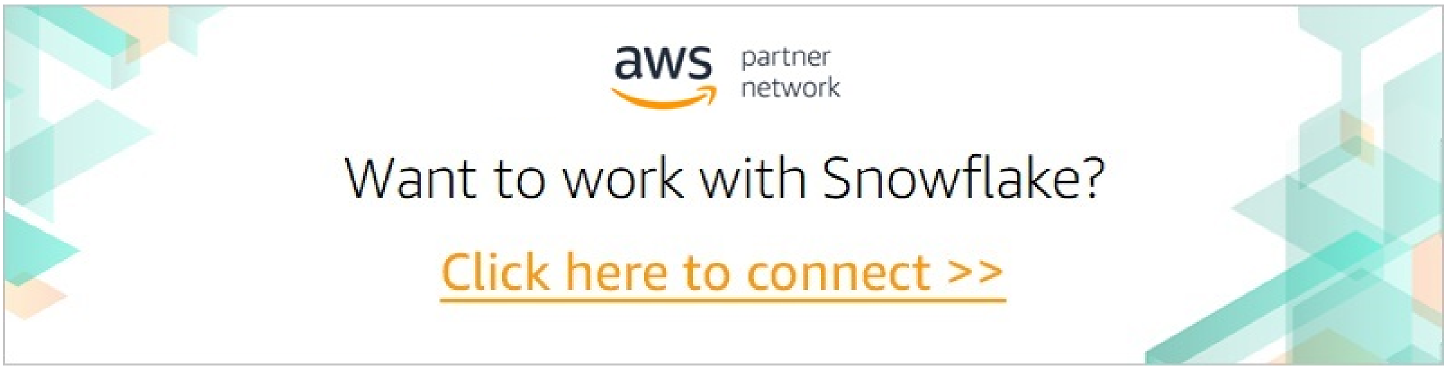
In this post, we showed you how to use AWS PrivateLink for Amazon S3 to establish private connectivity between resources in your AWS account and a Snowflake internal stage. We ran a test to show connectivity to the stage over the AWS network from an Amazon EC2 instance in a virtual private cloud (VPC).

This architecture ensures that data loading and data unloading from your account or on-premises infrastructure to Snowflake internal stages uses the AWS internal network and does not take place over the public internet.

After you set up these resources, you can further extend your use of VPC endpoints using gateway endpoints for S3 for workloads operating in your VPC. You can also extend your use of AWS PrivateLink and Snowflake with other services such as Amazon QuickSight or Amazon SageMaker.

To use AWS PrivateLink for Amazon S3 with resources inside of your VPC, you can configure your SDK client to use the VPC endpoint URL that's provided when the endpoint is created.

Learn more about AWS PrivateLink for Amazon S3 in the AWS documentation.



Snowflake – AWS Partner Spotlight

Snowflake is an AWS Competency Partner that has reinvented the data warehouse, building a new enterprise-class SQL data warehouse designed from the ground up for the cloud and today's data.

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