U.S. DEPARTMENT OF ENERGY'S CYBERFORCE® PROGRAM

CyberForce® 101

AWS EC2

October 2023

cyberforcecompetition@anl.gov

AWS EC2 101

Overview

Amazon EC2 (Elastic Compute Cloud) is a cloud service that Amazon Web Services (AWS) provides. This service allows users to rent virtual servers, known as EC2 instances so that they can run their applications. Users can create and delete as many of these servers as they need. There are various purposes for an EC2 instance. Some of these types include:

- **General purpose** instances can be used for a wide range of work. They provide a balance between computing, memory, and networking resources. These are best used for hosting web servers, smaller databases, or testing and developing software.

- **Compute optimized** instances are ideal for users needing a lot of computational power and access to high-performance CPUs (Central Processing Unit). Examples include high-performance web servers, gaming servers, batch-processing workloads, and financial and scientific modeling.

- **Memory optimized** instances are designed to deliver fast performance for workloads that process large data sets in memory. These instances use high-speed solid-state drives, making them perfect for apps needing more memory but less power, such as open database sources and real-time big data analytics.

- **Storage optimized** instances are designed to deliver tens of thousands of low-latency, random input-output operations per second (IOPS) to applications. This instance is best when you have large data sets saved locally.

- **Accelerated computing** instances use hardware accelerators, or co-processors, to perform functions, such as floating-point number calculations, graphics processing, or data pattern matching, more efficiently than is possible in software running on CPUs. These instances are best used for machine learning, deep learning, blockchain and cryptocurrency mining, genomics, and bioinformatics.

EC2 Networking

Understanding the networking capabilities of an EC2 is important for creating a secure and well-connected environment. To better understand how networking around EC2 instances works, we'll go over a couple of important features that are shown in the diagram below.

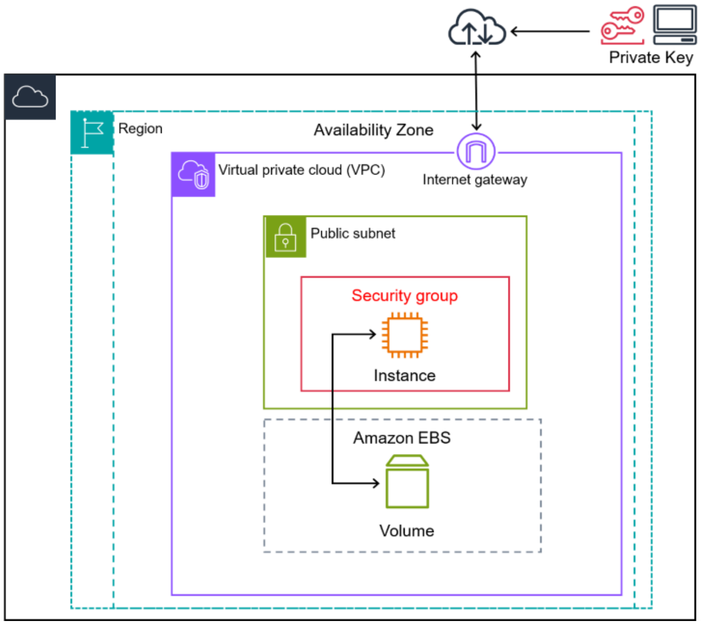


Figure 1. *EC2 Networking Architecture*

Figure 1 is a high-level overview of a simple EC2 network. The black square ☁represents 'The Cloud,' and it also represents the actual hardware that is used to run your cloud environment. Inside this is your region/availability zone, representing a data center somewhere in the world.

In purple is a virtual private cloud (VPC). A VPC is your own slice of the cloud, comparable to your home network. A default VPC will come with its own IPv4 CIDR of 172.31.0.0/16. When you create a new one, you have the option to specify the range you want, but it is recommended to stick to the ranges specified in [RFC 1918](). See the table below.

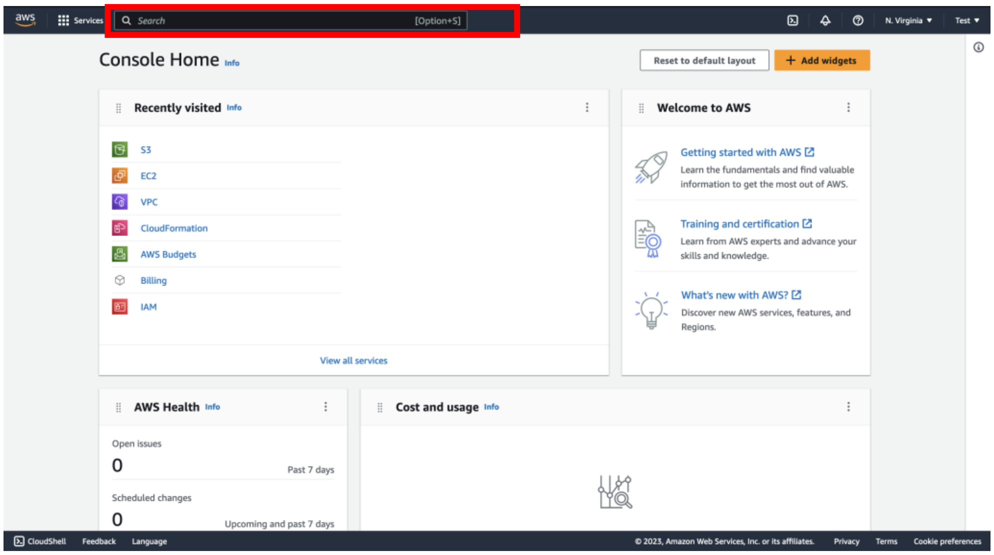
RFC 1918 range	Example CIDR block
10.0.0.0 - 10.255.255.255 (10/8 prefix)	10.0.0.0/16
172.16.0.0 - 172.31.255.255 (172.16/12 prefix)	172.31.0.0/16
192.168.0.0 - 192.168.255.255 (192.168/16 prefix)	192.168.0.0/20

Inside a VPC, you can have a private and public subnet, shown in green , and can choose which one your instance runs in. However, further configurations not covered in this guide are needed to access resources in this subnet. Instances launched in a public subnet will automatically receive a public IP, which is used to connect to it. This is not enough for your instance to communicate with the internet. The last thing needed is an **Internet Gateway** . The internet gateway is the circle attached to the purple square/VPC. This VPC component enables your resources in a public subnet to connect to the internet if it receives a public IP.

How to Launch a Linux EC2 Instance

Before launching your first EC2 instance, make sure to [sign up]() for an account. Once you sign up, proceed to the next steps. This section will show you how to launch Ubuntu Server 22.04. Other Linux distros should have very similar steps.

1. When you first log in to AWS, your screen will look similar to the picture below. This is the home page of your management console. At the top of the page, there is a search bar. Click on it and type in ‘EC2’, then hit enter or click on the first result. This should bring you to your EC2 dashboard and should look like Figure 3.



Learn the fundamentals and find valuable information to get the most out of AWS.

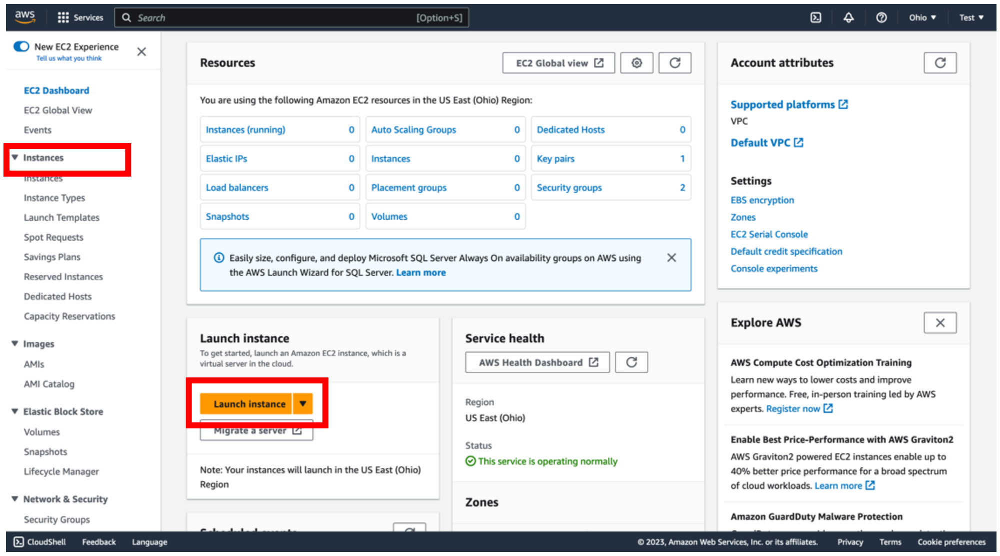
Learn from AWS experts and advance your skills and knowledge.

Discover new AWS services, features, and Regions.

© 2023, Amazon Web Services, Inc. or its affiliates.

Figure 2. AWS Management Console Home Page.

2. Next, on the left sidebar, click on ‘Instances’. In the middle of the page, some text will state that you have no instances in the region. Click ‘Launch Instances.’ Alternatively, on the middle of the page is an orange button labeled the same. Launch instances ▼



Resources

You are using the following Amazon EC2 resources in the US East (Ohio) Region:

Instances (running)	0	Auto Scaling Groups	0	Dedicated Hosts	0
Elastic IPs	0	Instances	0	Key pairs	1
Load balancers	0	Placement groups	0	Security groups	2
Snapshots	0	Volumes	0		

Easily size, configure, and deploy Microsoft SQL Server Always On availability groups on AWS using the AWS Launch Wizard for SQL Server. Learn more

Launch instance

To get started, launch an Amazon EC2 instance, which is a virtual server in the cloud.

Note: Your instances will launch in the US East (Ohio) Region

Service health

Region
US East (Ohio)

Status
This service is operating normally

Account attributes

Supported platforms
VPC

Default VPC

Settings
EBS encryption
Zones
EC2 Serial Console
Default credit specification
Console experiments

Explore AWS

AWS Compute Cost Optimization Training
Learn new ways to lower costs and improve performance. Free, in-person training led by AWS experts. Register now

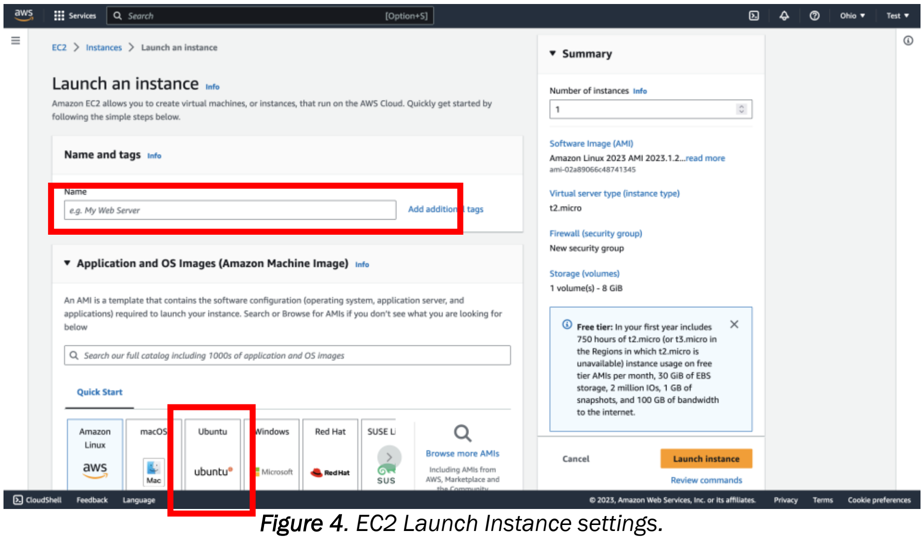
Enable Best Price-Performance with AWS Graviton2
AWS Graviton2 powered EC2 instances enable up to 40% better price performance for a broad spectrum of cloud workloads. Learn more

Amazon GuardDuty Malware Protection

© 2023, Amazon Web Services, Inc. or its affiliates.

Figure 3. EC2 Management Console

3. You should now be on the following page, shown in Figure 4. Start by giving your new instance a name. The next section is where you will select what OS you want. Click on the Ubuntu logo; this will default to the newest version.



Launch an instance

Amazon EC2 allows you to create virtual machines, or instances, that run on the AWS Cloud. Quickly get started by following the simple steps below.

Name and tags

Name: e.g. My Web Server

Application and OS Images (Amazon Machine Image)

An AMI is a template that contains the software configuration (operating system, application server, and applications) required to launch your instance. Search or Browse for AMIs if you don't see what you are looking for below

Search our full catalog including 1000s of application and OS images

Summary

Number of instances: 1

Software Image (AMI)
Amazon Linux 2023 AMI 2023.1.2...read more
ami-02a89066c48741345

Virtual server type (instance type)
t2.micro

Firewall (security group)
New security group

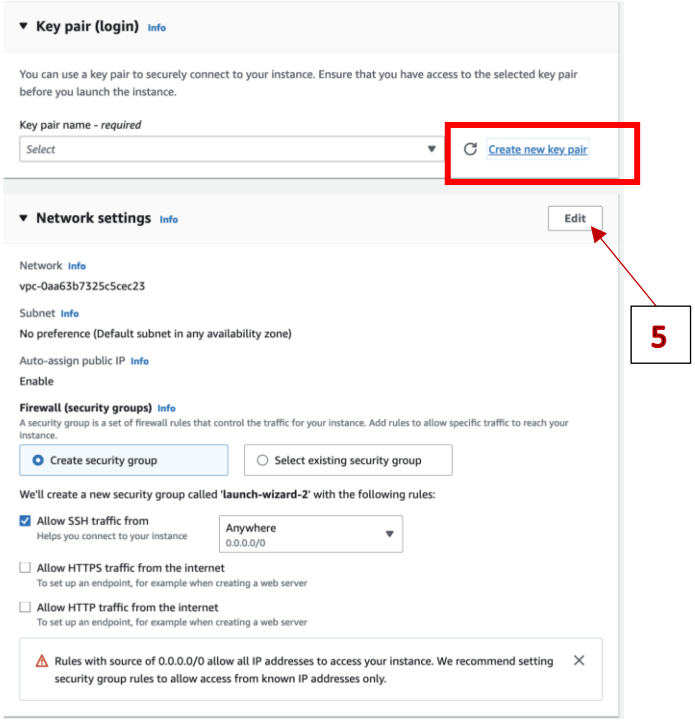
Storage (volumes)
1 volume(s) - 8 GiB

Free tier: In your first year includes 750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per month, 30 GiB of EBS storage, 2 million IOs, 1 GB of snapshots, and 100 GB of bandwidth to the internet.

© 2023, Amazon Web Services, Inc. or its affiliates.

Figure 4. EC2 Launch Instance settings.

4. Create a key pair by clicking on the blue text that says, ‘Create new key pair’; shown in Figure 5. Enter a name for it and keep all settings as default. This will automatically download a [.pem] file. Do not lose this file, or you will not be able to log in to your VM.



▼ Key pair (login) Info

You can use a key pair to securely connect to your instance. Ensure that you have access to the selected key pair before you launch the instance.

Key pair name - *required*

Select ▼ Create new key pair

▼ Network settings Info

Network Info

vpc-0aa63b7325c5cec23

Subnet Info

No preference (Default subnet in any availability zone)

Auto-assign public IP Info

Enable

Firewall (security groups) Info

A security group is a set of firewall rules that control the traffic for your instance. Add rules to allow specific traffic to reach your instance.

● Create security group ○ Select existing security group

We'll create a new security group called '**launch-wizard-2**' with the following rules:

☑ Allow SSH traffic from — Anywhere 0.0.0.0/0
Helps you connect to your instance

□ Allow HTTPS traffic from the internet
To set up an endpoint, for example when creating a web server

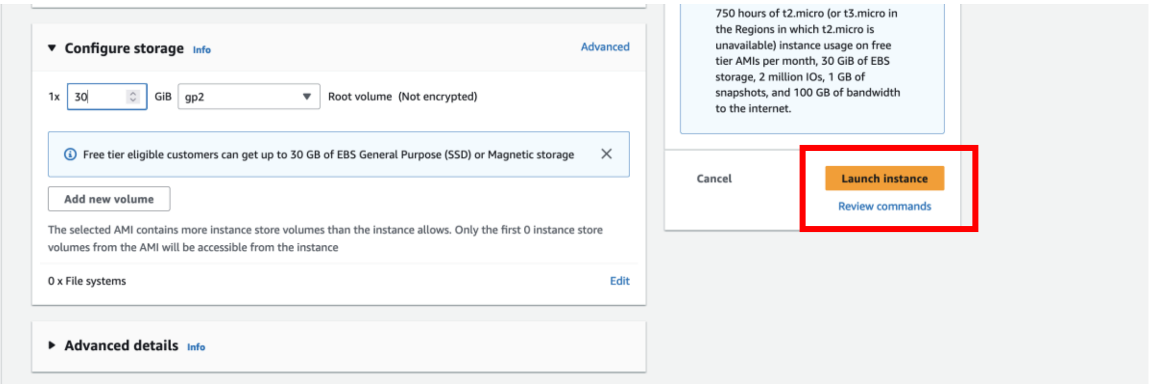
□ Allow HTTP traffic from the internet
To set up an endpoint, for example when creating a web server

⚠ Rules with source of 0.0.0.0/0 allow all IP addresses to access your instance. We recommend setting security group rules to allow access from known IP addresses only.

Figure 5. EC2 Key Pair and Network Settings.

5. Next are the network settings. Click on edit to show additional settings. This is where you would choose which VPC and subnet your new instance will launch in and can decide if your instance receives a public IP or not. Please keep the default settings for now. Next, you will create a security group for your instance. A security group is like a network firewall that decides who is allowed to connect. By default, any IP will be able to connect to your instance. You can keep it like this, or you can click the drop-down menu and select 'My IP' to only allow access from your public IP.

6. Finally, manage the storage for your instance. You can choose to leave this as the default value or adjust the storage depending on your needs. Click on the orange button labeled 'Launch instance.' **Launch instance**



▾ Configure storage Info   Advanced

1x 30 GiB gp2 ▾ Root volume (Not encrypted)

ⓘ Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage ✕

Add new volume

The selected AMI contains more instance store volumes than the instance allows. Only the first 0 instance store volumes from the AMI will be accessible from the instance

0 x File systems   Edit

▸ Advanced details Info

750 hours of t2.micro (or t3.micro in the Regions in which t2.micro is unavailable) instance usage on free tier AMIs per month, 30 GiB of EBS storage, 2 million IOs, 1 GB of snapshots, and 100 GB of bandwidth to the internet.

Cancel

Launch instance

Review commands

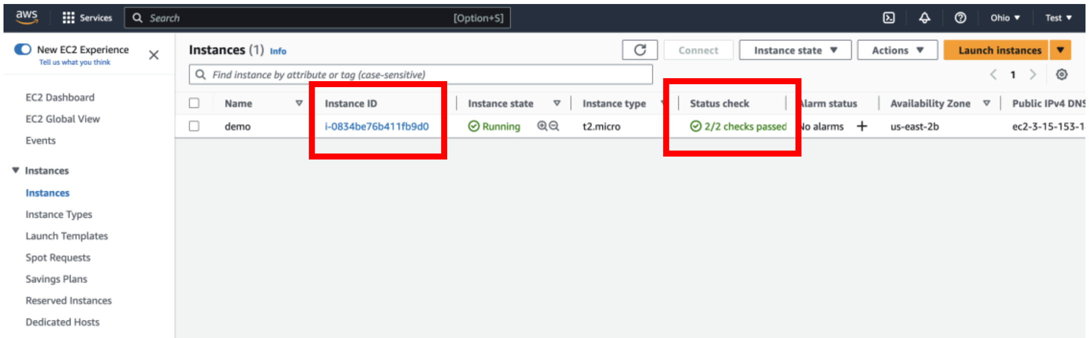
Figure 6. EC2 Storage Settings

Congratulations, you have successfully created your first EC2 instance.

Note: It will take about five minutes for your instance to initialize and be ready to use.

How to Connect to Your Linux Instance

1. When your instance is ready to connect, the **Status check** field will be green, as shown in Figure 7. Click on the Instance ID to see more details, shown in Figure 8. Here you will see the public IP that was assigned to your machine as well as the private IP that's associated with your VPC. Clicking on the tabs on the bottom of the page will provide further details.

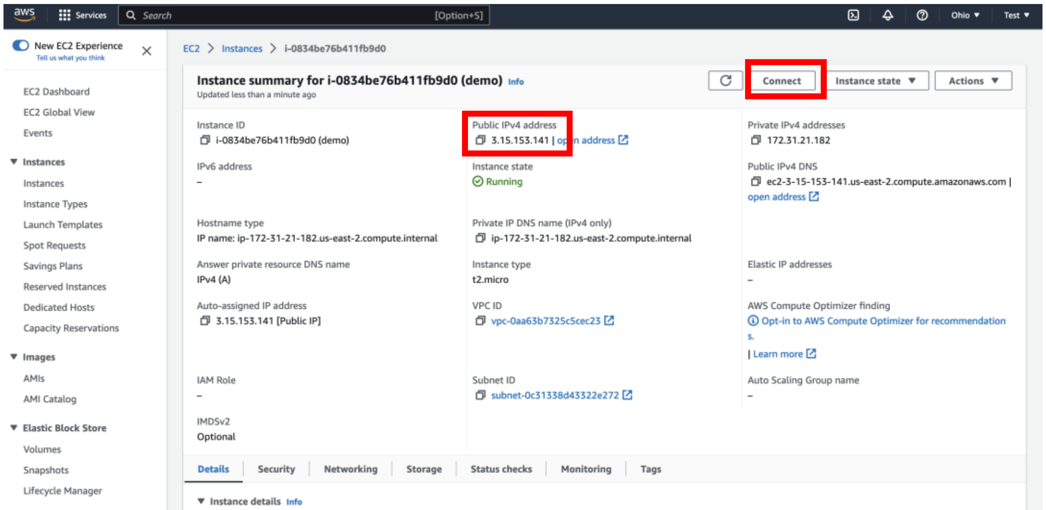


Instances (1) Info

□	Name	Instance ID	Instance state	Instance type	Status check	Alarm status	Availability Zone	Public IPv4 DNS
□	demo	i-0834be76b411fb9d0	✓ Running	t2.micro	✓ 2/2 checks passed	No alarms +	us-east-2b	ec2-3-15-153-1

Figure 7. EC2 Console – Running Instances View.

2. A button labeled 'Connect' will be in the top right area of the page. Click on this button; see Figure 8.



Instance summary for i-0834be76b411fb9d0 (demo) Info
Updated less than a minute ago

Instance ID
i-0834be76b411fb9d0 (demo)

Public IPv4 address
3.15.153.141 | open address

Private IPv4 addresses
172.31.21.182

IPv6 address
–

Instance state
Running

Public IPv4 DNS
ec2-3-15-153-141.us-east-2.compute.amazonaws.com | open address

Hostname type
IP name: ip-172-31-21-182.us-east-2.compute.internal

Private IP DNS name (IPv4 only)
ip-172-31-21-182.us-east-2.compute.internal

Answer private resource DNS name
IPv4 (A)

Instance type
t2.micro

Elastic IP addresses
–

Auto-assigned IP address
3.15.153.141 [Public IP]

VPC ID
vpc-0aa63b7325c5cec23

AWS Compute Optimizer finding
Opt-in to AWS Compute Optimizer for recommendations.
| Learn more

IAM Role
–

Subnet ID
subnet-0c31338d43322e272

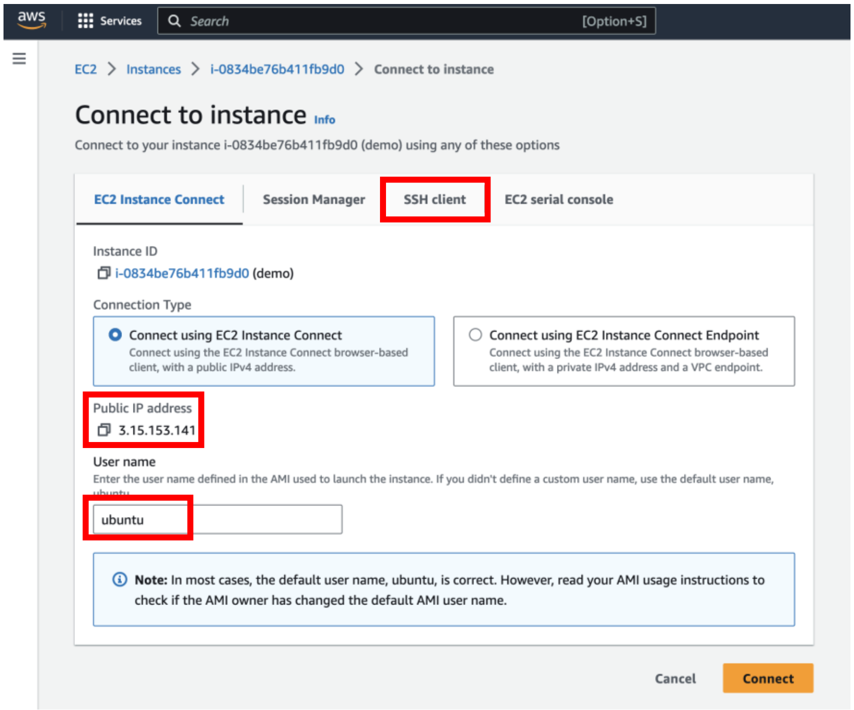
Auto Scaling Group name
–

IMDSv2
Optional

Instance details Info

Figure 8. *EC2 Instance Details.*

3. After clicking ‘Connect,’ you will be brought to the page in Figure 9. The public IP of your machine is shown here, as well as the default username. Now, click on the tab that says ‘SSH client.’



Connect to instance Info

Connect to your instance i-0834be76b411fb9d0 (demo) using any of these options

Instance ID
i-0834be76b411fb9d0 (demo)

Connection Type

● Connect using EC2 Instance Connect
Connect using the EC2 Instance Connect browser-based client, with a public IPv4 address.

○ Connect using EC2 Instance Connect Endpoint
Connect using the EC2 Instance Connect browser-based client, with a private IPv4 address and a VPC endpoint.

Public IP address
3.15.153.141

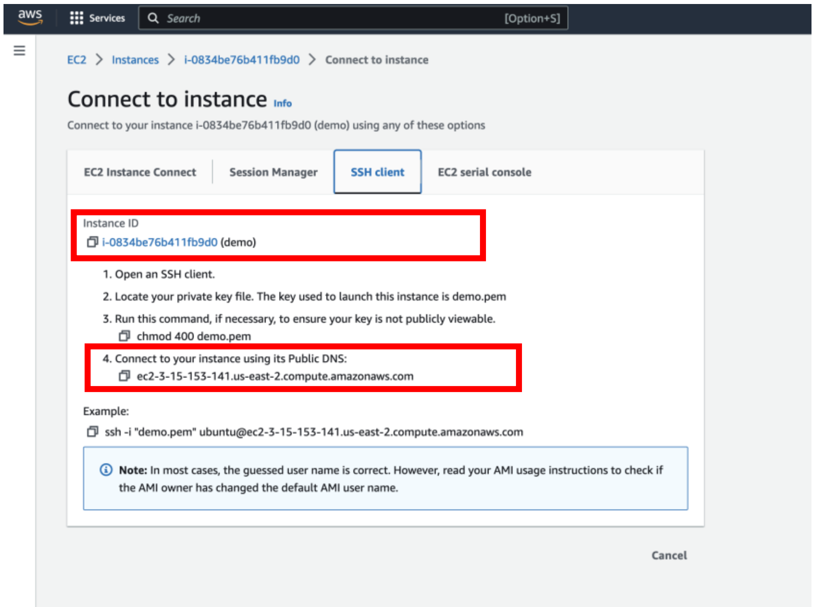
User name
Enter the user name defined in the AMI used to launch the instance. If you didn't define a custom user name, use the default user name, ubuntu.

ubuntu

Note: In most cases, the default user name, ubuntu, is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI user name.

Figure 9. *EC2 Connection Details.*

Your page should now look like Figure 10. You will now want to open a command line and navigate to where your .pem file is. Once you locate this file, run the command shown in step 3 of the page, shown in Figure 10. Next, copy the string shown under the example, paste, and execute this in your command line. You should now have access to your new VM.



Connect to instance

Connect to your instance i-0834be76b411fb9d0 (demo) using any of these options

Instance ID
i-0834be76b411fb9d0 (demo)

1. Open an SSH client.
2. Locate your private key file. The key used to launch this instance is demo.pem
3. Run this command, if necessary, to ensure your key is not publicly viewable.

```
chmod 400 demo.pem
```

4. Connect to your instance using its Public DNS:

```
ec2-3-15-153-141.us-east-2.compute.amazonaws.com
```

Example:

```
ssh -i "demo.pem" ubuntu@ec2-3-15-153-141.us-east-2.compute.amazonaws.com
```

Note: In most cases, the guessed user name is correct. However, read your AMI usage instructions to check if the AMI owner has changed the default AMI user name.

Figure 10. SSH client connection details.

Sources

- https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/concepts.html
- https://www.techtarget.com/searchaws/definition/Amazon-EC2-instances
- https://aws.amazon.com/ec2/instance-types/
- https://docs.aws.amazon.com/AWSEC2/latest/UserGuide/AccessingInstancesLinux.html
- https://www.youtube.com/watch?v=ZB4Li7vrF4c