



Amazon Web Services



Sunbeam Infotech AWS Certification Training

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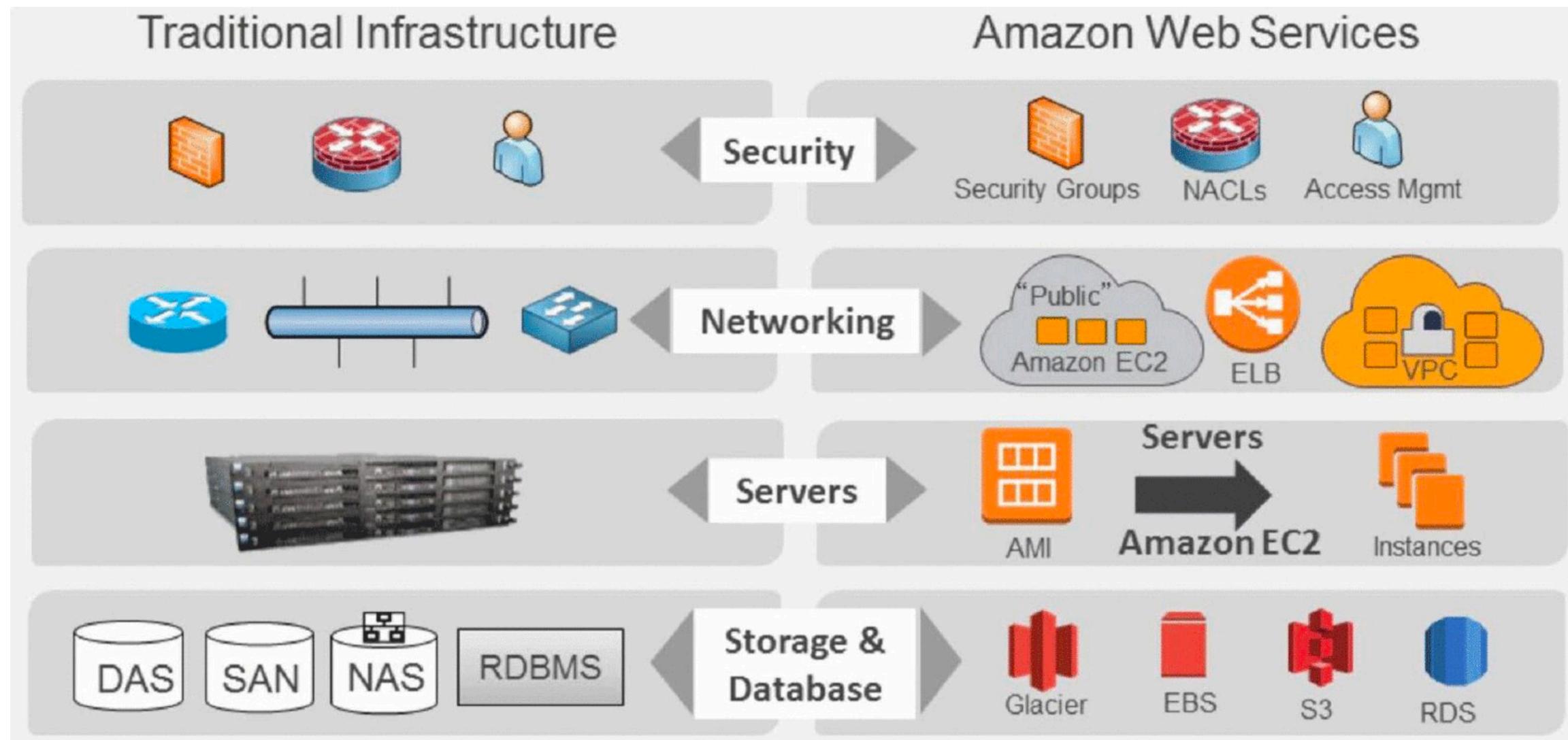
# Todays Agenda

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- Introduction to key terminologies
- Managing EC2 instances



# Traditional vs AWS



# Terminologies

- **High Availability**
  - Refers to architectures that continue to remain available to end users in the event of a component or systems failure
  - On AWS, multi-AZ architectures allow your applications to remain available in the event of AZ outage
- **Fault Tolerance**
  - Refers to the architecture, that not only remain available during an outage (High Availability) but also suffer no degradation in the performance.
  - Usually requires extra redundancy and should be traded off with cost concerns.
- **Scalability**
  - Refers to the ability of a system to increase in size and capacity in a cost effective way based on demand
  - Scaling can be
    - vertical (increase capacity of a single instance or server)
    - Horizontal (add or terminate number of instances)
- **Elasticity**
  - Refers to the ease of system's ability to change or adapt
  - Like automatically scaling up or down as per user demand



# EC2

Elastic Compute Cloud



# EC2

- Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides resizable compute capacity in the cloud
- It is a virtual machine you will be building in the cloud
- EC2 instances are designed to mimic traditional on-premise servers, but with the ability to be commissioned and decommissioned on-demand for easy scalability and elasticity
- EC2 supports variety of operating systems:
  - Linux: Amazon Linux, Ubuntu, Red Hat Enterprise, SUSE Linux Enterprise Server, Fedora, Debian, CentOS, Gentoo Linux, Oracle Linux, FreeBSD
  - Windows: Windows Server, Windows
- Every instance comprised of
  - Amazon Machine Image (AMI)
  - Instance type
  - Network Interface
  - Storage



# Step 1 - Choose AMI

The screenshot shows the AWS Launch Instance Wizard Step 1: Choose an Amazon Machine Image (AMI) page. The URL is https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard:.

The page displays a list of available Amazon Machine Images (AMIs) categorized by operating system:

- Windows**:
  - Microsoft Windows Server 2012 R2 with SQL Server 2016 Enterprise - ami-02c96bdc8f851187b (Free tier eligible)
  - Microsoft Windows Server 2012 Base - ami-0f83e0a40f08208db (Free tier eligible)
  - Microsoft Windows Server 2008 R2 Base - ami-094c0d39ab684c29a (Free tier eligible)
- Amazon Linux**:
  - Amazon Linux 2 LTS with SQL Server 2017 Standard - ami-0da21cbc0d899ebc7
  - Ubuntu Server 16.04 LTS (HVM) with SQL Server 2017 Standard - ami-66ca1419
  - .NET Core 2.1 with Amazon Linux 2 - Version 1.0 - ami-0e24aee0334f94155 (Free tier eligible)
  - .NET Core 2.1 with Ubuntu Server 18.04 - Version 1.0 - ami-e24b7d9d (Free tier eligible)

Each AMI entry includes details such as the AMI ID, description, root device type, virtualization type, and ENA Enabled status. A "Select" button is provided for each entry, and the "64-bit (x86)" option is highlighted.

At the bottom of the page, there are links for Feedback, English (US), Copyright information (© 2008 - 2019, Amazon Internet Services Private Ltd. or its affiliates. All rights reserved.), Privacy Policy, and Terms of Use.



# Amazon Machine Image (AMI)

- Operating System used to create virtual machine (EC2 instance)
- AMI are built for a specific region
- You can copy an AMI from one region to another
- You can also create a custom AMI with required applications/configuration
- AMI contains
  - Template for root volume
  - Launch permissions that control which account can use the AMI
  - EBS mapping that specifies the volume(s) to attach the instance when its launched
- AMI comes into two types
  - Instance store backed AMI
  - EBS backed AMI



# Step 2 - Instance Type

The screenshot shows the AWS Launch Instance Wizard Step 2: Choose an Instance Type page. The URL is <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard>. The page title is "Step 2: Choose an Instance Type". A sub-header states: "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." Below this, there are filter options: "Filter by: All instance types ▾ Current generation ▾ Show/Hide Columns". A table lists various instance types under the "Currently selected: t2.micro (Variable ECUs, 1 vCPUs, 2.5 GHz, Intel Xeon Family, 1 GiB memory, EBS only)" heading. The columns include Family, Type, vCPUs, Memory (GiB), Instance Storage (GB), EBS-Optimized Available, Network Performance, and IPv6 Support. The "t2.micro" row is highlighted with a green background and has a "Free tier eligible" badge. Other rows include t2.nano, t2.small, t2.medium, t2.large, t2.xlarge, t2.2xlarge, t3.nano, t3.micro, t3.small, t3.medium, t3.large, and t3.xlarge. At the bottom, there are buttons for "Cancel", "Previous", "Review and Launch" (which is blue and bold), and "Next: Configure Instance Details".

	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	<b>t2.micro</b> 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
	General purpose	t2.large	2	8	EBS only	-	Low to Moderate	Yes
	General purpose	t2.xlarge	4	16	EBS only	-	Moderate	Yes
	General purpose	t2.2xlarge	8	32	EBS only	-	Moderate	Yes
	General purpose	t3.nano	2	0.5	EBS only	Yes	Up to 5 Gigabit	Yes
	General purpose	t3.micro	2	1	EBS only	Yes	Up to 5 Gigabit	Yes
	General purpose	t3.small	2	2	EBS only	Yes	Up to 5 Gigabit	Yes
	General purpose	t3.medium	2	4	EBS only	Yes	Up to 5 Gigabit	Yes
	General purpose	t3.large	2	8	EBS only	Yes	Up to 5 Gigabit	Yes
	General purpose	t3.xlarge	4	16	EBS only	Yes	Up to 5 Gigabit	Yes



# Instance Type

- Used to decide the EC2 instance configuration
- AWS provides various instance types [<https://aws.amazon.com/ec2/instance-types/>]
  - General purpose: A (ARM), T (Cheapest), M (Main)
  - Compute optimized: C (Compute)
  - Memory optimized: R (RAM), X (Extreme RAM), Z (High compute and memory)
  - Accelerated computing: P (Picture-GPU), G (Graphics), F (Fast)
  - Storage optimized: I (IOPS), D (Data), H (High Disk Throughput)



# Instance Types

Type	Category	Description	Use Cases
M5	General Purpose	Balance of compute, memory and network resources	Mid-sized databases
C5	Compute Optimized	Advanced CPUs	Modelling, Analytics
H1	Storage Optimized	Local HDD Storage	Map Reduce
R4	Memory Optimized	More RAM for \$	In-memory caching
X1	Memory Optimized	Terabytes of RAM and SSD	In-memory database
I3	IO Optimized	Local SSD storage, high IOPS	NoSQL databases
G3	GPU Graphics	GPUs with video encoders	3d rendering
P3	GPU Compute	GPUs with tensor cores	Machine Learning
F1	Accelerated Computing	FPGA, custom hardware accelerations	Genomics
T2	Burstable	Shared CPUs, lowest cost	Web servers



# Step 3 – Configure Instance Details

The screenshot shows the AWS Launch Instance Wizard Step 3: Configure Instance Details. The page is titled "Step 3: Configure Instance Details" and includes a sub-instruction: "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." The configuration options are organized into sections:

- Number of instances:** Set to 1, with a link to "Launch into Auto Scaling Group".
- Purchasing option:** A checkbox for "Request Spot instances" is present.
- Network:** Set to "vpc-e658e69c | Default (default)". Options include "Create new VPC".
- Subnet:** Set to "No preference (default subnet in any Availability Zone)". Options include "Create new subnet".
- Auto-assign Public IP:** Set to "Use subnet setting (Enable)".
- Placement group:** A checkbox for "Add instance to placement group" is present.
- Capacity Reservation:** Set to "Open". Options include "Create new Capacity Reservation".
- IAM role:** Set to "None". Options include "Create new IAM role".
- Shutdown behavior:** Set to "Stop".
- Enable termination protection:** A checkbox for "Protect against accidental termination" is present.
- Monitoring:** A checkbox for "Enable CloudWatch detailed monitoring" is present, with a note: "Additional charges apply."
- Tenancy:** Set to "Shared - Run a shared hardware instance". Note: "Additional charges will apply for dedicated tenancy."
- Elastic Inference:** A checkbox for "Add an Elastic Inference accelerator" is present, with a note: "Additional charges apply."
- T2/T3 Unlimited:** A checkbox for "Enable" is present, with a note: "Additional charges may apply".

At the bottom, there is a link to "Advanced Details" and a navigation bar with buttons: "Cancel", "Previous", "Review and Launch" (highlighted in blue), and "Next: Add Storage".



# Purchasing Options

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- EC2 instances can be purchased using one of the following methods
  - On Demand
  - Spot instances
  - Reserved instances
  - Dedicated hosts
  - Dedicated instances



# On Demand

- Low cost and flexibility with no upfront cost
- Pay for hours used with no commitment
- Good option for developers or testers
- Ideal for
  - auto scaling groups
  - Unpredictable workloads



# Spot instances

- Very low hourly compute cost
- Ideal for grid computing and HPC
- Configurable start and end time
- Charged by hour unless AWS terminates in which case that hour will be free
- Can not use encrypted volumes
- Remaining capacity can be sold on AWS market



# Reserved instances

- Significant discounts over on demand pricing
- Capacity can be reserved for 1 to 3 years
- Following types of reserved instances can be created
  - Standard
    - Commitment of 1 to 3
    - Charged irrespective of the EC2 instance (whether it is on or off)
  - Convertible
    - Can change the instance family, OS, tenancy and payment options
  - Scheduled
    - Can be reserved for specific periods of time
    - Hourly charges



# Dedicated hosts

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- AWS uses physical servers for dedicated hosts only for your use
- You can control which instances are deployed on that host
- Available as on demand or with dedicated host reservation
- Good for regulatory compliance or licensing requirements
- Predictable performance as you will be using the physical hardware



# Dedicated instances

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- Billing is per instance
- AWS may share the hardware with other non-dedicated instances in the same account
- Available as on demand, reserved instances and spot instances
- Costs additional \$2 per hour per region



# Placement Groups

- Logical grouping of instances
- Types
  - Cluster
    - Instances are placed in the single availability zone
    - Gives best low latency network performance
  - Spread
    - Instances are spread across underlying hardware across availability zones
    - Reduces risk of simultaneous hardware failure
  - Partition
    - Spreads instances across logical partitions
    - Groups of instances in one partition do not share the underlying hardware with groups of instances in different partitions
    - Generally used in distributed and replicated workloads like Hadoop, Kafka etc



# Step 4 – Add Storage

The screenshot shows the AWS Launch Instance Wizard Step 4: Add Storage page. The URL is <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard>. The page displays storage settings for a new EC2 instance:

Volume Type	Device	Snapshot	Size (GiB)	Volume Type	IOPS	Throughput (MB/s)	Delete on Termination	Encrypted
Root	/dev/sda1	snap-0ac9e6b9d926e36c9	8	General Purpose SSD (gp2)	100 / 3000	N/A	<input checked="" type="checkbox"/>	Not Encrypted

An "Add New Volume" button is available below the table.

A note states: "Free tier eligible customers can get up to 30 GB of EBS General Purpose (SSD) or Magnetic storage. [Learn more](#) about free usage tier eligibility and usage restrictions."

At the bottom, there are navigation buttons: Cancel, Previous, **Review and Launch**, and Next: Add Tags.

Footer links include Feedback, English (US), Privacy Policy, and Terms of Use.



# Storage options

- Block storage
  - Instance store
  - EBS volume
- Object storage
  - S3
- File sharing
  - EFS



# Instance Store

- Virtual devices whose underlying hardware is physically attached to the host computer that is running the instance
  - Local storage
  - Faster IOPS
- Are ephemeral data (the volumes only exists for duration of life of the instance it is attaching to)
- Once the instance is stopped/shut down, the data is erased
- The instance can be rebooted and still maintain its ephemera data
- Suitable for paging/swap files, caches, replicated data (NoSQL DB)



# EBS – Elastic Block Store

- EBS volumes are persistent (they can live beyond the life of the EC2 instance they are attached to)
- Network attached storage (can be attached/detached to or from various EC2 instances)
- Can be attached to only ONE EC2 instance at a time
- Can be backed to S3 in a form of a snapshot which can later be stored into a new EBS volume
- 99.99% available
- The annual failure rate is about 1-2%
- Performance can be measured in IOPS
  - IOPS are input/output per second
  - IOPS measures the number of read and write operations per second, while throughput measures the number of bits read or written per second.
  - AWS measures IOPS in 256K chunk (or smaller)
  - Operations that are greater than 256KB are separated into individual 256KB chunk (512KB operation would count by 2 IOPS)
- Types
  - SSD
  - HDD



# EBS – Solid State Drives (SSD)

- General Purpose (gp2)
  - Used for dev/test environments
  - Baseline performance: 100 IOPS – 3000 IOPS
  - Bursts up to 32000 IOPS (credit based)
  - Volume size from 1GiB to 16 TiB
- Provisioned IOPS (io1)
  - Used for mission critical applications that require sustained IOPS performance
  - Large database workloads
  - Volume size: 4GiB to 16TiB
  - Performs at provisioned level and can provision up to 64K IOPS per volume
  - NOTE: EC2 instances have a maximum of 80K IOPS total



# EBS – Hard Disk Drive (HDD)

- Can not be boot volume
- Size: 500GiB – 16TiB
- Types
  - Throughput Optimized (st1)
    - Low storage cost
    - Used for frequently accessed, throughout intensive workloads
    - E.g. Streaming, Big Data
    - Max throughput of 500 MiB/s
    - NOTE: EC2 instances have a maximum throughput of 1750MiB/s
  - Cold HDD (sc1)
    - Lowest cost
    - Infrequently accessed data
    - Max throughput of 250MiB/s



# EBS - Snapshots

- Point-in-time backups of EBS volumes that are stored in S3
- They are incremental
- Stores only changes since the most recently taken snapshot, thus reducing costs
- If old snapshot is deleted blocks required to restore the other snapshots are retained
- Can be used to create fully restored EBS volumes
- Can be used to create AMIs
- Frequent snapshots of your data increases data durability
- Stop writes before issuing the snapshot command



# Step 5 – Add Tags

The screenshot shows the AWS Launch Instance Wizard Step 5: Add Tags page. The URL is <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard>. The page title is "Launch instance wizard | EC2". The top navigation bar includes "Services", "Resource Groups", and tabs for "1. Choose AMI", "2. Choose Instance Type", "3. Configure Instance", "4. Add Storage", "5. Add Tags" (which is selected), "6. Configure Security Group", and "7. Review". The user is signed in as "amit.kulkarni" in the N. Virginia region.

**Step 5: Add Tags**

A tag consists of a case-sensitive key-value pair. For example, you could define a tag with key = Name and value = Webserver. A copy of a tag can be applied to volumes, instances or both. Tags will be applied to all instances and volumes. [Learn more](#) about tagging your Amazon EC2 resources.

Key (127 characters maximum) | Value (255 characters maximum) | Instances (i) | Volumes (i)

This resource currently has no tags

Choose the Add tag button or [click to add a Name tag](#). Make sure your [IAM policy](#) includes permissions to create tags.

Add Tag (Up to 50 tags maximum)

Cancel Previous Review and Launch Next: Configure Security Group

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# Step 6 - Add Security Group

The screenshot shows the AWS Launch Instance Wizard at Step 6: Configure Security Group. The URL is <https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard>. The page title is "Step 6: Configure Security Group". A warning message at the bottom states: "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." The security group name is "launch-wizard-6" and the description is "launch-wizard-6 created 2019-04-01T18:49:38.542+05:30". A single rule is listed: Type: SSH, Protocol: TCP, Port Range: 22, Source: Custom 0.0.0.0/0, Description: e.g. SSH for Admin Desktop. There is an "Add Rule" button.

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:

Description:

Type	Protocol	Port Range	Source	Description
SSH	TCP	22	Custom 0.0.0.0/0	e.g. SSH for Admin Desktop

[Add Rule](#)

**Warning**  
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.

[Cancel](#) [Previous](#) [Review and Launch](#)

[Feedback](#) [English \(US\)](#)

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# Security Group

- Acts as a virtual firewall for your instance to control inbound and outbound traffic
- Controls the ports and protocols that can reach the front-end listener
- Every EC2 instance must have at least one security group attached
- Up to 5 security groups can be attached to an EC2 instance
- Security groups act at the instance level, not the subnet level
- Security group contains rules
  - You can specify allow rules, but not deny rules
  - You can specify separate rules for inbound and outbound traffic
  - When you create a security group, it has no inbound rules
  - By default, a security group includes an outbound rule that allows all outbound traffic
  - Security groups are stateful
  - Instances associated with a security group can't talk to each other unless you add rules allowing it
  - Security groups are associated with network interfaces



# Step 7 – Review and create PEM file

The screenshot shows the AWS Launch Instance Wizard at Step 7: Review Instance Launch. The main page displays instance details like AMI, Instance Type (t2.micro), and Security Groups. A modal window titled "Select an existing key pair or create a new key pair" is overlaid. The modal contains instructions about key pairs, a dropdown menu for selecting an existing key pair (with "cloud-workshop" listed), and a checkbox for acknowledging access to the private key file. At the bottom of the modal are "Cancel" and "Launch Instances" buttons.

Launch instance wizard | EC2 +

https://console.aws.amazon.com/ec2/v2/home?region=us-east-1#LaunchInstanceWizard:

Services Resource Groups

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

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.

**AMI Details**

Ubuntu Server 16.04 LTS (HVM), SSD Volume Type -  
Free tier eligible  
Ubuntu Server 16.04 LTS (HVM), EBS General Purpose (SSD) Vo  
Root Device Type: ebs Virtualization type: hvm

**Instance Type**

Instance Type	ECUs	vCPUs	Memory (GiB)
t2.micro	Variable	1	1

**Security Groups**

Security group name	Description
launch-wizard-6	launched-wizard-6 created 2019-04-01T

Type: SSH Protocol: TCP Port: 22 CIDR: 0.0.0.0/0

**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](#).

Choose an existing key pair  
Select a key pair  
cloud-workshop

I acknowledge that I have access to the selected private key file (cloud-workshop.pem), and that without this file, I won't be able to log into my instance.

Cancel Launch Instances

Edit AMI Edit instance type Edit security groups Edit instance details Edit storage Edit tags

Cancel Previous Launch

Feedback English (US)

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# EC2 Key Pairs

- Uses PEM format (Privacy Enhanced Mail)
- Used to authenticate a client when logging into EC2 instance
- Each key pair consists of a public key and a private key
- AWS stores the public key on the instance and you are responsible for storing the private key
- To log into the instance you must create and authenticate with key pair
  - Linux instances have no password and you use a key pair to log in
  - With windows you use a key pair to obtain the administrator password and then log into the instance with RDP
- During the creation process of an EC2 instance you are required to either create a new key pair or use existing pair
- The private key is available for download and stored on your local drive
- NOTE: it will be available only once in the form of .pem file

