Cloud

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Post Graduate Program in Cloud

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Cloud

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AWS Solution Architect: Associate Level

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Amazon Elastic Compute Cloud

# Learning Objectives

By the end of the lesson, you will be able to:

- Explain Amazon EC2 and its uses

- Describe Amazon Machine Image (AMI)

- Explain the difference between EBS and EFS

- Describe the use of EBS snapshots

- Describe the different instance pricing options

- Illustrate Auto Scaling, FSx, and HPC

- Evaluate the AWS recommended best practices for EC2

Introduction to Amazon EC2

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Elastic Compute Cloud (EC2)

Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides scalable computing capacity in the Amazon Web Services (AWS) cloud.
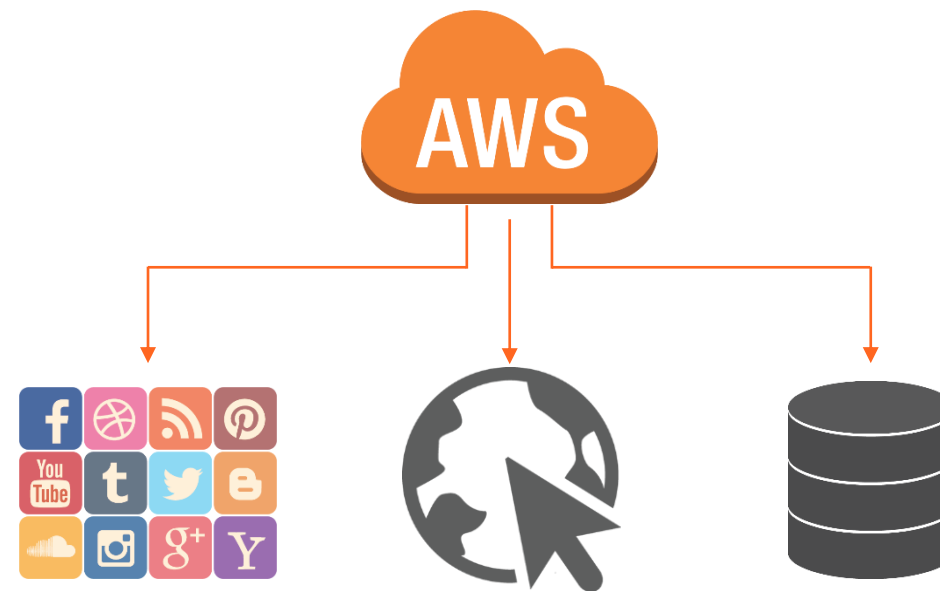
Benefits of Using EC2:
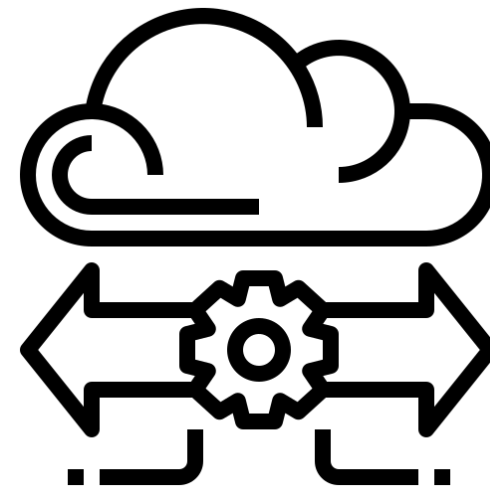
Elastic Web-Scale Computing

Flexible Cloud Hosting Services

AWS Integration

Reliability and Security

Low Cost

- EC2 increases or decreases your storage capacity in minutes.
- It launches thousands of server instances simultaneously.

Benefits of Using EC2:
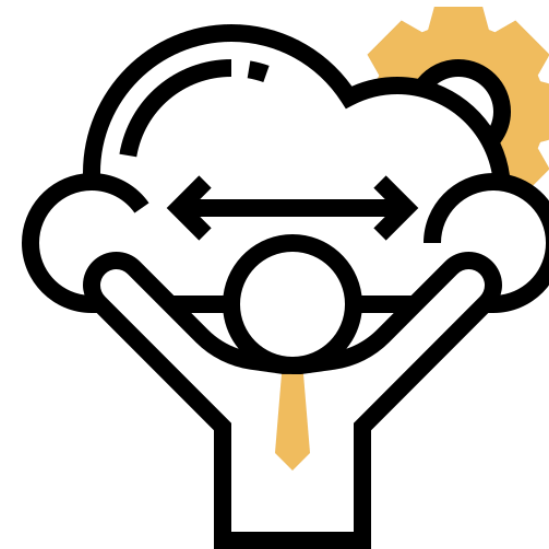
Elastic Web-Scale Computing

Flexible Cloud Hosting Services

AWS Integration

Reliability and Security

Low Cost

EC2 launches numerous operating systems, instance types, and software in just minutes.

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Benefits of Using EC2:
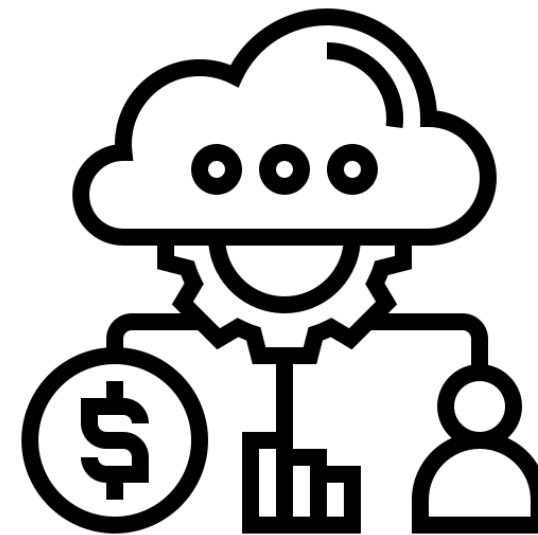
Elastic Web-Scale Computing

Flexible Cloud Hosting Services

AWS Integration

Reliability and Security

Low Cost

EC2 is integrated with other AWS products such as Amazon S3, Amazon RDS, and Amazon SQS, to provide a complete IT architecture solution.

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Benefits of Using EC2:

Elastic Web-Scale Computing

Flexible Cloud Hosting Services

AWS Integration

Reliability and Security

Low Cost

- AWS operates a Service Level Agreement (SLA) commitment of 99.95% availability.
- With Amazon VPC, you can easily create secure and robust networks to run your Amazon EC2 instances.

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Benefits of Using EC2:

Elastic Web-Scale Computing

Flexible Cloud Hosting Services

AWS Integration
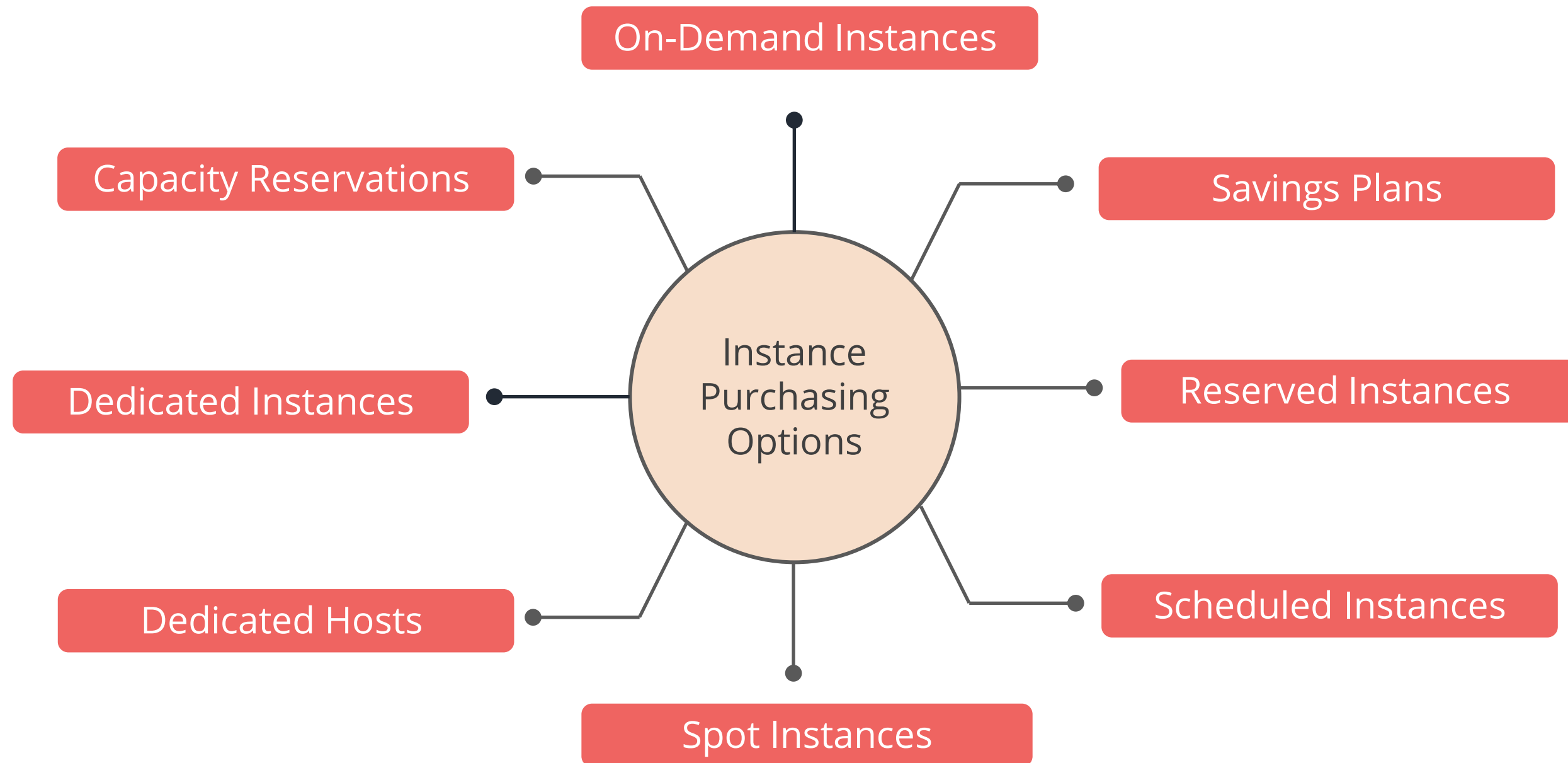
Reliability and Security

Low Cost

- AWS charges you by seconds and you only pay for what you use.
- Rates are lower than your existing on-premise infrastructure.

EC2 Instance Purchasing Options

Amazon EC2 provides the following purchasing options to enable you to optimize your costs based on your needs:

On-Demand Instances

Capacity Reservations

Savings Plans

Dedicated Instances

Reserved Instances

Dedicated Hosts

Scheduled Instances

Spot Instances

Instance Purchasing Options

Amazon Machine Images (AMI)

Amazon Machine Image (AMI)

Amazon's definition of an AMI:

"An Amazon Machine Image (AMI) provides the information required to launch an instance. You specify an AMI when you launch an instance, and you can launch as many instances from as many different AMIs as you need."

Amazon Machine Image (AMI)

Amazon Machine Image (AMI)

AMI is a virtual instance that includes:

- A template for the root volume for the instance

- Launch permissions to control AMI launch instances

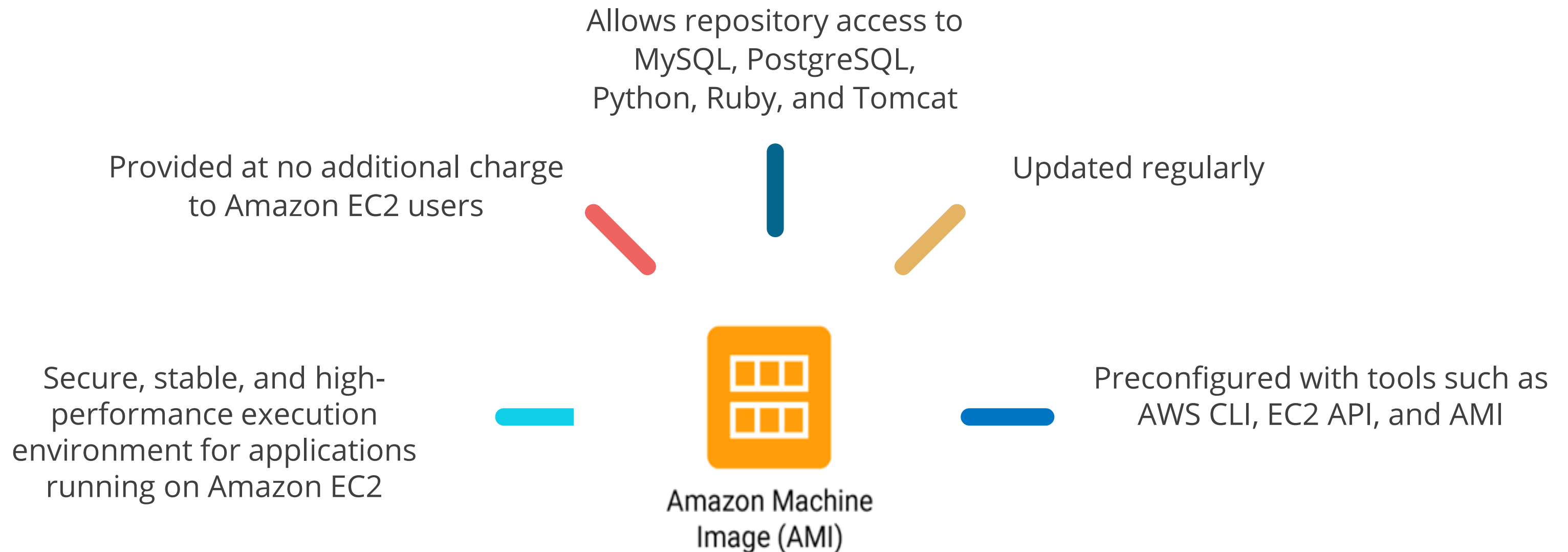- A block device mapping that specifies volumes to attach to the instance

AMI

Amazon Linux AMI

Amazon Linux AMI is a supported and maintained Linux image provided by AWS.

The following are the features of the Amazon Linux AMI:

Allows repository access to
MySQL, PostgreSQL,
Python, Ruby, and Tomcat

Provided at no additional charge
to Amazon EC2 users

Updated regularly

Secure, stable, and high-
performance execution
environment for applications
running on Amazon EC2

Preconfigured with tools such as
AWS CLI, EC2 API, and AMI

Amazon Machine
Image (AMI)

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Choose an AMI

The first step of launching any new instance is selecting an AMI.

AWS Marketplace

The AWS Marketplace is an online store where customers can find, buy, deploy, and manage the software, data, and services that run on AWS from third-party vendors.

My AMIs

Customize the instance that you launch from a public AMI and then save that configuration as a custom AMI for your use.

Standard
AMI
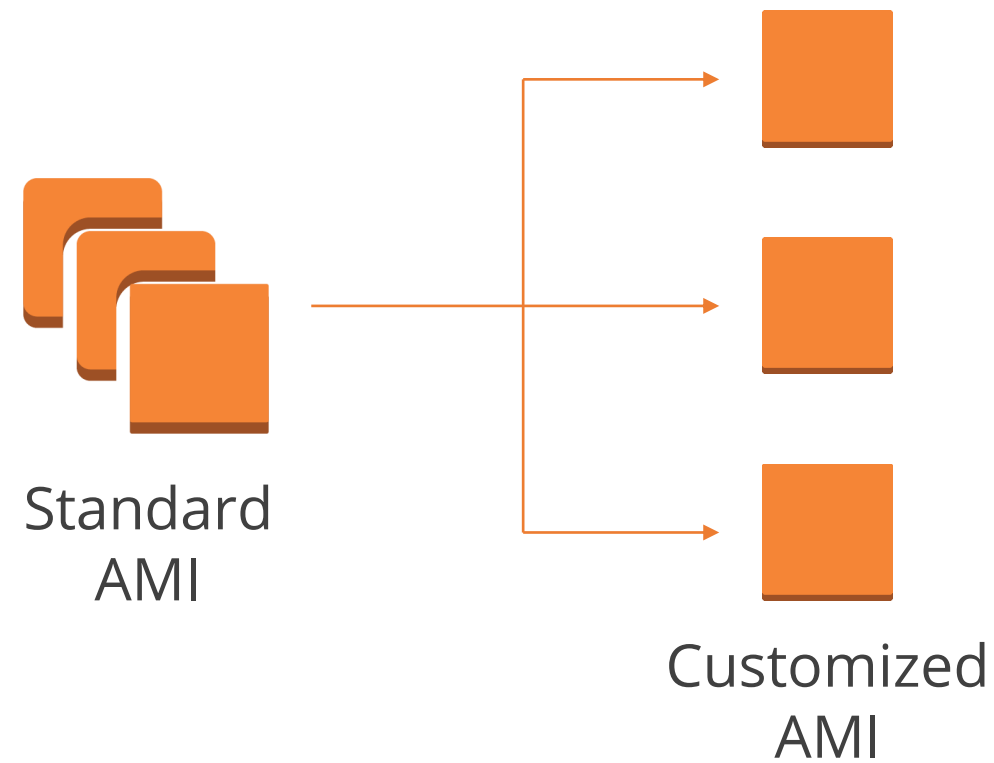
Customized
AMI

Creating AMIs

Use an existing AMI, launch an instance, customize it, create a new AMI from it, and finally launch an instance of your new AMI.

AMI #1 — EBS root volume snapshot #1 → **Launch instance** → EC2 instance #1 — EBS root volume #1 → **Create image** → AMI #2 — EBS root volume snapshot #2 → **Launch instance** → EC2 instance #2 — EBS root volume #2

Step 1   **Step 2**   **Step 3**   **Step 4**   **Step 5**   **Step 6**   **Step 7**

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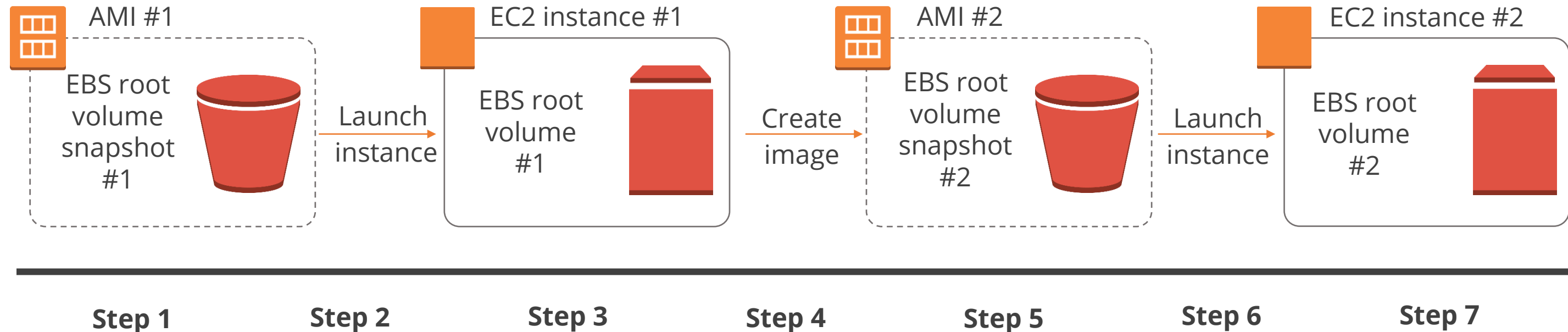
AMI Distribution

An AMI can be:

- Kept private

- Shared with a specific list of AWS accounts

- Made public

AMI

Private

Specific AWS Accounts

Public

awsmarketplace

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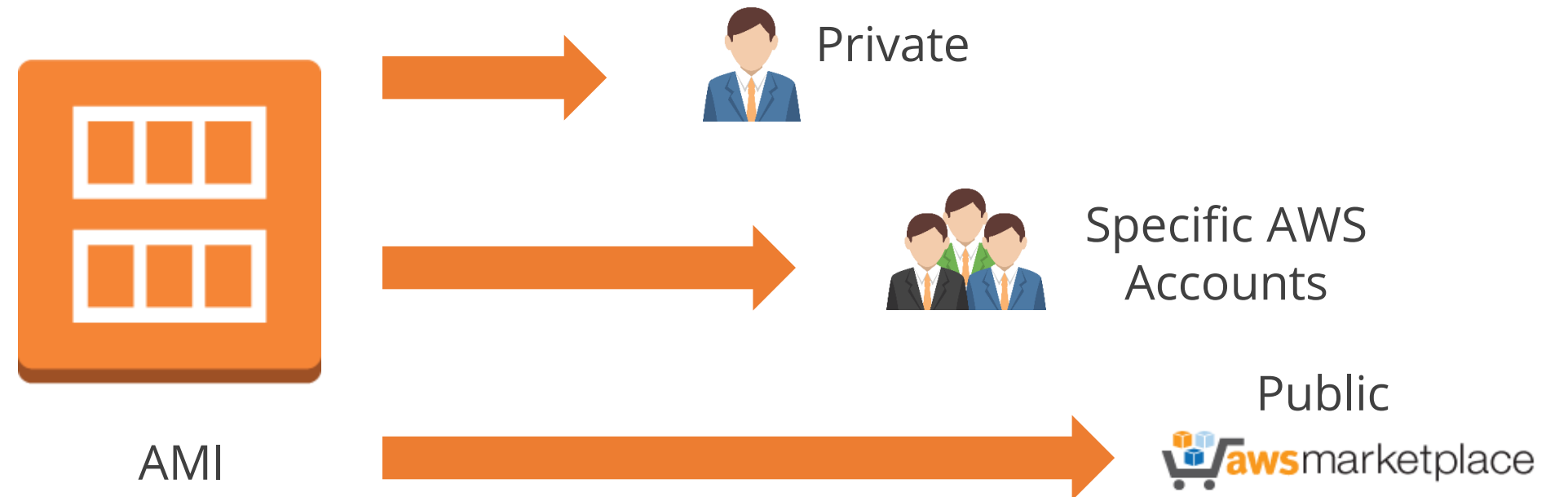
Deregistering AMIs

An AMI can be deregistered after its work is done. Once deregistered, it cannot launch new instances.

EBS snapshot

AMI

EC2 Instance

Deregister the AMI

EBS snapshot

EC2 Instance

Delete the snapshot

EC2 Instance

Your AMI, its snapshot, and an instance is launched from the AMI.

When you are finished with the instance, you can terminate it.

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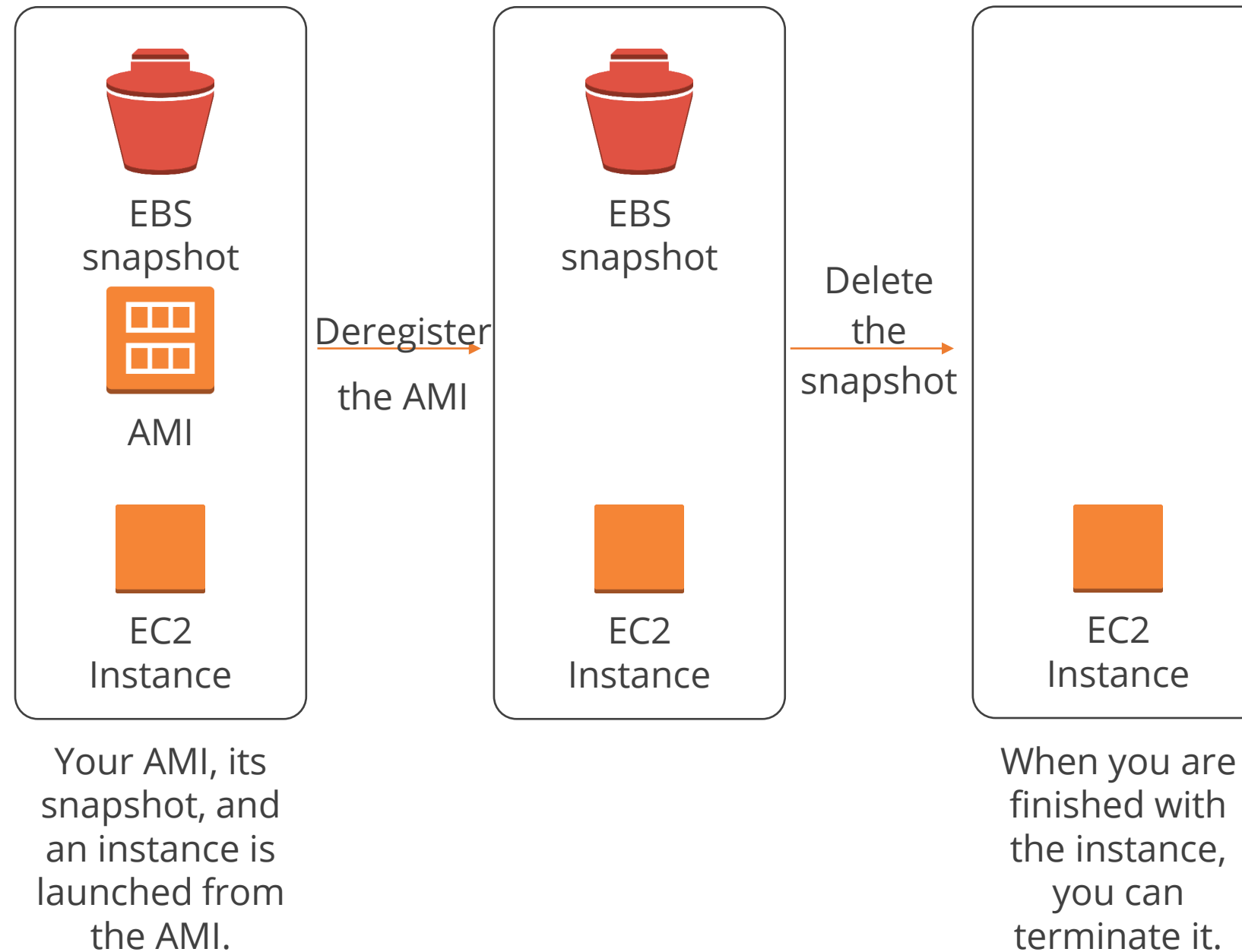
Assisted Practice

Assisted Practice: Create a Linux-based EC2 Instance

Problem Statement:

You are given a project to create a Linux-based EC2 instance.

Assisted Practice: Guidelines to Create a Linux-based EC2 Instance

Steps to perform:

1. Open the Amazon EC2 console
2. Create an EC2 Instance and launch the instance
3. Convert your private key to PuTTY using PuTTYgen
4. Connect to your Linux Instance

Assisted Practice

Create a Windows-based EC2 Instance

Problem Statement:

You are given a project to create a Windows-based EC2 instance.

Assisted Practice: Guidelines to Create a Windows-based EC2 Instance

Steps to perform:

1. Open the Amazon EC2 console
2. Create an EC2 Instance and launch the instance
3. Click on Download Remote Desktop File and save it
4. Connect to your Windows Instance

Assisted Practice

Create a Custom AMI

Problem Statement:

You are given a project to create a custom AMI.

Assisted Practice: Guidelines to Create a Custom AMI

Steps to perform:

1. Create image commands from the Actions dropdown menu

2. Give the detailed information of the image and create it

3. Check the custom image that you have created

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Assisted Practice

Create an Instance Using a Custom AMI

Duration: 25 min.

Problem Statement:

You are given a project to create an instance using a custom AMI.

Assisted Practice: Guidelines to Create a Custom AMI

Steps to perform:

1. Open the Amazon EC2 console

2. Choose AMIs from the navigation bar

3. Launch the instance using a custom AMI

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Introduction to Amazon EBS

Root Device Storage

There are two types of root device storage for AMIs:

- Instance store
- Amazon EBS

AMI

Instance Store

Elastic Storage (EBS)
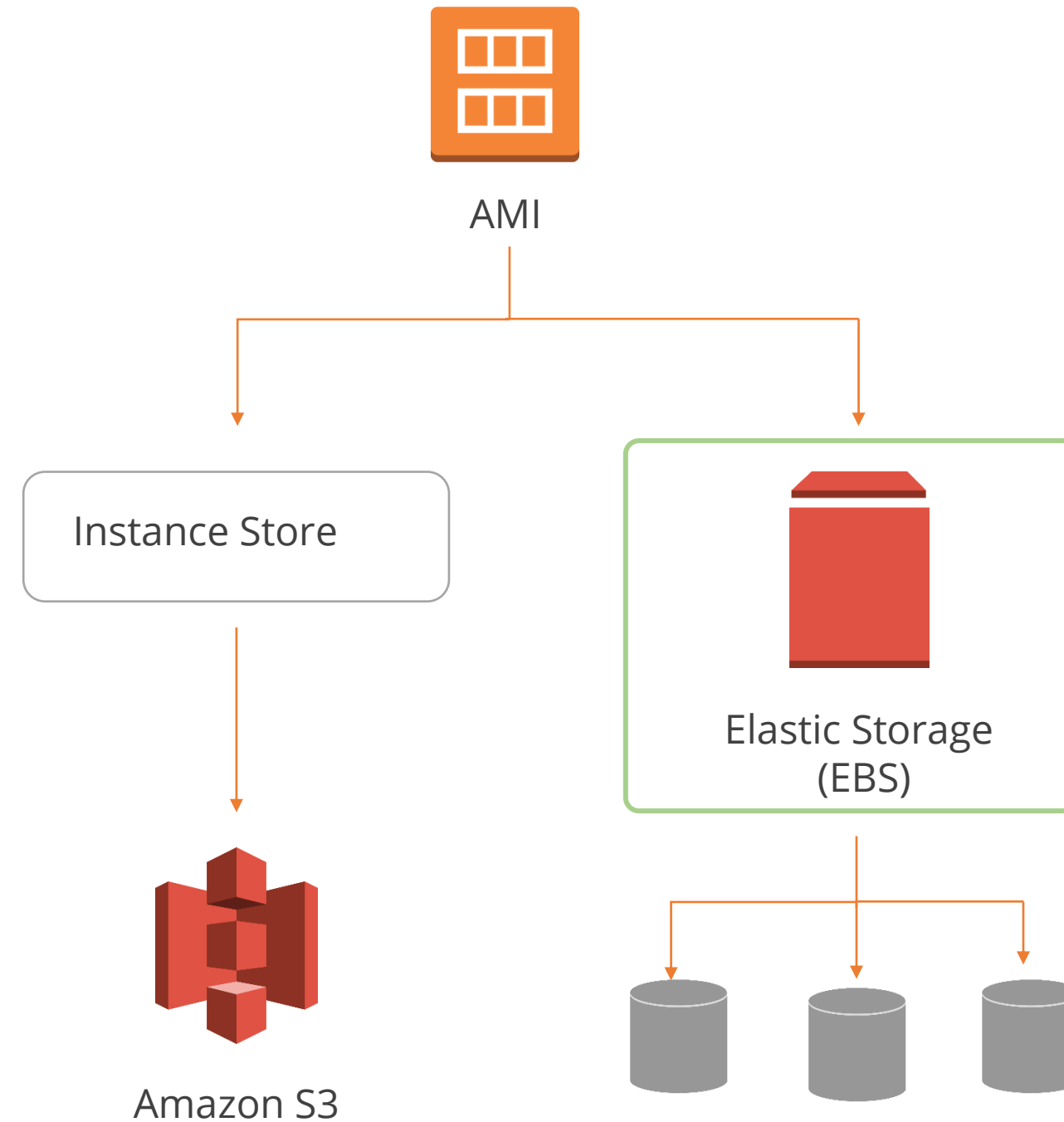
Amazon S3

EBS Overview

Amazon Elastic Block Store (Amazon EBS) provides persistent block-level storage volumes for use with Amazon EC2 instances in the AWS cloud.

Benefits of EBS

Data encryption

Data
persistence

Snapshots

Data
availability

Flexibility
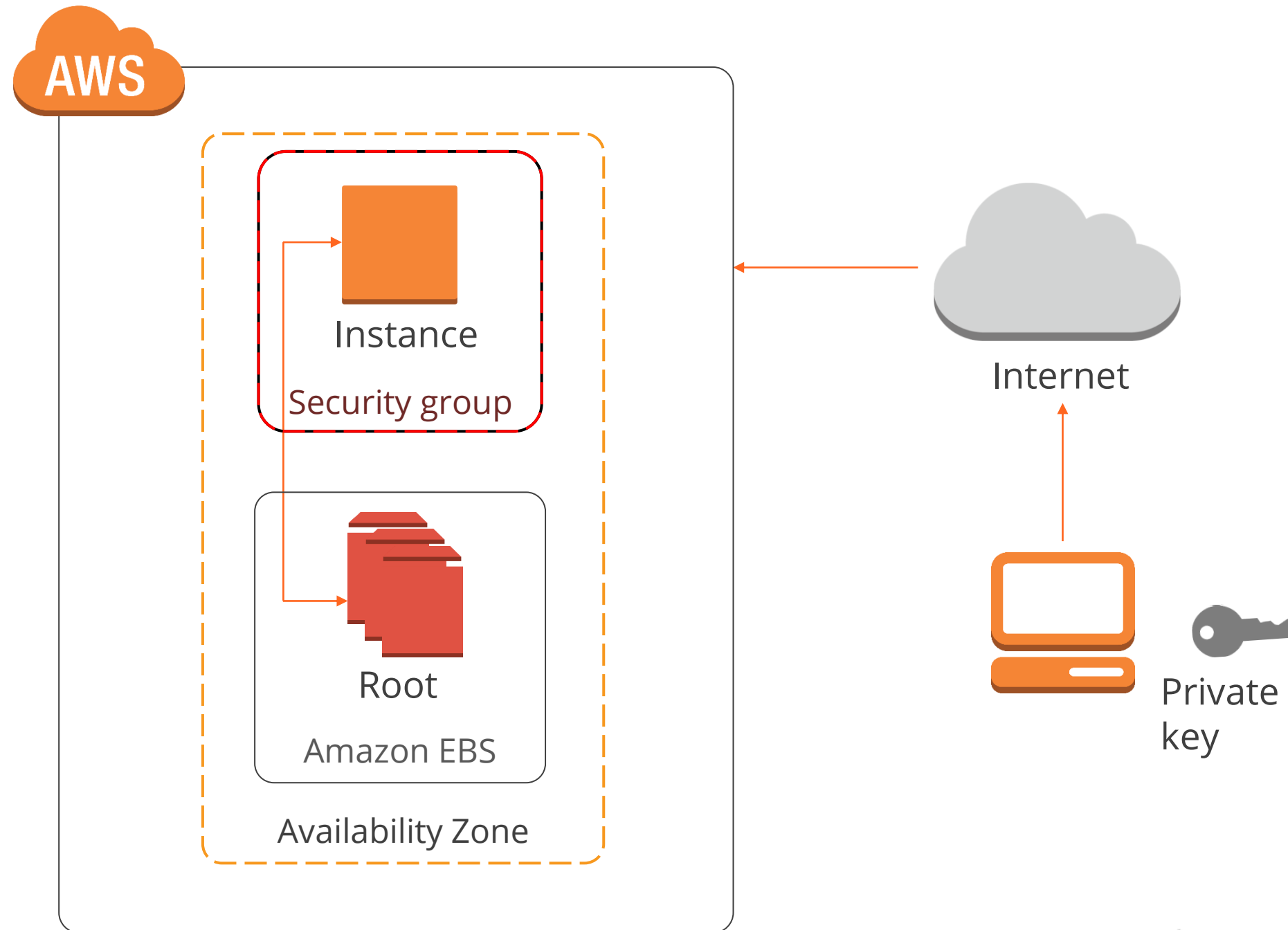
Here are some benefits of
using Amazon EBS
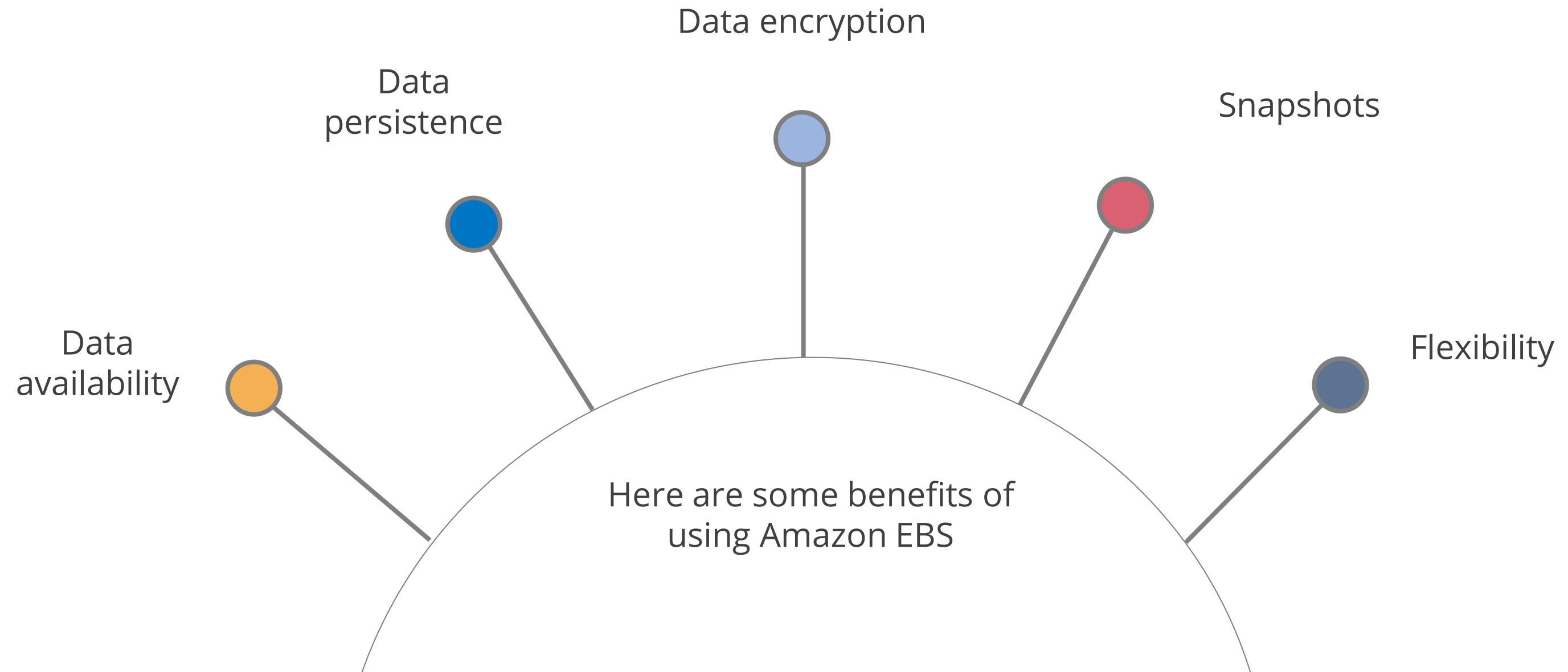
Storage Categories

	SSD-backed		HDD-backed	
Type	Provisioned IOPS SSD (io1)	General Purpose SSD (gp2)	Throughput Optimized HDD (st1)	Cold HDD (sc1)
Purpose	High performance SSD volume designed for latency-sensitive transactional workloads	General Purpose SSD volume that balances price performance for a wide variety of transactional workloads	Low-cost HDD volume designed for frequently accessed, throughput-intensive workloads	Lowest cost HDD volume designed for less frequently accessed workloads
Use Cases	I/O-intensive NoSQL and relational databases	Boot volumes, low-latency interactive apps, dev and test	Big data, data warehouses, log processing	Colder data requiring fewer scans per day
Volume Size	4 GB -16 TB	1 GB -16 TB	500 GB -16 TB	500 GB -16 TB
Max IOPS/Volume	64,000	16,000	500	250
Max Throughput/ Volume	1,000 MB/s	250 MB/s	500 MB/s	250 MB/s
Max IOPS/ Instance	80,000	80,000	80,000	80,000
Max Throughput/ Instance	2,375 MB/s	2,375 MB/s	2,375 MB/s	2,375 MB/s
Price	$0.125/GB-month + $0.065/provisioned IOPS	$0.10/GB-month	$0.045/GB-month	$0.025/GB-month
Dominant Performance Attribute	IOPS	IOPS	MB/s	MB/s

Instance Store

An instance store provides temporary block-level storage for your instance.

Host Computer 1   Host Computer 2
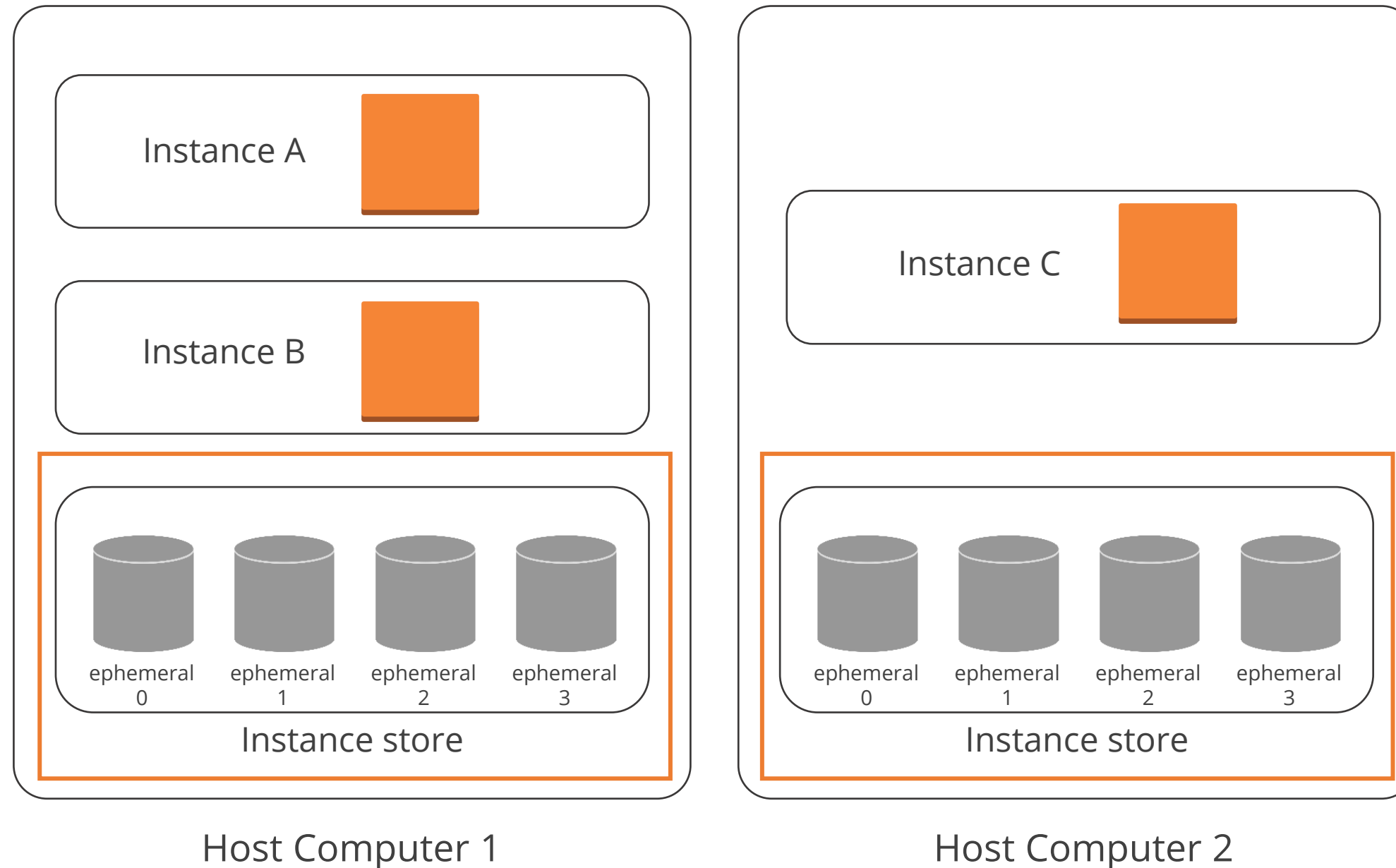
Amazon EBS vs. Instance Store

This table shows the different characteristics between the EBS-backed and Amazon Instance store-backed volumes.

Characteristics	Amazon EBS	Instance Store
Boot time	Usually less than 1 minute	Usually less than 5 minutes
Root device volume	Amazon EBS volume	Instance store volume
Upgrading	EBS-backed instances can be upgraded for instance type, Kernel, RAM disk, and user data	Instance store-backed instances cannot be upgraded
AMI creation	AMI can be easily created using a single command	AMI creation requires AMI tools and needs to be executed from within the running instance
Volume attachment	EBS volume can be attached as additional volumes when the instance is being launched and even when the instance is up and running	Instance store volume can be attached as additional volumes only when the instance is being launched and not when the instance is up and running

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EBS Snapshot

Features of EBS Snapshots

- You can back up EBS volumes by taking point-in-time snapshots and it is stored in the S3 owned by AWS.

- You can perform incremental backups, that is back up only the blocks on the device that have changed after the most recent snapshot is saved.

- When you delete a snapshot, only the data exclusive to that snapshot is removed.

- Active snapshots contain all the information needed to restore your data (from the time the snapshot was taken) to a new EBS volume.

- If the EBS volume is encrypted, then the snapshot is also encrypted.

EBS Snapshot

EBS Snapshot Storage

With Amazon EBS, you can:

- Create a point-in-time snapshot of volumes that are stored for you in Amazon Simple Storage Service (Amazon S3)

- Copy a snapshot from one AWS region to another or within the same region

- Encrypt your data with Amazon S3 server-side encryption (256-bit Advanced Encryption Standard)

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Assisted Practice

Create and Attach an EBS Volume to a Linux Instance

Duration: 25 min.

Problem Statement:

You are given a project to create and attach an EBS volume to a Linux Instance.

Assisted Practice: Guidelines to Create and Attach an EBS Volume to a Linux Instance

Steps to perform:

1. Open the Amazon EC2 console

2. Choose Elastic Block Store, and then Volumes from the navigation pane

3. Create an EBS Volume

4. Attach an EBS Volume to a Linux Instance

5. Convert your private key to PuTTY using PuTTYgen

6. Connect to your Linux Instance

Assisted Practice

Create a Snapshot of an Existing EBS Instance

Duration: 10 min.

Problem Statement:

You are given a project to create a snapshot of an existing EBS Instance.

Assisted Practice: Guidelines to Create a Snapshot of an Existing EBS Instance

Steps to perform:

1. Open the Amazon EC2 console

2. Choose Snapshots under Elastic Block Store in the navigation pane

3. Create Snapshot

Elastic IP Address

Elastic IP Address

An Elastic IP address is a static IPv4 address associated with the AWS account in a specific AWS region.

The users can associate an Elastic IP address with their EC2 instance at any time using:

AWS Command Line
Interface (AWS CLI)

Amazon EC2 console

AWS tools for Windows
PowerShell
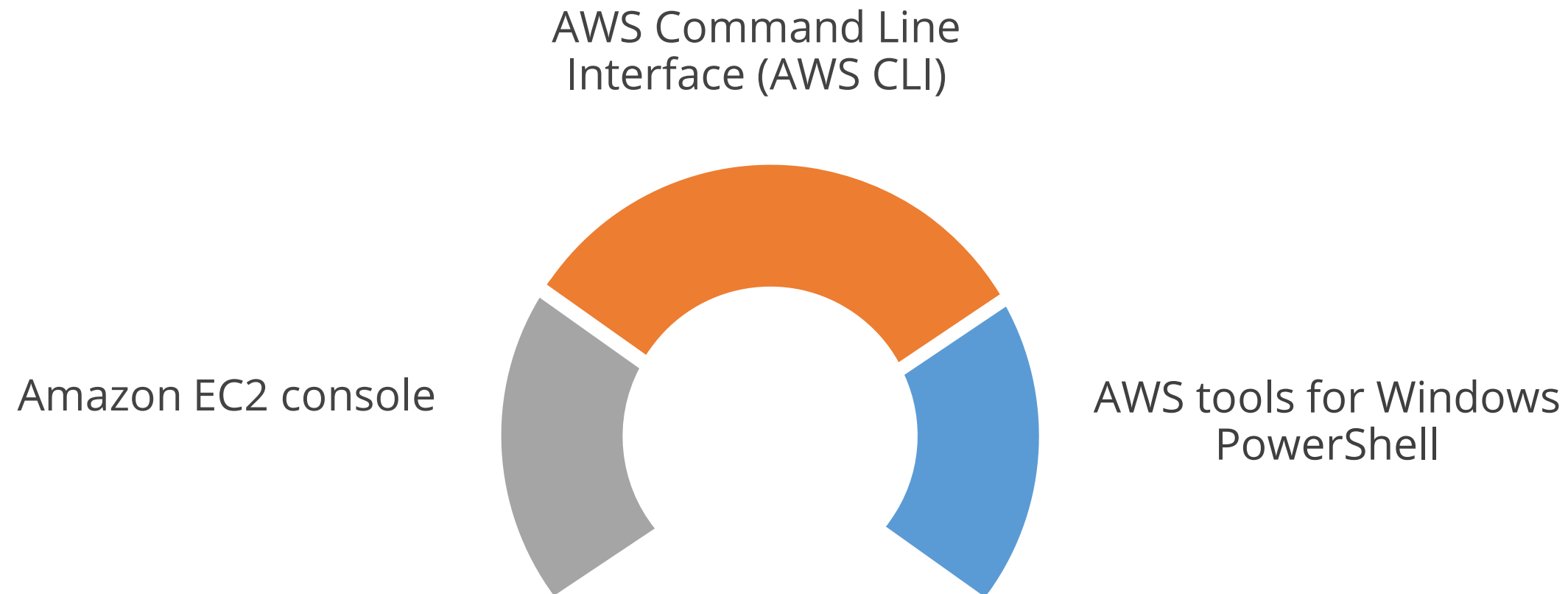
Note

There is a default limit of five Elastic IP addresses per region.

Elastic IP Address Overview

To allocate and associate an Elastic IP address with the EC2 Windows or Linux instance, follow these steps:

01	Allocate an Elastic IP address from either Amazon's pool of public IPv4 addresses or a custom IP address pool that the users bring to their AWS account

02	Associate the Elastic IP address with a running instance

Note

The user can also disassociate an existing Elastic IP address, and then reassociate it with a different instance.

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Elastic IP Address Overview

- An Elastic IP address can be associated with a single instance or network interface at a time.

- The user can move an Elastic IP address from one instance or network interface to another.

- Elastic IP addresses for IPv6 are not supported.

- An Elastic IP address is accessed through the internet gateway of a Virtual Private Cloud (VPC).

- A disassociated Elastic IP address remains allocated to the account until the user explicitly releases it.

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Elastic Public IP Address Overview

The users cannot manually associate or disassociate a public IP address from their instance. AWS releases the public IP address from their instance, or assigns it a new one in the following cases:

- AWS releases the instance's public IP address when it is stopped, hibernated, or terminated. The stopped or hibernated instance receives a new public IP address when it is started.

- AWS releases the instance's public IP address when the user associates an Elastic IP address with it. When the user disassociates the Elastic IP address from the instance, it receives a new public IP address.

- If the public IP address of the instance in a VPC has been released, it will not receive a new one if there is more than one network interface attached to the instance.

- If the instance's public IP address is released while it has a secondary private IP address that is associated with an Elastic IP address, the instance does not receive a new public IP address.

EC2 Instance Metadata

EC2 Instance Metadata

- Instance metadata is data about your instance that you can use to configure or manage the running instance.

- Instance metadata is divided into categories such as hostname, events, and security groups.

- You can also use instance metadata to access user data that you specified while launching your instance.

Note

- Metadata is the information about the EC2 instance.

- User data is the launch script of the EC2 instance.

EC2 Instance Metadata

You can access instance metadata from a running instance using one of the following methods:

- Instance Metadata Service Version 1 (IMDSv1) – a request/response method

- Instance Metadata Service Version 2 (IMDSv2) – a session-oriented method

To view all the categories of instance metadata from within a running instance, use the following URL:

IMDSv1	IMDSv2
curl http://169.254.169.254/latest/meta-data/	TOKEN=`curl -X PUT "http://169.254.169.254/latest/api/token" -H "X-aws-ec2-metadata-token-ttl-seconds: 21600"` \ && curl -H "X-aws-ec2-metadata-token: $TOKEN" -v http://169.254.169.254/latest/meta-data/

Instance Metadata Categories

The different categories of instance metadata are:

ami-id
ami-launch-index
ami-manifest-path
block-device mapping/
hostname
iam/
instance-action
instance-id
instance-type
local-hostname
local-ipv4
mac
metrics/
network/
placement/
profile
public-hostname
public-ipv4
public-keys/
reservation-id
security-groups
services/

Elastic File System

Elastic File System (EFS)

Amazon Elastic File System (Amazon EFS) provides a simple, scalable, fully manageable elastic NFS file system for use with AWS Cloud services and on-premises resources.

Amazon EFS

Elastic File System (EFS) Overview

EFS supports Network File System Version 4.0 and 4.1 protocol (NFSv4).

With Amazon EFS storage, you pay only for what you use.

With EFS, the data is stored and accessed from all the Availability Zones in the AWS region.

Benefits of Elastic File System (EFS)

POSIX-compliant shared file storage

Fully manageable

Scalable performance

Here are some benefits of EFS

Cost-effective

Dynamic elasticity

Security and compliance
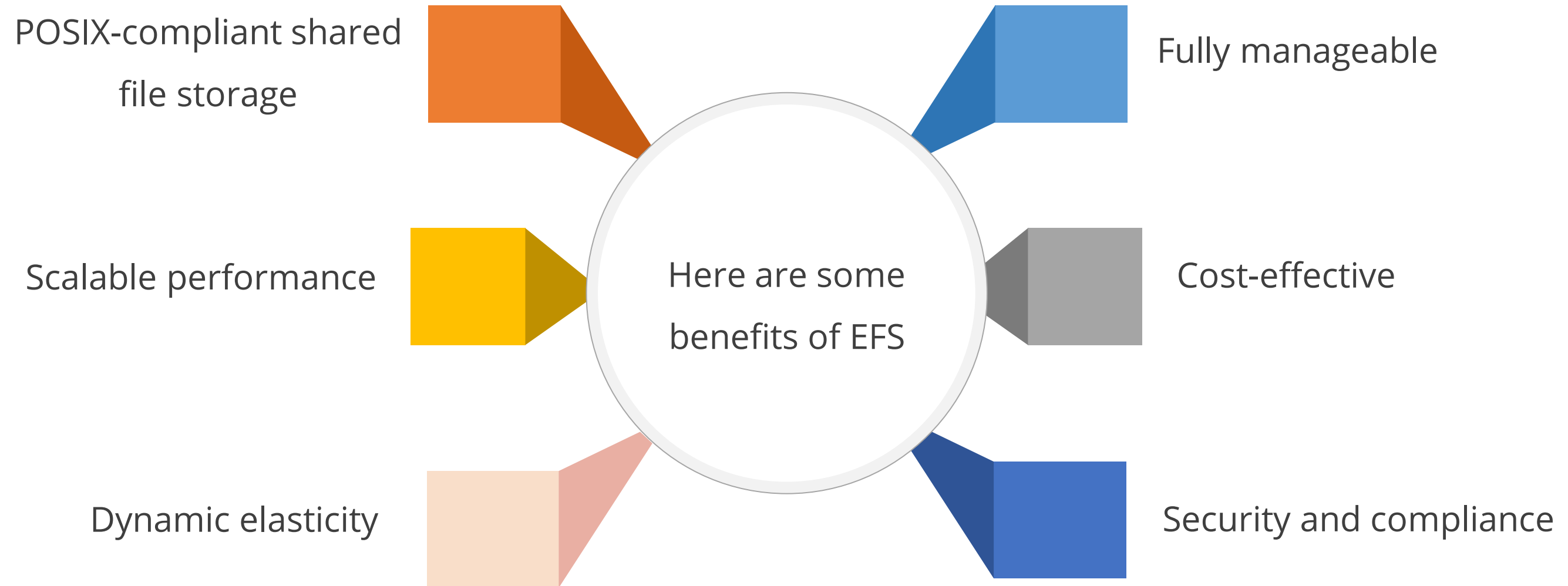
How Amazon EFS Works with Amazon EC2

The following illustration shows an example of VPC accessing an Amazon EFS file system:

Source: https://docs.aws.amazon.com/efs/latest/ug/how-it-works.html
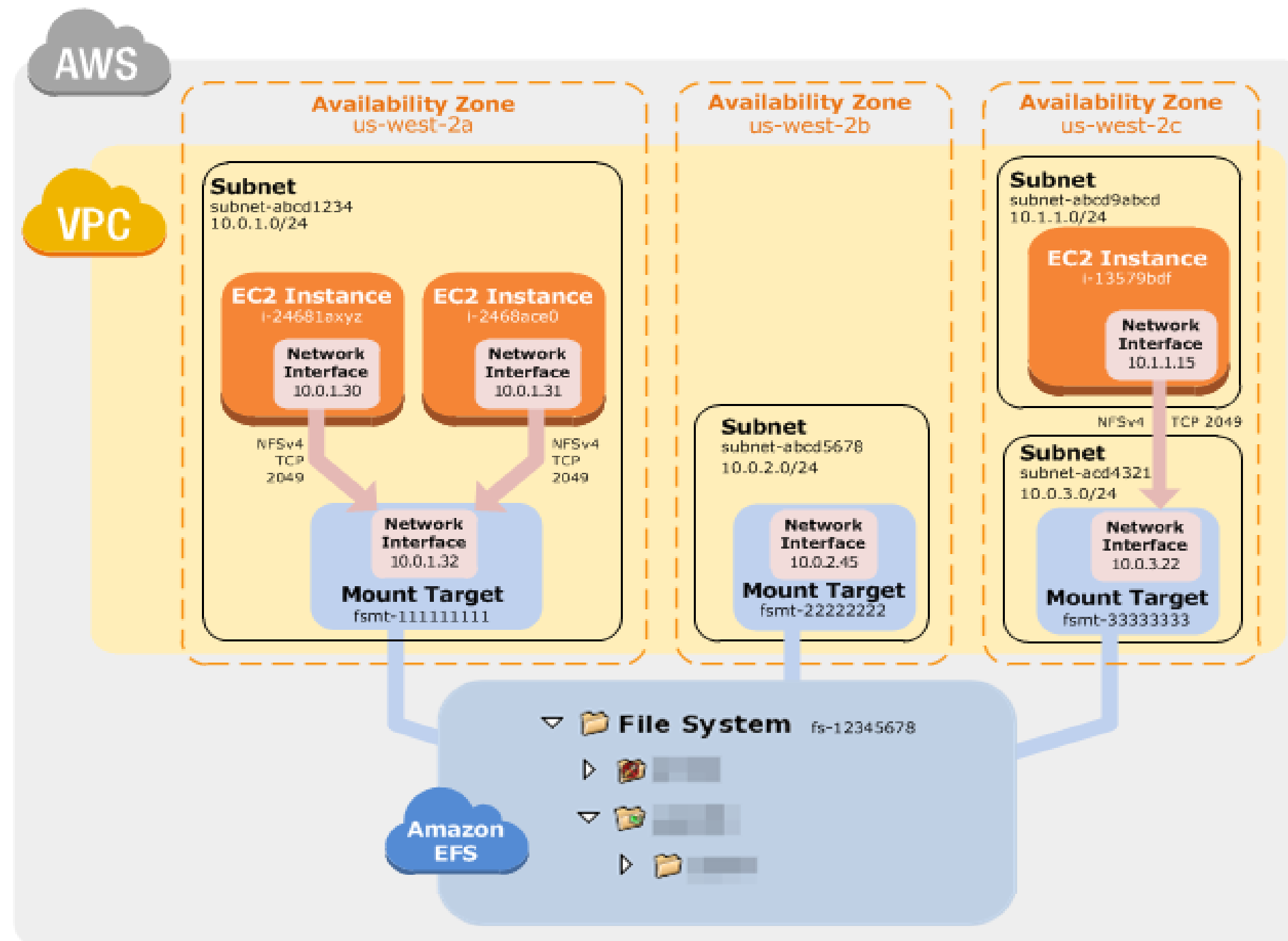
Difference between EFS and EBS

EFS vs. EBS

Feature	EFS	EBS
Storage Size	No limitations	Maximum 16 TiB
Storage Type	Object storage	Block storage
Performance	Scalable	Hardly scalable
File Size Limitation	Maximum file size 47.9 TiB	No limitation
Data Throughput	Default throughput of 3 GB	SSD- and HDD-backed storage types
Data Access	Can be accessed concurrently	Limited to single EC2 instance
Availability Zone (AZ) Failure	Can survive one AZ failure	Cannot withstand AZ failure without snapshots

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EC2 Instance Pricing

EC2 Instance Pricing

The following are the EC2 Instance pricing:

01 | On-Demand

02 | Spot

03 | Reserved

04 | Saving Plans

05 | Dedicated

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EC2 On-Demand instance pricing enables you to pay only for what you use with no long-term commitments.

Purchasing Options: On-Demand

On-Demand Instances are recommended for:

Users who prefer the low-cost and flexibility of Amazon EC2 without any up-front payment or long-term commitment

Applications with short-term, spiky, or unpredictable workloads that cannot be interrupted

Applications being developed or tested on Amazon EC2 for the first time

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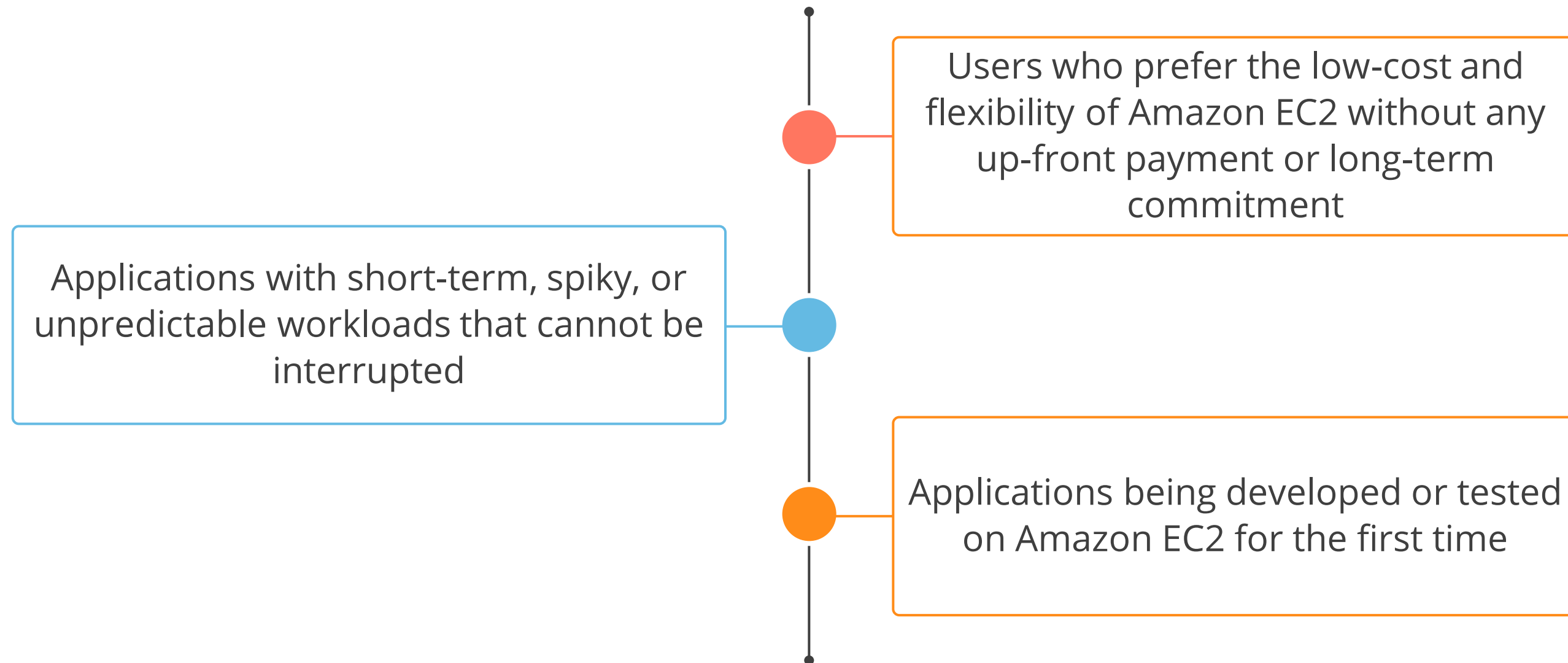
Purchasing Options: Spot

Amazon EC2 Spot Instances allow you to request spare computing capacity for up to 90% off the On-Demand price.

Spot Instances are recommended for:

Applications that have flexible start and end times

Applications that are only feasible at very low compute prices

Users with urgent computing needs for large amounts of additional capacity

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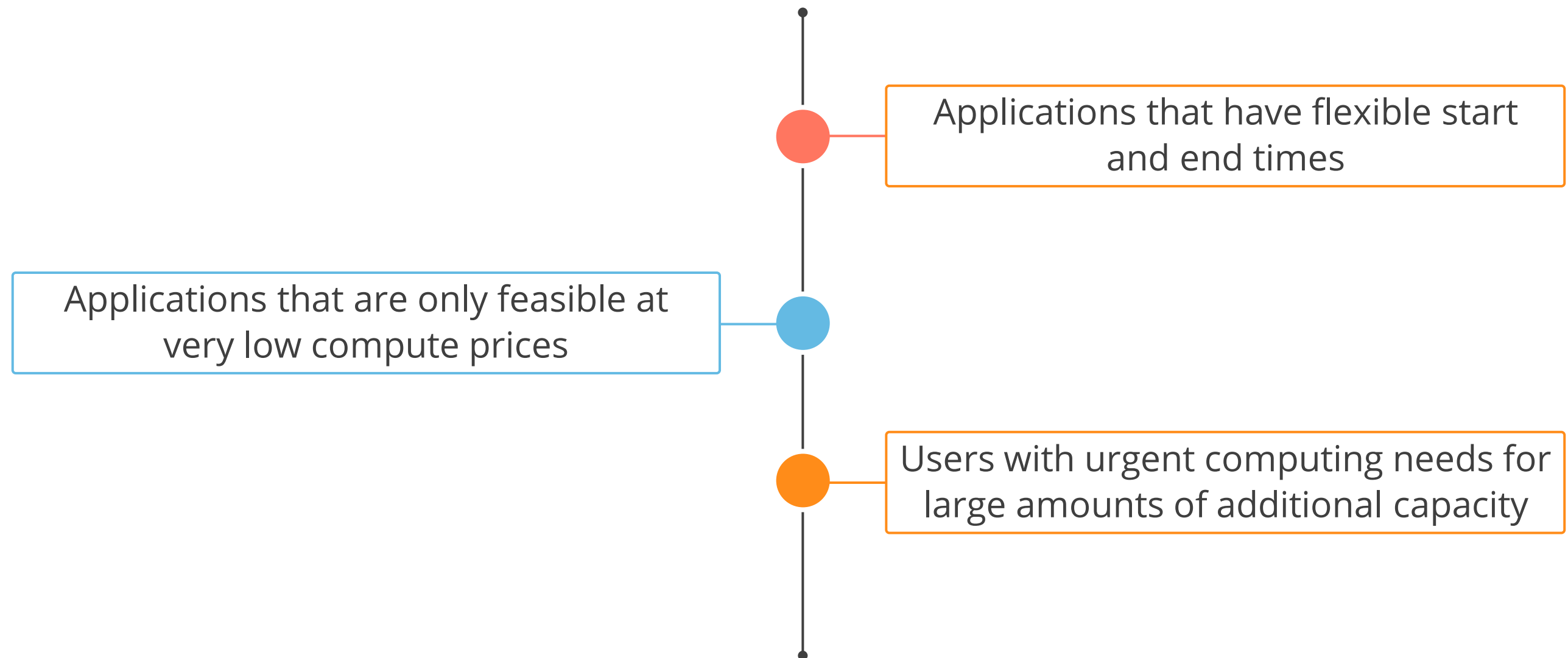
Purchasing Options: Reserved

Reserved Instances provide you with a significant discount (up to 75%) compared to On-Demand instance pricing.

Reserved Instances are recommended for:

Applications with steady state usage

Applications that may require reserved capacity

Customers that can commit to using EC2 over a one or three years term to reduce their total computing costs

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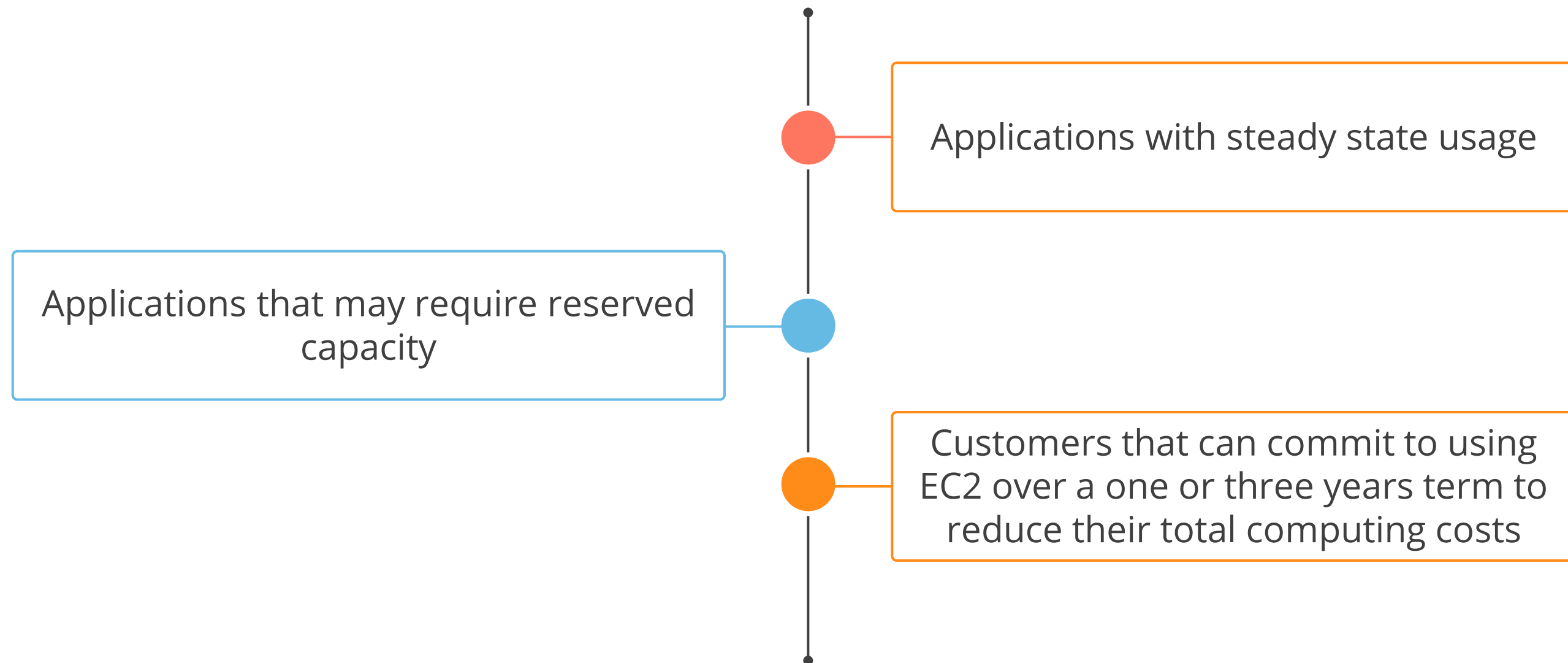
Purchasing Options: Savings Plans

Savings Plans are a flexible pricing model that offers low prices on EC2 usage, in exchange for a commitment to a consistent amount of usage (measured in $/hour), for a one or three year term.

Benefits of Savings Plans are:

Flexible

Significant savings

Easy to use
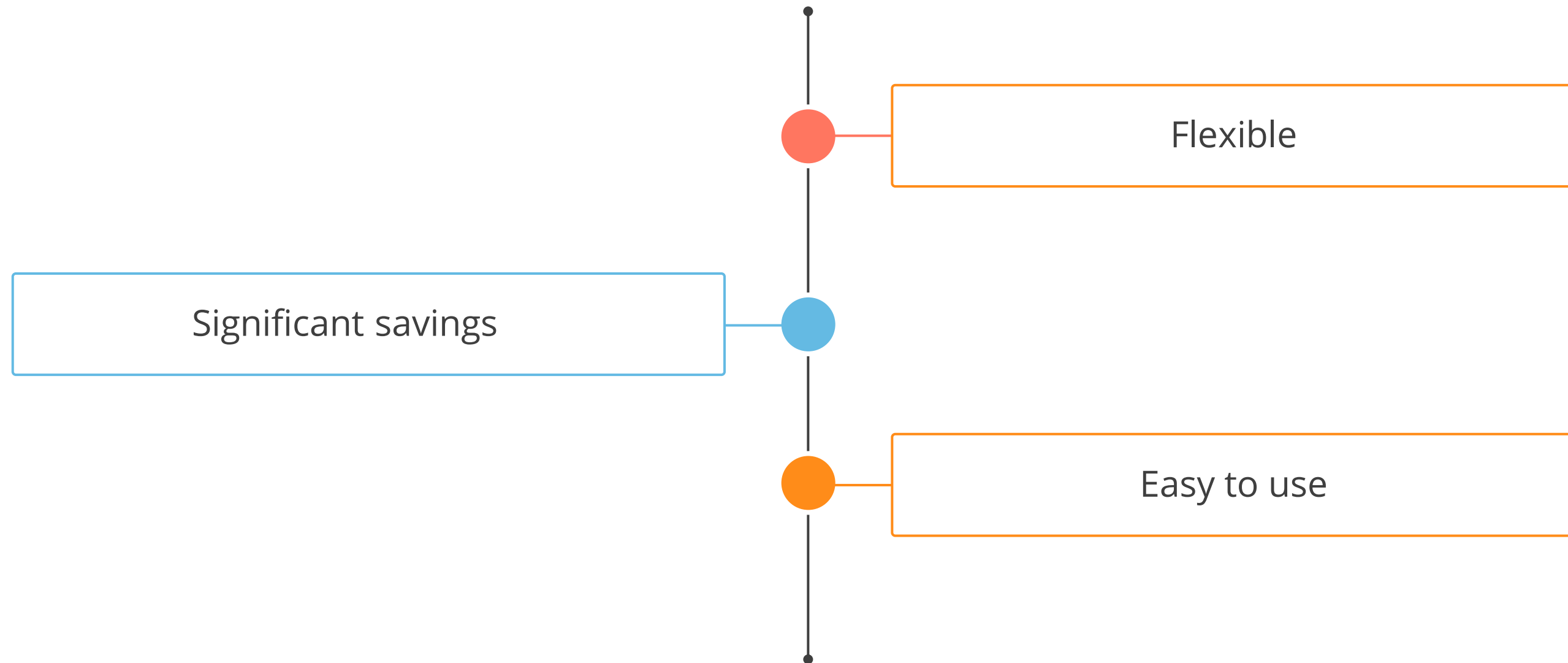
Purchasing Options: Dedicated

An Amazon EC2 Dedicated Host is a physical server with EC2 instance capacity fully dedicated to your use.

Dedicated Instances are recommended for:

Hourly On-Demand purchase

Reservation for up to 70% off the On-Demand price during the purchase

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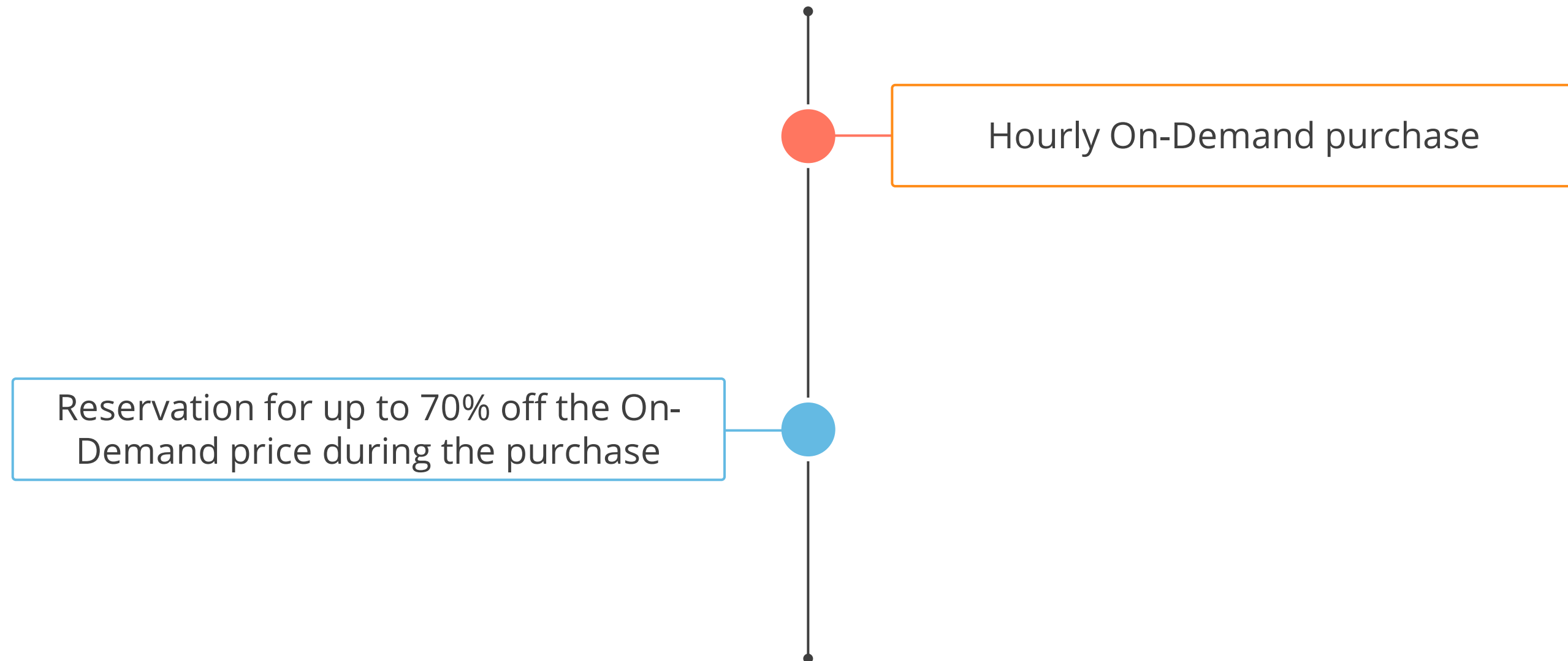
AWS EC2 Best Practices

AWS EC2 Best Practices

Storage

- Understand the implications of the root device type for data persistence, backup, and recovery

Resource Management

- Ensure that the volume with your data persists after instance termination

Backup and Recovery

- Use the instance store to store temporary data

- Encrypt EBS volumes and snapshots

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AWS EC2 Best Practices

Storage

Resource Management

- Use instance metadata and custom resource tags to track and identify your AWS resources

- View your current limits for Amazon EC2

Backup and Recovery

AWS EC2 Best Practices

Storage

Resource Management

Backup and Recovery

- Regularly back up your instance using Amazon EBS snapshots or a backup tool
- Deploy critical components of your application across multiple Availability Zones and replicate your data appropriately
- Design your applications to handle dynamic IP addressing while restarting your instance
- Monitor and respond to events
- Ensure you are prepared to handle failover
- Regularly test the process of recovering your instances and Amazon EBS volumes in case of failure

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Amazon FSx

Amazon FSx Overview

- Amazon FSx makes it easy and cost-effective to launch and run popular file systems.

- With Amazon FSx, you can leverage the rich feature sets and fast performance of widely-used open-source and commercially-licensed file systems.

- It provides cost-efficient capacity and high levels of reliability.

- It integrates with other AWS services so that you can manage and use the file systems in cloud-native ways.

Amazon FSx Overview

Benefits of Amazon FSx

- Simple and fully manageable
- Fast performance
- Available and durable
- Inexpensive
- Secure and compliant
- Integrated with AWS services
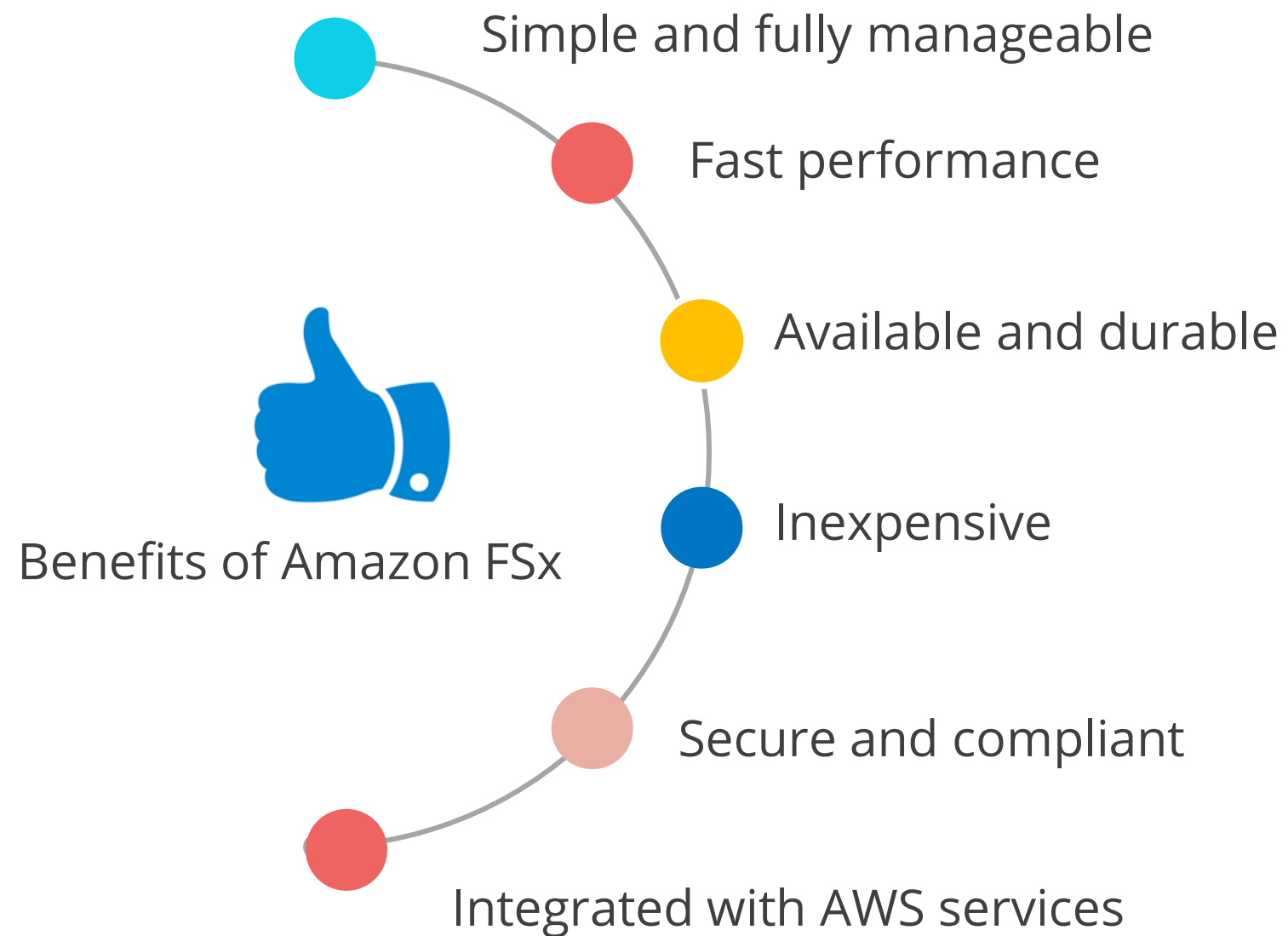
Types of Amazon FSx

Amazon FSx provides you with two file systems to choose from:

FSx

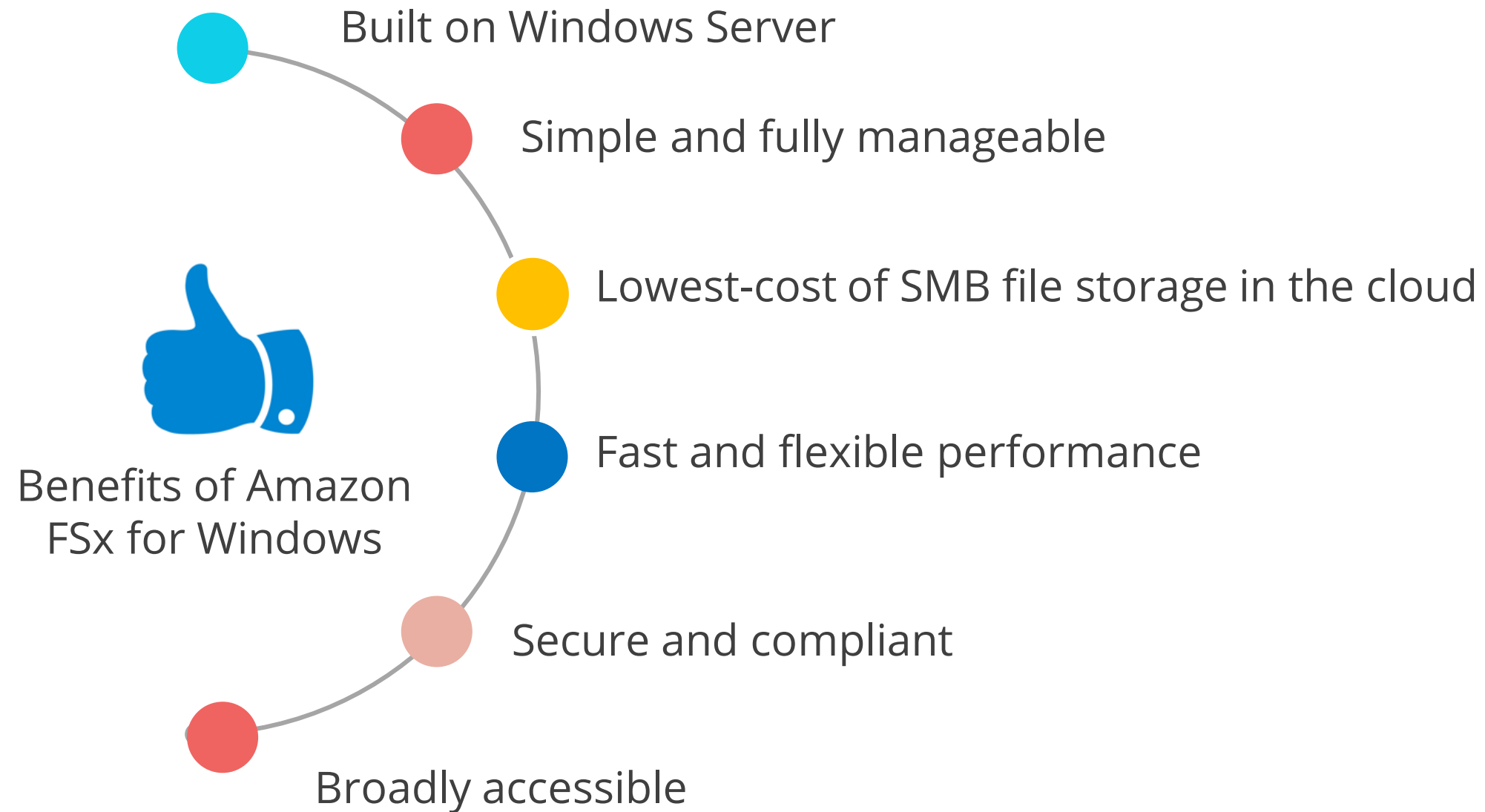Amazon FSx for Windows File Server for business applications

FSx

Amazon FSx for Lustre for high-performance workloads

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Amazon FSx for Windows

- Amazon FSx for Windows File Server provides fully managed, highly reliable, and scalable file storage that is accessible over the industry-standard Server Message Block (SMB) protocol.

- It is built on Windows Server, delivering a wide range of administrative features such as user quotas, end-user file restore, and Microsoft Active Directory (AD) integration.

- It offers single-AZ and multi-AZ deployment options, fully managed backups, and encryption of data at rest and in transit.

FSx

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Amazon FSx for Windows

Built on Windows Server

Simple and fully manageable

Lowest-cost of SMB file storage in the cloud

Fast and flexible performance

Benefits of Amazon FSx for Windows

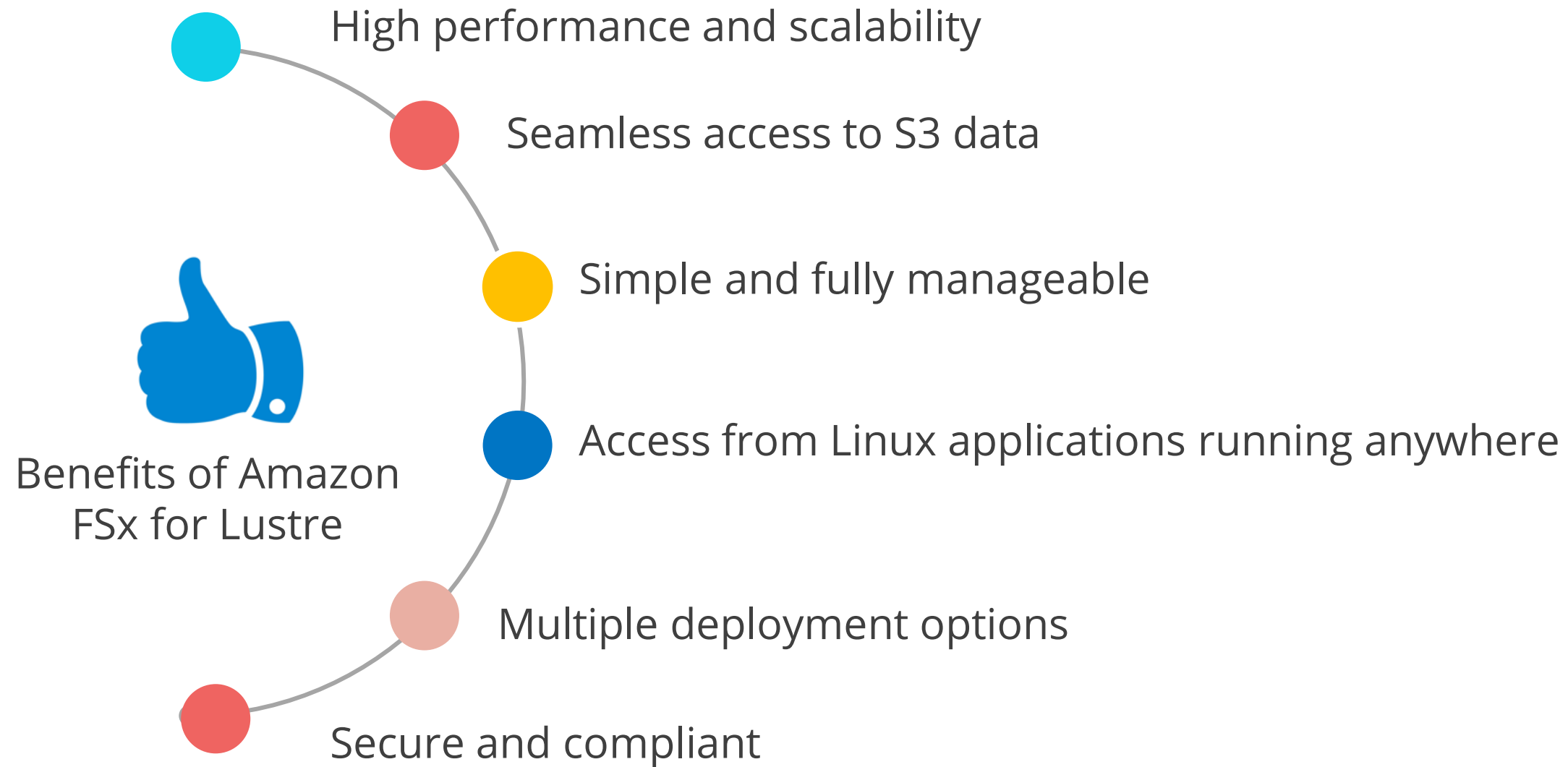Secure and compliant

Broadly accessible

Amazon FSx for Lustre

- Amazon FSx for Lustre makes it easy and cost-effective to launch and run the world's most popular high-performance file system.

- The open-source Lustre file system is designed for applications that require fast storage that can keep up with your computing performance.

- Amazon FSx enables you to use Lustre file systems for any workload where storage speed matters.

- Amazon FSx for Lustre integrates with Amazon S3, making it easy to use Lustre file system to access data sets.

Amazon FSx for Lustre

Benefits of Amazon FSx for Lustre

- High performance and scalability
- Seamless access to S3 data
- Simple and fully manageable
- Access from Linux applications running anywhere
- Multiple deployment options
- Secure and compliant

High Performance Computing (HPC)

High Performance Computing (HPC)

- AWS provides the most elastic and scalable cloud infrastructure to run your HPC applications.

- HPC on AWS removes the long wait times and lost productivity often associated with on-premises HPC clusters.

- The most compute-intensive workloads span the traditional HPC applications, like genomics, computational chemistry, financial risk modeling, computer-aided engineering, weather prediction, and seismic imaging, as well as emerging applications, like machine learning, deep learning, and autonomous driving.

- With access to a broad portfolio of cloud-based services like Data Analytics, Artificial Intelligence (AI), and Machine Learning (ML), you can redefine traditional HPC workflows to innovate faster.

HPC Benefits

Faster results

Flexible configurations

Cost-effective operations

HPC on AWS eliminates the wait times and long job queues often associated with limited on-premises HPC resources, helping you to get results faster.

HPC Benefits

Faster results

Flexible configurations

Cost-effective operations

Moving HPC workloads to the cloud can help increase productivity by matching the infrastructure configuration to the application.

HPC Benefits

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Cost-effective operations

There is no initial capital expenditure or long procurement periods for HPC on AWS. You pay only for the storage capacity you use, and AWS offers you with flexible pricing models which help you in significant cost savings when you process time-flexible, stateless workloads.

Key Takeaways

- Amazon Elastic Compute Cloud (Amazon EC2) is a web service that provides scalable computing capacity in the Amazon Web Services (AWS) cloud.

- An AMI is a virtual instance that includes a template, launch permissions, and a block device mapping.

- The storage categories of EBS are SSD-backed and HDD-backed.

- You can back up your EBS volumes by taking point-in-time snapshots and storing them on Amazon S3.

- EC2 On-Demand Instance pricing enables you to pay only for what you use with no long-term commitments.

Setting up an Instance with EBS Volume and Snapshot

Problem Statement:

As a developer, your development team has asked you to create a small Linux-based instance using a custom AMI for testing a new application.

Perform the following:

- Open the Amazon EC2 console
- Create a custom AMI
- Create the instance using a custom AMI
- Create an EBS Volume
- Attach an EBS Volume to a Linux Instance
- Create a Snapshot

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