



# AWS Cloud Foundations

Quan Phuong  
AWS Solutions Architect

Thanh Dang  
AWS Solutions Architect



# Best place to build. Best place to learn.

Our team of Solutions Architects deliver high-touch assistance to guide enterprise customers as they shift and incorporate AWS services into their architecture.

# Cloud Foundations



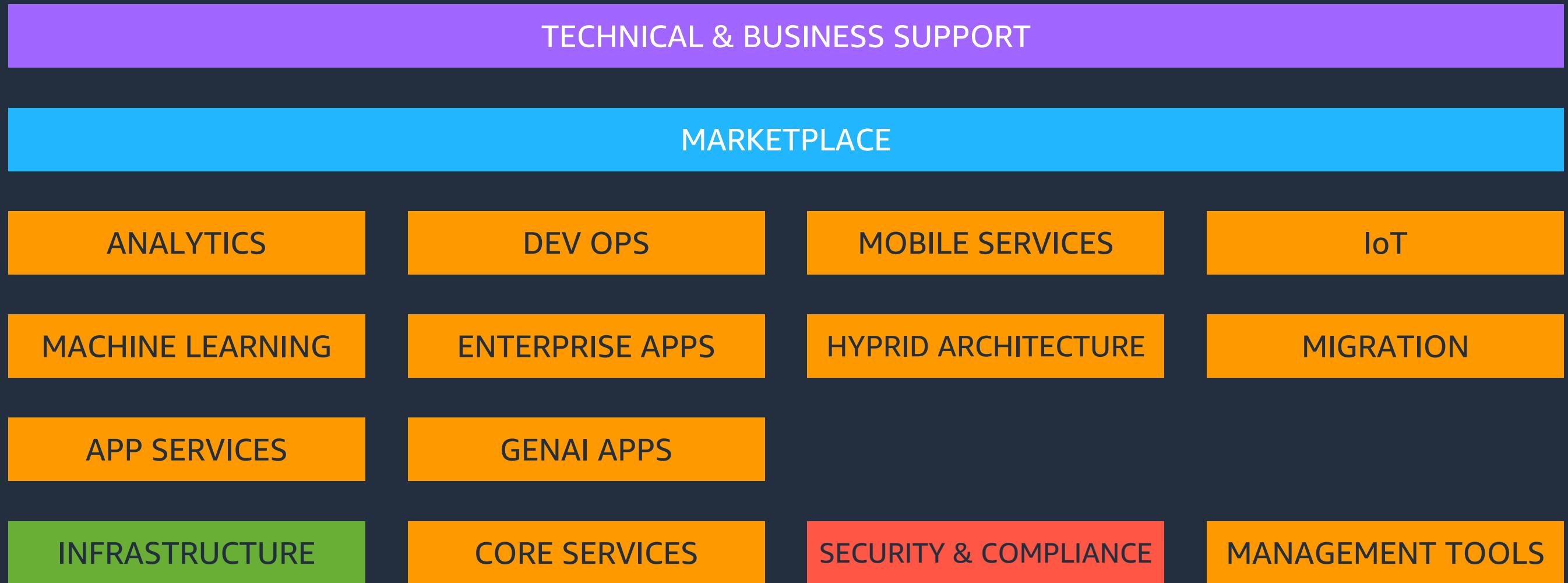
## WHAT IS CLOUD?

On-demand delivery of IT resources  
through the **Internet** with  
pay-as-you go pricing

# Introduction to AWS

The AWS logo, featuring the word "aws" in a white sans-serif font with a blue smiley arrow underneath.

# Broad and Deep Functionality



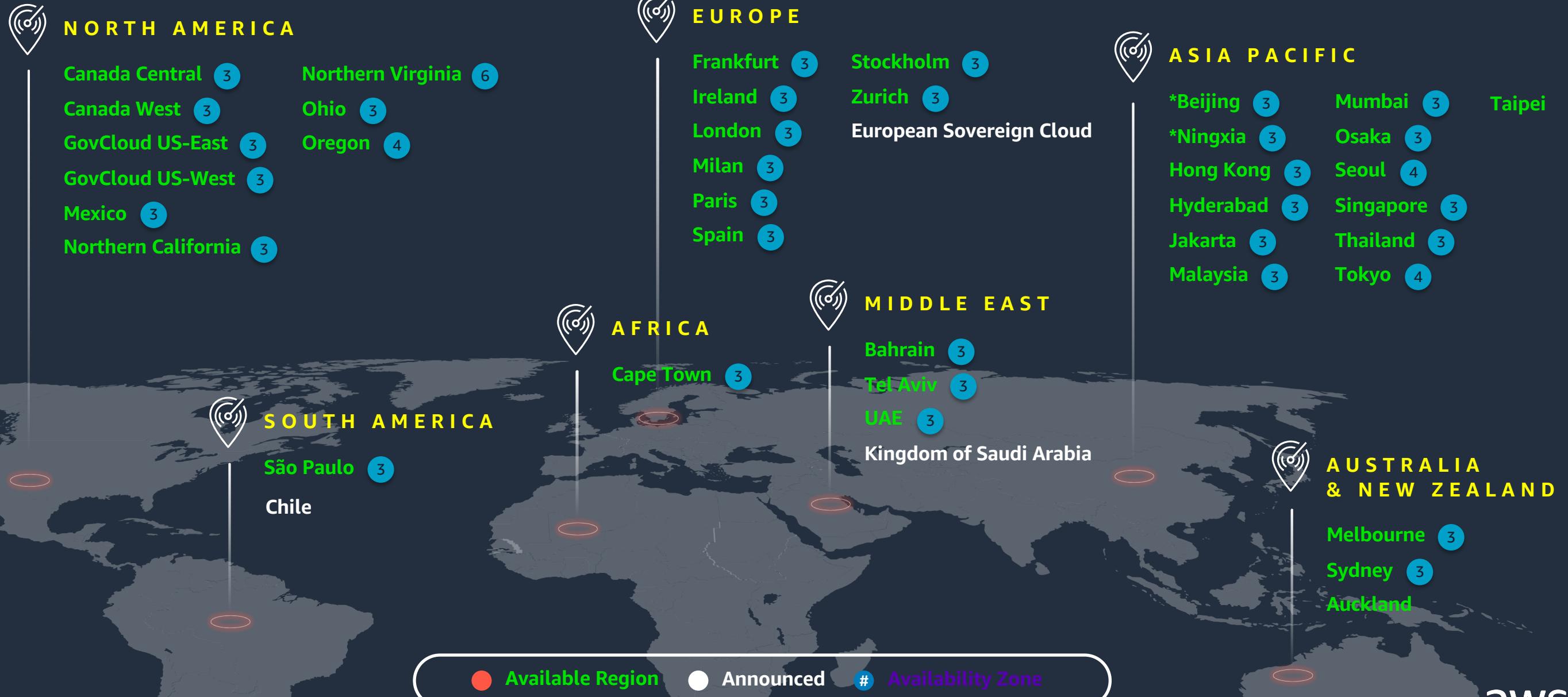
**200+**  
**SERVICES**

# Industry leaders are building on AWS



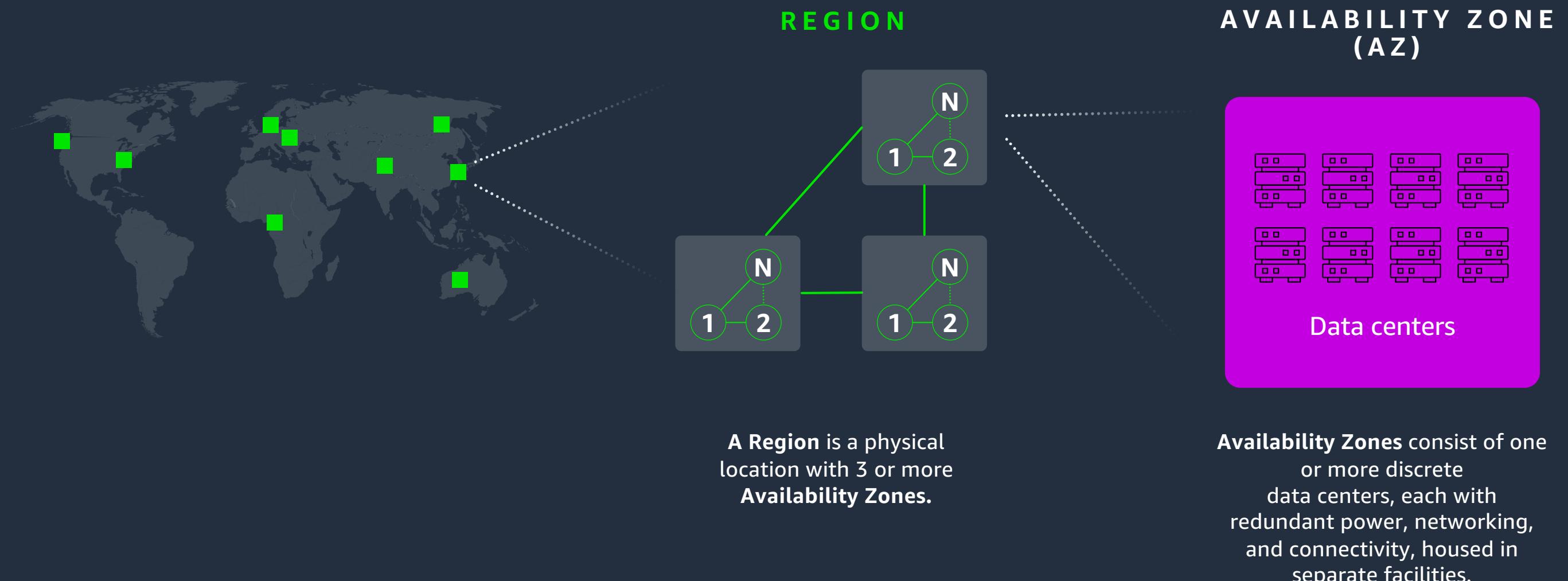
# AWS Global Infrastructure Regions & AZs

34 LAUNCHED REGIONS, 108 AVAILABILITY ZONES, AND 700+ POINTS OF PRESENCE

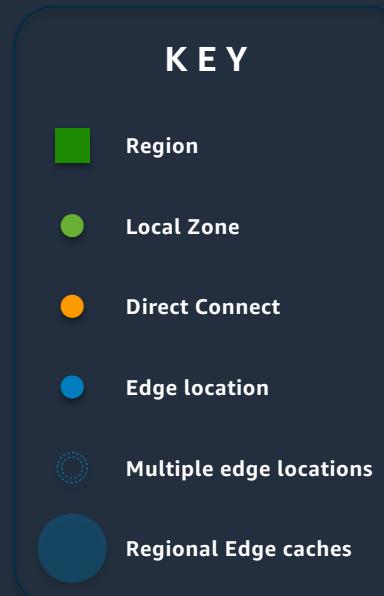


# AWS Region design

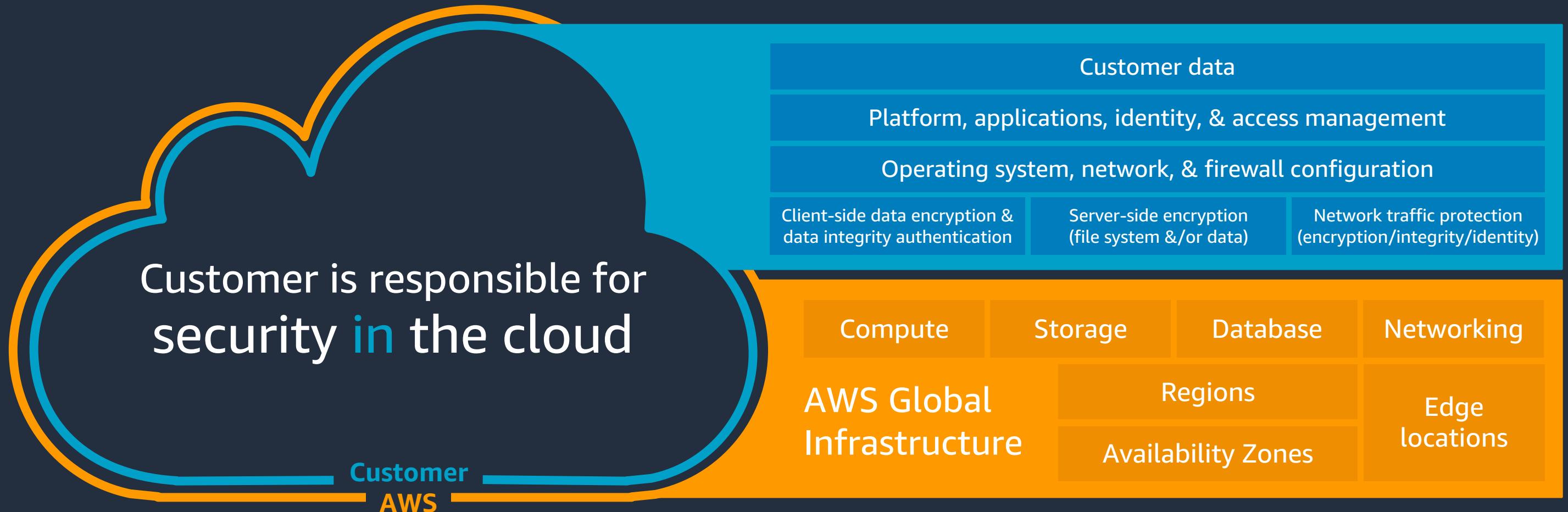
AWS Regions are comprised of multiple AZs for **high availability, high scalability, and high fault tolerance**. Applications and data are replicated in real time and consistent in the different AZs.



# AWS Global Infrastructure

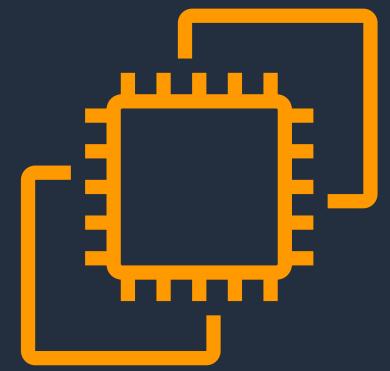


# Share your **security responsibility** with AWS



AWS is responsible for security **of** the cloud

# Foundational Services



Compute

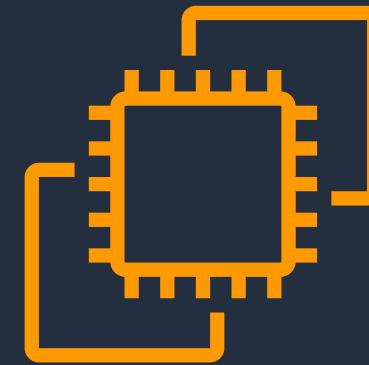


Storage



Database

# Computing on AWS



## Amazon EC2

Virtual server instances  
in the cloud



## Amazon ECS, EKS, and Fargate

Container management service  
for running  
containerized applications



## AWS Lambda

Serverless compute  
for stateless code execution in  
response to triggers

# Broadest and deepest portfolio of compute instances for virtually any workload

**OVER 850 INSTANCES**

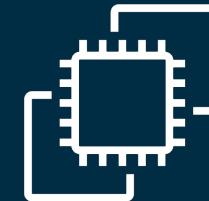
MORE THAN ANY OTHER CLOUD PROVIDER

Only cloud provider that supports Intel, AMD, Arm, and Apple processors

Only major cloud provider with on-demand macOS instances

Best price and performance for training ML models in EC2 with Trn2 instances

Lowest cost ML inference instances in EC2 with Inf2



**Amazon Elastic Compute Cloud  
(Amazon EC2)**

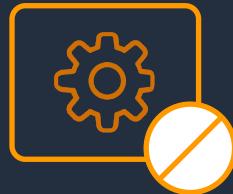
Graviton-based EC2 instances deliver up to 40% better price performance over x64-based EC2 instances

Fastest networking with Trn1 instances (3,200 Gbps)

Largest high memory instances for SAP (32 TiB of DDR5 memory and 896 vCPUs)

Largest local storage instances with D3en (336 TB)

# Computing on AWS: Serverless Introduction

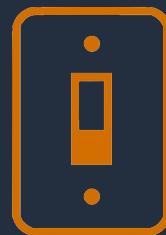


No infrastructure provisioning,  
no management



Automatic scaling

Pay for value



Highly available and secure

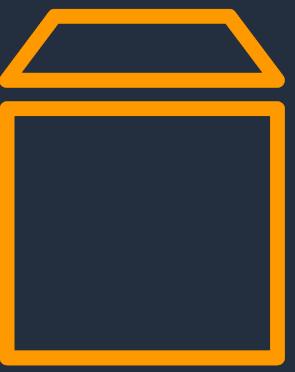


# Storage on AWS



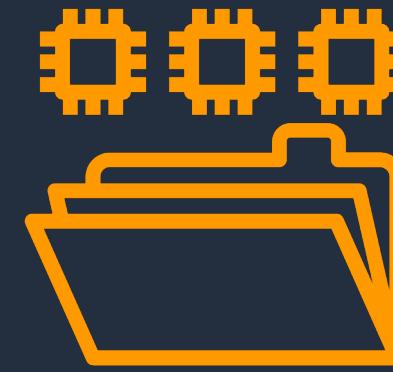
**S3**

Object storage built to store and retrieve any amount of data from anywhere



**EBS**

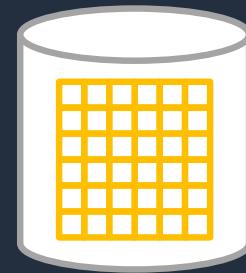
Easy to use, high performance block storage at any scale



**EFS**

Simple, serverless, set-and-forget, elastic file system

# Block vs File vs Object



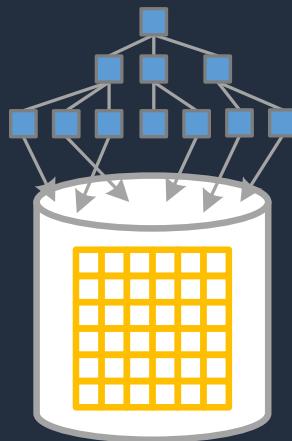
## Block Storage

Raw Storage

Data organized as an array of unrelated blocks

Host File System places data on disk

Ex: Hard Disks, Storage Area Network (SAN) Storage Arrays

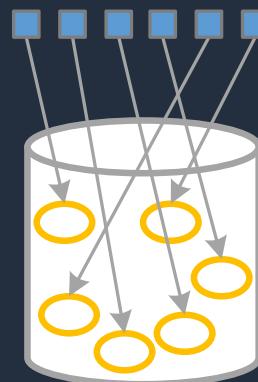


## File Storage

Unrelated data blocks managed by a file (serving) system

Native file system places data on disk

Ex: Network Attached Storage (NAS) Appliances, Windows File Servers, NetApp OnTap



## Object Storage

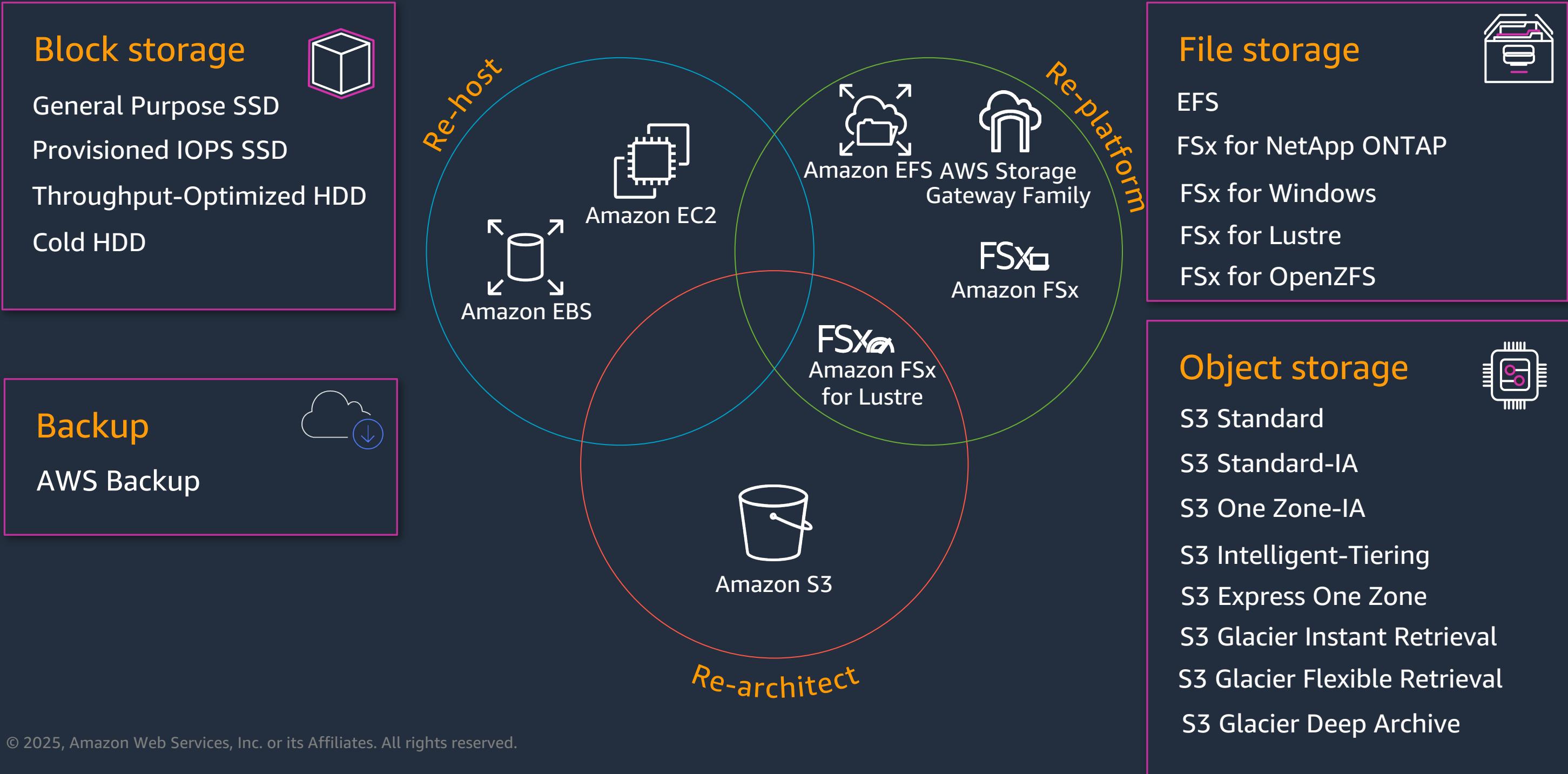
Stores Virtual containers that encapsulate the data, data attributes, metadata and Object IDs

API Access to data

Metadata Driven, Policy-based, etc.

Ex: Ceph, OpenStack Swift

# More choice for more applications

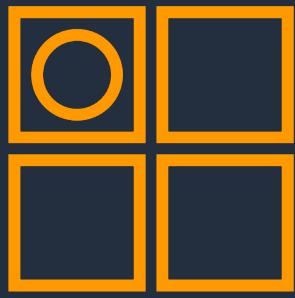


# Database on AWS



## RDS

Set up, operate, and scale a relational database in the cloud with just a few clicks



## DynamoDB

Fast and flexible NoSQL database service for any scale



## Redshift

Analyze all of your data with the fastest and most widely used cloud data warehouse

# Most complete set of relational and nonrelational databases

## Relational



Amazon  
Relational  
Database Service  
(Amazon RDS)



Amazon  
Aurora

### COMMERCIAL

IBM Db2 Microsoft SQL Server

Oracle

### COMMUNITY



PostgreSQL



## Nonrelational

### KEY VALUE



Amazon  
DynamoDB

### DOCUMENT



Amazon  
DocumentDB

### CACHING



Amazon  
ElastiCache

### GRAPH



Amazon  
Neptune

### TIME SERIES



Amazon  
TimeStream

### LEDGER



Amazon  
Quantum  
Ledger Database  
(Amazon QLDB)

### WIDE COLUMN



Amazon  
KeySpaces

### MEMORY



Amazon  
MemoryDB

# Additional: Most comprehensive set of analytics services

## INTERACTIVE QUERY



Amazon  
Athena

## BIG DATA PROCESSING



Amazon  
EMR

## REAL-TIME ANALYTICS



Amazon Kinesis  
Amazon Managed  
Streaming Service  
for Apache Kafka  
(Amazon MSK)

## DATA WAREHOUSING



Amazon  
RedShift

## DATA INTEGRATION



AWS  
Glue

## BUSINESS INTELLIGENCE



Amazon  
QuickSight

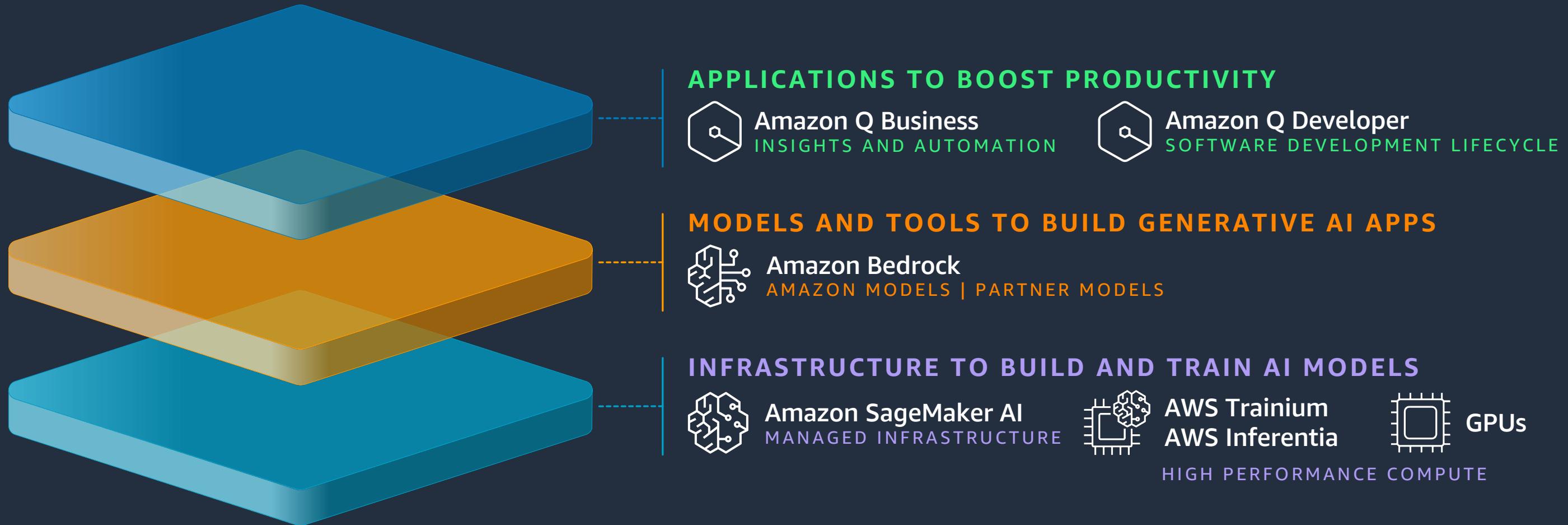
## OPERATIONAL ANALYTICS



Amazon  
OpenSearch Service

AWS has serverless options for all of its analytics services.  
No other cloud provider can say this.

# Additional: AWS Generative AI Stack



# Identity and Access Management



# What is IAM?



**Manage users and  
their access**



**Manage roles and  
their permissions**



**Manage federated  
users and their  
permissions**



# Principle of Least Privilege

**\*What area customer wants to learn about\* on AWS**



# Get Started on AWS

The AWS logo, featuring the word "aws" in a white sans-serif font with a blue smiley arrow underneath.

# Get Started

## New Account

Create your own AWS account

# Identity overview: Who can access what

**Who**



**Developers and applications**

**Can access**



**Permissions**

**What**



**Resources**

# Types of identities



Humans are developers,  
business analysts, data  
scientists, etc.

and



Workloads are CI/CD pipelines,  
applications, infrastructure, etc.

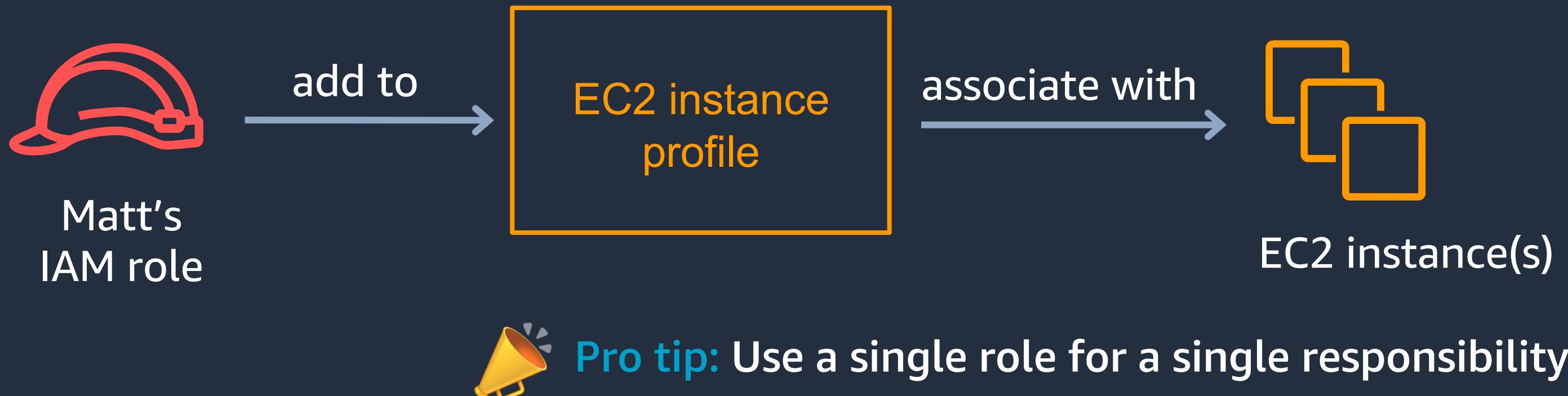
# Why use an identity provider for human access?

- 1 Centralize user stores
- 2 Reduce password fatigue
- 3 Decrease the number of systems to secure
- 4 Ease of auditing



# Temporary credentials: Workloads on AWS

- 💡 Prefer IAM roles (temporary credentials) to IAM users (long-term credentials)
- 💡 Use native IAM role integrations with AWS services

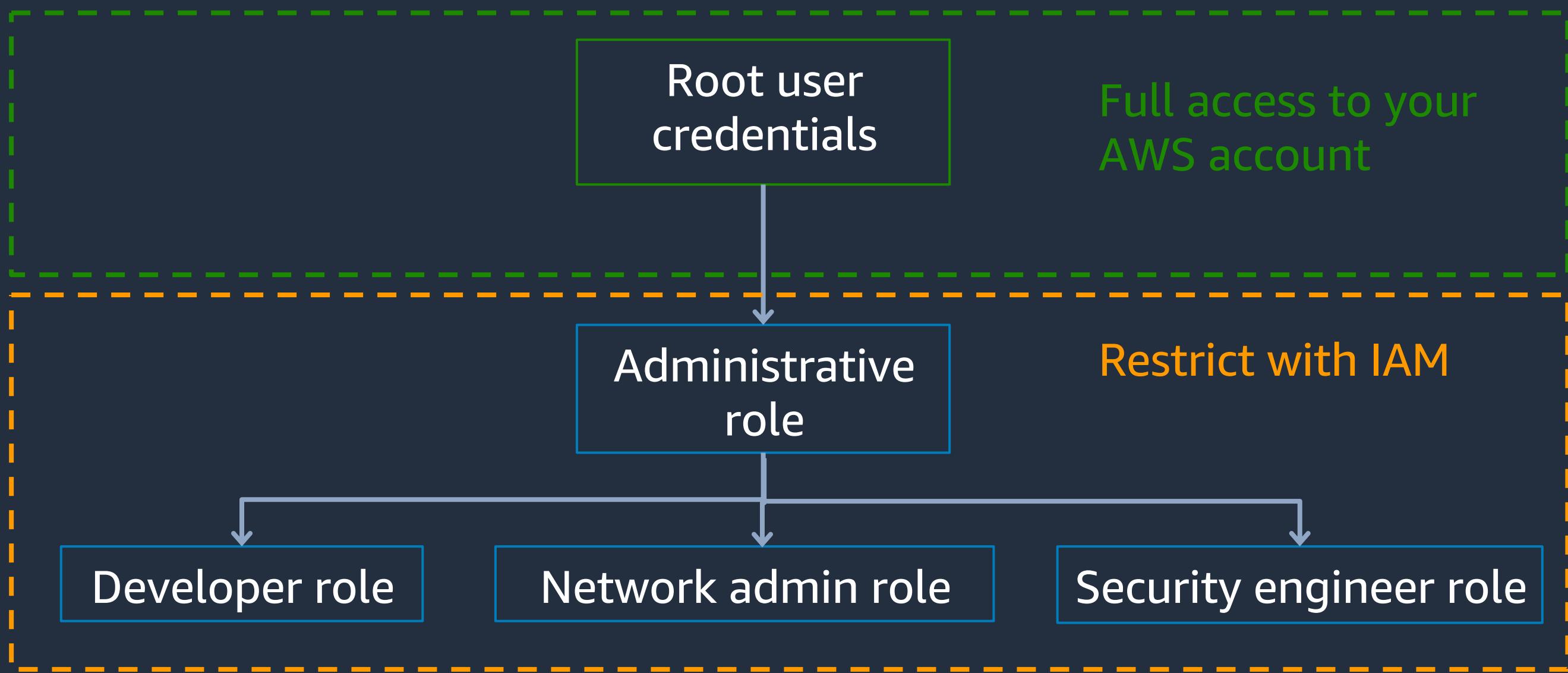


# Require multi-factor authentication (MFA)



# Why limit use of root credentials?

Requires long-term credentials that have full access to your AWS account

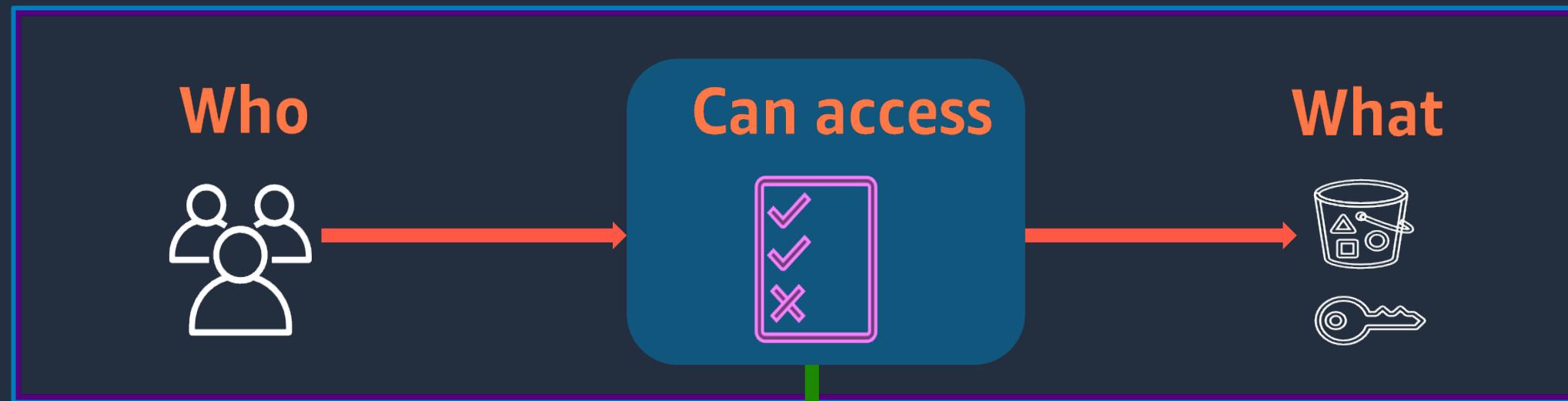


# Get Started

## Limit Permissions

Limit permissions granted for  
human/workloads

# Focus on access in AWS



Your job:  
**Specify**



AWS job:  
**Enforce**



**Access control**

# Apply least-privilege permissions



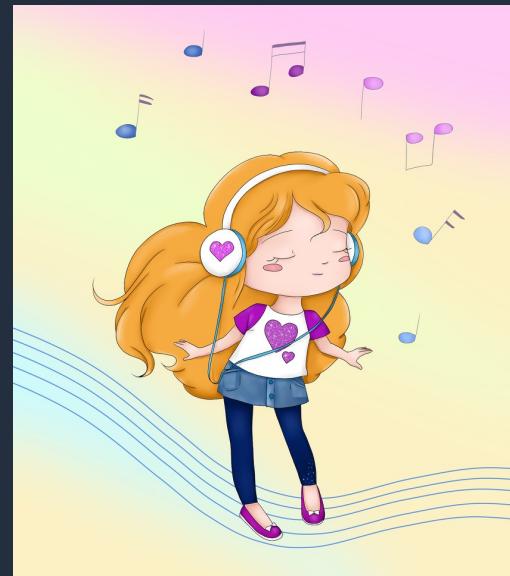
# Least privilege is a journey

## Exploring AWS



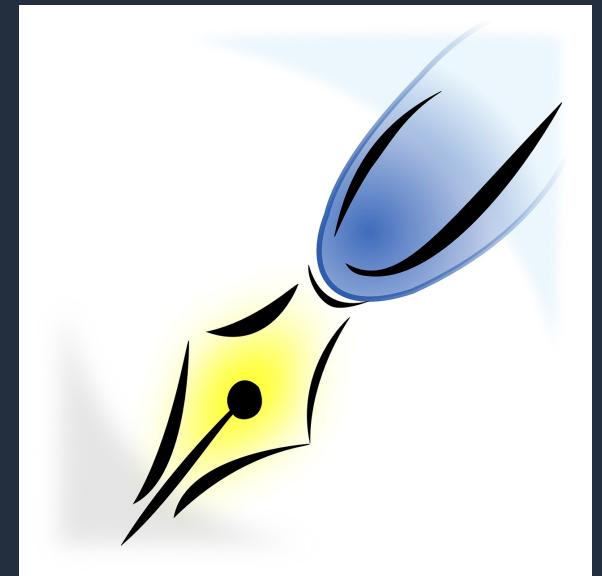
Start broader with AWS managed policies or custom templates

## Right-sizing



Generate and customize by using policy generation with IAM Access Analyzer

## Specifying conditions



Author custom policies and validate them by using policy validation with IAM Access Analyzer

**Use conditions in IAM policies  
to further restrict access**



# Fine-grained access controls with conditions

 Grant access to these actions, **but only if** these conditions are met

 Grant access to actions and resources, **but only if** the access request meets specific conditions

 Allow create Lambda function, **but only if** using AWS CloudFormation

 Allow create Lambda function, **but only if** in a VPC

# IAM Access Analyzer: Policy generation

Helps you get to the **right permissions more quickly** by analyzing your access activity in AWS CloudTrail



Run your application or task



Request a policy from IAM Access Analyzer



IAM Access Analyzer gets to work



Customize further and apply

Generated policy

Review and create managed policy

Review the permissions summary, add tags, and create the generated policy as a customer managed policy

Name\*

Use alphanumeric and '+=\_,@\_-' characters. Maximum 128 characters.

Description

Maximum 1000 characters. Use alphanumeric and '+=\_,@\_-' characters.

Summary

Service	Access level	Resource
Allow (7 of 299 services) Show remaining 292		
CloudFormation	Limited: List	StackName   string like   All
CloudWatch Logs	Limited: Write	LogGroupName   string like   All
EC2	Limited: List	All resources
Resource Group Tagging	Limited: Read	All resources
Resource Groups	Limited: List	arn:aws:resource-groups:us-west-2:group/Pickles-Pasture
S3	Limited: Read	BucketName   string like   All
Secrets Manager	Limited: Read	arn:aws:secretsmanager:us-west-2:secret:*

# Cost Control on AWS Account



# Cost Explorer Overview



Free tool to view your AWS costs based on your usage



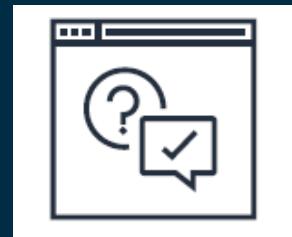
Monitor & Optimize your spend within AWS



Uses the same data-set used to generate the AWS CUR



View costs retroactively (last 12 months + current)



- RI/SP utilization & coverage reports
- RI/SP Expiration Alerts
- RI/SP Recommendations



- Analyze Your Costs in CSV
- Analyze Your Linked accounts spend



- Generate CE Reports based on Tags
- EC2 Rightsizing Recommendations

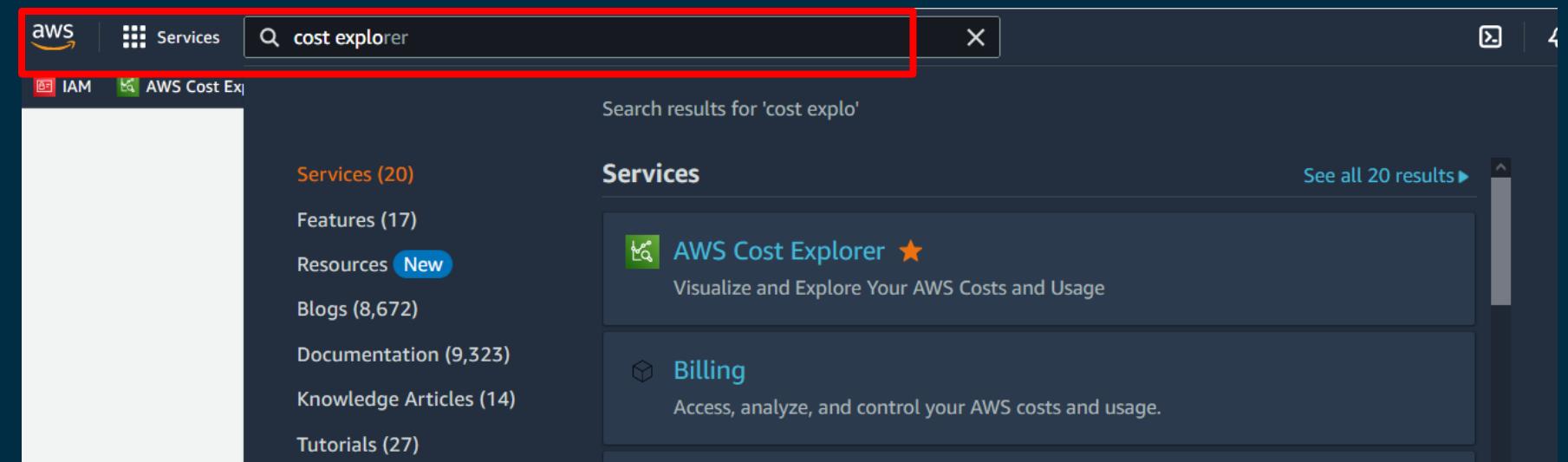


Forecast usage-based spend for the next 3 / 12 months

# How to access the Cost Explorer?

## Option 1:

Use the Search engine in the AWS Console to find AWS Cost Explorer in the Services section



## Option 2:

Open the Billing Dashboard and click on Cost Explorer on the left panel

A screenshot of the AWS Billing Dashboard. On the left, there is a navigation menu with options: Home, Billing, Bills, Payments, Credits, Purchase orders, Cost & usage reports, Cost categories, Cost allocation tags, Free tier, Billing Conductor, Cost Management, and Cost explorer. A large red box highlights the 'Cost explorer' option. On the right, the main content area displays the AWS Billing Dashboard with various metrics. A red box highlights the 'Billing Dashboard' link in the top right corner of the dashboard area. To the right of the dashboard, there is a sidebar with account information and a red box highlighting the 'Billing Dashboard' link under the 'Service Quotas' section. The number '3' is displayed next to the left panel navigation menu, and the number '2' is displayed next to the sidebar.

# Cost Explorer Features – Home page

AWS Cost Management X

Home

Cost Explorer

Reports

Budgets

Cost Anomaly Detection

Rightsizing recommendations

Savings Plans

Overview

Inventory

Recommendations

Purchase Savings Plans

Utilization report

Coverage report

Cart 0

Reservations

Overview

Recommendations

Utilization report

Coverage report

Preferences

Billing Console ↗

Documentation ↗

AWS Cost Management > Home

## Home Info

**1**

### Cost summary

Current month costs [Info](#)

\$142,248.62

Down 26% over last month

Forecasted month-end costs [Info](#)

\$198,879.03

Down 15% over last month

**2**

### April trends [Info](#)

Service usage

Amazon Managed Service for Prometheus costs are up \$946.76 (33%)

AWS Shield costs are up \$734.78 (32%)

AmazonCloudWatch costs are up \$598.46 (8%)

m5.2xlarge costs are up \$261.18 (5%)

t3.medium costs are up \$93.94 (5%)

Account usage

paas-infrastructure-services-dev (488753766243) costs are up \$394.34 (18%)

Telenor-se-prod (014413428939) costs are up \$511.06 (5%)

Reservations

You could have saved ~\$568.75 in the last 30 days if you purchased additional EC2 RIs.

### Daily unblended costs

Cost (\$ in thousands)

View in Cost Explorer

Mar 04 Mar 08 Mar 12 Mar 16 Mar 20 Mar 24 Mar 28 Apr 01 Apr 05 Apr 09 Apr 13 Apr 17 Apr 21

# Cost Explorer Features - Cost and Usage Reports

AWS Cost Management

- Home
- Cost Explorer**
- Reports
- Budgets
- Cost Anomaly Detection
- Rightsizing recommendations

▼ Savings Plans

- Overview
- Inventory
- Recommendations
- Purchase Savings Plans
- Utilization report
- Coverage report
- Cart 0

▼ Reservations

- Overview
- Recommendations
- Utilization report
- Coverage report

Preferences

Billing Console

Documentation

AWS Cost Management > Cost Explorer > New cost and usage report

## New cost and usage report

Cost and usage graph Info

Total cost \$854,467.68

Average monthly cost \$142,411.28

Service count 72

Costs (\$)

Oct 2022 Nov 2022 Dec 2022 Jan 2023 Feb 2023 Mar 2023

VPC EC2-Other Relational Database Service Network Firewall EC2-Instances CloudWatch S3 DynamoDB Direct Connect Others

Cost and usage breakdown

Find cost and usage data

Service	Service total	October 2022	November 2022	December 2022	January 2023	February 2023	March 2023
Total costs	\$854,467.68	\$142,450.76	\$128,793.98	\$139,788.71	\$145,915.78	\$136,790.54	\$160,727.91
VPC	\$128,622.72	\$19,210.23	\$19,738.62	\$22,038.88	\$22,773.02	\$20,999.11	\$23,862.86

Recent reports ▾ Save to report library

Report parameters

Time Date Range 2022-10-01 — 2023-03-31 Displaying last 6 months Granularity Monthly

Group by Dimension Service

Filters Info Applied filters (2) Clear all Service Choose services Region Choose regions Charge type Charge types included (1) Usage Clear Billing entity Billing entities excluded (1) AWS Marketplace API operation Choose api operations

1 2 3 4

# Cost Explorer Features - Exporting Data Output

Total cost  
**\$194,610.42**

Average daily cost  
**\$6,950.37**

Service count  
**73**

**Costs (\$)**

Feb-02 Feb-04 Feb-06 Feb-08 Feb-10 Feb-12 Feb-14 Feb-16 Feb-18 Feb-20 Feb-22 Feb-24 Feb-26 Feb-28

Tax Savings Plans for Compute usage VPC Relational Database Service EC2-Other Premium Support EC2-Instances Network Firewall S3 Others

**Cost and usage breakdown**

Service	Service total
Total costs	\$194,610.42
Tax	\$38,623.26
Savings Plans for Compute usage	\$29,833.90
VPC	\$17,639.26

**Report parameters**

Time: Date Range (2023-02-01 — 2023-02-28), Granularity (Daily)

Group by: Dimension (Service)

Filters: Applied filters (0), Service (Choose services), Linked account (Choose linked accounts), Region (Choose regions), Instance type (Choose instance types), Usage type (Choose usage types), Usage type group (Choose usage type groups)

**Opening costs.csv**

You have chosen to open: costs.csv which is: Microsoft Excel Comma Separated Values File (32.2 KB) from: blob:

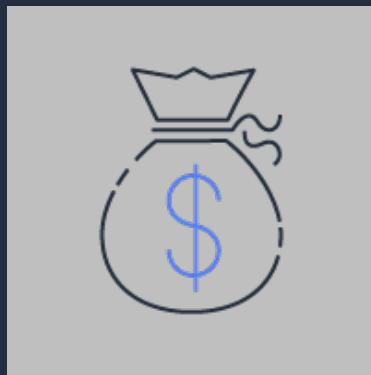
What should Firefox do with this file?

Open with Microsoft Excel (default)  
 Save File  
 Do this automatically for files like this from now on.

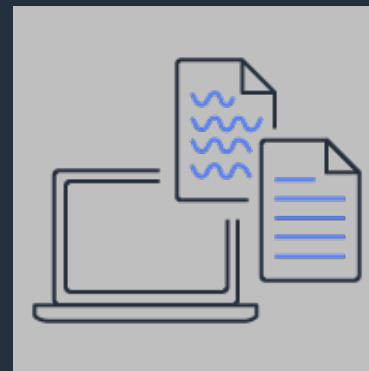
**Download as CSV**

Feb-06	Feb-07
\$4,985.78	\$5,133.53
-	-
\$1,065.50	\$1,065.50
\$638.21	\$649.57

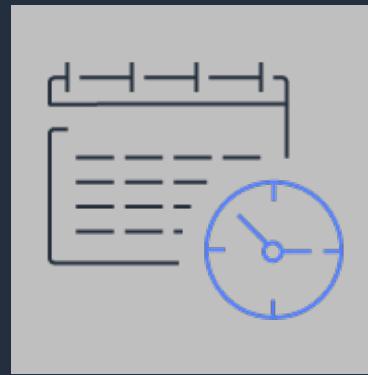
# AWS Budgets



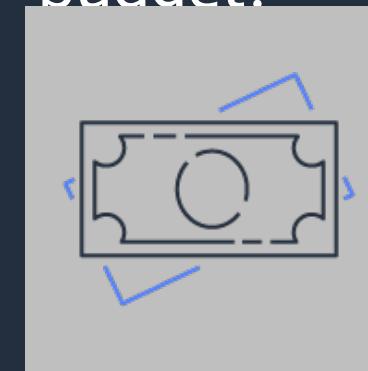
What is an AWS budget and how does it work?



How many alerts and subscribers can I add for each budget?



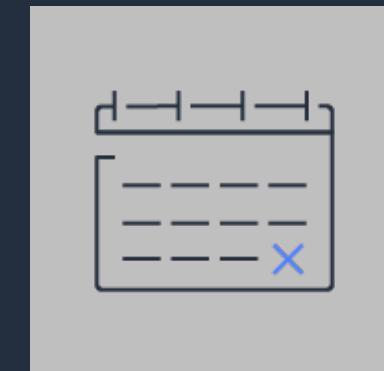
What kinds of dimensions can be used to create a budget?



Is there a cost associated with using AWS Budgets?



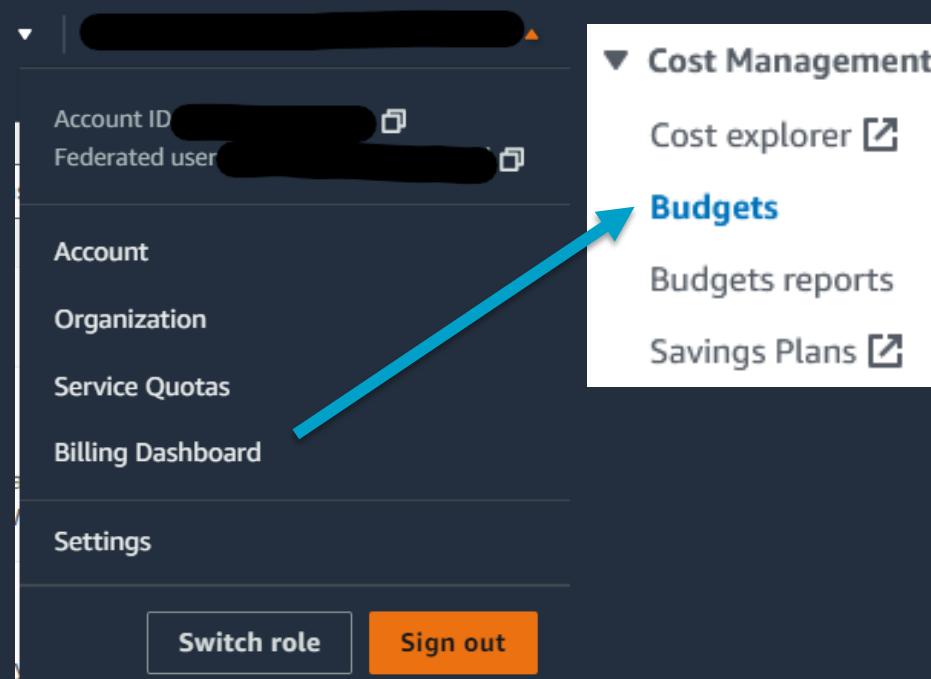
How many budgets can I create?



Can I create a budget starting from last month?

# AWS Budgets

AWS Budgets enable you to plan your service usage, service costs, your Savings Plans and Reserved Instances utilization and coverage.



The screenshot shows the 'AWS Billing > Budgets > Overview' page. At the top, it displays 'Overview' and 'Budgets (5)'. Below this are sections for 'Budget types' and 'Actions'. The 'Create budget' button is highlighted with a blue border and arrow. The 'Budget types' section lists four options: Cost budget - Recommended (selected), Usage budget, Savings Plans budget, and Reservation budget. Each option has a detailed description below it.

Budget Type	Description
Cost budget - Recommended	Monitor your costs against a specified dollar amount and receive alerts when your user-defined thresholds are met. Using cost budgets, the budgeted amount you set represents your expected cloud spend. For example, you can set a cost budget for a business unit and then add additional parameters such as the associated member accounts.
Usage budget	Monitor your usage of one or more specified usage types or usage type groups and receive alerts when your user-defined thresholds are met. Using usage budgets, the budgeted amount represents your expected usage. For example, you can use a usage budget to monitor the usage of certain services such as Amazon EC2 and Amazon S3.
Savings Plans budget	Track the utilization or coverage associated with your Savings Plans and receive alerts when your percentage drops below a threshold you define. Setting a coverage target lets you see how much of your instance usage is covered by Savings Plans, while setting a utilization target lets you see if your Savings Plans are unused or underutilized.
Reservation budget	Track the utilization or coverage associated with your reservations and receive alerts when your percentage drops below a threshold you define. Setting a coverage target lets you see how much of your instance usage is covered by reservations, while setting a utilization target lets you see if your reservations are unused or underutilized. Reservation alerts are supported for Amazon EC2, Amazon RDS, Amazon Redshift, Amazon ElastiCache, and Amazon Elasticsearch reservations.

*Budgets can be created and tracked from the AWS Budgets dashboard or via the Budgets API.*

# AWS Budgets Template

Budgets 1-click templates are a simplified way to start using AWS Budgets, with a single page workflow

**Budget setup**

**Use a template (simplified)**  
Use the recommended configurations. You can change some configuration options after the budget is created.

**Customize (advanced)**  
Customize a budget to set parameters specific to your use case. You can customize the time period, the start month, and specific accounts.

**Templates - new**  
Choose a template that best matches your use case.

**Zero spend budget**  
Create a budget that notifies you once your spending exceeds \$0.01 which is above the AWS Free Tier limits.

**Monthly cost budget**  
Create a monthly budget that notifies you if you exceed, or are forecasted to exceed, the budget amount.

**Daily Savings Plans coverage budget**  
Create a coverage budget for your Savings Plans that notifies you when you fall below the defined target.

**Daily reservation utilization budget**  
Create a utilization budget for your reservations that notifies you when you fall below the defined target.

**Zero spend budget - Template**

**Budget name**  
Provide a descriptive name for this budget.  
**My Zero-Spend Budget**  
Names must be between 1-100 characters.

**Email recipients**  
Specify the email recipients you want to notify when the threshold has exceeded.  
*Separate email addresses using commas*  
Maximum number of email recipients is 10.

**Scope**  
All AWS services are **in scope** in this budget.

**Info** You will be notified via email when any spend above \$0.01 is incurred.

# AWS Budgets - Cost

Cost budgets allow you to say how much you want to spend on a service.

### How to set up your budget

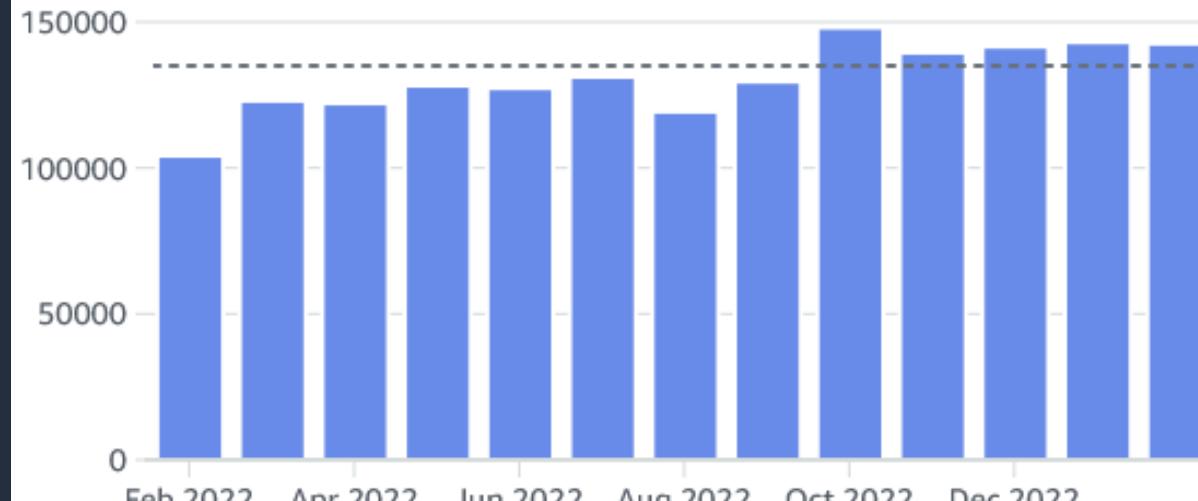
 Step 1: Enter your budget details  
Define the budget name.

 Step 2: Set budget amount  
Select the period and whether you would like to have a fixed budget or to specify a budget plan, then enter your budget amount.

 Step 3: Scope your budget - *optional*  
Add dimensions of data to narrow on a set of cost information. For example, you could select a number of AWS services to track as part of this budget.

### Budget preview

**Cost Data**  
Feb 2022 - Feb 2023 (MTD) | Unblended costs



Month	Actual Cost
Feb 2022	105,000
Mar 2022	125,000
Apr 2022	120,000
May 2022	125,000
Jun 2022	125,000
Jul 2022	130,000
Aug 2022	115,000
Sep 2022	130,000
Oct 2022	145,000
Nov 2022	135,000
Dec 2022	140,000
Jan 2023	140,000
Feb 2023	140,000

Actual cost    Budget

[View in AWS Cost Explorer](#)

# AWS Budgets – Set Budget Amount

Select the Period, the Renewal type and the budgeting method: Fixed, Planned or Auto-Adjusting

**Set budget amount**

**Period**  
Daily budgets do not support enabling forecasted alerts, or daily budget planning.

Monthly

**Budget renewal type**

Recurring budget  
Recurring budgets renew on the first day of every monthly billing period.

Expiring budget  
Expiring monthly budgets stop renewing at the end of the selected expiration month.

**Start month**

Jul ▾ 2023 ▾

**Budgeting method** | Info

Auto-adjusting (New)  
Use your spending or usage pattern to dynamically set your budget each period.

**Baseline time range** | Info

Select the time range that you want to base your budget amount on each budget period.

Custom range

**Budget amount (Jul 2023)**

0.00

Because your auto-adjusted budget depends on your cost data, your upcoming budget amounts can fluctuate as your spend patterns change. We will notify all alert recipients when we adjust your budget amount.

**Period**  
Daily budgets do not support enabling forecasted alerts, or daily budget planning.

Monthly

Daily

Monthly

Quarterly

Annually

**Budgeting method** | Info

Auto-adjusting (New)  
Use your spending or usage pattern to dynamically set your budget each period.

Fixed

Create a budget that tracks against a single monthly budgeted amount.

Planned

Specify your budgeted amount for each budget period.

Auto-adjusting (New)  
Use your spending or usage pattern to dynamically set your budget each period.

# AWS Budgets – Set Budget Scope

Select All Services, or filter by specific AWS cost dimensions. Budget preview will update automatically

**Budget scope [Info](#)**  
Add filtering and use advanced options to narrow the set of cost information tracked as part of this budget

**Scope options**

All AWS services (Recommended)  
Track any cost incurred from any service for this account as part of the budget scope

Filter specific AWS cost dimensions  
Select specific dimensions to budget against. For example, you can select the specific service "EC2" to budget against.

**Filters [Info](#)**

Services included (1)  
EC2-Instances (Elastic Compute Cloud - Compute)  
[Edit filter](#)

[Remove all](#) [Remove](#)

[Add filter](#)

**Advanced options**

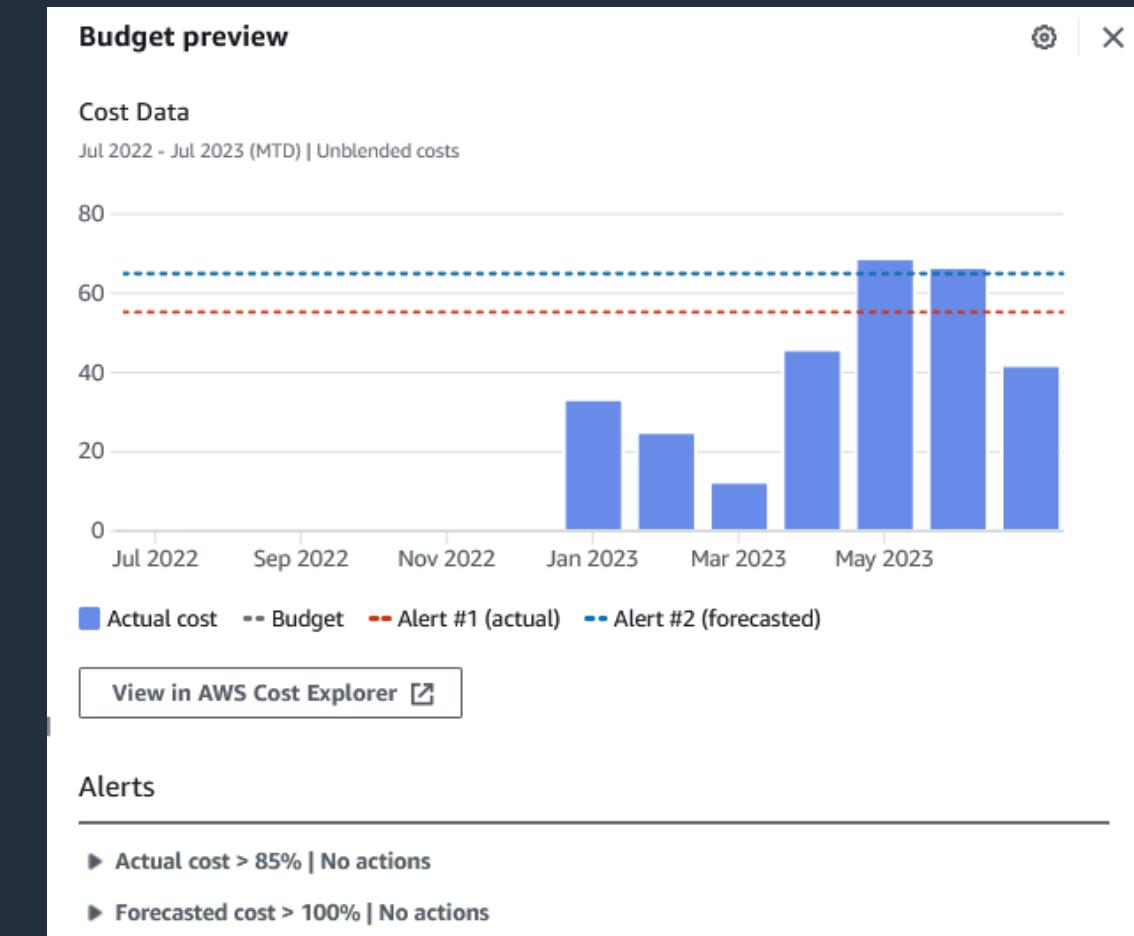
Aggregate costs by

Unblended costs

Supported charge types

Taxes [X](#) Upfront reservation fees [X](#) Recurring reservation charges [X](#)

Other subscription costs [X](#) Support charges [X](#) Discounts [X](#)



# AWS Budgets – Create Budget alerts

You can configure alerts to notify when you're reaching or about to reach the budget threshold.

1

**Alert #1**

**Set alert threshold**

**Threshold**  
When should this alert be triggered?  
80 % of budgeted amount Actual

**Trigger**  
How should this alert be triggered?  
% of budgeted amount ✓  
Absolute value  
Actual ✓  
Forecasted

**Summary:** When your actual cost is greater than 80.00% (\$72.00) of your budgeted amount (\$90.00), the alert threshold will be exceeded.

**Notification preferences**  
Select one or more notification preferences to receive alerts.

**Email recipients**  
Specify the email recipients you want to notify when the threshold has exceeded.  
Separate email addresses using commas

Maximum number of email recipients is 10.

► [Amazon SNS Alerts - Optional Info](#)  
► [AWS Chatbot Alerts](#)

2

**Budget preview**

**Cost Data**  
Jul 2022 - Jul 2023 (MTD) | Unblended costs

Month	Actual Cost	Budget	Alert #1 (actual)
Jul 2022	~50	~90	~90
Sep 2022	~50	~90	~90
Nov 2022	~50	~90	~90
Jan 2023	~90	~90	~90
Mar 2023	~80	~90	~90
May 2023	~100	~90	~90
Jun 2023	~60	~90	~90

Actual cost ■■■ Budget ■■■ Alert #1 (actual) ■■■

[View in AWS Cost Explorer](#)

**Alerts**

► Actual cost > 80% | No actions

# Q&A



# Thank you!.

Quan Phuong  
AWS Solutions Architect

Thanh Dang  
AWS Solutions Architect