# Intro to Amazon Cloud

## EC2 overview

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11/12/21

# Agenda

- Introduction to AWS Cloud
- Global Reach
- EC2 Overview
- EC2 Details

- Visit https://coatl.awsimmersionday.net for the full day agenda

# What is AWS?

AWS provides a highly reliable, scalable, low-cost infrastructure platform in the cloud that powers millions of businesses in over 190 countries around the world.

Benefits

- Low Cost
- Elasticity & Agility
- Open & Flexible
- Secure
- Global Reach

# What sets AWS apart?

| | |
|---|---|
| Security | Fine-grained control |
| Service Breadth & Depth; pace of innovation | 175+ services to support any cloud workload; rapid customer driven releases |
| Experience: 1M+ customers | Building and managing cloud since 2006 |
| Global Footprint | 80+ Availability Zones within 25 geographic Regions, 1 Local Zone, 216 Points of Presence (205 Edge Locations and 11 Regional Edge Caches) in 84 cities across 42 countries. |
| Machine Learning | More machine learning happens on AWS than anywhere else. Machine learning in the hands of every developer and data scientist |
| Ecosystem | Tens of thousands of APN partners. The AWS Marketplace offers 50 categories, and more than 8,000 software listings |
| Enterprise leader | AWS positioned as a Leader in the Gartner Magic Quadrant for Cloud Infrastructure as a Service, Worldwide |

# Pricing Philosophy

## High volume / low margin businesses are in our core DNA

| Trade CapEX for variable expense | Our economies of scale provide us with lower costs | Pricing model choice to support variable and stable workloads | Save more money as you grow bigger |
| --- | --- | --- | --- |
| Pay for what you use | 85 price reductions since 2006 | On-demand<br>Reserved Instances<br>Spot | Tiered pricing<br>Volume discounts<br>Custom pricing |

# Customer obsessed

90%

of roadmap originates with customer requests and are designed to meet specific needs

heroku

"Performance, reliability, and responsiveness are fundamental to our customer experience, and T3 instances help us to deliver on that customer promise while also controlling our costs."

—Heroku




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# It’s greener in the cloud.

**AWS’s infrastructure is**

## 3.6x more energy efficient

than the median of the surveyed U.S. enterprise data centers

AWS performs the same task with an

## 88% lower carbon footprint

Source: 451 Research, 2019, all rights reserved

# Reducing water used for cooling

AWS has multiple initiatives to improve our water use efficiency for cooling data centers:

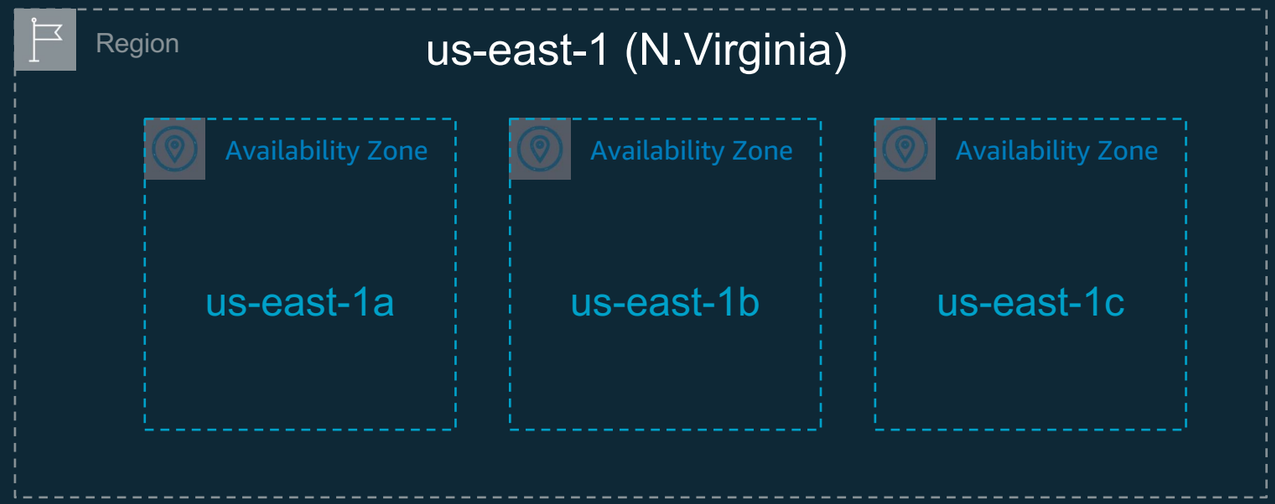
- **Evaporative cooling**
- **Reduce potable water usage**
- **Recycled cooling water**
- **Invest in reclaimed water infrastructure**


# AWS Global Reach

# 25 Regions

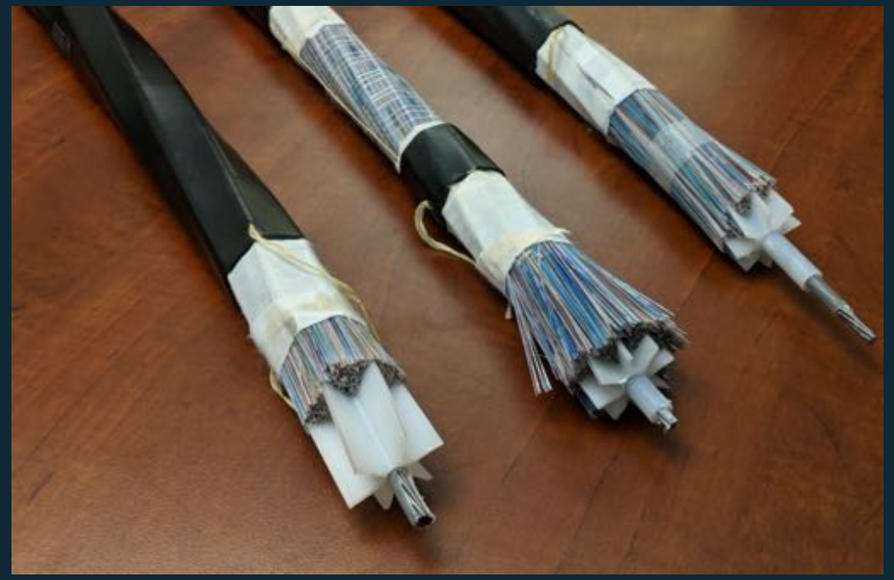
# Availability Zones

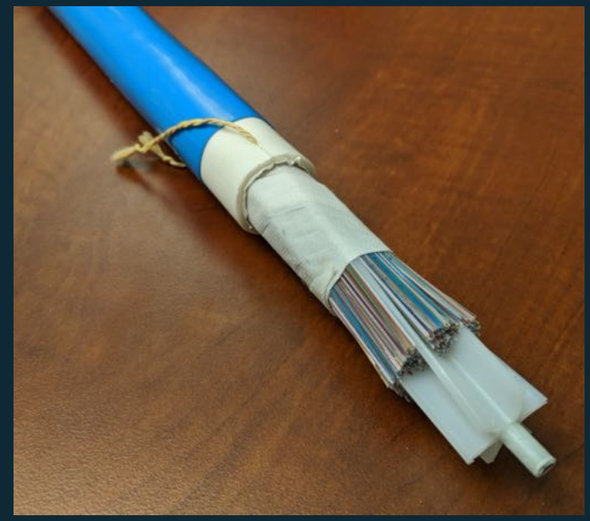
- A region is comprised of multiple Availability Zones (typically 3)
- An Availability Zone (AZ) is one or more discrete data centers with redundant power, networking, and connectivity in an AWS Region
- High throughput, low latency (<10mS) network  between Availability Zones
- All traffic between AZ’s is encrypted
- Physical Separation < 100km



# Intra & inter-AZ connectivity

- Dark fiber “spans”
  - Optimized for low-latency & physical diversity
- Amazon controlled infrastructure
- Geospatial coordinates
- Dense wavelength division multiplexing (DWDM)





# 275

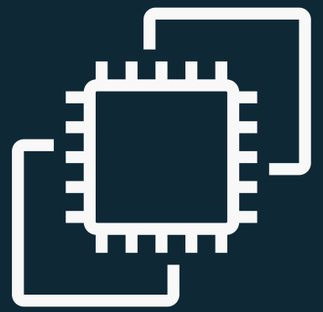
Amazon CloudFront Points of Presence

# 108

AWS Direct Connect locations


# EC2 Overview

# Choices for Compute



## Amazon EC2

Virtual server instances
in the cloud

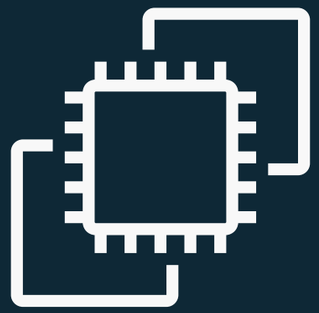
## Amazon ECS, EKS, and Fargate

Container management service
for running
Docker on a managed
cluster of EC2

## AWS Lambda

Serverless compute
for stateless code execution in
response to triggers

# Amazon EC2



Amazon EC2

Linux | Windows | Mac

Arm and x86 architectures

General purpose and workload optimized

Bare metal, disk, networking capabilities

Packaged | Custom | Community AMIs

Multiple purchase options: On-demand, RI, Spot

# What’s a virtual CPU? (vCPU)

- A vCPU is typically a hyper-threaded physical core*
- Divide vCPU count by 2 to get core count
- On Linux, “A” threads enumerated before “B” threads
- On Windows, threads are interleaved

- Cores by Amazon EC2 & RDS DB Instance type: https://aws.amazon.com/ec2/virtualcores/

** CPU Optimizing options allow disabling hyperthreading and reduce number of cores*

# Memory and Storage

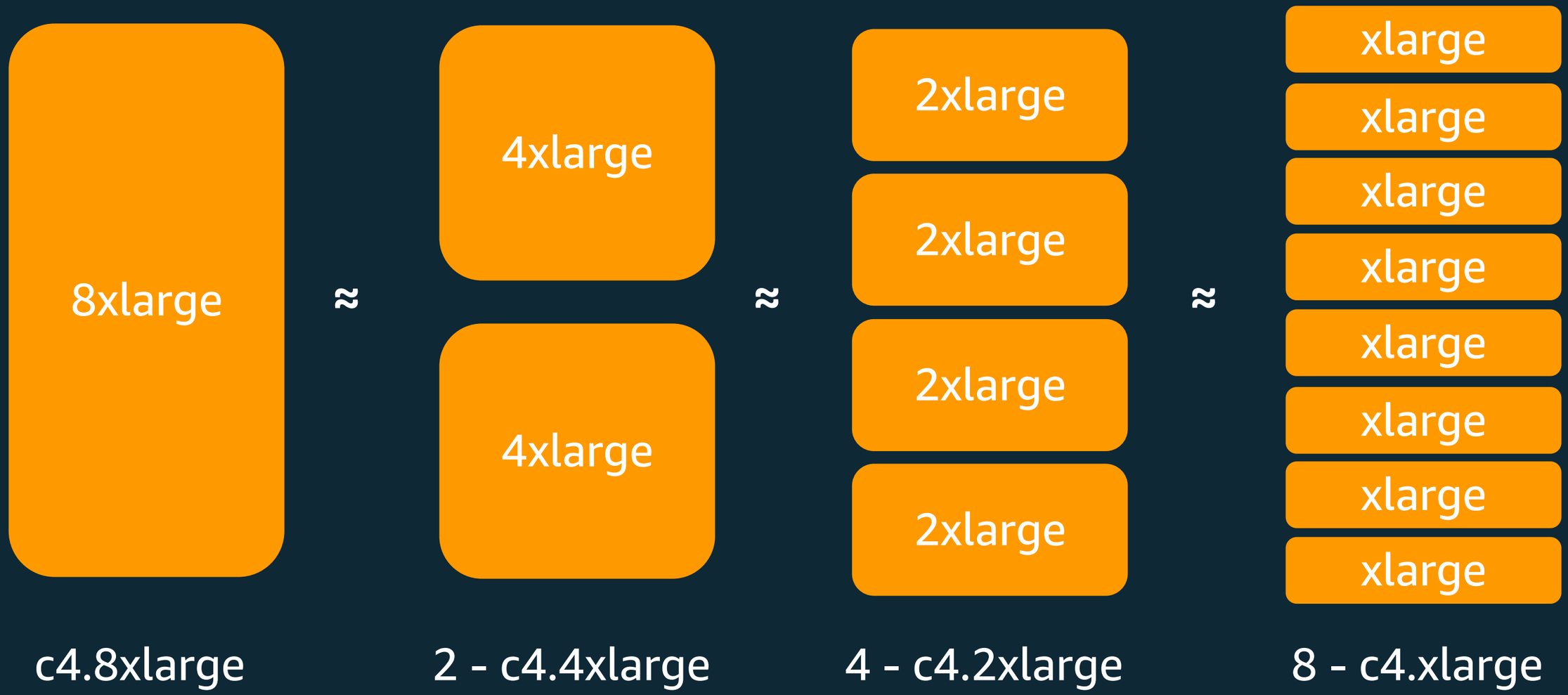
**What's a GiB?**

- Memory is presented as GibiBytes (GiB) and not Gigabytes (GB)
- 256 GiB = 275 GB

**What about storage?**

- Storage is independent of compute
- You allocate drives known as EBS volumes
- Max 16 TiB per volume
- Some instance types provide physically attached (ephemeral) storage

# Instance sizing




c4.8xlarge | 2 - c4.4xlarge | 4 - c4.2xlarge | 8 - c4.xlarge

# EC2 Naming Explained

# Instance Types

| | General Purpose | | Compute Optimized | | Memory Optimized | | | | Accelerated Computing | | | Storage Optimized | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Burstable performance | General Purpose | Compute Intensive | Compute +memory up to 100 Gbps | Memory Optimized | In-memory | Memory Intensive | Compute and Memory Intensive | Graphics Intensive | General Purpose GPU | FPGA | High I/O | Dense Storage | Big Data Optimized |
| intel | T3 | M5 | C5 | C5n | R5 | X1 | X1e | | G3 | P3 | F1 | | D2 | H1 |
| Local storage (NVMe SSD) | | M5d | C5d | | R5d | | | Z1d | | | | I3 | | |
| AMD | T3a | M5a | | | R5a | | | | | | | | | |
| metal | | M5m | c5m | | R5m | | u-12tb1 | Z1dm | | | | I3m | | |
| others | A1 | M6g | C6g | | R6g | | | | | P3dn | | I3en | | |

arm




aws

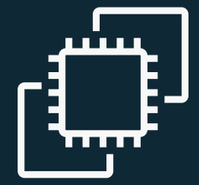
# Choose your processor and architecture


Intel® Xeon® Scalable (Skylake) processor


NVIDIA V100 Tensor Core GPUs


AMD EPYC processor


AWS Graviton Processor (arm)



FPGAs for custom hardware acceleration

**Right compute for the right application and workload**

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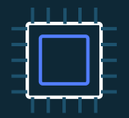
# AWS Graviton2 Processor

## Enabling the best price/performance for your cloud workloads

### Graviton Processor

First Arm-based processor available in major cloud



Built on 64-bit Arm Neoverse cores with AWS-designed silicon using 16 nm manufacturing technology

Up to 16 vCPUs,10 Gbps enhanced networking, 3.5 Gbps EBS bandwidth

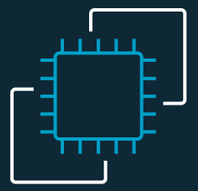
### Graviton2 Processor

7x performance, 4x compute cores, and 5x faster memory

Built with 64-bit Arm Neoverse cores with AWS-designed silicon using 7 nm manufacturing technology

Up to 64 vCPUs, 25 Gbps enhanced networking, 18 Gbps EBS bandwidth

# Choice of accelerators for specialized workloads



## Elastic Graphics

Easily add graphics acceleration to your EC2 instance

Configure right amount of graphics acceleration for your workload

Accelerate application for fraction of cost of standalone graphics instances

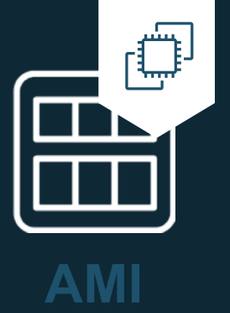
## Elastic Inference

Reduce deep learning inference costs by up to 75%

Easily attach fractional sizes of a full GPU instance to EC2 or SageMaker instances

Scale inference acceleration up or down as needed with EC2 Auto Scaling

# What is an Amazon Machine Image (AMI)?




Provides the information required to launch an instance

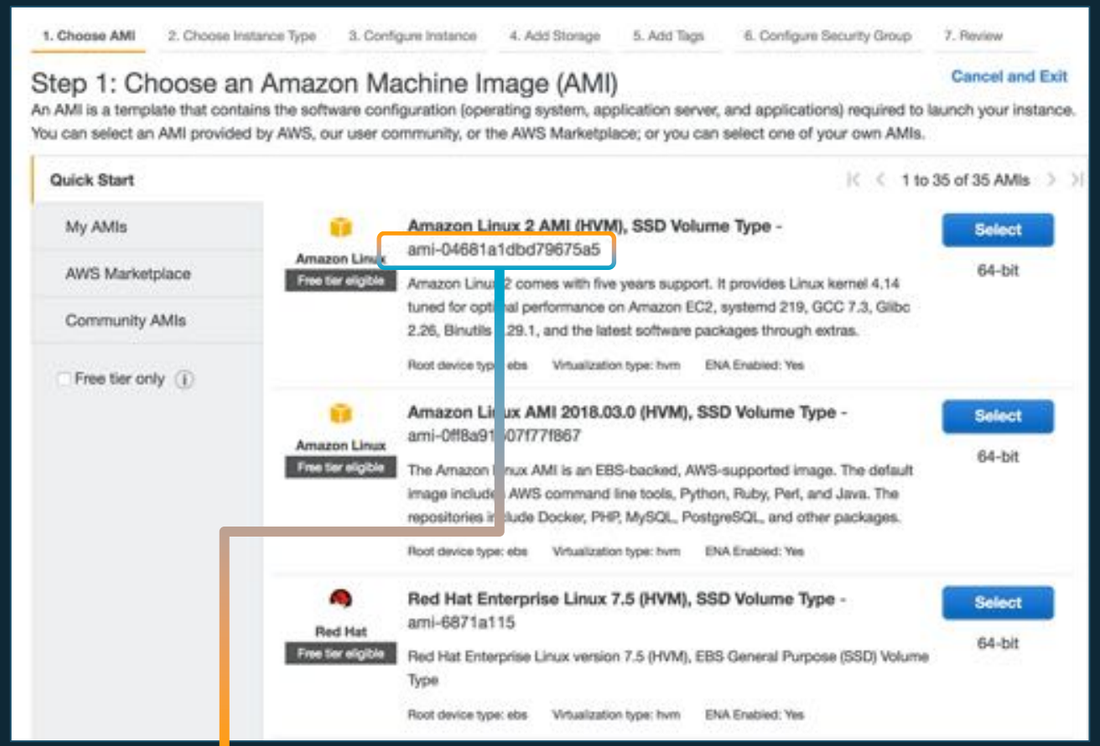
Launch multiple instances from a single AMI

An AMI includes the following

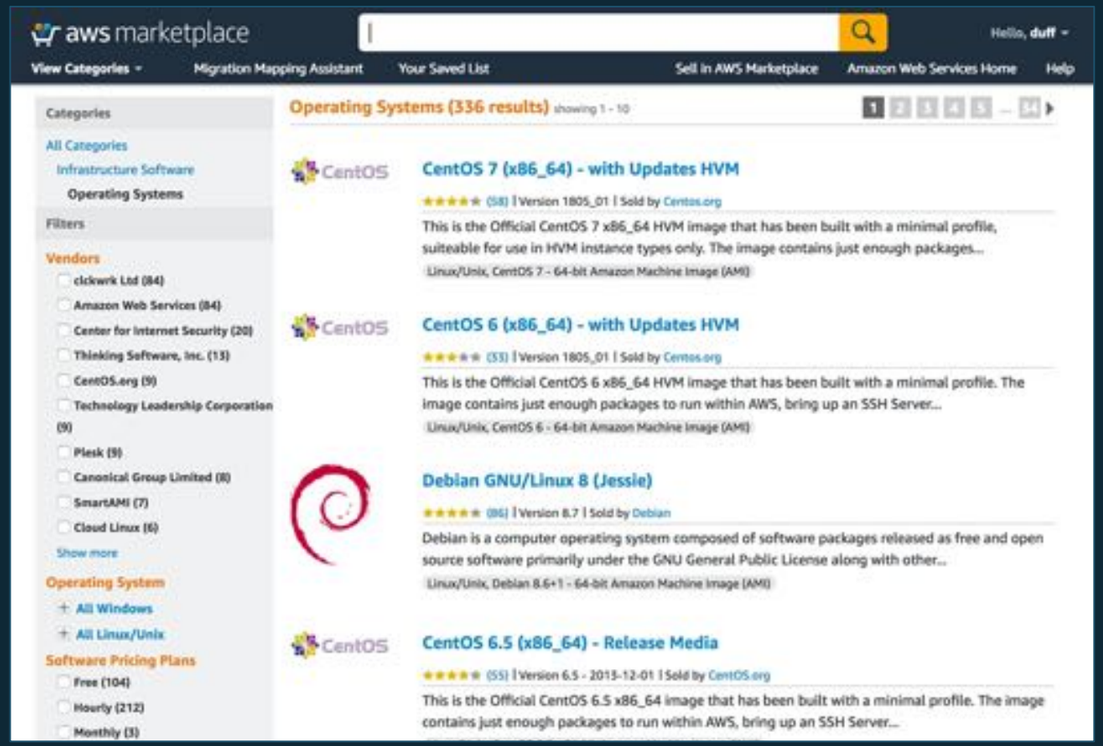
- A template for the root volume (for example, operating system, applications)
- Launch permissions that control which AWS accounts can use the AMI
- Block device mapping that specifies volumes to attach to the instance

# Choosing an AMI

## AWS Console




## AWS Marketplace




Use the AMI ID to launch through the API or AWS Command Line Interface (AWS CLI)

```
aws ec2 run-instances --image-id ami-04681a1dbd79675a5 --instance-type c4.8xlarge --count 10 --key-name MyKey
```

# EC2 Operating Systems Supported

- Windows 2003R2*/2008*/2008R2*/2012/2012R2/2016/2019
- Amazon Linux
- Debian
- Suse
- CentOS
- Red Hat Enterprise Linux
- Ubuntu
- Mac

for more OSes see: https://aws.amazon.com/marketplace/b/2649367011

# Broadest and deepest platform choice

| Categories | Capabilities | Options |
| --- | --- | --- |
| General purpose | Choice of processor (AWS, Intel, AMD) | Elastic Block Store |
| Burstable | Fast processors (up to 4.5 GHz) | Elastic Inference |
| Compute intensive | High memory footprint (up to 24 TiB) | Elastic Graphics |
| Memory intensive | Instance storage (HDD and SSD) | Linux, Unix, Windows, macOS |
| Storage (High I/O) | Accelerated computing (GPUs ,FPGA & ASIC) | |
| Dense storage | Networking (up to 400 Gbps) | |
| GPU compute | Bare Metal | |
| Graphics intensive | Size (Nano to 32xlarge) | |

**400**

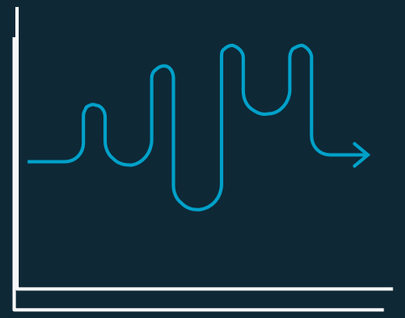
**instance types**

for virtually every workload and business need

# Amazon EC2 purchase options

## On-Demand

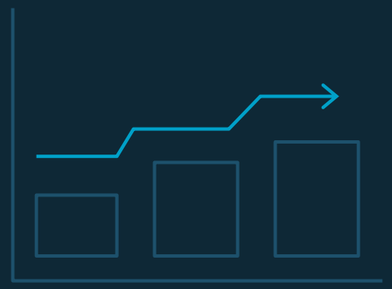
Pay for compute capacity by **the second** with no long-term commitments



Spiky workloads, to define needs

## Reserved Instances

Make a 1 or 3 year commitment and receive a **significant discount** off On-Demand prices



Committed and steady-state usage

## Savings Plan

Same great discounts as Amazon EC2 RIs with **more flexibility**

Committed flexible access to compute

## Spot Instances

Spare Amazon EC2 capacity at **savings of up to 90%** off On-Demand prices

Fault-tolerant, flexible, stateless workloads

# Hibernate Amazon EC2 Instances

## Maintain a fleet of pre-warmed instances to quickly get to a productive state

Available with Amazon EBS-backed instances

Use familiar Stop and Start APIs

Memory data saved in EBS root volume

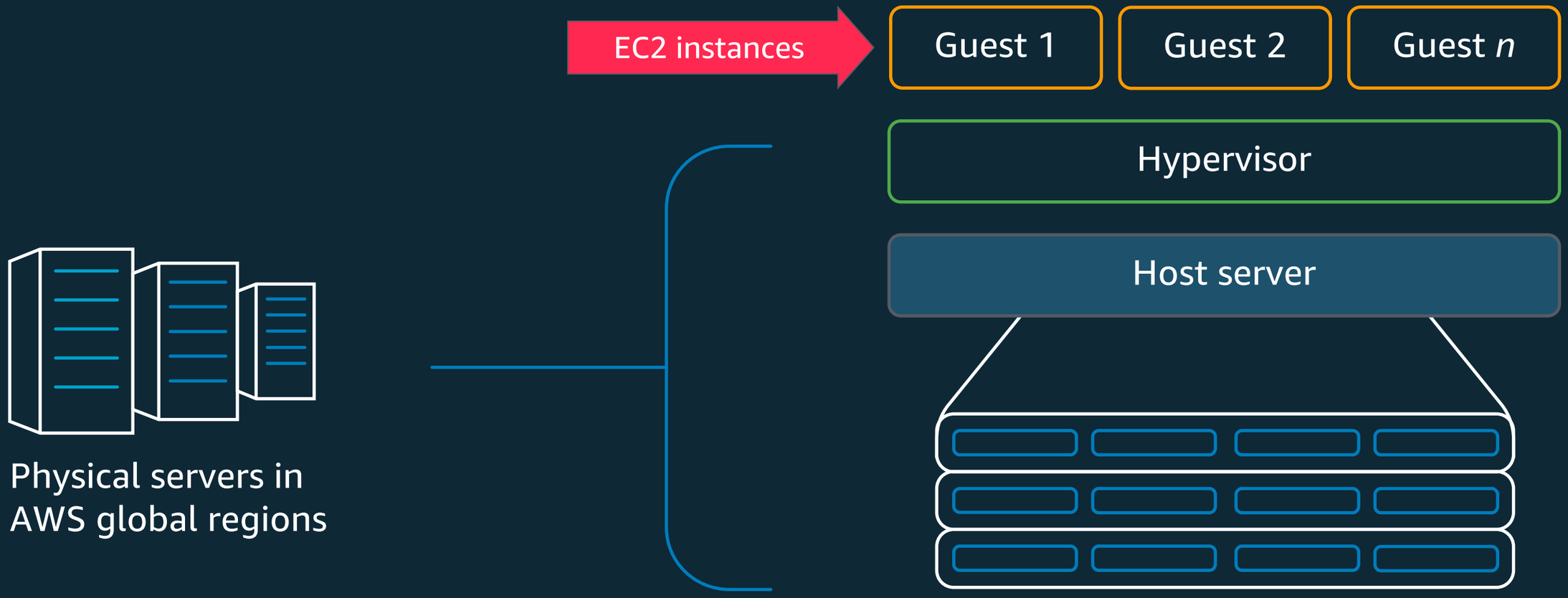
RAM contents are encrypted on EBS

Its just like closing and opening your laptop!

Applications can pick up right where it left off


# EC2 Design

# EC2 Host Virtualization



# Resource allocation

- All resources assigned to you are dedicated to your instance with no over commitment*
  - All vCPUs are dedicated to you
  - Memory allocated is assigned only to your instance
  - Network resources are partitioned to avoid “noisy neighbors”
- Curious about the number of instances per host?
  - See “Dedicated Hosts Configuration Table” for a guide.

*the “T” family is special

# Which hypervisor do we use?

**Original host architecture: Xen-based**

- Hypervisor consumed resources from the underlying host
- Limited optimization

**AWS Nitro Hypervisor: Custom KVM based hypervisor**

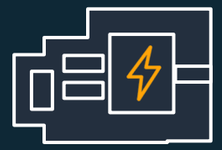
- AWS Nitro System (launched on Nov 2017)
- Less server resources used, more resources for the customer
- AWS optimized

Bare metal: **Direct access to processor and memory resources**

- Built on the AWS Nitro system
- Enables custom hypervisors and micro-VM runtimes

# AWS Nitro System

## Nitro Card

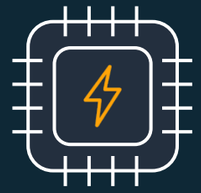


Local NVMe storage

Elastic Block Storage

Networking, monitoring, and security

## Nitro Security Chip



Integrated into motherboard

Protects hardware resources

## Nitro Hypervisor

Lightweight hypervisor

Memory and CPU allocation

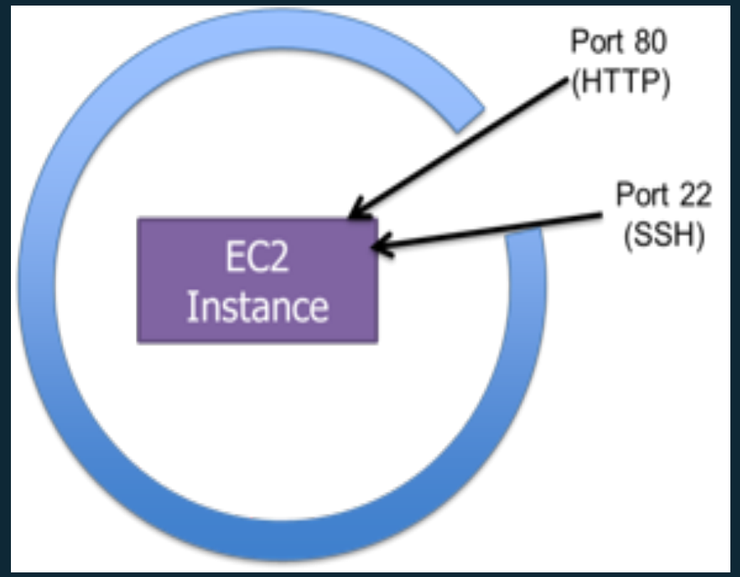
Bare metal-like performance

**Modular building blocks for rapid design and delivery of EC2 instances**

# EC2 Security Groups

## Security Group Rules

- Name
- Description
- Protocol
- Port range
- IP address, IP range, Security Group name



# EC2-Specific Credentials

## EC2 key pairs

- Linux – SSH key pair for first-time host login
- Windows – Retrieve Administrator password

## Standard SSH RSA key pair

- Public/Private Keys
- Private keys are not stored by AWS

## AWS approach for providing **initial** access to a generic OS

- Secure
- Personalized
- Non-generic (NIST, PCI DSS)

"Public Half" inserted by Amazon into each EC2 instance that you launch

"Private Half" downloaded to your desktop

# Any Questions?

Up Next:  EC2 Hands on Lab