Network Structure & Cloud Computing

AWS VS AZURE VS GOOGLE CLOUD

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BASIC COMPUTE

Basic Compute	Azure	AWS	Google Cloud
	EC2	Virtual Machines	Compute Engine

- ***AWS Compute:***
- **Elastic Compute Cloud:** Amazon's flagship compute service is Elastic Compute Cloud, or EC2. Amazon describes EC2 as "a web service that provides secure, resizable compute capacity in the cloud." EC2 offers a wide variety of options, including a huge assortment of instances, support for both Windows and Linux, bare metal instances (currently a preview), GPU instances, high-performance computing, auto scaling and more. AWS also offers a free tier for EC2 that includes 750 hours per month of t2.micro instances for up to twelve months.
- ***Microsoft Compute:***
- **Virtual Machines:** Microsoft's primary compute service is known simply as Virtual Machines. It boasts support for Linux, Windows Server, SQL Server, Oracle, IBM, and SAP, as well as enhanced security, hybrid cloud capabilities and integrated support for Microsoft software. Like AWS, it has an extremely large catalog of available instances, including GPU and high-performance computing options, as well as instances optimized for artificial intelligence and machine learning. It also has a free tier with 750 hours per month of Windows or Linux B1S virtual machines for a year.
- ***Google Compute:***
- **Compute Engine:** By comparison, Google's catalog of compute services is somewhat shorter than its competitors'. Its primary service is called Compute Engine, which boasts both custom and predefined machine types, per-second billing, Linux and Windows support, automatic discounts and carbon-neutral infrastructure that uses half the energy of typical data centers. It

STORAGE – DB - BACKUP

Vendor	Storage Services	Database Services	Backup Services
AWS	• Simple Storage Service (S3) • Elastic Block Storage (EBS) • Elastic File System (EFS) • Storage Gateway • Snowball • Snowball Edge • Snowmobile	• Aurora • RDS • DynamoDB • ElastiCache • Redshift • Neptune • Database migration service	• Glacier
Azure	• Blob Storage • Queue Storage • File Storage • Disk Storage • Data Lake Store	• SQL Database • Database for MySQL • Database for PostgreSQL • Data Warehouse • Server Stretch Database • Cosmos DB • Table Storage • Redis Cache • Data Factory	• Archive Storage • Backup • Site Recovery
GCP	• Cloud Storage • Persistent Disk • Transfer Appliance • Transfer Service	• Cloud SQL • Cloud Bigtable • Cloud Spanner • Cloud Datastore	Nearline Coldline

STORAGE SERVICES

Object Storage - Overview

	AWS	Azure	Google
Service Name	S3	Azure Storage (Blobs)	Google Cloud Storage
Availability SLA	99.95%	99.99%	99.95%
Hot	S3 Standard	Hot Blob Storage	GCS
Cool	S3 Standard – Infrequent Access	Cool Blob Storage	GCS Nearline
Cold (Archival)	Glacier	Use Cool Blob Storage	GCS Coldline
# Object Limits	Unlimited	Unlimited	Unlimited
Size Limit	5 TB/Object	500 TB/account	5TB per object

File Storage - Overview

	AWS	Azure	Google
Service Name	EFS	Azure File Storage	GCS + FUSE adapter
Storage size	Scales elastically to petabytes	5TB per file share, 500TB per storage account	
Scaling	Automatic	Manual	Manual
Attach to multiple VMs	Yes	Yes	One read/write volume and many read-only, or NFS, or SMB, or Gluster
Replication	Multiple AZs in the region	LRS or GRS	Built-in redundancy
Throughput	50MB/s (burst to 100) per TB of storage	60MB/s per file share	180 MB/s read, 120 MB/s write
On-premise support	NFS v4.1	SMB 3.0	NFS, SMB
Backup	Use 3rd party tools, AWS Data Pipeline, sync to EBS +snapshot.	Azure Backup	Snapshots
Encryption at rest	No (future)	SSE in Preview	Yes

Block Storage - SSD

	AWS	Azure	Google
Service Name	General Purpose and PIOPs SSD	Premium	SSD
Volume Sizes	1GB to 16TB 4GB to 16TB for PIOPs	1GB to 1TB	1GB to 64TB
Max IOPs per volume	10,000 (20,000 for PIOPs)	5000	40,000 read, 30,000 write
Max Throughput per volume (MB/s)	160 (320 for PIOPs)	200	800 read, 400 write
Replication	Within the AZ (essentially RAID-1)	LRS – multiple copies within datacenter	Built-in redundancy
Notes	Max IOPs of 65,000 per instance		

PRICING

- **AWS Pricing:** Amazon's pricing is particularly inscrutable. While it does offer a cost calculator, the many number of variables involved make it difficult to get accurate estimates. Gartner advised, "[Amazon's] granular pricing structure is complex; use of third-party cost management tools is highly recommended."
- **Azure Pricing:** Microsoft Azure doesn't make things any simpler. Because of Microsoft's complicated software licensing options and use of secretive discounts, its pricing structure can be even more difficult to understand without outside help.
- **Google Pricing:** By contrast, Google uses its pricing as a point of differentiation. It aims to offer "customer-friendly" prices that beats the list prices of the other providers. Gartner noted, "Google uses deep discounts and exceptionally flexible contracts to try to win projects from customers that are currently spending significant sums of money with cloud competitors."

Linux Instance	AWS	Azure	GCP
Small (hourly)	$0.067	$0.050	$0.048
Small (monthly)	$49	$37	$24
Small (annually)	$353	$438	$241
Small (3 year)	$687	$1,314	$520
Medium (hourly)	$0.100	$0.100	$0.095
Medium (monthly)	$73	$73	$49
Medium (annually)	$519	$876	$478
Medium (3 year)	$1,026	$2,628	$1027
Large (hourly)	$0.199	$0.199	$0.190
Large (monthly)	$146	$145	$97
Large (annually)	$1,043	$1,743	$951
Large (3-year)	$2,063	$5,230	$2042
Extra large (hourly)	$0.398	$0.398	$0.380
Extra large (monthly)	$291	$291	$194
Extra large (annually)	$2,082	$3,486	$1,898
Extra large (3 year)	$4,089	$10,459	$4,071
2X large (hourly)	$0.796	$0.796	$0.759
2X large (monthly)	$581	$581	$388
2X large (annually)	$4,150	$6,973	$3,791
2X large (3-year)	$8,165	$20,919	$8,128

NETWORKING

Azure	AWS	Google Cloud
Azure Virtual Network	Amazon VPC	Cloud Virtual Network
Azure ExpressRoute	AWS Direct Connect	Cloud Interconnect
Azure Traffic Manager	Amazon Route 53	Cloud DNS

ADMINISTRATION & SECURITY

Azure	AWS	Google Cloud
Azure Active Directory	AWS Directory Service AWS Identity and Access Management (IAM)	Cloud Identity & Access Management (IAM)

SECURITY GROUPS

- **AWS Security Groups**
- In AWS, Security Groups are sets of permissive ('Allow' only) inbound and outbound rules that are associated with instances. Whenever an instance is created within a VPC, it has to be associated with a Security Group. By default all VPC instances are associated with the "default" Security Group, which exists in each VPC.
- EC2 Classic Security Groups
- If your AWS account is old enough, it supports EC2 Classic. EC2 Classic treats compute as one big pool of resources in each region, as opposed to VPC which creates isolated cloud deployments. Generally, EC2 Classic Security Groups behave like their VPC counterparts
- **Azure Network Security Groups**
- Many of the same principles that apply to AWS can also apply to Azure, but Azure Network Security Groups (NSG) have a few important differences:
- NSGs can be applied to individual VMs, subnets, or both
- NSGs have both 'Deny' and 'Allow' rules – This means that rule order (or priority) matters!
- Like EC2 Classic Security Groups, Azure NSGs can only be applied to resources in the same region they were created in
- Azure has a security feature called Endpoint ACLs, you can't have both an NSG and an endpoint ACL applied to the same VM
- All NSGs include a set of default rules that cannot be changed or deleted, but can be overridden
- Like AWS Security Groups, Azure NSGs have two sets of rules, inbound and outbound.

MANAGEMENT SERVICES & OPTIONS

Azure	AWS	Google Cloud
Azure Resource Manager	Amazon CloudFormation	Cloud Deployment Manager

Vendor	Strengths	Weaknesses
AWS	• Dominant market position • Extensive, mature offerings • Support for large organizations • Extensive training • Global reach	• Difficult to use • Cost management • Overwhelming options
Microsoft Azure	• Second largest provider • Integration with Microsoft tools and software • Broad feature set • Hybrid cloud • Support for open source	• Less "enterprise-ready" • Incomplete management tooling
Google	• Designed for cloud-native businesses • Commitment to open source and portability • Deep discounts and flexible contracts • DevOps expertise	• Late entrant to IaaS market • Fewer features and services • Fewer worldwide data centers

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GCP	• Cloud Storage • Persistent Disk • Transfer Appliance • Transfer Service	• Cloud SQL • Cloud Bigtable • Cloud Spanner • Cloud Datastore	• None

RESOURCES

- https://www.datamation.com/cloud-computing/aws-vs.-azure-vs.-google-cloud-comparison.html
- https://stackify.com/microsoft-azure-vs-amazon-web-services-vs-google-compute-comparison/
- https://www.scalr.com/blog/aws-vs-azure-security-groups/
- https://www.datamation.com/cloud-computing/aws-vs.-azure-vs.-google-cloud-comparison.html