Cloud computing: Module - 5

1-How to configure, develop and maintain Security and Privacy in cloud?

→ 1. CONFIGURE SECURITY AND PRIVACY IN CLOUD

A. Choose the Right Cloud Model

- **Deployment model**: Public, Private, Hybrid, Community
- Service model: laaS, PaaS, SaaS each has different security responsibilities.

B. Implement Identity and Access Management (IAM)

- Use role-based access control (RBAC) or attribute-based access control (ABAC).
- Enable Multi-Factor Authentication (MFA).
- Use **Single Sign-On (SSO)** for centralized identity management.

C. Data Protection

- Encryption:
 - In transit (TLS/SSL)
 - o At rest (AES-256, etc.)
 - During processing (homomorphic encryption or confidential computing)

Key Management:

- Use Cloud Key Management Services (KMS).
- Manage keys securely with proper rotation policies.

D. Network Security

- Use Virtual Private Cloud (VPC) or Private Links.
- Configure firewalls, Network Security Groups (NSGs).
- Enable **DDoS protection**.

E. Compliance Configurations

- Configure services to meet standards like GDPR, HIPAA, SOC 2, ISO 27001, etc.
- Use **Compliance Manager** tools from providers (e.g., Azure, AWS, GCP).

2. DEVELOP SECURITY AND PRIVACY-AWARE APPLICATIONS

A. Secure Development Practices

- Implement Secure Software Development Life Cycle (SSDLC).
- Use tools for Static Application Security Testing (SAST) and Dynamic Application Security Testing (DAST).
- Integrate **DevSecOps**: shift security left in the CI/CD pipeline.

B. Secure APIs

- Use OAuth2, OpenID Connect, API Gateways, and rate limiting.
- Sanitize inputs to prevent injection attacks (SQLi, XSS).

C. Logging and Auditing

- Enable **cloud-native logging** (e.g., CloudTrail, Stackdriver, Azure Monitor).
- Ensure logs are:
 - o Immutable
 - Centralized
 - Monitored with SIEM systems

3. MAINTAIN SECURITY AND PRIVACY POST-DEPLOYMENT

A. Monitoring and Threat Detection

• Use:

- Intrusion Detection Systems (IDS)
- Security Information and Event Management (SIEM)
- Cloud-native threat detection tools (e.g., GuardDuty, Security Center)

B. Regular Security Assessments

- Conduct vulnerability scans, penetration testing, and configuration audits.
- Follow frameworks like NIST CSF, CIS Controls, OWASP Cloud Top 10.

C. Patch Management

- Regularly patch OS, apps, containers, and dependencies.
- Automate patching with cloud-native tools.

D. Backup and Disaster Recovery

- Schedule automated backups.
- Implement geo-redundant storage.
- Regularly test disaster recovery plans.

E. Privacy Management

- Perform Data Protection Impact Assessments (DPIA).
- Implement data minimization and user consent management.
- Use anonymization or pseudonymization techniques where necessary.

2-What is Portability in cloud?

→ The ability to move our applications and data from one cloud provider to another easily, without big changes.

Think of it like this:

Imagine we packed our stuff in boxes that fit in any truck. we can move from one house to another without repacking everything.

In cloud terms:

- our app and data are the "stuff."
- The cloud providers (like AWS, Azure, Google Cloud) are the "houses."
- Portability means we don't need to rewrite our app or change a lot just to switch cloud providers.

Why is Portability Important?

- Avoid vendor lock-in: we're not stuck with one provider.
- **Cost control**: Move to a cheaper or better-performing provider.
- Flexibility: Use different clouds for different needs (multi-cloud strategy).

What Makes Apps Portable?

- Using open standards and container technology (like Docker, Kubernetes).
- Avoiding provider-specific tools or services.
- Keeping data in **standard formats** (e.g., JSON, CSV, SQL databases).

What Hurts Portability?

- Relying on **proprietary cloud services** (e.g., AWS Lambda, Azure Functions).
- Hard-coding cloud-specific settings.
- Using non-standard APIs.

3-What is Reliability and high Availability in cloud?

→ Reliability

Reliability means that our **cloud service keeps working properly** over time — without frequent failures.

It's like a **well-made car** that starts every day and runs smoothly, even after a long time.

In the cloud, it means:

Our apps and data are always working.

• If something breaks, it gets fixed quickly or doesn't affect users.

High Availability (HA)

High Availability means our **cloud app or service stays online almost all the time**, even if something goes wrong.

Imagine a **restaurant with backup chefs** — if one gets sick, the others keep the kitchen running. Customers still get served.

In cloud terms:

- Our system runs on multiple servers in different locations (data centers).
- If one server fails, another one takes over immediately.
- This reduces downtime.

Key Differences

Term	Simple Meaning	Focus
Reliability	The system works well and doesn't fail often	Performance over time
High Availability	The system stays online even during failures	Minimal downtime, always accessible

4-Describe Mobility Cloud Computing

→ Mobile Cloud Computing means:

Using cloud services on mobile devices (like smartphones and tablets) — so the heavy work is done in the cloud, not on the phone.

Example:

Imagine we're using a photo editing app on our phone.

- our phone sends the photo to the **cloud**.
- The cloud does the heavy editing work (fast and powerful).
- Then it sends the finished photo back to our phone.

This way, our phone stays fast and doesn't need to do all the hard work.

Why Is It Useful?

- Saves phone battery and storage
- Faster performance (cloud computers are more powerful)
- Access from anywhere (just need internet)
- Keeps apps smaller and lighter

Real-Life Examples

- Google Docs or Microsoft Office apps (we edit documents stored in the cloud)
- Mobile banking apps
- Cloud gaming (like Xbox Cloud or NVIDIA GeForce NOW)
- Photo backup apps like Google Photos

How It Works

- 1. Mobile app connects to cloud over the internet
- 2. Cloud does processing, storage, or heavy tasks
- 3. Results are sent back to the mobile device

5-Describe AWS, Azure, Google cloud Platforms

→ These are the 3 biggest cloud platforms in the world:

They let people **store data**, **run apps**, and **do computing** over the internet — without needing their own servers.

Think of them as super powerful computers and services we rent online.

1. AWS (Amazon Web Services)

- Made by **Amazon**
- Biggest and oldest cloud provider
- Offers a wide range of tools from storage to AI to gaming servers

Example: Netflix runs on AWS!

Key Features:

- EC2 (virtual servers)
- S3 (storage like an online hard drive)
- Lambda (run code without servers)

2. Microsoft Azure

- Made by **Microsoft**
- Great if we already use Windows or Microsoft Office
- Works well with tools like Excel, Outlook, Teams

Example: Many businesses use Azure for internal apps and data.

Key Features:

- Virtual Machines (VMs)
- Azure Active Directory (for login & identity)
- Azure SQL (cloud version of Microsoft's database)

3. Google Cloud Platform (GCP)

- Made by Google
- Strong in data analytics, AI/ML, and big data
- Used by companies that need fast processing or work with lots of data

Example: Spotify and Snapchat use Google Cloud.

Key Features:

- Google Compute Engine (virtual servers)
- BigQuery (fast data analysis)
- Firebase (great for mobile/web app development)

6-Accessing AWS, Azure and Google cloud Platforms (any one portal)

Step-by-Step: Accessing the AWS Console

Step 1: Go to the AWS Website

- Open your browser and go to:
 - https://aws.amazon.com

Step 2: Create an AWS Account

- Click on "Create an AWS Account"
- Fill in our:
 - Email address
 - Password
 - Name
 - Credit/debit card (AWS asks for this, but there is a Free Tier available)
- Confirm our email and identity (via text or call)

Step 3: Sign in to the AWS Console

- Go to: https://console.aws.amazon.com
- Log in with our email and password

Step 4: Explore the AWS Dashboard

Once we're in, we'll see the **AWS Management Console** — it's like the control panel for all AWS services.

- We can:
 - Launch a virtual server (EC2)
 - Store files in the cloud storage (S3)
 - Create a database (RDS)
 - o And much more

Tip: Use the Free Tier

- AWS gives free access to many services for 12 months (like 750 hours of EC2, 5 GB of S3).
- Great for students and beginners to learn and practice

7-Create compute, create network, create storage on AWS , Azure and GCP

→ 1. Compute (Virtual Machines)

This means launching a server to run our apps.

Cloud	Service	Simple Steps
AWS	EC2 (Elastic Compute Cloud)	Go to EC2 dashboard.
	(2. Click "Launch Instance".
		3. Choose an OS (like Ubuntu or Windows).
		4. Select instance type (e.g., t2.micro).
		5. Create or select a key pair.
		6. Click "Launch".
Azure	Virtual Machines	1. Go to Virtual Machines in the portal.
		2. Click "Create VM".
		3. Fill details: name, region, OS, size.
		4. Create user and password.
		5. Click "Review + Create".
GCP	Compute Engine	1. Go to VM instances .
		2. Click "Create Instance".
		3. Choose OS, machine type.
		4. Allow HTTP/HTTPS if needed.
		5. Click "Create".

2. Network (VPC, Subnets, Firewalls)

This creates the network that connects your services securely.

Cloud	Service	Simple Steps
AWS	VPC (Virtual Private Cloud)	1. Go to VPC Dashboard .
		2. Click "Create VPC".
		3. Set name, IP range (CIDR).
		4. Create subnets (public/private).
		5. Add internet gateway if needed.
Azure	Virtual Network (VNet)	1. Go to Virtual Networks.
		2. Click "Create".
		3. Set name, region, and IP range.
		4. Add subnets.
		5. Review and create.
GCP	VPC Network	1. Go to VPC network .
		2. Click "Create VPC Network".
		3. Add name, region, IP range.
		4. Add subnetworks.
		5. Create firewall rules.

3. Storage (Object Storage / Disk)

Used to store files or attach storage to VMs.

Clou d	Service	Simple Steps
AWS	S3 (Simple Storage Service)	1. Go to \$3 .
		2. Click "Create bucket".
		3. Give a unique name.
		4. Choose region.
		5. Click "Create".
Azure	Blob Storage (inside Storage Account)	1. Go to Storage Accounts .
		2. Click "Create".
		3. Fill in name, region, and performance.
		4. After it's created, go to Blob containers and create one.
GCP	Cloud Storage	1. Go to Cloud Storage.
		2. Click "Create bucket".
		3. Set name, location, storage class.
		4. Click "Create".

8-Compare Cloud pricing of resources and services on all platform Amazon Web Services (AWS):

1. AWS Pricing Models

- On-Demand: Pay per second/hour, no commitments.
- Reserved Instances (RIs): Commit for 1 or 3 years to save 35–75% echoinnovateit.com+11kinsta.com+11devhunt.org+11echoinnovateit.com+4en.wikipe dia.org+4reddit.com+4.
- Savings Plans: Flexible spend-based model across EC2/Fargate/Lambda .

- **Spot Instances**: Use spare capacity at up to 90% off—can be interrupted echoinnovateit.com+2en.wikipedia.org+2datacamp.com+2.
- **Free Tier**: 12 months free for many services + perpetual free tiers en.wikipedia.org+15en.wikipedia.org+15datacamp.com+15.

2. Compute: EC2 vs. Azure VMs vs. GCP VMs

On-Demand Pricing (general-purpose):

- AWS t4g.xlarge: ~\$0.134/hr <u>clozon.com+5certidia.com+5kinsta.com+5</u>
- Azure B4MS: ~\$0.166/hr
- GCP e2-standard-4: ~\$0.135/hr

Result: AWS & GCP neck-and-neck; Azure slightly higher clozon.com+3certidia.com+3brocoders.com+3reddit.com.

3. Storage (per GB/Month)

- AWS S3 / EBS: ~\$0.023 aws-pricing.com+10xicom.biz+10certidia.com+10
- Azure Blob: ~\$0.021 (cheapest)
- GCP Cloud Storage: ~\$0.023-0.026 certidia.com+1clozon.com+1

Azure Blob storage edges out lowest cost.

4. Networking / Data Transfer (Egress)

• AWS: \$0.05–0.09/GB reddit.comclozon.com+8reddit.com+8

• **Azure**: ~\$0.05–0.087/GB

• **GCP**: ~\$0.06–0.105/GB

All three charge similar rates; AWS egress can reach \$0.09/GB datacamp.com+1kinsta.com+1simform.com.

5. Long-Term Discounts

1-Year Commitment (Reserved/Savings/Committed Use):

- AWS Reserved / Savings: ~40–60% off reddit.com+4reddit.com+4devhunt.org+4
- Azure RIs: Up to 72% off echoinnovateit.com+4kinsta.com+4datacamp.com+4
- GCP Committed Use: 37–55% off + sustained-use discounts up to 30% reddit.com+6brocoders.com+6datacamp.com+6

GCP gives combo of committed-use + sustained-use saving; AWS gives flexibility; Azure similar to AWS.

6. Spot / Preemptible Instances

- **AWS Spot**: Up to 90% off reddit.com+3certidia.com+3reddit.com+3echoinnovateit.com+1en.wikipedia.org+1
- Azure Spot VMs: Similar model
- GCP Preemptible VMs: Lower priced, auto-stop within 24 hrs instances.vantage.sh+8datacamp.com+8echoinnovateit.com+8

7. Free Tiers

- AWS: 12-month free for many services; 15 GB/month data out included reddit.com
- Azure: 12-month free + always-free services
- GCP: \$300 credit for 90 days + always-free tiers datacamp.com