AWS EBS (Elastic Block Store) – Full Notes

🔹 **What is EBS?**

Amazon **EBS (Elastic Block Store)** is **block-level storage** that you can attach to EC2 instances. It behaves like a traditional hard drive or SSD.

- **Persistent**: Data remains after instance stops.
- **Attached to EC2**: One EBS volume can only attach to one EC2 instance at a time (except Multi-Attach).
- **Highly available** within a single **Availability Zone**.

🔹 **EBS Volume Types (2024)**

Type	Use Case	Max IOPS / Throughput
gp3	General purpose SSD (default)	16,000 IOPS / 1,000 MB/s
gp2	Previous-gen general SSD	Performance scales with size
io2/io1	High-performance SSD	Up to 256,000 IOPS (io2 Block Express)
st1	Throughput-optimized HDD	Big data, log processing
sc1	Cold HDD	Infrequently accessed data
Magnetic	Deprecated legacy HDD	Low-cost, legacy support

💡 **gp3** is the recommended default for most workloads.

🔹 **EBS Features**

- **Snapshots**: Point-in-time backups stored in S3.
- **Encryption**: At rest using AWS KMS (automatic for new volumes).
- **Multi-Attach**: io1/io2 volumes can be attached to multiple EC2 instances (Nitro only).
- **Resize on the fly**: Can increase size, IOPS, and throughput without downtime.
- **Volume Lifecycle Management**: Automate snapshot backups with Amazon Data Lifecycle Manager (DLM).

🔹 **EBS vs Instance Store**

Feature	EBS	Instance Store
Persistent	✅ Yes	❌ No (ephemeral)
Resizable	✅ Yes	❌ No
AZ Scope	Single AZ	Single AZ
Use Case	General use	High-speed temp storage
Data on Stop/Terminate	✅ Retained (unless deleted)	❌ Lost

🔹 **Snapshot Usage**

- Can be used to **create a new volume** or **copy across regions**.
- **Incremental**: Only the changed blocks are stored.
- Supports **Fast Snapshot Restore (FSR)** for low-latency volume creation.

🔹 **Best Practices (EBS)**

✅ Use **gp3 or io2** based on workload
✅ Always enable **encryption** (enabled by default)
✅ Schedule **automated snapshots**
✅ Prefer **Multi-AZ apps** to survive AZ failures
✅ Use **EBS-optimized** EC2 instances for high performance

📘 **AWS EFS (Elastic File System) – Full Notes**

🔹 **What is EFS?**

Amazon EFS is a **fully managed, serverless, scalable file system** for use with AWS services and on-premises systems.

- **Network file system (NFSv4.1/v4.2)**
- Mountable on **multiple EC2 instances simultaneously**
- Designed for **shared access**, like Linux file systems

🔹 **EFS Features**

Feature	Description
Fully managed	No provisioning or scaling needed
Elastic	Grows and shrinks automatically
Multi-AZ	Data is stored redundantly across multiple AZs
POSIX compliant	Supports Linux file permissions
Encryption	In transit and at rest (via KMS)
Backup Integration	Built-in support with AWS Backup
Access Points	Simplified sharing and isolation per app/user

🔹 **EFS Storage Classes**

Storage Class	Use Case	Cost
Standard	Frequently accessed files	High
Infrequent Access (IA)	Cost-optimized for less-accessed files	~92% cheaper

- You can use **Lifecycle Management** to move files to IA after N days.

🔹 **EFS Performance Modes**

Mode	Description
General Purpose	Default, low-latency for most apps
Max I/O	High throughput for big data or analytics workloads (adds some latency)

🔹 **EFS Throughput Modes**

Mode	Description
Bursting	Scales with file system size
Provisioned	You define throughput (e.g., 100 MiB/s)

🔹 **Mounting EFS**

Mount using:

sudo mount -t nfs4 -o tls fs-xxxxxxxx.efs.<region>.amazonaws.com:/ /mnt/efs

Use **EFS mount helper** or fstab entries for auto-mounting on boot.

🔹 **EFS vs EBS vs S3**

Feature	EBS	EFS	S3
Type	Block Storage	File Storage	Object Storage
Multi-AZ	❌ (AZ-specific)	✅ (multi-AZ)	✅ (global)
Multi-attach	Limited (io2 only)	✅ Yes	✅ Yes (HTTP APIs)
Use Case	OS disk, DBs	Shared file system	Backup, archive, web hosting

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🔹 **EFS Security**

- Integrated with **IAM** and **POSIX permissions**
- Supports **VPC security groups**
- Supports **KMS encryption**
- Use **Access Points** to isolate app directories

🔹 **Pricing (as of 2024)**

Service	Pricing Model
EBS	Per GB/month + IOPS (for io2)
EFS Standard	Per GB/month
EFS IA	Much lower per GB, + per request
Snapshots	Separate cost (for EBS only)

Use AWS Cost Explorer to optimize costs.

🔹 **Best Practices (EFS)**

✅ Use **IA lifecycle policy** to cut costs
✅ Always enable **encryption**
✅ Use **Access Points** to isolate users/apps
✅ Combine with **Mount Targets** in each AZ
✅ Monitor with **CloudWatch metrics**

🔹 **Common Use Cases**

Use Case	EBS	EFS
OS Boot Disk	✅ Yes	❌ No
Databases (e.g., MySQL)	✅ Recommended	❌ Not ideal
Shared Storage	❌ No	✅ Yes
Machine Learning Output	✅ Fast read/write	✅ Shared output
WordPress or Web Hosting	✅ or ❌	✅ Ideal for PHP code
HPC / Analytics	✅ or io2	✅ Max I/O mode