### **Amazon DynamoDB**

### ⚡ **Amazon DynamoDB — At a Glance**

* 🛠️ Type: Serverless, NoSQL, fully managed database
* ⏱️ Performance: Millisecond response at any scale
* 📈 Scalability: Auto-scales to billions of requests/hour
* 🧳 Use Case: Ideal for operational workloads (e.g., shopping carts, user profiles)
* 🌍 Global Reach: Powers apps for Amazon.com, Alexa, fulfillment centers, etc.
* 🔁 High Availability: Built-in redundancy and fault tolerance
* 💸 Cost-Effective: Pay-per-request with no infrastructure to manage
* 🚫 No Servers to Manage: Truly serverless — focus on building, not provisioning

### ⚙️ **Key Characteristics of Amazon DynamoDB**

* 🧑‍💻 Serverless
  + No servers to manage, patch, or maintain
  + Auto-scales up/down with zero downtime
  + Pay only for what you use (on-demand pricing)
* 📦 NoSQL
  + Supports key-value & document models
  + No JOINs — encourages denormalized design
  + ACID transactions + strong read consistency
* 🛠️ Fully Managed
  + AWS handles all ops: setup, maintenance, backups, scaling, security
  + Always production-ready — no manual upgrades or patches
* ⚡ High Performance at Scale
  + Consistent single-digit millisecond response
  + Handles huge scale (millions of requests/sec, 100+ TB tables)
  + Powers high-traffic apps like Amazon.com & Alexa

### 🎯 **DynamoDB Use Cases**

* 💳 Financial Services
  + Live trading, loans, transactions
  + Global tables for fast, regional access
  + Supports ACID for secure operations
* 🎮 Gaming
  + Game state, player data, leaderboards
  + Auto-scales during peak gameplay
  + No cold starts, perfect for bursty traffic
* 📺 Streaming & Media
  + Metadata indexing, watchlists, real-time stats
  + Billions of events processed daily
  + Great for recommendation engines
* 🔄 Serverless Apps (General)
  + Start small, scale globally
  + Zero manual scaling/ops
  + High availability, low latency at any load

### 🚀 **Key Capabilities of Amazon DynamoDB**

* 🌍 Global Tables
  + Multi-region, multi-active replication with 99.999% availability
  + No primary needed, no downtime on region failover
* 🔐 ACID Transactions
  + All-or-nothing operations across items/tables
  + Native, server-side transaction support for complex logic
* 📡 Change Data Capture (CDC)
  + Near real-time item-level change tracking
  + Supports DynamoDB Streams and Kinesis Data Streams
* 🔎 Secondary Indexes
  + Query data using attributes other than the primary key
  + Supports both Global and Local Secondary Indexes (GSI, LSI)

### 🔌 **Service Integrations**

* AWS CloudFormation – Infrastructure as code
* Amazon CloudWatch – Performance monitoring
* Amazon S3 – Import/export for analytics & ML
* IAM – Access control & security
* Auto Scaling – Automatic capacity adjustment

### ⚡ **Serverless Integrations**

* AWS Lambda – Triggers on data change (Streams)
* Amazon API Gateway – Create REST APIs
* AWS AppSync – Build GraphQL APIs
* Kinesis Data Streams – Capture change data in real-time

### 📤 **S3 Import/Export**

* Full table or incremental exports
* Import to new tables easily
* Useful for analytics & backup

### 🔀 **Zero-ETL Integrations**

* Amazon Redshift – Run analytics directly
* OpenSearch – Full-text & vector search
* ⚠️ No impact on live workloads

### 🚀 **Caching with DAX**

* In-memory cache for DynamoDB
* 10x performance boost (μs latency)
* Fully managed — no manual caching logic

### 🔐 **DynamoDB Security Highlights**

* IAM-based access – No usernames/passwords; all access via IAM roles and policies
* Fine-grained control – Permissions down to individual item attributes
* Resource policies – Use BPA & IAM Access Analyzer to lock down access
* Encryption at rest – Default; uses AWS KMS (AWS-owned, managed, or customer keys)
* Seamless encryption – No code changes needed; zero performance impact
* Client-side encryption – Optional via AWS Database Encryption SDK
* Compliance – Meets HIPAA, PCI DSS, GDPR standards

### 🛡️ **DynamoDB Resilience Features**

* 99.99% Availability SLA
* Data auto-replicated across 3 Availability Zones
* Global Tables – Multi-Region replication
* Continuous backups + point-in-time recovery
* On-demand backups & restores for flexibility

### 🌍 **Global Tables**

* Multi-Region, multi-active replication
* 99.999% availability SLA
* No primary table — all replicas are active
* Integrated with AWS Fault Injection Simulator (FIS) for resilience testing

### 🕒 **Continuous Backups & Point-in-Time Recovery**

* Restore to any second in the past 1–35 days
* No impact on performance or capacity
* Great for accidental deletes or corruption recovery

### 💾 **On-Demand Backup & Restore**

* Full table backups for long-term retention
* No performance impact
* Integrated with AWS Backup for scheduling, tagging, lifecycle, and cross-region copies

### 🧑‍💻 **Accessing DynamoDB**

* AWS Console – Web UI
* AWS CLI – Command-line control
* DynamoDB APIs – Programmatic access
* NoSQL Workbench – Visual modeling & query tool

### 💸 **Pricing Overview**

* Charges for reads, writes, and storage
* Two modes:
  + On-Demand – Pay per request
  + Provisioned – Pre-allocate capacity (WCU/RCU)
* ✅ Free Tier:
  + 25 GB storage
  + 25 WCU + 25 RCU (≈200M requests/month)