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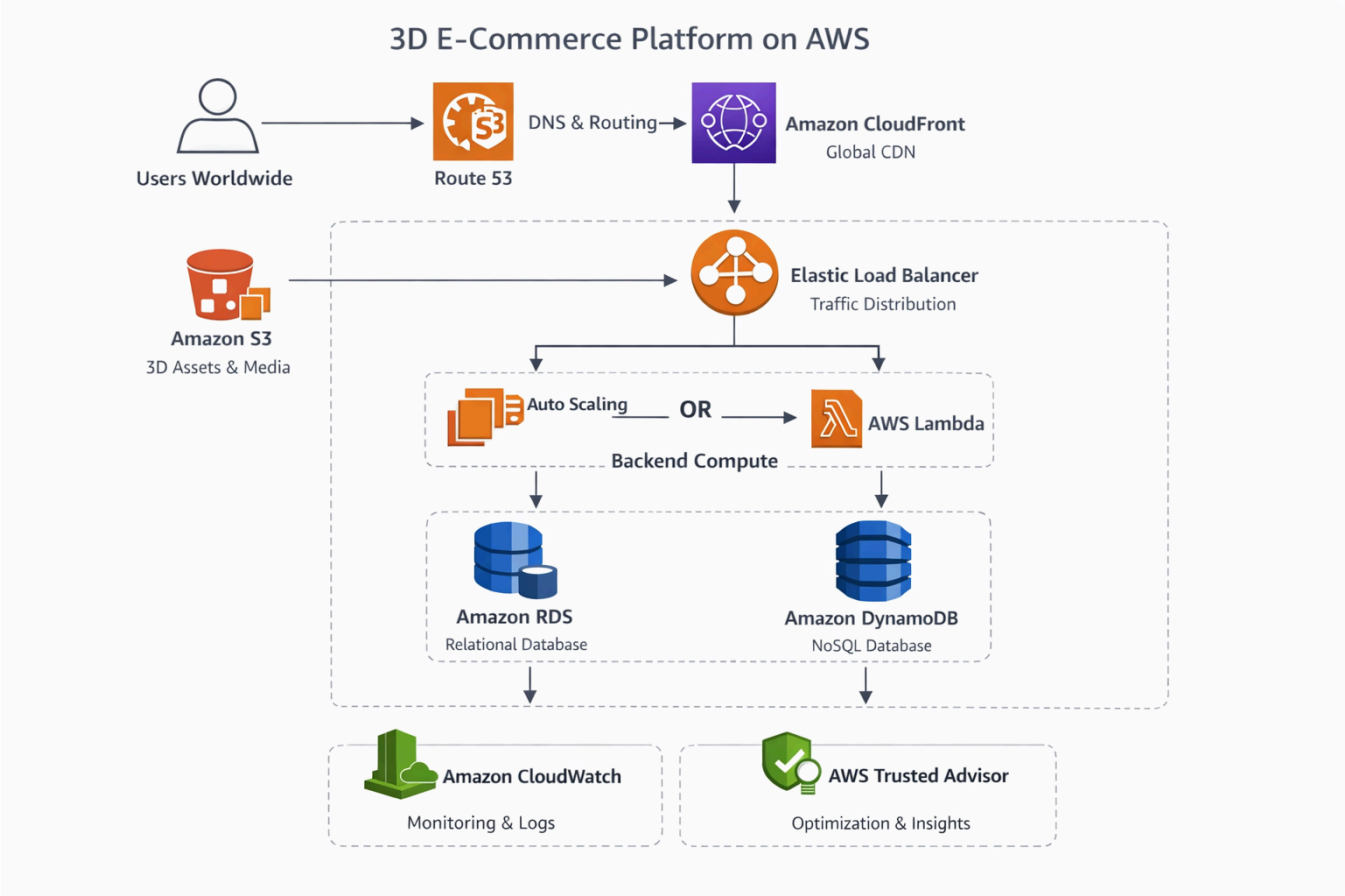
3D E-Commerce Platform Architecture on AWS



Architecture Overview

The 3D e-commerce platform is designed using core AWS managed services to ensure high availability, scalability, performance, security, and cost optimization.

Explanation of AWS Service Choices

1. Amazon S3 – 3D Asset Storage

S3 stores 3D models, product images, textures, and static web assets.

Why chosen:

- Highly durable (11 9's durability).
- Scales automatically.
- Integrates directly with CloudFront.
- Cost-effective storage tiers.

Benefit: Ensures reliable and scalable delivery of large 3D files.

2. CloudFront – Global Content Delivery

CloudFront caches content at edge locations worldwide.

Why chosen:

- Reduces latency by serving users from the nearest edge location.
- Caches 3D assets and static web files.
- Protects backend by reducing direct origin requests.

Benefit: Improves 3D rendering speed and global performance.

3. EC2 / AWS Lambda – Backend Compute

Option A: EC2 with Auto Scaling

- Suitable for persistent backend services.
- Auto Scaling adjusts instance count based on traffic.

Option B: AWS Lambda (Serverless)

- Ideal for event-driven APIs.
- No server management.
- Scales automatically.

Benefit: Handles unpredictable traffic spikes efficiently.

4. Elastic Load Balancer (ELB)

Distributes incoming traffic across multiple EC2 instances or containers.

Why chosen:

- Increases fault tolerance.
- Prevents overload on individual servers.
- Performs health checks.

Benefit: Ensures high availability and reliability.

5. RDS / DynamoDB – Data Layer

Amazon RDS

- Used for transactional data (orders, payments, user accounts).
- Multi-AZ deployment for high availability.

Amazon DynamoDB

- Used for high-scale product catalog and session data.
- Millisecond latency at any scale.

Benefit: Supports both structured and high-velocity data workloads.

6. Route 53 – DNS and Traffic Routing

- Highly available DNS.
- Supports health checks and failover routing.
- Can implement latency-based routing for global users.

Benefit: Ensures reliable and intelligent traffic distribution.

7. CloudWatch & Trusted Advisor – Monitoring and Optimization

CloudWatch

- Monitors metrics (CPU, memory, request counts).
- Triggers Auto Scaling.
- Creates alarms.

Trusted Advisor

- Provides cost, security, and performance recommendations.

Benefit: Maintains operational excellence and cost efficiency.

How the Architecture Meets the 5 Requirements

1. High Availability

- Multi-AZ RDS deployments.
- Auto Scaling EC2 across multiple Availability Zones.
- ELB distributes traffic across healthy instances.
- S3 and CloudFront are inherently highly available.
- Route 53 health checks enable failover routing.

Result: Platform operates 24/7 with minimal downtime.

2. Scalability

- Auto Scaling for EC2.
- Lambda scales automatically with requests.
- DynamoDB supports virtually unlimited scaling.
- CloudFront reduces backend load.

Result: Handles millions of global users and traffic spikes.

3. Performance

- CloudFront edge caching reduces latency.
- S3 delivers high throughput asset access.
- DynamoDB provides single-digit millisecond latency.
- Load balancer ensures smooth traffic flow.

Result: Fast page loads and smooth 3D rendering.

4. Security

Security best practices include:

- IAM roles with least privilege access.
- S3 bucket policies and encryption.
- HTTPS via CloudFront and ACM certificates.
- Security Groups and NACLs for network protection.
- RDS encryption at rest.
- CloudWatch logging for monitoring suspicious activity.

Result: Secure handling of customer data and transactions.

5. Cost Optimization

- Auto Scaling prevents over provisioning.
- Lambda eliminates idle server costs.
- S3 lifecycle policies move old assets to cheaper tiers.
- CloudWatch monitors unused resources.
- Trusted Advisor identifies cost saving opportunities.

Result: Optimized spending while maintaining performance.

Design Trade-offs and Challenges

1. EC2 vs Lambda
    - EC2 offers more control but requires management.
    - Lambda is easier but may have cold start latency.
2. RDS vs DynamoDB
    - RDS is ideal for structured transactional data.
    - DynamoDB offers extreme scalability but requires NoSQL design patterns.
3. Global Scale Complexity
    - Multi-region deployments increase resilience but add architectural complexity and cost.

Conclusion

This AWS architecture leverages managed services to build a highly available, scalable, secure, and cost-efficient 3D e-commerce platform. By combining S3, CloudFront, EC2/Lambda, ELB, RDS/DynamoDB, Route 53, and CloudWatch, the solution supports millions of users globally while maintaining smooth 3D interactions and operational excellence.