Build High-Performance Apps with In-Memory Data (Level 200)

Ganesh Raja, Solution Architect

µs is the new ms

Amazon ElastiCache

Amazon ElastiCache

In-memory key-value store supporting

- Redis 3.2.10 New
- Memcached 1.4.34

High-performance

Fully managed; zero admin

Highly available and reliable

Hardened by Amazon

Redis Overview

Ridiculously fast!
<1 ms latency for most commands

In-memory data structure server

Open source

Powerful
~200 commands + Lua scripting

redis

Persistence

Utility data structures
Strings, lists, hashes, sets, sorted sets, bitmaps, and HyperLogLogs

Highly available
replication

Simple

Atomic operations
supports transactions

aws | intel

and there is more…

and there is more…

Run Lua scripts

and there is more…

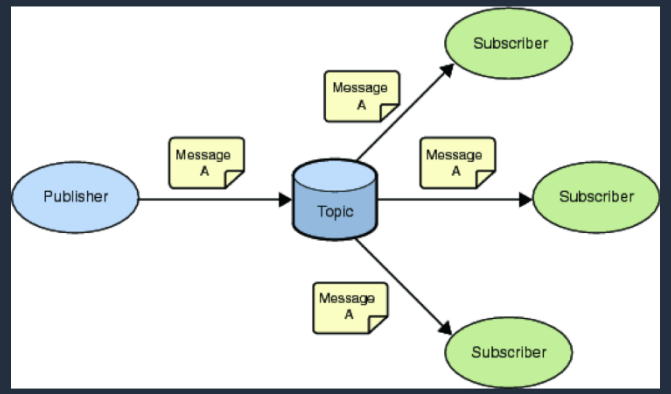
Run Lua scripts

Geospatial queries

and there is more…

Run Lua scripts

Geospatial queries



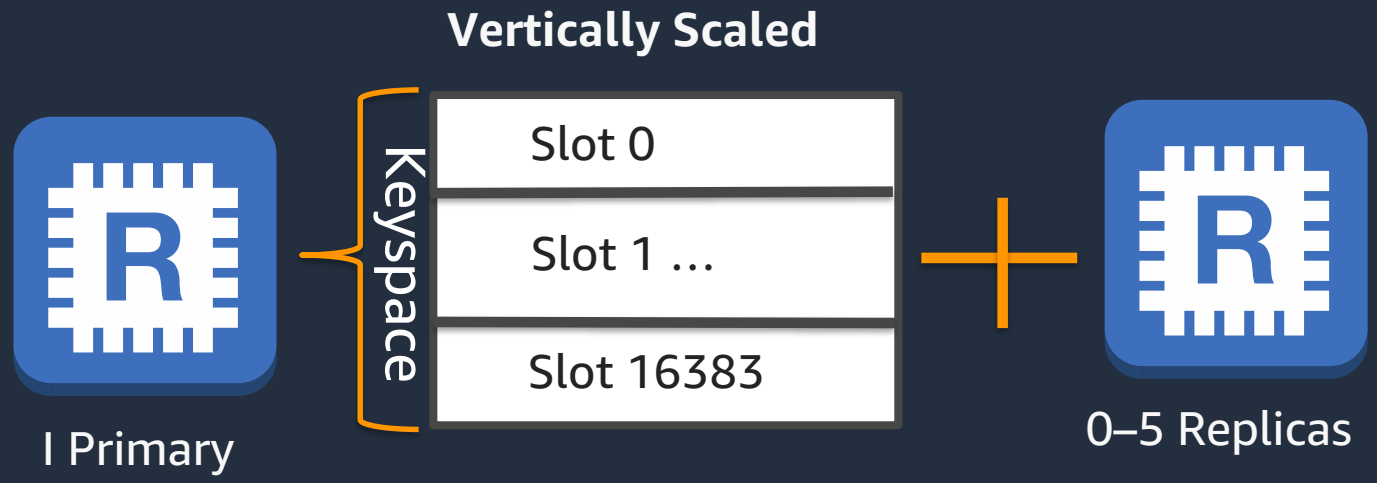
Pub/sub

Redis topologies

Cluster Mode Disabled

Max Storage 407 GiB

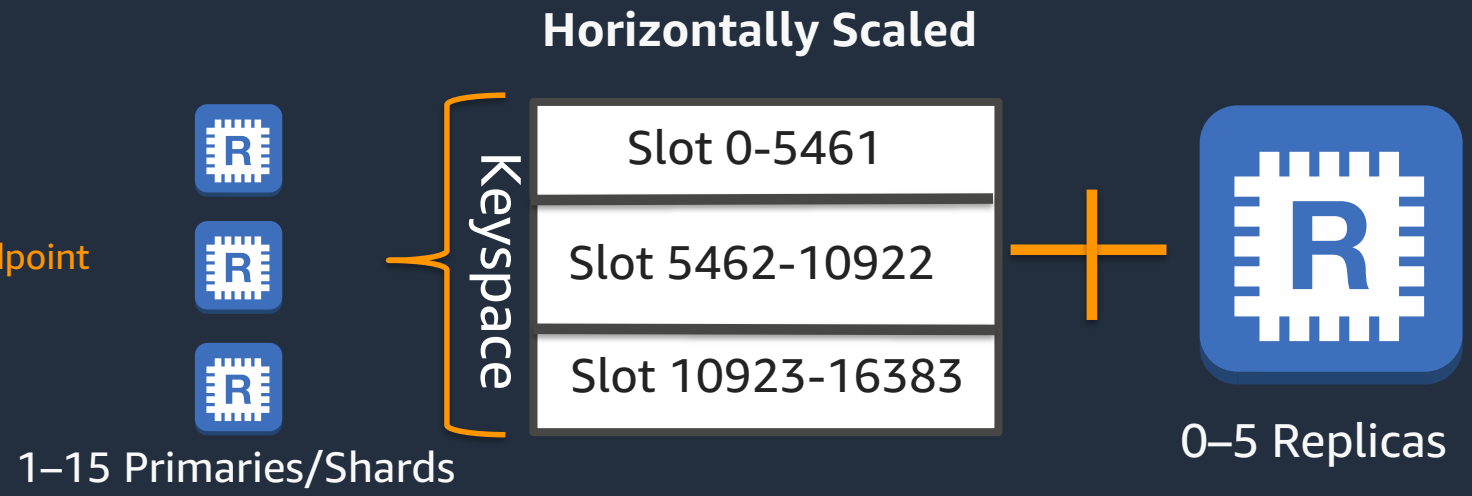
Primary Endpoint



Cluster Mode Enabled

Max Storage 6+ TiB

Configuration Endpoint



Redis cluster-mode enabled vs. disabled

Feature	Enabled	Disabled
Failover	15–30 sec (Non-DNS)	~1.5 min (DNS-based)
Failover risk	• Writes affected—partial dataset (less risk with more partitions) • Reads available	• Writes affected on entire dataset • Reads available
Performance	Scales with cluster size (90 nodes—15 primaries + 0–5 replicas per shard)	6 nodes (1 primary + 0–5 replicas)
Max connections	• Primaries (65,000 x 15 = 975,000) • Replicas (65,000 x 75 = 4,875,000)	• Primary: 65,000 • Replicas: (65,000 x 5 = 325,000)
Storage	6+ TiB	407 GB
Cost	Smaller nodes but more $$	Larger nodes less $

Amazon ElastiCache Encryption and Compliance

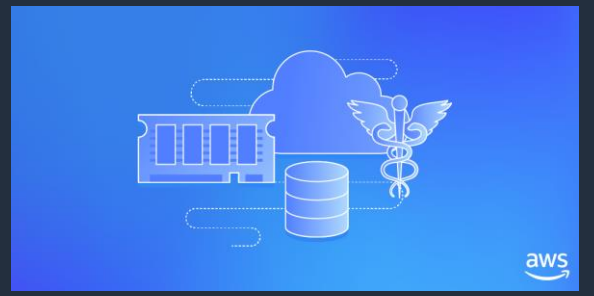
New

Encryption

- In-Transit: encrypt all communications between clients and Redis server as well as between nodes
- At-Rest: encrypt backups on disk and in Amazon S3
- Fully managed: setup via API or console, automatic issuance and renewal

Compliance

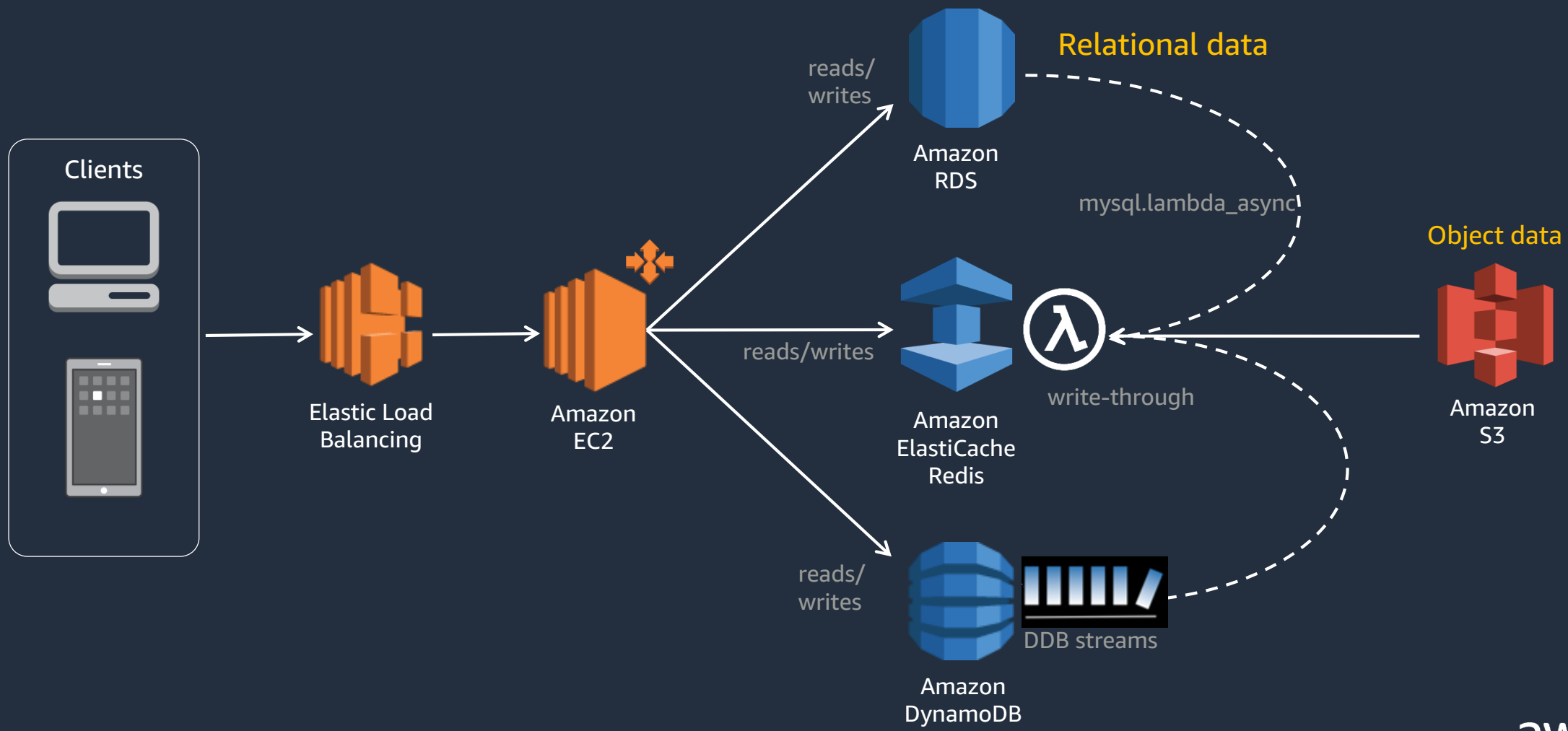
- HIPAA eligibility for ElastiCache for Redis
- Included in AWS Business Associate Addendum
- Redis 3.2.6



Usage patterns

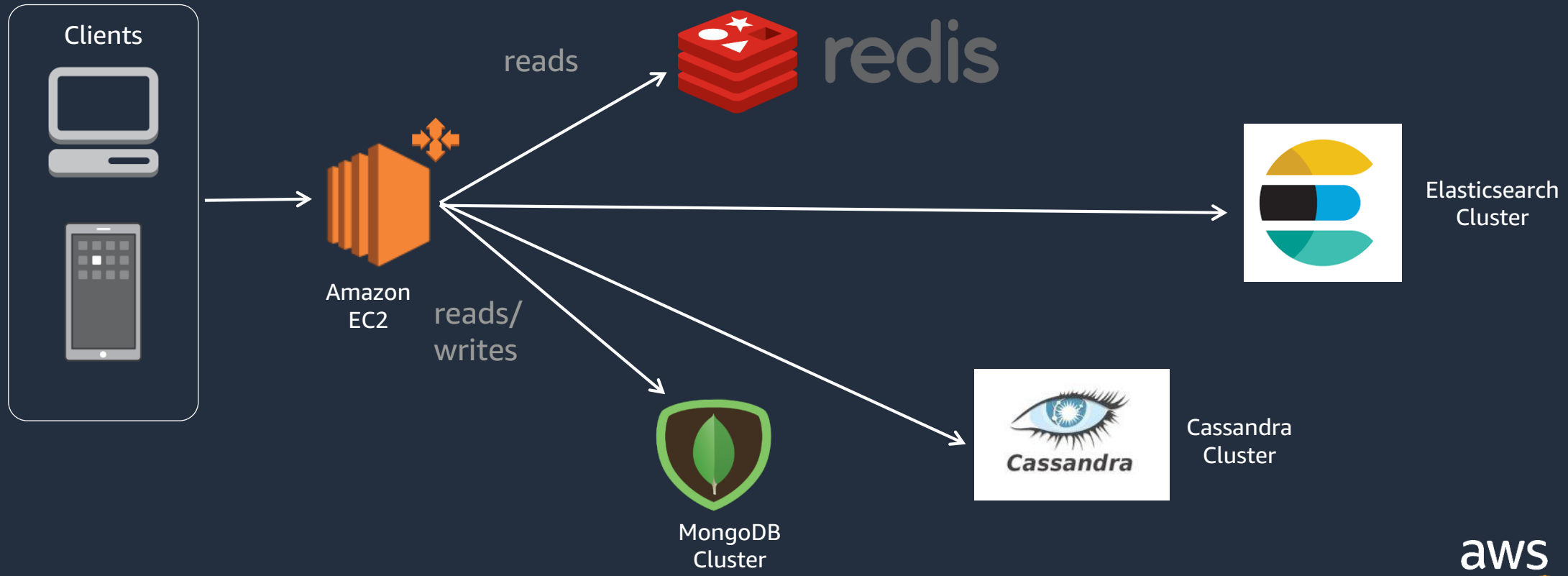
Session management	Database caching	APIs (HTTP responses)
IOT	Streaming data analytics (Filtering/aggregation)	Pub/sub
Social media (Sentiment analysis)	Standalone database (Metadata store)	Leaderboards

Caching


Clients
Elastic Load Balancing
Amazon EC2
reads/ writes
Amazon RDS
Relational data
mysql.lambda_async
reads/writes
Amazon ElastiCache Redis
write-through
Object data
Amazon S3
reads/ writes
DDB streams
Amazon DynamoDB
Unstructured data

Caching NoSQL

- ✓ Smaller NoSQL DB clusters needed = lower costs
- ✓ Faster data retrieval = better performance



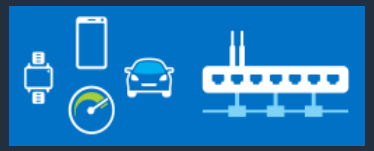
Big data architectures using Redis

Data Sources

Collect

Amazon Kinesis

Amazon EC2



AWS IoT

Process

Spark Streaming on Amazon EMR

Apache Kafka

Apache Storm on EMR

AWS Lambda

Amazon Kinesis app

Store

Amazon ElastiCache

Amazon S3

Analyze

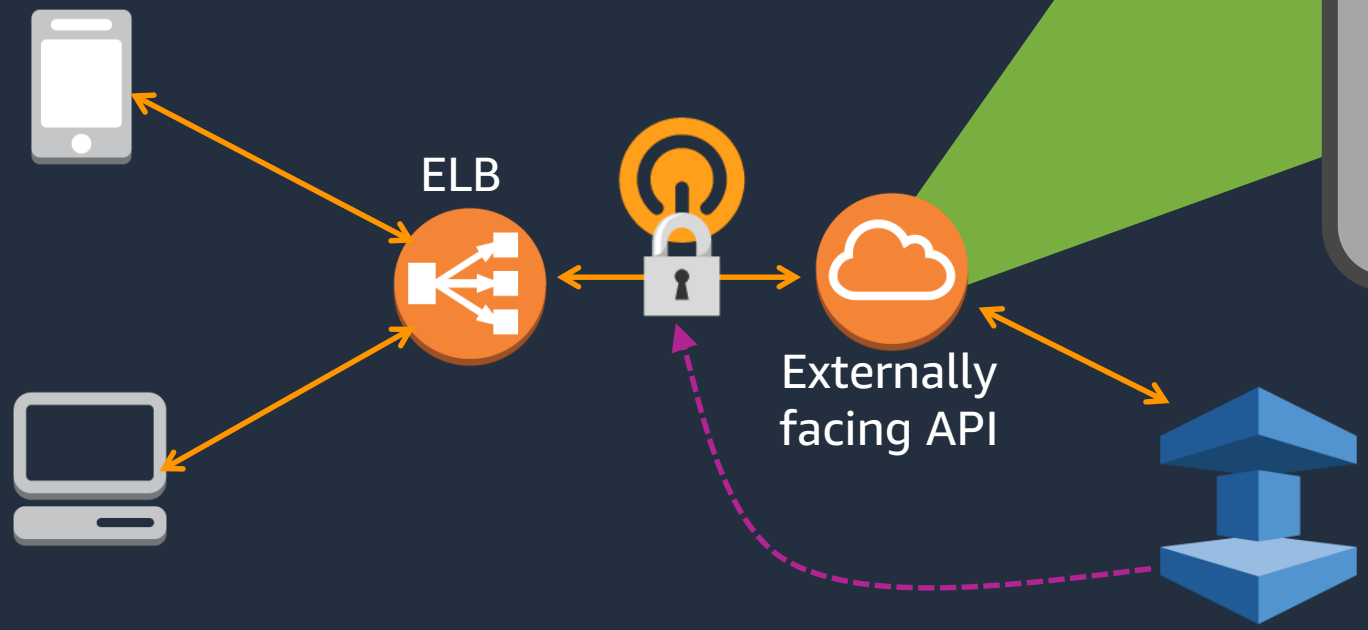
Spark on Amazon EMR

AWS Lambda

Custom app

Rate Limiting

Ex: throttling requests to an API uses Redis counters




```
FUNCTION LIMIT_API_CALL(APIaccesskey)
limit = HGET(APIaccesskey, “limit”)
time  = CURRENT_UNIX_TIME()
keyname = APIaccesskey + ":” + time
count = GET(keyname)
IF current != NULL && count > limit THEN
   ERROR "API request limit exceeded"
ELSE
   MULTI
      INCR(keyname)
      EXPIRE(keyname,10)
   EXEC
   PERFORM_API_CALL()
END
```

Reference: http://redis.io/commands/INCR

Near Real-time Dashboard Demo

Amazon ElastiCache

Scenario:

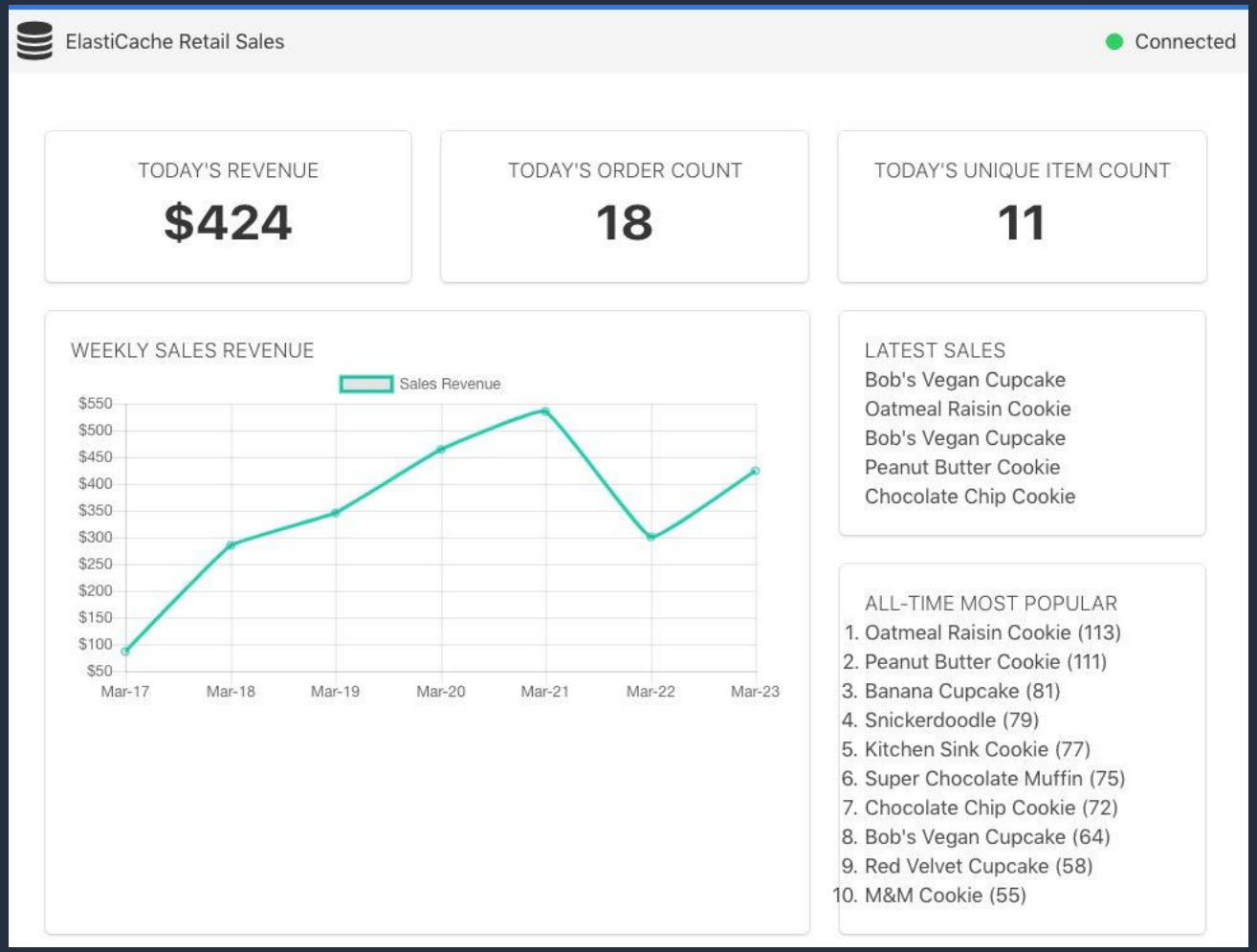
- High-Volume E-Commerce Website
- Data Streaming with Amazon Kinesis Streams
- Need insight into the real-time sales analytics data for the current hour and day
- Very Latency Sensitive
- Current Relational DBs are already maxed out.

Amazon ElastiCache

Metrics:

- Daily Order Count
- Unique Items Sold
- Product Leaderboard
- Recently Orders
- Historical Sales Revenue by Day

Dashboard


ElastiCache Retail Sales
Connected
TODAY'S REVENUE
$424
TODAY'S ORDER COUNT
18
TODAY'S UNIQUE ITEM COUNT
11
WEEKLY SALES REVENUE
Sales Revenue
$550
$500
$450
$400
$350
$300
$250
$200
$150
$100
$50
Mar-17
Mar-18
Mar-19
Mar-20
Mar-21
Mar-22
Mar-23
LATEST SALES
Bob's Vegan Cupcake
Oatmeal Raisin Cookie
Bob's Vegan Cupcake
Peanut Butter Cookie
Chocolate Chip Cookie
ALL-TIME MOST POPULAR
1. Oatmeal Raisin Cookie (113)
2. Peanut Butter Cookie (111)
3. Banana Cupcake (81)
4. Snickerdoodle (79)
5. Kitchen Sink Cookie (77)
6. Super Chocolate Muffin (75)
7. Chocolate Chip Cookie (72)
8. Bob's Vegan Cupcake (64)
9. Red Velvet Cupcake (58)
10. M&M Cookie (55)

Amazon ElastiCache

- ElastiCache:
  - Very Complex SQL Queries on Relational DBs
  - Millisecond Performance
- Elasticsearch:
  - Complex queries and computationally expensive
- Kinesis Analytics:
  - Query Complexity, Performance, and Data Retention.

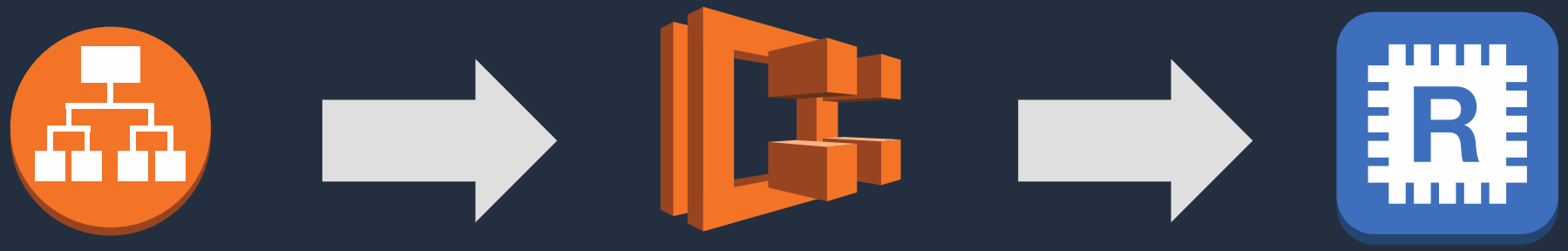
Ingestion Architecture

Kinesis Stream

AWS Lambda

Amazon ElastiCache Redis

Dashboard Architecture

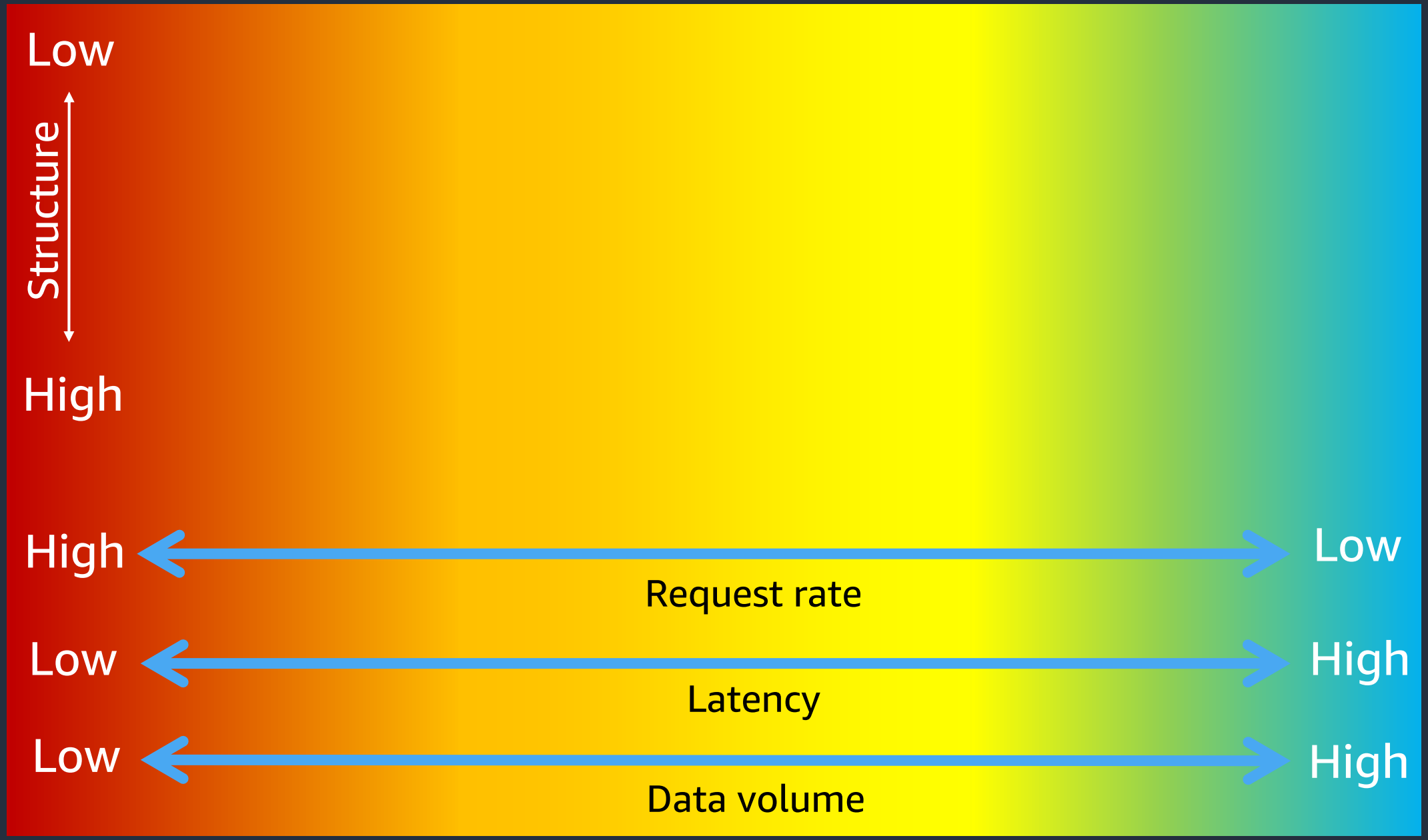


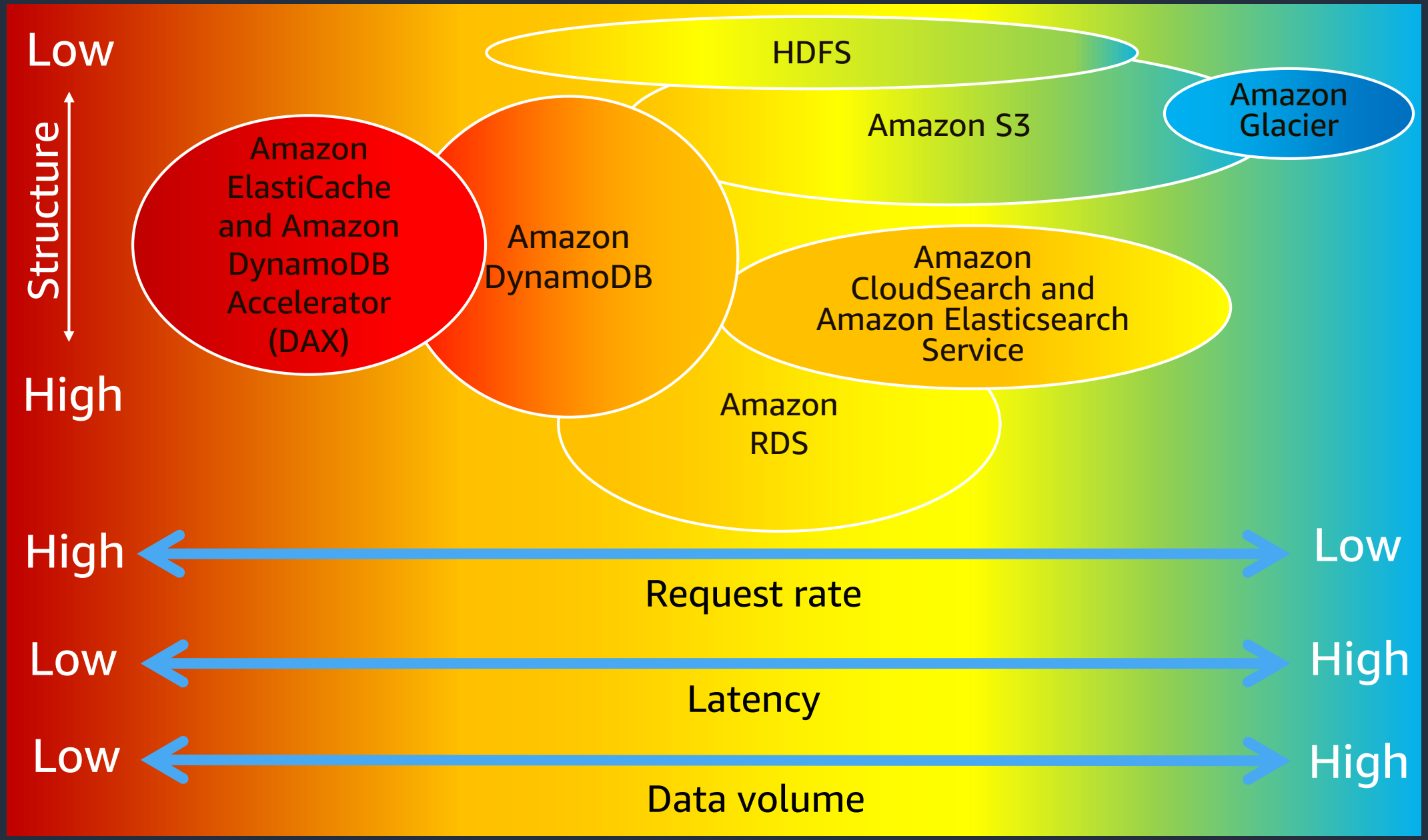
Application Load Balancer

Amazon ECS Fargate

Amazon ElastiCache Redis

Near Real-time Dashboard Demo





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- Monitor Cache HIT/MISS ratio and alarm on poor performance
- Use failover API to test application resiliency

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