Databases on AWS

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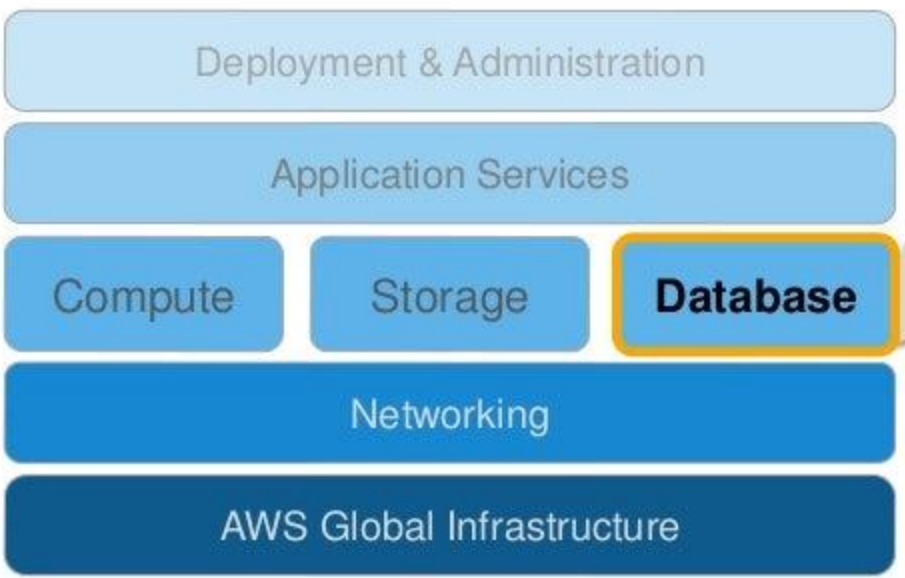
Amazon Web Services, Business Development Manager
Database Services, Asia Pacific

Time : 10:10 – 11:00

AWS Database Services



Why Managed Databases?

If you host your databases on-premises

- App optimization
- Scaling
- High availability
- Database backups
- DB s/w patches
- DB s/w installs
- OS patches
- OS installation
- Server maintenance
- Rack & stack
- Power, HVAC, net

If you host your databases in EC2

App optimization

Scaling

High availability

Database backups

DB s/w patches

DB s/w installs

OS patches

OS installation

Server maintenance

Rack & stack

Power, HVAC, net

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If you choose a managed DB service like RDS

- Scaling
- High availability
- Database backups
- DB s/w patches
- DB s/w installs
- OS patches
- OS installation
- Server maintenance
- Rack & stack
- Power, HVAC, net

Amazon RDS

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differentiated effort increases the uniqueness of an application

Amazon RDS

Relational Databases

Managed Service

Simple and fast to scale

Fast, predictable performance

Low cost, pay for what you use

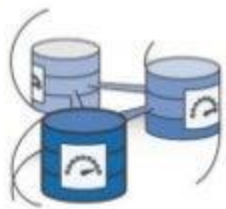
MySQL

Microsoft SQL Server

ORACLE

PostgreSQL

MariaDB



Amazon Aurora

Key Features

- Provision a database in 6 minutes
- Provision a MAZ database with a few mouse clicks
- Scale a database up/down with 60-90 seconds downtime
- Apply patches with 60-90 seconds downtime
- Add read replicas with a few mouse clicks
- Protect your backups and logs with 11 9's of durability
- Recover to any point in time from nightly backups + logs
- Detailed metrics, down to 1 second intervals
- Secure your data with single click encryption at rest

Amazon RDS Customers

Demo

Amazon Aurora

What is Amazon Aurora?

MySQL-compatible and PostgreSQL-compatible relational database platform

Performance and availability of commercial databases

Simplicity and cost-effectiveness of open source databases

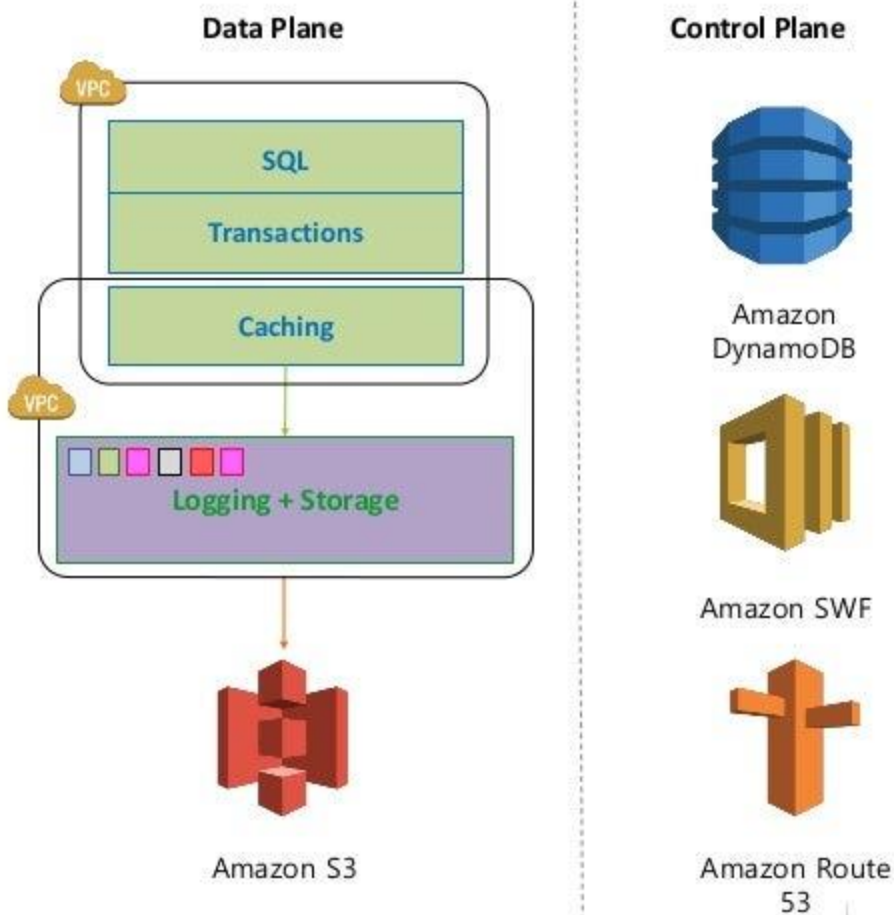
Delivered as a managed service

A service-oriented architecture applied to the database

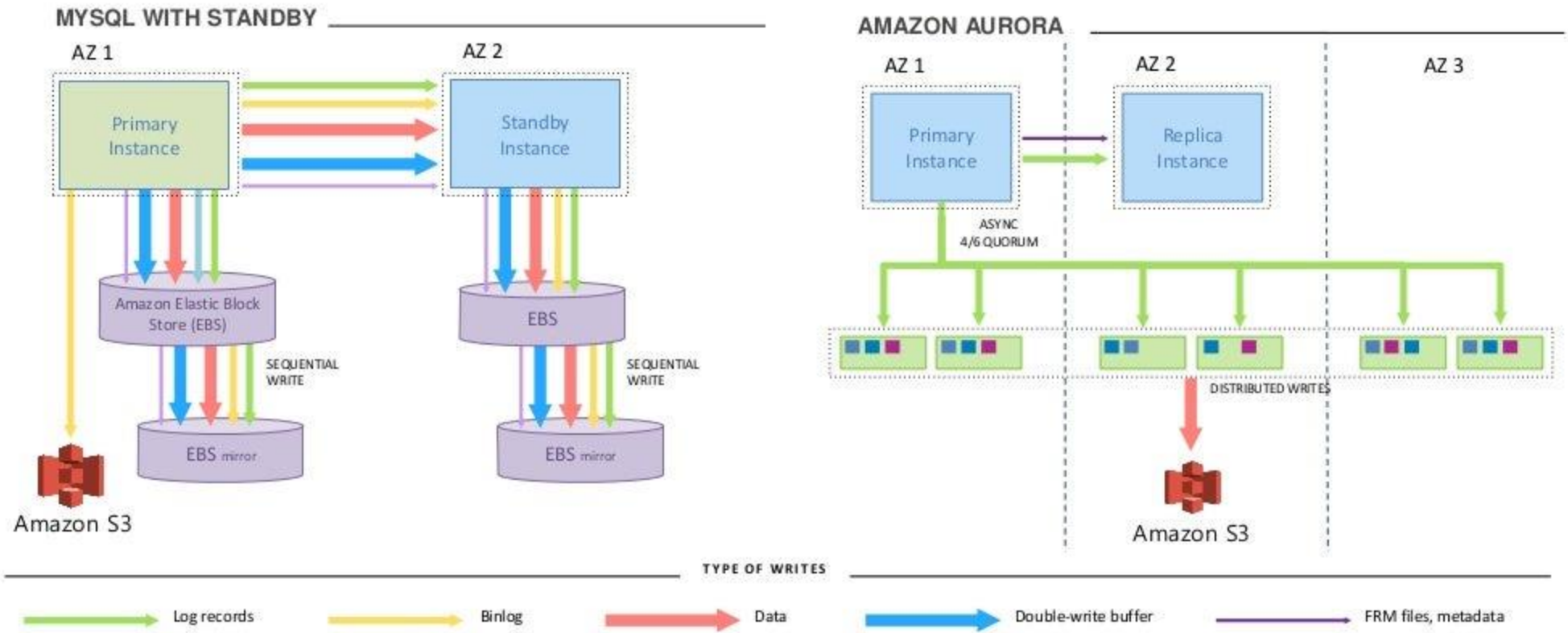
1. Moved the logging and storage layer into a multitenant, scale-out database-optimized storage service

2. Integrated with other AWS services like Amazon EC2, Amazon VPC, Amazon DynamoDB, Amazon SWF, and Amazon Route 53 for control plane operations

3. Integrated with Amazon S3 for continuous backup with 99.999999999% durability



I/O traffic patterns: MySQL vs. Aurora



Key Features

- Highly available storage, with 6 copies across 3 AZs
- No more MySQL replica lag!
- Auto-scaling storage for IOPS and capacity
- Parallel, distributed & asynchronous recovery
- Survivable caches: quick restart & no brown outs
- Faster, more predictable failover
- Up to 5x faster than MySQL and more than 2x faster than PostgreSQL on the same hardware
- Cheaper at scale!

Recent Announcements

- **Performance enhancements**: Fast DDL, fast index build, spatial indexing, hot row contention
- **Availability features**: Zero-downtime patching, database cloning (Q2), database backtrack (Q2)
- **Eco-system integration**: Load from S3, IAM integration (Q2), select into S3 (Q2), log upload to CloudWatch Logs & S3 (Q2)
- **Cost reduction**: t2.small – cuts cost of entry by half – you can run Aurora for $1 / day
- **Growing footprint**: London, Montreal, Ohio, and San Francisco – now available in all 3AZ regions

2/3 of top 100 AWS customers

8 of top 10 gaming customers

Fastest growing service in AWS history

RDS Engine Capability Matrix

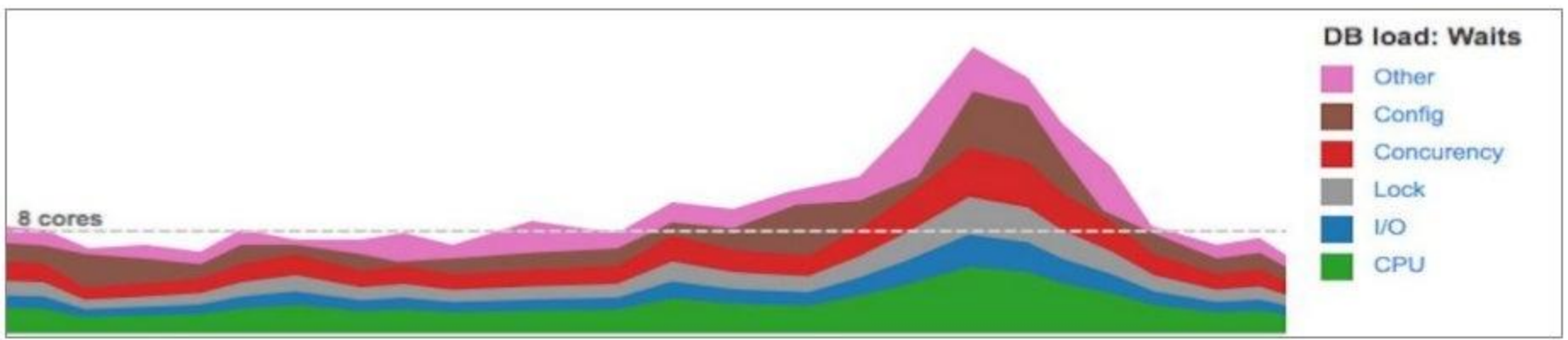
Feature	Aurora	MySQL	MariaDB	PostgreSQL	Oracle	SQL Server
VPC	✓	✓	✓	✓	✓	✓
High availability	✓	✓	✓	✓	✓	✓
Instance Scaling	✓	✓	✓	✓	✓	✓
Encryption	✓	✓	✓	✓	✓	✓
Read replicas	✓	✓	✓	✓	Oracle Golden Gate / DMS	DMS
Cross region replicas	✓	✓	✓	✓		
Max Storage	64 TB	6 TB	6 TB	6 TB	6 TB	4 TB
Scale Storage	Auto scaling	✓	✓	✓	✓	
Provisioned IOPS	NA	30,000	30,000	30,000	30,000	20,000
Largest Instance	R3.8XL	R3.8XL M4.10XL	R3.8XL M4.10XL	R3.8XL M4.10XL	R3.8XL M4.10XL	R3.8XL M4.10XL

Performance Insights

Performance Insights at a glance

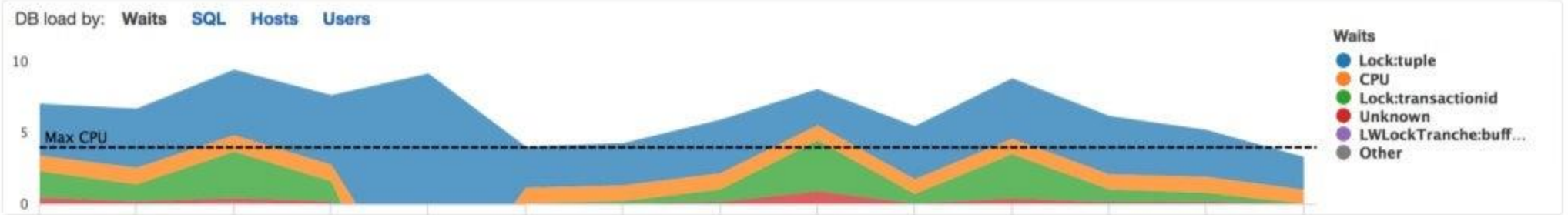
- Automates sampling of data
- Exposes data via API
- Provides UI to show Database Load

Database Load:



Last 5 minutes

DB load by: **Waits** SQL Hosts Users



Waits | **SQL** | Hosts | Users

Search SQL Queries

SQL Digest	DB Load	SQL
4e15b546005d9489980349e399cc1d24		UPDATE pgbench_tellers SET tbalance = tbalance + ? WHERE tid = ?;
9037de313c04df497488ab3670c2466b		UPDATE pgbench_branches SET bbalance = bbalance + ? WHERE bid = ?;
f64d0eecd0bac50e4d71b98c500599af		ROLLBACK TO SAVEPOINT JDBC_SAVEPOINT_1
a30112fac30fcf95bebbdc07e3e38573		select foo();
dc20ac1a0efa57e29ebf7f3df136c600		SELECT * FROM LOGIN("username_in" := $1,"password_in" := $2)
3e20d081813ac00ef7ecd3f778eaefa5		SELECT abalance FROM pgbench_accounts WHERE aid = ?;

Amazon ElastiCache

In-Memory Cache

Elastic and reliable

Memcached or Redis

Managed Service

Why In-Memory Caching?

- Everything is connected - phones, tablets, cars, air conditioners, toasters
- Demand for real-time performance – online games, ad tech, eCommerce, social apps, etc.
- Load is spikey and unpredictable
- Database performance is often the bottleneck

Memcached vs. Redis

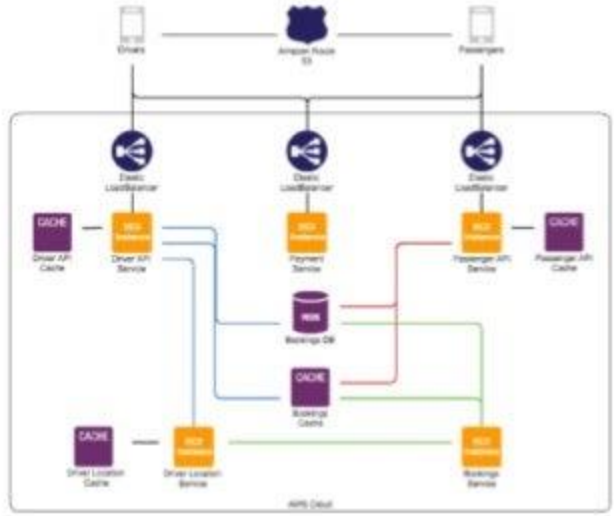
- In-memory
- Multithreaded / Multicore
- No persistence
- String values
- Easy horizontal clustering

- In-memory
- Single-threaded
- Read replicas
- Clustering
- Persistence
- Atomic operations
- Advanced data types - http://redis.io/topics/data-types
- Pub/sub messaging

RDS and ElastiCache are Behind Grab's Taxi-Booking App

> **The latency of a cab call must be low, and remain low even in times of peak traffic of hundreds of thousands of cab requests per minute. We use ElastiCache for Redis in front of RDS MySQL to keep our systems' real time performance at any scale.**
>
> **Ryan Ooi**
> Sr. Devops Engineer, Grab

- Grab is a popular taxi hailing app in southeast Asia.
- Average response time of the API layer is <40ms, mandating an in-memory layer to achieve such performance.
- A small devops team that tried running Redis on EC2 before, but that was too much work. Using both RDS and ElastiCache in Multi-AZ allowed them to outsource all the management to AWS.



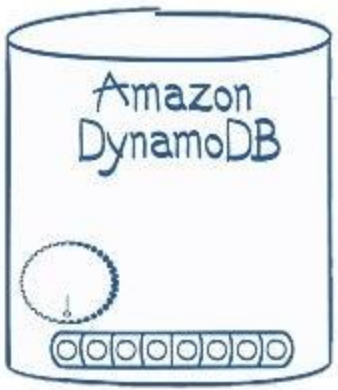
Amazon DynamoDB

NoSQL Database

Durable low latency

Managed Service

Massive and seamless scalability



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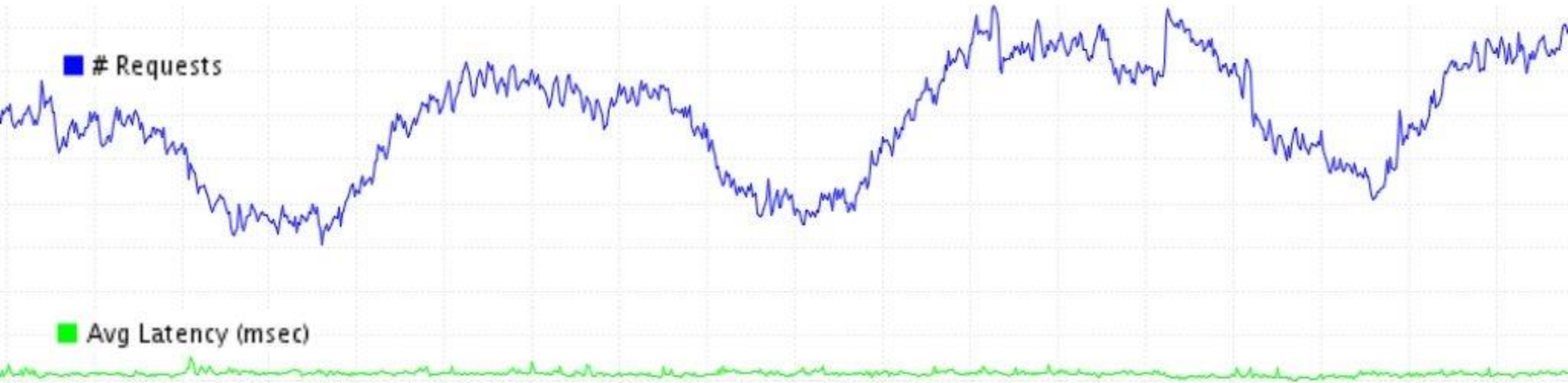
- Consistent, single-digit millisecond latency at any scale
- Highly durable and available—3x replication
- Accessible via simple and powerful APIs
- Supports both document and key-value data models
- No table size or throughout limits

Durable Low Latency – At Scale



Consistent low latency whether scaling up/down or operating at your provisioned limits

Amazon DynamoDB Customers

DynamoDB Accelerator

(DAX)

Amazon Redshift

a lot faster
a lot cheaper
a whole lot simpler

Relational data warehouse

Massively parallel; petabyte scale

Managed Service

HDD and SSD platforms

$1,000/TB/year; starts at $0.25/hour

Key Capabilities

- **Scaleable**: Petabyte scale data warehouse: from 160 GB to 2PB
- **Fast**: parallel execution with compressed, sorted data on optimized hardware
- **Inexpensive**: Start from $0.25/hour or $1,000/TB/year
- **Managed Service**: Easy to provision, backup, restore, patch and scale
- **Secure**: Load and store encrypted data, SSL, Audit logging
- **Innovative**: 100 new features since launch!
- **Large Ecosystem**: Major data integration and visualization ISVs support Redshift with a large consulting partner base

Amazon.com – Weblog analysis

Web log analysis for Amazon.com

- 1PB+ workload, 2TB/day, growing 67% YoY
- Largest table: 400 TB

Want to understand customer behavior

Solution

- Legacy DW—query across 1 week/hr.
- Hadoop—query across 1 month/hr.

Data warehouses can be fast and simple

Query 15 months of data (1PB) in 14 minutes

Load 5B rows in 10 minutes

21B rows joined with 10B rows – 3 days (Hive) to 2 hours

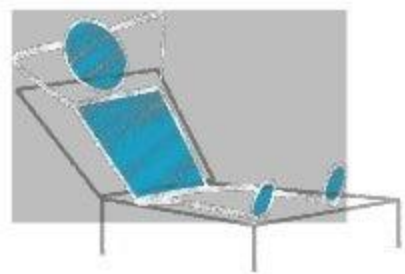
Load pipeline: 90 hours (Oracle) to 8 hours

64 clusters

800 total nodes

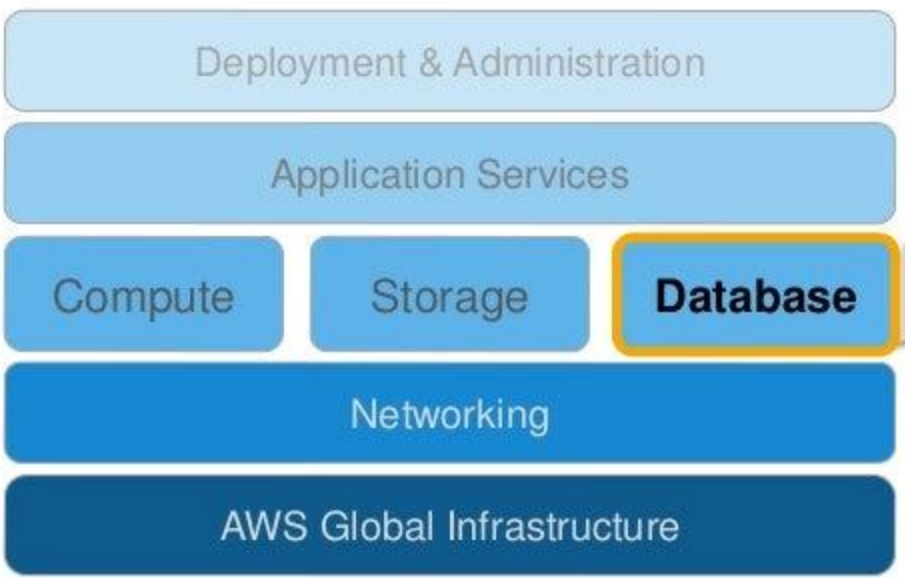
13PB provisioned storage

2 DBAs



Redshift Spectrum

AWS Database Services



Databases on EC2

- Any database that runs on Windows or Linux!
- Many AMIs available from technology partners
  - Oracle Database, MS SQL Server, MongoDB, Vertica, …
- White papers available on best practices
  - Oracle Database, MS SQL Server, MongoDB, Cassandra, …
- Why?
  - No managed service
  - Full control
  - Exceed limits of managed service, e.g. > 6TB of storage on RDS

New X1 Instance - Tons of Memory

- Designed for large-scale, in-memory applications in the cloud
- Ideal for in-memory databases like SAP HANA and big data processing apps like Spark and Presto
- Powered by Intel® Xeon® E7 8880 v3 Haswell processors
- Features up to 2TB of memory and up to 128 vCPUs per instance.
- Expanding to 4TB in 2017. With 8TB and 16TB in the works too!

AWS Database Migration Service (AWS DMS)

DMS migrates databases to AWS easily and securely with minimal downtime. It can migrate your data to and from most widely used commercial and open-source databases.

PostgreSQL

ORACLE

Amazon Aurora

MariaDB

Amazon DynamoDB

Amazon Redshift

MySQL

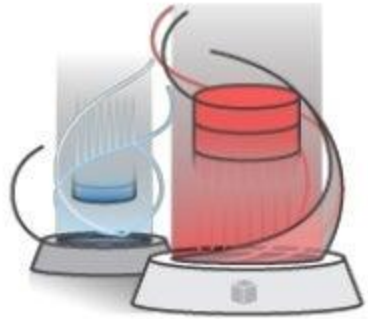
Microsoft SQL Server

SAP ASE

mongoDB

Less than $10 per TB with CDC!

AWS Schema Conversion Tool (AWS SCT)



SCT helps automate many database schema and code conversion tasks when migrating between database engines or data warehouse engines

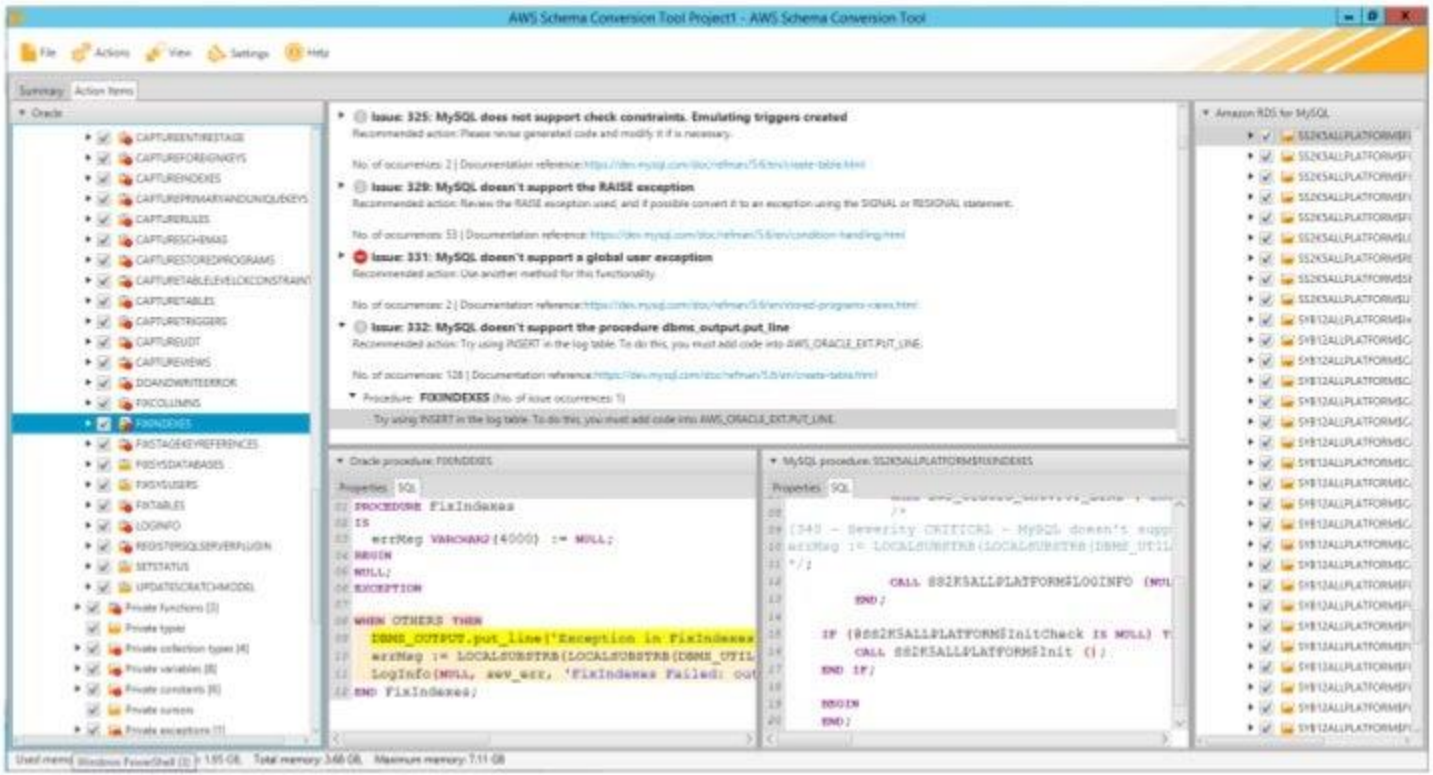
ORACLE
Microsoft SQL Server
MariaDB
PostgreSQL
MySQL

MariaDB
Amazon Aurora
MySQL
PostgreSQL

TERADATA
ORACLE
NETEZZA
Greenplum
Microsoft SQL Server
VERTICA

AMAZON REDSHIFT

SCT helps with converting tables, views, and code



- Sequences
- User Defined Types
- Synonyms
- Packages
- Stored Procedures
- Functions
- Triggers
- Schemas
- Tables
- Indexes
- Views

SCT can tell you how hard the migration will be

Database Migration Assessment Report

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Executive Summary

We completed the analysis of your Oracle source database and estimate that 91% of the database storage objects and 100% of database code objects can be converted automatically or with minimal changes if you select Amazon Aurora as your migration target. Database storage objects include schemas, tables, columns, constraints, indexes, sequences, synonyms, user define types and types. Database code objects include functions, procedures, packages, triggers, views, materialized views, events, SQL scalar functions, SQL inline functions, SQL table functions, attributes, variables, constants, table types, public types, private types, cursors, exceptions, parameters and other objects. Based on our analysis of SQL syntax elements of your source database schema, we estimate that 99.9% of your entire database schema can be converted automatically to Amazon Aurora. To complete the migration, we recommend 597 conversion action(s) ranging from simple tasks to medium-complexity actions to significant conversion actions.

Database Objects with Conversion Actions for Amazon Aurora

Of the total 1,575 database storage object(s) and 155 database code object(s) in the source database, we were able to identify 1,427 (91%) database storage object(s) and 155 (100%) database code objects that can be converted automatically or with minimal changes to Amazon Aurora.

149 (9%) database storage object(s) required 149 significant user action(s) to complete the conversion.

Figure: Conversion statistics for database storage objects

Figure: Conversion statistics for database code objects

Detailed Recommendations for Amazon Aurora Migrations

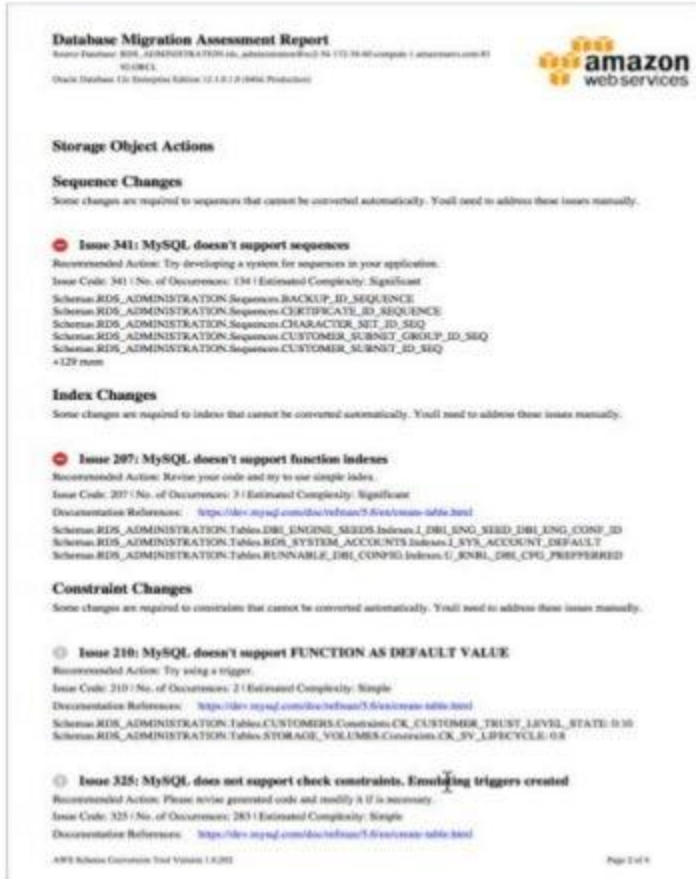
If you choose to migrate your Oracle database to Amazon Aurora, we recommend the following actions.

1. Connect SCT to Source and Target databases.

2. Run Assessment Report.

3. Read Executive Summary.

4. Follow detailed instructions.



Database Migration Assessment Report

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Storage Object Actions

Sequence Changes

Some changes are required to sequences that cannot be converted automatically. Youll need to address these issues manually.

Issue 341: MySQL doesn't support sequences

Recommended Action: Try developing a system for sequences in your application.

Issue Code: 341 | No. of Occurrences: 134 | Estimated Complexity: Significant

Schemas.RDS_ADMINISTRATION.Sequences.BACKUP_ID_SEQUENCE
Schemas.RDS_ADMINISTRATION.Sequences.CERTIFICATE_ID_SEQUENCE
Schemas.RDS_ADMINISTRATION.Sequences.CHARACTER_SET_ID_SEQ
Schemas.RDS_ADMINISTRATION.Sequences.CUSTOMER_SUBNET_GROUP_ID_SEQ
Schemas.RDS_ADMINISTRATION.Sequences.CUSTOMER_SUBNET_ID_SEQ
+129 more

Index Changes

Some changes are required to indexes that cannot be converted automatically. Youll need to address these issues manually.

Issue 207: MySQL doesn't support function indexes

Recommended Action: Revise your code and try to use simple index.

Issue Code: 207 | No. of Occurrences: 3 | Estimated Complexity: Significant

Documentation References: https://dev.mysql.com/doc/refman/5.6/en/create-table.html

Schemas.RDS_ADMINISTRATION.Tables.DBI_ENGINE_SEEDS.Indexes.1_DBI_ENG_SEED_DBI_ENG_CONF_ID
Schemas.RDS_ADMINISTRATION.Tables.RDS_SYSTEM_ACCOUNTS.Indexes.1_SYS_ACCOUNT_DEFAULT
Schemas.RDS_ADMINISTRATION.Tables.RUNNABLE_DBI_CONFIG.Indexes.U_RNBL_DBI_CFG_PREFFERRED

Constraint Changes

Some changes are required to constraints that cannot be converted automatically. Youll need to address these issues manually.

Issue 210: MySQL doesn't support FUNCTION AS DEFAULT VALUE

Recommended Action: Try using a trigger.

Issue Code: 210 | No. of Occurrences: 2 | Estimated Complexity: Simple

Documentation References: https://dev.mysql.com/doc/refman/5.6/en/create-table.html

Schemas.RDS_ADMINISTRATION.Tables.CUSTOMERS.Constraints.CK_CUSTOMER_TRUST_LEVEL_STATE: 0:10
Schemas.RDS_ADMINISTRATION.Tables.STORAGE_VOLUMES.Constraints.CK_SV_LIFECYCLE: 0:8

Issue 325: MySQL does not support check constraints. Emulating triggers created

Recommended Action: Please review generated code and modify it if is necessary.

Issue Code: 325 | No. of Occurrences: 283 | Estimated Complexity: Simple

Documentation References: https://dev.mysql.com/doc/refman/5.6/en/create-table.html

Which Service Should You Use?

Situation	Solution
Existing application	Use your existing engine on RDS • MySQL → Amazon Aurora, RDS for MySQL • PostgreSQL → RDS for PostgreSQL • Oracle, SQL Server → RDS for Oracle, RDS for SQL Server
New application	• If you can avoid relational features → DynamoDB • If you need relational features → Amazon Aurora
Data Warehouse & BI	• Amazon Redshift and Amazon QuickSight
Ad hoc analysis of data in S3	• Amazon Athena and Amazon QuickSight
Spark, Hadoop, Hive, HBase	• Amazon EMR
Log analytics, operational monitoring and search	• Amazon Elasticsearch Service

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추천서비스 고군분투기 on AWS

Jinwoo Park
RecoBell

Me?

반도체 쪽으로 유학을 가려던 평범한 전기공학도

어쩌다한 **창업**

지금은 *레코벨*에서 **빅데이터**를 경험중

AWS 사용 6년째

RECOBELL

데이터가 돈이 된다는 것을 증명하는 사람들

- 추천서비스
- 개인화 마케팅 서비스
- 검색광고 솔루션
- Retargeting 광고
- 대용량 푸시 서버
  ++ 데이터를 이용한 돈벌이

GS SHOP

TMON

LOTTE.com

LOTTE DUTY FREE 롯데인터넷면세점

KYOBO 교보문고

IKEA

AMOREPACIFIC CORPORATION

THE BODY SHOP

BCcard

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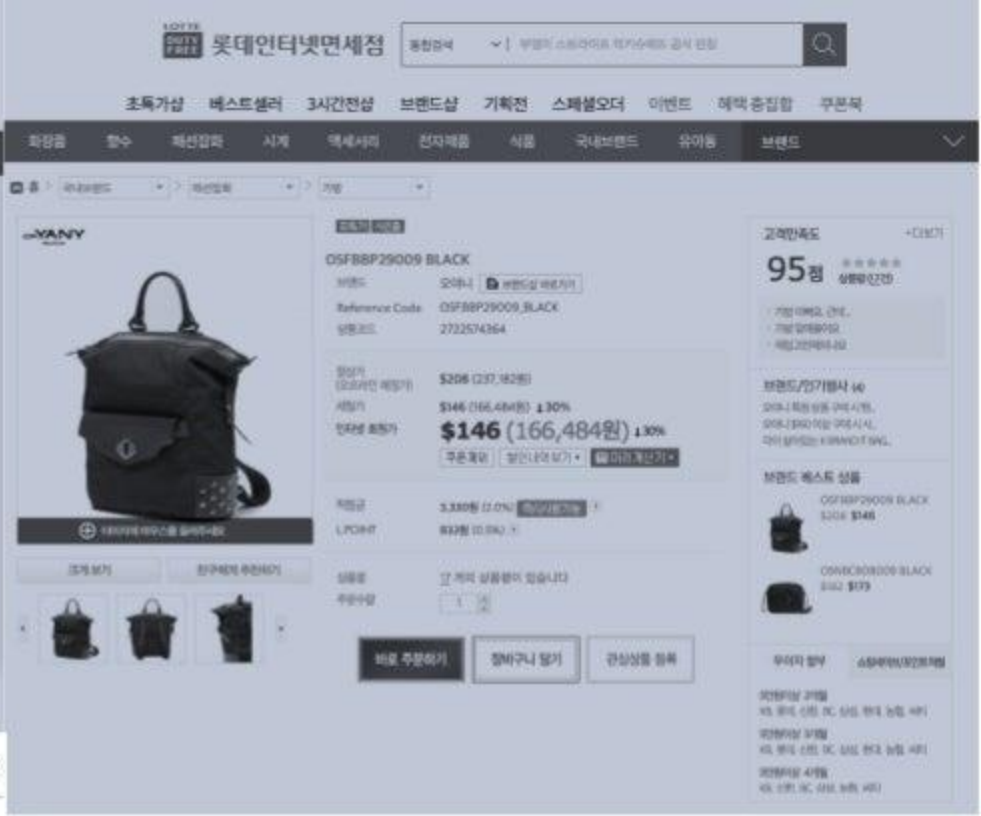
추천서비스?


롯데인터넷면세점
초특가샵 베스트셀러 3시간전샵 브랜드샵 기획전 스페셜오더 이벤트 혜택총집합 쿠폰북
화장품 향수 패션잡화 시계 액세서리 전자제품 식품 국내브랜드 유아동 브랜드
등업혜택
다시 만나서 반가워요
최고등급 혜택을
드립니다!
10.10 - 10.31
베링가
$150 이상 구매 시
하시겁 증정
끌로에
구매사은 이벤트
$120 이상 구매 시
파우치 증정


롯데인터넷면세점
초특가샵 베스트셀러 3시간전샵 브랜드샵 기획전 스페셜오더 이벤트 혜택총집합 쿠폰북
화장품 향수 패션잡화 시계 액세서리 전자제품 식품 국내브랜드 유아동 브랜드
VANY
OSFB8P29009 BLACK
Reference Code OSFB8P29009_BLACK
$146 (166,484원)
95점
바로 주문하기
장바구니 담기
관심상품 등록


박진우님을 위한 맞춤 추천 상품
1/3
SWAROVSKI
Earring
$84
SWAROVSKI
Earring
$84
SWAROVSKI
Earrings(pierce)
$59
SWAROVSKI
BEGIN PIERCED EARRINGS STUD CRY
$84


이 상품을 본 고객들이 함께 본 상품 BEST
1/2
BEST 1
오아니
OSFB8P04009 BLACK
$282
BEST 2
BENETTON
$144
BEST 3
오아니
OSFB8P29023 NAVY
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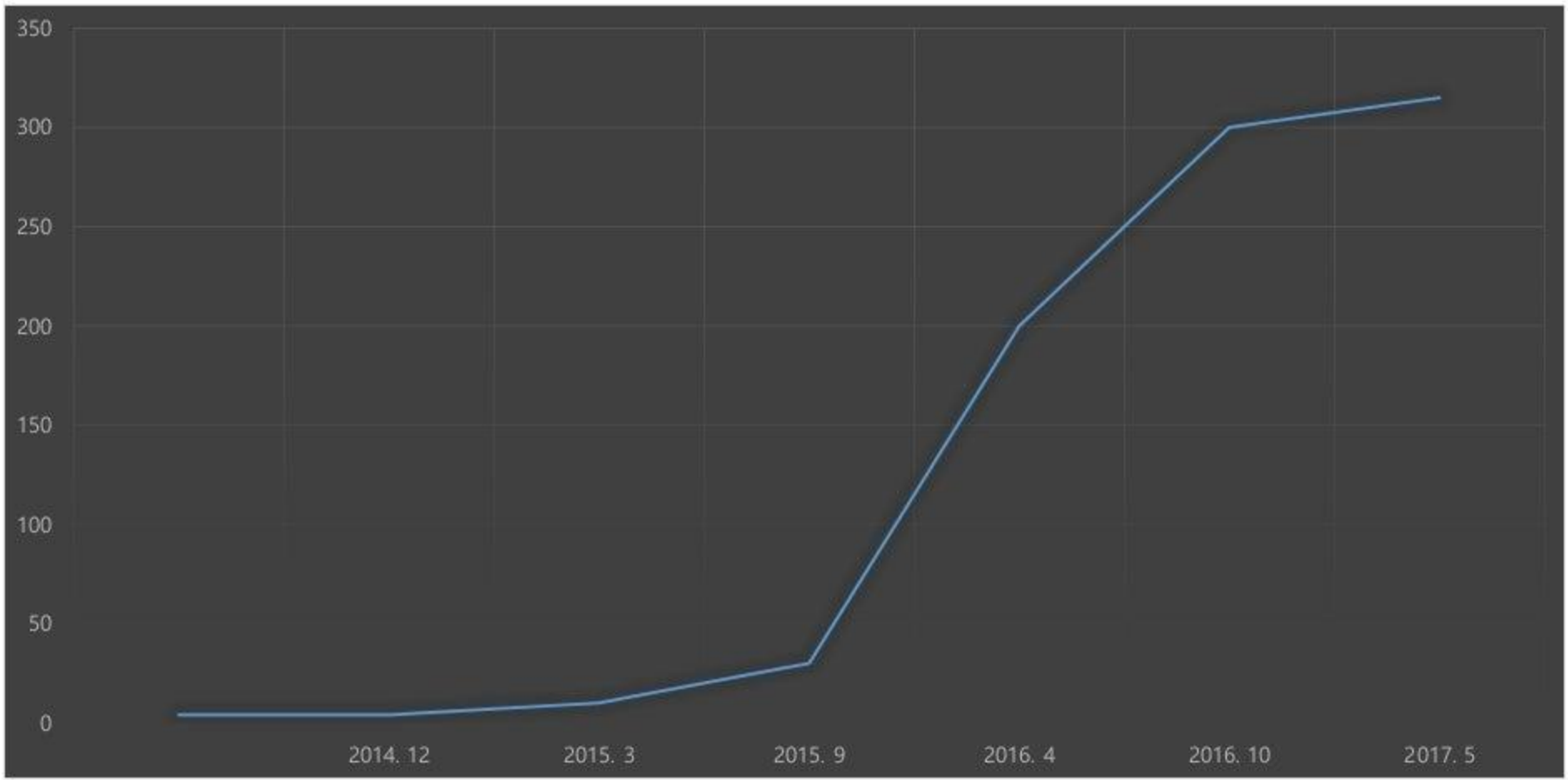
오아니
OSFBC822009 BLACK
$202


350
300
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2014. 12
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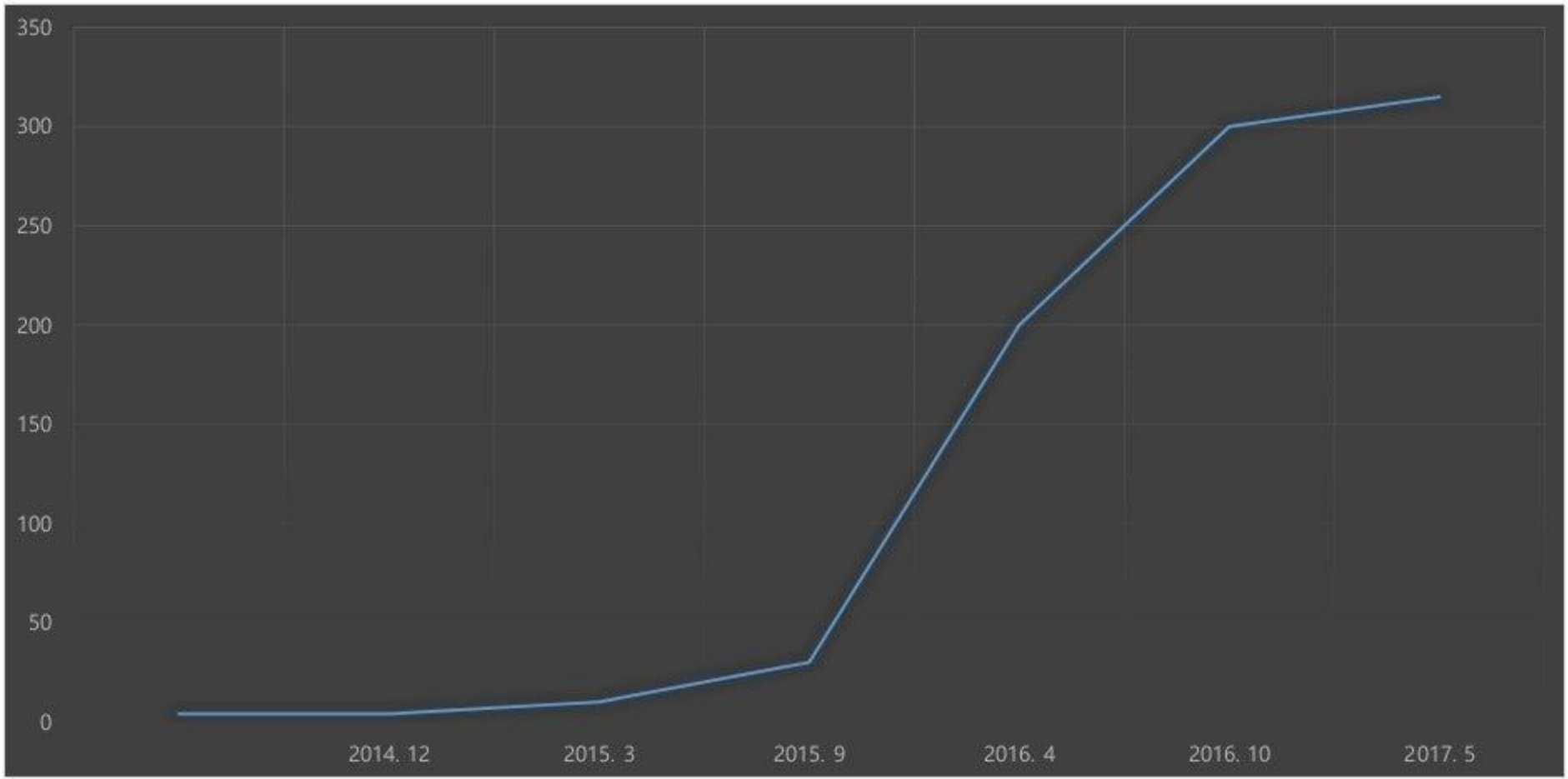
2016. 4
2016. 10
2017. 5

추천서비스 사용 사이트 숫자



이 세션에서 다룰 내용

IDC 에서 클라우드로

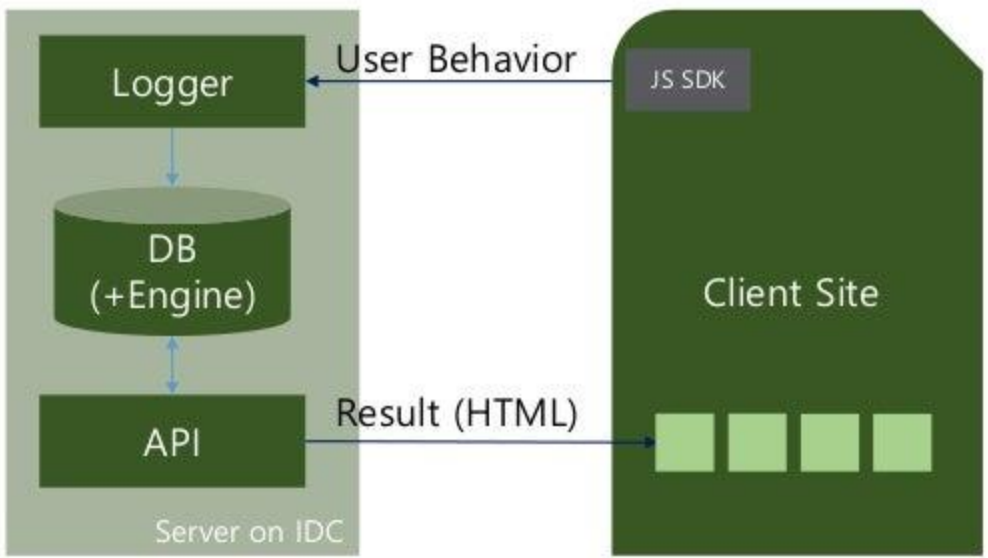
최초 10개 미만이던 사이트 숫자를 300개 이상으로

빠르게 성장한 이야기

데이터 분석은 크게 3 단계

추천서비스 on IDC

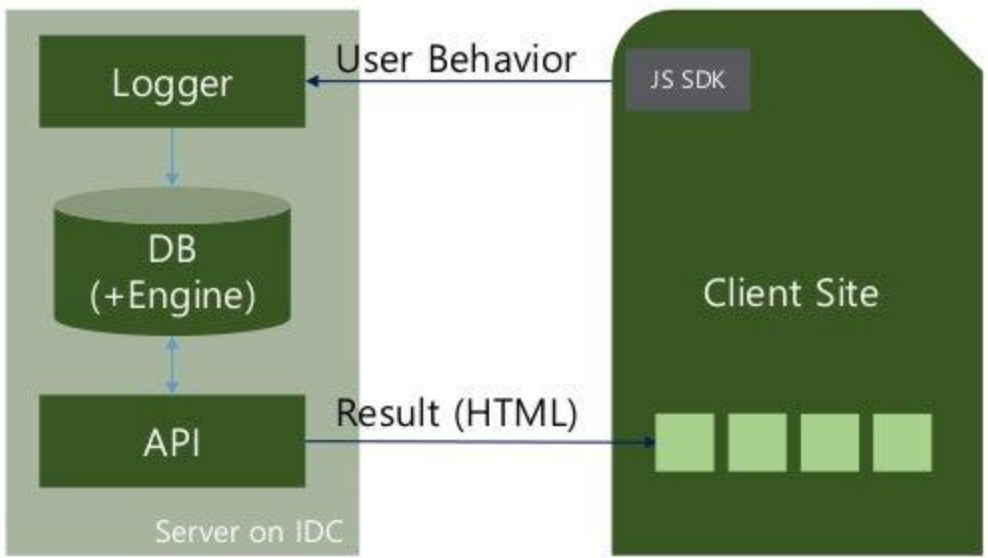
Legacy on IDC



- 대기업위주의 SI
- Engineer 보다는 Data Scientists 위주

- 간간히 알바/외주를 써서 몇 개의 고객사에 대해서만 IDC를 빌려서 구현

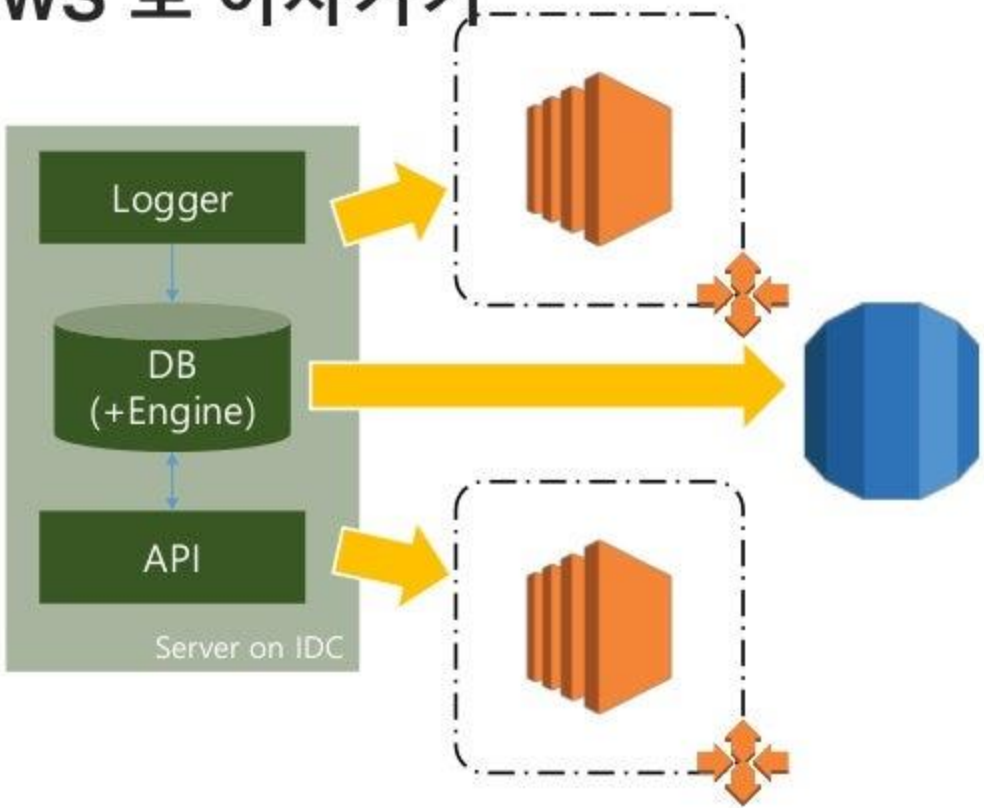
Legacy on IDC



- 고객사 영업되면, 세팅 한 세월
- 장애 대응 한 세월
- 테스트 한 세월

- 내가 SE 도 아니고..

AWS 로 이사가기

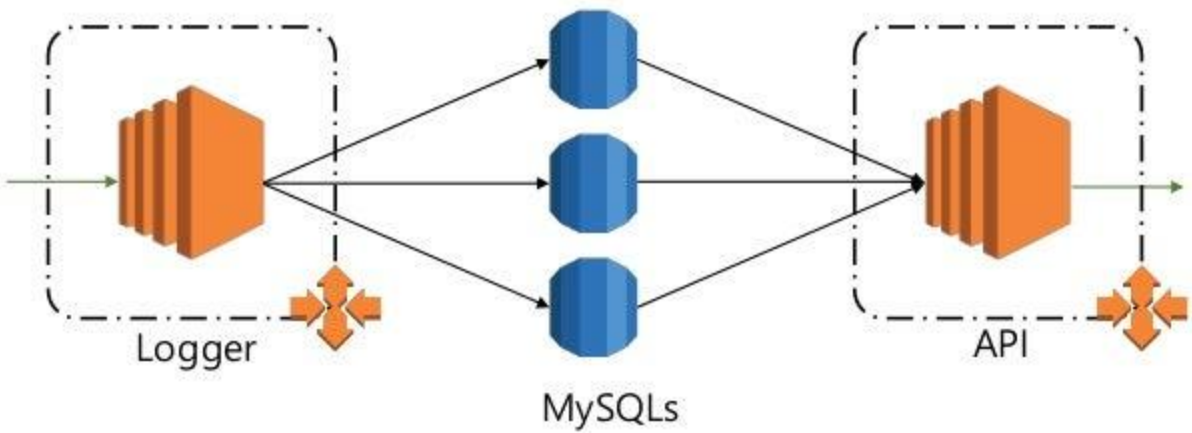


- AWS 로 이사가기로 결정
- Logger / API 는 묶어서 사용
- DB 는 RDS 를 이용

Amazon RDS

- 관리용이성
- 뛰어난 확장성
- 가용성 및 내구성
- 빠른속도(SSD)
- 보안
- 저렴한 비용

AWS 위 첫 번째 집



- 큰 규모의 업체는 SI
- 작은 규모의 업체는 클라우드

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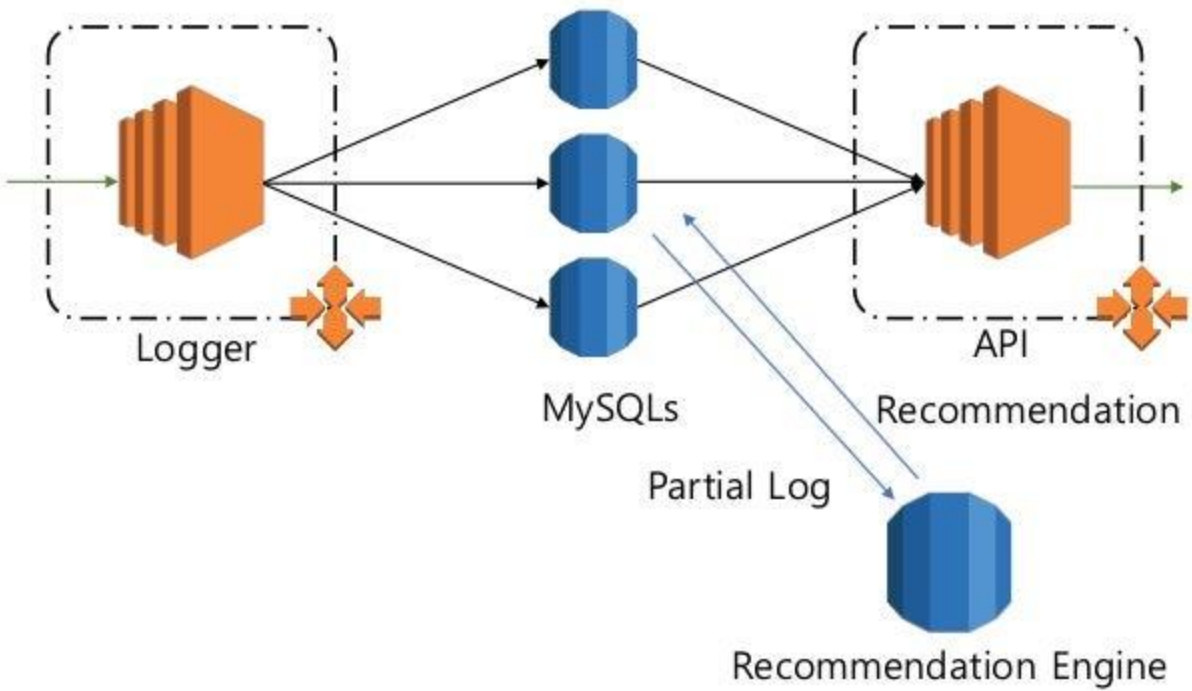
하지만 가정은 보통 깨어지고..

MAU 천만 업체 등장

AWS 위 두 번째 집



- 서비스 쪽과 엔진 쪽 분리
- LogDB + ResultDB
- Rec. Engine

Amazon RDS

- 관리용이성
- 뛰어난 확장성
- 가용성 및 내구성
- 빠른속도(SSD)
- 보안
- 저렴한 비용

Amazon RDS

- 빠른속도(SSD)

스토리지 크기 (GB)	기본 성능 (IOPS)	최대 버스트 지속 시간 @ 3,000 IOPS(초)	고갈된 크레딧 밸런스를 보충하는 데 소요되는 시간 (초)
1	100	1,862	54,000
100	300	2,000건	18,000
250	750	2,400	7,200
500	1,500	3,600	3,600
750	2,250	7,200	2,400
1,000	3,000	무제한	해당 사항 없음

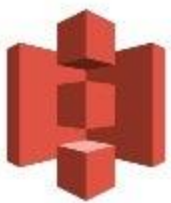
- 저렴한 비용 => SSD $0.138/GB.Month
- *+ 긴 RDS 생성시간*

대대적인 구조 개선 시작

구조개선 목표

- Logger : 안정성 및 TPS
- Engine : 속도 및 안정성
- API : Business 로직 최소화

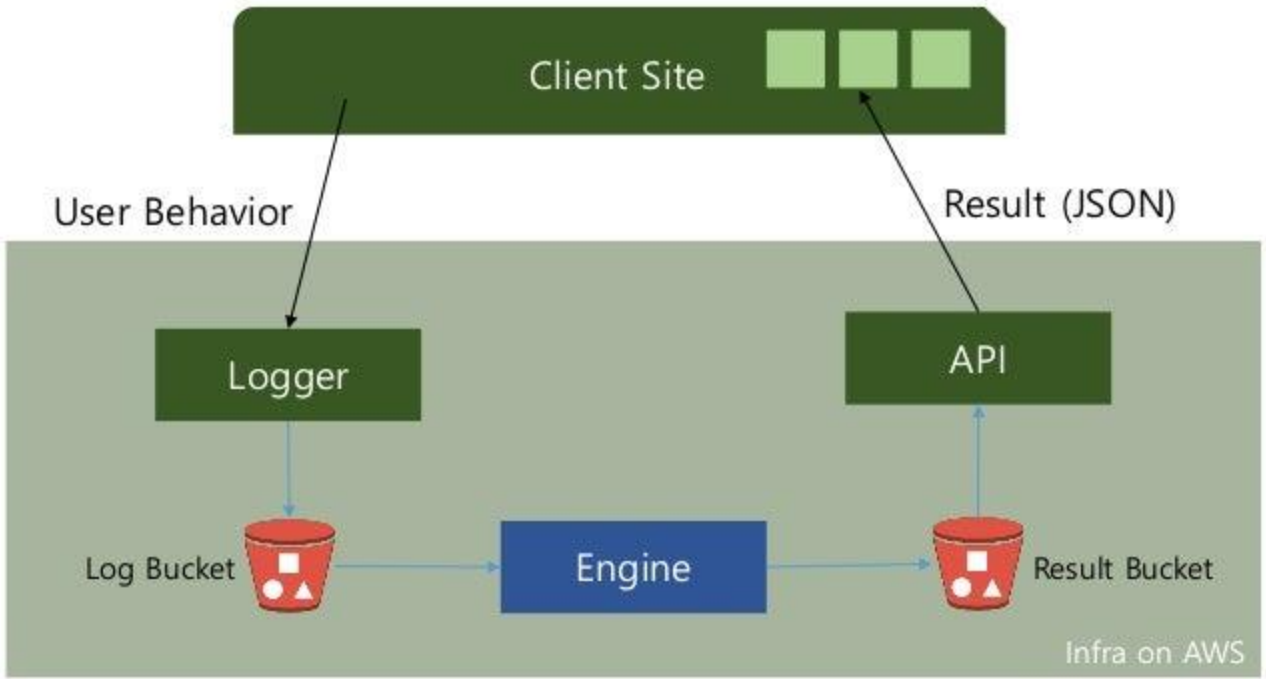
S3 (Simple Storage Service)



- 간편성
- 내구성
- 확장가능
- 보안
- 가용성
- 저렴한비용

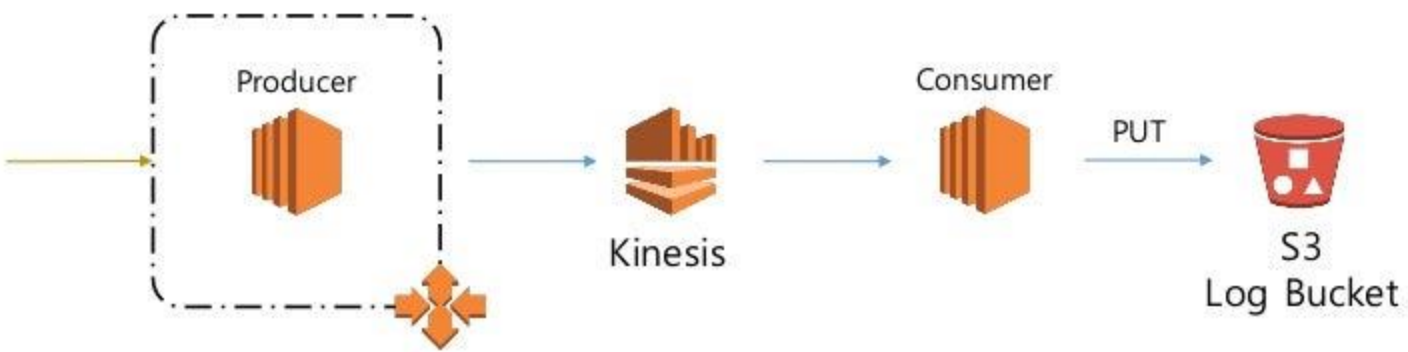
- 간편한 데이터 전송
- 통합
- 손쉬운관리

AWS 위 세 번째 집

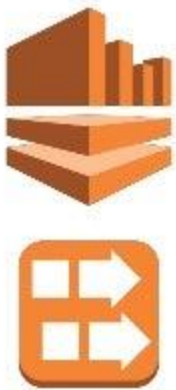


- S3 에 데이터 저장

Logger



Amazon Kinesis Stream



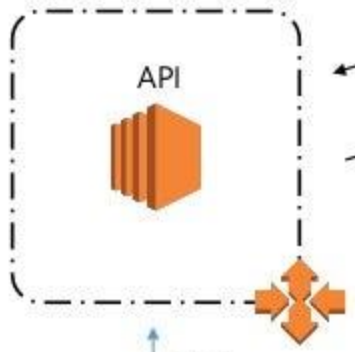
Real-time Streaming Data Buffer

- 실시간성
- 사용편의성
- 병렬처리
- 탄력성
- 저렴한비용
- 안정성

Engine

- EC2 : c4.8xlarge
  - 36 CPU / 132 ECU / 60G Mem.
  - Provisioned IOPS EBS (3000)
- PostgreSQL + Spring Boot

API



.../{siteId}/{recType}/{item or userId}.json

Req http://{apiUrl}/{recType}?itemId={itemId}

Res


```
"recType": "a002",
"itemId": "354427372",
"results":
[
        {
        "itemId": "362054013",
        "categoryId": "5502167",
        "rank": 1,
        "score": 1,
```

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성공적으로 20개 사이트 라이브

MAU 천만이 넘어도 문제 없음

이때 만든 로거는 지금까지도 문제 없음

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그런데

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사이트 200개 추가

상황 1

- 가장 쉽게 이 상황에 대처하는 방법?
  - Logger / API 는 Scale-out
  - Engine 220개를 띄운다. => **먼저 EC2 instance 의 Limit 을 풀어야한다.**

> I can confirm your limit is 1010 in the Asia Pacific (Tokyo) region. You can view your limits here: https://ap-northeast-1.console.aws.amazon.com/ec2/v2/home?region=ap-northeast-1#Limits:

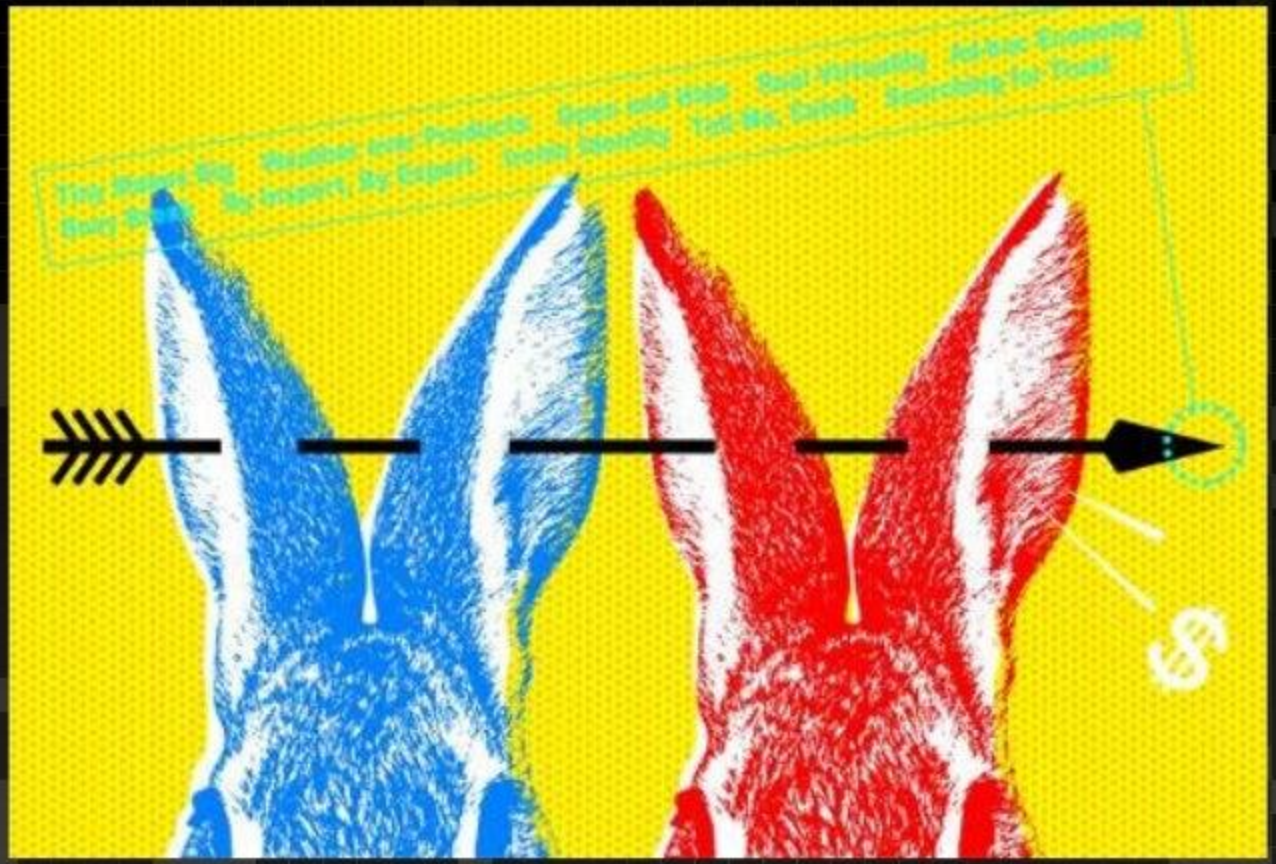
- **c4.8xlarge instance : $2.3/hour**
  - **AWS 과금형식이 시간당 과금**
  - **200 개 사이트 중에 수 분 내에 엔진이 끝나는 사이트도..**
  - **+ Provisioned IOPS 도 비싸**

상황 2

- 추천 고객사가 다양해 지면서 다양한 e-Commerce 고객사 등장
- e-Commerce 가 아닌 고객사도 등장

- Data Schema 가 다들 다름
- 이 때 레코벨의 개발자 **2명**

- Java + SpringBoot + PostgreSQL 수정이 너무 어려워

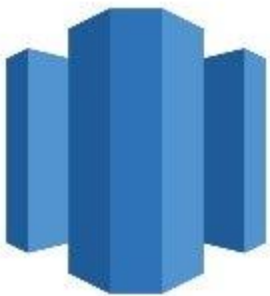


두마리 토끼

- 더 가격이 싼 구조
  - 비싼 c4.8xlarge 대체
  - Provisioned IOPS 도 대체

- 개발자 없이, 빠르게 고객사의 요구사항을 들어줄 수 있는 구조
  - Data Scientist 들이 SQL 은 빠르게 수정할 수 있으니,
    최대한 SQL 로 모든걸 해결할 수 있게하자.

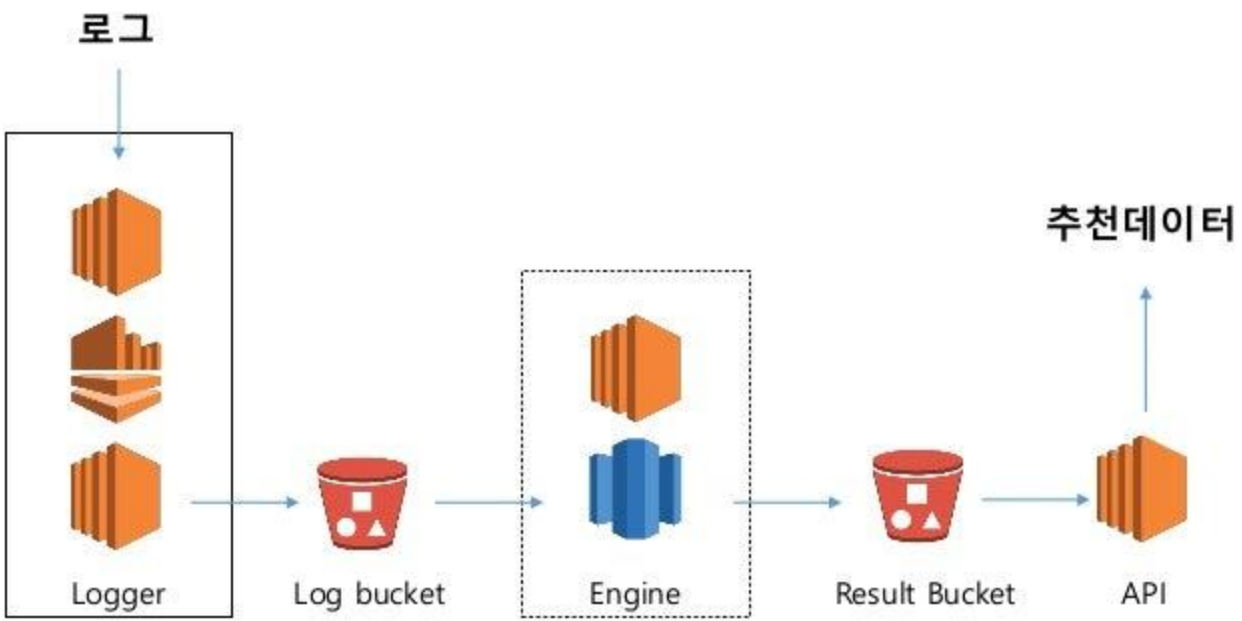
Amazon Redshift



Data Warehouse 서비스

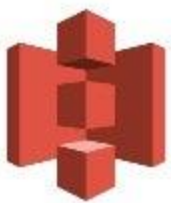
- 신속함
- 저렴함
- 간편성
- 탄력성
- 보안
- 호환성 (PostgreSQL)

AWS 위 네 번째 집



- 1/6 가격
- 쉬운 수정
- 개발자 2명
- DS 4명
- 사이트 220개

S3 (Simple Storage Service)



- 간편성
- 내구성
- 저렴한비용

요청의 경우 아래 달리 명시되지 않는 한

PUT, COPY, POST 또는 LIST 요청	$0.0047 요청 1,000건당
GET 및 기타 모든 요청	$0.0037 요청 10,000건당
삭제 요청	Free †

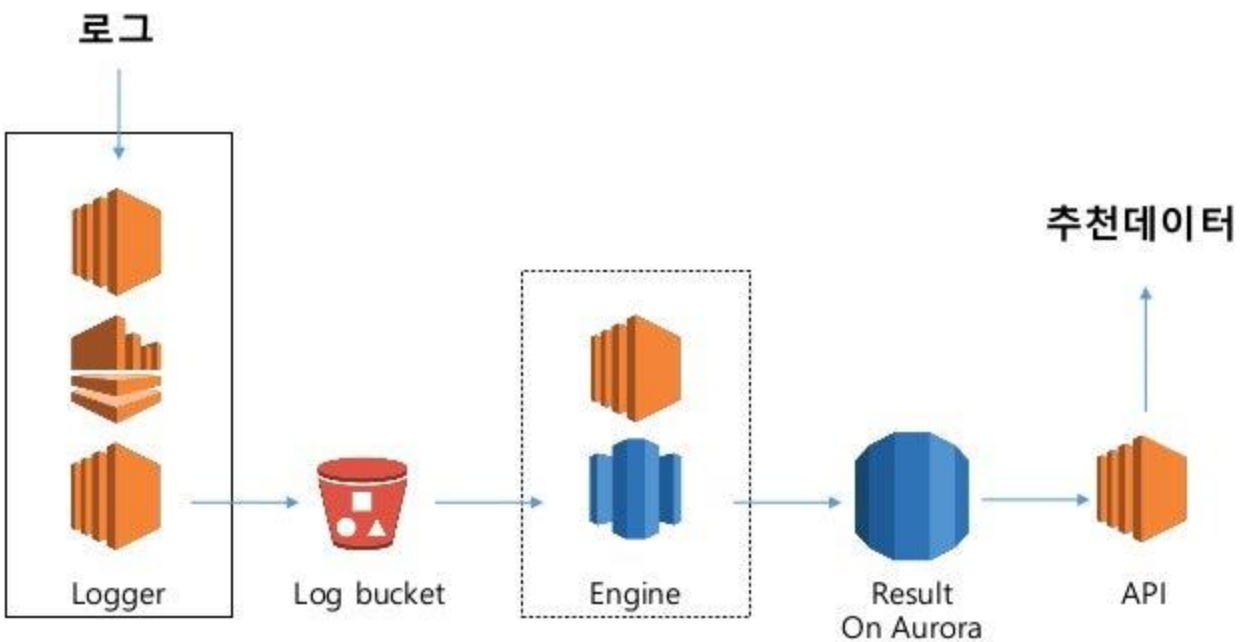
- 100만개의 상품을 가진 사이트면, 한번 엔진이 돌때마다 비용이..
  - $0.0047 / 1,000 * 1,000,000 = $4.7
- 하루에 세번, 한달이면..
  - $4.7 * 3 * 30 = **$423**

RDS : Amazon Aurora

고성능, 고-확장성 DB

- 고성능
- 뛰어난 보안
- MySQL/PostgreSQL 호환
- 뛰어난 확장성
- 높은 가용성 및 내구성
- 완전 관리형

AWS 위 다섯 번째 집



Remind & Tips

- RDS / EC2 의 IOPS 에 항상 주의
- 웬만한 데이터는 S3, 하지만 PUT 가격에 주의
- 데이터 버퍼로써 Kinesis 활용
- Aurora 는 요금체계가 기존 RDS 와 다르다. (IOPS 과금)
- Redshift 는 쉽고 빠르다.

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개발자 2명
하루 약 100기가 의 로그
당신을 기다리고 있습니다.

Thank you!

Thank you!

Back to the Demo!