



# Amazon Web Services

Worldwide Public Sector, Education

07-10-2021

Come automatizzare la gestione dei propri database

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# Webinar Tematici CRUI-AWS 2021

Garantire la propria Continuità Operativa attraverso il Cloud  
giovedì 27 maggio 2021 | dalle 14:30 alle 16:00

Aumentare la resilienza dell'Identity Provider di Ateneo  
giovedì 10 giugno 2021 | dalle 11:30 alle 13:00

Soluzioni AWS per la Didattica ed il Lavoro a distanza  
venerdì 25 giugno 2021 | dalle 11:30 alle 13:00

Sfruttare l'infrastruttura ed i servizi di AWS per rispondere ai requisiti di Sicurezza e Conformità  
giovedì 8 luglio 2021 | dalle 11:30 alle 13:00

Cloud Ibrido con AWS - Benefici e Casi d'uso  
giovedì 9 settembre 2021 | dalle 11:30 alle 13:00

Migrare applicazioni esistenti nel Cloud – Benefici e Best Practice  
venerdì 24 settembre 2021 | dalle 11:30 alle 13:00

**Come automatizzare la gestione dei propri database**  
giovedì 7 ottobre 2021 | dalle 11:30 alle 13:00

**Modernizzazione delle applicazioni attraverso i Containers**  
venerdì 22 ottobre 2021 | dalle 11:30 alle 13:00

**Ricerca e calcolo tecnico su AWS**  
giovedì 4 novembre 2021 | dalle 11:30 alle 13:00



<https://ict.cruai.it/certificazione/certificazione-webinar-tematici-cruai-aws-2021/>



# Agenda

Drivers for adopting managed database

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Managed Databases on AWS

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RDS

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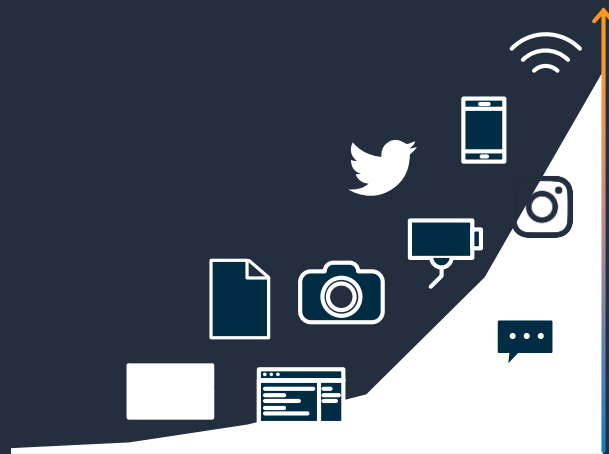
DEMO

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Q&A

# Unprecedented Data Growth Drives Innovation

## Explosion of data



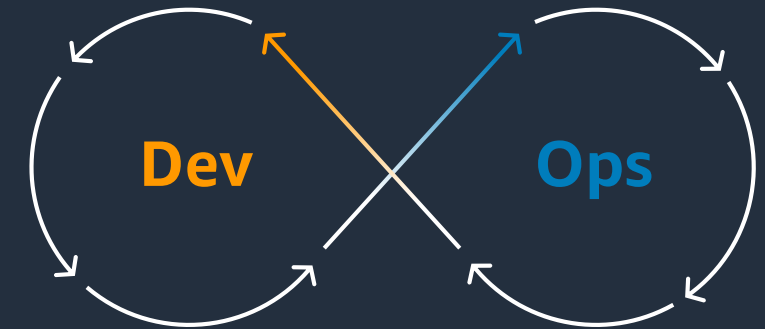
Data grows 10x every 5 years driven by network-connected smart devices

## Micro-services changes data and analytics requirements



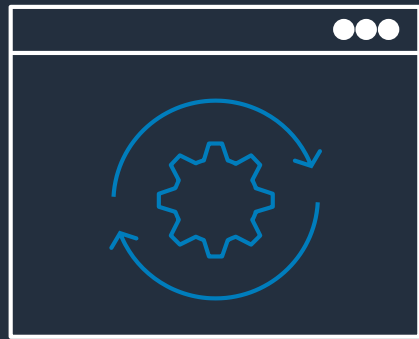
Micro-services architecture decreases need for one-size-fits-all databases and increases need for real-time monitoring and analytics

## Rapid rate of change driven by DevOps



Transition from IT to DevOps increases rate of change

# To get more value from their data, customers are...



Moving to fully managed database services



Building modern applications with purpose-built databases



Breaking free from legacy databases

# To get more value from their data, customers are...



Moving to fully managed database services



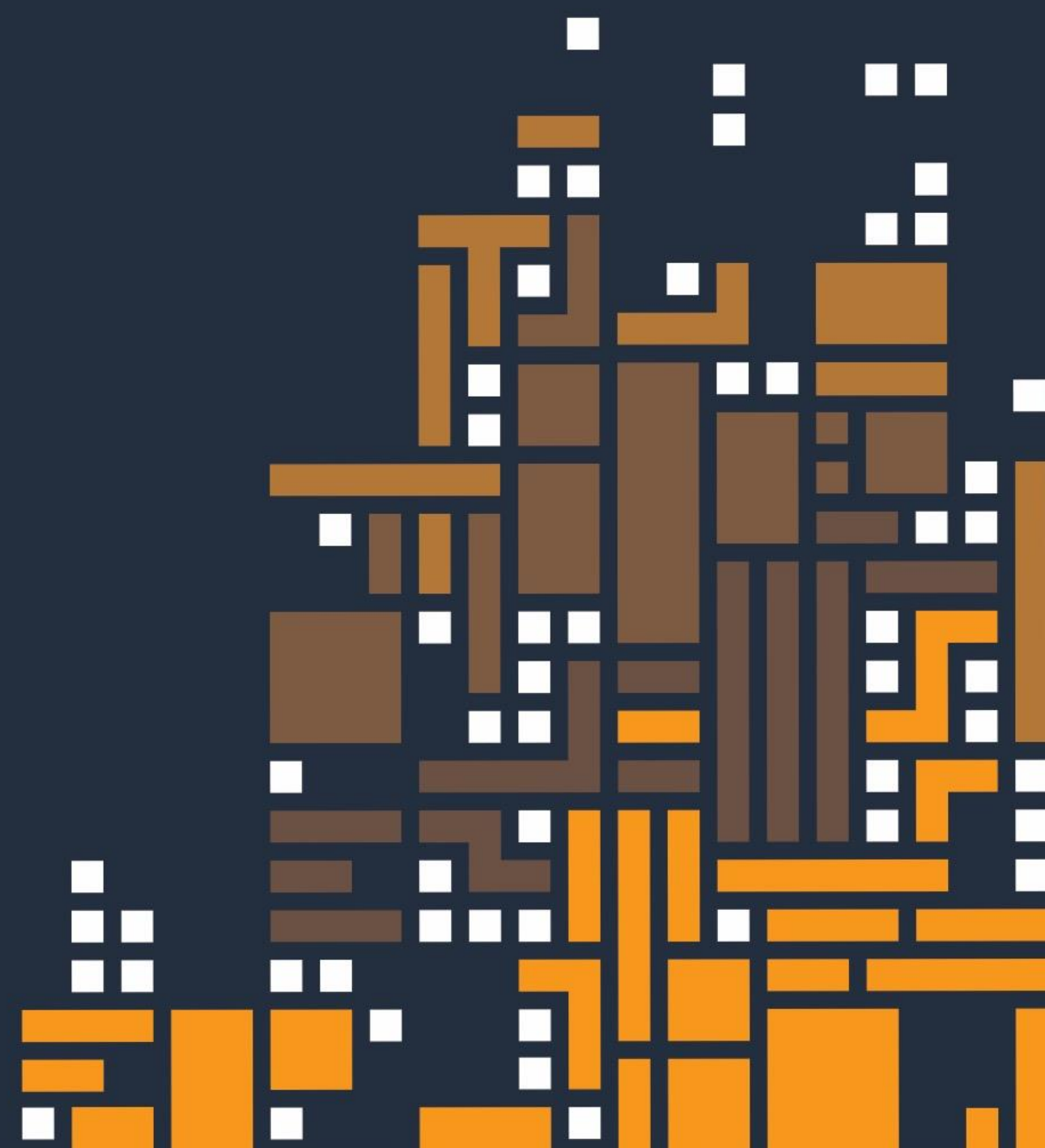
Building modern applications with purpose-built databases



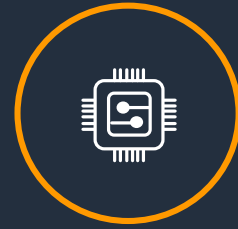
Breaking free from legacy databases

# Databases on **AWS**

Purpose built databases,  
the right tool for the right job



# Purpose-built databases



Reqs

## Relational

Referential integrity, ACID transactions, schema-on-write

## Key-value

High throughput, Low latency reads and writes, endless scale

## Document

Store documents and quickly access querying on any attribute

## In-memory

Query by key with microsecond latency

## Graph

Quickly and easily create and navigate relationships between data

## Time-series

Collect, store, and process data sequenced by time

## Ledger

Complete, immutable, and verifiable history of all changes to application data

## Wide Column

Scalable, highly available, and managed Apache Cassandra-compatible service

AWS Service(s)



Aurora RDS



DynamoDB



DocumentDB



ElastiCache MemoryDB



Neptune



Timestream



QLDB



Keyspaces Managed Cassandra

Common Use Cases

Lift and shift, ERP, CRM, finance

Real-time bidding, shopping cart, social, product catalog, customer preferences

Content management, personalization, mobile

Leaderboards, real-time analytics, caching

Fraud detection, social networking, recommendation engine

IoT applications, event tracking

Systems of record, supply chain, health care, registrations, financial

Build low-latency applications, leverage open source, migrate Cassandra to the cloud

# Purpose-built databases



**Relational**

Referential integrity, ACID transactions, schema-on-write

High throughput, Low latency reads and writes, endless scale

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*AWS Service(s)*



Aurora

RDS



DynamoDB



DocumentDB



ElastiCache



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Keyspaces  
Managed Cassandra

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# Amazon Relational Database Service (RDS)



# Relational databases are complex



Our experience running "amazon.com" taught us that relational databases are challenging to manage and operate with high availability

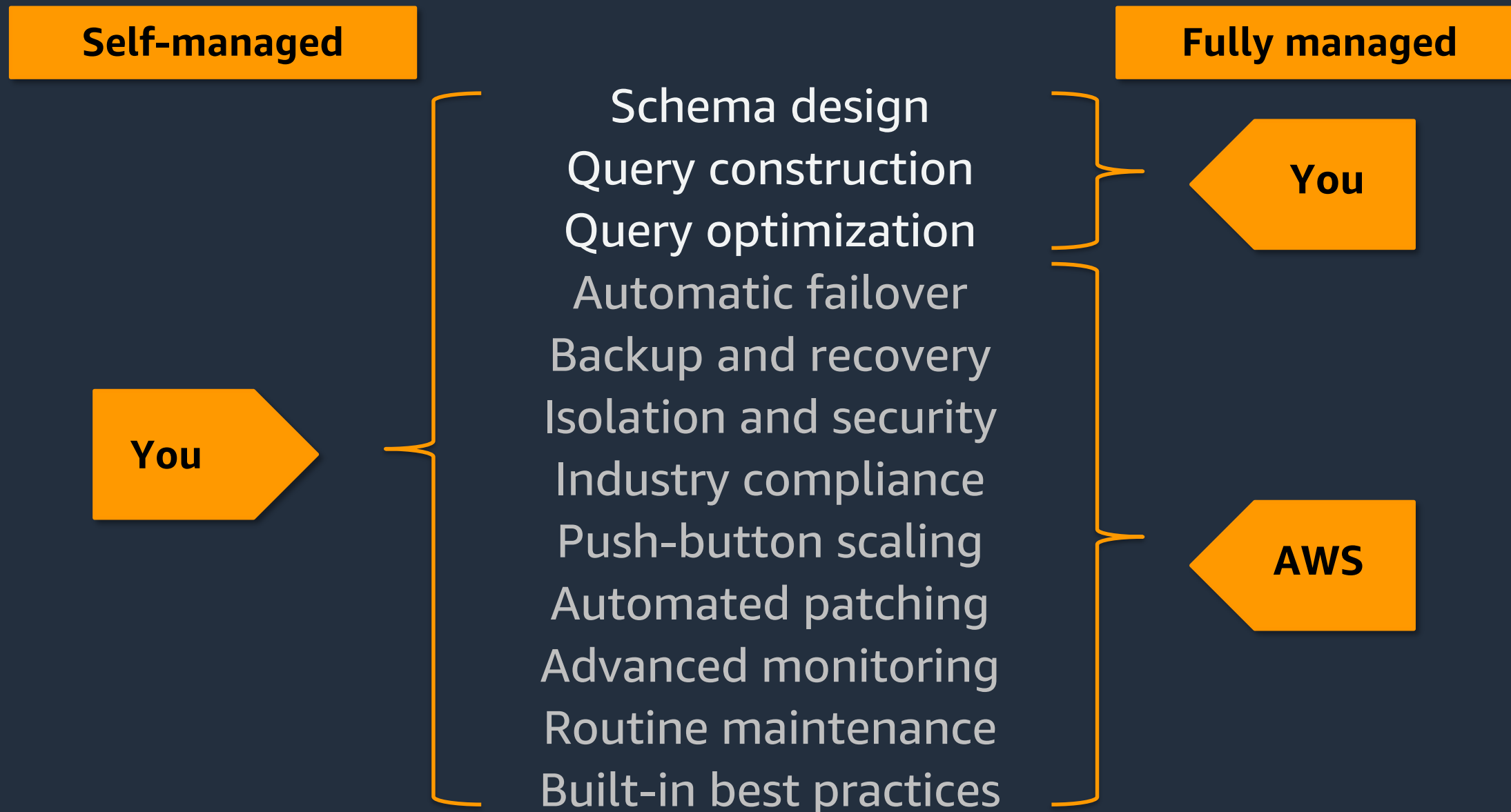
It's expensive and complex to manage administrative functions including **regular patching cycles, performance optimization and backup and disaster recovery** all for **constantly changing applications**

Self-managing databases is  
time-consuming, complex, and expensive

- Hardware and software installation, configuration, patching, backups
- Performance and high availability issues
- Capacity planning and scaling clusters for compute and storage
- Security and compliance

# Fully managed services on AWS

Spend time innovating and building new applications, not managing infrastructure



# Amazon RDS

Managed relational database service with a choice of popular databases

Amazon  
Aurora



Microsoft SQL Server

ORACLE



## Easy to administer

Easily deploy and maintain hardware, OS, and database software; built-in monitoring



## Performant & scalable

Scale compute and storage with a few clicks; minimal downtime for your application



## Available & durable

Automatic Multi-AZ data replication; automated backup, snapshots, and failover

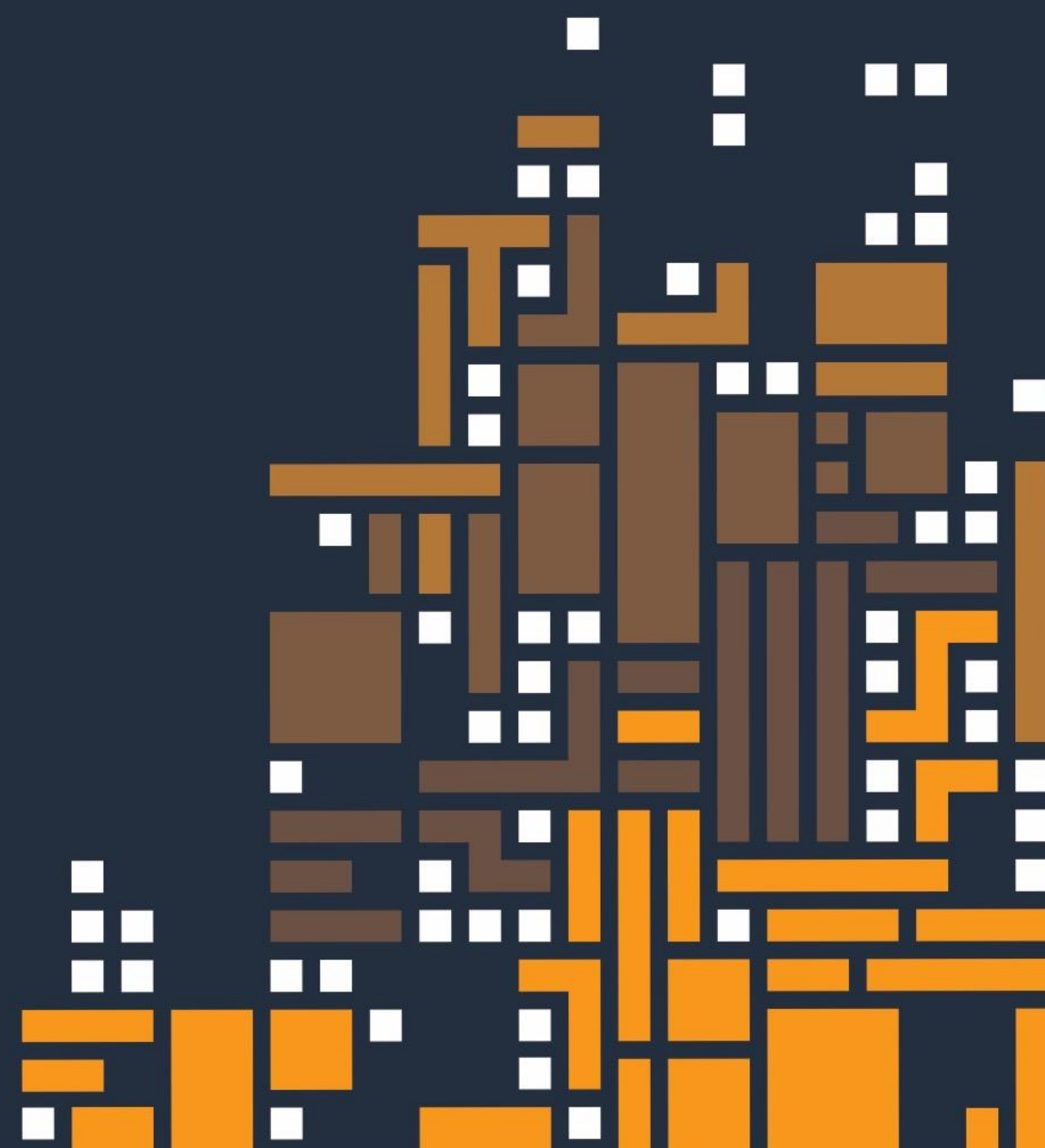


## Secure & compliant

Data encryption at rest and in transit; industry compliance and assurance programs



# Ease of Administration



# Ease of administration



- Single console and API for managing all your relational databases
- Hardware provisioning, patching, backup/restore, scaling, and high availability with a few clicks
- Security and monitoring is built in

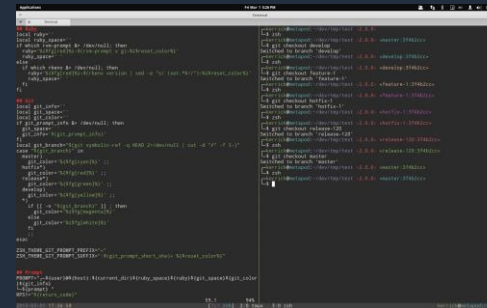
# Monitoring RDS/Aurora databases



**Instance**

## Amazon CloudWatch

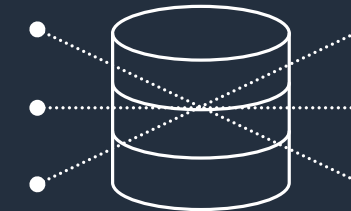
- CPU / Memory / IOPS / Network
- Per minute metric storage in Amazon CloudWatch



**Operating System**

## Amazon RDS Enhanced Monitoring

- Process / Thread list
- Per second metric storage in Amazon CloudWatch Logs

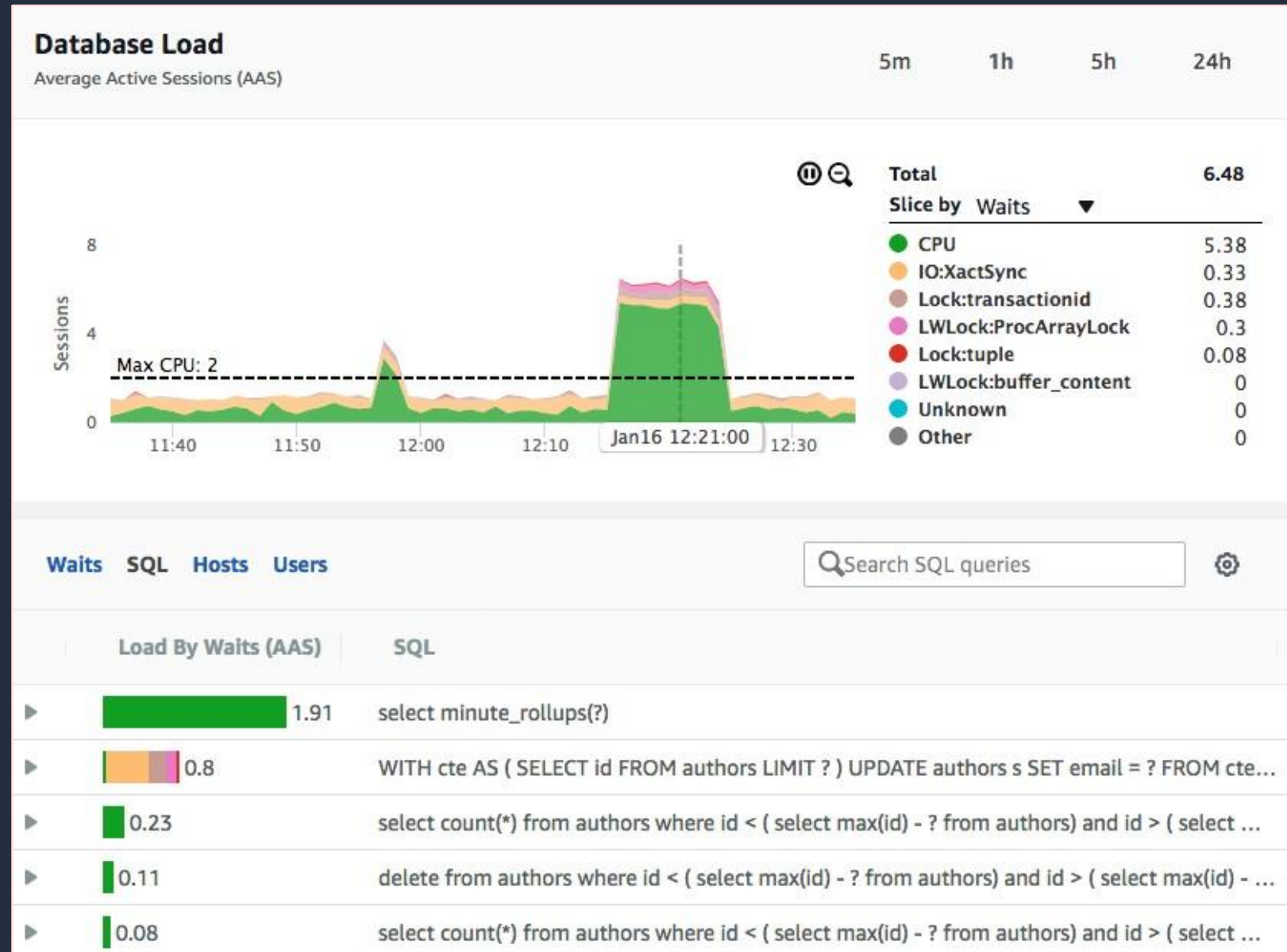


**Database Engine**

## Amazon RDS Performance Insights

- SQL / State / User / Host ("Database Load")
- Per second metric storage in Amazon RDS

# Performance Insights increases productivity



Amazon RDS Performance Insights measures database load over time

Easy to identify database bottlenecks

- Top SQL/most intensive queries

Enables problem discovery

Adjustable timeframe

- Hour, day, week, and longer

Available for all Amazon RDS database engines



# Availability and Durability



# Multi-AZ deployments

## Enterprise-grade high availability

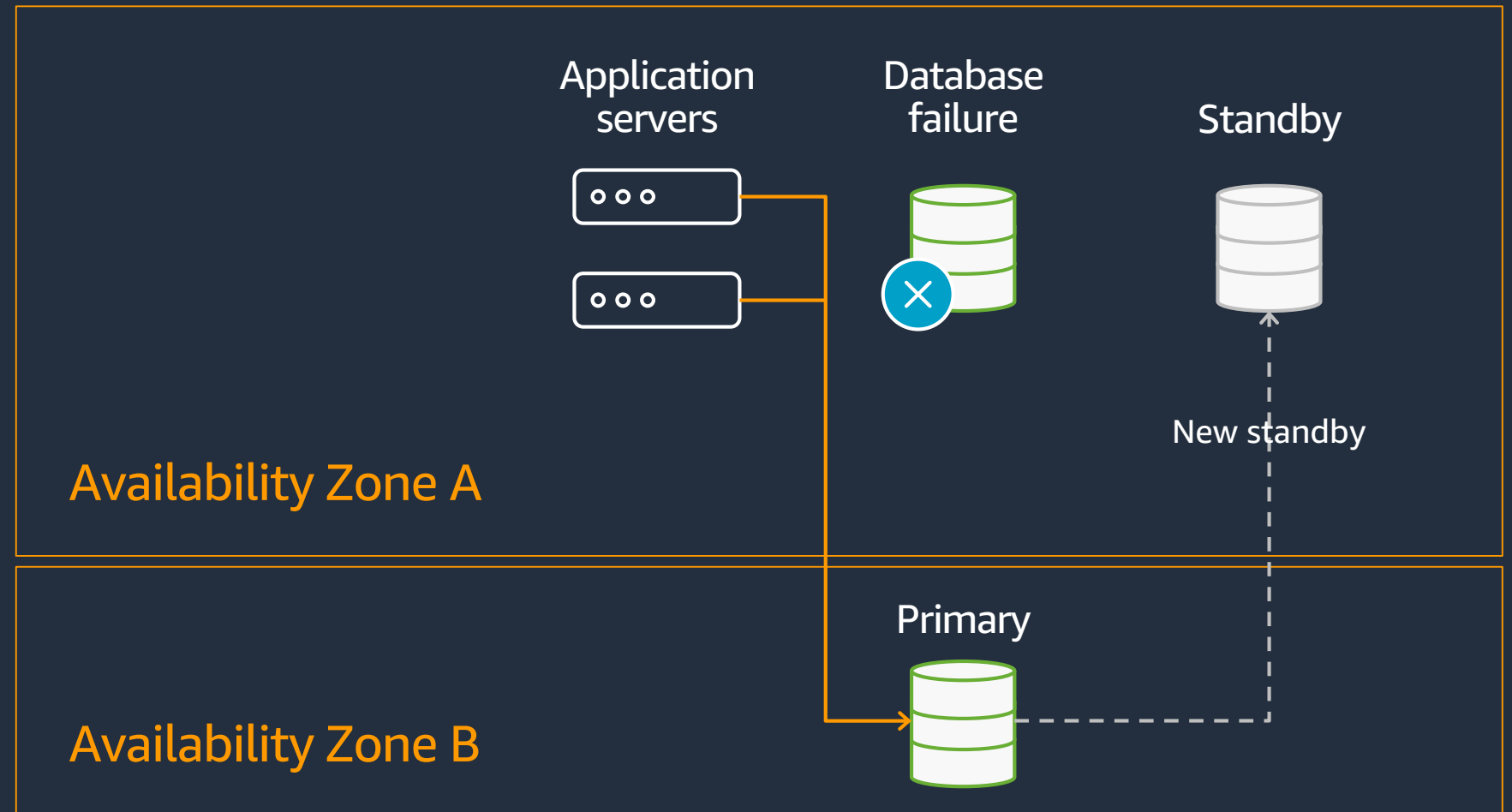
Fault tolerance across multiple data centers

- Automatic failover
- Synchronous replication
- Enabled with one click

### Availability & durability

#### Multi-AZ deployment [Info](#)

- Create a standby instance (recommended for production usage)  
Creates a standby in a different Availability Zone (AZ) to provide data redundancy, eliminate I/O freezes, and minimize latency spikes during system backups.
- Do not create a standby instance



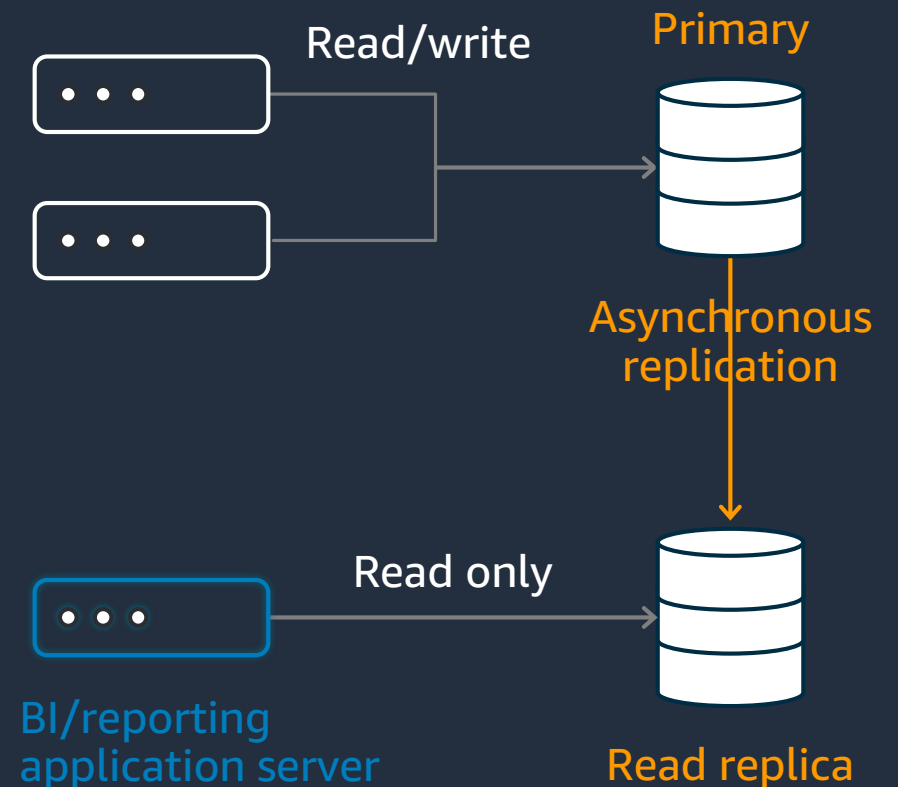
# Read Replicas

## Read scaling and disaster recovery

RDS for MySQL, PostgreSQL, MariaDB, MS SQL Server and Oracle

- Relieve pressure on your master node with additional read capacity
- Bring data close to your applications in different regions
- Promote a read replica to a master for faster recovery in the event of disaster

Application servers Database server



mymysql

Summary

DB identifier mymysql	CPU 2.00%	Info Available	Class db.t3.small
--------------------------	--------------	-------------------	----------------------

Modify Actions

- Stop
- Reboot
- Delete
- Create read replica
- Create Aurora read replica

mymysql-replica-stockholm

Summary

DB identifier mymysql-replica-stockholm	CPU 1.00%	Info Available	Class db.t3.small
Role Replica	Current activity 0 Connections	Engine MySQL Community	Region & AZ eu-north-1a

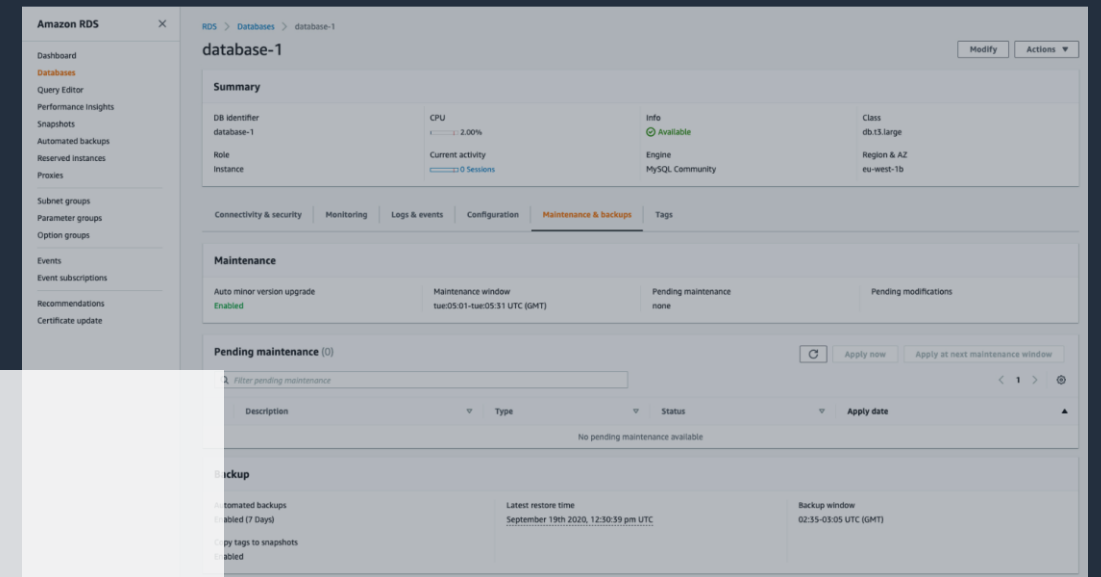
Modify Actions

- Stop
- Reboot
- Delete
- Create read replica
- Create Aurora read replica
- Promote

# Automated backups

## Point-in-time recovery for your DB instance

- Scheduled daily volume backup of entire instance
- Archive database change logs
- 35-day maximum retention
- Minimal impact on database performance
- Taken from standby when running Multi-AZ



DB instance status

available

Multi AZ

Yes

Secondary zone

us-east-1d

Automated backups

Enabled (7 Days)

Latest restore time

March 22, 2018 at 10:25:00 AM  
UTC-7



Every day during your backup window, RDS creates a storage volume snapshot of your instance



Every five minutes, RDS backs up the transaction logs of your database

# Database snapshots

Backups of your entire DB instance in Amazon S3

- Always incremental
- Amazon S3 → 99.9999999999% durability
- Supports encryption
- Copy across accounts, across regions

Amazon EBS



Volume

Amazon S3



Bucket



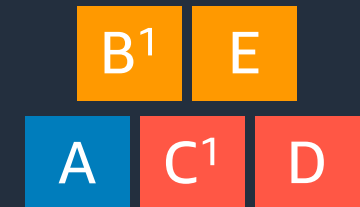
Snapshot 1



Snapshot 2

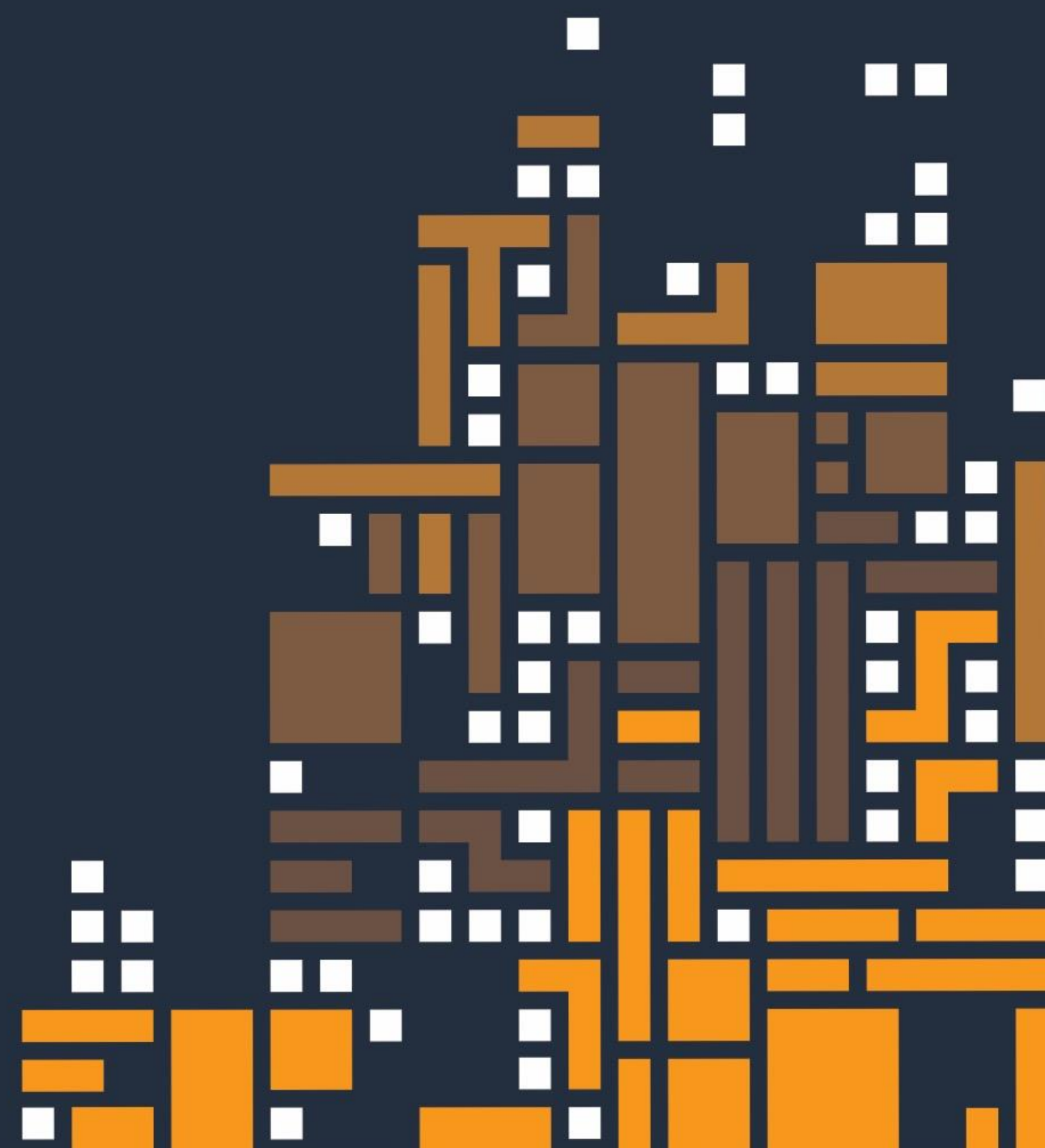


Snapshot 3





# Scalability



# Database server instance types

**DB instance size**

DB instance class [Info](#)

Choose a DB instance class that meets your processing power and memory requirements. The DB instance class options below are limited to those supported by the engine you selected above.

Standard classes (includes m classes)  
 Memory Optimized classes (includes r and x classes)  
 Burstable classes (includes t classes)

db.r4.large  
 2 vCPUs 15.25 GiB RAM EBS: 400 Mbps

Include previous generation classes

intensive workloads (e.g. WordPress)

<b>db.r4.large</b>	2 vCPUs	15.25 GiB RAM	EBS: 400 Mbps
<b>db.r4.xlarge</b>	4 vCPUs	30.5 GiB RAM	EBS: 800 Mbps
<b>db.r4.2xlarge</b>	8 vCPUs	61 GiB RAM	EBS: 1600 Mbps
<b>db.r4.4xlarge</b>	16 vCPUs	122 GiB RAM	EBS: 3000 Mbps
<b>db.r4.8xlarge</b>	32 vCPUs	244 GiB RAM	EBS: 6000 Mbps
<b>db.r4.16xlarge</b>	64 vCPUs	488 GiB RAM	EBS: 12000 Mbps
<b>db.r5.large</b>	2 vCPUs	16 GiB RAM	EBS: 3500 Mbps
<b>db.r5.xlarge</b>	4 vCPUs	32 GiB RAM	EBS: 3500 Mbps
<b>db.r5.2xlarge</b>	8 vCPUs	64 GiB RAM	EBS: 3500 Mbps
<b>db.r5.4xlarge</b>	16 vCPUs	128 GiB RAM	EBS: 3500 Mbps
<b>db.r5.12xlarge</b>	48 vCPUs	384 GiB RAM	EBS: 7000 Mbps
<b>db.r5.24xlarge</b>	96 vCPUs	768 GiB RAM	EBS: 14000 Mbps
<b>db.r4.large</b>	2 vCPUs	15.25 GiB RAM	EBS: 400 Mbps

Optimized (X1E)

Oracle and SQL  
 only  
 / 122 GiB RAM >  
 CPU 3904 GiB RAM  
 performance  
 king  
 nces offer the  
 memory per vCPU  
 instance types and  
 the lowest price per  
 memory  
 r query intensive  
 ds or high  
 ion counts

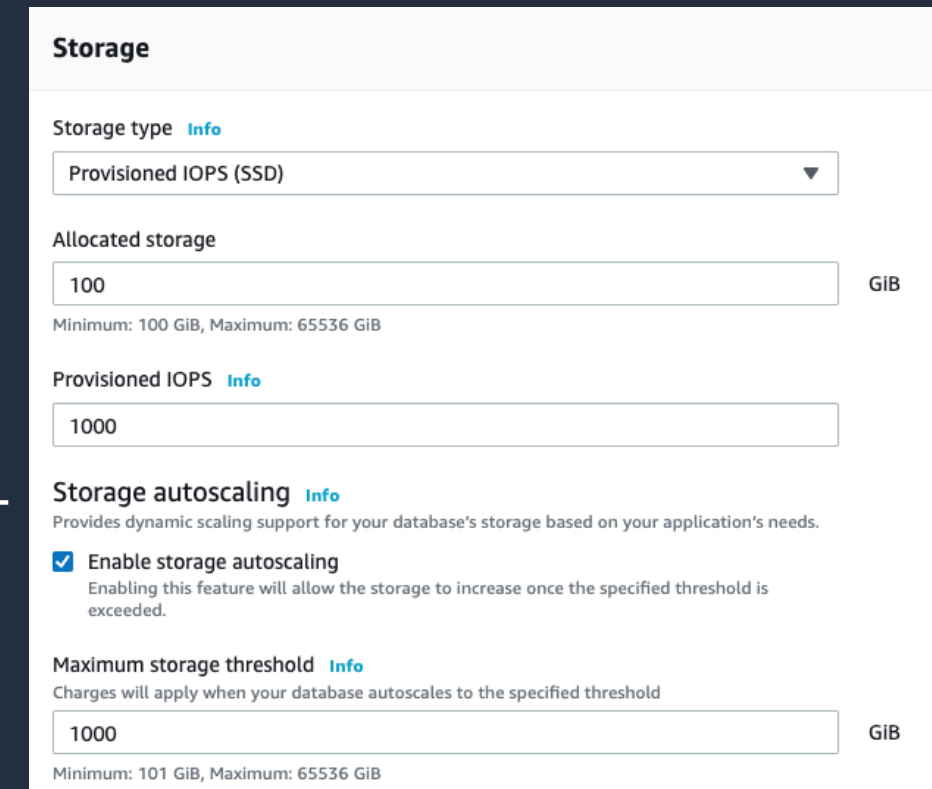
# High performance database storage

## General purpose (GP2)

- SSD storage
- Maximum of 64 TiB (16TiB for SQL Server)
- Latency in milliseconds
- IOPS determined by volume size
- Bursts to 3,000 IOPS (applicable below 1.3 TB)
- Affordable performance

## Provisioned IOPS (IO1)

- SSD storage
- Maximum of 64 TiB (16TiB for SQL Server)
- Single digit millisecond latencies
- Maximum of 80K IOPS (40K for SQL Server)
- Delivers the provisioned IOPS performance 99.9% of the time
- High performance and consistency



The screenshot shows the AWS RDS Storage configuration page. It includes a 'Storage type' dropdown menu set to 'Provisioned IOPS (SSD)'. Below this is an 'Allocated storage' input field set to '100' GIB, with a range from 100 to 65536 GIB. The 'Provisioned IOPS' input field is set to '1000'. There is a 'Storage autoscaling' section with a checked checkbox for 'Enable storage autoscaling' and a 'Maximum storage threshold' input field set to '1000' GIB. The page also contains 'Info' links for several sections.

Amazon RDS storage auto scaling: greater of 5GiB or 12% when less than 10% free storage for 5 minutes



# Security and Compliance



# Security and compliance

- Network security
  - Amazon Virtual Private Cloud (VPC) security groups act as a virtual firewall to control inbound and outbound traffic
- Resource access permissions
  - AWS Identity and Access Management (IAM) provides resource-level role permission controls
- Data encryption
  - Encryption at rest using AWS KMS or Oracle/Microsoft TDE
  - SSL protection for data in transit
- Compliance and assurance programs for finance, healthcare, government, and more
  - HIPAA eligibility under a Business Associate Agreement (BAA) with AWS
- Active Directory / Kerberos integration
  - RDS for Oracle, SQL Server, PostgreSQL



# Compliance

## Aurora

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- FedRAMP
- HIPAA BAA



## MySQL

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- FedRAMP
- HIPAA BAA
- UK Gov. Programs
- Singapore MTCS



## PostgreSQL

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- FedRAMP
- HIPAA BAA
- UK Gov. Programs
- Singapore MTCS



## Oracle

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- FedRAMP
- HIPAA BAA
- UK Gov. Programs
- Singapore MTCS



## MariaDB

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- HIPAA BAA



## SQL Server

- SOC 1, 2, 3
- ISO 27001/9001
- ISO 27017/27018
- ISO 27701
- PCI
- HIPAA BAA
- UK Gov. Programs
- Singapore MTCS
- FedRAMP



27001/9001  
27017/27018

# Great ! But how can I migrate my Apps and DBs to **AWS** ?

How do I create a business case?

How do I get started?

What workloads to move first?

How do we manage workloads  
in the cloud?

What do I have in my environment?

What should I move to the cloud?

How do I migrate these workloads?

How do I get my team re-skilled?

# Migration process



Assess

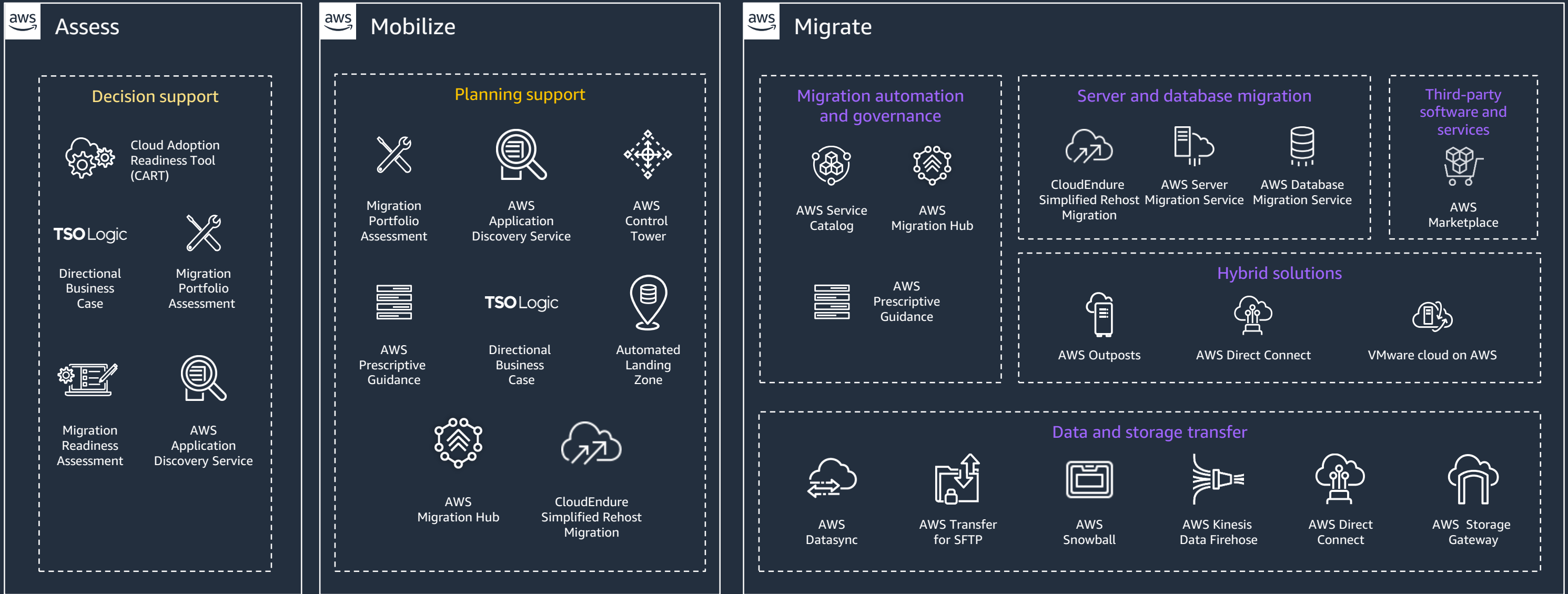


Mobilize



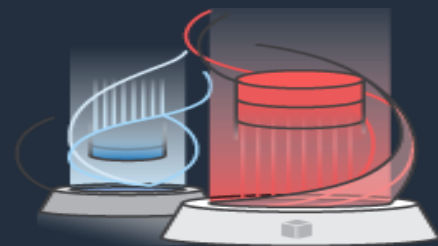
Migrate & modernize

# Broadest and deepest set of capabilities to accelerate your migration



# Simplify your database migration

***AWS Database Migration Service (DMS)*** easily and securely migrates and/or replicate your databases *and* data warehouses to AWS



***AWS Schema Conversion Tool (SCT)*** converts your commercial database and data warehouse schemas to open-source engines or AWS-native services, such as Amazon Aurora and Redshift

# SCT helps with converting tables, views, and code

The screenshot displays the AWS Schema Conversion Tool (SCT) interface. The top menu includes File, Actions, View, Settings, and Help. The main window is divided into several panes:

- Summary / Action Items:** Lists conversion issues. Three issues are highlighted:
  - Issue: 325: MySQL does not support check constraints. Emulating triggers created** (2 occurrences).
  - Issue: 329: MySQL doesn't support the RAISE exception** (53 occurrences).
  - Issue: 331: MySQL doesn't support a global user exception** (2 occurrences).
  - Issue: 332: MySQL doesn't support the procedure dbms\_output.put\_line** (128 occurrences).
- Oracle:** A tree view of Oracle database objects, with **FIXINDEXES** selected.
- Amazon RDS for MySQL:** A tree view of MySQL objects, showing a list of schemas like **SS2K5ALLPLATFORM\$FI** and **SYB12ALLPLATFORM\$C**.
- Code Snippets:** Two panes show SQL code:
  - Oracle procedure: FIXINDEXES:**

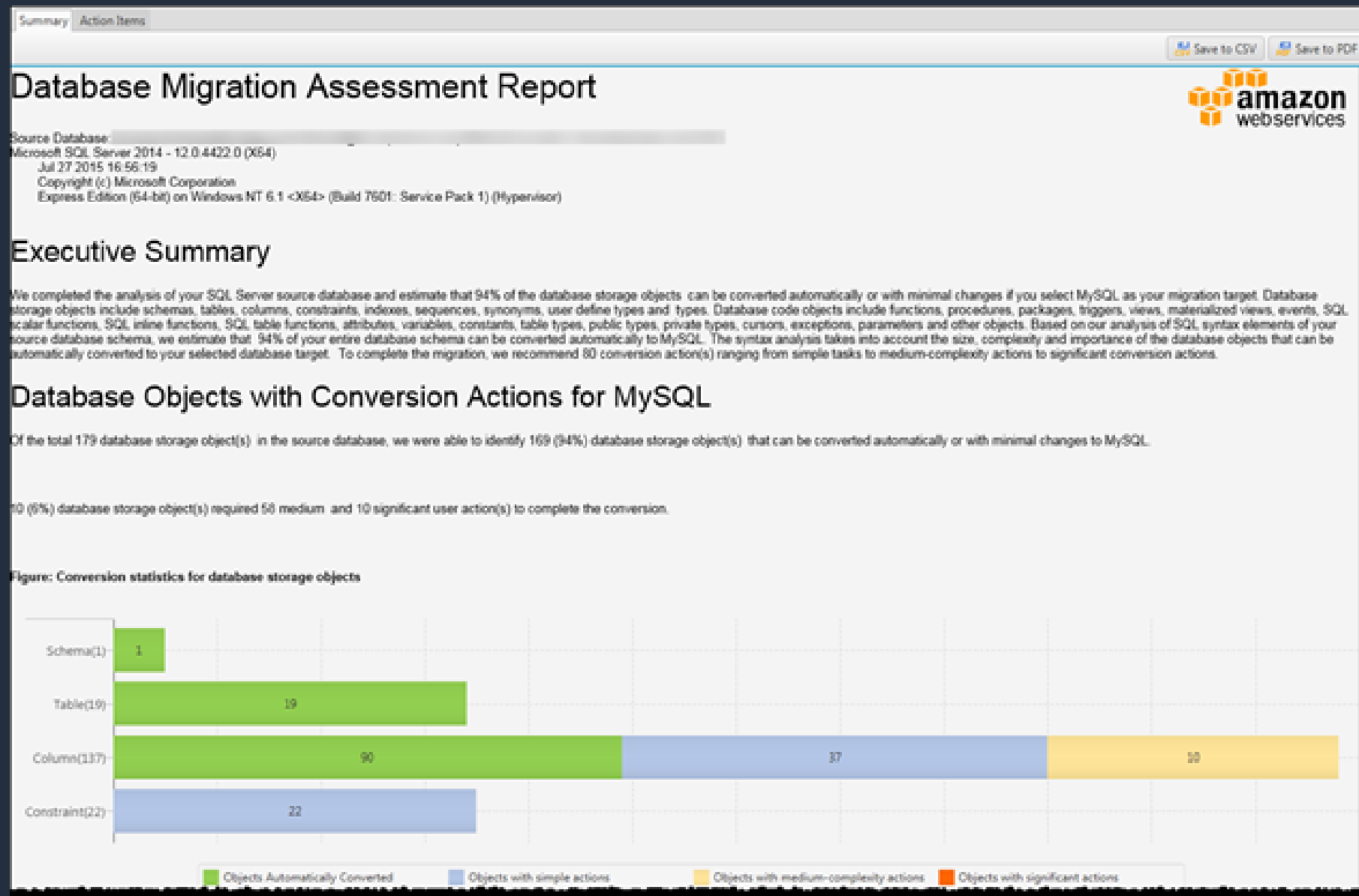
```
01 PROCEDURE FixIndexes
02 IS
03   errMsg VARCHAR2(4000) := NULL;
04 BEGIN
05 NULL;
06 EXCEPTION
07
08 WHEN OTHERS THEN
09   DBMS_OUTPUT.put_line('Exception in FixIndexes
10   errMsg := LOCALSUBSTRB(LOCALSUBSTRB(DBMS_UTIL
11   LogInfo(NULL, sev_err, 'FixIndexes Failed: out
12 END FixIndexes;
```
  - MySQL procedure: SS2K5ALLPLATFORM\$FIXINDEXES:**

```
08
09 [340 - Severity CRITICAL - MySQL doesn't supp
10 errMsg := LOCALSUBSTRB(LOCALSUBSTRB(DBMS_UTIL
11 */;
12
13   CALL SS2K5ALLPLATFORM$LOGININFO (NULL
14   END;
15
16 IF (@SS2K5ALLPLATFORM$InitCheck IS NULL) T
17   CALL SS2K5ALLPLATFORM$Init ();
18 END IF;
19
20 BEGIN
21 END;
```

System status at the bottom: Used mem Windows PowerShell (3) 1.95 GB, Total memory: 3.68 GB, Maximum memory: 7.11 GB.

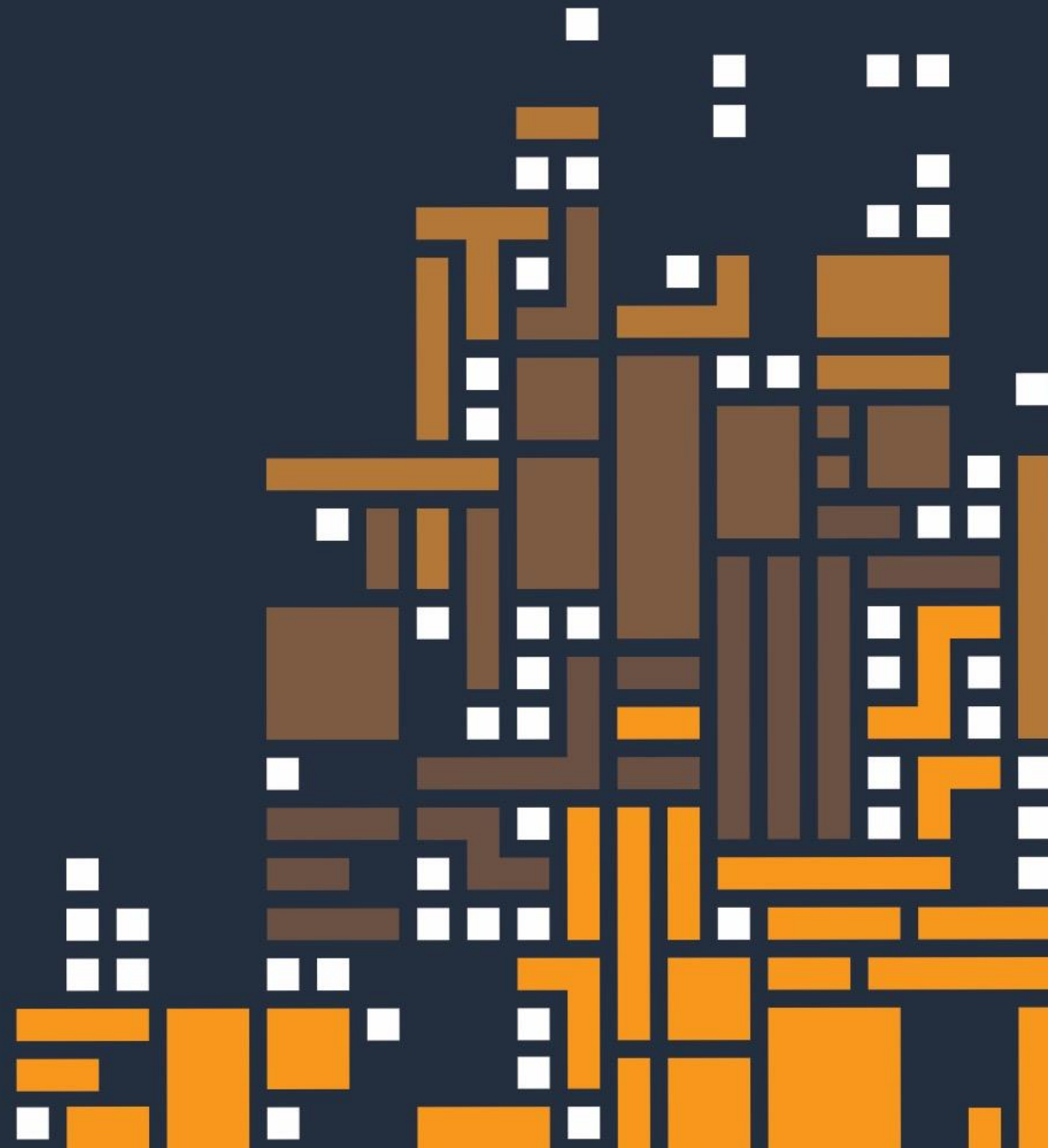
- Sequences
- User-defined types
- Synonyms
- Packages
- Stored procedures
- Functions
- Triggers
- Schemas
- Tables
- Indexes
- Views
- Sort and distribution keys

# SCT Migration Assessment Report



- Assessment of migration compatibility of source databases with open-source database engines – RDS MySQL, RDS PostgreSQL and Aurora
- Recommends best target engine
- Provides details level of efforts to complete migration

# Q&A





# Grazie a Tutti

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