Modernizing Microsoft SQL Server on AWS

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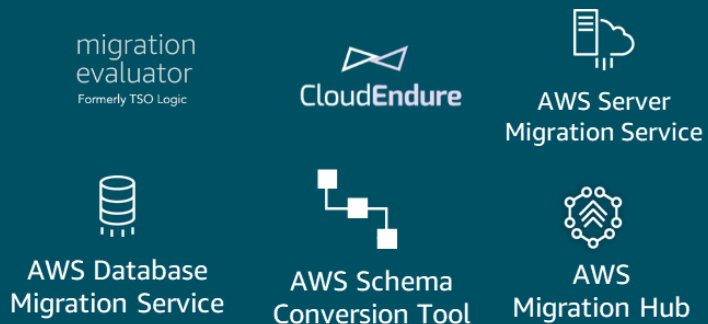
Agenda

- Why SQL Server on AWS

- SQL Server Options on AWS

- Run SQL Server on Linux

- Replatform SQL Server to RDS

- Refactor to purpose-built databases on AWS

Why SQL Server on AWS?

Broader and deeper functionality

Windows on AWS momentum

14 years of running Windows workloads

10k+ partners innovating on AWS

Customer Adoption →

AWS App2Container

Porting Assistant for .NET

MAP for Windows

.NET Core 3.1 Support with Lambda

SQL Server 2019 Windows + Linux

Windows Web App Migration Assistant (ASP.NET)

.NET Cloud Development Kit (CDK)

AWS Launch Wizard for SQL Server

AWS Launch Wizard

Joined .NET Foundation

New, Simplified, Bring Your Own License (BYOL) experience

EC2 Image Builder

Amazon Linux 2 and Ubuntu w/ Mono and .NET support

Azure to AWS Migration Support

AWS Toolkit for Visual Studio Code

CloudWatch AppInsights for .NET and SQL

Amazon EKS for Windows Containers

AWS License Manager

AWS X-Ray .NET Core Support

Active Directory Cross VPC Support

Amazon FSx for Windows File Server

Dedicated Host Enhancement Tag-On

Application migration using AWS SMS

.NET Developer Hub

.NET Core 2.1 Support with Lambda & X-Ray

Sessions Manager

Lambda Support for PowerShell Core

.NET Core on Linux AMIs

SQL Server 2017 Windows + Linux

EC2 Windows on Bare Metal/Hyper-V AMI

Windows Deep Learning AMI

.NET Core & PowerShell on AL2/Ubuntu

Hyper-V support in SMS

Application-consistent Snapshots through VSS

.NET Core Support in AWS CodeStar and CodeBuild

.NET Core 1.0 Support with Lambda

Windows for Lightsail

Trusted Advisor for Windows

.NET SDK v3

Windows Server 2016

EC2 Systems Manager

X-Ray .NET SDK

Microsoft SharePoint 2016 (Marketplace)

Amazon ECS for Windows Containers

SQL Server 2008

AWS Directory Service

SQL Server 2016

Windows Server 2003

Windows Server 2012

.NET SDK v2

EC2 Dedicated Hosts (BYOL)

SQL Server 2008 R2

Windows Server 2008

SQL Server 2012

AWS Tools for Windows PowerShell

NuGet (Package management)

Amazon RDS adds SQL Server

.NET SDK

AWS Toolkit for Visual Studio

Windows Server 2008 R2

SAP instance on AWS

2008   2010   2012   2014   2016   2018   2020   Today

■ Windows Server & EC2

■ SQL Server

■ .NET

■ App Modernization

4

Migrating and managing SQL Server on AWS is easy

Easy migration

- Automation tools are ready to assess, mobilize, and migrate & modernize
- More than 350,000 databases migrated using AWS Database Migration Service

Easy self-managed on EC2

- Easily size, configure, and deploy SQL Server with AWS Launch Wizard
- Gain operational insights and take action with AWS Systems Manager Fleet Manager and Application Manager
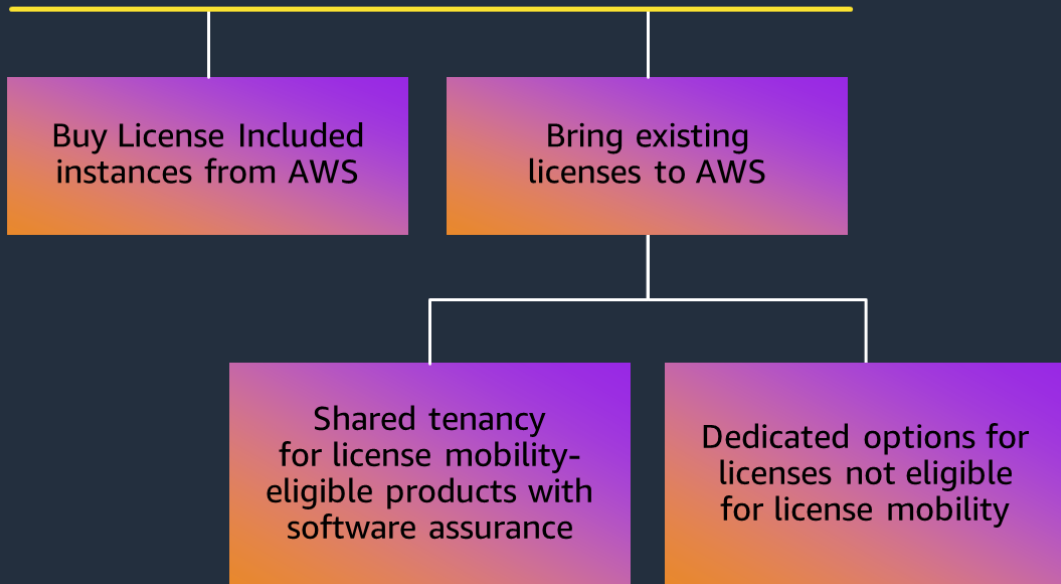- Easily manage SQL Server licenses with AWS License Manager

Fully AWS-managed RDS

- One click to enable Multi-AZ HA
- Automatically increase the storage size with zero downtime
- Automated hardware provisioning, software patching, setup, configuration, or backups

Flexible licensing options for SQL Server on AWS

Optimize your licenses with AWS Optimization and Licensing Assessment (OLA)

Buy License Included instances from AWS

Bring existing licenses to AWS

Shared tenancy for license mobility-eligible products with software assurance

Dedicated options for licenses not eligible for license mobility

Manage licenses with AWS License Manager

Amazon EC2   Amazon RDS   AWS Marketplace   On-premises

1 **Bring your licenses to AWS (BYOL)**
Save costs with Dedicated Hosts

2 **Buy licenses included (LI) from AWS**
Pay as you go with no upfront costs

3 **AWS License Manager**
Manage, discover, and report software license usage
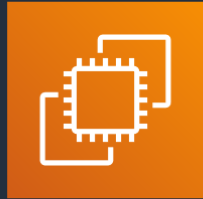
OLA: AWS Optimization and Licensing Assessment

SQL Server options on AWS

Rehost to EC2

"Lift and shift"

Managed physical infrastructure, OS installation, and scaling

OS-level control

Linux support
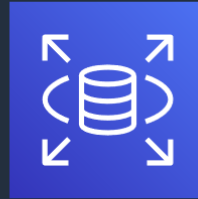
Replatform to RDS

Fully managed with single click high availability, auto-scaled storage, and automated backups

Business innovation focused
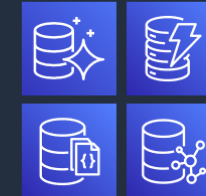
Refactor to purpose-built databases

Eliminate SQL Server licensing costs

broadest selection of AWS purpose-built databases

Performance and availability of commercial-grade databases at 1/10th the cost

The Right AWS Instance Type
Options to fit all your SQL Server workload needs

	General Purpose				Compute Optimized		Memory Optimized						Storage Optimized	
	Burstable Performance	General Purpose	Up to 25Gbps	Up to 100Gbps	Compute Intensive	w/ up to 100Gbps	Memory Optimized	Up to 25Gbps	Up to 100Gbps	Memory Intensive 2TB to 4TB		4Ghz CPU/ Mem Intensive	High I/O, Up to 25Gbps	High I/O, Up to 100Gbps
intel	t3	m5		m5n	c5	c5n	r5	r5b	r5n	x1	x1e			
Local storage (NVMe SSD)		m5d	m5ad (20 Gbps)	m5dn	c5d		r5d	r5ad (20 Gbps)	r5dn			z1d	i3	i3en
AMD	t3a		m5a (20 Gbps)		c5a			r5a (20 Gbps)						
Bare Metal		m5m			c5m/ c5dm			r5m				z1dm	i3m	i3enm
vmware		mv11			cv11			r5m/ rv11					i3m/ i3enm	

<-- 100Gbps support for i3en is on VMWare's roadmap

License Optimization with Optimize CPUs

- Control active vCPUs and Hyper-Threading status when launching new EC2 instances

- Reduce the number of SQL Server licenses

Instance Type	Total vCPUs	Active vCPUs with Optimize CPUs	SQL Server license savings
r5.4xlarge	16	8	50%
r5.8xlarge	32	8	75%

*Sample licensing example only

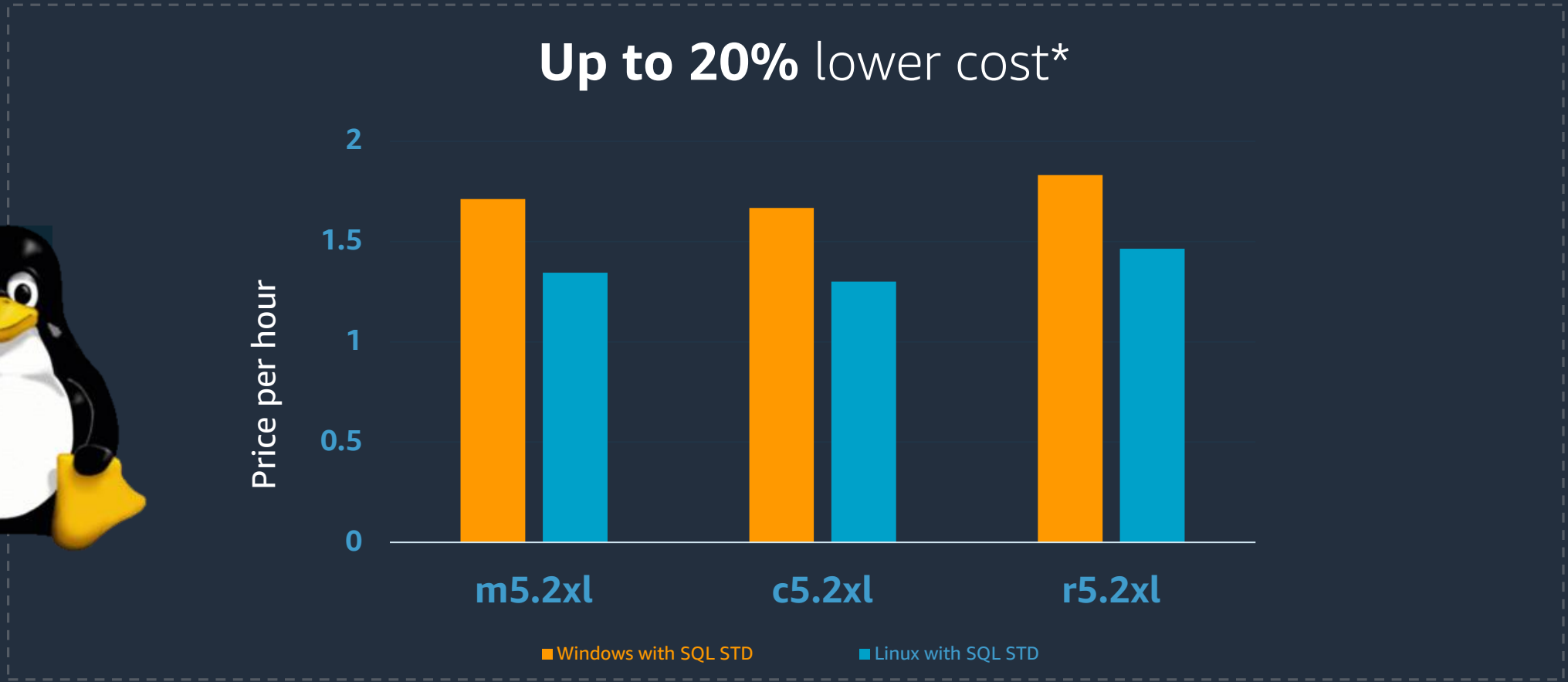# Customers running Windows Server and SQL Server

Run SQL Server on Linux

SQL Server on Linux Overview

SQL Server on

Linux
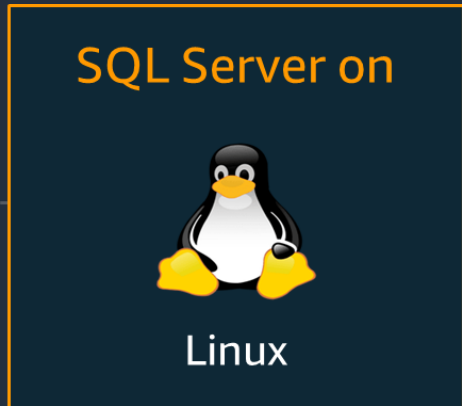
✓ Consistent user experience
✓ No change to apps
✓ Reduce costs of Windows license and support

✓ Organizations are looking to migrate applications and database workloads to the cloud

✓ With SQL Server 2017, 2019 you have the choice of running on Windows or Linux operating system

✓ Migrating to Linux reduces Windows licensing cost

SQL Server on Linux: TCO

Up to 20% lower cost*

Chart — Price per hour by instance type:

Instance	Windows with SQL STD	Linux with SQL STD
m5.2xl	~1.7	~1.35
c5.2xl	~1.65	~1.3
r5.2xl	~1.85	~1.47

- Windows with SQL STD
- Linux with SQL STD

Save EVEN MORE WITH Reserved Instances

SQL Server 2019 feature parity

✓   SQL Server on Windows and SQL Server on Linux are at functional parity with SQL Server 2019.

✓   Intelligent Query Processing (IQP)

✓   Clustered Column store online index build

✓   Lightweight query profiling by default

✓   Built-in data classification and auditing

✓   Cross-platform replication, managed from SQL Server Management Studio (SSMS)

✓   Distributed transactions across SQL Server Linked Servers, including cross-platform

✓   Active directory authentication

SQL Server Always On Solution

Failover Cluster Instance (FCI)	Availability Group (AG)

• Enhancements
    - Cloud Witness
    - Site Awareness
    - Fault Domain
 	
• SQL Server Instance Failover
 	
• Shared Storage
 	
• Passive Secondary Nodes
 	
• Failover takes 30s to a couple of minutes (instance restart)
	• Introduced in SQL 2012
	
	• Multi-database failover
	
	• Non-shared storage
	
	• Active secondary replica
	
	• Failover takes less than 30s (secondary replicas are online)
	
	• Subsequent features introduces in subsequent SQL Server versions

Example: RHEL failover cluster instance (FCI) cluster for SQL Server
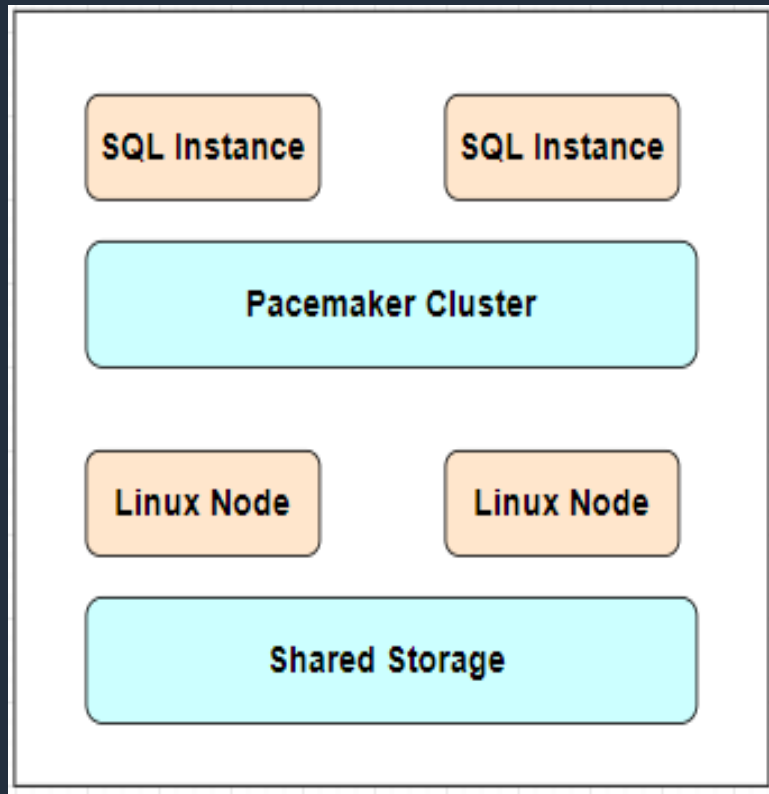
- Create a two-node failover cluster instance of SQL Server on Linux.

  ✓ Set up and configure Linux

  ✓ Install and configure SQL Server

  ✓ Configure the hosts file

  ✓ Configure shared storage and move the database files

  ✓ Install and configure Pacemaker on each cluster node

  ✓ Configure the failover cluster instance

SQL Server options on AWS
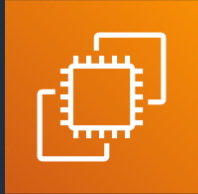
Rehost to EC2

"Lift and shift"

Managed physical infrastructure, OS installation, and scaling

OS-level control

Linux support

Replatform to RDS

Fully managed with single click high availability, auto-scaled storage, and automated backups

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Options for Deploying SQL Server on AWS

Amazon RDS for SQL Server

- **Consider RDS first**
- Focus on business value tasks
- High-level tuning tasks
- Schema optimization
- No in-house database expertise

Scaling
High Availability
Database Backups
DBMS Patching
DBMS Install/Maintenance
OS Patching
OS Install/Maintenance
Power, HVAC, net

SQL Server on Amazon EC2

- Need full control over DB instance
- Backups
- Replication
- Clustering
- Options that are not available in RDS

Scaling
High Availability
Database Backups
DBMS Patching
DBMS Install/Maintenance
OS Patching
OS Install/Maintenance
Power, HVAC, net

AWS managed   **Customer managed**

SQL Server Features at a Glance

	Amazon RDS	**Amazon EC2**
Licensing:	License Included	License Included / BYOL
Versions Supported:	2014, 2016, 2017, 2019	All**
Editions Supported:	Express, Web, Standard, Enterprise	All**
High Availability:	AWS-managed; AlwaysOn or Mirroring	Self-managed; AlwaysOn, Mirroring…
Encryption:	Encrypted Storage using AWS KMS (all editions); TDE Support	
Authentication:	Windows & SQL Authentication	
Backups:	Managed Automated Backups	Maintenance Plans & 3rd Party Tools
Maintenance:	Automated Software Patching	Self-managed
SQL Component Services:	SSAS(Tabular), SSIS(No OS tasks), SSRS	SSIS, SSAS, SSRS, MDS, DQS

Performance Insights for RDS SQL Server

Last 5 minutes ▾

Performance metrics
— CPU
— numbackends
— blks_read
— blks_written

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

10

Max CPU

5

0

Waits
● Lock:tuple
● CPU
● Lock:transactionid
● Unknown
● LWLockTranche:buff...
● Other
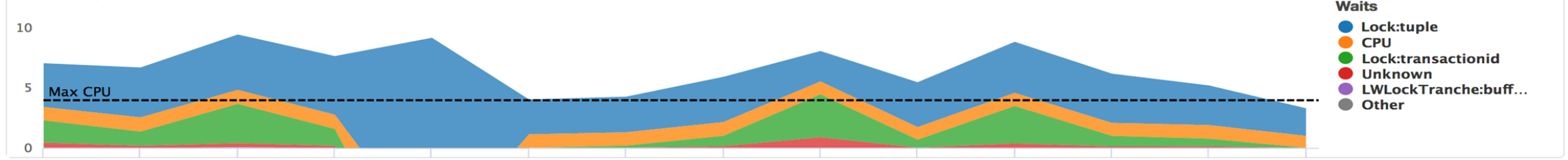
Waits	SQL	Hosts	Users

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 = ?;

Migrating Data to & from Amazon RDS

1 **.BAK File Save & Restore**
Leverages SQL Server's native backup functionality

2 **Microsoft SQL Server Database Publishing Wizard, Import/Export**
Export to T-SQL files, load using **sqlcmd**

3 **AWS Database Migration Service**
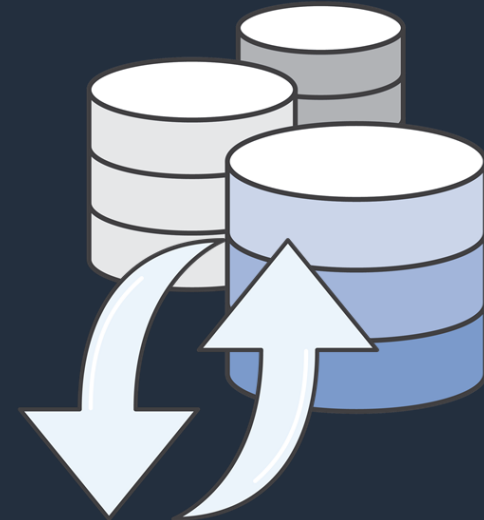Minimize downtime during migrations, migrate between different DB platforms, Schema Conversion Tool

4 **AWS Marketplace**
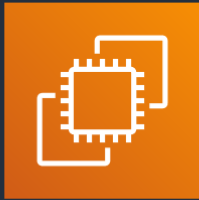Third-party data import and export tools and solutions

5 **SQL Server Replication**
Push subscriptions to transactional replication

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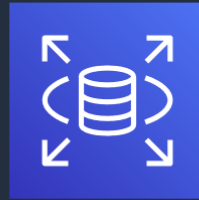
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Are you operating with old world databases?

Very
expensive

Proprietary

Lock-in

Punitive
licensing

AUDIT
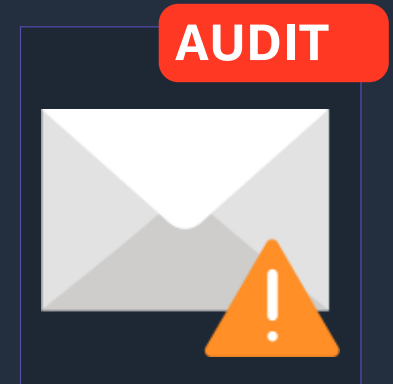
You've got
mail

Amazon Aurora
Enterprise database at an open source price

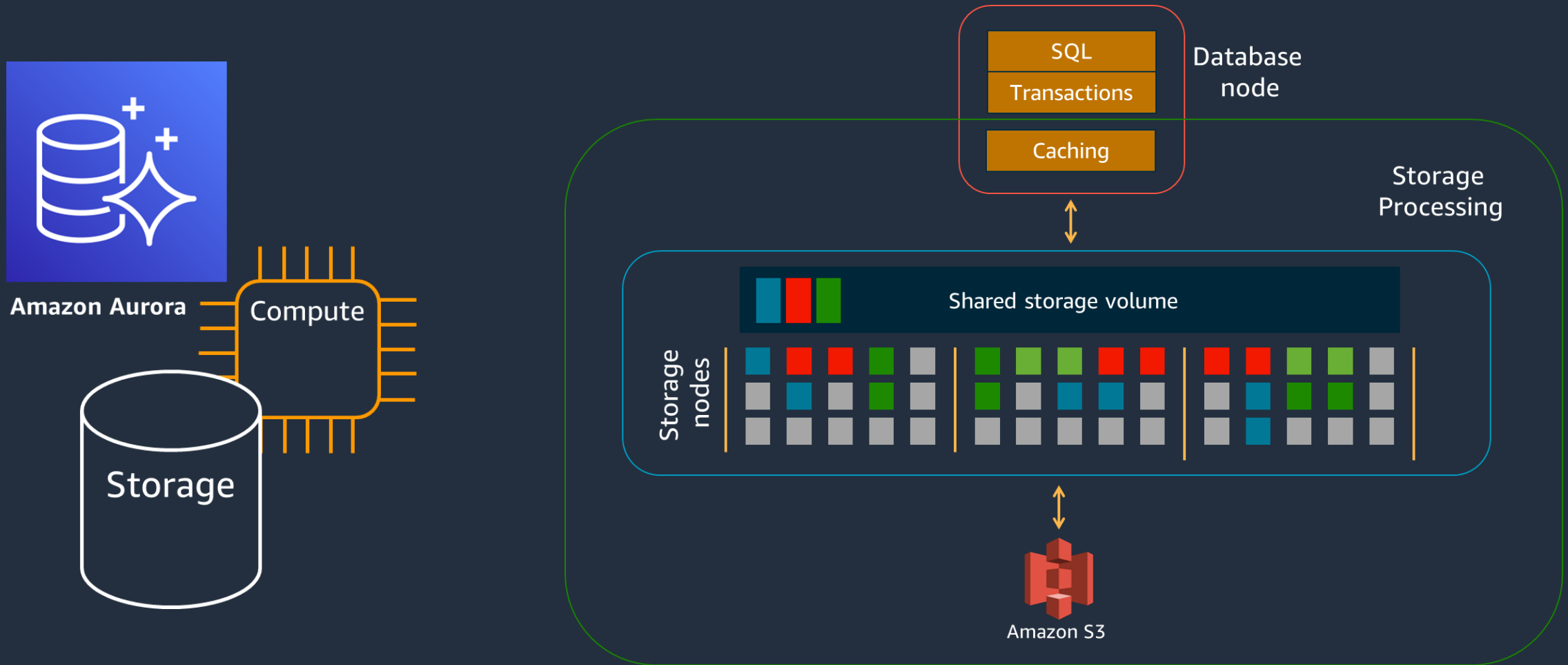Delivered as a **managed** service

Drop-in compatibility with MySQL and PostgreSQL

Simplicity and cost-effectiveness of open-source databases

Throughput and availability of commercial databases

Simple pay-as-you-go pricing

Amazon Aurora decouples storage and compute

Amazon Aurora

Compute

Storage

SQL

Transactions

Caching

Database node

Storage Processing

Shared storage volume

Storage nodes

Amazon S3

Amazon Aurora distributed storage provides:

Amazon Aurora

Delivered as a **managed** service

- Redo log processing
- Instant crash recovery
- Fault-tolerant and self-healing storage
- Fast database cloning
- Database backtrack
- Database snapshots
- Continuous backups and point-in-time restore
- Storage automatic scaling independent of compute
- Read and write scalability
- Warm cache on database restart
- Low latency replication

What are AWS DMS and AWS SCT?

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

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

Over 200,000 databases migrated and counting…

Challenges in migrating from commercial to open source
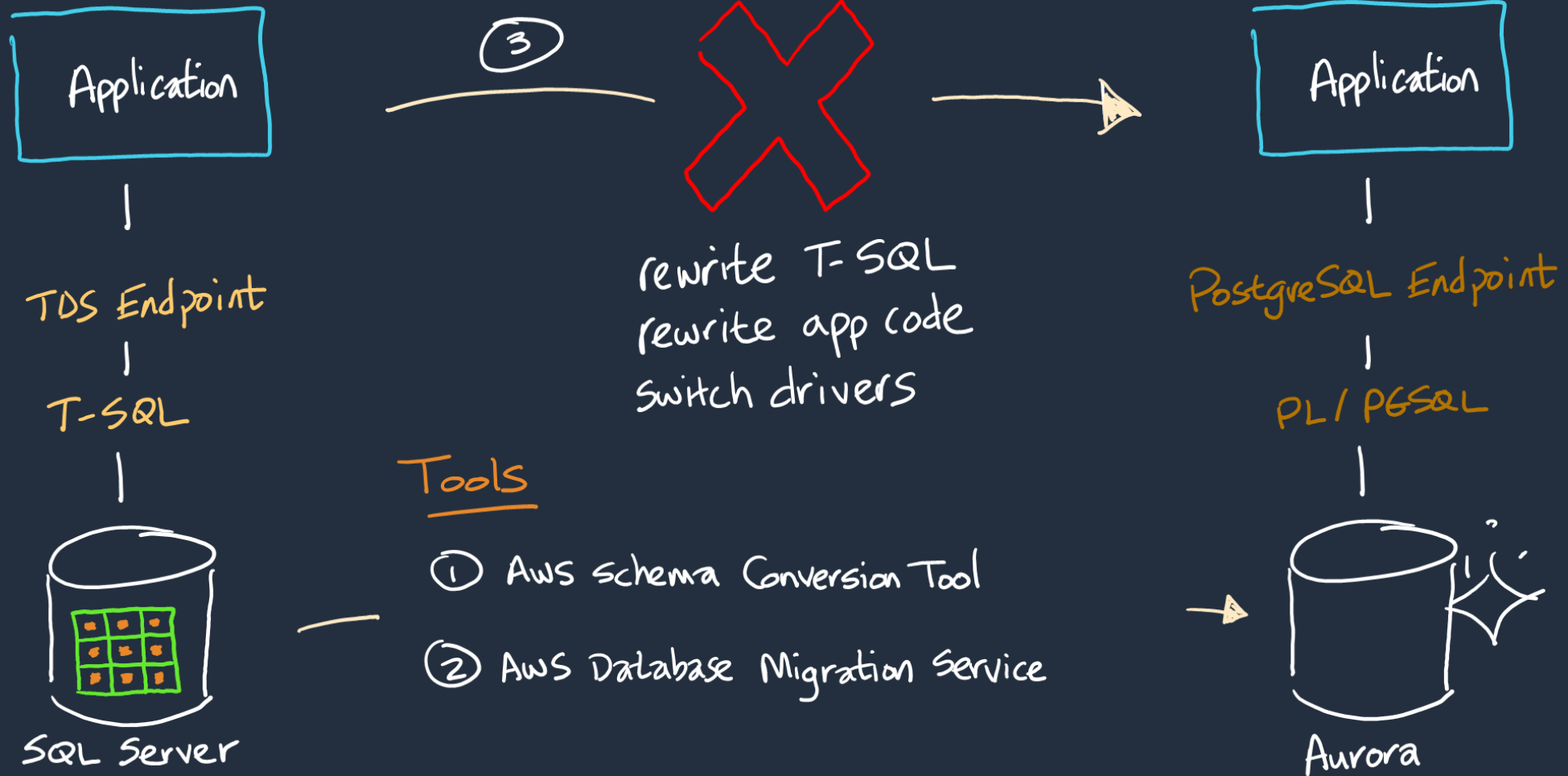
Application correctness

```
--example T-SQL application syntax

SELECT ProductID, ProductName, Price
    FROM dbo.Products
    WHERE Price < 30
```
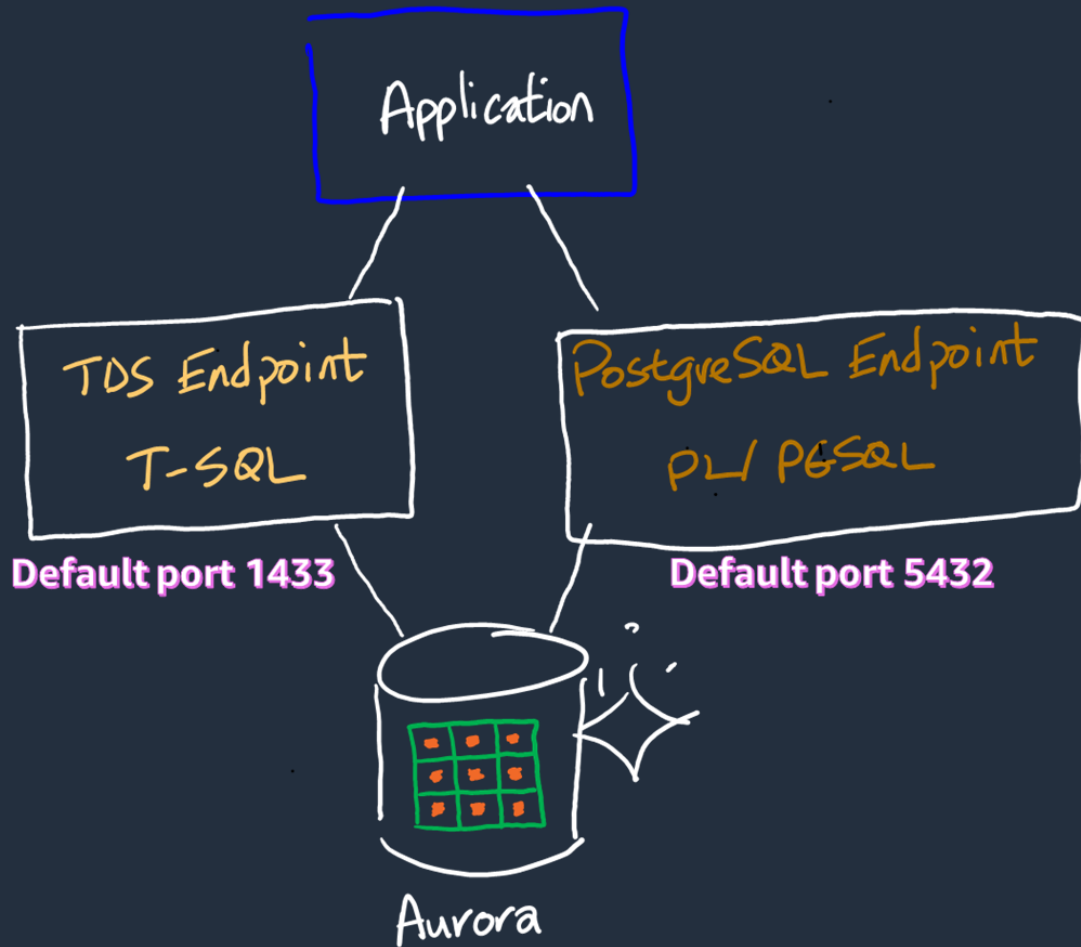
```
--example PGSQL application syntax

SELECT ProductID, ProductName, Price
    FROM Products
    WHERE Price < 30
```

ProductID	ProductName	Price
1	Clamp	$12.8182

ProductID	ProductName	Price
1	Clamp	$12.82

SQL Server

Aurora

Imagine if you could . . .

Application

TDS Endpoint
T-SQL

Default port 1433

PostgreSQL Endpoint
PL/ PGSQL

Default port 5432

Aurora

(1) Legacy application code remains written for SQL Server

(2) Client drivers do not need to be changed

(3) New application code written directly to PostgreSQL

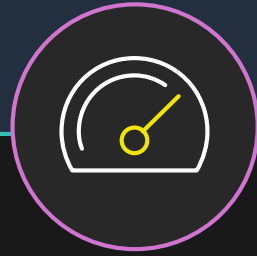# Introducing Babelfish for Aurora PostgreSQL

Run SQL Server applications on PostgreSQL with little to no code changes

Keep existing queries

T-SQL

Translation layer enables Aurora PostgreSQL to understand Microsoft SQL Server's proprietary T-SQL

Accelerate migrations

Lower risk and complete migrations faster, saving you months to years of work

Freedom to innovate

Run T-SQL code side-by-side with new open source functionality and continue developing with familiar tools

What is Babelfish?

Babelfish is:

- *"Babelfish is a migration accelerator providing semantically correct execution of T-SQL over the TDS protocol, natively implemented in PostgreSQL."*
- A native implementation of TDS and T-SQL, using PG building blocks
- A PostgreSQL extension (in fact, 3 extensions)
- A second endpoint in an Aurora cluster (TDS + PG ports)
- Open source

Babelfish is not:

- A SQL 'mapping' proxy between the client app and PG
- A separate server
- A temporary solution for customers
- Replacing PG

Support for...

✓ Triggers, Stored Procedures, scalar SQL Functions, Views

✓ T-SQL transactional semantics, incl. nested transactions & savepoints

✓ Data types (**money**, **sql_variant**, 3-millisecond **datetime**)

✓ Control-of-Flow statements (e.g. GOTO, TRY/CATCH)

✓ Table Data Types, Table Parameters and Table-Valued functions

✓ Static cursors

✓ Computed columns

✓ Dynamic SQL (*EXEC with string param*) and *sp_executesql*

✓ Application Locks

✓ SELECT…FOR XML { RAW | PATH }

✓ Multiple results sets per procedure/batch

Support for...

SQL SERVER-SPECIFIC FEATURES

✓ #Temporary Tables

✓ Built-in functions

✓ IDENTITY columns

✓ Case-insensitive identifiers

✓ Collation support

✓ DML OUTPUT clause support

✓ @@ERROR code mapping

✓ CREATE DATABASE; USE <db>

✓ SQL Server catalogs (selection)

✓ SSL/TLS; Kerberos

Migration Assessment Tool

- Users need to be able to determine if their application is compatible with Babelfish ➔ before starting a migration project

- Two options for Babelfish compatibility assessment

Option 1: new open-source tool, 'Babelfish Compass'

- Designed for Babelfish compatibility assessment

- Stand-alone, command-line tool

- Download from GitHub: https://github.com/babelfish-for-postgresql/babelfish_compass/releases/latest ➔ easy to install

  - User guide: https://github.com/babelfish-for-postgresql/babelfish_compass/blob/main/BabelfishCompass_UserGuide.pdf

Option 2: Use SCT's assessment feature for Babelfish

- NB: not for SQL code conversion, only for assessment

Option 3: Migration Hub Strategy Recommendations Service

Our Customers

Infor achieves substantial monthly cost savings on Amazon Aurora

"We needed more agility and building data centers did not make sense for our customers and the business. We're running tens of thousands of SQL and Aurora databases on AWS and are seeing substantial savings on our monthly costs."

—*Richard Sharp, Director of Databases, Infor*

Pacific Magazines tackles stability and scalability by migrating to AWS

"That [DDoS] attack was more than double the spike that had triggered the most recent downtime event on our previous cloud infrastructure, but on AWS it was barely a blip. With zero downtime and no effect on user experience, we avoided revenue losses and damage to our reputation with readers and advertisers."

—*Will Everitt, Director of Digital Product and Technology, Pacific Magazines*

Origin Energy increases flexibility and agility by moving Windows server to AWS

"Origin Energy is faced with tactical applications running on older, legacy Windows server operating system. Due to the tactical nature and limited lifespan of these applications, investment to re-platform or refactor the application is not preferred. Origin Energy is evaluating the AWS End-of-life Migration Program (EMP) to enable supported and secure migration of legacy Windows applications without code changes."

—*Nick Andrews, Group Manager, Origin IT*

Ancestry moves petabytes of workloads onto AWS for scalability, security, and privacy

"AWS provides us with the flexibility we need to stay at the forefront of consumer genomics. We're confident that AWS provides us with unmatched scalability, security, and privacy."

—*Nat Naterajan, VP Product & Technology, Ancestry*

Xero increases productivity, focuses on improvement on SQL server on Linux

"Stability of the EC2 platform when combined with Autoscaling groups gives us peace of mind around tolerating Availability Zone failure without missing a beat. This allows our teams to focus on improving the application or in some cases transitioning part of the stack to containers. Over the next 3 years, Xero plans to move from a 70% Windows/30% Linux mix to a 30% Windows/70% Linux mix of OS. The flexibility of the AWS Platform has been a key enabler in this change."

—*Ben Salt, Executive GM of Reliability, Xero*

eMarketer achieves 18% cost savings and reliability by moving from Azure to AWS

"A year ago we moved the majority of our workloads including .NET-based microservices, Kubernetes Clusters, Microsoft SQL Server, and more from Azure to AWS. Our experience with AWS's sales team, Technical Support and Solutions Architects is a world of difference. With improved performance and reliability of our microservices, and approximately 18% cost savings, we haven't looked back."

—*David Sheehan, Lead DevOps Engineer, eMarketer*

Thank you!