
AWS
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ENT306

SQL Server on AWS: Run with the best

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What we hear from customers

How do I use my SQL licenses?

Can I run SQL Server on AWS?

What about end of support?

How do I get the best performance?

What about failover?

How do I manage my databases?

How can I move my data?

Why should I run SQL Server on AWS?

How do I manage backups?

How do I get started?

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Agenda

Why and how should I run SQL Server on AWS?

- SQL Server on AWS deployment and modernization options

How can I get the most benefit from running SQL Server on AWS?

- Migrating and operating SQL Server at scale

How do I keep the lights on?

- High availability and disaster recovery

How can I modernize SQL Server while retaining compatibility?

- Babelfish for Aurora PostgreSQL

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SQL Server on AWS deployment and modernization options

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Running SQL Server: The self-hosted approach

AMAZON EC2

- You have complete control of and responsibility for your database server
- AWS offers a range of resources, including vCPU, memory, storage, network, and local disk, to optimize self-hosted SQL Server for virtually any workload
- SQL Server on EC2 supports all features of all SQL Server versions/editions
- High availability is supported by Always On availability groups, Windows Server Failover Cluster (WSFC) failover cluster instances, or any other SQL HA features
- Bring Your Own License (BYOL) options to maximize your existing investment
- AWS Managed Services (AMS) hands SQL Server operations, including patching, backup, and BYOL, to AWS resources to manage on your behalf

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Running SQL Server: The managed approach

AMAZON RDS

- AWS manages the operational requirements of the Windows Servers, SQL Server, storage, and your database backups
- AWS manages patching of the underlying servers (Windows Server, SQL Server) for you
- RDS for SQL Server supports SQL Server Management Studio and any other third-party SQL Server tools using SQL Server drivers and TDS
- RDS for SQL Server offers a range of compute and storage options to achieve the best price performance, along with logging and monitoring tools
- Managed high availability via Always On availability groups (AAG) and mirroring
- Comes in two flavors: a fully managed service and a custom managed service

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SQL Server deployment options

SQL Server on Amazon EC2

Self-managed experience

Full control

All DB engine features

Self-managed provisioning, monitoring, backup, restore, point-in-time recovery

Self-managed patching

Self-managed high availability

Allows third-party apps on DB host

BYOL, License Included
All
All

RDS Custom for SQL Server

Managed experience (shared responsibility)

Full control

Access all SQL Server configurations

Automated provisioning, monitoring, backup, restore, point-in-time recovery

Automated patching

Self-managed high availability

Allows third-party apps on DB host

License Included
Web, Standard, Enterprise
2019

RDS for SQL Server

Managed experience

No sysadmin/OS access

Optimized architecture

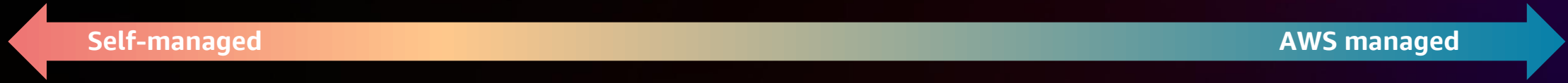
Automated provisioning, monitoring, backup, restore, point-in-time recovery

Automated patching

High availability & Multi-AZ

No third-party apps on DB host

License Included
Express, Web, Standard, Enterprise
2014, 2016, 2017, 2019



License supported | Editions supported | Versions supported

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SQL Server on AWS features at a glance

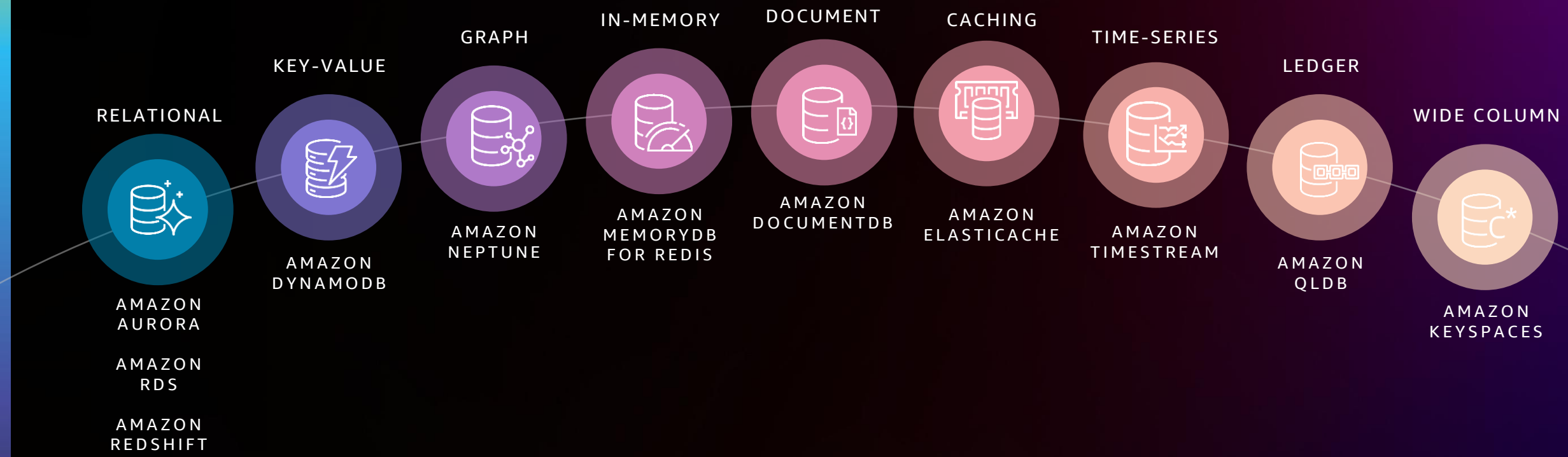
	SQL Server on Amazon EC2	Amazon RDS Custom for SQL Server	Amazon RDS for SQL Server
Versions supported	All	2019	2014, 2016, 2017, 2019
Editions supported	All	Web, Standard, Enterprise	Express, Web, Standard, Enterprise
High availability	Self-managed: Always On, mirroring, log shipping	Self-managed: Always On, mirroring, log shipping	AWS managed
Encryption	Encrypted storage using AWS KMS, TDE support	Encrypted storage using AWS KMS, no TDE support	Encrypted storage using AWS KMS, TDE support
Authentication	Windows AD & SQL authentication		
Backups	Maintenance plans and third-party tools	Managed automated backups, maintenance plans, and third-party tools	Managed automated backups, maintenance plans, and third-party tools
Maintenance	Self-managed	Automatic software patching/self-managed	Automatic software patching
Database limit per instance	Up to native SQL Server edition max	Up to 5,000 with PITR up to 100	Up to 100
Access to underlying OS/file system	Supported	Supported	Not supported

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Running SQL Server: The modernization approach

Modernizing SQL Server leads to maximum innovation velocity and an optimal total cost of ownership



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Migrating, deploying, and operating SQL Server on AWS at scale

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Migrating SQL Server to Amazon EC2 and RDS

1. **AWS Database Migration Service (AWS DMS) – EC2/RDS**
   Migrate SQL Server and other databases from on premises to AWS with full load and CDC replication; can combine with AWS Snowball appliance to ship large databases

2. **AWS Application Migration Service – EC2**
   Convert source servers, including SQL Server, to run natively on AWS with continuous replication, acceptance testing, and cutover

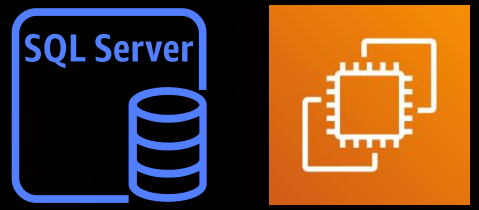
3. **AWS Migration Hub Orchestrator – EC2/RDS**
   Automate and simplify SQL Server native backup and restore from on premises to AWS using predefined workflow templates



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Deploying SQL Server to Amazon EC2 and RDS

Multiple ways to start and manage SQL Server on AWS according to DBA, DevOps, or developer workflows



AWS or RDS Management Console

AWS Command Line Interface (AWS CLI) or AWS Tools for PowerShell

AWS SDKs

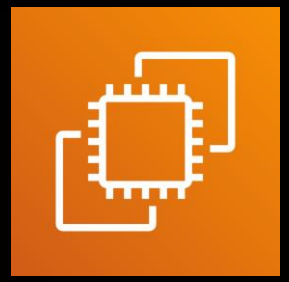
AWS CloudFormation templates or AWS Cloud Development Kit (AWS CDK) apps

AWS Launch Wizard

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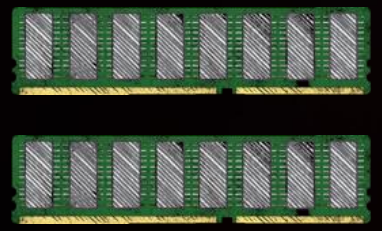
Operating SQL Server: Managing performance

EC2 or RDS instance



Compute capabilities

vCPUs



Memory capabilities

GB of RAM



Network performance

MB/s (throughput)



Storage performance

I/O throughput

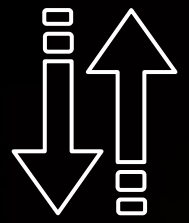
Amazon EBS storage type*

*Or decoupled storage service

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Operating SQL Server: Scale compute and storage for your workload



Scale up to handle increased load

RDS: Up to 128 vCPUs and 4,096 GiB of RAM (x1e.32xlarge)

EC2: Up to 448 vCPUs and 24.6 TB RAM (u-24tb1.metal)



Scale storage for larger datasets

RDS: Scalable EBS storage up to 16 TB

EC2: Up to 1.6 PB (26 volumes x 64 TB/volume)



Scale down to control costs

RDS: 1 vCPU and 1 GiB of RAM (t2.micro)

EC2: 1 vCPU and 1 GiB of RAM (t2.micro)

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Instance types for SQL Server on Amazon EC2 and RDS

Instance class	SQL Server on Amazon EC2	Amazon RDS for SQL Server	Memory to CPU Ratio	Network (Gb/s)	EBS Optimized (Gb/s)	Instance Storage (TB)
Burstable performance	t3	t3	4 to 1	Up to 5	2.8	-
General purpose	m5, m5d, m6i New!	m5, m5d, m6i	4 to 1	25	18	3.6
Memory optimized	r5, r5d, r6i New!	r5, r5d, r6i	8 to 1	25	19	3.6
	r5b	r5b	8 to 1	25	60	-
	z1d	z1d	8 to 1	25	19	1.8
	x1, x1e	x1, x1e	30 to 1	25	14	-
	x2, x2iezn, x2iedn	-	32 to 1	100	80	3.8
	u-24tb1	-	55 to 1	100	38	-
Storage optimized	i3, i3en, i4i	-	8 to 1	75	40	30

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Optimize SQL Server performance on AWS

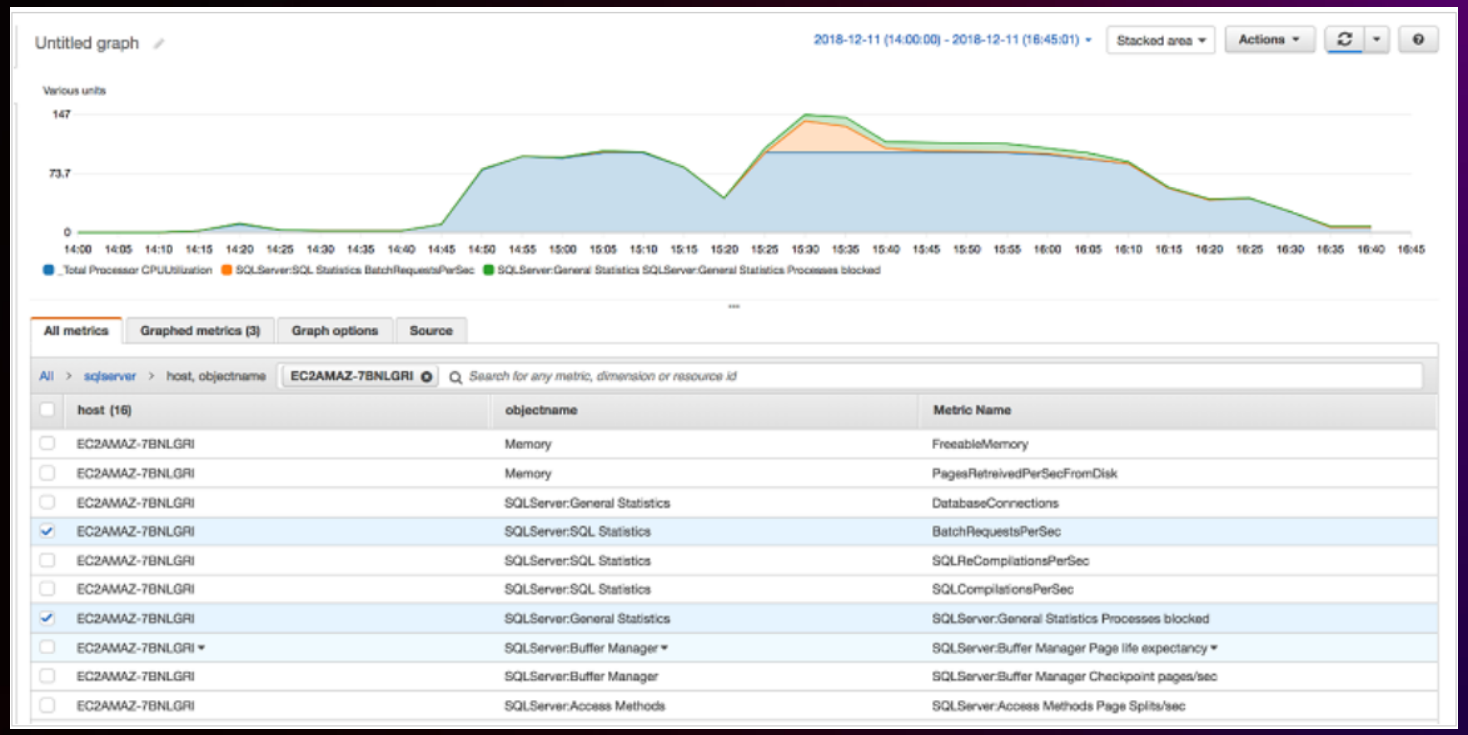
- Change the instance type
  - Requires a stop/start (EC2) or reboot (RDS)
  - Or failover to your standby, change the instance type, and fail back
  - Scale compute capacity with the workload, if practical
- Change the storage type or capacity
  - You can modify allocated storage, storage type, and IOPs (EC2, RDS)
  - Employ storage auto scaling (RDS) and EBS Elastic Volume resizing (EC2)
  - Storage size modifications available within minutes
- Modification options
  - AWS Management Console or RDS Management Console
  - AWS CLI, AWS API, or PowerShell

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CloudWatch metrics for SQL Server (RDS/EC2)

Amazon CloudWatch metrics

- CPU utilization
- DB connections
- Free storage space
- Freeable memory
- Write/read IOPS
- Queue depth
- Write/read throughput
- Swap usage
- Write/read latency
- Network receive throughput
- Network transmit throughput



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Storage choices for SQL Server on EC2 and RDS

EBS (EC2 and RDS)

- Burstable performance
  - Low cost, ideal for non-production, test, or lower-level environments
- General purpose
  - Resource-balanced compute and storage for general database workloads
- Memory optimized
  - High ratio of memory to compute
- Storage optimized
  - I/O-intensive workloads

Amazon FSx (EC2 only)



- 2 managed file systems support SQL Server
  - **FSx for Windows File Server** and **FSx for NetApp ONTAP**
- Amazon FSx shared storage supports Windows Server Failover Cluster (WSFC) and FCI
- Choose file system capacity and throughput up to 2 GB/s
- Use instance ENI to connect to Amazon FSx
- Enables reducing compute if instance size was picked for a corresponding I/O

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Amazon EBS SSD volume types

Type	EC2 / RDS	Performance	Durability	Latency
GP2	EC2 / RDS	Up to **16,000 IOPS** and **250 MB/sec** throughput per volume	99.9%	single digit millisecond
GP3	EC2 / RDS New!	Up to **16,000 IOPS** and **1,000 MB/sec** throughput per volume	99.9%	
IO1	EC2 / RDS	Up to **64,000** IOPS and **1000** MB/sec throughput per volume	99.9%	
IO2	EC2	Up to **64,000** IOPS and **1000** MB/sec throughput per volume	99.999%	
IO2 Block Express	EC2	Up to **256,000** IOPS and **4000** MB/sec throughput per volume	99.999%	sub-millisecond

https://aws.amazon.com/ebs/volume-types/

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Rovio



Challenge

Rovio Entertainment is the Finland-based game developer, publisher, and distributor that owns the Angry Birds franchise. Rovio's state-of-the-art gaming service platform, Hatch, has to handle significant traffic, and with its games being played around the world 24/7, service availability is vital.

Solution

Rovio operates its SQL Server databases on Amazon RDS for SQL Server to ensure services are always up and running and to not have to worry about scalability, hardware, networking, or any other infrastructure-related components.

Result

- Better, more affordable security tools than traditional infrastructure
- Scalability to meet demand of 120,000 new users per hour
- Benefit from the development work that AWS does in control, auditability, and encryption

"With AWS we have fewer security concerns—we don't have to worry about data center access controls on a physical level, for example."

Mikko Peltola, Senior Manager of Cloud Operations, Rovio

Microsoft SQL Server ···· MOVE TO MANAGED ⟶ ···· Amazon RDS for SQL Server

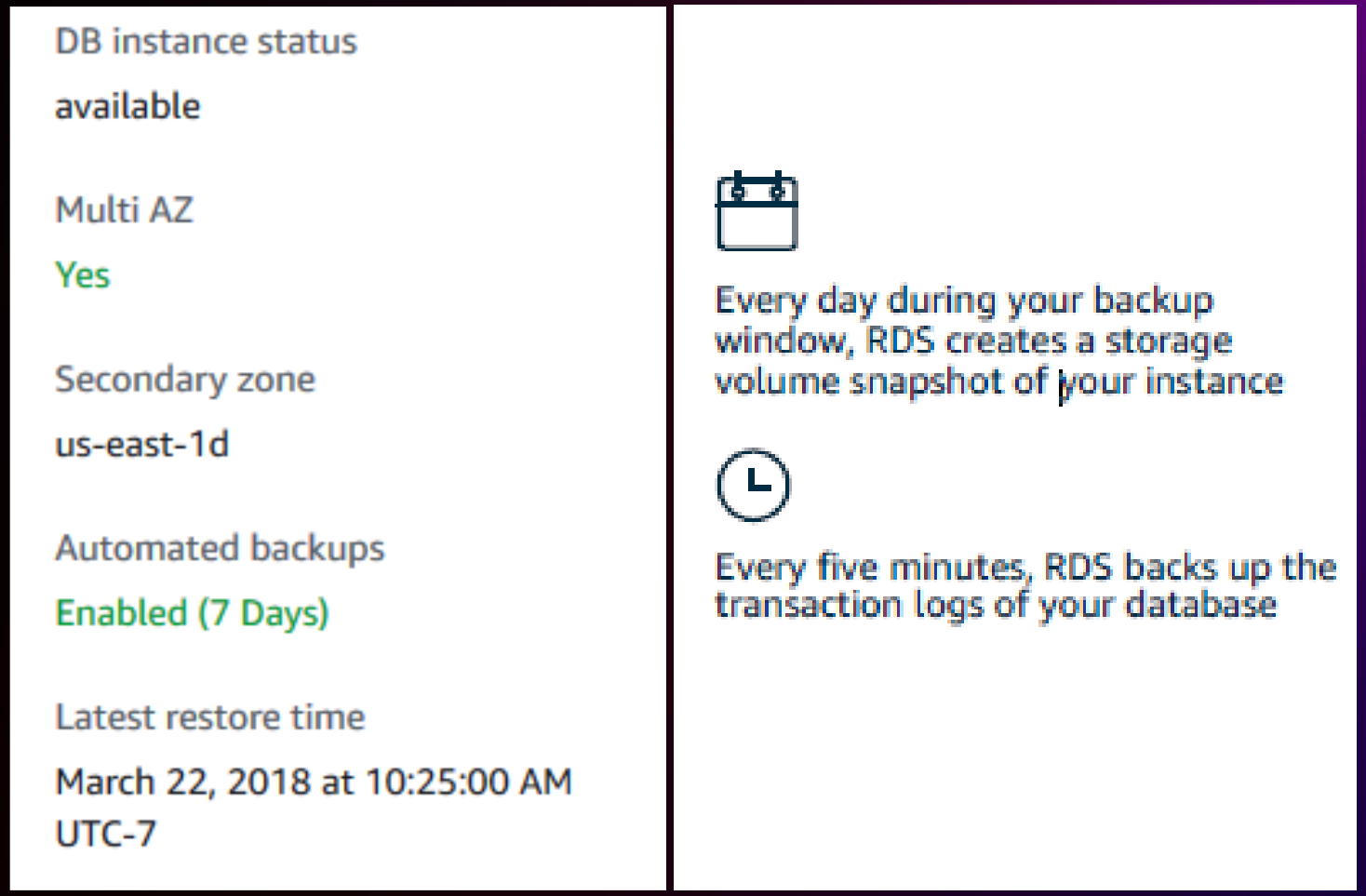
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High availability and disaster recovery: A deep dive on RDS for SQL Server

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Automated backups

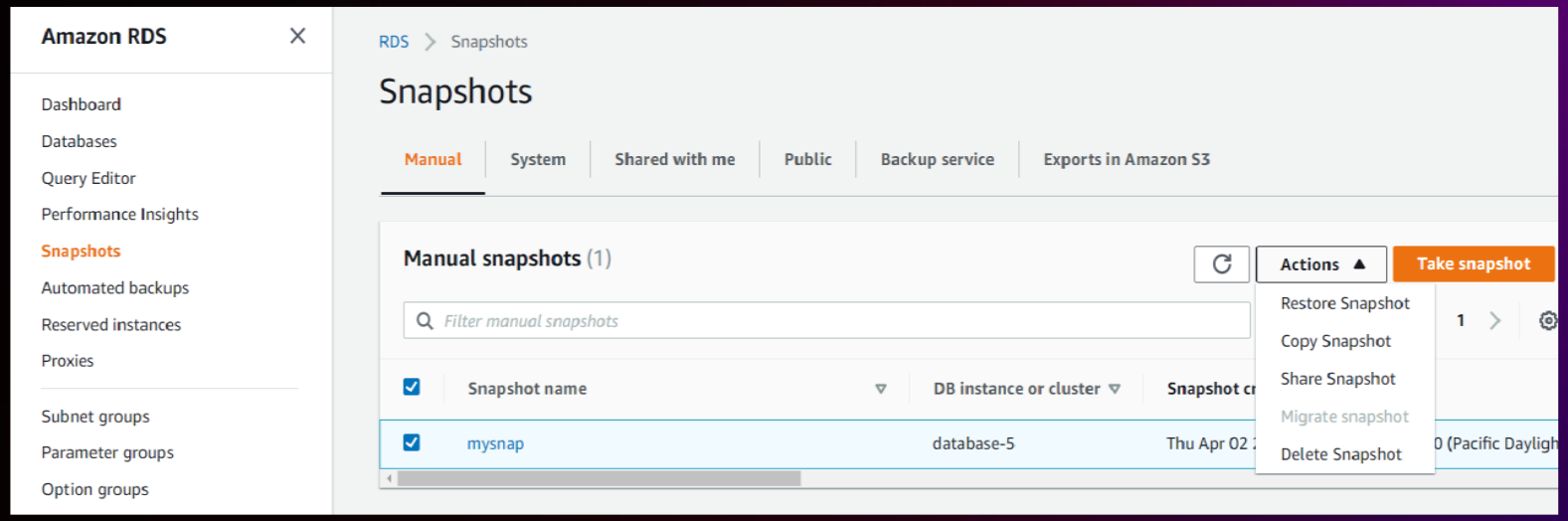
- Scheduled daily volume backup of entire instance
- VSS-enabled, application consistent
- Archive database change logs
- Access to T-log backups New!
- 35-day maximum retention
- Minimal impact on database performance



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Manual snapshots

- EBS volume snapshot
- Triggered by customer
- VSS-enabled, application consistent
- Instance level
- Keep as long as needed
- Not subject to RDS backup retention



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Native backups

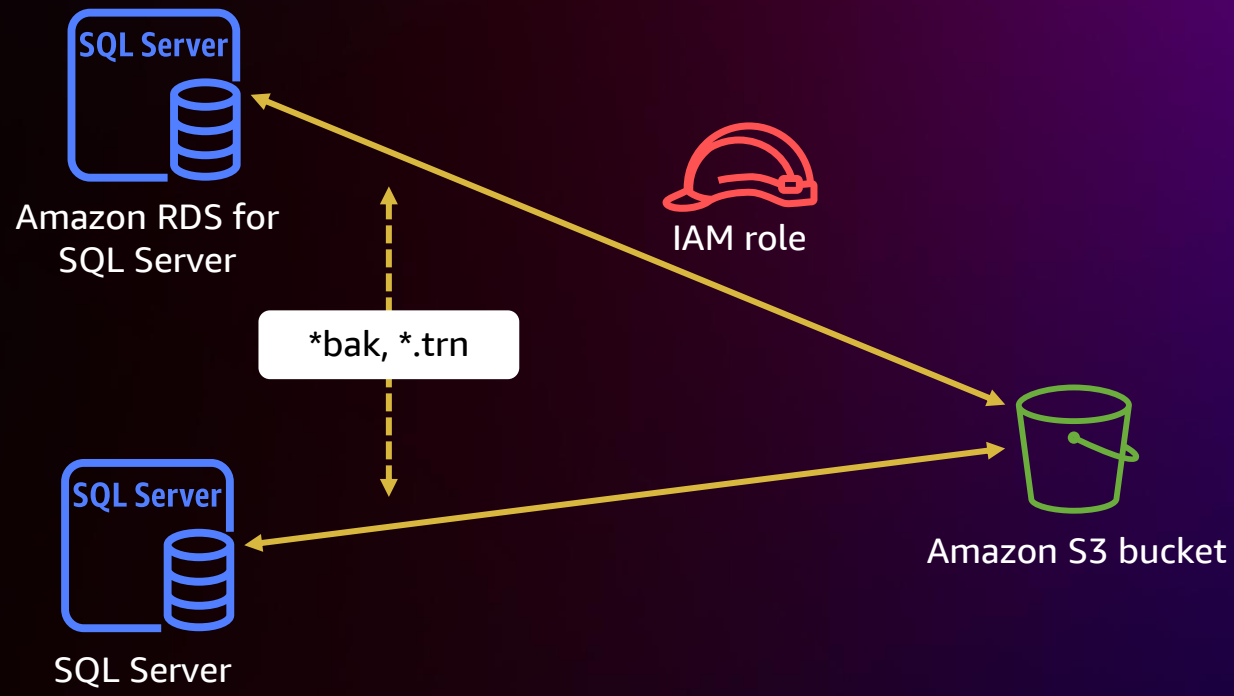
- Backup and restore directly to and from S3 bucket
- Supports compression and TDE New!
- Only full & diff backups (no T-log)
- Full, diff & T-log restores
- Multi-file backup/restore

Usage

```
exec msdb.dbo.rds_restore_database
        @restore_db_name='database_name',
        @s3_arn_to_restore_from='arn:aws:s3:::bucket_name/file_name.extension',
        @with_norecovery=0|1,
        [@kms_master_key_arn='arn:aws:kms:region:account-id:key/key-id'],
        [@type='DIFFERENTIAL|FULL'];
```

The following parameters are required:

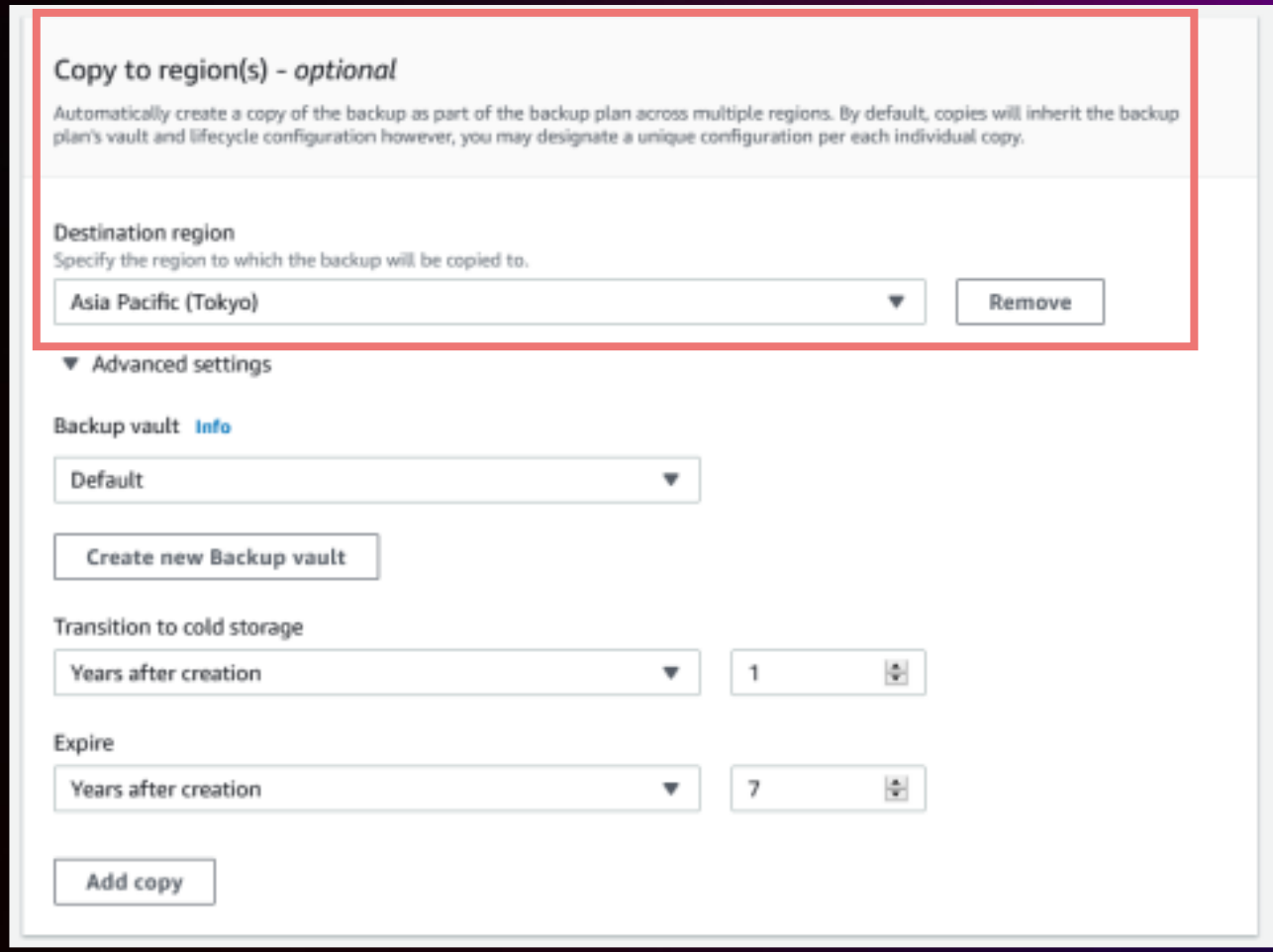
- `@restore_db_name` – The name of the database to restore. Database names are unique. You can't restore a database with the same name as an existing database.
- `@s3_arn_to_restore_from` – The ARN indicating the Amazon S3 prefix and names of the backup files used to restore the database.



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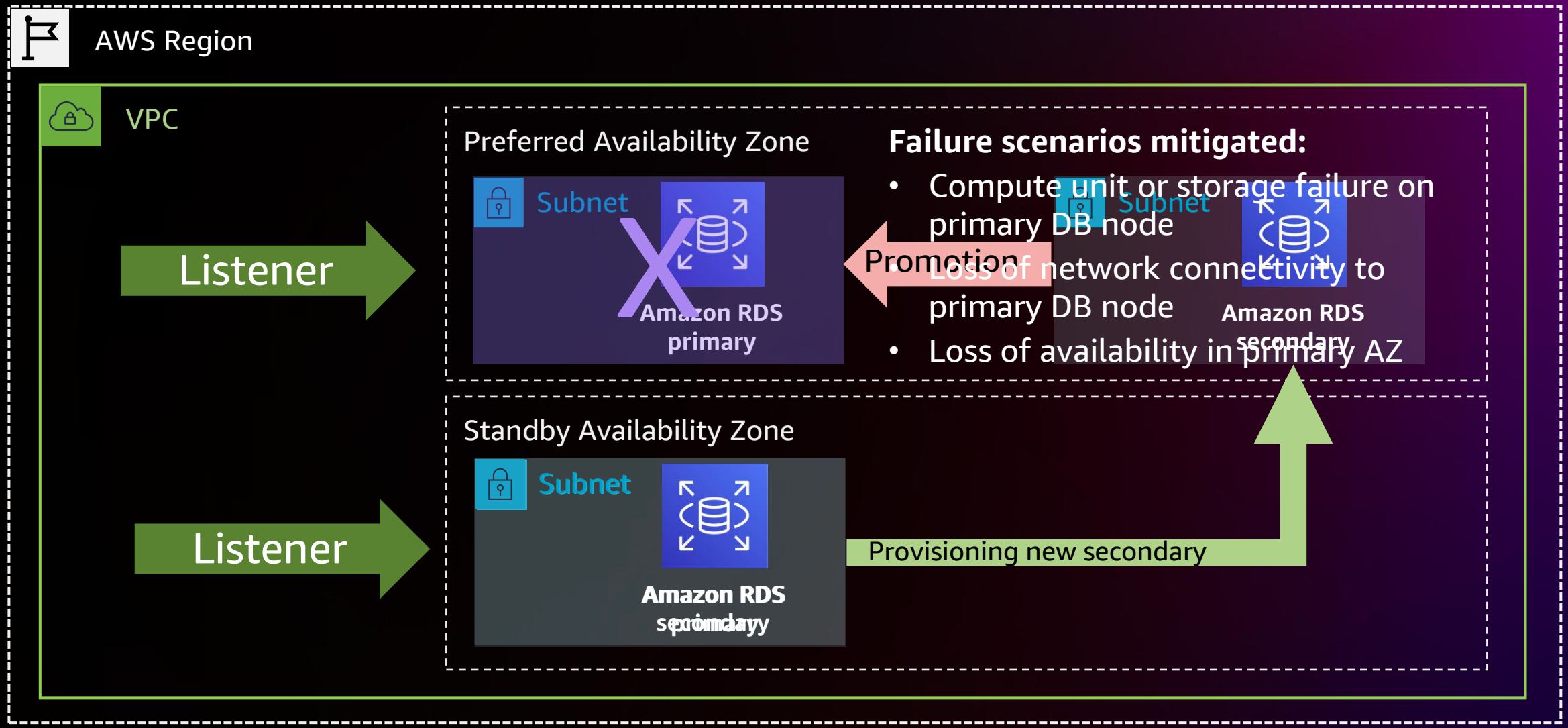
AWS Backup service

- Open AWS Backup service
- Create a backup plan
- Configure a backup rule
- Assign resources by using tags
- Restore by going to Protected Resources
- Choose the Recovery point ID, and click on “Restore”



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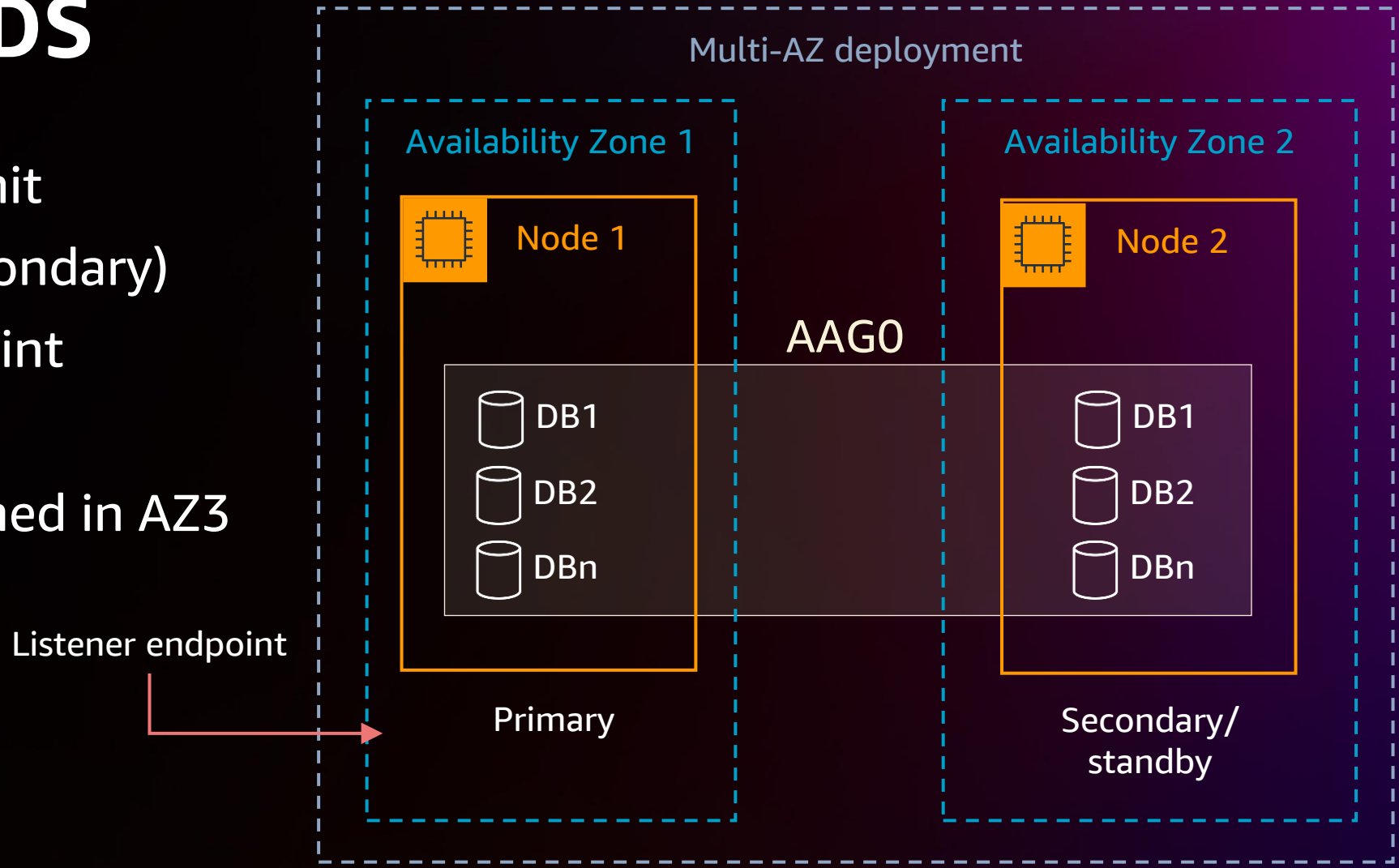
RDS for SQL Server Multi-AZ



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Always On availability group (AAG) architecture – Amazon RDS

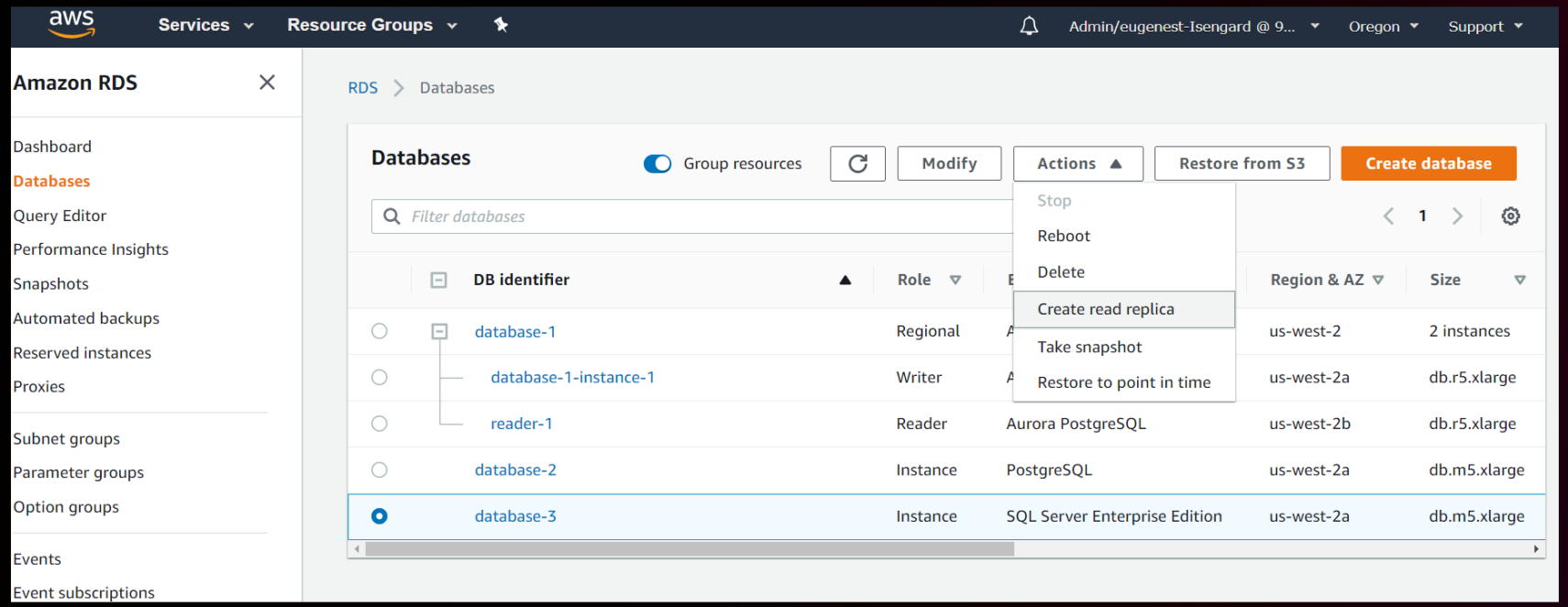
- Synchronous commit
- Active/passive (secondary)
- AAG listener endpoint
- Automatic failover
- Witness is provisioned in AZ3



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Read replica for SQL Server on Amazon RDS

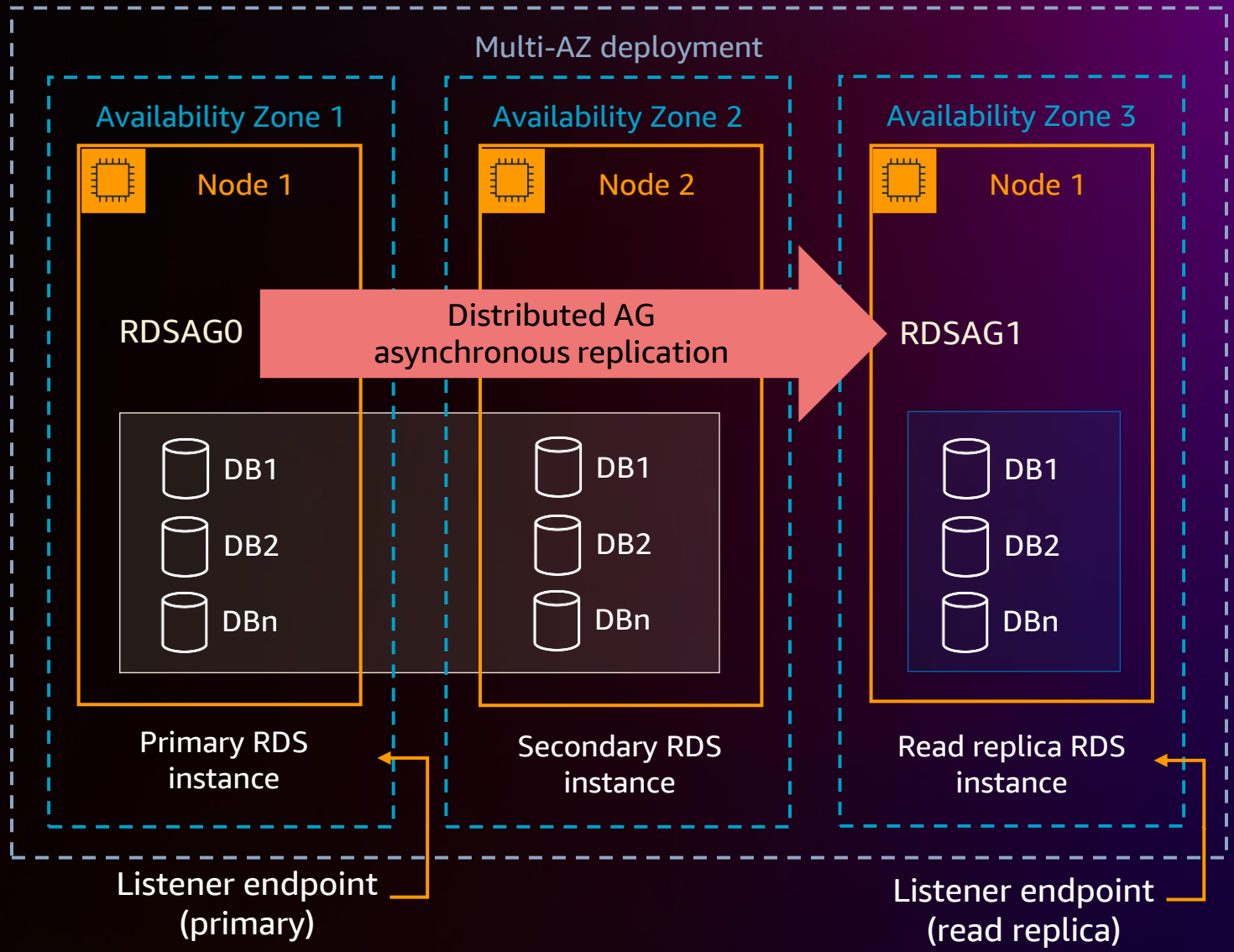
- 2016+ Enterprise edition
- Leverages Always On availability group feature
- Up to 5 asynchronous in-Region read replicas
- Requires manual promotion of read replica to primary
- If a read replica is promoted, the new primary is not enlisted in the AAG



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Single Region read replica architecture on RDS

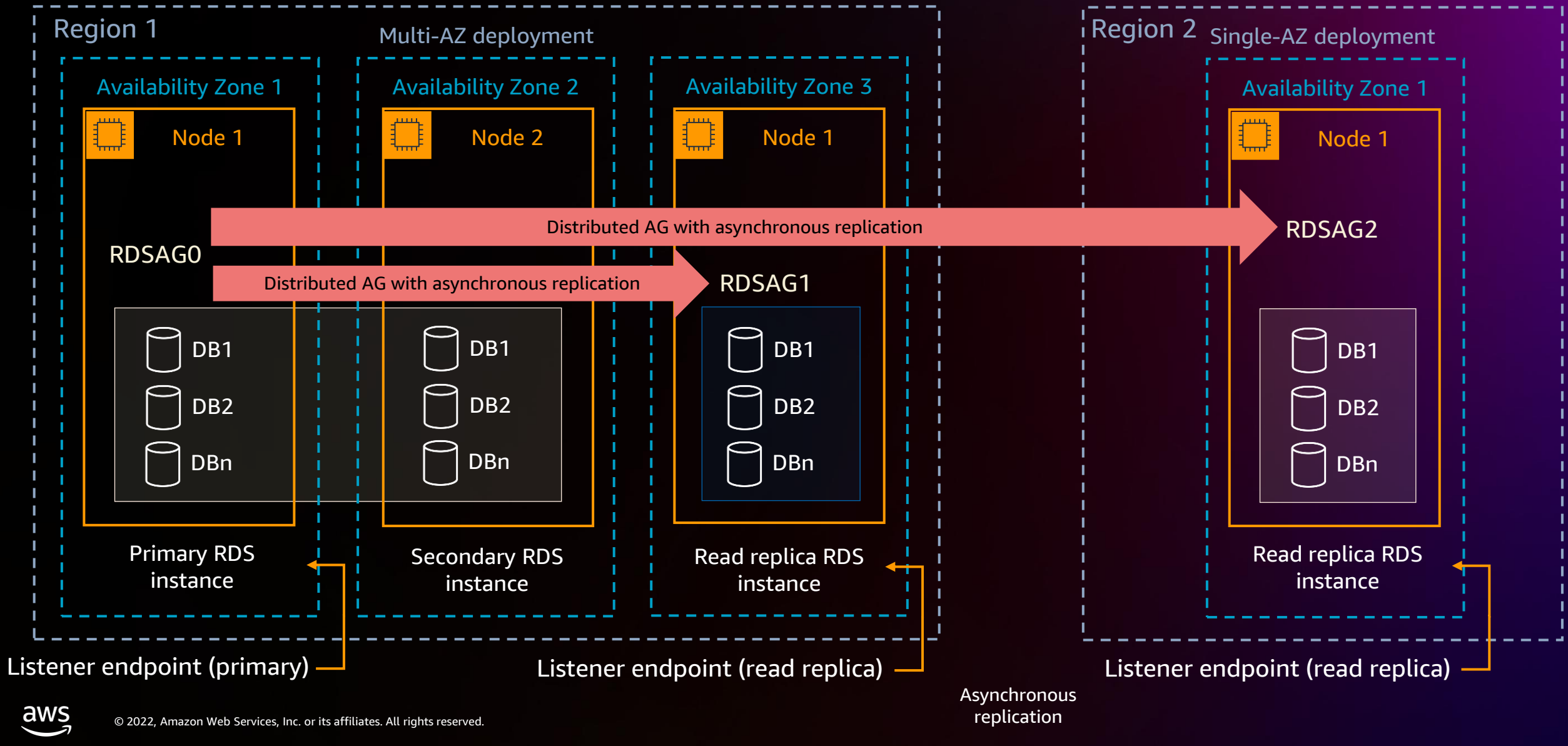
- Source instance must be a Multi-AZ deployment with AAG
- Source instance class has at least 4 vCPUs
- Separate AAG listener endpoint for EACH read replica
- Read replicas use asynchronous commit



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Cross-Region read replica architecture on RDS

New!



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Babelfish for Aurora PostgreSQL

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SQL Server migration choices on AWS

Rehost	Replatform		Refactor
EC2	**RDS Custom**	**RDS**	**Cloud-native services**
Familiar admin experience	Managed experience	Managed experience	Amazon Aurora
Full control	Familiar admin experience	Optimized architecture	Babelfish for Aurora PostgreSQL
All SQL Server features	Full control	Automated patching	Amazon Redshift
All SQL Server versions	All SQL Server features*	Automated backups	Amazon DynamoDB
Lift and shift business apps	Automated patching	High availability	Amazon ElastiCache
License Included + BYOL	Automated backups*	License Included	Amazon DocumentDB
	Lift and shift business apps		Amazon Neptune
	License Included		Amazon Timestream

Customer managed | Shared responsibility | AWS managed

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Babelfish for Aurora PostgreSQL

RUN SQL SERVER APPLICATIONS ON POSTGRESQL WITH LITTLE TO NO CODE CHANGES

Keep existing queries



PostgreSQL extension that 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

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Support for . . .

SQL SERVER–SPECIFIC FEATURES?

- Triggers and stored procedures
- Nested transaction
- Table-valued functions
- Data types (money, sql_variant)
- Savepoints
- Static cursors
- Support for control-of-flow statements (e.g., GOTO, TRY/CATCH)
- Case-insensitive identifiers
- Much, much more

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Migration assessment tool

Determines what part of your app/DDL is not supported by Babelfish

Option 1 (recommended): Open-source tool, Babelfish Compass

- Standalone, command-line tool
- GitHub download | User guide
- Updated regularly
- Always use the latest version

Option 2: Use AWS SCT's assessment feature for Babelfish assessment

- NB: not for SQL code conversion, only for assessment
- Updated upon AWS SCT releases only

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Migration path

- Export DDL
- Run assessment tool to find incompatibilities
  - Recode anything you find to be Babelfish incompatible (e.g., some XML isn’t fully supported)
- Import adjusted DDL into Babelfish with SSMS
  - No AWS SCT conversion needed! Babelfish supports the SQL Server DDLs
- Import data
  - Hint: Use a smaller dataset to start testing the app
- AWS Database Migration Service (AWS DMS) will migrate SQL Server to Babelfish

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Key takeaways

- AWS gives you multiple options for optimizing your use of SQL Server
- AWS supports the customer journey of migrating, deploying, operating & modernizing your databases
- AWS provides multiple options to architect for reliability and high availability
- Babelfish for Aurora PostgreSQL gives you the ability to start modernizing while eliminating proprietary licensing

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Related sessions

- DAT210: Modernize applications using Amazon RDS for SQL Server
- DAT308: Proven playbook for migrating from SQL Server to Amazon Aurora
- DAT324: Deep dive into Amazon RDS for SQL Server innovation, featuring iCIMS
- DAT401: Build a web-scale application with purpose-built databases & analytics
- ENT208: Salesforce’s journey of more than a billion messages: Innovating with AWS
- ENT301: Babelfish: Efficiently modernize SQL Server to Amazon Aurora
- ENT319: Achieve high availability and disaster recovery with SQL Server
- XNT304: Purpose-built databases for modern .NET applications on AWS

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Thank you!

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