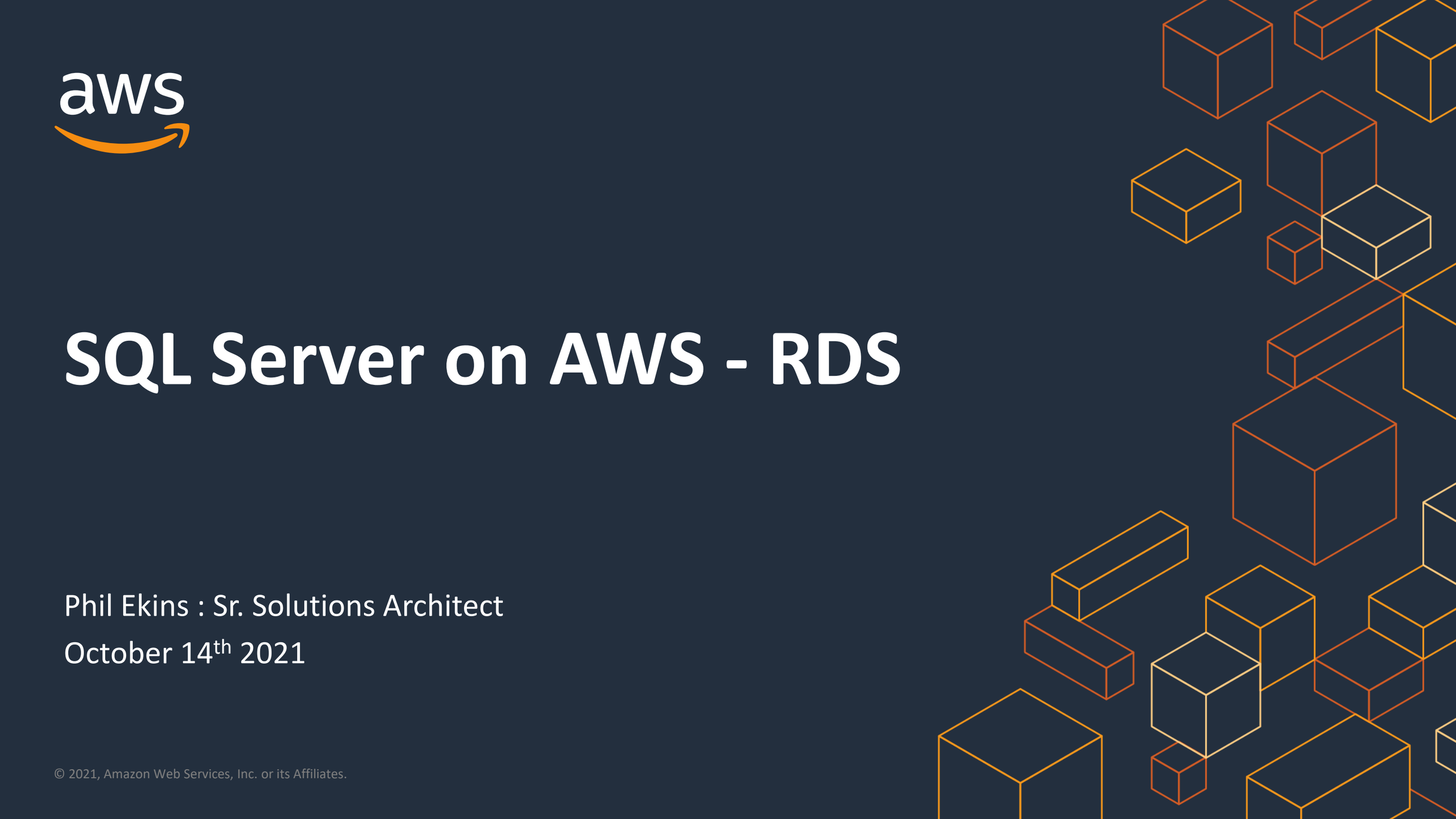


SQL Server on AWS - RDS

Phil Ekins : Sr. Solutions Architect

October 14th 2021

Agenda

- Selecting the Right Service
- Selecting the Right Instance
- Selecting the Right Storage
- High Availability and Disaster Recovery Options
- Active Directory Integration
- Deploy and Manage
- Best Practices
- Database Migration Service
- Q&A

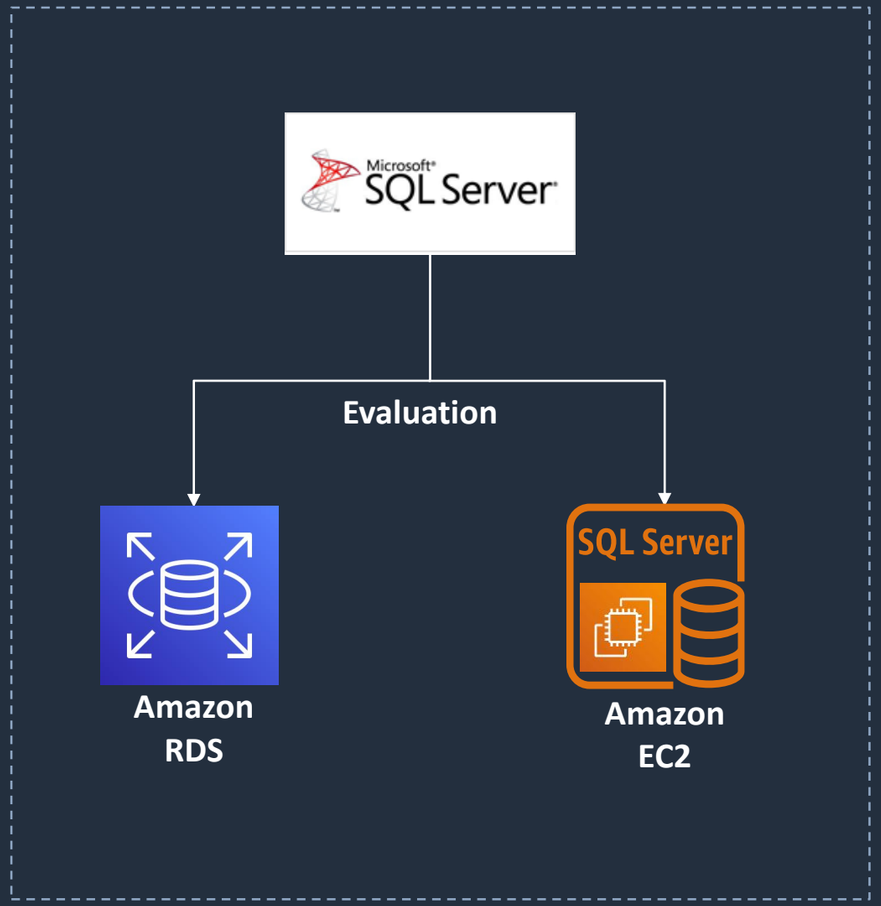
aws

Selecting the Right Service

Choose the best service for your needs

Amazon RDS SQL Server

- Managed Physical Infrastructure
- Managed DB Install and Backups
- Managed OS and Patching
- Managed High Availability and Scaling



SQL Server on Amazon EC2

- Managed Physical Infrastructure
- Managed OS Installation
- Managed Scaling
- OS-Level Control

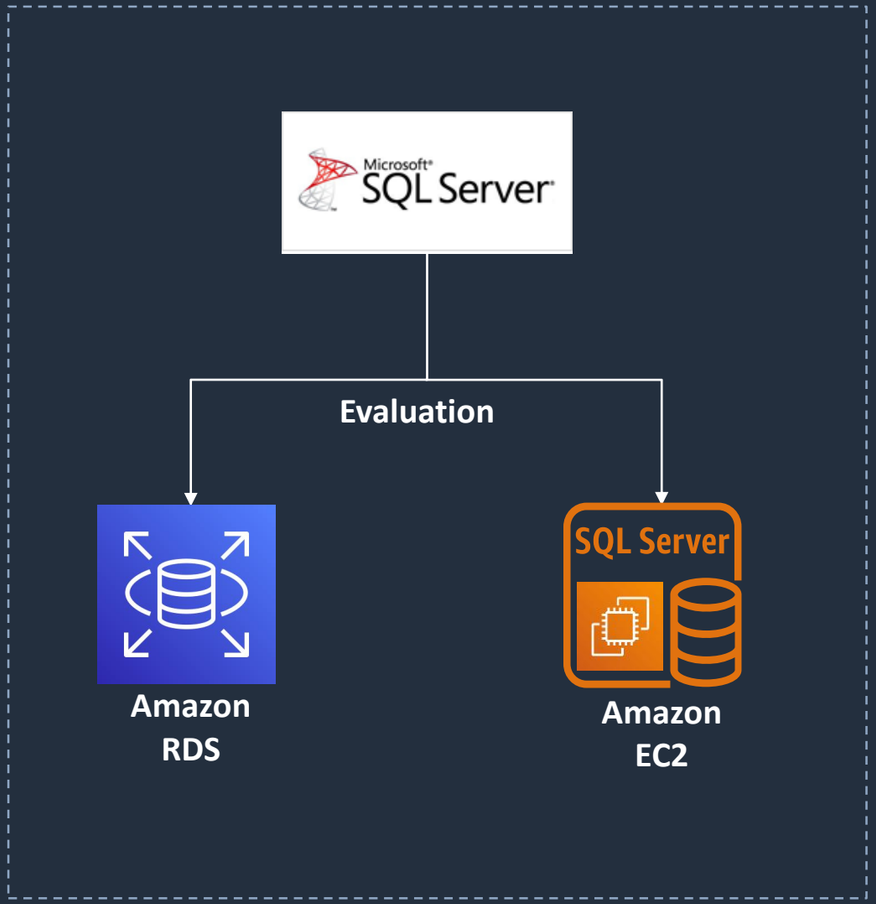
aws

Choose the best service for your needs

Amazon RDS SQL Server

Your Responsibility:

- App Optimization and Tuning
- Deployment Orchestration



SQL Server on Amazon EC2

Your Responsibility:

- App Optimization and Tuning
- Deployment Orchestration
- Monitoring and Recovery
- High Availability
- Backups
- DB & OS Patching

aws

Choose the best service for your needs

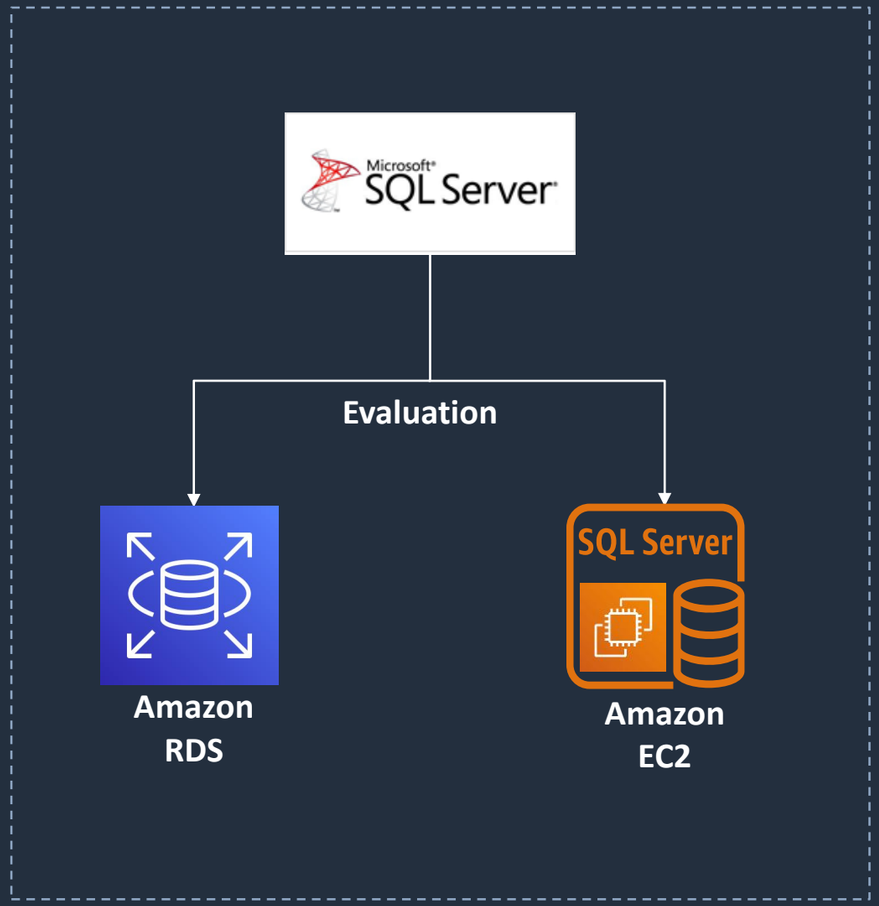
Amazon RDS SQL Server

Cloud-native solution

Focus on:

- Business value tasks
- High-level tuning tasks
- Schema optimization
- Limit of 100 DB's per Instance

No in-house database expertise



SQL Server on Amazon EC2

Need control over:

- DB instance & OS
- Backups, Replication
- Clustering
- `sysadmin` role

Need to use features, size or performance options not available in Amazon RDS

aws

Options for Deploying SQL Server on AWS

Amazon RDS for SQL Server

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

SQL Server on Amazon EC2

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

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

AWS managed **Customer managed**

aws

SQL Server Features at a Glance

	Amazon RDS	Amazon EC2
Licensing:	License Included	License Included / BYOL
Versions Supported:	2012, 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

SQL Server EC2 vs. RDS: Which should I use?

	EC2	RDS
License included	✓	✓
BYOL	✓	
Automated backups		✓
Self-managed Always-On Availability Groups / Failover Cluster Instance	✓	
AWS-managed Multi-AZ deployment		✓
Integrated Security	✓	✓ (MAD)
Co-hosting additional SQL Server components*	✓	✓
Auditable centralized engine parameter tuning		✓
Automated backups and point in time restore		✓
Full control over the instance	✓	
No direct instance or file system access		✓

*Special considerations for HA/DR environments

aws

Features not supported on RDS SQL Server

- Backing up to Microsoft Azure Blob Storage
- Buffer pool extension
- Custom password policies
- Data Quality Services
- Database Log Shipping
- Database snapshots (Amazon RDS supports only DB instance snapshots)
- Extended stored procedures, including xp_cmdshell
- FILESTREAM support
- File tables
- Machine Learning and R Services (requires OS access to install it)
- Maintenance plans
- Performance Data Collector
- Policy-Based Management
- PolyBase
- Replication
- Resource Governor
- Server-level triggers
- Service Broker endpoints
- Stretch database
- T-SQL endpoints (all operations using CREATE ENDPOINT are unavailable)
- WCF Data Services

https://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/CHAP_SQLServer.html

aws

RDS SQL Server Pace of Innovation – 2020

- Instance Launches:
  - R5b
  - Z1D instance family
- Versions:
  - Latest Minor Versions
  - SSRS on 2016
  - SQL Server 2019
  - BI tools on 2019 (SSIS/SSAS/SSRS)
- Security:
  - Windows Authentication in BJS and ZHY
  - Windows Authentication in Govcloud
  - Windows Authentication in more regions
  - Disable older versions of TLS and Ciphers
  - Cross Account/VPC Domain Joins With Managed AD
- Features:
  - Database Mail
  - In-Region Read Replicas
  - Native Restores on DB instances with Read Replica’s
  - Enterprise Edition Multi-AZ Price Reduction
  - Multifile Native Backups
  - SSAS / SSIS / SSRS
  - MSDTC
  - Bulk insert on Multi-AZ instances
  - Replicating the Service Master Key
  - Trace Flag 692
  - Time zones

aws

RDS SQL Server Pace of Innovation – 2021

- Launched:
  - R5d/M5d with Instance Store (tempdb)
  - Standard Edition Always On
  - Extended Events
  - Cross Region Automated Backup (Point in time restores) w/o Encryption
  - SQL Server Latest minor versions
  - Auto minor version updates

aws

Amazon RDS SQL Server tooling

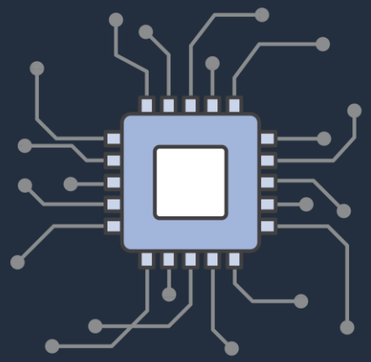
- Manage using common tools: SQL Server Management Studio, sqlcmd, etc.
- Maximum 100 databases per Amazon RDS instance
- Amazon RDS does not provide desktop, Administrator or file-system access to DB instances
- Not supported: Maintenance Plans

aws

Selecting the Right Instance

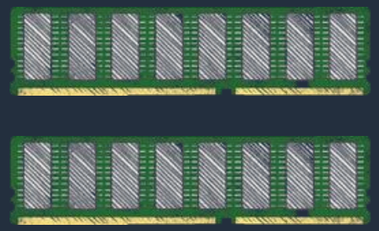
Service-level Performance Factors

RDS DB Instance Class



Compute Capabilities

vCPUs

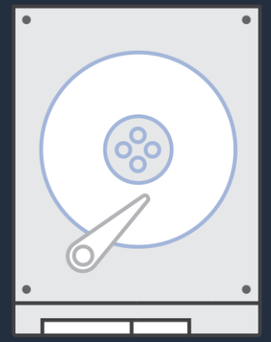


Memory Capabilities

GB of RAM

Network Performance

MB/s (Throughput)



Storage Performance

I/O Throughput

RDS Storage Type

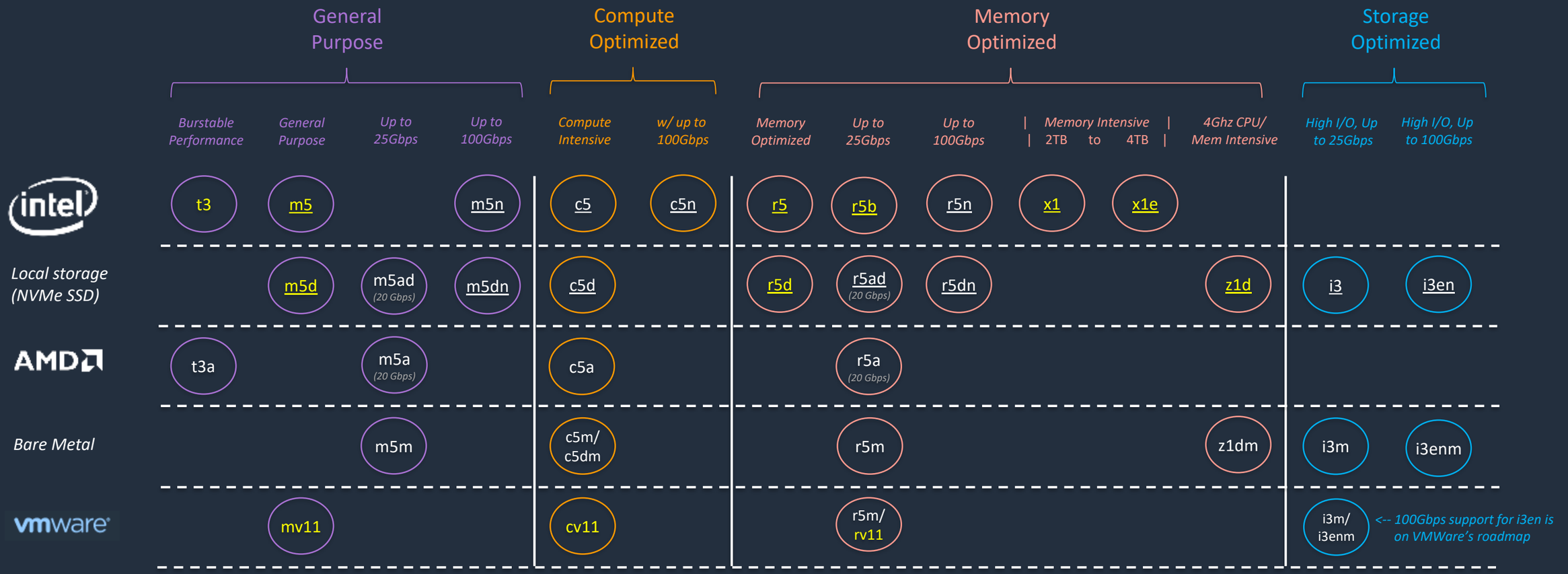
aws

The Right AWS Instance Type

Options to fit all your SQL Server workload needs

** Instance types that are underlined can be used as Dedicated Hosts*
(With Windows Server BYOL or LI and SQL Server BYOL licensing options for Microsoft workloads)

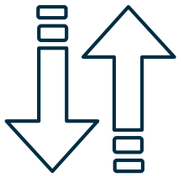
*** Instance types with yellow font are available to run SQL Server on RDS*
(Windows Server LI and SQL Server LI licensing options only)



Prescriptive Guidance:

- *Aligning the workload type with the instance type's capabilities are critical to avoid overprovisioning and higher compute cost*
- *Avoiding overprovisioning will ensure SQL licensing requirements are not bloated, putting AWS in the best position to compete*

Scale Compute and Storage with Ease



Scale Compute to Handle Increased Load

Up to 128 vCPUs and 3904 GB of RAM

Scale Storage for Larger Data Sets

Scalable EBS storage up to 16TiB*

* Up to 64TiB non-scalable available

Scale Down to Control Costs

As little as 2 vCPU and 2 GB of RAM

aws

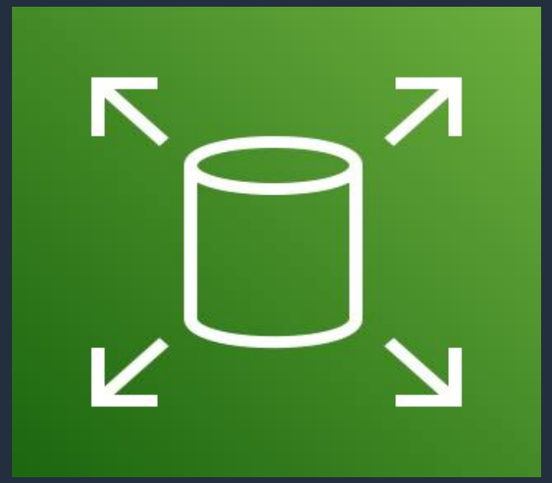
Performance Planning

- SQL Server workloads typically benefit from large amounts of memory (caching)
  - Consider db.r5, db.r5d, db.r5b, db.x1e, db.z1d - Memory Optimized instances
    - Instance availability might vary between regions
  - Instances with NVMe drives, RDS automatically allocates for tempdb
  - Edition and licensing may impact DB instance class options
- DB instances can be modified to change the DB instance class
  - Requires a reboot (or failover in Multi-AZ)
  - Can scale compute capacity with the workload, if practical
- DB instance can also be modified to change storage
  - Can modify size, type, and PIOPs
  - Size modifications available within minutes
  - Storage performance degraded during optimization

aws

Selecting the Right Storage

Amazon Elastic Block Storage



What is Amazon Elastic Block Storage (EBS)?

- Network-attached block storage
- Available for all instance types
- Many instance types support EBS optimization – dedicated channel for network storage I/O, eliminating contention with regular I/O
- Some instance types are EBS optimized, others offer it as an option

aws

Storage & I/O Performance

Amazon RDS				
Type	Size	Performance	Burst Capacity	Pricing Model
General Purpose gp2 (SSD)	20 GiB–16 TiB (min. 100 GiB recommended)	3 IOPS/GiB for volumes 1 TiB or less, up to 16,000 IOPS for larger volumes	Yes, up to 3000 IOPS per volume, subject to credits (< 1 TiB in size)	Allocated storage
Provisioned IOPS io1 (SSD)	20 GiB–16 TiB	Up to max. 64,000 IOPS**	No, fixed allocation	Allocated storage; Provisioned IOPS
Magnetic	20 GiB – 1024 GiB	1,000 IOPS	n/a	Allocated storage

aws

Amazon EBS Volume Types

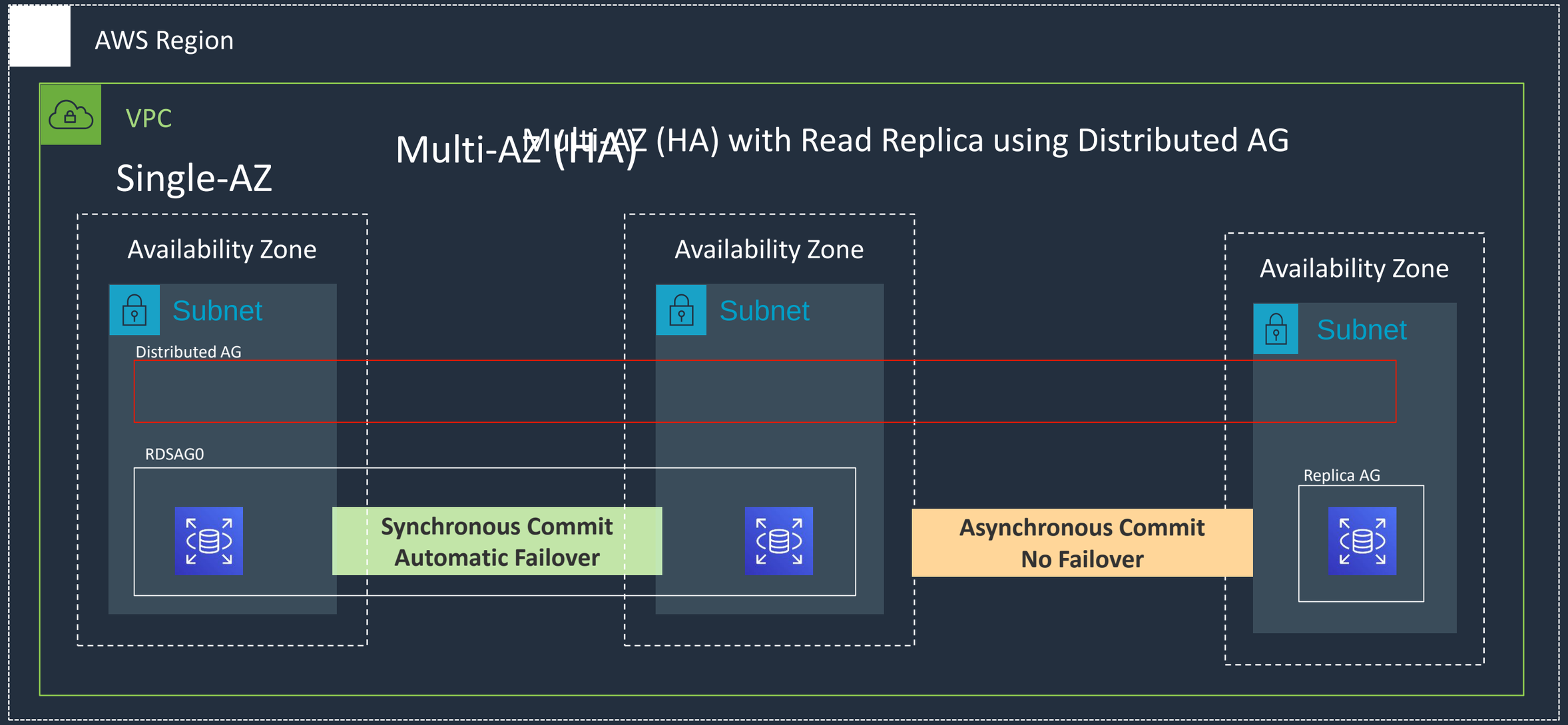
	Solid-state drives (SSD)					Hard disk drives (HDD)	
Volume Type	General Purpose (gp2)	General Purpose (gp3)	Provisioned IOPS SSD			Throughput Optimized (st1)	Cold HDD (sc1)
			io1	io2	io2 Block Express (Preview)		
Durability	99.8% - 99.9%			99.999%		99.8% - 99.9%	
Sizes	1 GB – 16 TB		4 GB – 16 TB			125 GB – 16TB	
Max IOPS per Volume	16,000 (16KB I/O)		64,000 (16KB I/O)*		256,000 (16KB I/O)*	500 (1 MB I/O)	250 (1 MB I/O)
Max IOPS per Instance	260,000			160,000 ***		260,000	
Max IOPS per GB	n/a	n/a	50	500	1000	n/a	n/a
Max Throughput per Volume	250 MB/s**	1000 MB/s**			4,000 MB/s	500 MB/sec	250 MB/sec
Max Throughput per Instance	7,500 MB/s			4,750 MB/s		7,500 MB/s	

aws

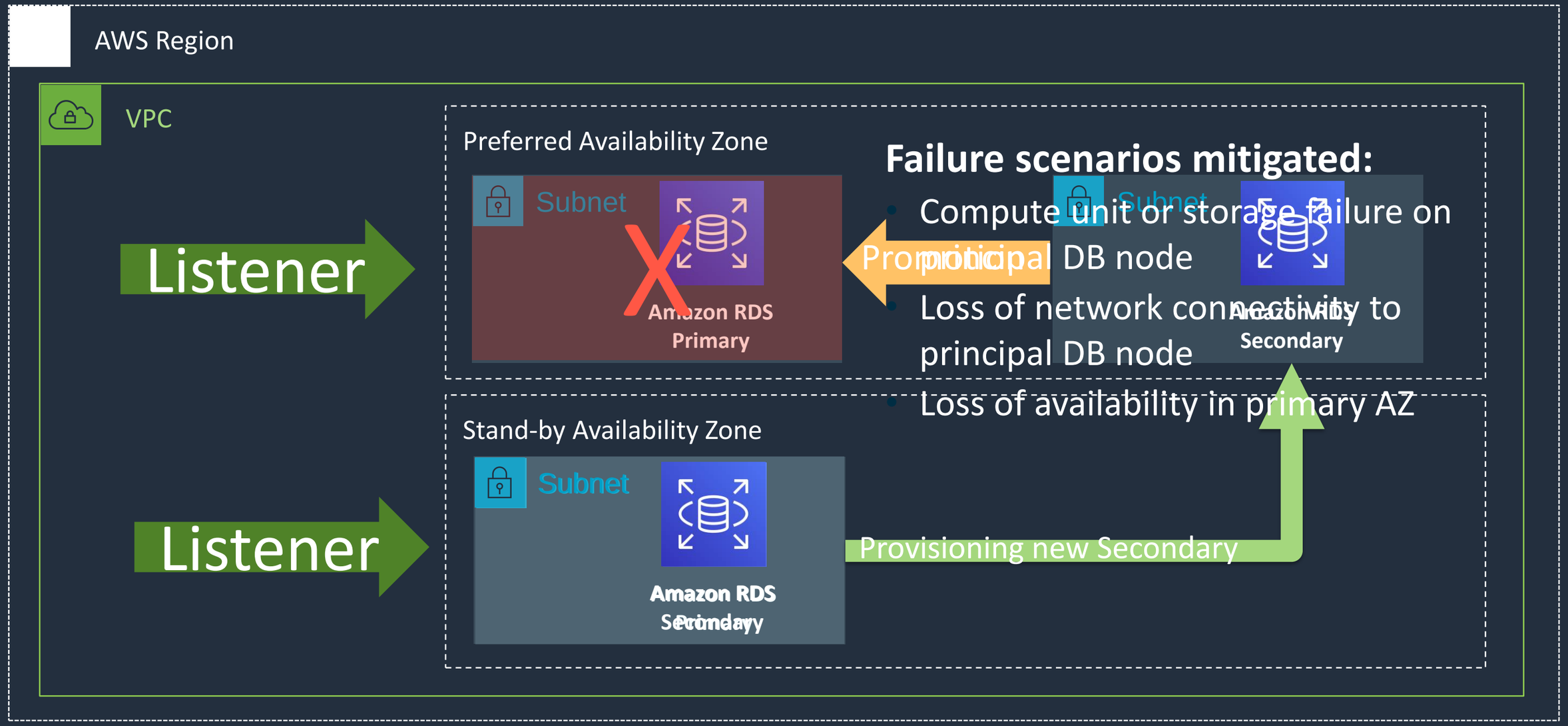
RDS SQL Server Deployment options - HA & DR

aws

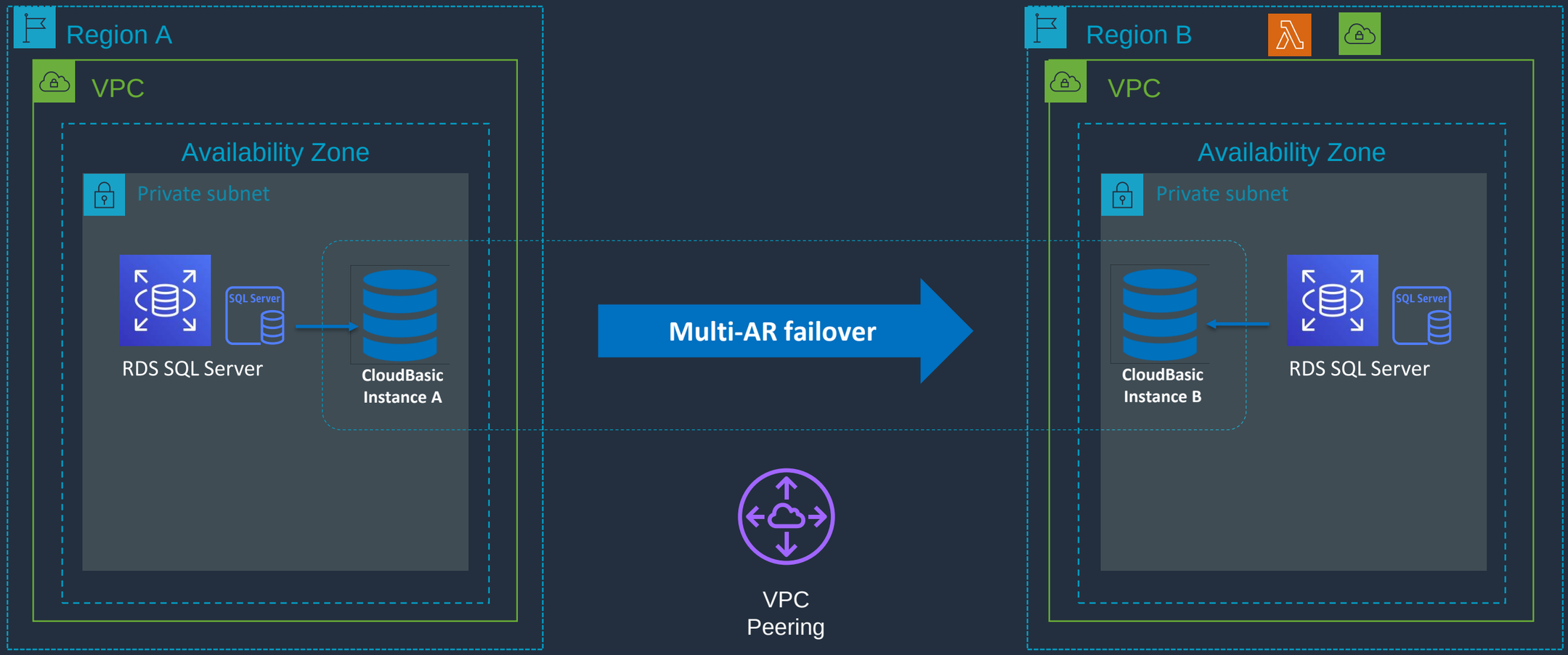
SQL Server on Amazon RDS – Deployment options



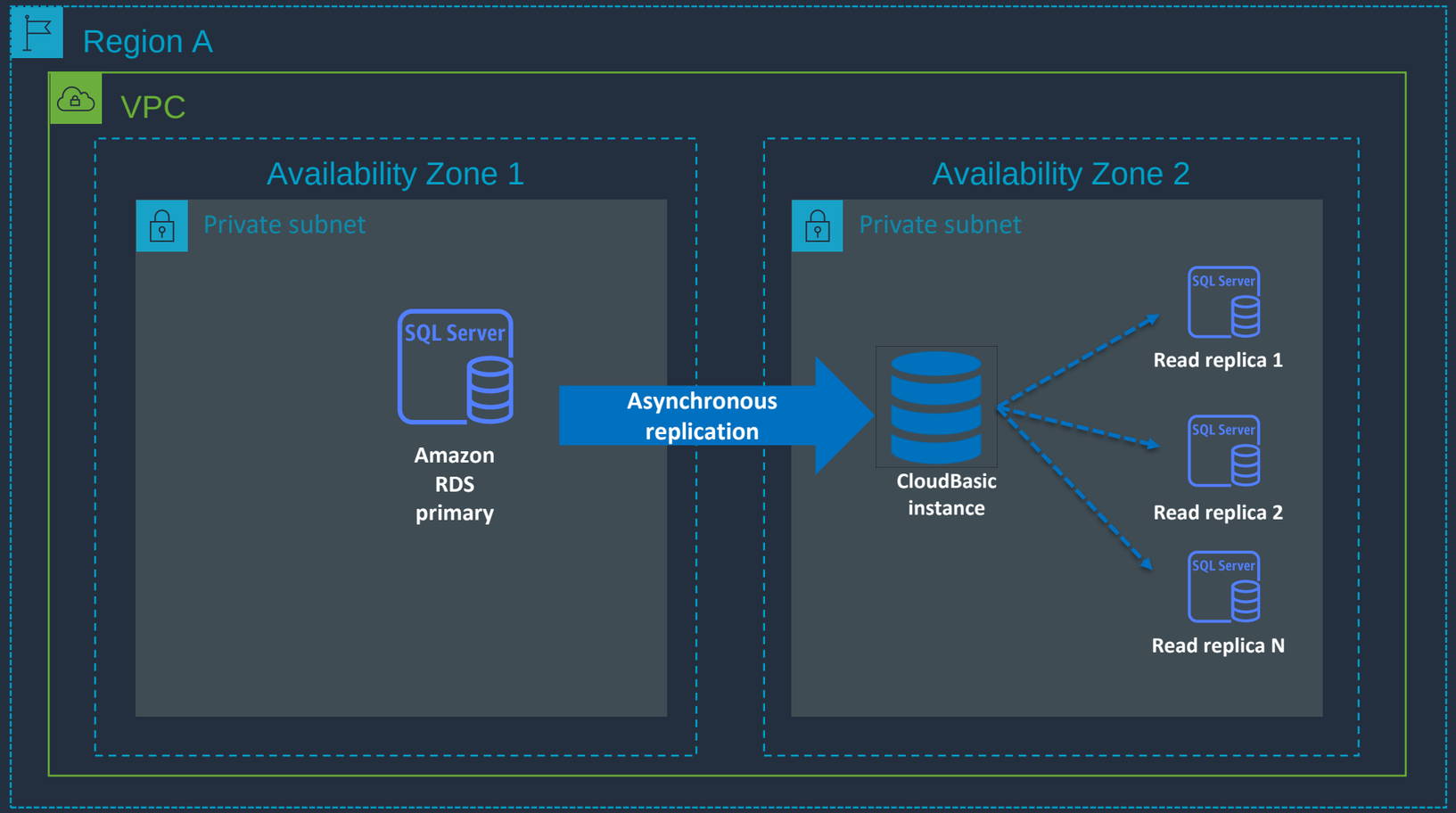
SQL Server on Amazon RDS – Fully Managed Solution



SQL Server on Amazon RDS - Multi-Region SQL Server Availability with CloudBasic



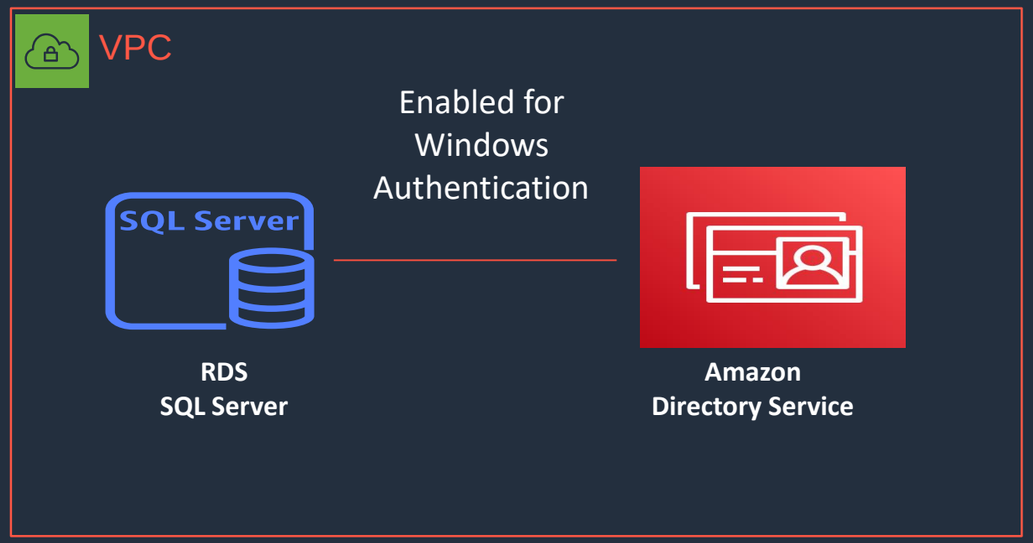
SQL Server on Amazon RDS – Multi-Region SQL Server Read Replicas with CloudBasic



Active Directory Integration

Integrate with Amazon Directory Service

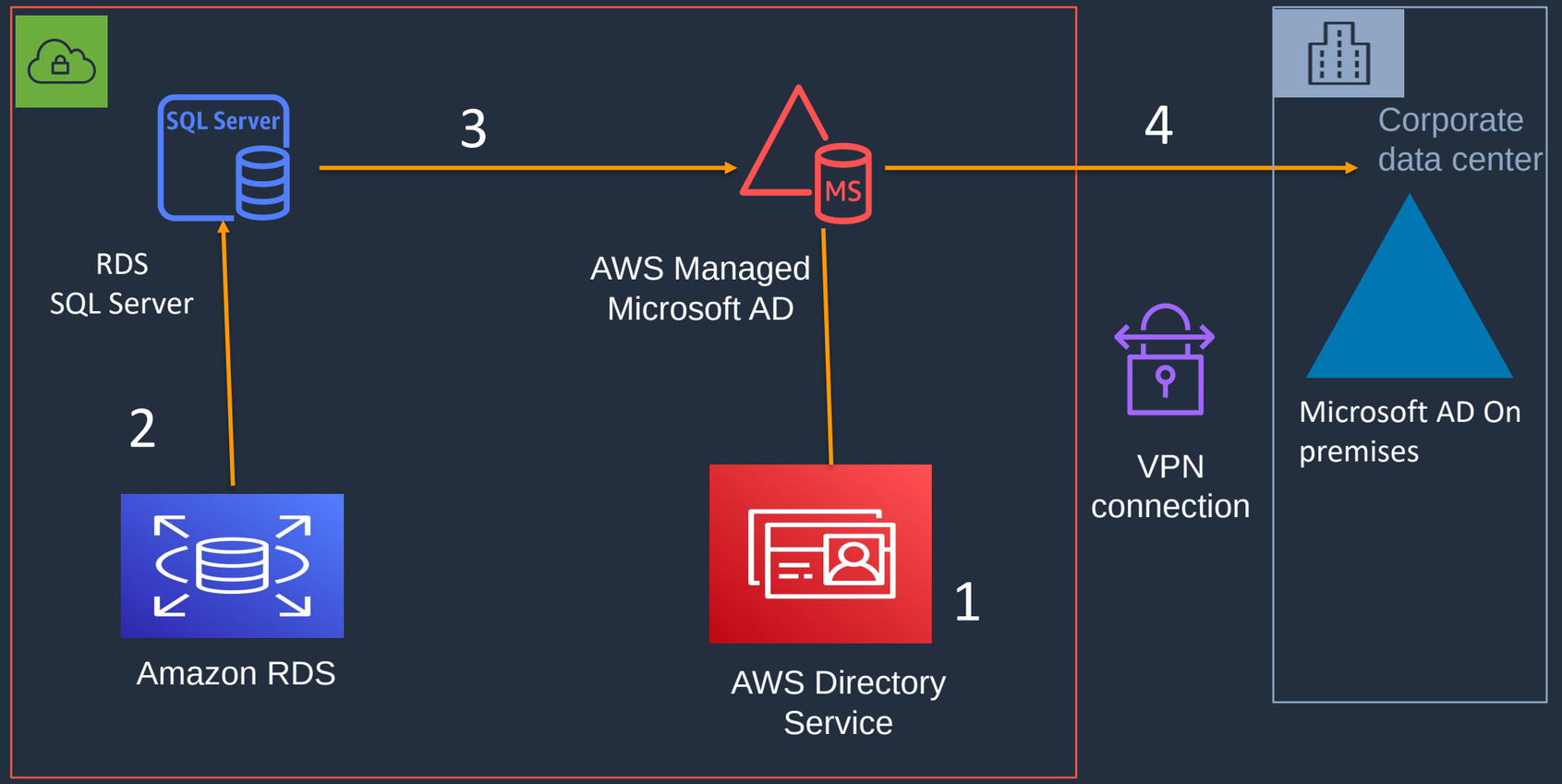
- Cloud-based Active Directory deployment using AWS Directory Services Microsoft AD
- Managed directory
- Credentials stored and managed in the directory
- RDS DB instance joined to the directory operated domain
- Add SQL Server logins for domain users, and authenticate using Windows Authentication



aws

Windows Authentication Using On-Premises AD

1. Setup Managed AD
2. Setup RDS
3. Enable Windows Integrated Authentication to use Managed AD directory
4. Create a Trust with On-Premises Domain
5. Assign privileges to On-Premises for access to RDS



Deploy and Manage

Deploy and Manage SQL Server

Multiple ways to start and manage your SQL Server resources using AWS

AWS Management Console

AWS CLI

AWS SDKs

AWS CloudFormation

aws

AWS Tools for Windows PowerShell

Launching an RDS DB Instance

```
New-RDSDBInstance
-DBInstanceIdentifier "demo-sqlsrv" -DBInstanceClass "db.r4.large"
-Engine "sqlserver-se" -EngineVersion "12.00.4422.0.v1"
-AllocatedStorage 200 -StorageType "gp2”

-MultiAZ 1 -DBParameterGroupName "demo-2014se" -AutoMinorVersionUpgrade 1
-MonitoringInterval 15 -MonitoringRoleArn "arn:aws:iam:..."
-BackupRetentionPeriod 35

-Domain "d-xxxxxxxxxx"-DomainIAMRoleName "rds-ds-access-role"

-DBSubnetGroupName "demo-subnets" -VpcSecurityGroupId "sg-xxxxxxxx”
-MasterUsername "demoadmin"-MasterUserPassword "demopassword"
-StorageEncrypted 1
```


aws

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General & Performance

aws

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```

Reliability & Tuning

aws

AWS Tools for Windows PowerShell

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-StorageEncrypted 1
```

Domain Membership

aws

AWS Tools for Windows PowerShell

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-MasterUsername "demoadmin"-MasterUserPassword "demopassword"
-StorageEncrypted 1
```

Network & Security

aws

Best Practices:
Tuning and Configuration Management

aws

Monitoring RDS SQL Server performance

Monitor performance using **Amazon CloudWatch**

1. **Alarms & notifications**
2. **Default metrics**
3. **Custom metrics**

CPU Utilization
Read / Write IOPS
Disk Queue Depth
Memory (RDS)
Storage Space (RDS)
Connections (RDS)
I/O Throughput (EC2)
…

Use SQL Server Profiler & Tuning Advisor to trace query performance

aws

Amazon RDS Enhanced Monitoring

Overview:

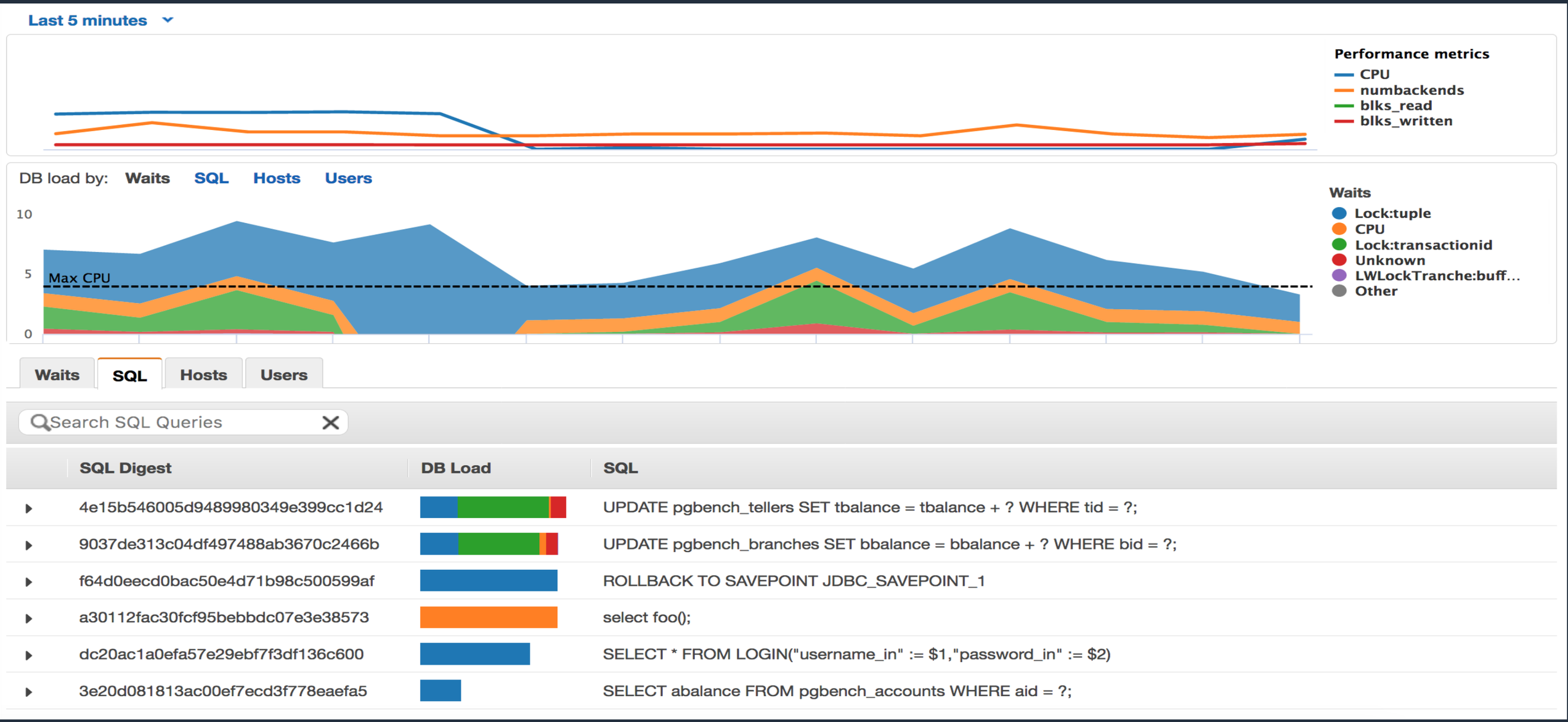
- OS Level Monitoring Metrics – 26 system and per process metrics
- Custom Metrics delivered to CloudWatch Logs
- Up to 1 second granularity

Compared to CloudWatch Metrics:

- Agent based metrics collections
- There can be differences with CloudWatch metrics due to collection source (hypervisor vs. agent) – CPU for example

aws

Performance Insights for RDS SQL Server

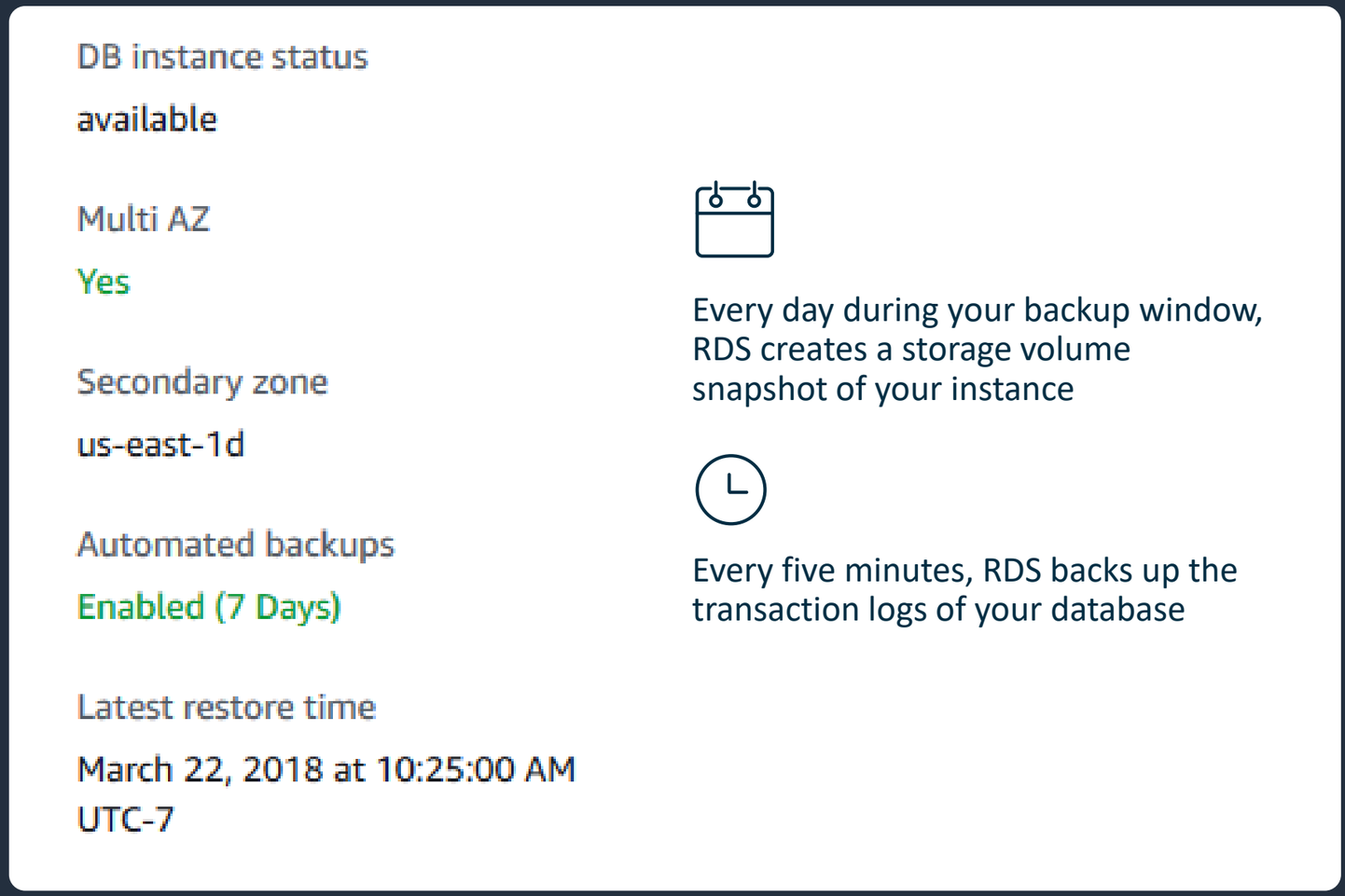


aws

Automated Backups

Point-in-time recovery for your DB instance

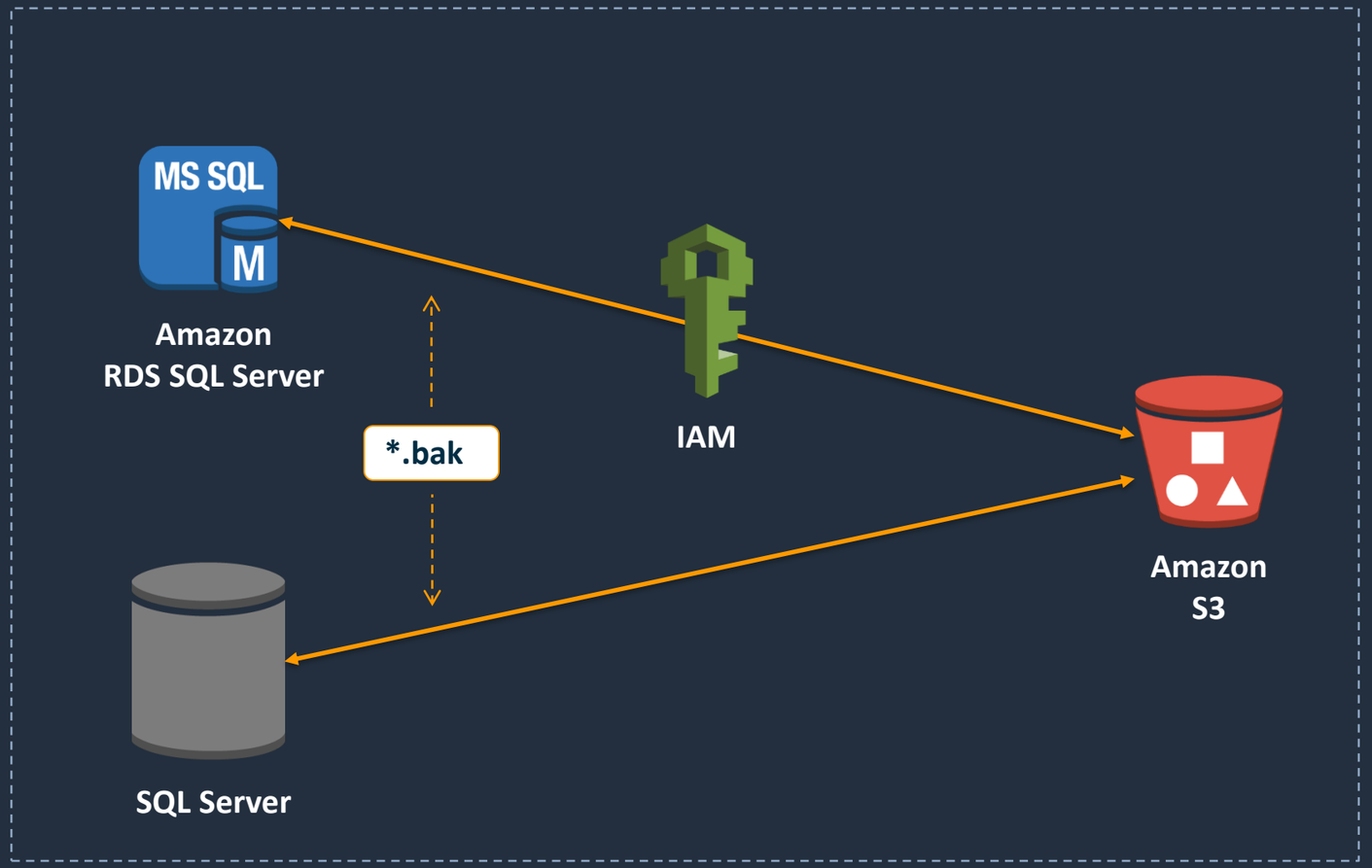
- Scheduled daily volume backup of entire instance
- Archive database change logs
- 35–day maximum retention
- Minimal impact on database performance



aws

Native Backups

- Backup and restore directly from S3 bucket
- Leverages SQL Server's native backup functionality
- Supports Compression
- Only full and differential backups (no Transactional log)
- Supports Restoring Full, differential and log backups
- Multi-file backup/restore



aws

Manage RDS SQL Server configuration

Parameter Groups

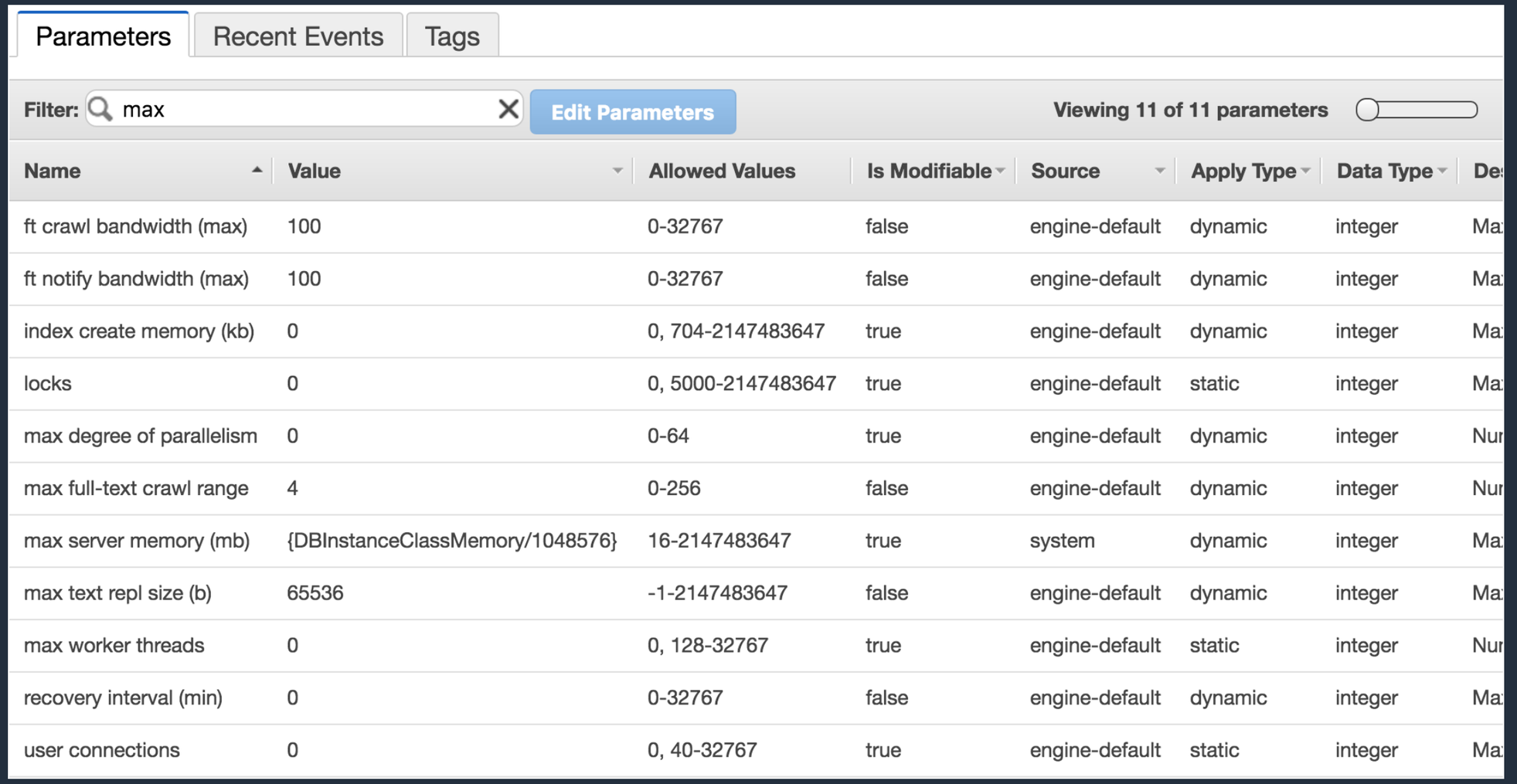
- Centralized management of DB engine parameters
- Ability to consistently apply configurations to DB instances
- Auditability of configuration
- Sensible defaults work for most use cases
- Ability to create custom parameter groups

Option Groups

- Used for enabling additional features
- Ability to create custom option groups
- Supported options:
  - Transparent Data Encryption (TDE)
  - S3 Backup & Restore
  - MSDTC
  - SQL Server Audit
  - SSIS
  - SSRS
  - SSAS

aws

Customizing Parameter Groups



Parameters | Recent Events | Tags

Filter: max | Edit Parameters | Viewing 11 of 11 parameters

Name	Value	Allowed Values	Is Modifiable	Source	Apply Type	Data Type	De
ft crawl bandwidth (max)	100	0-32767	false	engine-default	dynamic	integer	Ma
ft notify bandwidth (max)	100	0-32767	false	engine-default	dynamic	integer	Ma
index create memory (kb)	0	0, 704-2147483647	true	engine-default	dynamic	integer	Ma
locks	0	0, 5000-2147483647	true	engine-default	static	integer	Ma
max degree of parallelism	0	0-64	true	engine-default	dynamic	integer	Nur
max full-text crawl range	4	0-256	false	engine-default	dynamic	integer	Nur
max server memory (mb)	{DBInstanceClassMemory/1048576}	16-2147483647	true	system	dynamic	integer	Ma
max text repl size (b)	65536	-1-2147483647	false	engine-default	dynamic	integer	Ma
max worker threads	0	0, 128-32767	true	engine-default	static	integer	Nur
recovery interval (min)	0	0-32767	false	engine-default	dynamic	integer	Ma
user connections	0	0, 40-32767	true	engine-default	static	integer	Ma

- Dynamic (applied immediately) vs. Static (requires reboot)

aws

Best Practices:
Networking and Security

aws

Securing RDS SQL Server on AWS: network

1. **Amazon VPC:** Control subnets, AZ specificity (DB subnet groups), route tables and NACLs
2. **Security groups:** Restrict instance traffic
3. **Public access:** Avoid it or limit it
4. **Encrypt Traffic:** Forced SSL supported

VPC

aws

Securing RDS SQL Server on AWS: data

1

Protect data at rest

Encrypted DB instances using AWS KMS, TDE, column-level, encrypt before saving

2

Secure data in transit

Encrypted connections via SSL, forced SSL supported

aws

Securing RDS SQL Server on AWS: access & audit

1. Grant least privileges to applications and end users

2. **Control:** Use AWS Identity and Access Management (IAM) to control instance lifecycle permissions, grant least privileges

AWS Identity and Access Management (IAM)

3. **Audit:** Use AWS CloudTrail to log AWS API invocations. Use AWS Config for auditing your RDS Configurations.

aws

Enabling Data Access and Movement

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

aws

Database Migration Service

AWS
Database Migration
Service

- Start your first migration in 10 minutes or less
- Keep your apps running during the migration
- Replicate within, to or from Amazon EC2 or RDS
- Move data to the same or a different database engine

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Database Migration Service

Benefits:

- Simple and straightforward to use
- Minimal downtime
- Supports widely used databases
- Low cost
- Fast and easy to setup

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Database Migration Service

Use Cases:

- Migration or Replication
- Multiple Sources
  - Consolidation
- Multiple Targets
  - Sharding
  - Reporting
  - Disaster Recovery
- Cross Engine
  - Same / Same (SQL Server -> SQL Server)
  - Same / Different (SQL Server -> Aurora)

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DMS Components

- **Replication Instances**
  - Basically EC2 instances designed and configured with DMS software, managed by AWS
- **Endpoints**
  - Defines the connections used by the replication instances
- **Tasks**
  - Defines the workload of the replication instances

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Summary: Why RDS SQL Server on AWS

- Best performance in the Cloud
- Time to focus on your core application
- Largest number of Instance Types
- Every region with multiple Availability Zones
- Largest Global Reach
- Increase innovation and flexibility for future
- Improve security posture

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Questions Answers

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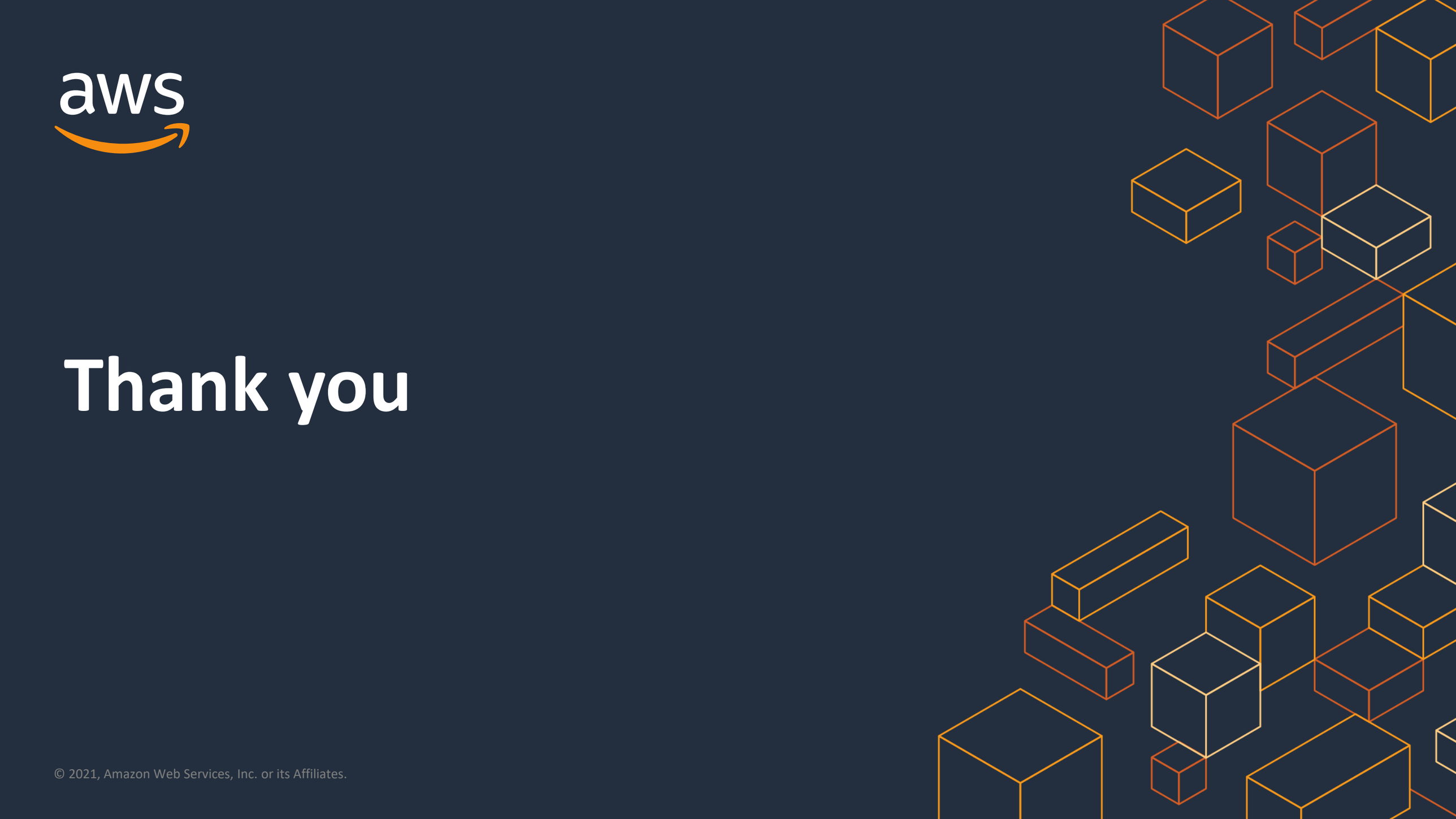

Thank you