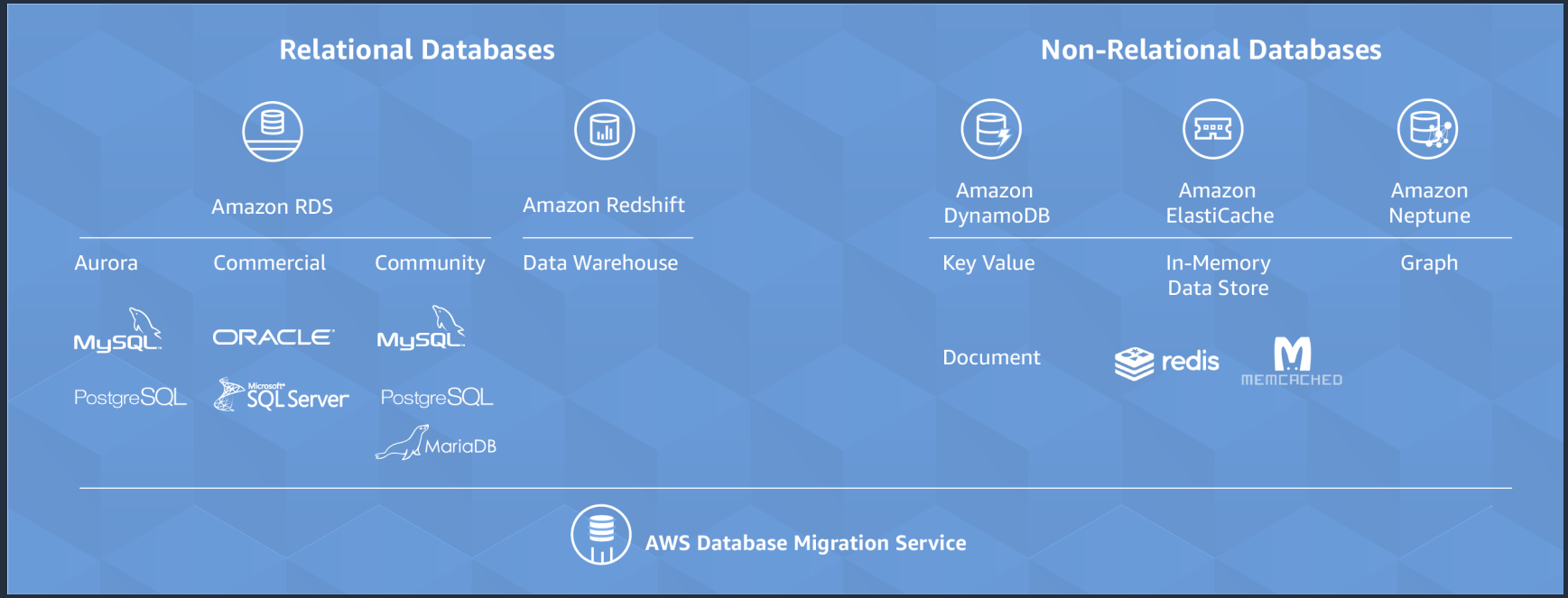
ASP.NET and Amazon RDS

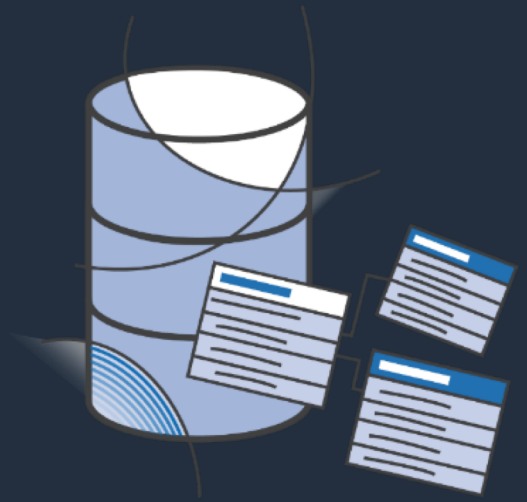
Team or presenters name

Date

Database Services



Amazon RDS DB options



- **6 Database Engines:**
  - SQL Server
  - PostgreSQL
  - MariaDB
  - Aurora
  - MySQL
  - Oracle

- **Enterprise-Grade Security**
- **99.95% availability**
- **License-included**

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SQL Server Features at a Glance

	Amazon RDS	Amazon EC2
Versions Supported:	2008R2, 2012, 2014, 2016, 2017	All**
Editions Supported:	Express, Web, Standard, Enterprise	All**
High Availability:	AWS-managed	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

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Deployment Options for 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
- BYOL Unavailable

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

RDS SQL Server Pace of Innovation - 2017

- **February –** Forced SSL Support
- **June –** TDE Encrypted Cross-Region Snapshot Copy
- **June –** SQL Server 2016 Service Pack 1
- June – Instance Hibernation
- **July –** Enterprise Edition with License Included Expanded to More Regions
- **July –** Windows Authentication Expanded to More Regions
- **July –** Price Reduction for R3 Instances running Enterprise Edition with License Included
- **August –** Multi-AZ available in EU (Frankfurt) Region
- **August –** 16 TB Maximum Database Storage
- **September –** HIPAA Eligibility
- **November** – Scaling of Storage Size
- **November** – Reconfiguration on Snapshot Restore
- **November** – SQL Server 2016 SP1 CU5 and 2017
- **November** – R4 and M4 Instance Types

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RDS SQL Server Pace of Innovation - 2018

- **February –** Differential Backups (limited)
- **February –** CDC Support
- **February –** Max IOPS increased to 32,000
- **May** – More regions support SQL Server High Availability

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SQL Management Flexibility

- Consider RDS (Relational Database Service) first
  - Managed Service
  - Automatic Failover
  - Automatic Backups
  - Single checkbox enables Multi-AZ high availability
  - Automatic Host replacement
  - Automatic software patching
  - Most tools and drivers that connect to SQL can connect to RDS
- EC2
  - Full administrative control
  - Full SQL Server capabilities

RDS Limitations

- Integration Services (SSIS)
- Reporting Services (SSRS)
- Analysis Services (SSAS)
- SQL Agent
- Service Broker
- Data Quality Service
- Master Data Service

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

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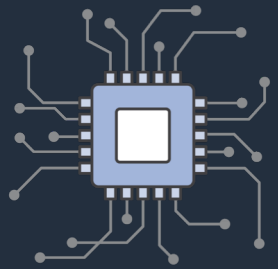
Service-level Performance Factors

RDS DB Instance Class



Compute Capabilities

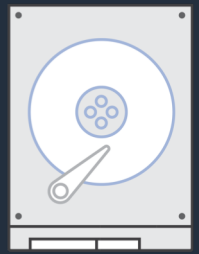
vCPUs

Memory Capabilities

GB of RAM

Network Performance

MB/s (Throughput)



Storage Performance

I/O Throughput

RDS Storage Type

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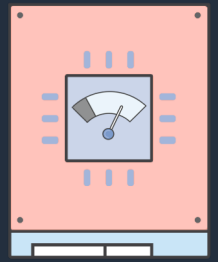
SQL Best Practices:

- Select an AMI with adequate CPU and Memory for your workload
- Select an EBS-optimized AMI if Possible
- Optimize TempDB Just Like On-Premises (Use Instance Storage if Possible or Fast EBS Otherwise)
- Provision Enough IOPs for your workload

EBS Volume Types: io1



Provisioned IOPS SSD

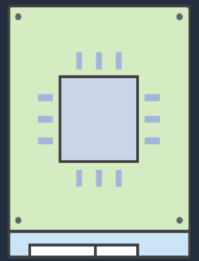
Volume Size: 4 GB to 16 TB

Max Throughput per Volume: 320 MB/s

Max IOPS per Volume: 32,000

Ideal for critical applications and databases with sustained IOPS

EBS Volume Types: gp2



General Purpose SSD

Volume Size: 1 GB to 16 TB

Max Throughput per Volume: 160 MB/s

Max IOPS per Volume: 10,000

Burst: 3,000 IOPS (for volumes up to 1 TB)

Great for boot volumes, low latency applications and bursty databases

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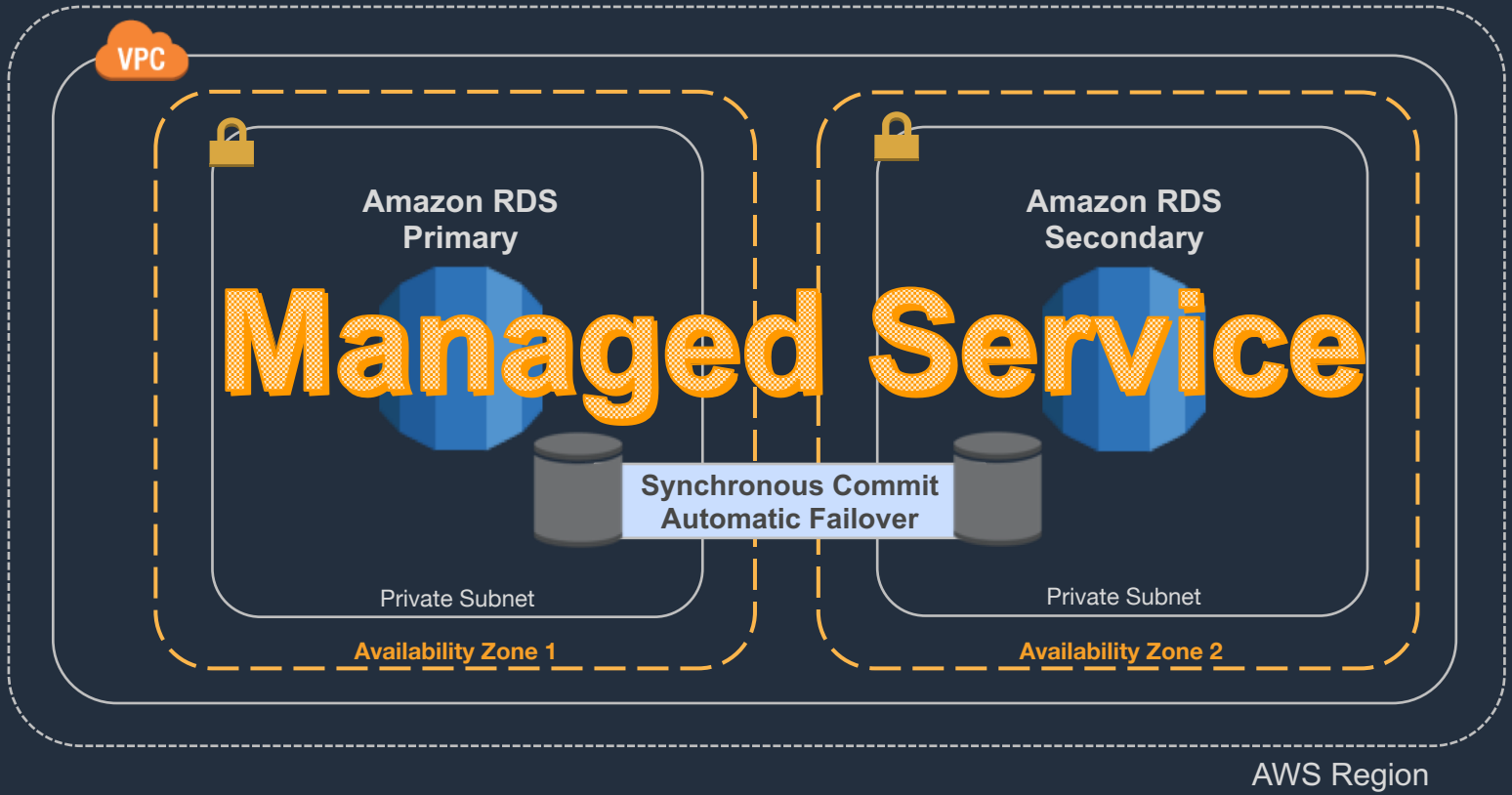
Performance Planning

- SQL Server workloads typically benefit from large amounts of memory (caching)
  - Consider db.r4 - Memory Optimized instances
  - 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

Multi-AZ SQL Server Deployment



Amazon RDS Multi-AZ in Depth

Failure scenarios mitigated:

- Loss of availability in primary AZ
- Loss of network connectivity to principal DB node
- Compute unit or storage failure on principal DB node

Failover process:

Consider:

- Implement retry logic at the application layer—trigger manual failover to test

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Monitoring SQL Server Performance

Monitor performance using **Amazon CloudWatch**

1. **Alarms & notifications:** Amazon RDS & Amazon EC2
2. **Default metrics:** Amazon RDS & Amazon EC2
3. **Custom metrics:** Amazon EC2

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

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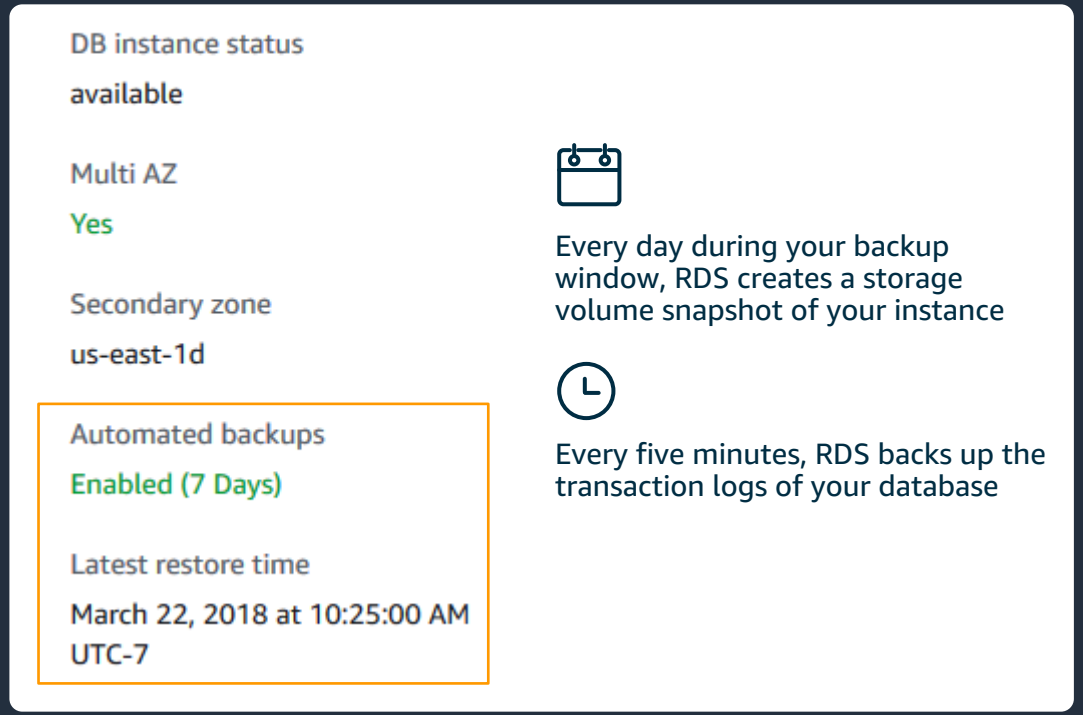
Automated Backups

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



Manage the RDS SQL Server Configuration

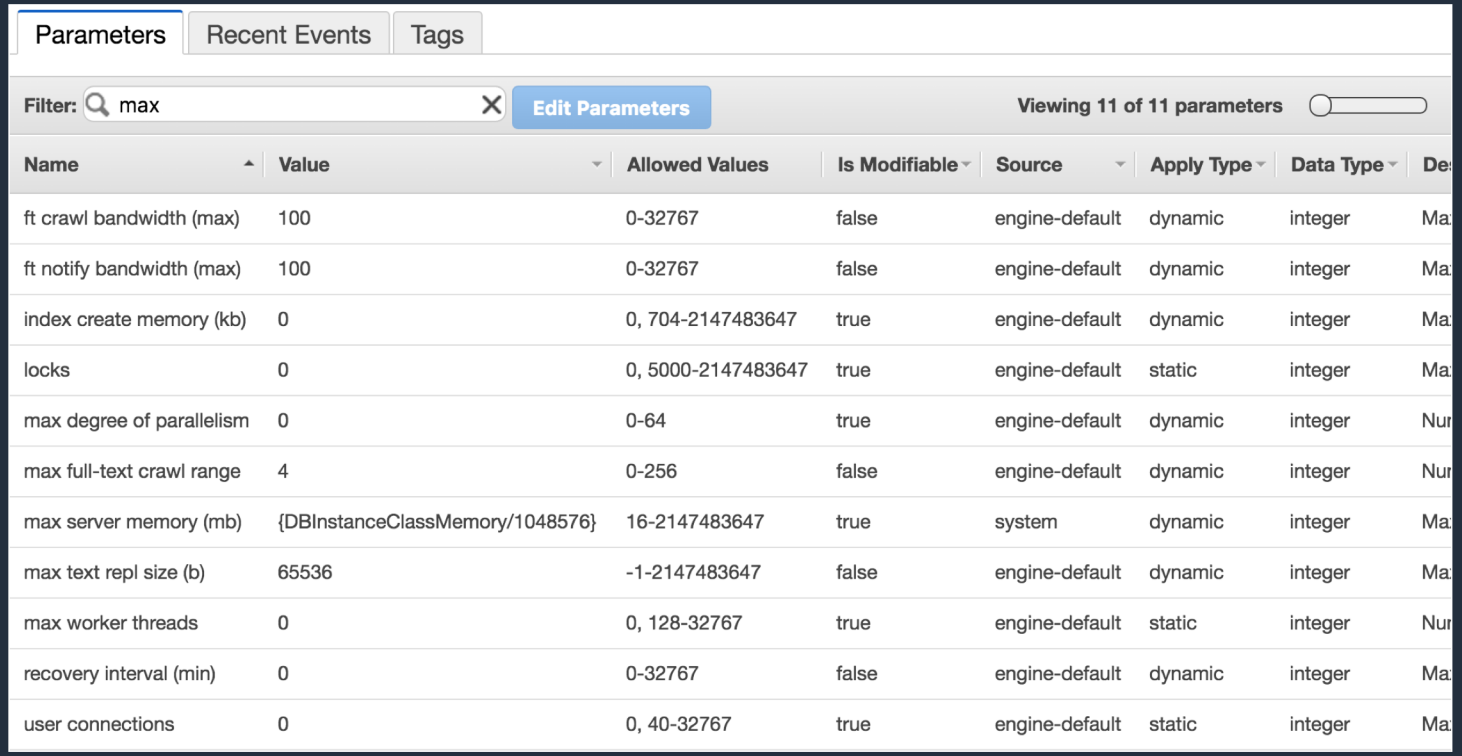
Parameter Groups

- 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) in Enterprise Edition only
  - S3 Backup & Restore

Customizing Parameter Groups



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	Nu
max full-text crawl range	4	0-256	false	engine-default	dynamic	integer	Nu
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	Nu
recovery interval (min)	0	0-32767	false	engine-default	dynamic	integer	Ma
user connections	0	0, 40-32767	true	engine-default	static	integer	Ma

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Customizing Parameter Groups

- **Exercise Caution - Change at Your Own Risk!**
- Not all parameters can be changed, some read only for visibility
- Dynamic (applied immediately) vs. Static (requires reboot)
- Fixed value, formula driven default, DB instance class dependent, interdependent

“clr”

Enable (1) or disable (0) the common language runtime, default disabled (0).

But if enabled, parameter “lightweight pooling” must be disabled (0)

“max server memory (mb)”

Memory allowed to be used by the server instance. Default based on instance class:

{DBInstanceClassMemory}/1048576

“max worker threads”

Number of worker threads available for SQL Server processes. Default is 0 – db engine computed based on formula:

512 + max(0, (vCPUs-4)x16)

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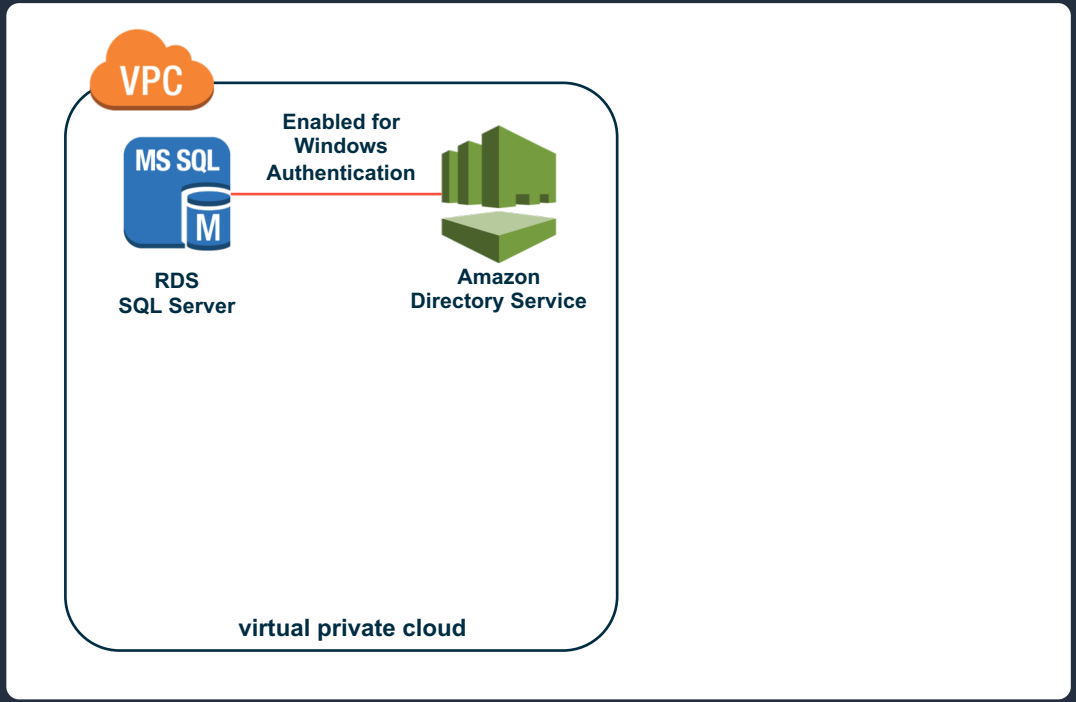
Using Windows Authentication

- Join RDS for SQL Server to a domain
- Domain provided by AWS Directory Services
  - Directory as a managed service
  - Deploy a Microsoft AD directory
  - Fully managed AD forest
  - Primary and secondary domain controllers in different AZs
  - Ability to establish forest trusts

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



Integrate with Existing Active Directory

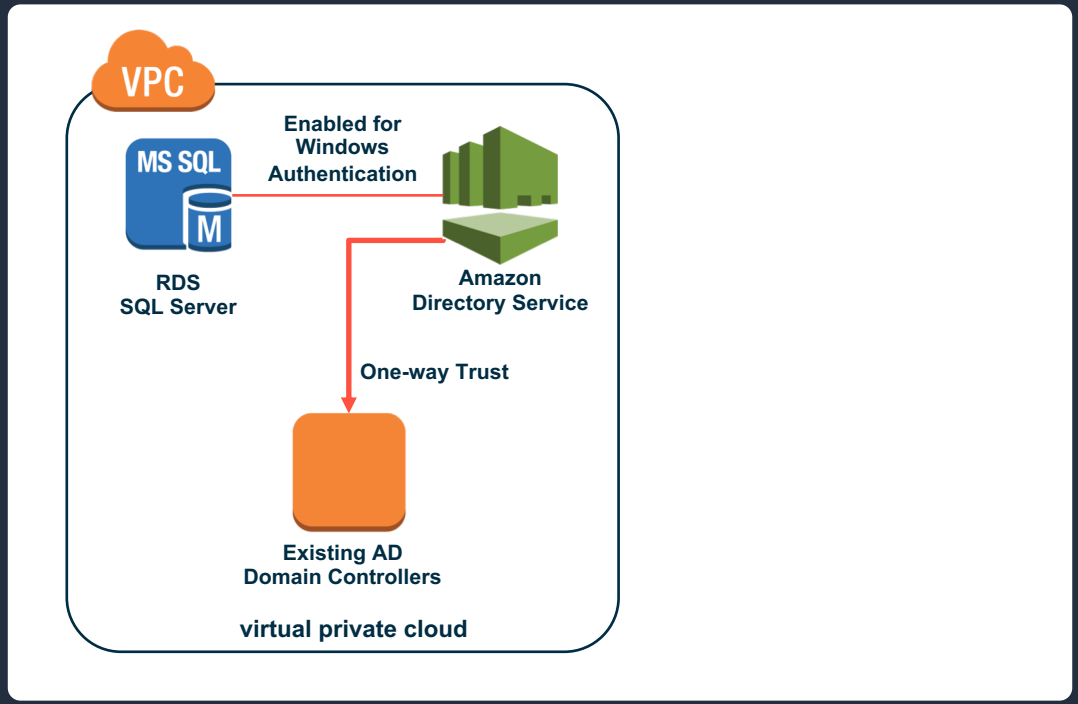
- Integrate with existing AD deployment using a Forest Trust
- Configure inbound trust on the external forest + outbound trust in the directory
- Configure conditional forwarders for the 2 domains

Pros

- Leverage an existing, self-managed AD deployment with RDS SQL Server

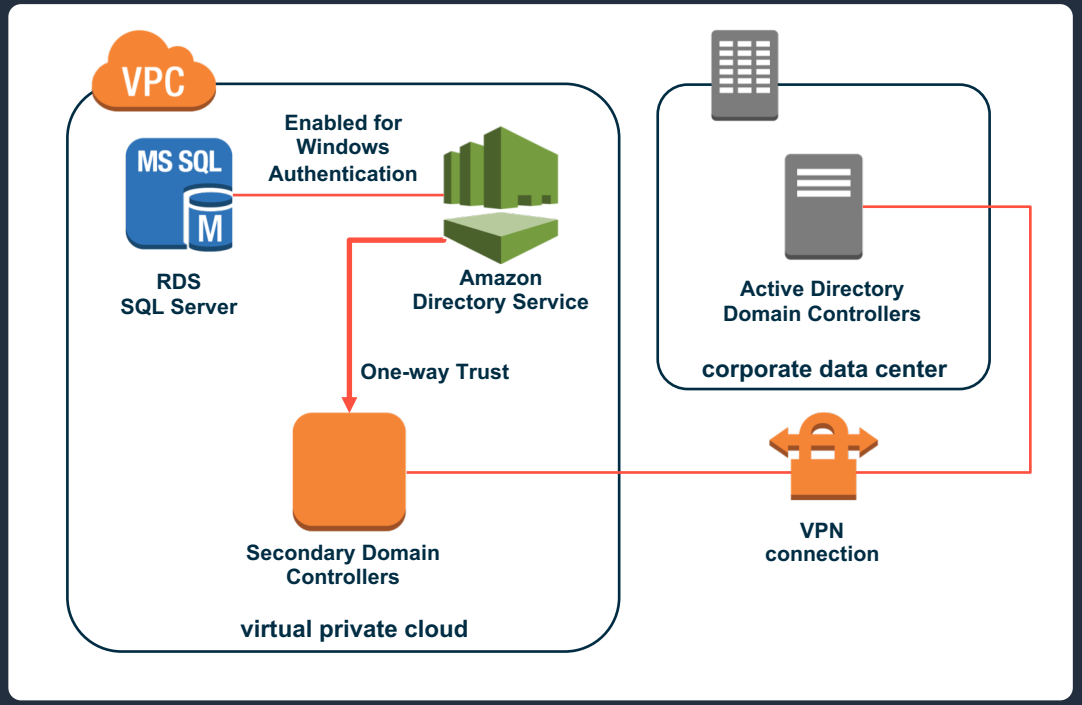
Cons

- Increased complexity operating 2 domains



Integrate with On-premise Domain

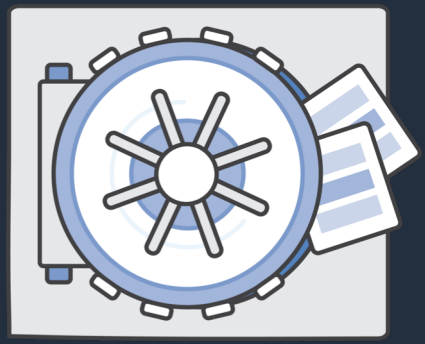
- Extend your internal network to AWS
- Private connectivity to your AWS VPC (VPN, DirectConnect)
- We recommend extending your AD deployment to AWS using secondary controllers in your VPC
- Establish Forest Trust between the existing AD and the Microsoft AD directory



Securing 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



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Securing 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
3. **Audit:** Use AWS CloudTrail to log AWS API invocations

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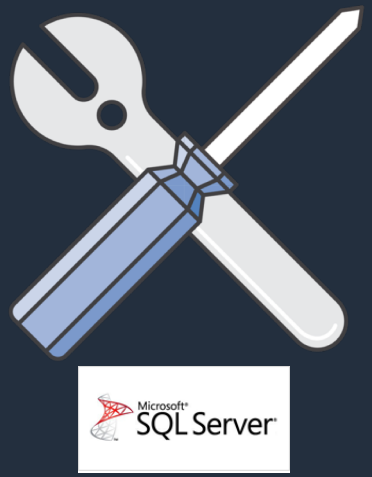
Amazon RDS SQL Server tooling

- Manage using common tools: SQL Server Management Studio, sqlcmd, etc.
- Data source or target only for SSAS, SSIS and SSRS
- Maximum 30 databases per Amazon RDS instance
- Amazon RDS does not provide desktop, Administrator or file-system access to DB instances
- Not supported: Maintenance Plans, Database Mail, MSDTC
- Limited support for Linked Servers available



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Migrating Data to & from Amazon RDS

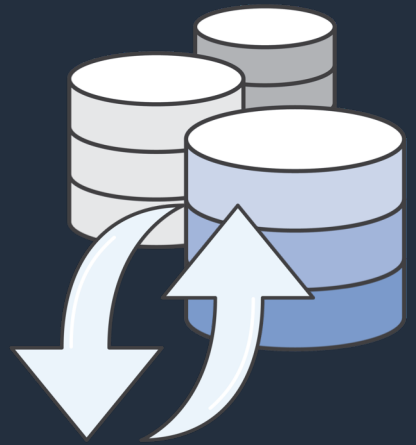
1. **.BAK File Save & Restore**
   Leverages SQL Server's native backup functionality

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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Why Microsoft SQL Server on AWS

- Largest Global Reach
- Cost benefits through license optimizations
- Increase innovation and flexibility for future
- Improve security posture

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Q&A

Name of presenter

Thank you!