3 0 1 0 2 4

Microsoft SQL Server Migration Strategies

Brian Beach
Principal Solutions Architect

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Agenda

Microsoft SQL Server on AWS

Best Practices for running SQL

Migration Methods

AWS Database Migration Service

Selecting the Migration Method

SQL 2008 End of Life

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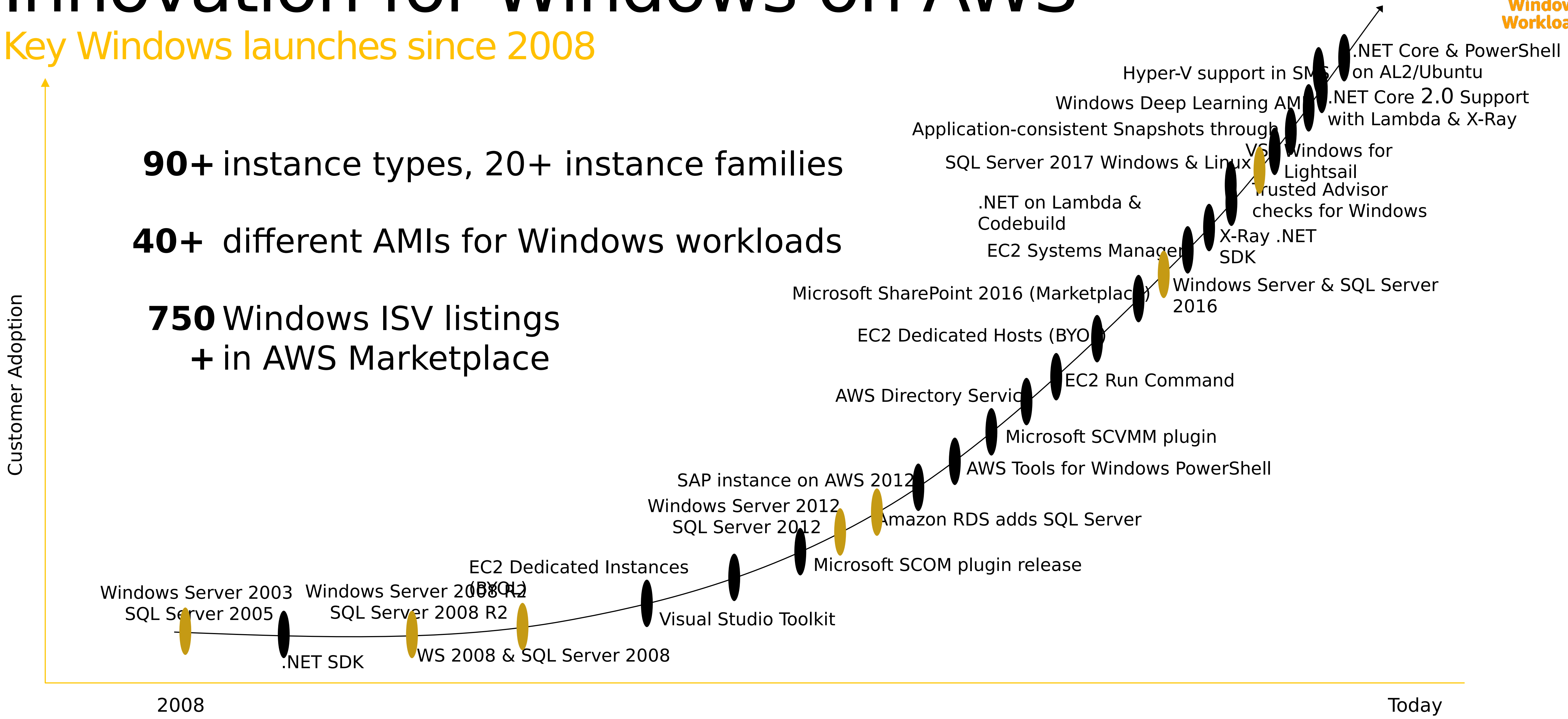
Innovation for Windows on AWS

Key Windows launches since 2008

90+ instance types, 20+ instance families

40+ different AMIs for Windows workloads

750+ Windows ISV listings in AWS Marketplace



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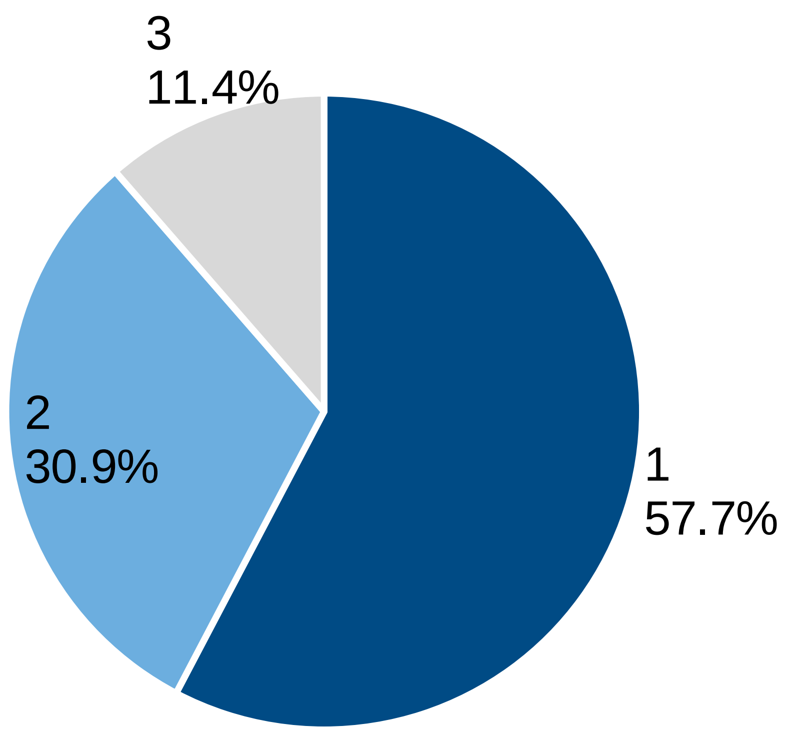
Public cloud market leaders dominate the Windows segment of the Infrastructure as a Service Market

Worldwide Windows public cloud IaaS instances by cloud provider, 2017



Note: Includes Windows instances deployed in the public cloud IaaS market during 2017
Source: IDC estimates, 2018

IDC estimates AWS accounted for approximately 57.7% of total Windows instances deployed in the public cloud IaaS market during 2017, followed by Microsoft Azure at 30.9%. The rest of the market collectively accounted for the remaining 11.4% of Windows instances deployed in the public cloud IaaS market during 2017.

IDC notes the Windows public cloud IaaS market continues to expand due to the growing usage of public cloud IaaS among enterprises and the movement of Windows workloads into public cloud IaaS.

SQL Server on AWS

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Which migration strategy is right for you?

Amazon Elastic Compute Cloud (Amazon EC2)

Rehost:
SQL Server on EC2

- Familiar administration experience
- Full control over the environment
- All SQL Server features available
- All SQL Server versions supported

Amazon Relational Database Service (Amazon RDS)

Replatform:
SQL Server on RDS

- Optimized architecture
- Automated patching
- Automated backups
- Proven high availability

Refactor:
Adopt Cloud Native Services

- Amazon Aurora – SQL/OLTP
- Amazon Redshift – SQL/OLAP
- Amazon DynamoDB – NoSQL
- Amazon Neptune – Graph
- <u>Eliminate</u> SQL Server licensing costs

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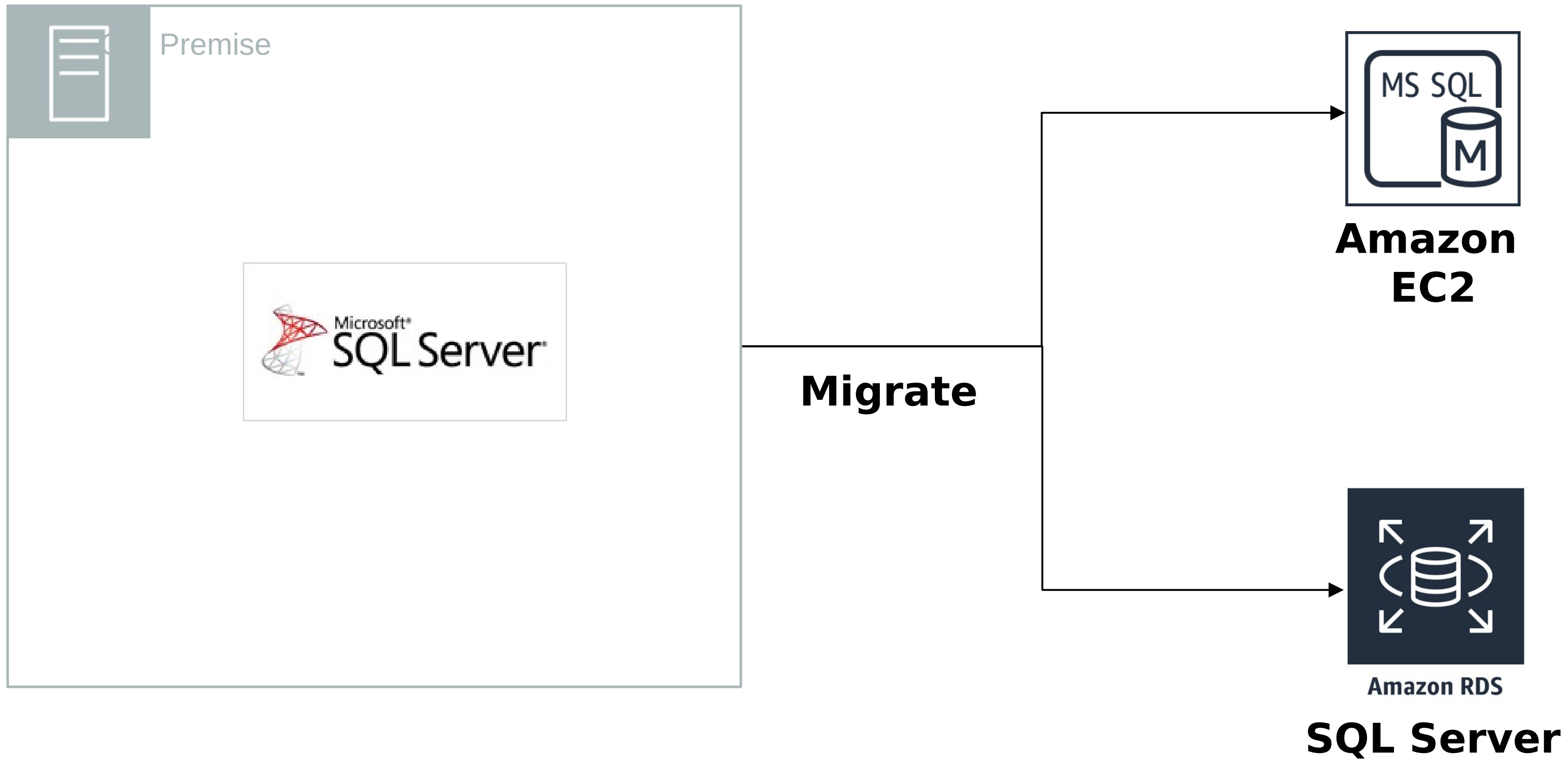
Migrating SQL Server databases to AWS



SQL Server on AWS

Amazon RDS

Amazon RDS for SQL Server

- **Consider RDS first**
- Focus on business value tasks
- High-level tuning asks
- 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

MS SQL

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**

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SQL Server features at a glance

Amazon RDS

* Self-installed

	Amazon RDS	Amazon EC2
Versions Supported:	~~2008 R2~~, 2012, 2014, 2016, 2017	All
Editions Supported:	Express, Web, Standard, Enterprise**	
High Availability:	AWS-managed	Self-managed; AlwaysOn, Mirror, Log Ship
Encryption:	Encrypted Storage using AWS Key Management Service (AWS KMS) (all editions); TDE Support	
Authentication:	Windows & SQL authentication	
Backups:	Managed automated backups	Maintenance plans & 3rd party tools
Maintenance:	Automatic software patching	Self-managed

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Amazon Relational Database Service

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SQL Server as a managed service

AMAZON RDS

- Same SQL Server DB engine as with Amazon Elastic Compute Cloud (Amazon EC2)
- Management, monitoring, and automation layer around the DB engine
- Automated full DB instance backups, with point-in-time restore
- Automated high availability (HA)
- Automated provisioning, patching, monitoring, directory integration

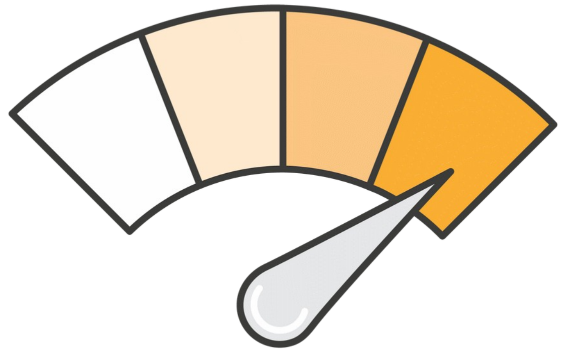
LIMITATIONS

- Cannot run SSRS, SSIS, SSAS on the DB instance (works as data source)
- No sysadmin role, server administrator, or direct file system access
  - https://docs.aws.amazon.com/AmazonRDS/latest/UserGuide/UsingWithRDS.MasterAccounts.html
- Not supported: MSDTC, maintenance plans, database mail

Storage performance planning

AMAZON RDS STORAGE

- Low latency, persistent, network-attached block storage
- Easy to change after initial selection
- Maximum storage: **16 TB**
- Maximum IOPS: **64,000**
- Maximum throughput: 500 MiB/sec
- Amazon RDS storage throughput
  depends on DB instance class (see equivalent
  Amazon EC2 EBS optimized instance type)
- Keep in mind this includes TempDB



MONITORING I/O EFFICIENCY

- Amazon CloudWatch metric a**verage queue depth**
  - I/O requests waiting to be serviced

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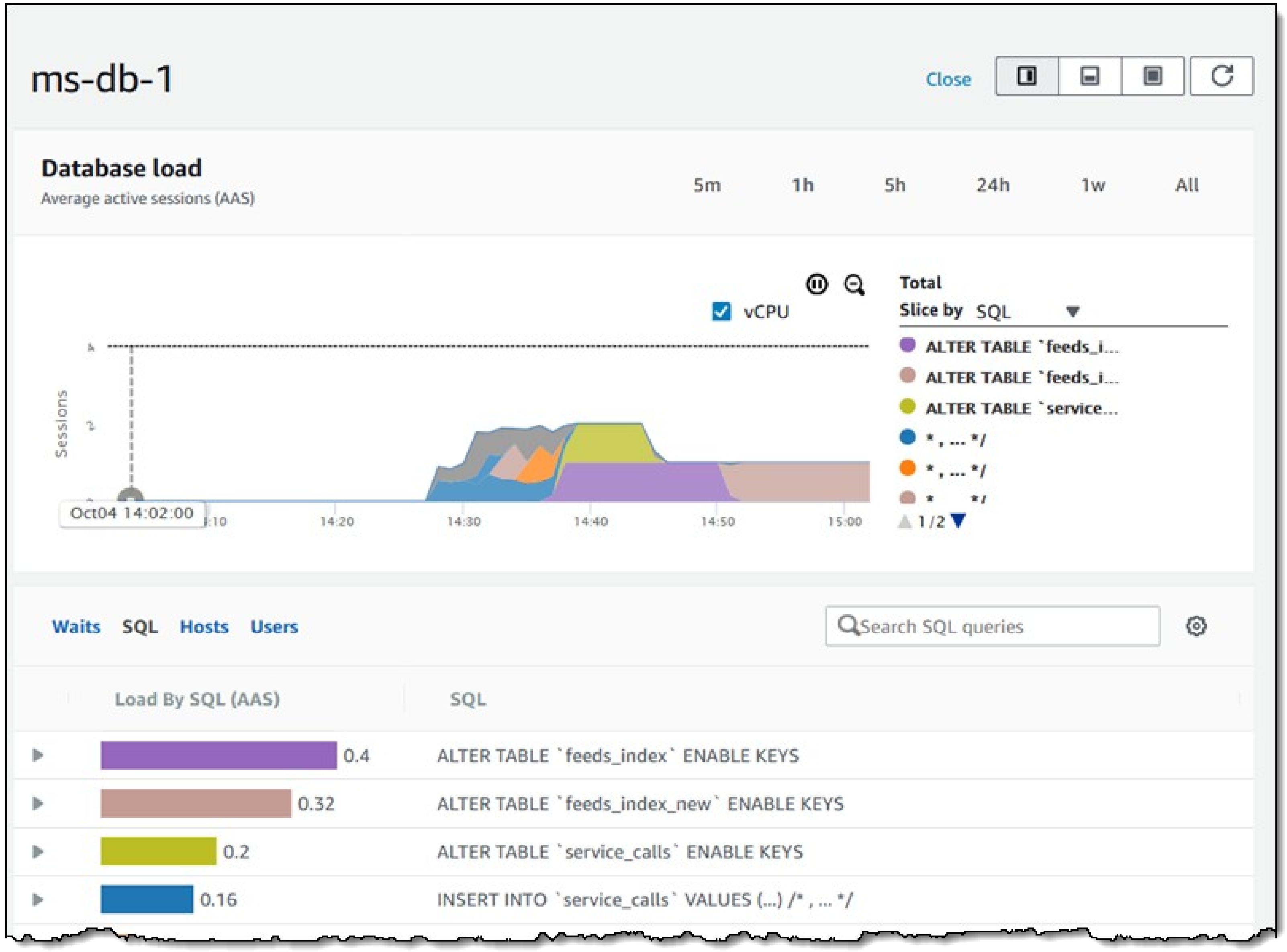
RDS SQL Server – Performance Insights



	Load By SQL (AAS)	SQL
▶	0.4	ALTER TABLE `feeds_index` ENABLE KEYS
▶	0.32	ALTER TABLE `feeds_index_new` ENABLE KEYS
▶	0.2	ALTER TABLE `service_calls` ENABLE KEYS
▶	0.16	INSERT INTO `service_calls` VALUES (...) /* , ... */

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SQL Server on EC2

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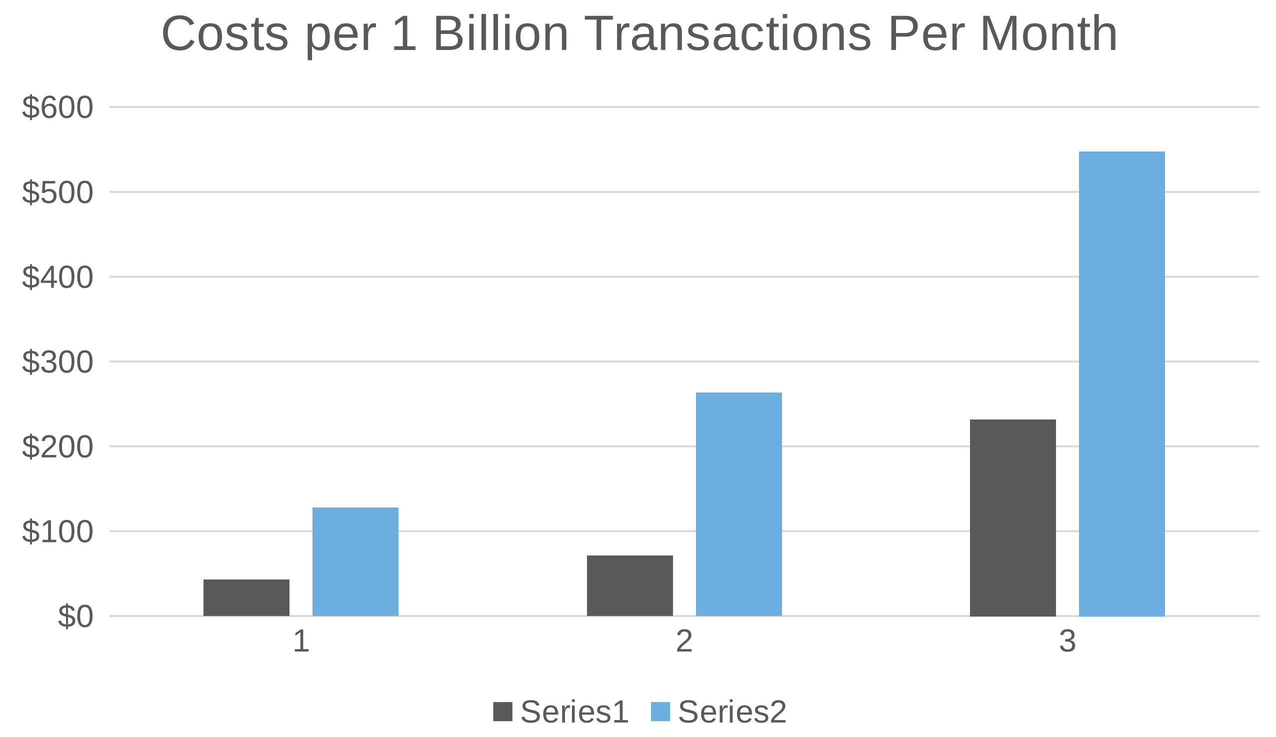
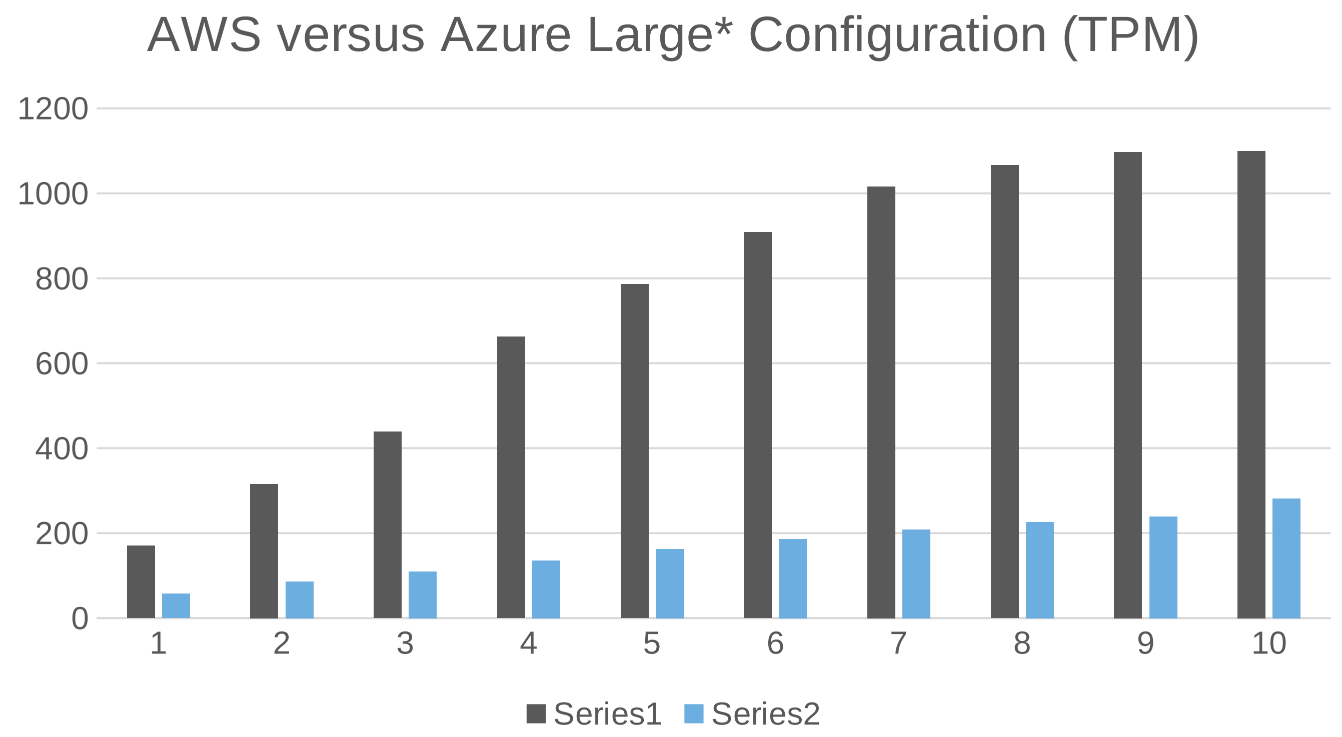
SQL Server on AWS exhibited 2X+ better price/ performance than Azure (ZK Research)



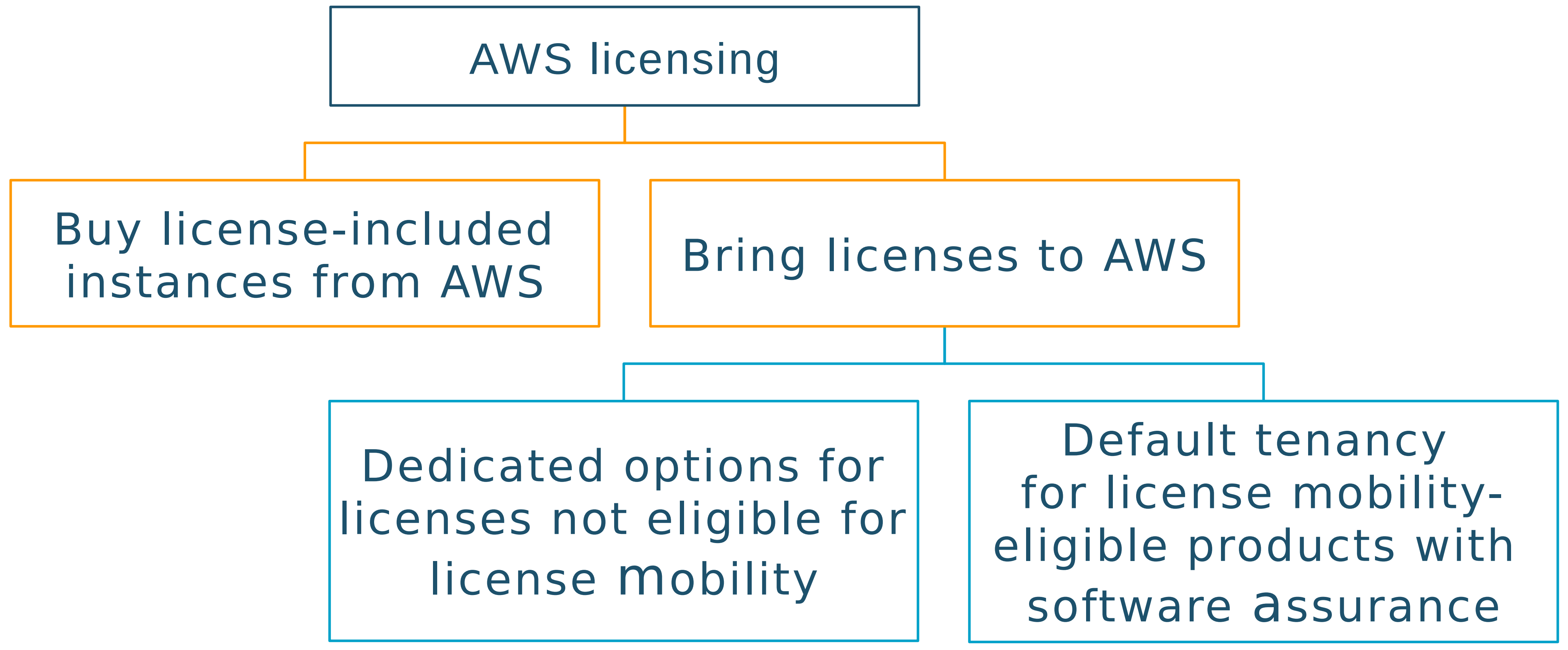


SQL Server on Amazon EC2 consistently outperforms Azure across a variety of machine types

https://zkresearch.com/blog/2018/11/comparing-sql-server-deployments-on-microsoft-azure-and-amazon-web-services

*Results for Small and Medium configuration available on https://zkresearch.com, a 3rd party research firm

Microsoft licensing on AWS


AWS licensing
Buy license-included instances from AWS
Bring licenses to AWS
Dedicated options for licenses not eligible for license mobility
Default tenancy for license mobility-eligible products with software assurance

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Amazon EC2: Purpose-built compute families

Current Instance Families and Generation	Family/Usage
M5, M4	General purpose compute
T2, T3	Burstable performance
C5, C4	Compute optimized
X1, X1E, R5, R5d, R4, R3	**Memory optimized**
P2, G3, F1	Accelerated computing
I3	Storage optimized (I/O)
D2	Storage optimized (Density)

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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

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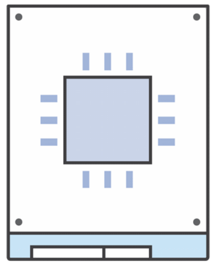
How do I use Optimize CPU?

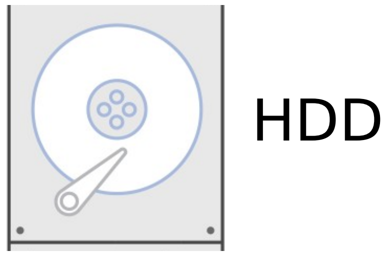
Set with AWS CLI run-instances
    --cpu-options “CoreCount=*x*,ThreadsPerCore=*y*”

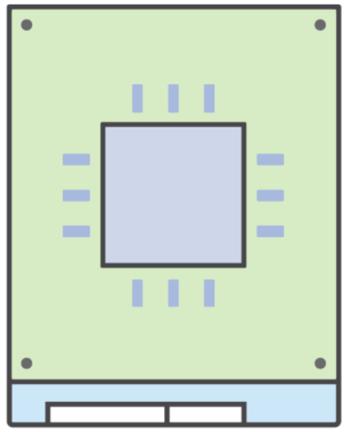
View with AWS CLI describe-instances
    “CpuOptions”: {“CoreCount”: *x*, “ThreadsPerCore”: *y*}

Alternatively, set with AWS SDK or Amazon EC2 API

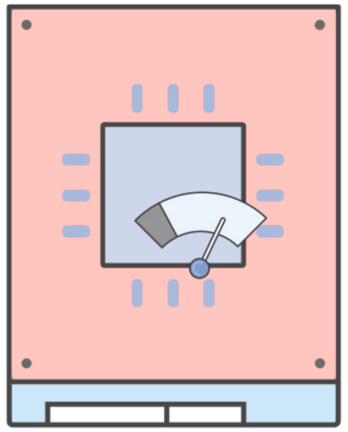
Amazon EBS volume types



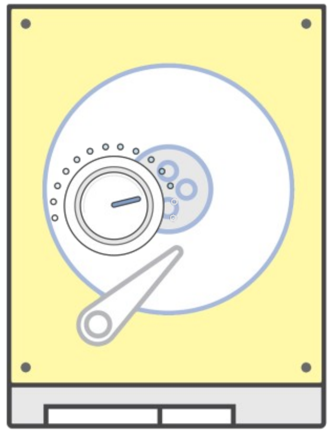




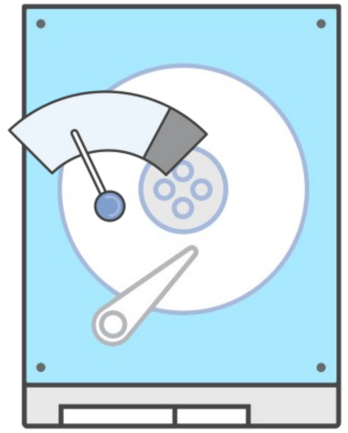
gp2
General purpose
$0.10 per GiB



io1
Provisioned IOPS
$0.125 per GiB
$0.065 per PIOPS



st1
Throughput optimized
$0.045 per GiB



sc1
Cold
$0.025 per GiB

Snapshot storage for all volume types is $0.05 per GiB per month

* All prices are per month, prorated to the second, and from the us-east-1 region as of October 2018

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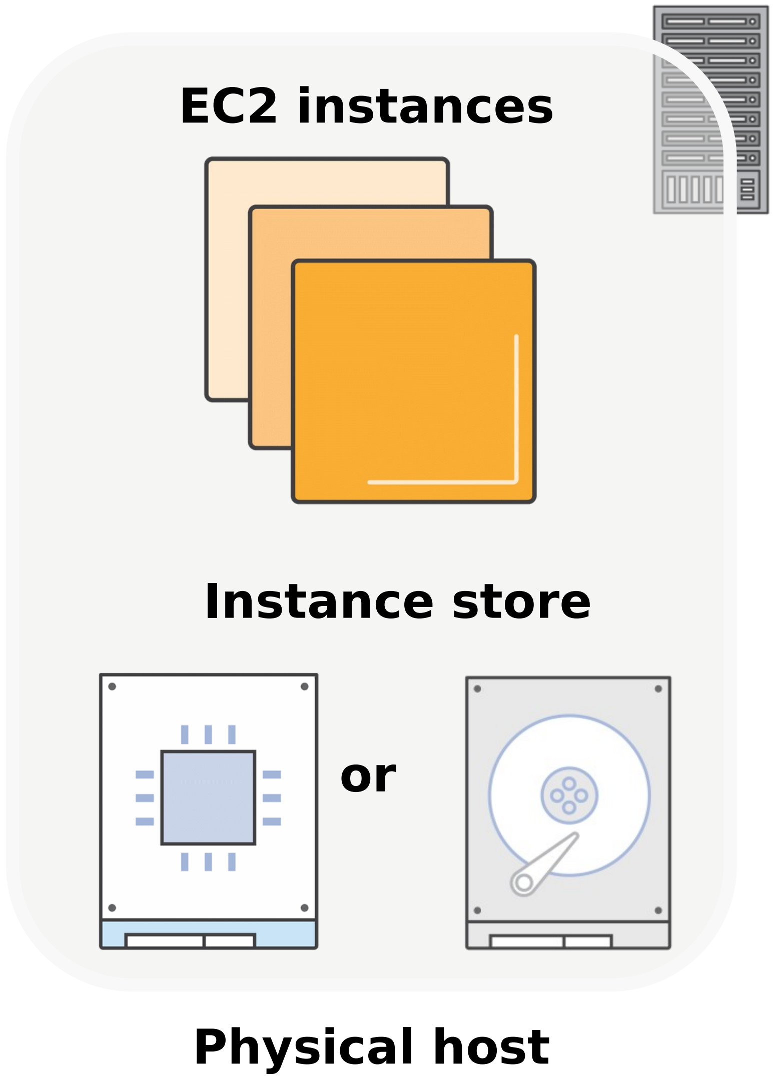
What is Amazon EC2 Instance Store?



- Local to instance
- SSD or HDD
- Non-persistent data store
- Data not replicated (by default)
- No snapshot support

* Not all instance types have local, instance storage

Migration methods

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Assessment and planning

- Inventory SQL Server all dependencies
- Authentication requirements (e.g., Windows Authentication vs. SQL)
- Identify SQL Server version or edition features currently used
- Know you licensing options (e.g., Leverage BYOL)
- Understand High Availability and Disaster Recovery Requirements
- Performance requirements (e.g., IOPS) and Capacity planning
- Leverage your Retention Policy
- Understand migration options
- List all database properties (e.g., Recovery Model and Compatibility Level)
- Acknowledge Internal capabilities

Hybrid Architecture

- Integration of on-premises resources with cloud resources
- Migrate SQL Server data to the AWS Cloud

Amazon S3

AWS Storage Gateway

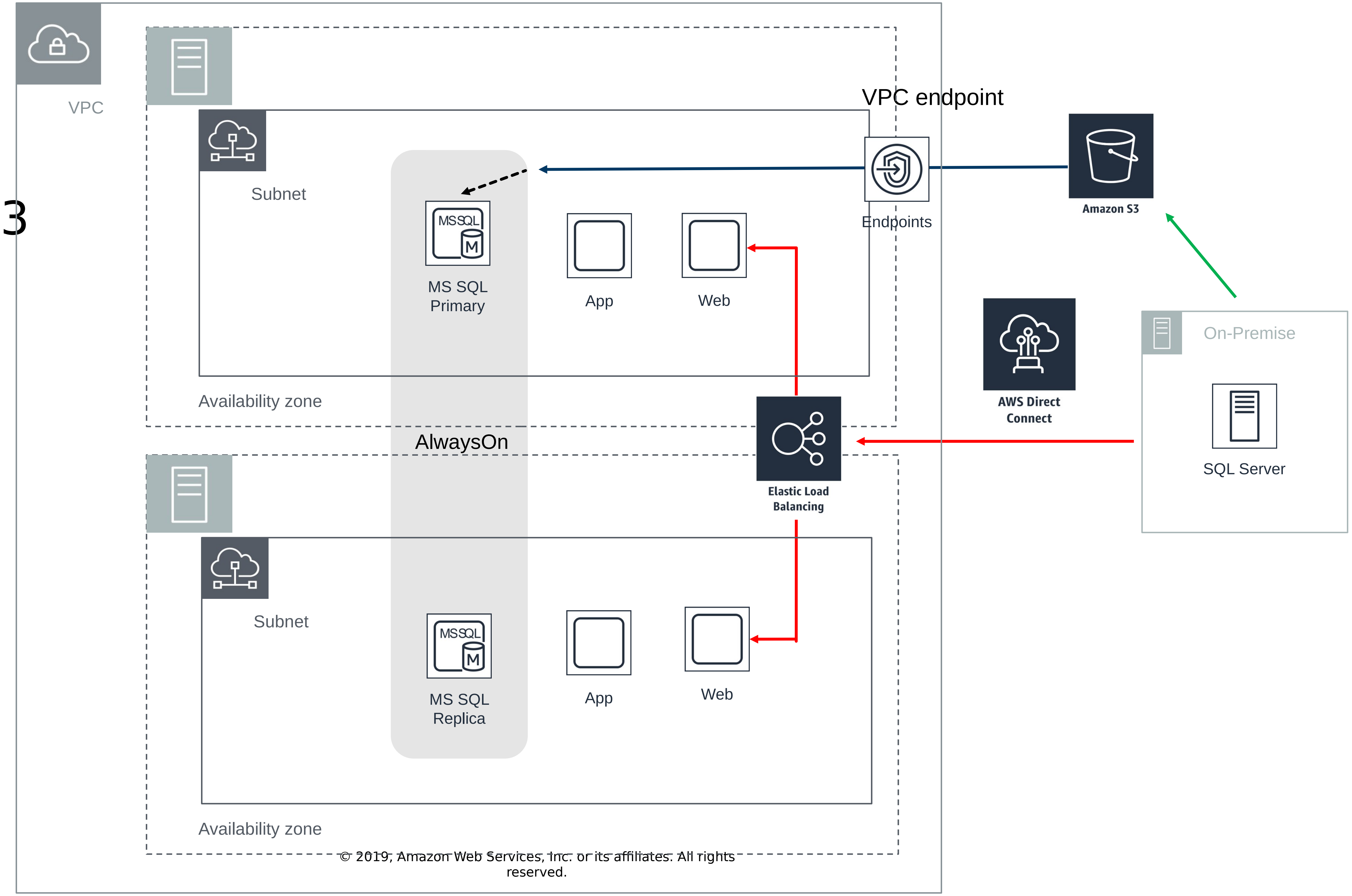
Amazon RDS

AWS Snowball

AWS Database Migration Service

https://aws.amazon.com/enterprise/hybrid/

SQL Server backups to Amazon S3



- .bak uploads to S3
- HTTPS traffic
- .bak downloads using VPC endpoint
- Restore .bak

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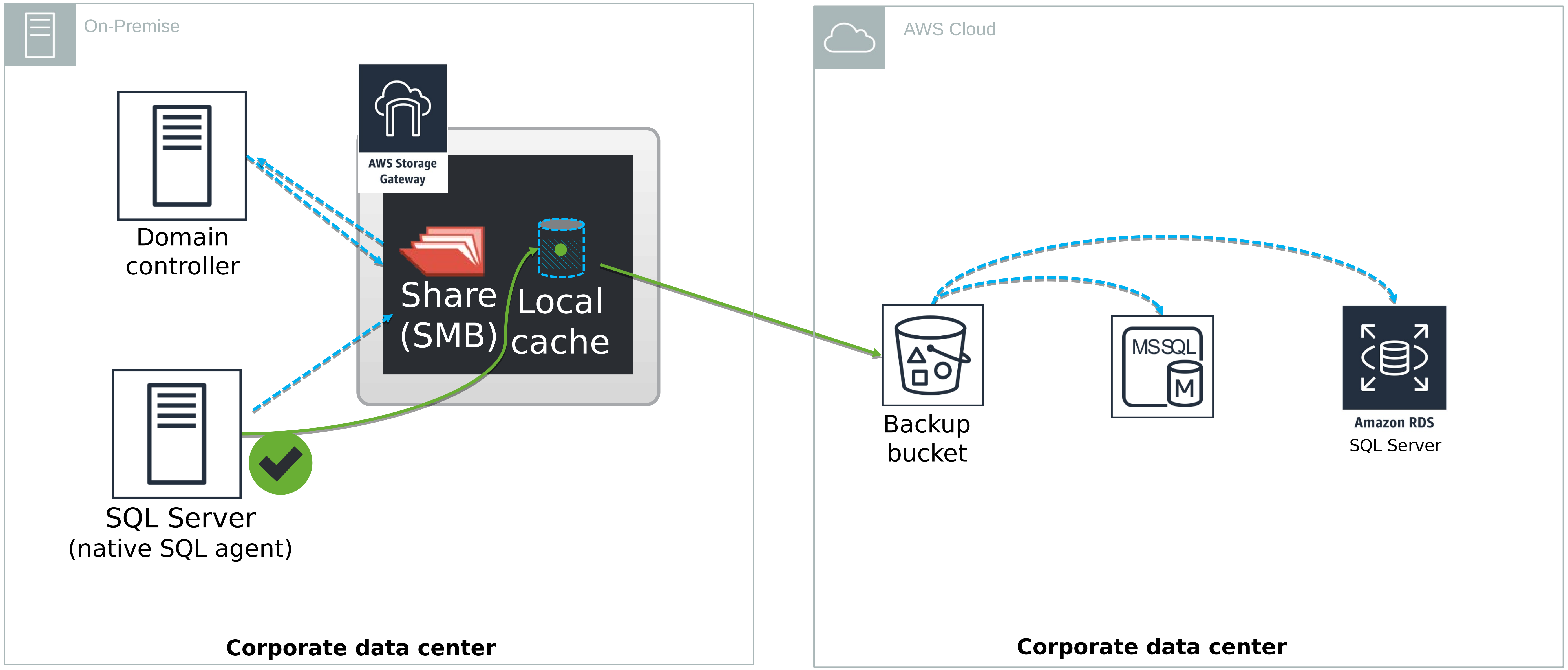
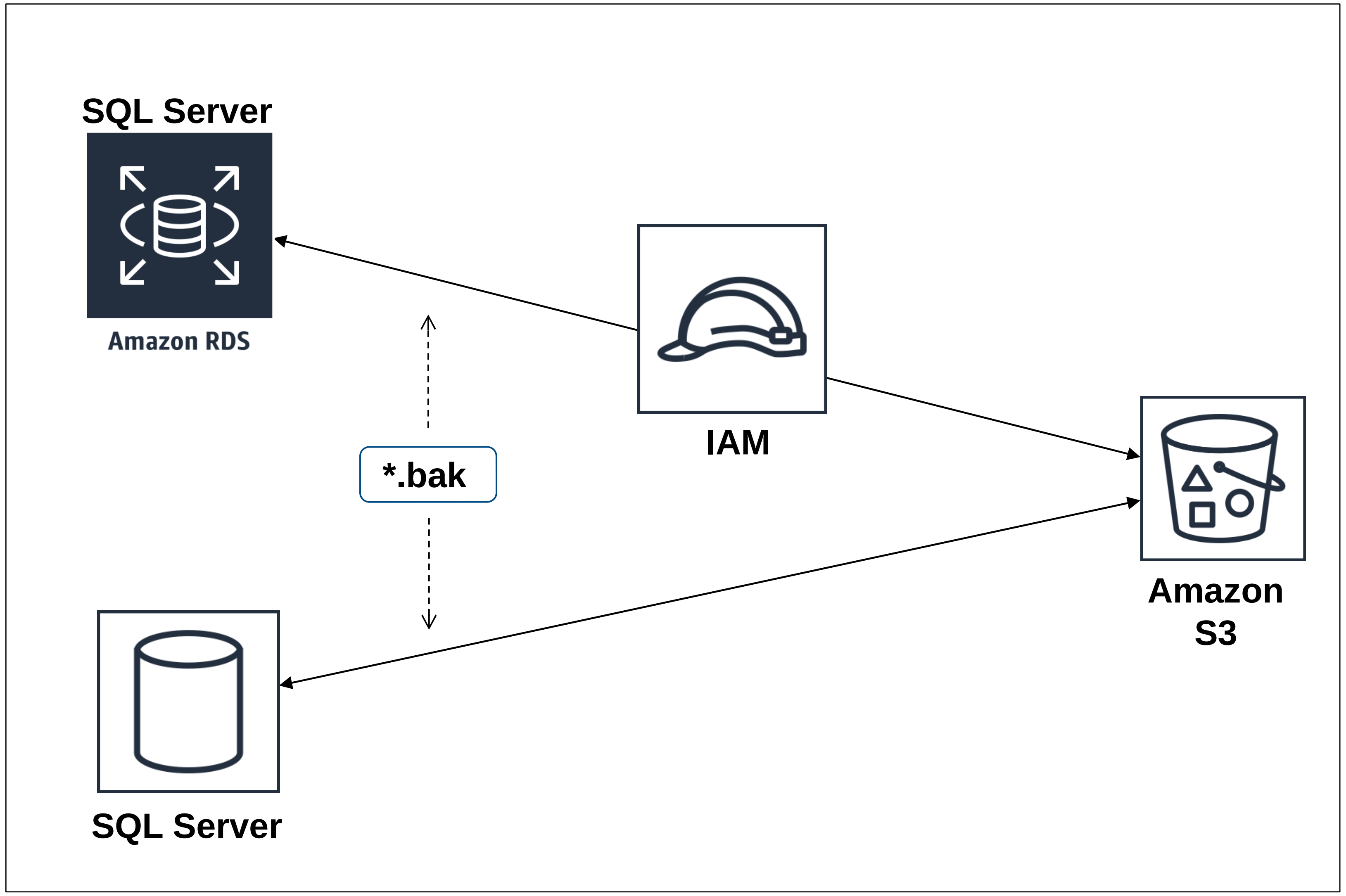
Native SQL backup to Amazon S3 via SMB

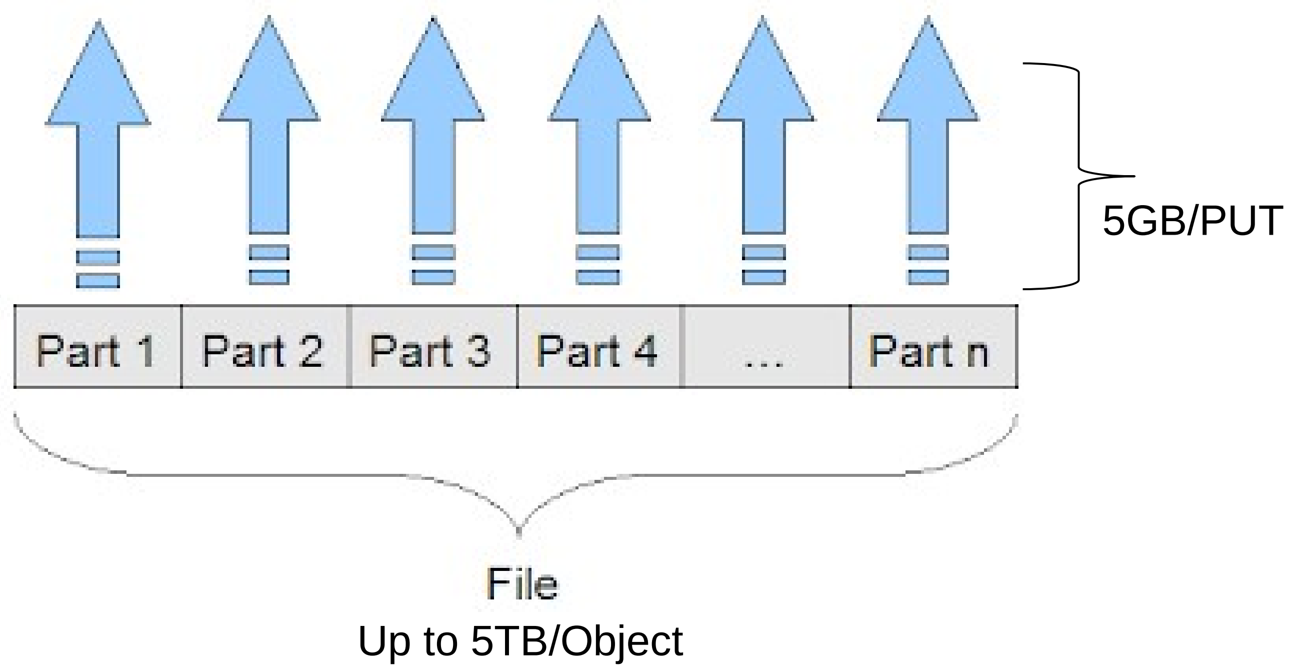


RDS SQL Server backup/restore

- Backup and restore using Amazon S3
- IAM Role to connect services
- Configure Option Group to enable functionality
- Specify an S3 Bucket as part of configuration
- Run Stored Procedure to perform restore
- Heavily optimized



Amazon S3 file transfer performance considerations



- If necessary, split backup files:

```
BACKUP DATABASE AdventureWorks
TO DISK = 'C:\Backup\AdventureWorks2014/1.bak',
   DISK = 'D:\Backup\AdventureWorks2014/2.bak',
    DISK = 'E:\Backup\AdventureWorks2014/3.bak'
GO
```

- Various ways optimizing, including using SDKs. Must be manually optimized.

- Storage Gateway automatically optimizes uploads

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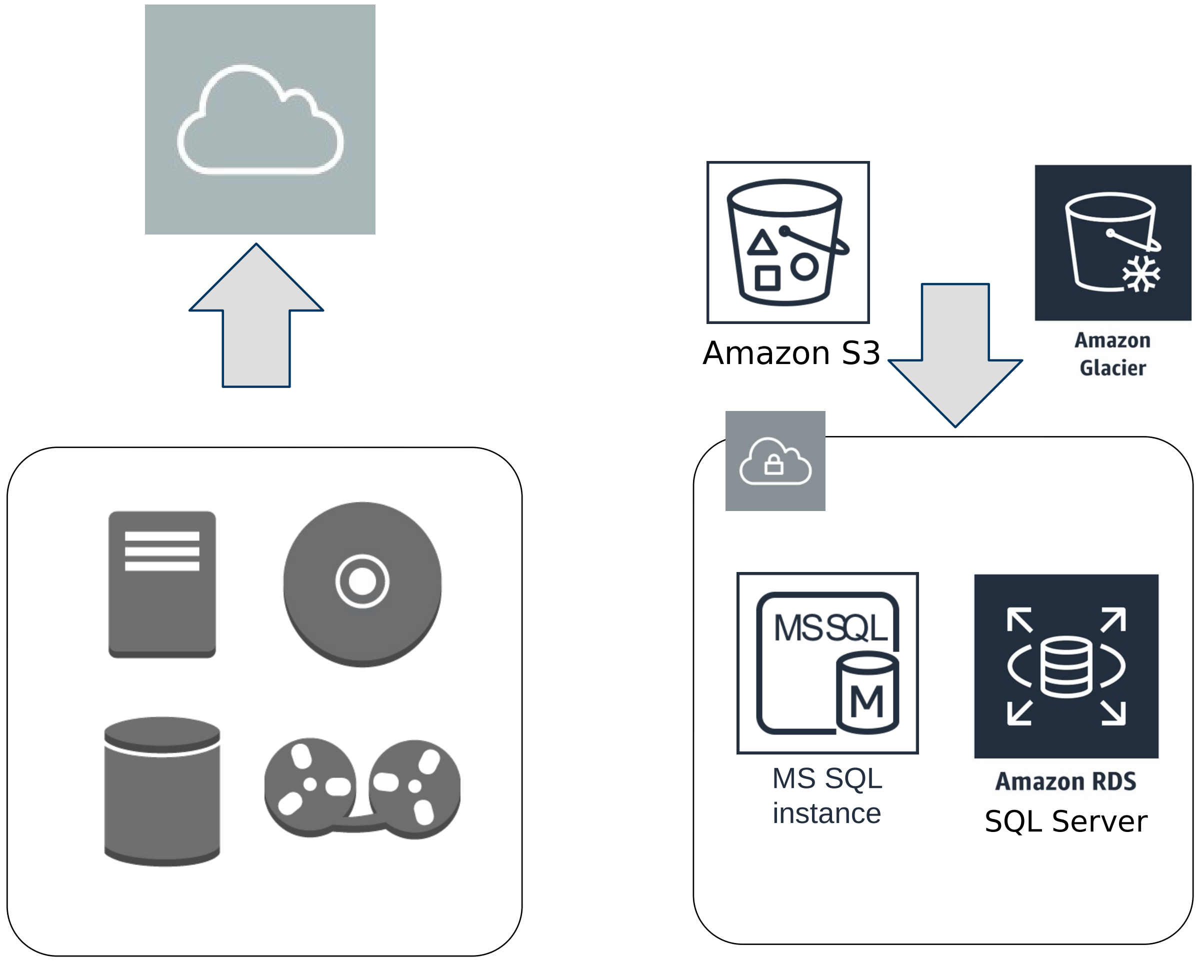
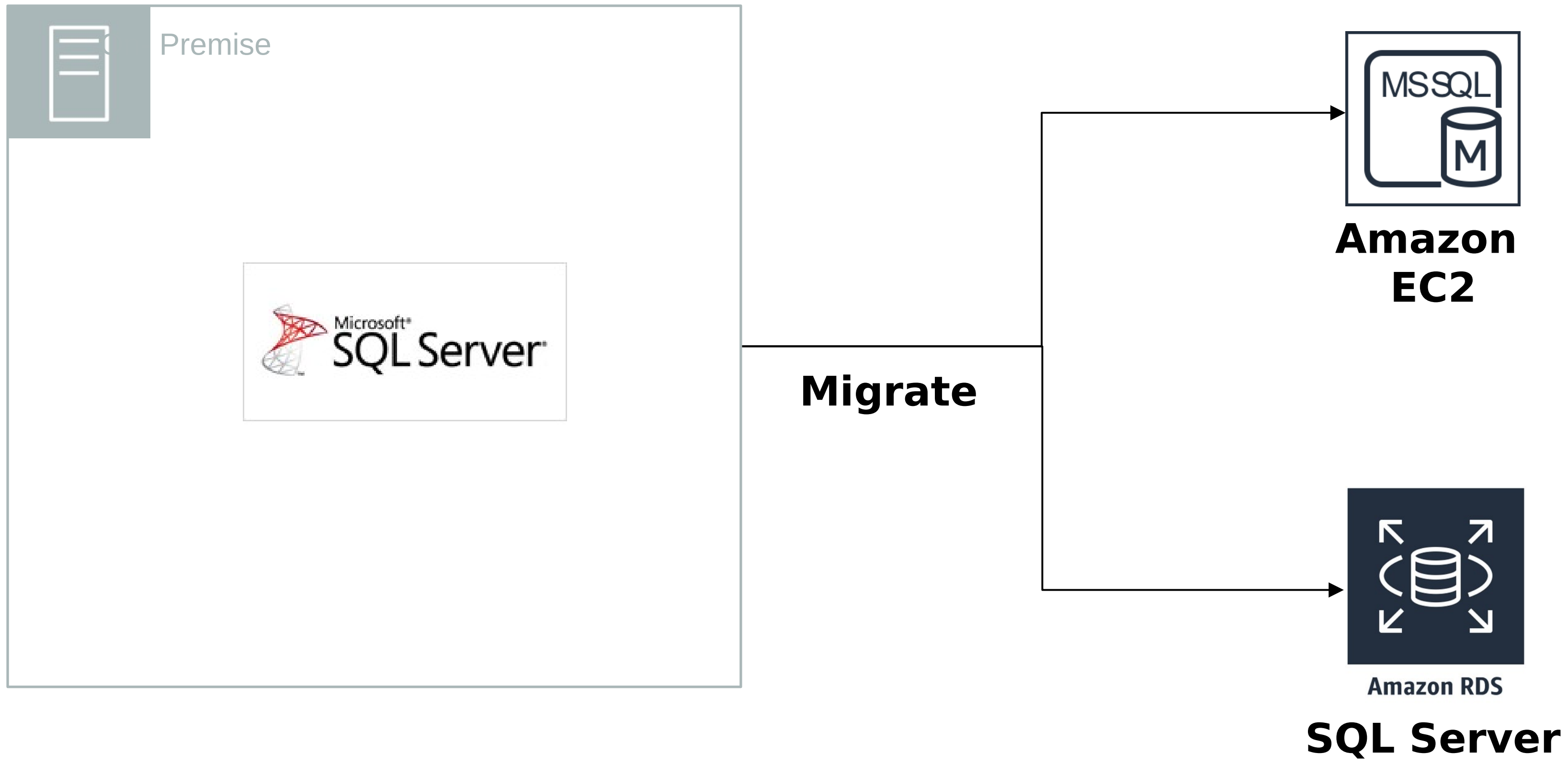
When to use AWS Import/Export Snowball

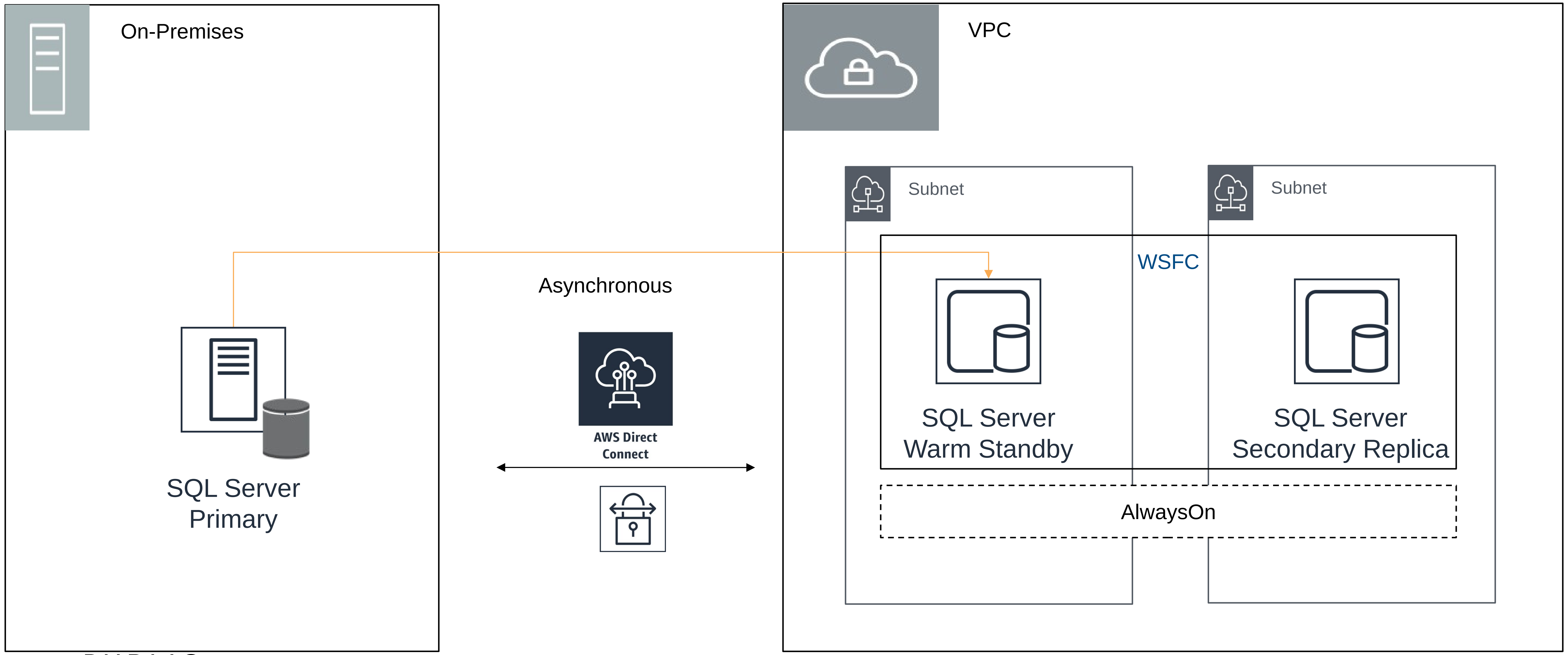


Cloud Migration

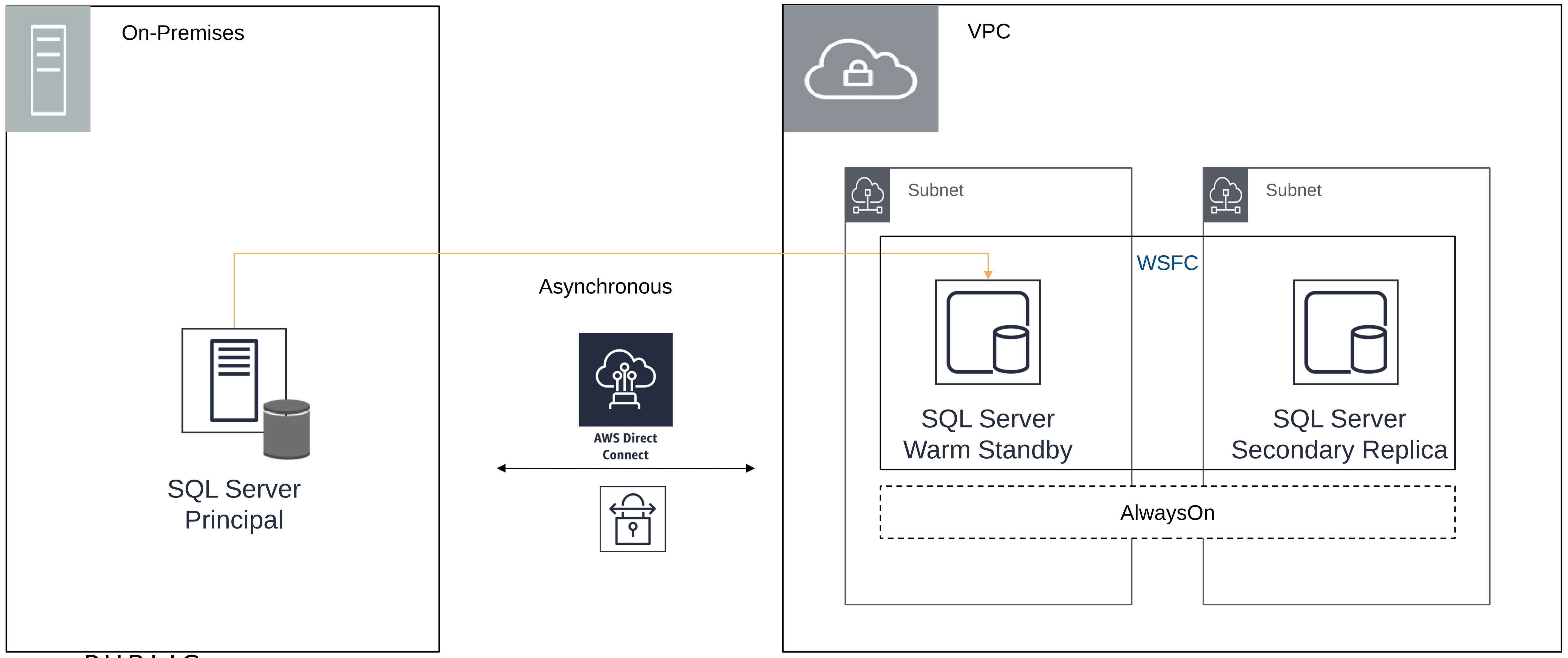
Native SQL Server migration methods



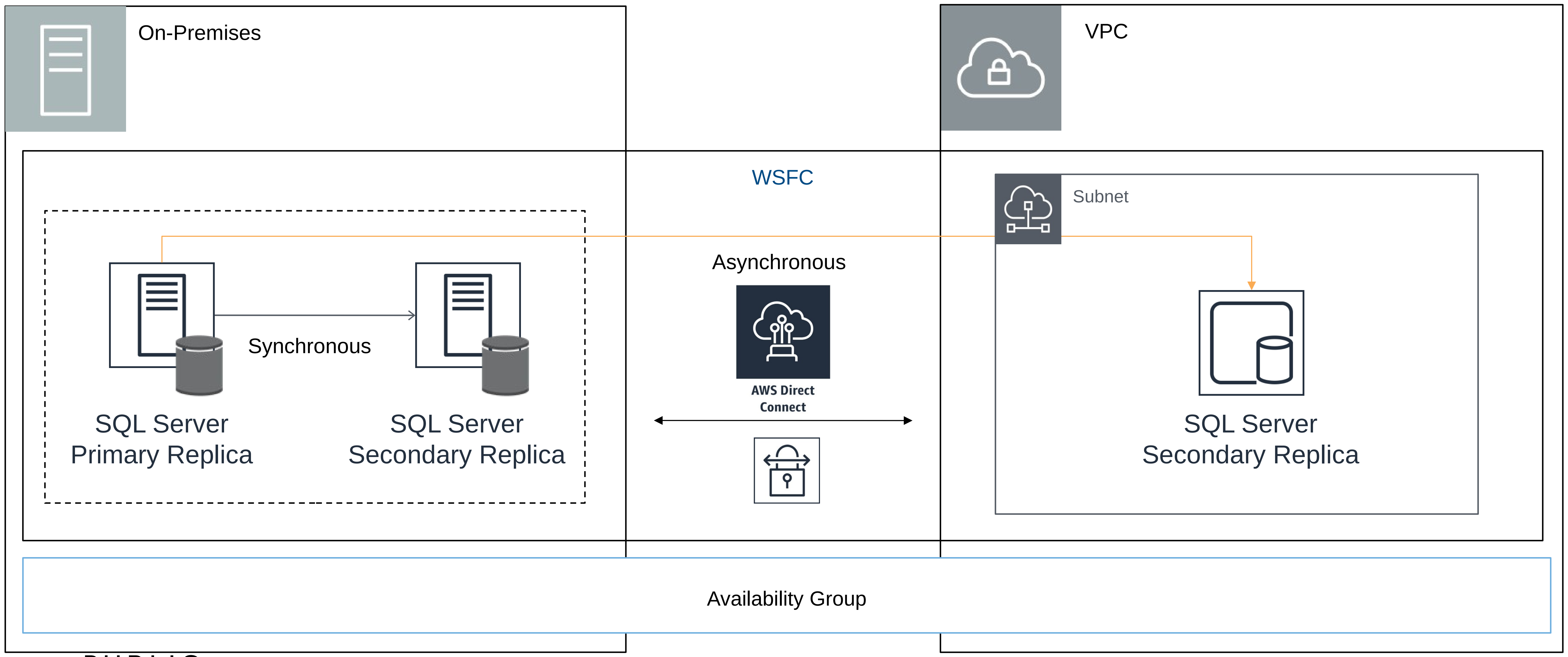
Log Shipping



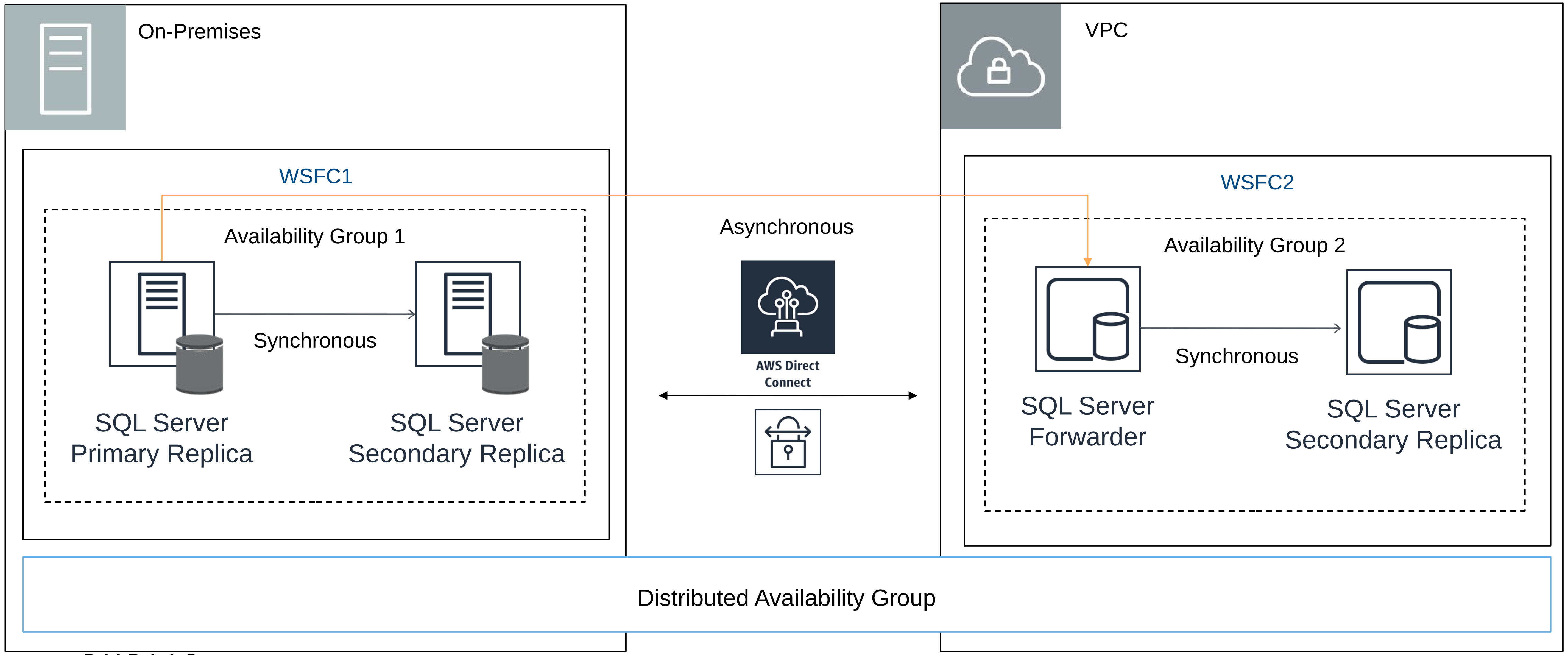
Database Mirroring



AlwaysOn Availability Groups

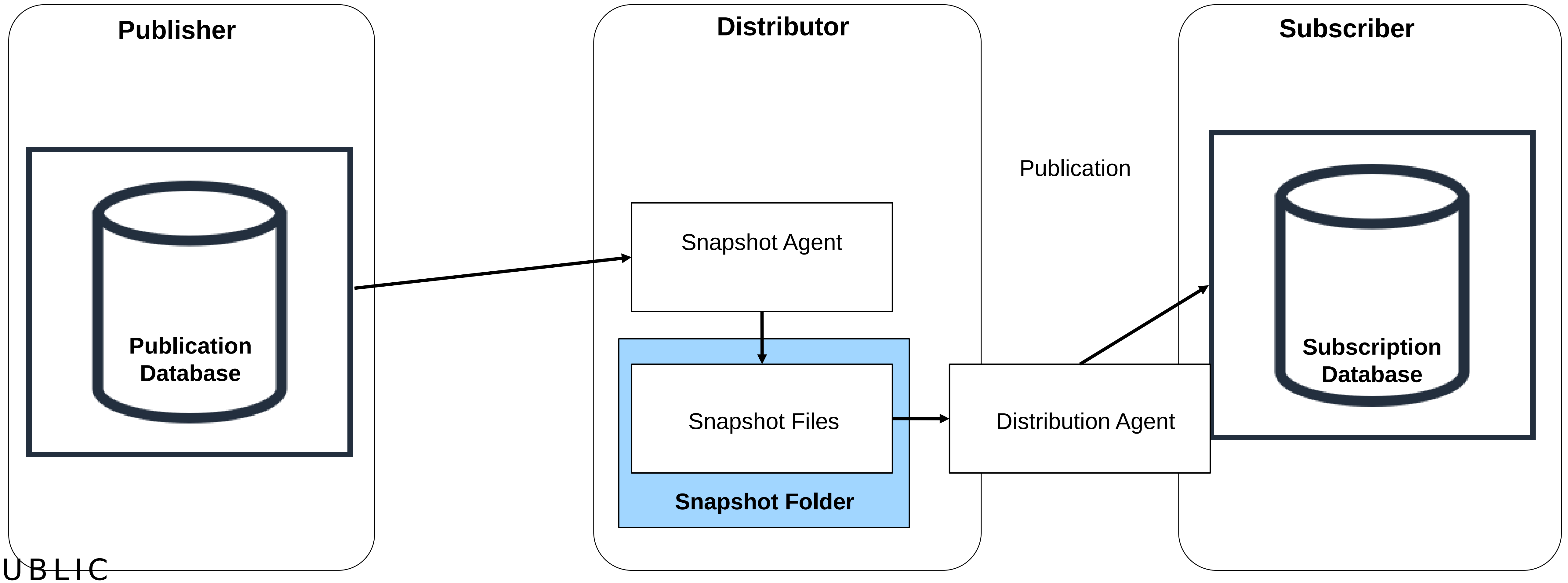


Distributed Availability Groups



Transactional Replication

Publish and filter database objects to a subscriber of choice



AWS Database Migration Service

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AWS Database Migration Service

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

AWS Database Migration Service

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

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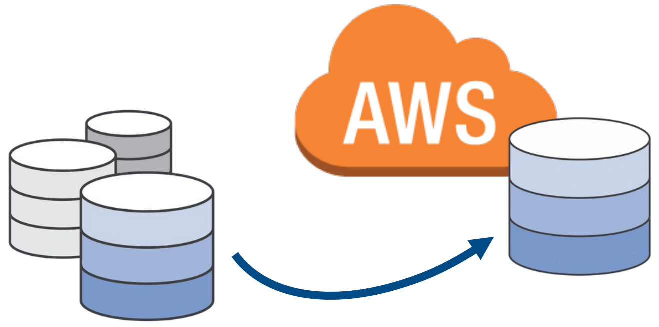
When to use AWS DMS and AWS SCT?

Modernize

Modernize your database tier

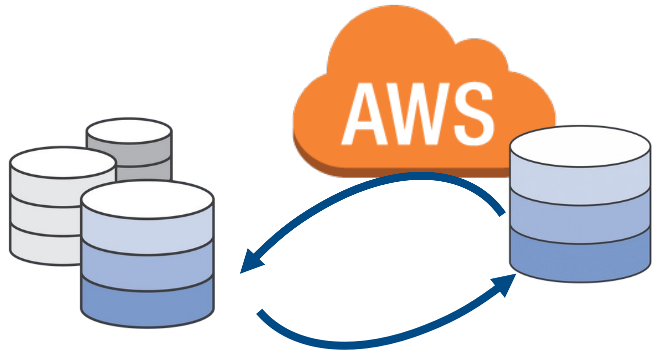
- SQL Server to open-source
- SQL Server to Amazon Aurora or PostgeSQL
- SQL Server to Amazon Redshift

Migrate



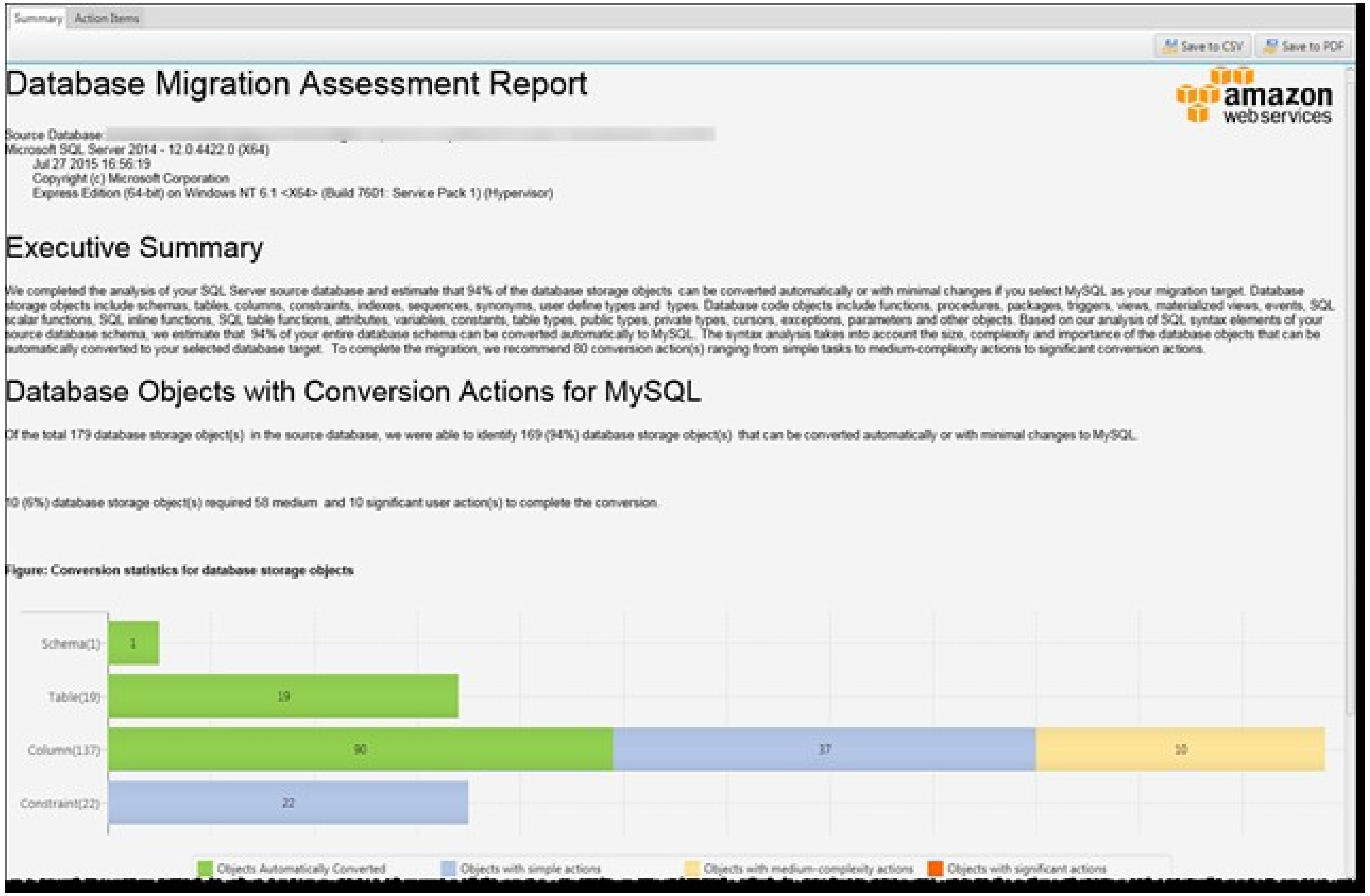
- Migrate business-critical applications
- Migrate data warehouse to Amazon Redshift
- Consolidate shards into Amazon Aurora

Replicate



- Create cross-regions Read Replicas
- Run your analytics in the cloud
- Keep your dev/test and production environment sync

SCT Migration Assessment Report



Database Migration Assessment Report

Source Database: [redacted]
Microsoft SQL Server 2014 - 12.0.4422.0 (X64)
Jul 27 2015 16:56:19
Copyright (c) Microsoft Corporation
Express Edition (64-bit) on Windows NT 6.1 <X64> (Build 7601: Service Pack 1) (Hypervisor)

Executive Summary

We completed the analysis of your SQL Server source database and estimate that 94% of the database storage objects can be converted automatically or with minimal changes if you select MySQL as your migration target. Database storage objects include schemas, tables, columns, constraints, indexes, sequences, synonyms, user define types and types. Database code objects include functions, procedures, packages, triggers, views, materialized views, events, SQL scalar functions, SQL inline functions, SQL table functions, attributes, variables, constants, table types, public types, private types, cursors, exceptions, parameters and other objects. Based on our analysis of SQL syntax elements of your source database schema, we estimate that 94% of your entire database schema can be converted automatically to MySQL. The syntax analysis takes into account the size, complexity and importance of the database objects that can be automatically converted to your selected database target. To complete the migration, we recommend 80 conversion action(s) ranging from simple tasks to medium-complexity actions to significant conversion actions.

Database Objects with Conversion Actions for MySQL

Of the total 179 database storage object(s) in the source database, we were able to identify 169 (94%) database storage object(s) that can be converted automatically or with minimal changes to MySQL.

10 (6%) database storage object(s) required 58 medium and 10 significant user action(s) to complete the conversion.

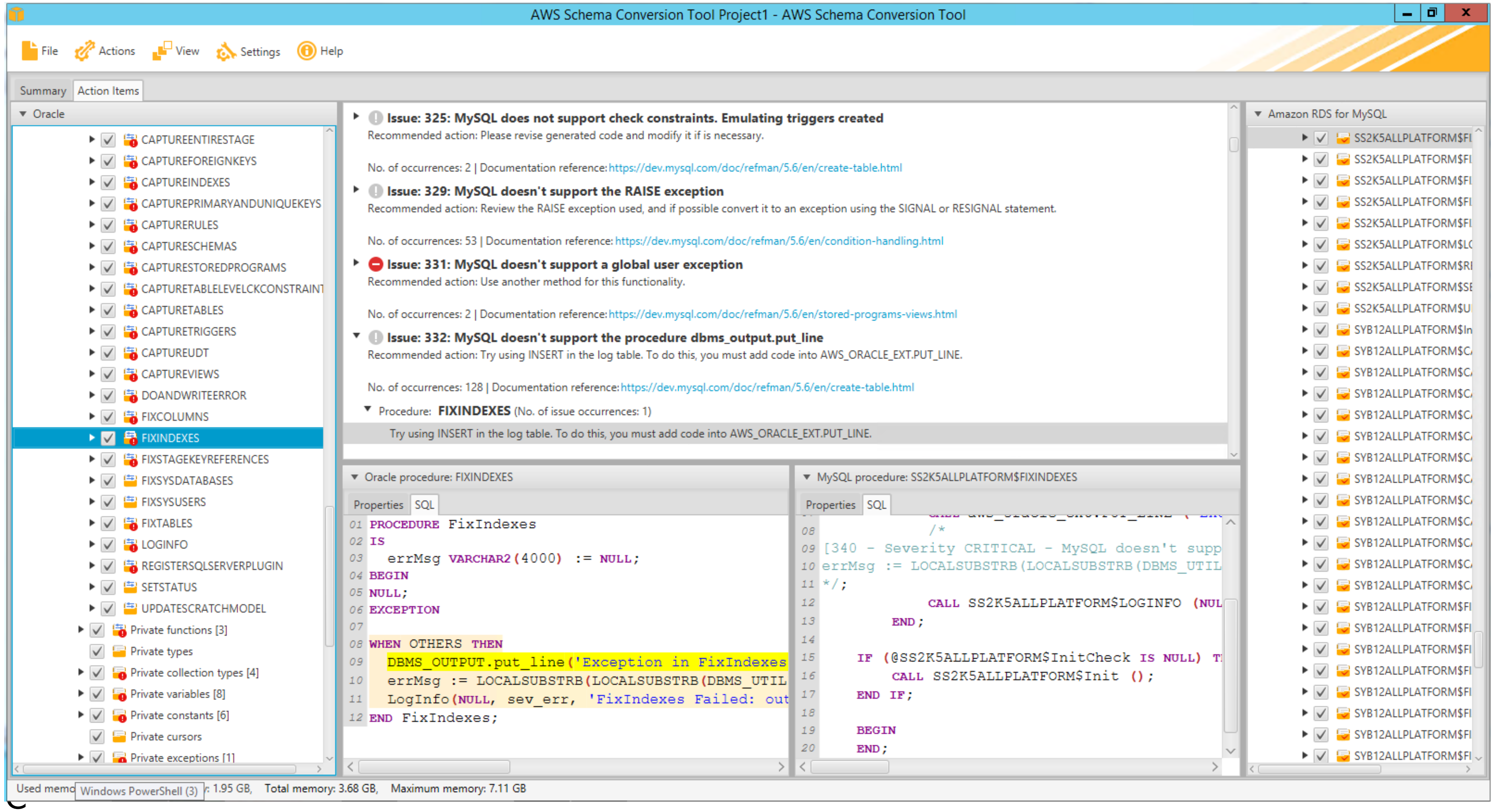
Figure: Conversion statistics for database storage objects

Schema(1)
1
Table(19)
19
Column(137)
90
37
10
Constraint(22)
22
Objects Automatically Converted
Objects with simple actions
Objects with medium-complexity actions
Objects with significant actions

- 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

AWS Schema Conversion Tool (AWS SCT)

- Understand the level of effort to migrate



AWS Schema Conversion Tool Project1 - AWS Schema Conversion Tool

File Actions View Settings Help

Summary | Action Items

Oracle

- CAPTUREENTIRESTAGE
- CAPTUREFOREIGNKEYS
- CAPTUREINDEXES
- CAPTUREPRIMARYANDUNIQUEKEYS
- CAPTURERULES
- CAPTURESCHEMAS
- CAPTURESTOREDPROGRAMS
- CAPTURETABLELEVELCKCONSTRAINT
- CAPTURETABLES
- CAPTURETRIGGERS
- CAPTUREUDT
- CAPTUREVIEWS
- DOANDWRITEERROR
- FIXCOLUMNS
- FIXINDEXES
- FIXSTAGEKEYREFERENCES
- FIXSYSDATABASES
- FIXSYSUSERS
- FIXTABLES
- LOGINFO
- REGISTERSQLSERVERPLUGIN
- SETSTATUS
- UPDATESCRATCHMODEL
- Private functions [3]
- Private types
- Private collection types [4]
- Private variables [8]
- Private constants [6]
- Private cursors
- Private exceptions [1]

Issue: 325: MySQL does not support check constraints. Emulating triggers created
Recommended action: Please revise generated code and modify it if is necessary.

No. of occurrences: 2 | Documentation reference: https://dev.mysql.com/doc/refman/5.6/en/create-table.html

Issue: 329: MySQL doesn't support the RAISE exception
Recommended action: Review the RAISE exception used, and if possible convert it to an exception using the SIGNAL or RESIGNAL statement.

No. of occurrences: 53 | Documentation reference: https://dev.mysql.com/doc/refman/5.6/en/condition-handling.html

Issue: 331: MySQL doesn't support a global user exception
Recommended action: Use another method for this functionality.

No. of occurrences: 2 | Documentation reference: https://dev.mysql.com/doc/refman/5.6/en/stored-programs-views.html

Issue: 332: MySQL doesn't support the procedure dbms_output.put_line
Recommended action: Try using INSERT in the log table. To do this, you must add code into AWS_ORACLE_EXT.PUT_LINE.

No. of occurrences: 128 | Documentation reference: https://dev.mysql.com/doc/refman/5.6/en/create-table.html

Procedure: **FIXINDEXES** (No. of issue occurrences: 1)

Try using INSERT in the log table. To do this, you must add code into AWS_ORACLE_EXT.PUT_LINE.

Oracle procedure: FIXINDEXES

Properties | SQL

```
PROCEDURE FixIndexes
IS
  errMsg VARCHAR2(4000)  := NULL;
BEGIN
NULL;
EXCEPTION

WHEN OTHERS THEN
  DBMS_OUTPUT.put_line('Exception in FixIndexes
  errMsg := LOCALSUBSTRB(LOCALSUBSTRB(DBMS_UTIL
  LogInfo(NULL, sev_err, 'FixIndexes Failed: out
END FixIndexes;
```

MySQL procedure: SS2K5ALLPLATFORM$FIXINDEXES

Properties | SQL

```
                /*
[340 - Severity CRITICAL - MySQL doesn't supp
errMsg := LOCALSUBSTRB(LOCALSUBSTRB(DBMS_UTIL
*/;
                CALL SS2K5ALLPLATFORM$LOGINFO (NUL
            END;

        IF (@SS2K5ALLPLATFORM$InitCheck IS NULL) T
            CALL SS2K5ALLPLATFORM$Init ();
        END IF;

        BEGIN
        END;
```

Amazon RDS for MySQL

- SS2K5ALLPLATFORM$FI
- SS2K5ALLPLATFORM$FI
- SS2K5ALLPLATFORM$FI
- SS2K5ALLPLATFORM$FI
- SS2K5ALLPLATFORM$FI
- SS2K5ALLPLATFORM$LC
- SS2K5ALLPLATFORM$RI
- SS2K5ALLPLATFORM$SE
- SS2K5ALLPLATFORM$U
- SYB12ALLPLATFORM$In
- SYB12ALLPLATFORM$CA
- SYB12ALLPLATFORM$CA
- SYB12ALLPLATFORM$CA
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- SYB12ALLPLATFORM$FI
- SYB12ALLPLATFORM$FI
- SYB12ALLPLATFORM$FI

Used memo Windows PowerShell (3) : 1.95 GB, Total memory: 3.68 GB, Maximum memory: 7.11 GB

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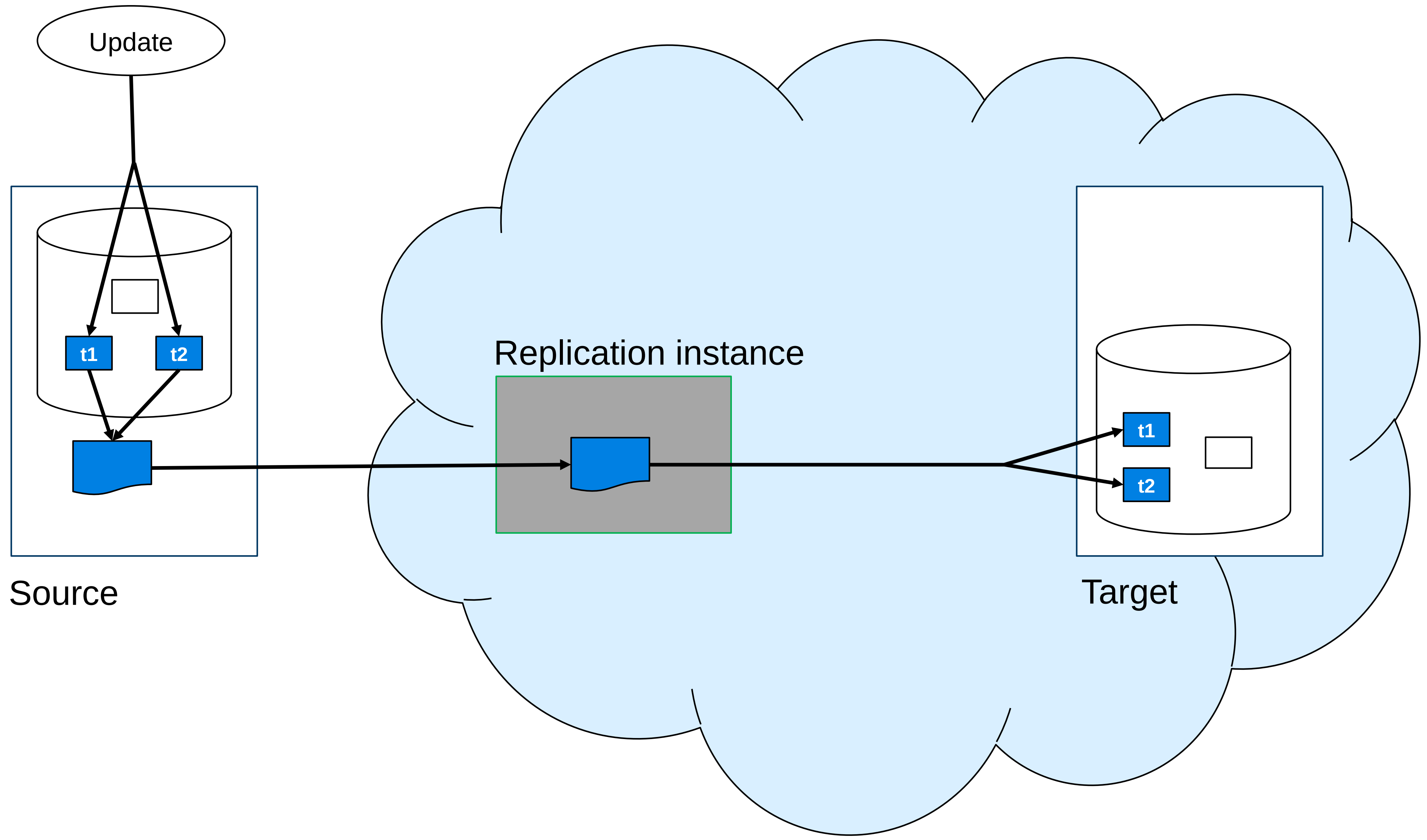
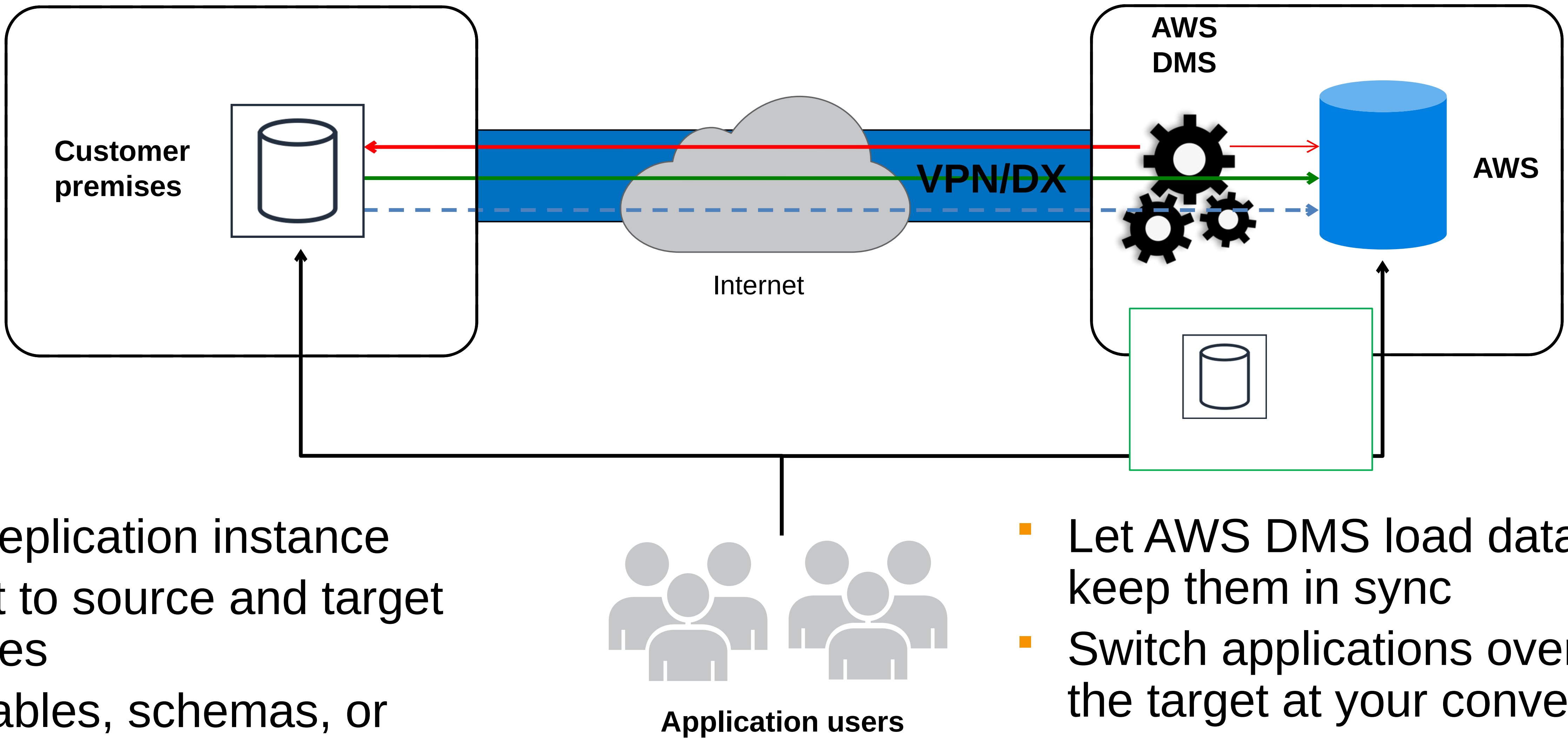
Change data capture (CDC) and apply

Transactions



Change apply after bulk load

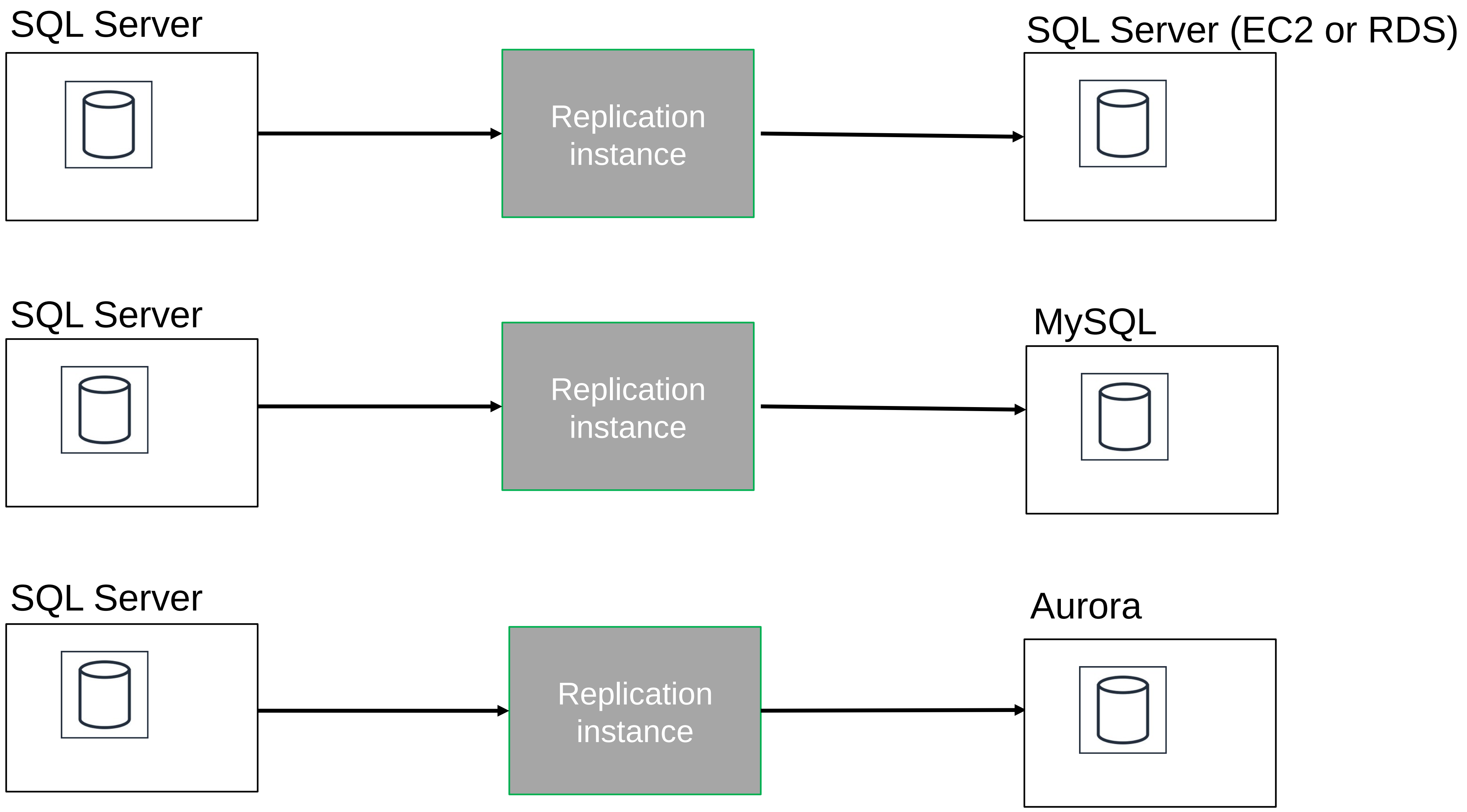
Keep your apps running during the migration



- Start a replication instance
- Connect to source and target databases
- Select tables, schemas, or databases

- Let AWS DMS load data, and keep them in sync
- Switch applications over to the target at your convenience

Homogenous or heterogeneous



Selecting the right migration method

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Migration Method: Which should I use?

	Backup/ Restore	Transactional Replication	AAGs	Log Shipping	DB Mirroring	DMS/ SCT	AWS Snowball
SQL Server Standard	✓	✓		✓		✓	✓
SQL Server Enterprise	✓	✓	✓	✓	✓	✓	✓
On-going Replication		✓	✓	✓	✓	✓	
Migrate Specific DB Objects (e.g. sprocs, tables, indexes, etc.)	✓	✓				✓	
SQL Server 2008/2008R2	✓(ALL)			✓(SE,EE)	✓(EE)	✓(ALL)	✓(ALL)
SQL Server 2012+	✓(ALL)	✓	✓(EE)	✓(SE,EE)	✓(EE)	✓(ALL)	✓(ALL)
SQL Server on EC2	✓	✓	✓	✓	✓	✓	✓
RDS for SQL Server	✓	✓				✓	✓

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SQL Server 2008/2008R2 EOL

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The SQL 2008 End of Life countdown is on

July 9, 2019

SQL Server 2008 and 2008 R2

Jan 14, 2020

Windows Server 2008 and 2008 R2

50-60% of On-Premises Microsoft workloads are running on **2008 versions**

No new security updates – customers are exposed to cyber attacks

Customers now have **strong need to put a strategic plan** in place

Compliance sensitive customers such as Health care and Fin Serv. especially so

Learn more at **https://wisdom.corp.amazon.com/Pages/Playbook_SQL-Windows-2008-End-of-Service.aspx**

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Migrating SQL Server 2008/2008R2

- Support ends July 9, 2019 – must upgrade DB Engine
- Upgrade to SQL Server 2012, 2014, 2016, or 2017 (with SQL Server 2008 SP4/2008R2 SP3)
- Understand Database Compatibility Level Dependencies
- Set your database combability level to 100
- Upgrade compatibility level, only if supported and necessary
- New home – Amazon RDS for SQL Server and SQL Server on Amazon EC2
- Migration options – Mirroring or Log Shipping? AWS DMS or Backup and Restore?

Considerations

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Summary of Migration Considerations

- SQL Server version and edition features
- Authentication requirements
- Amount of data being migrated
- Connectivity to AWS
- Migration method
- New home for the databases
- AWS Professional Services or Partner help
- Well Architected Framework
- Optimize after migration

Thank you!

Brian Beach
Principal Solutions Architect

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