AWS re:Invent

NOV. 29 – DEC. 3, 2021 | LAS VEGAS, NV

Dedalus

DAT306

Migrate your SQL Server database to Amazon RDS

Eugene Stepanov
Principal Database Solutions Architect
AWS

Greg Darby
Global Delivery VP
Dedalus Group

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Agenda

- Amazon Relational Database Service (Amazon RDS)
- Managed experience
- Amazon RDS building blocks
- Migrating to AWS
- Monitoring on RDS

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Amazon RDS

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Amazon RDS

CHOICE OF OPEN-SOURCE AND COMMERCIAL DATABASES

Cloud-native engine



Automatic failover
Backup & recovery
X-region replication

Open-source engines



Isolation & security
Industry compliance
Automated patching

Commercial engines



Advanced monitoring
Routine maintenance
Pushbutton scaling

Postgres, PostgreSQL and the Slonik Logo are trademarks or registered trademarks of the PostgreSQL Community Association of Canada, and used with their permission.

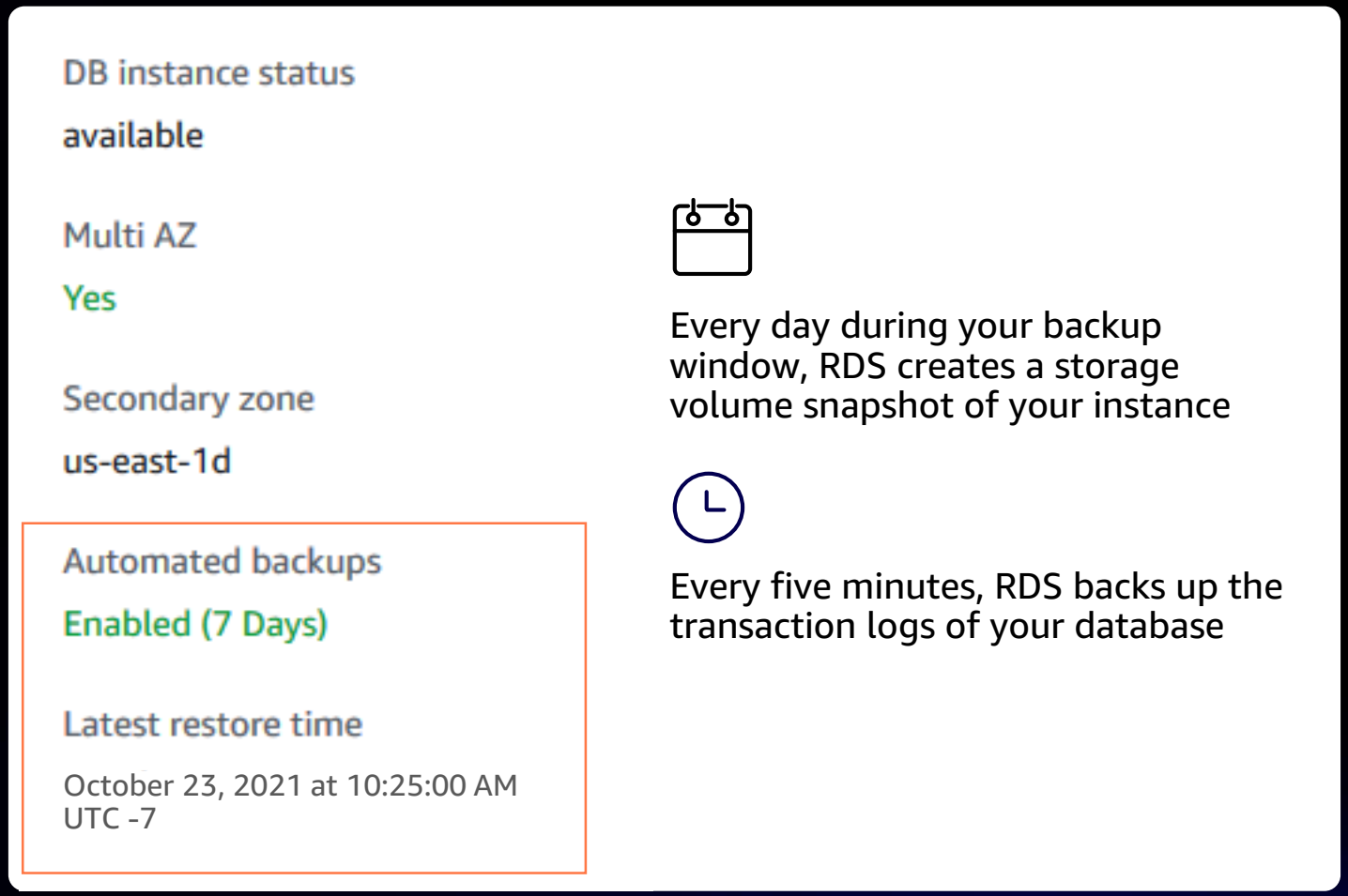
aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Automated backups

POINT-IN-TIME RECOVERY FOR YOUR DB INSTANCE

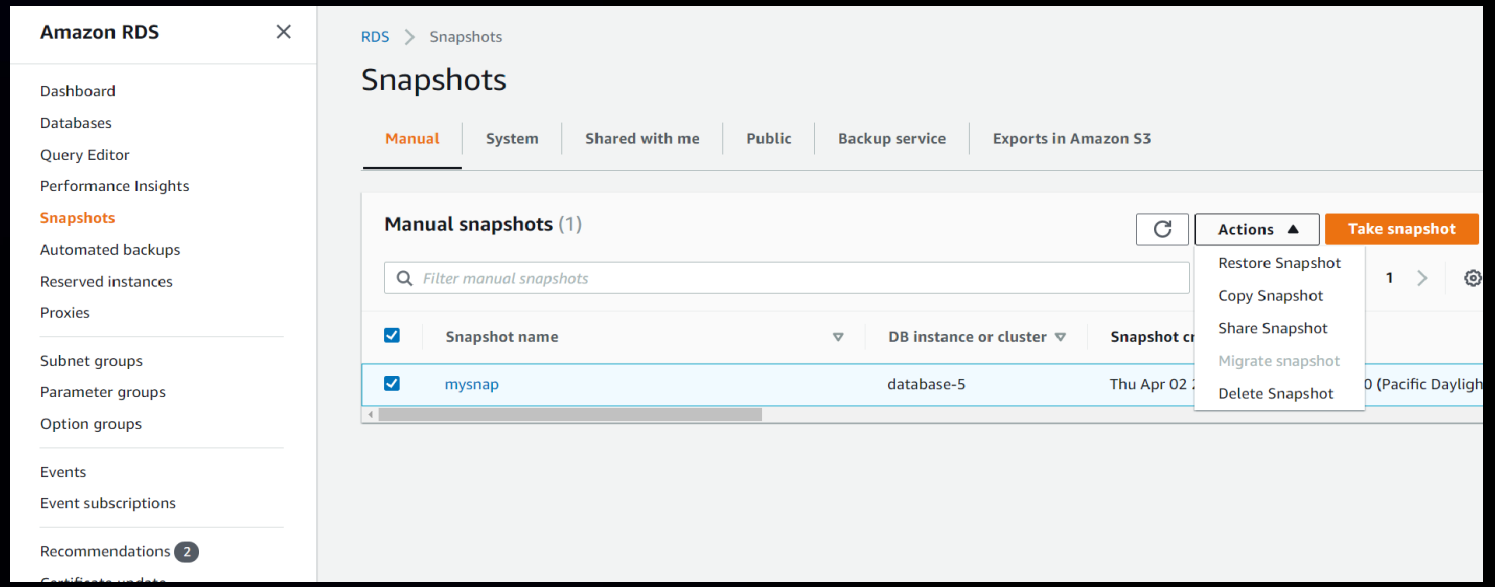
- Scheduled daily volume snapshots of entire instance
- T-log backups on 5 minute intervals
- 35-day maximum retention
- Minimal impact on database performance
- VSS-enabled
- Application-consistent
- TempDB on instance store, not part of the Amazon EBS snapshot (R5d only) **(new!)**



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Manual snapshot

- Triggered by user
- Instance level
- Keep as long as needed
- VSS-enabled
- Application-consistent



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Native backup

Usage

```
exec msdb.dbo.rds_backup_database
        @source_db_name='database_name',
        @s3_arn_to_backup_to='arn:aws:s3:::bucket_name/file_name.extension',
        [@kms_master_key_arn='arn:aws:kms:region:account-id:key/key-id'],
        [@overwrite_s3_backup_file=0|1],
        [@type='DIFFERENTIAL|FULL'],
        [@number_of_files=n];
```

The following parameters are required:

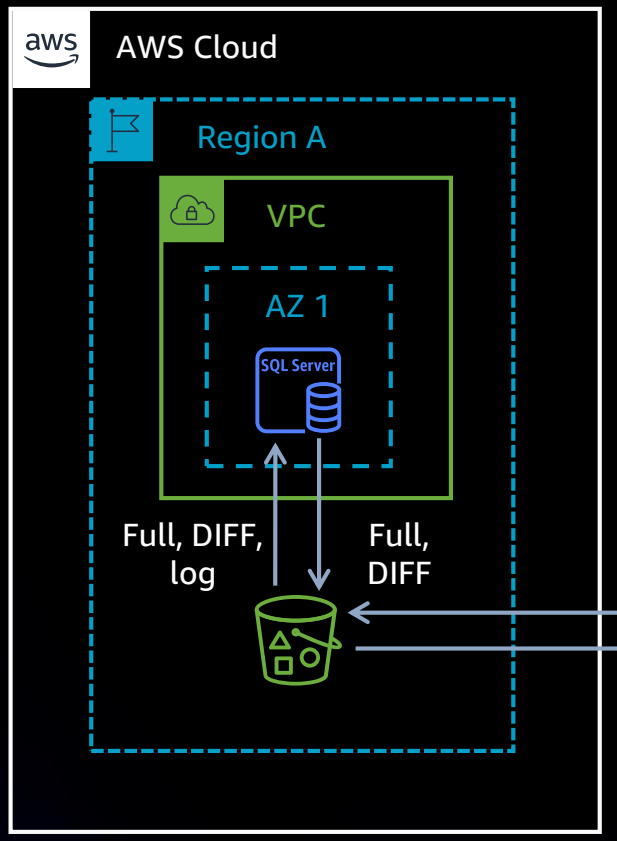
- `@source_db_name` – The name of the database to back up.
- `@s3_arn_to_backup_to` – The ARN indicating the Amazon S3 bucket to use for the backup, plus the name of the backup file. The file can have any extension, but `.bak` is usually used.

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:

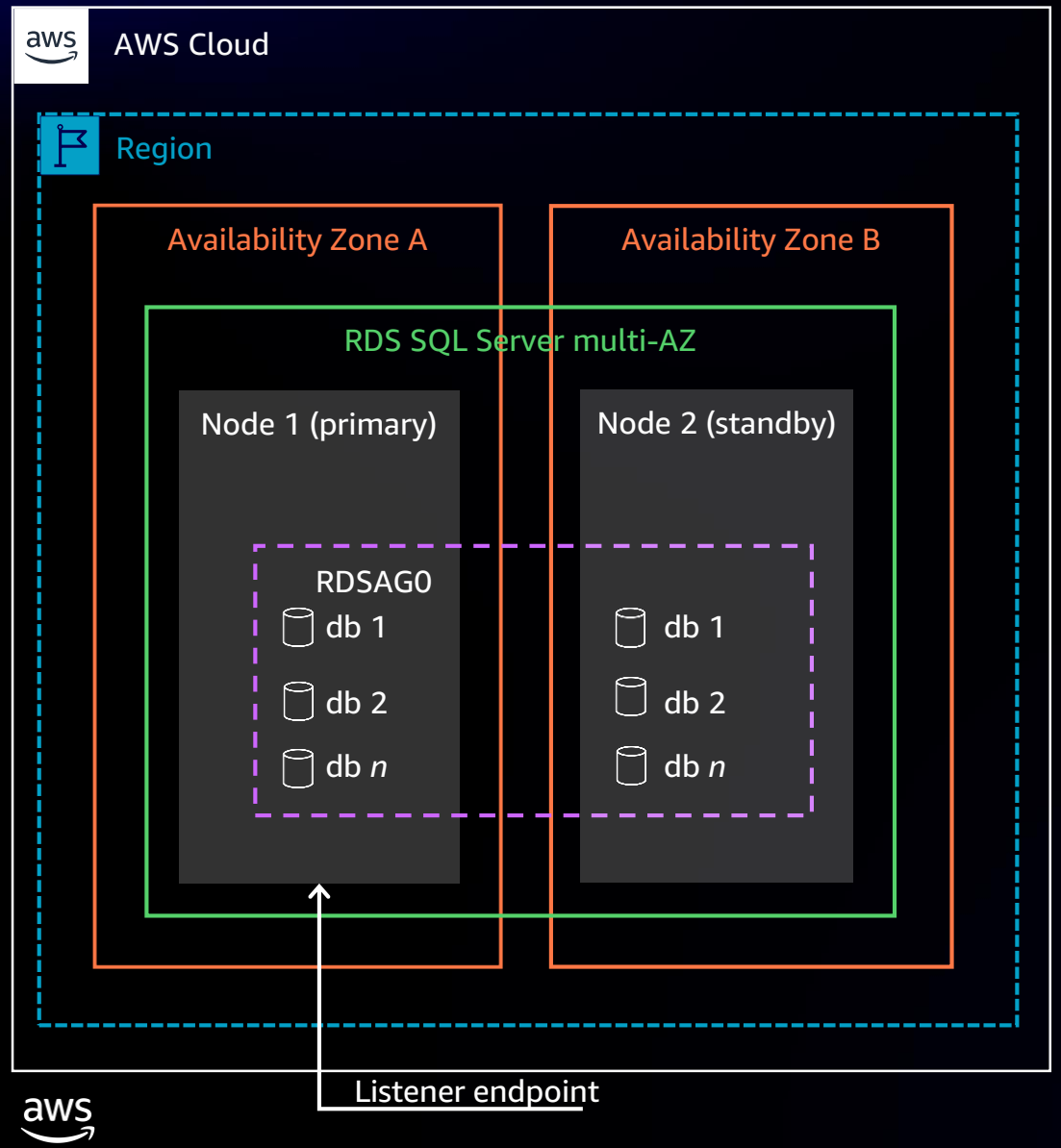
- `@restore_db_name` – The name of the database to restore. Database names are unique. You can't restore a database with
- `@s3_arn_to_restore_from` – The ARN indicating the Amazon S3 prefix and names of the backup files used to restore the
  - For a single-file backup, provide the entire file name.
  - For a multifile backup, provide the prefix that the files have in common, then suffix that with an asterisk (*).
  - If `@s3_arn_to_restore_from` is empty, the following error message is returned: `S3 ARN prefix cannot be empty`.



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

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

High availability (multi-AZ)

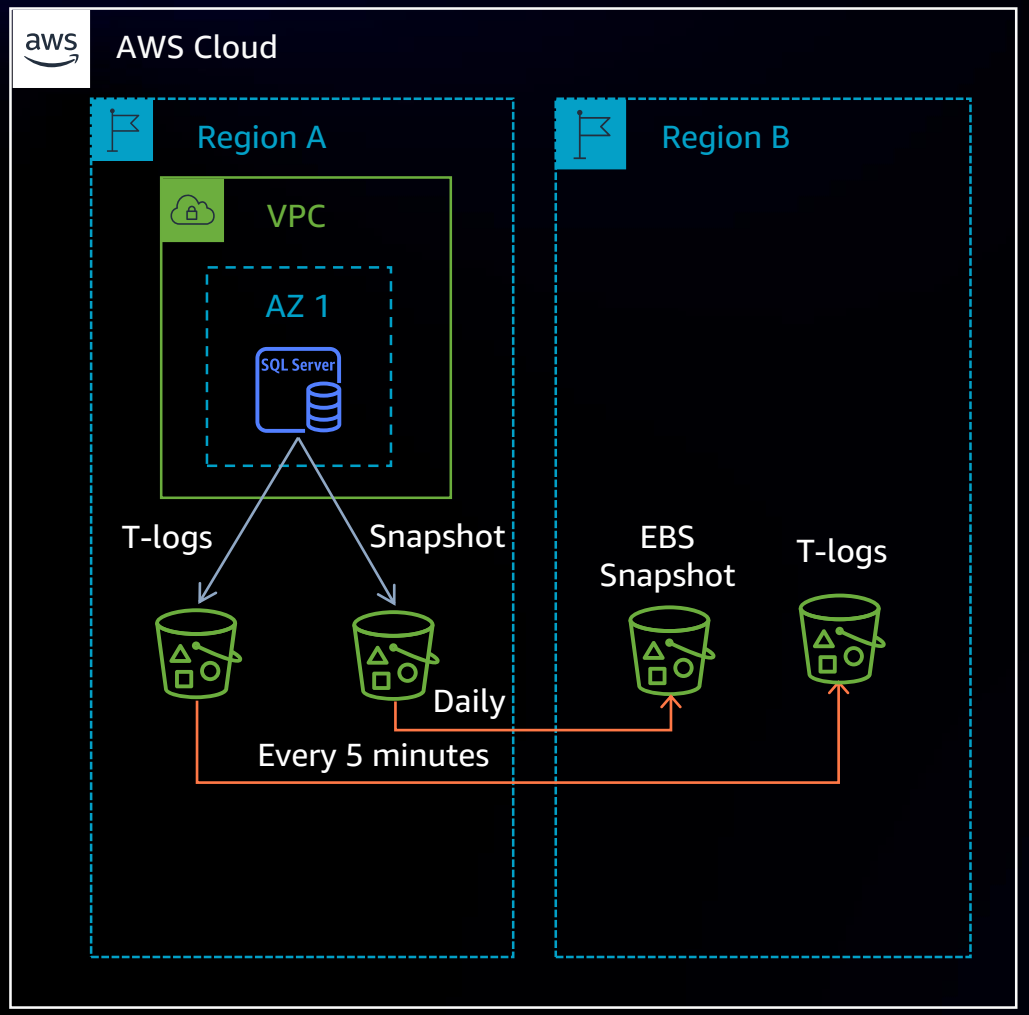


- Both Enterprise and Standard
- Built on Always On AG (2016 and up)
- Built on Mirroring (2012 and 2014)
- Backup retention >0
- Full recovery mode
- Synchronous replication
- Automatic and manual failover
- 5–6 seconds failover time*
- No read traffic
- Ability to add up to 5 read replicas (Enterprise only)

*Crash recovery times not included; MultiSubnetFailover = True

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Cross-Region Automated Backups (new!)

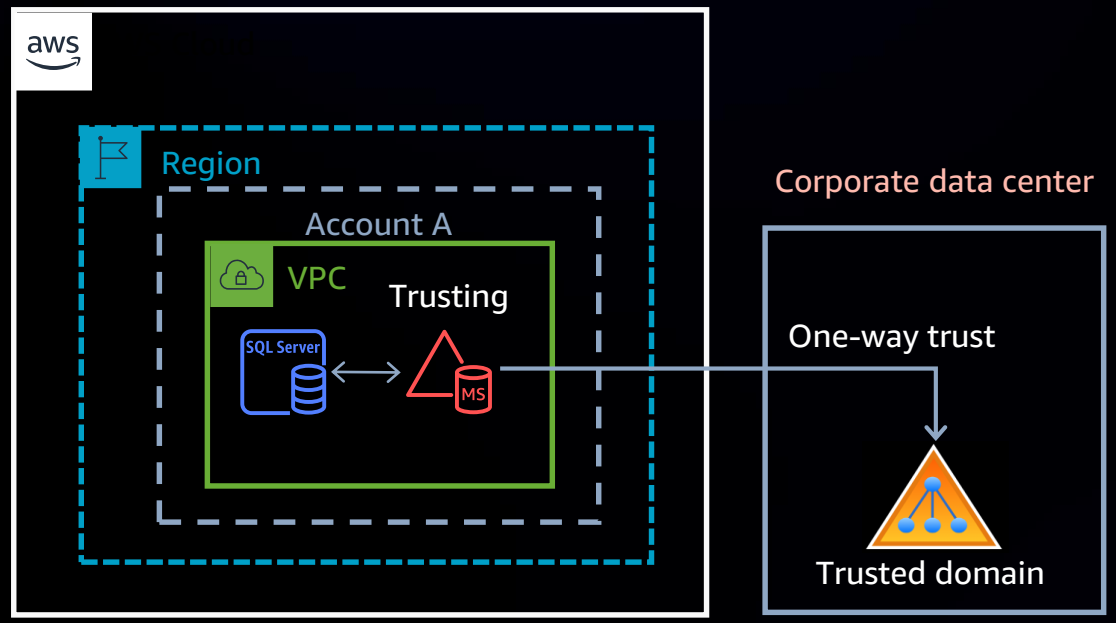


1.2 TB database test	Latest restorable time
Mininum	6 min behind source
Maximum	17 min behind source

Feature	RPO	RTO
RDS multi-AZ	0	1-2min
Read replica (promotion)	Minutes	<5 min
PiTR (in-Region)	5 min	min–hours
PiTR (x-Region)	6–20 min	min–hours
Snapshot restore	Hours	min–hours

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Integrated Windows Authentication



- AWS-managed AD is required
- Can cross VPC and account boundary
- Cannot join to self-managed AD
- Integrated Windows authentication (Kerberos & NTLM)
- Endpoint vs. fully qualified domain name (FQDN)
- Service principal name (SPN) will be created for FQDN only
- Kerberos requires use of FQDN otherwise defaults to NTLM

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Features supported

- Integration Services
- Reporting Services
- Analysis Services (Tabular only)
- SQL Server Agent jobs
- DB Mail
- Microsoft Distributed Transaction Coordinator (MSDTC)
- Integrated Windows Authentication
- Read Replicas
- Extended Events

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Building blocks

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Memory optimized instances

R5

- R5.Xlarge (4 vCPU/32 GiB)
- R5.24Xlarge (96 vCPU/768 GiB)
- High-performance networking
- Good for query-intensive workloads or high-connection counts

R5d

- R5.Xlarge (4 vCPU/32 GiB)
- R5.24Xlarge (96 vCPU/768 GiB)
- High-performance networking
- Good for query-intensive workloads or high-connection counts
- Up to 3,600 GiB of Instance store
- TempDB on instance store

R5b

- R5.Xlarge (4 vCPU/32 GiB)
- R5.24Xlarge (96 vCPU/768 GiB)
- High-performance networking
- Good for query-intensive workloads or high-connection counts
- io2 Block Express enabled

z1d

- CPU-optimized, 4 GHz
- z1d.Xlarge (4 vCPU/32 GiB)
- z1d.12Xlarge (48 vCPU/384 GiB)

X1/X1e

- Large-scale, enterprise-class and in-memory apps
- One of the lowest price per GiB of RAM
- x1e.Xlarge (4 vCPU/122 GiB)
- x1e.8Xlarge (32 vCPU/976 GiB)

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

General purpose and burstable instances

M5 (general purpose)

- M5.Xlarge (4 vCPU/16 GiB)
- M5.24Xlarge (96 vCPU/384 GiB)
- High-performance networking
- Good for running CPU-intensive workloads

M5d (general purpose)

- M5.Xlarge (4 vCPU/16 GiB)
- M5.24Xlarge (96 vCPU/384 GiB)
- High-performance networking
- Good for running CPU-intensive workloads
- Up to 3,600 GiB of instance storage
- TempDB on instance store

T2/T3 family (burstable)

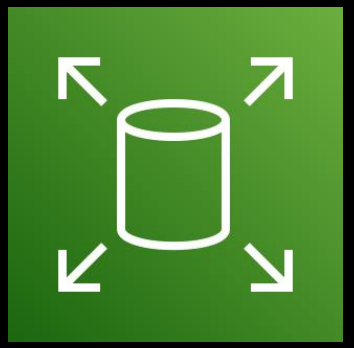
- Moderate networking performance
- Good for smaller or variable workloads
- T3.micro is eligible for free tier

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Amazon Elastic Block Store (Amazon EBS)

What is Amazon 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

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

EBS volume types

Dimension	gp2	io1
Durability	99.8%–99.9%	99.9%
Availability	99.999%	99.999%
Volume size	1GiB-16TiB	4GiB-16TiB
Max IOPS/volume (16KiB)	16,000	64,000
Latency	Single digit ms	Single digit ms
Max throughput/volume	250 MiB/s	1,000 MiB/s
IOPS/GiB ratio	3:1	up to 50:1
Performance delivered	99%	99.9%
Performance scalability	Scales with volume size	Scales independently up to 50:1 ratio
Use case	Wide range, low latency	I/O-intensive workloads

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Migrating to RDS

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Native backups

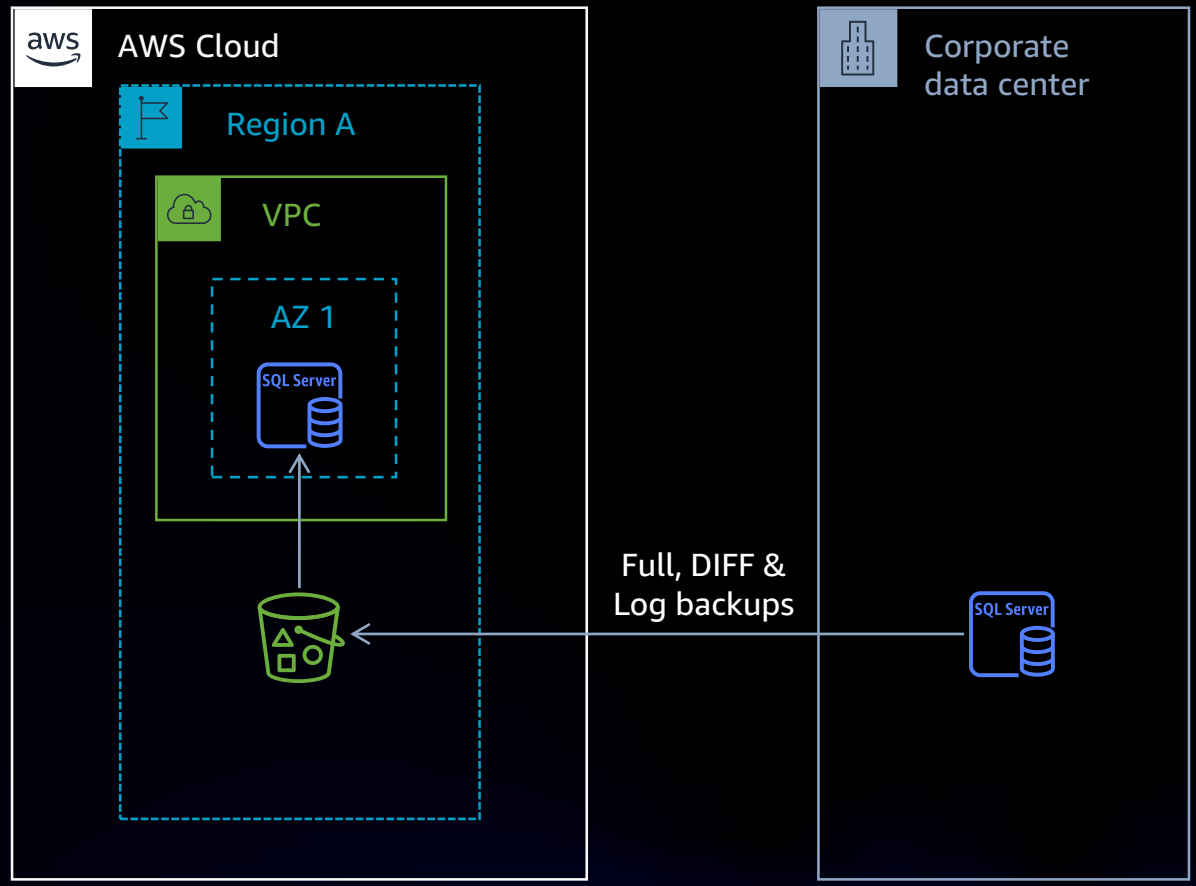
- Native and simple
- Full, DIFF & T-log restores
- Multi-file backup/restore
- Requires downtime

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'];
```

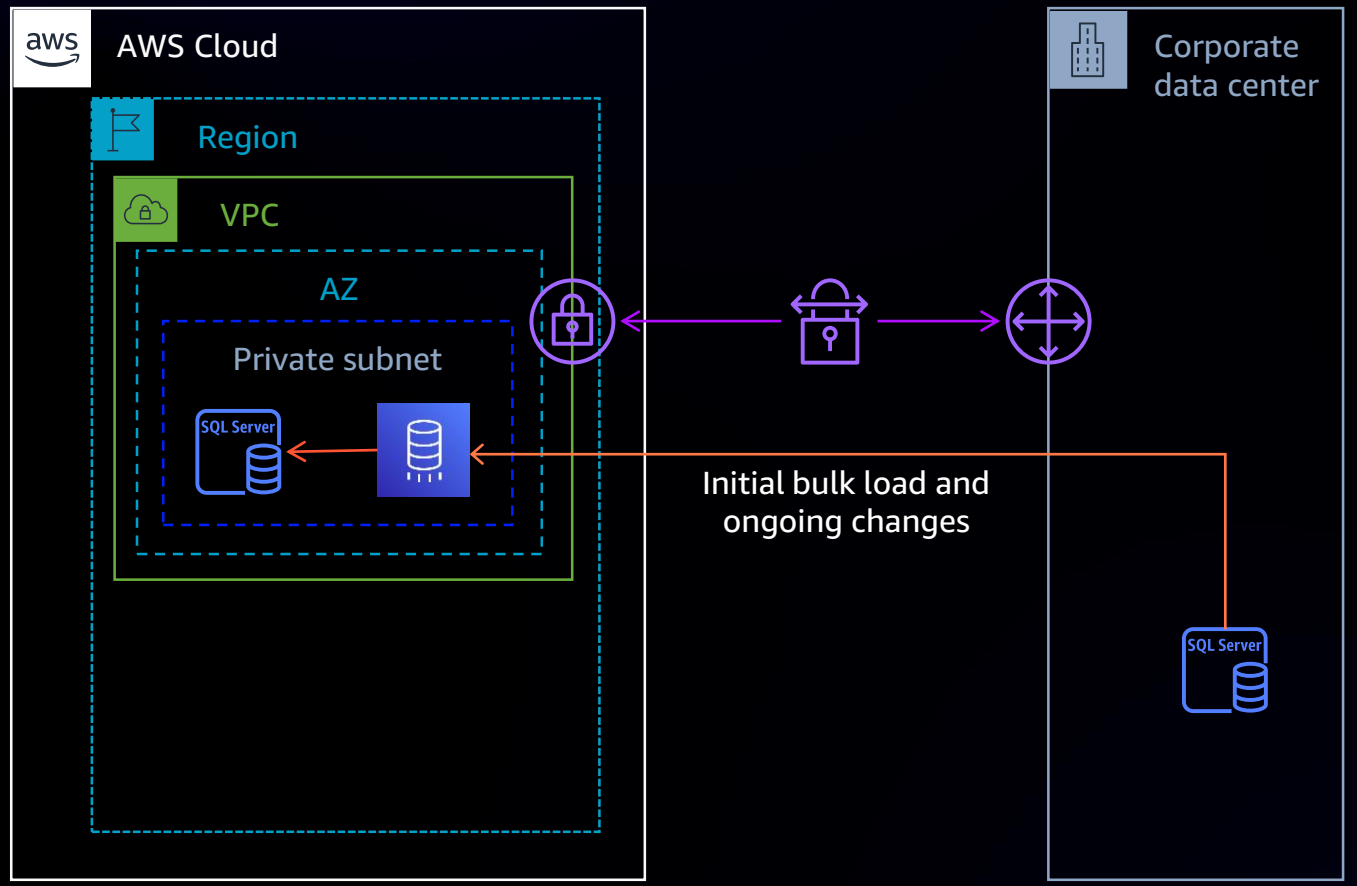
The following parameters are required:

- `@restore_db_name` – The name of the database to restore. Database names are unique. You can't restore a database with
- `@s3_arn_to_restore_from` – The ARN indicating the Amazon S3 prefix and names of the backup files used to restore the
  - For a single-file backup, provide the entire file name.
  - For a multifile backup, provide the prefix that the files have in common, then suffix that with an asterisk (*).
  - If `@s3_arn_to_restore_from` is empty, the following error message is returned: `S3 ARN prefix cannot be empty`.



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

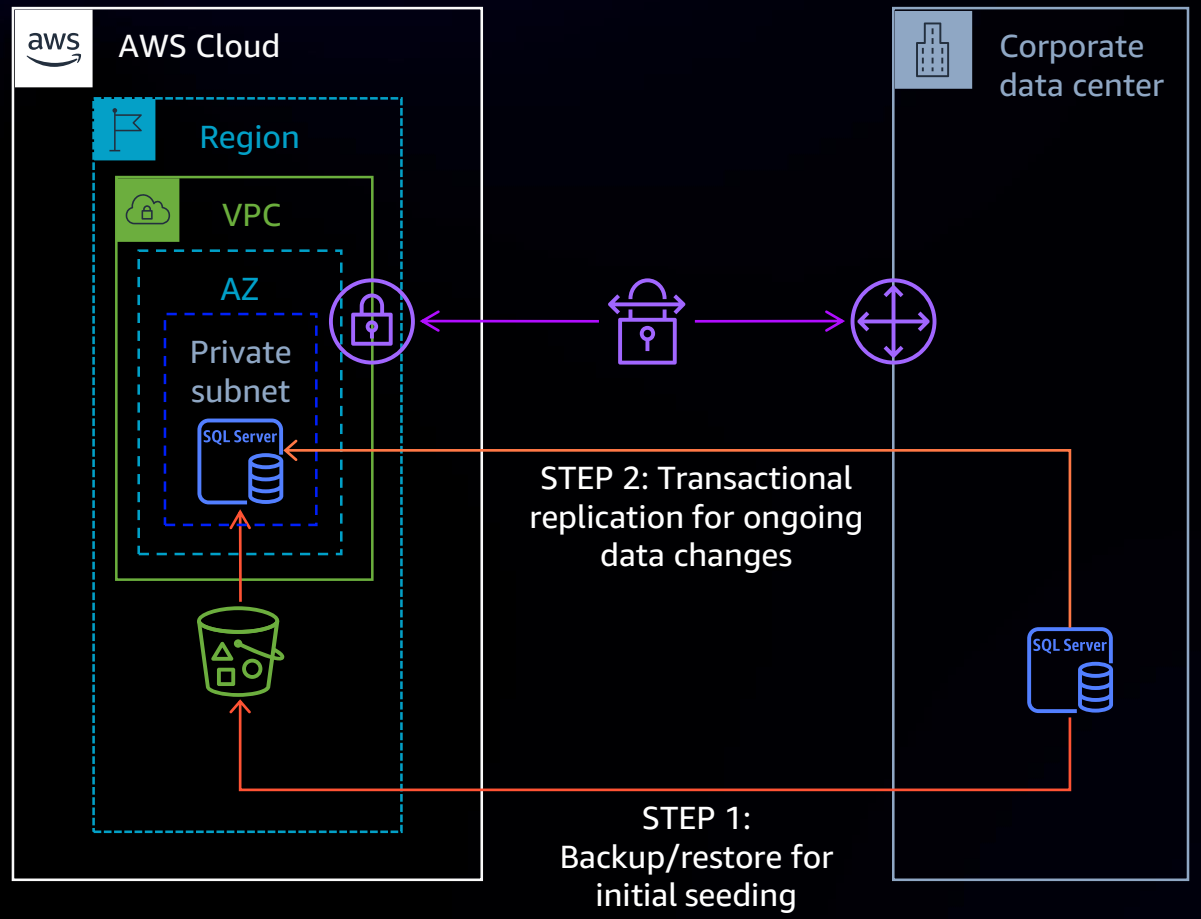
AWS Database Migration Service (AWS DMS)



- Near-zero downtime
- Logical decoding of physical changes on AWS DMS instance
- Heterogeneous migrations
- Wide variety of sources
- Added Azure SQL Managed Instance (since 3.4.6) **(new source!)**
- Limited support for DDL

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Transactional replication



- Near-zero downtime
- Native feature
- Homogenous migration
- Replicates data and objects
- Single direction (push)

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Post-migrations steps

- TempDB on local instance store (M5d and R5d)
- Parameter groups (MAXDOP, TF1211, TF1204, TF1222, etc.)
- DBCC CHECKDB
- Update statistics/rebuild indexes
- Set the database compatibility level
- Database recovery model set to full recovery
- Configure backups
- Enable Amazon CloudWatch, Performance Insights, and Enhanced Monitoring

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

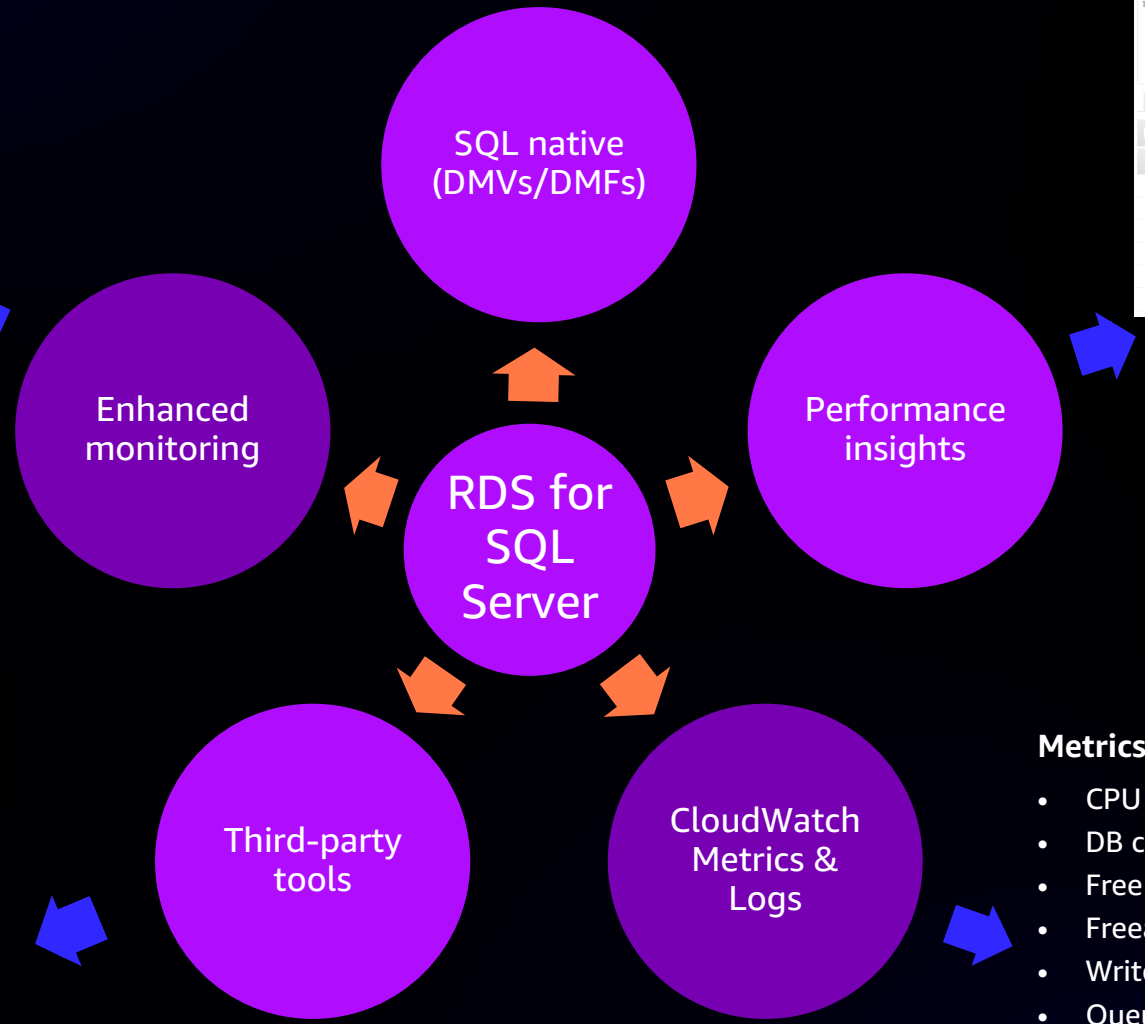
Monitoring on RDS

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Monitoring

Metrics are up to 1-second granularity

- Available memory
- SQL Server total memory
- CPU user
- Available disk space
- Available disk space
- Total disk space
- User disk space
- Used disk space %





- SentryOne
- Redgate
- SolarWinds
- Quest
- Datadog
- IDERA

Metrics are at 1-minute granularity

- 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
- EBS I/O balance
- EBS byte balance
- Total IOPS

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Additional resources

Post-migration steps and best practices for Amazon RDS for SQL Server (go.aws/3kdVSfE)

In this post, we talk about some of the post-migration steps and best practices

How to migrate to Amazon RDS for SQL Server using transactional replication: Part 1 (go.aws/3CQjgqR)

In this blog we show, how to configure transactional replication for single-AZ target

Migrating to Amazon RDS for SQL Server using transactional replication: Part 2 (go.aws/3wn2JIH)

In this blog we show, how to configure transactional replication for multi-AZ target

Migrating to Amazon RDS for SQL Server using transactional replication with native backup and restore: Part 3 (go.aws/2YkSFmS)

In this blog we show, how to initialize a subscription using native backup and restore

Improve native backup and restore performance in Amazon RDS for SQL Server (go.aws/3kbZWNA)

In this post, we demonstrate how to improve native backup and restore performance by tuning the configurations and testing different strategies

Managed disaster recovery with Amazon RDS for SQL Server using cross-Region automated backups (go.aws/3GVhIOK)

In this post, we discuss this new feature in detail and demonstrate how you can enable cross-Region automated backups and restore of your database to a point in time

Authenticating Amazon RDS for SQL Server using Kerberos (bit.ly/2YjPPhV)

In this video, we explain how to use Kerberos to authenticate Amazon RDS for SQL Server

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Migrate your SQL Server database to Amazon RDS

Greg Darby
Global Delivery VP
Dedalus Group



© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Current migration scope

13 Lorenzo EPRs live on cloud;
23 hospitals and >50 other sites

13 Go-lives planned in October

1 C4H (ERP) go-live planned for January

1 Medchart (Medications) go-live planned for May

4 ORMIS (Operating) Theatres live on cloud

Program is 4 products, 55 projects
Total of 400 TB of data to migrate
3 Windows-based products, 1 HP-UX-based
~1,400 AWS instances to support workload

aws

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Context – Previous landscape

- 24/7/365 premium application
- Zero downtime
- Large multi-tenant approach – 25M patients, 100K users, 7K concurrent user peak per instance
- Fully resilient clustered solution
- Failover within data centre
- Zero data loss solution to secondary DR site
- SaaS model

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Target model – Single customer instances

During migration

- Smaller, dedicated customer instances
- Independence and tuning for organizations of infrastructure and product
- Flexibility
- Data sharing accomplished through Dedalus DC4H solutions
- Utilize burstable instance family for low-use machines
- Consolidate server roles to single EC2 instance

Future

- Move away from enterprise commercial engines
- Use read replicas

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Configuration decisions

COMPARISON: RDS VS. EC2 SQL

	Multi-AZ SQL RDS	Failover EC2 SQL Always On Cluster
Pro	• Ease of deployment • Managed service • Automated patching • Integrated database backup (automated snapshots)	• Full control of SQL • DIFF/transactional backups • DB access control • Database snapshots, allows for more flexible use of SQL nodes (e.g., reporting replica)
Con	• Restrictive on what you can do (e.g., no system admin privilege) • SSRS limitation (does not support scaled out reporting) • Limited to two AZs	• Complex deployment • Need to manage clustering/failover • SQL manually patched • Manual database backups • Client monitoring
Hardware	• Maximum of 16 TB storage	• Storage only limited based on EC2

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Data migration

- Combination of AWS DMS solution & native backup and log shipping
- Solution OLTP is a large complex SQL database
- AWS DMS tool used to migrate Lorenzo OLTP database
- AWS DMS tool migration schema allows conditional selection of data to migrate
- Provided a mechanism to continuously replicate data to AWS from on premises
- User acceptance testing (UAT) against the migrated data by provisioning RDS database from RDS manual snapshot
- *Some legacy applications required database to be upgraded because RDS only supports SQL Server 2012 or later*

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Benefits

- Tailored solution operating “as a service”
- Increased business continuity
- Training flexibility
- Security
- A platform for care model transformation
- Reporting database
- Cloud opportunity for robotic process automation
- Methodology

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Performance: Hosted vs. AWS

Dedalus undertook an exercise to compare the performance of our solution in the data center vs. in the AWS Cloud

As far as possible, the comparison was made on a like-for-like basis

- Results show an overwhelming improvement in performance
- On average, there was a **40%** reduction in time to serve
- A **66%** improvement in time to serve was observed across **the slowest 10 pages** used
- A **49%** improvement in time to serve was observed across **the 10 most frequently viewed** pages (rising to **57%** with performance change made to one function)
- Of the 466 different pages compared, **78%** saw a reduction in time to serve

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.

Thank you!

Eugene Stepanov
eugenest@amazon.com

Greg Darby
gdarby@dedalus.group

© 2021, Amazon Web Services, Inc. or its affiliates. All rights reserved.