

Azure Database Migration Guide

Migrate SQL Server to SQL Server on Azure Virtual Machines

Pre-migration overview

As you prepare for migrating your SQL Server database to SQL Server on Azure VMs, be sure to consider the versions of SQL Server that are supported and to address any prerequisites. This will help to ensure an efficient and successful migration.

Important: For scenarios in which you need to meet certain regulatory, policy, or compliance requirements that prevent you from using SQL Server on Azure VMs, you can use [Azure Stack](#). You can run Azure Stack at the edge for remote locations, run it completely disconnected from the internet, or create a hybrid solution. The guidance in this scenario applies to migrations from SQL Server on-premises to SQL Server on Azure VMs as well as migrations to Azure Stack Virtual Machines.

Supported versions

SQL Server on Azure VMs supports migration of the following versions of SQL Server:

- SQL Server 2005
- SQL Server 2008 and SQL Server 2008 R2
- SQL Server 2012 and SQL Server 2012 SP1 CU2
- SQL Server 2014
- SQL Server 2016
- SQL Server 2017

Additional resources

- See the white paper [Choosing your database migration path to Azure](#) for additional information and recommendations.
- For a matrix of the Microsoft and third-party services and tools that are available to assist you with various database and data migration scenarios as well as specialty tasks, see the article [Service and tools for data migration](#).

Prerequisites

Before beginning your migration project, it is important to address the associated prerequisites.

- Download and install the latest version of the [MAP Toolkit](#).
- Download and install the latest version of the [Database Experimentation Assistant](#).
- Download and install the [Data Migration Assistant](#) v3.3 or later.
- Create an instance of SQL Server on Azure VMs by following the detail in the article [How to provision a Windows SQL Server virtual machine in the Azure portal](#).

Discover

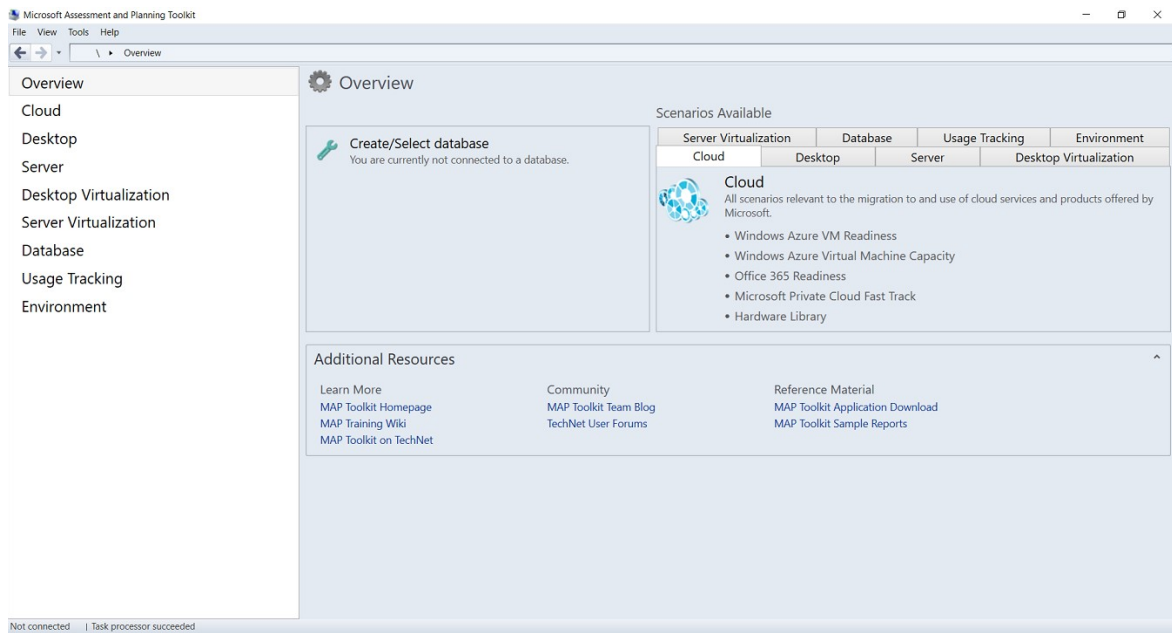
The goal of the Discover phase is to identify existing data sources and details about the features that are being used to get a better understanding of and plan for the migration. This process involves scanning the network to identify all your organization's SQL instances together with the version and features in use.

To use the MAP Toolkit to perform an inventory scan, perform the following steps.

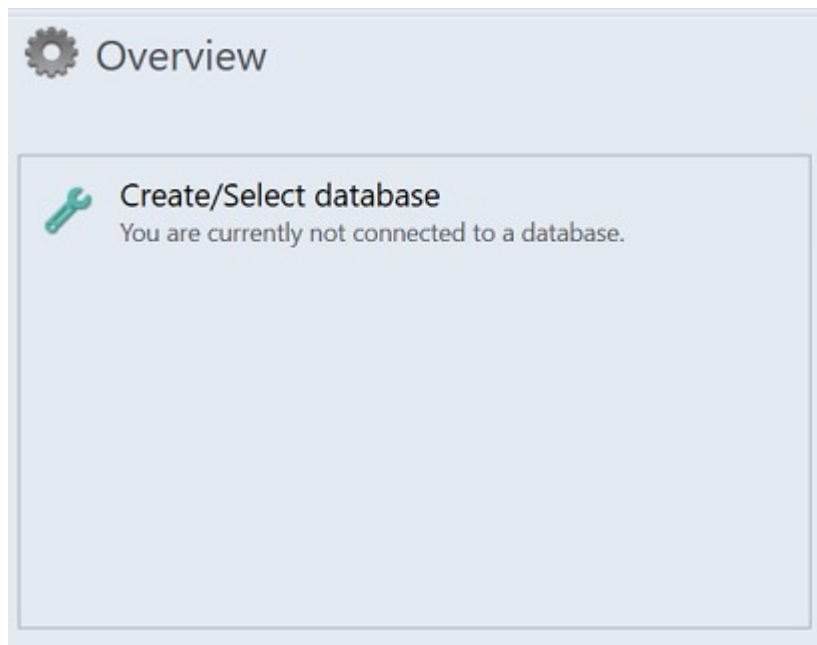
Steps

1. Run the MAP Toolkit.
 - a. Open the MAP Toolkit, and then on the left pane, select Database.

You will be on the following screen:



b. Select Create/Select database.



c. Ensure that Create an inventory database is selected, enter a name for the database, a brief description, and then select OK.

Microsoft Assessment and Planning Toolkit

Data source

Connection: LocalDB (MAPToolkit)

Create or select a database

☒ Create an inventory database

Name: MyPCInventory
Database names cannot contain special characters.

Description: This will be used to collect database related information on my PC.

☐ Use an existing database

Databases

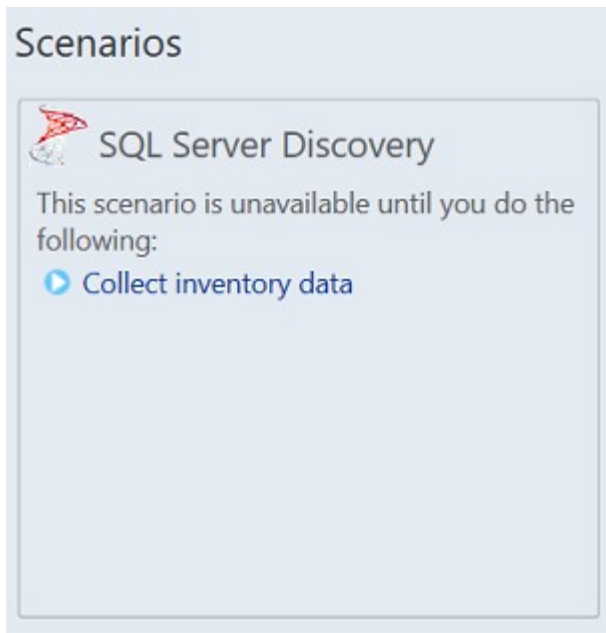
Summary Information

Currently supported database version: 5775

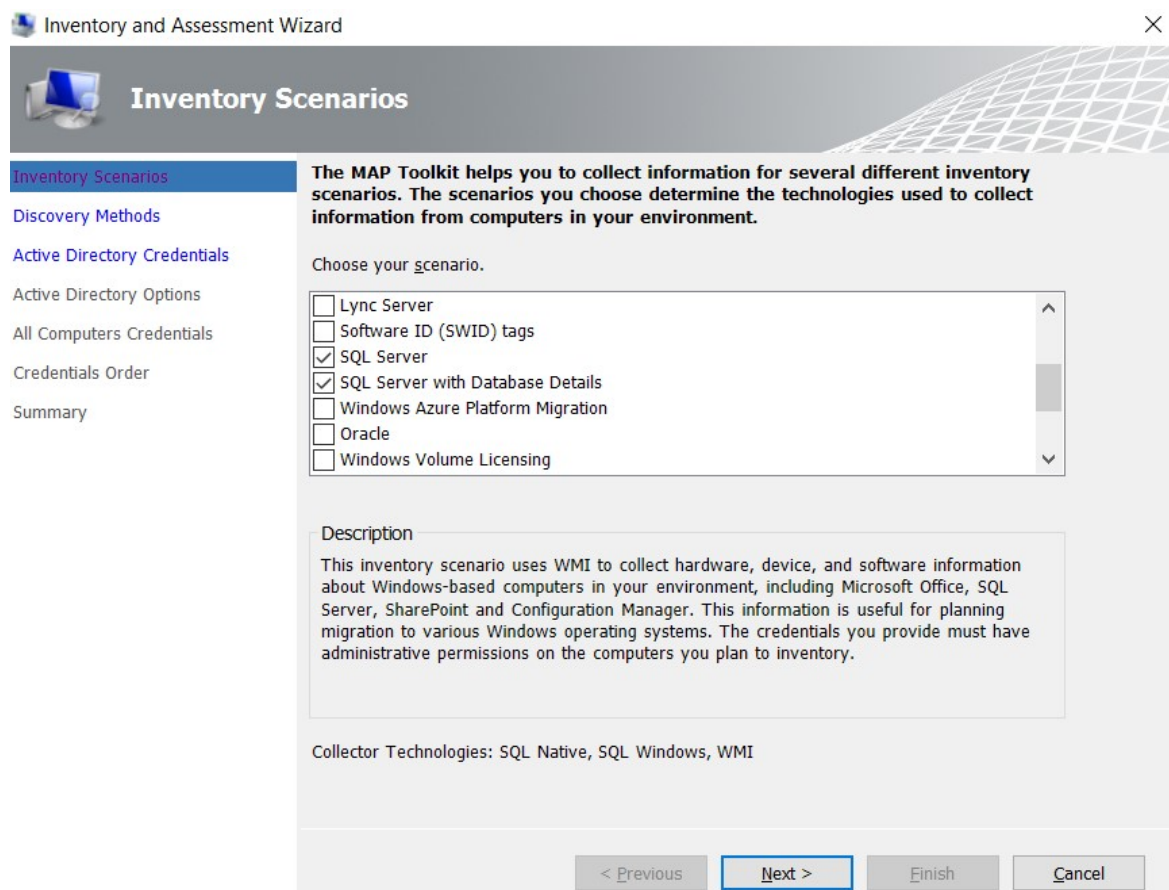
Manage... OK Cancel

The next step is to collect data from the database created.

d. Select Collect inventory data.



e. In the Inventory and Assessment Wizard, select SQL Server and SQL Server with Database Details, and then select Next.



f. Select the best method option to search the computers on which Microsoft Products are hosted, and then select Next.

Inventory and Assessment Wizard

Discovery Methods

Inventory Scenarios

Discovery Methods

All Computers Credentials

Credentials Order

Enter Computers Manually

Summary

Select which methods to use to discover computers.

- ☐ Use Active Directory Domain Services (AD DS)
- ☐ Use Windows networking protocols
- ☐ Use System Center Configuration Manager (SCCM)
- ☐ Scan an IP address range
- ☒ Manually enter computer names and credentials
- ☐ Import computer names from a file

< Previous **Next >** Finish Cancel

g. Enter credentials or create new credentials for the systems that you want to explore, and then select Next.

Inventory and Assessment Wizard

All Computers Credentials

Please supply account credentials for the platforms and technologies you've chosen. These credentials will be used to connect to the machines you've specified.

Specify accounts that can collect information from the computers.

Account	Applies to
SQL Native, SQL Windows, WMI	SQL Native, SQL Windows, WMI

Create... Edit... Remove

< Previous Next > Finish Cancel

h. Set the order of the credentials, and then select Next.

Inventory and Assessment Wizard

Credentials Order

You can prioritize the list of All Computers credentials for each collector technology. Credentials will be tried on each computer in the order they appear in the list.

Set the sequence of credentials to use for each technology.

Technology	Credentials	
WMI	malikumair@msn.com	Move Up
SQL Windows		Move Down
SQL Native		

< Previous Next > Finish Cancel

Now, you need to specify the credentials for each computer that you want to discover. You can use unique credentials for each computer/machine, or you can choose to use the All Computer Credentials list.

i. After setting up the credentials, select Save, and then select Next.

Specify Computers and Credentials

Enter one or more computers and then indicate which credential you want to use for the collector technologies.

Computers

Computer Name:

Computers

MUSAB-AIO

Add

Remove

☒ Use All Computers credential list

☐ Use specific credential

Credential

Account name*:

Examples: username, domain\username, username@domain

Password*:

Confirm password*:

☐ Validate credentials with the Domain Controller

Technology

Applies to:

☒ WMI

☒ SQL Windows

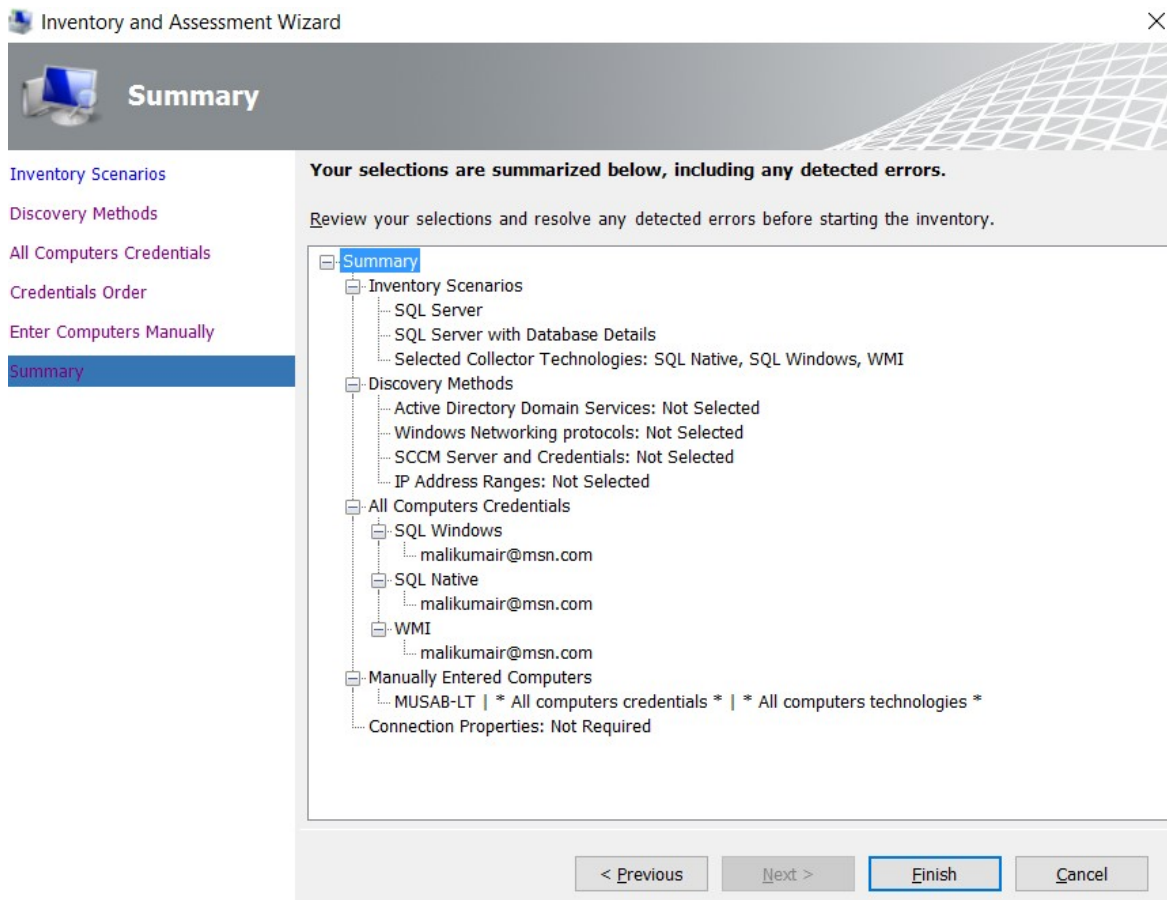
☒ SQL Native

Save

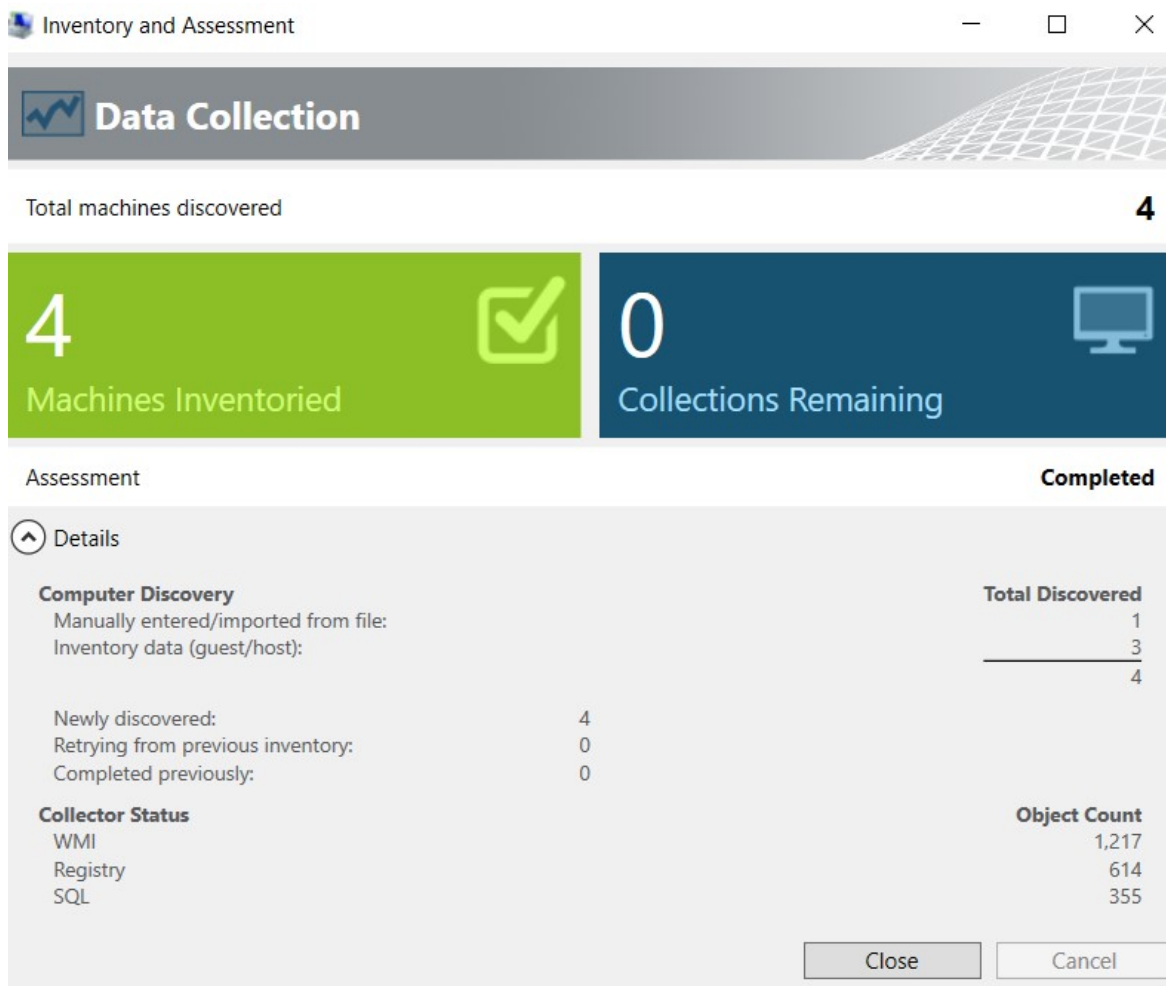
Save and New

Close

j. Verify your selection summary, and then select Finish.



k. Wait for a few minutes (depending on the number of databases) for the Data Collection summary report.

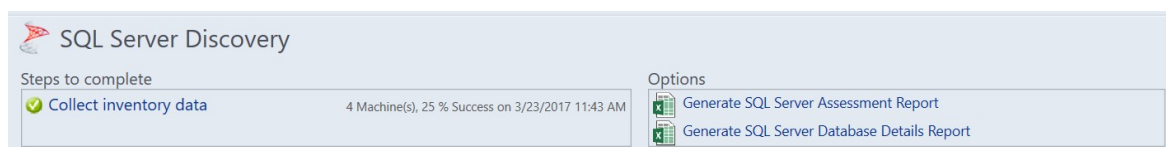


I. Select Close.

The Main window of the tool appears, showing a summary of the Database Discovery completed so far.

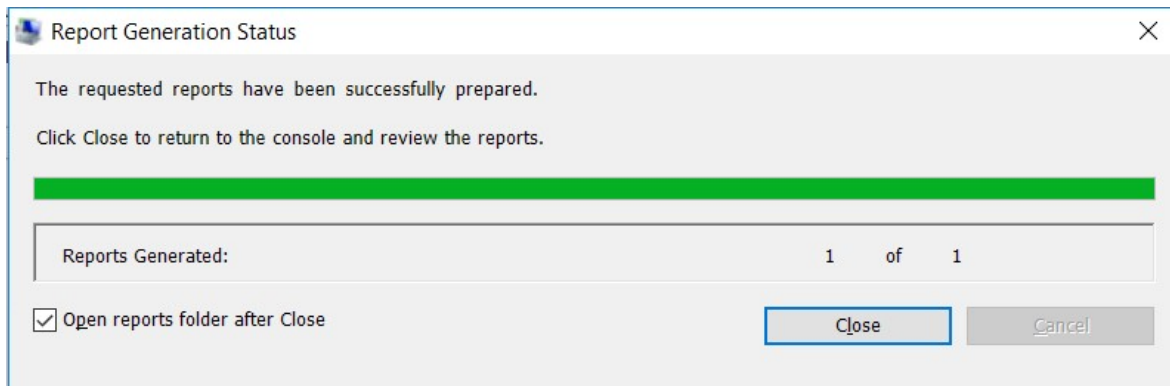
2. Generate a report.

On the top-right corner of the tool, an Options page appears, which you can use to generate report about the SQL Server Assessment and the Database Details.



a. Select both options (one by one) to generate the report.

This will take a couple of seconds to a few minutes depending on the size of the inventory completed during discovery.



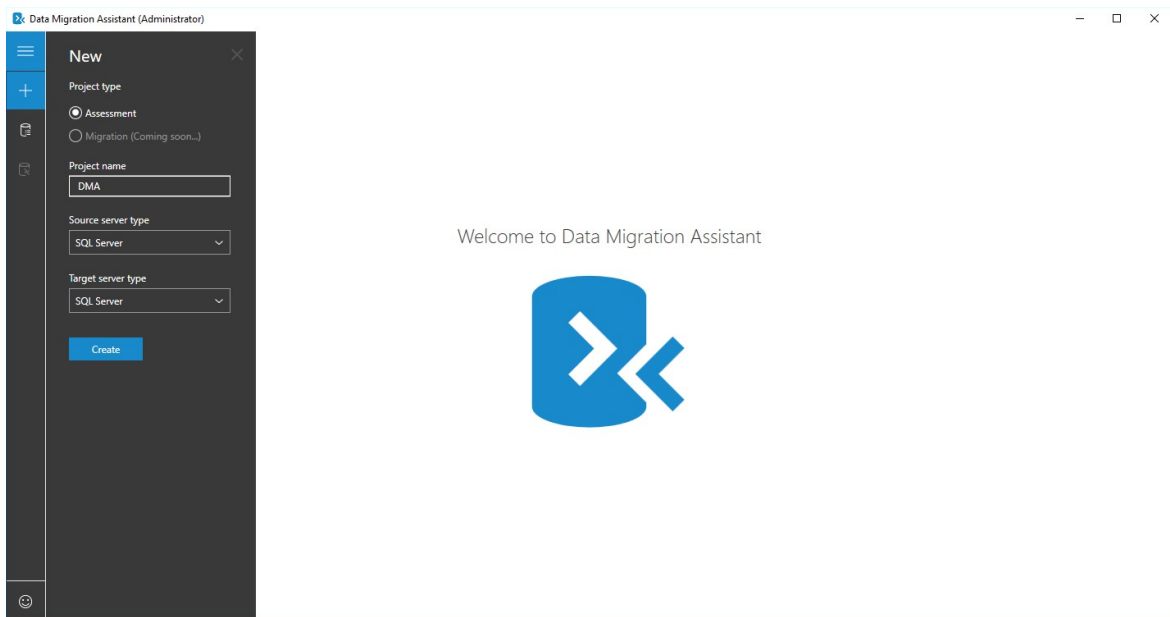
Assess

After identifying the data sources, the next step is to assess the on-premises SQL Server instance(s) migrating to a specific version of SQL Server on Azure VMs so that you understand the gaps between the source and target instances. Use the Data Migration Assistant (DMA) to assess your source database before migrating your SQL Server instance.

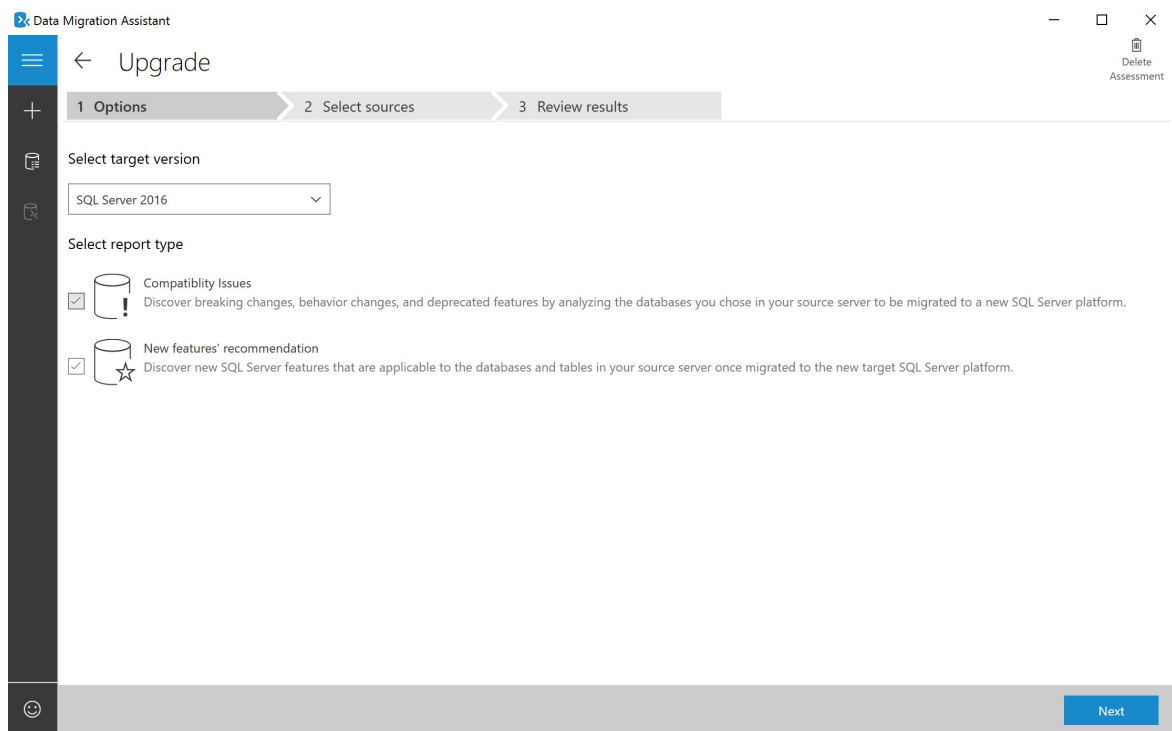
Steps

To use DMA to create an assessment, perform the following steps.

1. Create a new assessment project.
 - a. Launch DMA, select the New (+) icon, select the Assessment project type, specify a project name, select SQL Server as the source and target, and then select Create.

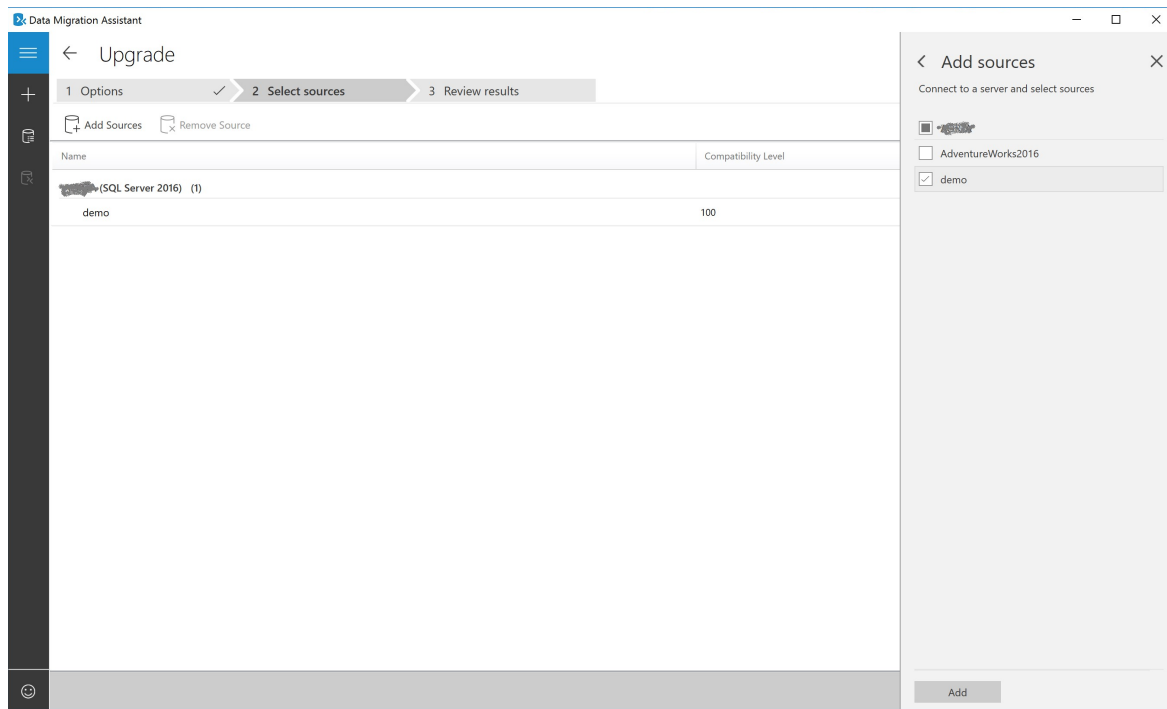


b. Select the target SQL Server version that you plan to migrate to and against which you need to run an assessment, select one or both of the assessment report types (Compatibility Issues and New features' recommendation), and then select Next.



c. In the Connect to a server fly-out, specify the name of the SQL Server instance to connect to, specify the Authentication type and Connection properties, and then select Connect.

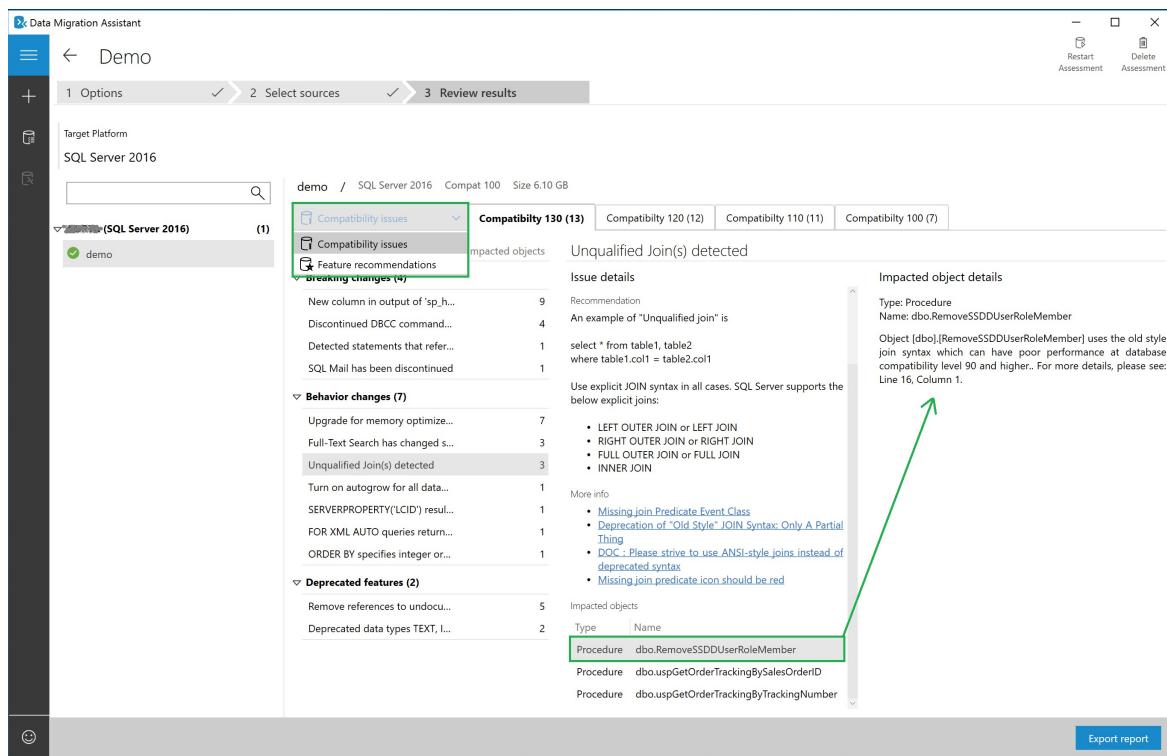
d. In the Add Sources fly-out, select the database(s) you that want to assess, and then select Add.



e. Select Start Assessment.

Now wait for the assessment results; the duration of the assessment depends on the number of databases added and the schema size of each database. Results will be displayed per database as soon as they are available.

f. Select the database that has completed assessment, and then switch between Compatibility issues and Feature recommendations by using the switcher.



g. Review the compatibility issues by analyzing the impacted object and its details for every issue identified under Breaking changes, Behavior changes, and Deprecated features.

h. Review feature recommendations across the Performance, Storage, and Security areas.

Feature recommendations cover a variety of features such as In-Memory OLTP and Columnstore, Stretch Database, Always Encrypted (AE), Dynamic Data Masking (DDM), and Transparent Data Encryption (TDE).

2. Review the assessment results.

a. After all database assessments are complete, select Export report to export the results to either a JSON or CSV file for analyzing the data at your own convenience.

Convert

After assessing the source database instance(s) you are migrating, for heterogeneous migrations, you need to convert the schema to work in the target environment. Since this is a homogeneous migration, the Convert phase is unnecessary.

Migration overview

After you have the necessary prerequisites in place and have completed the tasks associated with the Pre-migration phase, you are ready to perform the actual migration.

There are several methods for migrating a SQL Server database to an instance of SQL Server on Azure Virtual Machines (Azure VMs).

Overview of migration methods

The list below identifies the primary methods for migrating from SQL Server to SQL Server on Azure VMs.

- Use the Data Migration Assistant (DMA) to migrate the schema and data into an Azure VM.
- Perform an on-premises backup using compression, and then manually copy the backup file into an Azure VM.
- Perform a backup to URL, and then restore into an Azure VM from the URL.
- Detach and copy the data and log files to Azure Blob storage, and then attach to an Azure VM from the URL.
- Convert an on-premises VW to Hyper-V VHDs, upload to Azure Blob storage, and then deploy a new Azure VM using the uploaded VHD.
- Ship a hard drive using Windows Import/Export Service.
- Use the Add Azure Replica Wizard.
- Use SQL Server transactional replication.

A couple of key points to consider when reviewing the migration methods to determine the best option for your business scenario:

- For optimum data transfer performance, migrate database files into the SQL Server on Azure VM instance using a compressed backup file.
- To minimize downtime during the database migration process, use either the AlwaysOn option or the transactional replication option.

Tip: There is no supported way to upgrade the version/edition of an existing SQL Server on Azure VM instance. Instead, create a new SQL Server on Azure VM instance running the desired version/edition, and then use one of the techniques in the table above to move your databases.

If it is not possible to use the above methods, migrate your database manually. Using this method, you will generally start with a database backup followed by a copy of the database

backup into Azure and then perform a database restore. You can also copy the database files themselves into Azure and then attach them.

Note: When upgrading from older versions of SQL Server to SQL Server 2014 or SQL Server 2016, we recommend that you address all dependencies on features that are not supported by the later version of SQL Server as part of the migration project. For more information on the supported editions and scenarios, see the article [Upgrade SQL Server](#).

The following section provides details about using DMA to migrate the schema and data to an Azure VM.

For additional information about the other options for migrating from SQL Server on-premises to SQL Server on Azure VMs, see the article [Migrate a SQL Server database to SQL Server in an Azure VM](#).

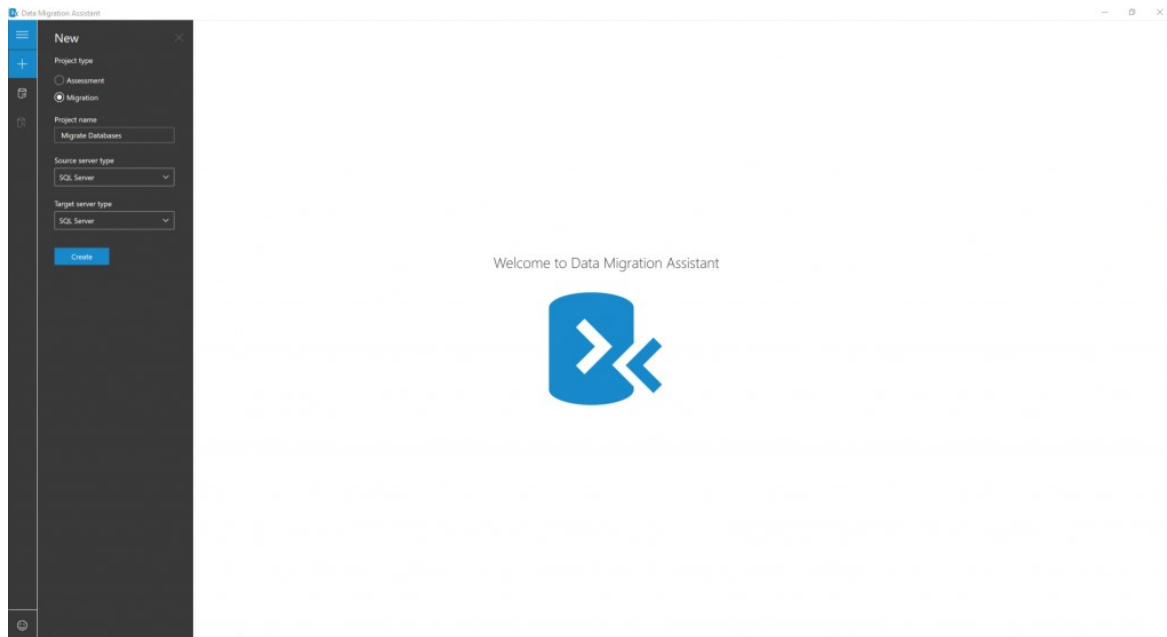
Migrate schema and data

After assessing your databases, the next step is to begin the process of migrating the schema and database by using DMA.

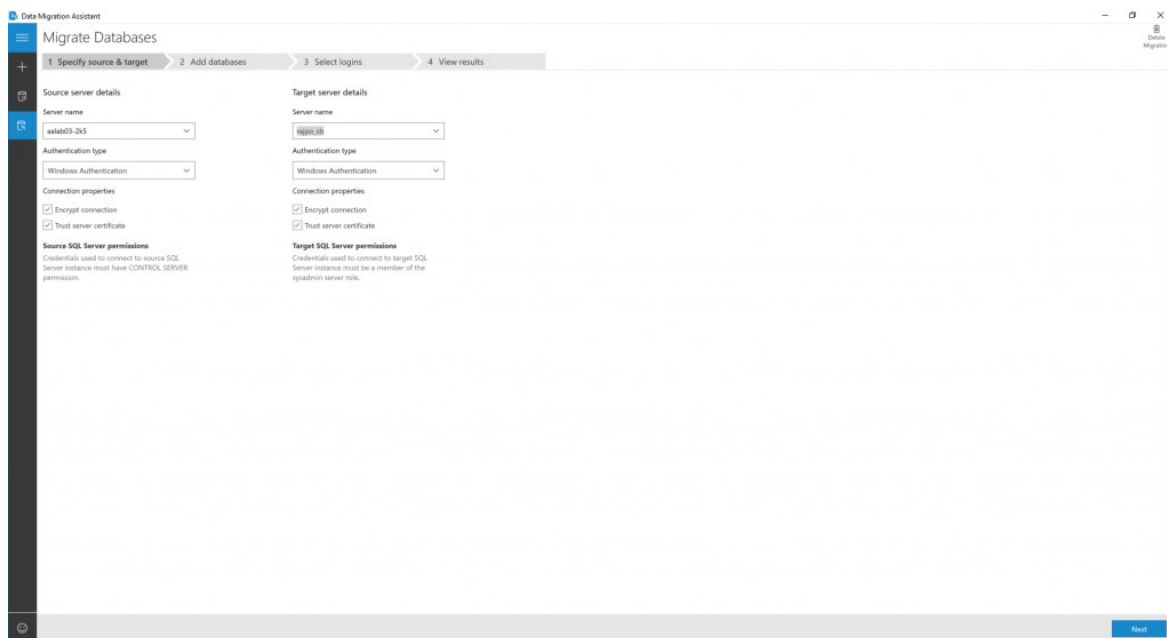
Steps

To use DMA to create a migration project, perform the following steps.

1. Create a New Migration project
 - a. Select the New icon, select the Migration project type, select SQL Server as source and target types, and then select Create.

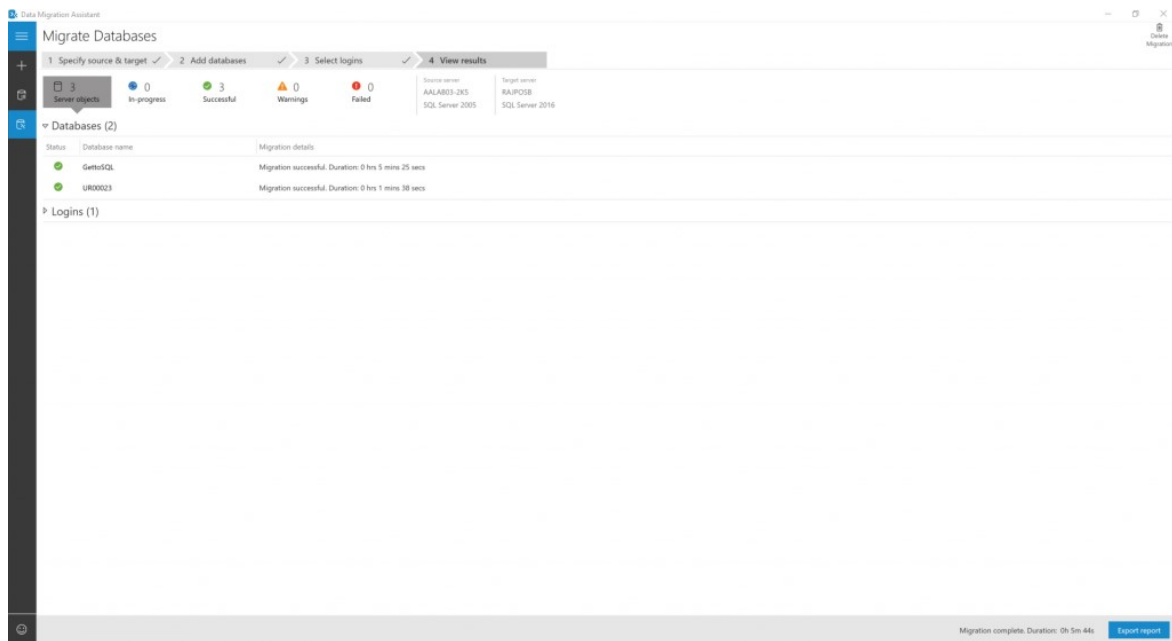


b. Provide source and target SQL server connection details, and then select Next.



c. Select databases from the source to migrate, and then specify the Shared location accessible by source and target SQL servers for backup operation.

Note: Be sure that the service account running the source SQL Server instance has write privileges on the shared location and that the target SQL Server service account has read privileges on the shared location.



2. Review Migration Results

- Select Export report to save the migration results to a .csv or .json file.
- Review the saved file for details about data and logins migration and verify successful completion of the process.

Note: If you are interested in participating in a Private preview of a one-time migration for SQL Server to Azure SQL Database using the Azure Database Migration Service, submit a nomination on the Azure Database Migration Service [Preview page](#).

Data sync and Cutover

For minimal-downtime migrations, the source you are migrating continues to change after the one-time migration occurs, and it will drift from the target in terms of data and schema. During this phase, you need to ensure that all changes in the source are captured and applied to the target in near real time. After you verify that all changes in source have been applied to the target, you can cutover from the source to the target environment.

Support for minimal-downtime migrations is not yet available for this scenario, so the Data sync and Cutover phases are not currently applicable.

Post-migration overview

After you have successfully completed the Migration stage, you need to go through a series of post-migration tasks to ensure that everything is functioning as smoothly and efficiently as possible.

Remediate applications

After the data is migrated to the target environment, all the applications that formerly consumed the source need to start consuming the target. Accomplishing this will in some cases require changes to the applications.

Perform tests

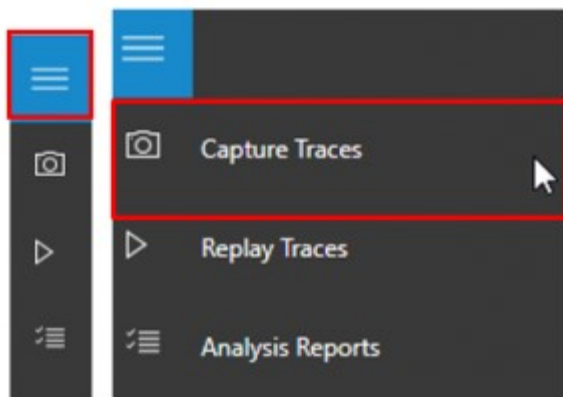
After the data is migrated to target, perform tests against the databases to verify that the applications perform well against the after the migration. Use the Database Experimentation Assistant (DEA) to assist with evaluating the target SQL Server on Azure VM environment.

Note: For assistance with developing and running post-migration validation tests, also consider using the Data Quality Solution available from the partner [QuerySurge](#).

Steps

To use DEA for database migration testing, perform the following steps.

1. Run a trace capture.
 - a. On the left navigation tree, select the camera icon the go to All Captures.



- b. To start a new capture, select New Capture.

c. To configure the capture, specify the trace name, duration, SQL Server instance name, database name, and the share location for storing the trace file on the computer running SQL Server.

Database Experimentation Assistant (Preview)

Please make sure to take backup of target databases before starting capture trace.

New Capture

SQL Server connection details

SQL Server instance name: localhost

Database name: AdventureWorks

Capture details

Trace file name: AdventureWorksTrace

Max file size (MB): 200

Duration (mins): 60

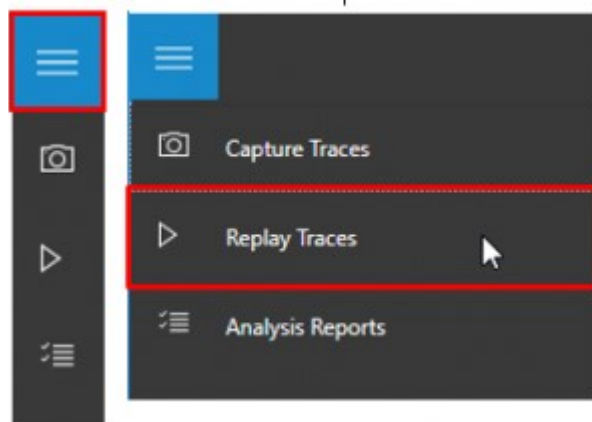
Path to store output trace file: C:\IDEA\

Cancel Start

d. Select Start to begin trace capture.

2. Run a trace replay.

a. On the left navigation tree, select the play icon to go to All Replays.



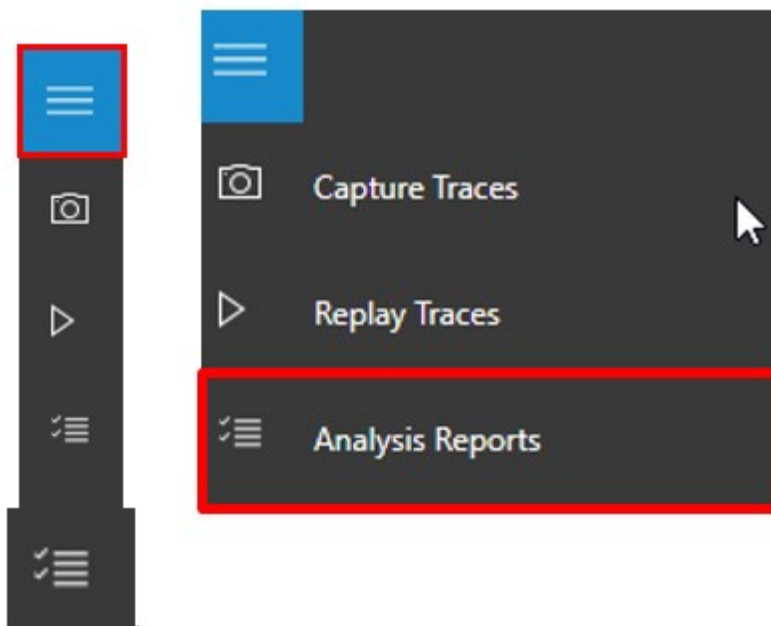
b. To start a new replay, select New Replay.

c. To configure the replay, specify the replay name, controller machine name, path to source trace file on controller, SQL Server instance name, and the path for storing the target trace file on the computer running SQL Server.

d. Select Start to begin replay of your capture.

3. Create an analysis report.

a. On the left navigation tree, select the checklist icon to go to Analysis Reports.

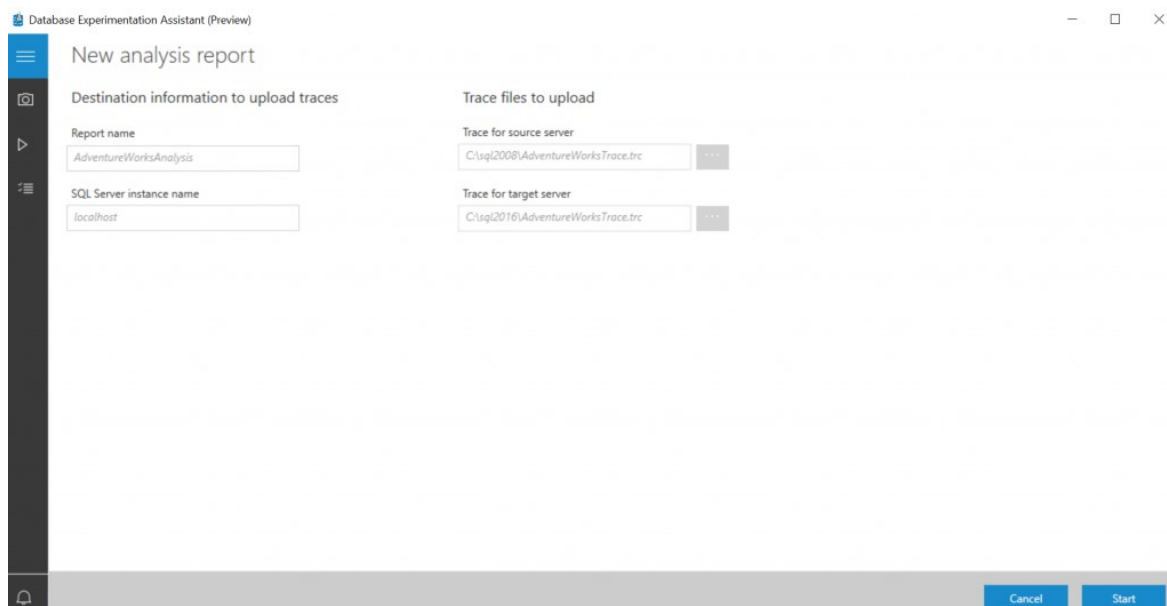


b. Connect to the SQL Server on which you will store your report databases.

You will see the list of all reports in the server.

c. Select New Report.

d. To configure the report, specify the report name, and specify paths to the traces for the source and target SQL Server instances.



4. Review the analysis report.

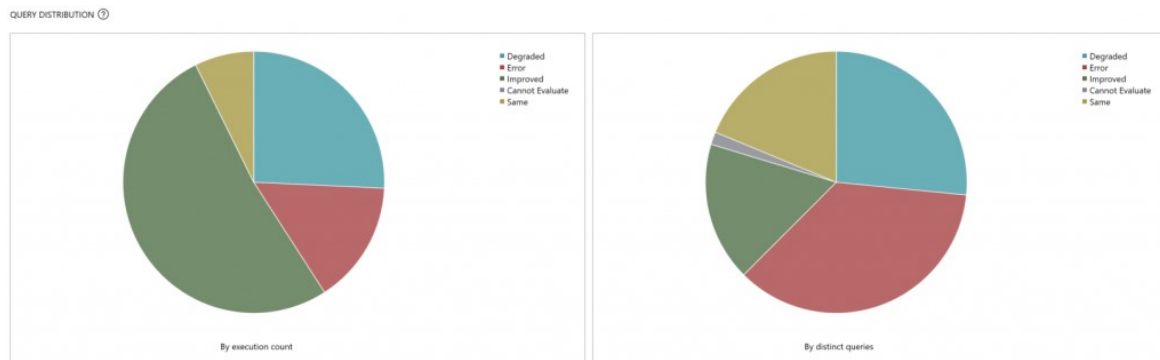
a. On the first page of the report, the version and build information for the target servers on which the experiment was run displays.

Threshold allows you to adjust the sensitivity or tolerance of your A/B Test analysis.

Note: By default, threshold is set to 5%; any performance improvement that is $\geq 5\%$ is categorized as 'Improved'. The drop-down selector allows you to evaluate the report using different performance thresholds.

Target 1 SQL2008SOURCE SQL Server 2008 SP4 MS15-059	Target 2 SQL2014TRACE SQL Server 2014 SP1 MS15-058	Threshold 5%
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b. Select the individual slices of the pie chart to view drill-down metrics on performance.



On the drill-down page for a performance change category, you will see a list of queries in that category.

> Dashboard > Error

AnalysisTestMsiB636215985401243523

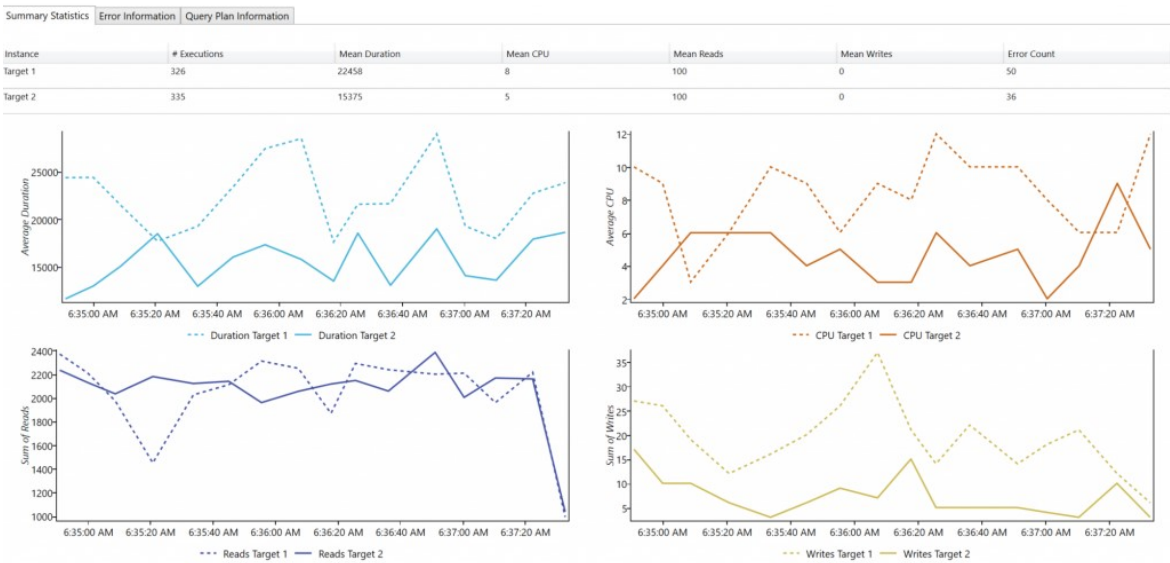
Target 1 SQL2008SOURCE SQL Server 2008 SP4 MS15-059	Target 2 SQL2014TRACE SQL Server 2014 SP1 MS15-058	Threshold 5%
---	--	-----------------

ERROR QUERIES

Error Type	Query Count	Execution Count
Existing Errors (Errors on target 1 server that continue to exist on the target 2 server.)	14	1892
New Errors (Errors which are new on the target 2 server.)	11	7696
Resolved Errors (Errors which existed on target 1 server but resolved in target 2 server.)	1	2

Query Text	Error ID	Error Count	Error Text
SELECT PP.LASTNAME, PP.FIRSTNAME, E.JOBTITLE INTO DBO.EMPLOYEE TWO FROM PERSON.PERSON AS PP JOIN HUMANRESOURCES.EMPLOYEE AS E ON E.BUSINESSENTITYID = PP.BUSINESSENTITYID WHERE LASTNAME = 'ISTRI';	539	2	Schema changed after the target table was created. Rerun the Select Into query.
SELECT PRODUCTMODELID, NAME INTO DBO.GLOVES FROM PRODUCTION.PRODUCTMODEL WHERE PRODUCTMODELID IN (LIST);	539	2	Schema changed after the target table was created. Rerun the Select Into query.
IF OBJECT_ID ('ISTRI. (STR)') IS NOT NULL DROP TABLE DBO.PRODUCTRESULTS;	3701	2	Cannot drop the table 'dbo.ProductResults', because it does not exist or you do not have permission.

c. Select an individual query to get performance summary statistics, error information, and query plan information.



Optimize

The post-migration phase is crucial for reconciling any data accuracy issues and verifying completeness, as well as addressing performance issues with the workload.

Note: For additional detail about these issues and specific steps to mitigate them, see the following resource:

- The [Post-migration Validation and Optimization Guide](#).