

Azure SQL Data Warehouse

Security and Administration



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Agenda

Security

Transparent Data Encryption (TDE)

Auditing

Backup and Restore

Workload Management

Connections



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Introduction to Security

The MPP Engine must provide appropriate security levels for administrators and users to accomplish tasks such as:

- Managing roles and logins
- Creating databases
- Monitoring system health
- Loading data
- Backing up and restoring databases
- Querying tables and views

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-overview-manage-security/>

Permission Model

Similar to SQL Server

Database Principals

- Database Roles
- Users
- User defined Roles

Permissions

- Grant
- Revoke
- Deny

User Defined Roles
are recommended

Adding users to
fixed database
roles requires
membership of
`db_owner`

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Server Principals are not available in Azure SQL Data Warehouse, because this is a "Database Level Service"
not a "SQL Server Instance Level Service" like APS or SMP SQL Server

Security – Client Authentication

- Administrators add user accounts with the CREATE LOGIN command
- User names and passwords are stored in SQL Server on control node as standard SQL logins with a hashed password
- Catalog view is available to track login accounts

View name: `sys.sql_logins`

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The DMV `sys.sql_logins` can be used to detect multiple failed login attempts for the same user.

Security – System Administrator Account

One built-in account: system administrator
(SQL DW: "Portal Admin Account")

- System administrator or "super user" account
- "super user" account cannot be removed or locked
- Cannot change its name
- "super user" account are set up at provisioning
- Best practice: Use "super user" account to create other admin accounts

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"super user" account:

SQL DW: Is the "Azure SQL DWH Portal Admin Account" is set up when you create the Azure Database Server, when you provision the Azure SQL Data Warehouse (SQL DW)

Security – Creating User Accounts

Example

```
▪ CREATE LOGIN Mary7 WITH PASSWORD = 'A2c3456'  
    ,Check_policy=ON, Check_Expiration=ON
```

LOGIN (name)

- First character must be a letter, followed by letters, digits and special
- The login name cannot be a reserved word
- Special characters: _, @, \$, #.
- 4–128 characters long

Security – LOGIN Passwords

LOGIN password

- Passwords are case-sensitive
- Should be 8-128 characters long
- Cannot contain single quotes, or the login_name
- May include letters, numbers, and special characters such as a: space, _ @, *, ^, %, !, \$, #, or &
- LOGIN name cannot be included as part of the password
- Must contain at least three of the following:
 - Uppercase letter
 - Lowercase letter
 - A digit (0-9)
 - a space, _ @, *, ^, %, !, \$, #, or &

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Security – Deleting a LOGIN

If a LOGIN owns one or more securable objects:

- delete objects
- or use ALTER AUTHORIZATION to reassign the securable

Requires ALTER ANY LOGIN permission

- Syntax: `DROP LOGIN {login_name} [:]`

Security – Password Ageing

Example SQL command:

```
ALTER LOGIN Mary5 WITH CHECK_EXPIRATION = ON
```

CheckExpiration:

- Sets a fixed number of days for the password age
- Can be set with “super user” account
- After expiration, user denied all privileges except Connect
 - User must then reset password (is then the only action possible)
- Examined at each login attempt

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A DMV is available to view user LOGIN details: sys.sql_logins

Security – Database Level

Security model very similar to SMP SQL Server

- Create database user to be affiliated with LOGIN
- Create database roles as needed
- Assign users to database roles

Security – Roles

Fixed database roles are available within each database

- Same as SMP SQL Server

User-defined database roles can be created

- CREATE ROLE statement

Add/remove users from database roles

- sp_addrolemember, sp_droprolemember

Roles can be added to multiple other roles,
forming a hierarchy

Security – Roles Example

```
CREATE LOGIN Mary;  
Use <DatabaseName>;  
CREATE USER Mary;  
CREATE ROLE Finance  
CREATE ROLE Purchasing  
sp_addrolemember 'Finance', 'Mary'  
sp_addrolemember 'Purchasing', 'Finance'
```

The database user Mary inherits all permissions granted to roles Finance and Purchasing.

Security – Setting Permissions

- GRANT – Explicitly grants one or more permissions
- DENY – Explicitly denies the principal from having one or more permissions
- REVOKE – Removes existing GRANT or DENY permissions

Privileges can be granted and denied for all users and roles

Example: GRANT SELECT ON factSales TO Finance

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TDE = “Transparent Data Encryption” - at Rest

Encryption of data at the page level

- Encrypted before written to disk
- Decrypted when read into memory
- TDE does not increase the size of the database
- TDE may slightly impact performance of the appliance

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Encryption of the data is performed at the page level. The pages in an encrypted database are encrypted before they are written to disk and decrypted when read into memory. TDE does not increase the size of the encrypted database.

- Data Encrypted by a key
- Key protected by a certificate
- Key required to access data in the database
- <https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-encryption-tde/>

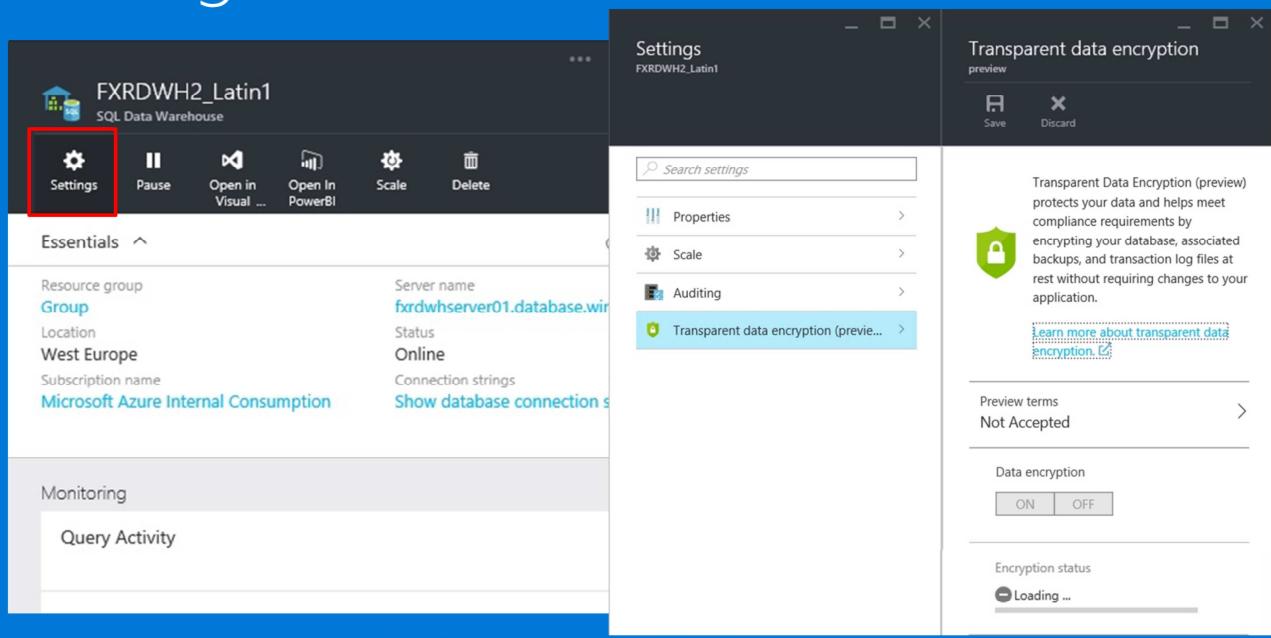
Scope of TDE

- Control Node
- Compute Node
- Database files
- Backups
- Tempdb and pdwtempdb

TDE: Out of Scope (not supported)

- Encryption between client and MPP Engine
- Encryption during Internal DMS operations
- Cell-level encryption (EncryptByKey/DecryptByKey)
- Shell master database isn't encrypted
- External tables aren't encrypted
- Diagnostic Sessions aren't encrypted
- Memory Dumps

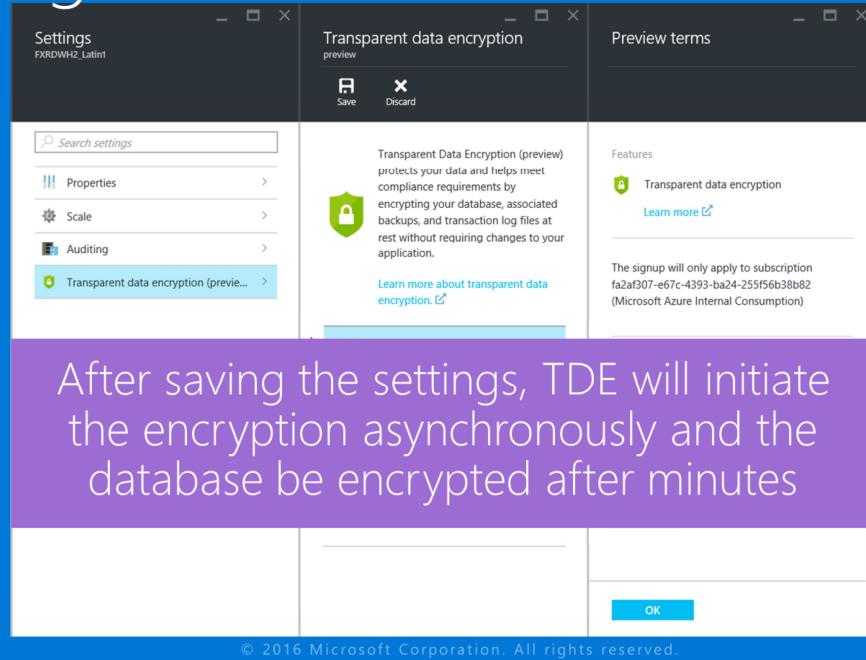
Enabling TDE – Azure SQL DW Portal



1. Click - shows the SQL DW Database Settings Dialog
2. Click – clicks the “Transparent data encryption” configuration Dialog
3. Click – points to the location where currently the “Preview terms” need to get accepted. Before SQL DW GA, this option will disappear.

<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-encryption-tde/>

Enabling TDE – Azure SQL DW Portal



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This slide shows that you need to press "ON" to get TDE enabled...

1.: First click starts the fully animated slide!

The time needed for the encryption depends highly on the amount of data in the database. On the slide it is mentioned that it required "minutes", which applies for an almost empty database, but if TB of data is loaded this can take a substantial amount of time!

Watch out for notifications in the Azure SQL DW portal for the message that the encryption is completed!

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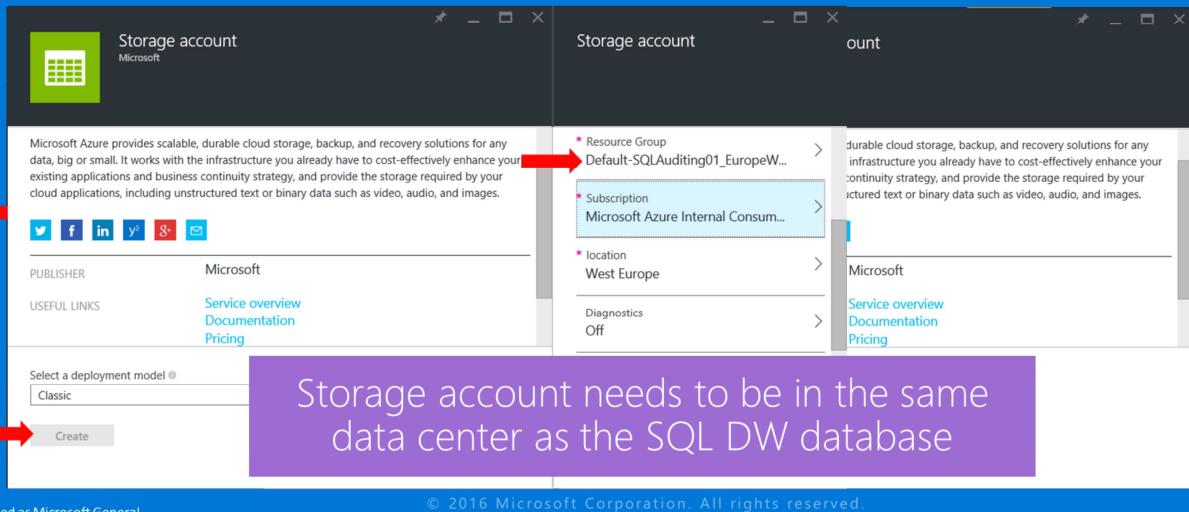


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Enabling Auditing – Azure SQL DW Portal

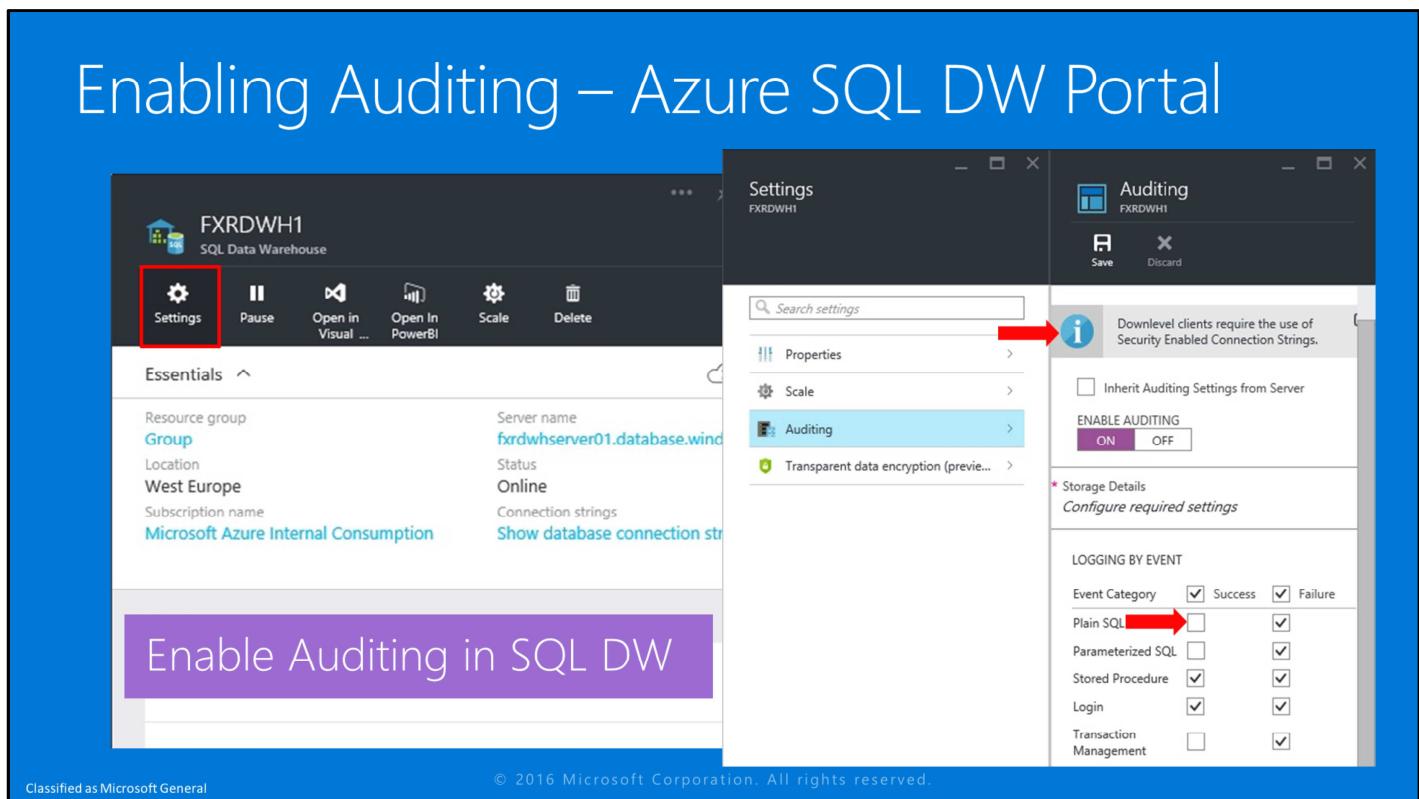
SQL DW supports Auditing, to enable it, you need first one or two Azure Storage accounts. This shows how to get one:



1.: First click starts the fully animated slide!

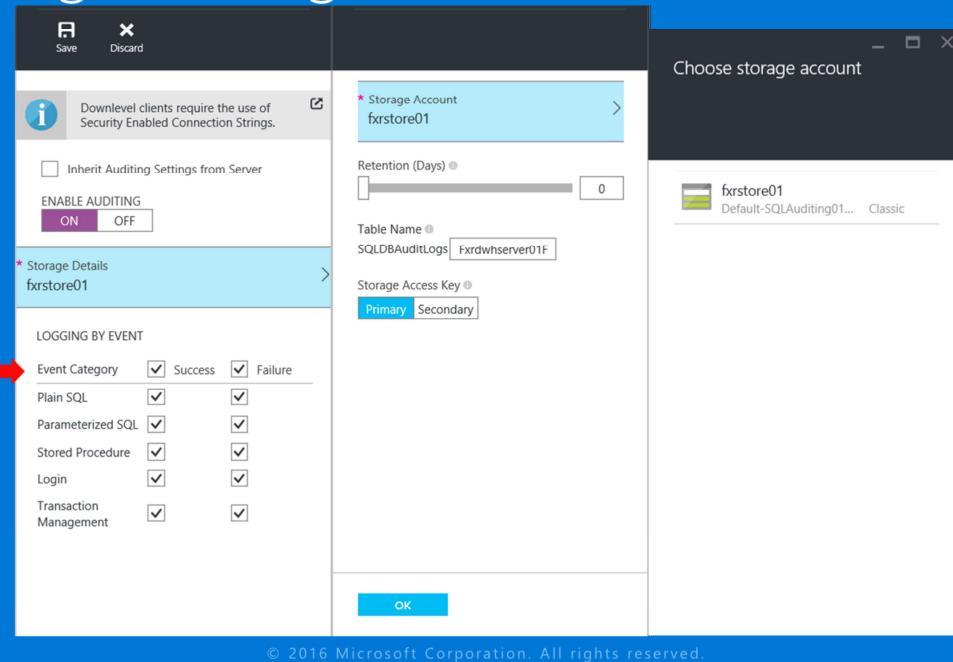
<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-auditing-get-started/>

Enabling Auditing – Azure SQL DW Portal



1. Click – shows Azure SQL DW – Settings
2. Click – shows Auditing Dialog
3. Click – shows Arrow with “ENABLE AUDITING” -> ON
4. Click shows “LOGGING EVENT” selection possibilities
5. Next click gets to next Slide

Enabling Auditing – Azure SQL DW Portal



1.: First click starts the fully animated slide!

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Introduction to Backup and Restore

Databases are backed up by Azure every 8 hours

The RECOVER can be done in case of a Disaster:

- Over PowerShell
- Over Rest-API

USE: <https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-business-continuity-recover-from-user-error/>

Restore (2 Methods)

Rest API

1. List all of your restorable deleted databases by using the [List restorable dropped databases](#) operation.
2. Get the details for the deleted database you want to restore by using the [Get restorable dropped database](#) operation.
3. Begin your restore by using the [Create database restore request](#) operation.
4. Track the status of your restore by using the [Database operation status](#) operation.

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-manage-backup-and-restore-tasks-rest-api/>

Restore

Powershell

1. Select the subscription under your account that contains the database to be restored.
2. List restore points for the database (requires Azure Resource Management mode)
3. Pick the desired restore point using the RestorePointCreationDate.
4. Restore the database to the desired restore point.
5. Monitor the progress of the restore.

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-manage-backup-and-restore-tasks-powershell/>

Restore

```
Select-AzureSubscription -SubscriptionId <Subscription_GUID>

# List database restore points
Switch-AzureMode AzureResourceManager
Get-AzureSqlDatabaseRestorePoints -ServerName "<YourServerName>" -DatabaseName "<YourDatabaseName>" -
ResourceGroupName "<YourResourceGroupName>"

# Pick desired restore point using RestorePointCreationDate
$PointInTime = "<RestorePointCreationDate>"

# Get the specific database to restore
Switch-AzureMode AzureServiceManagement
$Database = Get-AzureSqlDatabase -ServerName "<YourServerName>" –DatabaseName "<YourDatabaseName>"

# Restore database
$RestoreRequest = Start-AzureSqlDatabaseRestore -SourceServerName "<YourServerName>" -
SourceDatabase $Database -TargetDatabaseName "<NewDatabaseName>" -PointInTime $PointInTime

# Monitor progress of restore operation
Get-AzureSqlDatabaseOperation -ServerName "<YourServerName>" –
OperationGuid $RestoreRequest.RequestID
```

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Workload Management

Concurrency Slot Consumption	DW100	DW200	DW300	DW400	DW500	DW600	DW1000	DW1200	DW1500	DW2000
Max Concurrent Queries	32	32	32	32	32	32	32	32	32	32
Max Concurrency Slots	4	8	12	16	20	24	32	32	32	32

- Slots can also be bundled together to increase the resources allocated to a users query
- The bundles are defined in SQL DW as database roles
- Resource Governor allocates resources to database roles

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-develop-concurrency/>

Why Is Workload Management Important?

Enables you to:

- Reduce concurrent queries running on MPP DWH
- Allocate more resources to running queries
- Provide even affinity resources across appliance

Management:

- Database roles in SQL DW enable users to be categorized for workload management

Resource Classes

- Database role = Resource class
- Only non-default resource classes are visible

```

SELECT sp1.name      AS owner_principal_name
,      sp1.type_desc AS owner_type_desc
,      sp.name        AS database_principal_name
,      sp.type_desc   AS database_type_desc
FROM   sys.database_principals sp --ROLES
JOIN   sys.database_principals sp1 --Owner
ON     sp.owning_principal_id =
sp1.principal_id
WHERE   sp.type = N'R'
and sp.is_fixed_role = 0
and sp.principal_id > 2
and sp.principal_id < 16384
  
```

	owner_principal_name	owner_type_desc	database_principal_name	database_type_desc
1	dbo	SQL_USER	xlargerc	DATABASE_ROLE
2	dbo	SQL_USER	largerc	DATABASE_ROLE
3	dbo	SQL_USER	mediumrc	DATABASE_ROLE

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Resource Pools

```
SELECT DISTINCT
    rp.name
    ,max_memory_kb*1.0/1048576 AS rp_max_mem_GB
    ,min_cpu_percent
    ,max_cpu_percent
    ,min_memory_percent
    ,max_memory_percent
FROM sys.dm_pdw_nodes_resource_governor_resource_pools rp
JOIN sys.dm_pdw_nodes nod ON rp.pdw_node_id = nod.pdw_node_id
WHERE rp.name <> 'internal'
AND nod.[type] = 'compute';
```

Resource Pool Configuration

	name	rp_max_mem_GB	min_cpu_percent	max_cpu_percent	min_memory_percent	max_memory_percent
1	default	23.488372802	20	100	0	100
2	default	23.488380432	20	100	0	100
3	InMemBackupRestorePool	7.046508789	10	30	0	30
4	InMemDmvCollectorPool	4.697669982	0	20	0	20
5	MigrationPool	21.139533996	0	90	0	90
6	MigrationPool	21.139541625	0	90	0	90
7	SloDWPool	23.488372802	0	100	0	100
8	SloDWPool	23.488380432	0	100	0	100
9	SloHkPool	14.093017578	0	100	0	60
10	SloHkPool	14.093025207	0	100	0	60
11	SloSecSharedPool	23.488372802	50	100	0	100
12	SloSecSharedPool	23.488380432	50	100	0	100

- Pools have different ranges of % of the CPU
- Pools have different ranges of % of the MEMORY

Workload Groups

```
-- max memory grants per Resource Pool and per Workload Group
SELECT DISTINCT
    rp.name                                AS rp_name
    ,wg.name                                AS wg_name
    ,importance
    , max_memory_kb*1.0/1048576           AS rp_max_mem_GB
    ,(max_memory_kb*1.0/1048576/100)
        *request_max_memory_grant_percent AS request_max_memory_grant_GB
FROM sys.dm_pdw_nodes_resource_governor_resource_pools rp
JOIN sys.dm_pdw_nodes nod ON rp.pdw_node_id = nod.pdw_node_id
JOIN sys.dm_pdw_nodes_resource_governor_workload_groups wg
    ON rp.pdw_node_id= wg.pdw_node_id
    AND rp.pool_id= wg.pool_id
WHERE rp.name    <> 'internal'
AND nod.[type] = 'compute'
ORDER BY rp_name, request_max_memory_grant_GB;
```

Concurrency Matrix (Azure SQL DWH)

MEMORY AVAILABLE (PER DIST)	DW100	DW200	DW300	DW400	DW500	DW600	DW1000	DW1200	DW1500	DW2000
smallrc(default) (s)	100 MB	100 MB	100 MB	100 MB	100 MB	100 MB	100 MB	100 MB	100 MB	100 MB
mediumrc (m)	100 MB	200 MB	200 MB	400 MB	400 MB	400 MB	800 MB	800 MB	800 MB	1600 MB
largerc (l)	200 MB	400 MB	400 MB	800 MB	800 MB	800 MB	1600 MB	1600 MB	1600 MB	3200 MB
xlargerc (xl)	400 MB	800 MB	800 MB	1600 MB	1600 MB	1600 MB	3200 MB	3200 MB	3200 MB	6400 MB

CONCURRENCY SLOT CONSUMPTION	DW100	DW200	DW300	DW400	DW500	DW600	DW1000	DW1200	DW1500	DW2000
Max Concurrent Queries	32	32	32	32	32	32	32	32	32	32
Max Concurrency Slots	4	8	12	16	20	24	40	48	60	80
smallrc(default) (s)	1	1	1	1	1	1	1	1	1	1
mediumrc (m)	1	2	2	4	4	4	8	8	8	16
largerc (l)	2	4	4	8	8	8	16	16	16	32
xlargerc (xl)	4	8	8	16	16	16	32	32	32	64

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Workload Group Mappings

WORKLOAD GROUP	CONCURRENCY SLOT MAPPING	PRIORITY MAPPING
SloDWGroupC00	1	Medium
SloDWGroupC01	2	Medium
SloDWGroupC02	4	Medium
SloDWGroupC03	8	Medium
SloDWGroupC04	16	High
SloDWGroupC05	32	High
SloDWGroupC06	64	High
SloDWGroupC07	128	High

RESOURCE CLASS	WORKLOAD GROUP	CONCURRENCY SLOTS USED	IMPORTANCE
smallrc	SloDWGroupC00	1	Medium
mediumrc	SloDWGroupC02	4	Medium
largerc	SloDWGroupC03	8	Medium
xlargerc	SloDWGroupC04	16	High

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SQL DW - Workload Group Configuration

	rp_name	wg_name	importa...	rp_max_mem_...	request_max_memory_grant_...
1	default	default	Medium	23.488372802	5,8720932005
2	default	default	Medium	23.488380432	5,872095108
3	InMemBackupRestoreP...	InMemBackupGroup	Medium	7.046508789	1,76162719725
4	InMemBackupRestoreP...	InMemFullBackupGroup	Medium	7.046508789	1,76162719725
5	InMemBackupRestoreP...	InMemRestoreGroup	Medium	7.046508789	1,76162719725
6	InMemDrmvCollectorPool	InMemDrmvCollectorGroup	Medium	4.697669982	1,1744174955
7	MigrationPool	MigrationPriGroup	Medium	21.139533996	5,284883499
8	MigrationPool	MigrationSecGroup	Medium	21.139533996	5,284883499
9	MigrationPool	MigrationSeedingGroup	Medium	21.139533996	5,284883499
10	MigrationPool	MigrationPriGroup	Medium	21.139541625	5,28488540625
11	MigrationPool	MigrationSecGroup	Medium	21.139541625	5,28488540625
12	MigrationPool	MigrationSeedingGroup	Medium	21.139541625	5,28488540625
13	SloDWPool	SloDWGroupC00	Medium	23.488372802	0,093953491208
14	SloDWPool	SloDWGroupC00	Medium	23.488380432	0,093953521728
15	SloDWPool	SloDWGroupC01	Medium	23.488372802	0,187906982416
16	SloDWPool	SloDWGroupC01	Medium	23.488380432	0,187907043456
...					
26	SloDWPool	SloDWGroupC06	High	23.488380432	6,013025390592
27	SloDWPool	SloDWGroupC07	High	23.488372802	12,026046874624
28	SloDWPool	SloDWGroupC07	High	23.488380432	12,026050781184
29	SloSecSharedPool	SloSecSharedInitGroup	Medium	23.488372802	5,8720932005
30	SloSecSharedPool	SloSecSharedInitGroup	Medium	23.488380432	5,872095108

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Switching Resource Classes

```
sp_addrolemember 'largerc', 'FranzXR';
sp_droprolemember 'largerc', 'FranzXR';
```

- User can be a member of > 1 Resource Class
- Max Resource Class is the one that is used
- Don't be over-jealous – especially with xlarge

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If you are a DBA, make sure you don't grant yourself into the Xlarge resource class, or else every time you login and run a query, it will use 22 concurrency slots.

Identify Resource Class

Of a request

```
SELECT
    request_id
,session_id
,[status]
,command
,resource_class
FROM sys.dm_pdw_exec_requests;
```

Of a User

```
SELECT      sp1.name      AS owner_principal_name
,          sp1.type_desc AS owner_type_desc
,          sp.name       AS database_principal_name
,          sp.type_desc  AS database_type_desc
,          sp2.name      AS member_principal_name
,          sp2.type_desc AS member_type_desc
FROM        sys.database_principals sp
JOIN        sys.database_principals sp1
ON          sp.owning_principal_id = sp1.principal_id
JOIN        sys.database_role_members rm
ON          sp.principal_id = rm.role_principal_id
JOIN        sys.database_principals sp2
ON          rm.member_principal_id = sp2.principal_id
WHERE       sp.type_desc = 'DATABASE_ROLE'
and        sp.is_fixed_role = 0;
```

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This are optional slides with helpful queries for the audience for later reference.

→ no need to discuss these in details!

Concurrency slots used by Query

```
WITH rw
AS
(SELECT session_id
, request_id
, [type]
, [object_type]
, [object_name]
, request_time
, acquire_time
, DATEDIFF(ms,request_time,acquire_time) AS acquire_duration_ms
, ISNULL(resource_class, 'smallrc') AS resource_class
, concurrency_slots_used
,CASE WHEN ISNULL(resource_class, 'smallrc') = 'smallrc' THEN 1
      WHEN resource_class = 'mediumrc' THEN 3
      WHEN resource_class = 'largerc' THEN 7
      WHEN resource_class = 'xlargerc' THEN 22
      ELSE 0 END request_resource_class
FROM sys.dm_pdw_resource_waits
)
SELECT request_id, resource_class, concurrency_slots_used
, request_resource_class -concurrency_slots_used AS slots_required
FROM rw;
```

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Connection Strings

ADO.net

- Server=tcp:{Server Name},1433;Database={DBName};User ID={UserName}@{ServerName};Password={your_password_here};Encrypt=True;TrustServerCertificate=False;Connection Timeout=30;

ODBC

- Driver={SQL Server Native Client 11.0};Server=tcp:{Server Name},1433;Database={DBName};Uid={UserName}@{ServerName};Pwd={your_password_here};Encrypt=yes;TrustServerCertificate=no;Connection Timeout=30;

PHP

- Server: {Server Name},1433 \r\n Database: {DBName}\r\n User Name: {UserName}\r\n \r\n PHP Data Objects(PDO) Sample Code:\r\n try {\r\n \$conn = new PDO ("sqlsrv:server = tcp:{ServerName},1433; Database = {DBName}\", \"{UserName}\",\r\n \"{your_password_here}\")\r\n \$conn->setAttribute(PDO::ATTR_ERRMODE, PDO::ERRMODE_EXCEPTION);\r\n } catch (PDOException \$e) {\r\n print("Error connecting to SQL Server.\n")\r\n die(print_r(\$e));\r\n }\r\n \r\n SQL Server Extension Sample Code:\r\n \$connectionInfo = array("UID" => "{UserName}@{ServerName}", "pwd" =>\r\n "{your_password_here}", "Database" => "{DBName}", "LoginTimeout" => 30, "Encrypt" => 1, "TrustServerCertificate" => 0);\r\n \$serverName = "tcp:{ServerName},1433"\r\n \$conn = sqlsrv_connect(\$serverName, \$connectionInfo);

JDBC

- jdbc:sqlserver://{ServerName}:1433;database={DBName};user={UserName}@{ServerName};password={your_password_here};encrypt=true;trustServerCertificate=false;hostNameInCertificate=*.database.windows.net;loginTimeout=30;

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You don't need to read or remember this details, just be aware that you want to copy – paste this from the Azure Portal...

PowerBI

- Specify the fully qualified server name when connecting
- Ensure firewall rules for the database are configured to "Allow access to Azure services".
- Every action such as selecting a column or adding a filter will directly query the data warehouse
- Tiles are refreshed approximately every 15 minutes (refresh does not need to be scheduled)
- Q&A is not available for Direct Connect datasets
- Schema changes are not picked up automatically

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-integrate-power-bi/>

Connecting through the Power BI portal

- Click Get Data at the bottom of the navigation pane.
- Select Big Data & More.
- Once on the Big Data & More page, select the SQL Data Warehouse
- Enter the necessary connection information. The in the Finding Parameters section below shows where this data can be found.
- Drilling into the dataset, you can explore all of the tables and columns in your database. Selecting a column will send a query back to the source, dynamically creating your visual. These visuals can be saved in a new report, and pinned back to your dashboard.

Azure Stream Analytics

Prerequisites

- Create an Event Hub input
- Configure and start event generator application
- Provision a Stream Analytics job
- Specify job input and query

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-integrate-azure-stream-analytics/>

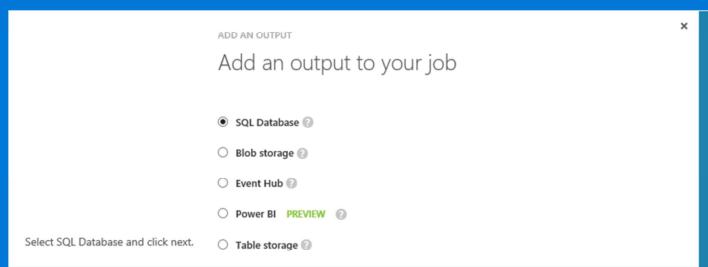
Azure Stream Analytics

Step 1:

- In your Stream Analytics job click OUTPUT from the top of the page, and then click ADD OUTPUT.

Step 2:

- Select SQL Database and click next.

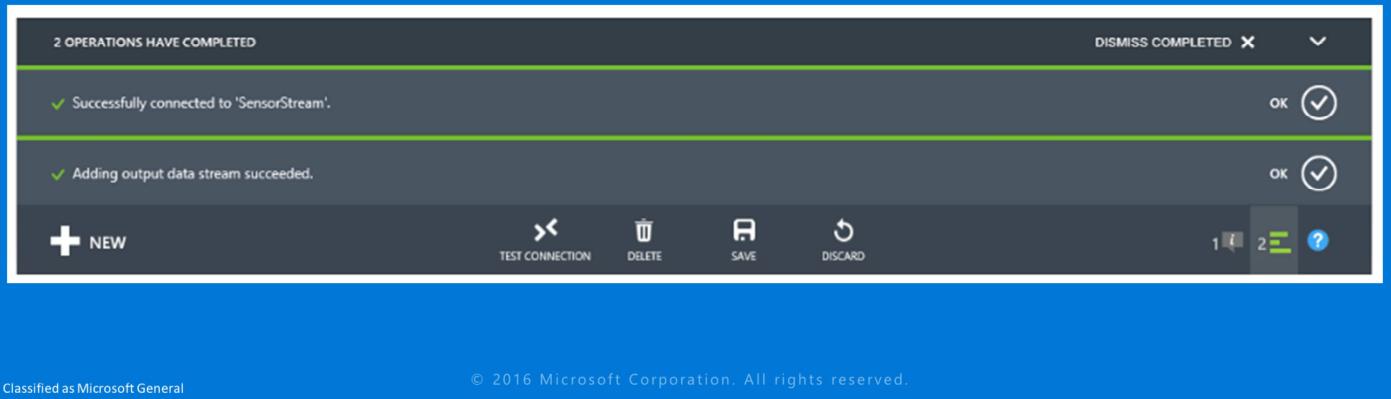


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Azure Stream Analytics

Step 4:

- Click the check button to add this job output and to verify that Stream Analytics can successfully connect to the database



Lab: Integrate connections

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<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-get-started-visualize-with-power-bi/>

<https://blogs.technet.microsoft.com/machinelearning/2016/03/08/how-to-use-azure-ml-with-azure-sql-data-warehouse/>

<https://azure.microsoft.com/en-us/documentation/articles/sql-data-warehouse-integrate-azure-stream-analytics/>



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Questions?



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