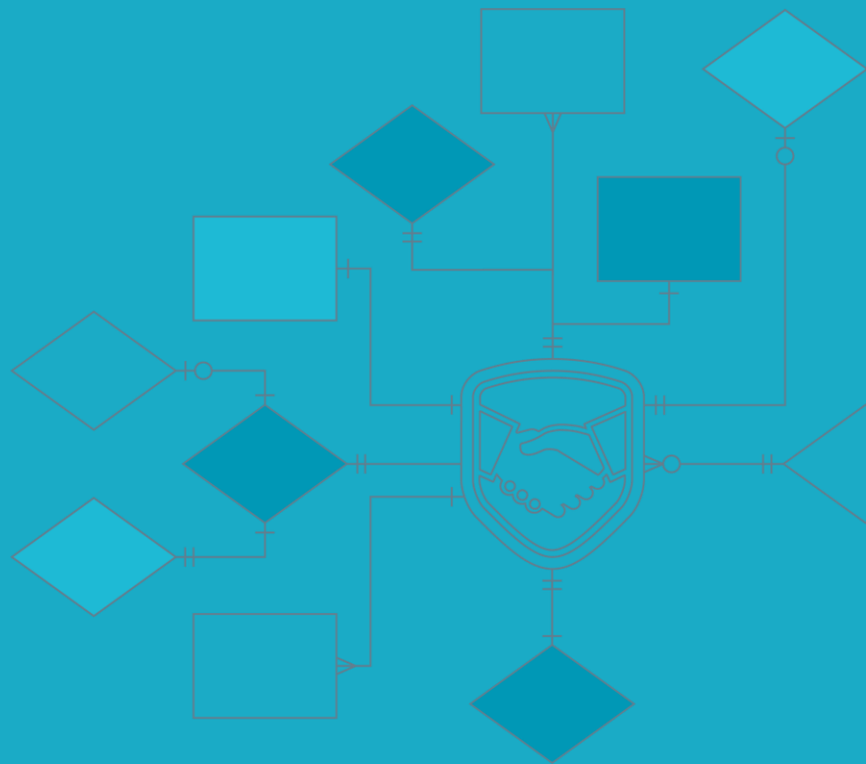
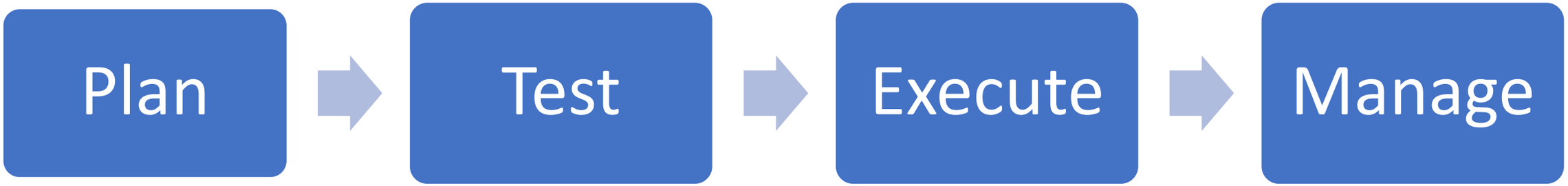
Procure SQL

Successfully migrate existing databases to Azure SQL Database

John Sterrett
Principal Consultant



Common Migration failures



Free Reference Material

Videos, Reference Links, Tips, and slide deck can be found at http://azuresqldbresources.procuresql.com/

Agenda

- Where Should My Data Go?
- How do I plan a successful migration?
- How to migrate my Data?
- How to leverage PaaS Benefits?
- What am I responsible for Post Migration?

About John Sterrett

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Data Platform

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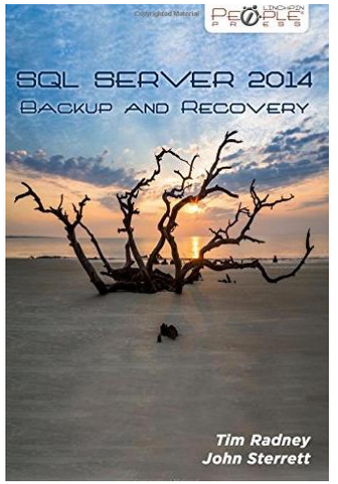
ProcureSQL



Three reasons people are migrating?

Cost Comparison

Qty	Item	Cost	Total Cost	Five Years	Ten Years
2	PowerEdge R930 2xE7-8893 v4 (16 cores)	54,224.05	$108,448.10	$21,689.62	$10,844.81
8	SQL 2016 Enterprise Cores (2 Core Pack)	14,256.00	$114,048.00	$22,809.60	$11,404.80
	Support				
	Power				
			$222,496.10	**$44,499.22**	**$22,249.61**
4	PowerEdge R930 2xE7-8893 v4 (16 cores)	54,224.05	$216,896.20	$43,379.24	$21,689.62
16	SQL 2016 Enterprise Cores (2 Core Pack)	14,256.00	**$342,144.00**	$68,428.80	$34,214.40
	Support				
	Power				
			$559,040.20	**$111,808.04**	**$55,904.02**

	Monthly	Yearly
Premium Elastic Database -eDTU 250	1,398.72	$16,784.64
Support (Standard)	300.00	$3,600.00
Power		$0.00
		$20,384.64
Premium Elastic Database - eDTU 1500	8,370.00	$100,440.00
Support (Professional Direct)	1,000.00	$12,000.00
		$112,440.00
P11 Single Database	7,001.04	$84,012.48
Support (Professional Direct)	1,000.00	$12,000.00
		$96,012.48

Security Enhancements

Azure SQL Features…

Security

Azure Data Sync

Active Geo-Replicas

Performance Insight

Automated Tuning

Adaptive Query Processing

Features Supported

SQL Server feature support in Azure SQL Database

The following table lists the major features of SQL Server and provides information about whether the feature is partially or fully supported and a link to more information about the feature.

SQL Feature	Supported by single databases and elastic pools	Supported by managed instances
Active geo-replication	Yes - all service tiers other than hyperscale	No, see Auto-failover groups
Auto-failover groups	Yes - all service tiers other than hyperscale	Yes, in public preview
Always Encrypted	Yes - see Cert store and Key vault	Yes - see Cert store and Key vault
Always On Availability Groups	High availability is included with every database. Disaster recovery is discussed in Overview of business continuity with Azure SQL Database	High availability is included with every database. Disaster recovery is discussed in Overview of business continuity with Azure SQL Database
Attach a database	No	No
Application roles	Yes	Yes

- https://docs.microsoft.com/en-us/azure/sql-database/sql-database-features

Where Should My Data Go?

Single Database (PaaS)

Elastic Pool (PaaS)

Managed Instance (PaaS)

SQL VM (IaaS)

Pricing Models

DTU [single database]

eDTU [elastic pool]

vCore

Hyperscale (Preview)

What is DTU?

Database Transaction Unit – DTU

Bounding box

Monitoring database workload utilization within bounding box

- Represents the relative power (resources) assigned to the database
- Blended measure of CPU, memory, and read-write rates
- Compare the power across performance levels
- Simplifies talking about performance, think IOPS vs. %

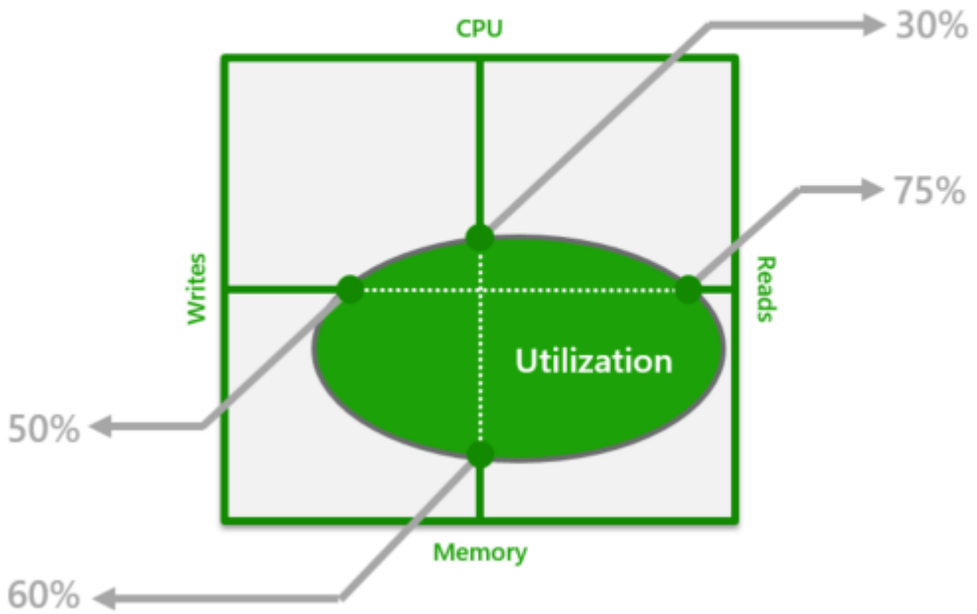


Image Source: [Microsoft Docs]

DTU vs vCore?

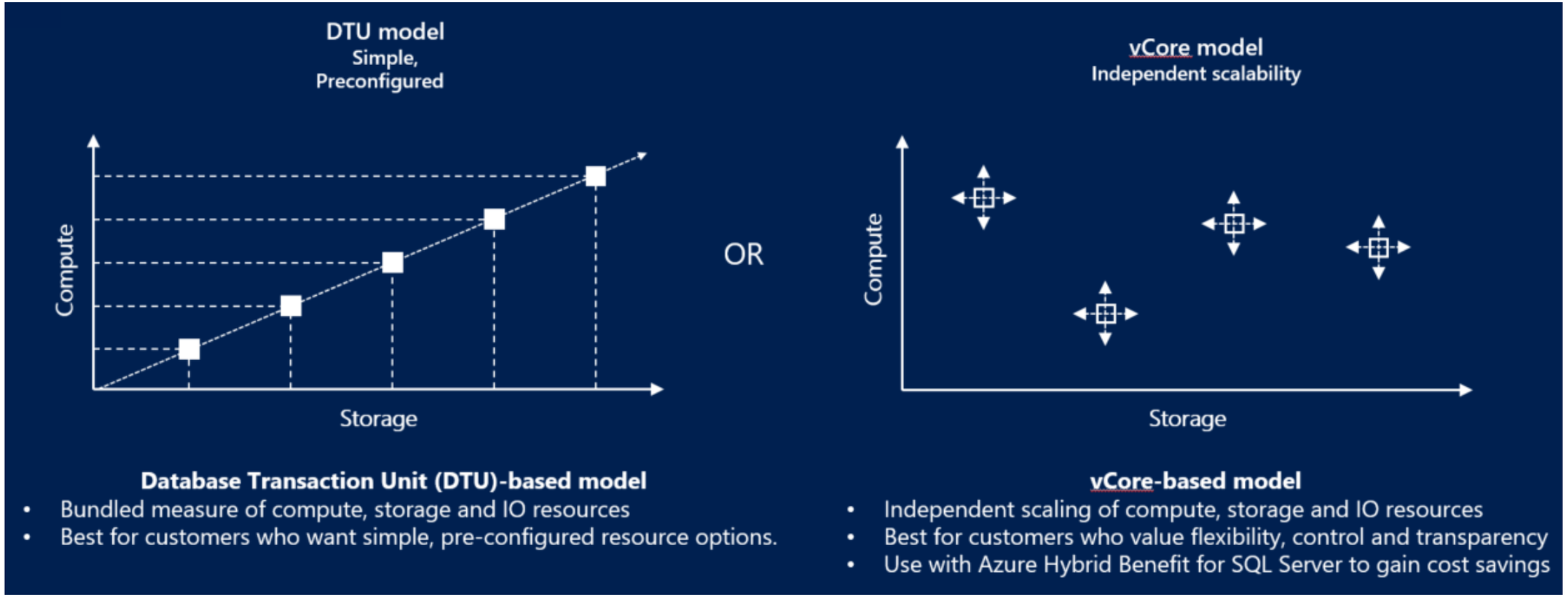
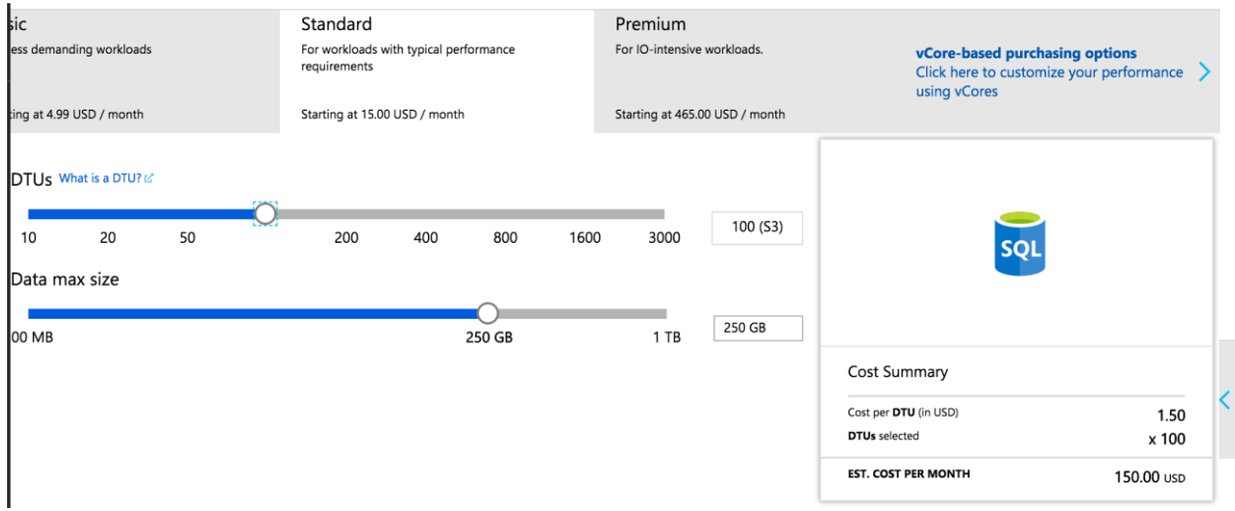


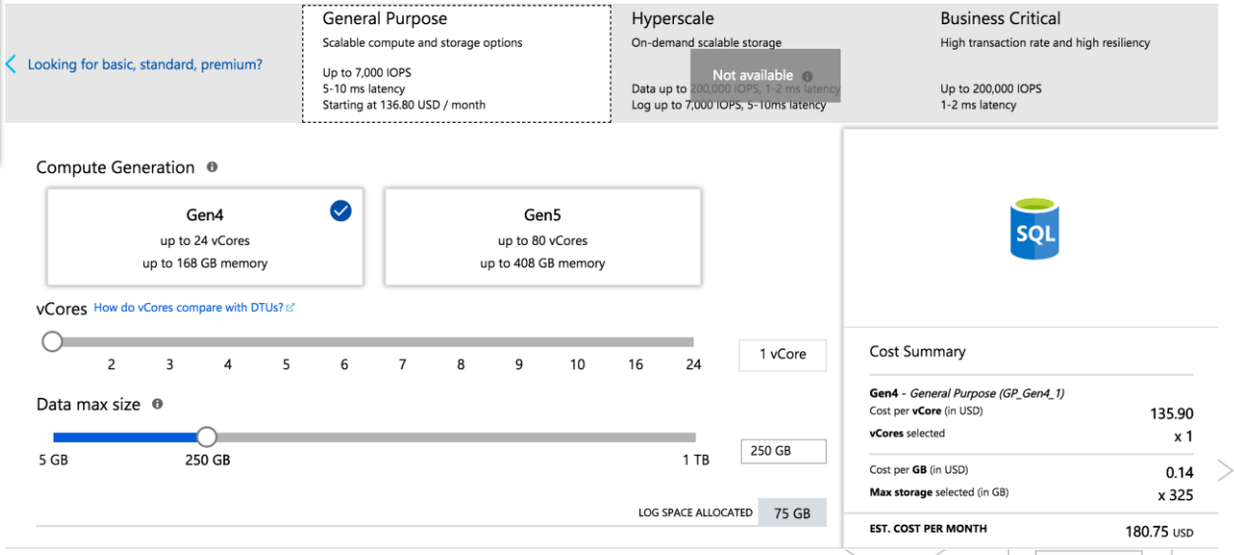
Image Source: [Microsoft Docs]

vCore to DTU ratio

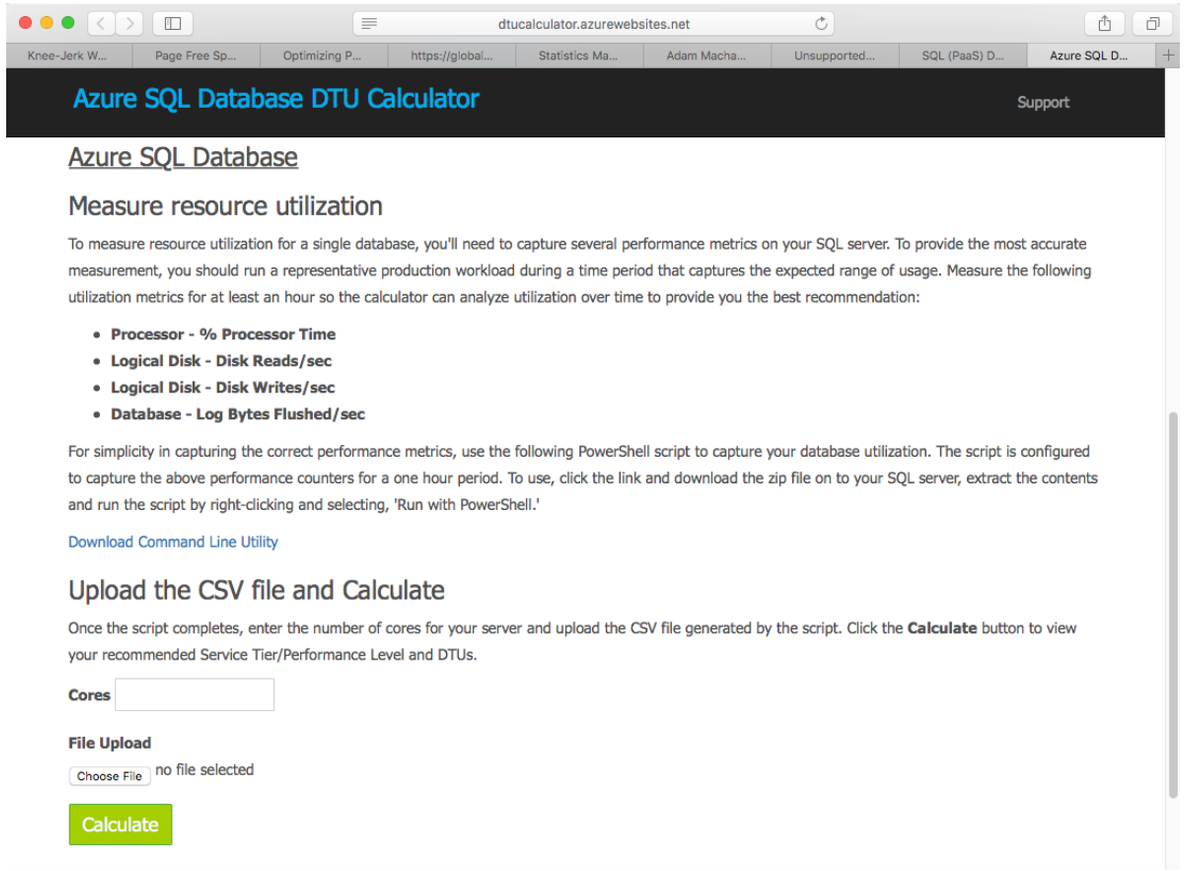
- Each **100 DTU in Standard** tier requires at least **1 vCore in General Purpose tier**
- Each **125 DTU in Premium** tier requires at least **1 vCore in Business Critical tier**

Pricing DTU vs vCore



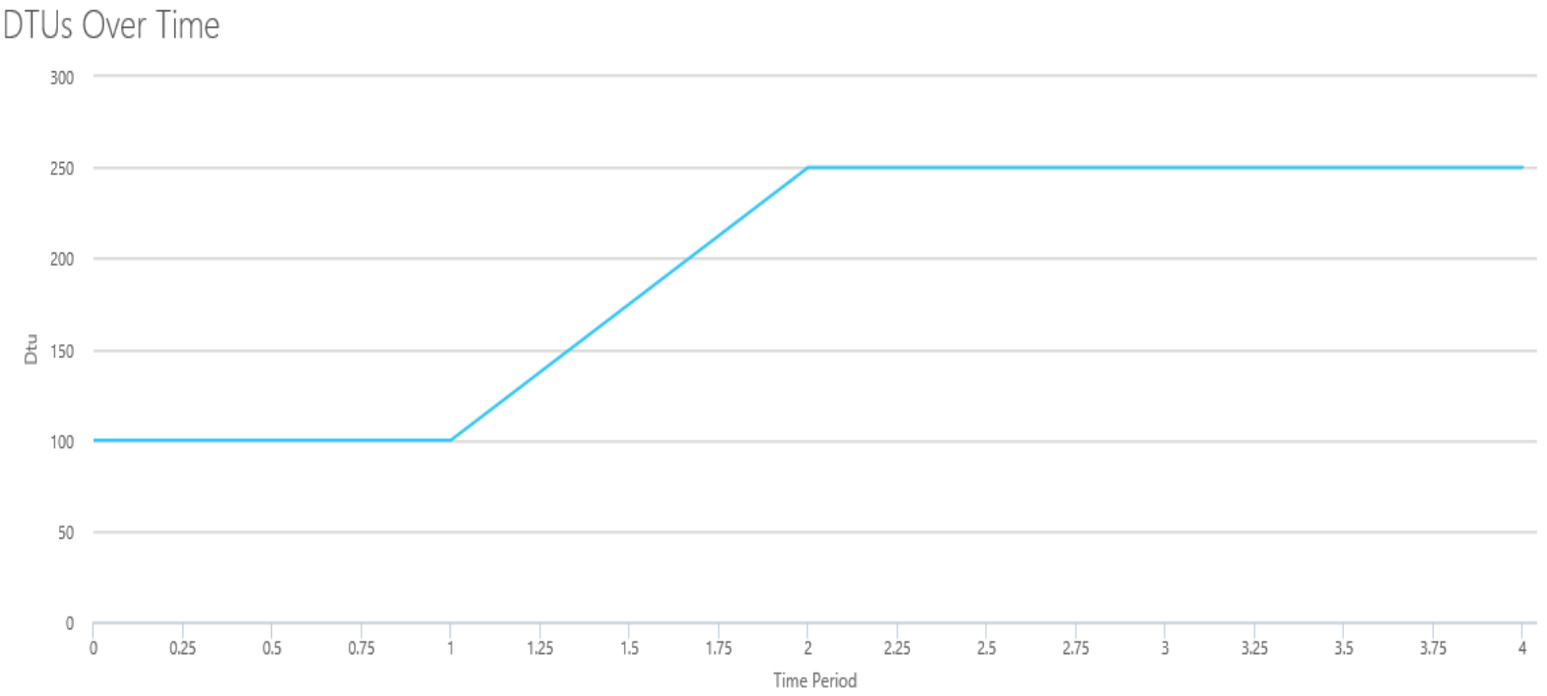


What performance tier should we use?



Dtucalculator.azurewebsites.net

DTU Calculator Results



Based on your database utilization, we recommend you migrate your SQL Server workload to **Premium - P2**. This Service Tier/Performance Level should cover approximately **100.00 %** of your utilization.

How do you successfully Migrate Databases?

Migrating Your Data To Azure SQL Database

Options to Move Your Data…

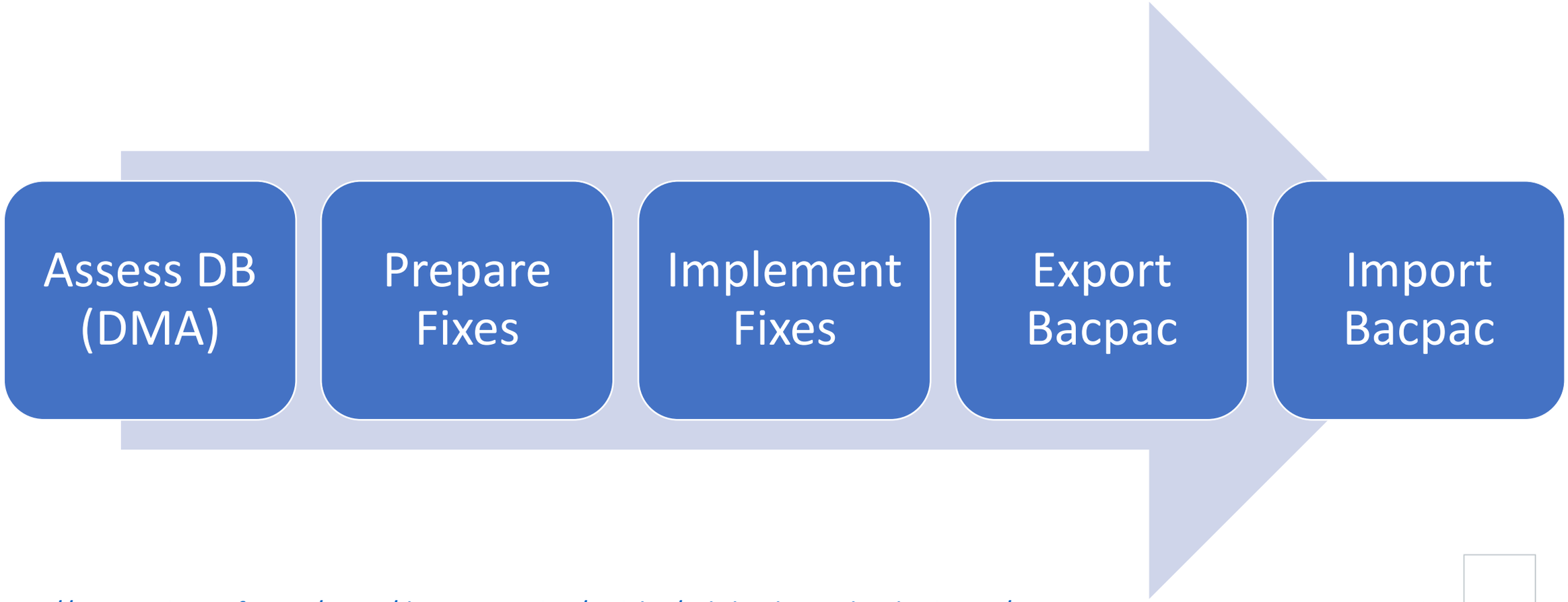
BACKPAC

Transactional Replication

Data Migration Service

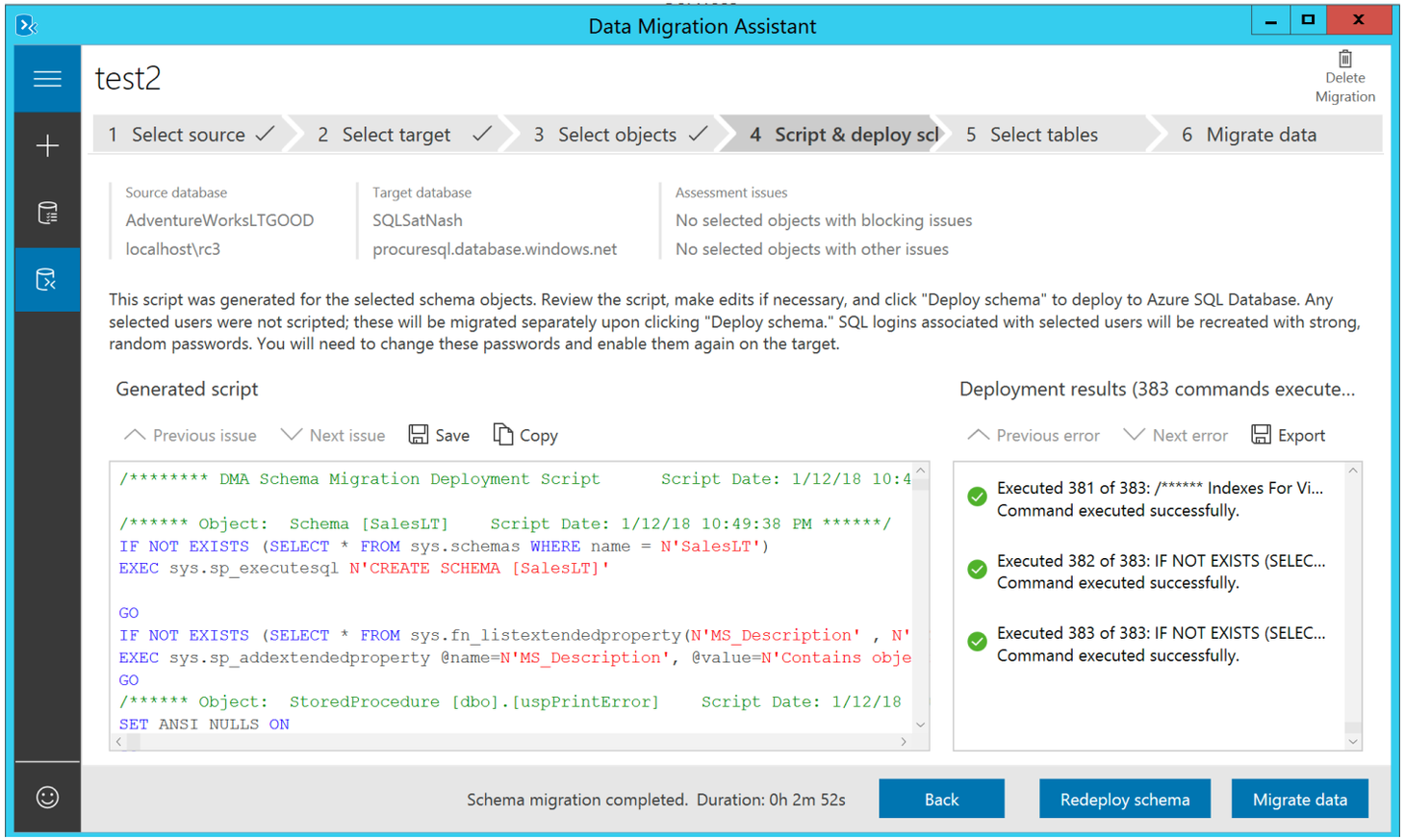
Restore Backup (Managed Instance)

Migrating to Azure SQL Database

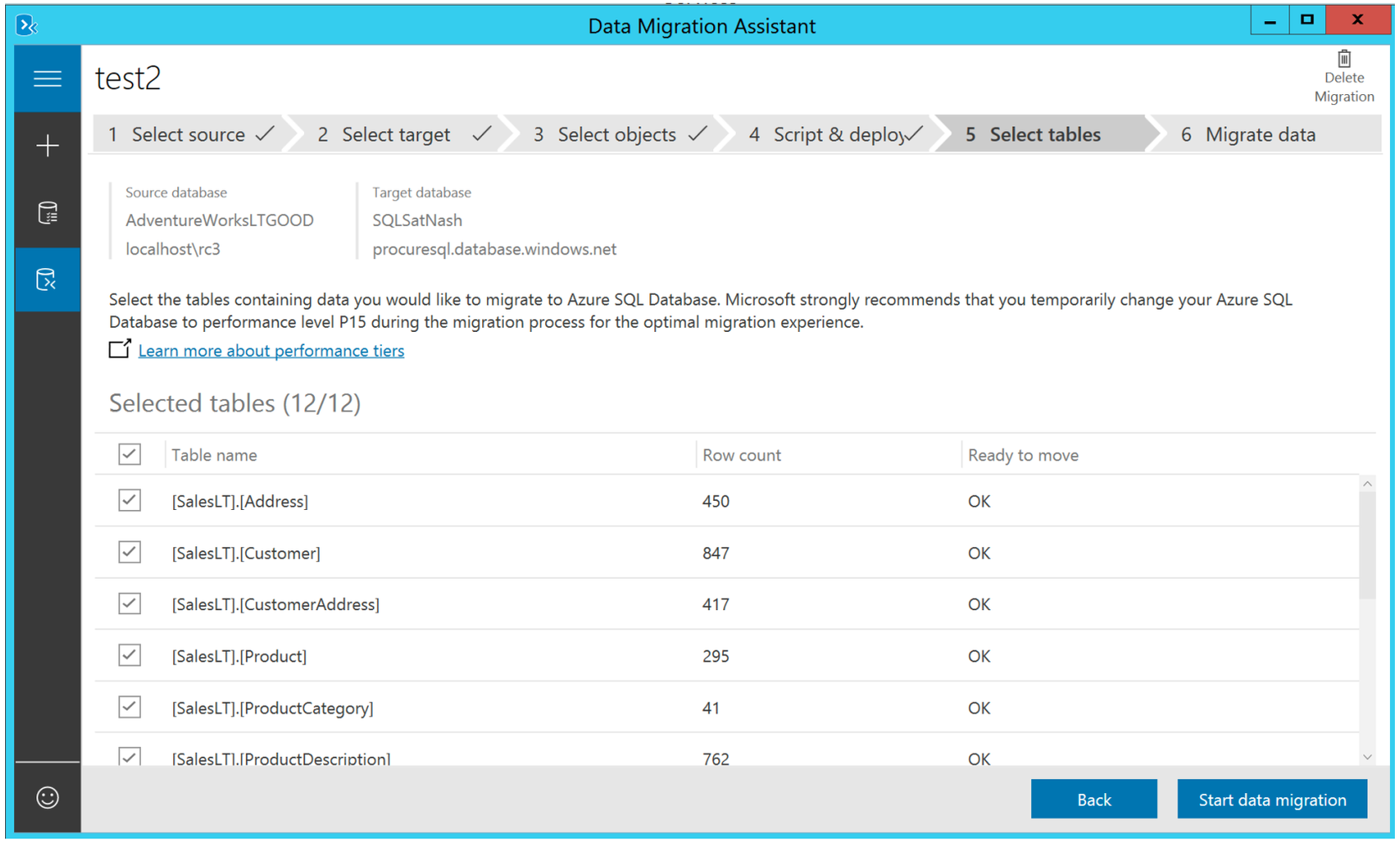


https://azure.microsoft.com/en-us/documentation/articles/sql-database-cloud-migrate/

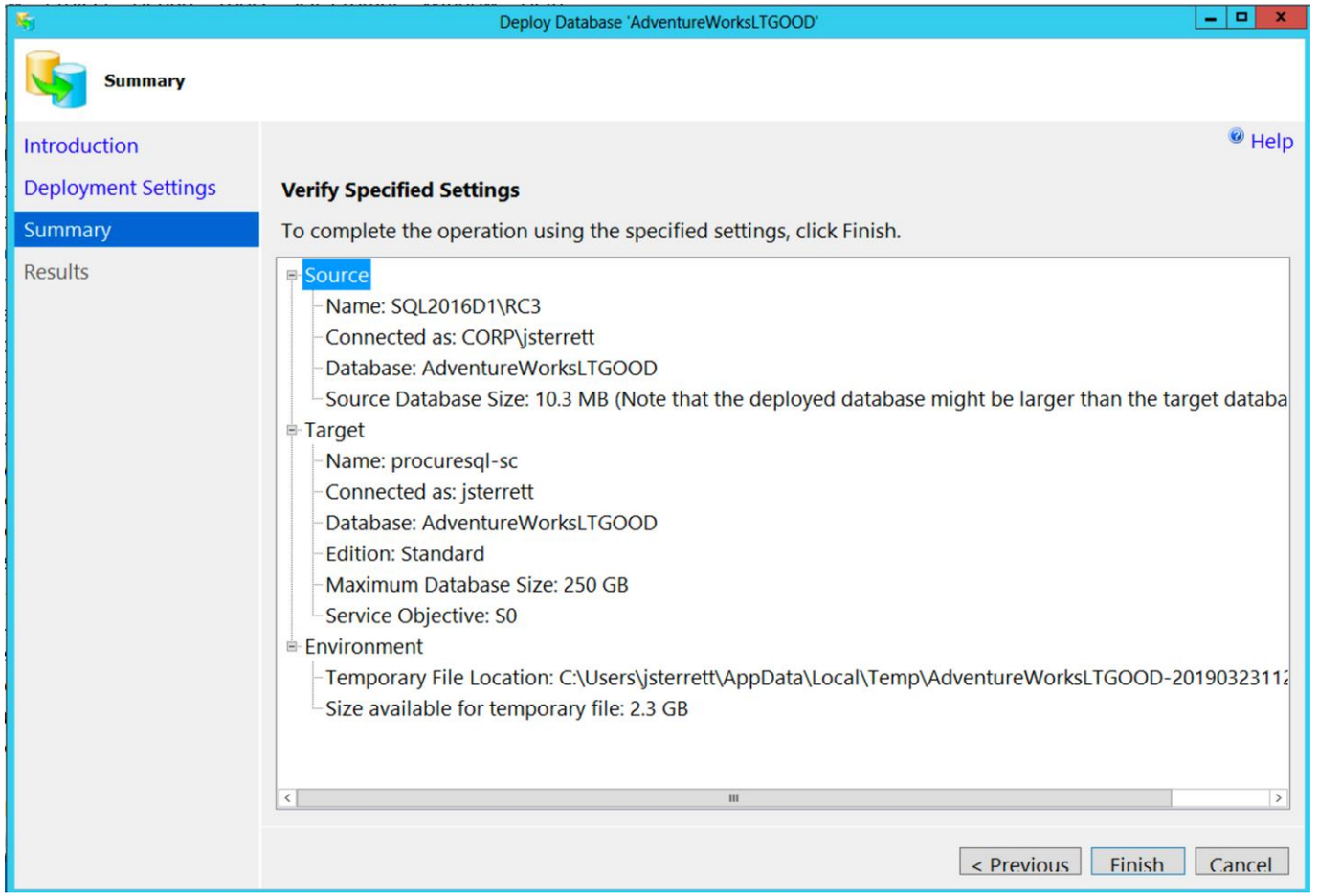
Migrate Schema with Data Migration Assistant



Select Tables to Move



Deploy with SSMS



Migrate with SQLPackage.exe

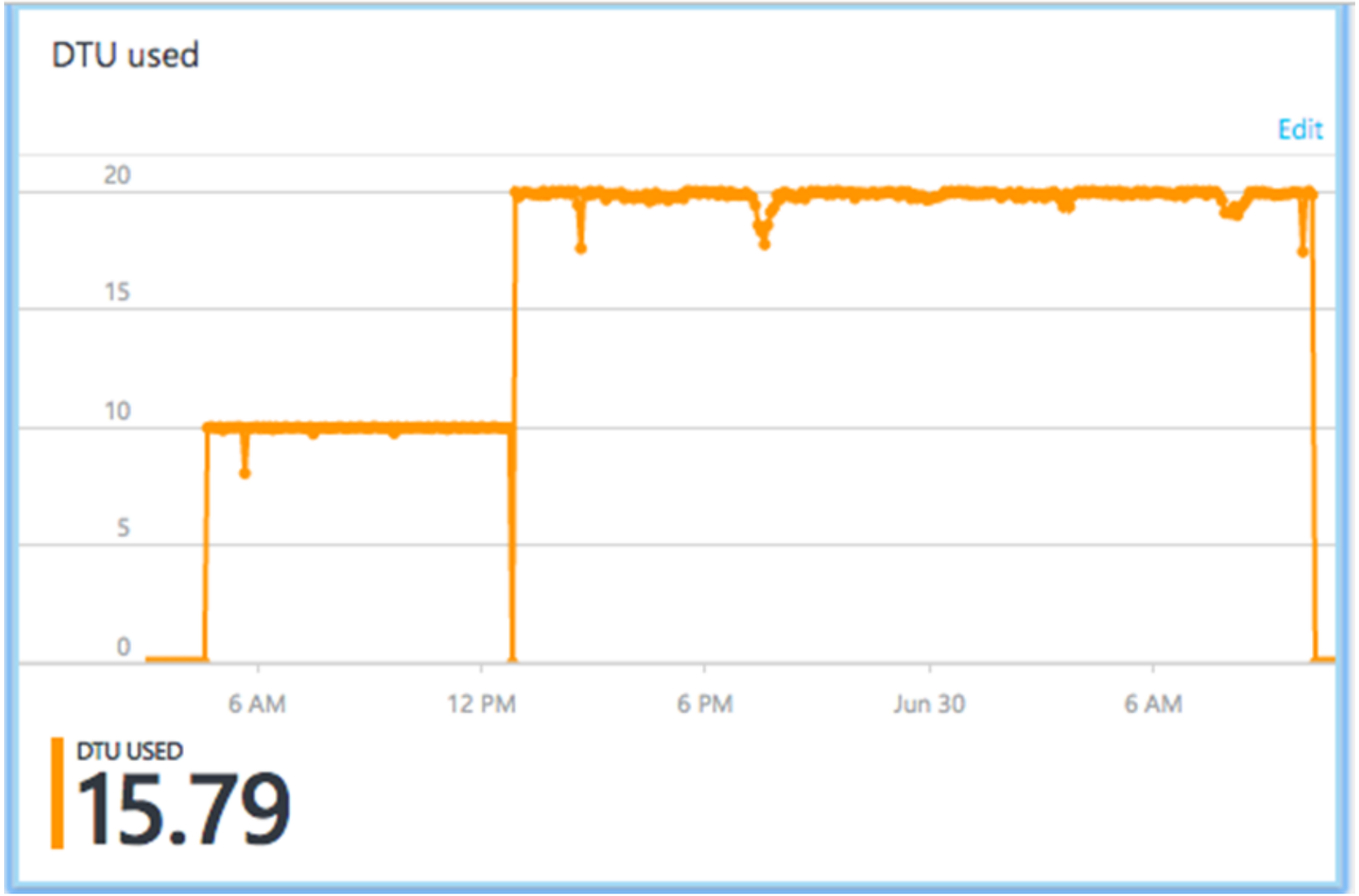
```
#Import bacpac to Azure SQL DB
.\SqlPackage.exe /a:import /tcs:"Server=tcp:procuresql-sc.database.windows.net,1433;Initial Catalog=TestDB;Persist
/sf:C:\Demo\MigrateAzureSQLDB\AdventureWorksLTGood.bacpac `
/p:DatabaseEdition=Standard /p:DatabaseServiceObjective=S1 /p:Storage=File
```

```
Processing Table '[SalesLT].[ProductDescription]'.
Processing Table '[SalesLT].[ProductModel]'.
Processing Table '[SalesLT].[ProductModelProductDescription]'.
Processing Table '[SalesLT].[SalesOrderDetail]'.
Processing Table '[SalesLT].[SalesOrderHeader]'.
Enabling indexes.
Enabling index 'IX_Address_AddressLine1_AddressLine2_City_StateProvince_PostalCode_CountryRegion'.
Enabling index 'IX_Address_StateProvince'.
Enabling index 'AK_Address_rowguid'.
Enabling index 'IX_Customer_EmailAddress'.
Enabling index 'AK_Customer_rowguid'.
Enabling index 'AK_CustomerAddress_rowguid'.
Enabling index 'AK_Product_Name'.
Enabling index 'AK_Product_ProductNumber'.
Enabling index 'AK_Product_rowguid'.
Enabling index 'AK_ProductCategory_Name'.
Enabling index 'AK_ProductCategory_rowguid'.
Enabling index 'AK_ProductDescription_rowguid'.
Enabling index 'AK_ProductModel_Name'.
Enabling index 'AK_ProductModel_rowguid'.
Enabling index 'AK_ProductModelProductDescription_rowguid'.
Enabling index 'IX_SalesOrderDetail_ProductID'.
Enabling index 'AK_SalesOrderDetail_rowguid'.
Enabling index 'IX_SalesOrderHeader_CustomerID'.
Enabling index 'AK_SalesOrderHeader_rowguid'.
Enabling index 'AK_SalesOrderHeader_SalesOrderNumber'.
Successfully imported database.

PS C:\Program Files\Microsoft SQL Server\150\DAC\bin>
```

Easy Guide to Quickly Migrating Data

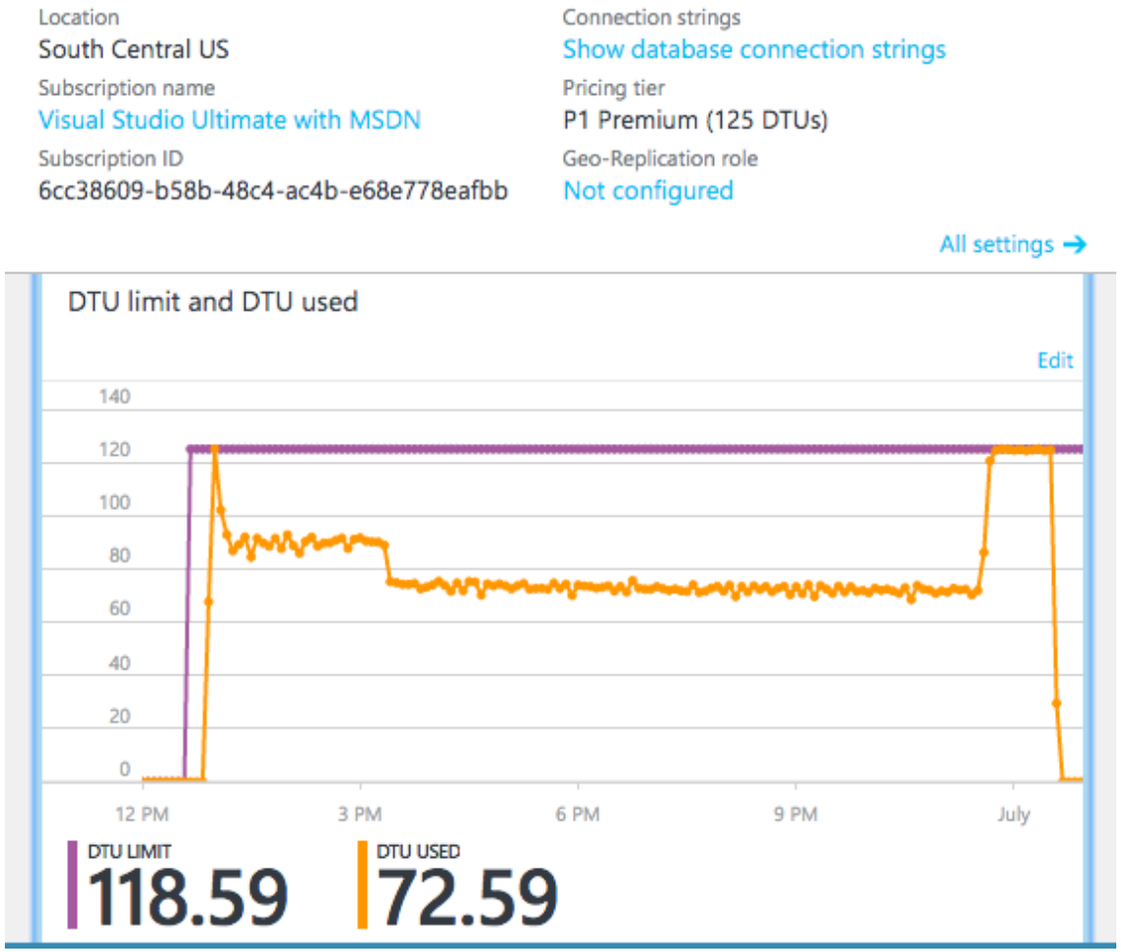
Migrating 60GB Database with S0



Overloading during Bulk Insert

Spid	command	Database	User	blocking_session_id	Status	Wait	sql_statement	Parent Query
51	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
52	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
53	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
80	BULK INSERT	StackOverflow	jsterrett	53	suspended	LCK_M_IX	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
81	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
82	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
88	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
89	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...

Migrating a 60gb Database to P1



How do you manage Azure SQL Databases Today?

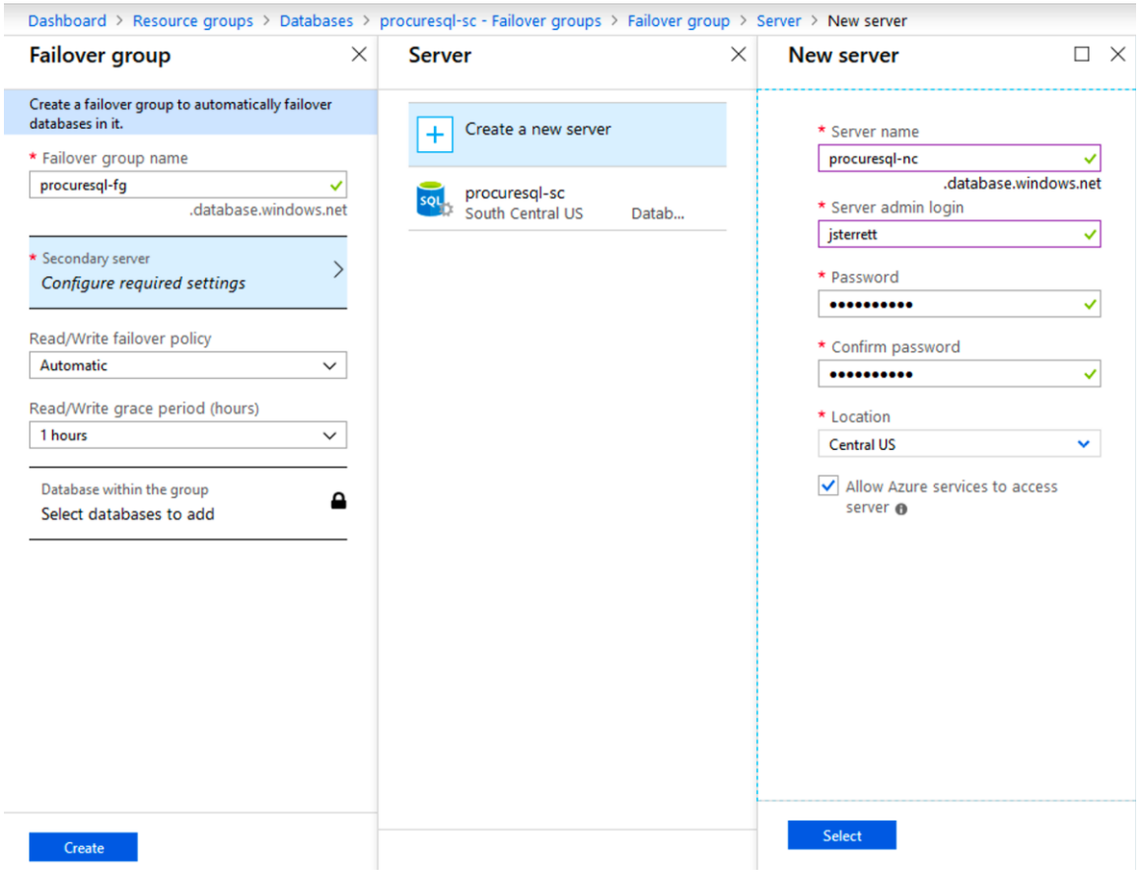
Biggest Database Management Mistake..

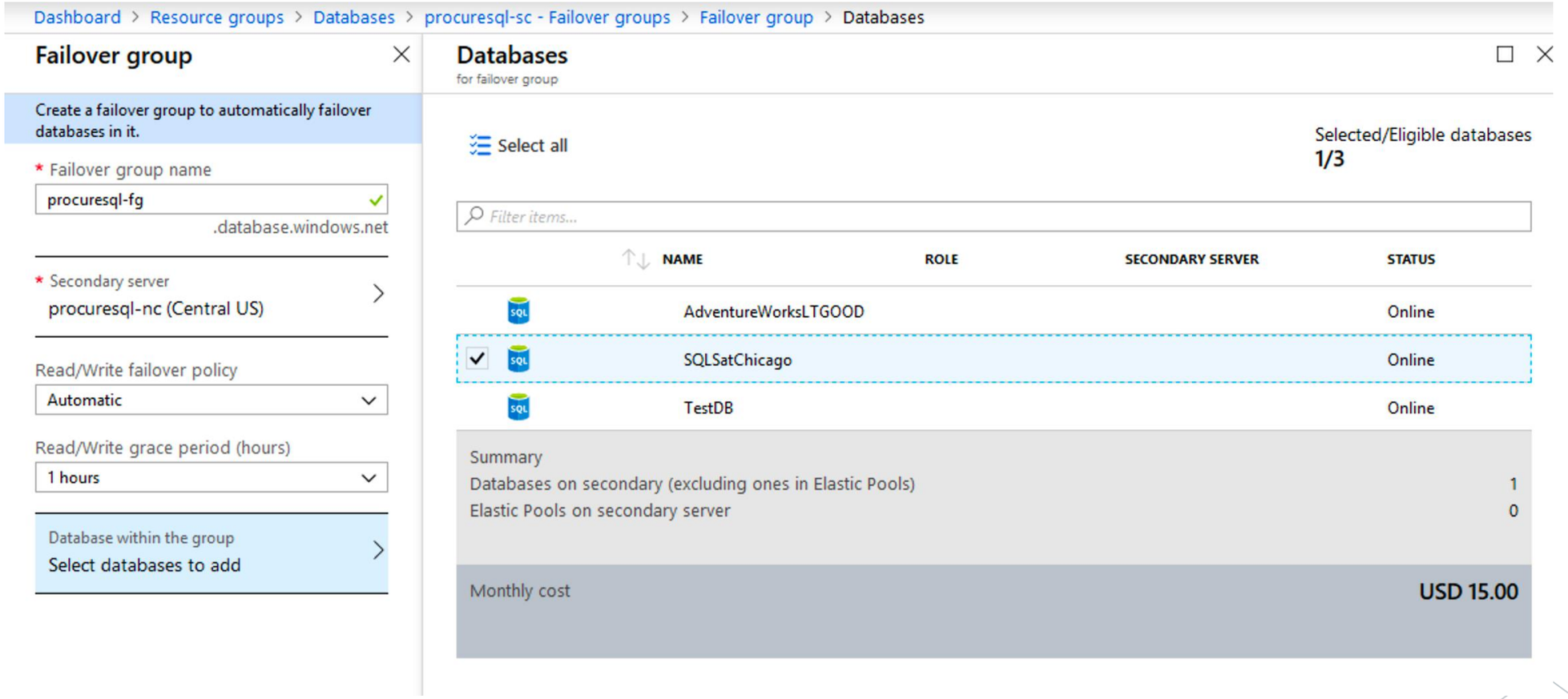
- Create it and forget it…

Manage Azure SQL DB Post Migration

Business continuity	Disaster Recovery	Security and Compliance
Sync Data	Data Transfer	Monitor and Improve Performance

High Availability with Failover Groups




Dashboard > Resource groups > Databases > procuresql-sc - Failover groups > Failover group > Databases
Failover group
Create a failover group to automatically failover databases in it.
* Failover group name
procuresql-fg
.database.windows.net
* Secondary server
procuresql-nc (Central US)
Read/Write failover policy
Automatic
Read/Write grace period (hours)
1 hours
Database within the group
Select databases to add
Databases
for failover group
Select all
Selected/Eligible databases
1/3
Filter items...
NAME
ROLE
SECONDARY SERVER
STATUS
AdventureWorksLTGOOD
Online
SQLSatChicago
Online
TestDB
Online
Summary
Databases on secondary (excluding ones in Elastic Pools)
1
Elastic Pools on secondary server
0
Monthly cost
USD 15.00

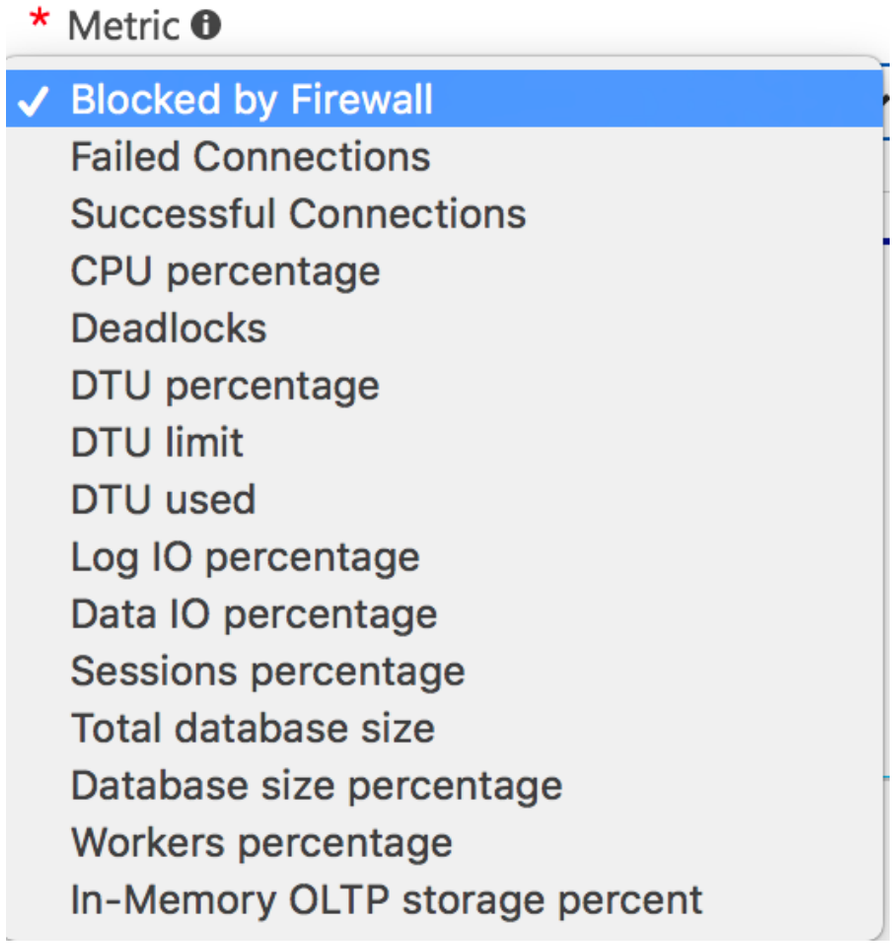
Azure Database Maintenance

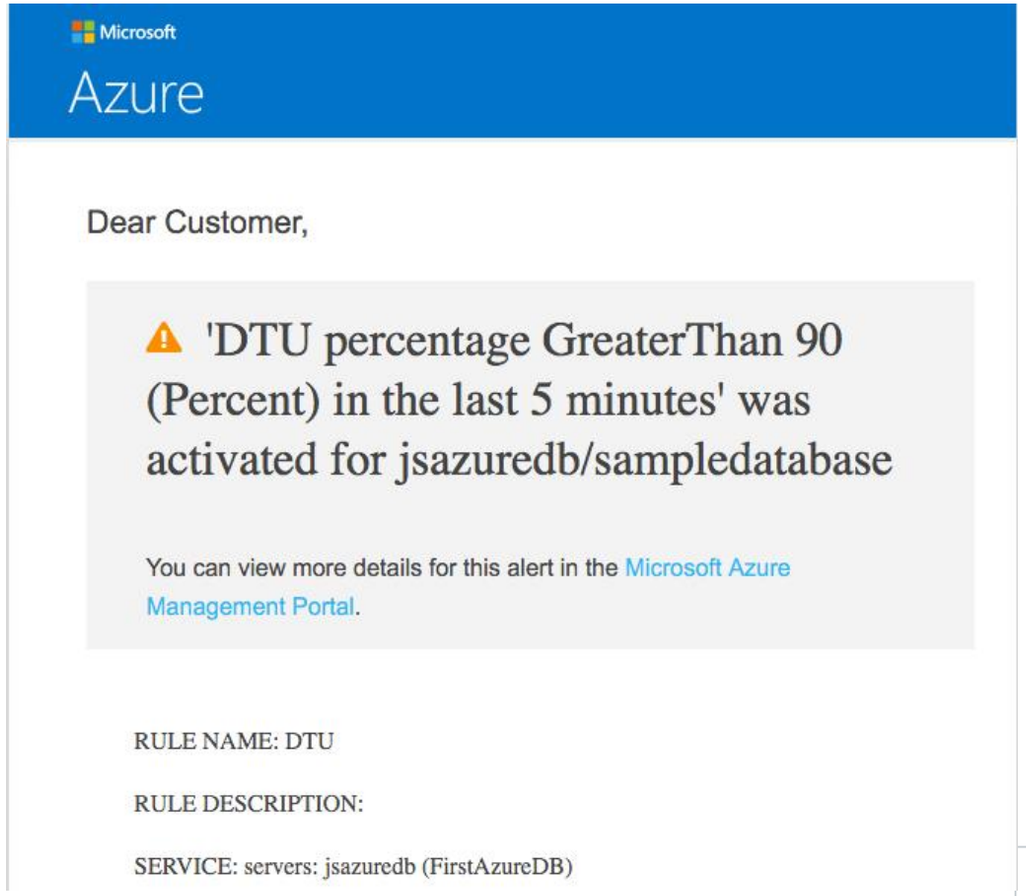
- ~~Integrity Checks~~ source
- Backups ??
- Restores (you control)
  - Point in Time
  - Deleted Database
  - Geo Restore
- Index Maintenance
  - Ola Hallengren Solution Works ;-)
- Statistics Maintenance
- GEO Replication / Failover Groups

Automating Maintenance Tasks

- ~~Azure SQL Agent~~ (Managed Instance Only)
- Linked Server
- PowerShell
- Azure
  - **Azure Automation**
  - Azure Elastic Jobs

Alerts


* Metric
Blocked by Firewall
Failed Connections
Successful Connections
CPU percentage
Deadlocks
DTU percentage
DTU limit
DTU used
Log IO percentage
Data IO percentage
Sessions percentage
Total database size
Database size percentage
Workers percentage
In-Memory OLTP storage percent


Microsoft
Azure
Dear Customer,
'DTU percentage GreaterThan 90 (Percent) in the last 5 minutes' was activated for jsazuredb/sampledatabase
You can view more details for this alert in the Microsoft Azure Management Portal.
RULE NAME: DTU
RULE DESCRIPTION:
SERVICE: servers: jsazuredb (FirstAzureDB)

How do you monitor and improve performance?

DTU in Azure Portal

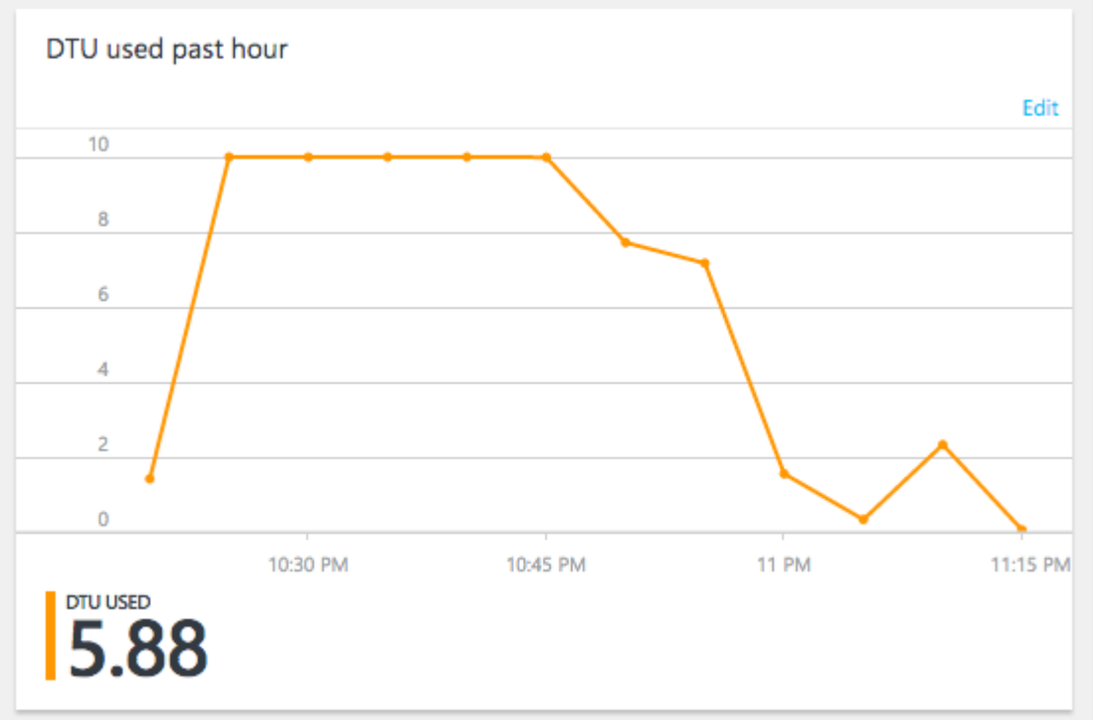


Photo Credit

What the DTU….

Did anyone understand what DTU Means? What is Power of database based on real-world measure?

What Really is DTU?

Photo Credit

http://bit.ly/AzureDTU

DTU Is…..

DTU = DTU Percent * DTU Limit

DTU Percent

```
(SELECT Max(v)
FROM (VALUES (avg_cpu_percent),
 (avg_data_io_percent),
 (avg_log_write_percent)) AS value(v)) AS
[avg_DTU_percent]
```

Calculating DTU

```
ISNULL(dtu_limit,0) *
     (SELECT Max(v)
          FROM (VALUES (avg_cpu_percent),
(avg_data_io_percent),
(avg_log_write_percent)) AS value(v)) / 100.0 AS DTU
```

SYS.DM_DB_RESOURCE_STATS

- User Database
- Captured Every Fifteen Seconds
- One Hour Historical Data
- Idle Database has Data

SYS.RESOURCE_STATS

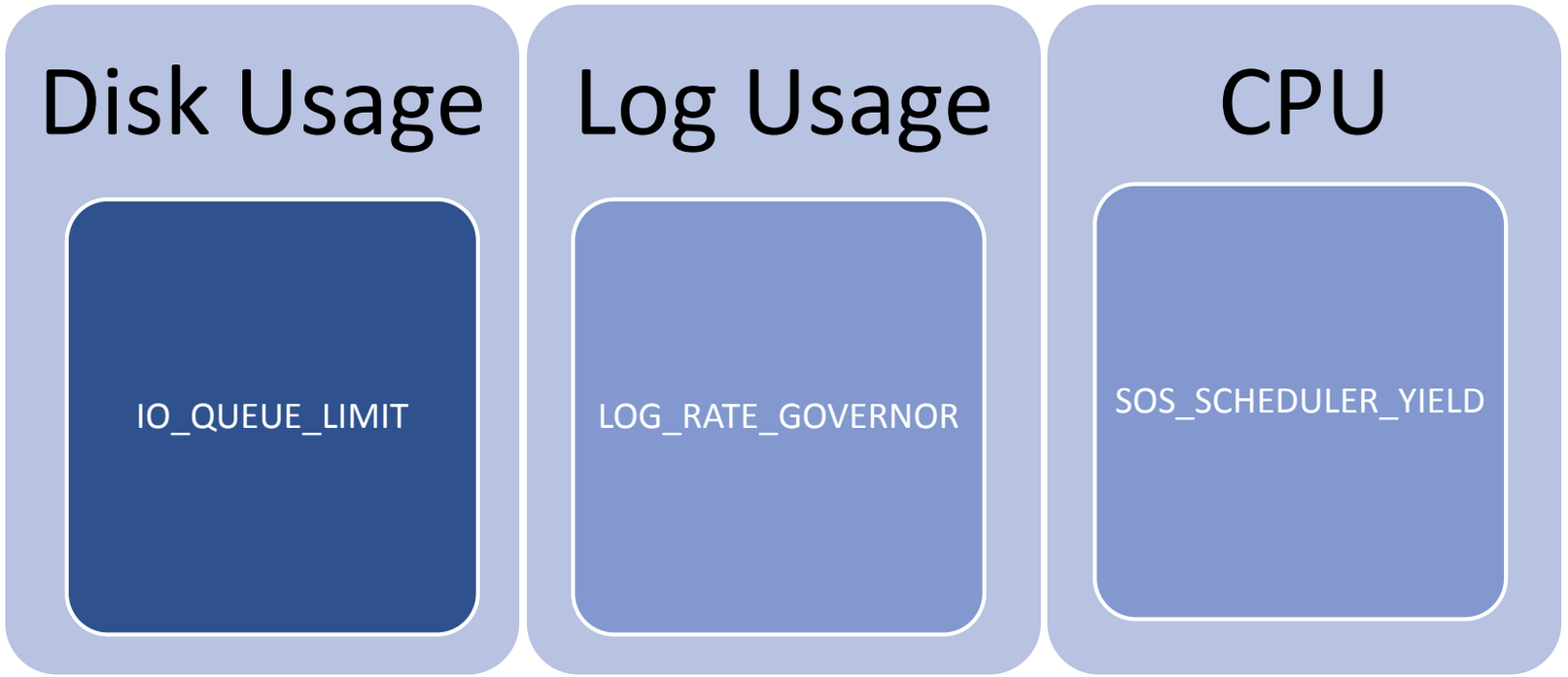
- Master Database
- Every Five Minutes
- 14 Days Historical Data
- Idle databases may not have rows

DTU DMV Example

dtu_limit	avg_DTU_percent	DTU	avg_cpu_percent	avg_data_io_percent	avg_log_write_percent	avg_memory_usage_percent	xtp_storage_percent	max_worker_percent	max_session_percent
10	99.61	9.9610000	99.61	0.00	0.63	98.46	0.00	40.00	6.50
10	99.66	9.9660000	99.66	0.00	0.53	98.46	0.00	40.00	6.16
10	99.52	9.9520000	99.52	0.00	0.48	98.46	0.00	41.66	6.33
10	95.29	9.5290000	95.29	0.00	0.80	98.46	0.00	36.66	6.50
10	96.47	9.6470000	96.47	0.00	0.40	98.45	0.00	40.00	6.33
10	95.09	9.5090000	95.09	0.00	0.21	98.45	0.00	41.66	6.00
10	98.17	9.8170000	98.17	0.00	0.20	98.45	0.00	41.66	6.16
10	99.58	9.9580000	99.58	0.00	0.00	98.45	0.00	41.66	6.00
10	99.44	9.9440000	99.44	0.00	0.37	98.44	0.00	41.66	6.33
10	99.80	9.9800000	99.80	0.00	0.63	98.44	0.00	38.33	6.50
10	99.61	9.9610000	99.61	0.00	1.05	98.44	0.00	40.00	6.50

Azure Wait Stats

Azure SQL Database Waits



bit.ly/azureSQLWaits

Wait Statistics

WaitType	wait_S	Resource_S	Signal_S	WaitCount	Avg_Wait_S	Avg_Resource_S	Avg_Signal_S	CaptureDate
LOG_RATE_GOVERNOR	119.20000	113.43100	5.76900	14587	0.008172	0.007776	0.000395	2016-06-30 19:12:15.160
LCK_M_IX	17.14000	17.13900	0.00100	3	5.713333	5.713000	0.000333	2016-06-30 19:12:15.160
PAGELATCH_EX	4.65200	4.49400	0.15800	822	0.005659	0.005467	0.000192	2016-06-30 19:12:15.160
SOS_SCHEDULER_YIELD	1.89200	0.00000	1.89200	310	0.006103	0.000000	0.006103	2016-06-30 19:12:15.160
PAGELATCH_SH	1.02300	0.90600	0.11700	44	0.023250	0.020591	0.002659	2016-06-30 19:12:15.160
ASYNC_NETWORK_IO	336.65800	335.51500	1.14300	10089	0.033369	0.033256	0.000113	2016-06-30 19:13:15.687
LOG_RATE_GOVERNOR	100.87600	95.99900	4.87700	13285	0.007593	0.007226	0.000367	2016-06-30 19:13:15.687
LCK_M_IX	19.12000	19.11900	0.00100	5	3.824000	3.823800	0.000200	2016-06-30 19:13:15.687
PAGELATCH_EX	9.14000	8.97200	0.16800	641	0.014259	0.013997	0.000262	2016-06-30 19:13:15.687
SOS_SCHEDULER_YIELD	1.91800	0.00000	1.91800	292	0.006568	0.000000	0.006568	2016-06-30 19:13:15.687
PAGELATCH_SH	1.21700	1.07000	0.14700	140	0.008693	0.007643	0.001050	2016-06-30 19:13:15.687

CPU Throttling

captureDate	WaitType	Wait_S	Resource_S	Signal_S	WaitCount	Avg_Wait_S
2016-08-30 06:01:58.987	SOS_SCHEDULER_YIELD	2.35800	0.00100	2.35700	87	0.027103
2016-08-30 06:09:59.513	SOS_SCHEDULER_YIELD	5.42400	-0.00100	5.42500	16	0.339000
2016-08-30 06:10:59.553	SOS_SCHEDULER_YIELD	1.49800	0.00100	1.49700	5	0.299600

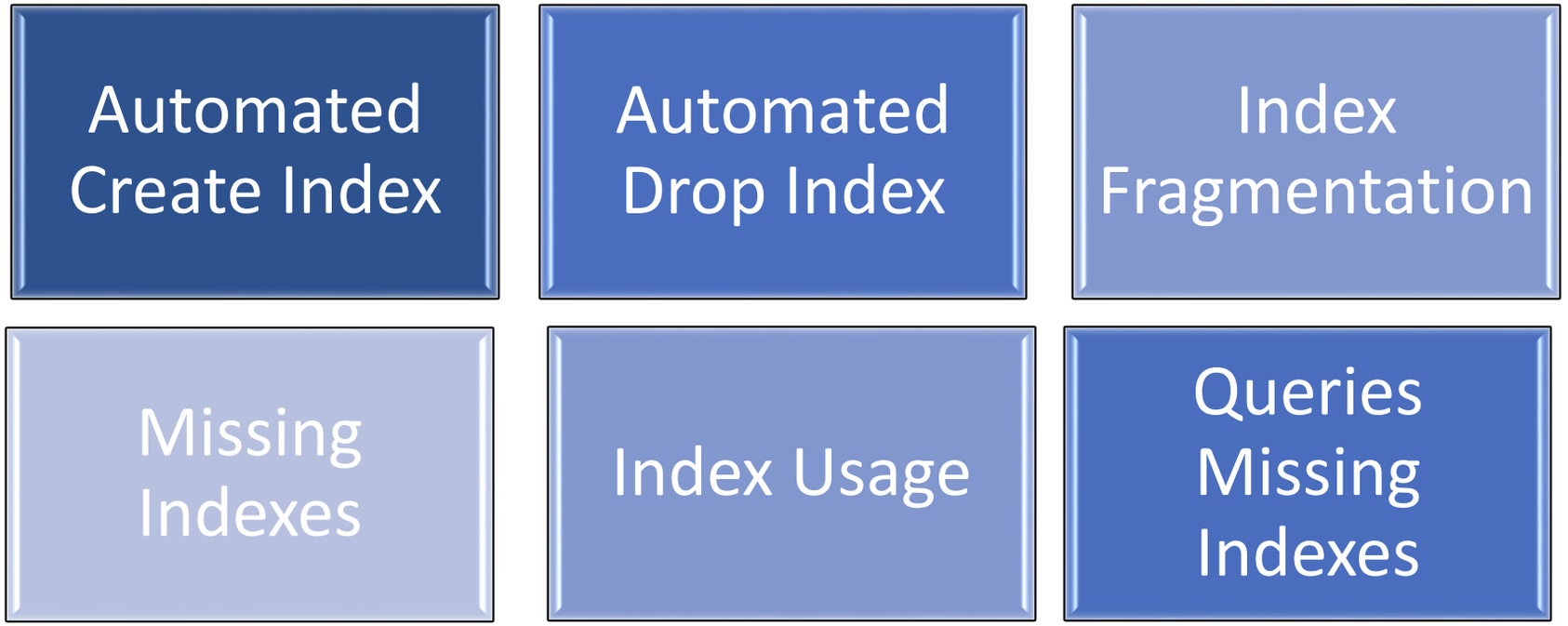
end_time	dtu_limit	avg_DTU_percent	DTU	avg_cpu_percent	avg_data_io_percent
2016-08-30 06:11:03.677	10	26.05	2.6050000	26.05	0.00
2016-08-30 06:10:48.647	10	99.28	9.9280000	99.28	0.00
2016-08-30 06:10:33.630	10	97.72	9.7720000	97.72	0.00
2016-08-30 06:10:18.613	10	99.50	9.9500000	99.50	0.00
2016-08-30 06:10:03.580	10	99.72	9.9720000	99.72	0.00
2016-08-30 06:09:48.580	10	99.52	9.9520000	99.52	0.00
2016-08-30 06:09:33.567	10	99.42	9.9420000	99.42	0.00
2016-08-30 06:09:18.563	10	99.58	9.9580000	99.58	0.00

I/O Throttling

Spid	command	Database	User	blocking_session_id	Status	Wait	sql_statement	Parent Query
51	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
52	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
53	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
80	BULK INSERT	StackOverflow	jsterrett	53	suspended	LCK_M_IX	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
81	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
82	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
88	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...
89	BULK INSERT	StackOverflow	jsterrett	0	suspended	LOG_RATE_GOVERNOR	<?query -- insert bulk [dbo].[Posts] ([Id] Int...	insert bulk [dbo].[Posts] ([Id] Int, [AcceptedAns...

Spid	command	Database	User	blocking_session_id	Status	Wait	sql_statement
109	SELECT	StackOverflow	jsterrett	0	suspended	IO_QUEUE_LIMIT	<?query -- CREATE PROCEDURE dbo.GetCommentsForP...

Indexes in Azure SQL Database



Automated Index Tuning

Recommendations

ACTION	RECOMMENDATION DESCRIPTION		IMPACT
CREATE INDEX	Table: Indexed columns:	[test_table_0.430709] [index_1],[index_2],[index_3]	HIGH IMPACT
CREATE INDEX	Table: Indexed columns:	[test_table_0.914675] [index_1],[index_2],[index_3]	HIGH IMPACT
DROP INDEX (PREVIEW)	Index name: Reason:	IR_[test_schema]_[test_table_0.112348]_CD2E5085881888FC9A4 Duplicate index	HIGH IMPACT
DROP INDEX (PREVIEW)	Index name: Reason:	IR_[test_schema]_[test_table_0.950691]_9A67D9E88A31B315D14 Duplicate index	HIGH IMPACT
FIX SCHEMA ISSUES (PREVIEW)	Error code: Error message:	208 Invalid object name 'dbo.Companies'.	HIGH IMPACT

Tuning history

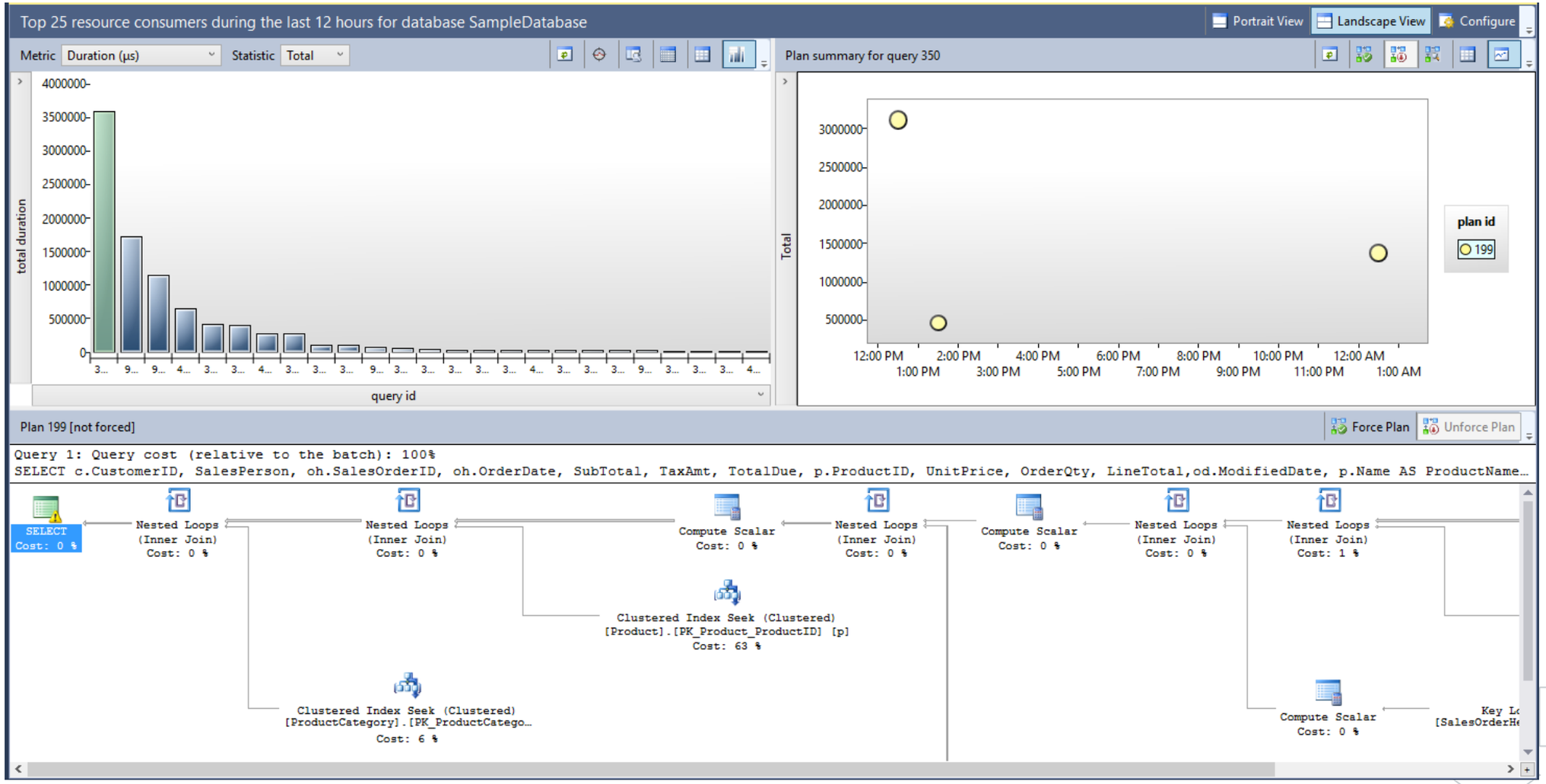
ACTION	RECOMMENDATION DESCRIPTION		STATUS	TIME
DROP INDEX (PREVIEW) Initiated by: User	Index name: Reason:	IR_[test_schema]_[test_table_0.182511]_1665B81581 Duplicate index	Success	4/25/2016 4:28:05 PM
CREATE INDEX Initiated by: User	Table: Indexed columns:	[test_table_0.138289] [index_1],[index_2],[index_3]	Success	4/25/2016 4:27:57 PM
PARAMETERIZE QUERIES (PREVIEW) Initiated by: N/A	Scope: Reason:	Entire database Non-parameterized queries are causing performanc	Success	4/21/2016 4:40:30 PM
DROP INDEX (PREVIEW) Initiated by: User	Index name: Reason:	IR_[test_schema]_[test_table_0.574879]_C13F85C293 Duplicate index	Error	4/25/2016 4:28:05 PM

Azure SQL Database Tuning Tools

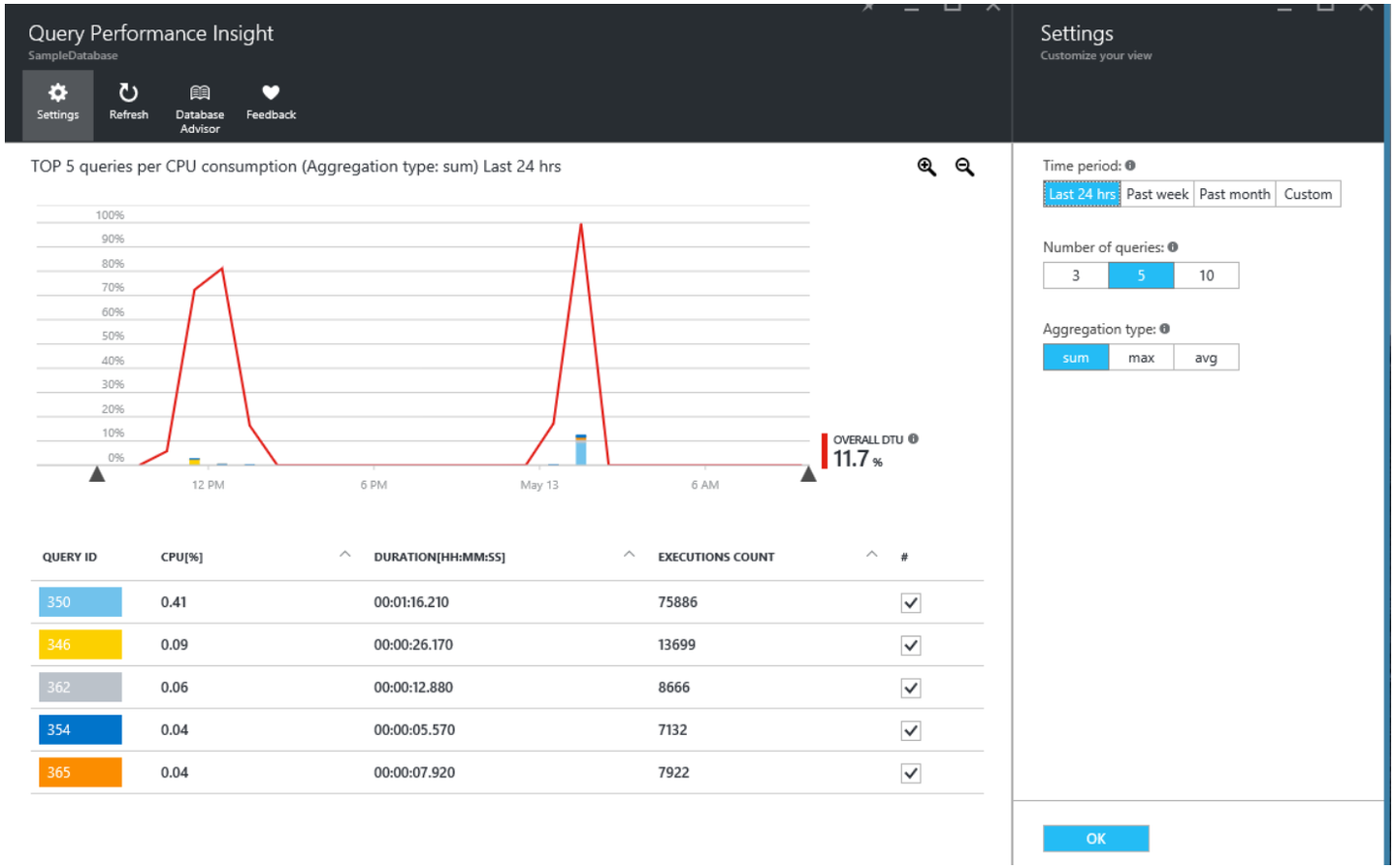
Azure SQL Database Performance Tools

Query Store	DMVs	Extended Events
Azure Portal	Query Performance Insight	Auto-Tuning Index

Query Store


Top 25 resource consumers during the last 12 hours for database SampleDatabase
Portrait View
Landscape View
Configure
Metric
Duration (µs)
Statistic
Total
total duration
query id
Plan summary for query 350
Total
plan id
199
Plan 199 [not forced]
Force Plan
Unforce Plan
Query 1: Query cost (relative to the batch): 100%
SELECT c.CustomerID, SalesPerson, oh.SalesOrderID, oh.OrderDate, SubTotal, TaxAmt, TotalDue, p.ProductID, UnitPrice, OrderQty, LineTotal,od.ModifiedDate, p.Name AS ProductName…
SELECT
Cost: 0 %
Nested Loops
(Inner Join)
Cost: 0 %
Nested Loops
(Inner Join)
Cost: 0 %
Compute Scalar
Cost: 0 %
Nested Loops
(Inner Join)
Cost: 0 %
Compute Scalar
Cost: 0 %
Nested Loops
(Inner Join)
Cost: 0 %
Nested Loops
(Inner Join)
Cost: 1 %
Clustered Index Seek (Clustered)
[Product].[PK_Product_ProductID] [p]
Cost: 63 %
Clustered Index Seek (Clustered)
[ProductCategory].[PK_ProductCatego…
Cost: 6 %
Compute Scalar
Cost: 0 %

Query Performance Insight



Automatic Tuning

Tuning history

	ACTION	RECOMMENDATION DESCRIPTION
	**CREATE INDEX** Initiated by: System	Table: [Users] Indexed columns: [Age]

	FORCE PLAN	ON	OFF	INHERIT
	CREATE INDEX	ON	OFF	INHERIT
	DROP INDEX	ON	OFF	INHERIT

Thank you!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