



SQLSATURDAY

Jacksonville 2022 #1022

SQL in the Cloud Comparing Azure, AWS & GCP

Darius Liktorius

Senior Solution Architect


Cognizant Softvision


#SQLSatJax





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Monthly Meetings
3rd Wednesday of each month
jssug.org

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Over 27 years of experience with SQL Server specializing in scalability, availability and performance tuning.

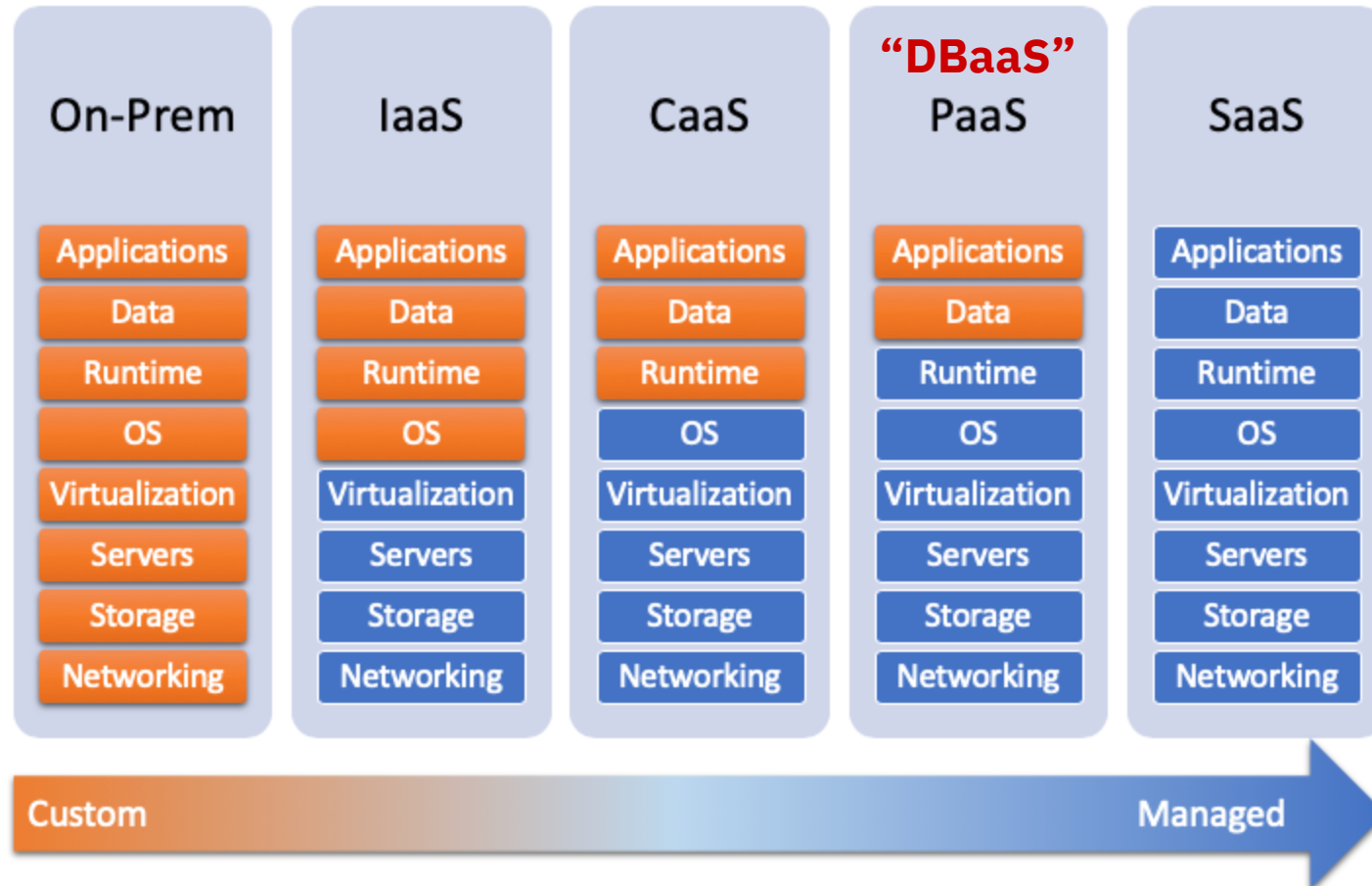
- Senior Solution Architect with Cognizant Softvision
- Co-Founder of Microsoft Cloud South Florida User Group

Agenda

- SQL Server in the Cloud
- Cloud Storage for SQL Server
- Migrating your Databases
- Licensing in the Cloud
- Q & A

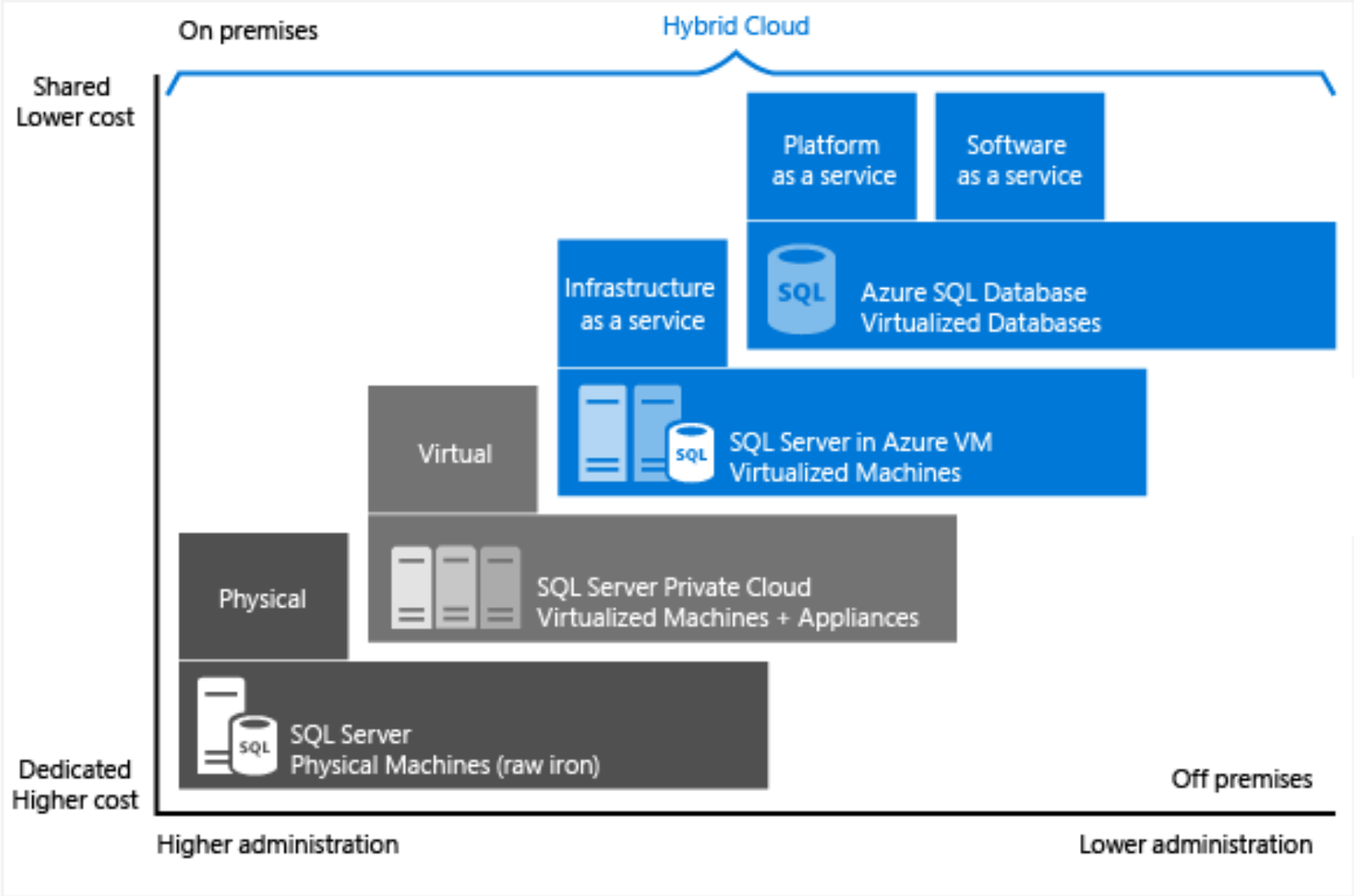
SQL Server in the Cloud

Application Hosting Models



Source: <https://subscription.packtpub.com/book/application-development/9781789538519/9/ch09lv1sec54/choosing-the-right-app-model>

Microsoft SQL Server Data Platform



Amazon RDS



GCP Cloud SQL



AWS EC2 Instance



GCP Compute Engine



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SQL Server – IaaS (Virtual Machines)

Azure

On Virtual Machines

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features
- You maintain the VM, Security, Updates, etc.
- Up to 64 x 65 TiB
= **4,160 TiB**

AWS

On EC2 Instances (VMs)

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features
- You maintain the VM, Security, Updates, etc.
- Up to 27 x 256 TiB
= **6,912 TiB**

GCP

On Compute Engine (VMs)

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features
- You maintain the VM, Security, Updates, etc.
- Up to **257 TB** total

Relational/SQL – DBaaS (Managed)

Azure

Azure Database for MariaDB

Azure Database for MySQL

Azure Database for PostgreSQL

AWS

Amazon Relational Database Service (RDS)

- MariaDB
- MySQL
- Microsoft SQL Server
- Oracle
- PostgreSQL

GCP

Cloud SQL for MySQL

Cloud SQL for PostgreSQL

Cloud SQL for SQL Server

SQL Server – DBaaS (Managed)

Azure

SQL Database Managed Instance

- `sqlserver.exe`
- **Latest version of MS SQL**
- Enterprise Edition only
- **No**: SSIS, SSRS or SSAS
- **Most feature-complete**
- 16 TB disk / 870 GB memory
- Multi-AZ Supported
- Tiers: GP 5-10ms, BC 1-2ms

AWS

Amazon RDS for SQL Server

- `sqlserver.exe`
- Versions: 2012 thru 2019
- Enterprise, Standard, Web, Express
- **No**: SSIS, SSRS or SSAS, **Replication**, Bulk Insert, Log Shipping, DB Mail, MSDTC, Filestream, others...
- 16 TiB disk / 3,904 GiB memory
- Multi-AZ Support: Ent. & Std.

GCP

Cloud SQL for SQL Server

- `sqlserver.exe`
- Versions: 2017 and 2019
- Enterprise, Standard, Web, Express
- **No**: SSIS, SSRS or SSAS, Bulk Insert, Log Shipping, DB Mail, MSDTC, Filestream, others...
- 64 TB disk / 624 GB memory
- Multi-Zone & Region Support

SQL Server – DBaaS (Native)

Azure

SQL Database

- Proprietary - **MS-SQL engine***
- Single DBs & Pools
- 4,096 GB / 100 TB (HS)
- DTU: Basic, Std., Premium
- vCore: GP, BC, Hyperscale
- Transient Fault Exceptions

AWS

AWS Aurora

- Proprietary - MySQL & PostgreSQL
- **No MS-SQL Equivalent**
- 128 TB
- Supports all MySQL and PostgreSQL drivers

GCP

Cloud Spanner

- Proprietary - Google Standard SQL & PostgreSQL
- **No MS-SQL Equivalent**
- **Unlimited DB size**
- Support for JDBC, Hibernate, Spring, EF

Azure SQL DB – Transient Faults (EF Core)

```
// Startup.cs from any ASP.NET Core Web API
public class Startup
{
    // Other code ...
    public IServiceCollection ConfigureServices(IServiceCollection services)
    {
        // ...
        services.AddDbContext<CatalogContext>(options =>
        {
            options.UseSqlServer(Configuration["ConnectionString"],
                sqlServerOptionsAction: sqlOptions =>
                {
                    sqlOptions.EnableRetryOnFailure(
                        maxRetryCount: 10,
                        maxRetryDelay: TimeSpan.FromSeconds(30),
                        errorNumbersToAdd: null);
                });
        });
    }
    //...
}
```

Azure SQL Edge

- IoT optimized, containerized SQL Server (ARM64/x64)
- Subset of features from SQL Server 2019 on Linux, *plus*:
- Built-in Data Streaming with Azure Stream Analytics
- Time-series: stream, store & analyze using time-windowing, aggregation & filtering
- Native data movement to Azure
- ML & Analytics built-in

Cloud Storage for SQL Server

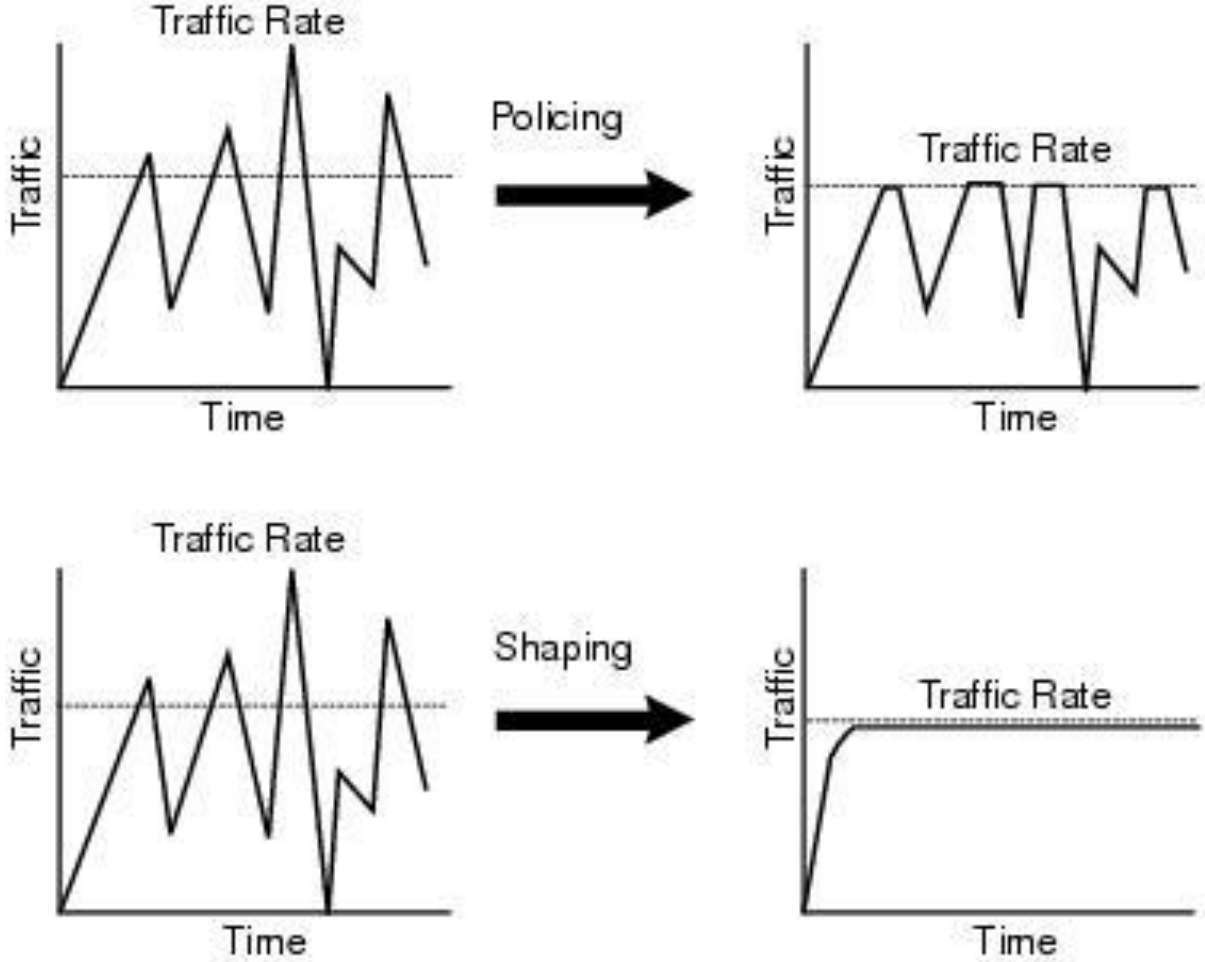
Storage for SQL Server

- Why should I care?
- SQL Server is sensitive to disk latency
 - Optimal latency for database: **$\leq 10\text{ms}$**
 - Optimal latency for transaction log: **$\leq 2\text{ms}$**

Storage Measurement Units

- Cloud providers vary units by service offering
- GB vs GiB
 - GB (GigaBytes) = $1,000^3$ (1,000,000,000) bytes **(7% smaller)**
 - GiB (GibiBytes) = $1,024^3$ (1,073,741,824) bytes
- TB vs TiB
 - TB (TeraBytes) = $1,000^3$ (1,000,000,000,000) bytes **(9.5% smaller)**
 - TiB (TebiBytes) = $1,024^4$ (1,099,511,627,776) bytes

Network Throttling - Policing vs Shaping



Azure Storage Architecture

Disks

Persistent disks for Azure IaaS VMs

Premium Storage
Disks option:
SSD based, high IOPS,
low latency

Files

Fully Managed File Shares in the Cloud

SMB and REST access
"Lift and shift" legacy apps

Blobs

Highly scalable, REST based cloud object store

Block Blobs: Sequential file I/O

Page Blobs: Random-write pattern data

Hybrid

Azure File Sync

StorSimple

Built on a unified Distributed Storage System

Durability, Encryption at Rest, Consistent Replication, Fault Tolerance, Load-Balancing

Storage Comparison

Azure

- **Shared** Infrastructure
- Throttling – **choppy**
(*Network Policing*)
- Also used in SQL Database & M.I. in Standard/GP Tiers
- **Multiple HA Options**
- VM hosted SQL Server:
Overcome performance limits w/ Storage Pools

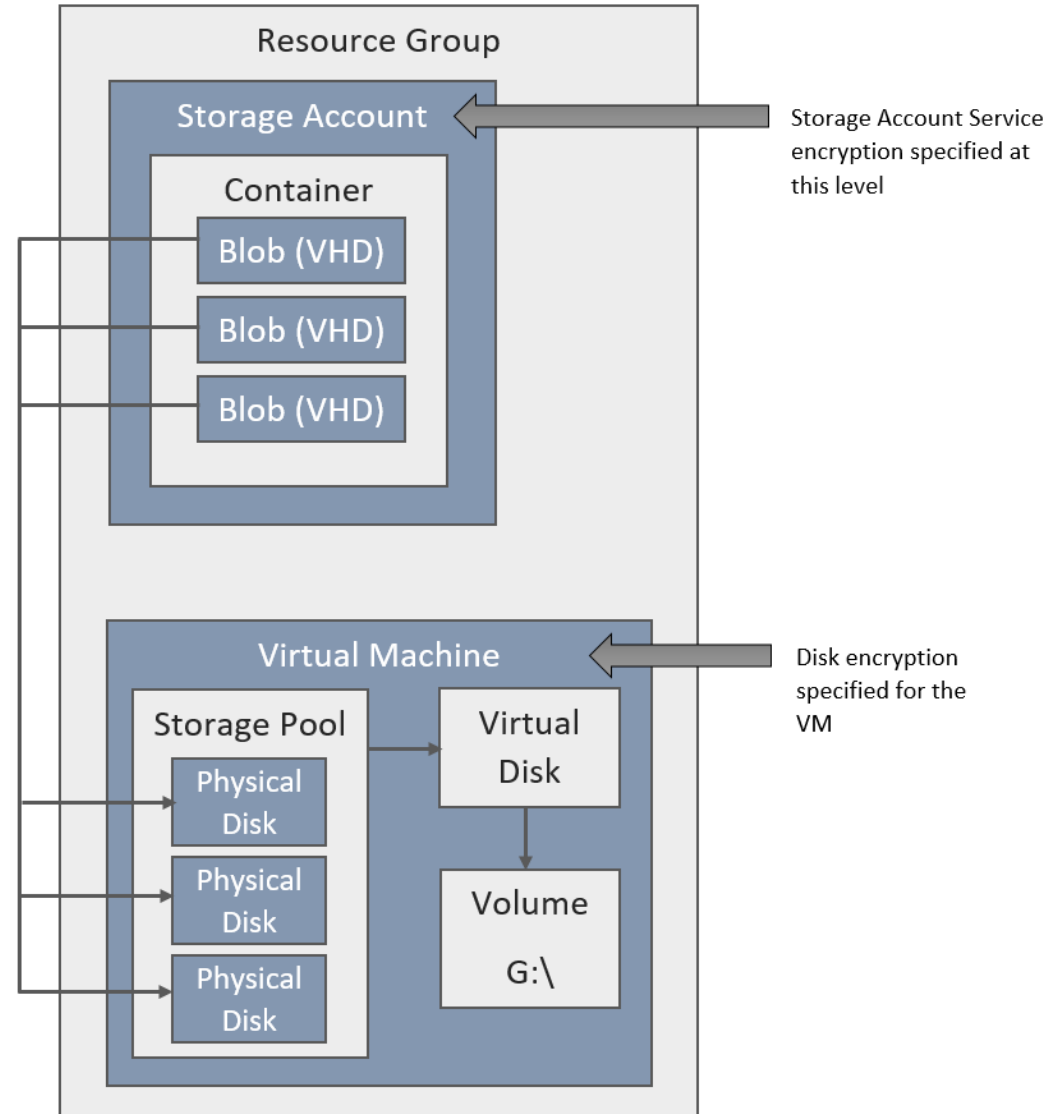
AWS

- **Dedicated** Infrastructure
- Throttling – **smooth**
(*Traffic Shaping*)
- Also used by Amazon RDS
- True **Block Storage**
- **Limited HA** – Local AZ only –
Like Azure LRS

GCP

- **Dedicated** Infrastructure
- Throttling – **smooth**
(*Traffic Shaping*)
- Also used by Cloud SQL
- True **Block Storage**
- **Multiple HA Options** –
Local AZ, Multi-AZ, Cross-Region

Azure Storage – Windows Storage Pools



Courtesy: Melissa Coates, MVP -SQLChick.com

Extreme Performance Storage Comparison

Azure

Ultra Disk

- **Dedicated** Infrastructure
- **Block** Storage (for VMs)
- **Fast** – Up to 160k IOPS or 4,000 MB/sec
- Throttling – VM and Disk but **smooth** (Shaping)
- Redundant Storage (LRS and ZRS) – Varies by Region

AWS

io2 Block Express

- Dedicated Infrastructure
- Block Storage
- **Fastest** – Up to 256k IOPS or 7,500 MB/sec
- Throttling – VM and Disk Smooth (Shaping)
- **Local-Zone Redundancy** only

GCP

Extreme Persistent Disks

- Dedicated Infrastructure
- Block Storage
- **Slowest** – Up to 120k IOPS or 2,200 MB/sec
- Throttling – Smooth
- **Local-Zone Redundancy** only

Don't forget about Tempdb!

Local SSD Storage

- **Ephemeral** (Transitory) – Not persistent
- Azure, AWS and GCP **all have Local SSD options**
- **USE THEM!**

Migrating SQL to the Cloud

Migrating Your Databases

Azure

Azure Database Migration Service

- Homogeneous Migrations
- Heterogeneous Migrations
- Continuous Replication
- Database Consolidations
- Bi-directional Migration

Data Migration Assistant (DMA)

AWS

AWS Database Migration Service

- Homogeneous Migrations
- Heterogeneous Migrations
- Continuous Replication
- Database Consolidations
- Bi-directional Migration

GCP

Database Migration Service

- Homogeneous Migrations
- Heterogeneous Migrations
- Continuous Replication

Licensing SQL Server in the Cloud

SQL Server Licensing

Azure

Microsoft Provided:

- SQL Server on a VM
- Azure SQL Database + M.I.
- Windows Server (for VMs)

Bring Your Own License (BYOL)

- SQL Server with SA on VMs
and Azure SQL DB incl. M.I.
- Windows Server Hybrid Benefit for Bare Metal **and VMs (SA)**

AWS

Amazon Provided:

- SQL Server on a EC2 instance
- SQL Server in RDS
- Windows Server (for EC2)

Bring Your Own License (BYOL)

- SQL Server with SA on EC2
- Discontinued: SQL BYOL in RDS
- Windows Server on Dedicated Instances (Bare Metal)

GCP

Google Provided:

- SQL Server on Compute Engine
- SQL Server in Cloud SQL
- Windows Server (for VM)

Bring Your Own License (BYOL)

- SQL w/ SA on Compute Engine
- Not Available for Cloud SQL
- Windows Server on Sole-Tenant nodes (Bare Metal)

Q & A

Thank you

Presentation Landing Page & Resources:

[Liktorius.com/go/SQLSAT1022](https://liktorius.com/go/SQLSAT1022)

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