SQLSATURDAY
Orlando 2022

SQL in the Cloud
Comparing Azure, AWS & GCP

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- Over 27 years with SQL Server
- Specializing in scalability, availability and performance tuning
- Co-Founder of Microsoft Cloud South Florida User Group
- Certified: Azure, AWS & MS-SQL

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Agenda

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

SQL in the Cloud

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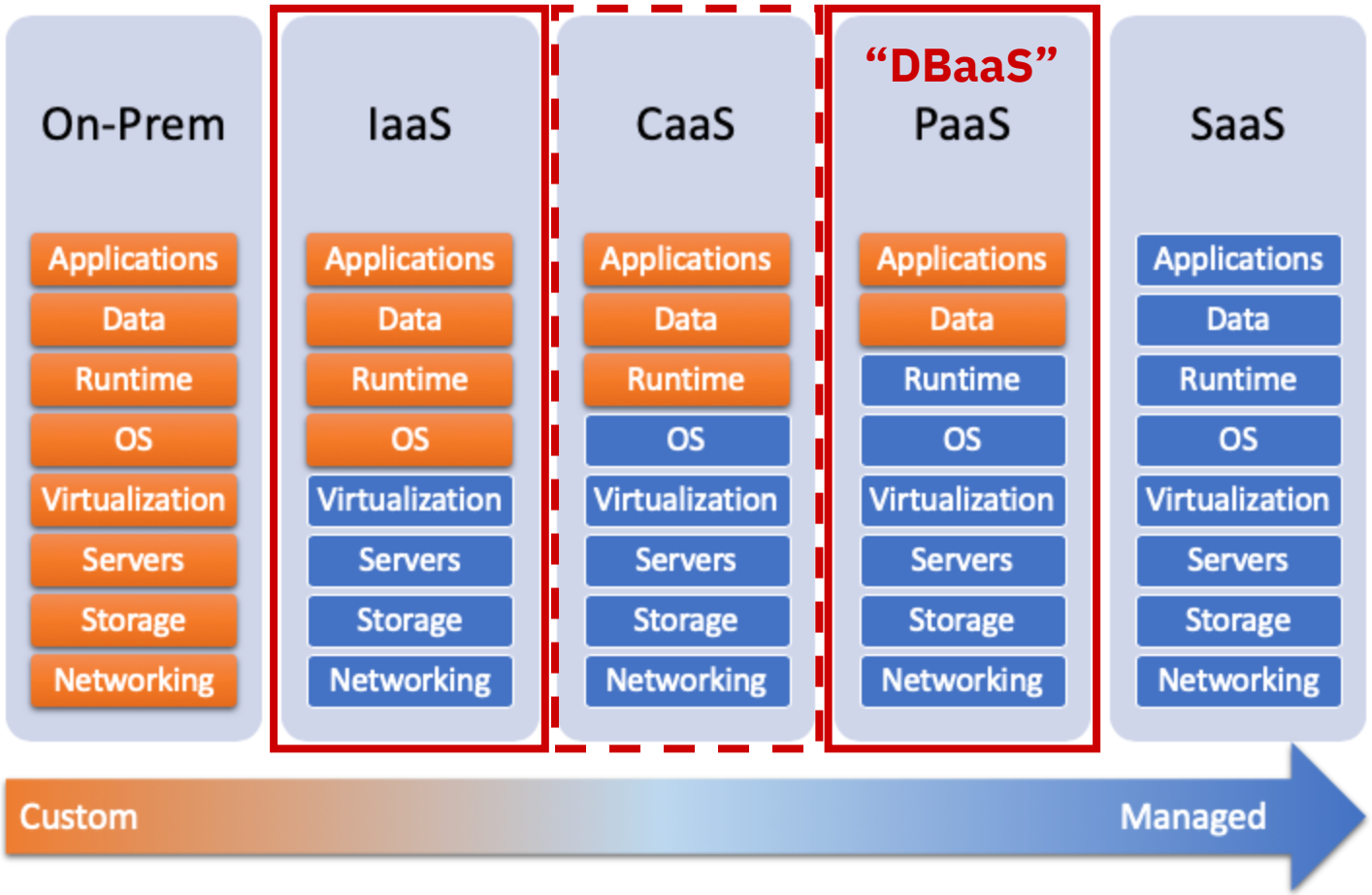
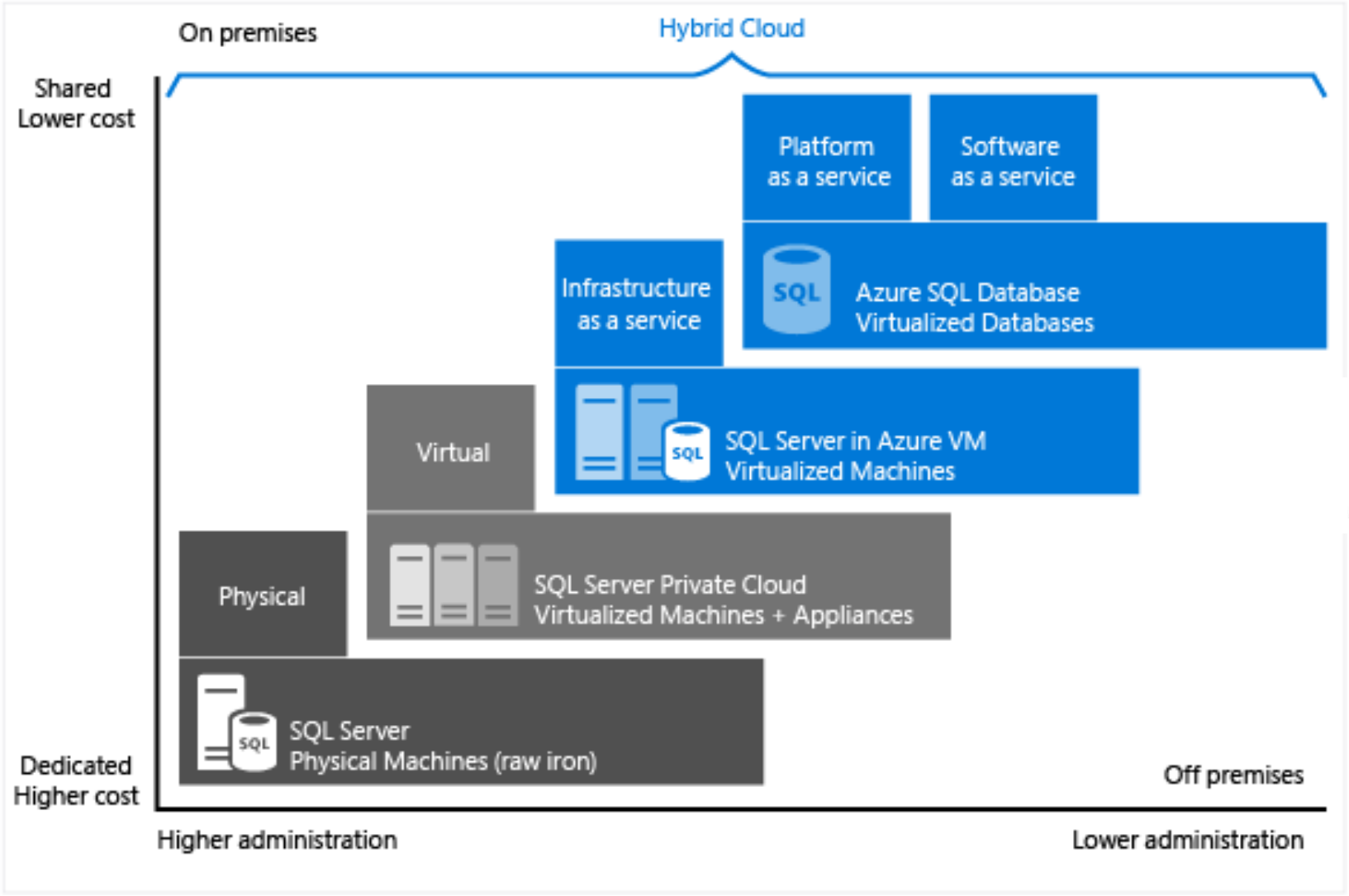
Application Hosting Models



Source: https://subscription.packtpub.com/book/application-development/9781789538519/9/ch09lvl1sec54/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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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

SQL Server – IaaS (Virtual Machines)

Azure

On Virtual Machines

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features

AWS

On EC2 Instances (VMs)

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features

GCP

On Compute Engine (VMs)

- Most Versatile Option
- DIY or Marketplace
- Full On-Prem Features

SQL Server Database Size Limit: 524 PB (524,272 TB)

- Up to 64 x 65 TiB = **4,160 TiB**
- Up to 27 x 256 TiB = **6,912 TiB**
- Up to **257 TB** total

Relational/SQL – DBaaS (Managed)

Azure

Azure Database for MariaDB

Azure Database for MySQL

Azure Database for PostgreSQL

Azure SQL Managed Instance

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 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

Azure SQL DB – Transient Faults (EF Core)

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

Cloud Storage for Databases

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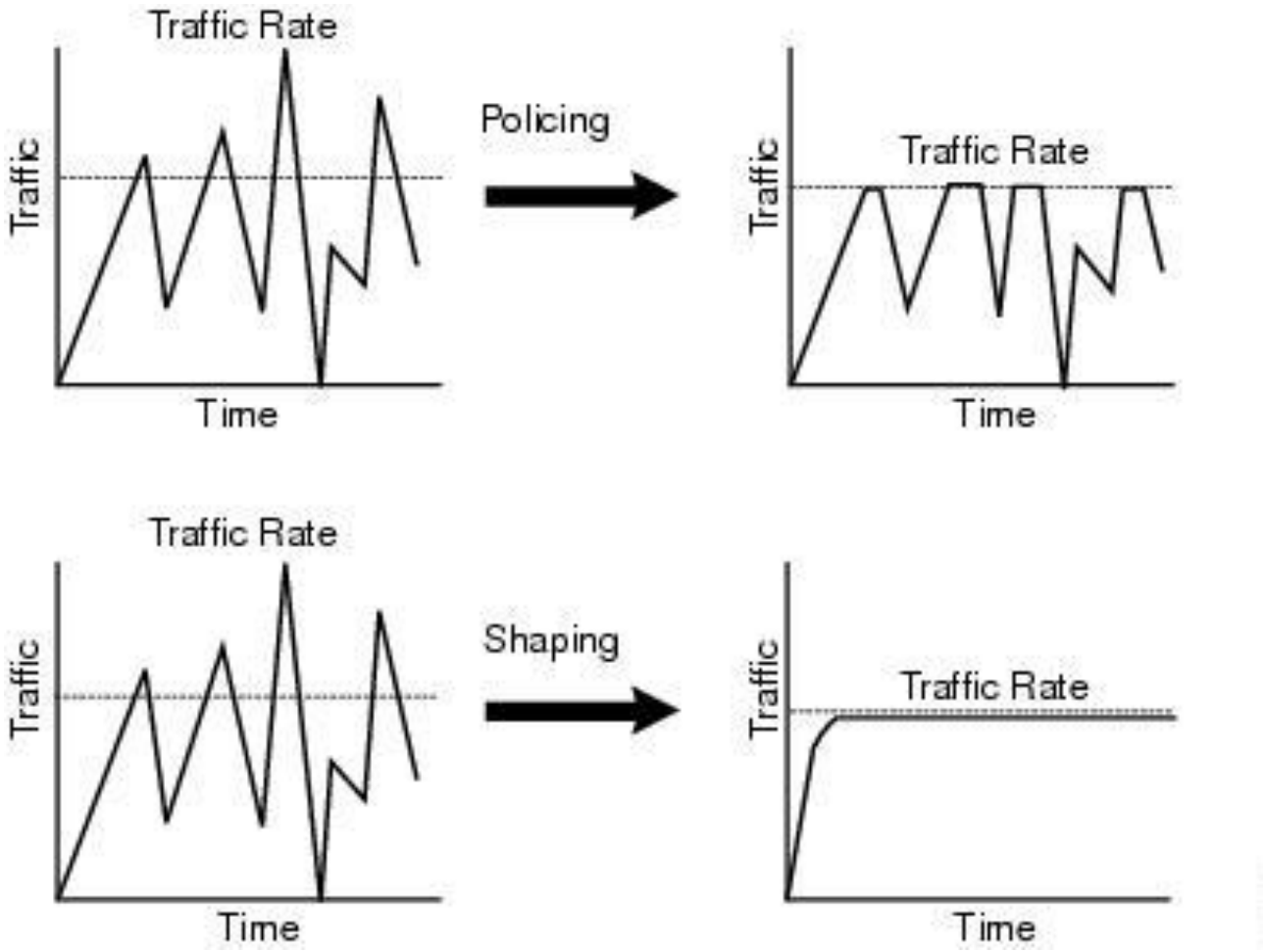
Storage for Databases

- Why should I care?
- Databases are sensitive to disk latency
  - Optimal latency for database: **<= 10ms**
  - Optimal latency for transaction log: **<= 2ms**
- Exceeding optimal latencies:
  - Delays transactional throughput & increases duration of locks
  - Thereby decreasing concurrency

Network Throttling - Policing vs Shaping



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

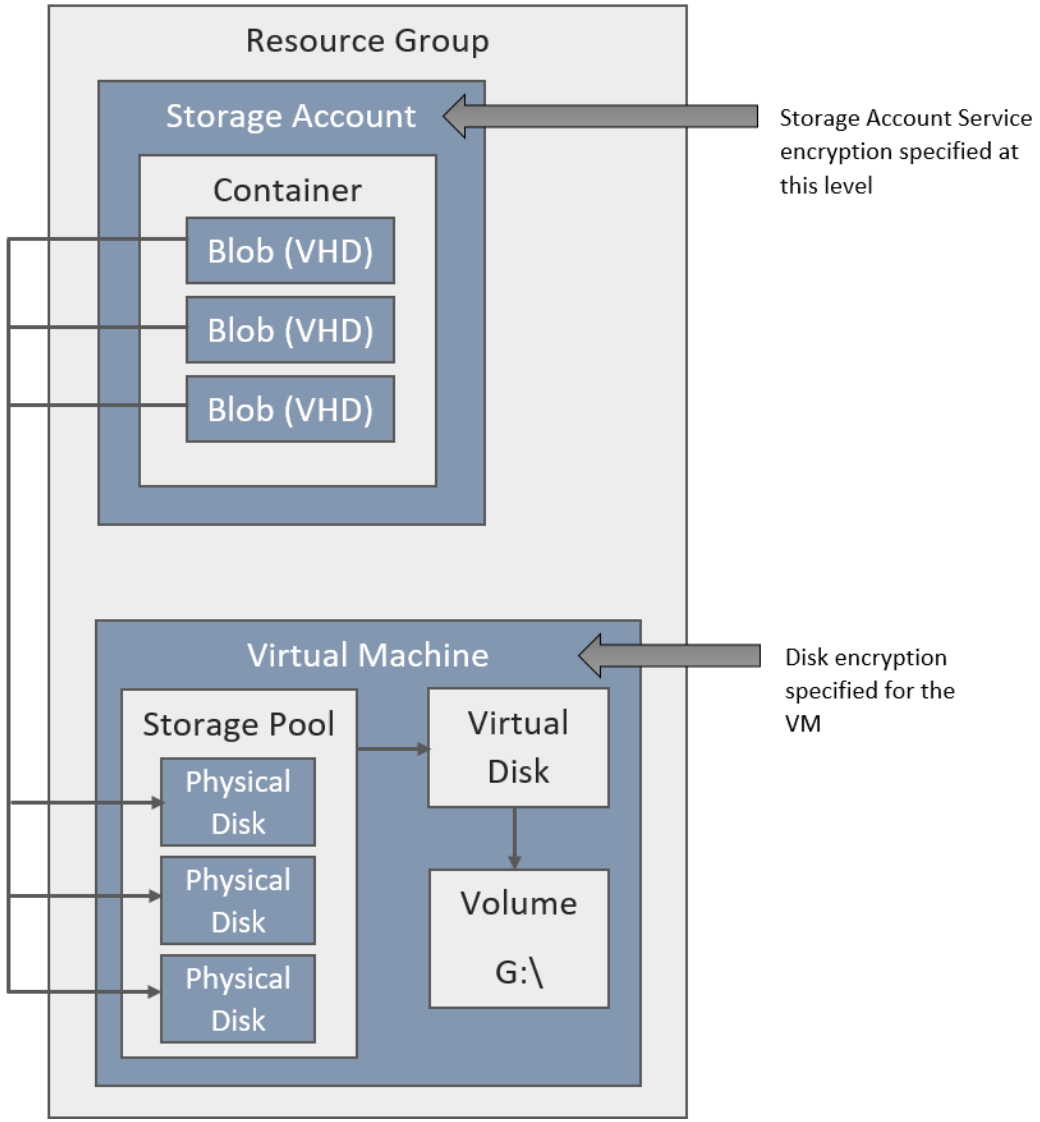
AWS

- **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 – **Smooth**
- 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 – **Smooth**
- **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
- **Perfect for MS SQL Tempdb** and other non-persistent needs
- Azure, AWS and GCP **all have Local SSD options**
- **USE THEM!**

Migrating SQL to the Cloud

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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
- ~~Database Consolidations~~
- ~~Bi-directional Migration~~

Licensing SQL Server in the Cloud

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SQL Server Licensing

Azure

Microsoft Provided:

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

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 + Windows (EC2)
- SQL Server in RDS

Bring Your Own License (BYOL)

- SQL Server with SA on EC2
- ***Discontinued*** SQL BYOL in RDS
- Window Server on Dedicated Instances (Bare Metal) **only**

GCP

Google Provided:

- SQL Server + Windows (on C.E.)
- SQL Server in Cloud SQL

Bring Your Own License (BYOL)

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

Q & A

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Thank you

Presentation Landing Page & Resources:

Liktorius.com/go/SQLSAT1030

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