



SQLSATURDAY

Jacksonville 2023 #1041

SQL in the Cloud Comparing Azure, AWS & GCP

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#SQLSatJax



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Over 25 years of experience with SQL Server:

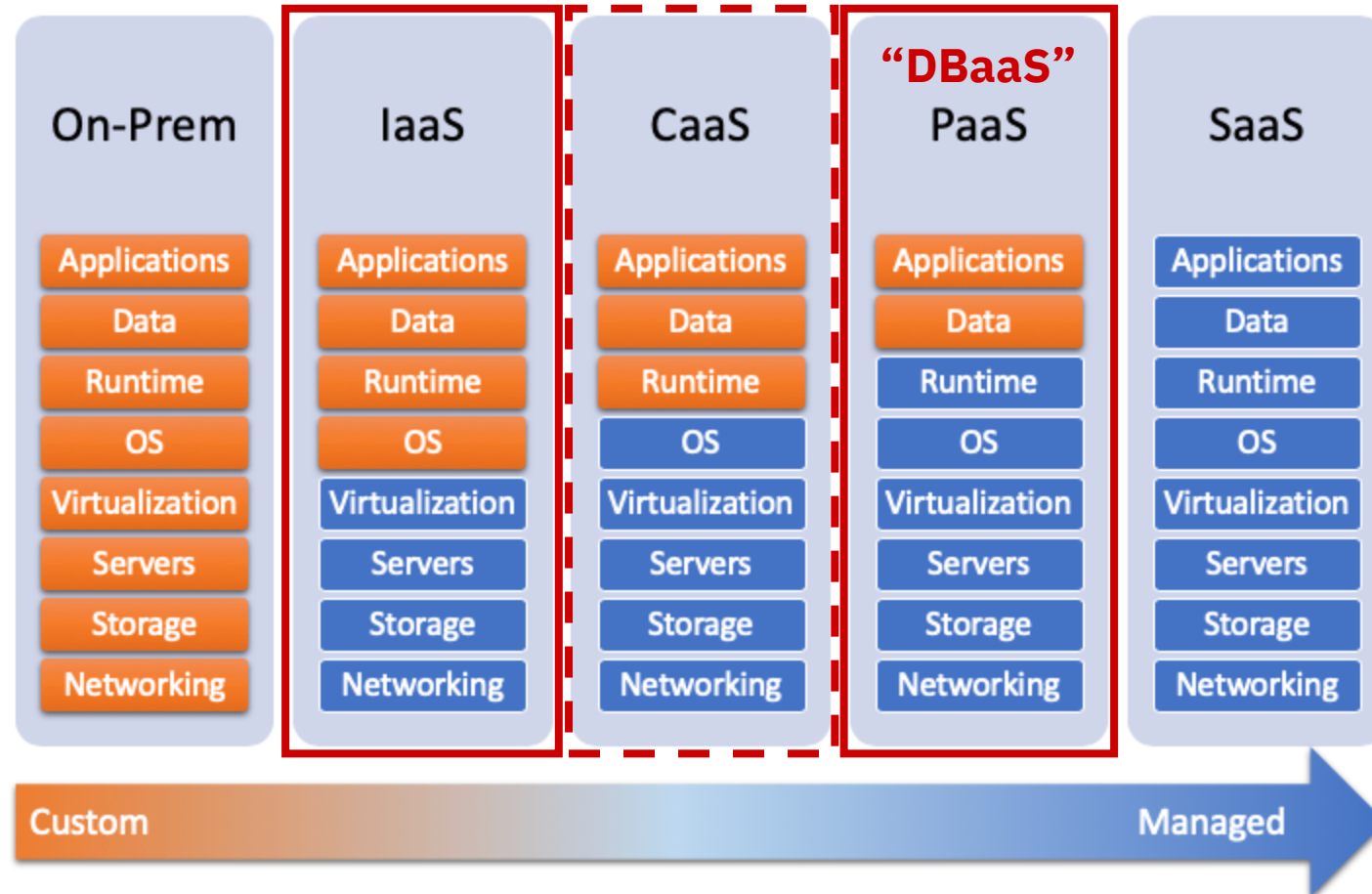
- Architect at Cognizant
- Specializing in scalability, availability and performance
- Co-Founder of Microsoft Cloud South Florida User Group

Agenda

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

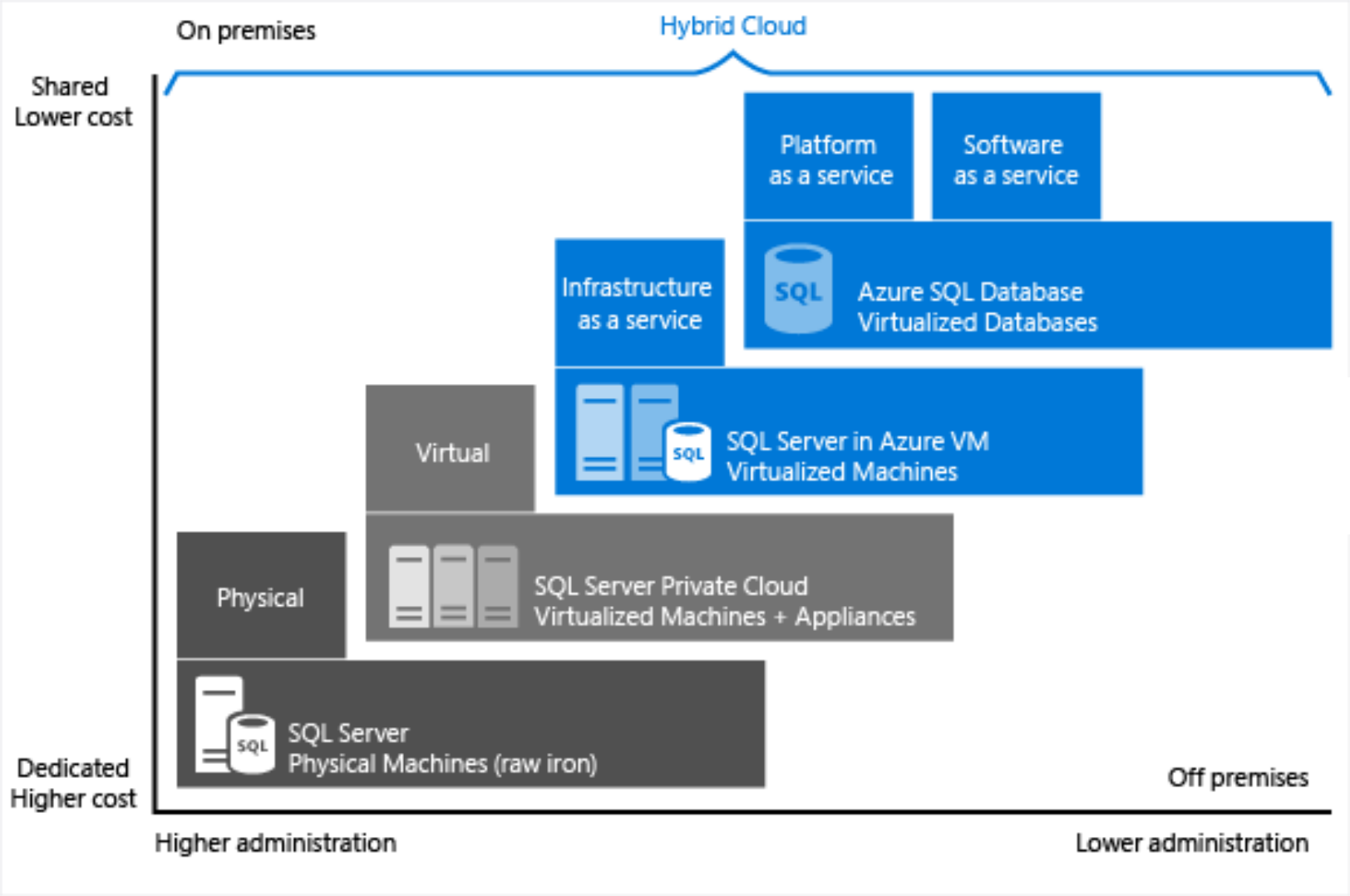
SQL Server in the Cloud

Application Hosting Models



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

Microsoft SQL Server Data Platform



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

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 (2022)**
- 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: 2014 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

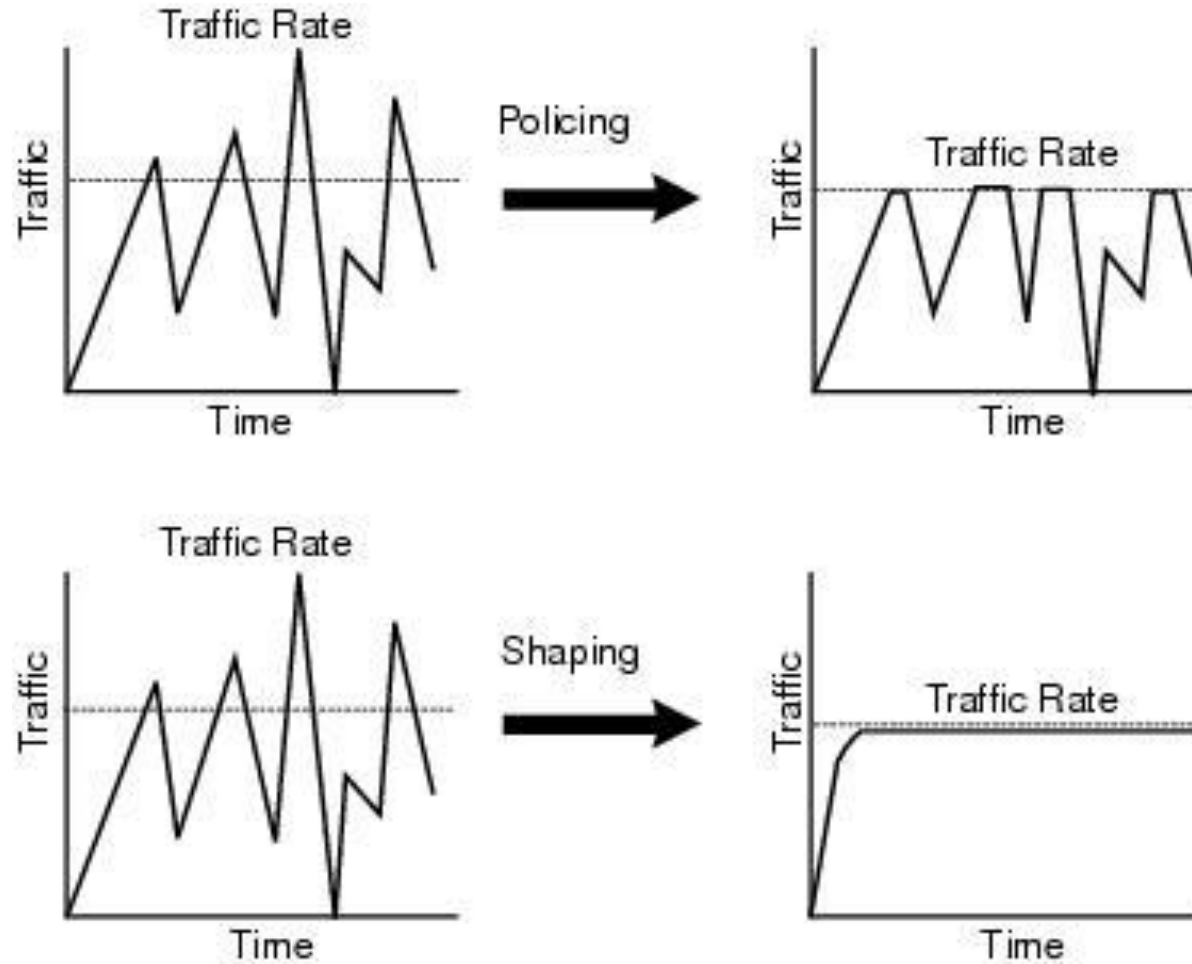
Storage for SQL Server

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

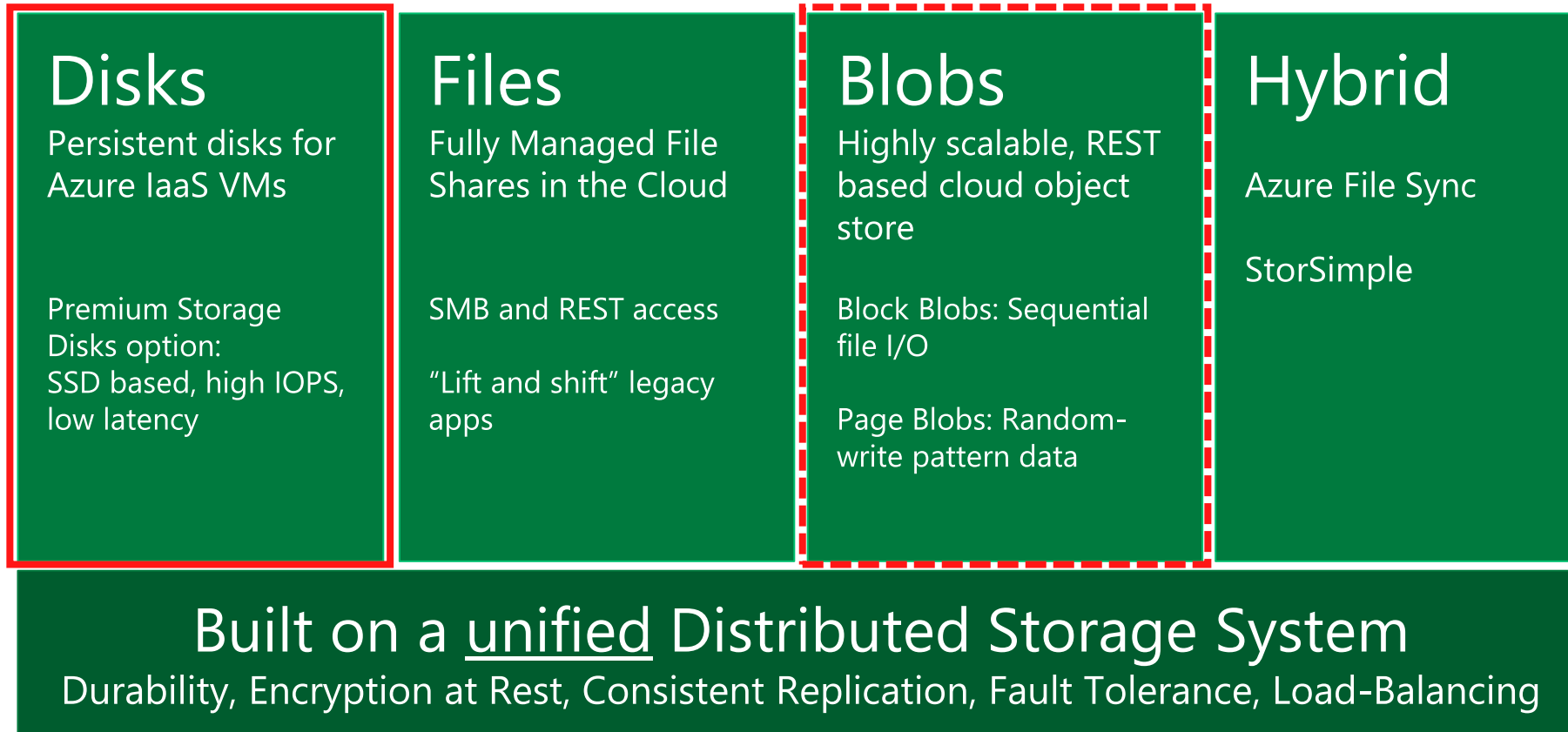
Storage Measurement Units

- 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



Storage Comparison

Azure

- Shared Infrastructure
- Throttling – **choppy**
(Network Policing)
- Affects SQL Database & M.I. in **Standard/GP Tiers** –
overcome with BC & HS
- **Multiple HA Options**
- VMs: *Overcome limits with 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

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)

Thank you

Presentation Landing Page & Resources:

[Liktorius.com/go/SQLSAT1041](https://liktorius.com/go/SQLSAT1041)

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