



# SQLSATURDAY

South Florida 2024 #1080

## **SQL in the Cloud** Comparing Azure, AWS & GCP

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# Session Evaluations

**Your feedback is important to us!**

**Please fill out and hand to speaker after the session!**

# Darius Liktorius



**Sr. Director, Architecture**  
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- Over 25 years of experience with SQL Server
- Specializing in scalability, availability and performance
- Proficient in Application, Data & Solutions Architecture

# Agenda

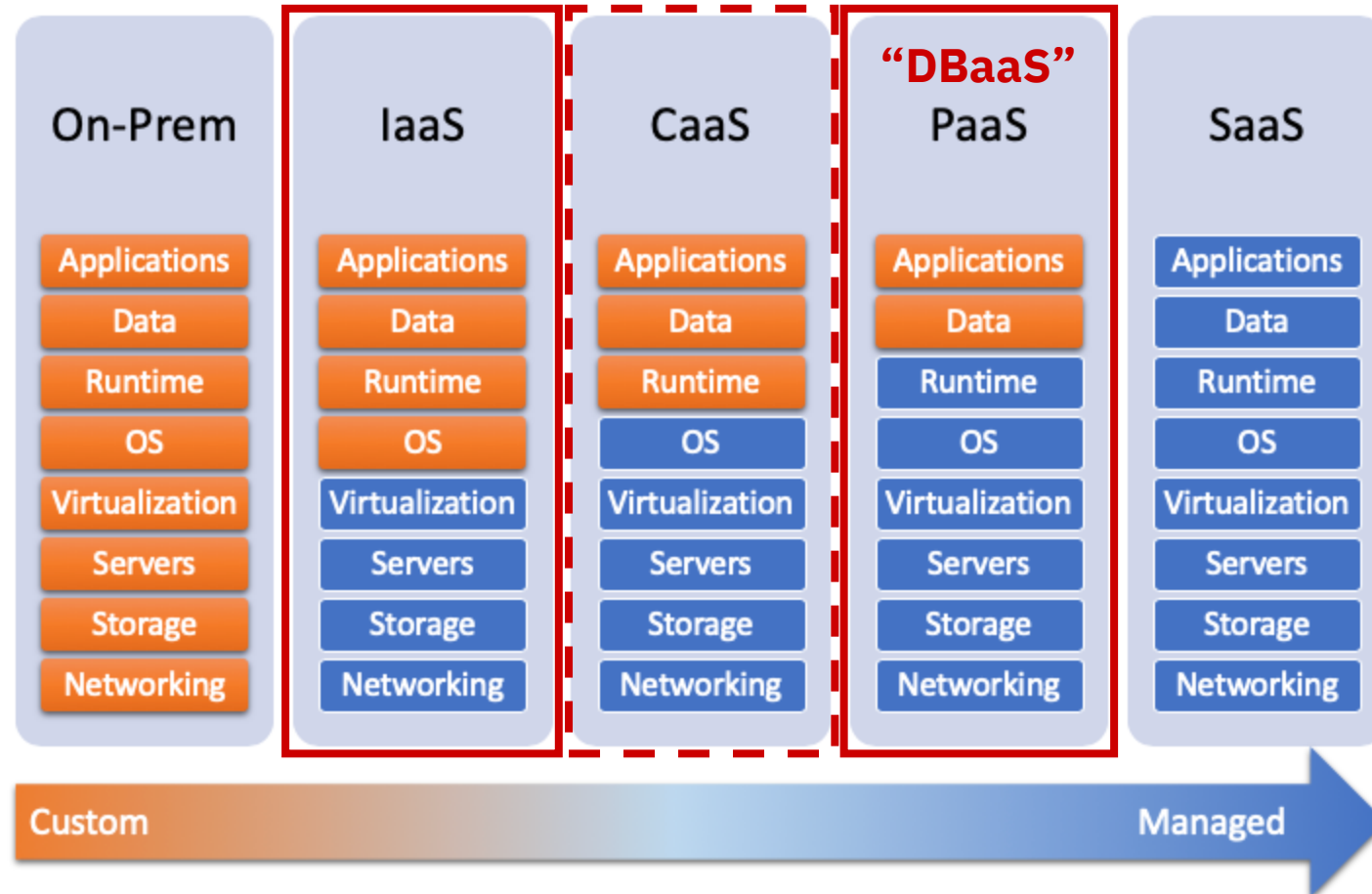
- SQL Server in the Cloud
- Cloud Storage for SQL Server
- Migrating your Databases
- Licensing in the Cloud
- Q & A

# SQL Server in the Cloud

# But first... Measurement Units

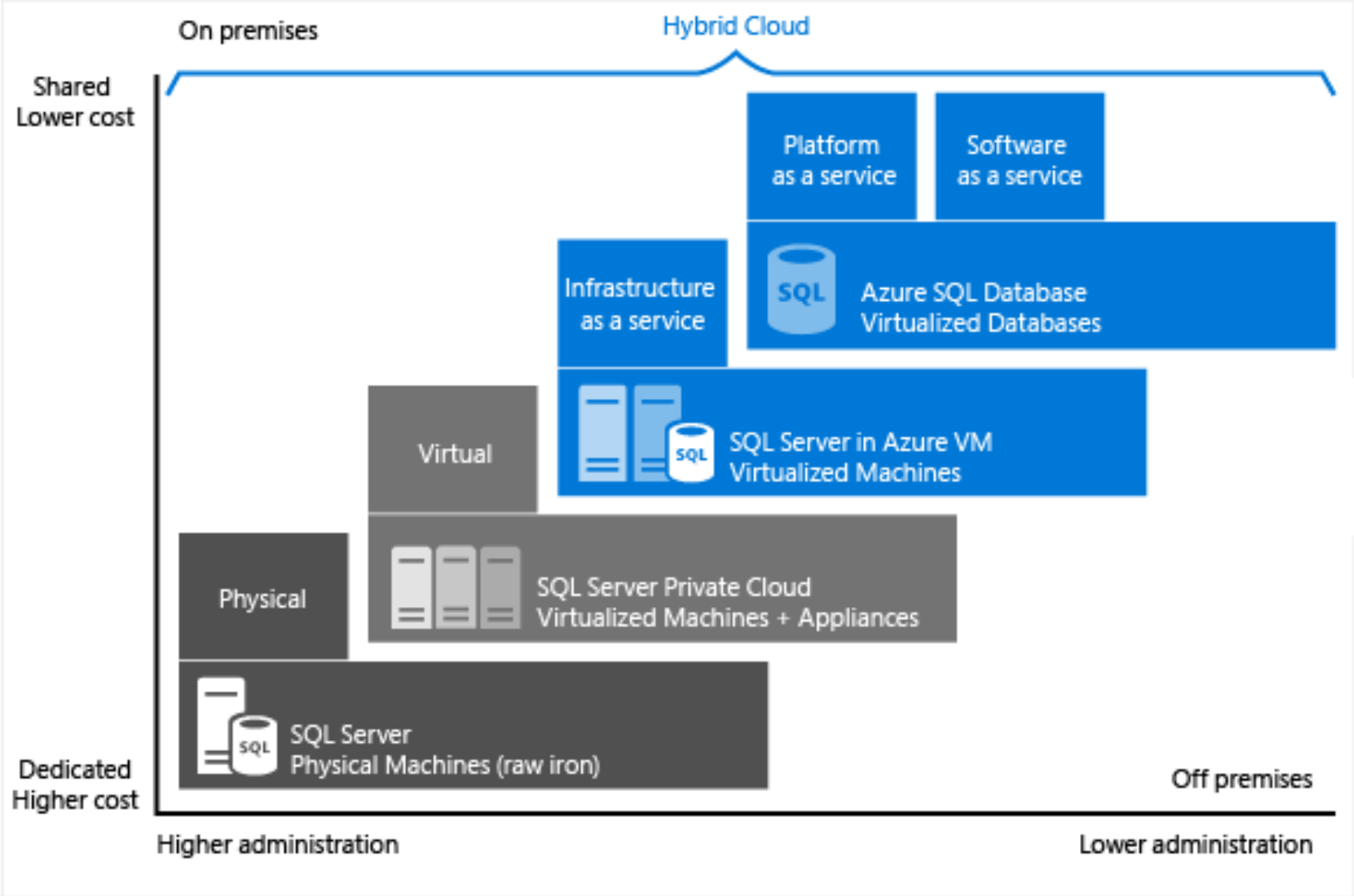
- Cloud providers vary units by service offering
- GB vs GiB
  - GB (GigaBytes) =  $1,000^3$  (1,000,000,000) bytes **(7% smaller)**
  - GiB (GibiBytes) =  $1,024^3$  (1,073,741,824) bytes
- TB vs TiB
  - TB (TeraBytes) =  $1,000^3$  (1,000,000,000,000) bytes **(9.5% smaller)**
  - TiB (TebiBytes) =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

# 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 (Self-managed VM's)

## 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
- Multi-Region: Failover Groups

## AWS

### Amazon RDS for SQL Server

- `sqlserver.exe`
- Versions: 2014 thru 2022
- 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: Standard & Enterprise
- Multi-Region: Enterprise

## GCP

### Cloud SQL for SQL Server

- `sqlserver.exe`
- Versions: 2017 and 2022
- 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 \* **Not M.I.**

- Proprietary - **MS-SQL engine\***
- Single DBs & Pools
- 4 TB / 100 TB (HS)
- **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 Database – Service & Compute Tiers

- Service Tiers
  - **vCore** model: General Purpose, Business Critical, Hyperscale
  - **DTU** model: Basic, Standard (GP), Premium (BC)
- Compute Tiers
  - **Provisioned**
  - **Serverless** – Only on vCore General Purpose or Hyperscale

# Azure SQL Database – Managed Instance Service & Compute Tiers

- Service Tiers
  - **vCore** model: General Purpose, Next-gen General Purpose, or Business Critical
- Compute Tiers
  - **Provisioned only**

# 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);
                });
        });
    }
    //...
}
```

# 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

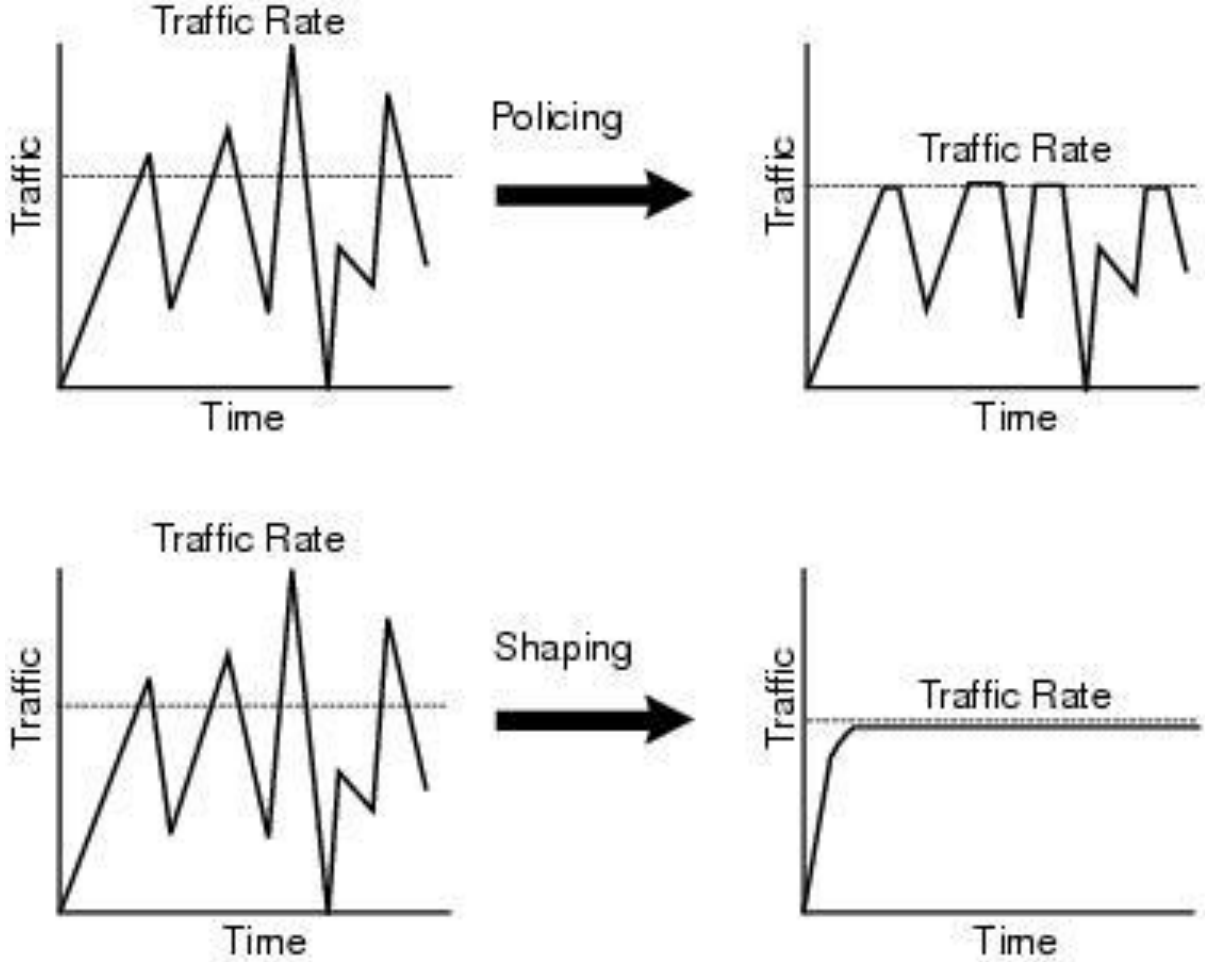


# Cloud Storage for SQL Server

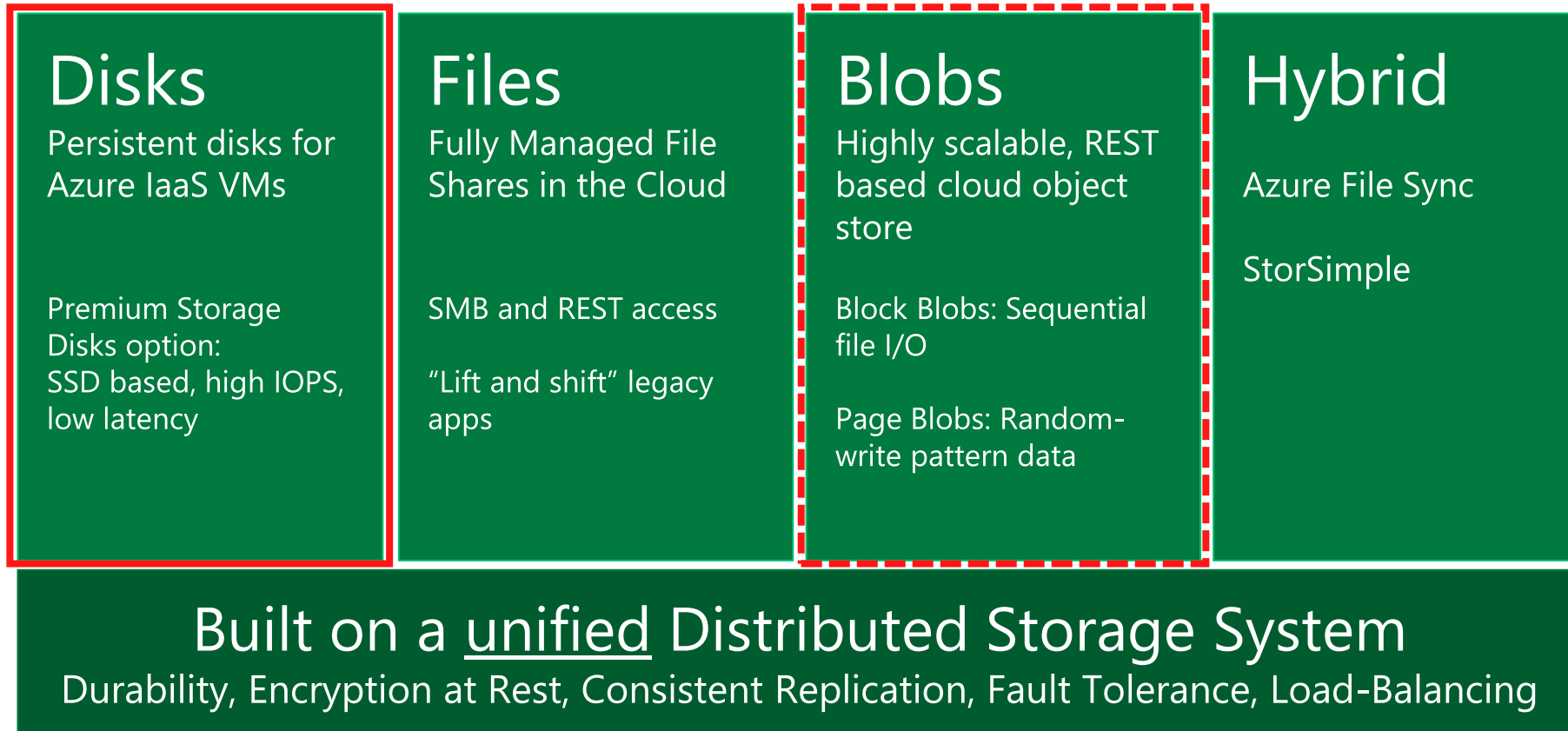
# Storage for SQL Server

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

# Network Throttling - Policing vs Shaping



# Azure Storage Architecture



# Storage Comparison

## Azure

- **Shared** Infrastructure
- Throttling – **choppy**  
(*Network Policing*)
- Ethernet Storage (iSCSI)
- SQL Database & M.I. in  
**Standard/GP Tiers** –  
*overcome w/BC, Prem. & HS*
- **Multiple HA Options**
- VMs: *Use Storage Pools*

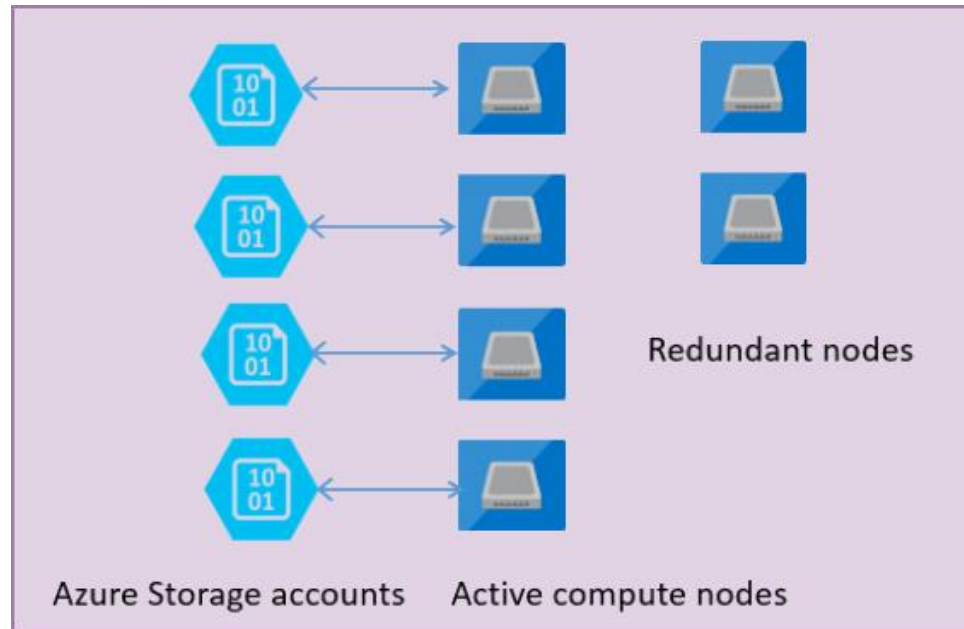
## AWS

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

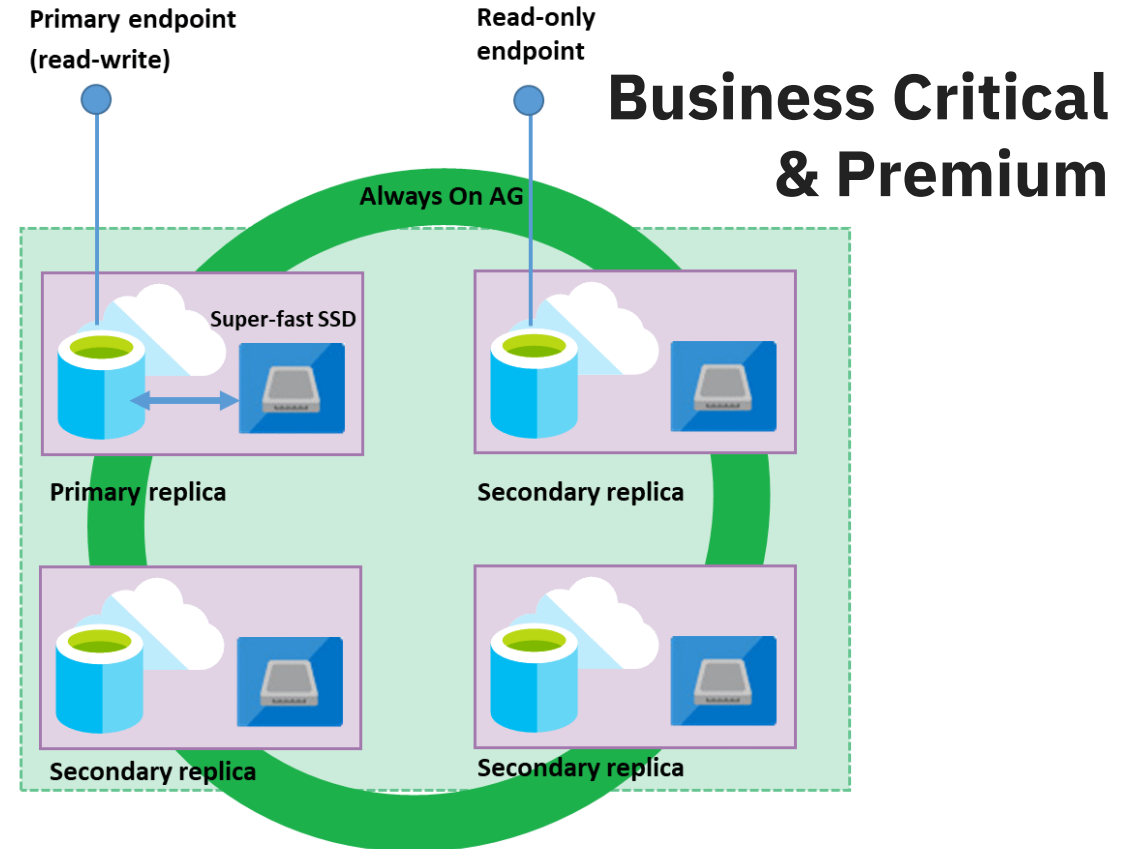
## GCP

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

# Azure SQL Database – Storage Comparison



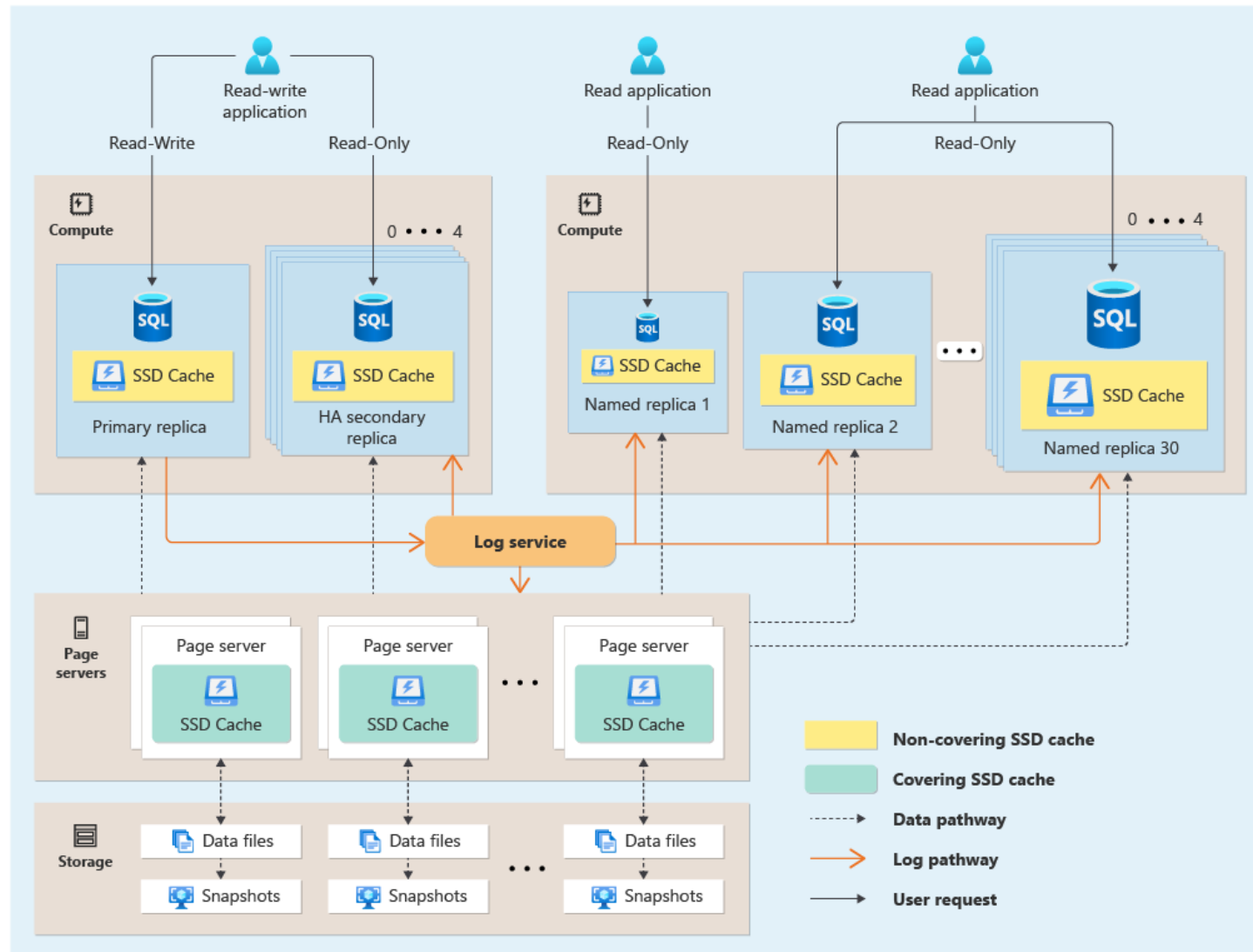
**General Purpose,  
Basic and Standard**



Business Critical service tier: collocated compute and storage

# Azure SQL Database – Storage Comparison

Region 1



## Hyperscale

# 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

# Session evaluation

Your feedback is important to us

**Please fill out your session evaluation and hand to speaker!**



# Thank you

**Presentation Landing Page & Resources:**

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