SQLSATURDAY

Orlando 2025 #1103

Optimize Your SQL Database

Tips for Peak Performance

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#SQLSatOrlando

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#1103 - Jacksonville, FL May 3rd, 2025

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Darius Liktorius

Sr. Dir., Global Data Services

PwC

- 25+ years with SQL Server
- Specializing in scalability, availability and performance
- App, Data & Solutions Arch.

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Agenda

- Overview
- Application Usage Patterns
- Infrastructure & Storage
- Partitioning, Indexes & Statistics
- Replicas & Sharding
- Q & A

Overview

Overview – What’s Covered

- We are covering:
  - Critically Important Design & Deployment Decisions
  - Essential Tools & Maintenance Operations
- We are <u>not</u> covering:
  - Troubleshooting & Optimizing Queries – enable Query Store!
  - Usage of Diagnostics Tools

Overview – Stereotypes

- Application Developers:
  - Are not bad people!
  - Leverage effort-reducing libraries
  - Do not appreciate impacts against DB
- DBAs, DevOps & Architects:
  - Rightfully question application code
  - *Sometimes* make critically important design oversights

Tools to Consider

- Database Engine Tuning Advisor
- Azure SQL Database – Automatic Tuning
- Third-Party:
    - SQL Sentry by SentryOne (Solarwinds)
    - Quest Foglight on SQL
    - Idera SQL Diagnostic Manager
    - SQL Grease

Application Usage Patterns

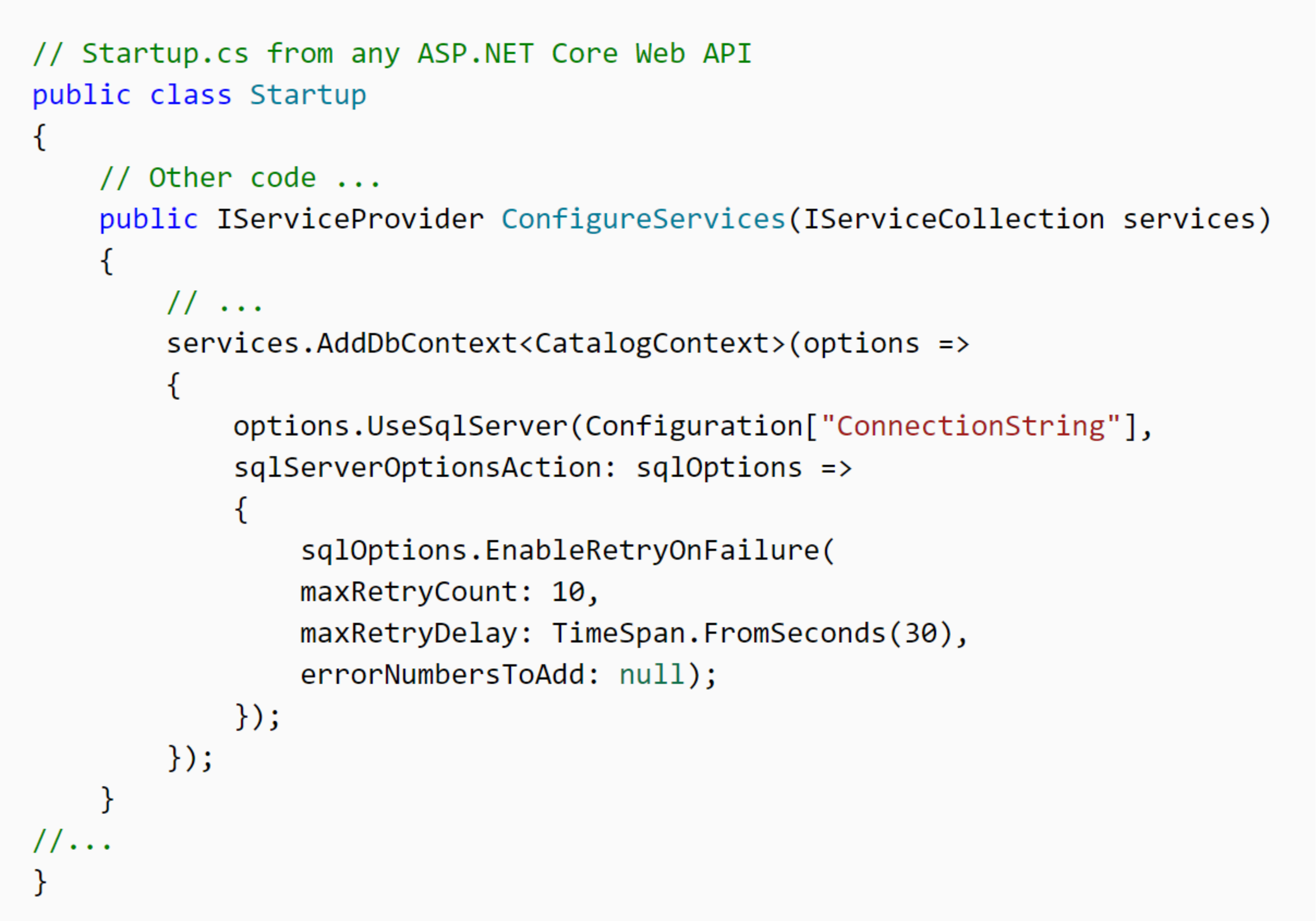
Application Usage Patterns

- Over-normalization
- Object-Relational Mapping (ORM) Libraries
    - Lazy-loading, Loops, Unnecessary Joins
    - Evaluate actual queries
    - Use DTOs
- Connection Pooling & Disposal

Application Usage Patterns – cont’d.

- Areas of contention:
  - Active Tables
  - Table “Hot” Spots
- Cache, Cache and Cache some more!
  - Redis
  - Memcached

Azure SQL DB – Transient Faults (EF Core/EF5+)



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

Infrastructure

Infrastructure – Self Managed

- Virtual Machine / Bare Metal:
  - Sufficient CPU allocation for the load – T.B.D.
  - Memory (RAM) to host frequently used tables, active partitions and indexes
  - Storage RAID Level:
    - 1 (SSD) or 10 (HDD) for Transaction Log and Tempdb
    - 5, 6, 50, 60, or 10 for Database

Infrastructure – Cloud Hosted

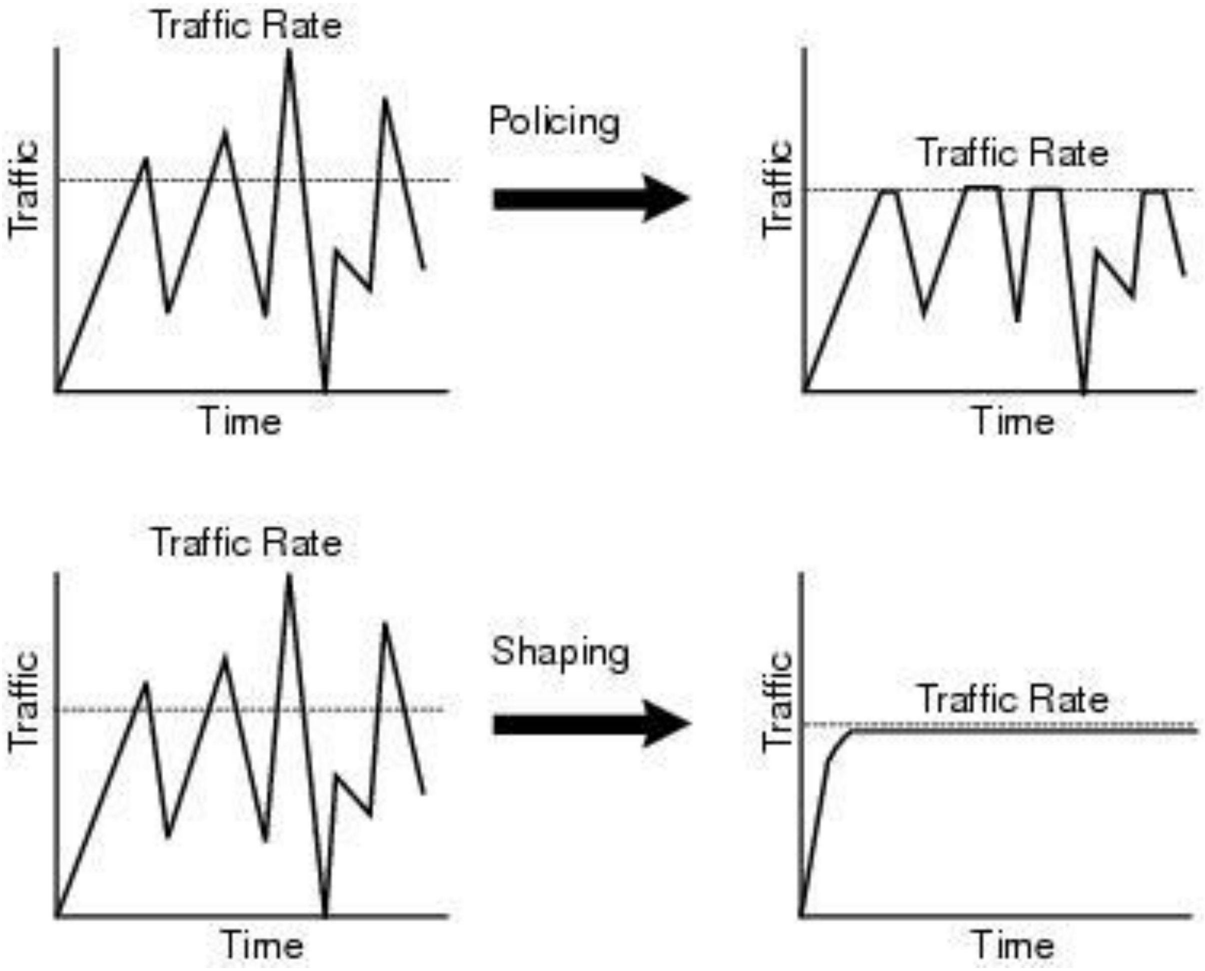
- Tiers, SKUs:
  - Affect CPU, Memory (e.g., E-Series), Disk (e.g., ephemeral)
  - SSD vs HDD & Throughput
  - Block vs Blob storage in Cloud (more later)
- Networking:
  - VNET integration, Service Endpoints, Private Link, etc.

Storage

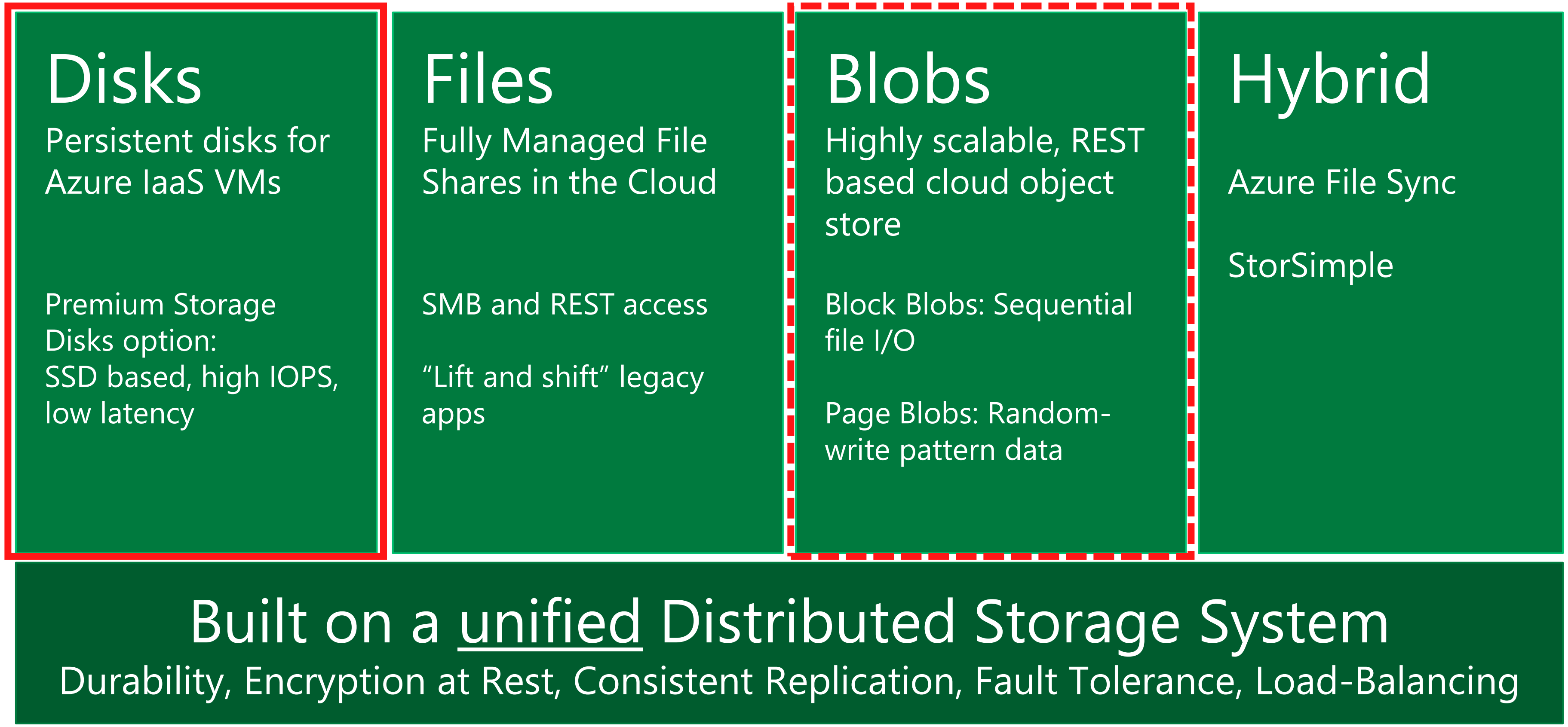
Storage for SQL Server

- Why should I care?
- SQL Server is sensitive to disk latency
  - Optimal latency for database: **<= 10ms**
  - Optimal latency for transaction log: **<= 2ms**

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*)
- Ethernet Storage (iSCSI)
- SQL Database & M.I. in **Standard/GP Tiers –** ***overcome with BC & HS***
- **Multiple HA Options**
- VMs: ***Use Storage Pools***

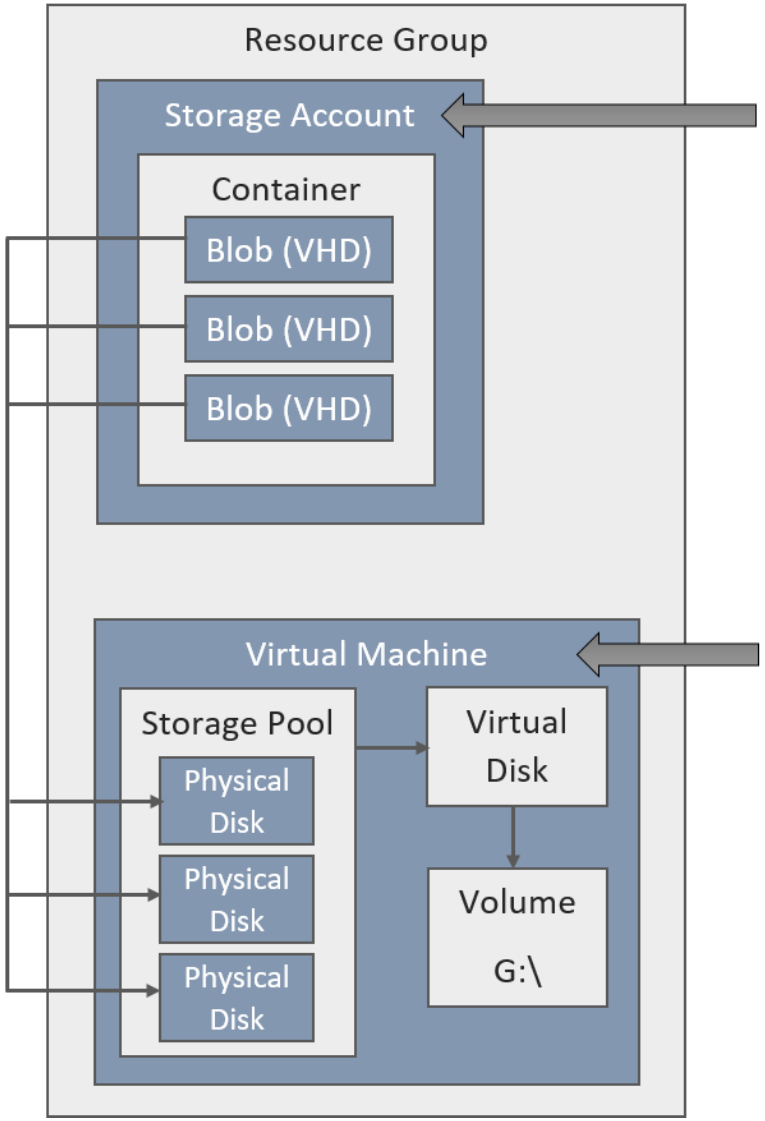
AWS

- **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 Storage – Windows Storage Pools



Storage Account Service encryption specified at this level

Disk encryption specified for the VM

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

File Placement

File Placement – for VM / On-Premises

- Separate Log & Data File Locations
- Utilize File Groups (FG’s)
- Split Tables and Non-Clustered Indexes into separate FG’s
- Consider dedicated FG for very large tables

Local SSD Storage for Tempdb in Cloud

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

Tempdb

- Used in numerous ways:
  - Temporary tables, cursors, stored procedures, & other internal objects
- Optimize storage and pre-allocate
- Consider load requirements in multi-database instance

Partitioning, Indexes & Statistics

Partitioning

- **Physically separates data** based on criteria (e.g., date ranges)
- **Reduces or eliminates** cross-query data page **locking**
- Allows for **efficient** management & **deprecation of data**
- **Marginal performance improvement** on most queries – requires larger quantity of partitions

Indexes

- **Clustering approach:** consider de-coupling Primary Key from Clustered Column(s)
- **Fill Factors:** Unless contiguously incrementing values (e.g., Identity Columns), *always* specify a Fill Factor < 100
- **Maintenance:** Ensure you are regularly (nightly, intra-day) reorganizing and/or rebuilding your indexes!
  Don’t forget about statistics!

Table Statistics “STATS”

- **Critically Important** – has direct impact on index selectivity
- **Rate of Change** – Will not update unless >=30% of delta
- **Best Practices** –
  - Keep **auto-update enabled**, but run nightly
  - Consider **specific tables** for one-off updates
  - Utilize **async** update (e.g., large tables w/ frequent, big updates)

Replicas & Sharding

Replicas

- Provide **High Availability & Scalability**
- Enabled via Availability Groups & DAGs
- Azure SQL Database Hyperscale – adds Named Replicas
- **Synchronous vs Asynchronous**
- **Readable** – connection string: “applicationIntent=readonly”

Sharding

- Divide a data store into a set of horizontal partitions or shards. This can improve scalability when storing and accessing large volumes of data.
- Azure SQL Database - Elastic Database Client Library

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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