

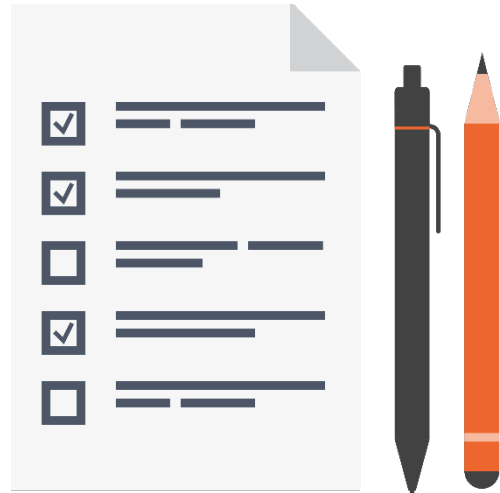
# Storage Subsystem Issues



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# What This Module Covers



Common storage subsystem issues

Designing a storage subsystem for different workloads

Configuring storage for scalability

Useful disk benchmark tools

# Common Storage Subsystem Issues

Inadequate random  
or sequential I/O  
performance for  
workload

Inappropriate RAID  
level for workload  
or availability SLA  
requirements

Improper database  
file layout

Misconfiguration of  
storage or caching

# Common SQL Server Workload Types

Online Transaction  
Processing (OLTP)

Relational Data  
Warehouse (DW)

Online Analytical  
Processing (OLAP)

Mixed workloads

# Different I/O Access Patterns of Workloads

- OLTP workload has frequent writes to data files and log file
  - Has frequent reads from data files if database does not fit in memory
  - Random I/O performance is very important
- DW workload has large sequential reads from data files
  - Sequential read I/O performance is very important if database is not in memory
- OLAP workload has lots of random reads from cube files
  - Random read I/O performance is very important

# Common DMV I/O Query Result Patterns

- Very common to see high write latency to tempdb data files
  - Make sure to have multiple tempdb data files (start with 4-8), and all same size
  - Make sure to use TF 1118
  - Consider using local flash-based storage for tempdb
- Common to see high read latency from user database files
  - Look for signs of memory pressure, consider adding more RAM
  - Make sure to do standard workload and index tuning to reduce memory pressure
  - Consider using SQL Server 2014 BPE (especially for Standard Edition)

# Sizing Your Storage Subsystem

- Use a RAID calculator to ensure there is more than enough disk space
  - Both magnetic and flash storage benefit from having ample free space
- After you have enough space, concentrate on performance
  - Ask for what you need to support your workload
  - Consider your workload as you make budget-driven compromises
- Aim for 10,000-20,000 or more 8K IOPS on all LUNs
  - More is always better
- Aim for 1GB/sec or more of sequential throughput on all LUNs
  - This gives you good performance for administrative tasks

# Choosing Storage Types

Flash storage is great for random I/O

Flash has better sequential performance than magnetic storage

Magnetic storage has fair sequential performance

Large controller caches can mask poor random I/O

Flash storage is best choice for performance

Flash storage prices continue to decline



## Storage Subsystem Design Tips

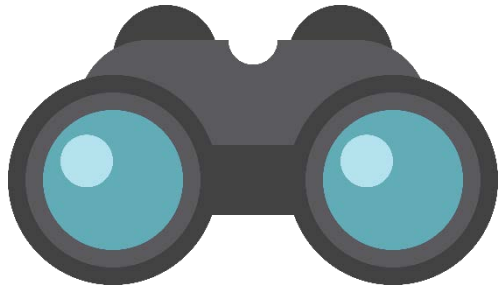
Prefer flash-based storage when best random I/O performance is needed

Multiple databases on same instance create a more random I/O workload

Prefer RAID 10 when best write performance is needed

RAID 5/6/50 may be sufficient for read-intensive workloads

# CrystalDiskMark 5.1



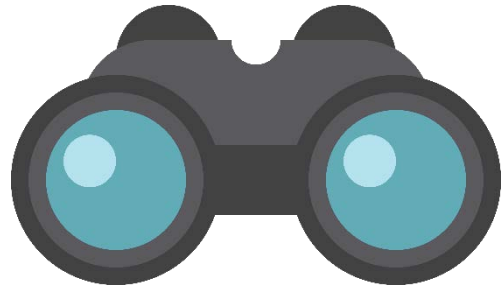
Free disk benchmarking utility that is quick to run and very easy to use

Completely rewritten in version 4.0 to use Microsoft DiskSpd for its testing

Should be used for initial storage testing

Available for download at: <http://bit.ly/1IVRCx0>

# Microsoft DiskSpd



Free disk benchmarking utility that can be quick to run and is relatively easy to use

More flexibility and more detailed results than older tools like SQLIO

Should be used for more comprehensive storage testing efforts

Available for download at: <http://bit.ly/1whNzQL>

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