[Course Overview](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live" \t "psplayer)

[Course Overview](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live)

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I'm a principal](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=10.5) [consultant with SQL skills as well as a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=12.785714285714286) [Microsoft data platform MVP, and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=16) [topic is one that I've been presenting and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=17.944444444444443) [writing about for many years, because I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=19.833333333333332) [feel so passionate about this subject. In](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=22.25) [the course of my career as a database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=24.7) [administrator and consultant, I've never](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=26.299999999999994) [had anyone tell me that their database or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=28) [database server was too fast. It's all too](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=30.83333333333333) [common for people to complain about slow](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=33.25) [application performance, and often jump to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=35.5) [the conclusion that any performance or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=37.83333333333334) [scalability issue must be caused by your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=39.9) [database server. Quit often, application](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=42.69999999999999) [and database performance issues are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=44.78571428571429) [actually caused by poor storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=47) [performance. I want to give you the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=50) [concepts and tools that you can use to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=52.500000000000014) [help prevent your storage subsystem from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=54.500000000000014) [being a performance or scalability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=55.92857142857143) [bottleneck. I also want to show you a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=58.071428571428584) [number of techniques that you can use to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=59.90000000000002)[reduce the load on your storage subsystem.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=62.375) [We cover how to measure and analyze your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=64.5) [storage subsystem performance, how to test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=67) [and benchmark your storage subsystem, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=69.625) [how to improve your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=71.875) [performance. If you work with SQL server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=74.125) [in any capacity, whatever your level, this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=76.49999999999997) [course is relevant to you. 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I hope you'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=85.99999999999999) [join me as we explore the world of storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=88.3181818181818) [subsystems with the SQL Server: Improving](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=91) [Storage Subsystem Performance course here on Pluralsight.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m0&clip=0&mode=live&start=93.9)

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So what are we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=9.5) [going to to talk about in this module?](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=11.666666666666664) [Well, first we'll be talking about the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=13) [overall importance of storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=15.333333333333337) [performance for SQL Server. So many](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=17.28571428571428) [instances that I see out in the field have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=20.333333333333336) [major storage bottleneck. So this is a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=23.181818181818187) [really important subject for SQL Server.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=25.599999999999994)[Then we're going to talk about the three](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=28) [main metrics for storage performance. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=29.599999999999994) [we'll get into some more detail about what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=32.125) [the rest of the course will cover. Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=33.5) [subsystem performance is absolutely](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=37.5) [critical for SQL Server. Database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=39.5) [performance is very often limited by your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=42.333333333333336) [storage performance. You can have the very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=44.5) [best processors and lots of RAM, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=46.818181818181834) [often, you just are limited by your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=49.4) [storage performance. So that's why this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=52.19999999999999) [course is very important. Many SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=54) [workloads just won't fit inside the SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=56.28571428571429) [Server buffer pools, so that means you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=59.00000000000001) [going to be have to pulling data in off of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=60.571428571428584) [the storage subsystem, into the buffer](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=63.09999999999998) [pool, on a pretty regular basis. Also,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=64.75) [different types of SQL Server workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=68.28571428571429) [have different storage requirements,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=70) [whether it's really good sequential](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=72) [performance, or really good random](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=73.66666666666664) [performance. And you're going to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=75.60000000000002)[different things when different activities](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=77.42857142857146) [are happening with your workload. Finally,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=79.125) [many DBAs are just simply not very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=81.5) [knowledgeable about storage. Storage is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=84.80000000000001) [some mysterious black box for them. And I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=86.75) [want to try to break through that and give](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=89.44444444444446) [you the knowledge you need to analyze and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=91.28571428571428) [improve your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=93.5) [performance. So the bottom line for all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=95.5) [this is that don't ignore your storage.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=97.99999999999997) [It's extremely important for your overall](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=101) [performance, and that's going to affect](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=103.57142857142858) [how your users perceive your system and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=105.36363636363633) [how happy you're going to be in your day-to-day work.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=0&mode=live&start=108)

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Then you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=8.105) [input/output operations per second, or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=11.438333333333334) [IOPS. And then finally, you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=13.660555555555558) [sequential throughput, which is also known](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=15.533571428571433) [as bandwidth. Now latency is simply the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=18.105) [time that it takes for an I/O to complete,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=20.77166666666666) [and it's sometimes called response time or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=23.105) [service time, depending on the vendor or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=25.438333333333325) [the tool that you're looking at. And this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=27.468636363636367) [measurement starts when the operating](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=30.105) [system sends a request to the drive or the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=31.962142857142855) [drive controller, and ends when the drive](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=34.53357142857142) [finishes processing the request. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=37.32722222222221) [especially for rights, the data may](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=39.504999999999995) [actually still be in a controller cache](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=41.90499999999999)[somewhere. So, a RAID controller cache, or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=43.90500000000001) [a SAN cache, or even a drive-level cache.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=46.771666666666654) [And you really need to understand whether](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=50.105) [you using write-back caching or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=51.855) [write-through caching when you're looking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=53.43833333333334) [at write latency for example. Now, latency](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=55.605) [is not the only measure of performance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=58.99388888888888)[Storage vendors tend to emphasize](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=62.105) [whichever one of these three measurements](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=64.105) [that makes their product look the best.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=66.105) [So, for example, SAN vendors like to tout](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=68.105) [their IOPS figures because they do quite](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=71.01409090909088) [well there, but they don't do nearly as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=72.77166666666669) [well on sequential throughput is a lot of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=74.90499999999999) [other types of storage. And SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=77.605) [workloads can be very different from other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=80.23) [server workloads, and there's different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=83.105) [kinds of SQL Server workloads and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=85.23) [different kinds of SQL Server files that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=87.3907142857143) [have very different storage requirements.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=89.605) [So make sure you understand that and think](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=92.105) [about that as you're designing and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=94.50499999999998) [configuring your storage subsystem. You](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=97.105) [need to understand how these metrics are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=99.405) [all related, the three ones we're talking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=101.50499999999998) [about right now. So, Input/Output](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=103.355) [Operations Per Second is just simply the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=104.855) [number of read or write operations per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=107.66055555555556) [second. And this is directly related to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=111.54944444444446) [latency because if you have a latency of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=113.81928571428575) [one millisecond, you can process 1, 000](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=116.4383333333333) [I/Os per second, and that's with a queue](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=118.98) [depth of one. And that's more of desktop](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=121.355) [kind of a workload. Server workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=123.21611111111115) [typically have higher queue depths. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=124.96214285714287) [that's going to affect your IOPS figures](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=127.48) [because you take the queue depth divided](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=130.105) [by the latency to get the IOPS. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=132.20500000000007) [there's different kinds of IOPS you need](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=136.37772727272727) [to think about. So, first of all, the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=138.28681818181823) [total IOPS for a particular file or a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=140.4686363636364) [particular logical drive, for example.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=142.96214285714282) [Then you're going to have the Random read](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=145.105) [IOPS. And then the Random write IOPS. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=147.77166666666673) [those are going to be quite different,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=150.355) [depending on your workload, and the file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=152.105) [type that you're dealing with, and the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=154.855)[kind of activity that SQL Server is doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=156.50499999999997) [at the time. Then finally, keep in mind](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=158.355) [again, that IOPS is related to queue](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=160.7716666666667) [depth. So the server workloads have higher](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=163.6764285714285) [queue depths, and that's going to affect your IOPS figures.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=1&mode=live&start=165.605)

[Sequential Throughput](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live)

[The next important storage metric we want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=2.229) [to talk about is Sequential Throughput.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=3.229) [And that's simply a measure of the data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=6.229) [volume through the system over time. It's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=8.229) [usually measured in megabytes per second](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=10.514714285714286) [with most systems, or gigabytes per second](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=12.229) [with systems with very good storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=15.229) [performance. This is also known as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=16.94328571428571) [bandwidth. And throughput is simply your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=18.89566666666666) [IOPS times a transfer size. Now, the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=21.228999999999992) [importance of sequential performance for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=24.229) [SQL Server really can't be overstated.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=26.657571428571426) [There's many things that you do, on a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=29.229) [daily basis, that are really affected by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=31.629000000000005) [your sequential throughput, and it's just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=34.104) [critical for many of your common SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=35.89566666666666) [Server activities you do on a day-to-day](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=37.67344444444444) [basis. So, a good example is doing a full](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=40.78455555555554) [database backup or a full database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=43.62899999999998) [restore. How long that ultimately takes,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=45.82899999999999) [depends on your sequential throughput, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=48.229) [this is a very common activity for most](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=50.528999999999996) [DBAs. Another thing you do quite often is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=52.928999999999974) [initializing some sort of an HA copy of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=55.592636363636366) [your data, whether it's a database mirror](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=58.5017272727273) [or an Always On Availability Group](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=60.229) [replica, or a replication subscriber, or a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=61.94328571428571) [log shipping copy of a database. The time](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=64.979) [it takes to initialize that copy is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=67.979) [limited by your sequential throughput.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=70.56233333333333) [Another good example is creating a new](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=72.229) [index on a large table, or rebuilding an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=75.00677777777777) [index on a large table. How long that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=78.354) [takes is again, limited by your sequential](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=81.22899999999998) [throughput. And having really good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=83.82900000000002) [sequential throughput gives you a lot more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=85.56233333333331) [freedom to do better index tuning, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=88.0471818181818) [can be very beneficial for your overall](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=90.67344444444444) [workload. And then finally, if you've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=93.78455555555554) [a data warehouse or reporting kind of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=95.56233333333337) [workload, that use lots of large](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=97.89566666666664) [sequential read scans from your data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=100.729) [files, then your query performance is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=103.729) [ultimately limited by your read sequential](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=105.65757142857146) [throughput. So, these are all good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=107.82900000000002) [examples of why sequential throughput is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=109.89566666666664) [so important for SQL Server. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=112.22900000000003) [unfortunately, sequential throughput often](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=114.729) [gets kind of the short end of the stick from a lot of storage vendors.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=2&mode=live&start=116.729)

[Course Objectives](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live)

[So what are the overall objectives of this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=1.873) [course? Well first, I want to provide a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=4.539666666666667) [very thorough understanding of how to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=6.2730000000000015) [measure and analyze your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=7.998) [performance from a SQL Server perspective.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=10.44442857142857) [I'm going to use tools and queries from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=13.873) [Windows and from SQL Server itself, to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=15.65077777777777)[measure your current and historical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=18.539666666666662) [storage subsystem performance. Also going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=21.073000000000004) [to show you how to use all these metrics](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=23.418454545454548) [you can collect, how you can analyze them,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=25.873) [and actually understand your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=28.873) [subsystem performance, especially from a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=31.015857142857136) [SQL Server perspective. Then I'm going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=33.373)[show you how to run and interpret some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=35.60027272727272) [synthetic storage benchmarks and some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=37.373) [actual SQL Server storage tests. So get](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=39.73014285714286) [over the objection you might get that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=42.373) [synthetic storage benchmarks are not valid](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=44.30157142857143) [for SQL Server workloads. Next, we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=46.873) [going to talk about the different types of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=50.418454545454544) [storage that are commonly used with SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=52.60027272727273) [Server and how to look at them and figure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=55.44442857142858) [out what their strengths and weaknesses](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=57.65077777777777) [are, and how to configure them for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=58.70633333333332) [different kinds of SQL Server workloads.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=60.30157142857143) [So, we've got internal storage, whether](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=62.873) [it's internal drives or add-in storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=65.248) [cards. We have direct-attached storage,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=67.498) [storage area networks, and then SMB file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=69.873) [shares that can use Storage Spaces Direct](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=73.32754545454544) [in Windows Server 2016. Then we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=75.873) [to talk about some of the differences](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=79.17299999999999) [between magnetic and flash storage. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=79.873) [then some of the differences between the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=83.07300000000001) [different types of flash storage that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=84.47300000000003) [available, because not all flash storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=86.53966666666665) [is the same. Then finally, we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=89.373) [talk about some of the different things](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=92.123) [you can do at all different levels to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=93.60027272727275) [improve your storage subsystem performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=95.20633333333333) [for SQL Server. So, this includes making](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=96.873) [sure your hardware and storage is properly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=100.58728571428573) [selected and configured for your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=103.58728571428573) [particular kind of SQL Server workload.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=105.873) [Then I'm going to talk about making sure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=108.873) [your operating system is configured](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=110.623) [properly and making sure that SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=112.498) [is configured properly for best storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=114.20633333333338) [performance. And then, talk about how to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=117.123) [do some workload and index tuning, to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=120.073) [reduce the load on your storage subsystem and get better performance for SQL Server.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=3&mode=live&start=122.123)

[Course Focus and Summary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live)

[So what is the focus and structure of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=1.84) [rest of this course? Well, we have five](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=4.006666666666667) [more modules. The first one is Measuring](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=6.673333333333332) [and Analyzing Storage Subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=8.76857142857143) [Performance. Then we go on to Testing and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=10.673333333333332) [Benchmarking your Storage Subsystem. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=13.965) [we move along to how to understand the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=16.74)[different Storage Types that are Suitable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=19.48285714285714) [for SQL Server Workloads. The next module](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=22.05428571428572) [is Understanding the Effects of different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=25.006666666666664) [RAID levels on SQL Server Workloads. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=26.34) [then finally, I'm going to talk about how](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=30.59) [to actually improve your Storage System](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=32.715) [Performance in the final module. So, what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=34.965)[did we cover in this module? Well, first I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=37.84) [talked about the absolute importance of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=40.465) [storage subsystem performance for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=42.768571428571434) [Server, and how often I see systems in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=44.91142857142859) [field that have major storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=47.117777777777775) [bottlenecks. Then I talked about the three](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=50.673333333333325) [main metrics for storage performance and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=53.59)[how they're related to each other. Then I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=55.62571428571429) [talked about what this course will](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=58.040000000000006) [actually cover. Then we went through how the rest of the course is structured.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m1&clip=4&mode=live&start=60.140000000000015)

[Measuring and Analyzing Storage Subsystem Performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live)

[This is module two, measuring and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=2) [analyzing storage subsystem performance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=3.7142857142857135) [So what am I going to cover in this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=6) [module? We'll start off talking about some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=8.700000000000001) [of the different methods you can use at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=10.199999999999996) [the operating system level and at the SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=12.5) [Server level to measure your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=15) [performance. These include things like](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=17.333333333333336) [PerfMon and Resource Monitor that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=19.5" \t "psplayer) [operating system tools, then we'll show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=21.444444444444443) [you some things that you can do inside of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=22.77777777777777) [SQL Server with DMV queries and other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=25.400000000000006) [queries to measure your I/O subsystem performance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=0&mode=live&start=27.25)

[Windows Performance Monitor and Windows Resource Monitor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live)

[Operating system tools. There are two main](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=1.737) [very useful tools that are included with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=4.737) [all modern versions of Windows that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=6.570333333333333) [extremely useful for measuring your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=8.903666666666668) [storage subsystem performance. The first](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=10.737) [one is Windows Performance Monitor and the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=13.094142857142858) [second one is Windows Resource Monitor. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=15.987) [Windows Performance Monitor, or PerfMon,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=18.737) [is a really low overhead tool that can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=21.237) [show you real time performance data in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=23.637000000000004) [several different formats or it can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=26.112) [capture it to a log file over time so you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=28.05518181818182) [can look at it later. Here's what it looks](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=30.808428571428568) [like when you're focused in on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=33.12588888888889)[LogicalDisk counters. And this shows you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=35.237) [some very useful metrics at the disk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=37.737) [level, so you can see what's happening to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=40.437) [your SQL server files that are on a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=43.509727272727275) [particular disk but they're all rolled up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=45.69154545454546) [to the disk level. And I always like to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=47.90366666666668) [focus in on the ones that are shown in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=50.237000000000016) [here, and we'll have a demo of this later.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=52.46776923076923) [Next we have Windows Resource Monitor and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=55.237) [Windows Resource Monitor is a tool that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=57.60063636363637) [also shows you some very interesting](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=60.14609090909094)[metrics but you don't have as much](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=61.987) [customization ability for this and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=64.237) [shows you what's happening at the file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=66.637) [level in real time, and quite often I will](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=68.03700000000002) [sit there and watch this when I'm doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=71.43700000000004) [something like creating a new index or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=73.95128571428575) [running a full database backup or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=76.41881818181815) [restoring from a database backup and watch](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=78.737) [what happens to the individual files on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=81.987) [the different drives as these things are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=84.57033333333332) [happening and get an understanding for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=86.90366666666662) [what's going on and what's happening with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=89.112) [my latency and then my throughput as I'm](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=91.43699999999998) [doing these different activities so this is a very useful tool in my opinion.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=1&mode=live&start=93.90366666666665)

[Demo: Windows Performance Monitor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live)

[For this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=1.636) [you some of the LogicalDisk counters in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=2.9485) [Performance Monitor and which ones are the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=5.386) [most relevant from a SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=7.564571428571428) [perspective. Here we have Performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=10.535999999999998) [Monitor running and we've got some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=12.469333333333335) [LogicalDisk counters set up for three](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=14.136" \t "psplayer) [separate SSDs that I have in my](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=15.736) [workstation. I've got a C drive, an L](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=17.836000000000006) [drive, and a T drive. And I have six](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=19.886) [specific counters set up that are really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=22.636) [useful in my opinion for looking at your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=24.993142857142853) [storage subsystem performance at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=27.850285714285707) [LogicalDisk level. So I've got average](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=30.136" \t "psplayer) [disk seconds per read, I've got average](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=32.636)[disk seconds per write, and those show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=34.99314285714286) [your latency for reads and writes at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=37.13600000000001) [disk level. Then I've got disk read bytes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=40.136) [per second and disk reads per second. Disk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=42.636) [read bytes per second is your throughput](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=45.436) [for reads, and then disk reads per second](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=47.53599999999998) [is your IOPS for reads and then down here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=50.317818181818204)[we have disk writes bytes per second,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=53.226909090909096) [which is your throughput for writes, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=55.136) [then disk writes per second is your IOPS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=57.408727272727276) [for writes for each drive, and so we can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=59.59054545454546) [watch this and see what's happening, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=62.46933333333335) [again you can watch this in real time or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=64.636) [you can log this information to a file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=67.46933333333331) [over time and see what's going on at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=70.136) [different times of the day with your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=71.46933333333332) [system and this lets you see what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=73.80266666666662) [happening with your LogicalDisk level rather than in individual files.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=2&mode=live&start=76.70742857142858)

[Demo: Windows Resource Monitor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live)

[For this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=1.171) [you how to get some very useful](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=3.5043333333333337) [information about what's going on at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=5.171000000000001) [file level in your storage subsystem with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=6.671) [Windows Resource Monitor. Now I have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=9.171) [Windows Resource Monitor running and I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=13.028142857142859) [have a long running query that's doing a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=14.742428571428572) [big sequential read from this particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=17.170999999999996) [database right here. So you can see that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=19.170999999999996) [the data file for this database is being](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=21.534636363636366) [hit really hard in terms of sequential](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=23.970999999999997) [reads. You can also see the latency fairly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=26.770999999999987) [high here as we're really stressing this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=29.504333333333324) [SSD hard. I've also got buffer pool](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=32.31385714285714) [extensions going on my SSNs here and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=34.59957142857142) [that's here on the L drive so you can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=36.534636363636366) [that SQL Server is trying to read from the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=39.26190909090909) [BPE file. It's also trying to write from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=41.671) [it, so doing common things like a big](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=44.3528181818182) [sequential read or building an index or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=47.17100000000001) [doing a backup or a restore and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=49.534636363636366) [watching it here in Resource Monitor to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=52.4437272727273) [see what's going on with the different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=54.83766666666668) [files on the different drives, it's very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=57.296) [educational to see what actually happens](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=59.921) [to your storage subsystem when this is occurring.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=3&mode=live&start=62.171)

[SQL Server Diagnostic Queries](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live)

[Another tool you can use to measure your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=1.542) [storage subsystem performance are a set of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=4.042) [SQL Server diagnostic queries. This lets](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=7.042) [you collect some very useful data about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=9.292) [your storage subsystem performance from a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=11.942) [SQL Server perspective. So after you run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=14.342) [this set of queries, it's very common to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=16.63290909090909) [see some typical query result patterns](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=18.986444444444444) [from this. So what I see quite often is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=21.6531111111111) [very high write latency for your tempdb](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=25.087454545454545) [data files. It's also very common to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=27.741999999999997) [very high read latency for your user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=30.342000000000006) [database data files, and I'll talk later](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=32.562) [about what you can do when you see these typical result patterns.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=4&mode=live&start=34.942)

[Demo: SQL Server I/O-Related Diagnostic Queries](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live)

[For this demonstration I'm going to talk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=1.338) [about some SQL Server I/O-related](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=3.338) [diagnostic queries that are very useful](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=5.480857142857143) [for understanding what's going on with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=7.671333333333332) [your storage subsystem. Now we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=11.195142857142853) [start going through some of these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=13.737999999999998) [I/O-focused diagnostic queries to better](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=14.338) [understand what's going on with storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=16.838) [from a SQL Server perspective. Now the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=19.337999999999994) [first query's going to tell us the name of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=21.838) [the server and the build number of SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=23.838000000000005) [Server that we're running, along with the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=25.171333333333347) [edition. So we're running Enterprise](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=27.909428571428563) [Edition and we're on SQL Server 2014](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=29.937999999999995) [SP1-CU7. So it's important to understand](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=32.90942857142857) [that so you can see how your system might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=34.83799999999999) [be performing whether it's Standard](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=37.671333333333344) [Edition or Enterprise Edition, for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=39.838) [example. Now the next one is going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=41.937999999999995) [us what trace flags are in effect. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=43.226888888888915) [we've got all the good, standard trace](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=45.67133333333334) [flags that should be in effect for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=48.00466666666669) [Server 2014 instance. Next we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=50.43799999999998) [go in and see what's going on with our](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=52.428909090909094) [hardware, just at a high level. So I want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=54.838) [to find out what kind of processors I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=57.088) [have. I've got one physical processor with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=59.088) [eight logical CPUs and I've got 32](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=62.00466666666666) [gigabytes of RAM, so that's showing me](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=64.67133333333332) [that and also it's showing me that SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=67.00466666666662) [Server was last started at this time and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=69.24709090909086) [date, so I need to know that for some of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=71.42890909090906) [the queries later on. Next we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=74.19514285714287)[figure out exactly what kind of processor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=76.48085714285716) [we're running. Well actually we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=78.67133333333331) [to find out first what licensing situation](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=80.838) [it is. So I've got one socket with four](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=83.53800000000001) [cores per socket and eight logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=86.43799999999997) [processors, so I've got a quad-core](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=88.19514285714287) [processor with hyper-threading. The next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=90.53799999999998) [one in this set is going to tell me the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=92.88345454545453) [processor description. So this'll show me](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=96.00466666666667) [exactly what kind of processor I have and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=98.06527272727274) [this is important to know because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=99.61072727272726)[depending on the age of your processor,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=101.24709090909086) [you might have PCIe 3. 0 or PCIe 2. 0 or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=103.49184615384615) [maybe even PCIe 1. 0 support which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=107.76657142857142) [something you don't want so now we know](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=111.00466666666665) [that, we can look this up and find out](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=113.138) [what we get from that particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=115.53800000000001) [processor. The next one in this set's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=117.93800000000005) [going to show a few of the instance-level](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=119.42890909090912) [configuration values that are relevant for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=122.13799999999998) [I/O. So I've got backup checksum default](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=125.73799999999997) [enabled, I've got backup compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=128.90942857142855)[default enabled, which are both usually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=131.338) [good things to do. Cost threshold for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=133.338) [parallelism's set at the default of five,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=135.538) [quite often you might want to raise that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=137.83800000000005) [to a higher value with certain kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=140.19514285714283) [workloads. Max degree of parallelism is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=142.93800000000002) [set to four. What you set that to depends](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=145.213) [on your hardware and a few other things.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=147.67133333333337) [Max server memory I have set artificially](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=150.338) [low to 8, 000 megabytes for demo purposes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=152.088) [and then optimize for ad hoc workloads is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=155.338) [enabled which is usually a good idea for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=158.00466666666674) [most workloads. The next query in this set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=161.4491111111112) [is going to be looking at what's going on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=163.33799999999994) [with buffer pool extensions which is a new](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=165.62371428571424) [feature that was added in SQL Server 2014.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=168.338) [When I run this query, it shows me that I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=170.338) [have VPE enabled and it shows where that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=173.4149230769232) [VPE cache file is and how large it is. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=176.0046666666667) [next one in the set is going to look and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=180.53799999999998) [see if we're actually using that VPE](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=182.738) [caching file. So when I run this query,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=185.53800000000004) [it's going to show me that I actually am](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=187.42890909090912) [using it a little bit for these specific](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=189.2268888888889) [databases, and I actually had to work](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=191.23800000000003)[pretty hard from a demo perspective to get](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=193.338) [it to use this and that's one reason I had](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=195.338) [max server memory set so low for this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=198.33800000000005) [instance. Now moving on, the next one in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=201.00466666666668) [this set is going to show me where all my](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=202.83800000000005) [database files are laid out in the file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=205.33800000000002) [system. So I've got these various](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=208.00466666666676) [different databases on here and you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=210.0046666666667) [see that most of them are on the C drive](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=212.03030769230767) [but I have some on the L drive and some on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=214.338) [the T drive, mainly tempdb, so I've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=217.48085714285705) [them spread out fairly well and I can also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=220.33800000000002) [see how big they are and whether or not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=223.67133333333337) [they're using percent grow so those are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=226.338) [things I'd like to look at here. Next in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=228.23800000000003) [the set, so I'm going to figure out okay,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=230.70163636363637) [what's the volume information for all of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=232.338) [my logical volumes that have any SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=235.13800000000003)[Server database files. So I've got a C, L,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=237.4808571428571) [and T drive, and you can see how large](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=239.72261538461535) [they are and how much free space I have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=242.06527272727274) [and that's really good information to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=245.338) [know. Alright the next one in the set is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=247.05228571428566) [going to go in and look and see if I have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=248.67133333333325) [any 15-second I/O warnings in the SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=251.8834545454546) [Server error log, and this is going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=254.33800000000002) [look at the first error log and then the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=257.00466666666665) [second one and you can add more to this if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=258.93799999999993) [you want to. So luckily I don't have any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=261.51981818181804)[15-second I/O warnings. If I did I'd want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=264.3379999999999) [to investigate that further and try to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=267.0046666666666) [if there's any kind of a pattern, are they](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=269.06527272727277) [always happening at the same time of day,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=270.738) [are they always happening with the same](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=272.338) [files, for example. Now the next one in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=274.4380000000001) [this set is going to show me the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=276.588) [drive-level latency information so I can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=278.838) [see what's happening with my latency since](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=281.0046666666667) [SQL Server's been running for all of my](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=282.738) [drives that have any SQL Server database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=285.9379999999998) [files. So you can see the read latency for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=288.9094285714287) [this C drive is pretty high, and that's on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=291.51981818181804) [purpose because I was purposefully doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=294.0522857142857) [some stuff to stress the C drive earlier](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=296.48085714285725) [but this is useful information to know,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=299.338) [the thing to keep in mind that this just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=301.338) [shows you what's been happening since SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=303.7925454545453)[Server's been running so it's cumulative](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=305.588) [and it includes everything that's touched](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=307.19514285714286) [those files, so your normal workload,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=309.088) [maintenance, backups, everything will go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=311.338) [under these numbers. The next one in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=313.338) [set is going to show me the same](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=316.7016363636363) [information except at the file level. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=319.088) [when I run this, this shows individual](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=321.738) [database files so we have C right here,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=324.53799999999984) [the data file for that database, and we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=327.3379999999999) [can scroll over and see some other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=329.8834545454545)[information here about the number of reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=331.7925454545453) [and the number of writes. So this helps us](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=333.8380000000001) [understand our workload better and shows](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=336.838) [us which specific files are seeing the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=339.00466666666665) [highest latency. So that's good information to know.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=5&mode=live&start=342.1380000000001)

[Demo: SQL Server I/O-Related Diagnostic Queries - Part 2](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live)

[The next query in this set is going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=1.898) [look at VLF Counts for all the databases](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=3.9749230769230772) [on the instance. And keeping your VLF](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=6.040857142857142) [Counts under control is a really good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=8.612285714285715) [idea. It helps improve the write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=10.697999999999997) [performance to your transaction log files](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=13.398) [and also reduces your recovery time when](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=15.148) [you go through a database restore and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=17.04085714285714) [recovery sequence, and it makes crash](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=19.898) [recovery go more quickly. And all my VLF](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=22.398) [Counts are pretty low on all my databases,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=24.898)[which is good. The next query in this set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=27.04085714285714) [is going to see which databases on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=29.398) [instance are generating the most total I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=31.564666666666664) [cumulatively, since the instance has been](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=33.898) [running. And this includes your normal](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=36.46942857142859) [workload plus things like backups and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=38.56466666666668) [index maintenance so you can see this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=40.32657142857143) [particular database has a lot of I/O, the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=42.56466666666668) [vast majority of the I/O for the instance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=45.23133333333334) [The next one in the set is the wait stats](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=47.898) [query and this shows you your cumulative](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=51.53436363636367) [wait stats since SQL Server has been](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=53.398) [running or since the wait stats were](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=55.56466666666668) [manually cleared. And this shows you, in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=58.148) [order, by the wait percentage here. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=60.71618181818184) [when you're looking at this, you want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=63.120222222222225) [take a look at the average time for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=64.898) [waits, so these are resource waits and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=68.49800000000005) [these are signal waits, which are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=70.69799999999998) [CPU-related, and these are all other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=72.56466666666665) [resources. And so as you look at this, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=74.56466666666662) [want to go and take a look at Paul](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=77.03133333333332)[Randal's new web page where he has a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=79.56466666666665) [really good set of resources that explain](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=82.273) [what these wait types mean and what you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=84.898) [might want to do when you see them. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=86.23133333333337) [next one in the set is going to show me](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=89.17072727272726) [average task counts, and it's going to go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=91.898) [in and look at a few things that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=94.148)[average across your schedulers. So the one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=96.56466666666665) [that's most relevant here is the average](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=98.75514285714287) [pending disk I/O count and you need to run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=100.75514285714287) [this multiple times and see if this ever](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=103.148) [goes above zero. If it does, that means](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=105.148) [you've got schedulers that are waiting for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=107.773) [disk I/O time which is a pretty good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=110.04085714285716) [symptom of I/O bottlenecks. Now the next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=113.12022222222221) [one in the set is going to look at page](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=115.39800000000001) [life expectancy by NUMA node and when I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=117.398) [look at this and I run it again, it's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=120.44345454545456) [going to be slowly going up as in there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=122.23133333333332) [no activity on my server right now, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=125.23133333333328) [this is a pretty good indicator of memory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=127.398) [pressure on your system and if your system](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=129.56466666666668) [is under memory pressure, then that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=131.898) [going to put more stress on your I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=133.44345454545456) [subsystem especially from a read](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=135.6252727272728)[perspective. So it's nice to know what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=137.49800000000002) [going on with your PLE. The next one in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=139.53436363636368) [this set is database-specific. It's I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=142.398) [statistics by file for the current](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=144.7868888888889)[database. So let's switch to a relevant](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=147.45355555555565) [database and then when I run this query](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=150.4694285714285) [it's going to help me understand what kind](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=152.898) [of workload I have from a storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=154.4979999999999) [perspective. So you can see my data file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=156.5646666666667) [and my log file, and the number of reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=158.80709090909096) [and the number of writes for example, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=161.39800000000005) [you can scroll over here and also see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=163.648) [megabytes read and written so this helps](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=166.398) [you figure out, is it more of an OLTP](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=168.89800000000002) [workload, or more of a reporting workload,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=170.75514285714283) [and what's the difference between the data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=172.69800000000006) [file and the log file. So rather than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=174.648) [guessing, looking at this query helps you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=177.023) [understand what's been happening to this database since SQL Server's been running.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=6&mode=live&start=179.56466666666668)

[Summary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live)

[So what did we cover in this module? We](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=2.092) [talked about some of the various methods](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=4.342) [you have available to measure your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=6.092) [subsystem performance. These include](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=8.092) [operating system tools such as Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=9.892000000000001) [Monitor and Performance Monitor, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=12.377714285714287) [some SQL Sever diagnostic queries that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=14.66342857142857) [can also use to measure your storage performance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m2&clip=7&mode=live&start=18.092)

[Testing and Benchmarking Storage Subsystems](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live)

[Introduction and Microsoft DiskSpd](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live)

[This is module three, Testing and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=2) [Benchmarking Storage Subsystems. So what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=4.666666666666668) [will we cover in this module? We'll start](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=6.625) [off talking about various methods you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=9.100000000000001) [use to test and benchmark your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=11.200000000000006) [subsystem. This includes things like](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=14.071428571428573) [Microsoft DiskSpd, CrystalDiskMark, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=16.5) [then tools you can get from the various](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=18.357142857142854) [Storage vendors to actually test your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=21.625) [storage subsystem. Finally we can use SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=23.833333333333332) [Server to test the storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=26.000000000000004) [performance, and that will help you get](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=27.785714285714285) [around sometimes you have storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=29.785714285714285) [administrators who don't set up some of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=31.214285714285708) [these other tools. So Microsoft DiskSpd is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=34.16666666666666) [a new tool that replaces SQLIO, SQLIO is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=37.099999999999994) [actually deprecated and Microsoft has](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=40.16666666666667) [removed it from the downloads that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=41.83333333333335)[available on the internet. So DiskSpd is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=44.722222222222214) [actually a much better tool. It doesn't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=47.25) [require or use SQL Server for its testing,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=49.3) [and it gives you much more detailed test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=52.5) [data when you run the test to see what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=55.166666666666686) [been going on with your storage subsystem.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=56.95454545454544) [Now you can use an old fashioned command](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=59.5)[prompt, or you can use PowerShell to run your tests.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=0&mode=live&start=61.27777777777777)

[Demo: Using Microsoft DiskSpd to Test Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live)

[In this demonstration I'm going to use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=2.219) [Microsoft DiskSpd to test our storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=3.774555555555556) [subsystem. This is a new tool that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=6.618999999999999) [replacing SQLIO, SQLIO is actually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=10.219)[deprecated, and you need to go and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=11.885666666666664) [download this, and I always like to put it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=13.519) [in the root, my C, I created a directory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=16.219) [called DiskSpd. So then once you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=19.49172727272727) [that, you need to go and figure out what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=21.37284615384615) [command line parameters you want to use,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=23.469) [so I've got a typical set of command line](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=25.219)[parameters you might start off with for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=27.919000000000008) [SQL Server in here, and you want to start](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=30.618999999999993) [a command prompt with administrator](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=33.71899999999999) [privileges so that it can create the test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=35.219) [file really quickly instead of going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=36.99677777777777) [through a slower method if you don't use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=38.88566666666668) [administrator privileges. So at any rate,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=42.219) [the first parameter, c10g means to create](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=44.67354545454547) [a 10 gigabyte test file. The next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=47.219) [parameter D30 means a 30 second test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=50.219) [duration. The next parameter of R means to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=53.719) [random IO for the test instead of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=55.969) [sequential IO. The next parameter W0 means](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=58.219) [to 0% write and 100% reads, the next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=61.946272727272735) [parameter T8, that means eight threads,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=66.219) [and then 08 means eight outstanding IO](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=69.219) [requests, which is more like a server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=72.719) [workload. And then B8K means a block size](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=74.93328571428574) [of 8K which is appropriate for most SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=77.5523333333333) [Server operations. Dash SH means disable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=81.01899999999998) [software caching and hardware write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=84.219) [caching, and then dash L means measure the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=87.469) [latency statistics while the test is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=90.5523333333333) [running, and then finally you give it the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=92.30990909090906) [path for where the test file is going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=94.469) [be created, and this controls which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=96.719) [logical drive you're actually going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=98.219) [test when you kick this thing off. So once](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=100.10788888888888) [I hit Enter, then the command line goes up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=103.719)[here at the top of my window, and it's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=105.969) [cranking away, it does a five second](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=108.81899999999999) [warmup, and then it runs a test for 30](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=110.91899999999997" \t "psplayer) [seconds, and it displays the results at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=113.88566666666662) [the end. And once it does that we'll take](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=115.719) [a look and see what came back from it, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=118.76445454545451) [this is much more powerful and gives you a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=121.85536363636359) [lot more information than SQLIO did, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=124.81900000000002) [there's a good reason that they deprecated](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=127.66344444444444) [SQLIO. So this should be done any time](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=130.77455555555562) [now, and we'll see the results when it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=132.969) [finally finishes. There we go, so, we can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=137.1078888888888) [scroll back up here and see that the first](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=140.21900000000005) [thing that it does is it displays the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=143.11900000000003) [command line for the test. And then it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=145.55233333333334) [goes through and shows all the input](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=148.11900000000003) [parameters including some ones that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=150.219) [default, they don't show up in here, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=152.7904285714285)[know, from your command line, so, you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=156.719) [see everything that it did for the test,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=159.12809090909096) [and then you start seeing the results here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=161.55233333333337) [and it shows you your CPU usage for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=164.219) [test, for each one of your logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=166.0189999999999) [processors. You can see that most of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=168.7904285714285) [CPU usage is on this particular logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=170.969) [core, and then some on this one, but most](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=173.1078888888889) [of the other ones weren't super busy](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=176.66344444444445) [during the test. And then you can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=178.219) [IO results for Total IO and then Read IO,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=182.9462727272728) [and we were doing a read test. So you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=186.30990909090912) [see the number of IOs per second on each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=188.969) [one of these threads. And then you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=191.219) [come down and see the write IO which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=194.94627272727274) [zero since we were doing 100% reads. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=196.88566666666668) [then you can see the percentile for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=199.719) [latency, and you can see as this is fairly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=203.719)[steady until we get to about 4 9s or 5 9s.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=206.68053846153856) [And it starts to really increase. So that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=210.219) [gives just kind of an indication of where the inflection point is for this.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=1&mode=live&start=213.61899999999997)

[CrystalDiskMark](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live)

[CrystalDiskMark is a free tool you can use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=1.943) [to test your storage subsystem. And it's a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=3.943) [really good idea to go in and test each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=6.988454545454545) [logical drive before you actually install](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=8.887444444444444) [SQL Server if at all possible. Now, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=11.554111111111112) [also want to make sure to test with a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=14.776333333333332) [large test file size when you do this, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=16.27633333333333) [can select from several different sizes,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=19.728714285714286) [and the reason you want a larger test file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=21.443) [size is so you can have a file that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=23.242999999999995) [large enough so it doesn't fit inside your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=25.443)[RAID controller cache, or your SAN cache](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=28.15728571428571) [if at all possible. Now you also want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=30.943) [make sure to run at least five test runs](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=33.514428571428574) [when you do this test rather than just say](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=35.443) [one or two. And that will help get rid of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=37.693) [outliers that might skew your results.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=40.596846153846144) [Also it's important to keep in mind that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=42.443)[CrystalDiskMark doesn't work with mount](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=45.10966666666668) [points. Now CrystalDiskMark actually uses](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=47.04299999999999) [Microsoft DiskSpd underneath the covers,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=49.443) [but it puts a nice graphical user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=51.443000000000005) [interface on top of it, which makes it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=53.643) [easier to do some quick and dirty testing.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=55.24300000000002) [So, here's what the results look like when](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=57.443) [you run CrystalDiskMark from a graphical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=59.842999999999975) [point of view. And the important parts of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=62.15728571428572) [this are the top two rows where it says](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=65.26118181818181) [Sequential Q32T1, and 4k Q32T1. Those are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=70.068) [more serverlike workloads, so that top row](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=75.10966666666666) [is showing you your sequential performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=77.443) [with a queue depth of 32. So you can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=79.443) [the reads and megabytes per second, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=82.24300000000001) [the writes and megabytes per second. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=83.87157142857143) [then the row below that is showing you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=86.66522222222223) [your 4K random IOs for reads and writes,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=88.443) [and this shows you the megabytes per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=92.443) [second for each one of those, but when you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=94.54299999999998) [see the text results, or if you look at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=96.64300000000001)[this live with a tool tip, you can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=98.80663636363633) [actual iOPs. So this is what it looks like](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=101.77633333333331) [when you copy the results out and stick it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=104.05838461538458) [into a text file, and this is actually a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=106.72871428571429) [better way to collect the results because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=109.35209090909093) [it gives you more details about the test,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=110.77633333333333) [and you can see what your IOPs are right](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=113.443) [here in the test along with all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=115.51992307692304) [details about the test and when it was](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=117.77633333333331) [run, and what operating system you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=120.2611818181818) [running on so this is a better way to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=121.8975454545454) [collect the results in my opinion. So now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=123.84300000000002) [you can see, here's an example of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=126.843) [relatively poor performance from a logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=128.243) [drive. This happened to be two 10000 RPM](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=130.943) [magnetic SAS drives in RAID 1, and they're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=134.943) [only giving you about 130 megabytes per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=138.26118181818188) [second for reads, and 138 MB per second](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=140.89754545454548) [for writes, which is, you know, typical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=144.53390909090922) [for a magnetic drive. And then your IOPs](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=147.10966666666673) [are even very, very low, and that's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=149.77633333333338) [the weakness of magnetic drives. Now in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=152.568) [contrast to that, here is some really good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=155.04300000000003) [performance from a logical drive. This is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=157.443) [a 512 gigabyte Samsung 950 Pro NVMe PCIe](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=160.843) [solid state drive, and you can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=166.443) [sequential performances, 2593 MB per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=169.10966666666675) [second, and the write performance is 1529](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=172.64300000000006) [MB per second, so, this is much better](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=175.84300000000005)[than the typical SAS or SATA SSD, and much](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=178.8975454545455) [better also than a magnetic drive. But](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=182.193) [what you're really seeing awesome](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=184.88744444444447) [performance from this is on your 4K random](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=187.10966666666675) [reads and writes with a queue depth of 32, and that's that second row there.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=2&mode=live&start=189.693)

[Demo: Using CrystalDiskMark to Test Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live)

[In this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=2) [you how you use CrystalDiskMark to test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=3.091125) [the storage for a particular logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=5.246999999999999) [drive. Here we have two copies of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=8.122) [CrystalDiskMark running. I already ran the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=10.997" \t "psplayer) [test with five test runs over here on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=12.837909090909093) [right so we can look at the results while](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=15.146999999999998) [the first one is running. So I'm going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=17.080333333333332) [go ahead and kick this off over here, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=19.41366666666667) [let it run, and while that's running we'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=20.997) [take a look at what happened with the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=22.997)[tests I ran previously. So on this one I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=24.858111111111107) [had five test runs, and I had a 4GB test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=27.41366666666666) [file and I'm testing my C drive. Down here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=30.59315384615384) [at the bottom is a text box where you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=33.08033333333333) [to type in the description of what it is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=34.747) [you're testing. It doesn't pick this up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=38.0197272727273) [automatically. And after you've done this,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=40.41366666666668) [you can click on this window and you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=42.11063636363637) [hover a tooltip over the second line to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=44.64699999999999) [see your IOPs right here in the GUI. But](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=47.080333333333336) [what's actually a better way to get your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=49.947)[results is if you go to File and Copy, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=51.547000000000025) [then you can paste that into Notepad here,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=56.19144444444444) [and you can look at it in more detail and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=59.747) [save it and see all the details of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=62.247) [test run, so you see what version of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=65.08033333333333) [CrystalDiskMark you had, all your detailed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=67.08033333333337" \t "psplayer) [results including the IOPs, and then you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=69.46128571428571) [can also see down here what volume you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=72.64699999999999) [tested and how much space it had](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=75.08033333333333) [available. And all the test parameters and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=77.41366666666663) [what operating system you were running,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=79.08033333333337) [and whatever you typed in the description](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=80.64699999999999) [for the test down here. So this is a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=82.747) [better way in my opinion to collect the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=85.63588888888891) [results. And also while this is running,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=88.247) [we can look up here, under Settings, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=89.83790909090912) [you can come in here and pick either](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=91.34700000000001) [Default data that's random, which doesn't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=93.347)[compress, or you can pick all zeroes which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=96.63588888888889) [compresses much better, and you might want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=100.01972727272727) [to test it both ways especially if you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=101.92881818181813) [thinking about using SQL Server data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=103.997) [compression, for example. So this runs and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=106.247) [then you can see over here, the results running for one test run.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=3&mode=live&start=108.94699999999999)

[Storage Vendor Tools](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live)

[Storage Vendor tools. The various storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=1.773) [vendors have some very useful tools you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=4.606333333333334) [can use for both management and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=6.717444444444444) [performance testing of your devices from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=9.384111111111112) [that particular vendor. An example is the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=11.415857142857146) [Intel Solid State Drive Toolbox. You also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=14.050777777777778) [have Samsung Magician, which is also quite](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=17.273)[useful. So here's what Intel Solid State](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=20.773) [Drive Toolbox looks like. You can use this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=23.67299999999999) [to check the health of your drives and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=26.000272727272733) [also to update your firmware, so when you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=27.606333333333332) [look at this, this shows you your drive](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=30.27299999999999) [health, whether it's good or bad, and also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=32.63663636363636) [your estimated life remaining, which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=35.273)[really important for flash devices. You](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=37.84442857142857) [can also see your firmware version, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=39.701571428571434) [you can actually do a firmware update](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=42.63663636363637) [using this tool. Another tool that's very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=45.18209090909094) [useful is Samsung Magician, and you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=47.773) [use this to check your drive health and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=50.172999999999995) [see how many writes you've done, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=52.55871428571429) [whether or not the operating system has](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=54.573) [been optimized for this device, you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=56.67299999999998) [also use it to update your firmware.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=59.717444444444446) [Finally with Samsung Magician, you can do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=61.273) [a performance benchmark, so this lets you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=64.38411111111111) [see what kind of performance you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=67.27300000000002) [actually getting from that device, and it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=69.60633333333332) [only takes less than a minute to run these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=71.63663636363637) [performance benchmarks. So they're pretty useful.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=4&mode=live&start=73.273)

[Demo: Using Vendor Tools to Test Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live)

[In this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=2) [you how to use one of these vendor tools](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=3.1098181818181834) [to actually test your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=4.994) [performance. In this case, it'll be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=7.994) [Samsung Magician. Here we have Samsung](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=11.601142857142856) [Magician opened up on the Performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=13.632888888888886) [Benchmark page. And you can pick which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=15.410666666666666) [drive you want to run the benchmark test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=17.57733333333334) [on and all you have to do is click the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=18.97476923076923) [Start button, and it goes through and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=21.28246153846153) [starts doing the test. And down here below](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=23.41066666666666) [it's showing you what it thinks this drive](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=25.944000000000003) [might be capable of based on it's specs.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=28.543999999999997) [And of course this is a vendor specific](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=31.744) [tool, so they know what that drive is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=33.52177777777777) [typically capable of. So you can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=36.54399999999999) [sequential read megabytes per second came](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=38.744000000000014) [in at 550 which is about the best you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=39.97476923076923) [going to do with a SATA 3 SSD. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=42.051692307692335) [the writes were a little bit lower which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=46.07733333333333) [is typical for SSDs, and then we can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=47.41066666666664) [the random read IOPs and the random write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=49.65309090909091) [IOPs. So this gives you a pretty quick](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=53.144000000000005) [test and in this case in 27 seconds, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=55.494) [it's just one more way of testing your storage from a specific vendor.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=5&mode=live&start=58.380363636363626)

[Storage Admins May Not Accept Benchmarks](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live)

[One issue you might run into occasionally](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=2) [is that the fact that sometimes your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=3.3354444444444455) [storage admins just don't want to accept](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=5.859857142857144) [the results of any of these previous](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=8.080636363636362) [benchmarks that I've been showing you.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=10.002714285714287) [They may claim that they're just a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=11.717) [synthetic benchmark that's not the same as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=14.050333333333338) [an actual SQL Server workload. So if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=16.717) [run into that kind of pushback, you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=19.383666666666663) [run some very easy SQL Server queries or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=21.383666666666663) [other tests to measure your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=24.05033333333332)[subsystem performance with SQL Server. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=26.939222222222227) [this is much harder to dispute, this is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=30.05033333333333) [real world tests from SQL Server, so I'm](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=32.717) [going to show you an example of that coming up.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=6&mode=live&start=38.717)

[Demo: Using SQL Server to Test Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live)

[In this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=2) [you how to use SQL Server to actually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=3.5533636363636374) [measure your sequential read throughput. I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=5.583857142857142) [also call this how to humble your SAN. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=8.774333333333335) [what we're going to do here is first we'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=11.713727272727274) [flush any dirty pages we might have in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=14.168272727272734) [buffer pool. Then we're going to go and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=17.640999999999995)[run DBCC DROPCLEANBUFFERS which you don't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=20.440999999999992) [want to do in production, this flushes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=22.191) [everything out of your buffer pool which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=24.191) [forces you to read the data from your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=26.741) [storage subsystem when you run a query](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=29.141000000000005) [later on. Now the next step is I want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=32.441) [come down here and turn on statistics IO](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=34.89554545454544) [and statistics time so we can see the IO](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=37.941) [statistics and how long it takes to run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=40.941) [this query, that's important for some of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=43.041) [the calculations we'll do later. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=45.14099999999998) [I'm going to switch to a large database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=48.90253846153847) [that I have, you can use any large](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=50.74869230769234) [database that you have access to to run a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=52.3500909090909) [similar test. So I'll switch to this no](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=54.641) [compression test database. Then I want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=58.10766666666666) [just see, okay, how big is this particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=60.10766666666666) [table in this database? So when I run this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=61.441)[query it comes back and tells me I have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=65.27433333333336) [151 million rows, and we're looking at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=67.64099999999999) [about 17. 8 gigabytes worth of data, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=70.89554545454544) [it's a decent sized table. Then what you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=73.941) [do is we can do select count star as row](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=77.2591818181818) [count from the table with an index hint](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=80.24100000000001) [that forces it to do a clustered index](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=83.441) [scan if there's a clustered index, or a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=86.10766666666663) [table scan if there isn't. So we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=89.01242857142859) [to kick off this query and this query](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=90.98645454545456) [typically takes about 38 seconds to run,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=92.441) [so while that's running, we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=95.441) [talk about the calculations we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=97.54099999999998) [do later on. So we're going to be reading](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=100.15528571428572) [pages, and every page is 8 KB. And the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=103.28715384615384) [number of pages we read times the physical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=106.16827272727272) [reads plus the readahead reads divided by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=109.0773636363636) [the elapsed time in milliseconds, that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=112.10766666666666) [little calculation is going to show us our](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=114.341) [sequential throughput in megabytes per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=117.01242857142857) [second. So this should be finishing up in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=119.86957142857142) [about 10 seconds, and when I ran this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=122.54099999999998) [earlier, these are the numbers that I got,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=124.27433333333336) [so we'll see if we come in roughly around](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=126.441) [the same when we do this, so it came back](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=128.89554545454544) [151 million rows, and if we go to the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=132.350090909091) [messages tab, we can see the number of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=134.941) [logical reads and the physical reads and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=136.941) [the readahead reads, and we can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=139.316) [elapsed time was 36. 241, so about 36](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=142.44100000000003) [seconds to run this test. So if I was to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=145.566) [plug in those numbers down here, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=148.35009090909094) [run this select statement, this would show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=150.441) [us our sequential throughput, which was](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=153.29814285714284) [543 megabytes per second when I ran this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=155.16827272727275) [earlier. And that's about all you can do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=158.07736363636374) [with a SATA 3 SSD, that's a limitation of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=160.7743333333334) [the SATA 3 interface. So then you can also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=163.941) [run another little calculation to take the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=167.10766666666672) [table size in megabytes right here, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=169.77433333333337) [then divide that by the read rate in MB](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=172.77433333333335) [per second and get the result which is the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=175.77433333333343) [elapsed time in seconds just a sort of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=178.98645454545462) [sanity check here. So this comes in pretty](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=181.691) [close. So the idea here is that you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=184.10766666666672) [run this test and then actually see in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=186.62281818181825) [real life how long it takes to do a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=189.25918181818187) [sequential read in a whole bunch of data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=192.25918181818184) [off your IO subsystem and in this case,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=194.441) [wherever your data file lives, for that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=197.441) [database, that's the drive you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=200.066) [be hitting, and seeing how much sequential](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=201.941) [throughput you can get out of it when you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=204.10766666666672) [run this test, and doing this kind of test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=205.8955454545455) [makes it much more difficult for SAN](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=208.07736363636369) [administrator or storage administrator to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=210.441) [argue with you and say that, oh that's not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=212.941) [a realistic test. This is absolutely testing your sequential throughput.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=7&mode=live&start=215.62281818181825)

[Summary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live)

[So what did we cover in this module? Well](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=2) [we talked about the various methods you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=4.364) [can use to test and benchmark your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=6.463999999999999) [subsystem. This included tools like](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=9.635428571428573) [Microsoft DiskSpd, CrystalDiskMark, some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=12.064) [storage vendor tools, and then how you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=14.664000000000001) [actually use SQL server itself to test](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=18.564000000000004) [your storage subsystem performance and get](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=20.730666666666664) [around skeptical storage admins and SAN admins.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m3&clip=8&mode=live&start=24.064)

[Understanding Storage Types Suitable for SQL Server Workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live)

[Introduction and SQL Server Storage Types](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live)

[This is module 2, understanding storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=2) [types that are suitable for SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=4.142857142857143) [workloads. So in this module, we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=6.642857142857141) [to talk about the different types of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=8.714285714285715) [storage that are commonly used for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=10.71428571428572) [Server. Then we're going to talk about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=13.571428571428573) [some of the strengths and the weaknesses](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=15) [of each type of storage as they relate to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=16) [different types of SQL Server workloads,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=18.200000000000003) [and then finally, we're going to talk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=20) [about some of the considerations for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=21.75)[getting the best performance from each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=23.66666666666666) [type of storage, specifically for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=25.888888888888886) [Server. So we've got several different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=28.555555555555543) [types of storage that are commonly used by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=30.25) [SQL Server, and these include internal SAS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=33.142857142857146) [or SATA drives. Modern servers typically](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=35.875) [have up to 24 internal drive bays, so you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=38.199999999999996)[can have quite a few internal drives](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=41.599999999999994) [there. You also have PCIe flash-based,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=43.699999999999974) [add-in storage cards, such as Fusion-io](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=47.125) [cards or cards from Intel. Next, we've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=50.5) [direct-attached storage, where you've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=54.199999999999996) [a number of drives and an external](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=55.42857142857144) [enclosure that's directly attached to one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=57.28571428571429) [or more RAID controllers in your host](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=59.66666666666667) [database server. Then we have storage area](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=62.800000000000004) [networks. Next, we've got SMB 3. 0 file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=65.66666666666664) [shares, which you can use with SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=68.625) [2012 or newer. Then we've got Scale-Out](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=71.09999999999998) [File Servers with Windows Server 2012 R2,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=74) [and then with Windows Server 2016, we've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=77) [got Storage Spaces Direct, which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=79.4) [another way of using Scale-Out File](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=82) [Servers using commodity hardware and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=85) [getting much better performance than you might have seen in the past.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=0&mode=live&start=88)

[Internal SAS/SATA Drives and Direct-attached Storage (DAS)](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live)

[One of the more common types of storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=2.154) [used for SQL Server are internal SAS or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=3.154) [SATA drives. These can be more than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=7.154) [adequate for many workloads, especially](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=9.265111111111107) [when they're flash-based drives, but even](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=10.554) [with magnetic drives, when you've got a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=12.553999999999998) [number of these, such as up to 24 that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=14.868285714285715) [might have in a modern, two use server,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=17.70955555555555) [that can be more than enough space and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=20.154) [performance for a lot of SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=21.93177777777777) [workloads. Now, these are also very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=23.868285714285708) [well-suited for AlwaysOn Availability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=25.82066666666666) [Group node storage. You don't have to use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=27.654) [shared storage such as a SAN for AlwaysOn](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=30.517636363636367)[Availability Group replicas and the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=33.354000000000006) [different nodes in your cluster. So these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=35.72542857142857) [work very well for that, and you have a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=37.72542857142857) [lot of flexibility to use any kind of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=39.72542857142859) [storage you want for that. It's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=41.65399999999999) [important if you're using internal SAS or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=43.820666666666675) [SATA drives that you use the best hardware](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=45.654) [RAID controller that's available for that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=48.404) [model server, and you also want to make](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=50.487333333333346) [sure that the hardware cache on the RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=52.86828571428571) [controller is actually enabled. I've run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=55.779) [into a lot of customers over the years](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=57.55400000000001) [where they had a pretty decent RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=59.154) [controller for their internal drives, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=61.779) [the RAID controller wasn't actually even](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=63.529) [enabled, and that was really hurting their](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=65.779) [performance. It's also important to talk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=67.86828571428575) [about direct-attached storage, which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=70.029) [also quite common for SQL Server. Now,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=71.904) [direct-attached storage is typically an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=74.554) [external storage enclosure with up to 24](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=76.654) [SAS or SATA drive bays, and these are two](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=80.37622222222222)[and a half inch drive bays, and this gives](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=83.95400000000001) [you again a very good level performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=86.05399999999999) [when you've got that many drives to work](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=88.154) [with, especially when some or all of them](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=89.93177777777782) [are flash-based. And again, what you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=93.2651111111111) [going to want to do with direct-attached](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=94.59844444444445) [storage is dedicate at least one RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=96.48733333333334)[controller and sometimes two RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=98.86828571428575) [controllers to each storage enclosure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=100.75400000000002) [rather than daisy chaining multiple](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=103.154) [enclosures off of a single RAID controller](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=105.654) [in your host because that represents a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=107.48733333333337) [single point of failure, and also it can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=109.654) [potentially become a performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=112.93177777777777) [bottleneck. You also want to make sure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=114.70955555555554) [that you think about how you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=116.35400000000001) [configure your logical drives before you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=118.654) [set them up with a direct-attached storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=120.82066666666665)[since it's a little bit harder sometimes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=123.154) [to change than it might be with something](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=125.4873333333333) [like a SAN. And these are very easy to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=128.15399999999997) [configure, and you don't need any special](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=130.86828571428566) [training to use direct-attached storage,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=132.01114285714283) [and again, they're very well-suited to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=134.154) [AlwaysOn Availability Group node storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=136.654" \t "psplayer) [because again, you don't have to have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=139.154) [shared storage for this. You can use any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=141.154) [kind of storage you want for availability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=143.0428888888889) [group replicas. And then finally, one of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=145.154) [the big advantages of direct-attached](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=148.029) [storage is that they give you very good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=149.75400000000002) [sequential read/write performance. They're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=152.154) [ultimately limited by the PCIe slot](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=154.654) [bandwidth and/or what the RAID controller](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=157.654) [can do. So you're going to get extremely](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=159.58257142857138) [good sequential performance, which is very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=161.904)[important for SQL Server usage. Then, what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=165.654) [you're going to want to think about for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=168.37622222222222) [both internal drives and for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=169.529) [direct-attached storage to make sure you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=171.404) [get the best performance are first of all,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=173.154) [you want to make to use the best RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=176.154) [controller possible, especially if you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=178.60854545454552) [going to use a parity-based RAID level,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=180.354) [like RAID 5 or RAID 6 for example. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=183.154) [processor in that RAID controller is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=185.48733333333334) [really important for your performance. You](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=187.654)[also want to make sure that that RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=190.454) [controller is in an appropriate PCIe slot.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=192.8540000000001) [So on a modern server, you hopefully have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=195.154) [PCIe 3. 0, and you might have an x4 or an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=198.79036363636374" \t "psplayer) [x8 slot for example, and you want to make](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=202.82066666666674) [sure your RAID controllers are in the best](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=205.26511111111114) [slots possible so you don't have any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=207.48733333333337)[bottlenecks at the slot level. Then you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=210.15400000000002) [going to want to make sure that that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=212.404) [hardware cache on your RAID controller,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=213.654) [make sure it's enabled because by default,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=215.154) [with certain kinds of system management](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=217.154) [software, when you create a RAID array, a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=219.7254285714285) [cache is not enabled, and again, I've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=222.35399999999998)[found many, many customers where this was](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=224.43971428571425) [the the case, and they had no idea. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=226.97218181818184) [you're going to want to dedicate the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=229.43971428571427) [hardware cache and the RAID controller to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=231.59844444444445) [writes, and the reason for that is quite](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=234.70955555555565) [often, especially with magnetic drives,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=236.904) [you have issues with random write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=238.154)[performance, and so using that hardware](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=241.5825714285715) [cache and the RAID controller for writes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=243.8206666666667) [will really help with that, and using it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=245.154) [for reads is not so helpful because you've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=247.82066666666668) [got the great big SQL Server buffer pool](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=249.75400000000002) [that's going to help you with that, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=252.154) [that's a much better and much larger read](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=253.454) [cache than you're going to get with your hardware RAID controller cache.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=1&mode=live&start=255.8540000000001)

[Storage Area Network (SAN)](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live)

[Another type of storage that's commonly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=1.896) [used for SQL Server is a storage area](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=3.096000000000001) [network or a SAN. Now a SAN is simply an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=5.396) [enclosure that has multiple, expensive](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=9.467428571428572) [components in there. So you're talking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=11.610285714285716) [anywhere from dozens to hundreds of either](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=14.021) [hard drives or flash drives. You've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=16.46742857142857)[multiple storage processors. You've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=19.096000000000004) [multiple power supplies. So all of this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=21.695999999999998) [can be pretty expensive, and that's why](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=23.896) [you have a very high initial capital cost](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=25.646) [with a SAN. And you're typically going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=28.396) [have to have some specialized training,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=31.146) [usually from the vendor, to know how to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=33.18171428571429) [set up and manage that SAN effectively. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=36.35054545454547) [there's a pretty high barrier to entry to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=39.22933333333334) [using a SAN. Now SANs are usually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=41.89600000000002) [optimized for IOPS. They have really good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=44.61028571428572) [IOPS numbers. But they don't do as well](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=47.896) [typically for latency, and their real big](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=50.22933333333333) [weak point is sequential throughput.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=52.229333333333344) [That's their Achilles' heel. Now, shared](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=53.896) [SAN performance tends to be inconsistent,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=56.896) [and that's very frustrating for database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=59.896) [administrators and users. You're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=62.096000000000004) [get good performance sometimes, and not so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=64.75314285714288) [good at other times, and that can be hard](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=66.75314285714288) [to pin down. The other thing to keep in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=69.146) [mind is that SANs are not magic. You know,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=71.61028571428575) [SAN vendors and people who are trying to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=75.396) [sell SANs will tell you all this wonderful](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=77.396) [stuff about how their specific technology](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=80.56266666666666)[for their SAN makes all the details about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=82.89599999999999) [the hardware unimportant, and all of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=86.396) [data is going to live in the great big](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=88.78488888888891) [cache on the SAN so it doesn't matter if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=90.896) [you're using flash storage or 15K drives](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=93.56266666666664) [or whatever the case may be. It's all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=95.89599999999999) [going to be great with the SAN, and that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=98.34044444444446) [just simply not true. You're going to get](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=100.56266666666666) [really good IOPS out of most SANs, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=102.62327272727275) [your latency's going to be higher than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=104.18171428571429) [with most other kinds of storage, and your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=106.32457142857143) [throughput can be quite a bit lower in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=109.396) [many cases than you can get from other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=111.396) [types of storage. So keeping that in mind,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=113.89599999999997) [if you are going to be using a SAN,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=115.96742857142854) [perhaps it's not your choice, there are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=117.896) [some things you need to think about to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=120.22933333333334) [make sure that you're going to get the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=121.56266666666671) [best performance from that SAN. So the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=123.5323636363636) [first thing you want to do is give](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=125.146) [specific performance requirements that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=127.496) [need for your workload to the SAN](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=130.496) [administrator. Don't just go to them and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=132.5960000000001) [say, "Well, I need five terabytes of space](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=133.75314285714282) [for this database. " You want to go and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=136.4414545454546) [tell them, "Well, this is going to be a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=138.61028571428568) [reporting workload, "so I need really good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=140.4515555555556) ["read sequential performance, " for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=142.896) [example, or "It's going to be a OLTP](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=144.5626666666667) [workload, "so I need really good random](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=146.646) [I/O performance "on these drives, " for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=149.146) [example. You want to give them more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=151.5626666666667) [specific performance requirements and not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=153.22933333333336) [just a space requirement. You also want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=154.896) [make sure that you and a SAN administrator](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=157.56266666666662) [look at the complete data path between the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=159.896) [host and the SAN, so that starts off with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=162.56266666666667) [a PCIe slot that your NIC or HBA is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=165.771) [plugged into and then the HBA or NIC](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=169.146) [itself and then your cabling and any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=172.46742857142848)[switches you go through and then finally](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=174.69600000000005) [the ports on the SAN to make sure there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=176.271) [no bottleneck in the middle of that that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=177.9869090909091) [really hurting your performance. You also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=180.49599999999998) [want to think about perhaps moving your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=183.2293333333333) [tempdb data files and log file to the host](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=185.896" \t "psplayer) [if your workload puts a heavy load on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=190.14599999999996)[tempdb, and by doing that, you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=193.47933333333322) [get much better performance than you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=195.79600000000002) [would, especially if you're using local](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=197.5960000000001) [flash storage on the host, than you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=199.39600000000004) [going to get from most SANs. Plus you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=201.396) [taking that tempdb workload off of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=203.496) [SAN, which helps the rest of the SAN, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=205.5960000000001) [you'll get better performance for your other drives that are on that SAN.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=2&mode=live&start=207.296)

[PCIe Flash Storage and SMB 3.0 File Shares](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live)

[PCIe flash-based, add-in storage cards,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=1.819) [these are flash-based storage on a PCIe](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=5.819) [expansion card that fits into one of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=8.930111111111112) [PCIe slots on the motherboard of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=11.319" \t "psplayer) [server. Now there are some newer models of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=13.48566666666667) [these types of products that actually fit](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=15.728090909090914) [into externally accessible drive bays on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=18.319)[the front of the server, but most of them](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=20.985666666666667) [still use regular PCIe slots on your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=23.59677777777777) [motherboard, and these are capable of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=26.485666666666663) [extremely high performance. Very high](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=28.694) [levels of IOPS and sequential performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=30.819) [that you can get from these kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=33.819) [cards. Now the latest products that use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=36.48566666666669) [this are using something called](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=38.53328571428571) [Non-Volatile Memory Express or NVMe, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=40.819) [is a new protocol that supersedes the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=44.10471428571429) [older AHCI protocol that was put out there](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=46.569)[many years ago for hard drives. And these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=50.63718181818184) [have much better performance than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=53.485666666666674) [AHCI-based products. They have lower](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=55.48566666666667) [latency, and they put less of a CPU load](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=58.319) [on your host. So they're extremely good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=61.00081818181819) [for performance for SQL Server. Now,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=63.152333333333345) [you're going to get much lower latency and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=65.319) [higher sequential bandwidth and a lot more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=69.15233333333333) [IOPS than you're got get from any kind of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=71.48566666666663) [a SAS- or SATA-based device because SAS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=72.819) [and SATA devices are using either the SAS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=75.67614285714286) [or SATA connector and whatever version of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=79.319) [SAS or SATA they're using, so they might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=82.15233333333332) [be limited to, for example, 12 gigabits](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=84.569)[per second, which is much lower than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=86.819) [you're going to get from one of these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=88.93011111111115) [add-in storage cards. And we're talking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=91.53328571428573) [orders of magnitude better performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=93.81899999999999) [with these compared to older types of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=95.819) [storage, so these are extremely](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=99.319) [interesting for SQL Server usage. Now,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=101.15233333333332) [another thing that you can use that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=103.24757142857143) [becoming more common now is SMB 3. 0 file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=106.21900000000001) [shares. So Server Message Block SMB 3. 0,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=111.15233333333336) [and this is fully supported with SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=113.819) [Server 2012 or newer and Windows Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=117.00081818181818) [2012 or newer. So you can actually host](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=119.81899999999999) [your system database files and your user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=122.48566666666665) [database files on file shares. Now that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=125.319) [doesn't mean you're just going to stick](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=128.219) [them on any regular old file server with,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=129.61899999999991) [you know, one gigabit Broadcom NICs. That](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=133.39042857142857) [might work, barely, but you're not going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=137.319) [to get the kind of performance and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=139.61899999999994) [redundancy that you need to actually do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=141.04122222222222) [this. So what you actually want to do is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=142.59677777777782)[make sure that you've got the right kind](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=145.21900000000008) [of networking equipment that supports](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=147.81900000000005) [something called Remote Direct Memory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=149.819) [Access or RDMA, and this offloads a lot of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=152.319) [the work that the NIC is doing onto the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=155.6651538461539) [processor on the NIC itself, and it takes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=158.67614285714282) [the load off of your host. And it also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=161.81900000000002) [gives you much lower latency and better](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=164.944) [throughput, and this is really required to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=168.1523333333333) [get SQL Server levels of performance with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=169.67614285714282) [remote file shares. You also, this lets](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=172.48566666666673) [you use something like this as an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=175.59677777777782) [alternative to a SAN in situations where](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=178.48566666666667) [you need shared storage, such as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=181.10471428571424) [traditional failover cluster instances,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=183.819) [which required shared disk resources for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=185.819) [the cluster. So you can use Scale-Out File](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=188.819) [Servers with SMB file shares to do this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=192.00081818181823) [instead of using a SAN. So that might be,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=195.319) [and that's very common actually in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=198.7078888888889) [hyperview world, and it's becoming more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=200.319" \t "psplayer) [common for SQL Server. And Windows Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=202.319) [2016 has something called Storage Spaces](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=205.53328571428574) [Direct or S2D that's going to let you use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=208.619) [commodity level file servers to do this and get even better performance.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=3&mode=live&start=211.819)

[Storage Spaces Direct and S2D](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live)

[Another type of storage that will be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=2.193) [available in Windows Server 2016 is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=3.943) [Storage Spaces Direct, and this is simply](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=5.693) [software-defined storage that's going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=8.526333333333334) [be highly available and highly scalable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=10.526333333333334) [that's meant for Hyper-V workloads and for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=13.193) [SQL Server workloads. This lets you use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=16.393) [commodity file servers, two-socket file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=19.90728571428571) [servers, that can use much lower cost SAS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=21.859666666666666) [or SATA drives, and they can be magnetic](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=25.693) [or flash drives. You're not restricted to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=28.443) [any one kind of drive like you were with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=30.52633333333333) [Scale-Out File Servers in Windows Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=33.33585714285714) [2012 R2. So you can have actually what are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=35.993) [called hybrid storage configurations,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=38.068) [where you have a combination of NVMe](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=40.193) [devices for caching, for example, and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=42.818) [might decide to use SATA SSDs and SATA](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=45.85966666666667) [hard drives for your capacity devices in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=48.526333333333355) [this kind of a setup. You have to use an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=50.692999999999984) [Ethernet/RDMA network as your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=54.33585714285715) [fabric, and that's really important, that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=56.693) [all of your networking equipment is RDMA](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=58.63744444444444) [capable. So this is what it's going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=61.74855555555554) [look like from a diagram perspective. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=63.74855555555555) [so you've got a software-defined storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=66.568) [subsystem is the great big blue box that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=68.818) [encompasses all these different layers.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=70.693) [And then you've Scale-Out File Servers](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=73.193) [that expose file shares to your SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=75.193) [database servers. And then you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=79.193) [have Cluster Shared Volumes and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=81.30411111111114) [storage spaces with storage pools, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=83.33585714285714) [then you've got the individual storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=86.443) [nodes in a cluster that's managed for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=87.943) [redundancy and performance purposes. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=91.593) [that's sort of the architecture that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=93.52633333333333) [you're going to be using here. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=95.33585714285714) [you have certain specific hardware](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=97.443)[requirements that you need to have for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=100.568) [your file servers. They're going to be in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=102.52633333333337) [this storage cluster node. So you're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=104.85966666666664) [to have homogeneous server configurations.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=107.318) [So that means all the servers have to be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=109.193) [identical, and you can have anywhere from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=111.89299999999997) [four to 16 file servers in one of these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=114.37481818181816)[storage clusters. And they need to be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=117.52633333333331) [relatively modern hardware. Microsoft's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=120.068) [recommending a two-socket server with an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=121.79299999999999) [Intel E5-26000 v3 or newer processor in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=125.193) [it, and they recommend a 128 gigs of RAM.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=128.693) [You also going to make sure that you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=132.193) [10 gigabit Ethernet or better, and all of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=134.318)[your network equipment has to be RDMA](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=137.01118181818185) [capable to make this work properly. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=138.92027272727282) [you have to have a minimum of two caching](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=141.5566363636364) [devices and four capacity devices in each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=144.82936363636375) [storage node, and each one of the nodes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=147.443) [has to be identical. So the caching](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=149.99300000000008) [devices are used to cache things and take](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=152.19300000000004)[some of the load off of the network, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=154.593) [then the capacity devices are used to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=156.4787142857143) [actually store your data permanently. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=158.85966666666667) [then finally, RAID controllers are not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=162.52633333333335) [required or supported with this in your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=164.52633333333338) [individual file servers. So you just throw](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=166.99300000000002) [all your drives into these file servers,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=169.6475454545455) [and they're all managed by the software.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=172.193) [That's the whole point of this, that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=175.193) [you're not using any kind of hardware to manage this.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=4&mode=live&start=177.193)

[Summary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live)

[So what did we cover in this module? Well,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=1.637) [first I talked about the different kinds](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=4.337) [of storage that are commonly used for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=5.737000000000001) [Server. Then we talked about some of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=8.708428571428572) [strengths and weaknesses for each type of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=10.536999999999995) [storage, and then we got into some of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=12.737000000000002) [considerations you need to think about to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=14.914777777777772) [get the best performance from each type of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=16.737000000000002) [storage for different kinds of SQL Server workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m4&clip=5&mode=live&start=18.870333333333328)

[Understanding the Effects of RAID Levels on SQL Server Workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live)

[This is module five, Understanding the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=2) [Effects of RAID Levels on SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=4.571428571428571) [Workloads. So what we're going to cover in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=7.571428571428573) [this module, we'll start off talking about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=9.499999999999995) [how the RAID level you decide to use is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=11) [affected by the different kinds of SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=14.000000000000005) [Server workloads that you're going to run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=16.33333333333334) [into. Then we'll talk about how your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=17.83333333333334) [availability requirements are going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=19.875) [affect your desired RAID level. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=21.4375) [finally, we'll talk about how performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=23.71875)[and redundancy are affected by the RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=25.875) [level that you choose for each one of your logical drives.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=0&mode=live&start=28.390625)

[Common RAID Levels](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live)

[So what are some of the more common RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=1.97) [levels that are typically used with SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=3.7700000000000014) [Server? Well first, we have RAID 1, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=6.112857142857141) [is also called mirroring. Then we have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=9.015454545454544) [RAID 5, which is called striping with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=11.136666666666665) [distributed parity or just striping with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=12.97) [parity. Then you have RAID 10, which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=15.97)[mirroring plus striping. And then finally,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=19.26999999999999) [you've got RAID 6, which is striping with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=21.327142857142853) [double parity. So let's go through these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=24.47) [different RAID levels and talk about some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=26.72) [of the differences and how they affect SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=28.04142857142857) [Server. Well first, we have RAID 1, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=30.97) [is mirroring, and this means you've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=33.80333333333334) [two drives where the data is written to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=36.61285714285715) [both of the disks in parallel, so each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=38.97) [drive is an exact copy of the other drive.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=41.379090909090905) [There's no parity information that's used](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=45.47) [with this RAID level, so there's no parity](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=47.13666666666667) [write performance overhead like you see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=49.61285714285714) [with some of the other RAID levels. Your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=51.669999999999995) [usable capacity is only 50% of your raw](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=54.769999999999996) [capacity, so you have two drives and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=57.16999999999997) [lose 50% of your total space to have RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=60.16230769230771) [1. Now it's very common to use RAID 1 for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=63.97) [your operating system drives and where](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=67.87) [your SQL server binaries are installed.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=69.97) [That's a very common scenario. Another](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=71.47) [place where I see RAID 1 used quite often](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=73.77) [is for the drive that you have your SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=76.47) [Server log files on, for example. Now the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=79.22) [next RAID level is RAID 5, which is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=82.22)[striping with distributed parity. And RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=85.47) [5 means that the data is striped across](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=88.13666666666666) [all of the disks in the array, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=90.72) [you have the parity information that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=93.32714285714286) [calculated by your RAID controller or by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=95.80333333333333) [software, in some cases, and striped](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=98.13666666666666) [across all the disks in the array in a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=100.13666666666666) [separate write. So because of that,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=103.47) [writing that parity information decreases](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=105.97) [your overall write performance because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=107.87) [you're having to do that extra write there](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=109.72)[anytime you change any of the data in a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=111.7776923076923) [RAID 5 array. Now, the capacity overhead](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=114.54692307692306) [for RAID 5 is one over the number of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=117.18428571428572) [drives in the array. So if you had three](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=120.87000000000003) [drives in the array, you'd lose one third](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=123.58111111111114) [of your capacity to store that parity](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=126.18428571428572) [information. And as you add more disks to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=129.07000000000002) [the array, that percentage goes down, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=131.8033333333334) [1/4 or 1/5 or 1/6, for example. But the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=133.97) [problem is, as you add more drives to a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=137.91444444444446) [RAID 5 array, the statistical chance of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=140.22)[any one of them going down increases. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=142.97) [as you have more and more drives in a RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=146.70076923076923) [5 array, it becomes less redundant. You](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=149.0084615384615) [can only lose one disk in a RAID 5 array,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=152.74272727272728) [so once you lose one disk, it's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=155.47) [important that you replace it as soon as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=158.04142857142855) [possible so you don't lose a second disk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=160.28818181818184) [in that array. And it's a good idea to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=162.47) [have a cold spare available rather than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=165.10636363636368) [relying on a hot spare or getting a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=167.04142857142855) [replacement from the vendor, for example.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=169.80333333333337)[Now the next level of RAID that we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=172.47) [going to talk about is RAID 10, and that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=173.80333333333326) [mirroring plus striping. And so that means](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=176.97) [your data is striped across all the disks](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=179.47) [in the array, and then it gets mirrored to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=181.6128571428571) [another set of disks. So you've got a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=185.47) [double layer of protection, and there's no](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=188.47) [parity information that's used with this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=190.67000000000002) [RAID level, so there's no parity write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=192.80333333333337) [performance overhead. This makes it really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=194.8985714285714) [good if you know you're going to be doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=196.47) [very write-intensive workloads for things](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=199.97) [like transaction log files, for example,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=202.22) [or data files where you have really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=204.47) [volatile data in your database. Now your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=207.5811111111112) [usable capacity is 50% of your raw](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=210.27) [capacity with RAID 10, and you can usually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=213.07000000000005) [lose more than one disk in the array, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=215.47) [it depends on which disk you lose. But](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=217.845) [it's generally more robust than RAID 5 is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=220.92454545454547) [by itself. Now the next level of RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=224.5609090909092) [that's fairly commonly used is RAID 6,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=227.87000000000003) [which is striping with double parity. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=230.80333333333337) [so the data, again, is striped across all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=233.74272727272728) [the disks in the array, just like RAID 5.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=235.92454545454552) [And then the parity information is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=238.47) [calculated and also striped across all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=241.0414285714285) [disks in two separate writes, so you've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=243.18428571428566) [got two different sets of parity](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=245.3588888888889) [information that's spread across all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=248.02555555555566) [disks in the array. And so writing that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=250.1366666666667) [second level of parity information](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=252.80333333333337) [decreases your overall write performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=254.47) [even more than what you'd get with RAID 5.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=257.47) [So this is not a good RAID level if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=259.47) [know you're going to do a lot of writes to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=262.01545454545453) [whatever files are going to be on this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=264.77000000000004) [array. Now the capacity overhead for this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=267.17000000000013) [parity information is two divided by the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=268.97) [number of disks in the array. So you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=271.2881818181819) [losing more space because of that double](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=274.07000000000005) [parity, but you have more redundancy here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=276.17000000000013) [because you can lose up to two disks in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=278.47) [the array without going down or losing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=280.9245454545453)[your data. So this makes it more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=283.61285714285725) [redundant, but it performs worse for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=286.1366666666666) [writes. There's no read performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=288.97) [penalty for RAID 5 or RAID 6, but writes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=290.56090909090904)[are hurt quite a bit, with RAID 6 being worse than RAID 5.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=1&mode=live&start=293.0414285714286)

[RAID Does Not Replace Backup/Restore Plans](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live)

[Now RAID does not replace backup and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=1.539) [restore plans. RAID is not a substitute](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=5.427888888888888) [for a good backup and restore strategy,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=8.539) [and I can't tell you how many times people](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=10.539) [have come to me in my career and said](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=11.789) [things like, "Well, we've got this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=14.205666666666668) [database "protected by RAID 5, so we don't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=16.20566666666667) [need to do backups. " And that's just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=19.455666666666676) [ridiculous. You need to be doing backups](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=22.289) [and you need to make sure you have an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=24.039) [effective restore strategy, and you need](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=26.538999999999998) [to actually test restoring your backups to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=28.538999999999998) [make sure that you have good backups no](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=30.789) [matter what else happens. And don't let](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=32.939) [anybody talk you into not doing backups](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=35.82471428571429) [and having a good restore strategy just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=38.53900000000001) [because you're using RAID. Now RAID is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=40.939) [also not a substitute for an effective](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=43.82471428571429)[HA/DR strategy. RAID is a very small](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=47.339000000000006) [component of your HA measures, but it's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=50.538999999999994) [not a substitute for doing other things,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=53.42788888888889) [such as failover clustering or database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=56.539) [mirroring or log shipping that you might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=59.110428571428585) [want to do to try to meet your RPO and RTO](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=60.87233333333333) [SLAs that you've set up with your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=65.09455555555554) [business. Now all RAID's going to do, an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=67.25328571428575) [appropriate RAID level is going to reduce](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=69.63899999999998) [the chance of unplanned downtime from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=72.31677777777777) [losing one or more hard drives or SSDs in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=74.95566666666667) [an array. That's all it's doing for you.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=78.70566666666672) [It's reducing the chance that you go down](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=80.539) [from losing a very simple component in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=83.539) [your overall infrastructure. Now RAID 10](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=87.039) [and RAID 6 are the most robust common RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=89.53899999999999) [levels, so if you're very concerned about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=93.11042857142859) [uptime, which you should typically need to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=96.11042857142859) [be with a database, then RAID 10 and RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=98.33899999999998) [6 are going to be more robust, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=100.789) [you might want to choose them just for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=103.039) [that reason, regardless of the performance implications.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=2&mode=live&start=105.039)

[Primary SQL Server Workload Types](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live)

[Primary SQL server workload types. As](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=1.43) [you're thinking about your storage, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=4.596666666666667) [need to think about what kind of workload](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=5.652222222222222) [that you're going to be dealing with,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=7.43) [because that's going to have an effect on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=9.43) [what RAID level you decide to use and also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=10.68) [how you configure your array. So you've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=13.287142857142857) [got Online Transaction Processing, or OLTP](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=16.096666666666668) [workloads. That's a very common workload](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=18.763333333333335) [type you're going to run into with SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=21.09666666666666) [Server. Another common type is doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=23.18) [reporting against your OLTP databases.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=25.09666666666666) [That's going to put different kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=28.43) [workloads on your I/O subsystem that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=30.18)[need to think about as you're deciding](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=32.230000000000004) [what RAID level to use. You've also got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=34.555) [Relational Data Warehouse or just pure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=37.43000000000001) [reporting workloads, where it's not an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=39.629999999999995) [OLTP workload, but it's just lots of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=42.43) [reads. And then another thing you might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=45.09666666666668) [run into is an OLAP, Online Analytical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=47.6118181818182) [Processing kind of a workload. So if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=50.00142857142857) [you're using that sort of a system, that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=52.09666666666667) [going to put different demands on your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=54.596666666666664) [storage subsystem. Now OLTP workload I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=56.93)[access patterns. What you're going to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=60.43) [with OLTP workloads is very frequent](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=62.68) [writes to your data files and to your log](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=64.93) [file. And of course, this depends on how](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=69.03000000000003) [much of an OLTP workload we're talking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=71.18) [about. Some OLTP workloads are very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=73.14428571428576) [volatile, so the data files are being](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=75.93) [changed a lot, and some are not quite that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=78.42999999999998) [volatile. But still, you're going to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=82.00142857142859) [lots of writes to your log files and to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=83.81461538461537) [your data files with most OLTP workloads.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=86.31888888888889)[You're also going to see pretty frequent](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=89.43) [reads from your data files if the active](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=91.18) [part of your database doesn't fit in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=93.33909090909087) [SQL Server buffer pool. And of course, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=95.93) [can do things like using clustered](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=98.00142857142856) [columnstore indexes or regular old page or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=100.22999999999999" \t "psplayer) [row data compression to try to fit more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=103.93) [data into your buffer pool to help with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=106.92999999999999) [this. But again, if you don't the luxury](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=109.18) [of fitting your entire active data set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=111.7633333333333) [into memory, you're going to see reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=114.57285714285716) [from your data files. Then you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=117.09666666666665) [writes to a single database log file are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=119.88454545454545) [going to be sequential. So if you have the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=122.63000000000001) [luxury of just having one OLTP database on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=125.09666666666665) [your instance, and your log file is on a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=127.76333333333334) [particular LUN, then there are going to be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=130.7633333333334) [nothing but sequential writes to that,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=132.62999999999994) [assuming you're not doing something else](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=133.93) [like transactional replication that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=135.43) [reading from that log file. But once you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=137.76333333333335) [start having more and more databases and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=140.43000000000004) [all the log files are on the same array,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=142.73000000000002) [then you're not going to see as much](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=145.43) [sequential. You're going to see more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=147.20777777777784) [random across all those different log](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=148.2633333333333) [files on that logical drive. Now data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=150.09666666666672) [warehouse and reporting I/O access](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=154.18) [patterns are quite different. So what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=156.055) [you're going to see there are very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=157.71571428571428) [frequent long sequential reads from your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=159.76333333333332) [data files, again, if the database doesn't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=162.93) [fit into the SQL Server buffer pool. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=165.09666666666672) [once again, you can use SQL Server data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=167.73000000000002) [compression or clustered columnstore](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=170.1300000000001) [indexes to make the data be much, much](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=171.555) [smaller and fit into the buffer pool in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=174.93) [many cases. So think about that if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=178.76333333333335) [have Enterprise Edition. Now typically,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=181.43000000000006) [you're going to see very little use of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=183.0966666666667) [log file with a data warehouse reporting](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=186.23000000000002) [workload, except during data loads because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=189.03000000000006) [basically, you're just doing lots of reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=190.805) [which hit the data files, and they're not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=193.43)[going to be hitting the log file. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=195.02999999999997) [that's going to have an effect on what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=196.6118181818182) [RAID level you might decide to use for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=198.0663636363637) [log file. Finally, sequential read I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=201.5411111111112) [performance is really important because if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=203.93) [you can't fit all your data in the buffer](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=205.93) [pool and you're having to pull it off the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=208.18) [data files on the storage subsystem, then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=210.02999999999992) [how quickly you can do that is really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=211.71571428571428) [important for your query performance. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=214.28714285714284) [again, using data compression and/or using](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=217.23000000000002) [clustered columnstore indexes can really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=221.63) [make a huge difference in the amount of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=224.0966666666667) [data you have to read out the storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=225.87444444444446) [subsystem to satisfy your queries. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=227.93) [consider that if you have Enterprise](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=230.68) [Edition. Now moving along, OLAP workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=232.18) [have a different kind of access pattern](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=235.43)[for your I/O subsystem. So you're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=237.43) [see pretty frequent random reads from your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=240.31888888888892) [cube files in most cases. And then you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=242.28714285714284) [going to see the fact that random read I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=245.18) [performance is quite important, so you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=247.93) [might want to really think about flash](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=250.03000000000003) [storage if you can afford it for your cube](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=252.1300000000001)[files. And then finally, sequential write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=255.68) [performance to the cube file is really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=258.0966666666666) [important when it's building the cubes. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=260.1442857142857) [you can watch all this in Resource Manager](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=262.65222222222224) [and see what's going on with your workload](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=264.43) [before you decide what RAID level to use for these different kinds of workloads.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=3&mode=live&start=267.43)

[SQL Server File Types and Workloads and RAID Level Choice](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live)

[Different SQL Server file types are going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=1.273) [to affect your RAID level choice and how](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=3.773) [you decide to configure your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=5.939666666666666) [subsystem. So the different file types are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=7.939666666666664) [going to have very different I/O patterns,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=9.648) [which also are going to vary based on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=12.273) [what's happening to your database at any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=13.872999999999994)[given point in time. So what you need to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=15.93966666666667) [do is use the tools you have available and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=18.42684615384615) [that you've seen earlier in this course,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=20.523) [such as Performance Monitor and Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=22.273) [Monitor and my DMV queries to actually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=24.844428571428562) [measure what's going on with your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=27.073000000000004) [different files during different kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=28.773) [activity. Don't just guess about this.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=30.872999999999994) [It's really important that you watch this.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=33.273) [And this actually is one of my favorite](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=35.273) [things to do on a production server. I'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=36.72754545454544)[sit there sometimes and watch Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=38.773) [Monitor and watch that when I'm doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=41.773) [something like doing a backup or doing a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=43.98728571428571) [restore of a database or building a new](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=46.81845454545457) [index or going in and running a very big](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=49.873) [reporting kind of a query, and watch](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=53.773) [what's happening to the different files in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=56.773) [terms of reads and writes as that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=58.60633333333334) [activity's going on. And doing that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=61.073) [occasionally is very educational and very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=63.13014285714286) [useful to understanding how this actually](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=65.16188888888888)[works. Now you also need to think about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=67.82855555555554) [your workloads and how that affects your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=70.6063333333333) [RAID level choice. You need to understand](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=73.773) [your workload characteristics. So the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=76.41585714285716) [first thing you need to understand is the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=77.773) [read/write ratio for your different file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=80.16188888888888) [types and the different workloads, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=82.82855555555554) [that's going to be different as different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=84.43966666666667) [things are happening. So your data files,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=86.07300000000001) [your log files, your TempDB files, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=88.41585714285716) [your SQL Server backup files are going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=90.60633333333331) [be seeing reads and writes happening in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=93.398) [different percentages depending on what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=96.773) [going on with the database of that one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=99.398) [point in time. So you need to think also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=101.77300000000001) [about whether you're seeing more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=103.98728571428575) [sequential versus random reads and writes,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=105.70157142857143) [and that's going to affect your RAID level](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=108.273)[choice and also what kind of storage you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=110.05077777777782) [might choose, whether it's magnetic or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=111.8285555555556) [flash-based storage. So all these things](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=114.273) [are going to influence what RAID level you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=116.773) [decide to choose in the end and your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=119.47299999999998) [storage type. So parity-based RAID levels](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=121.773) [such as RAID 5, RAID 6, RAID 50, have a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=124.273) [very distinct write performance penalty.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=129.13014285714283) [So if you know from watching your workload](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=131.273) [that you're doing lots of writes to a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=134.273) [particular file, then you want to avoid](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=136.273) [using a parity-based RAID level for that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=138.27299999999994) [file. Whereas if you can watch and see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=140.6063333333333) [that you're not doing that much writing,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=142.273) [it's mainly reads, then you can get away](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=144.273) [with a parity-based RAID level and not pay a big price for having that.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=4&mode=live&start=147.523)

[Summary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live)

[So what all did we cover in this module?](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=1.779) [We started talking about the different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=4.779) [RAID levels and how they're affected by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=6.279) [your SQL Server workload types. We also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=8.779000000000002) [talked about how your availability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=11.279) [requirements can affect your desired RAID](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=12.529) [level. You're going to want to use more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=14.44566666666667) [robust RAID levels when you have tighter](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=16.178999999999995) [uptime requirements. Then we talked about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=19.44566666666667) [how your performance and redundancy are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=22.11233333333333) [affected by your RAID level and how this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=23.945666666666668) [is affected by different file types and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=25.778999999999996) [what's happening with them at different points in time.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m5&clip=5&mode=live&start=28.179)

[Improving Storage Subsystem Performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live)

[Introduction](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live)

[This is Module Six, Improving Storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=2) [Subsystem Performance. So what are we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=5) [going to talk about in this module? We'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=6.727272727272727) [start off discussing things that you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=8.222222222222221) [do to improve your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=9.777777777777771) [performance. This includes things such as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=13.33333333333333) [index and query tuning, going through and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=15.66666666666667) [making sure that your SQL Server instance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=17.666666666666664) [configuration is set up properly, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=19.5) [making sure your operating system is set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=22.3) [up properly, and then finally, making sure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=24.400000000000006) [your hardware and storage configuration is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=26.25) [set up for the best performance and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=28.125) [scalability. So when you go and do this,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=31.333333333333336) [there's actually multiple layers of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=34.09999999999998) [optimization that you need to think about.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=35.66666666666667) [Multiple things in each layer that you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=38) [make sure that are set up correctly that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=39.60000000000002) [quite often are not set up correctly by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=41.79999999999998) [default. So, you can go through and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=44.599999999999994) [investigate and address each one of these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=47.66666666666666) [in each layer depending on your system.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=50.09090909090909) [So, for example, in some cases you may not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=52) [be able to do index and query tuning](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=54.45454545454546) [because you have a third party application](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=56.63636363636364) [and you're not allowed to touch that. But](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=58.44444444444444) [you certainly should investigate and see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=60.375) [if there's any opportunities there, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=62.625) [even if you can't do it, perhaps you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=64.66666666666666) [bring it to the attention of the vendor of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=66.90909090909093) [that application. Now more often you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=69.20000000000002) [make sure that your SQL Server Instance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=71.36363636363633) [Configuration settings are all set up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=73.375) [properly and you certainly should be able](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=75.625) [to go in and make sure your operating](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=77.5) [system is set up properly and that your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=79.66666666666666)[hardware and storage is set up properly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=82.2) [for the best performance of scalability,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=83.60000000000002) [because nobody's ever come to me, ever in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=85.71428571428572) [my career, and complained that a database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=89.00000000000003) [server is too fast. I've never heard that.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=91.66666666666666) [They'll always complain that it's too](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=94) [slow, so everything you can do to attack](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=95.71428571428575)[each one of these layers and make things better is a good thing to do.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=0&mode=live&start=97.90909090909086)

[Workload Tuning and Index Tuning](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live)

[The area where you're going to get the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=2.255) [most bang for the buck, if you're able to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=3.48576923076923) [do it, is workload tuning. So you can go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=5.588333333333332) [through and use what I call the bad man](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=8.397857142857143) [list of DMV queries to find the most](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=10.969285714285721) [expensive stored procedures and queries.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=13.588333333333338) [Then what you want to do is focus on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=16.255) [top five stored procedures or queries and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=18.755) [each one of the bad man lists, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=20.366111111111106) [prioritize the area where the instance is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=22.755) [under the most stress. So, for example, if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=25.54071428571428) [you're under CPU pressure, you can find](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=28.255) [which stored procedures or queries are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=30.38) [causing the most CPU pressure and attack](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=32.699444444444445) [those and see what you can do to optimize](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=35.810555555555545) [those and when you do that, you're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=38.92166666666669) [to see a benefit. You may have to go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=41.164090909090916) [through and do this more than one time but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=43.1640909090909) [it's really important to make it a team](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=45.154999999999994) [effort between the DBA's and the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=47.505) [developers, and make it an iterative](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=49.005) [process so that you go through and do one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=50.61863636363637) [run and see what performance benefits you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=53.07318181818182) [get and then you may switch to a different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=54.982272727272736) [area, and you keep on doing this as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=57.032777777777774)[necessary to get the performance where it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=59.80045454545457) [needs to be for that instance. Then, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=62.25500000000001) [can go through and do index tuning and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=64.92166666666665) [even with third party applications, quite](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=67.755) [often you can still do index tuning and so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=70.63) [proper index tuning can have huge](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=73.58833333333334) [performance benefits. I mean any DBA who's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=75.755) [been working with SQL Server for any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=78.505) [amount of time has probably seen this at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=80.14388888888891) [least on an isolated basis so going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=82.0731818181818) [through and making sure your indexes are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=83.98227272727266) [set up correctly is really important so,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=85.58833333333337) [as you're doing this, you need to consider](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=87.755) [your overall workload and figure out which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=90.96928571428572) [tables are more volatile than others. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=93.255) [if you have more of an OLTP workload,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=96.47722222222222) [you're probably going to want to have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=98.255) [fewer indexes, for example, then you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=99.8105555555556) [more of a reporting workload. But you need](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=100.81055555555557) [to look at this and there's plenty of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=102.855) [metrics you can collect to make this an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=104.655) [informed choice rather than just guessing.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=107.85500000000005) [And then finally think about using data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=109.255) [compression and clustered column store](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=112.755) [indexes if you have SQL Server, Enterprise edition.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=1&mode=live&start=114.755)

[Demo: 'Bad Man List' Queries](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live)

[In this demonstration we have a list of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=2.43) [queries we can use to identify the most](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=3.8845454545454534) [expensive stored procedures from a number](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=6.305) [of different perspectives. I call these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=8.18) [the bad man list for stored procedures and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=9.830000000000002) [these are all database specific, they're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=12.43) [not instant specific so you need to make](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=15.129999999999999) [sure that you're connected to the database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=16.729999999999993) [that you're concerned with when you run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=19.18) [these queries. So the first one is just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=21.358571428571423) [going to get the top cache stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=22.930000000000007) [procedures by execution count from the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=24.374444444444443) [plan cache. When I run this it gives me a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=27.0411111111111) [list of stored procedures that shows the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=29.93)[execution counts for these since they've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=31.929999999999996) [been in the plan cache that we can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=33.93) [some other statistics for this as we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=36.38454545454546) [scroll over to the right, including when](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=37.930000000000014) [they went into the plan cache. So this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=39.43) [helps you identify which stored procedures](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=41.68) [are called the most often and that might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=43.93) [give you some good opportunities for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=46.32999999999998) [finding ones that could be cached in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=48.07285714285714) [middle tier or maybe finding stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=50.429999999999986) [procedures that are being called too often](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=52.18) [because of a logic error in your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=53.93) [developer's code, for example. Now the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=56.26333333333335) [next one in this set is going to find the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=58.47545454545455) [top cache stored procedures by average](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=61.37444444444444) [elapsed time so when I run this, this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=64.0411111111111) [shows me the average elapsed time and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=66.13000000000002) [is in microseconds, not milliseconds so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=68.26333333333332)[this one at the top of the list is about a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=70.16076923076923) [tenth of a second for the average elapsed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=72.69923076923072) [time and we can also see some other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=75.555) [metrics about these stored procedures so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=77.4855555555556) [this is where you can find that low](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=79.13) [hanging fruit of a long running stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=81.59666666666666) [procedure that you can go on and do your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=83.93) [DBA magic on and hopefully make it run a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=86.3845454545454) [lot faster and have an impact on your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=87.5133333333333) [business so that the users are going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=89.67999999999999) [notice. The next one in the set is looking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=94.34666666666662)[at cache store procedures by total worker](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=97.11181818181814) [time. And worker time equates to CPU](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=100.32999999999998) [effort so especially if you're seeing that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=102.92999999999998) [your instance is under CPU pressure, this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=105.13) [will help you figure out which stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=107.26333333333334) [procedures in this database are taking the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=109.59666666666664) [most total worker time. And as you look at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=112.33000000000004) [this you can see that the numbers drop off](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=114.83909090909094) [quite quickly so just by going to the top,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=117.02090909090909) [say, five stored procedures and looking at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=120.15222222222224) [them and doing some optimization work on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=121.70777777777784) [those, you would probably have a decent](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=124.50142857142859) [effect on your overall CPU utilization.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=126.92999999999998) [And we have more metrics going over the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=129.93)[right but the important thing on this one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=131.70777777777784) [is, again, looking at the total worker and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=133.4855555555556) [the average worker time and then you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=135.73000000000008) [see the execution counts reach to our](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=138.26333333333338) [procedure. Now the next query in this set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=141.26333333333332) [is looking at stored procedures ranked by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=143.20272727272732) [total logical reads. And logical reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=145.92999999999998)[means that you're finding the data in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=148.93000000000004) [SQL Server buffer pool so this has an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=151.47545454545457) [effect on memory pressure and indirectly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=153.6572727272728) [on read I/O's and so I had to get it form](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=156.43) [storage in the first place to put it into](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=159.1607692307693) [the buffer pool. So by looking at this you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=160.50142857142856) [can see which stored procedures have the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=162.5663636363637) [highest total logical reads, and again by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=164.93) [looking at the top five, you can see the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=167.68) [numbers drop off quite quickly and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=169.81888888888892) [would want to go and look at those more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=171.5966666666667) [closely. Now, the next one in this set is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=174.59666666666678) [going to look for cache stored procedures](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=176.93) [by total physical reads. So this means](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=179.64428571428576) [that it's having to go out to the storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=182.74818181818185) [subsystem to find the data to satisfy this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=185.26333333333335) [query. So you can see these ones, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=188.43) [their total physical reads and their](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=190.83909090909097)[average physical reads and their execution](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=192.73000000000002) [counts and their total logical reads, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=194.93000000000004) [their cache time here. So again, by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=197.53) [looking at the top five here and working](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=200.5966666666667) [on them, you will hopefully have an effect](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=202.50142857142856) [that's going to help relieve some of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=204.83000000000004) [pressure on your storage subsystem. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=207.43) [finally, the last one in this set is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=210.18) [looking at cache stored procedures by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=212.26333333333335) [total logical writes. And when you run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=214.43) [this one, it shows you which stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=216.72999999999996)[procedures have the most total logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=218.305) [writes along with their average logical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=220.555) [writes and their execution counts, and how](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=222.59666666666672) [often they're being called, and a few](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=225.5966666666667) [other things such as the cache time. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=227.83000000000004) [you can kind of tell by the name of these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=230.13) [stored procedures that they probably are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=232.09666666666666)[doing right since they update. Looking at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=233.43) [these you might be able to look at those](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=236.53000000000003) [stored procedures in more detail and find](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=239.26333333333335) [stored procedures that are maybe writing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=241.50142857142856) [too much data or something along that line](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=243.26333333333335) [that you can maybe do something to affect.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=245.93) [But anyways, running all these stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=248.93) [procedures and looking at them and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=250.64428571428567) [collecting the results and then putting](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=252.805) [them out to your developers really helps](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=255.055) [you work as a team to reduce the stress on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=257.7871428571429) [your system from all these different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=261.43000000000006) [perspectives, so it's a very useful](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=263.305) [exercise, and again that's why I call them](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=265.555) [the bad man queries, since nobody wants to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=267.83909090909077) [be at the top of the bad man list, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=269.8530769230769) [usually your developers and your other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=272.18) [DBA's, they know who wrote these stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=273.68) [procedures and who last touched them, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=276.5014285714287) [it's a very effective way of improving](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=278.5663636363635) [performance and taking the stress off your I/O subsystem.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=2&mode=live&start=281.93)

[Demo: Queries to Find Index Tuning Opportunities](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live)

[For this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=1.86) [you a set of queries that'll help you find](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=2.814545454545454) [helpful index tuning opportunities. So for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=5.0266666666666655) [example, maybe you're missing some key](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=7.526666666666666) [indexes that could really help your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=9.526666666666669) [workload or maybe you've got indexes that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=11.526666666666669) [aren't being used. Plus I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=13.193333333333328)[you some queries that'll help you find](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=15.11) [what your index usage is for your existing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=17.193333333333328) [indexes. Now, all these queries are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=21.11) [database specific, not instance specific,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=23.288571428571423) [so make sure you're connected to a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=24.859999999999996) [database you care about rather than the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=27.36) [master database. So the first one in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=30.059999999999995) [set, I want to find non-clustered indexes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=31.9509090909091) [that have more writes than they have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=34.19333333333333) [reads. So when I run this query, it shows](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=38.36) [me I've got two indexes here that have a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=40.31454545454544)[decent number of writes and zero reads,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=43.25999999999999) [and this is since SQL Server has been last](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=46.059999999999995) [restarted, so that's really important you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=50.00285714285714) [understand how long that's been since that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=53.08222222222222) [occurred, because if it's only a few hours](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=54.63777777777777) [ago or a few days ago, you probably](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=56.475384615384634) [haven't seen your complete business](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=58.61) [process, so you might have a lot of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=60.485) [indexes that are actually needed for a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=63.485) [report, for example, that's run once a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=65.85999999999997) [week or once a month, and you just haven't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=68.19333333333331)[run into that yet so you need to be a lot](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=70.86) [more cautious with the results of this,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=72.6377777777778) [but if your instance has been running for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=73.97111111111114) [quite a while, and you see indexes that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=76.00285714285717) [have lots of writes and either zero reads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=78.52666666666664) [or a very low number of reads, then you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=81.31454545454544) [might want to think about dropping that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=84.46) [index after you do, maybe some more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=86.55999999999997) [investigation. So that's the first one in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=88.57428571428575) [the set. The second one in the set is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=90.36) [looking for missing indexes in the current](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=92.4155555555556)[database ordered by index advantage. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=95.36) [when I run this, I see I've got five](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=98.22363636363636) [indexes at SQL Server things that it wants](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=101.4963636363636) [and looking at this can be very useful if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=104.86) [you don't jump to the wrong conclusion and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=108.11) [just go in and blindly add every single](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=110.14571428571429) [index that you see here. So this index](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=112.43142857142858) [advantage is a calculated number based on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=114.61) [how expensive it is to not have the index](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=116.40545454545453) [and how many times SQL Server has wanted](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=118.86) [that index. As I scroll over to the right,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=121.25999999999998) [I see some more information about these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=123.86) [possible indexes so it shows me the table](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=126.9711111111111) [name that it wants the index on, how many](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=129.24461538461537) [rows are in that table, which is useful to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=131.71714285714285) [know if you're thinking about maybe](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=134.74888888888893) [creating an index or not, the average user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=136.36) [impact, which tells us the percentage that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=139.86000000000004) [the cost of the query would go down](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=142.08222222222224) [according to the query optimizer if it had](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=143.86) [this index, for whatever query triggered](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=146.95090909090914) [this request. Now the average total user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=149.13272727272738) [cost is just a relative number that gives](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=150.6933333333333) [you an indication to how expensive it is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=153.485) [to not have that index that it's asking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=155.61) [for. And then the number of user seeks is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=158.36) [how many times that SQL Server has wanted](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=161.04181818181826) [this index since the instance has been](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=163.2885714285714) [running or since you made an index change](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=165.52666666666673) [on that table. And then you've got some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=167.9600000000001) [more details about what database you're in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=170.11) [and the schema and the table, and then the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=172.06000000000006) [columns that it wants for this index. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=174.76000000000005) [again, if you use this properly, you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=177.1457142857143) [quite often find some very useful](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=179.36) [high-impact indexes that will make your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=180.86) [instance run better and perhaps take a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=183.52666666666676) [huge load off your storage subsystem. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=186.86) [the next one in this set, we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=190.11) [look for missing index warnings in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=192.36) [plan cache. So if we run this, and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=195.0028571428571) [can take a few seconds to run, it'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=198.1933333333334) [actually show you the stored procedures](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=200.86000000000004) [and it tells you that their procedure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=202.86) [right here, and how many times that stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=205.1933333333334) [procedure's been executed and if you click](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=207.19333333333338) [on the query plan link, it actually shows](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=209.19333333333338) [you the graphical query plan complete with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=211.61) [the missing index warning there that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=213.71714285714285) [can get some information and think about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=216.86) [whether or not you want to create that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=219.19333333333336) [index or not. So this helps you tie](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=220.26) [missing index requests to particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=222.735) [stored procedures or other queries. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=224.71714285714285) [that's how that one works. Now the next on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=227.19333333333336) [in the set, it's going to show me what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=230.00285714285712) [indexes and statistics in this database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=232.86000000000007) [are getting the most modifications, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=234.985) [when I run this it shows me my customer](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=237.31454545454548) [table. I've got an index right here that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=241.4054545454547) [has a lot of modifications, it's getting](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=244.485) [updated a lot with my work load, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=247.52666666666676) [my product table, I also have a decent](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=250.19333333333338) [number of modifications. So this is good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=252.735) [to know because if you know a particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=255.06000000000006) [table is seeing a lot of volatility, a lot](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=257.52666666666664) [of updates, inserts and deletes, you want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=260.43142857142857) [to be more cautious about adding more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=262.52666666666664) [indexes to it because having more indexes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=264.85999999999984) [on that is going to hurt your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=266.7488888888889) [insert-update-delete performance for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=268.52666666666664) [example. It also will have an effect on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=269.5266666666666) [whether you want to use data compression,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=271.7690909090908) [for example. A really volatile table might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=274.6600000000001) [not be a good candidate for that. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=277.2885714285714) [moving on, the next one in this set is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=280.07428571428574) [going to show me the index read right](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=282.00285714285724) [stats for all the tables in the current](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=284.19333333333327) [database ordered by reads, so when I run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=287.14571428571435) [this query it'll show me which indexes are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=290.3145454545455) [giving the most bang for the buck, that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=293.235) [are being used a lot for reads. So you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=296.11) [see the number of reads here versus the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=298.5266666666667) [number of writes, and you can see some](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=300.52666666666664) [other statistics about this, about the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=303.26) [last user scan, and the last user seek and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=305.26) [what the fill factor is, and that kind of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=307.13272727272727) [stuff. So again, this helps you understand](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=309.58727272727253) [which indexes and which tables are seeing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=312.86) [the most read activity and they're giving](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=316.0822222222223) [you good value for having an index on that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=318.76000000000005) [table. Now the next one in the set just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=321.52666666666664) [flips this and orders those by writes. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=323.4599999999999) [this will also help you understand which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=326.1933333333333) [indexes are seeing the most write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=328.52666666666653) [activity, and again I see lots of write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=330.5266666666666) [activity to my customer table in this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=332.61) [case, so I would be more cautious about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=335.4314285714287) [adding more indexes to that table because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=338.65999999999985) [it's a very volatile table, and I'd](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=340.7488888888889) [probably also be more cautious about using](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=342.43142857142857)[data compression on that table. So again,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=344.7171428571429) [this complete set of queries helps you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=347.52666666666664) [understand your index tuning opportunities](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=349.86) [much better, and if you have your indexes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=352.86) [set up correctly, that's going to take a big load off your storage subsystem.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=3&mode=live&start=355.86)

[Demo: Using Data Compression and Columnstore (1)](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live)

[In this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=1.281) [you some specific examples of how](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=2.836555555555556) [effective SQL Server data compression and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=4.995285714285715) [clustered column store indexes can be for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=7.4476666666666675) [particular types of queries. In this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=10.381) [demonstration, I'm going to show you a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=13.281) [fairly complex query that you can use to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=15.031) [figure out whether or not a particular](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=17.11433333333333) [table might be a good candidate for SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=19.447666666666656) [Server row store data compression, and row](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=22.406) [store data compression is an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=25.669888888888885)[enterprise-only feature that was](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=27.8921111111111) [introduced back in SQL Server 2008, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=29.531) [it's in every version of SQL Server since](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=32.080999999999996) [then. And this particular query might take](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=34.48099999999997) [a little bit of time to run, depending on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=35.87190909090908) [how fast your hardware is and how big a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=38.11433333333334) [table it is that you're running this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=40.781) [against, and so I've got a lot of comments](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=42.531) [here that explain this in even more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=45.447666666666684) [detail, but it's essentially I'm](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=47.63814285714285) [automating going through and running](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=49.35242857142857) [sp\_estimate data compression savings for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=52.209571428571415" \t "psplayer) [every index in a particular table and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=54.11433333333334) [giving some more information about what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=57.00322222222221) [going on with that table to help you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=59.14463636363636)[decide whether or not data compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=60.5991818181818) [might be a good idea or not, and again](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=62.031) [data compression is a very useful in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=64.531) [reducing your I/O usage at the cost,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=67.11433333333333) [potentially of some increased CPU usage on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=69.44766666666663) [your server. So I go in and first of all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=72.781) [you've got to specify what schema the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=76.44766666666663) [table is in, and then the name of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=78.681) [table and then what your desired data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=81.281) [compression type is, page, row, or none.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=83.281) [You just have to set those three variables](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=86.781)[right here at the top of the script, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=89.18099999999998) [then we go through and get the table name](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=91.081) [and the row count and the compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=93.781) [status for the clustered index or the heap](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=95.531) [to start with and then we go and check and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=98.58100000000005) [see how much space in your buffer pool is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=101.69009090909087) [being used by that current table for each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=104.20957142857146)[index, and then we go through and loop](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=106.49528571428576) [through all the indexes and get their](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=108.69009090909087) [information and then we run sp\_estimate](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=111.281) [data compression savings with all that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=113.656) [information that we've collected. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=116.0667142857143) [finally we go and get the index read/write](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=118.32645454545454) [stats for the table and then we get a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=120.50827272727267) [little bit of information for the indexes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=122.96281818181814) [for that particular index and then we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=125.781) [finally figure out how much space we have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=129.11433333333338) [available in our data files and our log](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=132.35242857142856)[files, and that's important to know that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=134.38099999999997) [before you go and compress an index. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=135.781) [after kind of walking through that query,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=139.031) [we'll go ahead and run it, and it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=140.781) [shouldn't take too long to run on my](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=143.1810000000001) [pretty fast work station. And it comes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=145.58100000000007) [back and tells me that this table has](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=147.68100000000004) [about 151 million rows of data, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=150.20957142857142) [there's no compression on the clustered](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=153.031) [index, and then I've got two indexes here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=154.531) [and here's how much space they're taking](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=157.781) [up, and neither one of them are using data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=159.531) [compression. And then we go through and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=161.55877777777783) [see sp\_estimate data compression savings,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=164.781) [here's how much space it takes with no](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=166.63814285714284) [compression, and here's how much space it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=169.38100000000003) [would take if we did page compression on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=171.4173636363637) [this. So that's a pretty decent amount,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=175.031) [it's roughly four to one compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=176.87190909090913) [ratio. And on this index we can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=178.781) [similar savings, about a four to one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=182.1143333333334) [compression ratio. And then we can see our](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=184.9238571428571) [index usage, and we can see sp\_helpindex](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=187.281) [and then finally we can see how much space we have available in the data file.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=4&mode=live&start=190.781)

[Demo: Using Data Compression and Columnstore (2)](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live)

[For the next part of this demonstration,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=1.829) [I'm going to show you a query that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=3.329) [compares the relative effectiveness of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=4.662333333333334) [clustered colomn store indexes to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=6.329) [traditional row store data compression. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=8.495666666666667) [I'm going to use the AdventureWorks 2014](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=12.051222222222222) [database for this, and then I've gone in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=13.606777777777772) [and added three new tables to that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=16.745666666666665) [database, so we have some data to use for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=19.628999999999998) [the queries here, and they're just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=23.204) [identical. They have 62 million rows of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=25.454) [data in each one, and you can use any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=28.228999999999992) [large table you have access to in one of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=30.738090909090918) [your databases to do similar testing. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=32.82900000000001) [it's important that you have the graphical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=35.162333333333336) [execution plan turned on when you run this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=37.495666666666686) [to see the full effect of this. So the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=39.829) [first part of this, we're going to run](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=43.229000000000006) [this little query here to see what's going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=44.829) [on with our clustered colomn sotre index,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=46.60677777777777) [and we can see that we've got one on this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=49.829) [table and then one on this table, and we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=51.6471818181818) [can see what's going on with the row](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=54.22899999999998) [groups and how many rows are in each row](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=56.54328571428571) [group. Then we can go on and get ready to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=58.60677777777777) [run the rest of this query, and we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=62.114714285714285) [going to run set statistics I/O on, so we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=64.49566666666666) [can get some I/O statistics from the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=67.229) [query, and then we're going to go in and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=68.62900000000002) [turn on set no-count on and do a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=71.22899999999997) [checkpoint to flush the dirty pages to the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=73.54328571428574) [disc, and we're going to drop clean](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=75.579) [buffers to flush everything out of the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=78.22900000000003) [buffer pool and force SQL Server to use a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=80.49566666666668) [storage subsystem to execute these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=82.82899999999998) [queries. So after we do all that, then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=84.49566666666662) [we've got three separate queries we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=86.73809090909086) [going to run back to back as part of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=88.42899999999999) [single batch. And the first one is just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=91.329) [reading from the table that doesn't have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=93.62899999999998) [any data compression whatsoever. And we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=96.11471428571429) [forcing a clustered index scan of that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=98.42899999999999) [table. The next query reads from the table](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=100.52899999999997) [that has page data compression and it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=103.1623333333333)[forces a clustered index scan of that, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=106.329) [then finally we're going to do a similar](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=109.9401111111111) [thing where we're going to read from the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=111.91990909090912) [table that has a clustered column store](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=113.91990909090907) [index and force a scan of that table. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=116.46536363636359) [we're going to run those three back to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=120.029) [back and then compare the execution time](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=121.62900000000002)[and I/O statistics for the three, if I can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=123.829) [get this going correctly, and see what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=126.91990909090907) [happened. So we run this, and what we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=129.46536363636366) [going to find is that the no-compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=131.579) [table is going to obviously take longer](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=133.71788888888892) [than the one with page data compression,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=136.829) [and then finally the clustered colomn](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=140.829) [sotre index. And we can see the row counts](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=142.329" \t "psplayer) [are identical for all three here, and we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=144.3845555555556) [can see the elapsed time was a little over](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=146.4653636363637) [five second for the table with no data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=148.71788888888892) [compression whatsoever. And then that goes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=151.02900000000002) [down to slightly over two seconds for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=153.02900000000005) [table with page data compression, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=155.68614285714284) [that's pretty significant. But then, with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=158.079) [the clustered colomn sotre index, we go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=159.954) [all the way down to 133 milliseconds, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=162.27344444444446) [if you go to the messages tab, we can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=164.079) [the relative I/O for these three queries.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=167.02900000000002) [So the first one was 287, 000 and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=169.829) [one's 121, 000 and then we go down to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=174.329) [four, actually 615 over here. So it's an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=178.38455555555566) [incredible difference and if we look at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=184.02900000000002) [the execution plan and the batch, we can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=186.079) [see the relative costs. So 66%, 32% and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=188.49566666666672) [3%, so in this particular case with this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=191.829) [data, it's an incredible difference](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=195.68614285714284) [between clustered column store indexes and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=197.829) [page data compression and no data compression.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=5&mode=live&start=201.329)

[Instance-level and tempdb Configuration Settings](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live)

[Instance-level configuration settings,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=1.754) [many important instance-level](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=4.754) [configuration settings should be changed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=6.254) [from their default values. These include](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=8.539714285714286) [things like backup checks on default,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=10.920666666666667) [which I think should be enabled. This is a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=12.754) [new setting in SQL Server 2014, and also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=14.92066666666667) [in 2016 that you should have enabled to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=17.142888888888887) [help detect corruption as your backup](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=20.629) [files are being written. Another one that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=22.879) [you probably want to turn on in most](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=24.920666666666666)[cases, is backup compression. Backup](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=26.920666666666666) [compression makes your backups go faster,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=28.68257142857143) [makes your restores go faster, and in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=31.254) [previous versions of SQL Server, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=33.82542857142857) [didn't really want to turn it on if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=35.504) [were using transparent database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=37.82542857142857) [encryption, but with SQL Server 2016 it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=38.968285714285706) [works much better. Now, cost threshold](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=41.25400000000001) [parallelism is another setting that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=43.754) [might want to change depending on your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=45.920666666666676) [workload. The default value for this is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=48.754) [five and quite often raising that to a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=50.968285714285706) [higher value is helpful, especially with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=52.80955555555555) [many OLTP workloads. Another setting to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=54.96828571428572) [think about is max degree of parallelism,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=57.754)[and by default that's set to zero, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=60.39685714285714) [means that you can use all the processor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=62.920666666666676) [cores in the instance for an individual](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=65.254) [query. My essential advice for that is to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=67.754) [set it to the number of cores in a NUMA](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=70.5873333333333) [node, the number of physical codes in a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=73.92066666666663) [NUMA node. So if you have an eight-core](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=75.8095555555556) [processor, you might start off with a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=77.96828571428576) [value of eight, and that's for an OLTP](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=80.25399999999998) [workload. Now, max server memory needs to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=82.92066666666665) [be set to an appropriate value based on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=84.754) [how much memory is in your machine and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=87.25399999999998) [what components you're using, and what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=89.92066666666665) [options you're using for SQL Server. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=92.004) [the idea here is to make sure that the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=94.42066666666668) [operating system is never under memory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=95.92066666666672) [pressure, so another one you want to think](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=98.65399999999998) [about, in fact, I think you ahold always](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=101.004)[turn it on, is optimize for ad hoc](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=102.65400000000002) [workloads. That makes it so that you only](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=104.92066666666665) [cache a stub of the complete query plan](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=108.05400000000004) [the first time that it's executed and it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=111.129) [helps reduce the plan cache bloating issue](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=114.39685714285716) [that you run into in some cases. It](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=116.254) [doesn't completely solve it, but it does](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=118.47622222222223) [help. And then finally, tempdb](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=120.03177777777783) [configuration, that needs to be changed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=122.65399999999998) [from the default configuration, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=124.92066666666665) [luckily SQL Server 2016 makes it even](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=126.58733333333333) [easier to do this during set up, but if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=128.92066666666668) [you're on an older version of SQL Server,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=131.854) [what is recommend that you do is start](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=134.254) [with four to eight tempdb data files in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=136.92066666666668) [order to reduce your allocation contention](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=139.6825714285714) [and then you want to make sure that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=142.254) [use dedicated, fast local storage and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=144.0539999999999) [consider flash storage if your workload](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=148.754) [heavily uses tempdb and you're seeing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=151.754) [performance issues there. Finally, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=154.129) [want to make sure that you enable Trace](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=155.92066666666668) [Flag 1118 if you're using any version](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=158.629) [older than 2016, if you're using SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=161.254) [Server 2016, this behavior is turned on by default.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=6&mode=live&start=163.9762222222222)

[Demo: Changing Instance-level Configuration Settings](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live)

[In this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=1.75) [you how to change some important](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=2.8586249999999995) [instance-level configuration settings. In](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=5.017) [this script, I'm going to show you how to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=7.317) [get your current configuration values for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=10.017) [your instance, and then I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=12.267) [you how to change some of the more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=14.216999999999995) [important ones to more appropriate values.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=16.217000000000002) [And some of these things might vary based](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=18.017) [on your workload. So the first query in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=20.198818181818186) [this set, we're going to just find out the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=21.786230769230766) [current values for these specific](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=23.517) [configuration settings. So we've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=26.517) [backup checks from default, backup](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=28.874142857142854) [compression default, cost threshold for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=30.44557142857143) [parallelism, max server memory and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=32.58842857142858) [megabytes, optimized for ad hoc workloads,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=34.617) [and remote admin connections. Those are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=37.017) [all ones that I think are pretty](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=40.817) [important. So coming down here, what you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=43.61699999999999) [do is you run sp\_configure and pass in the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=46.198818181818204) [name of the value you want to change and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=49.017) [here's what you change it to, and I think](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=51.30271428571429) [backup checks on default should always be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=53.87414285714286) [enabled, there's no reason not to ever](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=55.87414285714286) [have that enabled. Now this is only](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=58.01700000000001) [available in SQL Server 2014. If you're in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=60.794777777777774) [an older version of SQL Server, you need](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=63.68366666666667) [to enable global trace flag 3023, and set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=65.767) [as a startup trace flag. So we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=68.58842857142858) [go ahead and do this one. Then the next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=70.81700000000001) [one in the set is backup compression](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=73.38063636363636) [default, and I think that should be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=76.56245454545453) [enabled in most cases. Some of the key](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=78.81699999999998) [exceptions would be if you're using](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=81.15985714285716) [transparent database encryption, TDE,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=83.01699999999998) [backup compression doesn't work very well](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=84.44557142857143) [with that unless you're on SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=87.017) [2016. They made some changes so you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=89.642) [use those two features together and you'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=92.56245454545451) [get good compression so that's a really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=95.517) [nice improvement. Also, if you're using a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=99.017) [third-party backup compression product, or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=101.267) [if you're in sustained high CPU pressure,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=102.68366666666665) [if any of those things are true, you might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=105.017) [not want to use backup compression. But](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=107.517) [other than that you probably do want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=109.30271428571429) [use it in most cases. So I'm going to go](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=111.58842857142858) [ahead and enable it right there. Now, the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=114.38063636363633) [next one in the set is cost-threshold](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=116.61699999999999) [parallelism. The default value for that is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=118.71699999999997) [five, and that's basically how expensive a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=120.73128571428575) [query has to be before it gets](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=123.41700000000003) [parallelized. And a lot of workloads](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=126.517) [actually will run better if you raise this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=128.68366666666668) [to a higher value. And John Kehayias has](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=131.517) [some good queries on his blog that help](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=134.61700000000002) [you figure out what to set this to, but in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=137.61700000000002)[the mean time we're just going to set it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=140.47853846153845) [to 25 in this demo, so we'll do that. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=142.5554615384615) [the next one is max server memory, and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=145.267) [want to set that to an appropriate value](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=147.61700000000002) [so that you're not ever in any danger of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=150.017) [putting the operating system under memory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=153.392) [pressure, and what you set that to depends](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=155.642)[on how much memory you have in your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=157.767) [machine and what other SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=159.767) [components are installed and running. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=161.6836666666667) [so we're going to go ahead and set this to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=165.21699999999998) [27, 000 megabytes, which is about 26 and a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=167.43366666666665) [half gigabytes. So I'll go ahead and do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=171.18366666666657) [that. Then, max degree of parallelism, the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=174.5884285714285)[default of this is zero which means SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=176.65336363636368) [Server can use all of your processor cores](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=178.767) [for an individual query. Standard best](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=181.73128571428575) [practice is to set that to the number of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=184.58842857142855) [physical cores in a NUMA node, so just for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=187.61700000000002) [this demonstration I'm going to go ahead](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=191.217) [and set it to four. Now the next query in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=194.01700000000002) [this set, is optimized for ad hoc](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=197.6836666666667) [workloads, and I think that should always](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=199.767) [be enabled, and what it does is it lets](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=201.767) [SQL Server only cache the stub of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=205.35033333333337)[complete query plan the very first time](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=208.68366666666668) [that it's executed if it's an ad hoc](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=211.017) [query. And this helps minimize the plan](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=213.68366666666674) [cache bloating you get for those kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=215.517) [query plans. It doesn't completely](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=218.267) [eliminate it, but it reduces it pretty](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=220.217) [significantly so I always always turn this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=222.6836666666667) [on. So we'll go ahead and do that here.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=224.73128571428566) [The next one is remote admin connections.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=227.017) [And I think this is a good idea because it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=229.017) [helps you get into a server if you can't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=230.767) [get in through the normal method, and it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=233.68366666666668) [might help save you in a crisis which is a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=235.68366666666668) [good best practice to turn this one on. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=239.10790909090912) [after we've enabled and changed all those](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=242.23922222222222) [settings, we can go back and check and see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=243.79477777777782) [what their current values are right here.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=247.017) [So we can see we enabled these two, and we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=250.017) [set this to 25, and set max server memory](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=252.56245454545456) [to 27, 000 and then enabled these other](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=255.017) [two settings. So these are all good best](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=257.4170000000001) [practices that I think will help your system run better.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=7&mode=live&start=260.58842857142866)

[SQL Server Database Property Settings](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live)

[SQL Server database property settings.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=2) [There are a number of property settings at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=4.476) [the database level you probably should](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=5.726) [change to get the best performance from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=7.226) [SQL Server. One of these first ones is to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=8.976) [use a main file group when you first](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=11.809333333333338) [create a database, and put at least two](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=14.476000000000003) [files in there and make that file group](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=16.726) [the default file group. That way, all your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=19.14266666666666) [user objects will go in that main file](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=21.976) [group, and they'll be spread across two](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=24.676000000000002)[files that you can move to different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=26.80933333333333) [drives if you need to for either space or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=29.142666666666656) [performance reasons. Another thing that I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=31.876000000000005) [think you should think about is use a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=33.364888888888885) [reasonable auto growth size in megabytes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=35.80933333333333) [rather than an auto growth size that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=38.476) [based on a percentage. Both for your data](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=41.676) [files and your log files. Another thing to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=43.80933333333334) [think about is controlling your VLF counts](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=46.80933333333333) [in your log files. VLF's are virtual log](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=49.876) [files, and as your VLF counts get higher,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=52.67599999999999)[it hurts the write performance to your log](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=55.33314285714286) [file and makes the recovery portion of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=58.14266666666666) [database restore take longer, and it makes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=60.476) [crash recovery take longer which makes](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=63.76171428571429) [your SQL Server instance take longer to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=65.80933333333334) [start up. The next one that's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=67.67600000000002) [important is to grow your log file in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=69.47600000000001) [relatively large chunks, and this affects](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=71.976) [the VLF counts. So you grow lots of small](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=74.976) [growths, you're going to have a higher](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=78.19028571428575) [total VLF count than if you have a smaller](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=79.80933333333337) [number of larger growths, and that's what](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=82.87600000000003) [you want to have to have the lower VLF](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=84.80933333333334) [counts. Also, I think you should turn on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=87.726) [auto update statistics asynchronously for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=89.87600000000002) [all your user databases. That way if an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=91.80933333333334) [auto update statistics event occurs, it'll](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=95.976) [happen asynchronously and it won't halt](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=98.33314285714286) [query execution for any queries that are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=100.80933333333333) [using those statistics, and that's just](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=103.27600000000001) [something that I think you should turn on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=105.2941818181818) [even though you probably also want to do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=107.476) [your own manual statistics maintenance on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=109.07600000000002) [top of relying on auto statistics updates.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=111.851) [Finally, consider using delayed durability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=114.476) [if you are writing a whole lot of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=117.476) [information to your transaction log, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=120.14266666666663) [that's actually a performance bottleneck,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=122.61885714285715) [but at the same time be aware that there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=124.226) [some possible data loss if you use that setting, which is new for SQL Server 2014.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=8&mode=live&start=126.976)

[Demo: Changing Database Properties](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live)

[In this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=2) [you how to change some of these important](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=3.447599999999999) [database properties. First thing we want](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=5.4965714285714276) [to do in this demonstration is find out](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=7.401333333333332) [what our current database properties are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=10.068000000000001) [for all the databases on this instance, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=12.068) [if we query sys. databases and also look](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=15.368) [at DM database encryption keys, we can see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=17.768000000000004) [a lot of interesting things about all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=20.168000000000006) [databases on this instance. So this shows](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=22.734666666666662) [us the database name, the recovery model,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=25.267999999999997) [the state, the fact that they're all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=28.068) [online, whether or not they're partially](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=30.693) [contained databases, our log reuse\_wait](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=33.210857142857144)[description, which is really important to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=36.318) [know, our database compatibility level.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=39.568) [Our page verify option, a number of things](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=42.068) [about whether we have auto create stats](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=44.73466666666668) [on, auto update stats on, auto update](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=47.2498181818182) [stats asynchronously turned on, whether or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=50.401333333333326) [not we're using forced parameterization,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=53.63942857142857) [and so on. So there's a number of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=55.068) [interesting things in this query that we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=57.78228571428573) [can find out different properties for all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=59.943) [of our databases. And many of these are](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=62.21085714285714) [new for SQL Server 2014, such as delayed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=65.568) [durability for example. So, and then these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=69.06799999999998) [final four columns are encryption, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=71.78228571428572) [has to do with transparent database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=74.35371428571429) [encryption, TDE. So going back here, if we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=77.568) [decide we want to change some properties,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=80.26800000000001) [you want to be in the master database when](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=81.8861818181818) [you do this, and then you run a number of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=84.34072727272726) [altered database commands for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=87.068) [particular database that you want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=89.21085714285715) [change something for. So for example, I](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=91.21085714285717) [really think it's a good idea to have set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=92.86800000000001) [auto updates statistics asynchronously](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=95.568) [enabled for databases, especially OLTP](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=97.568) [databases, so this is the command you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=100.46799999999998) [would run to actually change that property](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=104.068) [just by doing this. And then it's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=106.73466666666664) [good in my opinion to have page verify set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=110.068) [to check some for all databases rather](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=113.8861818181818) [than torn page or none so here's how you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=116.568) [change it right there. And then finally](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=121.568)[depending on your workload and whether or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=124.92514285714287) [not you have the ability to possibly have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=127.26800000000001) [some data loss for your database, if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=130.49657142857143) [you're really seeing a bottleneck right](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=133.443) [into the transaction log file with your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=135.693) [workload, which is somewhat unusual, but](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=138.6394285714285) [if you're seeing that you can enable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=140.17911111111115) [delayed durability with this setting. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=142.943) [again, this is something you want to think](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=146.268) [about before you do it, so those are the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=147.8679999999999) [examples of how to change some key database properties.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=9&mode=live&start=150.73466666666675)

[ALTER DATABASE SCOPED CONFIGURATION](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live)

[Alter database scoped configuration. This](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=2) [is a new feature that's in SQL Server 2016](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=4.7426) [that lets you change many settings that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=6.926) [normally you could only change at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=9.226) [query level or the instance level with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=11.326000000000006) [previous versions of SQL Server. The fist](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=13.426000000000004) [one is the ability to enable or disable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=15.526) [legacy cardinality estimation, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=17.926) [perilously with older versions of SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=20.426) [Server, you had to change the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=23.426) [compatibility level or use a trace flag or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=25.354571428571422) [use a query hint to change this, but now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=27.310615384615378) [you can change it at the database level,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=29.726) [and this works with always-on availability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=32.926) [groups because you can do this on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=35.497428571428586) [principal database or on your replicate](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=38.25933333333335) [database. And you have the ability to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=40.525999999999996) [control how you do that in a pretty](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=42.56236363636364) [granular fashion. The next one is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=44.52600000000001) [enable/disable parameter sniffing. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=46.640285714285724) [previously, if you had a problem with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=48.226) [parameter sniffing and you wanted to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=50.32599999999998) [disable it, you could use a query hint](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=52.259333333333345) [optimized for unknown or you could use a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=54.425999999999995) [local variable inside of a stored](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=56.59266666666668) [procedure to effectively disable parameter](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=58.726) [sniffing. Well now you can do it for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=61.25933333333333) [entire database using this setting. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=63.526000000000025) [next one is the ability to enable or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=66.126) [disable query optimizer hotfixes. So this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=67.72600000000003) [is the equivalent of trace flag 40199, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=70.81488888888889) [now you can turn this on or off at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=74.15676923076923) [database level. The next one's probably](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=76.46446153846149) [the most useful one of the bunch. You can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=78.01690909090907) [set max degree of parallelism at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=80.65327272727272) [database level instead of just at the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=83.19872727272724) [instance level or at the individual query](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=86.06885714285715) [level. Finally, you have the ability to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=88.59266666666664) [clear the plan cache for a single](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=90.926) [database. Now previously you could do this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=94.426) [with a command that was a little bit](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=95.926) [tricky to use, but now you can do it with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=98.83509090909088) [a command that is much easier to use, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=101.4815555555556) [also this new command works with as your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=103.74418181818181) [SQL database where the older command did not work.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=10&mode=live&start=106.28963636363632)

[Demo: ALTER DATABASE SCOPED CONFIGURATION](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live)

[For this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=2) [you how to use the alter database scoped](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=2.875) [configuration commands. The books online](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=6.830555555555557) [for alter database scoped configuration is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=8.8625) [right here at this link. So the first](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=10.758333333333335) [thing we want to do is switch to the wide](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=13.024999999999999) [world importers database. And then we can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=16.925) [run this new system view, sys\_database](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=20.313888888888886) [scoped configurations to find out our](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=21.925) [current database scope configurations for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=25.025000000000002) [this database. So we can see what it is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=28.09166666666667) [for the primary database and for the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=31.334090909090914) [secondary, and what this is referring to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=33.025000000000006) [is if you have an always unavailability](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=34.425) [group set up, this would be your primary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=37.05) [database that's read writable, and this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=40.05) [would be for all of your secondary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=41.92499999999998) [databases that you might have on different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=44.28214285714286)[availability nodes. So going back to this,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=47.925) [you have the ability to set max degree of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=49.98055555555557) [parallelism for the primary database by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=52.925) [using this command, we can set it to four](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=55.3) [in this instance. Then we can go and set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=58.42500000000001) [it to a different value on the secondary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=61.06136363636364) [databases, and this affects all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=63.71071428571429) [secondary databases that you might have.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=65.925) [And it'll even let you set this if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=67.425) [don't have any secondary databases, which](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=70.12499999999997) [is sort of interesting. So we've done](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=73.20277777777778)[that, and you also have the ability with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=76.32499999999999) [most of these commands to set the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=78.86944444444444) [secondary to whatever the primary is by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=81.98055555555554) [using this command. So we can do that. Now](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=84.42499999999997) [next, we can turn on or off cadinality](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=87.725) [estimation for the primary database. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=90.12499999999997) [this is the same as using trace flag 4136,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=93.825) [except it only affects this one database.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=97.425) [So when we do this, this affects the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=100.425) [primary database. And then if we come down](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=103.62500000000004) [here we can set it to a different value](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=105.71071428571425) [for the secondary database. And then again](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=108.225) [we can set it to the same value on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=111.97045454545456) [secondary as it is on the primary. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=114.53611111111111) [next one in the set is parameter sniffing.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=118.64722222222223) [We can turn parameter sniffing on or off](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=120.425) [for the primary database, so in this case](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=122.425) [we're going to turn it off. And then we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=126.02500000000002) [can also set it off for any secondary](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=129.42500000000004) [databases. And then we can set it to the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=132.09166666666678) [same as on the secondary databases as it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=134.425) [is on the primary database. The next one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=138.5361111111111) [in this set is query optimizer fixes. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=143.32500000000005) [this is the equivalent of using trace flag](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=145.72500000000002) [4199, except again it only affects this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=148.1250000000001) [database. So by doing this we set it for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=150.9964285714285) [the primary database, and we can set it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=153.60681818181826) [for the secondary database. Then we can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=157.7583333333333) [come down and, the old legacy method that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=161.32500000000005) [I mentioned earlier, you can run DBCC](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=163.98055555555555) [flushprocindb and pass in the database ID.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=167.86944444444435" \t "psplayer) [So doing something like this and passing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=170.425) [in the name and the database, this will](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=173.05) [let you clear the plan cache, and this is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=174.9805555555556) [the old way that you had to do it on older](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=176.82499999999993) [versions of SQL Server. But now you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=179.425) [run alter database scope configuration,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=181.75833333333338) [clear procedure cache, and then finally](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=183.425) [you can see what your values are right here.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=11&mode=live&start=189.425)

[Using CPU-Z to Check Power Management](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live)

[CPU-Z can be used to confirm the net](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=2) [effect of your power management settings.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=4.666666666666667) [You've got several levels of power](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=6.896) [management settings you need to be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=8.396) [concerned with. So you've got the BIOS](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=10.229333333333336) [level, power management settings, and if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=12.56266666666667) [you're using virtualization, you have your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=14.696000000000002) [hyper-visor power management settings, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=16.753142857142855) [then finally you have your Windows power](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=18.229333333333333) [plan and so all those work at different](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=20.562666666666658) [levels, and you need to have some tool](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=22.646) [like CPU-Z to find out what's really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=25.229333333333326) [happening at the end of all this, and your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=27.56266666666666) [power management is going to affect your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=30.296000000000006) [processor performance and your storage performance with many types of storage.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=12&mode=live&start=33.03885714285715)

[Demo: Using CPU-Z to Check Power Management](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live)

[In this demonstration, I'm going to take a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=3.5) [look at how to use CPU-Z to confirm what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=5.055555555555557) [going on with your power management and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=6.7180000000000035) [how fast your current processor is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=8.870714285714287) [actually running. So we'll go ahead and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=12.918333333333337) [start this executable, and it takes a few](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=16.1475) [seconds to go and scan my system to see](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=18.335)[what's happening, and it comes up on the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=20.751666666666665) [CPU tab and it tells me what kind of a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=23.418333333333322) [processor I have and it tells me the rated](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=26.266818181818188) [base clock speed, which is 3. 5 gigahertz](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=29.084999999999994) [in this case. And then down here it tells](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=31.96) [me the current clock speed, and this will](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=34.17590909090908) [be jumping around whether or not you've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=36.08500000000001) [got a load on your system, but you also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=38.370714285714286) [want to look at the current clock speed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=40.90318181818182) [and the multiplier values. So the fact](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=43.085) [that my bus speed is set to about 100](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=45.68500000000001) [megahertz and the multiplier is 43, means](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=47.835) [that you can see it occasionally jump up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=50.41833333333334) [to 4300 megahertz, 4. 3 gigahertz in this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=53.085) [case. So that's what you want to see. You](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=57.52944444444446) [want to see it running at close to full](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=60.335) [clock speed most of the time, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=62.585) [occasionally going above the full-base](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=64.75166666666665) [clock speed of 3. 5 gigahertz. So doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=66.28499999999998) [this helps you figure out whether or not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=69.085) [you've got BIOS level power management set](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=73.085) [correctly, and whether your windows power](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=76.585) [plan is set correctly. And one other thing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=78.75166666666664) [that's interesting about CPU-Z with the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=81.085) [latest versions, is you can go to this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=82.585) [bench tab and then you can click on this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=84.585) [bench CPU tab and it goes and runs a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=88.585) [little benchmark test that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=91.41833333333336) [single-threaded performance for a few](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=92.51357142857142)[seconds and then it switches to a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=94.65642857142858) [multi-threaded performance test a few](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=98.085) [seconds after that, and after that's done](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=100.08499999999998) [then what you can do is compare these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=101.97388888888891) [results to another processor that you have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=105.65642857142858) [in this list. So this is a very fast newer](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=110.08499999999998) [processor that's a little bit faster than](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=113.71) [mine for single-threaded and for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=115.79928571428574) [multi-threaded, and this is about the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=118.48499999999997) [capacity of your system, and this is your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=120.19611111111114) [single-threaded performance. And you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=122.41833333333331)[run this test, I'll run it again. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=123.98499999999999) [while it's running, you can switch back](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=126.68499999999999) [over to the CPU tab and see whether or not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=128.785) [your clock speed is going up to the full](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=131.085) [rated turbo boost clock speed of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=134.585) [processor. So again, this little utility,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=138.41833333333332) [which is free from cpuid. com is very very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=140.335) [useful for finding out what's going on](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=143.48500000000004) [with your power management and your resultant core speed of your processor.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=13&mode=live&start=146.37071428571426)

[Demo: Windows Power Plan](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live)

[For this demonstration, I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=2) [you how to change the Windows power plan](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=3.0499999999999994) [settings that you're using on your server.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=5.2700000000000005) [Now all modern versions of Windows have](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=8.624) [their default power plans set to balance,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=10.17955555555555) [and that's not the best setting for your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=12.499) [overall performance, especially your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=15.052571428571433)[storage subsystem, so what we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=17.124) [do is come down here and type in power.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=19.623999999999995) [And that'll take us to power options, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=22.624) [when I pull that up that pulls up my power](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=24.84622222222222) [plan settings and the default is balance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=27.290666666666663) [which is shown as recommended by](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=29.624) [Microsoft, and just like it says there, it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=32.19542857142858)[balances performance with energy](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=34.95733333333335) [consumption on capable hardware. And all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=36.624) [you need to do is just change it from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=39.124) [balanced to high-performance, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=41.374) [that'll make sure that it's not using any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=43.338285714285725) [power management at the operating system](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=46.766857142857155) [level. The only problem with this is you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=49.224)[need to make sure that your BIOS is also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=50.89672727272726) [set correctly, and if you're running in a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=53.052571428571426) [VM, you need to make sure that your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=55.124) [hyper-visor power plan is set correctly.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=57.374) [So at the BIOS level, you want to make](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=59.624) [sure that it's set to OS control or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=61.42400000000003) [disabled, and at the hyper-visor level you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=65.124) [want to make sure that it's set to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=66.82400000000001) [high-performance. And once you've got this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=69.22400000000002) [set, then you'll get the best performance](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=70.874) [that you can get for your power management.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=14&mode=live&start=72.12400000000002)

[Demo: Using Resource Governor to Limit I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live)

[For this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=1.75) [you how to set up Resource Governor to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=3.0625) [control your I/O and also show you how to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=5.248499999999999) [test it and how to remove it when you're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=7.933999999999998) [done. So Resource Governor is an](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=11.159) [enterprise only edition feature, and it's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=13.20066666666667) [very useful, it's something they added](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=15.284) [some new functionality to in SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=17.534) [2014, and that was the ability to limit](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=20.159) [your I/O. So what we're going to do here](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=22.867333333333324) [is switch to the master database and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=24.933999999999994) [we're going to create a resource pool with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=27.756222222222213) [our desired limits for I/O, so we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=31.31177777777777) [to set max IOPS to volume equal to 300. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=34.534000000000006) [we create this resource pool, and then we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=38.034) [create a workload group that uses that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=40.96257142857144) [resource pool that we just created. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=43.20066666666667) [we actually have to create what's called a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=46.784) [classifier function in the master](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=48.96257142857143) [database. This is a user-defined function](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=51.10542857142858) [that's going to look at the login name as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=52.53400000000001) [people log into the database and decide](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=55.31177777777777) [whether it goes into our workload group or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=58.079454545454546) [not. So that's what we're going to do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=60.26127272727273) [right here. The next step is to assign](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=63.6451111111111) [that classifier function to the Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=66.53399999999998) [Governor, then the next step is to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=69.034) [reconfigure the Resource Governor. Then we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=74.33399999999999) [can check a couple of DMB's to see that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=78.134) [everything looks like it's set up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=80.784) [correctly. So this tells me that I've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=82.284) [the classifier function, it's set up and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=84.63399999999999) [it's not pending reconfiguration. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=87.034) [we can also make sure that it's enabled.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=89.134) [So everything's looking good there. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=91.534) [next step is to create a limited I/O SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=95.95066666666668)[Server login on the instance, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=99.70066666666672) [we're going to create a limited I/O user](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=102.75622222222222) [that's associated with that login. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=107.20066666666669) [we're going to switch to the Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=110.75622222222223) [Governor test database, and then we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=112.31177777777783) [going to turn on set\_nocount on and do a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=114.75622222222222) [checkpoint and then DBCC drop clean](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=119.034) [buffers, so make sure that SQL Server's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=122.034) [going to read the data from the disk](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=123.62490909090913) [rather than finding it in the buffer pool,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=125.62490909090909) [and you don't want to do that on a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=128.534)[production instance. Next we're going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=130.98854545454552) [find out how big is this table we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=132.33399999999995) [to use for our little test. So it's a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=134.53400000000002) [pretty decent size. And then we're going](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=137.53400000000002) [to turn on statistics I/O, and statistics](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=139.4228888888889) [time so we can get some I/O and time](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=141.10542857142855) [statistics. And then we're going to do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=144.93399999999997) [select count star, row count from that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=146.6249090909091) [table with an index that forces it to do a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=147.97844444444445) [clustered index scan. And this will take](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=152.03400000000002) [three to four seconds going full speed](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=155.534) [with no I/O throttling. And if we go to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=157.81971428571424) [the messages tab, we can see that it took](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=160.784) [about 3. 6 seconds, roughly. So now we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=163.17036363636367) [going to switch to this other connection,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=165.734) [and we're going to change connections and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=168.534) [make sure that we log in with SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=170.8673333333334) [authentication using that login that we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=174.159) [just created earlier. This will force it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=175.784) [to be under the control of Resource](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=177.86733333333336) [Governor. So we can run this query right](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=180.8673333333333) [here to confirm that we're logged in as](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=182.9339999999999) [limited I/O. Then we'll switch to the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=185.67685714285707) [Resource Governor database again. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=188.75622222222228) [we'll turn on all the same things that we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=191.034) [had on on the previous connection. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=195.284) [then we're going to run this query under](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=197.909) [the influence of Resource Governor. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=201.20066666666665) [this will take roughly 14 seconds since](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=204.67685714285713) [we're throttling the I/O, and this is good](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=206.134) [because it lets you limit the damage that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=209.9885454545455) [an individual application or user can do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=213.034) [to your system by throttling their I/O. Of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=216.4228888888889) [course they're not going to like that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=219.71581818181818) [did that, but this gives you a way of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=221.17036363636367) [prioritizing and protecting the system](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=223.284) [from rogue applications or users, and that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=225.81971428571433) [took roughly 14 seconds, 14. 8 seconds](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=229.034) [roughly. So then we can check the I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=232.034) [metrics from our resource pools and we're](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=235.4506666666666) [going to filter out the internal pool. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=237.97844444444445) [we'll see that we have the default pool,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=239.75622222222222) [that nothing has happened since we started](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=241.534) [looking here, and then we have the limited](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=244.6451111111112) [I/O pool. So then we can also get the I/O](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=248.534) [metrics from volumes that that pool has](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=251.71581818181824) [been using. So my data file for this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=253.20066666666662)[database lives on the C drive so all these](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=255.53400000000005) [metrics are coming from the C drive, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=258.434) [you can see all these different things](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=260.784) [that are showing up there that you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=262.534) [check out periodically. Then we can also](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=264.534) [find out what sessions are active in each](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=267.534) [group. So we've got spid55 that I'm using](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=270.9340000000001) [right here is in the limited I/O group,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=273.8673333333332) [and all the other spids are using the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=276.71581818181824) [default workload group. Then we can come](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=280.034) [in and give this guy a little bit more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=282.4228888888889)[IOPS, we'll change him to 500 IOPS per](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=284.534) [volume. And then we'll do a checkpoint and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=289.534) [DBCC drop clean buffers again. And then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=291.8673333333333) [run this same query one more time. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=294.6451111111111) [this will come back a little bit faster](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=298.8673333333333) [since we upped the IOPS from 300 to 500.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=301.534) [So this will come back any second now, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=305.534)[we can see that it took almost nine](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=308.834) [seconds. So then I'm going to go ahead and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=311.2340000000001) [close this connection and go back to the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=314.443090909091) [original script. And down here I've got](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=317.6768571428572) [some clean up code to show you how to take](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=319.64511111111113) [Resource Governor out of the picture. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=322.034) [the first thing you have to do is disable](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=324.834) [the Resource Governor, and then you drop](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=327.534) [the workload group, so you sort of go in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=331.034) [the opposite that you created it, and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=333.1339999999999) [drop the workload group. And then you drop](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=335.33400000000006) [the resource pool and then reconfigure the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=337.6768571428571) [Resource Governor. And then you unassign](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=340.534) [the classifier function and then you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=346.6768571428571) [disable the Resource Governor one more](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=351.3911428571428) [time just to be safe, and then we drop the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=353.3911428571429) [classifier function from the master](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=356.9625714285714) [database. Then we remove that user from](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=361.284) [the Resource Governor test database, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=364.5339999999999) [then we remove that SQL Server login, so](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=366.8197142857143) [now we've completely removed everything we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=370.8197142857142) [did for this test, and once again this is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=373.8197142857143) [an enterprise edition only feature that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=376.64511111111113) [can be very useful, especially now that you have the ability to limit I/O.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=15&mode=live&start=378.2006666666666)

[Demo: Granting OS Rights to SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live)

[For this demonstration I'm going to show](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=2) [you how to grant certain important](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=3.3125) [operating system rights to SQL Server. So](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=5.922272727272729) [to get in there, you just go and put in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=9.101727272727274) [group policy editor, gpedit. mc and when](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=11.829) [you do that that'll start up group policy](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=15.329) [editor, and then what you need to do is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=17.429000000000002) [navigate down through to find where you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=20.029) [need to make this change. So you go to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=21.428999999999995) [Windows settings and then you go to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=25.329) [security settings, and you go to local](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=27.429) [policies and user rights assignment. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=29.828999999999994) [I'm just going to make this window a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=32.079) [little bit bigger so we can see what's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=34.079) [going on here. And this is a list of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=36.079) [different rights that you can grant to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=38.46536363636364) [particular accounts. And the two that we](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=40.829) [want to grant to the SQL Server account](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=42.454) [are lock pages and memory, and then down](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=44.829) [here preform volume maintenance tasks,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=47.495666666666686) [right there. So what you need to do is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=49.16233333333334) [double click on this and add user or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=52.454)[group, and then you type in the name of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=55.454) [the SQL Server service account. Once you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=57.829) [have that in there, then you can hit the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=61.49566666666667) [check names button and it'll validate that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=64.704) [that's actually an account, either in this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=67.329) [case a local account or domain account.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=69.429) [And you click OK, and you click apply, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=70.829)[you do the same thing down here for](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=74.079) [perform volume maintenance tasks. So you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=76.229) [add user group, and you type in the name](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=78.37445454545453) [of the account and validate it and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=80.829) [click OK and click apply. And this won't](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=86.36746153846154) [go into effect until you restart SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=90.579) [Server, so really the best thing to do is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=92.329) [to do this before you install SQL Server,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=94.64718181818179) [as part of your installation and set up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=96.829) [checklist, but if you didn't do that, you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=100.38455555555554) [can go back and do it anytime you want to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=103.01081818181818) [and then it'll go into effect the next](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=104.829) [time SQL Server is restarted for any](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=106.629) [reason. And the reason you want to do](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=109.42900000000004) [this, especially perform volume](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=110.704) [maintenance tasks, is that it lets SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=112.02900000000001) [Server and the operating system skip the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=114.32899999999998) [step of zeroing out a data file after the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=116.71788888888888) [space is allocated and that can take a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=120.629) [long time to do, especially on older](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=123.49566666666664) [magnetic storage. So that's something you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=126.38899999999998) [definitely want to do. There's a very](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=128.62900000000002) [small security risk associated with it,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=130.82900000000004) [but unless you're doing a lot of really](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=132.62900000000005) [bad things, it's really a negligible risk and I think everybody should do this.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=16&mode=live&start=134.7623333333335)

[Server Hardware Configuration Settings](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live)

[Server hardware configuration settings.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=2) [There are a number of very important](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=5) [hardware configuration settings that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=6.5) [need to have set correctly to get the best](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=7.889374999999999) [performance from SQL Server, particularly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=10.223) [from your storage subsystem. The first one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=11.58014285714286) [you need to think about is Intel](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=13.723000000000003) [hyper-threading, and that's a feature](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=16.223) [that's been around since about 2002 that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=18.723) [lets an individual physical core look like](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=22.05633333333333) [two separate cores to the operating](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=24.611888888888885) [system. And this generally gives you about](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=27.278555555555542) [20-30% more capacity on a given machine.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=30.29442857142856) [It doesn't double the capacity like you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=33.723) [might think. It doesn't actually improve](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=36.05633333333335) [your performance, it just gives you a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=38.05633333333334) [little bit more concurrent capacity. And](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=40.222999999999985) [for most workloads, I think this should be](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=41.90481818181818) [turned on. The only time you might not](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=43.35936363636362) [want to use it is if you have a very pure](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=45.52299999999998) [data warehouse or reporting workload with](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=49.05633333333335) [lots of queries that are heavily](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=51.43728571428572) [parallelized and in some cases](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=54.223) [hyper-threading can hurt those kinds of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=56.723) [queries, but that's pretty rare, and you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=58.43728571428571) [really should just test it both ways if](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=61.16744444444444) [you have any doubt about it. And if you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=62.865857142857145) [don't have time to test, just have it](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=64.473) [enabled and I think that'll help you in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=66.473) [most cases. The next important setting is](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=68.92300000000002) [Intel turbo boost. And this is a feature](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=71.598) [that boosts the clock speed of individual](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=74.22299999999998) [processor cores based on how hard that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=76.723) [particular processor core is working and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=80.973) [how hard the other cores on the physical](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=84.923) [processor are working, and it'll go in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=86.52300000000002) [several steps from the base clock speed up](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=88.973) [to the full turbo boost speed. And there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=91.43728571428575) [really no reason not to have this turned](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=94.29442857142858) [on. All it does is help performance, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=97.223) [it has no downside whatsoever so there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=99.223) [no reason not to have this turned on and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=102.323) [both of these settings I've just talked](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=104.94522222222223) [about are controlled in your BIOS. The](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=106.50077777777783) [next one that's important is your BIOS or](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=109.098) [UEFI power management settings, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=112.323) [generally speaking, those should be set to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=115.00871428571429) [OS control or disabled completely because](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=117.38966666666667) [we don't want BIOS or UFEI power](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=121.27855555555556) [management to be overriding what you might](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=125.16744444444446) [have set at the hyper-visor level or at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=127.223) [your Windows power plan level, and so this](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=130.723) [is important not only for your processor](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=133.38966666666664) [performance, but also for your storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=135.38966666666673)[performance because these settings affect](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=137.38966666666673) [the voltage to your PCIE expansion slots](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=139.723) [for example, that can affect the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=142.0563333333334) [performance pretty severely of your add-in](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=144.43728571428568) [storage cards that you might have. 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The next one](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=166.9452222222223) [that's really important if you're doing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=169.72300000000004) [virtualization, is to make sure that the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=171.473) [virtualization support features are turned](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=173.72300000000007) [on in your BIOS so you'll get VTX and VTD](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=175.723) [support. VTD is for virtualization storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=179.43728571428568) [performance, so that's particularly](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=183.0563333333333) [important if you're going to be using](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=185.223) [virtualization and you want to get the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=187.43728571428568) [best storage performance possible. 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Most memory controllers see a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=196.2944285714285) [little bit lower performance if all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=198.9452222222223) [memory slots are populated. Now, that's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=202.00871428571426) [not a good reason not to populate them,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=204.32300000000004) [but just something to be aware of, and](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=206.723) [also if you're not going to populate all](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=208.9957272727273) [the slots, it's really important that you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=211.17754545454554) [pay attention to which slots you populate](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=213.1515714285714) [with what times of DIMS, and there's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=215.723) [usually server configuration utilities](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=218.348) [from all the server vendors that help you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=220.973) [figure out the best way to do this so that](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=223.723)[you're getting the most performance you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=225.27855555555556) [can from the amount of RAM you decide to put in that server.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=17&mode=live&start=226.94522222222218)

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It'll help you solve](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=80.254) [your problem and you'll learn how to use](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=82.79566666666669) [them better at the same time. Now, just to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=85.12899999999998) [summarize this course. There's lots of](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=88.12899999999999) [available queries and tools you can use to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=90.029) [understand your storage subsystem](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=92.629) [performance rather than just guessing](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=94.629) [about it. You also need to make sure you](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=96.46233333333332) [make all the need configuration changes at](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=98.879) [all the different layers to get the best](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=102.35122222222223) [storage performance possible from your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=104.129) [hardware and storage infrastructure. Then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=106.629) [it's really important to run benchmark](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=109.46233333333333) [tests and performance tests on all of your](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=111.46233333333333) [logical drives before you install SQL](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=114.129) [Server, and then sometimes after you've](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=117.55757142857142) [installed SQL Server, after you've seen a](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=120.004) [workload on your system. Finally, take the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=122.629) [time to analyze and consider all the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=125.254) [different layers of your system, from the](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=127.98614285714287)[application through SQL Server itself,](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=130.98614285714282) [through your operating system, and then](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=133.129) [through your hardware and storage](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=135.629) [subsystem to see what you can do to make](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=136.879) [things better, because again, nobody's](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=139.52900000000008) [ever come to me and said that SQL Server](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=141.41471428571424) [is too fast. So every little thing you can](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=145.004) [do at each one of these layers is going to](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=147.41471428571433) [help performance, and that's a worthwhile](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=150.4926363636363) [endeavor in my opinion. Thanks for listening to this course.](https://app.pluralsight.com/player?course=sqlserver-improving-storage-subsystem-performance&author=glenn-berry&name=sqlserver-improving-storage-subsystem-performance-m6&clip=18&mode=live&start=152.629)