Quality of Service
for Kingston DC400 SSD

What is Quality of Service (QoS)?

Quality of Service (QoS) of an SSD refers to the consistency and predictability of Latency (response time) and IOPS (IOs Per Second) performance while servicing a read/write workload. QoS metrics demonstrate that, given a worst case workload tested over a period of time, an SSD's latency and IOPS profiles stay within a specified range (typically up to a minimum of 99.9% of the data points over a predetermined period of time) without having unexpected outliers causing a sudden drop in application performance.

Why is QoS Important?

For datacenters, it is becoming mandatory that SSD performance stays consistent and predictable all the time. IT Administrators and Storage Architects are now drawing a line on what is considered "acceptable levels of performance" when making SSD purchasing decisions. Storage Service Providers need to be able to manage and guarantee performance levels to their customers with a high confidence level.

SSDs are built using NAND Flash Memory Technology and require a controller to manage all IOs and the NAND Flash. Due to the characteristics of NAND Flash memory, the SSD controller cannot always promptly process host read or write transactions because it must also perform required background NAND Flash management tasks. These background NAND management tasks include Garbage Collection, the process of clearing invalid data blocks into available space on the SSD and Wear Leveling, the even distribution of writes across the entire NAND Flash memory storage that helps extend the life of an SSD. If the SSD firmware is not properly designed to efficiently manage these background tasks for an enterprise application, inconsistent storage performance within an application may not meet the user experience Service Level Agreements(SLAs) required by IT.

Client system workloads generally do not expose these periodic drops in application performance because the typical client workload provides a lot of "idle time" for the SSD controller to perform its data management tasks without any noticeable indication of performance loss by the user. In contrast, a server workload can be very demanding on the SSD. Virtualization, Databases and OLTP applications present a very random read/write workload pattern to the SSD for extended periods of time; therefore, it is essential that the SSD controller firmware be optimized to deliver consistent and sustained performance levels.

Kingston DC400 SSD for Datacenters

Over Provisioning

The Kingston DC400 is offered with different levels of over-provisioning configured from the factory, either 7% or 28%. The DC400 is offered in capacities of 400GB, 480GB, 800GB, 960GB, 1.6TB and 1.8TB. The DC400 modes configured with greater levels of OP will generally deliver better latency and IOPS performance than drives configured with less OP. The 1.8TB DC400 is ideally suited for applications that require high density storage with excellent read performance while still delivering good write performance and endurance.

Kingston realizes that datacenter use of SSDs cannot be a "one size fits all" approach and therefore Kingston will provide a tool within the Kingston Storage Manager (KSM) GUI for users to set the OP that best fits their workload and/or endurance goals.

QoS

Kingston DC400 is engineered with both hardware and firmware features to deliver consistent read/write latency and IOPS performance.

SSD latency needs to hit specified service levels for an application workload for 99.9% of the data points, or on an even tighter scale of 99.99% of the data points. SSDs that are optimized around these SLAs will exhibit superior levels of performance predictability.

The table below shows Latency results by drive capacity and QoS levels for a Queue Depth (QD) of 1:

QoS [msec] (4K, Random) QD = 1	400GB		480GB		800GB		960GB		1600GB		1800GB	
	Read	Write	Read	Write	Read	Write	Read	Write	Read	Write	Read	Write
Quality of Service (99.9%)	0.3	0.5	0.2	0.3	0.3	0.5	0.3	3.7	0.3	0.5	0.3	3
Quality of Service (99.99%)	0.4	2.3	0.4	4.3	0.4	3	0.4	6.7	0.4	3.7	0.4	9.6

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Performance Consistency

Performance consistency is based upon the IOPS test results and is calculated as the slowest 1-second interval's IOPS divided by average IOPS result during the test time. Performance consistency among many Client SSDs used in servers is not predictable. Client SSDs are not optimized to provide the consistent IOs under sustained workloads that enterprise applications require. As previously mentioned, SSDs must perform background operations that can periodically consume much of the internal SSD Controller's bandwidth, temporarily reducing host I/O operations and creating undesirable performance variations.

Kingston DC400 firmware is engineered with performance consistency and QoS as key design features.

The table below shows the IOPS performance consistency of the DC400 under a 4KB, 100% random read/write workload. The DC400 delivers up to 99% performance consistency for 4KB reads and up to 90% consistency for 4KB writes across the capacity range.

Specification	Kingston DC 400 SSD					
	400GB	480GB	800GB	960GB	1600GB	1800GB
Random 4 KB Read (up to)	99	99	99	99	99	99
Random 4 KB Write (up to)	80	90	87	82	90	86

Performance consistency = the slowest 1-second interval divided by average IOs per second

Designed to meet the needs of today's datacenter market segment, DC400 is ideally suited for applications such as databases, cloud computing, web services and online transaction processing to ensure that businesses can meet the requirements of their customer Service Level Agreements (SLAs). Note that drives with greater OP can deliver higher consistency results; with configurable OP capacities, users can fine tune the DC400 to meet their performance needs.

Note: Actual performance may vary depending on user hardware and application.

Test condition:
Motherboard: Gigabyte GA-Z170X-UD5
CPU: Intel Core i5-6500
OS: Ubuntu 14.04 x64 (kernel 4.2)
Test Program: Fio 2.9

Conclusion

Kingston DC400 SSD delivers superior quality of service with consistently low latency operation and superior IOPS. Solutions providers for Virtualization, Cloud Computing, Databases and the Financial Services market can now take advantage of the consistent performance the DC400 can offer. DC400 also enables Hyperscale companies with scale-out architectures and complex workloads to deploy reliable, low cost high density Flash based storage to their datacenters. The DC400 is a superior SSD solution for today's diverse storage deployment models enabling datacenters to realize the full potential of their storage investment.

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