Hardware-Encrypted HCI

TCG Enterprise Data-at-Rest Encryption SSDs and Hyperconverged Infrastructure: Stellar 4K IOPS, Dramatically Low Average Latency

Hyperconverged infrastructure (HCI) is a system with a software-centric architecture that tightly integrates compute, storage, networking and virtualization resources, and other technologies. When deploying HCI, there are two important — and seemingly contradictory — goals:

- Performance

  Users demand performance. They want virtualized platforms to perform as well as physical platforms, and they are far more likely to embrace the migration to a virtual environment if it does not affect their business or productivity.

- Security

  IT demands security. With increasing concerns about security breaches across a broadening landscape of businesses, comprehensive security is not an afterthought, it's a design requirement.

In complex environments like HCI, there is often a concern that enabling encryption features can negatively influence IOPS performance and average latency. This is simply not the case with hardware-based encryption as used on the Micron M510DC.

This technical brief compares 4K IOPS performance and average latency in an all-flash HCI test system using Micron's M510DC SSDs — one system with Trusted Computing Group (TCG) Encryption enabled and another system with TCG Encryption disabled. Results show performance is statistically the same — enabling TCG Enterprise in an HCI system shows no effect on IOPS or average latency.

TCG Enterprise Encryption in Micron's Enterprise SSDs in HCI: Zero Impact on 4K IOPS, Zero Impact on Low Latency

Outstanding 4K IOPS

Workload	TCG Enterprise		Difference (%)
	Disabled	Enabled	
100% Read	375,240	383,576	2.2%
70% Read	44,402	44,092	0.7%
50% Read	31,417	31,015	1.3%
30% Read	18,536	19,081	2.9%
0% Read	12,940	12,912	0.2%

Very Low 4K Average Latency

Workload	TCG Enterprise		Difference (%)
	Disabled	Enabled	
100% Read	0.679	0.664	2.3%
70% Read	5.772	5.819	0.8%
50% Read	8.163	8.288	1.5%
30% Read	13.829	13.377	3.4%
0% Read	19.822	19.853	0.2%

Data measured on a four-node HCI all-flash system with a large working set (equivalent to 75% of the HCI capacity).

Micron's SSDs with TCG Enterprise hardware-based encryption offer the all-flash performance users want and the data-at-rest security IT needs.

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Testing IOPS and Latency

To determine the effect — if any — TCG Enterprise can have on 4K IOPS and average latency, we compared a four-node, all-flash system with TCG Encryption enabled to the same system with TCG Encryption disabled. We measured 4K IOPS and average latency across five workloads.

Using a centralized, synthetic I/O test tool (one virtual machine per node in our HCI test environment), we measured the IOPS and latency differences with TCG Encryption on and off. We used a deterministic approach to enable consistent, repeatable performance measurements to enable direct comparisons between the two configurations.

Each configuration used a caching mechanism in each node. To ensure we tested the capabilities of each configuration as a whole, we used a working set equivalent to 75% of the total HCI capacity. This extended the test data well beyond any caching, reflecting the performance of the complete architecture.

Similar 4K IOPS

Small, random I/Os are common in virtualized deployments, and exceptional performance with these small, random transfers is essential.

We ran the outside of cache test to measure the all-flash 4K IOPS performance with TCG Encryption enabled and with TCG Encryption disabled. Figure 1 shows the results.

Because there is little change in 4K IOPS, the IOPS difference between enabling and disabling TCG

| Workload | TCG Enterprise | | Difference |
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Table 1: 4K IOPS By TCG Enterprise Status and Workload

Enterprise can be difficult to see. Table 1 summarizes the differences by workload, expressing each as a percentage difference for clarity. The 4K IOPS performance difference is not significant.
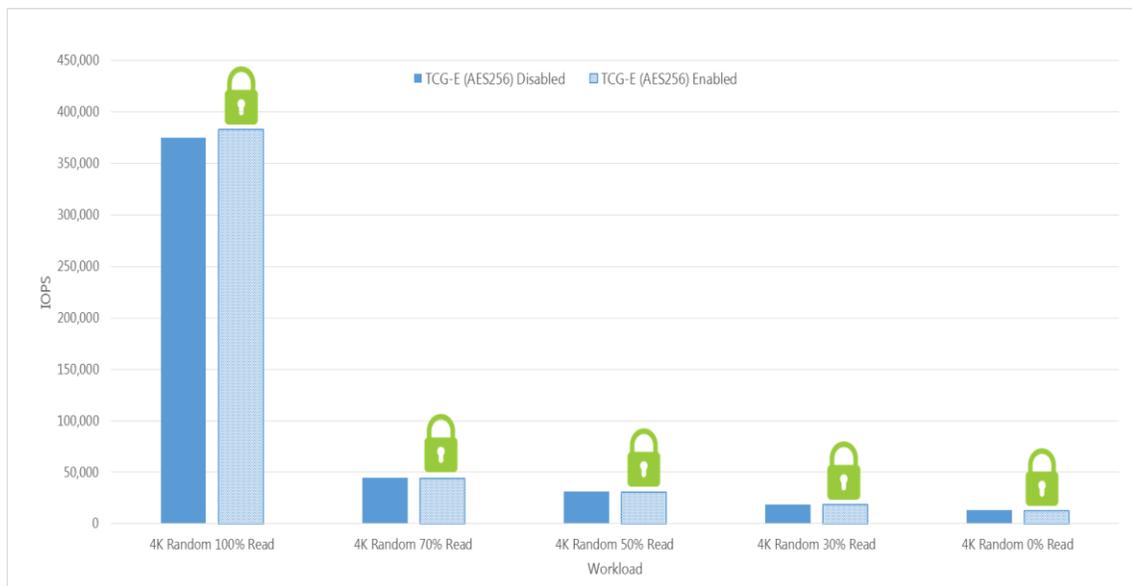

Figure 1: 4K IOPS vs. TCG Enterprise Status (Taller is Better)

Similar 4K Average Latency

For some deployments, how rapidly the HCI responds (its average latency) may be more important than how many responses it supports (its IOPS performance).

To determine the effect on 4K average latency — if any — of enabling TCG Enterprise, we used the same dataset as we did in the 4K IOPS tests with the same five workloads. We ran one workload set with TCG Enterprise enabled, and then repeated the test with TCG Enterprise disabled. Figure 2 shows the results.

As with the 4K IOPS tests, there is little difference in 4K average latency between enabling and disabling TCG Enterprise. The differences in Figure 2 are so small they can be difficult to see. For clarity, Table 2 summarizes the differences by workload, expressing each as a percentage difference. The 4K average latency difference is not significant.

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	Disabled	Enabled	
100% Read	0.679	0.664	2.3%
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Table 2: 4K Average Latency By TCG Enterprise Status and Workload

Figure 2: Average Latency vs. TCG Enterprise Status (Taller is Better)

The Bottom Line

Enabling TCG Enterprise on Micron SSDs showed no real 4K IOPS or average latency impact. When comparing 4K IOPS performance of a system with TCG Enterprise enabled to one with TCG Enterprise disabled, we found results within 3% across all tested workloads. 4K average latency for each configuration was similar, measuring within 3.4% across all workloads. These values are so close that, despite slightly better results with TCG Enterprise enabled, they are essentially the same.

As you move to a virtualized infrastructure, encryption can no longer be an afterthought — it is a design requirement, one that is best integrated into the architecture from day one. Micron's SSDs with hardware TCG Enterprise encryption enable HCI systems that not only give the all-flash performance users want, but also the security requirements IT needs.

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