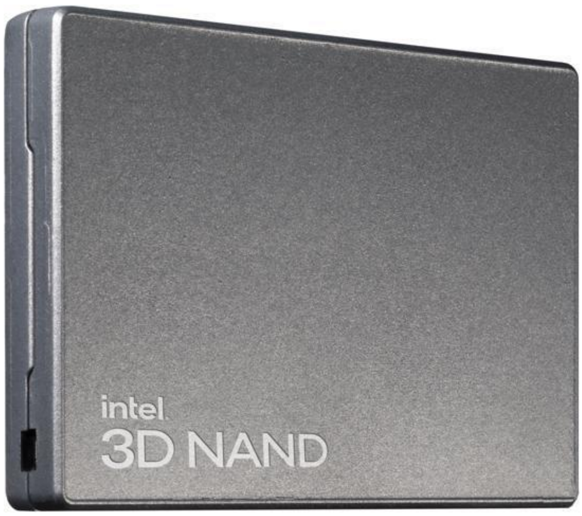
Open-E JovianDSS

# Intel® SSD D7-P5510

# 3.84 TB




**Certification report**

Release date: 2022.05.23

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# 1. Introduction

The following certification report aims to present the results of various compatibility and performance tests run on the Intel P5510 3.84 TB NVMe Solid State Drive when used in combination with Open-E JovianDSS. A description of the testing methods used during those procedures will also be provided. The results, obtained from the aforementioned testing, along with technical specifications were used as the basis for recommendations on specific roles in which to use the device under test (DUT) in Open-E JovianDSS-based systems.
The following applications were considered during the certification process:

- data disk (all-flash storage).

Validation was performed for both the Single node and HA non-shared storage cluster configurations. Detailed descriptions for each of the aforementioned are included in the appropriate report chapters.

# 2. Device Under Test description

The following table includes the Intel D7-P5510 3.84 TB NVMe drive hardware specifications.

Table 1. Intel D7-P5510 hardware specifications.

| | |
|---|---|
| **Product name** | Intel SSD D7-P5510 |
| **Model name** | SSDPF2KX038TZO |
| **Storage capacity** | 3.84 TB |
| **Form factor** | U.2 2.5” |
| **Interface** | PCIe 4.0 x4, NVMe |
| **Technology** | 144L TLC 3D NAND |
| **Enhanced Power Loss Data Protection** | Yes |
| **Security** | AES 256 bit encryption |

# 3. Test environment description

Hardware specifications for environments used during certification testing are included in the following tables. The configuration described in Table 2a was used for every Single node test. Table 2b shows the configuration used when testing High Availability non-shared storage cluster nodes. More information can be found on HA cluster compatibility testing in chapter 6.

Table 2a. Hardware specifications for single node tests.

| | |
|---|---|
| **System name** | Supermicro SYS-620U-TNR |
| **Motherboard** | Supermicro X12DPU-6 |
| **CPU** | 2x Intel Xeon Gold 6330 |
| **RAM** | 64 GB - 4x SK Hynix HMA82GR7DJR8N-XN 3200 MHz DDR4 ECC 16 GB |
| **Storage devices** | • 4x Intel D7-P5510 NVMe<br>• 4x Intel DC P4510 |
| **System** | Open-E JovianDSS up29r1 b44475 |

Table 2b. Hardware specifications for HA non-shared storage cluster tests.

| | |
|---|---|
| **System name** | Tarox ParX R2242i G6 Server |
| **Motherboard** | Intel S2600WFT |
| **CPU** | 2x Intel Xeon Gold 5222 |
| **RAM** | 192 GB - 16x Micron MTA18ASF2G72PDZ-3G2E1 3200 MHz DDR416GB DDR4 ECC 16 GB |
| **Storage devices** | • 2x Intel D7-P5510 NVMe<br>• 4x Intel DC P4510 |
| **System** | Open-E JovianDSS up29r1 b44475 |

Tool used for performance benchmarking: Fio for Linux, v3.28.

# 4. Raw device tests

In order to be able to properly interpret the results acquired from the tests of the Intel D7-P5510 drive while it was used as a data storage device for Open-E JovianDSS, it's necessary to measure the raw performance of the device. This benchmark then allows for a comparison to be made between the actual performance obtained in the test environment with the information provided by the vendor and guarantees that there are no bottlenecks on a hardware level allowing for effective storage performance tests to be done at the ZFS level.

## 4.1. Test description

Included test cases are described in Table 3. In all instances every combination of thread numbers (1, 4, 8, 16) and queue depths (1, 16, 64, 128) was applied to the fio test tool. For additional information, results of the same tests performed on the Intel DC P4510 2 TB NVMe disk are included.

Table 3. Test cases description for raw disk tests

| Test case | IO pattern | Read to write % | Block size |
|---|---|---|---|
| Random read | random | 100/0 | 4 kB |
| Random write | random | 0/100 | 4 kB |
| Sequential read | sequential | 100/0 | 1 MB |
| Sequential write | sequential | 0/100 | 1 MB |

## 4.2. Performance results

Figures 1 to 4 present the number of IOPS acquired in every test case.

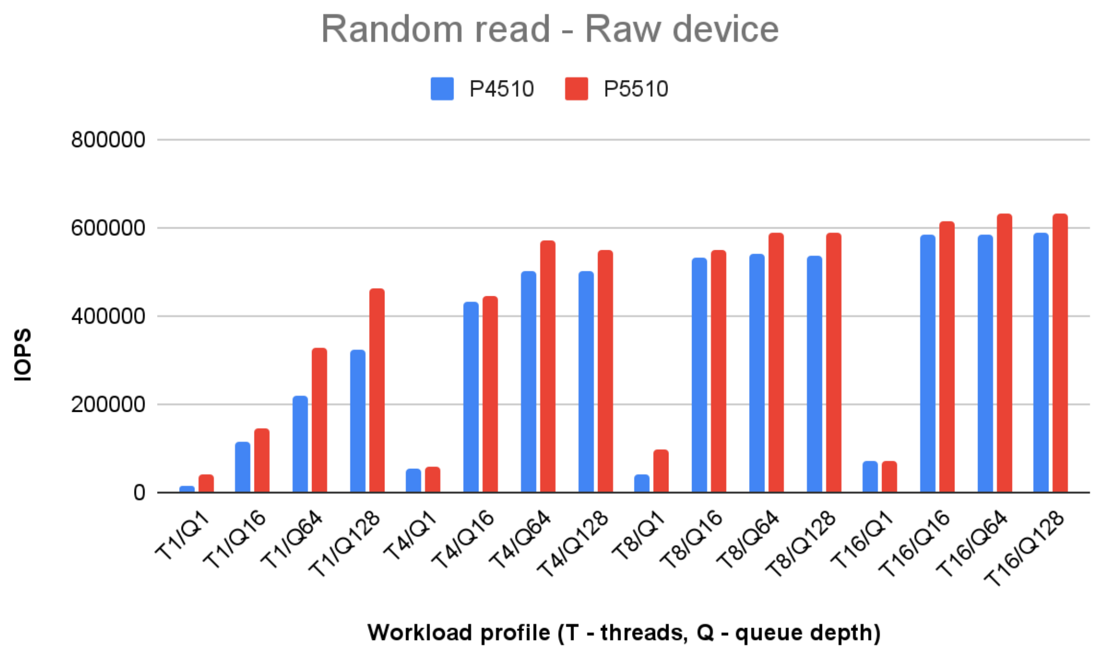


Fig. 1. Random read performance on raw device compared to P4510.

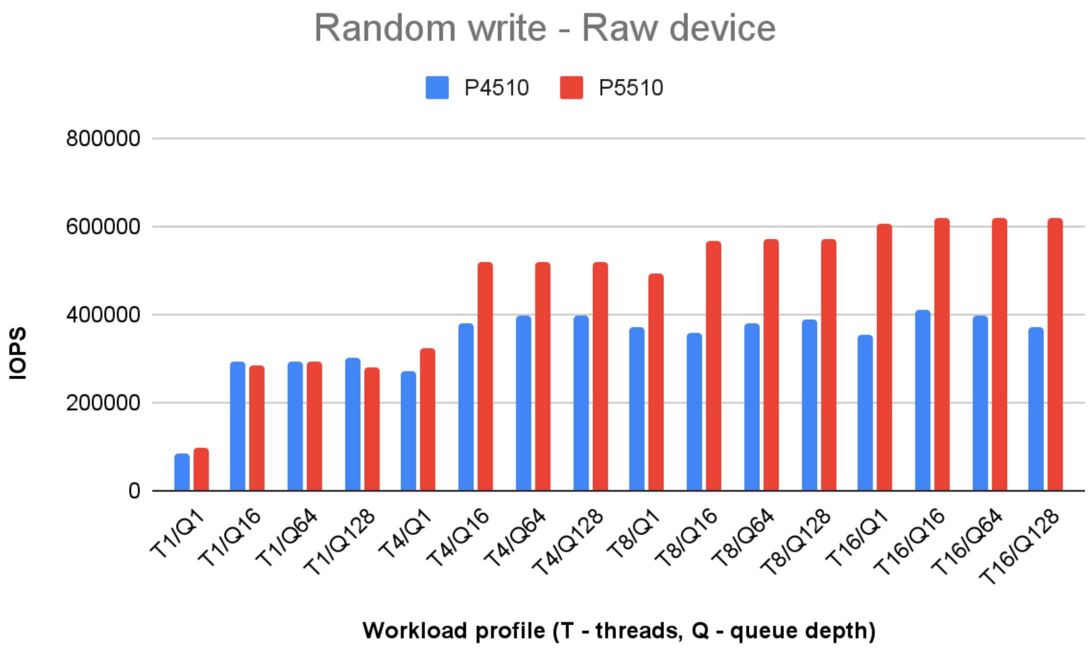


Fig. 2. Random write performance on raw device compared to P4510.

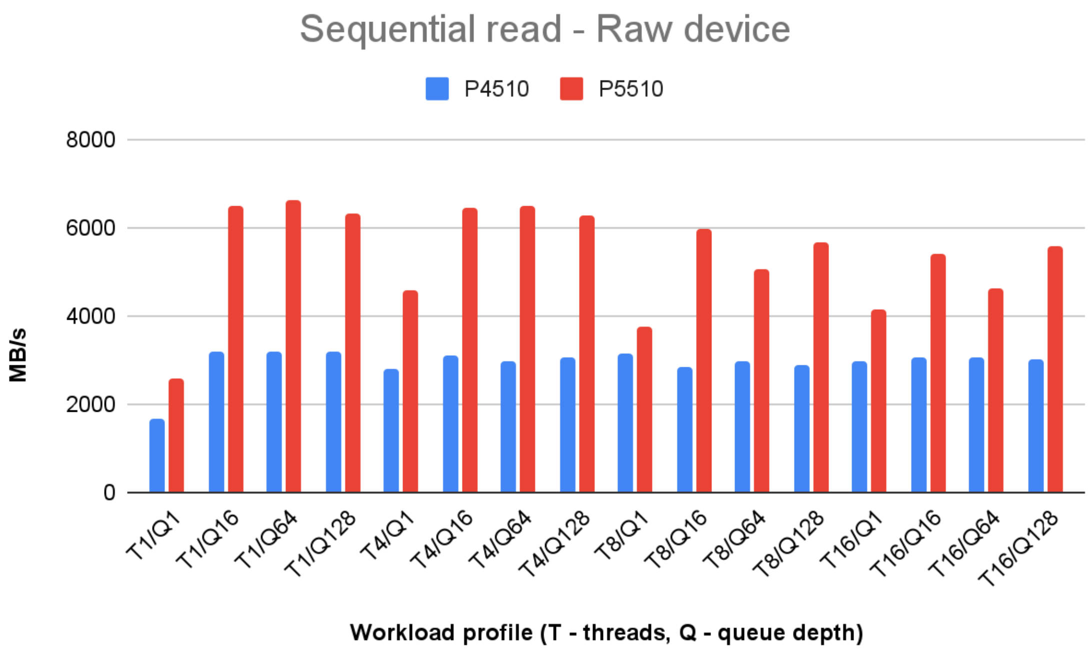


Fig. 3. Sequential read performance on raw device compared to P4510.

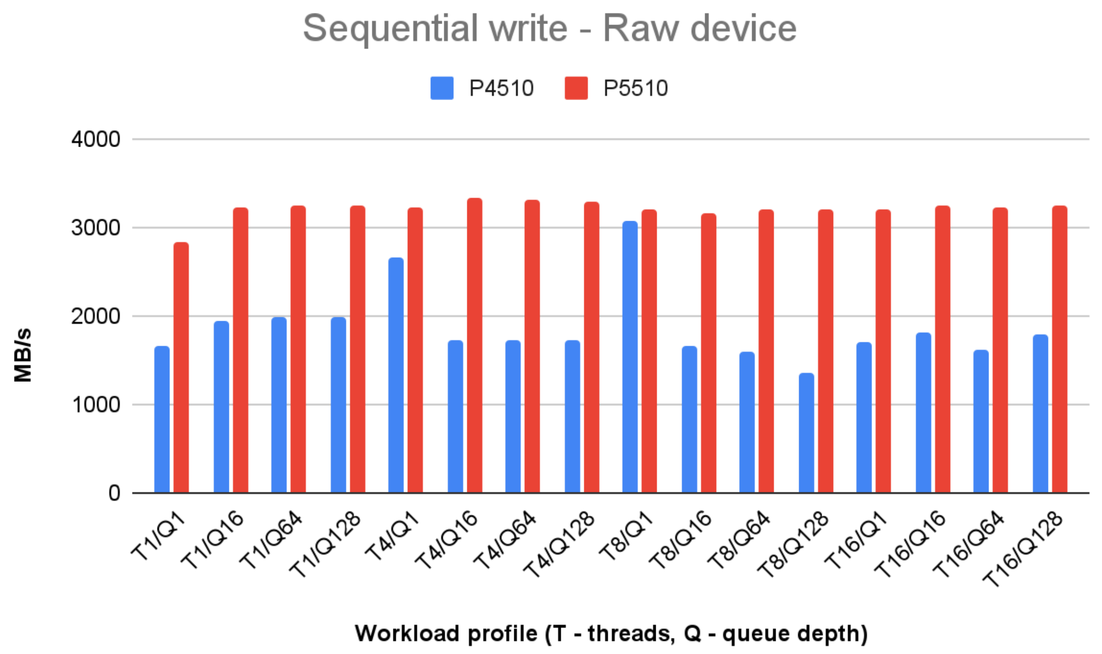


Fig. 4. Sequential write performance on raw device compared to P4510.

### 4.3. Test conclusions

All performance tests carried out on a raw device showed proper operation at the hardware level in the test environment. The results obtained are at a level similar to those declared by the manufacturer. Compared to the P4510 NVMe drive, the DUT showed slightly higher random IO performance (34% increase on average) as well as on average 80% better results for sequential read and write cases.

## 5. Data storage drive tests

Tests of the Intel P5510 drive, when used as a data storage device for Open-E JovianDSS, included both a functional and performance aspect. The device was considered for this role because of the following characteristics:

- form factor: U.2 NVMe interface - standard backplane connection for NVMe storage,
- large storage space,
- suitable write endurance,
- exceptional declared data transfer rates.

### 5.1. Functional tests

An examination of how the Intel P5510 SSD drive operated when used in conjunction with Open-E JovianDSS was conducted through functional testing, shown in Table 4. The results are also provided in said table.

Table 4. Functional test results of the Intel P5510 when used as a storage drive for Open-E JovianDSS.

| Functional aspect | Result |
|---|---|
| Open-E JovianDSS system compatibility | passed |
| Stripe, mirror, and RAIDZ compatibility | passed |
| System stability | passed |

| | |
|---|---|
| Drive failure simulation with replacement | passed |
| Disk activity and health monitoring | passed |

## 5.2. Performance tests

In addition to functional tests, performance measurements for the 4x single-disk data group zpool configuration was also carried out using the fio test tool. All test cases are presented in Table 5. Every combination of thread (1, 4, 8, 16) and queue depth number (1, 16, 64, 128) was used for the generated load. A comparison was also made to P4510 drives, when used in the same configuration.

Table 5. Test cases description for storage performance tests.

| Test case | IO pattern | Read to write % | Block size |
|---|---|---|---|
| Random read | random | 100/0 | 4 kB |
| Random write | random | 0/100 | 4 kB |
| Sequential read | sequential | 100/0 | 1 MB |
| Sequential write | sequential | 0/100 | 1 MB |
| Mixed | random | 70/30 | 4 kB |

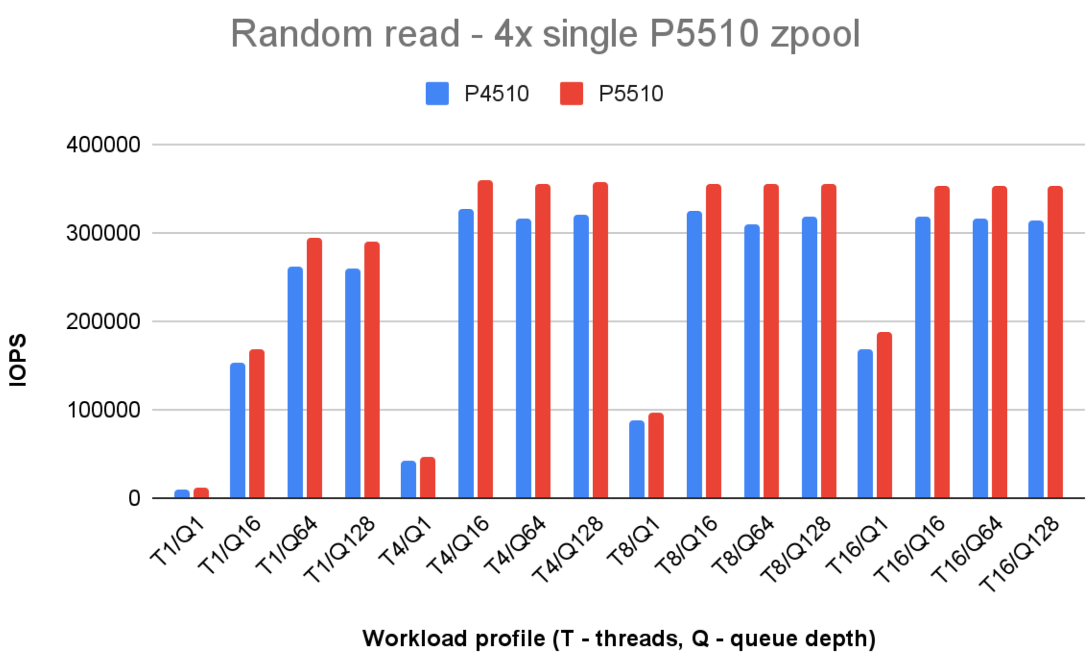


Fig. 5. Random read performance for a 4x single-disk data group zpool, compared to the P4510.

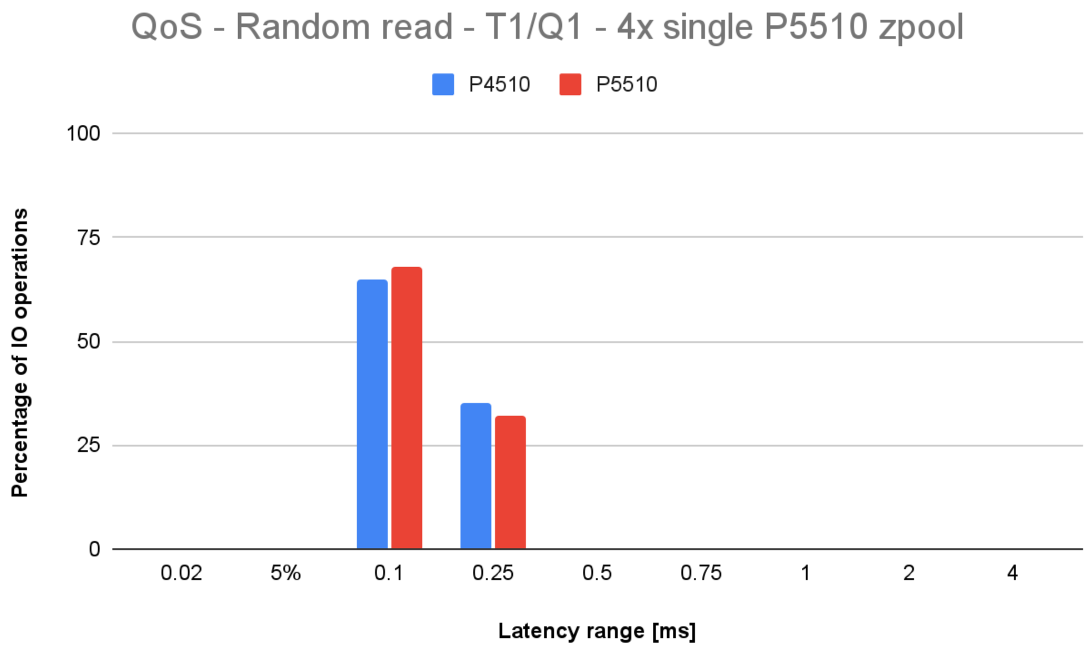


Fig. 6. Latency distribution for random read test, done on a 4x single-disk data group zpool (T1/Q1).

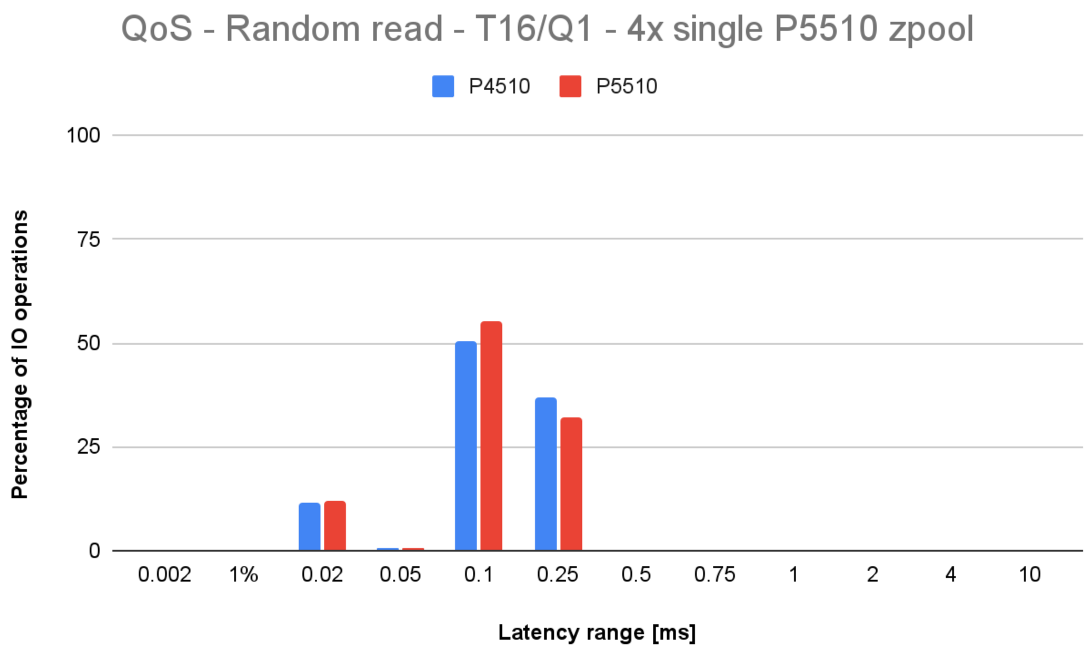


Fig. 7. Latency distribution for a random read test, done on a 4x single-disk data group zpool (T16/Q1).

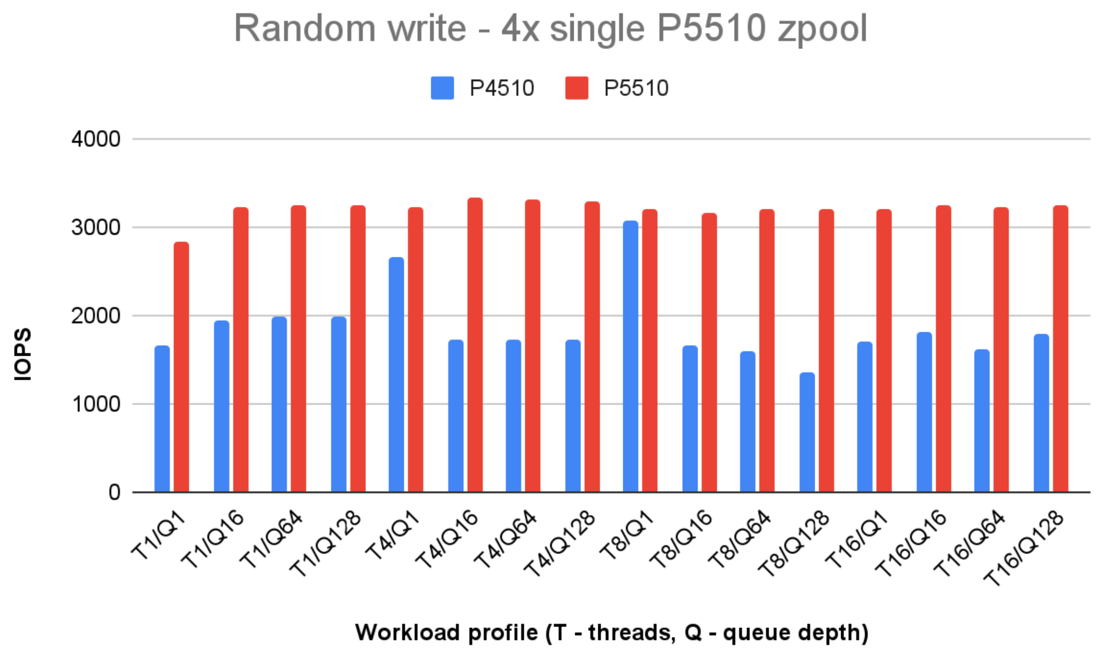


Fig. 8. Random write performance on a 4x single-disk data group zpool, compared to the P4510.

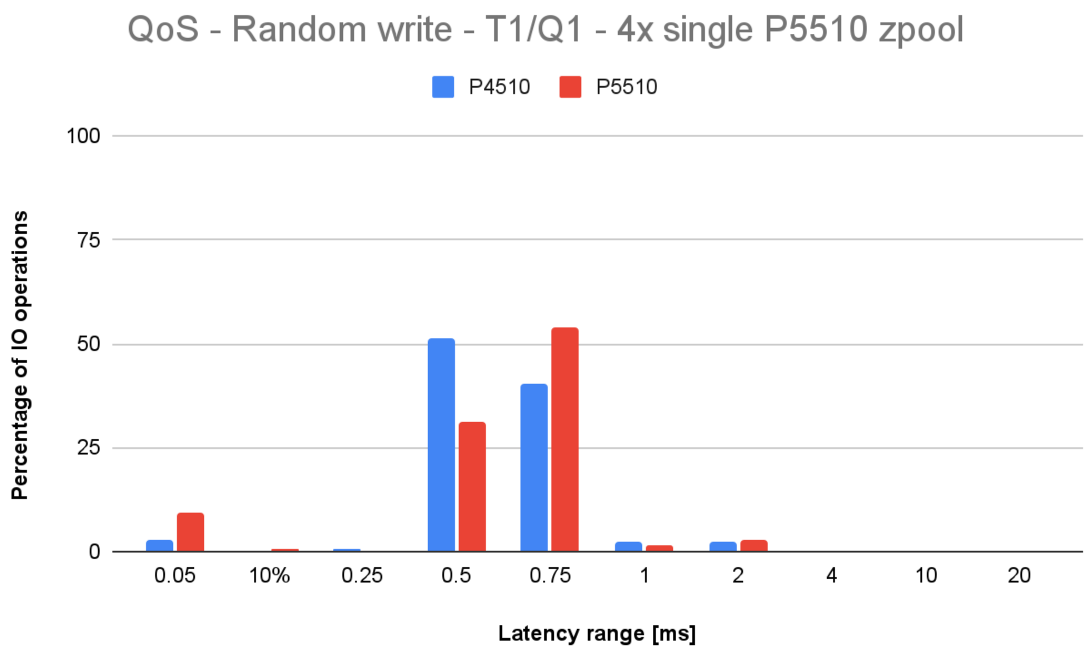


Fig. 9. Latency distribution for a random write test, done on a 4x single-disk data group zpool (T1/Q1).

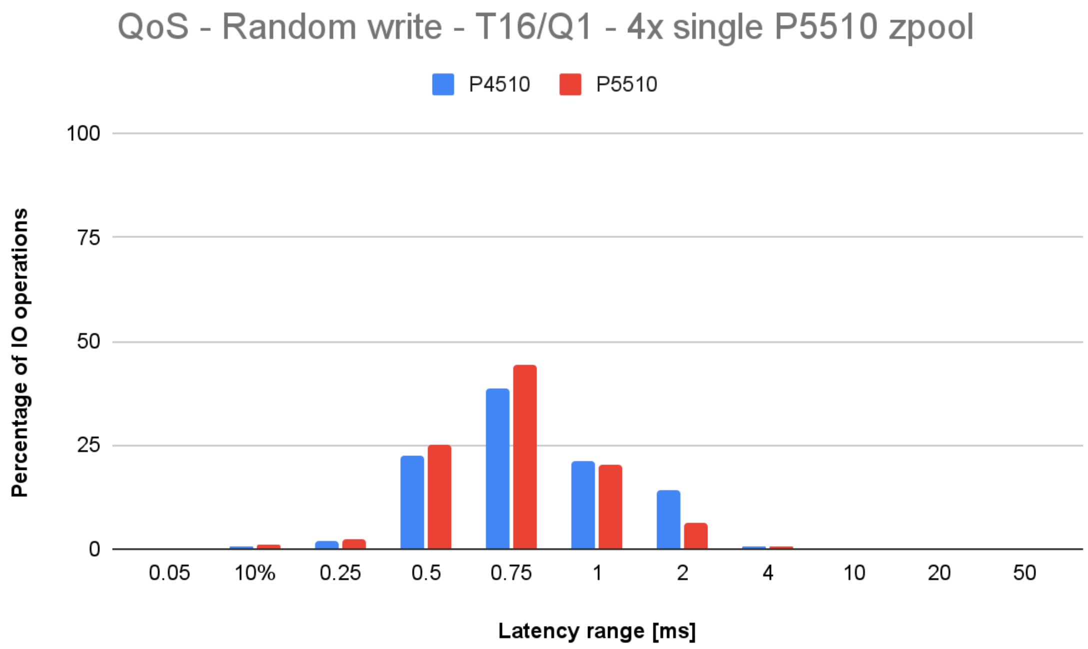


Fig. 10. Latency distribution for a random write test, done on a 4x single-disk data group zpool (T16/Q1).

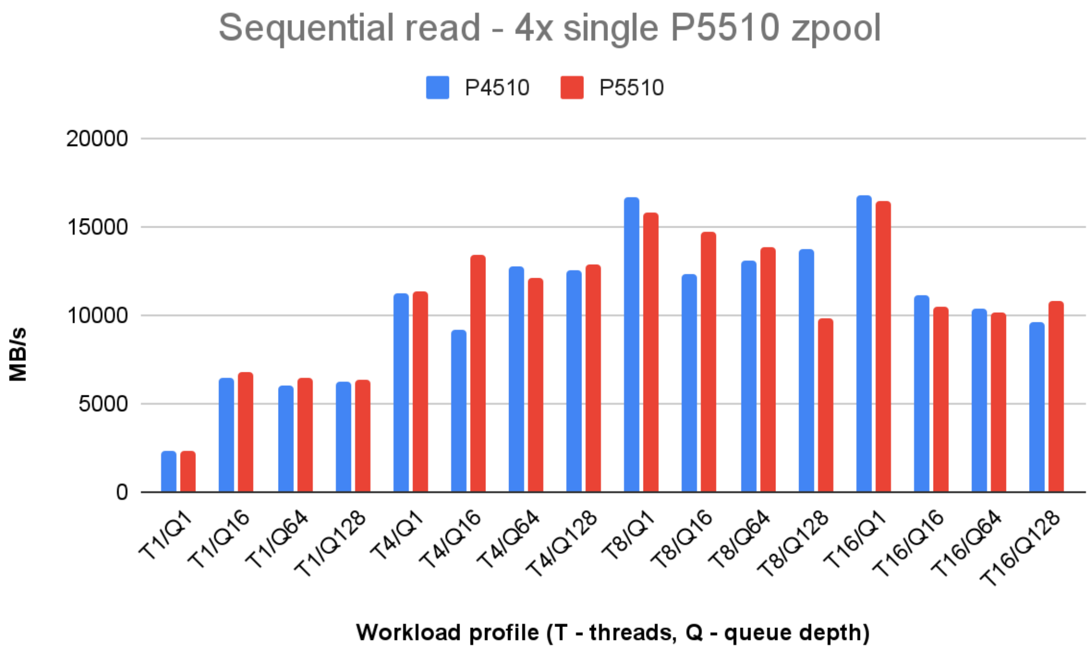


Fig. 11. Sequential read performance on a 4x single-disk data group zpool, compared to the P4510.

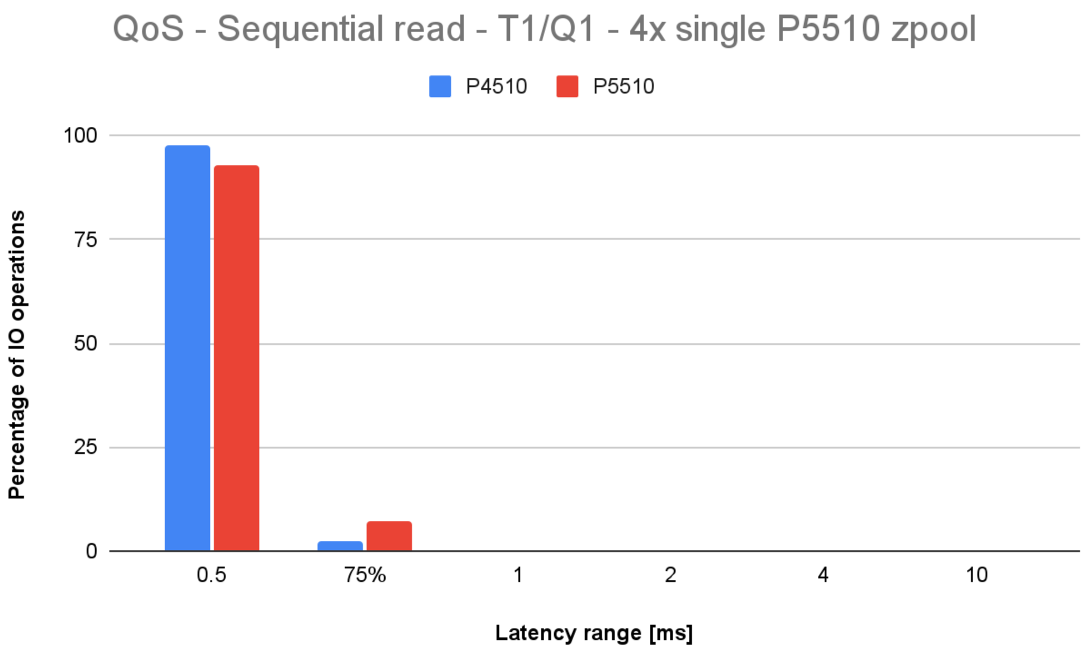


Fig. 12. Latency distribution for a sequential read test, done on a 4x single-disk data group zpool (T1/Q1).

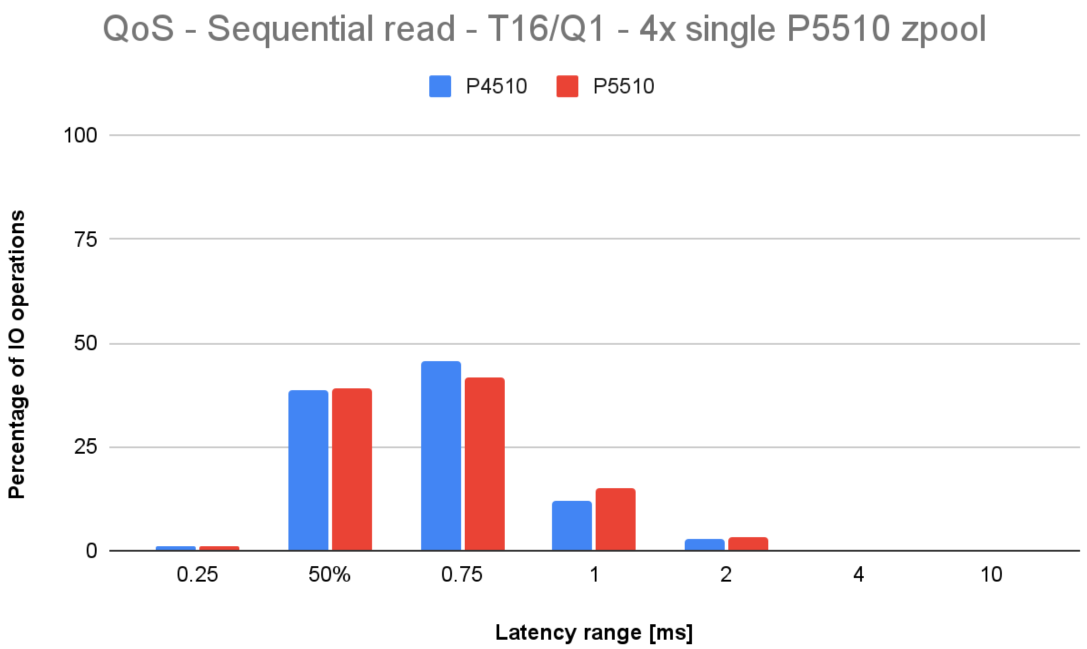


Fig. 13. Latency distribution for a sequential read test, done on a 4x single-disk data group zpool (T16/Q1).

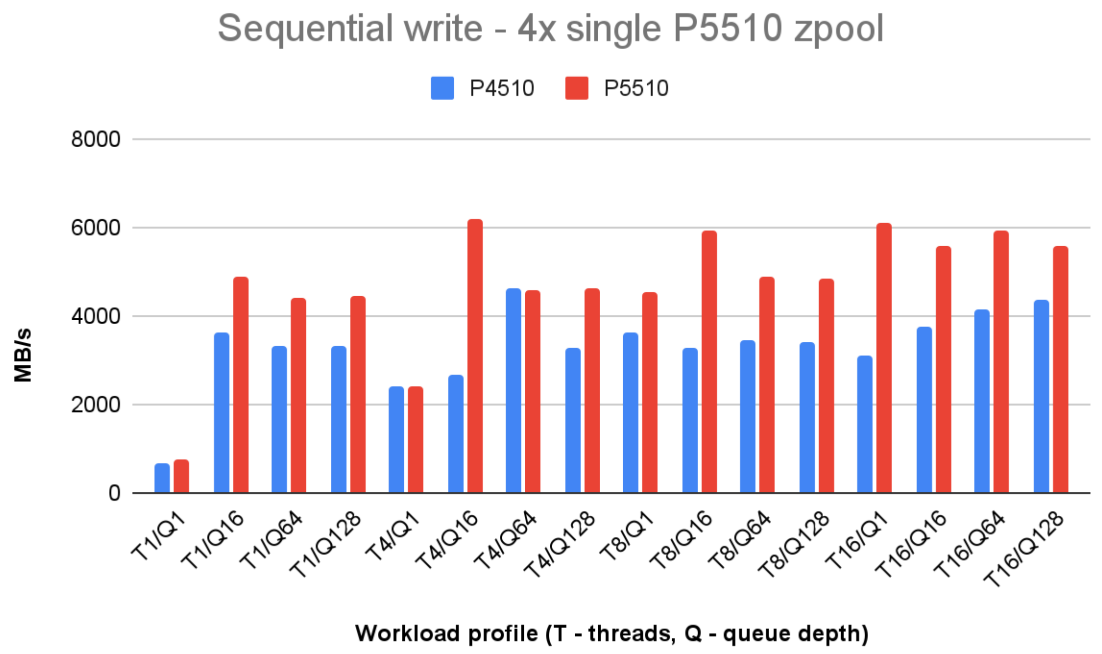


Fig. 14. Sequential write performance on a 4x single-disk data group zpool, compared to the P4510.

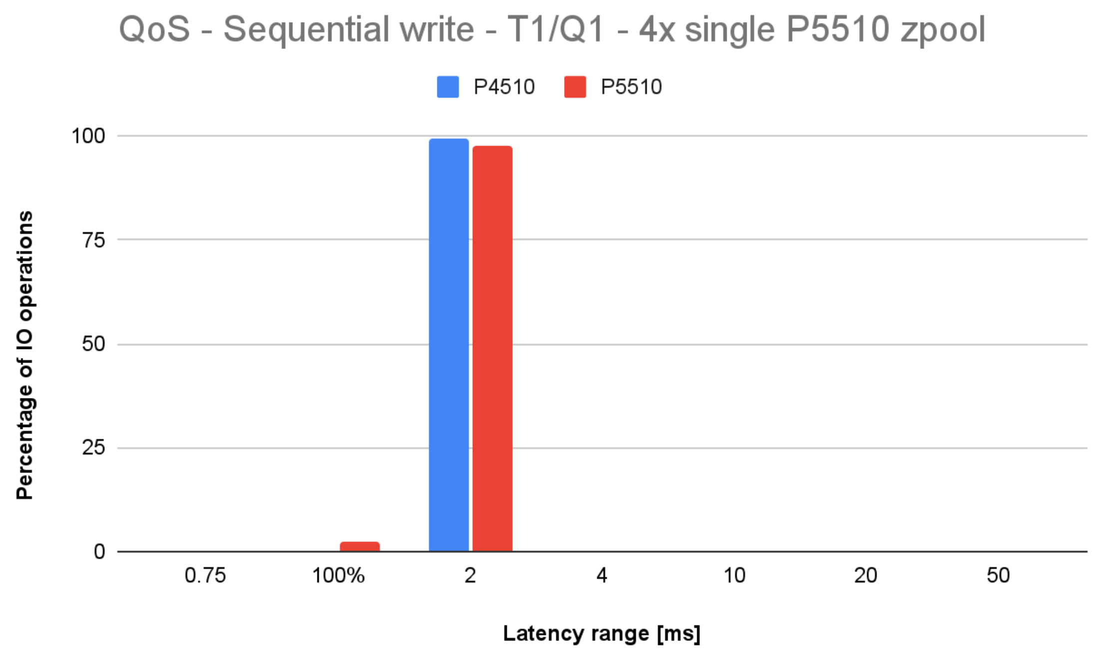


Fig. 15. Latency distribution for a sequential write test, done on a 4x single-disk data group zpool (T1/Q1).

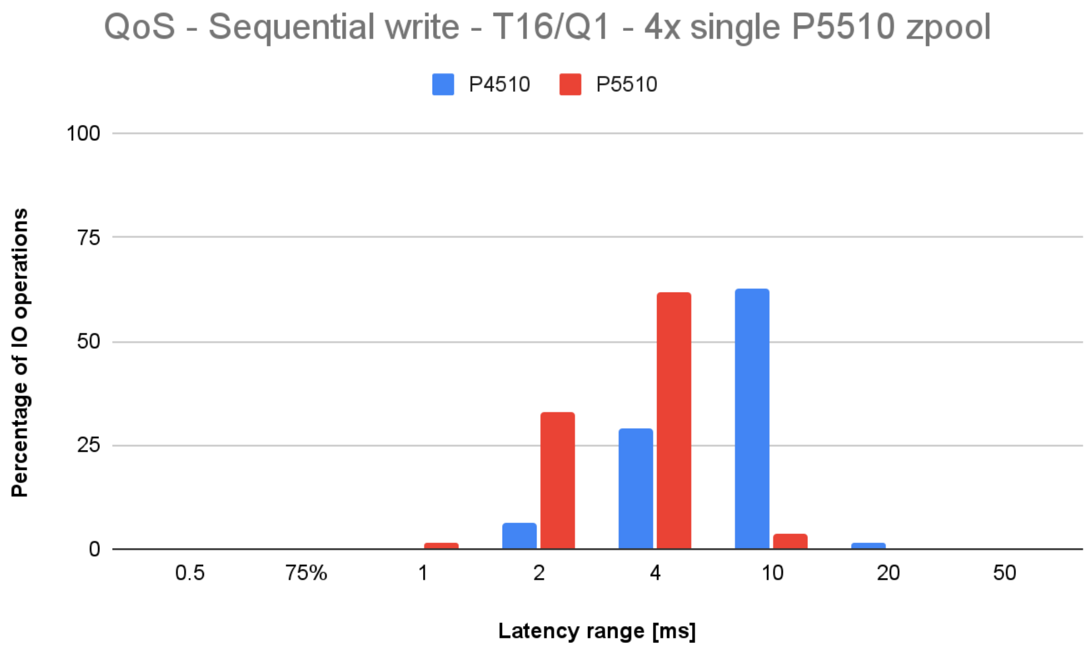


Fig. 16. Latency distribution for a sequential write test, done on a 4x single-disk data group zpool (T16/Q1).

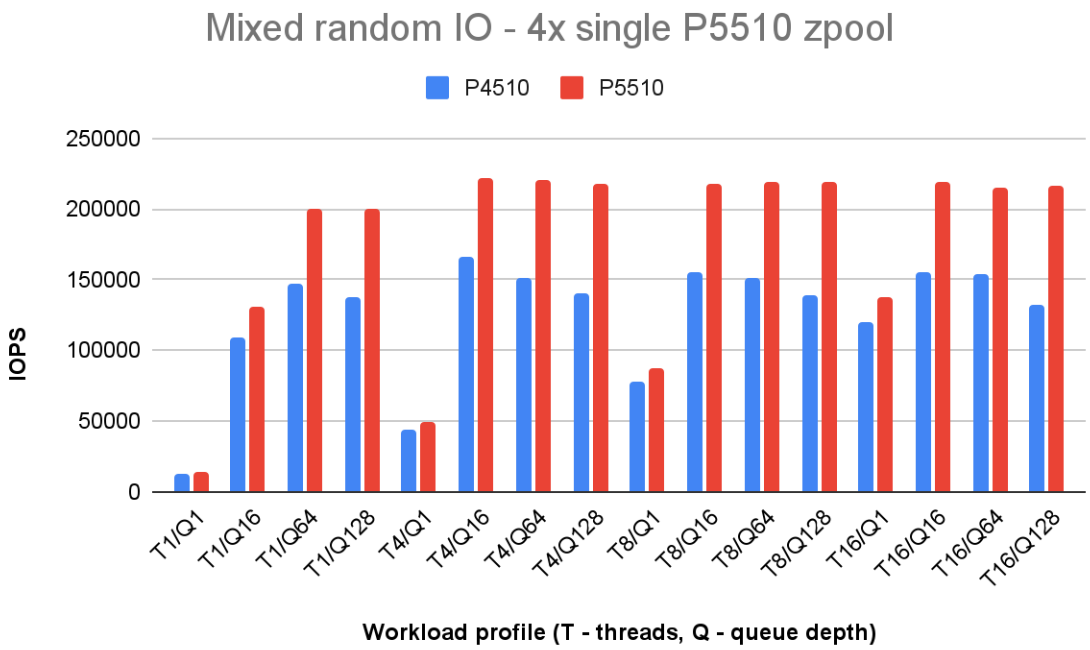


Fig. 17. Mixed random IO performance on a 4x single-disk data group zpool, compared to the P4510.

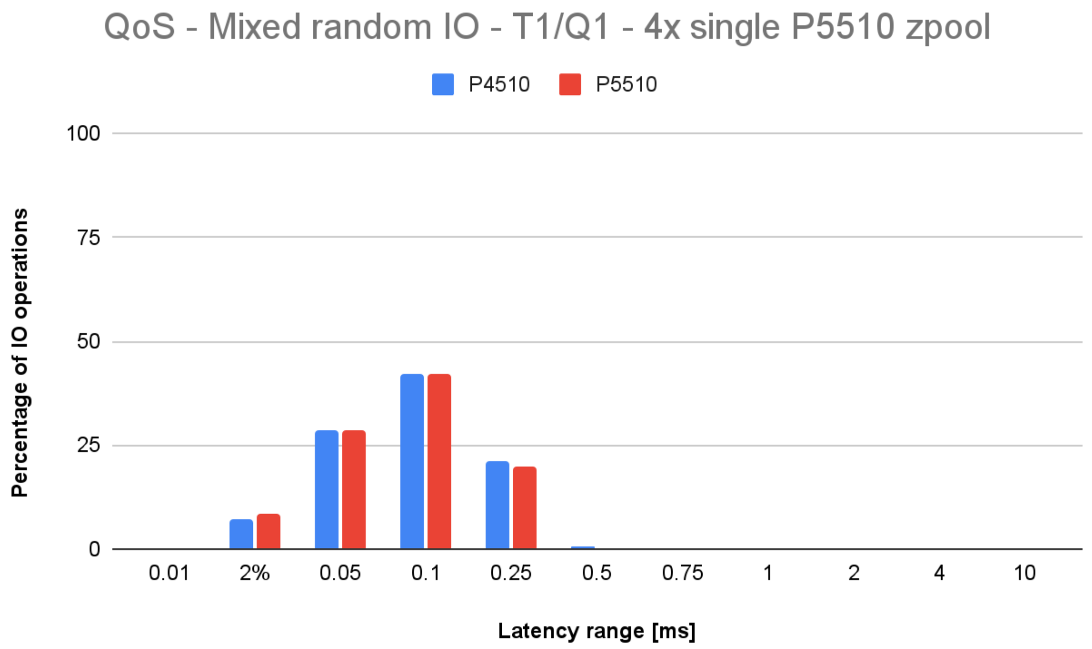


Fig. 18. Latency distribution for a mixed random IO test, done on a 4x single-disk data group zpool (T1/Q1).

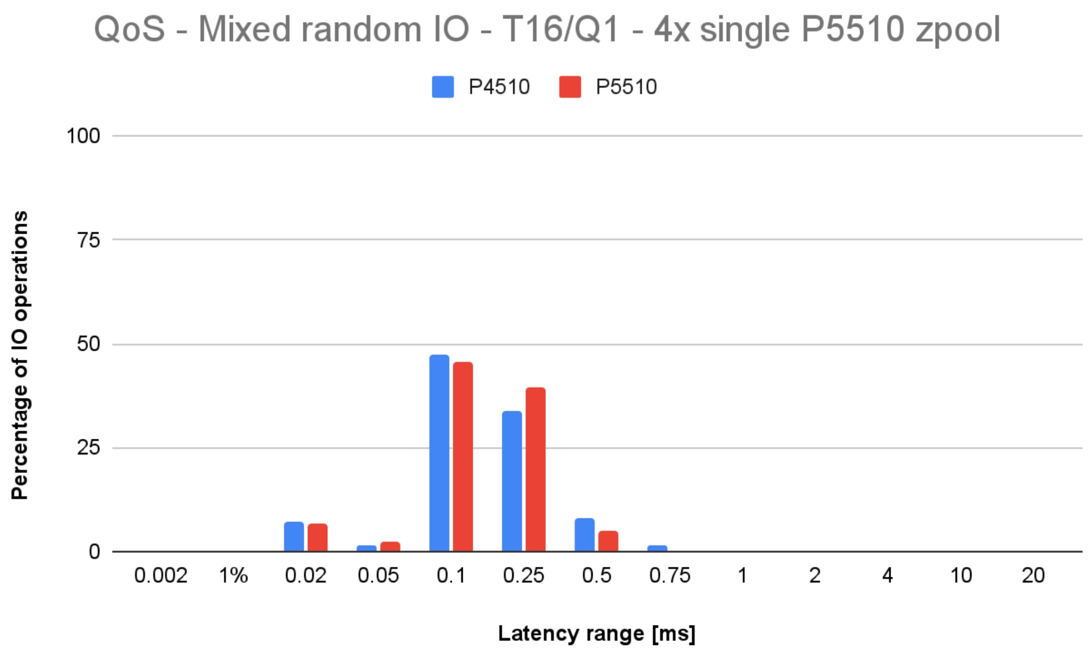


Fig. 19. Latency distribution for a mixed random IO test, done on a 4x single-disk data group zpool (T16/Q1).

## 5.3. Test conclusions

Analysis of an all-flash-based storage solution that used 4x Intel P5510 drives in a single-disk data group configuration, when compared to an Intel P4510, shows an average 11% improvement in random read IOPS (Figure 5) and a 47% improvement in a random write case (Figure 8), which leads to an average of 35% better performance when used for mixed random read and write IO workloads (Figure 17). In all those cases latency distribution was also improved with a visible shift to shorter response ranges (Figures 6-7, 9-10 and 18-19).

Although sequential read performance remained the same for both the P4510 and P5510 model (Figure 11), sequential write throughput improved 43% on average when using the latter device (Figure 14). Sequential read latency distribution was also similar (Figures 12-13), whereas for sequential write it shifted to shorter ranges (Figure 15-16).

# 6. HA Storage Cluster compatibility test

In order to ensure proper operation of the Intel D7-P5510 drive in Open-E JovianDSS High Availability Storage cluster environments, various compatibility tests were performed.

## 6.1. Functional tests

All essential and critical cluster mechanisms were examined to ensure proper operation with the tested devices, while they were part of an all-flash-based storage solution. The tested functionalities are summarized in Table 6.

Table 6. Results for the HA Storage Cluster compatibility test.

| Tested functionality | Result |
|---|---|
| Manual Failover | passed |
| Automatic Failover triggered after network failure | passed |
| Automatic Failover triggered after system shutdown | passed |
| Automatic Failover triggered after system reboot | passed |
| Automatic Failover triggered after system power-off | passed |
| Automatic Failover triggered after I/O failure | passed |

## 6.2. Test conclusions

Compatibility of the tested device with essential HA cluster operations was extensively checked. None of the test cases described in Table 6 showed any undesirable behaviour, indicating full compatibility with Open-E JovianDSS in cluster configurations.

# 7. Summary

All-flash storage based on Intel D7-P5510 NVMe drives showed no compatibility issues with Open-E JovianDSS in either Single node or HA cluster configurations. Compared to the previous generation's P4510, the new drives presented improved handling of random IO requests. Sequential write throughput was also notably improved while maintaining the same level of sequential read performance. As such, the tested device has been added to the Hardware Certification List and now has "Certified by Open-E" status.