



**INTEL<sup>®</sup> VIRTUAL RAID ON CPU**

**(INTEL<sup>®</sup> VROC)**

**COMPARATIVE PERFORMANCE GUIDE**

NSG Host Storage Software

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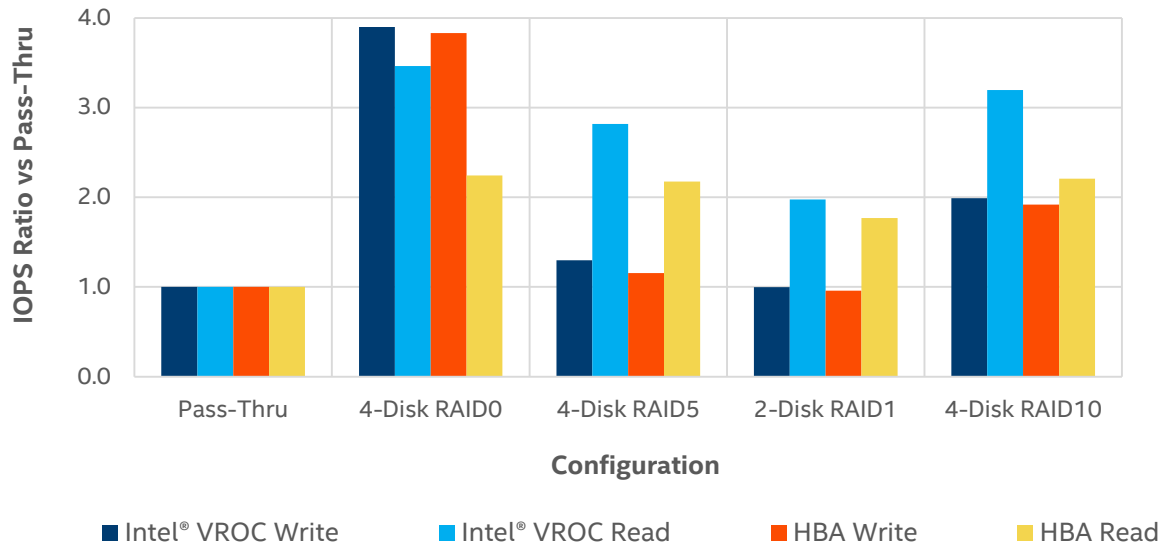
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# INTEL<sup>®</sup> VIRTUAL RAID ON CPU (INTEL<sup>®</sup> VROC) VS RAID HBA (LINUX\*)

\*Other names and brands may be claimed as the property of others.

# Performance – RAID vs Pass-Thru<sup>1</sup>

## RHEL7.4 with Intel® SSD DC P4510 Series (4k Random)



### Pass-Thru Data

	Intel® VROC	HBA
4k Ran Write	84k IOPS	84k IOPS
4k Ran Read	621k IOPS	622k IOPS

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	3.5 Cores	6.8 Cores
RAID5 Write	1.2 Cores	0.6 Cores

**52 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8170 based system**

See appendix for footnotes

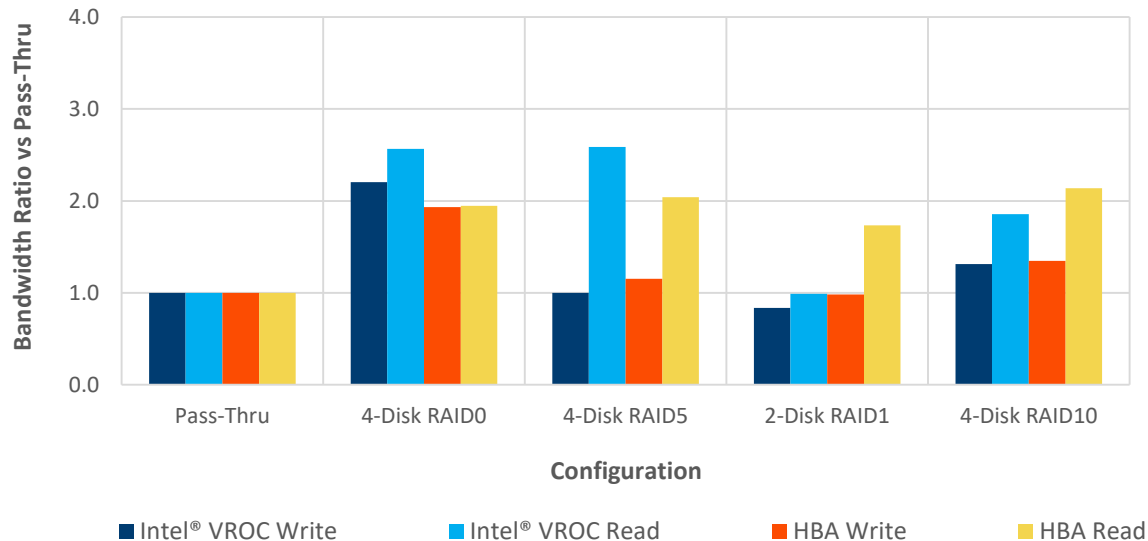
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Performance results are based on testing as of the date set forth in the Configuration and may not reflect all publicly available security updates. See configuration disclosure for details.

No product can be absolutely secure.

# Performance – RAID vs Pass-Thru<sup>2</sup>

## RHEL7.4 with Intel® SSD DC P4510 Series (128 Seq., 1 Worker)



### Pass-Thru Data

	Intel® VROC	HBA
4k Seq Write	1.7 GB/s	1.6 GB/s
4k Seq Read	2.6 GB/s	2.8 GB/s

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	0.3 Cores	0.2 Cores
RAID5 Write	1.0 Cores	0.2 Cores

**52 total physical cores on this 2 socket,  
Intel® Xeon® Scalable processor 8170 based system**

See appendix for footnotes

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

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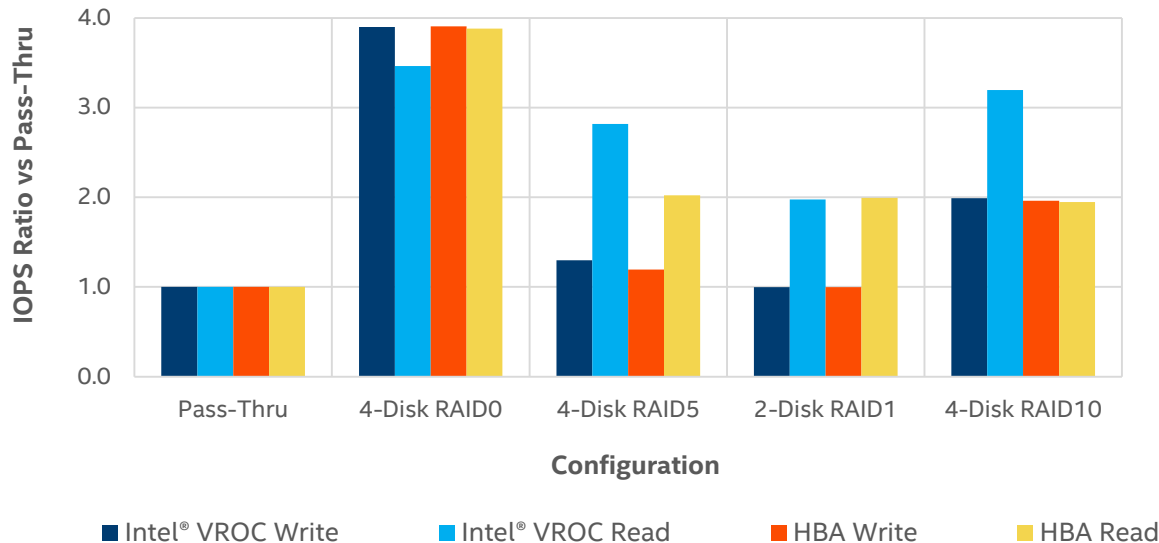
No product can be absolutely secure.

# INTEL<sup>®</sup> VIRTUAL RAID ON CPU (INTEL<sup>®</sup> VROC) VS SATA RAID HBA (LINUX\*)

\*Other names and brands may be claimed as the property of others.

# Performance – RAID vs Pass-Thru<sup>3</sup>

## RHEL7.4 with Intel® SSD DC P4510/S Series (4k Random)



### Pass-Thru Data

	Intel® VROC	HBA
4k Ran Write	84k IOPS	36k IOPS
4k Ran Read	621k IOPS	78k IOPS

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	3.5 Cores	0.9 Cores
RAID5 Write	1.2 Cores	1.4 Cores

**52 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8170 based system**

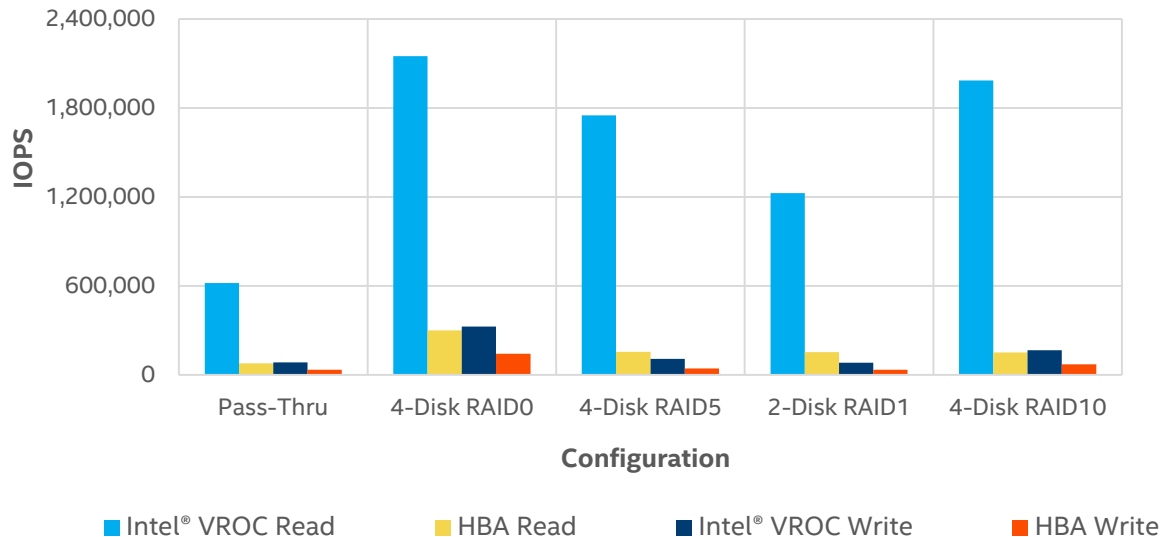
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# Performance – Total IOPS<sup>3</sup>

## RHEL7.4 with Intel® SSD DC P4510 Series (4k Random)



Intel® Virtual Raid on CPU (Intel® VROC) with NVMe\* SSDs delivers strong performance improvement over SATA RAID

- Intel VROC delivers **7x** more IOPS than SATA RAID in 4-Disk RAID0 Reads
- Intel VROC delivers **2.5x** more IOPS than SATA RAID in 4-Disk RAID5 Writes

**52 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8170 based system**

See appendix for footnotes

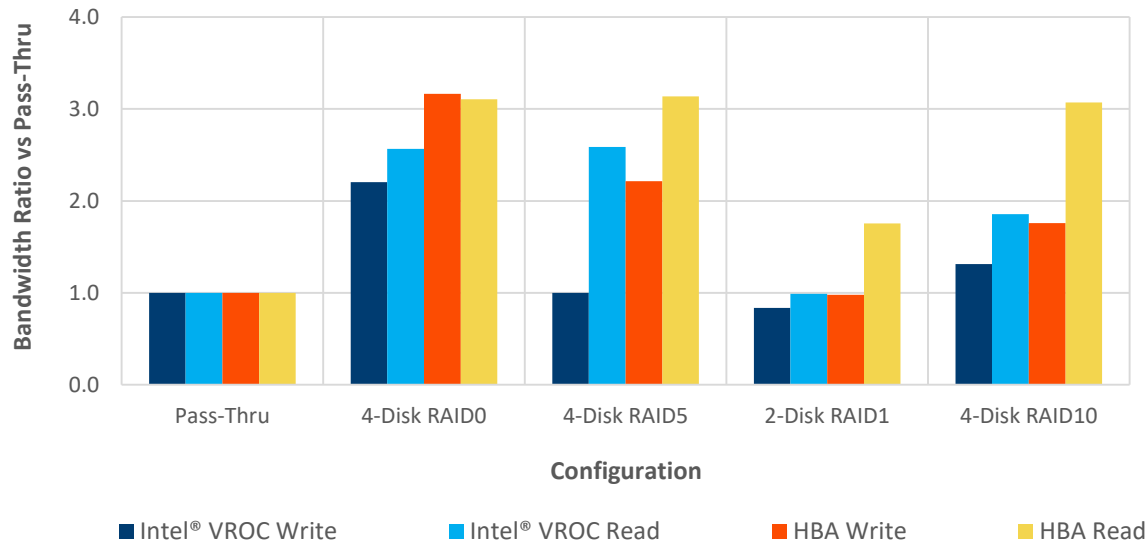
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# Performance – RAID vs Pass-Thru<sup>4</sup>

## RHEL7.4 with Intel® SSD DC P4510 Series (128 Seq., 1 Worker)



### Pass-Thru Data

	Intel® VROC	HBA
4k Seq Write	1.7 GB/s	0.4 GB/s
4k Seq Read	2.7 GB/s	0.5 GB/s

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	0.3 Cores	0.1 Cores
RAID5 Write	1.0 Cores	0.1 Cores

**52 total physical cores on this 2 socket,  
Intel® Xeon® Scalable processor 8170 based system**

See appendix for footnotes

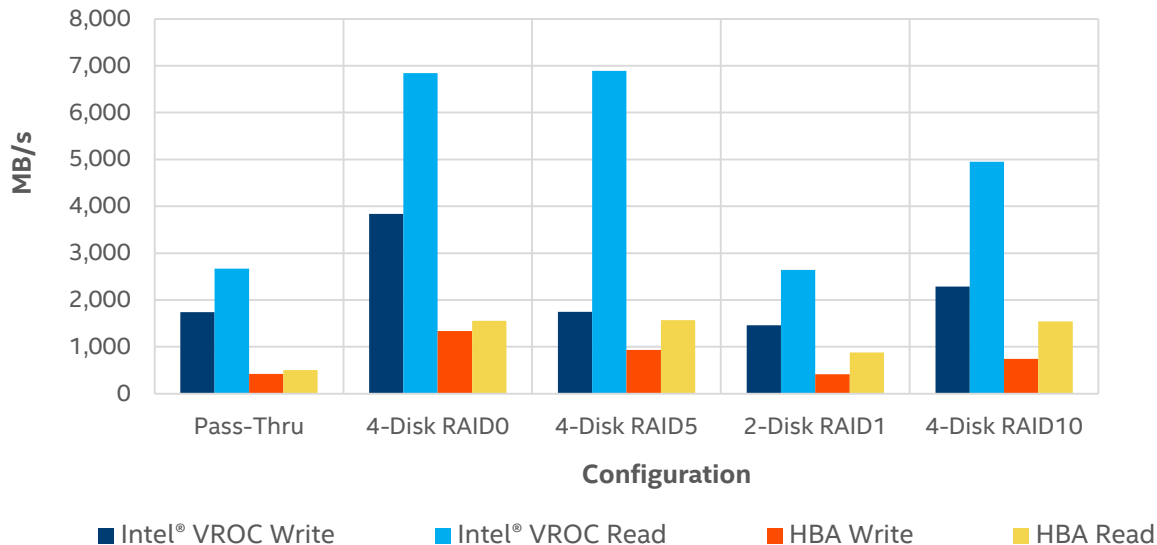
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# Performance – Bandwidth<sup>4</sup>

## RHEL7.4 with Intel® SSD DC P4510 Series (128 Seq., 1 Worker)



Intel® Virtual Raid on CPU (Intel® VROC) with NVMe\* SSDs delivers strong performance improvement over SATA RAID

- Intel VROC delivers **4.4x** more throughput than SATA RAID in 4-Disk RAID0 Reads
- Intel VROC delivers **1.9x** more throughput than SATA RAID in 4-Disk RAID5 Writes

**52 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8170 based system**

See appendix for footnotes

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

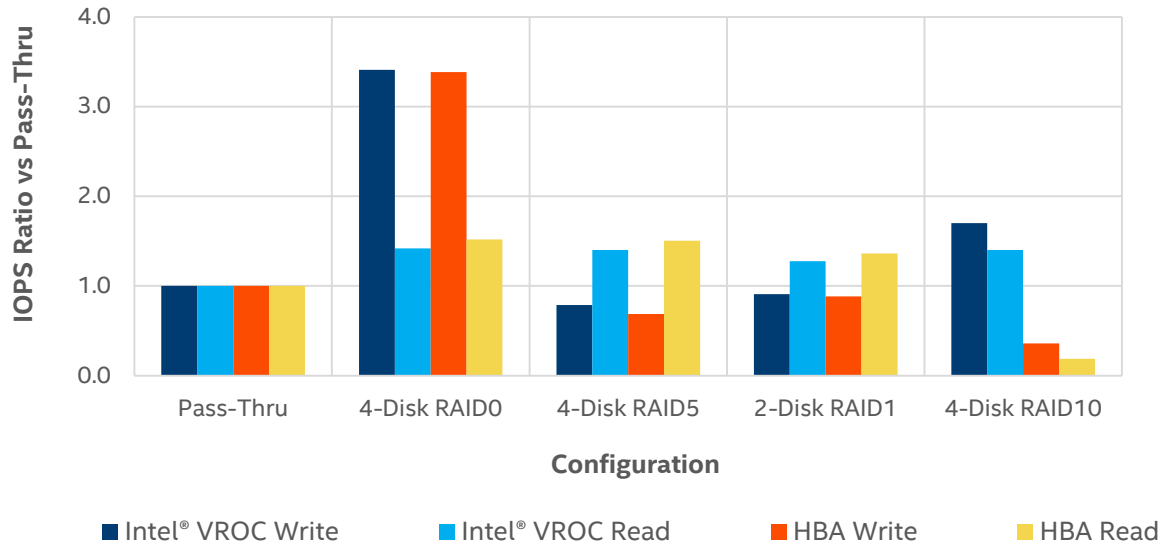
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# INTEL<sup>®</sup> VIRTUAL RAID ON CPU (INTEL<sup>®</sup> VROC) VS RAID HBA (WINDOWS\*)

\*Other names and brands may be claimed as the property of others.

# Performance – RAID vs Pass-Thru<sup>5</sup>

## Windows\* 2016 with Intel® SSD DC P4600 Series (4k Random)



### Pass-Thru Data

	Intel® VROC	HBA
4k Ran Write	234k IOPS	238k IOPS
4k Ran Read	627k IOPS	632k IOPS

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	16 Cores	11 Cores
RAID5 Write	8.1 Cores	2.4 Cores

**48 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8160T based system**

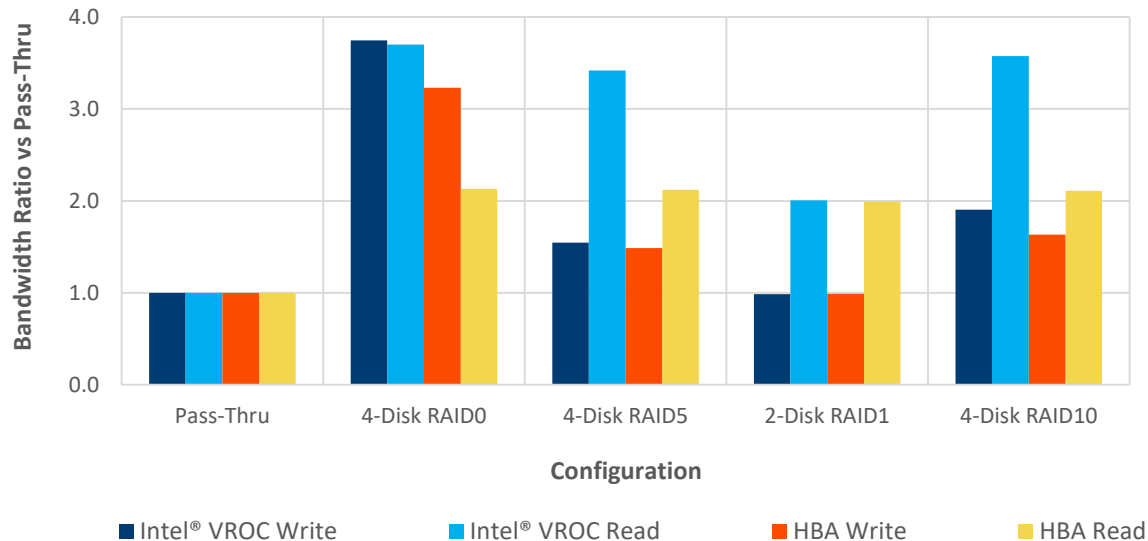
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# Performance – RAID vs Pass-thru<sup>6</sup>

## Windows\* 2016 with Intel® SSD DC P4600 Series (128 Seq., 1 Worker)



### Pass-Thru Data

	Intel® VROC	HBA
4k Seq Write	2.2 GB/s	2.1 GB/s
4k Seq Read	3.0 GB/s	3.4 GB/s

### Physical CPU Cores Used

	Intel® VROC	HBA
RAID0 Read	1.8 Cores	0.7 Cores
RAID5 Write	3.4 Cores	0.5 Cores

**48 total physical cores on this 2 socket, Intel® Xeon® Scalable processor 8160T based system**

See appendix for footnotes

Software and workloads used in performance tests may have been optimized for performance only on Intel microprocessors. Performance tests, such as SYSmark and MobileMark, are measured using specific computer systems, components, software, operations and functions. Any change to any of those factors may cause the results to vary. You should consult other information and performance tests to assist you in fully evaluating your contemplated purchases, including the performance of that product when combined with other products. For more complete information visit [www.intel.com/benchmarks](http://www.intel.com/benchmarks).

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# Appendix

**1. System configuration:** Intel® Server Board S2600WFT family, Intel® Xeon® 8170 Series Processors, 26cores@ 2.1GHz, RAM 192GB , BIOS Release 7/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** RedHat\* Linux 7.4, kernel- 3.10.0-693.33.1.el7.x86\_64, mdadm - v4.0 - 2018-01-26 Intel build: RSTe\_5.4\_WW4.5, Intel® VROC Pre-OS version 5.3.0.1039, 4x Intel® SSD DC P4510 Series 2TB drive firmware: VDV10131, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6 (non retention state) and processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** FIO 3.3, RANDOM: Workers-16, IOdepth- 256, No Filesystem, CPU Affinitized

**RAID HBA:** Intel® RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows\* driver version 7.704.09.00; Intel® Volume Management Device (Intel® VMD) disabled in BIOS

**Pass Thru Baseline:** 1x Intel® SSD DC P4510 Series, 2 TB, Firmware: VDV10120, SSDPE2KX020T8

Performance results are based on testing as of October 5, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

**2. System configuration:** Intel® Server Board S2600WFT family, Intel® Xeon® 8170 Series Processors, 26cores@ 2.1GHz, RAM 192GB , BIOS Release 7/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** RedHat\* Linux 7.4, kernel- 3.10.0-693.33.1.el7.x86\_64, mdadm - v4.0 - 2018-01-26 Intel build: RSTe\_5.4\_WW4.5, Intel® VROC Pre-OS version 5.3.0.1039, 4x Intel® SSD DC P4510 Series 2TB drive firmware: VDV10131, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6(non retention state) and Processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** FIO 3.3, SEQUENTIAL: Workers-1, IOdepth- 128, No Filesystem, CPU Affinitized

**RAID HBA:** Intel® RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows driver version 7.704.09.00; Intel® Volume Management Device (Intel® VMD) disabled in BIOS

**Pass Thru Baseline:** 1x Intel® SSD DC P4510 Series, 2 TB, Firmware: VDV10120, SSDPE2KX020T8

Performance results are based on testing as of October 5, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

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# Appendix

**3. System configuration:** Intel® Server Board S2600WFQ family, Intel® Xeon® processors 8170 , 26cores@ 2.1GHz, RAM 192GB , BIOS Release 7/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** RedHat\* Linux 7.4, kernel- 3.10.0-693.33.1.el7.x86\_64, mdadm - v4.0 - 2018-01-26 Intel build: RSTe\_5.4\_WW4.5, Intel® VROC Pre-OS version 5.3.0.1039, 4x Intel® SSD DC P4510 Series 2TB drive firmware: VDV10131, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6(non retention state) and Processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** FIO 3.3, RANDOM: Workers-16, IOdepth- 256, No Filesystem, CPU Affinitized

**RAID HBA:** Intel® RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows Driver Version 7.704.09.00; VMD disabled in BIOS; 4x Intel® SSD DC S4500 Series 3.84TB drive firmware: SCV10121

**Pass Thru Baseline:** 1x Intel® SSD DC P4510 Series, 2 TB, Firmware: VDV10120, SSDPE2KX020T8; 1x Intel® SSD DC S4500 Series 3.84TB drive firmware: SCV10121, SSDSC2KB038T7

Performance results are based on testing as of October 5, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

**4. System configuration:** Intel® Server Board S2600WFQ family, Intel® Xeon® processors 8170, 26cores@ 2.1GHz, RAM 192GB , BIOS Release 7/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** RedHat\* Linux 7.4, kernel- 3.10.0-693.33.1.el7.x86\_64, mdadm - v4.0 - 2018-01-26 Intel build: RSTe\_5.4\_WW4.5, Intel® VROC Pre-OS version 5.3.0.1039, 4x Intel® SSD DC P4510 Series 2TB drive firmware: VDV10131, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6(non retention state) and Processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** FIO 3.3, SEQUENTIAL: Workers-1, IOdepth- 128, No Filesystem, CPU Affinitized

**RAID HBA:** Intel® RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows Driver Version 7.704.09.00; VMD disabled in BIOS; 4x Intel® SSD DC S4500 Series 3.84TB drive firmware: SCV10121

**Pass Thru Baseline:** 1x Intel® SSD DC P4510 Series, 2 TB, Firmware: VDV10120, SSDPE2KX020T8; 1x Intel® SSD DC S4500 Series 3.84TB drive firmware: SCV10121, SSDSC2KB038T7

Performance results are based on testing as of October 5, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

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# Appendix

**5. System configuration:** Intel® Server Board S2600WFT family, Intel® Xeon® 8160T Series Processors, 24cores@ 2.1GHz, RAM 192GB , BIOS Release 07/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** Windows Server 2016, Version 10.0.14393 Build 14393, Intel RSTe UI version: 5.4.0.1464, Intel® VROC Pre-OS version 5.4.0.1039, 4x Intel® SSD DC P4600 Series 3.2TB drive firmware: QDV101D1, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6(non retention state) and Processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** IOMeter version: 1.1.0 Dyn buckets 1.2, RANDOM: Workers-16, IOdepth- 32, No Filesystem, CPU Affinitized

**RAID HBA:** Intel(R) RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows Driver Version 7.704.09.00; VMD disabled in BIOS

**Pass Thru Baseline:** 1x Intel® SSD DC P4600 Series, 3.2 TB, Firmware: QDV101D1, SSDPE2KE032T7)

Performance results are based on testing as of August 24, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure

**6. System configuration:** Intel® Server Board S2600WFT family, Intel® Xeon® 8160T Series Processors, 24cores@ 2.1GHz, RAM 192GB , BIOS Release 07/09/2018, BIOS Version: SE5C620.86B.00.01.0014.070920180847

**OS:** Windows Server 2016, Version 10.0.14393 Build 14393, Intel RSTe UI version: 5.4.0.1464, Intel® VROC Pre-OS version 5.4.0.1039, 4x Intel® SSD DC P4600 Series 3.2TB drive firmware: QDV101D1, Retimer

**BIOS setting:** Hyper-threading enabled, Package C-State set to C6(non retention state) and Processor C6 set to enabled, P-States set to default and SpeedStep and Turbo are enabled

**Workload Generator:** IOMeter version: 1.1.0 Dyn buckets 1.2, SEQUENTIAL: Workers-1, IOdepth- 128, No Filesystem, CPU Affinitized

**RAID HBA:** Intel(R) RAID Controller RSP3TD160F; Trimode Firmware Package Build 50.5.2-1326; Trimode Firmware Version 5.050.00-1367; Trimode Windows Driver Version 7.704.09.00; VMD disabled in BIOS

**Pass Thru Baseline:** 1x Intel® SSD DC P4600 Series, 3.2 TB, Firmware: QDV101D1, SSDPE2KE032T7)

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