



INTEL[®] VIRTUAL RAID ON CPU WINDOWS^{*} PERFORMANCE

NSG Host Storage Software

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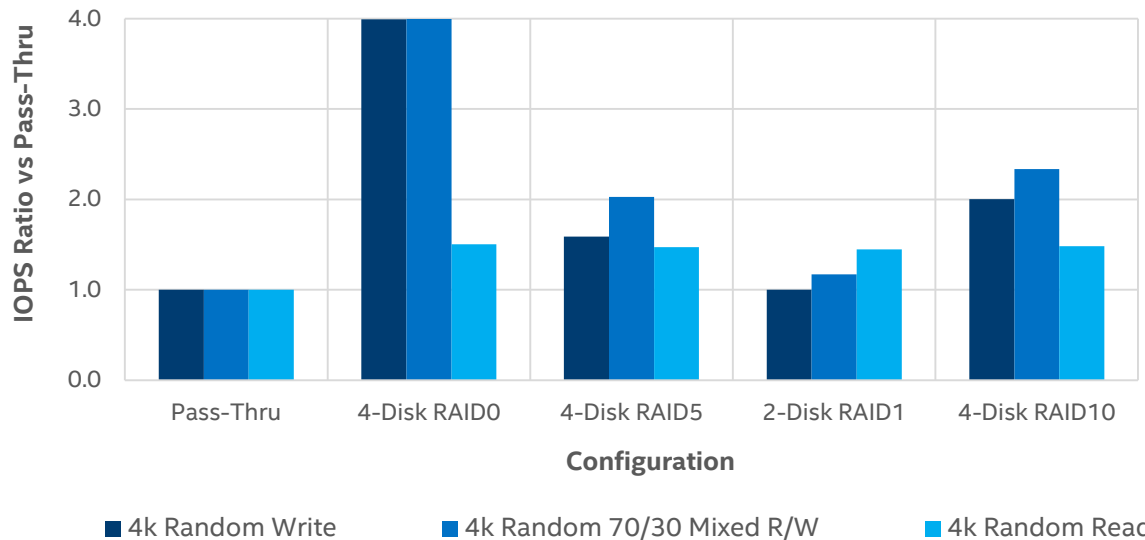
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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® SSD DC P4510¹

(4k Random)



- Pass-thru raw data:
 - 4k Rand Write: 80k IOPS
 - 4k Rand Mixed: 179k IOPS
 - 4k Rand Read: 634k IOPS
- 4-Disk RAID0 Read: 952k IOPS
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 17 Cores
 - 4-Disk RAID5 Write: 6.3 Cores

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

See appendix for footnotes.

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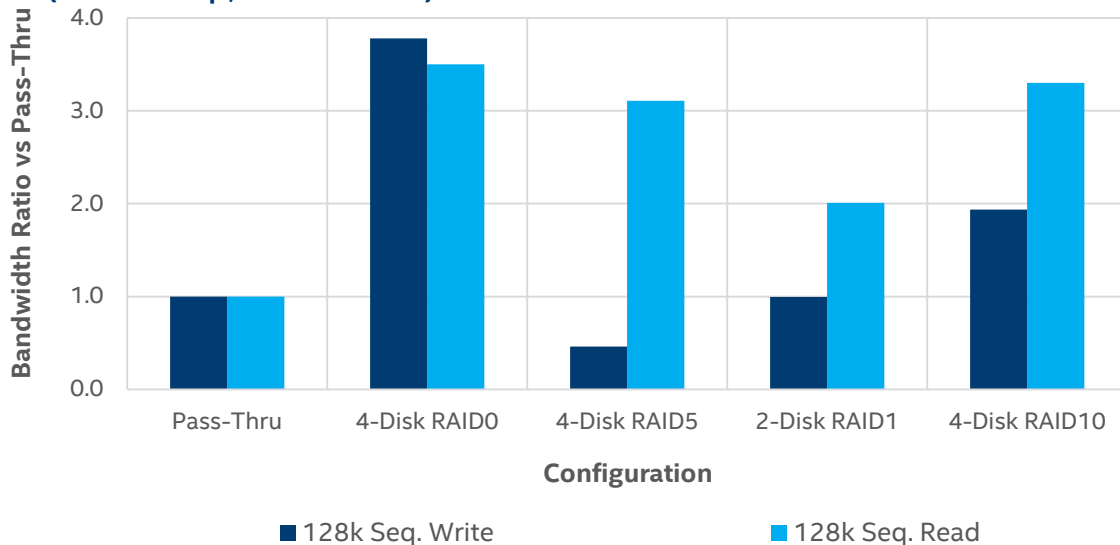
Performance results are based on testing as of August 26, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure.

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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® SSD DC P4510²

(128 Seq., 1 Worker)



- Pass-thru raw data:
 - 128k Seq. Write: 2.1GB/s
 - 128k Seq. Read: 2.9 GB/s
- 4-Disk RAID 0 Read: 10.3 GB/s
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 1.9 Cores
 - 4-Disk RAID5 Write: 1.6 Cores

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

See appendix for footnotes.

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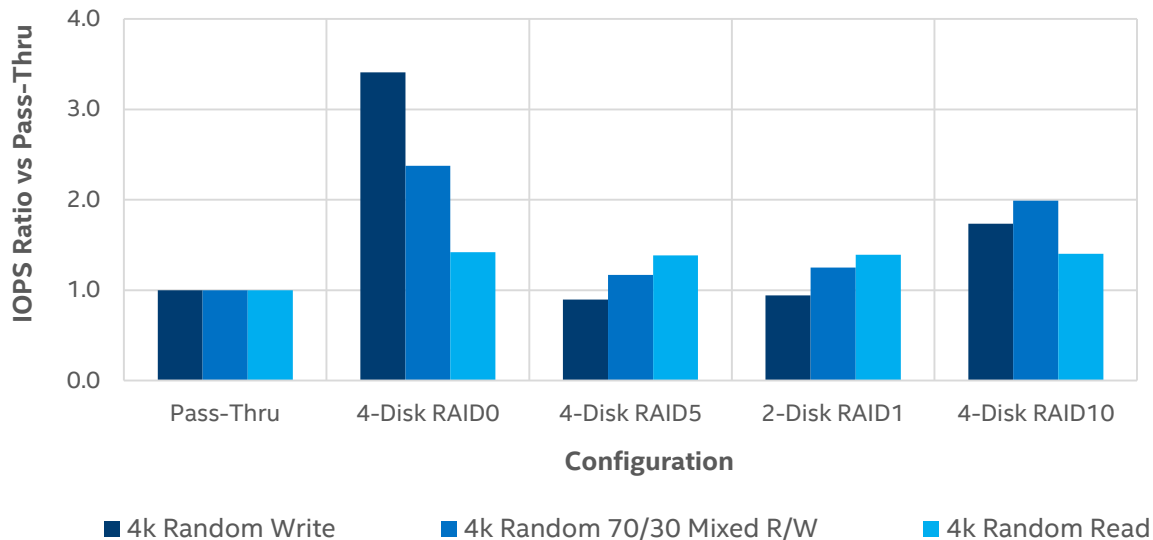
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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® SSD DC P4600³

(4k Random)



- Pass-thru raw data:
 - 4k Rand Write: 235k IOPS
 - 4k Rand Mixed: 412k IOPS
 - 4k Rand Read: 702k IOPS
- 4-Disk RAID0 Read: 1.0M IOPS
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 17 Cores
 - 4-Disk RAID5 Write: 9.2 Cores

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

See appendix for footnotes.

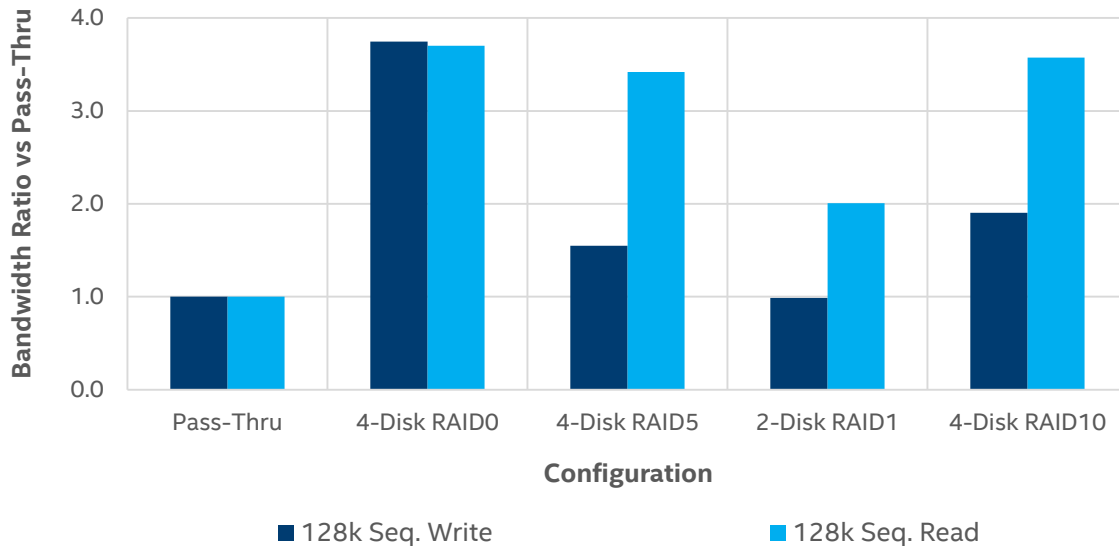
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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® SSD DC P4600⁴
(128 Seq., 1 Worker)



- Pass-thru raw data:
 - 128k Seq. Write: 2.2GB/s
 - 128k Seq. Read: 3.0 GB/s
- 4-Disk RAID 0 Read: 11.0 GB/s
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 1.8 Cores
 - 4-Disk RAID5 Write: 3.4 Cores

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

See appendix for footnotes.

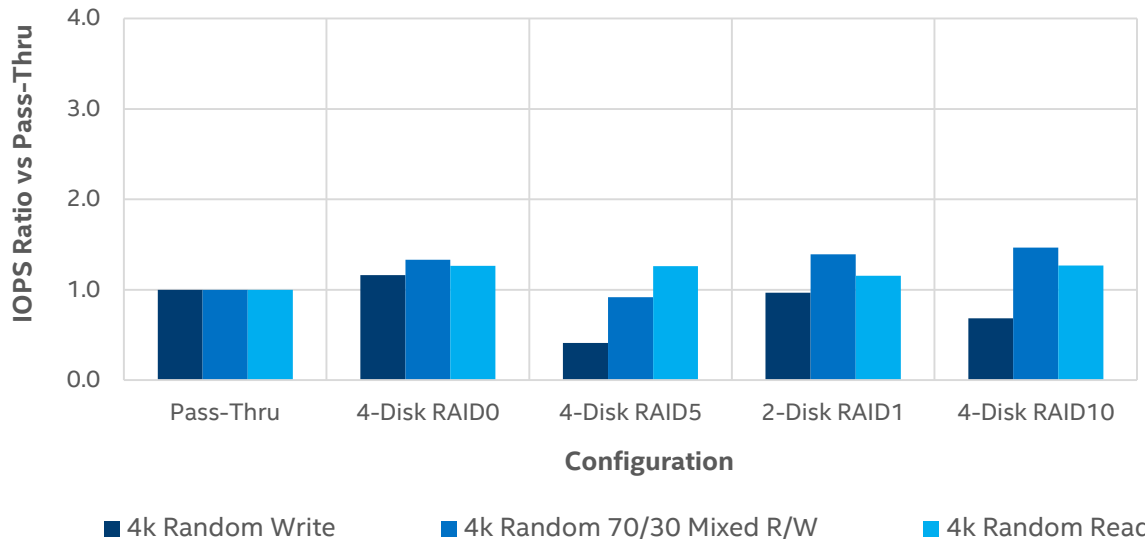
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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® Optane™ SSD DC P4800X⁵
(4k Random)



- Pass-thru raw data:
 - 4k Rand Write: 551k IOPS
 - 4k Rand Mixed: 505k IOPS
 - 4k Rand Read: 581k IOPS
- 4-Disk RAID0 Read: 734k IOPS
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 13 Cores
 - 4-Disk RAID5 Write: 10 Cores

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

See appendix for footnotes.

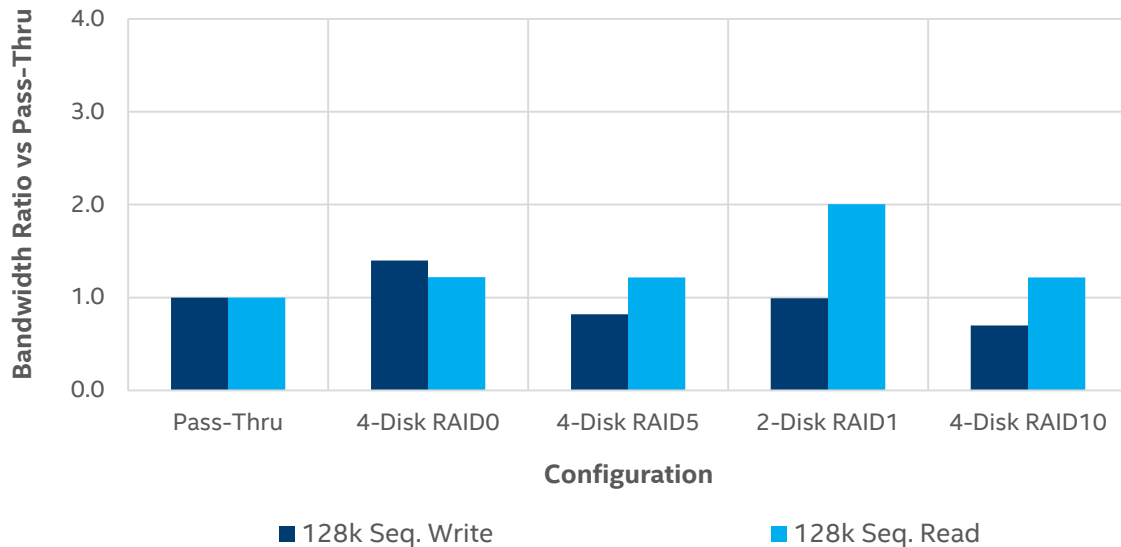
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Performance – RAID vs Pass-thru

Windows* 2016 with Intel® SSD DC P4800X⁶ (128 Seq., 1 Worker)



- Pass-thru raw data:
 - 128k Seq. Write: 2.3GB/s
 - 128k Seq. Read: 2.7 GB/s
- 4-Disk RAID 0 Read: 3.3 GB/s
- Physical CPU Cores Used:
 - 4-Disk RAID0 Read: 1.2 Cores
 - 4-Disk RAID5 Write: 2.3 Cores

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

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Appendix

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

Pass Thru Baseline: 1x Intel® SSD DC P4510 Series, 2TB, Firmware: VDV10131, SSDPE2KX020T8))

Performance results are based on testing as of August 26, 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® 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 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: IOMeter version: 1.1.0 Dyn buckets 1.2, SEQUENTIAL: Workers-1, IOdepth- 128, No Filesystem, CPU Affinitized

Pass Thru Baseline: 1x Intel® SSD DC P4510 Series, 2TB, Firmware: VDV10131, SSDPE2KX020T8))

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3. **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

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

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on testing as of September 27, 2018 and may not reflect all publicly available security updates. See configuration disclosure for details. No product can be absolutely secure.

Appendix cont.

4. 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: Winodws 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

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

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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: Winodws 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 P4800X Series 375GB drive firmware: E2010423, 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-8, IOdepth- 32, No Filesystem, CPU Affinitized

Pass Thru Baseline: 1x Intel® SSD DC P4800X Series, 375GB, Firmware: E2010423, SSDPE21K375GA)))

Performance results are based

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: Winodws 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 P4800X Series 375GB drive firmware: E2010423, 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-1, IOdepth- 128, No Filesystem, CPU Affinitized

Pass Thru Baseline: 1x Intel® SSD DC P4800X Series, 375GB, Firmware: E2010423, SSDPE21K375GA)))

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