# napp-it

ZFS Epyc ESXi/ Storage Server

Some short performance tests to compare

- Xeon Silver 4110 vs Epyc 7302
- Disk vs Flash vs Optane
- OmniOS 151034 vs 151036
- barebone vs virtualized

2021-Mar-05 (c) napp-it

# Content:

- 1.0 Hardware
- 2. TLDR, Results
- 2.1 Disk pool (opt Optane Slog) OmniOS 151034
- 2.2 Disk pool (opt Optane Slog) OmniOS 151036
- 2.3 Optane Intel DC 900 pool 151034 vs 151036
- 2.4 Flash Intel DC 750 pool 151034 vs 151036
- 3.0 Disk pool (opt Optane Slog) on AMD Epyc
- 3.1 Optane Pool on AMD Epyc
- 4.0 Virtualized NAS (ESXi 7.0U1, OmniOS)



#### 1.0 Intel Xeon vs AMD Epyc

This benchmark sequence was intended to answer some basic questions about how the new Epyc platform performs my current Intel Xeon silver on a disk pool vs Optane/Flash pool. Additionally we check encryption performance and OmniOS 151036 vs 151036 with FPU accelerated raid-Z. The Xeon system was my typical VM and storage server up to this year (without disks typically from the 3000 Euro region), the Epyc may become my next standard platform in this price range. While it is clear that a system from this year will always outperform one from last year at same price, I want to know how much and especially how fast is ZFS encryption now as encryption is a mandatory feature under the European data protection rules.

All tests are done via a filebench run that checks random io vs sequential io with sync and enc on/off and barebone vs virtualised in napp-it menu Pools > Benchmark. Intension is to get a feeling about behaviours.

Intel Hardware: SuperMicro X11SPH-NCTF, Xeon Silver 4110, 64 GB RAM, SAS 3008 7 x WD Ultrastar 8TB, 3 x Optane 900, 3 x Intel DC 750 (traditional Flash NVMe)

AMD Hardware: SuperMicro H12SSL-C, Epyc 7302 128 GB RAM, SAS 3008 (BTO system) 7 x WD Ultrastar 8TB, 3 x Optane 900, 3 x Intel DC 750 (traditional Flash NVMe)

### 2.0: TLDR

#### First write results on Intel

| 151034      | async         | sync        | sync+slog    | async/enc   | sync/enc    | sync+slog/enc |
|-------------|---------------|-------------|--------------|-------------|-------------|---------------|
| Disk Pool   | 770-1195MB/s  | 40-50MB/s   | 640-783MB/s  | 907-935MB/s | 22-24MB/s   | 19-24MB/s     |
| Flash pool  | 1112-1388MB/s | 430-613MB/s | -            | 950-954MB/s | 112-129MB/s | -             |
| Optane pool | 1600-2000MB/s | 550-770MB/s | -            | 930-960MB/s | 118-130MB/s | -             |
| 151036      | async         | sync        | sync+slog    | async/enc   | sync/enc    | sync+slog/enc |
| Disk Pool   | 930-1170MB/s  | 48-50MB/s   | 779-1195MB/s | 907-935MB/s | 34-36MB/s   | 22-24MB/s     |
| Flash pool  | 1112-1388MB/s | 430-613MB/s | -            | 950-954MB/s | 112-129MB/s | -             |
| Optane pool | 1600-2000MB/s | 550-750MB/s | -            | 930-960MB/s | 107-130MB/s | -             |

#### First result on AMD

| 151036                    | async                            | sync                            | sync+slog    | async/enc                        | sync/enc   | sync+slog/enc |
|---------------------------|----------------------------------|---------------------------------|--------------|----------------------------------|------------|---------------|
| Disk Pool                 | 1178-1197 MB/s                   | 51-55 MB/s                      | 908-956 MB/s | 1203-1230 MB/s                   | 36-40 MB/s | 31-32 MB/s    |
| Flash pool<br>Optane pool | 1591-1877 MB/s<br>3339-3707 MB/s | 943-1134 MB/s<br>1445-1471 MB/s | -            | 1541-1592 MB/s<br>1720-1730 MB/s |            | -             |

Some principles Encryption is much faster than on my last tests Storage + Encryption is perfect up to 10G, Storage + sync is perfect up to 10G, Storage + encryption + sync is much slower due encryption OmniOS 1510034/36 perform quite similar (despite hardware accelerated Raid-Z)

Improvements due a faster CPU (Epyc): 150-200%

# 2.1: Disk pool, Intel Xeon on OmniOS 151034

#### Disk Pool: without slog, enc off

| About Help Services Sys       | tem      | User Disks              | Pools     | ZFS       | Filesystems  | Snapshot    | s Comstar    |
|-------------------------------|----------|-------------------------|-----------|-----------|--------------|-------------|--------------|
| ome » Pools » Benchmarks      |          | 11                      | Honitor ) | e ta ets  | Pool® Cap    | beke net    | 0 CPU 0 3004 |
| > filebench > iccone examples | > locone | 1g > bonnie             | > dd ben  | ch.       |              |             |              |
|                               |          |                         |           |           |              |             |              |
| est done                      |          |                         |           |           |              |             | ond          |
|                               |          |                         |           |           |              |             |              |
|                               |          |                         |           |           |              |             |              |
| benchmark: write: filebench,  | sequent  | tial, Reads             | fileben   | ch, dor   | ter 11,13,2  | 020         |              |
| pool: Md-z1                   |          |                         |           |           |              |             |              |
| POPL: BH2-2.3                 |          |                         |           |           |              |             |              |
| BANK.                         |          | STATE                   | READ MR   | TTE CR    | NUM:         |             |              |
| hd-z1                         |          | ONLINE                  |           |           |              |             |              |
| maida1-0                      |          | ONLINE                  | •         |           | •            |             |              |
| CORSOBOCCARBBEIK              | E1Cd0    | ONLINE                  |           |           | •            |             |              |
| COR5000CCA0DECG8              | IE GAdo  | ONLINE                  |           |           |              |             |              |
| <045000CCA08EC68              | 651.80   | ONLINE.                 | •         |           |              |             |              |
| C015040CCA68EC68              | 29Td0    | ONLINE                  | •         |           |              |             |              |
| CR15099CCM8EC68               | 2F4d0    | ONLINE                  |           |           |              |             |              |
| <\$485000CCA26069             | 11ADd0   | ONLINE.                 |           |           |              |             |              |
| C845000CCA2621A3              | A91.00   | ONLINE                  | •         |           | ÷            |             |              |
| 100F                          | 0.00     | fosce_834               |           |           |              |             |              |
| looel.                        |          |                         | -128K.    | s share a | concructify. | readcache-a | 113          |
| log                           |          |                         |           |           |              |             |              |
| incryption                    |          |                         |           |           |              |             |              |
| esark                         |          |                         |           |           |              |             |              |
|                               |          |                         |           |           |              |             |              |
| rba                           | sy       | scralways               |           |           | syncrol      | befdeal     |              |
|                               | 200      | sc-always               |           |           | sum of       | isabled     |              |
|                               |          | 1 ops                   |           |           | 5622 4       |             |              |
| t4 singlestreamente,f         |          | stage Tet.              |           |           |              | 12 ops/s    |              |
| 64 singlestreamerite.f        |          | 1159US CDU/G            |           |           |              | s cpu/op    |              |
| b4 singlestreamente.f         | 1.71     |                         |           |           |              |             |              |
| 64 singlestreamente.T         |          |                         |           |           |              | ATABCK      |              |
| 54 singlestreamente.r         | 23       | -4ms Latency<br>-4 ND/s | ·         |           | 1124.2       | ND/s        |              |
| b4 singlestreamerite.f        | 21<br>46 | dan Latency             |           | onerus. f | 1124.2       | HB/s        |              |

I startet the write benchmark multiple times: sync was between 40 MB/s and 50 MB/s non-sync between 770 MB/s and 1195 MB/s

#### Disk Pool: with Optane 900 slog, enc off

| About Help Services Sys       | tem U             | Iser Disi              | ks Pool     | s ZFS     | Filesystems  | Snapshots        | Comst  |
|-------------------------------|-------------------|------------------------|-------------|-----------|--------------|------------------|--------|
| ome » Pools » Benchmarks      |                   |                        | Pro Monitor | 10:23 546 | Post® Cap®   | 0680 mm0         | crue a |
| > Nebench > sezone examples > | latone            | ig > bonn              | e > dd be   | sch       |              |                  |        |
| est done                      |                   |                        |             |           |              |                  |        |
|                               |                   |                        |             |           |              |                  |        |
| Benchmark: Write: filebench   | sequent           | 1al, Read              | : filebe    | nch, du   | te: 11.13.20 | 20               |        |
| poolt Md-z1                   |                   |                        |             |           |              |                  |        |
| NAME                          |                   | STATE                  | READ M      | RITE CK   | SUM          |                  |        |
| bd-z1                         |                   | ONLINE                 |             |           |              |                  |        |
| ra5d21-0                      |                   | ONLINE                 |             |           |              |                  |        |
| <045000CA688E3C               |                   | ONLINE                 | ۰           | ۰         | •            |                  |        |
| CR4204BECCMBECGB              |                   | OWLINE                 | ۰           |           | •            |                  |        |
| c9t5999CCA08EC6D              |                   | OWLINE                 |             |           |              |                  |        |
| c0t5000CA0BECGE               |                   | ONLINE.                | ٠           |           | •            |                  |        |
| CORSOBOCCARBECGE              |                   | OWLINE                 | ۰           |           | •            |                  |        |
| <14858880CCA26899             |                   | OWLINE                 |             |           |              |                  |        |
| 6885000CCA2621A3              | 49180             | ONLINE                 |             |           | •            |                  |        |
| c2t1d0                        |                   |                        |             |           |              |                  |        |
| Latown                        |                   | ONLINE                 |             |           | •            |                  |        |
| heat                          | one               | iosce_034              |             |           |              |                  |        |
| pool                          |                   |                        |             | ashe-a    | compriseff.  | readcachenal     | 0      |
| stog                          |                   |                        |             |           |              |                  |        |
| encryption                    |                   |                        |             |           |              |                  |        |
| resark                        |                   |                        |             |           |              |                  |        |
|                               |                   |                        |             |           |              |                  |        |
| Fb3                           | syn               | снаїмауз               |             |           | synced1      | sabled           |        |
| Fbd singlestreamerite.f       | 100               | crailways              |             |           | sync rdf     | beldes           |        |
|                               |                   | 8 005                  |             |           | 5776 00      |                  |        |
|                               |                   | .572 005/              | 5           |           |              | 0 ops/s          |        |
|                               |                   |                        |             |           |              |                  |        |
|                               |                   |                        | op.         |           |              |                  |        |
|                               | 342               | 65us cpu/<br>ms latenc |             |           | 0.985 1      | cpu/op<br>atency |        |
|                               | 342               | 65us epu/              |             |           |              | atency           |        |
|                               | 342<br>1.5<br>647 | 65us cpu/<br>ms laters | Ý           | donry, f  | 0.9ms 1      | atency<br>MB/s   |        |

# without slog, enc on (aes-256ccm) nopp-itewal omniosce\_034 275 coptance v 25 dov 12 okt 2020 Nopp-itewal omniosce\_034 275 coptance v 25 dov 12 okt 2020

| home := Pools := Benchmarks         |          | P                    | n Monitor | 36 17 14 | Pool  | 6 Cap 8              | Disk B Net | e crue | 308-00 |
|-------------------------------------|----------|----------------------|-----------|----------|-------|----------------------|------------|--------|--------|
| > filebench > lozone examples       | > iozone | 1g > bonnie          | > dd ber  | nch      |       |                      |            |        |        |
| est done                            |          |                      |           |          |       |                      |            |        | and    |
|                                     |          |                      |           |          |       |                      |            |        |        |
| Benchmark: write: filebench         | sequent  | fal, Reads           | filebo    | nch, da  | to1 1 | 1.13.202             | 9          |        |        |
| pool1 hd-z1                         |          |                      |           |          |       |                      |            |        |        |
| BARKE                               |          | STATE                | READ W    | NITE O   | SUM   |                      |            |        |        |
| hd-a1                               |          | ONLINE               |           |          |       |                      |            |        |        |
| raidz1-0                            |          | ONLINE               | ۰         | ۰        |       |                      |            |        |        |
| <015000CCA088E3                     |          |                      | ۰         | 0        |       |                      |            |        |        |
| C815000CCA68EC6                     |          |                      | ۰         | •        | ٠     |                      |            |        |        |
| C815000CCA68EC6                     |          |                      | •         | 0        | ٠     |                      |            |        |        |
| CRESHORCCARBECE                     |          |                      |           |          |       |                      |            |        |        |
| c015000CCA00EC6<br>c1415000CCA2606  |          |                      |           | 0        | :     |                      |            |        |        |
| c8t5000CCA2621A                     |          | ONLINE               |           | ő        | ē     |                      |            |        |        |
| heat                                |          | dosce 034            |           |          |       |                      |            |        |        |
| food                                |          | at (recain           | +:125K,   | sabu-,   | comp  | raoff, r             | eadcacheua | 41)    |        |
| alog                                | -        |                      |           |          |       |                      |            |        |        |
| encryption                          | 245      | -256-cca             |           |          |       |                      |            |        |        |
| renark                              |          |                      |           |          |       |                      |            |        |        |
| Enter passphrase: Re-enter passphra | 18t:     |                      |           |          |       |                      |            |        |        |
| Fb3                                 | 5 94     | cralways             |           |          |       | sync+d1s             | abled      |        |        |
| Fb4 singlestreamwrite.f             | syr      | c+always             |           |          |       | sync+d1s             | abled      |        |        |
|                                     |          | ops                  |           |          |       | 4747 ops             |            |        |        |
|                                     |          | 998 ops/s            |           |          |       | 949.366              |            |        |        |
|                                     |          | 928un epu/           |           |          |       | 12731544             |            |        |        |
|                                     |          | Ins latenc<br>5 HB/s | У         |          |       | 1.0ms la<br>949.2 FE |            |        |        |
|                                     | rar      | domread.f            | ran       | doerw.f  |       | singlest             | reatr      |        |        |
| pri/sec cache-all                   |          | 6 HB/S               |           | 0 PB/S   |       | 88.0 HE/             |            |        |        |

sync was between 22 MB/s and 24 MB/s and non-sync was between 907 MB/s and 935 MB/s

#### with Optane 900 slog, enc on (aes-256ccm)

| nopp-liteval omniosce_034 275       | opliance x 23-6 | ev 12. okt 2020 |           |        | logou              | t: admin | sol   E | dit   Mo | n   Acc |
|-------------------------------------|-----------------|-----------------|-----------|--------|--------------------|----------|---------|----------|---------|
| About Help Services System          | User Dis        | iks Pools       | ZFS       | Files  | ystems             | Snape    | ihots   | Com      | star    |
| ome » Pools » Benchmarks            |                 | Pro Hontor:     | 0.27 42   | s Fool | e cape             | Disk 😶   | net 🖲   | CPU O    | 200     |
| > filebench > lozone examples > loz | one 1g > bonr   | ne > dd ben     | ch        |        |                    |          |         |          |         |
| est done                            |                 |                 |           |        |                    |          |         |          | end     |
|                                     |                 |                 |           |        |                    |          |         |          |         |
| Denchmarkt Write: filebench_sequ    | ential, Rea     | d: fileben      | ch, de    | te: 1  | 1.13.20            | 20       |         |          |         |
| 15-bd : fooq                        |                 |                 |           |        |                    |          |         |          |         |
| NAME                                | STATE           | READ VE         | atte o    | SUM    |                    |          |         |          |         |
| hd-21                               | ONLINE          |                 |           | 0      |                    |          |         |          |         |
| raidz1-0                            | ONLINE          |                 | 0         | 0      |                    |          |         |          |         |
| c015088CCA000E3CE1C6                |                 |                 |           |        |                    |          |         |          |         |
| C015088CCA08ECGBEGA                 |                 |                 | 0         | 0      |                    |          |         |          |         |
| <015000CCA08EC606937                | 0 ONLINE        |                 |           |        |                    |          |         |          |         |
| <015000CCA08ECGE193/                | 6 ONLINE        |                 | 0         | 0      |                    |          |         |          |         |
| c0150880CA88E06E2F4/                | 6 ONLINE        |                 |           |        |                    |          |         |          |         |
| <1415000CCA2606011A3                | do CAULTRE      |                 | 0         | •      |                    |          |         |          |         |
| C815099CCA2621A3A930                | ONLINE          |                 |           |        |                    |          |         |          |         |
| logs                                |                 |                 |           |        |                    |          |         |          |         |
| c21100                              | ONLINE          | •               | •         | ۰      |                    |          |         |          |         |
| host                                | omntosce_63     | 4               |           |        |                    |          |         |          |         |
| pool                                | hd-z1 (necs)    | Spew128K,       | ssb+-,    | comp   | reaff,             | readcaci | he-all  | 0        |         |
| slog                                |                 |                 |           |        |                    |          |         |          |         |
| encryption                          | aes-256-con     |                 |           |        |                    |          |         |          |         |
| remark                              |                 |                 |           |        |                    |          |         |          |         |
| 63                                  | sync-always     |                 |           |        | sync=d1            | sabled   |         |          |         |
| Fb4 singlestreamarite.f             | syncializays    |                 |           |        | syncadi            | sabled   |         |          |         |
|                                     | 101 ops         |                 |           |        | 1726 op            | 5        |         |          |         |
|                                     | 20.100 ops/     |                 |           |        | 745.172            | ops/s    |         |          |         |
|                                     | \$10083us cp    |                 |           |        | 7-0619us           | cpu/op   |         |          |         |
|                                     | 49.0ms Later    | nsy             |           |        | 1.3ms 1            | atoncy   |         |          |         |
|                                     | 20.0 MB/S       |                 |           |        | 745.6 8            |          |         |          |         |
|                                     | randomread.     | f rand          | iomrei, f | ,      | singles            | treaser  |         |          |         |
| pri/sec cachewall                   | 455.2 NB/s      |                 | NO./s     |        | 5 mg.es<br>88.6 MB |          |         |          |         |
| The state of the second of the      | ABDIE 187.9     |                 | 10/19     |        | 2010 M             |          |         |          |         |

I startet the write benchmark multiple times: sync was between 640 MB/s and 783 MB/s non-sync was between 1002 MB/s and 1195 MB/s

sync was between 19 MB/s and 24 MB/s and non-sync was between 745 MB/s and 767 MB/s  $\,$ 

A Xeon SMB filer with sync=disabled is a perfect solution for a 10G network.

If you need to force sync either because you use it for VM/databases or want an SMB filer with a perfect behaviour in a crash/ power outage scenario, you need a good Slog like the Optane or a WD SS530 (12G SAS).

#### If you need encryption

This is ok for a SMB filer without sync. If you need sync, do not pair with encryption.

# 2.2: Disk pool, Intel Xeon on OmniOS 151036

#### Disk Pool: without slog, enc off

| About    | Help      | Services    | System       | Uper I    | Disks      | Pools      | Z      | FS File | systems | : Snag  | shots   | Com | star |
|----------|-----------|-------------|--------------|-----------|------------|------------|--------|---------|---------|---------|---------|-----|------|
| ome »    | Pools 34  | Benchmarks  |              |           | Prof       | Homitor: 1 | 7:16-6 | PS PO   | ke capt | DIA 0   | INCO.   | CPU | 300  |
| > fik    | bench >   | lozone exam | ples > lacon | e tg > bo | nnię >     | dd bena    | h      |         |         |         |         |     |      |
| est done | ,         |             |              |           |            |            |        |         |         |         |         |     | ) on |
|          |           |             |              |           |            |            |        |         |         |         |         |     |      |
| Benches  | ariki) Mr | itel filebe | mch_sequen   | esat, n   | ead1 f     | Steben     | on, 1  | Satel   | 11.13.2 | 020     |         |     |      |
| peel:    | bd-21     |             |              |           |            |            |        |         |         |         |         |     |      |
|          | NAME      |             |              | STATE     |            | EAD MR     | TTE (  | CREAT   |         |         |         |     |      |
|          | hd-z1     |             |              | ONLIN     |            | •          | ۰      |         |         |         |         |     |      |
|          |           | d21-0       |              | ONLIN     |            | •          | ۰      |         |         |         |         |     |      |
|          |           | 963000CCA00 |              | ONLIN     |            | ۰          |        |         |         |         |         |     |      |
|          |           | 042000CCM08 |              |           |            | •          |        |         |         |         |         |     |      |
|          |           | 045080CCA68 |              |           |            | •          |        |         |         |         |         |     |      |
|          |           | 045000CA0   |              |           |            | ۰          | ۰      |         |         |         |         |     |      |
|          |           | 945999CCM8  |              |           |            | -          | :      | :       |         |         |         |     |      |
|          |           | 3485000CCA3 |              | ONLIN     |            | ě          | ÷.     | - 2     |         |         |         |     |      |
| host     |           |             |              | ntosce.)  | 116        |            |        |         |         |         |         |     |      |
| peel.    |           |             |              |           |            | 1286. 1    | ssa-   |         | pr-off. | readca  | che-all | 0   |      |
| slog     |           |             |              |           |            |            |        |         |         |         |         | .,  |      |
| encryp   | tion      |             |              |           |            |            |        |         |         |         |         |     |      |
| resark   |           |             |              |           |            |            |        |         |         |         |         |     |      |
| FB3      |           |             | Ny           | ncialas   | y <b>n</b> |            |        |         | syncied | isabled |         |     |      |
| Fb4 sh   | nglestr   | eamer1te.f  | 59           | nc-alway  | y S        |            |        |         |         | Isabled |         |     |      |
|          |           |             |              | 1. ops    |            |            |        |         | 4695 0  |         |         |     |      |
|          |           |             |              | .195 op   |            |            |        |         |         | 4 ops/s |         |     |      |
|          |           |             |              | 0023vs    |            | •          |        |         |         | s spu/o |         |     |      |
|          |           |             |              | .tes la   |            |            |        |         |         | latency |         |     |      |
|          |           |             | 50           | UB M8/5   |            |            |        |         | 934.71  | ND/ 6   |         |     |      |
|          |           |             |              | ndomrea   | d.f        | rande      | NW W   | .1      |         | tream   |         |     |      |
| and from | c cache   |             | 1.0          | 1.5 MB/   |            | 346.0      | N 168  | Dec.    | 1.7 68  | Tec.    |         |     |      |

I startet the write benchmark multiple times: sync was between 48 MB/s and 50 MB/s non-sync between 930 MB/s and 1170 MB/s

#### Disk Pool: with Optane 900 slog, enc off

| napp     | -it eva  | omniosce,    | <b>,036</b> 295 ay | plience v          | 20.dev 12 | okt 2000   |       |      | logoul    | t: admin   sol   4 | idit   Mon   Ac |
|----------|----------|--------------|--------------------|--------------------|-----------|------------|-------|------|-----------|--------------------|-----------------|
| About    | Help     | Services     | System             | User               | Disks     | Pools      | ZFS   | File | systems   | Snapshots          | Comstar         |
| home >>  | Pools := | Benchmarks   |                    |                    | Prof      | Monitor: 1 | 15534 | Pos  | i O Cap O | Dake Nete          | CPUB Job        |
| > 60     | ebench > | iozone exam  | ples > kazo        | ne 1g > I          | bonnie >  | dd benc    | h     |      |           |                    |                 |
| test don | •        |              |                    |                    |           |            |       |      |           |                    | and             |
|          |          |              |                    |                    |           |            |       |      |           |                    |                 |
| Benchm   | arkt Wr  | ite: filebe  | inch_seque         | ntial,             | Reads f   | filebend   | h, di | ite: | 11.13.29  | 28                 |                 |
| pool:    | hd-z1    |              |                    |                    |           |            |       |      |           |                    |                 |
|          | NAME     |              |                    | STAT               | re #      | EAD WRO    | TE C  | (SUM |           |                    |                 |
|          | hd-z1    |              |                    | ONLI               |           | 0          |       | ę    |           |                    |                 |
|          |          | dz1-0        |                    | OPUL3              |           | 0          |       | 0    |           |                    |                 |
|          |          | 0±5000CCAN   |                    |                    |           | 0          |       | 0    |           |                    |                 |
|          |          | 815000CCAN   |                    |                    |           | 0          | 0     | 0    |           |                    |                 |
|          |          | #US660CCAN   |                    |                    |           | 0          |       | 0    |           |                    |                 |
|          |          | etseeeccae   |                    |                    |           | 0          |       | 0    |           |                    |                 |
|          |          | 1415000CCA08 |                    |                    |           | 0          |       |      |           |                    |                 |
|          |          | 1415000CCA2  |                    |                    |           | 0          |       |      |           |                    |                 |
|          |          | 113000CCA20  | 12113/0146         | ONLI               | NO.       | ė.         | •     | 0    |           |                    |                 |
|          | logs     | 109          |                    | ONL                |           | 0          |       |      |           |                    |                 |
|          | 621      | 109          |                    | ONLS               | NO.       | 0          |       |      |           |                    |                 |
| boat     |          |              |                    | en losce           | 016       |            |       |      |           |                    |                 |
| pool     |          |              |                    | d-21 (r            | ecsizer   | 1288, 1    | sbr-, | COR  | preoff, r | readcachenal       | 10              |
| slog     |          |              |                    |                    |           |            |       |      |           |                    |                 |
| encryp   | eion     |              |                    |                    |           |            |       |      |           |                    |                 |
| renark   |          |              |                    |                    |           |            |       |      |           |                    |                 |
| Fb3      |          |              |                    | ync-ala            | ays.      |            |       |      | sync=d1   | abled              |                 |
| Fb4 s1   | nglestr  | eamwrite.f   |                    | ync+alu            | ays       |            |       |      | syncedia  | abled              |                 |
|          |          |              | 2                  | 178 ops            |           |            |       |      | 4990 opt  |                    |                 |
|          |          |              |                    | 35.579             | ops/s     |            |       |      | 997.943   | ops/s              |                 |
|          |          |              | 5                  | 1483us             | cpu/op    |            |       |      | 51653us   | cpu/op             |                 |
|          |          |              |                    | ans to             |           |            |       |      | 1.0ms to  |                    |                 |
|          |          |              | 4                  | 35,4 18            | Vs.       |            |       |      | 997.7 H   | 1/5                |                 |
|          |          |              |                    | andonre            |           | randi      |       |      |           |                    |                 |
| and free | c cache  |              |                    | andomre<br>28.2 HB |           | 1329.1     |       |      | singlest  |                    |                 |
| pr 1/50  | e cache  | - 411        |                    | 2012 10            | 14.84     | +39-1      | 7871  | •    | 8-7 98/1  | ,                  |                 |

topp-if eval omniosce\_036 275 appliance v. 20 dev 12 okt 2020 | logout: admin | sol | Edit | Mon | Acc | About Help Services System User Disks Pools ZFS Filesystems Snapshots Comstar Pro Honitor: 17:20.355 Fool @ Cap @ Disk @ Net @ CPU @ Job @ me » Pools » Benchmarks bonnie > dd bench nch > tozone examples > iccone 1g > cmd Write: filebench\_sequential, Read: filebench, date: 11.11.2020 Isebel : food STATE READ WRITE CKSUM NAME hd-21 STATE OWLINE OWLINE OWLINE OWLINE OWLINE OWLINE OWLINE OWLINE d-21 ra1d21-0 cet5000CCA00BL3CL1Cd0 cet5000CCA00BCGBL5Ad0 cet5000CCA00BCGBL5Ad0 cet5000CCA00BCGBL3Fad0 cet5000CCA00BCGBL3Fad0 cet5000CCA00BCGBL3Fad0

ommiosce\_036 hd-a1 (recslaes128K, ssbn-, comprooff, readcacherall)

randomrw.f 31.4 PB/S

syncedisabled

sync-disabled 4513 ops 902.573 ops/s 12731des cpu/s 1.1ms latency 902.4 MB/s

singlestream 87.2 MB/S

without slog, enc on (aes-256ccm)

<1415000CCA2606011ADd0 <815000CCA2621A3A91d0

host pool slog encrypti remark

Fb3

Fbi singlestreamwrite.f

pr1/sec cache-all

sync was between 34 MB/s and 36 MB/s non-sync was between 890 MB/s and 924 MB/s

aes-256-con

synceshays

sync-sluays 174 ops 34.797 ops/s 457913us opu 28.6ms Laten 34.6 MB/s

randomread.f 42.2 MB/S

with Optane 900 slog, enc on (aes-256ccm)

| About   | Help     | Services    | System       | User    | Disks       | Pools      | ZF      | S File | systems             | Snapshots    | Com   | istar |
|---------|----------|-------------|--------------|---------|-------------|------------|---------|--------|---------------------|--------------|-------|-------|
| home av | Pools 30 | Benchmarks  |              |         | Prof        | Honitor: D | 1.00 31 | s Poo  | 0 cap0              | Disk® Net®   | CPU 0 | 308-0 |
| > file  | beach >  | iocone exam | ptes > iozon | elg > t | onnie >     | dd bend    | h       |        |                     |              |       |       |
| est don |          |             |              |         |             |            |         |        |                     |              |       | (cmd  |
|         |          |             |              |         |             |            |         |        |                     |              |       |       |
| Benchs  | arkt w   | ite: filebe | mch_sequer   | rtial,  | seads f     | fflebend   | h, d    | ates   | 11.13.29            | 29           |       |       |
| pools   | hd-z1    |             |              |         |             |            |         |        |                     |              |       |       |
|         | NANE     |             |              | STAT    | t 1         | IEAD WRIT  | TE C    | KSUR.  |                     |              |       |       |
|         | hd-a1    |             |              | ONL T   | NE          | 0          | •       |        |                     |              |       |       |
|         | rai      | da1-0       |              | ONLI    | NE          | ¢          | ۰       | ۰      |                     |              |       |       |
|         | 6        | 015000CCA08 | BE3CE2C40    | ONLI    | NE          | 0          | ۰       | ۰      |                     |              |       |       |
|         | 6        | 015000CCA08 | BECGBEGADE   | ONLI    | NE          | 0          | ۰       | ۰      |                     |              |       |       |
|         | 6        | 015000CCA08 | RECEDERID    | ONLI    | NE          | 0          | ۰       | ۰      |                     |              |       |       |
|         | 6        | 015000CCA08 | BEC6E19708   | ONLI    | NE          | 0          | ۰       | ۰      |                     |              |       |       |
|         | 0        | 015000CCA06 | RECKE2F4DB   | ONLI    | NE.         | 0          | •       |        |                     |              |       |       |
|         | ¢        | 1415000CCA3 | 25969114000  | ONLI    | NI,         | 0          | •       | •      |                     |              |       |       |
|         | ¢        | 815000CCA20 | 521A3A9100   | ONLI    | NI,         | 0          | ۰       | •      |                     |              |       |       |
|         | logs     |             |              |         |             |            |         |        |                     |              |       |       |
|         | c2t      | 1.00        |              | ONI, I  | NE          | 0          | 0       | 0      |                     |              |       |       |
| host    |          |             |              | wience  |             |            |         |        |                     |              |       |       |
| pool    |          |             | he           | 1-z1 (r | echizer     | 128K, 1    | who -   | . 000  | prooff, s           | readcachesal | 1)    |       |
| alog    |          |             |              |         |             |            |         |        |                     |              |       |       |
| encryp  |          |             | 47           | n-256-  | CON         |            |         |        |                     |              |       |       |
| renark  |          |             |              |         |             |            |         |        |                     |              |       |       |
| Fb3     |          |             | *)           | mc=als  | ays         |            |         |        | syncadia            | sabled       |       |       |
| Fbs s1  | nglestr  | earwrite.f  |              | ncrabs  | ays         |            |         |        | syncridia           |              |       |       |
|         |          |             |              | 7 ops   |             |            |         |        | 4674 op             |              |       |       |
|         |          |             |              | 1.398 0 |             |            |         |        | 934.775             |              |       |       |
|         |          |             |              |         | cpu/op      |            |         |        |                     | s cpu/op     |       |       |
|         |          |             |              | 1-2 MD/ | atency<br>5 |            |         |        | 1.185 l:<br>934.6 M |              |       |       |
|         |          |             |              |         |             |            |         |        |                     |              |       |       |
|         |          |             |              | adoare  |             | rando      |         |        | singlest            |              |       |       |

I startet the write benchmark multiple times: sync was between 359 MB/s and 435 MB/s non-sync between 770 MB/s and 1195 MB/s

sync was between 22 MB/s and 24 MB/s and non-sync was between 907 MB/s and 935 MB/s

# 2.3: Optane pool, Intel Xeon on OmniOS 151034 vs 151036

#### Optane Pool: 151034, enc off

| About H             | elp Serv     | ices S    | /stem     | User  | Disks        | Peols          | ZFS F   | ilesystems   | Snapshots    | Comsta  |
|---------------------|--------------|-----------|-----------|-------|--------------|----------------|---------|--------------|--------------|---------|
| ome » Poo           | it >> Benchr | marks     |           |       | Pee          | Monitor 18     | 62.05%  | Pool 🖲 Cap 🖲 | Disk® Net®   | CPU® Ja |
| > fileben           | ch > lazone  | example   | s > lozon | e1g⇒  | bonnie :     | dd bench       |         |              |              |         |
| est done            |              |           |           |       |              |                |         |              |              | 0       |
|                     |              |           |           |       |              |                |         |              |              |         |
| less beach          | Notes 1      | (i]abarci |           |       | Reads        | [i] abara      | date    | 11.13.28     | -            |         |
|                     |              |           | Condina.  |       | 100.000      |                | , a.c.  |              |              |         |
| pool: opt           | ane-z1       |           |           |       |              |                |         |              |              |         |
| 8.                  | AME          | STATE     | READ      | NRIT  | E OKSUR      |                |         |              |              |         |
| -                   | ptame-21     | OWLINE    |           |       |              |                |         |              |              |         |
|                     | raidz1-0     | ONLINE    |           |       | 0 0          |                |         |              |              |         |
|                     | <21340       | ONLINE    |           |       | e e          |                |         |              |              |         |
|                     | <31140       | ONLINE    |           |       | e e          |                |         |              |              |         |
|                     | c4t1d0       | ONLINE    |           |       | 0 0          |                |         |              |              |         |
| hest                |              |           | 08        | ntesc | 0_634        |                |         |              |              |         |
| peel                |              |           |           | tone- | zl (rec      | s1ze=128       | i, 558- | -, compr-o   | ff, readcach | e=all)  |
| slog                |              |           |           |       |              |                |         |              |              |         |
| encryptio<br>remark |              |           |           |       |              |                |         |              |              |         |
| яња                 |              |           | 83        | ncrab | a ya         |                |         | syncicit     | befdea       |         |
| Fb4 single          | estreameri   | Te.T      | 53        | nc-ab | NAV5         |                |         | sync-di      | sabled       |         |
|                     |              |           |           | dd op |              |                |         | 8284 00      |              |         |
|                     |              |           |           |       | ,<br>7 ops/s |                |         | 1656.73      |              |         |
|                     |              |           |           |       | cpu/op       |                |         | 50029us      |              |         |
|                     |              |           |           |       | atency       |                |         | 0.6m L       |              |         |
|                     |              |           |           | 19.6  |              |                |         | 1656.5       |              |         |
|                     |              |           |           |       |              |                |         |              |              |         |
|                     |              |           |           |       |              |                |         |              |              |         |
| ori/sec c           |              |           |           | ndoer | ead.f        | rando<br>209.8 |         | 1.5 GB/      | treaser      |         |

I startet the write benchmark multiple times: sync was between 550 and 770 MB/s non-sync between 1600 and 2000 MB/s

# Optane Pool: 151034, enc on (aes-256ccm)

| nopp      | -lit eval    | omni    | osce_  | 034 2F5 a  | planors          | r 20.dev 1 | 2 okt 2020  |         | 101        | jout | admin   sol   E | dit   Mon   A |
|-----------|--------------|---------|--------|------------|------------------|------------|-------------|---------|------------|------|-----------------|---------------|
| About     | Help         | Servi   | ices   | System     | User             | Disks      | Pools       | ZFS     | Filesysten | 15   | Snapshots       | Comsta        |
| home :+   | Poets :+     | Senche  | sarks  |            |                  | Pr         | Monitor: 17 | 51.595  | Post Ca    |      | Disk® Net®      | OPUB Jak      |
| > file    | brach >      | iczone  | examp  | des > iozo | ne 1g >          | bonnie     | > dd bend   | h       |            |      |                 |               |
| test done |              |         |        |            |                  |            |             |         |            |      |                 | (m            |
|           |              |         |        |            |                  |            |             |         |            |      |                 |               |
|           | and a second |         | 17.000 |            | Contract.        | manda      |             |         | 01 11.13.  |      |                 |               |
| Denkrink  | arks wr      | 1001 1  | Leber  | ncn_seque  | netal,           | Reads      | TT Leiberic | n, ear  | 001 11-10- | 202  |                 |               |
| pools (   | optane-i     | F1      |        |            |                  |            |             |         |            |      |                 |               |
|           | MARE         |         | STATI  |            | o vett           | r cosu     |             |         |            |      |                 |               |
|           | optan        | e- 21   | ONL T  | NE         | 0                | 0 0        |             |         |            |      |                 |               |
|           |              | dz1-0   |        |            |                  |            |             |         |            |      |                 |               |
|           | ¢.           | 21.240  | ONL 31 | NE         |                  | • •        |             |         |            |      |                 |               |
|           | c.           | 31100   | ONL 11 | N i        |                  | • •        |             |         |            |      |                 |               |
|           | 0            | 4t1d0   | ONL 11 | NG         | 9                | • •        | ,           |         |            |      |                 |               |
| host      |              |         |        |            | anioso           | e_034      |             |         |            |      |                 |               |
| pool      |              |         |        |            | otane-           | zi (rec    | aine-128    | K, aab  | ba-, compr | not  | f, readcache    | all)          |
| alog      |              |         |        |            |                  |            |             |         |            |      |                 |               |
| encryp    |              |         |        |            | HEL-256          | -008       |             |         |            |      |                 |               |
| renark    |              |         |        |            |                  |            |             |         |            |      |                 |               |
| Fb3       |              |         |        | ,          | ync-al           | way's      |             |         | sync-      | 415  | abled           |               |
| Fb4 s1    | nglestre     | eamer i | te.f   |            | ync:ab           |            |             |         |            |      | abled           |               |
|           |              |         |        |            | ill ops          |            |             |         | 4709       |      |                 |               |
|           |              |         |        |            | 26.195           |            |             |         |            |      | ops/s           |               |
|           |              |         |        |            |                  | is cpu/4   | i P         |         |            |      | cpu/op          |               |
|           |              |         |        |            | /.985 l          |            |             |         |            |      | tency           |               |
|           |              |         |        | ,          | 126 <b>-</b> 0 M | 8/s        |             |         | 941-6      | NO   | 15              |               |
|           |              |         |        |            | andomr           | ead, f     | rando       | erv, f  | singl      | est  | TAME            |               |
|           |              | 11      |        |            | 6 C MB           | 1.         | 29.4        | ALC: NO | 46.0       |      |                 |               |
| pri/am    | C CACER      |         |        |            |                  |            |             |         |            |      |                 |               |

sync was between 118 and 130 MB/s non-sync was between 930 and 960 MB/s

Optane Pool: 151036 enc off

| About     | Help Serv      | ices     | System          | User    | Disk    | s Pools     | ZFS FI   | lesystems  | Snapshots     | Comstar          |
|-----------|----------------|----------|-----------------|---------|---------|-------------|----------|------------|---------------|------------------|
| home :==  | Pools >> Bench | marks    | ,               |         |         |             |          | ,          | Pa            | Monitor: 18:23 / |
| > file    | bench > logone | enamp    | les > logo      | oe 1g > | bonnk   | e > dd bena | :h       |            |               |                  |
|           |                |          |                 |         |         |             |          |            |               |                  |
| test done |                |          |                 |         |         |             |          |            |               |                  |
|           |                |          |                 |         |         |             |          |            |               |                  |
| Loss has  | rk: Write: I   | (1) eber | wh come         | felter  | Proved. | . filebox   | date.    |            | 14            |                  |
| POINT N   |                |          | in and a second |         |         |             | ca, esce |            |               |                  |
| pool1 e   | optane-z1      |          |                 |         |         |             |          |            |               |                  |
|           | NAME           | STATI    | REA             | D WRIT  | E CKS   | UR          |          |            |               |                  |
|           | optane-z1      | OSE IN   | E               | 0       |         | •           |          |            |               |                  |
|           | raidz1-0       | 088,17   | 1E              | •       |         | •           |          |            |               |                  |
|           | c2t1d9         | OSE 17   | νE.             |         |         | •           |          |            |               |                  |
|           | c1t1d0         | ONE IF   | ¥E.             |         |         | •           |          |            |               |                  |
|           | c4t1d0         | ONLIN    | E.              | 0       | •       | 0           |          |            |               |                  |
| host      |                |          |                 | mn1osc  | 0.036   |             |          |            |               |                  |
| pool      |                |          |                 | ptone-  | 21 (r   | ecs1ze=12   | 5K, 558- | . compress | ff, readcache | (11a-            |
| slog      |                |          |                 | ÷       |         |             |          |            |               |                  |
| encrypt   | tion           |          |                 |         |         |             |          |            |               |                  |
| renark    |                |          |                 |         |         |             |          |            |               |                  |
| Fb3       |                |          | ,               | iync+a1 | ways    |             |          | sync+d1    | sabled        |                  |
| Fb4 wie   | glestreamri    | ite.f    | ,               | oricial | anay to |             |          | syncadio   | bled          |                  |
|           | -              |          | 3               | 760 00  | 6       |             |          | 9946 001   | 6             |                  |
|           |                |          | 7               | 51,968  | ops/    | 5           |          | 1965.65    | 6 ops/s       |                  |
|           |                |          | 2               | 743945  | cpu/    | 0p          |          | 4481GU5    | cpu/op        |                  |
|           |                |          | ;               | .3ms 1  | atenc   | ¥.          |          | 0.5ms 1/   | tency         |                  |
|           |                |          | 7               | 51.8 8  | 8/s     |             |          | 1988.7 )   |               |                  |
|           |                |          | ,               | andonr  |         | rand        | omrar.f  | singlest   | treamr        |                  |
|           | cache+all      |          |                 | 77.8 5  |         |             | 6 M8/5   |            |               |                  |

I startet the write benchmark multiple times: sync was between 550 and 770 MB/s non-sync between 1600 and 2000 MB/s Optane Pool: 151036, enc on (aes-256ccm)

|          | Mala       | -      |                  |          |              |              | (also | Deale     | -      |           | Franks     |            |
|----------|------------|--------|------------------|----------|--------------|--------------|-------|-----------|--------|-----------|------------|------------|
|          |            |        |                  | ystem    | Upe          | r D          |       |           |        | ,         |            | ts Comstan |
|          | Pools as 8 |        |                  |          |              |              |       |           | 15in P | ool@ Cap® | Dike Net   | 0 CPU0 365 |
| > file   | bench > i  | 620198 | example          | s > ineo | ne 1g        | > bor        | nię > | dd bench  |        |           |            |            |
| est done | ,          |        |                  |          |              |              |       |           |        |           |            | cni        |
|          |            |        |                  |          |              |              |       |           |        |           |            |            |
| Benches  | arkt Mri   |        | itebend          | h segu   | otial        | L. Re        | MD P  | Stebench  | date   | 11.13.20  | 20         |            |
|          |            |        |                  |          |              |              |       |           |        |           |            |            |
| peel:    | optane-z   | 2      |                  |          |              |              |       |           |        |           |            |            |
|          | NAME       |        | STATE            |          | D MR         |              |       |           |        |           |            |            |
|          |            |        | ONLINE           |          | 0            | 0            | 0     |           |        |           |            |            |
|          |            |        | ONLINE           |          | 0            | 0            | 0     |           |        |           |            |            |
|          |            |        | ONLINE<br>ONLINE |          | 0            |              | 0     |           |        |           |            |            |
|          |            |        | OAL INC          |          |              |              |       |           |        |           |            |            |
|          |            |        | Cost The         |          | *            |              |       |           |        |           |            |            |
| host     |            |        |                  |          | en de la com | LCP .        | 36    |           |        |           |            |            |
| peol.    |            |        |                  |          | ptan         | +- <b>x1</b> | (rect | 12e+1266. | asb.   | . compres | ff, readca | chevall)   |
| alog     |            |        |                  |          |              |              |       |           |        |           |            |            |
| encryp   | clon .     |        |                  |          | NIS-23       | 16-00        |       |           |        |           |            |            |
| resark   |            |        |                  |          |              |              |       |           |        |           |            |            |
| Fb3      |            |        |                  | ,        | унст         | alway        | 5     |           |        | syncedi   | sabled     |            |
| Fb4 add  | ngleatre   | ameri  | te.f             |          | улс н        | dana         |       |           |        | syncedi   | belder     |            |
|          |            |        |                  |          | 105 00       |              | -     |           |        | 4778 op   |            |            |
|          |            |        |                  |          | 21.5         |              | 5/5   |           |        | 935,573   |            |            |
|          |            |        |                  |          |              |              | pu/op |           |        |           | s cpu/op   |            |
|          |            |        |                  |          | 1.245        |              |       |           |        | 1.0es 1   |            |            |
|          |            |        |                  | 1        | 25.4         | M8/s         |       |           |        | 955.4 M   | 8/s        |            |
|          |            |        |                  |          | andor        | aread        | .1    | random    | w.f    | singles   | tream      |            |
|          | c caches   |        |                  |          | 5.6 1        |              |       | 26.2 1    |        | 60.2 MB   |            |            |

sync was between 107 and 130 MB/s non-sync was between 930 and 960 MB/s

# 2.4: Traditional Flash NVMe (Intel DC750) pool, Intel Xeon on OmniOS 151034 vs 151036

#### DC 750 Pool: 151034, enc off

| anse a Pools a Benchmarks     ProMontor 20+0545 Pool® Cap® Dak® Net® Cru® as       > Nickench > Norme examples > Norme ig > bonne > dd bench       extdome     Image: Comparison of the c                          |                             |               | wed. f  | random    |           | aingles  |              |        |
|--|-----------------------------|---------------|---------|-----------|-----------|----------|--------------|--------|
| Description     Profestive     Profestive       Profestive     Backensky     Profestive       NAME     State       State     State       NAME     STATE       READ     NAME       STATE     READ       NAME     STATE       State     0       CTSM-21     ONLINE       CTSM-21     ONLINE       CTSM-21     ONLINE       State     0       CTSM-21     ONLINE       State     0       CTSM-21     ONLINE       State     0       CTSM-21   |                             | 443.2 8       | 0/8     |           |           | 1112.0   | MB / 3       |        |
| ame a Pools a Benchmarks     ProMontorization (a cold cold cold out 0 int 0 cold cold cold cold cold cold cold cold  |                             |               |         |           |           |          |              |        |
| Bit bench     From Monton 2000 Set Fool Cap C Dak C Net C Cru C at<br>Bit bench > Hotome examples > Hotome Ig > bonne > dd bench       Mitteench > Hotome examples > Hotome Ig > bonne > dd bench       Matter       Matter       Dool: dc750-z1       MARE     STATE       READ MRETE     CASUM       dc750-z1     OwnExt       Out     O       casting   |                             |               |         |           |           |          |              |        |
| ame a Pools a Benchmarks     ProMontorization (a cold cold cold out 0 int 0 cold cold cold cold cold cold cold cold  |                             |               |         |           |           |          |              |        |
| Description     Protection     Provide Set Fool Cap D pak D het D cru D at the singlest reader for the single streamer ite.f   |                             |               |         |           |           |          |              |        |
| arms => Pools => Benchmarks     Pro Montor:20+0 jes: Pool® Cap® Duk® het® Cru® as       >> Bicbench >> Notes examples >> Notes 1g >> bonnie >> dd bench       extdeme  | fb4 singlestreamwrite.f     |               |         |           |           |          |              |        |
| America         ProfMontorization Set. Pool © Cap © Dak © Net © Cru© Jac           > Bibbench > Hotome examples > Hotome Ig > bonnie > dd bench           intdeme           Internetication in the set of the set   | Fb3                         | sync-a1       | ways    |           |           | sync+d1  | sabled       |        |
| America         ProfMontorization Set. Pool © Cap © Dak © Net © Cru© Jac           > Bibbench > Hotome examples > Hotome Ig > bonnie > dd bench           intdeme           Internetication in the set of the set   | renark.                     |               |         |           |           |          |              |        |
| America     Profile       and and an analysis     Profile       and analysis     Profile       analysi  | encryption                  | -             |         |           |           |          |              |        |
| Bitchendh > Benchmarks     Pro Montor:20+0 545 Pool® Cap® Duk® Net® Cru® at<br>> Bitchendh > Bosne examples > Bosne Ig > bonnie > dd bench       mitdene     Image: Comparison of the second seco | log                         | -             |         |           |           |          |              |        |
| America         Profile         Provide         Provide <t< td=""><td>pool</td><td></td><td></td><td>tre=128K.</td><td>ssbe-,</td><td>comprest</td><td>f, readcache</td><td>(ffees</td></t<>   | pool                        |               |         | tre=128K. | ssbe-,    | comprest | f, readcache | (ffees |
| Ame         From Monitor: 2000 bit: Pool Cap D Dak D Net D Cru D at<br>Bitchench > Hotome examples > Hotome Ig > bonnie > dd bench            Intdeme         Interference         Interfe  | host                        | centesc       | e 014   |           |           |          |              |        |
| Ame         ProMontor:20+0 bes Pool® Cap® Dek® Net® CPU® at<br>> Bickench > Hosse examples > Hosne ig > bonne > dd bench           Intdone         Intdone   | clétide ONLEME              |               | 0       | •         |           |          |              |        |
| ame a: Pools as Benchmarks     Pro Montor:20x0345     Pool® Cap® Dok® Net® Cru® as       > Bibbench > Hotes examples > Hotes Ig > bonnie > dd bench     Image: State is an intervention in the state is an intervention interventinterventintervention interventintervention intervention interventin             |                             |               | 0       | 0         |           |          |              |        |
| eme a Pools a Benchmarks Pro Montor 2040 545 Pool® Cap® Duk® Net® Cru® at<br>> Bickench > Bosse examples > Bosne Ig > bonne > dd bench<br>extdone [0]<br>Renchmarks Write: filebench_sequential, Read: filebench, date: 11-17-2020<br>pool: dc750-z1<br>NAME STATE READ METE CK5VM<br>dc750-z1 ONLINE 0 0 0  |                             |               |         |           |           |          |              |        |
| ame a Pools a Benchmarks Pro Montor:20x0 bis Pool® Cap® Dok® Not® Cru® a > Bicbench > Hotme examples > Hotme ig > bonnie > dd bench mtdane  indenchmarks Write: filebench_sequential, Reads filebench, date: 11.53.2020 pool: dc750-z1 NAME STATE READ WEITE CK50M   |                             |               |         |           |           |          |              |        |
| eme a Pools a Benchmarks Pro Montor 2000 565 Pool® Cap® Dok® Not® Cru® a > Bichench > Hoose examples > Hoome Ig > bonne > ddbench stdone  lenchmark: Write: filebench_sequential, Read: filebench, date: 11-12-2020 scol: dc750-z1   |                             |               |         |           |           |          |              |        |
| eme => Pools => Benchmarks Pio Honton:20+0545 Pool® Cap® Dak® Hut® Cru® as<br>>> Biebench >> Bosse examples >> Borne ig > bonne > dd bench<br>mtdane [0]<br>Renchmarks Write: filebench_sequential, Read: filebench, date: 11+13+2020  | NAME STATE                  | READ MRT      | TE CKSU | н         |           |          |              |        |
| ame » Pools » Benchmarks Pro Monton 2040 Ses Pool® Cap® Dak® Het ® Cru® 30<br>> Mebench > Noone examples > Norone Ig > bonnie > dd bench<br>wit done   | pool: dc750-z1              |               |         |           |           |          |              |        |
| > titebench > lozone examples > lozone Ig > bonnie > dd bench  | lenchmarkt Write: filebench | _sequential,  | Read:   | filebench | , dates   | 11.13.20 | 20           |        |
| eme av Poola av Benchmarka Pro Honton 20x0 Sks. Pool © Cap © Dok © Hitt © Chu © Jo<br>> thebench > lossee examples > lozene Ig > bonnie > dd bench   |                             |               |         |           |           |          |              |        |
| eme av Poola av Benchmarka Pro Honton 20x0 Sks. Pool © Cap © Dok © Hitt © Chu © Jo<br>> thebench > lossee examples > lozene Ig > bonnie > dd bench   | st done                     |               |         |           |           |          |              |        |
| ame av Pools av Benchmarks Pro Monitori 2840 S45. Pool © Cap © Disk © Net © CPU ® Jo   | P INCOME P INVINCING        | - 10100 IQ -  |         |           |           |          |              |        |
|  |                             | > lotone by > |         |           | 1545 Pool | 0 000    | Disk® Net®   | 000 1  |
|  | , , ,                       | stem User     |         |           |           |          |              |        |
|  |                             |               |         |           |           |          |              |        |

I startet the write benchmark multiple times: sync was between 359 and 570 MB/s non-sync between 1320 and 1490 MB/s

#### DC 750 Pool: 151036, enc off

nopp-if eval omniosce\_036 275 appliance v 20 dev 12 okt 2020 |logout: admin | sol | Edit | Mon | Acc | About Help Services System User Disks Pools ZFS Filesystems Snapshots Comstar me >> Pools >> Benchmarks Pro Monitor: 21:06 Sills Pool @ Cap @ Disk@ Net @ CPU@ Job @ > filebench > iozone examples > iozone Ig > bonnie > dd bench test done and Benchmark: Write: filebench\_sequential, Read: filebench, date: 11.11.2020 pool: dc750-z1 STATE ONLIME ONLIME ONLIME ONLIME AME 1750-21 raidzi READ MRITE CKSUM 0000 c1711d0 ommiesce\_006 dc750-z1 (recsize=118%, ssb=-, compr=off, readcache=all) Fb3 syncializeys synciclisabled sync-disabled 5563 ops 1112.061 opd/s 21180us opw/op 0.0ms latency 1112.8 MB/s sync-always 3066 ops 513.186 ops/s 41200ws cpu/op Fbs singlestreamwrite.f 1.6ms latency 613.0 MB/s randomrs.f 349.6 88/s singlestream 1.9 68/s randomread.f 228.2 MB/s pri/sec cachemall

I startet the write benchmark multiple times: sync was between 430 and 613 MB/s non-sync between 1112 and 1388 MB/s

#### DC 750 Pool: 151034, enc on (aes-256ccm)

| nopp    | iteval or    | nniosce  | _034 2554    | opliance           | x. 20.dev 12 | t.okt 2020    |            | logout    | : admin   sol   G | dit   Hon   Ac |
|---------|--------------|----------|--------------|--------------------|--------------|---------------|------------|-----------|-------------------|----------------|
| About   | Help Se      | ervices  | System       | User               | Disks        | Pools         | ZFS File   | systems   | Snapshots         | Comsta         |
| home :» | Pools >> Een | chmarks  |              |                    | Pro 8        | Honitor: 20 5 | Slidis Poo | i e cipe  | Disk® Net®        | crue Job       |
| > 18    | bench > 102  | one exan | npies > lozo | ne 1g >            | bonnie       | dd bench      | 1          |           |                   |                |
| est don | ,            |          |              |                    |              |               |            |           |                   | i cm           |
| Benchn  | ark: Write:  | : fileb  | ench_seque   | ontial,            | Read:        | filebend      | h, dates   | 11.13.20  | 20                |                |
| pool:   | dc750-21     |          |              |                    |              |               |            |           |                   |                |
|         | NAME         | ST       | ATC RI       | AD MRD             | TE OKSU      |               |            |           |                   |                |
|         | dc750-z1     | OW       | LINE         | 0                  | 0            |               |            |           |                   |                |
|         | raids1-      | -0 ON    | LINE         | 0                  | 0            |               |            |           |                   |                |
|         | <14t1        | ide ow   | LINE         | 0                  | 0            |               |            |           |                   |                |
|         | <15t1        | tde ow   | LINE         |                    | 0            |               |            |           |                   |                |
|         | <16t         | 1.40 08  | LINE         | 8                  |              |               |            |           |                   |                |
| host    |              |          |              | miosc              | w_034        |               |            |           |                   |                |
| pool    |              |          |              | 6c750-z            | d (reca      | ize=5128      | , asbe-,   | comprised | f, readcache      | -ell)          |
| alog    |              |          |              | -                  |              |               |            |           |                   |                |
| reaark  |              |          |              | Hes-256            | i-con        |               |            |           |                   |                |
| Fb3     |              |          |              | yncial             | ways         |               |            | sync of i | beldes            |                |
| Fbt ai  | ngleatream   | write.f  |              | yncial             | Mayn         |               |            | sync odd  | beldes            |                |
|         |              |          |              | 273 ops            |              |               |            | 5411 op   |                   |                |
|         |              |          |              | 54,598             |              |               |            |           | 0 opa/a           |                |
|         |              |          |              |                    | n cpu/o      |               |            |           | n cpu/op          |                |
|         |              |          |              |                    | Latency      |               |            | 0.9ms 1   |                   |                |
|         |              |          |              | 64.4 MB            | U'n          |               |            | 5005.4    | ND/s              |                |
|         |              |          |              |                    |              | randor        |            | aingles   | *******           |                |
|         | c cache+all  |          |              | Landomr<br>5.6 MB/ |              | 24.6 1        |            | 82.6 PB   |                   |                |

sync was between 52 and 56 MB/s non-sync was between 1086 and 1093 MB/s

#### DC 750 Pool: 151036, enc on (aes-256ccm)

|  | II CYCF CHINC      | sce_036          | 295 appliance   | rv. 20.dev  | 12.eks 2020          |        |                      | logout                                | admin          | 5010   | en (M  | in   Aci |
|--|--------------------|------------------|---|---|----------------------|--------|----------------------|---------------------------------------|----------------|--------|--------|----------|
| About                                    | Help Servio        | ces Syst         | em Use  | r Disk  | s Pools              | ZFS    | Filesys              | tems                                  | Snap           | pshots | Co     | mstar    |
|  | Pools » Benchm     | arks             |   | Pri   | Hunitor: 23          | 11104  | Pool®                | Cep                                   | Disk           | Net    | CPU    | 3.64     |
| > file                                   | bench > iozone     | examples >       | iccone 1g   | > bonnie  | > dd bene            | h      |                      |                                       |                |        |        |          |
| est done                                 |                    |                  |   |   |                      |        |                      |                                       |                |        |        | ond      |
|  |                    |                  |   |   |                      |        |                      |                                       |                |        |        |          |
|  |                    |                  |   | -   |                      |        |                      |                                       |                |        |        |          |
| Benchru                                  | ark: Write: fi     | Lebench_s        | requential  | , Read:   | none, da             | ited 1 | 1.13.24              | 120                                   |                |        |        |          |
| poolt (                                  | dc750-z1           |                  |   |   |                      |        |                      |                                       |                |        |        |          |
|  |                    |                  |   |   |                      |        |                      |                                       |                |        |        |          |
|  | NAME.              | STATE            | READ MR   | ate ors   | ųπ.                  |        |                      |                                       |                |        |        |          |
|  | dc750-z1           | ONLINE           |   | 0   |                      |        |                      |                                       |                |        |        |          |
|  | rafdz1-0           | ONLINE           |   | 0   |                      |        |                      |                                       |                |        |        |          |
|  |                    | COMPANY NAMES    |   |   |                      |        |                      |                                       |                |        |        |          |
|  | <16t1d0            | Case 7 147       |   |   |                      |        |                      |                                       |                |        |        |          |
|  | <1/t1d0<br><1/t1d0 |                  |   |   | :                    |        |                      |                                       |                |        |        |          |
|  |                    | ONLINE           |   |   |                      |        |                      |                                       |                |        |        |          |
| host                                     | c17t1d0            | ONLINE           | 0   |   |                      |        |                      |                                       |                |        |        |          |
|  | c17t1d0            | ONLINE           | e<br>e<br>enntos  | 9<br>9<br>co_636  |                      | (, ssb | *-, cor              | preof:                                | , rea          | dcache | r-all) |          |
| host<br>pool<br>slog                     | c17t1d0            | ONLINE           | e<br>e<br>enntos  | 9<br>9<br>co_636  | :                    | (, ssb | •-, car              | <b>p</b> refi                         | f, rea         | dcache | rall)  |          |
| pool                                     | c17t1d0<br>c15t1d0 | ONLINE           | e<br>e<br>dc158-  | 9<br>0<br>21 (rec                                       | :                    | (, ssb | •-, ca               | <b>p</b> reft                         | f, rea         | dcache | rall)  |          |
| pool                                     | clitide<br>clitide | ONLINE           | 0<br>0<br>dc156   | 9<br>0<br>21 (rec                                       | :                    | (, ssb | -, ca                | pr∘oft                                | f, rea         | dcache | r=əll) |          |
| pool<br>slog<br>encrypt                  | clitide<br>clitide | ONLINE           | 0<br>0<br>dc156   | 0<br>0<br>21 (rec<br>6-con                              | :                    | (, ssb | ,                    | prefi<br>modili                       |                |        | rall)  |          |
| pool<br>slog<br>encrypt<br>remark<br>Fb3 | clitide<br>clitide | ORLINE<br>ORLINE | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 0<br>0<br>21 (rec<br>6-ccm                              | :                    | (, ssb | *7                   |                                       | ubled          |        | rall)  |          |
| pool<br>slog<br>encrypt<br>remark<br>Fb3 | clitide<br>clitide | ORLINE<br>ORLINE | 0<br>0<br>dc758-<br>aes-25<br>syncta  | e_636<br>zi (rec<br>6-ccm<br>Annys<br>Annys             | :                    | (, ssb | ny<br>ny             | ma ndi i                              | ubled          |        | =all)  |          |
| pool<br>slog<br>encrypt<br>remark<br>Fb3 | clitide<br>clitide | ORLINE<br>ORLINE | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | e_636<br>zi (rec<br>6-ccm<br>Annys<br>Annys             | s12e-118             | (, ssb | 17<br>17<br>47       | encodia<br>encodia                    | abled          |        | rall)  |          |
| pool<br>slog<br>encrypt<br>remark<br>Fb3 | clitide<br>clitide | ORLINE<br>ORLINE | o<br>onnfos<br>dc758-<br>aes-25<br>synctia<br>synctia<br>S78 op<br>115,59                   | 0<br>0<br>21 (rec<br>6-ccm<br>Annyn<br>Annyn            | 5120-1288            | (, ssb | 57<br>57<br>47<br>95 | mandin<br>mandin<br>153 opt           | ubled          |        | rall)  |          |
| pool<br>slog<br>encrypt<br>remark<br>Fb3 | clitide<br>clitide | ORLINE<br>ORLINE | 0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0<br>0 | 9<br>9<br>21 (гес<br>6-сся<br>Линув<br>Линув<br>6 ора/в | 9<br>9<br>5120=12.09 | (, ssb | 57<br>57<br>47<br>95 | mandin<br>mandin<br>51 opti<br>10,574 | ubled<br>ops/s | op     | -all)  |          |

sync was between 112 and 129 MB/s non-sync was between 950 and 954 MB/s

# 3.0 Disk pool, Epyc on OmniOS 151036

I had to switch mpio off in menu Disk > Details > SAS, test date was Dec 03, 2020

#### Disk Pool: without slog, enc off

| Nout Help Services Sys               | tem l         | Jser Dis  | ks Pool      | E ZFI    | 5 File | systems   | Snapshot   | s Coms   |
|--------------------------------------|---------------|-----------|--------------|----------|--------|-----------|------------|----------|
| ome » Pools » Benchmarks             |               | 1         | Pro-Monitor: | 15:29:22 | e Po   | 10 Cap®   | Disk @ Nec | 0 CPU0 J |
| > filebench > lozone examples        | > lozone      | 1g > bonn | e > ddber    | ch       |        |           |            |          |
| est dane                             |               |           |              |          |        |           |            |          |
|                                      |               |           |              |          |        |           |            |          |
| Benchmark: Write: filebench          | and the state | ial. Read | 1 fileber    | en di    |        | 00.00.203 |            |          |
|                                      |               | ,         |              | ,        |        |           |            |          |
| pooli hd-zi                          |               |           |              |          |        |           |            |          |
| NAME                                 |               | STATE     | READ W       | ате с    | (SUM   |           |            |          |
| hd-z1                                |               | ONLENE    |              |          |        |           |            |          |
| raidz1-0                             |               | ONLINE.   |              |          |        |           |            |          |
| C27E5000CCA000E3                     |               |           |              | 0        | 0      |           |            |          |
| 629458886CCA88ECC                    |               |           | :            |          |        |           |            |          |
| <3115888CCA888CE<br><2815888CCA888CE |               |           |              |          | - 2    |           |            |          |
| c38t58886CCA88EC8                    |               |           |              |          | - 2    |           |            |          |
| c25t5888CCA38EC4                     |               |           |              |          |        |           |            |          |
| <26158886CCA26218                    |               |           |              | ÷.       |        |           |            |          |
|                                      |               |           |              |          |        |           |            |          |
| host                                 |               | feace_406 |              |          |        |           |            |          |
| pool                                 | hd-           | al (recs1 | 20+1208,     | ssb+-,   | 0.08   | preoff, a | eadcache+a | 11)      |
| alog                                 | -             |           |              |          |        |           |            |          |
| encryption                           | -             |           |              |          |        |           |            |          |
| remark                               |               |           |              |          |        |           |            |          |
| Fb3                                  | 591           | c-always  |              |          |        | syncedia  | abled      |          |
| Fbd singlestreamwrite.f              | 101           | crebergs  |              |          |        | syncrotic | abled      |          |
|                                      | 258           | ops       |              |          |        | 5947 opt  |            |          |
|                                      |               | 598 ops/s |              |          |        | 1189,363  | ops/s      |          |
|                                      | 722           | stus opu/ | 99           |          |        | 27453.05  | cpu/op     |          |
|                                      | 19-           | ims Later | cy           |          |        | 0.0ms lo  | tency      |          |
|                                      | 58.           | 4 MD/N    |              |          |        | 1119.2 1  | 0/1        |          |
|                                      |               | domread.f |              |          |        |           |            |          |
|                                      |               |           |              |          |        |           |            |          |

I startet the write benchmark multiple times: sync was between 51 and 55 MB/s non-sync between 1178 and 1197 MB/s

#### Disk Pool: with Optane 900 slog, enc off

| nopp      | -if pro          | omniosce,           | .036 275 ap  | pliancev  | 20.dev 12 | oke 2020   |          |       | logout     | : admin   soi   E         | dit   Mon   A |
|-----------|------------------|---------------------|--------------|-----------|-----------|------------|----------|-------|------------|---------------------------|---------------|
| About     | Help             | Services            | System       | User      | Disks     | Pools      | ZFS      | File  | systems    | Snapshots                 | Comsta        |
| horme xe  | Peols >>         | Benchmarks          |              |           | Pro       | Monitor: 1 | 5:43:405 | Por   | ile cipe   | DIA® NO                   | CPU 0 Ju      |
| > file    | bench >          | lotone exam         | ples > legor | e 1g >    | bonnie >  | dd bene    | h        |       |            |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
| est done  | •                |                     |              |           |           |            |          |       |            |                           | U             |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
| tenches   | ariko Mrt        | ite: filebe         | inch secure  | stial.    | Reads 1   | Tebers     | ch, da   | te:   | 08.10.202  |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
| peol: P   | bd-z1            |                     |              |           |           |            |          |       |            |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
|           | NAME             |                     |              | STA       |           | ILAD NR    |          |       |            |                           |               |
|           | hd-z1            | da1-0               |              | ONE.      |           | :          |          | 0     |            |                           |               |
|           |                  | 821-0<br>2755000CCA |              |           |           |            | -        |       |            |                           |               |
|           |                  | 2945000CCM          |              |           |           |            |          | ő     |            |                           |               |
|           |                  | 35+5000CCA          |              |           |           |            |          | ő     |            |                           |               |
|           |                  | 2845000CCA8         |              |           |           | ÷.         |          |       |            |                           |               |
|           |                  | 304 5000CCA         |              |           |           |            |          | ő     |            |                           |               |
|           |                  | 2585000CCA2         |              |           |           |            |          |       |            |                           |               |
|           |                  | 26450000043         |              |           |           |            |          | 0     |            |                           |               |
|           | logs             |                     |              |           |           |            |          |       |            |                           |               |
|           | <18 <sup>1</sup> | 1549                |              | ONL:      | 2016      |            | ٠        | ۰     |            |                           |               |
| heat      |                  |                     |              | mione     |           |            |          |       |            |                           |               |
| peel      |                  |                     |              |           |           | 1206.      | coher -  |       | ereft      | wadcachemal1              | 13            |
| slog      |                  |                     |              | ()        |           |            |          | 0.000 | priorit, i | And a construction of the | .,            |
| encrypt   | rion.            |                     |              |           |           |            |          |       |            |                           |               |
| remark    |                  |                     |              |           |           |            |          |       |            |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
| Fb3       |                  |                     |              | mc+al     |           |            |          |       | sync+d1;   | bled                      |               |
| 100       |                  |                     |              |           | agy s     |            |          |       | sync.eq.   | auteu                     |               |
| Fb4 str   | nglestre         | earner1te.f         | 5            | meral     | niny 5    |            |          |       | syncrolis  | abled                     |               |
|           | _                |                     | 4            | 541 op:   | 5         |            |          |       | 6863 005   | k.                        |               |
|           |                  |                     |              | 08.172    |           |            |          |       | 1212.564   |                           |               |
|           |                  |                     |              |           | cpa/op    |            |          |       | 26452us    |                           |               |
|           |                  |                     |              | ins l     |           |            |          |       | 0.8ms 1.   |                           |               |
|           |                  |                     | 9            | 08.0 M    | N/5       |            |          |       | 1212.4 3   | 8/5                       |               |
|           |                  |                     |              | and one o |           |            | anna, f  |       | ainglest   |                           |               |
|           |                  |                     |              |           |           |            |          |       |            |                           |               |
| or 1 from | c cache          | 164-                |              | 30.4 M    | 104       | 586.0      | C MB/S   |       | 4.0 G8/1   |                           |               |

#### without slog, enc on (aes-256ccm)

| About Help Services Sys         | tem Use          | r Diska    | Pools        | ZFS     | Filesy | stems   | Snaps    | hots  | Com   | star  |
|---------------------------------|------------------|------------|--------------|---------|--------|---------|----------|-------|-------|-------|
| home » Pools » Benchmarks       |                  | Pa         | a Monitor: 3 | 5.34 55 | Post   | Cap O   | Disk 😶 1 | Nut O | CPU O | Jubi  |
| > filebench > iszone examples > | iszone 1g        | > bonnie   | > dd bens    | h       |        |         |          |       |       |       |
| test done                       |                  |            |              |         |        |         |          |       |       | ] cmd |
|                                 |                  |            |              |         |        |         |          |       |       |       |
|                                 |                  |            |              |         |        |         |          |       |       |       |
| Benchmark: Write: filebench_    | sequential       | , Reads    | fileben      | ch, da  | te: 68 | .19.260 | 10       |       |       |       |
| pool: hd-21                     |                  |            |              |         |        |         |          |       |       |       |
| NAME                            | 57               | ATE        | READ WRI     | m o     | SUM    |         |          |       |       |       |
| hd-z1                           |                  | LINE       |              | 6       |        |         |          |       |       |       |
| raldz1-0                        | CR               | LINE       |              | •       |        |         |          |       |       |       |
| <2745666CCA888E3                | ceacile on       | LINE       |              |         |        |         |          |       |       |       |
| <2945090CCA88EC6                | secade or        | LINE       |              |         |        |         |          |       |       |       |
| <3115000CCA88EC6                | Deside on        | LINE       |              |         |        |         |          |       |       |       |
| C2845090CCA88EC6                | asside of        | LINE       |              |         |        |         |          |       |       |       |
| C3015000CCABBLCG                | E2F4d9 ON        | LINE       |              |         |        |         |          |       |       |       |
| C2545090CCA26069                | 11ADde of        | LINE       |              |         |        |         |          |       |       |       |
| C2685090CCA2621A                | 3.891d0 ON       | LINE       |              |         |        |         |          |       |       |       |
| host                            | omn1cs           | ce.035     |              |         |        |         |          |       |       |       |
| pool                            | hd-21            | (recstat   | -128K, 1     | ssb,    | compr  | -off, r | readcach | e-all | 13    |       |
| slog                            |                  |            |              |         |        |         |          |       |       |       |
| encryption                      | att-25           | 6-008      |              |         |        |         |          |       |       |       |
| renark                          |                  |            |              |         |        |         |          |       |       |       |
|                                 |                  |            |              |         |        |         |          |       |       |       |
| Fb3                             | sync+a           | Oways      |              |         |        | sync=d1 | abled    |       |       |       |
| Fbi singlestreamwrite.f         | sync+a           | (Lassey) S |              |         |        | yncedir | unbled   |       |       |       |
|                                 | 185 op           |            |              |         |        | 843 opt |          |       |       |       |
|                                 |                  | ops/a      |              |         |        | 208,56  |          |       |       |       |
|                                 |                  | us cpu/e   | 0            |         |        |         | cpu/op   |       |       |       |
|                                 |                  |            |              |         |        | .tes L  |          |       |       |       |
|                                 | 26,988           |            |              |         |        | 208.4 5 |          |       |       |       |
|                                 | 26.983<br>36.8 F |            |              |         | -      | 1000    | 10.7 5   |       |       |       |
|                                 | 36-8 8           |            |              |         |        | inglest |          |       |       |       |

sync was between 36 and 40 MB/s non-sync was between 1203 and 1230 MB/s

### with Optane 900 slog, enc on (aes-256ccm)

| napp-it pro a   | minosce_   | <b>1030</b> 215 30 | priance (       | 1. 20. MAY 1  | 2.6% 202  | N     |         | Legion           | C nominal set [ | Edit   Man-  Acc- |
|---|------------|--------------------|-----------------|---------------|-----------|-------|---------|------------------|-----------------|-------------------|
| About Help !  | Services   | System             | User            | Disks         | Pool      | is Z  | FS File | isystems         | Snapshots       | Comstar           |
| ome » Pools » Be  | nchmarks   |                    |                 | Pr            | o Merikor | 36:07 | ds Pr   | 40 cip0          | DEAD INCO       | 000 000           |
| > filebench > io  | zone exam  | ples > laza        | ne 1g >         | bonnie        | > dd be   | nch   |         |                  |                 |                   |
| est done  |            |                    |                 |               |           |       |         |                  |                 | and               |
|   |            |                    |                 |               |           |       |         |                  |                 |                   |
| and the second se |            |                    |                 | Received a    |           |       | d       |                  |                 |                   |
| Benchmarks Hrit   | es ritebe  | nch_seque          | ntiat,          | Reads         | TILEBO    | ncn,  | dates   | 08.19.20         | 20              |                   |
| pool: hd-z1   |            |                    |                 |               |           |       |         |                  |                 |                   |
| NAME  |            |                    | STA             | 16            | READ W    | RETE  | CKSUN   |                  |                 |                   |
| hd-z1   |            |                    | ONL             | INC           | 0         |       | 0       |                  |                 |                   |
| raidz   | 1-0        |                    | ONL             | INC           | 0         |       | 0       |                  |                 |                   |
| c27   | ±5000CCA0  | 00E3CE1Cd          | 0 ONL           | INC           | 0         |       |         |                  |                 |                   |
| c29   | t SODOCCAD | BECGBEGAD          | 0 ONL           | 2100          | 0         |       |         |                  |                 |                   |
| C31   | t5000CCA0  | BECEDED1d          | 0 ONL           | 2345          |           |       |         |                  |                 |                   |
| c28   | t5000CCA0  | BECKEDDIG          | 0 ONL           | 2345          |           |       |         |                  |                 |                   |
| c30   | L SOODCCAO | BECKE2Fed          | 9 OPL           | 2105          | é         | - é   |         |                  |                 |                   |
| c25   | 11000CCA2  | 686911ADd          | D OPIL          | 2105          | é         |       |         |                  |                 |                   |
| <26   | L SODDCCA2 | 621A3401d          | O ONL           | 2105          | é         | a.    |         |                  |                 |                   |
| logs  |            |                    |                 |               |           |       |         |                  |                 |                   |
| <1813   | 48         |                    | ONL             | THE           | 0         |       | 0       |                  |                 |                   |
| host  |            |                    | aniosc          | e 036         |           |       |         |                  |                 |                   |
| pool  |            |                    |                 |               | -1288.    | ssb-  |         | prestf.          | readcache-al    | 11                |
| slog  |            |                    |                 |               |           |       |         |                  |                 |                   |
| encryption  |            |                    | 01-256          |               |           |       |         |                  |                 |                   |
| remark  |            | -                  |                 |               |           |       |         |                  |                 |                   |
| rba   |            | 5                  | ync-at          | ways          |           |       |         | sync=d1          | sabled          |                   |
| Fb4 singlestrea   | -          |                    | vnc-at          |               |           |       |         | sync-d1          | to be false     |                   |
| anglestrea  | mer togat  |                    | 58 ops          |               |           |       |         | 5635 op          |                 |                   |
|   |            |                    |                 |               |           |       |         |                  |                 |                   |
|   |            |                    | 1.599           |               |           |       |         | 1166.96          |                 |                   |
|   |            |                    |                 | a cpu/e       |           |       |         | 1331420          |                 |                   |
|   |            |                    | 1.4ms<br>1.4 MD | Latency<br>/s | ,<br>,    |       |         | 0.5m 1<br>1166.8 |                 |                   |
|   |            |                    |                 |               |           |       |         |                  |                 |                   |
|   |            |                    | andomr          | ead.f         | C.80      | domny | • T     | aingles          | treamr          |                   |
| pri/sec cache+a   |            |                    | 53.2 N          |               |           | -4 ME |         | 2.2 68/          |                 |                   |

I startet the write benchmark multiple times: sync was between 908 MB/s and 956 MB/s non-sync between 1151 MB/s and 1212 MB/s

sync was between 31 MB/s and 32 MB/s and non-sync was between 1166 MB/s and 1213 MB/s

# 3.1: Traditional Flash NVMe (Intel DC750) pool, Epyc on OmniOS 151036

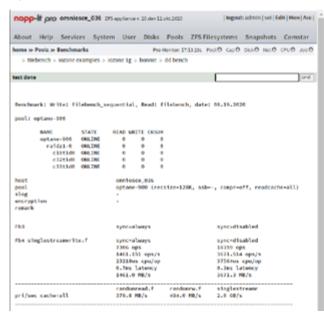
#### DC 750 Pool: 151036, enc off

| hout          | Help Service     | res System   | n User                        | Disks                    | Pools 7    | FS Filesystems               | Snapshots               | Comstar |
|---------------|------------------|--------------|-------------------------------|--------------------------|------------|------------------------------|-------------------------|---------|
|               | Paols to Benchm  |              |                               |                          |            | Sa Pool® Cap®                |                         |         |
|               | bench > iozone e |              |                               |                          |            | sa reso capo                 | Dato ano                | 000 200 |
| 2.114         |                  | Complete 2 H | North Laboratory              | Sector 2                 | CO DENOS   |                              |                         |         |
| est don       |                  |              |                               |                          |            |                              |                         | end     |
|               |                  |              |                               |                          |            |                              |                         |         |
|               |                  |              |                               |                          |            |                              |                         |         |
| enche         | ark: Write: fi   | Lebench_see  | quential,                     | Read: 1                  | ilebench,  | date: 08.19.20               | 29                      |         |
|               | dc750-21         |              |                               |                          |            |                              |                         |         |
| 0011          | 00130-22         |              |                               |                          |            |                              |                         |         |
|               | NAME             | STATE        | READ WRD                      | TE OKSUN                 |            |                              |                         |         |
|               | dc750-21         | ONLINE.      |                               | 0 6                      | •          |                              |                         |         |
|               | raidz1-0         | ONLINE       | ٠                             | • •                      | ,          |                              |                         |         |
|               |                  | ONLINE       | 0                             | 0 1                      |            |                              |                         |         |
|               | <19t1d0          | ONLINE       | 0                             | 0 0                      |            |                              |                         |         |
|               | <21t1d0          | ONLINE       |                               | 0 0                      |            |                              |                         |         |
| 105T          |                  |              | omfesc                        | e_036                    |            |                              |                         |         |
| food          |                  |              | dc750-a                       | 1 (recs)                 | ze-128K, s | sb, conpr-of                 | f, readcache-           | -att)   |
| slog          |                  |              |                               |                          |            |                              |                         |         |
| encryp        | tion             |              |                               |                          |            |                              |                         |         |
| resark        |                  |              |                               |                          |            |                              |                         |         |
|               |                  |              | syncral                       | anays                    |            | syncrd1                      | abled                   |         |
| FEB           |                  | e.f          | sync-al                       | ways.                    |            | sync-d1                      | sabled                  |         |
|               | nglestreamerit   |              | 5674 op                       | 15                       |            | 9352 opt                     |                         |         |
|               | nglestreamwit    |              |                               |                          |            | 1870.32                      | a consta                |         |
|               | nglestreamwrit   |              |                               | 2 ops/s                  |            |                              |                         |         |
|               | nglestreamwrit   |              | 1134.77                       | 2 ops/s<br>cpu/op        |            | 23143us                      |                         |         |
|               | nglestreamerit   |              | 1134.77                       | cpu/op                   |            |                              | cpu/op                  |         |
|               | nglestreanwrit   |              | 1134.77                       | cpu/op<br>atency         |            | 23143us                      | cpu/op<br>tency         |         |
| rba<br>fb4 st | nglestreamrit    |              | 1134.77<br>23984us<br>0.9ms 1 | cpu/op<br>atency<br>MB/s | randomra   | 23143u5<br>0.5mm L<br>1870.1 | cpu/op<br>itency<br>@/s |         |

I startet the write benchmark multiple times: sync was between 943 and 1134 MB/s non-sync between 1591 and 1877 MB/s

## 3.2: Optane 900 pool, Epyc on OmniOS 151036

#### Optane Pool: 151036, enc off



I startet the write benchmark multiple times: sync was between 1445 and 1471 MB/s non-sync between 3339 and 3707MB/s

#### DC 750 Pool: 151036, enc on (aes-256ccm)

| nopp             | lit pro         | omnios     | ce_036 77   | 5 appliance                              | v. 20.dev 12                                  | oke.2020       |        | logout   | t: admin   sol   E                    | dit   Mon   Ac |
|------------------|-----------------|------------|-------------|--|---|----------------|--------|--|---------------------------------------|----------------|
| About            | Help            | Service    | is System   | n User                                   | Disks   | Pools          | ZFS F  | ilesystems   | Snapshots                             | Comstan        |
| ieme »           | Peels » B       | enchmar    | rks         |  | Pro   | Nonition 10    | 50135  | Pool® Cap®   | pek@ set@                             | CPUB Jos       |
| > 6H             | beach > k       | 0.2000E EX | amples > lo | eone Ig >                                | bonnie >                                      | dd bench       | •      |  |                                       |                |
| est done         | ,               |            |             |  |   |                |        |  |                                       | cme            |
|                  |                 |            |             |  |   |                |        |  |                                       |                |
| Benchm           | erkt Writt      | e: fil     | ebench_we   | pential,                                 | Read: 1                                       | ilebenci       | , dete | : 68.19.202  | 20                                    |                |
| molt.            | 6c750-z1        |            |             |  |   |                |        |  |                                       |                |
|                  |                 |            |             |  |   |                |        |  |                                       |                |
|                  | MARE<br>dc758-a |            | STATE       | READ MRD                                 | e cksue                                       |                |        |  |                                       |                |
|                  |                 |            | CHILINE     |  |   |                |        |  |                                       |                |
|                  |                 |            | CHILINE     |  |   |                |        |  |                                       |                |
|                  |                 | elde -     |             |  |   |                |        |  |                                       |                |
|                  |                 | 100        |             | ē  |   |                |        |  |                                       |                |
| host             |                 |            |             | oantese                                  | e 836   |                |        |  |                                       |                |
| pool             |                 |            |             |  |   | ze=128K        | ssba   | , compressfi   | f, readcaches                         | (Ifa:          |
| slog             |                 |            |             |  |   |                |        |  |                                       |                |
| encryp<br>renark | tion            |            |             | aes-256                                  |   |                |        |  |                                       |                |
| Fb3              |                 |            |             | synceal                                  | any n   |                |        | syncedia   | bled                                  |                |
| 1.00             |                 |            |             |  |   |                |        |  |                                       |                |
|                  | nglestrea       | marite     | .f          | syncial                                  | any a   |                |        | synculis   | uabled.                               |                |
|                  | nglestres       | ewrite     | .f          | 1032 - 9                                 | n í   |                |        | synculia<br>7794 ops                                     |                                       |                |
|                  | nglestrea       | marite     | .f          | 1032 - 9                                 |   |                |        |  |                                       |                |
|                  | nglestrei       | murite     | .f          | 1032 og<br>206.395<br>2056646            | ns<br>Sops/s<br>ns cpu/og                     |                |        | 7794 opt<br>1558.744<br>14713301                         | ops/s<br>cpu/op                       |                |
|                  | nglestres       | marite     | .f          | 1032 og<br>206.395<br>2056644<br>4.885 1 | n<br>ops/s<br>s cpu/op<br>latency             | ,              |        | 7794 opt<br>1558.744<br>14713304<br>0.6% la              | t ops/s<br>i cpu/op<br>itency         |                |
|                  | nglestrea       | ener i te  | uf          | 1032 og<br>206.395<br>2056646            | n<br>ops/s<br>s cpu/op<br>latency             | •              |        | 7794 opt<br>1558.744<br>147133ui<br>0.6m5 li<br>1558.5 P | t ops/s<br>s cpu/op<br>stency<br>mb/s |                |
| Pbi si           | nglestrea       |            | f           | 1032 og<br>206.395<br>2056644<br>4.885 1 | ns<br>S ops/s<br>ns cpu/og<br>Latency<br>60/s | rando<br>245.4 |        | 7794 opt<br>1558.744<br>147133ui<br>0.6m5 li<br>1558.5 P | eps/s<br>cpu/op<br>itency<br>10/5     |                |

sync was between 201 and 206 MB/s non-sync was between 1541 and 1592MB/s

#### Optane Pool: 151036, enc on (aes-256ccm)

|               | -If pro omnio    | sce_036 z       | PS appliance  | x 20 dev 12   | okt.2020       |                            | logout   | : admin   sol   E                        | dit   Mon-  Ac |
|---------------|------------------|-----------------|---|---|----------------|----------------------------|--|--|----------------|
| About         | Help Servio      | ces Syste       | m User  | Disks   | Peols 2        | FS Filesys                 | stems  | Snapshots                                | Comstar        |
| home :==      | Pools := Benchm  | arks            |   | Pro   | Antikor, 17:18 | 52s Pool®                  | Cap B  | Disk@ Net@                               | child the      |
| > file        | bench > lozone e | examples >      | iozone 1g >   | bonnie >  | dd bench       |                            |  |  |                |
| est done      | ,                |                 |   |   |                |                            |  |  | un:            |
|               | urkt Writes fi   | laborth su      |   | Bandli d  | il shench.     | data1 00                   | 10.363   | *  |                |
|               | optane-900       | Consension _ se | iquent int,   | Nead1 1   | themen,        | 04141 05                   |  |  |                |
|               | NAME             | STATE           | READ VIRU   | TE CESUR  |                |                            |  |  |                |
|               | optane-900       |                 | 0   | 0 0   |                |                            |  |  |                |
|               | raidr1-0         |                 |   |   |                |                            |  |  |                |
|               | <18t1d0          |                 |   |   |                |                            |  |  |                |
|               | <32t1d0          | OWLINE          |   | 0 0   |                |                            |  |  |                |
|               | <3341d0          | OWLINE          |   | • •   |                |                            |  |  |                |
| host          |                  |                 | omnioso   | e_036   |                |                            |  |  |                |
| pool.         |                  |                 | optane-   | 900 (rec  | s1ze-128K      | ssb, 4                     | compres  | ff, readcad                              | he=all)        |
| slog          |                  |                 |   |   |                |                            |  |  |                |
|               | tion             |                 | aes-256   | -008  |                |                            |  |  |                |
| encrypt       |                  |                 |   |   |                |                            |  |  |                |
| renark        |                  |                 |   |   |                |                            |  |  |                |
| renark        |                  |                 | sync+a1   | ways  |                |                            | ymc=d1s  | abled                                    |                |
| renark<br>Fb3 | glestreamorit    | e.f             | sync+a1   | ways  |                |                            | ynced1s  | abled                                    |                |
| renark<br>Fb3 |                  | e.f             | sync+ol<br>1056 op                                  | ways<br>5   |                | 5                          | yncedis<br>611 ops                                 | abled                                    |                |
| renark<br>Fb3 |                  | e.f             | sync+ol<br>1056 op<br>203,194                       | nays<br>s<br>ops/s                                  |                | 5                          | ync=d1s<br>611 ops<br>722.548                      | abled ops/s                              |                |
| renark<br>Fb3 |                  | e.f             | sync+ol<br>1056 op<br>203.194<br>211559             | nays<br>is<br>ops/s<br>is cpu/op                    | ,              | 5)<br>84<br>51<br>54       | ync=d1s<br>611 ops<br>722.148<br>63334es           | abled<br>ops/s<br>cpu/op                 |                |
| renark<br>Fb3 |                  | e.f             | sync+al<br>1056 op<br>203.194<br>2115594<br>4.995 1 | nays<br>s<br>ops/s<br>s cpu/og<br>atency            | ,              | 5)<br>84<br>11<br>12<br>9  | yncedis<br>611 ops<br>722.848<br>63334es<br>686 la | abled<br>ops/s<br>cpu/op<br>(tency       |                |
| renark<br>Fb3 |                  | e.f             | sync+ol<br>1056 op<br>203.194<br>211559             | nays<br>s<br>ops/s<br>s cpu/og<br>atency            |                | 5)<br>84<br>11<br>12<br>9  | ync=d1s<br>611 ops<br>722.148<br>63334es           | abled<br>ops/s<br>cpu/op<br>(tency       |                |
| renark<br>Fb3 |                  | e.f             | sync+al<br>1056 op<br>203.194<br>2115594<br>4.995 1 | ways<br>is<br>i ops/s<br>is cpu/op<br>atency<br>#/s | randonr        | 5)<br>51<br>52<br>6.<br>12 | yncedis<br>611 ops<br>722.848<br>63334es<br>686 la | abled<br>opn/n<br>cpu/op<br>Rency<br>B/s |                |

sync was between 202 and 207 MB/s non-sync was between 1720 -1730 MB/s

## 4.0 Virtualized NAS, ESXi 7.0u1, 8Core, 64GB RAM, SAS HBA and NVMe pass-through

#### Disk Pool: without slog, enc off

| nopp-lit pro     | ) omnios36                      | 2PS appliance | e x. 20.06 | A3 Pro   |           |          |        | logout | admin  | I SOU   EA | and   Milde | + AIX |
|------------------|---------------------------------|---------------|------------|----------|-----------|----------|--------|--------|--------|------------|-------------|-------|
| About Help       | Services                        | System        | User       | Disks    | Peols     | ZFS      | Filesy | stems  | Snap   | pshots     | Cor         | nsta  |
| nome :» Pools :» | Benchmarks                      |               |            | ProM     | onitor 20 | 21.495   | Pool®  | Cap®   | Disk®  | Net 🖰      | oru@        | 3064  |
| > filebench      | <ul> <li>logane exam</li> </ul> | ples > locor  | e ig > l   | bonnie > | dd benc   | h        |        |        |        |            |             |       |
| est done         |                                 |               |            |          |           |          |        |        |        |            |             | Cinc  |
|                  |                                 |               |            |          |           |          |        |        |        |            |             |       |
| Benchmarkt W     | rite: filebe                    | ench_seque    | stial,     | Read: 1  | ileben    | ch, da   | te: 08 | .19.20 | 20     |            |             |       |
| In-bd : fooq     |                                 |               |            |          |           |          |        |        |        |            |             |       |
| NAME             |                                 |               | STATE      |          | AD MRIT   |          | a m    |        |        |            |             |       |
| hd-z             | 1                               |               | ONLIN      |          | 8         |          | 6      |        |        |            |             |       |
|                  | dr1-0                           |               | ONLIN      |          | ě.        |          | ē      |        |        |            |             |       |
|                  | OT5088CCADE                     | NET CETOM     |            |          | 6         | 0        | ě.     |        |        |            |             |       |
|                  | OTS000CCAD                      |               |            |          | ě.        | õ.       | ě.     |        |        |            |             |       |
|                  | 015080CCA0                      |               |            |          | ě.        | ě.       | ē      |        |        |            |             |       |
|                  | 015088CCA8                      |               |            |          | ě.        | ě.       | ē      |        |        |            |             |       |
|                  | 015088CCA0                      |               |            |          |           | ÷ .      | ě      |        |        |            |             |       |
|                  | C315088CCA24                    |               |            |          |           | ÷ .      | ě      |        |        |            |             |       |
|                  | C4159H0CCA20                    |               |            |          |           | ÷ .      | ě.     |        |        |            |             |       |
| host             |                                 |               | wios36     |          |           |          |        |        |        |            |             |       |
| pool             |                                 | b             | 1-21 (1    | ecaizes  | 1206.     | ab       | compr  | off.   | readca | che+al     | 13          |       |
| alog             |                                 | -             |            |          |           |          |        |        |        |            |             |       |
| encryption       |                                 | -             |            |          |           |          |        |        |        |            |             |       |
| renark.          |                                 |               |            |          |           |          |        |        |        |            |             |       |
| Fb3              |                                 | 5             | mc-alw     | ays      |           |          |        | ync=d1 | sabled |            |             |       |
| Fb4 singlest     | reamerite.f                     |               | mc-alw     | 215      |           |          |        | anc-di | sahled |            |             |       |
|                  |                                 |               | 19 005     |          |           |          |        | 894 op |        |            |             |       |
|                  |                                 |               | 7.797 0    | es.ls    |           |          |        | 179.14 |        |            |             |       |
|                  |                                 |               | 6308us     |          |           |          |        | 7188us |        |            |             |       |
|                  |                                 |               | 0.0ms 1    |          |           |          |        | .8ms l |        |            |             |       |
|                  |                                 |               | 7.6 HB/    |          |           |          |        | 178.9  |        |            |             |       |
|                  |                                 |               |            |          |           |          |        |        |        |            |             |       |
|                  |                                 |               | andoere    | ad.f     | rande     | ineres f |        | ingles | treasr |            |             |       |

I startet the write benchmark multiple times: sync was between 47 and 52 MB/s non-sync between 1178 and 1225 MB/s

#### Disk Pool: with Optane 900 slog, enc off

| bout Help Services System           | User       | Disks    | Pools      | ZFS     | ilesystems     | Snapshots    | Comsta   |  |  |  |
|-------------------------------------|------------|----------|------------|---------|----------------|--------------|----------|--|--|--|
| eme » Pools » Benchmarks            |            | Pro      | Monitor 20 | 135.305 | Fool® Cap®     | Dik® Net®    | CPUB Jos |  |  |  |
| > filebench > inzone examples > inz | one 1g > I | bonnie > | dd bend    | h       |                |              |          |  |  |  |
| st done                             |            |          |            |         |                |              | 67       |  |  |  |
|                                     |            |          |            |         |                |              |          |  |  |  |
| enchmark: Write: filebench.segu     | ential,    | Reads f  | Hebenc     | h, dat  | 01 08.19.200   | 19           |          |  |  |  |
| colt M-zi                           |            |          |            |         |                |              |          |  |  |  |
| 845                                 | STATE      |          | AD WRIT    | e cesu  |                |              |          |  |  |  |
| hd-z1                               | ONL 11     |          |            |         | 0              |              |          |  |  |  |
| raidz1-0                            | ONL TH     |          |            |         | 0              |              |          |  |  |  |
| CONSIDERCEASEBEICEICE               | ONL TR     | 1        |            |         | 0              |              |          |  |  |  |
| CRESORRCCARELOGERAN                 |            |          | -          | -       | 0              |              |          |  |  |  |
| c045000CCA88EC6D6914                |            |          |            |         | 0              |              |          |  |  |  |
| E045000CCAREFCEE1974                |            |          |            |         | à              |              |          |  |  |  |
| COTSOODCCARECOLE2F4d                |            |          |            |         | 0              |              |          |  |  |  |
| C315000CCA2600011ADd                |            |          |            |         | 0              |              |          |  |  |  |
| c4t5000CCA2621A3A93d                |            |          |            |         | 0              |              |          |  |  |  |
| logs                                | 0.000      |          |            |         | <i>a</i>       |              |          |  |  |  |
| clitide                             | ONLIN      |          |            |         | 0              |              |          |  |  |  |
| CITCIPL                             | 046.15     | ×.       | 0          | •       | 0              |              |          |  |  |  |
| 657                                 | ometers 30 |          |            |         |                |              |          |  |  |  |
|                                     |            |          |            |         |                | eadcacheral) |          |  |  |  |
|                                     | 100-22 ()  | 412154   | 3205, 5    |         | compression, a | ABDCACEM-AC  | 49       |  |  |  |
| log                                 |            |          |            |         |                |              |          |  |  |  |
| ncryption                           | -          |          |            |         |                |              |          |  |  |  |
| enark                               |            |          |            |         |                |              |          |  |  |  |
| ba                                  | sync-ala   | iby's    |            |         | sync-d1        | abled        |          |  |  |  |
|                                     | sync-ala   | ays.     |            |         | sync-di-       |              |          |  |  |  |
|                                     | 820 ops    |          |            |         |                | 5458 ops     |          |  |  |  |
|                                     | 163.990    |          |            |         | 1091.45        |              |          |  |  |  |
|                                     | 4466663    |          |            |         | 33156us        |              |          |  |  |  |
|                                     | 1.0m L     |          |            |         | 0.9m L         |              |          |  |  |  |
|                                     | 163.8 N    | U/s      |            |         | 1091.3 )       |              |          |  |  |  |
|                                     |            |          |            |         |                |              |          |  |  |  |
|                                     | randonre   | nad.¶    | rando      | erw. T  | singles        | ream         |          |  |  |  |

without slog, enc on (aes-256ccm)

|            |         |             | -            |              |          |           |          |      |          |            |       |        |
|------------|---------|-------------|--------------|--------------|----------|-----------|----------|------|----------|------------|-------|--------|
| About      | Help    | Services    | System       | User         | Disks    | Pool      | s ZFS    | File | systems  | Snapsho    | ts C  | omstar |
| home >> Pr | 1015 34 | Benchmarks  |              |              | Pro M    | onition 2 | 0.26 435 | Pool | 0 Cap 0  | Disk@ Net@ | 9 CPU | 0.66   |
| > fieb     | ench >  | KO2OBE EX3M | ples > lozor | ne 1g >      | bonnæ >  | dd ber    | xh       |      |          |            |       |        |
| est dene   |         |             |              |              |          |           |          | [    |          |            |       | ome    |
|            |         |             |              |              |          |           |          |      |          |            |       |        |
| Rend hear  |         | ite: filebe | inch secue   | stial        | Reads f  | llober    | ch de    | ter  | 88.10.36 | 20         |       |        |
|            |         |             | mm_serve     |              | Heads 1  | 1 Control |          |      | 00-19-41 | 1214       |       |        |
| pool: hd   | -21     |             |              |              |          |           |          |      |          |            |       |        |
|            | NME     |             |              | STATI        | E RE     | AD MR:    | ITE COS  | 4.00 |          |            |       |        |
|            | hd-zi   |             |              | ONLIN        | 46       |           | •        | ۰    |          |            |       |        |
|            | rati    | f21-0       |              | ONLIN        | 46       |           | •        | ۰    |          |            |       |        |
|            | C       | 945000CCA08 | IBEDCE1Cd8   | ONLIN        | 46       |           | •        | ۰    |          |            |       |        |
|            | 0       | 915000CCA08 | IECEBEEA30   | ONLIN        | 46       |           | •        | ۰    |          |            |       |        |
|            | 0       | 915000CCA08 | EC6069136    | ONLIN        | 46       |           | •        | •    |          |            |       |        |
|            | 0       | 915000CCA08 | IECGE19708   | ONLIN        | 46       |           | •        | •    |          |            |       |        |
|            | 0       | 915000CCA08 | EC6E2Fed8    | ONLIN        | 46       |           | •        | •    |          |            |       |        |
|            | 6       | 115000CCA26 | inigation de | ONLIN        | 10       |           |          | •    |          |            |       |        |
|            | 0       | 415000CCA26 | 214349108    | ONLES        | 46       | 0         | •        | 0    |          |            |       |        |
| host       |         |             |              | nnios34      | 6        |           |          |      |          |            |       |        |
| pool       |         |             |              | d-a1 ()      | recsize: | 128K.     | ssbire,  | 000  | pr=off,  | readcache: | all)  |        |
| slog       |         |             |              |              |          |           |          |      |          |            |       |        |
| encrypti   | an      |             |              | es-256       |          |           |          |      |          |            |       |        |
| renark     |         |             |              |              |          |           |          |      |          |            |       |        |
| Fb3        |         |             | 5            | ync+ala      | ays      |           |          |      | sync+d1  | sabled     |       |        |
| Fb4 single | lestr   | eamwrite.f  | 5            | ync+ala      | ays      |           |          |      | synced1  | sabled     |       |        |
|            |         |             | 1            | 87 ops       |          |           |          |      | 4519 00  | 15         |       |        |
|            |         |             | 3            | 37.398 ops/s |          |           |          |      | 963.752  | ops/s      |       |        |
|            |         |             | 2            | 682570       | cpu/og   |           |          |      | 67198us  | cpu/op     |       |        |
|            |         |             | 2            | 6.585 1      | Latency  |           |          |      | 1.105 1  | atency     |       |        |
|            |         |             | 3            | 7.2 HB       | ſs       |           |          |      | 963.6 8  |            |       |        |
|            |         |             |              | and an e     |          |           | foerw.t  |      | singles  | treaser    |       |        |
|            |         |             |              |              |          |           |          |      |          |            |       |        |

sync was between 37 and 40 MB/s non-sync was between 901 and 905 MB/s

### with Optane 900 slog, enc on (aes-256ccm)

| nopp-lit pro omnios36 275 apple     | nce x 20.00 | al Peo   |      |          |       | 1           | logout  | : admin | sol   E | dit   Mo | n- Acc |
|-------------------------------------|-------------|----------|------|----------|-------|-------------|---------|---------|---------|----------|--------|
| About Help Services System          | User        | Disks    | Po   | ols      | ZFS F | ilesyst     | ems     | Snap    | shots   | Com      | star   |
| home := Pools := Benchmarks         |             | Pro      |      | or: 20.4 | i ais | Post        | 600     | Disk®   | Net O   | crue.    | 200    |
| > filebench > iozone examples > ioz | one 1g >    | bonnie > | 66 B | ench     |       |             |         |         |         |          |        |
| test done                           |             |          |      |          |       |             |         |         |         |          | and    |
|                                     |             |          |      |          |       |             |         |         |         |          |        |
| Benchmark: Write: filebench_seq     | ential,     | Read: 1  | iLet | bench,   | date  | e: 08.:     | 19.202  | 0       |         |          |        |
| pool: hd-zi                         |             |          |      |          |       |             |         |         |         |          |        |
| NAME                                | STAT        | ( RI     | AD 1 | ALTE     | oxsu  | н           |         |         |         |          |        |
| hd-z1                               | ONL IN      | VE.      |      | 0        |       |             |         |         |         |          |        |
| raidz1-0                            | 010,13      | NE.      |      | 0        |       | a a         |         |         |         |          |        |
| c0t5000CCA088E3CE1C                 | 90 ONL 11   | NE .     |      | 0        |       | 0           |         |         |         |          |        |
| c0t5000CCA08ECG0EGA                 | 90 ONL IN   | VE.      | 0    | 0        |       | 0           |         |         |         |          |        |
| <015000CCA00EC606934                |             |          |      | 0        |       | 0           |         |         |         |          |        |
| <015000CCA08EC6E197                 |             |          |      |          |       |             |         |         |         |          |        |
| CO15000CCA0BECGE2F4                 |             |          | ě    | ě        |       | 6           |         |         |         |          |        |
| C315999CCA86ECG2244                 |             |          | 8    |          |       | 0<br>6      |         |         |         |          |        |
|                                     |             |          | -    |          |       | 9           |         |         |         |          |        |
| 6485000CCA2621A3A910                | 90 09LD     | VL.      | 0    | 0        |       | 9           |         |         |         |          |        |
| logs                                |             |          |      |          |       |             |         |         |         |          |        |
| <114140                             | OAL D       | 4 E      | 0    | 0        |       | 0           |         |         |         |          |        |
| host                                | om/ios34    |          |      |          |       |             |         |         |         |          |        |
| pool                                | hd-21 ()    | recsfaer | 1289 | (, sst   | ·     | competition | aff, r  | eadcac  | heral   | 13       |        |
| slog                                |             |          |      |          |       |             |         |         |         |          |        |
| encryption                          | aes-256-    | con      |      |          |       |             |         |         |         |          |        |
| renark                              |             |          |      |          |       |             |         |         |         |          |        |
| Fb3                                 | sync-als    | ays.     |      |          |       | 537         | scodis  | abled   |         |          |        |
| Fbs singlestreamwrite.f             | syncrab     | ays.     |      |          |       | 557         | aced 1s | abled   |         |          |        |
|                                     | 181 ops     |          |      |          |       | 450         | L0 ops  |         |         |          |        |
|                                     | 36.199 (    | aps/s    |      |          |       | 900         | .964    | ops/s   |         |          |        |
|                                     | 454433.0    |          |      |          |       |             |         | cpss/op |         |          |        |
|                                     | 27.5en      |          |      |          |       |             | las La  |         |         |          |        |
|                                     | 36.0 MB     |          |      |          |       |             |         |         |         |          |        |
|                                     |             |          |      |          |       |             |         |         |         |          |        |
|                                     | randomre    | iad.f    | ri   | andone   | m.f   | 51          | glest   | ream    |         |          |        |

I startet the write benchmark multiple times: sync was between 163 and 281 MB/s non-sync between 1091 and 1176 MB/s

sync was between 33 and 36 MB/s and non-sync was between 901 and 902 MB/s

| nopp             | lit pro  | omnio    | <b>636</b> 275 A | pplances | 20.0643          | Feo     |            |        | logout            | : admin   sol   E | dit   Mon   Acc |
|------------------|----------|----------|------------------|----------|------------------|---------|------------|--------|-------------------|-------------------|-----------------|
| About            | Help     | Servio   | es Sys           | tem U    | Iser I           | Disks   | Pools      | ZFS    | Filesystems       | Snapshots         | Comstar         |
| home »           | Pools :+ | Benchm   | arks             |          |                  | Pro3    | funitor 07 | 45 335 | Pool® Cap®        | Disk® Not®        | OND 345         |
| > fik            | bench >  | iozone e | mamples          | iozone   | 1g > bs          | onnie > | dd bencl   | •      |                   |                   |                 |
| test dans        | ,        |          |                  |          |                  |         |            |        |                   |                   | ond             |
| senchin          | arkt Wr  | ite: fi  | Lebench_         | sequent  | 1al, #           | ead: f  | lebenc     | h, da  | te: 03.20.20      | 2.8               |                 |
| pool: (          | optane-  | 900      |                  |          |                  |         |            |        |                   |                   |                 |
|                  | NAME     |          | STATE            | READ     | MRITE            | CRSAM   |            |        |                   |                   |                 |
|                  |          | e-960    |                  |          |                  | 0       |            |        |                   |                   |                 |
|                  |          |          | CALINE           | :        |                  | 0       |            |        |                   |                   |                 |
|                  | 617      | 6109     | COLUME           |          |                  | ÷       |            |        |                   |                   |                 |
| host             |          |          |                  | 080      | 10336            |         |            |        |                   |                   |                 |
| pool             |          |          |                  | opt      | arne - 90        | 0 (rec  | aize:12    | ВК, №  | abr-, compro-     | off, readcac      | hesall)         |
| slog             |          |          |                  | -        |                  |         |            |        |                   |                   |                 |
| encryp<br>resark | 100      |          |                  |          |                  |         |            |        |                   |                   |                 |
| Fb3              |          |          |                  | syn      | c=alwa           | ys.     |            |        | sync=d1           | bolder            |                 |
| Fb4 sti          | glestr   | eamrit   | r.1              | 540      | c+alwa           | 10      |            |        | sync=d1           | ubled             |                 |
|                  |          |          |                  |          | 1 ops            |         |            |        | 6828 op           |                   |                 |
|                  |          |          |                  |          | 2,539            |         |            |        | 1363.87           |                   |                 |
|                  |          |          |                  |          | 44NS C           |         |            |        | 35969us           |                   |                 |
|                  |          |          |                  |          | 85 lat<br>2.3 MB |         |            |        | 0.7m5 1<br>1363.7 |                   |                 |
|                  |          |          |                  | 147      |                  |         |            |        | 1363.1            |                   |                 |
|                  |          |          |                  |          |                  |         |            |        |                   |                   |                 |
|                  |          |          |                  | ran      | domrea           | d.f     | rando      | erw.f  | singles           | treame            |                 |

# Needed steps for Optane 900 or DC750 and Passthrough/ ESXi

#### - ssh to ESXi

- edit /etc/vmware/passthru.map
- add following lines at the end of the file:

# Intel Optane 900P pci-e device
8086 2700 d3d0 false
# Intel DC750 pci-e device
8086 370D d3d0 false
- restart hypervisor and add the pci device to OmniOS

check device id ex 2700 in ESXi > Management >PCI devices Either try id ex 2700 or sub id ex 3900 (Optane 900) on problems with passhrough

more device id ex Optane 900 2,5", Intel DC 750 etc, see https://pci-ids.ucw.cz/read/PC/8086

#### more

For some NVMe there is another hint on problems: add the following to the .vmx file of a VM: pciPassthru0.msiEnabled = "FALSE"

https://tinkertry.com/search?s=passhrough#gsc.tab=0&gsc. q=passthrough&gsc.sort= https://kb.vmware.com/s/article/2142307