

File Systems Used:

1. ext4
2. ZFS

Feature Used :
Deduplication

ext4 doesn't support deduplication whereas ZFS does.

By use of deduplication, ZFS doesn't store duplicate data. It stores a hash table of chunks, and if the chunk came with the data that it has stored earlier, it only stores the pointer from previous chunk, rather than storing the same data again.

ZFS implement block level deduplication and is synchronous.

Implementation details:

1. Mounted a pendrive with ZFS file system , pendrive size = 32 GB

command to mount as zfs:

1. cd /
2. mkdir <dir-name>
3. zpool create -f <dir-name> <mount-point>

2. Created a 2MB file in the system.

3. Copy 1000 copies of same file with different name in ZFS file system

command:

```
for i in `seq 1 1000`; do cp <orig.txt> <dir-name/foo$i.txt>;done
```

4. captured screenshot of iostat -x 1 10, and top command

Done same for ext4 file system.

Iostat -x 1 10 (for same file content zfs)

```
Terminal File Edit View Search Terminal Help
avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           1.01    0.00    0.25    2.78    0.00   95.95

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    10.00    0.00    7.00     0.00     68.00   19.43    0.10   14.86   0.00   14.86   10.40   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           2.01    0.25    0.50    0.25    0.00   96.98

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           2.02    0.00    0.50    0.00    0.00   97.48

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           2.52    0.00    0.25    0.25    0.00   96.98

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           2.52    0.00    0.25    0.25    0.00   96.98

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00

avg-cpu:  %user   %nice %system %iowait  %steal   %idle
           2.79    0.00    0.00    0.00    0.00   97.21

Device:            rrqm/s   wrqm/s     r/s     w/s    rkB/s    wkB/s avgrq-sz avgqu-sz   await r_await w_await  svctm  %util
sda                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
sdb                0.00    0.00    0.00    0.00     0.00     0.00    0.00    0.00    0.00   0.00   0.00    0.00   0.00
```

top (same file content zfs)

```
naveenkenz12@naveenkenz12-HP-15-Notebook-PC: ~
top - 16:53:54 up 7:57, 1 user, load average: 1.31, 1.30, 0.99
Tasks: 648 total, 6 running, 642 sleeping, 0 stopped, 0 zombie
%Cpu(s):  7.0 us, 74.0 sy,  0.0 ni, 14.4 id,  4.5 wa,  0.0 hi,  0.1 si,  0.0 st
KiB Mem : 8105288 total, 1252980 free, 2281848 used, 4570460 buff/cache
KiB Swap: 8318972 total, 8281620 free,  37352 used, 5173156 avail Mem

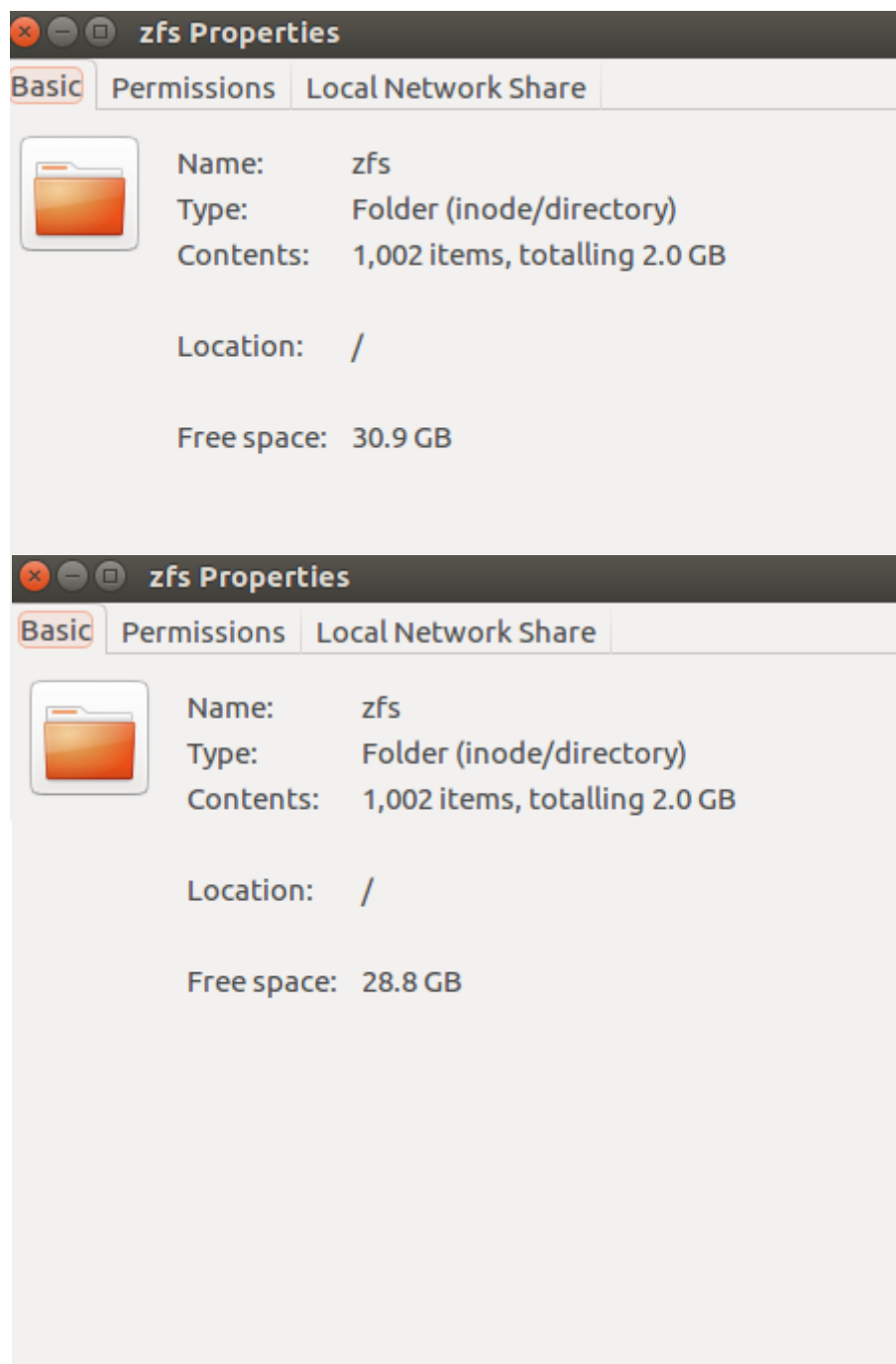
  PID USER      PR  NI    VIRT    RES    SHR S  %CPU  %MEM    TIME+  COMMAND
24691 root        1 -19     0      0      0 R   91.1   0.0   0:40.84 z_wr_iss
24692 root        1 -19     0      0      0 R   91.1   0.0   0:41.00 z_wr_iss
24693 root        1 -19     0      0      0 R   90.4   0.0   0:40.64 z_wr_iss
4516 naveen+    20   0 2009728 828160 83476 S  23.1 10.2   57:14.09 firefox
25578 root        0   0 35948  11436  3420 S   4.0  0.1   0:02.64 bash
5059 naveen+    20   0 674712 46824 27632 S   1.0  0.6   0:30.52 gnome-terminal-
10894 root        0   0      0      0      0 S   1.0  0.0   0:13.37 usb-storage
949  mysql      20   0 1234276 137928 2736 S   0.7  1.7   0:18.19 mysqld
24914 root        0   0      0      0      0 D   0.7  0.0   0:01.96 txg_sync
3  root        20   0      0      0      0 S   0.3  0.0   0:01.44 ksoftirqd/0
13 root        20   0      0      0      0 S   0.3  0.0   0:00.51 ksoftirqd/1
17 root        rt    0      0      0      0 S   0.3  0.0   0:00.06 migration/2
952  root        20   0 418500  83468 66724 S   0.3  1.0   7:48.93 Xorg
1124 root        0   0 176056   6380 1996 S   0.3  0.1   2:22.06 teamviewer
1682 naveen+    20   0 526204 27288 20936 S   0.3  0.3   0:11.51 bamfdemon
24584 root        0 -20     0      0      0 S   0.3  0.0   0:00.60 z_null_iss
24725 root        0 -20     0      0      0 S   0.3  0.0   0:00.06 z_wr_int_2
24774 root        0 -20     0      0      0 S   0.3  0.0   0:00.06 z_wr_int_6
26750 root        20   0      0      0      0 S   0.3  0.0   0:00.32 kworker/2:1
29333 root        20   0      0      0      0 S   0.3  0.0   0:00.23 kworker/u16:3
30729 naveen+    20   0 49380  4288  3140 R   0.3  0.1   0:00.11 top
1  root        20   0 185584   5464 3456 S   0.0  0.1   0:04.12 systemd
2  root        20   0      0      0      0 S   0.0  0.0   0:00.01 kthreadd
5  root        0 -20     0      0      0 S   0.0  0.0   0:00.00 kworker/0:0H
7  root        20   0      0      0      0 R   0.0  0.0   0:22.35 rcu_sched
8  root        20   0      0      0      0 S   0.0  0.0   0:00.00 rcu_bh
9  root        rt    0      0      0      0 S   0.0  0.0   0:00.04 migration/0
10 root        rt    0      0      0      0 S   0.0  0.0   0:00.12 watchdog/0
11 root        rt    0      0      0      0 S   0.0  0.0   0:00.12 watchdog/1
12 root        rt    0      0      0      0 S   0.0  0.0   0:00.06 migration/1
15 root        0 -20     0      0      0 S   0.0  0.0   0:00.00 kworker/1:0H
16 root        rt    0      0      0      0 S   0.0  0.0   0:00.12 watchdog/2
18 root        20   0      0      0      0 S   0.0  0.0   0:01.90 ksoftirqd/2
20 root        0 -20     0      0      0 S   0.0  0.0   0:00.00 kworker/2:0H
21 root        rt    0      0      0      0 S   0.0  0.0   0:00.11 watchdog/3
22 root        rt    0      0      0      0 S   0.0  0.0   0:00.06 migration/3
```

CPU extensive

size of 1 file = 2MB

total = 1000 files with same content

total = 2GB



When 2GB(1000 files of 2MB) having same content was written, free size was = 30.9GB
but when 2GB different content was written , free size = 28.8 GB

so, there was deduplication, in case of zfs file system.

Zpool List:

Alloc = 4.47 MB (after copying 1000 2MB files)

Free = 29.7 GB(same before and after copying) (as only 4.47MB was subtracted)

Dedup = 1000x

iostat -x 1 10 (1000 files of 2MB each all with same content written on ext4 fs)

```
naveenkenz12@naveenkenz12-HP-15-Notebook-PC: ~
```

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	6.05	0.04	1.32	5.19	0.00	87.41

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.09	5.35	3.59	3.03	326.04	283.16	184.18	0.36	54.00	15.41	99.70	5.72	3.79
sdd	0.00	1.11	0.03	0.73	0.80	82.44	218.42	0.29	373.47	3.39	388.17	10.09	0.77

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	2.27	0.25	0.76	58.84	0.00	37.88

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	28.00	0.00	2.00	0.00	120.00	120.00	0.04	20.00	0.00	20.00	20.00	4.00
sdd	0.00	0.00	0.00	96.00	0.00	11072.00	230.67	144.42	1934.71	0.00	1934.71	10.42	100.00

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	1.01	0.00	0.76	64.30	0.00	33.92

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sdd	0.00	0.00	0.00	101.00	0.00	11616.00	230.02	144.04	1393.31	0.00	1393.31	9.90	100.00

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	0.25	0.00	0.50	42.07	0.00	57.18

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sdd	0.00	14.00	0.00	88.00	0.00	10108.00	229.73	105.96	1696.77	0.00	1696.77	11.36	100.00

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	12.41	0.00	1.52	60.51	0.00	25.57

Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	0.00	1.00	0.00	52.00	0.00	104.00	0.03	32.00	32.00	0.00	32.00	3.20
sdd	0.00	0.00	0.00	98.00	0.00	11108.00	226.69	71.33	1092.90	0.00	1092.90	10.20	100.00

avg-cpu:	%user	%nice	%system	%iowait	%steal	%idle
	10.30	0.00	1.26	53.77	0.00	34.67

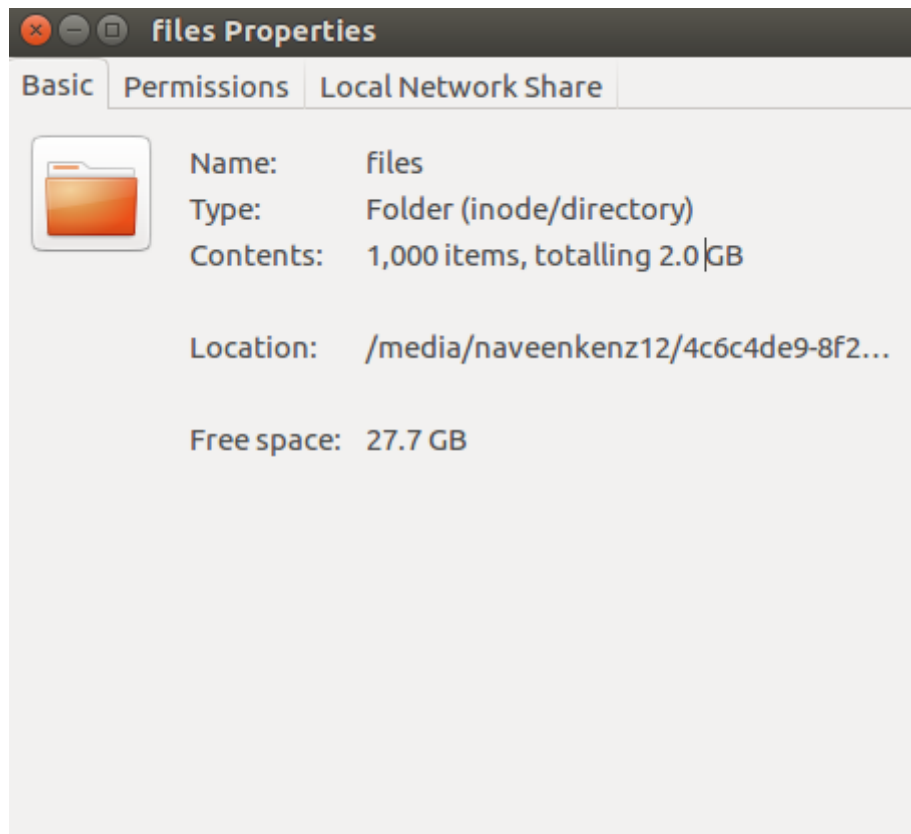
Device:	rrqm/s	wrqm/s	r/s	w/s	rkB/s	wkB/s	avgrq-sz	avgqu-sz	await	r_await	w_await	svctm	%util
sda	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
sdd	0.00	0.00	0.00	102.00	0.00	11736.00	230.12	144.48	843.61	0.00	843.61	9.80	100.00

```
naveenkenz12@naveenkenz12-HP-15-Notebook-PC: ~
```

top - 17:13:26 up 8:16, 1 user, load average: 5.98, 4.84, 3.18
Tasks: 658 total, 1 running, 657 sleeping, 0 stopped, 0 zombie
%Cpu(s): 1.7 us, 0.3 sy, 0.0 ni, 40.0 id, 57.9 wa, 0.0 hi, 0.1 si, 0.0 st
KiB Mem : 8105288 total, 326996 free, 1864132 used, 5914160 buff/cache
KiB Swap: 8318972 total, 8282024 free, 36948 used, 5610484 avail Mem

PID	USER	PR	NI	VIRT	RES	SHR	S	%CPU	%MEM	TIME+	COMMAND
4516	naveenk+	20	0	1972584	691560	83512	S	7.0	8.5	59:01.14	firefox
32029	root	20	0	0	0	0	D	1.0	0.0	0:01.85	usb-storage
952	root	20	0	409816	83540	66464	S	0.7	1.0	8:06.01	Xorg
3	root	20	0	0	0	0	S	0.3	0.0	0:01.65	ksoftirqd/0
18	root	20	0	0	0	0	S	0.3	0.0	0:02.13	ksoftirqd/2
327	root	20	0	29868	5540	3428	S	0.3	0.1	0:00.52	bash
1124	root	20	0	176056	6380	1996	S	0.3	0.1	2:27.84	teamviewer
1848	naveenk+	20	0	1542172	284192	51696	S	0.3	3.5	8:36.52	compiz
2636	naveenk+	20	0	49392	4300	3140	R	0.3	0.1	0:00.03	top
32242	root	20	0	0	0	0	D	0.3	0.0	0:00.34	kworker/u16:0
1	root	20	0	185584	5496	3488	S	0.0	0.1	0:04.22	systemd
2	root	20	0	0	0	0	S	0.0	0.0	0:00.01	kthreadd
5	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kworker/0:0H
7	root	20	0	0	0	0	S	0.0	0.0	0:23.42	rcu_sched
8	root	20	0	0	0	0	S	0.0	0.0	0:00.00	rcu_bh
9	root	rt	0	0	0	0	S	0.0	0.0	0:00.04	migration/0
10	root	rt	0	0	0	0	S	0.0	0.0	0:00.12	watchdog/0
11	root	rt	0	0	0	0	S	0.0	0.0	0:00.12	watchdog/1
12	root	rt	0	0	0	0	S	0.0	0.0	0:00.06	migration/1
13	root	20	0	0	0	0	S	0.0	0.0	0:00.55	ksoftirqd/1
15	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kworker/1:0H
16	root	rt	0	0	0	0	S	0.0	0.0	0:00.12	watchdog/2
17	root	rt	0	0	0	0	S	0.0	0.0	0:00.06	migration/2
20	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kworker/2:0H
21	root	rt	0	0	0	0	S	0.0	0.0	0:00.12	watchdog/3
22	root	rt	0	0	0	0	S	0.0	0.0	0:00.06	migration/3
23	root	20	0	0	0	0	S	0.0	0.0	0:03.70	ksoftirqd/3
25	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	kworker/3:0H
26	root	20	0	0	0	0	S	0.0	0.0	0:00.00	kdevtmpfs
27	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	netns
28	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	perf
29	root	20	0	0	0	0	S	0.0	0.0	0:00.02	khungtaskd
30	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	writeback
31	root	25	5	0	0	0	S	0.0	0.0	0:00.00	ksmd
32	root	39	19	0	0	0	S	0.0	0.0	0:05.07	khugepaged
33	root	0	-20	0	0	0	S	0.0	0.0	0:00.00	crypto

no cpu intensive process (Top command)



No deduplication in case of ext4 file system