WIP >> The Effects of Fragmentation and Capacity on Lustre File System Performance

May, 2017

SEAGATE

Seagate IEEE MSST WIP/Short Talk

AGENDA

- **Why?**
- **History/Background**
- **Focus**
- **Test Environment**
- **Nomenclature & Methodology**
- **Series 1 Performance Tests, Under Analysis**

WHY?

- **Production realities rarely match vendor promises**
- **HPC BM's/RFP's/RFI's tend to focus on simplistic IO modeling**
- **Consideration rarely factors in capacity or fragmentation**
- **Supposition is fragmentation in Lustre can make substantial impacts at lower capacities**
- **Drastic shifts in storage models and utilization**

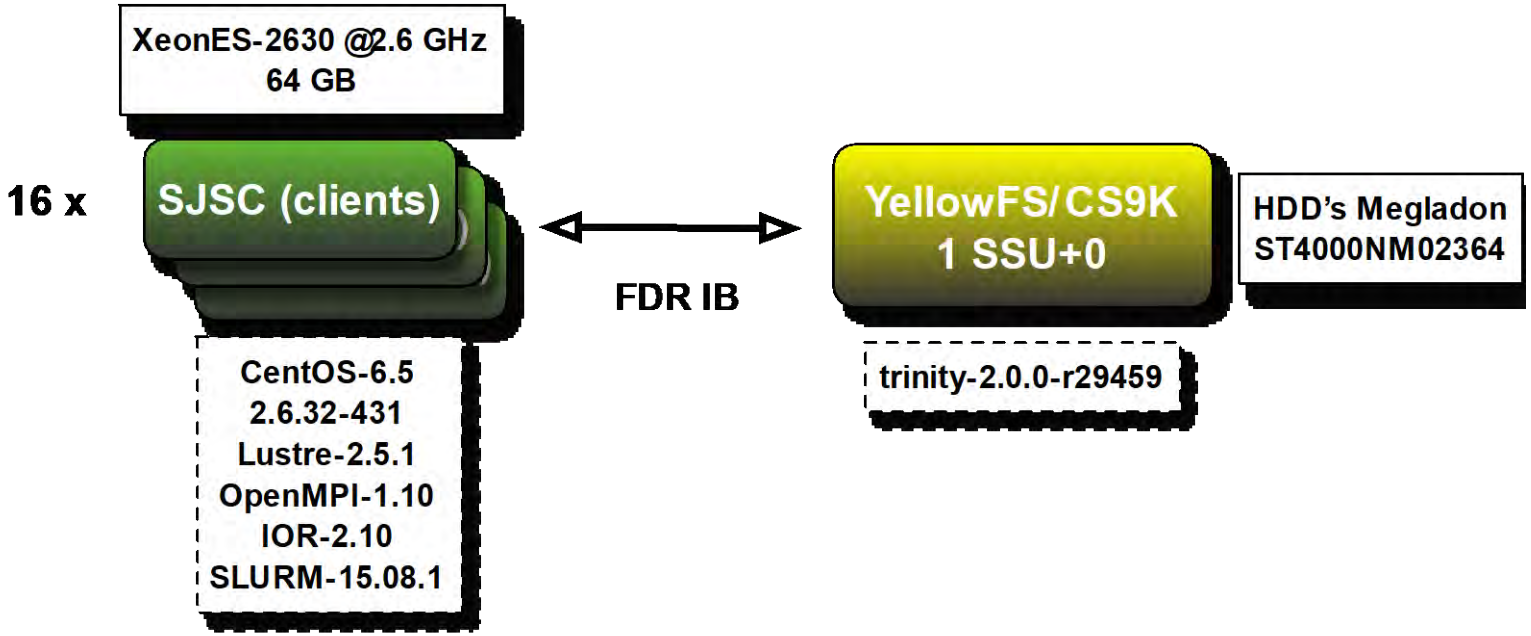
HISTORY/BACKGROUND

- **General fragmentation as an issue goes back years in the system literature, and the system software space**
- **A standardized way to generate/test file system fragmentation doesn't generally exist**
- **Some performance work, in general, has been done previously by others, on Lustre & fragmentation, but this was incomplete**
- **First Instance with ClusterStor of reported impactful fragmentation encountered at scale, dealing with a metadata performance decrease**
- **Dedicated resources allocated in Seagate lab to provide data collection.**

FOCUS…

- **Given limited resources/time….**
  - **Formalize the methodology to study capacity and fragmentation related to bandwidth impact**
  - **Gather as much data as possible related to performance impact of fragmentation on bandwidth, a very rough “baseline”**
  - **Produce information, to inform/educate customers and Seagate staff on the possible impacts of capacity and fragmentation related to the current ClusterStor product**
- **If possible….**
  - **Evaluate secondary approaches WRT: instrumentality**
  - **Determine, if data proves a high degree of impact with regard to this issue, possible points of remediation for longer term consideration**

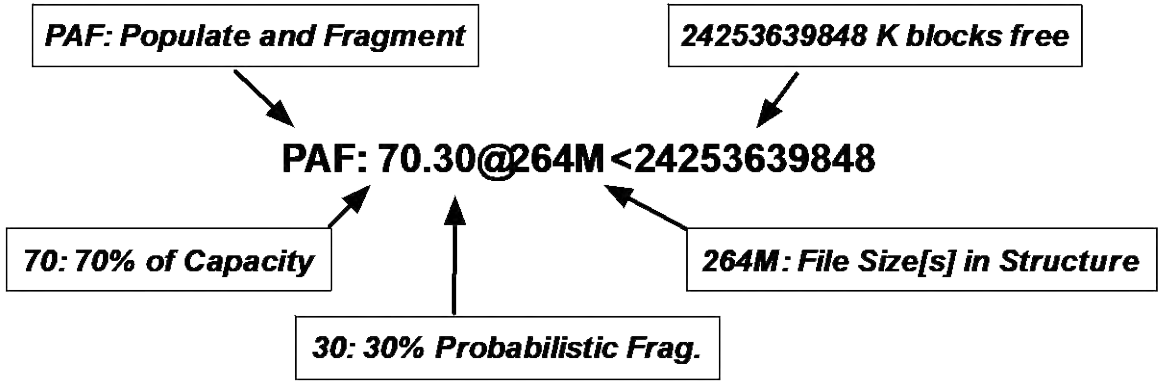
TEST ENVIRONMENT, FREMONT LAB

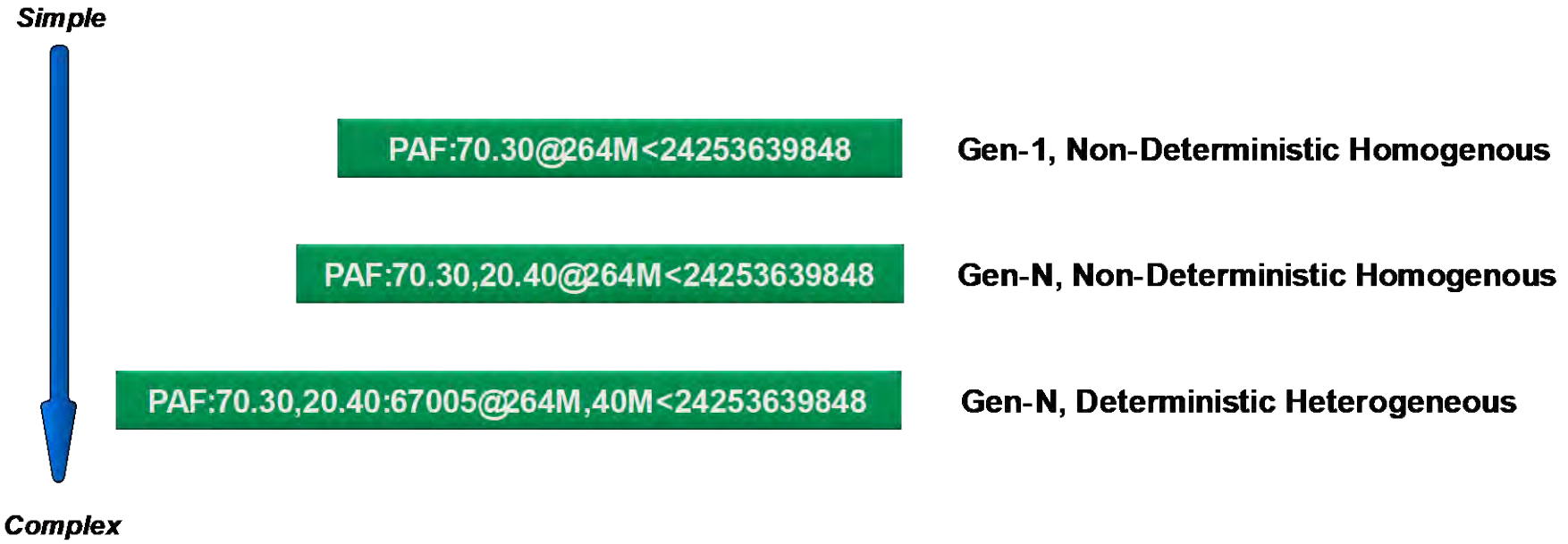


Lustre Client Parameters

```
max_rpcs_in_flight = 256
max_dirty_mb = 1024
max_pages_per_rpc = 1024
read_ahead_step = 4
max_read_ahead_mb = 512
max_read_ahead_per_file_mb = 512
```

NOMENTCLATURE, “PaF” (POPULATE and FRAGMENT)





SERIES 1, PERFORMANCE TESTS, UNDER ANALYSIS….

- 8 different PaF capacities, 10% to 80%
- x 8 degrees of fragmentation, 0% to 70%
- x 7 xfer sizes from 1MB to 64MB
- x 5 iterations for each XFER size

- = 2240 result pairs, composed of DIO write and reads.

PaF:00.00 Blck Size	Write	Read
1024	1876.44	3247.40
1024	1868.17	3236.41
1024	1861.75	3268.75
1024	1860.45	3289.47
1024	1857.75	3264.11
2048	3102.12	3994.84
2048	3076.79	3984.72
2048	3068.11	4013.94
2048	3081.90	4001.21
2048	3086.71	3980.96
4096	4835.71	5020.15
4096	4846.52	5002.37
4096	4855.30	5047.38
4096	4855.22	4995.85
4096	4799.63	5034.75
8192	7637.70	7041.72
8192	7673.32	7036.38
8192	7501.03	7115.09
8192	7793.69	7068.29
8192	7841.45	7125.70
16384	8782.72	8197.94
16384	8786.37	8204.51
16384	8861.11	8172.41
16384	8869.50	8079.82
16384	8547.80	8216.02
32768	8865.64	8534.55
32768	8957.30	8647.72
32768	8926.09	8555.03
32768	8878.50	8703.94
32768	8897.52	8718.34
65536	8839.55	8894.92
65536	8811.55	8870.79
65536	8894.13	8848.84
65536	8910.26	8754.34
65536	8861.54	8869.67

PaF:10.00 Blck Size	Write	Read
1024	1892.41	3698.35
1024	1906.88	3668.86
1024	1909.14	3683.75
1024	1906.34	3689.90
1024	1908.22	3661.63
2048	3023.34	4437.04
2048	3007.68	4462.56
2048	3021.21	4451.30
2048	3022.25	4440.09
2048	3027.65	4447.00
4096	4857.95	5634.46
4096	4851.30	5644.79
4096	4871.66	5616.79
4096	4871.36	5637.33
4096	4869.68	5666.65
8192	7948.29	7870.26
8192	7940.25	7919.26
8192	7373.77	7847.78
8192	8005.58	7942.40
8192	8079.10	7931.40
16384	8853.96	8358.57
16384	8860.60	8367.81
16384	8790.30	8284.89
16384	8845.12	8366.97
16384	8890.05	8330.92
32768	8951.26	8617.33
32768	8945.93	8563.64
32768	8967.78	8437.41
32768	8747.66	8521.00
32768	8852.33	8470.67
65536	8907.97	8777.53
65536	8964.01	8798.98
65536	9000.10	8794.21
65536	8878.19	8677.60
65536	8918.37	8781.91

PaF:10.10 Blck Size	Write	Read
1024	1732.08	2741.20
1024	1861.66	3480.52
1024	1881.65	3590.47
1024	1880.23	3598.46
1024	1876.71	3618.22
2048	2944.24	3616.35
2048	2976.11	3975.91
2048	2972.22	4069.85
2048	2982.17	4066.15
2048	2960.63	4124.84
4096	4522.98	5031.87
4096	4696.30	5111.76
4096	4736.90	5151.99
4096	4760.94	5123.16
4096	4734.36	5123.50
8192	6649.10	7626.76
8192	7368.61	7461.29
8192	7680.36	7560.13
8192	7689.41	7390.62
8192	7640.98	7434.37
16384	6841.39	8019.07
16384	8412.51	8036.41
16384	8761.46	8164.84
16384	8853.44	8100.25
16384	8777.65	8168.40
32768	6953.11	8274.85
32768	8542.13	8474.71
32768	8919.46	8420.08
32768	8918.47	8581.68
32768	8887.88	8414.77
65536	6934.56	8361.71
65536	8408.03	8698.05
65536	8881.54	8751.73
65536	8913.28	8775.96
65536	8876.77	8736.61

Series 1: PAF: AA.BB@264M<24253639848

Where AA = 10 to 80, and BB = 0 to 70

THANK YOU, QUESTIONS?

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