



ENERGY STAR Data Center Storage Data Report Submission Update

Patrick Stanko

Data Center Storage
Stakeholder Meeting

January 23, 2019



Agenda

➤ Block IO

- ◆ Review of Baseline submissions
- ◆ Review of New submissions
- ◆ Observations

➤ File IO

- ◆ Review of New submissions
- ◆ Observations



Baseline Review Block IO Reports

- ◆ Data collected through November of 2016: Storage Products Certified to ENERGY STAR
 - ◆ 159 Configurations
 - ◆ 45 Families
 - ◆ 14 (9) Manufacturers have equipment in the dataset.
 - › Some manufacturers are branding other manufacturer's equipment.

On-line Category	Number of Families	Number of Configurations	Number of Manufacturers
2 Transactional	3	11	2
2 Sequential	5	24	2
3 Transactional	16	48	5
3 Sequential	4	10	2
4 Transactional	10	35	5
4 Sequential	10	27	5

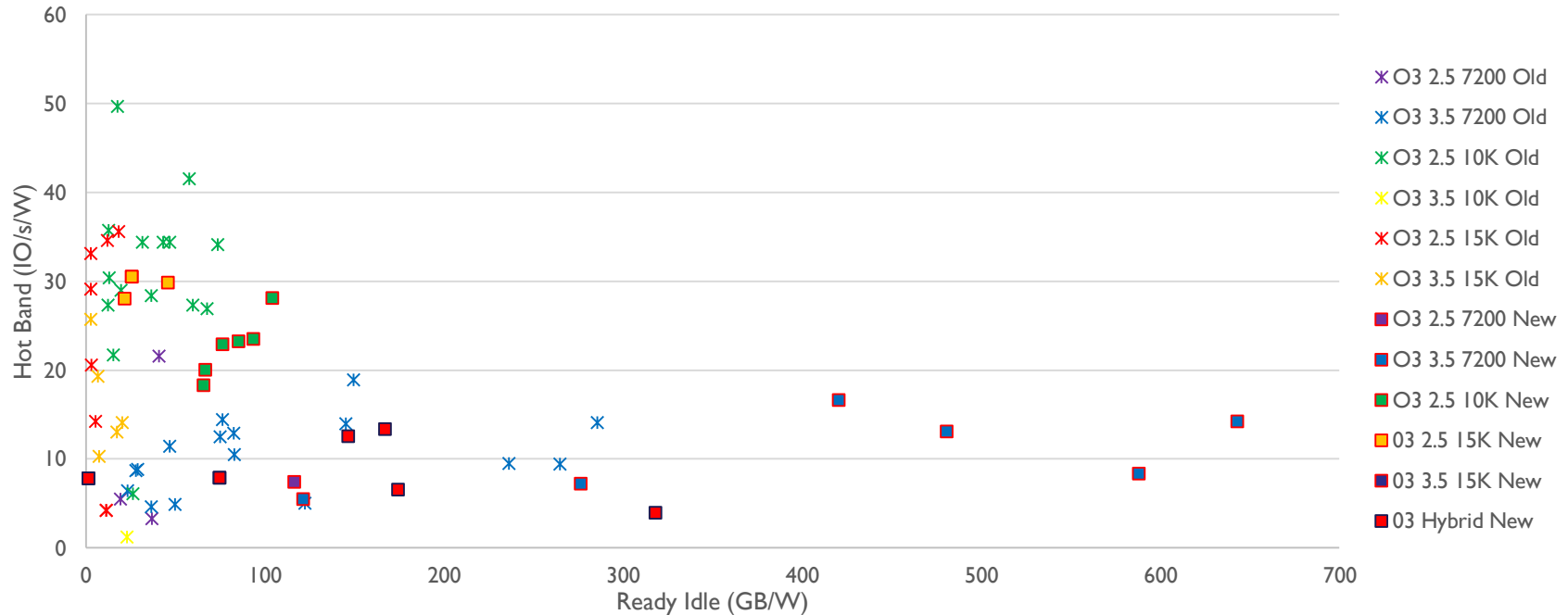
➤ New Submissions

- ◆ 76 New Submissions
- ◆ 57 New Families (Total of 102 Families)
- ◆ 64 New Configurations (Total of 223 Configuration)
 - › Some manufacturers are branding other manufacturer's equipment.
- ◆ No new manufacturers
 - › Vendor consolidation within the industry

	Workload	Submissions	Unique Families	Unique Configs
Online 2	Transactional	1	1	3
	Sequential	37	22	22
Online 3	Transactional	23	22	26
	Sequential	3	3	3
Online 4	Transactional	3	2	2
	Sequential	9	8	9



Online 3 Hot Band vs Ready Idle



Online 3 Transactional 2.5 7200 Drives

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Capacity (GB)	Total Num Installed Storage Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM12 2.5 7200 1000GB #Dr12	2.5	7200	1000	12	5.5	3.2	2.2	19.4
FAM15 2.5 7200 GB #Dr24	2.5	7200		24	21.6	6.8	7.8	40.7
FAM16 2.5 7200 GB #Dr24	2.5	7200		24	3.3	1.2	2.9	36.8
NewFAM72 2.5 7200 2000GB #Dr24	2.5	7200	2000	24	7.39	4.54	2.54	116.5

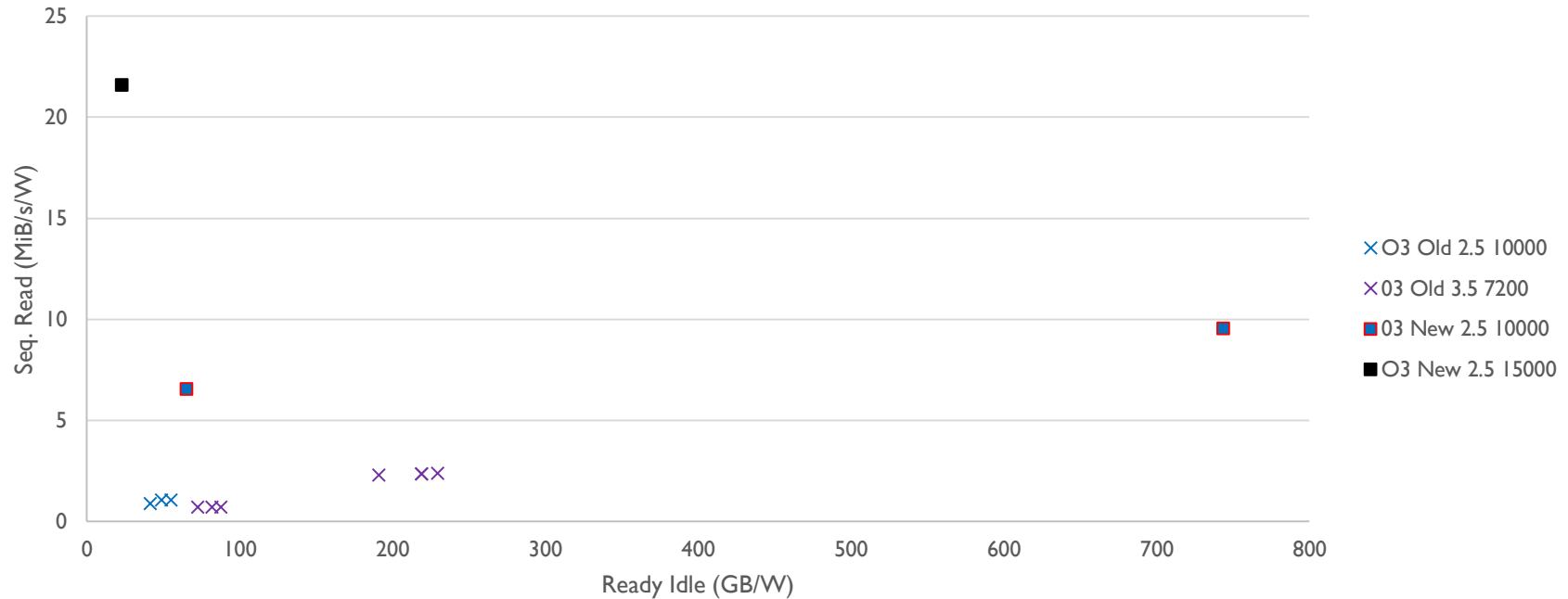
Online 3 Transactional 2.5 10K Drives

Label	Device Raw Capacity (GB)	Total Num Installed Storage Devices	Installed Solid State Devices	Installed Rotational Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM11 2.5 10000 600GB #Dr12	600	12	0	12	21.7	22.9	17.1	15.5
FAM12 2.5 10000 600GB #Dr24	600	24	0	24	27.3	17.4	21	12.5
FAM13 2.5 10000 600GB #Dr24	600	24	0	24	30.4	18.1	23.3	13
FAM13 2.5 10000 400;600GB #Dr24	400;600	24	7	17	29	21.8	6.9	19.8
FAM14 2.5 10000 600GB #Dr24	600	24	0	24	35.7	16.7	18.5	12.7
FAM14 2.5 10000 400;600GB #Dr24	400;600	24	7	17	49.7	21.1	7.2	17.7
FAM15 2.5 10000 GB #Dr24		24			6.1	16.9	11	26.2
FAM17 2.5 10000 1200GB #Dr24	1200	24	0	24	28.4	13.1	16.9	36.6
FAM17 2.5 10000 400;600GB #Dr24	400;600	24	7	17	34.4	18.5	8.3	31.5
FAM26 2.5 10000 600GB #Dr24	600	24	0	24	34.41	15.15	13.04	46.74
FAM27 2.5 10000 600GB #Dr60	600	60	0	60	27.34	18.32	16.77	59.71
FAM29 2.5 10000 600GB #Dr60	600	60	0	60	41.53	18.01	19.46	57.71
FAM30 2.5 10000 600GB #Dr24	600	24	0	24	34.42	13.51	13.26	43.3
FAM33 2.5 10000 900GB #Dr42	900	42	0	42	26.9	13.4	18.5	67.8
FAM33 2.5 10000 600GB #Dr84	600	84	0	84	34.1	19.4	23.9	73.6
NewFAM55 2.5 10000 GB #Dr90		90		90	18.27	13.88	7.48	65.8
NewFAM56 2.5 10000 900GB #Dr73	900	73	0	73	22.88	14.27	8.38	76.2
NewFAM60 2.5 10000 900GB #Dr78	900	78	0	78	23.22	16.04	8.82	85.3
NewFAM60 2.5 10000 GB #Dr78		78		78	20.02	13.43	8.22	66.8
NewFAM66 2.5 10000 1800GB #Dr24	1800	24	0	24	28.1	9.5	13	104.1
NewFAM69 2.5 10000 1800GB #Dr24	1800	24	0	24	23.5	8.4	10.9	93.6

Online 3 Transactional 3.5 7200 Drives

Label	Device Form Factor	Device Rated Speed (RPM)	Device Capacity (GB)	Raw Capacity (GB)	Total Num Storage Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM11	3.5 7200	1000GB #Dr12	1000	1000	12	6.4	3.5	2.8	23.3
FAM13	3.5 7200	1000GB #Dr24	1000	1000	24	8.8	4.4	3.5	29.1
FAM14	3.5 7200	1000GB #Dr12	1000	1000	12	8.7	4.3	3.3	28.1
FAM15	3.5 7200	1000GB #Dr12	1000	1000	12	11.4	3.9	5	46.9
FAM15	3.5 7200	1000GB #Dr60	1000	1000	60	10.5	5	5.2	83
FAM15	3.5 7200	1000GB #Dr60	1000	1000	60	12.5	5	4.3	75.1
FAM17	3.5 7200	4000GB #Dr12	4000	4000	12	5	2.6	1.8	122.3
FAM25	3.5 7200	2000GB #Dr12	2000	2000	12	12.91	3.45	6.6	82.61
FAM27	3.5 7200	2000GB #Dr60	2000	2000	60	18.9	4.48	10.47	149.6
FAM28	3.5 7200	2000GB #Dr12	2000	2000	12	14.42	3.14	6.3	76.38
FAM29	3.5 7200	2000GB #Dr60	2000	2000	60	13.97	4.6	11.72	145.25
FAM33	3.5 7200	4000GB #Dr42	4000	4000	42	9.5	3.4	6.6	236.1
FAM33	3.5 7200	4000GB #Dr84	4000	4000	84	14.1	5.4	8	285.7
FAM33	3.5 7200	800;4000GB #Dr84	800;4000	4000	84	9.4	0.3	1.5	264.9
FAM40	3.5 7200	384GB #Dr0	384	384	0	4.88	4.49	1.48	49.9
FAM40	3.5 7200	64GB #Dr0	64	64	0	4.6	3.97	1.4	36.49
NewFAM54	3.5 7200	4096GB #Dr36	4096	4096	36	8.36	4.66	2.16	588.09
NewFAM59	3.5 7200	8000GB #Dr40	8000	8000	40	13.1	3.17	4.61	480.54
NewFAM65	3.5 7200	4000GB #Dr30	4000	4000	30	5.5	2.24	1.4	121.2
NewFAM67	3.5 7200	8000GB #Dr12	8000	8000	12	7.2	2.5	5	276.4
NewFAM68	3.5 7200	8000GB #Dr60	8000	8000	60	16.6	3.4	5.8	420.4
NewFAM70	3.5 7200	10000GB #Dr60	10000	10000	60	14.2	5.4	17.4	643.8

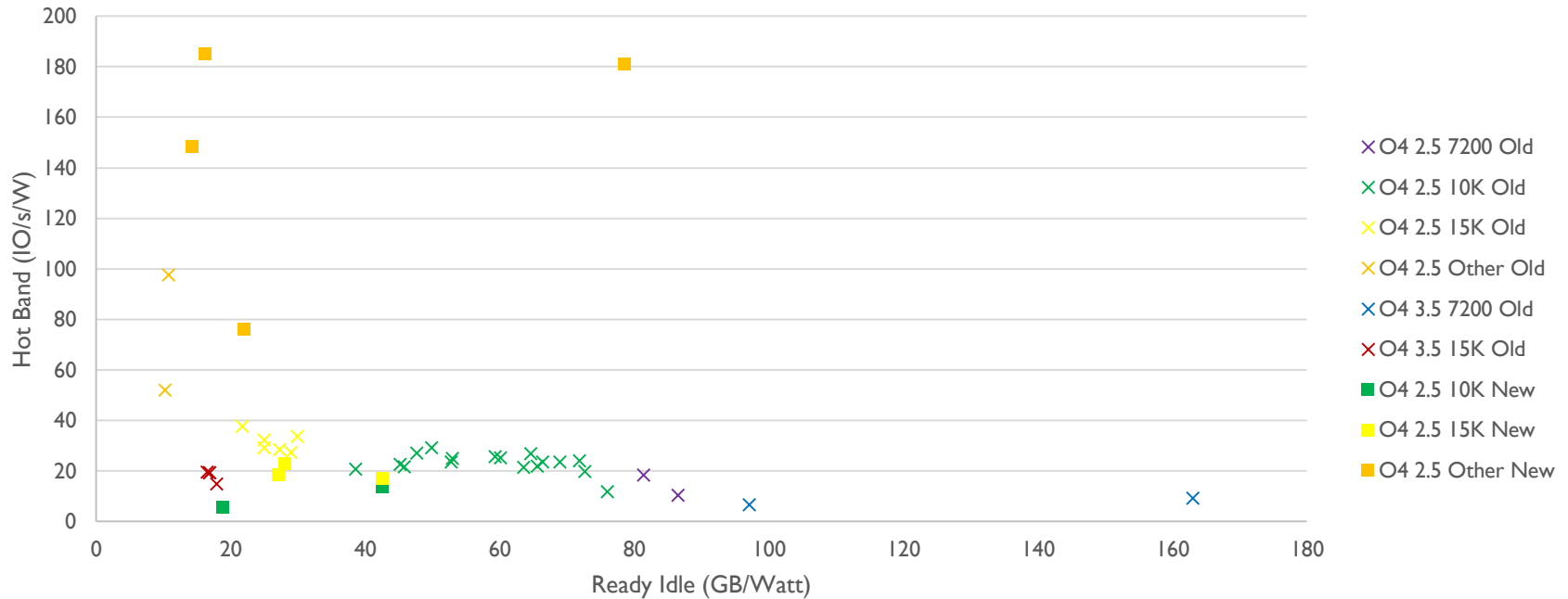
Online 3 Sequential Read vs Ready Idle



Online 3 Sequential

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Raw Capacity (GB)	Total Num Installed Storage Devices	Sequential Read Workload Test	Sequential Write Workload Test	Ready Idle Workload Test (GB/W)
FAM3 2.5 10000 450GB #Dr36	2.5	10000	450	36	1.06	0.63	48.67
FAM3 2.5 10000 450GB #Dr36	2.5	10000	450	36	0.89	0.54	41.38
FAM4 2.5 10000 450GB #Dr48	2.5	10000	450	48	1.07	0.51	55.27
FAM3 3.5 7200 1000GB #Dr36	3.5	7200	1000	36	0.71	0.38	81.99
FAM3 3.5 7200 1000GB #Dr36	3.5	7200	1000	36	0.71	0.39	72.67
FAM4 3.5 7200 1000GB #Dr48	3.5	7200	1000	48	0.7	0.24	87.87
FAM10 3.5 7200 4096GB #Dr36	3.5	7200	4096	36	2.37	0.59	229.7
FAM10 3.5 7200 4096GB #Dr12	3.5	7200	4096	12	2.3	0.91	191.2
FAM10 3.5 7200 4096GB #Dr24	3.5	7200	4096	24	2.34	0.68	219.2
FAM32 3.5 7200 4096GB #Dr24	3.5	7200	4096	24	2.34	0.68	219.2
NewFAM48 2.5 10000 900GB #Dr72	2.5	10000	900	72	9.54	2.84	743.57
NewFAM50 2.5 10000 1200GB #Dr24	2.5	10000	1200	24	6.54	5.43	65
NewFAM49 2.5 15000 300GB #Dr48	2.5	15000	300	48	21.59	14.24	23

Online 4 Hot Band vs Ready Idle



Online 4 Transactional 2.5 10K Drives

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Raw Capacity (GB)	Total Num Installed Storage Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM18 2.5 10000 900GB #Dr192	2.5	10000	900	192	20.63	19.63	12.39	38.6
FAM19 2.5 10000 600GB #Dr150	2.5	10000	600	150	11.75	7.85	14.54	75.98
FAM2 2.5 10000 600;600GB #Dr125	2.5	10000	600;600	125	23.48	12.48	5.67	52.8
FAM2 2.5 10000 600;600GB #Dr175	2.5	10000	600;600	175	25.62	13.81	5.46	59.3
FAM2 2.5 10000 600;600GB #Dr325	2.5	10000	600;600	325	23.48	9.82	5.85	66.4
FAM24 2.5 10000 600GB #Dr125	2.5	10000	600	125	24.91	12.3	10.03	53
FAM24 2.5 10000 600GB #Dr250	2.5	10000	600	250	26.84	14.63	7.96	64.6
FAM24 2.5 10000 600GB #Dr500	2.5	10000	600	500	24.03	16.04	6.89	71.9
FAM34 2.5 10000 GB #Dr24	2.5	10000		24	29.2	14.9	9.5	49.9
FAM37 2.5 10000 GB #Dr24	2.5	10000		24	27	13.2	8.9	47.7
FAM42 2.5 10000 600GB #Dr576	2.5	10000	600	576	21.49	16.21	5.71	63.6
FAM7 2.5 10000 600GB #Dr125	2.5	10000	600	125	21.83	2.91	5.11	65.6
FAM7 2.5 10000 600GB #Dr250	2.5	10000	600	250	19.8	2.25	4.12	72.7
FAM7 2.5 10000 600GB #Dr50	2.5	10000	600	50	21.6	3.85	6.9	45.8
FAM9 2.5 10000 600GB #Dr125	2.5	10000	600	125	25.12	13.1	7.04	60.1
FAM9 2.5 10000 600GB #Dr275	2.5	10000	600	275	23.38	7.9	5.39	69
FAM9 2.5 10000 600GB #Dr50	2.5	10000	600	50	22.5	6.21	8.13	45.2
NewFAM79 2.5 10000 300GB #Dr20	2.5	10000	300	20	5.65	2.71	4.64	18.8
NewFAM81 2.5 10000 600GB #Dr96	2.5	10000	600	96	13.86	6.38	6	42.5

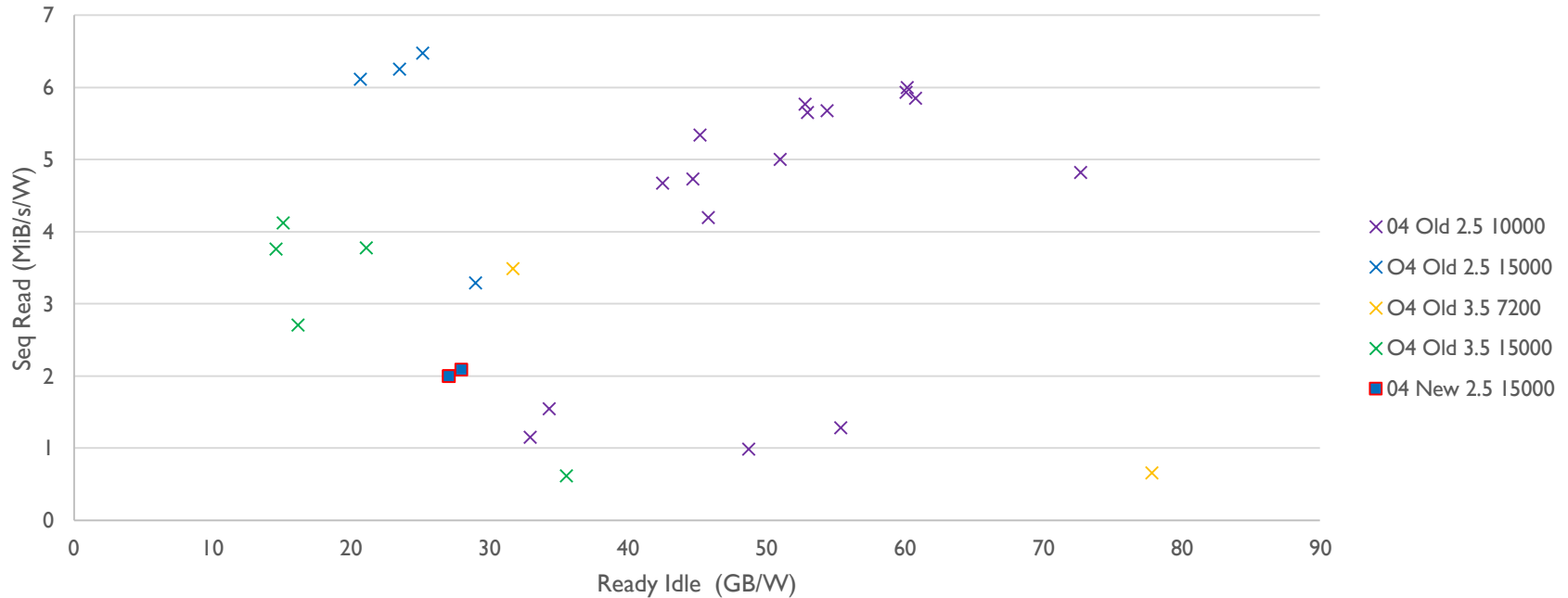
Online 4 Transactional 2.5 15K Drives

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Raw Capacity (GB)	Total Num Installed Storage Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM2 2.5 15000 300;300GB #Dr200	2.5	15000	300;300	200	33.68	21.52	4.53	29.9
FAM24 2.5 15000 300GB #Dr225	2.5	15000	300	225	32.29	21.39	7.18	25
FAM34 2.5 15000 GB #Dr24	2.5	15000		24	29.2	14.9	9.5	25
FAM37 2.5 15000 GB #Dr24	2.5	15000		24	37.7	19.3	11.4	21.7
FAM7 2.5 15000 300GB #Dr150	2.5	15000	300	150	27.28	3.98	9.87	29
FAM9 2.5 15000 300GB #Dr150	2.5	15000	300	150	28.42	20.45	12.24	27.3
NewFAM77 2.5 15000 600GB #Dr65	2.5	15000	600	65	17.23	16.5	7.06	42.5
NewFAM83 2.5 15000 300GB #Dr220	2.5	15000	300	220	18.38	13.55	5.62	27.1
NewFAM84 2.5 15000 300GB #Dr264	2.5	15000	300	264	22.88	15.23	8.15	28
NewFAM85 2.5 15000 300GB #Dr220	2.5	15000	300	220	18.38	13.55	5.62	27.1

Online 4 Transactional Solid State

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Capacity (GB)	Total Raw Storage Devices	Num Installed Solid State Devices	Num Installed Rotational Devices	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM38 2.5 Other 480GB #Dr16	2.5	Other	480	16	16	0	51.97	149.62	81.04	10.2
FAM38 2.5 Other 480GB #Dr8	2.5	Other	480	8	8	0	97.64	277.97	95.3	10.8
NewFAM76 2.5 Other 512GB #Dr20	2.5	Other	512	20	20	0	76	345	88	21.9
NewFAM80 2.5 Other 800GB #Dr10	2.5	Other	800	10	10	0	148.7	302.55	117.02	14.3
NewFAM82 2.5 Other 800GB #Dr10	2.5	Other	800	10	10	0	185.45	398.72	130.6	16.2
NewFAM82 2.5 Other 800GB #Dr10	2.5	Other	800	10	10	0	181.14	392.24	143.22	78.5

Online 4 Sequential Read vs Ready Idle



Online 4 Sequential 2.5 15K Drives

Label	Device Form Factor (1.8, 2.5, 3.5)	Device Rated Speed (RPM)	Device Raw Capacity (GB)	Total Num Installed Storage Devices	Sequential Read Workload Test	Sequential Write Workload Test	Ready Idle Workload Test (GB/W)
FAM2 2.5 15000 300;300GB #Dr100	2.5	15000	300	100	6.48	4.52	25.2
FAM7 2.5 15000 300GB #Dr150	2.5	15000	300	150	3.29	2.48	29
FAM8 2.5 15000 300GB #Dr75	2.5	15000	300	75	6.25	4.38	23.5
FAM24 2.5 15000 300GB #Dr100	2.5	15000	300	100	6.11	4.53	20.7
NewFAM73 2.5 15000 300GB #Dr220	2.5	15000	300	220	2	0.91	27.1
NewFAM74 2.5 15000 300GB #Dr264	2.5	15000	300	264	2.09	0.94	28
NewFAM75 2.5 15000 300GB #Dr220	2.5	15000	300	220	2	0.91	27.1

Online 3 Transactional 2.5 10K Top 25%

Baseline Dataset

With New Submissions

Label	Random				Random				Ready			
	Hot Band	Read	Write	Idle	Hot Band	Read	Write	Idle	Hot Band	Read	Write	Idle
	Workload	Workload	Workload	Workload	Workload	Workload	Workload	Workload	Workload	Workload	Workload	Workload
	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test	Test
	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)	(IOPS/W)
FAM11 2.5 10000 600GB #Dr12	21.7	22.9	17.1	15.5	21.7	22.9	17.1	15.5	21.7	22.9	17.1	15.5
FAM12 2.5 10000 600GB #Dr24	27.3	17.4	21	12.5	27.3	17.4	21	12.5	27.3	17.4	21	12.5
FAM13 2.5 10000 600GB #Dr24	30.4	18.1	23.3	13	30.4	18.1	23.3	13	30.4	18.1	23.3	13
FAM13 2.5 10000 400;600GB #Dr24	29	21.8	6.9	19.8	29	21.8	6.9	19.8	29	21.8	6.9	19.8
FAM14 2.5 10000 600GB #Dr24	35.7	16.7	18.5	12.7	35.7	16.7	18.5	12.7	35.7	16.7	18.5	12.7
FAM14 2.5 10000 400;600GB #Dr24	49.7	21.1	7.2	17.7	49.7	21.1	7.2	17.7	49.7	21.1	7.2	17.7
FAM15 2.5 10000 GB #Dr24	6.1	16.9	11	26.2	6.1	16.9	11	26.2	6.1	16.9	11	26.2
FAM17 2.5 10000 1200GB #Dr24	28.4	13.1	16.9	36.6	28.4	13.1	16.9	36.6	28.4	13.1	16.9	36.6
FAM17 2.5 10000 400;600GB #Dr24	34.4	18.5	8.3	31.5	34.4	18.5	8.3	31.5	34.4	18.5	8.3	31.5
FAM26 2.5 10000 600GB #Dr24	34.41	15.15	13.04	46.74	34.41	15.15	13.04	46.74	34.41	15.15	13.04	46.74
FAM27 2.5 10000 600GB #Dr60	27.34	18.32	16.77	59.71	27.34	18.32	16.77	59.71	27.34	18.32	16.77	59.71
FAM29 2.5 10000 600GB #Dr60	41.53	18.01	19.46	57.71	41.53	18.01	19.46	57.71	41.53	18.01	19.46	57.71
FAM30 2.5 10000 600GB #Dr24	34.42	13.51	13.26	43.3	34.42	13.51	13.26	43.3	34.42	13.51	13.26	43.3
FAM33 2.5 10000 900GB #Dr42	26.9	13.4	18.5	67.8	26.9	13.4	18.5	67.8	26.9	13.4	18.5	67.8
FAM33 2.5 10000 600GB #Dr84	34.1	19.4	23.9	73.6	34.1	19.4	23.9	73.6	34.1	19.4	23.9	73.6
NewFAM55 2.5 10000 GB #Dr90					18.27	13.88	7.48	65.8	18.27	13.88	7.48	65.8
NewFAM56 2.5 10000 900GB #Dr73					22.88	14.27	8.38	76.2	22.88	14.27	8.38	76.2
NewFAM60 2.5 10000 900GB #Dr78					23.22	16.04	8.82	85.3	23.22	16.04	8.82	85.3
NewFAM60 2.5 10000 GB #Dr78					20.02	13.43	8.22	66.8	20.02	13.43	8.22	66.8
NewFAM66 2.5 10000 1800GB #Dr24					28.1	9.5	13	104.1	28.1	9.5	13	104.1
NewFAM69 2.5 10000 1800GB #Dr24					23.5	8.4	10.9	93.6	23.5	8.4	10.9	93.6

Online 3 Transactional 3.5 7200 Top 25%

Baseline Data Set

With New Submissions

Label	Baseline Data Set				With New Submissions			
	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)	Hot Band Workload Test (IOPS/W)	Random Read Workload Test (IOPS/W)	Random Write Workload Test (IOPS/W)	Ready Idle Workload Test (GB/W)
FAM11 3.5 7200 1000GB #Dr12	6.4	3.5	2.8	23.3	6.4	3.5	2.8	23.3
FAM13 3.5 7200 1000GB #Dr24	8.8	4.4	3.5	29.1	8.8	4.4	3.5	29.1
FAM14 3.5 7200 1000GB #Dr12	8.7	4.3	3.3	28.1	8.7	4.3	3.3	28.1
FAM15 3.5 7200 1000GB #Dr12	11.4	3.9	5	46.9	11.4	3.9	5	46.9
FAM15 3.5 7200 1000GB #Dr60	10.5	5	5.2	83	10.5	5	5.2	83
FAM15 3.5 7200 1000GB #Dr60	12.5	5	4.3	75.1	12.5	5	4.3	75.1
FAM17 3.5 7200 4000GB #Dr12	5	2.6	1.8	122.3	5	2.6	1.8	122.3
FAM25 3.5 7200 2000GB #Dr12	12.91	3.45	6.6	82.61	12.91	3.45	6.6	82.61
FAM27 3.5 7200 2000GB #Dr60	18.9	4.48	10.47	149.6	18.9	4.48	10.47	149.6
FAM28 3.5 7200 2000GB #Dr12	14.42	3.14	6.3	76.38	14.42	3.14	6.3	76.38
FAM29 3.5 7200 2000GB #Dr60	13.97	4.6	11.72	145.25	13.97	4.6	11.72	145.25
FAM33 3.5 7200 4000GB #Dr42	9.5	3.4	6.6	236.1	9.5	3.4	6.6	236.1
FAM33 3.5 7200 4000GB #Dr84	14.1	5.4	8	285.7	14.1	5.4	8	285.7
FAM33 3.5 7200 800;4000GB #Dr84	9.4	0.3	1.5	264.9	9.4	0.3	1.5	264.9
FAM40 3.5 7200 384GB #Dr0	4.88	4.49	1.48	49.9	4.88	4.49	1.48	49.9
FAM40 3.5 7200 64GB #Dr0	4.6	3.97	1.4	36.49	4.6	3.97	1.4	36.49
NewFAM54 3.5 7200 4096GB #Dr36					8.36	4.66	2.16	588.09
NewFAM59 3.5 7200 8000GB #Dr40					13.1	3.17	4.61	480.54
NewFAM65 3.5 7200 4000GB #Dr30					5.5	2.24	1.4	121.2
NewFAM67 3.5 7200 8000GB #Dr12					7.2	2.5	5	276.4
NewFAM68 3.5 7200 8000GB #Dr60					16.6	3.4	5.8	420.4
NewFAM70 3.5 7200 10000GB #Dr60					14.2	5.4	17.4	643

- In general the new submissions did not improve performance
 - ◆ Exception Online 4 Transactional Solid State Systems
 - ◆ Exception Online 3 Sequential submissions
- In general new submissions improved Ready Idle scores through higher capacity drives or drive counts
- Assessment by taxonomy and workload type is biased
 - ◆ to the higher performance drives for transactional workloads,
 - ◆ to the higher capacity drives for sequential workloads
- Nothing new or conclusive to establish thresholds



Discussion

➤ Discussion

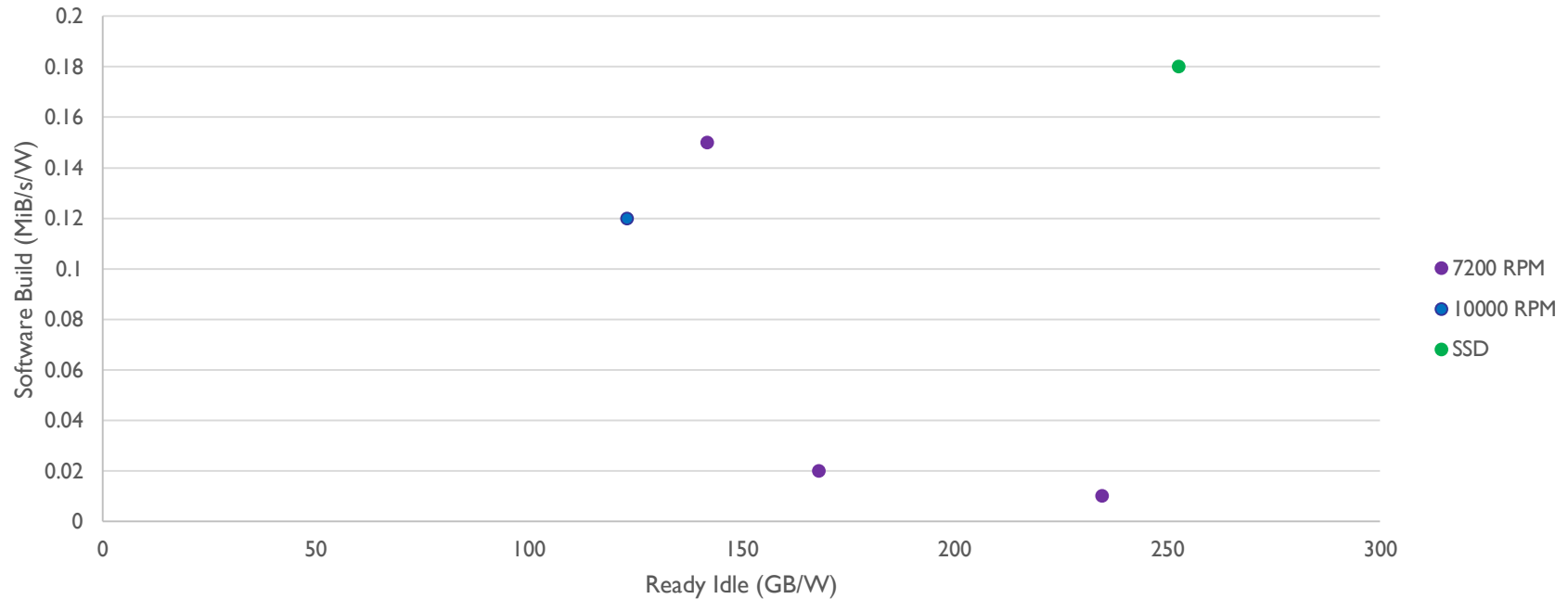


- Eight submissions from one manufacturer
 - ◆ Five Online 4 systems
 - › Performance Metrics present in EPA Report database
 - ◆ Three Online 2 systems
 - › **No Performance Metrics** in EPA Report database

Online 4 File IO Submissions

Label	Comp Device Type Highest Predicted Deployed Device	Comp Device Form Factor Highest Predicted Deployed Device	Comp Device Rated Speed (RPM) Highest Predicted Deployed Device	Comp Device Raw Capacity (GB) Highest Predicted Deployed Device	Comp Total Num Installed Storage Devices Optimal Point	Comp Installed Solid State Devices in Optimal Point	Comp Installed Rotational Devices in Optimal Point	Comp Optimal Point SW Build Workload Test	Comp Optimal Point Ready Idle Workload Test (GB/W)
FileFam 1	SSD	4u	(SSD)	192000	60	60	0	0.18	252.63
FileFam 2	SATA	4u	7200	120000	15		15	0.15	141.89
FileFam 3	SATA	4u	7200	120000	15	0	15	0.02	168.19
FileFam 4	SAS	4u	7200	200000	20	0	20	0.01	234.66
FileFam 5	SAS	4u	10000	36000	30	0	30	0.12	123.08

Online 4 File IO SW Build vs Ready Idle



File IO Observations

- Not enough submissions to date
- Online 2 File IO Data – is it available?
 - ◆ Data input setup correctly?
- Data analysis on non-publicized test data a future consideration when there are more submissions



Discussion

➤ Discussion

