

Request to remove the ENERGY STAR® requirement that a maximum power configuration be tested to certify a server to the ENERGY STAR computer server requirements.

STATEMENT OF CONCERN:

The Green Grid (TGG) SERT Analysis Working Group (WG) has undertaken an assessment of the value of the Maximum Power configuration in assessing the energy efficiency of a server product. This assessment was prompted by several issues identified with based on the assessment of the SERT worklet results generated for the certification of server products to the ENERGY STAR requirements.

1. In the July 2014 and November 2015 ENERGY STAR server stakeholder meetings, EPA expressed concern that:
 - a. There was no clear configuration type selected for the maximum power configuration and in some cases the maximum power configuration did not have the largest power demand of the five submitted configurations.
 - b. The maximum power configuration typically showed lower efficiency scores as compared to the high-end performance configuration.
2. The SERT data analysis work performed by the SERT Analysis WG indicated that efficiency scores for the maximum configuration will be lower than the scores for the high-end performance configuration because the maximum power configuration uses additional memory, storage, and I/O components to increase the power demand without increasing the worklet performance values. See the discussion below for the details of this analysis.
3. Building or procuring and testing the maximum configuration adds costs to the test without providing additional beneficial information:
 - a. Procuring the maximum configuration server product, either directly or through the procurement of additional components, represents approximately 1/3 of the cost to procure products for ENERGY STAR certification testing.
 - i. Analysis on low end rack servers indicated additional component costs of approximately \$11,400 and
 - ii. midrange rack server additional component costs of about \$24,000 for the maximum configuration systems.
 - b. It requires approximately 2 days to set-up and run the maximum configuration test, representing a resource cost of approximately between \$3 K and \$4 K.
 - c. Worklet performance values do not fully scale to the additional components, as observed in the CPU tests.

DATA ANALYSIS: Comparison of the SERT metric results for the maximum power and high-end performance configurations.

Tables A-1 and A-2 compare SERT worklet efficiency results for configurations with 2 and 4 processors respectively with the same approximate processor type as determined by core count and frequency. For these systems, the CPU and storage worklet scores are higher for the high-end

performance configuration. The efficiency score reduction when testing the higher power configuration is to be expected, as the higher power demand is generated by adding components that do not improve CPU or storage performance. Capacity and Flood(1) memory scores increase because maximum power is achieved by maximizing the system memory capacity which in turn increases the memory efficiency scores. Flood(2) scores either decrease (2 socket servers) or increase by a smaller amount than the Flood(1) scores. As the characteristics of the Flood(2) scores were not analyzed, the cause of this behavior cannot be analyzed at this time.

Table A-3 compares products where the maximum power configuration has a higher compute capacity than the high-end performance configuration. In general, a processor with higher compute capacity should deliver better CPU and memory worklet performance because its higher core count and frequency drives higher CPU performance and increased memory bandwidth and channel count. With the exception of the last machine type and a few of the compress scores, the high-end performance configuration had the higher CPU worklet efficiency scores. The Flood(1) and both capacity worklet efficiency scores increased from the high-end performance to the maximum power configuration due to the increased memory capacity. The Flood(2) worklet efficiency scores were higher for the high-end performance configuration, except for the fifth configuration where the memory capacity and DIMM counts were doubled from the high-end performance to the maximum configuration. The storage worklet efficiency scores largely decreased from the high-end performance to maximum power configurations, except for the second configuration where the core count and the number of HDD was doubled from the high-end performance to the maximum power configuration and the third and fifth configurations where the random (third) and sequential (fifth) scores were higher on the maximum power configuration. The random score increase occurred due to a doubling of the SSD capacity and the sequential score increase occurred due to a switch from 10 K to 7.5 K drives.

Table A-4 compares 2 socket configurations with higher core count processors on the high-end performance configuration. For all configurations, the CPU worklet efficiency scores are higher on the high-end performance configuration. The memory scores vary with configurations with the higher DIMM count and memory capacity having the higher memory worklet efficiency scores. Storage scores were higher on the high-end performance configuration except for the random scores on the 3rd and 4th configuration where the 15 K drive counts were increased by 8x and 2.5x respectively, driving higher random scores for the maximum power configuration.

Table A-5 compares configurations for 2 socket resilient servers where the maximum power configuration has processors with higher core counts. For these systems, the higher CPU worklet scores occur on the maximum power configuration, with a few exceptions on the individual worklets, except for the 6th configuration where the power demand associated with the higher memory capacity negates the performance benefits of the two additional cores lowering the CPU scores. Flood(1) and the Capacity scores are higher on the high-end performance configuration for systems and Flood(2) score is lower with the exception of the 5th machine type where both the DIMM count and the memory capacity double driving a higher Flood(2) score due to the increased channel count. The storage scores vary.

CONCLUSIONS and RECOMMENDATION:

The review of the data demonstrate that where a high-end performance configuration has equal or higher processor core counts and optimized memory capacity and storage device counts, the high-end performance configuration will provide a good view of the performance/power characteristics of a highly configured server for that server product. The maximum power configuration does not serve any purpose in the evaluation of the product where the high-end performance configuration uses the highest core count and frequency processor for that product family, as the addition of components to increase power demand increases the power demand without improving the performance values in the worklets - with the exception of the memory worklets. Removal of the maximum power configuration does not result in the loss of any meaningful information and would not impede the evaluation of the energy efficiency of a given machine type. Elimination of the requirement to test the maximum configuration testing will free up resources which can be applied to delivering more energy efficient server designs.

The comparison of the configurations also indicates that the parameters for the high-end performance configuration should be the maximum core count and frequency processor available for that machine type, memory capacity, speed and DIMM count which maximizes the memory efficiency score, and SSD storage devices. If the maximum power configuration is removed from the certification requirements, then we are at risk of having configuration choices which are desired by a customer but for which a comparable configuration has not been tested. In order to allow these configurations to be certified as ENERGY STAR, we believe there are two approaches that EPA can use to address this concern.

The Green Grid working group recommends that the requirement to test the maximum power configuration be removed from the server certification requirements. We believe this is appropriate, as the data demonstrates that the SERT test results for the maximum configuration do not provide any meaningful information about the server product that is not already supplied by the high-end performance configuration. We ask that companies be allowed to include server products configured beyond the high-end performance configuration as ENERGY STAR certified products. The integrity of the ENERGY STAR program can be maintained with this change, as the manufacturers retain their responsibility to insure that any configurations with components that drive power use beyond the high-end performance configuration meet the ENERGY STAR certification requirements. This responsibility is consistent with the current program requirement that all configurations sold as certified to the ENERGY STAR meet the relevant requirements: idle power thresholds, power management settings, energy use, CPU utilization, and temperature reporting and power supply efficiency.

APPENDIX A: DATA TABLES COMPARING MAXIMUM POWER AND HIGH-END PERFORMANCE CONFIGURATIONS

Table A-1: 2 Socket Managed Servers: Same CPU Capacity on High-End Performance and Maximum Power Configurations

Configuration	Processor Name	Processor Frequency	Number of Cores per socket	Number of DIMMs	Total GB of memory	Number of HDDs	HDD Speed	Number of SSD DIMMs	GB SSD	Compress	CryptoAES	LU	SOR	XML Validate	SORT	SHA256	Flood	Flood (2)	Capacity	Capacity(2)	Sequential	Random	SPECPower SSJ Hybrid	Maximum Power	Idle Power
High-End Performance	E5-2699 V3 Haswell	2.3	18	8	256			16	6400	65.793	260.857	84	79.893	52.029	70.718	67.098	584.434	103.3033	2961.548	459.8876	1830.7	5063.23	73.423	493.2	123.9
Maximum Power	E5-2699 V3 Haswell	2.3	18	24	768	24	10 K	0	0	37.049	129.791	56.099	48.064	36.815	43.506	40.439	844.878	86.22079	6401.453	572.4228	313.259	171.795	42.187	733.7	357
				200%	200%					44%	50%	33%	40%	29%	38%	40%	-45%	17%	-116%	-24%	83%	97%	43%	-49%	-188%
High-End Performance	E5-2670	2600	8	16	512			16	3200	35.001	28.618	28.201	40.966	26.883	36.389	26.663	608.242	76.02213	2564.72	281.0652	335.767	1555.014	38.393	460.5	174
Maximum Power	E5-2680	2700	8	24	768	16	15 K			24.223	20.89	21.139	29.707	19.688	26.532	19.296	565.977	57.75862	3047.736	272.5309	66.974	47.883	26.601	600.3	287.9
				50%	50%					31%	27%	25%	27%	27%	27%	28%	7%	24%	-19%	3%	80%	97%	31%	-30%	-65%
High-End Performance	E5-2699 V3 xeon	2.3	18	8	128	0		8	3200	79.3	310.024	105.063	71.331	74.08	60.605	70.278	327.878	81.96074	1460.38	321.9736	1231.105	4150.302	106.695	450.4	127.3
Maximum Power	E5-2699 V3 xeon	2.3	18	24	384	10	10 K	0	0	43.923	158.986	65.12	43.833	44.731	38.299	43.679	590.576	85.2332	3995.138	505.8849	201.194	92.314	57.283	513	221.6
				200%	200%					45%	49%	38%	39%	40%	37%	38%	-80%	-174%	-57%	84%	98%	46%	-14%	-74%	
High-End Performance	E5-2699 V3	2.3	18	8	256	0		8	2984	62.412	255.359	87.82	79.111	56.641	68.799	65.143	536.608	94.84966	2934.526	455.6914	982.296	3091.251	77.434	466.5	122.7
Maximum Power	E5-2699 V3	2.3	18	24	768	32	10 K			29.762	98.843	46.564	38.83	30.18	34.949	33.125	802.879	81.93474	5960.308	532.9752	228.894	131.229	36.239	793.6	373.1
				200%	200%					52%	61%	47%	51%	47%	49%	49%	-50%	14%	-103%	-17%	77%	96%	53%	-70%	-204%
High-End Performance	E5-2470 V2	2.4	10	12	192			12	6144	48.549	167.051	56.474	49.92	41.775	39.339	44.128	355.697	72.59859	1256.284	225.558	89.161	162.727	53.964	334.5	97.6
Maximum Power	E5-2470 V2	2.4	10	12	384	4	15 K			17.792	55.227	53.476	54.445	29.641	47.87	43.092	255.099	36.81644	2508.684	317.6625	19.677	9.778	21.923	369.9	158.6
				0%	100%					63%	67%	5%	-9%	29%	-22%	2%	28%	49%	-100%	-41%	78%	94%	59%	-11%	-63%
High-End Performance	E5-2683 v3	2000	14	8	128	8	15 K			57.282	260.03	74.352	62.654	48.498	56.181	53.793	351.03	87.74813	1182.253	260.6542	194.837	165.639	71.238	370	163.8
Maximum Power	E5-2695 v3	2300	14	12	192	8	15 K			52.766	235.605	70.799	60.517	45.958	53.063	51.749	444.574	90.73859	1635.426	293.6305	179.975	153.969	65.384	464.9	159.8
				50%	50%					8%	9%	5%	3%	5%	6%	4%	-27%	-3%	-38%	-13%	8%	7%	8%	-26%	2%
High-End Performance	E52680 V2	2.8	10	16	256	4	10 K	0	0	39.016	24.944	33.706	50.355	27.568	39.33	32.129	479.866	84.82006	1048.639	162.8392	31.517	36.101	24.496	446.3	150.5
Maximum Power	E52690 V2	3	10	32	512	4	7.5 K	0	0	32.422	21.596	29.216	44.24	23.438	34.141	27.304	630.581	78.81421	1717.488	188.2179	22.844	14.549	27.84	556.5	190.2
				100%	100%					17%	13%	13%	12%	15%	13%	15%	-31%	7%	-64%	-16%	28%	60%	-14%	-25%	-26%
High-End Performance	E5-2697	2.7	12	8	128	0		8	800	53.238	44.743	43.502	63.558	41.299	55.439	50.287	256.148	64.03016	839.529	185.093	1,285.93	2,186.54	61.54	460.5	154.2
Maximum Power	E5-2697	2.7	12	24	384	8	15 K	0	0	36.242	33.642	33.719	47.071	31.279	41.429	37.792	462.857	66.80052	2,223.31	281.5267	122.255	92.097	41.835	582.9	221.2
				200%	200%					32%	25%	22%	26%	24%	25%	25%	-81%	-4%	-165%	-52%	90%	96%	32%	-27%	-43%
High-End Performance	Xeon E5 2695 V2	2.4	12	8	252	0		8	4096	47.921	41.842	40.348	59.419	39.227	51.354	46.931	502.103	89.45222	1751.029	274.0772	797.256	1172.573	42.676	445.9	168.3
Maximum Power	Xeon E5 2695 V2	2.4	12	16	512	14	15 K	0	0	26.531	22.742	22.017	31.204	21.731	27.914	25.107	513.342	64.1609	2242.282	245.7296	147.843	105.607	22.977	696.8	410.5
				100%	103%					45%	46%	45%	47%	45%	46%	47%	-2%	28%	-28%	10%	81%	91%	46%	-56%	-144%
High-End Performance	E5-2697	2.7	12	8	128	0		8	800	54.327	45.774	44.511	64.639	42.286	56.18	51.274	266.411	66.59564	885.446	195.2165	793.25	2,009.71	62.165	441.3	169.5
Maximum Power	E5-2697	2.7	12	24	384	0		32	200	36.373	34.672	35.21	49.459	31.96	43.304	39.69	410.477	59.24092	2,266.35	286.9765	1,223.62	3,518.19	40.60	555.90	212.8
				200%	200%					33%	24%	21%	23%	24%	23%	23%	-54%	11%	-156%	-47%	-54%	-75%	35%	-26%	-26%
High-End Performance	E5-2697	2.7	12	8	128	0		8	800	54.22	45.195	43.443	64.806	41.605	56.827	51.102	262.241	65.55325	871.988	192.2493	1,120.06	2,144.81	62.602	445.6	158.3
Maximum Power	E5-2697	2.7	12	24	384	16	15 K	16	512	28.862	29.241	29.421	40.484	26.949	35.743	32.647	349.921	50.50135	1,968.77	249.2959	1,052.16	1,230.66	33.76	657.40	276.6
				200%	200%					47%	35%	32%	38%	35%	37%	36%	-33%	23%	-126%	-30%	6%	43%	46%	-48%	-75%
High-End Performance	E5 2680 V2	2.8	10	16	384	12	15 K	0	0	30.868	19.974	27.482	40.518	22.21	31.443	25.277	456.412	65.87036	1286.916	162.9559	102.94	93.975	26.139	514.7	209.3
Maximum Power	E5-2690 V2	3	10	24	768	3	15 K	9 HDD	7.2 K	22.829	15.711	21.626	31.609	16.949	24.845	19.629	539.155	55.0214	1944.335	173.8639	12.716	6.251	17.8	675.6	344
				50%	100%					26%	21%	21%	22%	24%	21%	22%	-18%	16%	-51%	-7%	88%	93%	32%	-31%	-64%

Table A-2: 4 Socket Managed Servers: Largely the Same CPU Capacity with Increased Memory and Storage Count and Capacity on the Maximum Power Configuration

Configuration	Processor Name	Number of Processor Sockets	Processor Frequency	Number of Cores per socket	Number of DIMMs	Total GB of memory	Number of HDDs	HDD Speed	Number of SSD DIMMs	GB SSD	Compress	CryptoAES	LU	SOR	XML Validate	SORT	SHA256	Flood	Flood (2)	Capacity	Capacity(2)	Sequential	Random	SPECPower SSI Hybrid	Maximum Power	Idle Power
High-End Performance	E5-4650	4	2.7	8	32	512			4	744	42.847	34.263	33.608	50.593	32.479	43.421	33.941	780.218	97.51683	1627.523	178.3587	290.015	1147.47	19.933	3187.7	765.5
Maximum Power	E5-4640	4	2.4	8	48	768	4	15 K			31.508	25.718	25.422	37.591	24.235	33.163	24.896	925.871	94.48622	3407.904	304.7373	51.915	37.459	34.739	3583.5	1188.8
											26%	25%	24%	26%	25%	24%	27%	-19%	3%	-109%	-71%	82%	97%	-74%	-12%	-55%
High-End Performance	E7-4890 V2	4	2.8	15	32	1024	4	10 K	0	0	34.486	24.942	32.862	49.401	30.727	37.5	30.25	1415.964	125.1413	4390.157	339.8658	4.03	2.44	30.754	1384.4	563
Maximum Power	E7-4890 V2	4	2.8	15	48	1536	4	10 K	0	0	28.699	23.006	30.216	45.281	28.119	34.795	27.703	2039.591	147.1791	6047.476	382.1329	3.127	3.274	25.937	1526.3	644.3
											17%	8%	8%	8%	8%	7%	8%	-44%	-18%	-38%	-12%	22%	-34%	16%	-10%	-14%
High-End Performance	AMD6376	4	2.3	16	16	128			6	1200	30.978	131.625	25.588	23.876	24.036	32.836	31.715	187.546	46.88149	625.294	137.8601	453.92	1102.69	42.911	791.7	217.8
Maximum Power	AMD6378	4	2.4	16	32	256	6	15 K			27.941	113.702	24	22.642	22.025	30.981	30.009	283.109	50.04173	1191.144	184.9682	93.37	44.006	37.521	947.8	238.9
											10%	14%	6%	5%	6%	5%	-51%	-7%	-90%	-34%	78%	96%	13%	-20%	-10%	
High-End Performance	E7-4880 V2	4	2.5	15	72	1156	8	15 K			20.437	25.261	32.49	51.005	30.038	38.154	31.377	1549.969	128.9266	5165.21	376.3033	21.483	12.044	18.506	1233.8	545.6
Maximum Power	E7-4890 V2	4	2.8	15	96	3072	12	10 K			24.521	18.532	24.378	36.768	21.999	28.104	22.926	3083.093	157.3166	9615.111	429.4753	20.163	7.128	20.838	1961.2	812.9
											-20%	27%	25%	28%	27%	26%	27%	-99%	-22%	-86%	-14%	6%	41%	-13%	-59%	-49%
High-End Performance	E5-4650 V2	4	2.4	10	32	512	4	10 K	0	0	45.27	29.218	38.173	56.088	38.437	47.391	33.285	1139.545	142.4279	3098.651	339.5782	27.665	18.348	54.087	346.55	676.7
Maximum Power	E5-4650 V2	4	2.4	10	32	1024	4	10 K	0	0	36.235	24.063	31.347	45.711	30.868	36.222	27.811	1637.183	144.6924	4651.73	360.1156	21.396	14.067	33.69	413.7	838.7
											20%	18%	18%	19%	20%	24%	16%	-44%	-2%	-50%	-6%	23%	23%	38%	-19%	-24%
High-End Performance	Opteron 6380	4	2.5	16	16	128	1	7.5 K	0	0	33.842	137.249	28.364	28.927	27.624	39.061	37.626	178.485	44.61648	704.755	155.3791	10.7	5.529	46.137	722.3	224.3
Maximum Power	Opteron 6386	4	2.8	16	32	512	6	15 K	0	0	23.147	98.471	20.071	19.724	18.552	26.469	25.392	549.212	68.64417	2158.575	236.5562	82.095	45.089	31.822	996.9	415.2
											32%	28%	29%	32%	33%	32%	33%	-208%	-54%	-206%	-52%	-667%	-716%	31%	-38%	-85%
High-End Performance	E5-4657L v2	4	2.4	12	32	512			4	744	32.849	28.066	27.662	38.459	26.15	34.625	31.63	684.813	85.59248	2734.346	299.6544	78.757	327.264	36.624	1146	599.6
Maximum Power	E5-4650 v2	4	2.4	10	48	768	4	15 K			28.549	23.549	24.097	32.04	22.133	28.907	26.449	804.948	82.14589	3785.402	338.4935	19.548	13.337	31.096	1196.5	665
											13%	16%	13%	17%	15%	17%	16%	-18%	4%	-38%	-13%	75%	96%	15%	-4%	-11%

Table A-3: 2 Socket Managed Servers with Higher Compute Capacity for the Max Power vs. High-End Performance Configurations

Configuration	Processor Name	Number of Processor Sockets	Processor Frequency	Number of Cores per socket	Number of DIMMs	Total GB of memory	Number of HDDs	HDD Speed	Number of SSD DIMMs	GB SSD	Compress	CryptoAES	LU	SOR	XML Validate	SORT	SHA256	Flood	Flood (2)	Capacity	Capacity(2)	Sequential	Random	SPECPower SSI Hybrid	Maximum Power	Idle Power
High-End Performance	E5-2430 v2	2	2.5	6	12	192			4	3200	45.0	187.3	48.2	48.1	32.9	43.0	38.4	434.4	88.7	232.9	41.8	593.8	699.3	50.5	248.8	106
Maximum Power	E5-2470 v2	2	2.4	10	12	384			4	3200	47.5	168.5	62.8	66.0	41.3	57.4	52.3	471.7	68.1	889.6	112.6	123.9	97.9	54.7	349.3	110.9
											-6%	10%	-30%	-37%	-25%	-33%	-36%	-9%	23%	-282%	-169%	79%	86%	-8%	-40%	-5%
High-End Performance	E5-2643-V2	2	3.5	6	16	256	16	15 K			30.2	23.4	23.2	31.6	22.3	28.2	26.0	431.2	76.2	1104.1	171.5	236.8	186.6	35.8	500.2	229
Maximum Power	E5-2697-V2	2	2.7	12	24	768	32	15 K			24.3	24.0	24.5	33.5	22.1	29.6	27.5	522.5	53.3	3321.5	297.0	278.5	225.8	26.8	816	352.5
											19%	-2%	-5%	-6%	1%	-5%	-6%	-21%	30%	-201%	-73%	-18%	-21%	25%	-63%	-54%
High-End Performance	E5-2430-V2	2	2.5	6	12	192	8	15K			37.9	31.8	32.1	43.4	29.7	38.6	35.7	339.4	69.3	1121.6	201.4	168.8	150.1	43.8	274.2	129.5
Maximum Power	E5-2470-V2	2	2.4	10	12	384	8	15K			38.7	38.4	39.1	54.4	35.1	47.6	44.3	390.1	56.3	2552.5	323.2	160.6	133.6	42.7	389.7	136
											0%	100%														
High-End Performance	E5-2420-V2	2	2.2	6	12	192	8	15K			26.1	20.0	20.6	27.4	19.4	24.6	22.3	303.1	61.9	805.3	144.6	202.5	86.3	30.0	353.7	200.9
Maximum Power	E5-2470-V2	2	2.4	10	12	384	8	15K			29.8	29.7	30.1	41.6	27.3	37.1	34.1	327.3	47.2	2108.5	267.0	182.9	96.1	33.2	472	229.8
											-14%	-48%	-46%	-52%	-41%	-51%	-53%	-8%	24%	-162%	-85%	10%	-11%	-11%	-33%	-14%
High-End Performance	E5-2667 V2	2	3.3	8	8	125.9			2	100	36.1	28.2	29.1	42.2	30.8	33.3	41.5	247.0	62.3	369.6	82.2	83.2	310.9	18.1	389.9	138.9
Maximum Power	E5-2690 V2	2	3	10	16	252.1			2	292	37.1	28.7	28.8	44.1	32.7	32.9	43.3	451.7	80.5	670.9	105.0	46.0	25.5	16.9	449.7	151.1
											-3%	-2%	1%	-5%	-6%	1%	-4%	-83%	-29%	-82%	-28%	45%	92%	7%	-15%	-9%
High-End Performance	E5-2680 V3	2	2.5	12	18	256	16	10 K	0	0	34.1	22.1	26.8	40.7	33.7	32.3	25.5	517.7	91.5	1286.5	199.8	10.9	6065.0	38.0	615.6	277.2
Maximum Power	E5-2699 V3	2	2.3	18	24	768	12	7.5 K	0	0	36.5	27.3	33.1	48.1	38.6	37.9	30.1	843.2	86.1	3838.2	343.2	12.7	4.6	32.2	762.5	314.2
											-7%	-24%	-23%	-18%	-15%	-17%	-18%	-63%	6%	-198%	-72%	-17%	100%	15%	-24%	-13%
High-End Performance	E5-2450 v2	2	2.5	8	12	192	16	15 K			37.4	150.2	41.5	42.1	28.3	37.5	33.6	275.1	56.2	988.0	177.4	459.1	206.7	41.4	417	173.8
Maximum Power	E5-2470 v2	2	2.4	10	12	384	16	15 K			30.8	28.9	29.5	41.4	26.5	36.4	33.8	318.0	45.9	1957.7	247.9	331.5	186.8	32.0	509.8	220.4
											18%	81%	29%	2%	6%	3%	-1%	-16%	18%	-98%	-40%	28%	10%	23%	-22%	-27%

Table A-4: Managed 2 Socket Servers with Higher CPU Capacity on the High-End Performance vs. Maximum Power Configurations

Configuration	Processor Name	Number of Processor Sockets	Processor Frequency	Number of Cores per socket	Number of DIMMs	Total GB of memory	Number of HDDs	HDD Speed	Compress	CryptoAES	LU	SOR	XML Validate	SORT	SHA256	Flood	Flood (2)	Capacity	Capacity(2)	Sequential	Random	SPECPower SSI Hybrid	Maximum Power	Idle Power
High-End Performance	E5-2680-V2	2	2.8	10	16	256	8	7.5 K	47.339	40.642	41.623	61.097	37.009	52.081	48.028	442.963	78.29717	1,630.55	253.2021	118.106	54.788	51.848	459.6	133.2
Maximum Power	E5-2650L	2	1.8	8	16	32	4	7.5 K	36.135	29.503	29.534	41.823	27.676	37.397	26.805	49.804	24.89934	141.037	63.69413	77.772	40.897	39.641	314.8	120.2
High-End Performance	E5-2699 v3	2	2300	18	16	256	10	10 K	68.204	292.369	91.755	75.609	59.754	66.947	66.474	638.795	112.912	2691.709	417.9853	1126.374	2087.645	77.866	505.6	168.2
Maximum Power	E5-2687W v3	2	3100	10	24	768	24	15 K	38.488	165.81	54.7	46.23	35.362	40.479	38.886	1079.907	110.2058	5386.538	481.6683	1389.294	1278.607	44.349	581.1	198
High-End Performance	E5-2699 v3	2	2300	18	12	384	4	15 K	40.497	130.316	80.042	66.15	50.803	58.586	58.111	538.695	77.74562	3632.106	459.9159	86.955	78.255	54.604	551.2	179.8
Maximum Power	E5-2687W v3	2	3100	10	16	512	32	15 K	30.662	140.691	41.29	34.312	27.02	30.911	29.609	713.496	89.17747	2891.302	316.855	350.581	310.608	31.524	696.9	324.1
High-End Performance	E5-2683 v3	2	2000	14	8	128	4	15 K	61.398	278.344	80.165	69.199	52.714	61.445	58.39	363.239	90.80005	1115.765	245.9955	102.756	83.908	77.272	439.5	115
Maximum Power	E5-2690 v3	2	2600	12	12	192	10	15 K	58.669	263.202	74.607	67.017	50.763	59.137	57.807	484.969	98.98331	1628.181	292.3297	229.047	103.103	77.233	481.4	116.5
									4%	5%	7%	3%	4%	4%	1%	-34%	-9%	-46%	-19%	-123%	-23%	0%	-10%	-1%

Table A-5: 2 Socket Resilient Servers: Higher Core Count on the Maximum Power versus High-End Performance Configuration

Configuration	Processor Name	Number of Processor Sockets	Processor Frequency	Number of Cores per socket	Number of DIMMs	Total GB of memory	Number of HDDs	GB SSD	Compress	CryptoAES	LU	SOR	XML Validate	SORT	SHA256	Flood	Flood (2)	Capacity	Capacity(2)	Sequential	Random	SPECPower SSI Hybrid	Maximum Power	Idle Power
High-End Performance	E5-2430 v2	2	2.5	6	12	192		3200	44.966	187.292	48.223	48.123	32.889	43.036	38.428	434.396	88.66124	232.88	41.81215	593.763	699.287	50.542	248.8	106
Maximum Power	E5-2470 v2	2	2.4	10	12	384		3200	47.534	168.481	62.759	65.987	41.261	57.448	52.291	471.747	68.08354	889.61	112.647	123.94	97.915	54.694	349.3	110.9
High-End Performance	E5-2643-V2	2	3.5	6	16	256	16		30.152	23.427	23.227	31.597	22.277	28.195	25.956	431.197	76.21744	1104.126	171.4555	236.821	186.577	35.751	500.2	229
Maximum Power	E5-2697-V2	2	2.7	12	24	768	32		24.303	23.97	24.48	33.538	22.116	29.621	27.49	522.478	53.31949	3321.469	297.0083	278.533	225.758	26.77	816	352.5
High-End Performance	E5-2430-V2	2	2.5	6	12	192	8		37.934	31.803	32.108	43.396	29.657	38.597	35.712	339.384	69.26907	1121.628	201.3813	168.801	150.071	43.76	274.2	129.5
Maximum Power	E5-2470-V2	2	2.4	10	12	384	8		38.707	38.405	39.118	54.448	35.053	47.62	44.256	390.085	56.29791	2552.505	323.2113	160.623	133.604	42.713	389.7	136
High-End Performance	E5-2420-V2	2	2.2	6	12	192	8		26.092	20.046	20.587	27.368	19.415	24.566	22.302	303.144	61.8724	805.348	144.5952	202.498	86.27	30.042	353.7	200.9
Maximum Power	E5-2470-V2	2	2.4	10	12	384	8		29.83	29.658	30.053	41.632	27.317	37.054	34.135	327.285	47.23447	2108.476	266.9861	182.879	96.051	33.199	472	229.8
High-End Performance	E5-2667 V2	2	3.3	8	8	125.9	100		36.146	28.247	29.088	42.164	30.825	33.341	41.533	247.006	62.25772	369.553	82.16375	83.171	310.905	18.096	389.9	138.9
Maximum Power	E5-2690 V2	2	3	10	16	252.1	292		37.068	28.728	28.829	44.087	32.658	32.887	43.269	451.714	80.4592	670.949	104.9983	45.982	25.535	16.901	449.7	151.1
High-End Performance	E5-2680 V3	2	2.5	12	18	256	16	0	34.088	22.082	26.841	40.677	33.7	32.308	25.545	517.679	91.50381	1286.54	199.7819	10.866	6065	37.951	615.6	277.2
Maximum Power	E5-2699 V3	2	2.3	18	24	768	12	0	36.478	27.274	33.108	48.054	38.603	37.928	30.081	843.225	86.0521	3838.154	343.2106	12.691	4.583	32.162	762.5	314.2
High-End Performance	E5-2450 v2	2	2.5	8	12	192	16		37.395	150.184	41.451	42.145	28.28	37.455	33.592	275.122	56.15304	988.041	177.3966	459.06	206.673	41.395	417	173.8
Maximum Power	E5-2470 v2	2	2.4	10	12	384	16		30.811	28.936	29.503	41.432	26.494	36.411	33.785	317.991	45.89314	1957.732	247.8981	331.542	186.845	31.962	509.8	220.4
									18%	81%	29%	2%	6%	3%	-1%	-16%	18%	-98%	-40%	28%	10%	23%	-22%	-27%