

Alibaba Cloud		Alibaba Cloud E-MapReduce		TPC-DS: 2.11.0 TPC-Pricing: 2.4.0 Report Date: Sep. 16, 2019	
Total System Cost		TPC-DS Throughput	Price / Performance	System Availability Date	
\$2,604,064.68 USD		14,861,137 QphDS@100000GB	\$0.18 USD/QphDS@100000GB	As of Publication	
Dataset Size¹	Database Manager	Operation System	Other Software	Cluster	
100,000 GB	E-MapReduce 3.21.2	CentOS Linux Release 7.4	N/A	Yes	
Alibaba Cloud E-MapReduce Cluster ecs.hfg5.6xlarge with 100GB SSD Cloud Disk + 3 x 100GB SSD Cloud Disk (Master node) 4.5GbE ... 40 x ecs.i2g.16xlarge with 100GB Ultra Cloud Disk + 4 x 1788 GB NVMe SSD Local Disk (Worker nodes) 10GbE Benchmarked Configuration			DM2 1,252.4 1% LOAD 11,830.0 8% PT 16,093.5 11% TT2 55,689.1 40% TT1 54,184.7 39% DM1 1,276.3 1% Elapsed Time		
Load includes backup = No			RAID = RAID-1 for metadata; HDFS with 3-way replication for table data		
System Configuration:		Alibaba Cloud E-MapReduce Cluster			
Servers:		1 x ecs.hfg5.6xlarge + 40 x ecs.i2g.16xlarge			
Total Processors/Cores/Threads:		41/1,292/2,584			
Total Memory:		10,336 GB			
Total Storage:		290,480 GB			
Storage Ratio:		2.91			
Server Configuration:		Per node (ecs.hfg5.6xlarge)			
Processors:		Intel(R)Xeon(R) Gold 6149 CPU @ 3.10GHz, 22 MB L3			
Memory:		96 GB			
Network:		Bandwidth: 4.5 Gbps, Packet forwarding rate: 2,000,000			
Storage Device:		3 x 100 GB SSD Cloud Disk (data disk) 1 x 100 GB SSD Cloud Disk (boot disk)			
Server Configuration:		Per node (ecs.i2g.16xlarge)			
Processors:		Intel(R)Xeon(R) Platinum 8163 CPU @ 2.50GHz, 33 MB L3			
Memory:		256 GB			
Network:		Bandwidth: 10.0 Gbps, Packet forwarding rate: 4,000,000			
Storage Device:		4 x 1788 GB NVMe SSD Local Disk (data disk) 1 x 100 GB Ultra Cloud Disk (boot disk)			
¹. Dataset Size includes only raw data (i.e., no temp, index, redundant storage space, etc.). ². Total Storage = (100 + 100 * 3) (Master node) + (100 + 1,788 * 4) * 40 (Worker nodes) = 290,480 GB ³. Storage Ratio = Total Storage / SF = 290,480 GB / 100,000 GB					

		Alibaba Cloud			TPC-DS: 2.11.0		
		E-MapReduce			TPC-Pricing: 2.4.0		
					Report Date: Sep. 16, 2019		
Description	Part Number	Src	Unit Price (USD)	Qty	Ext. Price (USD)	3-Year Maint. (USD)	
Licensed Compute Services							
<u>Virtual cloud server</u>							
ECS Instance ecs.hfg5.6xlarge	ecs.hfg5.6xlarge (China North 2)	1	6,389.48	3	19,168.44	included	
ECS System Disk (SSD Cloud Disk 100GB)	Option	1	156.06	3	468.18	included	
ECS Data Disk (SSD Cloud Disk 100GB)	Option	1	156.06	9	1,404.54	included	
<u>Virtual cloud server</u>							
ECS Instance ecs.i2g.16xlarge	ecs.i2g.16xlarge (China North 2)	1	18,628.46	120	2,235,415.20	included	
- NVMe SSD Local Disk (4 x 1788 GB)	Included						
ECS System Disk (Ultra Cloud Disk 100GB)	Option	1	78.54	120	9,424.80	included	
Licensed Compute Services Sub-Total					2,265,881.16	0.00	
Licensed Software Services							
E-MapReduce for emr.hfg5.6xlarge	emr.hfg5.6xlarge (China North 2)	1	818.4888	3	2,455.47	included	
E-MapReduce for emr.i2g.16xlarge	emr.i2g.16xlarge (China North 2)	1	2,793.9840	120	335,278.08	included	
Licensed Software Services Sub-Total					337,733.55	0.00	
Other Components							
Lenovo 120S-14IAP Laptop (Includes spares)	81A5001UUS	2	149.99	3	449.97		
Other Components Sub-Total					449.97	0.00	
1 = Alibaba Cloud, 2 = Bestbuy.com				3-Year Cost of Ownership: 2,604,064.68			
All Licensed Services prices are per year and based on 1-year pre-paid subscriptions.				QphDS@100000GB: 14,861,137			
Audited by Francois Raab, InfoSizing				\$ /QphDS@100000GB: 0.18			
Prices used in TPC benchmarks reflect the actual prices a customer would pay for a one-time purchase of the stated components. Individually negotiated discounts are not permitted. Special prices based on assumptions about past or future purchases are not permitted. All discounts reflect standard pricing policies for the listed components. For complete details, see the pricing sections of the TPC benchmark specifications. If you find that the stated prices are not available according to these terms, please inform at pricing@tpc.org. Thank you.							

	Alibaba Cloud E-MapReduce	TPC-DS: 2.11.0 TPC-Pricing: 2.4.0 Report Date: Sep. 16, 2019																																																																						
Metrics Details: <table><tr><th>Name</th><th>Value</th><th>Unit</th></tr><tr><td>Scale Factor (SF)</td><td>100,000</td><td>GB</td></tr><tr><td>Streams</td><td>4</td><td>Stream</td></tr><tr><td>Queries (Q)</td><td>396</td><td>Queries</td></tr><tr><td>T_load</td><td>11,830.0</td><td>Second</td></tr><tr><td>T_ld</td><td>0.1315</td><td>Hour</td></tr><tr><td>T_power</td><td>16,093.5</td><td>Second</td></tr><tr><td>T_pt</td><td>17.8817</td><td>Hour</td></tr><tr><td>T_tt1</td><td>54,184.7</td><td>Second</td></tr><tr><td>T_tt2</td><td>55,689.1</td><td>Second</td></tr><tr><td>T_dm1</td><td>1,276.3</td><td>Second</td></tr><tr><td>T_dm2</td><td>1,252.4</td><td>Second</td></tr><tr><td>T_tt</td><td>30.5205</td><td>Hour</td></tr><tr><td>T_dm</td><td>0.7025</td><td>Hour</td></tr></table>			Name	Value	Unit	Scale Factor (SF)	100,000	GB	Streams	4	Stream	Queries (Q)	396	Queries	T_load	11,830.0	Second	T_ld	0.1315	Hour	T_power	16,093.5	Second	T_pt	17.8817	Hour	T_tt1	54,184.7	Second	T_tt2	55,689.1	Second	T_dm1	1,276.3	Second	T_dm2	1,252.4	Second	T_tt	30.5205	Hour	T_dm	0.7025	Hour																												
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Timing Intervals for Each Query (In Seconds)

Query	Stream 0	Stream 1	Stream 2	Stream 3	Stream 4	Min	25%tile	Median	75%tile	Max	Stream 5	Stream 6	Stream 7	Stream 8	Min	25%tile	Median	75%tile	Max
1	20.5	60.1	213.1	153.6	302.9	60.1	130.2	183.4	235.6	302.9	607.5	221.2	540.1	296.1	221.2	277.4	418.1	557.0	607.5
2	94.7	293.6	166.3	1,386.9	324.4	166.3	261.8	309.0	590.0	1,386.9	547.2	676.9	618.5	933.8	547.2	600.7	647.7	741.1	933.8
3	15.3	414.8	361.3	64.1	30.6	30.6	55.7	212.7	374.7	414.8	32.0	33.2	273.5	142.6	32.0	32.9	87.9	175.3	273.5
4	1,112.7	1,587.3	1,204.7	1,409.0	1,631.6	1,204.7	1,357.9	1,498.2	1,598.4	1,631.6	1,624.1	1,436.9	1,280.3	1,131.8	1,131.8	1,243.2	1,358.6	1,483.7	1,624.1
5	188.1	487.2	525.0	274.8	245.3	245.3	267.4	381.0	496.7	525.0	1,226.1	618.5	1,448.6	731.3	618.5	703.1	978.7	1,281.7	1,448.6
6	25.1	125.6	55.7	481.4	129.6	55.7	108.1	127.6	217.6	481.4	115.2	207.0	250.2	92.3	92.3	109.5	161.1	217.8	250.2
7	38.1	206.9	379.6	62.3	65.2	62.3	64.5	136.1	250.1	379.6	119.8	237.1	122.8	87.4	87.4	111.7	121.3	151.4	237.1
8	29.1	257.7	915.6	323.0	474.9	257.7	306.7	399.0	585.1	915.6	419.8	80.5	397.5	1,485.4	80.5	318.3	408.7	686.2	1,485.4
9	90.0	773.2	129.3	363.3	133.4	129.3	132.4	248.4	465.8	773.2	133.2	179.6	565.7	144.4	133.2	141.6	162.0	276.1	565.7
10	45.2	947.0	307.0	153.1	227.2	153.1	208.7	267.1	467.0	947.0	147.0	493.9	126.7	661.8	126.7	141.9	320.5	535.9	661.8
11	261.7	442.3	1,040.8	371.7	418.2	371.7	406.6	430.3	591.9	1,040.8	1,054.5	369.5	422.8	404.9	369.5	396.1	413.9	580.7	1,054.5
12	6.5	368.3	156.9	321.4	709.6	156.9	280.3	344.9	453.6	709.6	15.9	220.0	48.0	28.4	15.9	25.3	38.2	91.0	220.0
13	65.7	165.5	625.0	410.6	324.5	165.5	284.8	367.6	464.2	625.0	693.3	143.7	216.8	269.3	143.7	198.5	243.1	375.3	693.3
14	1,359.9	4,030.5	3,178.4	4,555.1	5,532.8	3,178.4	3,817.5	4,292.8	4,799.5	5,532.8	3,300.7	3,120.0	3,905.9	2,585.7	2,585.7	2,986.4	3,210.4	3,452.0	3,905.9
15	21.8	112.1	987.8	255.8	137.5	112.1	131.2	196.7	438.8	987.8	165.3	286.8	63.8	456.1	63.8	139.9	226.1	329.1	456.1
16	191.6	385.1	843.6	574.8	365.1	365.1	380.1	480.0	642.0	843.6	354.2	219.4	363.1	531.2	219.4	320.5	358.7	405.1	531.2
17	87.3	1,008.8	1,112.1	173.1	495.7	173.1	415.1	752.3	1,034.6	1,112.1	349.5	725.6	161.8	119.2	119.2	151.2	255.7	443.5	725.6
18	63.4	1,011.6	369.8	166.7	564.0	166.7	319.0	466.9	675.9	1,011.6	792.2	200.5	169.6	196.2	169.6	189.6	198.4	348.4	792.2
19	18.5	1,437.9	184.5	605.5	274.0	184.5	251.6	439.8	813.6	1,437.9	75.9	107.9	719.1	538.0	75.9	99.9	323.0	583.3	719.1
20	7.8	244.6	212.5	15.8	75.4	15.8	60.5	144.0	220.5	244.6	42.7	14.5	196.3	507.0	14.5	35.7	119.5	274.0	507.0
21	3.5	269.9	11.9	146.9	132.0	11.9	102.0	139.5	177.7	269.9	118.0	10.2	15.2	67.6	10.2	14.0	41.4	80.2	118.0
22	23.7	34.0	39.2	293.5	754.1	34.0	37.9	166.4	408.7	754.1	676.8	428.6	181.3	247.8	181.3	231.2	338.2	490.7	676.8
23	3,022.4	3,868.1	5,776.6	4,450.6	5,692.4	3,868.1	4,305.0	5,071.5	5,713.5	5,776.6	5,847.4	4,796.9	5,049.0	4,993.3	4,796.9	4,944.2	5,021.2	5,248.6	5,847.4
24	686.3	2,221.5	2,055.2	3,107.1	3,795.3	2,055.2	2,179.9	2,664.3	3,279.2	3,795.3	2,828.6	3,611.3	3,925.8	2,721.8	2,721.8	2,801.9	3,220.0	3,689.9	3,925.8
25	73.7	511.9	143.5	131.8	198.0	131.8	140.6	170.8	276.5	511.9	69.8	91.6	864.2	782.2	69.8	86.2	436.9	802.7	864.2
26	24.8	248.7	258.4	143.6	56.6	56.6	121.9	196.2	251.1	258.4	31.0	171.1	879.2	143.0	31.0	115.0	157.1	348.1	879.2
27	30.4	714.1	517.1	296.6	389.4	296.6	366.2	453.3	566.4	714.1	811.7	579.2	81.0	208.3	81.0	176.5	393.8	637.3	811.7
28	247.3	1,208.7	1,212.4	349.7	378.1	349.7	371.0	793.4	1,209.6	1,212.4	688.4	458.0	405.4	365.3	365.3	395.4	431.7	515.6	688.4
29	222.1	645.9	290.5	516.3	421.8	290.5	389.0	469.1	548.7	645.9	211.6	805.4	494.9	1,014.8	211.6	424.1	650.2	857.8	1,014.8
30	37.8	438.4	182.6	291.7	637.6	182.6	264.4	365.1	488.2	637.6	353.5	145.1	127.3	127.3	140.7	155.1	212.2	353.5	637.6
31	92.7	512.0	501.4	256.6	286.3	256.6	278.9	393.9	504.1	512.0	106.0	542.8	496.3	193.9	106.0	171.9	345.1	507.9	542.8
32	47.3	104.8	237.7	228.0	409.3	104.8	197.2	232.9	280.6	409.3	78.0	508.0	283.4	642.8	78.0	232.1	395.7	541.7	642.8
33	12.2	112.7	316.2	221.4	421.8	112.7	194.2	268.8	342.6	421.8	318.7	90.3	370.6	55.0	55.0	81.5	204.5	331.7	370.6
34	47.3	245.3	251.5	155.1	57.9	57.9	130.8	200.2	246.9	251.5	37.1	138.4	379.2	79.5	37.1	68.9	109.0	198.6	379.2
35	107.6	662.0	897.8	372.4	403.8	372.4	396.0	532.9	721.0	897.8	621.6	633.4	836.5	638.9	621.6	630.5	636.2	688.3	836.5
36	33.5	101.0	765.2	79.0	990.6	79.0	95.5	433.1	821.6	990.6	103.4	120.8	61.7	134.1	61.7	93.0	112.1	124.1	134.1
37	89.7	365.0	310.5	306.0	164.5	164.5	270.6	308.3	324.1	365.0	169.3	438.4	356.8	255.9	169.3	234.3	306.4	377.2	438.4
38	297.1	317.7	450.7	640.4	1,423.9	317.7	417.5	545.6	836.3	1,423.9	323.8	497.9	880.8	934.4	323.8	454.4	689.4	894.2	934.4
39	36.4	87.5	494.0	412.6	276.0	87.5	228.9	344.3	433.0	494.0	62.9	1,106.7	866.1	209.2	62.9	172.6	539.2	926.3	1,106.7
40	47.6	374.3	401.2	805.8	291.5	291.5	353.6	387.8	502.4	805.8	77.7	64.3	392.9	66.7	64.3	66.1	72.2	156.5	392.9
41	3.2	280.5	20.8	198.7	17.3	17.3	19.9	109.8	219.2	280.5	15.0	3.6	234.9	116.4	3.6	12.2	65.7	146.0	234.9
42	6.3	41.8	147.2	133.2	66.0	41.8	60.0	99.6	136.7	147.2	54.6	44.5	34.3	9.5	9.5	28.1	39.4	47.0	54.6
43	19.5	69.4	170.5	392.4	55.6	55.6	66.0	120.0	226.0	392.4	1,135.8	289.5	175.3	241.2	175.3	224.7	265.4	501.1	1,135.8
44	32.8	624.0	842.8	855.1	653.9	624.0	646.4	748.4	845.9	855.1	469.8	718.7	651.3	897.0	469.8	605.9	680.5	763.3	897.0
45	17.1	115.3	59.5	190.3	90.5	59.5	82.8	102.9	134.1	190.3	81.6	328.9	79.6	147.0	79.6	81.1	114.3	192.5	328.9
46	35.1	407.8	158.8	790.5	287.0	158.8	255.0	347.4	503.5	790.5	123.5	990.8	181.1	591.6	123.5	166.7	386.4	691.4	990.8
47	57.9	445.7	209.2	155.1	105.2	105.2	142.6	182.2	268.3	445.7	1,702.0	452.2	231.9	130.9	130.9	206.7	342.1	764.7	1,702.0
48	49.4	348.6	53.2	737.0	508.8	53.2	274.8	428.7	565.9	737.0	384.1	496.4	560.0	568.1	384.1	468.3	528.2	562.0	568.1
49	48.8	234.5	159.7	78.3	208.1	78.3	139.4	183.9	214.7	234.5	369.5	737.4	145.3	790.4	145.3	313.5	553.5	750.7	790.4
50	638.4	1,088.5	2,146.1	1,066.2	954.6	954.6	1,038.3	1,077.4	1,352.9	2,146.1	1,517.7	825.8	800.6	1,517.3	800.6	819.5	1,171.6	1,517.4	1,517.7
51	61.8	220.8	367.8	1,024.6	451.9	220.8	331.1	409.9	595.1	1,024.6	144.1	548.7	567.5	369.2	144.1	312.9	459.0	553.4	567.5
52	8.5	80.7	12.7	9.2	24.5	9.2	11.8	18.6	38.6	80.7	26.2	17.5	80.3	12.4	12.4	16.2	21.9	39.7	80.3
53	17.8	203.0	94.6	807.5	170.8	94.6	151.8	186.9	354.1	807.5	132.3	254.3	455.2	41.1	41.1	109.5	193.3	304.5	455.2
54	52.3	437.3	338.7	1,982.5	424.8	338.7	403.3	431.1	823.6	1,982.5	848.9	296.3	1,283.5	55.0	55.0	236.0	572.6	957.6	1,283.5
55	11.1	11.8	128.8	16.6	89.6	11.8	15.4	53.1	99.4	128.8	62.5	5.6	32.0	1,082.9	5.6	25.4	47.3	317.6	1,082.9
56	24.4	147.2	69.6	101.9	300.2	69.6	93.8	124.6	185.5	300.2	426.5	950.5	327.3	394.7	327.3	377.9	410.6	557.5	950.5
57	43.2	933.5	188.5	86.5	382.3	86.5	163.0	285.4	520.1	933.5	226.4	253.1	220.8	116.1	116.1	194.6	223.6	233.1	253.1
58	93.8	395.9	839.8	376.2	337.8	337.8	366.6	386.1	506.9	839.8	599.7	294.2	197.1	244.9	197.1	233.0	269.6	370.6	599.7
59	123.0	254.1	435.0	313.9	637.7	254.1	299.0	374.5	485.7	637.7	731.7	352.8	294.7	301.2	294.7	299.6	327.0	447.5	731.7
60	23.3	890.6	684.3	1,144.1	388.4	388.4	610.3	787.5	954.0	1,144.1	341.8	26.9	563.7	694.6	26.9	263.1	452.8	596.	

95	284.7	395.7	353.3	360.0	374.3	353.3	358.3	367.2	379.7	395.7	713.9	429.4	394.5	435.8	394.5	420.7	432.6	505.3	713.9
96	67.3	111.2	411.3	257.2	74.6	74.6	102.1	184.2	295.7	411.3	397.6	55.1	46.5	645.1	46.5	53.0	226.4	459.5	645.1
97	114.5	224.7	537.3	303.7	309.6	224.7	284.0	306.7	366.5	537.3	1,537.6	943.1	399.2	430.3	399.2	422.5	686.7	1,091.7	1,537.6
98	11.0	34.3	102.5	17.7	60.5	17.7	30.2	47.4	71.0	102.5	494.9	686.8	105.5	145.0	105.5	135.1	320.0	542.9	686.8
99	55.8	151.9	122.4	61.8	899.5	61.8	107.3	137.2	338.8	899.5	569.7	746.8	105.2	1,726.2	105.2	453.6	658.3	991.7	1,726.2

Timing Intervals for Each Refresh Function (In Seconds)

DM Fx	R-Run 1	R-Run 2	R-Run 3	R-Run 4	Min	25%tile	Median	75%tile	Max
LF_CR	72.1	90.9	79.7	90.0	72.1	77.8	84.9	90.2	90.9
LF_CS	235.4	210.2	232.8	229.4	210.2	224.6	231.1	233.5	235.4
LF_I	35.8	30.9	39.2	36.0	30.9	34.6	35.9	36.8	39.2
LF_SR	90.8	76.5	73.1	64.5	64.5	71.0	74.8	80.1	90.8
LF_SS	276.5	238.8	255.4	256.5	238.8	251.3	256.0	261.5	276.5
LF_WR	77.5	67.5	84.4	89.8	67.5	75.0	81.0	85.8	89.8
LF_WS	189.5	181.4	180.1	177.2	177.2	179.4	180.8	183.4	189.5
DF_CS	265.7	266.6	243.4	246.1	243.4	245.4	255.9	265.9	266.6
DF_SS	301.9	285.6	294.7	297.1	285.6	292.4	295.9	298.3	301.9
DF_WS	253.5	205.5	205.6	224.6	205.5	205.6	215.1	231.8	253.5
DF_I	60.8	78.9	79.5	53.4	53.4	59.0	69.9	79.1	79.5