

Benchmark Results

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1 YCSB Benchmark

1.1 1 Thread

1000 Insert Operations			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	5.9	0.36	156.37
Average Latency (μs)	167,530	2,769,238	2,536
Min. Latency(μs)	61,248	2,281,472	1,672
Max. Latency(μs)	573,951	3,452,927	16,263
Top 95% (μs)	176,895	2,865,151	3,459
Top 99% (μs)	190,847	3,153,919	6,163

Workload A			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	23.4	2.2	157
Read			
Average Latency (μs)	10,776	180,750	2,748
Min. Latency(μs)	8,208	31,968	1,432
Max. Latency(μs)	48,831	226,047	19,903
Top 95% (μs)	13,879	205,823	4,743
Top 99% (μs)	19,711	221,055	9,743
Update			
Average Latency (μs)	69,851	723,317	2,347
Min. Latency(μs)	11,560	435,200	1,357
Max. Latency(μs)	435,967	1,471,487	19,135
Top 95% (μs)	124,415	984,575	3,721
Top 99% (μs)	128,831	1,253,375	8,123

Workload B			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	61.24	4,32	168
Read			
Average Latency (μs)	11,384	205,167	2,188
Min. Latency(μs)	8,592	26,944	1,367
Max. Latency(μs)	286,463	531,967	16,167
Top 95% (μs)	13,839	400,895	3,055
Top 99% (μs)	17,359	438,527	8,703
Update			
Average Latency (μs)	73,606	689,738	2,635
Min. Latency(μs)	13,776	422,912	1,657
Max. Latency(μs)	183,551	1,330,175	16,335
Top 95% (μs)	131,327	1,090,559	3,427
Top 99% (μs)	183,551	1,220,607	16,335

Workload C			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	75.2	4,57	174
Read			
Average Latency (μs)	11,448	218,423	1,916
Min. Latency(μs)	7,852	27,408	1,127
Max. Latency(μs)	286,791	405,759	14,447
Top 95% (μs)	15,199	306,175	2,643
Top 99% (μs)	21,023	385,023	3,975

1.2 4 Threads

1000 Insert Operations			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	27,7	0.37	214,36
Average Latency (μs)	136,432	10,946,373	2,938
Min. Latency(μs)	29,888	5,894,144	1,417
Max. Latency(μs)	600,063	13,090,815	18,015
Top 95% (μs)	153,983	12,247,039	5,811
Top 99% (μs)	188,671	12,656,639	9,807

Workload A			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	71.4	6	210
Read			
Average Latency (μs)	11,455	180,216	3,302
Min. Latency(μs)	7,724	61,728	1,221
Max. Latency(μs)	319,999	279,039	22,799
Top 95% (μs)	16,319	913,919	6,835
Top 99% (μs)	23,455	913,919	12,463
Update			
Average Latency (μs)	81,499	1,136,037	3,137
Min. Latency(μs)	11,264	449,280	1,064
Max. Latency(μs)	372,735	2,252,799	25,231
Top 95% (μs)	124,351	1,484,799	7,247
Top 99% (μs)	177,535	1,646,591	13,439

Workload B			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	170	18	223,4
Read			
Average Latency (μs)	12,154	170,211	2,383
Min. Latency(μs)	7,352	55,808	1,178
Max. Latency(μs)	355,071	294,143	23,231
Top 95% (μs)	17,151	198,911	4,267
Top 99% (μs)	27,791	221,951	9,911
Update			
Average Latency (μs)	79,693	971,800	2,583
Min. Latency(μs)	13,440	449,792	1,513
Max. Latency(μs)	199,551	1,525,759	9,759
Top 95% (μs)	130,943	1,356,799	5,627
Top 99% (μs)	199,551	1,435,647	9,759

Workload C			
	Ethereum	BigchainDB	DSE
Throughput(ops/sec)	201	24	222
Read			
Average Latency (μs)	12,353	162,676	2,345
Min. Latency(μs)	7,368	53,920	1,078
Max. Latency(μs)	376,063	277,503	16,287
Top 95% (μs)	17,647	188,671	4,707
Top 99% (μs)	36,351	202,367	8,335

2 System-oriented Benchmark

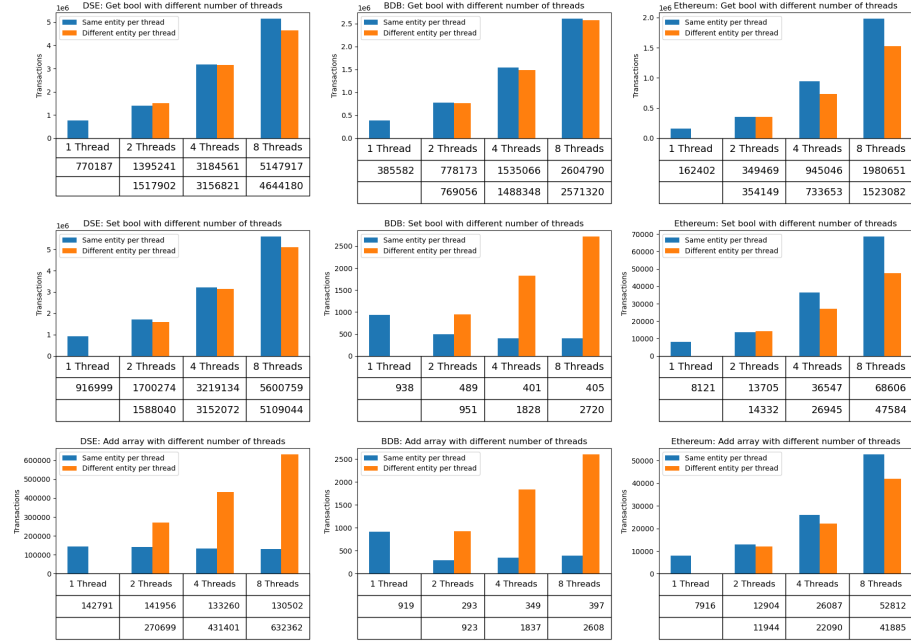


Figure 1: Comparison of the DSSs benchmarks concerning throughput

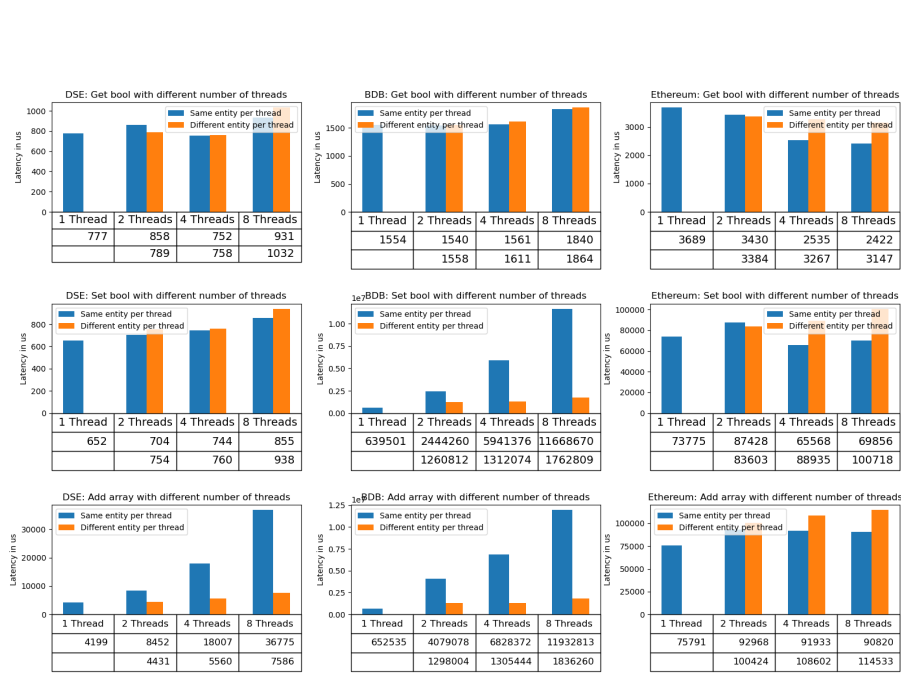


Figure 2: Comparison of the DSSs benchmarks concerning latency

2.1 Same entity

2.1.1 1 Thread

Get String (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	160,348	383,479	761,867
\emptyset transaction time (rounded μs)	3,740	1,564	787
Max time of top 10% (μs)	3,346	1,479	677
Max time of top 50% (μs)	3,665	1,555	764
Max time of top 80% (μs)	3,923	1,601	853
Max time of top 90% (μs)	4,094	1,629	921
Max time of top 95% (μs)	4,328	1,657	984
Max time of top 100% (μs)	32,689	33,424	33,143

Set String (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	7,889	928	860,709
\emptyset transaction time (rounded μs)	75,950	646,328	696
Max time of top 10% (μs)	14,986	427,433	555
Max time of top 50% (μs)	118,676	594,975	618
Max time of top 80% (μs)	121,902	824,649	727
Max time of top 90% (μs)	122,955	836,450	943
Max time of top 95% (μs)	123,880	877,108	1,190
Max time of top 100% (μs)	146,126	3,081,096	37,242

Get Bool (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	162,402	385,582	770,187
\emptyset transaction time (rounded μs)	3,689	1,555	778
Max time of top 10% (μs)	3,262	1,470	670
Max time of top 50% (μs)	3,603	1,549	753
Max time of top 80% (μs)	3,867	1,592	833
Max time of top 90% (μs)	4,053	1,618	901
Max time of top 95% (μs)	4,331	1,646	971
Max time of top 100% (μs)	54,657	22,953	95,345

Set Bool (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	8,121	938	916,999
\emptyset transaction time (rounded μs)	73,776	639,502	653
Max time of top 10% (μs)	14,525	431,636	568
Max time of top 50% (μs)	118,610	594,594	621
Max time of top 80% (μs)	121,726	825,977	679
Max time of top 90% (μs)	123,177	836,261	734
Max time of top 95% (μs)	124,721	843,966	816
Max time of top 100% (μs)	202,059	1,005,318	115,325

Get Integer (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	166,254	391,638	659,949
\emptyset transaction time (rounded μs)	3,606	1,531	907
Max time of top 10% (μs)	3,211	1,414	703
Max time of top 50% (μs)	3,527	1,533	906
Max time of top 80% (μs)	3,779	1,587	1,039
Max time of top 90% (μs)	3,970	1,616	1,106
Max time of top 95% (μs)	4,220	1,642	1,166
Max time of top 100% (μs)	33,962	18,589	84,797

Set Integer (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	7,978	940	912,535
\emptyset transaction time (rounded μs)	75,108	637,898	657
Max time of top 10% (μs)	14,527	434,096	580
Max time of top 50% (μs)	118,725	591,503	629
Max time of top 80% (μs)	121,402	826,255	678
Max time of top 90% (μs)	122,469	836,268	731
Max time of top 95% (μs)	123,507	883,644	881
Max time of top 100% (μs)	143,403	998,012	100,830

Set Mapping (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	7,894	939	380,333
\emptyset transaction time (rounded μs)	75,911	638,898	1,577
Max time of top 10% (μs)	15,031	432,695	1,314
Max time of top 50% (μs)	118,755	568,286	1,435
Max time of top 80% (μs)	121,797	825,404	1,863
Max time of top 90% (μs)	122,995	836,318	2,078
Max time of top 95% (μs)	124,129	843,566	2,222
Max time of top 100% (μs)	138,221	1,029,842	75,892

Get Mapping (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	151,148	384,409	646,159
\emptyset transaction time (rounded μs)	3,968	1,560	927
Max time of top 10% (μs)	3,502	1,483	716
Max time of top 50% (μs)	3,879	1,551	930
Max time of top 80% (μs)	4,157	1,592	1,055
Max time of top 90% (μs)	4,363	1,616	1,125
Max time of top 95% (μs)	4,682	1,640	1,185
Max time of top 100% (μs)	33,797	65,558	34,961

Add Element to Array (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	7,916	919	142,791
\emptyset transaction time (rounded μs)	75,792	652,535	4,200
Max time of top 10% (μs)	14,244	430,775	3,692
Max time of top 50% (μs)	118,227	607,930	4,018
Max time of top 80% (μs)	120,100	834,252	4,294
Max time of top 90% (μs)	120,950	841,599	4,524
Max time of top 95% (μs)	121,830	848,756	5,002
Max time of top 100% (μs)	136,008	2,183,097	195,388

Remove Element from Array (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	4,952	942	111,709
\emptyset transaction time (rounded μs)	121,064	636,663	5,371
Max time of top 10% (μs)	118,829	427,814	4,776
Max time of top 50% (μs)	120,413	552,195	5,190
Max time of top 80% (μs)	122,140	831,779	5,525
Max time of top 90% (μs)	124,328	844,425	5,783
Max time of top 95% (μs)	126,779	889,377	6,247
Max time of top 100% (μs)	148,854	1,278,343	231,922

Get Array (Number of threads: 1)			
	Ethereum	BigchainDB	DSE
Number of transactions	13,497	367,890	441,182
\emptyset transaction time (rounded μs)	44,405	1,628	1,359
Max time of top 10% (μs)	40,580	1,543	1,143
Max time of top 50% (μs)	44,065	1,614	1,352
Max time of top 80% (μs)	47,101	1,658	1,479
Max time of top 90% (μs)	48,359	1,686	1,551
Max time of top 95% (μs)	49,640	1,716	1,616
Max time of top 100% (μs)	66,115	13,345	45,819

2.1.2 2 Threads

Get String (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	339,195	774,429	1,375,586
\emptyset transaction time (rounded μs)	3,535	1,547	872
Max time of top 10% (μs)	3,065	1,428	752
Max time of top 50% (μs)	3,417	1,540	849
Max time of top 80% (μs)	3,722	1,612	934
Max time of top 90% (μs)	3,980	1,653	992
Max time of top 95% (μs)	4,355	1,695	1,049
Max time of top 100% (μs)	66,686	22,792	48,840

Set String (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,363	475	1,821,570
\emptyset transaction time (rounded μs)	96,925	1,266,003	658
Max time of top 10% (μs)	14,841	1,190,206	592
Max time of top 50% (μs)	117,336	1,275,007	645
Max time of top 80% (μs)	119,133	1,288,368	689
Max time of top 90% (μs)	120,221	1,293,562	723
Max time of top 95% (μs)	121,327	1,299,022	761
Max time of top 100% (μs)	536,951	2,689,025	44,651

Get Bool (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	349,469	778,173	1,395,241
\emptyset transaction time (rounded μs)	3,430	1,540	859
Max time of top 10% (μs)	2,965	1,358	710
Max time of top 50% (μs)	3,314	1,518	828
Max time of top 80% (μs)	3,617	1,622	943
Max time of top 90% (μs)	3,887	1,714	1,017
Max time of top 95% (μs)	4,274	1,798	1,087
Max time of top 100% (μs)	45,421	108,305	115,681

Set Bool (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	13,705	489	1,700,274
\emptyset transaction time (rounded μs)	87,429	2,444,261	704
Max time of top 10% (μs)	14,996	824,379	610
Max time of top 50% (μs)	117,777	1,297,078	675
Max time of top 80% (μs)	120,396	4,428,454	741
Max time of top 90% (μs)	121,707	4,867,448	794
Max time of top 95% (μs)	123,309	4,980,660	859
Max time of top 100% (μs)	216,848	13,628,788	130,492

Get Integer (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	351,927	769,031	1,493,772
\emptyset transaction time (rounded μs)	3,407	1,559	803
Max time of top 10% (μs)	2,966	1,473	700
Max time of top 50% (μs)	3,298	1,548	784
Max time of top 80% (μs)	3,585	1,595	850
Max time of top 90% (μs)	3,829	1,621	895
Max time of top 95% (μs)	4,187	1,646	943
Max time of top 100% (μs)	33,761	29,861	78,663

Set Integer (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,635	472	1,770,803
\emptyset transaction time (rounded μs)	94,837	1,274,959	676
Max time of top 10% (μs)	14,277	1,196,176	607
Max time of top 50% (μs)	116,970	1,286,403	660
Max time of top 80% (μs)	118,786	1,298,911	710
Max time of top 90% (μs)	119,843	1,305,723	748
Max time of top 95% (μs)	120,954	1,307,644	787
Max time of top 100% (μs)	229,122	2,728,753	47,130

Set Mapping (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	11,736	500	791,306
\emptyset transaction time (rounded μs)	102,103	2,390,552	1,515
Max time of top 10% (μs)	15,359	821,215	1,346
Max time of top 50% (μs)	117,291	1,289,790	1,461
Max time of top 80% (μs)	118,973	4,442,486	1,578
Max time of top 90% (μs)	120,088	4,943,624	1,688
Max time of top 95% (μs)	121,148	5,219,731	1,855
Max time of top 100% (μs)	224,520	12,200,296	70,535

Get Mapping (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	329,937	767,465	1,453,071
\emptyset transaction time (rounded μs)	3,635	1,561	825
Max time of top 10% (μs)	3,147	1,456	712
Max time of top 50% (μs)	3,512	1,561	801
Max time of top 80% (μs)	3,825	1,621	876
Max time of top 90% (μs)	4,098	1,652	929
Max time of top 95% (μs)	4,527	1,682	985
Max time of top 100% (μs)	35,324	13,089	45,984

Add Element to Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,904	293	141,948
\emptyset transaction time (rounded μs)	92,969	4,079,078	8,452
Max time of top 10% (μs)	14,120	3,967,300	3,655
Max time of top 50% (μs)	117,496	4,201,107	4,051
Max time of top 80% (μs)	118,975	4,351,736	4,419
Max time of top 90% (μs)	119,900	4,424,713	5,083
Max time of top 95% (μs)	120,876	4,447,816	10,428
Max time of top 100% (μs)	240,998	4,998,960	646,812

Remove Element from Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	10,137	289	123,941
\emptyset transaction time (rounded μs)	118,244	4,145,237	9,669
Max time of top 10% (μs)	116,223	3,979,955	4,641
Max time of top 50% (μs)	117,828	4,207,817	5,122
Max time of top 80% (μs)	119,405	4,348,006	5,581
Max time of top 90% (μs)	120,675	4,423,471	6,492
Max time of top 95% (μs)	122,318	4,448,032	11,886
Max time of top 100% (μs)	225,352	6,517,219	600,621

Get Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	58,662	746,049	973,272
\emptyset transaction time (rounded μs)	20,429	1,606	1,231
Max time of top 10% (μs)	18,764	1,530	1,054
Max time of top 50% (μs)	20,133	1,601	1,183
Max time of top 80% (μs)	21,273	1,649	1,307
Max time of top 90% (μs)	22,445	1,677	1,397
Max time of top 95% (μs)	23,584	1,703	1,489
Max time of top 100% (μs)	48,597	15,429	47,727

2.1.3 4 Threads

Get String (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	914,979	1,545,881	2,796,009
\emptyset transaction time (rounded μs)	2,619	1,550	858
Max time of top 10% (μs)	2,311	1,376	703
Max time of top 50% (μs)	2,534	1,510	825
Max time of top 80% (μs)	2,789	1,653	935
Max time of top 90% (μs)	2,949	1,762	1,014
Max time of top 95% (μs)	3,119	1,866	1,096
Max time of top 100% (μs)	48,047	23,738	74,039

Set String (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	21,454	468	2,828,240
\emptyset transaction time (rounded μs)	111,710	1,286,272	848
Max time of top 10% (μs)	112,457	1,248,065	666
Max time of top 50% (μs)	113,681	1,288,820	798
Max time of top 80% (μs)	114,811	1,301,624	929
Max time of top 90% (μs)	115,833	1,307,969	1,027
Max time of top 95% (μs)	117,262	1,314,509	1,131
Max time of top 100% (μs)	220,206	2,688,670	46,091

Get Bool (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	945,046	1,535,066	3,184,561
\emptyset transaction time (rounded μs)	2,535	1,562	752
Max time of top 10% (μs)	2,256	1,383	644
Max time of top 50% (μs)	2,477	1,498	731
Max time of top 80% (μs)	2,683	1,649	803
Max time of top 90% (μs)	2,813	1,765	856
Max time of top 95% (μs)	2,946	1,886	914
Max time of top 100% (μs)	50,835	36,209	44,137

Set Bool (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	36,547	401	3,219,134
\emptyset transaction time (rounded μs)	65,568	5,941,377	744
Max time of top 10% (μs)	10,493	878,291	584
Max time of top 50% (μs)	112,072	4,492,287	684
Max time of top 80% (μs)	114,443	9,071,526	799
Max time of top 90% (μs)	115,397	11,333,727	894
Max time of top 95% (μs)	116,091	14,074,664	1,002
Max time of top 100% (μs)	220,811	41,827,709	121,108

Get Integer (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	901,549	1,526,764	2,658,858
\emptyset transaction time (rounded μs)	2,658	1,570	902
Max time of top 10% (μs)	2,280	1,354	766
Max time of top 50% (μs)	2,554	1,553	874
Max time of top 80% (μs)	2,833	1,653	964
Max time of top 90% (μs)	3,016	1,706	1,025
Max time of top 95% (μs)	3,265	1,777	1,092
Max time of top 100% (μs)	62,684	62,676	88,316

Set Integer (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	21,868	454	2,954,049
\emptyset transaction time (rounded μs)	109,590	2,641,891	811
Max time of top 10% (μs)	112,276	1,287,888	657
Max time of top 50% (μs)	113,522	2,660,988	772
Max time of top 80% (μs)	114,544	2,696,956	889
Max time of top 90% (μs)	115,557	2,716,392	968
Max time of top 95% (μs)	117,013	2,722,744	1,056
Max time of top 100% (μs)	223,798	164,631,356	51,206

Set Mapping (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	21,433	417	1,340,956
\emptyset transaction time (rounded μs)	111,811	5,700,361	1,788
Max time of top 10% (μs)	112,591	1,135,784	1,468
Max time of top 50% (μs)	113,687	4,441,300	1,713
Max time of top 80% (μs)	114,517	7,667,577	1,950
Max time of top 90% (μs)	115,025	11,206,405	2,127
Max time of top 95% (μs)	115,490	12,502,805	2,331
Max time of top 100% (μs)	133,628	41,639,228	404,054

Get Mapping (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	838,432	1,524,526	2,829,171
\emptyset transaction time (rounded μs)	2,859	1,572	847
Max time of top 10% (μs)	2,446	1,402	706
Max time of top 50% (μs)	2,750	1,508	820
Max time of top 80% (μs)	3,045	1,681	915
Max time of top 90% (μs)	3,257	1,814	984
Max time of top 95% (μs)	3,545	1,951	1,056
Max time of top 100% (μs)	103,850	55,994	90,862

Add Element to Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	26,087	349	133,260
\emptyset transaction time (rounded μs)	91,934	6,828,373	18,007
Max time of top 10% (μs)	11,305	2,636,448	3,758
Max time of top 50% (μs)	114,194	5,592,902	4,194
Max time of top 80% (μs)	115,991	8,799,163	5,247
Max time of top 90% (μs)	117,072	11,418,955	56,079
Max time of top 95% (μs)	118,344	14,002,183	103,692
Max time of top 100% (μs)	224,405	29,999,595	809,896

Remove Element from Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	20,803	369	120,448
\emptyset transaction time (rounded μs)	115,287	6,421,244	19,841
Max time of top 10% (μs)	112,918	1,790,744	4,763
Max time of top 50% (μs)	114,548	4,673,952	5,288
Max time of top 80% (μs)	115,682	8,883,044	6,530
Max time of top 90% (μs)	116,435	11,807,550	57,332
Max time of top 95% (μs)	117,470	14,668,541	108,201
Max time of top 100% (μs)	229,699	30,528,235	814,930

Get Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	59,843	1,470,537	1,848,636
\emptyset transaction time (rounded μs)	40,045	1,630	1,296
Max time of top 10% (μs)	37,518	1,456	1,082
Max time of top 50% (μs)	39,571	1,644	1,252
Max time of top 80% (μs)	41,808	1,711	1,404
Max time of top 90% (μs)	43,022	1,748	1,515
Max time of top 95% (μs)	44,422	1,787	1,638
Max time of top 100% (μs)	77,460	70,566	49,652

2.1.4 8 Threads

Get String (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,979,254	2,585,866	5,029,291
\emptyset transaction time (rounded μs)	2,421	1,854	953
Max time of top 10% (μs)	2,197	1,587	770
Max time of top 50% (μs)	2,330	1,809	920
Max time of top 80% (μs)	2,497	2,030	1,059
Max time of top 90% (μs)	2,651	2,162	1,154
Max time of top 95% (μs)	2,831	2,282	1,247
Max time of top 100% (μs)	124,774	25,494	43,891

Set String (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	43,038	433	5,347,440
\emptyset transaction time (rounded μs)	111,372	10,900,987	897
Max time of top 10% (μs)	112,107	4,088,858	677
Max time of top 50% (μs)	113,430	8,289,359	864
Max time of top 80% (μs)	114,435	15,484,324	1,019
Max time of top 90% (μs)	115,106	19,873,767	1,126
Max time of top 95% (μs)	115,907	23,774,714	1,236
Max time of top 100% (μs)	219,487	46,155,382	177,337

Get Bool (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,980,651	2,604,790	5,147,917
\emptyset transaction time (rounded μs)	2,422	1,840	931
Max time of top 10% (μs)	2,161	1,545	736
Max time of top 50% (μs)	2,302	1,764	878
Max time of top 80% (μs)	2,491	1,996	1,033
Max time of top 90% (μs)	2,665	2,133	1,158
Max time of top 95% (μs)	2,881	2,267	1,290
Max time of top 100% (μs)	41,694	46,232	66,728

Set Bool (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	68,606	405	5,600,759
\emptyset transaction time (rounded μs)	69,857	11,668,670	856
Max time of top 10% (μs)	10,429	2,496,105	611
Max time of top 50% (μs)	111,581	8,198,336	798
Max time of top 80% (μs)	113,164	17,022,132	984
Max time of top 90% (μs)	118,210	24,598,205	1,118
Max time of top 95% (μs)	123,795	32,787,491	1,249
Max time of top 100% (μs)	289,002	72,274,192	112,304

Get Integer (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	2,021,267	2,566,343	5,003,786
\emptyset transaction time (rounded μs)	2,371	1,867	958
Max time of top 10% (μs)	2,155	1,564	769
Max time of top 50% (μs)	2,285	1,791	919
Max time of top 80% (μs)	2,446	2,027	1,057
Max time of top 90% (μs)	2,594	2,172	1,158
Max time of top 95% (μs)	2,765	2,314	1,263
Max time of top 100% (μs)	37,082	86,853	36,123

Set Integer (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	42,976	433	4,750,296
\emptyset transaction time (rounded μs)	111,510	10,870,356	1,009
Max time of top 10% (μs)	112,002	4,097,063	693
Max time of top 50% (μs)	113,301	8,383,827	946
Max time of top 80% (μs)	114,278	15,259,428	1,168
Max time of top 90% (μs)	114,983	19,662,337	1,325
Max time of top 95% (μs)	115,869	22,246,232	1,484
Max time of top 100% (μs)	220,988	50,121,540	44,613

Set Mapping (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	42,870	432	2,589,350
\emptyset transaction time (rounded μs)	111,871	10,969,796	1,851
Max time of top 10% (μs)	112,207	2,634,420	1,488
Max time of top 50% (μs)	113,514	7,841,128	1,789
Max time of top 80% (μs)	114,496	16,260,284	2,054
Max time of top 90% (μs)	115,182	24,490,420	2,232
Max time of top 95% (μs)	116,036	27,783,667	2,410
Max time of top 100% (μs)	222,515	61,921,430	92,824

Get Mapping (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,900,103	2,438,633	5,451,370
\emptyset transaction time (rounded μs)	2,522	1,967	879
Max time of top 10% (μs)	2,289	1,626	702
Max time of top 50% (μs)	2,428	1,917	838
Max time of top 80% (μs)	2,599	2,193	980
Max time of top 90% (μs)	2,759	2,359	1,085
Max time of top 95% (μs)	2,966	2,511	1,188
Max time of top 100% (μs)	26,619	26,698	35,210

Add Element to Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	52,812	397	130,502
\emptyset transaction time (rounded μs)	90,821	11,932,813	36,776
Max time of top 10% (μs)	10,809	3,074,010	3,760
Max time of top 50% (μs)	112,785	9,258,748	4,260
Max time of top 80% (μs)	114,654	17,292,792	60,945
Max time of top 90% (μs)	117,374	23,644,186	121,530
Max time of top 95% (μs)	120,891	25,203,469	189,170
Max time of top 100% (μs)	232,606	57,188,001	1,172,791

Remove Element from Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	41,545	434	119,133
\emptyset transaction time (rounded μs)	115,421	10,962,005	40,019
Max time of top 10% (μs)	111,935	2,674,966	4,788
Max time of top 50% (μs)	114,359	7,897,068	5,413
Max time of top 80% (μs)	120,005	15,797,172	67,653
Max time of top 90% (μs)	123,598	22,678,814	132,879
Max time of top 95% (μs)	126,577	25,495,284	199,562
Max time of top 100% (μs)	232,899	58,887,024	1,130,974

Get Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	115,144	2,459,317	3,144,755
\emptyset transaction time (rounded μs)	41,629	1,950	1,525
Max time of top 10% (μs)	29,760	1,648	1,187
Max time of top 50% (μs)	41,904	1,900	1,448
Max time of top 80% (μs)	48,269	2,149	1,711
Max time of top 90% (μs)	51,990	2,305	1,894
Max time of top 95% (μs)	55,415	2,447	2,078
Max time of top 100% (μs)	97,504	25,193	53,437

2.2 Different entity per Thread

2.2.1 2 Threads

Get String (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	338,562	754,747	1,315,368
\emptyset transaction time (rounded μs)	3,542	1,589	911
Max time of top 10% (μs)	3,065	1,509	744
Max time of top 50% (μs)	3,418	1,576	836
Max time of top 80% (μs)	3,727	1,622	941
Max time of top 90% (μs)	3,996	1,650	1,030
Max time of top 95% (μs)	4,399	1,675	1,151
Max time of top 100% (μs)	37,447	26,173	361,930

Set String (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,119	943	1,677,826
\emptyset transaction time (rounded μs)	98,883	1,270,570	714
Max time of top 10% (μs)	15,025	1,192,170	628
Max time of top 50% (μs)	117,315	1,285,741	693
Max time of top 80% (μs)	119,028	1,300,023	765
Max time of top 90% (μs)	120,024	1,308,103	812
Max time of top 95% (μs)	121,086	1,317,547	858
Max time of top 100% (μs)	223,930	1,484,282	32,382

Get Bool (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	354,149	769,056	1,517,902
\emptyset transaction time (rounded μs)	3,385	1,559	789
Max time of top 10% (μs)	2,896	1,478	684
Max time of top 50% (μs)	3,249	1,546	767
Max time of top 80% (μs)	3,567	1,594	836
Max time of top 90% (μs)	3,854	1,620	885
Max time of top 95% (μs)	4,273	1,646	943
Max time of top 100% (μs)	70,170	25,511	87,049

Set Bool (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	14,332	951	1,588,040
\emptyset transaction time (rounded μs)	83,604	1,260,813	755
Max time of top 10% (μs)	14,434	1,175,555	622
Max time of top 50% (μs)	117,252	1,280,033	720
Max time of top 80% (μs)	119,602	1,293,762	819
Max time of top 90% (μs)	121,002	1,300,643	893
Max time of top 95% (μs)	122,620	1,307,465	981
Max time of top 100% (μs)	189,056	1,530,744	100,454

Get Integer (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	348,911	773,607	1,518,543
\emptyset transaction time (rounded μs)	3,436	1,550	789
Max time of top 10% (μs)	2,976	1,431	689
Max time of top 50% (μs)	3,319	1,537	770
Max time of top 80% (μs)	3,620	1,608	837
Max time of top 90% (μs)	3,875	1,650	884
Max time of top 95% (μs)	4,250	1,690	937
Max time of top 100% (μs)	45,529	18,288	101,456

Set Integer (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,086	948	1,788,126
\emptyset transaction time (rounded μs)	99,144	1,265,004	670
Max time of top 10% (μs)	14,858	1,180,448	594
Max time of top 50% (μs)	117,134	1,281,335	656
Max time of top 80% (μs)	118,869	1,296,102	708
Max time of top 90% (μs)	119,860	1,304,680	744
Max time of top 95% (μs)	120,968	1,314,673	785
Max time of top 100% (μs)	221,017	1,441,642	46,830

Set Mapping (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	12,118	943	784,064
\emptyset transaction time (rounded μs)	98,881	1,271,089	1,529
Max time of top 10% (μs)	15,232	1,188,021	1,287
Max time of top 50% (μs)	117,477	1,288,325	1,384
Max time of top 80% (μs)	119,291	1,303,753	1,473
Max time of top 90% (μs)	120,477	1,312,016	1,581
Max time of top 95% (μs)	121,654	1,323,689	1,870
Max time of top 100% (μs)	223,696	1,644,091	343,021

Get Mapping (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	332,350	749,480	1,486,559
\emptyset transaction time (rounded μs)	3,609	1,600	806
Max time of top 10% (μs)	3,138	1,509	692
Max time of top 50% (μs)	3,482	1,583	776
Max time of top 80% (μs)	3,785	1,630	852
Max time of top 90% (μs)	4,057	1,658	908
Max time of top 95% (μs)	4,480	1,686	968
Max time of top 100% (μs)	36,444	17,772	65,932

Add Element to Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	11,944	923	270,699
\emptyset transaction time (rounded μs)	100,425	1,298,004	4,431
Max time of top 10% (μs)	16,268	1,282,091	3,768
Max time of top 50% (μs)	120,175	1,303,465	4,171
Max time of top 80% (μs)	121,816	1,315,159	4,543
Max time of top 90% (μs)	122,891	1,327,407	4,896
Max time of top 95% (μs)	124,086	1,337,107	5,737
Max time of top 100% (μs)	224,027	1,495,810	314,426

Remove Element from Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	9,772	931	115,225
\emptyset transaction time (rounded μs)	122,729	1,287,940	5,203
Max time of top 10% (μs)	119,265	1,208,477	4,431
Max time of top 50% (μs)	121,511	1,301,402	4,919
Max time of top 80% (μs)	123,516	1,315,906	5,351
Max time of top 90% (μs)	125,144	1,325,602	5,725
Max time of top 95% (μs)	127,364	1,334,378	6,537
Max time of top 100% (μs)	329,548	1,486,646	237,873

Get Array (Number of threads: 2)			
	Ethereum	BigchainDB	DSE
Number of transactions	21,987	727,385	1,281,719
\emptyset transaction time (rounded μs)	54,507	1,647	935
Max time of top 10% (μs)	50,969	1,559	659
Max time of top 50% (μs)	54,030	1,630	803
Max time of top 80% (μs)	56,816	1,681	1,180
Max time of top 90% (μs)	58,358	1,709	1,288
Max time of top 95% (μs)	60,009	1,735	1,371
Max time of top 100% (μs)	89,383	14,579	46,093

2.2.2 4 Threads

Get String (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	717,471	1,542,602	2,857,949
∅ transaction time (rounded μs)	3,341	1,553	838
Max time of top 10% (μs)	2,779	1,424	712
Max time of top 50% (μs)	3,154	1,517	810
Max time of top 80% (μs)	3,565	1,648	890
Max time of top 90% (μs)	4,000	1,710	945
Max time of top 95% (μs)	4,547	1,768	1,006
Max time of top 100% (μs)	48,864	21,619	100,623

Set String (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	20,684	1,869	3,251,463
∅ transaction time (rounded μs)	115,862	1,283,193	737
Max time of top 10% (μs)	115,806	1,221,101	587
Max time of top 50% (μs)	118,672	1,293,947	690
Max time of top 80% (μs)	120,747	1,307,568	798
Max time of top 90% (μs)	122,490	1,315,529	896
Max time of top 95% (μs)	124,318	1,324,117	1,013
Max time of top 100% (μs)	229,336	1,484,608	48,042

Get Bool (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	733,653	1,488,348	3,156,821
∅ transaction time (rounded μs)	3,268	1,611	759
Max time of top 10% (μs)	2,693	1,369	664
Max time of top 50% (μs)	3,057	1,505	742
Max time of top 80% (μs)	3,483	1,690	801
Max time of top 90% (μs)	3,934	1,838	843
Max time of top 95% (μs)	4,504	2,018	893
Max time of top 100% (μs)	45,923	144,642	42,848

Set Bool (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	26,945	1,828	3,152,072
\emptyset transaction time (rounded μs)	88,935	1,312,075	760
Max time of top 10% (μs)	13,673	1,195,368	619
Max time of top 50% (μs)	116,466	1,285,249	726
Max time of top 80% (μs)	120,275	1,300,376	824
Max time of top 90% (μs)	125,008	1,309,728	895
Max time of top 95% (μs)	131,198	1,335,537	976
Max time of top 100% (μs)	372,263	6,642,886	136,781

Get Integer (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	730,534	1,430,849	2,737,847
\emptyset transaction time (rounded μs)	3,282	1,676	875
Max time of top 10% (μs)	2,727	1,404	742
Max time of top 50% (μs)	3,085	1,631	846
Max time of top 80% (μs)	3,501	1,724	938
Max time of top 90% (μs)	3,935	1,827	1,002
Max time of top 95% (μs)	4,476	1,998	1,070
Max time of top 100% (μs)	54,277	389,381	71,014

Set Integer (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	20,964	1,876	3,138,385
\emptyset transaction time (rounded μs)	114,316	1,278,091	764
Max time of top 10% (μs)	115,550	1,200,631	618
Max time of top 50% (μs)	118,391	1,287,312	724
Max time of top 80% (μs)	120,440	1,303,962	832
Max time of top 90% (μs)	122,022	1,315,898	920
Max time of top 95% (μs)	123,888	1,333,337	1,025
Max time of top 100% (μs)	232,086	1,776,015	46,386

Set Mapping (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	20,850	1,873	1,386,909
\emptyset transaction time (rounded μs)	114,929	1,280,011	1,728
Max time of top 10% (μs)	115,484	1,195,749	1,455
Max time of top 50% (μs)	118,112	1,288,561	1,647
Max time of top 80% (μs)	120,036	1,306,214	1,833
Max time of top 90% (μs)	121,349	1,312,501	2,007
Max time of top 95% (μs)	123,018	1,327,014	2,236
Max time of top 100% (μs)	225,575	1,947,504	86,344

Get Mapping (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	694,362	1,434,851	2,854,011
\emptyset transaction time (rounded μs)	3,452	1,670	839
Max time of top 10% (μs)	2,897	1,474	713
Max time of top 50% (μs)	3,269	1,623	810
Max time of top 80% (μs)	3,669	1,744	889
Max time of top 90% (μs)	4,085	1,812	943
Max time of top 95% (μs)	4,590	1,968	1,001
Max time of top 100% (μs)	73,575	228,385	99,966

Add Element to Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	22,090	1,837	431,401
\emptyset transaction time (rounded μs)	108,603	1,305,445	5,561
Max time of top 10% (μs)	29,437	1,232,257	4,498
Max time of top 50% (μs)	118,050	1,310,293	5,232
Max time of top 80% (μs)	120,520	1,326,612	5,952
Max time of top 90% (μs)	121,813	1,336,986	6,634
Max time of top 95% (μs)	123,242	1,355,421	7,723
Max time of top 100% (μs)	585,389	1,765,442	940,777

Remove Element from Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	19,375	1,836	115,318
\emptyset transaction time (rounded μs)	123,782	1,306,716	5,200
Max time of top 10% (μs)	115,484	1,229,891	4,472
Max time of top 50% (μs)	117,673	1,308,037	4,892
Max time of top 80% (μs)	120,353	1,324,714	5,296
Max time of top 90% (μs)	123,363	1,338,060	5,746
Max time of top 95% (μs)	218,410	1,368,118	6,753
Max time of top 100% (μs)	330,107	2,681,197	344,528

Get Array (Number of threads: 4)			
	Ethereum	BigchainDB	DSE
Number of transactions	61,286	1,276,054	2,754,564
\emptyset transaction time (rounded μs)	39,104	1,879	870
Max time of top 10% (μs)	30,321	1,634	654
Max time of top 50% (μs)	41,137	1,813	785
Max time of top 80% (μs)	43,349	1,926	1,026
Max time of top 90% (μs)	44,717	2,037	1,232
Max time of top 95% (μs)	46,082	2,200	1,350
Max time of top 100% (μs)	74,836	184,471	52,526

2.2.3 8 Threads

Get String (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,515,178	2,086,030	4,979,427
\emptyset transaction time (rounded μs)	3,165	2,299	963
Max time of top 10% (μs)	2,563	1,679	770
Max time of top 50% (μs)	2,907	1,955	915
Max time of top 80% (μs)	3,341	2,321	1,069
Max time of top 90% (μs)	3,821	2,937	1,186
Max time of top 95% (μs)	4,532	4,295	1,303
Max time of top 100% (μs)	96,361	154,407	50,541

Set String (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	41,132	2,690	5,557,478
\emptyset transaction time (rounded μs)	116,532	1,780,338	863
Max time of top 10% (μs)	114,910	1,281,973	633
Max time of top 50% (μs)	117,719	1,337,768	813
Max time of top 80% (μs)	120,390	2,599,595	982
Max time of top 90% (μs)	122,411	2,700,707	1,114
Max time of top 95% (μs)	124,580	2,719,434	1,243
Max time of top 100% (μs)	230,710	3,114,762	50,525

Get Bool (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,523,082	2,571,320	4,644,180
\emptyset transaction time (rounded μs)	3,148	1,865	1,032
Max time of top 10% (μs)	2,514	1,565	806
Max time of top 50% (μs)	2,861	1,784	977
Max time of top 80% (μs)	3,332	2,016	1,146
Max time of top 90% (μs)	3,878	2,171	1,269
Max time of top 95% (μs)	4,733	2,327	1,400
Max time of top 100% (μs)	64,212	62,631	68,804

Set Bool (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	47,584	2,720	5,109,044
\emptyset transaction time (rounded μs)	100,719	1,762,810	938
Max time of top 10% (μs)	14,281	1,279,685	670
Max time of top 50% (μs)	116,054	1,323,205	876
Max time of top 80% (μs)	123,492	2,580,095	1,056
Max time of top 90% (μs)	131,055	2,694,569	1,193
Max time of top 95% (μs)	137,950	2,710,611	1,341
Max time of top 100% (μs)	605,017	2,892,820	124,965

Get Integer (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,508,727	2,519,661	5,006,922
\emptyset transaction time (rounded μs)	3,177	1,903	957
Max time of top 10% (μs)	2,543	1,614	780
Max time of top 50% (μs)	2,898	1,826	922
Max time of top 80% (μs)	3,369	2,054	1,049
Max time of top 90% (μs)	3,896	2,194	1,142
Max time of top 95% (μs)	4,757	2,327	1,242
Max time of top 100% (μs)	77,147	29,640	43,450

Set Integer (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	41,642	2,722	5,618,549
\emptyset transaction time (rounded μs)	115,089	1,760,585	853
Max time of top 10% (μs)	114,513	1,279,283	641
Max time of top 50% (μs)	116,999	1,316,786	817
Max time of top 80% (μs)	119,631	2,591,011	966
Max time of top 90% (μs)	121,699	2,691,070	1,075
Max time of top 95% (μs)	123,864	2,704,608	1,192
Max time of top 100% (μs)	233,472	2,955,108	65,647

Set Mapping (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	41,210	2,681	2,630,832
\emptyset transaction time (rounded μs)	116,305	1,787,390	1,822
Max time of top 10% (μs)	115,189	1,283,720	1,474
Max time of top 50% (μs)	118,419	1,368,430	1,755
Max time of top 80% (μs)	121,233	2,604,945	2,021
Max time of top 90% (μs)	123,475	2,704,681	2,199
Max time of top 95% (μs)	125,887	2,726,589	2,374
Max time of top 100% (μs)	237,274	3,268,968	85,392

Get Mapping (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	1,439,251	2,222,959	5,275,780
\emptyset transaction time (rounded μs)	3,332	2,157	909
Max time of top 10% (μs)	2,707	1,777	715
Max time of top 50% (μs)	3,069	2,070	863
Max time of top 80% (μs)	3,538	2,347	1,016
Max time of top 90% (μs)	4,028	2,523	1,133
Max time of top 95% (μs)	4,733	2,700	1,253
Max time of top 100% (μs)	66,135	147,941	89,435

Add Element to Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	41,885	2,608	632,362
\emptyset transaction time (rounded μs)	114,534	1,836,261	7,586
Max time of top 10% (μs)	114,565	1,299,163	5,841
Max time of top 50% (μs)	117,773	1,357,934	7,219
Max time of top 80% (μs)	121,748	2,655,351	8,441
Max time of top 90% (μs)	125,328	2,738,662	9,317
Max time of top 95% (μs)	128,607	2,764,226	10,426
Max time of top 100% (μs)	325,050	10,552,036	551,318

Remove Element from Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	30,388	2,662	115,847
\emptyset transaction time (rounded μs)	157,879	1,799,741	5,175
Max time of top 10% (μs)	114,333	1,299,858	4,301
Max time of top 50% (μs)	118,507	1,344,482	4,916
Max time of top 80% (μs)	219,928	2,660,594	5,393
Max time of top 90% (μs)	223,463	2,731,859	5,804
Max time of top 95% (μs)	233,390	2,750,245	6,416
Max time of top 100% (μs)	640,827	3,273,509	322,120

Get Array (Number of threads: 8)			
	Ethereum	BigchainDB	DSE
Number of transactions	88,443	2,145,044	5,280,188
\emptyset transaction time (rounded μs)	54,200	2,234	908
Max time of top 10% (μs)	40,353	1,900	667
Max time of top 50% (μs)	54,570	2,188	828
Max time of top 80% (μs)	62,293	2,450	1,038
Max time of top 90% (μs)	66,562	2,608	1,221
Max time of top 95% (μs)	70,423	2,750	1,401
Max time of top 100% (μs)	115,705	37,320	73,600