

Технополис  
Mail.ru Group

# Сравнительный отчёт по тестированию для Stage 4

**Дисциплина:** Проектирование высоконагруженных систем  
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2019

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# 1 Get empty

## 1.1 stage 4

Рассмотрим результаты нагрузочного тестирования на запросы данных при отсутствии каких-либо данных на сервере:

```
1 Running 1m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 4.366ms, rate sampling interval: 23ms
4 Thread calibration: mean lat.: 4.118ms, rate sampling interval: 22ms
5 Thread calibration: mean lat.: 4.138ms, rate sampling interval: 22ms
6 Thread calibration: mean lat.: 4.327ms, rate sampling interval: 23ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 9.00ms 57.93ms 1.00s 99.05%
9 Req/Sec 2.60k 808.74 8.48k 75.25%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000% 2.20ms
12 75.000% 5.13ms
13 90.000% 10.65ms
14 99.000% 43.62ms
15 99.900% 906.24ms
16 99.990% 993.28ms
17 99.999% 1.00s
18 100.000% 1.00s
19
20 Detailed Percentile spectrum:
21 Value Percentile TotalCount 1/(1-Percentile)
22
23 0.057 0.000000 1 1.00
24 0.575 0.100000 50094 1.11
25 0.948 0.200000 100022 1.25
26 1.243 0.300000 150029 1.43
27 1.653 0.400000 200052 1.67
28 2.197 0.500000 250041 2.00
29 2.603 0.550000 274968 2.22
30 3.065 0.600000 299984 2.50
31 3.603 0.650000 325025 2.86
32 4.279 0.700000 350027 3.33
33 5.131 0.750000 374959 4.00
34 5.643 0.775000 387470 4.44
35 6.239 0.800000 400018 5.00
36 6.939 0.825000 412463 5.71
37 7.831 0.850000 424982 6.67
38 9.055 0.875000 437501 8.00
39 9.799 0.887500 443730 8.89
40 10.647 0.900000 449977 10.00
41 11.623 0.912500 456229 11.43
42 12.695 0.925000 462434 13.33
43 13.903 0.937500 468690 16.00
44 14.567 0.943750 471806 17.78
45 15.295 0.950000 474947 20.00
46 16.087 0.956250 478060 22.86
47 16.975 0.962500 481191 26.67
48 18.047 0.968750 484334 32.00
49 18.703 0.971875 485876 35.56
50 19.487 0.975000 487450 40.00
51 20.367 0.978125 489001 45.71
52 21.503 0.981250 490572 53.33
53 23.343 0.984375 492116 64.00
54 25.055 0.985938 492896 71.11
```

55	28.351	0.987500	493674	80.00
56	33.855	0.989062	494457	91.43
57	78.975	0.990625	495238	106.67
58	224.255	0.992188	496018	128.00
59	311.295	0.992969	496408	142.22
60	382.463	0.993750	496799	160.00
61	460.287	0.994531	497190	182.86
62	549.375	0.995313	497581	213.33
63	615.423	0.996094	497973	256.00
64	656.895	0.996484	498167	284.44
65	696.831	0.996875	498361	320.00
66	729.087	0.997266	498557	365.71
67	773.631	0.997656	498752	426.67
68	808.447	0.998047	498947	512.00
69	829.439	0.998242	499045	568.89
70	849.407	0.998437	499143	640.00
71	867.327	0.998633	499242	731.43
72	893.439	0.998828	499340	853.33
73	910.335	0.999023	499436	1024.00
74	919.551	0.999121	499484	1137.78
75	924.671	0.999219	499535	1280.00
76	937.983	0.999316	499585	1462.86
77	947.711	0.999414	499631	1706.67
78	953.343	0.999512	499679	2048.00
79	959.487	0.999561	499705	2275.56
80	963.071	0.999609	499728	2560.00
81	968.191	0.999658	499754	2925.71
82	974.335	0.999707	499777	3413.33
83	979.967	0.999756	499802	4096.00
84	981.503	0.999780	499816	4551.11
85	983.551	0.999805	499826	5120.00
86	987.135	0.999829	499838	5851.43
87	990.719	0.999854	499852	6826.67
88	991.743	0.999878	499862	8192.00
89	992.767	0.999890	499871	9102.22
90	993.279	0.999902	499875	10240.00
91	994.303	0.999915	499883	11702.86
92	994.815	0.999927	499887	13653.33
93	996.351	0.999939	499893	16384.00
94	996.863	0.999945	499897	18204.44
95	997.375	0.999951	499899	20480.00
96	998.399	0.999957	499904	23405.71
97	998.911	0.999963	499907	27306.67
98	999.423	0.999969	499909	32768.00
99	999.935	0.999973	499911	36408.89
100	999.935	0.999976	499911	40960.00
101	1000.447	0.999979	499915	46811.43
102	1000.447	0.999982	499915	54613.33
103	1000.959	0.999985	499917	65536.00
104	1000.959	0.999986	499917	72817.78
105	1000.959	0.999988	499917	81920.00
106	1001.471	0.999989	499919	93622.86
107	1001.471	0.999991	499919	109226.67
108	1001.983	0.999992	499922	131072.00
109	1001.983	0.999993	499922	145635.56
110	1001.983	0.999994	499922	163840.00
111	1001.983	0.999995	499922	187245.71
112	1001.983	0.999995	499922	218453.33
113	1001.983	0.999996	499922	262144.00
114	1001.983	0.999997	499922	291271.11

```

115      1001.983      0.999997      499922      327680.00
116      1001.983      0.999997      499922      374491.43
117      1001.983      0.999998      499922      436906.67
118      1002.495      0.999998      499923      524288.00
119      1002.495      1.000000      499923      inf
120 #[Mean      =      9.002, StdDeviation      =      57.932]
121 #[Max      =      1001.984, Total count      =      499923]
122 #[Buckets      =      27, SubBuckets      =      2048]
123 -----
124      599955 requests in 1.00m, 39.48MB read
125      Non-2xx or 3xx responses: 599955
126 Requests/sec:      9998.80

```

## 1.2 stage 3

Сравним с результатами из stage 3:

```

1 Running 2m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 4.212ms, rate sampling interval: 21ms
4 Thread calibration: mean lat.: 4.205ms, rate sampling interval: 21ms
5 Thread calibration: mean lat.: 3.951ms, rate sampling interval: 19ms
6 Thread calibration: mean lat.: 4.017ms, rate sampling interval: 20ms
7 Thread Stats      Avg      Stdev      Max      +/- Stdev
8   Latency      6.37ms    38.18ms    1.00s    99.42%
9   Req/Sec      2.60k      0.87k    13.05k    75.29%
10  Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000%      2.12ms
12 75.000%      5.16ms
13 90.000%     10.82ms
14 99.000%     24.98ms
15 99.900%    759.29ms
16 99.990%    986.11ms
17 99.999%      1.00s
18 100.000%      1.00s
19
20 Detailed Percentile spectrum:
21      Value      Percentile      TotalCount  1/(1-Percentile)
22
23      0.053      0.000000           1           1.00
24      0.568      0.100000         80088           1.11
25      0.942      0.200000        160059           1.25
26      1.220      0.300000        240103           1.43
27      1.621      0.400000        320173           1.67
28      2.125      0.500000        400014           2.00
29      2.539      0.550000        440030           2.22
30      3.013      0.600000        479998           2.50
31      3.569      0.650000        519962           2.86
32      4.267      0.700000        560141           3.33
33      5.155      0.750000        600033           4.00
34      5.695      0.775000        620083           4.44
35      6.339      0.800000        640006           5.00
36      7.103      0.825000        659966           5.71
37      8.063      0.850000        679966           6.67
38      9.311      0.875000        700025           8.00
39     10.031      0.887500        709982           8.89
40     10.823      0.900000        719946          10.00
41     11.751      0.912500        730007          11.43
42     12.807      0.925000        740013          13.33
43     13.991      0.937500        749995          16.00

```

44	14.639	0.943750	754991	17.78
45	15.343	0.950000	759982	20.00
46	16.087	0.956250	764955	22.86
47	16.895	0.962500	769997	26.67
48	17.791	0.968750	774968	32.00
49	18.287	0.971875	777485	35.56
50	18.831	0.975000	779941	40.00
51	19.471	0.978125	782499	45.71
52	20.207	0.981250	784977	53.33
53	21.183	0.984375	787446	64.00
54	21.823	0.985938	788703	71.11
55	22.671	0.987500	789940	80.00
56	23.903	0.989062	791195	91.43
57	25.983	0.990625	792440	106.67
58	29.839	0.992188	793692	128.00
59	32.575	0.992969	794318	142.22
60	38.687	0.993750	794941	160.00
61	52.383	0.994531	795565	182.86
62	82.495	0.995313	796190	213.33
63	211.071	0.996094	796815	256.00
64	260.863	0.996484	797127	284.44
65	313.343	0.996875	797440	320.00
66	359.935	0.997266	797752	365.71
67	433.407	0.997656	798065	426.67
68	530.431	0.998047	798377	512.00
69	575.999	0.998242	798533	568.89
70	625.663	0.998437	798690	640.00
71	669.183	0.998633	798846	731.43
72	718.847	0.998828	799003	853.33
73	765.439	0.999023	799159	1024.00
74	790.015	0.999121	799236	1137.78
75	815.103	0.999219	799315	1280.00
76	838.655	0.999316	799394	1462.86
77	862.207	0.999414	799471	1706.67
78	887.295	0.999512	799549	2048.00
79	899.583	0.999561	799588	2275.56
80	912.383	0.999609	799627	2560.00
81	924.671	0.999658	799666	2925.71
82	937.471	0.999707	799705	3413.33
83	950.271	0.999756	799745	4096.00
84	956.415	0.999780	799764	4551.11
85	962.559	0.999805	799783	5120.00
86	968.703	0.999829	799803	5851.43
87	974.847	0.999854	799822	6826.67
88	981.503	0.999878	799843	8192.00
89	984.575	0.999890	799854	9102.22
90	986.623	0.999902	799861	10240.00
91	988.671	0.999915	799872	11702.86
92	990.719	0.999927	799882	13653.33
93	992.767	0.999939	799891	16384.00
94	994.303	0.999945	799897	18204.44
95	995.327	0.999951	799900	20480.00
96	996.351	0.999957	799906	23405.71
97	997.375	0.999963	799912	27306.67
98	997.887	0.999969	799915	32768.00
99	998.911	0.999973	799924	36408.89
100	998.911	0.999976	799924	40960.00
101	998.911	0.999979	799924	46811.43
102	999.423	0.999982	799927	54613.33
103	999.423	0.999985	799927	65536.00

```

104      999.935      0.999986      799930      72817.78
105      999.935      0.999988      799930      81920.00
106     1000.447      0.999989      799934      93622.86
107     1000.447      0.999991      799934     109226.67
108     1000.447      0.999992      799934     131072.00
109     1000.447      0.999993      799934     145635.56
110     1000.959      0.999994      799935     163840.00
111     1000.959      0.999995      799935     187245.71
112     1001.471      0.999995      799937     218453.33
113     1001.471      0.999996      799937     262144.00
114     1001.471      0.999997      799937     291271.11
115     1001.471      0.999997      799937     327680.00
116     1001.471      0.999997      799937     374491.43
117     1001.983      0.999998      799939     436906.67
118     1001.983      1.000000      799939      inf
119 #[Mean      =      6.370, StdDeviation      =      38.177]
120 #[Max       =     1001.472, Total count      =      799939]
121 #[Buckets  =           27, SubBuckets      =      2048]
122 -----
123      899972 requests in 1.50m, 59.22MB read
124      Non-2xx or 3xx responses: 899972
125 Requests/sec:    9999.74
126 Transfer/sec:    673.81KB

```

## 2 Put

### 2.1 stage 4

Рассмотрим результаты нагрузочного тестирования на запись данных:

```

1 Running 1m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 3.523ms, rate sampling interval: 17ms
4 Thread calibration: mean lat.: 3.423ms, rate sampling interval: 16ms
5 Thread calibration: mean lat.: 3.901ms, rate sampling interval: 19ms
6 Thread calibration: mean lat.: 91.602ms, rate sampling interval: 813ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 3.92ms 4.60ms 44.77ms 87.11%
9 Req/Sec 2.62k 0.98k 7.61k 75.01%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000% 2.06ms
12 75.000% 4.82ms
13 90.000% 10.28ms
14 99.000% 20.50ms
15 99.900% 31.38ms
16 99.990% 41.98ms
17 99.999% 44.45ms
18 100.000% 44.80ms
19
20 Detailed Percentile spectrum:
21 Value Percentile TotalCount 1/(1-Percentile)
22
23 0.058 0.000000 1 1.00
24 0.557 0.100000 50080 1.11
25 0.931 0.200000 100138 1.25
26 1.197 0.300000 150101 1.43
27 1.595 0.400000 200007 1.67
28 2.059 0.500000 250044 2.00
29 2.453 0.550000 275008 2.22

```

30	2.887	0.600000	300044	2.50
31	3.377	0.650000	324976	2.86
32	3.997	0.700000	350017	3.33
33	4.819	0.750000	375064	4.00
34	5.323	0.775000	387521	4.44
35	5.919	0.800000	400034	5.00
36	6.639	0.825000	412481	5.71
37	7.551	0.850000	424992	6.67
38	8.735	0.875000	437500	8.00
39	9.463	0.887500	443733	8.89
40	10.279	0.900000	449990	10.00
41	11.183	0.912500	456237	11.43
42	12.175	0.925000	462478	13.33
43	13.263	0.937500	468717	16.00
44	13.839	0.943750	471867	17.78
45	14.431	0.950000	474953	20.00
46	15.079	0.956250	478090	22.86
47	15.775	0.962500	481228	26.67
48	16.527	0.968750	484357	32.00
49	16.927	0.971875	485907	35.56
50	17.343	0.975000	487463	40.00
51	17.807	0.978125	489037	45.71
52	18.319	0.981250	490580	53.33
53	18.959	0.984375	492157	64.00
54	19.311	0.985938	492912	71.11
55	19.727	0.987500	493708	80.00
56	20.191	0.989062	494491	91.43
57	20.735	0.990625	495274	106.67
58	21.391	0.992188	496038	128.00
59	21.807	0.992969	496428	142.22
60	22.303	0.993750	496831	160.00
61	22.959	0.994531	497212	182.86
62	23.631	0.995313	497608	213.33
63	24.479	0.996094	497996	256.00
64	24.943	0.996484	498190	284.44
65	25.487	0.996875	498381	320.00
66	26.127	0.997266	498578	365.71
67	27.007	0.997656	498772	426.67
68	28.063	0.998047	498968	512.00
69	28.751	0.998242	499067	568.89
70	29.407	0.998437	499161	640.00
71	30.047	0.998633	499261	731.43
72	30.735	0.998828	499359	853.33
73	31.487	0.999023	499454	1024.00
74	31.999	0.999121	499503	1137.78
75	32.799	0.999219	499553	1280.00
76	33.631	0.999316	499601	1462.86
77	34.463	0.999414	499651	1706.67
78	35.359	0.999512	499701	2048.00
79	35.807	0.999561	499723	2275.56
80	36.351	0.999609	499747	2560.00
81	36.991	0.999658	499772	2925.71
82	37.631	0.999707	499796	3413.33
83	38.751	0.999756	499821	4096.00
84	39.423	0.999780	499835	4551.11
85	40.031	0.999805	499846	5120.00
86	40.351	0.999829	499857	5851.43
87	40.671	0.999854	499869	6826.67
88	41.311	0.999878	499881	8192.00
89	41.695	0.999890	499888	9102.22



```

90      42.047      0.999902      499894      10240.00
91      42.367      0.999915      499902      11702.86
92      42.527      0.999927      499906      13653.33
93      42.655      0.999939      499912      16384.00
94      42.751      0.999945      499916      18204.44
95      42.847      0.999951      499918      20480.00
96      42.911      0.999957      499921      23405.71
97      43.071      0.999963      499925      27306.67
98      43.167      0.999969      499927      32768.00
99      43.391      0.999973      499929      36408.89
100     43.519      0.999976      499930      40960.00
101     43.743      0.999979      499932      46811.43
102     43.935      0.999982      499933      54613.33
103     44.095      0.999985      499935      65536.00
104     44.255      0.999986      499936      72817.78
105     44.255      0.999988      499936      81920.00
106     44.447      0.999989      499937      93622.86
107     44.607      0.999991      499939      109226.67
108     44.607      0.999992      499939      131072.00
109     44.607      0.999993      499939      145635.56
110     44.607      0.999994      499939      163840.00
111     44.639      0.999995      499940      187245.71
112     44.639      0.999995      499940      218453.33
113     44.735      0.999996      499941      262144.00
114     44.735      0.999997      499941      291271.11
115     44.735      0.999997      499941      327680.00
116     44.735      0.999997      499941      374491.43
117     44.735      0.999998      499941      436906.67
118     44.799      0.999998      499942      524288.00
119     44.799      1.000000      499942      inf
120 #[Mean      =      3.916, StdDeviation      =      4.602]
121 #[Max      =      44.768, Total count      =      499942]
122 #[Buckets =      27, SubBuckets      =      2048]
123 -----
124 599960 requests in 1.00m, 38.34MB read
125 Requests/sec: 9999.38
126 Transfer/sec: 654.26KB
127 Running 1m test @ http://localhost:8080
128 4 threads and 4 connections
129 Thread calibration: mean lat.: 3.640ms, rate sampling interval: 17ms
130 Thread calibration: mean lat.: 3.073ms, rate sampling interval: 14ms

```

## 2.2 stage 3

Сравним с результатами из stage 3:

```

1 Running 2m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 4.240ms, rate sampling interval: 22ms
4 Thread calibration: mean lat.: 4.265ms, rate sampling interval: 23ms
5 Thread calibration: mean lat.: 4.011ms, rate sampling interval: 21ms
6 Thread calibration: mean lat.: 4.421ms, rate sampling interval: 23ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 15.63ms 86.28ms 1.01s 97.99%
9 Req/Sec 2.62k 0.91k 12.14k 75.50%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000% 2.38ms
12 75.000% 5.88ms
13 90.000% 13.07ms
14 99.000% 565.76ms

```

```

15 99.900% 961.02ms
16 99.990% 1.00s
17 99.999% 1.01s
18 100.000% 1.01s
19
20 Detailed Percentile spectrum:
21 Value Percentile TotalCount 1/(1-Percentile)
22
23 0.058 0.000000 1 1.00
24 0.594 0.100000 80172 1.11
25 0.973 0.200000 160383 1.25
26 1.296 0.300000 240130 1.43
27 1.726 0.400000 320246 1.67
28 2.379 0.500000 400263 2.00
29 2.835 0.550000 440330 2.22
30 3.351 0.600000 480289 2.50
31 3.991 0.650000 520280 2.86
32 4.815 0.700000 560349 3.33
33 5.875 0.750000 600319 4.00
34 6.555 0.775000 620373 4.44
35 7.367 0.800000 640332 5.00
36 8.399 0.825000 660313 5.71
37 9.695 0.850000 680329 6.67
38 11.247 0.875000 700328 8.00
39 12.127 0.887500 710373 8.89
40 13.071 0.900000 720362 10.00
41 14.095 0.912500 730342 11.43
42 15.247 0.925000 740375 13.33
43 16.591 0.937500 750368 16.00
44 17.359 0.943750 755419 17.78
45 18.239 0.950000 760410 20.00
46 19.327 0.956250 765362 22.86
47 20.783 0.962500 770381 26.67
48 23.679 0.968750 775357 32.00
49 26.735 0.971875 777856 35.56
50 32.111 0.975000 780351 40.00
51 45.663 0.978125 782854 45.71
52 166.015 0.981250 785360 53.33
53 307.455 0.984375 787860 64.00
54 380.927 0.985938 789105 71.11
55 450.303 0.987500 790359 80.00
56 523.519 0.989062 791608 91.43
57 594.943 0.990625 792858 106.67
58 657.919 0.992188 794115 128.00
59 692.735 0.992969 794734 142.22
60 728.063 0.993750 795358 160.00
61 759.807 0.994531 796000 182.86
62 796.159 0.995313 796610 213.33
63 833.535 0.996094 797238 256.00
64 850.943 0.996484 797550 284.44
65 868.351 0.996875 797861 320.00
66 888.319 0.997266 798176 365.71
67 903.679 0.997656 798493 426.67
68 922.111 0.998047 798797 512.00
69 930.815 0.998242 798959 568.89
70 938.495 0.998437 799123 640.00
71 945.151 0.998633 799274 731.43
72 952.831 0.998828 799431 853.33
73 962.047 0.999023 799579 1024.00
74 967.167 0.999121 799659 1137.78

```

```

75      972.287      0.999219      799740      1280.00
76      976.895      0.999316      799815      1462.86
77      981.503      0.999414      799900      1706.67
78      985.087      0.999512      799972      2048.00
79      987.647      0.999561      800016      2275.56
80      989.695      0.999609      800053      2560.00
81      991.743      0.999658      800094      2925.71
82      994.303      0.999707      800129      3413.33
83      996.863      0.999756      800177      4096.00
84      997.375      0.999780      800193      4551.11
85      997.887      0.999805      800206      5120.00
86      998.911      0.999829      800232      5851.43
87      999.423      0.999854      800243      6826.67
88     1000.959      0.999878      800275      8192.00
89     1000.959      0.999890      800275      9102.22
90     1001.471      0.999902      800284     10240.00
91     1002.495      0.999915      800299     11702.86
92     1003.007      0.999927      800306     13653.33
93     1003.519      0.999939      800313     16384.00
94     1004.031      0.999945      800318     18204.44
95     1004.543      0.999951      800322     20480.00
96     1005.055      0.999957      800327     23405.71
97     1006.079      0.999963      800333     27306.67
98     1006.591      0.999969      800337     32768.00
99     1007.103      0.999973      800340     36408.89
100     1007.615      0.999976      800343     40960.00
101     1007.615      0.999979      800343     46811.43
102     1008.127      0.999982      800348     54613.33
103     1008.127      0.999985      800348     65536.00
104     1008.639      0.999986      800352     72817.78
105     1008.639      0.999988      800352     81920.00
106     1008.639      0.999989      800352     93622.86
107     1009.151      0.999991      800355    109226.67
108     1009.151      0.999992      800355    131072.00
109     1009.151      0.999993      800355    145635.56
110     1009.663      0.999994      800358    163840.00
111     1009.663      0.999995      800358    187245.71
112     1009.663      0.999995      800358    218453.33
113     1009.663      0.999996      800358    262144.00
114     1009.663      0.999997      800358    291271.11
115     1009.663      0.999997      800358    327680.00
116     1009.663      0.999997      800358    374491.43
117     1010.175      0.999998      800359    436906.67
118     1010.175      0.999998      800359    524288.00
119     1010.175      0.999998      800359    582542.22
120     1010.175      0.999998      800359    655360.00
121     1010.175      0.999999      800359    748982.86
122     1010.687      0.999999      800360    873813.33
123     1010.687      1.000000      800360      inf
124 #[Mean      =      15.630, StdDeviation      =      86.281]
125 #[Max      =      1010.176, Total count      =      800360]
126 #[Buckets =      27, SubBuckets      =      2048]
127 -----
128      899946 requests in 1.50m, 57.50MB read
129 Requests/sec:      9999.45
130 Transfer/sec:      654.26KB

```

## 3 Get

### 3.1 stage 4

Рассмотрим результаты нагрузочного тестирования на запрос ранее записанных данных:

```
1 Running 1m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 5.217ms, rate sampling interval: 22ms
4 Thread calibration: mean lat.: 4.949ms, rate sampling interval: 22ms
5 Thread calibration: mean lat.: 4.806ms, rate sampling interval: 22ms
6 Thread calibration: mean lat.: 4.865ms, rate sampling interval: 21ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 3.94ms 4.46ms 56.19ms 87.89%
9 Req/Sec 2.58k 759.00 6.62k 75.76%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000% 2.30ms
12 75.000% 4.96ms
13 90.000% 9.52ms
14 99.000% 20.50ms
15 99.900% 34.65ms
16 99.990% 47.71ms
17 99.999% 54.88ms
18 100.000% 56.22ms
19
20 Detailed Percentile spectrum:
21 Value Percentile TotalCount 1/(1-Percentile)
22
23 0.071 0.000000 1 1.00
24 0.613 0.100000 50073 1.11
25 0.993 0.200000 100039 1.25
26 1.311 0.300000 150074 1.43
27 1.729 0.400000 200047 1.67
28 2.295 0.500000 250042 2.00
29 2.687 0.550000 275008 2.22
30 3.119 0.600000 300073 2.50
31 3.605 0.650000 325046 2.86
32 4.207 0.700000 350134 3.33
33 4.963 0.750000 375060 4.00
34 5.411 0.775000 387522 4.44
35 5.923 0.800000 400001 5.00
36 6.527 0.825000 412526 5.71
37 7.267 0.850000 425016 6.67
38 8.223 0.875000 437470 8.00
39 8.831 0.887500 443783 8.89
40 9.519 0.900000 450025 10.00
41 10.319 0.912500 456260 11.43
42 11.247 0.925000 462498 13.33
43 12.351 0.937500 468733 16.00
44 12.983 0.943750 471871 17.78
45 13.655 0.950000 474973 20.00
46 14.407 0.956250 478099 22.86
47 15.215 0.962500 481222 26.67
48 16.071 0.968750 484336 32.00
49 16.527 0.971875 485931 35.56
50 17.007 0.975000 487465 40.00
51 17.535 0.978125 489036 45.71
52 18.095 0.981250 490605 53.33
53 18.767 0.984375 492161 64.00
54 19.183 0.985938 492945 71.11
```

55	19.631	0.987500	493739	80.00
56	20.143	0.989062	494502	91.43
57	20.735	0.990625	495274	106.67
58	21.439	0.992188	496053	128.00
59	21.871	0.992969	496448	142.22
60	22.351	0.993750	496836	160.00
61	23.007	0.994531	497231	182.86
62	23.679	0.995313	497616	213.33
63	24.431	0.996094	498003	256.00
64	24.927	0.996484	498202	284.44
65	25.519	0.996875	498397	320.00
66	26.223	0.997266	498588	365.71
67	27.135	0.997656	498786	426.67
68	28.367	0.998047	498981	512.00
69	29.247	0.998242	499078	568.89
70	30.447	0.998437	499174	640.00
71	31.823	0.998633	499272	731.43
72	33.407	0.998828	499373	853.33
73	34.943	0.999023	499469	1024.00
74	35.839	0.999121	499519	1137.78
75	36.671	0.999219	499568	1280.00
76	37.311	0.999316	499615	1462.86
77	38.207	0.999414	499663	1706.67
78	39.359	0.999512	499711	2048.00
79	39.903	0.999561	499736	2275.56
80	40.575	0.999609	499761	2560.00
81	41.087	0.999658	499785	2925.71
82	42.015	0.999707	499809	3413.33
83	42.591	0.999756	499834	4096.00
84	42.879	0.999780	499846	4551.11
85	43.935	0.999805	499858	5120.00
86	45.087	0.999829	499870	5851.43
87	46.399	0.999854	499882	6826.67
88	47.327	0.999878	499896	8192.00
89	47.551	0.999890	499901	9102.22
90	47.807	0.999902	499907	10240.00
91	48.159	0.999915	499914	11702.86
92	48.543	0.999927	499919	13653.33
93	49.247	0.999939	499925	16384.00
94	49.855	0.999945	499928	18204.44
95	50.623	0.999951	499931	20480.00
96	51.231	0.999957	499935	23405.71
97	51.487	0.999963	499937	27306.67
98	52.319	0.999969	499940	32768.00
99	52.863	0.999973	499942	36408.89
100	53.119	0.999976	499943	40960.00
101	53.631	0.999979	499945	46811.43
102	53.887	0.999982	499946	54613.33
103	54.431	0.999985	499948	65536.00
104	54.655	0.999986	499949	72817.78
105	54.655	0.999988	499949	81920.00
106	54.879	0.999989	499950	93622.86
107	55.167	0.999991	499951	109226.67
108	55.455	0.999992	499952	131072.00
109	55.455	0.999993	499952	145635.56
110	55.455	0.999994	499952	163840.00
111	55.775	0.999995	499953	187245.71
112	55.775	0.999995	499953	218453.33
113	55.967	0.999996	499954	262144.00
114	55.967	0.999997	499954	291271.11

```

115      55.967      0.999997      499954      327680.00
116      55.967      0.999997      499954      374491.43
117      55.967      0.999998      499954      436906.67
118      56.223      0.999998      499955      524288.00
119      56.223      1.000000      499955      inf
120 #[Mean      =      3.936, StdDeviation      =      4.462]
121 #[Max      =      56.192, Total count      =      499955]
122 #[Buckets =      27, SubBuckets      =      2048]
123 -----
124 599985 requests in 1.00m, 41.88MB read
125 Non-2xx or 3xx responses: 6
126 Requests/sec: 9999.79
127 Transfer/sec: 714.76KB
128 Running 1m test @ http://localhost:8080
129 4 threads and 4 connections
130 Thread calibration: mean lat.: 4.150ms, rate sampling interval: 21ms

```

## 3.2 stage 3

Сравним с результатами из stage 3:

```

1 Running 2m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 7.918ms, rate sampling interval: 34ms
4 Thread calibration: mean lat.: 6.620ms, rate sampling interval: 30ms
5 Thread calibration: mean lat.: 6.457ms, rate sampling interval: 28ms
6 Thread calibration: mean lat.: 6.742ms, rate sampling interval: 31ms
7 Thread Stats      Avg      Stdev      Max      +/- Stdev
8   Latency      6.62ms    41.86ms    1.01s    99.49%
9   Req/Sec      2.57k     604.97    8.63k    75.24%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000%      2.41ms
12 75.000%      5.10ms
13 90.000%     10.28ms
14 99.000%     20.72ms
15 99.900%    801.79ms
16 99.990%    993.28ms
17 99.999%      1.01s
18 100.000%      1.01s
19
20 Detailed Percentile spectrum:
21      Value      Percentile      TotalCount  1/(1-Percentile)
22
23      0.070      0.000000           1           1.00
24      0.629      0.100000         80065           1.11
25      1.014      0.200000        160220           1.25
26      1.364      0.300000        240102           1.43
27      1.790      0.400000        320058           1.67
28      2.413      0.500000        399999           2.00
29      2.803      0.550000        440088           2.22
30      3.229      0.600000        480035           2.50
31      3.729      0.650000        519998           2.86
32      4.343      0.700000        560156           3.33
33      5.103      0.750000        599997           4.00
34      5.563      0.775000        620024           4.44
35      6.111      0.800000        639950           5.00
36      6.775      0.825000        659926           5.71
37      7.615      0.850000        679892           6.67
38      8.783      0.875000        699965           8.00
39      9.487      0.887500        709947           8.89

```

40	10.279	0.900000	719888	10.00
41	11.151	0.912500	729940	11.43
42	12.095	0.925000	739905	13.33
43	13.119	0.937500	749906	16.00
44	13.671	0.943750	754880	17.78
45	14.255	0.950000	759891	20.00
46	14.887	0.956250	764884	22.86
47	15.575	0.962500	769903	26.67
48	16.327	0.968750	774865	32.00
49	16.751	0.971875	777396	35.56
50	17.215	0.975000	779912	40.00
51	17.727	0.978125	782355	45.71
52	18.319	0.981250	784905	53.33
53	18.991	0.984375	787388	64.00
54	19.359	0.985938	788609	71.11
55	19.823	0.987500	789867	80.00
56	20.351	0.989062	791132	91.43
57	21.023	0.990625	792379	106.67
58	21.983	0.992188	793603	128.00
59	22.863	0.992969	794235	142.22
60	25.151	0.993750	794854	160.00
61	31.359	0.994531	795477	182.86
62	143.487	0.995313	796102	213.33
63	275.455	0.996094	796727	256.00
64	346.367	0.996484	797041	284.44
65	413.951	0.996875	797352	320.00
66	477.183	0.997266	797664	365.71
67	556.031	0.997656	797978	426.67
68	626.175	0.998047	798290	512.00
69	662.527	0.998242	798449	568.89
70	695.807	0.998437	798605	640.00
71	721.919	0.998633	798758	731.43
72	764.415	0.998828	798914	853.33
73	806.911	0.999023	799071	1024.00
74	826.879	0.999121	799149	1137.78
75	849.407	0.999219	799228	1280.00
76	869.375	0.999316	799305	1462.86
77	888.831	0.999414	799384	1706.67
78	909.823	0.999512	799461	2048.00
79	919.551	0.999561	799500	2275.56
80	929.791	0.999609	799540	2560.00
81	937.471	0.999658	799578	2925.71
82	949.247	0.999707	799618	3413.33
83	960.511	0.999756	799656	4096.00
84	966.655	0.999780	799676	4551.11
85	972.287	0.999805	799695	5120.00
86	978.431	0.999829	799716	5851.43
87	983.551	0.999854	799734	6826.67
88	988.671	0.999878	799755	8192.00
89	991.743	0.999890	799765	9102.22
90	993.791	0.999902	799776	10240.00
91	995.327	0.999915	799784	11702.86
92	997.887	0.999927	799793	13653.33
93	1000.959	0.999939	799804	16384.00
94	1001.983	0.999945	799810	18204.44
95	1002.495	0.999951	799814	20480.00
96	1003.519	0.999957	799818	23405.71
97	1005.055	0.999963	799823	27306.67
98	1006.591	0.999969	799828	32768.00
99	1007.103	0.999973	799830	36408.89

```

100      1008.127      0.999976      799833      40960.00
101      1008.639      0.999979      799835      46811.43
102      1009.151      0.999982      799837      54613.33
103      1010.175      0.999985      799840      65536.00
104      1010.687      0.999986      799842      72817.78
105      1010.687      0.999988      799842      81920.00
106      1011.199      0.999989      799844      93622.86
107      1011.199      0.999991      799844      109226.67
108      1011.711      0.999992      799845      131072.00
109      1012.223      0.999993      799847      145635.56
110      1012.223      0.999994      799847      163840.00
111      1012.223      0.999995      799847      187245.71
112      1012.735      0.999995      799850      218453.33
113      1012.735      0.999996      799850      262144.00
114      1012.735      0.999997      799850      291271.11
115      1012.735      0.999997      799850      327680.00
116      1012.735      0.999997      799850      374491.43
117      1012.735      0.999998      799850      436906.67
118      1012.735      0.999998      799850      524288.00
119      1012.735      0.999998      799850      582542.22
120      1012.735      0.999998      799850      655360.00
121      1012.735      0.999999      799850      748982.86
122      1013.247      0.999999      799851      873813.33
123      1013.247      1.000000      799851      inf
124 #[Mean      =      6.617, StdDeviation      =      41.858]
125 #[Max      =      1012.736, Total count      =      799851]
126 #[Buckets =      27, SubBuckets      =      2048]

```

## 4 Delete

### 4.1 stage 4

Рассмотрим результаты нагрузочного тестирования на удаление ранее записанных данных:

```

1 Running 1m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 4.316ms, rate sampling interval: 22ms
4 Thread calibration: mean lat.: 4.084ms, rate sampling interval: 21ms
5 Thread calibration: mean lat.: 4.738ms, rate sampling interval: 25ms
6 Thread calibration: mean lat.: 4.268ms, rate sampling interval: 22ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 9.21ms 60.27ms 1.01s 99.06%
9 Req/Sec 2.60k 792.34 9.00k 76.56%
10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000% 2.21ms
12 75.000% 5.11ms
13 90.000% 10.53ms
14 99.000% 41.02ms
15 99.900% 929.79ms
16 99.990% 1.00s
17 99.999% 1.01s
18 100.000% 1.01s
19
20 Detailed Percentile spectrum:
21 Value Percentile TotalCount 1/(1-Percentile)
22
23 0.058 0.000000 1 1.00
24 0.579 0.100000 50045 1.11

```



25	0.955	0.200000	100074	1.25
26	1.252	0.300000	149999	1.43
27	1.665	0.400000	200068	1.67
28	2.215	0.500000	250075	2.00
29	2.621	0.550000	274988	2.22
30	3.079	0.600000	300026	2.50
31	3.603	0.650000	324970	2.86
32	4.267	0.700000	349999	3.33
33	5.111	0.750000	375055	4.00
34	5.615	0.775000	387514	4.44
35	6.211	0.800000	399968	5.00
36	6.931	0.825000	412525	5.71
37	7.811	0.850000	424969	6.67
38	8.975	0.875000	437479	8.00
39	9.703	0.887500	443743	8.89
40	10.535	0.900000	449992	10.00
41	11.495	0.912500	456256	11.43
42	12.575	0.925000	462461	13.33
43	13.807	0.937500	468734	16.00
44	14.487	0.943750	471853	17.78
45	15.255	0.950000	474976	20.00
46	16.087	0.956250	478091	22.86
47	16.991	0.962500	481202	26.67
48	18.063	0.968750	484339	32.00
49	18.687	0.971875	485924	35.56
50	19.391	0.975000	487471	40.00
51	20.255	0.978125	489030	45.71
52	21.311	0.981250	490587	53.33
53	23.039	0.984375	492139	64.00
54	24.639	0.985938	492922	71.11
55	28.255	0.987500	493701	80.00
56	34.207	0.989062	494482	91.43
57	68.543	0.990625	495263	106.67
58	224.639	0.992188	496045	128.00
59	308.735	0.992969	496435	142.22
60	400.383	0.993750	496826	160.00
61	493.311	0.994531	497216	182.86
62	574.463	0.995313	497607	213.33
63	655.871	0.996094	498000	256.00
64	708.607	0.996484	498193	284.44
65	750.079	0.996875	498388	320.00
66	769.535	0.997266	498584	365.71
67	790.015	0.997656	498780	426.67
68	835.583	0.998047	498975	512.00
69	862.207	0.998242	499072	568.89
70	883.711	0.998437	499170	640.00
71	891.903	0.998633	499269	731.43
72	903.679	0.998828	499366	853.33
73	933.375	0.999023	499462	1024.00
74	948.223	0.999121	499512	1137.78
75	960.511	0.999219	499562	1280.00
76	967.167	0.999316	499614	1462.86
77	971.775	0.999414	499659	1706.67
78	976.383	0.999512	499707	2048.00
79	979.455	0.999561	499731	2275.56
80	983.551	0.999609	499758	2560.00
81	986.111	0.999658	499785	2925.71
82	988.159	0.999707	499806	3413.33
83	991.743	0.999756	499829	4096.00
84	992.767	0.999780	499841	4551.11

```

85      994.815      0.999805      499853      5120.00
86      997.375      0.999829      499865      5851.43
87      998.911      0.999854      499879      6826.67
88      999.935      0.999878      499891      8192.00
89     1000.959      0.999890      499900      9102.22
90     1001.471      0.999902      499907     10240.00
91     1001.983      0.999915      499917     11702.86
92     1001.983      0.999927      499917     13653.33
93     1002.495      0.999939      499925     16384.00
94     1002.495      0.999945      499925     18204.44
95     1003.007      0.999951      499930     20480.00
96     1003.007      0.999957      499930     23405.71
97     1003.519      0.999963      499934     27306.67
98     1004.031      0.999969      499939     32768.00
99     1004.031      0.999973      499939     36408.89
100     1004.031      0.999976      499939     40960.00
101     1004.543      0.999979      499943     46811.43
102     1004.543      0.999982      499943     54613.33
103     1004.543      0.999985      499943     65536.00
104     1005.055      0.999986      499947     72817.78
105     1005.055      0.999988      499947     81920.00
106     1005.055      0.999989      499947     93622.86
107     1005.055      0.999991      499947    109226.67
108     1005.055      0.999992      499947    131072.00
109     1005.055      0.999993      499947    145635.56
110     1005.055      0.999994      499947    163840.00
111     1005.567      0.999995      499950    187245.71
112     1005.567      1.000000      499950      inf
113 #[Mean      =      9.207, StdDeviation      =      60.265]
114 #[Max      =     1005.056, Total count      =      499950]
115 #[Buckets =      27, SubBuckets      =      2048]
116 -----
117 599963 requests in 1.00m, 38.91MB read
118 Requests/sec: 9999.56
119 Transfer/sec: 664.03KB
120 Running 1m test @ http://localhost:8080
121 4 threads and 4 connections
122 Thread calibration: mean lat.: 4.019ms, rate sampling interval: 20ms
123 Thread calibration: mean lat.: 3.950ms, rate sampling interval: 19ms
124 Thread calibration: mean lat.: 4.147ms, rate sampling interval: 18ms
125 Thread calibration: mean lat.: 3.837ms, rate sampling interval: 18ms
126 Thread Stats Avg Stdev Max +/- Stdev
127 Latency 9.00ms 58.18ms 1.00s 99.05%
128 Req/Sec 2.61k 0.92k 10.26k 76.64%
129 Latency Distribution (HdrHistogram - Recorded Latency)
130 50.000% 1.92ms

```

## 4.2 stage 3

Сравним с результатами из stage 3:

```

1 Running 2m test @ http://localhost:8080
2 4 threads and 4 connections
3 Thread calibration: mean lat.: 4.174ms, rate sampling interval: 22ms
4 Thread calibration: mean lat.: 4.059ms, rate sampling interval: 21ms
5 Thread calibration: mean lat.: 3.862ms, rate sampling interval: 20ms
6 Thread calibration: mean lat.: 3.716ms, rate sampling interval: 20ms
7 Thread Stats Avg Stdev Max +/- Stdev
8 Latency 12.85ms 76.15ms 1.01s 98.43%
9 Req/Sec 2.63k 0.94k 12.70k 73.44%

```

```

10 Latency Distribution (HdrHistogram - Recorded Latency)
11 50.000%    2.35ms
12 75.000%    5.54ms
13 90.000%   12.08ms
14 99.000%  436.73ms
15 99.900%  951.29ms
16 99.990%    1.00s
17 99.999%    1.01s
18 100.000%    1.01s

```

```

19
20 Detailed Percentile spectrum:
21      Value      Percentile      TotalCount  1/(1-Percentile)
22
23      0.051      0.000000           1          1.00
24      0.588      0.100000        80274          1.11
25      0.966      0.200000       160560          1.25
26      1.286      0.300000       240738          1.43
27      1.712      0.400000       320822          1.67
28      2.347      0.500000       401035          2.00
29      2.781      0.550000       441228          2.22
30      3.265      0.600000       481209          2.50
31      3.859      0.650000       521341          2.86
32      4.599      0.700000       561433          3.33
33      5.539      0.750000       601608          4.00
34      6.123      0.775000       621636          4.44
35      6.823      0.800000       641625          5.00
36      7.707      0.825000       661723          5.71
37      8.863      0.850000       681706          6.67
38     10.319      0.875000       701812          8.00
39     11.159      0.887500       711850          8.89
40     12.079      0.900000       721861         10.00
41     13.055      0.912500       731897         11.43
42     14.103      0.925000       741925         13.33
43     15.247      0.937500       751938         16.00
44     15.863      0.943750       756927         17.78
45     16.527      0.950000       761958         20.00
46     17.247      0.956250       766955         22.86
47     18.095      0.962500       771961         26.67
48     19.135      0.968750       776985         32.00
49     19.759      0.971875       779465         35.56
50     20.575      0.975000       781988         40.00
51     21.839      0.978125       784470         45.71
52     26.095      0.981250       786957         53.33
53     93.119      0.984375       789463         64.00
54    188.671      0.985938       790717         71.11
55    289.279      0.987500       791971         80.00
56    384.255      0.989062       793226         91.43
57    468.735      0.990625       794478        106.67
58    561.663      0.992188       795736        128.00
59    608.767      0.992969       796355        142.22
60    648.191      0.993750       796983        160.00
61    693.247      0.994531       797609        182.86
62    735.743      0.995313       798236        213.33
63    784.895      0.996094       798864        256.00
64    807.935      0.996484       799180        284.44
65    826.367      0.996875       799492        320.00
66    847.871      0.997266       799804        365.71
67    873.471      0.997656       800116        426.67
68    893.439      0.998047       800432        512.00
69    904.703      0.998242       800587        568.89

```

70	917.503	0.998437	800746	640.00
71	928.767	0.998633	800909	731.43
72	941.055	0.998828	801061	853.33
73	952.319	0.999023	801216	1024.00
74	957.439	0.999121	801292	1137.78
75	962.047	0.999219	801371	1280.00
76	967.167	0.999316	801454	1462.86
77	972.287	0.999414	801530	1706.67
78	976.383	0.999512	801603	2048.00
79	980.479	0.999561	801647	2275.56
80	984.575	0.999609	801686	2560.00
81	988.159	0.999658	801720	2925.71
82	991.743	0.999707	801765	3413.33
83	994.815	0.999756	801801	4096.00
84	995.839	0.999780	801819	4551.11
85	997.375	0.999805	801841	5120.00
86	998.399	0.999829	801860	5851.43
87	999.423	0.999854	801878	6826.67
88	1000.959	0.999878	801902	8192.00
89	1001.471	0.999890	801909	9102.22
90	1001.983	0.999902	801918	10240.00
91	1003.007	0.999915	801930	11702.86
92	1003.519	0.999927	801936	13653.33
93	1004.543	0.999939	801948	16384.00
94	1005.055	0.999945	801954	18204.44
95	1005.567	0.999951	801959	20480.00
96	1006.079	0.999957	801965	23405.71
97	1006.079	0.999963	801965	27306.67
98	1007.103	0.999969	801974	32768.00
99	1007.103	0.999973	801974	36408.89
100	1007.615	0.999976	801977	40960.00
101	1007.615	0.999979	801977	46811.43
102	1008.639	0.999982	801980	54613.33
103	1009.151	0.999985	801983	65536.00
104	1009.151	0.999986	801983	72817.78
105	1009.663	0.999988	801987	81920.00
106	1009.663	0.999989	801987	93622.86
107	1009.663	0.999991	801987	109226.67
108	1010.175	0.999992	801988	131072.00
109	1010.687	0.999993	801990	145635.56
110	1010.687	0.999994	801990	163840.00
111	1010.687	0.999995	801990	187245.71
112	1011.199	0.999995	801993	218453.33
113	1011.199	0.999996	801993	262144.00
114	1011.199	0.999997	801993	291271.11
115	1011.199	0.999997	801993	327680.00
116	1011.199	0.999997	801993	374491.43
117	1011.199	0.999998	801993	436906.67
118	1011.199	0.999998	801993	524288.00
119	1011.199	0.999998	801993	582542.22
120	1011.199	0.999998	801993	655360.00
121	1011.199	0.999999	801993	748982.86
122	1011.711	0.999999	801994	873813.33
123	1011.711	1.000000	801994	inf
124	#[Mean = 12.849, StdDeviation = 76.146]			
125	#[Max = 1011.200, Total count = 801994]			
126	#[Buckets = 27, SubBuckets = 2048]			
127	-----			
128	899829 requests in 1.50m, 58.35MB read			
129	Requests/sec: 10000.41			

## 5 Выводы

### 5.1 get empty

Максимальное ожидание для stage 4: 1002.495

Максимальное ожидание для stage 3: 1001.983

### 5.2 put

Максимальное ожидание для stage 4: 44.799

Максимальное ожидание для stage 3: 1010.687

### 5.3 get full

Максимальное ожидание для stage 4: 56.223

Максимальное ожидание для stage 3: 1013.247

### 5.4 delete

Максимальное ожидание для stage 4: 1005.567

Максимальное ожидание для stage 3: 1011.711

### 5.5 В общем

Ошибки допущенные в stage 3 были исправлены, но судя по длительности выполнения get empty и delete, всё ещё остались некоторые проблемы, требующие проверки и последующей оптимизации. Об этих проблемах можно судить и из SVG полученных в результате профилирования по CPU (не похоже, что многопоточность работает так, как должна).

Однако в целом можно сказать, что Stage 4 работает значительно быстрее Stage 3.