

MioHash: A Memory-Efficient and I/O-Optimized Hashing Index on Hybrid PMem-DARM Memories

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| Experiment 1 | | | | | | |
|---|-------------|-----------------|-----------------|-------------|-------------|-------------|
| Uniform Insert Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.080309792 | 2.067467027 | 3.54139375 | 5.265225163 | 5.601201605 | 5.560437909 |
| CCEH | 0.6927915 | 1.33181725 | 2.43652025 | 4.08677525 | 5.44514925 | 5.66926275 |
| Level | 0.517253332 | 0.566679181 | 0.706762602 | 0.864436573 | 1.014259263 | 1.056101841 |
| Clevel | 0.14161 | 0.272089 | 0.504664 | 0.903298 | 1.399661 | 1.716833 |
| Plush | 0.438103 | 0.83422125 | 1.6048145 | 2.4292295 | 4.294831 | 5.97354325 |
| Viper | 1.916868 | 3.51213 | 6.477029 | 9.194919 | 12.335607 | 13.04946 |
| MioHash | 2.523302 | 4.3044485 | 7.770145 | 11.19255225 | 16.8236075 | 19.88255167 |
| Uniform Positive Search Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 3.333146 | 5.646048 | 9.280315 | 13.539036 | 17.525591 | 18.408078 |
| CCEH | 2.145908 | 4.352373 | 9.02399 | 15.176016 | 19.615334 | 20.702171 |
| Level | 1.050534 | 1.738362 | 3.092409 | 4.906786 | 6.404106 | 7.143704 |
| Clevel | 0.990972 | 1.81147 | 3.56415 | 6.773919 | 12.12053 | 16.35713 |
| Plush | 0.66246525 | 1.2985415 | 2.479261 | 3.4266955 | 6.18491075 | 9.49267075 |
| Viper | 2.096916 | 4.012847 | 8.116097 | 12.593406 | 25.527122 | 37.48872 |
| MioHash | 3.134054 | 6.22590625 | 12.229869 | 14.0550155 | 26.7947485 | 38.912764 |
| Uniform Negative Search Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 3.33464 | 5.642306 | 9.312879 | 13.537437 | 17.621648 | 18.535994 |
| CCEH | 0.715493 | 1.414038 | 2.708599 | 4.740526 | 7.459968 | 7.946879 |
| Level | 1.051344 | 1.735256 | 3.113679 | 4.901411 | 6.449082 | 7.051144 |
| Clevel | 0.811196 | 1.542197 | 3.005827 | 5.733635 | 10.279313 | 13.616402 |
| Plush | 0.92998575 | 1.8471755 | 3.605941 | 4.82533025 | 9.25337825 | 13.745963 |
| Viper | 4.435612 | 8.763846 | 17.417176 | 21.866726 | 42.342509 | 61.9225 |
| MioHash | 3.62707425 | 7.2290625 | 14.08542675 | 19.298319 | 34.82591625 | 47.20718225 |
| Uniform Delete Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.898662 | 3.598952 | 5.935547 | 8.094248 | 7.910209 | 8.000926 |
| CCEH | 1.229131 | 2.490614 | 4.70361 | 7.886595 | 8.918177 | 10.328562 |
| Level | 0.937153 | 1.531833 | 2.772285 | 4.398251 | 5.593817 | 5.666127 |
| Clevel | 0.299471 | 0.559957 | 1.03137 | 1.956335 | 3.418501 | 4.645158 |
| Plush | 0.39326175 | 0.77641925 | 1.513762 | 2.283574725 | 4.14544275 | 6.05539775 |
| Viper | 1.85327 | 3.519253 | 6.853577 | 10.342089 | 15.766681 | 17.652877 |
| MioHash | 1.690429 | 3.293858125 | 6.254388 | 8.86109575 | 15.02798225 | 19.60113467 |
| Zipfian Insert Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.053913 | 2.036119 | 3.449268 | 5.292045 | 5.805819 | 5.4589 |
| CCEH | 0.589479 | 1.18045 | 2.285433 | 4.021246 | 5.582147 | 5.985942 |
| Level | 0.474362 | 0.757504 | 0.973837 | 1.374645 | 1.461386 | 1.382936 |
| Clevel | 0.137404 | 0.261074 | 0.491295 | 0.887227 | 1.380396 | 1.717355 |
| Plush | 0.372362 | 0.757704 | 1.534042 | 2.734872 | 3.891831 | 4.608914 |
| Viper | 1.918128 | 3.488715 | 6.433229 | 9.637801 | 12.175177 | 12.902454 |
| MioHash | 2.516055 | 4.243159 | 7.60807025 | 11.10811225 | 17.041096 | 20.1762295 |
| Zipfian Positive Search Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 3.336167 | 5.586168 | 9.299656 | 13.530452 | 17.573843 | 18.276381 |
| CCEH | 2.046681 | 4.19717 | 8.781548 | 15.505613 | 19.346186 | 20.01743 |
| Level | 1.032295 | 1.740166 | 3.093239 | 4.901955 | 6.396258 | 7.103214 |
| Clevel | 0.997262 | 1.877826 | 3.626865 | 6.997729 | 13.112314 | 18.246416 |
| Plush | 0.585573 | 1.188494 | 2.514597 | 4.270248 | 7.509008 | 9.457597 |
| Viper | 2.102515 | 3.944174 | 8.176301 | 12.950664 | 24.569926 | 36.804304 |
| MioHash | 3.00255875 | 5.9849455 | 11.780668 | 13.1106245 | 23.660596 | 34.29530725 |
| Zipfian Negative Search Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 3.332858 | 5.648635 | 9.31015 | 13.563526 | 17.526157 | 18.38305 |
| CCEH | 0.713374 | 1.405746 | 2.7034 | 4.67963 | 7.465958 | 7.823678 |
| Level | 1.05248 | 1.740997 | 3.098963 | 4.889724 | 6.410645 | 7.096786 |
| Clevel | 0.812245 | 1.534612 | 2.948581 | 5.728126 | 10.174163 | 12.411457 |
| Plush | 0.796609 | 1.654961 | 3.517741 | 6.129173 | 10.566435 | 13.902013 |
| Viper | 4.47395 | 8.295752 | 17.129539 | 22.372177 | 42.177021 | 60.593687 |
| MioHash | 3.64170925 | 7.18883175 | 14.346825 | 19.3584845 | 34.70292175 | 47.010148 |
| Uniform Delete Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.607616 | 3.240823 | 5.494735 | 7.556856 | 7.241076 | 7.64346 |
| CCEH | 1.224438 | 2.468547 | 4.720928 | 7.922391 | 9.215614 | 10.335044 |
| Level | 0.809582 | 1.383746 | 2.516669 | 4.048322 | 5.082029 | 5.198309 |
| Clevel | 0.295755 | 0.55504 | 1.008447 | 2.030666 | 3.581514 | 4.975246 |
| Plush | 0.337059 | 0.711316 | 1.453221 | 2.597762 | 3.946841 | 4.739526 |
| Viper | 1.863955 | 3.492423 | 6.891585 | 10.442913 | 15.672394 | 17.574828 |
| MioHash | 1.66992575 | 3.2749535 | 6.235328 | 8.60868725 | 14.852254 | 19.423247 |
| Experiment 2 | | | | | | |
| Uniform YCSB-A Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| CCEH | 1.941595 | 3.613314 | 6.282357 | 9.603273 | 10.940991 | 11.432127 |
| Clevel | 0.215008 | 0.419314 | 0.809303 | 1.53451 | 2.702261 | 3.576111 |
| Plush | 0.423265 | 0.95656 | 1.878408 | 2.619554 | 5.083122 | 7.476417 |
| Viper | 1.780937 | 3.28364 | 5.034586 | 5.644092 | 5.529003 | 4.956198 |
| MioHash | 1.9295995 | 3.779359 | 7.358267 | 9.924119 | 18.3813365 | 25.373776 |
| Uniform YCSB-B Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| CCEH | 1.553614 | 3.214115 | 6.395054 | 10.17395 | 12.110555 | 13.752623 |
| Clevel | 0.547787 | 1.032996 | 1.977721 | 3.493462 | 4.435138 | 5.079593 |
| Plush | 0.62971 | 1.225157 | 2.422948 | 3.13946 | 6.263437 | 9.295119 |
| Viper | 1.778103 | 3.250971 | 4.995168 | 5.592824 | 5.477951 | 5.06256 |
| MioHash | 2.622453 | 5.198723 | 10.266235 | 12.136581 | 23.401413 | 33.741323 |
| Uniform YCSB-D Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 2.547534 | 4.556558 | 7.806189 | 10.655705 | 9.969395 | 9.275043 |
| CCEH | 1.519133 | 3.087774 | 6.070746 | 9.841329 | 11.607526 | 12.588382 |
| Level | 0.872114 | 1.425969 | 1.972523 | 3.644325 | 4.716346 | 5.236053 |
| Clevel | 0.575072 | 1.102422 | 2.145923 | 4.137716 | 7.2416 | 9.988099 |
| Plush | 1.16033 | 1.20241 | 2.2662 | 4.880244 | 6.240233 | 9.361369 |
| Viper | 3.625560333 | 7.433447667 | 14.772049 | 21.772137 | 25.086287 | 25.97748067 |
| MioHash | 5.043314 | 5.3270765 | 10.502546 | 20.5088805 | 24.746811 | 36.5088485 |
| Uniform YCSB-F Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.361149 | 2.770951 | 4.811631 | 7.28332 | 7.353183 | 7.086551 |
| CCEH | 0.732373 | 1.389933 | 2.745591 | 4.836576 | 6.132695 | 6.397954 |
| Level | 0.694532 | 1.239523 | 2.192028 | 3.537363 | 4.236918 | 4.501145 |
| Clevel | 0.237316 | 0.453495 | 0.884652 | 1.651285 | 2.836115 | 3.920888 |
| Plush | 0.446808 | 0.89648 | 1.7672565 | 2.413629 | 4.704921 | 6.940909 |
| Viper | 1.959922 | 4.22807 | 8.227409 | 10.98181 | 11.3979743 | 10.901977 |
| MioHash | 1.8972135 | 3.5556535 | 6.6841395 | 9.6083835 | 15.8329955 | 20.028024 |
| Experiment 4 | | | | | | |
| Average Latency (us) | Insert | Positive Search | Negative Search | Delete | | |
| DASH | 1.044361667 | 0.373066833 | 0.5000925 | 0.718684667 | | |
| CCEH | 1.524968333 | 0.386246 | 1.176861667 | 0.728425333 | | |
| Level | 1.570881667 | 0.5450395 | 1.077073333 | 1.039588333 | | |
| Clevel | 7.030871667 | 1.033883333 | 1.263503333 | 3.415083333 | | |
| Plush | 2.420722 | 1.583204 | 1.154294 | 2.629362 | | |
| Viper | 0.62575 | 0.328 | 0.327 | 0.5745 | | |
| MioHash | 0.442224 | 0.5871938 | 0.348968 | 0.6487288 | | |
| Tail Latency (us) | Insert | Positive Search | Negative Search | Delete | | |
| DASH | 1.835166667 | 0.924166667 | 0.814833333 | 1.379166667 | | |
| CCEH | 2.243333333 | 1.098333333 | 1.776166667 | 1.322833333 | | |
| Level | 3.057166667 | 1.446333333 | 1.527166667 | 1.833166667 | | |
| Clevel | 9.195833333 | 2.0745 | 1.710333333 | 4.414666667 | | |
| Plush | 248.0072 | 3.3296 | 2.7224 | 261.3952 | | |
| Viper | 41.24025 | 2.37875 | 2.37925 | 4.132 | | |
| MioHash | 6.6324 | 1.2416 | 1.0794 | 1.452 | | |
| Experiment 5 | | | | | | |
| Generality Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| DASH | 1.080309792 | 2.067467027 | 3.54139375 | 5.265225163 | 5.601201605 | 5.560437909 |
| CCEH | 0.6927915 | 1.33181725 | 2.43652025 | 4.08677525 | 5.44514925 | 5.66926275 |
| Level | 0.517253332 | 0.566679181 | 0.706762602 | 0.864436573 | 1.014259263 | 1.056101841 |
| Clevel | 0.14161 | 0.272089 | 0.504664 | 0.903298 | 1.399661 | 1.716833 |
| Plush | 0.438103 | 0.83422125 | 1.6048145 | 2.4292295 | 4.294831 | 5.97354325 |
| Viper | 1.916868 | 3.51213 | 6.477029 | 9.194919 | 12.335607 | 13.04946 |
| MioHash-ADR | 1.943972 | 3.540634 | 6.496861 | 9.368059 | 14.062237 | 15.435523 |
| MioHash | 2.523302 | 4.3044485 | 7.770145 | 11.19255225 | 16.8236075 | 19.88255167 |

| Experiment 6 | | |
|-----------------|--------------------|-------------------|
| Storage Traffic | Write Traffic (GB) | Read Traffic (GB) |
| DASH | 35.11431432 | 33.44651294 |
| CCEH | 21.9854815 | 128.2352502 |
| Level | 27.12402272 | 74.41524744 |
| Cleavel | 41.02325344 | 102.6981823 |
| Plush | 12.37470412 | 7.149165392 |
| Viper | 7.8515625 | 0.803710938 |
| MioHash | 6.346679688 | 3.326171875 |

| Experiment 7 | | | | | | |
|--------------|-------------------------------|-------------|-------------|-------------|-------------|-------------|
| Space(GB) | Number of inserted items=10M | 20M | 30M | 40M | 50M | 60M |
| Plush-DRAM | 0.249999746 | 0.262560851 | 0.250000104 | 0.249999771 | 0.249999632 | 0.250000264 |
| Plush-PM | 0.249998939 | 4.249999495 | 4.250000493 | 4.249998931 | 4.25000808 | 4.250006269 |
| Viper-DRAM | 0.396240234 | 0.794219971 | 1.047981263 | 1.587265016 | 2.0145607 | 2.093997956 |
| Viper-PM | 0.150764466 | 0.301551819 | 0.452316284 | 0.603103638 | 0.753890991 | 0.904655457 |
| MioHash-DRAM | 0.066098828 | 0.132199512 | 0.183785938 | 0.264400391 | 0.264400391 | 0.367154297 |
| MioHash-PM | 0.291180664 | 0.575436523 | 0.802583984 | 1.155664063 | 1.153710938 | 1.586894531 |
| Space(GB) | Number of inserted items=70M | 80M | 90M | 100M | 110M | 120M |
| Plush-DRAM | 0.250000051 | 0.250000017 | 0.249999711 | 0.250000352 | 0.249970499 | 0.249999636 |
| Plush-PM | 4.250008685 | 4.250005096 | 4.249994726 | 4.250002624 | 4.250003643 | 4.25000454 |
| Viper-DRAM | 2.375648499 | 3.173919678 | 3.845325471 | 4.030708313 | 4.082023621 | 4.193206787 |
| Viper-PM | 1.055442811 | 1.206207275 | 1.356994629 | 1.507781982 | 1.658546448 | 1.809333802 |
| MioHash-DRAM | 0.528804688 | 0.528803711 | 0.528803711 | 0.529323242 | 0.533805664 | 0.739245117 |
| MioHash-PM | 2.282929688 | 2.296601563 | 2.296601563 | 2.298916016 | 2.333466797 | 3.203115234 |
| Space(GB) | Number of inserted items=130M | 140M | 150M | 160M | 170M | 180M |
| Plush-DRAM | 0.250000085 | 0.250000074 | 0.249999896 | 0.249999777 | 0.249999799 | 0.249999666 |
| Plush-PM | 4.249996225 | 4.250001735 | 4.249998959 | 4.250003048 | 4.249998202 | 4.250003074 |
| Viper-DRAM | 4.428947449 | 4.85838318 | 5.520629883 | 6.344173432 | 7.139011384 | 7.690620423 |
| Viper-PM | 1.960116893 | 2.11088562 | 2.261672974 | 2.412437439 | 2.563224793 | 2.714005627 |
| MioHash-DRAM | 0.739245117 | 1.057611328 | 1.057610352 | 1.057610352 | 1.057609375 | 1.057608398 |
| MioHash-PM | 3.203115234 | 4.553066406 | 4.601894531 | 4.595058594 | 4.595058594 | 4.597988281 |
| Space(GB) | Number of inserted items=190M | 200M | 210M | 220M | 230M | 240M |
| Plush-DRAM | 0.250000195 | 0.250000172 | 0.24999976 | 0.250000245 | 0.249999726 | 0.250000213 |
| Plush-PM | 4.250001257 | 4.250002091 | 68.2499742 | 68.24978246 | 68.24991443 | 68.24981132 |
| Viper-DRAM | 7.961681366 | 8.058933259 | 8.105636598 | 8.168132782 | 8.254638672 | 8.382823944 |
| Viper-PM | 2.864776611 | 3.015563965 | 3.16632843 | 3.317115784 | 3.467903137 | 3.618667603 |
| MioHash-DRAM | 1.057608398 | 1.058648438 | 1.059292969 | 1.068192383 | 1.145938477 | 1.476976563 |
| MioHash-PM | 4.593105469 | 4.591884766 | 4.595302734 | 4.645605469 | 5.025908203 | 6.390634766 |
| Space(GB) | Number of inserted items=250M | 260M | 270M | 280M | 290M | 300M |
| Plush-DRAM | 0.249999631 | 0.249999887 | 0.249999807 | 0.249999916 | 0.250000147 | 0.250000207 |
| Plush-PM | 68.25001036 | 68.25005041 | 68.25025806 | 68.24994929 | 68.250072 | 68.25005004 |
| Viper-DRAM | 8.573005677 | 8.845458984 | 9.217933655 | 9.708759309 | 10.31484985 | 11.03757095 |
| Viper-PM | 3.769481659 | 3.920246124 | 4.071033478 | 4.221820831 | 4.372585297 | 4.52337265 |
| MioHash-DRAM | 1.974335938 | 2.112382813 | 2.115224609 | 2.115224609 | 2.115224609 | 2.115224609 |
| MioHash-PM | 8.364619141 | 8.966396484 | 9.056240234 | 9.113857422 | 9.167568359 | 9.184169922 |

| Experiment 8 | | | | | |
|-----------------------------------|----------------|-------------|------------|-------------|-------------|
| Variable Size Throughput (Mops/s) | Value size=16B | 32B | 64B | 128B | 256B |
| DASH | 4.761206 | 4.370462 | 4.012544 | 3.648672 | 2.531003 |
| Cleavel | 1.75256215 | 1.7737998 | 1.7562037 | 1.771669775 | 1.741172375 |
| Plush | 4.0494265 | 3.61212125 | 3.46075975 | 3.36415675 | 3.05871875 |
| Viper | 12.55229975 | 12.30331375 | 9.808057 | 7.12537625 | 4.50371775 |
| MioHash | 14.092812 | 12.9155135 | 10.503505 | 7.34719125 | 4.3792125 |

| Experiment 9 | | | | | | |
|-----------------|-------------------------------|---------|---------|---------|---------|---------|
| Load Factor (%) | Number of inserted items=10M | 20M | 30M | 40M | 50M | 60M |
| DASH | 66.0554 | 66.0554 | 53.2927 | 66.0554 | 82.4597 | 53.3501 |
| CCEH | 59.5719 | 59.5737 | 47.6062 | 59.5728 | 69.9493 | 47.5765 |
| Level | 90.8261 | 90.8261 | 68.1196 | 90.8261 | 56.7663 | 68.1196 |
| Cleavel | 79.4729 | 34.0598 | 59.6046 | 79.4729 | 49.6705 | 59.6046 |
| Plush | 59.6046 | 7.01231 | 10.5185 | 14.0246 | 17.308 | 21.0369 |
| Viper | 37.7066 | 37.668 | 42.8273 | 37.7237 | 37.1483 | 42.9255 |
| MioHash | 56.0727 | 56.0856 | 61.5157 | 56.092 | 70.1151 | 61.5264 |
| Load Factor (%) | Number of inserted items=70M | 80M | 90M | 100M | 110M | 120M |
| DASH | 57.7984 | 66.0554 | 74.3123 | 82.434 | 79.1072 | 53.3446 |
| CCEH | 52.1537 | 59.5742 | 66.6419 | 70.1075 | 59.5115 | 47.6101 |
| Level | 79.4729 | 90.8261 | 51.0897 | 56.7663 | 62.443 | 68.1196 |
| Cleavel | 69.5388 | 34.0598 | 44.7035 | 49.6705 | 54.6376 | 59.6046 |
| Plush | 24.5431 | 28.0492 | 31.5554 | 35.0616 | 38.5677 | 42.0739 |
| Viper | 43.2452 | 37.7426 | 35.0398 | 37.1422 | 40.3423 | 42.8817 |
| MioHash | 49.0834 | 56.953 | 63.1072 | 70.1191 | 76.5192 | 61.3701 |
| Load Factor (%) | Number of inserted items=130M | 140M | 150M | 160M | 170M | 180M |
| DASH | 53.6829 | 57.7984 | 61.9269 | 66.0554 | 70.1838 | 74.3117 |
| CCEH | 48.4817 | 52.1525 | 55.8725 | 59.5756 | 63.2159 | 66.6449 |
| Level | 73.7962 | 79.4729 | 85.1495 | 90.8261 | 48.2514 | 51.0897 |
| Cleavel | 64.5717 | 69.5388 | 74.5058 | 34.0598 | 42.22 | 44.7035 |
| Plush | 45.58 | 49.0862 | 52.5923 | 56.0985 | 59.6046 | 63.1108 |
| Viper | 43.9789 | 43.1678 | 40.6975 | 37.7694 | 35.6577 | 35.0449 |
| MioHash | 45.6442 | 49.0848 | 52.5908 | 56.0969 | 59.6029 | 63.109 |
| Load Factor (%) | Number of inserted items=190M | 200M | 210M | 220M | 230M | 240M |
| DASH | 78.4342 | 82.4434 | 84.9072 | 79.1159 | 63.3772 | 53.3364 |
| CCEH | 69.3263 | 70.0462 | 66.8545 | 59.503 | 51.8082 | 47.5918 |
| Level | 53.928 | 56.7663 | 59.6046 | 62.443 | 65.2813 | 68.1196 |
| Cleavel | 47.187 | 49.6705 | 52.1541 | 54.6376 | 57.1211 | 59.6046 |
| Plush | 66.617 | 70.1231 | 4.58497 | 4.8033 | 5.02164 | 5.23997 |
| Viper | 35.7313 | 37.1574 | 38.7904 | 40.3647 | 41.7568 | 42.9049 |
| MioHash | 66.615 | 70.1168 | 73.6002 | 76.5144 | 74.8935 | 61.2596 |

| Experiment 10 | | | | | | |
|-------------------|------------------------------|----------|----------|----------|----------|----------|
| Recovery Time (s) | Number of inserted items=10M | 20M | 30M | 40M | 50M | 60M |
| Thread-1 | 0.560193 | 1.089347 | 1.614449 | 2.549051 | 2.559382 | 3.447411 |
| Thread-2 | 0.331689 | 0.644957 | 0.923353 | 1.445274 | 1.507391 | 1.922619 |
| Thread-4 | 0.235937 | 0.416497 | 0.614051 | 0.916964 | 0.923644 | 1.172099 |
| Thread-8 | 0.159552 | 0.301159 | 0.420544 | 0.64551 | 0.640922 | 0.864405 |
| Thread-16 | 0.154403 | 0.233623 | 0.332565 | 0.494526 | 0.502285 | 0.743899 |
| Thread-24 | 0.122917 | 0.216846 | 0.310919 | 0.471374 | 0.4684 | 0.642067 |
| Recovery Time (s) | Number of inserted items=70M | 80M | 90M | 100M | | |
| Thread-1 | 4.971479 | 5.305649 | 5.405138 | 5.512479 | | |
| Thread-2 | 2.75402 | 2.958968 | 2.966657 | 3.025063 | | |
| Thread-4 | 1.704711 | 1.787486 | 1.785323 | 1.811582 | | |
| Thread-8 | 1.248624 | 1.263118 | 1.254723 | 1.289331 | | |
| Thread-16 | 0.968667 | 1.017342 | 1.034704 | 1.021178 | | |
| Thread-24 | 0.881894 | 0.923817 | 0.944532 | 0.945199 | | |

| Experiment 11 | | | | | | |
|--------------------------------------|----------|----------|----------|-----------|-----------|-----------|
| Collecting Table Throughput (Mops/s) | Thread=1 | 2 | 4 | 8 | 16 | 24 |
| # of CT=4 | 2.533653 | 4.293149 | 7.137802 | 8.904839 | 10.007422 | 8.26563 |
| # of CT=8 | 2.545541 | 4.268679 | 7.45585 | 10.502003 | 13.94874 | 14.238366 |
| # of CT=16 | 2.526699 | 4.32143 | 7.621123 | 10.50557 | 15.644961 | 17.940957 |
| # of CT=64 | 2.529887 | 4.301137 | 7.665617 | 10.878732 | 16.60617 | 19.671948 |
| # of CT=256 | 2.536601 | 4.338474 | 7.88022 | 11.090656 | 16.991854 | 20.213206 |
| # of CT=1024 | 2.551242 | 4.373844 | 7.852751 | 11.811766 | 17.486818 | 20.370545 |

| Experiment 12 | | |
|--|-----------------|------------|
| Variable D-Bucket Size Throughput (M Insert) | Positive Search | |
| D-bucket=32B | 1.85281225 | 2.94434275 |
| D-bucket=64B | 2.16642825 | 2.9541595 |
| D-bucket=128B | 2.42965825 | 2.9828735 |
| D-bucket=256B | 2.54010175 | 2.980101 |
| D-bucket=512B | 2.50579775 | 3.006221 |
| Variable P-Bucket Size Throughput (M Insert) | Positive Search | |
| P-bucket=1KB | 2.23251575 | 3.08697575 |
| P-bucket=2KB | 2.410912 | 3.06805275 |
| P-bucket=4KB | 2.54756875 | 2.97051575 |
| P-bucket=8KB | 2.6717505 | 2.77006725 |
| P-bucket=16KB | 2.84456175 | 2.3266485 |