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Samsung 980 NVMe SSD Linux Benchmarks

Samsung 980 NVMe SSD Linux benchmarks by Michael Larabel.

Automated Executive Summary

WD_BLACK SN850 1TB had the most wins, coming in first place for 93% of the tests.

Based on the geometric mean of all complete results, the fastest (WD_BLACK SN850 1TB) was 2.998x the speed of the slowest (Samsung 980 1TB). Sabrent Rocket 4.0 1TB was 0.617x the speed of WD_BLACK SN850 1TB, Corsair Force MP600 1TB was 0.649x the speed of Sabrent Rocket 4.0 1TB, Samsung 980 1TB was 0.833x the speed of Corsair Force MP600 1TB.

Test Systems:

Corsair Force MP600 1TB

Processor: AMD Ryzen 9 5900X 12-Core @ 3.70GHz (12 Cores / 24 Threads), Motherboard: ASUS ROG CROSSHAIR VIII HERO (3202 BIOS), Chipset: AMD Starship/Matisse, Memory: 16GB, Disk: 1000GB Sabrent Rocket 4.0 Plus +

1000GB Corsair Force MP600, Graphics: Sapphire AMD Radeon RX 5600 OEM/5600 XT / 5700/5700 6GB (1780/875MHz), Audio: AMD Navi 10 HDMI Audio, Monitor: ASUS VP28U, Network: Realtek RTL8125 2.5GbE + Intel I211

OS: Ubuntu 20.10, Kernel: 5.12.0-051200rc2-generic (x86_64) 20210306, Desktop: GNOME Shell 3.38.1, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.2.1 (LLVM 11.0.0), Vulkan: 1.2.131, Compiler: GCC 10.2.0, File-System: ext4, Screen Resolution: 3840x2160

Kernel Notes: Transparent Huge Pages: madvise
Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++,m2 --enable-libphobos-checking=release --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-nvptx/usr,amdgcn-amdhsa=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-gcn/usr,hsa --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib=auto --with-tune=generic --without-cuda-driver -v
Disk Notes: NONE / relatime,rw / Block Size: 4096
Processor Notes: Scaling Governor: acpi-cpufreq schedutil (Boost: Enabled) - CPU Microcode: 0xa201009
Security Notes: itlb_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec_store_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre_v1: Mitigation of usercopy/swapgs barriers and __user pointer sanitization + spectre_v2: Mitigation of Full AMD retpoline IBPB: conditional IBRS_FW STIBP: always-on RSB filling + srbds: Not affected + tsx_async_abort: Not affected

WD_BLACK SN850 1TB

Processor: AMD Ryzen 9 5900X 12-Core @ 3.70GHz (12 Cores / 24 Threads), Motherboard: ASUS ROG CROSSHAIR VIII HERO (3202 BIOS), Chipset: AMD Starship/Matisse, Memory: 16GB, Disk: 1000GB Sabrent Rocket 4.0 Plus + 1000GB Western Digital WD_BLACK SN850 1TB, Graphics: Sapphire AMD Radeon RX 5600 OEM/5600 XT / 5700/5700 6GB (1780/875MHz), Audio: AMD Navi 10 HDMI Audio, Monitor: ASUS VP28U, Network: Realtek RTL8125 2.5GbE + Intel I211

OS: Ubuntu 20.10, Kernel: 5.12.0-051200rc2-generic (x86_64) 20210306, Desktop: GNOME Shell 3.38.1, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.2.1 (LLVM 11.0.0), Vulkan: 1.2.131, Compiler: GCC 10.2.0, File-System: ext4, Screen Resolution: 3840x2160

Kernel Notes: Transparent Huge Pages: madvise
Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++,m2 --enable-libphobos-checking=release --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-nvptx/usr,amdgcn-amdhsa=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-gcn/usr,hsa --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib=auto --with-tune=generic --without-cuda-driver -v
Disk Notes: NONE / relatime,rw / Block Size: 4096
Processor Notes: Scaling Governor: acpi-cpufreq schedutil (Boost: Enabled) - CPU Microcode: 0xa201009
Security Notes: itlb_multihit: Not affected + l1tf: Not affected + mds: Not affected + meltdown: Not affected + spec_store_bypass: Mitigation of SSB disabled via prctl and seccomp + spectre_v1: Mitigation of usercopy/swapgs barriers and __user pointer sanitization + spectre_v2: Mitigation of Full AMD retpoline IBPB: conditional IBRS_FW STIBP: always-on RSB filling + srbds: Not affected + tsx_async_abort: Not affected

Sabrent Rocket 4.0 1TB

Processor: AMD Ryzen 9 5900X 12-Core @ 3.70GHz (12 Cores / 24 Threads), Motherboard: ASUS ROG CROSSHAIR VIII HERO (3202 BIOS), Chipset: AMD Starship/Matisse, Memory: 16GB, Disk: 1000GB Sabrent Rocket 4.0 Plus + 1000GB Sabrent Rocket 4.0 1TB, Graphics: Sapphire AMD Radeon RX 5600 OEM/5600 XT / 5700/5700 6GB (1780/875MHz), Audio: AMD Navi 10 HDMI Audio, Monitor: ASUS VP28U, Network: Realtek RTL8125 2.5GbE + Intel I211

OS: Ubuntu 20.10, Kernel: 5.12.0-051200rc2-generic (x86_64) 20210306, Desktop: GNOME Shell 3.38.1, Display Server: X Server 1.20.9, OpenGL: 4.6 Mesa 20.2.1 (LLVM 11.0.0), Vulkan: 1.2.131, Compiler: GCC 10.2.0, File-System: ext4, Screen Resolution: 3840x2160

Kernel Notes: Transparent Huge Pages: madvise
Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++,m2 --enable-libphobos-checking=release --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-nvptx/usr,amdgcn-amdhsa=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-gcn/usr,hsa --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib=auto --with-tune=generic --without-cuda-driver -v
Disk Notes: NONE / relatime,rw / Block Size: 4096
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Samsung 980 1TB

Processor: AMD Ryzen 9 5900X 12-Core @ 3.70GHz (12 Cores / 24 Threads), Motherboard: ASUS ROG CROSSHAIR VIII HERO (3202 BIOS), Chipset: AMD Starship/Matisse, Memory: 16GB, Disk: 1000GB Sabrent Rocket 4.0 Plus + 1000GB Samsung SSD 980 1TB, Graphics: Sapphire AMD Radeon RX 5600 OEM/5600 XT / 5700/5700 6GB (1780/875MHz), Audio: AMD Navi 10 HDMI Audio, Monitor: ASUS VP28U, Network: Realtek RTL8125 2.5GbE + Intel I211

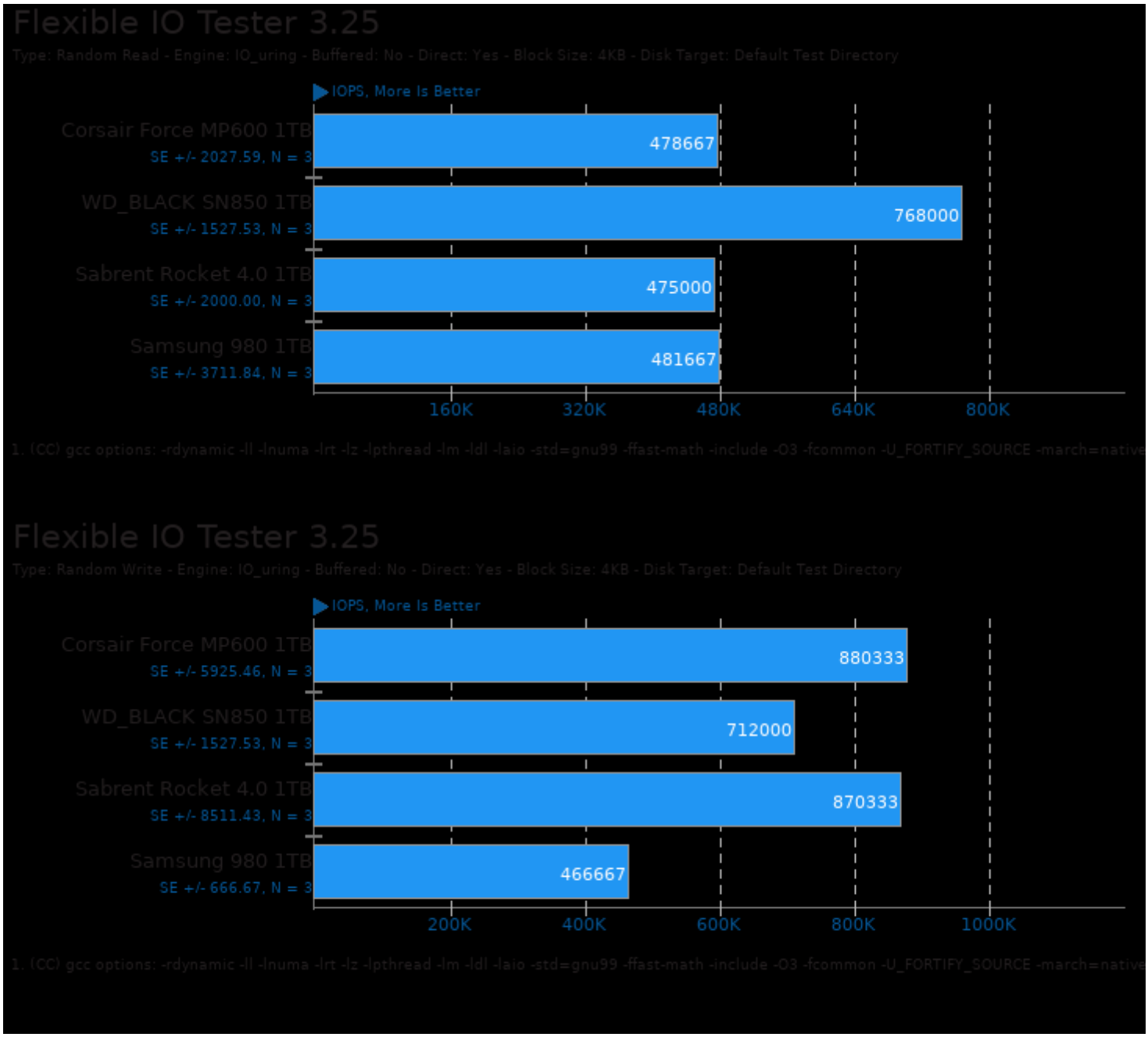
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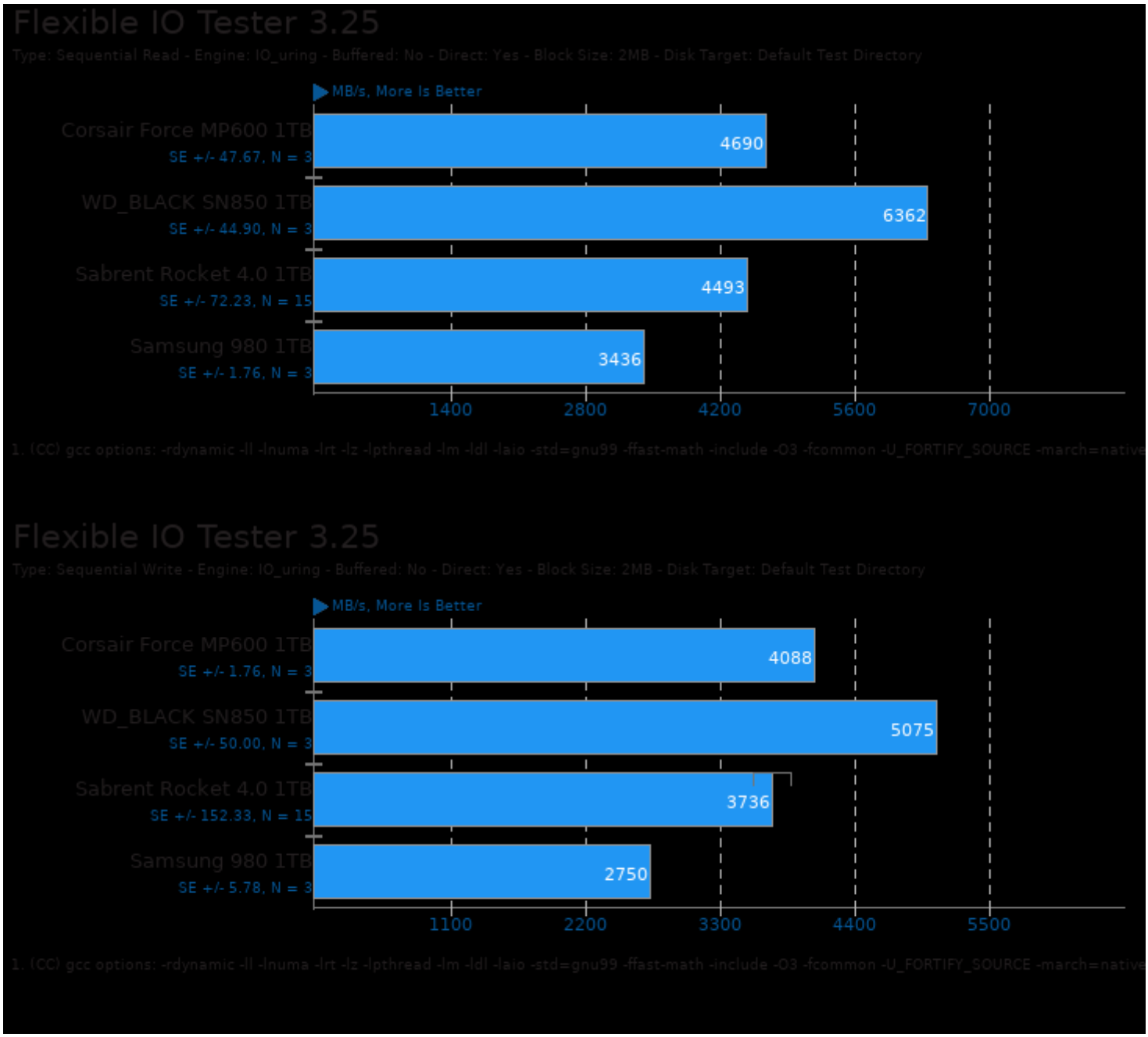
Kernel Notes: Transparent Huge Pages: madvise
Compiler Notes: --build=x86_64-linux-gnu --disable-vtable-verify --disable-werror --enable-checking=release --enable-clocale=gnu --enable-default-pie --enable-gnu-unique-object --enable-languages=c,ada,c++,go,brig,d,fortran,objc,obj-c++,m2 --enable-libphobos-checking=release --enable-libstdcxx-debug --enable-libstdcxx-time=yes --enable-multiarch --enable-multilib --enable-nls --enable-objc-gc=auto --enable-offload-targets=nvptx-none=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-nvptx/usr,amdgcn-amdhsa=/build/gcc-10-JvwpWM/gcc-10-10.2.0/debian/tmp-gcn/usr,hsa --enable-plugin --enable-shared --enable-threads=posix --host=x86_64-linux-gnu --program-prefix=x86_64-linux-gnu- --target=x86_64-linux-gnu --with-abi=m64 --with-arch-32=i686 --with-default-libstdcxx-abi=new --with-gcc-major-version-only --with-multilib-list=m32,m64,mx32 --with-target-system-zlib=auto --with-tune=generic --without-cuda-driver -v
Disk Notes: NONE / relatime,rw / Block Size: 4096
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	Corsair Force MP600 1TB	WD_BLACK SN850 1TB	Sabrent Rocket 4.0 1TB	Samsung 980 1TB
Flexible IO Tester - Rand Read - IO_uring - No - Yes - 4KB (IOPS)	478667	**768000**	**475000**	481667
Normalized	62.33%	100%	61.85%	62.72%
Standard Deviation	0.7%	0.3%	0.7%	1.3%
Flexible IO Tester - Rand Write - IO_uring - No - Yes - 4KB (IOPS)	**880333**	712000	870333	**466667**
Normalized	100%	80.88%	98.86%	53.01%
Standard Deviation	1.2%	0.4%	1.7%	0.2%
Flexible IO Tester - Seq Read - IO_uring - No - Yes - 2MB (MB/s)	4690	**6362**	4493	**3436**
Normalized	73.72%	100%	70.62%	54.01%
Standard Deviation	1.8%	1.2%	6.2%	0.1%

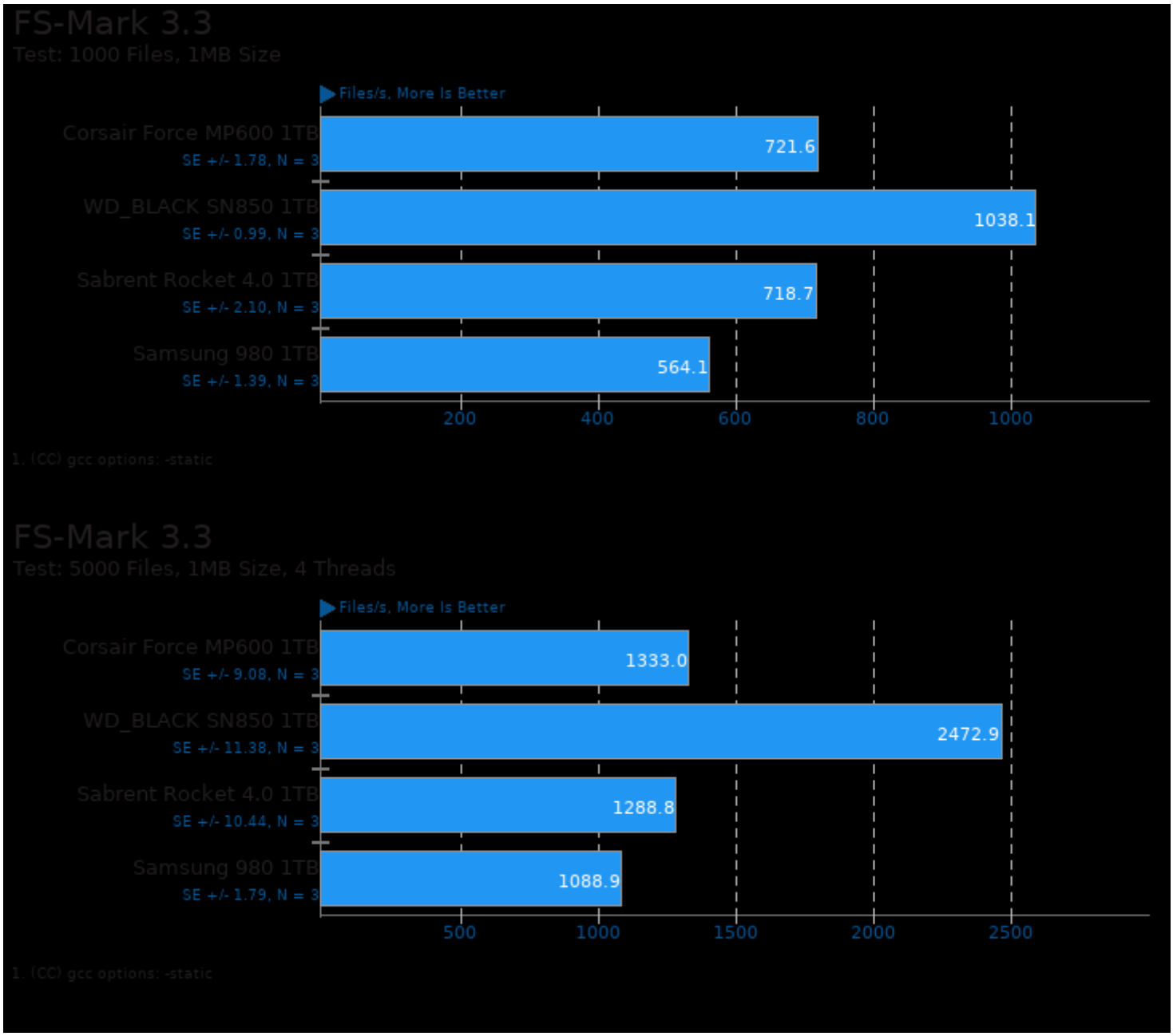
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Flexible IO Tester - Seq Write - IO_uring - No - Yes - 2MB (MB/s)	4088	**5075**	3736	**2750**
Normalized	80.55%	100%	73.62%	54.19%
Standard Deviation	0.1%	1.7%	15.8%	0.4%
FS-Mark - 1.F.1.S (Files/s)	721.6	**1038**	718.7	**564.1**
Normalized	69.51%	100%	69.23%	54.34%
Standard Deviation	0.4%	0.2%	0.5%	0.4%
FS-Mark - 5.F.1.S.4.T (Files/s)	1333	**2473**	1289	**1089**
Normalized	53.9%	100%	52.12%	44.03%
Standard Deviation	1.2%	0.8%	1.4%	0.3%
FS-Mark - 4.F.3.S.D.1.S (Files/s)	721.2	**1016**	720.9	**565.9**
Normalized	70.97%	100%	70.94%	55.69%
Standard Deviation	0.6%	0.6%	1%	0.2%
Dbench - 6 (MB/s)	1492	**2656**	1485	**1370**
Normalized	56.18%	100%	55.92%	51.56%
Standard Deviation	0.2%	0.2%	0.3%	0.1%
MariaDB - 8 (Queries/sec)	578	**3565**	1872	**370**
Normalized	16.21%	100%	52.51%	10.38%
Standard Deviation	15.2%	3.9%	0.3%	2.2%
MariaDB - 16 (Queries/sec)	674	**3469**	1805	**324**
Normalized	19.43%	100%	52.03%	9.34%
Standard Deviation	52.3%	2%	0.2%	3.4%
PostgreSQL pgbench - 1000 - 1 - Read Write (TPS)	**280**	**2156**	776	316
Normalized	12.99%	100%	35.99%	14.66%
Standard Deviation	10.9%	0.5%	32.5%	13.8%
PostgreSQL pgbench - 1000 - 1 - Read Write - Average Latency (ms)	**3.602**	**0.464**	1.361	3.220
Normalized	12.88%	100%	34.09%	14.41%
Standard Deviation	9.8%	0.6%	18.1%	13.4%
PostgreSQL pgbench - 1000 - 50 - Read Write (TPS)	**3089**	**17144**	10828	4717
Normalized	18.02%	100%	63.16%	27.51%
Standard Deviation	13.1%	11%	9.4%	7.9%
PostgreSQL pgbench - 1000 - 50 - Read Write - Average Latency (ms)	**16.439**	**2.948**	4.658	10.654
Normalized	17.93%	100%	63.29%	27.67%
Standard Deviation	12.6%	10.6%	9.7%	7.6%
IOR - 2MB (MB/s)	1503	**1608**	1524	**877.93**
Normalized	93.43%	100%	94.76%	54.59%
Standard Deviation	4.1%	3.9%	1.3%	18.6%

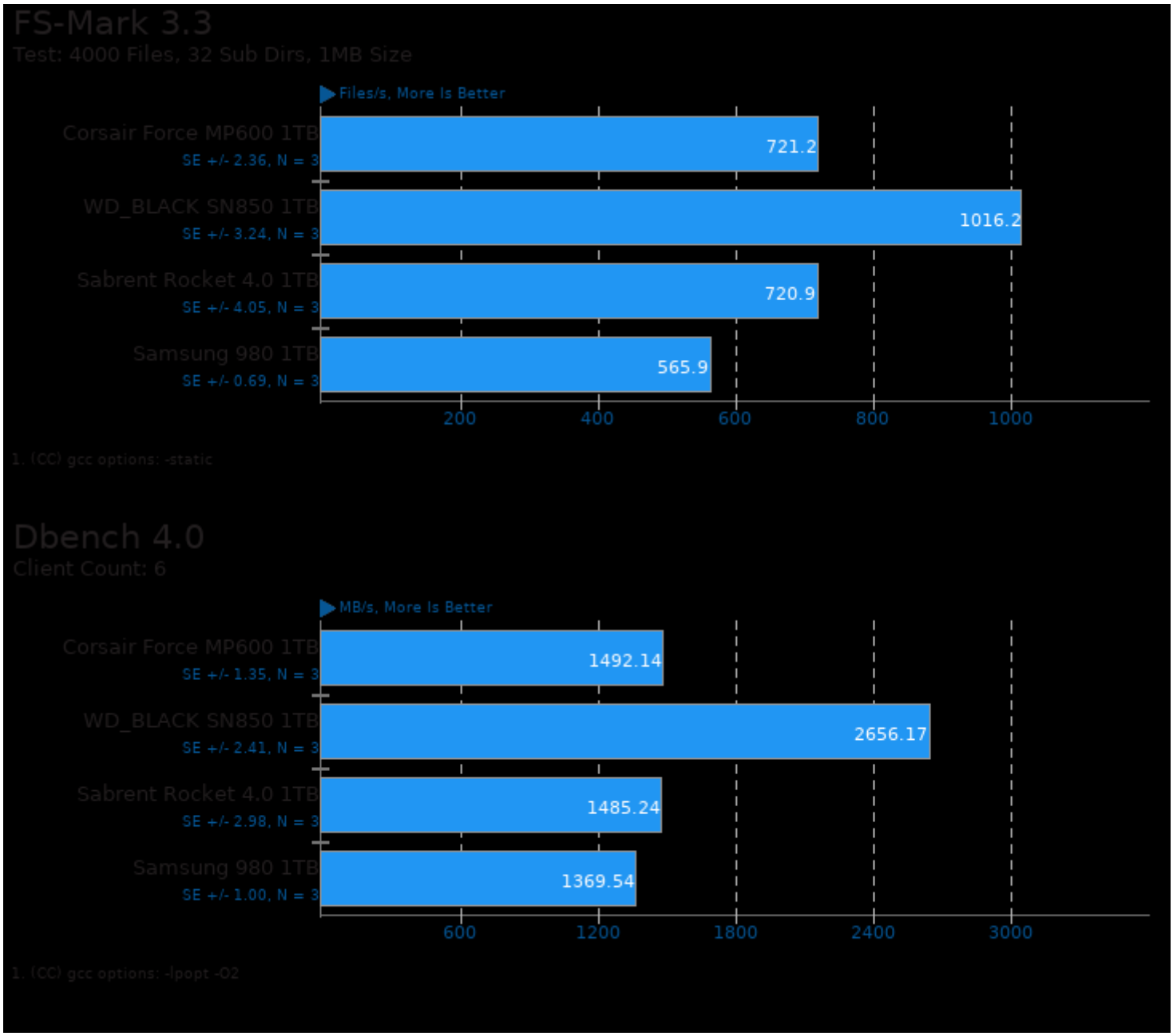

Flexible IO Tester 3.25
Type: Random Read - Engine: IO_uring - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
IOPS, More Is Better
Corsair Force MP600 1TB
SE +/- 2027.59, N = 3
478667
WD_BLACK SN850 1TB
SE +/- 1527.53, N = 3
768000
Sabrent Rocket 4.0 1TB
SE +/- 2000.00, N = 3
475000
Samsung 980 1TB
SE +/- 3711.84, N = 3
481667
160K
320K
480K
640K
800K
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE -march=native
Flexible IO Tester 3.25
Type: Random Write - Engine: IO_uring - Buffered: No - Direct: Yes - Block Size: 4KB - Disk Target: Default Test Directory
IOPS, More Is Better
Corsair Force MP600 1TB
SE +/- 5925.46, N = 3
880333
WD_BLACK SN850 1TB
SE +/- 1527.53, N = 3
712000
Sabrent Rocket 4.0 1TB
SE +/- 8511.43, N = 3
870333
Samsung 980 1TB
SE +/- 666.67, N = 3
466667
200K
400K
600K
800K
1000K
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE -march=native

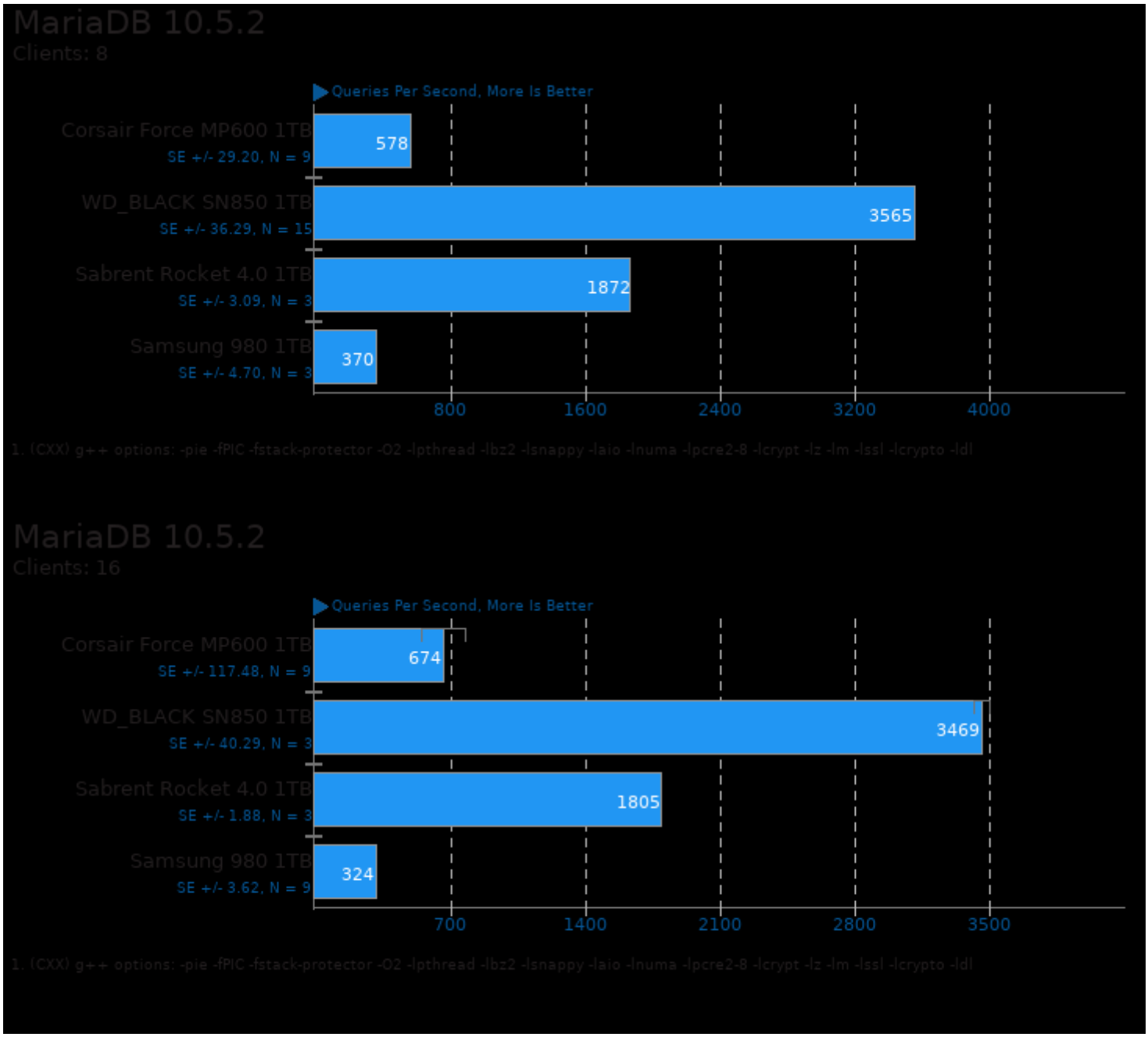

Flexible IO Tester 3.25
Type: Sequential Read - Engine: IO_uring - Buffered: No - Direct: Yes - Block Size: 2MB - Disk Target: Default Test Directory
MB/s, More Is Better
Corsair Force MP600 1TB
SE +/- 47.67, N = 3
4690
WD_BLACK SN850 1TB
SE +/- 44.90, N = 3
6362
Sabrent Rocket 4.0 1TB
SE +/- 72.23, N = 15
4493
Samsung 980 1TB
SE +/- 1.76, N = 3
3436
1400
2800
4200
5600
7000
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE -march=native
Flexible IO Tester 3.25
Type: Sequential Write - Engine: IO_uring - Buffered: No - Direct: Yes - Block Size: 2MB - Disk Target: Default Test Directory
MB/s, More Is Better
Corsair Force MP600 1TB
SE +/- 1.76, N = 3
4088
WD_BLACK SN850 1TB
SE +/- 50.00, N = 3
5075
Sabrent Rocket 4.0 1TB
SE +/- 152.33, N = 15
3736
Samsung 980 1TB
SE +/- 5.78, N = 3
2750
1100
2200
3300
4400
5500
1. (CC) gcc options: -rdynamic -ll -lnuma -lrt -lz -lpthread -lm -ldl -laio -std=gnu99 -ffast-math -include -O3 -fcommon -U_FORTIFY_SOURCE -march=native

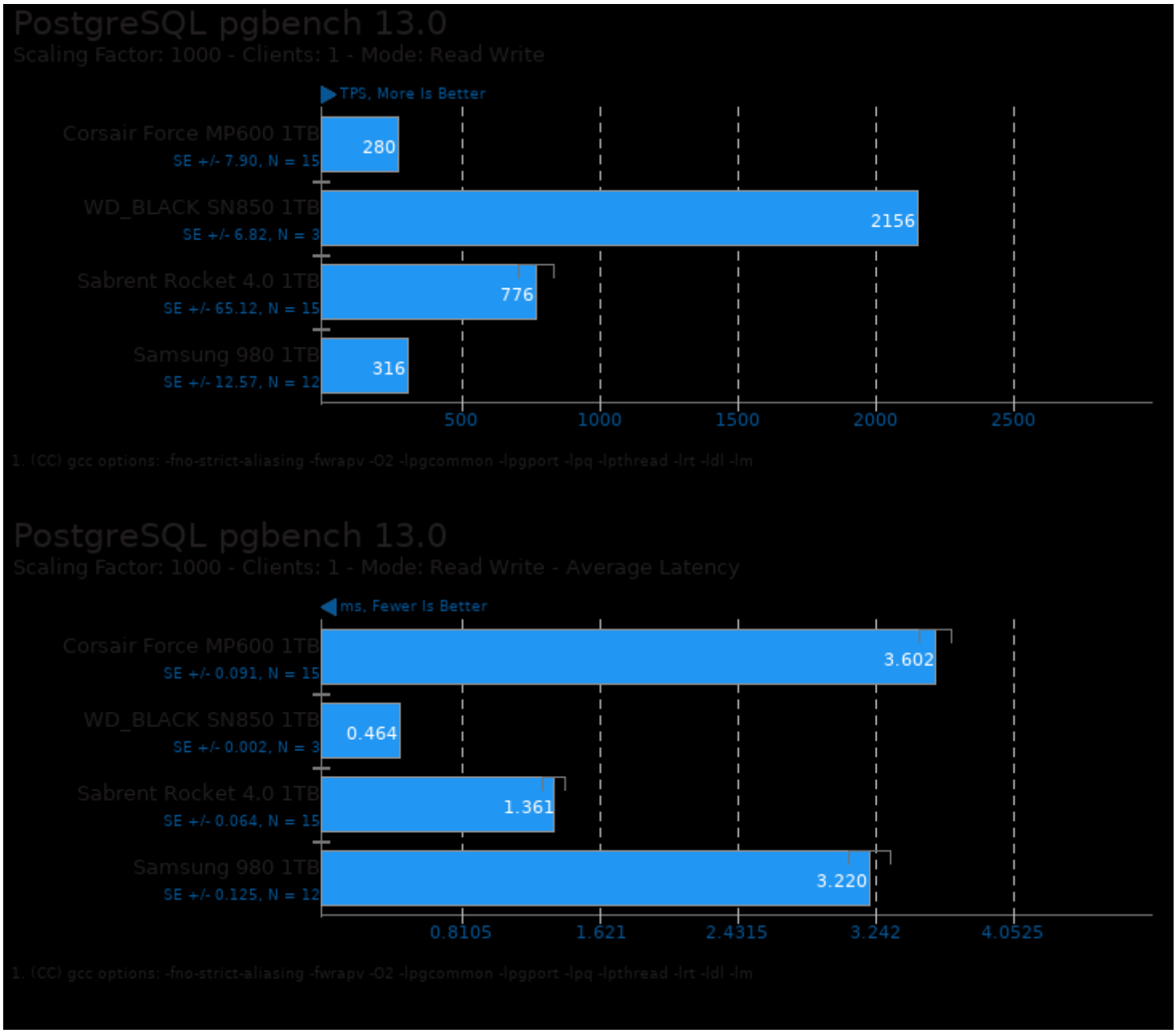
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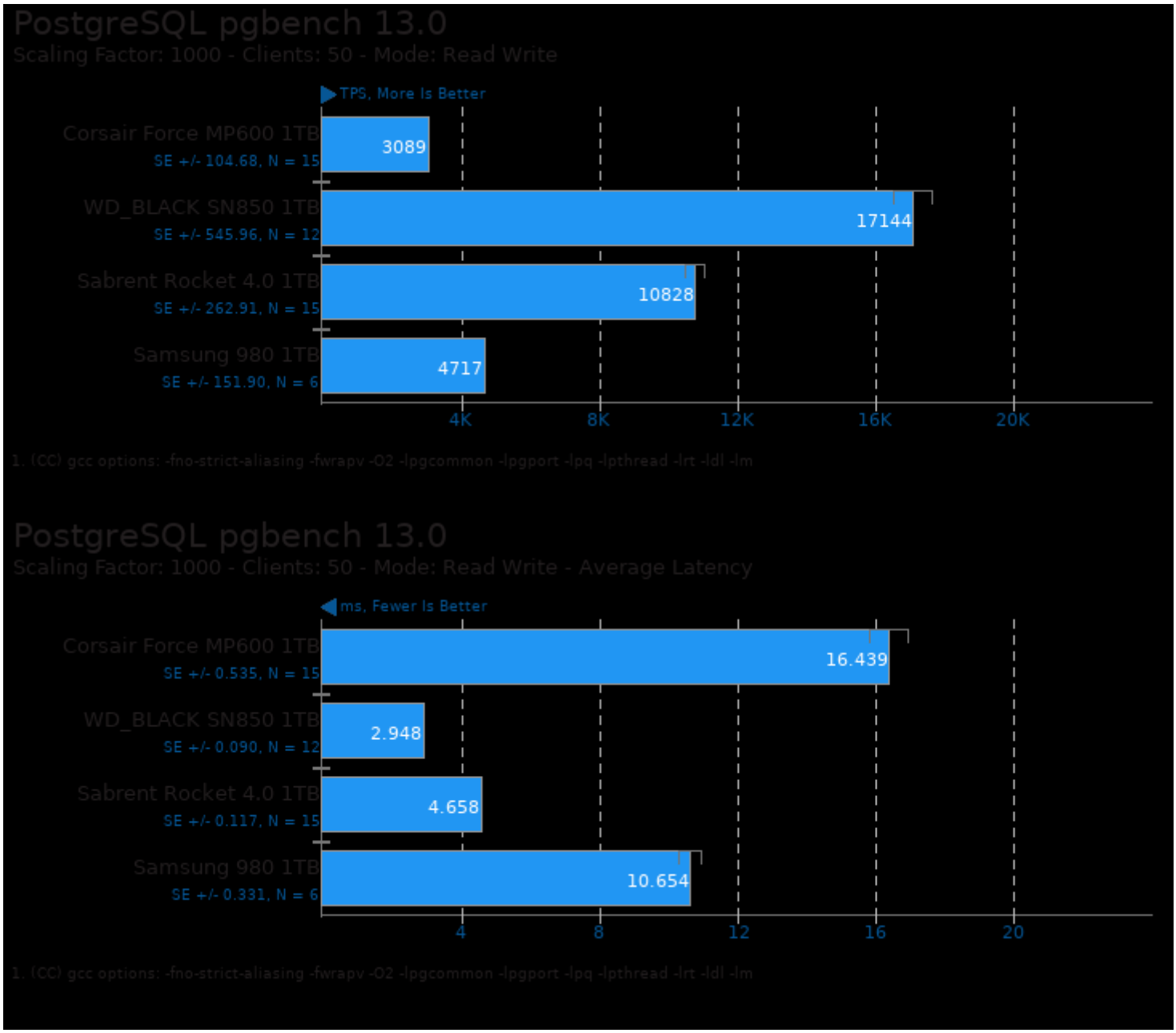


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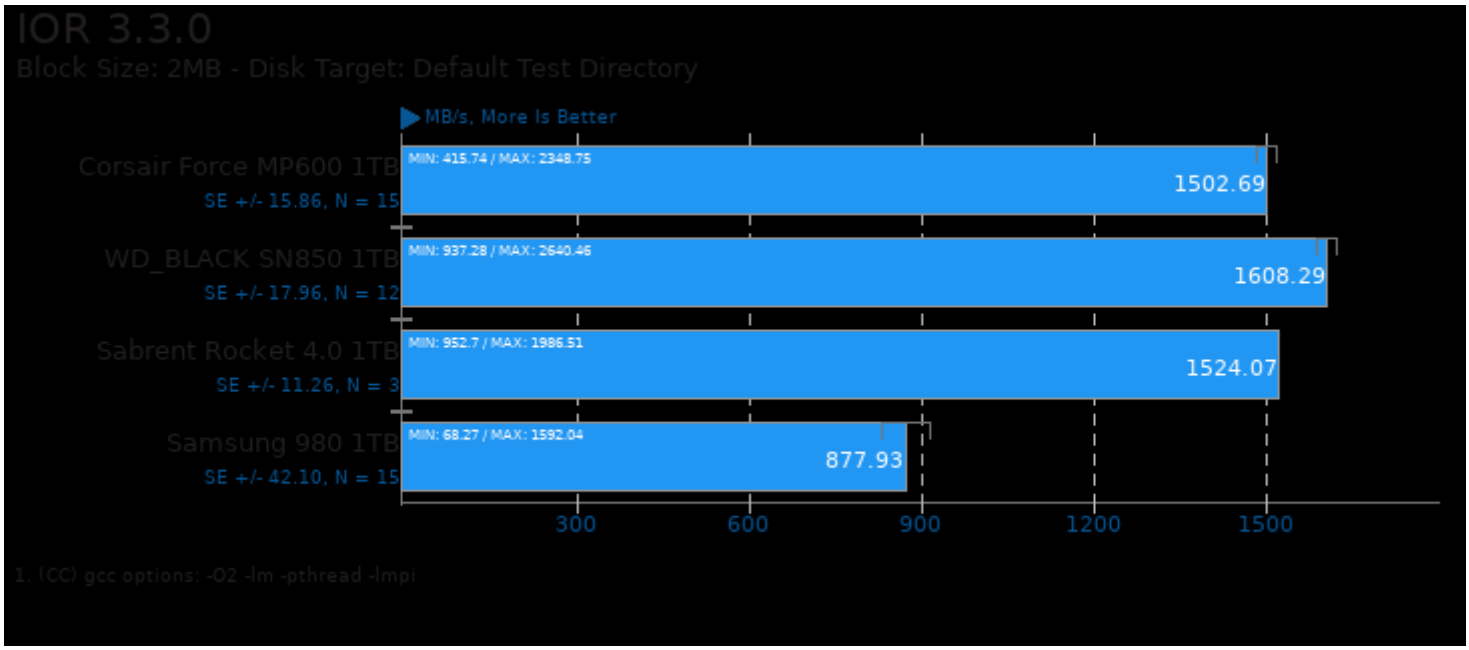



MariaDB 10.5.2
Clients: 8
Queries Per Second, More Is Better
Corsair Force MP600 1TB
SE +/- 29.20, N = 9
578
WD_BLACK SN850 1TB
SE +/- 36.29, N = 15
3565
Sabrent Rocket 4.0 1TB
SE +/- 3.09, N = 3
1872
Samsung 980 1TB
SE +/- 4.70, N = 3
370
800
1600
2400
3200
4000
1. (CXX) g++ options: -pie -fPIC -fstack-protector -O2 -lpthread -lbz2 -lsnappy -laio -lnuma -lpcre2-8 -lcrypt -lz -lm -lssl -lcrypto -ldl
MariaDB 10.5.2
Clients: 16
Queries Per Second, More Is Better
Corsair Force MP600 1TB
SE +/- 117.48, N = 9
674
WD_BLACK SN850 1TB
SE +/- 40.29, N = 3
3469
Sabrent Rocket 4.0 1TB
SE +/- 1.88, N = 3
1805
Samsung 980 1TB
SE +/- 3.62, N = 9
324
700
1400
2100
2800
3500
1. (CXX) g++ options: -pie -fPIC -fstack-protector -O2 -lpthread -lbz2 -lsnappy -laio -lnuma -lpcre2-8 -lcrypt -lz -lm -lssl -lcrypto -ldl

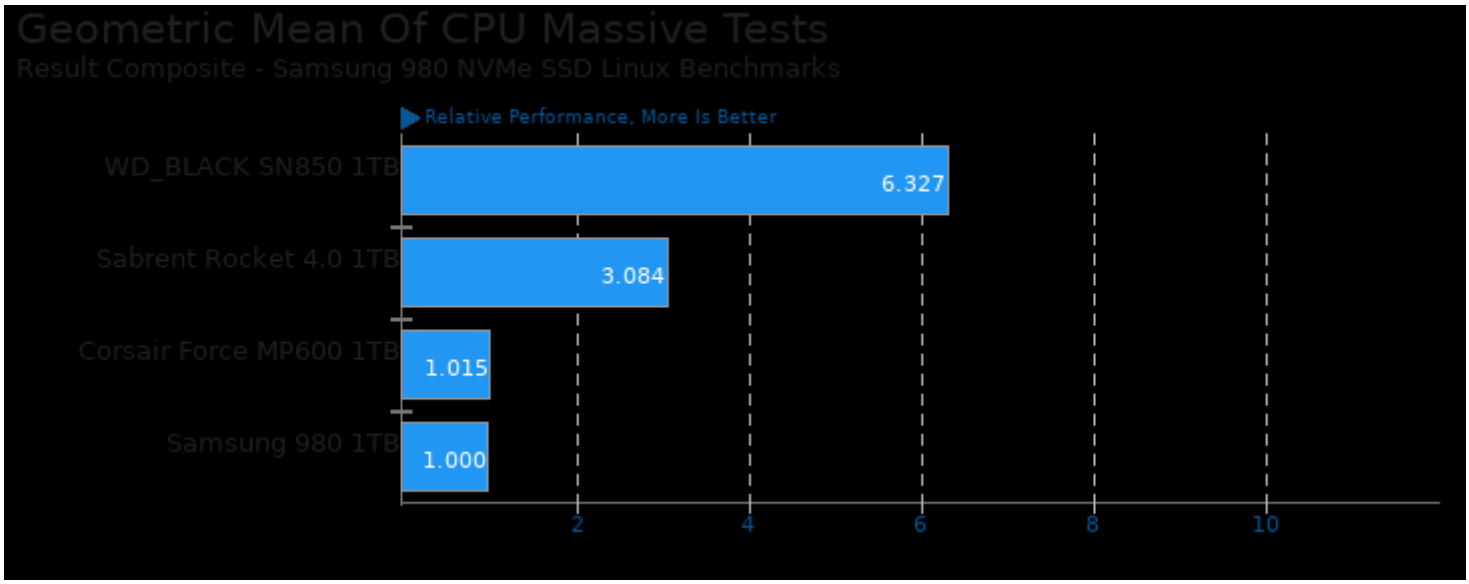

PostgreSQL pgbench 13.0
Scaling Factor: 1000 - Clients: 1 - Mode: Read Write
TPS, More Is Better
Corsair Force MP600 1TB
SE +/- 7.90, N = 15
280
WD_BLACK SN850 1TB
SE +/- 6.82, N = 3
2156
Sabrent Rocket 4.0 1TB
SE +/- 65.12, N = 15
776
Samsung 980 1TB
SE +/- 12.57, N = 12
316
500
1000
1500
2000
2500
1. (CC) gcc options: -fno-strict-aliasing -fwrapv -O2 -lpgcommon -lpgport -lpq -lpthread -lrt -ldl -lm
PostgreSQL pgbench 13.0
Scaling Factor: 1000 - Clients: 1 - Mode: Read Write - Average Latency
ms, Fewer Is Better
Corsair Force MP600 1TB
SE +/- 0.091, N = 15
3.602
WD_BLACK SN850 1TB
SE +/- 0.002, N = 3
0.464
Sabrent Rocket 4.0 1TB
SE +/- 0.064, N = 15
1.361
Samsung 980 1TB
SE +/- 0.125, N = 12
3.220
0.8105
1.621
2.4315
3.242
4.0525
1. (CC) gcc options: -fno-strict-aliasing -fwrapv -O2 -lpgcommon -lpgport -lpq -lpthread -lrt -ldl -lm


PostgreSQL pgbench 13.0
Scaling Factor: 1000 - Clients: 50 - Mode: Read Write
TPS, More Is Better
Corsair Force MP600 1TB
SE +/- 104.68, N = 15
3089
WD_BLACK SN850 1TB
SE +/- 545.96, N = 12
17144
Sabrent Rocket 4.0 1TB
SE +/- 262.91, N = 15
10828
Samsung 980 1TB
SE +/- 151.90, N = 6
4717
4K
8K
12K
16K
20K
1. (CC) gcc options: -fno-strict-aliasing -fwrapv -O2 -lpgcommon -lpgport -lpq -lpthread -lrt -ldl -lm
PostgreSQL pgbench 13.0
Scaling Factor: 1000 - Clients: 50 - Mode: Read Write - Average Latency
ms, Fewer Is Better
Corsair Force MP600 1TB
SE +/- 0.535, N = 15
16.439
WD_BLACK SN850 1TB
SE +/- 0.090, N = 12
2.948
Sabrent Rocket 4.0 1TB
SE +/- 0.117, N = 15
4.658
Samsung 980 1TB
SE +/- 0.331, N = 6
10.654
4
8
12
16
20
1. (CC) gcc options: -fno-strict-aliasing -fwrapv -O2 -lpgcommon -lpgport -lpq -lpthread -lrt -ldl -lm

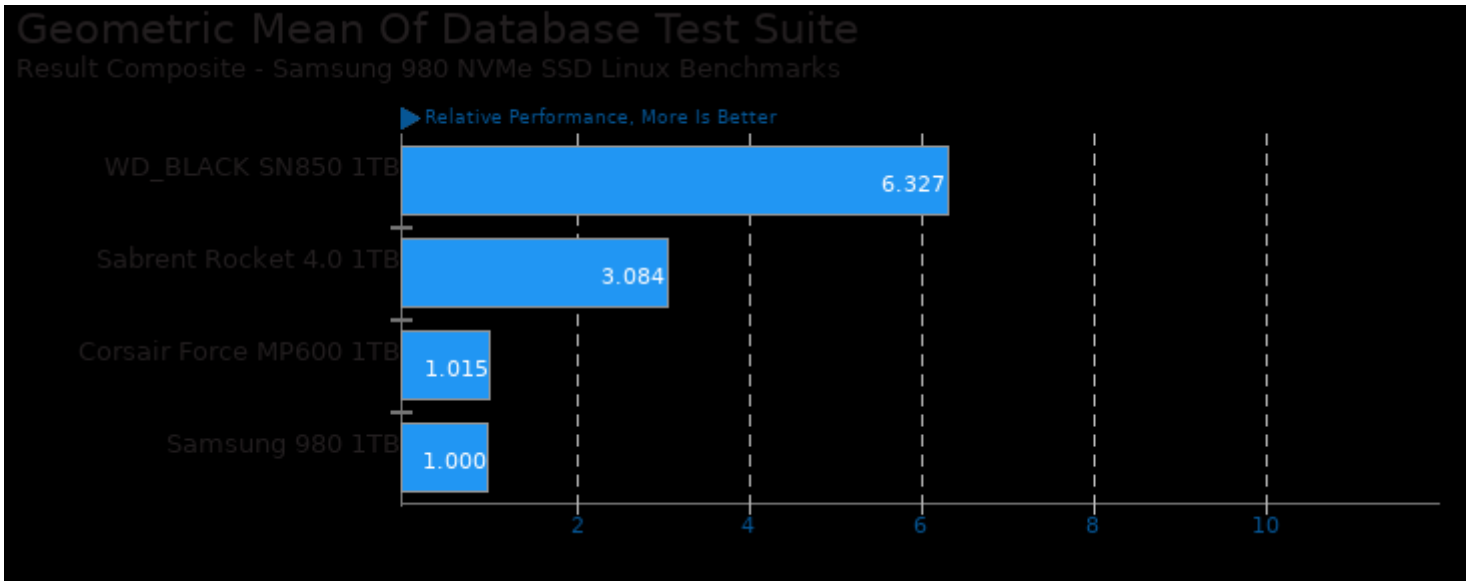
Samsung 980 NVMe SSD Linux Benchmarks



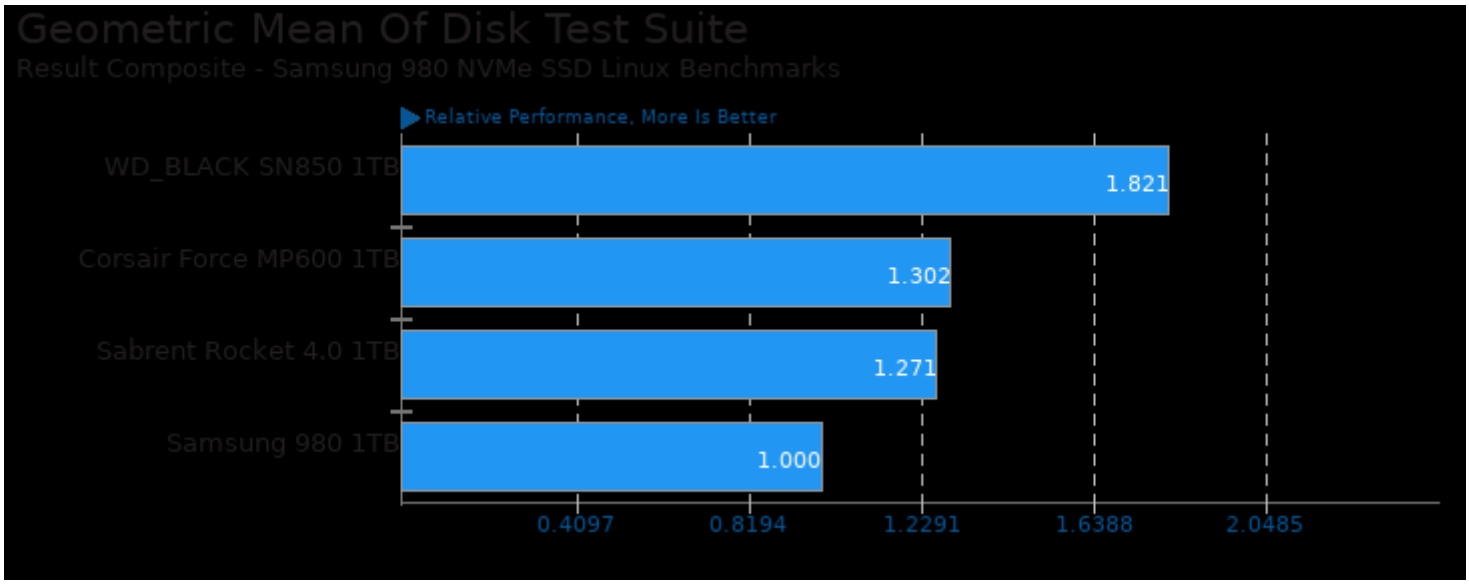
These geometric means are based upon test groupings / test suites for this result file.



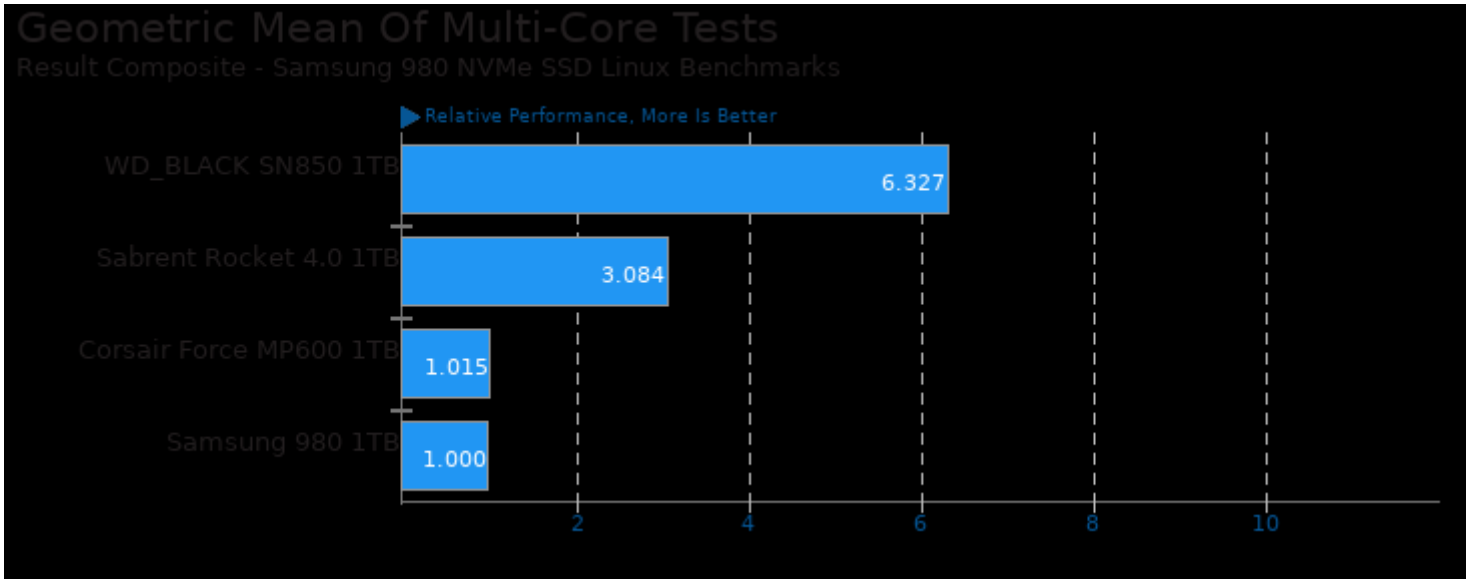
Geometric mean based upon tests: pts/mysqlslap and pts/pgbench



Geometric mean based upon tests: pts/pgbench and pts/mysqlslap

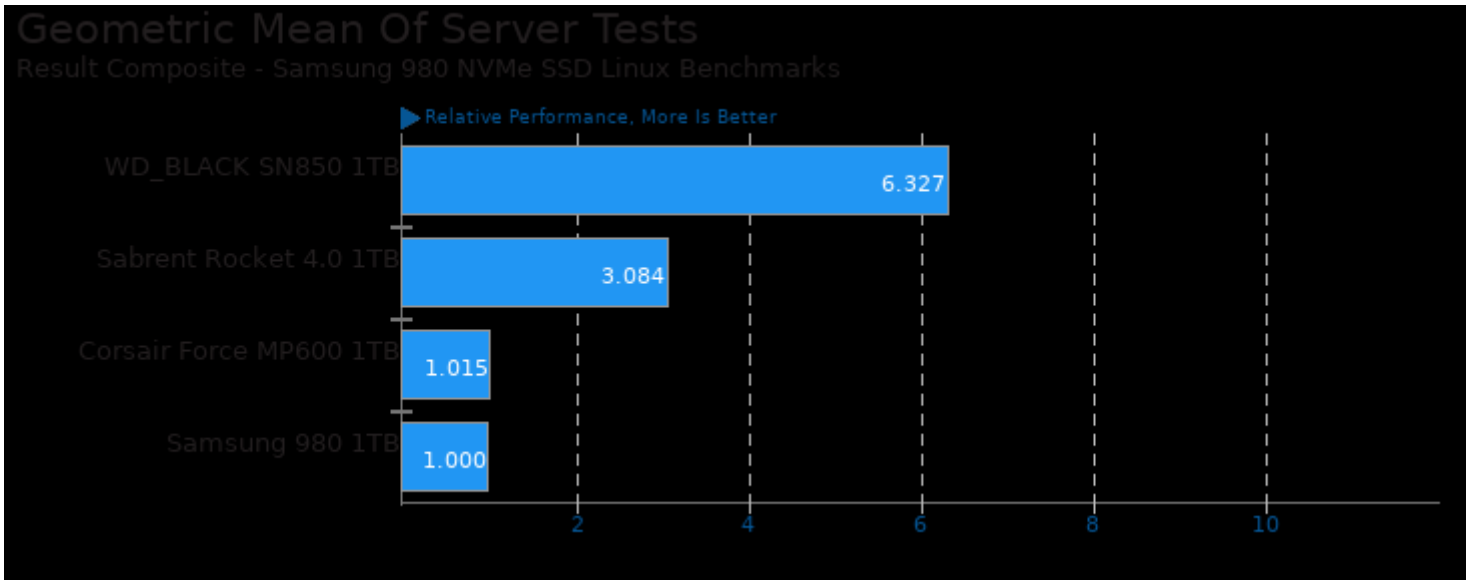


Geometric mean based upon tests: pts/fs-mark, pts/dbench and pts/fio



Geometric mean based upon tests: pts/mysqlslap and pts/pgbench

Samsung 980 NVMe SSD Linux Benchmarks



Geometric mean based upon tests: pts/mysqlslap and pts/pgbench

This file was automatically generated via the Phoronix Test Suite benchmarking software on Thursday, 28 March 2024 17:56.