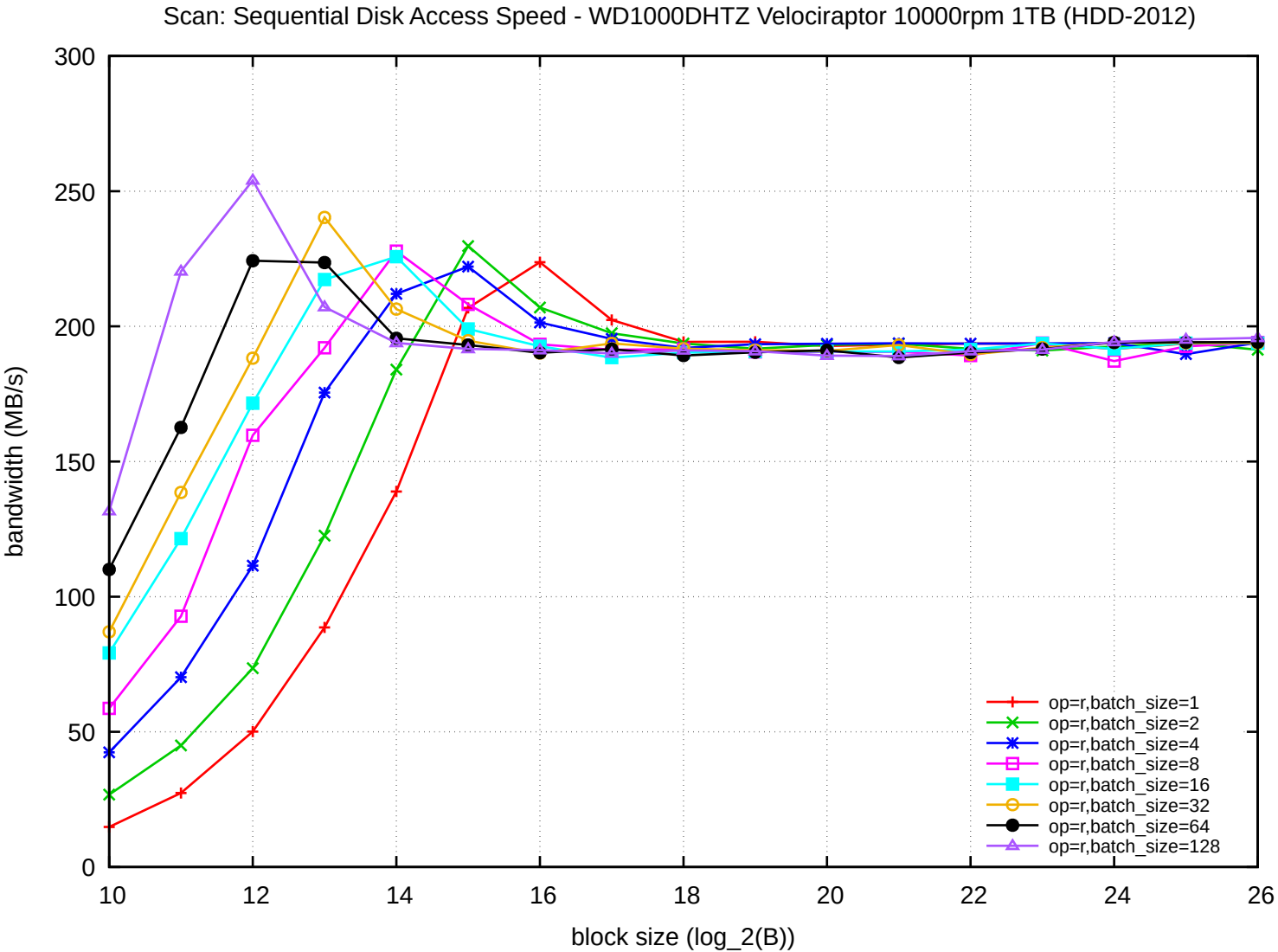
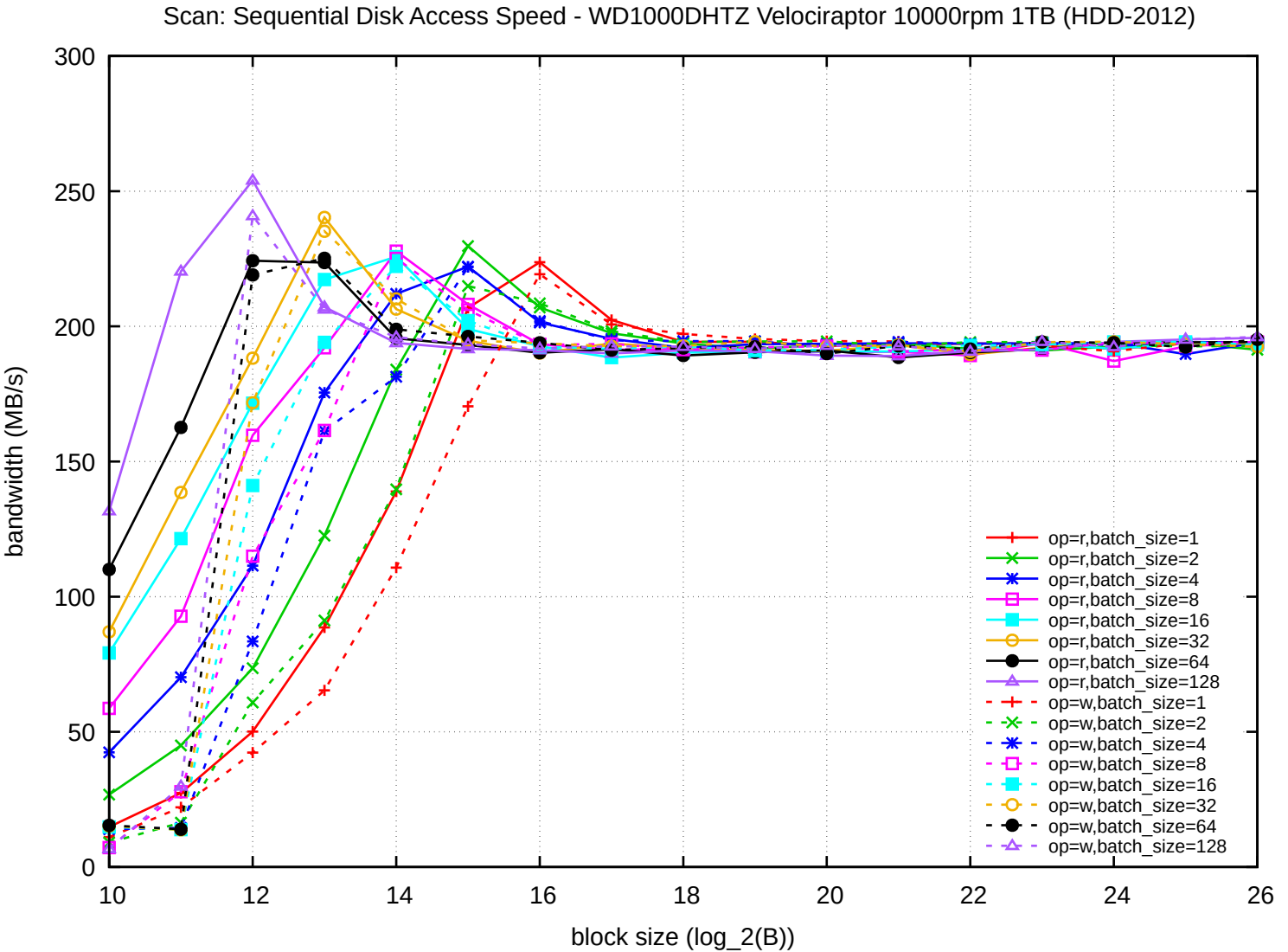
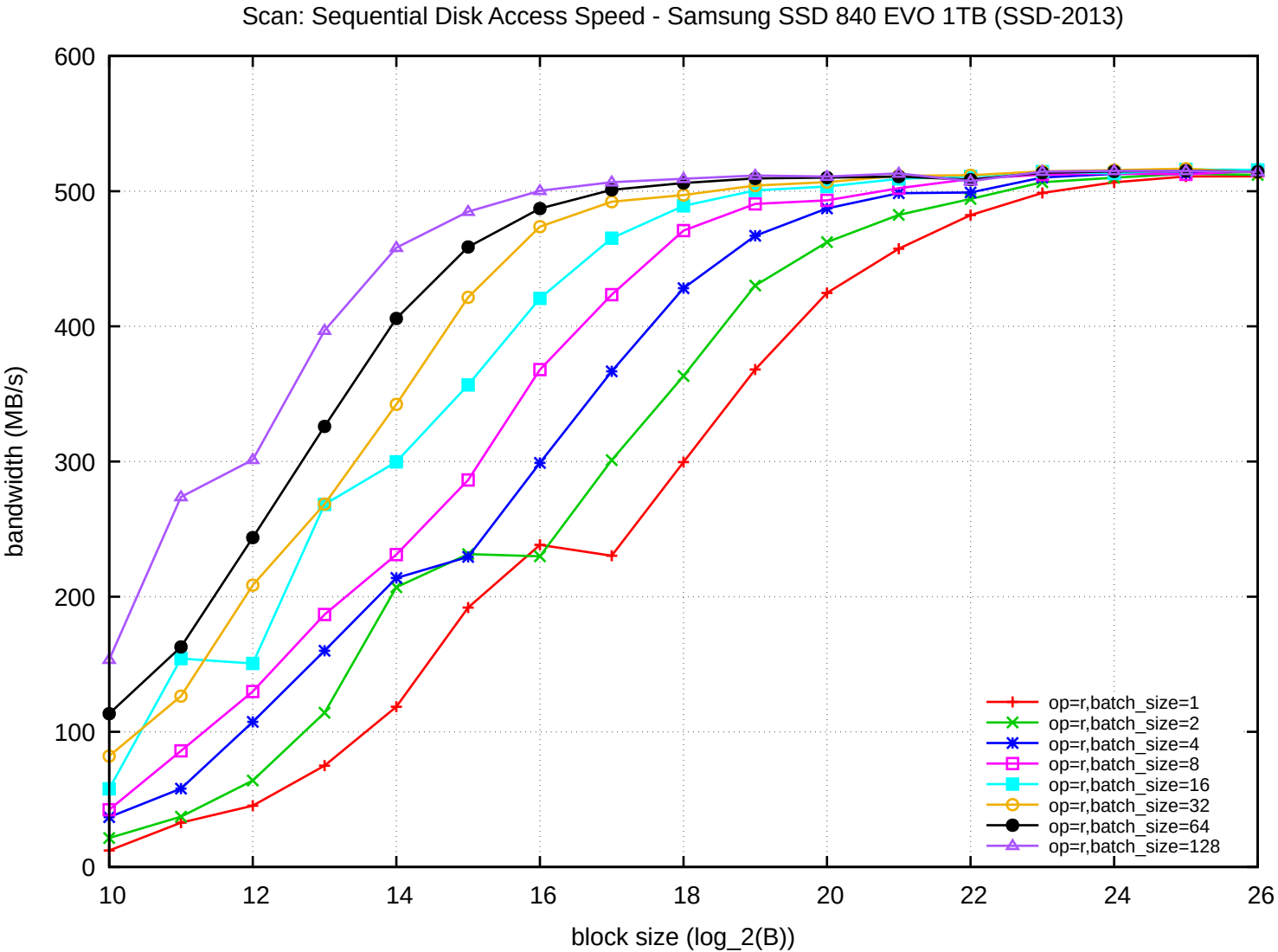
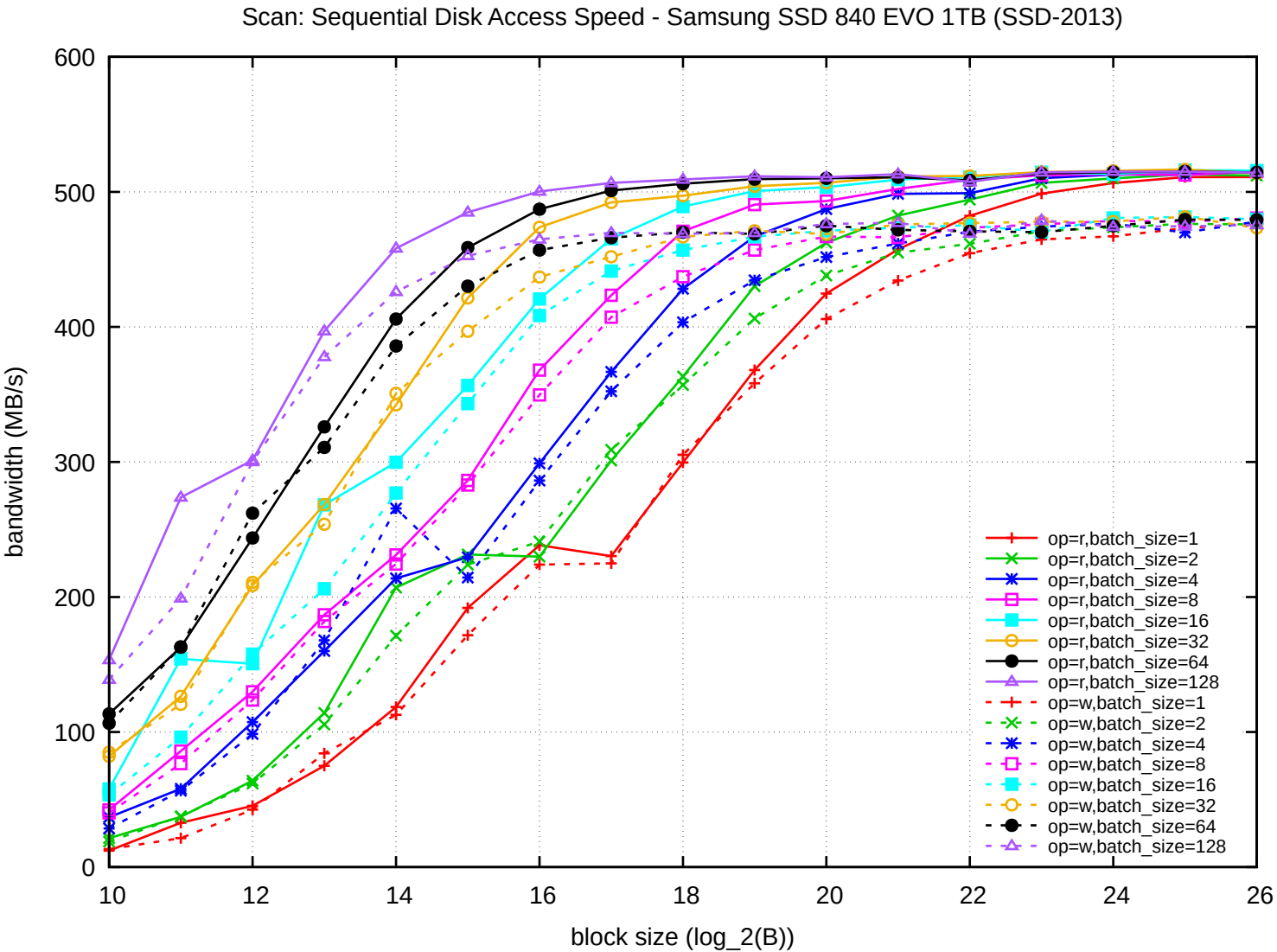
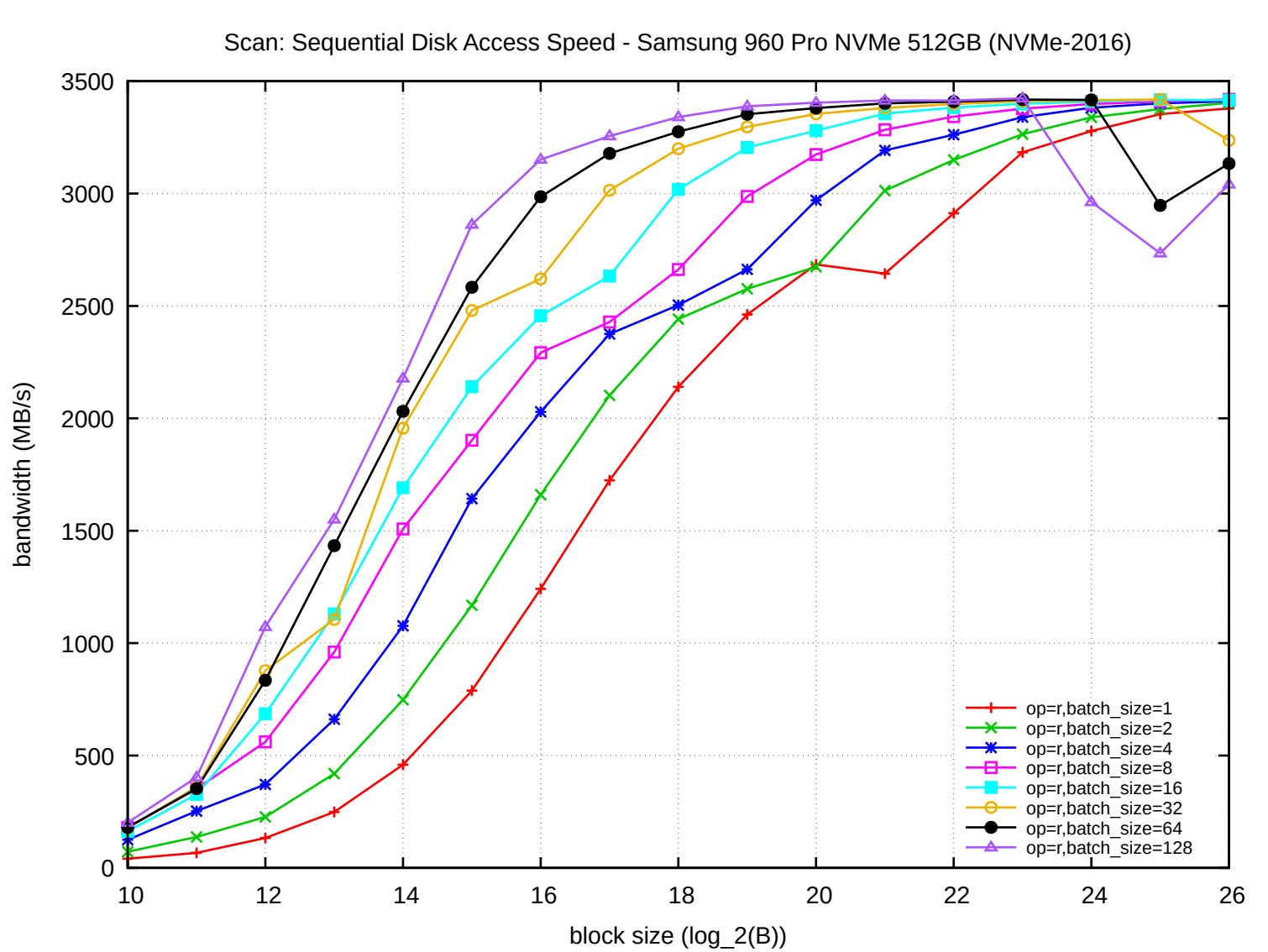
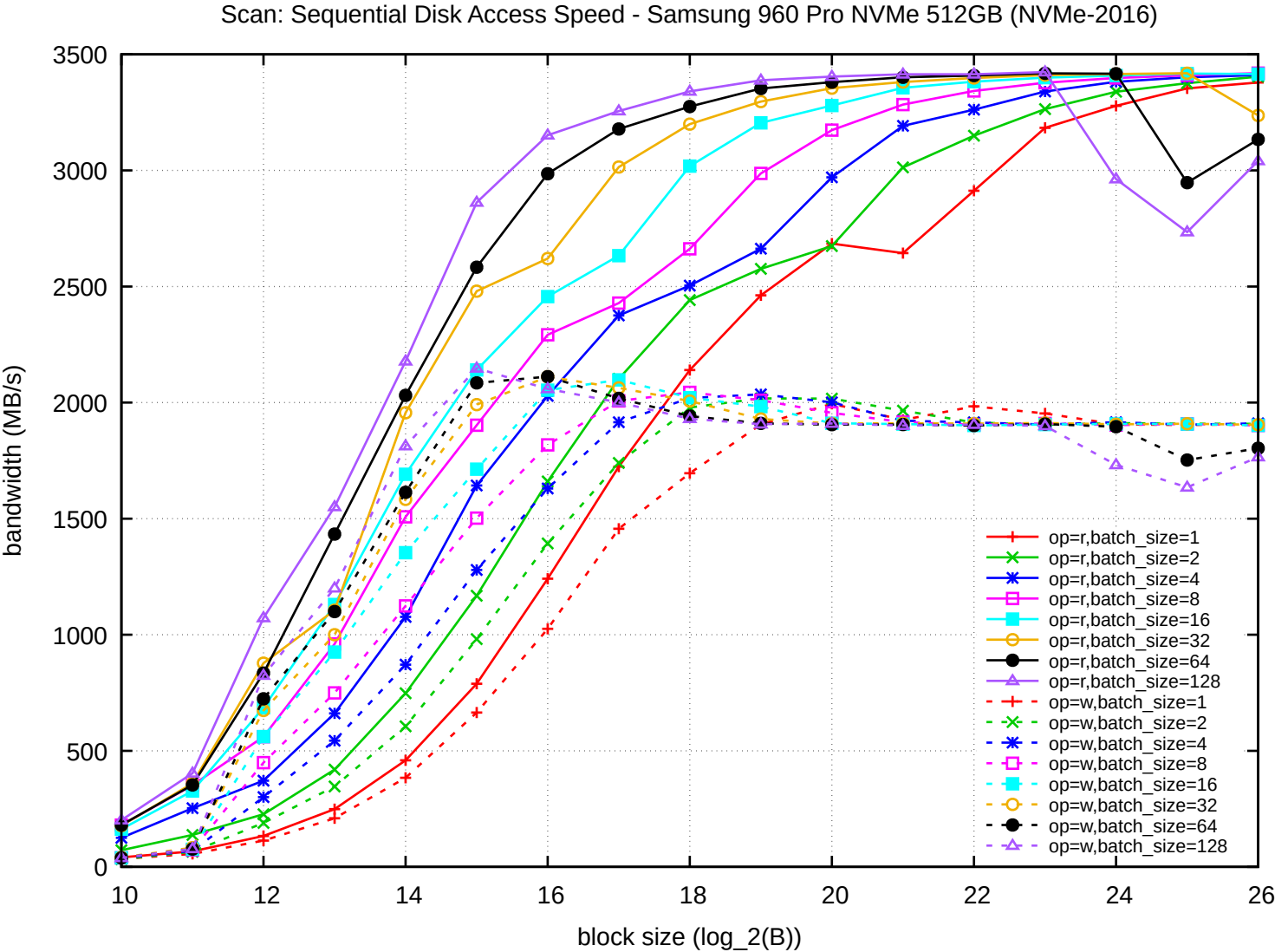

Scan: Sequential Disk Access Speed - WD1000DHTZ Velociraptor 10000rpm 1TB (HDD-2012)
bandwidth (MB/s)
block size (log_2(B))
0
50
100
150
200
250
300
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128

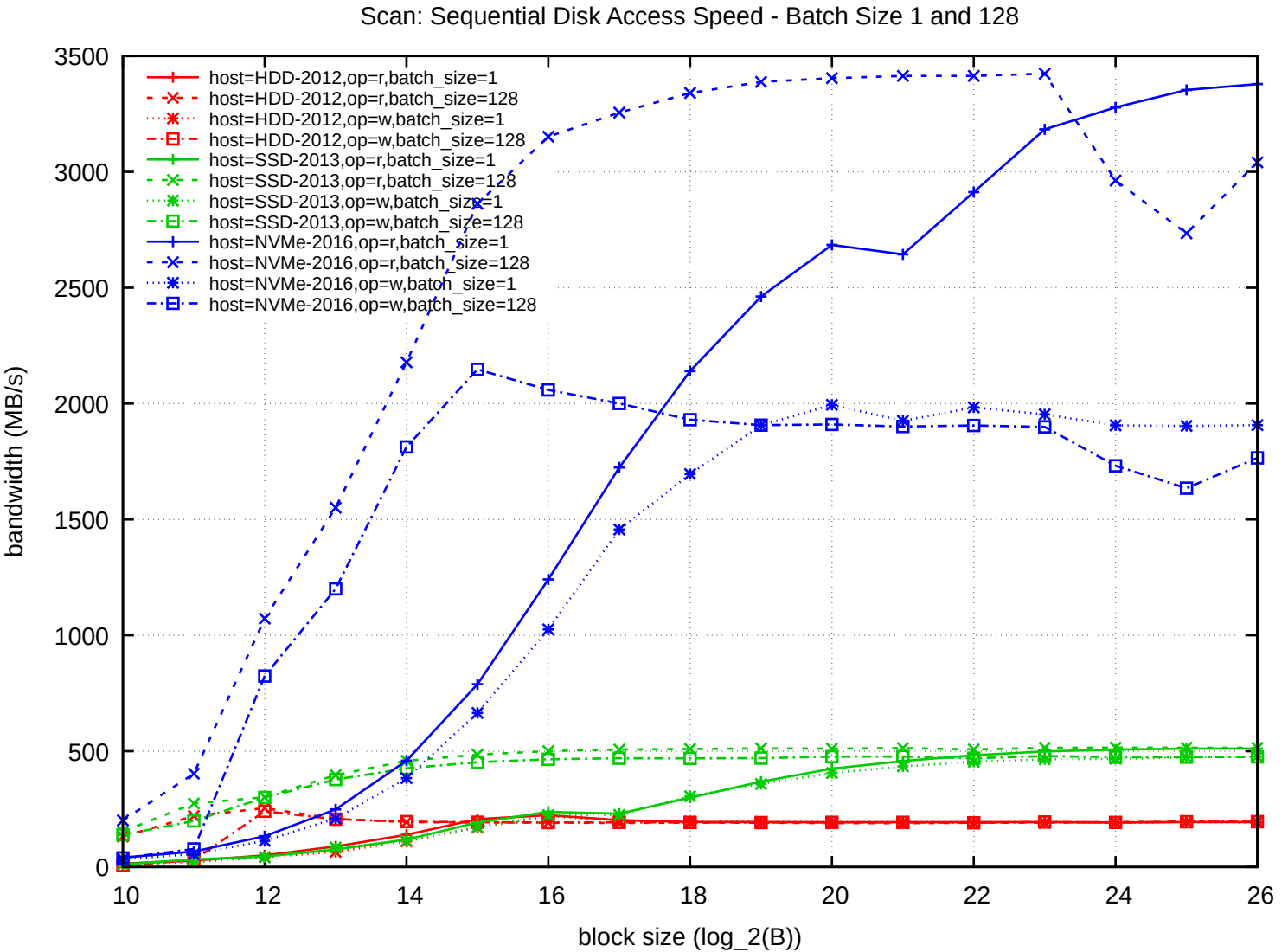

Scan: Sequential Disk Access Speed - WD1000DHTZ Velociraptor 10000rpm 1TB (HDD-2012)
bandwidth (MB/s)
block size (log_2(B))
0
50
100
150
200
250
300
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128

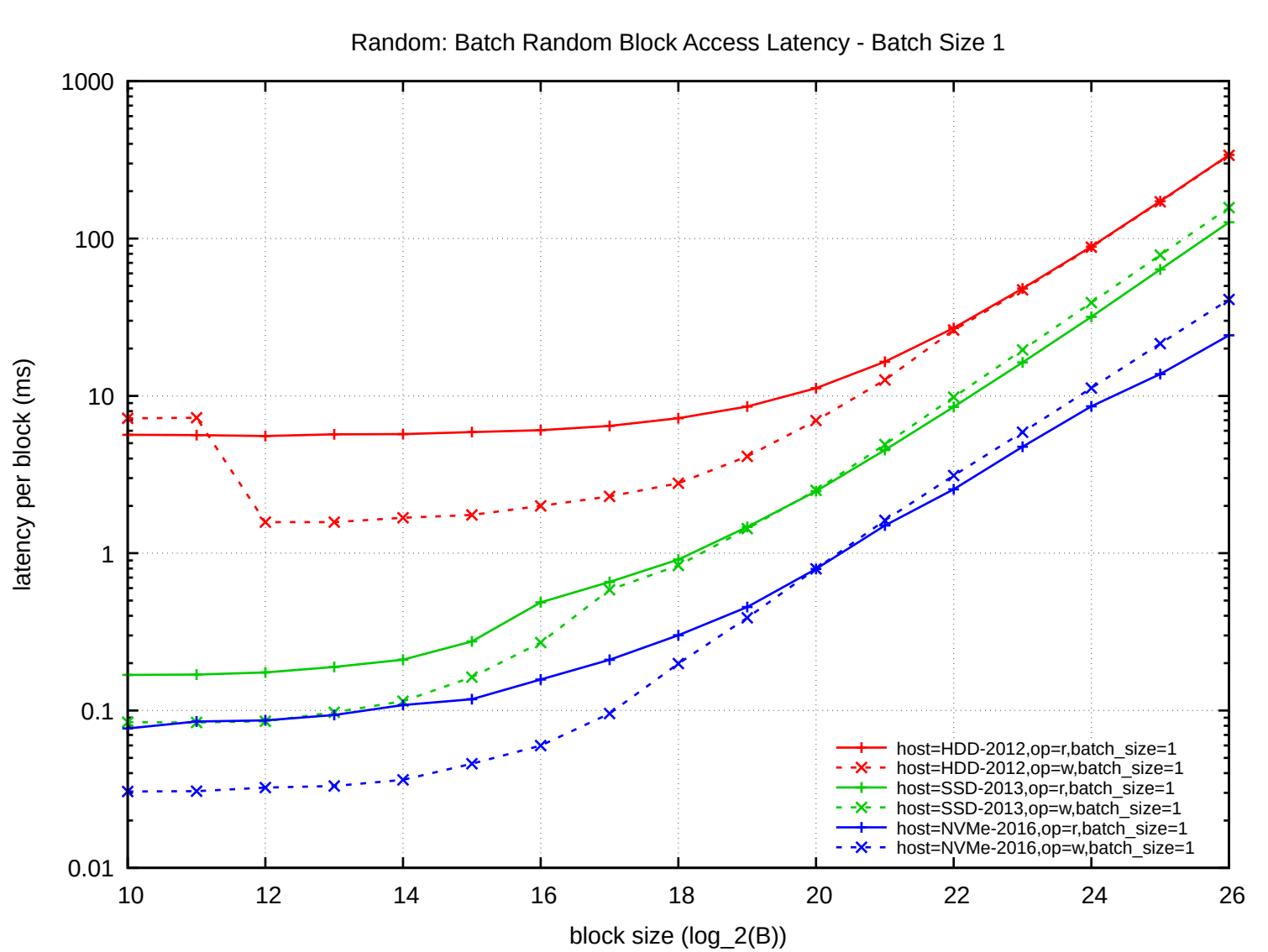

Scan: Sequential Disk Access Speed - Samsung SSD 840 EVO 1TB (SSD-2013)
bandwidth (MB/s)
block size (log_2(B))
0
100
200
300
400
500
600
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128

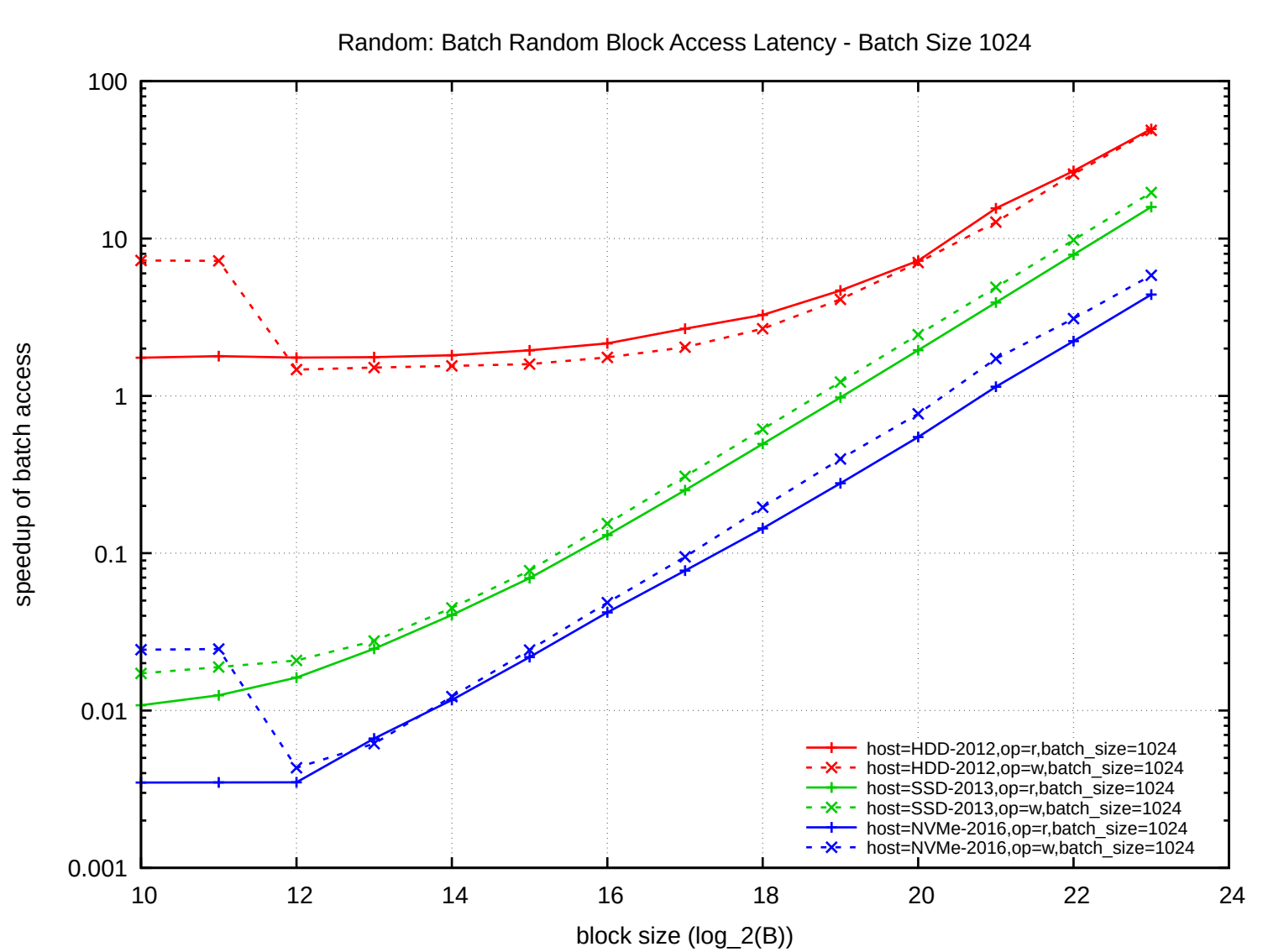

Scan: Sequential Disk Access Speed - Samsung SSD 840 EVO 1TB (SSD-2013)
bandwidth (MB/s)
block size (log_2(B))
0
100
200
300
400
500
600
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128

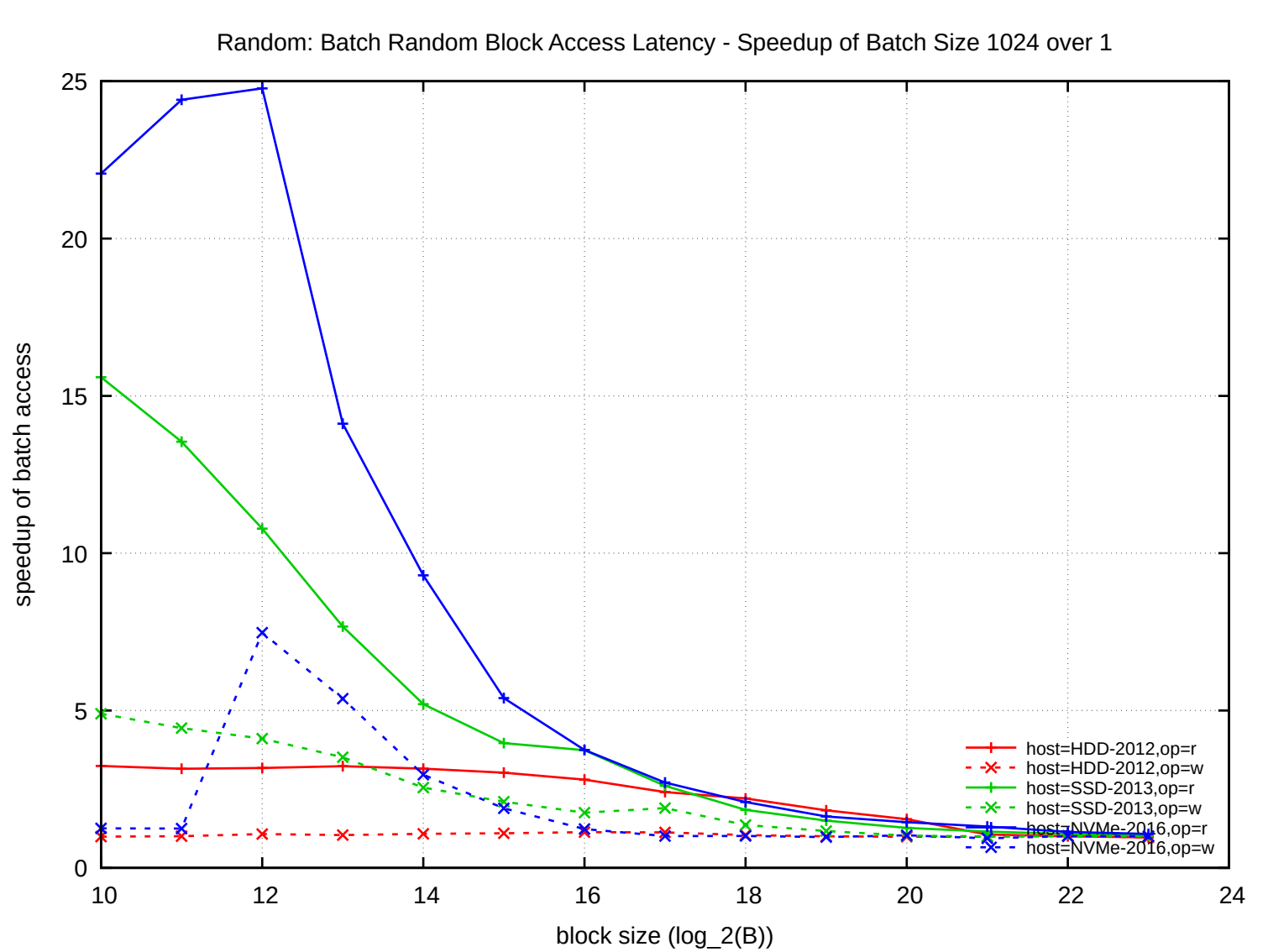

Scan: Sequential Disk Access Speed - Samsung 960 Pro NVMe 512GB (NVMe-2016)
bandwidth (MB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
3500
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128

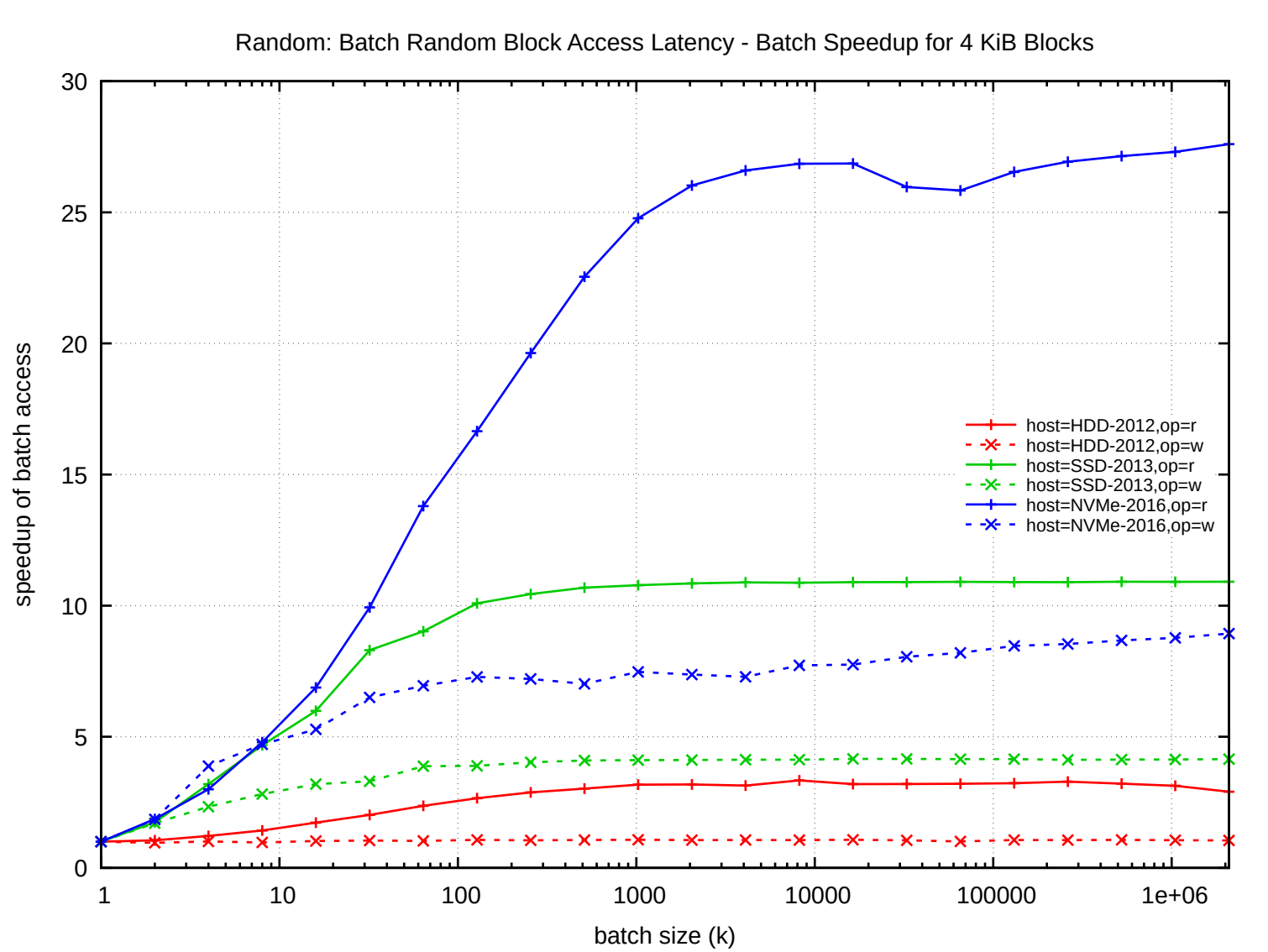

Scan: Sequential Disk Access Speed - Samsung 960 Pro NVMe 512GB (NVMe-2016)
bandwidth (MB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
3500
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128

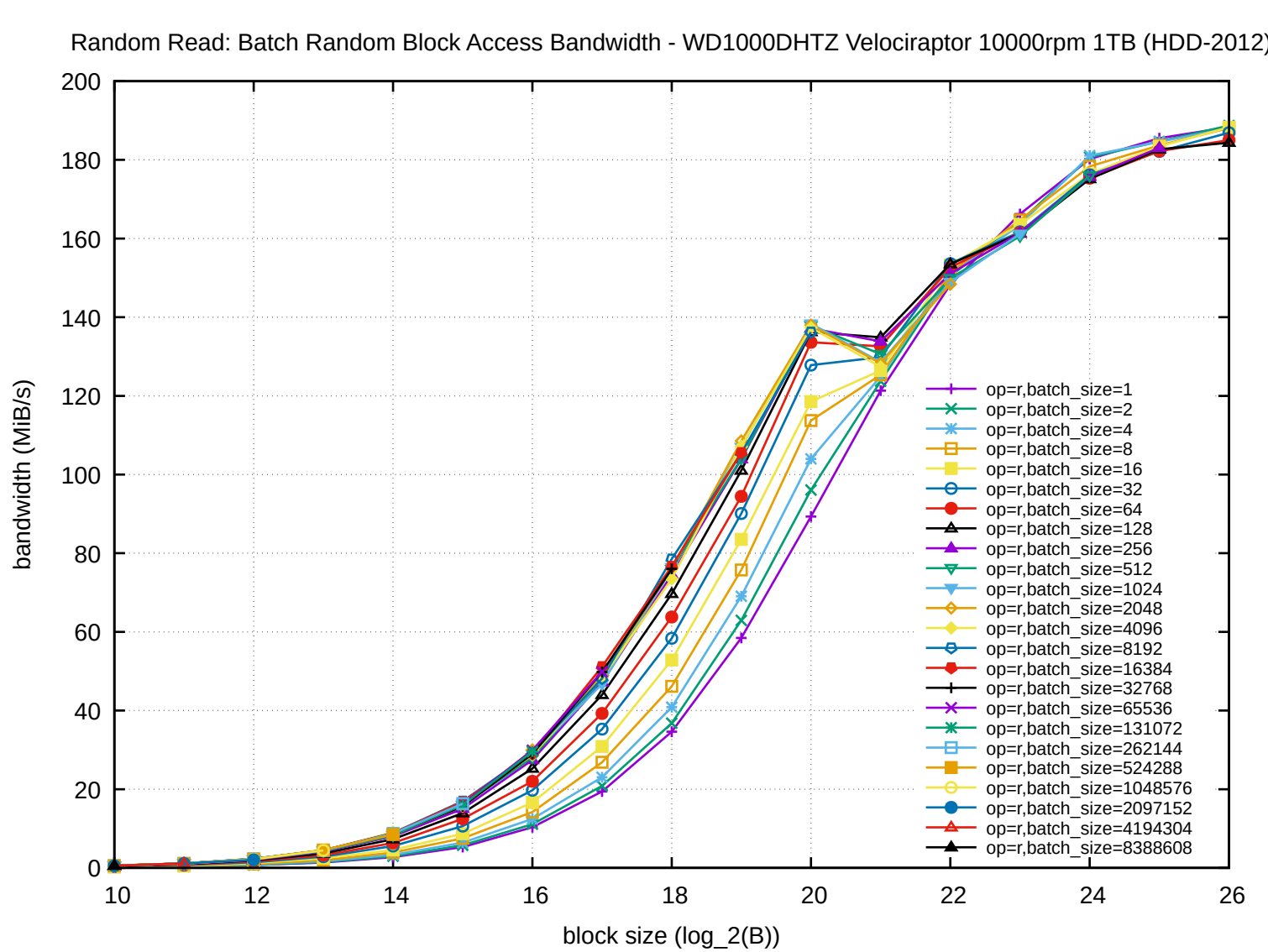

Scan: Sequential Disk Access Speed - Batch Size 1 and 128
host=HDD-2012,op=r,batch_size=1
host=HDD-2012,op=r,batch_size=128
host=HDD-2012,op=w,batch_size=1
host=HDD-2012,op=w,batch_size=128
host=SSD-2013,op=r,batch_size=1
host=SSD-2013,op=r,batch_size=128
host=SSD-2013,op=w,batch_size=1
host=SSD-2013,op=w,batch_size=128
host=NVMe-2016,op=r,batch_size=1
host=NVMe-2016,op=r,batch_size=128
host=NVMe-2016,op=w,batch_size=1
host=NVMe-2016,op=w,batch_size=128
bandwidth (MB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
3500
10
12
14
16
18
20
22
24
26

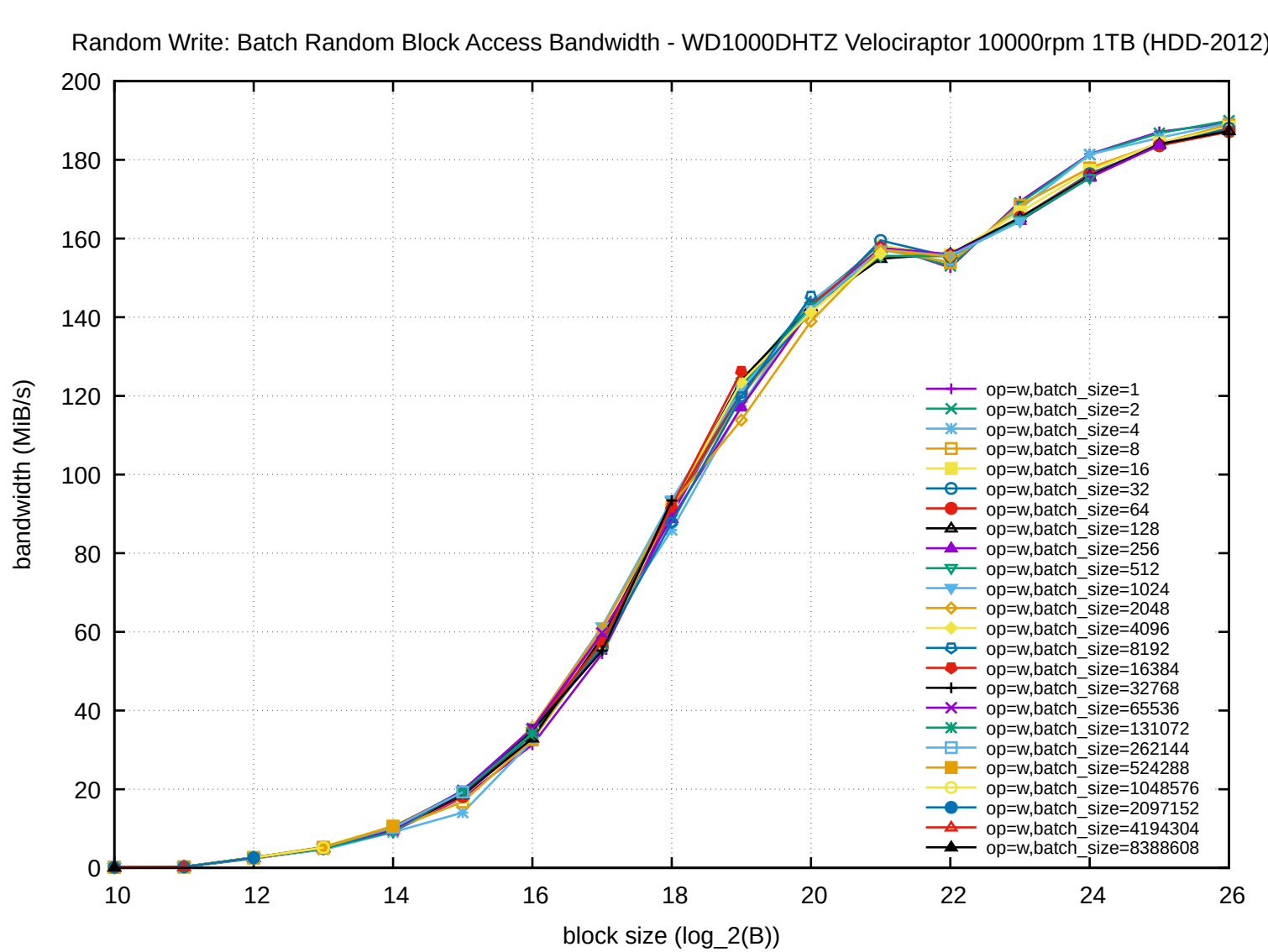

Random: Batch Random Block Access Latency - Batch Size 1
latency per block (ms)
block size (log_2(B))
1000
100
10
1
0.1
0.01
10
12
14
16
18
20
22
24
26
host=HDD-2012,op=r,batch_size=1
host=HDD-2012,op=w,batch_size=1
host=SSD-2013,op=r,batch_size=1
host=SSD-2013,op=w,batch_size=1
host=NVMe-2016,op=r,batch_size=1
host=NVMe-2016,op=w,batch_size=1

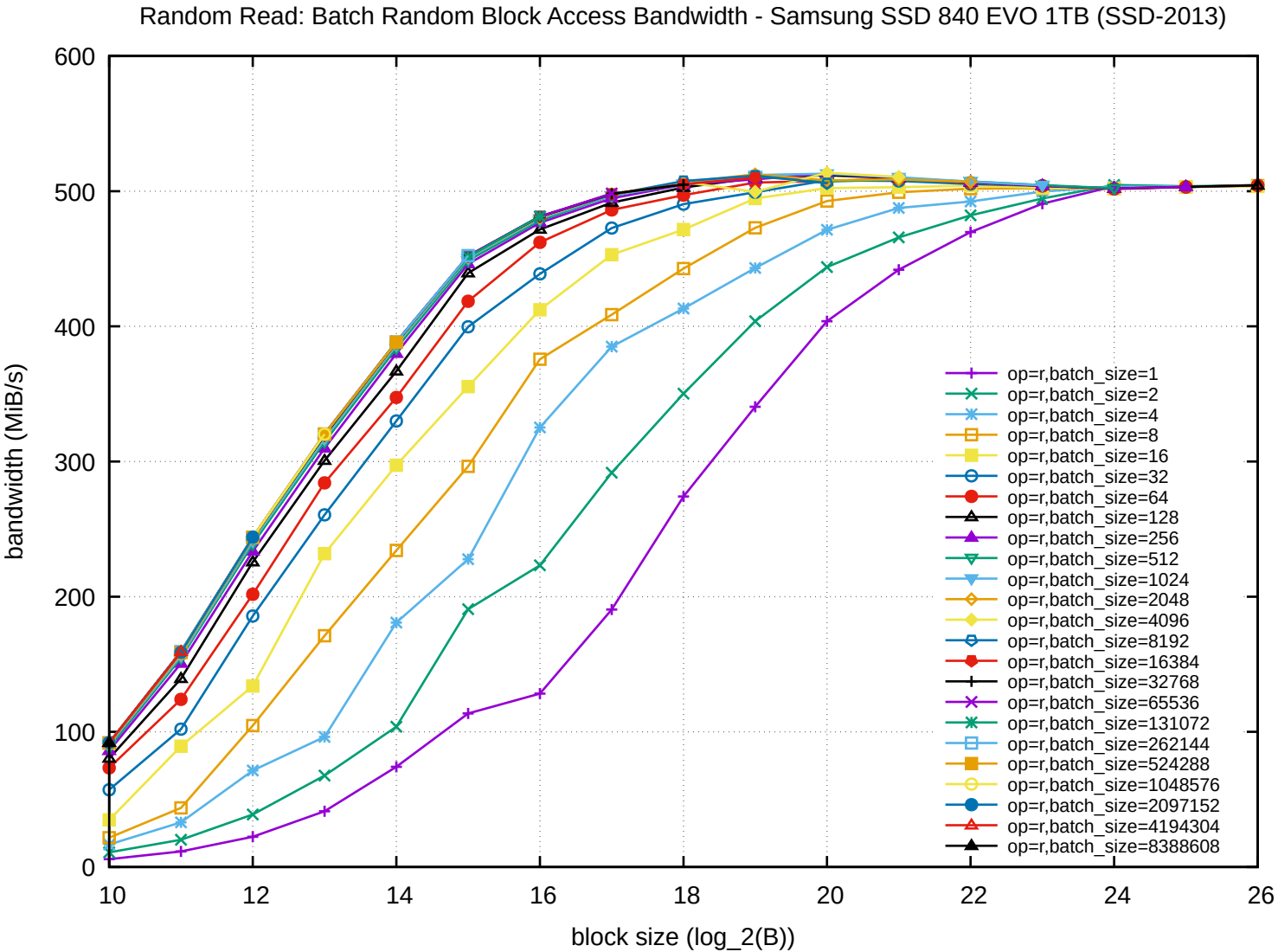

Random: Batch Random Block Access Latency - Batch Size 1024
speedup of batch access
block size (log_2(B))
100
10
1
0.1
0.01
0.001
10
12
14
16
18
20
22
24
host=HDD-2012,op=r,batch_size=1024
host=HDD-2012,op=w,batch_size=1024
host=SSD-2013,op=r,batch_size=1024
host=SSD-2013,op=w,batch_size=1024
host=NVMe-2016,op=r,batch_size=1024
host=NVMe-2016,op=w,batch_size=1024

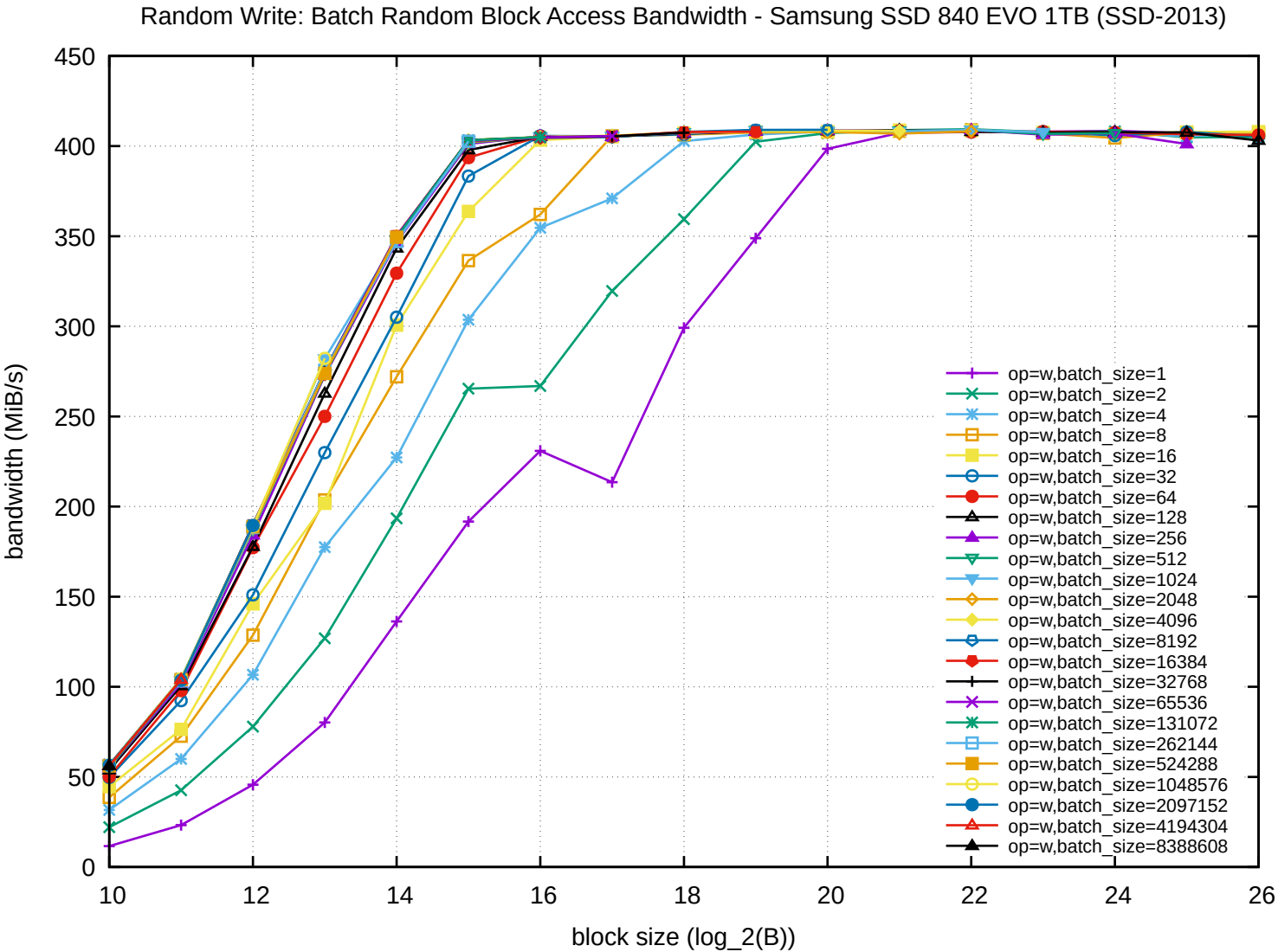

Random: Batch Random Block Access Latency - Speedup of Batch Size 1024 over 1
speedup of batch access
block size (log_2(B))
0
5
10
15
20
25
10
12
14
16
18
20
22
24
host=HDD-2012,op=r
host=HDD-2012,op=w
host=SSD-2013,op=r
host=SSD-2013,op=w
host=NVMe-2016,op=r
host=NVMe-2016,op=w

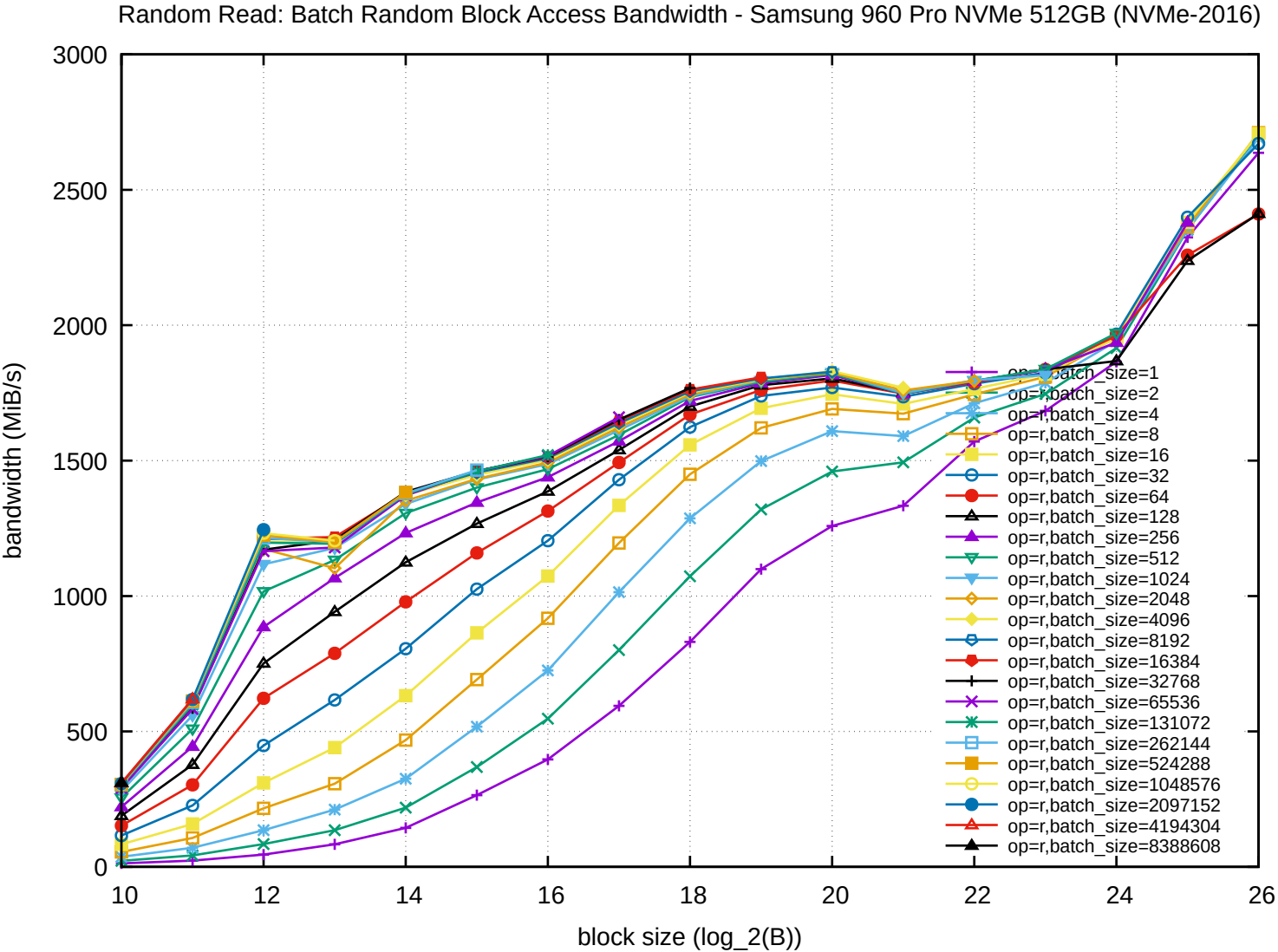

Random: Batch Random Block Access Latency - Batch Speedup for 4 KiB Blocks
speedup of batch access
batch size (k)
0
5
10
15
20
25
30
1
10
100
1000
10000
100000
1e+06
host=HDD-2012,op=r
host=HDD-2012,op=w
host=SSD-2013,op=r
host=SSD-2013,op=w
host=NVMe-2016,op=r
host=NVMe-2016,op=w

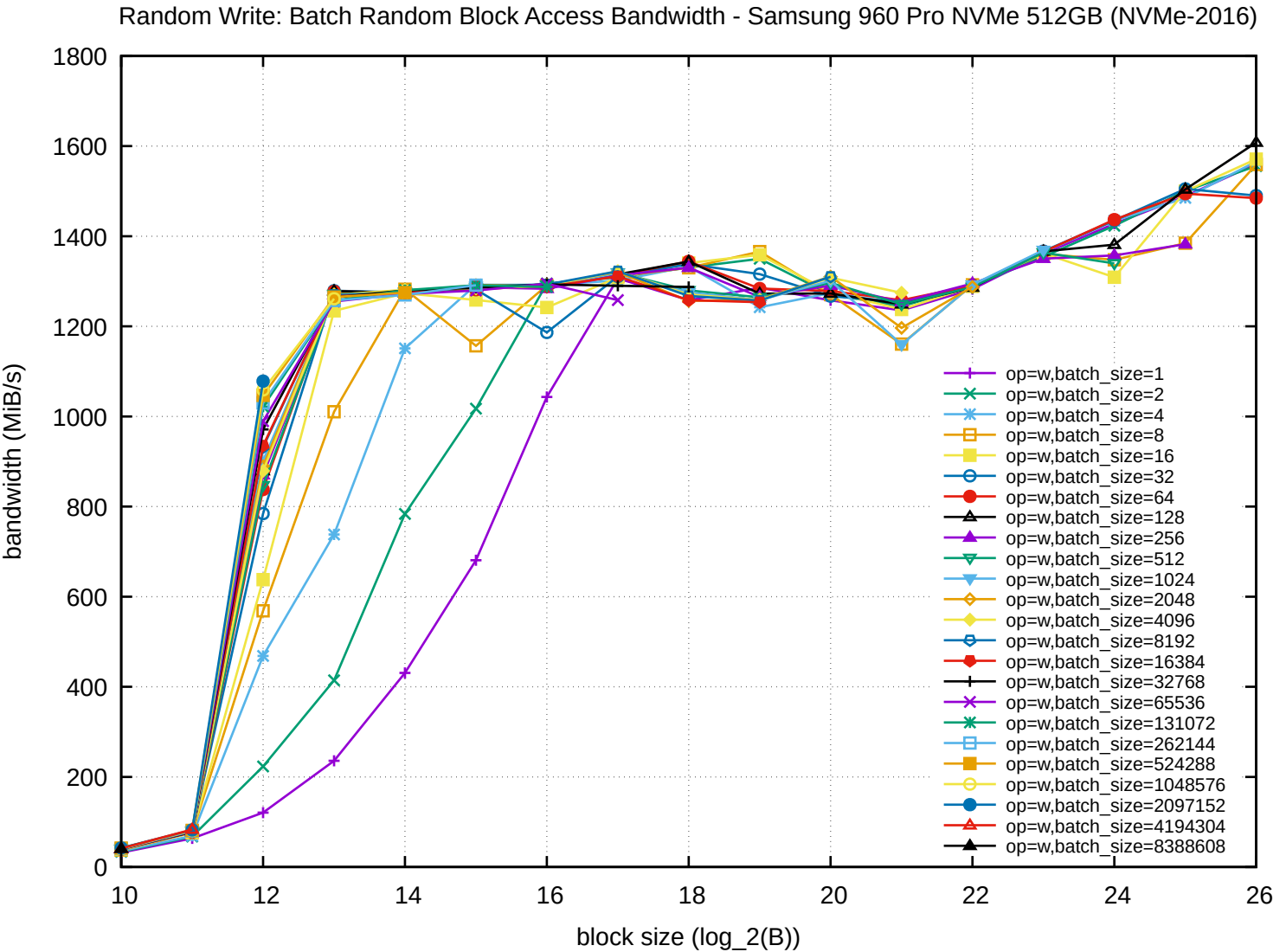

Random Read: Batch Random Block Access Bandwidth - WD1000DHTZ Velociraptor 10000rpm 1TB (HDD-2012)
bandwidth (MiB/s)
block size (log_2(B))
0
20
40
60
80
100
120
140
160
180
200
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=r,batch_size=256
op=r,batch_size=512
op=r,batch_size=1024
op=r,batch_size=2048
op=r,batch_size=4096
op=r,batch_size=8192
op=r,batch_size=16384
op=r,batch_size=32768
op=r,batch_size=65536
op=r,batch_size=131072
op=r,batch_size=262144
op=r,batch_size=524288
op=r,batch_size=1048576
op=r,batch_size=2097152
op=r,batch_size=4194304
op=r,batch_size=8388608

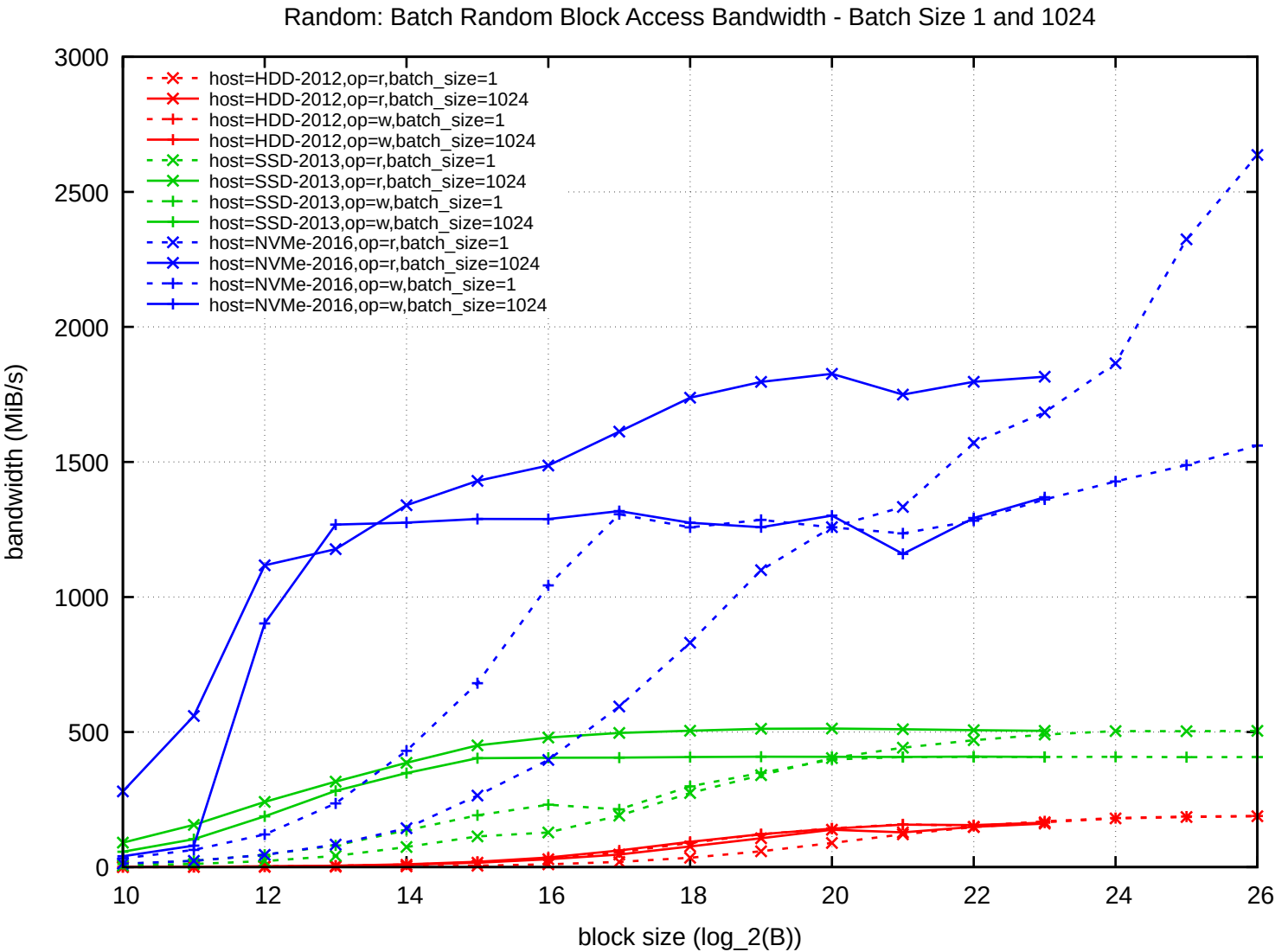

Random Write: Batch Random Block Access Bandwidth - WD1000DHTZ Velociraptor 10000rpm 1TB (HDD-2012)
bandwidth (MiB/s)
block size (log_2(B))
0
20
40
60
80
100
120
140
160
180
200
10
12
14
16
18
20
22
24
26
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128
op=w,batch_size=256
op=w,batch_size=512
op=w,batch_size=1024
op=w,batch_size=2048
op=w,batch_size=4096
op=w,batch_size=8192
op=w,batch_size=16384
op=w,batch_size=32768
op=w,batch_size=65536
op=w,batch_size=131072
op=w,batch_size=262144
op=w,batch_size=524288
op=w,batch_size=1048576
op=w,batch_size=2097152
op=w,batch_size=4194304
op=w,batch_size=8388608

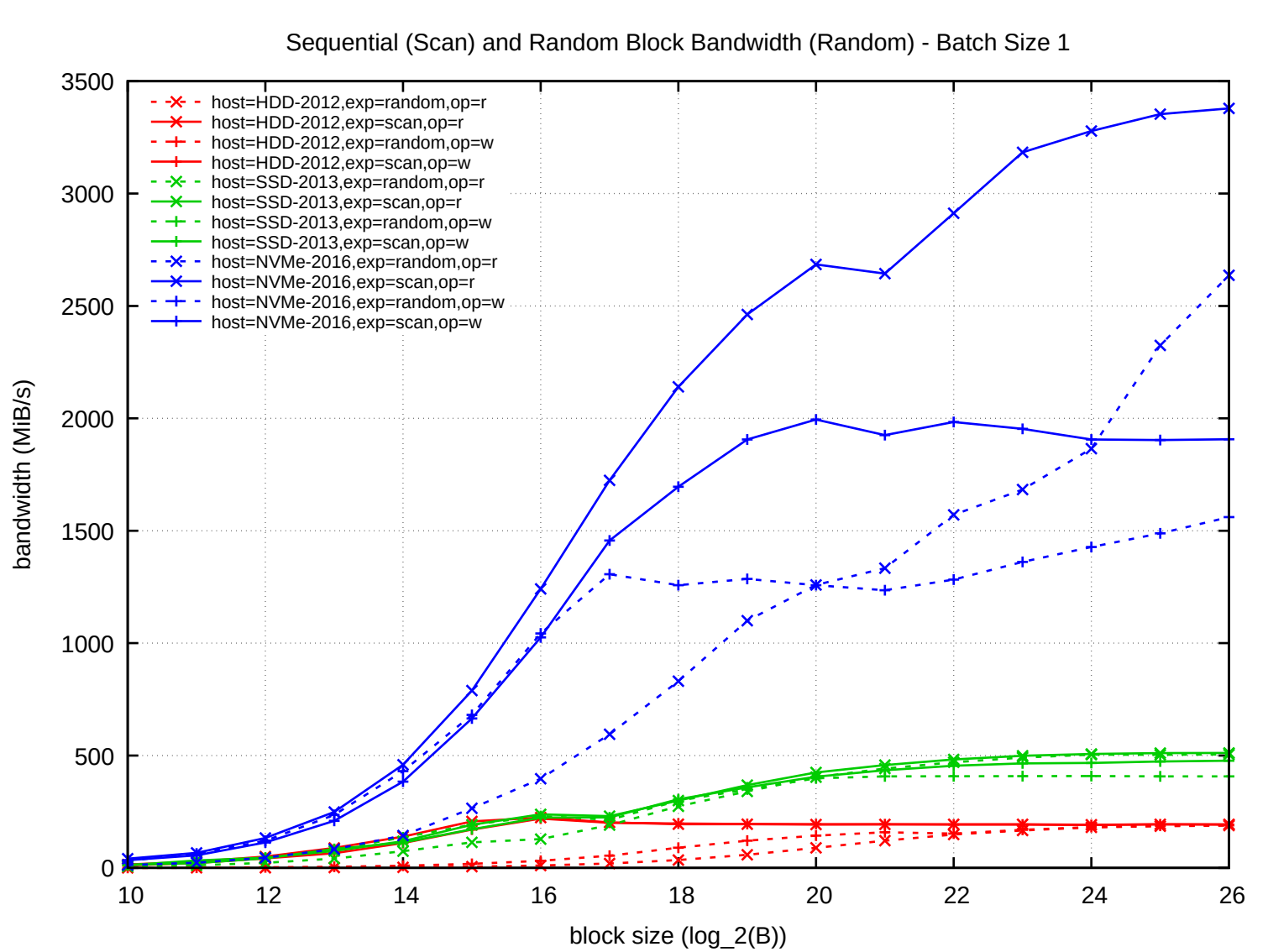

Random Read: Batch Random Block Access Bandwidth - Samsung SSD 840 EVO 1TB (SSD-2013)
bandwidth (MiB/s)
block size (log_2(B))
0
100
200
300
400
500
600
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=r,batch_size=256
op=r,batch_size=512
op=r,batch_size=1024
op=r,batch_size=2048
op=r,batch_size=4096
op=r,batch_size=8192
op=r,batch_size=16384
op=r,batch_size=32768
op=r,batch_size=65536
op=r,batch_size=131072
op=r,batch_size=262144
op=r,batch_size=524288
op=r,batch_size=1048576
op=r,batch_size=2097152
op=r,batch_size=4194304
op=r,batch_size=8388608

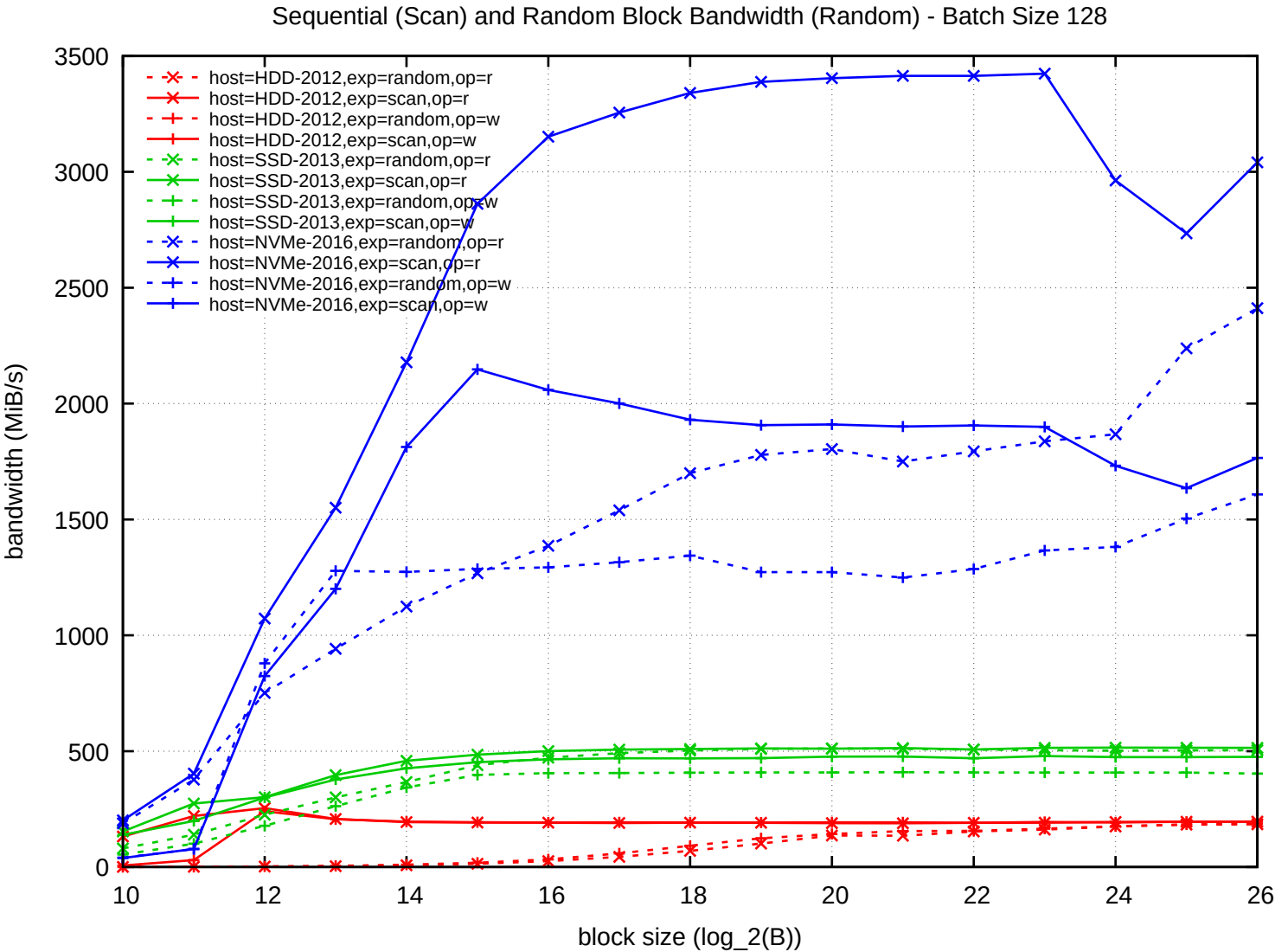

Random Write: Batch Random Block Access Bandwidth - Samsung SSD 840 EVO 1TB (SSD-2013)
bandwidth (MiB/s)
block size (log_2(B))
0
50
100
150
200
250
300
350
400
450
10
12
14
16
18
20
22
24
26
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128
op=w,batch_size=256
op=w,batch_size=512
op=w,batch_size=1024
op=w,batch_size=2048
op=w,batch_size=4096
op=w,batch_size=8192
op=w,batch_size=16384
op=w,batch_size=32768
op=w,batch_size=65536
op=w,batch_size=131072
op=w,batch_size=262144
op=w,batch_size=524288
op=w,batch_size=1048576
op=w,batch_size=2097152
op=w,batch_size=4194304
op=w,batch_size=8388608


Random Read: Batch Random Block Access Bandwidth - Samsung 960 Pro NVMe 512GB (NVMe-2016)
bandwidth (MiB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
10
12
14
16
18
20
22
24
26
op=r,batch_size=1
op=r,batch_size=2
op=r,batch_size=4
op=r,batch_size=8
op=r,batch_size=16
op=r,batch_size=32
op=r,batch_size=64
op=r,batch_size=128
op=r,batch_size=256
op=r,batch_size=512
op=r,batch_size=1024
op=r,batch_size=2048
op=r,batch_size=4096
op=r,batch_size=8192
op=r,batch_size=16384
op=r,batch_size=32768
op=r,batch_size=65536
op=r,batch_size=131072
op=r,batch_size=262144
op=r,batch_size=524288
op=r,batch_size=1048576
op=r,batch_size=2097152
op=r,batch_size=4194304
op=r,batch_size=8388608


Random Write: Batch Random Block Access Bandwidth - Samsung 960 Pro NVMe 512GB (NVMe-2016)
bandwidth (MiB/s)
block size (log_2(B))
0
200
400
600
800
1000
1200
1400
1600
1800
10
12
14
16
18
20
22
24
26
op=w,batch_size=1
op=w,batch_size=2
op=w,batch_size=4
op=w,batch_size=8
op=w,batch_size=16
op=w,batch_size=32
op=w,batch_size=64
op=w,batch_size=128
op=w,batch_size=256
op=w,batch_size=512
op=w,batch_size=1024
op=w,batch_size=2048
op=w,batch_size=4096
op=w,batch_size=8192
op=w,batch_size=16384
op=w,batch_size=32768
op=w,batch_size=65536
op=w,batch_size=131072
op=w,batch_size=262144
op=w,batch_size=524288
op=w,batch_size=1048576
op=w,batch_size=2097152
op=w,batch_size=4194304
op=w,batch_size=8388608


Random: Batch Random Block Access Bandwidth - Batch Size 1 and 1024
host=HDD-2012,op=r,batch_size=1
host=HDD-2012,op=r,batch_size=1024
host=HDD-2012,op=w,batch_size=1
host=HDD-2012,op=w,batch_size=1024
host=SSD-2013,op=r,batch_size=1
host=SSD-2013,op=r,batch_size=1024
host=SSD-2013,op=w,batch_size=1
host=SSD-2013,op=w,batch_size=1024
host=NVMe-2016,op=r,batch_size=1
host=NVMe-2016,op=r,batch_size=1024
host=NVMe-2016,op=w,batch_size=1
host=NVMe-2016,op=w,batch_size=1024
bandwidth (MiB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
10
12
14
16
18
20
22
24
26


Sequential (Scan) and Random Block Bandwidth (Random) - Batch Size 1
host=HDD-2012,exp=random,op=r
host=HDD-2012,exp=scan,op=r
host=HDD-2012,exp=random,op=w
host=HDD-2012,exp=scan,op=w
host=SSD-2013,exp=random,op=r
host=SSD-2013,exp=scan,op=r
host=SSD-2013,exp=random,op=w
host=SSD-2013,exp=scan,op=w
host=NVMe-2016,exp=random,op=r
host=NVMe-2016,exp=scan,op=r
host=NVMe-2016,exp=random,op=w
host=NVMe-2016,exp=scan,op=w
bandwidth (MiB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
3500
10
12
14
16
18
20
22
24
26


Sequential (Scan) and Random Block Bandwidth (Random) - Batch Size 128
bandwidth (MiB/s)
block size (log_2(B))
0
500
1000
1500
2000
2500
3000
3500
10
12
14
16
18
20
22
24
26
host=HDD-2012,exp=random,op=r
host=HDD-2012,exp=scan,op=r
host=HDD-2012,exp=random,op=w
host=HDD-2012,exp=scan,op=w
host=SSD-2013,exp=random,op=r
host=SSD-2013,exp=scan,op=r
host=SSD-2013,exp=random,op=w
host=SSD-2013,exp=scan,op=w
host=NVMe-2016,exp=random,op=r
host=NVMe-2016,exp=scan,op=r
host=NVMe-2016,exp=random,op=w
host=NVMe-2016,exp=scan,op=w