

Scalable File Service Turbo

Best Practices

Issue 01
Date 2025-02-26



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Contents

1 Migrating Data to SFS Turbo.....	1
1.1 Solution Overview.....	1
1.2 Migrating Data Using Direct Connect (rclone).....	1
1.3 Cross-Server Migration (rclone).....	4
1.4 Migrating Data Using Direct Connect (rsync).....	7
1.5 Migrating Data Between File Systems.....	10
2 Testing SFS Turbo Performance.....	13
3 Testing SFS Turbo Latency.....	21

1 Migrating Data to SFS Turbo

1.1 Solution Overview

By default, an SFS Turbo file system can only be accessed by Elastic Cloud Servers (ECSs) or Cloud Container Engine (CCE) containers in the same Virtual Private Cloud (VPC) as the file system. To access an SFS Turbo file system from an on-premises data center or a different VPC, you need to establish network connections using Direct Connect, Virtual Private Network (VPN), or VPC peering connections.

- To access from on premises or another cloud, use Direct Connect or VPN.
- To access from a different VPC using the same account in the same region, use VPC peering.
- To access using a different account in the same region, use VPC peering.
- To access from a different region, use Cloud Connect.

You can use an ECS that can access the Internet to migrate data to SFS Turbo.

- Mount the SFS Turbo file system to the ECS and migrate data from the local Network Attached Storage (NAS) to the SFS Turbo file system.
 - [Migrating Data Using Direct Connect \(rclone\)](#)
 - [Migrating Data Using Direct Connect \(rsync\)](#)
- If the connection cannot be established through file system mounting, migrate data through the ECS over the Internet.

[Cross-Server Migration \(rclone\)](#)

1.2 Migrating Data Using Direct Connect (rclone)

Solution Overview

You can migrate data from a local NAS to SFS Turbo using rclone over Direct Connect.

In this solution, a Linux ECS is created to connect the local NAS and SFS Turbo, and data is migrated to the cloud using this ECS.

You can also refer to this solution to migrate data from an on-cloud NAS to SFS Turbo. For details, see [Migrating Data from On-Cloud NAS to SFS Turbo](#).

Notes and Constraints

- Only Linux ECSs can be used to migrate data.
- The UID and GID of your file will no longer be consistent after data migration.
- The file access modes will no longer be consistent after data migration.
- Incremental migration is supported, so you can only migrate the changed data.
- If data is written to the file system after you have run the rclone command to migrate data, data inconsistency may occur.

Prerequisites

- You have purchased and configured Direct Connect. For details, see [Direct Connect User Guide](#).
- You have created a Linux ECS.
- You have created an SFS Turbo file system and have obtained the shared path of the file system.
- You have obtained the shared path of the local NAS.

Resource Planning

[Table 1-1](#) describes the resource planning in this solution.

Table 1-1 Resource planning

Resource	Example Configuration	Description
ECS	Specifications: 8 vCPUs 16 GB c7.2xlarge.2 OS: Linux Region: CN-Hong Kong VPC: VPC1	Ensure that the <code>/mnt/src</code> and <code>/mnt/dst</code> directories have been created.

Procedure

Step 1 Log in to the ECS console.

Step 2 Log in to the Linux ECS.

Step 3 Mount the local NAS to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the local NAS /mnt/src
```

Step 4 Mount the SFS Turbo file system to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the file system /mnt/dst
```

Step 5 Install rclone on the Linux ECS.

```
wget https://downloads.rclone.org/v1.53.4/rclone-v1.53.4-linux-amd64.zip --no-check-certificate
unzip rclone-v1.53.4-linux-amd64.zip
chmod 0755 ./rclone-*/rclone
cp ./rclone-*/rclone /usr/bin/
rm -rf ./rclone-*
```

Step 6 Synchronize data to the SFS Turbo file system.

```
rclone copy /mnt/src /mnt/dst -P --transfers 32 --checkers 64 --links --create-empty-src-dirs
```

 **NOTE**

The parameters are described as follows. Set **transfers** and **checkers** based on the system specifications.

- **--transfers**: number of files that can be transferred concurrently
- **--checkers**: number of local files that can be scanned concurrently
- **-P**: data copy progress
- **--links**: replicates the soft links from the source. They are saved as soft links in the destination.
--copy-links: replicates the content of files to which the soft links point. They are saved as files rather than soft links in the destination.
- **--create-empty-src-dirs**: replicates the empty directories from the source to the destination.

After data synchronization is complete, go to the SFS Turbo file system to check whether data is migrated.

----End

Verification

Step 1 Log in to the Linux ECS.

Step 2 Check the file synchronization results on the destination server.

```
cd /mnt/dst
ls | wc -l
```

Step 3 If the data volume is the same as that on the source server, data is migrated successfully.

----End

Migrating Data from On-Cloud NAS to SFS Turbo

To migrate data from an on-cloud NAS to your SFS Turbo file system, ensure that the NAS and SFS Turbo file system are in the same VPC, or you have established the network using Cloud Connect.

For details about how to configure Cloud Connect, see [Cloud Connect User Guide](#).

1.3 Cross-Server Migration (rclone)

Solution Overview

You can use rclone to migrate data from a local NAS to SFS Turbo over the Internet or private network.

In this solution, to migrate data from the local NAS to the cloud, a Linux server is created both on the cloud and on-premises. Inbound and outbound traffic is allowed on port 22 of the two servers. The on-premises server is used to access the local NAS, and the ECS is used to access SFS Turbo.

You can also refer to this solution to migrate data from an on-cloud NAS to SFS Turbo over the Internet or private network.

Notes and Constraints

- Only Linux ECSs can be used to migrate data.
- The UID and GID of your file will no longer be consistent after data migration.
- The file access modes will no longer be consistent after data migration.
- Inbound and outbound traffic must be allowed on port 22.
- Incremental migration is supported, so you can only migrate the changed data.
- If data is written to the file system after you have run the rclone command to migrate data, data inconsistency may occur.

Prerequisites

- A Linux server has been created on the cloud and on-premises respectively.
- An elastic IP address (EIP) has been bound to the ECS to ensure that the two servers can communicate with each other.
- You have created an SFS Turbo file system and have obtained the shared path of the file system.
- You have obtained the shared path of the local NAS.

Resource Planning

[Table 1-2](#) describes the resource planning in this solution.

Table 1-2 Resource planning

Resource	Example Configuration	Description
ECS	Specifications: 8 vCPUs 16 GB c7.2xlarge.2 OS: Linux Region: CN-Hong Kong VPC: VPC1 Enabled port: 22 EIP: xxx.xxx.xxx.xxx	Ensure that the /mnt/dst directory has been created.

Procedure

Step 1 Log in to the ECS console.

Step 2 Log in to the on-premises server **client1** and run the following command to mount the local NAS:

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the local NAS /mnt/src
```

Step 3 Log in to the Linux ECS **client2** and run the following command to mount the SFS Turbo file system:

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the SFS Turbo file system /mnt/dst
```

Step 4 Install rclone on **client 1**.

```
wget https://downloads.rclone.org/v1.53.4/rclone-v1.53.4-linux-amd64.zip --no-check-certificate
unzip rclone-v1.53.4-linux-amd64.zip
chmod 0755 ./rclone-*/rclone
cp ./rclone-*/rclone /usr/bin/
rm -rf ./rclone-*
```

Step 5 Configure the environment on **client1**.

```
rclone config
No remotes found - make a new one
n) New remote
s) Set configuration password
q) Quit config
n/s/q> n
name> remote name (New name)
Type of storage to configure.
Enter a string value. Press Enter for the default ("").
Choose a number from below, or type in your own value
24 / SSH/SFTP Connection
  \ "sftp"
Storage> 24 (Select the SSH/SFTP number)
SSH host to connect to
Enter a string value. Press Enter for the default ("").
Choose a number from below, or type in your own value
 1 / Connect to example.com
  \ "example.com"
host> ip address (IP address of client2)
SSH username, leave blank for current username, root
Enter a string value. Press Enter for the default ("").
user> user name (Username of client2)
SSH port, leave blank to use default (22)
Enter a string value. Press Enter for the default ("").
port> 22
SSH password, leave blank to use ssh-agent.
y) Yes type in my own password
```



```

g) Generate random password
n) No leave this optional password blank
y/g/n> y
Enter the password:
password: (Password for logging in to client2)
Confirm the password:
password: (Confirm the password)
Path to PEM-encoded private key file, leave blank or set key-use-agent to use ssh-agent.
Enter a string value. Press Enter for the default ("").
key_file> (Press Enter)
The passphrase to decrypt the PEM-encoded private key file.

Only PEM encrypted key files (old OpenSSH format) are supported. Encrypted keys
in the new OpenSSH format can't be used.
y) Yes type in my own password
g) Generate random password
n) No leave this optional password blank
y/g/n> n
When set forces the usage of the ssh-agent.
When key-file is also set, the ".pub" file of the specified key-file is read and only the associated key is
requested from the ssh-agent. This allows to avoid `Too many authentication failures for *username*` errors
when the ssh-agent contains many keys.
Enter a boolean value (true or false). Press Enter for the default ("false").
key_use_agent> (Press Enter)
Enable the use of the aes128-cbc cipher. This cipher is insecure and may allow plaintext data to be
recovered by an attacker.
Enter a boolean value (true or false). Press Enter for the default ("false").
Choose a number from below, or type in your own value
1 / Use default Cipher list.
  \ "false"
2 / Enables the use of the aes128-cbc cipher.
  \ "true"
use_insecure_cipher> (Press Enter)
Disable the execution of SSH commands to determine if remote file hashing is available.
Leave blank or set to false to enable hashing (recommended), set to true to disable hashing.
Enter a boolean value (true or false). Press Enter for the default ("false").
disable_hashcheck>
Edit advanced config? (y/n)
y) Yes
n) No
y/n> n
Remote config
-----
[remote_name]
type = sftp
host=(client2 ip)
user=(client2 user name)
port = 22
pass = *** ENCRYPTED ***
key_file_pass = *** ENCRYPTED ***
-----
y) Yes this is OK
e) Edit this remote
d) Delete this remote
y/e/d> y
Current remotes:

Name          Type
====          ====
remote_name   sftp

e) Edit existing remote
n) New remote
d) Delete remote
r) Rename remote
c) Copy remote
s) Set configuration password
q) Quit config
e/n/d/r/c/s/q> q

```

 NOTE

Enter a public IP address for **IP address of client2**.

Step 6 View the **rclone.conf** file in **/root/.config/rclone/rclone.conf**.

```
cat /root/.config/rclone/rclone.conf
[remote_name]
type = sftp
host=(client2 ip)
user=(client2 user name)
port = 22
pass = ***
key_file_pass = ***
```

Step 7 Run the following command on **client1** to synchronize data:

```
rclone copy /mnt/src remote_name:/mnt/dst -P --transfers 32 --checkers 64
```

 NOTE

- Replace *remote_name* in the command with the actual remote name.
- The parameters are described as follows. Set **transfers** and **checkers** based on the system specifications.
 - **transfers**: number of files that can be transferred concurrently
 - **checkers**: number of local files that can be scanned concurrently
 - **P**: data copy progress

After data synchronization is complete, go to the SFS Turbo file system to check whether data is migrated.

----End

Verification

Step 1 Log in to the Linux ECS.

Step 2 Check the file synchronization results on the destination server.

```
cd /mnt/dst
ls | wc -l
```

Step 3 If the data volume is the same as that on the source server, data is migrated successfully.

----End

1.4 Migrating Data Using Direct Connect (rsync)

Solution Overview

You can migrate data from a local NAS to SFS Turbo using rsync over Direct Connect.

In this solution, a Linux ECS is created to connect the local NAS and SFS Turbo, and data is migrated to the cloud using this ECS.

You can also refer to this solution to migrate data from an on-cloud NAS to SFS Turbo using the Internet. Ensure that the on-cloud NAS and SFS Turbo belong to the same VPC.

Notes and Constraints

- Special files, such as devices and linked files, can be migrated.
- Resumable data transfer is supported.
- Properties, such as permissions, time, soft and hard links, owner, and group, of the original files and directories can be retained after data migration.
- The rcp, rsh, and ssh tools are supported during file transfer.
- Incremental migration is supported, so you can only migrate the changed data.
- If there are multi-level directories or massive small files, you are recommended to use a multi-process script or rclone. This is because rsync has low efficiency in these scenarios.

Prerequisites

- You have purchased and configured Direct Connect. For details, see [Direct Connect User Guide](#).
- You have created a Linux ECS.
- You have created an SFS Turbo file system and have obtained the shared path of the file system.
- You have obtained the shared path of the local NAS.
- A trust relationship has been established between the local NAS and the ECS.

Resource Planning

[Table 1-3](#) describes the resource planning in this solution.

Table 1-3 Resource planning

Resource	Example Configuration	Description
ECS	Specifications: 8 vCPUs 16 GB c7.2xlarge.2 OS: Linux Region: CN-Hong Kong VPC: VPC1	Ensure that the <code>/mnt/src</code> and <code>/mnt/dst</code> directories have been created.

Procedure

Step 1 Log in to the Linux ECS.

Step 2 Mount the local NAS to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the local NAS /mnt/src
```

Step 3 Mount the SFS Turbo file system to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Shared path of the file system /mnt/dst
```

Step 4 Install rsync on the Linux ECS.

```
yum install rsync
```

Figure 1-1 Installing rsync

```
[root@ ~]# yum install rsync
Loaded plugins: fastestmirror
Determining fastest mirrors
epel/x86_64/metalink
* base: mirrors.huaweicloud.com
* epel: mirrors.bfsu.edu.cn
* extras: mirrors.ustc.edu.cn
* updates: mirrors.huaweicloud.com
```

 **NOTE**

Ensure that rsync is installed on both the source and destination servers. Or, an error will be reported.

Step 5 Check the installation result and version of rsync.

```
rsync -version
```

Figure 1-2 Checking the installation result

```
[root@ ~]# rsync -version
rsync version 3.1.2 protocol version 31
Copyright (C) 1996-2015 by Andrew Tridgell, Wayne Davison, and others.
Web site: http://rsync.samba.org/
Capabilities:
 64-bit files, 64-bit inums, 64-bit timestamps, 64-bit long ints,
 socketpairs, hardlinks, symlinks, IPv6, batchfiles, inplace,
 append, ACLs, xattrs, iconv, symtimes, prealloc

rsync comes with ABSOLUTELY NO WARRANTY. This is free software, and you
are welcome to redistribute it under certain conditions. See the GNU
General Public Licence for details.

rsync is a file transfer program capable of efficient remote update
via a fast differencing algorithm.

Usage: rsync [OPTION]... SRC [SRC]... DEST
or rsync [OPTION]... SRC [SRC]... [USER@]HOST:DEST
or rsync [OPTION]... SRC [SRC]... [USER@]HOST::DEST
or rsync [OPTION]... SRC [SRC]... rsync://[USER@]HOST[:PORT]/DEST
or rsync [OPTION]... [USER@]HOST:SRC [DEST]
or rsync [OPTION]... [USER@]HOST::SRC [DEST]
or rsync [OPTION]... rsync://[USER@]HOST[:PORT]/SRC [DEST]
The ':' usages connect via remote shell, while '::' & 'rsync://' usages connect
to an rsync daemon, and require SRC or DEST to start with a module name.
```

Step 6 Migrate data in the **/mnt/src** directory on the source server to the **/mnt/dst** directory (file system) on the destination server.

```
rsync -avP /mnt/src /mnt/dst
```

Figure 1-3 Data synchronization

```
103669.dat 1,024 100% 38.46kB/s 0:00:00 (xfr#4080, to-chk=295920/300001)
10367.dat 1,024 100% 37.04kB/s 0:00:00 (xfr#4081, to-chk=295919/300001)
103670.dat 1,024 100% 37.04kB/s 0:00:00 (xfr#4082, to-chk=295918/300001)
103671.dat 1,024 100% 35.71kB/s 0:00:00 (xfr#4083, to-chk=295917/300001)
103672.dat 1,024 100% 35.71kB/s 0:00:00 (xfr#4084, to-chk=295916/300001)
103673.dat 1,024 100% 34.48kB/s 0:00:00 (xfr#4085, to-chk=295915/300001)
103674.dat 1,024 100% 34.48kB/s 0:00:00 (xfr#4086, to-chk=295914/300001)
103675.dat 1,024 100% 33.33kB/s 0:00:00 (xfr#4087, to-chk=295913/300001)
```

----End

Verification

Step 1 Log in to the Linux ECS.

Step 2 Check the file synchronization results on the destination server.

```
cd /mnt/dst
ls | wc -l
```

Step 3 If the data volume is the same as that on the source server, data is migrated successfully.

----End

1.5 Migrating Data Between File Systems

Solution Overview

You can migrate data from an SFS Capacity-Oriented file system to an SFS Turbo file system or the other way around.

In this solution, a Linux ECS is used to connect the SFS Capacity-Oriented file system and the SFS Turbo file system.

Notes and Constraints

- Only Linux ECSs can be used to migrate data.
- The Linux ECS, SFS Capacity-Oriented file system, and SFS Turbo file system must be in the same VPC.
- Incremental migration is supported, so you can only migrate the changed data.

Prerequisites

- You have created a Linux ECS.
- You have created an SFS Capacity-Oriented file system and an SFS Turbo file system and have obtained their addresses.

Resource Planning

Table 1-4 describes the resource planning in this solution.

Table 1-4 Resource planning

Resource	Example Configuration	Description
ECS	Specifications: 8 vCPUs 16 GB c7.2xlarge.2 OS: Linux Region: CN-Hong Kong VPC: VPC1	Ensure that the <code>/mnt/src</code> and <code>/mnt/dst</code> directories have been created.

Procedure

Step 1 Log in to the ECS console.

Step 2 Log in to the Linux ECS.

Step 3 Mount either the SFS Capacity-Oriented or SFS Turbo file system to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Address of the file system /mnt/src
```

Step 4 Mount the other file system to the ECS.

```
mount -t nfs -o vers=3,timeo=600,noresvport,nolock,tcp Address of the other file system /mnt/dst
```

Step 5 Download and install rclone. For the download address, see <https://rclone.org/downloads/>.

Step 6 Synchronize data.

```
rclone copy /mnt/src /mnt/dst -P --transfers 32 --checkers 64 --links --create-empty-src-dirs
```

NOTE

The parameters are described as follows. Set **transfers** and **checkers** based on the system specifications.

- `/mnt/src`: source path
- `/mnt/dst`: destination path
- `--transfers`: number of files that can be transferred concurrently
- `--checkers`: number of local files that can be scanned concurrently
- `-P`: data copy progress
- `--links`: replicates the soft links from the source. They are saved as soft links in the destination.
- `--copy-links`: replicates the content of files to which the soft links point. They are saved as files rather than soft links in the destination.
- `--create-empty-src-dirs`: replicates the empty directories from the source to the destination.

After data synchronization is complete, go to the target file system to check whether data is migrated.

----End

Verification

Step 1 Log in to the Linux ECS.

Step 2 Check the file synchronization results on the destination server.

```
cd /mnt/dst  
ls | wc -l
```

Step 3 If the data volume is the same as that on the source server, data is migrated successfully.

----End

2 Testing SFS Turbo Performance

Fio is an open-source I/O tester. You can use fio to test the throughput and IOPS of SFS Turbo file systems.

Prerequisites

Fio has been installed on the cloud server. It can be downloaded from [the official website](#) or from [GitHub](#).

Note and Description

The test performance depends on the network bandwidth between the client and server, as well as the capacity of the file system.

Installing fio

The following uses a Linux CentOS system as an example:

1. Download fio.
yum install fio
2. Install the libaio engine.
yum install libaio-devel
3. Check the fio version.
fio --version

File System Performance Data

[Table 2-1](#) lists the performance metrics of SFS Turbo file systems including IOPS and throughput.

Table 2-1 File system performance data

Parameter	20 MB/s/TiB	40 MB/s/TiB	125 MB/s/TiB	250 MB/s/TiB	500 MB/s/TiB	1,000 MB/s/TiB
Max. capacity	1 PB	1 PB	1 PB	1 PB	1 PB	1 PB
Max. IOPS	250,000	250,000	1 million	1 million	4 million If you need a higher IOPS, submit a service ticket. The maximum IOPS is 10 million.	4 million If you need a higher IOPS, submit a service ticket. The maximum IOPS is 10 million.
Max. throughput	8 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 20 Gbit/s.	8 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 20 Gbit/s.	20 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 100 Gbit/s.	20 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 100 Gbit/s.	80 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 200 Gbit/s.	80 GB/s If you need a higher throughput, submit a service ticket. The maximum throughput is 200 Gbit/s.
Formula used to calculate the IOPS	$IOPS = \frac{Min. (250,000, 600 \times Capacity)}{Capacity}$ Capacity unit: TB	$IOPS = \frac{Min. (250,000, 1,200 \times Capacity)}{Capacity}$ Capacity unit: TB	$IOPS = \frac{Min. (1,000,000, 6,000 \times Capacity)}{Capacity}$ Capacity unit: TB	$IOPS = \frac{Min. (1,000,000, 12,500 \times Capacity)}{Capacity}$ Capacity unit: TB	$IOPS = \frac{Min. (4,000,000, 25,000 \times Capacity)}{Capacity}$ Capacity unit: TB	$IOPS = \frac{Min. (4,000,000, 50,000 \times Capacity)}{Capacity}$ Capacity unit: TB

Common Test Configuration Example

NOTE

The following estimated values are obtained from the test on a single ECS. You are advised to use multiple ECSs to test the **SFS Turbo** performance.

In the following examples, the Performance type and cloud servers with the following specifications are used for illustration.

Specifications: General computing-plus | c3.xlarge.4 | 4 vCPUs | 16 GB

Image: CentOS 7.5 64-bit

- fio command:

```
fio --randrepeat=1 --ioengine=libaio --name=test -output=output.log --
direct=1 --filename=/mnt/nfs/test_fio --bs=1M --iodepth=128 --
size=10240M --readwrite=rw --rwmixwrite=30 --fallocate=none
```

NOTE

Variable `/mnt/nfs/test_fio` is the location of the file to be tested. The location must be specific to the file name, which is the `test_fio` file in the `/mnt/nfs` directory in this example. Set it based on the site requirements.

- fio result:

```
test: (groupid=0, jobs=1): err=0: pid=10110: Mon Jun  8 11:40:57 2020
read: IOPS=7423, BW=28.0MiB/s (30.4MB/s)(7167MiB/247160msec)
   slat (usec): min=1234, max=397477, avg=4145.45, stdev=3344.48
   clat (usec): min=245, max=133325, avg=11162.10, stdev=12136.31
   lat (usec): min=252, max=133330, avg=11166.32, stdev=12136.34
   clat percentiles (usec):
   |  1.00th=[ 2245],  5.00th=[ 2540], 10.00th=[ 2671], 20.00th=[ 2900],
   | 30.00th=[ 3130], 40.00th=[ 3450], 50.00th=[ 4293], 60.00th=[ 7032],
   | 70.00th=[13173], 80.00th=[19792], 90.00th=[20443], 95.00th=[36439],
   | 99.00th=[53216], 99.50th=[60031], 99.90th=[79160], 99.95th=[85459],
   | 99.99th=[90042]
   bw ( KIB/s): min=16600, max=45560, per=100.00%, avg=29696.00, stdev=5544.46, samples=494
   iops         : min= 4150, max=11390, avg=7424.01, stdev=1306.11, samples=494
write: IOPS=3182, BW=12.4MiB/s (13.0MB/s)(3073MiB/247160msec)
   slat (usec): min=1400, max=302730, avg=4613.59, stdev=3359.60
   clat (usec): min=1447, max=140666, avg=14166.05, stdev=13373.72
   lat (usec): min=1457, max=140671, avg=14170.73, stdev=13373.74
   clat percentiles (msec):
   |  1.00th=  41,  5.00th=  41, 10.00th=  41, 20.00th=  51,
   | 30.00th=  51, 40.00th=  61, 50.00th=  81, 60.00th= 141,
   | 70.00th= 101, 80.00th= 241, 90.00th= 331, 95.00th= 421,
   | 99.00th= 591, 99.50th= 671, 99.90th= 871, 99.95th= 941,
   | 99.99th= 1221
   bw ( KIB/s): min= 7144, max=19600, per=100.00%, avg=12730.90, stdev=2395.77, samples=494
   iops         : min= 1706, max= 4900, avg=3182.70, stdev=590.96, samples=494
   lat (usec)   : 250=0.01%, 500=0.01%, 750=0.01%, 1000=0.01%
   lat (msec)   : 2=0.20%, 4=39.15%, 10=21.01%, 20=17.92%, 50=20.06%
   lat (msec)   : 100=1.62%, 250=0.02%
   cpu          : usr=1.35%, sys=6.43%, ctx=1072910, majf=0, minf=30
   IO depths    : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
   submit      : 0=0.0%, 4=100.0%, 0=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
   complete    : 0=0.0%, 4=100.0%, 0=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
   issued rwts: total=1034036,706604,0,0 short=0,0,0,0 dropped=0,0,0,0
   latency     : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
  READ: bw=28.0MiB/s (30.4MB/s), 28.0MiB/s-28.0MiB/s (30.4MB/s-30.4MB/s), io=7167MiB (7515MB), run=247160-247160msec
  WRITE: bw=12.4MiB/s (13.0MB/s), 12.4MiB/s-12.4MiB/s (13.0MB/s-13.0MB/s), io=3073MiB (3222MB), run=247160-247160msec
```

- fio command:

```
fio --randrepeat=1 --ioengine=libaio --name=test -output=output.log --
direct=1 --filename=/mnt/nfs/test_fio --bs=1M --iodepth=128 --
size=10240M --readwrite=rw --rwmixwrite=70 --fallocate=none
```

NOTE

Variable `/mnt/nfs/test_fio` is the location of the file to be tested. The location must be specific to the file name, which is the `test_fio` file in the `/mnt/nfs` directory in this example. Set it based on the site requirements.

- fio result:

```

test: (groupid=0, jobs=1): err= 0: pid=20350: Mon Jun 8 11:57:14 2020
read: IOPS=5065, BW=19.8MiB/s (20.7MB/s)(3073MiB/155200msec)
slat (nsec): min=1271, max=269500, avg=4073.51, stdev=3040.12
clat (usec): min=226, max=80185, avg=5711.35, stdev=7079.46
lat (usec): min=232, max=80187, avg=5715.49, stdev=7079.48
clat percentiles (usec):
| 1.00th=[ 1221], 5.00th=[ 1950], 10.00th=[ 2100], 20.00th=[ 2442],
| 30.00th=[ 2606], 40.00th=[ 2802], 50.00th=[ 2999], 60.00th=[ 3220],
| 70.00th=[ 3687], 80.00th=[ 5604], 90.00th=[14222], 95.00th=[21890],
| 99.00th=[35914], 99.50th=[40633], 99.90th=[51643], 99.95th=[55837],
| 99.99th=[66047]
bw ( KIB/s): min=13360, max=28848, per=99.99%, avg=20257.97, stdev=2913.05, samples=310
iops      : min= 3340, max= 7212, avg=5064.48, stdev=720.27, samples=310
write: IOPS=11.8k, BW=46.2MiB/s (48.4MB/s)(7167MiB/155200msec)
slat (nsec): min=1396, max=390604, avg=4405.68, stdev=3091.75
clat (usec): min=857, max=140259, avg=8377.47, stdev=8400.15
lat (usec): min=867, max=140264, avg=8382.02, stdev=8400.16
clat percentiles (nsec):
| 1.00th=[  31], 5.00th=[  41], 10.00th=[  41], 20.00th=[  41],
| 30.00th=[  51], 40.00th=[  51], 50.00th=[  51], 60.00th=[  61],
| 70.00th=[  71], 80.00th=[ 131], 90.00th=[ 211], 95.00th=[ 201],
| 99.00th=[ 421], 99.50th=[ 471], 99.90th=[ 601], 99.95th=[ 601],
| 99.99th=[ 1201]
bw ( KIB/s): min=32224, max=67456, per=99.90%, avg=47254.23, stdev=6792.41, samples=310
iops      : min= 0056, max=16864, avg=11813.55, stdev=1690.11, samples=310
lat (usec) : 250=0.01%, 500=0.04%, 750=0.07%, 1000=0.09%
lat (msec) : 2=1.53%, 4=36.85%, 10=41.27%, 20=11.30%, 50=0.61%
lat (msec) : 100=0.23%, 250=0.01%
cpu       : usr=2.13%, sys=9.90%, ctx=925770, majf=0, minf=31
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued rwts: total=706597,1834043,0,0 short=0,0,0,0 dropped=0,0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=120

Run status group 0 (all jobs):
READ: bw=19.8MiB/s (20.7MB/s), 19.8MiB/s-19.8MiB/s (20.7MB/s-20.7MB/s), io=3073MiB (3222MB), run=155200-155200msec
WRITE: bw=46.2MiB/s (48.4MB/s), 46.2MiB/s-46.2MiB/s (48.4MB/s-48.4MB/s), io=7167MiB (7516MB), run=155200-155200msec
    
```

Sequential read IOPS

- fio command:
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=read --bs=4k --size=1G --iodepth=128 --runtime=120 --numjobs=10

NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```

test: (groupid=0, jobs=1): err= 0: pid=20459: Mon Jun 8 12:20:18 2020
read: IOPS=9654, BW=37.7MiB/s (39.5MB/s)(10.0GiB/271519msec)
slat (nsec): min=1233, max=662160, avg=4118.17, stdev=4773.23
clat (usec): min=365, max=131116, avg=13253.10, stdev=13950.09
lat (usec): min=371, max=131118, avg=13257.29, stdev=13950.09
clat percentiles (usec):
| 1.00th=[ 1762], 5.00th=[ 1991], 10.00th=[ 2147], 20.00th=[ 2376],
| 30.00th=[ 2704], 40.00th=[ 3621], 50.00th=[ 7767], 60.00th=[ 11994],
| 70.00th=[ 16909], 80.00th=[ 23462], 90.00th=[ 33162], 95.00th=[ 41681],
| 99.00th=[ 59507], 99.50th=[ 66847], 99.90th=[ 83362], 99.95th=[ 90702],
| 99.99th=[103285]
bw ( KIB/s): min=10656, max=61576, per=99.99%, avg=30615.41, stdev=7703.32, samples=543
iops      : min= 4664, max=15394, avg=9653.02, stdev=1925.03, samples=543
lat (usec) : 500=0.01%, 750=0.01%, 1000=0.02%
lat (msec) : 2=5.25%, 4=36.35%, 10=12.76%, 20=20.56%, 50=22.62%
lat (msec) : 100=2.42%, 250=0.02%
cpu       : usr=1.04%, sys=5.35%, ctx=913130, majf=0, minf=159
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued rwts: total=2621440,0,0,0 short=0,0,0,0 dropped=0,0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=120

Run status group 0 (all jobs):
READ: bw=37.7MiB/s (39.5MB/s), 37.7MiB/s-37.7MiB/s (39.5MB/s-39.5MB/s), io=10.0GiB (10.7GB), run=271519-271519msec
    
```

Random read IOPS

- fio command:
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --

rw=randread --bs=4k --size=1G --iodepth=128 --runtime=120 --numjobs=10

 NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (g=0): rw=randread, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=128
fio-2.1.10
Starting 1 process
Jobs: 1 (f=1): [r] [100.0% done] [17824KB/0KB/0KB /s] [4456/0/0 iops] [eta 00m:00s]
test: (groupid=0, jobs=1): err= 0: pid=20755: Tue Dec 28 09:41:43 2021
read : io=10240MB, bw=18597KB/s, iops=4649, runt=563832msec
slat (usec): min=1, max=375, avg= 2.64, stdev= 2.52
clat (usec): min=715, max=755902, avg=27527.31, stdev=106233.39
lat (usec): min=718, max=755903, avg=27530.03, stdev=106233.39
clat percentiles (msec):
| 1.00th=[ 3], 5.00th=[ 5], 10.00th=[ 6], 20.00th=[ 6],
| 30.00th=[ 7], 40.00th=[ 7], 50.00th=[ 8], 60.00th=[ 9],
| 70.00th=[ 11], 80.00th=[ 15], 90.00th=[ 21], 95.00th=[ 28],
| 99.00th=[ 676], 99.50th=[ 693], 99.90th=[ 725], 99.95th=[ 734],
| 99.99th=[ 750]
bw (KB /s): min= 1896, max=35752, per=100.00%, avg=18605.56, stdev=1980.86
lat (usec) : 750=0.01%, 1000=0.01%
lat (msec) : 2=0.32%, 4=3.28%, 10=63.65%, 20=22.42%, 50=7.50%
lat (msec) : 100=0.07%, 250=0.01%, 500=0.03%, 750=2.72%, 1000=0.01%
cpu        : usr=0.82%, sys=2.41%, ctx=1231561, majf=0, minf=155
IO depths  : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
submit     : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued    : total=r=2621440/w=0/d=0, short=r=0/w=0/d=0
latency    : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
READ: io=10240MB, aggrb=18597KB/s, minb=18597KB/s, maxb=18597KB/s, mint=563832msec, maxt=563832msec
```

Sequential write IOPS

- fio command:

fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=write --bs=4k --size=1G --iodepth=128 --runtime=120 --numjobs=10

 NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (groupid=0, jobs=1): err= 0: pid=20874: Mon Jun 8 14:23:09 2020
write: IOPS=11.0k, BW=43.1MiB/s (45.2MB/s)(10.06GiB/237436msec)
slat (msec): min=1483, max=368726, avg=4388.87, stdev=3688.87
clat (usec): min=1953, max=186548, avg=11588.61, stdev=5876.84
lat (usec): min=1959, max=186552, avg=11593.86, stdev=5876.86
clat percentiles (usec):
| 1.00th=[ 4015], 5.00th=[ 5932], 10.00th=[ 6652], 20.00th=[ 7439],
| 30.00th=[ 8029], 40.00th=[ 8848], 50.00th=[ 9634], 60.00th=[10814],
| 70.00th=[12518], 80.00th=[15533], 90.00th=[19268], 95.00th=[22676],
| 99.00th=[32637], 99.50th=[37487], 99.90th=[49821], 99.95th=[53748],
| 99.99th=[69731]
bw ( KiB/s): min=31712, max=52431, per=99.99%, avg=44158.84, stdev=3987.31, samples=474
iops       : min= 7928, max=13187, avg=11839.58, stdev=996.83, samples=474
lat (msec) : 2=0.01%, 4=1.00%, 10=51.94%, 20=38.58%, 50=8.39%
lat (msec) : 100=0.00%, 250=0.01%
cpu        : usr=1.33%, sys=5.47%, ctx=392117, majf=0, minf=27
IO depths  : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
submit     : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued rwts: total=r=8,2621448,0,0 short=r=0,0,0,0 dropped=0,0,0,0
latency    : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
WRITE: bw=43.1MiB/s (45.2MB/s), 43.1MiB/s-43.1MiB/s (45.2MB/s-45.2MB/s), io=10.06GiB (10.7GB), run=
```

Random write IOPS

- fio command:
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=randwrite --bs=4k --size=1G --iodepth=128 --runtime=120 --numjobs=10

 NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (g=0): rw=randwrite, bs=4K-4K/4K-4K/4K-4K, ioengine=libaio, iodepth=128
fio-2.1.10
Starting 1 process

test: (groupid=0, jobs=1): err= 0: pid=16622: Thu Jan 13 10:13:22 2022
write: io=10240MB, bw=18463KB/s, iops=4615, runt=567947msec
slat (usec): min=1, max=356, avg= 3.21, stdev= 2.04
clat (usec): min=890, max=815560, avg=27727.54, stdev=101207.14
lat (usec): min=893, max=815564, avg=27730.83, stdev=101207.14
clat percentiles (msec):
| 1.00th=[ 4], 5.00th=[ 6], 10.00th=[ 6], 20.00th=[ 7],
| 30.00th=[ 7], 40.00th=[ 8], 50.00th=[ 8], 60.00th=[ 10],
| 70.00th=[ 13], 80.00th=[ 16], 90.00th=[ 23], 95.00th=[ 30],
| 99.00th=[ 644], 99.50th=[ 668], 99.90th=[ 701], 99.95th=[ 709],
| 99.99th=[ 734]
bw (KB /s): min=1064, max=36589, per=100.00%, avg=18469.11, stdev=3769.64
lat (usec): 1000=0.01%
lat (msec): 2=0.20%, 4=1.85%, 10=60.93%, 20=24.30%, 50=9.85%
lat (msec): 100=0.09%, 250=0.01%, 500=0.08%, 750=2.68%, 1000=0.01%
cpu      : usr=0.98%, sys=2.90%, ctx=1552744, majf=0, minf=27
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.1%, 32=0.1%, >=64=100.0%
submit   : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued   : total=r=0/w=2621440/d=0, short=r=0/w=0/d=0
latency  : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
WRITE: io=10240MB, aggrb=18462KB/s, minb=18462KB/s, maxb=18462KB/s, mint=567947msec, maxt=567947msec
```

Sequential read bandwidth

- fio command:
fio --randrepeat=1 --ioengine=libaio --name=test -output=output.log --direct=1 --filename=/mnt/sfs-turbo/test_fio --bs=1M --iodepth=128 --size=10240M --readwrite=read --fallocate=none

 NOTE

Variable `/mnt/sfs-turbo/test_fio` is the location of the file to be tested. The location must be specific to the file name, which is the `test_fio` file in the `/mnt/sfs-turbo` directory in this example. Set it based on the site requirements.

- fio result:

```
test: (groupid=0, jobs=1): err= 0: pid=28962: Mon Jun 8 14:37:48 2020
read: IOPS=398, BW=391MiB/s (489MB/s)(10.8GiB/26221msec)
slat (usec): min=78, max=595, avg=99.58, stdev=39.89
clat (msec): min=35, max=544, avg=327.38, stdev=99.64
lat (msec): min=36, max=545, avg=327.48, stdev=99.63
clat percentiles (msec):
| 1.00th=[ 155], 5.00th=[ 161], 10.00th=[ 167], 20.00th=[ 188],
| 30.00th=[ 368], 40.00th=[ 372], 50.00th=[ 380], 60.00th=[ 384],
| 70.00th=[ 388], 80.00th=[ 393], 90.00th=[ 401], 95.00th=[ 414],
| 99.00th=[ 472], 99.50th=[ 586], 99.90th=[ 535], 99.95th=[ 542],
| 99.99th=[ 542]
bw ( KiB/s): min=381856, max=768000, per=99.52%, avg=397987.65, stdev=81583.56, samples=52
iops      : min= 294, max= 758, avg=388.65, stdev=79.67, samples=52
lat (msec): 50=0.17%, 100=0.28%, 250=27.61%, 500=71.37%, 750=0.58%
cpu      : usr=0.80%, sys=4.21%, ctx=18395, majf=0, minf=97
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.2%, 32=0.3%, >=64=99.4%
submit   : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued rwts: total=10240,0,0,0 short=0,0,0,0 dropped=0,0,0,0
latency  : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
READ: bw=391MiB/s (489MB/s), 391MiB/s-391MiB/s (489MB/s-489MB/s), io=10.8GiB (10.7GB), run=26221-26221msec
```

Random read bandwidth

- fio command:

```
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=randread --bs=1M --size=10G --iodepth=128 --runtime=120 --numjobs=1
```

NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (g=0): rw=randread, bs=1M-1M/1M-1M/1M-1M, ioengine=libaio, iodepth=128
fio-2.1.10
Starting 1 process

test: (groupid=0, jobs=1): err= 0: pid=14261: Tue Dec 28 09:18:04 2021
read : io=10240MB, bw=154130KB/s, iops=150, runt= 68032msec
slat (usec): min=61, max=8550, avg=142.99, stdev=187.96
clat (msec): min=12, max=2002, avg=849.91, stdev=347.27
lat (msec): min=12, max=2003, avg=850.05, stdev=347.26
clat percentiles (msec):
| 1.00th=[ 47], 5.00th=[ 84], 10.00th=[ 105], 20.00th=[ 914],
| 30.00th=[ 947], 40.00th=[ 963], 50.00th=[ 971], 60.00th=[ 988],
| 70.00th=[ 996], 80.00th=[ 1012], 90.00th=[ 1037], 95.00th=[ 1057],
| 99.00th=[ 1876], 99.50th=[ 1926], 99.90th=[ 1975], 99.95th=[ 1975],
| 99.99th=[ 2008]
bw (KB /s): min=69974, max=167768, per=98.85%, avg=152360.15, stdev=10783.47
lat (msec) : 20=0.33%, 50=0.80%, 100=7.02%, 250=7.95%, 1000=55.30%
lat (msec) : 2000=28.57%, >=2000=0.02%
cpu       : usr=0.02%, sys=1.93%, ctx=4399, majf=0, minf=602
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.2%, 32=0.3%, >=64=99.4%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued   : total=r=10240/w=0/d=0, short=r=0/w=0/d=0
latency   : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
  READ: io=10240MB, aggrb=154129KB/s, minb=154129KB/s, maxb=154129KB/s, mint=68032msec, max
t=68032msec
```

Sequential write bandwidth

- fio command:

```
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=write --bs=1M --size=10G --iodepth=128 --runtime=120 --numjobs=1
```

NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (groupid=0, jobs=1): err= 0: pid=21889: Mon Jun 8 14:53:44 2020
write: IOPS=243, BW=244MiB/s (255MB/s)(10.0GiB/42048msec)
slat (usec): min=103, max=504, avg=190.38, stdev=29.47
clat (msec): min=18, max=1104, avg=525.23, stdev=253.35
lat (msec): min=18, max=1104, avg=525.42, stdev=253.35
clat percentiles (msec):
| 1.00th=[ 51], 5.00th=[ 108], 10.00th=[ 167], 20.00th=[ 292],
| 30.00th=[ 422], 40.00th=[ 468], 50.00th=[ 506], 60.00th=[ 550],
| 70.00th=[ 625], 80.00th=[ 760], 90.00th=[ 902], 95.00th=[ 970],
| 99.00th=[ 1036], 99.50th=[ 1045], 99.90th=[ 1070], 99.95th=[ 1091],
| 99.99th=[ 1099]
bw ( KiB/s): min= 4096, max=468992, per=100.00%, avg=249580.99, stdev=147656.62, samples=83
iops      : min=   4, max=  458, avg=243.63, stdev=144.22, samples=83
lat (msec) : 20=0.03%, 50=0.96%, 100=3.36%, 250=12.55%, 500=31.63%
lat (msec) : 750=30.07%, 1000=18.96%
cpu       : usr=2.28%, sys=2.50%, ctx=3972, majf=0, minf=27
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.2%, 32=0.3%, >=64=99.4%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued rwt: total=0,10240,0,0 short=0,0,0,0 dropped=0,0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
WRITE: bw=244MiB/s (255MB/s), 244MiB/s-244MiB/s (255MB/s-255MB/s), io=10.0GiB (10.7GB), run=42048-42048msec
```

Random write bandwidth

- fio command:

```
fio --ioengine=libaio --direct=1 --fallocate=none --time_based=1 --group_reporting=1 --name=iops_fio --directory=/mnt/sfs-turbo/ --rw=randwrite --bs=1M --size=10G --iodepth=128 --runtime=120 --numjobs=1
```

NOTE

Variable `/mnt/sfs-turbo/` is the location of the file to be tested. The location must be specific to the file name. Set it to the actual file name.

- fio result:

```
test: (g=0): rw=randwrite, bs=1M-1M/1M-1M/1M-1M, ioengine=Libaio, iodepth=128
fio-2.1.10
Starting 1 process

test: (groupid=0, jobs=1): err= 0: pid=16370: Tue Dec 28 09:22:59 2021
write: io=10240MB, bw=15600KB/s, iops=152, runt= 67216msec
slat (usec): min=93, max=349, avg=156.14, stdev=22.29
clat (msec): min=17, max=1964, avg=839.92, stdev=345.94
lat (msec): min=17, max=1964, avg=840.08, stdev=345.94
clat percentiles (msec):
| 1.00th=[ 30], 5.00th=[ 37], 10.00th=[ 42], 20.00th=[ 97],
| 30.00th=[ 97], 40.00th=[ 98], 50.00th=[ 98], 60.00th=[ 99],
| 70.00th=[ 99], 80.00th=[ 100], 90.00th=[ 100], 95.00th=[ 101],
| 99.00th=[ 102], 99.50th=[ 102], 99.90th=[ 103], 99.95th=[ 104],
| 99.99th=[ 195]
bw (KB /s): min=150104, max=180654, per=98.76%, avg=154058.04, stdev=3404.48
lat (msec) : 20=0.04%, 50=13.44%, 100=1.04%, 250=0.73%, 500=1.05%
lat (msec) : 750=0.04%, 1000=60.69%, 2000=22.97%
cpu       : usr=0.91%, sys=1.52%, ctx=2011, majf=0, minf=28
IO depths : 1=0.1%, 2=0.1%, 4=0.1%, 8=0.1%, 16=0.2%, 32=0.3%, >=64=99.4%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.1%
issued   : total=r=0/w=10240/d=0, short=r=0/w=0/d=0
latency   : target=0, window=0, percentile=100.00%, depth=128

Run status group 0 (all jobs):
WRITE: io=10240MB, aggrbw=15600KB/s, minbw=15600KB/s, maxbw=15600KB/s, mint=67216msec, maxt=67216msec
```

3 Testing SFS Turbo Latency

This section uses the SFS Turbo Performance-Enhanced type to test the file system latency. The specifications of the ECSs to be used are as follows:

Specifications: General computing-plus | c6.4xlarge.4 | 16 vCPUs | 64 GB

Image: EulerOS 2.5

Single-queue random read

- fio command:

```
fio -direct=1 -iodepth=1 -rw=randread -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_01 -name=randread_test
```

NOTE

Variable `/mnt/sfsturbo/fio_test_01 -name` indicates the location of the file to be tested. The location must be specific to the file name, which is the `fio_test_01 -name` file in the `/mnt/sfsturbo` directory in this example. Set the location based on site requirements.

- fio result:

```
[root@100 ~]# fio -direct=1 -iodepth=1 -rw=randread -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_01 -name=randread_test
randread_test: (g=0): rw=randread, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=libaio, iodepth=1
fio-3.15
Starting 1 process
randread_test: Laying out IO file (1 file / 10240MiB)
Jobs: 1 (F=1): [r(1)][100.0%][r]=5606KiB/s,w=0KiB/s|[r]=1400,w=0 IOPS|[eta 00m:00s]
randread_test: (groupid=0, jobs=1): err=0: pid=23015: Mon Nov 7 11:44:12 2022
  read: IOPS=1401, BW=5606KiB/s (5740kB/s)(328MiB/60001msec)
    slat (nsec): min=2370, max=51192, avg=4228.52, stdev=1319.26
    clat (usec): min=559, max=8483, avg=707.69, stdev=197.66
    lat (msec): min=562, max=8407, avg=712.00, stdev=197.71
    clat percentiles (usec):
      | 1.00th=[ 603], 5.00th=[ 627], 10.00th=[ 635], 20.00th=[ 652],
      | 30.00th=[ 660], 40.00th=[ 668], 50.00th=[ 676], 60.00th=[ 693],
      | 70.00th=[ 701], 80.00th=[ 725], 90.00th=[ 750], 95.00th=[ 807],
      | 99.00th=[1369], 99.50th=[2040], 99.90th=[3523], 99.95th=[3982],
      | 99.99th=[5735]
  bw ( KIB/s): min= 5120, max= 5856, per=100.00%, avg=5605.12, stdev=134.52, samples=119
  iops       : min= 1280, max= 1464, avg=1401.28, stdev=33.63, samples=119
  lat (msec) : 750=80.70%, 1000=9.31%
  lat (msec) : 2=1.39%, 4=0.46%, 10=0.05%
  cpu        : usr=0.86%, sys=1.77%, ctx=84892, majf=0, minf=33
  IO depth   : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
  submit     : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
  complete   : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
  issued rwts: total=84887,0,0,0 short=0,0,0,0 dropped=0,0,0,0
  latency    : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
  READ: bw=5606KiB/s (5740kB/s), 5606KiB/s-5606KiB/s (5740kB/s-5740kB/s), io=328MiB (344MB), run=60001:60001msec
[root@100 ~]#
```

Single-queue random write

- fio command:

```
fio -direct=1 -iodepth=1 -rw=randwrite -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_02 -name=randwrite_test
```


NOTE

Variable `/mnt/sfsturbo/fio_test_02 -name` indicates the location of the file to be tested. The location must be specific to the file name, which is the `fio_test_02 -name` file in the `/mnt/sfsturbo` directory in this example. Set the location based on site requirements.

- fio result:

```
[root@100 ~]# fio -direct=1 -iodepth=1 -rw=randwrite -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_02 -name=randwrite_test
Starting 1 process
Jobs: 1 (f=1): [w(1)|1100.0%|r=0kIB/s,w=6709kIB/s|r=0,w=1677 IOPS|eta 00m:00s]
read_test: (g=0): rw=randwrite, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=libaio, iodepth=1
fio-3.5
Starting 1 process
Jobs: 1 (f=1): [w(1)|1100.0%|r=0kIB/s,w=6709kIB/s|r=0,w=1677 IOPS|eta 00m:00s]
read_test: (groupid=0, jobs=1): err=0: pid=25703: Tue Nov 8 21:37:13 2022
write: IOPS=1661, BW=6645kIB/s (6884k/s) (389MiB/60001msec)
slat (nsec): min=2566, max=34191, avg=4528.29, stdev=1661.31
clat (usec): min=473, max=8228, avg=595.67, stdev=169.48
lat (usec): min=477, max=8234, avg=600.38, stdev=169.55
clat percentiles (usec):
| 1.00th=[ 515], 5.00th=[ 529], 10.00th=[ 537], 20.00th=[ 553],
| 30.00th=[ 562], 40.00th=[ 570], 50.00th=[ 570], 60.00th=[ 586],
| 70.00th=[ 594], 80.00th=[ 611], 90.00th=[ 635], 95.00th=[ 668],
| 99.00th=[ 938], 99.50th=[ 1383], 99.90th=[ 3130], 99.95th=[ 3949],
| 99.99th=[ 5691]
bw ( KIB/s): min= 6288, max= 6968, per=100.00%, avg=6644.03, stdev=152.58, samples=119
iops      : min= 1572, max= 1742, avg=1660.99, stdev=38.16, samples=119
lat (usec) : 500=0.12%, 750=97.53%, 1000=1.51%
lat (msec) : 2=0.59%, 4=0.29%, 10=0.09%
cpu       : usr=1.13%, sys=2.03%, ctx=99679, majf=0, minf=34
IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
issued rwts: total=0,99676,0,0 short=0,0,0,0 dropped=0,0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
WRITE: bw=6645kIB/s (6884k/s), 6645kIB/s-6645kIB/s (6884k/s-6884k/s), io=389MiB (488MiB), run=60001.60001msec
[root@100 ~]#
```

Single-queue sequential read

- fio command:

fio -direct=1 -iodepth=1 -rw=read -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_03 -name=read_test

NOTE

Variable `/mnt/sfsturbo/fio_test_03 -name` indicates the location of the file to be tested. The location must be specific to the file name, which is the `fio_test_03 -name` file in the `/mnt/sfsturbo` directory in this example. Set the location based on site requirements.

- fio result:

```
[root@100 ~]# fio -direct=1 -iodepth=1 -rw=read -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_03 -name=read_test
Starting 1 process
Jobs: 1 (f=1): [R(1)|100.0%|r=6412kIB/s,w=0kIB/s|r=1603,w=0 IOPS|eta 00m:00s]
read_test: (groupid=0, jobs=1): err=0: pid=30647: Tue Nov 8 21:39:05 2022
read: IOPS=1576, BW=6306kIB/s (6457k/s) (379MiB/60001msec)
slat (nsec): min=249, max=30953, avg=1152.29, stdev=112.71
clat (usec): min=473, max=8642, avg=628.77, stdev=155.53
lat (usec): min=477, max=8646, avg=633.10, stdev=155.62
clat percentiles (usec):
| 1.00th=[ 545], 5.00th=[ 562], 10.00th=[ 570], 20.00th=[ 570],
| 30.00th=[ 594], 40.00th=[ 603], 50.00th=[ 611], 60.00th=[ 619],
| 70.00th=[ 635], 80.00th=[ 644], 90.00th=[ 676], 95.00th=[ 717],
| 99.00th=[ 1020], 99.50th=[ 1369], 99.90th=[ 2900], 99.95th=[ 3818],
| 99.99th=[ 5472]
bw ( KIB/s): min= 5888, max= 6552, per=99.96%, avg=6303.65, stdev=141.48, samples=119
iops      : min= 1452, max= 1638, avg=1575.87, stdev=35.37, samples=119
lat (usec) : 500=0.61%, 750=96.48%, 1000=2.54%
lat (msec) : 2=0.91%, 4=0.29%, 10=0.04%
cpu       : usr=0.99%, sys=1.84%, ctx=94596, majf=0, minf=34
IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete  : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
issued rwts: total=94593,0,0,0 short=0,0,0,0 dropped=0,0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
READ: bw=6306kIB/s (6457k/s), 6306kIB/s-6306kIB/s (6457k/s-6457k/s), io=379MiB (387MiB), run=60001.60001msec
[root@100 ~]#
```

Single-queue sequential write

- fio command:

fio -direct=1 -iodepth=1 -rw=write -ioengine=libaio -bs=4k -size=10G -numjobs=1 -runtime=60 -group_reporting -filename=/mnt/sfsturbo/fio_test_04 -name=write_test

 NOTE

Variable `/mnt/sfsturbo/fio_test_04 -name` indicates the location of the file to be tested. The location must be specific to the file name, which is the `fio_test_04 -name` file in the `/mnt/sfsturbo` directory in this example. Set the location based on site requirements.

- fio result:

```
[root@100 ~]# fio --direct=1 --iodepth=1 --write --ioengine=libaio --bs=4k --size=100 --numjobs=1 --runtime=60 --group_reporting --filename=/mnt/sfsturbo/fio_test_04 --name=write_test
write_test: (g=0): rw=write, bs=(R) 4096B-4096B, (W) 4096B-4096B, (T) 4096B-4096B, ioengine=libaio, iodepth=1
fio-3.7.5
Starting 1 process
Jobs: 1 (f=1): [w(1)][100.0%][r=0kIB/s,w=6886kIB/s][r=0,w=1721 IOPS][eta 00m:00s]
write_test: (group=0, job=1): err=0: pid=969: Tue Nov 8 21:40:23 2022
write: 1095=1790, bw=7194kIB/s (7367kB/s)(422MB/6000Imsec)
slat (msec): min=2266, max=32022, avg=4256.55, stdev=1452.74
clat (usec): min=443, max=10894, avg=550.41, stdev=168.67
lat (usec): min=447, max=10900, avg=554.82, stdev=168.73
clat percentiles (usec):
| 1.00th=[ 469], 5.00th=[ 486], 10.00th=[ 494], 20.00th=[ 502],
| 30.00th=[ 515], 40.00th=[ 523], 50.00th=[ 529], 60.00th=[ 537],
| 70.00th=[ 553], 80.00th=[ 562], 90.00th=[ 594], 95.00th=[ 627],
| 99.00th=[ 963], 99.50th=[ 1483], 99.90th=[ 3064], 99.95th=[ 3654],
| 99.99th=[ 5211]
bw ( KIB/s): min= 6528, max= 7688, per=99.99%, avg=7193.45, stdev=213.10, samples=120
iops      : min= 1632, max= 1922, avg=1798.35, stdev=53.28, samples=120
lat (usec) : 500=16.99%, 750=80.94%, 1000=1.14%
lat (msec) : 2=0.63%, 4=0.26%, 10=0.03%, 20=0.01%
cpu       : usr=0.97%, sys=2.16%, ctx=107916, majf=0, minf=33
IO depths : 1=100.0%, 2=0.0%, 4=0.0%, 8=0.0%, 16=0.0%, 32=0.0%, >=64=0.0%
submit    : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
complete : 0=0.0%, 4=100.0%, 8=0.0%, 16=0.0%, 32=0.0%, 64=0.0%, >=64=0.0%
issued rwts: total=0,107912,0,0 short=0,0,0 dropped=0,0,0
latency   : target=0, window=0, percentile=100.00%, depth=1

Run status group 0 (all jobs):
WRITE: bw=7194kIB/s (7367kB/s), 7194kIB/s-7194kIB/s (7367kB/s-7367kB/s), io=422MB (442MB), run=60001-60001msec
[root@100 ~]#
```