Oracle Cloud Infrastructure

File Storage Service Performance Guide

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Revision History

The following revisions have been made to this white paper since its initial publication:

Date	Revision
September 28, 2018	Initial publication

You can find the most recent versions of the Oracle Cloud Infrastructure white papers at https://cloud.oracle.com/iaas/technical-resources.

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Overview

This paper describes the performance of the Oracle Cloud Infrastructure File Storage service. Specifically, it describes what customers can expect for read, write, IOPS, and metadata performance, and it offers suggestions for optimizing performance. This information can help customers assess whether File Storage is suitable for their workloads.

What Is File Storage?

Oracle Cloud Infrastructure File Storage is a managed file storage service that can be accessed concurrently by thousands of compute instances. Using industry-standard Network File System (NFSv3) file access protocols and file system semantics, you can start with a file system that contains only a few kilobytes (KB) of data and scale to exabytes (EB) of data without capacity planning or provisioning. File Storage protects your data by maintaining multiple replicas, providing transparent encryption, and enabling frequent snapshots.

Testing Methodology

To test File Storage performance, we used internally developed tools for both aggregate and individual results. These performance-testing tools are not publicly available, but we plan to expand our performance testing to include industry-standard benchmarks in the future.

File Storage Read/Write Performance

File Storage is a cloud storage service; the available read and write throughput increases proportionally to the size of the file system. For each terabyte (TB) of data stored, customers who are performing reads and writes of large (~1 MB) blocks can expect the following results:

- Overall read performance of at least 100 MB/second
- Overall write performance of at least 50 MB/second
- At least 2,500 read IOPS

Currently, Oracle Cloud Infrastructure does not reserve or throttle performance; therefore, observed performance might be higher or lower for your scenarios. Burst performance might be significantly better than these targets.

The highest levels of performance assume concurrent access and can be achieved only by using multiple clients, multiple threads, and multiple mount targets. A multithreaded client running on a single bare metal instance with a single mount target should be able to achieve approximately the performance described for a 10-TB file system.

The following table describes the level of performance that customers can expect for different size file systems. Although we do not guarantee these numbers, we expect that customers should be able to achieve at least this level of performance in the current File Storage service.

File System Size	Read Bandwidth (1-MB Blocks)	Write Bandwidth (1-MB Blocks)	Read IOPS (8K Blocks)	Cost Per Month
1 TB	100 MB/s	50 MB/s	2,500	$43
10 TB	1 GB/s	500 MB/s	25,000	$425
100 TB	10 GB/s	5 GB/s	250,000	$4,250

File Storage Metadata Performance

The performance of metadata operations such as file create, delete, and rename is difficult to characterize in a single number. Although File Storage runs independent metadata operations in parallel, many commonly used applications don't issue parallel requests. Therefore, the performance of a client performing operations such as `ls` or `tar` is limited by the round-trip latency of the system. The following common examples illustrate this performance:

- Running `ls –l` (long format) for 100,000 files in one directory takes 12.7 seconds. Running `ls` (short format) takes 8.3 seconds.
- Running `tar –xf` to unpack the Linux kernel (834 MB, about 67,000 files) takes 10 minutes, 30 seconds.
- A parallel implementation of `tar –xf` can unpack the Linux kernel in 54 seconds with 48 threads.

Maximizing File Storage Performance

To optimize the performance of File Storage, consider the following guidelines:

- File Storage scales based on consumed capacity, with larger file systems receiving more available bandwidth.
- File Storage performance increases with parallelism. Increase concurrency by using multiple threads, multiple clients, and multiple mount targets.
- Several Linux-based tools run file operations in parallel: parallel tar and untar (`puntar`), parallel copy (`parcp`), and parallel remove (`parrm`). The File Storage engineering team has developed these tools, and we are in the process of publishing them externally. For more information, send an email to filestorage_grp@oracle.com.

* The available bandwidth to a file system can significantly impact its performance. In Oracle Cloud Infrastructure, larger instances (more CPUs) are entitled to more network bandwidth. File Storage performance is best with Oracle bare metal instances or large VM shapes.
* To minimize latency, clients and file systems should be in the same availability domain.
* For best performance, don't set any mount options such as `rsize` or `wsize` when mounting the file system. The system automatically negotiates optimal window sizes.

Conclusion

Customers who need large-scale, highly durable, highly available storage capacity can benefit from using the File Storage service. The performance of File Storage scales linearly with capacity, so as customers add more data they can expect a corresponding growth in performance. The elasticity of File Storage eliminates capacity planning and growth management, significantly reducing both storage and operational costs.

Customers with the following types of workloads can benefit from a File Storage solution:

* Enterprise applications
* Media and streaming
* Scale-out applications
* Persistence for containers
* Scientific and Research workloads
* Engineering and Technology Design workloads
* Unstructured content

If you need more guidance or assistance on performance-related questions, contact us at filestorage_grp@oracle.com.

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