Enterprise Strategy Group™

TECHNICAL VALIDATION

Oracle on Google Cloud NetApp Volumes

Reducing the Complexity and Cost of Running Database Workloads on Google Cloud

By Alex Arcilla, Principal Analyst – Validation Services
Enterprise Strategy Group

April 2025

Contents

Introduction

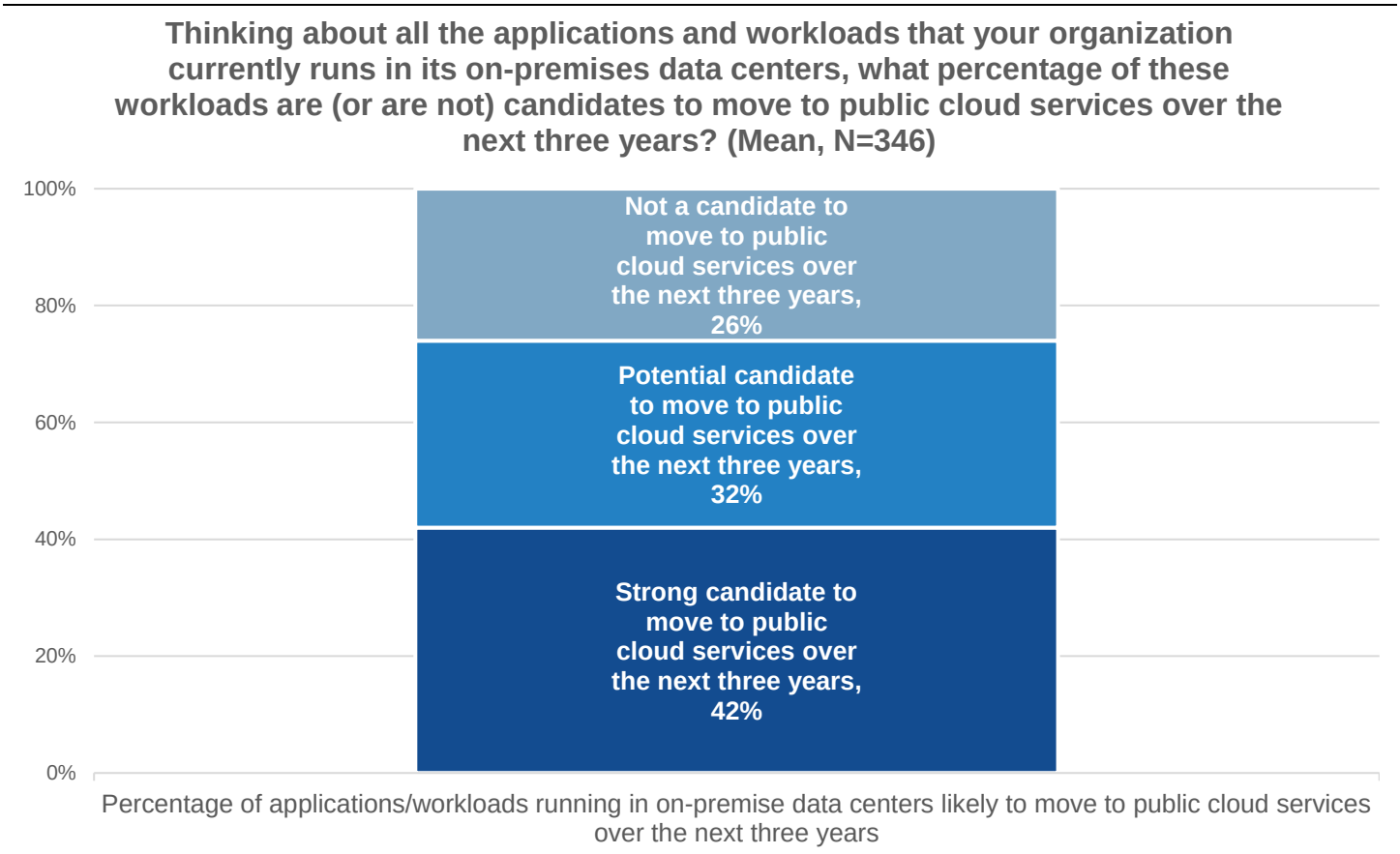
This Technical Validation from Enterprise Strategy Group, now part of Omdia, documents our evaluation of Oracle on Google Cloud NetApp Volumes. We evaluated how this managed service enables organizations to migrate and manage Oracle workloads and their data onto Google Cloud NetApp Volumes simply and cost-effectively.

Background

Organizations continue to evaluate the public cloud as a path to modernizing their IT environments. They see the potential of business applications in the public cloud to address issues such as flexibility in resource consumption, ease of scalability, and greater potential for automation, especially when compared to purchasing and maintaining on-premises infrastructure. It is no surprise then that, according to Enterprise Strategy Group research, 67% of organizations anticipate increasing their spending on the public cloud for deploying their applications.[1]

Moreover, organizations are keen on moving existing applications to the public cloud. While it is far from an "all-or-nothing" proposition, Enterprise Strategy Group research found that organizations believe 42% of their applications are strong candidates to move to the public cloud over the next three years, while 32% are potential candidates (see Figure 1).

Figure 1. Potential of Existing Applications Moving to Public Cloud Services



Source: Enterprise Strategy Group, now part of Omdia

[1] Source: Enterprise Strategy Group Research Report, *Cloud Application Deployment and Migration Decision-making*, August 2024. All Enterprise Strategy Group research references and charts in this Technical Validation are from this report unless otherwise noted.

A key component of successfully migrating existing applications to the public cloud is to ensure continuous access and availability to the right data. This is especially true today, as data continues to grow at higher rates than anticipated. For database applications, such as those supported by Oracle, making storage available to manage this growth, while ensuring accessibility, becomes critical, as organizations want to unlock business value quickly or they risk losing business or competitive advantage.

While cloud service providers offer numerous storage options, the time and skills to re-engineer and refactor public cloud storage may not be present, thus the organization incurs unnecessary delays and costs in migrations. Other factors that may come into play include the presence of features and functionality that organizations may not see present in public cloud storage offerings and overall TCO to be incurred.

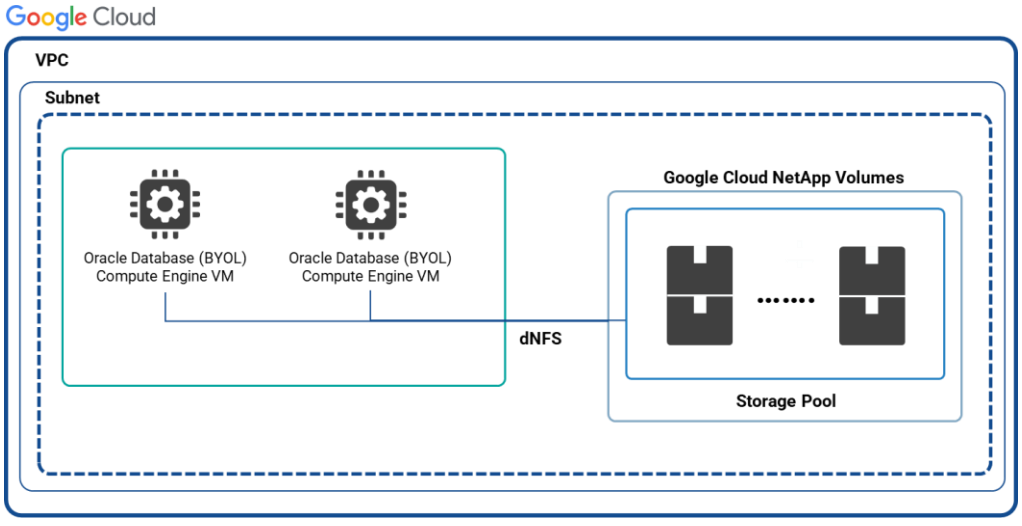
Oracle on NetApp Volumes

Google Cloud NetApp Volumes is a fully managed, cloud-based file storage service for a wide range of business-critical workloads. NetApp Volumes is a native Google Cloud servicejointly developed by NetApp and Google. With NetApp Volumes, organizations can benefit from the same features and functionality that existing customers have come to expect when using NetApp ONTAP on premises, while being able to take advantage of the scalability and security of Google Cloud infrastructure. Figure 2 shows the high-level architecture of Oracle applications supported by NetApp Volumes.

The Oracle on NetApp Volumes solution consists of the following components:

- **Google Cloud NetApp Volumes**. This storage service provides advanced data management capabilities and scalable performance, without the need for extensive provisioning and configuration workflows.
- **Google Compute Engine**. This service enables provisioning virtual machine (VM) instances that run Oracle Bring-Your-Own-License (BYOL).
- **Google Virtual Private Cloud (VPC)**. Google Cloud's networking service provides the necessary connectivity to Compute Engine virtual machine (VM) instances, Google Kubernetes Engineclusters, and serverless workloads.
- **Oracle database with Direct NFS (dNFS) client**. Directly integrated into the Oracle software, dNFS is designed to optimize the I/O path between Oracle and the NFS server, leading to performance improvements.

Figure 2. Oracle on NetApp Volumes



Source: Enterprise Strategy Group, now part of Omdia

Organizations that use NetApp Volumes to support Oracle database workloads can benefit from:

- **Dynamic resource management**. Using Google Cloud, storage resources can be scaled in real time to meet distinct levels of performance and capacity when business needs change. Volumes can be provisioned, adjusted, and scaled to support databases ranging from GB to PB in size.
- **Independent scaling of compute and storage resources**. This is especially useful when dealing with data-heavy workloads. Because organizations can scale and adjust storage at any time, storage consumption over time is better managed, leading to an overall lower TCO.
- **Multiple scaling options**. NetApp Volumes offers multiple options—Flex, Standard, Premium, and Extreme—covering a wide range of latency and throughput requirements with associated storage pool and volume sizes (see Table 1).
- **Enterprise-grade architecture**. NetApp Volumes is built on ONTAP technology, ensuring that organizations can experience the same features and functionality as they have when running NetApp ONTAP on premises. Organizations running Oracle workloads in Google Cloud can expect the same levels of data security, reliability, and high availability when using NetApp Volumes. For example, NetApp Volumes provides cross-region volume replication capabilities for business continuity and disaster recovery.
- **Workload management**. Organizations can manage storage of individual databases and database components, such as data files or archival log destinations with NetApp Volumes. This level of granular management enables organizations to consolidate multiple databases onto a single VM instance while maintaining proper isolation and performance characteristics of their individual storage volumes. This especially applies when organizations consolidate multiple smaller databases on a single instance while maintaining isolation of each database's data files located across multiple storage volumes.
- **Data protection and management**. NetApp Volumes provides instantaneous snapshots that capture data volumes as point-in-time images at specific points in time for rapid point-in-time recovery and backup and restore operations.
- **Development and testing support**. To speed up development and testing cycles, teams can quickly provision test environments cost-effectively with volume cloning, thus not interrupting the production workload.

Table 1. NetApp Volumes Service Levels

Service Level	Flex	Standard	Premium	Extreme
Performance	16 MiB/sec per TB Max 5 GiBps (Throughput)*	16 MiB/sec per TB Max 1 GiBps (Throughput)	64 MiB/sec per TB Max 30 GiBps** (Throughput)	128 MiB/sec per TB Max 30 GiBps** (Throughput)
Storage Pool Size	1TiB – 100TiB	1TiB – 100TiB	2TiB – 10PiB	
Volume Size	1GiB – 100TiB	100GiB – 100TiB	100GiB – 1PiB**	
Regional Availability	40 Google Cloud regions	14 Google Cloud regions		
Protocols	NFSv3/v4.1, SMB, Dual (SMB/NFS)			
Data Protection	Snapshots, Copies, Cross-region volume replication, Backup			

* Higher throughput and independent throughput capacity in roadmap

** With large volumes

Source: NetApp and Enterprise Strategy Group, now part of Omdia

Enterprise Strategy Group Technical Validation

Enterprise Strategy Group validated how Oracle on NetApp Volumes can help organizations ensure that migrating Oracle database applications to the cloud can be accomplished easily and cost-effectively, without sacrificing the features and functionality NetApp Volumes delivers, to ensure consistent database performance, availability, and reliability.

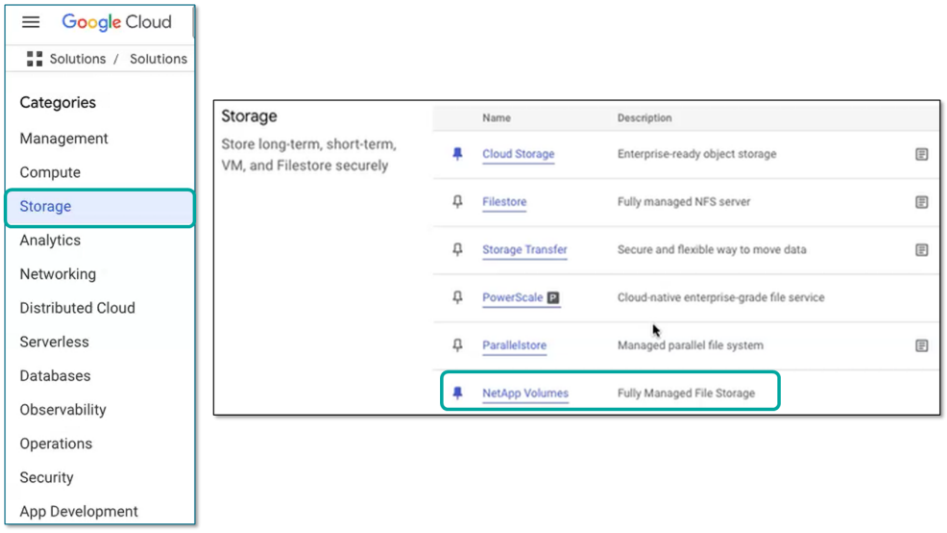
Simple Provisioning and Scaling of Database Storage

As more data becomes available for Oracle applications, provisioning and scaling database storage needs to be as easy as possible. If not, users of these applications may not be able to access this new data, delaying their ability to extract business value. With NetApp Volumes, provisioning and scaling file-based storage for Oracle databases presents a simpler worklflow (e.g., fewer clicks to make) than creating a new storage architecture from existing public cloud storage options.

Enterprise Strategy Group Testing

To observe the simplicity of provisioning database storage with NetApp Volumes, following the standard Google Cloud provisioning process, Enterprise Strategy Group navigated to the Google Cloud Console to provision services and and selected “NetApp Volumes” under the ‘Storage’ options (see Figure 3).

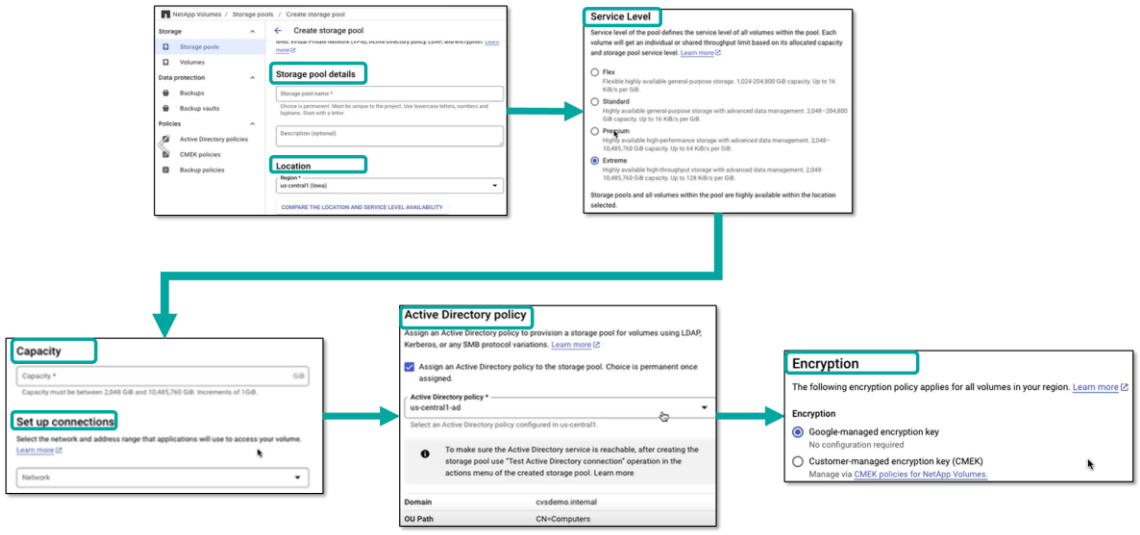
Figure 3. NetApp Volumes as a Google Cloud Offering



Source: Enterprise Strategy Group, now part of Omdia

After selecting “NetApp Volumes,” we then created a storage pool (see Figure 4). This pool would be used to provision the volumes that contain the data supporting one or more Oracle database workloads. Starting the configuration process was as simple as clicking on the button named “Create Storage Pool” and inputting configuration details, such as its location (the region in which the pool will reside), the service level (Flex, Standard, Premium, Extreme), total capacity, network connectivity (what IP addresses will be used for connecting workloads to storage), and volume encryption. Those using Active Directory for authentication, such as in the case of Windows file shares, can also input any associated configurations. Once the storage pool was configured, we then deployed it.

Figure 4. Configuring a NetApp Volumes Storage Pool



Source: Enterprise Strategy Group, now part of Omdia

Should organizations wish to configure Oracle storage using other Google Cloud storage options, additional skills and/or expertise in the relevant public cloud storage would be required. Provisioning the storage and networking resources must be done from two different interfaces, as each resource is represented by a different Google Cloud service. Achieving the features to ensure data security, reliability, and availability requires organizations to build them from the ground up using Google Cloud best practices, prior experience, and trial and error. The entire architecture would also need to be tested before deployment, which can easily lead to rework. Because the architecture is built with specific performance and capacity requirements in mind, if business needs change, organizations need to execute changes manually to comply with new requirements. However, this can ultimately lead to unwanted downtime and negatively impacts business operations.

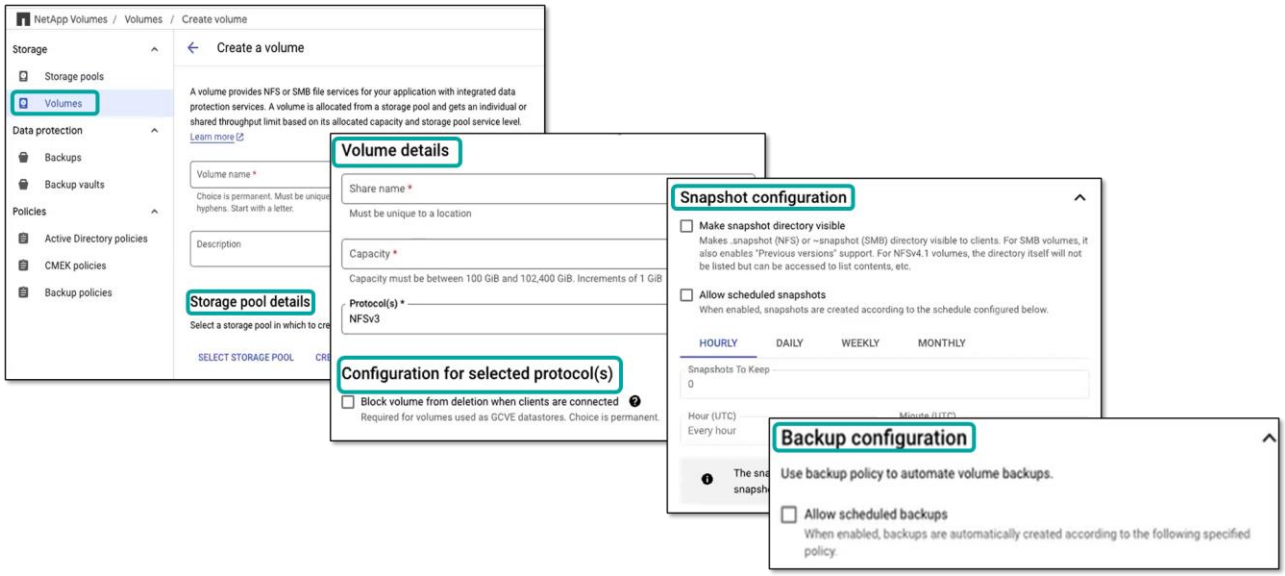
With NetApp Volumes delivered as a managed service, the aforementioned level of manual configuration and testing is practically eliminated. All provisioning and configuration tasks are accomplished using one interface. Once the details are entered, all background work in creating the storage resources and connecting it to the Oracle workloads is done automatically. And all features supporting data security, reliability, and availability are already built into the provisioned storage. Additionally, a database administrator can simply revise the service level should performance requirements change (e.g., when managing spikes in database transactions). Scaling storage is as simple as increasing the amount of capacity in the storage pool (e.g., for planned growth in storage); making these changes does not interrupt normal operations.

The simplicity of configuring database storage can also improve overall cost management. When business requirements evolve, NetApp Volumes enables organizations to scale the performance and capacity of the storage pool up or down. Resources are not wasted, eliminating unnecessary expenses. Alternatively, organizations can right-size the storage volumes to start small at the time of provisioning and manage growth as they need for cost control.

Enterprise Strategy Group also noted the simplicity of creating storage volumes in our newly created storage pool. Under the NetApp Volumes page, we clicked on “Volumes” in the sidebar menu. Again, we only needed to enter values for the parameters listed in a single interface (see Figure 5). Values included the volume capacity, the

storage pool where the volume is to be located, the protocol used (e.g., NFSv3), the snapshot configuration (e.g., schedule for regular snapshots), and the backup policy for snapshots.

Figure 5. Creating Storage Volumes With NetApp Volumes



Source: Enterprise Strategy Group, now part of Omdia

Crash-consistent snapshots can be configured (for point-in-time recovery) to ensure that the storage service is not interrupted. For application consistency, halting the application or performing necessary steps to pause the application is required before taking the snapshot copy. For Oracle databases, hot backup facilities depend on the database management system and do not always pause I/O to database files. Snapshots are local to the volume and available within the same region as the volume, while in-region and cross-region options are available for volume backups based on snapshots

We should note that NetApp Volumes snapshots can also help in managing overall costs, as charges are incurred only for storage for snapshots, which are space-efficient as they only store data changes, not full data copies.

Why This Matters

Of the concerns raised that led organizations to decide against migration for specific applications, 28% of organizations cited facing a costly or complex migration as a top concern. For organizations that seek to migrate Oracle workloads to the public cloud, provisioning and configuring database storage using traditional public cloud storage options and manual workarounds can unfortunately raise those same concerns.

Enterprise Strategy Group validated that provisioning and configuring database storage with NetApp Volumes can be done simply, eliminating the need to build a storage architecture for Oracle workloads from scratch. We observed that using this fully managed file-based storage service can help organizations increase productivity and save valuable time and resources, thus supporting quick deployment of database workloads into production. We found that we could configure database storage pools and volumes via a single interface. Should business requirements change, we could also dynamically change both the performance level and capacity of the database storage without disrupting normal business operations. Simultaneously, organizations can better manage their storage costs by scaling performance and capacity up or down so that resources and their associated costs are not wasted.

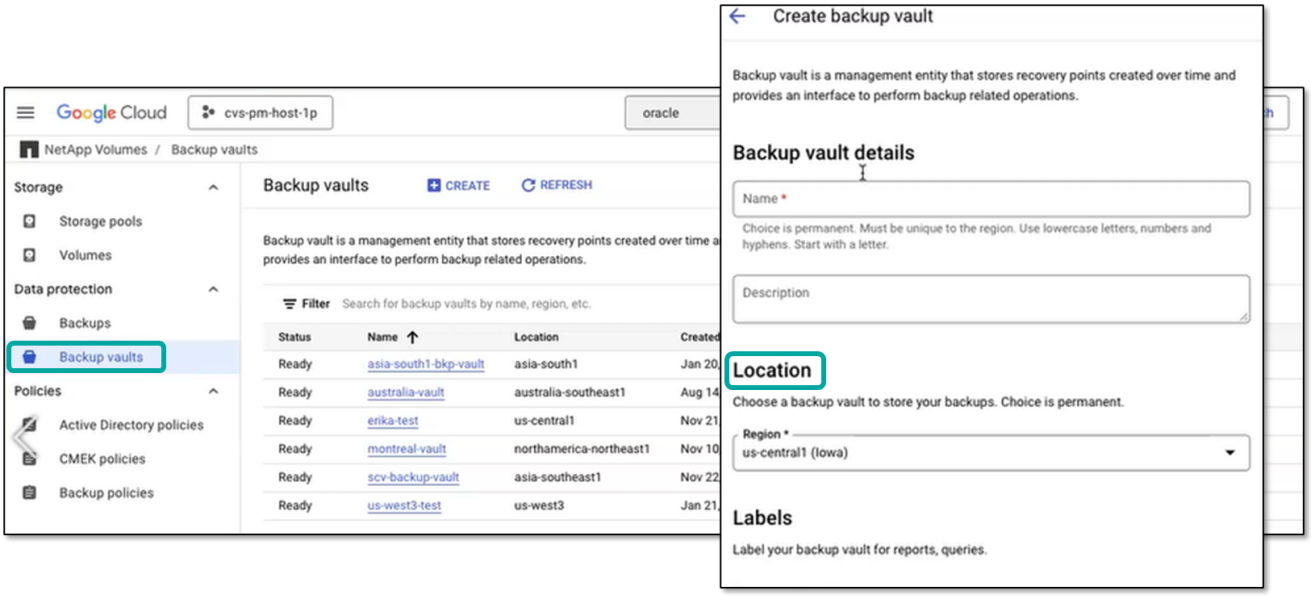
Simple Data Protection Configuration

To ensure business operations recover from any “disaster,” such as data corruption or a ransomware attack, quickly, NetApp Volumes provides multiple recovery options, including secondary asynchronous data copy in a different location, backups, and snapshots. NetApp Volumes simplifies the process for implementing these data protection options so that Oracle workloads can recover as quickly and smoothly.

Enterprise Strategy Group Testing

Enterprise Strategy Group navigated to the NetApp Volumes main menu and selected “Backup Vaults” (see Figure 6). A backup vault must be created for storing recovery points created over time.

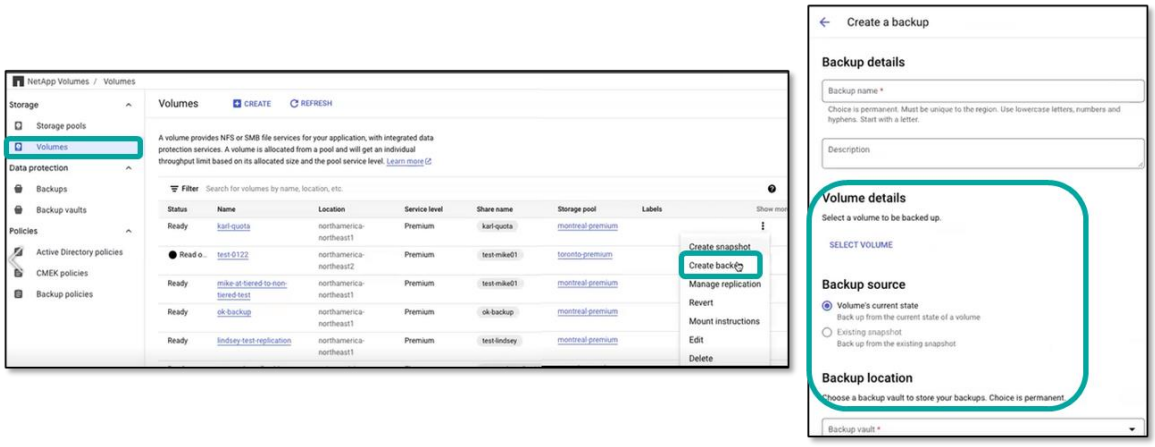
Figure 6. Creating a Backup Vault



Source: Enterprise Strategy Group, now part of Omdia

Once the vault was created, we chose the volume that would be associated with our backup vault and right-clicked to select the “Create Backup” option (see Figure 7). We were prompted to enter details such as the backup source and location, noting that NetApp Volumes supports storing backups in the same region as the volume or a different region. The backup source can either be the existing state of the volume or an existing backup. Backup policies can also be configured via this interface.

Figure 7. Creating a Backup of a Single NetApp Volume



Source: Enterprise Strategy Group, now part of Omdia

For database administrators, creating these backups is critical to ensure that downtime is minimized and normal operations continue in case of any disruption. Backups stored in another region can function as the last line of defense should a volume become corrupted.

Why This Matters

Ensuring that Oracle workloads continue to operate in light of any disruption is a constant challenge. Creating and placing backups at the right intervals in the right location can become tedious, especially when dealing with multiple Oracle workloads.

Enterprise Strategy Group validated that NetApp Volumes greatly simplifies the process of creating backups and backup policies across multiple storage volumes. We observed the simplicity in completing these tasks while enabling organizations to configure exactly the schedule and location of backups tailored to individual Oracle workloads.

Database Performance With NetApp Volumes

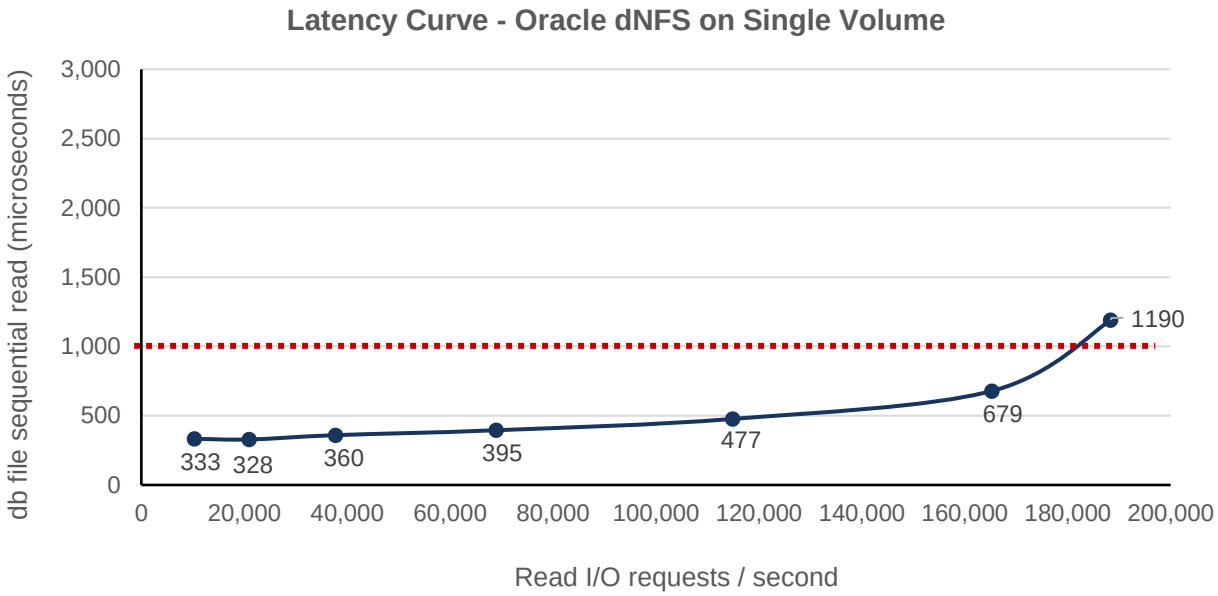
While we have seen how NetApp Volumes can simplify the way storage is provisioned and configured for Oracle workloads, organizations must maintain the database performance that end users need to complete their business tasks.

Enterprise Strategy Group Testing

To assess the potential real-world performance of Oracle workloads with NetApp Volumes, Enterprise Strategy Group audited results characterizing Oracle cloud-based workloads supported by a NetApp-powered cloud storage offering similar to NetApp Volumes. The Silly Little Oracle Benchmark (SLOB), a widely known Oracle I/O workload generation tool kit, was used to simulate the workloads during testing. All metrics displayed in the following charts were gathered by the Oracle database via its Automatic Workload Repository (AWR) reports.

We first audited results that revealed the performance limits of an 80% SELECT/20% UPDATE Oracle workload with dNFS client supported by a 16 TiB NetApp-powered storage pool (see Figure 8). Random I/O was generated, and the database buffer hit ratio was set at 8%.

Figure 8. Maintaining Low Latencies as Read I/Os Increase

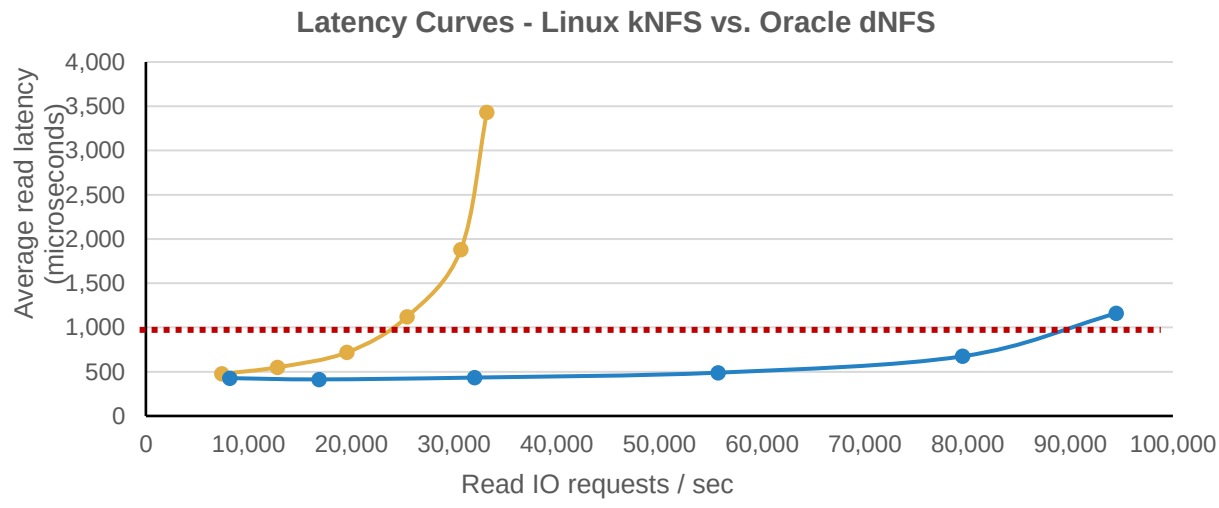


Source: Enterprise Strategy Group, now part of Omdia

Results revealed that the Oracle workload maintained average latencies under one millisecond in light of increasing read I/O requests up to a maximum around 160,000. From there, latencies exceeded one millisecond.

We then audited results to compare the performance between the Linux kernel Network File System (kNFS) and dNFS protocols to highlight how dNFS optimizes database performance when coupled with NetApp-powered cloud storage. For this test, a workload of 75% SELECT and 25% UPDATE was used, consisting mostly of random I/O. The database buffer hit was set at around 7.5%, the storage pool was 8 TiB, and four user schemas were used to generate requests in parallel. The comparison is displayed in Figure 9.

Figure 9. Oracle dNFS Maintains Average Low Latencies



Source: Enterprise Strategy Group, now part of Omdia

The results revealed that Oracle dNFS outperformed the Linux kNFS client. The average read latency for the read I/O request per second remained below one millisecond. Average latency exceeded one millisecond when read I/O requests reached approximately 90,000. On the other hand, the average latency exhibited by the kNFS client exceeded one millisecond when the maximum read I/O requests reached approximately 26,000.

Overall, these results show that the Oracle dNFS client, supported with NetApp-powered cloud storage, can process large amounts of read requests from multiple users, without sacrificing high performance.

Why This Matters

Enterprise Strategy Group research shows that performance and scalability remain a key issue when deploying database applications, with 38% of organizations citing them as one of their top three criteria when evaluating and selecting database technologies.[2] Yet, to support this high performance, the appropriate storage must also be chosen while keeping cost considerations in mind

Enterprise Strategy Group validated that Oracle-based cloud workloads, supported by NetApp-powered cloud storage, can deliver the performance that organizations need as the number of I/O requests increases. By auditing testing results, we found that the combination of Oracle and NetApp-powered cloud storage consistently delivers low latencies under one millisecond, especially as simulated read requests increased. Based on the testing methodology and results, we believe that the results are indicative of the performance that organizations can expereince when supporting Oracle workloads with NetApp Volumes.

Conclusion

Organizations are choosing to migrate Oracle applications to the public cloud to lower their infrastructure costs while leveraging the flexibility and scalability offered by public cloud infrastructure. As business needs evolve for Oracle workloads, the time and effort needed to architect the right type and amount of storage, while ensuring data is protected and secure should service-affecting events occur, can become too costly.

With Google Cloud NetApp Volumes, organizations can significantly simplify how storage can be provisioned and managed for Oracle workloads, with little, if any, disruption to normal business operations. NetApp Volumes is delivered as a fully managed, cloud-based file storage service in Google Cloud. Instead of manually purchasing and configuring storage using available public cloud storage services, organizations can simply request the service level and capacity required, then configure the storage into storage volumes supporting one or more Oracle workloads. All tasks are completed via a single interface, removing the need to access and coordinate tasks between multiple interfaces, including Google Cloud Console, gCloud command line operations, REST APIs, and Terraform. Any configuration of Google Cloud's infrastructure to satisfy these storage needs is automated. While Google Cloud provides the scalability and security for Oracle workloads, NetApp Volumes provides the enterprise-grade storage features that organizations need when running business- and mission-critical Oracle applications (such as backup and recovery). Should business requirements change, organizations can simply change the service level of the NetApp Volumes and capacity to meet new performance and capacity requirements. No manual rearchitecting of storage needs to be done.

Based on our evaluation, Enterprise Strategy Group validated that running Oracle workloads on NetApp Volumes can benefit organizations in the following ways:

- Decreased time, resources, and cost for provisioning and configuring storage for Oracle workloads using the single interface associated with the managed file storage service.

[2] Source: Enterprise Strategy Group Research Report, *Rethinking Database Requirements in the Age of AI*, February 2025.

- Simple and quick configuration of enterprise-grade features, such as backup and recovery, which are already delivered via this managed service.
- Low latencies when processing database I/Os, especially as database activity and users increase.

With these benefits, organizations can expect to decrease the costs of deploying and configuring storage to meet a wide range of performance and capacity requirements, while still receiving the performance and enterprise-level features needed for supporting Oracle workloads in production.

The challenges to provide the right amount of storage to meet a wide range of performance requirements are constant. Organizations must be able to handle growing amounts of data so that they can extract value and gain competitive advantage, and they require quick storage provisioning and configuration. However, should business requirements change, organizations must adopt new storage requirements, leading to possible overprovisioning or misconfiguration.

Over the years, Enterprise Strategy Group has had the opportunity to evaluate multiple NetApp offerings. During this time, we have repeatedly validated the simplicity in provisioning, configuring, and managing NetApp storage, while delivering the features and performance that organizations expect in enterprise-grade storage. This report is no different. Our evaluation of NetApp Volumes for Oracle workloads shows that this offering provides a simpler and comprehensive way to obtain the right amount of storage for any given performance requirement, at lower cost and effort. This offering simply delivers on the benefits that we have validated repeatedly—simplified provisioning and configuration of storage for business- and mission-critical workloads. Therefore, Enterprise Strategy Group believes organizations should take a close look at NetApp Volumes when migrating Oracle workloads to Google Cloud.

About Enterprise Strategy Group
Enterprise Strategy Group, now part of Omdia, provides focused and actionable market intelligence, demand-side research, analyst advisory services, GTM strategy guidance, solution validations, and custom content supporting enterprise technology buying and selling.

contact@esg-global.com
www.esg-global.com