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A Comparative Analysis of NetApp Cloud Volumes ONTAP, and Azure NetApp Files: Evaluating Cloud Storage Solutions for Modern Enterprise Needs

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Abstract:
In cloud-driven digital transformation, organizations are adopting advanced storage solutions to meet demands for scalability, performance, and efficiency. This paper compares two cloud storage platforms: NetApp Cloud Volumes ONTAP (CVO) and Azure NetApp Files (ANF). Both use NetApp's ONTAP technology but differ in deployment models, management frameworks, and cost structures. CVO is a software-defined storage solution extending on-premises ONTAP to multi-cloud environments, supporting workloads like disaster recovery, databases, and file services. ANF, a fully managed Azure-native service, facilitates file-based workload migration with high performance, scalability, and built-in redundancy. This study evaluates their architectural designs, performance, and data protection. Key findings show CVO offers cross-cloud flexibility and advanced data management, while ANF excels in Azure integration and simplicity. Analyzing use cases, protocol support, and SLAs, this paper provides insights for selecting the optimal cloud storage solution, enabling efficient data management and supporting digital transformation.

Keywords: Cloud Storage, NetApp Cloud Volumes ONTAP, Azure NetApp Files, Data Management, Cloud Migration, Performance, Scalability.

INTRODUCTION

In the era of digital transformation, cloud-based file-sharing services have emerged as pivotal components of contemporary data management strategies. These services offer unparalleled scalability, availability, and durability, thereby addressing the dynamic requirements of enterprise environments. Protocols such as the Network File System (NFS) and the Common Internet File System (CIFS) facilitate seamless global data accessibility, enabling diverse applications across distributed computing infrastructures. Among the leading solutions in this domain, NetApp® Cloud Volumes ONTAP® and Azure NetApp Files are robust platforms that address the complexities of cloud-data management.

NetApp Cloud Volumes ONTAP, a cloud-native data management service built on the established ONTAP storage software, provides a universal storage platform that seamlessly integrates with major cloud providers, such as AWS, Azure, and Google Cloud. This solution extends the capabilities of on-premises storage systems to the cloud, ensuring consistency and operational efficiency without necessitating the extensive retraining of IT personnel. Cloud Volumes ONTAP supports a wide range of applications,

including disaster recovery, development and testing environments, and mission-critical applications that require high availability and non-disruptive operations. By leveraging advanced features, such as NetApp Snapshot™ technology, organizations can achieve near-instantaneous data backup and recovery without compromising storage resources or application performance.

Complementing this, Azure NetApp Files, a service delivered by Microsoft and powered by NetApp's ONTAP technology, offers a streamlined approach for migrating file-based workloads to Azure. This service eliminates the need for costly and time-consuming architectural modifications, enabling organizations to transition legacy applications and NFS file shares to the cloud with minimal effort. Azure NetApp Files provide a dedicated high-performance environment within the Azure ecosystem, ensuring optimal operational efficiency and scalability. Its integration with the Azure portal simplifies provisioning and management, allowing users to dynamically adjust their performance levels and storage capacity without disrupting existing workflows.

Together, cloud volume ONTAP and Azure NetApp Files represent transformative solutions that enable organizations to meet their cloud mandates with agility and precision. This study examines the capabilities, benefits, and applications of these platforms, highlighting their role in advancing cloud-based data management and facilitating seamless digital transformation.

CLOUD VOLUMES ONTAP

Cloud Volumes ONTAP (CVO) is a cloud-based data management solution built on NetApp ONTAP storage software that provides a unified storage platform for diverse cloud data requirements. It maintains a consistent storage operating system across on-premises and cloud environments, enhancing data fabric continuity while minimizing additional IT training requirements. CVO is available on AWS, Azure, and Google Cloud, addressing organizational needs including disaster recovery, development, testing, and mission-critical applications. It supports highly available operations for enterprise workloads, such as production applications and file services, using NFS and SMB. Deployed and managed through the NetApp Cloud Manager, CVO is a software-defined storage solution utilizing cloud computing instances to manage cloud storage, creating a virtualized storage environment within the cloud infrastructure. CVO provides advanced data management capabilities, supporting NAS and SAN storage provisioning via the SMB, NFS, and iSCSI protocols. It offers NetApp Snapshot™ technology, enabling zero-impact, near-instantaneous point-in-time backups and recovery copies, ensuring efficient data protection without additional storage consumption or performance impact.

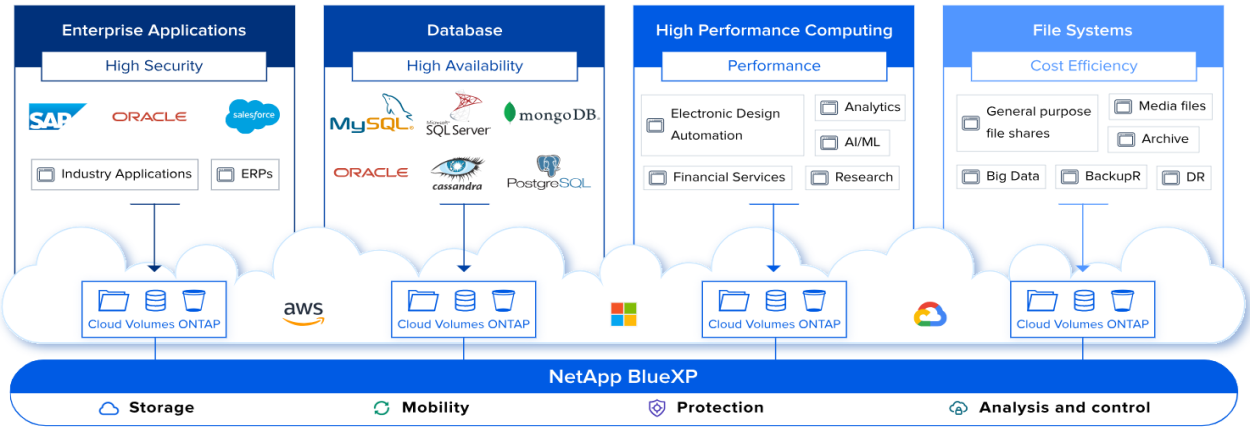

Figure 1: Cloud volumes Ontap storage designed with the unique performance, scalability, and security

Deployment	CVO is deployed through hyperscaler integration on cloud.netapp.com, though manual installation is an option. Cloud Manager is first deployed as an orchestration layer, managing ONTAP provisioning and replication setup. During deployment, a wizard guides you through configuring instance types, storage, networking, and security policies. Since CVO runs on virtual machines, you must define security, networking, and resource allocation. CVO can be deployed as a single instance or a high availability (HA) pair (recommended for redundancy).
Management	Management of Cloud Volumes ONTAP (CVO) is primarily facilitated through the Cloud Manager instance, which serves as the central orchestration platform. Additionally, direct access to CVO is available via the System Manager interface or command-line utilities for administrative tasks. Furthermore, REST API support is provided, enabling integration with automation frameworks and external management systems.
Network Access	Multiple virtual network interfaces (Logical Interfaces, LIFs) can be configured across different virtual networks (VNets), enabling enhanced network segmentation and connectivity within the cloud infrastructure.
Supported capacity	A Cloud Volumes ONTAP (CVO) High Availability (HA) cluster supports a maximum storage capacity of 368 TiB per node pair. This capacity is allocated across the active and standby nodes, ensuring data redundancy and high availability. Additionally, capacity tiering to object storage (such

	as Azure Blob, Amazon S3, or Google Cloud Storage) allows for virtually unlimited scalability, enabling efficient data lifecycle management and cost optimization.
Protocol Support	CVO supports NFS, SMB, and iSCSI
Performance Characteristics	The performance characteristics of Cloud Volumes ONTAP (CVO) are influenced by multiple factors, including the virtual machine instance type, the underlying storage media (e.g., HDD or SSD), and the specific workload requirements. These factors collectively determine the throughput, latency, and overall system efficiency.
Data Protection	ONTAP provides native snapshot capabilities, data vaulting, including Write Once, Read Many (WORM) protections, and compatibility with various third-party backup solutions. Snapshots can be policy-driven and scheduled to align with data protection requirements. Cloud Volumes ONTAP (CVO) supports up to 1,023 snapshots per volume, enabling efficient backup and recovery strategies.
Data Replication	ONTAP volumes and Storage Virtual Machines (SVMs) natively support SnapMirror replication between on-premises ONTAP instances and Cloud Volumes ONTAP (CVO) instances. Additionally, CVO instances can replicate data between other CVO instances within or across regions, as well as to CVO instances deployed in different hyperscaler environments, enabling seamless data mobility and disaster recovery strategies.
SLA	The Service Level Agreement (SLA) for Cloud Volumes ONTAP (CVO) is contingent on the reliability of the underlying Azure infrastructure

	supporting its deployment. The virtual machine SLA guarantees 99.9% availability for single-zone deployments, while high-availability (HA) configurations within a single resource group offer an enhanced 99.95% SLA. Additionally, the Azure Blob Storage SLA, which is utilized for cold data tiering, ranges between 99.9% and 99.99%, depending on the specific deployment configuration.
Ownership	Customer is responsible for upgrading CVO.
Licensing	Cloud Volumes ONTAP (CVO) offers flexible licensing options, allowing deployment through a pay-as-you-go model, where usage is billed via the Azure account and charged back to NetApp. Alternatively, organizations can opt for a Bring Your Own License (BYOL) model, enabling upfront license procurement for long-term cost optimization.
Cost	The cost structure of Cloud Volumes ONTAP (CVO) comprises two primary components: the licensing fee and the Azure infrastructure costs. The latter includes expenses associated with the virtual machine instance, underlying storage, and any Blob storage capacity utilized for data tiering and management.
Support	Support for CVO is provided through NetApp.

Table1: Key Features and Characteristics of Cloud volumes Ontap

III. Azure NetApp Files

Azure NetApp Files (ANF) are a fully managed enterprise-grade file storage solution integrated into the Azure ecosystem. Designed for high performance and scalability, ANF allows organizations to provide file storage volumes as a service within a NetApp account and capacity pool. These volumes can be shared with clients using industry-standard protocols such as NFS and SMB, ensuring flexible and secure data access. ANF offers configurable service and performance tiers along with robust data protection

mechanisms to ensure business continuity and operational resilience. ANF's scalable architecture supports the creation and management of high-performance, highly available file shares using the same protocols and tools common in on-premises storage environments. This integration aids the transition to cloud storage while maintaining operational familiarity with the IT staff.

Key Features of Azure NetApp Files:

Optimized Performance and Cost Efficiency: ANF delivers high-throughput and low-latency storage, ensuring optimal performance for critical workloads while being cost-effective.

Simplified Management and High Availability: The platform enables seamless deployment, automated provisioning, built-in redundancy, reduced administrative overhead, and enhanced reliability.

Comprehensive Data Management and Security: ANF meets enterprise-grade security standards and offers advanced data protection features, ensuring compliance and safeguarding sensitive information.

Use Cases for Azure NetApp Files:

Enterprise File Sharing: ANF enables multiuser access to centralized file storage and streamlines workflows across distributed teams.

Home Directories: This solution supports user profile storage and access, ensuring consistent user experiences across diverse environments.

Databases: ANF is optimized for database workloads and offers low latency and high throughput for data-intensive applications.

High-Performance Computing (HPC): The platform supports computation-intensive applications, providing the necessary storage performance for HPC workloads.

By leveraging Azure NetApp Files, organizations can achieve scalable, secure, and high-performance file storage, thereby simplifying the migration and modernization of workloads in the cloud. This study examines the architectural design, key features, and practical applications of ANF, highlighting its role in enabling efficient and resilient cloud-based data management.

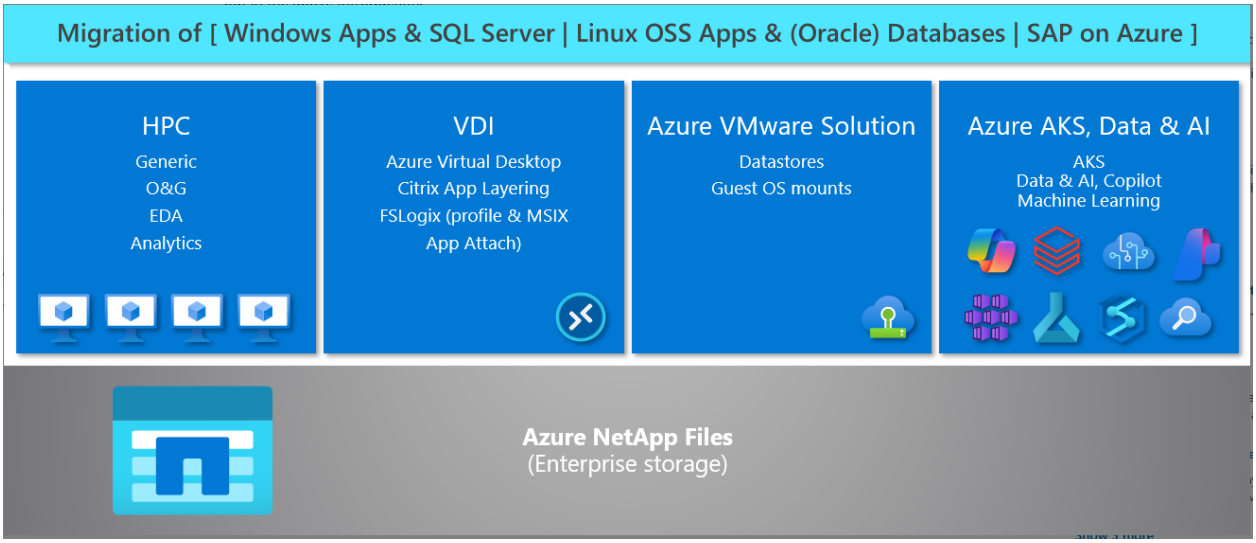

Figure 2: Azure NetApp files use cases

Deployment	In the Azure Portal, navigate to Azure NetApp Files (ANF) and select + Create to initiate the deployment process, following the standard Azure workflow. ANF is provisioned within a designated subnet, utilizing IP addresses from the allocated address space. Other subnets within the same Virtual Network (VNet) can natively access ANF shares. Additionally, VNet peering or a VPN can be configured to enable access from external VNets.
Management	Azure NetApp Files (ANF) is managed through the Azure Portal, providing a centralized interface for configuration and administration. Additionally, ANF offers REST API, SDK, and CLI support within the Azure ecosystem, enabling automation, integration, and programmatic management of storage resources.
Network Access	Azure NetApp Files (ANF) is accessed via a dedicated delegated subnet within the virtual network (VNet), ensuring seamless integration and optimized network performance within the Azure environment.
Supported capacity	A single NetApp account can support up to 25 capacity pools, with each capacity pool accommodating up to 500 volumes. Each individual volume can scale up to 100 TiB, enabling flexible and high-capacity storage management within the Azure NetApp Files (ANF) environment.
Protocol Support	ANF supports NFS & SMB
Performance Characteristics	Azure NetApp Files (ANF) capacity pools are available in three service tiers, each offering distinct performance levels: Standard: Provides 16 MiB/s per 1 TiB of allocated capacity. Premium: Delivers 64 MiB/s per 1 TiB of allocated capacity. Ultra: Offers 128 MiB/s per 1 TiB of allocated capacity. These tiers enable performance scaling based on workload requirements, ensuring optimal storage throughput and efficiency.
Data Protection	Azure NetApp Files (ANF) provides the capability to create on-demand snapshots of volumes directly through the Azure Portal. Each volume supports up to 255 snapshots, facilitating robust data protection and rapid recovery options.
Data Replication	Azure NetApp Files (ANF) supports cross-region replication (CRR) for disaster recovery and data redundancy. This feature enables replication of ANF volumes between different Azure regions.
SLA	Azure guarantees at least 99.99% uptime.
Ownership	Azure retains full responsibility for the support, maintenance, and upgrades of the service, ensuring that enhancements and additional

	functionality are seamlessly deployed without requiring customer intervention.
Licensing	Azure NetApp Files (ANF) does not incur any licensing fees, as its cost structure is based solely on provisioned storage and service tier selection within the Azure ecosystem.
Cost	Azure NetApp Files (ANF) is billed based on an hourly capacity rate, which varies according to the selected performance tier. A minimum allocation of 4 TiB is required for provisioning, ensuring baseline storage availability and performance consistency
Support	Support is provided through Azure.

Table2: Key Features and Characteristics of Azure NetApp Files

IV. CONCLUSION

This study provides a comprehensive comparative analysis of NetApp Cloud Volumes ONTAP (CVO) and Azure NetApp Files (ANF), two leading cloud storage solutions built on NetApp's ONTAP technology. This study elucidates their distinct architectural designs, performance capabilities, and operational frameworks, offering valuable insights for enterprises seeking to optimize their cloud storage strategies.

CVO distinguishes itself through its flexibility, enabling seamless integration across multi-cloud environments such as AWS, Azure, and Google Cloud. Its advanced data management features, including NetApp Snapshot™ technology and cross-cloud replication, render it an optimal choice for organizations that require robust disaster recovery, database workloads, and hybrid cloud deployments. Conversely, ANF excels as a fully managed Azure-native service that provides high performance, scalability, and streamlined management for file-based workloads. Its seamless integration with Azure ecosystems and inherent redundancy makes it particularly suitable for enterprises that prioritize operational efficiency and expeditious cloud migration.

The findings underscore that the selection between CVO and ANF is contingent upon specific organizational requirements, such as multi-cloud compatibility, performance specifications, and cost considerations. CVO is well suited for enterprises seeking cross-cloud flexibility and advanced data management, while ANF is ideal for those leveraging Azure because of its simplicity and native integration. Both platforms play pivotal roles in facilitating efficient cloud-based data management, supporting digital transformation initiatives, and addressing the evolving demands of modern enterprises.

V. FUTURE WORK

Future research could investigate the integration of these solutions with emerging technologies such as artificial intelligence (AI) and machine learning (ML) to further enhance their capabilities in managing complex, data-intensive workloads. This study contributes to the expanding corpus of knowledge on cloud storage solutions, providing a foundation for informed decision making in enterprise cloud adoption strategies.

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