Technical Report

Performance Characterization of ONTAP Cloud in Azure with Application Workloads

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Abstract

This technical report examines the performance and fit of application workloads to NetApp® ONTAP® cloud instances that are running in Microsoft Azure.

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1 Introduction

To help NetApp customers select the most appropriate solutions for their IT infrastructure, NetApp provides up-to-date documentation describing its products. This technical report describes the results of performance tests for the NetApp ONTAP Cloud data management software running on Microsoft Azure virtual machines. NetApp partners, customers, and employees can use this information to make informed decisions about which workloads are appropriate for ONTAP Cloud.

The test configuration environments described in this report consist of the following components:

- ONTAP Cloud single-node clusters of the following Microsoft Azure virtual machines:
  - Standard_D14_v2 (Premium license)
  - Standard_D13_v2 (Standard license)
  - Standard_D3_v2 (Explore license)
- A Microsoft Windows Server 2012 R2 host running Iometer. For each test, the virtual machine used for the Iometer machine matched the ONTAP Cloud system virtual machine.
- The iSCSI protocol for block workloads.

2 Differences Among Virtual Machines

The Azure document General purpose virtual machine sizes describes the capabilities of the different Windows virtual machines in terms of network, CPU, and memory.

The specific combination of these components is what determines the overall performance of an instance. For ONTAP Cloud, the CPU capability contributes to general performance, whereas memory contributes heavily to read performance. The network capability acts as a throughput limiting factor that is independent of read and write performance levels.

Table 1) Capabilities of supported Azure Microsoft virtual machines.

VM Type	CPU	RAM	Expected Network Bandwidth (Mbps)
Standard_DS3_v2	4	14GB	3,000
Standard_DS13_v2	8	56GB	4,000
Standard_DS14_v2	16	112GB	6,000–8,000 or more

3 Test Configurations

All test configurations used the iSCSI protocol for block I/O connectivity. The tests focused on the following:

- Iometer was used to generate I/O workloads. We used different numbers of LUNs and different numbers of outstanding I/O operations to see the effect of concurrency level on IOPS, throughput, and latency.
- Normal writing speed was used for single-node systems. Under normal write speed, data is written directly to disk, minimizing the likelihood of data loss if an unplanned system outage occurs. Conversely, when high write speed is used, data is buffered in memory before it is written to disk. This configuration provides faster write performance but increases the potential for data loss if an unplanned system outage occurs. High write speed is recommended if fast write performance is required and you can tolerate the risk of data loss due to an unplanned system outage. For example, data loss might be handled by the application.
- We tested different Microsoft Azure virtual machines. The virtual machines tested had different hardware characteristics, and, because they belonged to different licensing packages, different costs were incurred by Microsoft Azure and NetApp. A virtual machine from each licensing package was picked for the tests.

- All the tests were performed with Premium_LRS volumes. ONTAP Cloud supports an additional volume type: Standard_LRS.
- ONTAP Cloud was tested on three different Microsoft Azure virtual machines:
  - **Standard_DS3_v2**, included in the Explore license, which allows up to 2TB of storage
  - **Standard_DS13_v2**, included in the Standard license, which allows up to 10TB of storage
  - **Standard_DS14_v2,** included in the Premium license, which allows up to 368TB of storage

4 Summary of Test Results

Each tested configuration consisted of a unique workload that is representative of the workloads used in widely deployed POSIX applications:

- **OLTP workload.** 8KB block size, 100% random access I/O, and a mixture of 70% reads. This workload simulates database applications (SAP, Oracle, SQL) and OLTP servers.
- **Streaming reads.** 64KB block size, 100% reads, and 100% sequential access I/O. This workload simulates applications such as media servers (for example, video on demand) and virtual tape libraries.
- **Streaming writes.** 64KB block size, 100% writes, and 100% sequential access I/O. This workload simulates applications such as media capture, virtual type libraries, medical imaging, archiving, backup, and video surveillance.
- **Analytics.** 16KB block size, 50% reads, and 100% random access I/O. Analytics workloads are ad hoc in nature. They involve both read and write operations and require high throughput and low latency.

The test workloads differed significantly. Collectively, however, they represent workloads that might be considered for an ONTAP Cloud deployment. The results of each test are discussed separately in this section because the workloads were so different.

4.1 OLTP Workload

The 8KB block size workload simulates an OLTP transactional database. Transactional workloads tend to be read heavy as data about an item is retrieved, but they involve a smaller number of writes as transactions are committed. Transactional workloads are highly sensitive to write latency, especially for writes to the transaction log. Typically, it is best for log writes not to exceed 15ms of latency. Lower latency is always better.

The workload tested consisted of 8KB block size, 70% reads, and 100% random access I/O.

Table 2 shows the results of 8KB blocks, 70% reads, and 100% random access I/O for the different virtual machines.

Table 2) OLTP workload IOPS and latency.

VM Type	IOPS (Ops/sec)	Latency (msec)	License
Standard_DS14_v2	18,120	9	Premium
Standard_DS13_v2	18,617	9	Standard
Standard_DS3_v2	6,742	14	Explore

4.2 Streaming Read Workload

We tested a workload with a large contiguous read request size that simulates applications such as media servers (for example, video on demand) and virtual tape libraries. The workload consisted of 64KB block size, 100% reads, and 100% sequential access I/O.

The most significant measurement for this type of workload is throughput, as Table 3 shows.

Table 3) Streaming read workload.

VM Type	Throughput (MBps)	License
Standard_DS14_v2	427	Premium
Standard_DS13_v2	411	Standard
Standard_DS3_v2	329	Explore

ONTAP Cloud has robust performance for streaming reads. The differences between the virtual machines are mainly caused by the networking capabilities of the instance and the number of CPUs available.

4.3 Streaming Write Workload

We tested a workload with a large contiguous write request size that simulates applications such as media capture, virtual tape libraries, medical imaging, archiving, backup, video surveillance, and reference data. The workload consisted of 64KB block size, 100% writes, and 100% sequential access I/O.

The most significant measurement for this type of workload is throughput, as Table 4 shows.

Table 4) Streaming write workload throughput.

VM Type	Throughput (MBps)	License
Standard_DS14_v2	200	Premium
Standard_DS13_v2	198	Standard
Standard_DS3_v2	22	Explore

ONTAP Cloud performed well for the streaming write workload.

4.4 Analytics Workloads

We tested a workload with analytics characteristics. Analytics consist of a read and write mixture, for which throughput and latency are the most important measurements. The workload we tested consisted of 16KB block size, 50% read, and 100% random access I/O.

Table 5) Analytics workload throughput.

VM Type	Throughput (MBps)	Latency (msec)	License
Standard_DS14_v2	182	9	Premium
Standard_DS13_v2	176	9	Standard
Standard_DS3_v2	32	14	Explore

The results show that ONTAP Cloud is a good fit for analytics workloads, because it can maintain high throughput under strict latency constraints.

Conclusion

ONTAP Cloud was found to be a good fit for OLTP workloads, streaming read workloads, streaming write workloads, and analytics workloads. NetApp has a long history of providing high-performance and feature-rich storage systems. ONTAP Cloud extends this legacy to Azure. With ONTAP Cloud, NetApp continues to develop leading-edge storage solutions that provide the agility and mobility that current NetApp customers need and that future NetApp customers will want. ONTAP Cloud is part of a family of products that stretch from the private cloud to the hybrid cloud to the public cloud and that run the NetApp ONTAP data management software. Understanding the performance characteristics of ONTAP Cloud is critical for setting our customers' expectations and enabling their continued success.

Where to Find Additional Information

To learn more about the information described in this document, refer to the following website:

- NetApp Documentation Center

Version History

Version	Date	Document Version History
Version 1.0	March 2018	Updated performance with ONTAP Cloud 9.3

Refer to the Interoperability Matrix Tool (IMT) on the NetApp Support site to validate that the exact product and feature versions described in this document are supported for your specific environment. The NetApp IMT defines the product components and versions that can be used to construct configurations that are supported by NetApp. Specific results depend on each customer's installation in accordance with published specifications.