ONTAP® 9

FlexCache® Volumes for Faster Data Access Power Guide

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doccomments@netapp.com
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This guide describes how to configure and manage FlexCache volumes for accelerating data access.

You should use this guide if you want to configure FlexCache volumes in the following way:

- You are running ONTAP 9.5 or later.
- You want to use the ONTAP command-line interface (CLI), not ONTAP System Manager or an automated scripting tool.
- You want to use best practices, not explore every available option.
  Details about command syntax are available from the CLI help and the ONTAP man pages.
- You do not want to read a lot of conceptual background.
- You have cluster administrator privileges, not SVM administrator privileges.

If this guide is not suitable for your situation, you should see the following documentation instead:

- *ONTAP 9 commands*
- *Cluster management using System Manager*

Starting with ONTAP 9.6, you can use ONTAP System Manager for creating and managing FlexCache volumes.
Using FlexCache volumes to accelerate data access

A FlexCache volume is a sparsely populated volume that is backed by an origin volume. The FlexCache volume can be on the same cluster as or on a different cluster than that of the origin volume. The FlexCache volume provides access to data in the origin volume without requiring that all of the data be in the FlexCache volume.

In ONTAP 9.5, the origin volume is a FlexVol volume and the FlexCache volume is a FlexGroup volume. An origin volume supports NFSv3, NFSv4, and SMB/CIFS protocols. A FlexCache volume supports only NFSv3 protocol in ONTAP 9.5.

A FlexCache volume directly serves read requests if the volume contains the data requested by the client. Otherwise, the FlexCache volume requests the data from the origin volume and stores the data before serving the client request. Subsequent read requests for the data are then served directly from the FlexCache volume. This improves performance when the same data is accessed repeatedly, because after the first request, the data no longer has to travel across the network, or be served from an overloaded system.

You can use FlexCache volumes to speed up access to data or to offload traffic from heavily accessed volumes. FlexCache volumes help improve performance, especially when clients need to access the same data repeatedly, because the data can be served directly without having to access the origin volume. Therefore, you can use FlexCache volumes to handle system workloads that are read-intensive.

Any write operation is applied at the origin volume.

Typical FlexCache deployments

FlexCache volumes are typically used for read-intensive workloads. You can have a FlexCache volume in the same cluster to accelerate performance for frequently accessed data or “hot objects”. You can also have FlexCache volumes to distribute data across multiple clusters to reduce WAN latencies.

You can have FlexCache deployments with AFF, FAS, or ONTAP Select systems. Starting with ONTAP 9.6, FlexCache deployments are also supported with Cloud Volumes ONTAP.

Performance acceleration for hot volumes

In a LAN deployment, the FlexCache volume is in the same cluster as the origin cluster. The FlexCache volume can in the same SVM as or in a different SVM than that of the origin volume.

The FlexCache volume is used for CPU-intensive workloads to offload work from busy file servers and to free system resources. You can use multiple mount points corresponding to different FlexCache volumes for reducing network latency because the data access load is shared among all of the caching systems. This type of LAN deployment reduces the workload of an overloaded storage system.

Cross-cluster data distribution

In a WAN deployment, the FlexCache volume is remote from the data center and is in a different cluster than the origin volume. When clients request data, the FlexCache volume caches popular data, giving the end user faster access to information. This type of WAN deployment decreases the average access time for remote clients.

The FlexCache volume is placed as close as possible to the remote office. Client requests are then explicitly directed to the FlexCache volume. If valid data exists in the cache, that data is served.
directly to the client. If the data does not exist in the cache, the data is retrieved across the WAN from the origin system, cached in the FlexCache volume, and then served to the client.

Supported and unsupported features for FlexCache volumes

You must be aware of the features that are supported by FlexCache volumes and their origin volumes.

<table>
<thead>
<tr>
<th>Feature</th>
<th>Supported at the origin volume?</th>
<th>Supported at the FlexCache volume?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Antivirus</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>If antivirus is enabled for the SVM in which the origin volume resides, antivirus works for all of the volumes in the SVM except for the origin volume.</td>
<td>If antivirus is enabled for the SVM in which the FlexCache volume resides, antivirus works for all of the volumes in the SVM except for the FlexCache volume.</td>
</tr>
<tr>
<td>Auditing</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>If auditing is enabled for the SVM in which the origin volume resides, auditing works for all of the volumes in the SVM except for the origin volume.</td>
<td>If auditing is enabled for the SVM in which the FlexCache volume resides, auditing works for all of the volumes in the SVM except for the FlexCache volume.</td>
</tr>
<tr>
<td>Cloud Volumes ONTAP</td>
<td>Yes Supported starting with ONTAP 9.6</td>
<td>Yes Supported starting with ONTAP 9.6</td>
</tr>
<tr>
<td>Compaction</td>
<td>Yes Supported starting with ONTAP 9.6</td>
<td>No</td>
</tr>
<tr>
<td>Compression</td>
<td>Yes Supported starting with ONTAP 9.6</td>
<td>Yes Supported starting with ONTAP 9.6</td>
</tr>
<tr>
<td>Deduplication</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Inline deduplication is supported on the FlexCache volume starting with ONTAP 9.6. Cross-volume deduplication is not supported on FlexCache volumes.</td>
</tr>
<tr>
<td>FabricPool</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>FlexGroup volume</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>FlexVol volume</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>FPolicy</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>If FPolicy is enabled for the SVM in which the origin volume resides, FPolicy works for all of the volumes in the SVM except for the origin volume.</td>
<td>If FPolicy is enabled for the SVM in which the FlexCache volume resides, FPolicy works for all of the volumes in the SVM except for the FlexCache volume.</td>
</tr>
<tr>
<td>MetroCluster configuration</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>NFSv3</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>NFSv4</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Feature</td>
<td>Supported at the origin volume?</td>
<td>Supported at the FlexCache volume?</td>
</tr>
<tr>
<td>--------------------------------------</td>
<td>----------------------------------</td>
<td>-------------------------------------</td>
</tr>
<tr>
<td>QoS</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Note: File-level QoS is not supported for FlexCache volumes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Qtrees</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Supported starting with ONTAP 9.6</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Quotas</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Note: Starting with ONTAP 9.6, remote quota (rquota) is supported at FlexCache volumes.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>SMB/CIFS</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>SnapLock volumes</td>
<td>No</td>
<td>No</td>
</tr>
<tr>
<td>SnapMirror Asynchronous relationships</td>
<td>Yes</td>
<td>No</td>
</tr>
</tbody>
</table>
| Note: • The primary volume or secondary volume in a SnapMirror relationship cannot be a FlexCache volume.  
• Only the primary volume of a SnapMirror relationship can be a FlexCache origin volume. A SnapMirror secondary volume cannot be a FlexCache origin volume.  
• You can have a FlexCache volume from an origin primary volume in SnapMirror relationship, but not from a secondary volume. |
| SnapMirror Synchronous relationships | No                               | No                                  |
| SnapRestore                          | Yes                              | No                                  |
| Snapshot copies                      | Yes                              | No                                  |
| SVM DR configuration                 | Supported starting with ONTAP 9.5. The primary SVM of an SVM DR relationship can have the origin volume; however, if the SVM DR relationship is broken, the FlexCache relationship must be re-created with a new origin volume. | No  
You can have FlexCache volumes in primary SVMs, but not in secondary SVMs. Any FlexCache volume in the primary SVM is not replicated as part of the SVM DR relationship. |
<p>| Storage-level Access Guard (SLAG)    | No                               | No                                  |</p>
<table>
<thead>
<tr>
<th>Feature</th>
<th>Supported at the origin volume?</th>
<th>Supported at the FlexCache volume?</th>
</tr>
</thead>
<tbody>
<tr>
<td>Volume cloning</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td></td>
<td>Cloning of an origin volume and the files in the origin volume is supported starting with ONTAP 9.6.</td>
<td></td>
</tr>
<tr>
<td>Volume granular encryption (VGE)</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Supported starting with ONTAP 9.6</td>
<td>Supported starting with ONTAP 9.6</td>
</tr>
<tr>
<td>Volume move</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td>Yes (only for volume constituents)</td>
<td>Moving volume constituents of a FlexCache volume is supported from ONTAP 9.6 onwards.</td>
</tr>
<tr>
<td>Volume rehost</td>
<td>No</td>
<td>No</td>
</tr>
</tbody>
</table>
FlexCache volume creation workflow

You must first install the FlexCache license from ONTAP System Manager. You can then create a FlexCache volume in the same cluster or in a remote cluster by using the CLI.

Before you begin
You must be running ONTAP 9.5 or later.

About this task
You can use FlexCache volumes in the same cluster for accelerated performance when accessing hot volumes. You can use FlexCache volumes in different clusters for improving the performance of cross-cluster data distribution.

Adding a FlexCache license
You must install a FlexCache license, which is a capacity-based and term-based license, by using ONTAP System Manager.

About this task
The FlexCache license is a cluster-wide license. The license includes an entitled usage limit that you purchase for using FlexCache volumes in the cluster. The space usage by FlexCache volumes across
the cluster must not exceed the capacity of the entitled usage limit. If you need to increase the usage limit of the license, you should contact your sales representative.

**Steps**

1. Download the NetApp License File for the FlexCache license from the NetApp Support Site.
   
   *NetApp Support*

2. Use ONTAP System Manager to upload the FlexCache license to the cluster:
   
   a. Click the **Configurations** > **Cluster** > **Licenses** tab.
   b. In the **Packages** window, click **Add**.
   c. In the **Add License Packages** dialog box, click **Choose Files** to select the NetApp License File that you downloaded, and then click **Add** to upload the file to the cluster.

---

**Creating a FlexCache volume**

You can create a FlexCache volume in the same cluster for improving performance when accessing a hot object. If you have data centers in different locations, you can create FlexCache volumes on remote clusters for accelerating data access.

**About this task**

The FlexCache volume is always a FlexGroup volume, and not a FlexVol volume.

**Steps**

1. If the FlexCache volume to be created is in a different cluster, create a cluster peer relationship:
   
   a. On the destination cluster, create a peer relationship with the data protection source cluster:

   ```
   cluster peer create --generate-passphrase --offer-expiration MM/DD/YYYY HH:MM:SS [1...7days] [1...168hours] --peer-addrs peer_LIF_IPs --initial-allowed-vserver-peers svm_name,..|* --ipspace ipspace_name
   ```

   Starting with ONTAP 9.6, TLS encryption is enabled by default when creating a cluster peer relationship. TLS encryption is supported for the intercluster communication between the origin and FlexCache volumes. You can also disable TLS encryption for the cluster peer relationship, if required.

   **Example**

   ```
   cluster02::> cluster peer create --generate-passphrase --offer-expiration 2days --initial-allowed-vserver-peers *
   
   Passphrase: UCa+6lRVICeL/gq1WrK7ShR
   Expiration Time: 6/7/2017 08:16:10 EST
   Initial Allowed Vserver Peers: *
   Intercluster LIF IP: 192.140.112.101
   Peer Cluster Name: Clus_7ShR (temporary generated)
   
   Warning: make a note of the passphrase - it cannot be displayed again.
   ```

   b. On the source cluster, authenticate the source cluster to the destination cluster:

   ```
   cluster peer create --peer-addrs peer_LIF_IPs --ipspace ipspace
   ```
Example

cluster01::> cluster peer create -peer-addrs 192.140.112.101,192.140.112.102

Notice: Use a generated passphrase or choose a passphrase of 8 or more characters.
To ensure the authenticity of the peering relationship, use a phrase or sequence of characters that would be hard to guess.
Enter the passphrase:
Confirm the passphrase:
Clusters cluster02 and cluster01 are peered.

2. If the FlexCache volume is in a different SVM than that of the origin volume, create an SVM peer relationship with `flexcache` as the application:
   a. If the SVM is in a different cluster, create an SVM permission for the peering SVMs:

   
   ```
   vserver peer permission create -peer-cluster cluster_name -vserver svm-name -applications flexcache
   ```

   Example
   The following example illustrates how to create an SVM peer permission that applies for all of the local SVMs:

   ```
   cluster1::> vserver peer permission create -peer-cluster cluster2 -vserver "*" -applications flexcache
   ```
   Warning: This Vserver peer permission applies to all local Vservers. After that no explicit "vserver peer accept" command required for Vserver peer relationship creation request from peer cluster "cluster2" with any of the local Vservers. Do you want to continue? {y|n}: y

   b. Create the SVM peer relationship:

   ```
   vserver peer create -vserver local_SVM -peer-vserver remote_SVM -peer cluster cluster_name -applications flexcache
   ```

3. Create a FlexCache volume:

   ```
   volume flexcache create -vserver cache_svm -volume cache_vol_name -auto-provision-as flexgroup -size vol_size -origin-vserver origin_svm -origin-volume origin_vol_name
   ```

   Example

   ```
   cluster1::> volume flexcache create -vserver vs_1 -volume fc1 -auto-provision-as flexgroup -origin-volume vol_1 -size 160MB -origin-vserver vs_1
   [Job 443] Job succeeded: Successful
   ```

4. Verify the FlexCache relationship from the FlexCache volume and the origin volume.
   a. View the FlexCache relationship in the cluster:

   ```
   volume flexcache show
   ```
Example

```
cluster1::> volume flexcache show
-- -- -- --
Vserver Volume Size Origin-Vserver Origin-Volume Origin-Cluster
--- ----- ---- ---------- -------------- -------------
vs_1 fc1 160MB vs_1 vol_1 cluster1
```

b. View all of the FlexCache relationships in the origin cluster:

```
volume flexcache origin show-caches
```

Example

```
cluster::> volume flexcache origin show-caches
-- -- -- -- -- --
--- --- --- ---- ---- ----
vs0 ovol1 vs1 cfg1 clusA
vs0 ovol1 vs2 cfg2 clusB
vs_1 vol_1 vs_1 fc1 cluster1
```

Result

The FlexCache volume is successfully created. Clients can mount the volume by using the junction path of the FlexCache volume.

Related information

Cluster and SVM peering
ONTAP 9 commands

Guidelines for sizing a FlexCache volume

You must be aware of the limits for FlexCache volumes before you start provisioning the volumes.

The size limit of a FlexVol volume is applicable to an origin volume. The size of a FlexCache volume can be less than or equal to the origin volume. The best practice for the size of a FlexCache volume is to be at least 10 percent of the size of the origin volume.

You must also be aware of the following additional limits on FlexCache volumes:

<table>
<thead>
<tr>
<th>Limit</th>
<th>ONTAP 9.6</th>
<th>ONTAP 9.5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum number of FlexCache volumes that you can create from an origin volume</td>
<td>10</td>
<td>10</td>
</tr>
<tr>
<td>Maximum number of origin volumes per node</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Maximum number of FlexCache volumes per node</td>
<td>100</td>
<td>10</td>
</tr>
<tr>
<td>Maximum number of FlexGroup constituents in a FlexCache volume per node</td>
<td>800</td>
<td>40</td>
</tr>
</tbody>
</table>

Related information

NetApp Interoperability
Managing a FlexCache relationship

If the origin volume and the FlexCache volume are in the disconnected mode, you might need to perform some additional operations to update a FlexCache relationship manually.

Viewing the connection status of a FlexCache relationship

Starting with ONTAP 9.6, you can view the connection status of a FlexCache relationship and take any corrective action if the connection status between the origin and FlexCache volumes goes to the disconnected mode.

About this task

A FlexCache relationship can have one of the following connection status:

- connected
- disconnected
- unknown

Steps

1. Log in to the advanced privilege mode:
   ```
   set -privilege advanced
   ```
2. Verify the connection status of all the FlexCache relationships in the cluster:
   ```
   volume flexcache connection-status show
   ```

   ```
   cluster::*> volume flexcache connection-status show
   Node: cluster-01
   
   +Vserver| Volume | Vserver | Remote Volume | Endpoint | Status
   +-------|--------|---------|---------------|---------|---------
   vs_1   | vol_origin | vs_2    | fc_11__0001   | cache   | connected
   vs_1   | vol_origin | vs_2    | fc_11__0002   | cache   | connected
   vs_1   | vol_origin | vs_2    | fc_11__0003   | cache   | connected
   vs_1   | vol_origin | vs_2    | fc_11__0004   | cache   | connected
   vs_2   | fc_11     | vs_1    | vol_origin    | origin   | connected
   ```
Synchronizing properties of a FlexCache volume from an origin volume

Some of the volume properties of the FlexCache volume must always be synchronized with those of the origin volume. If the volume properties of a FlexCache volume fail to synchronize automatically after the properties are modified at the origin volume, you can manually synchronize the properties.

About this task

The following volume properties of a FlexCache volume must always be synchronized with those of the origin volume:

- Security style (-security-style)
- Volume name (-volume-name)
- Maximum directory size (-maxdir-size)
- Minimum read ahead (-min-readahead)

Step

1. From the FlexCache volume, synchronize the volume properties:

   ```
   volume flexcache sync-properties -vserver svm_name -volume flexcache_volume
   ```

   Example

   ```
   cluster1::> volume flexcache sync-properties -vserver vs1 -volume fc1
   ```

Updating the configurations of a FlexCache relationship

After events such as volume move, aggregate relocation, or storage failover, the volume configuration information on the origin volume and FlexCache volume is updated automatically. In case the automatic updates fail, an EMS message is generated and then you must manually update the configuration for the FlexCache relationship.

About this task

If you want to update the configurations of a FlexCache volume, you must run the command from the origin volume. If you want to update the configurations of an origin volume, you must run the command from the FlexCache volume.

Step

1. Update the configuration of the FlexCache relationship:

   ```
   volume flexcache config-refresh -peer-vserver peer_svm -peer-volume peer_volume_to_update -peer-endpoint-type [origin | cache]
   ```
Deleting a FlexCache relationship

You can delete a FlexCache relationship and the FlexCache volume if you no longer require the FlexCache volume.

Steps

1. From the cluster that has the FlexCache volume, take the FlexCache volume offline:
   
   \[ \text{volume offline -vserver svm\_name -volume volume\_name} \]

2. Delete the FlexCache volume:
   
   \[ \text{volume flexcache delete -vserver svm\_name -volume volume\_name} \]

   The FlexCache relationship details are removed from the origin volume and the FlexCache volume.

   **Troubleshooting:** If the `volume flexcache delete` command fails to clean up the origin side configuration, you are prompted to run the `volume flexcache origin cleanup-cache-relationship` command. In this scenario, go to Step 3.

3. From the origin cluster, clean up the FlexCache relationship details from the origin volume:
   
   \[ \text{volume flexcache origin cleanup-cache-relationship -origin-volume origin\_volume -origin-vserver origin\_svm -cache-vserver flexcache\_svm -cache-volume flexcache\_vol} \]

   **Important:** If you run the `volume flexcache origin cleanup-cache-relationship` command, the FlexCache relationship is deleted and cannot be reestablished.

Example

```
cluster1::> volume flexcache origin cleanup-cache-relationship -origin-volume origin1 -origin-vserver vs34 -cache-vserver vs56 -cache-volume fc1

Warning: This command only needs to be run if "volume flexcache delete" fails on
the FlexCache cluster and prompts you to run this command.
The cache configuration will be deleted and cannot be reestablished
for the cache relationship between origin of a FlexCache volume "origin1" in Vserver "vs34" and FlexCache volume "fc1" in Vserver "vs56".
Do you want to continue? {y|n}: y
```
Where to find additional information

There are other reference manuals to help you configure FlexCache volumes. You can use the following document to understand the FlexCache commands:

*ONTAP 9 commands*

You can use the following documentation to configure the NFS protocol:

- *NFS configuration*
- *NFS express configuration*
- *NFS management*

You can use the following documentation for managing FlexCache volumes with ONTAP System Manager:

*Cluster management using System Manager*

You can use the following documentation for ONTAP conceptual information:

*ONTAP concepts*
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