Use deduplication, data compression, and data compaction to increase storage efficiency

ONTAP 9

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Deduplication, data compression, data compaction, and storage efficiency

You can run deduplication, data compression, and data compaction together or independently to achieve optimal space savings on a FlexVol volume. Deduplication eliminates duplicate data blocks. Data compression compresses the data blocks to reduce the amount of physical storage that is required. Data compaction stores more data in less space to increase storage efficiency.

All inline storage efficiency features, such as inline deduplication and inline compression, are enabled by default on AFF volumes.

Enable deduplication on a volume

You can enable deduplication on a FlexVol volume to achieve storage efficiency. You can enable postprocess deduplication on all volumes and inline deduplication on volumes that reside on AFF or Flash Pool aggregates.

If you want to enable inline deduplication on other types of volumes, see the NetApp Knowledge Base: How to enable volume inline deduplication on Non-AFF (All Flash FAS) aggregates.

Before you begin

For a FlexVol volume, you must have verified that enough free space exists for deduplication metadata in volumes and aggregates. The deduplication metadata requires a minimum amount of free space in the aggregate. This amount is equal to 3% of the total amount of physical data for all deduplicated FlexVol volumes or data constituents within the aggregate. Each FlexVol volume or data constituent should have 4% of the total amount of physical data's worth of free space, for a total of 7%.

Inline deduplication is enabled by default on AFF systems.

Choices

- Use the `volume efficiency on` command to enable postprocess deduplication. Learn more about `volume efficiency on` in the ONTAP command reference.

  The following command enables postprocess deduplication on volume VolA:

  ```
  volume efficiency on -vserver vs1 -volume VolA
  ```

- Use the `volume efficiency on` command followed by the `volume efficiency modify` command with the `-inline-deduplication` option set to `true` to enable both postprocess deduplication and inline deduplication. Learn more about `volume efficiency modify` in the ONTAP command reference.

  The following commands enable both postprocess deduplication and inline deduplication on volume VolA:

```
volume efficiency on -vserver vs1 -volume VolA

volume efficiency modify -vserver vs1 -volume VolA -inline-dedupe true
```

- Use the `volume efficiency on` command followed by the `volume efficiency modify` command with the `-inline-deduplication` option set to `true` and the `-policy` option set to `inline-only` to enable only inline deduplication.

  The following commands enable only inline deduplication on volume VolA:

  ```
  volume efficiency on -vserver vs1 -volume VolA

  volume efficiency modify -vserver vs1 -volume VolA -policy inline-only -inline
  -dedupe true
  ```

After you finish

Verify that the setting has changed by viewing the volume efficiency settings: `volume efficiency show -instance`

Learn more about `volume efficiency show -instance` in the ONTAP command reference.

Disable deduplication on a volume

You can disable postprocess deduplication and inline deduplication independently on a volume.

Before you begin

Stop any volume efficiency operation that is currently active on the volume: `volume efficiency stop`

Learn more about `volume efficiency stop` in the ONTAP command reference.

About this task

If you have enabled data compression on the volume, running the `volume efficiency off` command disables data compression. Learn more about `volume efficiency off` in the ONTAP command reference.

Choices

- Use the `volume efficiency off` command to disable both postprocess deduplication and inline deduplication.

  The following command disable both postprocess deduplication and inline deduplication on volume VolA:

  ```
  volume efficiency off -vserver vs1 -volume VolA
  ```

- Use the `volume efficiency modify` command with the `-policy` option set to `inline only` to disable postprocess deduplication, but inline deduplication remains enabled.

  The following command disables postprocess deduplication, but inline deduplication remains enabled on volume VolA:

  ```
  volume efficiency modify -vserver vs1 -volume VolA -policy inline-only
  ```

- Use the `volume efficiency modify` command with the `-inline-deduplication` option set to `false` to disable inline deduplication only.

  The following command disables only inline deduplication on volume VolA:

  ```
  volume efficiency modify -vserver vs1 -volume VolA -inline-deduplication false
  ```

  Learn more about `volume efficiency modify` in the ONTAP command reference.

Automatic volume-level background deduplication on AFF systems

Beginning with ONTAP 9.3, you can configure volume-level background deduplication to run automatically using a predefined `auto` AFF policy. No manual configuration of the schedules is required. The `auto` policy performs continuous deduplication in the background.

The `auto` policy is set for all newly created volumes and for all upgraded volumes that have not been manually configured for background deduplication. You can change the policy to `default` or any other policy to disable the feature.

If a volume moves from a non-AFF system to an AFF system, the `auto` policy is enabled on the destination node by default. If a volume moves from an AFF node to a non-AFF node, the `auto` policy on the destination node is replaced by the `inline-only` policy by default.

On AFF, the system monitors all the volumes having the `auto` policy and deprioritizes the volume that has less savings or has frequent overwrites. The deprioritized volumes no longer participate in automatic background deduplication. Change logging on deprioritized volumes is disabled and metadata on the volume is truncated.

Users can promote the deprioritized volume to re-participate in an automatic background deduplication using the `volume efficiency promote` command available at the advanced privilege level.

Learn more about `volume efficiency promote` in the ONTAP command reference.

Manage aggregate-level inline deduplication on AFF systems

Aggregate-level deduplication eliminates duplicate blocks across volumes belonging to the same aggregate. You can perform aggregate-level deduplication inline on AFF systems. The feature is enabled by default for all newly created volumes and all upgraded volumes with volume inline deduplication turned on.

About this task

The deduplication operation eliminates duplicate blocks before data is written to disk. Only volumes with the `space guarantee` set to `none` can participate in aggregate-level inline deduplication. This is the default setting on AFF systems.

Aggregate-level inline deduplication is sometimes referred to as cross-volume inline deduplication.

Step

1. Manage aggregate-level inline deduplication on AFF systems:

If you want to…	Use this command
Enable aggregate-level inline deduplication	`volume efficiency modify -vserver vserver_name -volume vol_name -cross -volume-inline-dedupe true`
Disable aggregate-level inline deduplication	`volume efficiency modify -vserver vserver_name -volume vol_name -cross -volume-inline-dedupe false`
Display aggregate-level inline deduplication status	`volume efficiency config -volume vol_name`

Examples

The following command displays the aggregate-level inline deduplication status:

```
wfit-8020-03-04::> volume efficiency config -volume choke0_wfit_8020_03_0
Vserver:                                    vs0
Volume:                                     choke0_wfit_8020_03_0
Schedule:                                   -
Policy:                                     choke_VE_policy
Compression:                                true
Inline Compression:                         true
Inline Dedupe:                              true
Data Compaction:                            true
Cross Volume Inline Deduplication:          false
```

Manage aggregate-level background deduplication on AFF systems

Aggregate-level deduplication eliminates duplicate blocks across volumes belonging to the same aggregate. Beginning with ONTAP 9.3, you can perform aggregate-level deduplication in the background on AFF systems. The feature is enabled by default for all newly created volumes and all upgraded volumes with volume background deduplication turned on.

About this task

The operation is triggered automatically when a large enough percentage of the change log has been populated. No schedule or policy is associated with the operation.

Beginning with ONTAP 9.4, AFF users can also run the aggregate-level deduplication scanner to eliminate duplicates of existing data across volumes in the aggregate. You can use the `storage aggregate efficiency cross-volume-dedupe start` command with the `-scan-old-data=true` option to start the scanner:

```
cluster-1::> storage aggregate efficiency cross-volume-dedupe start
-aggregate aggr1 -scan-old-data true
```

Deduplication scanning can be time consuming. You might want to run the operation in off-peak hours.

Aggregate-level background deduplication is sometimes referred to as cross-volume background deduplication.

Learn more about `storage aggregate efficiency cross-volume-dedupe start` in the ONTAP command reference.

Steps

1. Manage aggregate-level background deduplication on AFF systems:

If you want to…	Use this command
Enable aggregate-level background deduplication	`volume efficiency modify -vserver <vserver_name\> -volume <vol_name\> -cross-volume-background-dedupe true`
Disable aggregate-level background deduplication	`volume efficiency modify -vserver <vserver_name\> -volume <vol_name\> -cross-volume-background-dedupe false`
Display aggregate-level background deduplication status	`aggregate efficiency cross-volume-dedupe show`

Learn more about the commands described in this procedure in the ONTAP command reference.

Related information

- volume efficiency modify
- aggregate efficiency cross-volume-dedupe show

Learn about ONTAP temperature-sensitive storage efficiency

ONTAP provides temperature-sensitive storage efficiency (TSSE) benefits by assessing how often your volume's data is accessed and mapping that frequency to the degree of compression applied to that data. For cold data that is accessed infrequently, larger data blocks are compressed, and for hot data, which is accessed frequently and is overwritten more often, smaller data blocks are compressed, making the process more efficient.

TSSE is introduced in ONTAP 9.8 and is enabled automatically on newly created thinly provisioned AFF volumes. You can enable temperature-sensitive storage efficiency on existing thinly provisioned AFF volumes and on thinly provisioned non-AFF DP volumes. TSSE is not supported on thickly provisioned volumes.

Temperature-sensitive storage efficiency is not applied on the following platforms:

Unresolved directive in volumes/enable-temperature-sensitive-efficiency-concept.adoc - include::_include/dedicated-offload-processor-supported-platforms.adoc[]

These platforms use CPU or dedicated offload processor storage efficiency. Compression is performed using either the main CPU or a dedicated offload processor is not based on hot or cold data.

> Over time, the amount of space used in your volume might be more pronounced with TSSE compared to 8K adaptive compression. This behavior is expected due to the architectural differences between TSSE and 8K adaptive compression.

Introduction of "default" and "efficient" modes

Beginning with ONTAP 9.10.1, *default* and *efficient* volume-level storage efficiency modes are introduced for AFF systems only. The two modes provide a choice between file compression (default), which is the default mode when creating new AFF volumes, or temperature-sensitive storage efficiency (efficient), which uses auto adaptive compression to provide increased compression savings on cold, infrequently accessed, data.

When upgrading to ONTAP 9.10.1 and later, existing volumes are assigned a storage efficiency mode based on the type of compression currently enabled on the volumes. During an upgrade, volumes with compression enabled are assigned the default mode, and volumes with temperature-sensitive storage efficiency enabled are assigned the efficient mode. If compression is not enabled, storage efficiency mode remains blank.

With ONTAP 9.10.1, temperature-sensitive storage efficiency must be explicitly set to enable auto adaptive compression. However, other storage efficiency features like data-compaction, auto dedupe schedule, inline deduplication, cross volume inline deduplication, and cross volume background deduplication are enabled by default on AFF platforms for both default and efficient modes.

Both storage efficiency modes (default and efficient) are supported on FabricPool-enabled aggregates and with all tiering policy types.

Temperature-sensitive storage efficiency enabled on C-Series platforms

Temperature-sensitive storage efficiency is enabled by default on AFF C-Series platforms and when migrating thinly provisioned volumes from a non-TSSE platform to a TSSE-enabled C-Series platform using volume move or SnapMirror with the following releases installed on the destination:

- ONTAP 9.12.1P4 and later
- ONTAP 9.13.1 and later

For more information, see Storage efficiency behavior with volume move and SnapMirror operations.

For existing thinly provisioned volumes, temperature-sensitive storage efficiency is not enabled automatically; however, you can modify the storage efficiency mode manually to change to efficient mode.

> Once you change the storage efficiency mode to efficient you cannot change it back.

Improved storage efficiency with sequential packing of contiguous physical blocks

Beginning with ONTAP 9.13.1, temperature-sensitive storage efficiency adds sequential packing of contiguous physical blocks to further improve storage efficiency. Volumes that have temperature-sensitive storage

efficiency enabled automatically have sequential packing enabled when you upgrade systems to ONTAP 9.13.1. After sequential packing is enabled, you must manually repack existing data.

Storage efficiency behavior with volume move and SnapMirror operations

The behavior of storage efficiency can be affected by other storage operations that are active or started at the same time. You should be aware of the impact of these operations on storage efficiency.

There are several situations where storage efficiency on a volume can be affected by other operations including volume moves, SnapMirror relationships, FabricPool volumes, and temperature-sensitive storage efficiency (TSSE).

FabricPool

The `all` tiering policy is commonly used on data protection volumes to immediately mark data as cold and tier it as soon as possible. There is no waiting for a minimum number of days to pass before the data is made cold and tiered.

Because the `all` tiering policy tiers data as soon as possible, storage efficiencies that rely on background processes, like 32K efficient adaptive compression (TSSE), do not have enough time to be applied. Inline storage efficiencies like 8K compression are applied as normal.

The following table describes the behavior of a source volume and destination volume when you perform one of these operations.

Source volume efficiency	**Destination volume default behavior**			**Default behavior after manually enabling TSSE (after SnapMirror break)**		
	Storage efficiency type	**New writes**	**Cold data compression**	**Storage efficiency type**	**New writes**	**Cold data compression**
No storage efficiency (likely FAS)	File compression	File compression is attempted inline on newly written data	No cold data compression, data remains as it is	TSSE with cold data scan algorithm as ZSTD	8k inline compression is attempted in TSSE format	**File compressed data**: N/A **Uncompressed data**: 32K compression attempted after threshold days met **Newly written data**: 32K compression attempted after threshold days met

No storage efficiency (likely FAS)	File compression on C-Series platforms using ONTAP 9.11.1P10 or ONTAP 9.12.1P3	No TSSE-enabled cold data compression	**File compressed data**: N/A	TSSE with cold data scan algorithm as ZSTD	8K inline compression	**File compressed data**: N/A **Uncompressed data**: 32K compression attempted after threshold days met **Newly written data**: 32K compression attempted after threshold days met
No storage efficiency (likely FAS)	TSSE on C-Series platforms using ONTAP 9.12.1P4 and later or ONTAP 9.13.1 and later	8K inline compression is attempted in TSSE format	**File compressed data**: N/A **Uncompressed data**: 32K compression attempted after threshold days met **Newly written data**: 32K compression attempted after threshold days met	TSSE with cold data scan algorithm as ZSTD	8K inline compression is attempted in TSSE format	**File compressed data**: N/A **Uncompressed data**: 32K compression attempted after threshold days met **Newly written data**: 32K compression attempted after threshold days met
File compression group	Same as source	File compression is attempted inline on newly written data	No cold data compression, data remains as it is	TSSE with cold data scan algorithm as ZSTD	8k inline compression is attempted in TSSE format	**File compressed data**: Not compressed **Uncompressed data**: 32K compression is attempted after threshold days met **Newly written data**: 32K compression is attempted after threshold days met
TSSE cold data scan	TSSE using the same compression algorithm as source volume (LZOPro→LZOPro and ZSTD→ZSTD)	8K inline compression attempted in TSSE format	32K compression attempted with LzoPro after threshold days based coldness is met on both existing data and newly written data.	TSSE is enabled. NOTE: LZOPro cold data scan algorithm can be changed to ZSTD.	8K inline compression is attempted in TSSE format	32K compression is attempted after threshold days coldness is met on both existing data and newly written data.

Set storage efficiency mode during volume creation

Beginning with ONTAP 9.10.1, you can set the storage efficiency mode when creating a new AFF volume.

About this task

You can control the storage efficiency mode on a new AFF volume using the parameter `-storage`

`-efficiency-mode`. You can choose between two options to set the storage efficiency mode: `default` or `efficient`. The storage efficiency mode you choose depends on whether you want greater performance or higher storage efficiency on the volume. The parameter `-storage-efficiency-mode` is not supported on non-AFF volumes or on data protection volumes.

Performance mode is set by default when you create new AFF volumes with storage efficiency.

Learn more about temperature-sensitive storage efficiency and storage efficiency modes.

Steps

1. Create a new volume and set the efficiency mode:

   ```
   volume create -vserver <vserver name> -volume <volume name> -aggregate
   <aggregate name> -size <volume size> -storage-efficiency-mode
   <efficient|default>
   ```

   Set `-storage-efficiency-mode` to `efficient` for efficiency mode or to `default` for performance mode.

   In the following example, aff_vol1 is created with efficiency mode.

```
volume create -vserver vs1 -volume aff_vol1 -aggregate aff_aggr1 -storage
-efficiency-mode efficient -size 10g
```

Change the volume inactive data compression threshold in ONTAP

You can change how frequently ONTAP performs a cold data scan by modifying the coldness threshold on volumes using temperature-sensitive storage efficiency.

Before you begin

You must be a cluster or SVM administrator and use the ONTAP CLI advanced privilege level.

About this task

The coldness threshold can be from 1 to 60 days. The default threshold is 14 days.

Steps

1. Set the privilege level:

   ```
   set -privilege advanced
   ```

2. Modify inactive data compression on a volume:

   ```
   volume efficiency inactive-data-compression modify -vserver <vserver_name>
   -volume <volume_name> -threshold-days <integer>
   ```

Learn more about `volume efficiency inactive-data-compression modify` in the ONTAP

command reference.

Check volume efficiency mode

You can use the `volume-efficiency-show` command on an AFF volume to check whether efficiency is set and to view the current efficiency mode.

Step

1. Check the efficiency mode on a volume:

```
volume efficiency show -vserver <vserver name> -volume <volume name> -fields
storage-efficiency-mode
```

Learn more about `volume efficiency show` in the ONTAP command reference.

Change volume efficiency mode

Beginning with ONTAP 9.10.1, the volume-level storage efficiency modes *default* and *efficient* are supported for AFF systems only. These modes provide a choice between file compression (default), which is the default mode when creating new AFF volumes, or temperature-sensitive storage efficiency (efficient), which enables temperature-sensitive storage efficiency (TSSE).

TSSE is supported only on thinly provisioned volumes. Learn more about TSSE.

Steps

You can perform this task using ONTAP System Manager or the ONTAP CLI.

System Manager

Beginning with ONTAP 9.10.1, you can use System Manager to enable higher storage efficiency using the temperature-sensitive storage efficiency feature. Performance-based storage efficiency is enabled by default.

1. Click **Storage > Volumes**.
2. Locate the volume on which you want to enable or disable storage efficiency, and click ⋮.
3. Click **Edit > Volumes**, and scroll to **Storage Efficiency**.
4. Select **Enable Higher Storage Efficiency**.

CLI

You can use the `volume efficiency modify` command to change the storage efficiency mode for an AFF volume from `default` to `efficient`, or you can set an efficiency mode when volume efficiency is not already set.

1. Change the volume efficiency mode:

```
volume efficiency modify -vserver <vserver name> -volume <volume
name> -storage-efficiency-mode <default|efficient>
```

Learn more about `volume efficiency modify` in the ONTAP command reference.

View volume footprint savings with or without temperature-sensitive storage efficiency

Depending on your ONTAP release, you can view the physical footprint savings on each volume. You might do this to assess the effectiveness of your administrative processes or as part of capacity planning.

About this task

Beginning with ONTAP 9.11.1, you can use the command `volume show-footprint` to view the physical footprint savings on volumes with temperature-sensitive storage efficiency (TSSE) enabled. Beginning with ONTAP 9.13.1, you can use the same command to view the physical footprint savings on volumes not enabled with TSSE.

Steps

1. View the volume footprint savings:

```
volume show-footprint
```

Example output with TSSE enabled

```
Vserver : vs0
Volume  : vol_tsse_75_per_compress

Feature                                    Used       Used%
--------------------------------          ----------    -----
Volume Data Footprint                       10.15GB      13%
Volume Guarantee                                0B       0%
Flexible Volume Metadata                    64.25MB       0%
Delayed Frees                               235.0MB       0%
File Operation Metadata                         4KB       0%

Total Footprint                             10.45GB      13%

Footprint Data Reduction                     6.85GB       9%
     Auto Adaptive Compression               6.85GB       9%
Effective Total Footprint                    3.59GB       5%
```

Example output without TSSE enabled

```
Vserver : vs0
Volume  : vol_file_cg_75_per_compress

Feature                                    Used       Used%
--------------------------------          ----------    -----
Volume Data Footprint                        5.19GB       7%
Volume Guarantee                                0B       0%
Flexible Volume Metadata                    32.12MB       0%
Delayed Frees                               90.17MB       0%
File Operation Metadata                         4KB       0%

Total Footprint                              5.31GB       7%

Footprint Data Reduction                     1.05GB       1%
     Data Compaction                         1.05GB       1%
Effective Total Footprint                    4.26GB       5%
```

Related information

- Set storage efficiency mode during volume creation

Enable data compression on a volume

You can enable data compression on a FlexVol volume to achieve space savings by using the `volume efficiency modify` command. You can also assign a compression

type to your volume, if you do not want the default compression type. Learn more about `volume efficiency modify` in the ONTAP command reference.

Before you begin

You must have enabled deduplication on the volume.

- Deduplication only needs to be enabled and does not need to be running on the volume.
- The compression scanner must be used to compress the existing data on the volumes present in AFF platforms.

Enabling deduplication on a volume

About this task

- In HDD aggregates and Flash Pool aggregates, you can enable both inline and postprocess compression or only postprocess compression on a volume.

  If you are enabling both, then you must enable postprocess compression on the volume before enabling inline compression.

- In AFF platforms, only inline compression is supported.

  Before enabling inline compression, you must enable postprocess compression on the volume. However, because postprocess compression is not supported in AFF platforms, no postprocess compression takes place on those volumes and an EMS message is generated informing you that postprocess compression was skipped.

- Temperature sensitive storage efficiency is introduced in ONTAP 9.8. With this feature, storage efficiency is applied according to whether data is hot or cold. For cold data, larger data blocks are compressed, and for hot data, which is overwritten more often, smaller data blocks are compressed, making the process more efficient. Temperature sensitive storage efficiency is enabled automatically on newly created thin-provisioned AFF volumes.
- The compression type is automatically assigned based on the aggregate's platform:

Platform/aggregates	Compression type
AFF	Adaptive compression
Flash Pool aggregates	Adaptive compression
HDD aggregates	Secondary compression

Choices

- Use the `volume efficiency modify` command to enable data compression with the default compression type.

  The following command enables postprocess compression on volume VolA of SVM vs1:

  ```
  volume efficiency modify -vserver vs1 -volume VolA -compression true
  ```

  The following command enables both postprocess and inline compression on volume VolA of SVM vs1:

```
volume efficiency modify -vserver vs1 -volume VolA -compression true -inline
-compression true
```

- Use the `volume efficiency modify` command at the advanced privilege level to enable data compression with a specific compression type.
  a. Use the `set -privilege advanced` command to change the privilege level to advanced.
  b. Use the `volume efficiency modify` command to assign a compression type to a volume.

     The following command enables postprocess compression and assigns the adaptive compression type to volume VolA of SVM vs1:

     ```
     volume efficiency modify -vserver vs1 -volume VolA -compression true
     -compression-type adaptive
     ```

     The following command enables both postprocess and inline compression and assigns the adaptive compression type to volume VolA of SVM vs1:

     ```
     volume efficiency modify -vserver vs1 -volume VolA -compression true
     -compression-type adaptive -inline-compression true
     ```

  c. Use the `set -privilege admin` command to change the privilege level to admin.

Move between secondary compression and adaptive compression

You can switch between secondary compression and adaptive compression depending on the amount of data reads. Adaptive compression is preferred when there are a high volume of random reads on the system and higher performance is required. Secondary compression is preferred when data is written sequentially and higher compression savings are required.

About this task

The default compression type is selected based on your aggregates and platform.

Steps

1. Disable efficiency on the volume:

   ```
   volume efficiency off
   ```

   For example, the following command disables efficiency on volume vol1:

   ```
   volume efficiency off -vserver vs1 -volume vol1
   ```

2. Change to the advanced privilege level:

   ```
   set -privilege advanced
   ```

3. Decompress the compressed data:

   ```
   volume efficiency undo
   ```

For example, the following command decompresses the compressed data on volume vol1:

```
volume efficiency undo -vserver vs1 -volume vol1 -compression true
```

> You must verify that you have sufficient space in the volume to accommodate the decompressed data.

4. Change to the admin privilege level:

```
set -privilege admin
```

5. Verify that the status of the operation is idle:

```
volume efficiency show
```

For example, the following command displays the status of an efficiency operation on volume vol1:

```
volume efficiency show -vserver vs1 -volume vol1
```

6. Enable efficiency for the volume:

`volume efficiency on` For example, the following command enables efficiency on volume vol1:

```
volume efficiency on -vserver vs1 -volume vol1
```

7. Enable data compression, and then set the type of compression:

```
volume efficiency modify
```

For example, the following command enables data compression and sets the compression type as secondary compression on volume vol1:

```
volume efficiency modify -vserver vs1 -volume vol1 -compression true
-compression-type secondary
```

> This step only enables secondary compression on the volume; the data on the volume is not compressed.
>
> - To compress existing data on AFF systems, you must run the background compression scanner.
> - To compress existing data on Flash Pool aggregates or HDD aggregates, you must run the background compression.

8. Optional: Enable inline compression:

```
volume efficiency modify
```

For example, the following command enables inline compression on volume vol1:

```
volume efficiency modify -vserver vs1 -volume vol1 -inline-compression true
```

Disable data compression on a volume

You can disable data compression on a volume by using the `volume efficiency modify` command. Learn more about `volume efficiency modify` in the ONTAP command reference.

About this task

If you want to disable postprocess compression, you must first disable inline compression on the volume.

Steps

1. Stop any volume efficiency operation that is currently active on the volume:

   `volume efficiency stop`

2. Disable data compression:

   `volume efficiency modify`

   Existing compressed data will remain compressed on the volume. Only new writes coming into the volume are not compressed.

Examples

The following command disables inline compression on volume VolA:

```
volume efficiency modify -vserver vs1 -volume VolA -inline-compression false
```

The following command disables both postprocess compression and inline compression on volume VolA:

```
volume efficiency modify -vserver vs1 -volume VolA -compression false -inline
-compression false
```

Learn more about `volume efficiency stop` in the ONTAP command reference.

Manage inline data compaction for AFF systems

You can control inline data compaction on AFF systems at the volume level using the `volume efficiency modify` command. Data compaction is enabled by default for all volumes on AFF systems.

Before you begin

Data compaction requires that the volume space guarantee be set to `none`. This is the default for AFF systems.

The default space guarantee on non-AFF data protection volumes is set to none.

Steps

1. To verify the space guarantee setting for the volume:

   `volume show -vserver vserver_name -volume volume_name -fields space-guarantee`

2. To enable data compaction:

   ```
   volume efficiency modify -vserver vserver_name -volume volume_name -data
   -compaction true
   ```

3. To disable data compaction:

   ```
   volume efficiency modify -vserver vserver_name -volume volume_name -data
   -compaction false
   ```

4. To display data compaction status:

   ```
   volume efficiency show -instance
   ```

Examples

```
cluster1::> volume efficiency modify -vserver vs1 -volume vol1 -data-compaction
true cluster1::> volume efficiency modify -vserver vs1 -volume vol1 -data
-compaction false
```

Enable inline data compaction for FAS systems

YYou can enable inline data compaction on FAS systems with Flash Pool (hybrid) aggregates or HDD aggregates at the volume level by using the `volume efficiency` cluster shell command. Data compaction is disabled by default for volumes created on FAS systems. Learn more about `volume efficiency` in the ONTAP command reference.

About this task

To enable inline data compaction on a volume, its `-space-guarantee` option must be set to `none`. Enabling data compaction on a volume on an HDD aggregate uses additional CPU resources.

Steps

1. Change to the advanced privilege level:

   ```
   set -privilege advanced
   ```

   Learn more about `set` in the ONTAP command reference.

2. Check the data compaction state of the volumes and aggregates for the desired node:

   ```
   volume efficiency show -volume <volume_name>
   ```

   Learn more about `volume efficiency show` in the ONTAP command reference.

3. Enable data compaction on volume:

```
volume efficiency modify -volume <volume_name> -data-compaction true
```

Learn more about `volume efficiency modify` in the ONTAP command reference.

> If data compaction is set to `false` for either an aggregate or a volume, then compaction fails. Enabling compaction does not compact existing data; only new writes to the system are compacted. The `volume efficiency start` command contains more information about how to compact existing data. Learn more about `volume efficiency start` in the ONTAP command reference.

4. View the compaction statistics:

```
volume efficiency show -volume <volume_name>
```

Inline storage efficiency enabled by default on AFF systems

Storage efficiency features are enabled by default on all newly created volumes on AFF systems. All inline storage efficiency features are enabled by default on all existing and newly created volumes on all AFF systems.

Storage efficiency features include inline deduplication, inline cross-volume deduplication and inline compression, and are enabled by default on AFF systems as shown in the table.

> Data compaction behavior on AFF volumes is enabled by default.

Volume conditions	**Storage efficiency features enabled by default**		
	Inline deduplication	Inline cross-volume deduplication	Inline compression
Cluster upgrade	Yes	Yes	Yes
ONTAP 7-Mode transition to clustered ONTAP	Yes	Yes	Yes
Volume move	Yes	Yes	Yes
Thick-provisioned volumes	Yes	No	Yes
Encrypted volumes	Yes	No	Yes

The following exceptions apply to one or more inline storage efficiency features:

- Only read-write volumes can support default inline storage efficiency enablement.

- Volumes with compression savings are omitted from enabling inline compression.
- Volumes that have postprocess deduplication turned on are omitted from enabling inline compression.
- On volumes where volume efficiency is turned off, the system overrides the existing volume efficiency policy settings and sets it to enable the inline-only policy.

Storage efficiency visualization

Use the `storage aggregate show-efficiency` command to display information about the storage efficiency of all the aggregates in your system.

The `storage aggregate show-efficiency` command has three different views that can be invoked by passing command options.

Learn more about `storage aggregate show-efficiency` in the ONTAP command reference.

Default view

The default view displays the overall ratio for each of the aggregates.

```
cluster1::> storage aggregate show-efficiency
```

Detailed view

Invoke the detailed view with the `-details` command option. This view displays the following:

- Overall efficiency ratio for each of the aggregates.
- Overall ratio without snapshots.
- Ratio split for the following efficiency technologies: volume deduplication, volume compression, snapshots, clones, data compaction, and aggregate inline deduplication.

```
cluster1::> storage aggregate show-efficiency -details
```

Advanced view

The advanced view is similar to the detailed view and displays both logical and physical used details.

You must run this command at the advanced privilege level. Switch to advanced privilege by using the `set -privilege advanced` command.

The command prompt changes to `cluster::*>`.

```
cluster1::> set -privilege advanced
```

Invoke the advanced view with the `-advanced` command option.

```
cluster1::*> storage aggregate show-efficiency -advanced
```

To view ratios for a single aggregate individually invoke the `-aggregate` *`aggregate_name`* command. This command can be run at the admin level, as well as the advanced privilege level.

```
cluster1::> storage aggregate show-efficiency -aggregate aggr1
```

Learn more about `set -privilege advanced` in the ONTAP command reference.

Create a volume efficiency policy to run efficiency operations

Create a volume efficiency policy

You can create a volume efficiency policy to run deduplication or data compression followed by deduplication on a volume for a specific duration, and specify the job schedule using the `volume efficiency policy create` command.

Before you begin

You must have created a cron schedule using the `job schedule cron create` command. For more information about managing the cron schedules, see the System administration reference. Learn more about `job schedule cron create` in the ONTAP command reference.

About this task

An SVM administrator with default predefined roles cannot manage the deduplication policies. However, the cluster administrator can modify the privileges assigned to an SVM administrator by using any customized roles. For more information about the SVM administrator capabilities, see Administrator authentication and RBAC.

> You can run deduplication or data compression operations at a scheduled time, or by creating a schedule with a specific duration, or by specifying a threshold percentage, which waits for the new data to exceed the threshold and then triggers the deduplication or data compression operation. This threshold value is the percentage of the total number of blocks used in the volume. For example, if you set the threshold value on a volume to 20% when the total number of blocks used on the volume is 50%, data deduplication or data compression triggers automatically when new data written on the volume reaches 10% (20% of 50% blocks used). If required, you can obtain the total number of blocks used from the `df` command output.

Steps

1. Use the `volume efficiency policy create` command to create a volume efficiency policy.

Examples

The following command creates a volume efficiency policy named pol1 that triggers an efficiency operation daily:

```
volume efficiency policy create -vserver vs1 -policy pol1 -schedule daily
```

The following command creates a volume efficiency policy named pol2 that triggers an efficiency operation when the threshold percentage reaches 20%:

```
volume efficiency policy create -vserver vs1 -policy pol2 -type threshold -start
-threshold-percent 20%
```

Learn more about `volume efficiency policy create` in the ONTAP command reference.

Assign a volume efficiency policy to a volume

You can assign an efficiency policy to a volume to run deduplication or data compression operations by using the `volume efficiency modify` command.

Before you begin

Ensure that you create the volume efficiency policy before you assign it to a volume.

About this task

If an efficiency policy is assigned to a SnapVault secondary volume, only the volume efficiency priority attribute is considered when running volume efficiency operations. The job schedules are ignored and the deduplication operation is run when incremental updates are made to the SnapVault secondary volume.

Step

1. Use the `volume efficiency modify` command to assign a policy to a volume.

Example

The following command assigns the volume efficiency policy named `new_policy` to volume `VolA`:

```
volume efficiency modify -vserver vs1 -volume VolA -policy new_policy
```

Learn more about `volume efficiency modify` in the ONTAP command reference.

Modify a volume efficiency policy

You can modify a volume efficiency policy to run deduplication and data compression for a different duration or change the job schedule using the `volume efficiency policy modify` command. Learn more about `volume efficiency policy modify` in the ONTAP command reference.

Steps

1. Use the `volume efficiency policy modify` command to modify a volume efficiency policy.

Examples

The following command modifies the volume efficiency policy named policy1 to run every hour:

```
volume efficiency policy modify -vserver vs1 -policy policy1 -schedule hourly
```

The following command modifies a volume efficiency policy named pol2 to threshold 30%:

```
volume efficiency policy modify -vserver vs1 -policy pol1 -type threshold -start
-threshold-percent 30%
```

View a volume efficiency policy in ONTAP

You can view the volume efficiency policy including the name, schedule, duration, and description.

About this task

The command `volume efficiency policy show` is used to display a volume efficiency policy. When you

run the command in cluster scope, the cluster-scoped policies are not displayed. However, you can view the cluster-scoped policies in the SVM context. Learn more about `volume efficiency policy show` in the ONTAP command reference.

Steps

1. Use the `volume efficiency policy show` command to view information about a volume efficiency policy.

   The output depends on the parameters you specify. Learn more about `volume efficiency policy show` in the ONTAP command reference.

Examples

The following command displays information about the policies created for the SVM vs1: `volume efficiency policy show -vserver vs1`

The following command displays the policies for which the duration is set as 10 hours: `volume efficiency policy show -duration 10`

Disassociate a volume efficiency policy from a volume

You can disassociate a volume efficiency policy from a volume to stop running any further schedule-based deduplication and data compression operations on the volume. Once you disassociate a volume efficiency policy, you have to trigger it manually.

Step

1. Use the `volume efficiency modify` command to disassociate a volume efficiency policy from a volume.

Example

The following command disassociates the volume efficiency policy from volume VolA: `volume efficiency modify -vserver vs1 -volume VolA -policy -`

Learn more about `volume efficiency modify` in the ONTAP command reference.

Delete a volume efficiency policy

You can delete a volume efficiency policy by using the `volume efficiency policy delete` command.

Before you begin

You must have ensured that the policy you want to delete is not associated with any volume.

> You cannot delete the *inline-only* and the *default* predefined efficiency policy.

Step

1. Use the `volume efficiency policy delete` command to delete a volume efficiency policy.

Example

The following command deletes a volume efficiency policy named policy1: `volume efficiency policy`

```
delete -vserver vs1 -policy policy1
```

Learn more about `volume efficiency policy delete` in the ONTAP command reference.

Manage volume efficiency operations manually

Manage volume efficiency operations manually overview

You can manage how the efficiency operations run on a volume by running efficiency operations manually.

You can also control how the efficiency operations run based on the following conditions:

- Use checkpoints or not
- Run efficiency operations on existing data or only new data
- Stop efficiency operations if required

You can use the `volume efficiency show` command with `schedule` as value for the `-fields` option to view the schedule assigned to the volumes.

Learn more about `volume efficiency show` in the ONTAP command reference.

Run an efficiency operation manually

You can run efficiency operations on a volume manually. You might do this when scheduling efficiency operations is not appropriate.

Before you begin

Depending on the efficiency operation you want to run manually, you must have enabled deduplication or both data compression and deduplication on a volume.

About this task

This operation is performed using the `volume efficiency start` command. When temperature-sensitive storage efficiency is enabled on a volume, deduplication is run initially followed by data compression.

Deduplication is a background process that consumes system resources while it is running. If the data does not change often in a volume, it is best to run deduplication less frequently. Multiple concurrent deduplication operations running on a storage system lead to a higher consumption of system resources.

You can run a maximum of eight concurrent deduplication or data compression operations per node. If any more efficiency operations are scheduled, the operations are queued.

Beginning with ONTAP 9.13.1, if temperature-sensitive storage efficiency is enabled on a volume, you can run volume efficiency on existing data to take advantage of sequential packing to further improve storage efficiency.

Run efficiency manually

Steps

1. Start the efficiency operation on a volume: `volume efficiency start`

Example

+ The following command allows you to manually start only deduplication or deduplication followed by logical compression and container compression on the volume VolA

+

```
volume efficiency start -vserver vs1 -volume VolA
```

Repack existing data

To take advantage of sequential data packing introduced in ONTAP 9.13.1 on volumes with temperature-sensitive storage efficiency enabled, you can repack existing data. You must be in advanced privilege mode to use this command.

Steps

1. Set the privilege level: `set -privilege advanced`
2. Repack existing data: `volume efficiency inactive-data-compression start -vserver` *`vserver_name`* `-volume` *`volume_name`* `-scan-mode extended_recompression`

Example

```
volume efficiency inactive-data-compression start -vserver vs1 -volume
vol1 -scan-mode extended_recompression
```

Related information

- Run efficiency operations manually on existing data

Checkpoints and efficiency operations

Checkpoints are used internally to log the execution process of an efficiency operation. When an efficiency operation is stopped for any reason (such as system halt, system disruption, reboot, or because the last efficiency operation failed or stopped) and checkpoint data exists, the efficiency operation can resume from the latest checkpoint file.

A checkpoint is created:

- in each stage or substage of the operation
- when you run the `sis stop` command
- when the duration expires

Learn more about the commands described in this procedure in the ONTAP command reference.

Resume a halted efficiency operation

If an efficiency operation is halted due to a system halt, system disruption, or reboot, you can resume the efficiency operation from the same point it was halted. This helps to save time and resources by not needing to restart the operation from the beginning.

About this task

If you enabled only deduplication on the volume, deduplication runs on the data. If you enabled both deduplication and data compression on a volume, then data compression runs first, followed by deduplication.

You can view the details of the checkpoint for a volume by using the `volume efficiency show` command. Learn more about `volume efficiency show` in the ONTAP command reference.

By default, the efficiency operations resume from checkpoints. However, if a checkpoint corresponding to a previous efficiency operation (the phase when the `volume efficiency start`-scan-old-data` command is run) is older than 24 hours, then the efficiency operation does not resume from the previous checkpoint automatically. In this case, the efficiency operation starts from the beginning. However, if you know that significant changes have not occurred in the volume since the last scan, you can force continuation from the previous checkpoint by using the `-use-checkpoint` option.

Steps

1. Use the `volume efficiency start` command with the `-use-checkpoint` option to resume an efficiency operation.

   The following command enables you to resume an efficiency operation on new data on volume VolA:

   ```
   volume efficiency start -vserver vs1 -volume VolA -use-checkpoint true
   ```

   The following command enables you to resume an efficiency operation on existing data on volume VolA:

   ```
   volume efficiency start -vserver vs1 -volume VolA -scan-old-data true -use
   -checkpoint true
   ```

   Learn more about `volume efficiency start` in the ONTAP command reference.

Run an efficiency operation manually on existing data

You can run the efficiency operations manually on the data that exists in non-temperature sensitive storage efficiency volumes prior to enabling deduplication, data compression, or data compaction. You can run these operations with ONTAP versions earlier than ONTAP 9.8.

About this task

This operation is performed using the `volume efficiency start` command with the `-scan-old-data` parameter. The `-compression` option does not work with `-scan-old-data` on temperature sensitive storage efficiency volumes. Inactive data compression runs automatically on pre-existing data for temperature sensitive storage efficiency volumes in ONTAP 9.8 and later.

If you enable only deduplication on a volume, then deduplication runs on the data. If you enable deduplication, data compression, and data compaction on a volume, then data compression runs first, followed by deduplication and data compaction.

When you run data compression on existing data, by default the data compression operation skips the data blocks that are shared by deduplication and the data blocks that are locked by snapshots. If you choose to run data compression on shared blocks, then optimization is turned off and the fingerprint information is captured and used for sharing again. You can change the default behavior of data compression when compressing existing data.

You can run a maximum of eight deduplication, data compression, or data compaction operations concurrently per node. The remaining operations are queued.

> Post process compression does not run on AFF platforms. An EMS message is generated to inform you that this operation was skipped.

Learn more about `volume efficiency start` in the ONTAP command reference.

Steps

1. Use the `volume efficiency start -scan-old-data` command to run deduplication, data compression, or data compaction manually on the existing data.

   The following command enables you to run these operations manually on the existing data in volume VolA:

   ```
   volume efficiency start -vserver vs1 -volume VolA -scan-old-data true [-
   compression | -dedupe | -compaction ] true
   ```

Related information

- Run efficiency operations manually

Manage volume efficiency operations using schedules

Run an efficiency operation based on the amount of new data written

You can modify the efficiency operation schedule to run deduplication or data compression when the number of new blocks written to the volume after the previous efficiency operation exceeds a specified threshold percentage. This applies whether the previous efficiency operation was performed manually or scheduled.

About this task

If the `schedule` option is set to `auto`, the scheduled efficiency operation runs when the amount of new data exceeds the specified percentage. The default threshold value is 20 percent. This threshold value is the percentage of the total number of blocks already processed by the efficiency operation.

Steps

1. Use the `volume efficiency modify` command with the `auto@num` option to modify the threshold percentage value.

   `num` is a two-digit number to specify the percentage.

Example

The following command modifies the threshold percentage value to 30 percent for the volume VolA:

```
volume efficiency modify -vserver vs1 -volume -VolA -schedule auto@30
```

Related information

- Run efficiency operations using scheduling
- volume efficiency modify

Run an efficiency operation using scheduling

You can modify the scheduling of deduplication or data compression operations on a volume. The configuration options of a schedule and volume efficiency policy are mutually exclusive.

About this task

This operation is performed using the `volume efficiency modify` command. Learn more about `volume efficiency modify` in the ONTAP command reference.

Steps

1. Use the `volume efficiency modify` command to modify the scheduling of deduplication or data compression operations on a volume.

Examples

The following command modifies the scheduling of efficiency operations for VolA to run at 11 p.m., Monday through Friday:

```
volume efficiency modify -vserver vs1 -volume VolA -schedule mon-fri@23
```

Related information

- Run efficiency operations depending on the amount of new data written

Monitor volume efficiency operations

View efficiency operations and status

You can view whether deduplication or data compression is enabled on a volume. You can also view the status, state, type of compression, and progress of the efficiency operations on a volume.

There are two tasks available. Both use the command `volume efficiency show`.

View efficiency status

Steps

1. View the status of an efficiency operation on a volume: `volume efficiency show`

   The following command displays the status of an efficiency operation on volume VolA that is assigned the adaptive compression type:

   ```
   volume efficiency show -instance -vserver vs1 -volume VolA
   ```

   If the efficiency operation is enabled on volume VolA and the operation is idle, then you can see the following in the system output:

```
cluster1::> volume efficiency show -vserver vs1 -volume VolA

  Vserver Name: vs1
   Volume Name: VolA
   Volume Path: /vol/VolA
         State: Enabled
        Status: Idle
      Progress: Idle for 00:03:20
```

Determine if volumes contain sequentially packed data

You can display a list of volumes that have sequential packing enabled, for instance, when you need to revert to an ONTAP release earlier than 9.13.1. You must be in advanced privilege mode to use this command.

Steps

1. Set the privilege level: `set -privilege advanced`
2. List volumes that have sequential packing enabled:

   `volume efficiency show -extended-auto-adaptive-compression true`

View efficiency space savings

You can view the amount of space savings achieved through deduplication and data compression on a volume. You might do this to assess the effectiveness of your administrative processes or as part of capacity planning.

About this task

You need to use the command `volume show` to display the space savings on a volume. Note that the space savings in snapshots is not included when calculating the space savings achieved on a volume. Using deduplication does not affect volume quotas. Quotas are reported at the logical level and remain unchanged.

Steps

1. Use the `volume show` command to view space savings achieved on a volume using deduplication and data compression.

Example

The following command enables you to view the space savings achieved by using deduplication and data compression on volume VolA: `volume show -vserver vs1 -volume VolA`

```
cluster1::> volume show -vserver vs1 -volume VolA

                                  Vserver Name: vs1
                                   Volume Name: VolA

...
            Space Saved by Storage Efficiency: 115812B
       Percentage Saved by Storage Efficiency: 97%
                 Space Saved by Deduplication: 13728B
            Percentage Saved by Deduplication: 81%
                Space Shared by Deduplication: 1028B
                   Space Saved by Compression: 102084B
        Percentage Space Saved by Compression: 97%

...
```

Learn more about `volume show` in the ONTAP command reference.

View efficiency statistics of a FlexVol volume

You can view the details of the efficiency operations run on a FlexVol volume. You might do this to assess the effectiveness of your administrative processes or as part of capacity planning.

Steps

1. Use the `volume efficiency stat` command to view the statistics of efficiency operations on a FlexVol volume.

Example

The following command enables you to view the statistics of the efficiency operations on the volume VolA: `volume efficiency stat -vserver vs1 -volume VolA`

```
cluster1::> volume efficiency stat -vserver vs1 -volume VolA

               Vserver Name: vs1
                Volume Name: VolA
                Volume Path: /vol/VolA
Inline Compression Attempts: 0
```

Learn more about `volume efficiency stat` in the ONTAP command reference.

Stop volume efficiency operations

You can stop a deduplication or postprocess compression operation.

About this task

This operation uses the command `volume efficiency stop`. This command automatically generates a checkpoint.

Steps

1. Use the `volume efficiency stop` command to stop an active deduplication or postprocess compression operation.

   If you specify the `-all` option, active and queued efficiency operations are aborted.

Examples

The following command stops the deduplication or postprocess compression operation that is currently active on volume VolA:

```
volume efficiency stop -vserver vs1 -volume VolA
```

The following command aborts both active and queued deduplication or postprocess compression operations on volume VolA:

```
volume efficiency stop -vserver vs1 -volume VolA -all true
```

Learn more about `volume efficiency stop` in the ONTAP command reference.

Additional information about removing space savings from a volume

You can choose to remove the space savings achieved by running efficiency operations on a volume. However, you must have enough space to accommodate a reversal.

There are several related resources available to help you plan and implement the removal of the space savings.

Related information

- How to see space savings from deduplication, compression, and compaction in ONTAP 9
- How to undo the storage efficiency savings in ONTAP

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