Use quotas to restrict or track resource usage

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Table of Contents

Use quotas to restrict or track resource usage 1
Overview of the quota process 1
Set up quotas on an SVM 34
Modify (or Resizing) quota limits 35
Reinitialize quotas after making extensive changes 36
Commands to manage quota rules and quota policies 37
Commands to activate and modify quotas 38

Use quotas to restrict or track resource usage

Overview of the quota process

Quota process

Quotas provide a way to restrict or track the disk space and number of files used by a user, group, or qtree. Quotas are applied to a specific FlexVol volume or qtree.

Quotas can be soft or hard. Soft quotas cause ONTAP to send a notification when specified limits are exceeded, and hard quotas prevent a write operation from succeeding when specified limits are exceeded.

When ONTAP receives a request from a user or user group to write to a FlexVol volume, it checks to see whether quotas are activated on that volume for the user or user group and determines the following:

- Whether the hard limit will be reached

  If yes, the write operation fails when the hard limit is reached and the hard quota notification is sent.

- Whether the soft limit will be breached

  If yes, the write operation succeeds when the soft limit is breached and the soft quota notification is sent.

- Whether a write operation will not exceed the soft limit

  If yes, the write operation succeeds and no notification is sent.

Differences among hard, soft, and threshold quotas

Hard quotas prevent operations while soft quotas trigger notifications.

Hard quotas impose a hard limit on system resources; any operation that would result in exceeding the limit fails. The following settings create hard quotas:

- Disk Limit parameter
- Files Limit parameter

Soft quotas send a warning message when resource usage reaches a certain level, but do not affect data access operations, so you can take appropriate action before the quota is exceeded. The following settings create soft quotas:

- Threshold for Disk Limit parameter
- Soft Disk Limit parameter
- Soft Files Limit parameter

Threshold and Soft Disk quotas enable administrators to receive more than one notification about a quota. Typically, administrators set the Threshold for Disk Limit to a value that is only slightly smaller than the Disk Limit, so that the threshold provides a "final warning" before writes start to fail.

About quota notifications

Quota notifications are messages that are sent to the event management system (EMS) and also configured as SNMP traps.

Notifications are sent in response to the following events:

- A hard quota is reached; in other words, an attempt is made to exceed it
- A soft quota is exceeded
- A soft quota is no longer exceeded

Thresholds are slightly different from other soft quotas. Thresholds trigger notifications only when they are exceeded, not when they are no longer exceeded.

Hard-quota notifications are configurable byusing the volume quota modify command. You can turn them off completely, and you can change their frequency, for example, to prevent sending of redundant messages.

Soft-quota notifications are not configurable because they are unlikely to generate redundant messages and their sole purpose is notification.

The following table lists the events that quotas send to the EMS system:

When this occurs…	This event is sent to the EMS…
A hard limit is reached in a tree quota	`wafl.quota.qtree.exceeded`
A hard limit is reached in a user quota on the volume	`wafl.quota.user.exceeded` (for a UNIX user) `wafl.quota.user.exceeded.win` (for a Windows user)
A hard limit is reached in a user quota on a qtree	`wafl.quota.userQtree.exceeded` (for a UNIX user) `wafl.quota.userQtree.exceeded.win` (for a Windows user)
A hard limit is reached in a group quota on the volume	`wafl.quota.group.exceeded`
A hard limit is reached in a group quota on a qtree	`wafl.quota.groupQtree.exceeded`
A soft limit, including a threshold, is exceeded	`quota.softlimit.exceeded`
A soft limit is no longer exceeded	`quota.softlimit.normal`

The following table lists the SNMP traps that quotas generate:

When this occurs…	This SNMP trap is sent…
A hard limit is reached	quotaExceeded

When this occurs…	This SNMP trap is sent…
A soft limit, including a threshold, is exceeded	quotaExceeded and softQuotaExceeded
A soft limit is no longer exceeded	quotaNormal and softQuotaNormal

Notifications contain qtree ID numbers rather than qtree names. You can correlate qtree names to ID numbers by using the `volume qtree show -id` command.

Why you use quotas

You can use quotas to limit resource usage in FlexVol volumes, to provide notification when resource usage reaches specific levels, or to track resource usage.

You specify a quota for the following reasons:

- To limit the amount of disk space or the number of files that can be used by a user or group, or that can be contained by a qtree
- To track the amount of disk space or the number of files used by a user, group, or qtree, without imposing a limit
- To warn users when their disk usage or file usage is high

Use default, explicit, derived and tracking quotas to manage disk usage in the most efficient manner.

What quota rules, quota policies, and quotas are

Quotas are defined in quota rules specific to FlexVol volumes. These quota rules are collected together in a quota policy of a storage virtual machine (SVM), and then activated on each volume on the SVM.

A quota rule is always specific to a volume. Quota rules have no effect until quotas are activated on the volume defined in the quota rule.

A quota policy is a collection of quota rules for all the volumes of an SVM. Quota policies are not shared among SVMs. An SVM can have up to five quota policies, which enable you to have backup copies of quota policies. One quota policy is assigned to an SVM at any given time.

A quota is the actual restriction that ONTAP enforces or the actual tracking that ONTAP performs. A quota rule always results in at least one quota, and might result in many additional derived quotas. The complete list of enforced quotas is visible only in quota reports.

Activation is the process of triggering ONTAP to create enforced quotas from the current set of quota rules in the assigned quota policy. Activation occurs on a volume-by-volume basis. The first activation of quotas on a volume is called initialization. Subsequent activations are called either reinitialization or resizing, depending on the scope of the changes.

When you initialize or resize quotas on a volume, you are activating the quota rules in the quota policy that is currently assigned to the SVM.

Quota targets and types

Quotas have a type: they can be either user, group, or tree. Quota targets specify the user, group, or qtree for which the quota limits are applied.

The following table lists the kinds of quota targets, what types of quotas each quota target is associated with, and how each quota target is represented:

Quota target	Quota type	How target is represented	Notes
user	user quota	UNIX user name UNIX UID A file or directory whose UID matches the user Windows user name in pre-Windows 2000 format Windows SID A file or directory with an ACL owned by the user's SID	User quotas can be applied for a specific volume or qtree.
group	group quota	UNIX group name UNIX GID A file or directory whose GID matches the group	Group quotas can be applied for a specific volume or qtree. ONTAP does not apply group quotas based on Windows IDs.
qtree	tree quota	qtree name	Tree quotas are applied to a particular volume and do not affect qtrees in other volumes.
""	user quotagroup quota tree quota	Double quotation marks ("")	A quota target of "" denotes a *default quota*. For default quotas, the quota type is determined by the value of the type field.

Special kinds of quotas

How default quotas work

You can use default quotas to apply a quota to all instances of a given quota type. For example, a default user quota affects all users on the system for the specified FlexVol volume or qtree. In addition, default quotas enable you to modify your quotas easily.

You can use default quotas to automatically apply a limit to a large set of quota targets without having to create separate quotas for each target. For example, if you want to limit most users to 10 GB of disk space, you can

specify a default user quota of 10 GB of disk space instead of creating a quota for each user. If you have specific users for whom you want to apply a different limit, you can create explicit quotas for those users. (Explicit quotas—quotas with a specific target or list of targets—override default quotas.)

In addition, default quotas enable you to use resizing rather than reinitialization when you want quota changes to take effect. For example, if you add an explicit user quota to a volume that already has a default user quota, you can activate the new quota by resizing.

Default quotas can be applied to all three types of quota target (users, groups, and qtrees).

Default quotas do not necessarily have specified limits; a default quota can be a tracking quota.

A quota is indicated by a target that is either an empty string ("") or an asterisk (*), depending on the context:

- When you create a quota using the `volume quota policy rule create` command, setting the `-target` parameter to an empty string ("") creates a default quota.
- In the output of the `volume quota policy rule show` command, a default quota appears with an empty string ("") as the Target.
- In the output of the `volume quota report` command, a default quota appears with an asterisk (*) as the ID and Quota Specifier.

Default user quota example

The following quotas file uses a default user quota to apply a 50-MB limit on each user for vol1:

```
#Quota target type           disk  files  thold  sdisk  sfile
#------------  ----           ----  -----  -----  -----  -----
*              user@/vol/vol1  50M
```

If any user on the system enters a command that would cause that user's data to take up more than 50 MB in vol1 (for example, writing to a file from an editor), the command fails.

How you use explicit quotas

You can use explicit quotas to specify a quota for a specific quota target, or to override a default quota for a specific target.

An explicit quota specifies a limit for a particular user, group, or qtree. An explicit quota replaces any default quota that is in place for the same target.

When you add an explicit user quota for a user that has a derived user quota, you must use the same user mapping setting as the default user quota. Otherwise, when you resize quotas, the explicit user quota is rejected because it is considered a new quota.

Explicit quotas only affect default quotas at the same level (volume or qtree). For example, an explicit user quota for a qtree does not affect the default user quota for the volume that contains that qtree. However, the explicit user quota for the qtree overrides (replaces the limits defined by) the default user quota for that qtree.

Examples of explicit quotas

The following quotas file contains a default user quota that limits all users in vol1 to 50 MB of space. However, one user, jsmith, is allowed 80 MB of space, because of the explicit quota (shown in bold):

```
#Quota target type            disk  files  thold  sdisk  sfile
#-----------  ----            ----  -----  -----  -----  -----
*             user@/vol/vol1  50M
**jsmith      user@/vol/vol1  80M**
```

The following quotas entry restricts the specified user, represented by four IDs, to 500MB of disk space and 10,240 files in the vol1 volume:

```
jsmith,corp\jsmith,engineering\”john smith”,
S-1-5-32-544   user@/vol/vol1         500M      10K
```

The following quotas entry restricts the eng1 group to 150 MB of disk space and an unlimited number of files in the /vol/vol2/proj1 qtree:

```
eng1        group@/vol/vol2/proj1  150M
```

The following quotas entry restricts the proj1 qtree in the vol2 volume to 750 MB of disk space and 76,800 files:

```
/vol/vol2/proj1   tree               750M      75K
```

How derived quotas work

A quota enforced as a result of a default quota, rather than an explicit quota (a quota with a specific target), is referred to as a *derived quota*.

The number and location of the derived quotas depends on the quota type:

- A default tree quota on a volume creates derived tree quotas for every qtree on the volume.
- A default user or group quota creates a derived user or group quota for every user or group that owns a file at the same level (volume or qtree).
- A default user or group quota on a volume creates a default user or group quota on every qtree that also has a tree quota.

The settings—including limits and user mapping—of derived quotas are the same as the settings of the corresponding default quotas. For example, a default tree quota with a 20-GB disk limit on a volume creates derived tree quotas with 20-GB disk limits on the qtrees in the volume. If a default quota is a tracking quota (with no limits), the derived quotas are also tracking quotas.

To see derived quotas, you can generate a quota report. In the report, a derived user or group quota is indicated by a Quota Specifier that is either blank or an asterisk (*). A derived tree quota, however, has a Quota Specifier; to identify a derived tree quota, you must look for a default tree quota on the volume with the same limits.

Explicit quotas interact with derived quotas in the following ways:

- Derived quotas are not created if an explicit quota already exists for the same target.
- If a derived quota exists when you create an explicit quota for a target, you can activate the explicit quota by resizing rather than having to perform a full quota initialization.

How you use tracking quotas

Tracking quotas generate reports of disk and file usage and do not limit resource usage. When tracking quotas are used, modifying quota values is less disruptive, because you can resize quotas rather than turning them off and back on.

To create a tracking quota, you omit the Disk Limit and Files Limit parameters. This tells ONTAP to monitor disk and files usage for that target at that level (volume or qtree), without imposing any limits. Tracking quotas are indicated in the output of `show` commands and the quota report with a dash ("-") for all limits.

You can also specify a *default tracking quota*, which applies to all instances of the target. Default tracking quotas enable you to track usage for all instances of a quota type (for example, all qtrees or all users). In addition, they enable you use resizing rather than reinitialization when you want quota changes to take effect.

Examples

The following quotas file shows tracking quotas in place for a specific user, group, and qtree:

```
#Quota target   type           disk files thold sdisk sfile
#-----------    ----           ---- ----- ----- ----- -----
kjones          user@/vol/vol1    -  -
eng1            group@/vol/vol1   -  -
proj1           tree@/vol/vol1    -  -
```

The following quotas file contains the three possible default tracking quotas (users, groups, and qtrees):

```
#Quota target   type           disk  files thold sdisk sfile
#-----------    ----           ----  ----- ----- ----- -----
*               user@/vol/vol1    -   -
*               group@/vol/vol1   -   -
*               tree@/vol/vol1    -   -
```

How quotas are applied

Understanding how quotas are applied enables you to configure quotas and set the expected limits.

Whenever an attempt is made to create a file or write data to a file in a FlexVol volume that has quotas enabled, the quota limits are checked before the operation proceeds. If the operation exceeds either the disk limit or the files limit, the operation is prevented.

Quota limits are checked in the following order:

1. The tree quota for that qtree (This check is not relevant if the file is being created or written to qtree0.)

2. The user quota for the user that owns the file on the volume
3. The group quota for the group that owns the file on the volume
4. The user quota for the user that owns the file on the qtree (This check is not relevant if the file is being created or written to qtree0.)
5. The group quota for the group that owns the file on the qtree (This check is not relevant if the file is being created or written to qtree0.)

The quota with the smallest limit might not be the one that is exceeded first. For example, if a user quota for volume vol1 is 100 GB, and the user quota for qtree q2 contained in volume vol1 is 20 GB, the volume limit could be reached first if that user has already written more than 80 GB of data in volume vol1 (but outside of qtree q2).

Considerations for assigning quota policies

A quota policy is a grouping of the quota rules for all the FlexVol volumes of an SVM. You must be aware of certain considerations when assigning the quota policies.

- An SVM has one assigned quota policy at any given time. When an SVM is created, a blank quota policy is created and assigned to the SVM. This default quota policy has the name "default" unless a different name is specified when the SVM is created.
- An SVM can have up to five quota policies. If an SVM has five quota policies, you cannot create a new quota policy for the SVM until you delete an existing quota policy.
- When you need to create a quota rule or change quota rules for a quota policy, you can choose either of the following approaches:
  - If you are working in a quota policy that is assigned to an SVM, you need not assign the quota policy to the SVM.
  - If you are working in an unassigned quota policy and then assigning the quota policy to the SVM, you must have a backup of the quota policy that you can revert to if required.

    For example, you can make a copy of the assigned quota policy, change the copy, assign the copy to the SVM, and rename the original quota policy.
- You can rename a quota policy even when it is assigned to the SVM.

How quotas work with users and groups

How quotas work with users and groups overview

When you specify a user or group as the target of a quota, the limits imposed by that quota are applied to that user or group. However, some special groups and users are handled differently. There are different ways to specify IDs for users, depending on your environment.

How you specify UNIX users for quotas

You can specify a UNIX user for a quota using one of three formats: the user name, the UID, or a file or directory owned by the user.

To specify a UNIX user for a quota, you can use one of the following formats:

- The user name, such as jsmith.

> You cannot use a UNIX user name to specify a quota if that name includes a backslash (\) or an @ sign. This is because ONTAP treats names containing these characters as Windows names.

- The UID, such as 20.
- The path of a file or directory owned by that user, so that the file's UID matches the user.

> If you specify a file or directory name, you must select a file or directory that will last as long as the user account remains on the system.
>
> Specifying a file or directory name for the UID does not cause ONTAP to apply a quota to that file or directory.

How you specify Windows users for quotas

You can specify a Windows user for a quota using one of three formats: the Windows name in pre-Windows 2000 format, the SID, or a file or directory owned by the SID of the user.

To specify a Windows user for a quota, you can use one of the following formats:

- The Windows name in pre-Windows 2000 format.
- The security ID (SID), as displayed by Windows in text form, such as S-1-5-32-544.
- The name of a file or directory that has an ACL owned by that user's SID.

> If you specify a file or directory name, you must select a file or directory that will last as long as the user account remains on the system.
>
> For ONTAP to obtain the SID from the ACL, the ACL must be valid.
>
> If the file or directory exists in a UNIX-style qtree, or if the storage system uses UNIX mode for user authentication, ONTAP applies the user quota to the user whose **UID**, not SID, matches that of the file or directory.
>
> Specifying a file or directory name to identify a user for a quota does not cause ONTAP to apply a quota to that file or directory.

How default user and group quotas create derived quotas

When you create default user or group quotas, corresponding derived user or group quotas are automatically created for every user or group that owns files at the same level.

Derived user and group quotas are created in the following ways:

- A default user quota on a FlexVol volume creates derived user quotas for every user that owns a file anywhere on the volume.
- A default user quota on a qtree creates derived user quotas for every user that owns a file in the qtree.

- A default group quota on a FlexVol volume creates derived group quotas for every group that owns a file anywhere on the volume.
- A default group quota on a qtree creates derived group quotas for every group that owns a file in the qtree.

If a user or group does not own files at the level of a default user or group quota, derived quotas are not created for the user or group. For example, if a default user quota is created for qtree proj1 and the user jsmith owns files on a different qtree, no derived user quota is created for jsmith.

The derived quotas have the same settings as the default quotas, including limits and user mapping. For example, if a default user quota has a 50-MB disk limit and has user mapping turned on, any resulting derived quotas also have a 50-MB disk limit and user mapping turned on.

However, no limits exist in derived quotas for three special users and groups. If the following users and groups own files at the level of a default user or group quota, a derived quota is created with the same user-mapping setting as the default user or group quota, but it is only a tracking quota (with no limits):

- UNIX root user (UID 0)
- UNIX root group (GID 0)
- Windows BUILTIN\Administrators group

  Since quotas for Windows groups are tracked as user quotas, a derived quota for this group is a user quota that is derived from a default user quota, not a default group quota.

Example of derived user quotas

If you have volume where three users—root, jsmith, and bob—own files, and you create a default user quota on the volume, ONTAP automatically creates three derived user quotas. Therefore, after you reinitialize quotas on the volume, four new quotas appear in the quota report:

```
cluster1::> volume quota report
  Vserver: vs1
                                     ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1               user    *          0B   50MB       0       -   *
vol1               user    root       5B      -       1       -
vol1               user    jsmith    30B   50MB      10       -   *
vol1               user    bob       40B   50MB      15       -   *
4 entries were displayed.
```

The first new line is the default user quota that you created, which is identifiable by the asterisk (*) as the ID. The other new lines are the derived user quotas. The derived quotas for jsmith and bob have the same 50-MB disk limit as the default quota. The derived quota for the root user is a tracking quota without limits.

How quotas are applied to the root user

The root user (UID=0) on UNIX clients is subject to tree quotas, but not user quotas or

group quotas. This allows the root user to take actions on behalf of other users that would otherwise be prevented by a quota.

When root carries out a file or directory ownership change or other operation (such as the UNIX `chown` command) on behalf of a user with less privileges, ONTAP checks the quotas based on the new owner but does not report errors or stop the operation, even if the hard quota restrictions of the new owner are exceeded. This can be useful when an administrative action, such as recovering lost data, results in temporarily exceeding quotas.

After the ownership transfer is carried out, however, a client system will report a disk space error if the user attempts to allocate more disk space while the quota is still exceeded.

How quotas work with special Windows groups

Quotas are applied to the Everyone group and the BUILTIN\Administrators group differently than to other Windows groups.

The following list describes what happens if the quota target is a special Windows group ID:

- If the quota target is the Everyone group, a file whose ACL shows that the owner is Everyone is counted under the SID for Everyone.
- If the quota target is BUILTIN\Administrators, the entry is considered a user quota, for tracking only.

  You cannot impose restrictions on BUILTIN\Administrators.

  If a member of BUILTIN\Administrators creates a file, the file is owned by BUILTIN\Administrators and is counted under the SID for BUILTIN\Administrators, not the user's personal SID.

ONTAP does not support group quotas based on Windows group IDs. If you specify a Windows group ID as the quota target, the quota is considered to be a user quota.

How quotas are applied to users with multiple IDs

A user can be represented by multiple IDs. You can set up a single user quota for such a user by specifying a list of IDs as the quota target. A file owned by any of these IDs is subject to the restriction of the user quota.

Suppose a user has the UNIX UID 20 and the Windows IDs corp\john_smith and engineering\jsmith. For this user, you can specify a quota where the quota target is a list of the UID and Windows IDs. When this user writes to the storage system, the specified quota applies, regardless of whether the write originates from UID 20, corp\john_smith, or engineering\jsmith.

Separate quota file entries are considered separate targets, even if the IDs belong to the same user. For example, for the same user you can specify one quota that limits UID 20 to 1 GB of disk space and another quota that limits corp\john_smith to 2 GB of disk space, even though both IDs represent the same user. ONTAP applies quotas to UID 20 and corp\john_smith separately.

In this case, no limits are applied to engineering\jsmith, even though limits are applied to the other IDs used by the same user.

How ONTAP determines user IDs in a mixed environment

If you have users accessing your ONTAP storage from both Windows and UNIX clients, then both Windows and UNIX security are used to determine file ownership. Several factors determine whether ONTAP uses a UNIX or Windows ID when applying user quotas.

If the security style of the qtree or FlexVol volume that contains the file is only NTFS or only UNIX, then the security style determines the type of ID used when applying user quotas. For qtrees with the mixed security style, the type of ID used is determined by whether the file has an ACL.

The following table summarizes what type of ID is used:

Security Style	ACL	No ACL
UNIX	UNIX ID	UNIX ID
Mixed	Windows ID	UNIX ID
NTFS	Windows ID	Windows ID

How quotas with multiple users work

When you put multiple users in the same quota target, the quota limits defined by that quota are not applied to each individual user; in this case, the quota limits are shared among all users listed in the quota target.

Unlike with commands for managing objects, such as volumes and qtrees, you cannot rename a quota target, including a multi-user quota. This means that after a multi-user quota is defined, you cannot modify the users in the quota target, and you cannot add users to a target or remove users from a target. If you want to add or remove a user from a multi-user quota, then the quota containing that user must be deleted and a new quota rule with the set of users in the target defined.

If you combine separate user quotas into one multi-user quota, you can activate the change by resizing quotas. However, if you want to remove users from a quota target with multiple users, or add users to a target that already has multiple users, you must reinitialize quotas before the change takes effect.

Example of more than one user in a quotas file entry

In the following example, there are two users listed in the quota entry. The two users can use up to 80 MB of space combined. If one uses 75 MB, then the other one can use only 5 MB.

```
#Quota       target type    disk files thold sdisk sfile
#----------  ----           ---- ----- ----- ----- -----
jsmith,chen  user@/vol/vol1 80M
```

How you link UNIX and Windows names for quotas

In a mixed environment, users can log in as either Windows users or UNIX users. You can configure quotas to recognize that a user's UNIX id and Windows ID represent the same user.

Quotas for Windows user name are mapped to a UNIX user name, or vice versa, when both of the following conditions are met:

- The `user-mapping` parameter is set to "on" in the quota rule for the user.
- The user names have been mapped with the `vserver name-mapping` commands.

When a UNIX and Windows name are mapped together, they are treated as the same person for determining quota usage.

How quotas work with qtrees

You can create quotas with a qtree as their target; these quotas are called *tree quotas*. You can also create user and group quotas for a specific qtree. In addition, quotas for a FlexVol volume are sometimes inherited by the qtrees contained by that volume.

How tree quotas work

How tree quotas work overview

You can create a quota with a qtree as its target to limit how large the target qtree can become. These quotas are also called *tree quotas*.

When you apply a quota to a qtree, the result is similar to a disk partition, except that you can change the qtree's maximum size at any time by changing the quota. When applying a tree quota, ONTAP limits the disk space and number of files in the qtree, regardless of their owners. No users, including root and members of the BUILTIN\Administrators group, can write to the qtree if the write operation causes the tree quota to be exceeded.

> The size of the quota does not guarantee any specific amount of available space. The size of the quota can be larger than the amount of free space available to the qtree. You can use the `volume quota report` command to determine the true amount of available space in the qtree.

How user and group quotas work with qtrees

Tree quotas limit the overall size of the qtree. To prevent individual users or groups from consuming the entire qtree, you specify a user or group quota for that qtree.

Example user quota in a qtree

Suppose you have the following quotas file:

```
#Quota target type            disk files thold sdisk sfile
#-----------  ----            ---- ----- ----- ----- -----
*             user@/vol/vol1  50M   -     45M
jsmith        user@/vol/vol1  80M   -     75M
```

It comes to your attention that a certain user, kjones, is taking up too much space in a critical qtree, qt1, which resides in vol2. You can restrict this user's space by adding the following line to the quotas file:

```
kjones        user@/vol/vol2/qt1  20M  -   15M
```

How default tree quotas on a FlexVol volume create derived tree quotas

When you create a default tree quota on a FlexVol volume, corresponding derived tree quotas are automatically created for every qtree in that volume.

These derived tree quotas have the same limits as the default tree quota. If no additional quotas exist, the limits have the following effects:

- Users can use as much space in a qtree as they are allotted for the entire volume (provided they did not exceed the limit for the volume by using space in the root or another qtree).
- Each of the qtrees can grow to consume the entire volume.

The existence of a default tree quota on a volume continues to affect all new qtrees that are added to the volume. Each time a new qtree is created, a derived tree quota is also created.

Like all derived quotas, derived tree quotas display the following behaviors:

- Are created only if the target does not already have an explicit quota.
- Appear in quota reports but do not appear when you show quota rules with the `volume quota policy rule show` command.

Example of derived tree quotas

You have a volume with three qtrees (proj1, proj2, and proj3) and the only tree quota is an explicit quota on the proj1 qtree limiting its disk size to 10 GB. If you create a default tree quota on the volume and reinitialize quotas on the volume, the quota report now contains four tree quotas:

```
                                     ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1     proj1     tree    1           0B   10GB       1       -   proj1
vol1               tree    *           0B   20GB       0       -   *
vol1     proj2     tree    2           0B   20GB       1       -   proj2
vol1     proj3     tree    3           0B   20GB       1       -   proj3
...
```

The first line shows the original explicit quota on the proj1 qtree. This quota remains unchanged.

The second line shows the new default tree quota on the volume. The asterisk (*) Quota Specifier indicates it is a default quota. This quota is a result of the quota rule that you created.

The last two lines show new derived tree quotas for the proj2 and proj3 qtrees. ONTAP automatically created these quotas as a result of the default tree quota on the volume. These derived tree quotas have the same 20-GB disk limit as the default tree quota on the volume. ONTAP did not create a derived tree quota for the proj1 qtree because the proj1 qtree already had an explicit quota.

How default user quotas on a FlexVol volume affect quotas for the qtrees in that volume

If a default user quota is defined for a FlexVol volume, a default user quota is automatically created for every qtree contained by that volume for which an explicit or derived tree quota exists.

If a default user quota on the qtree already exists, it remains unaffected when the default user quota on the volume is created.

The automatically created default user quotas on the qtrees have the same limits as the default user quota you create for the volume.

An explicit user quota for a qtree overrides (replaces the limits applied by) the automatically created default user quota, the same way as it overrides a default user quota on that qtree that was created by an administrator.

How qtree changes affect quotas

How qtree changes affect quotas overview

When you delete, rename, or change the security style of a qtree, the quotas applied by ONTAP might change, depending on the current quotas being applied.

How deleting a qtree affects tree quotas

When you delete a qtree, all quotas applicable to that qtree, whether they are explicit or derived, are no longer applied by ONTAP.

Whether the quota rules persist depends on where you delete the qtree:

- If you delete a qtree using ONTAP, the quota rules for that qtree are automatically deleted, including tree quota rules and any user and group quota rules configured for that qtree.
- If you delete a qtree using your CIFS or NFS client, you must delete any quota rules for that qtree to avoid getting errors when you reinitialize quotas. If you create a new qtree with the same name as the one you deleted, the existing quota rules are not applied to the new qtree until you reinitialize quotas.

How renaming a qtree affects quotas

When you rename a qtree using ONTAP, the quota rules for that qtree are automatically updated. If you rename a qtree using your CIFS or NFS client, you must update any quota rules for that qtree.

> If you rename a qtree using your CIFS or NFS client and do not update quota rules for that qtree with the new name before you reinitialize quotas, quotas will not be applied to the qtree and explicit quotas for the qtree—including tree quotas and user or group quotas for the qtree—might be converted into derived quotas.

How changing the security style of a qtree affects user quotas

You can apply Access Control Lists (ACLs) on qtrees by using NTFS or mixed security styles, but not by using the UNIX security style. Therefore, changing the security style of a qtree might affect how quotas are calculated. You should always reinitialize quotas after you change the security style of a qtree.

If you change the security style of a qtree from NTFS or mixed to UNIX, any ACLs on files in that qtree are ignored and the file usage is charged against the UNIX user IDs.

If you change the security style of a qtree from UNIX to either mixed or NTFS, the previously hidden ACLs become visible. In addition, any ACLs that were ignored become effective again, and the NFS user information is ignored. If no ACL existed before, the NFS information continues to be used in the quota calculation.

> To make sure that quota usages for both UNIX and Windows users are properly calculated after you change the security style of a qtree, you must reinitialize quotas for the volume containing that qtree.

Example

The following example shows how a change in the security style of a qtree results in a different user being charged for the usage of a file in the particular qtree.

Suppose NTFS security is in effect on qtree A, and an ACL gives Windows user corp\joe ownership of a 5 MB file. User corp\joe is charged with 5 MB of disk space usage for qtree A.

Now you change the security style of qtree A from NTFS to UNIX. After quotas are reinitialized, Windows user corp\joe is no longer charged for this file; instead, the UNIX user corresponding to the UID of the file is charged for the file. The UID could be a UNIX user mapped to corp\joe or the root user.

How quotas are activated

How quotas are activated overview

New quotas and changes to quotas do not take effect until they are activated. Knowing how quota activation works can help you manage your quotas less disruptively.

You can activate quotas at the volume level.

Your quotas file does not need to be free of all errors to activate quotas. Invalid entries are reported and skipped. If the quotas file contains any valid entries, the quotas are activated.

Quotas are activated either by *initializing* (turning them on) or by *resizing*. Turning off quotas and turning them on again is called reinitializing.

The length of the activation process and its impact on quota enforcement depends on the type of activation:

- The initialization process involves two parts: a `quota on` job and a quota scan of the volume's entire file system. The scan begins after the `quota on` job completes successfully. The quota scan can take some time; the more files that the volume has, the longer it takes. Until the scan is finished, quota activation is not complete and quotas are not enforced.
- The resize process involves only a `quota resize` job. Because it does not involve a quota scan, resizing takes less time than a quota initialization. During a resize process, quotas are enforced.

By default, the `quota on` and `quota resize` jobs run in the background, which permits you to use other commands at the same time.

Errors and warnings from the activation process are sent to the event management system. If you use the `-foreground` parameter with the `volume quota on` or `volume quota resize` commands, the command does not return until the job is complete; this is useful if you are reinitializing from a script. To display errors and warnings later, you can use the `volume quota show` command with the `-instance` parameter.

Quota activation persists across halts and reboots. The process of quota activation does not affect the availability of the storage system data.

When you can use resizing

Because quota resizing is faster than quota initialization, you should use resizing whenever possible. However, resizing only works for certain types of quota changes.

You can resize quotas when making the following types of changes to the quota rules:

- Changing an existing quota.

  For example, changing the limits of an existing quota.

- Adding a quota for a quota target for which a default quota or a default tracking quota exists.
- Deleting a quota for which a default quota or default tracking quota entry is specified.
- Combining separate user quotas into one multi-user quota.

After you have made extensive quotas changes, you should perform a full reinitialization to ensure that all of the changes take effect.

If you attempt to resize and not all of your quota changes can be incorporated by using a resize operation, ONTAP issues a warning. You can determine from the quota report whether your storage system is tracking disk usage for a particular user, group, or qtree. If you see a quota in the quota report, it means that the storage system is tracking the disk space and the number of files owned by the quota target.

Example quotas changes that can be made effective by resizing

Some quota rule changes can be made effective by resizing. Consider the following quotas:

```
#Quota Target type             disk  files thold sdisk sfile
#------------ ----             ----  ----- ----- ----- -----
*             user@/vol/vol2    50M   15K
*             group@/vol/vol2  750M   85K
*             tree@/vol/vol2     -     -
jdoe          user@/vol/vol2/  100M   75K
kbuck         user@/vol/vol2/  100M   75K
```

Suppose you make the following changes:

- Increase the number of files for the default user target.
- Add a new user quota for a new user, boris, that needs more disk limit than the default user quota.
- Delete the kbuck user's explicit quota entry; the new user now needs only the default quota limits.

These changes result in the following quotas:

```
#Quota Target type             disk  files thold sdisk sfile
#------------ ----             ----  ----- ----- ----- -----
*             user@/vol/vol2    50M   25K
*             group@/vol/vol2  750M   85K
*             tree@/vol/vol2     -     -
jdoe          user@/vol/vol2/  100M   75K
boris         user@/vol/vol2/  100M   75K
```

Resizing activates all of these changes; a full quota reinitialization is not necessary.

When a full quota reinitialization is required

Although resizing quotas is faster, you must do a full quota reinitialization if you make certain small or extensive changes to your quotas.

A full quota reinitialization is necessary in the following circumstances:

- You create a quota for a target that has not previously had a quota.
- You change user mapping in the `usermap.cfg` file and you use the QUOTA_PERFORM_USER_MAPPING entry in the quotas file.

- You change the security style of a qtree from UNIX to either mixed or NTFS.
- You change the security style of a qtree from mixed or NTFS to UNIX.
- You remove users from a quota target with multiple users, or add users to a target that already has multiple users.
- You make extensive changes to your quotas.

Example of quotas changes that require initialization

Suppose you have a volume that contains three qtrees and the only quotas in the volume are three tree quotas. You decide to make the following changes:

- Add a new qtree and create a new tree quota for it.
- Add a default user quota for the volume.

Both of these changes require a full quota initialization. Resizing does not make the quotas effective.

How you can view quota information

How you can view quota information overview

You can use quota reports to view details such as the configuration of quota rules and policies, enforced and configured quotas, and errors that occur during quota resizing and reinitialization.

Viewing quota information is useful in situations such as the following:

- Configuring quotas—for example, to configure quotas and verify the configurations
- Responding to notifications that disk space or file limits will soon be reached or that they have been reached
- Responding to requests for more space

How you can use the quota report to see what quotas are in effect

Because of the various ways that quotas interact, more quotas are in effect than just the ones you have explicitly created. To see what quotas are in effect, you can view the quota report.

The following examples show quota reports for different types of quotas applied on a FlexVol volume vol1, and a qtree q1 contained in that volume:

Example with no user quotas specified for the qtree

In this example, there is one qtree, q1, which is contained by the volume vol1. The administrator has created three quotas:

- A default tree quota limit on vol1 of 400 MB
- A default user quota limit on vol1 of 100 MB
- An explicit user quota limit on vol1 of 200 MB for the user jsmith

The quotas file for these quotas looks similar to the following excerpt:

```
#Quota target type            disk files  thold sdisk  sfile
#------------  ----            ---  -----  ----  -----  -----
*              tree@/vol/vol1  400M
*              user@/vol/vol1  100M
jsmith         user@/vol/vol1  200M
```

The quota report for these quotas looks similar to the following excerpt:

```
cluster1::> volume quota report
Vserver: vs1
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1     -          tree   *           0B  400MB       0       -   *
vol1     -          user   *           0B  100MB       0       -   *
vol1     -          user   corp/jsmith
                                     150B  200MB       7       -
corp/jsmith
vol1     q1         tree   1           0B  400MB       6       -   q1
vol1     q1         user   *           0B  100MB       0       -
vol1     q1         user   corp/jsmith 0B  100MB       5       -
vol1     -          user   root        0B   0MB        1       -
vol1     q1         user   root        0B   0MB        8       -
```

The first three lines of the quota report display the three quotas specified by the administrator. Since two of these quotas are default quotas, ONTAP automatically creates derived quotas.

The fourth line displays the tree quota that is derived from the default tree quota for every qtree in vol1 (in this example, only q1).

The fifth line displays the default user quota that is created for the qtree as a result of the existence of the default user quota on the volume and the qtree quota.

The sixth line displays the derived user quota that is created for jsmith on the qtree because there is a default user quota for the qtree (line 5) and the user jsmith owns files on that qtree. Note that the limit applied to the user jsmith in the qtree q1 is not determined by the explicit user quota limit (200 MB). This is because the explicit user quota limit is on the volume, so it does not affect limits for the qtree. Instead, the derived user quota limit for the qtree is determined by the default user quota for the qtree (100 MB).

The last two lines display more user quotas that are derived from the default user quotas on the volume and on the qtree. A derived user quota was created for the root user on both the volume and the qtree because the root user owned files on both the volume and the qtree. Since the root user gets special treatment in terms of quotas, its derived quotas are tracking quotas only.

Example with user quotas specified for the qtree

This example is similar to the previous one, except that the administrator has added two quotas on the qtree.

There is still one volume, vol1, and one qtree, q1. The administrator has created the following quotas:

- A default tree quota limit on vol1 of 400 MB
- A default user quota limit on vol1 of 100 MB
- An explicit user quota limit on vol1 for the user jsmith of 200 MB
- A default user quota limit on qtree q1 of 50 MB
- An explicit user quota limit on qtree q1 for the user jsmith of 75 MB

The quotas file for these quotas looks like this:

```
#Quota target type             disk files  thold sdisk  sfile
#-----------  ----              ---  -----  ----  -----  -----
*             tree@/vol/vol1    400M
*             user@/vol/vol1    100M
jsmith        user@/vol/vol1    200M
*             user@/vol/vol1/q1 50M
jsmith        user@/vol/vol1/q1 75M
```

The quota report for these quotas looks like this:

```
cluster1::> volume quota report
Vserver: vs1
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1     -          tree   *           0B  400MB       0       -   *
vol1     -          user   *           0B  100MB       0       -   *
vol1     -          user   corp/jsmith
                                    2000B  200MB       7       -
corp/jsmith
vol1     q1         user   *           0B   50MB       0       -   *
vol1     q1         user   corp/jsmith 0B  75MB        5       -
corp/jsmith
vol1     q1         tree   1           0B 400MB        6       -   q1
vol1     -          user   root        0B   0MB        2       -
vol1     q1         user   root        0B   0MB        1       -
```

The first five lines of the quota report display the five quotas created by the administrator. Since some of these quotas are default quotas, ONTAP automatically creates derived quotas.

The sixth line displays the tree quota that is derived from the default tree quota for every qtree in vol1 (in this

example, only q1).

The last two lines display the user quotas that are derived from the default user quotas on the volume and on the qtree. A derived user quota was created for the root user on both the volume and the qtree because the root user owned files on both the volume and the qtree. Since the root user gets special treatment in terms of quotas, its derived quotas are tracking quotas only.

No other default quotas or derived quotas were created for the following reasons:

- A derived user quota was not created for the jsmith user even though the user owns files on both the volume and the qtree because the user already has explicit quotas at both levels.
- No derived user quotas were created for other users because no other users own files on either the volume or the qtree.
- The default user quota on the volume did not create a default user quota on the qtree because the qtree already had a default user quota.

Why enforced quotas differ from configured quotas

Enforced quotas differ from configured quotas because derived quotas are enforced without being configured but configured quotas are enforced only after they are successfully initialized. Understanding these differences can help you compare the enforced quotas that are shown in quota reports to the quotas that you configured.

Enforced quotas, which appear in quota reports, might differ from the configured quota rules for the following reasons:

- Derived quotas are enforced without being configured as quota rules; ONTAP creates derived quotas automatically in response to default quotas.
- Quotas might not have been reinitialized on a volume after quota rules were configured.
- Errors might have occurred when quotas were initialized on a volume.

Use the quota report to determine which quotas limit writes to a specific file

You can use the volume quota report command with a specific file path to determine which quota limits affect write operations to a file. This can help you understand which quota is preventing a write operation.

Step

1. Use the volume quota report command with the -path parameter.

Example of showing quotas affecting a specific file

The following example shows the command and output to determine what quotas are in effect for writes to the file file1, which resides in the qtree q1 in the FlexVol volume vol2:

```
cluster1:> volume quota report -vserver vs0 -volume vol2 -path
/vol/vol2/q1/file1
Virtual Server: vs0
                                     ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol2     q1        tree    jsmith     1MB  100MB       2   10000   q1
vol2     q1        group   eng        1MB  700MB       2   70000
vol2               group   eng        1MB  700MB       6   70000   *
vol2               user    corp\jsmith
                                      1MB   50MB       1       -   *
vol2     q1        user    corp\jsmith
                                      1MB   50MB       1       -
5 entries were displayed.
```

Commands for displaying information about quotas

You can use commands to display a quota report containing enforced quotas and resource usage, display information about quota state and errors, or about quota policies and quota rules.

You can run the following commands only on FlexVol volumes.

If you want to…	Use this command…
View information about enforced quotas	`volume quota report`
View resource usage (disk space and number of files) of quota targets	`volume quota report`
Determine which quota limits are affected when a write to a file is allowed	`volume quota report` with the `-path` parameter
Display the quota state, such as `on`, `off`, and `initializing`	`volume quota show`
View information about quota message logging	`volume quota show` with the `-logmsg` parameter
View errors that occur during quota initialization and resizing	`volume quota show` with the `-instance` parameter
View information about quota policies	`volume quota policy show`

If you want to…	Use this command…
View information about quota rules	`volume quota policy rule show`
View the name of the quota policy that is assigned to a storage virtual machine (SVM, formerly known as Vserver)	`vserver show` with the `-instance` parameter

See the man page for each command for more information.

When to use the volume quota policy rule show and volume quota report commands

Although both commands show information about quotas, the `volume quota policy rule show` quickly displays configured quota rules while the `volume quota report` command, which consumes more time and resources, displays enforced quotas and resource usage.

The `volume quota policy rule show` command is useful for the following purposes:

- Check the configuration of quota rules before activating them

  This command displays all configured quota rules regardless of whether the quotas have been initialized or resized.

- Quickly view quota rules without affecting system resources

  Because it does not display disk and file usage, this command is not as resource intensive as a quota report.

- Display the quota rules in a quota policy that is not assigned to the SVM.

The `volume quota report` command is useful for the following purposes:

- View enforced quotas, including derived quotas
- View the disk space and number of files used by every quota in effect, including targets affected by derived quotas

  (For default quotas, the usage appears as "0" because the usage is tracked against the resulting derived quota.)

- Determine which quota limits affect when a write to a file will be allowed

  Add the `-path` parameter to the `volume quota report` command.

The quota report is resource-intensive operation. If you run it on many FlexVol volumes in the cluster, it might take a long time to complete. A more efficient way would be to view the quota report for a particular volume in an SVM.

Difference in space usage displayed by a quota report and a UNIX client

Difference in space usage displayed by a quota report and a UNIX client overview

The value of used disk space that is displayed in a quota report for a FlexVol volume or qtree can be different from the value displayed by a UNIX client for the same volume or qtree. The difference in usage values is because of the difference in methods followed by the quota report and the UNIX commands for calculating the data blocks in the volume or qtree.

For example, if a volume contains a file that has empty data blocks (to which data is not written), the quota report for the volume does not count the empty data blocks while reporting the space usage. However, when the volume is mounted on a UNIX client and the file is shown as the output of the `ls` command, the empty data blocks are also included in the space usage. Therefore, the `ls` command displays a higher file size when compared to the space usage displayed by the quota report.

Similarly, the space usage values shown in a quota report can also differ from the values shown as a result of UNIX commands such as `df` and `du`.

How a quota report accounts for disk space and file usage

The number of files used and the amount of disk space specified in a quota report for a FlexVol volume or a qtree depend on the count of the used data blocks corresponding to every inode in the volume or the qtree.

The block count includes both direct and indirect blocks used for regular and stream files. The blocks used for directories, Access Control Lists (ACLs), stream directories, and metafiles do not get accounted for in the quota report. In case of UNIX sparse files, empty data blocks are not included in the quota report.

How the ls command accounts for space usage

When you use the `ls` command to view the contents of a FlexVol volume mounted on a UNIX client, the file sizes displayed in the output could be lesser or more than the space usage displayed in the quota report for the volume depending on the type of data blocks for the file.

The output of the `ls` command displays only the size of a file and does not include indirect blocks used by the file. Any empty blocks of the file also get included in the output of the command.

Therefore, if a file does not have empty blocks, the size displayed by the `ls` command might be less than the disk usage specified by a quota report because of the inclusion of indirect blocks in the quota report. Conversely, if the file has empty blocks, then the size displayed by the `ls` command might be more than the disk usage specified by the quota report.

The output of the `ls` command displays only the size of a file and does not include indirect blocks used by the file. Any empty blocks of the file also get included in the output of the command.

Example of the difference between space usage accounted by the ls command and a quota report

The following quota report shows a limit of 10 MB for a qtree q1:

```
                                        ----Disk----  ----Files-----   Quota
  Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
  -------  --------  ------  -------  -----  -----  ------  ------
---------
  vol1     q1          tree    user1   10MB  10MB        1       -   q1

...
```

A file present in the same qtree can have a size exceeding the quota limit when viewed from a UNIX client by using the `ls` command, as shown in the following example:

```
[user1@lin-sys1 q1]$ ls -lh
-rwxr-xr-x  1 user1 nfsuser  **27M** Apr 09  2013 file1
```

How the df command accounts for file size

The way in which in the `df` command reports the space usage depends on two conditions: whether the quotas are enabled or disabled for the volume that contains the qtree, and if quota usage within the qtree is tracked.

When quotas are enabled for the volume that contains the qtree and quota usage within the qtree is tracked, the space usage reported by the `df` command equals the value specified by the quota report. In this situation, quota usage excludes blocks used by directories, ACLs, stream directories, and metafiles.

When quotas are not enabled on the volume, or when the qtree does not have a quota rule configured, the reported space usage includes blocks used by directories, ACLs, stream directories, and metafiles for the entire volume, including other qtrees within the volume. In this situation, the space usage reported by the `df` command is greater than the expected value reported when quotas are tracked.

When you run the `df` command from the mount point of a qtree for which quota usage is tracked, the command output shows the same space usage as the value specified by the quota report. In most cases, when the tree quota rule has a hard disk-limit, the total size reported by the `df` command equals the disk limit and the space available equals the difference between the quota disk limit and quota usage.

However, in some cases, the space available reported by the `df` command might equal the space available in the volume as a whole. This can occur when there is no hard disk limit configured for the qtree. Beginning with ONTAP 9.9.1, it can also occur when the space available in the volume as a whole is less than the remaining tree quota space. When either of these conditions occur, the total size reported by the `df` command is a synthesized number equal to the quota used within the qtree plus the space available in the FlexVol volume.

This total size is neither the qtree disk limit nor the volume configured size. It can also vary based on your write activity within other qtrees or on your background storage efficiency activity.

Example of space usage accounted by the `df` command and a quota report

The following quota report shows a disk limit of 1 GB for qtree alice, 2 GB for qtree bob, and no limit for qtree project1:

```
C1_vsim1::> quota report -vserver vs0
Vserver: vs0
                                     ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol2     alice     tree    1
                                   502.0MB    1GB       2       -   alice
vol2     bob       tree    2
                                    1003MB    2GB       2       -   bob
vol2     project1  tree    3
                                   200.8MB      -       2       -
project1
vol2               tree    *           0B      -       0       -   *
4 entries were displayed.
```

In the following example, the output of the `df` command on qtrees alice and bob reports the same used space as the quota report, and the same total size (in terms of 1M blocks) as the disk limit. This is because the quota rules for qtrees alice and bob have a defined disk limit and the volume available space (1211 MB) is greater than the tree quota space remaining for qtree alice (523 MB) and qtree bob (1045 MB).

```
linux-client1 [~]$ df -m /mnt/vol2/alice
Filesystem          1M-blocks  Used Available Use% Mounted on
172.21.76.153:/vol2      1024   502       523  50% /mnt/vol2

linux-client1 [~]$ df -m /mnt/vol2/bob
Filesystem          1M-blocks  Used Available Use% Mounted on
172.21.76.153:/vol2      2048  1004      1045  50% /mnt/vol2
```

In the following example, the output of the `df` command on qtree project1 reports the same used space as the quota report, but the total size is synthesized by adding the available space in the volume as a whole (1211 MB) to the quota usage of qtree project1 (201 MB) to give a total of 1412 MB. This is because the quota rule for qtree project1 has no disk limit.

```
linux-client1 [~]$ df -m /mnt/vol2/project1
Filesystem          1M-blocks  Used Available Use% Mounted on
172.21.76.153:/vol2      1412   201      1211  15% /mnt/vol2
```

The following example shows how the output of the `df` command on the volume as a whole reports the same available space as project1.

```
linux-client1 [~]$ df -m /mnt/vol2
Filesystem          1M-blocks  Used Available Use% Mounted on
172.21.76.153:/vol2      2919  1709      1211  59% /mnt/vol2
```

How the du command accounts for space usage

When you run the `du` command to check the disk space usage for a qtree or FlexVol volume mounted on a UNIX client, the usage value might be higher than the value displayed by a quota report for the qtree or volume.

The output of the `du` command contains the combined space usage of all the files through the directory tree beginning at the level of the directory where the command is issued. Because the usage value displayed by the `du` command also includes the data blocks for directories, it is higher than the value displayed by a quota report.

Example of the difference between space usage accounted by the du command and a quota report

The following quota report shows a limit of 10 MB for a qtree q1:

```
                                      ----Disk----  ----Files-----   Quota
  Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
  -------  --------  ------  -------  -----  -----  ------  ------
---------
  vol1     q1          tree    user1   10MB   10MB       1       -   q1

...
```

In the following example, the disk space usage as the output of the `du` command shows a higher value that exceeds the quota limit:

```
[user1@lin-sys1 q1]$ du -sh
**11M**     q1
```

Examples of quota configuration

These examples help you understand how to configure quotas and read quota reports.

For the following examples, assume that you have a storage system that includes an SVM, vs1, with one volume, vol1. To start setting up quotas, you create a new quota policy for the SVM with the following command:

```
cluster1::>volume quota policy create -vserver vs1 -policy-name
quota_policy_vs1_1
```

Since the quota policy is new, you assign it to the SVM:

```
cluster1::>vserver modify -vserver vs1 -quota-policy quota_policy_vs1_1
```

Example 1: Default user quota

You decide to impose a hard limit of 50 MB for each user in vol1:

```
cluster1::>volume quota policy rule create -vserver vs1 -policy-name
quota_policy_vs1_1 -volume vol1 -type user -target "" -disk-limit 50MB
-qtree ""
```

To activate the new rule, you initialize quotas on the volume:

```
cluster1::>volume quota on -vserver vs1 -volume vol1 -foreground
```

To view the quota report, you enter the following command:

```
cluster1::>volume quota report
```

The resulting quota report is similar to the following report:

```
Vserver: vs1
                                     ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1               user    *           0B   50MB       0       -   *
vol1               user    jsmith     49MB   50MB      37       -   *
vol1               user    root        0B      -       1       -
```

The first line shows the default user quota that you created, including the disk limit. Like all default quotas, this default user quota does not display information about disk or file usage. In addition to the quota that was created, two other quotas appear—one quota for each user that currently owns files on vol1. These additional quotas are user quotas that were derived automatically from the default user quota. The derived user quota for the user jsmith has the same 50-MB disk limit as the default user quota. The derived user quota for the root user is a tracking quota (without limits).

If any user on the system (other than the root user) tries to perform an action that would use more than 50 MB

in vol1 (for example, writing to a file from an editor), the action fails.

Example 2: Explicit user quota overriding a default user quota

If you need to provide more space in volume vol1 to the user jsmith, then you enter the following command:

```
cluster1::>volume quota policy rule create -vserver vs1 -policy-name
quota_policy_vs1_1 -volume vol1 -type user -target jsmith -disk-limit 80MB
-qtree ""
```

This is an explicit user quota, because the user is explicitly listed as the target of the quota rule.

This is a change to an existing quota limit, because it changes the disk limit of the derived user quota for the user jsmith on the volume. Therefore, you do not need to reinitialize quotas on the volume to activate the change.

To resize quotas:

```
cluster1::>volume quota resize -vserver vs1 -volume vol1 -foreground
```

Quotas remain in effect while you resize, and the resizing process is short.

The resulting quota report is similar to the following report:

```
cluster1::> volume quota report
Vserver: vs1
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1               user    *           0B   50MB       0       -   *
vol1               user    jsmith     50MB   80MB      37       -   jsmith
vol1               user    root        0B      -       1       -
3 entries were displayed.
```

The second line now shows a Disk Limit of 80 MB and a Quota Specifier of jsmith.

Therefore, jsmith can use up to 80 MB of space on vol1, even though all other users are still limited to 50 MB.

Example 3: Thresholds

Suppose you want to receive a notification when users reach within 5 MB of their disk limits. To create a threshold of 45 MB for all users, and a threshold of 75 MB for jsmith, you change the existing quota rules:

```
cluster1::>volume quota policy rule modify -vserver vs1 -policy
quota_policy_vs1_1 -volume vol1 -type user -target "" -qtree "" -threshold
45MB
cluster1::>volume quota policy rule modify -vserver vs1 -policy
quota_policy_vs1_1 -volume vol1 -type user -target jsmith -qtree ""
-threshold 75MB
```

Since the sizes of the existing rules are changed, you resize quotas on the volume in order to activate the changes. You wait until the resize process is finished.

To see the quota report with thresholds, you add the `-thresholds` parameter to the `volume quota report` command:

```
cluster1::>volume quota report -thresholds
Vserver: vs1
                                    ----Disk----  ----Files-----
Volume   Tree      Type    ID        Used  Limit   Used    Limit  Quota
                                          (Thold)
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1              user    *           0B   50MB       0       -  *
                                          (45MB)
vol1              user    jsmith     59MB   80MB      55       -  jsmith
                                          (75MB)
vol1              user    root        0B      -       1       -
                                          ( -)
3 entries were displayed.
```

The thresholds appear in parentheses in the Disk Limit column.

Example 4: Quotas on qtrees

Suppose you need to partition some space for two projects. You can create two qtrees, named proj1 and proj2, to accommodate those projects within vol1.

Currently, users can use as much space in a qtree as they are allotted for the entire volume (provided they did not exceed the limit for the volume by using space in the root or another qtree). In addition, each of the qtrees can grow to consume the entire volume. If you want to ensure that neither qtree grows beyond 20 GB, you can create default tree quota on the volume:

```
cluster1:>>volume quota policy rule create -vserver vs1 -policy-name
quota_policy_vs1_1 -volume vol1 -type tree -target "" -disk-limit 20GB
```

Note that the correct type is *tree*, not qtree.

Because this is a new quota, you cannot activate it by resizing. You reinitialize quotas on the volume:

```
cluster1:>>volume quota off -vserver vs1 -volume vol1
cluster1:>>volume quota on -vserver vs1 -volume vol1 -foreground
```

> You must ensure that you wait for about five minutes before reactivating the quotas on each affected volume, as attempting to activate them almost immediately after running the `volume quota off` command might result in errors. Alternatively, you can run the commands to re-initialize the quotas for a volume from the node that contains the particular volume.

Quotas are not enforced during the reinitialization process, which takes longer than the resizing process.

When you display a quota report, it has several new lines: some lines are for tree quotas and some lines are for derived user quotas.

The following new lines are for the tree quotas:

```
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
...
vol1              tree    *           0B   20GB       0       -   *
vol1     proj1    tree    1           0B   20GB       1       -   proj1
vol1     proj2    tree    2           0B   20GB       1       -   proj2
...
```

The default tree quota that you created appears in the first new line, which has an asterisk (*) in the ID column. In response to the default tree quota on a volume, ONTAP automatically creates derived tree quotas for each qtree in the volume. These are shown in the lines where proj1 and proj2 appear in the Tree column.

The following new lines are for derived user quotas:

```
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
...
vol1     proj1    user    *           0B   50MB       0       -
vol1     proj1    user    root        0B      -       1       -
vol1     proj2    user    *           0B   50MB       0       -
vol1     proj2    user    root        0B      -       1       -
...
```

Default user quotas on a volume are automatically inherited for all qtrees contained by that volume, if quotas are enabled for qtrees. When you added the first qtree quota, you enabled quotas on qtrees. Therefore, derived default user quotas were created for each qtree. These are shown in the lines where ID is asterisk (*).

Because the root user is the owner of a file, when default user quotas were created for each of the qtrees, special tracking quotas were also created for the root user on each of the qtrees. These are shown in the lines where ID is root.

Example 5: User quota on a qtree

You decide to limit users to less space in the proj1 qtree than they get in the volume as a whole. You want to keep them from using any more than 10 MB in the proj1 qtree. Therefore, you create a default user quota for the qtree:

```
cluster1::>volume quota policy rule create -vserver vs1 -policy-name
quota_policy_vs1_1 -volume vol1 -type user -target "" -disk-limit 10MB
-qtree proj1
```

This is a change to an existing quota, because it changes the default user quota for the proj1 qtree that was derived from the default user quota on the volume. Therefore, you activate the change by resizing quotas. When the resize process is complete, you can view the quota report.

The following new line appears in the quota report showing the new explicit user quota for the qtree:

```
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1     proj1     user    *           0B   10MB       0       -   *
```

However, the user jsmith is being prevented from writing more data to the proj1 qtree because the quota you created to override the default user quota (to provide more space) was on the volume. As you have added a default user quota on the proj1 qtree, that quota is being applied and limiting all the users' space in that qtree, including jsmith. To provide more space to the user jsmith, you add an explicit user quota rule for the qtree with an 80 MB disk limit to override the default user quota rule for the qtree:

```
cluster1::>volume quota policy rule create -vserver vs1 -policy-name
quota_policy_vs1_1 -volume vol1 -type user -target jsmith -disk-limit 80MB
-qtree proj1
```

Since this is an explicit quota for which a default quota already existed, you activate the change by resizing quotas. When the resize process is complete, you display a quota report.

The following new line appears in the quota report:

```
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1     proj1     user    jsmith    61MB   80MB      57       -   jsmith
```

The final quota report is similar to the following report:

```
cluster1::>volume quota report
Vserver: vs1
                                    ----Disk----  ----Files-----   Quota
Volume   Tree      Type    ID        Used  Limit    Used   Limit
Specifier
-------  --------  ------  -------  -----  -----  ------  ------
---------
vol1               tree    *           0B   20GB       0       -   *
vol1               user    *           0B   50MB       0       -   *
vol1               user    jsmith    70MB   80MB      65       -   jsmith
vol1     proj1     tree    1           0B   20GB       1       -   proj1
vol1     proj1     user    *           0B   10MB       0       -   *
vol1     proj1     user    root        0B      -       1       -
vol1     proj2     tree    2           0B   20GB       1       -   proj2
vol1     proj2     user    *           0B   50MB       0       -
vol1     proj2     user    root        0B      -       1       -
vol1               user    root        0B      -       3       -
vol1     proj1     user    jsmith    61MB   80MB      57       -   jsmith
11 entries were displayed.
```

The user jsmith is required to meet the following quota limits to write to a file in proj1:

1. The tree quota for the proj1 qtree.
2. The user quota on the proj1 qtree.
3. The user quota on the volume.

Set up quotas on an SVM

To set up quotas on a new storage virtual machine (SVM, formerly known as Vserver), you must create a quota policy, add quota policy rules to the policy, assign the policy to the SVM, and initialize quotas on each FlexVol volume on the SVM.

Steps

1. Use the `vserver show` command with the `-instance` option to display the name of the default quota policy that was automatically created when the SVM was created.

If a name was not specified when the SVM was created, the name is "default". You can also use the `vserver quota policy rename` command to give the default policy a name.

> You can also create a new policy by using the `volume quota policy create` command.

2. Use the `volume quota policy rule create` command to create *any* of the following quota rules for each volume on the SVM:
   - Default quota rules for all users
   - Explicit quota rules for specific users
   - Default quota rules for all groups
   - Explicit quota rules for specific groups
   - Default quota rules for all qtrees
   - Explicit quota rules for specific qtrees
3. Use the `volume quota policy rule show` command to check that the quota rules are configured correctly.
4. If you are working on a new policy, use the `vserver modify` command to assign the new policy to the SVM.
5. Use the `volume quota on` command to initialize the quotas on each volume on the SVM.

   You can monitor the initialization process in the following ways:

   - When you use the `volume quota on` command, you can add the `-foreground` parameter to run the quota on job in the foreground. (By default, the job runs in the background.)

     When the job runs in the background, you can monitor its progress by using the `job show` command.
   - You can use the `volume quota show` command to monitor the status of the quota initialization.
6. Use the `volume quota show -instance` command to check for initialization errors, such as quota rules that failed to initialize.
7. Use the `volume quota report` command to display a quota report so that you can ensure the enforced quotas match your expectations.

Modify (or Resizing) quota limits

When you make changes to the size of existing quotas, you can resize the quotas on all affected volumes, which is faster than reinitializing quotas on those volumes.

About this task

You have a storage virtual machine (SVM, formerly known as Vserver) with enforced quotas and you want either to change the size limits of existing quotas or to add or delete quotas for targets that already have derived quotas.

Steps

1. Use the `vserver show` command with the `-instance` parameter to determine the name of the policy that is currently assigned to the SVM.

2. Modify quota rules by performing any of the following actions:
   - Use the `volume quota policy rule modify` command to modify the disk or file limits of existing quota rules.
   - Use the `volume quota policy rule create` command to create explicit quota rules for targets (users, groups, or qtrees) that currently have derived quotas.
   - Use the `volume quota policy rule delete` command to delete explicit quota rules for targets (users, groups, or qtrees) that also have default quotas.
3. Use the `volume quota policy rule show` command to check that the quota rules are configured correctly.
4. Use the `volume quota resize` command on each volume where you changed quotas, to activate the changes on each volume.

   You can monitor the resize process in either of the following ways:
   - When you use the `volume quota resize` command, you can add the `-foreground` parameter to run the resize job in the foreground. (By default, the job runs in the background.)

     When the job runs in the background, you can monitor its progress by using the `job show` command.
   - You can use the `volume quota show` command to monitor the resize status.
5. Use the `volume quota show -instance` command to check for resize errors such as, quota rules that failed to get resized.

   In particular, check for “new definition” errors, which occur when you resize quotas after adding an explicit quota for a target that does not already have a derived quota.
6. Use the `volume quota report` command to display a quota report so that you can ensure the enforced quotas match your requirements.

Reinitialize quotas after making extensive changes

When you make extensive changes to existing quotas; for example, by adding or deleting quotas for targets that have no enforced quotas-- you must make the changes and re-initialize quotas on all affected volumes.

About this task

You have a storage virtual machine (SVM) with enforced quotas and you want to make changes that require a full reinitialization of quotas.

Steps

1. Use the `vserver show` command with the `-instance` parameter to determine the name of the policy that is currently assigned to the SVM.
2. Modify quota rules by performing any of the following actions:

If you want to…	Then…
Create new quota rules	Use the `volume quota policy rule create` command

If you want to…	Then…
Modify the settings of existing quota rules	Use the `volume quota policy rule modify` command
Delete existing quota rules	Use the `volume quota policy rule delete` command

3. Use the `volume quota policy rule show` command to check that the quota rules are configured correctly.
4. Re-initialize quotas on each volume where you changed quotas by turning quotas off and then turning quotas on for those volumes.
   a. Use the `volume quota off` command on each affected volume to deactivate quotas on that volume.
   b. Use the `volume quota on` command on each affected volume to activate quotas on that volume.

> You must ensure that you wait for about five minutes before reactivating the quotas on each affected volume, as attempting to activate them almost immediately after running the `volume quota off` command might result in errors.
>
> Alternatively, you can run the commands to re-initialize the quotas for a volume from the node that contains the particular volume.

   You can monitor the initialization process in either of the following ways:

   - When you use the `volume quota on` command, you can add the `-foreground` parameter to run the quota on job in the foreground. (By default, the job runs in the background.)

     When the job runs in the background, you can monitor its progress by using the `job show` command.

   - You can use the `volume quota show` command to monitor the status of the quota initialization.

5. Use the `volume quota show -instance` command to check for initialization errors, such as quota rules that failed to initialize.
6. Use the `volume quota report` command to display a quota report so that you can ensure the enforced quotas match your expectations.

Commands to manage quota rules and quota policies

You can use the `volume quota policy rule` commands to configure quota rules, and use the `volume quota policy` commands and some `vserver` commands to configure quota policies.

> You can run the following commands only on FlexVol volumes.

Commands for managing quota rules

If you want to…	Use this command…
Create a new quota rule	`volume quota policy rule create`
Delete an existing quota rule	`volume quota policy rule delete`
Modify an existing quota rule	`volume quota policy rule modify`
Display information about configured quota rules	`volume quota policy rule show`

Commands for managing quota policies

If you want to…	Use this command…
Duplicate a quota policy and the quota rules it contains	`volume quota policy copy`
Create a new, blank quota policy	`volume quota policy create`
Delete an existing quota policy that is not currently assigned to a storage virtual machine (SVM)	`volume quota policy delete`
Rename a quota policy	`volume quota policy rename`
Display information about quota policies	`volume quota policy show`
Assign a quota policy to anSVM	`vserver modify`
Display the name of the quota policy assigned to anSVM	`vserver show`

See the man page for each command for more information.

Commands to activate and modify quotas

You can use the `volume quota` commands to change the state of quotas and configure message logging of quotas.

If you want to…	Use this command…
Turn quotas on (also called *initializing* them)	`volume quota on`
Resize existing quotas	`volume quota resize`

If you want to…	Use this command…
Turn quotas off	`volume quota off`
Change the message logging of quotas, turn quotas on, turn quotas off, or resize existing quotas	`volume quota modify`

See the man page for each command for more information.

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