



Silicon Graphics, Inc.

XFS Overview & Internals

08 - Quotas

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Quotas

- Quotas provide a method for managing disk resources.
 - Quotas can be used to report on disk usage.
 - Quotas can be used to control disk usage.
- Quotas manage filesystem resources in two ways.
 - by Managing Disk Space (blocks)
 - by Managing the Number of Files (inodes)
- These resources can be managed on a per user, group or directory (project) basis.

Quota Types

- Quotas can be tracked or enforced for
- Users
 - Manage the disk usage of individuals or system users.
- Groups
 - Manage the disk usage of groups.
- Projects
 - Manage the disk usage of directories associated with a specific project. Projects may cross organizational 'group' boundaries
 - Provide broader levels of control than available using user or group quotas.
 - Can be used to effectively shrink a file system allowing administrators to reallocate disk space as needed.

Reporting Vs Enforcement

Quotas can be used to monitor disk usage and optionally enforce limits.

- Quotas can be used to monitor disk usage across quota types.
 - More efficient than using unix tools like du that must traverse the filesystem.
 - Quotas are maintained as the filesystem is used.
- Quotas can be used to enforce limits on users, groups or projects. Quota limits can prevent.
 - Individual users consuming excessive resources.
 - Rogue processes bringing down a system or causing denial of services.

Enforcement (Limits)

There are two types of limits; Hard and Soft.

- **Soft** limits are advisory.
 - Allow additional disk resources to be consumed for a period of time. this is known as the *grace* period.
 - Provide flexibility to users and processes that may occasionally need to exceed their quota temporarily
- **Hard** Prevent further allocation of disk resources.
 - Any I/O that attempt to allocate further disk resources is failed.
 - Existing data on the disk is preserved and existing disk allocations can still be written.
 - Users must remove existing files before new resources can be used.
 - Soft limits are enforced as hard limits after the *grace* period.
- Limits are never applied to the *root* user.

Configuring Quotas

- XFS quotas are enabled as filesystem mount options when the filesystem is mounted.
- User, Group and Project quotas are enabled independently. Group and Project quotas are incompatible.
- Each quota type can be specified as noenforce, in this case quota reporting will be maintained but not enforced.
- Valid mount options are
 - uquota, uqnoenforce - User quotas
 - gquota, gqnoenforce - Group quotas
 - pquota, pqnoenforce - Project quota

xfs_quota

- Once quotas are configured the xfs_quota tool can be used to report on disk usage and set limits.
- Quota operation is controlled by xfs_quota.
- xfs_quota has two modes of operation, basic and expert mode
 - Basic mode includes commands for reporting disk usage to users.
 - Expert mode (xfs_quota -x) contains advanced commands that allow the modification of the quota system.

Quota Reporting

```
> sudo xfs_quota -xc 'report -h' /home
User quota on /home (/dev/hdb1)
                                Blocks
User ID      Used   Soft   Hard Warn/Grace
-----
root        4.6G    0     0  00 [-----]
testuser    103.4G   0     0  00 [-----]
...
...
```

- Running report as an ordinary user simply reports that users disk usage while running as root allows the disk usage of all users to be reported.
- Performance
 - sudo xfs_quota -xc 'report -h' /home 0m0.287s
 - sudo du -hs /home 0m3.086s

Quota Limits

- User Limits

- `limits xfs_quota -x -c 'limit bsoft=1000m bhard=1200m username'`
 - `limits xfs_quota -x -c 'limit isoft=500 ihard=700 username'`

- Group Limits.

- `xfs_quota -x -c 'limit -g bsoft=1000m bhard=1200m groupname'`

- Project Limits

- Project controlled directories are first added to /etc/projects. Project names are optionally added to /etc/projid to provide an id/name mapping.
 - `xfs_quota -c 'project -s projectname'` is run to initialize project directories.
 - `xfs_quota -x -c 'limit -p bsoft=1000m bhard=1200m projectname'`

Enabling/Disabling Quotas

- `xfs_quota` can be used to temporarily or permanently disable quotas on a filesystem using the following commands:
 - `disable` – Temporarily disable quota enforcement.
 - `enable` – Enable quota enforcement. Used to enable quotas if they have been disabled or the filesystem was mounted with `qnoenforce`.
 - `off` – Switch off quota management. Quotas can only be re-enabled by un-mounting and remounting the filesystem
 - Limit information is preserved
 - `remove` – remove quota extents from a filesystem. All quota limits are destroyed.

Expert xfs commands

- `xfs_quota` also contains commands to
 - Summarise the state of xfs quotas on a system using the `state` command.
 - Manipulate the grace period using the `timer` command.
 - Backup and restore the quota information contained in a filesystem using the `dump` and `restore` commands. These commands are also used internally by `xfsdump`

Generic Quota Tools

- In addition to `xfs_quota` `xfs` also works with generic quota tools provided on Linux.
- These tools include
 - `quota`
 - `repquota`
 - `quotactl`
 - `edquota`
 - `quotacheck`
 - `setquota`
 - `quotaon/quotaoff` (enforcement only)
 - `quotawarn`
- The generic tools do not understand XFS project quotas.

Providing user feedback

- Usually systems are configured to provide a level of feedback to users if they exceed their quota limits.
- The most common method for informing users is to send email using the quotawarn command from the generic quota package.
 - Quotawarn is often run as a cron job daily.
- Feedback can be provided for interactive users by running “xfs_quota -c quota” in users login scripts (/etc/bash.bashrc.local for example).

Implementation

- Quota operations and data are treated as first-class operations in XFS
 - xfs quotas are implemented as part of the filesystem metadata instead of maintaining quota data in a file within filesystem
 - Quota changes are journaled
- Quotas are updated in realtime as the filesystem is changed. No “quota checks” need to be run.

Implementation – Project Quotas.

- Project quotas are implemented using the group quota inode. This excludes project and group quotas from being enabled at the same time.
- Project configuration information is stored in /etc/projects and /etc/projid.
- `xfs_quota -s projectname` initializes the project id in inodes contained under directories specified in /etc/projects.

Quotas Ondisk

- `xfs_db` can be used to understand the internals of the quota implementation.
- Quota inodes can be seen in the filesystem superblock

```
# xfs_db -xr -c sb -c p /dev/hdb1
...
uquotino = 131
gquotino = 148

# xfs_db -xr -c 'inode 131' -c p /dev/hdb1
```

Quotas Ondisk

- Individual quota entries can be viewed with xfs_db's dquot command.

```
# xfs_db -xr -c 'dquot username' -c p /dev/hdb1  
# xfs_db -xr -c 'dquot -p projectname' -c p /dev/hdb1
```

- inodes can be interrogated to determine which project they belong to.

```
> ls -ia  
> sudo xfs_db -xr -c 'inode 675234191' -c p /dev/hdb1  
...  
core.projid = 33  
core.uid = 0  
core.gid = 0
```

