

Silicon Graphics, Inc.

XFS Overview & Internals

08 - Quotas

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Delme? Quotas – Dave's Initial Slide.

- User and group quota
 - “UID 42 currently has X blocks & Y inodes”
 - Used space/inodes vs dynamic bounds
 - Block count is file data, intimately tied to space allocator (NB: dquot is journaled)
- Project (pseudo-directory) quota
 - “/var/log currently has X blocks & Y inodes, is limited to ...”
- Quota files and dquot
 - Two (invisible) inodes in primary SB
 - Too simple `xfs_disk_dquot_t` array, ID index
- Realtime

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.
 - Prevent users
 - Protects against rouge processes bringing down systems.
 - There are two types of limits. Hard and soft.

•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 there 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 to before new resources can be used.
 - Soft limits are be 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`, `uquotanoenforce` - User quotas
 - `gquota`, `gquotanoenforce` - Group quotas
 - `pquota`, `pquotanoenforce` - Project quota
- eg
`mount -o quota,pquota /dev/hdb1 /media/xfstest`
Or in `fstab`
`/dev/hdb1 /media/xfstest xfs defaults,quota,pquota 0 0`

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 (xfs_quota -x). Basic mode includes commands for reporting disk usage to users. Expert mode contains advanced commands that allow the modification of the quota system.

Quota Reporting

- XFS 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.

Advanced xfs commands (xfs_quota -x)

- 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`, and `quotaon/quotaoff` (enforcement only) and `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 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

- xfs quotas are implemented as part of the filesystem metadata (instead of maintaining quota data in a file within filesystem).
- 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.

Implementation – Examining

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`
- Individual quota entries can be viewed with xfs_db's dquot command.
 - `sudo xfs_db -xr -c 'dquot username' -c p /dev/hdb1`
 - `sudo 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