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.

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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.

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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.

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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.

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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

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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.

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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

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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'`

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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.

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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

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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 to not understand XFS project quotas.

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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).

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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.

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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.

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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
```

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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
```

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