

Network File System

Michael Tsai
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Network File Services

- Goal:
 - Share filesystems among computers
 - Transparent to users
(as if the files is stored locally)
 - No information is lost when the server crashes
- Get better in the last 25 years
(very complex, bugs in unusual situations)

Related Terms

- Storage Area Network (SAN): serve blocks (not files)
 - Example: iSCSI
- Network Attached Storage (NAS):
file-level data storage attached to the network
- Server Message Block / Common Internet File System (SMB/CIFS)
 - Microsoft Windows Network —> Active Directory
 - Samba: Implementation on Unix-like systems
- Apple Filing Protocol (AFP)

State

- State:
e.g., files that each client has open.
- State**less**: if the server does not track the status of the users & files
- Stateful: otherwise.
- Stateful is more complex, but allow more control over files and their management.

Performance Concerns

- Goal:
transparent == no difference from local access
- Challenge: network latency (over WAN)
- Techniques:
 - Read-ahead caching:
preload the file into local memory
 - Batch writes
cache writes in memory and send them in batches

Security

- Bottom line: allow files to be accessed (read/write) **from the network** (read: entire world)!
- Access control
- How to authenticate the users?
- Modern solution: centralized authentication system

NFS Security

- Flavors of authentication:
 1. AUTH_NONE: no authentication
 2. AUTH_SYS: UNIX-style user & group access control
 3. RPCSEC_GSS: a powerful flavor that ensures integrity and privacy plus authentication

NFS Security

- AUTH_SYS: how to attack?
 - Take control of a client machine that is allowed to access the NFS
 - **Pretend** that a user that owns the file is authenticated, and tell NFS server to serve the file to the client machine

NFS history

- NFS v2:
client write op. is completed until ack from the server (read: HIGH DELAY!), UDP only
- NFS v3:
asynchronous writes, TCP or UDP
(NFS v2 should not be used now)
- NFS v4: numerous enhancements, TCP only! (congestion control)
Compatibility with firewall & NAT devices
Lock & mount → core NFS protocol
ACLs
Unicode filenames
Good performance on low-bandwidth connections

Root access

- In NFS-mounted filesystems, usually root is changed to run as nobody (or other similar account)
- Prevent files owned by root to be accessed by the world
- But cannot protect user files (since root of the client can su to become other user)

Server configuration

- /etc/exports: specify the directories to share
- Each line: <path(local)> <client>(options)
Example:
/mnt/backup 140.112.31.40(rw,async)
- See manpage exports(5) (man 5 exports)
- Possible client ID: IP (192.168.1.1), IP networks (192.168.1.0/24), hostnames (www.csie.ntu.edu.tw), wildcards (*.csie.ntu.edu.tw) — hostname determined via reverse DNS lookup
- Common options: ro/rw, sync/async, root_squash/no_root_squash/all_squash
- Package: nfs-kernel-server

Client configuration

- Example:
mount nfs.csie.ntu.edu.tw:/mnt/backup /mnt/
backup_nfs_csie
- Put it in /etc/fstab for mounting at start-up
- What's the downside of putting it in fstab?
- Package: nfs-common

Why Automount

- Downsides of putting NFS filesystems in fstab:
 1. Maintaining fstab file on 100+ machines is tedious (different needs on different machines)
 2. Dependency on multiple servers (hung commands)
 3. No backup provisions

Automount

- Mounts a virtual filesystem at locations for automatic mounting
- Mount the filesystems “on-demand”
- Unmount when a filesystem is not used for a time duration (time-out)
- Check out packages: autofs, autofs5

In-class Lab

- Download CentOS1116.ova
<https://goo.gl/l0mu3y>
(root, pw=nasa2017)
- Use the OVA to start two VMs
- One VM acts as a NFS server, and the other acts as a NFS client
- Create a directory (e.g., /home/nfs) to be exported on NFS server.
- Show that NFS client can mount the exported directory on NFS server and access the files in that directory.