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31338 Network Servers
32520 Systems Administration

Week 8
Networked filesystems: NFS & Samba

(Connect to Lab 8)

Professor Jian Zhang

School of Electrical & Data Engineering

University of Technology, Sydney

Network File System (NFS) Lab 8a

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- Network File System (NFS)* is a distributed file system protocol originally developed by Sun Microsystems (Sun) in 1984, allowing a user on a client computer to access files which is much like a local storage and munted locally but over a computer network
- From the sever side, NFS is used to export local file system over NT
- NFS builds on the Open Network Computing Remote Procedure Call (ONC RPC) system.
- NFS is an open IETF standard defined in a Request for Comments (RFC), allowing anyone to implement the protocol. On-going !
- NFS is often used with Unix OS such as Solaris, AIX, HP-UX), Apple's macOS, Unix-like OS such as Linux and FreeBSD and also available to Mac OS, MS-DOS, Microsoft Windows etc.

IETF: Internet Engineering Task Force

* https://en.wikipedia.org/wiki/Network_File_System

NFS History

1. NFSv1 (‘84): for in-house experimental purposes.
2. NFSv2 (’89): UDP* only, cannot guarantee delivery, 32-bit files
3. NFSv3 (1995):
   - Support for 64-bit file sizes to handle files larger than 2 gigabytes (GB);
   - UDP-- Stateless, /TCP** – stateful, support caching
   - Network Lock Manager (NLM) prevent data corruption in client sides
4. NFSv4 (May 2015): 4.1, 4.2
   - Popular now, TCP only, support v3’s feature
   - Stateful (TCP): stateless for v2 and v3
   - Consolidate multiple ports to well-known TCP port 2049
   - Built-in file-locking management feature (not NLM)
   - Cross-platform interoperability, including Windows
   - Improved security and strong authentication (Kerberos protocol)

**User Datagram Protocol (UDP)*
***Transmission Control Protocol (TCP)*

Stateless and Stateful NFS

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- "Stateless" --
  - Simplicity
  - Makes recovery simpler if server crashes
  - Client must keep info about open files & current location in file
  - Client pings back to check state of file
  - No consistency guarantee

Use the *User Datagram Protocol* (UDP) running over an IP network

- "Stateful" --
  - all state information is stored on both the client and the server when they are active and recovered mutually in the event of an outage.

Use the *Transmission Control Protocol* (*TCP*) running over an IP network

Open Network Computing Remote Procedure Call (ONC RPC) system

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- NFS builds on ONC RPC
  - RPC is a programming mechanism to allow one application to transparently invoke procedure/method calls on a remote machine (network call)
    - Many varieties of RPC – standard UNIX one is "Sun RPC"
    - NFS, NIS* and a few other things built on Sun RPC
    - Independent from machine types, operating systems, and network architectures

- Need to run a daemon that maps RPC addresses into the port numbers that the service is listening on
  - The daemon is called: **`rpcbind`**
    - previously known as **`portmap`**

* Network Information Service (NIS) is a distributed database that allows you to maintain consistent configuration files throughout your network – looks like a yellow page

Typical NFS Implementation

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- Assuming a Unix-style scenario in which one machine (the client) needs access to data stored on another machine (the NFS server):
  1. The server implements NFS daemon processes, running by default as nfsd, to make its data generically available to clients.
  2. The server administrator determines what to make available, exporting the names and parameters of directories, typically using the **/etc/exports** configuration file and the **exportfs** command.
  3. The server security-administration ensures that it can recognize and approve validated clients.
  4. The server network configuration ensures that appropriate clients can negotiate with it through any firewall system.
  5. The client machine requests access to exported data, typically by issuing a mount command. (The client asks the server (rpcbind) which port the NFS server is using, the client connects to the NFS server (nfsd), nfsd passes the request to mountd)
  6. If all goes well, users on the client machine can then view and interact with mounted filesystems on the server within the parameters permitted.
- Note that automation of the NFS mounting process using /etc/fstab and/or automounting facilities

NFS Server (Lab 8a)

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- Packages: **nfs-servre nfs-utils, rpcbind & nfs4-acl-tools**
- Configure file for which directories to export and how
  - **/etc/exports** (on machine '**ens37**' 10.0.2.1/24 with its subnet)

Directory to share — client machines that will have access to the directory

```
/share/IT_Projects client1(ro) # Lab 8a
/opt/perl       client1(rw,no_root_squash) client2(ro)
/opt/general  192.168.3.0/24(rw,root_squash) # allow 192.168.3.0 - 255
```

Option Definitions

rw – allows both read and write access on the file system.

ro = allow clients read only access to the share

sync – tells the NFS server to write changes to disk before reply (applies by default).

all_squash – maps all UIDs and GIDs from client requests to the anonymous user.

no_all_squash – used to map all UIDs and GIDs from client requests to identical UIDs and GIDs on the NFS server.

root_squash – maps requests from root user or UID/GID 0 from the client to the anonymous UID/GID.

- Turn on (CMD) – *systemctrl start repcbind and system start nfs server*

NFS Server

- Start the NFS server daemons: **nfsd, mountd**:

  systemctl start nfs-server

  The other services that are required for running an NFS server or mounting NFS shares such as rpcbind, **rpc.mountd**, lockd, will be automatically started.

- The configuration files for the NFS server are:
  - /etc/nfs.conf – main configuration file for the NFS daemons and tools.
  - /etc/nfsmount.conf – an NFS mount configuration file.
- rpc.mountd
  - When an NFS client requests a mount, **rpc.mountd** checks **/var/lib/nfs/etab** to verify:
    - which directories are exported,
    - which clients are allowed,
    - and with what options (rw, ro, root_squash, etc.). The workflow is . . . .
- To export system, run the **exportfs** command

  -a means export or unexport all directories,
  -r means reexport all directories
  -v enables verbose output.
- Display current export list: exportfs -s or -v

Examples: exportfs –a; exportfs /home/notes; More details*

* https://sites.ualberta.ca/dept/chemeng/AIX-43/share/man/info/C/a_doc_lib/cmds/aixcmds2/exportfs.htm

Enable NFS in Firewall

- Enable NFS services in firewall
  - GUI: `firewall-config`: enable NFS and make it permanent
  - CMD:
    - `firewall-cmd --permanent --add-service=nfs`
    - `firewall-cmd --permanent --add-service=rpc-bind`
    - `firewall-cmd --permanent --add-service=mountd`
    - `firewall-cmd --reload`

NFS Client (Lab 8a)

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- On the client node(s), install the necessary packages to access NFS shares on the client systems.

  dnf install nfs-utils

- Clients mount a filesystem that is located on a server

  showmount –e 10.0.2.1

- Create a local file system/directory (yellow page) for mounting the remote NFS file system and mount it as a ntf file system.

  mkdir –p /media/perl

  mount –t nfs4 10.0.2.1:/opt/perl /media/perl

In the directory /media/perl*, Files are written by perl*

* Perl is a programming language (for text manipulation) that can be used to perform tasks that would be difficult or cumbersome on the command line.

NFS Client (recall lecture/lab 7!)

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- To enable the mount to persistent even after a system reboot:
- Add entry to **/etc/fstab** to access remote directory (on machine '**client1**'):

```
# Device            Mount point   FS type   FS options      F P
server1:/opt/perl   /media/perl     nfs        rw            0 0
```

The last two digits: dump and pass

dump: A number indicating whether and how often the file system should be backed up by the dump program. 0 means never automatically backed up.

Pass: A number indicating the order in which the fsck program will check the devices for errors at boot time. 1: root file system; 2: check after root; 0: not check for all other devices

rw: read and write; ro: read only

e.g., noauto, nosuid, rw can be the options field (namely "rw" field in above example)

- Then mount:

```
mount /media/perl
```

Automount

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- NFS becomes complex in a system with several servers and many clients
  - Lots of copies of `/etc/fstab` to maintain
  - Network stops if server crashes

- Automount is more flexible and easier to manage
  - Install `autofs` service and edit `/etc/auto.master`
- Clients mount directories when they need them
  - directories unmounted when no longer used
  - directories may be available from alternative servers

- Which of the following /etc/exports directives would be important for trying to create a read-only share's configuration record? (Choose all that apply.)

  A. ro

  B. rw

  C. async

  D. sync

SMB and Samba (Lab 8b)

- There is no user authentication when we configure the NFS. Hence,
- SMB = Server Message Block: is a client-server communication protocol used for sharing access to files, printers, serial ports and other resources on a network.
- Samba: a software implements of SMB
  - Samba allows files to be shared across windows and Linux and printers and other devices in a simple and seamless manner.
  - Samba is an open-source SMB implementation
  - On Windows: Common Internet File System (CIFS): A software implemented SMB protocol, native network filesystem protocol for Windows

Samba Server (Win/Linux)

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- On Windows: Right click to share – easy job!
- On Linux:
  - Package: samba using `dnf install samba` to install
  - Service/daemon: `smbd` and `nmbd`
    - `smb (d)`: samba server, provide share locking, user authentication
    - `nmb (d)`: NetBIOS* over TCP/IP name service, like RPC in NFS
      - Designed by IBM, only support LAN initially, now both LAN and WAN
    - `systemctl start/restart/enable smb (nmb)`
    - Log file: `/var/log/samba/*`
  - Configuration file (see the next slide!):
    /etc/samba/smb.conf

*** NetBIOS (Network Basic Input/Output System) is a network service that enables applications on different computers to communicate with each other across a local area network (LAN).**

Samba Server (Win/Linux)

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- Configuration: global section in /etc/samba/smb.conf

[global] – (more info see *)

workgroup = WORKGROUP # This is default workgroup for Windows machines

security = user # together with next line, enables Linux system users to log in to the Samba server.

passdb backend = tdbsam # backends" (or ways) of storing login access with Samba.

printing = cups # Common UNIX Printing System to share printers via Samba host systems

printcap name = cups # users connects to any printer specified in the local host's printcap file

load printers = yes # Enable the automatic printer sharing

cups options = raw # File is print-ready, do not process any further

netbios name = MYSAMBASERVER # used to specify a server name that is not tied to the hostname, this becomes the machines's "Samba hostname"

interfaces = 10.0.2.0/24 127.0.0.0/8 #used to configure Samba to listen on multiple network interfaces. (two subnets!)

hosts allow = 10.0.2. # the hosts allowed to connect (Local subnet).

* https://www.liquidweb.com/blog/how-to-install-samba-on-linux-windows/

Samba Server Lab 8b

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- Configure "Global section" in **/etc/samba/smb.conf**
  - Highly commented (see smb.conf.example), read and uncomment as required

Copy the settings from example file to [global] section of smb.conf [global]

```
        workgroup = MYGROUP
        server string = Samba Server Version %v

;       netbios name = MYSERVER

;       interfaces = lo eth0 192.168.12.2/24 192.168.13.2/24
;       hosts allow = 127. 192.168.12. 192.168.13.
```

Then modify the settings based on the task 1 of Lab 8b

- `workgroup` (e.g. set to "WORKGROUP", which is the default for Windows machines)
- `netbios name` (set to "MYSAMBASERVER" – this becomes the machine's "Samba hostname")
- `interfaces` (e.g. use "10.0.2.0/24" and "127.0.0.0/8")
- `hosts allow` (set to "10.0.2." – note the unusual usage of dots)

Samba Server (Lab 8b)

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- Configure "shares" in **/etc/samba/smb.conf**
  - Highly recommended (see smb.conf.example), read and uncomment as required

```
[homes]        # [homes] is a special entry – notice it has no path attribute
comment = Home Directories
valid user = %s, %D%w%S
browseable = Yes
read only =  Yes
Inherit acls = Yes # Access Control Lists
```

Note: [homes], [opt] & [public] are all share entries

Lab 8b: Tesks 4 and 5

```
[opt]  # general entry
path=/opt
public=yes
writable=no
browseable = yes

[public]
comment = Shared public
directory
path = /pub
writeable = yes
public = yes
```

- Log and troubleshooting
  - syntax check: **testparm /etc/samba/smb.conf**
  - Log file: **/var/log/samba/***
- Firewall
  - **fireall-config (GUI!)**: public runtime & permanent samba service

[global] = server-wide settings (authentication, logging, networking).
[share] = per-folder configuration (who can access, read/write rules, permissions).

Samba security

- As with NFS, basic Samba access control comes from configuring options on shares, e.g.
  - `browseable` `(can browse directory)`
  - `writeable` `(can write to directory)`
  - `public` `(publically accessable)`
  - `Read only` `(publically read only)`

  Instead of 'writeable = Yes' you can also say 'read only = Yes'

- Samba configuration can get quite complicated
  - Not too bad for simple sharing
  - For serious use, read the long, long manual

Samba Configuration (Lab 8b)

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- Samba security is user-based
  - users require username & password to access Samba shares
  - password is encrypted during transmission, file data is not
- Samba maintains its own authentication database
  - Separate from UNIX passwd file
  - Tools to keep Samba/UNIX passwords in sync
    - or have Linux authenticate against Samba database (PAM)
    - or authenticate against central Windows PDC or LDAP server
  - **pdbedit** CMD to create new users and edit Samba password database
    - **pdbedit -a -u newuser #** -a: to add a user into the database. It needs a user name specified with the -u switch. When adding a new user, pdbedit will also ask for the password to be used.
    - **pdbedit -x -u olduser #** -x: to delete an account from the database. It needs a username specified with the -u switch.
    - **pdbedit -L #** lists all the user accounts present in the users database.

Note: Don't forget to run "systemctl restart smb" and "systemctl restart nmb*" & enable them!

* **nmb (d)**: NetBIOS* over TCP/IP name service, like RPC in NFS

Samba Client (Win/Linux) Lab 8b

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- Task 2: Testing Samba from Linux machines
  - Permanent access in `/etc/fstab`

```
//server/public  /pub  cifs  username=xxx,password=xxx  0 0
```

  - Temporary:
    - Connect: `smbclient -U peter //10.0.2.1/peter # user login`

```
smbclient  -L 10.0.2.1 # list=HOST
```

    - Check files: `ls, dir`
    - Download: `get mywinfile.txt  /tmp/win`
    - Upload: `put /etc/samba/smb.conf  samba.txt`
    - normal directory: `\\10.0.2.1\shared` `#create it,lab task 4`
- Task 3: Testing Samba from Windows machines
  - if kernel has smbfs /cifs support
  - Access by server's IP address or NetBIOS name
    - File Explore  in the address bar type `\\10.0.2.1\peter`
    - normal directory: `\\10.0.2.2\shared` `#create it the lab task 5`

Q & A

- Which of the following Samba directives can be used to set whether passwords are required to access this file share service? (Choose the best answer.)

A. public → synonym for guest ok. If set to yes, the share allows guest access **without requiring a password**.

B. browseable → only controls whether the share is visible in "Network Neighborhood / Explorer". Doesn't affect password.

C. guest only → means users can only connect as guests (never with a password).

D. writable → controls write access, not password requirement.

E. read only → controls read/write, not password requirement.

- After class practice: how to share directories with different access control for different groups?
  - User, Group
  - File permission, ownership
  - Samba configuration: group? `man smb.conf`
    - Samba doesn't have its own group concept; it relies on **Unix/Linux groups**. Instead using: admin users, valid users, create mask, directory mask