Chapter 10
Backups

Outline

- Backup devices and media
- Backup philosophy
- Unix backup and archiving commands

Backup Media – By Storage (1)

- By Storage category
  - Hard disk
    - IDE / SCSI
      - **30 ~ 40 MB /s**
    - 160 GB IDE : NT 3500.
    - 36GB SCSI: NT 5000.
  - CD/DVD R RW
    - CD
      - **4 ~ 6 MB/s**
    - DVD
      - **8 ~ 15 MB/s**
    - CD-R 0.7G : NT 8.
    - DVD-R 4.7G : NT 20.
    - DVD DL 8.5GB : NT 400.

Backup Media – By Storage (2)

- Tape
  - DAT (Digital Audio Tape) 4mm tapes
    - > **DDS (Digital Data Storage)**
    - > **DDS-4**
      - **20 GB NT 330.**
      - **2.5 MB /s**
  - Travan tapes
    - > **QIC (Quarter-Inch Cartridge) technology**
      - **20GB NT 1000.**
      - **1 MB /s**
  - DLT (Digital Linear Tape)
    - > **DLT IV**
      - **40GB NT 1000.**
      - **6 MB /s**
  - Mammoth
    - > **Mammoth-2**
      - **20GB NT 1800.**
      - **12 MB /2**

Backup Media – By Storage (3)

- Ultrium LTO (Linear Tape Open)
  - > **Ultrium LTO G2**
    - **200 GB** **NT 2300.**
    - **15 MB /s**

– **MO (Magneto-Optical)**
  - MO 540, 640, 1.3G, 2.3G

– **Removable Media**
  - Floppy, LS-120, ZIP

– **Jukebox**
  - Automatically change removable media
    - > **DAT, DLT, CD, …**

– **Tape Library**
  - Hardware backup solution for large data set

Backup Media – By Storage (4)

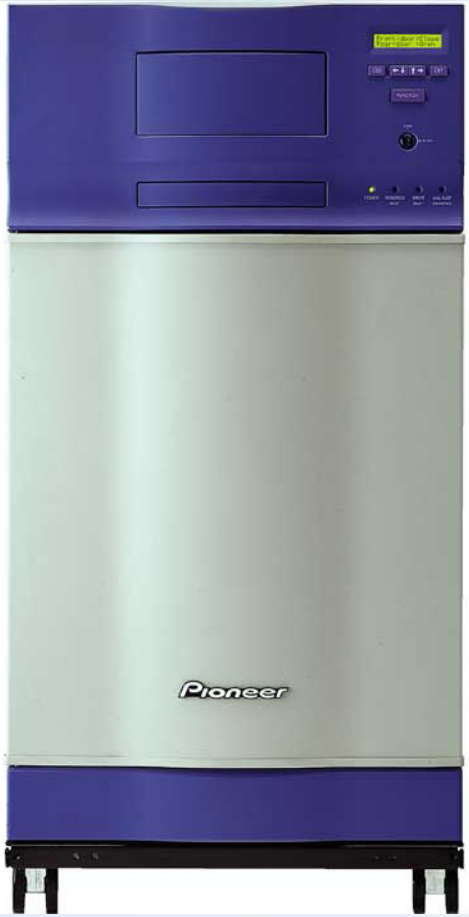
> Ex: Tape Library

IBM TotalStorage Ultrium Scalable Tape Library 3583 規格一覽表	
型號	L18 (18 個磁帶)；L36 (36 個磁帶)；L72 (72 個磁帶)
機架特性代碼	8006 機架套件
Native Fibre Channel Drive 特性	特性代碼 8105
Ultrium Scalable Tape Library 屬於客戶自行安裝的產品，如需 IBM 安裝則需酌收部分費用。	
特色	
磁帶機類型	IBM LTO Ultrium 2 或 1
磁帶機數目	最多 6 個
磁帶數目	18 、 36 、 54 或 72
每個磁帶的容量[1]	壓縮時每個磁帶容量可達 400GB；原始容量為 200GB 壓縮時每個磁帶庫容量可達 28.8TB；原始容量為 14.4TB
持續的資料傳輸速率[1]	壓縮時可達 70MB/ 秒；原始為 35MB/ 秒

IBM TotalStorage UltraScalable Tape Library 3584 規格一覽表	
型號	L32-LTO 基本框架、 D32-LTO 擴充架
特點	
磁帶機類型	IBM LTO Ultrium 2 或 1
框架數量	1 個基本框架與最多 15 個擴充架
磁帶機數量	最多 192 個：L32-1 到 12 LTO；D32-0 到 12 LTO
磁帶盒數量	最多 6,881 個：L32-87 至 281；D32-396 至 440
邏輯資料庫數量	最多 192 個：L32- 最多至 12; D32- 最多至 12
容量[1,2]	2,752 TB 壓縮，使用 16 個框架配置與 4 台磁帶機 L32 (1-4 台磁帶機)- 最多 112.4 TB/ 框架壓縮；56.2 TB 原生 D32 (0 台磁帶機)- 最多 176 TB/ 框架壓縮；88.0 TB 原生

Backup Media – By Storage (5)

> Ex: JukeBox (Pioneer)



Specifications

Number of Magazines (50-disc Magazine)	Max. 6 units (front: max. 3, rear: max. 3)
Number of Magazines (20-disc)	1
Number of Drives	Max. 8 drives
Disc Change Time	Max. 8 seconds

Backup Media – By Storage (6)

> Ex: JukeBox (HP)

Overview

With an HP optical jukebox, your storage system becomes a competitive asset that allows you to improve customer service, reduce back-office costs, provide information for audits and enhance the way you analyze, share and distribute information.

Key features

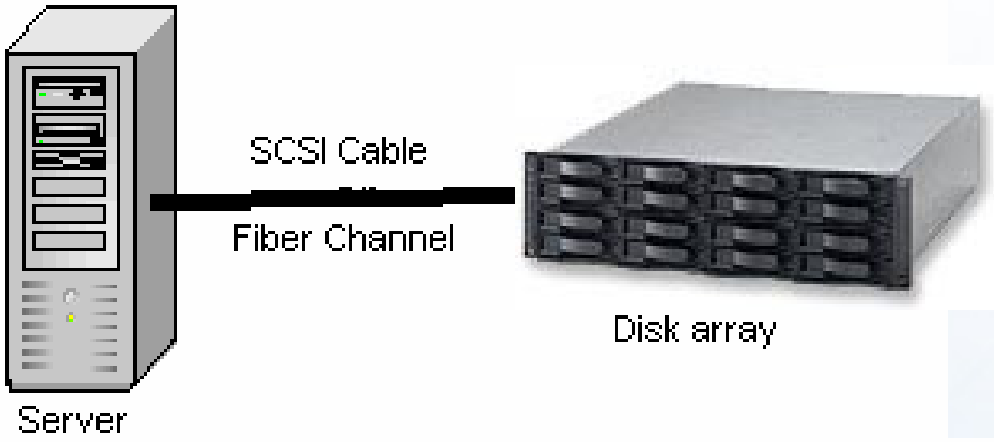
- Provides storage capacities of 2165.8 GB with 4, 6 or 10 multifunction drives and 238 slots
- Online drive repair (system/software dependent) eliminates costly downtime
- A 75% increase in storage capacity over the 5.2 GB jukeboxes at a much lower cost per gigabyte

Backup Media – By Availability

- Off-line Storage
  - CD、DVD、MO
    - **Adv:**
      - low cost, high reliability
    - **Disadv:**
      - Not-convenient, low speed
- Near-line Storage
  - JukeBox、Tape Library
    - **Adv:**
      - High capacity, high reliability
    - **Disadv:**
      - High malfunction rate, Not-convenient
- On-line Storage
  - Disk Array (RAID)
    - **Adv:**
      - Fast and high availability
    - **Disadv:**
      - High cost

Backup Media – By Enterprise Product (1)

> RAID architecture



IBM TotalStorage DS6000 的目標：

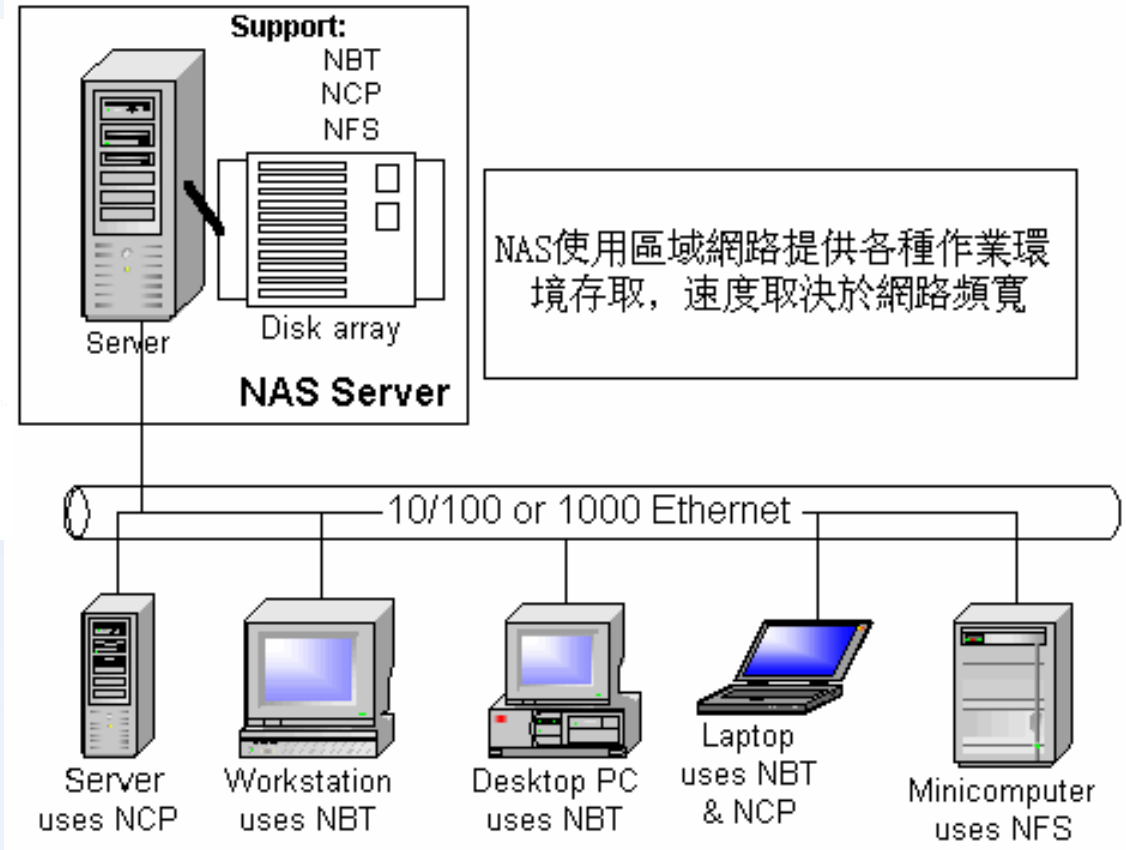
- 以合理價格的儲存系統解決方案，爲大中型企業提供高可用性
- 具有企業級功能、模組化、可擴充特性，能支援開放性平台與大型主機
- 提供進階複製服務，與 IBM TotalStorage DS8000 系列及 IBM TotalStorage Enterprise Storage Server® (ESS) 800 和 750 系統互通
- 提供 GUI 介面與「快捷組態 (Express Configuration)」精靈，透過隨附的 IBM TotalStorage DS Storage Manager 來簡化系統配置與管理
- 採用模組化、3U、16 個磁碟機、機架式，隨儲存需求而擴增，最高可達 67.2TB 的實體容量

Backup Media – By Enterprise Product (2)

> NAS (Network Attached Storage)

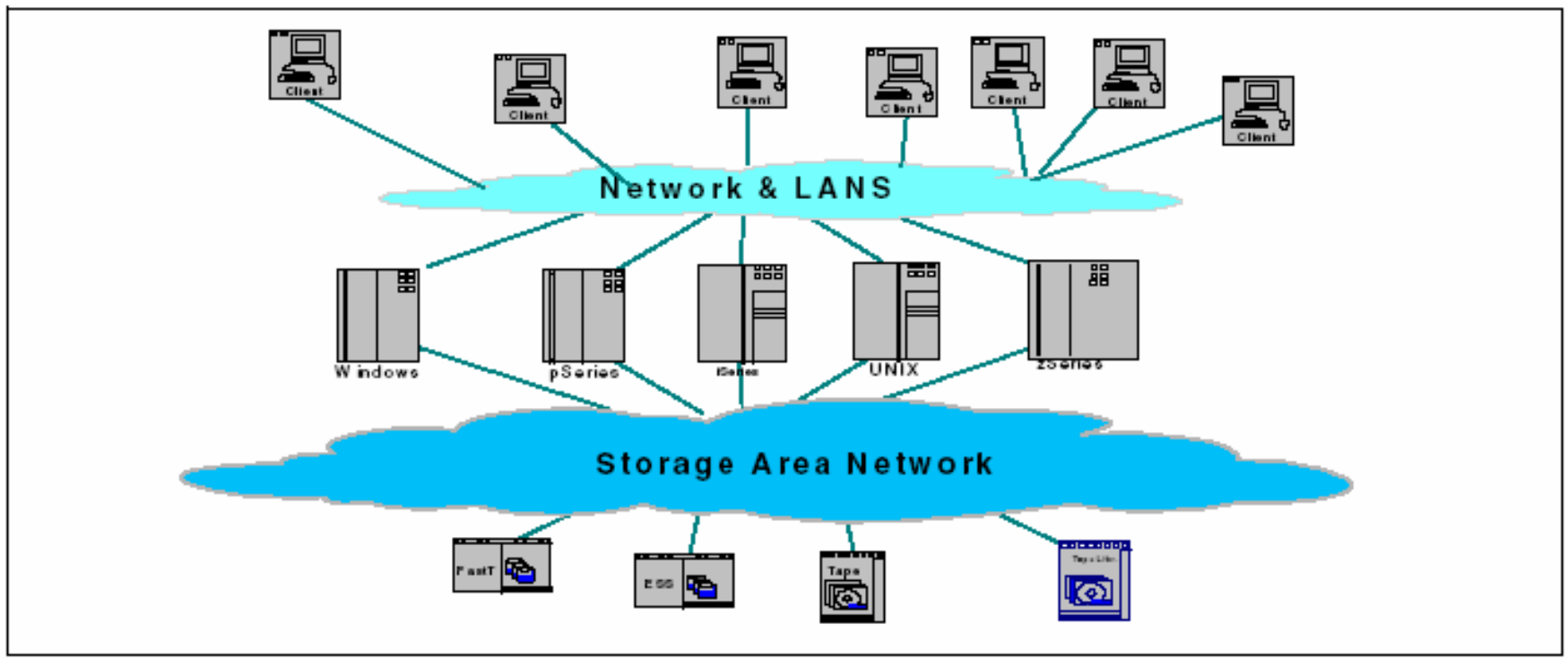
– Storage + Server + Cross-platform access OS + network access protocol

IBM NAS 300G
Supported Protocol:
NFS, HTTP, FTP, CIFS
Netware



Backup Media – By Enterprise Product (3)

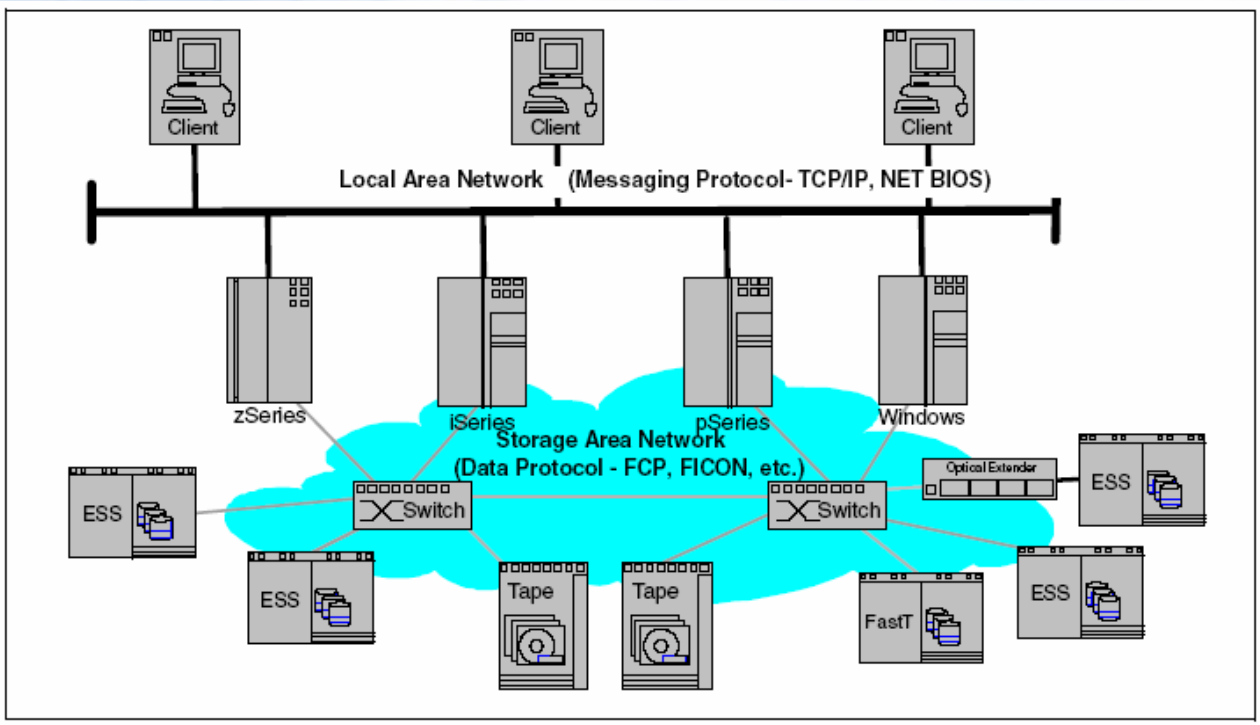
- SAN (Storage Area Network)
  - A high-speed network that allows the direct connections between storage devices and servers



Backup Media – By Enterprise Product (4)

– In SAN, data transfer can be in the following ways:

- **Server to Storage**
- **Server to Server**
- **Storage to Storage**



Backup Philosophy

- Perform all dumps from one machine
- Label your taps
- Pick a reasonable backup interval
- Choose filesystems carefully
- Make daily dumps fit on one tape
- Make filesystems smaller than your dump device
- Keep Tapes off-site
- Protect your backups
- Limit activity during dumps
- Check your tapes
- Develop a tape life cycle
- Design your data for backups
- Prepare for the worst

Dumping filesystems – dump command (1)

- Used to backup filesystem into a large file to a external device
- Advantages:
  - Backups can span multiple output media
  - Files of any type can be backed up and restored
  - Permissions, ownerships, and modification times are preserved
  - Files with holes are handled correctly
  - Backups can be performed incrementally
- Limitations:
  - Each filesystems must be dumped individually
  - Only filesystems on the local machine can be dumped

Dumping filesystems – dump command (2)

- Backup level
  - 0 ~ 9
    - Level 0 ➔ full backup
    - Level N ➔ incremental backup of Level ≦ N-1 for N = 1 ~ 9
- dump command format
  - % dump [arguments] file-system
- dump command arguments
  - **u: update the /etc/dumpdates file after dump**
  - **f: the output backup file**
    - Special device file, like /dev/nrsa0
    - Ordinary file
    - '-' to standard out
    - "user@host:file"
  - **d: tape density in bytes per inch**
  - **s: tape length in feet**

Dumping filesystems – dump command (3)

- Ex:
  - Full backup

```
tytsai@tybsd:/home> dump 0uf - / | gzip > /home/root.0.gz
  DUMP: Date of this level 0 dump: Sun Nov  7 14:15:32 2004
  DUMP: Date of last level 0 dump: the epoch
  DUMP: Dumping /dev/ad0s1a (/) to standard output
  DUMP: mapping (Pass I) [regular files]
  DUMP: mapping (Pass II) [directories]
  DUMP: estimated 2574705 tape blocks.
  DUMP: dumping (Pass III) [directories]
  DUMP: dumping (Pass IV) [regular files]
  DUMP: 28.55% done, finished in 0:12
  DUMP: 60.41% done, finished in 0:06
  DUMP: 93.38% done, finished in 0:01
  DUMP: DUMP: 2771926 tape blocks
  DUMP: finished in 1033 seconds, throughput 2683 KBytes/sec
  DUMP: level 0 dump on Sun Nov  7 14:15:32 2004
  DUMP: DUMP IS DONE
339.739u 49.836s 17:25.91 37.2% 148+716k 14+6366io 1pf+0w
tytsai@tybsd:/home> cat /etc/dumpdates
/dev/ad0s1a                 0 Sun Nov  7 14:15:32 2004
tytsai@tybsd:/home> ls -lh /home/root.0.gz
-rw-r--r--  1 root  wheel      795M Nov  7 14:32 /home/root.0.gz
```

Dumping filesystems – dump command (4)

- Ex:
  - Incremental backup

```
tytsai@tybsd:/home> dump 3uf - / | gzip > /home/root.3.gz
  DUMP: Date of this level 3 dump: Sun Nov  7 14:37:58 2004
  DUMP: Date of last level 0 dump: Sun Nov  7 14:15:32 2004
  DUMP: Dumping /dev/ad0s1a (/) to standard output
  DUMP: mapping (Pass I) [regular files]
  DUMP: mapping (Pass II) [directories]
  DUMP: estimated 706 tape blocks.
  DUMP: dumping (Pass III) [directories]
  DUMP: dumping (Pass IV) [regular files]
  DUMP: DUMP: 496 tape blocks
  DUMP: finished in less than a second
  DUMP: level 3 dump on Sun Nov  7 14:37:58 2004
  DUMP: DUMP IS DONE
tytsai@tybsd:/home> cat /etc/dumpdates
/dev/ad0s1a                 0 Sun Nov  7 14:15:32 2004
/dev/ad0s1a                 3 Sun Nov  7 14:37:58 2004
tytsai@tybsd:/home> ls -al /home/root.3.gz
-rw-r--r--  1 root  wheel  12643 Nov  7 14:41 /home/root.3.gz
tytsai@tybsd:/home> ls -alh /home/root.3.gz
-rw-r--r--  1 root  wheel    12K Nov  7 14:41 /home/root.3.gz
```

Dumping filesystems – dump command (5)

- Default SCSI tape drive device file

System	Rewinding	Nonrewinding
FreeBSD	/dev/rsa0	/dev/nrsa0
Red Hat	/dev/st0	/dev/nst0
Solaris	/dev/rmt/0	/dev/rmt/0n
SunOS	/dev/rst0	/dev/nrst0

Restoring from dumps – restore command (1)

- Restore can do
  - Restoring individual files
  - Restoring entire filesystem
- Options of restore command
  - i: interactive restore
  - r: restore an entire filesystem
  - f: the backup file that restore is going to use

Restoring from dumps – restore command (2)

- Restore individual file interactively

```
tytsai@tybsd:/home/temp> ls -al
total 2772628
drwxr-xr-x  2 root  wheel          512 Nov  8 11:50 ./
drwxr-xr-x  4 root  wheel          512 Nov  8 11:44 ../
-rw-r--r--  1 root  wheel  2838446080 Nov  7 14:32 root.0
tytsai@tybsd:/home/temp> sudo restore -if root.0
Password:
restore > ls
.:
.cshrc          cdrom/          kernel          modules.old/    sys@
.profile        compat@         kernel.GENERIC  proc/           tmp/
COPYRIGHT       dev/            kernel.old      root/           usr/
bin/            etc/            mnt/            sbin/           var/
boot/           home/           modules/        stand/

restore > cd etc
```

Restoring from dumps – restore command (3)

> Restore individual file interactively (cont.)

```
restore > ?
Available commands are:
        ls [arg] - list directory
        cd arg - change directory
        pwd - print current directory
        add [arg] - add `arg' to list of files to be extracted
        delete [arg] - delete `arg' from list of files to be extracted
        extract - extract requested files
        setmodes - set modes of requested directories
        quit - immediately exit program
        what - list dump header information
        verbose - toggle verbose flag (useful with ``ls'')
        help or `?' - print this list
If no `arg' is supplied, the current directory is used
restore >
```

Restoring from dumps – restore command (4)

> Restore individual file interactively (cont.)

```
restore > add /etc/passwd
restore > extract
You have not read any tapes yet.
If you are extracting just a few files, start with the last volume
and work towards the first; restore can quickly skip tapes that
have no further files to extract. Otherwise, begin with volume 1.
Specify next volume #: 1
set owner/mode for '.'? [yn] n
restore > quit
tytsai@tybsd:/home/temp> ls -al etc
total 6
drwxr-xr-x  2 root  wheel   512 Nov  4 17:09 ./
drwxr-xr-x  3 root  wheel   512 Nov  8 11:57 ../
-rw-r--r--  1 root  wheel  1253 Oct 19 22:48 passwd
tytsai@tybsd:/home/temp>
```

Restoring from dumps – restore command (5)

- Restore entire filesystem
  - % restore -rf /home/temp/root.0
  - Steps
    - **Restore level 0 first**
    - **Restore incremental dumps**

> 0 0 0 0 **0**
> **0** 5 5 5 **5**
> **0** 3 **2** 5 **4** **5**
> **0** 9 9 5 9 9 **3** 9 9 **5** 9 **9**
> **0** 3 5 9 **3** **5** **9**

Other archiving programs

- tar command
  - Read multiple files and packages them into one file
  - % tar czvf name.tar.gz /etc/
  - % tar xzvf name.tar.gz
  - % tar cf – fromdir | (cd todir ; tar xfp –)
- dd command
  - Copy filesystems between partitions of exactly the same size
  - % dd if=/dev/rst0 of=/dev/rst1
  - % dd if=/tmp/kern.flp of=/dev/fd0
  - % dd if=/dev/da1 of=/dev/da2 bs=1048576

csie home backup

- Using rsync
  - % rsync –a --delete
    - -a: archive mode
      - > Recursive and preserve everything
    - --delete:
      - > Delete any file that are not in the sending side

```
0 4 * * 1 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete cp     /backup/user/;/bin/date)
0 4 * * 2 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete gcp    /backup/user/;/bin/date)
0 4 * * 3 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete staff  /backup/user/;/bin/date)
0 4 * * 4 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete dcp    /backup/user/;/bin/date)
0 4 * * 5 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete faculty /backup/user/;/bin/date)
0 4 * * 6 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete relative /backup/user/;/bin/date)
0 3 * * 2 (/bin/date;cd /raid;/usr/local/bin/rsync -al --delete alumni /backup/user/;/bin/date)
```