

# 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/ SATA / SCSI**
      - **40 ~ 60 MB /s**
  - > CD/DVD R RW
    - **CD**
      - **4 ~ 6 MB/s**
    - **DVD**
      - **8 ~ 15 MB/s**
    - **CD-R 0.7G**
    - **DVD-R 4.7G**
    - **DVD DL 8.5GB**

# Backup Media – By Storage (2)

## > Tape

- **DAT (Digital Audio Tape) 4mm tapes**
  - **DDS (Digital Data Storage), Minimal Error Rate, Higher Efficiency**
  - **DDS-4 (often used)**
    - 20/40GB(compressed), about NT 400.
    - 1.0~3.0MB/s
- **Travan tapes**
  - **High Transfer Rate**
  - **Travan 40 (often used)**
    - 20/40GB(compressed), about NT 2000.
    - Up to 8.0MB/s
- **DLT (Digital Linear Tape)**
  - **High Capacity, Solid Reliability**
  - **Media**
    - Max 1600 GB (compressed), about NT 4000.
    - Speed: worst at all
- **LTO Ultrium**
  - **Fast Transfer Rate, High Performance, and High Storage Capacity**
  - **LTO Ultrium 3 (often used)**
    - Max 800 GB (compressed), about NT 5000.
    - Speed: up to 80 MB/s
    - Tape Drive is much more expensive.....

# Backup Media – By Storage (3)

- > **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) 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 特性代碼	8105
Drive 特性	
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。	
<b>特色</b>	
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 <sup>1</sup>	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 <sup>1</sup>	壓縮時可達 70MB/秒；原始為 35MB/秒

**IBM TotalStorage UltraScalable Tape Library 3584 規格一覽表**

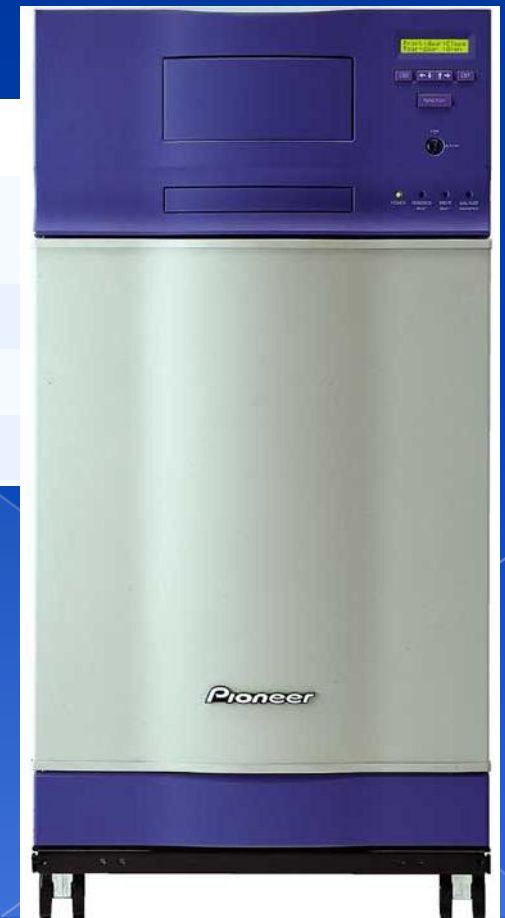
型號	L32-LTO 基本框架、D32-LTO 擴充架
<b>特點</b>	
磁帶機類型	IBM LTO Ultrium 2 或 1
框架數量	1 個基本框架與最多 15 個擴充架
磁帶機數量	最多 192 個：L32-1 到 12 LTO；D32-0 到 12 LTO
磁帶盒數量	最多 6,881 個：L32-87 至 281；D32-396 至 440
邏輯資料庫數量	最多 192 個：L32-最多至 12；D32-最多至 12
容量 <sup>1,2</sup>	2,752 TB 壓縮，使用 16 個框架配置與 4 台磁帶機 L32 (1-4 台磁帶機)-最多 112.4 TB/ 框架壓縮；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)

## 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)

## 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



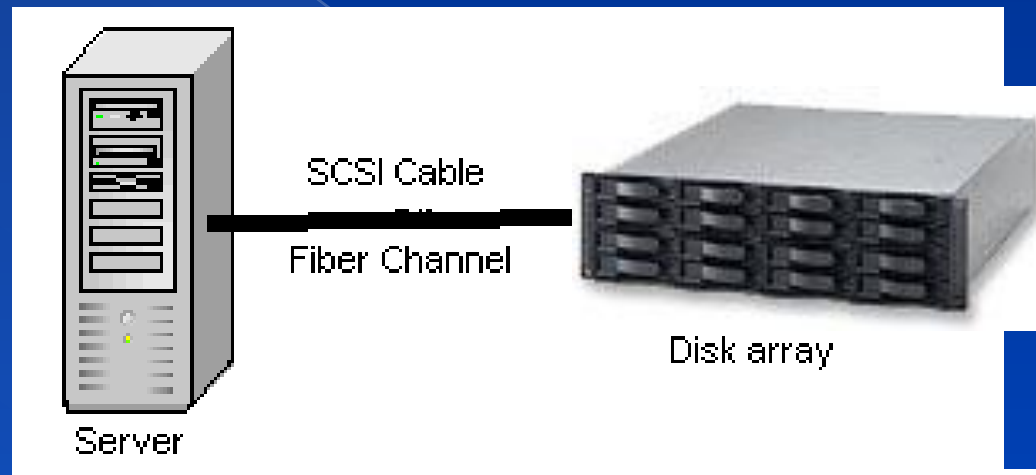


# Backup Media – By Availability

- 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，為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

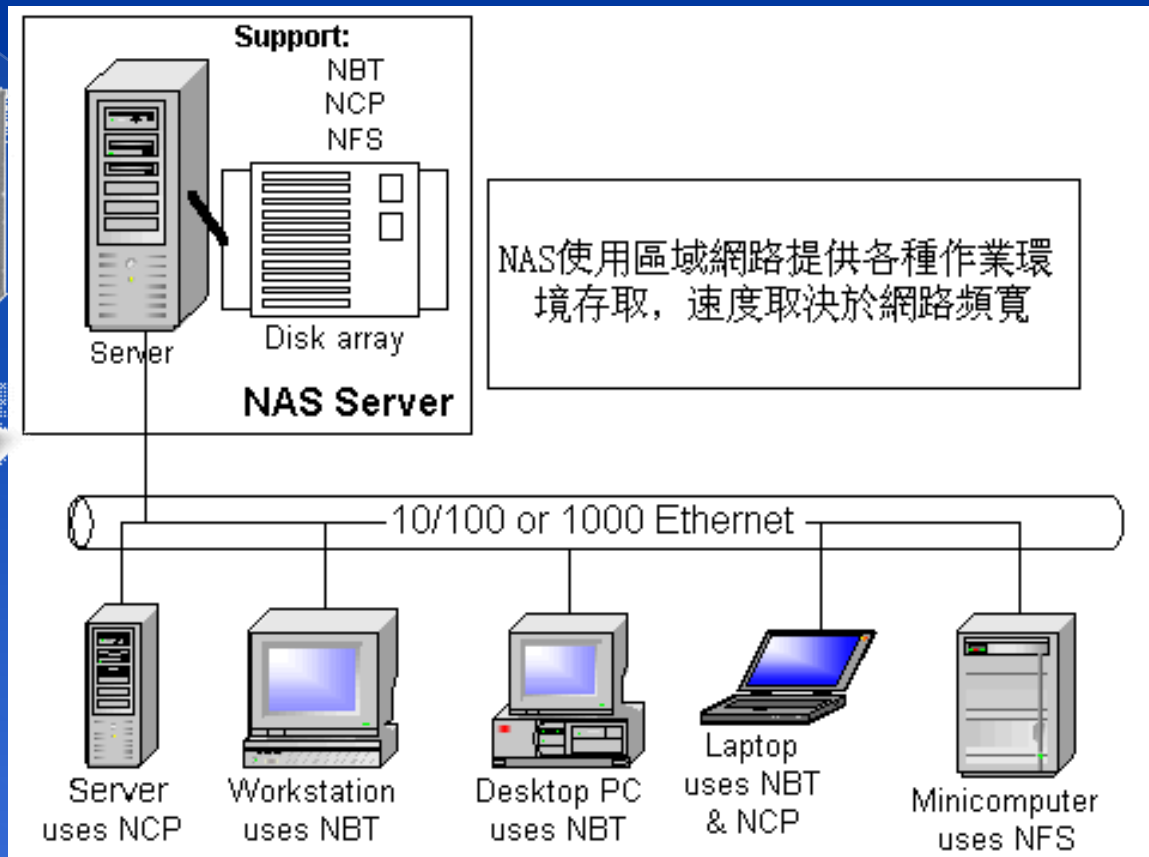
# Backup Media – By Enterprise Product (2)

## ◎ NAS (Network Attached Storage)

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



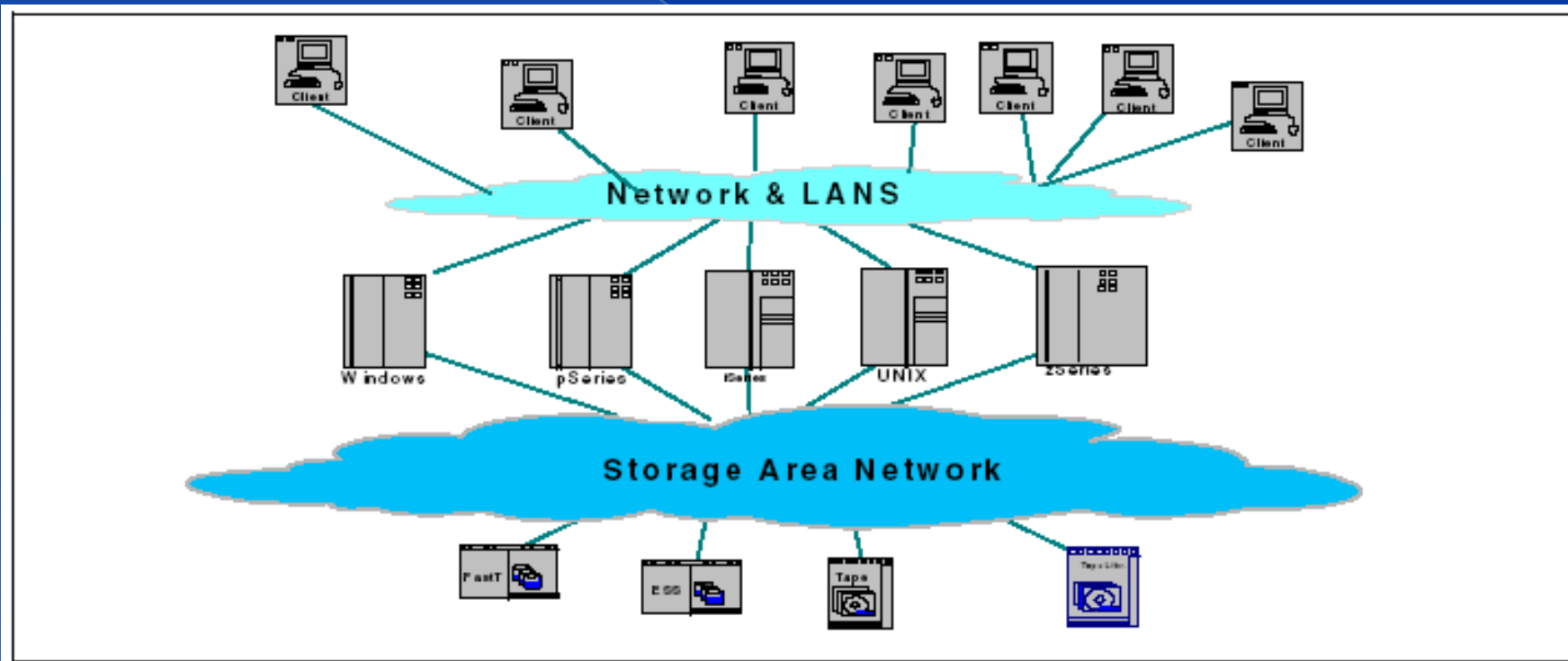
IBM NAS 300G  
Supported Protocol:  
NFS, HTTP, FTP, CIFS  
Netware



# Backup Media – By Enterprise Product (3)

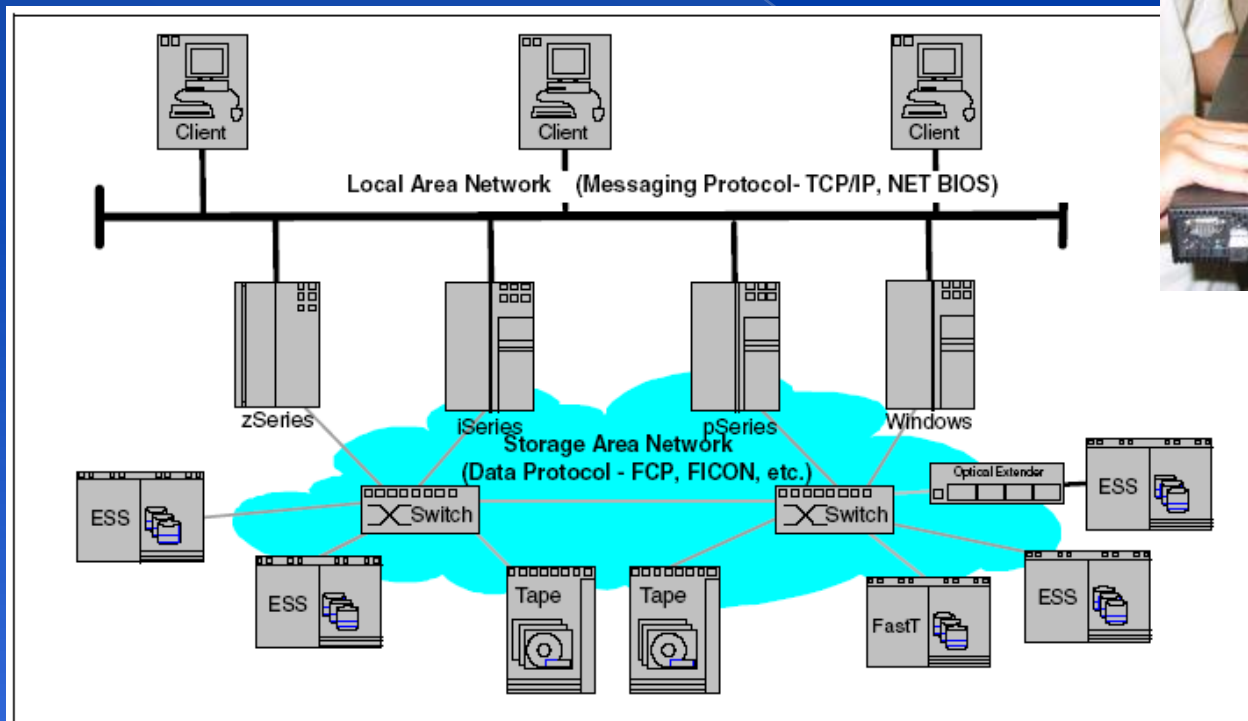
## ◎ SAN (Storage Area Network)

- > 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



# 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  $\leq$  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)

## ○ Example: Full backup

```
lwbsd:~ -lwshsu- sudo dump 0uLf - / > /z/dump/root.0
DUMP: Date of this level 0 dump: Tue Dec  2 07:12:48 2008
DUMP: Date of last level 0 dump: the epoch
DUMP: Dumping snapshot of /dev/ad4s1a (/) to standard output
DUMP: mapping (Pass I) [regular files]
DUMP: mapping (Pass II) [directories]
DUMP: estimated 5852372 tape blocks.
DUMP: dumping (Pass III) [directories]
DUMP: dumping (Pass IV) [regular files]
DUMP: 22.70% done, finished in 0:17 at Tue Dec  2 07:34:53 2008
DUMP: 58.59% done, finished in 0:07 at Tue Dec  2 07:29:56 2008
DUMP: DUMP: 5853968 tape blocks
DUMP: finished in 854 seconds, throughput 6854 KBytes/sec
DUMP: level 0 dump on Tue Dec  2 07:12:48 2008
DUMP: DUMP IS DONE
lwbsd:~ -lwshsu- cat /etc/dumpdates
/dev/ad4s1a          0 Tue Dec  2 07:12:48 2008
lwbsd:~ -lwshsu- ls -lh /z/dump/root.0
-rw-r--r--  1 lwshsu  staff  -  5.6G Dec  2 07:27 /z/dump/root.0
```

# Dumping filesystems – dump command (4)

## Example: Incremental backup

```
lwbsd:~ -lwshsu- sudo dump 2uLf - / | gzip > /z/dump/root.2.gz
DUMP: Date of this level 2 dump: Tue Dec  2 15:51:24 2008
DUMP: Date of last level 0 dump: Tue Dec  2 07:12:48 2008
DUMP: Dumping snapshot of /dev/ad4s1a (/) to standard output
DUMP: mapping (Pass I) [regular files]
DUMP: mapping (Pass II) [directories]
DUMP: estimated 30406 tape blocks.
DUMP: dumping (Pass III) [directories]
DUMP: dumping (Pass IV) [regular files]
DUMP: DUMP: 29925 tape blocks
DUMP: finished in 3 seconds, throughput 9975 KBytes/sec
DUMP: level 2 dump on Tue Dec  2 15:51:24 2008
DUMP: DUMP IS DONE
```

```
lwbsd:~ -lwshsu- cat /etc/dumpdates
```

```
/dev/ad4s1a          0 Tue Dec  2 07:12:48 2008
```

```
/dev/ad4s1a          2 Tue Dec  2 15:51:24 2008
```

```
lwbsd:~ -lwshsu- ls -lh /z/dump/
```

```
total 5861223
```

```
-rw-r--r--  1 lwshsu  staff  -  5.6G Dec  2 07:27 root.0
```

```
-rw-r--r--  1 lwshsu  staff  -  2.7M Dec  2 15:52 root.2.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

```
Lwbsd:~ -lwshsu- cat /z/dump/root.0 | restore -if -
restore > ls
.:
.cshrc      boot/      etc/      mnt/      sbin/
.profile   cdrom/    home@    old_backup/ sys@
.snap/     compat@   lib/     proc/     tmp/
COPYRIGHT  dev/     libexec/ rescue/    usr/
bin/       entropy  media/   root/     var/

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
```

# Restoring from dumps – restore command (4)

- Restore individual file interactively (cont.)

```
restore > add /etc/motd
restore > extract
set owner/mode for '.'? [yn] n
restore > quit
lwbsd:~ -lwshsu- ls -al etc
total 6
drwxr-xr-x  2 lwshsu  wheel  -  512 Nov 29 13:46 .
drwxr-xr-x 36 lwshsu  wheel  - 2048 Nov 29 14:08 ..
-rw-r--r--  1 lwshsu  wheel  - 1120 Nov 26 12:01 motd
```

# Restoring from dumps – restore command (5)

## ◎ Restore entire filesystem

> \$ restore -rf /home/temp/root.0

> Steps

- Restore level 0 first
- Restore incremental dumps
  - 0000**0**
  - **0**555**5**
  - **0**3**2**5**4**5
  - **0**99599**3**99**5**99
  - **0**359**3**59



# Other archiving programs

- tar command

- > Read multiple files and packages them into one file

- > Example

```
$ tar czvf etc.tar.gz /etc/
```

```
$ tar xzvf etc.tar.gz
```

```
$ tar cf - fromdir | tar xfp - -C todir
```

- dd command

- > Copy filesystems between partitions of exactly the same size

- > Example

```
$ dd if=/dev/rst0 of=/dev/rst1
```

```
$ dd if=/tmp/kern.flp of=/dev/fd0
```

```
$ dd if=/dev/da1 of=/dev/da2 bs=1048576
```

# CS home backup

## Using rsync

> \$ rsync -a --delete

- **-a: archive mode** (-rlptgoD)
  - 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 -a --delete cs /backup/user/;/bin/date)
0 4 * * 2 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete gcs /backup/user/;/bin/date)
0 4 * * 3 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete staff /backup/user/;/bin/date)
0 4 * * 4 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete dcs /backup/user/;/bin/date)
0 4 * * 5 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete faculty /backup/user/;/bin/date)
0 4 * * 6 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete relative /backup/user/;/bin/date)
0 3 * * 2 (/bin/date;cd /raid;/usr/local/bin/rsync -a --delete alumni /backup/user/;/bin/date)
```

# Advanced Backup

- ◎ Snapshot
- ◎ Bacula
  - > [sysutils/backla-\\*](#)
  - > [www/bacula-web](#)