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LCE506 - Archiving and Compression

Contents

Traditional Backup Tools

Preparation

Before proceeding further, you need to create some files and directories to backup and archive:

```
[root@centos8 ~]# mkdir -p /test/repY; mkdir /test/repZ
[root@centos8 ~]# cd /test/repY; touch Y1 Y2 Y3
[root@centos8 repY]# cd /test/repZ; touch Z1 Z2
[root@centos8 repZ]# ls -lR /test
/test:
total 0
drwxr-xr-x. 2 root root 36 Jun  2 14:05 repY
drwxr-xr-x. 2 root root 26 Jun  2 14:05 repZ
```

```
/test/repY:
total 0
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y1
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y2
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y3

/test/repZ:
total 0
-rw-r--r--. 1 root root 0 Jun  2 14:05 Z1
-rw-r--r--. 1 root root 0 Jun  2 14:05 Z2
```

The tar Command

Presentation

The **tar** command can be used to archive or back-up files to:

- a special file such as a streamer,
- an ordinary file on disk,
- Standard Output to be used in a pipe.

tar is an abbreviation of **tape archiver**.

Command Line Switches

The switches associated with the **tar** command are:

```
[root@centos8 repZ]# tar --help
Usage: tar [OPTION...] [FILE]...
GNU 'tar' saves many files together into a single tape or disk archive, and can
restore individual files from the archive.
```

```
Examples:
  tar -cf archive.tar foo bar  # Create archive.tar from files foo and bar.
  tar -tvf archive.tar         # List all files in archive.tar verbosely.
  tar -xf archive.tar          # Extract all files from archive.tar.

 Local file name selection:

      --add-file=FILE        add given FILE to the archive (useful if its name
                             starts with a dash)
  -C, --directory=DIR        change to directory DIR
      --exclude=PATTERN      exclude files, given as a PATTERN
      --exclude-backups      exclude backup and lock files
      --exclude-caches       exclude contents of directories containing
                             CACHEDIR.TAG, except for the tag file itself
      --exclude-caches-all   exclude directories containing CACHEDIR.TAG
      --exclude-caches-under exclude everything under directories containing
                             CACHEDIR.TAG
      --exclude-ignore=FILE  read exclude patterns for each directory from
                             FILE, if it exists
      --exclude-ignore-recursive=FILE
                             read exclude patterns for each directory and its
                             subdirectories from FILE, if it exists
      --exclude-tag=FILE     exclude contents of directories containing FILE,
                             except for FILE itself
      --exclude-tag-all=FILE exclude directories containing FILE
      --exclude-tag-under=FILE   exclude everything under directories
                             containing FILE
      --exclude-vcs          exclude version control system directories
      --exclude-vcs-ignores  read exclude patterns from the VCS ignore files
      --no-null              disable the effect of the previous --null option
      --no-recursion         avoid descending automatically in directories
      --no-unquote           do not unquote input file or member names
      --no-verbatim-files-from   -T treats file names starting with dash as
                             options (default)
```

```
      --null                 -T reads null-terminated names; implies
                             --verbatim-files-from
      --recursion            recurse into directories (default)
  -T, --files-from=FILE      get names to extract or create from FILE
      --unquote              unquote input file or member names (default)
      --verbatim-files-from  -T reads file names verbatim (no escape or option
                             handling)
  -X, --exclude-from=FILE    exclude patterns listed in FILE

File name matching options (affect both exclude and include patterns):

      --anchored             patterns match file name start
      --ignore-case          ignore case
      --no-anchored          patterns match after any '/' (default for
                             exclusion)
      --no-ignore-case       case sensitive matching (default)
      --no-wildcards         verbatim string matching
      --no-wildcards-match-slash   wildcards do not match '/'
      --wildcards            use wildcards (default)
      --wildcards-match-slash   wildcards match '/' (default for exclusion)

Main operation mode:

  -A, --catenate, --concatenate   append tar files to an archive
  -c, --create               create a new archive
  -d, --diff, --compare      find differences between archive and file system
      --delete               delete from the archive (not on mag tapes!)
  -r, --append               append files to the end of an archive
  -t, --list                 list the contents of an archive
      --test-label           test the archive volume label and exit
  -u, --update               only append files newer than copy in archive
  -x, --extract, --get       extract files from an archive

Operation modifiers:
```

```
      --check-device         check device numbers when creating incremental
                             archives (default)
  -g, --listed-incremental=FILE   handle new GNU-format incremental backup
  -G, --incremental          handle old GNU-format incremental backup
      --hole-detection=TYPE  technique to detect holes
      --ignore-failed-read   do not exit with nonzero on unreadable files
      --level=NUMBER         dump level for created listed-incremental archive
  -n, --seek                 archive is seekable
      --no-check-device      do not check device numbers when creating
                             incremental archives
      --no-seek              archive is not seekable
      --occurrence[=NUMBER]  process only the NUMBERth occurrence of each file
                             in the archive; this option is valid only in
                             conjunction with one of the subcommands --delete,
                             --diff, --extract or --list and when a list of
                             files is given either on the command line or via
                             the -T option; NUMBER defaults to 1
      --sparse-version=MAJOR[.MINOR]
                             set version of the sparse format to use (implies
                             --sparse)
  -S, --sparse               handle sparse files efficiently

Overwrite control:

  -k, --keep-old-files       don't replace existing files when extracting,
                             treat them as errors
      --keep-directory-symlink   preserve existing symlinks to directories when
                             extracting
      --keep-newer-files     don't replace existing files that are newer than
                             their archive copies
      --no-overwrite-dir     preserve metadata of existing directories
      --one-top-level[=DIR]  create a subdirectory to avoid having loose files
                             extracted
      --overwrite            overwrite existing files when extracting
```

```
      --overwrite-dir        overwrite metadata of existing directories when
                             extracting (default)
      --recursive-unlink     empty hierarchies prior to extracting directory
      --remove-files         remove files after adding them to the archive
      --skip-old-files       don't replace existing files when extracting,
                             silently skip over them
  -U, --unlink-first         remove each file prior to extracting over it
  -W, --verify               attempt to verify the archive after writing it

Select output stream:

      --ignore-command-error ignore exit codes of children
      --no-ignore-command-error   treat non-zero exit codes of children as
                             error
  -O, --to-stdout            extract files to standard output
      --to-command=COMMAND   pipe extracted files to another program

Handling of file attributes:

      --atime-preserve[=METHOD]   preserve access times on dumped files, either
                             by restoring the times after reading
                             (METHOD='replace'; default) or by not setting the
                             times in the first place (METHOD='system')
      --clamp-mtime          only set time when the file is more recent than
                             what was given with --mtime
      --delay-directory-restore   delay setting modification times and
                             permissions of extracted directories until the end
                             of extraction
      --group=NAME           force NAME as group for added files
      --group-map=FILE       use FILE to map file owner GIDs and names
      --mode=CHANGES         force (symbolic) mode CHANGES for added files
      --mtime=DATE-OR-FILE   set mtime for added files from DATE-OR-FILE
  -m, --touch                don't extract file modified time
      --no-delay-directory-restore
```

```
                            cancel the effect of --delay-directory-restore
                            option
     --no-same-owner        extract files as yourself (default for ordinary
                            users)
     --no-same-permissions  apply the user's umask when extracting permissions
                            from the archive (default for ordinary users)
     --numeric-owner        always use numbers for user/group names
     --owner=NAME           force NAME as owner for added files
     --owner-map=FILE       use FILE to map file owner UIDs and names
 -p, --preserve-permissions, --same-permissions
                            extract information about file permissions
                            (default for superuser)
     --same-owner           try extracting files with the same ownership as
                            exists in the archive (default for superuser)
 -s, --preserve-order, --same-order
                            member arguments are listed in the same order as
                            the files in the archive
     --sort=ORDER           directory sorting order: none (default), name or
                            inode

Handling of extended file attributes:

     --acls                 Enable the POSIX ACLs support
     --no-acls              Disable the POSIX ACLs support
     --no-selinux           Disable the SELinux context support
     --no-xattrs            Disable extended attributes support
     --selinux              Enable the SELinux context support
     --xattrs               Enable extended attributes support
     --xattrs-exclude=MASK  specify the exclude pattern for xattr keys
     --xattrs-include=MASK  specify the include pattern for xattr keys

Device selection and switching:

 -f, --file=ARCHIVE         use archive file or device ARCHIVE
```

```
      --force-local          archive file is local even if it has a colon
  -F, --info-script=NAME, --new-volume-script=NAME
                             run script at end of each tape (implies -M)
  -L, --tape-length=NUMBER   change tape after writing NUMBER x 1024 bytes
  -M, --multi-volume         create/list/extract multi-volume archive
      --rmt-command=COMMAND  use given rmt COMMAND instead of rmt
      --rsh-command=COMMAND  use remote COMMAND instead of rsh
      --volno-file=FILE      use/update the volume number in FILE

Device blocking:

  -b, --blocking-factor=BLOCKS   BLOCKS x 512 bytes per record
  -B, --read-full-records    reblock as we read (for 4.2BSD pipes)
  -i, --ignore-zeros         ignore zeroed blocks in archive (means EOF)
      --record-size=NUMBER   NUMBER of bytes per record, multiple of 512

Archive format selection:

  -H, --format=FORMAT        create archive of the given format

FORMAT is one of the following:

   gnu                       GNU tar 1.13.x format
   oldgnu                    GNU format as per tar <= 1.12
   pax                       POSIX 1003.1-2001 (pax) format
   posix                     same as pax
   ustar                     POSIX 1003.1-1988 (ustar) format
   v7                        old V7 tar format

     --old-archive, --portability
                             same as --format=v7
     --pax-option=keyword[[:]=value][,keyword[[:]=value]]...
                             control pax keywords
     --posix                 same as --format=posix
```

```
 -V, --label=TEXT           create archive with volume name TEXT; at
                            list/extract time, use TEXT as a globbing pattern
                            for volume name

Compression options:

 -a, --auto-compress        use archive suffix to determine the compression
                            program
 -I, --use-compress-program=PROG
                            filter through PROG (must accept -d)
 -j, --bzip2                filter the archive through bzip2
 -J, --xz                   filter the archive through xz
     --lzip                 filter the archive through lzip
     --lzma                 filter the archive through xz --format=lzma
     --lzop                 filter the archive through lzop
     --no-auto-compress     do not use archive suffix to determine the
                            compression program
 -z, --gzip, --gunzip, --ungzip   filter the archive through gzip
 -Z, --compress, --uncompress   filter the archive through compress

Local file selection:

     --backup[=CONTROL]     backup before removal, choose version CONTROL
 -h, --dereference          follow symlinks; archive and dump the files they
                            point to
     --hard-dereference     follow hard links; archive and dump the files they
                            refer to
 -K, --starting-file=MEMBER-NAME
                            begin at member MEMBER-NAME when reading the
                            archive
     --newer-mtime=DATE     compare date and time when data changed only
 -N, --newer=DATE-OR-FILE, --after-date=DATE-OR-FILE
                            only store files newer than DATE-OR-FILE
     --one-file-system      stay in local file system when creating archive
```

```
 -P, --absolute-names       don't strip leading '/'s from file names
     --suffix=STRING        backup before removal, override usual suffix ('~'
                            unless overridden by environment variable
                            SIMPLE_BACKUP_SUFFIX)

File name transformations:

     --strip-components=NUMBER   strip NUMBER leading components from file
                            names on extraction
     --transform=EXPRESSION, --xform=EXPRESSION
                            use sed replace EXPRESSION to transform file
                            names

Informative output:

     --checkpoint[=NUMBER]  display progress messages every NUMBERth record
                            (default 10)
     --checkpoint-action=ACTION   execute ACTION on each checkpoint
     --full-time            print file time to its full resolution
     --index-file=FILE      send verbose output to FILE
 -l, --check-links          print a message if not all links are dumped
     --no-quote-chars=STRING   disable quoting for characters from STRING
     --quote-chars=STRING   additionally quote characters from STRING
     --quoting-style=STYLE  set name quoting style; see below for valid STYLE
                            values
 -R, --block-number         show block number within archive with each message
     --show-defaults        show tar defaults
     --show-omitted-dirs    when listing or extracting, list each directory
                            that does not match search criteria
     --show-snapshot-field-ranges
                            show valid ranges for snapshot-file fields
     --show-transformed-names, --show-stored-names
                            show file or archive names after transformation
     --totals[=SIGNAL]      print total bytes after processing the archive;
```

```
                             with an argument - print total bytes when this
                             SIGNAL is delivered; Allowed signals are: SIGHUP,
                             SIGQUIT, SIGINT, SIGUSR1 and SIGUSR2; the names
                             without SIG prefix are also accepted
      --utc                  print file modification times in UTC
  -v, --verbose              verbosely list files processed
      --warning=KEYWORD      warning control
  -w, --interactive, --confirmation
                             ask for confirmation for every action

 Compatibility options:

  -o                         when creating, same as --old-archive; when
                             extracting, same as --no-same-owner

 Other options:

  -?, --help                 give this help list
      --restrict             disable use of some potentially harmful options
      --usage                give a short usage message
      --version              print program version

Mandatory or optional arguments to long options are also mandatory or optional
for any corresponding short options.

The backup suffix is '~', unless set with --suffix or SIMPLE_BACKUP_SUFFIX.
The version control may be set with --backup or VERSION_CONTROL, values are:

  none, off       never make backups
  t, numbered     make numbered backups
  nil, existing   numbered if numbered backups exist, simple otherwise
  never, simple   always make simple backups

Valid arguments for the --quoting-style option are:
```

```
  literal
  shell
  shell-always
  shell-escape
  shell-escape-always
  c
  c-maybe
  escape
  locale
  clocale

*This* tar defaults to:
--format=gnu -f- -b20 --quoting-style=escape --rmt-command=/etc/rmt
--rsh-command=/usr/bin/ssh
```

LAB #1 - Working with the tar Command

You can now proceed with the back-up of the directory **test** and it's contents to an ordinary file:

```
[root@centos8 repZ]# tar cvf /tmp/test.tar /test
tar: Removing leading `/' from member names
/test/
/test/repY/
/test/repY/Y1
/test/repY/Y2
/test/repY/Y3
/test/repZ/
/test/repZ/Z1
/test/repZ/Z2
```

To consult the archive's **table of contents**, you need to use the following command:

```
[root@centos8 repZ]# tar tvf /tmp/test.tar
drwxr-xr-x root/root         0 2021-06-02 14:04 test/
drwxr-xr-x root/root         0 2021-06-02 14:05 test/repY/
-rw-r--r-- root/root         0 2021-06-02 14:05 test/repY/Y1
-rw-r--r-- root/root         0 2021-06-02 14:05 test/repY/Y2
-rw-r--r-- root/root         0 2021-06-02 14:05 test/repY/Y3
drwxr-xr-x root/root         0 2021-06-02 14:05 test/repZ/
-rw-r--r-- root/root         0 2021-06-02 14:05 test/repZ/Z1
-rw-r--r-- root/root         0 2021-06-02 14:05 test/repZ/Z2
```

In order to create an incremental back-up, you now need to create an empty file to be used as a time reference file. All files modified or created after the creation of this file will be included in the incremental archive:

```
[root@centos8 repZ]# touch /tmp/dateref
```

Having created your reference file, you can now proceed with making some changes to some files:

```
[root@centos8 repZ]# echo "CentOS est super \!" > /test/repY/Y1
[root@centos8 repZ]# echo "RHEL is wonderful \!" > /test/repZ/Z1
```

You can now use this file to create an incremental archive using the **-N** option of the **tar** command:

```
[root@centos8 repZ]# tar -cvf /tmp/incremental.tar -N /tmp/dateref /test
tar: Removing leading `/' from member names
/test/
/test/repY/
/test/repY/Y1
tar: /test/repY/Y2: file is unchanged; not dumped
tar: /test/repY/Y3: file is unchanged; not dumped
/test/repZ/
/test/repZ/Z1
tar: /test/repZ/Z2: file is unchanged; not dumped
```

Check the contents of the archive by using the **-t** option of the **tar** command:

```
[root@centos8 repZ]# tar tvf /tmp/incremental.tar
drwxr-xr-x root/root         0 2021-06-02 14:04 test/
drwxr-xr-x root/root         0 2021-06-02 14:05 test/repY/
-rw-r--r-- root/root        20 2021-06-02 14:08 test/repY/Y1
drwxr-xr-x root/root         0 2021-06-02 14:05 test/repZ/
-rw-r--r-- root/root        21 2021-06-02 14:09 test/repZ/Z1
```

> **Important** - Note that the archive contains the directories **test**, **repY** and **repZ** in addition to the two modified files **Y1** and **Z1**.

Now delete the contents of the **test** directory:

```
[root@centos8 repZ]# rm -rf /test/*
```

> **Important** - Note that the system allows you to delete the **/test/repZ** directory despite the fact that it is your working directory!

To restore your first archive, you need to be at the root of your file system:

```
[root@centos8 repZ]# cd /
[root@centos8 /]# tar xvf /tmp/test.tar
test/
test/repY/
test/repY/Y1
test/repY/Y2
test/repY/Y3
```

```
test/repZ/
test/repZ/Z1
test/repZ/Z2
```

Using the **ls** command, you can check that the contents of the **test** directory have been restored:

```
[root@centos8 /]# ls -lR /test
/test:
total 0
drwxr-xr-x. 2 root root 36 Jun  2 14:05 repY
drwxr-xr-x. 2 root root 26 Jun  2 14:05 repZ

/test/repY:
total 0
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y1
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y2
-rw-r--r--. 1 root root 0 Jun  2 14:05 Y3

/test/repZ:
total 0
-rw-r--r--. 1 root root 0 Jun  2 14:05 Z1
-rw-r--r--. 1 root root 0 Jun  2 14:05 Z2
```

Important - Note that both **Y1** and **Z1** are empty.

Now restore your incremental archive:

```
[root@centos8 /]# tar xvf /tmp/incremental.tar
test/
test/repY/
test/repY/Y1
```

```
test/repZ/
test/repZ/Z1
```

Using the **ls** command, you can check that the contents of incremental.tar have been restored:

```
[root@centos8 /]# ls -lR /test
/test:
total 0
drwxr-xr-x. 2 root root 36 Jun  2 14:05 repY
drwxr-xr-x. 2 root root 26 Jun  2 14:05 repZ

/test/repY:
total 4
-rw-r--r--. 1 root root 20 Jun  2 14:08 Y1
-rw-r--r--. 1 root root  0 Jun  2 14:05 Y2
-rw-r--r--. 1 root root  0 Jun  2 14:05 Y3

/test/repZ:
total 4
-rw-r--r--. 1 root root 21 Jun  2 14:09 Z1
-rw-r--r--. 1 root root  0 Jun  2 14:05 Z2
```

Important - Note that both **Y1** and **Z1** have been restored.

The GPL tar Command and Compression

The tar command can use switches to enable compression during archive creation:

Compression Type	Switch

Compression Type	Switch
gzip	z
bzip2	j
lzma	J

The cpio Command

Presentation

cpio stands for **Copy Input To Output**. As well as having its own archive format, cpio can also manage tar files.

Command Line Switches

The switches associated with the **cpio** command are:

```
[root@centos8 /]# cpio --help
Usage: cpio [OPTION...] [destination-directory]
GNU `cpio' copies files to and from archives

Examples:
  # Copy files named in name-list to the archive
  cpio -o < name-list [> archive]
  # Extract files from the archive
  cpio -i [< archive]
  # Copy files named in name-list to destination-directory
  cpio -p destination-directory < name-list

 Main operation mode:
  -i, --extract              Extract files from an archive (run in copy-in
                             mode)
  -o, --create               Create the archive (run in copy-out mode)
```

```
 -p, --pass-through         Run in copy-pass mode
 -t, --list                 Print a table of contents of the input

Operation modifiers valid in any mode:

     --block-size=BLOCK-SIZE   Set the I/O block size to BLOCK-SIZE * 512
                            bytes
 -B                         Set the I/O block size to 5120 bytes
 -c                         Identical to "-H newc", use the new (SVR4)
                            portable format. If you wish the old portable
                            (ASCII) archive format, use "-H odc" instead.
 -C, --io-size=NUMBER       Set the I/O block size to the given NUMBER of
                            bytes
 -D, --directory=DIR        Change to directory DIR
     --force-local          Archive file is local, even if its name contains
                            colons
 -H, --format=FORMAT        Use given archive FORMAT
     --quiet                Do not print the number of blocks copied
 -R, --owner=[USER][:.][GROUP]   Set the ownership of all files created to the
                            specified USER and/or GROUP
 -v, --verbose              Verbosely list the files processed
 -V, --dot                  Print a "." for each file processed
 -W, --warning=FLAG         Control warning display. Currently FLAG is one of
                            'none', 'truncate', 'all'. Multiple options
                            accumulate.

Operation modifiers valid in copy-in and copy-out modes

 -F, --file=[[USER@]HOST:]FILE-NAME
                            Use this FILE-NAME instead of standard input or
                            output. Optional USER and HOST specify the user
                            and host names in case of a remote archive
 -M, --message=STRING       Print STRING when the end of a volume of the
                            backup media is reached
```

```
      --rsh-command=COMMAND  Use COMMAND instead of rsh

Operation modifiers valid only in copy-in mode:

  -b, --swap                 Swap both halfwords of words and bytes of
                             halfwords in the data. Equivalent to -sS
  -f, --nonmatching          Only copy files that do not match any of the given
                             patterns
  -I [[USER@]HOST:]FILE-NAME Archive filename to use instead of standard input.
                             Optional USER and HOST specify the user and host
                             names in case of a remote archive
  -n, --numeric-uid-gid      In the verbose table of contents listing, show
                             numeric UID and GID
  -r, --rename               Interactively rename files
  -s, --swap-bytes           Swap the bytes of each halfword in the files
  -S, --swap-halfwords       Swap the halfwords of each word (4 bytes) in the
                             files
      --to-stdout            Extract files to standard output

  -E, --pattern-file=FILE    Read additional patterns specifying filenames to
                             extract or list from FILE
      --only-verify-crc      When reading a CRC format archive, only verify the
                             checksum of each file in the archive, don't
                             actually extract the files

Operation modifiers valid only in copy-out mode:

  -A, --append               Append to an existing archive.
      --device-independent, --reproducible
                             Create device-independent (reproducible) archives
      --ignore-devno         Don't store device numbers
  -O [[USER@]HOST:]FILE-NAME Archive filename to use instead of standard
                             output. Optional USER and HOST specify the user
                             and host names in case of a remote archive
```

```
     --renumber-inodes      Renumber inodes

Operation modifiers valid only in copy-pass mode:

 -l, --link                 Link files instead of copying them, when
                            possible

Operation modifiers valid in copy-in and copy-out modes:

     --absolute-filenames   Do not strip file system prefix components from
                            the file names
     --no-absolute-filenames   Create all files relative to the current
                            directory

Operation modifiers valid in copy-out and copy-pass modes:

 -0, --null                 Filenames in the list are delimited by null
                            characters instead of newlines
 -a, --reset-access-time    Reset the access times of files after reading
                            them
 -L, --dereference          Dereference  symbolic  links  (copy  the files
                            that they point to instead of copying the links).

Operation modifiers valid in copy-in and copy-pass modes:

 -d, --make-directories     Create leading directories where needed
 -m, --preserve-modification-time
                            Retain previous file modification times when
                            creating files
     --no-preserve-owner    Do not change the ownership of the files
     --sparse               Write files with large blocks of zeros as sparse
                            files
 -u, --unconditional        Replace all files unconditionally
```

```
  -?, --help                 give this help list
      --usage                give a short usage message
      --version              print program version

Mandatory or optional arguments to long options are also mandatory or optional
for any corresponding short options.

Report bugs to <bug-cpio@gnu.org>.
```

LAB #2 - Working with the cpio Command

Before using cpio, you need to construct a list of files to be included in the archive:

```
[root@centos8 /]# find /test > /tmp/cpio.list
[root@centos8 /]# cat /tmp/cpio.list
/test
/test/repY
/test/repY/Y2
/test/repY/Y3
/test/repY/Y1
/test/repZ
/test/repZ/Z2
/test/repZ/Z1
```

Using both the cpio command and the contents of the above file, an archive can be created using the following command:

```
[root@centos8 /]# cpio -ov < /tmp/cpio.list > /tmp/test.cpio
/test
/test/repY
/test/repY/Y2
/test/repY/Y3
/test/repY/Y1
```

```
/test/repZ
/test/repZ/Z2
/test/repZ/Z1
1 block
```

To consult the archive's **table of contents**, you need to use the following command:

```
[root@centos8 /]# cpio -it < /tmp/test.cpio
/test
/test/repY
/test/repY/Y2
/test/repY/Y3
/test/repY/Y1
/test/repZ
/test/repZ/Z2
/test/repZ/Z1
1 block
```

Now delete the contents of the **/test/repY** directory:

```
[root@centos8 /]# rm -rf /test/repY
```

Check that the files have been deleted with the following command:

```
[root@centos8 /]# ls -lR /test
/test:
total 0
drwxr-xr-x. 2 root root 26 Jun  2 14:05 repZ

/test/repZ:
total 4
-rw-r--r--. 1 root root 21 Jun  2 14:09 Z1
-rw-r--r--. 1 root root  0 Jun  2 14:05 Z2
```

Restore the deleted files with the following command:

```
[root@centos8 /]# cpio -ivdum "/test/repY/*" < /tmp/test.cpio
/test/repY/Y2
/test/repY/Y3
/test/repY/Y1
1 block
```

> **Important** - Note the use of the **"/test/repY/*"** string which searches the test.cpio archive for **repY**, **Y1**, **Y2** and **Y3**.

Using the **ls** command, you can check that the contents of incremental.tar have been restored:

```
[root@centos8 /]# ls -lR /test
/test:
total 0
drwxr-xr-x. 2 root root 36 Jun  2 14:17 repY
drwxr-xr-x. 2 root root 26 Jun  2 14:05 repZ

/test/repY:
total 4
-rw-r--r--. 1 root root 20 Jun  2 14:08 Y1
-rw-r--r--. 1 root root  0 Jun  2 14:05 Y2
-rw-r--r--. 1 root root  0 Jun  2 14:05 Y3

/test/repZ:
total 4
-rw-r--r--. 1 root root 21 Jun  2 14:09 Z1
-rw-r--r--. 1 root root  0 Jun  2 14:05 Z2
```

The dd Command

Presentation

dd stands for **Disk to Disk Copy** and is not considered to be backup command.

dd copies the file presented on Standard Input to the file on Standard Output limiting the number of blocks copied by the use of two options:

- **count**
  - the number of blocks.
- **bs**
  - the size of each block

Command Line Switches

The switches associated with the **dd** command are:

```
[root@centos8 /]# dd --help
Usage: dd [OPERAND]...
  or:  dd OPTION
Copy a file, converting and formatting according to the operands.

  bs=BYTES        read and write up to BYTES bytes at a time (default: 512);
                  overrides ibs and obs
  cbs=BYTES       convert BYTES bytes at a time
  conv=CONVS      convert the file as per the comma separated symbol list
  count=N         copy only N input blocks
  ibs=BYTES       read up to BYTES bytes at a time (default: 512)
  if=FILE         read from FILE instead of stdin
  iflag=FLAGS     read as per the comma separated symbol list
  obs=BYTES       write BYTES bytes at a time (default: 512)
  of=FILE         write to FILE instead of stdout
```

```
  oflag=FLAGS     write as per the comma separated symbol list
  seek=N          skip N obs-sized blocks at start of output
  skip=N          skip N ibs-sized blocks at start of input
  status=LEVEL    The LEVEL of information to print to stderr;
                  'none' suppresses everything but error messages,
                  'noxfer' suppresses the final transfer statistics,
                  'progress' shows periodic transfer statistics

N and BYTES may be followed by the following multiplicative suffixes:
c =1, w =2, b =512, kB =1000, K =1024, MB =1000*1000, M =1024*1024, xM =M,
GB =1000*1000*1000, G =1024*1024*1024, and so on for T, P, E, Z, Y.

Each CONV symbol may be:

  ascii     from EBCDIC to ASCII
  ebcdic    from ASCII to EBCDIC
  ibm       from ASCII to alternate EBCDIC
  block     pad newline-terminated records with spaces to cbs-size
  unblock   replace trailing spaces in cbs-size records with newline
  lcase     change upper case to lower case
  ucase     change lower case to upper case
  sparse    try to seek rather than write the output for NUL input blocks
  swab      swap every pair of input bytes
  sync      pad every input block with NULs to ibs-size; when used
            with block or unblock, pad with spaces rather than NULs
  excl      fail if the output file already exists
  nocreat   do not create the output file
  notrunc   do not truncate the output file
  noerror   continue after read errors
  fdatasync  physically write output file data before finishing
  fsync     likewise, but also write metadata

Each FLAG symbol may be:
```

```
  append    append mode (makes sense only for output; conv=notrunc suggested)
  direct    use direct I/O for data
  directory  fail unless a directory
  dsync     use synchronized I/O for data
  sync      likewise, but also for metadata
  fullblock  accumulate full blocks of input (iflag only)
  nonblock  use non-blocking I/O
  noatime   do not update access time
  nocache   Request to drop cache.  See also oflag=sync
  noctty    do not assign controlling terminal from file
  nofollow  do not follow symlinks
  count_bytes  treat 'count=N' as a byte count (iflag only)
  skip_bytes  treat 'skip=N' as a byte count (iflag only)
  seek_bytes  treat 'seek=N' as a byte count (oflag only)

Sending a USR1 signal to a running 'dd' process makes it
print I/O statistics to standard error and then resume copying.

Options are:

      --help     display this help and exit
      --version  output version information and exit

GNU coreutils online help: <https://www.gnu.org/software/coreutils/>
Full documentation at: <https://www.gnu.org/software/coreutils/dd>
or available locally via: info '(coreutils) dd invocation'
```

LAB #3 - Working with the dd Command

The **dd** command is very useful for backing up the **MBR** (Master Boot Record) and the **FAT** (File Allocation Table).

Use of the following command backs up the MBR to a file called **mbr.save**:

```
[root@centos8 /]# dd if=/dev/sda of=/tmp/mbr.save bs=1 count=446
446+0 records in
446+0 records out
446 bytes copied, 0.00202127 s, 221 kB/s
```

Use of the following command backs up the FAT to a file called **tblpart.save**:

```
[root@centos8 /]# dd if=/dev/sda of=/tmp/tblpart.save bs=1 count=64 skip=446
64+0 records in
64+0 records out
64 bytes copied, 0.000409593 s, 156 kB/s
```

Important - Note the use of the **skip** switch which start the backup at the 447th byte.

The dump et restore Commands

Presentation

dump and **restore** are commands that base their output on the format of the file system being backed up (ext2, ext3, ext4). Due to this fact, only complete file systems can be backed up with the **dump** command and not specific directories within a file system.

The file system must not be in use whilst being dumped. As a result it is advisable to unmount the file system prior to proceeding with a dump.

The **dump** command can manage 10 dump levels ranging from **0** to **9**. Each time the file system is dumped, the dump level is specified and that information together with the dump date and time are saved to the file **/etc/dumpdates**.

By definition a dump **0** is a complete backup of the entire file system whilst dump **1** is an incremental backup.

dump stores all files and directories with relative paths. As a result, to restore a dump using the **restore** command you need to be positioned in the

file system itself.

LAB #4 - System Backups

Backing up the Installed Package List

Start by deleting the RPM database's lock files:

```
[root@centos8 ~]# rm -f /var/lib/rpm/__db*
```

Now backup the RPM database:

```
[root@centos8 ~]# tar czvf $(hostname).rpmdatabase.tar.gz /var/lib/rpm
tar: Removing leading `/' from member names
/var/lib/rpm/
/var/lib/rpm/.dbenv.lock
/var/lib/rpm/Packages
/var/lib/rpm/Conflictname
/var/lib/rpm/Name
/var/lib/rpm/Basenames
/var/lib/rpm/Group
/var/lib/rpm/Requirename
/var/lib/rpm/Providename
/var/lib/rpm/Obsoletename
/var/lib/rpm/Triggername
/var/lib/rpm/Dirnames
/var/lib/rpm/Installtid
/var/lib/rpm/Sigmd5
/var/lib/rpm/Sha1header
/var/lib/rpm/Filetriggername
/var/lib/rpm/Transfiletriggername
/var/lib/rpm/Recommendname
```

```
/var/lib/rpm/Suggestname
/var/lib/rpm/Supplementname
/var/lib/rpm/Enhancename
/var/lib/rpm/.rpm.lock
```

To backup a list of the installed RPM packages, use the following command:

```
[root@centos8 ~]# rpm -qa > package_list_`hostname`_`date +%Y-%m-%d-%H-%M`
```

Consult the contents of the file:

```
[root@centos8 ~]# more liste-des-paquets_centos8.ittraining.loc_2021-06-02-15-04
dracut-squash-049-95.git20200804.el8_3.4.x86_64
gnutls-dane-3.6.14-8.el8_3.x86_64
mtr-0.92-3.el8.x86_64
fontpackages-filesystem-1.44-22.el8.noarch
dhcp-libs-4.3.6-41.el8.x86_64
alsa-lib-1.2.3.2-1.el8.x86_64
geolite2-city-20180605-1.el8.noarch
cockpit-ws-224.2-1.el8.x86_64
python3-dbus-1.2.4-15.el8.x86_64
libvirt-daemon-config-network-6.0.0-28.1.module_el8.3.0+755+88436ea4.x86_64
samba-client-libs-4.12.3-12.el8.3.x86_64
libICE-1.0.9-15.el8.x86_64
bind-license-9.11.20-5.el8_3.1.noarch
dnf-4.2.23-4.el8.noarch
at-spi2-core-2.28.0-1.el8.x86_64
libssh-config-0.9.4-2.el8.noarch
bzip2-libs-1.0.6-26.el8.x86_64
python3-syspurpose-1.27.16-1.el8.x86_64
perl-Unicode-Normalize-1.25-396.el8.x86_64
centos-linux-release-8.3-1.2011.el8.noarch
sssd-krb5-2.3.0-9.el8.x86_64
perl-MIME-Base64-3.15-396.el8.x86_64
```

```
glibc-langpack-en-2.28-127.el8.x86_64
--More--(2%)
```

Important - To complete the process, it is now necessary to backup the **package_list_*** and **$(hostname).rpmdatabase.tar.gz** files on an external filesystem.

To restore the backups, first copy the **package_list_*** and **$(hostname).rpmdatabase.tar.gz** from the external filesystem to the root of the system filesystem:

```
[root@centos8 ~]# cp package_list_centos8.ittraining.loc_2021-06-02-15-04
centos8.ittraining.loc.rpmdatabase.tar.gz /
```

Move to the filesystem's root and restore the database using tar:

```
[root@centos8 ~]# cd /
[root@centos8 /]# tar xvf centos8.ittraining.loc.rpmdatabase.tar.gz
var/lib/rpm/
var/lib/rpm/.dbenv.lock
var/lib/rpm/Packages
var/lib/rpm/Conflictname
var/lib/rpm/Name
var/lib/rpm/Basenames
var/lib/rpm/Group
var/lib/rpm/Requirename
var/lib/rpm/Providename
var/lib/rpm/Obsoletename
var/lib/rpm/Triggername
var/lib/rpm/Dirnames
var/lib/rpm/Installtid
var/lib/rpm/Sigmd5
var/lib/rpm/Sha1header
```

```
var/lib/rpm/Filetriggername
var/lib/rpm/Transfiletriggername
var/lib/rpm/Recommendname
var/lib/rpm/Suggestname
var/lib/rpm/Supplementname
var/lib/rpm/Enhancename
var/lib/rpm/.rpm.loc
```

To restore the packages, use the yum or dnf commands:

```
[root@centos8 /]# yum -y install $(cat package_list_centos8.ittraining.loc_2021-06-02-15-04)
```

Backing up the Disk Structure

```
[root@centos8 /]# cd ~
[root@centos8 ~]# fdisk -l /dev/sda > structure.list
[root@centos8 ~]# cat structure.list
Disk /dev/sda: 20 GiB, 21474836480 bytes, 41943040 sectors
Units: sectors of 1 * 512 = 512 bytes
Sector size (logical/physical): 512 bytes / 512 bytes
I/O size (minimum/optimal): 512 bytes / 512 bytes
Disklabel type: dos
Disk identifier: 0x70b17285

Device     Boot   Start      End  Sectors  Size Id Type
/dev/sda1  *       2048   616447   614400  300M 83 Linux
/dev/sda2        616448  4712447  4096000    2G 82 Linux swap / Solaris
/dev/sda3       4712448 35432447 30720000 14.7G 83 Linux
```

Important - To complete the process, it is now necessary to backup the **structure.list** file on an external filesystem.

Backing up Mount Points

Use the following command:

```
[root@centos8 ~]# df -h | grep "^/dev/" > mounts.list
[root@centos8 ~]# cat mounts.list
/dev/sda3        15G  2.7G   13G  18% /
/dev/sda1       283M  194M   70M  74% /boot
```

> **Important** - To complete the process, it is now necessary to backup the **mounts.list** file on an external filesystem.

Backing up the Boot Loader

GRUB Legacy

```
# cp /boot/grub/menu.lst grubmenu.lst
```

GRUB 2 on BIOS

Use the following two commands:

```
[root@centos8 ~]# cp /boot/grub2/grub.cfg grub.cfg
[root@centos8 ~]# cp /boot/grub2/device.map device.map
```

GRUB 2 on EFI

```
# cp /boot/efi/EFI/redhat/grub.cfg grub.cfg
# cp /boot/grub2/device.map device.map
```

> **Important** - To complete the process, it is now necessary to backup the **menu.lst** or **grub.cfg** and **device.map** files to an external filesystem.

Backing up User Files

```
[root@centos8 ~]# cp -apv /home/ .
'/home/' -> './home'
'/home/trainee' -> './home/trainee'
'/home/trainee/.viminfo' -> './home/trainee/.viminfo'
'/home/trainee/typescript' -> './home/trainee/typescript'
'/home/trainee/bin' -> './home/trainee/bin'
'/home/trainee/bin/myscript' -> './home/trainee/bin/myscript'
'/home/trainee/abc' -> './home/trainee/abc'
'/home/trainee/bca' -> './home/trainee/bca'
'/home/trainee/file2' -> './home/trainee/file2'
'/home/trainee/xyz' -> './home/trainee/xyz'
'/home/trainee/file1' -> './home/trainee/file1'
'/home/trainee/file' -> './home/trainee/file'
'/home/trainee/.bash_logout' -> './home/trainee/.bash_logout'
'/home/trainee/.bash_profile' -> './home/trainee/.bash_profile'
'/home/trainee/.bashrc' -> './home/trainee/.bashrc'
'/home/trainee/.bash_history' -> './home/trainee/.bash_history'
'/home/trainee/tux.jpg' -> './home/trainee/tux.jpg'
'/home/trainee/tux1.jpg' -> './home/trainee/tux1.jpg'
```

```
'/home/trainee/pwd.txt' -> './home/trainee/pwd.txt'
'/home/trainee/errorlog' -> './home/trainee/errorlog'
'/home/trainee/backup.acl' -> './home/trainee/backup.acl'
'/home/trainee/aac' -> './home/trainee/aac'
'/home/trainee/rep1' -> './home/trainee/rep1'
'/home/trainee/rep1/fichier1' -> './home/trainee/rep1/fichier1'
'/home/trainee/rep1/backup.acl' -> './home/trainee/rep1/backup.acl'
'/home/trainee/training' -> './home/trainee/training'
'/home/trainee/training/f1' -> './home/trainee/training/f1'
'/home/trainee/training/f2' -> './home/trainee/training/f2'
'/home/trainee/training/f3' -> './home/trainee/training/f3'
'/home/trainee/training/f4' -> './home/trainee/training/f4'
'/home/trainee/training/f5' -> './home/trainee/training/f5'
'/home/trainee/training/f52' -> './home/trainee/training/f52'
'/home/trainee/training/f62' -> './home/trainee/training/f62'
'/home/trainee/training/a100' -> './home/trainee/training/a100'
'/home/trainee/training/f' -> './home/trainee/training/f'
'/home/trainee/training/f.txt' -> './home/trainee/training/f.txt'
'/home/trainee/training/f123.txt' -> './home/trainee/training/f123.txt'
'/home/trainee/training/f123123.txt' -> './home/trainee/training/f123123.txt'
'/home/trainee/training/f123123123.txt' -> './home/trainee/training/f123123123.txt'
'/home/trainee/training/file' -> './home/trainee/training/file'
'/home/trainee/training/user_check' -> './home/trainee/training/user_check'
'/home/trainee/codes' -> './home/trainee/codes'
'/home/trainee/codes/exit.txt' -> './home/trainee/codes/exit.txt'
'/home/fenestros2' -> './home/fenestros2'
'/home/fenestros2/.bash_logout' -> './home/fenestros2/.bash_logout'
'/home/fenestros2/.bash_history' -> './home/fenestros2/.bash_history'
'/home/fenestros2/.bash_profile' -> './home/fenestros2/.bash_profile'
'/home/fenestros2/.bashrc' -> './home/fenestros2/.bashrc'
'/home/fenestros1' -> './home/fenestros1'
'/home/fenestros1/.bash_logout' -> './home/fenestros1/.bash_logout'
'/home/fenestros1/.bash_profile' -> './home/fenestros1/.bash_profile'
```

```
'/home/fenestros1/.bashrc' -> './home/fenestros1/.bashrc'
```

> **Important** - To complete the process, it is now necessary to backup the **/root/home** directory to an external filesystem.

Rsync

Prrsentation

Rsync or *Remote Sync* is a utility that synchronises files between local or distant directories. It uses an algorythme that reduces the amount of data transfered by only copying the modified parts of files.

LAB #5 - Working with the rsync Command

Create the directories **/test/repA** and **/test/repB**:

```
[root@centos8 ~]# mkdir -p /test/repA; mkdir /test/repB
```

Now create 20 empty files in **/test/repA** :

```
[root@centos8 ~]# touch /test/repA/file{1..20}
[root@centos8 ~]# ls -l /test/repA/
total 0
-rw-r--r--. 1 root root 0 Jun  2 15:49 file1
-rw-r--r--. 1 root root 0 Jun  2 15:49 file10
-rw-r--r--. 1 root root 0 Jun  2 15:49 file11
-rw-r--r--. 1 root root 0 Jun  2 15:49 file12
-rw-r--r--. 1 root root 0 Jun  2 15:49 file13
```

```
-rw-r--r--. 1 root root 0 Jun  2 15:49 file14
-rw-r--r--. 1 root root 0 Jun  2 15:49 file15
-rw-r--r--. 1 root root 0 Jun  2 15:49 file16
-rw-r--r--. 1 root root 0 Jun  2 15:49 file17
-rw-r--r--. 1 root root 0 Jun  2 15:49 file18
-rw-r--r--. 1 root root 0 Jun  2 15:49 file19
-rw-r--r--. 1 root root 0 Jun  2 15:49 file2
-rw-r--r--. 1 root root 0 Jun  2 15:49 file20
-rw-r--r--. 1 root root 0 Jun  2 15:49 file3
-rw-r--r--. 1 root root 0 Jun  2 15:49 file4
-rw-r--r--. 1 root root 0 Jun  2 15:49 file5
-rw-r--r--. 1 root root 0 Jun  2 15:49 file6
-rw-r--r--. 1 root root 0 Jun  2 15:49 file7
-rw-r--r--. 1 root root 0 Jun  2 15:49 file8
-rw-r--r--. 1 root root 0 Jun  2 15:49 file9
```

To synchronise the files from **/test/repA** to **/test/repB**, use the **-r** switch:

```
[root@centos8 ~]# rsync -r /test/repA/ /test/repB
[root@centos8 ~]# ls -l /test/repB/
total 0
-rw-r--r--. 1 root root 0 Jun  2 15:50 file1
-rw-r--r--. 1 root root 0 Jun  2 15:50 file10
-rw-r--r--. 1 root root 0 Jun  2 15:50 file11
-rw-r--r--. 1 root root 0 Jun  2 15:50 file12
-rw-r--r--. 1 root root 0 Jun  2 15:50 file13
-rw-r--r--. 1 root root 0 Jun  2 15:50 file14
-rw-r--r--. 1 root root 0 Jun  2 15:50 file15
-rw-r--r--. 1 root root 0 Jun  2 15:50 file16
-rw-r--r--. 1 root root 0 Jun  2 15:50 file17
-rw-r--r--. 1 root root 0 Jun  2 15:50 file18
-rw-r--r--. 1 root root 0 Jun  2 15:50 file19
-rw-r--r--. 1 root root 0 Jun  2 15:50 file2
-rw-r--r--. 1 root root 0 Jun  2 15:50 file20
```

```
-rw-r--r--. 1 root root 0 Jun  2 15:50 file3
-rw-r--r--. 1 root root 0 Jun  2 15:50 file4
-rw-r--r--. 1 root root 0 Jun  2 15:50 file5
-rw-r--r--. 1 root root 0 Jun  2 15:50 file6
-rw-r--r--. 1 root root 0 Jun  2 15:50 file7
-rw-r--r--. 1 root root 0 Jun  2 15:50 file8
-rw-r--r--. 1 root root 0 Jun  2 15:50 file9
```

Important - Note that the timestamps of the files has not been preserved.

Now delete the files in **/test/repB**:

```
[root@centos8 ~]# rm -rf /test/repB/*
[root@centos8 ~]# ls -l /test/repB/
total 0
```

This time, to synchronise the files from **/test/repA** to **/test/repB**, use the **-a** switch:

```
[root@centos8 ~]# rsync -a /test/repA/ /test/repB
[root@centos8 ~]# ls -l /test/repB/
total 0
-rw-r--r--. 1 root root 0 Jun  2 15:49 file1
-rw-r--r--. 1 root root 0 Jun  2 15:49 file10
-rw-r--r--. 1 root root 0 Jun  2 15:49 file11
-rw-r--r--. 1 root root 0 Jun  2 15:49 file12
-rw-r--r--. 1 root root 0 Jun  2 15:49 file13
-rw-r--r--. 1 root root 0 Jun  2 15:49 file14
-rw-r--r--. 1 root root 0 Jun  2 15:49 file15
-rw-r--r--. 1 root root 0 Jun  2 15:49 file16
-rw-r--r--. 1 root root 0 Jun  2 15:49 file17
-rw-r--r--. 1 root root 0 Jun  2 15:49 file18
```

```
-rw-r--r--. 1 root root 0 Jun  2 15:49 file19
-rw-r--r--. 1 root root 0 Jun  2 15:49 file2
-rw-r--r--. 1 root root 0 Jun  2 15:49 file20
-rw-r--r--. 1 root root 0 Jun  2 15:49 file3
-rw-r--r--. 1 root root 0 Jun  2 15:49 file4
-rw-r--r--. 1 root root 0 Jun  2 15:49 file5
-rw-r--r--. 1 root root 0 Jun  2 15:49 file6
-rw-r--r--. 1 root root 0 Jun  2 15:49 file7
-rw-r--r--. 1 root root 0 Jun  2 15:49 file8
-rw-r--r--. 1 root root 0 Jun  2 15:49 file9
```

Important - Note that the **-a** switch has preserved the original timestamps. This switch also synchronises special files, soft links, file permission, file owners and group information.

Once again, delete the files in **/test/repB**:

```
[root@centos8 ~]# rm -rf /test/repB/*
[root@centos8 ~]# ls -l /test/repB/
total 0
```

Execute the following command and check the result:

```
[root@centos8 ~]# rsync -a /test/repA /test/repB
[root@centos8 ~]# ls -l /test/repB/
total 0
drwxr-xr-x. 2 root root 277 Jun  2 15:49 repA
[root@centos8 ~]# ls -l /test/repB/repA
total 0
-rw-r--r--. 1 root root 0 Jun  2 15:49 file1
-rw-r--r--. 1 root root 0 Jun  2 15:49 file10
```

```
-rw-r--r--. 1 root root 0 Jun  2 15:49 file11
-rw-r--r--. 1 root root 0 Jun  2 15:49 file12
-rw-r--r--. 1 root root 0 Jun  2 15:49 file13
-rw-r--r--. 1 root root 0 Jun  2 15:49 file14
-rw-r--r--. 1 root root 0 Jun  2 15:49 file15
-rw-r--r--. 1 root root 0 Jun  2 15:49 file16
-rw-r--r--. 1 root root 0 Jun  2 15:49 file17
-rw-r--r--. 1 root root 0 Jun  2 15:49 file18
-rw-r--r--. 1 root root 0 Jun  2 15:49 file19
-rw-r--r--. 1 root root 0 Jun  2 15:49 file2
-rw-r--r--. 1 root root 0 Jun  2 15:49 file20
-rw-r--r--. 1 root root 0 Jun  2 15:49 file3
-rw-r--r--. 1 root root 0 Jun  2 15:49 file4
-rw-r--r--. 1 root root 0 Jun  2 15:49 file5
-rw-r--r--. 1 root root 0 Jun  2 15:49 file6
-rw-r--r--. 1 root root 0 Jun  2 15:49 file7
-rw-r--r--. 1 root root 0 Jun  2 15:49 file8
-rw-r--r--. 1 root root 0 Jun  2 15:49 file9
```

Important - Note that in this case the **/** character is missing after **repA** in the **rsync -a /test/repA /test/repB** command. The result is the synchronisation of the **/test/repA** directory to **/test/repB**.

In order to test a synchronisation, rsync allows the use of dry runs by using the **-n** and **-r** switches.

Once again, delete the files in **/test/repB**:

```
[root@centos8 ~]# rm -rf /test/repB/*
[root@centos8 ~]# ls -l /test/repB/
total 0
```

Now execute the following command:

```
[root@centos8 ~]# rsync -anv /test/repA/ /test/repB
sending incremental file list
./
file1
file10
file11
file12
file13
file14
file15
file16
file17
file18
file19
file2
file20
file3
file4
file5
file6
file7
file8
file9

sent 372 bytes  received 79 bytes  902.00 bytes/sec
total size is 0  speedup is 0.00 (DRY RUN)
```

Important - Note that in this case the result is to send the **contents** of **/test/repA** to **/test/repB**.

Now execute the following command:s :

```
[root@centos8 ~]# rsync -anv /test/repA /test/repB
sending incremental file list
repA/
repA/file1
repA/file10
repA/file11
repA/file12
repA/file13
repA/file14
repA/file15
repA/file16
repA/file17
repA/file18
repA/file19
repA/file2
repA/file20
repA/file3
repA/file4
repA/file5
repA/file6
repA/file7
repA/file8
repA/file9

sent 385 bytes  received 80 bytes  930.00 bytes/sec
total size is 0  speedup is 0.00 (DRY RUN)
```

Important - Note that in this case the result is to send the **directory /test/repA** to **/test/repB**.

Command Line Switches

The switches associated with the **rsync** command are:

```
[root@centos8 ~]# rsync --help
rsync  version 3.1.3  protocol version 31
Copyright (C) 1996-2018 by Andrew Tridgell, Wayne Davison, and others.
Web site: http://rsync.samba.org/
Capabilities:
    64-bit files, 64-bit inums, 64-bit timestamps, 64-bit long ints,
    socketpairs, hardlinks, symlinks, IPv6, batchfiles, inplace,
    append, ACLs, xattrs, iconv, symtimes, prealloc

rsync comes with ABSOLUTELY NO WARRANTY.  This is free software, and you
are welcome to redistribute it under certain conditions.  See the GNU
General Public Licence for details.

rsync is a file transfer program capable of efficient remote update
via a fast differencing algorithm.

Usage: rsync [OPTION]... SRC [SRC]... DEST
  or   rsync [OPTION]... SRC [SRC]... [USER@]HOST:DEST
  or   rsync [OPTION]... SRC [SRC]... [USER@]HOST::DEST
  or   rsync [OPTION]... SRC [SRC]... rsync://[USER@]HOST[:PORT]/DEST
  or   rsync [OPTION]... [USER@]HOST:SRC [DEST]
  or   rsync [OPTION]... [USER@]HOST::SRC [DEST]
  or   rsync [OPTION]... rsync://[USER@]HOST[:PORT]/SRC [DEST]
The ':' usages connect via remote shell, while '::' & 'rsync://' usages connect
to an rsync daemon, and require SRC or DEST to start with a module name.

Options
 -v, --verbose               increase verbosity
     --info=FLAGS            fine-grained informational verbosity
```

```
    --debug=FLAGS           fine-grained debug verbosity
    --msgs2stderr           special output handling for debugging
-q, --quiet                 suppress non-error messages
    --no-motd               suppress daemon-mode MOTD (see manpage caveat)
-c, --checksum              skip based on checksum, not mod-time & size
-a, --archive               archive mode; equals -rlptgoD (no -H,-A,-X)
    --no-OPTION             turn off an implied OPTION (e.g. --no-D)
-r, --recursive             recurse into directories
-R, --relative              use relative path names
    --no-implied-dirs       don't send implied dirs with --relative
-b, --backup                make backups (see --suffix & --backup-dir)
    --backup-dir=DIR        make backups into hierarchy based in DIR
    --suffix=SUFFIX         set backup suffix (default ~ w/o --backup-dir)
-u, --update                skip files that are newer on the receiver
    --inplace               update destination files in-place (SEE MAN PAGE)
    --append                append data onto shorter files
    --append-verify         like --append, but with old data in file checksum
-d, --dirs                  transfer directories without recursing
-l, --links                 copy symlinks as symlinks
-L, --copy-links            transform symlink into referent file/dir
    --copy-unsafe-links     only "unsafe" symlinks are transformed
    --safe-links            ignore symlinks that point outside the source tree
    --munge-links           munge symlinks to make them safer (but unusable)
-k, --copy-dirlinks         transform symlink to a dir into referent dir
-K, --keep-dirlinks         treat symlinked dir on receiver as dir
-H, --hard-links            preserve hard links
-p, --perms                 preserve permissions
-E, --executability         preserve the file's executability
    --chmod=CHMOD           affect file and/or directory permissions
-A, --acls                  preserve ACLs (implies --perms)
-X, --xattrs                preserve extended attributes
-o, --owner                 preserve owner (super-user only)
-g, --group                 preserve group
    --devices               preserve device files (super-user only)
```

```
    --copy-devices          copy device contents as regular file
    --specials              preserve special files
-D                          same as --devices --specials
-t, --times                 preserve modification times
-O, --omit-dir-times        omit directories from --times
-J, --omit-link-times       omit symlinks from --times
    --super                 receiver attempts super-user activities
    --fake-super            store/recover privileged attrs using xattrs
-S, --sparse                turn sequences of nulls into sparse blocks
    --preallocate           allocate dest files before writing them
-n, --dry-run               perform a trial run with no changes made
-W, --whole-file            copy files whole (without delta-xfer algorithm)
    --checksum-choice=STR   choose the checksum algorithms
-x, --one-file-system       don't cross filesystem boundaries
-B, --block-size=SIZE       force a fixed checksum block-size
-e, --rsh=COMMAND           specify the remote shell to use
    --rsync-path=PROGRAM    specify the rsync to run on the remote machine
    --existing              skip creating new files on receiver
    --ignore-existing       skip updating files that already exist on receiver
    --remove-source-files   sender removes synchronized files (non-dirs)
    --del                   an alias for --delete-during
    --delete                delete extraneous files from destination dirs
    --delete-before         receiver deletes before transfer, not during
    --delete-during         receiver deletes during the transfer
    --delete-delay          find deletions during, delete after
    --delete-after          receiver deletes after transfer, not during
    --delete-excluded       also delete excluded files from destination dirs
    --ignore-missing-args   ignore missing source args without error
    --delete-missing-args   delete missing source args from destination
    --ignore-errors         delete even if there are I/O errors
    --force                 force deletion of directories even if not empty
    --max-delete=NUM        don't delete more than NUM files
    --max-size=SIZE         don't transfer any file larger than SIZE
    --min-size=SIZE         don't transfer any file smaller than SIZE
```

```
    --partial               keep partially transferred files
    --partial-dir=DIR       put a partially transferred file into DIR
    --delay-updates         put all updated files into place at transfer's end
-m, --prune-empty-dirs      prune empty directory chains from the file-list
    --numeric-ids           don't map uid/gid values by user/group name
    --usermap=STRING        custom username mapping
    --groupmap=STRING       custom groupname mapping
    --chown=USER:GROUP      simple username/groupname mapping
    --timeout=SECONDS       set I/O timeout in seconds
    --contimeout=SECONDS    set daemon connection timeout in seconds
-I, --ignore-times          don't skip files that match in size and mod-time
-M, --remote-option=OPTION  send OPTION to the remote side only
    --size-only             skip files that match in size
-@, --modify-window=NUM     set the accuracy for mod-time comparisons
-T, --temp-dir=DIR          create temporary files in directory DIR
-y, --fuzzy                 find similar file for basis if no dest file
    --compare-dest=DIR      also compare destination files relative to DIR
    --copy-dest=DIR         ... and include copies of unchanged files
    --link-dest=DIR         hardlink to files in DIR when unchanged
-z, --compress              compress file data during the transfer
    --compress-level=NUM    explicitly set compression level
    --skip-compress=LIST    skip compressing files with a suffix in LIST
-C, --cvs-exclude           auto-ignore files the same way CVS does
-f, --filter=RULE           add a file-filtering RULE
-F                          same as --filter='dir-merge /.rsync-filter'
                            repeated: --filter='- .rsync-filter'
    --exclude=PATTERN       exclude files matching PATTERN
    --exclude-from=FILE     read exclude patterns from FILE
    --include=PATTERN       don't exclude files matching PATTERN
    --include-from=FILE     read include patterns from FILE
    --files-from=FILE       read list of source-file names from FILE
-0, --from0                 all *-from/filter files are delimited by 0s
-s, --protect-args          no space-splitting; only wildcard special-chars
    --address=ADDRESS       bind address for outgoing socket to daemon
```

```
     --port=PORT             specify double-colon alternate port number
     --sockopts=OPTIONS      specify custom TCP options
     --blocking-io           use blocking I/O for the remote shell
     --stats                 give some file-transfer stats
 -8, --8-bit-output          leave high-bit chars unescaped in output
 -h, --human-readable        output numbers in a human-readable format
     --progress              show progress during transfer
 -P                          same as --partial --progress
 -i, --itemize-changes       output a change-summary for all updates
     --out-format=FORMAT     output updates using the specified FORMAT
     --log-file=FILE         log what we're doing to the specified FILE
     --log-file-format=FMT   log updates using the specified FMT
     --password-file=FILE    read daemon-access password from FILE
     --list-only             list the files instead of copying them
     --bwlimit=RATE          limit socket I/O bandwidth
     --outbuf=N|L|B          set output buffering to None, Line, or Block
     --write-batch=FILE      write a batched update to FILE
     --only-write-batch=FILE like --write-batch but w/o updating destination
     --read-batch=FILE       read a batched update from FILE
     --protocol=NUM          force an older protocol version to be used
     --iconv=CONVERT_SPEC    request charset conversion of filenames
     --checksum-seed=NUM     set block/file checksum seed (advanced)
 -4, --ipv4                  prefer IPv4
 -6, --ipv6                  prefer IPv6
     --version               print version number
(-h) --help                  show this help (-h is --help only if used alone)

Use "rsync --daemon --help" to see the daemon-mode command-line options.
Please see the rsync(1) and rsyncd.conf(5) man pages for full documentation.
See http://rsync.samba.org/ for updates, bug reports, and answers
```

Compression

The gzip Command

Presentation

The **gzip** command is a compression utility found in most GNU/Linux distributions whereas the **gunzip** command is a decompression utility.

Command Line Switches

The switches associated with the **gzip** command are:

```
[root@centos8 /]# gzip --help
Usage: gzip [OPTION]... [FILE]...
Compress or uncompress FILEs (by default, compress FILES in-place).

Mandatory arguments to long options are mandatory for short options too.

  -c, --stdout      write on standard output, keep original files unchanged
  -d, --decompress  decompress
  -f, --force       force overwrite of output file and compress links
  -h, --help        give this help
  -k, --keep        keep (don't delete) input files
  -l, --list        list compressed file contents
  -L, --license     display software license
  -n, --no-name     do not save or restore the original name and timestamp
  -N, --name        save or restore the original name and timestamp
  -q, --quiet       suppress all warnings
  -r, --recursive   operate recursively on directories
      --rsyncable   make rsync-friendly archive
```

```
  -S, --suffix=SUF  use suffix SUF on compressed files
      --synchronous synchronous output (safer if system crashes, but slower)
  -t, --test        test compressed file integrity
  -v, --verbose     verbose mode
  -V, --version     display version number
  -1, --fast        compress faster
  -9, --best        compress better

With no FILE, or when FILE is -, read standard input.

Report bugs to <bug-gzip@gnu.org>.
```

The switches associated with the **gunzip** command are:

```
[root@centos8 /]# gunzip --help
Usage: /usr/bin/gunzip [OPTION]... [FILE]...
Uncompress FILEs (by default, in-place).

Mandatory arguments to long options are mandatory for short options too.

  -c, --stdout      write on standard output, keep original files unchanged
  -f, --force       force overwrite of output file and compress links
  -k, --keep        keep (don't delete) input files
  -l, --list        list compressed file contents
  -n, --no-name     do not save or restore the original name and timestamp
  -N, --name        save or restore the original name and timestamp
  -q, --quiet       suppress all warnings
  -r, --recursive   operate recursively on directories
  -S, --suffix=SUF  use suffix SUF on compressed files
      --synchronous synchronous output (safer if system crashes, but slower)
  -t, --test        test compressed file integrity
  -v, --verbose     verbose mode
      --help        display this help and exit
      --version     display version information and exit
```

```
With no FILE, or when FILE is -, read standard input.

Report bugs to <bug-gzip@gnu.org>.
```

LAB #6 - Working with the gzip Command

Start by using the **gzip** command to compress the **/tmp/test.tar** file:

```
[root@centos8 /]# gzip /tmp/test.tar
```

Check the size of the resulting **test.tar.gz** file:

```
[root@centos8 /]# ls -l /tmp/test.tar.gz
-rw-r--r--. 1 root root 218 Jun  2 14:07 /tmp/test.tar.gz
```

> **Important** - Note that, by default, the compressed file has been created in the cwd and that the source file has been removed.

Before proceeding further, decompress the **test.tar.gz** file:

```
[root@centos8 /]# gunzip /tmp/test.tar.gz
```

The bzip2 Command

Presentation

The **bzip2** command is a compression utility also found in most GNU/Linux distributions whereas the **bunzip2** command is a decompression utility.

Command Line Switches

The switches associated with the **bzip2** command are:

```
[root@centos8 /]# bzip2 --help
bzip2, a block-sorting file compressor.  Version 1.0.6, 6-Sept-2010.

   usage: bzip2 [flags and input files in any order]

   -h --help           print this message
   -d --decompress     force decompression
   -z --compress       force compression
   -k --keep           keep (don't delete) input files
   -f --force          overwrite existing output files
   -t --test           test compressed file integrity
   -c --stdout         output to standard out
   -q --quiet          suppress noncritical error messages
   -v --verbose        be verbose (a 2nd -v gives more)
   -L --license        display software version & license
   -V --version        display software version & license
   -s --small          use less memory (at most 2500k)
   -1 .. -9            set block size to 100k .. 900k
   --fast              alias for -1
   --best              alias for -9

   If invoked as `bzip2', default action is to compress.
              as `bunzip2',  default action is to decompress.
              as `bzcat', default action is to decompress to stdout.

   If no file names are given, bzip2 compresses or decompresses
   from standard input to standard output.  You can combine
   short flags, so `-v -4' means the same as -v4 or -4v, &c.
```

The switches associated with the **bunzip2** command are:

```
[root@centos8 /]# bunzip2 --help
bzip2, a block-sorting file compressor.  Version 1.0.6, 6-Sept-2010.

   usage: bunzip2 [flags and input files in any order]

   -h --help           print this message
   -d --decompress     force decompression
   -z --compress       force compression
   -k --keep           keep (don't delete) input files
   -f --force          overwrite existing output files
   -t --test           test compressed file integrity
   -c --stdout         output to standard out
   -q --quiet          suppress noncritical error messages
   -v --verbose        be verbose (a 2nd -v gives more)
   -L --license        display software version & license
   -V --version        display software version & license
   -s --small          use less memory (at most 2500k)
   -1 .. -9            set block size to 100k .. 900k
   --fast              alias for -1
   --best              alias for -9

   If invoked as `bzip2', default action is to compress.
              as `bunzip2',  default action is to decompress.
              as `bzcat', default action is to decompress to stdout.

   If no file names are given, bzip2 compresses or decompresses
   from standard input to standard output.  You can combine
   short flags, so `-v -4' means the same as -v4 or -4v, &c.
```

LAB #7 - Working with the bzip2 Command

Start by using the **bzip2** command to compress the **/tmp/test.tar** file:

```
[root@centos8 /]# bzip2 /tmp/test.tar
```

Check the size of the resulting **test.tar.bz2** file:

```
[root@centos8 /]# ls -l /tmp | grep test.tar.bz
-rw-r--r--. 1 root root    206 Jun  2 14:07 test.tar.bz2
```

> **Important** - Note that, by default, the compressed file has been created in the cwd and that the source file has been removed. Note also that the compression ration is slightly better than that obtained when using gzip.

Before proceeding further, decompress the **test.tar.bz2** file:

```
[root@centos8 /]# bunzip2 /tmp/test.tar.bz2
```

The xz Command

Presentation

The **xz** command is yet another compression utility found in most GNU/Linux distributions:

- **xz –decompress** which is equivalent to **unxz**,
- **xz –decompress –stdout** which is equivalent to **xzcat**,
- **xz –format=lzma** which is equivalent to **lzma**,

- **xz –format=lzma –decompress** which is equivalent to **unlzma**,
- **xz –format=lzma –decompress –stdout** which is equivalent to **lzcat**.

The xz Command will not compress a file if:

- the file is not of a standard type,
- the file is a soft link,
- the file is a hard link,
- the file has a sticky bit a SUID bit or a SGID bit placed upon it,
- the file extension is .xz or .lzma.

The xz Command will not decompress a file if:

- the file does not possess a .xz or .lzma extension.

Command Line Switches

The switches associated with the **xz** command are:

```
[root@centos8 /]# xz --help
Usage: xz [OPTION]... [FILE]...
Compress or decompress FILEs in the .xz format.

  -z, --compress      force compression
  -d, --decompress    force decompression
  -t, --test          test compressed file integrity
  -l, --list          list information about .xz files
  -k, --keep          keep (don't delete) input files
  -f, --force         force overwrite of output file and (de)compress links
  -c, --stdout        write to standard output and don't delete input files
  -0 ... -9           compression preset; default is 6; take compressor *and*
                      decompressor memory usage into account before using 7-9!
  -e, --extreme       try to improve compression ratio by using more CPU time;
```

```
                      does not affect decompressor memory requirements
  -T, --threads=NUM   use at most NUM threads; the default is 1; set to 0
                      to use as many threads as there are processor cores
  -q, --quiet         suppress warnings; specify twice to suppress errors too
  -v, --verbose       be verbose; specify twice for even more verbose
  -h, --help          display this short help and exit
  -H, --long-help     display the long help (lists also the advanced options)
  -V, --version       display the version number and exit

With no FILE, or when FILE is -, read standard input.

Report bugs to <lasse.collin@tukaani.org> (in English or Finnish).
XZ Utils home page: <https://tukaani.org/xz/>
```

LAB #8 - Working with the xz Command

Start by using the **xz** command to compress the **/tmp/test.tar** file:

```
[root@centos8 /]# xz /tmp/test.tar
```

Important - Note it is not necessary to stipulate the **-z** switch.

Check the size of the resulting **test.tar.xz** file:

```
[root@centos8 /]# ls -l /tmp | grep test.tar.xz
-rw-r--r--. 1 root root    228 Jun  2 14:07 test.tar.xz
```

Important - Note that, by default, the compressed file has been created in the cwd and

that the source file has been removed. The source file can be retained by using the **–keep** switch.

Before proceeding further, decompress the **test.tar.xz** file:

```
[root@centos8 /]# xz -d /tmp/test.tar.xz
[root@centos8 /]# ls -l /tmp | grep test
-rw-r--r--. 1 root root    512 Jun  2 14:15 test.cpio
-rw-r--r--. 1 root root  10240 Jun  2 14:07 test.tar
```

Other Compression Utilities

Linux can also use other compression utilities, each one producing a file with a specific file extension. For example:

Utility	Extension	Compression Command	Decompression Command
compress	.Z	compress	uncompress
rar	.rar	rar	unrar
zip	.zip	zip	unzip
