Bacula Console and Operators Guide

It comes in the night and sucks the essence from your computers.

Kern Sibbald

July 19, 2009
This manual documents Bacula version 3.0.2 (18 July 2009)

Contents

Chapter 1

Bacula Console

The **Bacula Console** (sometimes called the User Agent) is a program that allows the user or the System Administrator, to interact with the Bacula Director daemon while the daemon is running.

The current Bacula Console comes in two versions: a shell interface (TTY style), and a GNOME GUI interface. Both permit the administrator or authorized users to interact with Bacula. You can determine the status of a particular job, examine the contents of the Catalog as well as perform certain tape manipulations with the Console program.

In addition, there is a bwx-console built with wxWidgets that allows a graphic restore of files. As of version 1.34.1 it is in an early stage of development, but it already is quite useful. Unfortunately, it has not been enhanced for some time now.

Since the Console program interacts with the Director through the network, your Console and Director programs do not necessarily need to run on the same machine.

In fact, a certain minimal knowledge of the Console program is needed in order for Bacula to be able to write on more than one tape, because when Bacula requests a new tape, it waits until the user, via the Console program, indicates that the new tape is mounted.

1.1 Console Configuration

When the Console starts, it reads a standard Bacula configuration file named **bconsole.conf** or **bgnome-console.conf** in the case of the GNOME Console version from the current directory unless you specify the **-c** command line option (see below). This file allows default configuration of the Console, and at the current time, the only Resource Record defined is the Director resource, which gives the Console the name and address of the Director. For more information on configuration of the Console program, please see the Console Configuration File Chapter of this document.

1.2 Running the Console Program

The console program can be run with the following options:

```
Usage: bconsole [-s] [-c config_file] [-d debug_level]
       -c <file>   set configuration file to file
       -dnn        set debug level to nn
       -n          no conio
       -s          no signals
       -t          test - read configuration and exit
       -?          print this message.
```

After launching the Console program (bconsole), it will prompt you for the next command with an asterisk (*). (Note, in the GNOME version, the prompt is not present; you simply enter the commands you want in the command text box at the bottom of the screen.) Generally, for all commands, you can simply enter the command name and the Console program will prompt you for the necessary arguments. Alternatively, in most cases, you may enter the command followed by arguments. The general format is:

```
<command> <keyword1>[=<argument1>] <keyword2>[=<argument2>] ...
```

where **command** is one of the commands listed below; **keyword** is one of the keywords listed below (usually followed by an argument); and **argument** is the value. The command may be abbreviated to the shortest unique form. If two commands have the same starting letters, the one that will be selected is the one that appears first in the **help** listing. If you want the second command, simply spell out the full command. None of the keywords following the command may be abbreviated.

For example:

```
list files jobid=23
```

will list all files saved for JobId 23. Or:

```
show pools
```

will display all the Pool resource records.

The maximum command line length is limited to 511 characters, so if you are scripting the console, you may need to take some care to limit the line length.

1.3 Stopping the Console Program

Normally, you simply enter **quit** or **exit** and the Console program will terminate. However, it waits until the Director acknowledges the command. If the Director is already doing a lengthy command (e.g. prune), it may take some time. If you want to immediately terminate the Console program, enter the **.quit** command.

There is currently no way to interrupt a Console command once issued (i.e. Ctrl-C does not work). However, if you are at a prompt that is asking you to select one of several possibilities and you would like to abort the command, you can enter a period (**.**), and in most cases, you will either be returned to the main command prompt or if appropriate the previous prompt (in the case of nested prompts). In a few places such as where it is asking for a Volume name, the period will be taken to be the Volume name. In that case, you will most likely be able to cancel at the next prompt.

1.4 Alphabetic List of Console Keywords

Unless otherwise specified, each of the following keywords takes an argument, which is specified after the keyword following an equal sign. For example:

```
jobid=536
```

Please note, this list is incomplete as it is currently in the process of being created and is not currently totally in alphabetic order ...

restart Permitted on the python command, and causes the Python interpreter to be restarted. Takes no argument.

all Permitted on the status and show commands to specify all components or resources respectively.

allfrompool Permitted on the update command to specify that all Volumes in the pool (specified on the command line) should be updated.

allfrompools Permitted on the update command to specify that all Volumes in all pools should be updated.

before Used in the restore command.

bootstrap Used in the restore command.

catalog Allowed in the use command to specify the catalog name to be used.

catalogs Used in the show command. Takes no arguments.

client — fd

clients Used in the show, list, and llist commands. Takes no arguments.

counters Used in the show command. Takes no arguments.

current Used in the restore command. Takes no argument.

days Used to define the number of days the "list nextvol" command should consider when looking for jobs to be run. The days keyword can also be used on the "status dir" command so that it will display jobs scheduled for the number of days you want.

devices Used in the show command. Takes no arguments.

dir — director

directors Used in the show command. Takes no arguments.

directory Used in the restore command. Its argument specifies the directory to be restored.

enabled This keyword can appear on the **update volume** as well as the **update slots** commands, and can allows one of the following arguments: yes, true, no, false, archived, 0, 1, 2. Where 0 corresponds to no or false, 1 corresponds to yes or true, and 2 corresponds to archived. Archived volumes will not be used, nor will the Media record in the catalog be pruned. Volumes that are not enabled, will not be used for backup or restore.

done Used in the restore command. Takes no argument.

file Used in the restore command.

files Used in the list and llist commands. Takes no arguments.

fileset

filesets Used in the show command. Takes no arguments.

help Used in the show command. Takes no arguments.

jobs Used in the show, list and llist commands. Takes no arguments.

jobmedia Used in the list and llist commands. Takes no arguments.

jobtotals Used in the list and llist commands. Takes no arguments.

jobid The JobId is the numeric jobid that is printed in the Job Report output. It is the index of the database record for the given job. While it is unique for all the existing Job records in the catalog database, the same JobId can be reused once a Job is removed from the catalog. Probably you will refer specific Jobs that ran using their numeric JobId.

job — jobname The Job or Jobname keyword refers to the name you specified in the Job resource, and hence it refers to any number of Jobs that ran. It is typically useful if you want to list all jobs of a particular name.

level

listing Permitted on the estimate command. Takes no argument.

limit

messages Used in the show command. Takes no arguments.

media Used in the list and llist commands. Takes no arguments.

nextvol — nextvolume Used in the list and llist commands. Takes no arguments.

on Takes no keyword.

off Takes no keyword.

pool

pools Used in the show, list, and llist commands. Takes no arguments.

select Used in the restore command. Takes no argument.

storages Used in the show command. Takes no arguments.

schedules Used in the show command. Takes no arguments.

sd — store — storage

ujobid The ujobid is a unique job identification that is printed in the Job Report output. At the current time, it consists of the Job name (from the Name directive for the job) appended with the date and time the job was run. This keyword is useful if you want to completely identify the Job instance run.

volume

volumes Used in the list and llist commands. Takes no arguments.

where Used in the restore command.

yes Used in the restore command. Takes no argument.

1.5 Alphabetic List of Console Commands

The following commands are currently implemented:

add [pool=<pool-name> storage=<storage> jobid=<JobId>] This command is used to add Volumes to an existing Pool. That is, it creates the Volume name in the catalog and inserts into the Pool in the catalog, but does not attempt to access the physical Volume. Once added, Bacula expects that Volume to exist and to be labeled. This command is not normally used since Bacula will automatically do the equivalent when Volumes are labeled. However, there may be times when you have removed a Volume from the catalog and want to later add it back.

Normally, the **label** command is used rather than this command because the **label** command labels the physical media (tape, disk, DVD, ...) and does the equivalent of the **add** command. The **add** command affects only the Catalog and not the physical media (data on Volumes). The physical media must exist and be labeled before use (usually with the **label** command). This command can, however, be useful if you wish to add a number of Volumes to the Pool that will be physically labeled at a later time. It can also be useful if you are importing a tape from another site. Please see the **label** command below for the list of legal characters in a Volume name.

autodisplay on/off This command accepts **on** or **off** as an argument, and turns auto-display of messages on or off respectively. The default for the console program is **off**, which means that you will be notified when there are console messages pending, but they will not automatically be displayed. The default for the bgnome-console program is **on**, which means that messages will be displayed when they are received (usually within five seconds of them being generated).

When autodisplay is turned off, you must explicitly retrieve the messages with the **messages** command. When autodisplay is turned on, the messages will be displayed on the console as they are received.

automount on/off This command accepts **on** or **off** as the argument, and turns auto-mounting of the Volume after a **label** command on or off respectively. The default is **on**. If **automount** is turned off, you must explicitly **mount** tape Volumes after a label command to use it.

cancel [jobid=<number> job=<job-name> ujobid=<unique-jobid>] This command is used to cancel a job and accepts **jobid=nnn** or **job=xxx** as an argument where nnn is replaced by the JobId and xxx is replaced by the job name. If you do not specify a keyword, the Console program will prompt you with the names of all the active jobs allowing you to choose one.

Once a Job is marked to be canceled, it may take a bit of time (generally within a minute but up to two hours) before the Job actually terminates, depending on what operations it is doing. Don't be surprised that you receive a Job not found message. That just means that one of the three daemons had already canceled the job. Messages numbered in the 1000's are from the Director, 2000's are from the File daemon and 3000's from the Storage daemon.

create [pool=<pool-name>] This command is not normally used as the Pool records are automatically created by the Director when it starts based on what it finds in the conf file. If needed, this command can be to create a Pool record in the database using the Pool resource record defined in the Director's configuration file. So in a sense, this command simply transfers the information from the Pool resource in the configuration file into the Catalog. Normally this command is done automatically for you when the Director starts providing the Pool is referenced within a Job resource. If you use this command on an existing Pool, it will automatically update the Catalog to have the same information as the Pool resource. After creating a Pool, you will most likely use the **label** command to label one or more volumes and add their names to the Media database.

When starting a Job, if Bacula determines that there is no Pool record in the database, but there is a Pool resource of the appropriate name, it will create it for you. If you want the Pool record to appear in the database immediately, simply use this command to force it to be created.

delete [volume=<vol-name> pool=<pool-name> job jobid=<id>] The delete command is used to delete a Volume, Pool or Job record from the Catalog as well as all associated catalog Volume records that were created. This command operates only on the Catalog database and has no effect on the actual data written to a Volume. This command can be dangerous and we strongly recommend that you do not use it unless you know what you are doing.

If the keyword **Volume** appears on the command line, the named Volume will be deleted from the catalog, if the keyword **Pool** appears on the command line, a Pool will be deleted, and if the keyword **Job** appears on the command line, a Job and all its associated records (File and JobMedia) will be deleted from the catalog. The full form of this command is:

```
delete pool=<pool-name>
```

or

```
delete volume=<volume-name> pool=<pool-name>  or

delete JobId=<job-id> JobId=<job-id2> ...  or

delete Job JobId=n,m,o-r,t ...
```

The first form deletes a Pool record from the catalog database. The second form deletes a Volume record from the specified pool in the catalog database. The third form deletes the specified Job record from the catalog database. The last form deletes JobId records for JobIds n, m, o, p, q, r, and t. Where each one of the n,m,... is, of course, a number. That is a "delete jobid" accepts lists and ranges of jobids.

disable job<job-name> This command permits you to disable a Job for automatic scheduling. The job may have been previously enabled with the Job resource **Enabled** directive or using the console **enable** command. The next time the Director is restarted or the conf file is reloaded, the Enable/Disable state will be set to the value in the Job resource (default enabled) as defined in the bacula-dir.conf file.

enable job<job-name> This command permits you to enable a Job for automatic scheduling. The job may have been previously disabled with the Job resource **Enabled** directive or using the console **disable** command. The next time the Director is restarted or the conf file is reloaded, the Enable/Disable state will be set to the value in the Job resource (default enabled) as defined in the bacula-dir.conf file.

estimate Using this command, you can get an idea how many files will be backed up, or if you are unsure about your Include statements in your FileSet, you can test them without doing an actual backup. The default is to assume a Full backup. However, you can override this by specifying a **level=Incremental** or **level=Differential** on the command line. A Job name must be specified or you will be prompted for one, and optionally a Client and FileSet may be specified on the command line. It then contacts the client which computes the number of files and bytes that would be backed up. Please note that this is an estimate calculated from the number of blocks in the file rather than by reading the actual bytes. As such, the estimated backup size will generally be larger than an actual backup.

The `estimate` command can use the accurate code to detect changes and give a better estimation. You can set the accurate behavior on command line using `accurate=yes/no` or use the Job setting as default value.

Optionally you may specify the keyword **listing** in which case, all the files to be backed up will be listed. Note, it could take quite some time to display them if the backup is large. The full form is:

```
estimate job=<job-name> listing client=<client-name> accurate=<yes/no>
       fileset=<fileset-name> level=<level-name>
```

Specification of the **job** is sufficient, but you can also override the client, fileset, accurate and/or level by specifying them on the estimate command line.

As an example, you might do:

```
@output /tmp/listing
estimate job=NightlySave listing level=Incremental
@output
```

which will do a full listing of all files to be backed up for the Job **NightlySave** during an Incremental save and put it in the file **/tmp/listing**. Note, the byte estimate provided by this command is based on the file size contained in the directory item. This can give wildly incorrect estimates of the actual storage used if there are sparse files on your systems. Sparse files are often found on 64 bit systems for certain system files. The size that is returned is the size Bacula will backup if the sparse option is not specified in the FileSet. There is currently no way to get an estimate of the real file size that would be found should the sparse option be enabled.

exit This command terminates the console program.

gui Invoke the non-interactive gui mode.

```
gui [on|off]
```

help This command displays the list of commands available.

label This command is used to label physical volumes. The full form of this command is:

```
label storage=<storage-name> volume=<volume-name>
      slot=<slot>
```

If you leave out any part, you will be prompted for it. The media type is automatically taken from the Storage resource definition that you supply. Once the necessary information is obtained, the Console program contacts the specified Storage daemon and requests that the Volume be labeled. If the Volume labeling is successful, the Console program will create a Volume record in the appropriate Pool.

The Volume name is restricted to letters, numbers, and the special characters hyphen (**-**), underscore (_), colon (**:**), and period (**.**). All other characters including a space are invalid. This restriction is to ensure good readability of Volume names to reduce operator errors.

Please note, when labeling a blank tape, Bacula will get **read I/O error** when it attempts to ensure that the tape is not already labeled. If you wish to avoid getting these messages, please write an EOF mark on your tape before attempting to label it:

```
mt rewind
mt weof
```

The label command can fail for a number of reasons:

1. The Volume name you specify is already in the Volume database.
2. The Storage daemon has a tape or other Volume already mounted on the device, in which case you must **unmount** the device, insert a blank tape, then do the **label** command.
3. The Volume in the device is already a Bacula labeled Volume. (Bacula will never relabel a Bacula labeled Volume unless it is recycled and you use the **relabel** command).
4. There is no Volume in the drive.

There are two ways to relabel a volume that already has a Bacula label. The brute force method is to write an end of file mark on the tape using the system **mt** program, something like the following:

```
mt -f /dev/st0 rewind
mt -f /dev/st0 weof
```

For a disk volume, you would manually delete the Volume.

Then you use the **label** command to add a new label. However, this could leave traces of the old volume in the catalog.

The preferable method to relabel a Volume is to first **purge** the volume, either automatically, or explicitly with the **purge** command, then use the **relabel** command described below.

If your autochanger has barcode labels, you can label all the Volumes in your autochanger one after another by using the **label barcodes** command. For each tape in the changer containing a barcode, Bacula will mount the tape and then label it with the same name as the barcode. An appropriate Media record will also be created in the catalog. Any barcode that begins with the same characters as specified on the "CleaningPrefix=xxx" directive in the Director's Pool resource, will be treated as a cleaning tape, and will not be labeled. However, an entry for the cleaning tape will be created in the catalog. For example with:

```
Pool {
  Name ...
  Cleaning Prefix = "CLN"
}
```

Any slot containing a barcode of CLNxxxx will be treated as a cleaning tape and will not be mounted. Note, the full form of the command is:

```
label storage=xxx pool=yyy slots=1-5,10 barcodes
```

list The list command lists the requested contents of the Catalog. The various fields of each record are listed on a single line. The various forms of the list command are:

```
list jobs

list jobid=<id>           (list jobid id)

list ujobid=<unique job name> (list job with unique name)

list job=<job-name>   (list all jobs with "job-name")

list jobname=<job-name>  (same as above)

    In the above, you can add "limit=nn" to limit the output to
    nn jobs.

list jobmedia

list jobmedia jobid=<id>

list jobmedia job=<job-name>

list files jobid=<id>

list files job=<job-name>
```

```
list pools

list clients

list jobtotals

list volumes

list volumes jobid=<id>

list volumes pool=<pool-name>

list volumes job=<job-name>

list volume=<volume-name>

list nextvolume job=<job-name>

list nextvol job=<job-name>

list nextvol job=<job-name> days=nnn
```

What most of the above commands do should be more or less obvious. In general if you do not specify all the command line arguments, the command will prompt you for what is needed.

The **list nextvol** command will print the Volume name to be used by the specified job. You should be aware that exactly what Volume will be used depends on a lot of factors including the time and what a prior job will do. It may fill a tape that is not full when you issue this command. As a consequence, this command will give you a good estimate of what Volume will be used but not a definitive answer. In addition, this command may have certain side effect because it runs through the same algorithm as a job, which means it may automatically purge or recycle a Volume. By default, the job specified must run within the next two days or no volume will be found. You can, however, use the **days=nnn** specification to specify up to 50 days. For example, if on Friday, you want to see what Volume will be needed on Monday, for job MyJob, you would use **list nextvol job=MyJob days=3**.

If you wish to add specialized commands that list the contents of the catalog, you can do so by adding them to the **query.sql** file. However, this takes some knowledge of programming SQL. Please see the **query** command below for additional information. See below for listing the full contents of a catalog record with the **llist** command.

As an example, the command **list pools** might produce the following output:

```
+------+---------+---------+---------+----------+-------------+
| PoId | Name    | NumVols | MaxVols | PoolType | LabelFormat |
+------+---------+---------+---------+----------+-------------+
|    1 | Default |       0 |       0 | Backup   | *           |
|    2 | Recycle |       0 |       8 | Backup   | File        |
+------+---------+---------+---------+----------+-------------+
```

As mentioned above, the **list** command lists what is in the database. Some things are put into the database immediately when Bacula starts up, but in general, most things are put in only when they are first used, which is the case for a Client as with Job records, etc.

Bacula should create a client record in the database the first time you run a job for that client. Doing a **status** will not cause a database record to be created. The client database record will be created whether or not the job fails, but it must at least start. When the Client is actually contacted, additional info from the client will be added to the client record (a "uname -a" output).

If you want to see what Client resources you have available in your conf file, you use the Console command **show clients**.

llist The llist or "long list" command takes all the same arguments that the list command described above does. The difference is that the llist command list the full contents of each database record selected. It does so by listing the various fields of the record vertically, with one field per line. It is possible to produce a very large number of output lines with this command.

If instead of the **list pools** as in the example above, you enter **llist pools** you might get the following output:

```
          PoolId: 1
            Name: Default
         NumVols: 0
         MaxVols: 0
         UseOnce: 0
      UseCatalog: 1
  AcceptAnyVolume: 1
     VolRetention: 1,296,000
  VolUseDuration: 86,400
      MaxVolJobs: 0
     MaxVolBytes: 0
       AutoPrune: 0
         Recycle: 1
        PoolType: Backup
     LabelFormat: *

          PoolId: 2
            Name: Recycle
         NumVols: 0
         MaxVols: 8
         UseOnce: 0
      UseCatalog: 1
  AcceptAnyVolume: 1
     VolRetention: 3,600
  VolUseDuration: 3,600
      MaxVolJobs: 1
     MaxVolBytes: 0
       AutoPrune: 0
         Recycle: 1
        PoolType: Backup
     LabelFormat: File
```

messages This command causes any pending console messages to be immediately displayed.

memory Print current memory usage.

mount The mount command is used to get Bacula to read a volume on a physical device. It is a way to tell Bacula that you have mounted a tape and that Bacula should examine the tape. This command is normally used only after there was no Volume in a drive and Bacula requests you to mount a new Volume or when you have specifically unmounted a Volume with the **unmount** console command, which causes Bacula to close the drive. If you have an autoloader, the mount command will not cause Bacula to operate the autoloader unless you specify a **slot** and possibly a **drive**. The various forms of the mount command are:

mount storage=<storage-name> [slot=<num>] [drive=<num>]

mount [jobid=<id> — job=<job-name>]

If you have specified **Automatic Mount = yes** in the Storage daemon's Device resource, under most circumstances, Bacula will automatically access the Volume unless you have explicitly **unmount**ed it in the Console program.

prune The Prune command allows you to safely remove expired database records from Jobs, Volumes and Statistics. This command works only on the Catalog database and does not affect data written to Volumes. In all cases, the Prune command applies a retention period to the specified records. You can Prune expired File entries from Job records; you can Prune expired Job records from the database, and you can Prune both expired Job and File records from specified Volumes.

prune files—jobs—volume—stats client=<client-name> volume=<volume-name>

For a Volume to be pruned, the **VolStatus** must be Full, Used, or Append, otherwise the pruning will not take place.

purge The Purge command will delete associated Catalog database records from Jobs and Volumes without considering the retention period. **Purge** works only on the Catalog database and does not affect data written to Volumes. This command can be dangerous because you can delete catalog records associated with current backups of files, and we recommend that you do not use it unless you know what you are doing. The permitted forms of **purge** are:

purge files jobid=<jobid>—job=<job-name>—client=<client-name>

purge jobs client=<client-name> (of all jobs)

purge volume—volume=<vol-name> (of all jobs)

For the **purge** command to work on Volume Catalog database records the **VolStatus** must be Append, Full, Used, or Error.

The actual data written to the Volume will be unaffected by this command.

python The python command takes a single argument **restart**:

python restart

This causes the Python interpreter in the Director to be reinitialized. This can be helpful for testing because once the Director starts and the Python interpreter is initialized, there is no other way to make it accept any changes to the startup script **DirStartUp.py**. For more details on Python scripting, please see the Python Scripting chapter of this manual.

query This command reads a predefined SQL query from the query file (the name and location of the query file is defined with the QueryFile resource record in the Director's configuration file). You are prompted to select a query from the file, and possibly enter one or more parameters, then the command is submitted to the Catalog database SQL engine.

The following queries are currently available (version 2.2.7):

```
Available queries:
1: List up to 20 places where a File is saved regardless of the directory
2: List where the most recent copies of a file are saved
3: List last 20 Full Backups for a Client
4: List all backups for a Client after a specified time
5: List all backups for a Client
6: List Volume Attributes for a selected Volume
7: List Volumes used by selected JobId
8: List Volumes to Restore All Files
9: List Pool Attributes for a selected Pool
10: List total files/bytes by Job
11: List total files/bytes by Volume
12: List Files for a selected JobId
13: List Jobs stored on a selected MediaId
14: List Jobs stored for a given Volume name
15: List Volumes Bacula thinks are in changer
16: List Volumes likely to need replacement from age or errors
Choose a query (1-16):
```

quit This command terminates the console program. The console program sends the **quit** request to the Director and waits for acknowledgment. If the Director is busy doing a previous command for you that has not terminated, it may take some time. You may quit immediately by issuing the **.quit** command (i.e. quit preceded by a period).

relabel This command is used to label physical volumes. The full form of this command is:

relabel storage=<storage-name> oldvolume=<old-volume-name> volume=<newvolume-name>

If you leave out any part, you will be prompted for it. In order for the Volume (old-volume-name) to be relabeled, it must be in the catalog, and the volume status must be marked **Purged** or **Recycle**. This happens automatically as a result of applying retention periods, or you may explicitly purge the volume using the **purge** command.

Once the volume is physically relabeled, the old data previously written on the Volume is lost and cannot be recovered.

release This command is used to cause the Storage daemon to rewind (release) the current tape in the drive, and to re-read the Volume label the next time the tape is used.

release storage=<storage-name>

After a release command, the device is still kept open by Bacula (unless Always Open is set to No in the Storage Daemon's configuration) so it cannot be used by another program. However, with some tape drives, the operator can remove the current tape and to insert a different one, and when the next Job starts, Bacula will know to re-read the tape label to find out what tape is mounted. If you want to be able to use the drive with another program (e.g. **mt**), you must use the **unmount** command to cause Bacula to completely release (close) the device.

reload The reload command causes the Director to re-read its configuration file and apply the new values. The new values will take effect immediately for all new jobs. However, if you change schedules, be aware that the scheduler pre-schedules jobs up to two hours in advance, so any changes that are to take place during the next two hours may be delayed. Jobs that have already been scheduled to run (i.e. surpassed their requested start time) will continue with the old values. New jobs will use the new values. Each time you issue a reload command while jobs are running, the prior config values will queued until all jobs that were running before issuing the reload terminate, at which time the old config values will be released from memory. The Directory permits keeping up to ten prior set of configurations before it will refuse a reload command. Once at least one old set of config values has been released it will again accept new reload commands.

While it is possible to reload the Director's configuration on the fly, even while jobs are executing, this is a complex operation and not without side effects. Accordingly, if you have to reload the Director's configuration while Bacula is running, it is advisable to restart the Director at the next convenient opportunity.

restore The restore command allows you to select one or more Jobs (JobIds) to be restored using various methods. Once the JobIds are selected, the File records for those Jobs are placed in an internal Bacula directory tree, and the restore enters a file selection mode that allows you to interactively walk up and down the file tree selecting individual files to be restored. This mode is somewhat similar to the standard Unix **restore** program's interactive file selection mode.

restore storage=<storage-name> client=<backup-client-name> where=<path> pool=<pool-name> fileset=<fileset-name> restoreclient=<restore-client-name> select current all done

Where **current**, if specified, tells the restore command to automatically select a restore to the most current backup. If not specified, you will be prompted. The **all** specification tells the restore command to restore all files. If it is not specified, you will be prompted for the files to restore. For details of the **restore** command, please see the Restore Chapter of this manual.

The client keyword initially specifies the client from which the backup was made and the client to which the restore will be make. However, if the restoreclient keyword is specified, then the restore is written to that client.

run This command allows you to schedule jobs to be run immediately. The full form of the command is:

run job=<job-name> client=<client-name> fileset=<FileSet-name> level=<level-keyword> storage=<storage-name> where=<directory-prefix> when=<universal-time-specification> spool-data=yes—no yes

Any information that is needed but not specified will be listed for selection, and before starting the job, you will be prompted to accept, reject, or modify the parameters of the job to be run, unless you have specified **yes**, in which case the job will be immediately sent to the scheduler.

On my system, when I enter a run command, I get the following prompt:

```
A job name must be specified.
The defined Job resources are:
     1: Matou
     2: Polymatou
     3: Rufus
     4: Minimatou
     5: Minou
     6: PmatouVerify
     7: MatouVerify
     8: RufusVerify
     9: Watchdog
Select Job resource (1-9):
```

If I then select number 5, I am prompted with:

```
Run Backup job
JobName:  Minou
FileSet:  Minou Full Set
Level:    Incremental
Client:   Minou
Storage:  DLTDrive
Pool:     Default
When:     2003-04-23 17:08:18
```

```
OK to run? (yes/mod/no):
```

If I now enter **yes**, the Job will be run. If I enter **mod**, I will be presented with the following prompt.

```
Parameters to modify:
     1: Level
     2: Storage
     3: Job
     4: FileSet
     5: Client
     6: When
     7: Pool
Select parameter to modify (1-7):
```

If you wish to start a job at a later time, you can do so by setting the When time. Use the **mod** option and select **When** (no. 6). Then enter the desired start time in YYYY-MM-DD HH:MM:SS format.

The spooldata argument of the run command cannot be modified through the menu and is only accessible by setting its value on the intial command line. If no spooldata flag is set, the job, storage or schedule flag is used.

setdebug This command is used to set the debug level in each daemon. The form of this command is:

setdebug level=nn [trace=0/1 client=<client-name> — dir — director — storage=<storage-name> — all]

If trace=1 is set, then tracing will be enabled, and the daemon will be placed in trace mode, which means that all debug output as set by the debug level will be directed to the file **bacula.trace** in the current directory of the daemon. Normally, tracing is needed only for Win32 clients where the debug output cannot be written to a terminal or redirected to a file. When tracing, each debug output message is appended to the trace file. You must explicitly delete the file when you are done.

setip Sets new client address – if authorized.

show The show command will list the Director's resource records as defined in the Director's configuration file (normally **bacula-dir.conf**). This command is used mainly for debugging purposes by developers. The following keywords are accepted on the show command line: catalogs, clients, counters, devices, directors, filesets, jobs, messages, pools, schedules, storages, all, help. Please don't confuse this command with the **list**, which displays the contents of the catalog.

sqlquery The sqlquery command puts the Console program into SQL query mode where each line you enter is concatenated to the previous line until a semicolon (;) is seen. The semicolon terminates the command, which is then passed directly to the SQL database engine. When the output from the SQL engine is displayed, the formation of a new SQL command begins. To terminate SQL query mode and return to the Console command prompt, you enter a period (.) in column 1.

Using this command, you can query the SQL catalog database directly. Note you should really know what you are doing otherwise you could damage the catalog database. See the **query** command below for simpler and safer way of entering SQL queries.

Depending on what database engine you are using (MySQL, PostgreSQL or SQLite), you will have somewhat different SQL commands available. For more detailed information, please refer to the MySQL, PostgreSQL or SQLite documentation.

status This command will display the status of all components. For the director, it will display the next jobs that are scheduled during the next 24 hours as well as the status of currently running jobs. For the Storage Daemon, you will have drive status or autochanger content. The File Daemon will give you information about current jobs like average speed or file accounting. The full form of this command is:

status [all — dir=<dir-name> — director [days=nnn] — client=<client-name> — [slots] storage=<storage-name>]

If you do a **status dir**, the console will list any currently running jobs, a summary of all jobs scheduled to be run in the next 24 hours, and a listing of the last ten terminated jobs with their statuses. The scheduled jobs summary will include the Volume name to be used. You should be aware of two things: 1. to obtain the volume name, the code goes through the same code that will be used when the job runs, but it does not do pruning nor recycling of Volumes; 2. The Volume listed is at best a guess.

The Volume actually used may be different because of the time difference (more durations may expire when the job runs) and another job could completely fill the Volume requiring a new one.

In the Running Jobs listing, you may find the following types of information:

```
2507 Catalog MatouVerify.2004-03-13_05.05.02 is waiting execution
5349 Full    CatalogBackup.2004-03-13_01.10.00 is waiting for higher
             priority jobs to finish
5348 Differe Minou.2004-03-13_01.05.09 is waiting on max Storage jobs
5343 Full    Rufus.2004-03-13_01.05.04 is running
```

Looking at the above listing from bottom to top, obviously JobId 5343 (Rufus) is running. JobId 5348 (Minou) is waiting for JobId 5343 to finish because it is using the Storage resource, hence the "waiting on max Storage jobs". JobId 5349 has a lower priority than all the other jobs so it is waiting for higher priority jobs to finish, and finally, JobId 2507 (MatouVerify) is waiting because only one job can run at a time, hence it is simply "waiting execution"

If you do a **status dir**, it will by default list the first occurrence of all jobs that are scheduled today and tomorrow. If you wish to see the jobs that are scheduled in the next three days (e.g. on Friday you want to see the first occurrence of what tapes are scheduled to be used on Friday, the weekend, and Monday), you can add the **days=3** option. Note, a **days=0** shows the first occurrence of jobs scheduled today only. If you have multiple run statements, the first occurrence of each run statement for the job will be displayed for the period specified.

If your job seems to be blocked, you can get a general idea of the problem by doing a **status dir**, but you can most often get a much more specific indication of the problem by doing a **status storage=xxx**. For example, on an idle test system, when I do **status storage=File**, I get:

```
status storage=File
Connecting to Storage daemon File at 192.168.68.112:8103

rufus-sd Version: 1.39.6 (24 March 2006) i686-pc-linux-gnu redhat (Stentz)
Daemon started 26-Mar-06 11:06, 0 Jobs run since started.

Running Jobs:
No Jobs running.
====

Jobs waiting to reserve a drive:
====

Terminated Jobs:
 JobId  Level   Files          Bytes Status   Finished        Name
====================================================================
    59  Full        234      4,417,599 OK       15-Jan-06 11:54 kernsave
====

Device status:
Autochanger "DDS-4-changer" with devices:
   "DDS-4" (/dev/nst0)
Device "DDS-4" (/dev/nst0) is mounted with Volume="TestVolume002"
Pool="*unknown*"
    Slot 2 is loaded in drive 0.
    Total Bytes Read=0 Blocks Read=0 Bytes/block=0
    Positioned at File=0 Block=0

Device "DVD-Writer" (/dev/hdc) is not open.
Device "File" (/tmp) is not open.
====

In Use Volume status:
====
```

Now, what this tells me is that no jobs are running and that none of the devices are in use. Now, if I **unmount** the autochanger, which will not be used in this example, and then start a Job that uses the File device, the job will block. When I re-issue the status storage command, I get for the Device status:

```
status storage=File
...
Device status:
```

```
Autochanger "DDS-4-changer" with devices:
   "DDS-4" (/dev/nst0)
Device "DDS-4" (/dev/nst0) is not open.
    Device is BLOCKED. User unmounted.
    Drive 0 is not loaded.

Device "DVD-Writer" (/dev/hdc) is not open.
Device "File" (/tmp) is not open.
    Device is BLOCKED waiting for media.
====
...
```

Now, here it should be clear that if a job were running that wanted to use the Autochanger (with two devices), it would block because the user unmounted the device. The real problem for the Job I started using the "File" device is that the device is blocked waiting for media – that is Bacula needs you to label a Volume.

time Prints the current time.

trace Turn on/off trace to file.

umount For old-time Unix guys. See the unmount command for full details.

unmount This command causes the indicated Bacula Storage daemon to unmount the specified device. The forms of the command are the same as the mount command:

```
unmount storage=<storage-name> [ drive=<num> ]

unmount [ jobid=<id> | job=<job-name> ]
```

Once you unmount a storage device, Bacula will no longer be able to use it until you issue a mount command for that device. If Bacula needs to access that device, it will block and issue mount requests periodically to the operator.

If the device you are unmounting is an autochanger, it will unload the drive you have specified on the command line. If no drive is specified, it will assume drive 1.

update This command will update the catalog for either a specific Pool record, a Volume record, or the Slots in an autochanger with barcode capability. In the case of updating a Pool record, the new information will be automatically taken from the corresponding Director's configuration resource record. It can be used to increase the maximum number of volumes permitted or to set a maximum number of volumes. The following main keywords may be specified:

```
media, volume, pool, slots, stats
```

In the case of updating a Volume, you will be prompted for which value you wish to change. The following Volume parameters may be changed:

```
Volume Status
Volume Retention Period
Volume Use Duration
Maximum Volume Jobs
Maximum Volume Files
Maximum Volume Bytes
Recycle Flag
Recycle Pool
Slot
InChanger Flag
Pool
Volume Files
Volume from Pool
All Volumes from Pool
All Volumes from all Pools
```

For slots **update slots**, Bacula will obtain a list of slots and their barcodes from the Storage daemon, and for each barcode found, it will automatically update the slot in the catalog Media record to correspond to the new value. This is very useful if you have moved cassettes in the magazine, or if you have removed the magazine and inserted a different one. As the slot of each Volume is updated,

the InChanger flag for that Volume will also be set, and any other Volumes in the Pool that were last mounted on the same Storage device will have their InChanger flag turned off. This permits Bacula to know what magazine (tape holder) is currently in the autochanger.

If you do not have barcodes, you can accomplish the same thing in version 1.33 and later by using the **update slots scan** command. The **scan** keyword tells Bacula to physically mount each tape and to read its VolumeName.

For Pool **update pool**, Bacula will move the Volume record from its existing pool to the pool specified.

For **Volume from Pool**, **All Volumes from Pool** and **All Volumes from all Pools**, the following values are updated from the Pool record: Recycle, RecyclePool, VolRetention, VolUseDuration, MaxVolJobs, MaxVolFiles, and MaxVolBytes. (RecyclePool feature is available with bacula 2.1.4 or higher.)

The full form of the update command with all command line arguments is:

```
update volume=xxx pool=yyy slots volstatus=xxx VolRetention=ddd
  VolUse=ddd MaxVolJobs=nnn MaxVolBytes=nnn Recycle=yes|no
  slot=nnn enabled=n recyclepool=zzz
```

use This command allows you to specify which Catalog database to use. Normally, you will be using only one database so this will be done automatically. In the case that you are using more than one database, you can use this command to switch from one to another.

use <database-name>

var This command takes a string or quoted string and does variable expansion on it the same way variable expansion is done on the **LabelFormat** string. Thus, for the most part, you can test your LabelFormat strings. The difference between the **var** command and the actual LabelFormat process is that during the var command, no job is running so "dummy" values are used in place of Job specific variables. Generally, however, you will get a good idea of what is going to happen in the real case.

version The command prints the Director's version.

wait The wait command causes the Director to pause until there are no jobs running. This command is useful in a batch situation such as regression testing where you wish to start a job and wait until that job completes before continuing. This command now has the following options:

```
wait [jobid=nn] [jobuid=unique id] [job=job name]
```

If specified with a specific JobId, ... the wait command will wait for that particular job to terminate before continuing.

1.6 Special dot Commands

There is a list of commands that are prefixed with a period (.). These commands are intended to be used either by batch programs or graphical user interface front-ends. They are not normally used by interactive users. Once GUI development begins, this list will be considerably expanded. The following is the list of dot commands:

```
.backups job=xxx      list backups for specified job
.clients              list all client names
.defaults client=xxx fileset=yyy  list defaults for specified client
.die                  cause the Director to segment fault (for debugging)
.dir                  when in tree mode prints the equivalent to the dir command,
                        but with fields separated by commas rather than spaces.
.exit                 quit
.filesets             list all fileset names
.help                 help command output
.jobs                 list all job names
.levels               list all levels
.messages             get quick messages
.msgs                 return any queued messages
```

```
.pools              list all pool names
.quit               quit
.status             get status output
.storage            return storage resource names
.types              list job types
```

1.7 Special At (@) Commands

Normally, all commands entered to the Console program are immediately forwarded to the Director, which may be on another machine, to be executed. However, there is a small list of **at** commands, all beginning with an at character (@), that will not be sent to the Director, but rather interpreted by the Console program directly. Note, these commands are implemented only in the tty console program and not in the GNOME Console. These commands are:

@input <filename> Read and execute the commands contained in the file specified.

@output <filename> w/a Send all following output to the filename specified either overwriting the file (w) or appending to the file (a). To redirect the output to the terminal, simply enter **@output** without a filename specification. WARNING: be careful not to overwrite a valid file. A typical example during a regression test might be:

```
@output /dev/null
commands ...
@output
```

@tee <filename> w/a Send all subsequent output to both the specified file and the terminal. It is turned off by specifying **@tee** or **@output** without a filename.

@sleep <seconds> Sleep the specified number of seconds.

@time Print the current time and date.

@version Print the console's version.

@quit quit

@exit quit

@# anything Comment

@help Get the list of every special @ commands.

@separator <char> When using bconsole with readline, you can set the command separator to one of those characters to write commands who require multiple input on one line, or to put multiple commands on a single line.

```
!$%&'()*+,-/:;<>?[]^`{|}~
```

Note, if you use a semicolon (;) as a separator character, which is common, you will not be able to use the **sql** command, which requires each command to be terminated by a semicolon.

1.8 Running the Console from a Shell Script

You can automate many Console tasks by running the console program from a shell script. For example, if you have created a file containing the following commands:

```
./bconsole -c ./bconsole.conf <<END_OF_DATA
unmount storage=DDS-4
quit
END_OF_DATA
```

when that file is executed, it will unmount the current DDS-4 storage device. You might want to run this command during a Job by using the **RunBeforeJob** or **RunAfterJob** records.

It is also possible to run the Console program from file input where the file contains the commands as follows:

```
./bconsole -c ./bconsole.conf <filename
```

where the file named **filename** contains any set of console commands.

As a real example, the following script is part of the Bacula regression tests. It labels a volume (a disk volume), runs a backup, then does a restore of the files saved.

```
bin/bconsole -c bin/bconsole.conf <<END_OF_DATA
@output /dev/null
messages
@output /tmp/log1.out
label volume=TestVolume001
run job=Client1 yes
wait
messages
@#
@# now do a restore
@#
@output /tmp/log2.out
restore current all
yes
wait
messages
@output
quit
END_OF_DATA
```

The output from the backup is directed to /tmp/log1.out and the output from the restore is directed to /tmp/log2.out. To ensure that the backup and restore ran correctly, the output files are checked with:

```
grep "^Termination: *Backup OK" /tmp/log1.out
backupstat=$?
grep "^Termination: *Restore OK" /tmp/log2.out
restorestat=$?
```

1.9 Adding Volumes to a Pool

If you have used the **label** command to label a Volume, it will be automatically added to the Pool, and you will not need to add any media to the pool.

Alternatively, you may choose to add a number of Volumes to the pool without labeling them. At a later time when the Volume is requested by **Bacula** you will need to label it.

Before adding a volume, you must know the following information:

1. The name of the Pool (normally "Default")
2. The Media Type as specified in the Storage Resource in the Director's configuration file (e.g. "DLT8000")
3. The number and names of the Volumes you wish to create.

For example, to add media to a Pool, you would issue the following commands to the console program:

```
*add
Enter name of Pool to add Volumes to: Default
Enter the Media Type: DLT8000
Enter number of Media volumes to create. Max=1000: 10
Enter base volume name: Save
Enter the starting number: 1
10 Volumes created in pool Default
*
```

To see what you have added, enter:

```
*list media pool=Default
+-------+----------+---------+---------+-------+------------------+
| MedId | VolumeNa | MediaTyp| VolStat | Bytes | LastWritten      |
+-------+----------+---------+---------+-------+------------------+
|    11 | Save0001 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    12 | Save0002 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    13 | Save0003 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    14 | Save0004 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    15 | Save0005 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    16 | Save0006 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    17 | Save0007 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    18 | Save0008 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    19 | Save0009 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
|    20 | Save0010 | DLT8000 | Append  |     0 | 0000-00-00 00:00 |
+-------+----------+---------+---------+-------+------------------+
*
```

Notice that the console program automatically appended a number to the base Volume name that you specify (Save in this case). If you don't want it to append a number, you can simply answer 0 (zero) to the question "Enter number of Media volumes to create. Max=1000:", and in this case, it will create a single Volume with the exact name you specify.

Chapter 2

GUI Programs

2.1 List of GUI Programs

This document briefly describes the GUI programs that work with Bacula. The GUI programs that are currently available are:

bat **bat** is short for Bacula Administration Tool. It is a GUI form of bconsole, but with many additional features. Although we are still working on adding new features to bat, at this point, it has more features than both bwx-console and the bgnome-console, and over time many additional features will be added, including the functionality of the tray-monitor as well as the reporting capabilities of bweb.

It is very difficult to provide a guide for using bat other than to say to try it. In many of the graphical display "panes" (shown in the right window), you can click with the right mouse button to bring up a context sensitive menu that provides quite a lot of features that can be easily missed.

The Bacula wiki has a number of screenshots of bat.

To build bat, you will need to have Qt4 ¿= 4.2 loaded (libraries and the devel libraries) as well as the QWT graphics package. Please see the enable-bat section of the Installation chapter of this manual for the details of how to build it.

The major bat features are:

- Graphical features
  - Undockable (floating) windows of all interfaces.
  - Page selector for deciding and finding interfaces to view.
  - Console command window for entering standard text console commands.
  - A preferences interface for listing limits and debugging.
- Graphical console
  - A console to perform all the commands available from bconsole.
- Graphical restoring
  - High performance restore of backup with GUI tree browsing and file and directory selecting. Pre-restore Interface to assist in selecting jobs for this restore method.
  - Restore by browsing and selecting from all cataloged versions of files. This method allows for Multiple simultaneous views of catalog data. The only selection limitation for this browsing method is one client at a time.
- Graphical listing Interfaces
  - List the backup jobs that have run. ** see details below
  - List the clients and perform 4 commands on the client within context.
  - List the Filesets
  - List the Job resources and perform 8 commands on the job within context.
  - List the Pools and the volumes in each pool. Perform 7 different commands on each media.

  - List the storage resources and perform any of 5 commands on the storage resource.
- Graphical Media Management
  - Modify Volume parameters
  - Label a new volume
  - Relabel an existing volume
  - Select jobs on a volume in Job List directly from media interface
  - Delete a Volume
  - Purge Jobs on volume
  - Update Volume Parameters from Pool Parameters
- Graphical Graphing
  - Interface to plot the files and bytes of backup jobs.
- Other Graphical interfaces:
  - Open the cataloged Log messages of a job that has run
  - Run a job manually and modify job defaults before running.
  - Estimate a job. Determine the files and bytes that would be backed up if the job were run now.
- JobList features
  - As many joblist windows at a time as desired.
  - Nine different selection criterion: client, volume, job, Fileset, level, status, purged or not, record limit and days limit
  - Lists the 11 most commonly desired job attributes.
  - Run the following console commands by issuing the command within the context of the know job number: List job, list files on job, list jobmedia, list volumes, delete job and purge files.
  - Open other interfaces knowing the jobid: show the cataloged log of the running of the job, restore from that job only browsing the filestructure, restore from the job end time to get the most recent version of a restore after the job completed running and browse the combined filestucture, jump directly to view a plot of the selected jobs files and bytes backed up.

Bat also has a nice online help manual that explains a lot of the interface.

bimagemgr Bimagemgr is a web based interface written in Perl that monitors disk Volumes intended to be written to CDROM.

For more information on bimagemgr, please see below.

bwx-console bwx-console is a graphical console interface written in wxWidgets and available on all client platforms. bwx-console allows you to do anything you can do in the standard tty console and in addition has a graphic tree based point and click restore feature.

bgnome-console The bgnome-console is a graphical console interface available on systems that support GNOME 2.x. Although it runs in its own graphical window and permits all the standard console commands, it has almost no additional graphical features implemented.

For more information on bgnome-console, please consult the Console Chapter of this manual.

tray-monitor The tray-monitor is a daemon monitoring program that resides in the system tray on GNOME and KDE systems. It is a monitor program that will show you the status of any daemon. It is not a program for interfacing to the console.

For more information, please see Configuring the Monitor Program chapter this manual.

bweb Bweb is a perl based web program that provides a tool to do basic operations and get statistics. (it requires Bacula ¿= 1.39) It obtains its information from your catalog database and the bconsole program.

Some of its major features are the following:

1. Follow, in real time, job progression (with client status and job log)
2. See Pool/Media occupation
3. Update volume parameters

4. Manage locations (with a workflow to move in/out media)
5. Get graphic statistics about jobs (file number, job size, job duration)
6. Get csv group statistics for servers
7. Run a new job
8. Re-run a failed job with the same options (pool, level, etc.)
9. Manage easily failed and missed jobs (with non-event detection)
10. Manage your autochanger (put cartridge on I/O, empty I/O slots with free slots, etc.)
11. Creates interactive map of concentric, segmented rings that help visualise disk usage on your backups.
12. Define users
13. Works with both PostgreSQL and MySQL
14. Works correctly under Mozilla and Firefox

Please, read the INSTALL file in the bweb source directory for detailed instructions on getting it to work.

brestore Brestore is a graphical restoration interface available on systems that support Perl/GTK/Glade. (it requires Bacula ¿= 1.38) It has the following features:

1. Direct SQL access to the database for good performance
2. Fast Time Navigation (switch almost instantaneously between the different versions of a directory, by changing the date from a list)
3. Possibility to choose a selected file, then browse all its available versions, and directly see if these versions are online in a library or not
4. Simple restoration by generation of a BSR file
5. Works with both PostgreSQL and MySQL
6. Works with bweb to follow job

Please, read README file in the bweb source directory for detailed instructions on getting it to work.

bacula-web Bacula-web is a php based web program that provides a summarized output of jobs that have already run. It obtains its information from your catalog database. Aside from a nice graphical display, it provides summaries of your jobs, as well as graphs of job usage. This is a fairly high level bacula management tool.

Here are a few points that one user made concerning this tool:

1. It is web-based so can be accessed from anywhere.
2. It is "read only". Users can examine the state of the backups but cannot write to anything and therefore can do no damage.
3. It packs a phenomenal amount of information into a single web-page - that I credit as being very good design!

The documentation for bacula-web can be found in a separate bacula-web document that in the **bacula-docs** release.

Chapter 3

GNU Free Documentation License

Version 1.2, November 2002

51 Franklin St, Fifth Floor, Boston, MA 02110-1301 USA

Preamble

The purpose of this License is to make a manual, textbook, or other functional and useful document "free" in the sense of freedom: to assure everyone the effective freedom to copy and redistribute it, with or without modifying it, either commercially or noncommercially. Secondarily, this License preserves for the author and publisher a way to get credit for their work, while not being considered responsible for modifications made by others.

This License is a kind of "copyleft", which means that derivative works of the document must themselves be free in the same sense. It complements the GNU General Public License, which is a copyleft license designed for free software.

We have designed this License in order to use it for manuals for free software, because free software needs free documentation: a free program should come with manuals providing the same freedoms that the software does. But this License is not limited to software manuals; it can be used for any textual work, regardless of subject matter or whether it is published as a printed book. We recommend this License principally for works whose purpose is instruction or reference.

1. APPLICABILITY AND DEFINITIONS

This License applies to any manual or other work, in any medium, that contains a notice placed by the copyright holder saying it can be distributed under the terms of this License. Such a notice grants a world-wide, royalty-free license, unlimited in duration, to use that work under the conditions stated herein. The **"Document"**, below, refers to any such manual or work. Any member of the public is a licensee, and is addressed as **"you"**. You accept the license if you copy, modify or distribute the work in a way requiring permission under copyright law.

A **"Modified Version"** of the Document means any work containing the Document or a portion of it, either copied verbatim, or with modifications and/or translated into another language.

A **"Secondary Section"** is a named appendix or a front-matter section of the Document that deals exclusively with the relationship of the publishers or authors of the Document to the Document's overall subject

(or to related matters) and contains nothing that could fall directly within that overall subject. (Thus, if the Document is in part a textbook of mathematics, a Secondary Section may not explain any mathematics.) The relationship could be a matter of historical connection with the subject or with related matters, or of legal, commercial, philosophical, ethical or political position regarding them.

The **"Invariant Sections"** are certain Secondary Sections whose titles are designated, as being those of Invariant Sections, in the notice that says that the Document is released under this License. If a section does not fit the above definition of Secondary then it is not allowed to be designated as Invariant. The Document may contain zero Invariant Sections. If the Document does not identify any Invariant Sections then there are none.

The **"Cover Texts"** are certain short passages of text that are listed, as Front-Cover Texts or Back-Cover Texts, in the notice that says that the Document is released under this License. A Front-Cover Text may be at most 5 words, and a Back-Cover Text may be at most 25 words.

A **"Transparent"** copy of the Document means a machine-readable copy, represented in a format whose specification is available to the general public, that is suitable for revising the document straightforwardly with generic text editors or (for images composed of pixels) generic paint programs or (for drawings) some widely available drawing editor, and that is suitable for input to text formatters or for automatic translation to a variety of formats suitable for input to text formatters. A copy made in an otherwise Transparent file format whose markup, or absence of markup, has been arranged to thwart or discourage subsequent modification by readers is not Transparent. An image format is not Transparent if used for any substantial amount of text. A copy that is not "Transparent" is called **"Opaque"**.

Examples of suitable formats for Transparent copies include plain ASCII without markup, Texinfo input format, LaTeX input format, SGML or XML using a publicly available DTD, and standard-conforming simple HTML, PostScript or PDF designed for human modification. Examples of transparent image formats include PNG, XCF and JPG. Opaque formats include proprietary formats that can be read and edited only by proprietary word processors, SGML or XML for which the DTD and/or processing tools are not generally available, and the machine-generated HTML, PostScript or PDF produced by some word processors for output purposes only.

The **"Title Page"** means, for a printed book, the title page itself, plus such following pages as are needed to hold, legibly, the material this License requires to appear in the title page. For works in formats which do not have any title page as such, "Title Page" means the text near the most prominent appearance of the work's title, preceding the beginning of the body of the text.

A section **"Entitled XYZ"** means a named subunit of the Document whose title either is precisely XYZ or contains XYZ in parentheses following text that translates XYZ in another language. (Here XYZ stands for a specific section name mentioned below, such as **"Acknowledgements"**, **"Dedications"**, **"Endorsements"**, or **"History"**.) To **"Preserve the Title"** of such a section when you modify the Document means that it remains a section "Entitled XYZ" according to this definition.

The Document may include Warranty Disclaimers next to the notice which states that this License applies to the Document. These Warranty Disclaimers are considered to be included by reference in this License, but only as regards disclaiming warranties: any other implication that these Warranty Disclaimers may have is void and has no effect on the meaning of this License.

2. VERBATIM COPYING

You may copy and distribute the Document in any medium, either commercially or noncommercially, provided that this License, the copyright notices, and the license notice saying this License applies to the Document are reproduced in all copies, and that you add no other conditions whatsoever to those of this License. You may not use technical measures to obstruct or control the reading or further copying of the copies you make or distribute. However, you may accept compensation in exchange for copies. If you distribute a large enough number of copies you must also follow the conditions in section 3.

You may also lend copies, under the same conditions stated above, and you may publicly display copies.

3. COPYING IN QUANTITY

If you publish printed copies (or copies in media that commonly have printed covers) of the Document, numbering more than 100, and the Document's license notice requires Cover Texts, you must enclose the copies in covers that carry, clearly and legibly, all these Cover Texts: Front-Cover Texts on the front cover, and Back-Cover Texts on the back cover. Both covers must also clearly and legibly identify you as the publisher of these copies. The front cover must present the full title with all words of the title equally prominent and visible. You may add other material on the covers in addition. Copying with changes limited to the covers, as long as they preserve the title of the Document and satisfy these conditions, can be treated as verbatim copying in other respects.

If the required texts for either cover are too voluminous to fit legibly, you should put the first ones listed (as many as fit reasonably) on the actual cover, and continue the rest onto adjacent pages.

If you publish or distribute Opaque copies of the Document numbering more than 100, you must either include a machine-readable Transparent copy along with each Opaque copy, or state in or with each Opaque copy a computer-network location from which the general network-using public has access to download using public-standard network protocols a complete Transparent copy of the Document, free of added material. If you use the latter option, you must take reasonably prudent steps, when you begin distribution of Opaque copies in quantity, to ensure that this Transparent copy will remain thus accessible at the stated location until at least one year after the last time you distribute an Opaque copy (directly or through your agents or retailers) of that edition to the public.

It is requested, but not required, that you contact the authors of the Document well before redistributing any large number of copies, to give them a chance to provide you with an updated version of the Document.

4. MODIFICATIONS

You may copy and distribute a Modified Version of the Document under the conditions of sections 2 and 3 above, provided that you release the Modified Version under precisely this License, with the Modified Version filling the role of the Document, thus licensing distribution and modification of the Modified Version to whoever possesses a copy of it. In addition, you must do these things in the Modified Version:

A. Use in the Title Page (and on the covers, if any) a title distinct from that of the Document, and from those of previous versions (which should, if there were any, be listed in the History section of the Document). You may use the same title as a previous version if the original publisher of that version gives permission.

B. List on the Title Page, as authors, one or more persons or entities responsible for authorship of the modifications in the Modified Version, together with at least five of the principal authors of the Document (all of its principal authors, if it has fewer than five), unless they release you from this requirement.

C. State on the Title page the name of the publisher of the Modified Version, as the publisher.

D. Preserve all the copyright notices of the Document.

E. Add an appropriate copyright notice for your modifications adjacent to the other copyright notices.

F. Include, immediately after the copyright notices, a license notice giving the public permission to use the Modified Version under the terms of this License, in the form shown in the Addendum below.

G. Preserve in that license notice the full lists of Invariant Sections and required Cover Texts given in the Document's license notice.

H. Include an unaltered copy of this License.

I. Preserve the section Entitled "History", Preserve its Title, and add to it an item stating at least the title, year, new authors, and publisher of the Modified Version as given on the Title Page. If there is no section Entitled "History" in the Document, create one stating the title, year, authors, and publisher of the Document as given on its Title Page, then add an item describing the Modified Version as stated in the previous sentence.

J. Preserve the network location, if any, given in the Document for public access to a Transparent copy of the Document, and likewise the network locations given in the Document for previous versions it was based on. These may be placed in the "History" section. You may omit a network location for a work that was published at least four years before the Document itself, or if the original publisher of the version it refers to gives permission.

K. For any section Entitled "Acknowledgements" or "Dedications", Preserve the Title of the section, and preserve in the section all the substance and tone of each of the contributor acknowledgements and/or dedications given therein.

L. Preserve all the Invariant Sections of the Document, unaltered in their text and in their titles. Section numbers or the equivalent are not considered part of the section titles.

M. Delete any section Entitled "Endorsements". Such a section may not be included in the Modified Version.

N. Do not retitle any existing section to be Entitled "Endorsements" or to conflict in title with any Invariant Section.

O. Preserve any Warranty Disclaimers.

If the Modified Version includes new front-matter sections or appendices that qualify as Secondary Sections and contain no material copied from the Document, you may at your option designate some or all of these sections as invariant. To do this, add their titles to the list of Invariant Sections in the Modified Version's license notice. These titles must be distinct from any other section titles.

You may add a section Entitled "Endorsements", provided it contains nothing but endorsements of your Modified Version by various parties–for example, statements of peer review or that the text has been approved by an organization as the authoritative definition of a standard.

You may add a passage of up to five words as a Front-Cover Text, and a passage of up to 25 words as a Back-Cover Text, to the end of the list of Cover Texts in the Modified Version. Only one passage of Front-Cover Text and one of Back-Cover Text may be added by (or through arrangements made by) any one entity. If the Document already includes a cover text for the same cover, previously added by you or by arrangement made by the same entity you are acting on behalf of, you may not add another; but you may replace the old one, on explicit permission from the previous publisher that added the old one.

The author(s) and publisher(s) of the Document do not by this License give permission to use their names for publicity for or to assert or imply endorsement of any Modified Version.

5. COMBINING DOCUMENTS

You may combine the Document with other documents released under this License, under the terms defined in section 4 above for modified versions, provided that you include in the combination all of the Invariant Sections of all of the original documents, unmodified, and list them all as Invariant Sections of your combined work in its license notice, and that you preserve all their Warranty Disclaimers.

The combined work need only contain one copy of this License, and multiple identical Invariant Sections may be replaced with a single copy. If there are multiple Invariant Sections with the same name but different contents, make the title of each such section unique by adding at the end of it, in parentheses, the name of the original author or publisher of that section if known, or else a unique number. Make the same adjustment to the section titles in the list of Invariant Sections in the license notice of the combined work.

In the combination, you must combine any sections Entitled "History" in the various original documents, forming one section Entitled "History"; likewise combine any sections Entitled "Acknowledgements", and any sections Entitled "Dedications". You must delete all sections Entitled "Endorsements".

6. COLLECTIONS OF DOCUMENTS

You may make a collection consisting of the Document and other documents released under this License, and replace the individual copies of this License in the various documents with a single copy that is included in the collection, provided that you follow the rules of this License for verbatim copying of each of the documents in all other respects.

You may extract a single document from such a collection, and distribute it individually under this License, provided you insert a copy of this License into the extracted document, and follow this License in all other respects regarding verbatim copying of that document.

7. AGGREGATION WITH INDEPENDENT WORKS

A compilation of the Document or its derivatives with other separate and independent documents or works, in or on a volume of a storage or distribution medium, is called an "aggregate" if the copyright resulting from the compilation is not used to limit the legal rights of the compilation's users beyond what the individual works permit. When the Document is included in an aggregate, this License does not apply to the other works in the aggregate which are not themselves derivative works of the Document.

If the Cover Text requirement of section 3 is applicable to these copies of the Document, then if the Document is less than one half of the entire aggregate, the Document's Cover Texts may be placed on covers that bracket the Document within the aggregate, or the electronic equivalent of covers if the Document is in electronic form. Otherwise they must appear on printed covers that bracket the whole aggregate.

8. TRANSLATION

Translation is considered a kind of modification, so you may distribute translations of the Document under the terms of section 4. Replacing Invariant Sections with translations requires special permission from their copyright holders, but you may include translations of some or all Invariant Sections in addition to the original versions of these Invariant Sections. You may include a translation of this License, and all the license notices in the Document, and any Warranty Disclaimers, provided that you also include the original English version of this License and the original versions of those notices and disclaimers. In case of a disagreement between the translation and the original version of this License or a notice or disclaimer, the original version will prevail.

If a section in the Document is Entitled "Acknowledgements", "Dedications", or "History", the requirement (section 4) to Preserve its Title (section 1) will typically require changing the actual title.

9. TERMINATION

You may not copy, modify, sublicense, or distribute the Document except as expressly provided for under this License. Any other attempt to copy, modify, sublicense or distribute the Document is void, and will automatically terminate your rights under this License. However, parties who have received copies, or rights, from you under this License will not have their licenses terminated so long as such parties remain in full compliance.

10. FUTURE REVISIONS OF THIS LICENSE

The Free Software Foundation may publish new, revised versions of the GNU Free Documentation License from time to time. Such new versions will be similar in spirit to the present version, but may differ in detail to address new problems or concerns. See http://www.gnu.org/copyleft/.

Each version of the License is given a distinguishing version number. If the Document specifies that a particular numbered version of this License "or any later version" applies to it, you have the option of following the terms and conditions either of that specified version or of any later version that has been published (not as a draft) by the Free Software Foundation. If the Document does not specify a version number of this License, you may choose any version ever published (not as a draft) by the Free Software Foundation.

ADDENDUM: How to use this License for your documents

To use this License in a document you have written, include a copy of the License in the document and put the following copyright and license notices just after the title page:

> Copyright ©YEAR YOUR NAME. Permission is granted to copy, distribute and/or modify this document under the terms of the GNU Free Documentation License, Version 1.2 or any later version published by the Free Software Foundation; with no Invariant Sections, no Front-Cover Texts, and no Back-Cover Texts. A copy of the license is included in the section entitled "GNU Free Documentation License".

If you have Invariant Sections, Front-Cover Texts and Back-Cover Texts, replace the "with...Texts." line with this:

> with the Invariant Sections being LIST THEIR TITLES, with the Front-Cover Texts being LIST, and with the Back-Cover Texts being LIST.

If you have Invariant Sections without Cover Texts, or some other combination of the three, merge those two alternatives to suit the situation.

If your document contains nontrivial examples of program code, we recommend releasing these examples in parallel under your choice of free software license, such as the GNU General Public License, to permit their use in free software.

General Index