Bacula
The Network Backup Solution

Presented by Kern Sibbald at FOSDEM

25 February 2007 in Brussels

Bacula – the Network Backup Tool for Linux, Mac, Unix and Windows

It comes by night and sucks the vital essence from your computers.

Introduction

Bacula is a network backup solution, designed for Linux, Mac OS, Unix and Windows systems.

Project goals are to:

- backup any client from a Palm to a mainframe computer
- have “Enterprise” features similar to the largest commercial applications
- assure compatibility of your data for at least 30 years (providing you have the appropriate hardware)
- use a Free and Open Source (GPL v2 + clarifications) license

Introduction (cont)

Do you do backups?

- No
- Yes, I did one last month
- Yes, tarballs every week
- Sometimes I rsync ...
- Yes, CDs every week

Problems with the above that Bacula solves:

- Finding the files you need to restore (GUI)
- Restoring to a point in time
- Knowing what was backed up when
- Scaling to handle 2000 machines
- Bare-metal recovery is complex

Project History and Statistics

- Bacula = Backup + Dracula

- January 2000 – Project started
- 14 April 2002 – First release to Source Forge (version 1.16)
- 29 June 2006 – Release 1.38.11
- January 2007 – Release 2.0.0 (current 2.0.2)

- 41 Source Forge project members
- 33 developers with subversion write access
- 656 bugs.bacula.org
- 1,444 bacula-users@lists.sourceforge.net
- 712 bacula-announce@lists.sourceforge.net

- Downloads
  - 74 version 1.16
  - 10,919 version 1.36
  - 12,408 version 1.38.11

The Six Bacula Components

1. Director (DIR)

- Central control and administration for everything
- Basic unit is a Job (one client, one set of files, ...)
- Schedules, initiates and supervises all Jobs
- Maintains the catalog
- Typically one Director except in very large shops

The Six Bacula Components

2. File daemon or Client (FD)

- Does file backup, restore and verification as requested by Director
- Installed on each machine as a service (daemon)
- Communicates over network with Director and Storage daemon
- Needs access to all files to be backed up (root)
- Common code but adapted specifically to each OS
- Typically multiple File daemons per Director; one for each machine

The Six Bacula Components

3. Storage daemon (SD)

- Reads and writes data to the physical medium
  - Disk
  - Tape
  - DVD
  - USB
- Accepts orders and authorization from the Director
- Accepts and returns data to/from File daemons (FD)
- Sends file storage location to Director -> Catalog
- Typically one per Director

The Six Bacula Components

4. Console

- Allows user or administrator to control Bacula
- Communicates with Director via network
- Start jobs, review Job output, query/modify catalog
- Consoles available
  - TTY (bconsole)
  - wxWidgets (GUI) – Linux, Unix, Win32
  - Gnome (GUI)
  - Several web interfaces
  - Comprehensive Qt 4 console being developed (bat)
- Restricted consoles (ACL) for security

The Six Bacula Components

5. Catalog database

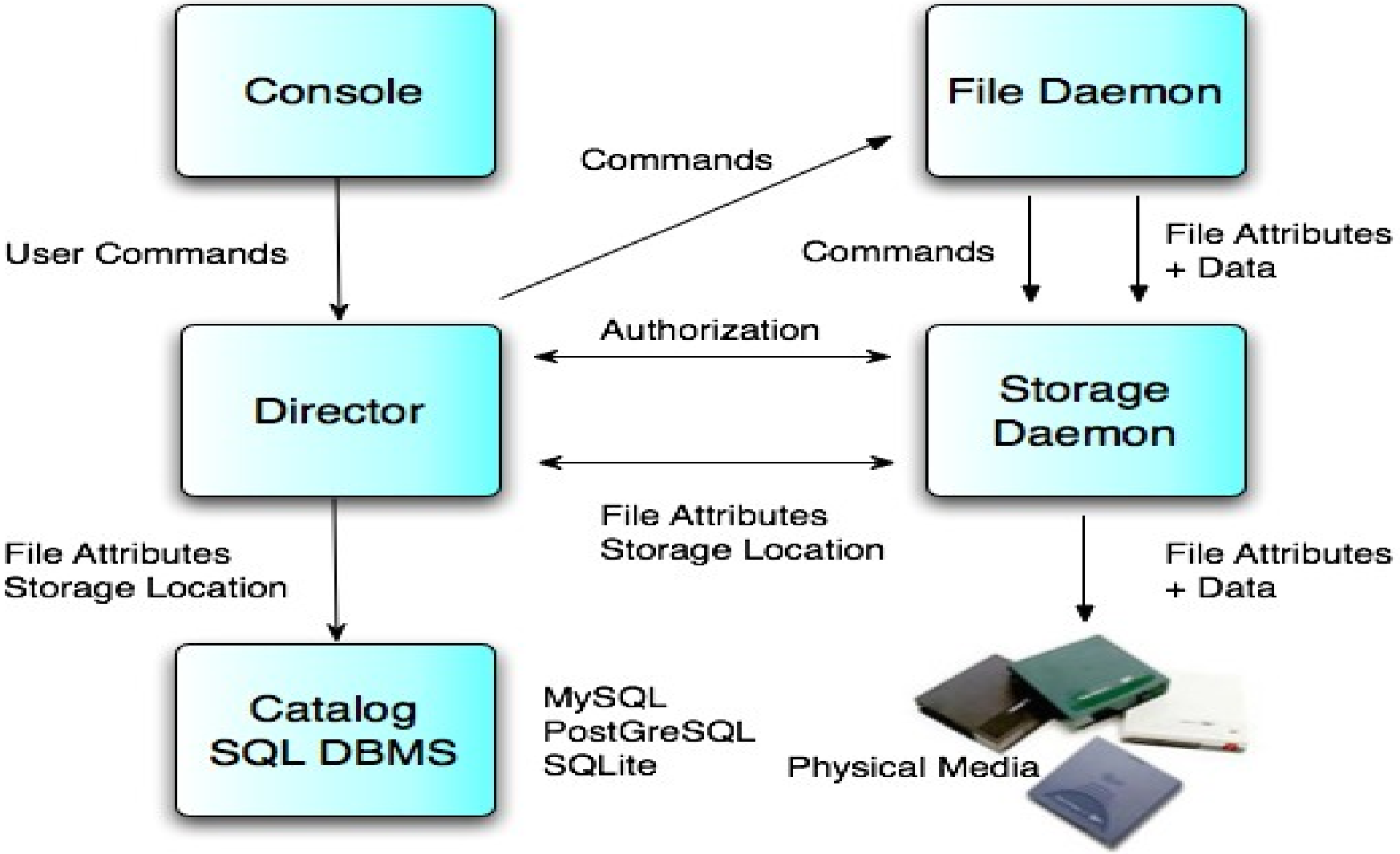
- SQL database (MySQL, PostgreSQL, or SQLite)
- Keeps Jobs run, Volumes used, File locations, ...
- Permits rapid restores
- Allows inquiry of when and where files were backed up
- Automatic pruning of old data
- Supports multiple databases of same vendor

The Six Bacula Components

6. Tray Monitor

- Gnome/KDE/Win32 GUI tray applet
- Monitors Director, File daemons, Storage daemon
- Near real-time display of activity

Main Components



Features

- Distributed backup with a central server and catalog
- All components communicate via the network and can be deployed separately.
- Internal scheduler for automatic and simultaneous job execution with priorities.
- Interactive restore of one or more files from:
  - current backup
  - prior backup of time and date
  - many more options
- Simple administration with consoles (command line, GUI, and web)
  - bconsole (TTY) ideal over remote ssh connection

Features (cont.)

- Support for ANSI / IBM labels
- Support for Unicode on Win32; UTF-8 on Unix
- Support for direct writing on DVD
- Integrated Python interpreter for “event” (job start, end, ...) scripting
- Specification of multiple possible Storage devices with automatic selection of a free device
- Rescue CDROM for “bare metal” recovery.

Bacula – Hardware Features

- Wide tape drive support with configurable Device resources
- Support for multiple drive autochangers (libraries)
- Supports tape barcode readers
- Pool and Volume library management
- Backups can span multiple volumes
- Multiple backups (jobs, clients, OSes) per volume
- Rapid restoration of individual files (one user reported 4 to 6 hours with tar and 3 to 4 minutes with Bacula!).

Bacula – Security Features

- Inter-daemon authorization with CRAM-MD5
- Director and Storage daemon can be run non-root
- MD5, SHA1, ... signatures for each file
- CRC checksum for each Volume block
- Restricted consoles and tray-monitors
- Communications (TLS) encryption
- Data (PKI) encryption
- Tripwire like intrusion detection (Verify)

Technical Highlights

- OS support : Linux (all versions including the zSeries), Win32, Solaris, *BSD, Mac OS X, Irix, Tru64, AIX, HP-UX
- Backup to disk or tape with spooling capability to avoid “shoe-shine” on tapes
- Backup/restore of POSIX Access Control Lists (ACL), Mac resource forks, Win32 permissions
- Support for large files (>2GB) and 64 bit architectures
- Multi-thread implementation
- Originally written in C, now converted to a subset of C++

Bacula Configuration - Job

Jobs are the basic unifying structure

- Type – what to do, backup, restore, migrate, ...
- Level – level of detail of type
- FileSet – what to backup (inclusion and exclusion)
- Client – where to get the files
- Storage – where to put the files (which hardware)
- Pool – which set of Volumes (tapes, disk) to use
- Schedule – when to do it

Bacula Configuration – Job Type

- Backup – save files
- Migration – move files from Volume to Volume
- Verify – verify Volumes or Client files
- Admin – run administrative tasks
- Restore – restore files

Bacula Configuration – Job Level

- Type = Backup
  - Full – everything defined in FileSet
  - Differential – everything changed since last Full
  - Incremental – everything changed since last Full, Diff
- Type = Verify
  - Catalog – Compare Client files to catalog
  - InitCatalog – Create base for Client comparison
  - VolumeToCatalog – verify Volume files to catalog
  - DiskToCatalog – verify Client files to catalog

Bacula Configuration – FileSet

- Include/Exclude files and/or directories
- Regex or wildcard for file/directory name selection
- Compression using similar selection criteria
- Which filesystem types to backup
- ACL support
- Sparse file handling
- Signature (MD5, SHA1, ...)

Bacula – Director Configuration File

```
Director {
  Name = bacula-dir
  Query File = “/usr/local/etc/query.sql”
  Working Directory = “/var/bacula”
  PID Directory = “/var/run”
  Maximum Concurrent Jobs = 20
  Password = “secret”
  Messages = Standard
}
```

Bacula – Director Configuration File (cont)

```
Job {
  Name = “Laptop”
  Type = Backup
  Client = laptop-fd
  FileSet = “Full Set”
  Schedule = “Weekly Cycle”
  Storage = File
  Messages = Standard
  Pool = Standard
  Write Bootstrap = “/var/bacula/laptop.bsr”
  Priority = 10
}
```

Bacula – Director Configuration File (cont)

```
Client {
  Name = laptop-fd
  Address = laptop.example.org
  Catalog = MyCatalog
  Password = “secret-fd”
  File Retention = 30 days
  Job Retention = 6 months
  AutoPrune = yes
  Maximum Concurrent Jobs = 20
}
```

Bacula – Director Configuration File (cont)

```
FileSet {
   Name = “Full Set”
   Include {
      Options {
         signature=SHA1;   sparse = yes
         regex = ".*\.c$";   wild = "*.txt"
         exclude = yes
      }
      File = /
      File = /usr
      File = /var
   }
   Exclude {
      File = /proc;   File = /tmp; File = /sys; File = /.journal
   }
}
```

Bacula – Director Configuration File (cont)

```
Schedule {
  Name = “Weekly Cycle”
  Run = Level=Full 1st sun at 2:05
  Run = Level=Differential 2nd-5st sun at 2:05
  Run = Level=Incremental mon-sat at 2:05
}
```

Bacula – File daemon Configuration File

```
FileDaemon {
  Name = laptop-fd
  Working Directory = /var/bacula
  PID Directory = /var/run
}

Director {
  Name = bacula-dir
  Password = “secret-fd”
}
```

Bacula – Storage Configuration File

```
Storage {
  Name = bacula-sd
  Working Directory = /var/bacula
  PID Directory = /var/run
}

Director {
  Name = bacula-dir
  Password = “secret-sd”
}
```

Bacula – Storage Configuration File (cont)

```
Device {
  Name = FileStorage
  Device Type = File      # DVD, Tape, FIFO
  Media Type = File
  Archive Device = /usr/bacula-backups
  Label Media = yes
  Random Access = yes
}

AutoChanger {
  ...
}
```

Developers

Most developers believe that backup programs are not very "sexy". Perhaps, but they **are** extremely complicated:

- Database – SQL
- GUI
- Web
- Networking
- OS (every bit must be restored)
- Restore
  - Full, Diff, Inc
  - Find Volumes
  - Directory tree (100 million records, 5 million files)
  - where is the file?
- Job resource allocation (drives, Volumes)

Project development

Site : http://www.bacula.org/

Development style:

- SourceForge project
- Patches and commits reviewed by K. Sibbald
- Developer SVN access. Currently 13 (35) developers may commit.
- Developer's guide with code style guidelines
- All code tested using a regression test suite.
- Email list for developers (bacula-devel).

License:

- GPL 2 (+ clarifications) copyright assigned FSFE.
- Freedom Task Force (FTF)

Resources

For users and system administrators

- Manual: http://www.bacula.org/rel-manual/index.html
- OS and Hardware compatibility lists (in manual)
- Bugs reports: http://bugs.bacula.org/
- Email support list : bacula-devel@lists.sourceforge.net
-

For developers

- Docs : http://www.bacula.org/developers/index.html
- Email list : bacula-devel@lists.sourceforge.net
- SVN at Source Forge

Credits

Thanks

- Dan Langille who created the original presentation
- Karl Cunningham who updated it
- This presentation draws heavily on their work

A .pdf copy of this presentation can be found at:

http://www.bacula.org -> Presentations -> ...

Live Demo

The following slides are not part of this slide show but are screenshots of the live demo that will be presented after the slide show.

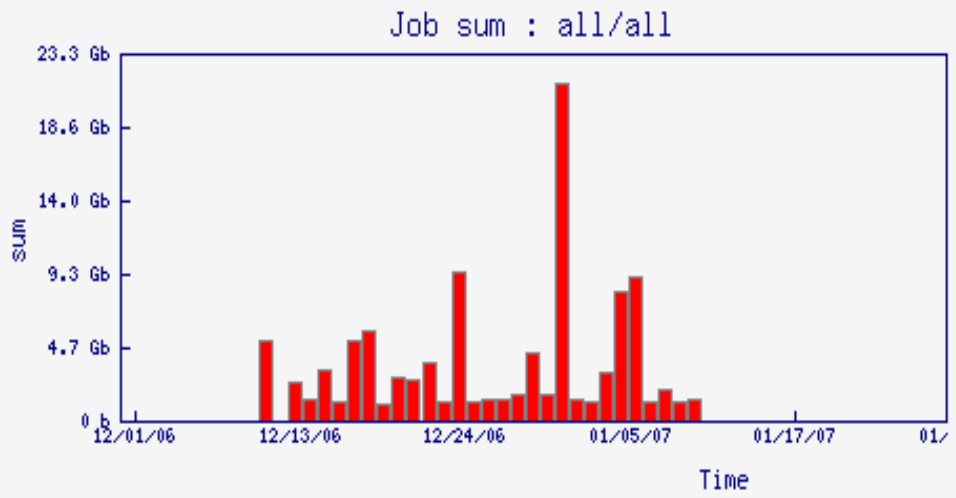
Informations

Total clients: 11 Total bytes stored: 1.0 Tb Total media: 3

Database size: ??? Total Pool: 1 Total Job: 1334

Job failed (last 7 days): 0

Statistics



Running Jobs

JobId	Client	Job Name	Level	Start Time	Duration	Status	Select
1038	Rufus	Rufus	Incr (since last backup)	2006-10-07 10:52:20	2285:49:00		
343	Matou	Matou	Incr (since last backup)	2006-03-21 14:32:06	7081:09:14		

Last Jobs (limited to 10)

JobId	Client	Job Name	FileSet	Level	StartTime	Duration	JobFiles	JobBytes	Errors	Status
1436	Roxie	CatalogBackup	CatalogFile	F	2007-01-10 05:04:32	00:00:13	1	345.5 Mb	0	✓
1435	Minou	Minou	Minou Full Set	I	2007-01-10 03:17:18	00:00:09	1	236 b	0	✓
1434	Tibs	Tibs	Win32 Full Set	I	2007-01-10 03:13:42	00:03:29	24	2.3 Mb	0	✓
1433	Rufus	Rufus	RufusAll	I	2007-01-10 03:08:50	00:04:45	3695	657.2 Mb	0	✓

Running Jobs

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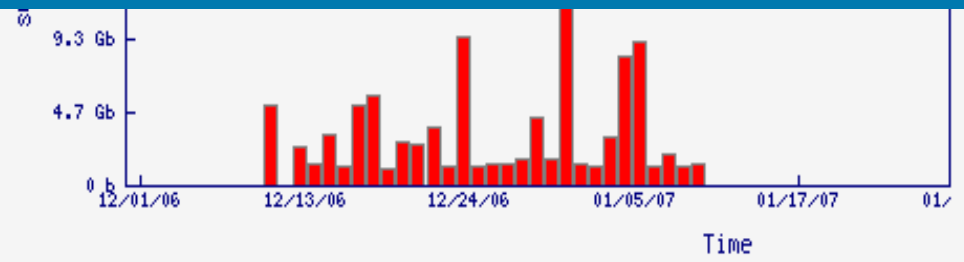
343	Matou	Matou	Incr (since last backup)	2006-03-21 14:32:06	7081:10:18		



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1435	Minou	Minou	Minou Full Set	I	2007-01-10 03:17:18	00:00:09	1	236 b	0	✓
1434	Tibs	Tibs	Win32 Full Set	I	2007-01-10 03:13:42	00:03:29	24	2.3 Mb	0	✓
1433	Rufus	Rufus	RufusAll	I	2007-01-10 03:08:50	00:04:45	3695	657.2 Mb	0	✓
1432	Matou	Matou	Matou Set	I	2007-01-10 03:05:03	00:03:43	158	428.9 Mb	0	✓
1431	Roxie	CatalogBackup	CatalogFile	F	2007-01-09 05:04:31	00:00:13	1	345.1 Mb	0	✓
1430	Minou	Minou	Minou Full Set	I	2007-01-09 03:16:13	00:00:09	1	236 b	0	✓
1429	Tibs	Tibs	Win32 Full Set	I	2007-01-09 03:12:35	00:03:31	26	2.3 Mb	0	✓
1428	Rufus	Rufus	RufusAll	I	2007-01-09 03:08:20	00:04:05	333	543.4 Mb	0	✓
1427	Matou	Matou	Matou Set	I	2007-01-09 03:05:04	00:03:12	137	375.9 Mb	0	✓

Information about job

JobId	Client	Job Name	FileSet	Level	StartTime	Duration	JobFiles	JobBytes	Errors	Pool	Volume Name	Status
1433	Rufus	Rufus	RufusAll	I	2007-01-10 03:08:50	00:04:45	3695	657.2 Mb	0	Default	LTO-004	✓

Delete View media View jobs View stats View FileSet

Log : Rufus on Rufus (1433)

```
roxie-dir: Start Backup JobId 1433, Job=Rufus.2007-01-10_03.05.01
roxie-sd: Spooling data ...
rufus-fd:       /boot is a different filesystem. Will not descend from / into /boot
rufus-fd:       /home is a different filesystem. Will not descend from / into /home
rufus-fd:       /tmp is a different filesystem. Will not descend from / into /tmp
rufus-fd:       /usr is a different filesystem. Will not descend from / into /usr
rufus-fd:       /sys is a different filesystem. Will not descend from / into /sys
rufus-fd:       /dev is a different filesystem. Will not descend from / into /dev
rufus-fd:       /mnt is a different filesystem. Will not descend from / into /mnt
rufus-fd:       /net is a different filesystem. Will not descend from / into /net
rufus-fd:       /smb is a different filesystem. Will not descend from / into /smb
rufus-fd:       /misc is a different filesystem. Will not descend from / into /misc
roxie-sd: Job write elapsed time = 00:04:26, Transfer rate = 2.592 M bytes/second
roxie-sd: Committing spooled data to Volume "LTO-004". Despooling 690,353,872 bytes ...
roxie-sd: Despooling elapsed time = 00:00:11, Transfer rate = 62.75 M bytes/second
roxie-sd: Sending spooled attrs to the Director. Despooling 1,025,113 bytes ...
roxie-dir: Bacula 2.0.0 (28Dec06): 10-Jan-2007 03:13:35
  JobId:                  1433
  Job:                    Rufus.2007-01-10_03.05.01
  Backup Level:           Incremental, since=2007-01-09 03:08:20
  Client:                 "Rufus" 1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2
  FileSet:                "RufusAll" 2005-12-26 19:31:20
  Pool:                   "Default" (From Job resource)
  Storage:                "LTO-changer" (From Job resource)
  Scheduled time:         10-Jan-2007 03:05:00
  Start time:             10-Jan-2007 03:08:50
  End time:               10-Jan-2007 03:13:35
  Elapsed time:           4 mins 45 secs
  Priority:               10
  FD Files Written:       3,695
```

```
roxie-sd: Spooling data ...
rufus-fd:      /boot is a different filesystem. Will not descend from / into /boot
rufus-fd:      /home is a different filesystem. Will not descend from / into /home
rufus-fd:      /tmp is a different filesystem. Will not descend from / into /tmp
rufus-fd:      /usr is a different filesystem. Will not descend from / into /usr
rufus-fd:      /sys is a different filesystem. Will not descend from / into /sys
rufus-fd:      /dev is a different filesystem. Will not descend from / into /dev
rufus-fd:      /mnt is a different filesystem. Will not descend from / into /mnt
rufus-fd:      /net is a different filesystem. Will not descend from / into /net
rufus-fd:      /smb is a different filesystem. Will not descend from / into /smb
rufus-fd:      /misc is a different filesystem. Will not descend from / into /misc
roxie-sd: Job write elapsed time = 00:04:26, Transfer rate = 2.592 M bytes/second
roxie-sd: Committing spooled data to Volume "LTO-004". Despooling 690,353,872 bytes ...
roxie-sd: Despooling elapsed time = 00:00:11, Transfer rate = 62.75 M bytes/second
roxie-sd: Sending spooled attrs to the Director. Despooling 1,025,113 bytes ...
roxie-dir: Bacula 2.0.0 (28Dec06): 10-Jan-2007 03:13:35
  JobId:                  1433
  Job:                    Rufus.2007-01-10_03.05.01
  Backup Level:           Incremental, since=2007-01-09 03:08:20
  Client:                 "Rufus" 1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2
  FileSet:                "RufusAll" 2005-12-26 19:31:20
  Pool:                   "Default" (From Job resource)
  Storage:                "LTO-changer" (From Job resource)
  Scheduled time:         10-Jan-2007 03:05:00
  Start time:             10-Jan-2007 03:08:50
  End time:               10-Jan-2007 03:13:35
  Elapsed time:           4 mins 45 secs
  Priority:               10
  FD Files Written:       3,695
  SD Files Written:       3,695
  FD Bytes Written:       689,101,439 (689.1 MB)
  SD Bytes Written:       689,599,036 (689.5 MB)
  Rate:                   2417.9 KB/s
  Software Compression:   None
  VSS:                    no
  Encryption:             no
  Volume name(s):         LTO-004
  Volume Session Id:      28
  Volume Session Time:    1167914635
  Last Volume Bytes:      297,401,029,632 (297.4 GB)
  Non-fatal FD errors:    0
  SD Errors:              0
  FD termination status:  OK
  SD termination status:  OK
  Termination:            Backup OK
```

FileSet RufusAll

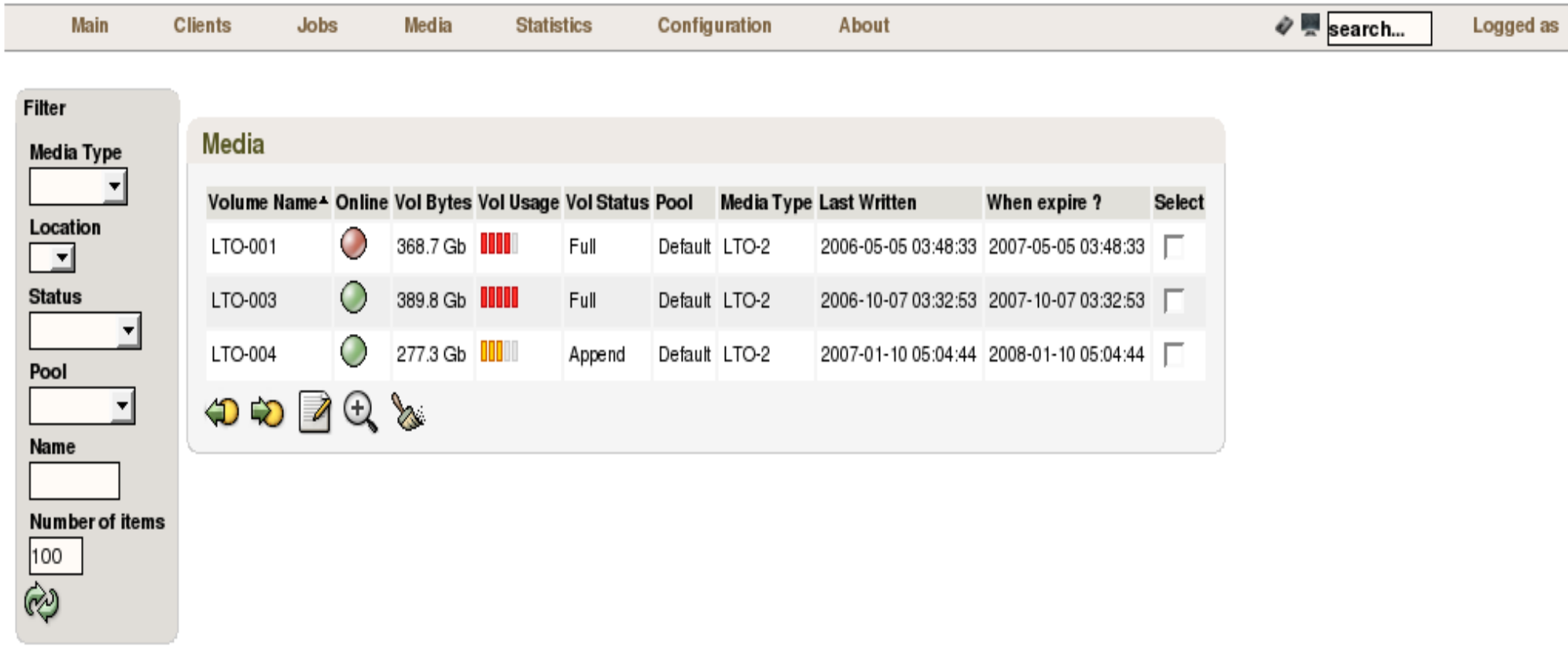
What is included :

```
/
/boot
/home
/usr
```

What is excluded :

```
/home/kern/bacula/bin/working
/home/kern/bacula/working
.journal
.autofsck
/proc
lost+found
/var/tmp
/var/lock
/var/spool/cups/tmp
/usr/tmp
```

Tips: Warning, this is the current fileset, it could have changed ...


Main
Clients
Jobs
Media
Statistics
Configuration
About
search...
Logged as
Filter
Media Type
Location
Status
Pool
Name
Number of items
100
Media
Volume Name
Online
Vol Bytes
Vol Usage
Vol Status
Pool
Media Type
Last Written
When expire ?
Select
LTO-001
368.7 Gb
Full
Default
LTO-2
2006-05-05 03:48:33
2007-05-05 03:48:33
LTO-003
389.8 Gb
Full
Default
LTO-2
2006-10-07 03:32:53
2007-10-07 03:32:53
LTO-004
277.3 Gb
Append
Default
LTO-2
2007-01-10 05:04:44
2008-01-10 05:04:44

Statistics

Options

Level: Any

Status: Any

Age: This week

Size: Width: 640, Height: 480

Clients: Matou, MatouVerify, Minou, Polymatou, Roxie, Rufus, RufusVerify, Tibs, Timmy, Watchdog, timmy-fd

Job Name: CatalogBackup, Matou, Minou, Polymatou, RestoreFiles, Rufus, Tibs, Timmy

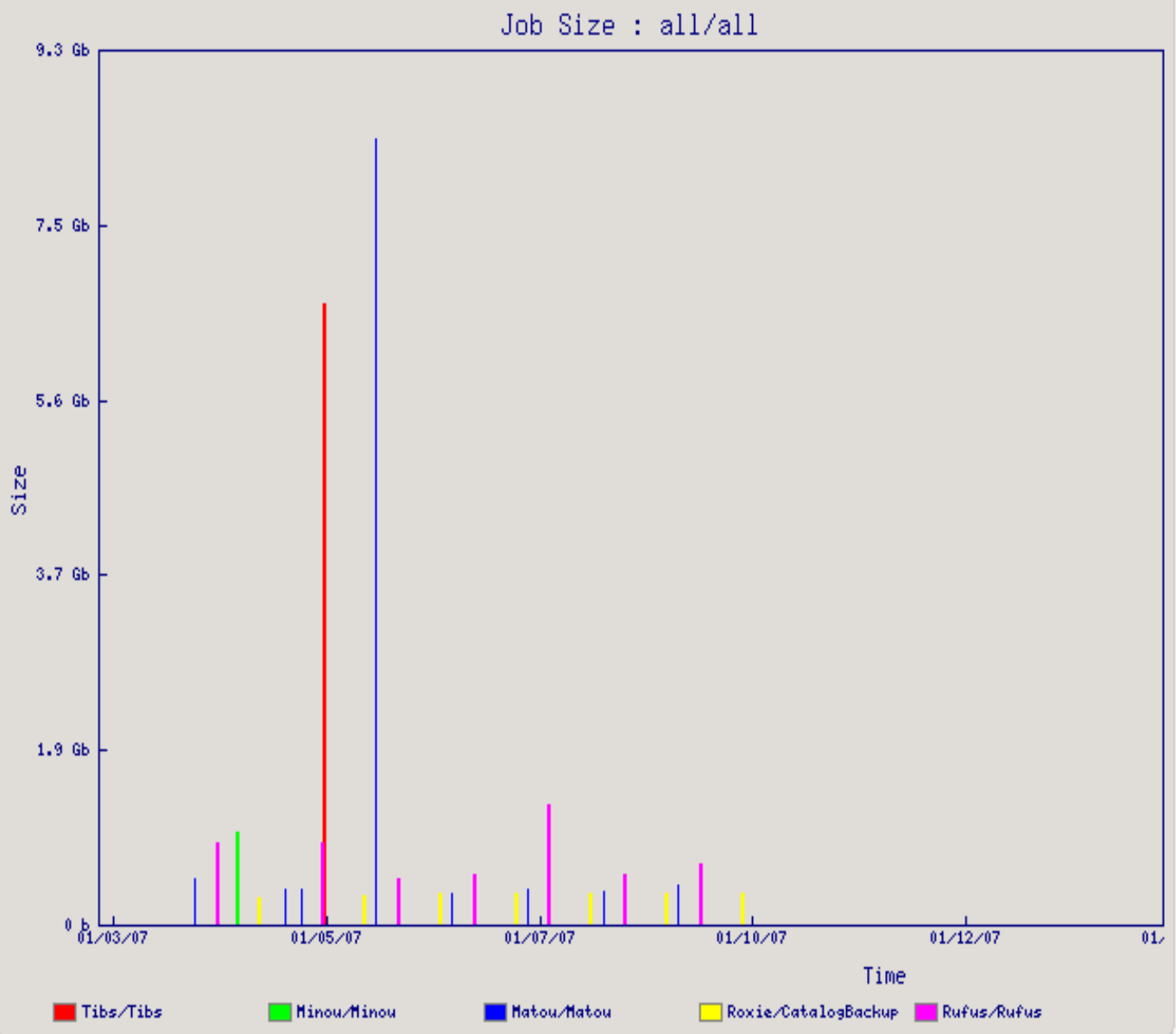
Type: Job Size

Number of items: 100

Graph type: Bars

graph

Current

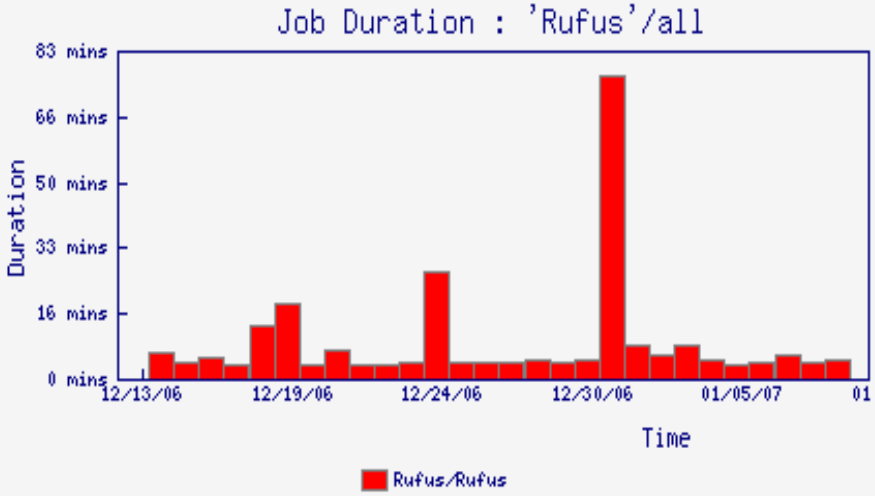
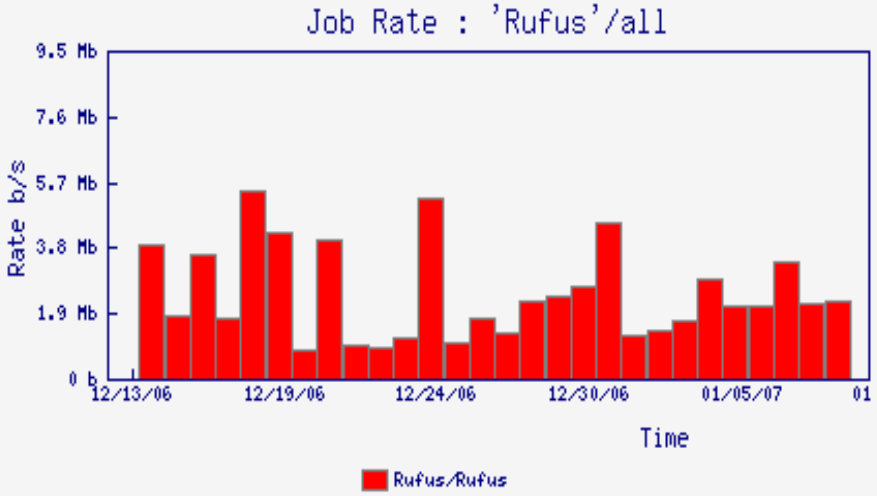
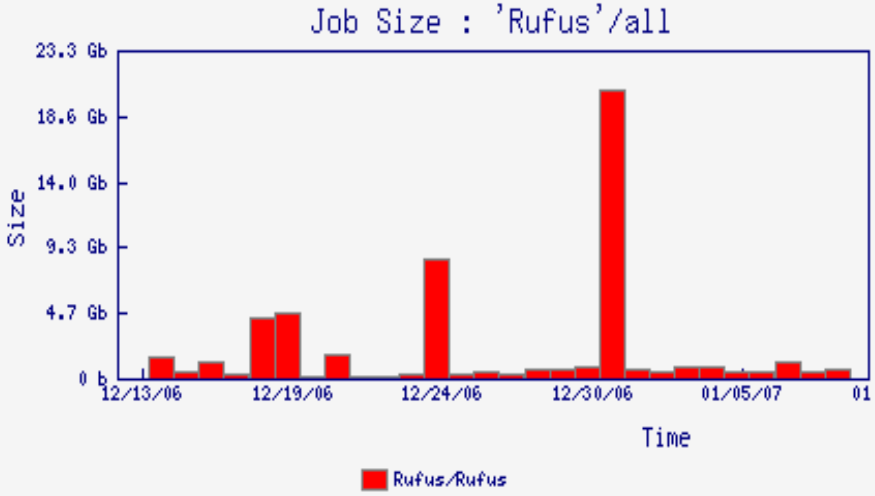


Clients

Name▲	Select	Desc	Auto Prune	File Retention	Job Retention
Matou	☐	1.39.29 (04Dec06) i686-pc-linux-gnu,redhat,(Stentz)	1	30 days	365 days
MatouVerify	☐		1	30 days	30 days
Minou	☐	Windows NT 4.0,MVS,NT 4.0.1381	1	30 days	365 days
Polymatou	☐	i686-pc-linux-gnu,redhat,(Stentz)	1	30 days	365 days
Roxie	☐	2.0.0 (28Dec06) i686-pc-linux-gnu,suse,10.2	1	30 days	365 days
Rufus	☐	1.39.34 (28Dec06) i686-pc-linux-gnu,suse,10.2	1	30 days	365 days
RufusVerify	☐	i686-pc-linux-gnu,redhat,(Bordeaux)	1	30 days	30 days
Tibs	☐	2.0.0 (04Jan07) Linux,Cross-compile,Win32	1	30 days	365 days
Timmy	☐	i686-pc-linux-gnu,redhat,(Stentz)	1	30 days	365 days
timmy-fd	☐	2.0.0 (28Dec06) i686-pc-linux-gnu,suse,10.2	1	30 days	365 days
Watchdog	☐		1	24 hours	30 days

Actions

Last jobs Current jobs Status Stats

Client : Rufus (last 7 days)

Name	Nb Jobs	Nb Bytes	Nb Files	Nb Errors
Rufus	7	5.3 Gb	44540	0