Friedrich-Schiller-Universität Jena

27.09.2016

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The backup report of the Friedrich Schiller University Jena

Open Source **Backup** Conference

seit 1558

10 Faculties

- **Theology**
- Faculty of Law
- Economics
- Philosophy
- Social and Behavioural Sciences
- Mathematic & **Computer Science**
- **Physics** and Astronomy
- Chemistry and Earth Sciences
- Biology and Pharmacy
- **Medicine**

...

- many scientific departments and institutes

- other facilities
  - Academic Affairs
  - Human Resources
  - Library (ThULB)
  - ...

Needs & Conclusions

- independent -> difficult to set rules

- freedom of research and education

- very heterogeneous resources and knowledge

  - sometimes own IT department

  - sometimes nothing

- sometimes rival to each other

→ different requirements

→ self service (notification, restore)

→ separation (only show self information)

- replace our two backup systems

  - Veritas NetBackup

    ➢ old and no support

    ➢ 400TB, 400 million files, 120 clients

  - Atempo Time Navigator

    ➢ failed to replace NetBackup (unsatisfactory)

    ➢ license expires in fall 2016

    ➢ 2 catalogs, 750TB, 460 million files, 150 clients

- long-term satisfying backup system

Veritas NetBackup

- antique GUI

✓ command interface available

✓ save backup data as files (.tar) in our HSM

− license fee for special things (NDMP,…)

− difficult client installing

− not intuitively operable concerning restoring in client

- problem with offline clients → retention expires

- ✓ campus license (all inclusive)
- ✓ many features included (NDMP, NetworkShare, SQL, Exchange, VMware, …)
- ✓ intuitive restoring with GUI (on client)
- • GUI only (no really useable CMD interface) → many clicks necessary
- – proprietary (no SQL) catalog max. 512GB
- – no cross-restoring without catalog administrator rights
- – no/bad restrictions
  - • all configured backups in catalog are visible for everybody
  - • possible to restore world-readable files from other clients
  - • some world-writeable files/dirs in installation directory
- • no spooling → only indirect with VTL and migration

backup system

- stable system
- stable configuration
- stable catalog
- useful command-interface
- ACL, right management for users (self service)
- LTO6-Library useable
- save files on HSM
- longtime or no license
- incremental forever or virtual full (for laptops/desktops)

clients

- Windows
- Linux
- MacOS
- Filer (Isilon, NetApp) via NDMP
- Novell Filer
- Exchange Server
- VMware Cluster
- DBMS (MySQL, MariaDB, Oracle, MS SQL)

- open source → no migration necessary (no license validity) !!
- configuration files → stable, easy saveable
- good and scriptable command-interface
- uses real! SQL database ☺
  - no catalog restrictions (size,…)
  - possibility to develop own SQL reports
- uses standards (i.e. mtx for library control)
- good file backup (Windows, Linux, Novell Filer)
- self service
  - restricted console
 - notifications after backup

- self service for users

  - no useable GUI

  - WebUI was not available

  - no LDAP users!

- NDMP at file level → has to be developed

- Exchange → no special client

- VMware → not finished

- DBMS → nothing special

- NetDisk → problematic backup of Windows/NAS share

Handle Cons

- SQL → use dump via 'run before script'

- Exchange → use Windows-Backup via 'run before script'

- file level NDMP for Isilon → funded development

- wait for WebUI with LDAP users (hopefully soon!!)

- VMware → use temporary VMware integrated backup

- NetDisk → try to unsupport this

- use consulting for initial installing

  - thereby gathering of knowledges to run by our own

- replace backup systems until spring 2016

- use existing LTO6-Library

LTO6-Library
with Partitions
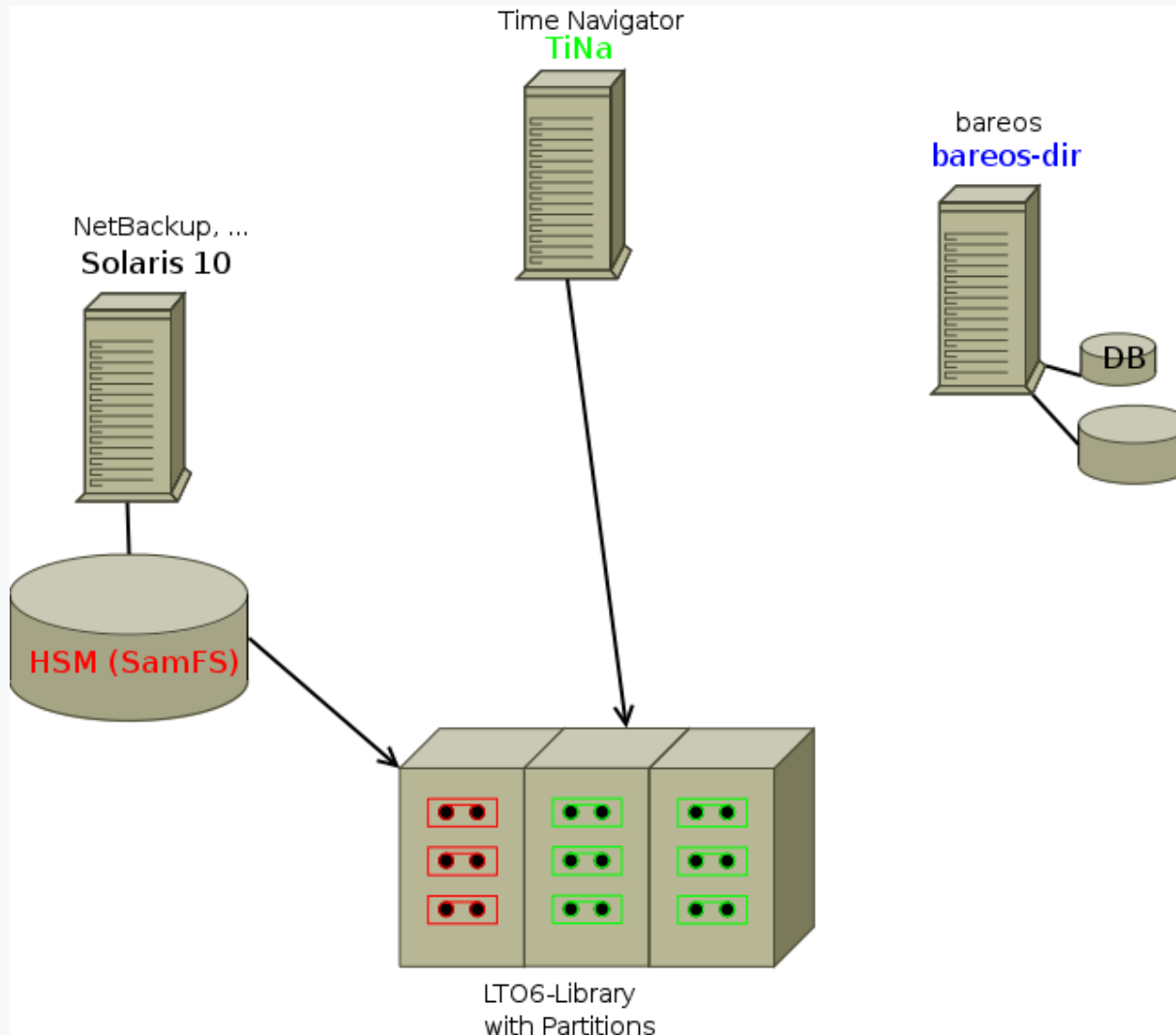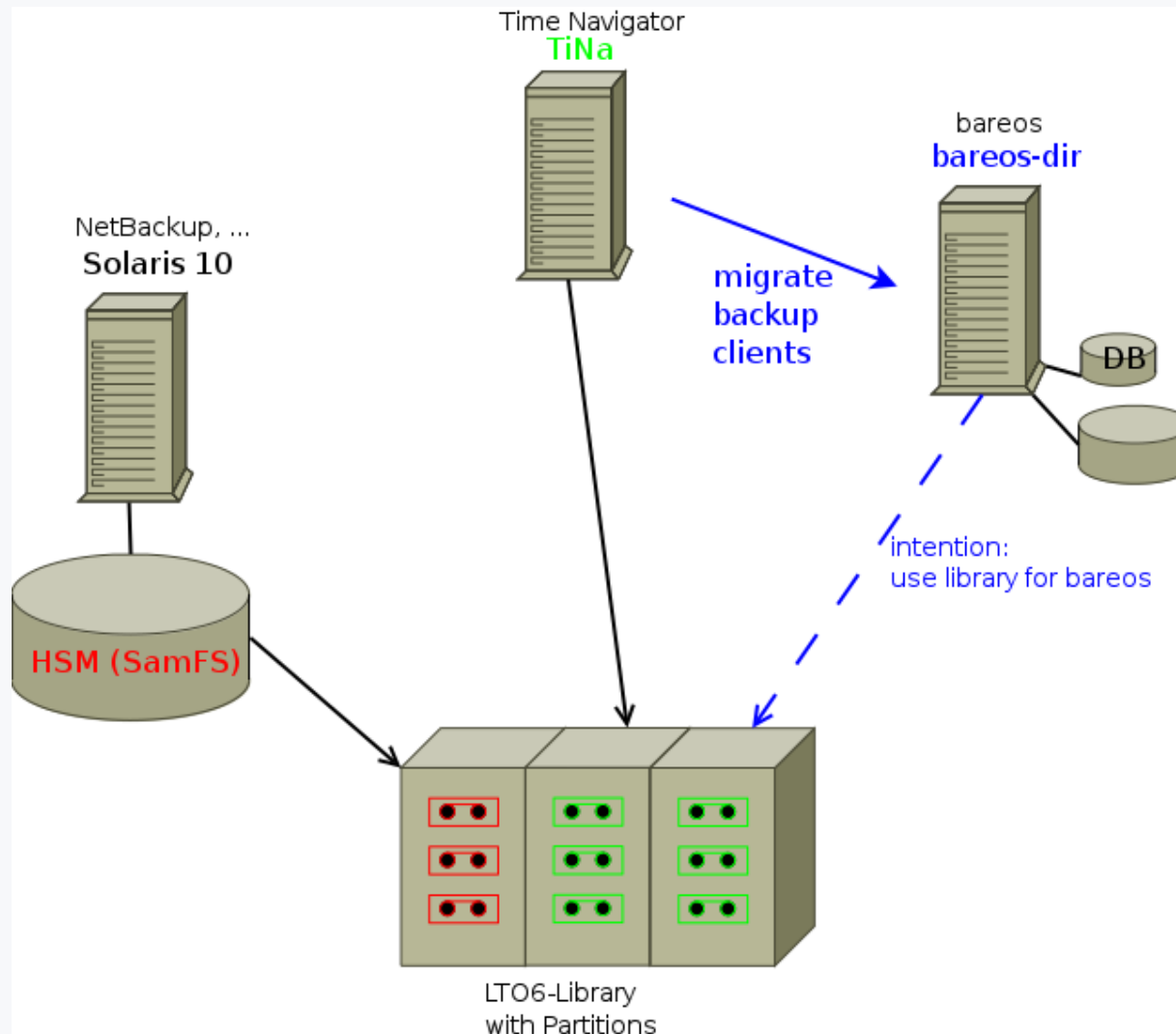
- used consulting for initial installing and setup

  ✓ Daniel Neuberger (dass IT) → many thanks to him

- installing of Bareos-Dir (new Linux server)

- installing of Bareos-SD on Solaris

  - with local virtual autochanger (on HSM file system)

- configured some default Pools, Jobdefs, Filesets, Schedules

- installed and tested NDMP-Clients

- migration of clients from Time Navigator to Bareos
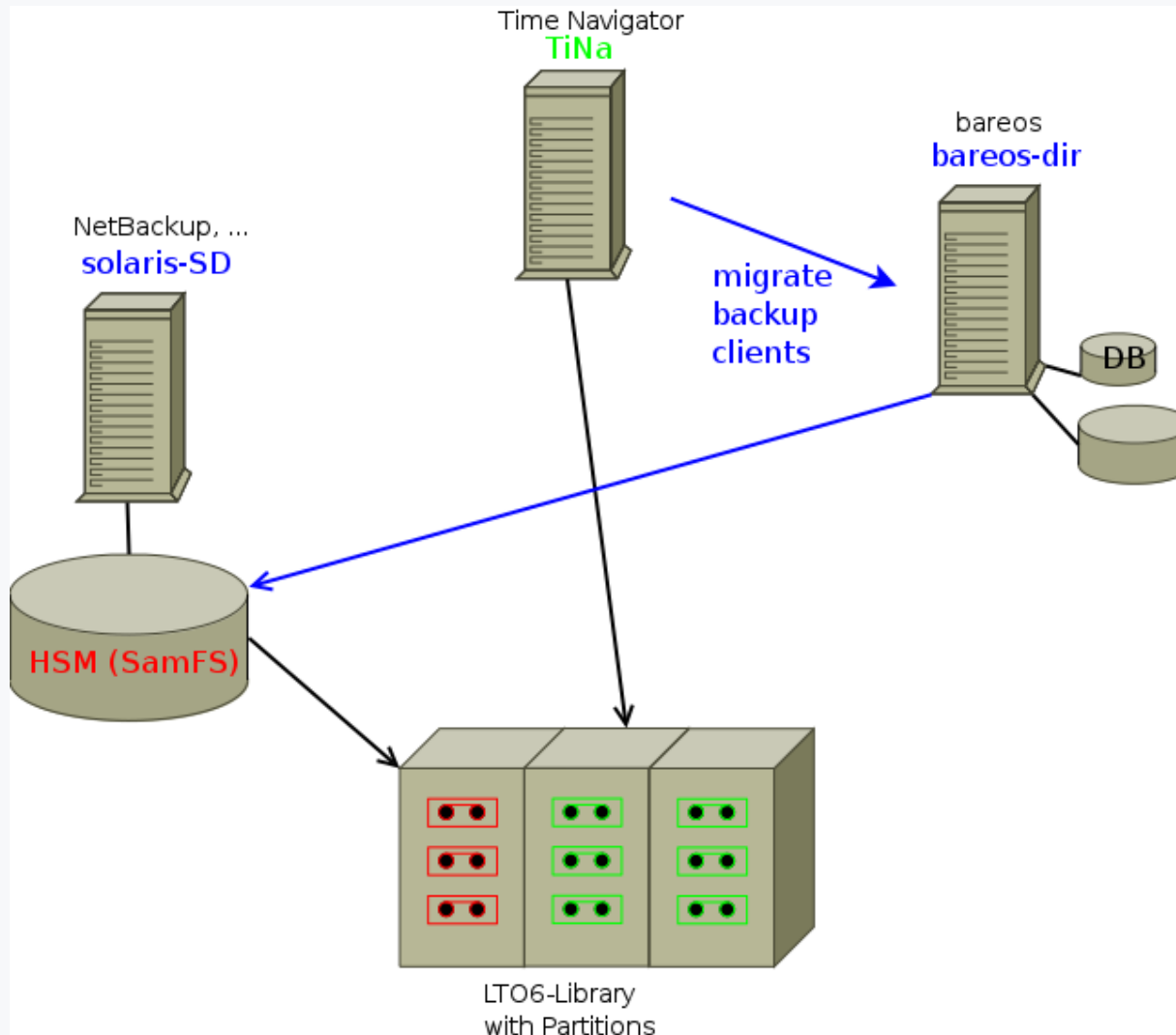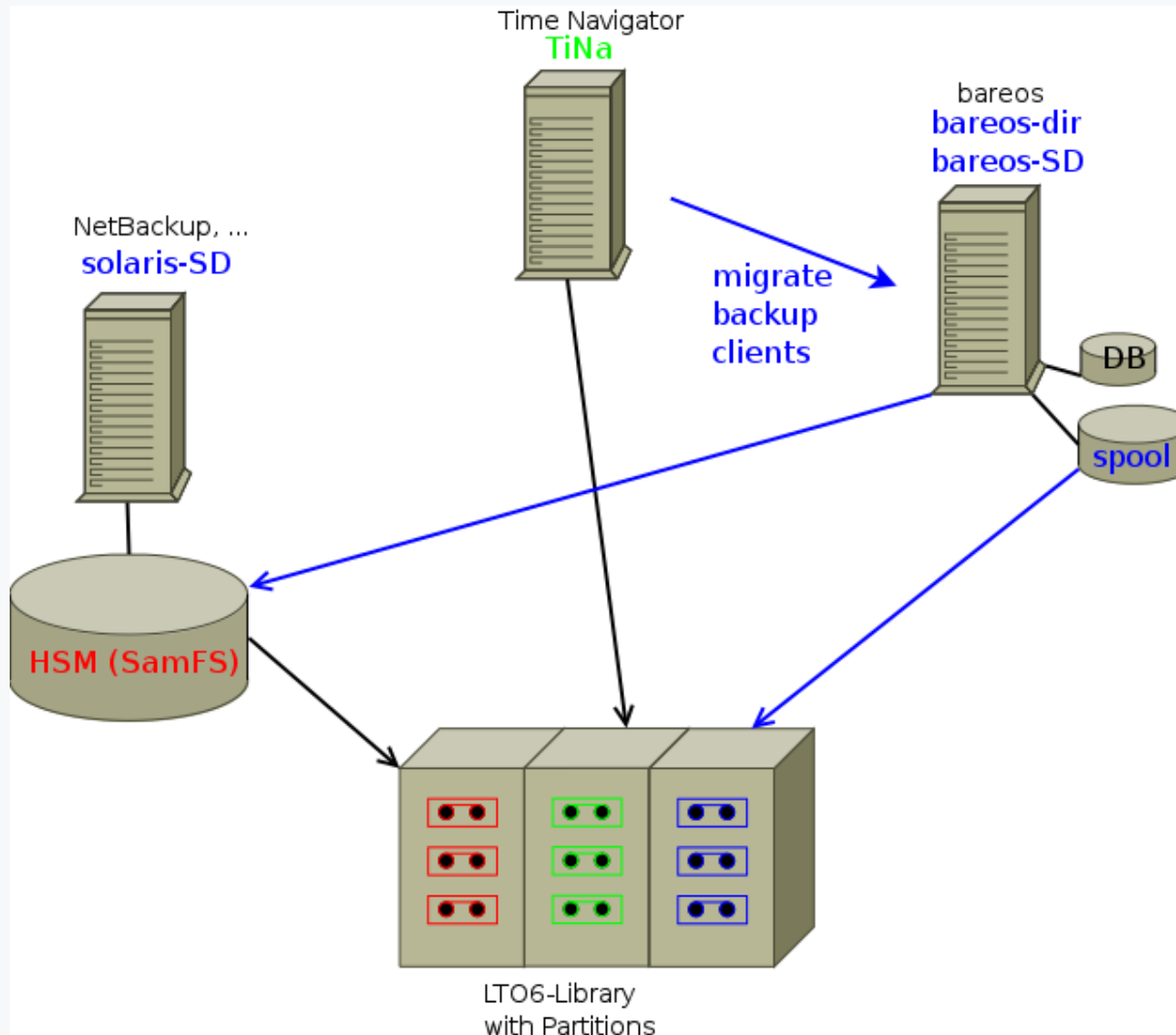
- some data migrated (freed space on library)

  → create new partition for Bareos

- install Bareos-SD on Linux

  - map library partition in SAN

- move data / jobs to new SD

  - change Jobdef to new Pool

- … from time to time …

  - decrease Time Navigator partition (in library)

  - increase Bareos partition (in library)

  → very easy to increase tape slots in Bareos

Server Backup Strategy
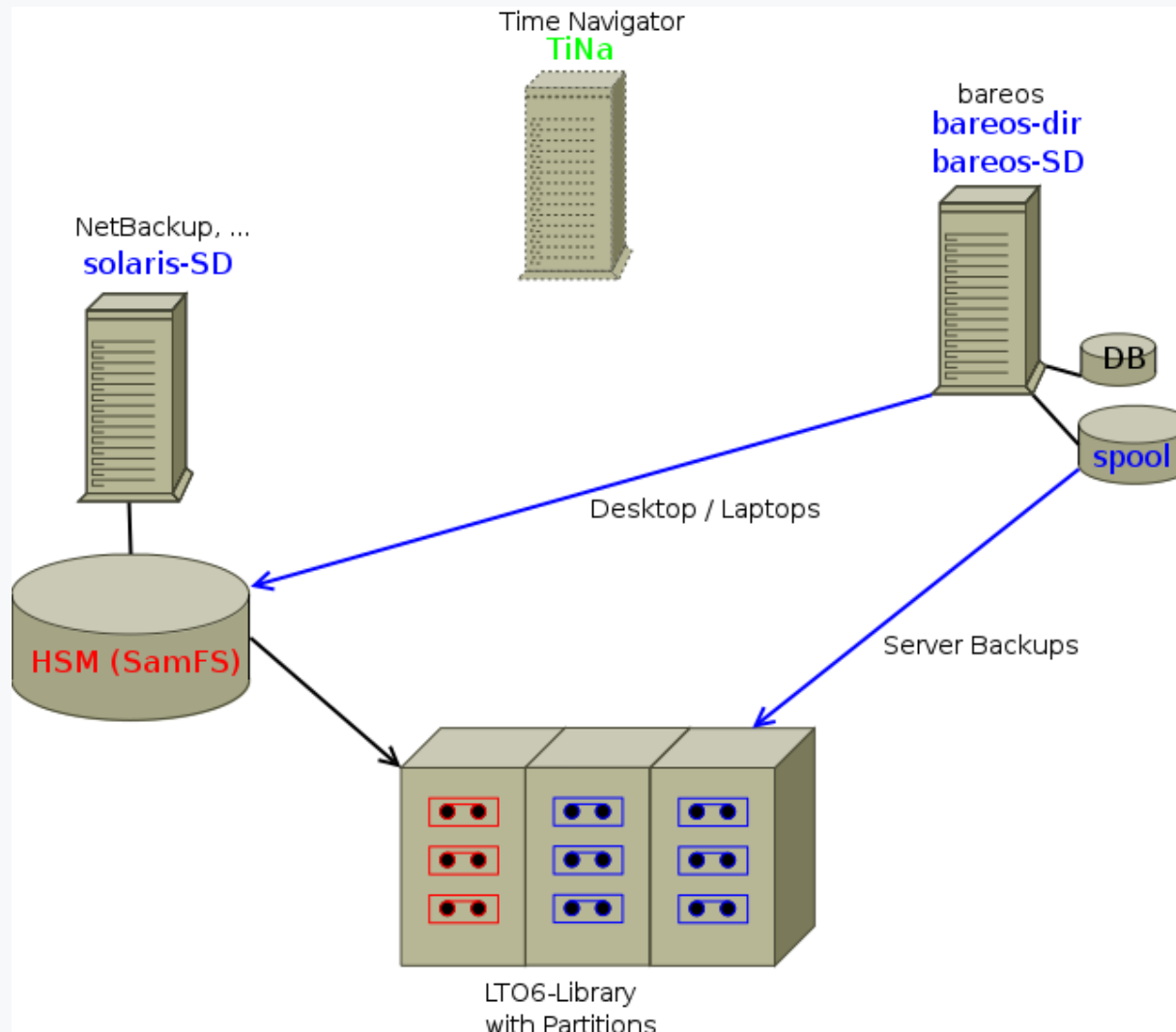
- backup data to local spool

- despooling to LTO6-Library (Linux-SD)

- Pools by retention (3 months, 3 weeks, 1 year, …)

- special Pools (NDMP3M, NDMP3W)

- inefficient use of tape drives detected!

  - first 2 drives, now 4 drives

  - all backups in a Pool uses only 1 drive → more drives not used

  - drive is already reserved while spooling → drive is blocked for other Pools

  - ‚Prefer Mounted Volumes = no' → one Pool reserves all drives

Desktop and Laptop Backup

- no normal scheduling of clients → online/offline?

- 1 trigger job which starts a script daily at 09:00, 12:00, 15:00

  - select clients by schedule=VFS

  - check if client is available (FD-Port 9102 open)

  - start incremental backup

- normal schedule (VFS) starts ‚virtual full' 2 times per month

- save backups to virtual autochanger (SD on Solaris) via HSM

- works as designed ☺

  - stable (running, database, configuration)

  - likely command-interface

  - own SQL reports possible

- nice NDMP funding development

- support works, especially on critical bugs

- current status:

  - 183 clients (244 jobs)

  - >1000 million files, ~1PB saved

  - 428 LTO6-Tapes, 4 LTO6-Drives

  - on HSM 13TB (client backups)

- self service –> status e-mail

  - set description for e-mail address and mode of client

  - run after script: contact_user.pl

    - collects data from job and client

        show client=…

        llist jobid=…

        list joblog jobid=…

    - send e-mail to user if necessary

- self service –> restricted consoles

  - we use one configuration file per client

  - set tags (in comment) on client files for allowed user

    - # Admin: user1, user2

  - script: update-user.pl

    - generate restricted console with random password

    - update ACLs for all necessary Jobs, Clients, …

    - enable LDAP-Login on remote host

    - copy Bareos bconsole-configuration to remote host

    - → goal: known LDAP-Users on Bareos console

- status monitor via watch + status storage + awk-script

```
Every 2.0s: ssh fsuj01 ls -l /bareos_cache/*pool ; ls -l /backup/spool/*pool ; printf "status storage=VirtualStorageVIB\nstatu...   Sun Sep 25 00:27:54 2016

/bareos_cache/*pool: No such file or directory
-rw-r----- 1 bareos bareos 112252393875 Sep 25 00:27 /backup/spool/bareos1-sd.data.51771.ulblin07.thulb-bj1.2016-09-23_19.10.01_01.LTO6-twr-05.spool
-rw-r----- 1 bareos bareos  62362529792 Sep 25 00:27 /backup/spool/bareos1-sd.data.51773.ulblin16.thulb-bj1.2016-09-23_19.10.01_03.LTO6-twr-05.spool
-rw-r----- 1 bareos bareos 132761767936 Sep 25 00:27 /backup/spool/bareos1-sd.data.51813.winex03.ads-bj.2016-09-23_20.02.00_59.LTO6-twr-03.spool
-rw-r----- 1 bareos bareos  55991177216 Sep 25 00:27 /backup/spool/bareos1-sd.data.51838.fsuj-fe-c337904.ads-bj.2016-09-24_00.00.00_18.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos     49283636 Sep 24 19:56 /backup/spool/bareos1-sd.data.51898.daedalus.iap-bj_home.2016-09-24_00.10.00_06.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  35119980544 Sep 25 00:27 /backup/spool/bareos1-sd.data.51912.mail1.rz-bjmd-uz.2016-09-24_00.14.00_28.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos 209288605696 Sep 25 00:27 /backup/spool/bareos1-sd.data.51913.ipc671.bioinf-bj.2016-09-24_00.14.00_29.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos 170264476169 Sep 24 19:48 /backup/spool/bareos1-sd.data.51914.ipc662.bioinf-bj.2016-09-24_00.14.00_30.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  67038327953 Sep 24 19:47 /backup/spool/bareos1-sd.data.51917.sl-fsfn1.med-bj_dat7.2016-09-24_00.14.00_33.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos   7273006368 Sep 24 19:47 /backup/spool/bareos1-sd.data.51918.winpdc02.mirzms-bj.2016-09-24_00.14.00_34.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  11926794240 Sep 25 00:27 /backup/spool/bareos1-sd.data.51919.prost.bioinf-bj.2016-09-24_00.14.00_35.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos 181133090934 Sep 24 19:48 /backup/spool/bareos1-sd.data.51922.dresden.biomag-bj_raid19.2016-09-24_00.15.00_50.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  34830947519 Sep 24 19:48 /backup/spool/bareos1-sd.data.51923.berlin.biomag-bj_raid8.2016-09-24_00.15.00_51.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  93202198528 Sep 25 00:27 /backup/spool/bareos1-sd.data.51924.berlin.biomag-bj_raid12.2016-09-24_00.15.00_52.LTO6-twr-04.spool
-rw-r----- 1 bareos bareos  84988006400 Sep 25 00:27 /backup/spool/bareos1-sd.data.51925.meggy.rz-bj1.2016-09-24_00.50.36_38.LTO6-twr-03.spool
-rw-r----- 1 bareos bareos 165828730880 Sep 25 00:27 /backup/spool/bareos1-sd.data.51933.NDMP-zufs-bj_SERVICE.2016-09-24_01.32.00_57.LTO6-twr-06.spool
-rw-r----- 1 bareos bareos 419375430484 Sep 24 19:48 /backup/spool/bareos1-sd.data.51945.NDMP-zufs-bj_FSUJ_RZ.2016-09-24_01.32.01_09.LTO6-twr-06.spool
-rw-r----- 1 bareos bareos  72758091776 Sep 25 00:27 /backup/spool/bareos1-sd.data.51946.NDMP-zufs-bj_FSUJ_SVW.2016-09-24_01.32.01_10.LTO6-twr-06.spool
-rw-r----- 1 bareos bareos  46950527700 Sep 25 00:27 /backup/spool/bareos1-sd.data.51949.NDMP-zufs-bj_FSUJ_WIWI.2016-09-24_01.32.01_13.LTO6-twr-06.spool
-rw-r----- 1 bareos bareos  25551992159 Sep 25 00:27 /backup/spool/bareos1-sd.data.52022.jenlbs6.thulb-bj1.2016-09-24_19.00.02_27.LTO6-twr-05.spool
-rw-r----- 1 bareos bareos       357774 Sep 25 00:27 /backup/spool/bareos1-sd.data.52027.sl-cscc2.med-bj1.2016-09-24_22.05.00_50.LTO6-twr-04.spool
```

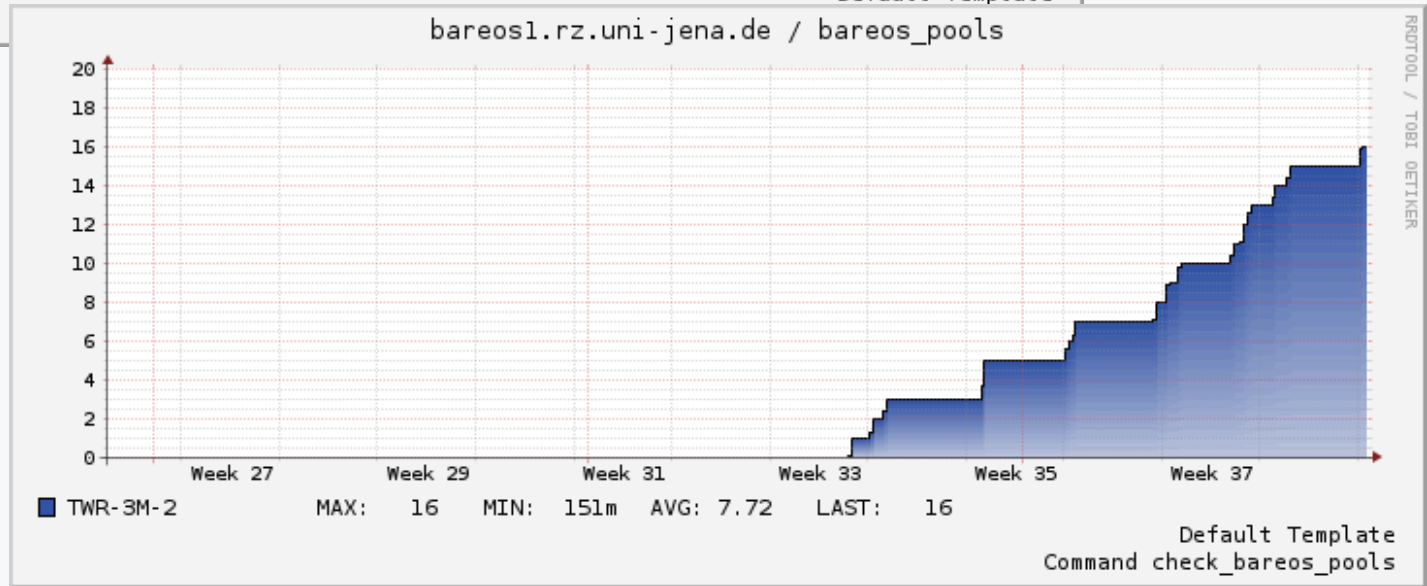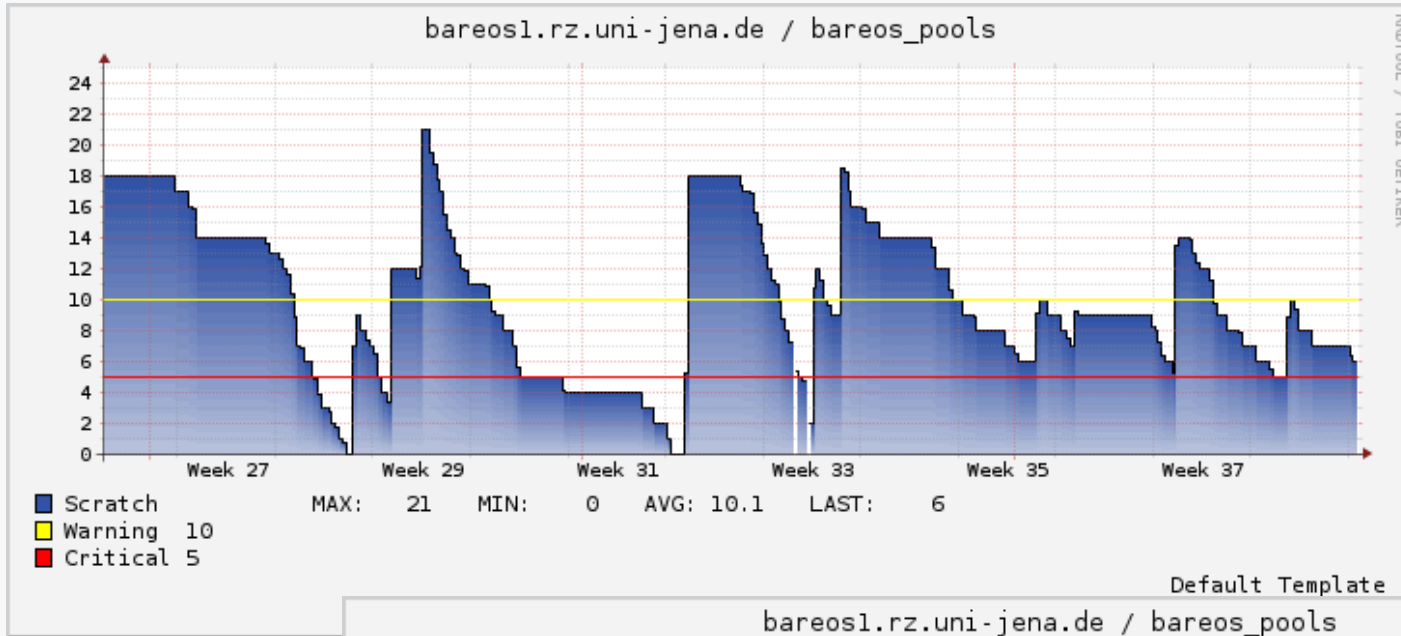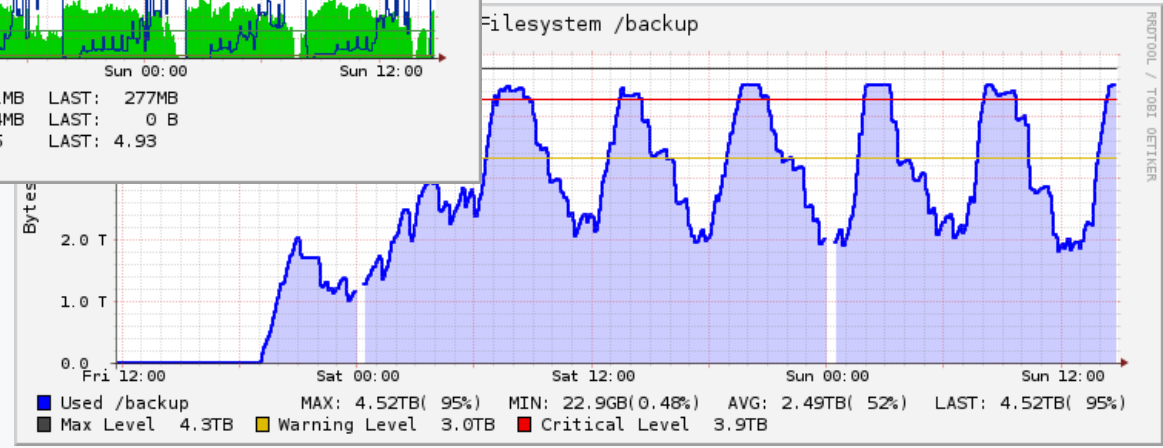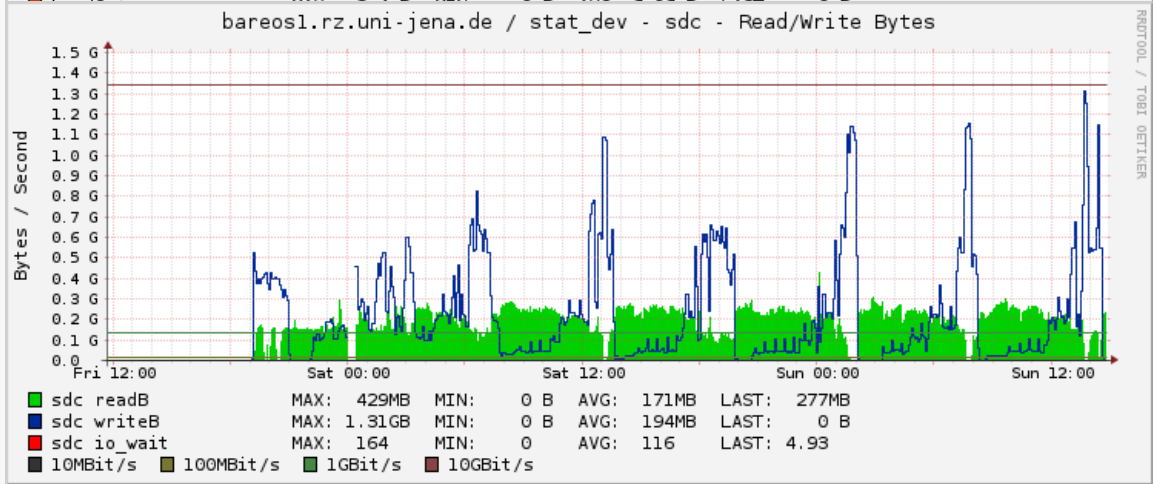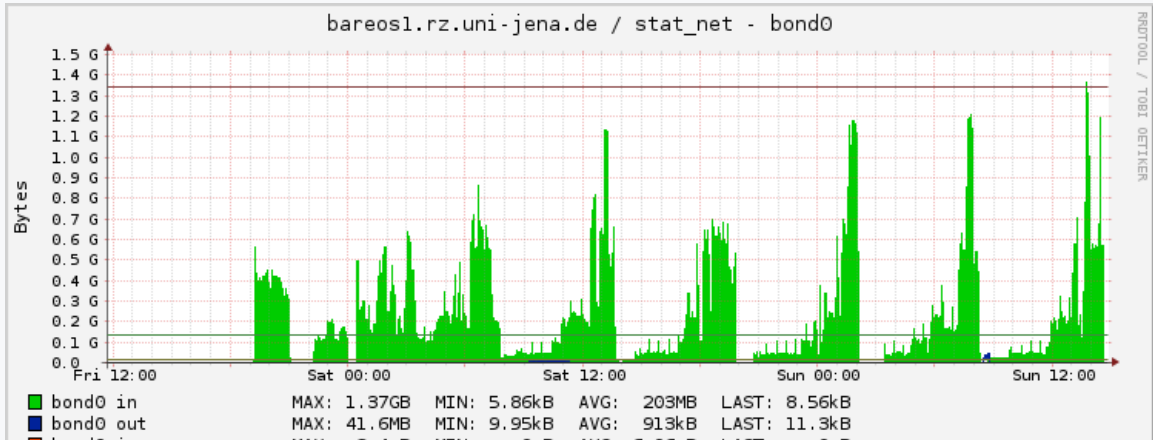|	Level	JobName	JobID	Volume	Pool	device	DSpooling	Files	Data	AVG	LAST
Writing:	Full	ulblin07.thulb-bj1	51771	OF0549L6	TWR-3W	LTO6-twr-05	spooling	245,544	1,881,328,085,086 B	16.1MB/s	15.7MB/s
Writing:	Full	ulblin16.thulb-bj1	51773	OF0549L6	TWR-3W	LTO6-twr-05	spooling	621,837	2,628,518,752,116 B	15.9MB/s	15.3MB/s
Writing:	Full	winex03.ads-bj	51813	OF0307L6	TWR-3M-2	LTO6-twr-03	spooling	20	1,334,498,833,604 B	15.9MB/s	15.3MB/s
Writing:	Full	fsuj-fe-c337904.ads-bj	51838	OF0450L6	TWR-3M	LTO6-twr-04	spooling	16,163	1,408,463,430,924 B	15.7MB/s	15.3MB/s
Writing:	Diffe	NDMP-zufs-bj_SERVICE	51933	OF0567L6	TWR-NDMP3M	LTO6-twr-06	spooling	1	1,619,982,314,577 B	15.8MB/s	15.3MB/s
Writing:	Incre	daedalus.iap-bj_home	51898	OF0450L6	TWR-3M	LTO6-twr-04	despool_w	2,820	8,620,460,654 B	0.0 B/s	0.0 B/s
Writing:	Incre	daedalus.iap-bj_owncloud	51899	OF0450L6	TWR-3M	LTO6-twr-04	--	0	0 B	0.0 B/s	0.0 B/s
Writing:	Full	mail1.rz-bjmd-uz	51912	OF0307L6	TWR-3M-2	LTO6-twr-03	spooling	4,059,451	875,548,958,401 B	16.1MB/s	15.7MB/s
Writing:	Full	ipc671.bioinf-bj	51913	OF0450L6	TWR-3M	LTO6-twr-04	spooling	4,529,891	787,724,277,945 B	15.9MB/s	15.3MB/s
Writing:	Full	ipc662.bioinf-bj	51914	OF0450L6	TWR-3M	LTO6-twr-04	despool_w	5,852,420	566,375,162,425 B	0.0 B/s	0.0 B/s
Writing:	Full	sl-fsfn1.med-bj_dat7	51917	OF0450L6	TWR-3M	LTO6-twr-04	despool	153,219	234,085,524,007 B	0.0 B/s	0.0 B/s
Writing:	Full	NDMP-zufs-bj_FSUJ_RZ	51945	OF0567L6	TWR-NDMP3M	LTO6-twr-06	despool	1	1,124,310,168,657 B	0.0 B/s	0.0 B/s
Writing:	Full	winpdc02.mirzms-bj	51918	OF0450L6	TWR-3M	LTO6-twr-04	despool_w	584,870	113,343,255,690 B	0.0 B/s	0.0 B/s
Writing:	Full	prost.bioinf-bj	51919	OF0450L6	TWR-3M	LTO6-twr-04	spooling	102,545	705,705,876,727 B	15.9MB/s	15.3MB/s
Writing:	Full	daedalus.iap-bj_user	51921	OF0450L6	TWR-3M	LTO6-twr-04	--	0	0 B	0.0 B/s	0.0 B/s
Writing:	Full	dresden.biomag-bj_raid19	51922	OF0450L6	TWR-3M	LTO6-twr-04	despool_w	2,016	269,739,634,560 B	0.0 B/s	0.0 B/s
Writing:	Full	berlin.biomag-bj_raid8	51923	OF0450L6	TWR-3M	LTO6-twr-04	despool_w	353,414	261,228,346,470 B	0.0 B/s	0.0 B/s
Writing:	Full	berlin.biomag-bj_raid12	51924	OF0450L6	TWR-3M	LTO6-twr-04	spooling	381,183	584,691,511,818 B	16.3MB/s	15.7MB/s
Writing:	Full	meggy.rz-bj1	51925	OF0307L6	TWR-3M-2	LTO6-twr-03	spooling	1,041,261	567,388,717,520 B	15.9MB/s	15.3MB/s
Writing:	Full	NDMP-zufs-bj_FSUJ_SVW	51946	OF0567L6	TWR-NDMP3M	LTO6-twr-06	spooling	1	514,320,113,746 B	15.9MB/s	15.3MB/s
Writing:	Full	NDMP-zufs-bj_FSUJ_WIWI	51949	OF0567L6	TWR-NDMP3M	LTO6-twr-06	spooling	1	240,671,692,883 B	15.9MB/s	15.3MB/s
Writing:	Incre	jenlbs6.thulb-bj1	52022	OF0549L6	TWR-3W	LTO6-twr-05	spooling	550	25,554,456,929 B	16.0MB/s	15.6MB/s

- SQL report: expired volumes

```
root@bareos1:~# date && cat /root/dev_checks/expire1.sql |sudo -u postgres psql bareos |grep -v Reserve | head -n 45
Sun Sep 25 00:31:29 CEST 2016
could not change directory to "/root": Permission denied
   vname  | vstatus |    pool     | jobs |    lastwritten      |     retention      | recycle |   expired_since_start   |   expired_since_end
---------+---------+-------------+------+---------------------+--------------------+---------+-------------------------+------------------------
 OF0414L6 | Append  | Scratch     |    0 |                     |                    |       1 |                         |
 OF0495L6 | Append  | Scratch     |    0 |                     |                    |       1 |                         |
 OF0512L6 | Purged  | Scratch     |    0 | 2016-07-24 17:56:26 | 22 days 02:00:00   |       1 | 1 mon 9 days 04:35:04   |
 OF0656L6 | Purged  | Scratch     |    0 | 2016-07-25 16:42:35 | 22 days 02:00:00   |       1 | 1 mon 8 days 05:48:55   |
 OF0556L6 | Full    | Scratch     |    0 | 2016-05-24 15:54:07 | 2 mons 30 days 02:00:00 |  1 | 1 mon 1 day 06:37:23    |
 OF0588L6 | Full    | Scratch     |    0 | 2016-05-25 01:40:43 | 2 mons 30 days 02:00:00 |  1 | 1 mon 20:50:47          |
 OF0587L6 | Full    | Scratch     |    0 | 2016-05-25 11:23:36 | 2 mons 30 days 02:00:00 |  1 | 1 mon 11:07:54          |
 OF0542L6 | Full    | TWR-3M      |    0 | 2016-06-14 06:35:10 | 2 mons 29 days 02:00:00 |  1 | 11 days 15:56:20        |
 OF0523L6 | Full    | TWR-3M      |    0 | 2016-06-14 12:34:01 | 2 mons 29 days 02:00:00 |  1 | 11 days 09:57:29        |
 OF0420L6 | Full    | TWR-3M      |    0 | 2016-06-14 19:24:45 | 2 mons 29 days 02:00:00 |  1 | 11 days 03:06:45        |
 OF0517L6 | Full    | TWR-3M      |    0 | 2016-06-15 04:04:19 | 2 mons 29 days 02:00:00 |  1 | 10 days 18:27:11        |
 OF0539L6 | Full    | TWR-3M      |    0 | 2016-06-15 21:02:42 | 2 mons 29 days 02:00:00 |  1 | 10 days 01:28:48        |
 OF0580L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-19 09:05:56 | 2 mons 29 days 02:00:00 |  1 | 6 days 13:25:34         |
 OF0541L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-19 20:23:27 | 2 mons 29 days 02:00:00 |  1 | 6 days 02:08:03         |
 OF0548L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-20 05:39:19 | 2 mons 29 days 02:00:00 |  1 | 5 days 16:52:11         |
 OF0546L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-20 14:03:00 | 2 mons 29 days 02:00:00 |  1 | 5 days 08:28:30         |
 OF0553L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-20 20:52:34 | 2 mons 29 days 02:00:00 |  1 | 5 days 01:38:56         |
 OF0578L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-21 06:41:43 | 2 mons 29 days 02:00:00 |  1 | 4 days 15:49:47         |
 OF0358L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-21 18:20:58 | 2 mons 29 days 02:00:00 |  1 | 4 days 04:10:32         |
 OF0359L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-22 04:26:50 | 2 mons 29 days 02:00:00 |  1 | 3 days 18:04:40         |
 OF0360L6 | Full    | TWR-NDMP3M  |    0 | 2016-06-22 14:48:31 | 2 mons 29 days 02:00:00 |  1 | 3 days 07:42:59         |
 OF0593L6 | Full    | TWR-3M      |   41 | 2016-06-16 11:58:28 | 2 mons 29 days 02:00:00 |  1 | 9 days 10:33:02         | 9 days 12:18:40
 OF0500L6 | Full    | TWR-3M      |   84 | 2016-06-18 01:08:11 | 2 mons 29 days 02:00:00 |  1 | 7 days 21:23:19         | 7 days 21:02:10
 OF0507L6 | Full    | TWR-3W      |   53 | 2016-08-27 00:09:57 | 22 days 02:00:00   |       1 | 6 days 22:21:33         | 4 days 12:42:50
 OF0571L6 | Full    | TWR-3W      |   16 | 2016-08-27 11:02:47 | 22 days 02:00:00   |       1 | 6 days 11:28:43         | 4 days 12:42:50
 OF0503L6 | Full    | TWR-3W      |   60 | 2016-08-28 12:33:32 | 22 days 02:00:00   |       1 | 5 days 09:57:58         | 4 days 12:42:50
 OF0370L6 | Full    | TWR-3W      |  129 | 2016-08-29 08:18:29 | 22 days 02:00:00   |       1 | 4 days 14:13:01         | 4 days 12:42:50
 OF0527L6 | Full    | TWR-3M      |   53 | 2016-06-18 13:23:11 | 2 mons 29 days 02:00:00 |  1 | 7 days 09:08:19         | 4 days 05:31:24
 OF0583L6 | Full    | TWR-3M      |   18 | 2016-06-18 23:44:04 | 2 mons 29 days 02:00:00 |  1 | 6 days 22:47:26         | 4 days 05:31:24
 OF0332L6 | Full    | TWR-3W      |   60 | 2016-08-29 20:13:10 | 22 days 02:00:00   |       1 | 5 days 02:18:20         | 3 days 23:17:43
 OF0664L6 | Full    | TWR-NDMP3W  |   24 | 2016-08-30 03:01:41 | 22 days 02:00:00   |       1 | 3 days 19:29:49         | 3 days 19:27:40
 OF0547L6 | Full    | TWR-3W      |   66 | 2016-08-30 11:31:51 | 22 days 02:00:00   |       1 | 3 days 10:59:39         | 3 days 08:46:26
 OF0608L6 | Full    | TWR-3M      |   17 | 2016-06-19 12:17:51 | 2 mons 29 days 02:00:00 |  1 | 6 days 10:13:39         | 3 days 02:20:06
 OF0591L6 | Full    | TWR-3M      |   46 | 2016-06-20 00:54:40 | 2 mons 29 days 02:00:00 |  1 | 5 days 21:36:50         | 3 days 02:20:06
 OF0573L6 | Full    | TWR-3M      |   25 | 2016-06-20 11:51:10 | 2 mons 29 days 02:00:00 |  1 | 5 days 10:40:20         | 3 days 02:20:06
 OF0577L6 | Full    | TWR-3M      |   51 | 2016-06-20 23:19:06 | 2 mons 29 days 02:00:00 |  1 | 4 days 23:12:24         | 3 days 02:20:06
 OF0614L6 | Full    | TWR-3M      |   37 | 2016-06-21 07:49:22 | 2 mons 29 days 02:00:00 |  1 | 4 days 14:42:08         | 3 days 02:20:06
 OF0592L6 | Full    | TWR-3M      |   56 | 2016-06-22 07:08:40 | 2 mons 29 days 02:00:00 |  1 | 3 days 15:22:50         | 3 days 02:20:06
 OF0699L6 | Full    | TWR-3W      |  105 | 2016-08-31 07:44:21 | 22 days 02:00:00   |       1 | 2 days 14:47:09         | 2 days 09:16:48
 OF0380L6 | Full    | TWR-3W      |  115 | 2016-09-01 05:27:01 | 22 days 02:00:00   |       1 | 1 day 17:04:29          | 1 day 16:08:38
 OF0609L6 | Full    | TWR-3M      |  180 | 2016-06-25 06:48:03 | 2 mons 29 days 02:00:00 |  1 | 15:43:27                | 10:47:04
 OF0361L6 | Full    | TWR-NDMP3M  |   11 | 2016-06-25 07:13:41 | 2 mons 29 days 02:00:00 |  1 | 15:17:49                | 02:47:18
 OF0519L6 | Full    | TWR-3W      |  163 | 2016-09-02 22:40:50 | 22 days 02:00:00   |       1 | -00:09:20               | -1 days -04:25:02
```

Performance

bareos1.rz.uni-jena.de / stat_net - bond0

	MAX:	MIN:	AVG:	LAST:
bond0 in	1.37GB	5.86kB	203MB	8.56kB
bond0 out	41.6MB	9.95kB	913kB	11.3kB

bareos1.rz.uni-jena.de / stat_dev - sdc - Read/Write Bytes

	MAX:	MIN:	AVG:	LAST:
sdc readB	429MB	0 B	171MB	277MB
sdc writeB	1.31GB	0 B	194MB	0 B
sdc io_wait	164	0	116	4.93
10MBit/s 100MBit/s 1GBit/s 10GBit/s				

Filesystem /backup

	MAX:	MIN:	AVG:	LAST:
Used /backup	4.52TB(95%)	22.9GB(0.48%)	2.49TB(52%)	4.52TB(95%)
Max Level 4.3TB Warning Level 3.0TB Critical Level 3.9TB				

- efficient use of tape drives

  - reserve on demand (despooling), not at spooling

  - reserve more than one drive by Pool

- list-command respects ACL-Rights → fixed in version 16.2 ☺

- usefull WebUI with LDAP users

- parallel despooling and spooling for a job

  → use of spooling extends backup time

- new command: audit volume=…

- autoupdate for Windows client?

Thank you for your attention.