

The old data tape setup

We are given:

- A set of ~ 4000 2.5/5GB 8mm data and video tape cartridges written from 1992 and 1996 during the RUN-1 phase of the CDF experiment (Fermilab)
- A set of old autoloader (2 \times EZ17, 7-slots, 1 \times EXB-210, 10 slots)
- A textfiles based catalog describing tape content
- A working set of scsi (`mtx`) commands to perform basic operations on the autoloader and on the drive

The rescue problem

Our goal is to manage the extraction of most of the readable files from the old data tape set and copy them on current and reliable storage

- + Available autoloader can hold up to 7 or 10 tapes at once, depending on the model
- + A script can automate the interaction with the tape drive and the loader
- Problematic tapes can halt the reading process
- In case of error condition, manual intervention might be necessary
- File integrity validation not available
- + Data loss is acceptable up to a certain extent

Managing the reading process

We need to

- Keep track of the overall progress status and read failures
- Automate the read process and reduce manual interventions at a minimum
- Collect statistics, useful to plan further steps
- Operate all the available drive and loaders in parallel

Software tool

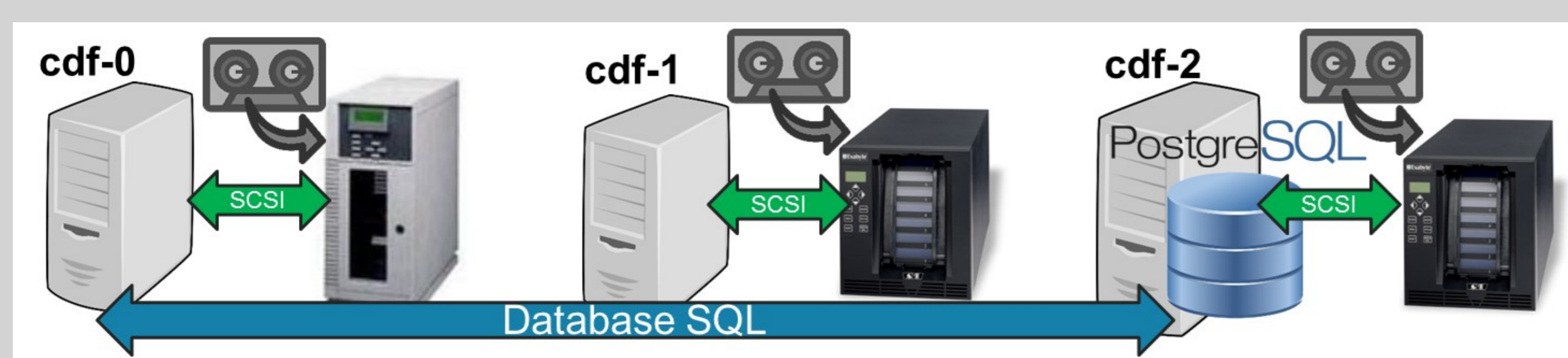
Python script

- Controls both tape movement and reading
- Notifies by email in case of work finished or blocking error
- Recognizes tape name by inspecting its header info
- Extracts files from position indicated in the backend database
- Updates read progress to the common backend database
- Performs the possible consistency checks

PostgreSQL database

- Initially populated from textfile catalog provided by the tape owner
- Reports filenames and their position in the tape
- On read success, filesize, reading times (start, end) and Adler32 checksum are stored in the database
- On read failure, the file status is correspondingly updated

The reading setup



Tapes and read problems

- ~ 3200 of the 4000 tapes to read actually are "video tapes" used as data tapes.
- A test performed by CDF (R. Krull, 1990) suggested the viability of this solution.
- 27 years after the test, however, the video tapes prove to be more error prone.
- Quite often, read error from these puts the drive in "cleaning request", which requires manual intervention.
- We decided to read the data tapes first.

Software operating states

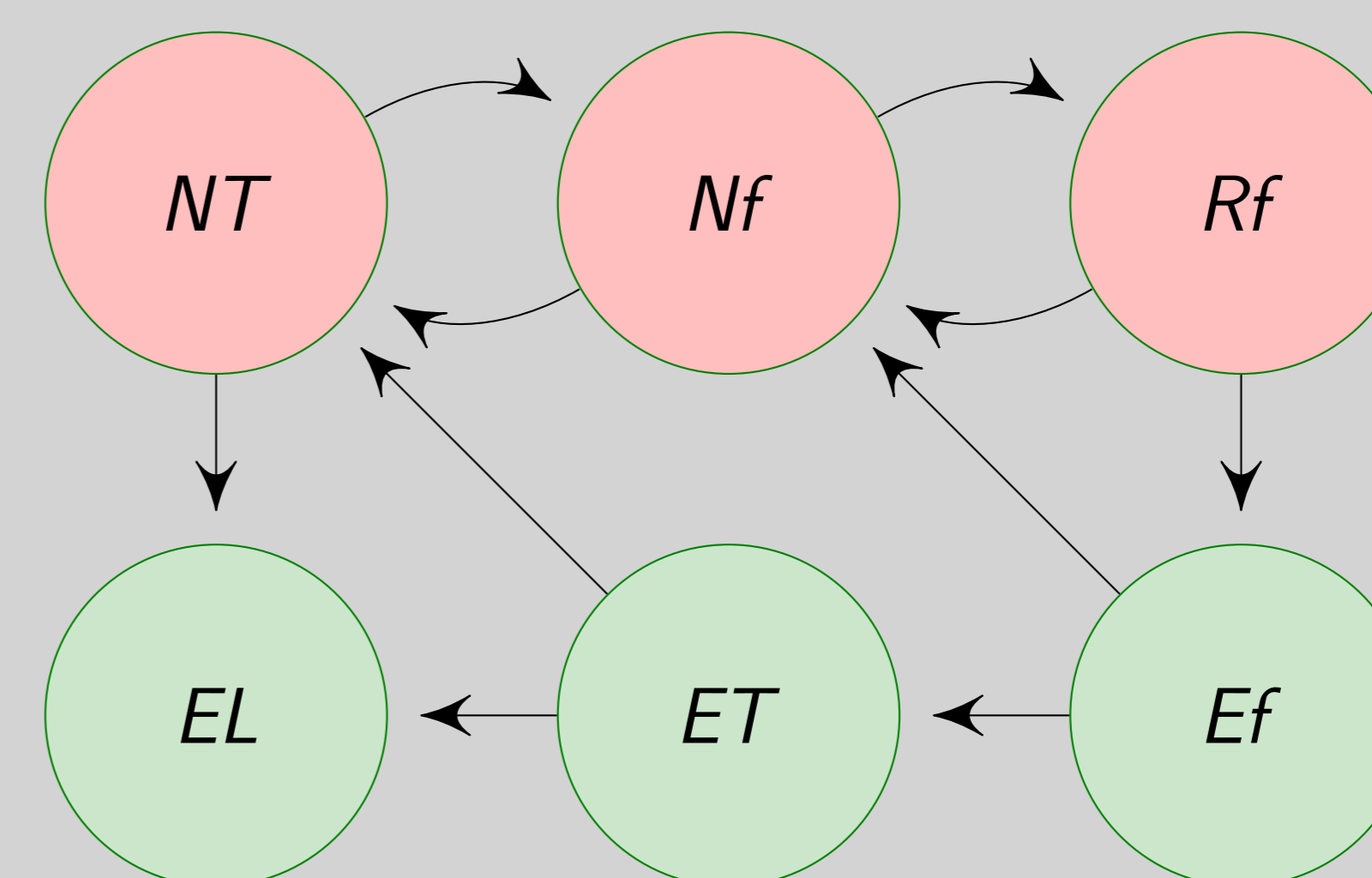


Figure: The Status Transition Map. The software tool operates as a Finite State Machine. In Normal Operation Mode (pink circles) the states are: **Next Tape** to umount and eject, then load and mount a new tape and recognize it by reading its header; **Next file** to retrieve from the database the name and the position of the next file in the tape; **Read file** to seek at the start position of the file, read and check for consistency its header, read the file. The error conditions (green circles) are: **Error file** An error before or while reading the file. Might be due to incoherent header or actual I/O error; **Error Tape** The tape could no be read further; **Error Loader** No more tapes could be loaded.

Tape read progress and read errors

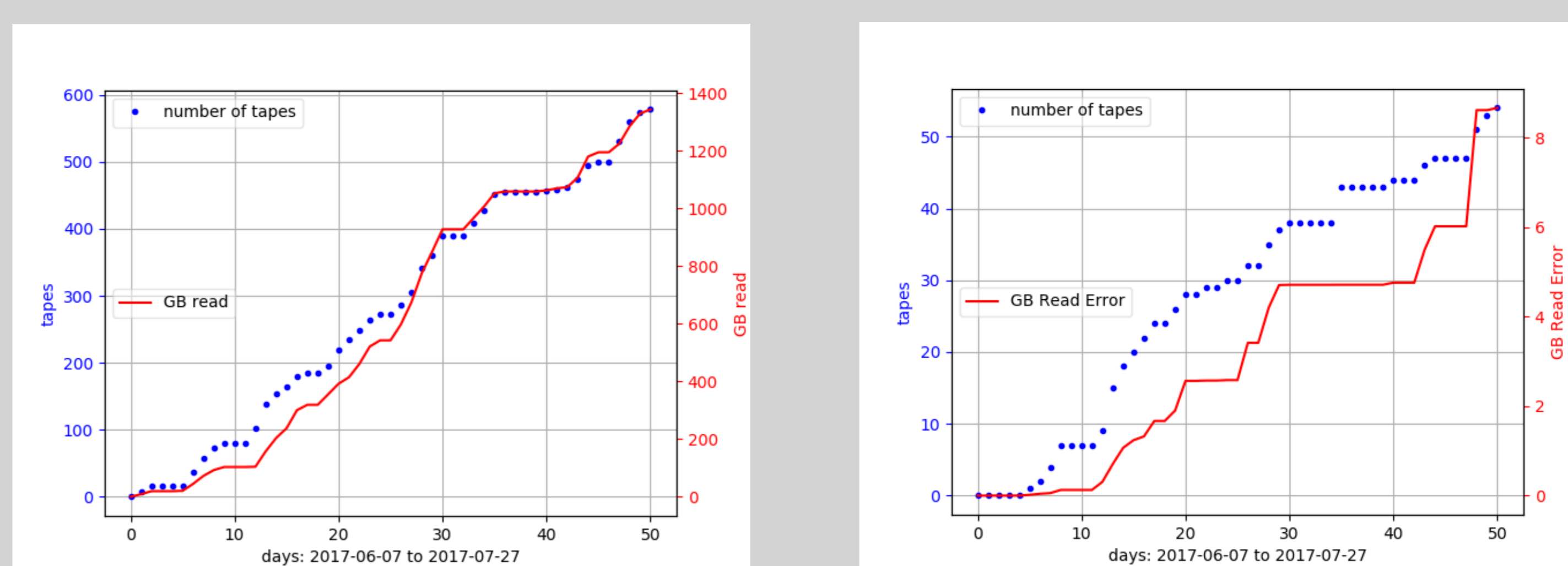


Figure: Reading progress and Read Errors by tape.

Reading activity by week

week	nfiles	GiB	cdf-0	cdf-1	cdf-2
23	1207	19.52	0	1207	0
24	6369	83.84	1600	4767	2
25	5526	215.82	781	2620	2125
26	3891	223.76	18	1095	2778
27	3852	385.17	866	1288	1698
28	5635	131.36	0	2385	3250
29	1021	136.05	99	376	546
30	5744	151.28	0	840	4904
31	240	4.36	0	240	0

Table: Reading activity by week and drive. The three available drives have had different performances. Drive *rd1* for example have had more frequent failures than the other two. However, after nine weeks all three the readers have frequent blocking errors with drives requiring cleaning much more frequently than expected

Conclusions

- The implemented solution has proved effective at reading a first 20% of the total amount.
- Eventhought a few aspects of this work are strictly dependant on how the CDF experiment organized its datasets, we believe that several decisions taken and the overall organization still make sense on a variety of use cases, where a relevant amount of data has to be retrieved from obsolete media.

References

- R. Krull "8mm video Tape Test", (FNAL, 1990) <http://lss.fnal.gov/archive/test-tm/1000/fermilab-tm-1702.pdf>
- P. P. Ricci, S. Dal Pra, E. Fattibene, A. Falabella, M. Pezzi, S. Amerio "Last developments of the INFN CNAF Long Term Data Preservation (LTDP) project: the CDF data recover and safekeeping", (ACAT, 2017)