BESSY

Berliner Elektronenspeicherring-Gesellschaft
für Synchrotronstrahlung m.b.H.

Development of a Standardized Data-Backup System for Protein Crystallography (PX-DBS)

Michael Hellmig, BESSY GmbH

Leibniz Gemeinschaft

Motivation

- Individual solutions for data backup at each synchrotron PX beamline
- With the introduction of new detectors and automation, planning of data backup becomes more important

Idea

- Setup of data backup early
- Simple-to-use software
- Open solution to be shared between synchrotrons
- Integration of device interfaces with significantly higher transfer rates
- Support for very high-capacity backup devices
- Classical interfaces still available
- Cost-efficient Implementation

Hardware prototype system: evaluation of components

Construction of a prototype computer system: Hardware evaluation

- Test of a set of commonly available hard disks from different manufacturers
- Test of different device interfaces to the backup devices

  Reference measurements with commonly used USB and Firewire interface
- External SATA interface (eSATA)

  Multi-disk container: all disks can be addressed with a single data cable

  Parallel writing can be implemented to increase total transfer rate
- SATA disk attached to an internal bus interface

Construction of a prototype computer system: Hardware evaluation

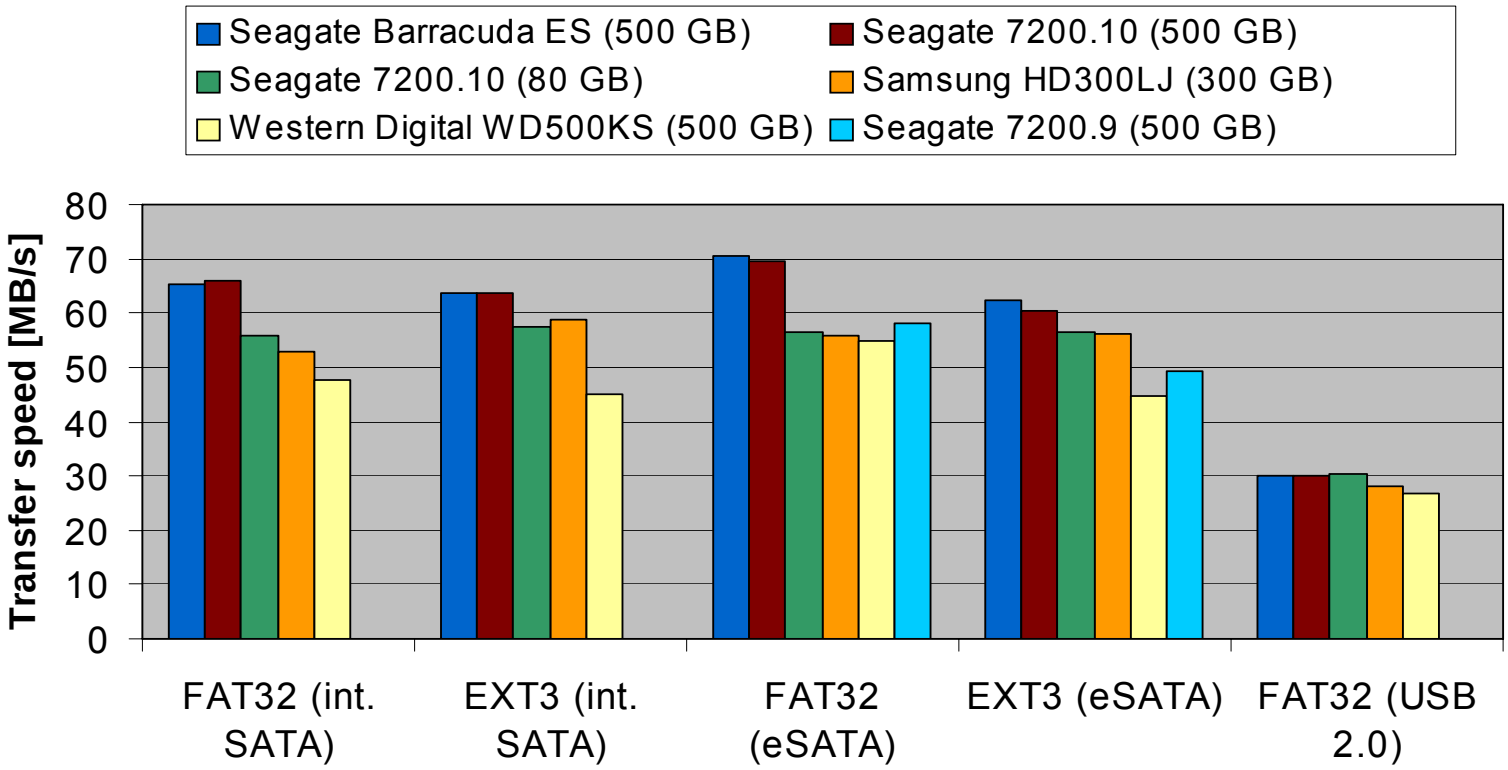
- Test of a set of commonly available hard disks from different manufactures
- Test of different device interfaces in order to access the backup devices

  Reference measurements with commonly used USB interface
- SATA disk attached to an internal bus interface
- External SATA interface (eSATA)

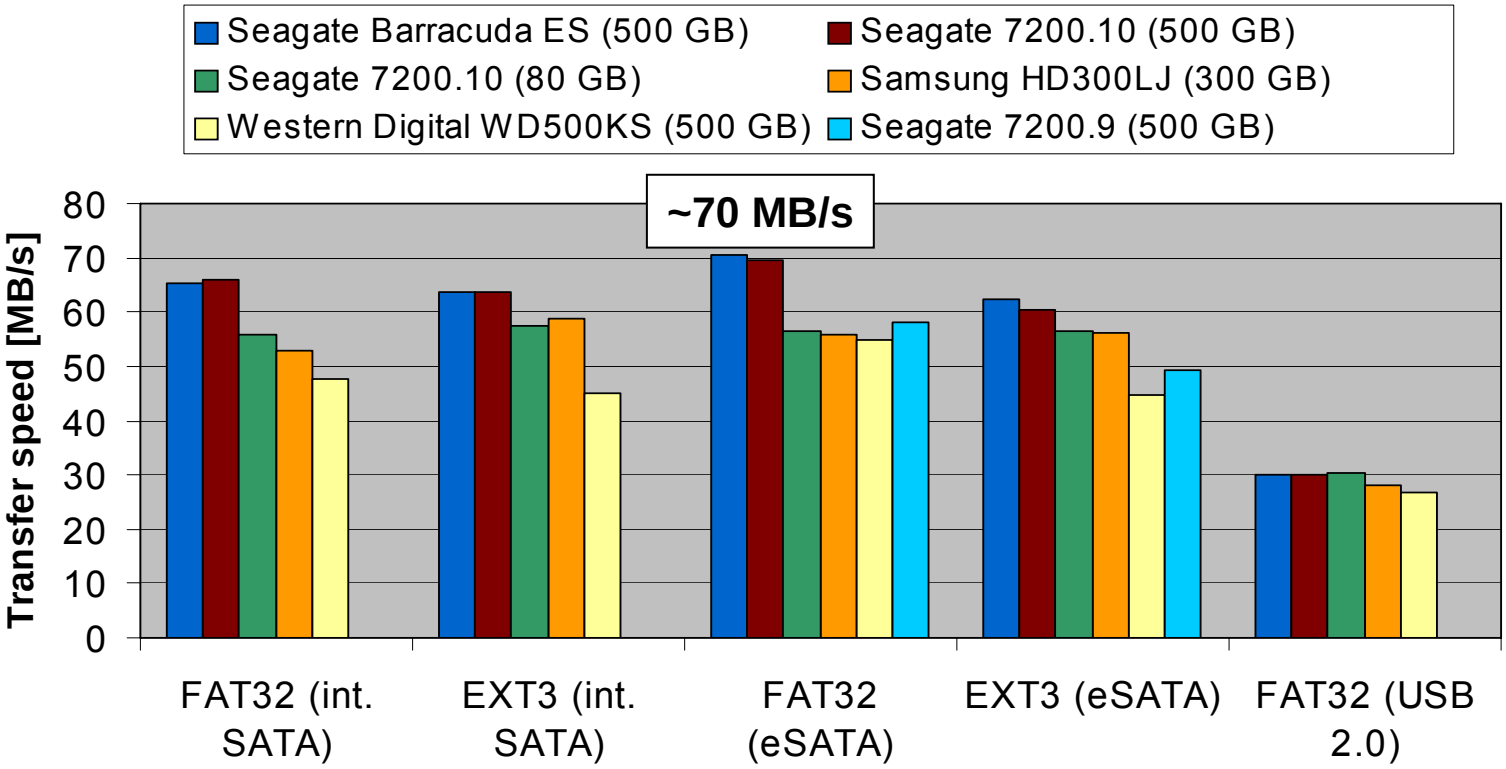
  Multi-disk container: all disks can be addressed with a single data cable

  Parallel writing can be implemented to increase total transfer rate

Results of I/O performance tests (Bonnie++ Disk Benchmark)

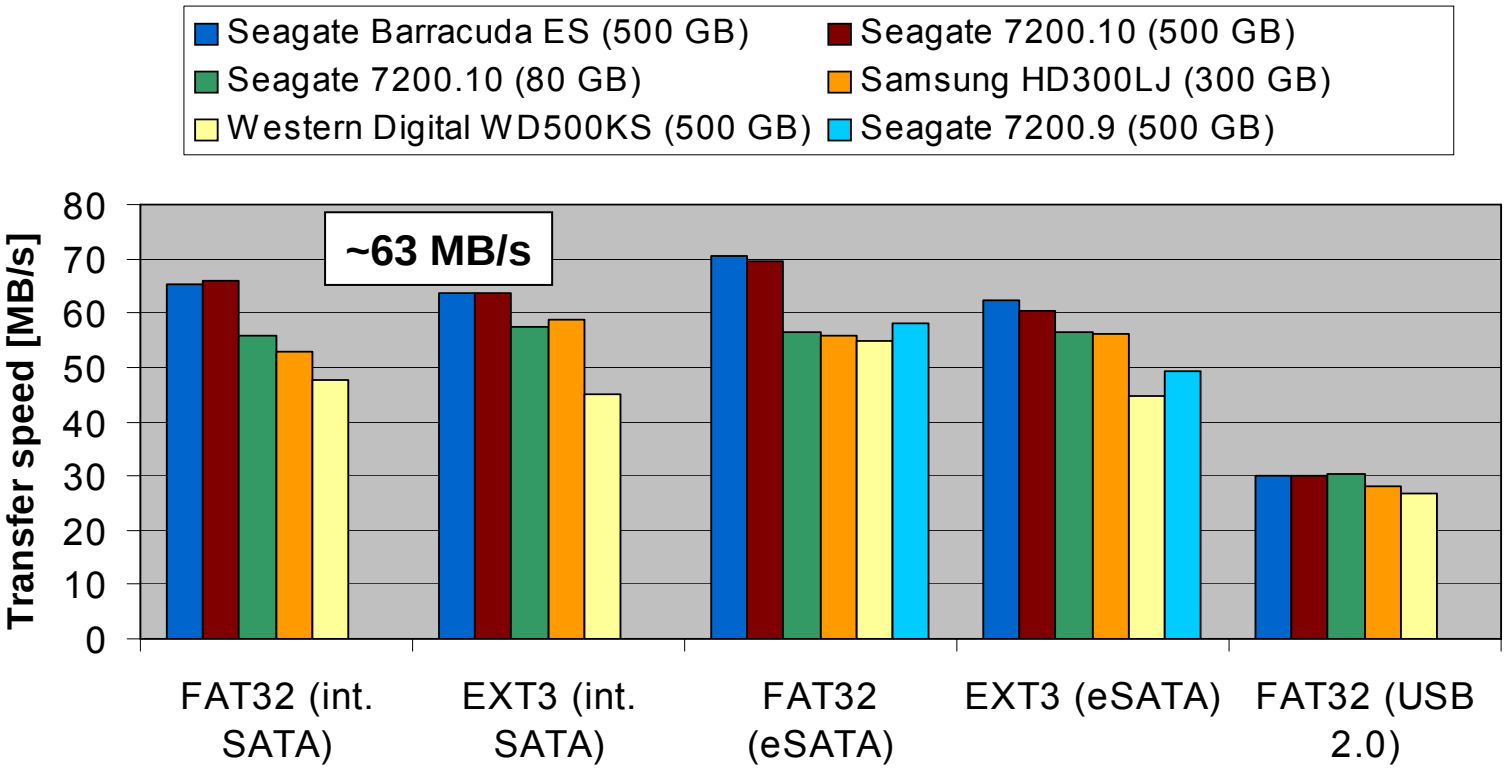


Results of I/O performance tests (Bonnie++ Disk Benchmark)



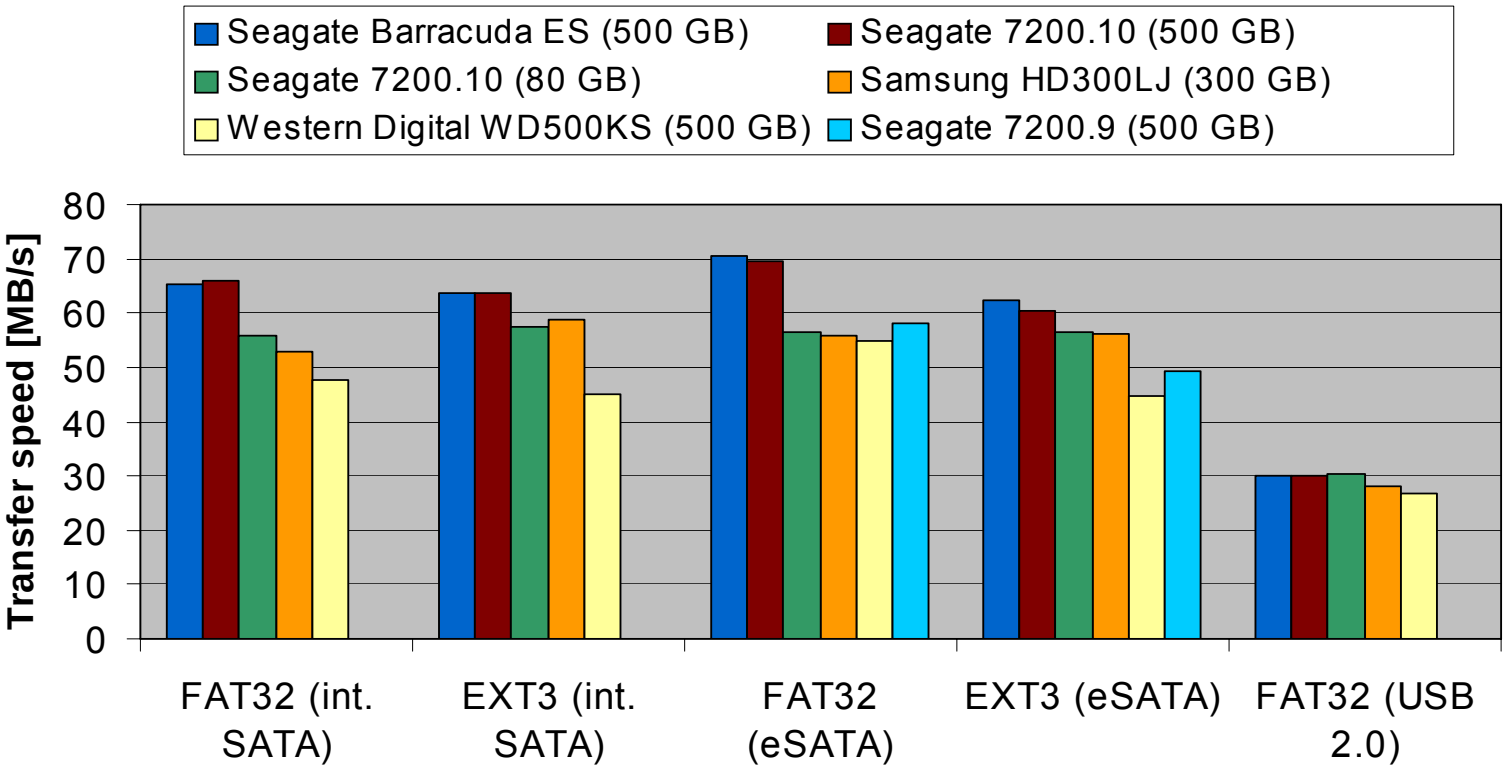
- Best writing I/O performance: FAT32 file system
- Transfer rates up to 70 MB/s can be expected with the SATA bus interface

Results of I/O performance tests (Bonnie++ Disk Benchmark)



- Up to 63 MB/s transfer rates are measured with the EXT3 file systems
- Journaling feature makes EXT3 more robust against handling errors

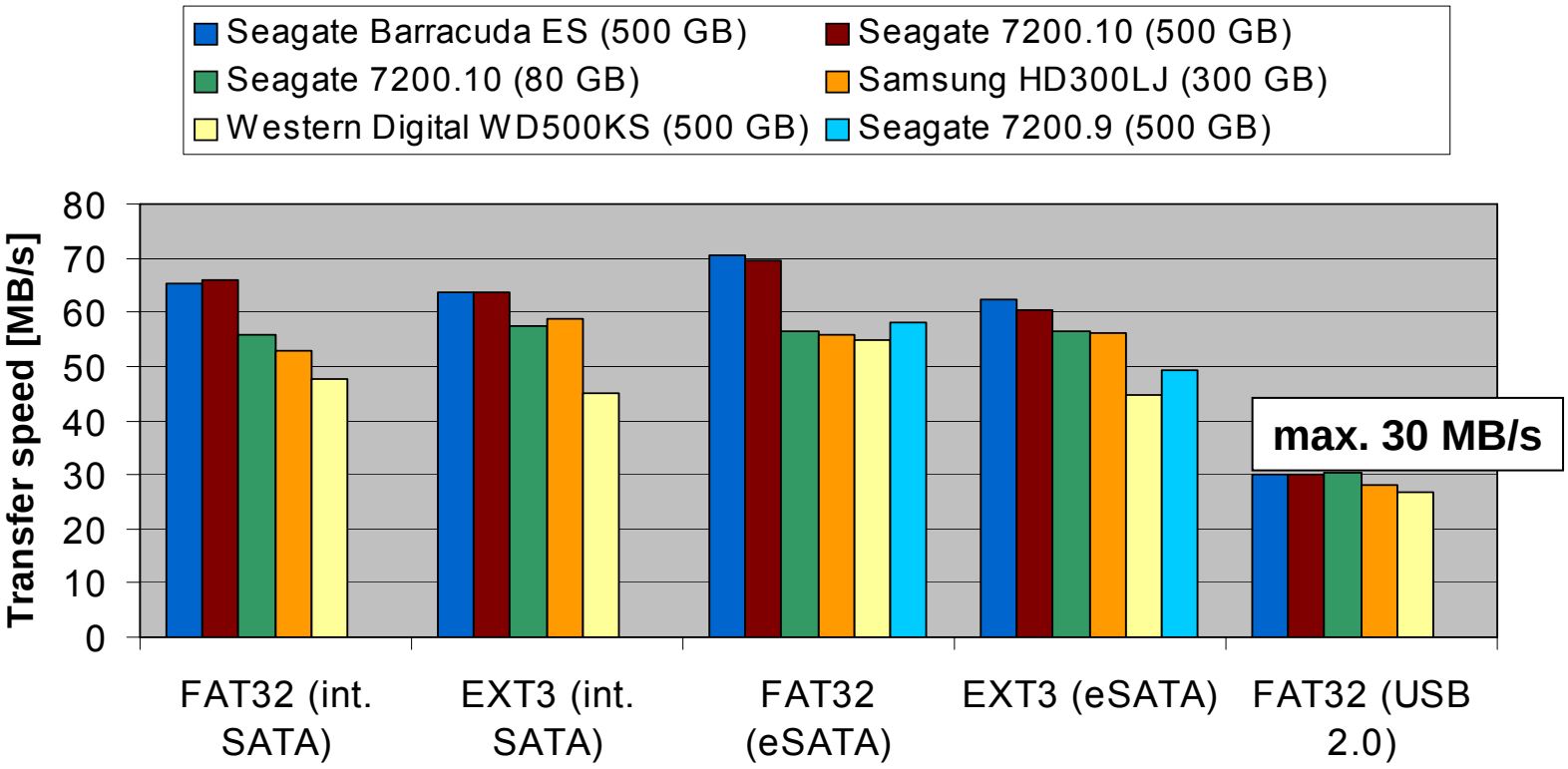
Results of I/O performance tests (Bonnie++ disk benchmark)



- Hard disks from different manufacturers show significant differences (up to 20 MB/s) in writing performance

  Best results with hard disks using perpendicular recording technology

Results of I/O performance tests (Bonnie++ Disk Benchmark)



- Performance is dramatically decreased by a factor of 2 if the USB 2.0 bus interface is used

Application example: PX data collection for 10 different projects

Setup of the example

- Basic experiment: MAD data collection
  - Three datasets
  - Collection over 180° rotation range
- Data collection for 10 different projects
- Two detector configurations

	MarMosaic 225	Pilatus 6M
Image size	18 MB	6 MB (compressed)
No. of images/dataset	180	900 (0.2° fine slicing)
Exposure time/image	1s	0.2 s

Application example: PX data collection

		MarMosaic 225	Pilatus 6M
Total data size [GB]		95	158
Data generation rate (user perspective) [MB/s]		**9**	**30**
Backup time (single full backup) [h]	SATA (50 MB/s)	0.5	0.9
	USB 2.0 3,5 " HDD (25 MB/s)	1.1	1.8
	USB 2.0 2,5 " HDD (20 MB/s)	1.4	2.3

Conclusion

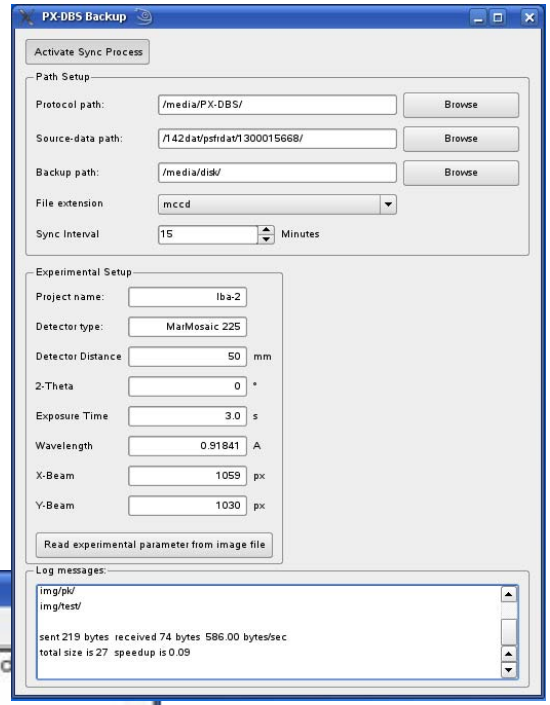
- Data of common CCD detectors can be written in parallel to the experiment using all available interface technologies

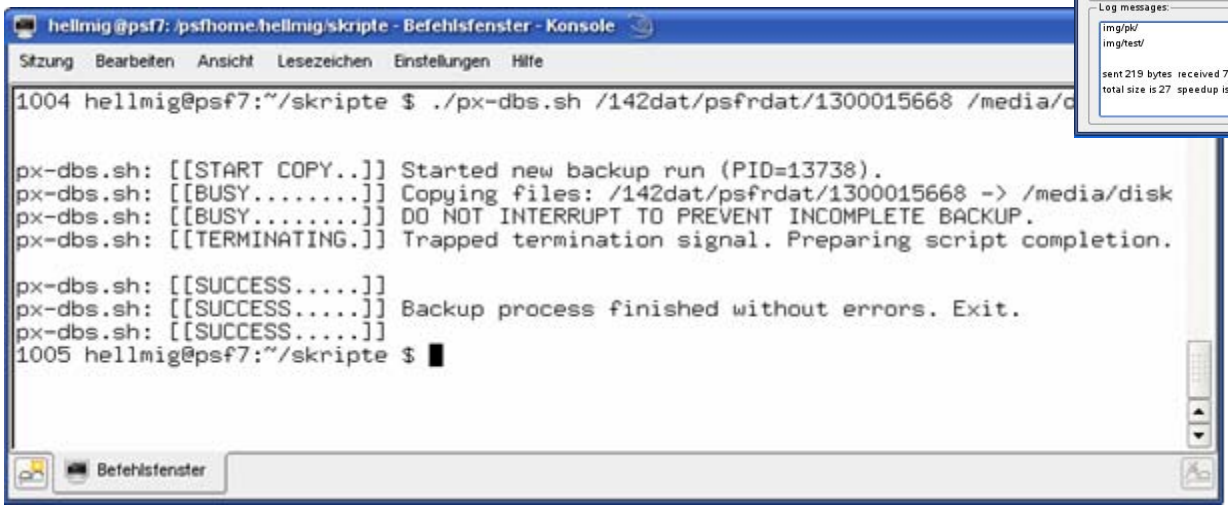
  Even USB2 mobile disks (2,5”) would supply adequate transfer rates

- Pilatus data can only be saved in parallel using high-performance SATA interfaces and fast hard disks

PX-DBS software components

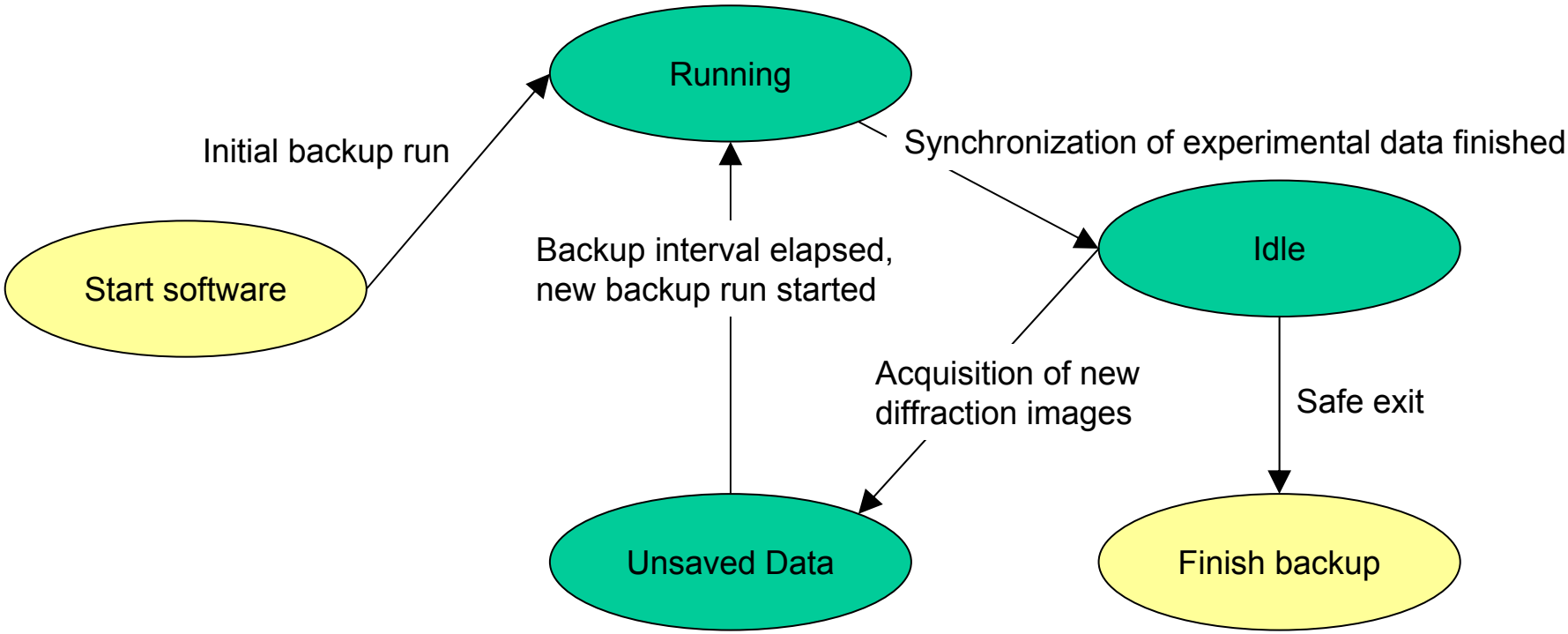
- Command-line based script solution
- Graphical user interface
  - Basic functionality same as script solution
  - Restoration process more comfortable
  - Protocols logged of older experiments
- Both solutions based on rsync for data synchronization





I. Command-line based backup script: Working principle

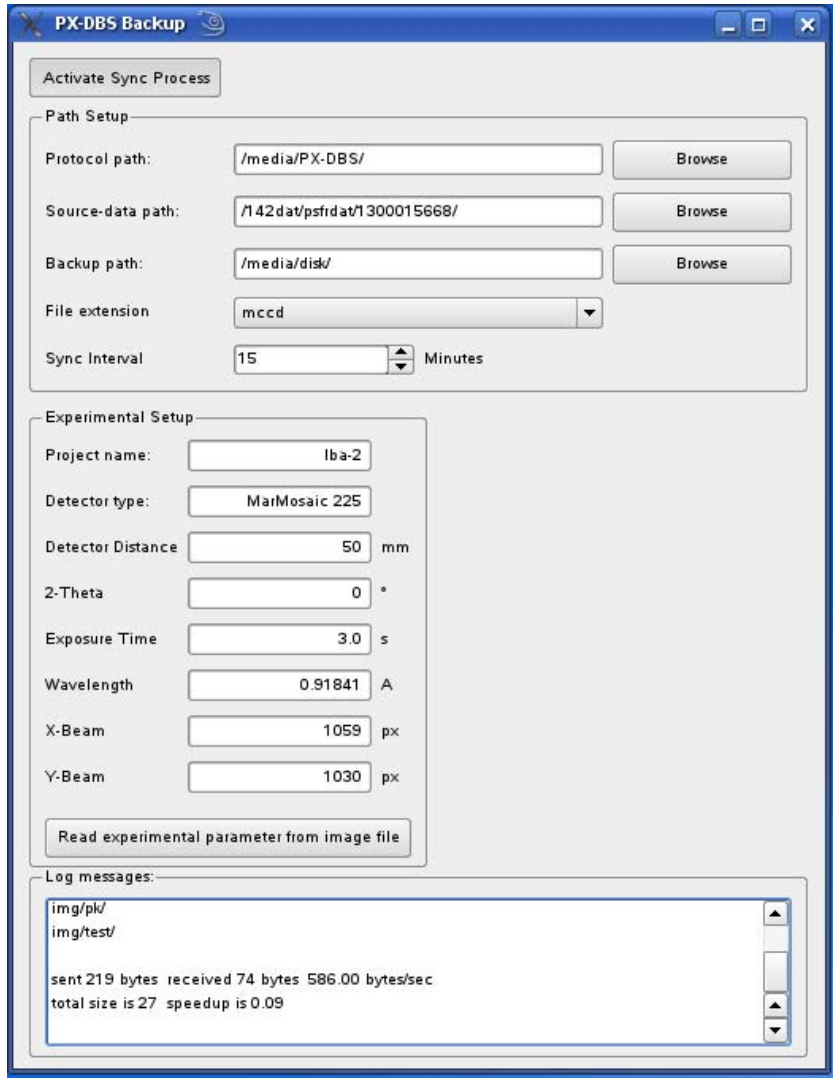
Compatible with all backup devices that are detected from the operating system (e.g. USB, Firewire, eSATA)



II. GUI software component

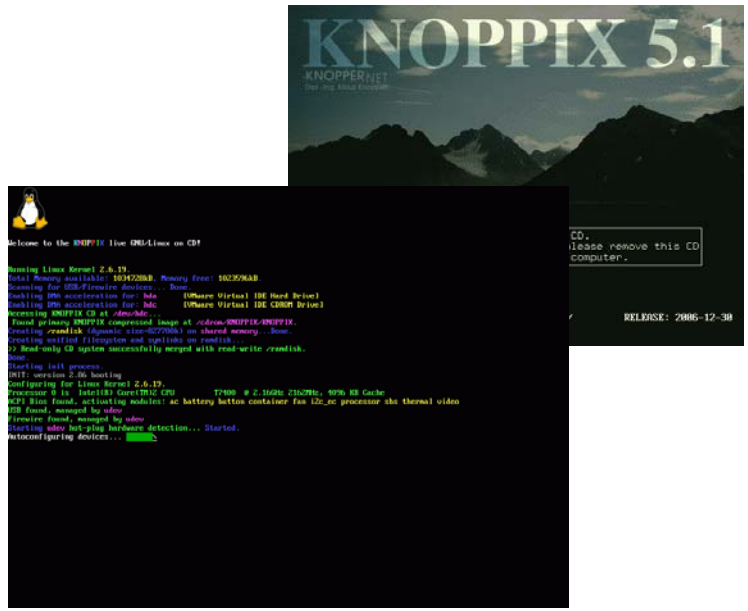
- Backup setup similar to command-line solution
- Description using experimental parameters to identify the backup job
- Logging of experimental details, transferred files and directories

- Restore more comfortable compared to the script solution
  - Protocol information about finished backup jobs is read in from the USB flash pen
  - Selection of job from list
  - Connection of respective backup device and start of restore process



Deployment of project results

- Preparation of customized Live-CD Linux distribution
- Comprehensive support for different hardware configurations
- Integrated support for hot-plugging of internally mounted backup devices on the SATA interface bus
- Integration of both backup software components



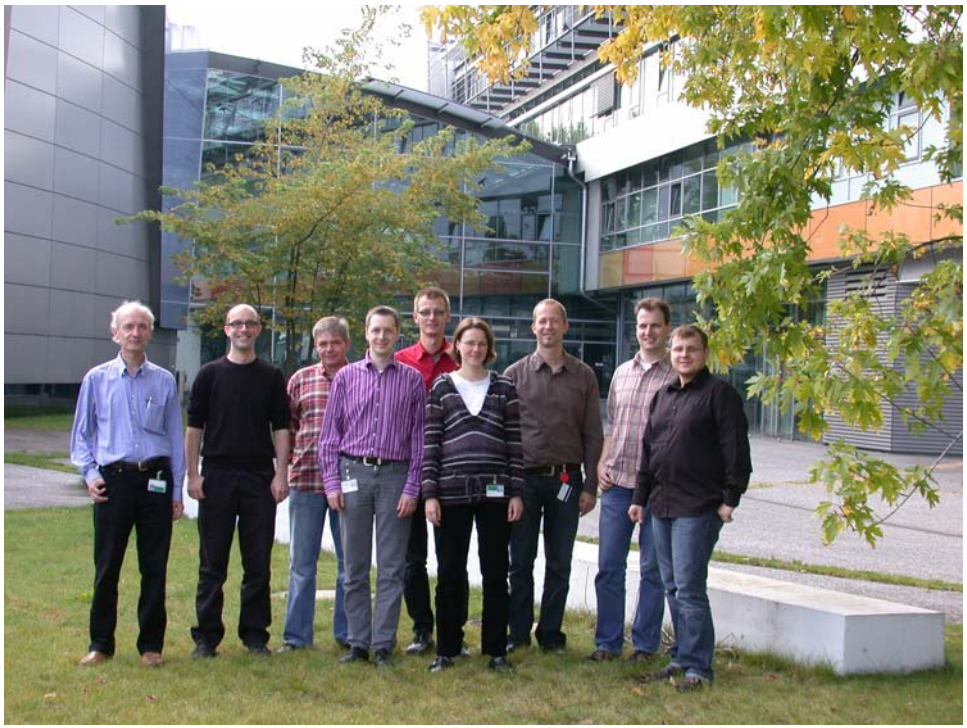
Future prospects

- Complete implementation of functionality until end of February 2008
- Testing with interested institutes

- Implementation of Server API
  - Control the backup process from a client in the LAN
  - User control brick integrated in the BLISS Framework

Acknowledgements

- Thanks to staff members from the ESRF and SLS for their valuable input and suggestions
- BESSY PX work group



IA-SFS