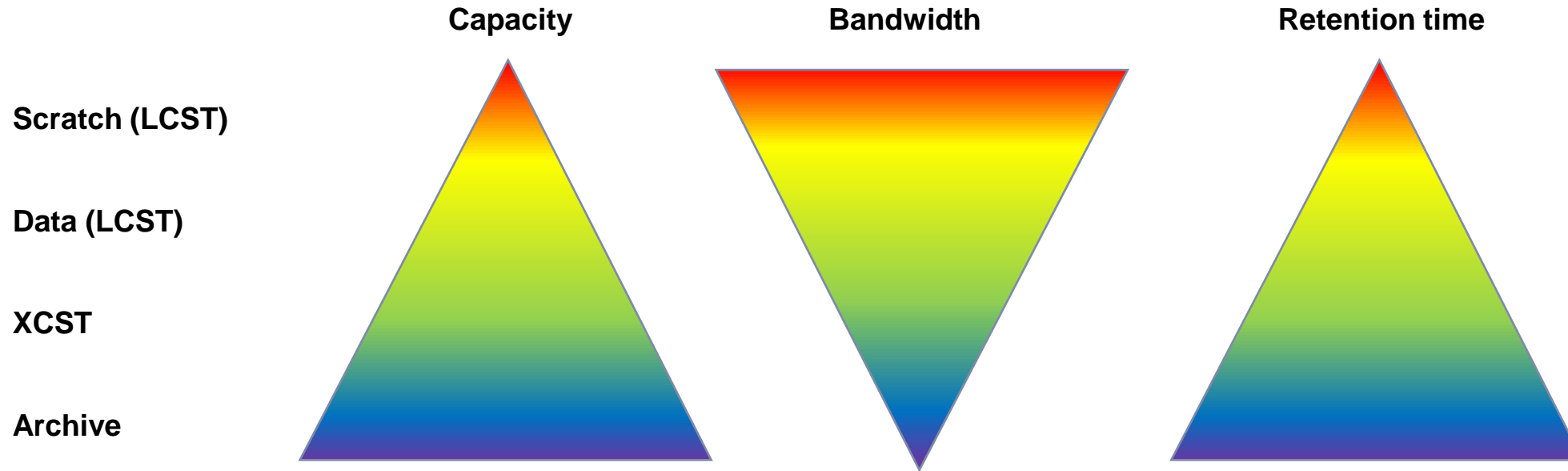


JUST JÜLICH STORAGE CLUSTER

10. NOVEMBER 2025 | STEPHAN GRAF (JSC - HPCCDSS)

TIERED STORAGE OFFERING



- Large Capacity Storage Tier: IBM ESS/SSS Cluster (GNR, 6th Gen. of JUST, bandwidth optimized) → LCST
- Extended Capacity Storage Tier (XCST): GPFS Building Blocks (target: capacity) → XCST
- Archive: Tape storage (Backup + GPFS&TSM-HSM)

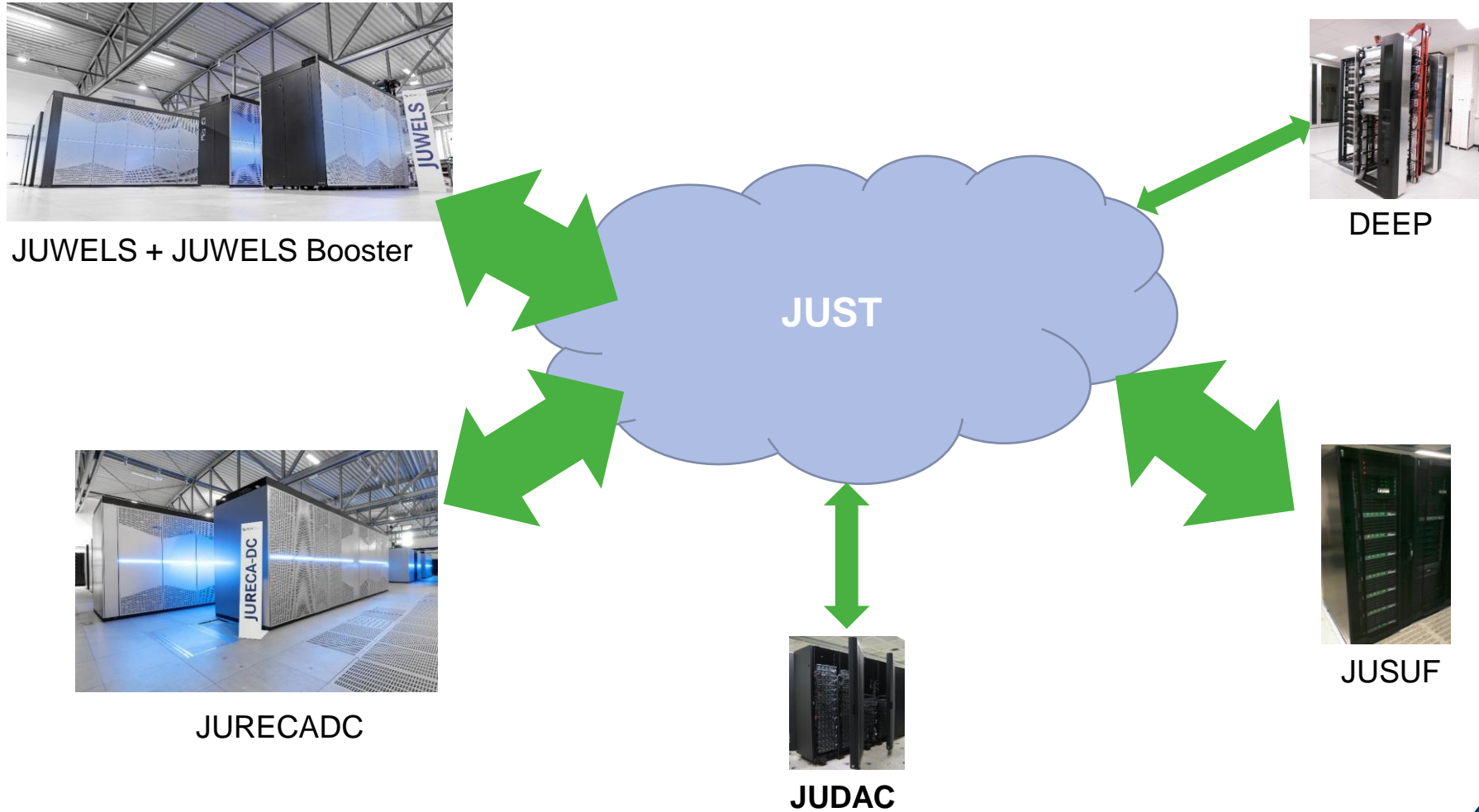
JUST CLUSTER(S)

Key Characteristics

- File system access: parallel, POSIX compliant
- No user login
- Cross mounted on HPC systems
- One global namespace
- exported to JSCCLOUD (optional)

LCST	XCST	ARCHIVE
Spinning Disc bandwidth optimized	Spinning Disc Capacity optimized	Tape
11 Capacity Building Blocks 1 NVMe Building Blocks	2 Building Blocks	1 Capacity Building Block 4 Tape Libraries
7.000 x 22 TB Discs 24 x 7.68 TB NVMe	1856 x 16 TB Discs	~54.000 Tapes (9TB – 18TB)
150 PB (raw)	~30 PB (raw)	~770 PB
Storage Scale (GPFS)+ GPFS Native RAID	Storage Scale (GPFS)	Storage Scale + Storage Protect (GPFS + TSM-HSM)

CENTRALIZED STORAGE



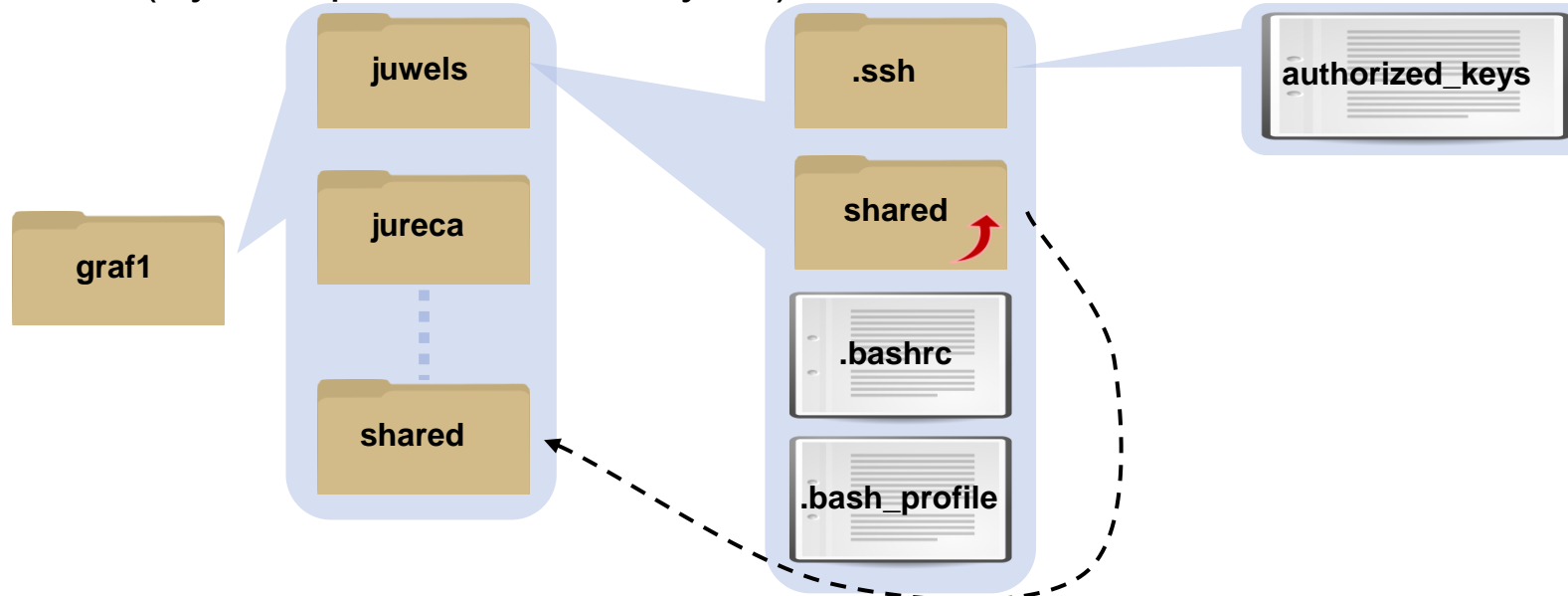
HPC USAGE MODEL @ JÜLICH

Key Characteristics

- One account per user: `surname#` (# is a consecutive number)
- Separation of user and project data - user must be joined to project to get access
- Data owner is the project
- Two project types: Compute + Data
- Project membership realized by UNIX groups
 - User's primary group: `surname#`
 - User's secondary groups:
 - <list of project groups user is joined>
 - legacy groups, e.g. `jusers`
 - Files/directories created in project directory belongs to project group, realized by setGID bit: `drwxrwS---`
!! Owner can overrule it !! (chown, rsync, cp -pR, ...)
- Project Quota accounted on directory base

USER DIRECTORY (HOME)

- Path: `/p/home/jusers/<surename#>`
- **Small quota per user: 20 GB + 80.000 files**
- Data is in **Backup**
- Store your personal data (System profiles, SSH Key, ...)
- For user **graf1**:



- Separate HOME on each system, e.g. on JUDAC: **\$HOME** = `/p/home/jusers/graf1/judac`
- Link to **shared** folder

SCRATCH DIRECTORY

Compute Project

- Bandwidth optimized
 - JUST is capable of >300 GB/s
 - JURECA and JUWELS can achieve up to 200 GB/s by design
- Belongs to compute project
- Path: `/p/scratch/<group>`
\$SCRATCH = `/p/scratch/cjsc`
- Temporary files, checkpointing
- **Default Quota per group: 90 TB + 4 million files**
- **No Backup**
- **!!!Data deleted after 90 days without access!!!**
- Empty directories are deleted after 3 days

PROJECT REPOSITORY

Compute Project

- Data repository for the compute project
Path: `/p/project1/<group>` e.g: `$PROJECT = /p/project1/cjsc`
- Default Quota: 16 TB / 3 Mio inodes (files)
- Data is backed up
- Lifetime depends on project time span ➡ longterm storage/archiving can be realized by a ***data project***

DATA REPOSITORY

Data Project

- High Bandwidth (close to \$SCRATCH)
- Path: `/p/data1/<group>` e.g: `$DATA = /p/data1/zam`
- **Quota per group: as granted to project**
- Data is backed up

LARGEDATA REPOSITORY (DEPRECATED)

Data Project

- Separate storage cluster (XCST)
- High Capacity (disk based)
- *will stay until Q4/2026, than migrated to \$DATA*
- Path: **/p/largedata2/<group>**
\$LARGEDATA = **/p/largedata2/zam**
- Quota per group: as granted to project
- Data is backed up

ARCHIVE REPOSITORY

Data Project

- Filesystem consist of 2 tiers: disks (cache) and tapes (long term)
- Path: /p/arch#/<group>
\$ARCHIVE = /p/arch1/zam
- Archive your results
- Only available on login
- **Quota per group: as g**
- **Data are in Backup**
- Special rules:
 - Files > 7 days are migration candidate → moved to tape
 - Recall per file is expensive (1 minute mount time + 200 MB/s)
→ **use (zipped) tar balls > 1TB**
 - **Avoid renaming of directory structures** (may trigger huge recalls)

```
[zdv124@judac01:/p/arch1/zam/zdv124> ls -lisah
total 320K
 407977 128K drwx----- 2 zdv124 zam 64K May 18 10:01 .
 407555 128K drwxr-xr-x 316 root sys 64K May 24 15:00 ..
18062260 64K -rw-r--r-- 1 zdv124 zam 5 Sep 2 2011 datum.txt
12920848 0 -rw-r--r-- 1 zdv124 zam 12G Jun 3 2015 Vervet_s0050_tiff.tgz
```

FILESYSTEMS - SUMMARY

File System	Shell Variable	Description	Project Type	Characteristics
home	\$HOME	Users HOME File Systems		User Quota: 10GB/40.000 Files Files in Backup
project1	\$PROJECT	Compute Project File System	Compute	Group Quota: 16TB/3Mio Files Files in Backup
scratch	\$SCRATCH	Compute Project Scratch File System	Compute	Group Quota: 90TB/4Mio Files Files deleted after 90 days
data1	\$DATA	High Bandwidth and large Capacity File System	Data	Group Quota: depends Files in Backup
largedata2	\$LARGEDATA	Large Capacity (Disk based, deprecated)	Data	Group Quota: depends Files in Backup
arch1 arch2	\$ARCHIVE	Archive File System (Tape)	Data	Group Quota: depends Files in Backup Migration to tape

OBJECT STORAGE

Data Project

- Solution based on minIO
- Web Address: <https://just-object.fz-juelich.de>
- Supported protocols: **S3**
- Accessible from the world (also HPC nodes)
- **Client environment on JUDAC available**
<https://apps.fz-juelich.de/jsc/hps/just/object-storage.html>
- **Default Quota: 16TB**
- **Backup: Versioning enabled**

JUDAC – JUELICH DATA ACCESS

Data access and transfer cluster

- All HPC user can login on judac: `ssh <userid>@judac.fz-juelich.de`
- Independent from HPC systems (e.g. in maintenance)
- Access to Jülich Object Storage
- Purpose: data transfer in & out the HPC filesystems
 - **scp, rsync**
 - Standard ssh setup can be used (connection must be initiated from external)
 - Use **screen** or **tmux** for long running data transfer
 - **jutil**
 - Grid Tools
 - UNICORE FTP (next slide)
- For more information go to [→ JUDAC Web Page](#)

DATA TRANSFER TO/FROM JÜLICH USING UNICORE

- Install client from [sourceforge](https://sourceforge.net/projects/unicore/) on your system (1x)
- Create client SSH key (1x)

```
[user@home ~]$ mkdir -p $HOME/.uftp  
[user@home ~]$ ssh-keygen -a 100 -t ed25519 -f $HOME/.uftp/id_uftp
```

- Prepare client environment (1x)

```
[user@home ~]$ export UFTP_USER=<your_remote_user_id>  
[user@home ~]$ export UFTP_AUTH_URL=https://uftp.fz-juelich.de:9112/UFTP_Auth/rest/auth/JUDAC:  
[user@home ~]$ export UFTP_KEY=$HOME/.uftp/id_uftp
```

- Copy public key to JUDAC (UNICORE server) (1x)

```
[user@home ~]$ ssh $UFTP_USER@judac.fz-juelich.de 'mkdir -p $HOME/.uftp'  
[user@home ~]$ scp $HOME/.uftp/id_uftp.pub $UFTP_USER@judac.fz-juelich.de:.uftp/authorized_keys
```

- Upload/download data

```
[user@home ~]$ uftp cp --user $UFTP_USER --identity $UFTP_KEY "file.tar" $UFTP_AUTH_URL/p/home/jusers/$UFTP_USER/jureca  
[user@home ~]$ uftp cp --user $UFTP_USER --identity $UFTP_KEY $UFTP_AUTH_URL/p/home/jusers/$UFTP_USER/juwels/file.tar .
```

DATA SHARING

Private sharing inside Jülich HPC

1. Use compute project repository (\$PROJECT)

Any user can be joined to project without access to project's compute resources

2. Use data project

Members of different compute projects can join a common data project

3. Single files

All users can access common directory „**\$SCRATCH**/. . /share“. Remember the automatic file deletion after 90 days!

4. Software project

Special data project which is mounted on compute nodes

Public sharing

Session ***Uniform Resource Access, Data Access and Cloud Resources at JSC***
(Tuesday 16:15, B. Hagemeyer)

HINTS & TIPS

- Create **checksums** on data files
- Best practices for data comparison and migration: https://go.fzj.de/just_data_best_practices
- Restore files from backup: **adsmback**
 - **available only on JUDAC**
 - Calls IBM TSM Backup/Restore GUI
- Hard to guaranty daily backup → snapshots available, eg: `$PROJECT/../../snapshots/daily-YYYYMMDD/<project>/`
- Quota usage information: **jutil**
 - Project group quota info: `jutil project dataquota -p <project>`
 - User quota info: `jutil user dataquota -u <user>`
- SSH/SCP usage
 - Multiple external (scripted) access can be classified as an attack → Firewall will block external IP
 - Outgoing SSH is blocked!
- Take care of your files
 - No special characters in filenames (newline, tab, escape, ...)

Currently not available

- We are working on a new solution
- Try snapshots
- In urgent cases open ticket @ SC support

AND FINALLY

- **Filesystem status:** <https://status.jsc.fz-juelich.de/>
- **JUST web pages (e.g. FAQ)** <https://go.fzj.de/JUST>
- **JUDAC web pages (e.g. data transfer, object store)** <https://go.fzj.de/JUDAC>
- **Jülich HPC Usage Model:** <http://www.fz-juelich.de/ias/jsc/usage-model>
- **JuDoor – manage accounts/projects, overview of resources, ...** <http://www.fz-juelich.de/ias/jsc/judoor>
- **For any problem (accessing files, access rights, restore, quota, data transfer, ...) contact JSC application support** (sc@fz-juelich.de)
- **Training course “Parallel I/O and Portable Data Formats” (H2/2026)**
 - Learn about parallel IO and related libraries/formats (HDF5, netCDF-4, ...)
 - Optimize your IO

OUTLOOK

- Exascale system **JUPITER** in pre-production state
 - Separate storage cluster **EXASTORE** (providing **\$HOME**, **\$SCRATCH**, **\$DATA**, ...)
 - **\$ARCHIVE** will be provided by JUST6
 - All file systems are available on **JUDAC**
 - NVMe based storage cluster **EXAFLASH** in acceptance
- New **datamover service**
 - Move/copy data between
 - EXAFLASH ↔ EXASTORE
 - EXASTORE ↔ JUST
 - Slurm integration



Questions?