



JUPITER AND IBM STORAGE JÜLICH STORAGE CLUSTERS “JUST” & “EXASTORE”

16. NOVEMBER 2025 | STEPHAN GRAF (JÜLICH SUPERCOMPUTING CENTRE)

LOCATION



Member of the Helmholtz Association

AT FIRST GLANCE

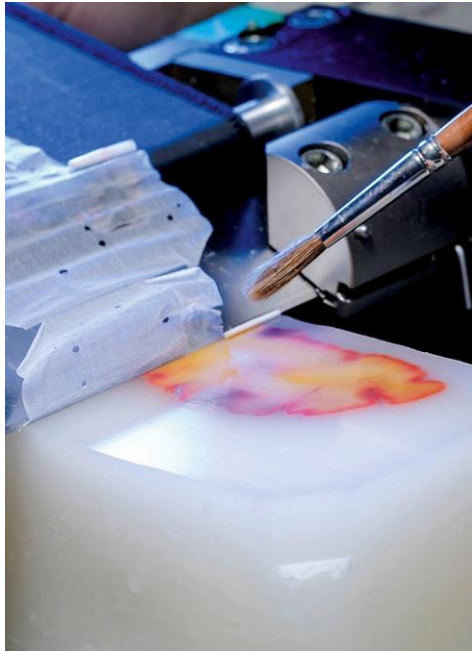
Founded in 1956



Revenue:
€ 987 million in
2023



Research priorities:
information, energy, bioeconomy



Research campus
with 14 institutes and
18 branch offices in
Germany and abroad



Shareholders:
Federal Republic of
Germany (90%),
federal state of
North Rhine-
Westphalia (10%)

Member of the
Helmholtz
Association

JÜLICH SUPERCOMPUTING CENTRE

- **Supercomputer operation for**

- Centre – FZJ
- Region – RWTH Aachen University
- Germany – Gauss Centre for Supercomputing (GCS)
John von Neumann Institute for Computing (NIC)
- Europe – EuroHPC, PRACE, EU projects

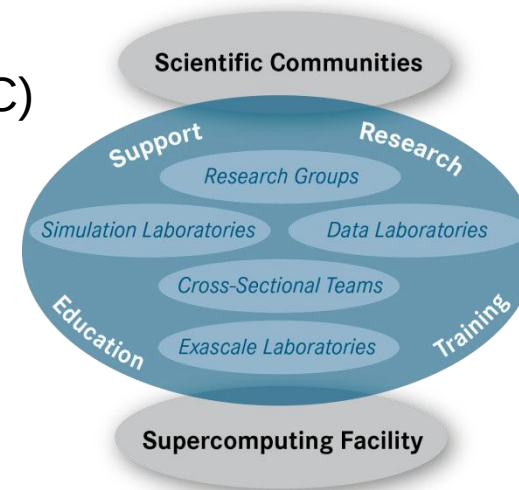
- **Application support**

- Unique support & research environment at JSC
- Peer review support and coordination

- **R&D work**

- Methods and algorithms, computational science, performance analysis and tools
- Scientific Machine Learning and AI with HPC
- Computer architectures, Co-Design, Exascale Labs together with IBM, Intel, NVIDIA

- **Education and training**



**First Exascale
supercomputer
in Europe**

DEEP





~300 Employees
(~280 FTE)



210 Scientists



22 PhD Students (+ externals)
27 Students (Bachelor/Master)



fz-juelich.de/jsc

JÜLICH SUPERCOMPUTING CENTRE

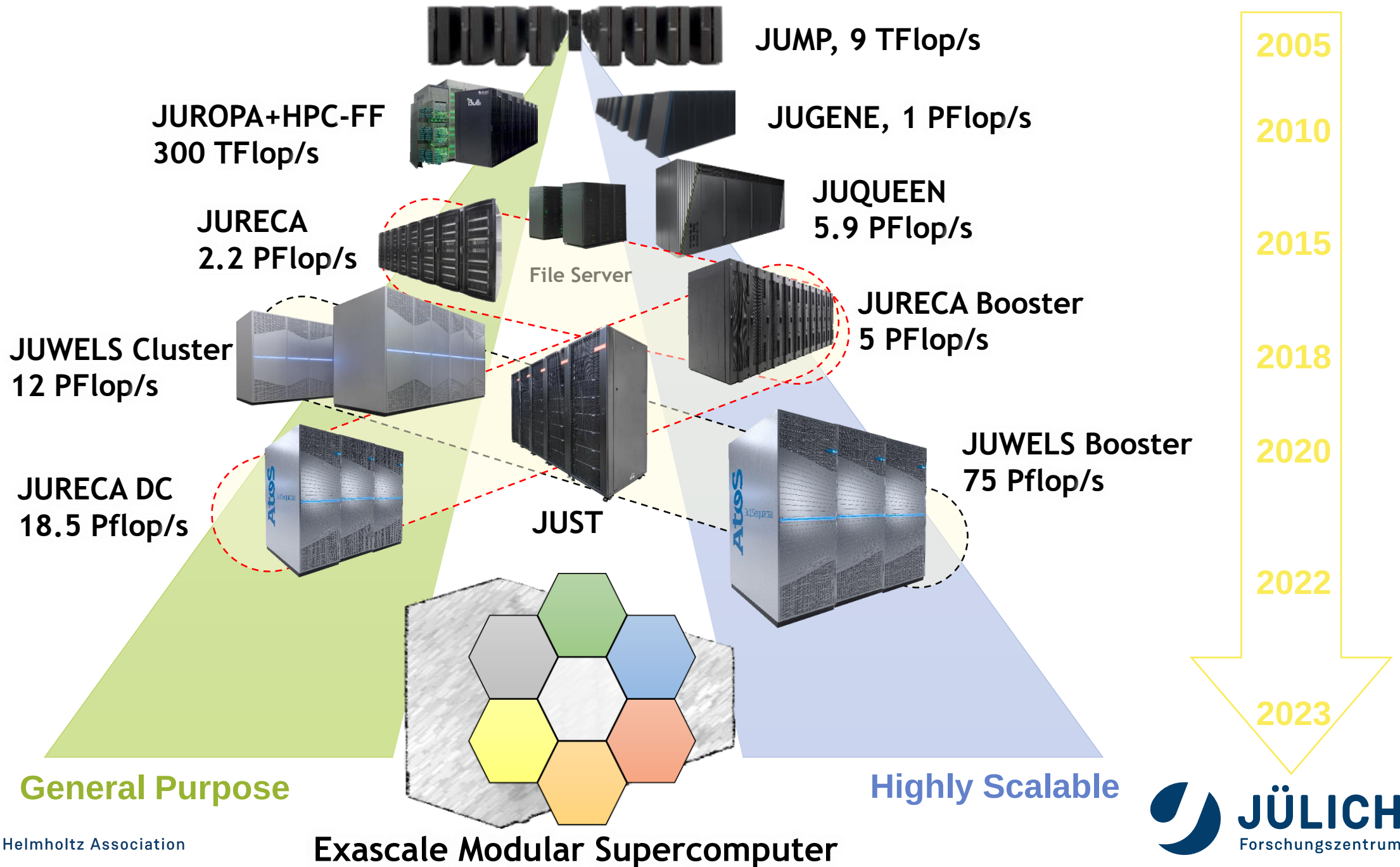
also some JSC

JSC

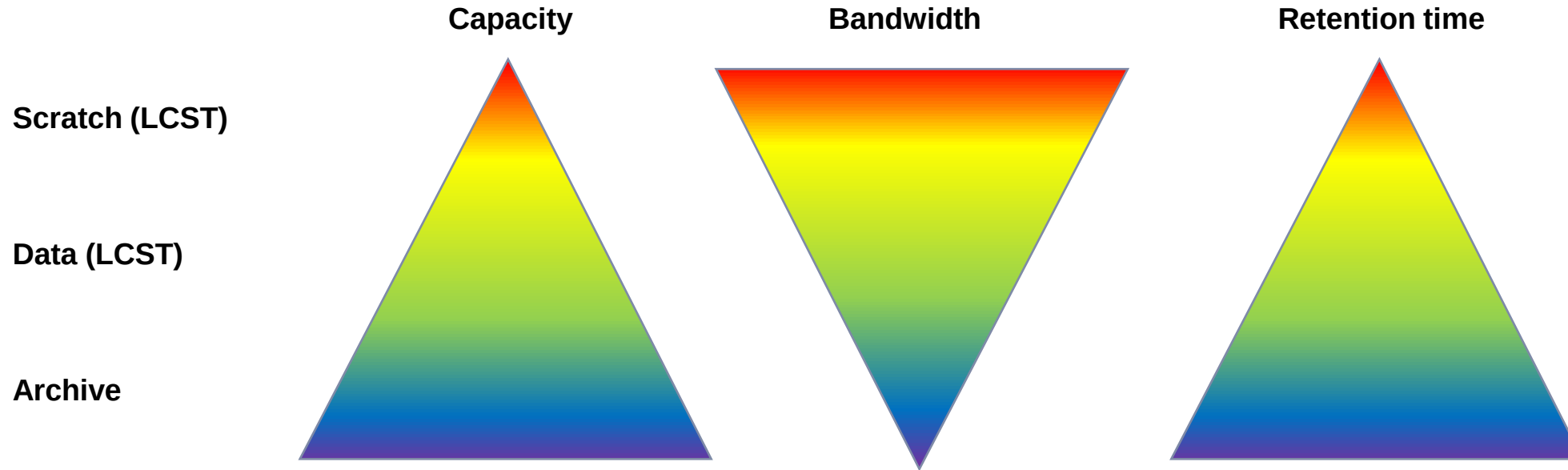
also some JSC



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HPC, Cloud and Data Systems and Services Division at JSC

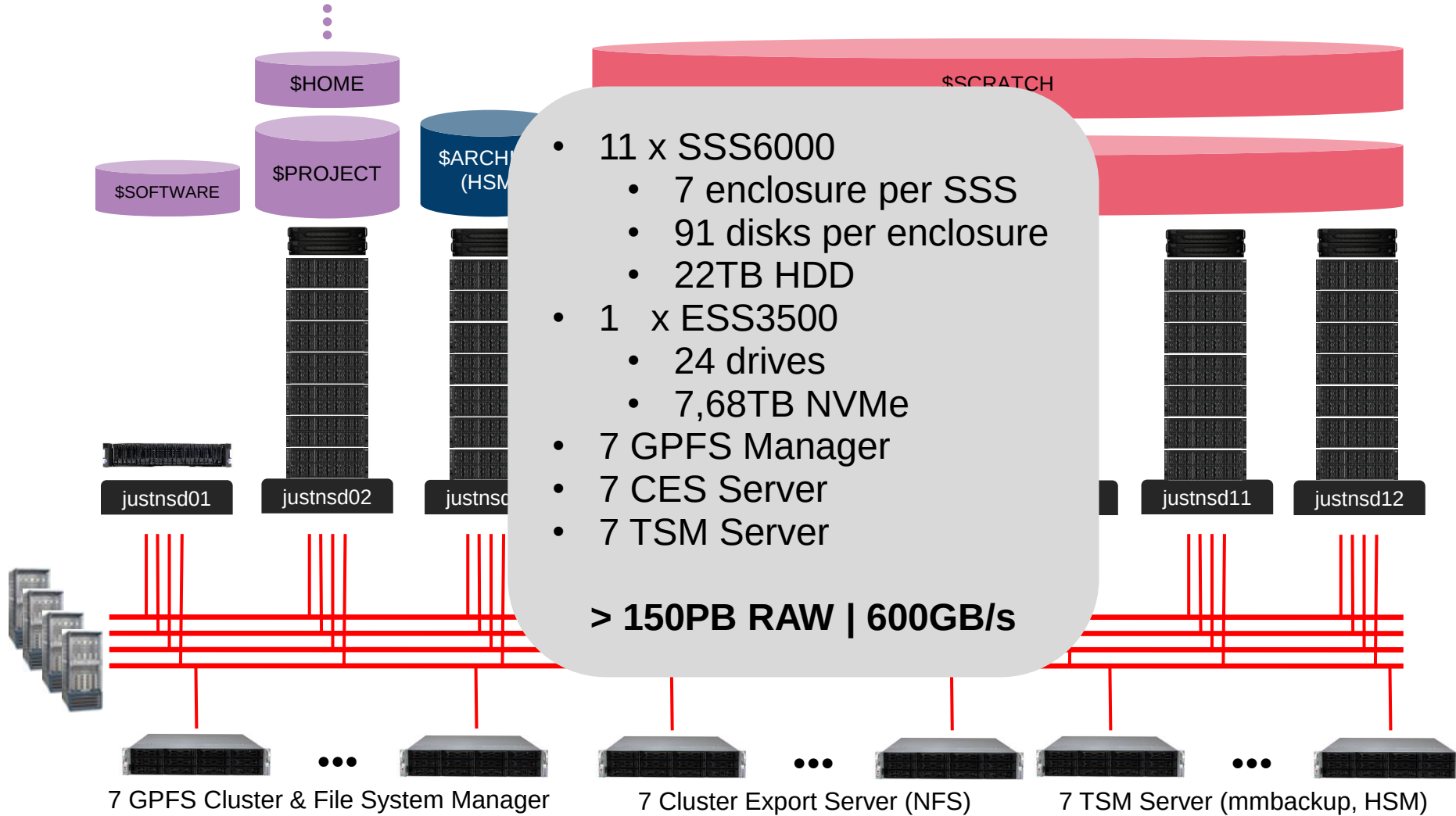


TIERED STORAGE OFFERING

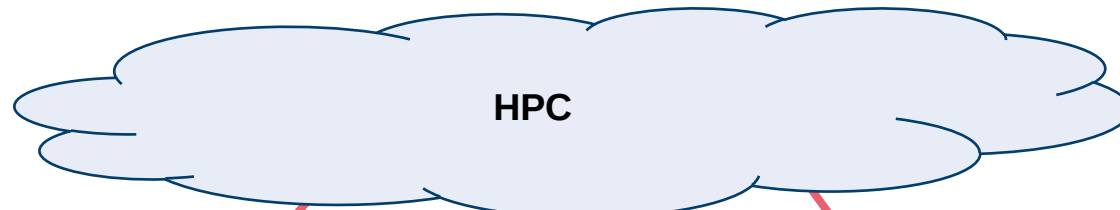
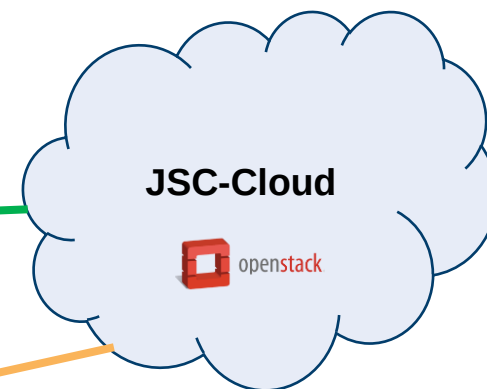
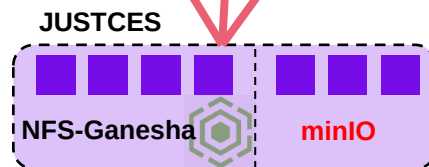
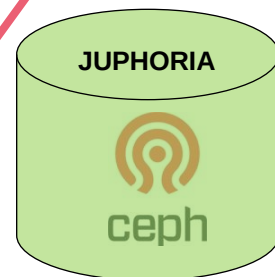
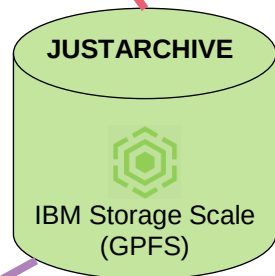
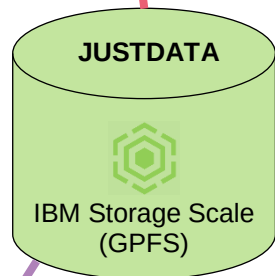
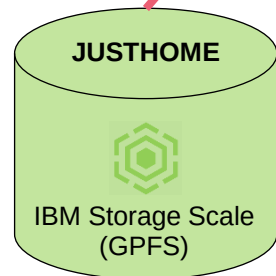
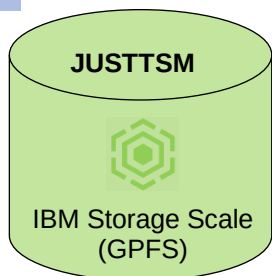


- Large Capacity Storage Tier: IBM ESS/SSS Cluster (GNR, 6th Gen. of JUST, bandwidth optimized) → LCST
- Archive: Tape storage (Backup + GPFS&TSM-HSM)

JUST6 - SERVERS AND JBODS

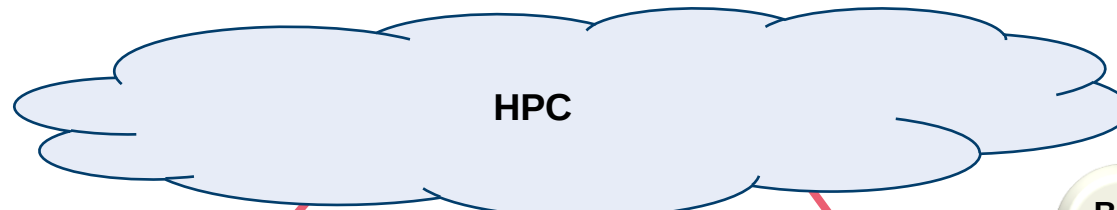
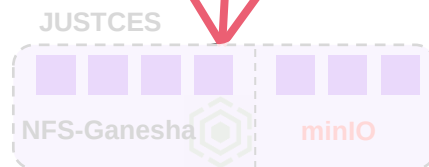
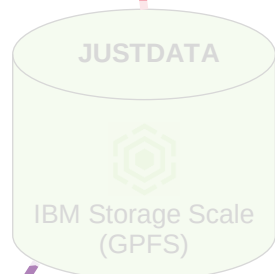
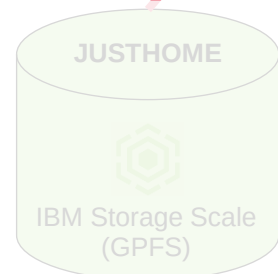
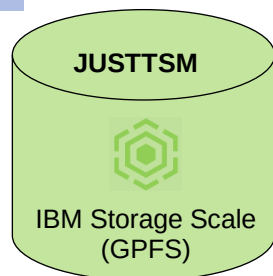


JUST



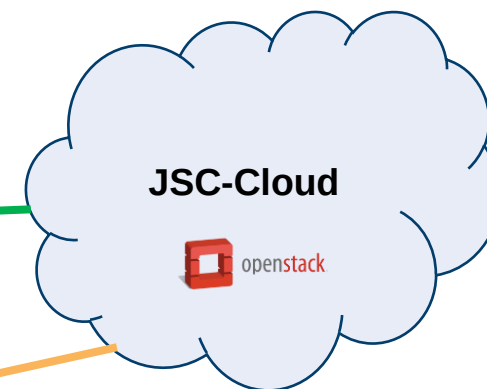
- GPFS export
- Backup
- NFS
- Block Storage
- S3

JUST



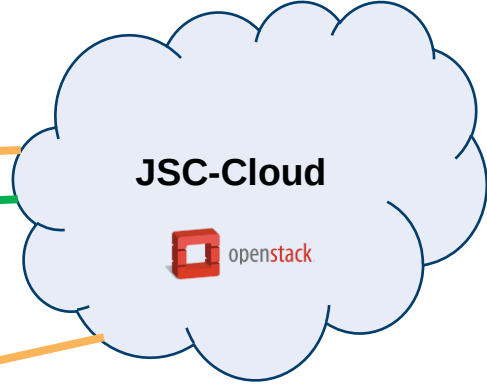
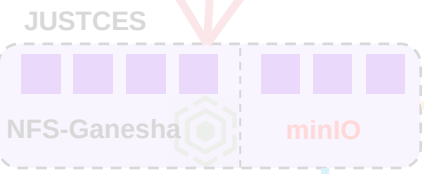
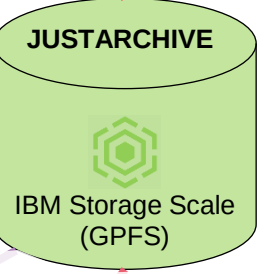
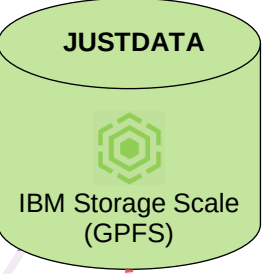
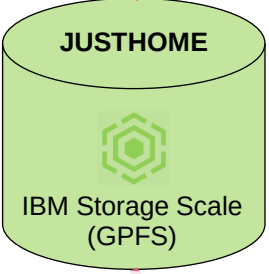
Backup/Archive Infrastructure:

- ~ 770 PB tape capacity
 - 4 tape libraries (2 buildings)
 - 76 tape drives
 - ~ 55.000 tapes
- Software (Client): IBM Spectrum Protect
- Backup/Archive HPC (core user)
- Backup/Archive FZJ (→ IT-Service)
- dCache backend (LOFAR)



- GPFS export
- Backup
- NFS
- Block Storage
- S3

JUST



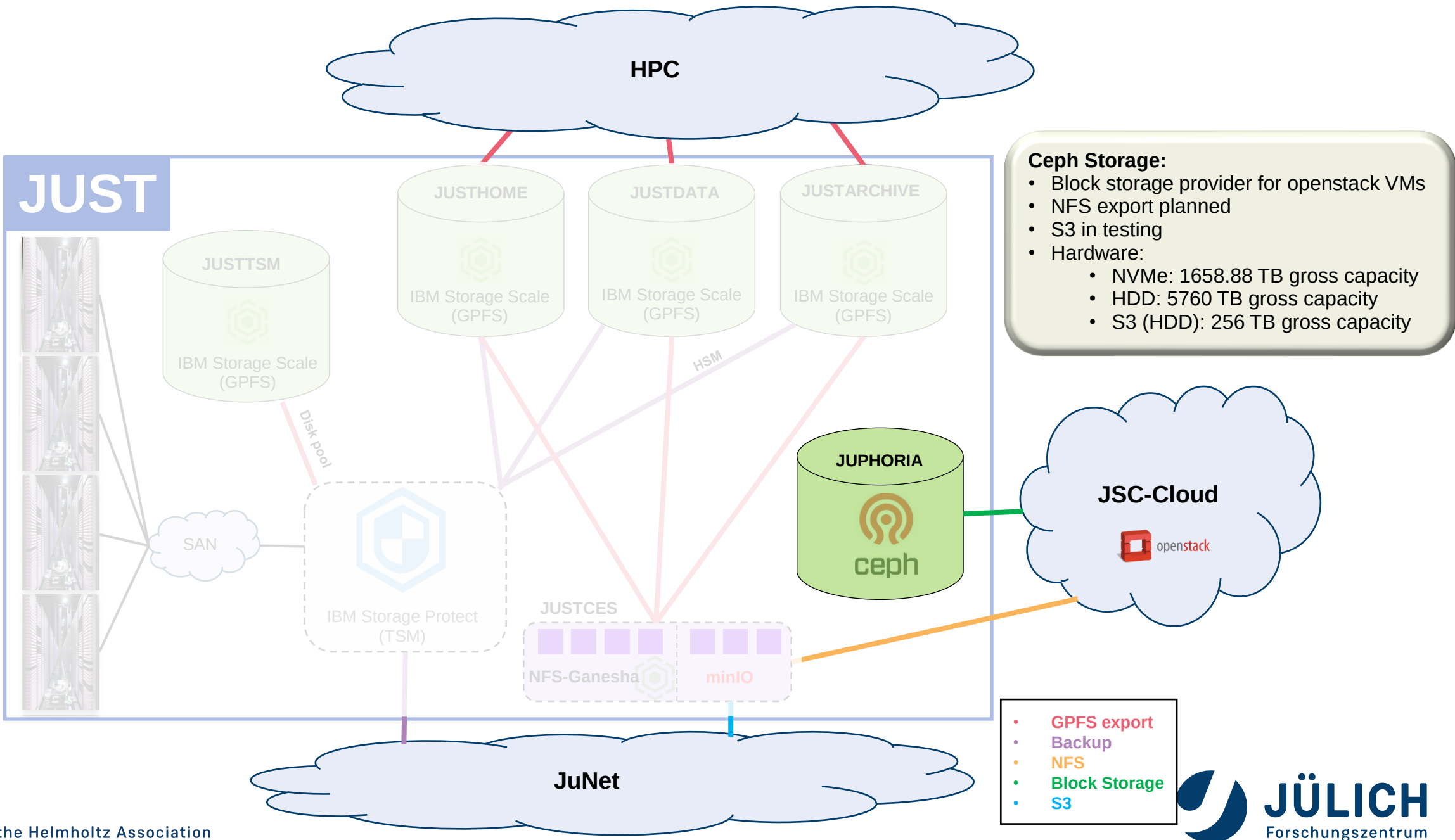
Large Capacity Storage Tier:

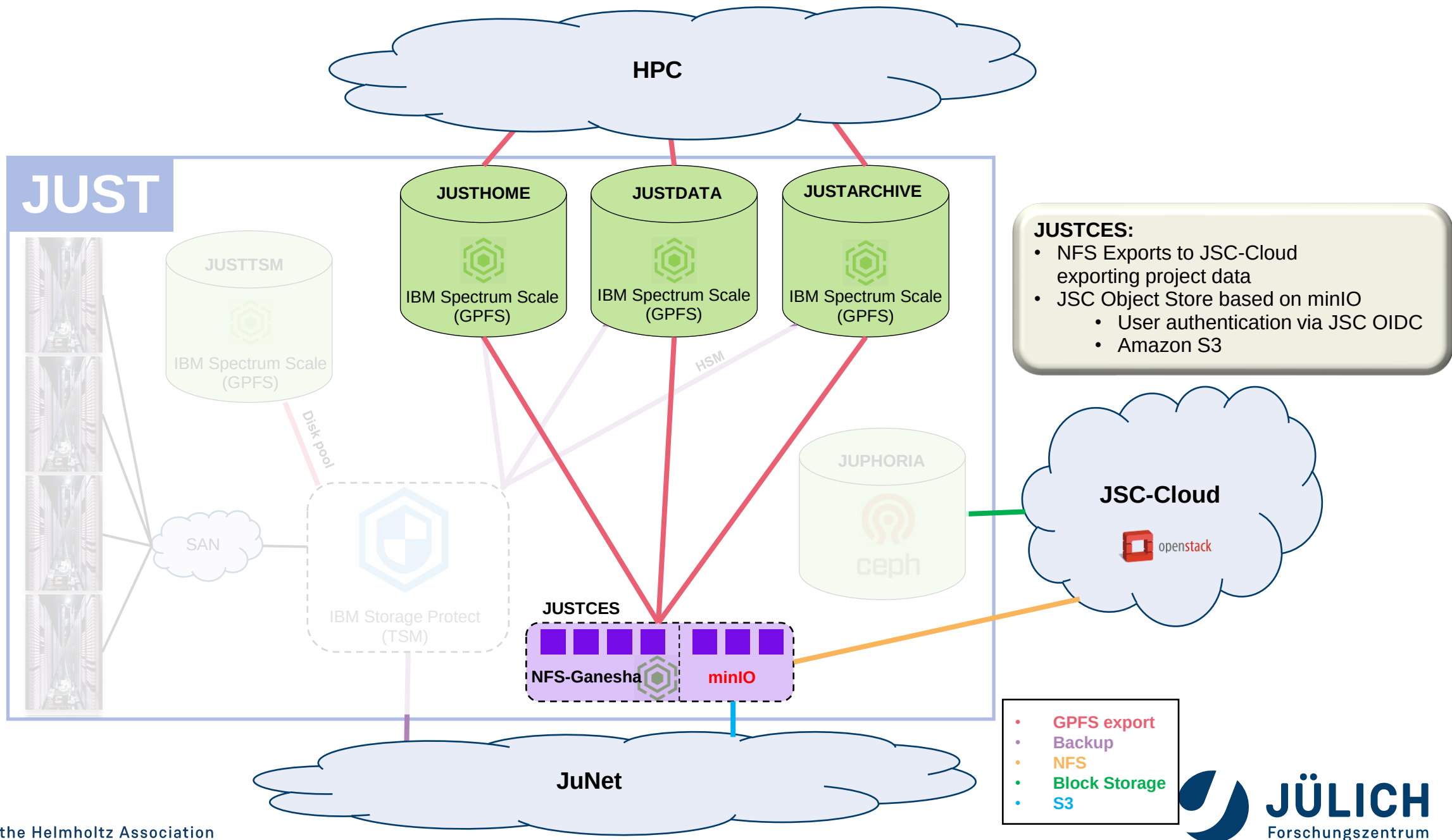
- \$SCRATCH: high bandwidth, temporary files
- \$DATA: high bandwidth, persistent files
- \$PROJECT: compute project repository
- \$ARCHIVE: data project for archiving (tape)
- \$HOME: users home directory
- \$SOFTWARE: special software projects

Characteristics:

- 150 PB gross capacity (spinning 22 TB disks)
- Available on all computes/logins

- GPFS export
- Backup
- NFS
- Block Storage
- S3





JUST5 → JUST6: DESIGN CHANGES

- Split core JUST5 cluster
 - There was only one **justgss** cluster
 - Overload situations lead to failing managers and thus global unavailability
 - Recovery process: In the past sequential, now parallel on three clusters
- Storage Protect: Replace Power/AIX by x86/Linux
 - Affects server and clients (mmBackup + HSM)
- Cluster management
 - JUST5: xcat with 2 master servers and one monitoring server
 - JUST6: xops (HPCCDSS software stack) with 3 master servers and private ceph
- SOFTWARE filesystem
 - Spinning disks with poor performance -> Dedicated NVMe Building Blocks

JUST5 → JUST6: MIGRATION

GPFS data

File system	usage in GB	number of inodes	Migration Method	Target Cluster	old mountpoint	new mountpoint	Backup?	
arch	+ 50 PB on tape	491.836	22.400.480	nsd restripe	justarchive	/arch	/p/arch1	yes
arch2		454.473	8.879.869	nsd restripe	justarchive	/arch2	/p/arch2	yes
scratch	9.501.539	419.819.397	no migration	justdata	/p/scratch	/p/scratch	no	
fastdata	6.590.133	110.923.593	AFM	justdata	/p/fastdata	/p/data1	yes	
largedata	15.578.638	110.496.477	AFM	justdata	/p/largedata	/p/data1	yes	
largedata2	6.518.200	38.355.794	AFM	justdata	/p/largedata2	/p/data1	yes	
home	28.608	55.590.547	copy	justhome	/p/home	/p/home	yes	
project	3.625.717	702.994.066	AFM	justhome	/p/project	/p/project1	yes	
hpcmon	5.815	3.399.143	copy	justhome	/p/hpcmon	/p/hpcmon	no	
usersoftware	2.245	19.917.899	copy	justhome	/p/usersoftware	/p/usersoftware	yes	

TSM server + client (Talk at GSE ISP Symposium 2024 in Cologne)

- TSM Server: DB export – import
- HSM: stubfile migration



JUPITER – FIRST EXASCALE SYSTEM IN EUROPA

Storage Scale for Exascale



Member of the Helmholtz Association



EuroHPC
Joint Undertaking



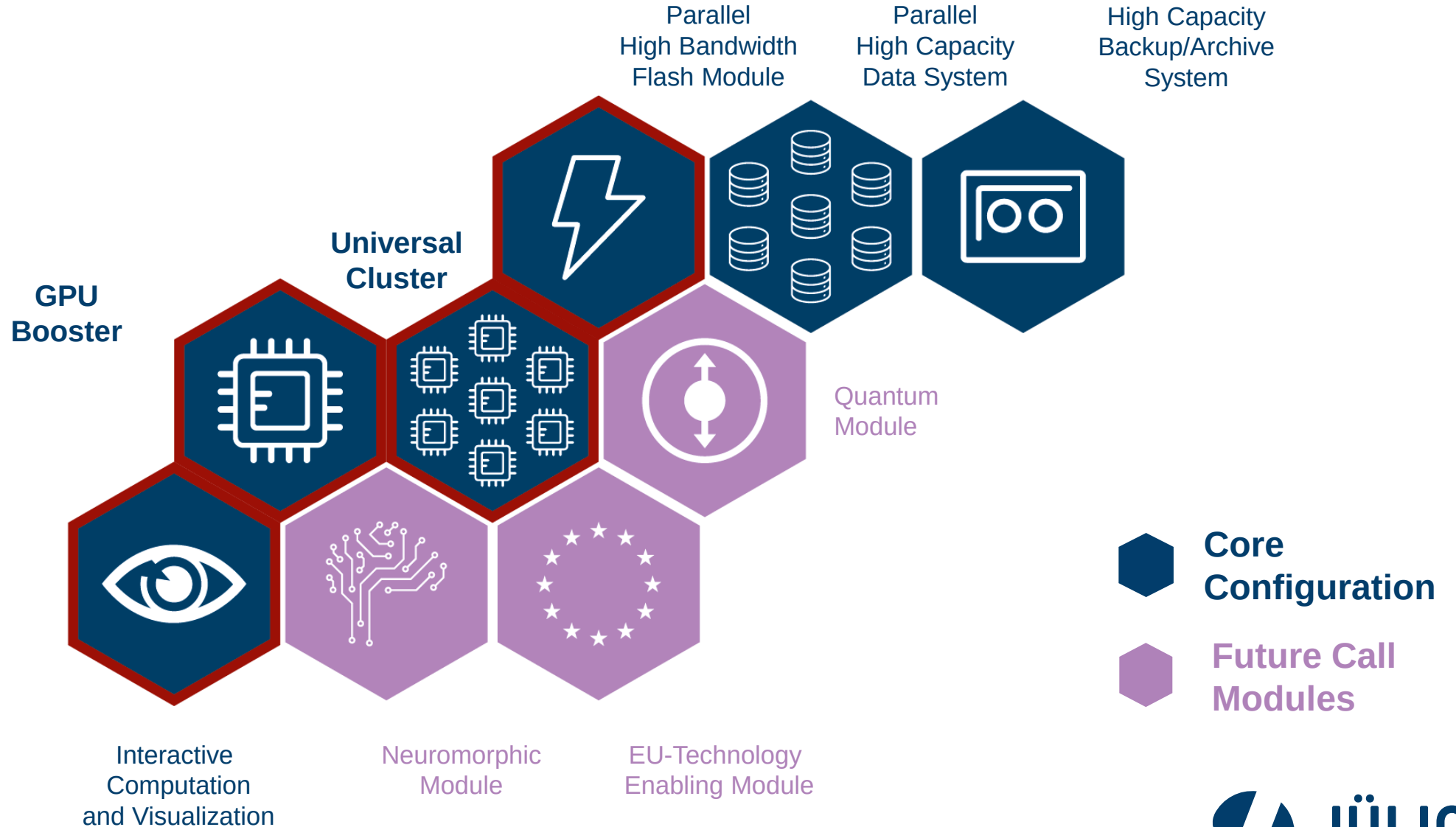
Bundesministerium
für Bildung
und Forschung

Ministerium für
Kultur und Wissenschaft
des Landes Nordrhein-Westfalen



JÜLICH
Forschungszentrum

JUPITER – HIGH-LEVEL ARCHITECTURE



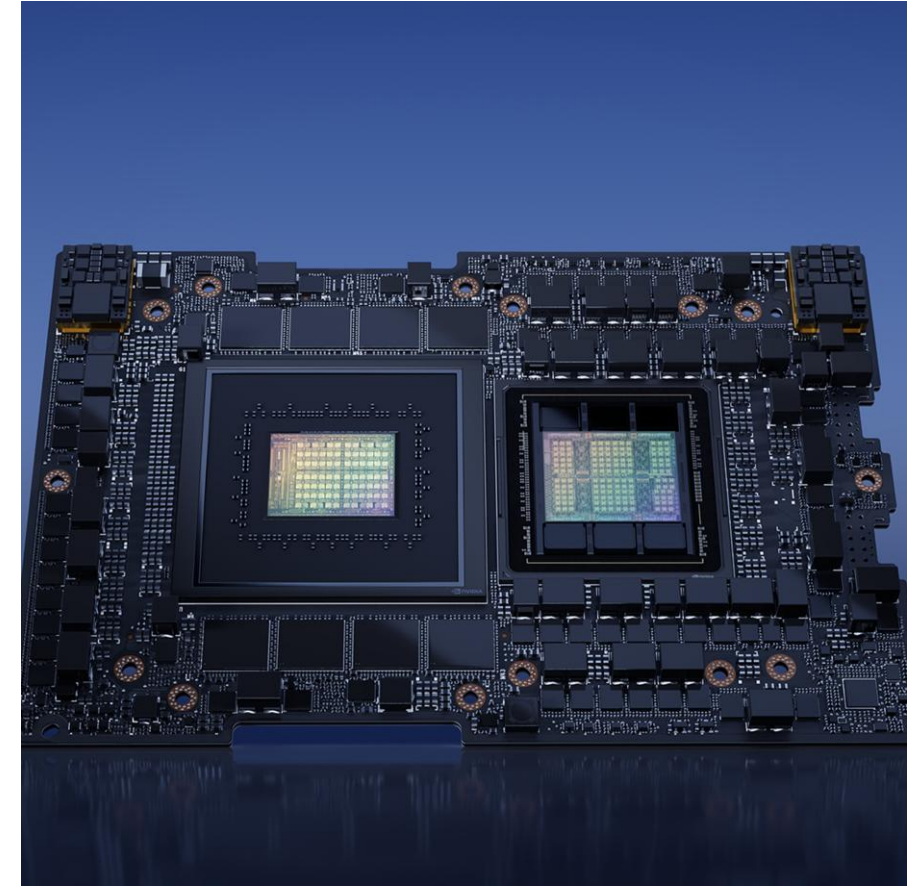


JUPITER – THE BOOSTER

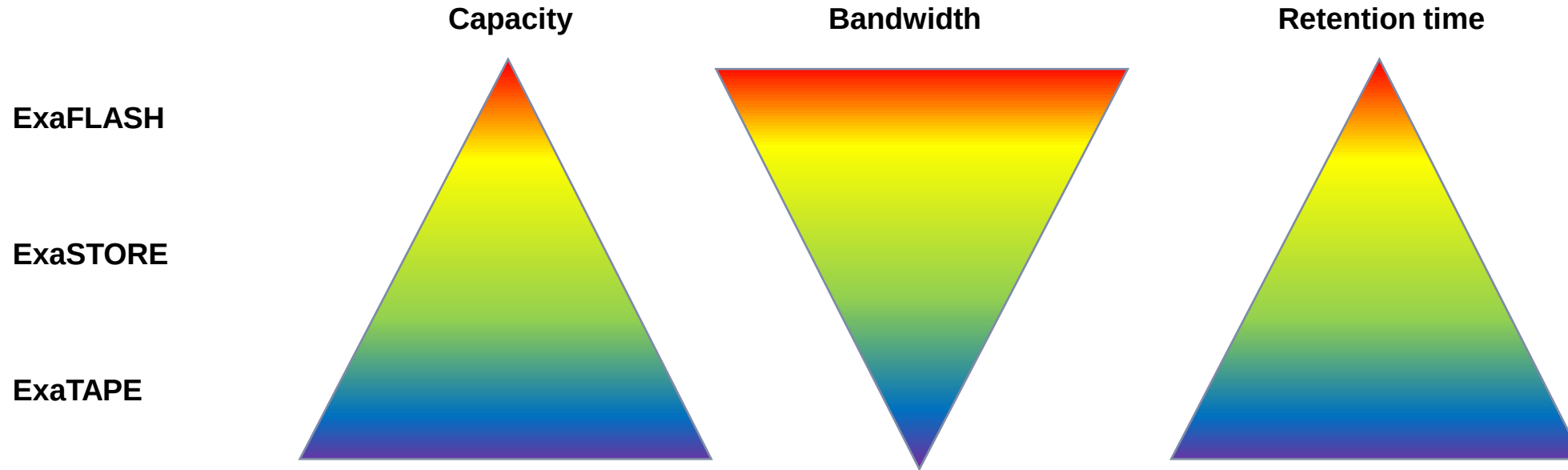
Highly-Scalable Module for HPC and AI workloads



- 1 ExaFLOP/s (FP64, HPL)
 - Current Top500 value ~800 PFLOPS (rank 4)
- NVIDIA Grace-Hopper CG1
 - ~5900 compute nodes
 - 4× CG1 chips per compute node
- NVIDIA Mellanox NDR
 - 4 NDR200 NICs per compute node
- BullSequana XH3000
 - Direct Liquid Cooled blades
 - 2 compute node per blade



TIERED STORAGE OFFERING FOR JUPITER



- ExaFLASH: IBM SSS6K cluster (29 PB raw capacity on NVMe)
- ExaSTORE: IBM SSS6K + ESS3500 cluster (308 PB raw capacity on 22 TB HDD)
- ExaTAPE: Tape storage (Backup + GPFS&TSM-HSM as part of JUST6, 2x TS4500, ~370 PB)

STORAGE FOR HPC @ JÜLICH AT A GLANCE

JUST6

- 154 PB raw, 116 PB net
- 600 GB/s write, 700 GB/s read
- 22 TB Spinning Disk
- 11x IBM SSS6000
- IBM Storage Scale
- 100 GE fabric



ExaSTORE

- 308 PB raw, 229 PB net
- 1,1 TB/s write, 1,4 TB/s read,
- 22 TB Spinning Disk
- 22x IBM SSS6000
- IBM Storage Scale
- **InfiniBand and 100GE**



ExaFLASH

- 29 PB raw, 21PB net
- 2,1 TB/s write, 3,1 TB/s read
- 30 TB NVME
- 20x IBM SSS6000
- IBM Storage Scale
- InfiniBand



SOFTWARE ENHANCEMENT FOR JÜLICH

TWO EXAMPLE OF OUR SUCCESSFULL COLLABORATION WITH IBM

PERFORMANCE ISSUE ON BUILDING SOFTWARE

- User tried to compile PARAVIEW on one of the login nodes to build software for our HPC systems.
His observation (May 2022): „***The build using the GPFS file system takes 12h-24h, but doing it on my notebook only takes 15-30 minutes***“
- IBM Devs did a lot of investigation (traces, recreating in test environment, demonstrator @ Jülich, ...)
 - Long LD_LIBRARYPATH, a lot of file stat calls
 - ACL usage is related
 - Most time consumed in the kernel (glibc)
 - Code enhancement implemented (Olaf Weiser, Mathias Dietz)
- Final measurement October 2025 (same file system, different client code level):

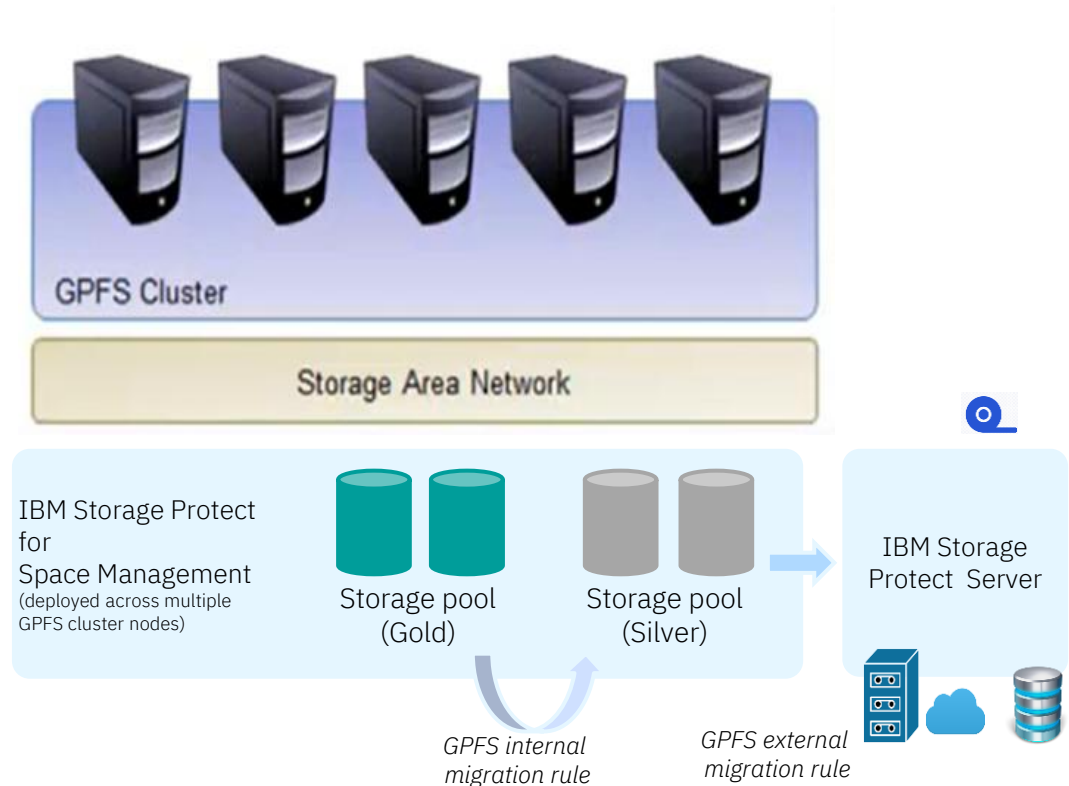
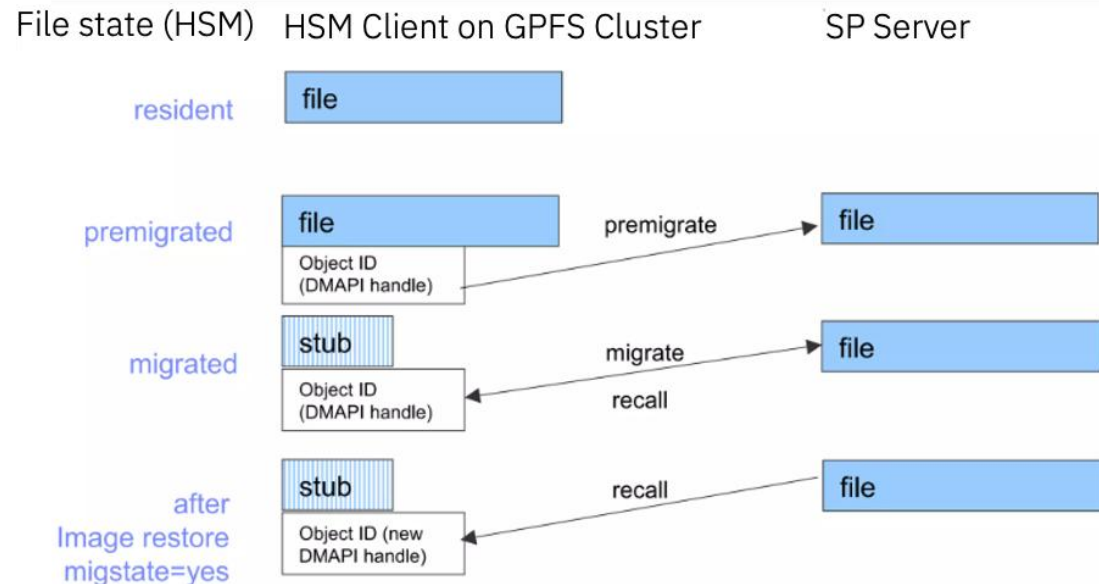
Client node config	Build time
Rocky 9.4 + GPFS 5.1.9-4	13:29:07
Rocky 9.4 + GPFS 5.2.2fzj + cifsBypassTraversalChecking	02:33:34
Rocky 9.6 + GPFS 5.2.3	01:34:29

Data & metadata separation for backup/restore while using HSM



Background

- **Scale + Protect** deployments typically use HSM & BA Client to save on TCO and protect data
- **HSM** - to tier data (files + ACLs + Extended Attributes) to tape (via Storage Protect)
- **mmbackup** – to backup data to Storage Protect.



In Jülich 50 PB user data are stored in this setup

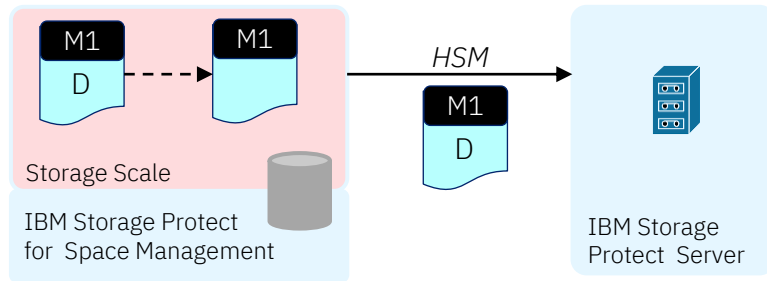
Problem we are solving ...



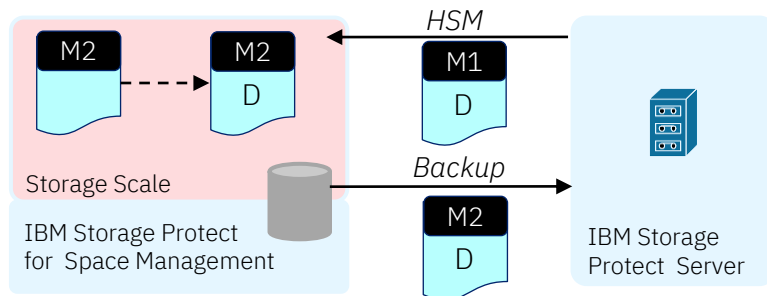
Before

- File: **data & metadata stored as one atomic unit**
- Any **metadata changes** and a **subsequent backup** results in **recalling data from Tape** back to source
- Potentially 10s to 100s of different tape cartridges must be loaded.
- This is a process takes a long time (several hours to days)
- Making the solution impractical for the customer use.

1. HSM tiers the Data & Metadata to SP Tape, keep a stub behind on filesystem



2. User modified only metadata and triggers a backup, resulting in HSM pulling back entire old data, patch new metadata to it and backup to SP again

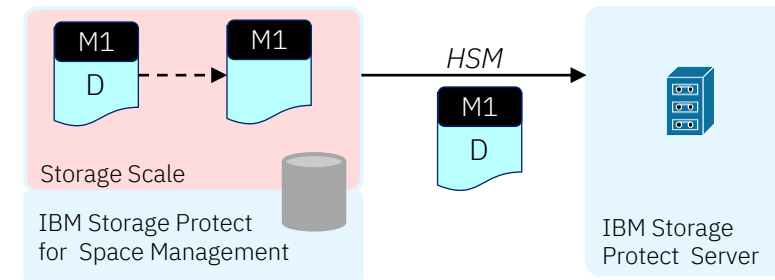


M1 : Metadata (1KB)
D : Data (~1TB)

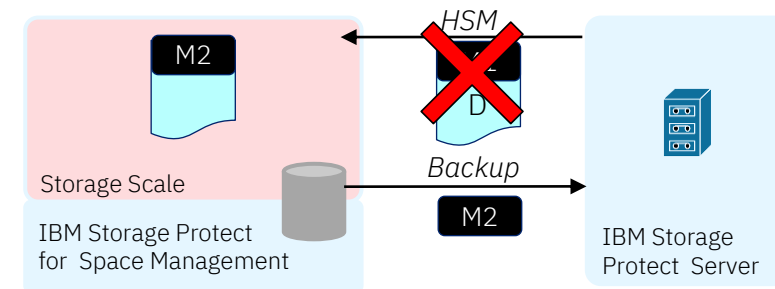
After

- Break the “File” into data & metadata - bundled together, for backup and HSM
- If only metadata is updated, **allow backup of the metadata only** from source, without needing to pull back data from HSM’ed data (from SP Tape)
- At Server, associate the new metadata with old data copy logically, forming a single unit of new backup version

1. HSM Tiers Data & Metadata to SP Tape, keeps a stub behind on filesystem



2. Only backup new metadata, if only metadata changes.
On Server, associate new metadata with old data, logically forming new backup version



Peer Grouping for ACL + Metadata & Data

- Peer grouping is used by other SP clients like VE client
- **ACL+Metadata to be stored in a storage pool that stays on disk (not Tape).**
- Requires the client to bind ACL objects to a management class, that would be disk resident, while the data object use a different management class (to store data in Tape)
 - This behavior is similar to VMCTLMC, VMMC, used in case of VE Backups.
- Each peer group represents a backup version, Members (ACL or Data) can be shared across peer groups

Pre-Requisite

Enable **MIGREQUIRESBkup**

- Should be set to yes if the mmbackup command is used.
- In this way, you can ensure that files are migrated only when they have been backed up, to avoid recalls upon backup.

Performance Benefits

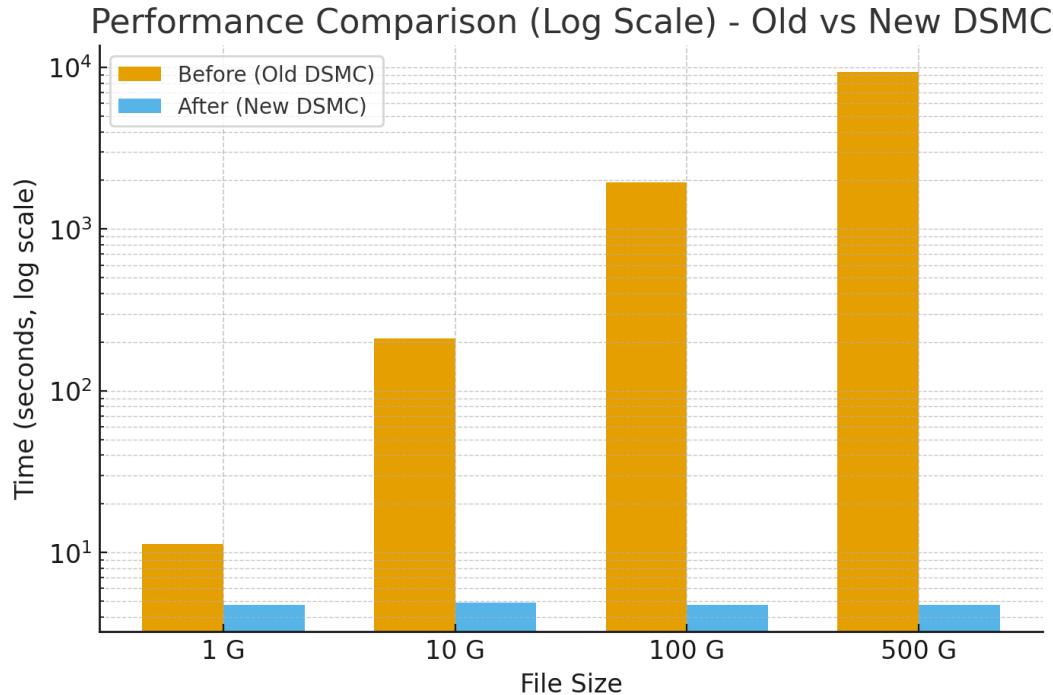


Time taken in seconds, for an **incremental backup** of a **migrated file**, when **only metadata** (GPFS ACLs / Extended Attributes) is **changed** on the file

Test Environment

- IBM Storage Scale 5.2.3, RHEL 8.10 / SLES 15 SP5
- BA, HSM Client: RHEL 8.10, 9.6

File Size	Before (Legacy DSMC)	After (Enhanced DSMC)	Performance Boost
1 G	11.336	4.762	2 x
10 G	210.761	4.768	45 x
100 G	1938.234	4.764	400 x
500 G	9354.796	4.739	2000 x



- ✓ Clearly shows how the **Legacy BA Client (DSMC)** scales exponentially with file size (almost linear growth on a log scale).
- ✓ The **Enhanced BA Client (DSMC)** remains nearly flat — demonstrating **consistent** and **dramatically improved performance** across all file sizes.
- ✓ Confirming **massive scalability** and **efficiency improvements**.

DEMONSTRATION OF THE NEW TSM CLIENT CODE

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# ls -l TestFile2
-rw-r--r-- 1 root root 20971520 Nov 11 11:29 TestFile2
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmc incr -se=hsm TestFile2
IBM Storage Protect
Command Line Backup-Archive Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:34:53
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.

Node Name: PROXYAGENT-22
Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:34:54  Last access: 11/11/2025 11:14:10

Accessing as node: HSM-PROXY

Incremental backup of volume 'TestFile2'
Directory-->          4,096 /gpfs/hsm/SPF-I-2572-MVP1 [Sent]
Normal File-->       20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile2 [Sent]
Successful incremental backup of '/gpfs/hsm/SPF-I-2572-MVP1/TestFile2'

Total number of objects inspected:      2
Total number of objects backed up:      2
Total number of objects updated:        0
Total number of objects rebound:        0
Total number of objects deleted:        0
Total number of objects expired:        0
Total number of objects failed:         0
Total number of objects encrypted:      0
Total number of objects grew:           0
Total number of retries:                0
Total number of bytes inspected:        20.00 MB
Total number of bytes transferred:      20.00 MB
Data transfer time:                     0.07 sec
Network data transfer rate:             269,305.57 KB/sec
Aggregate data transfer rate:           19,480.68 KB/sec
Objects compressed by:                  0%
Total data reduction ratio:             0.02%
Elapsed processing time:                00:00:01
```

Production environment

Member of the Helmholtz Association

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# ls -l TestFile3
-rw-r--r-- 1 root root 20971520 Nov 11 11:29 TestFile3
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmc incr -se=hsm TestFile3
IBM Storage Protect
Command Line Backup-Archive Client Interface
  Client Version 8, Release 1, Level 27.0 DEVBUILD
  Client date/time: 11/11/2025 11:35:12
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.

Node Name: PROXYAGENT-23
Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:35:12  Last access: 10/28/2025 10:55:21

Accessing as node: HSM-PROXY

Incremental backup of volume 'TestFile3'
Normal File-->       20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile3 [Sent]
Successful incremental backup of '/gpfs/hsm/SPF-I-2572-MVP1/TestFile3'

Total number of objects inspected:      1
Total number of objects backed up:      1
Total number of objects updated:        0
Total number of objects rebound:        0
Total number of objects deleted:        0
Total number of objects expired:        0
Total number of objects failed:         0
Total number of objects encrypted:      0
Total number of objects grew:           0
Total number of retries:                0
Total number of bytes inspected:        20.00 MB
Total number of bytes transferred:      20.00 MB
Data transfer time:                     0.13 sec
Network data transfer rate:             151,849.15 KB/sec
Aggregate data transfer rate:           19,481.59 KB/sec
Objects compressed by:                  0%
Total data reduction ratio:             0.00%
Elapsed processing time:                00:00:01
```

Development environment (MVP1)

DEMONSTRATION OF THE NEW TSM CLIENT CODE

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmmigrate -d TestFile2
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:41:33
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.

Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:41:33 Last access: 11/11/2025 11:34:54

Normal File-->      20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile2 [Sent]
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmls TestFile2
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:41:51
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.
```

ActS	ResS	ResB	FSt	FName
20971520	1024	1	m	TestFile2

Production environment

Member of the Helmholtz Association

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmmigrate -d TestFile3
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0 DEVBUILD
  Client date/time: 11/11/2025 11:42:19
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.

Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:42:19 Last access: 11/11/2025 11:35:13

Normal File-->      20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile3 [Sent]
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmls TestFile3
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:42:25
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.
```

ActS	ResS	ResB	FSt	FName
20971520	1024	1	m	TestFile3

Development environment (MVP1)

DEMONSTRATION OF THE NEW TSM CLIENT CODE

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmmigrate -d TestFile2
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:41:33
(c) Copyright IBM Corp. 1990, 2025. All Rights Reserved.

Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:41:33  Last access: 11/11/2025 11:34:54

Normal File-->          20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile2 [Sent]
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmls TestFile2
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:41:51
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```

ActS	ResS	ResB	FSt	FName
20971520	1024	1	m	TestFile2

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# getfacl TestFile2
# file: TestFile2
# owner: root
# group: root
user::rw-
group::r--
other::r--
[root@x3850-x6-22 SPF-I-2572-MVP1]# setfacl -m u:tsminst1:rwX TestFile2
[root@x3850-x6-22 SPF-I-2572-MVP1]# getfacl TestFile2
# file: TestFile2
# owner: root
# group: root
user::rw-
user:tsminst1:rwX
group::r--
mask::rwX
other::r--
```

Production environment

Member of the Helmholtz Association

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmmigrate -d TestFile3
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0 DEVBUILD
  Client date/time: 11/11/2025 11:42:19
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Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:42:19  Last access: 11/11/2025 11:35:13

Normal File-->          20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile3 [Sent]
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmls TestFile3
IBM Storage Protect
Command Line Space Management Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:42:25
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```

ActS	ResS	ResB	FSt	FName
20971520	1024	1	m	TestFile3

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# getfacl TestFile3
# file: TestFile3
# owner: root
# group: root
user::rw-
group::r--
other::r--
[root@x3850-x6-23 SPF-I-2572-MVP1]# setfacl -m u:tsminst1:rwX TestFile3
[root@x3850-x6-23 SPF-I-2572-MVP1]# getfacl TestFile3
# file: TestFile3
# owner: root
# group: root
user::rw-
user:tsminst1:rwX
group::r--
mask::rwX
other::r--
```

Development environment (MVP1)

DEMONSTRATION OF THE NEW TSM CLIENT CODE

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmc incr -se=hsm TestFile2
IBM Storage Protect
Command Line Backup-Archive Client Interface
  Client Version 8, Release 1, Level 27.0
  Client date/time: 11/11/2025 11:50:09
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Node Name: PROXYAGENT-22
Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:50:09 Last access: 11/11/2025 11:42:49

Accessing as node: HSM-PROXY

Incremental backup of volume 'TestFile2'
Normal File-->      20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile2 [Sent]
Successful incremental backup of '/gpfs/hsm/SPF-I-2572-MVP1/TestFile2'

Total number of objects inspected:      1
Total number of objects backed up:      1
Total number of objects updated:        0
Total number of objects rebound:        0
Total number of objects deleted:        0
Total number of objects expired:        0
Total number of objects failed:         0
Total number of objects encrypted:      0
Total number of objects grew:           0
Total number of retries:                0
Total number of bytes inspected:        20.00 MB
Total number of bytes transferred:      20.00 MB
Data transfer time:                    0.05 sec
Network data transfer rate:             351,710.86 KB/sec
Aggregate data transfer rate:           19,487.23 KB/sec
Objects compressed by:                  0%
Total data reduction ratio:              0.00%
Elapsed processing time:                00:00:01
```

Production environment

Member of the Helmholtz Association

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmc incr -se=hsm TestFile3
IBM Storage Protect
Command Line Backup-Archive Client Interface
  Client Version 8, Release 1, Level 27.0 DEVBUILD
  Client date/time: 11/11/2025 11:49:51
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Node Name: PROXYAGENT-23
Session established with server PROTECT1: Linux/x86_64
  Server Version 8, Release 1, Level 27.000
  Server date/time: 11/11/2025 11:49:52 Last access: 11/11/2025 11:45:04

Accessing as node: HSM-PROXY

Incremental backup of volume 'TestFile3'
Normal File-->      20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile3 [Sent]
Successful incremental backup of '/gpfs/hsm/SPF-I-2572-MVP1/TestFile3'

Total number of objects inspected:      1
Total number of objects backed up:      1
Total number of objects updated:        0
Total number of objects rebound:        0
Total number of objects deleted:        0
Total number of objects expired:        0
Total number of objects failed:         0
Total number of objects encrypted:      0
Total number of objects grew:           0
Total number of retries:                0
Total number of bytes inspected:        20.00 MB
Total number of bytes transferred:      226 B
Data transfer time:                    0.00 sec
Network data transfer rate:             0.00 KB/sec
Aggregate data transfer rate:           0.20 KB/sec
Objects compressed by:                  0%
Total data reduction ratio:             100.00%
Elapsed processing time:                00:00:01
```

Development environment (MVP1)

DEMONSTRATION OF THE NEW TSM CLIENT CODE

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmls TestFile2
```

IBM Storage Protect

Command Line Space Management Client Interface

Client Version 8, Release 1, Level 27.0

Client date/time: 11/11/2025 11:50:22

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ActS	ResS	ResB	FSt	FName
20971520	20971520	20480	p	TestFile2

```
[root@x3850-x6-22 SPF-I-2572-MVP1]# dsmmigrate -d TestFile2
```

IBM Storage Protect

Command Line Space Management Client Interface

Client Version 8, Release 1, Level 27.0

Client date/time: 11/11/2025 11:59:50

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Session established with server PROTECT1: Linux/x86_64

Server Version 8, Release 1, Level 27.000

Server date/time: 11/11/2025 11:59:50 Last access: 11/11/2025 11:50:10

Normal File--> 20,971,520 /gpfs/hsm/SPF-I-2572-MVP1/TestFile2 [Sent]

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmls TestFile3
```

IBM Storage Protect

Command Line Space Management Client Interface

Client Version 8, Release 1, Level 27.0

Client date/time: 11/11/2025 11:50:37

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ActS	ResS	ResB	FSt	FName
20971520	1024	1	m	TestFile3

```
[root@x3850-x6-23 SPF-I-2572-MVP1]# dsmmigrate -d TestFile3
```

IBM Storage Protect

Command Line Space Management Client Interface

Client Version 8, Release 1, Level 27.0 DEVBUILD

Client date/time: 11/11/2025 12:00:04

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Session established with server PROTECT1: Linux/x86_64

Server Version 8, Release 1, Level 27.000

Server date/time: 11/11/2025 12:00:04 Last access: 11/11/2025 11:49:52

11/11/2025 12:00:04 ANS1228E Sending of object '/gpfs/hsm/SPF-I-2572-MVP1/TestFile3' failed.

11/11/2025 12:00:04 ANS1268E This file has been migrated.

Production environment

Member of the Helmholtz Association

Development environment (MVP1)





Thank You For Your Attention

HPC USER DATA (USAGE Q3/2025)

JUST6 only

File System	Shell Variable	Description	INODES	Capacity
home	\$HOME	Users HOME File Systems	90.316.141	24 TB
project1	\$PROJECT	Compute Project File System	885.084.342	4.9 PB
scratch	\$SCRATCH	Compute Project Scratch File System	310.588.611	12 PB
data1	\$DATA	High Bandwidth and large Capacity File System	320.298.652	37 PB
largedata2	\$LARGEDATA	Large Capacity (Disk based, deprecated)	47.488.911	7.5 PB
arch1 arch2	\$ARCHIVE	Archive File System (Tape)	29.488.759	~50 PB

SP: PEER GROUPING FOR ACL + METADATA & DATA

```
Protect: PROTECT1>select * from backups where hl_name like '%SPF-I-2572-MVP1%' order by backup_date desc
```

```

  NODE_NAME: HSM-PROXY
  FILESPACE_NAME: /gpfs/hsm
  FILESPACE_ID: 1
    STATE: ACTIVE_VERSION
    TYPE: FILE
    HL_NAME: /SPF-I-2572-MVP1/TestFile3/
    LL_NAME:
    OBJECT_ID: 7663470
    BACKUP_DATE: 2025-11-11 11:49:52.000000
  DEACTIVATE_DATE:
    OWNER: *
    CLASS_NAME: DEFAULT
    ACTUAL_SIZE:

  NODE_NAME: HSM-PROXY
  FILESPACE_NAME: /gpfs/hsm
  FILESPACE_ID: 1
    STATE: ACTIVE_VERSION
    TYPE: FILE
    HL_NAME: /TestFile3/
    LL_NAME: Tes/SPF-I-2572-MVP1tFile3.md
    OBJECT_ID: 7663471
    BACKUP_DATE: 2025-11-11 11:49:52.000000
  DEACTIVATE_DATE:
    OWNER: *
    CLASS_NAME: DEFAULT
    ACTUAL_SIZE:
```

```

  NODE_NAME: HSM-PROXY
  FILESPACE_NAME: /gpfs/hsm
  FILESPACE_ID: 1
    STATE: INACTIVE_VERSION
    TYPE: FILE
    HL_NAME: /SPF-I-2572-MVP1/TestFile3/
    LL_NAME:
    OBJECT_ID: 7663466
    BACKUP_DATE: 2025-11-11 11:35:13.000000
  DEACTIVATE_DATE: 2025-11-11 11:49:52.000000
    OWNER: *
    CLASS_NAME: DEFAULT
    ACTUAL_SIZE:

  NODE_NAME: HSM-PROXY
  FILESPACE_NAME: /gpfs/hsm
  FILESPACE_ID: 1
    STATE: ACTIVE_VERSION
    TYPE: FILE
    HL_NAME: /SPF-I-2572-MVP1/TestFile3/
    LL_NAME: TestFile3.dat
    OBJECT_ID: 7663467
    BACKUP_DATE: 2025-11-11 11:35:13.000000
  DEACTIVATE_DATE:
    OWNER: *
    CLASS_NAME: DEFAULT
    ACTUAL_SIZE:
```

```
[tsminst2@x3850-x6-22 ~]$ db2 "select * from tsmdb1.group_leaders where nodeid=37"
```

NODEID	FSID	LEADERID	GROUPTYPE	MEMBERID	MEMBEROBJTYPE
...					
...					
	37	1		7663466	2
	37	1		7663470	2
	37	1		7663471	2