



KATHOLIEKE UNIVERSITEIT
LEUVEN



Storage @ HPC KU Leuven

ICTS, Leuven

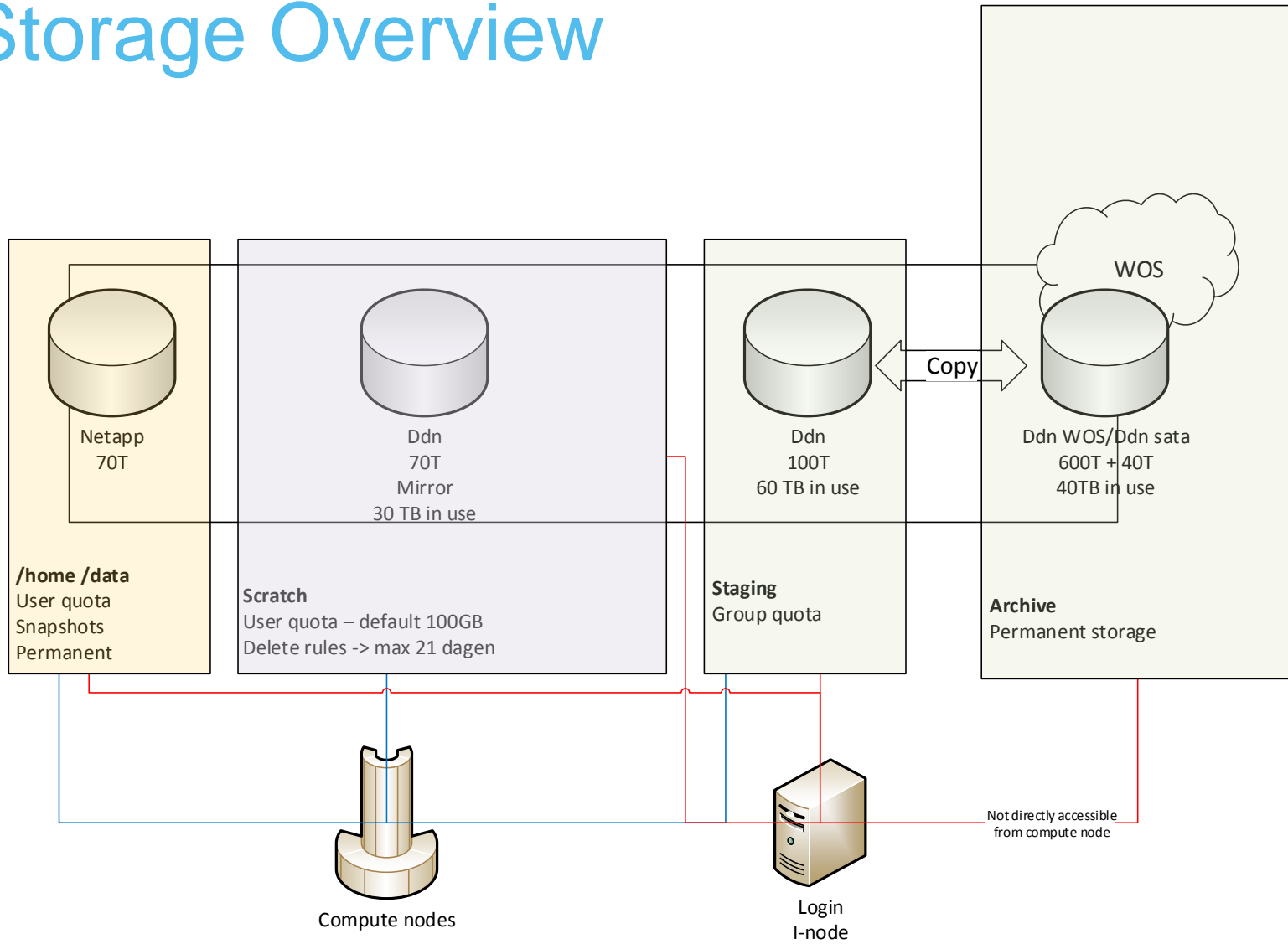
Overview

- Storage overview
- Use Cases
- Best practices
- Prices
- Questions

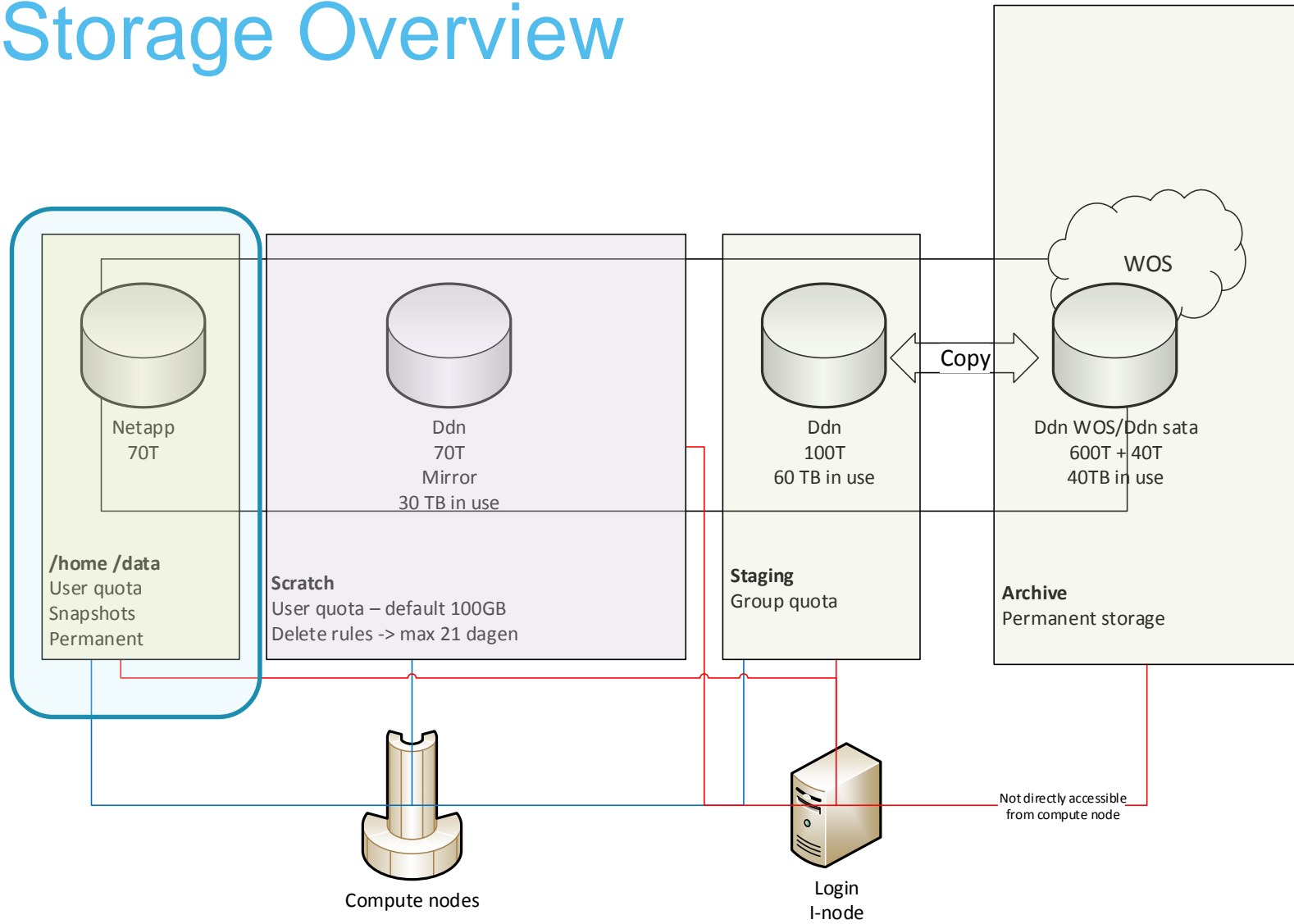
Storage Overview



Storage Overview



Storage Overview

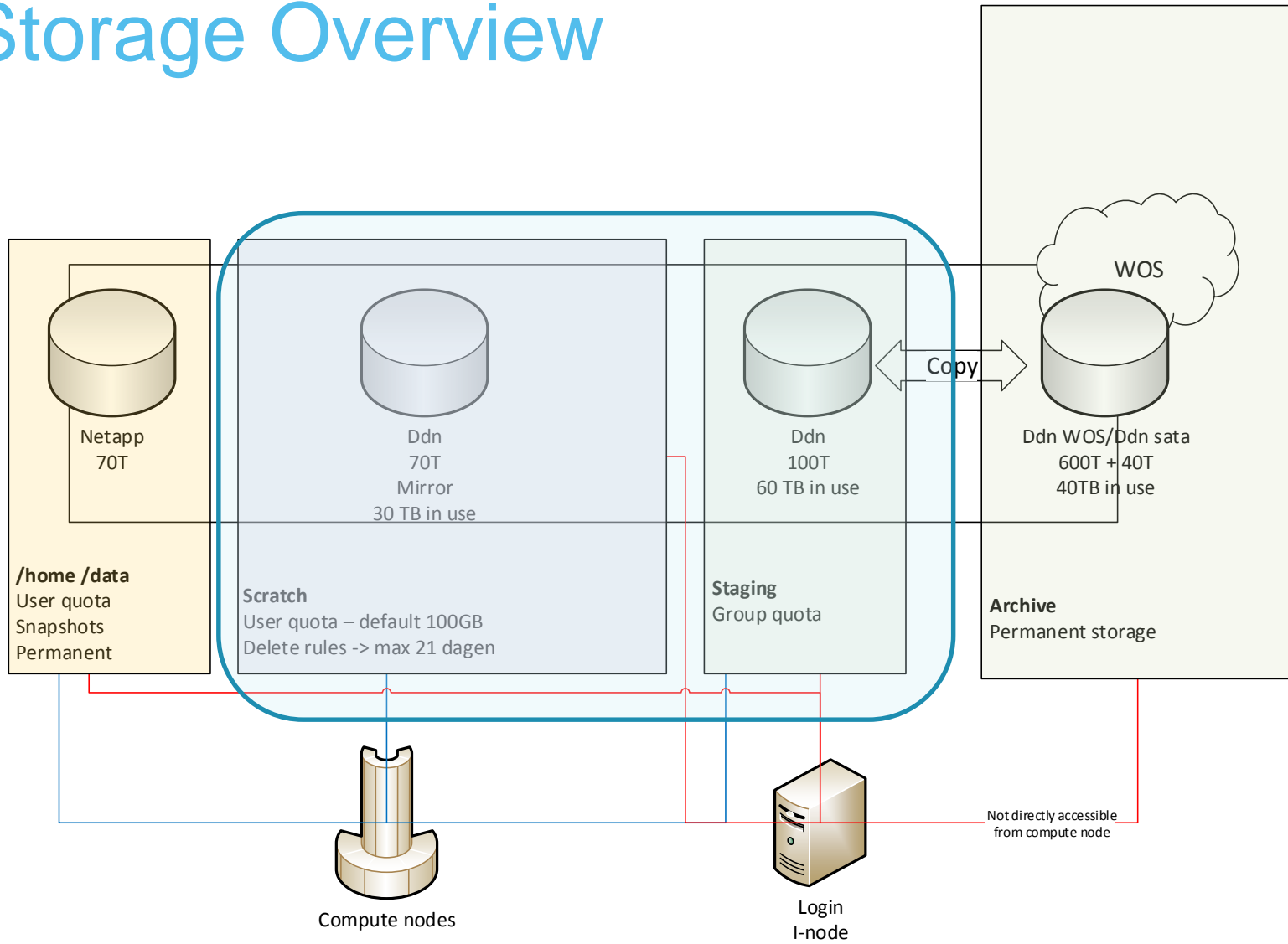


HOME and DATA space



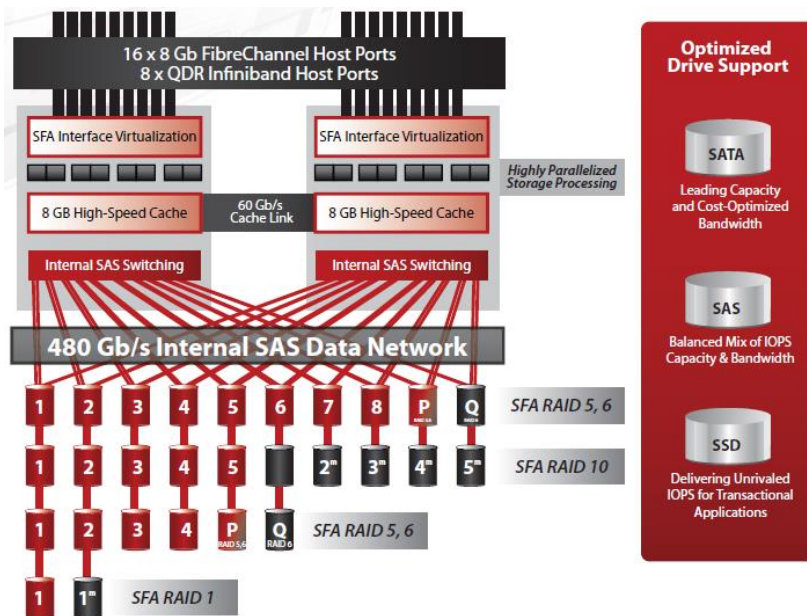
- very reliable
- back-ups
- Not designed for HPC use
- Best practice:
 - Use it to store important data.

Storage Overview



SCRATCH space

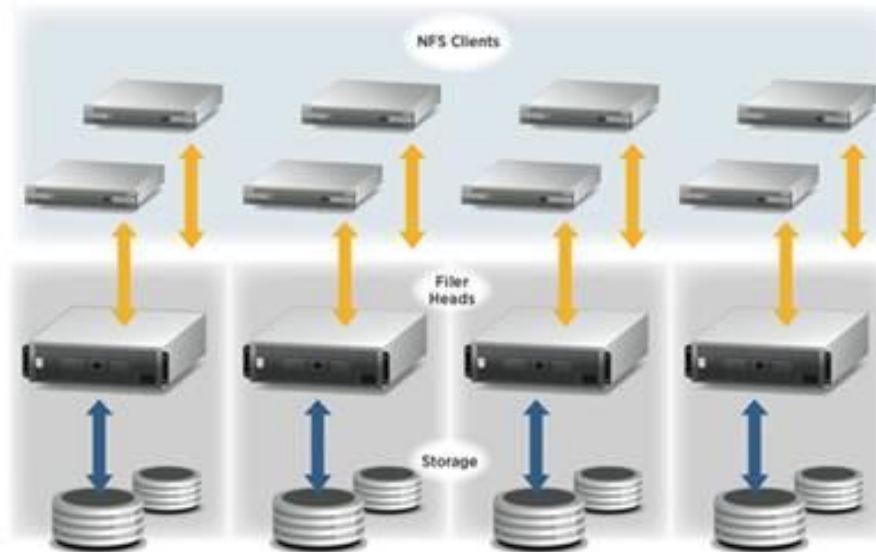
- Designed for HPC use
- Parallel filesystem: GPFS
- No back-ups.
- Scalable
- Best practice:
 - Use it during your calculations.



Parallel IO principles

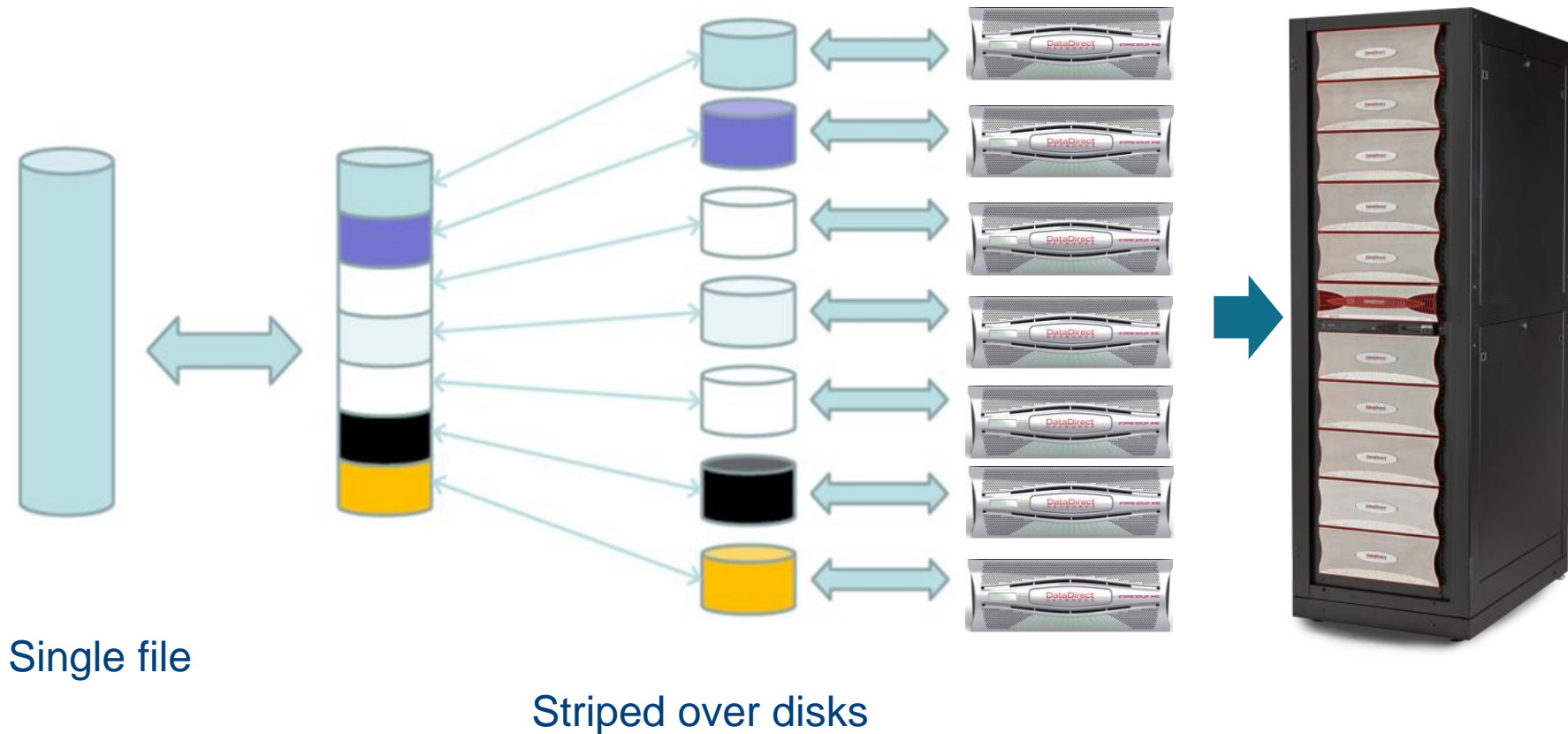
Enable direct data paths

NFS Storage Islands

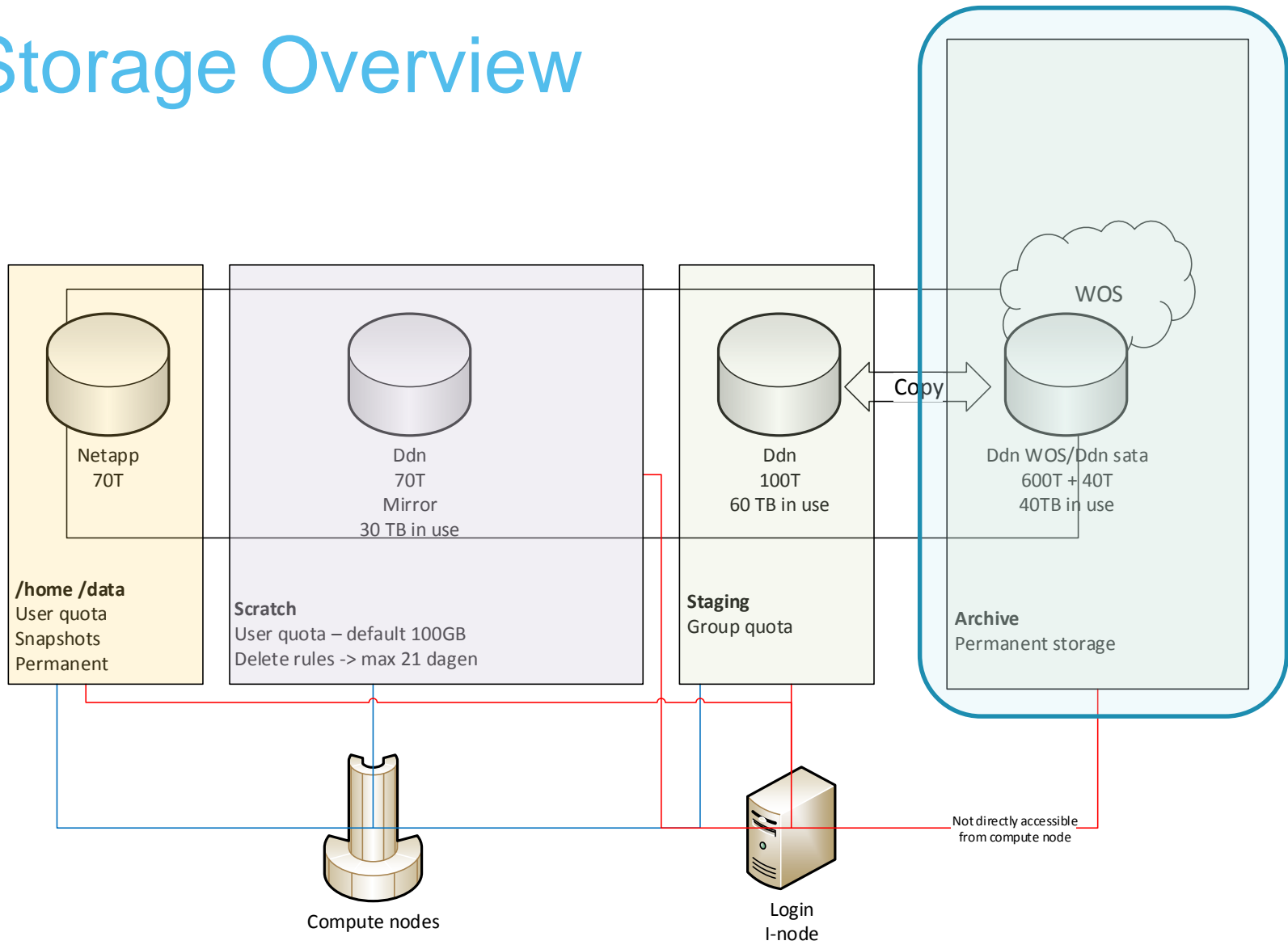


Parallel IO: principles

- Striping of data:



Storage Overview

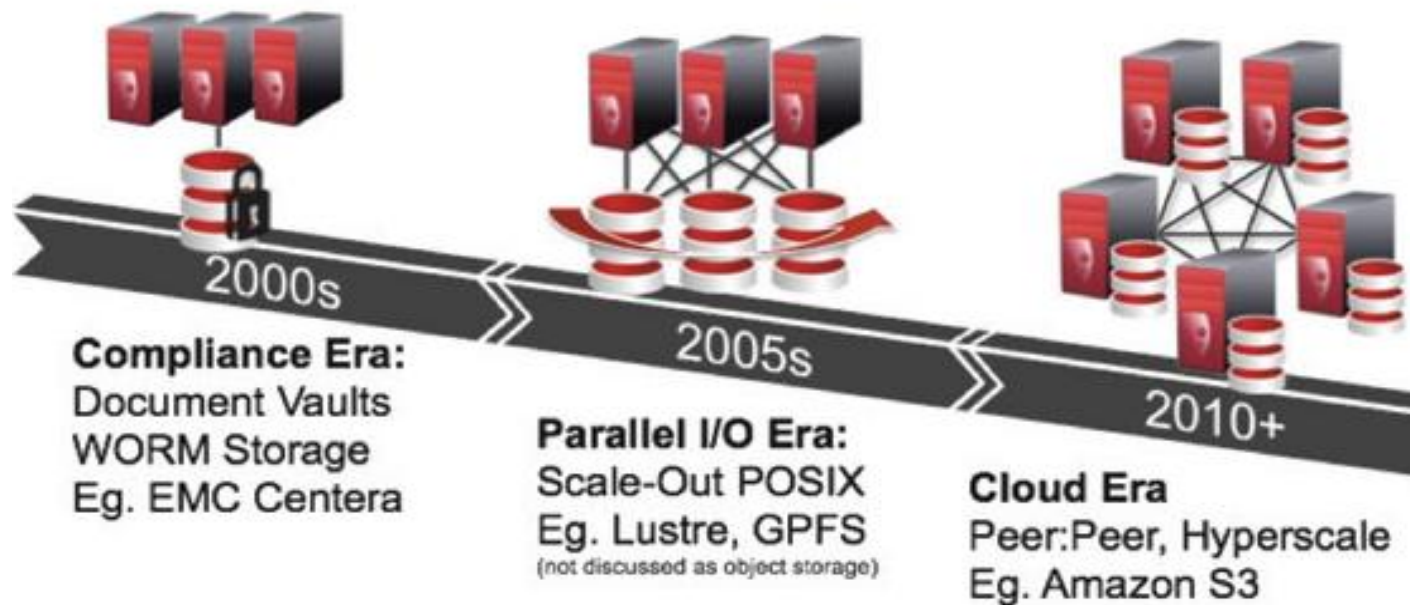


Object Storage

- History

Object Storage

Challenges & Opportunities



- Object storage's history in the archive and compliance market has created an impression in the market that object storage is for archive only.
- POSIX-applications are difficult to integrate with object storage interfaces.

Object Storage: Use cases

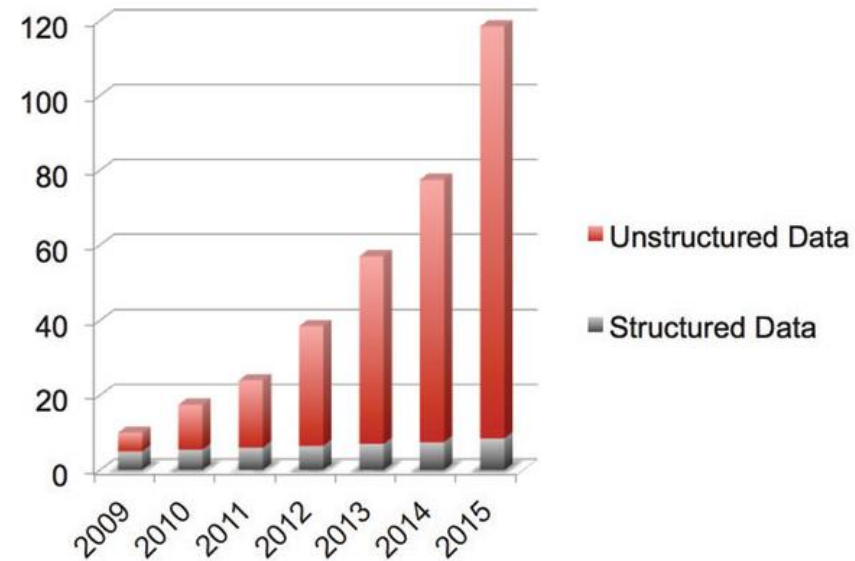
- Massive scalability, REST APIs, geographic distribution, ... enable a series of use cases:
 - **Online Web Services**
 - **File Sharing**
 - **Cloud Backup**
 - **Cloud Archives**
 - **Worldwide Collaboration**
 - **Or Mix of all or several of above.**

EXAMPLES:

Dropbox®, **Box(.net)™**, **Netflix®**, **Apple®**, **Google®** and **Facebook®**, ...

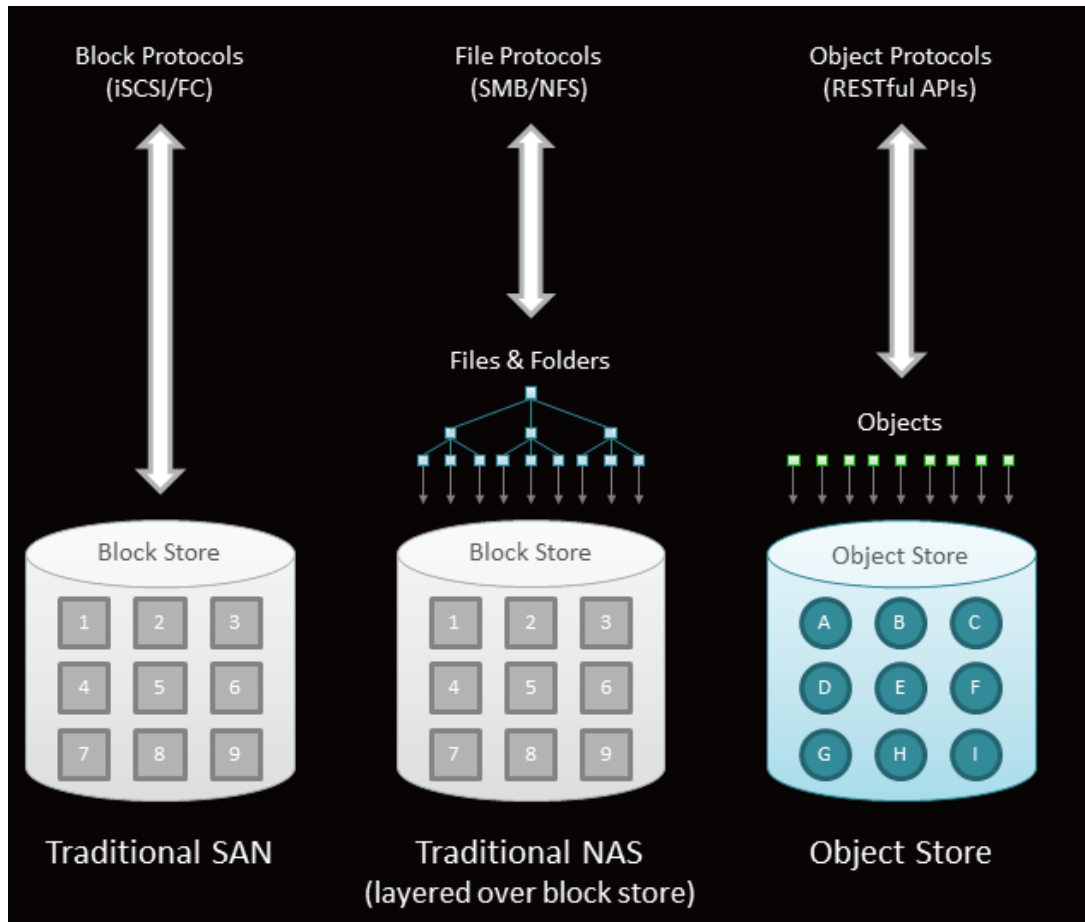
Object Storage

- Motivation
 - Massive Data Growth
 - Always Online
 - Power to the Applications (REST API's)
 - Big Unstructured Data

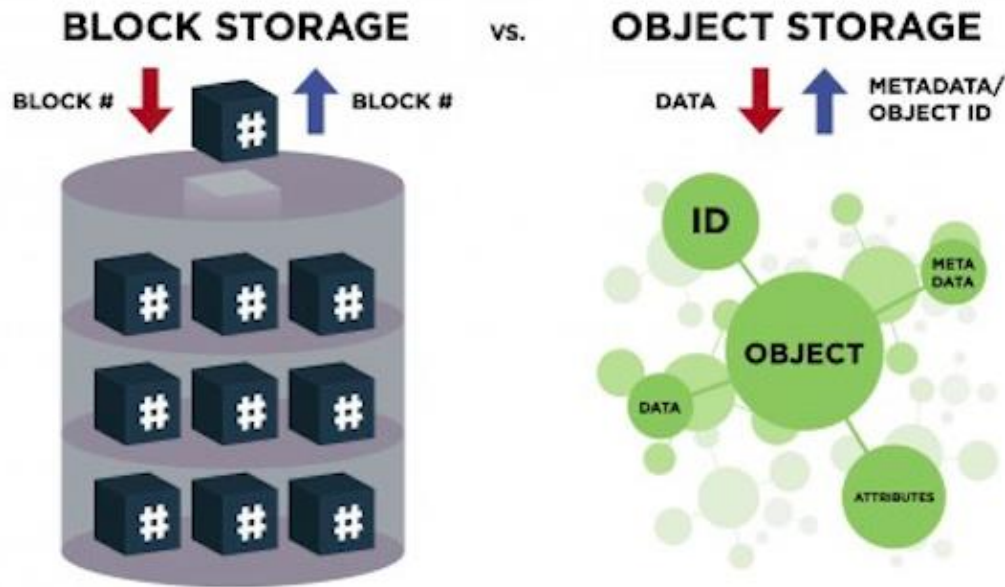


What is Object storage?

a different way of organizing data to disks

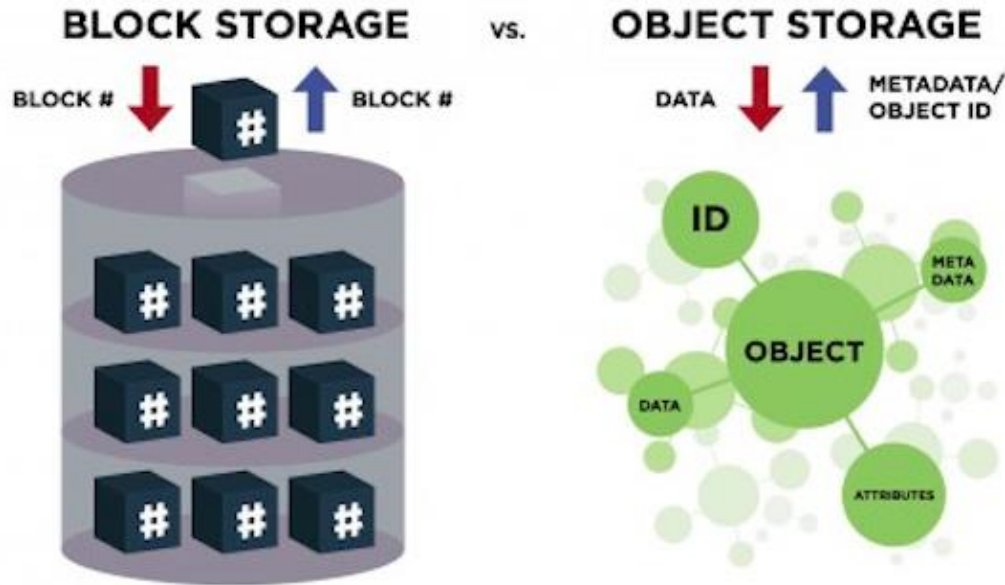


Object Storage vs Block Storage



- Block storages splits files in evenly sized blocks. A block itself is meaningless.
- Block storage permits you to edit one block at the time
- Object Storage: object contains data, metadata (no limit), unique ID
- Object Storage: Objects are manipulated as a unit.

Object Storage vs Block Storage

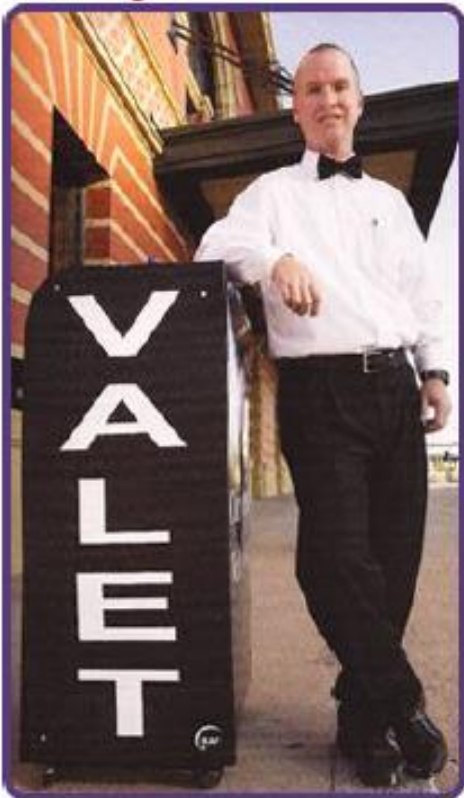


- Scalability is limited.
- Better for random read/write.
- Accessed directly by the operating system

- Very scalable
- Works well for unstructured data, generally read-only

Example Object Storage : Valet Parking

Object Store



Method (Put)



Returned Object ID



Object Metadata

OID

38002

License =
"2BZ 984"

Make =
"Audi"

Damage =
"Dent, right
front fender"

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OFFICE STUB **38-002**

LICENSE #	TIME IN	TIME OUT


Black	Acura	Hyundai	Olds.
Blue	Audi	Infiniti	Plym.
Brown	B.M.W.	Isuzu	Pont.
Gold	Buick	Jaguar	Rover L/R
Gray	Cadillac	Jeep	Saab
Green	Chrysler	Lexus	St. Wagon
Red	Corvet	Mazda	T-Bird
Silver	Dodge	Mercury	Toyota
Tan	Ford	M-Benz	Volksw.
White	Ford	Mitsubishi	Volvo
Yellow	Honda	Nissan	Conv.
			Compact
			4 X 4

CLAIM CHECK **38-002**

RIGHT



LEFT



INDICATE DAMAGED AREA WITH AN X

Applies when ticket issued in New York City:
NOTES: FURNISHES 15-MIN. UNLIMITED GARAGE FOR LOAN OR DAMAGE OF SERVICE BY PARK, TRUCK, OR EQUIPMENT LIMITED TO DAMAGE UNLESS ADDITIONAL FEE FOR VEHICLE FIRST PARKED AND RECEIPT ISSUED FOR SAME. WE WILL NOT BE RESPONSIBLE FOR PERSONAL PROPERTY LEFT IN CAR. NO CLAIMS RETURNED/PAID FOR AT THE TIME CAR IS RETURNED.

- HOURS AND RATES AS POSTED -
PRESENT THIS CHECK WHEN CALLING FOR CAR
NOT RESPONSIBLE FOR LOSS OF ANY ARTICLES OR PERSONAL PROPERTY LEFT IN CAR. UNLESS CHECKED WITH THE MANAGER.
NOT RESPONSIBLE FOR CAR LEFT AFTER POSTED HOURS.
PLEASE REMOVE ALL VALUABLES

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Object Namespace

Single flat namespace



Dude! Where's my object?



Your "object" might be moved while stored.

Where your "object" is actually stored is unknown to you. In fact, for all practical purposes you need not know where it is stored.



What you care about ...

“Get” Object ID



Lookup/Retrieval



Object/Data Returned



And of course ...

No data corruption!

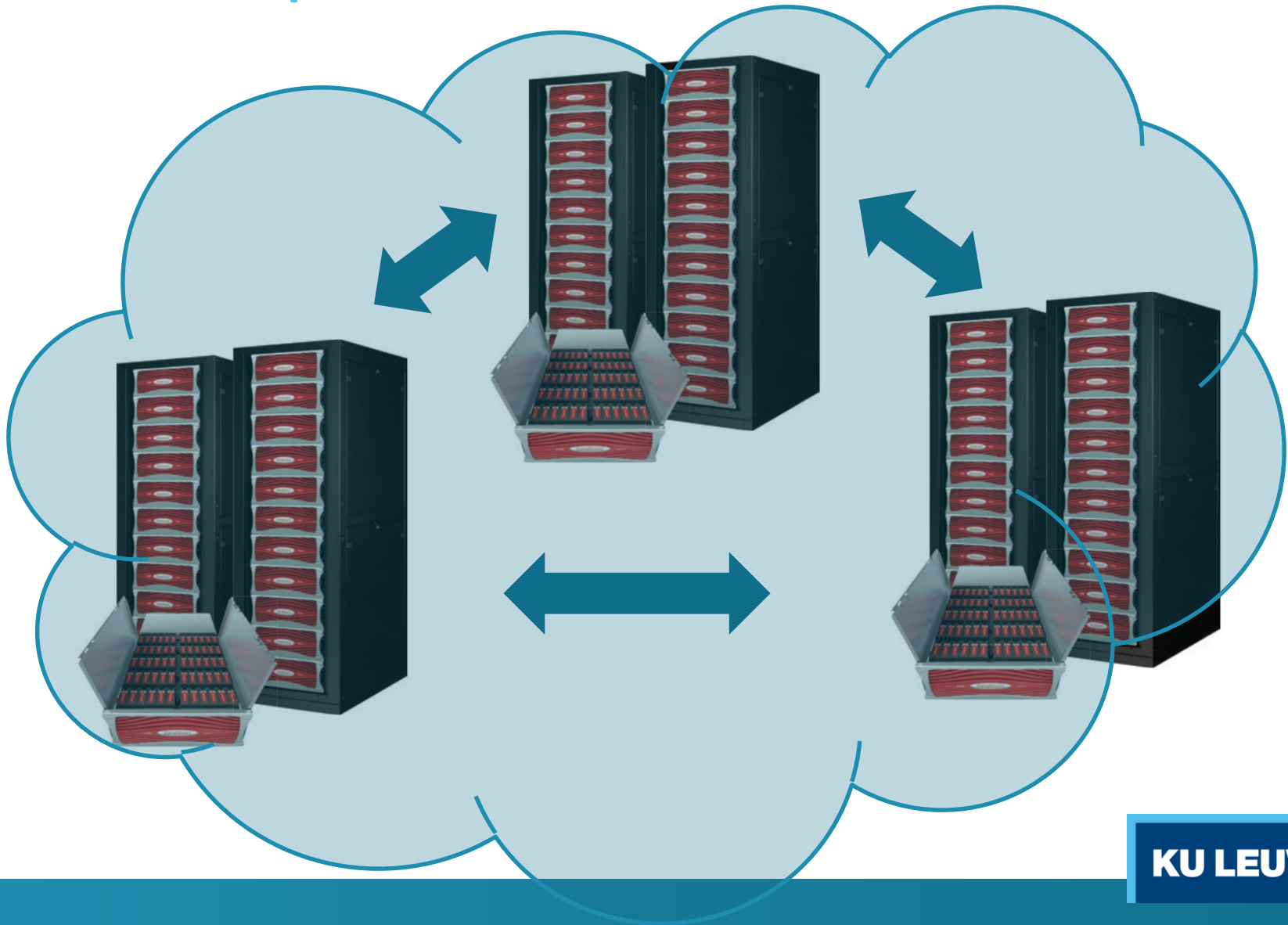




WOS

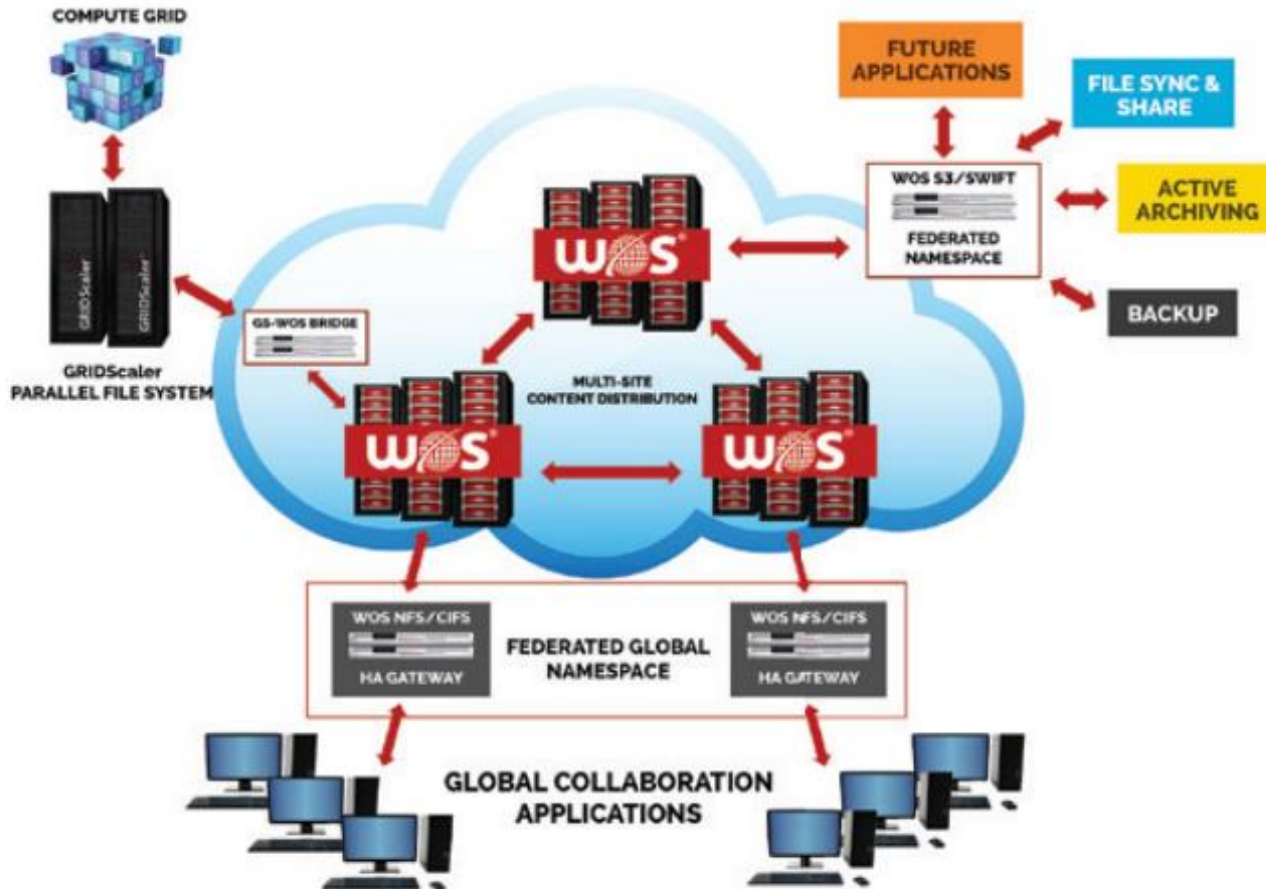
Web Object Scaler

WOS implementation

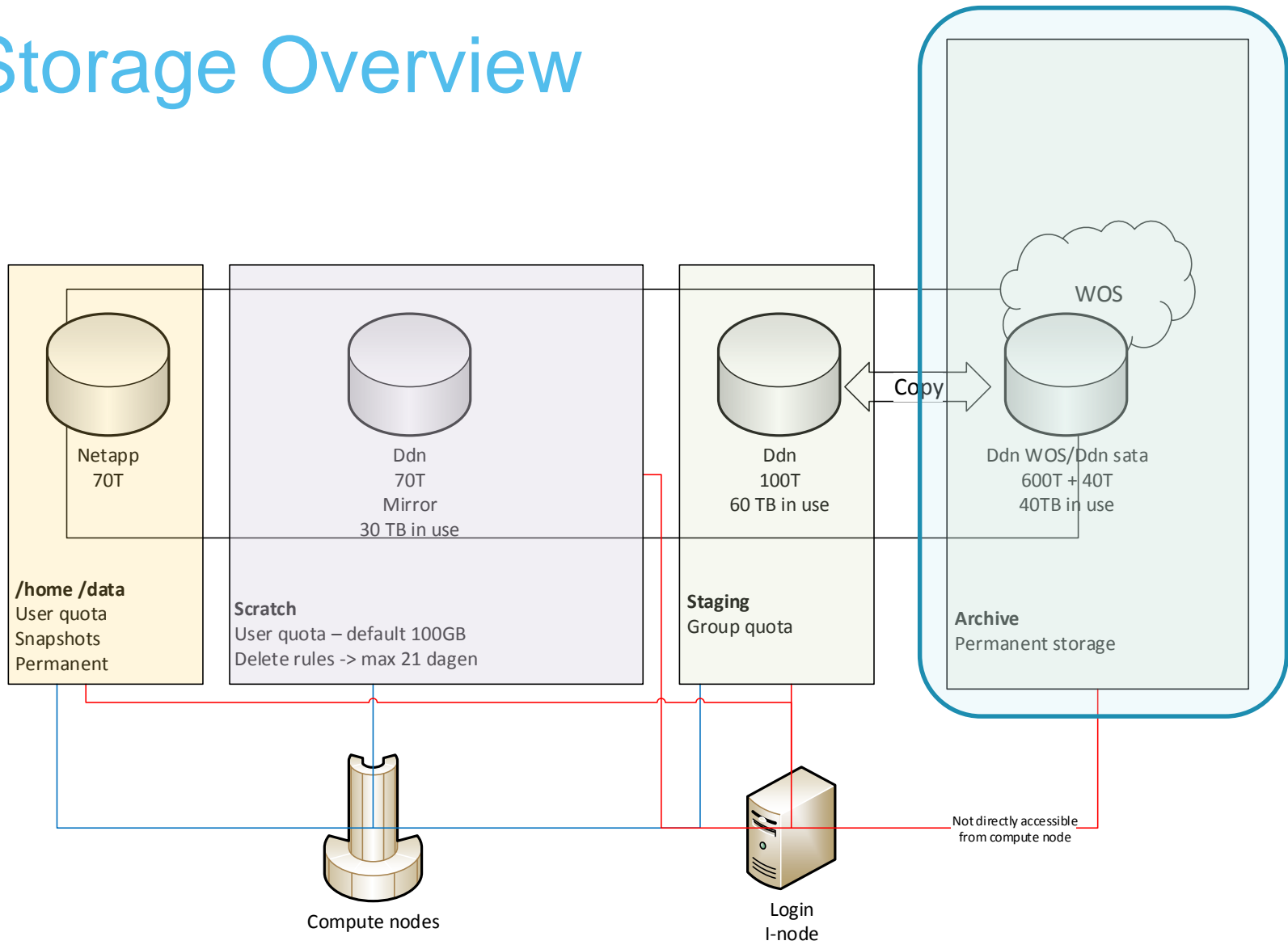


WOS Implementation

WOS ACCESS OVERVIEW



Storage Overview



Storage areas

Name	Variable	Access	Quota
/scratch/leuven/30X/vsc30XXX	\$VSC_SCRATCH \$VSC_SCRATCH_SITE	Global	100 GB
/data/leuven/30X/vsc30XXX	\$VSC_DATA	Global	75 GB
/user/leuven/30X/vsc30XXX	\$VSC_HOME	Global	3 GB
/node_scratch	\$VSC_SCRATCH_NODE	Compute nodes	250 GB
/staging/leuven/stg_XXXXX	n/a	Global	Minimum 1TB
/archive/leuven/arc_XXXXX	n/a	Login nodes	Minimum 1TB

Use Cases



Use Cases

- Use case : Data is in archive, how can I use it in a compute job?

- Command to use:

```
rsync -a <PATH_to_archive/archive_folder> <PATH_to_scratch>
```

Use Cases

- Use case: Data produced on cluster, stored for longer time?
 - Command to use:

```
rsync -i -u -r --dry-run <PATH_to_scratch/archive_folder>  
<PATH_to_archive/archive_folder>
```

Use Cases

- Use case : How to get local data on archive?

Data that is stored at the users local facilities can be copied to the archive through scp/bbcp/sftp methods. For this I would refer to the VSC documentation here:

- <https://www.vscentrum.be/client/linux/data-openssh> (for linux)
- <https://www.vscentrum.be/client/windows/filezilla> and
- <https://www.vscentrum.be/client/windows/winscp> (for windows)
- <https://www.vscentrum.be/client/macosx/data-cyberduck> (for OS X)

Best Practices



Best Practices

- Work for a longer period on Big Data:
 - Store it in staging. Once in a while back things up to Archive.

Prices



Prices

- Scratch space: free (limited by capacity)
- Data space: € 13,55 per 25 GB/year
- Archive Space (+ staging area): 70€ per TB/Year

Questions?

