Data Science

Data Life Cycle

Data Storage

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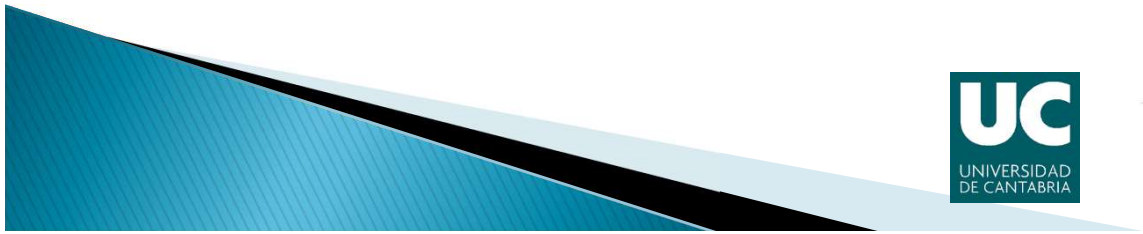
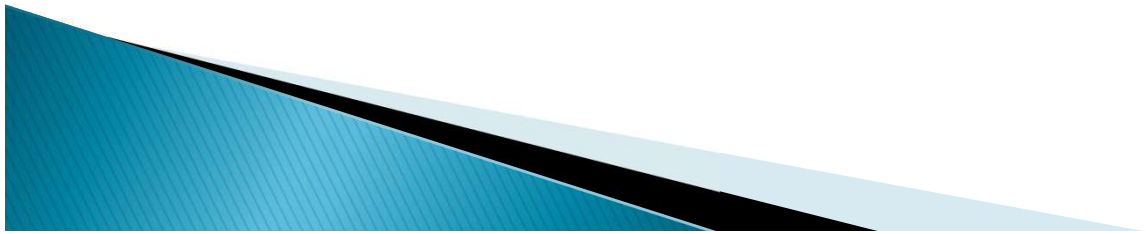


Summary

- Physical Storage Devices
- Network Storage Devices
- Data Storage
- Data Management
- Backup



Schema

- Flexible Storage
  - Block Storage
  - Object Storage
  - File Storage
- File Systems
  - Conceps
    - What is a File System?
    - Journaling
    - Posix
    - acls
  - Most common Disk File Systems
    - Ext3, Ext4
    - Brtfs
    - XFS, NTFS…
    - Logical Volume Manager (LVM)
- OwnCloud
  - Examples

Flexible Storage I

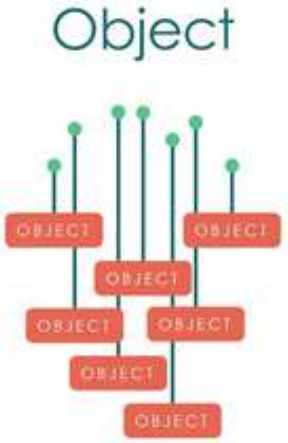
- Most modern applications and services need a flexible storage.
- Storing large o small amounts of data (text, audio, images, video), need a flexible, distributed and specific solution for each enviroment each some time.
- To solve modern the storage issues ,can use commercial or non-comercial sotfware that provide us with 3 kinds of storage
  - Block Storage
  - Object Storage
  - File System Storage

Flexible Storage II

- Block Storage
  - Raw volumes of storage are created and each block can be controlled as an individual hard drive
    - There is no file access
    - There is no predefined File System
  - Block level storage is usually deployed in SAN or storage area network environment.
  - Block storage may offers boot-up of systems which are connected to them
  - Each block storage volume/lun/device can be treated as an independent disk drive and it can be controlled by external server operating system.
  - Block level storage data performance is much efficient and reliable.
  - Until now block storage use to be expensive (FCoE, Fiber Channel, SAS, iSCSi)

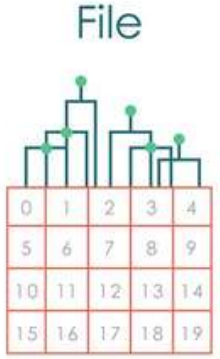
Flexible Storage III

- Object Storage
  - Object storage keeps the blocks of data that make up a file together and adds all of its associated metadata to that file
    - Adds extended metadata to the file
    - Eliminates the hierarchical structure used in file storage
    - Place everything into a flat address space, called a *storage pool*
    - Uses a unique identifier assigned to the object to find any particular object
  - Profits
    - Data can be stored across multiple regions
    - Can scale infinitely to petabytes and beyond
    - Performs best for big content and high stream throughput
    - Customizable metadata allows data to be easily organized and retrieved



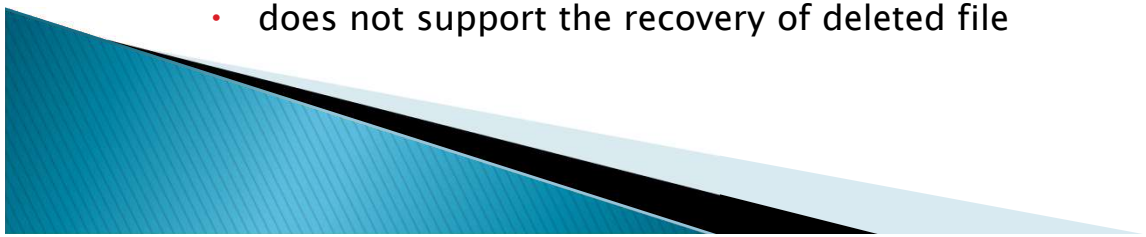
Flexible Storage IV

- File Storage
  - The the way to store data under Filesystems
- What is a File System?
  - It is the logical organization of a device that allows us to store and retrieve information in file format
- The physical filesystem is divided first by disk *partitions*
  - Partition size determines the number of blocks that the filesystem use
  - Each filesystem has a *superblock*, *inodes* and *data blocks*
    - The superblock holds the control information for the system
    - Inodes contain similar information for individual files
    - The data blocks hold data, the information in the files
- The logical filesystem refers to a hierarchy of connected directories made of all the files (or disk partitions) that are accessible to the user
- Use an underlying storage system
- Usually are organize in files and directories
- Can handler metadataPermissions, acl, mtime, ctime, atime, checksum, Data encryption
- Metadata (data about data)
  - Data providing information about one or more aspects of the data
    - Purpose of the data
    - Time and date of creation
    - Permissions, etc
    - Metadata can be data too



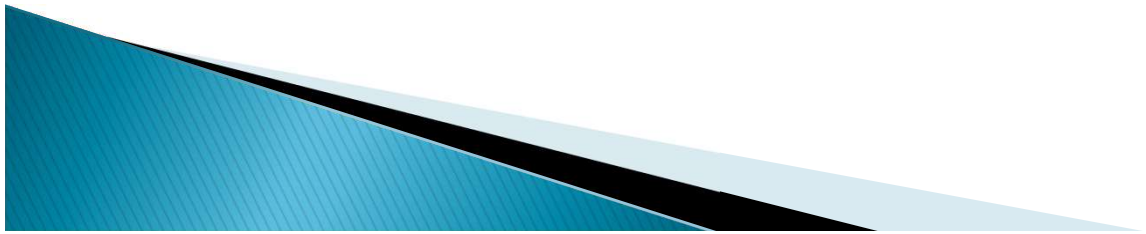
Flexible Storage V

- Journaling
  - A file system that implement transaction
  - Keeps a diary or “journal” with the transaction data
  - Can be recovered, reducing the time to recover.
  - Tries to avoid data corruption
- POSIX (Portable Operating System Interface)
  - Standars specified by IEEE for maintaining and compatibility
  - Standard threading library API
- Access Control Lists (Acls)
  - lists of permissions attached to an object or file
  - Each entry in a typical ACL specifies a subject and an operation
  - Is an extension about the common permissions
- Most common Disk File Systems
  - Ext3 is a jorunal extension of linux ext2 file system
    - Less CPU than XFS or RaiseFS
    - Poor Performance than ext4, xfs, JFS, or raiseFS
    - 31998 Subdirectories per directory
    - No defragmentation utilitie,
    - Max File 2TB (8KB)
    - Max Volume 32TB
    - does not support the recovery of deleted file



File Systems I

- Ext4 is the Ext3 evolution.
  - backward compatible extensions to ext3
  - FS until 1024 PTB
  - Lower CPU consumption
  - I/O performance
  - 64000 Subdirectories per directory
  - Max File 16TB
  - Max Volume 1EXB
- Brtfs (B-tree File System) Oracle for Linux
  - Stable since 2014
  - Lots of features y 4.x kernel
  - Max big file 16 EiB
  - Max Volume 16 EiB
  - 2^64 files
  - POSIX, acls, encription



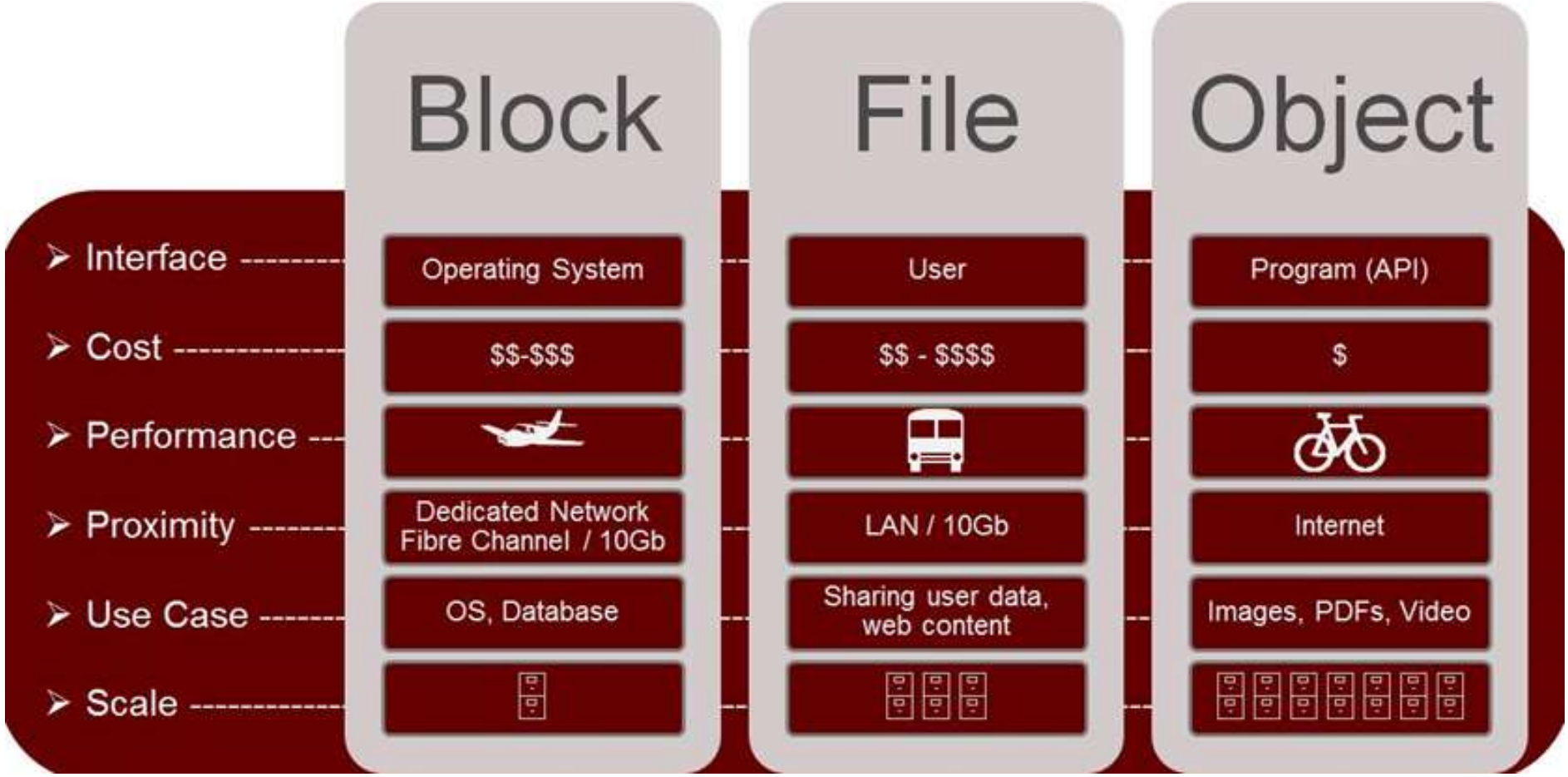
File Systems II

- XFS Silicon Graphics
  - the firts journal fs for unix
  - Max big file 8 EXB
  - Max Volume 18EXB
  - Online defragmentation and resize
  - Parallel I/O, filesystem bandwidth
  - POSIX
  - Quotas
  - Slow Metadata operation
- NTFS (New Technology File System) by Microsoft
  - Max files 2^32-1
  - Max big file 16TB (W7, WS2008R2), 256TB (WS2008-2012)
  - Max Volume size 2^64-1 (for clusters), or 256TB
  - Partial POSIX, acls, encription
  - Quotas in the latest versions
  - Resize (page file realocation)

File Systems III

Logical Volume Manager (LVM)

- Is not a file system, it only manage “mass-storage”
- Physical Volume (PV)
  - The physical storage partitions
- Logical Volume (LV)
  - Logical partitions distributed between physical ones
- Volume Groups (VG)
  - The container for the logical partitions
- Intallation
  - install lvm2 dmsetup mdadm reiserfsprogs xfsprogs
- Configuration
  - Partition each disk as LVM
    - fdisk /dev/partition_dev1 ….. /dev/partition_devn
  - Create the PV
    - pvcreate /dev/partition_dev1 ….. /dev/partition_devn
    - Pvdisplay, pvremove
  - Create the VG
    - vgcreate “vg_name” /dev/partition_dev1 ….. /dev/partition_devn
    - Vgdisplay, vgrename
  - Create the LVs
    - Lvcreate --name “volume_name” --size 10G “vg_name”
    - Lvdisplay, lvrename, lvremove, lvreduce,lvextend

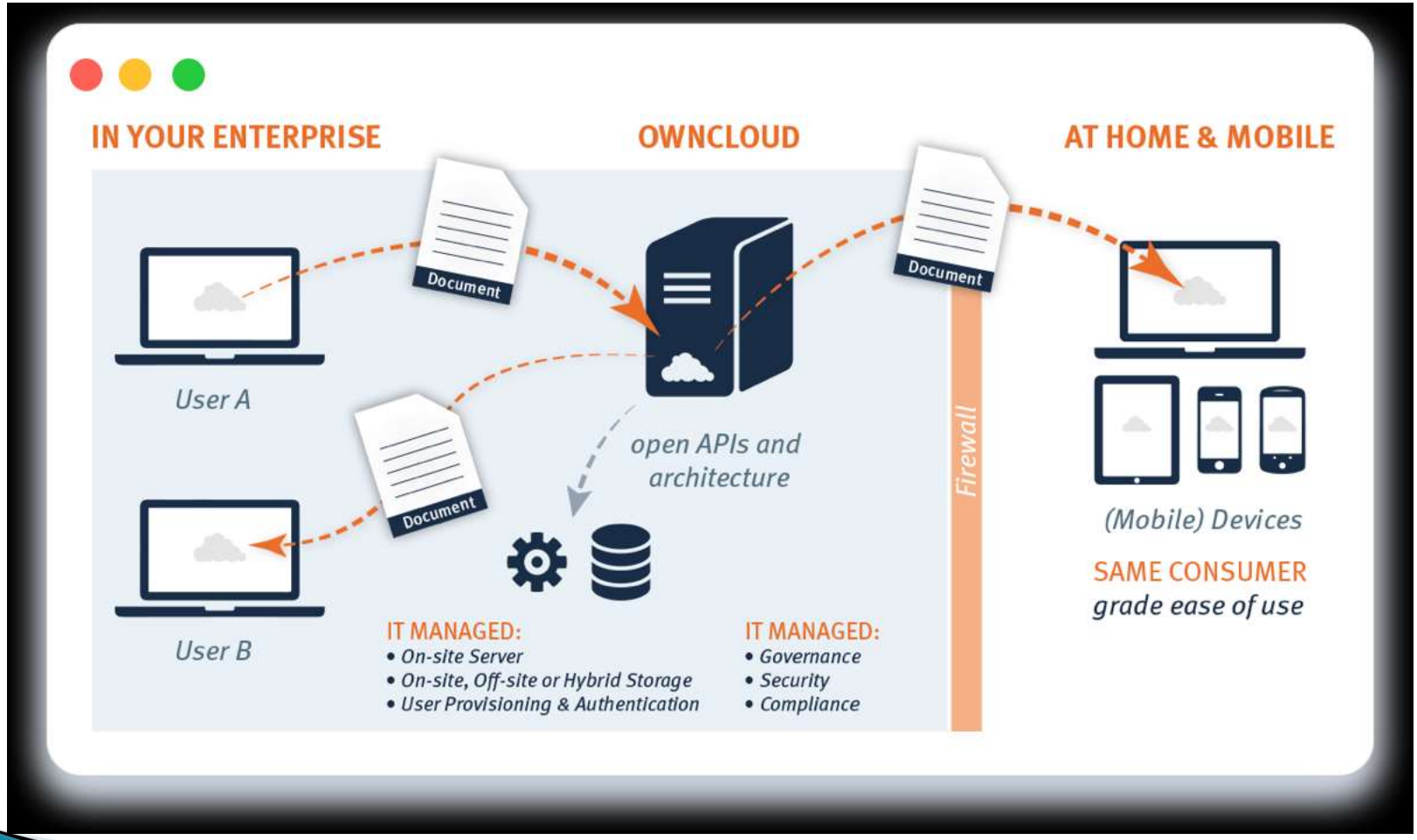

Block
File
Object
Interface
Cost
Performance
Proximity
Use Case
Scale
Operating System
$$-$$$
Dedicated Network
Fibre Channel / 10Gb
OS, Database
User
$$ - $$$$
LAN / 10Gb
Sharing user data,
web content
Program (API)
$
Internet
Images, PDFs, Video

OwnCloud I

- OwnCloud, the flexible open source file synchronization and sharing solution
  - ownCloud includes the ownCloud server (which runs on Linux)
  - client applications for Microsoft Windows, Mac OS X and Linux
  - mobile clients for the Android and Apple iOS operating systems.
- Requeriments small deployment
  - Operating system: Linux.
  - Web server: Apache 2.4.
  - Database: MySQL/MariaDB with InnoDB storage engine (MyISAM is not supported)
  - PHP 5.6+.
  - Consider setting up a scale-out deployment, or using Federetad Cloud Sharing to keep individual ownCloud instances to a manageable size.
  - One machine running the application, web, and database server, as well as local storage. Authentication via an existing LDAP or Active Directory server.

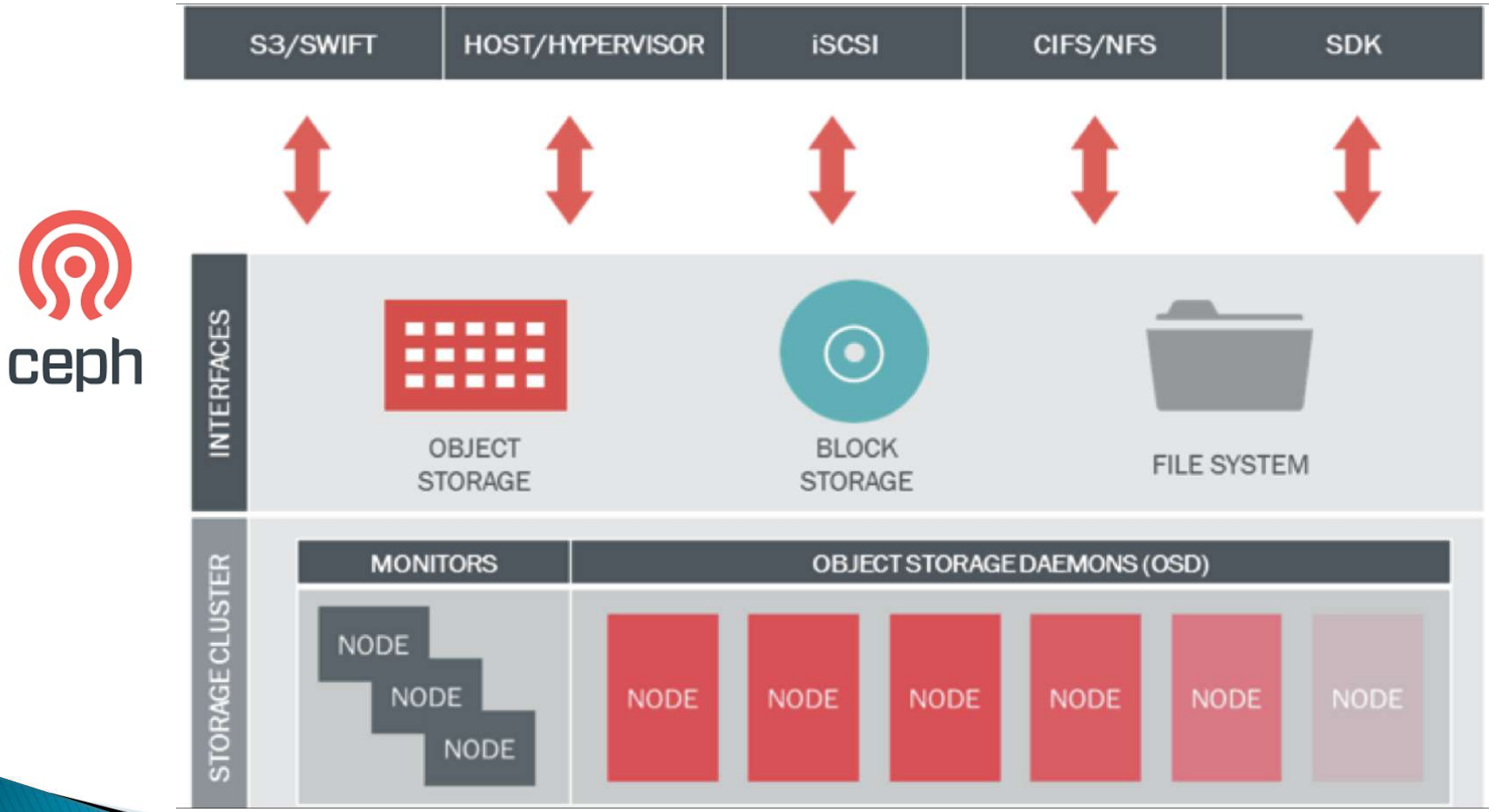
Number of users	Up to 150 users
Storage size	100 GB to 10TB
High availability level	backups via Btrfs snapshots component failure leads to interruption of service.

OwnCloud II


IN YOUR ENTERPRISE
OWNCLOUD
AT HOME & MOBILE
Document
Document
Document
User A
User B
open APIs and architecture
Firewall
(Mobile) Devices
SAME CONSUMER grade ease of use
IT MANAGED:
• On-site Server
• On-site, Off-site or Hybrid Storage
• User Provisioning & Authentication
IT MANAGED:
• Governance
• Security
• Compliance

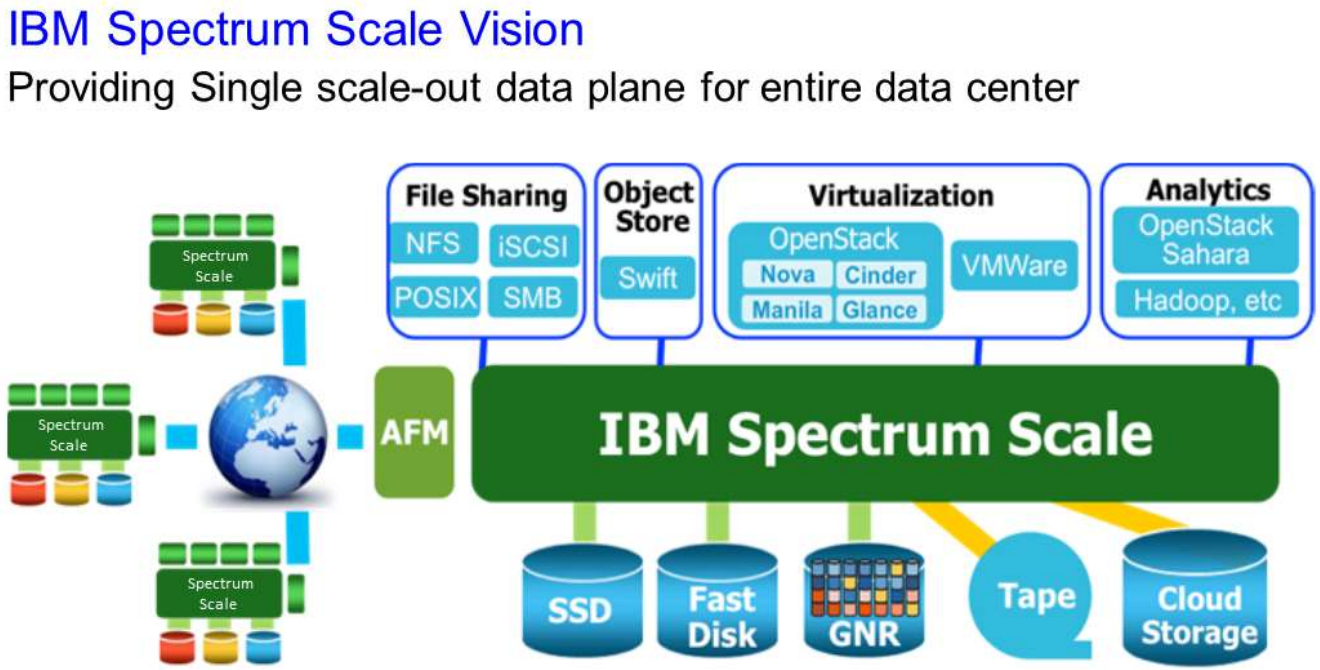
Storage Software Examples I

- Ceph



Storage Software Examples I

- Spectrum Scale (GPFS)



- **High Performance**, **Scale-out**, **Clustered File System**
- Unifies VM images, block devices, objects, and files
- Space efficiency - GPFS Native RAID (GNR)
- Enterprise features for automatic tiering, data distribution, encryption, migration to tape and cloud
- Data in **best location, on best tier, at the right time**

IBM Spectrum Scale

Examples

- Add a Block Storage to cloud machine
- Use Object Storage to put and get data