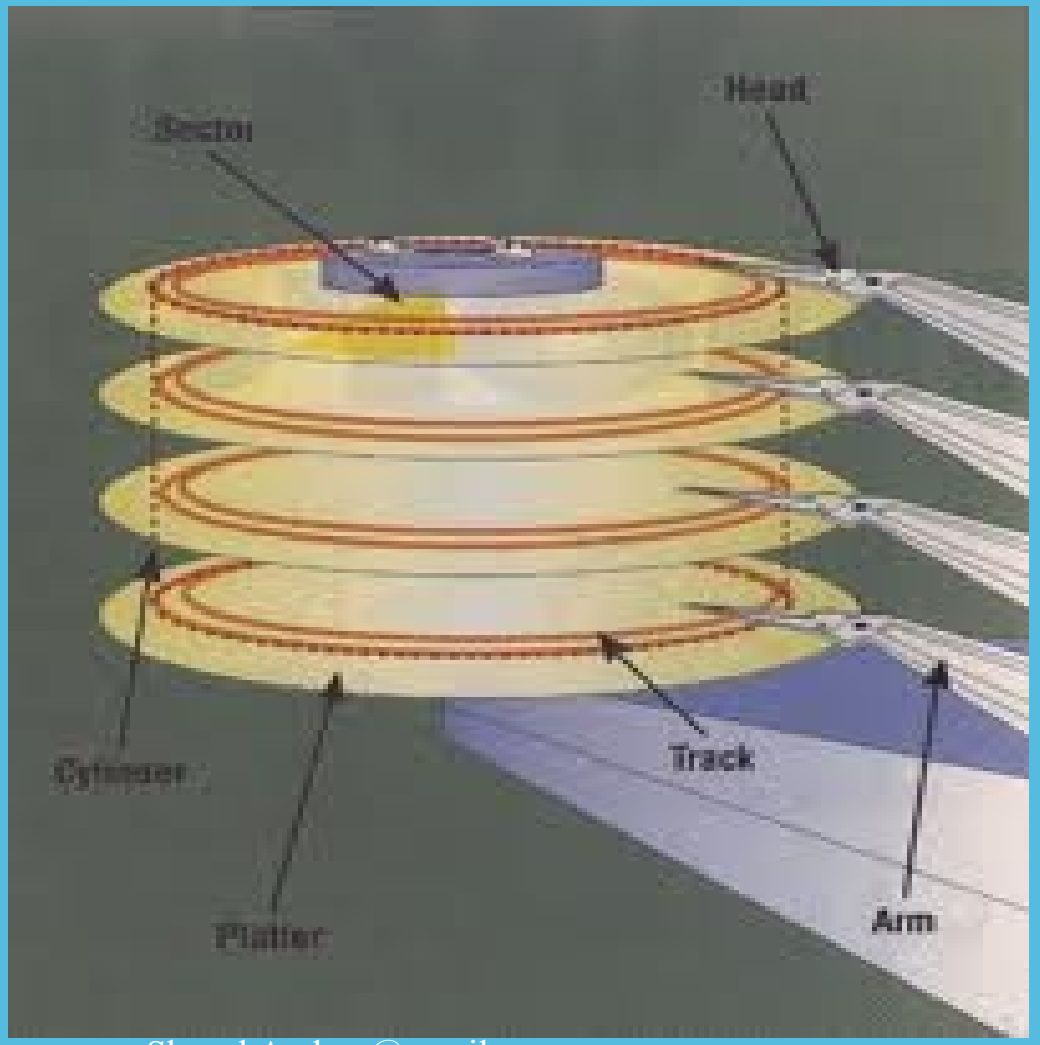
Lecture 3: Data store and transfer

https://sites.google.com/site/clustergateorg/

- Where to store the data
- Disk drives
- Organisation of the data store on disk drives (RAID)
- Data transfer in LAN
- Distributed file systems
- Data transfer on large distance (intercity, between countries)

Shevel.Andrey@gmail.com

Disk drive with magnetic method write/read

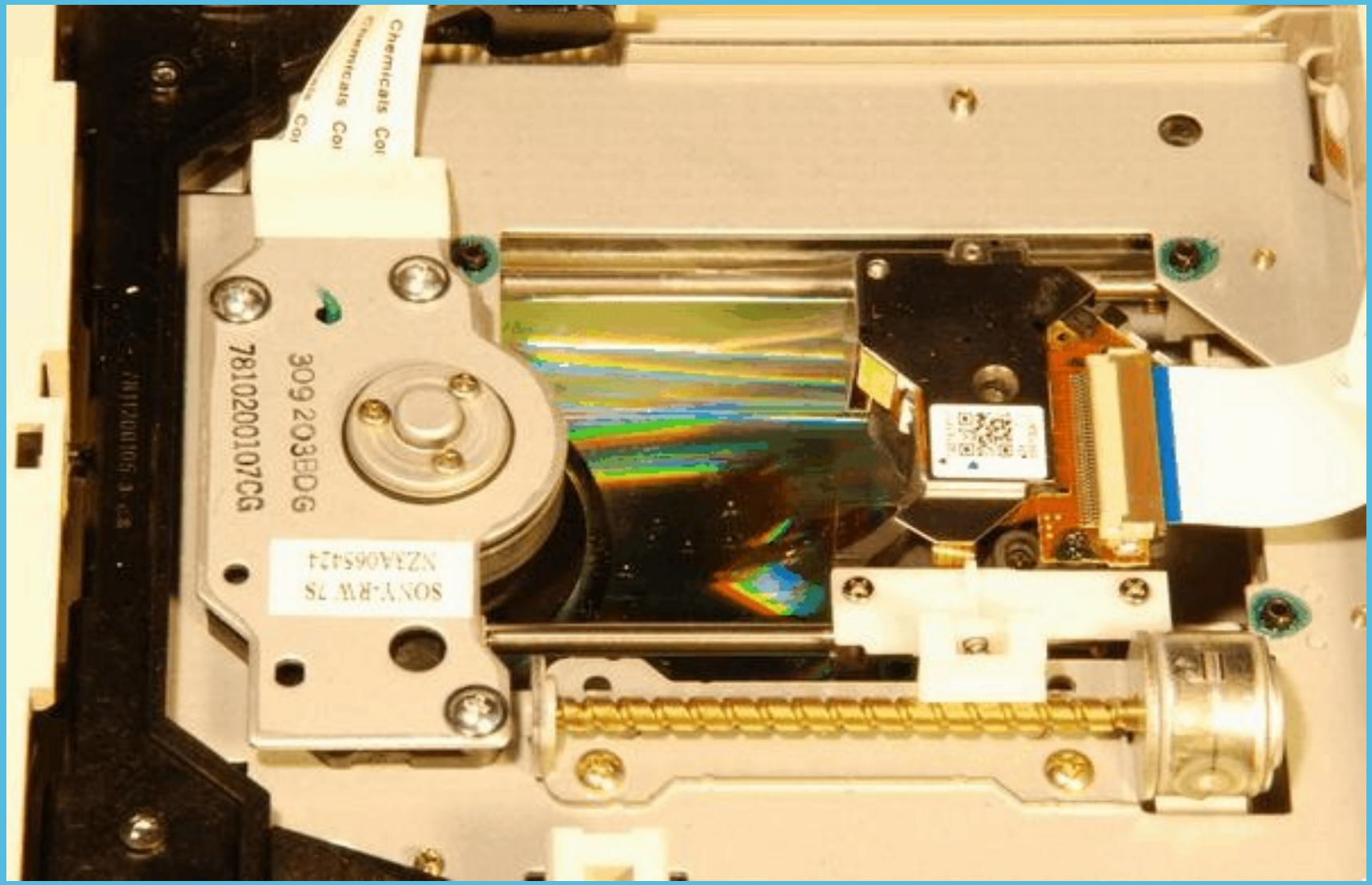


Shevel.Andrey@gmail.com

Disk drive

Shevel.Andrey@gmail.com

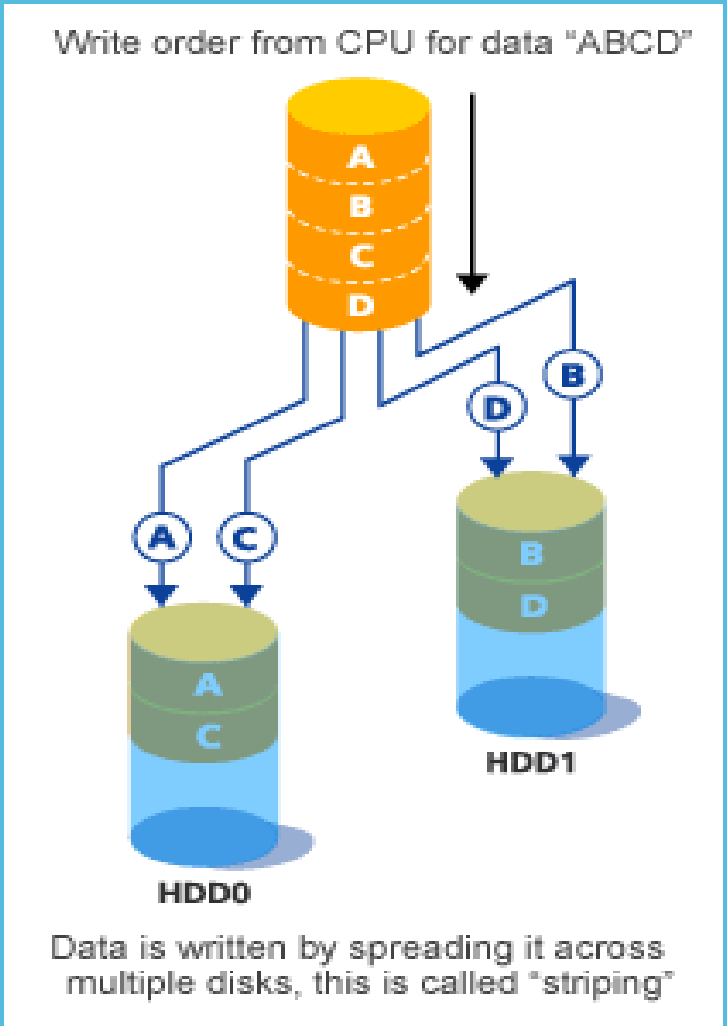
Optical disk drive

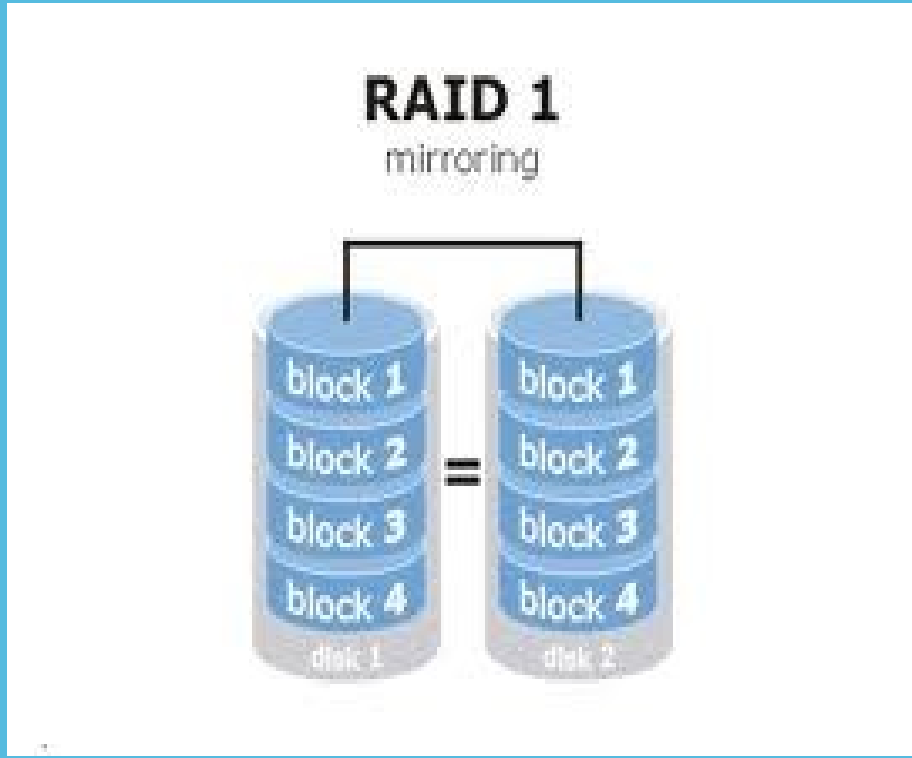


Shevel.Andrey@gmail.com

redundant array of independent *(inexpensive)* disks

RAID0

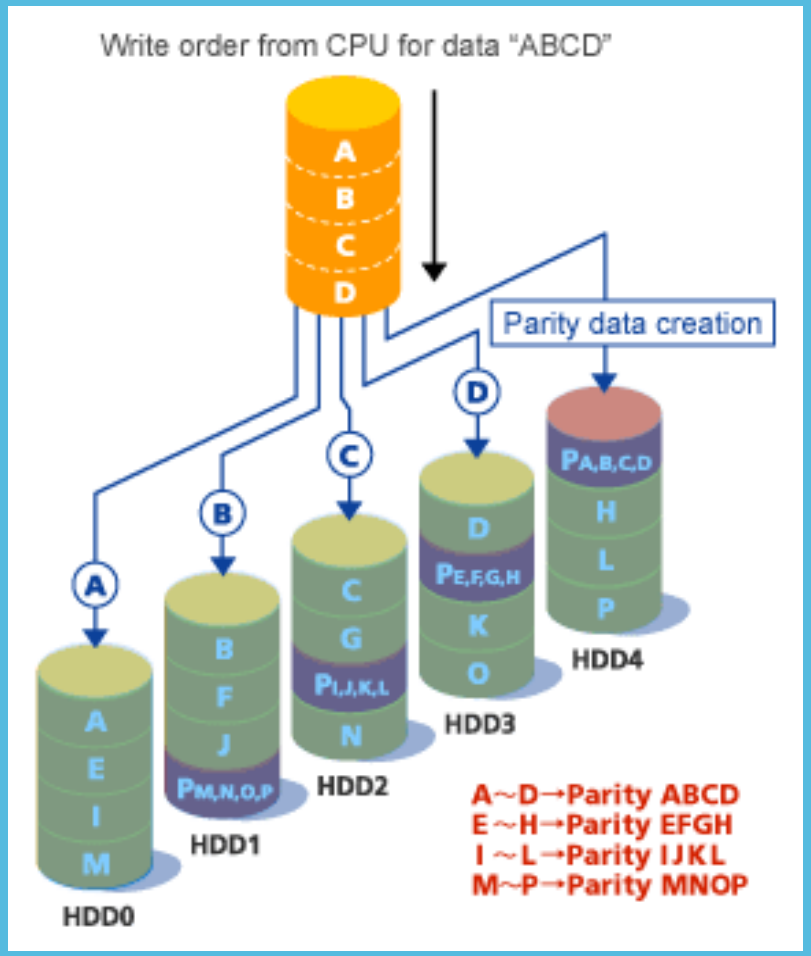




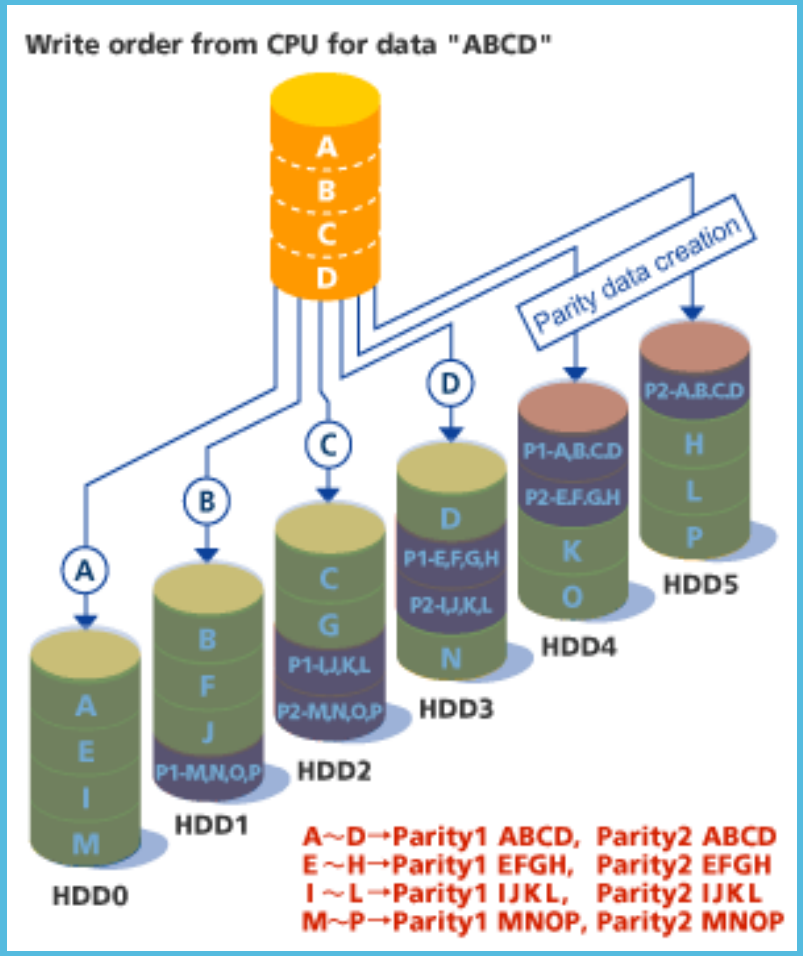
Shevel.Andrey@gmail.com

RAID5 и RAID6

RAID5



RAID6



Shevel.Andrey@gmail.com

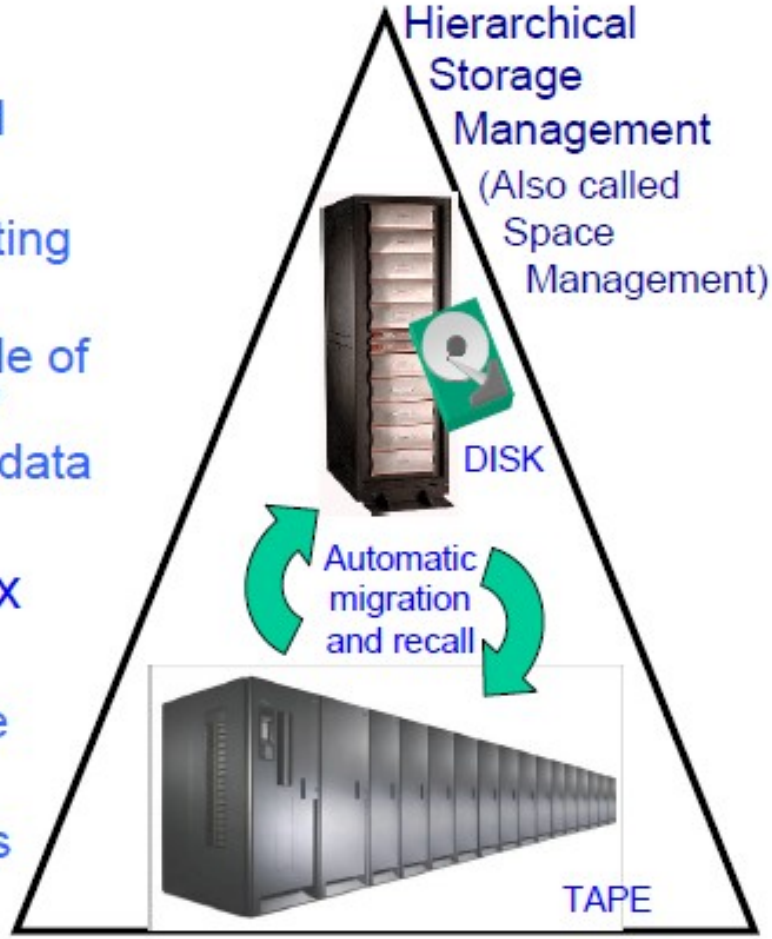
Robotic storage

Shevel.Andrey@gmail.com

High Performance Storage System

HPSS

- Disk and tape file repository
  - Hierarchical storage management (HSM) with automatic migration and recall
  - Highly scalable for high-end computing and storage customers
  - A single instance of HPSS is capable of concurrently accessing hundreds of tapes for extremely high aggregate data transfers.
- User sees HPSS as a single Unix file system
  - "Classic" HPSS presents its own file system
  - New HPSS for GPFS extends IBM's most scalable file system to tape



Data storage in large systems

- **High Performance Storage System (HPSS) http://www.hpss-collaboration.org/**
  - HPSS (High Performance Storage System) is a storage management system especially designed for moving large files and large amounts of data around a network that may consist of parallel processing computers, supercomputers, and clusters of high-end workstations.
- **Who uses large volume storages http://www.hpss-collaboration.org/learn_who_petabyte_data.shtml**
  -
  - NCSA - 380 PB http://www.hpcwire.com/2013/05/30/blue_waters_seals_off_with_tape/
  - **NSA** - http://nsa.gov1.info/utah-data-center/

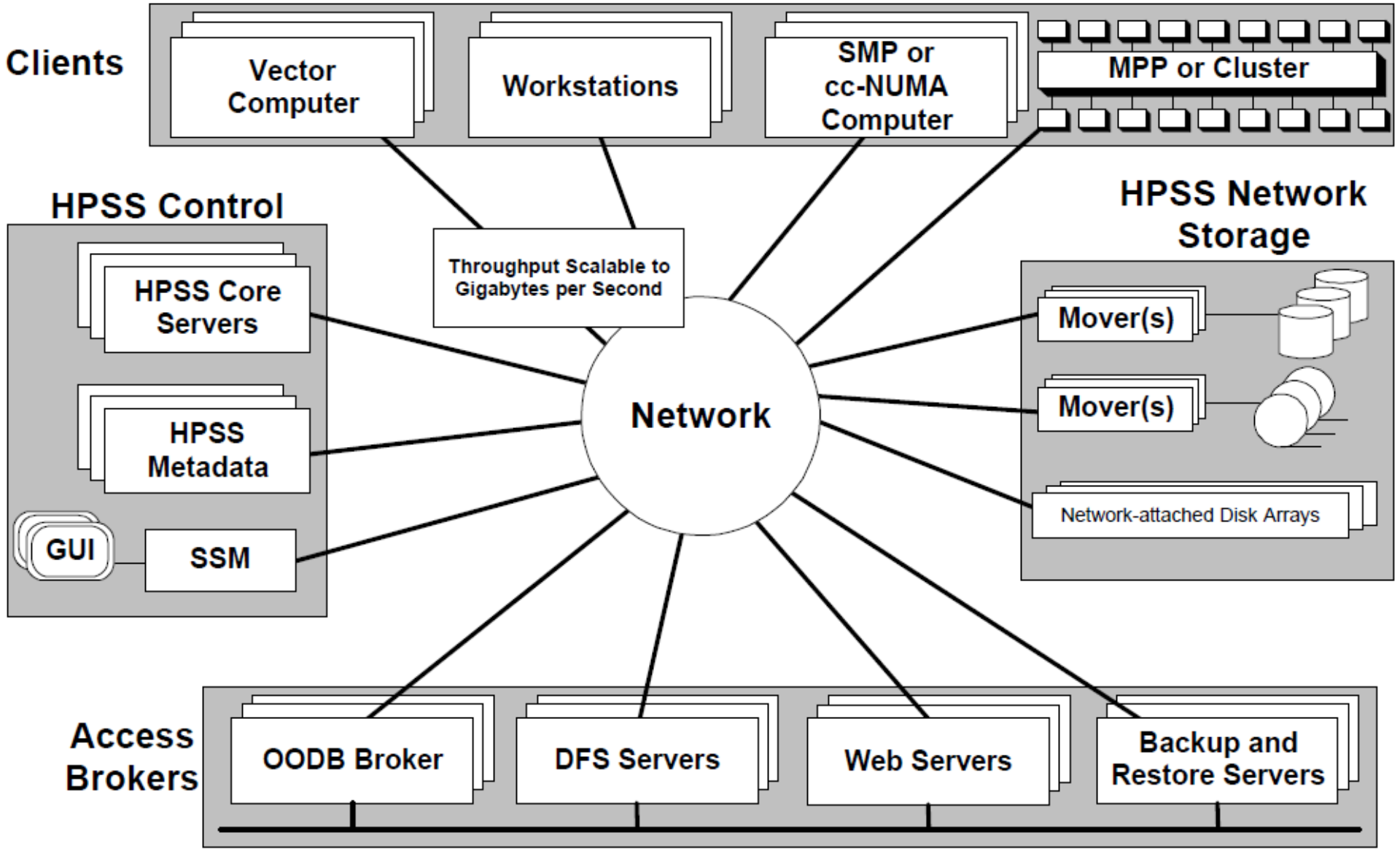
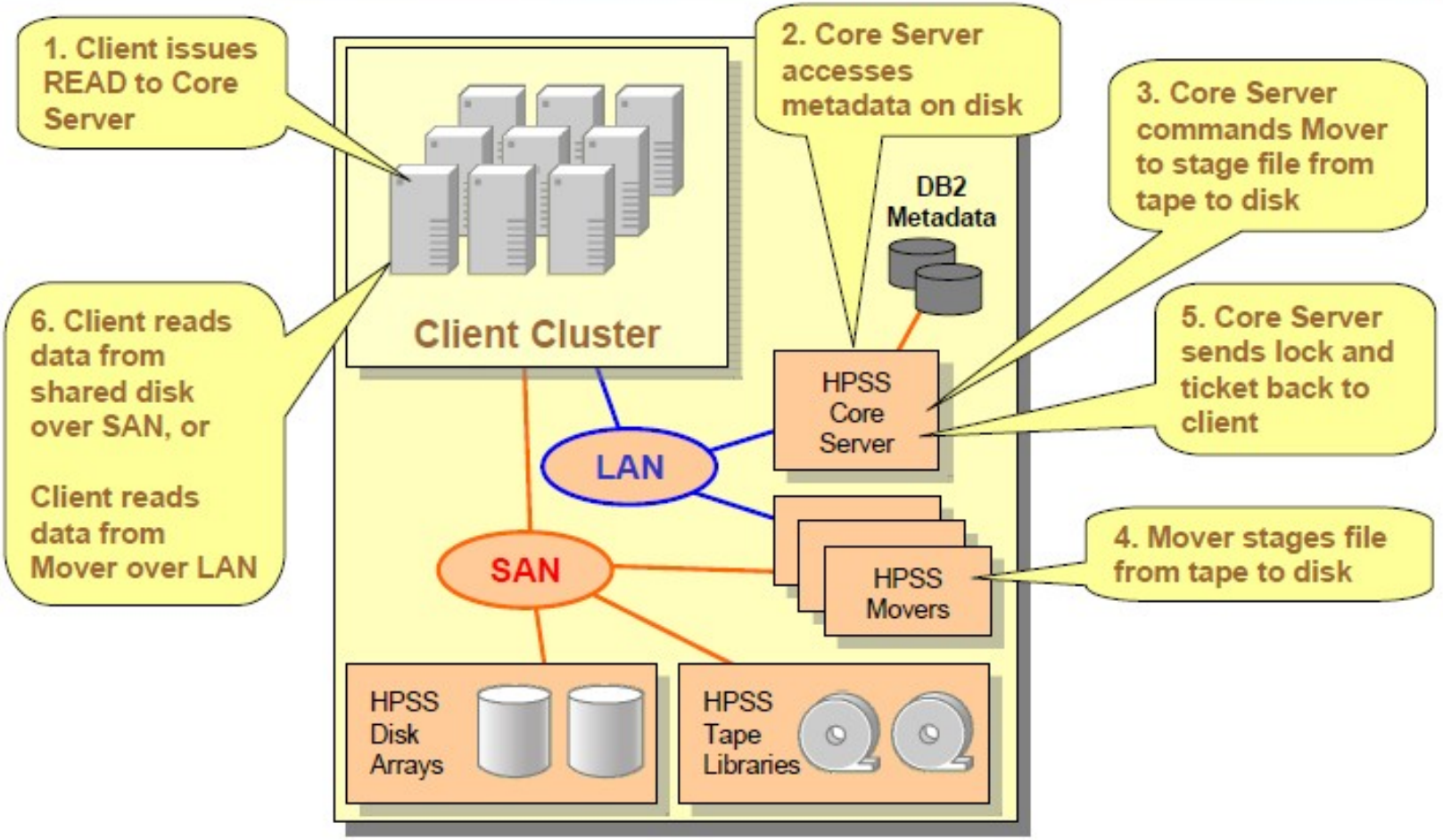


Figure 1 - HPSS Network Centered Architecture

How HPSS works

Example of an hpss_read

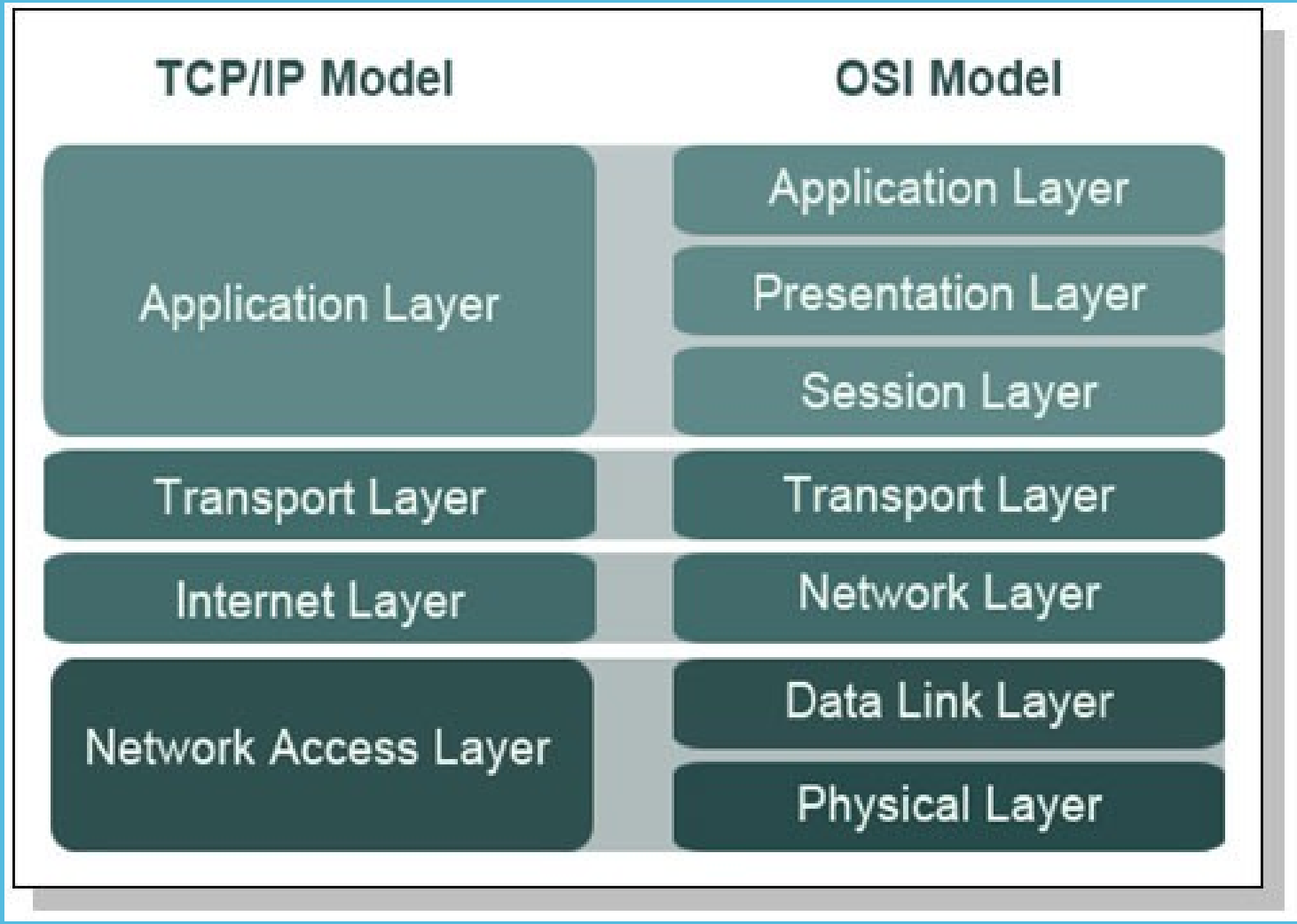


Shevel.Andrey@gmail.com

Data transfer in LAN

- **In LAN it is still used the stack of TCP/IP**
  - Initial and most longest used protocols for data transfer is ftp and its successor sftp;
  - Later on a lot of protocols/utilities for data transfer have been appeared
  - http://en.wikipedia.org/wiki/List_of_file_transfer_protocols

Data transfer models



Shevel.Andrey@gmail.com

Network filesystems

- ***Distributed filesystem*** - AFS
- *Global filesystem (in RedHat GFS2)*
- ***Symmetric filesystem*** – clients perform also manager codes for metadata.
- ***Asymmetric filesystem*** – there are several managers for metadata, which supprt filesystem. Examples: Panasas ActiveScale, Lustre. Traditional client/server filesystems like NFS and CIFS are also asymmetric.
- ***Cluster filesystem*** – distributed filesystem, which is not one server, but cluster, mainly for data storing. For clients such the cluster is just "filesystem".
- ***Parallel filesystem*** – filesystem to support parallel computing, all nodes might use same files. Data in the file is distributed by strips among many servers in order to increase the performance.

CAP theorem

- **Not possible all of them**
  - Consistency
  - Availability
  - Partitioning

Type of the access to the disk storage

- **By File, e.g. NFS**
- **By Block, e.g. SAN**
  - In SAN might be used SCSI, iSCSI, Fibre Channel, Network Block Device, Infiniband

Cluster filesystem

- **http://en.wikipedia.org/wiki/Clustered_file_system**

Data Transfer Utilities

- **The list of the protocols (quite often they are also utilities)**
  - http://en.wikipedia.org/wiki/List_of_file_transfer_protocols

Long distance Data Transfer

- **Long distance: in between cities, countries, continents, planets.**
- **Tasks:**
  - Reliable transfer;
  - Time of the transfer;
  - Volume of the transfer;
  - Interruption and restart the transfer;
  - Forecast when data transfer is accomplished;
  - API, Statistics.

Data Transfer systems

- Physics Experiment Data Export (**PhEDEx**) http://iopscience.iop.org/1742-6596/219/6/062010/pdf/1742-6596_219_6_062010.pdf
- FTS3 - https://svnweb.cern.ch/trac/fts3/wiki/UserGuide
- “Bittorrent”, http://www.bittorrent.com
- “GnuTella”, http://www.gnutella.com

End of Lecture