Lecture 3: Data store and transfer
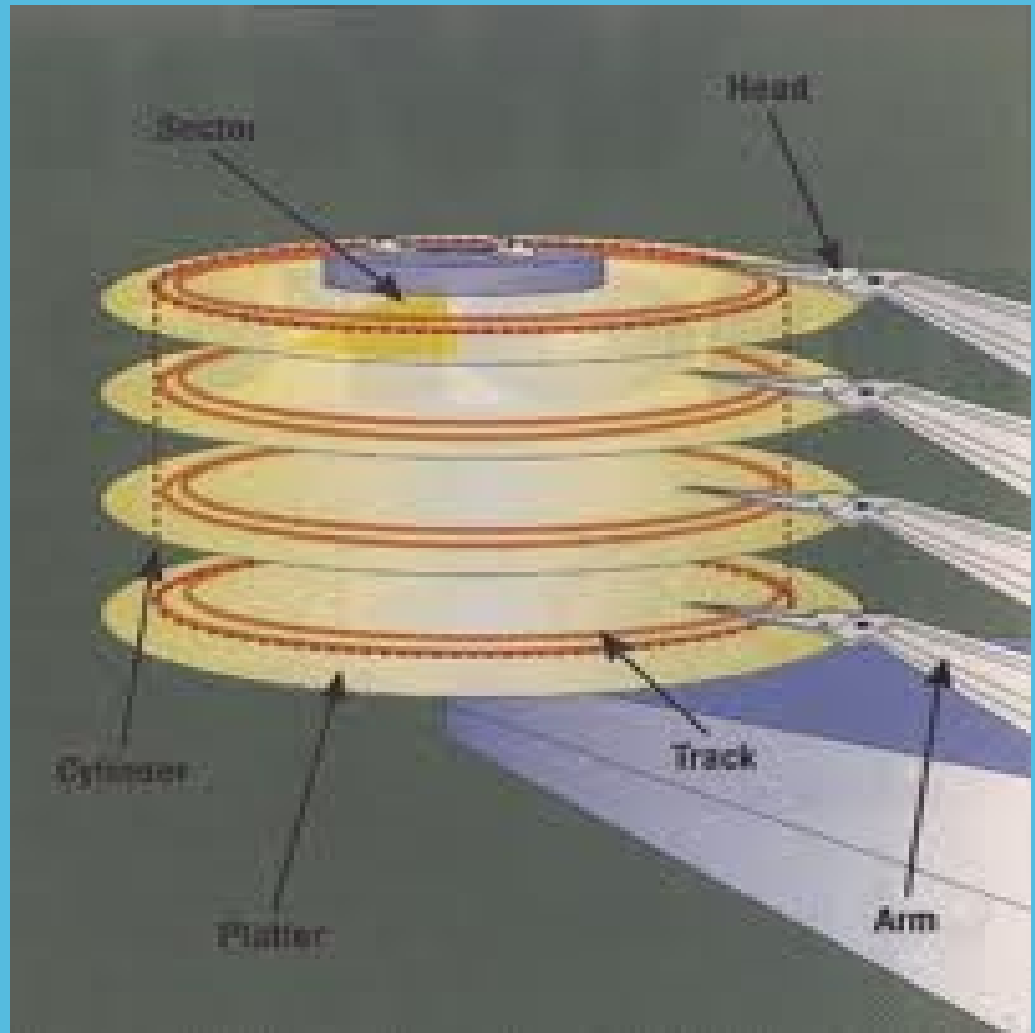## https://sites.google.com/site/clustergateorg/

- **Where to store the data**
- **Disk drives**
- **Organisation of the data store on disk drives (RAID)**

- **Data transfer in LAN**
- **Distributed file systems**
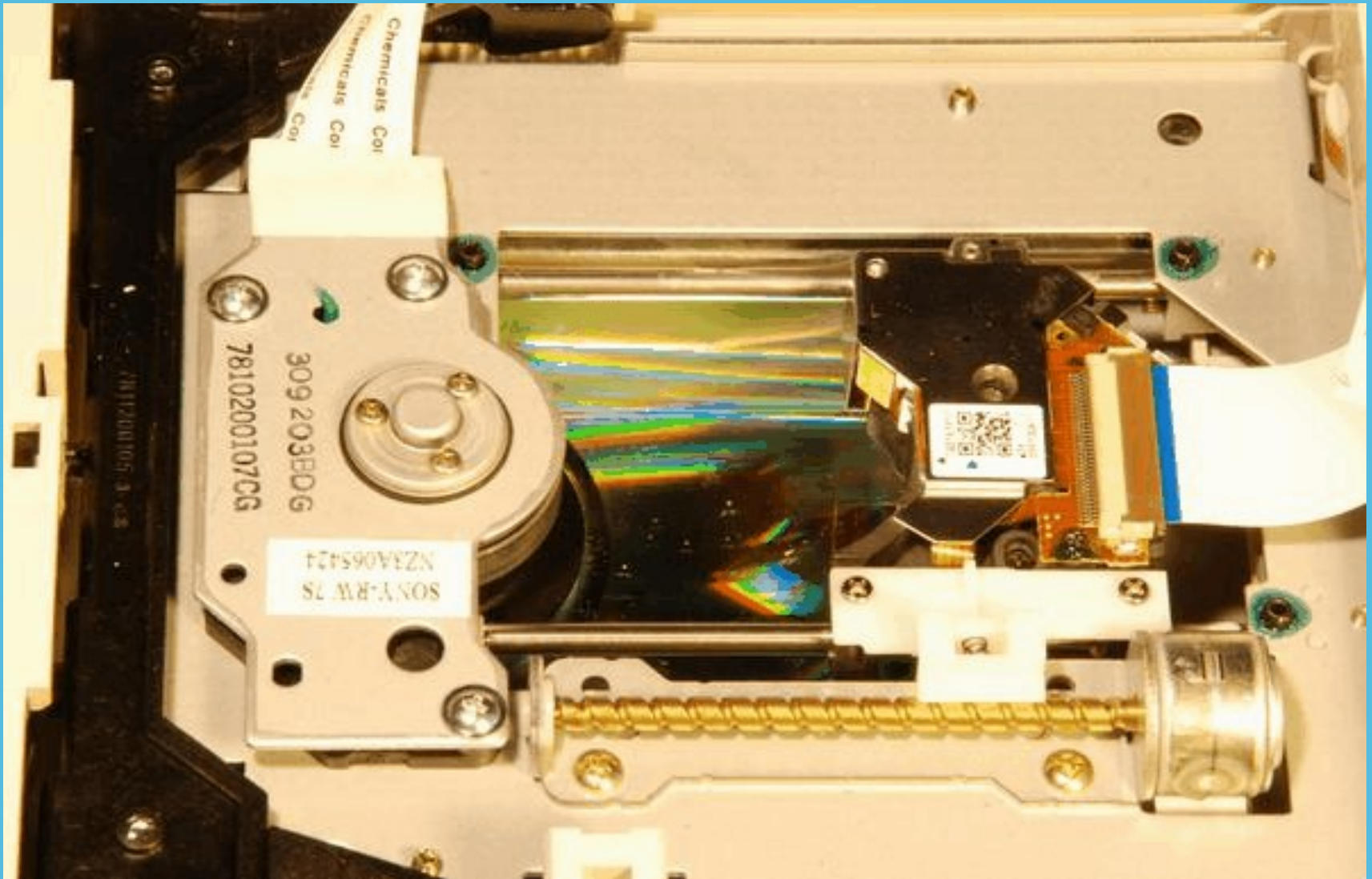- **Data transfer on large distance (intercity, between countries)**

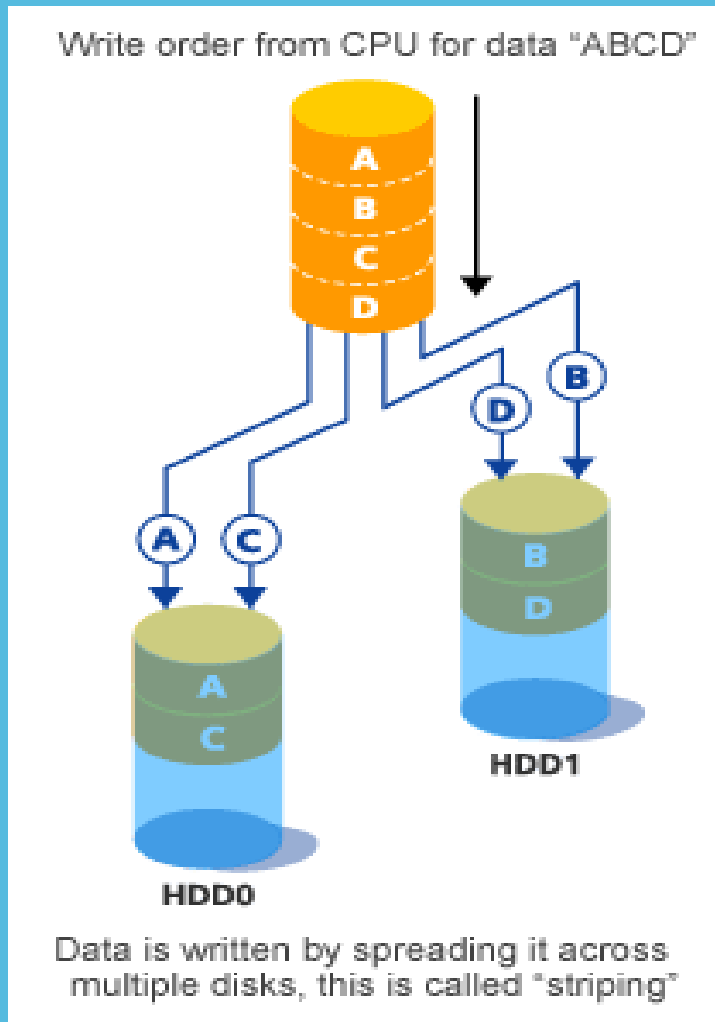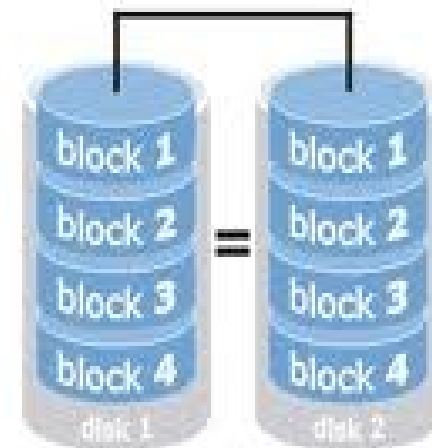# Disk drive with magnetic method write/read

Disk drive

Optical disk drive

redundant array of independent *(inexpensive)* disks

RAID0

RAID5 и RAID6

RAID5

Write order from CPU for data "ABCD"

Parity data creation

A~D→Parity ABCD
E~H→Parity EFGH
I~L→Parity IJKL
M~P→Parity MNOP

RAID6

Write order from CPU for data "ABCD"

Parity data creation

A~D→Parity1 ABCD, Parity2 ABCD
E~H→Parity1 EFGH, Parity2 EFGH
I~L→Parity1 IJKL, Parity2 IJKL
M~P→Parity1 MNOP, Parity2 MNOP
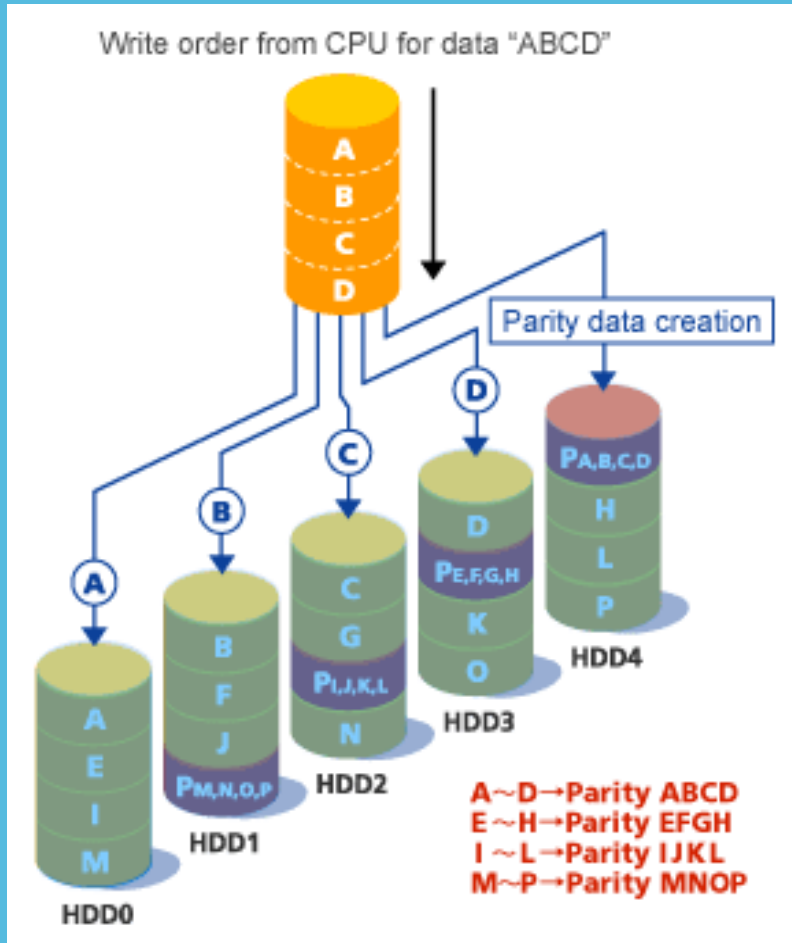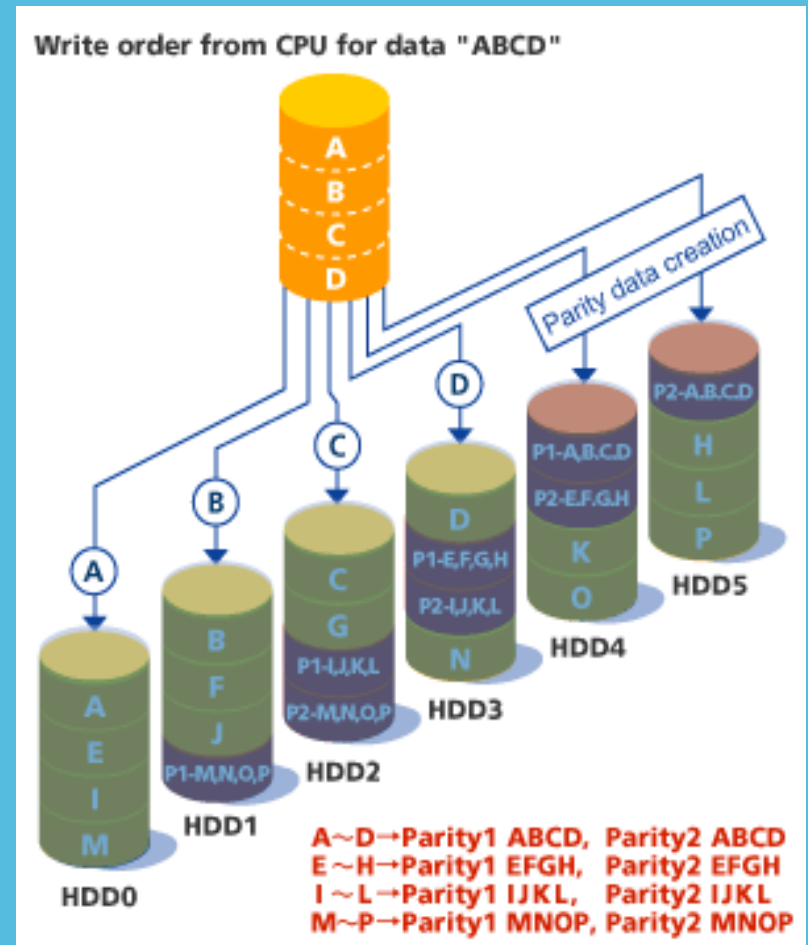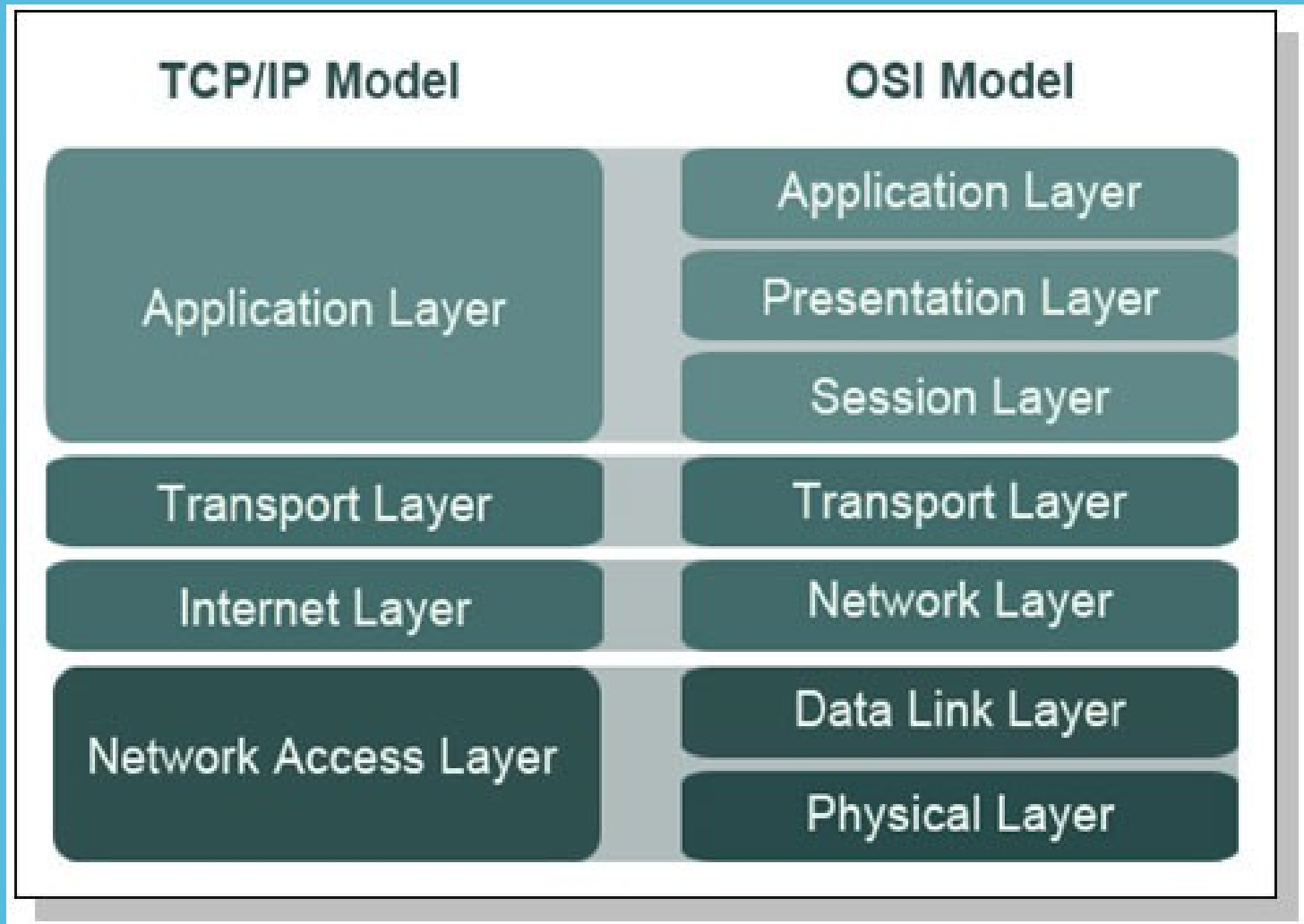
Data transfer in LAN

- **In LAN it is still used 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

TCP/IP Model	OSI Model
Application Layer	Application Layer
	Presentation Layer
	Session Layer
Transport Layer	Transport Layer
Internet Layer	Network Layer
Network Access Layer	Data Link Layer
	Physical Layer

Network filesystems

- ***Distributed filesystem*** - AFS

- *Global filesystem*

- ***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.

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

- "Bittorrent", http://www.bittorrent.com

- "GnuTella", http://www.gnutella.com

End of Lecture