



What's a Hard Disk and How Should I Organise My Files?

By Patrick Khoo

11 May 2002



Outline

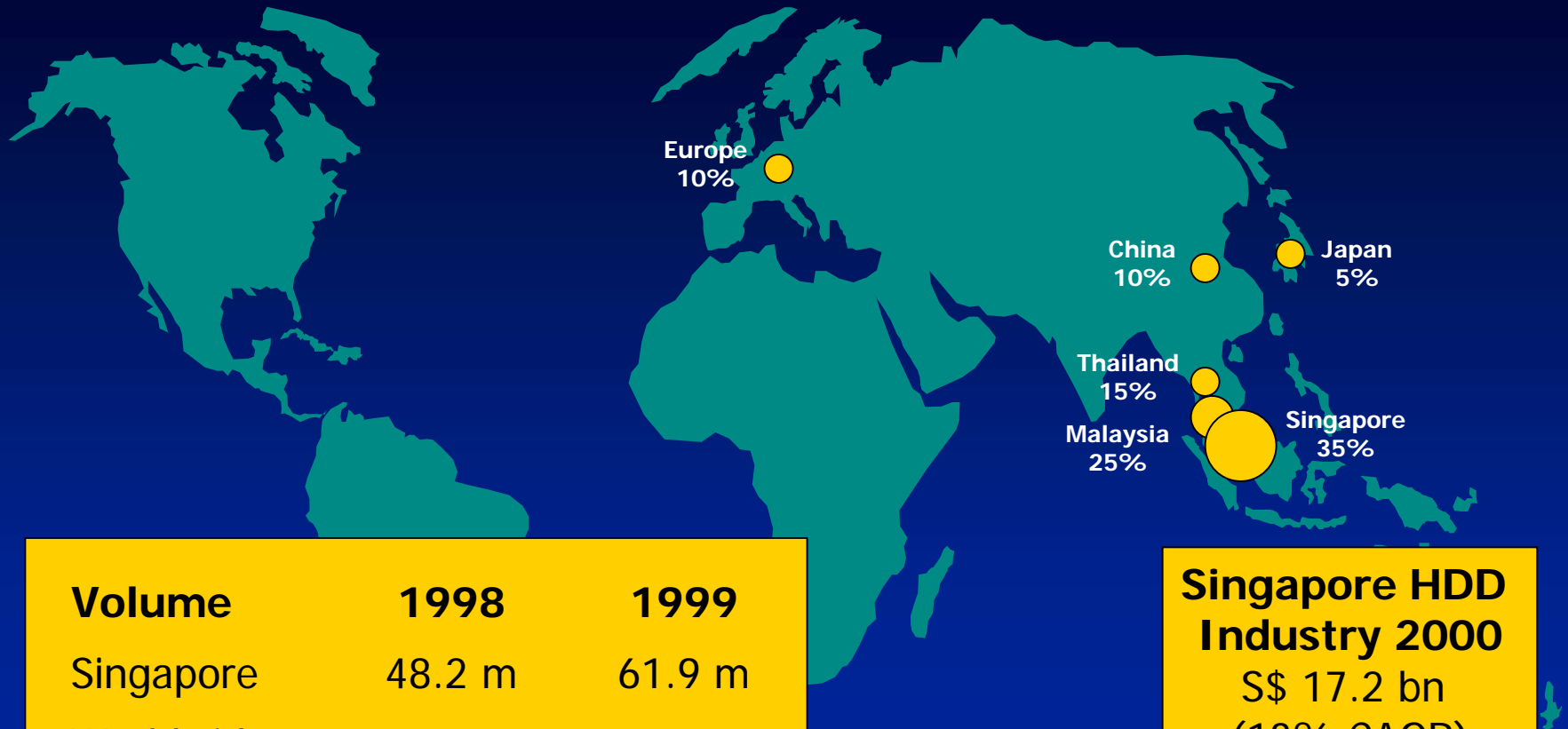
- How does a Hard Disk Drive work
- Challenges and Future of HDDs
- Storing and Retrieving Data

Different Storage Types



HDD Industry and Market

World HDD Assembly Locations (US Firms Only) - 1998



Volume	1998	1999
Singapore	48.2 m	61.9 m
Worldwide	144.9 m	174.4 m
Market Share	33%	36%

Singapore HDD Industry 2000

S\$ 17.2 bn
(13% CAGR)
22,400 jobs

Yesterday and Today

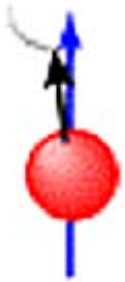


1956 – IBM 305 RAMAC
First HDD Storage Unit

2000 – IBM 1GB Microdrive
Portable / Personal Storage Unit



Basics of Hard Disk Drives



Based on:

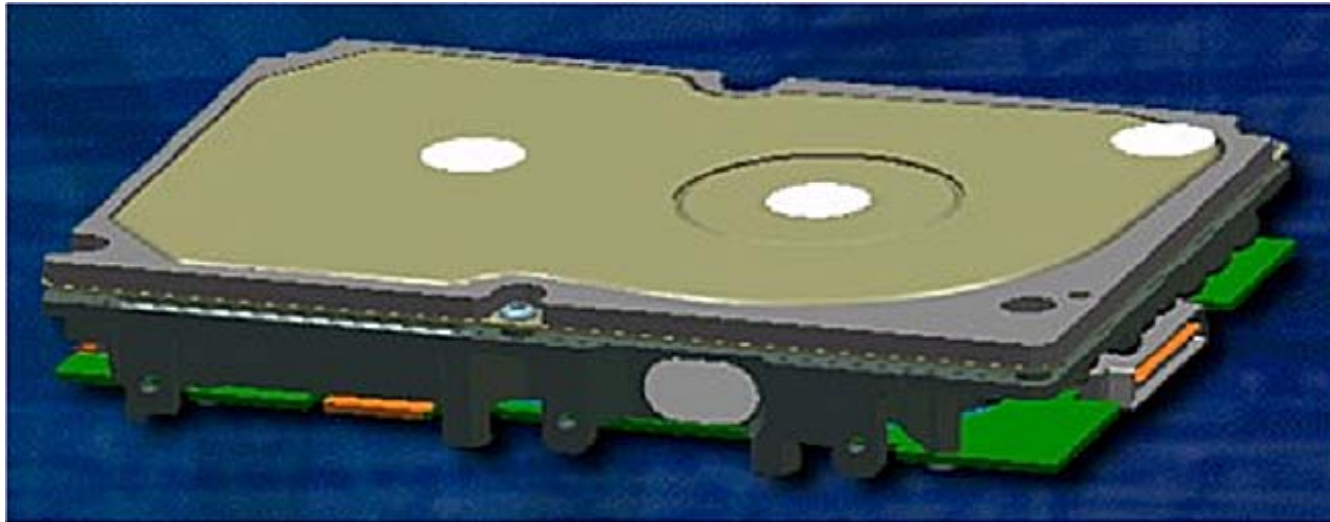
- Magnetism
- “Spin” in Electrons
- Quantum Mechanics

But also includes:

- Mechanics
- Electronics
- Chemicals and Materials
- Fluid Dynamics
- and much more . . .

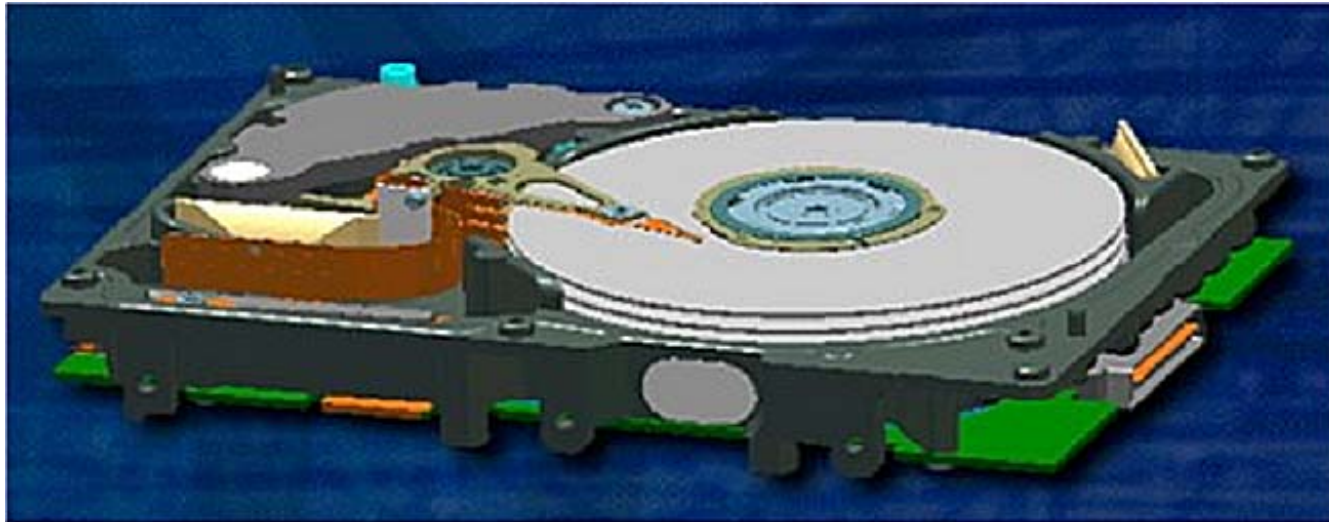


Inside the HDD



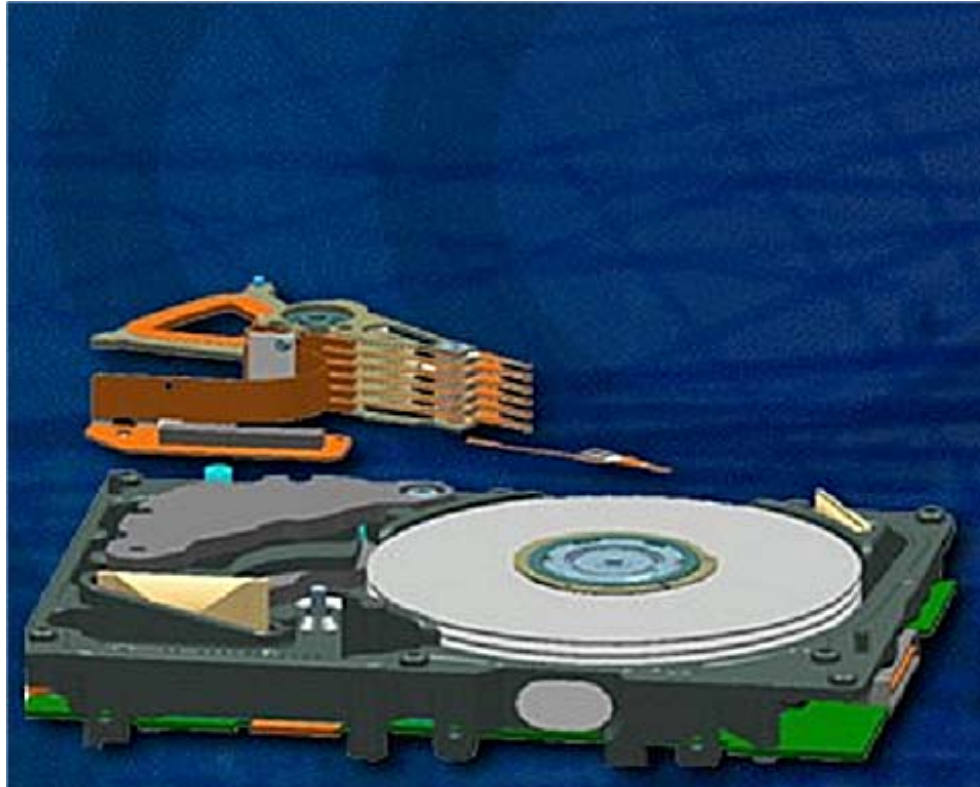
Cover, Drive Electronics

Inside the HDD



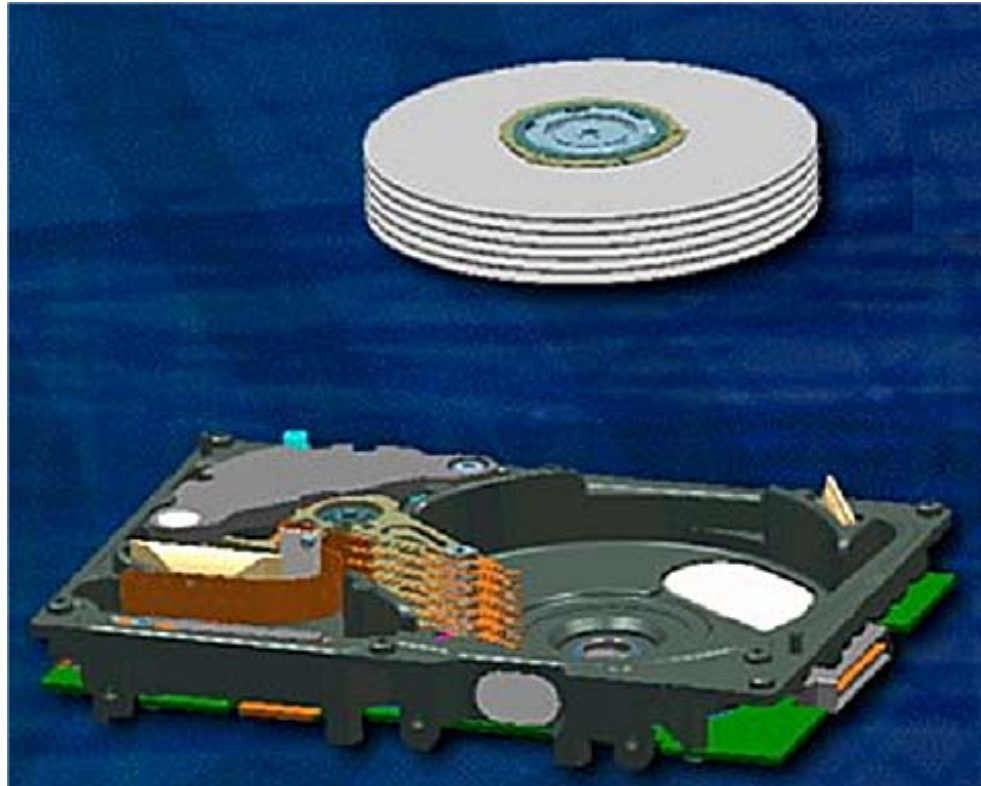
Contact-Start-Stop HDD

Inside the HDD



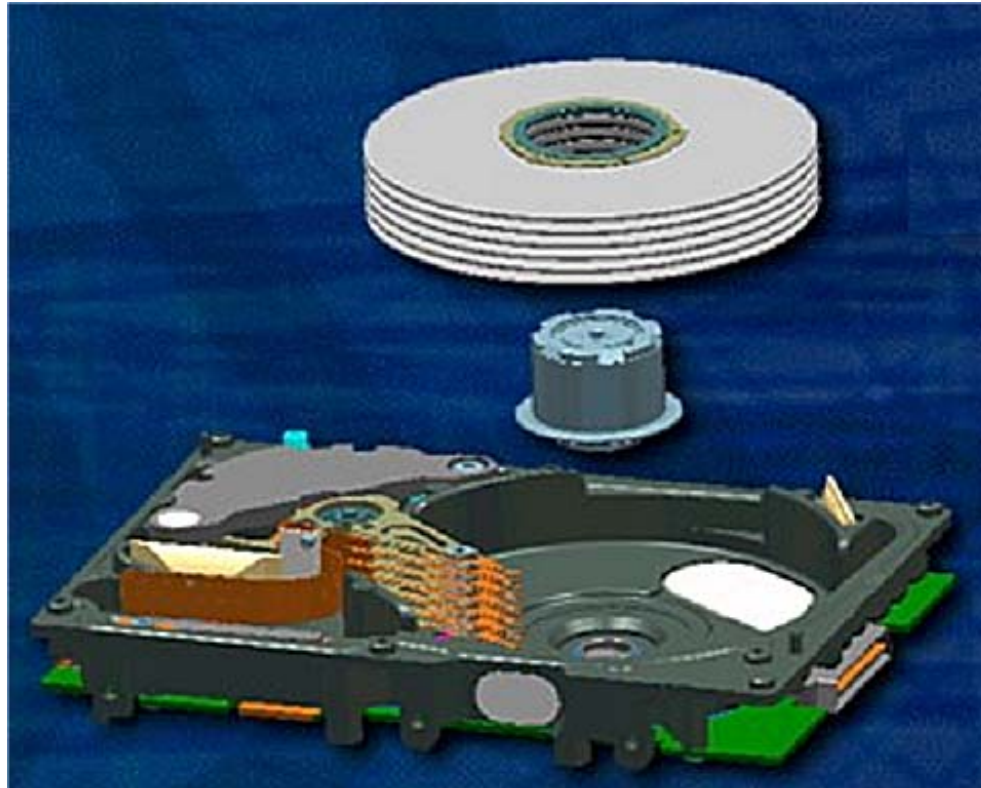
Heads, Sliders, Actuators

Inside the HDD



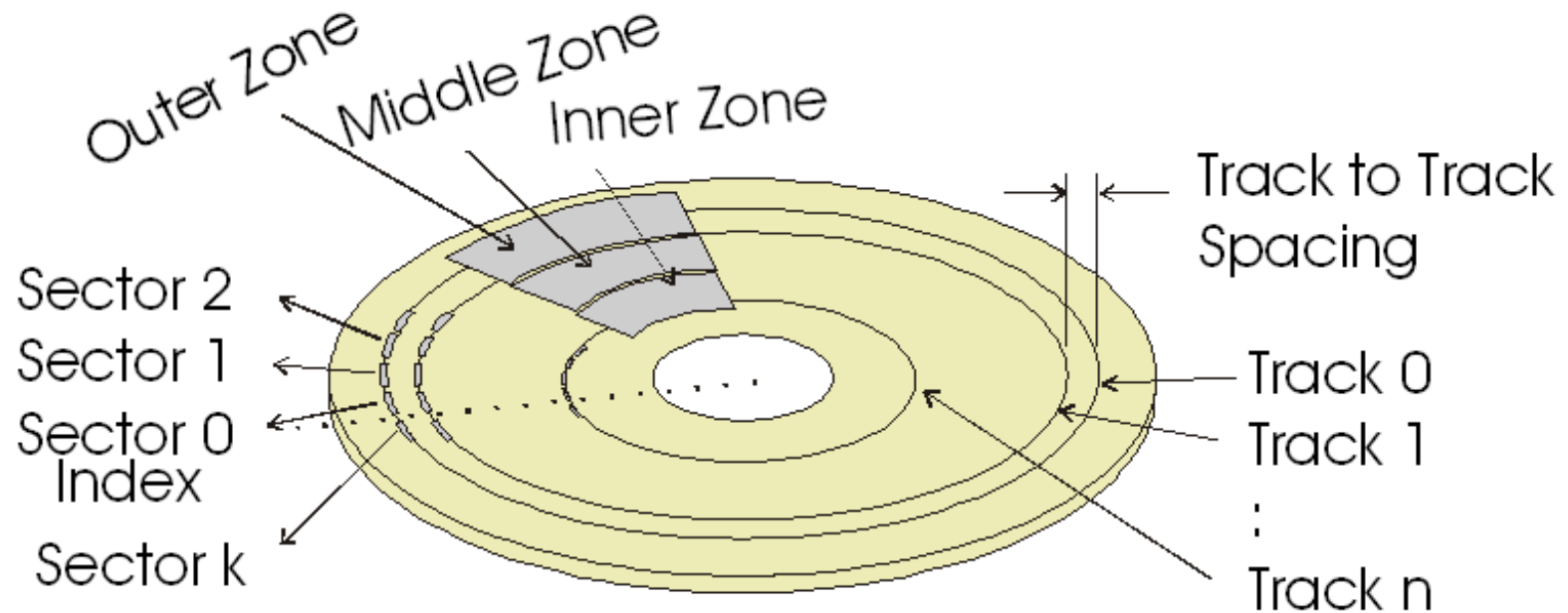
Platters, Media

Inside the HDD

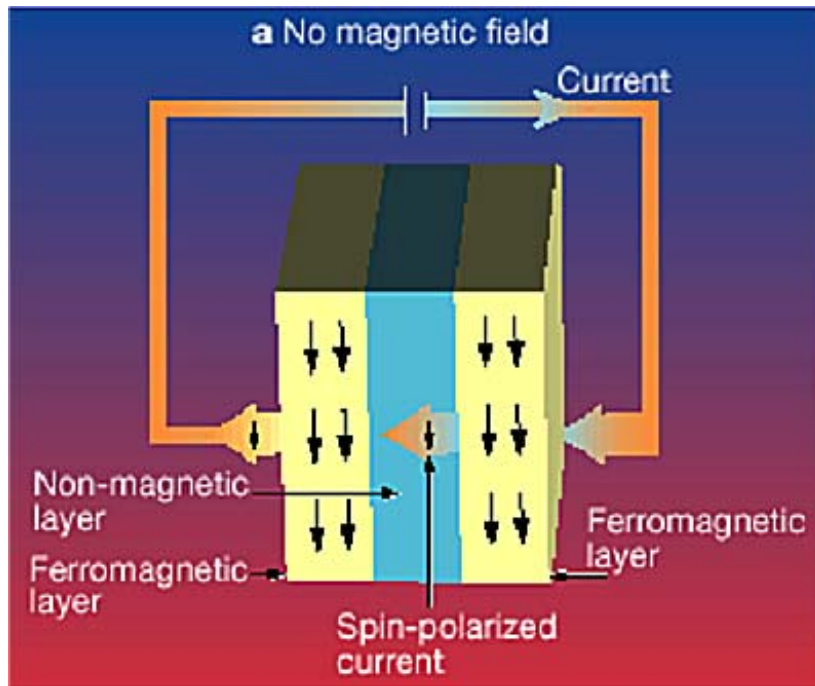


Motor

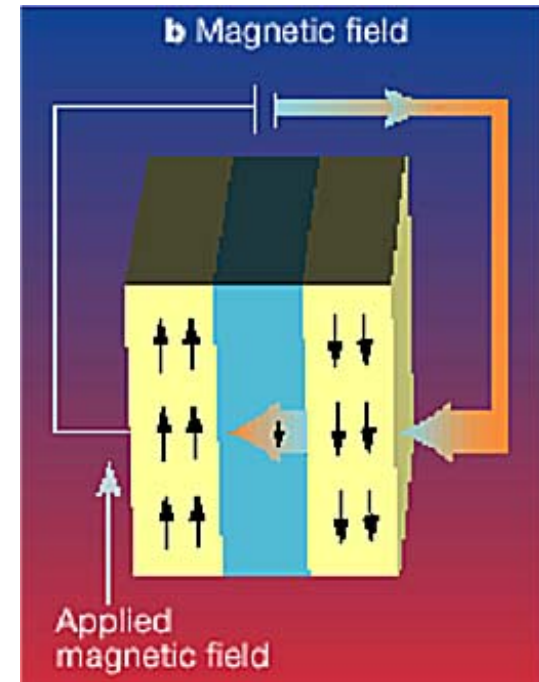
Understanding Magnetic Storage



A Spin-Valve in Action

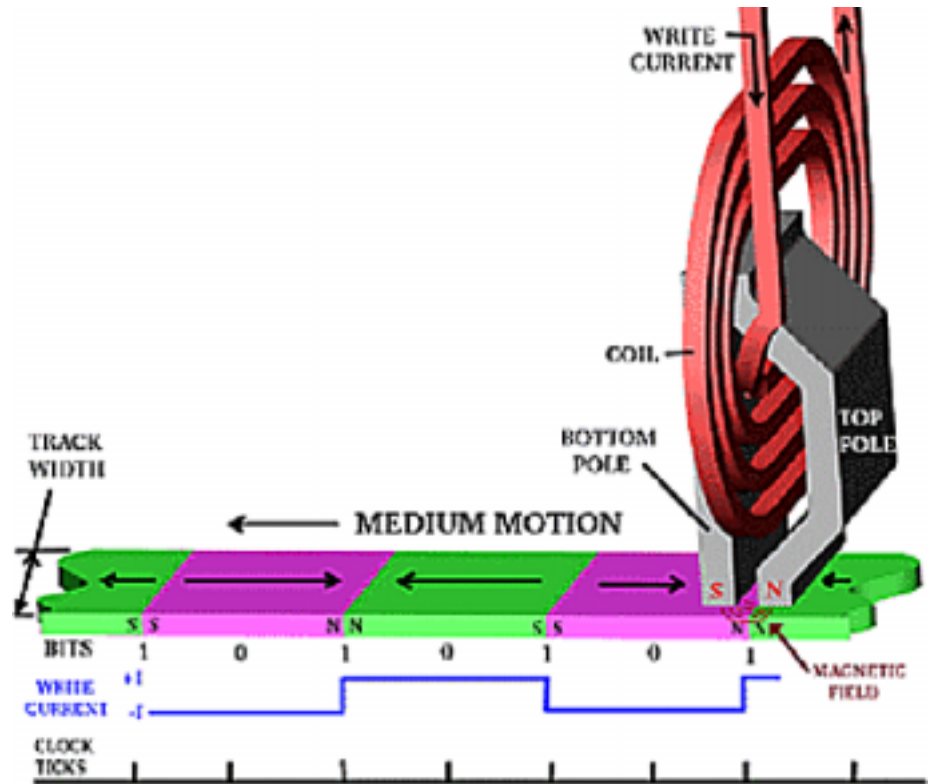
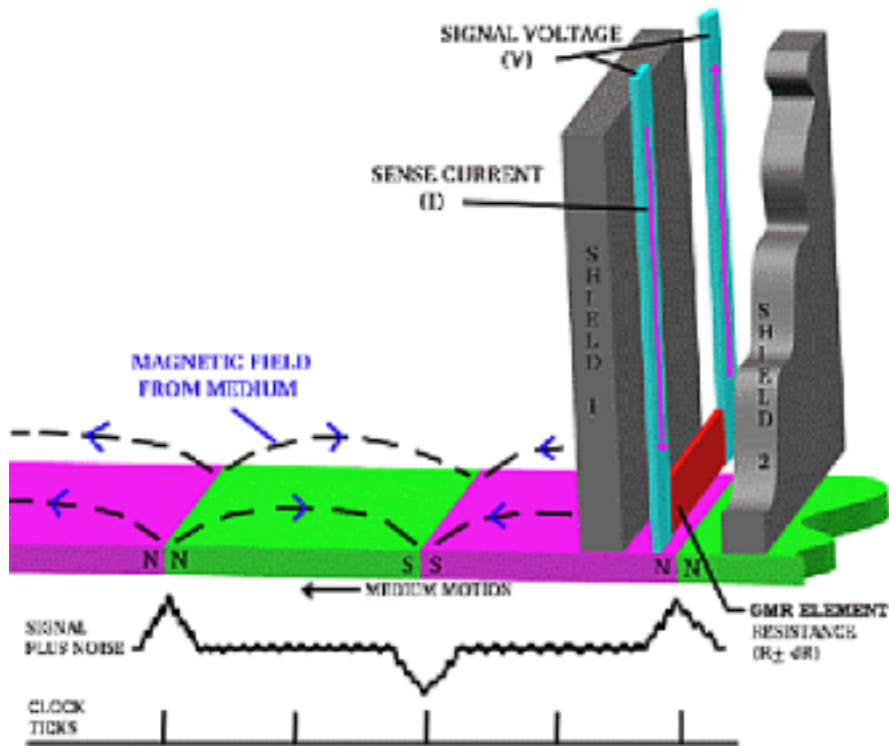


With no magnetic field, the spin-polarised current can flow through the system

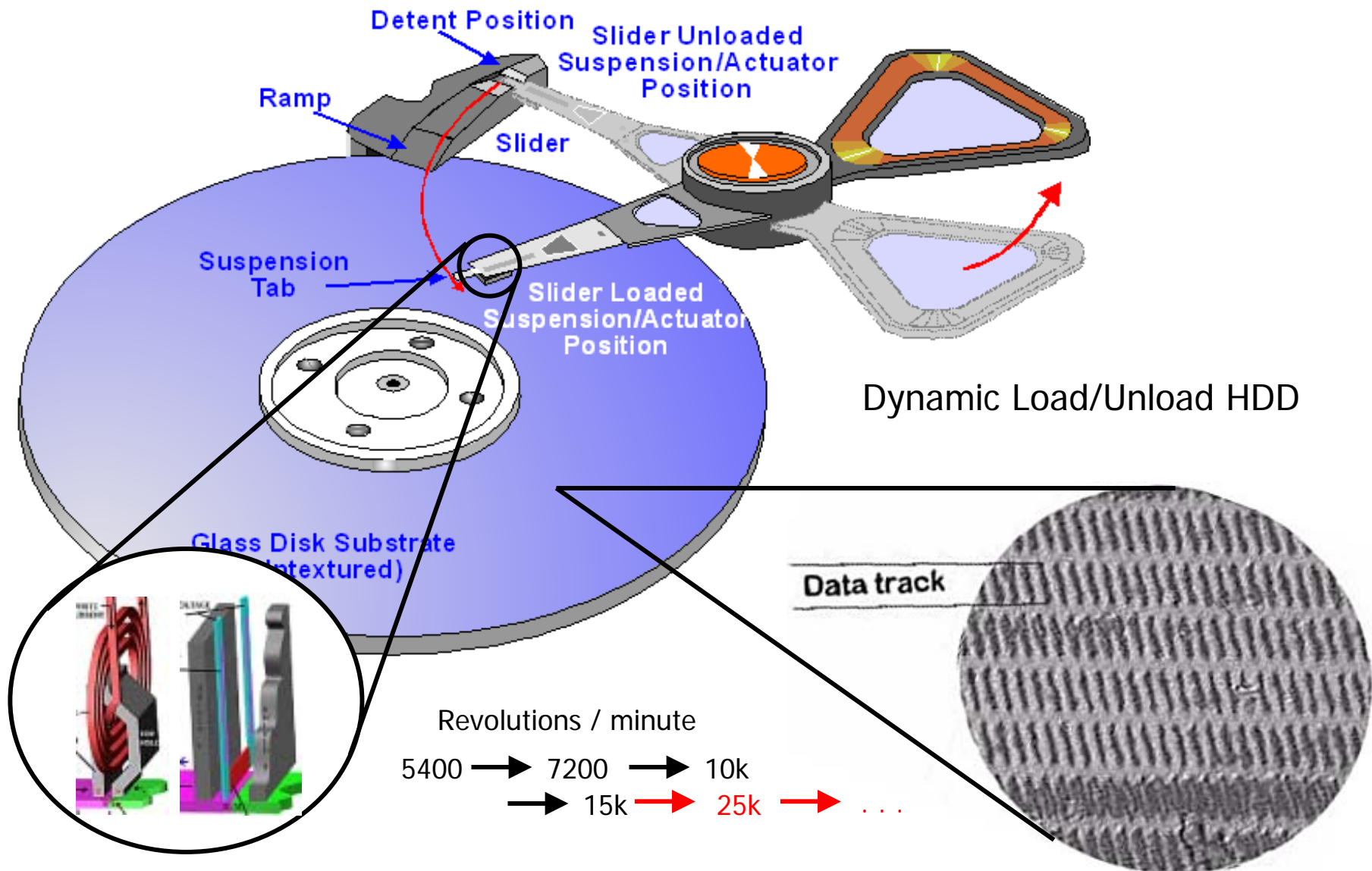


But when a magnetic field is applied, the spin-polarised current cannot flow through the Ferromagnetic layers, thus breaking the circuit

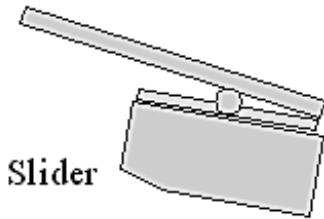
Reading and Writing Data



The Main Assembly

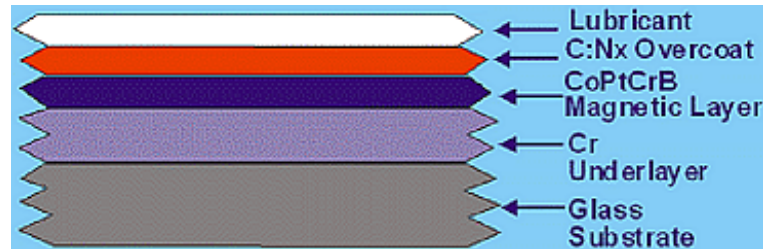
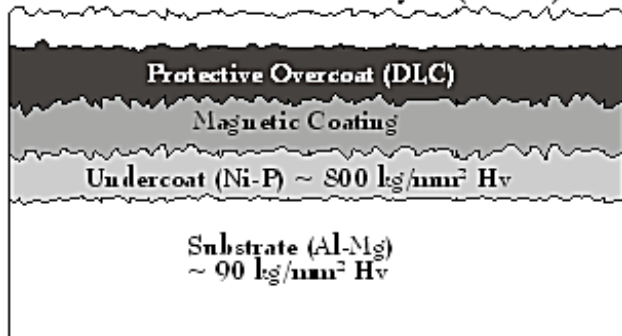


Flying Height



Slider

Lubrication Layer (PFPE)



Media Layer

Slider Clearance
15 nm

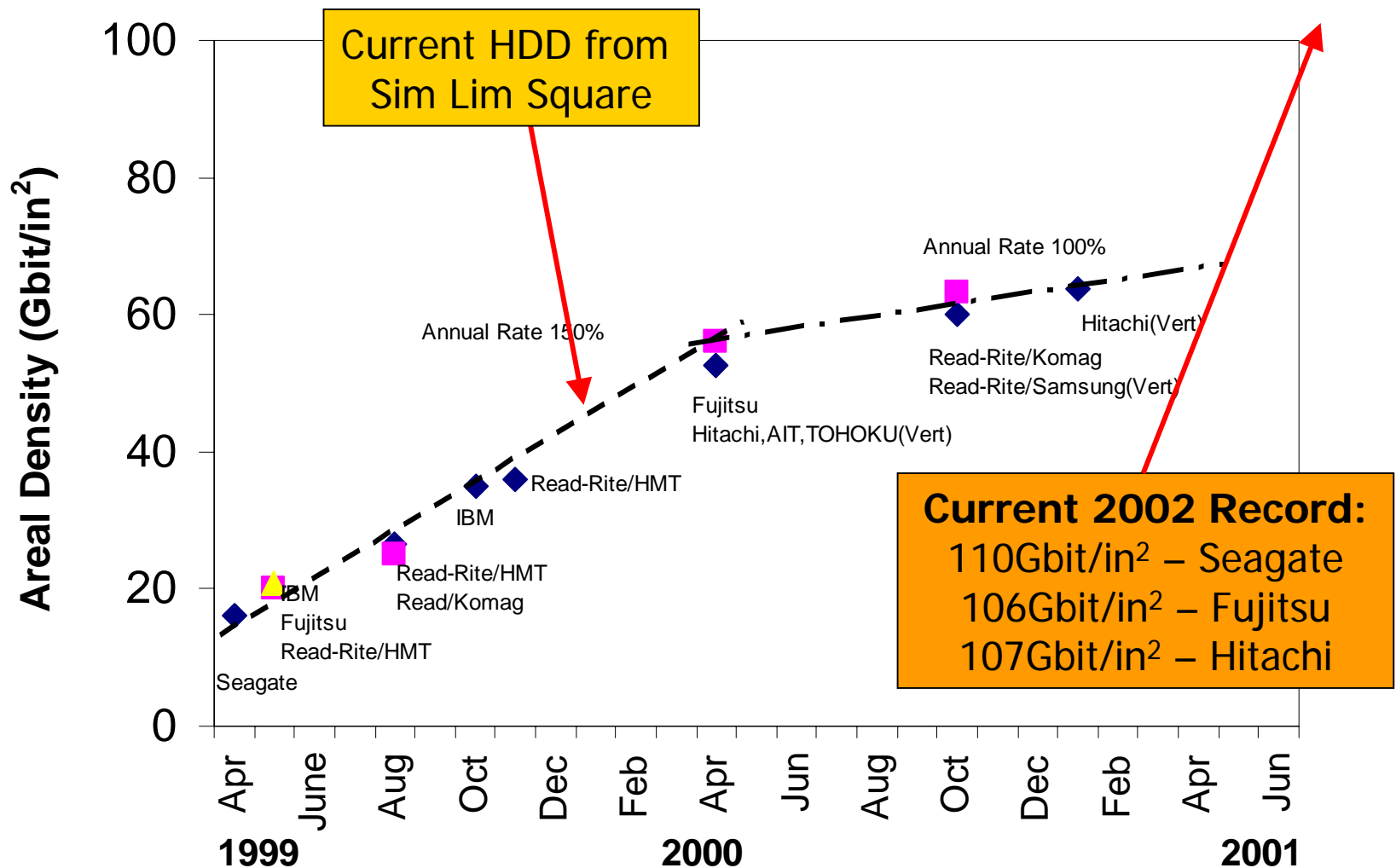


"Flying Height"



1 cm = 10mm, 1mm = 1000 Microns, 1 Micron = 1000nm, 1cm = 10,000,000nm

I Want to Store More!



Areal Density Laboratory/Spin Stand Demonstrations

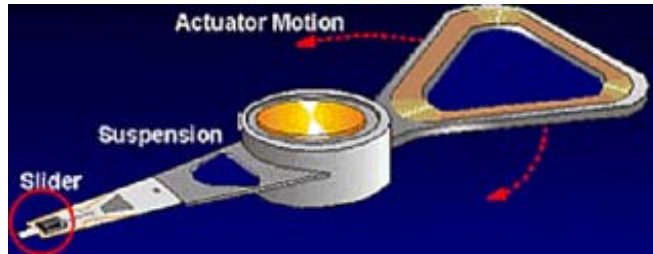
Hard Disk Drive Challenges



Fly a Boeing 747 smoothly at 600mph only 1cm above the ground, then get a fisherman to stand on top of it and use a spear to catch 300 million fish a second.

Hard Disk Drive Challenges

Millimeter
Accuracy

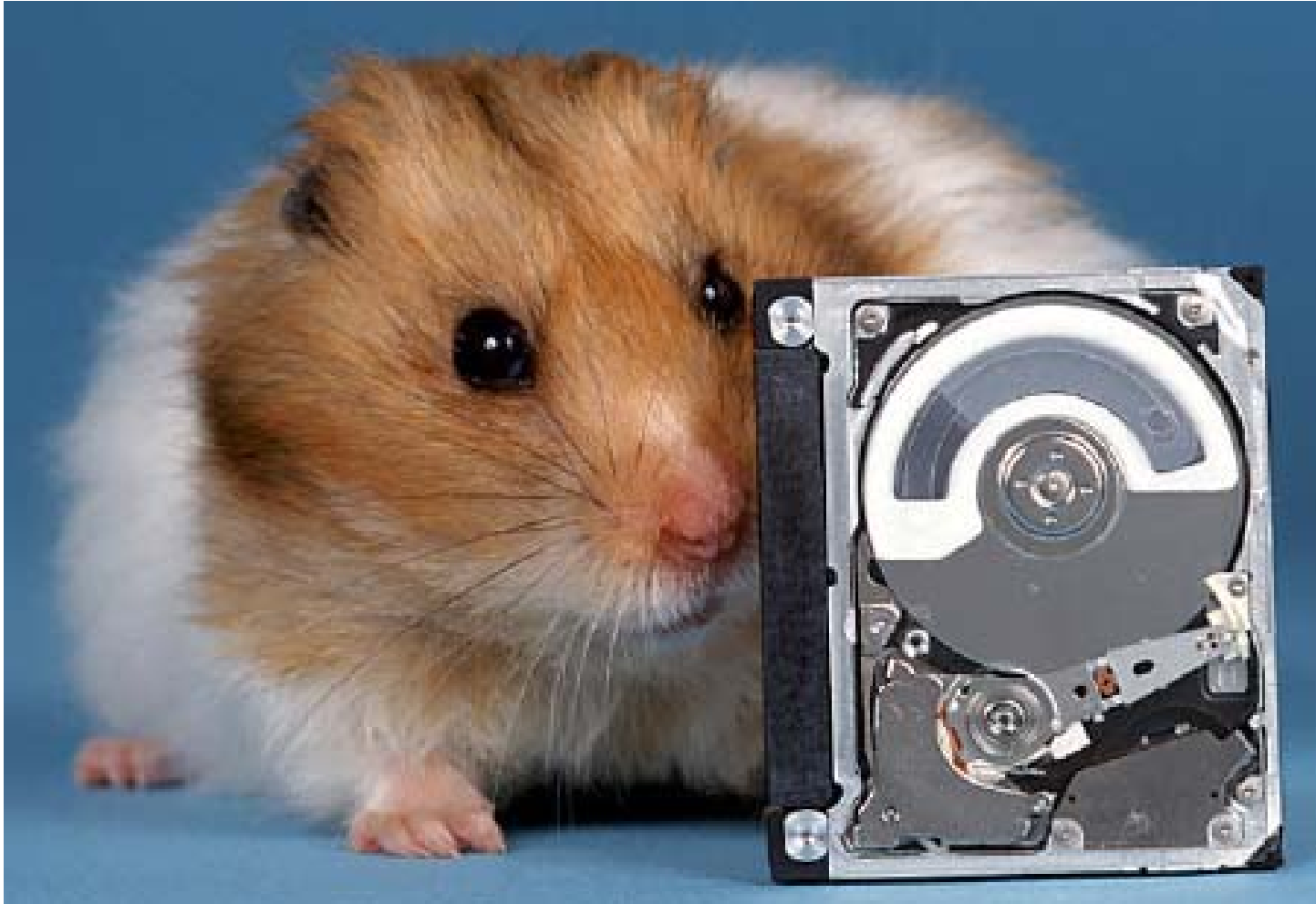


Positioning the slider is like holding the Republic Plaza by its base and then trying to position the tip of the tower accurately to within a few millimeters.

The Republic Plaza is 280m tall

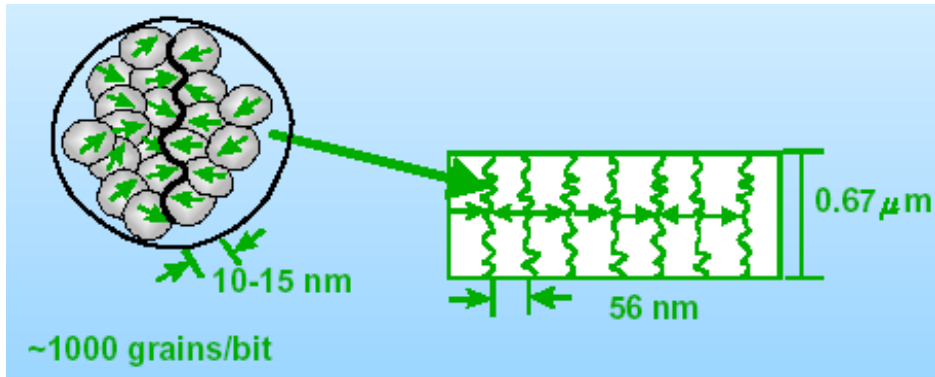


Hard Disk Drive Challenges



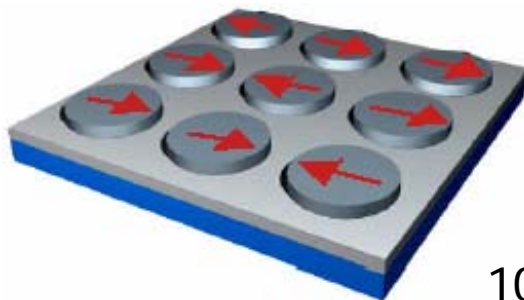
And to top it off – keep making it smaller and smaller . . .

Patterned Media

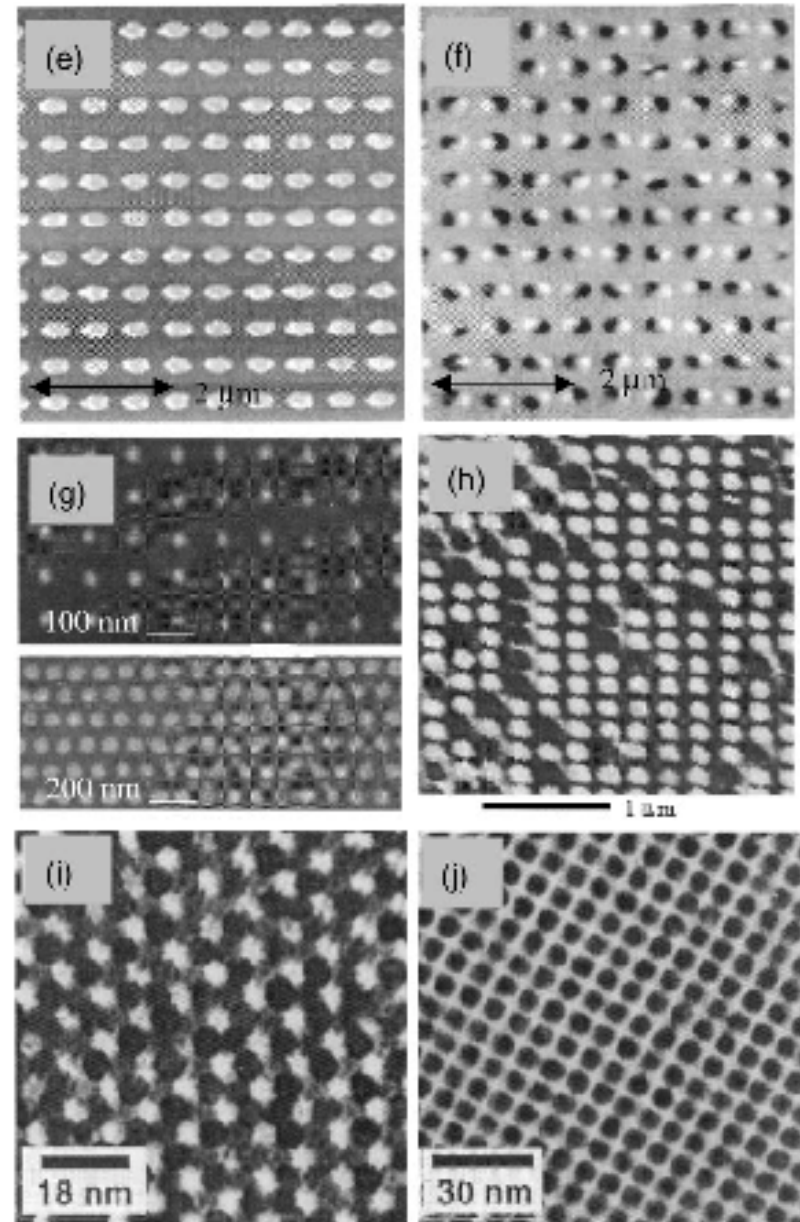


17.1 Gbit/in²

Extremely high density media can be obtained by "patterning" the media beforehand. This allows the squeezing of "dots" at very small grain sizes.

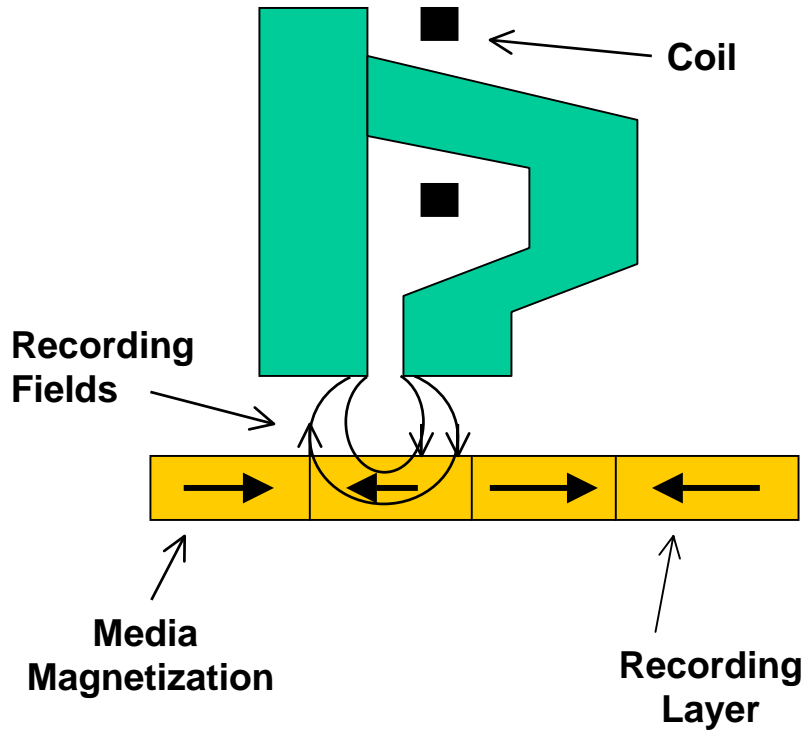


100+ Gbit/in²

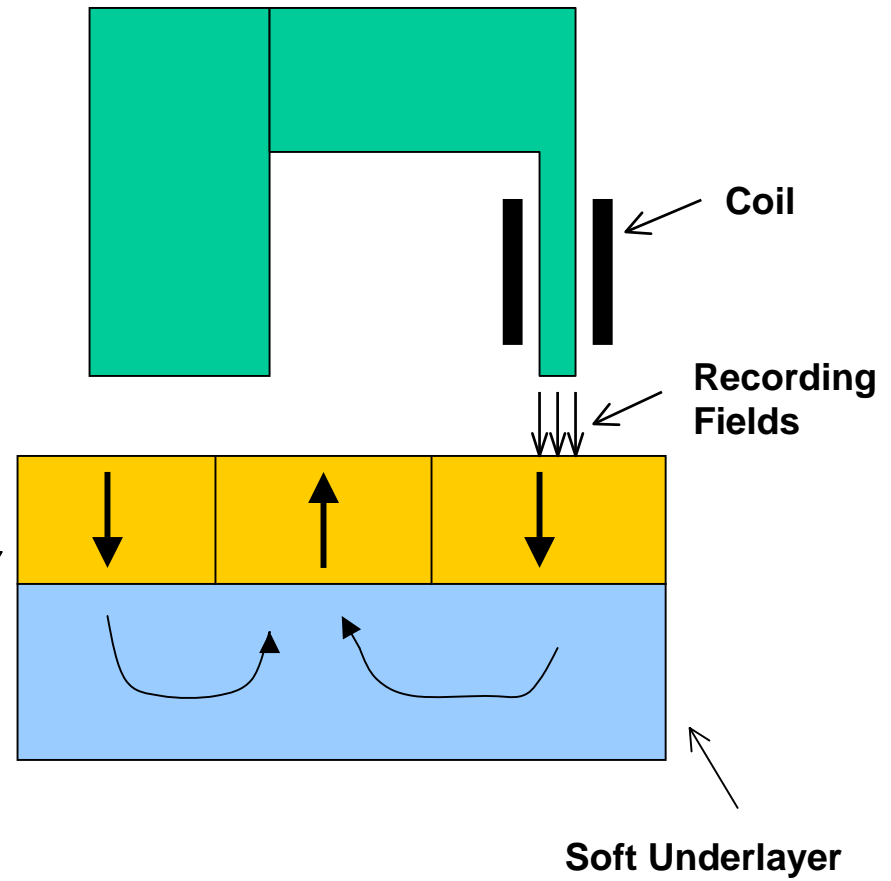


Longitudinal vs Perpendicular

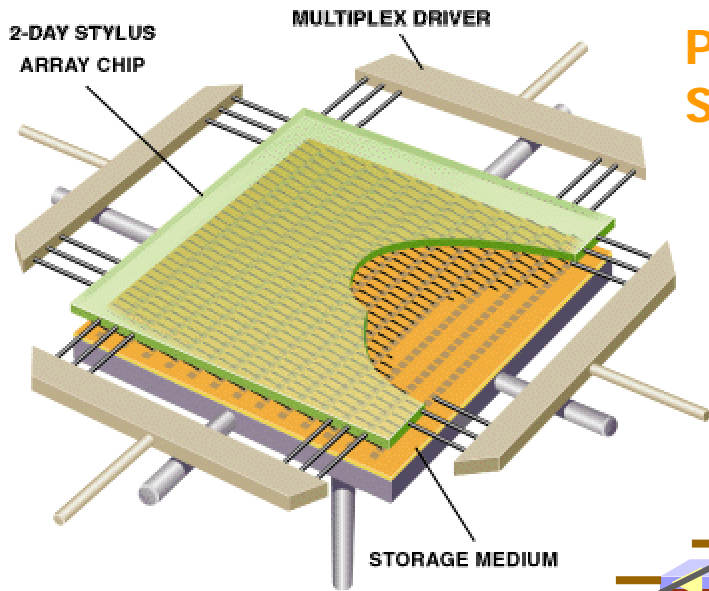
Longitudinal Recording



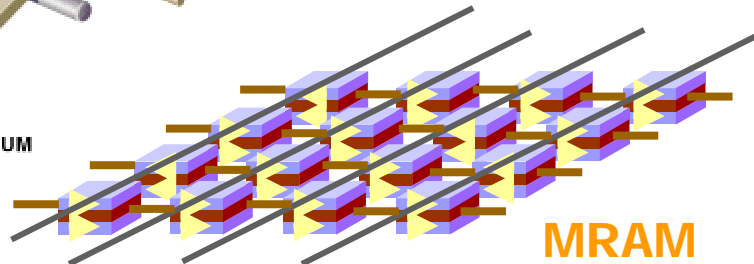
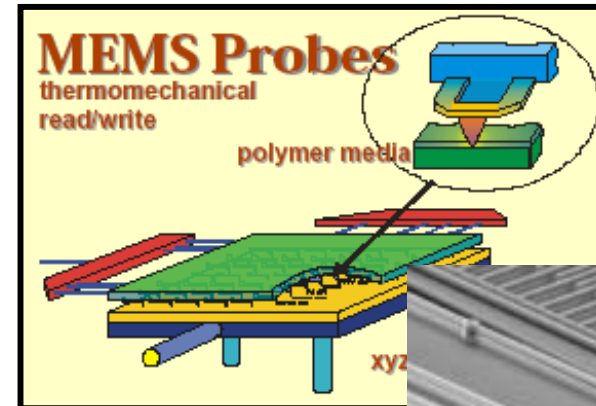
Perpendicular Recording



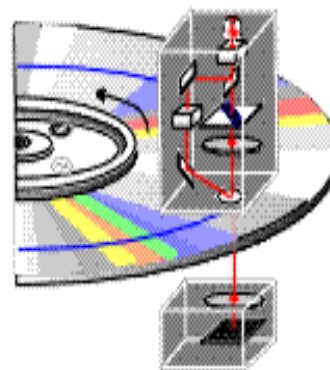
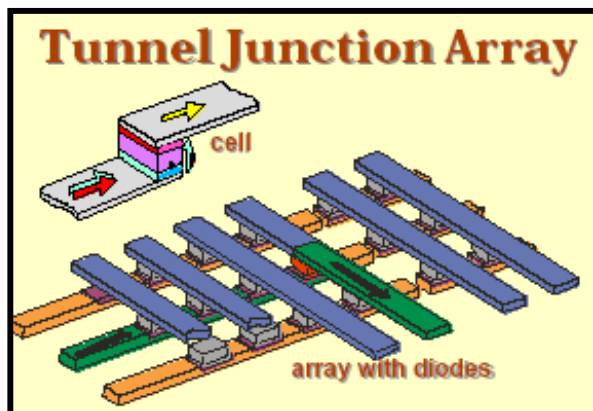
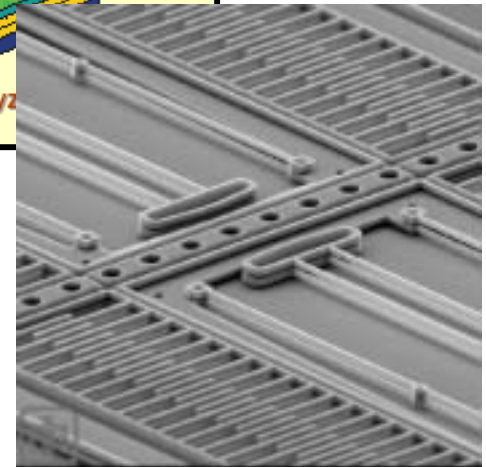
Other Future Storage



Probe Storage



MRAM



Holographic





Storing and Retrieving Files



Un-common Common Sense

- Use Common Sense
- Decide on a Structure / Strategy
- Plan for future growth
 - Be careful of assumptions
- Use available technology / features
 - Learn it!
- Back-up and Restore
 - And test your backups!
- Invest in the effort now, save time in the future

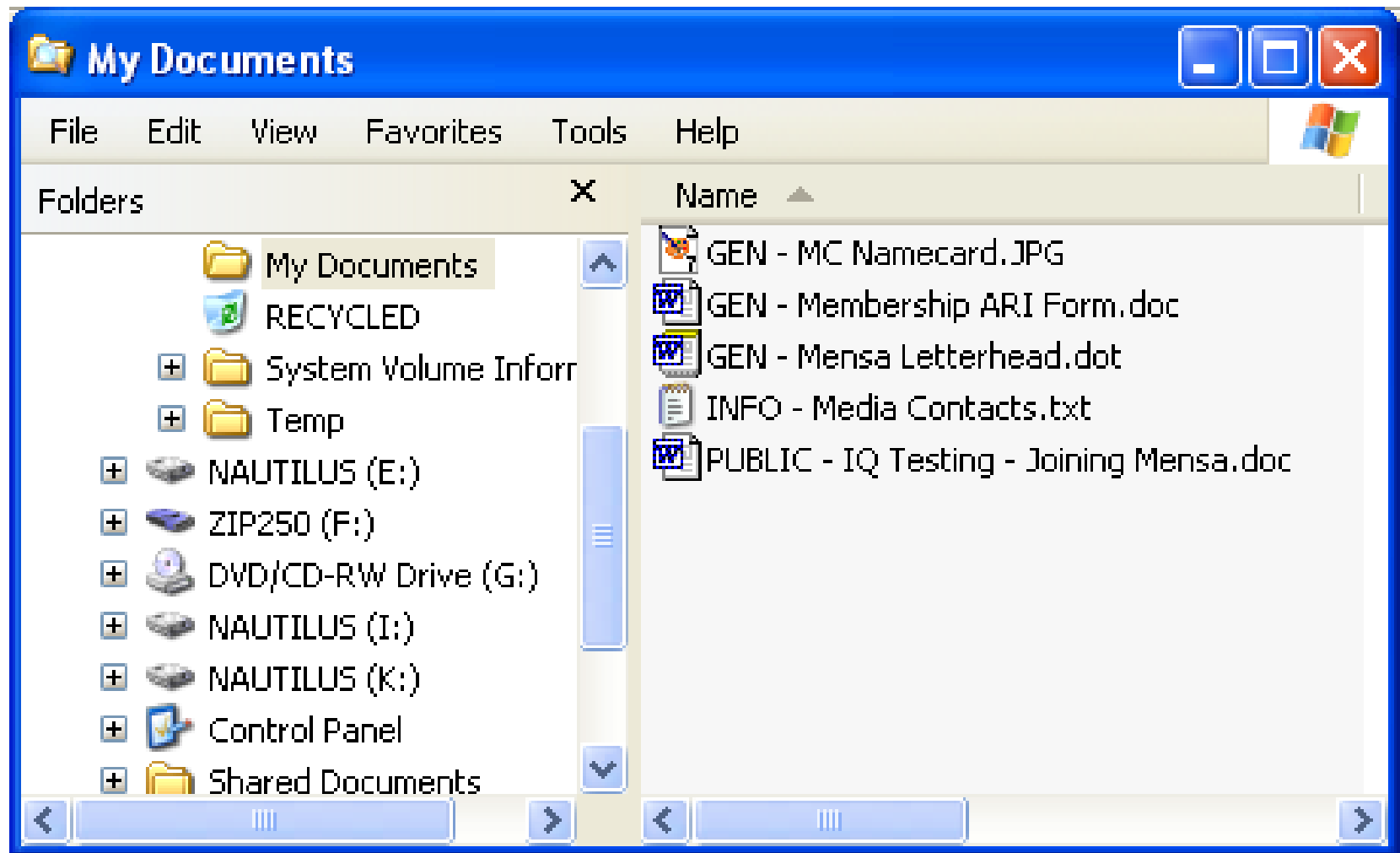


Structure / Strategy

- Use long file and folder names
- Number the files and folders
- Group same category files into one folder
- Group same category folders into another folder
- Keep all of the above in one place
- Make all these your “**File Structure Rules**”

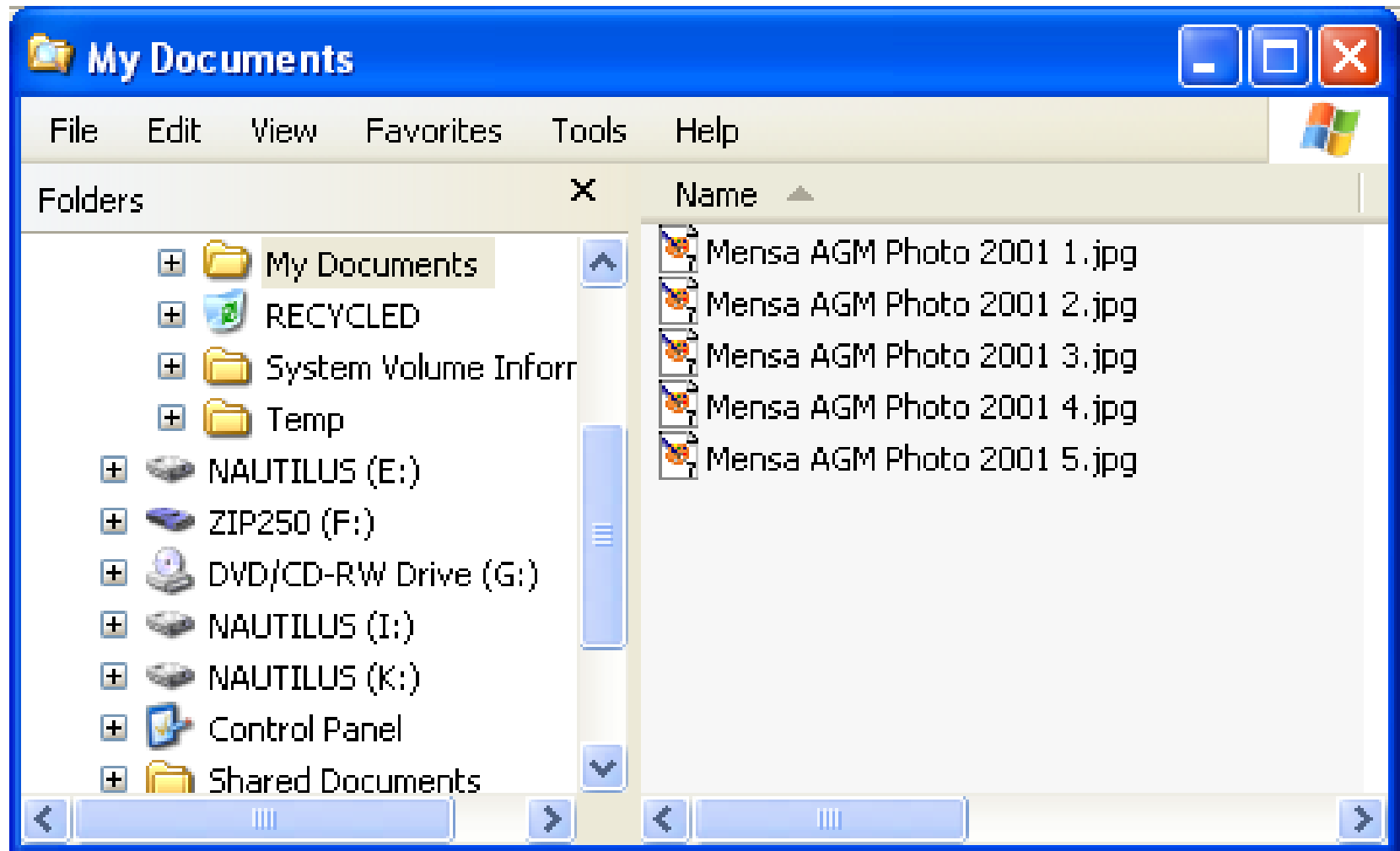
- Category Types:
 - Date and Time
 - Topic / Subject Matter
 - Project / Organisation
 - People / Places

Long File Names



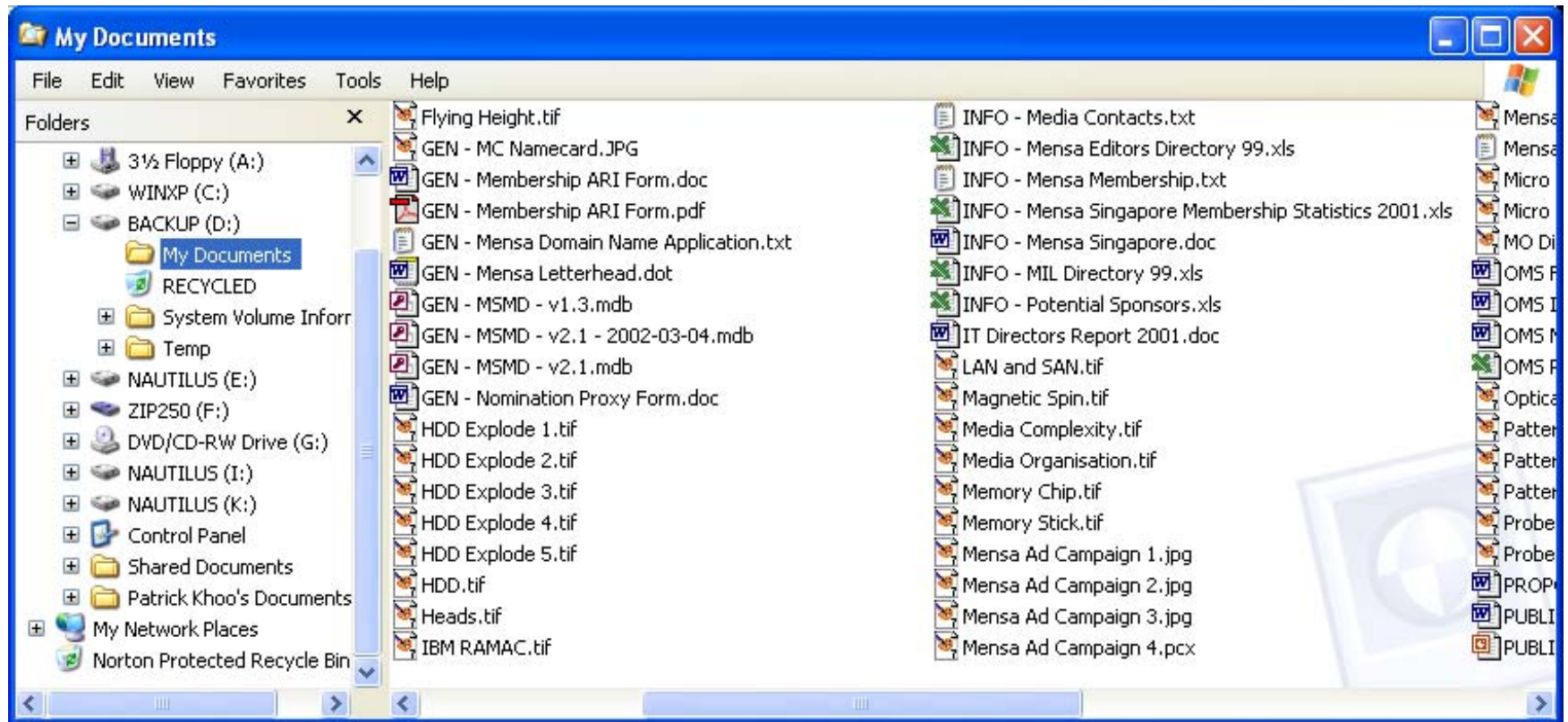
Be as descriptive as possible, and categorise the file in the name if possible

File Numbering



Same category files can also be numbered for sequence

Group Files into Folders



When there are too many files, group them into folders

Group Folders into Folders

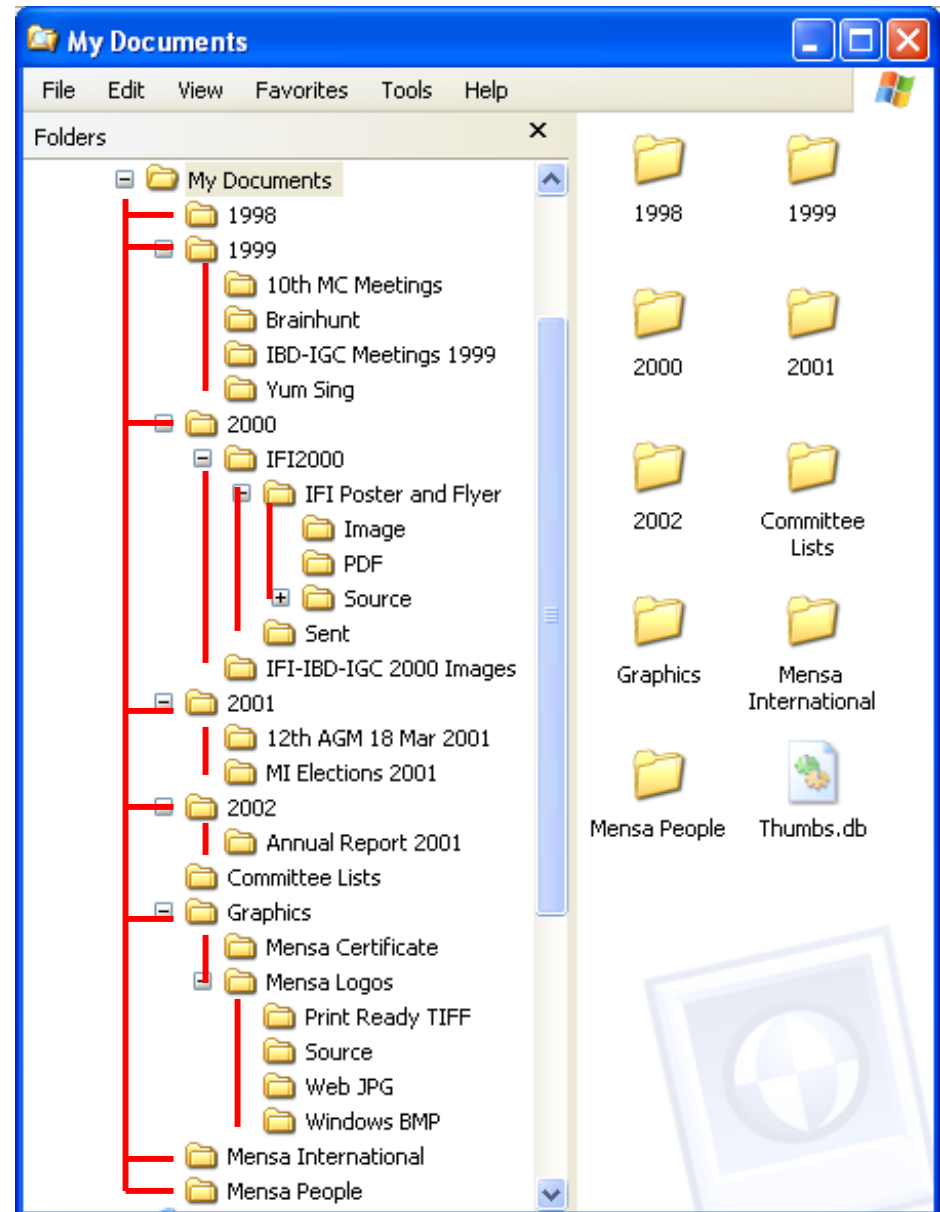
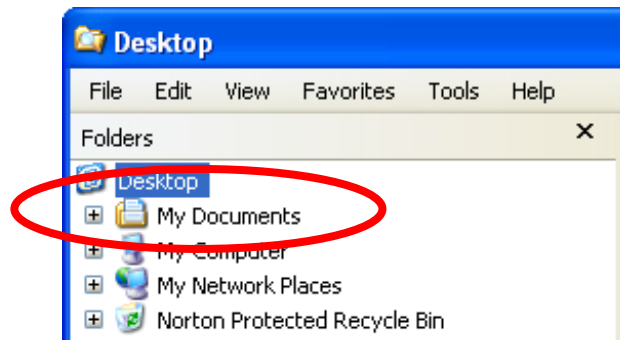
Follow your own **File Structure Rules**

Group Files into Folders

Group Folders into Folders

Create a folder "Tree"

Keep everything in one place

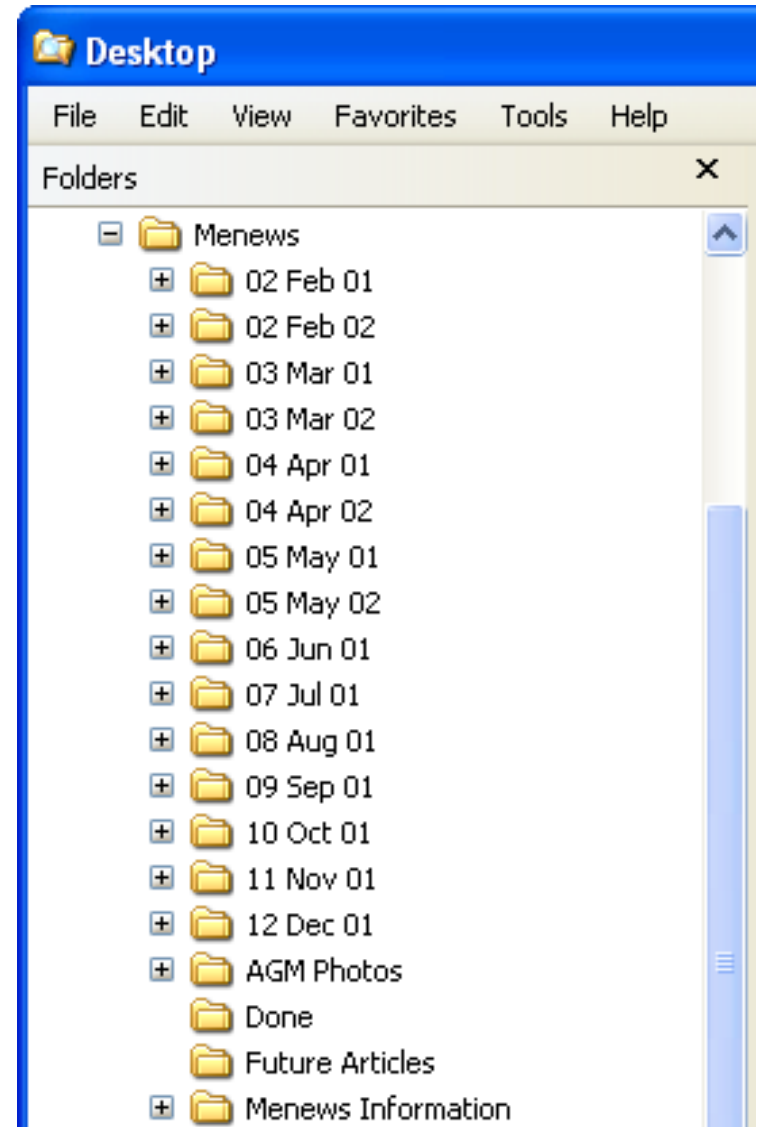


Plan for the Future

If you can predict it, build it first

Never underestimate how events of the future will affect the way you organise and store your files

Example: Y2K Problem



Numbering and the Future



Plan for the future when using numbering

Number order might not be displayed properly

Dates and Ordering

Name	Ext	Size	Date	Time	Attr
..		DIR	14/12/2000	12:00:20 PM	
sent-mail-apr-1999		589,016	31/12/2001	12:00:00 PM	A
sent-mail-apr-2000		2,182,244	31/12/2001	12:00:00 PM	A
sent-mail-apr-2001		2,099,731	31/12/2001	12:00:00 PM	A
sent-mail-aug-1999		2,567,133	31/12/2001	12:00:00 PM	A
sent-mail-aug-2000		2,650,490	31/12/2001	12:00:00 PM	A
sent-mail-aug-2001		3,095,058	31/12/2001	12:00:00 PM	A
sent-mail-dec-1999		2,869,449	31/12/2001	12:00:00 PM	A
sent-mail-dec-2000		268,306	31/12/2001	12:00:00 PM	A
sent-mail-dec-2001		1,955,703	31/12/2001	12:00:00 PM	A
sent-mail-feb-1999		1,415,729	31/12/2001	12:00:00 PM	A
sent-mail-feb-2000		1,789,979	31/12/2001	12:00:00 PM	A
sent-mail-feb-2001		586,843	31/12/2001	12:00:00 PM	A
sent-mail-jan-1999		983,032	31/12/2001	12:00:00 PM	A
sent-mail-jan-2000		3,352,684	31/12/2001	12:00:00 PM	A
sent-mail-jan-2001		321,336	31/12/2001	12:00:00 PM	A

Use numbers for date

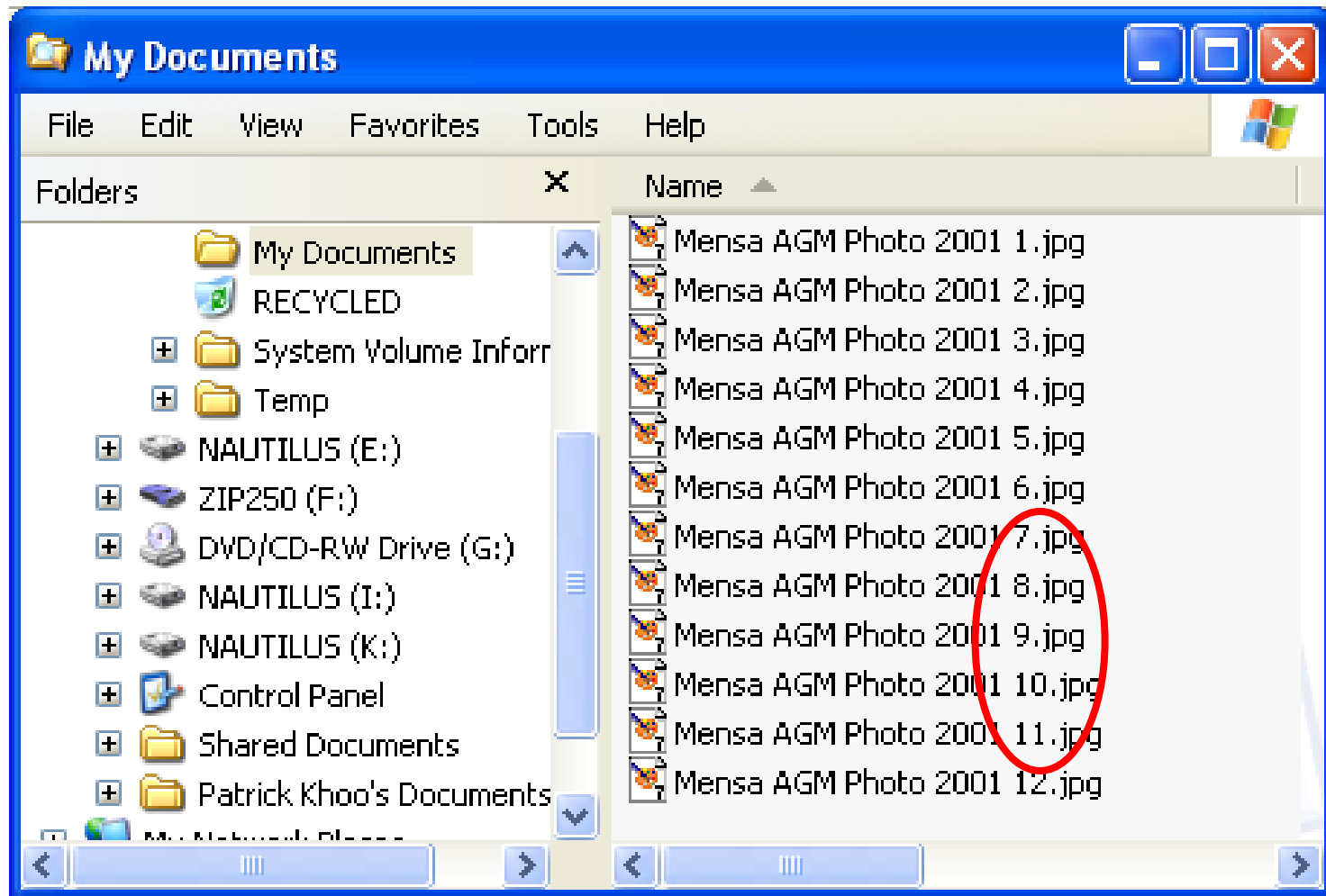
YYYY-MM-DD format

Use Folders

Name	Ext	Size	Date	Time	Attr
..		DIR	14/12/2000	12:00:20 PM	
sent-mail-1999-01		983,032	31/12/2001	12:00:00 PM	A
sent-mail-1999-02		1,415,729	31/12/2001	12:00:00 PM	A
sent-mail-1999-04		589,016	31/12/2001	12:00:00 PM	A
sent-mail-1999-08		2,567,133	31/12/2001	12:00:00 PM	A
sent-mail-1999-12		2,869,449	31/12/2001	12:00:00 PM	A
sent-mail-2000-01		3,352,684	31/12/2001	12:00:00 PM	A
sent-mail-2000-02		1,789,979	31/12/2001	12:00:00 PM	A
sent-mail-2000-04		2,182,244	31/12/2001	12:00:00 PM	A
sent-mail-2000-08		2,650,490	31/12/2001	12:00:00 PM	A
sent-mail-2000-12		268,306	31/12/2001	12:00:00 PM	A
sent-mail-2001-01		321,336	31/12/2001	12:00:00 PM	A
sent-mail-2001-02		586,843	31/12/2001	12:00:00 PM	A
sent-mail-2001-04		2,099,731	31/12/2001	12:00:00 PM	A
sent-mail-2001-08		3,095,058	31/12/2001	12:00:00 PM	A
sent-mail-2001-12		1,955,703	31/12/2001	12:00:00 PM	A

Name	Ext	Size	Date	Time	Attr
..		DIR	14/12/2000	12:00:20 PM	
Sent Mail 1999		DIR	11/5/2002	11:21:38 AM	
Sent Mail 2000		DIR	11/5/2002	11:21:42 AM	
Sent Mail 2001		DIR	11/5/2002	11:21:46 AM	

New Technology Fixes Things



Windows XP fixes it, but what about CDs written and used on older systems?

Use Existing Technology & Features

Microsoft Excel - Pat and Eileen's CD Collection.xls

File Edit View Insert Format Tools Data Window Help Acrobat

Arial 8 B I U

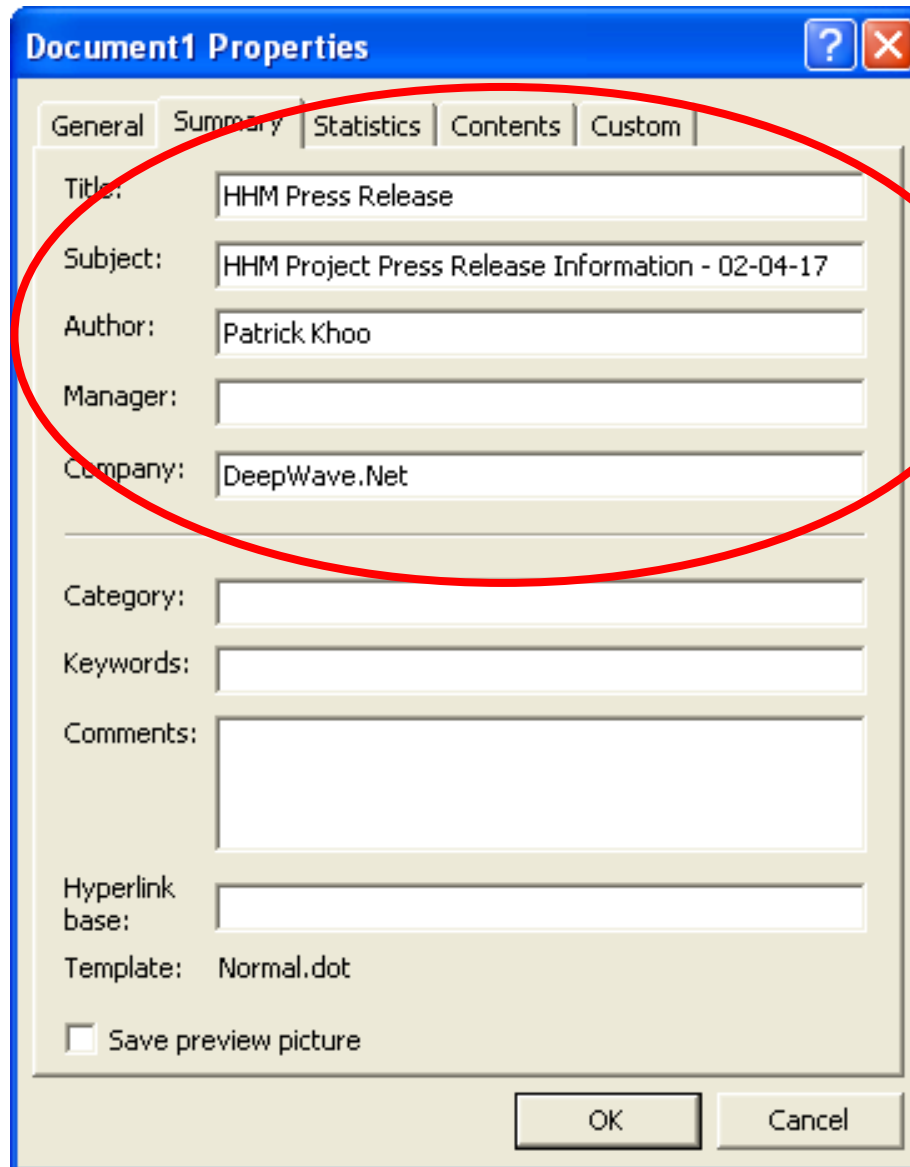
A1 = Last Updated: 5 May 2002

	A	B	C	D	E	F	G
1	Last Updated: 5 May 2002	Total: 188					
2							
3	Quality	Review					
4	# - Some Blotchy Sections	# - Unless you're really bored					
5	## - Good VCD	## - Entertaining					
6	### - High Quality	### - Good Show					
7	#### - LD or DVD Quality	#### - Outstanding					
8							
9	Title	Type	Quality	Review			
10							
11	12 Monkeys	DVD+DTS	####	###			
12	A Beautiful Mind	DVD+DD	####	####			
13	Abyss, Special Edition	DVD+THX	####	###			
14	Air Force One	VCD	###	##			
15	Akira, Special Edition	DVD+THX	####	##	Anime		
16	Antitrust	DVD+DD	####	##			
17	Amadeus	VCD	###	##			
18	American Beauty	DVD+DD	####	####			
19	Apollo 13	VCD	###	####			
20	Army of Darkness, Evil Dead III	VCD	###	###			
21	Artificial Intelligence	DVD+DD	####	###			
22	Awakenings	DVD	####	###			

Ready NUM

Movies / Other Movies / CDs - Groups / CDs - Male / CDs - Female

Use Existing Technology & Features



The image shows a screenshot of a Windows-style dialog box titled "Document1 Properties". The dialog has a blue title bar with a question mark icon and a close button. Below the title bar are five tabs: "General", "Summary", "Statistics", "Contents", and "Custom". The "General" tab is selected. The fields in the "General" tab are: "Title:" with the value "HHM Press Release", "Subject:" with the value "HHM Project Press Release Information - 02-04-17", "Author:" with the value "Patrick Khoo", "Manager:" (empty), "Company:" with the value "DeepWave.Net", "Category:" (empty), "Keywords:" (empty), "Comments:" (empty text area), "Hyperlink base:" (empty), and "Template:" with the value "Normal.dot". At the bottom of the dialog is a checkbox labeled "Save preview picture" which is unchecked. At the very bottom are "OK" and "Cancel" buttons. A red circle is drawn around the "Title", "Subject", "Author", and "Company" fields.

Document1 Properties

General Summary Statistics Contents Custom

Title: HHM Press Release

Subject: HHM Project Press Release Information - 02-04-17

Author: Patrick Khoo

Manager:

Company: DeepWave.Net

Category:

Keywords:

Comments:

Hyperlink base:

Template: Normal.dot

☐ Save preview picture

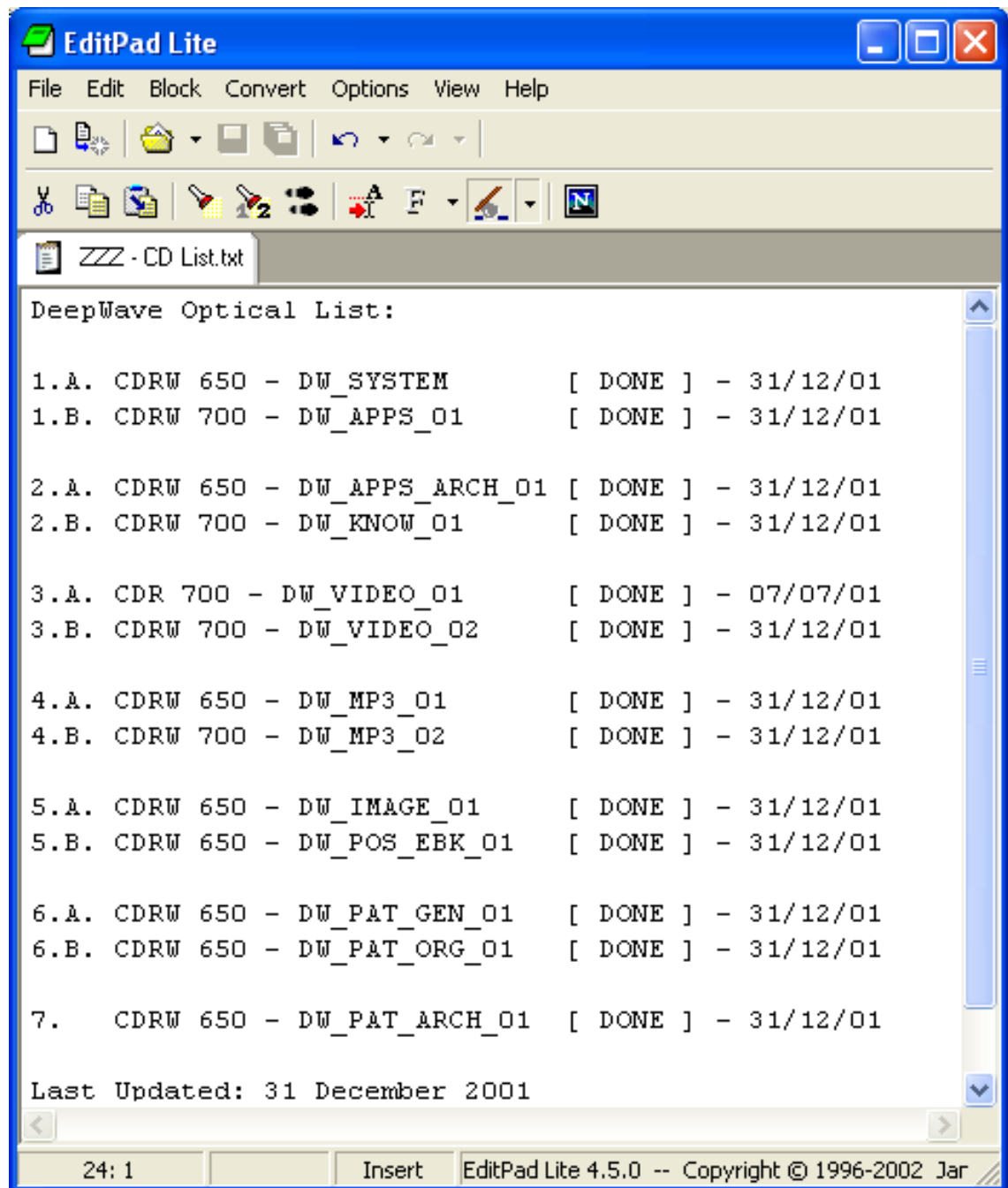
OK Cancel



Backup and Restore

- You can use CDR/RW, or even Zip Disks for backup
- But always backup your data regularly
 - Fix a schedule and stick to it
- Organise your backup the way you organise your files
 - Use one disk per category?
 - Keep an index of your backups, label accordingly
 - Consider how you will find the file you want in the sea of backups
- Always restore your backup – Zip disks and CDR/RWs **do** fail

Keep a List!





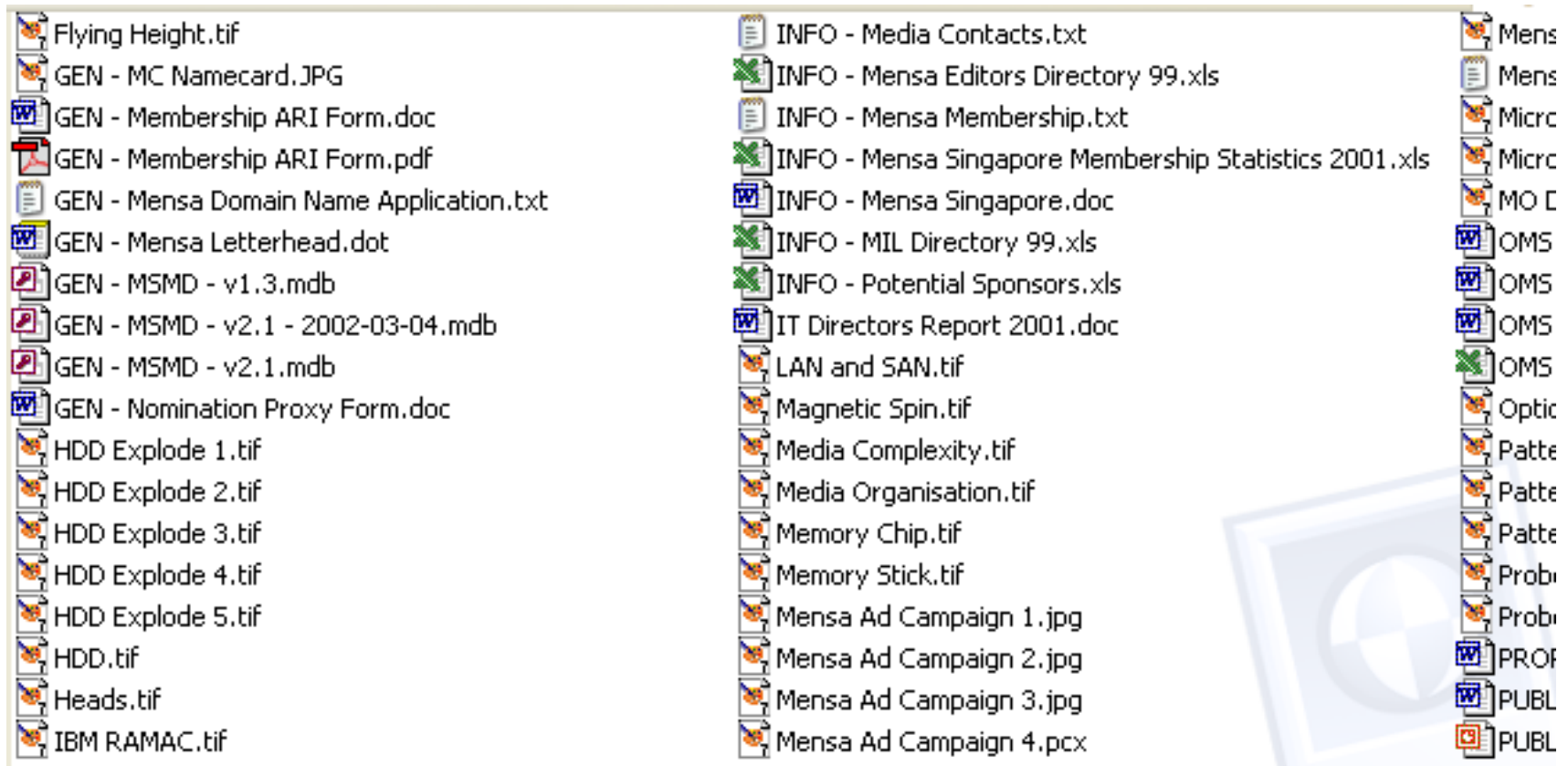
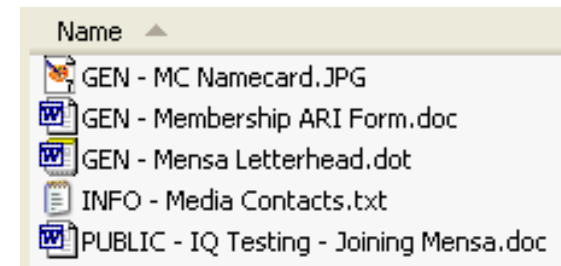
Phew! A Lot of Work! – Why do it?

- If information is the key to the future, it is more important than money, shouldn't you spend the time to do it properly?
- If in the event of an emergency, someone needs to know something, will they be able to find it in your "pile of mess"?
- In a company, people move from job to job, can you retain this information from employee to employee, and can you share it among employees?
- Storing information is never the problem, getting it back is the real headache – So store and organise it properly, so you can get the information you want when you need it most with minimum fuss
- Invest in the time and effort to do it, and learn the new techniques and features

Invest in it . . .

Start organising this many files today . . .

Or wait until tomorrow?

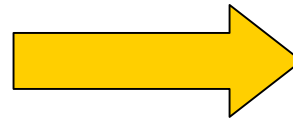


What Does Storage Mean to Me?

115 Video Tapes



100Gbit/in²
(2003)



1 HDD



250 hours of video
or
80,000+ songs



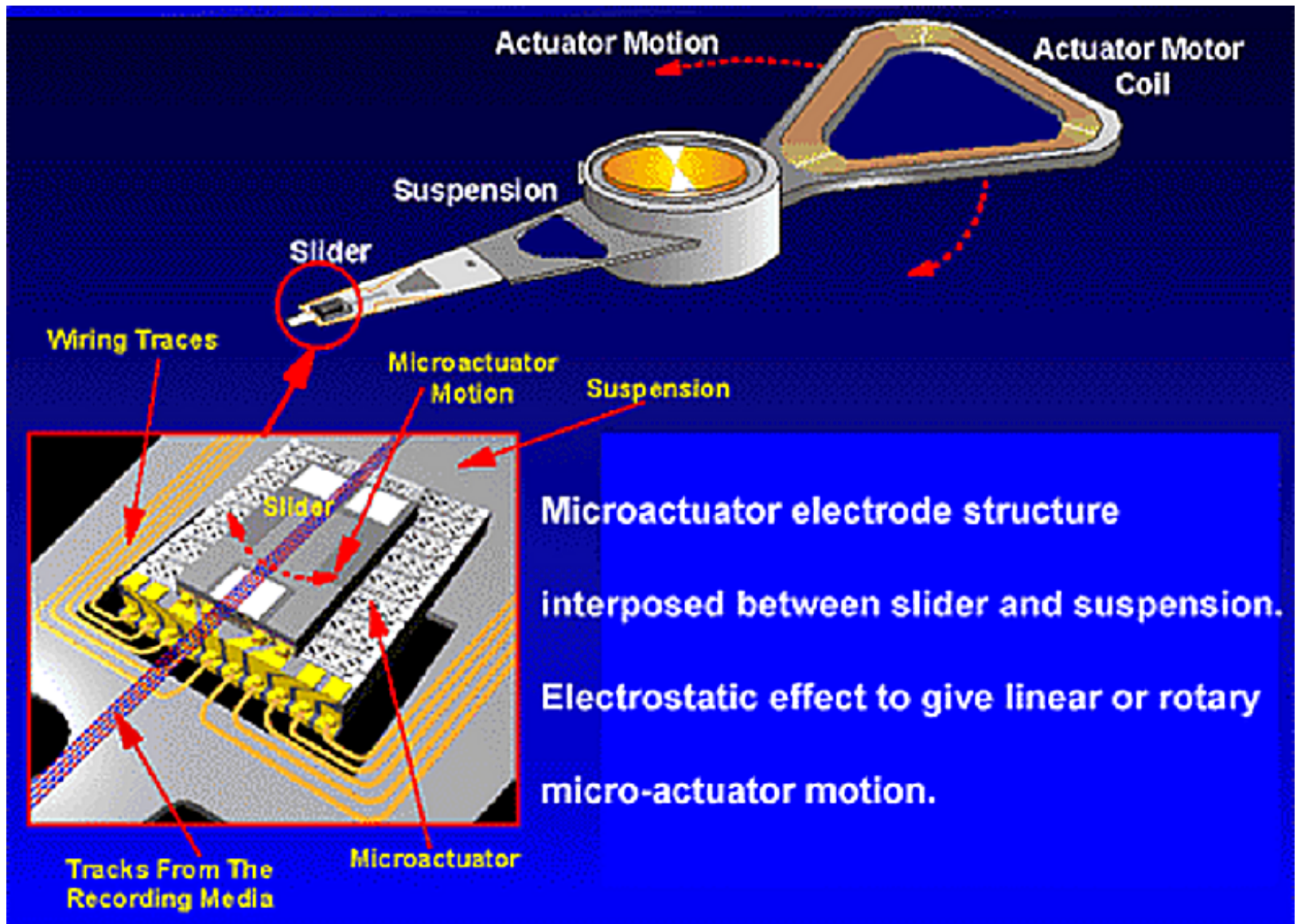
What Does Storage Mean to Me?

- 100Gbit/in² means we can store
 - 400 Bytes / second for 50 years
- We will most likely achieve 1000Gbit/in²
 - Which will allow 400KB/sec for 50 years of combined audio and video
- This will allow the development of the “Memory Prosthesis” – A personal, always on, digital audio/video diary
 - Can you afford to be the only person in a meeting who forgets things?

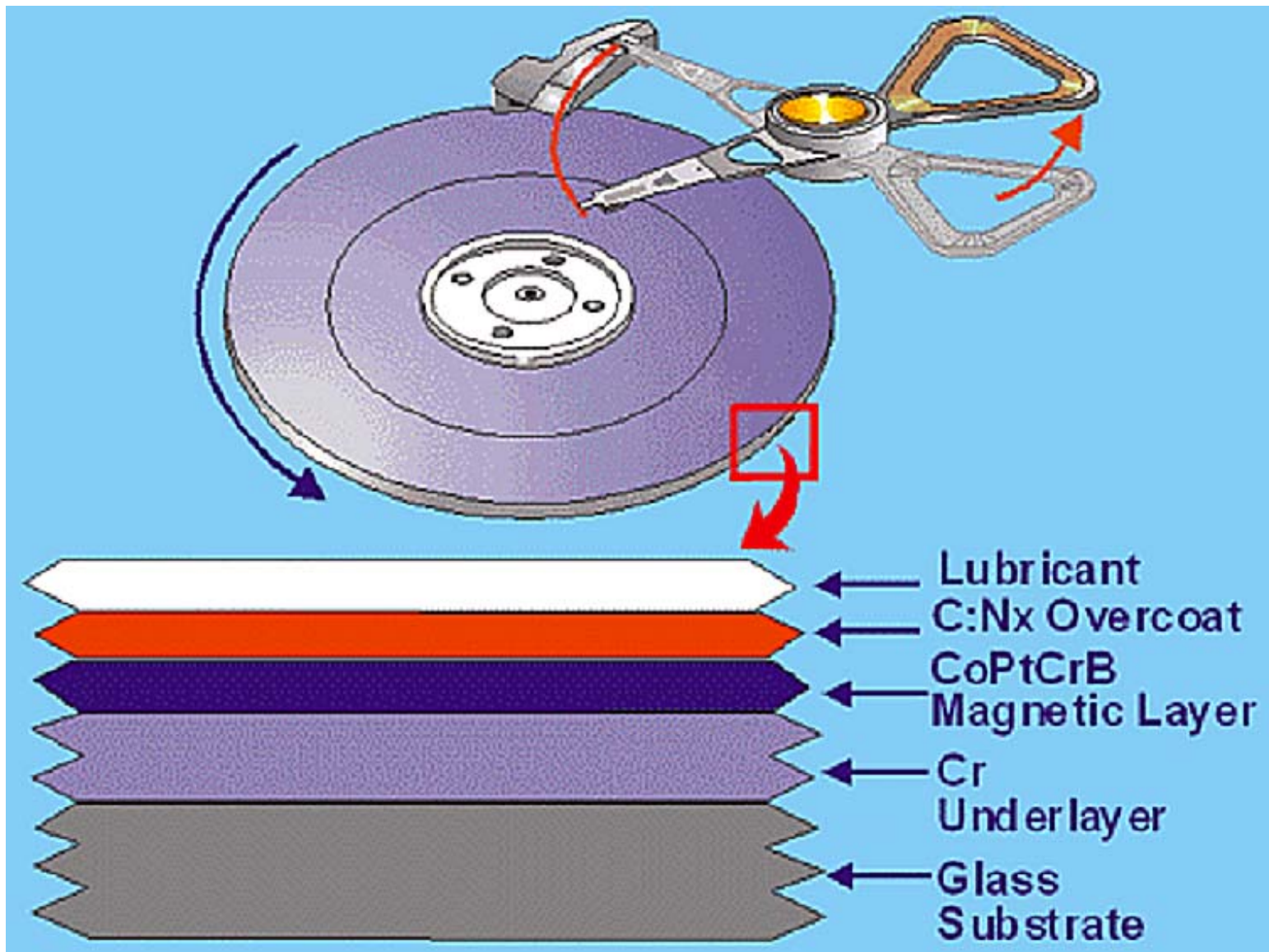


Thank You

Heads and Sliders



Media Complexity



Spindle-Disk Stack Assembly

