Storage - Profound Changes Ahead
THIC, April 22, 1997

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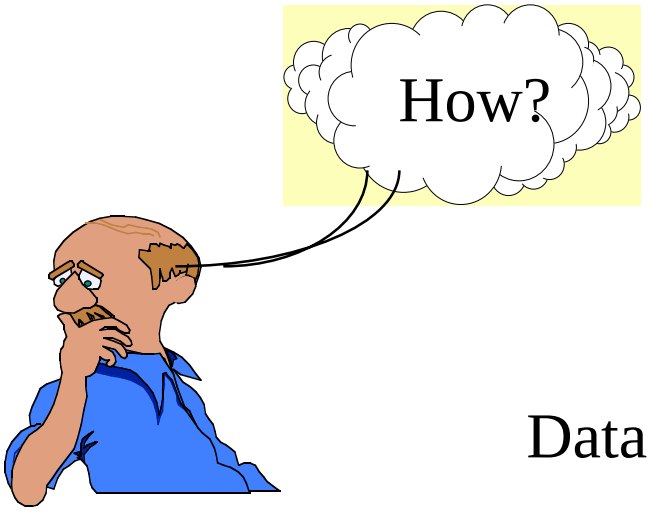
Growth



	1990	1996	2000
Data (PB)	10	150	1000?
Internet Servers*		153K	700K
Intranet Servers*		311K	3,300K+

* Data derived from Zona Research, Inc., 1996

A Petabyte Is . . .

- Very Large
- “One” Followed by 15 Zeros
- 95 Libraries of Congress
- Petapeople Would Fill 14 Billion Stadiums
- Petacard Would Stretch to Three Round Trips to the Sun

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Evolutionary vs. Revolutionary

- Evolutionary - 18 month cycles
- Revolutionary - 180 + month cycles
- Prerequisites to “Emerge”

  Software Support

  Enthusiastic Sponsor

Twelve Month Retrospective

- Denser Magnetic Disk
- 12 GB 12” Optical Disks
- 2.6 GB 5.25 Optical Disks
- DVD
- Quantum’s DLT 7000
- IBM’s MP System
- STK’s RedWood - 50 GB
- Smaller, Faster Libraries
- Subscription Services
- STK - Union Bank Project

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Near Term Future - By 2000
(Three Technologies to Watch)

- Magnetic Disk
- Digital Versatile Disks (DVDs)
- Tape w Record Level Software

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Global Management System

- Images with Data (Unstructured with Structured)
- Indecies and Data
- Active and Archival
- Local and Remote

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Small Magnetic Disk Evolution

	5.25 In	3.5 In	2.5 In	1.8 In	1.0 In
1995	9 GB	4 GB	1 GB	.25 GB	
1996	23 GB	9 GB	3 GB	.5 GB	
1999		32 GB	10 GB	2 GB	1 GB

Source: Gartner Group, April 10, 1996
IBM, October 29, 1996

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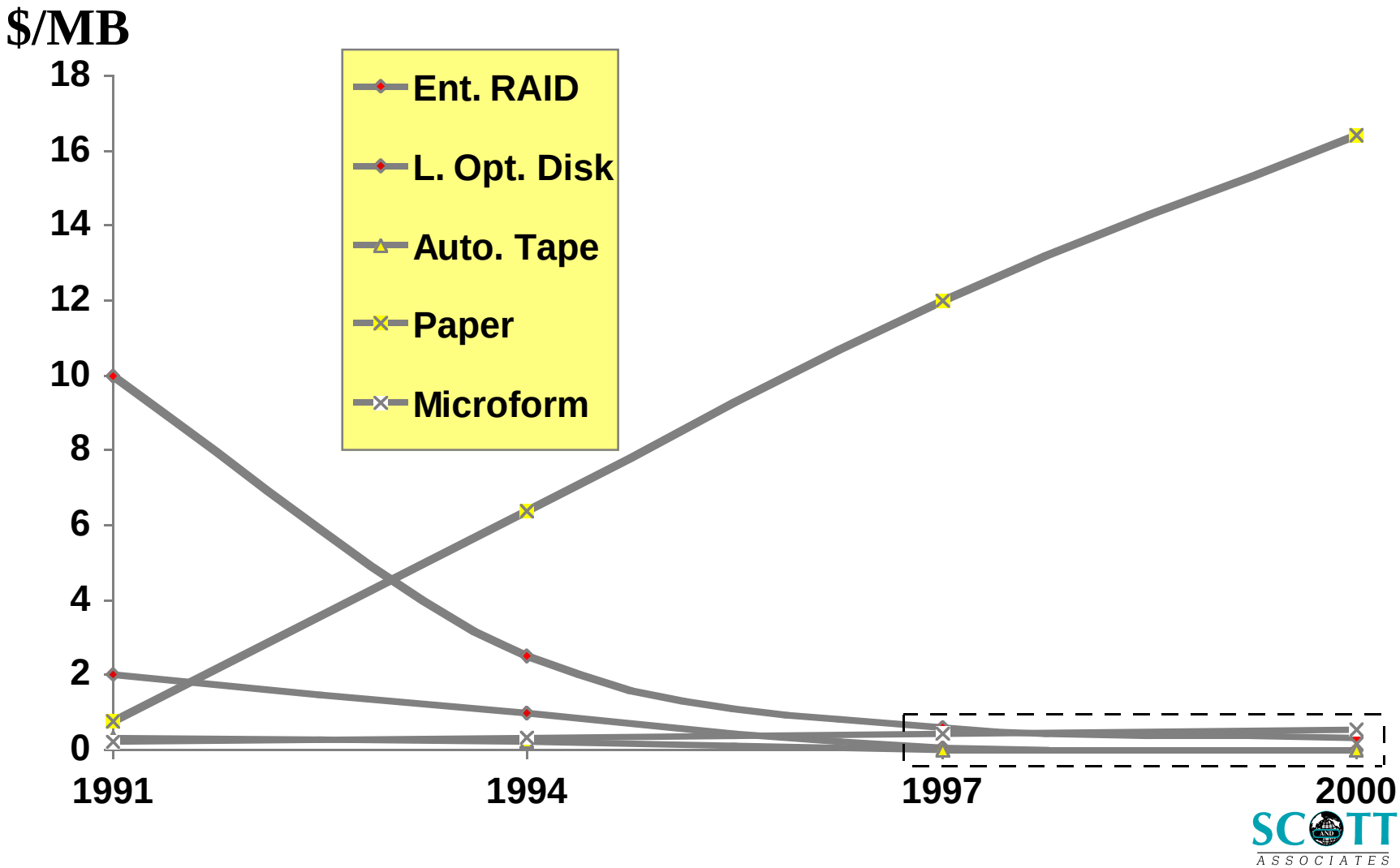
10 Year Price Per Megabyte



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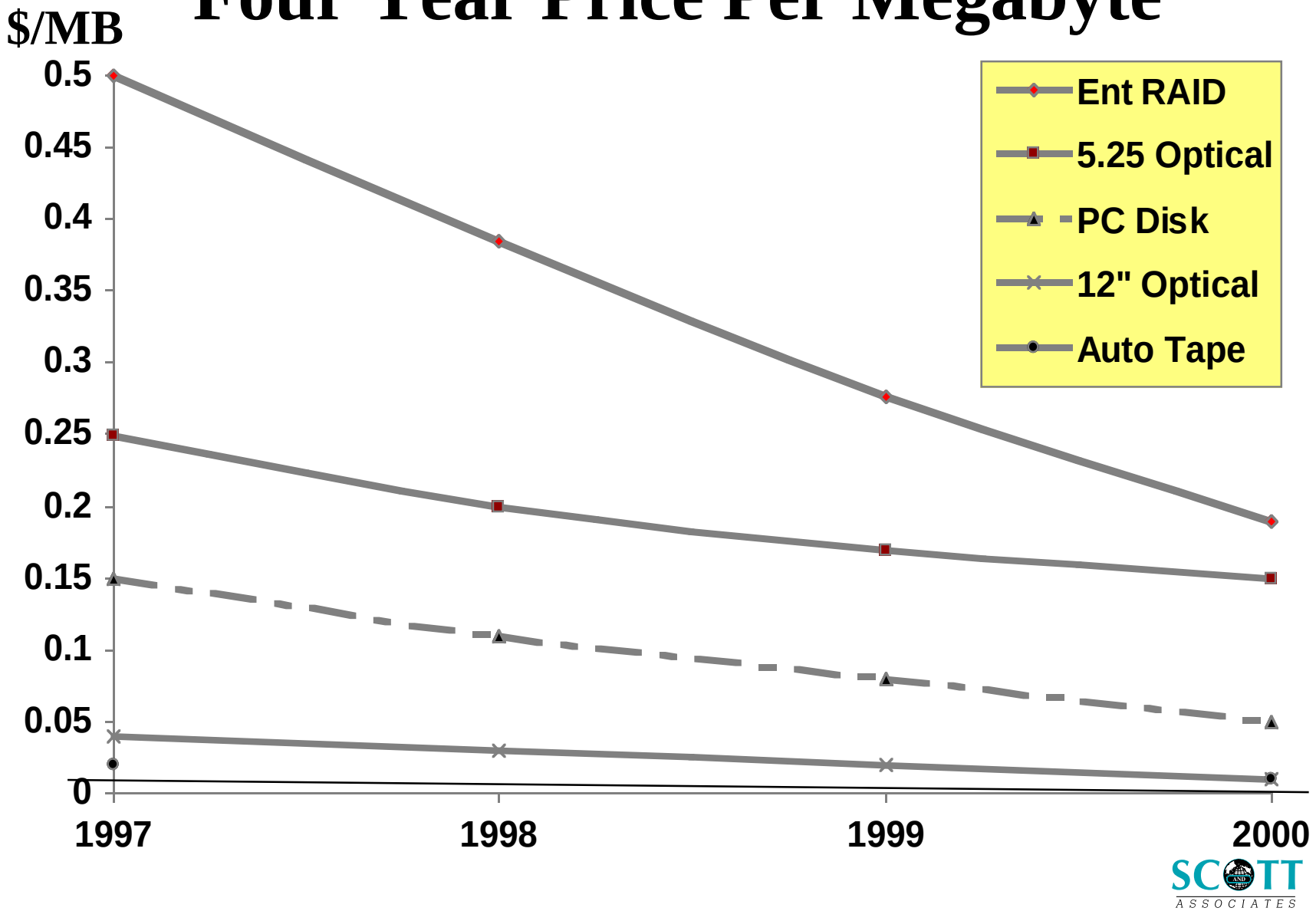
Four Year Price Per Megabyte



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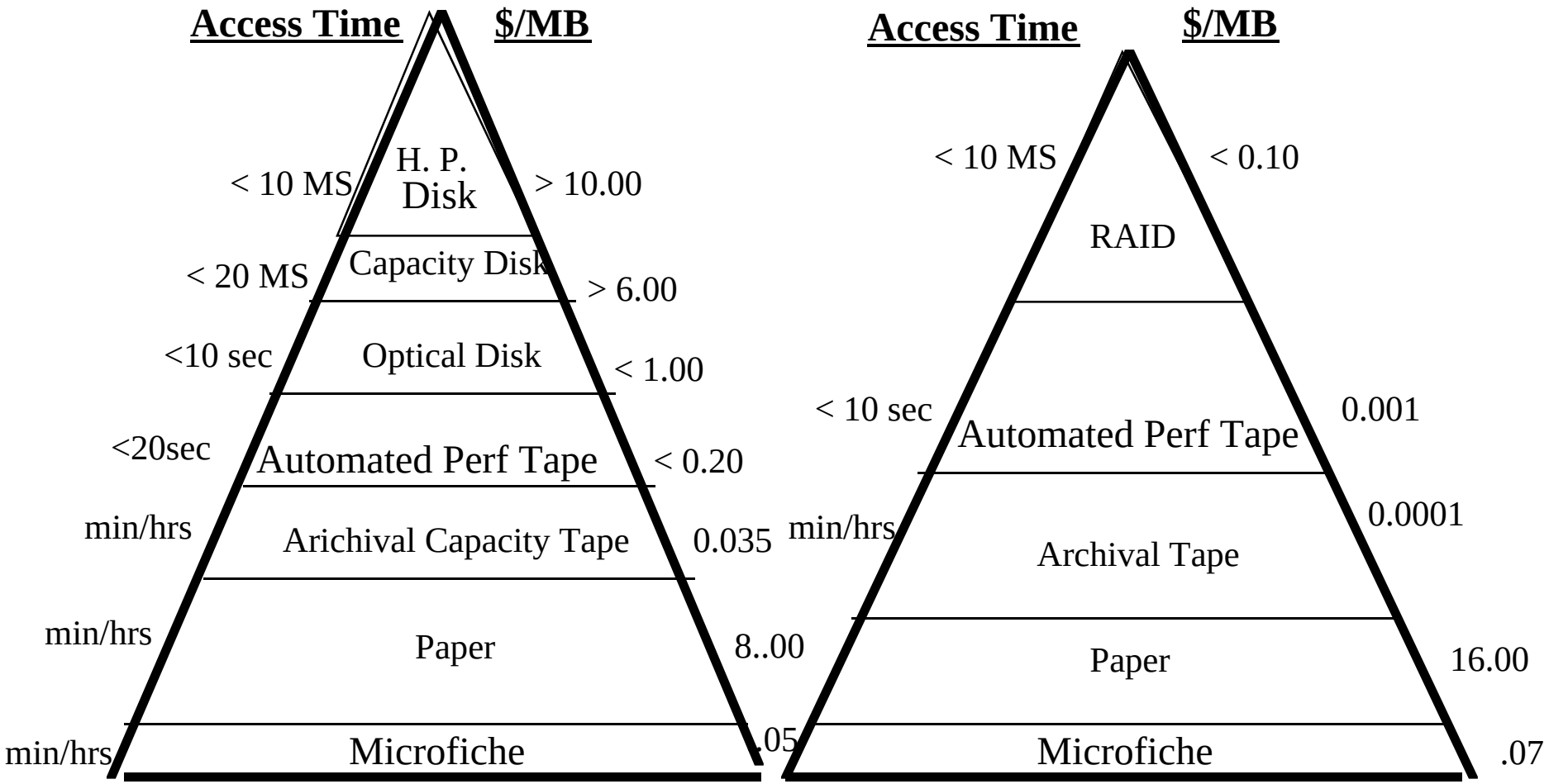
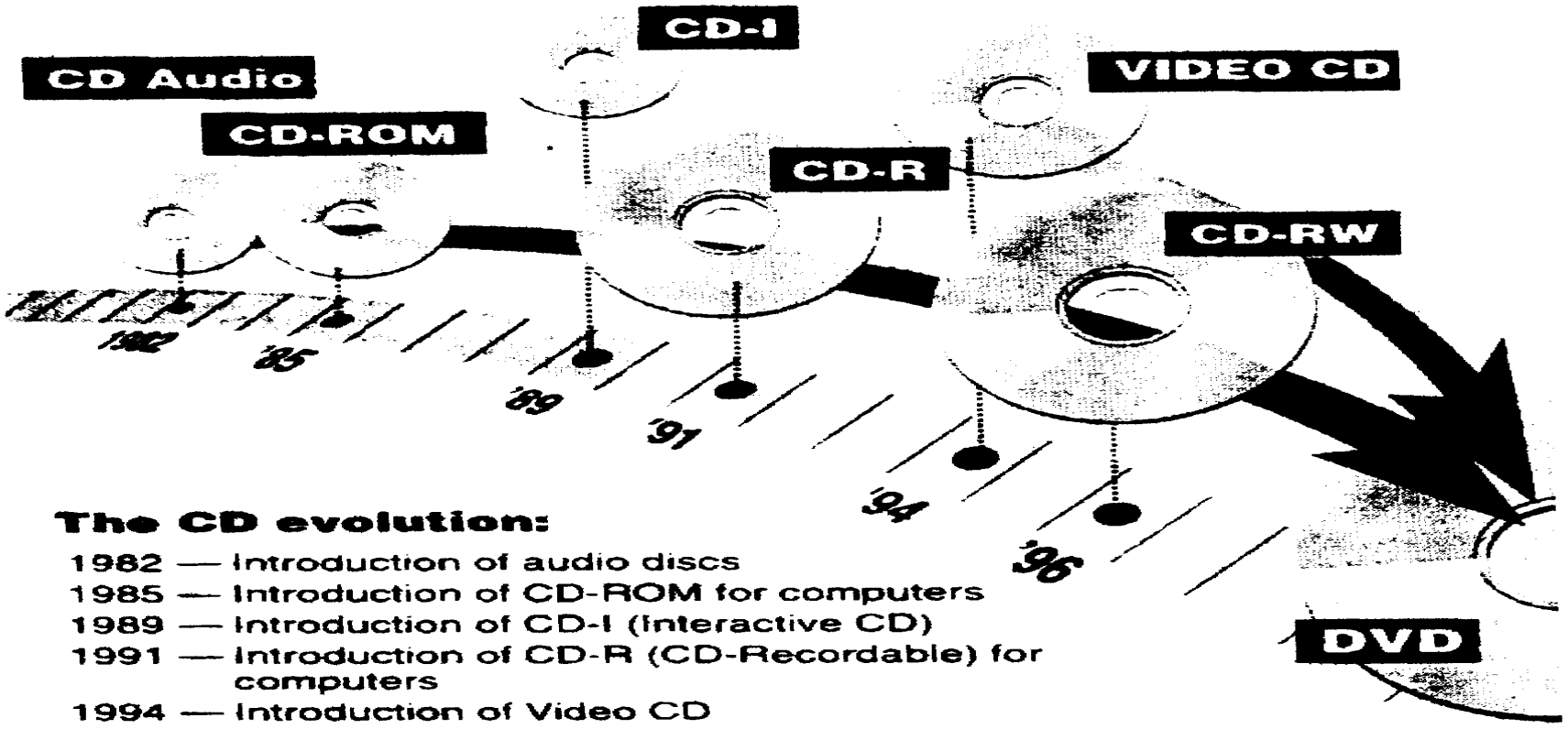
Flatter Hierarchies



Compact Disc technology: Back to the future

ReWritable Compact Disc, or CD-RW is the latest type of CD to emerge from a 15-year evolution of the technology. CD-RW will allow users to erase their discs as well as read and write to them, but with 450 times the capacity (650 Mbytes) of a floppy disc.

Hewlett-Packard, Mitsubishi Chemical, Philips Electronics, Ricoh and Sony are leading the industry charge to make CD-RW available to computer users.



The CD evolution:

1982 — Introduction of audio discs
1985 — Introduction of CD-ROM for computers
1989 — Introduction of CD-I (Interactive CD)
1991 — Introduction of CD-R (CD-Recordable) for computers
1994 — Introduction of Video CD
1996 — Introduction of CD-RW (CD-ReWritable)
More than 100 million CD-ROM drives in use

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Digital Versatile Disks (DVD)

	Compact Disks	DVDs
Reader Price	$300-500	$400-600
Disk Diameter	120 mm	120 mm
Disk Thickness	1.2 mm	1.2 mm
Laser Wavelength	780 nm (infrared)	635/650 nm (red)
Data Layers	1; 1 side	1, 2 or 4 ; 1 or 2 sides
Data Capacity	680MB	4.7, 8.5, 9.4, 17.0GBs
Data Rate	153-176KB/s	1.108MB/s

Source: Dataquest, August, 1996

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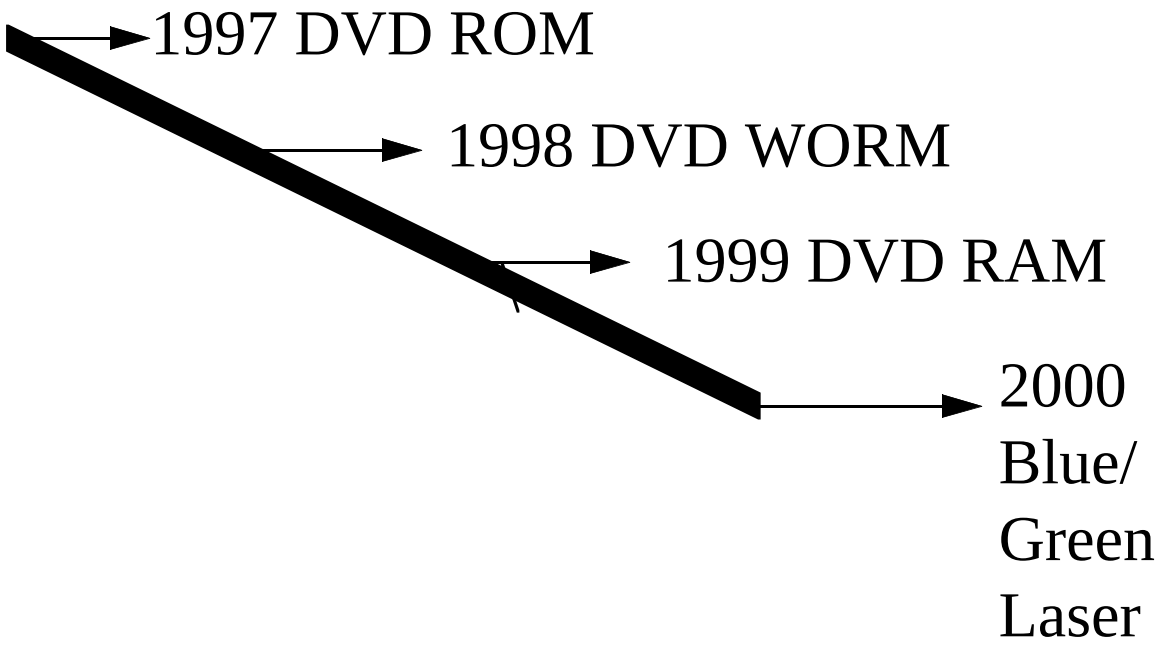
Digital Versatile Disks (DVDs)

Timeline as of August, 1996



Source: Dataquest, August, 1996

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Tape WORMs

- P- WORM: Physical - Write Once, Read Many
- E- WORM: Coded - Write Once, Read Many
- S-WORM: Software - Write Once, Read Many

Source: Dick Fisher, Cohasset Associates

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Tape in Year 2000 for Servers

Magnetic Recording

- 100 GB in Cartridge* (2 million pages)
- 20+ MB/s Transfer
- < 30 Sec. Aver. Acc.
- $30K Purchase R/W
- $30 per cartridge
- 3+ Year Warranty
- E WORM
- Library Enabled
- Record Level Indexed

* Uncompressed

Optical Recording

- 0.2 / 1 TB in Cartridge* (4 - 10 million pages)
- 12 / 100 MB/s Transfer
- < 50 Sec. Aver. Acc.
- $ 50K Purchase R/W
- < $35 per cartridge
- 3+ Year Warranty
- P WORM
- Library Enabled
- Record Level Indexed

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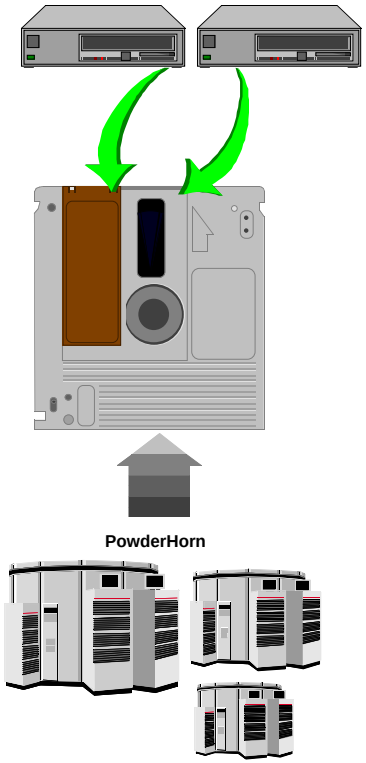
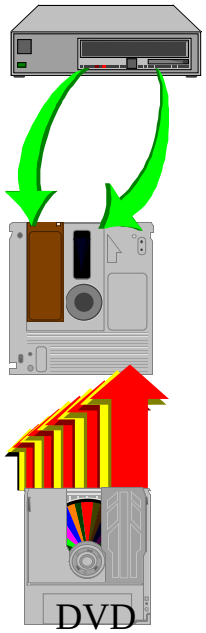
Optical Disk Technology in Transition

- **Large Form Factor**



- **Small Form Factor**



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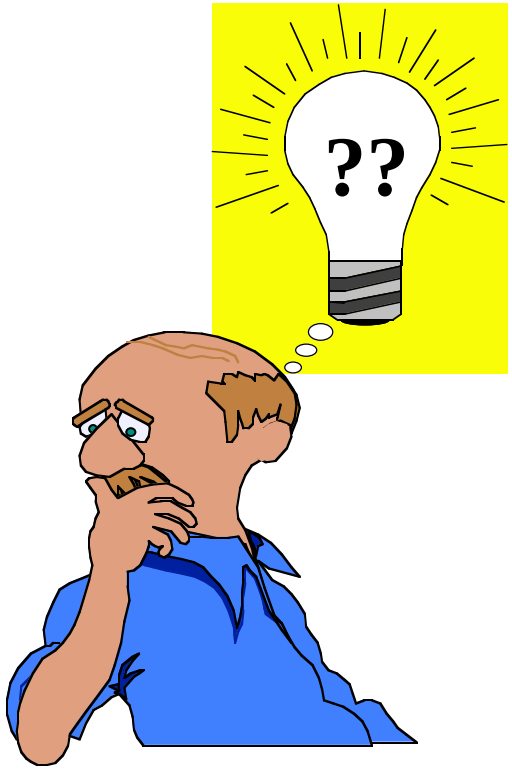
Subscription Storage Services

- Storage Utility - you pay for capacity, time, access and management
- Eight Vendors Now + One in Development
- Support Variety of Platforms
- Media = Optical, RAID and Automated Tape
- **Use Caution**

Beyondo

- Accuracy of Projection Falls Exponentially w Time
  - 3 Years = 70%
  - 4 Years = 50%
  - 6 Years = 30%
- Good Visibility to 2000
- Conjecture Beyond 2000



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AdTech - Holographic Memory

- HDDS Consortium: ARPA, Carniegie-Mellon, GTE, IBM, Kodak, Optitek, Rochester Photonics, Rockwell, Stanford University, U of Arizona, U of Dayton
- Dates back to 1963; P. van Heerden at Polaroid
- Recent technology improvements
  - photorefractive crystals
  - spatial light modulation
  - others
- Stores 100s of billions of bytes; transfers at 100-300 MB/s; accesses in microseconds; non volatile
- Introduction this decade for specialized applications, commercialization next decade to replace disks

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A Word About Legality

- Fast growth for electronic records; slow growth for analog records

- Law is becoming technology neutral
  - SEC; 17 CFR part 240 (Brkr/Dealer) released 2/5/97
  - IRS Notice 96-9 still under revision
  - States generally technology non specific

- *Seek qualified* expert advice

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CIO Concerns

- Generating New Revenues (89%)*
- Increasing Competitiveness (88%)
- Improving Customer Service (83%)
- Reducing Time to Market (81%)
- Improving Quality (76%)
- Lowering Costs (72%)
- Managing Growth (1996-97)
  - 35% growth in servers
  - 52% growth in information storage capacity

* Second annual survey of I.T. executives by Find/SVP, New York City. 700 respondents worldwide.

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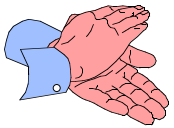
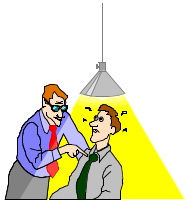
Additional Concerns

- Access Security
- Managing Electronic Records

Thank you!



Finish!



Questions ???

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