

MicroContinuum, Inc.

TERABYTE & PETABYTE STORAGE REQUIREMENTS AND CAPABILITIES

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“Storage is becoming much more strategic as a component in the IT environment. The notion of protecting the integrity of the data and being able to manipulate it is crucial because many companies’ corporate assets are riding on how storage is managed.”

(Peter Gibbs, director of marketing for Data General's Clariion storage product line)

"Storage is now the focal point of IT purchases.”

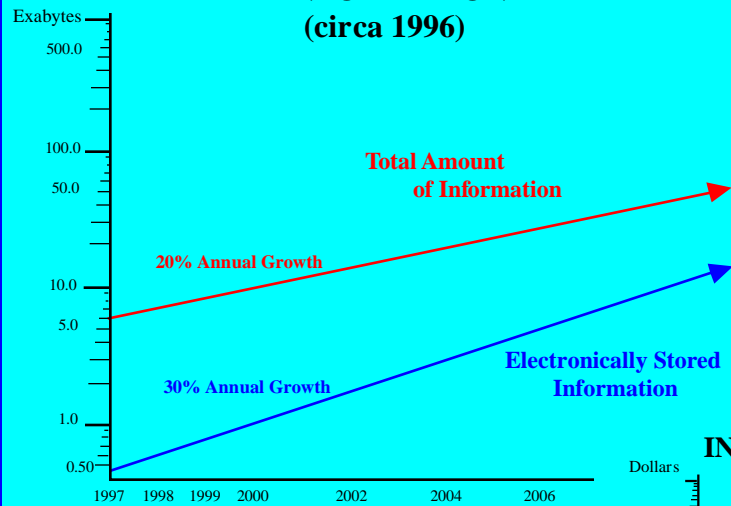
(Mark Matson, acting general manager and vice president of the new HP Storage Organization.)

“Storage is a key area that will account for 75 percent of new corporate hardware spending.”

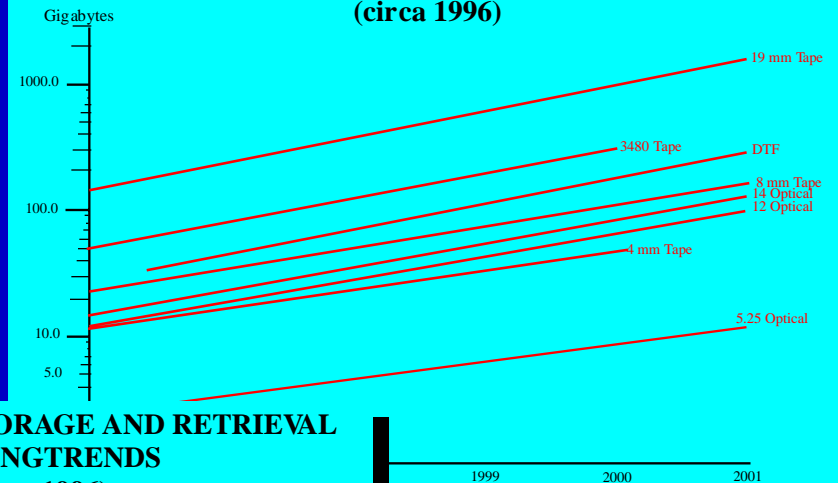
(Lou Gerstner, IBM chief executive, May 18, 2000 (CNET))

Balanced Requirements, Costs and Capabilities

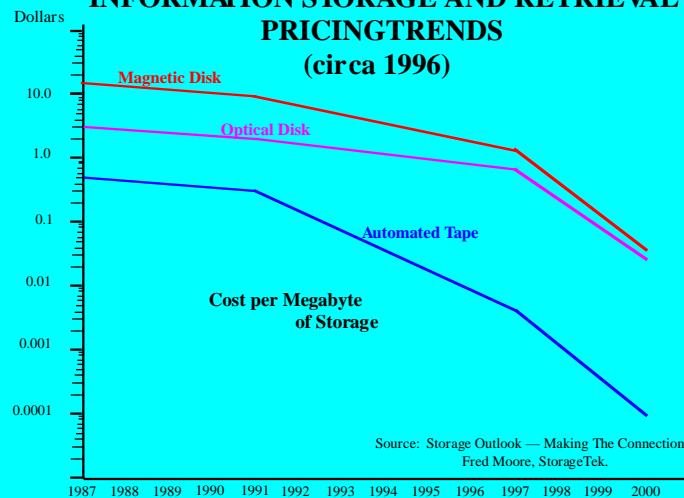
GROWTH OF ELECTRONICALLY STORED INFORMATION (circa 1996)



UNIT STORAGE CAPACITY (circa 1996)

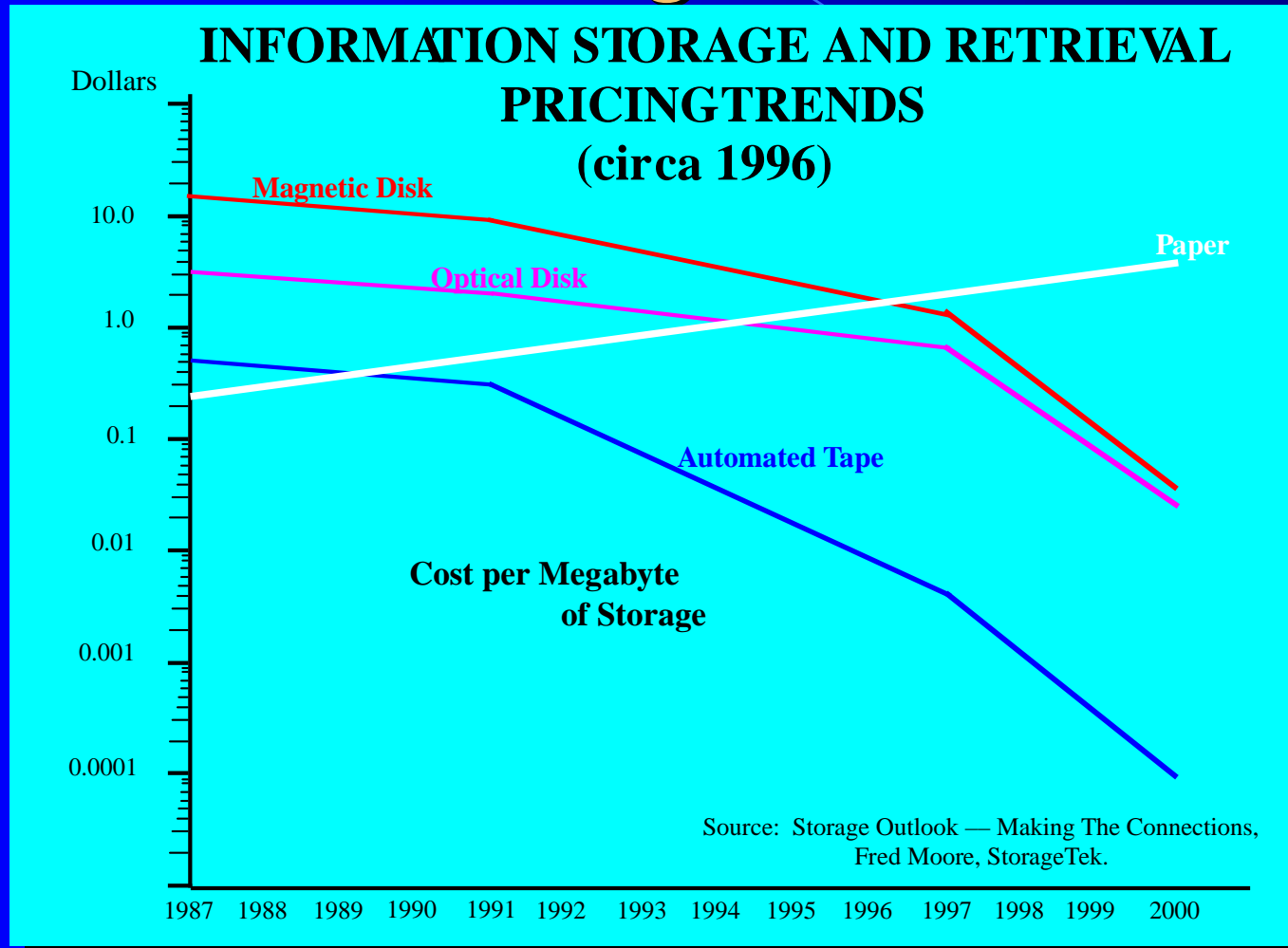


INFORMATION STORAGE AND RETRIEVAL PRICING TRENDS (circa 1996)



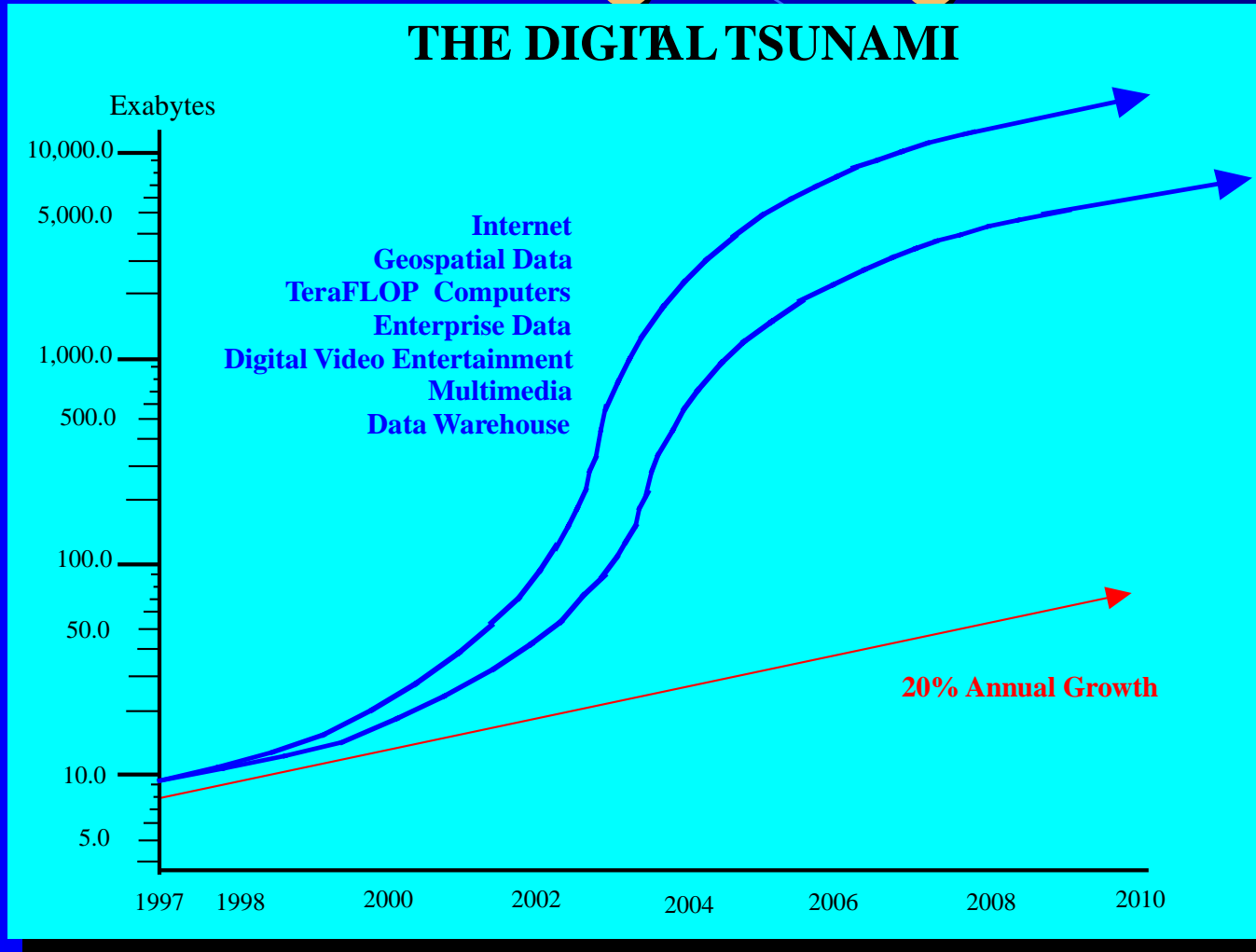
Source: Storage Outlook — Making The Connections, Fred Moore, StorageTek.

Paradigm Shift



From the Information Age into the Digital Age

The Digital Age



The Internet

- E-brokerages have attracted 12 million investors in less than five years.
- Business-to-business e-commerce will generate \$7.3 trillion in sales transactions worldwide in 2004. (Gartner Group)
- Business-to-business sites are exploding, growing 99 percent a year.
- "In five years' time, all companies will be Internet companies, or they won't be companies at all." (Andy Grove, chairman of Intel)
- By the year 2001, 35 percent of business documents – that's 21 million missives per day – will move across the Internet. (Aberdeen Group)
- By 2002, it is estimated that there will be more than 300 million users on the Internet driving at least 2 PB of traffic per month (500 TB volume in 1999).
- 55 million surfers shop on-line and more than half of them are buying.
- The Internet storage requirement is between 1 and 10 TB. (EE Times, 1996)

E-Brokerages

- On-line trading accounts represent 12.5% of all accounts, that proportion is expected to increase to 29.2% of the projected 227 million securities transactions by 2002 -- a **53% annual increase**. (Fortune, October 1999)
- The number of accounts will more than quadruple by 2002, to more than 18 million. \$1.5 trillion invested in the bond market (Forrester Research)
- In 1999, 300,000 401(k)-plan participants accessed on-line advice services. By 2000, that number will reach 9.6 million and swell to 32 million over the next five years -- a **27% annual increase** (\$2 trillion invested) (TowerGroup)
- The number of investors who use on-line advice services to research more than 15,500 securities will soar from 1.7 million in 1999 to 13.7 million over the next five years -- a **52% annual increase**. (TowerGroup)
- Millions of daily transactions between brokerages, clearing houses, mutual funds and investment banks.

Business-to-Business

- Business-to-business on-line commerce could be a \$1-trillion to \$2-trillion business by the year 2002. (John Chambers, CEO of Cisco Systems)
- B2B e-commerce will generate \$7.3 trillion in sales transactions in a \$105 trillion market worldwide by 2004 up from \$145 billion in 1999 -- a **119% annual increase**. (GartnerGroup)
- There were about 130 B2B sites in 1999. That number will jump to 3,250 by the end of the year and balloon to 32,500 by 2001 -- a **1450% annual increase**. (GartnerGroup)
- "In five years' time, all companies will be Internet companies, or they won't be companies at all." (Andy Grove, chairman of Intel)

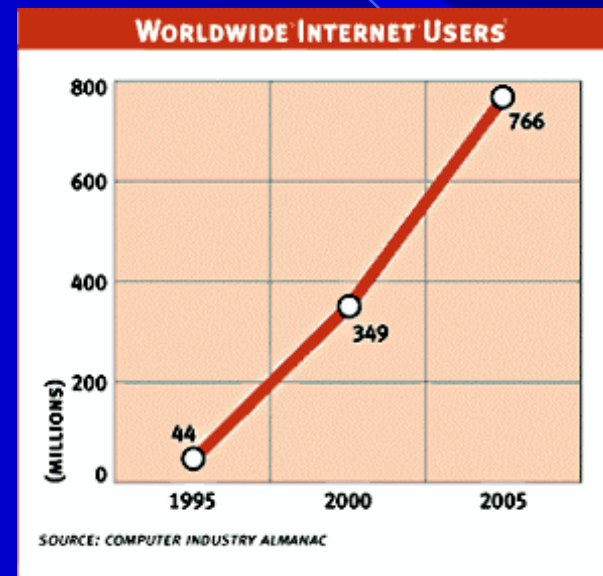
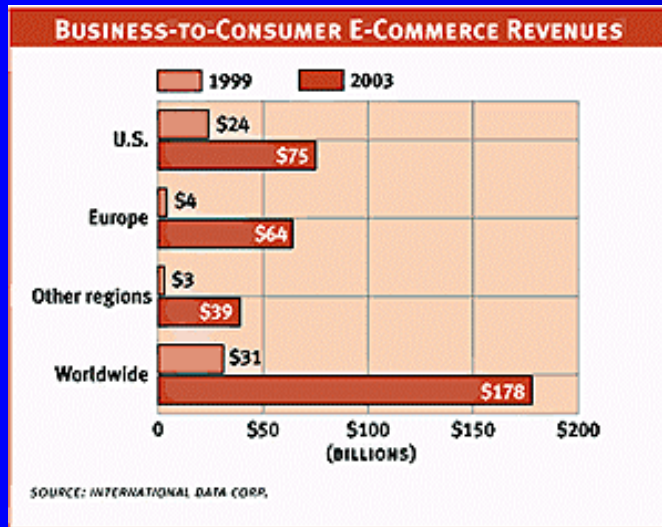


Business-to-Business Sales

- On average, B2B sites will save participants anywhere from 18 percent to 45 percent through quicker ordering of supplies, speedier delivery of goods, fewer errors, better information and more opportunities to find the lowest-priced products and services. (Forrester Research)
- The high-tech marketplace has the potential to be larger than any other Internet trading community, citing an analyst estimate that the electronics market would be worth \$600 billion in 2004. (HP chief executive Carly Fiorina in 1 May, 2000 AP Business Wire)
- The business of establishing e-commerce capabilities will be a \$2.71 trillion market by the year 2004. (GartnerGroup)

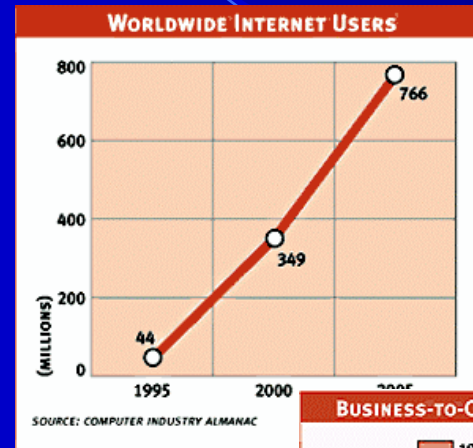
BUSINESS TO BUSINESS INDUSTRY/SUPPLIERS	ON-LINE REVENUE (\$s Billions)					
	1998	1999	2000	2001	2002	2003
Aerospace and Defense	\$2.5	\$5.5	\$14.8	\$25.6	\$34.0	\$38.2
Computing and Electronics	\$19.7	\$50.4	\$121.4	\$229.1	\$319.1	\$395.3
Construction	\$0.4	\$1.6	\$3.4	\$8.0	\$14.2	\$28.6
Consumer Goods	\$1.4	\$2.8	\$6.1	\$12.7	\$23.0	\$51.9
Food and Agriculture	\$0.3	\$3.0	\$6.3	\$13.1	\$26.5	\$53.6
Heavy Industries	\$0.1	\$1.3	\$2.5	\$4.7	\$8.7	\$15.8
Industrial Equipment	\$0.1	\$1.3	\$2.4	\$4.5	\$8.5	\$15.8
Motor Vehicles	\$3.7	\$9.3	\$22.7	\$53.2	\$114.3	\$212.9
Paper and Office Products	\$1.3	\$2.9	\$5.4	\$14.3	\$31.1	\$55.2
Petrochemicals	\$4.7	\$10.3	\$22.6	\$48.0	\$96.8	\$178.3
Pharmaceuticals and Medical Supplies	\$0.5	\$1.4	\$3.5	\$8.5	\$20.0	\$44.1
Shipping and Warehousing	\$1.2	\$2.9	\$6.8	\$15.4	\$32.7	\$51.6
Utilities	\$7.1	\$15.4	\$32.2	\$52.9	\$110.6	\$169.5
Source: Forrester Research						

Business-to-Consumer



Expanding Markets

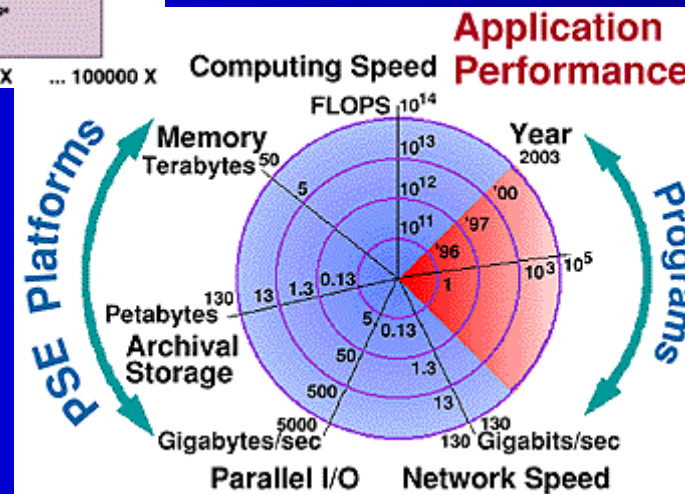
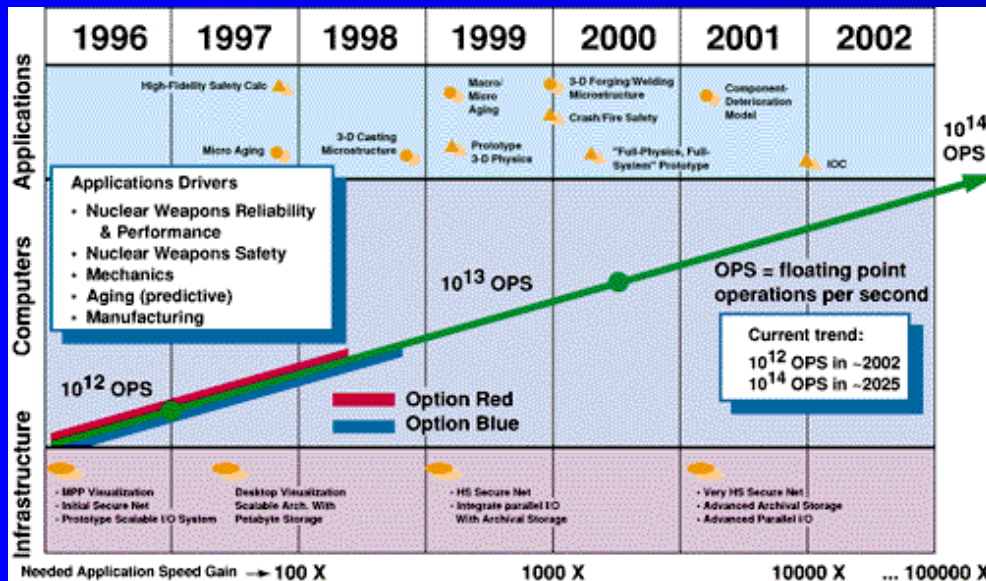
- Data storage equipment leader EMC Corp. unveiled a new program to sell customized storage equipment, software and services to Internet service providers and companies that manage the networks and computers of Web-based businesses. The company said it would allocate \$1 billion dollars in research and development, staff and other resources over an unspecified multiyear period to place EMC systems in the data centers that house the back office operations of Web sites. (5/24/00 NYSE:EMC - news)



Geospatial Data

- Radio astronomy data collection -- typically 1 Gbps continuously for 24 hours at 10 stations (**110 TB/day**) repeated several times a month. (Alan Whitney, MIT Haystack Observatory)
- NOAA manages some 1300 data bases, containing over 2400 environmental variables, totaling 535,000 tapes, 375,000,000 film records and 140,000,000 paper records. This amounts to **600 TB of data**, growing at 20 percent per year. (Robert Winokur, Assistant for Satellite Services, 1998)
- Shuttle Radar Topography Mission to provide accuracy to ~ 20-m horizontal and 16-m vertical over most of populated land mass requires **11.5 TB**. (Earl White, Manager Space Shuttle Integration at Military Space Conference, 1999)
- Discover II, SAR (Synthetic Aperture Radar) goal to map planet to 1 meter 3D resolution by '02 - '03. [Equates to **76,800 TB**.] (Tom Tillotson, NRO Acting Program Manager at Military Space Conference, 1999)

TeraFLOP Computers

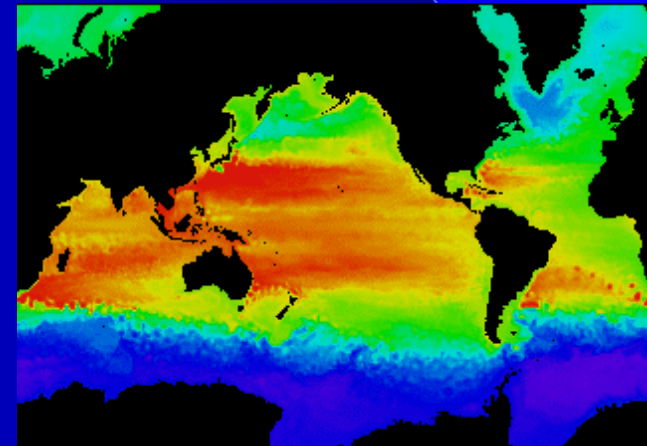
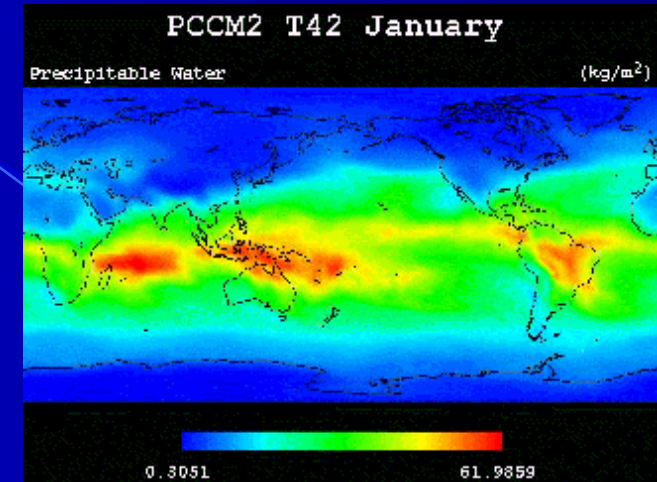


TeraFLOP Computers

- IBM plans to spend \$100 million to build “Blue Gene” a PetaFLOP machine by 2005.
- Analysts who develop the Top 500 Supercomputer list predict that by 2004 only TeraFLOP machines will be on the list.
 - The peak execution rate at which data is produced is 300 MB per TeraFLOP. (Dr. Reagan Moore)
 - Assuming the sustained data production rate is 20 MB per TeraFLOP, the Top 500 Supercomputers will generate between 10 and 100 Exabytes of storage per year by 2004.
- In 2010 nearly every organization will have its own PetaFLOP supercomputer. (Gordon Bell -- senior researcher in Microsoft's Telepresence Research Group)

NCAR

- National Center for Atmospheric Research stored 196 TB on 162,000 tape cartridges as of July 1999 and 250 TB by March 2000 -- a **44.6% annual increase**.
- 8,600 of the tapes are in robots.
- Migrate data once every three years. Next migration is Spring of 2000.
- 5 TB/month Net Growth -- with 25 TB/month data read/written and 25 TB/month data migrated.
- By end FY05 projected growth is: 1,000 GigaFLOPS with 5,700TB Total Storage of 165×10^6 files -- a **2,800% increase**. (Gene Harano -- NCAR)



Enterprise Data

- In the survey of 250 IT executives from 500 companies, more than eight in 10 said relational databases and data warehouses were among their strategic technology priorities for the coming year. (InformationWeek)
- The market for CRM (customer relationship management) solutions is expected to grow to more than \$11.5 billion in 2002. (AMR Research, Inc.)
- NT servers today are generating 44 TB of business-critical data on a daily basis. That data generation rate is predicted to swell to 538 TB per day by the year 2002 -- a **374% increase**. (International Data Corporation)
- The entry- and workgroup-level NAS appliance market alone will grow to almost \$2.5 billion by 2002. (Dataquest)

Unit costs for data storage products are dropping.
The cost of a gigabyte of storage has dropped
25 percent since the beginning of 1999.
(Forrester Research Inc.)

The Gartner Group puts the drop between 30 and
40 percent annually for the past five years.

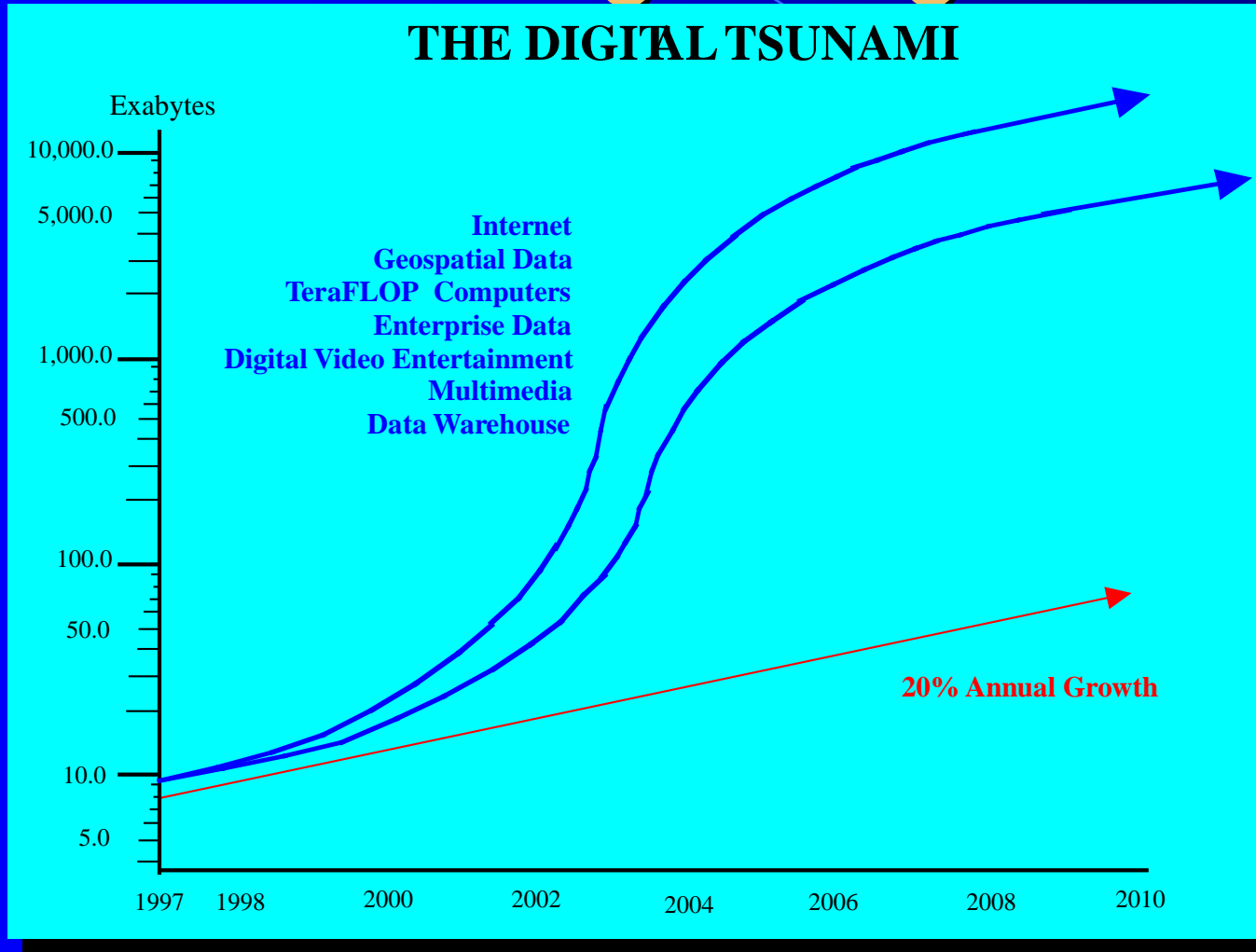
But the amount of data is growing faster than costs
are dropping, so total storage expenditures are
increasing rapidly.

Forrester expects storage spending to grow from 4
percent of IT budgets this year ('99) to 17
percent by 2003 -- a **325% increase**.

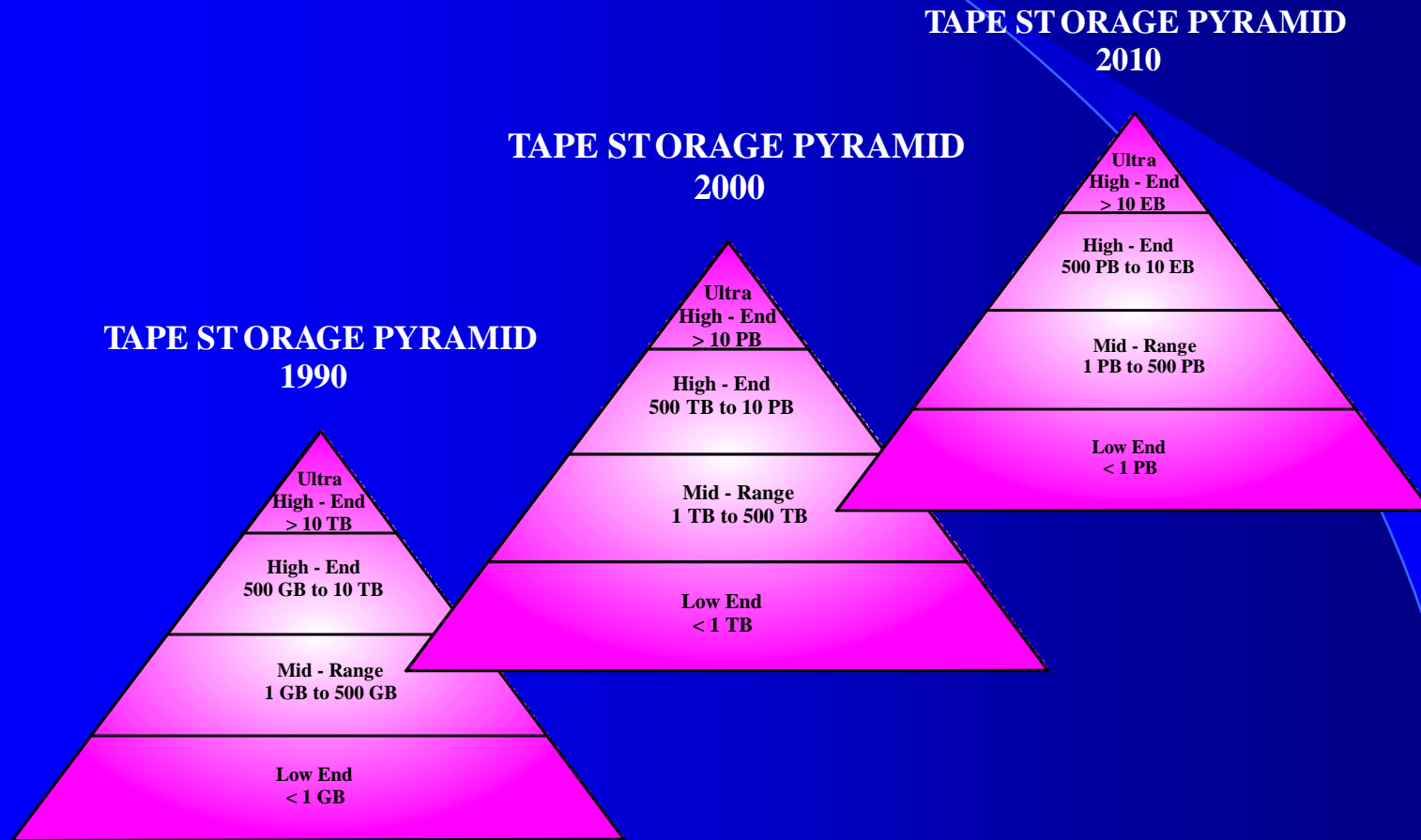
Do the Math -- By 2003

- Decreasing storage costs:
 - 25% per annum decrease in storage costs means that by 2003, a 1999 budget will buy 2.44 times more storage.
 - 40% per annum decrease in cost will buy 3.84 times more storage.
- Increasing budget requirements:
 - 17% budget requirement in 2003 is 4.25 times the 1999 budget.
- Total storage requirement growth from 1999 to 2003:
 - 10 times to
 - 16 times.

The Digital Age

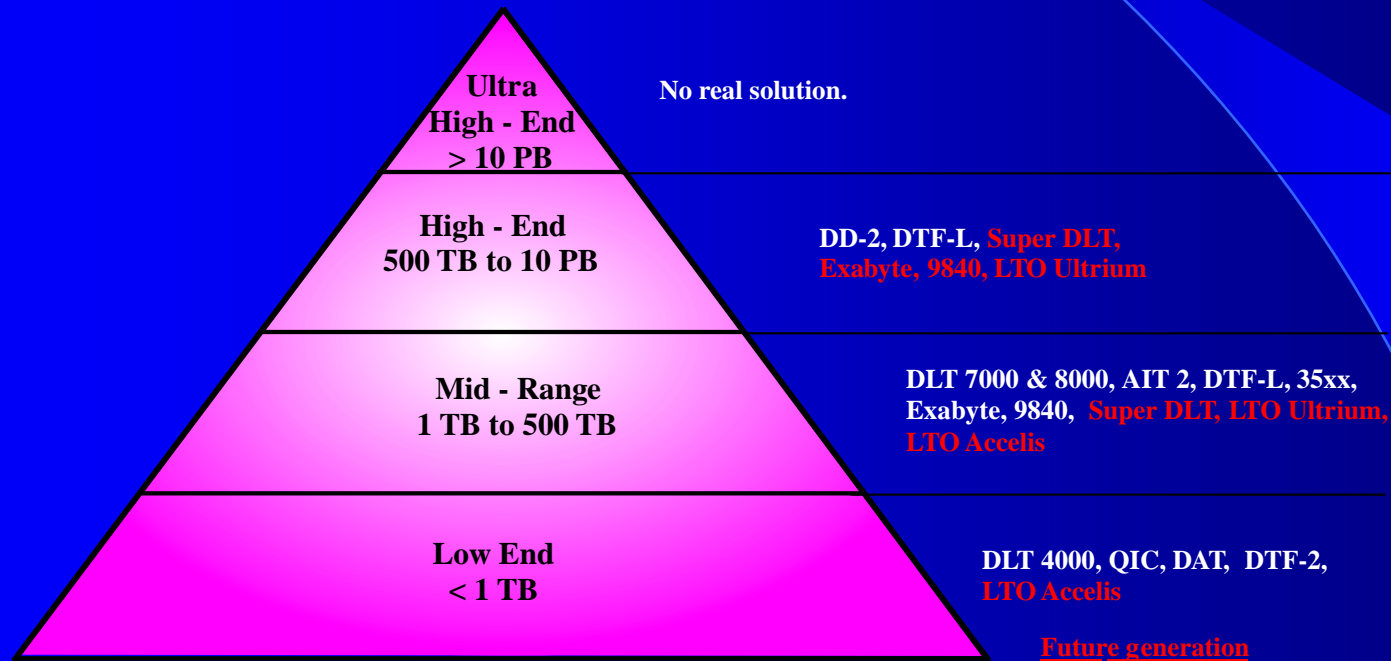


Tape Storage Migration



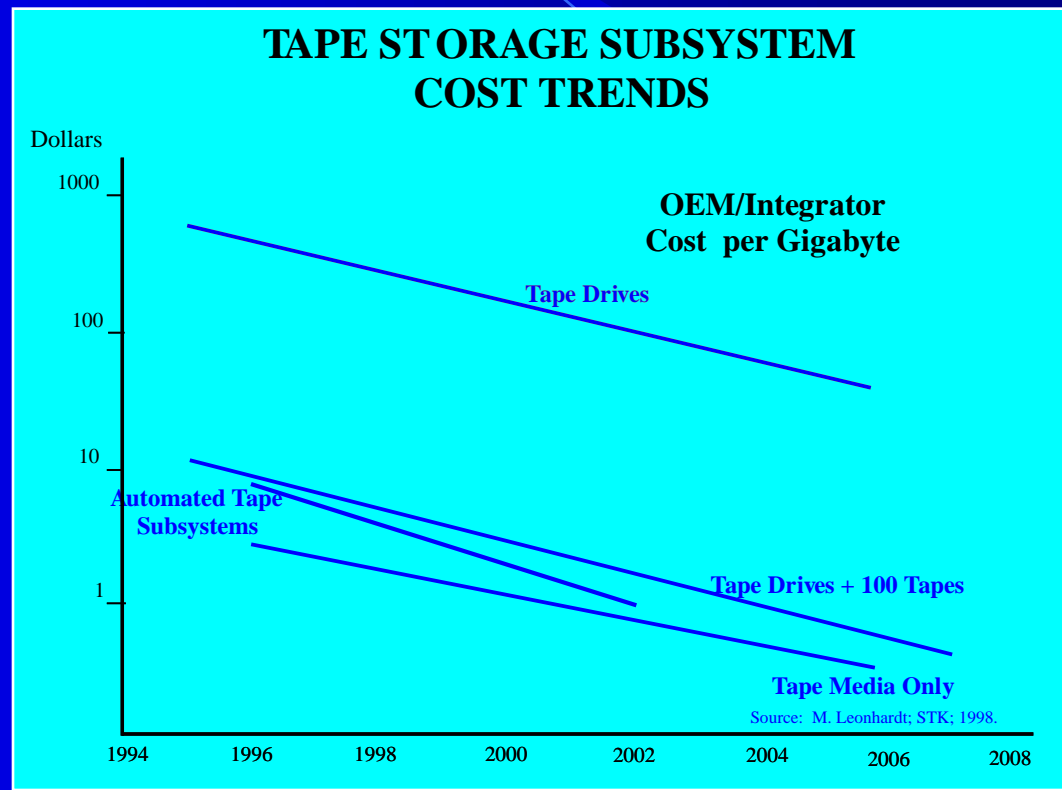
Tape Storage Solutions

TAPE STORAGE PYRAMID 2000

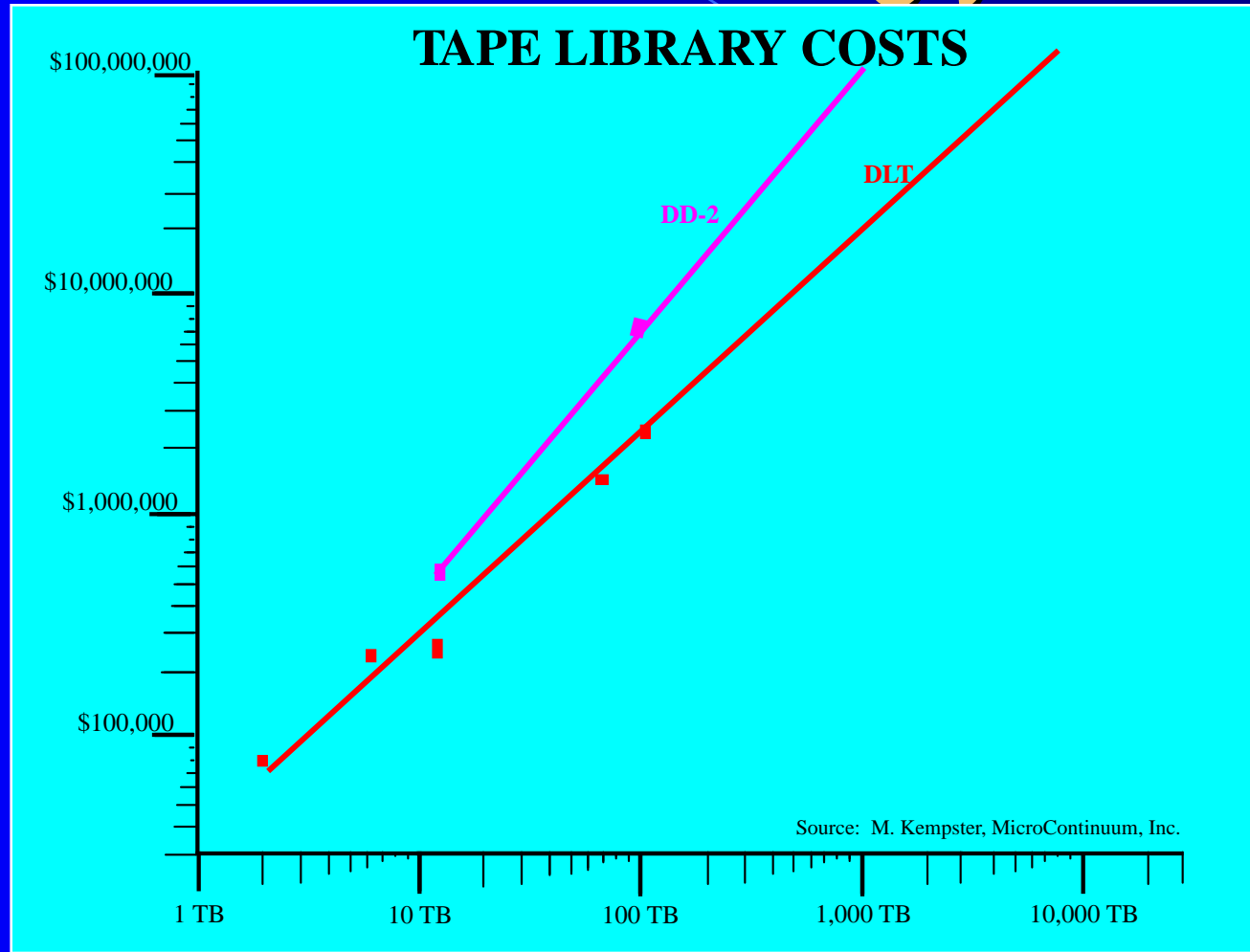


The Good -- The Bad . . .

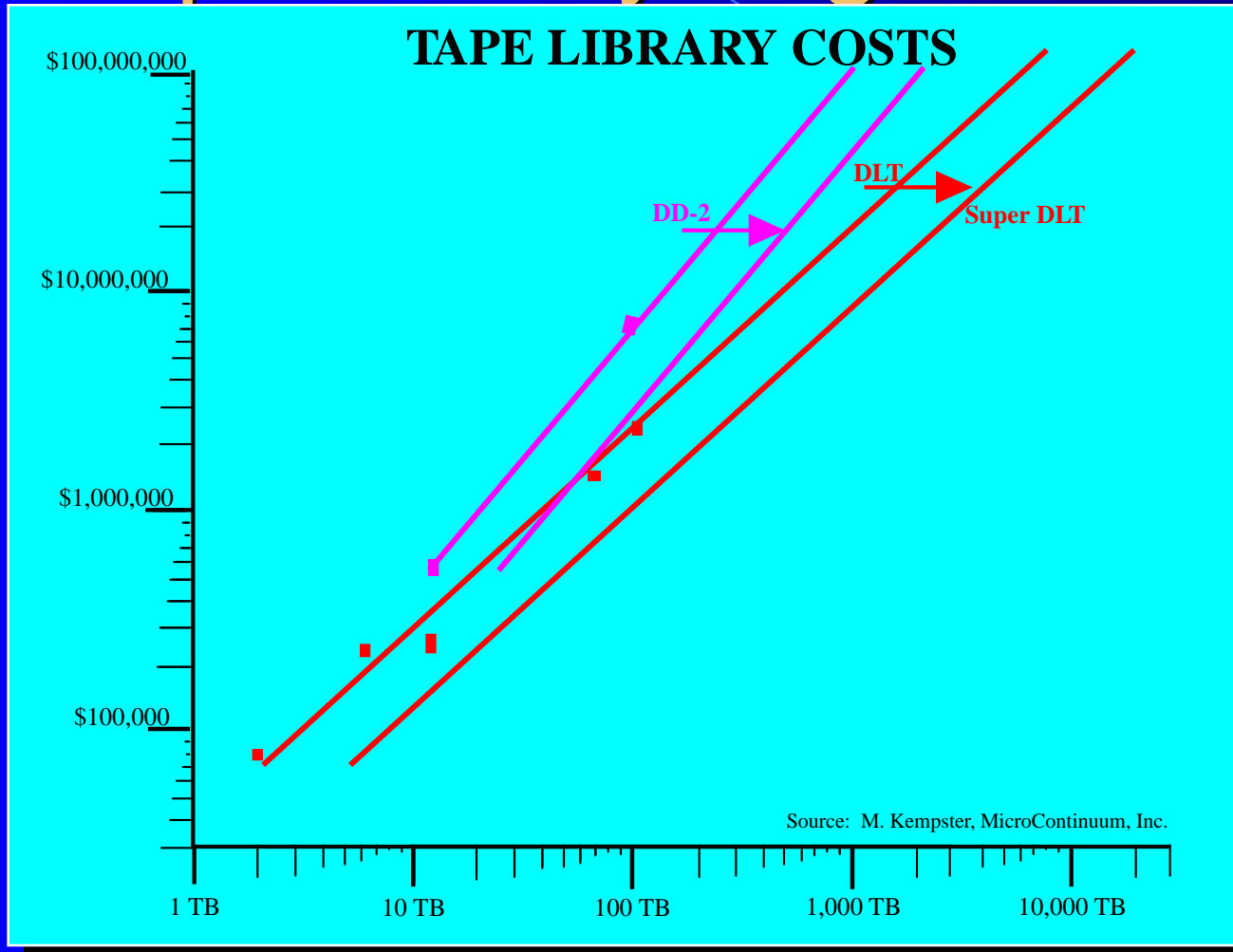
- There is some good news amid the data deluge. Unit costs for data storage products are dropping. The cost of a gigabyte of storage has dropped 25 percent since the beginning of 1999, according to Forrester Research Inc., a market research company in Cambridge, Mass.
- But the amount of data is growing faster than costs are dropping, so total storage expenditures are increasing rapidly. Forrester expects storage spending to grow from 4 percent of IT budgets this year to 17 percent by 2003.



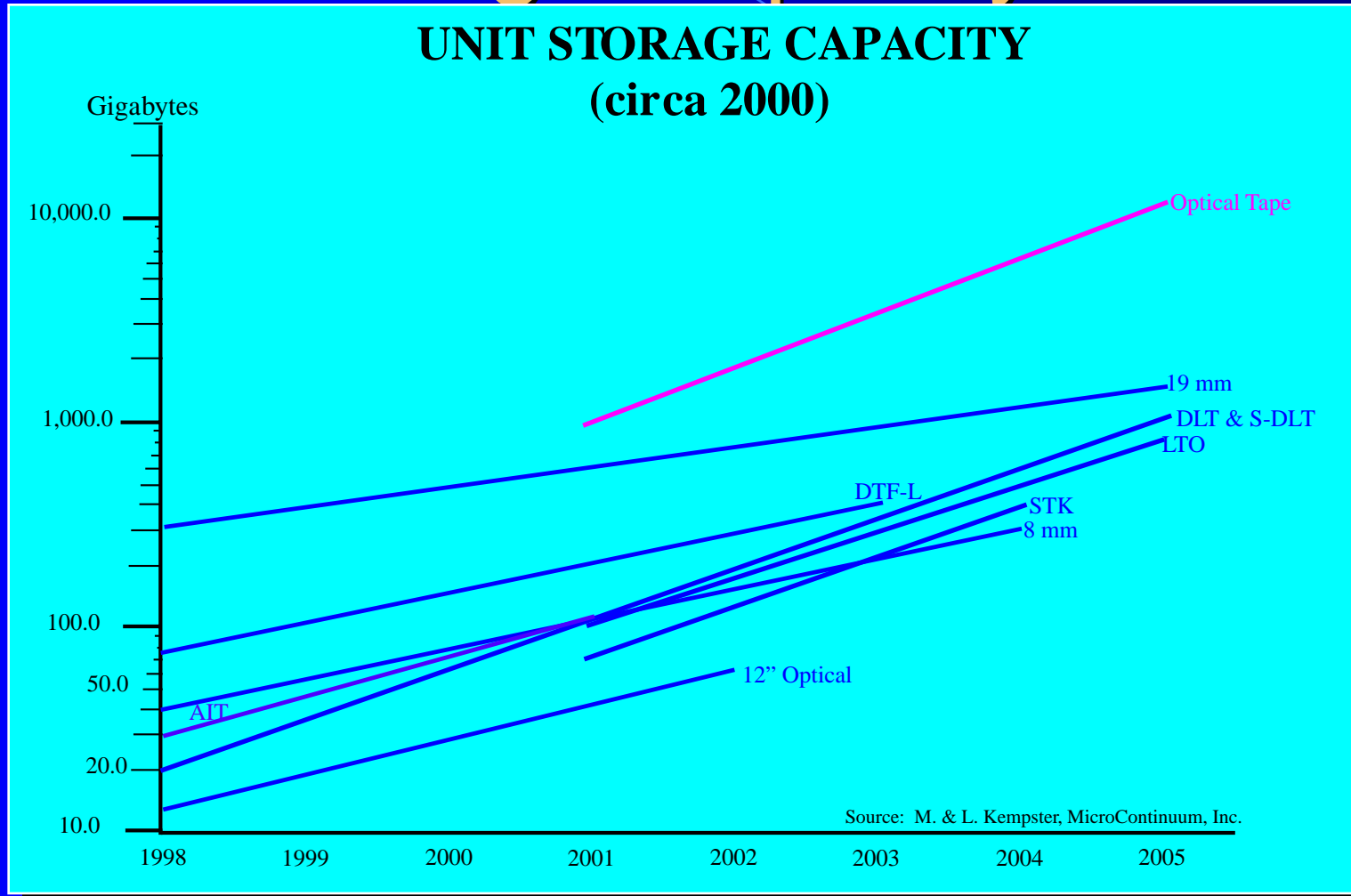
... and The Ugly



Tape Library Migration

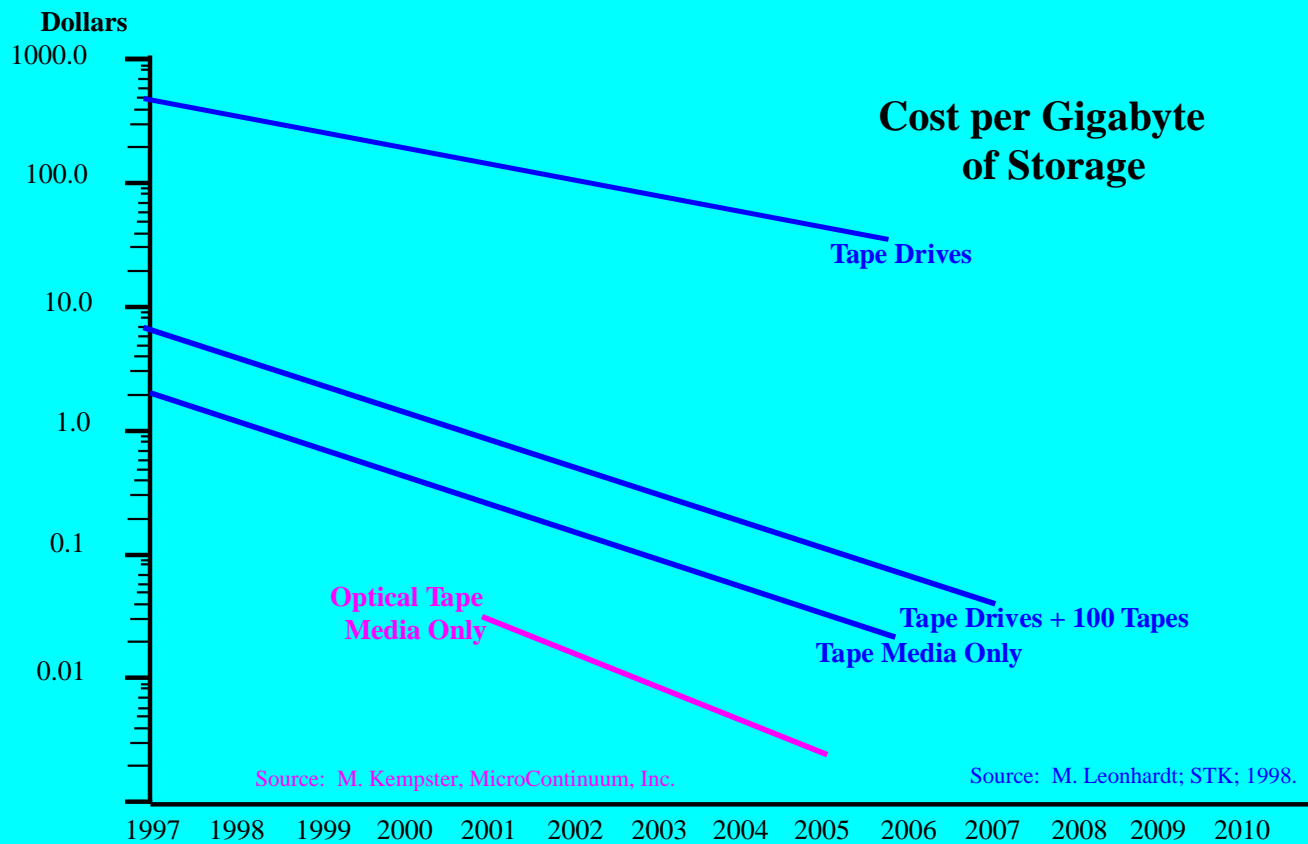


Storage Capacity

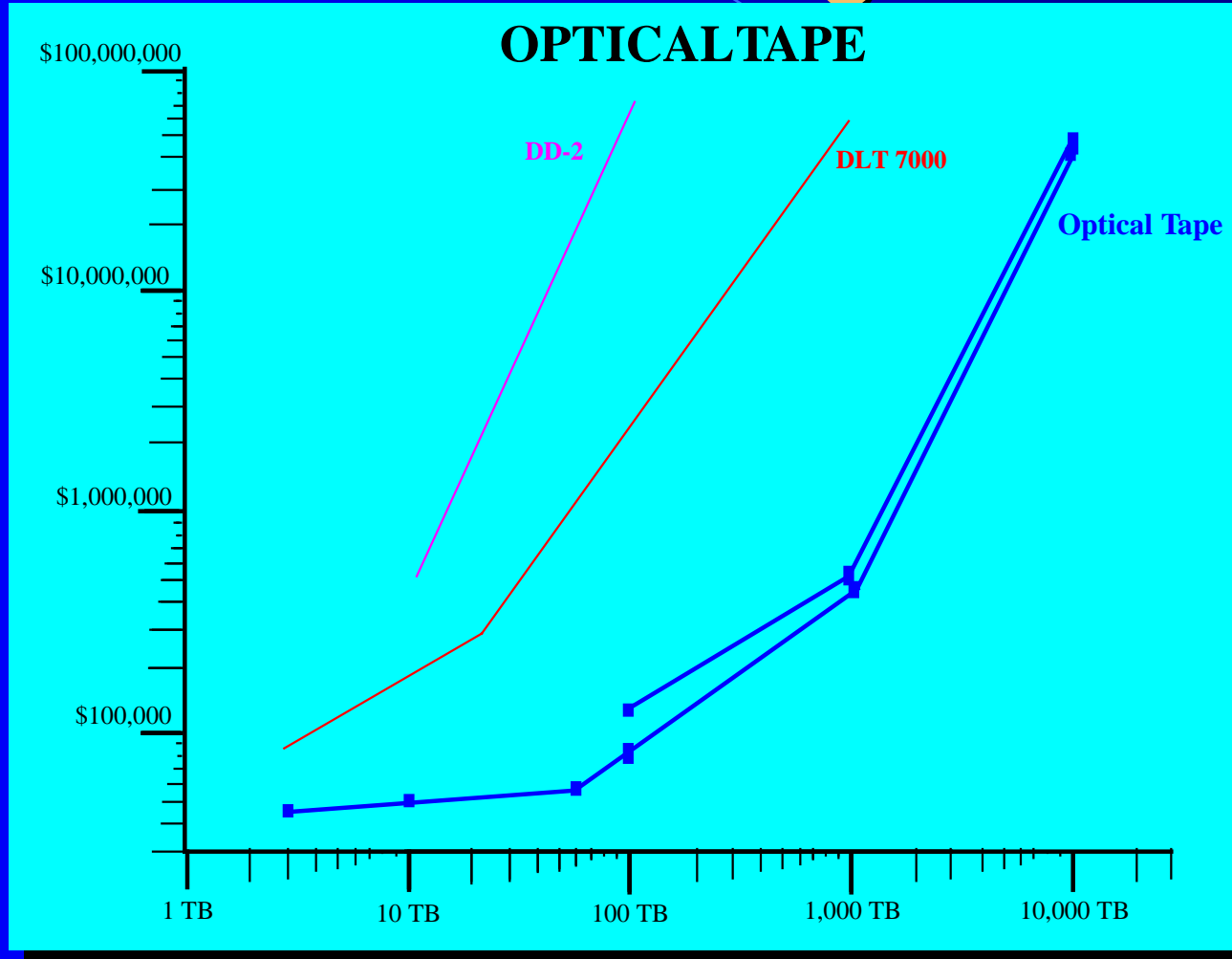


Cost Trends

FUTURE TRENDS FOR INFORMATION STORAGE AND RETRIEVAL

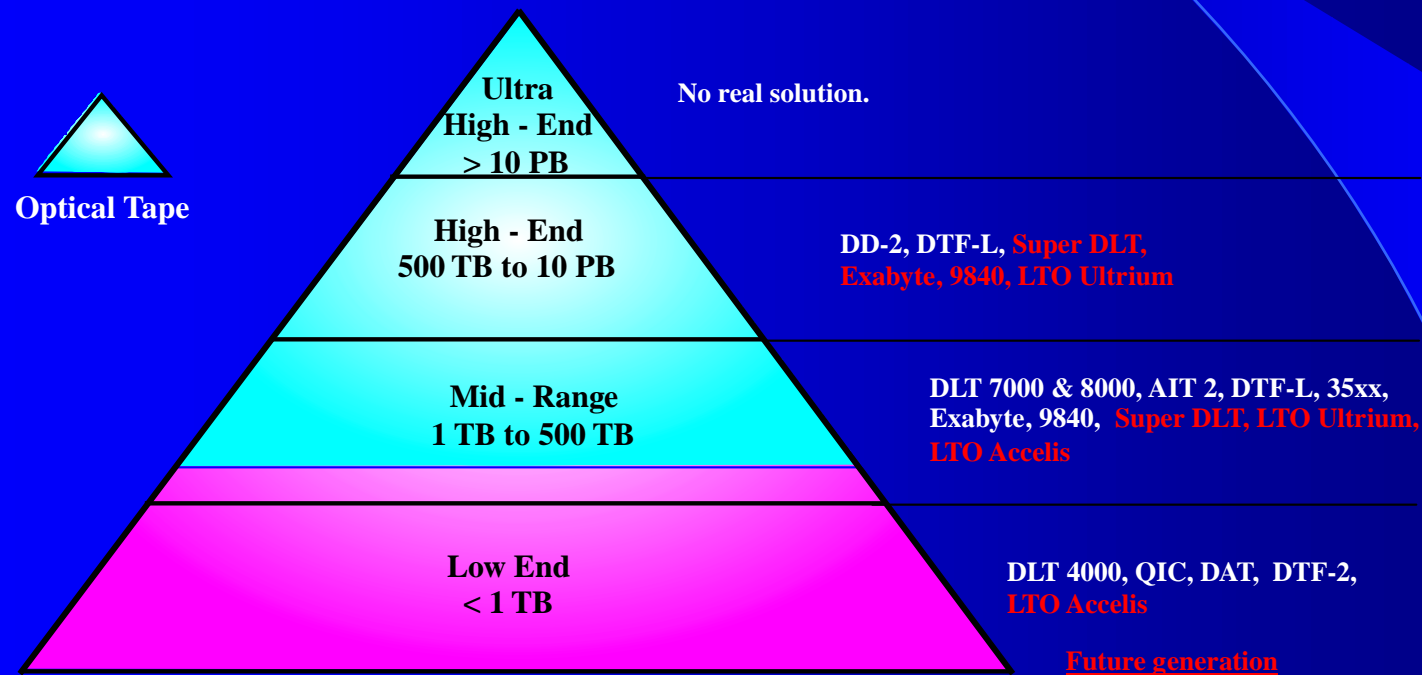


New Paradigm



Optical Tape Competitive Range

TAPE STORAGE PYRAMID 2000



Current Status

- Government and private funding.
- Beta by end of 2000.
- AIIM standards group chaired by NIST.
- LOTS -- drive technology.
- Kodak -- WORM tape.
- MicroContinuum -- WORM, erasable and ROM tape.

"Leadership in the tape drive market now depends on manufacturers that can provide the most reliable, high-performance and high-capacity tape storage solutions for the fast-growing midrange and enterprise-class server environments."

Fara Yale, chief analyst, Computer Storage Service for Gartner Group's Dataquest.

Of all the technologies we might consider today, the ones that demand our attention most are those that can fundamentally change the way we do business.