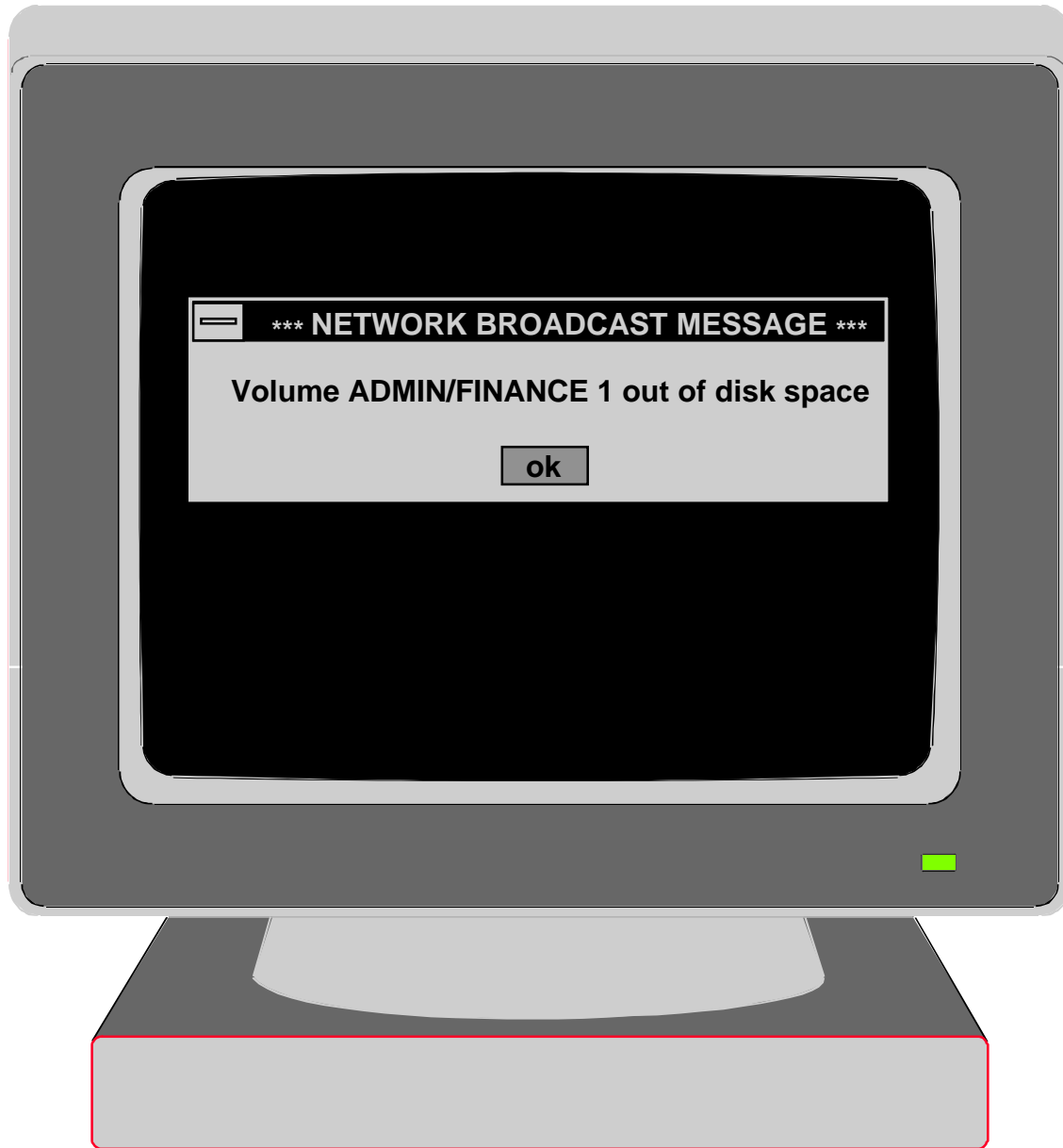


Examine Your Strategy, Weigh Your Options in Choosing Removable Storage

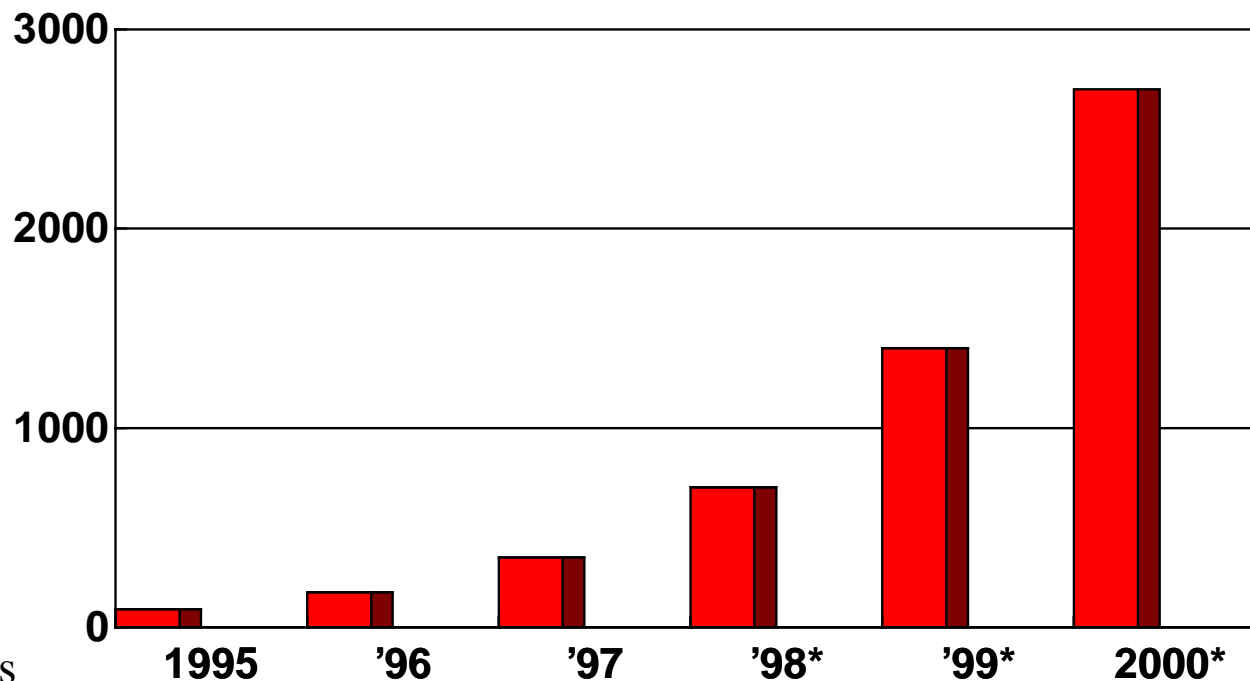
**Dave Holmstrom
Associate Director of New Products
Verbatim Corporation**

Evaluating Storage Solutions

- What type of data is being stored?
- How much will you need to store?
- How quickly do you need to access the data?
- Will people need to share and distribute data with others?
- How reliable are the various storage media?
- Finally, how much are you willing to spend?



Growing Storage Requirements (Petabytes Shipped)



* Forecasts

Source: IDC

A Petabyte = 1 quadrillion bytes of data

Storage Equivalents

- **Text Storage**

- 1TB (terabyte) = 500 million text pages
- 1PB (petabyte) = 500 billion pages
- 1EB (exabyte) = 500 trillion pages
- 1GB (gigabyte) = 500,000 text pages
- 1MB (megabyte) = 500 text pages

- **Still Video Storage**

- .9MB = 300 dpi 8x10 B/W image
- 38MB = high-res color photo
- .31MB = 256 VGA computer screen

- **Full-Motion Video Storage**

- 120GB = 90-min. movie

Storage Options

Tape

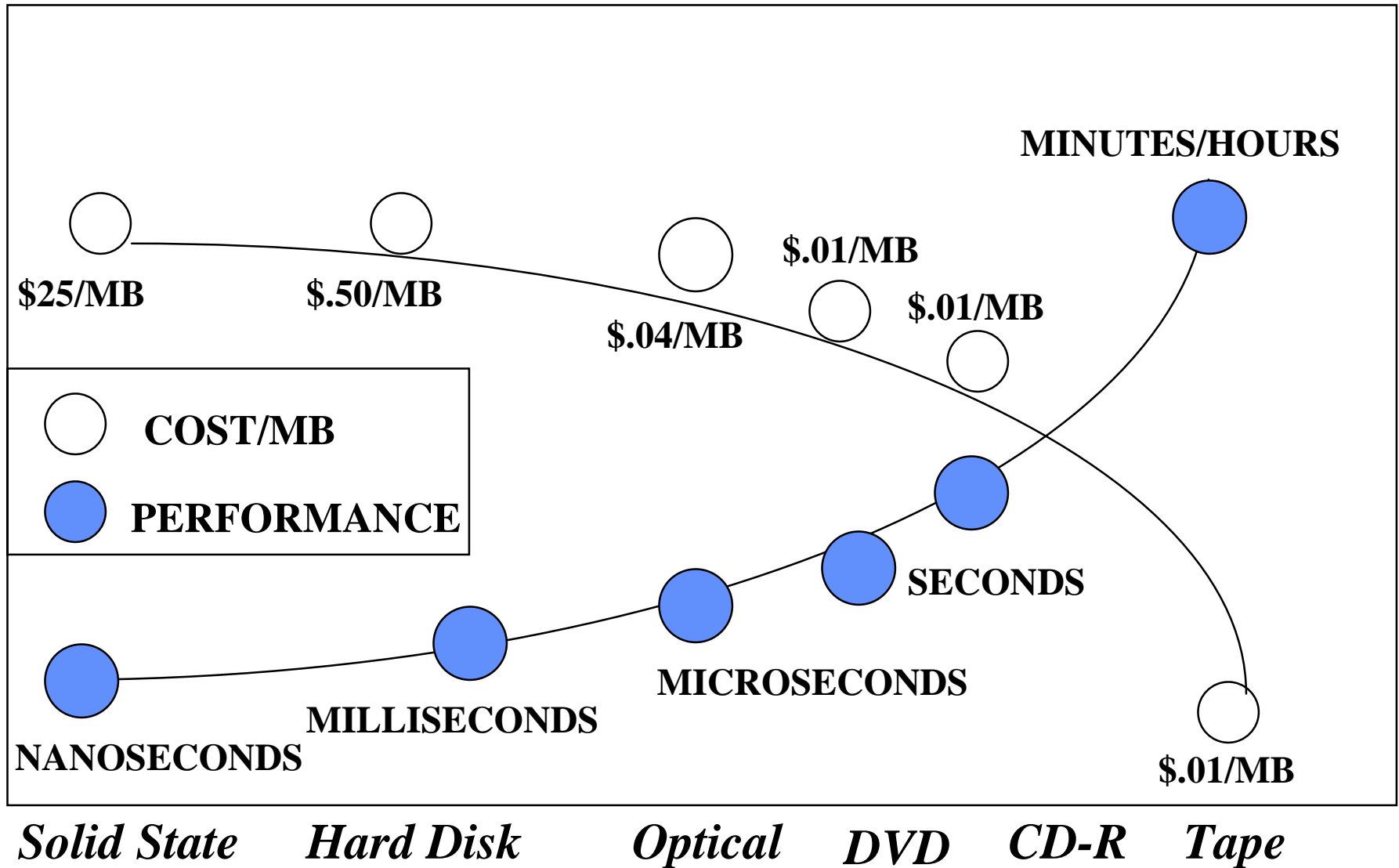
Hard Drives

CD-ROM

MO

DVD

Storage Price/Performance Solutions

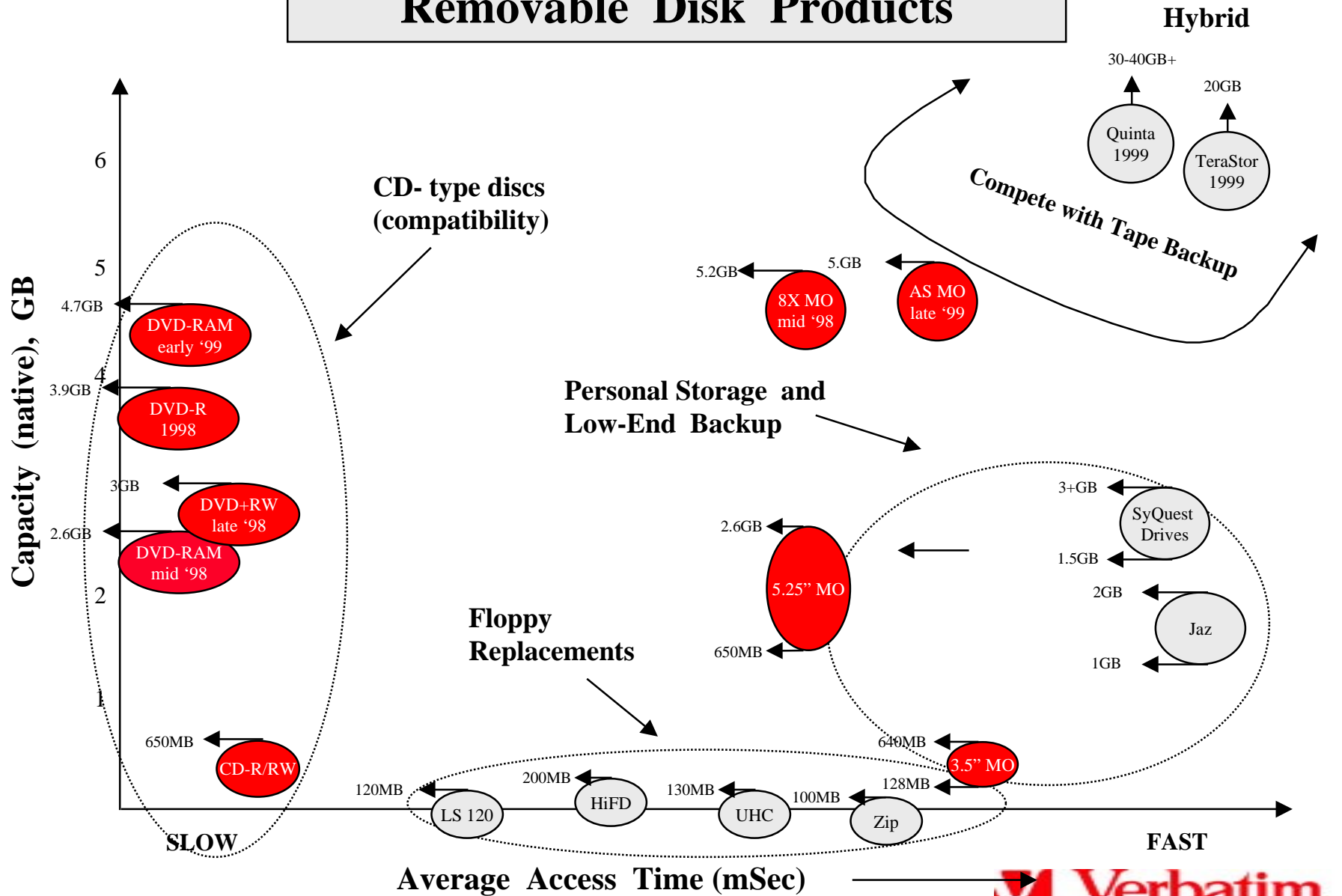


(Only Part of the price/performance equation)

Media CPM

\$.005	Tape
\$.005	CD-R
\$.03	CD-RW
\$.011	DVD Rewritable
\$.003	Floppy Diskette
\$.3	Hard Disk
\$.04	2.6GB MO
\$.12	ZIP, JAZ, Syquest
\$25	RAM

Disk Capacity and Access Time Removable Disk Products



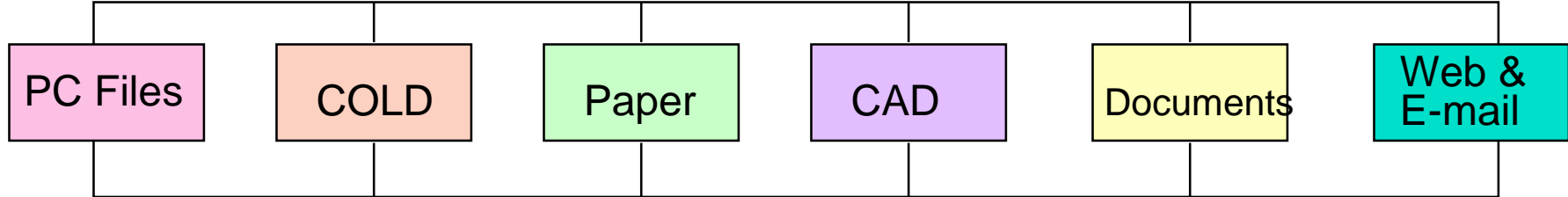
CD Data Storage Strategy



Massive Amounts of Diverse Business Information



Application-specific Storage Management Software Modules

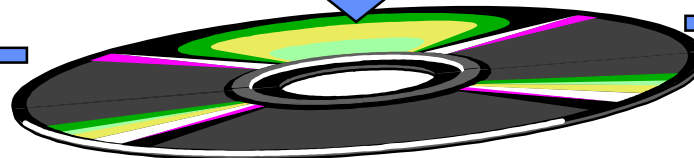


Content Management

Indexing, Search/Retrieval of CD Discs & Libraries



Portable Resource
for Information Access



Network Resource for
Shared Information
Access

Universal Access to Any Information



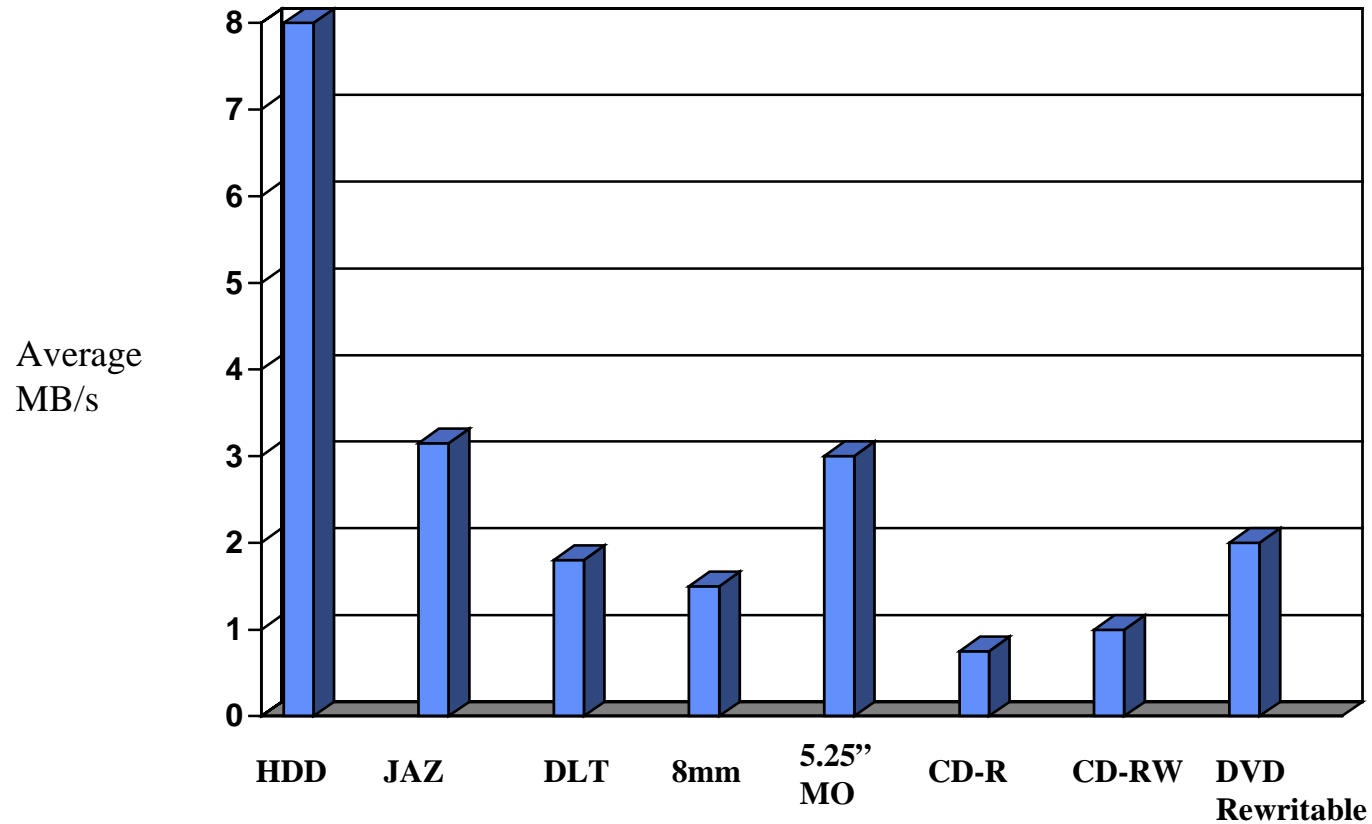
Optical Disk Technologies

Technology	Key Characteristics	Street Price	Availability	Media	
5-25" MO	<ul style="list-style-type: none"> • 5.2GB rewrite • 10.4GB rewrite 	\$1,200	now	\$80	
		\$1,200	late '99	TBD	
CD	<ul style="list-style-type: none"> • 650MB write-once • 650MB rewritable 	\$ 400	now	\$1-2	
		\$ 500	now	\$10-12	
DVD	<ul style="list-style-type: none"> • 2.6GB • 4.7GB 				
		read-only (DVD-ROM)	\$ 129	now	---
		write once (DVD-R)	\$12,000	now	\$50
	rewritable (DVD-RAM)	\$ 700	now	\$25	

Comparing Removable Storage Choices

	5.25" MO	Jaz	DLT	CD-R	CD-RW	DVD
Scalability	High	Low	High	High	Moderate	High
Reliability	High	TBD	High	High	Moderate	Moderate
Write Speeds	Fast	Fast	Fast	Slow	Slow	Moderate
Cost of Retrieval	Low	Moderate	Moderate	Low	Low	Low
Cost of Media (\$/MB)	<.04	>.10	<.01	<.001	>.01	.008
Ease of Use	Easy	Easy	Easy	Moderate	Moderate	Easy
Multiple Sources	Yes	No	No	Yes	Yes	Yes
Availability	NOW	NOW	NOW	NOW	NOW	NOW

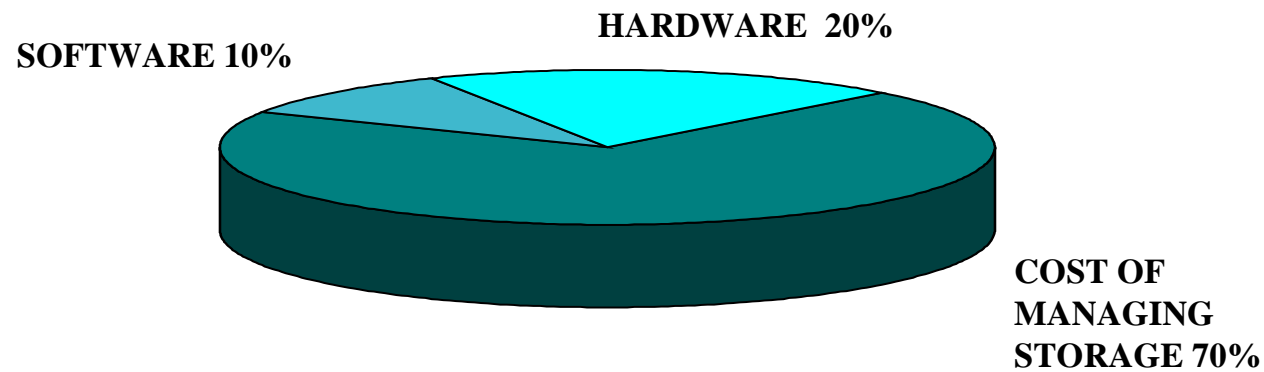
Comparison-Sustained Write Transfer Rates*



* Uncompressed

Removable Technologies

Storage & Storage Management Expenses



Source: Giga Information Group

Initial Optical Selection Criteria

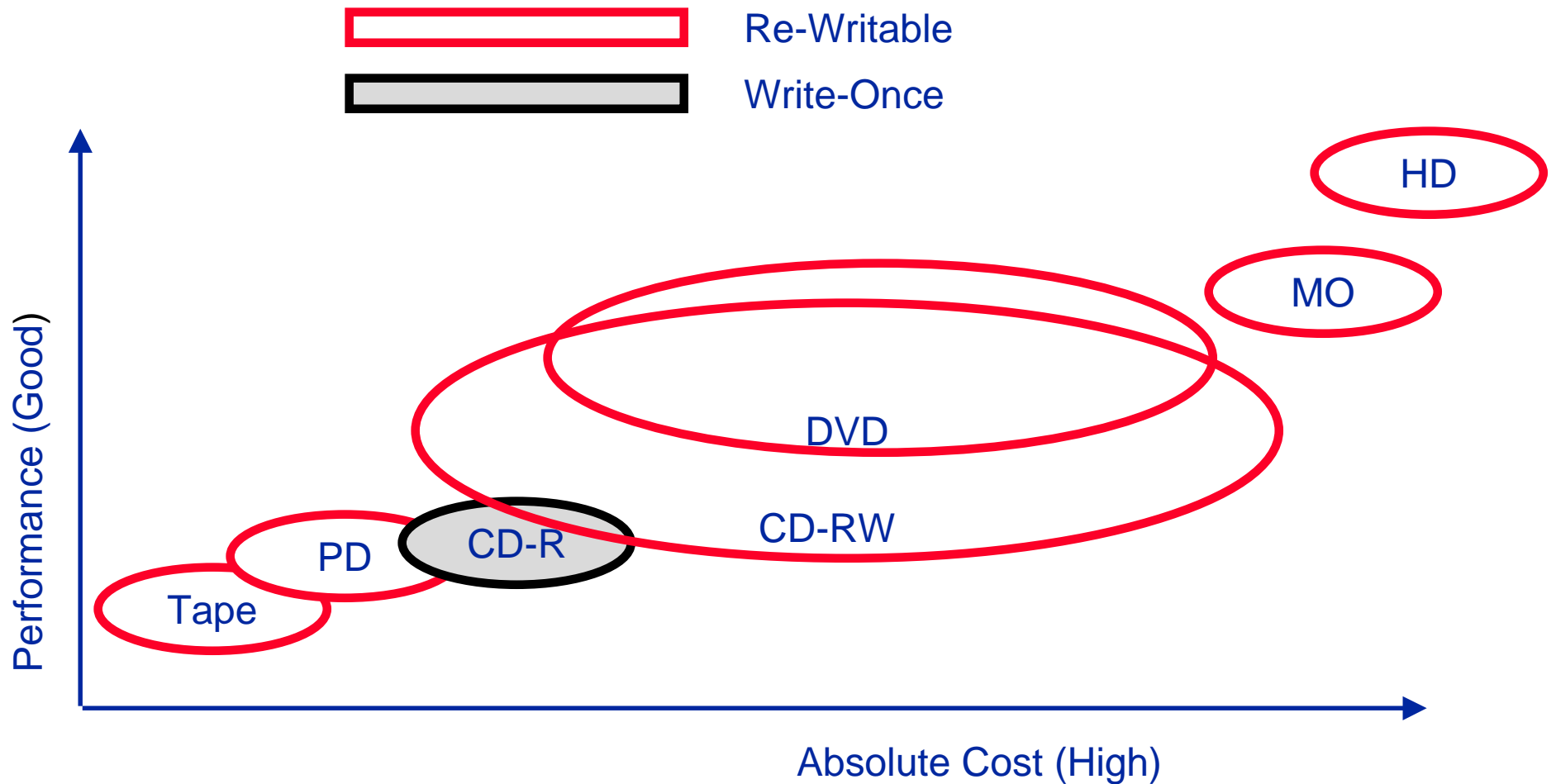
Storage Requirements =

**Number of documents per year X .00005
(scanned compressed image in GB)
X years on-line
X annual growth rate**

Mix, Match Your Selection

- Determine “value” of online, near-online, off-line storage/access
- Determine Length of Access Period, Storage Period
- Choose scalable, long-term solutions
- Develop integrated, automated solution

Positioning of Removable Technologies





Applications for CD-R

- Distribution
- Audio (personal & professional)
- Archiving
- Short-run production
- Prototyping, testing
- Pre-mastering for replication



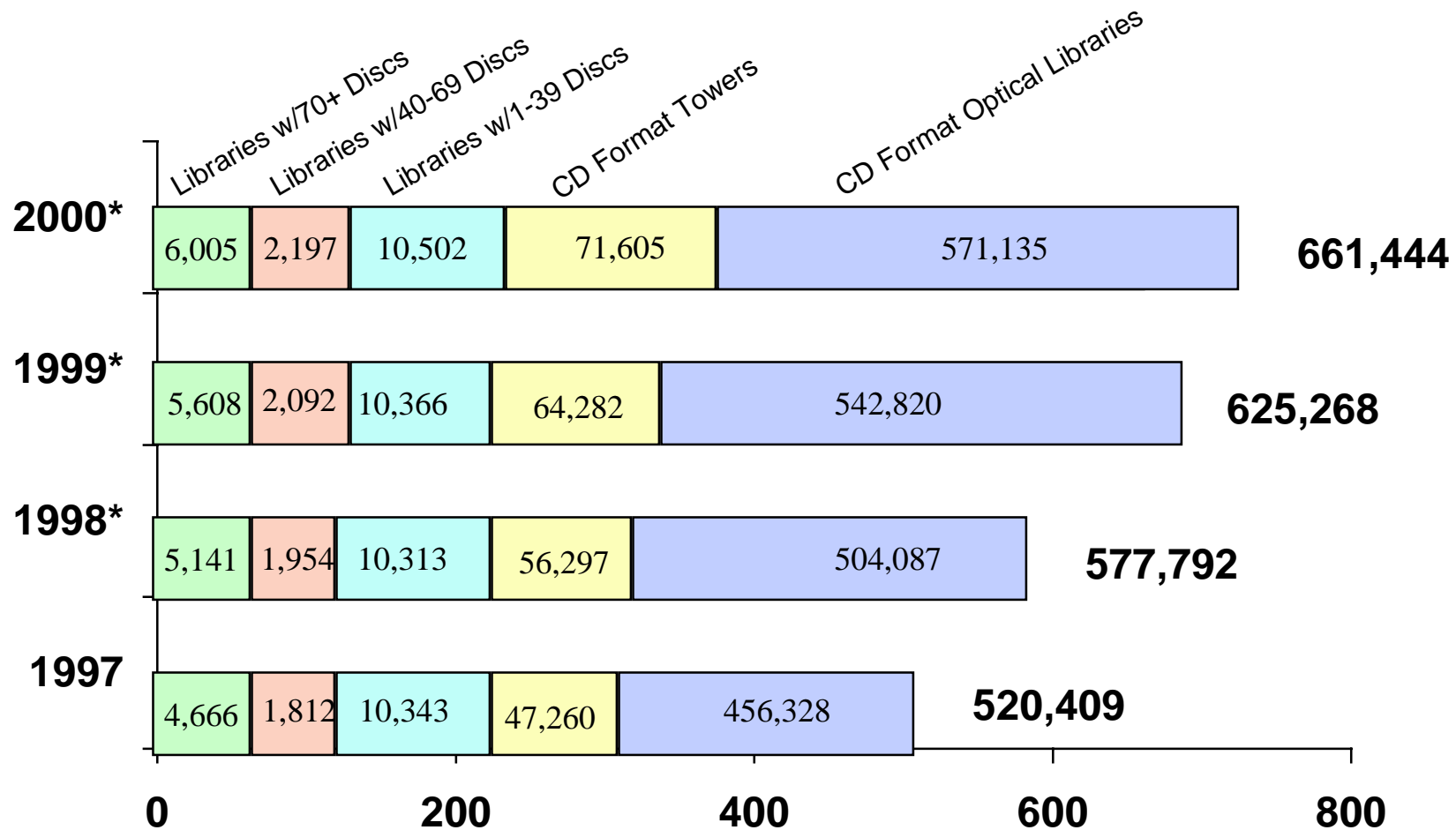
Applications for CD-RW

- Back-up
- Personal/Enterprise Storage
 - Replacement for Syquest, Zip Drives, Magneto-Optical
- Prototyping
 - Software, multi-media, games, works in progress

CD-RW vs. Zip/Jaz

- **CD-RW has a higher capacity (650MB vs. Zip 120MB)**
- **CD-RW is a standard, Zip is a proprietary format**
- **CD-RW has a lower cost per MB (4 cents vs. 11 cents)**
- **CD-RW lifetime is 30 years (optical), Zip is 5 years (magnetic)**

Worldwide Optical Disk Library Unit Shipments (in Thousands)

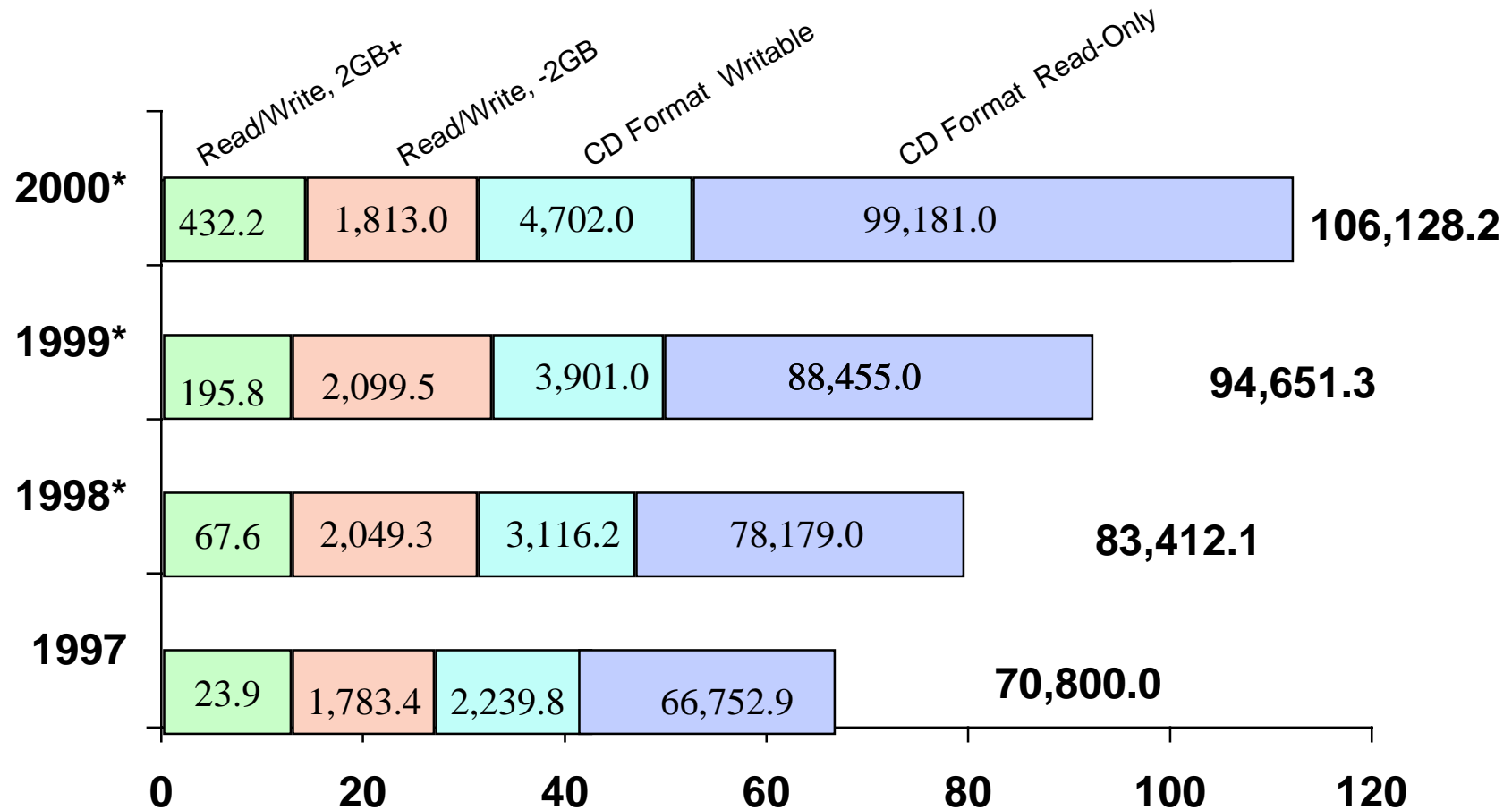


* Projected

Source: DISK/TREND, Inc.



Worldwide Optical Disk Drive Unit Shipments (in Thousands)



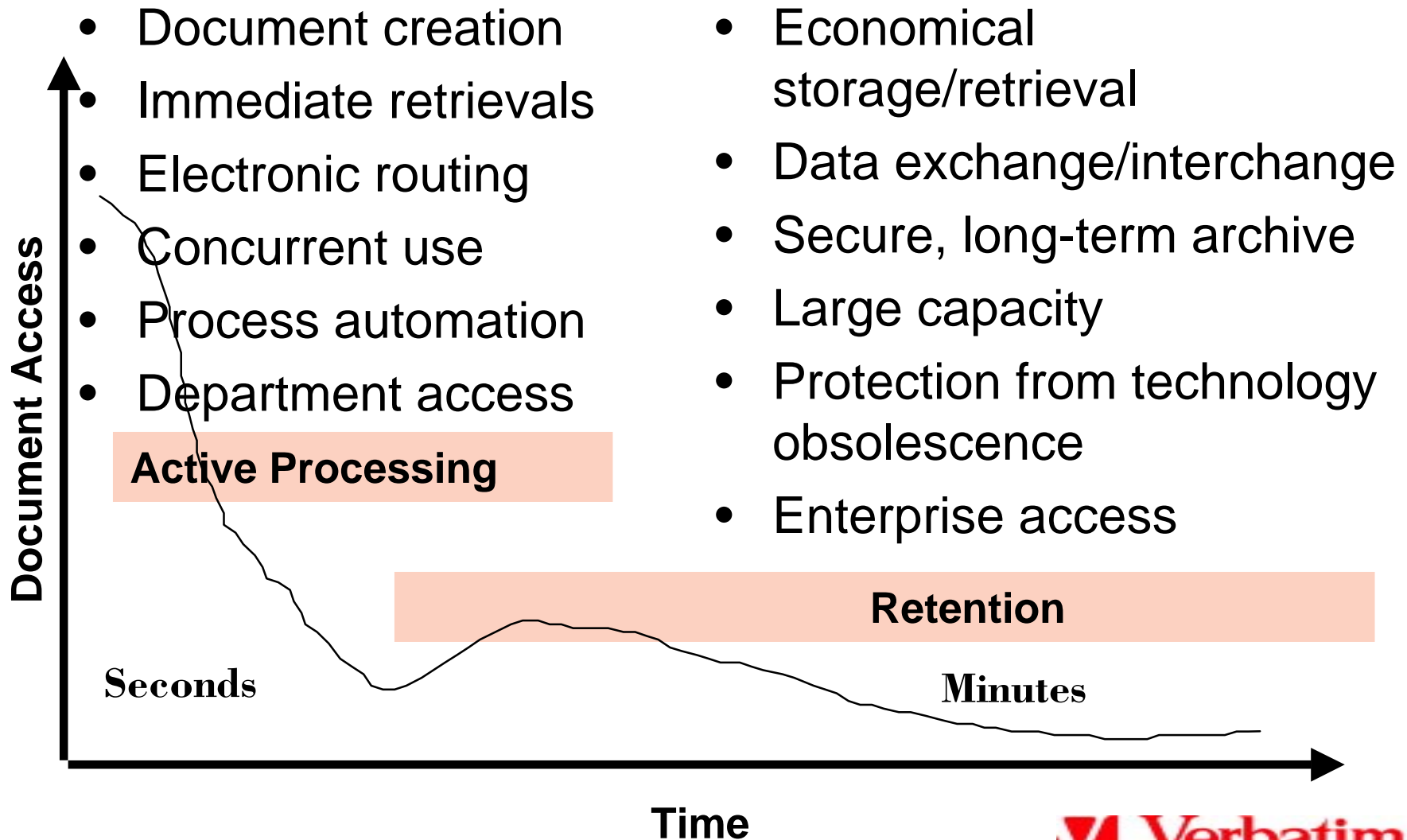
* Projected

Source: DISK/TREND, Inc.

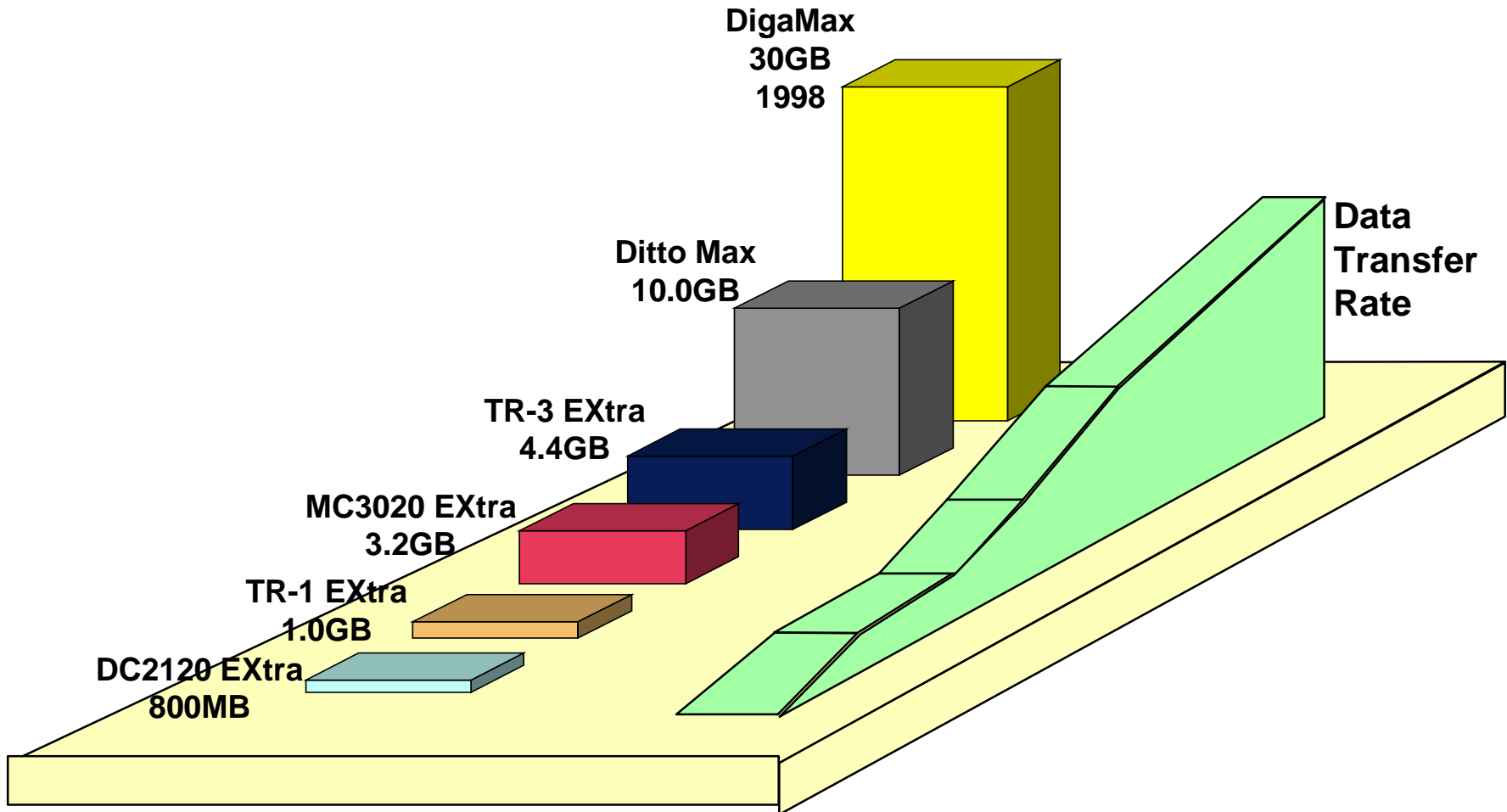


Storage Lifecycle

Evolution of Storage Requirements



Tape Technology



Recovery Principles

- **Recovery is a Complex Art: Plan for it, Test in Advance**
- **Know Your Operating Requirements**
 - **How much data can you afford to lose?**
 - **How long can your applications be offline for backup or recovery?**
 - **How quickly can you recover?**
 - **Are the capabilities to reverse changes needed?**
 - **What resources are available for recovery?**
- **Can your recovery system reliably respond in the time required?**
 - **Requires high data integrity, rapid access and performance**