



# **A Drive for all Seasons**

**— Hard Disk Drives, Mass  
Storage for Mankind—**

Tom Coughlin

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# Thomas M. Coughlin

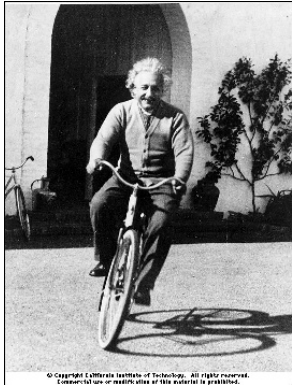
## President, Coughlin Associates



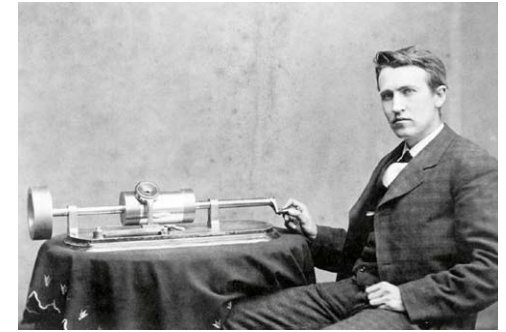
Tom has been working for over 25 years in the data storage industry at numerous companies such as Ampex, Polaroid, Seagate, Maxtor, Micropolis, Syquest, and 3M. He has over 70 publications and six patents to his credit. Tom is active with IDEMA, the IEEE, and other professional organizations. Tom is Vice-Chairman of the 2006 Santa Clara Valley IEEE Section and Chairman of the Santa Clara Valley IEEE Consumer Electronics Society. He is the founder and organizer of the Annual Storage Visions Conference, a partner to the annual Consumer Electronics Show. Coughlin Associates provides market and technology analysis as well as Data Storage Technical Consulting services. For more information go to [www.tomcoughlin.com](http://www.tomcoughlin.com)

### Publications:

- [Hard Disk Drive Capital Equipment Market and Technology Report](#)
- [Tape and Disk--A User's Perspective](#)
- [Backup and Archive--A User's Perspective](#)
- [Continuous Data Protection--A User's Perspective](#)
- [Tiered Storage--A User's Perspective](#)
- [NAS and NAS Virtualization- A User's Perspective](#)
- [Digital Storage in Entertainment Creation and Distribution](#)
- [Integration of Digital Storage in Consumer Electronics](#)



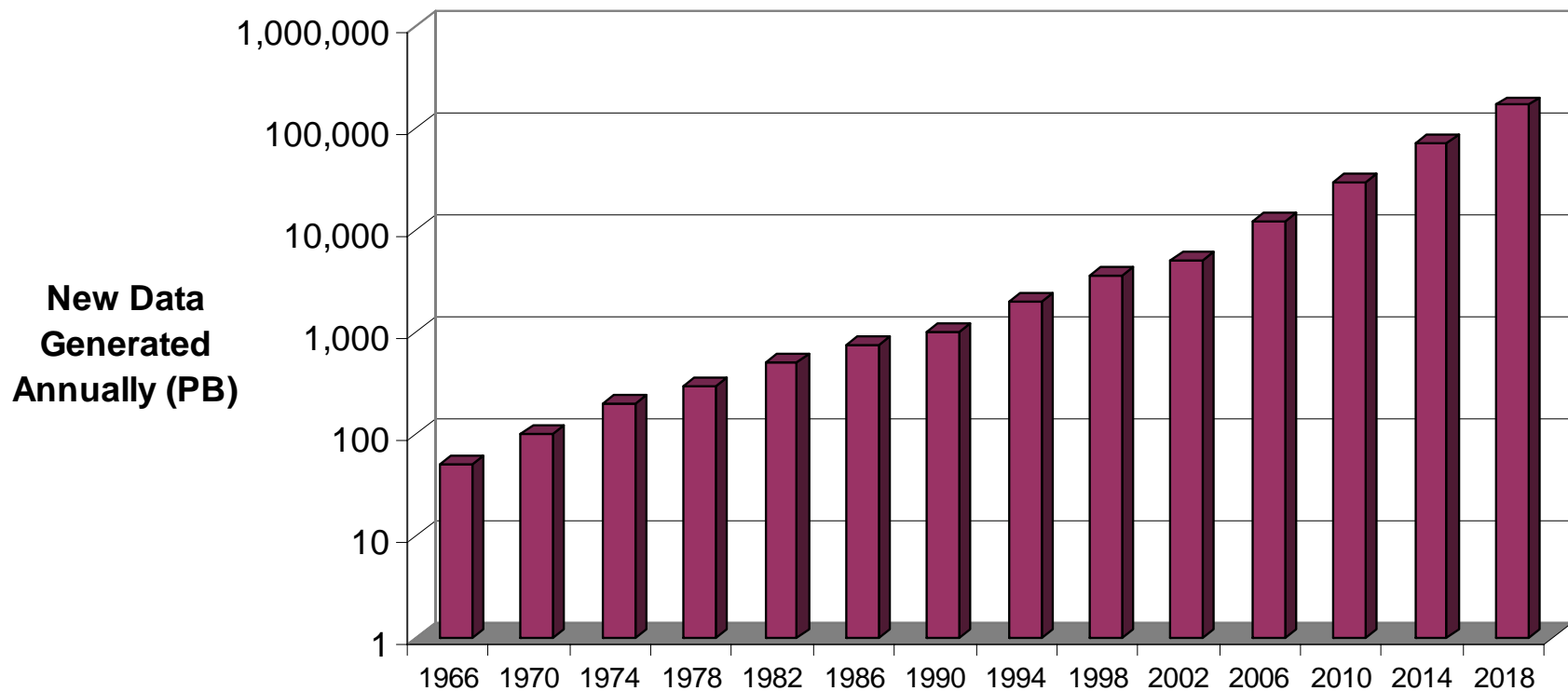
# Outline



- Drivers for Storage in the Entertainment and Personal Content Value Chain
- Hard Disk Drives—Mass Storage for the Masses!
- The Next Steps in HDD Storage
- Conclusions
- Sources



# Projections for Annual New Data Production (Projected from 2003 Berkeley Study)



***This may be conservative if personal content creation really takes off...***

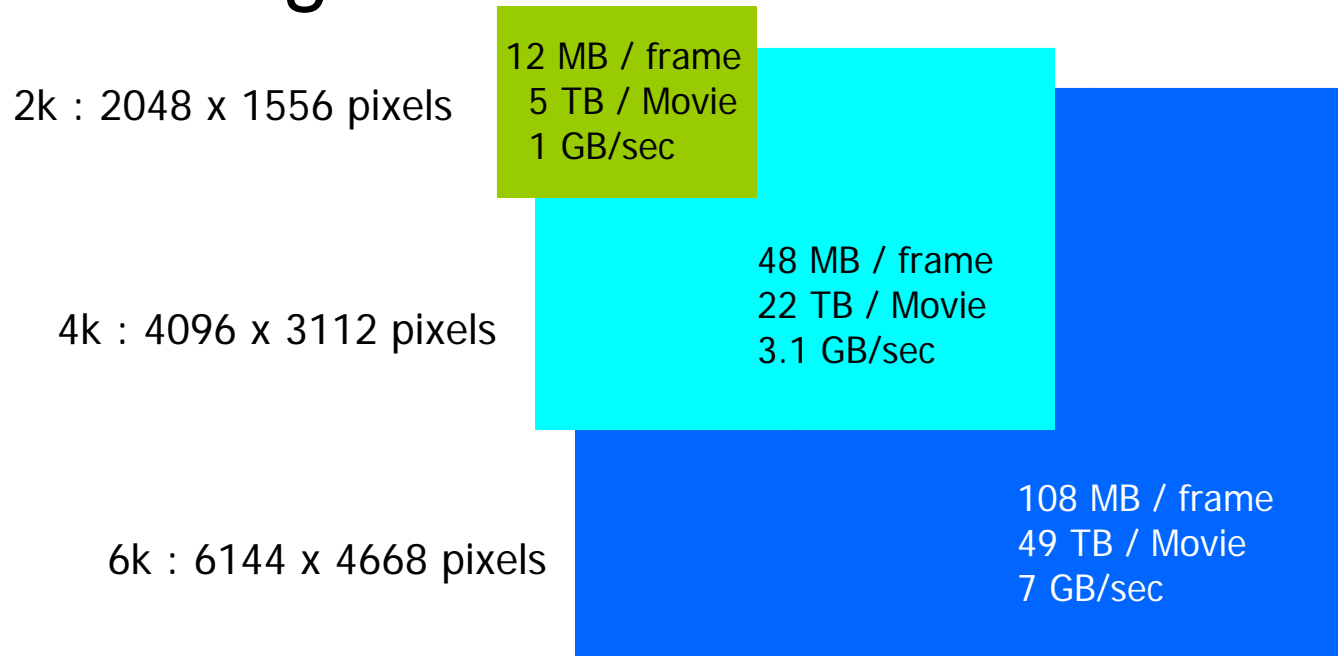
# THE COSMIC WHEEL OF STORAGE KARMA



Content Creation  
Content Editing  
Content Archiving  
Content  
Distribution  
Content Reception

# Uncompressed Professional Content Eats Storage

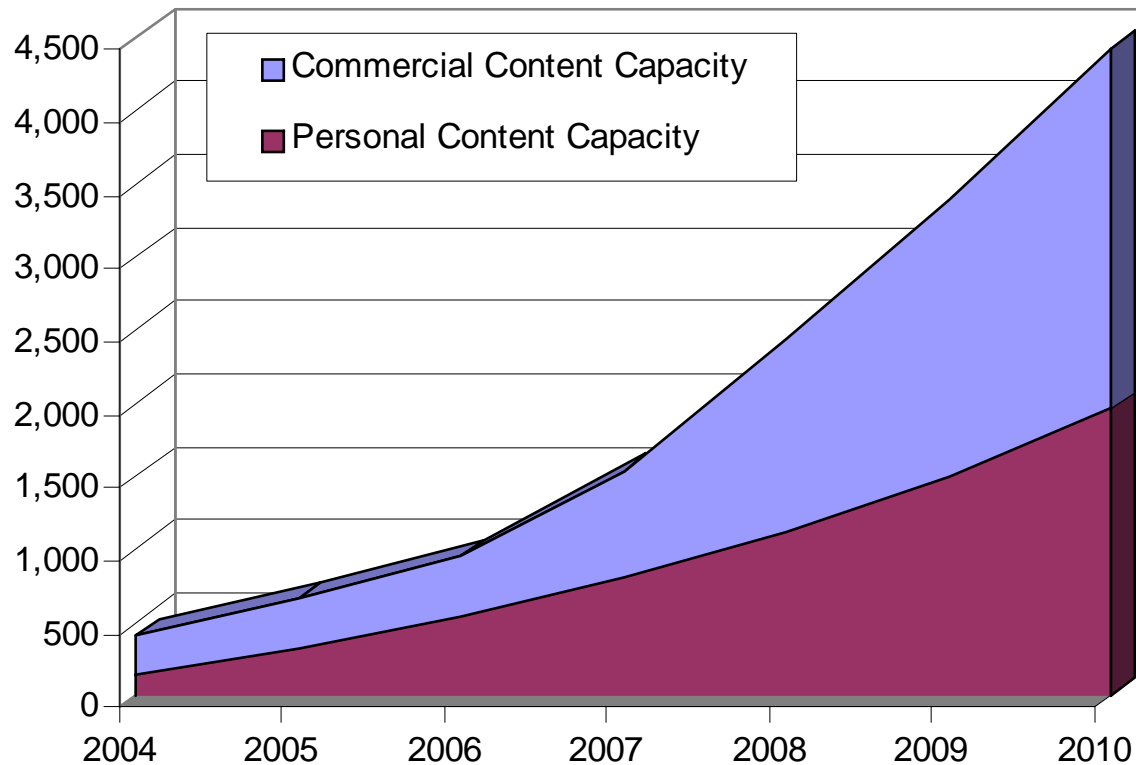
- Uncompressed 2k, 4k, and 6k frame sizes for an average movie (Number of frames in a 2 hour film : 172,800)





# Cumulative Original-Instance Home Storage Capacity

Capacity (GB)



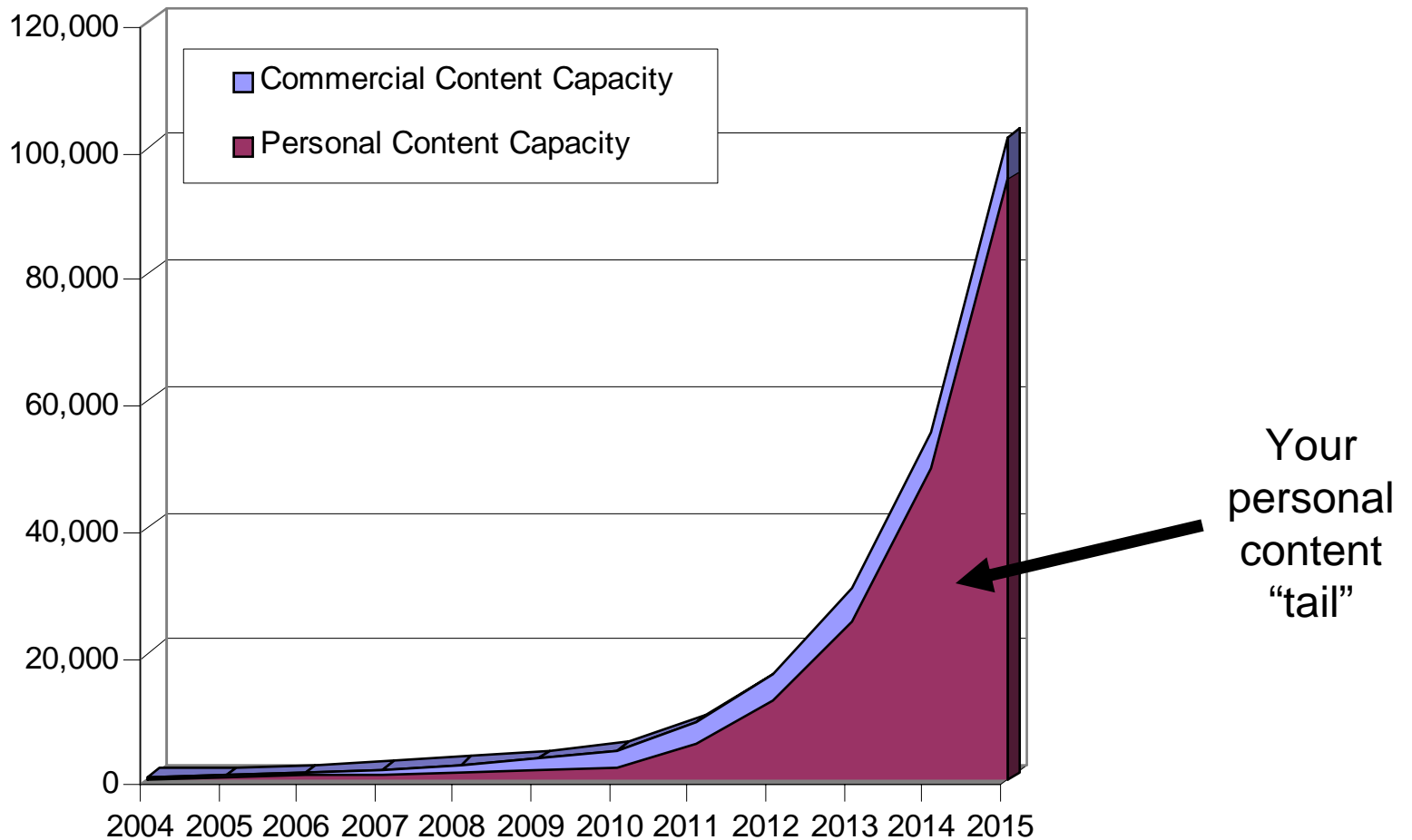
• **Almost 5 TB of combined personal reference data and home commercial content by 2010**

• **By next decade more personal than commercial content (could be 100's of Terabytes of personal content per person)**

# Growth in personalized...maybe even personal content....

- New technology allows ever finer market segmentation—the ultimate segmentation is the individual
- Could we see demand for Life Logs or personal memory assistants (PMA)
  - access our own histories or friends and relatives' histories, or even just to find things we lost?
- To handle the required storage we would have to make these devices organizers that actually do so...
  - Indexing, organizing and management
  - Growth in metadata in personal content
  - What to leave at home and what to bring with you (proxies)?
  - Not only large storage capacities needed but much more intelligent storage systems required.

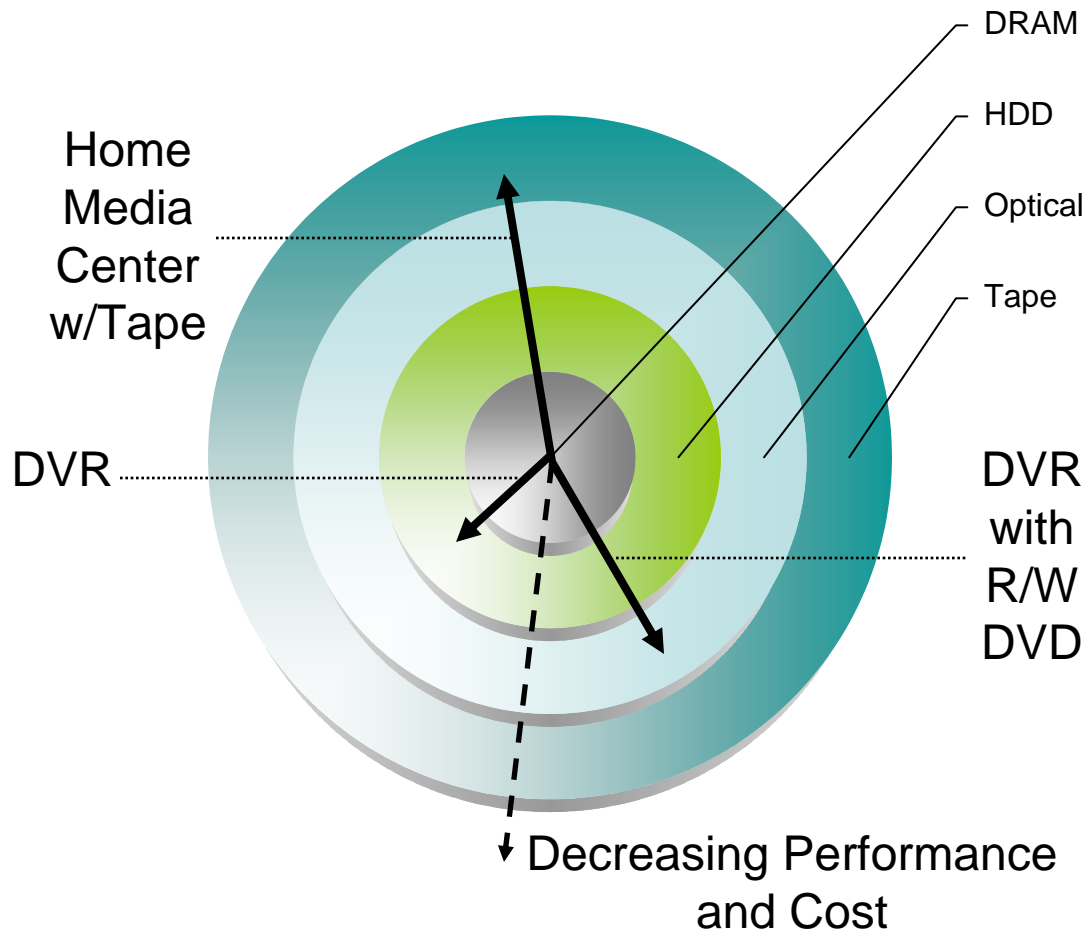
# Revised plot with new personal content creation sources--Your personal tail!



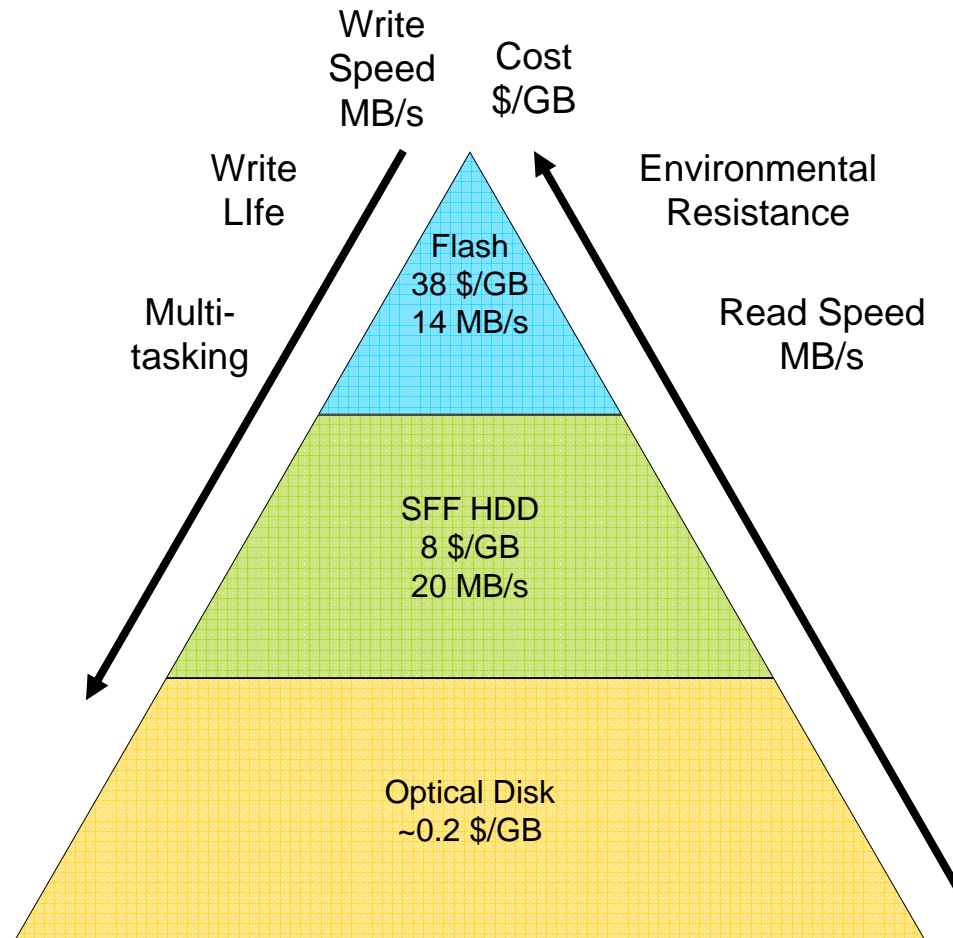


**HDDs—Mass Storage for the  
Masses!**

# Consumer Devices Using Various Elements of Available Storage Hierarchy



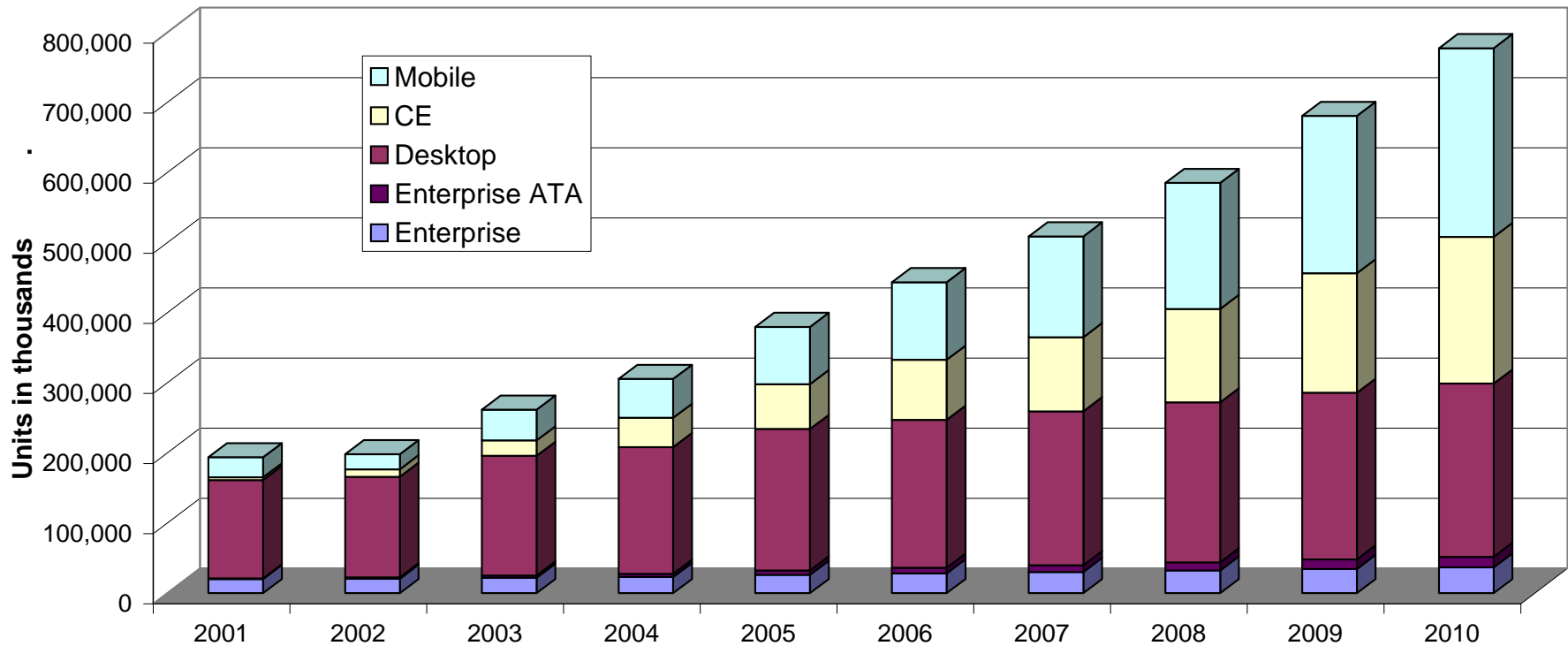
# Mobile Storage Hierarchy



# Consumer Products Using Hard Disk Storage

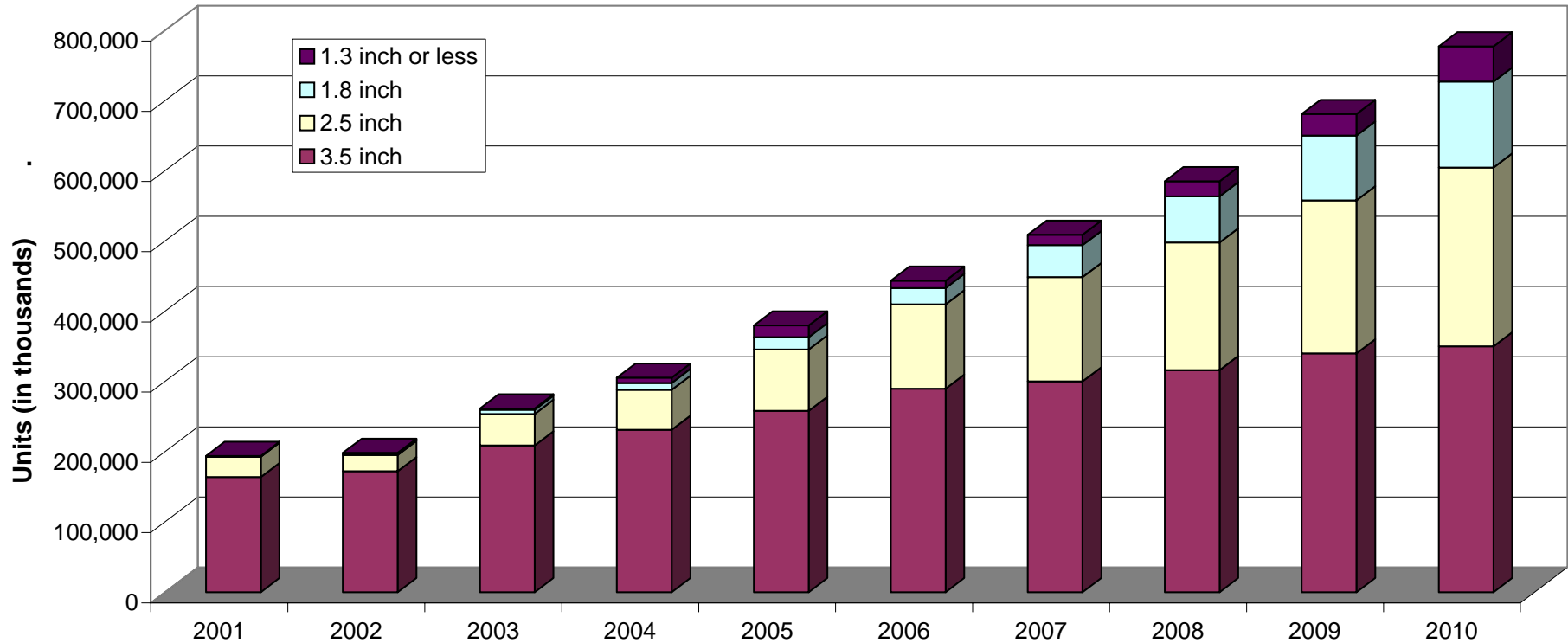


# HDD Market Niche Projection



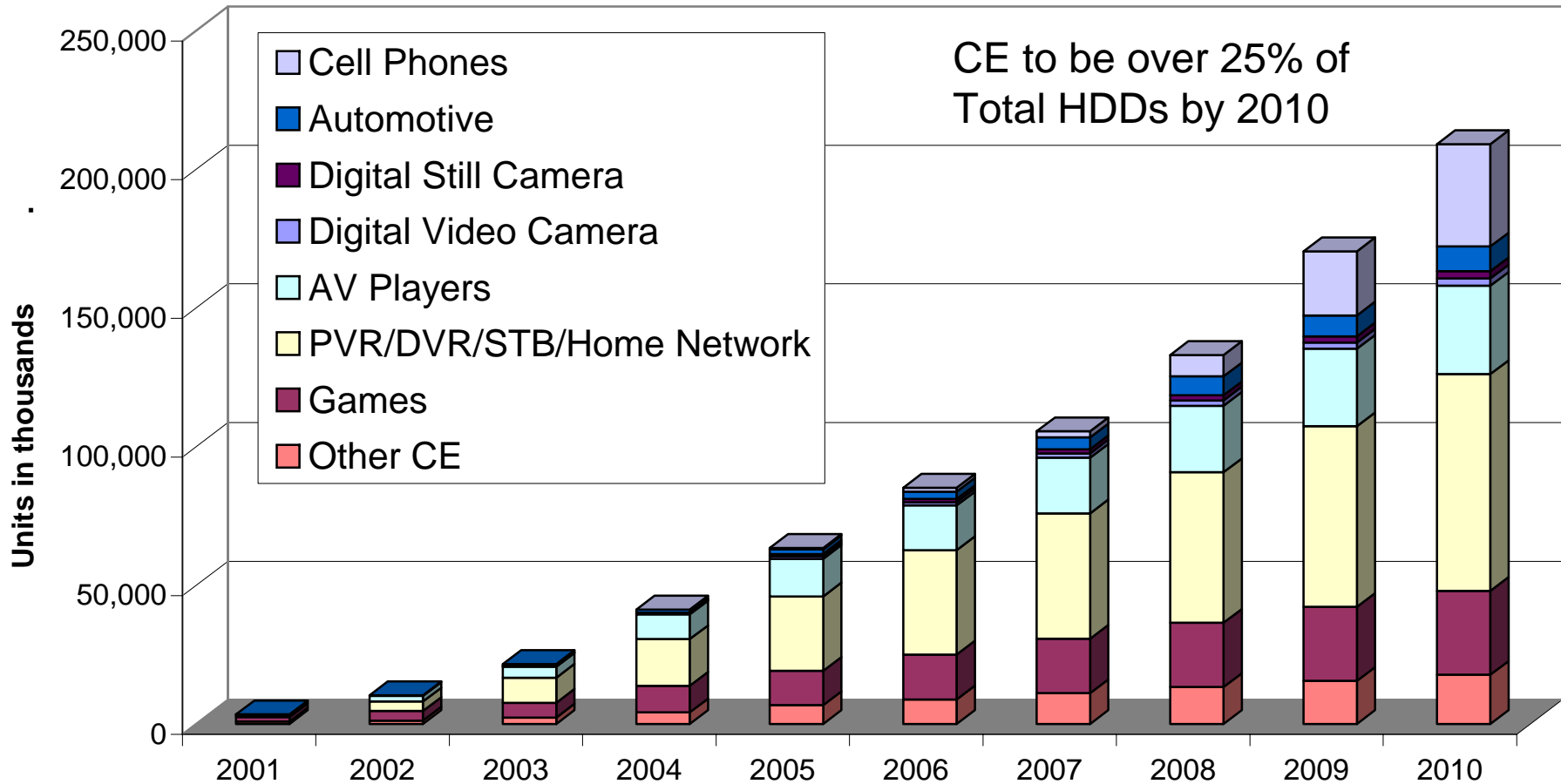
By 2010 CE and Mobile Computers will dominate in disk drive unit volume

# HDD Form Factor Trends

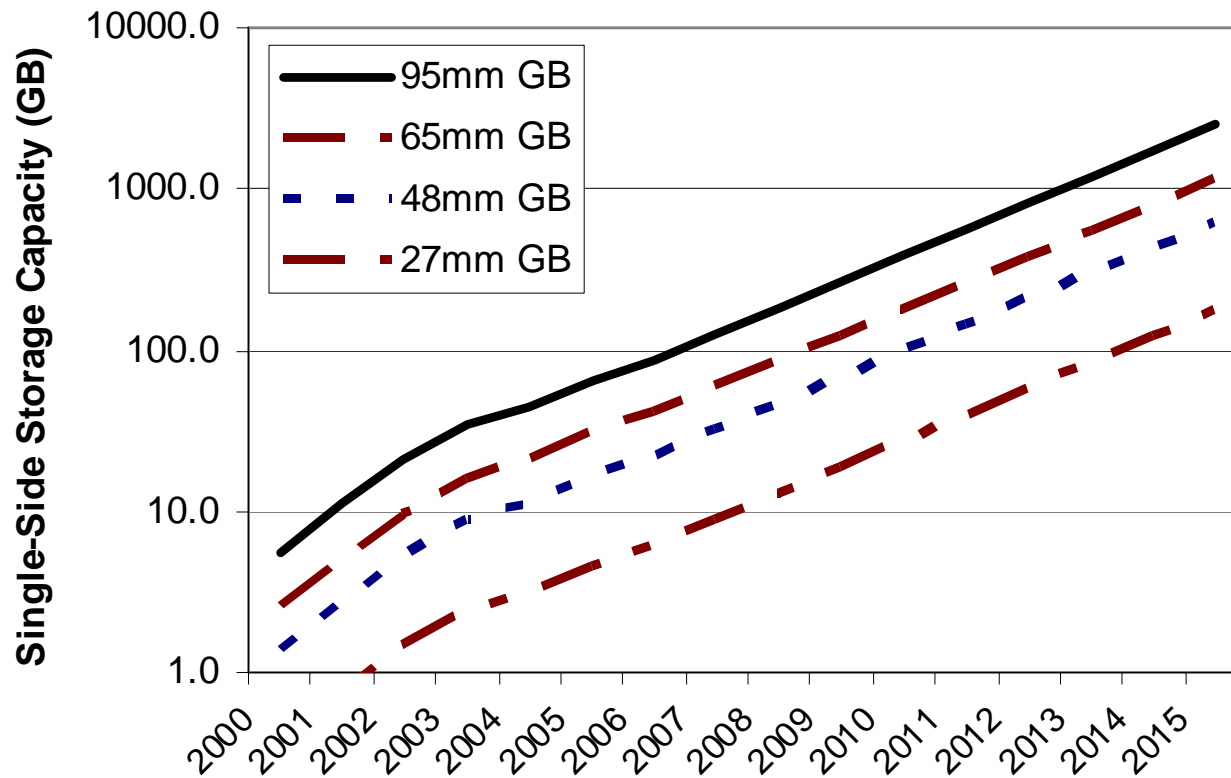


By 2010 2.5-inch and smaller HDD will provide over half of total disk drive volume

# HDDs for Consumer Applications, Units Shipments



# Single Side Disk Capacity Estimates (Shipping Volume Average, Conservative)



***Technology for 1 TB in your pocket and 1 PB in your home before 2020!***

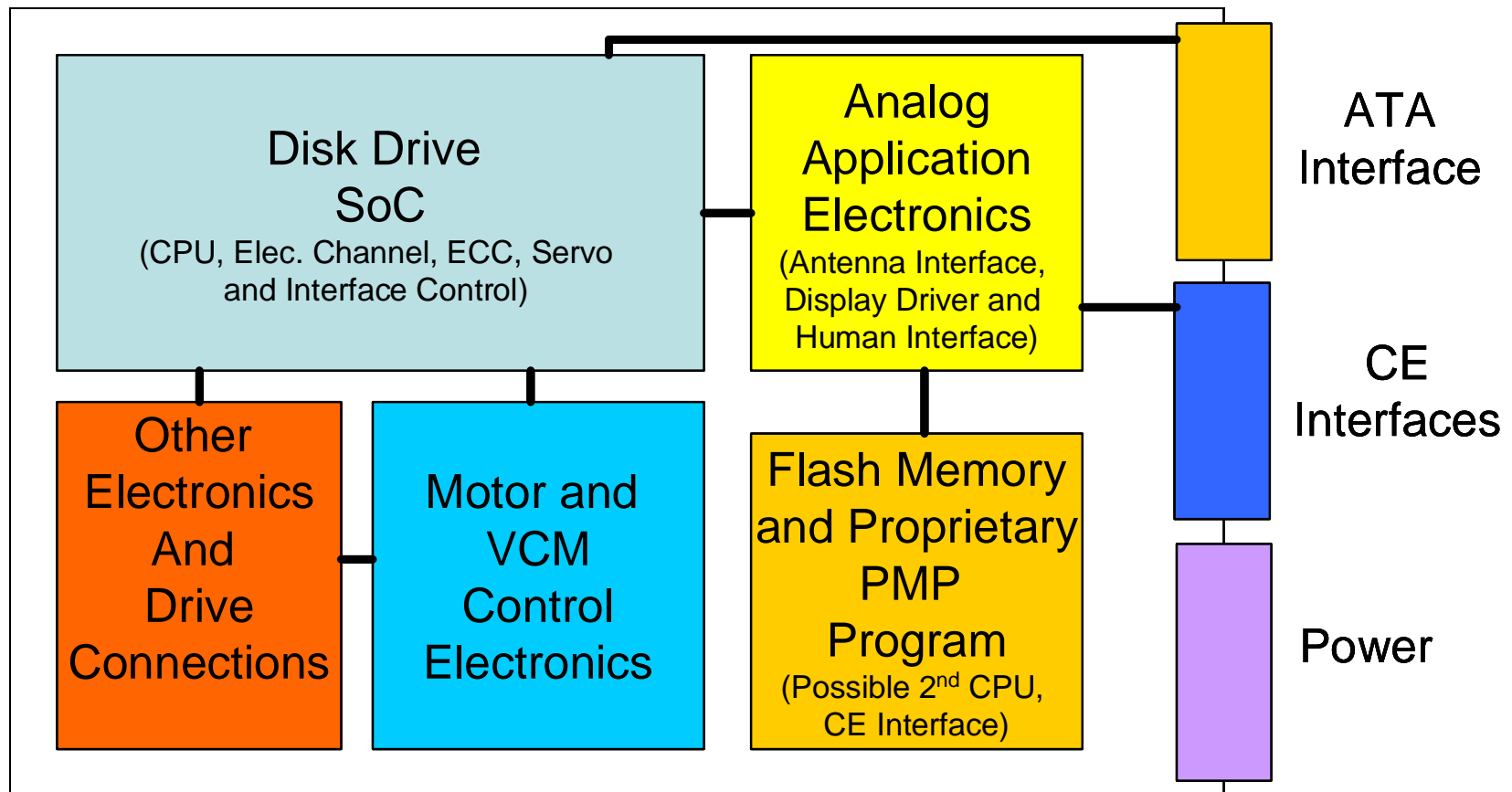


# The Next Steps in HDD Storage

# Drivers and Consequences for Applications on Storage Devices

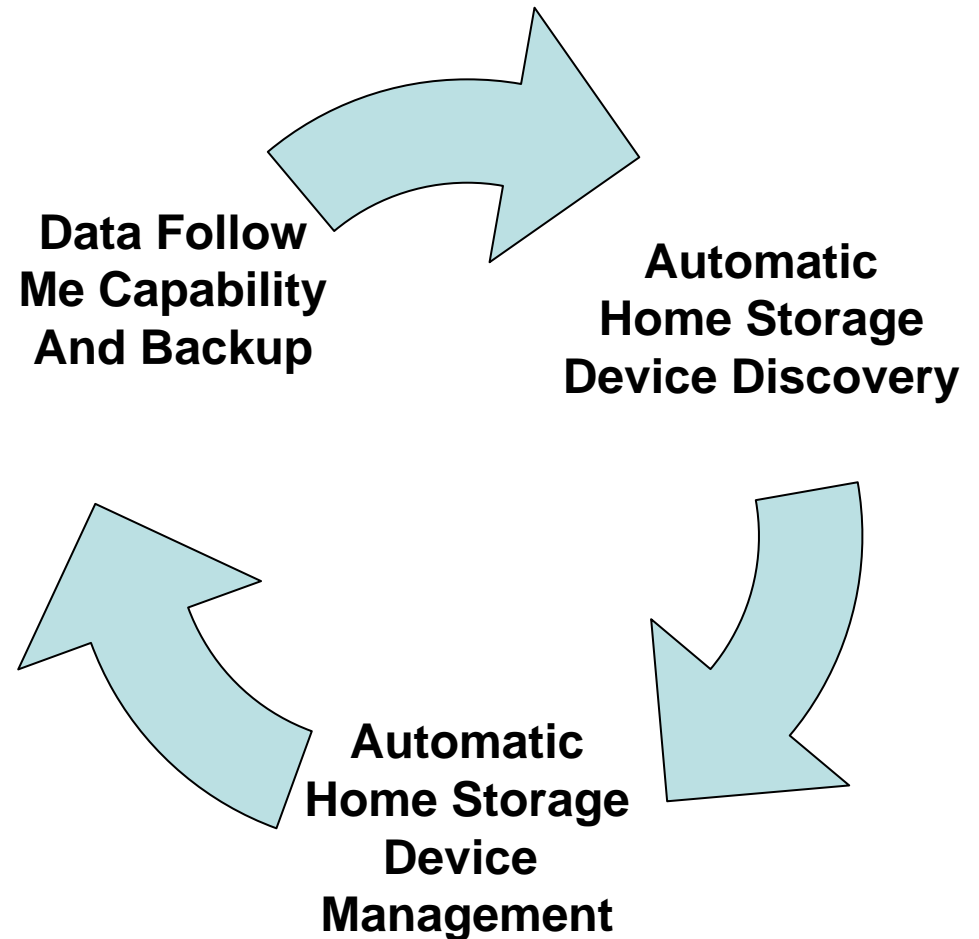
- There is a drive to reduce number of devices and increase ease of use in entertainment networking
- For many applications the digital storage device is highest cost items in the BOM
- Decreasing semiconductor line-widths increase the complexity that can be implemented on a chip allowing new functions and lower overall costs
- Reduced cost of CE products overall by eliminating second circuit board and integrating product test into drive burn-in
- Tighter integration of applications and digital storage could result in lower power usage and higher performance
- Many CE applications are reaching a level of maturity that they could be implemented as a sequence of standard command calls in the hard drive electronics

# Example of a Personal Media Player (PMP) implemented on a Hard Disk Drive



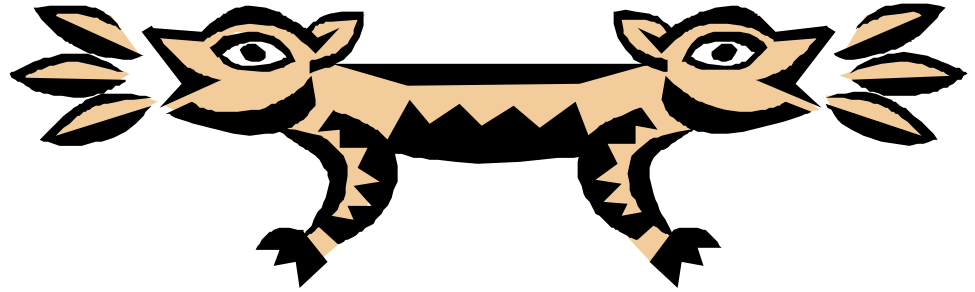
# Home Storage Utility

- Discovers any digital storage device in the home that is on the network
- Once detected a storage device is made part of the home storage pool
- The storage pool managing functions such as backup, synchronization and content distribution as well as traffic control
- Organizes and indexes all data in storage pool
- Watches your use of content anticipating your needs and prepositioning material for you.
- Protects itself from outsiders



Source: 2005 Integration of Storage in Consumer Electronics  
Coughlin Associates

# Conclusions



- Commercial and personal content will become the biggest drivers of digital storage growth
- Personal content creation could greatly exceed commercial content by the next decade
- Hard disk drives provide economical mass storage for many content applications enabling higher resolution content creation, distribution and consumption
- Economic forces will drive increased electronic integration of digital storage and CE applications
- The growth of storage devices in the home combined with increased use of home networking will bring new levels of storage virtualization into the home



**Thank  
you!**

# Sources

- **2006 Entertainment Creation and Distribution Digital Storage Report**, Coughlin Associates (November 2006)
- **2006 Digital Storage in Consumer Electronics**, Coughlin Associates (December 2006)
- **Trends in Digital Home Storage: Defining the Opportunities for Network-Attached Storage**, Tom Coughlin, Coughlin Associates, TDG Report, 2005
- Presentations at **2006 Storage Visions Conference** ([www.storagevisions.com](http://www.storagevisions.com))
- **The Development of Digital Storage for Consumer Electronics**, Presented at July 2006 ISCE Conference

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