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By 2008, Consumer Electronics (CE) Hard Disk Drive (HDD) shipments will grow to 30% of total HDDs and External Storage will account for 10%.
Growing Use of Hard Drives for Storage in Homes

By 2010, 10 – 20 HDDs in each household
Innovation is Driving CE Market Penetration

- In portable handheld products...
  - low power
  - small form factor
  - simple interface
  - high shock tolerance

- In products used in the home...
  - high performance
  - quiet
  - supporting security features

- Common to both markets...
  - low cost
  - high capacity

Hitachi 1.0” Microdrive
- 6GB CF+II

Hitachi Deskstar 3.5”
- 500GB Serial ATA

Hitachi Travelstar 2.5”
- 7200 RPM
- 100GB
Small Form Factor - Drive Miniaturization

Continuous innovation in drive capacity and miniaturization has enabled penetration of, first IT markets, and now Consumer Electronics markets.
Small Form Factor - Hitachi Microdrives

- Microdrives invented by IBM hard drive team (now Hitachi) in 1990s
- Hitachi leading the 1.0” industry
  - #1 market share
  - Shipping fourth generation drive
  - Growing number of customers and applications
- Progress over five years

<table>
<thead>
<tr>
<th>Year</th>
<th>Max. Capacity</th>
<th>Volume</th>
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<tr>
<td>1999</td>
<td>340 MB</td>
<td>&lt; 100 k</td>
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<tr>
<td>2004</td>
<td>4 GB</td>
<td>&gt; 3 M</td>
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- Hitachi’s newest Microdrive - Mikey”
  - 8 – 10 GB
  - 20% smaller footprint
  - New ZIF connector, new interface (CE-ATA)
  - Lower power
  - Improved operating shock
  - Available later this year
Small Form Factor  -  1.8-inch Travelstar “Slim”

- **Reduced Size and Volume**
  - 54mm x 71mm x 5mm
  - 28% smaller by volume than current Hitachi 1.8” drive

- **Easy Integration with embedded design**
  - ZIF connector
  - Support for PATA and CE-ATA (future)

- **Single disk (5mm) and 2 disk (8mm) models**
  - 30 – 40 GB (single disk), 60 – 80 GB (two disk)

- **Greater shock robustness**
  - 10 – 20% improvement

- **Low Power Electronics**
  - 10% - 20% reduction in power

- **Available in 2nd half 2005**

2.5-inch Travelstar®

“Slim” 1.8-inch Travelstar®

1.0-inch 4GB Microdrive®

1.0-inch “Mikey,” the baby Microdrive®
High Capacity - Perpendicular Technology

Growth of Recording Densities
(Gigabits/square-inch vs. Year-of-Introduction)

Simple scaling allowed for increasing areal density for many years at 30% CGR.

In 1990’s rate of increase greatly accelerated to 60-100% CGR.

“Superparamagnetic” effect now poses a significant challenge.

Perpendicular technology required.

Thermal Stability Limited Region

Areal Density (Gb/in²)

Year

Perpendicular Technology Introduction

- Strengths and long-term experience of Hitachi Research teams and Development teams in both the US & Japan are being leveraged to develop perpendicular recording
- Major technology changes required: Media, Heads, & Read/Write Electronics
- Emphasize quality, reliability, & robustness throughout the technology introduction
- Conduct exhaustive additional testing to uncover all possible issues!

Perpendicular HDD Sample
- 100 GB Capacity, 2.5” form-factor, 4200 rpm, Standard ATA interface

Field Test
- In everyday use by persons inside and outside Hitachi
Simple Interfaces  -  The Need for CE-ATA

- Primary small form factor HDD interface is CF+, i.e. **Parallel ATA crammed into a small space**
  - All the parallel ATA baggage is included: 50 pin interface, 5V tolerance, bloated command set

- CE segment has even greater need for efficient integration than desktop segment

- PATA already being displaced by Serial ATA in desktop due to integration issues (high pincount, 5V tolerance, …)

- Serial ATA is not ideal for tiny handheld gadgets where easy integration and power efficiency are the most important factors
Optimize power, performance, pin-count, and protocol
- **Power:** Small number of low-voltage transceivers with low static power consumption
- **Performance:** Scalable transfer rates appropriate for needs of SFF drives (range from modest transfer rates to up to 50MB/s)
- **Pin-count:** Only 6 or 10 interface signals depending on performance needs (plus power and ground pins)
- **Protocol:** Reduced feature set, streamlined ATA command set, and simple digital protocol

Enable fast TTM for initial solutions
- Some existing hosts can support with no hardware modifications
- Leverage ATA, a proven command set
- Built on MMC, a proven and established electrical interface

CE-ATA is an optimized HDD interface for handhelds that builds on proven technologies
CE-ATA Initiative Status and Roadmap

- CE-ATA protocol specification was ratified & published in March
  - Initiative formation announced at IDF 9/04 and completed specification published just 6 months later!

- Download the protocol specification at www.ce-ata.org

CE-ATA protocol specification already delivered just 6 months after formation
CE-ATA Initiative Status and Roadmap

- Solid cable/connector draft specification for embedded applications delivered to CE-ATA members

- Cooperative relationship with the MMCA organization established and announced

- CE-ATA product support has been announced as early as 2H’05

Technology delivered to support products as early as 2H’05
CE-ATA Summary

- CE-ATA is an optimized HDD interface for handhelds that builds on proven technologies

- Solid specifications already delivered supporting products as early as 2H’05

- CE-ATA adds enhancements to MMC to deliver an optimized HDD interface

- CE-ATA streamlines ATA to the bare essentials
Brodest Product Line in the Industry

3.5” Ultrastar
- 15K & 10K RPM
- Quality & reliability

3.5” Deskstar
- 7200 RPM
- Parallel & Serial ATA

2.5” & 1.8” Travelstar
- 7200/5400/4200 RPM
- Capacities to 100GB

Microdrive, Endurastar, iVDR
- Lightweight & Rugged
- Portable
HITACHI
Inspire the Next