Hitachi Global Storage Technologies
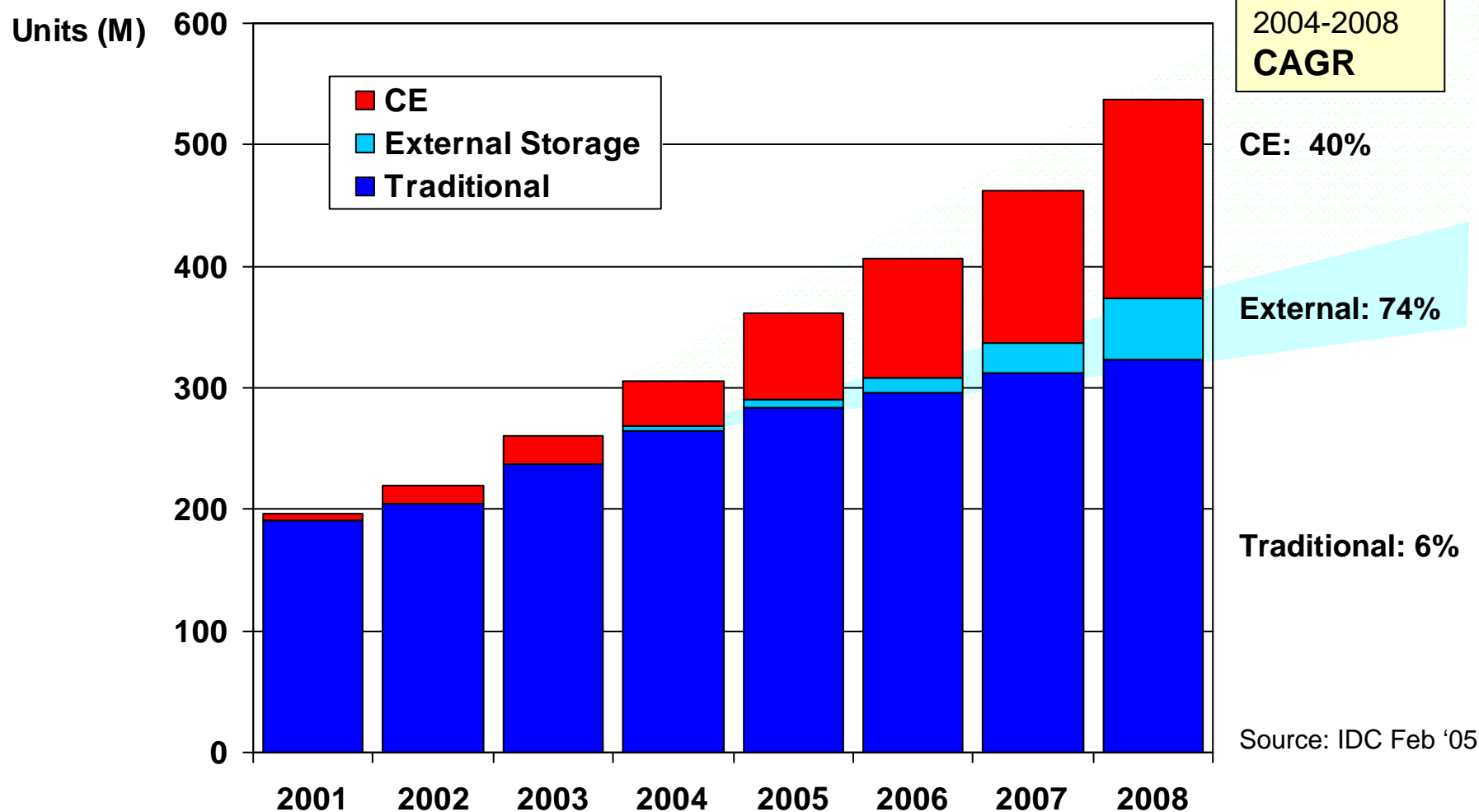
f r e e d o m t o i n n o v a t e

John Osterhout
Director of Marketing

IEEE Conference
June 27, 2005

Market Growth for Hard Disk Drives

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

Units (M)

Legend:
- CE
- External Storage
- Traditional

2004-2008 **CAGR**

CE: 40%

External: 74%

Traditional: 6%

Source: IDC Feb '05

X-axis: 2001 2002 2003 2004 2005 2006 2007 2008

Growing Use of Hard Drives for Storage in Homes

By 2010, 10 – 20 HDDs in each household

Digital Still Camera
Digital Video Camera

PMC

DVR

MP3

Mobile Manager

Laptop

PC

Gaming

GPS & Telematics
Entertainment System

iVDR

Home Server

Converged Mobile Phone

Desktop Audio

Innovation is Driving CE Market Penetration

Hitachi 1.0" Microdrive

- **In portable handheld products…**

  … low power

  … **small form factor**

  … **simple interface**

  … **high shock tolerance**

6GB CF+II

Hitachi Deskstar 3.5"

- **In products used in the home...**

  … **high performance**

  … **quiet**

  … **supporting security features**

500GB
Serial ATA

Hitachi Travelstar 2.5"

- **Common to both markets…**

  … low cost

  … **high capacity**

7200 RPM
100GB

1956 RAMAC
- **5 Mbytes**
- **Fifty 24" disks, 1200 RPM**
- **2000 bits/in2**

50 years ago

21 years ago
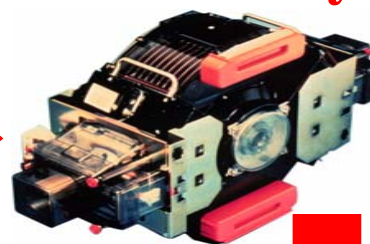
3380
- **1.2 GB**
- **Nine 14" disks, 3600 RPM**
- **12 Mb/in^2**

25kg

**1/1562 weight
5X capacity**

2005

2.5" Mobile
- **100 GB**
- **Two 2.5" disks, 7200 RPM**
- **81 Gb/in^2**

Microdrive
- **6 GB**
- **One 1"disk, 3600 RPM**
- **78 Gb/in^2**

16g

Continuous innovation in drive capacity and miniaturization has enabled penetration of, first IT markets, and now Consumer Electronics markets.

- **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**

Year	Max. Capacity	Volume
1999	340 MB	< 100 k
2004	4 GB	> 3 M

- **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**

"Slim" the new, thinner 1.8" hard drive

- #2 pencil
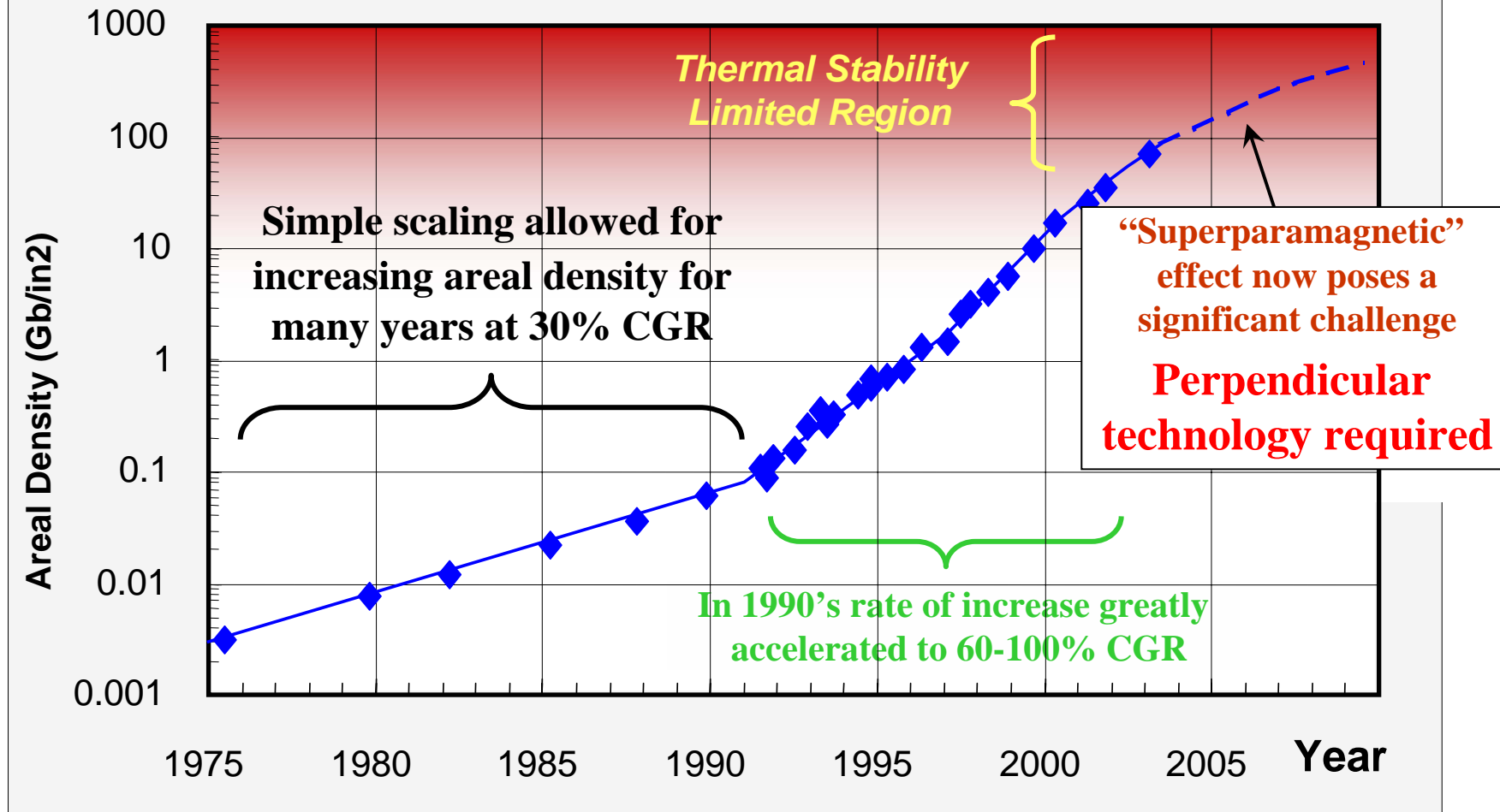- 2.5-inch Travelstar®
- "Slim" 1.8-inch Travelstar®
- 1.0-inch 4GB Microdrive®
- 1.0-inch "Mikey," the baby Microdrive®

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

Areal Density (Gb/in2)

Thermal Stability Limited Region

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

"Superparamagnetic" effect now poses a significant challenge

Perpendicular technology required

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

1975   1980   1985   1990   1995   2000   2005   **Year**

HITACHI
Inspire the Next

■ **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

HITACHI
Inspire the Next

- **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

From IDF 9/04

■ **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 Digital Protocol

Revision 1.0
2-March-2005

1.0 adoption on 3/2/05

Hitachi Global Storage Technologies, Inc.
Intel Corporation
Marvell Semiconductor, Inc.
Nokia Corporation
Seagate Technology LLC
...ba America Information Systems, Inc.

CE-ATA protocol specification already delivered just 6 months after formation

- **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**
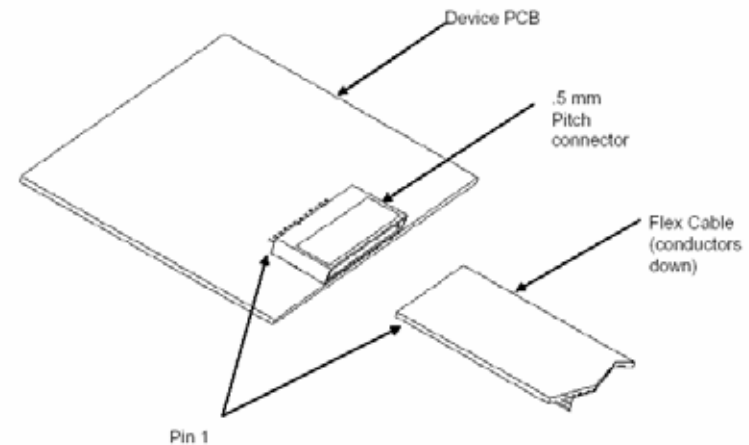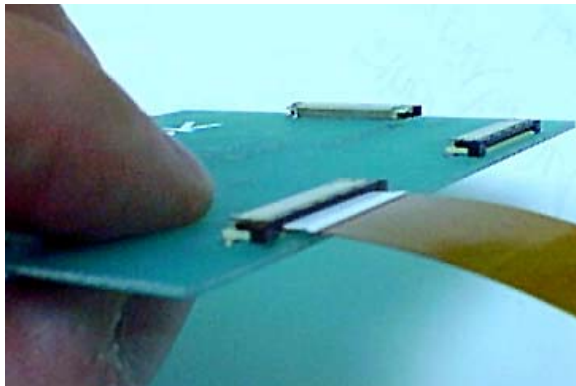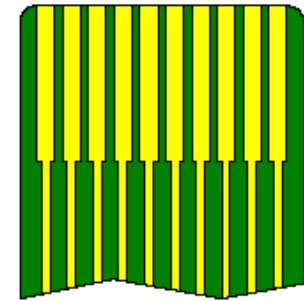
Technology delivered to support products as early as 2H'05

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**

3.5" Ultrastar

- 15K & 10K RPM
- Quality & reliability

15K RPM

10K RPM

3.5" Deskstar

- 7200 RPM
- Parallel & Serial ATA

**500GB
Serial ATA**

2.5" & 1.8" Travelstar

- 7200/5400/4200 RPM
- Capacities to 100GB

**5400 RPM
100GB**

ATA

"Slim"

ZIF

**7200 RPM
100GB**

4200 RPM

Microdrive, Endurastar, iVDR

- Lightweight & Rugged
- Portable

"Mikey"

6GB CF+II