Future of Intelligent Storage

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Outline

Seagate Research

Intelligent Storage:
- Definitions & Goals
- History
- Future…?
Seagate: Storage Leader

• Seagate is the world’s leading provider of hard disc drives
  – Q3 FY2007*: 39.5M drives shipped; revenue of $2.8B

• Provides storage solutions for Enterprise, Desktop, Mobile Computing, Consumer Electronics and Branded Retail markets
  – Share leader in Desktop, Enterprise and Consumer Electronics
  – 35% overall market share: highest in the industry
  – Broadest product offering in the industry – Largest customer base

• Ownership and vertical integration of critical technologies: heads, media, motors, and printed circuit boards

• Approximately 54,539** employees worldwide

• Acquired Maxtor Corporation on May 19, 2006

• Forbes Magazine 2006 “Company of the Year”
Seagate’s Global Presence

- Emeryville, Fremont, Milpitas, Sunnyvale, Scotts Valley, CA
- Oklahoma City, OK
- Longmont, CO
- Minneapolis, MN
- Toronto, Canada
- Pittsburgh, PA
- Shrewsbury, MA
- Bray, Ireland
- Amsterdam, Netherlands
- Paris, France
- Beijing, China
- Wuxi, China
- Bangkok & Korat, Thailand
- Delhi, India
- Penang & Senai, Malaysia
- Ang Mo Kio, Science Park & Woodlands, Singapore
- Minneapolis, MN
- Oklahoma City, OK
- Longmont, CO

Locations:
- Drives and Components Regional HQ’s and Sales Design Customer Support Seagate Services
- Tokyo, Japan
- Suzhou, China
- Shanghai, China
- Taiwan, China
- Pittsburgh, PA
- Suzhou, China
- Shanghai, China
- Taiwan, China
Digital Content Explosion

...Between 2006 and 2010, the information added annually to the digital universe will increase more than six fold from 161 exabytes (or 161 million Moose 1TB drives) to 988 exabytes...
(The Expanding Digital Universe – an IDC whitepaper sponsored by EMC)

...We believe global online ad spending, now around $32 billion (in 2006), will exceed $80 billion by 2011 (20% CAGR)...We believe Google is the most important company to watch over the next ten years in the Internet...the combination of Google’s strong market share, brand in search, and aggressive innovative strategy on new products aligns Google more than any other company with the new User-based media.

...Most large businesses are reaching the limit of their available space and are struggling to host new equipment...The problem, however, is not only about available data center space...but needs [for] a considerable amount of power and cooling.
(A Message From Data Center Managers to CIOs: Floor Space, Power and Cooling Will Limit Our Growth – Gartner)
Installed base is growing...

U.S. Market

Spending (US$B)

- New server spending
- Power and cooling

Installed base (M units)
Digital Content Landscape Forming

Network Infrastructure

Content Aggregators

Content Creation

Content Enjoyment

Storage

Broadband, Cable, Satellite...

Google, Flickr, iTunes, MySpace...

Video, Photos, Movies, Music...

DVRs, HH, Gaming, Cars, Backup...
Users Want a Personal Experience

• Users are fragmenting
• They want personalized, interactive & on-demand content
• Everyone is a publisher, producer, reporter, etc.
• Users want tools to gain access to content beyond what they already know
• Young users will readily adapt new technology

Source: Seagate Technology
Seagate Research Mission

To create, develop and evaluate advanced recording systems, components, materials, processes and technologies for future storage products that will address market and customer needs 4-10 years in the future.
Intelligent Storage Definitions

- Provides secure access to features or services
- Capable of processing data
- Contextually aware
- Supports peer to peer cooperation
Intelligent Storage Goals

- Improve internal HDD operations
- Migrate S/W stack functions onto HDD enabling value
Seagate Storage Systems Research

Optimizing system-level reliability
- reliability mgmt through workload-specific failure & recovery models
- extends system-level performance

Data-aware processing
- understand and optimize for the structure of stored data via common data types – video, audio, email
- in future – actually process content

Integrated and interoperable security
- seamless data protection across the entire Seagate product line
- content protection (DRM) in CE
- privacy-enhanced drives and secure erase in desktop / notebook
- encryption, secure erase, and audit trails in archive / nearline

OSD (Object-based Storage Devices)
- space mgmt inside drives
- interface standard ratified Sept 2004
- external demo IBM/Seagate in Apr 2005

DriveTrust (on-drive security)
- disc drives as a core trusted component
- dCards – drive-enhanced smart cards
- full-disc encryption for secure delete
- drive locking – links drives to hosts
- Momentus FDE announced June 2005
OSD
Security

ATA Commands

Encrypt/Decrypt

ATA Commands

SeaCos commands

dCards

LBA0

User Addressable Space

Max LBA

System sectors

RD/ WR

Trusted Send/Receive
Automatic video object synchronization/backup

Transparent video object analysis and indexing

Game highlights where John scores/assists in SD please!
BTW, sync my contacts!

Mission Impossible III in HD to go please!

Wireless Home Network w/ seamless object synchronization

Seagate

UM DTC ISW5
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Future…?

Time to re-evaluate long term research agendas around intelligent storage devices

1. Applications of devices?
2. How do we understand changes needed in devices?
Questions to consider:

What new or migrated S/W Stack functionality would improve:

- End user value or experience?
- OEM system performance or reliability?
- OEM operations – yields, cycle time, warranties, etc.?

What new functions would improve:

- Capacity, Performance or Reliability?
- HDD operations – yields, cycle time, warranties, etc.?

You have all worked with HDD’s, based on your experience, what research projects do you think we should begin?