Emerging Technology

Hard Disk Drive System Architectures
ATA - Coming of Age

Dave Hughes -- Vice President of Engineering, ExaDrive Networks
Why ATA Disk Technology?

• “Once viewed as strictly a desktop or mobile play, parallel IDE -- specifically, Ultra ATA/100- has been making great strides in traditional high-end SCSI markets. Problems with its performance, capacity, and even scalability have become relative non-issues...”

  – INFOSTOR, ATA Goes Beyond the Desktop, October 2000
• “In certain markets and for certain applications, ATA can be a low-cost alternative to SCSI. As a result, analysts expect ATA to penetrate entry-level server, RAID, and network-attached storage (NAS) segments. ‘There's no doubt that ATA is going to invade this market,” says Dave Reinsel, senior research analyst at International Data Corp. ‘It’s already happening.’ ”

– INFOSTOR, *ATA Goes Beyond the Desktop*, October 2000
“Generally, disruptive innovations are technologically straightforward, consisting of off-the-shelf components put together in a product architecture that is often simpler than prior approaches.”

Clayton M. Christensen, *The Innovator’s Dilemma*
Why ATA Disk Technology?

- Most common disk technology used today
- Lowest cost disk/interface technology
- Evolved to be high performance and reliable:
  - 100MB/sec transfer speeds
  - Overlapped command support
  - Command queuing support
  - Double clocked transfers
  - Complete error detection on transfers
    -- Advanced CRC and ECC protection
  - 5400/7200 RPM drive speeds
  - Ultra reliable mechanisms and disk platters

Perfect for “In the Box” storage connectivity
Drive Solutions Compared

Cost of Storage

- ATA HDD: $0.004
- SCSI HDD: $0.020
- DLT Tape: $0.054
- Optical: $0.42

ATA: Lowest cost/MB

Volumetric Comparison

- ATA HDD
- SCSI HDD
- DLT Tape
- Optical

ATA: Highest volumetric density

Cost of Data Transfer Rate

- ATA HDD: $7.04
- SCSI HDD: $17.91
- DLT Tape: $360.00
- Optical: $473.00

ATA: Lowest Cost/MB/Sec

Average Access Time

- ATA HDD: 14.5 ms
- SCSI HDD: 9 ms
- DLT Tape: 60000 ms
- Optical: 35 ms

ATA: Adequate performance

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Exabytes and Interfaces

- ATA outships all other interfaces
  - ATA “sweet-spot” capacities are growing at 85% annually
  - SCSI/FC “sweet-spot” capacities are growing at 58% annually
- ATA disk drives are encroaching in enterprise applications:
  - Workstations
  - Entry NAS
  - Entry servers

“By 2004, 20% of entry servers will use ATA”
-IDC, 2000

Source: Composite Trendfocus, Dataquest, IDC, 2000
Application Considerations

OLTP

Includes high performance processors, disk drives and large memory. Connectivity via FC or Gigabit Ethernet. IOPS is King.

File Sharing

Challenge of high capacity, high performance and competitive cost. Connectivity via 10/100 Ethernet. Interoperability is King.

Archive/Nearline

Highest capacity. “Better than tape library performance”. Connectivity via 10/100 or Gb/sec Ethernet. $/MB and sustained throughput are Key.

Client Backup

Assertion: 10% of the data generates 90% of the IO

Database

Video Delivery

Server Replication

eMail

Workstation Storage

Increasing Performance

Increasing Cost/MB

SCSI Storage

ATA Storage

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# ATA vs. Other Disk Technologies

<table>
<thead>
<tr>
<th>Connectivity</th>
<th>IDE</th>
<th>ATA</th>
<th>SCSI</th>
<th>Fibre Channel</th>
</tr>
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<tbody>
<tr>
<td>Max Devices</td>
<td>2</td>
<td>2</td>
<td>16</td>
<td>126 / Millions</td>
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<td>Cable Length</td>
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<td>18”</td>
<td>25 m</td>
<td>10 km</td>
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<td>160 MB/s</td>
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<td>Manageability</td>
<td>None</td>
<td>Low-Medium</td>
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<td>Medium+</td>
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ATA is perfect for “In the Box” storage connectivity
Disadvantages of ATA

• Not leading edge performance
  – 5400/7200 RPM vs. 10K/15K
  – Slightly slower access times

• Single ported / single initiator
  – Single point of failure makes it more difficult to do traditional H.A. implementation

• Reliability is a concern to some
  – ATA and SCSI disks are traditionally measured differently, hard to get accurate data.

• Can’t replace SCSI/FC
  – (but nobody’s saying it should)
ExaDrive Networks RAID Storage Arrays

The Performance of Fibre Channel Combined with the Affordability of Ultra ATA Disk Technology!

- Industry leading density - 2 Terabytes in a 3U 19” rackmount chassis
- Extraordinary performance - 400 MB/sec dual Fibre Channel interfaces
- SAN ready connectivity
- Advanced technology aggregates the power of many UltraATA disk drives for high performance
- Enterprise class reliability - hot swappable, fully redundant features
**ExaDrive Networks**

**Diamond Series**

- Dual 1Gb Fibre Channel interfaces (400MB/sec peak)
- 24 UltraATA disk drive capacity
- 2 Terabytes in 19” 3U rack chassis or deskside enclosure
- 950MB/cubic inch -- highest density in industry
- Only 150 watts/TB
- ADXT™ advanced technology for fast I/O and bandwidth performance
- In band, RS-232, ethernet management
- JBOD, RAID 0/1/10 configurable
- Upgradable disk drive, interface technology
- High Reliability/Accessibility/Serviceability features
- Dual power supply/blower assemblies
- O/S independent
- MSRP $45,000 (2.3¢/MB)

**Enterprise Level Storage**