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

Why ATA Disk Technology?

- **“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

ATA -- a Disruptive Technology

“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*

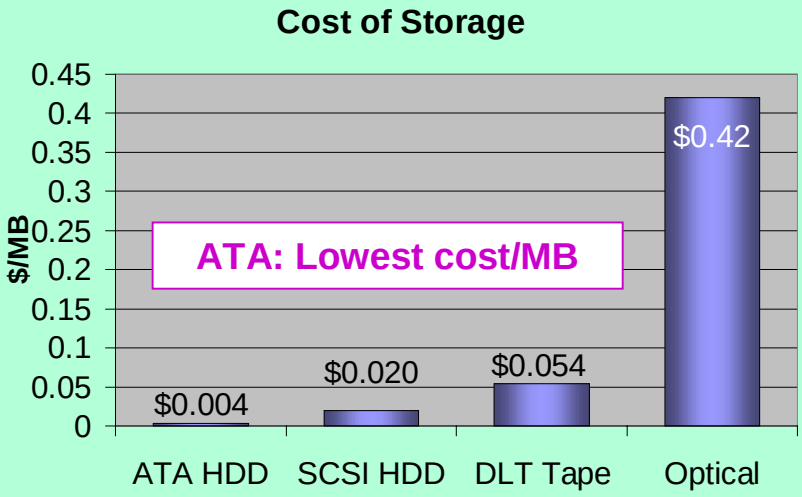
Why ATA Disk Technology?

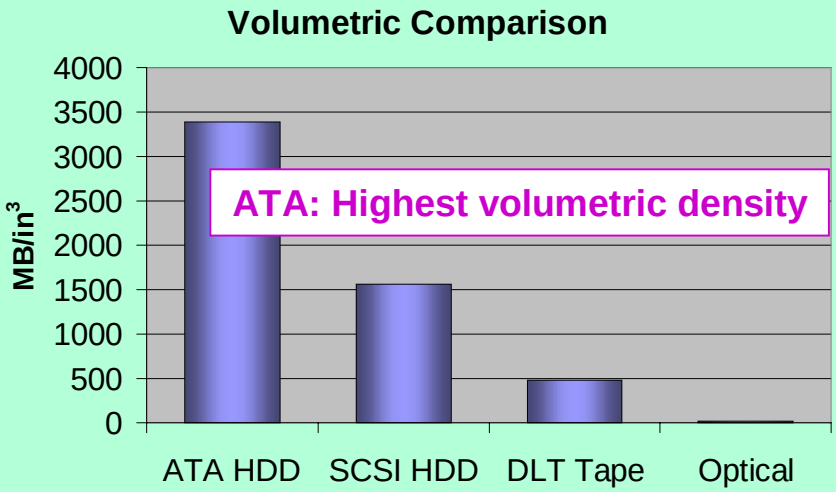
- **Most common disk technology used today**
- **Lowest cost disk/interface technology**
- **Evolved to be high performance and reliable:**
  - 100MB/sec transfer speeds
  - Overlapped command support
  - Command queuing support
  - Double clocked transfers
  - Complete error detection on transfers
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

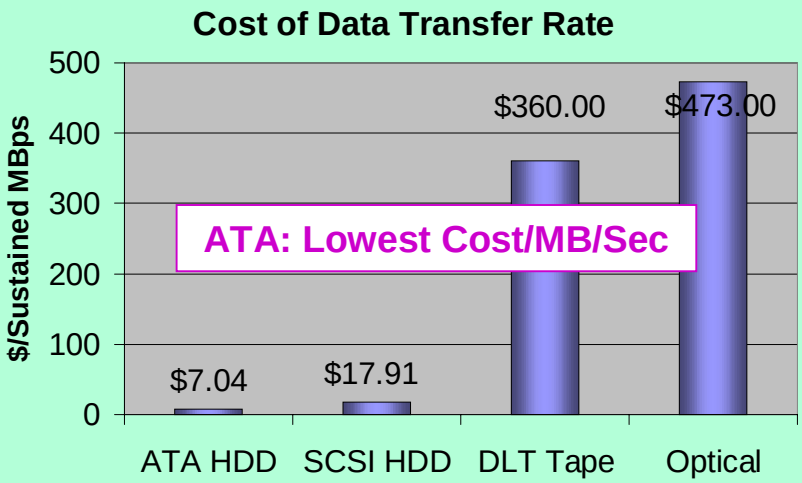
ExaDrive

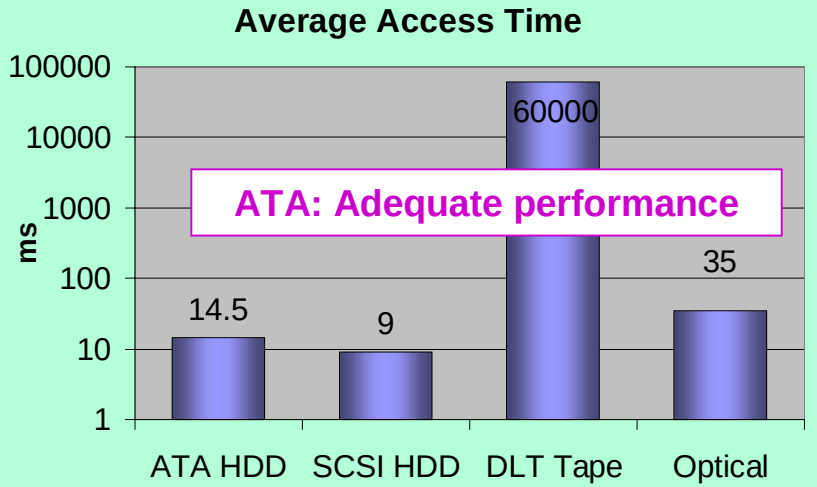
Perfect for "In the Box" storage connectivity

Drive Solutions Compared









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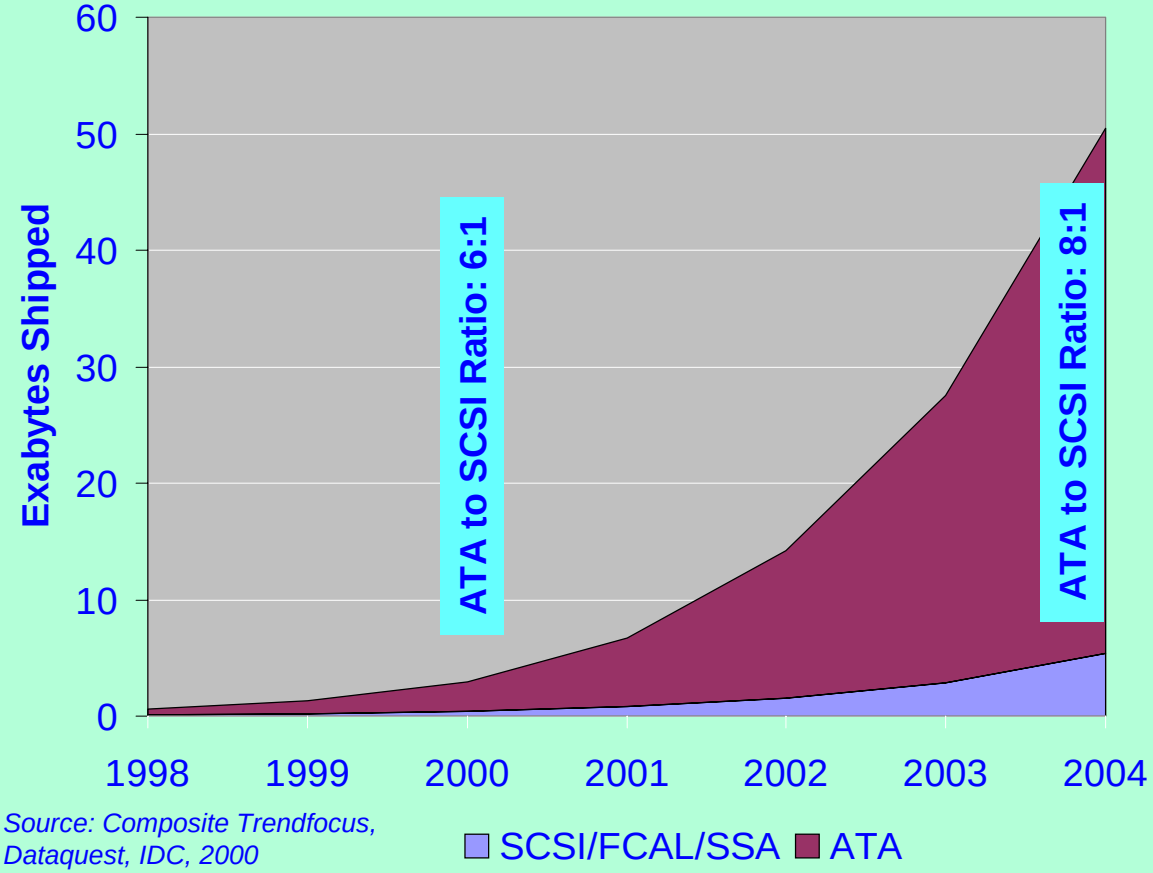
Exabytes and Interfaces



Source: Composite Trendfocus, Dataquest, IDC, 2000

- 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

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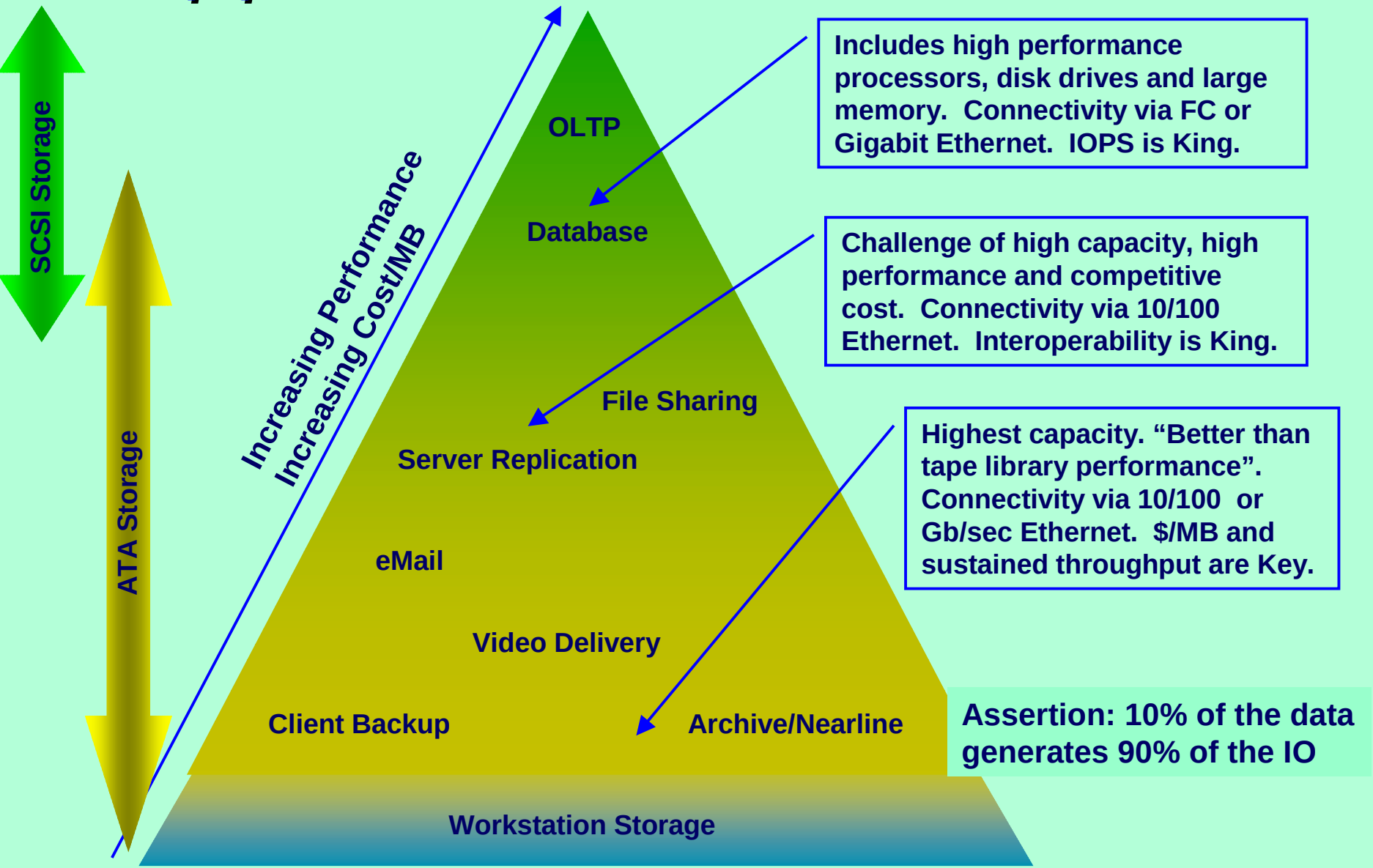
Application Considerations



ATA vs. Other Disk Technologies

	IDE	ATA	SCSI	Fibre Channel
Connectivity • **Max Devices** • **Cable Length**	2 18”	**2** **18”**	16 25 m	126 / Millions 10 km
Performance • **Bandwidth** • **Bandwidth / drive** • **Multi-threaded I/O**	16 MB/s 8 MB/s No	**100 MB/s** **50 MB/s** **Yes**	160 MB/s 10 MB/s Yes	200 MB/s 1.6 MB/s Yes
Max Initiators	1	**1**	<16	125 / Millions
Topologies	Bussed	**Bussed**	Bussed	Loop / Fabric
Error Detection	None	**Yes**	Yes	Yes
Protocol “Weight”	Very Light	**Light**	Med-Heavy	Heavy
Cost • **Interface** • **Drives**	N/A N/A	**Lowest** **Lowest**	Med-High Med-High	Highest Med-High
Manageability	None	**Low-Medium**	Medium	Medium+

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

The Leader in High Performance ATA Storage Technology

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