Serial Attached SCSI

- Better Performance, Scalability, and Reliability for better Storage Solutions
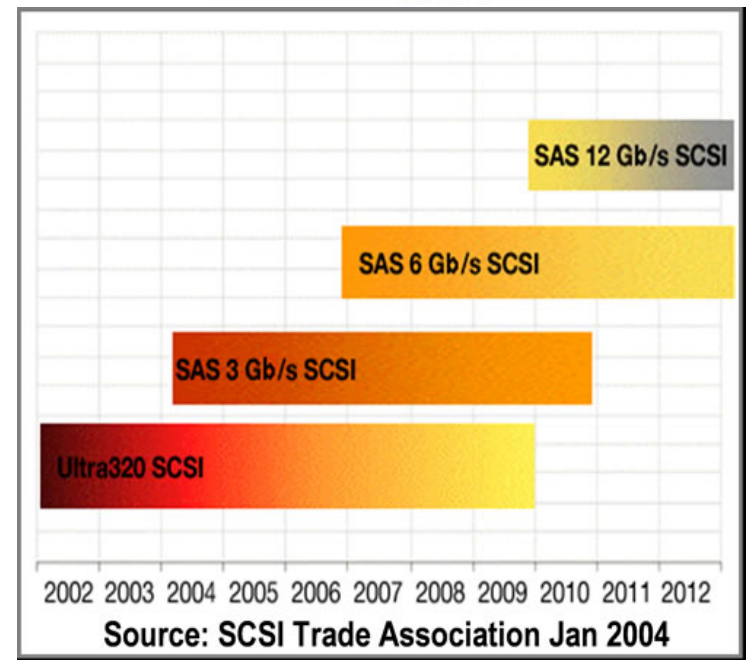

Presenting at Intel Booth #812
4/6/06

New Storage Challenges

- Companies are facing new storage challenges driven by rapid data growth, new applications that require high throughput and high availability, and new regulations that require long-term accessible data storage

- Shrinking budgets are making IT departments more cost-conscious than ever

- The SCSI interface can no longer keep up with these increased demands

- Fibre Channel and SATA interfaces force customers to choose between performance and budget
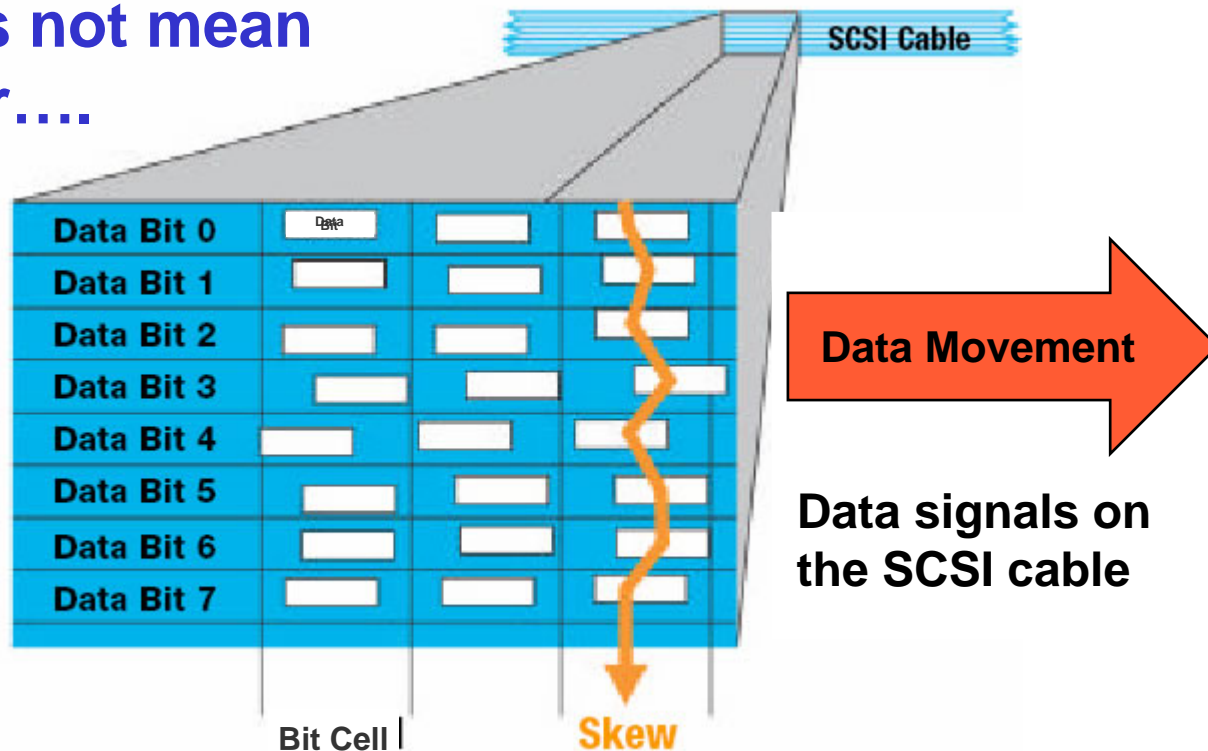
The Emergence of Serial Attached SCSI (SAS)

❖ Newest Storage Interface for Direct Attach Storage (DAS)

❖ SAS Improves & Builds on Parallel SCSI Foundation

  ➢ Supported by ANSI T10 Standards Committee (Same as SCSI)

  ➢ Successor to Ultra320 SCSI on Industry Roadmap

❖ Significant Performance & Feature Set Enhancements

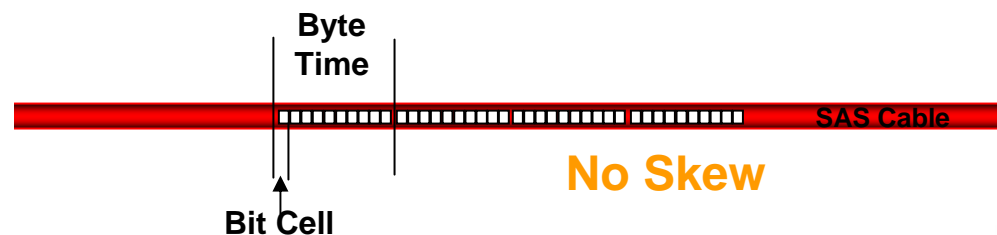Serial Attached SCSI

SAS 12 Gb/s SCSI

SAS 6 Gb/s SCSI

SAS 3 Gb/s SCSI

Ultra320 SCSI

2002 2003 2004 2005 2006 2007 2008 2009 2010 2011 2012

Source: SCSI Trade Association Jan 2004

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Serial Attached SCSI

Why Serial?

Parallel does not mean faster….

SCSI Cable

Parallel clock rate is limited by bit skew

| Data Bit 0 | Data Bit |
| Data Bit 1 |
| Data Bit 2 |
| Data Bit 3 |
| Data Bit 4 |
| Data Bit 5 |
| Data Bit 6 |
| Data Bit 7 |

Data Movement

Data signals on the SCSI cable

Bit Cell

Skew

Serial is self-clocking

Byte Time

SAS Cable

No Skew

Bit Cell

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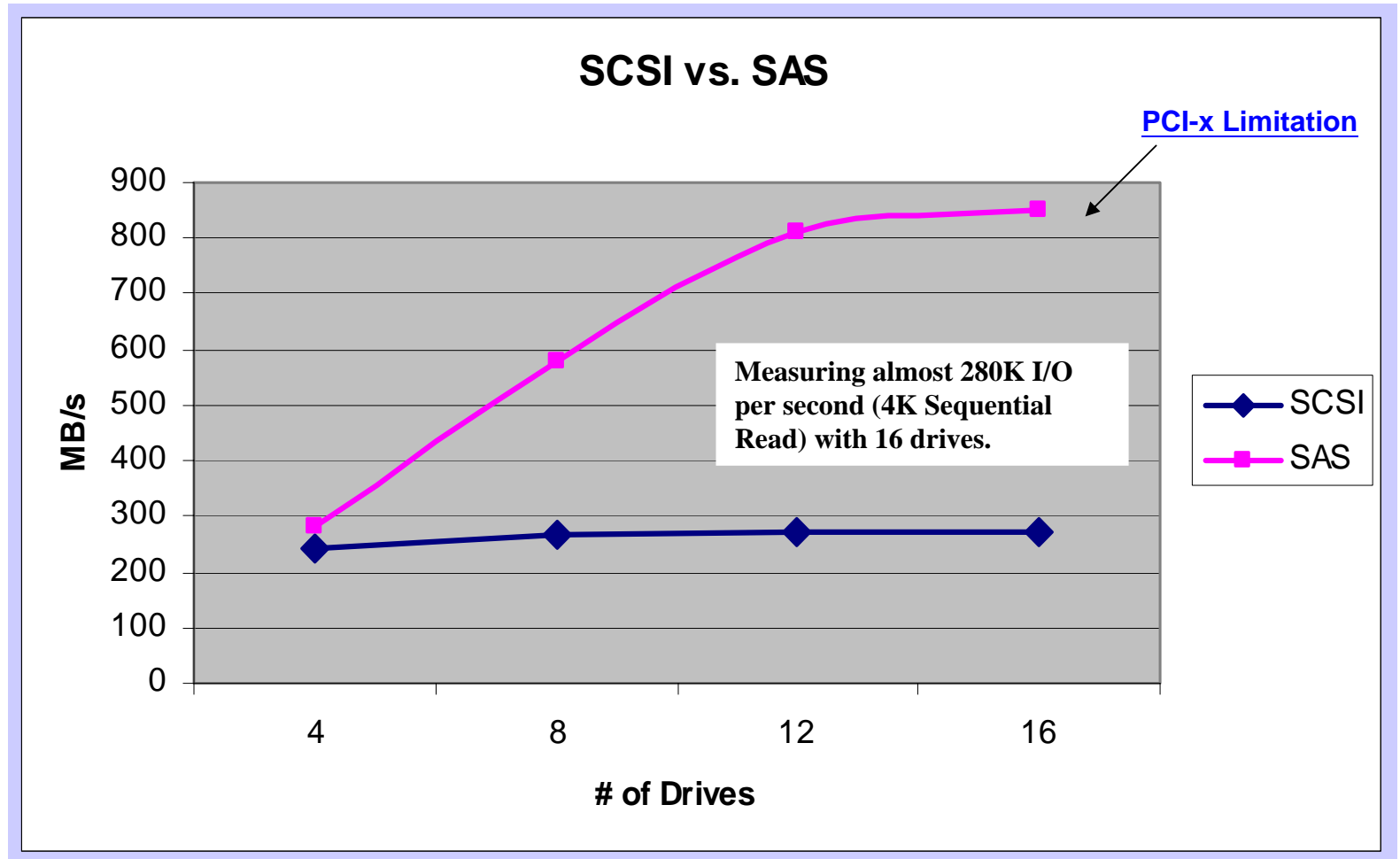Serial Attached SCSI

SAS Delivers Increased Performance

❖ 3 Gb/s (300 MB/s) Initial Transfer Rate Increasing to 12 Gb/s (1.2 GB/s) in Successive Generations

❖ Point to Point Connection with Dedicated Bandwidth

❖ Full Duplex Data Transfer Allowing Simultaneous Upstream & Downstream Data Flow Effectively Doubling Line Rate Performance

❖ Ability to Combine up to Four Ports to Aggregate Bandwidth (Wide Ports)

Parallel to Serial
Shared Bus to Point-to-point
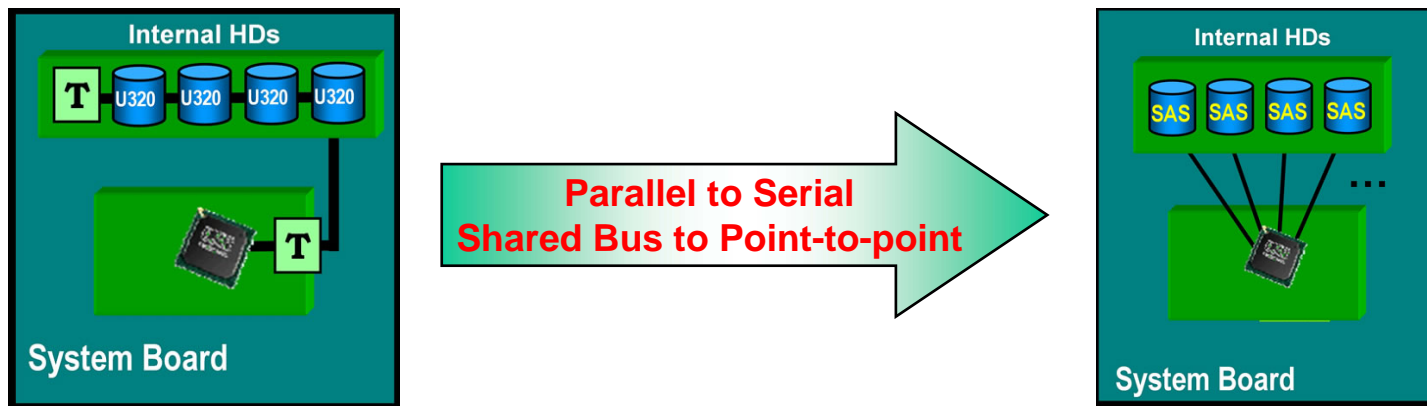
SAS Performs better than SCSI

SCSI vs. SAS

PCI-x Limitation

Measuring almost 280K I/O per second (4K Sequential Read) with 16 drives.

Fewer Signal Lines

❖ **As server form factors shrink,**

- Cabling becomes more difficult,

- Backplanes become harder to route,

- Small Form Factor HDDs are used to improve IOPs while reducing power and space requirements.
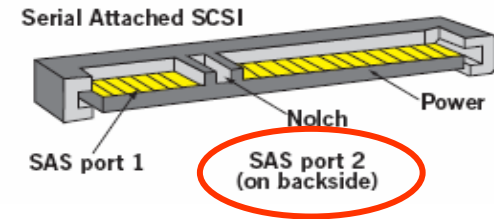
❖ **Serial technologies require less signal lines**

- Creating thinner cables to ease cable routing,

- Reducing backplane routing complexity,

- Enabling the use of smaller connectors with SFF HDDs

Parallel Cables

Serial Cables

Serial Attached SCSI
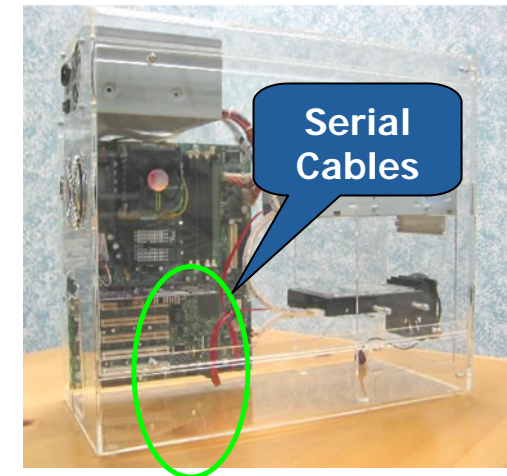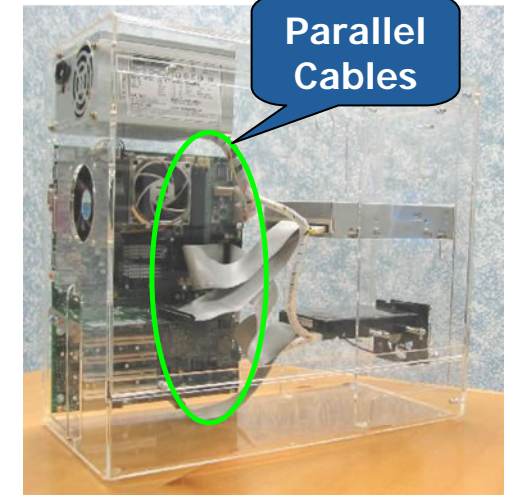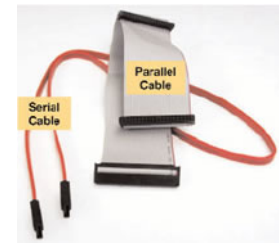
Serial Technology Enables Choice

✓ **One backplane accommodates SAS and SATA HDDs**
✓ **Dual-port is available for redundancy & high reliability server operations**

System Backplane

SAS Drives

SATA Drives

Serial Attached SCSI

SAS port 1
SAS port 2 (on backside)
Nolch
Power
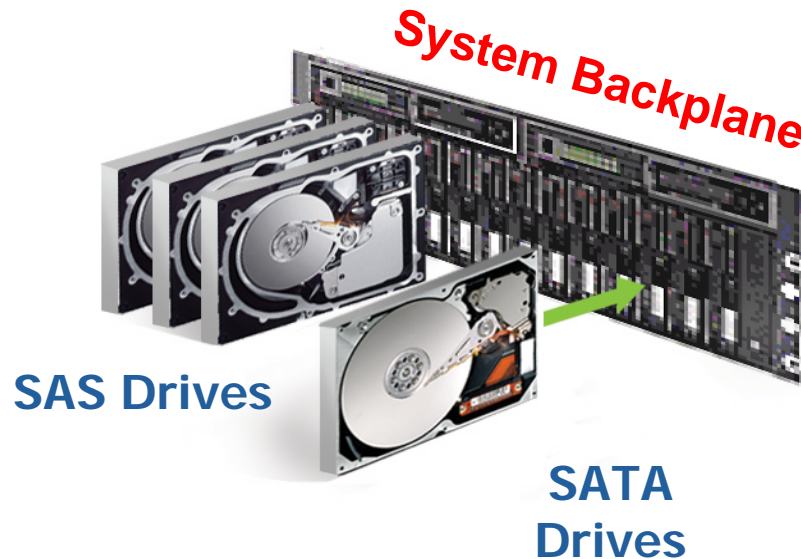
- High-performance & highly-reliable **SAS** disk drives can be used for mission critical and performance-oriented applications
- High-capacity **SATA** drives can be used for disk enhanced backup or reference data

SAS is Exceptionally Scalable

- SAS Supports up to 16,256 Devices in a Single Domain, greatly Improving on the 16 device limit of a Parallel SCSI Bus

- Each Device is Assigned a Unique World Wide Name (WWN) Making SCSI Bus IDs No Longer Necessary

- SAS Offers Cabling Distances of up to 8m

- Smaller Connector Size Enables Small Form Factor HDDs for increasing Drive Density and Spindle Count

- SAS Expanders Act as High Speed Switches Allowing Tremendous Flexibility in Application Configuration

SAS Controller   SAS Expander   SAS Expander

Benefits of Serial Attached SCSI
SAS vs. SCSI

Serial Attached SCSI Features	System Benefits
Point-to-point topology vs. sharing bus	Dedicated disk connections with scalable throughput
Performance starts at 3.0Gb/s (300MB/s) per link, Full duplex data transfer 6.0Gb/s version will available in 2007	Better performance and future investment protection
Work with expander for cascading devices	Allowing much higher capacity and scalability of storage system
Fewer signals than parallel buses	Easier routing for higher density (e.g. backplane design)
Thinner cables / small connectors	Improved chassis airflow / Enabling Small Form Factor HDD increasing Drive Density and Spindle Count
Disk/backplane interoperability	Flexible SATA or SAS HDD deployment
Dual port available	Providing high availability I/O (higher system reliability similar advantage to Fibre Channel Dual loop)

Serial Attached SCSI

SAS Board Overview

- X6DH3-G2 (Nocona/Irwindale) 8 ports / RAID 0, 1

- X6DHR-3G2 (Nocona/Irwindale) 8 ports / RAID 0, 1

- X6DHP-3G2 (Nocona/Irwindale) 8 ports (4 in, 4 out) / RAID 0, 1

- X6DA3-G2 (Nocona/Irwindale) 8 ports / RAID 0, 1

- PDSM3 (8 ports / RAID 0, 1) – Pentium D

- X7DA3/i   dual Xeon (Dempsey/Woodcrest), Greencreek Chipset,

- X7DB(G)3+/i+   dual Xeon (Dempsey/Woodcrest), Blackford (Greencreek) Chipset

- X7DB(G)R-3/i, dual Xeon (Dempsey/Woodcrest), Blackford (Greencreek) Chipset

- X7DB(G)P-3/E, dual Xeon (Dempsey/Woodcrest), Blackford (Greencreek) Chipset

- X7DB(G)A-3/i   dual Xeon (Dempsey/Woodcrest), Blackford Chipset

- All-In-One SAS ZCR card (additional RAID 5, 10 and performance)

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Serial Attached SCSI
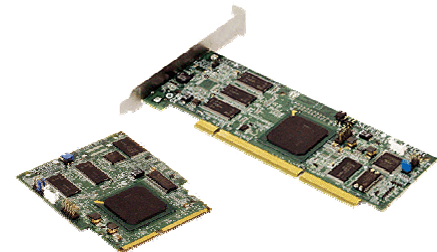
Supermicro SAS Motherboards

MODEL	X6DH3-G2 / X6DHi-G2	X6DHR-3G2 / X6DHR-EG2	X6DA3-G2 / X6DAi-G2	X6DHP-3G2
Processor	Dual 64-bit Xeon up to 3.80GHz (Paxville support)	Dual 64-bit Xeon up to 3.80GHz (Paxville support)	Dual 64-bit Xeon up to 3.80GHz (Paxville support)	Dual 64-bit Xeon up to 3.80GHz (Paxville support)
Chipset/ System Bus	Intel E7520 800MHz	Intel E7520 800MHz	Intel E7525 800MHz	Intel E7520 800MHz
Form Factor	Ext. ATX 12" x 13.05"	Ext. ATX 12" x 13.05"	Ext. ATX 12" x 13.05"	Proprietary 11.24" x 16.2"
Optimized Chassis	X6DH3-G2 2U: SC823T-R500RC, SC823T-550LP, SC823T/TQ-R500LP 3U: SC833T-R760, SC833T-550 Tower/4U: SC743T/TQ-R760, SC743T-650 X6DHi-G2 2U: SC823i-R500RC/550LP	X6DHR-3G2 1U: SC813TQ-500 SC813T-500 X6DHR-EG2 1U: SC812i-420	X6DA3-G2 Tower/4U: SC743T-645, SC743T/TQ-R760, SC743T-650 3U: SC833T-R760, SC833T-550 X6DAi-G2 Tower/4U: SC743i-645	1U: SC816A-700 (oem only) SC816A-R700 (oem only)
Memory Capacity & Slots	16 GB ECC Reg. DDRII 400 SDRAM in 8 DIMMs	16 GB ECC Reg. DDRII 400 SDRAM in 8 DIMMs	16 GB ECC Reg. DDRII 400 SDRAM in 8 DIMMs	16 GB ECC Reg. DDRII 400 SDRAM in 8 DIMMs
Expansion Slots	2 PCI Express x8 1 PCI-X 133MHz 2 PCI-X 100MHz 1 PCI	1 Universal PCI-X 133MHz or 1 PCI Express x8 1 Universal PCI-X 100MHz or 1 PCI Express x8	1 PCI Express x16 1 PCI Express x4 (using x16 slot) 1 PCI-X 133MHz 2 PCI-X 100MHz 1 PCI 33MHz	1 Universal PCI-X 100MHz/ 1 PCI Express x8 1 Universal PCI-X 100MHz/ 1 PCI Express x8
Onboard SCSI/ SATA/SAS/ SATA RAID	Adaptec 9410 controller for 8 SAS/SATA; RAID 0, 1 (X6DH3-G2 only) Intel 6300ESB controller for 2 SATA; RAID 0, 1	Adaptec 9410 controller for 8 SAS/SATA (4 Int. & 4 Ext.); RAID 0, 1 (X6DHR-3G2 only) Intel ICH5R controller for 2 SATA; RAID 0, 1	Adaptec 9410 controller for 8 SAS/SATA; RAID 0, 1 (X6DA3-G2 only) Intel ICH5R controller for 2 SATA; RAID 0, 1	Adaptec 9410 controller for 8 SAS/SATA (4 Int. & 4 Ext.); RAID 0, 1 (X6DHR-3G2 only) Intel ICH5R controller for 2 SATA; RAID 0, 1
Zero Channel RAID (ZCR) card support	AOC-LPZCR1 (X6DH3-G2 only)	AOC-SOZCR1 (X6DHR-3G2 only)	AOC-LPZCR1 (X6DA3-G2 only)	AOC-LPZCR1

SAS Chassis with SES2

SES2 (SCSI Enclosure Service 2) feature:
- ✓ Provide Drive Activity, Drive Failure, and Drive Presence Indication for each individual drive slot
- ✓ Include Drive Failure Alarm and an Overheat / Drive Fail / Drive Rebuild LED Indicator
- ✓ Temperature Monitoring

SUPER® SC813T/SC813TQ*-500

Form Factor:	1U Chassis supports up to 12" x 13" E-ATX Motherboard
CPU Support:	Dual 64-bit Xeon Processors
PCI I/O:	1 Full height full length and 1 low profile
Hard Drive Bay:	**4 SAS (w/SES2*) or SATA drive bays**
Peripheral Drives:	1 slim CD and 1 slim floppy drive
Cooling System:	2 x 5000rpm blowers
Power Supply:	500W cold-swap (+5V: 30 amp, +12V: 39 amp)
Dimensions & Weight:	17.2" (437mm) x 1.7" (43mm) x 25.6" (650mm) / 36 lbs.

SUPER® SC811T/SC811TQ*-520

Form Factor:	1U Chassis supports up to 12" x 10" ATX Motherboard
CPU Support:	Dual 64-bit Xeon Processors
PCI I/O:	1 Full height full length
Hard Drive Bay:	**2 SAS (w/SES2*) or SATA drive bays**
Peripheral Drives:	1 slim CD and 1 floppy drive (optional)
Cooling System:	2 x 5000rpm blowers
Power Supply:	520W (+5V: 20 amp, +12V: 39 amp)
Dimensions & Weight:	16.8" (426mm) x 1.7" (43mm) x 22.6" (574mm) / 28 lbs.

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Serial Attached SCSI

SUPER●® **SC823T/SC823TQ*-R500 (RC/LP)**

Form Factor: 2U Chassis supports up to 12" x 13" E-ATX Motherboard
CPU Support: Dual 64-bit Xeon, Pentium D & Pentium 4 Processors
PCI I/O: 7 low-profile full-length expansion slots
Hard Drive Bay: **6 SAS (w/SES2*) or SATA drive bays**
Peripherial Drives: 1 slim CD and 1 floppy drive
Cooling System: 4 x 6300rpm fans
Power Supply: 500W redundant w/I^2C(+5V: 30 amp, +12V: 32 amp)
Dimensions & Weight: 16.8" (426mm) x 3.5" (89mm) x 25.6" (650mm) / 50 lbs.

2U Low-Profile Expansion Slots

SUPER●® **SC733T/SC733TQ*-645**

Form Factor: Mid-tower Chassis supports up to 12" x 13" E-ATX Motherboard
CPU Support: Dual 64-bit Xeon, Pentium D & Pentium 4 Processors
PCI I/O: 7 expansion slots
Hard Drive Bay: **4 SAS (w/SES2*) or SATA drive bays**
Peripherial Drives: 1 floppy drive & 2 USB
Cooling System: 1 x 12cm & 1 x 9cm Pulse Width Modulated fans
Power Supply: 645W w/low-noise fan control (+5V: 30 amp, +12V: 46 amp)
Dimensions & Weight: 16.8" (427mm) x 7" (178mm) x 20.9" (531mm) / 40 lbs.

Mid-tower Workstation Chassis

SUPER●® **SC743T/SC743TQ*-R760**

Form Factor: Tower/4U Rackmount Chassis supports up to 12" x 13"
E-ATX Motherboard
CPU Support: Dual 64-bit Xeon, Pentium D & Pentium 4 Processors
PCI I/O: 7 tool-less expansion slots
Hard Drive Bay: **8 SAS (w/SES2*) or SATA drive bays**
90° Rotatable Module: 2 Front side USB 2.0, 2 x 5.25" drive bays, 1 floppy
100% Cooling Redundancy: 4 cooling fans, 2 exhaust fans and air shroud
Power Supply: 760W triple-redundant w/I^2C (+5V: 36 amp, +12V: 50 amp)
Dimensions & Weight: 17.8" (452mm) x 7" (178mm) x 25.5" (648mm) / 72 lbs.

4U/Tower Rackmount Server Chassis
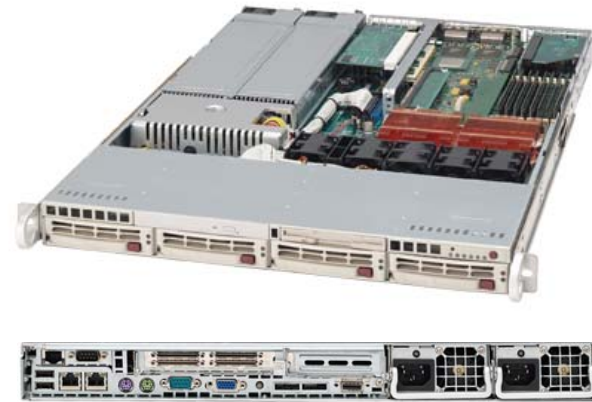
SUPERMICR●®

Serial
Attached
SCSI

Super Server With SAS
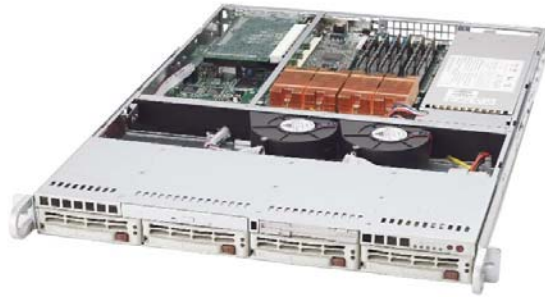
1U Rack mount server

2U Rack mount server

Tower or 4U Rack mount server

1U Rack mount redundant power server

SUPERMICRO®

SAS Mobile Rack and JBOD

Serial Attached SCSI

SUPERO® M28E1/M28E2

CSE-M28E1   CSE-M28E2

Backplane   Daughter card

M14 Mobile Rack

M14:
- Enclosure (single 5.25" drive bay) (x1)
- 2.5" hot swappable HDD trays (x4)
- 40mm x 28mm cooling fan (x1)
- Backplane (x1)
- Dimension (W)146mm x (H)42.5mm x (D)204mm
  (W)146mm x (H)42.5mm x (D)171mm (W/O fan)

Front View
- 8 x 2.5" hot-swap SAS HDD
- Fan fail detection LED & Alarm
- Overheat LED indication alarm
- HDD fail alarm & indication
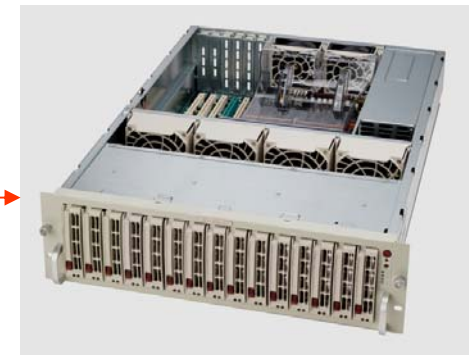- Two 5.25" drive bay enclosure (2U height)

Rear View
CSE-M28E1
- 8cm fan cooling subsystem
- CSE-M28E1: 1 expander supports SAS HDD

CSE-M28E2
- 8cm fan cooling subsystem
- CSE-M28E2: 2 expanders support dual-ports SAS HDD

3U JBOD (3.5" SAS)
SC836 – 16 Drives
SC933 – 15 Drives
Single or Dual Expanders

SUPERMICRO®

Serial Attached SCSI

Supermicro *All-in-One* ZCR Cards

❖ All-in-One Zero-Channel RAID Cards second generation:

  ❖ AOC-LPZCR2

❖ Take advantage of onboard SAS/SATA/SCSI onboard controllers to achieve hardware RAID.

❖ All-In-One: Support SAS/SATA/SCSI modes by jumper settings. Save cost without buying separate ZCR cards.

❖ Replace the old Adaptec SCSI DAC-0008(2010S), DAC-0009(2015S), SATA AOC-2020SA and AOC-2025SA.

❖ Better performance, cost-effective and complete solution.

❖ Support SAS mode SES-II enclosure management functionalities.

❖ Available now.
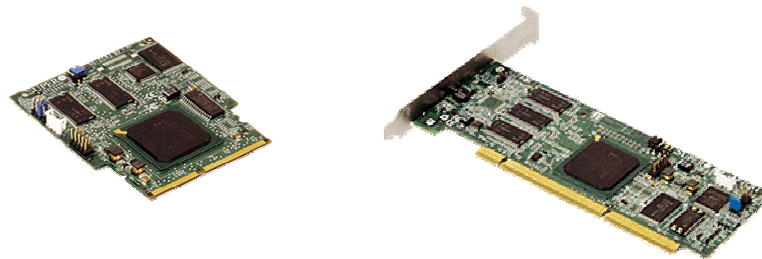
SCSI SAF-TE Enclosure Management and SES2: SCSI Enclosure Service 2

❖ SCSI Accessed Fault Tolerant Enclosures Industry standard to to interface with enclosed components

❖ Indicate disk drives failure with alarm and LED.

❖ Indicate disk drives rebuild through LED.

❖ Avoid human error, such as pulling out wrong disk drives.

❖ Temperature monitoring.

❖ SAF-TE chips:

  ▪ SCSI controlled by GEM318 firmware and I2C interface

  ▪ SAS controlled by AMI MG9071/9072 firmware and I2C interface. Downward compatible to support SATA disk drives.
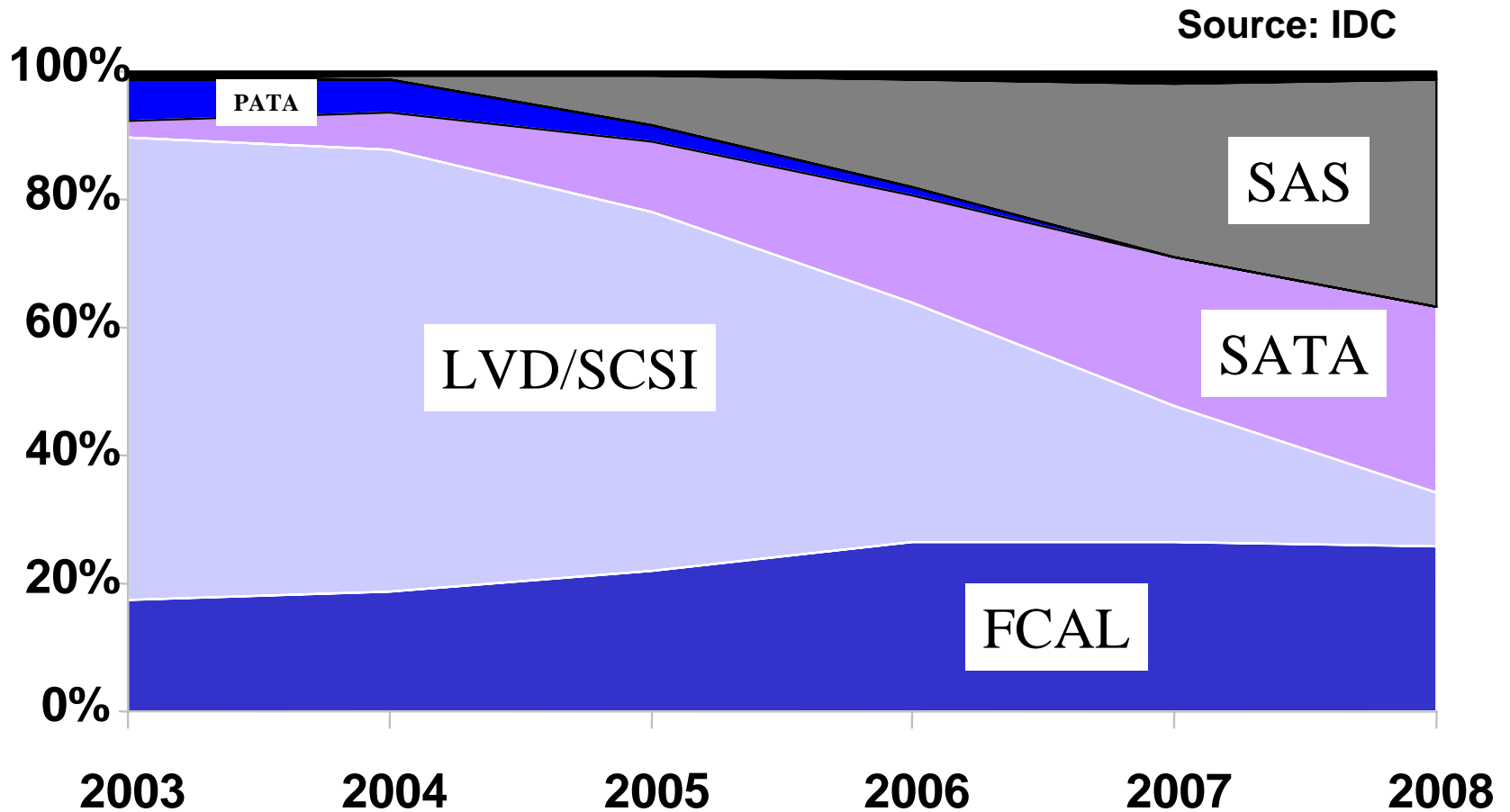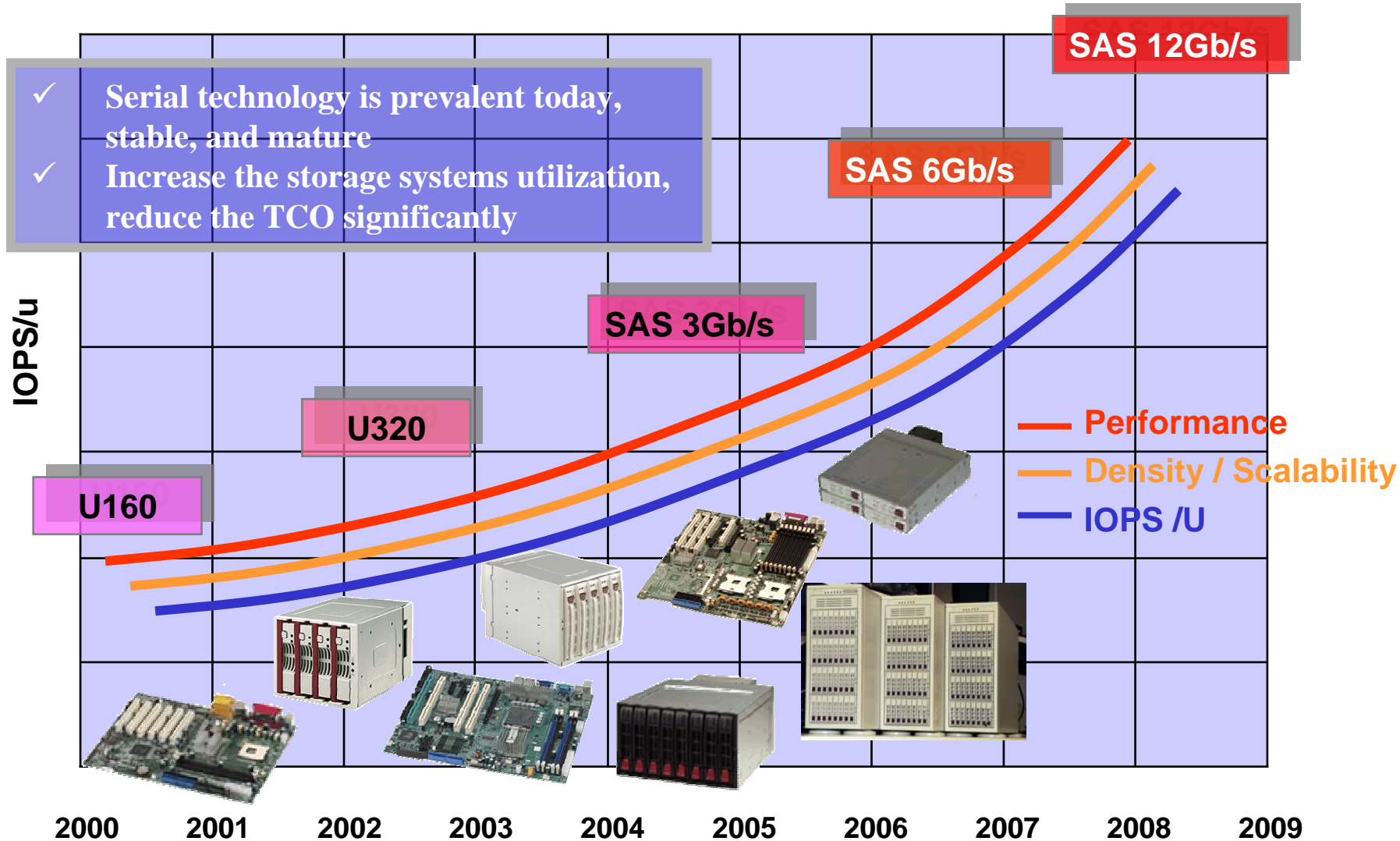
SCSI vs. SAS vs. FC

	SCSI	SAS	FC-AL
Performance	Parallel Bus	Full duplex	Full duplex
	320MB/s	3.0Gbps/300MB/s	2.0Gbps/200MB/s
	Extensive Command Queuing	Extensive command queuing	Extensive Command queuing
Connectivity	12m	8m	15m
	15 device	>128 devices	127 devices
	Arbitrated bus	Point to Point Connection	Arbitrated loop
	Interconnect not compatible with SAS	Interconnect compatible with SATA	Not compatible with SAS or SATA
Availability	Single port	Dual port	Dual port
	Multi initiator	Multi initiator	Multi initiator
	Hot swappable (80 pin)	Hot swappable	Hot swappable
Driver Model	Software not transparent with SAS	Software transparent with Parallel SCSI	Software transparent with Parallel SCSI

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Serial Attached SCSI

SAS Technology Has Room to Grow

SAS 12Gb/s

- ✓ Serial technology is prevalent today, stable, and mature
- ✓ Increase the storage systems utilization, reduce the TCO significantly

SAS 6Gb/s

SAS 3Gb/s

U320

U160

IOPS/u

— Performance
— Density / Scalability
— IOPS /U

2000 2001 2002 2003 2004 2005 2006 2007 2008 2009

SUPERMICRO®

Serial Attached SCSI

The next evolution of SCSI,

Serial Attached SCSI,

SAS is the answer!

Where SCSI Fits

SCSI currently addresses the need for high-performance, reliable storage – such as direct attached primary storage.

High Performance	Reliability
Scalability	Low Cost

Where SATA Fits

SATA currently addresses the need for low-cost storage – such as near line storage and disk-to-disk backup.

High Performance	**Reliability**
Scalability	**Low Cost**

Where Fibre Channel Fits

Fibre Channel currently addresses the need for high-performance, highly reliable, scalable storage – such as transaction-intensive and networked storage.

High Performance	**Reliability**
Scalability	**Low Cost**

SUPERMICRO®

Serial Attached SCSI

Serial Attached SCSI Fits Everywhere – One Solution for Many Needs

Serial Attached SCSI will address all of these needs, with high-performance, highly reliable, scalable storage that can be mixed-and-matched with SATA drives, allowing you more control over your storage budgets.

High Performance	**Reliability**
Scalability	**Low Cost**

SUPERMICR● ®

Serial Attached SCSI

Key Points

❖ Serial Attached SCSI is an evolutionary technology, based on the most trusted architecture in the data center – SCSI

❖ SAS provides many benefits including greater flexibility, scalability, and performance

❖ Enables mixing-and-matching of both SAS and SATA drives in the same enclosure

❖ SCSI and Fibre Channel ideal for scenarios that require high-performance and reliability; SATA is ideal for low-cost, large capacity storage – and SAS is suited for use across the entire storage spectrum!

❖ Supermicro is an industry leading provider of complete and mature SAS server solution.

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Serial Attached SCSI