Serial ATA in Servers and Networked Storage

Serial ATA (SATA) in Servers and Networked Storage

Introduction

Serial ATA (SATA) is a storage interface technology developed by a group of the industry's leading vendors to replace parallel ATA (P-ATA). While parallel ATA has traditionally been implemented as a desktop storage interface technology, Serial ATA technology introduces capabilities that provide a compelling alternative for servers and networked storage, especially where price/performance is the key factor.

This overview outlines Serial ATA's unique value proposition and the roadmap for specification enhancements. In addition, it includes usage models that illustrate the benefits of Serial ATA across multiple storage market segments. The illustrations in this guide demonstrate how SATA can be used in server-attached and networked storage applications, and they indicate how Serial ATA technology can make an impact now and in future specification revisions. The usage models include information on the required release versions of the Serial ATA specification to make a given configuration viable.

To obtain more information on Serial ATA technology, visit the working group's official web site at: www.serialata.org.

Market Segments

Serial ATA may be deployed in three common scenarios: Direct Attached Storage (DAS), Network Attached Storage (NAS) and Storage Area Network (SAN). Many iterations of these configurations are possible. A generic guideline is provided below.

DAS is a configuration in which storage is directly attached to the server. The storage can reside inside the server (internal) or be attached to the server via an external enclosure such as a JBOD ("Just a Bunch of Disks"). The external connection may be provided by any of a variety of interfaces including Small Computer System Interface (SCSI), iSCSI or Fibre Channel (FC). For "close proximity" connection to a JBOD within the same rack, SATA can be used directly.

NAS is an application-specific storage appliance that connects directly to an IP network. This configuration provides any machine connected to the network with potential access to the NAS at the file level. NAS appliances are dedicated to file serving by utilizing file-sharing protocols such as NFS or CIFS.

SAN is a high-speed, special-purpose network that interconnects heterogeneous data storage devices with associated data servers. Storage is usually connected via an external array that houses multiple hard disk drives with Redundant Array of Independent Disks (RAID). The SAN provides block-level data access to servers and storage devices attached to the network.

Serial ATA Value Proposition

While parallel ATA technology has had some success in servers and networked storage, Serial ATA provides significant benefits to storage vendors and end-users. These include point-to-point signaling that provides full bandwidth to each connected device, hot plug capability, smaller connectors, standardized connector placement and layout, simpler cabling and longer cable lengths. The cost advantages and performance of Serial ATA can make it a compelling alternative to other technologies.

Table 1: Serial ATA offers more features and better performance than parallel ATA.

End-User Needs

- More storage in limited space
- Improved price/performance
- Investment protection
- Lower overall system cost

System Vendor Needs

- Dense boxes
- Similar components
- Lower power consumption
- Increased air flow
- More motherboard space

Serial ATA Value Proposition

Serial ATA Delivers

- ✔ Narrower Cabling
- ✔ Supports Lower Power Requirements
- ✔ Lower Pin Counts
- ✔ 10-year Roadmap
- ✔ Higher Performance
- ✔ Improved Connectivity (no master/slave)
- ✔ Longer Cabling
- ✔ PC Economies of Scale

Evolution of the Serial ATA Specification

The Serial ATA working group will deliver incremental specification releases over the next several years. These enhancements, as summarized below, will enable the technology to support a variety of possible storage configurations.

Table 2: Serial ATA specification for servers and networked storage.

In addition to providing a roadmap with increased throughput, the evolution of the Serial ATA specification enhances features and management functionality, allowing greater penetration into servers and networked storage market segments.

Serial ATA II, Phase 2 (Future Extensions)

- Second-generation speed grade for desktops and networked storage systems
  Targeted 300 MB/sec
- Improvements to address additional needs in higher-end networked storage segments
- Topology support for dual host active failover
- Efficient connectivity to larger number of devices

Spec
II P2

Serial ATA II, Phase 1 (Current Extensions)

- Improved use of SATA 1.0 technology in server and networked storage
- Backplane interconnect solution for racks of hot-swap drives
- Complete enclosure management solution
  Fan control, drive lights, temperature control, new device notification, etc.
- Performance improvement to address industry needs
  Firmware/software, performance enhancements including native queuing
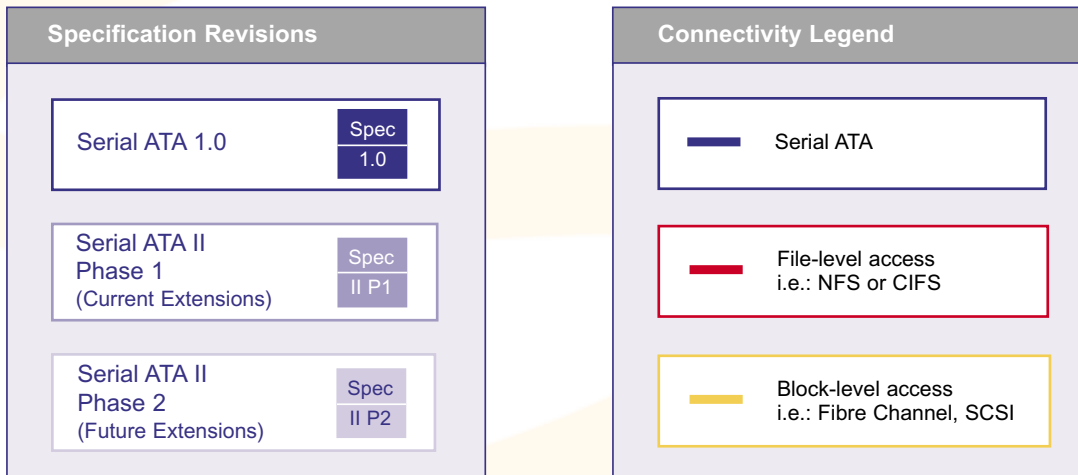
Spec
II P1

Serial ATA 1.0 Specification Complete

- Primary inside-the-box storage connection to replace parallel ATA

Spec
1.0

Serial ATA in Servers and Networked Storage

The usage models in this guide show how Serial ATA can be deployed in servers and networked storage applications. Each of the usage models includes one of the following icons, which indicate the Serial ATA specification revision required for the particular model. Where two specification revisions are listed, the later version is not required but will make implementation for that configuration easier. The connectivity legend shows the interface used for each model.

Specification Revisions	
Serial ATA 1.0	Spec 1.0
Serial ATA II Phase 1 (Current Extensions)	Spec II P1
Serial ATA II Phase 2 (Future Extensions)	Spec II P2

| Connectivity Legend	
—	Serial ATA
—	File-level access i.e.: NFS or CIFS
—	Block-level access i.e.: Fibre Channel, SCSI

The models presented here attempt to embody the technical features of the specification. Some of these features have been defined, while others are still a work-in-progress. While the working group hopes to enable all of the features that are outlined, some may prove to be impossible, while other possibilities not yet known may surface. The models are not intended to represent any required system design and in no way imply specific product intentions by any vendor.

Model 1: Direct Attached Storage (DAS)/
Network Attached Storage (NAS)

A NAS appliance is attached to the network. An add-in RAID card or RAID on the motherboard (ROMB) enables a high-performance and low-cost implementation of RAID. SATA's simpler connector saves board real estate over parallel ATA, and its point-to-point signaling enables full-bandwidth communication with multiple internal hard disk drives.
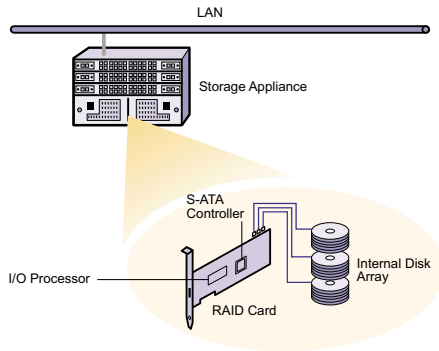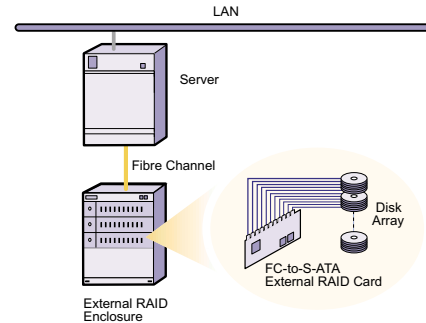
Model 2: Direct Attached Storage (DAS) –
External Enclosure

A server is attached to an external RAID enclosure with a Fibre Channel connection. The Fibre Channel-to-Serial ATA RAID card in the enclosure supports RAID, with Serial ATA providing dedicated-bandwidth connections to multiple hard disk drives.

Spec
1.0

LAN

Storage Appliance

S-ATA
Controller

I/O Processor

Internal Disk
Array

RAID Card

Spec
1.0

Spec
II P1

LAN

Server

Fibre Channel

Disk
Array

External RAID
Enclosure

FC-to-S-ATA
External RAID Card

Model 3: Storage Area Network (SAN) –
External Enclosures

Servers are attached to the storage network accessing block-level data via the SAN. The storage arrays use multiple SATA hard disk drives and RAID cards providing Fibre Channel or iSCSI interface to the host, and SATA interface to the HDDs. This configuration provides low cost storage in a SAN environment.
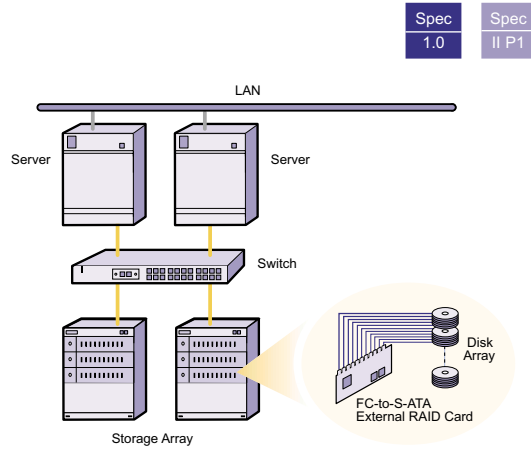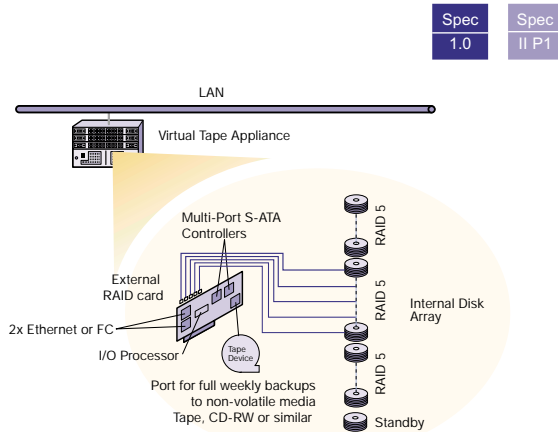
Model 4: Network Attached Storage (NAS) –
with Redundancy

NAS servers are attached to the network and access file-level data from multiple storage arrays. NAS servers route file-level requests from the LAN to the appropriate storage array. SATA in the storage array in this application provides a cost effective RAID implementation with the benefits of a fault-tolerant, redundant architecture.
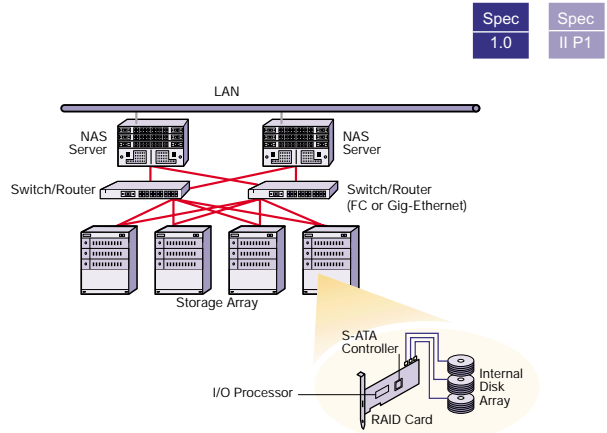
Model 5: Virtual Tape – Disk-based Back-up Storage

This model demonstrates a virtual tape appliance housing multi-port SATA controllers connected to multiple disks, capable of terabytes of storage capacity for cost-effective, real-time, online access to stored data. The appliance may be used in lieu of incremental tape back-up for servers and clients. Multiple appliances can be used to achieve many terabytes of available storage.

Spec 1.0   Spec II P1

LAN

Virtual Tape Appliance

Multi-Port S-ATA Controllers

RAID 5

External RAID card

RAID 5

Internal Disk Array

2x Ethernet or FC

I/O Processor

Tape Device

RAID 5

Port for full weekly backups to non-volatile media Tape, CD-RW or similar

Standby

Model 6: Direct Attached Storage (DAS) – Bandwidth Aggregation and/or Redundant Paths to Disks

Two Serial ATA RAID controller cards are implemented in the host. The combination of point-to-point signaling and RSM (routing/switching/muxing) technology enables both controllers to access any disk in the array. If one controller card fails, the other will take control of the disks, providing failover capability for data protection.

Spec II P2

LAN

DAS

Disk Array

2 Internal RAID Cards

RSM Technology allows both controllers to access each disk in the array
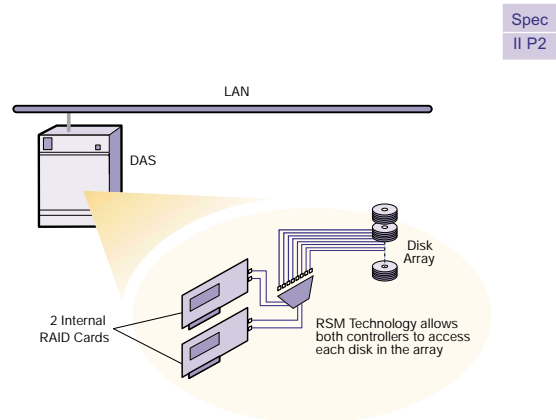
Model 7: Direct Attached Storage (DAS) – SATA Fan-out for Storage Scalability

Storage arrays are connected to the server with more diverse cables enabled by the evolution of the Serial ATA specification. Easy, clean connectivity to multiple drives utilizes a fan-out capability by RSM (routing/switching/muxing) technology.
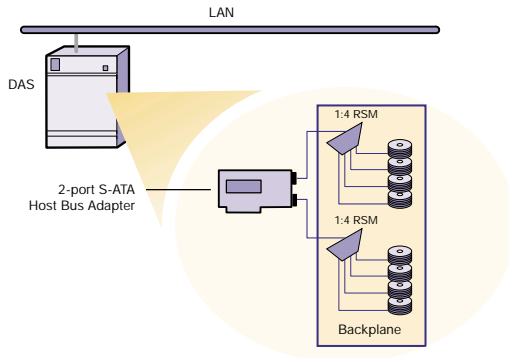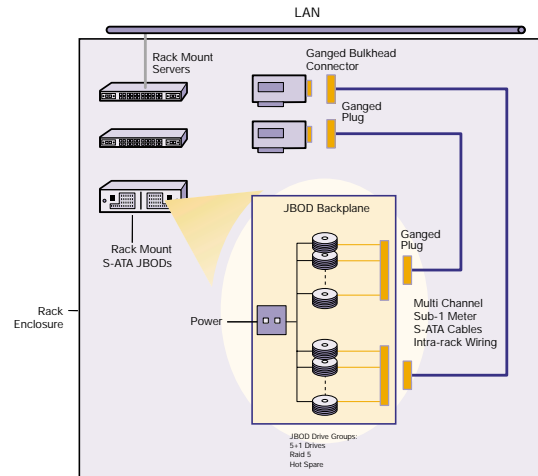
Model 8: Rack Mount DAS/JBOD Hi-Density Plug

The rack enclosure contains multiple rack-mounted servers with Serial ATA RAID cards featuring ganged bulkhead connectors. The rack also includes multiple rack-mounted JBOD ("Just a Bunch of Disks") chassis containing dozens of disk drives. The JBOD backplane provides connections for multiple disk drives. With its support for ganged cable connectors, Serial ATA II provides the backplane interconnect solution for the JBOD hot-swap drives with support for RAID. Serial ATA multi-channel cables with ganged plug provide the intra-rack connections.
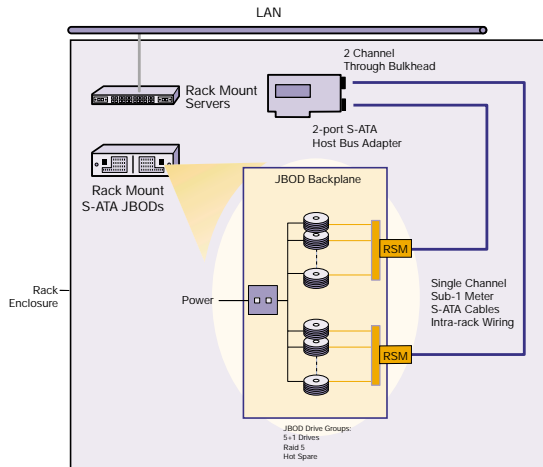
Spec II P2

LAN

DAS

2-port S-ATA
Host Bus Adapter

1:4 RSM

1:4 RSM

Backplane

Spec II P1

LAN

Rack Mount
Servers

Ganged Bulkhead
Connector

Ganged
Plug

Rack Mount
S-ATA JBODs

JBOD Backplane

Ganged
Plug

Rack
Enclosure

Power

Multi Channel
Sub-1 Meter
S-ATA Cables
Intra-rack Wiring

JBOD Drive Groups:
5+1 Drives
Raid 5
Hot Spare

Model 9: Rack Mount DAS/JBOD with RSM

The rack enclosure contains multiple rack-mounted servers with 2-port Serial ATA RAID HBA cards. The rack also includes multiple JBOD ("Just a Bunch of Disks") chassis containing dozens of disk drives. Serial ATA II RSM (routing/switching/muxing) connectivity enhancements enable flexible access to hot-swap drives in each array, with support for RAID. Serial ATA single-channel cables provide the intra-rack connections.

Summary

Serial ATA technology provides a consistent platform for the ongoing development and deployment of direct-attached and networked storage applications offering enhanced performance and reliability. Serial ATA overcomes the limitations of parallel ATA by providing an improved point-to-point signaling configuration, reduced pin count, lower voltage, smaller connectors, and thinner cabling. Going forward, storage vendors from across the globe will provide a wide range of SATA products for use in multiple market segments. Serial ATA introduces a roadmap that provides the industry with scalable performance for the next 10 years.

Additional information is available at:
www.serialata.org

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