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American National Standard

for Information Technology –
SAS Protocol Layer - 3
(SPL-3)

INCITS 492-2015

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American National Standard
for Information Technology –

SAS Protocol Layer - 3 (SPL-3)

Secretariat

Information Technology Industry Council

Approved January 26, 2015

American National Standards Institute, Inc.

Abstract

This standard specifies three transport protocols used over the SAS interconnect specified in SAS-3, one to transport SCSI commands, another to transport Serial ATA commands to multiple SATA devices, and a third to support interface management. This standard is intended to be used in conjunction with SAS standards, SCSI command set standards, and ATA command set standards.

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This standard defines the three transport protocols that use the SAS interconnect (see SAS-3):

Serial SCSI Protocol (SSP): a mapping of SCSI supporting multiple initiators and targets;

Serial ATA Tunneled Protocol (STP): a mapping of Serial ATA expanded to support multiple initiators and targets; and Serial Management Protocol (SMP): a management protocol.

This standard contains 14 annexes. Annex A is normative and is considered part of the standard. Annexes B through N are informative and are not considered part of this standard.

Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent to the INCITS Secretariat, International Committee for Information Technology Standards, Information Technology Industry Council, Suite 610, 1101 K Street, NW, Washington, DC 20005-7031.

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Introduction

This standard defines the protocol layer of the Serial Attached SCSI (SAS) interconnect and three transport protocols that use the SAS interconnect:

a) Serial SCSI Protocol (SSP): a mapping of SCSI supporting multiple initiators and targets;
b) Serial ATA Tunneled Protocol (STP): a mapping of Serial ATA expanded to support multiple initiators and targets; and
c) Serial Management Protocol (SMP): a management protocol.

The standard is organized as follows:

Clause 1 (Scope) describes the relationship of this standard to the SCSI and ATA families of standards.
Clause 2 (Normative references) provides references to other standards and documents.
Clause 3 (Definitions, symbols, abbreviations, keywords, and conventions) defines terms and conventions used throughout this standard.
Clause 4 (General) describes architecture, names and identifiers, state machines, resets, I_T nexus loss, provides an expander device model, the discover process, the configuration subprocess, zoning, phy power conditions, phy test functions, and phy events.
Clause 5 (Phy layer) describes the phy layer. It describes 8b10b encoding, bit order, out of band (OOB) signals, phy reset sequences, phy layer state machines, multiplexing, character encoding, character decoding, dwords, primitives, BMC coding, phy power conditions, and spinup.
Clause 6 (Link layer) describes the link layer. It describes primitives, physical link rate tolerance management, idle physical links, CRC, scrambling, address frames, power control, the link reset sequence and its state machine, low phy power condition, SAS domain changes, connections, rate matching, link layer for SAS logical phys state machines and link layer for expander logical phys state machines, and SSP, STP, and SMP connection rules and link layer state machines.
Clause 7 (Port layer) describes the port layer, which sits between one or more link layers and one or more transport layers. It includes port layer state machines.
Clause 8 (Transport layer) describes the transport layer. It includes SSP, STP, and SMP frame definitions and transport layer state machines.
Clause 9 (Application layer) describes the application layer. It describes SCSI transport protocol services, mode parameters, log parameters, diagnostic parameters, power conditions, error handling, and vital product data. It describes ATA application layer rules. It describes management application layer rules including READY LED signal behavior and SMP functions.

Normative Annex A (Jitter tolerance patterns) provides information on methods the SAS protocol uses to control generation of JTPAT and CJTPAT.
Informative Annex B (SAS to SAS phy reset sequence examples) provides additional phy reset sequence examples.
Informative Annex C (CRC) provides information and example implementations of the CRC algorithm.

Informative Annex D (SAS address hashing) provides information and example implementations of the hashing algorithm.
Informative Annex E (Scrambling) provides information and example implementations of the scrambling algorithm.
Informative Annex F (ATA architectural notes) describes ATA architectural differences from Serial ATA and Serial ATA II.
Informative Annex G (Minimum deletable primitive insertion rate summary) describes the minimum ALIGN and/or NOTIFY insertion rates for physical link rate tolerance management and rate matching.
Informative Annex H (Zone permission configuration descriptor examples) provides examples of using multiple zone permission configuration descriptors in the SMP CONFIGURE ZONE PERMISSION TABLE function.
Informative Annex I (SAS addressing) provides information on SAS addressing in SAS domains and expander device SAS addressing.
Informative Annex J (Expander device handling of connections) describes expander device behavior in a variety of connection examples.
Informative Annex K (Primitive encoding) lists the primitive encodings available for future versions of this standard.
Informative Annex L (Standards bodies contact information) lists the standards bodies contact information.
Informative Annex M (Successful low phy power condition handshake sequence) contains an example of the sequencing required between attached phys to successfully enter into a partial phy power condition.
Informative Annex N (Bibliography) lists a bibliography for this standard.

Figure 0 shows the organization of the layers of this standard.

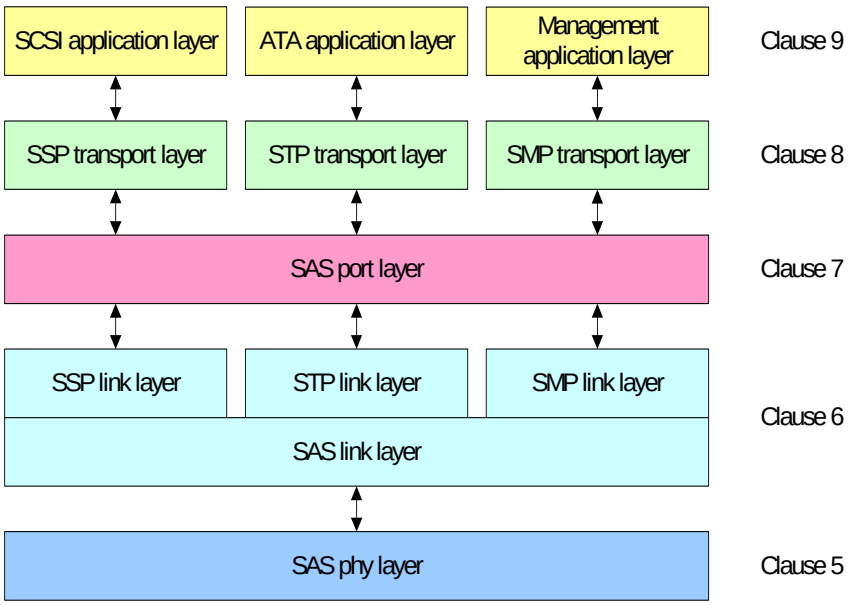

Figure 0 — Organization of this standard

American National Standard
for Information Technology -

SAS Protocol Layer - 3 (SPL-3)

1 Scope

The SCSI family of standards provides for many different transport protocols that define the rules for exchanging information between different SCSI devices. This standard defines the rules for exchanging information between SCSI devices using a serial interconnect. Other SCSI transport protocol standards define the rules for exchanging information between SCSI devices using other interconnects.

Figure 1 shows the relationship of this standard to the other standards and related projects in the SCSI family of standards.

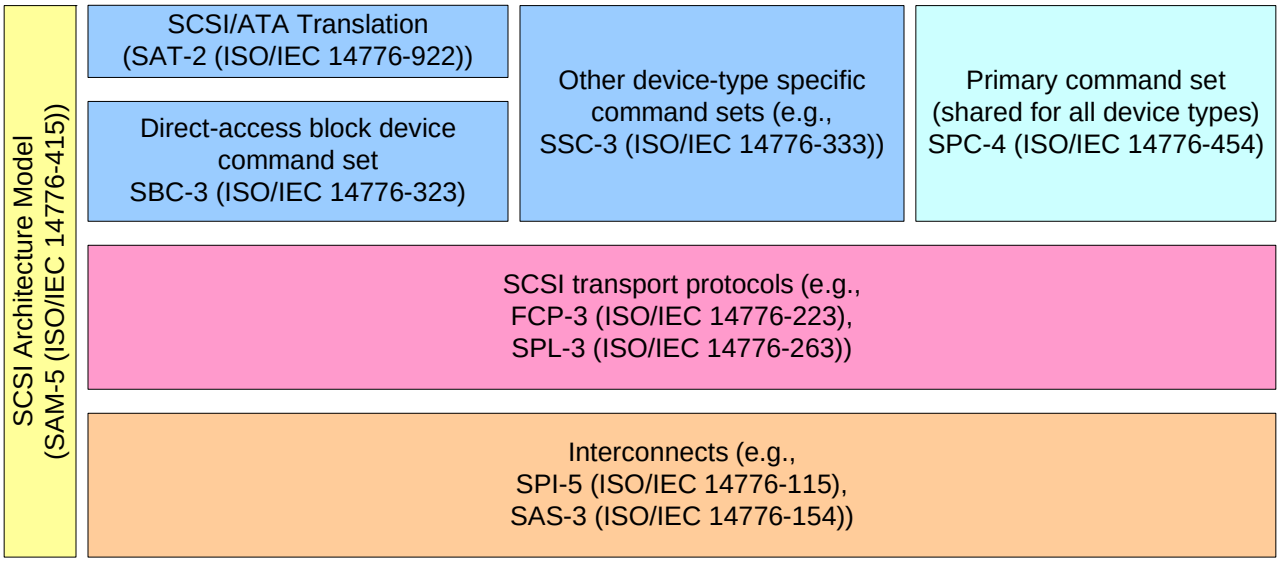

Figure 1 — SCSI document relationships

This standard also defines the rules for exchanging information between ATA hosts and ATA devices using the same serial interconnect. Other ATA transport protocol standards define the rules for exchanging information between ATA hosts and ATA devices using other interconnects.