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**INFORMATION TECHNOLOGY -
SMALL COMPUTER SYSTEM INTERFACE -
PART 150: Serial attached SCSI (SAS)**

FOREWORD

- 1) ISO (International Organization for Standardization) and IEC (International Electrotechnical Commission) form the specialized system for worldwide standardization. National bodies that are members of ISO or IEC participate in the development of International Standards through technical committees established by the respective organization to deal with particular fields of technical activity. ISO and IEC technical committees collaborate in fields of mutual interest. Other international organizations, governmental and non-governmental, in liaison with ISO and IEC, also take part in the work.
- 2) In the field of information technology, ISO and IEC have established a joint technical committee, ISO/IEC JTC 1. Draft International Standards adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75 % of the national bodies casting a vote.
- 3) All users should ensure that they have the latest edition of this publication.
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- 6) CAUTION: The developers of this standard have requested that holders of patents that may be required for the implementation of the standard, disclose such patents to the publisher. However, neither the developers nor the publisher have undertaken a patent search in order to identify which, if any, patents may apply to this standard.

As of the date of publication of this standard and following calls for the identification of patents that may be required for the implementation of the standard, no such claims have been made. No further patent search is conducted by the developer or the publisher in respect to any standard it processes. No representation is made or implied that licenses are not required to avoid infringement in the use of this standard.

ISO and IEC shall not be held responsible for identifying any or all such patent rights.

International Standard ISO/IEC 14776-150 was prepared by subcommittee 25: Interconnection of information technology equipment, of ISO/IEC joint technical committee 1: Information technology.

INTRODUCTION

SCSI family of standards

The SCSI family of standards provides for many different transport protocols. The SCSI transfer protocol standards define the rules for exchanging information between SCSI devices using interconnects.

Figure 1 shows the relationship of this standard, ISO/IEC 14776-150, to other standards and to related projects in the SCSI family of standards.

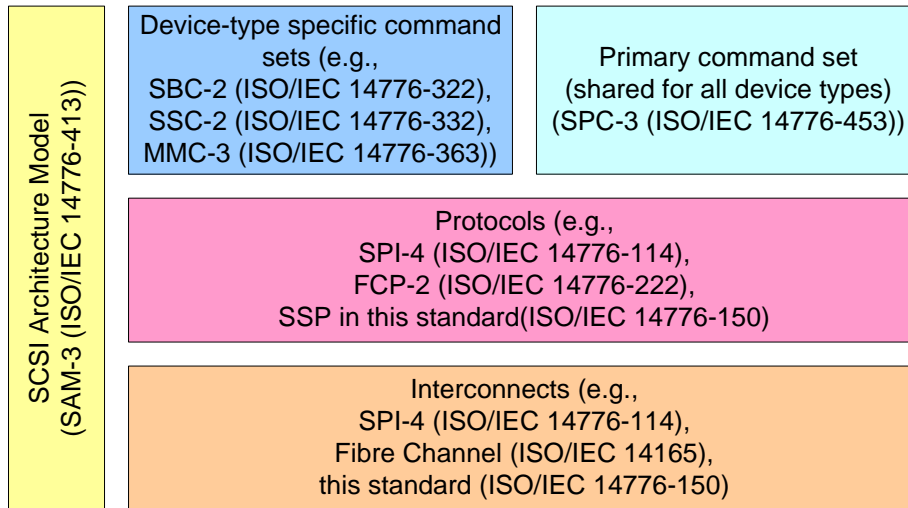


Figure 1 — SCSI document relationships

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.

Figure 2 shows the relationship of this standard, SO/IEC 14776-150, to other standards and related projects in the ATA family of standards.

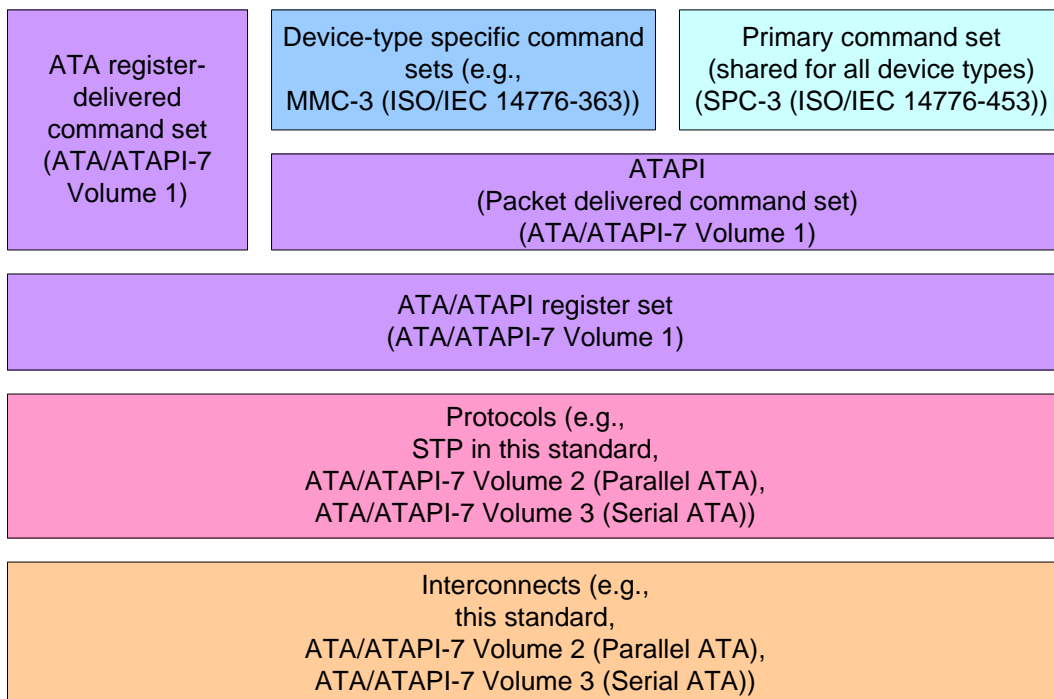


Figure 2 — ATA document relationships

Figure 1 and figure 2 show the general relationship of the documents to one another, and do not imply a relationship such as a hierarchy, protocol stack or system architecture.

These standards specify the interfaces, functions and operations necessary to ensure interoperability between conforming implementations. This standard is a functional description. Conforming implementations may employ any design technique that does not violate interoperability.

This standard is intended to be used in conjunction with other SCSI and with ATA specifications.

Organisation of this standard

Clause 1 (Scope) describes the relationship of this standard to the SCSI and ATA families of standards.

Clause 2 (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, and provides an expander device model.

Clause 5 (Physical layer) describes the physical layer. It describes passive interconnect components (connectors, cables, and backplanes) and defines the transmitter and receiver electrical characteristics.

Clause 6 (Phy layer) describes the phy layer. It describes 8b10b encoding, bit order, out of band (OOB) signals, phy reset sequences, phy layer state machines, and spin-up.

Clause 7 (Link layer) describes the link layer. It describes primitives, clock skew management, idle physical links, CRC, scrambling, address frames, the identification sequence and its state machine, power management, SAS domain changes, connections, rate matching, and SSP, STP, and SMP connection rules and link layer state machines.

Clause 8 (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 9 (Transport layer) describes the transport layer. It includes SSP, STP, and SMP frame definitions and transport layer state machines.

Clause 10 (Application layer) describes the application layer. It describes SCSI protocol services, mode parameters, log parameters, and power conditions, ATA specifics, and SMP functions.

Normative Annex A (Compliant jitter test pattern (CJTPAT)) describes the jitter test patterns.

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 (Expander device handling of connections) describes expander device behavior in a variety of connection examples.

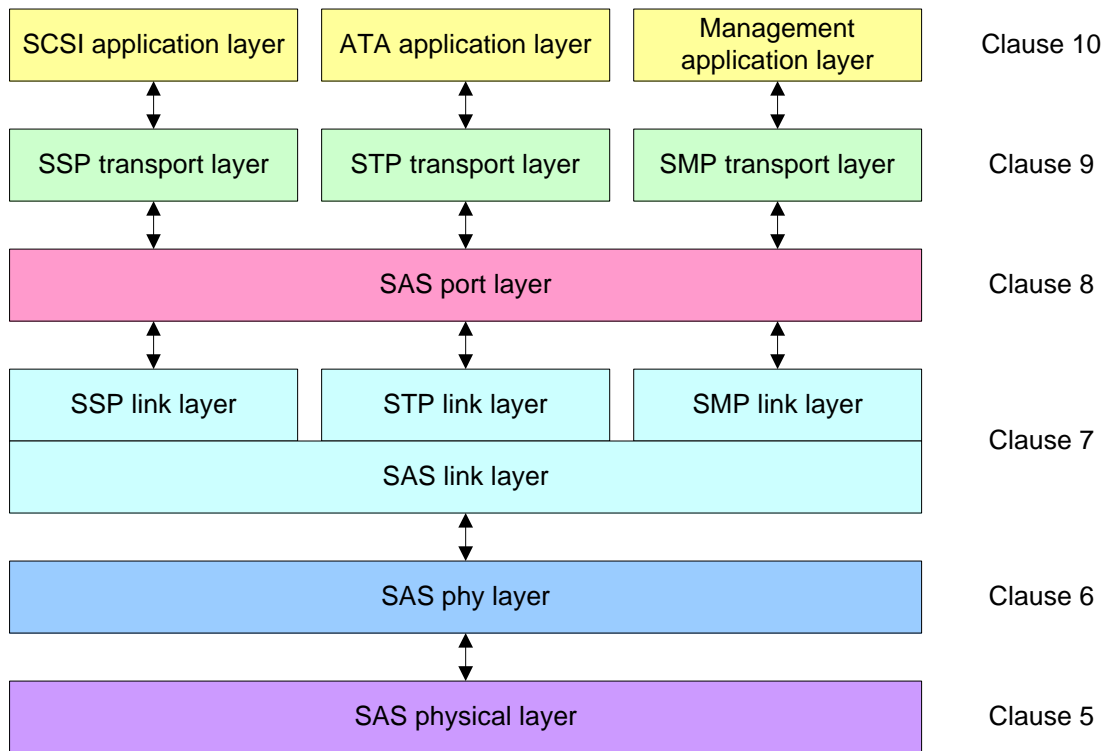
Informative Annex H (Primitive encoding) lists the primitive encodings available for future versions of this standard.

Informative Annex I (Messages between state machines) contains a list of messages between state machines.

Informative Annex J (Discover process example implementation) provides an example implementation of the discover process.

Informative Annex K (SAS icon) defines the SAS logo.

The following diagram shows the organization of the layers of this standard.



Organization of this standard

Information Technology - Small Computer System Interface (SCSI) - Part 150: Serial Attached SCSI (SAS)

1 Scope

This part of ISO/IEC 14776 defines the rules for exchanging information between SCSI devices using the Serial Attached SCSI (SAS) interconnect, which is compatible with the Serial ATA (SATA) physical interconnect. It also specifies three transport protocols, one to transport SCSI commands, another to transport Serial ATA commands to multiple SATA devices, and a third one to support interface management.

2 References

2.1 Normative references

At the time of publication, none of the referenced standards were published.

2.2 References under development

At the time of publication, the following referenced standards were still under development. For information on the current status of the document, or regarding availability, contact the relevant standards body or other organization, as indicated.

ISO/IEC xxx (under consideration), *AT Attachment with Packet Interface-7 volume 1 (ATA/ATAPI-7 V1) standard (T13/1532-D)*

ISO/IEC xxx (under consideration), *AT Attachment with Packet Interface-7 volume 2 (ATA/ATAPI-7 V2) standard (T13/1532-D)*

ISO/IEC xxx (under consideration), *AT Attachment with Packet Interface-7 volume 3 (ATA/ATAPI-7 V3) standard (T13/1532-D)*

ISO/IEC 14776-114 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 114: (SPI-4)*

ISO/IEC 14776-222 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 222: Fibre channel protocol for SCSI 2 (FCP-2)*

ISO/IEC 14776-322 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 322: (SBC-2)*

ISO/IEC 14776-332 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 332: (SSC-2)*

ISO/IEC 14776-363 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 363: (MMC-3)*

ISO/IEC 14776-413 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 413: Architecture Model-3 (SAM-3)*

ISO/IEC 14776-453 (under consideration), *Information technology - Small computer system interface (SCSI) - Part 453: Primary Commands-3 (SPC-3)*

NOTE 1 For more information on the current status of these documents, contact the INCITS Secretariat at 202-737-8888 (phone), 202-638-4922 (fax) or via Email at incits@itic.org. To obtain copies of these documents, contact Global Engineering at 15 Inverness Way, East Englewood, CO 80112-5704 at 303-792-2181 (phone), 800-854-7179 (phone), or 303-792-2192 (fax) or see <http://www.incits.org>.

2.3 Bibliography

For information on the current status of the listed documents, or regarding availability, contact the indicated organization.

ISO/IEC 14165 (all parts), *Information technology - Fibre channel*

Serial ATA II: Extensions to Serial ATA 1.0. Revision 1.0. 16 October 2002

NOTE 2 For more information on the current status of the Serial ATA documents, contact the Serial ATA International Organisation at <http://www.serialata.org>.

SFF-8223, 2.5" Drive w/Serial Attachment Connector

SFF-8323, 3.5" Drive w/Serial Attachment Connector

SFF-8410, High Speed Serial Testing for Copper Links

SFF-8460, HSS Backplane Design Guidelines

SFF-8470, Multi Lane Copper Connector

SFF-8482, Unshielded Dual Port Serial Attachment Connector

SFF-8523, 5,25" Drive w/Serial Attachment Connector

NOTE 3 For more information on the current status of the SFF documents, contact the SFF Committee at 408-867-6630 (phone), or 408-867-2115 (fax). To obtain copies of these documents, contact the SFF Committee at 14426 Black Walnut Court, Saratoga, CA 95070 at 408-867-6630 (phone) or 408-741-1600 (fax) or see <http://www.sffcommittee.org>.

OMG Unified Modeling Language (UML) Specification. Version 1.4, September 2001.

NOTE 4 For more information on the UML specification, contact the Object Modeling Group at <http://www.omg.org>.

Common Information Model (CIM) Specification. Version 2.2, 14 June 1999.

NOTE 5 For more information on the CIM specification, contact the Desktop Management Task Force, Inc. at <http://www.dmtf.org>.