

UNH IOL iSCSI CONSORTIUM

Interoperability Test Suite
Version 1.0

Technical Document



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MODIFICATION RECORD

- [1] April 11, 2005 (Version 0.1) DRAFT RELEASE
David Woolf: Initial draft release
- [2] April 11, 2005 (Version 0.2) DRAFT RELEASE
David Woolf: added discussion of options being enabled/disabled in each test, added multi-target tests
- [3] May 5, 2005 (Version 0.5) DRAFT RELEASE
David Woolf: added multi-initiator tests
- [4] December 1, 2005 (Version 1.0) FINAL RELEASE
David Woolf:

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David Woolf UNH InterOperability Laboratory

INTRODUCTION

The University of New Hampshire's InterOperability Laboratory (IOL) is an institution designed to improve the interoperability of standards based products by providing an environment where a product can be tested against other implementations of a standard. This particular suite of tests has been developed to help implementers evaluate the Full Feature Phase functionality of their iSCSI initiators..

These tests are designed to determine if an iSCSI product is interoperable with other iSCSI products, based on *IETF RFC 3720 iSCSI* (hereafter referred to as the "iSCSI Standard"). Successful completion of all tests contained in this suite does not guarantee that the tested device will successfully operate with other iSCSI products. However, when combined with satisfactory operation in the IOL's interoperability test bed, these tests provide a reasonable level of confidence that the Device Under Test (DUT) will function properly in many iSCSI environments.

The tests contained in this document are organized in order to simplify the identification of information related to a test, and to facilitate in the actual testing process. Tests are separated into groups, primarily in order to reduce setup time in the lab environment, however the different groups tend to focus on specific aspects of device functionality.

The test definitions themselves are intended to provide a high-level description of the motivation, resources, procedures, and methodologies specific to each test. Formally, each test description contains the following sections:

Purpose

The purpose is a brief statement outlining what the test attempts to achieve. The test is written at the functional level.

References

This section specifies all reference material *external* to the test suite, including the specific subclause references for the test in question, and any other references that might be helpful in understanding the test methodology and/or test results. External sources are always referenced by a bracketed number (e.g., [1]) when mentioned in the test description. Any other references in the test description that are not indicated in this manner refer to elements within the test suite document itself (e.g., "Appendix 5.A", or "Table 5.1.1-1")

Resource Requirements

The requirements section specifies the test hardware and/or software needed to perform the test. This is generally expressed in terms of minimum requirements, however in some cases specific equipment manufacturer/model information may be provided.

Last Modification

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This specifies the date of the last modification to this test.

Discussion

The discussion covers the assumptions made in the design or implementation of the test, as well as known limitations. Other items specific to the test are covered here as well.

Test Setup

The setup section describes the initial configuration of the test environment. Small changes in the configuration should not be included here, and are generally covered in the test procedure section (next).

Procedure

The procedure section of the test description contains the systematic instructions for carrying out the test. It provides a cookbook approach to testing, and may be interspersed with observable results.

Observable Results

This section lists the specific observables that can be examined by the tester in order to verify that the DUT is operating properly. When multiple values for an observable are possible, this section provides a short discussion on how to interpret them. The determination of a pass or fail outcome for a particular test is generally based on the successful (or unsuccessful) detection of a specific observable.

Possible Problems

This section contains a description of known issues with the test procedure, which may affect test results in certain situations. It may also refer the reader to test suite appendices and/or other external sources that may provide more detail regarding these issues.

GROUP 1: POINT TO POINT VERIFICATION

Overview:

This group of tests verifies the ability of two iSCSI devices to link and send traffic.

Scope:

Comments and questions regarding the implementation of these tests are welcome, and may be forwarded to Peter Scruton, UNH InterOperability Lab (pjs@iol.unh.edu).

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Test #1.1: Power On

Purpose: To verify that an iSCSI initiator target pair properly initializes on power on.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to connect at power on. After power on, the Target should be visible from the host OS.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The DUT and Test Station pair are powered off.

Procedure:

Case 1: Initiator is powered on before Target

- The Initiator and Target are physically connected, but not powered on. If the Initiator and Target are connected through a switch, the switch is powered on.
- Power on the Initiator. Allow the initiator to boot and load all drivers and software.
- Power on the Target. Allow the Target to boot and load all drivers and software.

Case 2: Target is powered on before Initiator

- The Initiator and Target are physically connected, but not powered on. If the Initiator and Target are connected through a switch, the switch is powered on.
- Power on the Target. Allow the Target to boot and load all drivers and software.
- Power on the Initiator. Allow the initiator to boot and load all drivers and software.

Observable Results:

- Verify that the target is visible from the host OS.
- Verify that SCSI traffic can be transmitted on the connection.

Possible Problems: None.

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Test #1.2: Disconnect Reconnect

Purpose: To verify that an iSCSI initiator target pair properly initializes after a physical disconnect.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to reconnect after a physical disconnect. The Target should be visible from the host OS.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and Target pair are powered on and physically connected. The Target should be visible from the host OS.

Procedure:

- Disconnect the initiator from the target. Wait 5 seconds, then reconnect the initiator to the target. If a switch is between the initiator and target, disconnect and reconnect the initiator from the switch and check the observable results, then disconnect and reconnect the target from the switch and check the observable results.
- Disconnect the initiator from the target. Wait 1 minute, then reconnect the initiator to the target. If a switch is between the initiator and target, disconnect and reconnect the initiator from the switch and check the observable results, then disconnect and reconnect the target from the switch and check the observable results.
- From the host OS, disable the iSCSI Initiator HBA. Wait 5 seconds, then enable the Initiator HBA. Check the observable results.
- From the host OS, disable the iSCSI Initiator HBA. Wait 1 minute, then enable the Initiator HBA. Check the observable results.

Observable Results:

- Verify after each disconnect, reconnect, or enable, that the target is visible from the host OS.
- Verify after each disconnect, reconnect, or enable, that SCSI traffic can be transmitted on the connection.

Possible Problems: None.

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Test #1.3: Disconnect Reconnect Maintain Traffic Flow

Purpose: To verify that an iSCSI initiator target pair properly initializes after a physical disconnect and can continue transmitting traffic.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.
- Software on the host system capable of generating SCSI Data transfers.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to reconnect and resume any previous transactions after a physical disconnect.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and Target pair are powered on and physically connected. The Target should be visible from the host OS.

Procedure:

- Using software on the host system, begin SCSI Data Transfers to and from the Host.
- Disconnect the initiator from the target. Wait 5 seconds, then reconnect the initiator to the target. If a switch is between the initiator and target, disconnect and reconnect the initiator from the switch and check the observable results, then disconnect and reconnect the target from the switch and check the observable results.
- Disconnect the initiator from the target. Wait 1 minute, then reconnect the initiator to the target. If a switch is between the initiator and target, disconnect and reconnect the initiator from the switch and check the observable results, then disconnect and reconnect the target from the switch and check the observable results.
- From the host OS, disable the iSCSI Initiator HBA. Wait 5 seconds, then enable the Initiator HBA. Check the observable results.
- From the host OS, disable the iSCSI Initiator HBA. Wait 1 minute, then enable the Initiator HBA. Check the observable results.

Observable Results:

- Verify after each disconnect, reconnect, or enable, that the target is visible from the host OS.
- Verify after each disconnect, reconnect, or enable, that SCSI traffic resumes on the connection without user intervention.

Possible Problems: None.

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Test #1.4: Stressing Pattern

Purpose: To verify that an iSCSI initiator target pair can maintain error free transmissions when the data within those transmissions contains a stressing pattern.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link and counting received digest errors.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.
- Software running on the host system capable of generating SCSI Data frames containing stressing patterns.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to maintain error free transmission of the stressing patterns.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and Target pair are powered on and physically connected. The Target should be visible from the host OS and SCSI data containing a stressing pattern should be transmitted. The data frames should contain patterns that will be stressful to all of the physical media present in the system. For example, if the system includes a Fibre Channel disk drive, the CJTPAT for Fibre Channel should be used. If the system contains a Gigabit Ethernet link, the CJTPAT for Gigabit Ethernet should be used.

Procedure:

- Transmit SCSI Data to and from the Initiator. The data contains a stressing pattern for different physical elements in the system.

Observable Results:

- Using on board error counters on each device in the system, verify that the number of detected digest errors does not increase when a stressing pattern is used, compared to random data.

Possible Problems: This is an informative test. It is necessary to refer to the appropriate standard to find stressing data patterns for the network infrastructure being used. Appendix A contains information on stressing patterns for various technologies.

GROUP 2: INITIATOR TO MULTIPLE TARGET VERIFICATION

Overview:

This group of tests verifies the ability of a single iSCSI initiator and multiple iSCSI target devices to link and send traffic.

Scope:

Comments and questions regarding the implementation of these tests are welcome, and may be forwarded to Peter Scruton, UNH InterOperability Lab (pjs@iol.unh.edu).

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Test #2.1: Multiple Targets Found

Purpose: To verify that an iSCSI initiator connected to multiple iSCSI targets can properly initialize and transmit traffic.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to connect at power on.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and Target pair are powered off and physically connected.

Procedure:

- Power on the iSCSI Initiator.
- Power on a single iSCSI Target, verify that the target is visible from the host OS. Continue powering on each iSCSI Target one at a time until all targets are powered and visible from the host OS.
- Using a Storage Management tool, configure the attached targets as a single volume. This may be achieved with a virtualization tool or a simple software RAID.
- Transmit SCSI Data to and from the iSCSI Initiator.

Observable Results:

- Verify as each target is added that all added targets are visible from the host OS.
- Verify after the targets are configured as a single volume, traffic can be transmitted.

Possible Problems: None.

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Test #2.2: Target Removed

Purpose: To verify that an iSCSI initiator connected to multiple iSCSI targets can handle a single target being removed.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to connect and resume any previous transactions after a physical disconnect.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPSec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and several Targets powered on and physically connected. The targets are visible from the host OS. A Storage Management tool, has been used to configure the attached targets as a single volume.

Procedure:

- Transmit SCSI Data to and from the iSCSI Initiator.
- Disconnect and Reconnect a single target from the network.

Observable Results:

- Verify that no data is lost when the target is disconnected.
- Verify that when the target is reconnected, it is visible from the host OS.
- Verify that the single volume returns to its original state.

Possible Problems: None.

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Test #2.3: Stressing Pattern

Purpose: To verify that an iSCSI initiator connected to multiple iSCSI targets can maintain error free transmissions when the data within those transmissions contains a stressing pattern.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link and counting received digest errors.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.
- Software running on the host system capable of generating SCSI Data frames containing stressing patterns.

Last Modification: April 11, 2005

Discussion: iSCSI Initiator and Target pairs are expected to maintain error free transmission of the stressing patterns.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPsec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: The Initiator and several Targets are powered on and physically connected. The targets are visible from the host OS. A Storage Management tool, has been used to configure the attached targets as a single volume. Software on the host OS should be used to transmit SCSI data containing a stressing pattern should be transmitted. The data frames should contain patterns that will be stressful to all of the physical media present in the system. For example, if the system includes a Fibre Channel disk drive, the CJTPAT for Fibre Channel should be used. If the system contains a Gigabit Ethernet link, the CJTPAT for Gigabit Ethernet should be used.

Procedure:

- Transmit SCSI Data to and from the Initiator. The data contains a stressing pattern for different physical elements in the system.

Observable Results:

- Using on board error counters on each device in the system, verify that the number of detected digest errors does not increase when a stressing pattern is used, compared to random data.

Possible Problems: This is an informative test. It is necessary to refer to the appropriate standard to find stressing data patterns for the network infrastructure being used. Appendix A contains information on stressing patterns for various technologies.

**GROUP 3: MULTIPLE INITIATOR TO SINGLE TARGET
VERIFICATION**

Overview:

This group of tests verifies the ability of multiple iSCSI initiators and a single iSCSI target device to link and send traffic.

Scope:

Comments and questions regarding the implementation of these tests are welcome, and may be forwarded to Peter Scruton, UNH InterOperability Lab (pjs@iol.unh.edu).

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Test #3.1: Configure Multi Initiator System

Purpose: To verify that a system containing multiple iSCSI initiators can be configured so that iSCSI targets are only accessed by initiators that are authorized.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.

Last Modification: May 3, 2005

Discussion: An iSCSI target can be configured to only allow access to its resources to particular initiators by using one of the authentication methods described in the iSCSI standard. An iSCSI target implementing an authentication method should not allow access to an initiator that has not completed authentication.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPSec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: An iSCSI Targets are on the same TCP/IP network as two or more iSCSI Initiators.

Procedure:

- Using an iSCSI authentication method, configure the iSCSI target to appear as 2 or more targets on the network. Configure each virtual iSCSI target to allow access by only a single initiator on the network. If no iSCSI targets with this capability are available, multiple targets can be placed on the network, each configured to only allow access by a single initiator.
- Transmit SCSI Data to and from each iSCSI Initiators each virtual target.

Observable Results:

- Verify that iSCSI traffic only appears on the authenticated connections.

Possible Problems: None.

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Test #3.2: Target Removed

Purpose: To verify that multiple iSCSI initiator connected to one or more iSCSI targets can maintain error free transmissions when the data within those transmissions contains a stressing pattern.

Reference: iSCSI Standard

Resource Requirements:

- A reference test bed of iSCSI initiators and targets.
- Local management resource on each device capable of reporting the state of the link and counting received digest errors.
- Monitoring facilities capable of capturing and decoding iSCSI PDUs.
- Software running on the host system capable of generating SCSI Data frames containing stressing patterns.

Last Modification: May 5, 2005

Discussion: An iSCSI target can be configured to only allow access to its resources to particular initiators by using one of the authentication methods described in the iSCSI standard. An iSCSI target implementing an authentication method should not allow access to an initiator that has not completed authentication. All iSCSI Initiator and Target pairs are expected to maintain error free transmission of the stressing patterns.

The iSCSI protocol allows for several variables and features to be enabled or disabled, which may affect how the Initiator and Target perform discovery, authenticate, and transmit data. This test should be performed with these options both enabled and disabled to verify that they do not cause the Initiator and Target to have a connection failure. These options include having IPSec enabled, having an iSNS server on the network, performing discovery, enabling Authentication, different AuthMethods, using IPv4 or IPv6 devices, using IPv4/v6 bridging devices, and enabling jumbo frames on each end device and on the network infrastructure. Whatever options are used should be recorded and effort should be made to perform each test with all variations of these options.

Test Setup: An iSCSI Targets are on the same TCP/IP network as two or more iSCSI Initiators.

Procedure:

- Using an iSCSI authentication method, configure the iSCSI target to appear as 2 or more targets on the network. Configure each virtual iSCSI target to allow access by only a single initiator on the network. If no iSCSI targets with this capability are available, multiple targets can be placed on the network, each configured to only allow access by a single initiator.
- Transmit SCSI Data to and from the Initiator. The data contains a stressing pattern for different physical elements in the system.

Observable Results:

- Using on board error counters on each device in the system, verify that the number of detected digest errors does not increase when a stressing pattern is used, compared to random data.

Possible Problems: This is an informative test. It is necessary to refer to the appropriate standard to find stressing data patterns for the network infrastructure being used. Appendix A contains information on stressing patterns for various technologies.

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APPENDICES

Overview:

Test suite appendices are intended to provide additional low-level technical detail pertinent to specific tests contained in this test suite. These appendices often cover topics that are outside of the scope of the standard, and are specific to the methodologies used for performing the measurements in this test suite. Appendix topics may also include discussion regarding a specific interpretation of the standard (for the purposes of this test suite), for cases where a particular specification may appear unclear or otherwise open to multiple interpretations.

Scope:

Test suite appendices are considered informative supplements, and pertain solely to the test definitions and procedures contained in this test suite.

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Appendix A: Stressing Patterns

Purpose: To describe data patterns which can be stressing to various underlying technologies used in a system that uses iSCSI as a transport mechanism.

Reference: IETF RFC 3720 iSCSI Standard
IEEE 802.3 Gigabit Ethernet Standard
ANSI INCITS FC-MJSQ Rev 14
ANSI INCITS 376-2003 SAS
Serial ATA 1.0a

Resource Requirements:

- Software running on the host system capable of generating the stressing patterns inside of SCSI Data frames.

Last Modification: April 11, 2005

Discussion: The iSCSI protocol is a transport layer technology. As such, iSCSI will use other technologies for physical infrastructure. In addition, an iSCSI system may include a bridge device, which decodes rather than forwards, iSCSI PDUs. Some of the technologies that may be used are described in Table A.1, along with references for appropriate stressing patterns.

Table A.1: References for stressing patterns in various technologies.

Technology	Standard	Subclause
Gigabit Ethernet	IEEE 802.3	Annex 36A
Fibre Channel	ANSI INCITS FC-MJSQ Rev 14	Annex A
Serial Attached SCSI	ANSI INCITS 376-2003 (SAS)	Annex A
Serial ATA	Serial ATA 1.0a	Clause 6.7