Date: July 22, 2003

To: T10 Committee (SCSI)

From: George Penokie (IBM/Tivoli)

Subject: Device Identifiers and VPD Data

1 Overview

The INQUIRY Device Identification VPD page (83h) returns logical unit, target port, and (with 02-254) target device related identifiers. However, it has several limitations for iSCSI, SRP, and SBP-2 devices, and for devices with target ports using more than one transport protocols:

1. iSCSI port names and device names use a string format that cannot be represented in the current VPD formats. The strings approach 256 bytes in length; 02-303 expanded INQUIRY's allocation length to return such amounts of data.

Suggestion: A new VPD device identifier type for this string format is needed so iSCSI devices can report its target port (ASSOCIATION field set to 1h) and target device identifiers (ASSOCIATION field set to 2h).

2. iSCSI logical unit names are undefined. RAID controllers tend to name their logical units (reported with ASSOCIATION field set to 0h) by concatenating a self-generated number to the end of a port name (e.g. the NAA IEEE Registered Extended identifier is 64 bits concatenated onto an IEEE Registered identifier). An iSCSI-only RAID controller needs to do this based on the iSCSI device name; it may not have an NAA IEEE Registered identifier to use.

Suggestion: A logical unit name based on the iSCSI string format is needed.

3. SRP target port names use an EUI-64-based format - EUI-64 plus 8 byte extension - that cannot be represented with the current EUI-64 format (2h). Thus, there is no way to report its target port identifier (ASSOCIATION field set to 1h).

Suggestion: A 16 byte version of the EUI-64 identifier is needed (or the string format needs to be used; see below).

4. SBP-2/3 target port names use an EUI-64-based format - EUI-64 plus 3 byte extension - that cannot be represented with the current EUI-64 format (2h). Thus, there is no way to report its target port identifier (ASSOCIATION field set to 1h).

Suggestion: A 12 byte version of the EUI-64 identifier is needed (or the string format needs to be used); see below.

5. SAM-3 target device names. SAM-3 allows target devices with target ports of more than one protocol to have one device name per transport protocol. The iSCSI string format could be defined to serve all the protocols. It can currently carry two formats:

    a) "iqn." A UTF-8 encoded string with a reverse domain name.
    b) "eui." An EUI-64 identifier encoded into a hexadecimal string (e.g. "eui.ABCDEF0123456789")

Along with this proposal, a proposal to the IETF IPS WG to add a third format:

    a) "naa." An NAA identifier (e.g. "naa.56789ABCDEF01234" for an IEEE Registered identifier or "naa.6789ABCDEF0123456789ABCDEF012345" for an IEEE Registered Extended identifier)

This covers the native name formats for FCP-3, SAS, SRP-2, and SBP-3.

Suggestion: Device names for all SCSI devices could follow the string format, rather than protocol-specific formats.

Devices with NAA identifiers handy for their target ports may choose to use "naa." format for their device names; devices with EUI-64 identifiers handy may use "eui." format; iSCSI-only devices may use "iqn." Devices with multiple protocol support may choose the best device identifier format for their needs.

SAM-3 could become the home for defining this string format; IETF and iSCSI would just own the "iqn." subset.

6. Logical unit names (ASSOCIATION field set to 0h) have the same problem as device names for devices with multiple protocols. A combination FCP and SRP device would have trouble deciding to use NAA or EUI-64-based format for a logical unit name if each protocol requires only its own format.

Suggestion: The iSCSI string format should be allowed for logical unit names ("iqn", "eui", or "naa" based regardless of protocol).

7. The current iSCSI identifier sizes in SAM-3 are unclear as to whether the trailing NULL is included in the size.

Suggestion: Remove trailing NULL from all sizes.

8. The SAM-3 informative annex entries for iSCSI port name sizes are too large; the rules on the formats slightly reduce the maximum lengths from 255.

Suggestion: Make the entries exact.

Summary

This is how the Device Identification VPD data for all the protocols line up with these suggestions:

Protocol	Logical unit (ASSOCIATION field set to 0h)	Target port (ASSOCIATION field set to 1h)	Target device (ASSOCIATION field set to 2h)
Devices with more than one protocol shall use these formats	a)SCSI name string format "<name>,L,0xABCDEF0123456789"; b)NAA format; or c)EUI-64-based format	Based on protocol of the port (see below for more details of each format) a)SCSI name string format; b)NAA format; or c)EUI-64-based format	a)SCSI name string format; b)NAA format; or c)EUI-64-based format.
Devices with only one protocol shall use these formats for logical unit names and device names:			
iSCSI	SCSI name string format "iqn.<iSCSI name>,L,0xABCDEF0123456789"	SCSI name string format "iqn.<iSCSI name>,t,0xABCD"	SCSI name string format "iqn.<iSCSI name>"
FCP-3	NAA format (usually with NAA = 2, 5, or 6)	NAA format (usually with NAA = 2 or 5)	a)SCSI name string format "naa.[2 or 5]NNN..."; or b)NAA format
SAS	NAA format (with NAA = 5 or 6)	NAA format (with NAA = 5)	a)SCSI name string format "naa.[5]NNN..."; or b)NAA format
SRP-2	SCSI name string format "eui.ABCDEF0123456789, L,0xABCDEF0123456789"	EUI-64-based 16 byte format	a)SCSI name string format "eui.NNNN...."; b)or EUI-64-based format
SBP-3	SCSI name string format "eui.ABCDEF0123456789, L,0xABCDEF0123456789"	EUI-64-based 12 byte format	a)SCSI name string format "eui.NNNN..."; or b)EUI-64-based format

The SCSI name string format, when used, may have one of 3 fundamental formats based on the ASSOCIATION field:

a) logical unit name (with an ASSOCIATION value of 0h). The format is "<name>" concatenated with ",L,0xNNNNNNNNNNNNNNNN", defined in SPC-3;

    b) target port name (with an ASSOCIATION value of 1h). The format is "<name>" concatenated with ",t," concatenated with "<transport protocol dependent>" (in iSCSI, the target portal group identifier), defined in SCSI and by the transport protocol; or

    c) target device name (with an ASSOCIATION value of 2h). The format is "<name>" (alone), defined in SPC-3.

Suggested Changes to SAM-3

3.1.91 SCSI device name: A name (see 3.1.66) of a SCSI device that is world wide unique ~~within the SCSI transport protocol of a SCSI domain in which the SCSI device has SCSI ports~~ (see 4.7.6). The SCSI device name may be made available to other SCSI devices or SCSI ports ~~in that SCSI domain~~ in SCSI transport protocol specific ways.

4.7.1 SCSI initiator device

A SCSI initiator device (see figure 11) contains:

    a) Zero or more initiator device names;
    b) One or more SCSI initiator ports each containing an initiator port identifier and an optional initiator port name; and
    c) One or more application clients.

An initiator port identifier is a value that is the SCSI port identifier (see 4.7.4) for an initiator port.

An initiator device name is a name (see 3.1.68) that is a SCSI device name (see 4.7.6) for a SCSI initiator device. ~~A SCSI initiator device shall have no more than one initiator device name for each supported SCSI transport protocol.~~ If the format of the SCSI device name is the SCSI name string format (see SPC-3) then a SCSI initiator device ~~shall~~ should have no more than one initiator device name. If the format of the SCSI device name is not the SCSI name string format then a SCSI initiator device shall have no more than one initiator device name for each supported SCSI transport protocol. A SCSI transport protocol standard may place additional requirements on initiator device names.

An initiator port name is a name (see 3.1.68) that is the SCSI port name (see 4.7.7) for the initiator port. A SCSI transport protocol standard may place additional requirements on initiator port names.

Application clients are the sources of commands and task management functions.

4.7.2 SCSI target device

A SCSI target device (see figure 12) contains:

    a) Zero or more target device names;
    b) One or more SCSI target ports each containing a task router, SCSI target port identifier, and an optional target port name; and
    c) One or more logical units.

A SCSI target port identifier is a value that is a SCSI port identifier (see 4.7.4) for a SCSI target port.

A target device name is a name (see 3.1.68) that is a SCSI device name (see 4.7.6) for a SCSI target device. ~~A SCSI target device shall have no more than one target device name for each supported SCSI transport protocol.~~ If the format of the SCSI device name is the SCSI name string format (see SPC-3) then a SCSI target device ~~shall~~ should have no more than one target device name. If the format of the SCSI device name is not the SCSI name string format then a SCSI target device shall have no more than one target device name for each supported SCSI transport protocol. A SCSI transport protocol standard may place additional requirements on target device names.

A target port name is a name (see 3.1.68) that is the SCSI port name (see 4.7.7) for the target port. A SCSI transport protocol standard may place additional requirements on target port names.

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4.7.3 SCSI target/initiator device

A SCSI target/initiator device (see figure 13) contains:

    a) Zero or more target/initiator device names;

b) One or more SCSI target/initiator ports each containing a task router, target port identifier, an initiator port identifier, an optional target port name and an optional initiator port name;
c) One or more logical units; and
d) One or more application clients.

The target port identifier and the initiator port identifier are values containing a SCSI port identifier (see 4.7.4) for a SCSI target/initiator port. The target port identifier and the initiator port identifier may or may not be identical.

A target/initiator device name is a name (see 3.1.68) that is a SCSI device name (see 4.7.6) for a SCSI target/initiator device. ~~A SCSI target/initiator device shall have no more than one target/initiator device name for each supported SCSI transport protocol.~~ If the format of the SCSI device name is the SCSI name string format (see SPC-3) then a SCSI target/initiator device ~~shall~~ should have no more than one target/initiator device name. If the format of the SCSI device name is not the SCSI name string format then a SCSI target/initiator device shall have no more than one target/initiator device name for each supported SCSI transport protocol. A SCSI transport protocol standard may place additional requirements on target/initiator device names.

The target port name and initiator port name are names (see 3.1.68) that are the SCSI port name (see 4.7.7) for the target/initiator port when operating as a target port and initiator port, respectively. The target port name and the initiator port name may or may not be identical. A SCSI transport protocol standard may place additional requirements on target port names and initiator port names.

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4.7.6 SCSI device name

A SCSI device name is an optional name (see 3.1.68) for a SCSI device that is world wide unique. ~~within the SCSI transport protocol of each SCSI domain in which the SCSI device has SCSI ports. A SCSI device may have more than one name if that device has SCSI ports in different SCSI transport protocol domains. A SCSI device shall have no more than one name for each supported SCSI transport protocol.~~ If the format of the SCSI device name is the SCSI name string format (see SPC-3) then a SCSI device ~~shall~~ should have no more than one device name. If the format of the SCSI device name is not the SCSI name string format then a SCSI device may have more than one name if that device has SCSI ports in different SCSI transport protocol domains. A SCSI device shall have no more than one name for each supported SCSI transport protocol. A SCSI device name shall never change and may be used to persistently identify a SCSI device in contexts where specific references to port names or port identifiers is not required.

A SCSI transport protocol standard may require that a SCSI device include a SCSI device name if the SCSI device has SCSI ports in a SCSI domain of that SCSI transport protocol. The SCSI device name may be made available to other SCSI devices or SCSI ports in a given SCSI domain in SCSI transport protocol specific ways.

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4.10 Well known logical units

A well known logical unit is identical to a logical unit (see 4.8) except as defined in this subclause.

Well known logical units are addressed using the well known logical unit addressing method of extended logical unit addressing (see 4.9.8). Each well known logical unit has a well known logical unit number (W-LUN). W-LUN values are defined in SPC-3.

If a SCSI target device receives a W-LUN and that well known logical unit is not exist, a task manager shall follow the SCSI rules for selection of invalid logical units (see 5.9.4).

If a well known logical unit is supported within a SCSI target device then that logical unit shall support all the commands defined for it.

~~Access to well known logical units shall not be affected by access controls.~~

All well known logical units:

a) Shall not have logical unit names;

b) Shall identify themselves using the SCSI target device names of the SCSI target device in which they are contained; and

c) Within a single SCSI target device shall have the same SCSI target device names as the SCSI target device in which they are contained.

If the format of the SCSI device name is the SCSI name string format (see SPC-3) then a SCSI target device ~~shall~~ should have only one SCSI target device name.

If the format of the SCSI device name is not the SCSI name string format then a SCSI target device may have more than one SCSI target device name if the SCSI target device supports multiple SCSI transport protocols.

The name of the well known logical unit may be determined by issuing an INQUIRY command requesting the Device Identification VPD page (see SPC-3).

All well known logical units shall support the INQUIRY command's Device Identification VPD page as defined in SPC-3. ~~and, at a minimum, shall support the IDENTIFIER TYPE field set to the SCSI name string format (i.e., 8h). or one or more identification descriptors with the IDENTIFIER TYPE field set to the NAA (i.e., 3h) or the EUI-64 (i.e., 2h). The contents of the IDENTIFIER field shall be equal to one of the SCSI target device's SCSI target device names. The returned Device Identification VPD page shall contain all the SCSI target device names.~~

All well known logical units within a SCSI target device shall return the same list of SCSI target device names.

[Editor's note: SAM-3 informative annex changes are at the end of this proposal]

Suggested Changes to SPC-3

3.1.78 SCSI device name: A name (see 3.1.57) of a SCSI device that is world wide unique ~~within the protocol of a SCSI domain (see 3.1.79) in which the SCSI device has SCSI ports~~ (see SAM-3). The SCSI device name may be made available to other SCSI devices or SCSI ports ~~in that SCSI domain~~ in protocol specific ways.

7.5.1 Protocol specific parameters introduction

Some commands use protocol specific information in their CDBs or parameter lists. This subclause describes those protocol specific parameters.

Protocol specific parameters may include a PROTOCOL IDENTIFIER field (see table 1) as a reference for the SCSI protocol to which the protocol specific parameter applies.

Table 1 — PROTOCOL IDENTIFIER values

Protocol Identifier	Description	Protocol Standard
0h	Fibre Channel	FCP-2
1h	Parallel SCSI	SPI-4
2h	SSA	SSA-S3P
3h	IEEE 1394	SBP-2
4h	Remote Direct Memory Access (RDMA)	SRP
5h	Internet SCSI	iSCSI
6h	SAS Serial SCSI Protocol	SAS
7h - Eh	Reserved	
Fh	~~Multiple Protocols~~ No specific protocol	

7.6 Vital product data parameters

7.6.1 Vital product data parameters overview and page codes [no changes]

7.6.2 ASCII Implemented Operating Definition VPD page [no changes]

7.6.3 ASCII Information VPD page [no changes]

7.6.4 Device Identification VPD page [with changes]

7.6.4.1 Device Identification VPD page overview

The Device Identification VPD page (see table 269) provides the means to retrieve identification descriptors applying to the logical unit. Logical units may have more than one identification descriptor (e.g., if several types or associations of identifier are supported).

Device identifiers shall be assigned to the peripheral device (e.g., a disk drive) and not to the currently mounted media, in the case of removable media devices. Media identification is outside the scope of this standard. Operating systems are expected to use the device identifiers during system configuration activities to determine whether alternate paths exist for the same peripheral device.

> NOTE 1 - In the case of virtual logical units (e.g., volume sets as defined by SCC-2), the IDENTIFIER field (see table 267) should be in the NAA IEEE Registered Extended name format as defined in 8.6.4.5.3.

A SCSI target device may have more than one SCSI target device name if the SCSI target device supports multiple SCSI transport protocols. If the returned Device Identification VPD page contains any SCSI target device names it shall contain all the SCSI target device names.

Table 269 - Device Identification VPD page

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Each Identification descriptor (see table 270) contains information identifying the logical unit, physical device, or access path used by the command and returned parameter data. For identification descriptor requirements see 7.6.4.x.

Table 270 - Identification descriptor

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The PROTOCOL IDENTIFIER field may indicate the SCSI transport protocol to which the identification descriptor applies. If the ASSOCIATION field contains a value other than 1h (i.e., SCSI target port) or 2h (i.e., SCSI target device) or the PIV bit is set to zero, then the PROTOCOL IDENTIFIER field should be ignored. If the ASSOCIATION field contains a value of 1h or 2h and the PIV bit is set to one, then the PROTOCOL IDENTIFIER field shall contain one of the values shown in table 238 (see 7.5.1) to indicate the SCSI transport protocol to which the identification descriptor applies.

The CODE SET field specifies the code set used for the IDENTIFIER field, as described in table 271. This field is intended to be an aid to software that displays the IDENTIFIER field.

Table 271 - Code set

Value	Description
0h	Reserved
1h	The IDENTIFIER field shall contain binary values.
2h	The IDENTIFIER field shall contain ASCII graphic codes (i.e., code values 20h through 7Eh)
3h	The IDENTIFIER field shall contain ISO/IEC 10646-1 (UTF-8) codes
4h - Fh	Reserved

The ASSOCIATION field specifies the entity with which the IDENTIFIER field is associated, as described in table 272. If a logical unit returns an Identification descriptor with the ASSOCIATION field set to 0h, it shall return the same descriptor when it is accessed through any other path.

Table 272 - Association

Value	Description
0h	The IDENTIFIER field is associated with the addressed logical unit.
1h	The IDENTIFIER field is associated with the SCSI target port that received the request.
2h	The IDENTIFIER field is associated with the SCSI target device that contains the addressed logical unit.
3h	Reserved

The IDENTIFIER TYPE field (see table 273) specifies the format and assignment authority for the identifier.

Table 273 - Identifier type

Value	Description	Reference
0h	Vendor specific	7.6.4.2
1h	T10 vendor identification	7.6.4.3
2h	EUI-64	7.6.4.4
3h	NAA	7.6.4.5
4h	Relative target port	7.6.4.6
5h	Target port group	7.6.4.7
6h	Logical unit group	7.6.4.8
7h	MD5 logical unit identifier	7.6.4.9
8h	SCSI name string	7.6.4.x
9h - Fh	Reserved	

For logical units that are not W-LUNs (see clause 9) at least one identification descriptor shall contain 1h, 2h, or 3h in the IDENTIFIER TYPE field and 0h in the ASSOCIATION field. At least one identification descriptor should contain 2h, or 3h in the IDENTIFIER TYPE field and 0h in the ASSOCIATION field.

For W-LUNs at least one identification descriptor shall contain 2h, or 3h, or 8h in the IDENTIFIER TYPE field and shall contain a 2h in the ASSOCIATION field.

The IDENTIFIER LENGTH field specifies the length in bytes of the IDENTIFIER field. If the ALLOCATION LENGTH field of the CDB is too small to transfer all of the identifier, the identifier length shall not be adjusted to reflect the truncation.

The IDENTIFIER field contains the identifier as described by the ASSOCIATION, IDENTIFIER TYPE, CODE SET, and IDENTIFIER LENGTH fields.

7.6.4.2x.1 Logical unit identifier2 Vendor specific identifier format

Each logical unit that is not a well-known logical unit shall include at least one logical unit name descriptor. The logical unit name descriptor shall contain an identification descriptor with the ASSOCIATION field set to 0h (i.e., logical unit) and the IDENTIFIER TYPE field set to:

    a) 1h (i.e., T10 vendor identification);
    b) 2h (i.e., EUI-64 based);
    c) 3h (i.e., NAA); or
    d) 8h (i.e., SCSI name string).

At least one identification descriptor should contain an IDENTIFIER TYPE field set to:

    a) 2h (i.e., EUI-64 based);
    b) 3h (i.e., NAA); or
    c) 8h (i.e., SCSI name string).

In the case of virtual logical units (e.g., volume sets as defined by SCC-2), identification descriptor should contain an IDENTIFIER TYPE field set to:

a) 2h (i.e., EUI-64 based);
b) 3h (i.e., NAA); or
c) 8h (i.e., SCSI name string).

Each logical unit that is a well known logical unit shall include one or more SCSI target device name descriptors. Each SCSI target device name descriptor shall contain an identification descriptor with the ASSOCIATION field set to 2h (i.e., SCSI target device) and the IDENTIFIER TYPE field set to:

a) 2h (i.e., EUI-64 based);
b) 3h (i.e., NAA); or
c) 8h (i.e., SCSI name string).

For a well known logical unit:

a) if the IDENTIFIER TYPE field is set to 8h then the returned Device Identification VPD page shall only contain one SCSI target device name descriptor; or
b) if the IDENTIFIER TYPE fields are set to 2h or 3h then the returned Device Identification VPD page shall contain all the SCSI target device names for all the SCSI transport protocols supported by the SCSI target device.

Well known logical units shall not return any logical unit name descriptors If the identifier type is 0h (i.e., ASSOCIATION field set to vendor specific (0h), ...

A logical unit shall return the same set of logical unit name descriptors regardless of the I_T nexus being used to retrieve the identification descriptors.

7.6.4.2x.2 Target port identifiers

Each logical unit should include one identification descriptor with the ASSOCIATION field set to 1h (i.e., SCSI target port) and the IDENTIFIER TYPE field set to 4h (i.e., relative target port) identifying the target port being used to retrieve the identification descriptors.

A target port name descriptor is an identification descriptor with the ASSOCIATION field set to 1h (i.e., SCSI target port) and the IDENTIFIER TYPE field set to:

a) 2h (i.e., EUI-64 based);
b) 3h (i.e., NAA); or
c) 8h (i.e., SCSI name string).

If the transport protocol of the target port defines target port names, the target port name descriptor shall contain the target port name. If the transport protocol of the target port does not define target port names, the target port name descriptor shall contain the target port identifier.

7.6.4.2x.3 Target device identifier

A SCSI target device shall have one or more SCSI target device name descriptors. Each SCSI target device name descriptor shall contain an identification descriptor with the ASSOCIATION field set to 2h (i.e., SCSI target device) and the IDENTIFIER TYPE field set to:

a) 2h (i.e., EUI-64 based);
b) 3h (i.e., NAA); or
c) 8h (i.e., SCSI name string).

If the IDENTIFIER TYPE field is set to 8h then the returned Device Identification VPD page shall only contain one SCSI target device name descriptor. If the IDENTIFIER TYPE fields are set to 2h or 3h then the returned Device Identification VPD page shall contain all the SCSI target device names for all the SCSI transport protocols supported by the SCSI target device.

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7.6.4.2 Vendor specific identifier format

If the identifier type is 0h (i.e., vendor specific (0h), ...

7.6.4.3 T10 vendor identification format

If the identifier type is 1h (i.e., T10 vendor identification ~~(1h~~), ...

7.6.4.4 EUI-64-based identifier format

7.6.4.4.1 ~~EIU~~EUI-64-based identifier format overview

If the identifier type is 2h (i.e., EUI-64-based identifier), the IDENTIFIER LENGTH field indicates the format of the identification descriptor (see table 273).

Table 273 - Identifier type

Identifier Length	Description	Reference
0008h	EUI-64 identifier	7.6.4.4.2
000Ch	EUI-64-based 12-byte identifier	7.6.4.4.3
0010h	EUI-64-based 16-byte identifier	7.6.4.4.4
All others	Reserved	

7.6.4.4.2 ~~EIU~~EUI-64 identifier format

If the identifier type is 2h (i.e., EUI-64-based identifier ~~(2h~~) and the IDENTIFIER LENGTH field is set to 8h, the ~~eight byte fixed length~~ IDENTIFIER field has the format shown in table 273. The CODE SET field shall be set to 1h (i.e., binary) ~~and the IDENTIFIER LENGTH field shall be set to 8h~~.

Table 273 - EUI-64 IDENTIFIER field format

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The IEEE COMPANY_ID field contains a 24 bit OUI (see 3.1.60) assigned by the IEEE.

The VENDOR SPECIFIC EXTENSION IDENTIFIER field contains a 40 bit numeric value that is uniquely assigned by the organization associated with the IEEE company_id as required by the IEEE definition of EUI-64 (see D.2).

7.6.4.4.3 ~~EIU~~EUI-64-based 12-byte identifier format

If the identifier type is 2h (i.e., EUI-64-based identifier) and the IDENTIFIER LENGTH field is set to Ch, the IDENTIFIER field has the format shown in table 2730. The CODE SET field shall be set to 1h (i.e., binary).

Table 2730 - EUI-64-based 12 byte IDENTIFIER field format

	7	6	5	4	3	2	1	0
0	(MSB)			IEEE COMPANY_ID				
2								(LSB)
3	(MSB)			VENDOR SPECIFIC EXTENSION IDENTIFIER				
7								(LSB)
8	(MSB)			DIRECTORY ID				
11								(LSB)

The IEEE COMPANY_ID field and VENDOR SPECIFIC EXTENSION IDENTIFIER field are defined in 7.6.4.4.2.

The DIRECTORY ID field contains a directory identifier, as specified by ISO/IEC 13213:1994.

NOTE 2 - The EUI-64-based 12 byte format may be used to report IEEE 1394 target port identifiers (see SBP-3).

7.6.4.4.4 ~~EIU~~EUI-64-based 16-byte identifier format

If the identifier type is 2h (i.e., EUI-64-based identifier) and the IDENTIFIER LENGTH field is set to 10h, the IDENTIFIER field has the format shown in table 2731. The CODE SET field shall be set to 1h (i.e., binary).

Table 2731 - EUI-64-based 16-byte IDENTIFIER field format

	7	6	5	4	3	2	1	0
0	(MSB)			IDENTIFIER EXTENSION				
7								(LSB)
8	(MSB)			IEEE COMPANY_ID				
10								(LSB)
11	(MSB)			VENDOR SPECIFIC EXTENSION IDENTIFIER				
15								(LSB)

The IEEE COMPANY_ID field and VENDOR SPECIFIC EXTENSION IDENTIFIER field are defined in 7.6.4.4.2.

The IDENTIFIER EXTENSION field contains a 64 bit numeric value.

> NOTE 3 - The EUI-64-based 16-byte format may be used to report SCSI over RDMA target port identifiers (see SRP).

7.6.4.5 NAA identifier format

7.6.4.5.1 NAA identifier basic format

If the identifier type is 3h (i.e., NAA identifier ~~(3h)~~), ...

7.6.4.5.2 NAA IEEE Extended identifier format

When NAA is 2h (i.e., IEEE Extended ~~(2h)~~), the eight byte fixed length IDENTIFIER field shall have the format shown in table 279. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 8h.

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7.6.4.5.3 NAA IEEE Registered identifier format

When NAA is 5h (i.e., IEEE Registered ~~(5h)~~), the eight byte fixed length IDENTIFIER field shall have the format shown in table 280. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 8h.

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7.6.4.5.4 NAA IEEE Registered Extended identifier format

When NAA is 6h (i.e., IEEE Registered Extended ~~(6h)~~), the sixteen byte fixed length IDENTIFIER field shall have the format shown in table 281. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 10h.

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7.6.4.6 Relative target port identifier format

If the identifier type is 4h (i.e., relative target port ~~(4h)~~) and the ASSOCIATION field contains 1h (i.e., SCSI target port), the four byte fixed length IDENTIFIER field shall have the format shown in table 282. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 4h. If the ASSOCIATION field does not contain 1h, use of this identifier type is reserved.

The RELATIVE TARGET PORT field (see table 283) identifies the SCSI target port relative to other SCSI target ports in the device.

Table 283 - Relative target port identifier values

Value	Description
0h	Reserved
1h	Relative target port 1, historically known as port A
2h	Relative target port 2, historically known as port B
3h - 7FFF FFFFh	Relative target port 3 through 2 147 483 647
8000 0000h - FFFF FFFFh	Reserved

7.6.4.7 Target port group identifier format

If the identifier type is 5h (i.e., target port group (5h) and the association value is 1h (i.e., SCSI target port), the four byte fixed length IDENTIFIER field shall have the format shown in table 284. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 4h. If the ASSOCIATION field does not contain 1h, use of this identifier type is reserved.

...

7.6.4.8 Logical unit group identifier format

A logical unit group is a group of logical units that share the same target port group (see 5.7) definitions. The target port groups maintain the same target port group asymmetric access states for all logical units in the same logical unit group. A logical unit shall be in no more than one logical unit group.

If the identifier type is 6h (i.e., logical unit group (6h) and the association value is 0h (i.e., logical unit), the four byte fixed length IDENTIFIER field shall have the format shown in table 285. The CODE SET field shall be set to 1h (i.e., binary) and the IDENTIFIER LENGTH field shall be set to 4h. If the ASSOCIATION field does not contain 0h, use of this identifier type is reserved.

...

7.6.4.9 MD5 logical unit identifier format

If the identifier type is 7h (i.e., MD5 logical unit identifier (7h), the IDENTIFIER field has the format shown in table 286. The MD5 logical unit identifier shall not be used if a logical unit provides unique identification using identifier types 2h (i.e., EUI-64-based identifier) or 3h (i.e., NAA identifier)) (see table 273). A bridge device may return a MD5 logical unit identifier type for that logical unit that does not support the Device Identification VPD page (see 7.6.4).

...

7.6.4.x SCSI name string identifier format [this section is entirely new]

If the identifier type is 8h (i.e., SCSI name string), the IDENTIFIER field has the format shown in table xxx. The CODE SET field shall be set to 3h (i.e., UTF-8).

Table xxx - SCSI name string IDENTIFIER field format

	7	6	5	4	3	2	1	0
0				SCSI NAME STRING				
n								
n + 1				NULL (00h)				
n + 2				PAD (if needed)				
4m - 1								

The SCSI NAME STRING field contains a UTF-8 format string. The SCSI NAME STRING field shall not include a byte set to 00h. The SCSI NAME STRING field shall be no larger than 255 bytes.

The SCSI NAME STRING field starts with either:

 a) "eui." concatenated with 8, 12, or 16 hex characters for an EUI-64-based identifier (see 7.6.4.4);
 b) "naa." concatenated with 16 or 32 hex characters for an NAA identifier (see 7.6.4.5); or
 c) "iqn." concatenated with an iSCSI Name for an iSCSI-name based identifier (see iSCSI).

When the ASSOCIATION field is set to 0h (i.e., logical unit), the SCSI NAME STRING field ends with ",L,0x" concatenated with 16 hex characters for the logical unit name extension. The logical unit name extension is a UTF-8 string containing no more than 16 hexadecimal digits (i.e., 0 through 9 and A through F). The logical unit name extension is assigned by the target device vendor and shall be assigned so the logical unit name is worldwide unique.

When the ASSOCIATION field is set to 1h (i.e., SCSI target port), the SCSI NAME STRING field ends with ",t,0x" concatenated with hex characters (see the appropriate transport protocol standard).

When the ASSOCIATION field is set to 2h (i.e., SCSI target device), the SCSI NAME STRING field has no additional characters.

The NULL field contains 00h.

The PAD field shall consist of zero to three bytes set to 00h such that the total length of the IDENTIFIER field is a multiple of four. The PAD field shall be ignored.

7.6.4.10 Device identification VPD page example [delete this section]

7.6.4.x Device identification descriptor requirements [this section is entirely new]

7.6.4.x.1 Identification descriptors for Logical Units

Each logical unit that is not a well-known logical unit shall include at least one logical unit name descriptor. The logical unit name descriptor shall contain an identification descriptor with the ASSOCIATION field set to 0h (i.e., logical unit) and the IDENTIFIER TYPE field set to:

 a) 1h (i.e., T10 vendor identification);
 b) 2h (i.e., EUI-64-based);
 c) 3h (i.e., NAA); or
 d) 8h (i.e., SCSI name string).

At least one identification descriptor should contain an IDENTIFIER TYPE field set to:

 a) 2h (i.e., EUI-64-based);
 b) 3h (i.e., NAA); or
 c) 8h (i.e., SCSI name string).

In the case of virtual logical units (e.g., volume sets as defined by SCC-2), identification descriptor should contain an IDENTIFIER TYPE field set to:

 a) 2h (i.e., EUI-64-based);
 b) 3h (i.e., NAA); or
 c) 8h (i.e., SCSI name string).

   NOTE 4 - In the case of virtual logical units, the IDENTIFIER field (see table 267) should be in the NAA IEEE Registered Extended name format as defined in 8.6.4.5.3.

Each logical unit that is a well-known logical unit shall include one or more SCSI target device name descriptors (see 7.6.4.x.3). The SCSI target device name descriptors shall contain all the SCSI target device names for all the SCSI transport protocols supported by the SCSI target device.

Well-known logical units shall not return any logical unit name descriptors (i.e., ASSOCIATION field set to 0h).

A logical unit shall return the same set of SCSI target device name descriptors regardless of the I_T nexus being used to retrieve the identification descriptors.

7.6.4.x.2 Identification descriptors for Target ports

Each logical unit should include one identification descriptor with the ASSOCIATION field set to 1h (i.e., SCSI target port) and the IDENTIFIER TYPE field set to 4h (i.e., relative target port) identifying the target port being used to retrieve the identification descriptors.

A target port name descriptor is an identification descriptor with the ASSOCIATION field set to 1h (i.e., SCSI target port) and the IDENTIFIER TYPE field set to:

   a)   2h (i.e., EUI-64-based);
   b)   3h (i.e., NAA); or
   c)   8h (i.e., SCSI name string).

If the transport protocol of the target port defines target port names, the target port name descriptor shall contain the target port name. If the transport protocol of the target port does not define target port names, the target port name descriptor shall contain the target port identifier.

7.6.4.~~10 Device identification vpd page example [delete this section]~~x.3 Identification descriptors for Target devices

A SCSI target device shall have one or more SCSI target device name descriptors. Each SCSI target device name descriptor shall contain an identification descriptor with the ASSOCIATION field set to 2h (i.e., SCSI target device) and the IDENTIFIER TYPE field set to:

   a)   2h (i.e., EUI-64-based);
   b)   3h (i.e., NAA); or
   c)   8h (i.e., SCSI name string).

The returned Device Identification VPD page shall contain all the SCSI target device names for all the SCSI transport protocols supported by the SCSI target device.

7.6.5 Software Interface Identification page [no changes]

7.6.6 Supported VPD pages [no changes]

7.6.7 Unit Serial Number ~~PVD~~ VPD page [no changes]

8.1 Model for well known logical units

Well known logical units are addressed using the well known logical unit addressing method of extended logical unit addressing (see SAM-2). Each well known logical unit has a well known logical unit number (W-LUN) as shown in table 294.

Table 294 — Well known logical unit numbers

...

If a well known logical unit is supported within a SCSI target device then that logical unit shall support all the commands defined for it.

Access to well known logical units shall not be affected by access controls.

The SCSI target device name of the well known logical unit may be determined by issuing an INQUIRY command (see 6.4) requesting the Device Identification VPD page (see 7.6.4).

All well known logical units shall support the INQUIRY command's Device Identification VPD page (see 7.6.4.x.1). ~~and, at a minimum, shall support the IDENTIFIER TYPE field set to the SCSI name string format identifier (i.e., 8h). or one or more the identify descriptors with the IDENTIFIER TYPE field set to the NAA identifier (i.e., 3h) or the EUI-64 identifier (i.e., 2h). The contents of the IDENTIFIER field shall be equal to one of the SCSI target device's names. The returned Device Identification VPD page shall contain all the SCSI target device names for all the SCSI transport protocols supported by the SCSI target device. All well known logical units within a SCSI target device shall return the same list of SCSI target device names.~~

~~Proposed changes for SAS~~

Proposed changes for SAS 1.1

Edit the VPD requirements subclause to reflect these rules:

A SCSI target device containing only SSP target ports shall use the NAA format for its logical unit names. If a SCSI target device contains both SSP target ports and target ports using other transport protocols, the logical unit names should use SCSI name string format (with "naa" "eui" or "iqn" formats).

A SCSI target device containing only SSP target ports shall use the NAA format for its target port identifiers. If a SCSI target device contains both SSP target ports and target ports using other transport protocols, the target port identifiers should use the SCSI name string format (with "naa" "eui" or "iqn" formats).

Proposed changes for FCP-3

Add these rules wherever appropriate:

A SCSI target device containing only FCP target ports shall use the NAA format for its logical unit names. If a SCSI target device contains both FCP target ports and target ports using other transport protocols, the logical unit names should use SCSI name string format (with "naa", "eui", or "iqn" formats).

A SCSI target device containing only FCP target ports shall use the NAA format for its target port identifiers. If a SCSI target device contains both FCP target ports and target ports using other transport protocols, the target port identifiers should be in SCSI name string format (with "naa", "eui", or "iqn" formats).

Proposed changes for SRP-2

Add these rules wherever appropriate:

A SCSI target device containing only SRP target ports shall use the EUI-64-based format [or SCSI name string format] for its logical unit names. If a SCSI target device contains both SRP target ports and target ports using other transport protocols, the logical unit names should use SCSI name string format (with "naa", "eui", or "iqn" formats).

A SCSI target device containing only SRP target ports shall use the EUI-64-based format for its target port identifiers. If a SCSI target device contains both SRP target ports and target ports using other transport protocols, the target port identifiers should be in SCSI name string format (with "naa", "eui", or "iqn" formats).

More proposed changes for SAM-3

Annex A
(informative)

Identifiers and names for objects

A.1 Identifiers and names overview

This standard defines the identifiers and names for the objects listed in A.1. The size requirements placed on identifiers by this standard are as shown in table A.1. This standard places no requirements on the sizes of names. Table A.1 also lists whether this standard or SPC-~~2~~3 requires SCSI transport protocols and logical units to support identifiers and names for an object.

Table A.1 — Object size and support requirements

Object	Identifier		Name	
	Size	**Support Requirements**	**Size**	**Support Requirements**
Initiator device	n/a	n/a	not specified	optional
Target device	n/a	n/a	not specified [a]	optional
Initiator port	not specified	mandatory	not specified	optional
Target port	not specified	mandatory	not specified [a]	optional
Logical unit	8 bytes (maximum)	mandatory	not specified [a]	mandatory
[a] Reported in the Device Identification VPD page (see SPC-~~2~~3)				

Each SCSI transport protocol defines the size and format of identifiers and names for each object.

See table A.2 for a list of the size of the identifiers for each SCSI transport protocol. See table A.3 for a list of the format of the identifiers for each SCSI transport protocol.

Table A.2 — Object identifier size for each SCSI transport protocol

Object	Identifier size					
	SPI-4	**FCP-2**	**SRP**	**iSCSI**	**SBP-3**	**SAS SSP**
Initiator port	4 bits [a]	3 bytes	16 bytes	245 bytes [b]	2 bytes	8 bytes
Target port	4 bits [a]	3 bytes	16 bytes	232 bytes [b]	11 bytes	8 bytes
Logical unit	6 bits (data group transfers) 8 bytes (information unit transfers)	8 bytes	8 bytes	8 bytes	2 bytes	8 bytes
[a] SPI-4 uses a bit significant representation of the SCSI port identifier, therefore, the maximum number of SCSI ports is 16, a value that can be represented in 4 bits [b] Not including null termination.						

Table A.3 — Object identifier format for each SCSI transport protocol

Object	Identifier format					
	SPI-4	FCP-2	SRP	iSCSI	SBP-3	SAS SSP
Initiator port	bit significant (a maximum of 16 ports; one for each bit)	~~binary value~~ address identifier	EUI-64 + 8 byte extension [a]	~~iSCSI name + "i" + Initiator Session Identifier (ISID)~~ iSCSI name concatenated with ",i,0x" concatenated with Initiator Session Identifier [b] [c]	binary value	NAA IEEE Registered format ~~per SPC-3~~
Target port	bit significant (a maximum of 16 ports; one for each bit)	~~binary value~~ address identifier	EUI-64 + 8 byte extension [a]	~~iSCSI name + "t" + Target Portal Group Tag~~ iSCSI name concatenated with ",t,0x" concatenated with Target Portal Group Tag [b] [d]	EUI-64 + Discovery ID [e]	NAA IEEE Registered format ~~per SPC-3~~
Logical unit	binary value (6 bit) or As specified in this standard ~~(8 byte)~~ (see 4.9)	As specified in this standard (see 4.9)	As specified in this standard (see 4.9)	As specified in this standard (see 4.9)	~~As specified in this standard~~ binary value (2 bytes)	As specified in this standard (see 4.9)

[a] Required to be worldwide unique and recommend to be EUI-64 + 8 byte extension. ~~The iSCSI name should be worldwide unique, 223 bytes maximum in UTF-8 format with null termination~~.

[b] The iSCSI name is a worldwide unique UTF-8 string no more than ~~223~~ 224 bytes long (~~not~~ including null termination). ~~The Initiator Session Identifier (ISID) is a non zero six byte integer.~~

[c] The Initiator Session Identifier (ISID) is a UTF-8 encoded hexadecimal representation of a non-zero six byte integer. The ISID is represented in no more than 12 bytes (not including null termination). ~~The Target Portal Group Tag is a non zero two byte integer.~~

[d] The Target Portal Group Tag (TPGT) is a UTF-8 encoded hexadecimal representation of a non-zero two byte integer. The TPGT is represented in no more than 4 bytes (not including null termination).

[e] See IEEE Std P1212 for more information on the Discovery ID.

See table A.4 for a list of the size of the names for each SCSI transport protocol. See table A.5 for a list of the format of the names for each SCSI transport protocol.

Table A.4 — Object name size for each SCSI transport protocol

Object	Name size					
	SPI-4	**FCP-2**	**SRP**	**iSCSI**	**SBP-3**	**SAS SSP**
Initiator device	not specified	not specified	not specified	~~223~~ 224 bytes [a]	not specified	8 bytes [b] or ~~223~~ 224 bytes [a] [c]
Target device	not specified	not specified	not specified	~~223~~ 224 bytes [a]	not specified	8 bytes [b] or ~~223~~ 224 bytes [a] [c]
Initiator port	not specified	8 bytes	16 bytes	~~255~~ 245 bytes [a]	8 bytes	not specified
Target port	not specified	8 bytes	16 bytes	~~255~~ 245 bytes [a]	11 bytes	not specified
Logical unit	Reported in the Device Identification VPD page (see SPC-~~2~~3).					
[a] ~~Not including~~ Including null termination. [b] Size if NAA IEEE Registered format is used. [c] Size if SCSI name string format is used.						

Table A.5 — Object name format for each SCSI transport protocol

Object	Name format					
	SPI-4	**FCP-2**	**SRP**	**iSCSI**	**SBP-3**	**SAS SSP**
Initiator device	not specified	not specified	not specified	~~iSCSI name~~ SCSI name string format	not specified	NAA IEEE Registered format ~~per SPC-3~~ or SCSI name string format
Target device	not specified	not specified	not specified	~~iSCSI name~~ SCSI name string format	not specified	NAA IEEE Registered format ~~per SPC-3~~ or SCSI name string format
Initiator port	not specified	Fibre Channel name_ identifier	EUI-64 + 8 byte extension [b]	~~iSCSI name + "i" + Initiator Session Identifier (ISID)~~ iSCSI name concatenated with ",i,0x" concatenated with Initiator Session Identifier [a] [c]	EUI-64	not specified

~~The iSCSI name should be worldwide unique, 223 bytes maximum in UTF-8 format with null termination.~~

[a] The iSCSI name is a worldwide unique UTF-8 string no more than ~~223~~ 224 bytes long (~~not~~ including null termination).

[b] Required to be worldwide unique and recommend to be EUI-64 + 8 byte extension.
~~The Initiator Session Identifier (ISID) is a non-zero six byte integer.~~

[c] The Initiator Session Identifier (ISID) is a UTF-8 encoded hexadecimal representation of a non-zero six byte integer. The ISID is represented in no more than 12 bytes (not including null termination).
~~The Target Portal Group Tag is a non-zero two byte integer.~~

[d] The Target Portal Group Tag (TPGT) is a UTF-8 encoded hexadecimal representation of a non-zero two byte integer. The TPGT is represented in no more than 4 bytes (not including null termination).

[e] See IEEE Std P1212 for more information on the Discovery ID.

Table A.5 — Object name format for each SCSI transport protocol

Object	Name format					
	SPI-4	**FCP-2**	**SRP**	**iSCSI**	**SBP-3**	**SAS SSP**
Target port	not specified	Fibre Channel name_ identifier	EUI-64 + 8 byte extension [b]	~~iSCSI name + "t" + Target Portal Group Tag~~ iSCSI name concatenated with ".t.0x" concatenated with Target Portal Group Tag [a] [d]	EUI-64 + Discovery ID [e]	not specified
Logical unit	Device Identification VPD page name (see SPC-2)					

~~The iSCSI name should be worldwide unique, 223 bytes maximum in UTF-8 format with null termination.~~

[a] The iSCSI name is a worldwide unique UTF-8 string no more than ~~223~~ 224 bytes long (~~not~~ including null termination).

[b] Required to be worldwide unique and recommend to be EUI-64 + 8 byte extension. ~~The Initiator Session Identifier (ISID) is a non-zero six byte integer.~~

[c] The Initiator Session Identifier (ISID) is a UTF-8 encoded hexadecimal representation of a non-zero six byte integer. The ISID is represented in no more than 12 bytes (not including null termination). ~~The Target Portal Group Tag is a non-zero two byte integer.~~

[d] The Target Portal Group Tag (TPGT) is a UTF-8 encoded hexadecimal representation of a non-zero two byte integer. The TPGT is represented in no more than 4 bytes (not including null termination).

[e] See IEEE Std P1212 for more information on the Discovery ID.

A.2 SCSI transport protocol acronyms and bibliography

A.2.1 EUI-64 (Extended Unique Identifier, a 64-bit globally unique identifier): The IEEE maintains a tutorial describing EUI-64 at http://standards.ieee.org/regauth/oui/tutorials/EUI64.html.

A.2.2 FCP-2: SCSI Fibre Channel Protocol -2 (see 1.3).

A.2.3 IEEE Std P1212: Standard for a Control and Status Register (CSR) Architecture for Microcomputer Buses. See http://www.ieee.org/.

A.2.4 iSCSI: As of this writing, the most recently published iSCSI internet draft is: http://www.ietf.org/internet-drafts/draft-ietf-ips-iscsi-~~16~~20.txt. Newer drafts may be identified at http://http://www.ietf.org/html.charters/ips-charter.html. The iSCSI internet draft is a standards track RFC specification.

A.2.5 NAA: Name Address Authority (see SPC-3).

A.2.6 SAS: Serial Attached SCSI (see 1.3).

A.2.7 SAS SSP: SAS (see A.2.6) Serial SCSI Protocol.

A.2.8 SBP-3: Serial Bus Protocol -3 (see 1.3).

A.2.9 SPI-4: SCSI Parallel Interface -4 (see 1.3).

A.2.10 SRP: SCSI RDMA Protocol (see 1.3).

A.2.11 UTF-8: See ISO/IEC 10646-1:2000, Information technology - Universal Multiple-Octet Coded Character Set (UCS) - Part 1: Architecture and Basic Multilingual Plane. See http://www.iso.org/.