

To: T10 Technical Committee  
From: Rob Elliott, HP (elliott@hp.com)  
Date: 19 December 2005  
Subject: T10/06-002r1 IEEE OUI tutorial for SCSI

### **Revision history**

Revision 0 (1 December 2005) First revision

Revision 1 (19 December 2005) Incorporating comments from T13, T11 FC-FS WG, and T10 CAP WG meetings. Split into separate files.

### **Related documents**

<http://standards.ieee.org/regauth/oui> - *IEEE Standards Association OUI and Company\_id Assignments*

<http://standards.ieee.org/regauth/oui/tutorials> - *IEEE Standards Tutorials: OUI and company\_id*. This page is supposed to link to tutorials for each standard using OUI/Company\_IDs.

<http://standards.ieee.org/regauth/oui/tutorials/fibreformat.html> - *New identifier formats based on IEEE registration*. Incorrectly posted as *Guidelines for Fibre Channel Use of the Company id* on the IEEE tutorial page. This is actually X3T11/96-467r2, the proposal to T11 that defined the NAA format, not the tutorial.

[http://standards.ieee.org/regauth/oui/tutorials/fibrecomp\\_id.html](http://standards.ieee.org/regauth/oui/tutorials/fibrecomp_id.html) - *Use of the IEEE Registration Authority assigned "company\_id" with the ANSI X3.230 FC-PH Fibre Channel specification and its extensions* February 24, 1997. This is the real Fibre Channel tutorial. However, a link to it is not available on the tutorial page, although the link is referenced by the FibreAlliance version of the Fibre Channel MIB (available at [http://www.fibrealliance.org/fb/mib/mib1\\_5.htm](http://www.fibrealliance.org/fb/mib/mib1_5.htm)).

X3T10/97-101r2 - *IEEE Tutorial for SCSI use of IEEE company\_id - Use of the IEEE Registration Authority assigned "company\_id" for SCSI-3 Primary Commands, SCSI Enclosure Services commands, and all SCSI extensions* - February 25, 1997. This SCSI tutorial is not posted on the IEEE site.

T10/spc4r02 - SCSI Primary Commands - 4 (SPC-4) revision 2

T11/05-190v3 - Fibre Channel Framing and Signaling - 2 (FC-FS-2) revision 0.9

T13/d1699r2-ata8-acb - AT Attachment - 8 ATA/ATAPI Command Set (ATA8-ACS) revision 2

T11/05-802v1 - IEEE OUI tutorial for FC

T13/e05180r1 - IEEE OUI tutorial for ATA

T13/e05181r0 - ATA8-ACS IDENTIFY PACKET DEVICE World Wide Name field

### **Overview**

The IEEE Standards Association Registration Authority web site is supposed to contain tutorials on every standard that uses IEEE OUI/Company\_ID values. However:

- a) the SCSI tutorial is not posted. There is one on the T10 web site from 1997 that is out of date;
- b) the Fibre Channel tutorial is not linked to by the site - the wrong document (the T11 proposal defining the format) is posted in its place. The tutorial is posted on the site if you know the filename, but it is from 1997 and is out of date; and
- c) an ATA tutorial does not exist. ATA/ATAPI-7 and -8 include an NAA format Worldwide Name field, which uses the IEEE OUI/Company\_ID.

### **Suggested tutorial content**

Add separate tutorials for SCSI and ATA, and update the Fibre Channel tutorial. This file contains the SCSI tutorial.

# 1 SCSI OUI/Company\_ID tutorial

## 1.1 Overview

SCSI standards support several identifier formats that incorporate IEEE OUI/Company\_ID values:

- a) EUI-48 (6 bytes)(see 1.1.1);
- b) EUI-64 (8 bytes)(see 1.1.2);
- c) EUI-64 based 12-byte (12 bytes)(see 1.1.3);
- d) EUI-64 based 16-byte (16 bytes)(see 1.1.4);
- e) NAA IEEE Extended (NAA 2h)(8 bytes)(see 1.1.5);
- f) NAA IEEE Registered (NAA 5h)(8 bytes)(see 1.1.6);
- g) NAA IEEE Registered Extended (NAA 6h)(16 bytes)(see 1.1.7); and
- h) SCSI name string (variable length)(see 1.1.8).

### 1.1.1 EUI-48 format

The EUI-48 format is shown in table 1 and is defined in *Guidelines for use of a 48-bit Extended Unique Identifier (EUI-48™)*.

**Table 1 — EUI-48 format**

Byte\Bit	7	6	5	4	3	2	1	0
0	(MSB)							
	IEEE COMPANY ID							
2	(LSB)							
3	(MSB)							
	VENDOR-SPECIFIC EXTENSION IDENTIFIER							
5	(LSB)							

Bit 1 of byte 0, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is set to zero.

Bit 0 of byte 0, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is set to zero.

### 1.1.2 EUI-64 format

The EUI-64 format is shown in table 2 and is defined in *Guidelines for 64-bit Global Identifier (EUI-64™) Registration Authority*.

**Table 2 — EUI-64 format**

Byte\Bit	7	6	5	4	3	2	1	0
0	(MSB)							
	IEEE COMPANY ID							
2	(LSB)							
3	(MSB)							
	VENDOR-SPECIFIC IDENTIFIER							
7	(LSB)							

Bit 1 of byte 0, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is set to zero.

Bit 0 of byte 0, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is set to zero.

**1.1.3 EUI-64 based 12-byte format**

The EUI-64 based 12-byte format is shown in table 3 and is defined in SPC-4.

**Table 3 — EUI-64 based 12-byte format**

Byte\Bit	7	6	5	4	3	2	1	0	
0	EUI-64 (see table 2 in 1.1.2)								
7									
8	(MSB)	DIRECTORY ID							
11								(LSB)	

**1.1.4 EUI-64 based 16-byte format**

The EUI-64 based 16-byte format is shown in table 4 and is defined in SPC-4.

**Table 4 — EUI-64 based 16-byte format**

Byte\Bit	7	6	5	4	3	2	1	0	
0	(MSB)	IDENTIFIER EXTENSION							
7								(LSB)	
8	EUI-64 (see table 2 in 1.1.2)								
15									

**1.1.5 NAA IEEE Extended format**

The NAA IEEE Extended format is shown in table 5 and is defined in SPC-4.

**Table 5 — NAA IEEE Extended format**

Byte\Bit	7	6	5	4	3	2	1	0
0	NAA (2h)				(MSB)			
1	VENDOR-SPECIFIC IDENTIFIER A							(LSB)
2	(MSB)	IEEE COMPANY ID						
4								(LSB)
5	(MSB)	VENDOR-SPECIFIC IDENTIFIER B						
7								(LSB)

Bit 1 of byte 2, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is set to zero.

Bit 0 of byte 2, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is set to zero.

**1.1.6 NAA IEEE Registered format**

The NAA IEEE Registered format is shown in table 6 and is defined in SPC-4.

**Table 6 — NAA IEEE Registered format**

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (5h)				(MSB)			
1	IEEE COMPANY ID							
3	(LSB)				(MSB)			
4	VENDOR-SPECIFIC IDENTIFIER							
7	(LSB)							

Bit 5 of byte 1, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is set to zero.

Bit 4 of byte 1, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is set to zero.

**1.1.7 NAA IEEE Registered Extended format**

The NAA IEEE Registered Extended format is shown in table 7 and is defined in SPC-4.

**Table 7 — NAA IEEE Registered Extended format**

Byte/Bit	7	6	5	4	3	2	1	0
0	NAA (6h)				(MSB)			
1	IEEE COMPANY ID							
3	(LSB)				(MSB)			
4	VENDOR-SPECIFIC IDENTIFIER							
7	(LSB)							
8	(MSB)	VENDOR-SPECIFIC IDENTIFIER EXTENSION						
15	(LSB)							

Bit 5 of byte 1, which serves as the UNIVERSALLY/LOCALLY ADMINISTERED ADDRESS bit, is set to zero.

Bit 4 of byte 1, which serves as the INDIVIDUAL/GROUP ADDRESS bit, is set to zero.

**1.1.8 SCSI name string format**

The SCSI name string format is shown in table 8 and is defined in SPC-4.

**Table 8 — SCSI name string format**

Byte/Bit	7	6	5	4	3	2	1	0
0	SCSI NAME STRING							
n								

The SCSI name string contains UTF-8 characters.

Formats for the SCSI name string that include IEEE OUI/Company\_ID values are:

- a) the four UTF-8 characters "eui." concatenated with 16, 24, or 32 hexadecimal digits (i.e., the UTF-8 characters 0 through 9 and A through F) representing an EUI-64 (see table 2 in 1.1.2), an EUI-64 based 12-byte (see table 3 in 1.1.3), or an EUI-64 based 16-byte (see table 4 in 1.1.4). The first hexadecimal digit is the most significant four bits of the first byte (i.e., most significant byte) of the EUI-64 based identifier; and
- b) the four UTF-8 characters "naa." concatenated with 16 or 32 hexadecimal digits representing an NAA identifier (see table 5 in 1.1.5, table 6 in 1.1.6, and table 7 in 1.1.7). The first hexadecimal digit is the most significant four bits of the first byte (i.e., most significant byte) of the NAA identifier.

## 1.2 SCSI command sets

### 1.2.1 SCSI Primary Commands (SPC)

#### 1.2.1.1 Device Identification VPD page

The INQUIRY command Device Identification VPD page (83h) supports several identifiers incorporating IEEE OUI/Company\_ID values:

- a) EUI-64 designation descriptor (8 bytes)(see table 9);
- b) EUI-64 based 12-byte designation descriptor (see table 10);
- c) EUI-64 based 16-byte designation descriptor (see table 11);
- d) NAA IEEE Extended designation descriptor (NAA 2h)(8 bytes)(see table 12);
- e) NAA IEEE Registered designation descriptor (NAA 5h)(8 bytes)(see table 13);
- f) NAA IEEE Registered Extended designation descriptor (NAA 6h)(16 bytes)(see table 14); and
- g) SCSI name string designation descriptor (see table 15).

The EUI-64 designation descriptor is shown in table 9.

**Table 9 — EUI-64 designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (2h)			
2	Reserved							
3	DESIGNATOR LENGTH (08h)							
4	DESIGNATOR (EUI-64 (see table 2 in 1.1.2))							
11								

The EUI-64 based 12-byte designation descriptor is shown in table 10. This is used to report IEEE 1394 target port identifiers and names.

**Table 10 — EUI-64 based 12-byte designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (2h)			
2	Reserved							
3	DESIGNATOR LENGTH (0Ch)							
4	DESIGNATOR (EUI-64 based 12-byte (see table 3 in 1.1.3))							
14								

The EUI-64 based 16-byte designation descriptor is shown in table 11. This is used to report SCSI over RDMA (SRP) target port identifiers and names.

**Table 11 — EUI-64 based 16-byte designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (2h)			
2	Reserved							
3	DESIGNATOR LENGTH (10h)							
4	DESIGNATOR (EUI-64 based 16-byte (see table 4 in 1.1.4))							
19								

An IDENTIFIER TYPE field set to 3h (i.e., NAA identifier), an DESIGNATOR LENGTH field set to 08h or 10h, and a CODE SET field set to 1h (i.e., binary) mean the IDENTIFIER field contains an NAA (Name Address Authority) identifier. The first 4 bits contain an NAA field which defines the structure of the remaining bytes.

The NAA IEEE Extended designation descriptor is shown in table 12. This may be used to report Fibre Channel target port names.

**Table 12 — NAA IEEE Extended designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (3h)			
2	Reserved							
3	DESIGNATOR LENGTH (08h)							
4	DESIGNATOR (NAA IEEE Extended (see table 5 in 1.1.5))							
11								

The NAA IEEE Registered designation descriptor is shown in table 13. This is used to report Serial Attached SCSI (SAS) target port identifiers, may be used to report Fibre Channel target port names, and may be used to report ATAPI target device names.

**Table 13 — NAA IEEE Registered designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (3h)			
2	Reserved							
3	DESIGNATOR LENGTH (08h)							
4	DESIGNATOR (NAA IEEE Registered (see table 6 in 1.1.6))							
11								

The NAA IEEE Registered Extended format designation descriptor is shown in table 14. This may be used to report logical unit names.

**Table 14 — NAA IEEE Registered Extended designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (1h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (3h)			
2	Reserved							
3	DESIGNATOR LENGTH (10h)							
4	DESIGNATOR (NAA IEEE Registered Extended (see table 7 in 1.1.7))							
19								

The SCSI name string designation descriptor is shown in table 15. This may be used to report target device names, target port names, and logical unit names.

**Table 15 — SCSI name string designation descriptor format**

Byte\Bit	7	6	5	4	3	2	1	0
0	PROTOCOL IDENTIFIER				CODE SET (3h)			
1	PIV	Reserved	ASSOCIATION		DESIGNATOR TYPE (8h)			
2	Reserved							
3	DESIGNATOR LENGTH (n - 3)							
4	DESIGNATOR (SCSI name string (see table 8 in 1.1.8))							
n								

### 1.2.1.2 Software Identification VPD page

The Software Interface Identification VPD page (84h) is shown in table 16.

**Table 16 — Software interface identifier**

Byte\Bit	7	6	5	4	3	2	1	0
0	EUI-48 (see table 1 in 1.1.1)							
5								

### 1.2.2 Other SCSI command sets

Several other SCSI commands sets use SPC's identifier formats:

- a) in SCSI Enclosure Services (SES), in the Configuration diagnostic page (1h) accessed via the RECEIVE DIAGNOSTIC RESULTS command, the ENCLOSURE LOGICAL IDENTIFIER field contains an 8-byte NAA format identifier as defined in SPC identifying each subenclosure; and
- b) in SCSI Media Changers (SMC), element descriptors contain identification descriptors as defined in SPC.

## 1.3 SCSI transport protocols

### 1.3.1 Serial Attached SCSI (SAS)

The SAS address is an NAA IEEE Registered identifier. This format is used for these names and identifiers:

- a) target port identifier;
- b) initiator port identifier;
- c) initiator device name;
- d) target device name; and
- e) expander device name.

### 1.3.2 Fibre Channel Protocol (FCP)

Each initiator port name and target port name uses an 8-byte NAA format identifier (see table 5 in 1.1.5 and table 6 in 1.1.6). See the *Fibre Channel OUI/Company\_ID tutorial* and FCP-3 for more information.

### 1.3.3 ATA Packet Interface (ATAPI)

ATAPI devices may include an NAA IEEE Registered format identifier (see table 6 in 1.1.6) as a World Wide Name field in the IDENTIFY PACKET DEVICE command. This serves as a target device name. See the *ATA/ATAPI OUI/Company\_ID tutorial* and ATA8-ACS for more information.

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[Editor's Note 1: IDENTIFY PACKET DEVICE does not currently support The World Wide Name field. e05181 proposes adding it, and making it serve as the target device name if present.](#)

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### 1.3.4 SCSI RDMA Protocol (SRP)

When SRP is used over InfiniBand, the initiator port identifier and target port identifier are each a GUID, which is an EUI-64 based 16-byte identifier (see table 4 in 1.1.4). See SRP for more information.

### 1.3.5 Serial Bus Protocol (SBP)

The Serial Bus Protocol (SBP) is a SCSI mapping over IEEE 1394. This initiator port name is an EUI-64 (see table 2 in 1.1.2). The target port name is an EUI-64 based 12-byte identifier (see table 3 in 1.1.3). See the IEEE 1212 Control and Status Register (CSR) Architecture standard and SBP-3 for more information.



### 1.3.6 iSCSI

iSCSI devices use a SCSI name string (see table 8 in 1.1.8) as the basis for initiator device names, target device names, initiator port names, and target port names. See RFC-3720 and RFC-3980 for more information.

## 1.4 References

### SCSI command set standards:

ISO/IEC 14776-454, *SCSI Primary Commands-4 (SPC-4)* (INCITS T10/1731-D)

ISO/IEC 14776-372, *SCSI Media Changers-2 (SMC-2)* (ANSI INCITS 382-2004)

ISO/IEC 14776-372, *SCSI Enclosure Services-2 (SES-2)* (INCITS T10/1559-D)

### SCSI transport protocol standards:

ISO/IEC 14776-223, *Fibre Channel Protocol-3 (FCP-3)* (INCITS T10/1560-D)

ISO/IEC 14776-232, *Serial Bus Protocol-3 (SBP-3)* (ANSI INCITS 375-2004)

ISO/IEC 14776-241, *SCSI RDMA Protocol (SRP)* (ANSI INCITS 365-2002)

ISO/IEC 14776-351, *Serial Attached SCSI 1.1 (SAS-1.1)* (INCITS T10/1601-D)

ISO/IEC 14776-871, *AT Attachment-8 ATA/ATAPI Command Set (ATA8-ACS)* (INCITS T13/1699-D)

SCSI standards are developed by the INCITS (<http://www.incits.org>) T10 committee (<http://www.t10.org>). SCSI standards are published by ANSI (<http://www.ansi.org>) and ISO/IEC (<http://www.iso.int>). 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>.

### Other documents:

IETF RFC-3720, *Internet SCSI (iSCSI)*

IETF RFC-3980, *T11 Network Address Authority (NAA) Naming Format for iSCSI Node Names*.

IETF RFCs are available from <http://www.ietf.org>.

ISO/IEC 13213:1994 *Control and Status Registers Architecture for microcomputer buses* (ANSI IEEE 1212:1994). Available from <http://www.iso.int>.

*InfiniBand Architecture Specification Release 1.2*. Available from <http://www.infinibandta.org>.

*Guidelines for use of a 48-bit Extended Unique Identifier (EUI-48™)* by the IEEE Standards Association. Available at <http://standards.ieee.org/regauth/oui/tutorials/EUI48.html>.

*Guidelines for 64-bit Global Identifier (EUI-64™) Registration Authority* by the IEEE Standards Association. Available at <http://standards.ieee.org/regauth/oui/tutorials/EUI64.html>.

*Fibre Channel OUI/Company\_ID tutorial* by T11 for the IEEE Standards Association. Available at <http://standards.ieee.org/regauth/oui/tutorials/FC.html>.

*ATA/ATAPI OUI/Company\_ID tutorial* by T13 for the IEEE Standards Association. Available at <http://standards.ieee.org/regauth/oui/tutorials/ATA.html>.