



Intel® Storage System JBOD 2000S3 Product Family

SCSI Enclosure Services Programming Guide

SES Version 3.0, Revision 1.8
Apr 2017

Intel® Server Boards and Systems

<This page is intentionally left blank.>

Revision History

Date	Revision Number	Modifications
August 2014	1.0	Initial Release
August 2014	1.1	Edited per feedback recommendation
August 2014	1.2	Added document table reference cross-references
August 2014	1.3	Updated per Riverbed feedback
August 2014	1.4	Move String In/Out Diagnostic page to proper order location
September 2014	1.4.5	Updated per DM feedback
September 2014	1.5	Updated per DM feedback. Added Request/Response functions in section 4. Added Operation commands in section 5. Split SPC Customization & VPD Page List sections.
October 2014	1.6	Updated Fan Speed Control table 188. Added PHY EVENT SOURCE field tables on pages 56. Updated Buffer ID table and text on page 143.
October 2014	1.7	Updates as needed
March 2016	1.8	Applied new format

Disclaimers

No license (express or implied, by estoppel or otherwise) to any intellectual property rights is granted by this document.

Intel disclaims all express and implied warranties, including without limitation, the implied warranties of merchantability, fitness for a particular purpose, and non-infringement, as well as any warranty arising from course of performance, course of dealing, or usage in trade.

This document contains information on products, services and/or processes in development. All information provided here is subject to change without notice. Contact your Intel representative to obtain the latest Guide.

The products and services described may contain defects or errors known as errata which may cause deviations from published specifications. Current characterized errata are available on request.

Intel, and the Intel logo are trademarks of Intel Corporation in the U.S. and/or other countries.

*Other names and brands may be claimed as the property of others

© 2017 Intel Corporation.

Table of Contents

1. Introduction	1
1.1 <i>Server Product Use Disclaimer</i>	1
1.2 <i>Product Errata</i>	1
1.3 <i>Supported Commands and Elements</i>	1
2. Product Family Overview	2
3. Firmware Customization for the JBOD2312S3SP Expander	3
3.1 <i>Firmware Customization for the Components</i>	3
3.1.1 <i>SoC</i>	3
3.1.2 <i>PHY Management</i>	3
4. SMP Management Function Customization	5
4.1 <i>SMP Initiator</i>	5
4.2 <i>SMP Target</i>	5
4.2.1 <i>Report General Function (00h)</i>	6
4.2.2 <i>Report Manufacturer Information Function (01h)</i>	12
4.2.3 <i>REPORT SELF-CONFIGURATION STATUS Function (03h)</i>	15
4.2.4 <i>REPORT ZONE PERMISSION TABLE Function (04h)</i>	18
4.2.5 <i>REPORT ZONE MANAGER PASSWORD Function (05h)</i>	21
4.2.6 <i>REPORT BROADCAST Function (06h)</i>	22
4.2.7 <i>DISCOVER Function (10h)</i>	25
4.2.8 <i>REPORT PHY ERROR LOG Function (11h)</i>	38
4.2.9 <i>REPORT PHY SATA Function (12h)</i>	40
4.2.10 <i>REPORT ROUTE INFORMATION Function (13h)</i>	43
4.2.11 <i>REPORT PHY EVENT Function (14h)</i>	45
4.2.12 <i>DISCOVER LIST Function (20h)</i>	47
4.2.13 <i>REPORT PHY EVENT LIST Function (21h)</i>	51
4.2.14 <i>REPORT EXPANDER ROUTE TABLE LIST Function (22h)</i>	53
4.2.15 <i>CONFIGURE GENERAL Function (80h)</i>	56
4.2.16 <i>ENABLE DISABLE ZONING Function (81h)</i>	59
4.2.17 <i>ZONED BROADCAST Function (85h)</i>	61
4.2.18 <i>ZONE LOCK Function (86h)</i>	62
4.2.19 <i>ZONE ACTIVATE Function (87h)</i>	63
4.2.20 <i>ZONE UNLOCK Function (88h)</i>	64
4.2.21 <i>CONFIGURE ZONE MANAGER PASSWORD Function (89h)</i>	65
4.2.22 <i>CONFIGURE ZONE PHY INFORMATION Function (8Ah)</i>	67
4.2.23 <i>CONFIGURE ZONE PERMISSION TABLE Function (8Bh)</i>	69
4.2.24 <i>CONFIGURE ROUTE INFORMATION Function (90h)</i>	71
4.2.25 <i>PHY CONTROL Function (91h)</i>	73
4.2.26 <i>PHY TEST FUNCTION Function (92h)</i>	80
4.2.27 <i>CONFIGURE PHY EVENT Function (93h)</i>	82
5. SPC Command Customization	84
5.1 <i>TEST UNIT READY command (00h)</i>	84

5.2	<i>INQUIRY (12h)</i>	85
5.3	<i>REPORT LUNS command (A0h)</i>	86
5.4	<i>SEND DIAGNOSTIC command (1Dh)</i>	87
5.5	<i>RECEIVE DIAGNOSTIC RESULTS command (1Ch)</i>	89
5.6	<i>READ BUFFER command (3Ch)</i>	89
5.7	<i>WRITE BUFFER command (3Bh)</i>	90
5.8	<i>REQUEST SENSE command (03h)</i>	90
6.	Supported VPD Page List	92
6.1	<i>EVPD INQUIRY Data (Page 00)</i>	92
6.2	<i>Unit Serial Number VPD page (Page 80h)</i>	92
6.3	<i>EVPD INQUIRY Data (Page 83h)</i>	92
6.4	<i>Extended INQUIRY Data VPD page (Page 86h)</i>	93
7.	SES Pages	94
7.1	<i>Supported Diagnostic Page (00h)</i>	94
7.2	<i>Configuration Diagnostic Page (01h)</i>	95
7.3	<i>Enclosure Control Diagnostic Page (02h)</i>	98
7.4	<i>String Out Diagnostic Page (04h)</i>	99
7.5	<i>String In Diagnostic Page (04h)</i>	100
7.6	<i>Threshold Out Diagnostic Page (05h)</i>	100
7.7	<i>Threshold In Diagnostic Page (05h)</i>	102
7.8	<i>Element Description Diagnostic Page (07h)</i>	105
7.9	<i>Additional Element Status Diagnostic Page (0Ah)</i>	108
7.10	<i>Supported SES Diagnostic Pages diagnostic page (0Dh)</i>	110
7.11	<i>Download Microcode Control diagnostic page (0Eh)</i>	110
7.12	<i>Download Microcode Status diagnostic page (0Eh)</i>	112
7.13	<i>Subenclosure Nickname Control diagnostic page (0Fh)</i>	113
7.14	<i>Subenclosure Nickname Status diagnostic page (0Fh)</i>	114
8.	Element Customization	116
8.1	<i>Array Device Slot Element</i>	116
8.1.1	<i>Control Element</i>	116
8.1.2	<i>Array Device Slot Status Element</i>	116
8.2	<i>Power Supply</i>	117
8.2.1	<i>Power Supply Control Element</i>	117
8.2.2	<i>Power Supply Status Element</i>	117
8.3	<i>Cooling Element</i>	118
8.3.1	<i>Cooling Control Element</i>	118

8.3.2	Cooling Status Element.....	118
8.4	<i>Temperature Sensor</i>	119
8.4.1	Temperature Control Element.....	119
8.4.2	Temperature Status Element.....	119
8.5	<i>Voltage Sensor</i>	120
8.5.1	Voltage Control Element	120
8.5.2	Voltage Status Element.....	120
8.6	<i>Enclosure Element Control</i>	121
8.6.1	Enclosure Element Control.....	121
8.6.2	Enclosure Element Status	121
8.6.3	Front Panel LEDs.....	122
9.	Firmware Update	123
	<i>Firmware Download Procedure</i>	123
Appendix A.	Reference Documents.....	124
Appendix B.	Glossary	125

List of Tables

Table 1. System Feature Set	2
Table 2. JBOD Expander PHY Mapping.....	3
Table 3. SMP Initiator functions.....	5
Table 4. SMP Target Functions	5
Table 5. SMP Report General Request	6
Table 6. SMP Report General Response (1 of 3)	6
Table 7. SMP Report General Response (part 2 of 3).....	7
Table 8. SMP Report General Response (part 3 of 3).....	7
Table 9. FUNCTION RESULT field	10
Table 10. NUMBER OF ZONE GROUPS field.....	10
Table 11. Report Manufacturer Information Request	12
Table 12. Report Manufacturer Information Response	12
Table 13. REPORT SELF-CONFIGURATION STATUS request.....	15
Table 14. REPORT SELF-CONFIGURATION STATUS response	15
Table 15. Self-configuration status descriptor	17
Table 16. Self Configuration Status Types Logged (part 1 of 2).....	17
Table 17. Self Configuration Status Types Logged (part 2 of 2).....	18
Table 18. REPORT ZONE PERMISSION TABLE request.....	18
Table 19. REPORT TYPE field.....	19
Table 20. REPORT ZONE PERMISSION TABLE response	19
Table 21. Zone permission descriptors	20
Table 22. Zone permission descriptor for a source zone group (i.e., s) with 256 zone groups	20
Table 23. Zone permission descriptor bit requirements.....	20
Table 24. REPORT ZONE MANAGER PASSWORD request.....	21
Table 25. REPORT TYPE field.....	22
Table 26. REPORT ZONE MANAGER PASSWORD response	22
Table 27. REPORT BROADCAST request	22
Table 28. REPORT BROADCAST response.....	23
Table 29. Broadcast descriptor	24
Table 30. BROADCAST REASON field for originated Broadcasts.....	24
Table 31. SMP Discover Request	25
Table 32. SMP Discover Response.....	26
Table 33. Attached Device Type field	28
Table 34. Negotiated Logical link Rate field and Negotiated Physical link Rate field	29
Table 35. NEGOTIATED PHYSICAL LINK RATE field and NEGOTIATED LOGICAL LINK RATE field combinations based on multiplexing.....	29
Table 36. ATTACHED SATA PORT SELECTOR and ATTACHED SATA DEVICE bits.....	30
Table 37. PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field.....	33
Table 38. The HARDWARE MINIMUM PHYSICAL LINK RATE field and the HARDWARE MAXIMUM PHYSICAL LINK RATE field.....	33
Table 39. ROUTING ATTRIBUTE field	34
Table 40. Connector Type Field	34
Table 41. PHY POWER CONDITION field	34
Table 42. SAS POWER CAPABLE field	34
Table 43. PWR_DIS SIGNAL field	35
Table 44. PWR_DIS CONTROL CAPABLE field	35
Table 45. ATTACHED DEVICE NAME field.....	35
Table 46. SELF-CONFIGURATION STATUS field.....	36
Table 47. SELF-CONFIGURATION LEVELS COMPLETED field	37
Table 48. REPORT PHY ERROR LOG request.....	39
Table 49. REPORT PHY ERROR LOG response	39
Table 50. REPORT PHY SATA request	40

Table 51. REPORT PHY SATA response	41
Table 52. REPORT ROUTE INFORMATION request	43
Table 53. REPORT ROUTE INFORMATION response.....	44
Table 54. REPORT PHY EVENT request	45
Table 55. PHY EVENT SOURCE field.....	46
Table 56. REPORT PHY EVENT response.....	46
Table 57. Phy event descriptor	47
Table 58. DISCOVER LIST request	47
Table 59. PHY FILTER field.....	48
Table 60. DESCRIPTOR TYPE field	48
Table 61. DISCOVER LIST response	49
Table 62. SHORT FORMAT descriptor.....	50
Table 63. REPORT PHY EVENT LIST request	51
Table 64. REPORT PHY EVENT LIST response.....	52
Table 65. Phy event list descriptor	53
Table 66. REPORT EXPANDER ROUTE TABLE LIST request.....	53
Table 67. REPORT EXPANDER ROUTE TABLE LIST response	54
Table 68. Expander route table descriptor.....	56
Table 69. CONFIGURE GENERAL request	56
Table 70. STP SMP I_T NEXUS LOSS TIME field	58
Table 71. CONFIGURE GENERAL response	59
Table 72. ENABLE DISABLE ZONING request.....	59
Table 73. SAVE field.....	60
Table 74. ENABLE DISABLE ZONING field	60
Table 75. ENABLE DISABLE ZONING response.....	60
Table 76. ZONED BROADCAST request	61
Table 77. BROADCAST TYPE field	61
Table 78. ZONED BROADCAST response	62
Table 79. ZONE LOCK request.....	62
Table 80. ZONE LOCK response	63
Table 81. ZONE ACTIVATE request.....	64
Table 82. ZONE ACTIVATE response	64
Table 83. ZONE UNLOCK request	64
Table 84. ZONE UNLOCK response	65
Table 85. CONFIGURE ZONE MANAGER PASSWORD request	65
Table 86. SAVE field.....	66
Table 87. CONFIGURE ZONE MANAGER PASSWORD response	66
Table 88. CONFIGURE ZONE PHY INFORMATION request.....	67
Table 89. SAVE field.....	67
Table 90. Zone phy configuration descriptor.....	68
Table 91. CONFIGURE ZONE PHY INFORMATION response	68
Table 92. CONFIGURE ZONE PERMISSION TABLE request	69
Table 93. NUMBER OF ZONE GROUPS field.....	69
Table 94. SAVE field.....	70
Table 95. Zone permission configuration descriptors.....	70
Table 96. Zone permission configuration descriptor for source zone group for 256 zone groups	70
Table 97. Zone permission configuration descriptor bit requirements	70
Table 98. CONFIGURE ZONE PERMISSION TABLE response	71
Table 99. CONFIGURE ROUTE INFORMATION request.....	71
Table 100. CONFIGURE ROUTE INFORMATION response.....	73
Table 101. PHY CONTROL request	73
Table 102. PHY OPERATION field (1 of 3)	75
Table 103. PHY OPERATION field (2 of 3)	75
Table 104. PHY OPERATION field (3 of 3)	76
Table 105. PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE	

field.....	78
Table 106. ENABLE SAS SLUMBER field	78
Table 107. ENABLE SAS PARTIAL field	78
Table 108. ENABLE SATA SLUMBER field	79
Table 109. ENABLE SATA PARTIAL field	79
Table 110. PWR_DIS CONTROL field.....	79
Table 111. PHY CONTROL response	79
Table 112. PHY TEST FUNCTION request	80
Table 113. PHY TEST FUNCTION field.....	81
Table 114. PHY TEST FUNCTION PHYSICAL LINK RATE field	81
Table 115. PHY TEST PATTERN field	82
Table 116. PHY TEST FUNCTION response.....	82
Table 117. CONFIGURE PHY EVENT request.....	82
Table 118. Phy event configuration descriptor	83
Table 119. CONFIGURE PHY EVENT response.....	83
Table 120. Supported SCSI Commands.....	84
Table 121. TEST UNIT READY command.....	84
Table 122. Preferred TEST UNIT READY responses.....	85
Table 123. INQUIRY CDB Format	85
Table 124. Standard INQUIRY Data	85
Table 125. REPORT LUNS command.....	86
Table 126. SELECT REPORT field	86
Table 127. REPORT LUNS parameter data format	87
Table 128. SEND DIAGNOSTIC AND SELFTEST	87
Table 129. SEND DIAGNOSTIC AND NOT SELFTEST	88
Table 130. SEND DIAGNOSTIC command	88
Table 133. RECEIVE DIAGNOSTIC RESULTS command	89
Table 134. Read Buffer Command (Page 3Ch)	89
Table 135. Buffer ID.....	89
Table 136. Write Buffer Command (Page 3Bh)	90
Table 137. Buffer Mode.....	90
Table 138. REQUEST SENSE command	90
Table 139. DESC bit	90
Table 140. Sense Key.....	91
Table 141. ASC and ASCQ.....	91
Table 142. EVPD INQUIRY Data (Page 00).....	92
Table 143. Unit Serial Number VPD page.....	92
Table 144. EVPD INQUIRY Data (Page 83h) – Device Identification VPD Page.....	93
Table 145. Extended INQUIRY Data VPD page	93
Table 146. Supported Diagnostic Page Format	94
Table 147. Supported Diagnostic Pages.....	94
Table 148. Configuration Diagnostic Page Format.....	95
Table 149. Configuration Diagnostic Page Fields for 12 slots	95
Table 150. Configuration Diagnostic Page Fields for 24 slots	96
Table 151. Vendor-Specific Information	97
Table 152. Enclosure Control Diagnostic Page Format.....	98
Table 153. Enclosure Control Diagnostic Page Fields 12 slots.....	98
Table 154. Enclosure Control Diagnostic Page Fields 24 slots.....	98
Table 155. String Out Page Format.....	99
Table 156. String Out Diagnostic Page Fields	99
Table 157. String Out Diagnostic Commands	100
Table 158. String In Page Format.....	100
Table 159. String In Diagnostic Page Fields	100
Table 160. Threshold Out Diagnostic Page Format.....	100
Table 161. Threshold Out Diagnostic Page Fields 12 slot	101

Table 162. Threshold Out Diagnostic Page Fields 24 slot	101
Table 163. Threshold In Diagnostic Page Format.....	102
Table 164. Threshold In Diagnostic Page Fields 12 Slot	103
Table 165. Threshold In Diagnostic Page Fields 24 Slot	103
Table 166. FP Temperature Element Default Threshold Value.....	104
Table 167. Expander Temperature Element Default Threshold Value	104
Table 168. ADT7476 Voltage Element Default Threshold Value.....	104
Table 169. Element Description Diagnostic Page Format	105
Table 170. Element Description Diagnostic Page Fields 12 slot	105
Table 171. Element Description Diagnostic Page Fields 24 slot	106
Table 172. Additional Element Status Diagnostic Page Format for 24 slots	108
Table 173. Additional Element Status Page Fields for 12 slots.....	108
Table 174. Additional Element Status Page Fields for 24 slots.....	109
Table 175. Additional Element Status Descriptor with EIP Bit Set To One.....	109
Table 176. Supported SES Diagnostic Pages diagnostic page	110
Table 177. Supported Diagnostic Page Fields	110
Table 178. Download Microcode Control diagnostic page	111
Table 179. Download Microcode Status diagnostic page	112
Table 180. Download microcode status descriptor format	113
Table 181. Subenclosure Nickname Control diagnostic page	113
Table 182. Subenclosure Nickname Status diagnostic page	114
Table 183. Subenclosure nickname status descriptor format.....	115
Table 184. Subenclosure Nickname Status field.....	115
Table 185. Array Device Slot Control Element.....	116
Table 186. Fault LED Blink Control Pattern	116
Table 187. Array Device Slot Status Element.....	116
Table 188. Power Supply Control Element.....	117
Table 189. Power Supply Status Element.....	117
Table 190. Cooling Control Element	118
Table 191. Fan Speed Control	118
Table 192. Cooling Status Element	118
Table 193. Temperature Control Element	119
Table 194. Temperature Status Element	119
Table 195. Voltage Control Element.....	120
Table 196. Voltage Status Element.....	120
Table 197. Enclosure control element	121
Table 198. POWER CYCLE REQUEST field.....	121
Table 199. POWER CYCLE DELAY field	121
Table 200. Enclosure Element Status.....	121
Table 201. Front Panel LED Behavior	122

List of Figures

Figure 1. 12 x 3.5" Drive JBOD2312S3SP Product Drawing	2
Figure 2. 12 x 3.5" Drive JBOD2312S3SP Drive Slot Numbering.....	2
Figure 3. Front Panel.....	122

1. Introduction

This SCSI Enclosure Services Programming Guide provides information for a programmer to control the JBOD2312S3SP through SCSI Enclosures Services (SES) commands. This document describes the SES functions of the JBOD2312S3SP product that include diagnostics, array status and control, temperature status, voltage status, LED control and fan control.

This document is divided into the following chapters:

- Chapter 1 – Introduction
- Chapter 2 – Product Family Overview
- Chapter 3 – Firmware Customization for the JBOD2312S3SP Expander
- Chapter 4 – SMP Management Function Customization
- Chapter 5 – SPC Command Customization
- Chapter 6 – Supported VPD Page List
- Chapter 7 – SES Pages
- Chapter 8 – Element Customization
- Chapter 9 – Firmware Update
- Reference Documents
- Glossary

1.1 Server Product Use Disclaimer

It is the responsibility of the system integrator who chooses not to use Intel-developed server building blocks to consult vendor datasheets and operating parameters to determine the amount of airflow required for their specific application and environmental conditions. Intel Corporation cannot be held responsible if components fail to operate correctly when used outside any of their published operating or non-operating limits.

1.2 Product Errata

The products described in this document may contain design defects or errors known as errata which may cause the product to deviate from published specifications. Product Errata are documented in the *Intel® Storage Server System JBOD2312S3SP Monthly Specification Update* which can be downloaded from <http://www.intel.com>.

1.3 Supported Commands and Elements

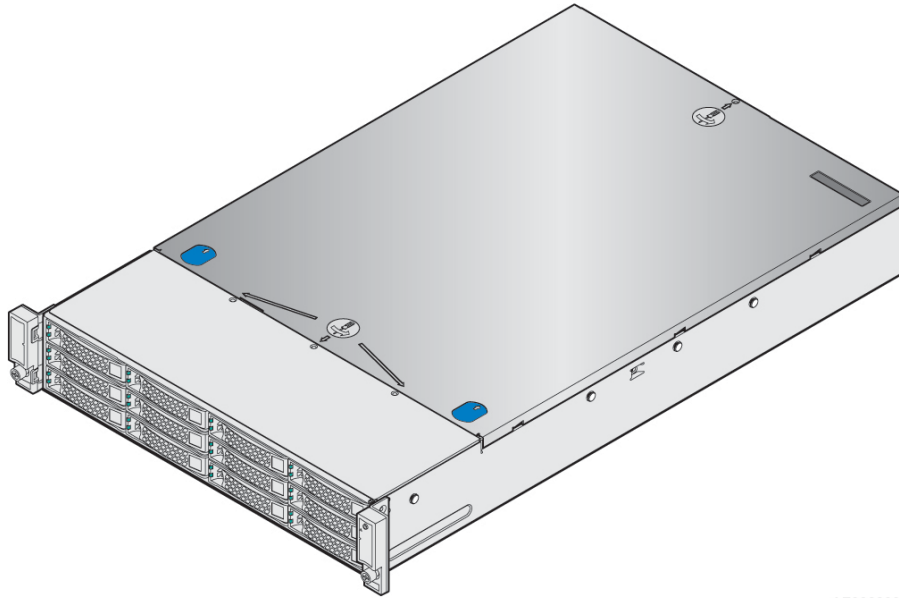
Only supported commands and elements for the products described in this document are listed in this document.

2. Product Family Overview

This generation of Intel® Storage Server System JBOD2312S3SP offers a variety of options to meet the configuration requirements of high-density high-performance computing environments.

Table 1. System Feature Set

Intel® Storage Server System JBOD2312S3SP	Description
JBOD2312S3SP	2U JBOD supports 12 x 3.5" drives, with a single-port backplane.



AF006293

Figure 1. 12 x 3.5" Drive JBOD2312S3SP Product Drawing

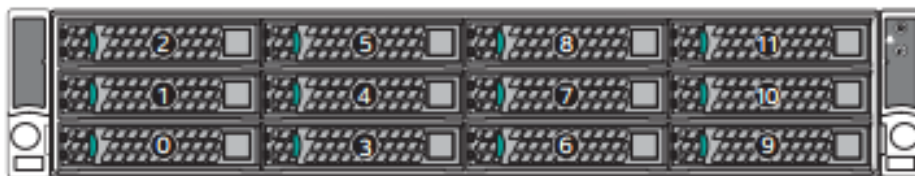


Figure 2. 12 x 3.5" Drive JBOD2312S3SP Drive Slot Numbering

3. Firmware Customization for the JBOD2312S3SP Expander

3.1 Firmware Customization for the Components

3.1.1 SoC

The Intel® RAID Expander Card RES3FV288-R uses the PMC expander chip PM8044 as the SoC of the expander card.

3.1.2 PHY Management

3.1.2.1 PHY Mapping

In the JBOD Expander design, optimal PHY signal routing requires the use of hardware PHYs 0 – 3, 16 – 19 and 32 – 35 for the host-facing PHYs, so a logical-to-physical PHY mapping is used to organize the PHYs. The physical PHY mapping for the JBOD Expander board is found in Table 2. The PCSD firmware initialization string is used to configure the logical-to-physical PHY mapping, as well as the PHY connector settings.

Table 2. JBOD Expander PHY Mapping

Connector Label	Physical PHY ID	Logical PHY ID	Connected Devices
A (CN1)	4	3	Drives Slot 0-3
	5	2	
	6	0	
	7	1	
B (CN3)	12	4	Drives Slot 4-7
	13	5	
	14	7	
	15	6	
C (CN2)	8	8	Drives Slot 8-11
	9	9	
	10	11	
	11	10	
D (CN7)	28	15	Drive Slots 12-15
	29	14	
	30	12	
	31	13	
E (CN6)	24	16	Drive Slots 16-19
	25	17	
	26	19	
	27	18	
F (CN5)	20	20	Drive Slots 20-23
	21	21	
	22	23	
	23	22	

Connector Label	Physical PHY ID	Logical PHY ID	Connected Devices
G (CN8)	32	27	Host PHYs 0-3
	33	26	
	34	24	
	35	25	
H (CN0)	0	31	Host PHYs 4-7
	1	30	
	2	28	
	3	29	
I (CN4)	16	35	Host PHYs 8-11
	17	34	
	18	32	
	19	33	

3.1.2.2 PHY Settings

The firmware initialization string is used to configure the PHY settings. By default, SSC is enabled for SAS and SATA drives. The drive strength settings are also adjusted in the initialization string based on SI testing during product development.

3.1.2.3 Zoning Settings

The JBOD firmware supports the SAS Zoning feature with 256 zone groups. By default, Zoning is supported but disabled. The Zone group and Zone group persistent settings of all PHYs are set to 1 (Enabled), and the Zoning saving functions are supported. Users can use the smp_utils utilities for SAS Serial Management Protocol (SMP) function management in a Linux environment to configure the Zoning settings on a running system.

The smp_utils package can be downloaded from the [SMP Utilities Package site](#).

3.1.2.4 Spin-up

To manage power consumption during drive spin-up, firmware allows two drives to spin up every 2 seconds.

4. SMP Management Function Customization

4.1 SMP Initiator

The Serial Management Protocol (SMP) Initiator Application provides a means for the Topology Discovery Application to generate and send SMP Request frames. The SMP initiator functions in the firmware work for different SMP targets, so no customization is necessary.

Table 3. SMP Initiator functions

Function code	SMP functions
00h	REPORT GENERAL
01h	REPORT MANUFACTURER INFORMATION
10h	DISCOVER
13h	REPORT ROUTE INFORMATION
21h	REPORT PHY EVENT LIST
22h	REPORT EXPANDER ROUTE TABLE LIST
85h	ZONED BROADCAST
90h	CONFIGURE ROUTE INFORMATION
91h	PHY CONTROL

4.2 SMP Target

The SMP Target Application provides standard SMP services to an external SMP initiator. The REPORT GENERAL, REPORT MANUFACTURER INFORMATION and DISCOVER function are customized for some fields. The Serial Management Protocol (SMP) Target functions can be accessed using SMP Utils which can be downloaded from the [SMP Utilities Package site](#).

Table 4. SMP Target Functions

Function code	SMP functions
00h	REPORT GENERAL
01h	REPORT MANUFACTURER INFORMATION
03h	REPORT SELF-CONFIGURATIONSTATUS
04h	REPORT ZONE PERMISSION TABLE
05h	REPORT ZONE MANAGER PASSWORD
06h	REPORT BROADCAST
10h	DISCOVER
11h	REPORT PHY ERROR LOG
12h	REPORT PHY SATA
13h	REPORT ROUTE INFORMATION
14h	REPORT PHY EVENT
20h	DISCOVER LIST
21h	REPORT PHY EVENT LIST
22h	REPORT EXPANDER ROUTE TABLE LIST
80h	CONFIGURE GENERAL
81h	ENABLE DISABLE ZONING
85h	ZONED BROADCAST
86h	ZONE LOCK
87h	ZONE ACTIVATE
88h	ZONE UNLOCK
89h	CONFIGURE ZONE MANAGER PASSWORD
8Ah	CONFIGURE ZONE PHY INFORMATION
8Bh	CONFIGURE ZONE PERMISSION TABLE

Function code	SMP functions
90h	CONFIGURE ROUTE INFORMATION
91h	PHY CONTROL
92h	PHY TEST FUNCTION
93h	CONFIGURE PHY EVENT

4.2.1 Report General Function (00h)

The REPORT GENERAL function returns general information about the expander.

Table 5. SMP Report General Request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (00h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (00h)							
4	(MSB)	C R C						(LSB)
7								

Table 6. SMP Report General Response (1 of 3)

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (00h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h or 11h)							
4	(MSB)	EXPANDER CHANGE COUNT						(LSB)
5								
6	(MSB)	EXPANDER ROUTE INDEXES						(LSB)
7								
8	LONG RESPONSE	Reserved						
9	NUMBER OF PHYS							
10	TABLE TO TABLE SUPPORTED	ZONE CONFIGURING	SELF CONFIGURING	STP CONTINUE AWT	OPEN REJECT RETRY SUPPORTED	CONFIGURES OTHERS	CONFIGURING	EXTERNALLY CONFIGURABLE ROUTE TABLE
11	Reserved							INITIATES SSP CLOSE
12								
...	ENCLOSURE LOGICAL IDENTIFIER							
19								
20								
...	Reserved							
27								
28	(MSB)	SSP MAXIMUM CONNECT TIME LIMIT						(LSB)
29								
30	(MSB)	STP BUS INACTIVITY TIME LIMIT						(LSB)
31								

Table 7. SMP Report General Response (part 2 of 3)

Byte\Bit	7	6	5	4	3	2	1	0	
32	(MSB)	STP MAXIMUM CONNECT TIME LIMIT							(LSB)
33									
34	(MSB)	STP SMP I_T NEXUS LOSS TIME							(LSB)
35									
36	NUMBER OF ZONE GROUPS	Reserved	ZONE LOCKED	PHYSICAL PRESENCE SUPPORTED	PHYSICAL PRESENCE ASSERTED	ZONING SUPPORTED	ZONING ENABLED		
37	Reserved		SAVING	SAVING ZONE MANAGER PASSWORD SUPPORTED	SAVING ZONE PHY INFORMATION SUPPORTED	SAVING ZONE PERMISSION TABLE SUPPORTED	SAVING ZONING ENABLED SUPPORTED		
38	(MSB)	MAXIMUM NUMBER OF ROUTED SAS ADDRESSES							(LSB)
39									
40									
...	ACTIVE ZONE MANAGER SAS ADDRESS								
47									
48	(MSB)	ZONE LOCK INACTIVITY TIME LIMIT							(LSB)
49									
50	Reserved								
51									
52	POWER DONE TIMEOUT								
53	FIRST ENCLOSURE CONNECTOR ELEMENT INDEX								
54	NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES								
55	Reserved								
56	REDUCED FUNCTIONALITY	Reserved							
57	TIME TO REDUCED FUNCTIONALITY								
58	INITIAL TIME TO REDUCED FUNCTIONALITY								
59	MAXIMUM REDUCED FUNCTIONALITY TIME								
60	(MSB)	LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							(LSB)
61									

Table 8. SMP Report General Response (part 3 of 3)

Byte\Bit	7	6	5	4	3	2	1	0	
62	(MSB)	MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS							(LSB)
63									
64	(MSB)	LAST PHY EVENT LIST DESCRIPTOR INDEX							(LSB)
65									
66	(MSB)	MAXIMUM NUMBER OF STORED PHY EVENT LIST DESCRIPTORS							(LSB)
67									
68	(MSB)	STP REJECT TO OPEN LIMIT							(LSB)
69									
70									
71	Reserved								
72	(MSB)	CRC							(LSB)
...									
75									

- The ENCLOSURE LOGICAL IDENTIFIER field is defined in the SEEPROM of the Intel JBOD PDB.
- Zoning is supported but disabled by default. The zoning saving functions are supported by default.
 - ZONING SUPPORTED: 1
 - ZONING ENABLED: 0
 - SAVING ZONE MANAGER PASSWORD SUPPORTED: 1
 - SAVING ZONE PHY INFORMATION SUPPORTED: 1
 - SAVING ZONE PERMISSION TABLE SUPPORTED: 1
 - SAVING ZONING ENABLED SUPPORTED: 1
- The SMP FRAME TYPE field shall be set as shown in Table 6, Table 7 and Table 8 for the REPORT GENERAL response.
- The FUNCTION field shall be set as shown in Table 6, Table 7 and Table 8 for the REPORT GENERAL response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 6, Table 7 and Table 8 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field indicates the number of Broadcast (Change) originated by an expander device. Management device servers in expander devices shall support this field. Management device servers in other device types (e.g., end devices) shall set this field to 0000h. This field shall be set to at least 0001h at power on. If the expander device has originated Broadcast (Change) for any reason described in section 4.2.25.1 since transmitting any SMP response frame containing an EXPANDER CHANGE COUNT field, then it:
 - Shall increment this field at least once from the value in the previous REPORT GENERAL response;
 - Shall not increment this field when forwarding a Broadcast (Change) (see section 4.2.25.1).
 - This field shall wrap to at least 0001h after reaching the maximum value (i.e., FFFFh).

NOTES:

- Management application clients that use the EXPANDER CHANGE COUNT field should read the field often enough to ensure that the field does not increment a multiple of 65 535 times between reading the field in an expander device compliant with this standard or a multiple of 65 536 times between reading the field in an expander device compliant with SAS-1.1.
 - The originated Broadcast (Change) count is also reported in the REPORT BROADCAST response.
-
- The EXPANDER ROUTE INDEXES field indicates the maximum number of expander route indexes per phy for the expander device. Management device servers in externally configurable expander devices containing phy-based expander route tables shall support this field. Management device servers in other device types (e.g., end devices, externally configurable expander devices with expander-based expander route tables, and self-configuring expander devices) shall set the EXPANDER ROUTE INDEXES field to 0000h. Not all phys in an externally configurable expander device are required to support the maximum number indicated by this field.
 - A LONG RESPONSE bit set to one indicates that the management device server supports returning non-zero values in the RESPONSE LENGTH field of the response frame for any SMP function if the ALLOCATED RESPONSE LENGTH field in the request frame for that SMP function is set to a non-zero value. The LONG RESPONSE bit shall be set to one.
 - A TABLE TO TABLE SUPPORTED bit set to one indicates that the expander device is a self-configuring expander device that supports its table routing phys being attached to table routing phys in other expander devices (i.e., table-to-table attachment). The TABLE TO TABLE SUPPORTED bit shall only be set to one if the EXTERNALLY CONFIGURABLE ROUTE TABLE bit is set to zero. A TABLE TO TABLE SUPPORTED bit set to zero indicates that the expander device is not a self-configuring expander device that supports its table routing phys being attached to table routing phys in other expander devices.
 - A ZONE CONFIGURING bit set to one indicates that the zoning expander device is locked and the zoning

expander shadow values differ from the zoning expander current values. A ZONE CONFIGURING bit set to zero indicates that is not true. Management device servers in zoning expander devices shall support this bit. Management device servers in non-zoning expander devices and in other device types shall set this bit to zero.

- A SELF CONFIGURING bit set to one indicates that the management device server is in a self-configuring expander device, the self-configuring expander device's management application client is currently performing the discover process (see 4.6), and that management application client has identified at least one change to its expander routing table. Management device servers in self-configuring expander devices shall support this bit. Management device servers in externally configurable expander devices and in other device types shall set this bit to zero.
- An STP CONTINUE AWT bit set to one specifies that the STP port shall not stop the Arbitration Wait Time timer and shall not set the Arbitration Wait Time timer to zero when the STP port receives an OPEN_REJECT:
 - (RETRY). An STP CONTINUE AWT bit set to zero specifies that the STP port shall stop the Arbitration Wait Time timer and shall set the Arbitration Wait Time timer to zero when the STP port receives an OPEN_REJECT.
 - (RETRY). An OPEN REJECT RETRY SUPPORTED bit set to one indicates that the expander device returns OPEN_REJECT (RETRY) for any connection requests that detects a condition that results in OPEN_REJECT (NO DESTINATION) while the SELF CONFIGURING bit is set to one or the ZONE CONFIGURING bit is set to one. An OPEN REJECT RETRY SUPPORTED set to zero indicates that the expander device complies with SAS-1.1 (i.e., it returns OPEN_REJECT (NO DESTINATION) while the CONFIGURING bit is set to one). Self-configuring expander devices compliant with this standard shall set the OPEN REJECT RETRY SUPPORTED bit to one.
- A CONFIGURES OTHERS bit set to one indicates that the expander device is a self-configuring expander device that performs the configuration subprocess. A CONFIGURES OTHERS bit set to zero indicates that the expander device may or may not perform the configuration subprocess. Self-configuring expander devices compliant with this standard shall set the CONFIGURES OTHERS bit to one.

NOTE: If the CONFIGURES OTHERS bit is set to zero, then the expander device may configure all externally configurable expander devices in the SAS domain.

- The CONFIGURING bit indicates the logical OR of the ZONE CONFIGURING bit and the SELF CONFIGURING bit. Changes in this bit from one to zero result in a Broadcast (Change) being originated (see 6.13). Management device servers that support the ZONE CONFIGURING bit or the SELF CONFIGURING bit shall support this bit.
- An EXTERNALLY CONFIGURABLE ROUTE TABLE bit set to one indicates that the management device server is in an externally configurable expander device that has a phy-based expander route table that is required to be configured with the SMP CONFIGURE ROUTE INFORMATION function. An EXTERNALLY CONFIGURABLE ROUTE TABLE bit set to zero indicates that the management device server is not in an externally configurable expander device (e.g., the management device server is in an end device, in a self-configuring expander device, or in an expander device with no phys with table routing attributes).
- The INITIATES SSP CLOSE bit set to one indicates that the expander device is capable of initiating the closing of SSP connections. An INITIATES SSP CLOSE bit set to zero indicates that the expander device is not capable of initiating closing of SSP connections.
- The ENCLOSURE LOGICAL IDENTIFIER field identifies the enclosure, if any, in which the device is located, and is defined in SES-3. The ENCLOSURE LOGICAL IDENTIFIER field shall be set to the same value reported by the enclosure services process, if any, for the enclosure. An ENCLOSURE LOGICAL IDENTIFIER field set to 00000000 00000000h indicates no enclosure information is available.
- The SSP CONNECT TIME LIMIT field indicates the maximum connect time limit for expander device SSP connections. The maximum time limit is specified by the CONFIGURE GENERAL function.

- The STP BUS INACTIVITY LIMIT field indicates the bus inactivity time limit for STP connections. The STP bus inactivity limit is specified by the CONFIGURE GENERAL function.
- The STP CONNECT TIME LIMIT field indicates the maximum connect time limit for STP connections. The STP maximum connect time limit is specified by the CONFIGURE GENERAL function.
- The STP SMP I_T NEXUS LOSS TIME field indicates the minimum time that an STP target port and an SMP initiator port retry certain connection requests. The STP SMP I_T nexus loss time timer is specified by the CONFIGURE GENERAL function.

Table 9. FUNCTION RESULT field

Code	Name	SMP function(s)	Description
00h	SMP FUNCTION ACCEPTED	All	The management device server supports the SMP function and processed the SMP function.
02h	SMP FUNCTION FAILED	All	The requested SMP function failed.
03h	INVALID REQUEST FRAME LENGTH	All	The SMP request frame length was invalid.
04h	INVALID EXPANDER CHANGE COUNT	CONFIGURE GENERAL, ENABLE DISABLE ZONING, ZONE LOCK, ZONE ACTIVATE, CONFIGURE ZONE MANAGER PASSWORD, CONFIGURE ZONE PHY INFORMATION, CONFIGURE ZONE PERMISSION TABLE, CONFIGURE ROUTE INFORMATION, PHY CONTROL, PHY TEST FUNCTION, CONFIGURE PHY EVENT	The management device server supports the SMP function, but the EXPECTED EXPANDER CHANGE COUNT field does not match the current expander change count.

The NUMBER OF ZONE GROUPS field indicates the number of zone groups (e.g., the number of entries in the zone group permission table) supported by the expander device and is defined in Table 10.

Table 10. NUMBER OF ZONE GROUPS field

Code	Description
00b	128 zone groups
01b	256 zone groups (Default)
All others	Reserved

- A ZONE LOCKED bit set to one indicates that the zoning expander device is locked. A ZONE LOCKED bit set to zero indicates that the zoning expander device is not locked.
- A PHYSICAL PRESENCE SUPPORTED bit set to one indicates that the expander device supports physical presence as a mechanism for allowing locking from phys in zone groups without access to zone group 2. A PHYSICAL PRESENCE SUPPORTED bit set to zero indicates that the expander device does not support physical presence as a mechanism for allowing locking.
- A PHYSICAL PRESENCE ASSERTED bit set to one indicates that the expander device is currently detecting physical presence. A PHYSICAL PRESENCE ASSERTED bit set to zero indicates that the expander device is not currently detecting physical presence. The PHYSICAL PRESENCE ASSERTED bit shall be set to zero if the PHYSICAL PRESENCE SUPPORTED bit is set to zero.
- A ZONING SUPPORTED bit set to one indicates that zoning is supported by the expander device (i.e., it is a zoning expander device). A ZONING SUPPORTED bit set to zero indicates that zoning is not supported by the expander device.
- A ZONING ENABLED bit set to one indicates that zoning is enabled in the expander device. A ZONING ENABLED bit set to zero indicates that zoning is disabled in the expander device. The ZONING ENABLED bit shall be set to zero if the ZONING SUPPORTED bit is set to zero.
- A SAVING bit set to one indicates that the management device server is currently saving zoning values to non-volatile storage and may return a function result of BUSY for SMP zone management functions that access saved zoning values. A SAVING bit set to zero indicates that the management device server is not currently saving zoning values to non-volatile storage.
- A SAVING ZONE MANAGER PASSWORD SUPPORTED bit set to one indicates that saving the zone manager password is supported. A SAVING ZONE MANAGER PASSWORD SUPPORTED bit set to zero indicates that

saving the zone manager password is not supported.

- A SAVING ZONE PHY INFORMATION SUPPORTED bit set to one indicates that saving the zone phy information is supported. A SAVING ZONE PHY INFORMATION SUPPORTED bit set to zero indicates that saving the zone phy information is not supported.
- A SAVING ZONE PERMISSION TABLE SUPPORTED bit set to one indicates that saving the zone permission table is supported. A SAVING ZONE PERMISSION TABLE SUPPORTED bit set to zero indicates that saving the zone permission table is not supported.
- A SAVING ZONING ENABLE SUPPORTED bit set to one indicates that saving the ZONING ENABLED bit is supported.
- A SAVING ZONING ENABLE SUPPORTED bit set to zero indicates that saving the ZONING ENABLED bit is not supported.
- The MAXIMUM NUMBER OF ROUTED SAS ADDRESSES field indicates the number of routed SAS addresses in an expander-based expander route table. Management device servers in expander devices containing expander-based expander route tables shall support this field. Management device servers in other device types (e.g., end devices and expander devices with phy-based expander route tables) shall set this field to 0000h.
- The ACTIVE ZONE MANAGER SAS ADDRESS field indicates the SAS address of the zone manager that last locked the zoning expander device. If the zoning expander device is currently being configured by a vendor specific sideband method then the ACTIVE ZONE MANAGER SAS ADDRESS field shall be set to 00000000 00000000h. This field shall be set to 00000000 00000000h at power on.
- The ZONE LOCK INACTIVITY TIME LIMIT field indicates the minimum time between any SMP ZONE LOCK requests, SMP zone configuration function requests, or SMP ZONE ACTIVATE requests from the active zone manager that the locked expander device allows and is set in the SMP ZONE LOCK request.
- The POWER DONE TIMEOUT field indicates the maximum time the management application layer allows a power consumer device to consume additional power. The power done timeout is specified by the CONFIGURE GENERAL function. A POWER DONE TIMEOUT field set to 00h or FFh indicates that the maximum time is vendor specific.
- The FIRST ENCLOSURE CONNECTOR ELEMENT INDEX field indicates the lowest CONNECTOR ELEMENT INDEX field of all the expander phys in all the expander devices in the enclosure that have CONNECTOR TYPE fields set to 20h to 2Fh (i.e., an internal connector to an end device) in their SMP DISCOVER responses.
- The NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES field indicates the number of expander phys in all the expander devices in the enclosure that have CONNECTOR TYPE fields set to 20h to 2Fh (i.e., an internal connector to an end device) in their SMP DISCOVER responses.

NOTE: The NUMBER OF ENCLOSURE CONNECTOR ELEMENT INDEXES field assumes that all internal connectors to end devices are assigned to a contiguous range of CONNECTOR ELEMENT INDEX field values.

- A REDUCED FUNCTIONALITY bit set to one indicates that:
 - The expander device is scheduled to reduce its functionality in the time indicated in the TIME TO REDUCED FUNCTIONALITY field

Or

 - The expander device is currently operating with reduced functionality.
- A REDUCED FUNCTIONALITY bit set to zero indicates that the expander device is not scheduled to reduce functionality and that the contents of the TIME TO REDUCED FUNCTIONALITY field shall be ignored.
- If the REDUCED FUNCTIONALITY bit is set to one, then the TIME TO REDUCED FUNCTIONALITY field indicates the time, in 100 ms increments, remaining until the expander device is scheduled to reduce functionality. The expander device starts the reduced functionality delay timer after originating a Broadcast (Expander).

- The INITIAL TIME TO REDUCED FUNCTIONALITY field indicates the minimum time, in 100 ms increments, that an expander device waits from originating a Broadcast (Expander) to reducing functionality. The expander device should set the default value for the INITIAL TIME TO REDUCED FUNCTIONALITY field to at least 2 000 ms (i.e., 14h).
- The MAXIMUM REDUCED FUNCTIONALITY TIME field indicates the maximum time, in one second increments, that the expander device responds with OPEN_REJECT (RETRY) to connection requests that map to an expander phy or an SMP target port that is not accessible during expander device reduced functionality. This timer starts after the reduced functionality delay timer expires.
- The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is defined in the REPORT SELF-CONFIGURATION STATUS response.
- The MAXIMUM NUMBER OF STORED SELF-CONFIGURATION STATUS DESCRIPTORS field indicates the maximum number of self-configuration status descriptors that the management device server supports.
- The LAST PHY EVENT LIST DESCRIPTOR INDEX field is defined in the REPORT PHY EVENT LIST response.
- The MAXIMUM NUMBER OF STORED PHY EVENT LIST DESCRIPTORS field indicates the maximum number of phy event list descriptors that the management device server supports.
- The STP REJECT TO OPEN LIMIT field indicates the minimum time, in 10 μs increments, that an STP port waits to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT (RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1). An STP REJECT TO OPEN LIMIT field set to 0000h indicates that the time limit is vendor specific.

4.2.2 Report Manufacturer Information Function (01h)

The REPORT MANUFACTURER INFORMATION function returns the vendor and product identification.

Table 11. Report Manufacturer Information Request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (01h)								
2	ALLOCATION RESPONSE LENGTH								
3	REQUEST LENGTH (00h)								
4	(MSB)	CRC							
7							(LSB)		

- The SMP FRAME TYPE field shall be set as shown in Table 11 for the REPORT MANUFACTURER INFORMATION request.
- The FUNCTION field shall be set as shown in Table 11 for the REPORT MANUFACTURER INFORMATION request.
 - If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame.
 - Return the first 60 bytes defined in Table 12 plus the CRC field as the response frame.
 - If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the non-zero value defined in Table 12.
 - Return the response frame.

The REQUEST LENGTH field shall be set as shown in Table 11 for the REPORT MANUFACTURER INFORMATION request.

Table 12. Report Manufacturer Information Response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (01h)							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0	
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h or 0Eh)								
4	(MSB)	EXPANDER CHANGE COUNT							
5								(LSB)	
6	Reserved								
7	Reserved								
8	Reserved							SAS-1.1 FORMAT	
9	Reserved								
...	Reserved								
11	Reserved								
12	(MSB)	VENDOR IDENTIFICATION							
...								(LSB)	
19	VENDOR IDENTIFICATION								
20	(MSB)	PRODUCT IDENTIFICATION							
...								(LSB)	
35	PRODUCT IDENTIFICATION								
36	(MSB)	PRODUCT REVISION LEVEL							
...								(LSB)	
39	PRODUCT REVISION LEVEL								
40	(MSB)	COMPONENT VENDOR IDENTIFICATION							
...								(LSB)	
47	COMPONENT VENDOR IDENTIFICATION								
48	(MSB)	COMPONENT ID							
49								(LSB)	
50	COMPONENT REVISION LEVEL								
51	Reserved								
52	Reserved								
...	Vendor specific								
59	Vendor specific								
60	(MSB)	CRC							
...								(LSB)	
63	CRC								

- The SMP FRAME TYPE field shall be set as shown in Table 12 for the REPORT MANUFACTURER INFORMATION response.
- The FUNCTION field shall be set as shown in Table 12 for the REPORT MANUFACTURER INFORMATION response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 12 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- A SAS-1.1 FORMAT bit.
- ASCII data fields (e.g., the VENDOR IDENTIFICATION field, the PRODUCT IDENTIFICATION field, and PRODUCT REVISION LEVEL field, and the COMPONENT VENDOR IDENTIFICATION field) shall contain only graphic codes (i.e., code values 20h to 7Eh). Left-aligned fields shall place any unused bytes at the end of the field (i.e., at the highest offset) and the unused bytes shall be filled with space characters (i.e., 20h).
- The VENDOR IDENTIFICATION field contains eight bytes of ASCII data identifying the vendor of the subsystem (e.g., the board or enclosure) containing the component. The data shall be left-aligned within the field. The vendor identification string shall be one assigned by INCITS for use in the standard INQUIRY data VENDOR IDENTIFICATION field. A list of assigned vendor identification strings is in SPC-4 and on the T10 web site (see <http://www.t10.org>).

- The PRODUCT IDENTIFICATION field contains 16 bytes of ASCII data identifying the type of the subsystem (e.g., the board or enclosure model number) containing the component, as defined by the vendor of the subsystem. The data shall be left-aligned within the field. The PRODUCT IDENTIFICATION field should be changed whenever the subsystem design changes in a way noticeable to a user (e.g., a different stock-keeping unit (SKU)).
- The PRODUCT REVISION LEVEL field contains four bytes of ASCII data identifying the revision level of the subsystem (e.g., the board or enclosure) containing the component, as defined by the vendor of the subsystem. The data shall be left-aligned within the field. The PRODUCT REVISION LEVEL field should be changed whenever the subsystem design changes (e.g., any component change, even including resistor values).
- All components on a subsystem should have the same values for their VENDOR IDENTIFICATION fields, PRODUCT IDENTIFICATION fields, and PRODUCT REVISION LEVEL fields.

NOTE: Management application clients may use the VENDOR IDENTIFICATION field and PRODUCT IDENTIFICATION field to identify the subsystem (e.g., for a user interface). Management application clients may use the VENDOR IDENTIFICATION field, PRODUCT IDENTIFICATION field, PRODUCT REVISION LEVEL field to perform workarounds for problems in a specific revision of a subsystem.

- The COMPONENT VENDOR IDENTIFICATION field contains eight bytes of ASCII data identifying the vendor of the component (e.g., the expander device) containing the management device server. The data shall be left-aligned within the field. The component vendor identification string shall be one assigned by INCITS for use in the standard INQUIRY data VENDOR IDENTIFICATION field. A list of assigned vendor identification strings is in SPC-4 and on the T10 web site (see <http://www.t10.org>).
- The COMPONENT ID field contains a 16-bit identifier identifying the type of the component (e.g., the expander device model number) containing the management device server, as defined by the vendor of the component.
- The COMPONENT ID field should be changed whenever the component's programming interface (e.g., the management device server definition) changes.
- The COMPONENT REVISION LEVEL field contains an 8-bit identifier identifying the revision level of the component (e.g., the expander device) containing the management device server, as defined by the vendor of the component. The COMPONENT REVISION LEVEL field should be changed whenever the component changes but its programming interface does not change.

NOTE: Management application clients may use the COMPONENT VENDOR IDENTIFICATION field and the COMPONENT ID field to interpret vendor specific information (e.g., vendor specific SMP functions) correctly for that component. Management application clients may use the COMPONENT VENDOR IDENTIFICATION field, the COMPONENT ID field, and the COMPONENT REVISION LEVEL field to perform workarounds for problems in a specific revision of a component. The vendor specific bytes are defined by the vendor of the subsystem (e.g., the board or enclosure) containing the component.

The Manufacturer Information response is defined as follows:

- VENDOR IDENTIFICATION: INTEL
- PRODUCT IDENTIFICATION: JBOD2312S3SP
- PRODUCT REVISION LEVEL: 0xB020 (As of October 20th, 2014)
- COMPONENT VENDOR IDENTIFICATION: PMCSIERA
- COMPONENT ID: 8044
- COMPONENT REVISION LEVEL: 0x02
- VENDOR SPECIFIC: 0x0000000000000000

4.2.3 REPORT SELF-CONFIGURATION STATUS Function (03h)

The REPORT SELF-CONFIGURATION STATUS function returns self-configuration expander device status. This SMP function shall be implemented by the management device server in self-configuring expander devices and shall not be implemented by any other management device servers.

Table 13. REPORT SELF-CONFIGURATION STATUS request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (03h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4								
5	Reserved							
6	(MSB)							(LSB)
7	STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							
8	(MSB)							(LSB)
...								
11	CRC						(LSB)	

- The SMP FRAME TYPE shall be set as shown in Table 13 for the REPORT SELF-CONFIGURATION STATUS request.
- The FUNCTION field shall be set as shown in Table 13 for the REPORT SELF-CONFIGURATION STATUS request.
- The ALLOCATED RESPONSE LENGTH field specifies the maximum number of dwords that the management application client has allocated in the data-in buffer for the additional response bytes in the response frame.
- The REQUEST LENGTH field shall be set as shown in Table 13 for the REPORT SELF-CONFIGURATION STATUS request.
- The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field specifies the first self-configuration status descriptor that the management device server shall return in the SMP response frame. If the specified index does not contain a valid self-configuration status descriptor, then the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in the response may differ from the specified index. A STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field set to 0000h specifies that the management device server shall return no self-configuration status descriptors.

Table 14. REPORT SELF-CONFIGURATION STATUS response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (03h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH $((n - 7) / 4)$							
4	(MSB)							(LSB)
5	EXPANDER CHANGE COUNT							
6	(MSB)							(LSB)
7	STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							
8	(MSB)							(LSB)
9	TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS							
10	(MSB)							(LSB)
11	LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							
12	SELF-CONFIGURATION STATUS DESCRIPTOR LENGTH							

Byte\Bit	7	6	5	4	3	2	1	0
13	Reserved							
...								
18								
19	NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS							
Self-configuration status descriptor list								
20	Self-configuration status descriptor (first) (see Table 15)							
...								
...	Self-configuration status descriptor (last) (see Table 15)							
...								
n - 4	(MSB)							
n - 3								
...	CRC							
n								

- The SMP FRAME TYPE field shall be set as shown in Table 14 for the REPORT SELF-CONFIGURATION STATUS response.
- The FUNCTION field shall be set as shown in Table 14 for the REPORT SELF-CONFIGURATION STATUS response.
- The RESPONSE LENGTH field is shall be set as shown in Table 14 for the REPORT
- SELF-CONFIGURATION STATUS response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response. If the management application client detects a change in the value of this field while retrieving multiple response frames, then it should retrieve the response frames again.
- The STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field indicates the index of the first self-configuration status descriptor being returned.
 - If the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in the SMP request frame is set to 0000h, then the management device server shall:
 - a) Set the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field to 0000h.
 - b) Set the TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field to 0000h.
 - c) Return no descriptors.
 - If the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in the SMP request frame does not specify a valid descriptor, then the management device server shall:
 - a) Set the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field to the next index, in ascending order wrapping from FFFFh to 0001h, which contains a valid descriptor.
 - If the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is not set to 0000h and specifies a valid descriptor, then this field shall be set to the same value as the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field in the SMP request frame.
- The SELF-CONFIGURATION STATUS DESCRIPTOR LENGTH field indicates the length, in dwords, of the self-configuration status descriptor (see Table 15).
- The TOTAL NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field indicates the number of self-configuration status descriptors are available at this time from the management device server.
- The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field indicates the index of the last recorded self-configuration status descriptor.
- The NUMBER OF SELF-CONFIGURATION STATUS DESCRIPTORS field indicates the number of self-configuration status descriptors in the self-configuration status descriptor list.
- The self-configuration status descriptor list contains self-configuration status descriptors (see Table 15). The management device server s hall return either all the self-configuration status descriptors that fit in

one SMP response frame or all the self-configuration status descriptors until the index indicated in the LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is reached. The self-configuration status descriptor list shall start with the self-configuration status descriptor specified by the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field, and shall continue with self-configuration status descriptors sorted in ascending order, wrapping from FFFFh to 0001h, based on the self-configuration status descriptor index. The self-configuration status descriptor list shall not contain any truncated self-configuration status descriptors. If the STARTING SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is equal to the LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field, then the self-configuration status descriptor at that index shall be returned.

Table 15. Self-configuration status descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	STATUS TYPE							
1	Reserved							FINAL
2	Reserved							
3	PHY IDENTIFIER							
4	Reserved							
...								
7								
8	SAS ADDRESS							
...								
15								

The STATUS TYPE field indicates the type of status being reported and is defined in Table 16 and Table 17.

Table 16. Self-Configuration Status Types Logged (part 1 of 2)

Code	Description
Status not related to specific layers (00h to 0Fh)	
02h	The expander device currently has a connection or is currently attempting to establish a connection with the SMP target port with the indicated SAS address.
03h	Expander route table is full. The expander device was not able to add the indicated SAS address to the expander route table.
Status reported by the phy layer (20h to 3Fh)	
Status reported by the link layer (40h to 5Fh)	
41h	Connection request failed as a result of an Open Timeout timer expiring
42h	Connection request failed as a result of receiving an abandon-class OPEN_REJECT (e.g., BAD DESTINATION, PROTOCOL NOT SUPPORTED, ZONE VIOLATION, STP RESOURCES BUSY, WRONG DESTINATION)
43h	Connection request failed as a result of receiving a vendor specific number of retry-class OPEN_REJECTs (e.g., RETRY, PATHWAY BLOCKED)
44h	Connection request failed as a result of an I_T nexus loss occurring (e.g., OPEN_REJECT (NO DESTINATION) received for longer than the time specified by the STP SMP I_T NEXUS LOSS TIME field in the CONFIGURE GENERAL function)
45h	Connection request failed as a result of receiving a BREAK
46h	Connection established as a result of an SMP response frame having a CRC error
Status reported by the port layer (60h to 7Fh)	
61h	During an SMP connection, there was no SMP response frame within the maximum SMP connection time
Status reported by the SMP transport layer (80h to 9Fh)	
Status reported by the management application layer (A0h to BFh)	
A2h	SMP response frame contains field(s) with unsupported values

Code	Description
A4h	The SAS ADDRESS field contains the SAS address of a self-configuring expander device that returned a REPORT GENERAL response with the CONFIGURING bit set to one, the SELF CONFIGURING bit set to zero, and the ZONE CONFIGURING bit set to zero (e.g., compliant with a previous version of this standard). Accesses to SAS addresses two or more levels beyond this expander device may not succeed until the indicated expander device completes configuration. This may or may not be an error.
A5h	The SAS ADDRESS field contains the SAS address of a self-configuring expander device that returned a REPORT GENERAL response with the SELF CONFIGURING bit set to one. Accesses to SAS addresses two or more levels beyond this expander device may not succeed until the indicated expander device completes configuration. This may or may not be an error.

Table 17. Self-Configuration Status Types Logged (part 2 of 2)

Code	Description
A6h	The SAS ADDRESS field contains the SAS address of a self-configuring expander device that returned a REPORT GENERAL response with the ZONE CONFIGURING bit set to one. Accesses to SAS addresses two or more levels beyond this expander device may not succeed until the indicated expander device completes configuration. This may or may not be an error.
Other status (C0h to FFh)	

- A FINAL bit set to one indicates that the expander device is no longer attempting to establish connections to the SMP target port with the indicated SAS address as part of the discover process because of the error indicated by the descriptor. A FINAL bit set to zero indicates that the expander device is still attempting to access the SMP target port with the indicated SAS address as part of the discover process.
- The PHY IDENTIFIER field indicates the phy identifier of the phy that was used to request a connection with the SMP target port with the indicated SAS address.
- The SAS ADDRESS field indicates the SAS address of the SMP target port to which the expander device established a connection or attempted to establish a connection.

4.2.4 REPORT ZONE PERMISSION TABLE Function (04h)

The REPORT ZONE PERMISSION function returns a set of zone permission table entries. This function shall be supported by all zoning expander devices.

Table 18. REPORT ZONE PERMISSION TABLE request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (04h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4	Reserved						REPORT TYPE	
5	Reserved							
6	STARTING SOURCE ZONE GROUP							
7	MAXIMUM NUMBER OF ZONE PERMISSION DESCRIPTORS							
8	(MSB)							
...	CRC							
11	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 18 for the REPORT ZONE PERMISSION TABLE request.
- The FUNCTION field shall be set as shown in Table 18 for the REPORT ZONE PERMISSION TABLE request.
- The REQUEST LENGTH field shall be set as shown in Table 18 for the REPORT ZONE PERMISSION TABLE request.

request.

- The REPORT TYPE field specifies the zone permission table values that the management device server shall return and is defined in Table 19.

Table 19. REPORT TYPE field

Code	Description
00b	Current zone permission table
01b	Shadow zone permission table
	Saved zone permission table.
10b	If the expander device does not support saving, it shall return a function result of SAVING NOT SUPPORTED in the response frame.
11b	Default zone permission table

- The STARTING SOURCE ZONE GROUP field specifies the first source zone group (i.e., s) returned. If the value in this field exceeds the end of the zone permission table, then the management device server shall return a function result of SOURCE ZONE GROUP DOES NOT EXIST in the response frame.
- The MAXIMUM NUMBER OF ZONE PERMISSION DESCRIPTORS field specifies the maximum number of complete zone permission descriptors that the management device server shall return.

Table 20. REPORT ZONE PERMISSION TABLE response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (04h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH ((n - 7) / 4)								
4	(MSB)	EXPANDER CHANGE COUNT							
5								(LSB)	
6	ZONE LOCKED	Reserved					REPORT TYPE		
7	NUMBER OF ZONE GROUPS		Reserved						
8	Reserved								
...	Reserved								
12	Reserved								
13	ZONE PERMISSION DESCRIPTOR LENGTH								
14	STARTING SOURCE ZONE GROUP								
15	NUMBER OF ZONE PERMISSION DESCRIPTORS								
Zone permission descriptor list									
16	Zone permission descriptor (first) (see Table 22)								
...	Zone permission descriptor (first) (see Table 22)								
31 or 47	Zone permission descriptor (first) (see Table 22)								
...	Zone permission descriptor (last) (see Table 22)								
(n - 20) or (n - 36)	Zone permission descriptor (last) (see Table 22)								
...	Zone permission descriptor (last) (see Table 22)								
n - 4	Zone permission descriptor (last) (see Table 22)								
n - 3	(MSB)	CRC							
...	CRC								
n	(LSB)								

- The SMP FRAME TYPE field shall be set as shown in Table 20 for the REPORT ZONE PERMISSION TABLE

response.

- The FUNCTION field shall be set as shown in Table 20 for the REPORT ZONE PERMISSION TABLE response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 20 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response. If the SMP initiator port detects a change in the value of this field while retrieving multiple response frames, then it should retrieve the response frames again because the status information returned is incomplete and inconsistent.
- The ZONE LOCKED bit is defined in the SMP REPORT GENERAL response.
- The REPORT TYPE field indicates the value of the REPORT TYPE field in the request frame.
- The NUMBER OF ZONE GROUPS field indicates the number of zone groups supported by the expander device and is defined in the REPORT GENERAL response.
- The ZONE PERMISSION DESCRIPTOR LENGTH field indicates the length, in dwords, of the zone permission descriptor.
- The STARTING SOURCE ZONE GROUP field indicates the first source zone group (i.e., s) being returned, and shall be set to the same value as the STARTING SOURCE ZONE GROUP field in the SMP request frame.
- The NUMBER OF ZONE PERMISSION DESCRIPTORS field indicates the number of zone permission descriptors in the zone permission descriptor list.
- The zone permission descriptor list contains a zone permission descriptor for each source zone group in ascending order starting with the source zone group specified in the STARTING SOURCE ZONE GROUP field in the request.
- The zone permission descriptor format is based on the NUMBER OF ZONE GROUPS field as defined in Table 21.

Table 21. Zone permission descriptors

NUMBER OF ZONE GROUPS field	Zone permission descriptor format
00b	
01b	Table 22
All others	Reserved

Table 22. Zone permission descriptor for a source zone group (i.e., s) with 256 zone groups

Byte\Bit	7	6	5	4	3	2	1	0
0	ZP[s, 255]	ZP[s, 254]	ZP[s, 253]	ZP[s, 252]	ZP[s, 251]	ZP[s, 250]	ZP[s, 249]	ZP[s, 248]
...	...							
31	ZP[s, 7] (0b)	ZP[s, 6] (0b)	ZP[s, 5] (0b)	ZP[s, 4] (0b)	ZP[s, 3]	ZP[s, 2]	ZP[s, 1] (1b)	ZP[s, 0] (0b)

The zone permission descriptor contains all of the zone permission table entries for the source zone group (i.e., s).

Table 23 defines how the zone permission descriptor bits shall be set by the management device server.

Table 23. Zone permission descriptor bit requirements

Source zone group (i.e., s)	Management device server requirement(s) ^a
0	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 2 to (z-1)] shall be set to zero.
1	ZP[s, 0 to (z-1)] shall be set to one.
4, 5, 6, or 7	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 4 to (z-1)] shall be set to zero.

Source zone group (i.e., s)	Management device server requirement(s) ^a
2, 3, or 8 to (z-1) ^a	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 2 to 3] shall be set to zero or one as specified by the CONFIGURE ZONE PERMISSION TABLE function. ZP[s, 4 to 7] shall be set to zero. ZP[s, 8 to (z-1)] shall be set to zero or one as specified by the CONFIGURE ZONE PERMISSION TABLE function.
^a The number of zone groups (i.e., z) is reported in NUMBER OF ZONE GROUPS field.	

4.2.5 REPORT ZONE MANAGER PASSWORD Function (05h)

The REPORT ZONE MANAGER PASSWORD function returns the zone manager password. This SMP function may be implemented by a management device server in a zoning expander device and shall be implemented if the management device server supports the CONFIGURE ZONE MANAGER PASSWORD function. Other management device servers shall not support this SMP function. This function shall only be processed if the request is received from:

- An SMP initiator port that has access to zone group 2.
- Any SMP initiator port while physical presence is asserted.

If physical presence is not asserted and the SMP initiator port does not have access to zone group 2, then the management device server shall return a function result of NO MANAGEMENT ACCESS RIGHTS in the response frame.

Table 24. REPORT ZONE MANAGER PASSWORD request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (05h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4	Reserved						REPORT TYPE	
5	Reserved							
...								
7								
8	(MSB)	CRC						
...								
11	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 24 for the REPORT ZONE MANAGER PASSWORD request.
- The FUNCTION field shall be set as shown in Table 24 for the REPORT ZONE MANAGER PASSWORD request.
- The REQUEST LENGTH field shall be set as shown in Table 24 for the REPORT ZONE MANAGER PASSWORD request.
- The REPORT TYPE field specifies the zone manager password value that the management device server shall return and is defined in Table 25.

Table 25. REPORT TYPE field

Code	Description
00b	Current zone manager password
01b	Reserved ^a
10b	Saved zone manager password.
11b	Default zone manager password

^a The CONFIGURE ZONE PASSWORD function updates the current zone manager password, not a shadow zone manager password.

Table 26. REPORT ZONE MANAGER PASSWORD response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (05h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (09h)							
4	(MSB)							(LSB)
5	EXPANDER CHANGE COUNT							
6	Reserved						REPORT TYPE	
7	Reserved							
8	ZONE MANAGER PASSWORD							
...								
39								
40	(MSB)							(LSB)
...	CRC							
43								

- The SMP FRAME TYPE field shall be set as shown in Table 26 for the REPORT ZONE MANAGER PASSWORD response.
- The FUNCTION field shall be set as shown in Table 26 for the REPORT ZONE MANAGER PASSWORD response.
- The RESPONSE LENGTH field shall be set as shown in Table 26 for the REPORT ZONE MANAGER PASSWORD response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The REPORT TYPE field indicates the value of the REPORT TYPE field in the request frame.
- The ZONE MANAGER PASSWORD field indicates the zone manager password of the type indicated by the REPORT TYPE field.

4.2.6 REPORT BROADCAST Function (06h)

The REPORT BROADCAST function returns information about Broadcasts that were either originated from this expander device or SAS device, or received on a phy directly attached to an end device.

This SMP function may be implemented by any management device server.

Table 27. REPORT BROADCAST request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (06h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4	Reserved				BROADCAST TYPE			
5	Reserved							

Byte\Bit	7	6	5	4	3	2	1	0
...								
7								
8	(MSB)							
...	CRC							
11								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 27 for the REPORT BROADCAST request.
- The FUNCTION field shall be set as shown in Table 27 for the REPORT BROADCAST request.
- The REQUEST LENGTH field shall be set as shown in Table 27 for the REPORT BROADCAST request.
- The BROADCAST TYPE field, defined in the ZONED BROADCAST request, specifies the type of Broadcast for which counts shall be returned in the response frame.

Table 28. REPORT BROADCAST response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (06h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n - 7) / 4)							
4	(MSB)							
5	EXPANDER CHANGE COUNT							(LSB)
6	Reserved				BROADCAST TYPE			
7								
...	Reserved							
9								
10	BROADCAST DESCRIPTOR LENGTH							
11	NUMBER OF BROADCAST DESCRIPTORS							
Broadcast descriptor list								
12								
...								
19	Broadcast descriptor (first) (see Table 29)							
...	...							
n - 11								
...								
n - 4	Broadcast descriptor (last) (see Table 29)							
n - 3	(MSB)							
...	CRC							
n								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 28 for the REPORT BROADCAST response.
- The FUNCTION field shall be set as shown in Table 28 for the REPORT BROADCAST response.
- The RESPONSE LENGTH field shall be set as shown in Table 28 for the REPORT BROADCAST response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The BROADCAST TYPE field indicates the value of the BROADCAST TYPE field in the request frame.
- The BROADCAST DESCRIPTOR LENGTH field indicates the length, in dwords, of the Broadcast descriptor.
- The NUMBER OF BROADCAST DESCRIPTORS field indicates the number of Broadcast descriptors in the Broadcast descriptor list.

NOTE: If Broadcast descriptors are 8 bytes, then the number of Broadcast descriptors is limited to 126 by the SMP response frame size.

- The Broadcast descriptor list contains Broadcast descriptors. Broadcast descriptors shall be returned for all Broadcasts of the type specified in the BROADCAST TYPE field for which the count is non-zero. Broadcast descriptors shall be returned with the descriptor, if any, pertaining to no particular phy (i.e., PHY IDENTIFIER field set to FFh) first, followed by descriptors, if any, in ascending order sorted by the PHY IDENTIFIER field in each descriptor.

Table 29. Broadcast descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved				BROADCAST TYPE			
1	PHY IDENTIFIER							
2	Reserved				BROADCAST REASON			
3	Reserved							
4	(MSB)	BROADCAST COUNT						(LSB)
5								
6								
7	Reserved							

- The BROADCAST TYPE field, defined in the ZONED BROADCAST request, indicates the type of Broadcast described by this Broadcast descriptor.
- The PHY IDENTIFIER field indicates the phy identifier of the phy that caused the Broadcast described by this Broadcast descriptor to be originated or the phy on which the Broadcast was received. A PHY IDENTIFIER field set to FFh indicates that no specific phy caused the Broadcast described by this Broadcast descriptor.
- The BROADCAST COUNT field indicates the number of Broadcasts that were either:
 - a) Originated by the SAS device or expander device.
 - Or
 - b) Received by a phy attached to an end device.
- If the SAS device or expander device has originated the Broadcast or received the Broadcast since transmitting a REPORT BROADCAST response, then it shall increment this field at least once from the value in the previous REPORT BROADCAST response. It shall not increment this field when forwarding a Broadcast. This field shall wrap to at least 0001h after the maximum value (i.e., FFFFh) has been reached.

NOTE: A management application client that uses the BROADCAST COUNT field should read and save all the BROADCAST COUNT field values after performing the discover process, and then read them after each receipt of each Broadcast to ensure that none of the counts increments a multiple of 65 535 times between reading them.

For Broadcasts that are received, the BROADCAST REASON field shall be set to Fh. For Broadcasts that are originated, the BROADCAST REASON field indicates the reason that the Broadcast described by this Broadcast descriptor was originated and is defined in Table 30.

Table 30. BROADCAST REASON field for originated Broadcasts

BROADCAST TYPE field	BROADCAST REASON field	Description
0h (i.e., Broadcast (Change))	0h	Unspecified ^{a b}
4h (i.e., Broadcast (Expander))	0h	Unspecified
	1h	A phy event peak value detector has reached its threshold value.
	2h	A phy event peak value detector has been cleared by the SMP CONFIGURE PHY EVENT function.

BROADCAST TYPE field	BROADCAST REASON field	Description
	3h	The expander device is going to have reduced functionality (e.g., disable SMP access, reduced performance, and disable phy to phy communication) for a period of time.
8h (i.e., Broadcast (Zone Activate))	0h	Unspecified
All others		Reserved

^a In an expander device, the Broadcast (Change) count is also reported in the REPORT GENERAL response and in other SMP response frames containing an EXPANDER CHANGE COUNT field.

^b Broadcast (Change)s originated by this expander device or SAS device shall be counted, with the PHY IDENTIFIER field set to FFh.

4.2.7 DISCOVER Function (10h)

The DISCOVER function returns the physical link configuration information for the specified PHY. This SMP function provides information from the IDENTIFY address frame received by the PHY and PHY-specific information as well.

Table 31. SMP Discover Request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (10h)							
2	ALLOCATION RESPONSE LENGTH							
3	REQUEST LENGTH (00h)							
4								
7	RESERVED							
8	RESERVED							IGNORE ZONE GROUP
9	PHY IDENTIFIER							
10	RESERVED							
11								
12	(MSB)							
15	CRC							(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 31 for the DISCOVER request.
- The FUNCTION field shall be set as shown in Table 31 for the DISCOVER request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - a) Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - b) Return the first 52 bytes defined in Table 32 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - a) Set the RESPONSE LENGTH field in the response frame to the non-zero value defined in Table 32
 And
 - b) Return the response frame.
- The REQUEST LENGTH field shall be set to one of the values defined in Table 31 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are two dwords before the CRC field.
- An IGNORE ZONE GROUP bit set to one specifies that the management device server shall return information about the specified phy (i.e., the phy specified by the PHY IDENTIFIER field) regardless of the zone permission table.
- An IGNORE ZONE GROUP bit set to zero specifies that the management device server shall if the SMP initiator port:

- a) Has access to the specified phy based on the zone permission table, return the requested information

Or

- b) Does not have access to the specified phy, return a function result of PHY VACANT in the response frame.

- If the management device server is not in a zoning expander device with zoning enabled, then it shall ignore the IGNORE_ZONE_GROUP bit.
- The PHY_IDENTIFIER field specifies the phy for which the information is being requested.

Table 32. SMP Discover Response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (10h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h or 1Dh)							
4	(MSB)	EXPANDER CHANGE COUNT						(LSB)
5								
6								
...	Reserved							
8								
9	PHY IDENTIFIER							
10								
11	Reserved							
12	Reserved	ATTACHED DEVICE TYPE			ATTACHED REASON			
13	Reserved			NEGOTIATED LOGICAL LINK RATE				
14	Reserved			ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST	
15	ATTACHED SATA PORT SELECTOR	Reserved		STP BUFFER TOO SMALL	ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE
16								
...	SAS ADDRESS							
23								
24								
...	ATTACHED SAS ADDRESS							
31								
32	ATTACHED PHY IDENTIFIER							
33	ATTACHED PERSISTENT CAPABLE	ATTACHED POWER CAPABLE		ATTACHED SLUMBER CAPABLE	ATTACHED PARTIAL CAPABLE	ATTACHED INSIDE ZPSDS PERSISTENT	ATTACHED REQUESTED INSIDE ZPSDS	ATTACHED BREAK_REPLY CAPABLE
34	Reserved for IDENTIFY address frame-related fields							ATTACHED PWR_DIS CAPABLE
35								
...	Reserved for IDENTIFY address frame-related fields							
39								
40	PROGRAMMED MINIMUM PHYSICAL LINK RATE				HARDWARE MINIMUM PHYSICAL LINK RATE			
41	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				HARDWARE MAXIMUM PHYSICAL LINK RATE			
42	PHY CHANGE COUNT							
43	VIRTUAL PHY	Reserved			PARTIAL PATHWAY TIMEOUT VALUE			
44	Reserved				ROUTING ATTRIBUTE			
45	Reserved	CONNECTOR TYPE						
46	CONNECTOR ELEMENT INDEX							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
47	CONNECTOR PHYSICAL LINK							
48	PHY POWER CONDITION		SAS POWER CAPABLE		SAS SLUMBER CAPABLE	SAS PARTIAL CAPABLE	SATA SLUMBER CAPABLE	SATA PARTIAL CAPABLE
49	PWR_DIS SIGNAL		PWR_DIS CONTROL CAPABLE		SAS SLUMBER ENABLED	SAS PARTIAL ENABLED	SATA SLUMBER ENABLED	SATA PARTIAL ENABLED
50	Vendor specific							
51	Vendor specific							
52	Vendor specific							
...	Vendor specific							
59	ATTACHED DEVICE NAME							
60	Reserved	REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER	INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	Reserved	ZONE GROUP PERSISTENT	INSIDE ZPSDS	ZONING ENABLED
61	Reserved for zoning-related fields							
62	Reserved for zoning-related fields							
63	ZONE GROUP							
64	SELF-CONFIGURATION STATUS							
65	SELF-CONFIGURATION LEVELS COMPLETED							
66	Reserved for self-configuration related fields							
67	Reserved for self-configuration related fields							
68	Reserved for self-configuration related fields							
...	Reserved for self-configuration related fields							
75	SELF-CONFIGURATION SAS ADDRESS							
76	Reserved for self-configuration related fields							
...	Reserved for self-configuration related fields							
79	PROGRAMMED PHY CAPABILITIES							
80	Reserved for self-configuration related fields							
...	Reserved for self-configuration related fields							
83	CURRENT PHY CAPABILITIES							
84	Reserved for self-configuration related fields							
...	Reserved for self-configuration related fields							
87	ATTACHED PHY CAPABILITIES							
88	Reserved							
...	Reserved							
93	Reserved							
94	REASON				NEGOTIATED PHYSICAL LINK RATE			
95	Reserved					OPTICAL MODE ENABLED	NEGOTIATED SSC	HARDWARE MUXING SUPPORTED
96	Reserved	DEFAULT INSIDE ZPSDS PERSISTENT	DEFAULT REQUESTED INSIDE ZPSDS	Reserved	DEFAULT ZONE GROUP PERSISTENT	Reserved	DEFAULT ZONING ENABLED	
97	Reserved							
98	Reserved							
99	DEFAULT ZONE GROUP							
100	Reserved	SAVED INSIDE ZPSDS	SAVED REQUESTED INSIDE	Reserved	SAVED ZONE GROUP PERSISTENT	Reserved	SAVED ZONING ENABLED	

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0	
			PERSISTENT	ZPSDS					
101	Reserved								
102	Reserved								
103	SAVED ZONE GROUP								
104	Reserved		SHADOW INSIDE ZPSDS PERSISTENT	SHADOW REQUESTED INSIDE ZPSDS	Reserved	SHADOW ZONE GROUP PERSISTENT	Reserved	SHADOW ZONING ENABLED	
105	Reserved								
106	Reserved								
107	SHADOW ZONE GROUP								
108	DEVICE SLOT NUMBER								
109	DEVICE SLOT GROUP NUMBER								
110	(MSB)								
...	DEVICE SLOT GROUP OUTPUT CONNECTOR								
115								(LSB)	
116	(MSB)								
117		STP BUFFER SIZE							(LSB)
118	Reserved								
119	Reserved								
120	(MSB)								
...	CRC								
123								(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 32 for the DISCOVER response.
- The FUNCTION field shall be set as shown in Table 32 for the DISCOVER response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 32 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The PHY IDENTIFIER field indicates the phy identifier of the phy for which information is being returned.
- The ATTACHED DEVICE TYPE field indicates the device type attached to this phy and is defined in Table 33.

Table 33. Attached Device Type field

Code	Description
000b	No device attached
001b	SAS device or SATA device
010b	Expander device
011b	Obsolete
All others	Reserved

- If the phy is a physical phy, then the ATTACHED DEVICE TYPE field shall only be set to a value other than 000b:
 - If a SAS device or expander device is attached, after the identification sequence is complete.
 - If a SATA phy is attached and the STP/SATA bridge does not retrieve IDENTIFY (PACKET) DEVICE data, after the STP/SATA bridge receives the initial Register - Device to Host FIS
- Or
 - If a SATA phy is attached and the STP/SATA bridge retrieves IDENTIFY (PACKET) DEVICE data, after the STP/SATA bridge receives IDENTIFY (PACKET) DEVICE data or it encounters a failure retrieving that data.
- If the NEGOTIATED PHYSICAL LINK RATE field (see Table 34) is not set to a physical link rate, then the management device server may set the ATTACHED DEVICE TYPE field to 000b.
- If the phy is a physical phy and a SATA phy is attached, then the ATTACHED REASON field shall be set to 0h after the initial Register - Device to Host FIS has been received. If the phy is a virtual phy, then the

ATTACHED REASON field shall be set to 0h.

- The NEGOTIATED LOGICAL LINK RATE field is defined in Table 34 and indicates the logical link rate being used by the phy. For physical phys, this is negotiated during the link reset sequence. For virtual phys, this field should be set to the maximum physical link rate supported by the expander device. This field may be different from the negotiated physical link rate when multiplexing is enabled (see Table 35).

Table 34. Negotiated Logical link Rate field and Negotiated Physical link Rate field.

SP state machine ResetStatus state machine variable	Code	Description
UNKNOWN	0h	Phy is enabled; unknown physical link rate. ^a
DISABLED	1h	Phy is disabled.
PHY_RESET_PROBLEM	2h	Phy is enabled; and a phy reset problem occurred.
SPINUP_HOLD	3h	Phy is enabled; did not detect a SAS phy or an expander phy (i.e., the attached phy did not respond with COMSAS within the COMSAS timeout) and entered the SATA spinup hold state. The SMP PHY CONTROL function phy operations of LINK RESET and HARD RESET may be used to release the phy.
PORT_SELECTOR	4h	Phy is enabled; and detected a SATA port selector. The physical link rate has not been negotiated since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The SATA spinup hold state has not been entered since the last time the phy's SP state machine entered the SP0:OOB_COMINIT state. The value in this field may change to 3h, 8h, 9h, or Ah if attached to the active phy of the SATA port selector. Presence of a SATA port selector is indicated by the ATTACHED SATA PORT SELECTOR bit (see Table 36).
RESET_IN_PROGRESS	5h	Phy is enabled; and the expander phy is performing an SMP PHY CONTROL function phy operation of LINK RESET or HARD RESET. This value is returned if the specified phy contained a value of 8h to Fh in this field when an SMP PHY CONTROL function phy operation of LINK RESET or HARD RESET phy operation is processed.
UNSUPPORTED_PHY_ATTACHED	6h	Phy is enabled; and a phy is attached without any commonly supported settings.
Reserved	7h	Reserved
G1	8h	Phy is enabled; with a 1.5 Gbit/s physical link rate or logical link rate.
G2	9h	Phy is enabled; with a 3 Gbit/s physical link rate or logical link rate.
G3	Ah	Phy is enabled with a 6 Gbit/s physical link rate or logical link rate.
G4	Bh	Phy is enabled with a 12 Gbit/s physical link rate or logical link rate.
Reserved	Ch to Fh	Phy is enabled and reserved for future logical link rate or physical link rates.

^a This code may be used by a management application client in its local data structures to indicate an unknown negotiated logical link rate or physical link rate (e.g., before the discover process has queried the phy).

Table 35. NEGOTIATED PHYSICAL LINK RATE field and NEGOTIATED LOGICAL LINK RATE field combinations based on multiplexing

NEGOTIATED PHYSICAL LINK RATE field	Multiplexing	NEGOTIATED LOGICAL LINK RATE field
9h (i.e., G2)	Disabled	9h (i.e., 3 Gbit/s)
	Enabled	8h (i.e., 1.5 Gbit/s)
Ah (i.e., G3)	Disabled	Ah (i.e., 6 Gbit/s)
	Enabled	9h (i.e., 3 Gbit/s)
Bh (i.e., G4)	Disabled	Bh (i.e., 12 Gbit/s)
	Enabled	Ah (i.e., 6 Gbit/s)

NOTE: In SAS-1.1 which did not define multiplexing, the NEGOTIATED LOGICAL LINK RATE field was called the NEGOTIATED PHYSICAL LINK RATE field and the NEGOTIATED PHYSICAL LINK RATE field in byte 94 did not exist.

Table 36. ATTACHED SATA PORT SELECTOR and ATTACHED SATA DEVICE bits

ATTACHED SATA PORT SELECTOR bit value ^{a b d}	ATTACHED SATA DEVICE bit value ^{c d}	Description
0	0	Either the phy is: <ul style="list-style-type: none"> • A virtual phy; or • A physical phy, and neither a SATA port selector nor a SATA device is attached and ready on the selected phy.
0	1	The phy is a physical phy and the attached phy is neither a SAS phy nor an expander phy (i.e., the attached phy did not respond with COMSAS within the COMSAS timeout). No SATA port selector is present (i.e., the SP state machine did not detect COMWAKE in response to the initial COMINIT, detected COMINIT, and then timed out waiting for COMSAS).
1	0	The phy is a physical phy, the attached phy is a SATA port selector host phy, and either the attached phy is: <ul style="list-style-type: none"> • The inactive host phy; or • The active host phy and a SATA device is either not present or not ready behind the SATA port selector.
1	1	The phy is a physical phy, the attached phy is a SATA port selector's active host phy, and neither a SAS phy nor an expander phy is present behind the SATA port selector (i.e., the SP state machine detected COMWAKE while waiting for COMINIT, detected COMINIT, and then timed out waiting for COMSAS).

The ATTACHED SATA PORT SELECTOR bit shall be ignored if the NEGOTIATED LOGICAL LINK RATE field is set to UNKNOWN (i.e., 0h), DISABLED (i.e., 1h), or RESET_IN_PROGRESS (i.e., 5h).

Whenever the ATTACHED SATA PORT SELECTOR bit changes, the phy shall originate a Broadcast (Change).

For the purposes of the ATTACHED SATA DEVICE bit, a SATA port selector is not considered a SATA device.

The ATTACHED SATA PORT SELECTOR bit and the ATTACHED SATA DEVICE bit are updated as specified in the SP state machine.

- An ATTACHED SATA HOST bit set to one indicates a SATA host port is attached. An ATTACHED SATA HOST bit set to zero indicates a SATA host port is not attached.

NOTE: Support for SATA hosts is outside the scope of this standard.

- If a SAS phy reset sequence occurs (i.e., one or more of the ATTACHED SSP INITIATOR PORT bit, the ATTACHED STP INITIATOR PORT bit, the ATTACHED SMP INITIATOR PORT bit, the ATTACHED SSP TARGET PORT bit, the ATTACHED STP TARGET PORT bit, and/or the ATTACHED SMP TARGET PORT bit is set to one), then the ATTACHED SATA PORT SELECTOR bit, the ATTACHED SATA DEVICE bit, and the ATTACHED SATA HOST bit shall each be set to zero.
- An ATTACHED SSP INITIATOR PORT bit set to one indicates that the attached phy supports an SSP initiator port.
- An ATTACHED SSP INITIATOR PORT bit set to zero indicates that the attached phy does not support an SSP initiator port. If the phy is a physical phy, then the ATTACHED SSP INITIATOR PORT bit indicates the value of the SSP INITIATOR PORT bit received in the IDENTIFY address frame during the identification sequence.
- An ATTACHED STP INITIATOR PORT bit set to one indicates that the attached phy supports an STP initiator port.
- An ATTACHED STP INITIATOR PORT bit set to zero indicates that the attached phy does not support an STP initiator port. If the phy is a physical phy, then the ATTACHED STP INITIATOR PORT bit indicates the value of the STP INITIATOR PORT bit received in the IDENTIFY address frame (see 6.8.2) during the identification sequence.
- An ATTACHED SMP INITIATOR PORT bit set to one indicates that the attached phy supports an SMP initiator port.
- An ATTACHED SMP INITIATOR PORT bit set to zero indicates that the attached phy does not support an SMP initiator port. If the phy is a physical phy, then the ATTACHED SMP INITIATOR PORT bit indicates the

value of the SMP INITIATOR PORT bit received in the IDENTIFY address frame during the identification sequence.

- The STP BUFFER TOO SMALL bit set to one indicates that the phy does not contain sufficient buffers to support STP connections for the attached cable assembly. The STP BUFFER TOO SMALL bit set to zero indicates that the phy may contain sufficient buffers to support STP connections for the attached cable assembly.
- An ATTACHED SSP TARGET PORT bit set to one indicates that the attached phy supports an SSP target port.
- An ATTACHED SSP TARGET PORT bit set to zero indicates that the attached phy does not support an SSP target port. If the phy is a physical phy, then the ATTACHED SSP TARGET PORT bit indicates the value of the SSP TARGET PORT bit received in the IDENTIFY address frame during the identification sequence.
- An ATTACHED STP TARGET PORT bit set to one indicates that the attached phy supports an STP target port.
- An ATTACHED STP TARGET PORT bit set to zero indicates that the attached phy does not support an STP target port. If the phy is a physical phy, then the ATTACHED STP TARGET PORT bit indicates the value of the STP TARGET PORT bit received in the IDENTIFY address frame during the identification sequence.
- An ATTACHED SMP TARGET PORT bit set to one indicates that the attached phy supports an SMP target port.
- An ATTACHED SMP TARGET PORT bit set to zero indicates that the attached phy does not support an SMP target port. If the phy is a physical phy, then the ATTACHED SMP TARGET PORT bit indicates the value of the SMP TARGET PORT bit received in the IDENTIFY address frame during the identification sequence.
- If the phy is a physical phy, then the ATTACHED SSP INITIATOR PORT bit, the ATTACHED STP INITIATOR PORT bit, the ATTACHED SMP INITIATOR PORT bit, the ATTACHED SSP TARGET PORT bit, the ATTACHED STP TARGET PORT bit, and the ATTACHED SMP TARGET PORT bit shall be updated at the end of the identification sequence.
- If a SATA phy reset sequence occurs (i.e., the ATTACHED SATA PORT SELECTOR bit is set to one, the ATTACHED SATA DEVICE bit is set to one, or the ATTACHED SATA HOST bit is set to one), then the ATTACHED SSP INITIATOR PORT bit, the ATTACHED STP INITIATOR PORT bit, the ATTACHED SMP INITIATOR PORT bit, the ATTACHED SSP TARGET PORT bit, the ATTACHED STP TARGET PORT bit, and the ATTACHED SMP TARGET PORT bit shall each be set to zero.
- If the phy is an expander phy, then the SAS ADDRESS field contains the SAS address of the expander device. If the phy is a SAS phy, then the SAS ADDRESS field contains the SAS address of the SAS port. If the phy is a physical phy, then the SAS ADDRESS field contains the value of the SAS ADDRESS field transmitted in the IDENTIFY address frame during the identification sequence.
- The ATTACHED SAS ADDRESS field is defined as follows:
 - If the attached port is an expander port, then the ATTACHED SAS ADDRESS field contains the SAS address of the attached expander device.
 - If the attached port is a SAS port, then the ATTACHED SAS ADDRESS field contains SAS address of the attached SAS port.

Or

- If the attached port is a SATA device port, then the ATTACHED SAS ADDRESS field contains the SAS address of the STP/SATA bridge.
- For a physical phy, the ATTACHED SAS ADDRESS field contains the value of the SAS ADDRESS field received in the IDENTIFY address frame during the identification sequence, and shall be updated after:
 - The identification sequence completes, if a SAS phy or expander phy is attached

Or

 - The COMSAS Detect Timeout timer expires, if a SATA phy is attached.
- An STP initiator port should not make a connection request to the attached SAS address until the ATTACHED DEVICE TYPE field is set to a value other than 000b (see Table 33).
- The ATTACHED PHY IDENTIFIER field is defined as follows:

- If the attached phy is a SAS phy, then the ATTACHED PHY IDENTIFIER field contains the phy identifier of the attached SAS phy in the attached SAS device.
- If the attached phy is an expander phy, then the ATTACHED PHY IDENTIFIER field contains the phy identifier of the attached expander phy in the attached expander device.
- If the attached phy is a SATA device phy, then the ATTACHED PHY IDENTIFIER field contains 00h
- If the attached phy is a SATA port selector phy and the expander device is able to determine the port of the SATA port selector to which it is attached, then the ATTACHED PHY IDENTIFIER field contains 00h or 01h.

Or

- If the attached phy is a SATA port selector phy and the expander device is not able to determine the port of the SATA port selector to which it is attached, then the ATTACHED PHY IDENTIFIER field contains 00h.
- If the phy is a physical phy and the attached phy is a SAS phy or an expander phy, then the ATTACHED PHY IDENTIFIER field contains the value of the PHY IDENTIFIER field received in the IDENTIFY address frame during the identification sequence.
- For a physical phy, the ATTACHED PHY IDENTIFIER field shall be updated after:
 - The identification sequence completes, if a SAS phy or expander phy is attached.
- Or
 - The COMSAS Detect Timeout timer expires, if a SATA phy is attached.
- An ATTACHED PERSISTENT CAPABLE bit indicates the value of the PERSISTENT CAPABLE bit received in the IDENTIFY address frame from the attached phy during the identification sequence.
- The ATTACHED POWER CAPABLE field indicates the value of the POWER CAPABLE field received in the IDENTIFY address frame from the attached phy during the identification sequence.
- The ATTACHED SLUMBER CAPABLE bit indicates the value of the SLUMBER CAPABLE bit received in the IDENTIFY address frame from the attached phy during the identification sequence.
- The ATTACHED PARTIAL CAPABLE bit indicates the value of the PARTIAL CAPABLE bit received in the IDENTIFY address frame from the attached phy during the identification sequence.
- If the phy is a physical phy, then the ATTACHED INSIDE ZPSDS PERSISTENT bit indicates the value of the INSIDE ZPSDS PERSISTENT bit received in the IDENTIFY address frame from the attached phy during the identification sequence. If the phy is a virtual phy, then the ATTACHED INSIDE ZPSDS PERSISTENT bit shall be set to zero.
- If the phy is a physical phy, then the ATTACHED REQUESTED INSIDE ZPSDS bit indicates the value of the REQUESTED INSIDE ZPSDS bit received in the IDENTIFY address frame from the attached phy during the identification sequence. If the phy is a virtual phy, then the ATTACHED REQUESTED INSIDE ZPSDS bit shall be set to zero.
- If the phy is a physical phy, then the ATTACHED BREAK_REPLY CAPABLE bit indicates the value of the BREAK_REPLY CAPABLE bit received in the IDENTIFY address frame during the identification sequence.
- If a phy reset sequence occurs, then the ATTACHED BREAK_REPLY CAPABLE bit shall be set to zero.
- If the phy is a virtual phy, then the ATTACHED BREAK_REPLY CAPABLE bit shall be set to zero.
- The ATTACHED PWR_DIS CAPABLE bit indicates the value of the PWR_DIS CAPABLE bit received in the IDENTIFY address frame from the attached phy during the identification sequence.
- The PROGRAMMED MINIMUM PHYSICAL LINK RATE field indicates the minimum physical link rate set by the PHY CONTROL function. The values are defined in Table 37. The default value shall be the value of the HARDWARE MINIMUM PHYSICAL LINK RATE field.
- The HARDWARE MINIMUM PHYSICAL LINK RATE field indicates the minimum physical link rate supported by the phy. The values are defined in Table 38.
- The PROGRAMMED MAXIMUM PHYSICAL LINK RATE field indicates the maximum physical link rate set by the PHY CONTROL function. The values are defined in Table 37. The default value shall be the value of the HARDWARE MAXIMUM PHYSICAL LINK RATE field.

Table 37. PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field

Code	Description
0h	Not programmable
1h to 7h	Reserved
8h	1.5 Gbit/s
9h	3 Gbit/s
Ah	6 Gbit/s
Bh	12 Gbit/s
Ch to Fh	Reserved for future physical link rates

- The HARDWARE MAXIMUM PHYSICAL LINK RATE field indicates the maximum physical link rate supported by the phy. The values are defined in Table 38. If the phy is a virtual phy, this field should be set to the maximum physical link rate supported by the expander device.

Table 38. The HARDWARE MINIMUM PHYSICAL LINK RATE field and the HARDWARE MAXIMUM PHYSICAL LINK RATE field

Code	Description
0h to 7h	Reserved
8h	1.5 Gbit/s
9h	3 Gbit/s
Ah	6 Gbit/s
Bh	12 Gbit/s
Ch to Fh	Reserved for future physical link rates

- The PHY CHANGE COUNT field indicates the number of Broadcast (Change)s originated by an expander phy. Expander devices shall support this field. Other device types shall not support this field. This field shall be set to 00h at power on. The expander device shall increment this field at least once when:
 - The expander device originates a Broadcast (Change) for an expander phy-related reason from the specified expander phy.
 - Or
 - The zone phy information changes for the specified expander phy (e.g., when a locked expander device is unlocked).
- The expander device shall not increment this field when forwarding a Broadcast (Change). After incrementing the PHY CHANGE COUNT field, the expander device is not required to increment the PHY CHANGE COUNT field again unless a DISCOVER response or a DISCOVER LIST response for the phy is transmitted. The PHY CHANGE COUNT field shall wrap to 00h after the maximum value (i.e., FFh) has been reached.

NOTE: Management application clients that use the PHY CHANGE COUNT field should read it often enough to ensure that it does not increment a multiple of 256 times between reading the field.

- A VIRTUAL PHY bit set to one indicates that the phy is a virtual phy and is part of an internal port and the attached device is contained within the expander device. A VIRTUAL PHY bit set to zero indicates that the phy is a physical phy and the attached device is not contained within the expander device.
- The PARTIAL PATHWAY TIMEOUT VALUE field indicates the partial pathway timeout value in microseconds set by the PHY CONTROL function.

NOTE: The recommended default value for PARTIAL PATHWAY TIMEOUT VALUE is 7 μ s.

- The ROUTING ATTRIBUTE field indicates the routing attribute supported by the phy and is defined in Table 39.

Table 39. ROUTING ATTRIBUTE field

Code	Name	Description
0h	Direct routing attribute	Direct routing method for attached end devices. Attached expander devices are not supported on this phy.
1h	Subtractive routing attribute	Either: subtractive routing method for attached expander devices; or direct routing method for attached end devices.
2h	Table routing attribute	Either: table routing method for attached expander devices; or direct routing method for attached end devices.
All others	Reserved	

- The ROUTING ATTRIBUTE field shall not change based on the attached device type.
- The CONNECTOR TYPE field indicates the type of connector used to access the phy, as reported by the enclosure services process for the enclosure (see Table 40. Connector Type Field). A CONNECTOR TYPE field set to 00h indicates no connector information is available and that the CONNECTOR ELEMENT INDEX field and the CONNECTOR PHYSICAL LINK fields shall be ignored.

Table 40. Connector Type Field

Code	Description
05h	Mini SAS HD 4x receptacle (see SAS-2.1 and SFF-8644)
12h	Mini SAS HD 4i receptacle (see SAS-2.1 and SFF-8643)
20h	SAS Drive backplane receptacle (see SAS-2.1 and SFF-8482)

- The CONNECTOR ELEMENT INDEX field indicates the element index of the SAS Connector element representing the connector used to access the phy, as reported by the enclosure services process for the enclosure (see the SAS Connector element in SES-3).
- The CONNECTOR PHYSICAL LINK field indicates the physical link in the connector used to access the phy, as reported by the enclosure services process for the enclosure (see the SAS Connector element in SES-3).
- The PHY POWER CONDITION field is defined in Table 41 and indicates the power condition of the phy.

Table 41. PHY POWER CONDITION field

Code	Description
00b	Active phy power condition
01b	Partial phy power condition
10b	Slumber phy power condition
11b	Reserved

Table 42. SAS POWER CAPABLE field

Code	Description
00b	The device containing the phy: <ul style="list-style-type: none"> • Does not respond to PWR_GRANT with PWR_ACK, PWR_REQ with PWR_ACK, or PWR_DONE with PWR_ACK; and • Does not issue PWR_REQ or PWR_DONE.
01b	Reserved
10b	The device containing the phy is capable of managing the additional consumption of power by responding to: <ul style="list-style-type: none"> • PWR_REQ with PWR_ACK; • PWR_REQ with PWR_GRANT; and • PWR_DONE with PWR_ACK.
11b	Reserved

- A SAS SLUMBER CAPABLE bit set to one indicates that the phy supports the slumber phy power condition. A SAS SLUMBER CAPABLE bit set to zero indicates that the phy does not support the slumber phy power condition.
- A SAS PARTIAL CAPABLE bit set to one indicates that the phy supports the partial phy power condition. A SAS PARTIAL CAPABLE bit set to zero indicates that the phy does not support the partial phy power condition.
- DISCOVER Function bit set to one indicates that the phy supports the SATA slumber interface power

management sequence. A SATA SLUMBER CAPABLE bit set to zero indicates that the phy does not support the SATA slumber interface power management sequence.

- A SATA PARTIAL CAPABLE bit set to one indicates that the phy supports the SATA partial interface power management sequence. A SATA PARTIAL CAPABLE bit set to zero indicates that the phy does not support the SATA partial interface power management sequence.

Table 43. PWR_DIS SIGNAL field

Code	Description
00b	Not capable of reporting the POWER DISABLE signal associated with the phy.
01b	Reserved
10b	The POWER DISABLE signal associated with the phy is negated.
11b	The POWER DISABLE signal associated with the phy is asserted.

Table 44. PWR_DIS CONTROL CAPABLE field

Code	Description
00b	Not capable of controlling the POWER DISABLE signal associated with the phy.
01b	Capable of controlling the POWER DISABLE signal associated with the phy using the PWR_DIS CONTROL field in the SMP PHY CONTROL function.
10b	Capable of controlling the POWER DISABLE signal associated with the phy and controlled by a method outside the scope of this standard.
11b	Reserved

- A SAS SLUMBER ENABLED bit set to one indicates that the slumber phy power condition is enabled on the phy (see Table 106). A SAS SLUMBER ENABLED bit set to zero indicates that the slumber phy power condition is disabled on the phy.
- A SAS PARTIAL ENABLED bit set to one indicates that the partial phy power condition is enabled on the phy (see Table 107). A SAS PARTIAL ENABLED bit set to zero indicates that the partial phy power condition is disabled on the phy.
- A SATA SLUMBER ENABLED bit set to one indicates that the SATA slumber interface power management sequence is enabled on the phy (see Table 108). A SATA SLUMBER ENABLED bit set to zero indicates that the SATA slumber interface power management sequence is disabled on the phy.
- A SATA PARTIAL ENABLED bit set to one indicates that the SATA partial interface power management sequence is enabled on the phy (see Table 109). A SATA PARTIAL ENABLED bit set to zero indicates that the SATA partial interface power management sequence is disabled on the phy.
- The ATTACHED DEVICE NAME field is defined as follows:
 - If the attached phy is an expander phy, then the ATTACHED DEVICE NAME field contains the device name of the attached expander device
 - If the attached phy is a SAS phy, then the ATTACHED DEVICE NAME field contains the device name of the attached SAS device

Or

- If the attached phy is a SATA device phy, then the ATTACHED DEVICE NAME field contains the world wide name of the SATA device or 00000000 00000000h.
- For physical phys, Table 45 defines how the ATTACHED DEVICE NAME field is updated.

Table 45. ATTACHED DEVICE NAME field

Condition	Update time	Value
A SAS phy or expander phy is attached	Completion of the identification sequence	The management device server shall set this field to the DEVICE NAME field in the incoming IDENTIFY address frame (i.e., the attached expander device name or attached SAS device name).
A SATA phy is attached	Expiration of the COMSAS Detect Timeout timer	The management device server shall set this field to 00000000 00000000h.

Condition	Update time	Value
	Reception of IDENTIFY (PACKET) DEVICE data from the SATA device ^a	Either: <ul style="list-style-type: none"> • If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108 to 111 (i.e., the World Wide Name field) are not set to zero, then the management device server shall set this field to the world wide name indicated by words 108 to 111; • If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108 to 111 (i.e., the World Wide Name) are set to zero, then the management device server shall set this field to 00000000 00000000h; or • If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is not correct, then the management device server shall set this field to 00000000 00000000h.
	Processing a PHY CONTROL function SET ATTACHED DEVICE NAME phy operation	The management device server shall set this field to the value specified in the ATTACHED DEVICE NAME field in the PHY CONTROL request.
^a This row only applies if the expander device originates the IDENTIFY (PACKET) DEVICE command.		

- A REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit set to one indicates that the zoning expander device set the REQUESTED INSIDE ZPSDS bit to zero in the zone phy information at the completion of the last link reset sequence. A REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit set to zero indicates that the zoning expander device did not set the REQUESTED INSIDE ZPSDS bit to zero in the zone phy information at the completion of the last link reset sequence. The REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit shall be set to zero if the management device server is not in a zoning expander device.

NOTE: The zone manager may use the REQUESTED INSIDE ZPSDS CHANGED BY EXPANDER bit to determine why the REQUESTED INSIDE ZPSDS bit has changed in the DISCOVER response from the value to which it last set the bit.

- The INSIDE ZPSDS PERSISTENT bit indicates the value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information. The INSIDE ZPSDS PERSISTENT bit shall be set to zero if the management device server is not in a zoning expander device.
- The REQUESTED INSIDE ZPSDS bit indicates the value of the REQUESTED INSIDE ZPSDS bit in the zone phy information. The REQUESTED INSIDE ZPSDS bit shall be set to zero if the management device server is not in a zoning expander device.
- The ZONE GROUP PERSISTENT bit indicates the value of the ZONE GROUP PERSISTENT bit in the zone phy information. The ZONE GROUP PERSISTENT bit shall be set to zero if the management device server is not in a zoning expander device.
- The INSIDE ZPSDS bit indicates the value of the INSIDE ZPSDS bit in the zone phy information. The INSIDE ZPSDS bit shall be set to zero if the management device server is not in a zoning expander device.
- The ZONING ENABLED bit is defined in the SMP REPORT GENERAL response.
- The ZONE GROUP field indicates the value of the ZONE GROUP field in the zone phy information.
- The ZONE GROUP field shall be set to 00h if the management device server is not in a zoning expander device.
- The SELF-CONFIGURATION STATUS field indicates the status of a self-configuring expander device pertaining to the specified phy and is defined in Table 46.

Table 46. SELF-CONFIGURATION STATUS field

Code	Description
00h	No status available.
01h to FFh	As defined for the STATUS TYPE field in the self-configuration status descriptor in the REPORT SELF-CONFIGURATION STATUS response (see Table 14).

- The SELF-CONFIGURATION LEVELS COMPLETED field indicates the number of levels of expander devices

beyond the expander port containing the specified phy for which the self-configuring expander device's management application client has completed the discover process and is defined in Table 47.

Table 47. SELF-CONFIGURATION LEVELS COMPLETED field

Code	Description
00h	The management application client: <ul style="list-style-type: none"> • Has not begun the discover process through the expander port containing the specified phy; • Has not completed the discover process through the expander port containing the specified phy; or an expander device is not attached to the expander port containing the specified phy.
01h	The management application client has completed discovery of the expander device attached to the expander port containing the specified phy (i.e., level 1).
02h	The management application client has completed discovery of the expander devices attached to the expander device attached to the expander port containing the specified phy (i.e., level 2).
...	...
FFh	The management application client has completed discovery of the expander devices attached at level 255.

NOTE: The self-configuration levels completed field does not reflect the level of externally configurable expander devices that the configuration subprocess updates to enable the discover process to proceed to higher levels.

- The SELF-CONFIGURATION SAS ADDRESS field indicates the SAS address of the SMP target port to which the self-configuring expander device established a connection or attempted to establish a connection using the specified phy and resulted in the status indicated by the SELF-CONFIGURATION STATUS field.
- The PROGRAMMED PHY CAPABILITIES field indicates the SNW-3 phy capabilities bits that are going to be transmitted in the next link reset sequence containing SNW-3.
- The CURRENT PHY CAPABILITIES field indicates the outgoing SNW-3 phy capabilities bits transmitted in the last link reset sequence. If the last link reset sequence did not include SNW-3 or was a SATA link reset sequence, then the CURRENT PHY CAPABILITIES field shall be set to 00000000h.
- The ATTACHED PHY CAPABILITIES field indicates the incoming SNW-3 phy capabilities bits received in the last SNW-3. If the last link reset sequence did not include SNW-3 or was a SATA link reset sequence, then the ATTACHED PHY CAPABILITIES field shall be set to 00000000h.
- The REASON field indicates the reason for the last reset of the phy. If the phy is a physical phy, then the REASON field indicates the value of the REASON field transmitted in the IDENTIFY address frame during the identification sequence. If the phy is a physical phy and a SATA phy is attached, then the REASON field indicates the reason for the link reset sequence.
- The NEGOTIATED PHYSICAL LINK RATE field is defined in Table 34. If the phy is a physical phy, this field indicates the physical link rate negotiated during the link reset sequence. If the phy is a virtual phy, this field should be set to the maximum physical link rate supported by the expander device. The negotiated physical link rate may be less than the programmed minimum physical link rate or greater than the programmed maximum physical link rate if the programmed physical link rates have been changed since the last link reset sequence.
- An OPTICAL MODE ENABLED bit set to one indicates that optical mode is enabled on the phy. An OPTICAL MODE ENABLED bit set to zero indicates that D.C. mode is enabled on the phy. A NEGOTIATED SSC bit set to one indicates that SSC is enabled (see SAS-3). A NEGOTIATED SSC bit set to zero indicates that SSC is disabled. The NEGOTIATED SSC bit is only valid if the NEGOTIATED PHYSICAL LINK RATE field is greater than or equal to 8h.
- A HARDWARE MUXING SUPPORTED bit set to one indicates that the phy supports multiplexing. A HARDWARE MUXING SUPPORTED bit set to zero indicates that the phy does not support multiplexing. This value is not adjusted based on the negotiated physical link rate.
- The DEFAULT INSIDE ZPSDS PERSISTENT bit contains the default value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information.

- The DEFAULT REQUESTED INSIDE ZPSDS bit contains the default value of the REQUESTED INSIDE ZPSDS bit in the zone phy information.
- The DEFAULT ZONE GROUP PERSISTENT bit contains the default value of the ZONE GROUP PERSISTENT bit in the zone phy information.
- The DEFAULT ZONING ENABLED bit contains the default value of the ZONING ENABLED bit.
- The DEFAULT ZONE GROUP field contains the default value of the ZONE GROUP field in the zone phy information.
- The SAVED INSIDE ZPSDS PERSISTENT bit contains the saved value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information.
- The SAVED REQUESTED INSIDE ZPSDS bit contains the saved value of the REQUESTED INSIDE ZPSDS bit in the zone phy information.
- The SAVED ZONE GROUP PERSISTENT bit contains the saved value of the ZONE GROUP PERSISTENT bit in the zone phy information.
- The SAVED ZONING ENABLED bit contains the saved value of the ZONING ENABLED bit.
- The SAVED ZONE GROUP field contains the saved value of the ZONE GROUP field in the zone phy information.
- The SHADOW INSIDE ZPSDS PERSISTENT bit contains the shadow value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information.
- The SHADOW REQUESTED INSIDE ZPSDS bit contains the shadow value of the REQUESTED INSIDE ZPSDS bit in the zone phy information.
- The SHADOW ZONE GROUP PERSISTENT bit contains the shadow value of the ZONE GROUP PERSISTENT bit in the zone phy information.
- The SHADOW ZONING ENABLED bit contains the shadow value of the ZONING ENABLED bit.
- The SHADOW ZONE GROUP field contains the shadow value of the ZONE GROUP field in the zone phy information.
- The DEVICE SLOT NUMBER field indicates the number of the enclosure device slot to which the phy provides access, as reported by the enclosure services process for the enclosure (see the Additional Element Status descriptor for Device Slot and Array Device Slot elements in SES-3). A DEVICE SLOT NUMBER field set to FFh indicates that no device slot number is available.
- The DEVICE SLOT GROUP NUMBER field indicates the number of the group of device slots containing the device slot indicated by the DEVICE SLOT NUMBER field. A DEVICE SLOT GROUP NUMBER field set to FFh indicates that no device slot group number is available.

NOTE: This may be the same as the Group ID reported via the SGPIO input stream from the enclosure (see SFF-8485).

- The DEVICE SLOT GROUP OUTPUT CONNECTOR field contains a left-aligned ASCII string describing the connector of the enclosure containing the management device server attached to the device slot group indicated by the DEVICE SLOT GROUP NUMBER field. A DEVICE SLOT GROUP OUTPUT CONNECTOR field set to 2020 20202020h (i.e., six space characters) indicates that no device slot group output connector information is available.
- The STP BUFFER SIZE field indicates the largest buffer size in data dwords that is supported by the phy. An STP BUFFER SIZE field set to 00h indicates unknown buffer size.

4.2.8 REPORT PHY ERROR LOG Function (11h)

The REPORT PHY ERROR LOG function returns error logging information about the specified phy. This SMP function may be implemented by any management device server.

Table 48. REPORT PHY ERROR LOG request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (11h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (00h or 02h)								
4	Reserved								
...									
8									
9	PHY IDENTIFIER								
10	Reserved								
11									
12									(MSB)
...	CRC								
15									(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 48 for the REPORT PHY ERROR LOG request.
- The FUNCTION field shall be set as shown in Table 48 for the REPORT PHY ERROR LOG request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 28 bytes defined in Table 49 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the non-zero value defined in Table 49
 And
 - Return the response frame.
- The REQUEST LENGTH field shall be set to one of the values defined in Table 48 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are two dwords before the CRC field.
- The PHY IDENTIFIER field specifies the phy for which information shall be reported.

Table 49. REPORT PHY ERROR LOG response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (11h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h or 06h)								
4	(MSB)	EXPANDER CHANGE COUNT							
5	(LSB)								
6	Reserved								
...									
8									
9	PHY IDENTIFIER								
10	Reserved								
11									
12									(MSB)
...	INVALID DWORD COUNT								
15									(LSB)
16									(MSB)

Byte\Bit	7	6	5	4	3	2	1	0
...	RUNNING DISPARITY ERROR COUNT							
19	(LSB)							
20	(MSB)	LOSS OF DWORD SYNCHRONIZATION COUNT						
...								
23	(LSB)							
24	(MSB)	PHY RESET PROBLEM COUNT						
...								
27	(LSB)							
28	(MSB)	CRC						
...								
31	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 49 for the REPORT PHY ERROR LOG response.
- The FUNCTION field shall be set as shown in Table 49 for the REPORT PHY ERROR LOG response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 49 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The PHY IDENTIFIER field indicates the phy for which information is being reported and is the same as the PHY IDENTIFIER field in the request frame.
- The INVALID DWORD COUNT field indicates the number of invalid dwords that have been received outside of phy reset sequences (i.e., between when the SP state machine sends a Phy Layer Ready (SAS) confirmation or Phy Layer Ready (SATA) confirmation and when it sends a Phy Layer Not Ready confirmation to the link layer). The count shall stop at the maximum value. The INVALID DWORD COUNT field is set to a vendor specific value after power on.
- The RUNNING DISPARITY ERROR COUNT field indicates the number of dwords containing running disparity errors that have been received outside of phy reset sequences. The count shall stop at the maximum value. The RUNNING DISPARITY ERROR COUNT field is set to a vendor specific value after power on.
- The LOSS OF DWORD SYNCHRONIZATION COUNT field indicates the number of times the phy has restarted the link reset sequence because it lost dword synchronization (i.e., the SP state machine transitioned from SP15:SAS_PHY_Ready or SP22:SATA_PHY_Ready to SP0:OOB_COMINIT). The count shall stop at the maximum value. The LOSS OF DWORD SYNCHRONIZATION COUNT field is set to a vendor specific value after power on.
- The PHY RESET PROBLEM COUNT field indicates the number of times a phy reset problem occurred. The count shall stop at the maximum value. The PHY RESET PROBLEM COUNT field is set to a vendor specific value after power on.

4.2.9 REPORT PHY SATA Function (12h)

The REPORT PHY SATA function returns information about the SATA state for a specified phy. This SMP function shall be implemented by management device servers behind SMP target ports that share SAS addresses with STP target ports and by management device servers in expander devices with STP/SATA bridges. This SMP function shall not be implemented by any other type of management device server.

Table 50. REPORT PHY SATA request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (12h)							
2	ALLOCATED RESPONSE LENGTH							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
3	REQUEST LENGTH (00h or 02h)							
4								
...	Reserved							
8								
9	PHY IDENTIFIER							
10	AFFILIATION CONTEXT							
11	Reserved							
12	(MSB)							
...	CRC							
15								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 50 for the REPORT PHY SATA request.
- The FUNCTION field shall be set as shown in Table 50 for the REPORT PHY SATA request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 56 bytes defined in 7 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the non-zero value defined in Table 51
 And
 - Return the response frame.
- The REQUEST LENGTH field shall be set to one of the values defined in Table 50 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are two dwords before the CRC field.
- The PHY IDENTIFIER field specifies the phy for which information shall be reported.
- The AFFILIATION CONTEXT field specifies the relative identifier of the affiliation context for which information shall be reported.

Table 51. REPORT PHY SATA response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (12h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h or 10h)							
4	(MSB)							
5	EXPANDER CHANGE COUNT							(LSB)
6								
...	Reserved							
8								
9	PHY IDENTIFIER							
10	Reserved							
11	Reserved				STP I_T NEXUS LOSS OCCURRED	AFFILIATIONS SUPPORTED	AFFILIATION VALID	
12								
...	Reserved							
15								
16								
...	STP SAS ADDRESS							
23								
24								
...	REGISTER DEVICE TO HOST FIS							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
43								
44								
47	Reserved							
48								
...								
55	AFFILIATED STP INITIATOR SAS ADDRESS							
56								
...								
63	STP I_T NEXUS LOSS SAS ADDRESS							
64	Reserved							
65	AFFILIATION CONTEXT							
66	CURRENT AFFILIATION CONTEXTS							
67	MAXIMUM AFFILIATION CONTEXTS							
68	(MSB)							
...								
71	CRC							
	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 51. REPORT PHY SATA response for the REPORT PHY SATA response.
 - The FUNCTION field shall be set as shown in Table 51. REPORT PHY SATA response for the REPORT PHY SATA response.
 - The RESPONSE LENGTH field shall be set to one of the values defined in Table 51. REPORT PHY SATA response based on the ALLOCATED RESPONSE LENGTH field in the request frame.
 - The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
 - The PHY IDENTIFIER field indicates the phy for which information is being reported and is the same as the PHY IDENTIFIER field in the request frame.
 - An STP I_T NEXUS LOSS OCCURRED bit set to one indicates that the STP target port encountered an I_T nexus loss in the specified affiliation context for the STP initiator port whose SAS address is indicated in the STP I_T NEXUS LOSS SAS ADDRESS field. An STP I_T NEXUS LOSS OCCURRED bit set to zero indicates that:
 - An I_T nexus loss has not occurred in the specified affiliation context.
 - An I_T nexus loss has occurred in the specified affiliation context and been cleared by the SMP PHY CONTROL function CLEAR STP I_T NEXUS LOSS phy operation (see Table 102).
- Or
- The STP target port has established a connection with the indicated STP initiator port in the specified affiliation context.
- An AFFILIATIONS SUPPORTED bit set to one indicates that the specified affiliation context is supported by the STP target port containing the specified phy. An AFFILIATIONS SUPPORTED bit set to zero indicates that the specified affiliation context is not supported by the STP target port containing the specified phy.
 - An AFFILIATION VALID bit set to one indicates that the STP target port is currently maintaining an affiliation in the specified affiliation context and the AFFILIATED STP INITIATOR SAS ADDRESS field is valid. An AFFILIATION VALID bit set to zero indicates that the STP target port is not currently maintaining an affiliation in the specified affiliation context and the AFFILIATED STP INITIATOR SAS ADDRESS field is not valid.
 - The STP SAS ADDRESS field indicates the SAS address of the STP target port that contains the specified phy.
 - The REGISTER DEVICE TO HOST FIS field indicates the contents of the initial Register - Device to Host FIS. For an STP/SATA bridge, this is delivered by the attached SATA device after a link reset sequence (see SATA). For a native STP target port in an end device, this is directly provided.
 - The FIS contents shall be stored with little-endian byte ordering (e.g., the first byte of the field (i.e., byte 24) contains the FIS Type).

- For an STP/SATA bridge, the first byte of the field (i.e., the FIS Type) shall be set to 00h on power on and whenever the phy has restarted the link reset sequence after losing dword synchronization (i.e., the SP state machine transitioned from SP22:SATA_PHY_Ready to SP0:OOB_COMINIT) to indicate that the REGISTER DEVICE TO HOST FIS field does not contain the Register - Device to Host FIS contents of the currently attached SATA device. The first byte of the field shall be set to 34h when the attached SATA device has delivered the initial Register – Device to Host FIS. The remaining contents of the REGISTER DEVICE TO HOST FIS field shall remain constant until a link reset sequence causes the attached SATA device to deliver another initial Register – Device to Host FIS.
- If the AFFILIATION VALID bit is set to one, then the AFFILIATED STP INITIATOR SAS ADDRESS field indicates the SAS address of the STP initiator port that has an affiliation in the specified affiliation context with the
- STP target port that contains the specified phy. If the AFFILIATION VALID bit is set to zero, then the AFFILIATED STP INITIATOR SAS ADDRESS field may contain the SAS address of the STP initiator port that previously had an affiliation in the specified affiliation context with the STP target port that contains the specified phy.
- The STP I_T NEXUS LOSS SAS ADDRESS field indicates the SAS address of the last STP initiator port for which the STP target port experienced an I_T nexus loss in the specified affiliation context.
- The AFFILIATION CONTEXT field indicates the relative identifier of the affiliation context for which affiliation-related information (i.e., the AFFILIATIONS SUPPORTED bit, the AFFILIATION VALID bit, the AFFILIATED STP
- INITIATOR SAS ADDRESS field, the STP I_T NEXUS LOSS OCCURRED bit, and the STP I_T NEXUS LOSS SAS ADDRESS field) is being reported and is the same as the AFFILIATION CONTEXT field in the request frame.
- The CURRENT AFFILIATION CONTEXTS field indicates the current number of affiliations established by the STP target port.
- The MAXIMUM AFFILIATION CONTEXTS field indicates the maximum number of affiliation contexts supported by the STP target port.

4.2.10 REPORT ROUTE INFORMATION Function (13h)

The REPORT ROUTE INFORMATION function returns an expander route entry from a phy-based expander route table within an expander device. This SMP function shall be supported by management device servers in expander devices if the EXPANDER ROUTE INDEXES field is set to a non-zero value in the SMP REPORT GENERAL response. This SMP function may be used as a diagnostic tool to resolve topology issues.

Table 52. REPORT ROUTE INFORMATION request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (13h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (00h or 02h)								
4	Reserved								
5	Reserved								
6	(MSB)	EXPANDER ROUTE INDEX							
7							(LSB)		
8	Reserved								
9	PHY IDENTIFIER								
10	Reserved								
11	Reserved								

12	(MSB)	CRC	(LSB)
...			
15			

- The SMP FRAME TYPE field shall be set as shown in Table 52. REPORT ROUTE INFORMATION request for the REPORT ROUTE INFORMATION request.
- The FUNCTION field shall be set as shown in Table 52. REPORT ROUTE INFORMATION request for the REPORT ROUTE INFORMATION request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 40 bytes defined in Table 53 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the non-zero value defined in Table 53
 And
 - Return the response frame.
- The REQUEST LENGTH field shall be set to one of the values defined in Table 52. REPORT ROUTE INFORMATION request based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are two dwords before the CRC field.
- The EXPANDER ROUTE INDEX field specifies the expander route index for the expander route entry being requested.
- The PHY IDENTIFIER field specifies the phy identifier of the phy for which the expander route entry is being requested.

Table 53. REPORT ROUTE INFORMATION response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (13h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h or 09h)								
4	(MSB)	EXPANDER CHANGE COUNT						(LSB)	
5									
6	(MSB)	EXPANDER ROUTE INDEX						(LSB)	
7									
8	Reserved								
9	PHY IDENTIFIER								
10	Reserved								
11									
12	EXPANDER ROUTE ENTRY DISABLED	Reserved							
13	Reserved								
...									
15									
16	ROUTED SAS ADDRESS								
...									
23									
24									Reserved
...									
39									
40	(MSB)	CRC							

Byte\Bit	7	6	5	4	3	2	1	0
...								
43								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 53 for the REPORT ROUTE INFORMATION response.
- The FUNCTION field shall be set as shown in Table 53 for the REPORT ROUTE INFORMATION response.
- The RESPONSE LENGTH field shall be set to one of the values defined in Table 53 based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The EXPANDER ROUTE INDEX field indicates the expander route index for the expander route entry being returned.
- The PHY IDENTIFIER field indicates the phy identifier for the expander route entry being returned and is the same as the PHY IDENTIFIER field in the request frame.
- The EXPANDER ROUTE ENTRY DISABLED bit indicates whether the ECM shall use the expander route entry to route connection requests. If the EXPANDER ROUTE ENTRY DISABLED bit is set to zero, then the ECM shall use the expander route entry to route connection requests. If the EXPANDER ROUTE ENTRY DISABLED bit is set to one, then the ECM shall not use the expander route entry to route connection requests. Default value for EXPANDER ROUTE ENTRY DISABLED is 1b (disabled).
- The ROUTED SAS ADDRESS field indicates the SAS address in the expander route entry.

4.2.11 REPORT PHY EVENT Function (14h)

The REPORT PHY EVENT function returns phy events concerning the specified phy. This SMP function may be implemented by any management device server.

NOTE: The REPORT PHY EVENT LIST function returns information about one or more phys.

Table 54. REPORT PHY EVENT request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (14h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (02h)							
4	Reserved							
5	Reserved							
...								
8	PHY IDENTIFIER							
9								
10	Reserved							
11								
12	(MSB)	CRC						
...								
15								

- The SMP FRAME TYPE field shall be set as shown in Table 54 for the REPORT PHY EVENT request.
- The FUNCTION field shall be set as shown in Table 54 for the REPORT PHY EVENT request.
- The REQUEST LENGTH field shall be set as shown in Table 54 for the REPORT PHY EVENT request.
- The PHY IDENTIFIER field specifies the phy for which information shall be reported.
- The PHY EVENT SOURCE field, defined in Table 55, indicates or specifies the type of phy event in the accompanying PHY EVENT field.

Table 55. PHY EVENT SOURCE field

Code	Name	Type ^a	Description
00h	No event	N/A	No event. The PHY EVENT field is not valid.
01h	Invalid dword count ^b	WC	Number of invalid dwords that have been received outside of phy reset sequences (i.e., between when the SP state machine sends a Phy Layer Ready (SAS) confirmation or Phy Layer Ready (SATA) confirmation and when it sends a Phy Layer Not Ready confirmation to the link layer).
02h	Running disparity error count ^b	WC	Number of dwords containing running disparity errors that have been received outside of phy reset sequences.
03h	Loss of dword synchronization count ^b	WC	Number of times the phy has restarted the link reset sequence because it lost dword synchronization (i.e., the SP state machine transitioned from SP15:SAS_PHY_Ready or SP22:SATA_PHY_Ready to SP0:OOB_COMINIT).
04h	Phy reset problem count ^b	WC	Number of times a phy reset problem has occurred.
20h	Received address frame error count	WC	Number of times the phy's elasticity buffer has overflowed outside of phy reset sequences (e.g., because it did not receive a sufficient number of deletable primitives).
41h	Received SSP frame count	WC	Number of SSP frames received.
43h	Received SSP frame error count	WC	Number of times the phy was used in a connection involving the SSP target port, detected an invalid SSP frame, and transmitted a NAK (CRC ERROR) (e.g., because of a CRC error).
61h	Received SMP frame count	WC	Number of SMP frames received.
63h	Received SMP frame error count	WC	Number of times the phy was used to access the SMP target port and the SMP target port detected an invalid SMP frame and transmitted a BREAK primitive sequence (e.g., because of a CRC error).

Table 56. REPORT PHY EVENT response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (14h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n - 7) / 4)							
4	(MSB)	EXPANDER CHANGE COUNT						(LSB)
5								
6								
...	Reserved							
8								
9	PHY IDENTIFIER							
10								
...	Reserved							
13								
14	PHY EVENT DESCRIPTOR LENGTH							
15	NUMBER OF PHY EVENT DESCRIPTORS							
Phy event descriptor list								
16								
...	Phy event descriptor (first) (see Table 57)							
27								
...	...							
n - 15								
...	Phy event descriptor (last) (see Table 57)							
n - 4								
n - 3	(MSB)	CRC						(LSB)
...								
n								

- The SMP FRAME TYPE field shall be set as shown in Table 56 for the REPORT PHY EVENT response.
- The FUNCTION field shall be set as shown in Table 56 for the REPORT PHY EVENT response.
- The RESPONSE LENGTH field shall be set as shown in Table 56 for the REPORT PHY EVENT response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The PHY IDENTIFIER field indicates the phy identifier of the phy for which information is being reported and is the same as the PHY IDENTIFIER field in the request frame.
- The PHY EVENT DESCRIPTOR LENGTH field indicates the length, in dwords, of the phy event descriptor.
- The NUMBER OF PHY EVENT DESCRIPTORS field indicates the number of phy event descriptors in the phy event descriptor list.
- The phy event descriptor list contains phy event descriptors as defined in Table 57.

Table 57. Phy event descriptor

Byte\Bit	7	6	5	4	3	2	1	0	
0	Reserved								
...									
2									
3	PHY EVENT SOURCE								
4	(MSB)	PHY EVENT						(LSB)	
...									
7									
8	(MSB)	PEAK VALUE DETECTOR THRESHOLD						(LSB)	
...									
11									

- The PHY EVENT SOURCE field indicates the type of phy event being reported in the PHY EVENT field.
- The PHY EVENT field indicates the value (i.e., the count or peak value detected) of the phy event indicated by the PHY EVENT SOURCE field.
- If the phy event source is a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field indicates the value of the peak value detector that causes the expander device to originate a Broadcast (Expander). If the phy event source is not a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field is reserved.

4.2.12 DISCOVER LIST Function (20h)

The DISCOVER LIST function returns information about the device (i.e., some fields from the REPORT GENERAL response) and one or more phys (i.e., some fields from the DISCOVER response). This SMP function shall be implemented by all management device servers. This function provides the necessary information in a single SMP response for a self-configuring expander device to perform the discover process and configure its own expander routing table.

Table 58. DISCOVER LIST request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (20h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (06h)							
4	Reserved							
...								
7								
8	STARTING PHY IDENTIFIER							

9	MAXIMUM NUMBER OF DISCOVER LIST DESCRIPTORS		
10	IGNORE ZONE GROUP	Reserved	PHY FILTER
11	Reserved		DESCRIPTOR TYPE
12	Reserved		
...			
15			
16	Vendor specific		
...			
27			
28	(MSB)	CRC	
...			
31	(LSB)		

- The SMP FRAME TYPE field shall be set as shown in Table 58 for the DISCOVER LIST request.
- The FUNCTION field shall be set as shown in Table 58 for the DISCOVER LIST request.
- The REQUEST LENGTH field shall be set as shown in Table 58 for the DISCOVER LIST request.
- The STARTING PHY IDENTIFIER field specifies the phy identifier of the first phy for which the information is being requested.
- The MAXIMUM NUMBER OF DISCOVER LIST DESCRIPTORS field specifies the maximum number of complete DISCOVER LIST descriptors that the management device server shall return.
- The IGNORE ZONE GROUP bit is defined in the SMP DISCOVER request.
- The PHY FILTER field is defined in Table 59 and specifies a filter limiting the phys that the management device server shall return in the DISCOVER LIST descriptor list in the DISCOVER response.

Table 59. PHY FILTER field

Code	Description
0h	All phys. If the management device server is a zoning expander device with zoning enabled and the IGNORE ZONE GROUP bit is set to zero, then for any phy that is not accessible the FUNCTION RESULT field is set to of PHY VACANT.
1h	Phys with: the ATTACHED DEVICE TYPE field set to 010b or 011b (i.e., phys attached to expander devices); and the FUNCTION RESULT field not set to PHY VACANT.
2h	Phys with: the ATTACHED DEVICE TYPE field set to a value other than 000b (i.e., phys attached to end devices or expander devices); and the FUNCTION RESULT field not set to PHY VACANT.
All others	Reserved

The DESCRIPTOR TYPE field is defined in Table 60 and specifies the DISCOVER LIST descriptor format and length.

Table 60. DESCRIPTOR TYPE field

Code	DISCOVER LIST descriptor format	Descriptor length
0h	DISCOVER response defined in Table 32, starting with byte 0 and not including the CRC field.	The length of the DISCOVER response, not including the CRC field ^a
1h	SHORT FORMAT descriptor defined in Table 62	24 bytes ^b
All others	Reserved	

^a A maximum response frame size of 1028 bytes supports eight 120-byte DISCOVER LIST descriptors containing DISCOVER responses.

^b A maximum response frame size of 1028 bytes supports 40 24-byte DISCOVER LIST descriptors containing SHORT FORMAT descriptors.

Table 61. DISCOVER LIST response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (20h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH ((n - 7) / 4)							
4	(MSB)							(LSB)
5	EXPANDER CHANGE COUNT							(LSB)
6								
7	Reserved							
8	STARTING PHY IDENTIFIER							
9	NUMBER OF DISCOVER LIST DESCRIPTORS							
10	Reserved			PHY FILTER				
11	Reserved			DESCRIPTOR TYPE				
12	DISCOVER LIST DESCRIPTOR LENGTH							
13								
...	Reserved							
15								
16	ZONING SUPPORTED	ZONING ENABLED	Reserved		SELF CONFIGURING	ZONE CONFIGURING	CONFIGURING	EXTERNALLY CONFIGURABLE ROUTE TABLE
17	Reserved							
18	(MSB)							(LSB)
19	LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX							(LSB)
20	(MSB)							(LSB)
21	LAST PHY EVENT LIST DESCRIPTOR INDEX							(LSB)
22								
...	Reserved							
31								
32								
...	Vendor specific							
47								
DISCOVER LIST descriptor list								
48	DISCOVER LIST descriptor (first) (see Table 60, and Table 61 or Table 62)							
...								
...	DISCOVER LIST descriptor (last) (see Table 60, and Table 61 or Table 62)							
n - 4								
n - 3	(MSB)							(LSB)
...								
n	CRC							(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 61 for the DISCOVER LIST response.
- The FUNCTION field shall be set as shown in Table 61 for the DISCOVER LIST response.
- The RESPONSE LENGTH field shall be set as shown in Table 61 for the DISCOVER LIST response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The STARTING PHY IDENTIFIER field indicates the phy identifier of the first phy in the DISCOVER LIST descriptor list.

NOTE: The STARTING PHY IDENTIFIER field may be different than the STARTING PHY IDENTIFIER field in the request frame due to the filter specified by the PHY FILTER field in the request frame.

- The NUMBER OF DISCOVER LIST DESCRIPTORS field indicates the number of DISCOVER LIST descriptors returned in the DISCOVER LIST descriptor list.
 - The PHY FILTER field indicates the phy filter (see Table 59) being used and is the same as the PHY FILTER field in the request frame.
 - The DISCOVER LIST DESCRIPTOR LENGTH field indicates the length, in dwords, of the DISCOVER LIST descriptor (see Table 60).
 - The PHY EVENT DESCRIPTOR LENGTH field indicates the length, in dwords, of the phy event descriptor.
 - The ZONING SUPPORTED bit is defined in the SMP REPORT GENERAL response.
 - The ZONING ENABLED bit is defined in the SMP REPORT GENERAL response.
 - The SELF CONFIGURING bit is defined in the REPORT GENERAL response.
 - The ZONE CONFIGURING bit is defined in the REPORT GENERAL response.
 - The CONFIGURING bit is defined in the REPORT GENERAL response.
 - The EXTERNALLY CONFIGURABLE ROUTE TABLE bit is defined in the SMP REPORT GENERAL response.
 - The LAST SELF-CONFIGURATION STATUS DESCRIPTOR INDEX field is defined in the REPORT SELF-CONFIGURATION STATUS response.
 - The LAST PHY EVENT LIST DESCRIPTOR INDEX field is defined in the REPORT PHY EVENT LIST response.
 - The DISCOVER LIST descriptor list contains DISCOVER LIST descriptors for each phy:
 - Starting with the phy whose phy identifier is specified in the STARTING PHY IDENTIFIER field in the request.
 - Satisfying the filter specified in the PHY FILTER field in the request (see Table 59).
 - Sorted in ascending order by phy identifier.
- And
- That is able to be included in the response frame without being truncated.
- Each DISCOVER LIST descriptor shall use the format specified in the DESCRIPTOR TYPE field in the request (see Table 60).
 - The management device server shall not include DISCOVER LIST descriptors for phys with phy identifiers greater than or equal to the NUMBER OF PHYS field reported in the SMP REPORT GENERAL response. The management device server shall not include partial DISCOVER LIST descriptors.

Table 62. SHORT FORMAT descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	PHY IDENTIFIER							
1	FUNCTION RESULT							
2	Restricted for DISCOVER response byte 12	ATTACHED DEVICE TYPE			ATTACHED REASON			
3	Restricted for DISCOVER response byte 13				NEGOTIATED LOGICAL LINK RATE			
4	Restricted for DISCOVER response byte 14				ATTACHED SSP INITIATOR	ATTACHED STP INITIATOR	ATTACHED SMP INITIATOR	ATTACHED SATA HOST
5	ATTACHED SATA PORT SELECTOR	Restricted for DISCOVER response byte 15	STP BUFFER TOO SMALL	ATTACHED SSP TARGET	ATTACHED STP TARGET	ATTACHED SMP TARGET	ATTACHED SATA DEVICE	
6	VIRTUAL PHY	Reserved			ROUTING ATTRIBUTE			
7	REASON				NEGOTIATED PHYSICAL LINK RATE			

Byte\Bit	7	6	5	4	3	2	1	0
8	ZONE GROUP							
9	Restricted for DISCOVER response byte 60	INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	Reserved	ZONE GROUP PERSISTENT	INSIDE ZPSDS	Reserved	
10	ATTACHED PHY IDENTIFIER							
11	PHY CHANGE COUNT							
12	ATTACHED SAS ADDRESS							
...								
19								
20								
...	Reserved							
23								

- The PHY IDENTIFIER field indicates the phy identifier of the phy for which information is being returned.
- The FUNCTION RESULT field indicates the value that is returned in the FUNCTION RESULT field in the SMP DISCOVER response for the specified phy (e.g., SMP FUNCTION ACCEPTED, PHY VACANT, or PHY] DOES NOT EXIST). If the FUNCTION RESULT field is set to PHY VACANT or PHY DOES NOT EXIST, then the rest of the fields in the SHORT FORMAT descriptor shall be ignored.
- The fields in the SHORT FORMAT descriptor not defined in this subclause are defined in the SMP DISCOVER response.

4.2.13 REPORT PHY EVENT LIST Function (21h)

The REPORT PHY EVENT LIST function returns phy events. This SMP function may be implemented by any management device server.

Table 63. REPORT PHY EVENT LIST request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (21h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4	Reserved							
5								
6	(MSB)	STARTING PHY EVENT LIST DESCRIPTOR INDEX						(LSB)
7								
8	(MSB)	CRC						
...								
11								
								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 63 for the REPORT PHY EVENT LIST request.
- The FUNCTION field shall be set as shown in Table 63 for the REPORT PHY EVENT LIST request.
- The REQUEST LENGTH field shall be set as shown in Table 63 for the REPORT PHY EVENT LIST request.
- The STARTING PHY EVENT LIST DESCRIPTOR INDEX field specifies the first phy event list descriptor that the management device server shall return in the SMP response frame. A STARTING PHY EVENT LIST DESCRIPTOR INDEX field set to 0000h specifies that the management device server shall return no phy event list descriptors. The requested starting index and the indicated starting index in the response may differ.

Table 64. REPORT PHY EVENT LIST response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (21h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH ((n - 7) / 4)								
4	(MSB)								
5	EXPANDER CHANGE COUNT							(LSB)	
6	(MSB)								
7	FIRST PHY EVENT LIST DESCRIPTOR INDEX							(LSB)	
8	(MSB)								
9	LAST PHY EVENT LIST DESCRIPTOR INDEX							(LSB)	
10	PHY EVENT LIST DESCRIPTOR LENGTH								
11									
...	Reserved								
14									
15	NUMBER OF PHY EVENT LIST DESCRIPTORS								
Phy event list descriptor list									
16									
...	Phy event list descriptor (first) (see Table 65)								
...	...								
...	Phy event list descriptor (last) (see Table 65)								
n - 4									
n - 3	(MSB)								
...	CRC								
n								(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 64 for the REPORT PHY EVENT LIST response.
- The FUNCTION field shall be set as shown in Table 64 for the REPORT PHY EVENT LIST response.
- The RESPONSE LENGTH field shall be set as shown in Table 64 for the REPORT PHY EVENT LIST response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The FIRST PHY EVENT LIST DESCRIPTOR INDEX field indicates the index of the first phy event list descriptor being returned. If the STARTING PHY EVENT LIST DESCRIPTOR INDEX field in the SMP request frame is set to 0000h, then the management device server shall:
 - Set the FIRST PHY EVENT LIST DESCRIPTOR INDEX field to 0000h.
 - Set the NUMBER OF PHY EVENT LIST DESCRIPTORS field to 00h.
- And
 - Return no descriptors.
- If the STARTING PHY EVENT LIST DESCRIPTOR INDEX field specified in the SMP request frame does not contain a valid descriptor, then the device management server shall set the FIRST PHY EVENT LIST DESCRIPTOR INDEX field to the next index, in ascending order wrapping from FFFFh to 0001h that contains a valid descriptor. Otherwise, this field shall be set to the same value as the STARTING PHY EVENT LIST DESCRIPTOR INDEX field in the SMP request frame.
- The PHY EVENT LIST DESCRIPTOR LENGTH field indicates the length, in dwords, of the phy event list descriptor (see Table 65).
- The LAST PHY EVENT LIST DESCRIPTOR INDEX field indicates the last index of the last recorded phy event

list descriptor.

- The NUMBER OF PHY EVENT LIST DESCRIPTORS field indicates the number of phy event list descriptors in the phy event list descriptor list.
 - The phy event list descriptor list contains phy event list descriptors. The management device server shall return either all the phy event list descriptors that fit in one SMP response frame or all the phy event list descriptors until the index indicated in the LAST PHY EVENT LIST DESCRIPTOR INDEX field is reached. The phy event list descriptor list shall start with the phy event list descriptor indicated by the FIRST PHY EVENT LIST DESCRIPTOR INDEX field, and continue with phy event list descriptors sorted in ascending order, wrapping from FFFFh to 0001h, based on the phy event list descriptor index. The phy event list descriptor list shall not contain any truncated phy event list descriptors.
- If the FIRST PHY EVENT LIST DESCRIPTOR INDEX field is equal to the LAST PHY EVENT LIST DESCRIPTOR INDEX field, then the phy event list descriptor at that index shall be returned.

Table 65. Phy event list descriptor

Byte\Bit	7	6	5	4	3	2	1	0	
0	Reserved								
1	Reserved								
2	PHY IDENTIFIER								
3	PHY EVENT SOURCE								
4	(MSB)	PHY EVENT							
...									
7	(LSB)								
8	(MSB)	PEAK VALUE DETECTOR THRESHOLD							
...									
11	(LSB)								

- The PHY IDENTIFIER field indicates the phy identifier of the phy for which information is being returned.
- The PHY EVENT SOURCE field indicates the type of phy event being reported in the PHY EVENT field.
- The PHY EVENT field indicates the value (i.e., the count or peak value detected) of the phy event indicated by the PHY EVENT SOURCE field.
- If the phy event source is a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field indicates the value of the peak value detector that causes the expander device to originate a Broadcast (Expander). If the phy event source is not a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field is reserved.

4.2.14 REPORT EXPANDER ROUTE TABLE LIST Function (22h)

The REPORT EXPANDER ROUTE TABLE LIST function returns the contents of an expander-based expander route table. The list may be in any order. Self-configuring expander devices shall support this function.

Table 66. REPORT EXPANDER ROUTE TABLE LIST request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (22h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (06h)								
4	Reserved								
...									
7									
8	(MSB)	MAXIMUM NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS							
9	(LSB)								
10	(MSB)	STARTING ROUTED SAS ADDRESS INDEX							

Byte\Bit	7	6	5	4	3	2	1	0
11	(LSB)							
12	Reserved							
...								
18								
19	STARTING PHY IDENTIFIER							
20	Reserved							
...								
27								
28	(MSB)	CRC						
...								
31	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 66 for the REPORT EXPANDER ROUTE TABLE LIST request.
- The FUNCTION field shall be set as shown in Table 66 for the REPORT EXPANDER ROUTE TABLE LIST request.
- The REQUEST LENGTH field is defined shall be set as shown in Table 66 for the REPORT EXPANDER ROUTE TABLE LIST request.
- The MAXIMUM NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS field specifies the maximum number of expander route table descriptors that the management device server shall return.
- The STARTING ROUTED SAS ADDRESS INDEX field specifies the index of the first routed SAS address that the management device server shall return in the expander route table descriptor list.
- The STARTING PHY IDENTIFIER field specifies the first phy identifier of the phy identifier bit map returned in each expander route table descriptor (see Table 68). This field should be set to a multiple of 48 (e.g., 0, 48, or 96) and shall be less than the value indicated in the NUMBER OF PHYS field in the REPORT GENERAL response.

Table 67. REPORT EXPANDER ROUTE TABLE LIST response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (22h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH $((n - 7) / 4)$							
4	(MSB)	EXPANDER CHANGE COUNT						
5	(LSB)							
6	(MSB)	EXPANDER ROUTE TABLE CHANGE COUNT						
7	(LSB)							
8	Reserved				SELF CONFIGURING	ZONE CONFIGURING	CONFIGURING	ZONING ENABLED
9	Reserved							
10	EXPANDER ROUTE TABLE DESCRIPTOR LENGTH							
11	NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS							
12	(MSB)	FIRST ROUTED SAS ADDRESS INDEX						
13	(LSB)							
14	(MSB)	LAST ROUTED SAS ADDRESS INDEX						
15	(LSB)							
16	Reserved							
...								
18								
19	STARTING PHY IDENTIFIER							
20								

Byte\Bit	7	6	5	4	3	2	1	0
...	Reserved							
31								
Expander route table descriptor list								
32	Expander route table descriptor (first) (see Table 68)							
...								
47	Expander route table descriptor (last) (see Table 68)							
...								
n - 20	Expander route table descriptor (last) (see Table 68)							
...								
n - 4	CRC							
n - 3								
...	CRC							
n								

- The SMP FRAME TYPE field shall be set as shown in Table 67 for the REPORT EXPANDER ROUTE TABLE LIST response.
- The FUNCTION field shall be set as shown in Table 67 for the REPORT EXPANDER ROUTE TABLE LIST response.
- The RESPONSE LENGTH field shall be set as shown in Table 67 for the REPORT EXPANDER ROUTE TABLE LIST response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The EXPANDER CHANGE COUNT field is defined in the SMP REPORT GENERAL response.
- The EXPANDER ROUTE TABLE CHANGE COUNT field indicates the number of times the expander route table has been modified by the self-configuring expander device. Self-configuring expander devices shall support this field. This field shall be set to at least 0001h at power on. If the self-configuring expander device modified the expander route table since responding to a previous REPORT EXPANDER ROUTE TABLE LIST request, then it shall increment this field at least once from the value in the previous REPORT EXPANDER ROUTE TABLE LIST response. This field shall wrap to at least 0001h after the maximum value (i.e., FFFFh) has been reached.

NOTE: Management application clients that use the EXPANDER ROUTE TABLE CHANGE COUNT field should read it often enough to ensure that it does not increment a multiple of 65 536 times between reading the field.

- The SELF CONFIGURING bit is defined in the REPORT GENERAL response.
- The ZONE CONFIGURING bit is defined in the REPORT GENERAL response.
- The CONFIGURING bit is defined in the REPORT GENERAL response.
- The ZONING ENABLED bit is defined in the SMP REPORT GENERAL response. A ZONING ENABLED bit set to one indicates that the ZONE GROUP field in each expander route table descriptor is valid. A ZONING ENABLED bit set to zero indicates that the ZONE GROUP field in each expander route table descriptor is not valid.
- The EXPANDER ROUTE TABLE DESCRIPTOR LENGTH field indicates the length, in dwords, of each expander route table descriptor.
- The NUMBER OF EXPANDER ROUTE TABLE DESCRIPTORS field indicates the number of expander route table descriptors in the expander route table descriptor list.
- The FIRST ROUTED SAS ADDRESS INDEX field indicates the index of the first expander route table descriptor reported in the expander route table descriptor list.
- The LAST ROUTED SAS ADDRESS INDEX field indicates the index of the last expander route table

descriptor reported in the expander route table descriptor list. The management application client may set the STARTING

- ROUTED SAS ADDRESS INDEX field in its next REPORT EXPANDER ROUTE TABLE LIST request to the value of this field plus one.
- The STARTING PHY IDENTIFIER field indicates the value of the STARTING PHY IDENTIFIER field in the request frame, rounded down to a multiple of 48.
- The expander route table descriptor list contains expander route table descriptors.
- The management device server shall return either all the expander route table descriptors that fit in one SMP response frame or all the expander route table descriptors until the index indicated in the LAST ROUTED SAS ADDRESS INDEX field is reached. The expander route table descriptor list shall start with the expander route table descriptor indicated by the FIRST ROUTED SAS ADDRESS INDEX field, and continue with expander route table descriptors sorted in a vendor specific order based on the routed SAS address index. The expander route table descriptor list shall not contain any truncated expander route table descriptors. If the FIRST ROUTED SAS ADDRESS INDEX field is equal to the LAST ROUTED SAS ADDRESS INDEX field, then the expander route table descriptor at that index shall be returned.

Table 68. Expander route table descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	ROUTED SAS ADDRESS							
...								
7								
8	(starting phy identifier + 47)						(starting phy identifier + 40)	
...	PHY BIT MAP							
13	(starting phy identifier + 7)						(starting phy identifier)	
14	Reserved							
15	ZONE GROUP							

- The ROUTED SAS ADDRESS field indicates the routed SAS address.
- The PHY BIT MAP field indicates the phy(s) to which connection requests to the SAS address indicated by the ROUTED SAS ADDRESS field may be forwarded. This field is a bit map where each bit position indicates a corresponding phy (e.g., bit zero of byte 13 indicates the phy indicated by the starting phy identifier). A bit set to one indicates that connection requests to the SAS address indicated by the ROUTED SAS ADDRESS field may be forwarded to the corresponding phy. A bit set to zero indicates that connection requests to the SAS address indicated by the ROUTED SAS ADDRESS field are not forwarded to that corresponding phy. Bits representing phys beyond the value of the NUMBER OF PHYS field reported in the REPORT GENERAL response shall be set to zero.
- The ZONE GROUP field is only valid if the ZONING ENABLED bit is set to one.

4.2.15 CONFIGURE GENERAL Function (80h)

The CONFIGURE GENERAL function requests actions by the device containing the management device server. This SMP function may be implemented by any management device server. In zoning expander devices, if zoning is enabled, then this function shall only be processed from SMP initiator ports that have access to zone group 2.

Table 69. CONFIGURE GENERAL request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (80h)							
2	ALLOCATED RESPONSE LENGTH							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
3	REQUEST LENGTH (04h)							
4	(MSB) EXPECTED EXPANDER CHANGE COUNT (LSB)							
5	(MSB) SSP MAXIMUM CONNECT TIME LIMIT (LSB)							
6	(MSB) SSP MAXIMUM CONNECT TIME LIMIT (LSB)							
7	(MSB) SSP MAXIMUM CONNECT TIME LIMIT (LSB)							
8	Reserved	UPDATE SSP TIME LIMIT	UPDATE POWER DONE TIMEOUT	UPDATE STP REJECT TO OPEN LIMIT	UPDATE INITIAL TIME TO REDUCED FUNCTIONALITY	UPDATE STP SMP I_T NEXUS LOSS TIME	UPDATE STP MAXIMUM CONNECT TIME LIMIT	UPDATE STP BUS INACTIVITY TIME LIMIT
9	Reserved							
10	(MSB) STP BUS INACTIVITY TIME LIMIT (LSB)							
11	(MSB) STP MAXIMUM CONNECT TIME LIMIT (LSB)							
12	(MSB) STP SMP I_T NEXUS LOSS TIME (LSB)							
13	(MSB) STP SMP I_T NEXUS LOSS TIME (LSB)							
14	(MSB) STP SMP I_T NEXUS LOSS TIME (LSB)							
15	(MSB) STP SMP I_T NEXUS LOSS TIME (LSB)							
16	INITIAL TIME TO REDUCED FUNCTIONALITY							
17	POWER DONE TIMEOUT							
18	(MSB) STP REJECT TO OPEN LIMIT (LSB)							
19	(MSB) STP REJECT TO OPEN LIMIT (LSB)							
20	(MSB) STP REJECT TO OPEN LIMIT (LSB)							
...	CRC							
23	(MSB) STP REJECT TO OPEN LIMIT (LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 69 for the CONFIGURE GENERAL request.
- The FUNCTION field shall be set as shown in Table 69 for the CONFIGURE GENERAL request.
- The REQUEST LENGTH field shall be set as shown in Table 69 for the CONFIGURE GENERAL request. If the management device server is not in an expander device or the EXPECTED EXPANDER CHANGE COUNT field is set to 0000h, then the EXPECTED EXPANDER CHANGE COUNT field shall be ignored. If the management device server is in an expander device and the EXPECTED EXPANDER CHANGE COUNT field is not set to 0000h, then:
 - If the EXPECTED EXPANDER CHANGE COUNT field contains the current expander change count (i.e., the value of the EXPANDER CHANGE COUNT field that is returned by an SMP REPORT GENERAL response at this time), then the management device server shall process the function

And

- If the EXPECTED EXPANDER CHANGE COUNT field does not contain the current expander change count, then the management device server shall return a function result of INVALID EXPANDER CHANGE COUNT in the response frame.
- The SSP CONNECT TIME LIMIT field specifies the maximum duration of an SSP connection in 100 μ s increments (e.g., a value of 0001h in this field means that the time is less than or equal to 100 μ s and a value of 0002h in this field means that the time is less than or equal to 200 μ s). If this time is exceeded, then the expander logical phy requests the end device close the connection. A value of 0000h in this field specifies that there is no maximum connection time limit. This value is reported in the SSP CONNECT TIME LIMIT field in the SMP REPORT GENERAL response. For expander logical phys the maximum connection time limit is enforced by the expander link layer.
- An UPDATE SSP TIME LIMIT bit set to one specifies that the SSP CONNECT TIME LIMIT field shall be honored. An UPDATE SSP TIME LIMIT bit set to zero specifies that the SSP CONNECT TIME LIMIT field shall be ignored.
- An UPDATE POWER DONE TIMEOUT bit set to one specifies that the POWER DONE TIMEOUT field shall

be honored.

- An UPDATE POWER DONE TIMEOUT bit set to zero specifies that the POWER DONE TIMEOUT field shall be ignored.
- An UPDATE STP REJECT TO OPEN LIMIT bit set to one specifies that the STP REJECT TO OPEN LIMIT field shall be honored.
- An UPDATE STP REJECT TO OPEN LIMIT bit set to zero specifies that the STP REJECT TO OPEN LIMIT field shall be ignored.
- An UPDATE INITIAL TIME TO REDUCED FUNCTIONALITY bit set to one specifies that the INITIAL TIME TO REDUCED FUNCTIONALITY field shall be honored. An UPDATE INITIAL TIME TO REDUCED FUNCTIONALITY bit set to zero specifies that the INITIAL TIME TO REDUCED FUNCTIONALITY field shall be ignored.
- An UPDATE STP BUS INACTIVITY TIME LIMIT bit set to one specifies that the STP BUS INACTIVITY LIMIT field shall be honored. An UPDATE STP BUS INACTIVITY TIME LIMIT bit set to zero specifies that the STP BUS INACTIVITY LIMIT field shall be ignored.
- An UPDATE STP MAXIMUM CONNECT TIME LIMIT bit set to one specifies that the STP CONNECT TIME LIMIT field shall be honored. An UPDATE STP MAXIMUM CONNECT TIME LIMIT bit set to zero specifies that the STP CONNECT TIME LIMIT field shall be ignored.
- An UPDATE STP SMP I_T NEXUS LOSS TIME bit set to one specifies that the STP SMP I_T NEXUS LOSS TIME field shall be honored. An UPDATE STP SMP I_T NEXUS LOSS TIME bit set to zero specifies that the STP SMP I_T NEXUS LOSS TIME field shall be ignored.
- The STP BUS INACTIVITY LIMIT field specifies the maximum time, in 100 μs increments, that an STP target port is permitted to maintain a connection while transmitting and receiving SATA_SYNC. When this time is exceeded, the STP target port shall close the connection. A value of 0000h in this field specifies that there is no bus inactivity time limit. This value is reported in the STP BUS INACTIVITY LIMIT field in the SMP REPORT GENERAL response. The bus inactivity time limit is enforced by the port layer.
- The STP CONNECT TIME LIMIT field specifies the maximum duration of a connection in 100 μs increments (e.g., a value of 0001h in this field means that the time is less than or equal to 100 μs and a value of 0002h in this field means that the time is less than or equal to 200 μs). When this time is exceeded, the STP target port shall close the connection at the next opportunity. If the STP target port is transferring a frame when the maximum connection time limit is exceeded, then the STP target port shall complete transfer of the frame before closing the connection. A value of 0000h in this field specifies that there is no maximum connection time limit. This value is reported in the STP CONNECT TIME LIMIT field in the SMP REPORT GENERAL response. The maximum connection time limit is enforced by the port layer.
- The STP SMP I_T NEXUS LOSS TIME field specifies the minimum time that an STP target port or SMP initiator port shall retry connection requests that are rejected with responses indicating the destination port may no longer be present before recognizing an I_T nexus loss.
- An STP initiator port or an SMP initiator port should retry connection requests for at least the time indicated by the STP SMP I_T NEXUS LOSS TIME field in the SMP REPORT GENERAL response for the STP target port to which it is trying to establish a connection.
- Table 70 defines the values of the STP SMP I_T NEXUS LOSS TIME field. This value is enforced by the port layer.

T

Table 70. STP SMP I_T NEXUS LOSS TIME field

Code ^a	Description
0000h	Vendor specific amount of time.
0001h to FFFEh	Time in one millisecond increments.
FFFFh	The port shall never recognize an I_T nexus loss (i.e., it shall retry the connection requests forever).

^a The default value of the STP SMP I_T NEXUS LOSS TIME field should be non-zero. It is recommended that this value be 07D0h (i.e., 2 000 ms).

- The INITIAL TIME TO REDUCED FUNCTIONALITY field specifies the minimum time, in 100 ms increments, that an expander device shall wait from originating a Broadcast (Expander) to reducing functionality. This value is reported in the INITIAL TIME TO REDUCED FUNCTIONALITY field in the SMP REPORT GENERAL response.
- The POWER DONE TIMEOUT field specifies the maximum time, in one second increments, that a management application layer allows a power consumer device to consume additional power. This value is reported in the POWER DONE TIMEOUT field in the SMP REPORT GENERAL response. A POWER DONE TIMEOUT field set to 00h specifies that the time limit shall not be changed from the current value. A POWER DONE TIMEOUT field set to FFh specifies that the time limit is vendor specific. The power done timeout limit is enforced by the management application layer.
- The STP REJECT TO OPEN LIMIT field specifies the minimum time, in 10 μ s increments, that an STP port shall wait to establish a connection request with an initiator port on an I_T nexus after receiving an OPEN_REJECT (RETRY), OPEN_REJECT (RESERVED CONTINUE 0), or OPEN_REJECT (RESERVED CONTINUE 1). This value may be rounded as defined in SPC-4. An STP REJECT TO OPEN LIMIT field set to 0000h specifies that the minimum time is vendor specific. This minimum time is enforced by the port layer. This value is reported in the STP REJECT TO OPEN LIMIT field in the SMP REPORT GENERAL response.

Table 71. CONFIGURE GENERAL response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (80h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)								
...	CRC								
7								(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 71 for the CONFIGURE GENERAL response.
- The FUNCTION field shall be set as shown in Table 71 for the CONFIGURE GENERAL response.
- The RESPONSE LENGTH field shall be set as shown in Table 71 for the CONFIGURE GENERAL response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.16 ENABLE DISABLE ZONING Function (81h)

The ENABLE DISABLE ZONING function enables or disables zoning. This SMP function shall be supported by SMP target ports in zoning expander devices. Other SMP target ports shall not support this SMP function. This function is an SMP zone configuration function.

SMP zone configuration functions change the zoning expander shadow values, which do not become zoning expander current values until the activate step.

Table 72. ENABLE DISABLE ZONING request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (81h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (02h)								
4	(MSB)								
5	EXPECTED EXPANDER CHANGE COUNT							(LSB)	
6	Reserved						SAVE		
7	Reserved								

8	Reserved	ENABLE DISABLE ZONING
9	Reserved	
...		
11		
12	(MSB)	
...	CRC	
15		(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 72 for the ENABLE DISABLE ZONING request.
- The FUNCTION field shall be set as shown in Table 72 for the ENABLE DISABLE ZONING request.
- The REQUEST LENGTH field shall be set as shown in Table 72 for the ENABLE DISABLE ZONING request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the CONFIGURE GENERAL request.
- The SAVE field specifies whether the management device server shall apply the specified changes to the shadow value and/or the saved value of the zoning enabled setting and is defined in Table 73.

Table 73. SAVE field

Code	Values updated	Return function result of SAVING NOT SUPPORTED if saving is not supported
00b	Shadow	no
01b	Saved ^a	yes
10b	Saved ^a , if saving is supported, and shadow.	no
11b	Saved ^a and shadow.	yes

^a Saving only begins during the activate step. The management device server shall return the function result without waiting for the save to complete, and set the SAVING bit to one in the REPORT GENERAL response until the save is complete.

Table 74. ENABLE DISABLE ZONING field

Code	Description
00b	No change
01b	Enable zoning
10b	Disable zoning
11b	Reserved

If the ENABLE DISABLE ZONING field is set to 11b (i.e., reserved), then the management device server shall return a function result of UNKNOWN ENABLE DISABLE ZONING VALUE in the response frame.

Table 75. ENABLE DISABLE ZONING response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (81h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 75 for the ENABLE DISABLE ZONING response.
- The FUNCTION field shall be set as shown in Table 75 for the ENABLE DISABLE ZONING response.
- The RESPONSE LENGTH field shall be set as shown in Table 75 for the ENABLE DISABLE ZONING response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.17 ZONED BROADCAST Function (85h)

This SMP ZONED BROADCAST function shall be supported by management device servers in zoning expander devices. Other management device servers shall not support this SMP function. This SMP function shall only be processed from SMP initiator ports that have access to zone group 3.

Table 76. ZONED BROADCAST request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (85h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH ((N - 7) / 4)							
4	RESTRICTED (FOR AN EXPECTED EXPANDER CHANGE COUNT FIELD)							
5	RESERVED							
6	RESERVED				BROADCAST TYPE			
7	NUMBER OF BROADCAST SOURCE ZONE GROUPS							
BROADCAST SOURCE ZONE GROUP LIST								
8	BROADCAST SOURCE ZONE GROUP (FIRST)							
...	...							
	BROADCAST SOURCE ZONE GROUP (LAST)							
PAD (IF NEEDED)								
...								
n - 4								
n - 3	(MSB)							
...	CRC							
n	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 76 for the ZONED BROADCAST request.
- The FUNCTION field shall be set as shown in Table 76 for the ZONED BROADCAST request.
- The REQUEST LENGTH field shall be set as shown in Table 76 for the ZONED BROADCAST request.
- The BROADCAST TYPE field specifies the type of Broadcast that shall be forwarded and is defined in Table 77.

Table 77. BROADCAST TYPE field

Code	Description
0000b	Broadcast (Change)
0001b	Broadcast (Reserved Change 0)
0010b	Broadcast (Reserved Change 1)
0011b	Broadcast (SES)
0100b	Broadcast (Expander)
0101b	Broadcast (Asynchronous Event)
0110b	Broadcast (Reserved 3)
0111b	Broadcast (Reserved 4)
1000b	Broadcast (Zone Activate)
All others	Reserved for Broadcasts only supported by the ZONED BROADCAST function

- The NUMBER OF BROADCAST SOURCE ZONE GROUPS field specifies the number of zone groups to which the specified Broadcast is to be forwarded.
- The Broadcast source zone group list contains BROADCAST SOURCE ZONE GROUP fields. The Broadcast source zone group list shall contain no more than one entry for each source zone group.
- Each BROADCAST SOURCE ZONE GROUP field specifies a source zone group for the Broadcast. The expander device forwards the Broadcast to each destination zone group accessible to that source zone group.
- The PAD field contains zero, one, two, or three bytes set to 00h such that the total length of the SMP request frame is a multiple of four bytes.

Table 78. ZONED BROADCAST response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (85h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 78 for the ZONED BROADCAST response.
- The FUNCTION field shall be set as shown in Table 78 for the ZONED BROADCAST response.
- The RESPONSE LENGTH field shall be set as shown in Table 78 for the ZONED BROADCAST response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.18 ZONE LOCK Function (86h)

The ZONE LOCK function locks a zoning expander device to provide exclusive access to SMP zone configuration functions for one zone manager. All zoning expander devices shall support this function. If:

- The ZONING ENABLED bit is set to one, the ZONE LOCKED bit is set to zero in the REPORT GENERAL response, and the SMP initiator port has access to zone group 2;
- The ZONE LOCKED bit is set to zero in the REPORT GENERAL response, and the PHYSICAL PRESENCE ASSERTED bit is set to one in the REPORT GENERAL response;
- The ZONE LOCKED bit is set to zero in the REPORT GENERAL response, and the request contains the correct zone manager password

Or

- The ZONE LOCKED bit is set to one in the REPORT GENERAL response, and the request originated from the active zone manager,

Then the management device server shall:

- Set the ACTIVE ZONE MANAGER SAS ADDRESS field to the SAS address of the SMP initiator port in the ZONE LOCK response and the REPORT GENERAL response

And

- Set the ZONE LOCKED bit to one in the REPORT GENERAL response, otherwise the management device server shall return a function result of NO MANAGEMENT ACCESS RIGHTS.
- When the management device server changes the ZONE LOCKED bit from zero to one, the locked zoning expander device sets the zoning expander shadow values equal to the zoning expander current values.

Table 79. ZONE LOCK request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (86h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (09h)							
4	(MSB)							
5	EXPECTED EXPANDER CHANGE COUNT (LSB)							
6	(MSB)							
7	ZONE LOCK INACTIVITY TIME LIMIT (LSB)							
8	(MSB)							
...	ZONE MANAGER PASSWORD							

Byte\Bit	7	6	5	4	3	2	1	0
39								(LSB)
40	(MSB)							
...	CRC							
43								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 79 for the ZONE LOCK request.
- The FUNCTION field shall be set as shown in Table 79 for the ZONE LOCK request.
- The REQUEST LENGTH field shall be set as shown in Table 79 for the ZONE LOCK request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the CONFIGURE GENERAL request.
- The ZONE LOCK INACTIVITY TIME LIMIT field specifies the minimum time that the locked expander device shall allow between any SMP zone configuration function requests or SMP ZONE LOCK requests from the active zone manager (i.e., the maximum time that a zone manager may allow to pass without accessing the locked expander device) and is reported in the SMP REPORT GENERAL response. This field specifies the number of 100 ms increments that a locked zoning expander device shall remain locked without processing any SMP zone configuration function or SMP ZONE LOCK function (e.g., a value of 0001h in this field means that the time is less than or equal to 100 ms and a value of 0002h in this field means that the time is less than or equal to 200 ms). A value of 0000h in this field specifies that there is no zone lock inactivity time limit (i.e., the zone lock inactivity timer is disabled).
- The ZONE MANAGER PASSWORD field specifies a password used to allow permission to lock without physical presence being asserted.

Table 80. ZONE LOCK response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (86h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (03h)								
4	Reserved								
...									
7									
8	ACTIVE ZONE MANAGER SAS ADDRESS								
...									
15									
16	(MSB)	CRC							
...									
19									(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 80 for the ZONE LOCK response.
- The FUNCTION field shall be set as shown in Table 80 for the ZONE LOCK response.
- The RESPONSE LENGTH field shall be set as shown in Table 80 for the ZONE LOCK response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.
- The ACTIVE ZONE MANAGER SAS ADDRESS field is defined in the REPORT GENERAL response.

4.2.19 ZONE ACTIVATE Function (87h)

The ZONE ACTIVATE function causes the zoning expander device to set the zoning expander current values equal to the zoning expander shadow values. All zoning expander devices shall support this function. This function is an SMP zone configuration function.

Table 81. ZONE ACTIVATE request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (87h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (01h)								
4	(MSB)								
5	EXPECTED EXPANDER CHANGE COUNT							(LSB)	
6									
7	Reserved								
8	(MSB)								
...									
11	CRC							(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 81 for the ZONE ACTIVATE request.
- The FUNCTION field shall be set as shown in Table 81 for the ZONE ACTIVATE request.
- The REQUEST LENGTH field shall be set as shown in Table 81 for the ZONE ACTIVATE request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the CONFIGURE GENERAL request.

Table 82. ZONE ACTIVATE response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (87h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)								
...									
7	CRC							(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 82 for the ZONE ACTIVATE response.
- The FUNCTION field shall be set as shown in Table 82 for the ZONE ACTIVATE request.
- The RESPONSE LENGTH field shall be set as shown in Table 82 for the ZONE ACTIVATE request. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.20 ZONE UNLOCK Function (88h)

The ZONE UNLOCK function unlocks a zoning expander device. All zoning expander devices shall support this function. This function is an SMP zone configuration function.

If a locked zoning expander device processes a ZONE UNLOCK request from the active zone manager then the management device server shall set the ZONE LOCKED bit to zero in the REPORT GENERAL response.

Table 83. ZONE UNLOCK request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (88h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (01h)							
4								
5	Restricted (for an EXPECTED EXPANDER CHANGE COUNT field)							
6	Reserved							ACTIVATE REQUIRED

Byte\Bit	7	6	5	4	3	2	1	0
7	Reserved							
8	(MSB)							
...	CRC							
11	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 83 for the ZONE UNLOCK request.
- The FUNCTION field shall be set as shown in Table 83 for the ZONE UNLOCK request.
- The REQUEST LENGTH field shall be set as shown in Table 83 for the ZONE UNLOCK request.
- An ACTIVATE REQUIRED bit set to one specifies that the management device server shall unlock the zoning expander device only if the activate step has been completed. An ACTIVATE REQUIRED bit set to zero specifies that the management device server shall unlock the zoning expander device regardless of whether the activate step has been completed.

Table 84. ZONE UNLOCK response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (88h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 84 for the ZONE UNLOCK response.
- The FUNCTION field shall be set as shown in Table 84 for the ZONE UNLOCK response.
- The RESPONSE LENGTH field shall be set as shown in Table 84 for the ZONE UNLOCK response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.21 CONFIGURE ZONE MANAGER PASSWORD Function (89h)

The CONFIGURE ZONE MANAGER PASSWORD function configures the zone manager password. This SMP function may be supported by a management device server in a zoning expander device.

Other management device servers shall not support this SMP function. This SMP function shall only be processed if the request is received from any:

- SMP initiator port and specifies the correct zone manager password
- Or
- SMP initiator port while physical presence is asserted.

Table 85. CONFIGURE ZONE MANAGER PASSWORD request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (89h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (11h)							
4	(MSB)							
5	EXPECTED EXPANDER CHANGE COUNT							
6	Reserved						SAVE	
7	Reserved							
8	(MSB)							
...	ZONE MANAGER PASSWORD							
	(LSB)							

39		(LSB)
40	(MSB)	
...		
71		(LSB)
72	(MSB)	
...		
75		(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 85 for the CONFIGURE ZONE MANAGER PASSWORD request.
- The FUNCTION field shall be set as shown in Table 85 for the CONFIGURE ZONE MANAGER PASSWORD request.
- The REQUEST LENGTH field shall be set as shown in Table 85 for the CONFIGURE ZONE MANAGER PASSWORD request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the CONFIGURE GENERAL request.
- The SAVE field specifies whether the management device server shall apply the specified changes to the current value and/or the saved value of the zone manager password and is defined in Table 86.

Table 86. SAVE field

Code	Values updated	Return function result of SAVING NOT SUPPORTED if saving is not supported
00b	Current ^a	No
01b	Saved ^b	Yes
10b	Saved ^b , if saving is supported, and current	no
11b	Saved ^b and current	yes

^a The CONFIGURE ZONE PASSWORD function updates the current zone manager password, not a shadow zone manager password.

^b The management device server shall return the function result without waiting for the save to complete, and set the SAVING bit to one in the REPORT GENERAL response until the save is complete.

- If physical presence is not asserted and the ZONE MANAGER PASSWORD field does not match the current zone manager password maintained by the management device server, then the management device server shall return a function result of NO MANAGEMENT ACCESS RIGHTS in the response frame.
- The NEW ZONE MANAGER PASSWORD field specifies a new value for the zone manager password maintained by the management device server. A NEW ZONE MANAGER PASSWORD field set to ZERO specifies that the zone manager password is disabled and all zone managers have access. A NEW ZONE MANAGER PASSWORD field set to DISABLED specifies that the zone manager password is disabled and access shall only be allowed if physical presence is asserted. If the expander device does not support a zone manager password of DISABLED, then the management device server shall return a function result of DISABLED PASSWORD NOT SUPPORTED in the response frame.

Table 87. CONFIGURE ZONE MANAGER PASSWORD response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (89h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...								
7								(LSB)

- The SMP FRAME TYPE field shall be set as shown in Table 87 for the CONFIGURE ZONE MANAGER PASSWORD response.
- The FUNCTION field shall be set as shown in Table 87 for the CONFIGURE ZONE MANAGER PASSWORD response.

- The RESPONSE LENGTH field shall be set as shown in Table 87 for the CONFIGURE ZONE MANAGER PASSWORD response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.22 CONFIGURE ZONE PHY INFORMATION Function (8Ah)

The CONFIGURE ZONE PHY INFORMATION function configures zone phy information for one or more phys in a locked zoning expander device. This function shall be supported by all zoning expander devices. This function is an SMP zone configuration function.

SMP zone configuration functions change the zoning expander shadow values, which do not become zoning expander current values until the activate step.

Table 88. CONFIGURE ZONE PHY INFORMATION request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (8Ah)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH ((n - 7) / 4)							
4	(MSB)	EXPECTED EXPANDER CHANGE COUNT						(LSB)
5								
6	ZONE PHY CONFIGURATION DESCRIPTOR LENGTH						SAVE	
7	NUMBER OF ZONE PHY CONFIGURATION DESCRIPTORS							
Zone phy configuration descriptor list								
8								
...	Zone phy configuration descriptor (first) (see Table 90)							
11								
...	...							
n - 7								
...	Zone phy configuration descriptor (last) (see Table 90)							
n - 4								
n - 3	(MSB)	CRC						(LSB)
...								
n								

- The SMP FRAME TYPE field shall be set as shown in Table 88 for the CONFIGURE ZONE PHY INFORMATION request.
- The FUNCTION field shall be set as shown in Table 88 for the CONFIGURE ZONE PHY INFORMATION request.
- The REQUEST LENGTH field shall be set as shown in Table 88 for the CONFIGURE ZONE PHY INFORMATION request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- The ZONE PHY CONFIGURATION DESCRIPTOR LENGTH field indicates the length, in dwords, of the zone phy configuration descriptor.
- The SAVE field specifies whether the management device server shall apply the specified changes to the shadow value and/or the saved value of the zone phy information and is defined in Table 89.

Table 89. SAVE field

Code	Values updated	Return function result of SAVING NOT SUPPORTED if saving is not supported
00b	Shadow	no
01b	Saved ^a	yes

10b	Saved ^a , if saving is supported, and shadow	no
11b	Saved ^a and shadow	yes
^a Saving only begins during the activate step. The management device server shall return the function result without waiting for the save to complete, and set the SAVING bit to one in the REPORT GENERAL response until the save is complete.		

- The NUMBER OF ZONE PHY CONFIGURATION DESCRIPTORS field specifies the number of zone phy configuration descriptors in the zone phy configuration descriptor list.
- The zone phy configuration descriptor list contain a zone phy configuration descriptors for each expander phy in the expander device. The zone phy configuration descriptor list shall contain no more than one zone phy configuration descriptor with the same value in the PHY IDENTIFIER field.

NOTE: Because the maximum number of response bytes is 1023 bytes, the length of the header is 8 bytes, and the length of the zone phy configuration descriptor is 4 bytes, the zone phy configuration descriptor list has a maximum of 254 entries.

Table 90. Zone phy configuration descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	PHY IDENTIFIER							
1	Reserved		INSIDE ZPSDS PERSISTENT	REQUESTED INSIDE ZPSDS	Reserved	ZONE GROUP PERSISTENT	Reserved	
2	Reserved							
3	ZONE GROUP							

- The PHY IDENTIFIER field specifies the phy to which the zone phy configuration descriptor information shall be applied.
- The INSIDE ZPSDS PERSISTENT bit specifies the value of the INSIDE ZPSDS PERSISTENT bit in the zone phy information.
- The REQUESTED INSIDE ZPSDS bit specifies the value of the REQUESTED INSIDE ZPSDS bit in the zone phy information.
- The ZONE GROUP PERSISTENT bit specifies the value of the ZONE GROUP PERSISTENT bit in the zone phy information.
- The ZONE GROUP field specifies the value of the ZONE GROUP field in the zone phy information.

Table 91. CONFIGURE ZONE PHY INFORMATION response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (8Ah)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 91 for the CONFIGURE ZONE PHY INFORMATION response.
- The FUNCTION field shall be set as shown in Table 91 for the CONFIGURE ZONE PHY INFORMATION response.
- The RESPONSE LENGTH field shall be set as shown in Table 91 for the CONFIGURE ZONE PHY INFORMATION response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.23 CONFIGURE ZONE PERMISSION TABLE Function (8Bh)

The CONFIGURE ZONE PERMISSION TABLE function configures the zone permission table. This function shall be supported by all zoning expander devices. This function is an SMP zone configuration function.

SMP zone configuration functions change the zoning expander shadow values, which do not become zoning expander current values until the zoning expander device processes the activate step.

Table 92. CONFIGURE ZONE PERMISSION TABLE request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (8Bh)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH ((n - 7) / 4)							
4	(MSB)	EXPECTED EXPANDER CHANGE COUNT						(LSB)
5								
6	STARTING SOURCE ZONE GROUP							
7	NUMBER OF ZONE PERMISSION CONFIGURATION DESCRIPTORS							
8	NUMBER OF ZONE GROUPS	Reserved					SAVE	
9	ZONE PERMISSION CONFIGURATION DESCRIPTOR LENGTH							
10								
...	Reserved							
15								
Zone permission configuration descriptor list								
16								
...	Zone permission configuration descriptor (first) (see Table 96)							
31 or 47								
...	...							
(n - 20) or (n - 36)	Zone permission configuration descriptor (last) (see Table 96)							
...								
n - 4								
n - 3	(MSB)	CRC						(LSB)
...								
n								

- The SMP FRAME TYPE field shall be set as shown in Table 92 for the CONFIGURE ZONE PERMISSION TABLE request.
- The FUNCTION field shall be set as shown in Table 92 for the CONFIGURE ZONE PERMISSION TABLE request.
- The REQUEST LENGTH field shall be set as shown in Table 92 for the CONFIGURE ZONE PERMISSION TABLE request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- The STARTING SOURCE GROUP field specifies the first source zone group (i.e., s) to be written with the first zone permission configuration descriptor.
- The NUMBER OF ZONE PERMISSION CONFIGURATION DESCRIPTORS field specifies the number of zone permission configuration descriptors in the zone permission configuration descriptor list.
- The NUMBER OF ZONE GROUPS field specifies the number of elements in each zone permission configuration descriptor and is defined in Table 93.

Table 93. NUMBER OF ZONE GROUPS field

Code	Description
00b	128 zone groups
01b	256 zone groups (Default)
All others	Reserved

The SAVE field specifies whether the management device server shall apply the specified changes to the shadow value and/or the saved value of the zone permission table and is defined in Table 94.

Table 94. SAVE field

Code	Values updated	Return function result of SAVING NOT SUPPORTED if saving is not supported
00b	Shadow	no
01b	Saved ^a	yes
10b	Saved ^a , if saving is supported, and shadow	no
11b	Saved ^a and shadow	yes

^a Saving only begins during the activate step. The management device server shall return the function result without waiting for the save to complete, and set the SAVING bit to one in the REPORT GENERAL response until the save is complete.

- The ZONE PERMISSION CONFIGURATION DESCRIPTOR LENGTH field indicates the length, in dwords, of the zone permission configuration descriptor.
- The zone permission configuration descriptor list contains a zone permission configuration descriptor as defined in for each source zone group in ascending order starting with the source zone group specified in the STARTING SOURCE GROUP field. The management device server shall process the zone permission configuration descriptors in order (i.e., a subsequent zone permission configuration descriptor overrides a previous zone permission configuration descriptor).
- The zone permission configuration descriptor format is based on the NUMBER OF ZONE GROUPS field as defined in Table 95.

Table 95. Zone permission configuration descriptors

NUMBER OF ZONE GROUPS field	Zone permission configuration descriptor format
00b	
01b	Table 96
All others	Reserved

Table 96 defines the zone permission configuration descriptor for a source zone group (i.e., s) containing 256 zone groups.

Table 96. Zone permission configuration descriptor for source zone group for 256 zone groups

Byte\Bit	7	6	5	4	3	2	1	0
0	ZP[s, 255]	ZP[s, 254]	ZP[s, 253]	ZP[s, 252]	ZP[s, 251]	ZP[s, 250]	ZP[s, 249]	ZP[s, 248]
...	...							
31	ZP[s, 7] (ignored)	ZP[s, 6] (ignored)	ZP[s, 5] (ignored)	ZP[s, 4] (ignored)	ZP[s, 3]	ZP[s, 2]	ZP[s, 1] (ignored)	ZP[s, 0] (ignored)

- The zone permission configuration descriptor contains all of the zone permission table entries for the source zone group (i.e., s). To preserve symmetry about the ZP[s, s] table axis, the management device server shall apply the same value to both the source and destination zone groups for the zone permission entries.
- Table 97 defines how the zone permission descriptor bits shall be set by the management application client and processed by the management device server.

Table 97. Zone permission configuration descriptor bit requirements

Source zone group (i.e., s)	Management application client requirement(s) ^a	Management device server requirement(s) ^a
0	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 2 to (z-1)] shall be set to zero.	ZP[s, 0 to (z-1)] shall be ignored.
1	ZP[s, 0 to (z-1)] shall be set to one.	ZP[s, 0 to (z-1)] shall be ignored.

Source zone group (i.e., s)	Management application client requirement(s) ^a	Management device server requirement(s) ^a
4, 5, 6, or 7	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 4 to (z-1)] shall be set to zero.	ZP[s, 0 to (z-1)] shall be ignored.
2, 3, or 8 to (z-1) ^a	ZP[s, 0] shall be set to zero. ZP[s, 1] shall be set to one. ZP[s, 2 to 3] may be set to zero or one. ZP[s, 4 to 7] shall be set to zero. ZP[s, 8 to (z-1)] may be set to zero or one.	ZP[s, 0 to 1] shall be ignored. ZP[s, 2 to 3] shall be processed. ZP[s, 4 to 7] shall be ignored. ZP[s, 8 to (z-1)] shall be processed. For each source zone group t other than s, ZP[t, s] shall be set to ZP[s, t].
^a The number of zone groups (i.e., z) is specified in NUMBER OF ZONE GROUPS field.		

Table 98. CONFIGURE ZONE PERMISSION TABLE response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (8Bh)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 98 for the CONFIGURE ZONE PERMISSION TABLE response.
- The FUNCTION field shall be set as shown in Table 98 for the CONFIGURE ZONE PERMISSION TABLE response.
- The RESPONSE LENGTH field shall be set as shown in Table 98 for the CONFIGURE ZONE PERMISSION TABLE response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

4.2.24 CONFIGURE ROUTE INFORMATION Function (90h)

The CONFIGURE ROUTE INFORMATION function sets an expander route entry within the expander route table of a configurable expander device. This SMP function shall be supported by management device servers in expander devices if the CONFIGURABLE ROUTE TABLE field is set to one in the SMP REPORT GENERAL response. Other management device servers shall not support this SMP function.

Table 99. CONFIGURE ROUTE INFORMATION request

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (40h)							
1	FUNCTION (90h)							
2	ALLOCATED RESPONSE LENGTH							
3	REQUEST LENGTH (00h or 09h)							
4	(MSB)							
5	EXPECTED EXPANDER CHANGE COUNT							
6	(MSB)							
7	EXPANDER ROUTE INDEX							
8	Reserved							
9	PHY IDENTIFIER							
10	Reserved							

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
11								
12	DISABLE EXPANDER ROUTE ENTRY	Reserved						
13	Reserved							
...								
15	ROUTED SAS ADDRESS							
16								
...	Reserved							
23								
24	Reserved							
...								
39	(MSB)							
40								
...	CRC							(LSB)
43								

- The SMP FRAME TYPE field shall be set as shown in Table 99 for the CONFIGURE ROUTE INFORMATION request.
- The FUNCTION field shall be set as shown in Table 99 for the CONFIGURE ROUTE INFORMATION request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 4 bytes defined in Table 100 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the value defined in Table 100 (i.e., 00h)
 And
 - Return the response frame.

NOTE: Future versions of this standard may change the value defined in Table 100.

- The REQUEST LENGTH field shall be set to one of the values defined in Table 99 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are 9 dwords before the CRC field.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- The EXPANDER ROUTE INDEX field specifies the expander route index for the expander route entry being configured.
- The PHY IDENTIFIER field specifies the phy identifier of the phy for which the expander route entry is being configured.
- The DISABLE EXPANDER ROUTE ENTRY bit specifies whether the ECM shall use the expander route entry to route connection requests. If the DISABLE EXPANDER ROUTE ENTRY bit is set to zero, then the ECM shall use the expander route entry to route connection requests. If the DISABLE EXPANDER ROUTE ENTRY bit is set to one, then the ECM shall not use the expander route entry to route connection requests.
- The ROUTED SAS ADDRESS field specifies the SAS address for the expander route entry being configured.

Table 100. CONFIGURE ROUTE INFORMATION response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (90h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)								
...	CRC								
7								(LSB)	

- The FUNCTION field shall be set as shown in Table 100 for the CONFIGURE ROUTE INFORMATION response.
- The RESPONSE LENGTH field shall be set as shown in Table 100 for the CONFIGURE ROUTE INFORMATION response.

4.2.25 PHY CONTROL Function (91h)

The PHY CONTROL function requests actions by the specified phy. This SMP function may be implemented by any management device server. In zoning expander devices, if zoning is enabled, then this function shall only be processed from SMP initiator ports that have access to zone group 2 or the zone group of the specified phy.

Table 101. PHY CONTROL request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (91h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (00h or 09h)								
4	(MSB)								
5	EXPECTED EXPANDER CHANGE COUNT							(LSB)	
6									
...	Reserved								
8									
9	PHY IDENTIFIER								
10	PHY OPERATION								
11	Reserved							UPDATE PARTIAL PATHWAY TIMEOUT VALUE	
12									
...	Reserved								
23									
24									
...	ATTACHED DEVICE NAME								
31									
32	PROGRAMMED MINIMUM PHYSICAL LINK RATE				Reserved				
33	PROGRAMMED MAXIMUM PHYSICAL LINK RATE				Reserved				
34	ENABLE SAS SLUMBER		ENABLE SAS PARTIAL		ENABLE SATA SLUMBER		ENABLE SATA PARTIAL		
35	PWR_DIS CONTROL		Reserved						
36	Reserved				PARTIAL PATHWAY TIMEOUT VALUE				
37	Reserved								

Byte\Bit	7	6	5	4	3	2	1	0
...								
39								
40	(MSB)							
...	CRC							
43	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 101 for the PHY CONTROL request.
- The FUNCTION field shall be set as shown in Table 101 for the PHY CONTROL request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 4 bytes defined in Table 111 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the value defined in Table 111 (i.e., 00h)
 And
 - Return the response frame.

NOTE: Future versions of this standard may change the value defined in Table 111.

- The REQUEST LENGTH field shall be set to one of the values defined in Table 101 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are 9 dwords before the CRC field.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- The PHY IDENTIFIER field specifies the phy to which the SMP PHY CONTROL request applies.

Table 102. PHY OPERATION field (1 of 3)

Code	Operation	Description
00h	NOP	No operation.
01h	LINK RESET	<p>If:</p> <ul style="list-style-type: none"> a) a SAS phy is attached; b) a SATA phy is attached and there is no affiliation; or c) a SATA phy is attached and an affiliation exists for the STP initiator port with the same SAS address as the SMP initiator port that opened this SMP connection, <p>then:</p> <ul style="list-style-type: none"> a) if the specified phy is a physical phy, then perform a link reset sequence on the specified phy and enable the specified phy even if the specified phy is in a connection; and b) if the specified phy is a virtual phy, then perform an internal reset and enable the specified phy even if the specified phy is in a connection. <p>If a SATA phy is attached and an affiliation does not exist for the STP initiator port with the same SAS address as the SMP initiator port that opened this SMP connection, then the management device server shall return a function result of AFFILIATION VIOLATION in the response frame.^a</p> <p>See 0 for Broadcast (Change) requirements related to this phy operation in an expander device.</p> <p>Any affiliation shall continue to be present. The phy shall bypass the SATA spinup hold state, if implemented.</p> <p>The management device server shall:</p> <ol style="list-style-type: none"> 1) Send a Management Reset request to the SP state machine. 2) Return the PHY CONTROL response, and 3) Wait for the LINK RESET phy operation to complete.

Table 103. PHY OPERATION field (2 of 3)

Code	Operation	Description
02h	HARD RESET	<p>If the specified phy is a physical phy, perform a link reset sequence (see 4.4) on the specified phy and enable the specified phy even if the specified phy is in a connection. If the attached phy is a SAS phy or an expander phy, then the link reset sequence shall include a hard reset sequence. If the attached phy is a SATA phy, then the phy shall bypass the SATA spinup hold state. See 0 for Broadcast (Change) requirements related to this phy operation in an expander device.</p> <p>If the specified phy is a virtual phy, then perform an internal reset and enable the specified phy even if the specified phy is in a connection.</p> <p>Any affiliation shall be cleared.</p> <p>The management device server shall return the PHY CONTROL response without waiting for the HARD RESET phy operation to complete.</p> <p>If the PHY IDENTIFIER field specifies the PHY that is in the same wide port with the one being used for the SMP connection and a PHY operation of HARD RESET is requested, the function result SMP FUNCTION FAILED is returned in the response frame.</p>

Code	Operation	Description
03h	DISABLE	Disable the specified phy (i.e., stop transmitting valid dwords and receiving dwords on the specified phy). The LINK RESET and HARD RESET operations may be used to enable the phy. See 4.2.25.1 for Broadcast (Change) requirements related to this phy operation in an expander device.
04h	Reserved	
05h	CLEAR ERROR LOG	Clear the error log counters reported in the REPORT PHY ERROR LOG function for the specified phy.
06h	CLEAR AFFILIATION	Clear an affiliation from the STP initiator port with the same SAS address as the SMP initiator port that opened this SMP connection. If there is no such affiliation, then the management device server shall return a function result of AFFILIATION VIOLATION ^b in the response frame.

Table 104. PHY OPERATION field (3 of 3)

Code	Operation	Description
07h	TRANSMIT SATA PORT SELECTION SIGNAL	<p>This function shall only be supported by phys in an expander device.</p> <p>If the expander phy incorporates an STP/SATA bridge and supports SATA port selectors, then the phy shall transmit the SATA port selection signal which causes the SATA port selector to select the attached phy as the active host phy and make its other host phy inactive. See 4.2.25.1 for Broadcast (Change) requirements related to this phy operation in an expander device.</p> <p>Any affiliation shall be cleared.</p> <p>If the expander phy does not support SATA port selectors, then the management device server shall return a function result of PHY DOES NOT SUPPORT SATA.</p> <p>If the expander phy supports SATA port selectors but is attached to a SAS phy or an expander phy, then the management device server shall return a function result of SMP FUNCTION FAILED in the response frame.</p>
08h	CLEAR STP I_T NEXUS LOSS	The STP I_T NEXUS LOSS OCCURRED bit shall be set to zero in the REPORT PHY SATA function.
09h	SET ATTACHED DEVICE NAME	If the expander phy is attached to a SATA phy, then set the ATTACHED DEVICE NAME field reported in the DISCOVER response to the value of the ATTACHED DEVICE NAME field in the PHY CONTROL request.
All others	Reserved	
<p>^a Phys compliant with SAS-1.1 did not reject this phy operation due to affiliations.</p> <p>^b Phys compliant with SAS-1.1 returned SMP FUNCTION REJECTED.</p>		

- If the operation specified by the PHY OPERATION field is unknown, then the management device sever shall return a function result of UNKNOWN PHY OPERATION in the response frame and not process any other fields in the request.
- If the PHY IDENTIFIER field specifies the phy that is being used for the SMP connection and a phy operation of LINK RESET, HARD RESET, or DISABLE is requested, then the management device server shall not perform the requested operation and shall return a function result of SMP FUNCTION FAILED in the response frame.
- An UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit set to one specifies that the PARTIAL PATHWAY TIMEOUT VALUE field shall be honored. An UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit set to zero specifies that the PARTIAL PATHWAY TIMEOUT VALUE field shall be ignored.
- The ATTACHED DEVICE NAME field is used by the SET ATTACHED DEVICE NAME phy operation and is reserved for all other phy operations. If a management application client detects the ATTACHED DEVICE NAME field set to 00000000 00000000h in the DISCOVER response when a SATA device is attached, then it shall set the ATTACHED DEVICE NAME field based on the IDENTIFY (PACKET) DEVICE data retrieved by an ATA application client in the same SAS initiator device as follows:
 - If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108 to 111

(i.e., the World Wide Name field) are not set to zero, then set this field to the world wide name indicated by words 108 to 111

- If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is correct and words 108 to 111 (i.e., the World Wide Name) are set to zero, then set this field to 00000000 00000000h

Or

- If IDENTIFY (PACKET) DEVICE data word 255 (i.e., the Integrity word) is not correct, then set this field to 00000000 00000000h.
- The PROGRAMMED MINIMUM PHYSICAL LINK RATE field specifies the minimum physical link rate the phy shall support during a link reset sequence. Table 105 defines the values for this field. This value is reported in the DISCOVER response. If this field is changed along with a phy operation of LINK RESET or HARD RESET, then that phy operation shall utilize the new value for this field.
- The PROGRAMMED MAXIMUM PHYSICAL LINK RATE field specifies the maximum physical link rates the phy shall support during a link reset sequence. Table 105 defines the values for this field. This value is reported in the DISCOVER response. If this field is changed along with a phy operation of LINK RESET or HARD RESET, then that phy operation shall utilize the new value for this field.

4.2.25.1 SAS domain changes (Broadcast (Change) usage)

An expander device shall originate Broadcast (Change) from at least one phy in each of its expander ports other than the expander port that is the cause for originating Broadcast (Change).

- Expander devices shall originate Broadcast (Change) for the following expander phy-related reasons:
 - After an expander phy's SP state machine transitions from the SP15:SAS_PHY_Ready state, SP22:SATA_PHY_Ready state, SP31:SAS_PS_Low_Phy_Power state, SP32:SAS_PS_ALIGN0 state, or SP33:SAS_PS_ALIGN1 state to the SP0:OOB_COMINIT state;

NOTE: This occurs when the expander phy is reset or disabled with the SMP PHY CONTROL function DISABLE, LINK RESET, HARD RESET, or TRANSMIT SATA PORT SELECTION SIGNAL phy operations as well as when dword synchronization is lost for any other reason.

- After an expander phy's SP state machine reaches the SP26:SATA_SpinupHold state and sends a SATA Spinup Hold confirmation;
- After an expander phy's SP state machine sends a SATA Port Selector change confirmation to the link layer;
- After an expander phy completes the link reset sequence;
- After a virtual phy has been enabled or completed processing a reset requested by the SMP PHY CONTROL function LINK RESET or HARD RESET phy operations

And

- After an STP/SATA bridge receives an initial Register - Device to host FIS. In zoning expander devices with zoning enabled, forwarding Broadcasts is subject to restrictions.
- In zoning expander devices with zoning enabled, a Broadcast (Change) for an expander phy-related reason shall be originated from the source zone group of the expander phy causing the Broadcast (Change) or from zone group 1.
- Expander devices shall originate Broadcast (Change) for the following expander device-related reasons:
 - After a self-configuring expander device has changed its SELF CONFIGURING bit from one to zero in the SMP REPORT GENERAL response. In zoning expander devices with zoning enabled, the source zone group shall be 01h

And

- After a locked expander device is unlocked (i.e., a zoning expander device has changed its ZONE CONFIGURING bit from one to zero in the SMP REPORT GENERAL response), with the source zone

group.

- Expander devices shall forward Broadcast (Change) after an expander phy receives Broadcast (Change).
- For a virtual phy, if there is any time after a reset is originated during which connection requests to the attached SAS address result in connection responses of OPEN_REJECT (NO DESTINATION), then the expander device shall originate the Broadcast (Change) twice, once at the start of the reset (i.e., when the SAS address becomes unavailable) and once at its completion (i.e., when the SAS address becomes available). If there is no such time window, then the expander device shall originate the Broadcast (Change) once.
- SAS initiator ports may originate Broadcast (Change) to force other SAS initiator ports and expander ports to re-run the discover process. SAS target ports should not originate Broadcast (Change).

Table 105. PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field

Code	Description
0h	Do not change current value
1h to 7h	Reserved
8h	1.5 Gbit/s
9h	3 Gbit/s
Ah	6 Gbit/s
Bh	12 Gbit/s
Ch to Fh	Reserved for future physical link rates

If the PROGRAMMED MINIMUM PHYSICAL LINK RATE field or the PROGRAMMED MAXIMUM PHYSICAL LINK RATE field is set to an unsupported or reserved value, or the PROGRAMMED MINIMUM PHYSICAL LINK RATE field and PROGRAMMED MAXIMUM PHYSICAL LINK RATE field are set to an invalid combination of values (e.g., the minimum is greater than the maximum), then the management device server shall not change either of their values and may return a function result of SMP FUNCTION FAILED in the response frame. If the management device server returns a function result of SMP FUNCTION FAILED, then it shall not perform the requested phy operation.

Table 106. ENABLE SAS SLUMBER field

Code	Description
00b	No change
01b	If supported, then the management device server shall manage slumber phy power conditions.
10b	If supported, then the management device server shall disable slumber phy power conditions.
11b	Reserved

If the ENABLE SAS SLUMBER field is set to an unsupported or reserved value, then the management device server shall not issue a Manage Power Conditions request to any XL state machine and shall return a function result of SMP FUNCTION FAILED in the response frame.

Table 107. ENABLE SAS PARTIAL field

Code	Description
00b	No change
01b	If supported, then the management device server shall manage partial phy power conditions.
10b	If supported, then the management device server shall disable partial phy power conditions.
11b	Reserved

If the ENABLE SAS PARTIAL field is set to an unsupported or reserved value, then the management device server shall not issue a Manage Power Conditions request to any XL state machine and shall return a function result of SMP FUNCTION FAILED in the response frame.

Table 108. ENABLE SATA SLUMBER field

Code	Description
00b	No change
01b	If supported, then the management device server shall manage SATA slumber interface power management sequences.
10b	If supported, then the management device server shall disable SATA slumber interface power management sequences.
11b	Reserved

If the ENABLE SATA SLUMBER field is set to an unsupported or reserved value, then the management device server shall not issue a Manage Power Conditions request to any XL state machine and shall return a function result of SMP FUNCTION FAILED in the response frame.

Table 109. ENABLE SATA PARTIAL field

Code	Description
00b	No change
01b	If supported, then the management device server shall manage SATA partial interface power management sequences.
10b	If supported, then the management device server shall disable SATA partial interface power management sequences.
11b	Reserved

If the ENABLE SATA PARTIAL field is set to an unsupported or reserved value, then the management device server shall not issue a Manage Power Conditions request to any XL state machine and shall return a function result of SMP FUNCTION FAILED in the response frame.

Table 110. PWR_DIS CONTROL field

Code	Description
00b	No change
01b	Reserved
10b	If supported, then the management device server shall negate the POWER DISABLE signal associated with the phy.
11b	If supported, then the management device server shall assert the POWER DISABLE signal associated with the phy.

The PARTIAL PATHWAY TIMEOUT VALUE field specifies the amount of time, in one microsecond intervals, the expander phy shall wait after receiving an Arbitrating (Blocked On Partial) confirmation from the ECM before requesting that the ECM resolve pathway blockage. A PARTIAL PATHWAY TIMEOUT VALUE field value of zero (i.e., 0 μ s) specifies that partial pathway resolution shall be requested by the expander phy after receiving an Arbitrating (Blocked On Partial) confirmation from the ECM. This value is reported in the DISCOVER response. The PARTIAL PATHWAY TIMEOUT VALUE field is only honored if the UPDATE PARTIAL PATHWAY TIMEOUT VALUE bit is set to one.

Table 111. PHY CONTROL response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (91h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 111 for the PHY CONTROL response.
- The FUNCTION field shall be set as shown in Table 111 for the PHY CONTROL response.
- The RESPONSE LENGTH field shall be set as shown in Table 111 for the PHY CONTROL response.

4.2.26 PHY TEST FUNCTION Function (92h)

The PHY TEST FUNCTION function requests actions by the specified phy. This SMP function may be implemented by any management device server. In zoning expander devices, if zoning is enabled, then this function shall only be processed from SMP initiator ports that have access to zone group 2 or the zone group of the specified phy.

Table 112. PHY TEST FUNCTION request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (92h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH (00h or 09h)								
4	(MSB)	EXPECTED EXPANDER CHANGE COUNT							
5								(LSB)	
6	Reserved								
...									
8	Reserved								
9									
10	PHY IDENTIFIER								
11	PHY TEST FUNCTION								
12	PHY TEST PATTERN								
13	Reserved								
...									
14	Reserved								
15									Reserved
16	Reserved								
...									
18	Reserved								
19									
20	PHY TEST PATTERN DWORDS CONTROL								
21	PHY TEST PATTERN DWORDS								
...									
27	Reserved								
28									
...	Reserved								
39									
40	(MSB)	CRC							
...									
43								(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 112 for the PHY TEST FUNCTION request.
- The FUNCTION field shall be set as shown in Table 112 for the PHY TESTFUNCTION request.
- If the ALLOCATED RESPONSE LENGTH field is set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field to 00h in the response frame
 And
 - Return the first 4 bytes defined in Table 116 plus the CRC field as the response frame.
- If the ALLOCATED RESPONSE LENGTH field is not set to 00h, then the management device server shall:
 - Set the RESPONSE LENGTH field in the response frame to the value defined in Table 116 (i.e., 00h)
 And
 - Return the response frame.

NOTE: Future versions of this standard may change the value defined in Table 116.

- The REQUEST LENGTH field shall be set to one of the values defined in Table 112 based on the LONG RESPONSE bit in the REPORT GENERAL response. A REQUEST LENGTH field set to 00h specifies that there are 9 dwords before the CRC field.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- The PHY IDENTIFIER field specifies the phy to which the SMP PHY TEST PATTERN request applies.
- If the PHY IDENTIFIER field specifies the phy that is being used for the SMP connection, then the management device server shall not perform the requested operation and shall return a function result of SMP FUNCTION FAILED in the response frame.
- The PHY TEST FUNCTION field specifies the phy test function to be performed, and is defined in Table 113. If the PHY TEST FUNCTION field specifies a phy test function that is not supported by the phy, then the management device server shall return a function result of UNKNOWN PHY TEST FUNCTION in the response frame.

Table 113. PHY TEST FUNCTION field

Code	Name	Description
00h	STOP	If the selected phy is performing a phy test function, then the selected phy shall stop performing the phy test function and originate a link reset sequence. If the selected phy is not performing a phy test function, then this function has no effect on the selected phy.
01h	TRANSMIT PATTERN	If the selected phy is not performing a phy test function, then the selected phy shall be set to transmit the phy test pattern specified by the PHY TEST PATTERN field at the physical link rate specified by the PHY TEST FUNCTION PHYSICAL LINK RATE field and set to ignore its receiver. If the selected phy receives data while transmitting the pattern, then the selected phy shall ignore the received data. If the selected phy is performing a phy test function, then the management device server shall return a function result of PHY TEST FUNCTION IN PROGRESS in the response frame.
02h to EFh	Reserved	
F0h to FFh	Vendor specific	

- If the PHY TEST FUNCTION field is set to 01h (i.e., TRANSMIT PATTERN), then the PHY TEST PATTERN field specifies the phy test pattern to be performed, and is the same as that defined in the Protocol Specific diagnostic page. The phy test pattern shall be sent at the physical link rate specified by the PHY TEST FUNCTION PHYSICAL LINK RATE field.
- The PHY TEST FUNCTION SATA bit is as defined in the Protocol Specific diagnostic page.
- The PHY TEST FUNCTION SSC field is as defined in the Protocol Specific diagnostic page.
- The PHY TEST FUNCTION PHYSICAL LINK RATE field specifies the physical link rate at which the phy test function, if any, shall be performed. Table 114 defines the values for this field.

Table 114. PHY TEST FUNCTION PHYSICAL LINK RATE field

Code	Description
0h to 7h	Reserved
8h	1.5 Gbit/s
9h	3 Gbit/s
Ah	6 Gbit/s
Bh	12 Gbit/s
Ch to Fh	Reserved for future physical link rates

The PHY TEST PATTERN DWORDS CONTROL field and the PHY TEST PATTERN DWORDS field are as defined in the Protocol Specific diagnostic page.

Table 115. PHY TEST PATTERN field

Code	Name	Description
00h	Reserved	
01h	JTPAT	The selected phy shall repeatedly transmit JTPAT for RD+ and RD- (see A.1).
02h	CJTPAT	The selected phy shall repeatedly transmit CJTPAT (see A.2).
03h to 0Fh	Reserved	
13h	SCRAMBLED_0	The selected phy shall repeatedly transmit a repeating pattern of at least 58 dwords (i.e., 2 320 bits on the physical link) set to 00000000h that are transmitted scrambled and 8b10b encoded. The scrambler shall be reinitialized at the beginning of each pattern.
14h to 3Fh	Reserved	
41h to EFh	Reserved	
F0h to FFh	Vendor specific	

Table 116. PHY TEST FUNCTION response

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (41h)								
1	FUNCTION (92h)								
2	FUNCTION RESULT								
3	RESPONSE LENGTH (00h)								
4	(MSB)								
...									
7	CRC							(LSB)	

- The SMP FRAME TYPE field shall be set as shown in Table 116 for the PHY TEST FUNCTION response.
- The FUNCTION field shall be set as shown in Table 116 for the PHY TEST FUNCTION response.
- The RESPONSE LENGTH field shall be set as shown in Table 116 for the PHY TEST FUNCTION response.

4.2.27 CONFIGURE PHY EVENT Function (93h)

The CONFIGURE PHY EVENT function configures phy events for the specified phy. This SMP function may be implemented by any management device server. In zoning expander devices, if zoning is enabled, then this function shall only be processed from SMP initiator ports that have access to zone group 2 or the zone group of the specified phy.

Table 117. CONFIGURE PHY EVENT request

Byte\Bit	7	6	5	4	3	2	1	0	
0	SMP FRAME TYPE (40h)								
1	FUNCTION (93h)								
2	ALLOCATED RESPONSE LENGTH								
3	REQUEST LENGTH ((n - 7) / 4)								
4	(MSB)								
5	EXPECTED EXPANDER CHANGE COUNT							(LSB)	
6	Reserved							CLEAR PEAKS	
7	Reserved								
8	Reserved								
9	PHY IDENTIFIER								
10	PHY EVENT CONFIGURATION DESCRIPTOR LENGTH								
11	NUMBER OF PHY EVENT CONFIGURATION DESCRIPTORS								
Phy event configuration descriptor list									
12									
...	Phy event configuration descriptor (first) (see Table 118)								
19									
...	...								
n - 11	Phy event configuration descriptor (last) (see Table 118)								
...									

Byte\Bit	7	6	5	4	3	2	1	0
n - 4								
n - 3	(MSB)							
...	CRC							
n	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 117 for the CONFIGURE PHY EVENT request.
- The FUNCTION field shall be set as shown in Table 117 for the CONFIGURE PHY EVENT request.
- The REQUEST LENGTH field shall be set as shown in Table 117 for the CONFIGURE PHY EVENT request.
- The EXPECTED EXPANDER CHANGE COUNT field is defined in the SMP CONFIGURE GENERAL request.
- A CLEAR PEAKS bit set to one specifies that all phy event peak value detectors shall be set to zero. A CLEAR PEAKS bit set to zero specifies no change to the phy event peak value detectors.
- The PHY IDENTIFIER field specifies the phy to which the configure phy event information shall be applied.
- The PHY EVENT CONFIGURATION DESCRIPTOR LENGTH field indicates the length, in dwords, of the phy event configuration descriptor.
- The NUMBER OF PHY EVENT CONFIGURATION DESCRIPTORS field specifies the number of phy event configuration descriptors in the phy event configuration descriptor list, and shall be set to the same value as the NUMBER OF PHY EVENT DESCRIPTORS field in the SMP REPORT PHY EVENT function.
- The phy event configuration descriptor list contains phy event configuration descriptors.

Table 118. Phy event configuration descriptor

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
2	PHY EVENT SOURCE							
3	PHY EVENT SOURCE							
4	(MSB)							
...	PEAK VALUE DETECTOR THRESHOLD							
7	(LSB)							

- The PHY EVENT SOURCE field specifies the type of event that shall be recorded by the corresponding phy event monitor.
- If the phy event source is a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field specifies the value of the peak value detector that causes the expander device to originate a Broadcast (Expander). If the phy event source is not a peak value detector, then the PEAK VALUE DETECTOR THRESHOLD field is reserved.
- If the PHY EVENT SOURCE field contains a value that is not supported, then the management device server shall return a function result of UNKNOWN PHY EVENT SOURCE in the response frame.

Table 119. CONFIGURE PHY EVENT response

Byte\Bit	7	6	5	4	3	2	1	0
0	SMP FRAME TYPE (41h)							
1	FUNCTION (93h)							
2	FUNCTION RESULT							
3	RESPONSE LENGTH (00h)							
4	(MSB)							
...	CRC							
7	(LSB)							

- The SMP FRAME TYPE field shall be set as shown in Table 119 for the CONFIGURE PHY EVENT response.
- The FUNCTION field shall be set as shown in Table 119 for the CONFIGURE PHY EVENT response.
- The RESPONSE LENGTH field shall be set as shown in Table 119 for the CONFIGURE PHY EVENT response. A RESPONSE LENGTH field set to 00h does not have a special meaning based on the ALLOCATED RESPONSE LENGTH field in the request frame.

5. SPC Command Customization

The following table shows the supported SCSI commands. The INQUIRY command is customized.

Table 120. Supported SCSI Commands

Operation Code	Command Name
00h	TEST UNIT READY
12h	INQUIRY
A0h	REPORT LUNS
5Ah	MODE SENSE(10)
55h	MODE SELECT(10)
1Dh	SEND DIAGNOSTIC
1Ch	RECEIVE DIAGNOSTIC RESULTS
3Ch	READ BUFFER
3Bh	WRITE BUFFER
03h	REQUEST SENSE (Undocumented)
4Ch	LOG SELECT (Undocumented)
4Dh	LOG SENSE (Undocumented)

5.1 TEST UNIT READY command (00h)

The TEST UNIT READY command (see Table 121) provides a means to check if the logical unit is ready. This is not a request for a self-test. If the logical unit is able to accept an appropriate medium-access command without returning CHECK CONDITION status, this command shall return a GOOD status. If the logical unit is unable to become operational or is in a state such that an application client action (e.g., START UNIT command) is required to make the logical unit ready, the command shall be terminated with CHECK CONDITION status, with the sense key set to NOT READY.

Table 121. TEST UNIT READY command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (00h)							
1	Reserved							
...								
4	CONTROL							
5								

- The OPERATION CODE field shall be set as shown in Table 121 for the TEST UNIT READY command.
- Table 122 defines the suggested CHECK CONDITION status responses to the TEST UNIT READY command. Other conditions (e.g., deferred errors, reservations, or target port asymmetric access state changes) may result in other responses (e.g., GOOD status, CHECK CONDITION status, BUSY status, or RESERVATION CONFLICT status, each with or without other sense key and additional sense code values).

Table 122. Preferred TEST UNIT READY responses

Status	Sense Key	Additional Sense Code
CHECK CONDITION	ILLEGAL REQUEST	LOGICAL UNIT NOT SUPPORTED
CHECK CONDITION	NOT READY	LOGICAL UNIT DOES NOT RESPOND TO SELECTION
CHECK CONDITION	NOT READY	MEDIUM NOT PRESENT
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, CAUSE NOT REPORTABLE
CHECK CONDITION	NOT READY	LOGICAL UNIT IS IN PROCESS OF BECOMING READY
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, INITIALIZING COMMAND REQUIRED
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, MANUAL INTERVENTION REQUIRED
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, FORMAT IN PROGRESS
CHECK CONDITION	NOT READY	LOGICAL UNIT NOT READY, SANITIZE IN PROGRESS

5.2 INQUIRY (12h)

Table 123. INQUIRY CDB Format

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATION CODE (12h)							
1	RESERVED						OBSOLETE	EVPD
2	PAGE CODE							
3	(MSB)				ALLOCATION LENGTH			
4	ALLOCATION LENGTH				(LSB)			
5	CONTROL							

- The OPERATION CODE for the INQUIRY command (12h).
- An enable vital product data (EVPD) bit set to one specifies that the device server shall return the vital product data specified by the PAGE CODE field.
- The PAGE CODE field is specified in Table 142. EVPD INQUIRY Data (Page 00).
- The ALLOCATION LENGTH field specifies the maximum number of bytes allocated in the Data-In Buffer.
- The CONTROL byte is defined in SAM-5.

Table 124. Standard INQUIRY Data

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER = 0h			PERIPHERAL DEVICE TYPE = 0Dh				
1	RMB = 0h	Reserved						
2	VERSION = 06h							
3	Obsolete		NormACA = 0h	HISUP = 0h	RESPONSE DATA FORMAT = 2h			
4	ADDITIONAL LENGTH (n-4) = 5Bh							
5	SCCS = 0h	ACC = 0h	TPGS= 0h		3PC = 0h	Reserved		PROTEC T = 0h
6	Obsolete	ENCSE R V = 1h	Reserved	MULTIP = 0h	Obsolete	Reserved		ADDR16 = 0h
7	Obsolete		WBUS16 = 0h	SYNC = 0h	Obsolete	Reserved	CMDQUE = 1h	VS = 0h
8	T10 VENDOR IDENTIFICATION = INTEL							
..								
15								
16	PRODUCT IDENTIFICATION = JBOD2312S3SP							
..								
31								
32	PRODUCT REVISION LEVEL = B020							
..								
35								

5.3 REPORT LUNS command (A0h)

The REPORT LUNS command (see Table 125) requests that the peripheral device logical unit inventory accessible to the I_T nexus be sent to the application client. The logical unit inventory is a list that shall include the logical unit numbers of all logical units having a PERIPHERAL QUALIFIER value of 000b. Logical unit numbers for logical units with PERIPHERAL QUALIFIER values other than 000b and 011b may be included in the logical unit inventory. Logical unit numbers for logical units with a PERIPHERAL QUALIFIER value of 011b shall not be included in the logical unit inventory.

Table 125. REPORT LUNS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (A0h)							
1	Reserved							
2	SELECT REPORT							
3	Reserved							
...								
5								
6	(MSB)	ALLOCATION LENGTH						(LSB)
...								
9								
10	Reserved							
11	CONTROL							

- The OPERATION CODE field shall be set as shown in Table 125 for the REPORT LUNS command.
- The SELECT REPORT field (see Table 126) specifies the types of logical unit addresses that shall be reported.

Table 126. SELECT REPORT field

Code	Description
00h	The list shall contain the logical units accessible to the I_T nexus with the following addressing methods (see SAM-5): logical unit addressing method; peripheral device addressing method; flat space addressing method; extended logical unit addressing method; and long extended logical unit addressing method. If there are no logical units, the LUN LIST LENGTH field shall be zero.
01h	The list shall contain only well-known logical units, if any. If there are no well-known logical units, the LUN LIST LENGTH field shall be zero.
02h	The list shall contain all logical units accessible to the I_T nexus.
F8h to FFh	Vendor specific
all others	Reserved

- The REPORT LUNS command shall return CHECK CONDITION status only if the device server is unable to return the requested report of the logical unit inventory.
- If a REPORT LUNS command is received from an I_T nexus with a pending unit attention condition (i.e., before the device server reports CHECK CONDITION status), the device server shall perform the REPORT LUNS command.
- The REPORT LUNS parameter data should be returned even though the device server is not ready for other commands. The report of the logical unit inventory should be available without incurring any media access delays. If the device server is not ready with the logical unit inventory or if the inventory list is null for the requesting I_T nexus and the SELECT REPORT field set to 02h, then the device server shall provide a default logical unit inventory that contains at least LUN 0 or the REPORT LUNS well known logical unit. Anon-empty peripheral device logical unit inventory that does not contain either LUN 0 or the REPORT LUNS well known logical unit is valid.

- If a REPORT LUNS command is received for a logical unit that the SCSI target device does not support and the device server is not capable of returning the logical unit inventory, then the command shall be terminated with CHECK CONDITION status, with the sense key set to ILLEGAL REQUEST, and the additional sense code set to LOGICAL UNIT NOT SUPPORTED.
- The device server shall report those devices in the logical unit inventory using the format shown in Table 127.

Table 127. REPORT LUNS parameter data format

Bit Byte	7	6	5	4	3	2	1	0
0	(MSB)							
...	LUN LIST LENGTH (n-7)							
3								(LSB)
4								
...	Reserved							
7								
	LUN list							
8								
...	LUN [first]							
15								
	..							
	.							
n-7								
...	LUN [last]							
N								

- The LUN LIST LENGTH field shall contain the length in bytes of the LUN list that is available to be transferred. The LUN list length is the number of logical unit numbers in the logical unit inventory multiplied by eight. The contents of the LUN LIST LENGTH field are not altered based on the allocation length.
- The firmware supports all report types for the REPORT LUNS command.
- The well-known logical units report (0x01) will return an empty LUN list.
- The single LUN (zero) supported by the firmware is reported for the other types.

5.4 SEND DIAGNOSTIC command (1Dh)

The expander firmware supports two modes of the SEND DIAGNOSTIC command; default self-test and SES page download.

- If the SELFTEST bit is set, then firmware will assume that a default self-test is being specified and validate the CDB parameters according to the following table.

Table 128. SEND DIAGNOSTIC AND SELFTEST

CDB Parameter	Valid Setting
SELFTEST	1
PF	X (Don't Care)
SELF-TEST CODE	0b000
PARAMETER LIST LENGTH	0

- If the SELFTEST bit is not set, then STE will assume that an SES page download is being specified and validate the CDB parameters according to the following table.

Table 129. SEND DIAGNOSTIC AND NOT SELFTEST

CDB Parameter	Valid Setting
SELFTEST	0
PF	1
SELF-TEST CODE	000b
PARAMETER LIST LENGTH	Length of SES page

- If the PF is also set to zero in this table configuration, firmware should ignore it and report error since the command has no significance, the Firmware need the PF bit is set to 1.
- The SEND DIAGNOSTIC command (see Table 130) requests that the device server perform diagnostic operations on the SCSI target device.

Table 130. SEND DIAGNOSTIC command

Bit Byte	7	6	5	4	3	2	1	0	
0	OPERATION CODE (1Dh)								
1	SELF-TEST CODE			PF	Reserved	SELFTEST	DEVOFFL	UNITOFFL	
2	Reserved								
3	(MSB)								
4	PARAMETER LIST LENGTH							(LSB)	
5	CONTROL								

- The OPERATION CODE field shall be set as shown in Table 130 for the SEND DIAGNOSTIC command.
- The SELF-TEST CODE field
- The page format (PF) bit.
 - The self-test (SELFTEST) bit (see Table 130) specifies whether the device server shall perform the default self-test.
 - A SCSI target device offline (DEVOFFL) bit set to one specifies that the device server may perform a default self-test that affects any logical unit in the SCSI target device (e.g., by alteration of reservations, log parameters, or sense data). A DEVOFFL bit set to zero specifies that, after the device server has completed a default self-test specified in the SEND DIAGNOSTIC command, no logical unit shall exhibit any effects resulting from the device server's processing the SEND DIAGNOSTIC command that are detectable by any application client. If the SELFTEST bit is set to zero, the device server shall ignore the DEVOFFL bit.
 - A unit offline (UNITOFFL) bit set to one specifies that the device server may perform a default self-test that affects the user accessible medium on the logical unit (e.g., write operations to the user accessible medium or repositioning of the medium on sequential access devices). A UNITOFFL bit set to zero specifies that, after the device server has completed a default self-test specified in the SEND DIAGNOSTIC command, the user accessible medium shall exhibit no effects resulting from the device server's processing the SEND DIAGNOSTIC command that are detectable by any application client. If the SELFTEST bit is set to zero, the device server shall ignore the UNITOFFL bit.
 - The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter list that shall be transferred from the application client Data-Out Buffer to the device server. A parameter list length of zero specifies that no data shall be transferred. This condition shall not be considered an error.
 - The CONTROL byte is defined in SAM-5.

5.5 RECEIVE DIAGNOSTIC RESULTS command (1Ch)

The RECEIVE DIAGNOSTIC RESULTS command (see Table 133) requests that data be sent to the application client Data-In Buffer. The data is either data based on the most recent SEND DIAGNOSTIC command or is a diagnostic page specified by the PAGE CODE field.

Table 131. RECEIVE DIAGNOSTIC RESULTS command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (1Ch)							
1	Reserved							PCV
2	PAGE CODE							
3	(MSB)							(LSB)
4	ALLOCATION LENGTH							(LSB)
5	CONTROL (00h)							

- The OPERATION CODE field shall be set as shown in Table 133 for the RECEIVE DIAGNOSTIC RESULTS command.
- A page code valid (PCV) bit set to one specifies that the device server return the diagnostic page specified in the PAGE CODE field.

5.6 READ BUFFER command (3Ch)

Table 132. Read Buffer Command (Page 3Ch)

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATIONAL CODE (3Ch)							
1	Reserved			Mode				
2	BUFFER ID							
3	(MSB)							(LSB)
5	BUFFER OFFSET (0h)							(LSB)
6	(MSB)							(LSB)
8	ALLOCATION LENGTH							(LSB)
9	CONTROL (00h)							

These buffers allow customers to change how the JBOD reports itself. The table below maps the buffer to the command information it changes. All of these buffers can be read via read buffer command; however, the Unit Serial Number, Vendor ID, & Product ID are also mapped to the command/field stated in the command map column. The custom serial number and identification buffer are not mapped to actual SAS commands, these values can only be read via the read buffer command.

Table 133. Buffer ID

Code	Buffer	Command Map	Description
02h	Unit Serial Number	See: Unit Serial Number VPD page (Page 80h)	Unit Serial Number – Maximum of 20 characters
03h	Vendor Identification	Inquiry (T10 VENDOR IDENTIFICATION)	Vendor ID – Maximum of 8 characters
04h	Product Identification	Inquiry (T10 PRODUCT IDENTIFICATION)	Product ID – Maximum of 16 characters
05h	Custom Serial Number	Read Buffer	Custom Serial Number – Maximum of 24 characters
06h	Custom Identification	Read Buffer	Custom Identification String – Maximum of 20 characters

5.7 WRITE BUFFER command (3Bh)

Table 134. Write Buffer Command (Page 3Bh)

Byte\Bit	7	6	5	4	3	2	1	0
0	OPERATIONAL CODE (3Bh)							
1	Reserved			Mode				
2	BUFFER ID							
3	(MSB)	BUFFER OFFSET (0h)						(LSB)
5								
6	(MSB)	PARAMETER LIST LENGTH						(LSB)
8								
9	CONTROL (00h)							

The PARAMETER LIST LENGTH field specifies the length in bytes of the parameter data that shall be transferred from the application client to the device server. The PARAMETER LIST LENGTH for each buffer is listed in Table 135. A parameter list length value of zero specifies that no data shall be transferred and no changes shall be made in the buffer.

Table 135. Buffer Mode

Code	Description
02h	Data (Customized string buffers 2h – 6h)
07h	Download microcode with offsets, save, and activate
0Eh	Download microcode with offsets, save, and defer activate
0Fh	Activate deferred microcode

5.8 REQUEST SENSE command (03h)

The REQUEST SENSE command (see Table 138) requests that the device server transfer parameter data containing sense data to the application client.

Table 136. REQUEST SENSE command

Bit Byte	7	6	5	4	3	2	1	0
0	OPERATION CODE (03h)							
1	Reserved							DESC (0b)
2								
3	Reserved							
4	ALLOCATION LENGTH							
5	CONTROL (00h)							

- The OPERATION CODE field shall be set as shown in Table 138 for the REQUEST SENSE command.
- The descriptor format (DESC) bit (see Table 139) specifies which sense data format the device server shall return in the parameter data.

Table 137. DESC bit

Code	Descriptor format sense data supported?	Description
0b	yes	The device server shall return fixed format sense data in the parameter data.
1b	no	The device server shall return no parameter data and terminate the REQUEST SENSE command with CHECK CONDITION status with the sense key set to ILLEGAL REQUEST and the additional sense code set to INVALID FIELD IN CDB.
Note: Device servers that are compliant with SPC-3 are capable of ignoring a DESC bit that is set to one.		

- Application clients should request 252 bytes of sense data to ensure they retrieve all the sense data. If fewer than 252 bytes are requested, sense data may be lost since the REQUEST SENSE command with any allocation length clears the sense data.

- The CONTROL byte is defined in SAM-5.
 - Sense data shall be available and cleared under the conditions defined in SAM-5.
 - Upon completion of the REQUEST SENSE command, the logical unit shall return to the same power condition that was active before the REQUEST SENSE command was received. A REQUEST SENSE command shall not reset any power condition timers.
 - The device server shall return CHECK CONDITION status for a REQUEST SENSE command only to report exception conditions specific to the REQUEST SENSE command itself. Examples of conditions that cause a REQUEST SENSE command to return CHECK CONDITION status are:
 - An invalid field value is detected in the CDB.
 - The device server does not support the REQUEST SENSE command.
 - The initiator port that sent the REQUEST SENSE command is pending enrollment for access controls and no other sense data is available to return.
 - An unrecovered error is detected by a SCSI target port
 - A malfunction prevents return of the sense data.
 - If a REQUEST SENSE command is terminated with CHECK CONDITION status, then:
 - Any parameter data that is transferred is invalid (i.e., the parameter data does not contain sense data).
- And
- If the REQUEST SENSE command was received on an I_T nexus with a pending unit attention condition (i.e., before the device server reports CHECK CONDITION status), then the device server shall not clear the pending unit attention condition (see SAM-5).
- The firmware will return only the sense keys and sense codes which are listed in Table 140 and Table 141.

Table 138. Sense Key

Sense Key	Description
00	NO SENSE
05	ILLEGAL REQUEST
06	UNIT ATTENTION
0B	ABORTED COMMAND

Table 139. ASC and ASCQ

Key	ASC	ASCQ	Description
06	29	03	BUS DEVICE RESET OCCURRED
06	2F	00	COMMAND CLEARED BY ANOTHER INITIATOR
0B	44	00	INTERNAL TARGET FAILURE
05	20	00	INVALID COMMAND OPERATION CODE
05	24	00	INVALID FIELD IN CDB
05	26	00	INVALID FIELD IN PARAMETER LIST
05	49	00	INVALID MESSAGE ERROR
05	25	00	LOGICAL UNIT NOT SUPPORTED
06	29	00	POWER ON, RESET, OR BUS DEVICE RESET OCCURRED
05	35	01	UNSUPPORTED ENCLOSURE FUNCTION
05	39	00	SAVING PARAMETERS NOT SUPPORTED
0B	0E	01	INFORMATION UNIT TOO SHORT
0B	4B	02	TOO MUCH WRITE DATA
0B	4B	03	ACK/NAK TIMEOUT
0B	4B	04	NAK RECEIVED
0B	4B	05	DATA OFFSET ERROR
0B	4B	06	INITIATOR RESPONSE TIMEOUT

6. Supported VPD Page List

6.1 EVPD INQUIRY Data (Page 00)

This VPD page contains a list of the VPD page codes supported by the SES device.

Table 140. EVPD INQUIRY Data (Page 00)

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER = 0h			PERIPHERAL DEVICE TYPE = 0Db				
1	PAGE CODE (00h)							
2	(MSB)							(LSB)
3								
4	Supported VPD Page = 00h							
5	Unit Serial Number = 80h							
6	Device Identification = 83h							
7	Extended INQUIRY Data = 86h							

6.2 Unit Serial Number VPD page (Page 80h)

The Unit Serial Number VPD page provides a product serial number for the SCSI target device or logical unit.

Table 141. Unit Serial Number VPD page

Bit Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER = 0h			PERIPHERAL DEVICE TYPE = 0Db				
1	PAGE CODE (80h)							
2	(MSB)							(LSB)
3	PAGE LENGTH (n-3)							
4	(MSB)							(LSB)
...	PRODUCT SERIAL NUMBER							
n	(LSB)							

- The PERIPHERAL QUALIFIER field shall be set to 000b hex.
- PERIPHERAL DEVICE TYPE field for the enclosure services device shall be set to 0x0D hex.

6.3 EVPD INQUIRY Data (Page 83h)

The Device Identification VPD page (see Table 144) provides the means to retrieve designation descriptors applying to the logical unit. Logical units may have more than one designation descriptor (e.g., if several types or associations of designator are supported). Designators consist of one or more of the following:

- Logical unit names
- SCSI target port identifiers
- SCSI target port names
- SCSI device names
- Relative target port identifiers
- Primary target port group number
- Logical unit group number

Designation descriptors 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. Operating systems are expected to use the

designation descriptors during system configuration activities to determine whether alternate paths exist for the same peripheral device.

Table 142. EVPD INQUIRY Data (Page 83h) – Device Identification VPD Page

Byte\Bit	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER = 0h			PERIPHERAL DEVICE TYPE = 0Dh				
1	PAGE CODE (83h)							
2	(MSB)							
3	PAGE LENGTH = 20h							(LSB)
4	PROTOCOL IDENTIFIER = 6h				CODE SET = 1h			
5	RESERVED		ASSOCIATION = 1b	DESIGNATOR TYPE = 3h				
6	RESERVED = 00h							
7	DESIGNATOR LENGTH = 08h							
8	DESIGNATOR							
15	DESIGNATOR							
16	PROTOCOL IDENTIFIER = 0h				CODE SET = 1h			
17	PIV = 0b	RESERVED = 0b	ASSOCIATION = 00b		DESIGNATOR TYPE = 3h			
18	RESERVED = 00h							
19	DESIGNATOR LENGTH = 08h							
20	DESIGNATOR							
27	DESIGNATOR							

The DESIGNATOR IDENTIFIER is the SAS ADDRESS field of the enclosure device, which is obtained from the SEEPROM of the Intel backplane.

6.4 Extended INQUIRY Data VPD page (Page 86h)

The Extended INQUIRY Data VPD page provides the application client with a means to obtain information about the logical unit.

Table 143. Extended INQUIRY Data VPD page

Bit\ Byte	7	6	5	4	3	2	1	0
0	PERIPHERAL QUALIFIER=0h			PERIPHERAL DEVICE TYPE=0x0D				
1	PAGE CODE (86h)							
2	(MSB)							
3	PAGE LENGTH (003Ch)							(LSB)
4	ACTIVATE MICROCODE		SPT			GRD_CHK	APP_CHK	REF_CHK
5	Reserved		UASK_SUP	GROUP_SUP	PRIOR_SUP	HEADSUP	ORDSUP	SIMPSUP
6	Reserved				WU_SUP	CRD_SUP	NV_SUP	V_SUP
7	Reserved			P_I_I_SUP	Reserved			LUICLR
8	Reserved			R_SUP	Reserved			CBCS
9	Reserved				MULTI I_T NEXUS MICROCODE DOWNLOAD			
10	(MSB)							
11	EXTENDED SELF-TEST COMPLETION MINUTES							(LSB)
12	POA_SUP	HRA_SUP	VSA_SUP	Reserved				
13	MAXIMUM SUPPORTED SENSE DATA LENGTH							
14	Reserved							
...	Reserved							
63	Reserved							

7. SES Pages

The SES pages are used to set and report the configuration information for the enclosure. Other than the standard SES pages, the expander firmware also supports some PMC-specific SES pages for better device diagnostics which are not covered in this document.

NOTE: If a command is not listed in tables below, it is not supported.

7.1 Supported Diagnostic Page (00h)

Table 144. Supported Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0	
0	PAGE CODE (00h)								
1	Reserved								
2	(MSB)								
3	PAGE LENGTH (n - 3)							(LSB)	
4									
n	SUPPORTED SES PAGE LIST								

Table 145. Supported Diagnostic Pages

Page Code	Page Name	Control/Status
0x00	Supported Diagnostic Pages diagnostic page	Status
0x01	Configuration diagnostic page	Status
0x02	Enclosure Control diagnostic page	Control
	Enclosure Status diagnostic page	Status
0x03	Help Text diagnostic page	Status
0x04	String Out diagnostic page	Control
	String In diagnostic page	Status
0x05	Threshold Out diagnostic page	Control
	Threshold In diagnostic page	Status
0x07	Element Descriptor diagnostic page	Status
0x0A	Additional Element Status diagnostic page	Status
0x0D	Supported SES Diagnostic Pages diagnostic page	Status
0x0E	Download Microcode Control diagnostic page	Control
	Download Microcode Status diagnostic page	Status
0x0F	Subenclosure Nickname Control diagnostic page	Control
	Subenclosure Nickname Status diagnostic page	Status
0x3F	Protocol-Specific Diagnostics (SAS)	Control
0x80	Vendor Specific Undocumented Command	Unsupported
0x81	Vendor Specific Undocumented Command	Unsupported
0x82	Vendor Specific Undocumented Command	Unsupported
0x83	Vendor Specific Undocumented Command	Unsupported
0x84	Vendor Specific Undocumented Command	Unsupported
0x85	Vendor Specific Undocumented Command	Unsupported
0x86	Vendor Specific Undocumented Command	Unsupported
0x90	Vendor Specific Undocumented Command	Unsupported
0x91	Vendor Specific Undocumented Command	Unsupported
0xF0	Vendor Specific Undocumented Command	Unsupported
0xF1	Vendor Specific Undocumented Command	Unsupported
0xF2	Vendor Specific Undocumented Command	Unsupported
0xF3	Vendor Specific Undocumented Command	Unsupported

7.2 Configuration Diagnostic Page (01h)

Table 146. Configuration Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (01h)							
1	NUMBER OF SECONDARY SUBENCLOSURES = 0							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Enclosure descriptor list								
8	Enclosure descriptor(s) (one per subenclosure)							
Type descriptor header list								
Type descriptor header(s)								
Type descriptor text list								
n	Type descriptor text(s) (one per type descriptor header)							

Table 147. Configuration Diagnostic Page Fields for 12 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x01
	1	Number of sub enclosures	0x00
	2-3	Page Length (n-3)	0xD8
Generation Code	4-7	Generation Code	0x00000000
Enclosure Descriptor Header	8[0-3]	Rsvd Number of Enclosure Services Processes	0x1
	8[4-7]	Rsvd Relative enclosure service process identifier	0x0
	9	Subenclosure Identifier	0x00
	10	Number of type descriptor headers	0x5
	11	Enclosure Descriptor Len (m-3)	0x58
Enclosure Descriptor	12-19	Enclosure Logical Identifier	These fields are same as the related fields in SMP REPORT GENERAL and REPORT MANUFACTURER INFORMATION response
	20-27	Enclosure Vendor Identification	
	28-43	Product Identification	
	44-47	Product Revision Level	
	48-99	Vendor Specific Information	
Type Descriptor Header List 0	100	Element Type	0x17 (Array Device Slot)
	101	Number of Possible Elements	12
	102	Subenclosure Identifier	00
	103	Type descriptor Text Length	16
Type Descriptor Header List 1	104	Element Type	0x02(Power Supply)
	105	Number of Possible Elements	2
	106	Subenclosure Identifier	00
	107	Type descriptor Text Length	16
Type Descriptor Header List 2	108	Element Type	0x03(Cooling)

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	109	Number of Possible Elements	4
	110	Subenclosure Identifier	00
	111	Type descriptor Text Length	16
Type Descriptor Header List 3	112	Element Type	0x04(Temperature Sensor)
	113	Number of Possible Elements	2
	114	Subenclosure Identifier	00
	115	Type descriptor Text Length	16
	116	Element Type	0x12(Voltage Sensor)
	117	Number of Possible Elements	3
	118	Subenclosure Identifier	00
	119	Type descriptor Text Length	16
Type Descriptor Header List 5	120	Element Type	0x0E(Enclosure Element)
	121	Number of Possible Elements	1
	122	Subenclosure Identifier	00
	123	Type descriptor Text Length	16
Type Descriptor Text List 0	124-139	Element Descriptor Text	"Array Device "
Type Descriptor Text List 1	140-155	Element Descriptor Text	"Power Supply "
Type Descriptor Text List 2	156-171	Element Descriptor Text	"Cooling "
Type Descriptor text List 3	172-187	Element Descriptor Text	"Temperature "
Type Descriptor Text List 4	188-203	Element Descriptor Text	"Voltage "
Type Descriptor Text List 4	204-219	Element Descriptor Text	"Enclosure "

Table 148. Configuration Diagnostic Page Fields for 24 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x01
	1	Number of sub enclosures	0x00
	2-3	Page Length (n-3)	0xD8
Generation Code	4-7	Generation Code	0x00000000
Enclosure Descriptor Header	8[0-3]	Rsvd Number of Enclosure Services Processes	0x1
	8[4-7]	Rsvd Relative enclosure service process identifier	0x0
	9	Subenclosure Identifier	0x00
	10	Number of type descriptor headers	0x5
	11	Enclosure Descriptor Len (m-3)	0x58
Enclosure Descriptor	12-19	Enclosure Logical Identifier	These fields are same as the related fields in SMP REPORT GENERAL and REPORT MANUFACTURER INFORMATION response
	20-27	Enclosure Vendor Identification	
	28-43	Product Identification	
	44-47	Product Revision Level	
	48-99	Vendor Specific Information	
Type Descriptor Header List 0	100	Element Type	0x17 (Array Device Slot)
	101	Number of Possible Elements	24
	102	Subenclosure Identifier	00
	103	Type descriptor Text Length	16
Type Descriptor Header List 1	104	Element Type	0x02(Power Supply)
	105	Number of Possible Elements	2
	106	Subenclosure Identifier	00

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	107	Type descriptor Text Length	16
Type Descriptor Header List 2	108	Element Type	0x03(Cooling)
	109	Number of Possible Elements	4
	110	Subenclosure Identifier	00
	111	Type descriptor Text Length	16
Type Descriptor Header List 3	112	Element Type	0x04(Temperature Sensor)
	113	Number of Possible Elements	2
	114	Subenclosure Identifier	00
	115	Type descriptor Text Length	16
	116	Element Type	0x12(Voltage Sensor)
	117	Number of Possible Elements	3
	118	Subenclosure Identifier	00
	119	Type descriptor Text Length	16
Type Descriptor Header List 5	120	Element Type	0x0E(Enclosure Element)
	121	Number of Possible Elements	1
	122	Subenclosure Identifier	00
	123	Type descriptor Text Length	16
Type Descriptor Text List 0	124-139	Element Descriptor Text	"Array Device "
Type Descriptor Text List 1	140-155	Element Descriptor Text	"Power Supply "
Type Descriptor Text List 2	156-171	Element Descriptor Text	"Cooling "
Type Descriptor text List 3	172-187	Element Descriptor Text	"Temperature "
Type Descriptor Text List 4	188-203	Element Descriptor Text	"Voltage "
Type Descriptor Text List 4	204-219	Element Descriptor Text	"Enclosure "

The Vendor Specific Information, displayed in Table 151, contains the information on the firmware version, including the backplane type, the backplane part number, the kernel revision and the application revision.

Table 149. Vendor-Specific Information

Component Name	Bytes	Field Name	Value
Vendor Specific Information	0	Configuration mode	0x00
	1-32	Backplane Type	0x00
	33-41	Backplane Part Number	0x00
	42	Reserved	0x00
	43-46	Kernel Version	0x00
	47-50	Firmware Version	0x00
	51	Reserved	0x00

NOTE: Vendor-Specific information is not implemented, but reflects template data only.

- There are 12 or 24 Array Device Slot elements, 2 Power Supply elements, 4 Cooling Fan elements, 2 Temperature elements, 3 Voltage elements and 1 enclosure elements in the system.
- The type descriptor header list contains the type descriptor headers in the following order regardless of their sub-enclosure identifiers:
 - Array Device Slot element
 - Power Supply element
 - Cooling Fan element
 - Temperature element
 - Voltage Sensor element
 - Enclosure element

7.3 Enclosure Control Diagnostic Page (02h)

Table 150. Enclosure Control Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (02h)							
1	Reserved				INFO	NON-CRIT	CRIT	UNRECOVER
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	EXPECTED GENERATION CODE						(LSB)
7								
Control descriptor list								
8	Control descriptor (first)							
...								
n	Control descriptor (last)							

Table 151. Enclosure Control Diagnostic Page Fields 12 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0x7C
Generation Code	4-7	Expected Generation Code	0x00000000
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167 For elements of type voltage refer to Table 168
	12-15	Element Control (1 st element of Array Device Slot type)	
	56-59	Element Control (12 th element of Array Device Slot type)	
	60-63	Overall Control (Power Supply type)	
	64-67	Element Control (1 st element of Power Supply element type)	
	68-71	Element Control (2 nd element of Power Supply element type)	
	72-75	Overall Control (Cooling Fan type)	
	76-79	Element Control (1 st element of Cooling Fan type)	
	80-83	Element Control (2 nd element of Cooling Fan type)	
	84-87	Element Control (3 rd element of Cooling Fan type)	
	88-91	Element Control (4 th element of Cooling Fan type)	
	92-95	Overall Control (Temperature type)	
	96-99	Element Control (1 st element of Temperature type)	
	100-103	Element Control (2 nd element of Temperature type)	
	104-107	Overall Control (Voltage Sensor type)	
	108-111	Element Control (1 st element of Voltage Sensor type)	
	112-115	Element Control (2 nd element of Voltage Sensor type)	
116-119	Element Control (3 rd element of Voltage Sensor type)		
120-123	Overall Control (Enclosure Type)		
124-127	Element Control (1st element of Enclosure type)		

Table 152. Enclosure Control Diagnostic Page Fields 24 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0xAC
Generation Code	4-7	Expected Generation Code	0x00000000

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167 For elements of type voltage refer to Table 168
	12-15	Element Control (1 st element of Array Device Slot type)	
	.		
	104-107	Element Control (24 th element of Array Device Slot type)	
	108-111	Overall Control (Power Supply type)	
	112-115	Element Control (1 st element of Power Supply element type)	
	116-119	Element Control (2 nd element of Power Supply element type)	
	120-123	Overall Control (Cooling Fan type)	
	124-127	Element Control (1 st element of Cooling Fan type)	
	128-131	Element Control (2 nd element of Cooling Fan type)	
	132-135	Element Control (3 rd element of Cooling Fan type)	
	136-139	Element Control (4 th element of Cooling Fan type)	
	140-143	Overall Control (Temperature type)	
	144-147	Element Control (1 st element of Temperature type)	
	148-151	Element Control (2 nd element of Temperature type)	
	152-155	Overall Control (Voltage Sensor type)	
	156-159	Element Control (1 st element of Voltage Sensor type)	
	160-163	Element Control (2 nd element of Voltage Sensor type)	
	164-167	Element Control (3 rd element of Voltage Sensor type)	
	168-171	Overall Control (Enclosure Type)	
172-175	Element Control (1st element of Enclosure type)		

7.4 String Out Diagnostic Page (04h)

Table 153. String Out Page Format

Byte\Bit	7	6	5	4	3	2	1	0	
0	PAGE CODE (04h)								
1	Obsolete								
2	(MSB)	PAGE LENGTH (n - 3)							
3								(LSB)	
4	PRIMARY SUBENCLOSURE STRING OUT DATA								
n									

Table 154. String Out Diagnostic Page Fields

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x04
	1	Obsolete	0x00
	2-3	Page Length	n-3
Vendor Specific	4	Command	See Table 157 "String Out Diagnostic Commands".
	5-n	User Data	

This page provides SES diagnostic commands to download the firmware images, reset the board, update

EEPROM data, program the CPLD, and control the FAN's speeds.

Table 155. String Out Diagnostic Commands

Command	Purpose	Data	Notes
0x01	Download Firmware	The binary firmware images, including bootloader, main firmware, initialization string, boot configuration.	Not supported for field firmware updates.
0x02	Reboot	01: soft-reset 02: hard-reset	This command causes the board to soft-reset or hard-reset.
0x06	Test FAN's speed	5[0-2] Speed code This field is valid only when the bit 5[3] is ZERO.	
		5[3] 1: Firmware automatically controls mode 0: Manually control mode via SES page	
		5[4-7] Reserved	

7.5 String In Diagnostic Page (04h)

Table 156. String In Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (04h)							
1	Obsolete							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	PRIMARY SUBENCLOSURE STRING IN DATA							
n								

Table 157. String In Diagnostic Page Fields

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x04
	1	Sub-Enclosure Identifier	0x00
	2-3	Page Length (n-3)	0x04
Vendor Specific	4	Firmware Download Status	Firmware Download Status Field
	5-7	Reserved	0

- This page gets the firmware download status.
- Download Status: Firmware download using String Out Diagnostic Page is not supported.

7.6 Threshold Out Diagnostic Page (05h)

Table 158. Threshold Out Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (05h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	EXPECTED GENERATION CODE						(LSB)
7								
Threshold control descriptor list								

SCSI Enclosure Services Programming Guide

Byte\Bit	7	6	5	4	3	2	1	0
8	Threshold control descriptor (first)							
	...							
n	Threshold control descriptor (last)							

Table 159. Threshold Out Diagnostic Page Fields 12 slot

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0x7C
Generation Code	4-7	Expected Generation Code	0x00000000
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167 For elements of type voltage refer to Table 168
	12-15	Element Control (1 st element of Array Device Slot type)	
	.		
	56-59	Element Control (12 th element of Array Device Slot type)	
	60-63	Overall Control (Power Supply type)	
	64-67	Element Control (1 st element of Power Supply element type)	
	68-71	Element Control (2 nd element of Power Supply element type)	
	72-75	Overall Control (Cooling Fan type)	
	76-79	Element Control (1 st element of Cooling Fan type)	
	80-83	Element Control (2 nd element of Cooling Fan type)	
	84-87	Element Control (3 rd element of Cooling Fan type)	
	88-91	Element Control (4 th element of Cooling Fan type)	
	92-95	Overall Control (Temperature type)	
	96-99	Element Control (1 st element of Temperature type)	
	100-103	Element Control (2 nd element of Temperature type)	
	104-107	Overall Control (Voltage Sensor type)	
	108-111	Element Control (1 st element of Voltage Sensor type)	
	112-115	Element Control (2 nd element of Voltage Sensor type)	
116-119	Element Control (3 rd element of Voltage Sensor type)		
120-123	Overall Control (Enclosure Type)		
124-127	Element Control (1st element of Enclosure type)		

Table 160. Threshold Out Diagnostic Page Fields 24 slot

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0xAC
Generation Code	4-7	Expected Generation Code	0x00000000
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167
	12-15	Element Control (1 st element of Array Device Slot type)	
	.		
	104-107	Threshold Control (24 th element of Array Device Slot type)	

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	108-111	Threshold Control (Power Supply type)	For elements of type voltage refer to Table 168
	112-115	Threshold Control (1 st element of Power Supply element type)	
	116-119	Threshold Control (2 nd element of Power Supply element type)	
	120-123	Overall Threshold Control (Cooling Fan type)	
	124-127	Element Control (1 st element of Cooling Fan type)	
	128-131	Threshold Control (2 nd element of Cooling Fan type)	
	132-135	Threshold Control (3 rd element of Cooling Fan type)	
	136-139	Threshold Control (4 th element of Cooling Fan type)	
	140-143	Threshold Control (Temperature type)	
	144-147	Element Control (1 st element of Temperature type)	
	148-151	Threshold Control (2 nd element of Temperature type)	
	152-155	Overall Threshold Control (Voltage Sensor type)	
	156-159	Threshold Control (1 st element of Voltage Sensor type)	
	160-163	Threshold Control (2 nd element of Voltage Sensor type)	
	164-167	Threshold Control (3 rd element of Voltage Sensor type)	
	168-171	Overall Control (Enclosure Type)	
	172-175	Element Control (1st element of Enclosure type)	

- This page sets the threshold for the following elements:
 - Array Device Slot element
 - Power Supply element
 - Cooling Fan element
 - Temperature element
 - Voltage Sensor element
 - Enclosure element
- Only the thresholds for Temperature elements and Voltage elements are valid.

NOTE: The new HIGH CRITICAL/WARNING threshold value should be less than the default value and the new LOW CRITICAL/WARNING threshold value should be larger than the default value. Refer to Table 166, Table 167 and Table 168 for the default threshold values. The Overall Threshold Control is not supported.

7.7 Threshold In Diagnostic Page (05h)

Table 161. Threshold In Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (05h)							
1	Reserved				INVOP	Reserved		
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Threshold status descriptor list								
8	Threshold status descriptor (first)							
...								
n	Threshold status descriptor (last)							

Table 162. Threshold In Diagnostic Page Fields 12 Slot

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0x7C
Generation Code	4-7	Expected Generation Code	0x00000000
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167 For elements of type voltage refer to Table 168
	12-15	Element Control (1 st element of Array Device Slot type)	
	.		
	56-59	Element Control (12 th element of Array Device Slot type)	
	60-63	Overall Control (Power Supply type)	
	64-67	Element Control (1 st element of Power Supply element type)	
	68-71	Element Control (2 nd element of Power Supply element type)	
	72-75	Overall Control (Cooling Fan type)	
	76-79	Element Control (1 st element of Cooling Fan type)	
	80-83	Element Control (2 nd element of Cooling Fan type)	
	84-87	Element Control (3 rd element of Cooling Fan type)	
	88-91	Element Control (4 th element of Cooling Fan type)	
	92-95	Overall Control (Temperature type)	
	96-99	Element Control (1 st element of Temperature type)	
	100-103	Element Control (2 nd element of Temperature type)	
	104-107	Overall Control (Voltage Sensor type)	
	108-111	Element Control (1 st element of Voltage Sensor type)	
	112-115	Element Control (2 nd element of Voltage Sensor type)	
	116-119	Element Control (3 rd element of Voltage Sensor type)	
120-123	Overall Control (Enclosure Type)		
124-127	Element Control (1 st element of Enclosure type)		

Table 163. Threshold In Diagnostic Page Fields 24 Slot

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x02
	1	System Control Byte	0x00
	2-3	Page Length (n-3)	0xAC
Generation Code	4-7	Expected Generation Code	0x00000000
Element Control	8-11	Overall Control (Array Device Slot type)	For elements of type temperature refer to Table 166 and Table 167 For elements of type voltage refer to Table 168
	12-15	Element Control (1 st element of Array Device Slot type)	
	.		
	104-107	Threshold Control (24 th element of Array Device Slot type)	
	108-111	Threshold Control (Power Supply type)	
	112-115	Threshold Control (1 st element of Power Supply element type)	
	116-119	Threshold Control (2 nd element of Power Supply element type)	
	120-123	Overall Threshold Control (Cooling Fan type)	
124-127	Element Control (1 st element of Cooling Fan type)		

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	128-131	Threshold Control (2 nd element of Cooling Fan type)	
	132-135	Threshold Control (3 rd element of Cooling Fan type)	
	136-139	Threshold Control (4 th element of Cooling Fan type)	
	140-143	Threshold Control (Temperature type)	
	144-147	Element Control (1 st element of Temperature type)	
	148-151	Threshold Control (2 nd element of Temperature type)	
	152-155	Overall Threshold Control (Voltage Sensor type)	
	156-159	Threshold Control (1 st element of Voltage Sensor type)	
	160-163	Threshold Control (2 nd element of Voltage Sensor type)	
	164-167	Threshold Control (3 rd element of Voltage Sensor type)	
	168-171	Overall Control (Enclosure Type)	
	172-175	Element Control (1st element of Enclosure type)	

- This page gets the threshold for the following elements:
 - Array Device Slot element
 - Power Supply element
 - Cooling Fan element
 - Temperature element
 - Voltage Sensor element
 - Enclosure element
- Only the thresholds for Temperature elements and Voltage elements are valid.
- Refer to the Table 166, Table 167 and Table 168 for the default threshold values. The Overall Threshold Status is not supported.

Table 164. FP Temperature Element Default Threshold Value

Bytes	Field Name	Value
0	HIGH CRITICAL THRESHOLD	55 (35°C + 20)
1	HIGH WARNING THRESHOLD	53 (33°C + 20)
2	LOW WARNING THRESHOLD	25 (5°C + 20)
3	LOW CRITICAL THRESHOLD	20 (0°C + 20)

Table 165. Expander Temperature Element Default Threshold Value

Bytes	Field Name	Value
0	HIGH CRITICAL THRESHOLD	125 (105°C + 20)
1	HIGH WARNING THRESHOLD	120 (100°C + 20)
2	LOW WARNING THRESHOLD	25 (5°C + 20)
3	LOW CRITICAL THRESHOLD	20 (0°C + 20)

Table 166. ADT7476 Voltage Element Default Threshold Value

Bytes	Field Name	Value
0	HIGH CRITICAL THRESHOLD	30(+15%)
1	HIGH WARNING THRESHOLD	20(+10%)
2	LOW WARNING THRESHOLD	20(-10%)
3	LOW CRITICAL THRESHOLD	30(-15%)

The 3.3V, 5V, 12V voltages have the same default threshold values.

7.8 Element Description Diagnostic Page (07h)

Table 167. Element Description Diagnostic Page Format

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (07h)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Element descriptor by type list								
8	Element descriptor by type descriptor (first element type)							
...								
n	Element descriptor by type descriptor (last element type)							

Table 168. Element Description Diagnostic Page Fields 12 slot

Component Name	Bytes	Field Name	Value	
Page Header	0	Page Code	0x07	
	1	Reserved	0x00	
	2-3	Page Length (n-3)	0x25C	
Generation Code	4-7	Generation Code	0x00000000	
Element Descriptor	8-9	Overall Descriptor (Array Device Slot type)	Reserved	0x0000
	10-11		LENGTH	0x10
	12-27		DESCRIPTOR	"Array Device OV "
	28-29	Element Descriptor (1 st element of Array Device Slot type)	Reserved	0x0000
	30-31		LENGTH	0x10
	32-47		DESCRIPTOR	"Array Device 00 "
			
	248-249	Element Descriptor (12 th of element of Array Device Slot type)	Reserved	0x0000
	250-251		LENGTH	0x10
	252-267		DESCRIPTOR	"Array Device 11 "
	268-269	Overall Descriptor (Power Supply type)	Reserved	0x0000
	270-271		LENGTH	0x10
	272-287		DESCRIPTOR	"Power Supply OV "
	288-289	Element Descriptor (1 st element of Power Supply type)	Reserved	0x0000
	290-291		LENGTH	0x10
	292-307		DESCRIPTOR	"Power Supply 00 "
	308-309	Element Descriptor (2 nd of element of Power Supply type)	Reserved	0x0000
	310-311		LENGTH	0x10
	312-327		DESCRIPTOR	"Power Supply 01 "
	328-329	Overall Descriptor (Cooling Fan type)	Reserved	0x0000
	330-331		LENGTH	0x10
332-347	DESCRIPTOR		"Cooling OV "	
348-349	Element Descriptor (1 st element of Cooling Fan type)	Reserved	0x0000	
350-351		LENGTH	0x10	
352-367		DESCRIPTOR	"Cooling 00 "	

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	368-369	Element Descriptor (2 nd element of Cooling Fan type)	Reserved
	370-371		LENGTH
	372-387		DESCRIPTOR
	388-389	Element Descriptor (3 rd element of Cooling Fan type)	Reserved
	390-391		LENGTH
	392-407		DESCRIPTOR
	408-409	Element Descriptor (4 th of element of Cooling Fan)	Reserved
	410-411		LENGTH
	412-427		DESCRIPTOR
	428-429	Overall Descriptor (Temperature type)	Reserved
	430-431		LENGTH
	432-447		DESCRIPTOR
	448-449	Element Descriptor (1 st element of Temperature type)	Reserved
	450-451		LENGTH
	452-467		DESCRIPTOR
	468-469	Element Descriptor (2 nd element of Temperature type)	Reserved
	470-471		LENGTH
	472-487		DESCRIPTOR
	488-489	Overall Descriptor (Voltage type)	Reserved
	490-491		LENGTH
	492-507		DESCRIPTOR
	508-509	Element Descriptor (1 st element of Voltage type)	Reserved
	510-511		LENGTH
	512-527		DESCRIPTOR
	528-529	Element Descriptor (2 nd of element of Voltage type)	Reserved
	530-531		LENGTH
	532-547		DESCRIPTOR
	548-549	Element Descriptor (3 rd of element of Voltage type)	Reserved
	550-551		LENGTH
	552-567		DESCRIPTOR
	568-569	Overall Descriptor	Reserved
	570-571		LENGTH
	572-587		DESCRIPTOR
	588-589	Element Descriptor (1 st of element of Enclosure type)	Reserved
	590-591		LENGTH
	592-607		DESCRIPTOR

Table 169. Element Description Diagnostic Page Fields 24 slot

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x07
	1	Reserved	0x00
	2-3	Page Length (n-3)	0x34C
Generation Code	4-7	Generation Code	0x00000000
Element Descriptor	8-9	Overall Descriptor (Array Device Slot type)	Reserved
	10-11		LENGTH
	12-27		DESCRIPTOR

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	28-29	Element Descriptor (1 st element of Array Device Slot type)	Reserved
	30-31		LENGTH
	32-47		DESCRIPTOR
....			
	488-489	Element Descriptor (24 th of element of Array Device Slot type)	Reserved
	490-491		LENGTH
	492-507		DESCRIPTOR
	508-509	Overall Descriptor (Power Supply type)	Reserved
	510-511		LENGTH
	512-527		DESCRIPTOR
	528-529	Element Descriptor (1 st element of Power Supply type)	Reserved
	530-531		LENGTH
	532-547		DESCRIPTOR
	548-549	Element Descriptor (2 nd of element of Power Supply type)	Reserved
	550-551		LENGTH
	552-567		DESCRIPTOR
	568-569	Overall Descriptor (Cooling Fan type)	Reserved
	570-571		LENGTH
	572-587		DESCRIPTOR
	588-589	Element Descriptor (1 st element of Cooling Fan type)	Reserved
	590-591		LENGTH
	592-607		DESCRIPTOR
	608-609	Element Descriptor (2 nd element of Cooling Fan type)	Reserved
	610-611		LENGTH
	612-627		DESCRIPTOR
	628-629	Element Descriptor (3 rd element of Cooling Fan type)	Reserved
	630-631		LENGTH
	632-647		DESCRIPTOR
	648-649	Element Descriptor (4 th of element of Cooling Fan)	Reserved
	650-651		LENGTH
	652-667		DESCRIPTOR
	668-669	Overall Descriptor (Temperature type)	Reserved
	670-671		LENGTH
	672-687		DESCRIPTOR
	688-689	Element Descriptor (1 st element of Temperature type)	Reserved
	690-691		LENGTH
	692-707		DESCRIPTOR
	708-709	Element Descriptor (2 nd element of Temperature type)	Reserved
	710-711		LENGTH
	712-727		DESCRIPTOR
	728-729	Overall Descriptor (Voltage type)	Reserved
	730-731		LENGTH
	732-747		DESCRIPTOR
	748-749	Element Descriptor (1 st element of Voltage)	Reserved
	750-751		LENGTH

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name		Value
	752-767	type)	DESCRIPTOR	"Voltage 00 "
	768-769	Element Descriptor (2 nd of element of Voltage type)	Reserved	0x0000
	770-771		LENGTH	0x10
	772-787		DESCRIPTOR	"Voltage 01 "
	788-789	Element Descriptor (3 rd of element of Voltage type)	Reserved	0x0000
	790-791		LENGTH	0x10
	792-807		DESCRIPTOR	"Voltage 02 "
	808-809	Overall Descriptor	Reserved	0x0000
	810-811		LENGTH	0x10
	812-827		DESCRIPTOR	"Element OV "
	828-829	Element Descriptor (1 st of element of Enclosure type)	Reserved	0x0000
	830-831		LENGTH	0x10
	832-847		DESCRIPTOR	"Enclosure 00 "

This page reports the element descriptor for all elements in all element types by the order listed in the Configuration Diagnostic Page (01h):

- Array Device Slot element
- Power Supply element
- Cooling Fan element
- Temperature element
- Voltage Sensor element
- Enclosure element

7.9 Additional Element Status Diagnostic Page (0Ah)

Table 170. Additional Element Status Diagnostic Page Format for 24 slots

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Ah)							
1	Reserved							
2	(MSB)	PAGE LENGTH (n - 3)						(LSB)
3								
4	(MSB)	GENERATION CODE						(LSB)
7								
Additional Element status descriptor list								
8	Additional Element status descriptor (first)							
...								
N	Additional Element status descriptor (last)							

Table 171. Additional Element Status Page Fields for 12 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x0A
	1	Reserved	0x00
	2-3	Page Length (n-3)	0x1B4
Generation Code	4-7	Generation Code	0x00000000
Additional Element Status for Array Device Slot elements	8-43	Additional Element Status Descriptor for Device 1	Additional Element Status Descriptor (refer to Table 175)
	--		

SCSI Enclosure Services Programming Guide

Component Name	Bytes	Field Name	Value
	404 to 439	Additional Element Status Descriptor for Device 12	

Table 172. Additional Element Status Page Fields for 24 slots

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x0A
	1	Reserved	0x00
	2-3	Page Length (n-3)	0x364
Generation Code	4-7	Generation Code	0x00000000
Additional Element Status for Array Device Slot elements	8-43	Additional Element Status Descriptor for Device 1	Additional Element Status Descriptor (refer to Table 175)
	--		
	836 to 871	Additional Element Status Descriptor for Device 24	

This page provides additional information for Array Device Slot elements.

Table 173. Additional Element Status Descriptor with EIP Bit Set To One

Byte\Bit	7	6	5	4	3	2	1	0	
0	Invalid	Reserved		EIP(1b)	Protocol Identifier(6h)				
1	Additional Element Status Descriptor Length								
2	Reserved								
3	Element Index								
4	Number Of PHY Descriptors								
5	Descriptor Type(00b)		Reserved			Not All PHYs			
6	Reserved								
7	Device Slot Number								
8	Reserved	Device Type			Reserved				
9	Reserved								
10	Reserved				SSP Initiator Port	STP Initiator Port	SMP Initiator Port	Reserved	
11	SATA Port Selector	Reserved			SSP Target Port	STP Target Port	SMP Target Port	SATA Device	
12	Attached SAS Address								
19									
20									
27	SAS Address								
28	PHY Identifier								
29	Reserved								
35									

7.10 Supported SES Diagnostic Pages diagnostic page (0Dh)

Table 174. Supported SES Diagnostic Pages diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Dh)							
1	Reserved							
2	(MSB)							
3	PAGE LENGTH (n - 3)							(LSB)
4	SUPPORTED SES PAGE LIST							
n	PAD (if needed)							

- The PAGE CODE field is set to 0Dh.
- The PAGE LENGTH field indicates the number of bytes that follow in the diagnostic page.
- The SUPPORTED SES PAGE LIST field contains a list of all diagnostic page codes, one per byte, in the range of 01h to 2Fh that are implemented by the enclosure services process. It shall be sorted in ascending order beginning with page code 01h. The Supported SES Diagnostic Pages page code (i.e., 0Dh) shall be included in the list.
- The PAD field contains zero, one, two, or three bytes set to 00h such that the total length of the diagnostic page is a multiple of four.

Table 175. Supported Diagnostic Page Fields

Component Name	Bytes	Field Name	Value
Page Header	0	Page Code	0x0D
	1	Reserved	0x00
	2-3	Page Length (n-3)	0x000C
Supported SES Page List	4	Page Code 0	0x01
	5	Page Code 1	0x02
	6	Page Code 2	0x03
	7	Page Code 3	0x04
	8	Page Code 4	0x05
	9	Page Code 5	0x07
	10	Page Code 6	0x0A
	11	Page Code 7	0x0D
	12	Page Code 8	0x0E
	13	Page Code 9	0x0F
	14	Pad Code	0x00
	15	Pad Code	0x00

7.11 Download Microcode Control diagnostic page (0Eh)

The Download Microcode Control diagnostic page transmits a vendor specific microcode (i.e., firmware) image to the control memory space of the enclosure services process. The image may be saved to non-volatile storage (e.g., a flash ROM).

The Download Microcode Control diagnostic page is written by the SEND DIAGNOSTIC command. A RECEIVE DIAGNOSTIC RESULTS command with a PCV bit set to one and a PAGE CODE field set to 0Eh is defined as the request to read the Download Microcode Status diagnostic page (see Section 7.12).

The microcode image may be sent using one or more SEND DIAGNOSTIC commands. If the complete set of SEND DIAGNOSTIC commands required to deliver the microcode image are not received before:

- For standalone enclosure services processes (see Note 1 below), a logical unit reset, hard reset, power on, or I_T nexus lossor.
- For attached enclosure services processes (see **Note 2** below), power on, then the incomplete microcode image shall not be used.

If an error is detected, then the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to the appropriate value in the Download Microcode Status diagnostic page.

Table 176. Download Microcode Control diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Eh)							
1	SUBENCLOSURE IDENTIFIER							
2	(MSB)							(LSB)
3	PAGE LENGTH (n - 3)							
4	(MSB)							(LSB)
7	EXPECTED GENERATION CODE							
8	DOWNLOAD MICROCODE MODE							
9	Reserved							
10	BUFFER ID							
11	(MSB)							(LSB)
12	BUFFER OFFSET							
15	(MSB)							(LSB)
16	MICROCODE IMAGE LENGTH							
19	(MSB)							(LSB)
20	MICROCODE DATA LENGTH (m - 23)							
23	(MSB)							(LSB)
24	MICROCODE DATA							
m	MICROCODE DATA							
m + 1	MICROCODE DATA							
n	PAD (if needed)							

- The PAGE CODE field is set to 0Eh.
- The SUBENCLOSURE IDENTIFIER field specifies the subenclosure to which the application client is sending the microcode image. When a single subenclosure is present, it is considered the primary subenclosure. When multiple subenclosures are present:
 - The primary subenclosure is the subenclosure whose enclosure services process provides access to enclosure services information of all the subenclosures.
- And
 - All other subenclosures are considered secondary subenclosures.
- If the SUBENCLOSURE IDENTIFIER field does not match a SUBENCLOSURE IDENTIFIER field value found in the Configuration diagnostic page (Section 7.2), then the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.
- The PAGE LENGTH field specifies the number of bytes that follow in the diagnostic page. If the PAGE LENGTH field value does not match the number of bytes that follow in the diagnostic page, then the enclosure services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.
- The EXPECTED GENERATION CODE field is defined in the Enclosure Control diagnostic page (Section 7.3). If the EXPECTED GENERATION CODE field is not set to the current generation code, then the enclosure

services process shall abort the download microcode operation and set the SUBENCLOSURE DOWNLOAD MICROCODE STATUS field to 80h in the Download Microcode Status diagnostic page.

- Download Microcode Mode: Expander firmware support the below three modes.
 - Mode 0x07: Download microcode with offsets, save, and activate.
 - Mode 0x0E: Download microcode with offsets, save, and defer activation.
 - Mode 0x0F: Activate deferred microcode. The page will cause a reset of expander, and new microcode will be executed.
- Buffer Offset: the current offset in bytes within the firmware image.
- Microcode Image Length: the total number of bytes in the firmware image.
- Microcode Data Length: the number of bytes in the Microcode Data field.
- PAD: fill the field so that the total length of the page is a multiple of four bytes.

7.12 Download Microcode Status diagnostic page (0Eh)

The Download Microcode Status diagnostic page transmits information about the status of one or more download microcode operations to the application client.

The transmission of a page using the SEND DIAGNOSTIC command with a PAGE CODE field set to 0Eh is defined as the transmission of a Download Microcode Control diagnostic page (see Table 178).

Table 177. Download Microcode Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0	
0	PAGE CODE (0Eh)								
1	NUMBER OF SECONDARY SUBENCLOSURES								
2	(MSB)	PAGE LENGTH (n - 3)							
3								(LSB)	
4	(MSB)	GENERATION CODE							
7								(LSB)	
Download microcode status descriptor list									
8	Download microcode status descriptor (primary subenclosure)(see table 51)								
23									
...									
n - 15	Download microcode status descriptor (last subenclosure)(see table 51)								
n									

- The PAGE CODE field is set to 0Eh.
- The NUMBER OF SECONDARY SUBENCLOSURES field indicates the number of separate subenclosure download microcode status descriptors that are included in the download microcode status descriptor list, not including the primary subenclosure download microcode status descriptor. The NUMBER OF SECONDARY SUBENCLOSURES field shall be set to the same value as the NUMBER OF SECONDARY SUBENCLOSURES field in the Configuration diagnostic page (see Section 7.2).
- The PAGE LENGTH field indicates the number of bytes that follow in the diagnostic page.
- The GENERATION CODE field indicates the value of the four-byte wrapping counter called the generation code.
- The download microcode status descriptor list contains a download microcode status descriptor for each download microcode operation for which status is being reported.

Table 178. Download microcode status descriptor format

Byte\Bit	7	6	5	4	3	2	1	0
0	Reserved							
1	SUBENCLOSURE IDENTIFIER							
2	SUBENCLOSURE DOWNLOAD MICROCODE STATUS							
3	SUBENCLOSURE DOWNLOAD MICROCODE ADDITIONAL STATUS							
4	(MSB)	SUBENCLOSURE DOWNLOAD MICROCODE MAXIMUM SIZE						(LSB)
7								
8	Reserved							
10								
11	SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER ID							
12	(MSB)	SUBENCLOSURE DOWNLOAD MICROCODE EXPECTED BUFFER OFFSET						(LSB)
15								

Subenclosure Download Microcode Status: the status of download microcode operation.

Firmware may return one of the below values, depending on the Download Microcode Control diagnostic page and the download operation.

- **00h:** No download microcode operation in progress.
- **01h:** Download in progress.
- **10h:** Download complete with no error, and firmware begins using new microcode after returning this page.
- **11h:** Download complete with no error, and firmware begins using new microcode after the next hard reset or power on.
- **13h:** Download complete with no error, firmware begins using new microcode after hard reset, power on, or processing a Download Microcode Control diagnostic page specifying the activate deferred microcode mode.
- **80h:** Error in one or more of the Download Microcode Control diagnostic page fields, new microcode discarded.
- **81h:** CRC checksum error, new microcode discarded.
- **84h:** Internal error in the download microcode operation.
- **85h:** Try to activate the deferred microcode when there is no deferred microcode.

7.13 Subenclosure Nickname Control diagnostic page (0Fh)

This page allows the host application to transmit a text string to the enclosure service process to serve as the nickname for the specified sub-enclosure.

Table 179. Subenclosure Nickname Control diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0
0	PAGE CODE (0Fh)							
1	SUBENCLOSURE IDENTIFIER							
2	(MSB)	PAGE LENGTH (n-3)						(LSB)
3								
4	(MSB)	EXPECTED GENERATION CODE						(LSB)
7								
8								
39	SUBENCLOSURE NICKNAME							

- The PAGE CODE field is set to 0Fh.
- The SUBENCLOSURE IDENTIFIER field specifies the subenclosure to which the application client is sending the subenclosure nickname.
- The PAGE LENGTH field specifies the number of bytes that follow in the diagnostic page. If the PAGE LENGTH field value does not match the length of the page, then the enclosure services process shall not change the subenclosure nickname and shall set the SUBENCLOSURE NICKNAME MICROCODE STATUS field to 80h in the Subenclosure Nickname Status diagnostic page.
- The EXPECTED GENERATION CODE field is defined in the Enclosure Control diagnostic page (see Section 7.3). If the EXPECTED GENERATION CODE field is not set to the current generation code, the enclosure services process shall not change the subenclosure nickname and shall set the SUBENCLOSURE NICKNAME MICROCODE STATUS field to 80h in the Subenclosure Nickname Status diagnostic page.
- The SUBENCLOSURE NICKNAME field specifies the subenclosure nickname. If a Language element, which manages the language used for visual displays, is present, then the SUBENCLOSURE NICKNAME field shall contain a text string with characters using the language and character set indicated by the Language element and the enclosure services process shall store the language code value indicated by the Language element along with the subenclosure nickname. If a Language element is not available, then the SUBENCLOSURE NICKNAME field shall contain an ASCII string and the enclosure services process shall store the language code value of 0000h along with the subenclosure nickname.

7.14 Subenclosure Nickname Status diagnostic page (0Fh)

The Subenclosure Nickname Status diagnostic page transmits the nickname of each subenclosure to the application client.

The transmission of a page using the SEND DIAGNOSTIC command with a PAGE CODE field set to 0Fh is defined as the transmission of a Subenclosure Nickname Control diagnostic page (see Section 7.13).

Table 182 defines the Subenclosure Nickname Status diagnostic page.

Table 180. Subenclosure Nickname Status diagnostic page

Byte\Bit	7	6	5	4	3	2	1	0	
0	PAGE CODE (0Fh)								
1	NUMBER OF SECONDARY SUBENCLOSURES								
2	(MSB)	PAGE LENGTH (n - 3)							
3								(LSB)	
4	(MSB)	GENERATION CODE							
7								(LSB)	
Subenclosure nickname status descriptor list									
8	Subenclosure nickname status descriptor (primary subenclosure) (see Table 183)								
47									
...									
n - 39	Subenclosure nickname status descriptor (last subenclosure) (see Table 183)								
n									

- The PAGE CODE field is set to 0Fh.
- The NUMBER OF SECONDARY SUBENCLOSURES field indicates the number of secondary subenclosure nickname status descriptor values that are included, not including the primary subenclosure. The NUMBER OF SECONDARY SUBENCLOSURES field shall be set to the same value as the NUMBER OF SECONDARY SUBENCLOSURES field in the Configuration diagnostic page (see Section 7.2).
- The PAGE LENGTH field indicates the number of bytes that follow in the diagnostic page.
- The GENERATION CODE field indicates the value of the four-byte wrapping counter called the generation

code.

- The subenclosure nickname status descriptor list contains a subenclosure nickname status descriptor for each subenclosure nickname reported.
- Table 183 defines the format of each subenclosure's enclosure nickname status descriptor. The first subenclosure nickname status descriptor shall be for the primary subenclosure. Subenclosure nickname status descriptors for secondary subenclosures may follow in any order.

Table 181. Subenclosure nickname status descriptor format

Byte\Bit	7	6	5	4	3	2	1	0	
0	Reserved								
1	SUBENCLOSURE IDENTIFIER								
2	SUBENCLOSURE ENCLOSURE NICKNAME STATUS								
3	SUBENCLOSURE ENCLOSURE NICKNAME ADDITIONAL STATUS								
4	Reserved								
5	Reserved								
6	(MSB)	SUBENCLOSURE NICKNAME LANGUAGE CODE						(LSB)	
7	SUBENCLOSURE NICKNAME LANGUAGE CODE								
8	SUBENCLOSURE NICKNAME								
39	SUBENCLOSURE NICKNAME								

- The SUBENCLOSURE IDENTIFIER field indicates the subenclosure to which the subenclosure nickname status descriptor applies.
- When a single subenclosure is present, it is considered the primary subenclosure. When multiple subenclosures are present:
 - The primary subenclosure is the subenclosure whose enclosure services process provides access to enclosure services information of all the subenclosures;
 - All other subenclosures are considered secondary subenclosures.
- The SUBENCLOSURE NICKNAME STATUS field indicates the status of nickname operations for the subenclosure and is defined in Table 184. After reporting a non-zero value, the enclosure services process shall set the SUBENCLOSURE NICKNAME STATUS field to 00h and shall set the SUBENCLOSURE NICKNAME ADDITIONAL STATUS field to 00h.

Table 182. Subenclosure Nickname Status field

Code	Description
00h	No errors
80h	Error in one or more of the Subenclosure Nickname Control diagnostic page fields. The SUBENCLOSURE NICKNAME ADDITIONAL STATUS field shall be set to the offset of the lowest byte of the field in the Subenclosure Nickname Control diagnostic page that has an error.
81h	Internal error. The nickname is lost.
82h	Internal error. The previous nickname preserved.
All others	Reserved

- The SUBENCLOSURE NICKNAME ADDITIONAL STATUS field provides additional status for certain values of the SUBENCLOSURE NICKNAME STATUS field as described in Table 184.
- The SUBENCLOSURE NICKNAME LANGUAGE CODE field indicates the language and character set of the subenclosure nickname, as defined by the LANGUAGE CODE field in the Language element which manages the language used for visual displays.
- The SUBENCLOSURE NICKNAME field indicates the subenclosure nickname.

8. Element Customization

8.1 Array Device Slot Element

8.1.1 Control Element

Table 183. Array Device Slot Control Element

Byte\Bit	7	6	5	4	3	2	1	0
0	Common Control							
	SELECT	PRDFAIL	DISABLED	RST SWAP	RESERVED			
1	RQST OK	RQST RSVD DEVICE	RQST HOT SPARE	RQST CONS CHECK	RQST IN CRIT ARRAY	RQST IN FAILED ARRAY	RQST REBUILD / REMAP	RQST R/R ABORT
2	RQST ACTIVE	DO NOT REMOVE	RESERVED	RQST MISSING	RQST INSERT	RQST REMOVE	RQST IDENT	RESERVED
3	RESERVED		RQST FAULT	DEVICE OFF	ENABLE BYP A	ENABLE BYP B	RESERVED	

Note: The fields in gray are not supported by this element.

RST SWAP: When set to one, the swap status for this element will be set to zero.

For RQST REBUILD/REMAP, RQST OK, RQST IDENT, RQST FAULT fields, refer to Table 186 for LED behavior.

Table 184. Fault LED Blink Control Pattern

Condition	Expected LED Behavior (Intel)
RQST FAULT	On
RQST IDENT	Fast (2.5Hz)
RQST REBUILD/REMAP	Slow (1Hz)
RQST OK	Off

Activity blink pattern is driven directly from the drive. See drive manufacturer's documentation for specific blink pattern and meaning.

8.1.2 Array Device Slot Status Element

Table 185. Array Device Slot Status Element

Byte\Bit	7	6	5	4	3	2	1	0
0	Common Status							
	RESERVED	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	OK	RSVD DEVICE	HOT SPARE	CONS CHECK	IN CRIT ARRAY	IN FAILED ARRAY	REBUILD/ REMAP	R/R ABORT
2	APP CLIENT BYPASSED A	DO NOT REMOVE	ENCLOSURE BYPASSED A	ENCLOSURE BYPASSED B	READY TO INSERT	RMV	IDENT	REPORT
3	APP CLIENT BYPASSED B	FAULT SENSED	FAULT REQSTD	DEVICE OFF	BYPASSED A	BYPASSED B	DEVICE BYPASSED A	DEVICE BYPASSED B

NOTE: The fields in gray are not supported by this element.

- **ELEMENT STATUS CODE:** The status code indicates the overall operating status of the element. This field only reports 1h (OK) & 5h (Not Installed). If the expander PHY for this element is not ready, the firmware sets this field to 5h (Not Installed).
- **SWAP:** When set to one, this bit indicates that an element has been removed and reinserted in the location indicated. When powered on, all drives are considered to be performing hotplug, the SWAP bit is reported as '1' for each initiator.
- **OK, REBUILD/REMAP, IDENT and FAULT REQSTD** indicate the current operating status of the element.

8.2 Power Supply

The Expander firmware only reports the presence of two power supplies via SES pages. There are no control operations for the power supply element.

8.2.1 Power Supply Control Element

Table 186. Power Supply Control Element

Byte\Bit	7	6	5	4	3	2	1	0
0	SELECT	PRDFAIL	DISABLE	RST SWAP	RESERVED			
1	RQST IDENT	RESERVED						
2	RESERVED							
3	RESERVED	RQST FAIL	RQST ON	RESERVED				

NOTE: The fields in gray are not supported by this element.

The Power Supply element only needs to report whether the Power Supply is present or not by checking the STATUS_BYTE register or the STATUS_WORD register. There is no additional monitoring for it the power supply.

8.2.2 Power Supply Status Element

Table 187. Power Supply Status Element

Byte\Bit	7	6	5	4	3	2	1	0
0	RESERVED	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	IDENT	RESERVED						
2	RESERVED				DC OVER VOLTAGE	DC UNDER VOLTAGE	DC OVER CURRENT	RESERVED
3	HOT SWAP	FAIL	RQSTED ON	OFF	OVERTMP FAIL	TEMP WARN	AC FAIL	DC FAIL

NOTE: The fields in gray are not supported by this element.

ELEMENT STATUS CODE: This field only reports 1h (OK), 7h (Not Available), and 5h (Not Installed). Status code

of 7h (Not Available) would be reported in cases where the power supply is installed in the system but AC power is not applied or if the power supply reports a status other than OK. When the firmware detects a status of 7h (Not Available) it will set the Enclosure element warning event and the front panel system status LED will turn on to indicate a warning event.

8.3 Cooling Element

The Expander firmware controls and reports the status of four fans on the JBOD front panel via SES pages.

8.3.1 Cooling Control Element

Table 188. Cooling Control Element

Byte\Bit	7	6	5	4	3	2	1	0
0	SELECT	PRDFAIL	DISABLE	RST WAP	RESERVED			
1	RQST IDENT	RESERVED						
2	RESERVED							
3	RESERVED	RQST FAIL	RQST ON	RESERVED		REQUESTED SPEED CODE		

NOTE: The fields in gray are not supported by this element.

By default the fans work in firmware automatic fan control mode.

Table 189. Fan Speed Control

#	Increasing Tsa (°C)	Decreasing Tsa (°C)	% Target Fan speed	Speed	Code
1	27	26	45%	Lowest Speed	001b
2	28	28	50%	Second Lowest	010b
3	30	31	55%	Third Lowest	011b
4	33	33	60%	Intermediate	100b
5	35	38	65%	Third Highest	101b
6	40	41	80%	Second Highest	110b
7	43		100%	Highest	111b

Averaging of the inlet ambient temperature along with a 2°C hysteresis prevents the fans from oscillation around the fan speed thresholds. Tsa number is a running average of 4 temperature measurement from the front panel temperature sensor, each measurement is taken every 15 seconds. The hysteresis requires the Tsa temperature to drop 2°C before the fan will drop to the next lower speed.

8.3.2 Cooling Status Element

Table 190. Cooling Status Element

Byte\Bit	7	6	5	4	3	2	1	0	
0	RESERVED	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE				
1	IDENT	RESERVED					(MSB)		
2	ACTUAL FAN SPEED (LSB)								
3	HOT SWAP	FAIL	RQSTED ON	OFF	RESERVED (0b)	ACTUAL SPEED CODE			

NOTE: The fields in gray are not supported by this element.

ELEMENT STATUS CODE: This field reports 1h (OK), 2h (Critical), and 7h (Not Available). If the firmware can't access the registers of ADT7476, the firmware reports this field as 7h (Not Available).

ACTUAL FAN SPEED reflects the fan's actual speed.

FAN FAILURE can take up to 15 seconds to be set by the JBOD firmware, the JBOD polls the fans every 15 seconds. If JBOD firmware detects a fan fault it will set the enclosure element failure bit.

8.4 Temperature Sensor

The firmware only reports the status for one temperature sensor on the JBOD front panel, one local temperature sensor, and one remote temperature sensor on the expander via SES pages. There are no control operations for them.

8.4.1 Temperature Control Element

Table 191. Temperature Control Element

Byte\Bit	7	6	5	4	3	2	1	0
0	SELECT	PRDFAIL	DISABLE	RST SWAP	RESERVED			
1	RQST IDENT	RQST FAIL	RESERVED					
2	RESERVED							
3	RESERVED							

NOTE: The fields in gray are not supported by this element.

There are no LEDs for the temperature sensor and no hot-plug operations, so no control operations are needed.

8.4.2 Temperature Status Element

Table 192. Temperature Status Element

Byte\Bit	7	6	5	4	3	2	1	0
0	RESERVED	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	IDENT	FAIL	RESERVED					
2	TEMPERATURE							
3	RESERVED				OT FAILURE	OT WARNING	UT FAILURE	UT WARNING

NOTE: The fields in gray are not supported by this element.

- **ELEMENT STATUS CODE:** This field reports 1h (OK), 2h (Critical), 3h (Noncritical), and 7h (Not Available). If the firmware cannot access the registers of the temperature sensor, the firmware reports this field as 7h (Not Available).
- **TEMPERATURE** reflects the actual temperature monitored by the temperature sensor.

- OT FAILURE, OT WARNING, UT FAILURE and UT WARNING reflect whether the current temperature has crossed the upper or lower thresholds.
- Default setting for OT WARNING is set to 33°C, once the temperature exceeds this temperature a Noncritical status will be set. The firmware will set Enclosure element warning event and the front panel system status LED will turn on to indicate a warning event.
- Default setting for OT FAILURE is set to 35°C, once the temperature exceeds this temperature limit a Critical status will be set. The firmware will set Enclosure element failure event and the front panel system status LED will turn on and blink to indicate a failure event.

8.5 Voltage Sensor

The Expander firmware only reports the presence of the voltage sensor via the SES pages. There are no control operations for the voltage sensor. The voltage sensor in the ADT7476 monitor the 3.3V, 5V and 12V voltages on the power distribution board.

8.5.1 Voltage Control Element

Table 193. Voltage Control Element

Byte\Bit	7	6	5	4	3	2	1	0
0	SELECT	PRDFAIL	DISABLE	RST SWAP	RESERVED			
1	RQST IDENT	RQST FAIL	RESERVED					
2	RESERVED							
3	RESERVED							

NOTE: The fields in gray are not supported by this element.

There are no LEDs for the voltage sensor and no hot-plug operations, so no control operations are needed.

8.5.2 Voltage Status Element

Table 194. Voltage Status Element

Bit Byte	7	6	5	4	3	2	1	0
0	RESERVED	PRDFAIL	DISABLED	SWAP	ELEMENT STATUS CODE			
1	IDENT	FAIL	RESERVED		WARN OVER	WARN UNDER	CRIT OVER	CRIT UNDER
2	(MSB)							
3	VOLTAGE							(LSB)

NOTE: The fields in gray are not supported by this element.

- ELEMENT STATUS CODE: This field reports 1h (OK), 2h (Critical), 3h (Noncritical), and 7h (Not Available). If the firmware cannot access the registers of the ADT7476, the firmware reports this field as 7h (Not Available).
- VOLTAGE reflects the actual voltage monitored by the voltage sensor.
- WARN OVER, WARN UNDER, CRIT OVER and CRIT UNDER reflect whether the current voltage has crossed the upper or lower thresholds.
- WARN OVER and WARN UNDER will set Noncritical status. The firmware will set the Enclosure element warning event and the front panel system status LED will turn on to indicate a warning event.
- CRIT OVER and CRIT UNDER will set Critical status. The firmware will set the Enclosure element failure event and the front panel system status LED will turn on and blink to indicate a failure event.

8.6 Enclosure Element Control

8.6.1 Enclosure Element Control

Table 195. Enclosure control element

Byte\Bit	7	6	5	4	3	2	1	0
0	SELECT	PRDFAIL	DISABLE	RST SWAP	RESERVED			
1	RQST IDENT	Reserved						
2	POWER CYCLE REQUEST		POWER CYCLE DELAY					
3	POWER OFF DURATION						REQUEST FAILURE	REQUEST WARNING

- A RQST IDENT (request identify) bit set to one specifies that the enclosure services process identify the element by a visual indication. The front panel blue identification LED will blink fast rate for 10 seconds then change to steady on (Same behavior as standard servers).
- The POWER CYCLE REQUEST field is defined in Table 198. A request to begin a power cycle while a previous request is still active shall override the previous request.

Table 196. POWER CYCLE REQUEST field

Code	Description
00b	No power cycle request
01b	The enclosure shall begin a power cycle beginning when specified in the DELAY TO POWER CYCLE field for the duration specified in the POWER OFF DURATION field.
10b	The enclosure shall cancel any scheduled power cycle
11b	Reserved

Table 197. POWER CYCLE DELAY field

Code	Description
0 to 60	The enclosure shall begin a power cycle after the specified number of minutes after completing the SEND DIAGNOSTIC command.
61 to 63	Reserved

- The POWER OFF DURATION field will not be supported, the power off duration will be a fixed time of 30 seconds.
- If the REQUEST FAILURE bit is set to one, the enclosure shall enable a visual indication of enclosure failure (e.g., a failure LED). If the REQUEST FAILURE bit is set to zero, the enclosure may enable a visual indication of enclosure failure if the failure is self-detected. Visual indication on the front panel will be slow blink rate of the system status LED.
- If the REQUEST WARNING bit is set to one, the enclosure shall enable a visual indication of enclosure warning zero, the enclosure may enable a visual indication of enclosure warning if the warning is self-detected.

8.6.2 Enclosure Element Status

Table 198. Enclosure Element Status

Byte\Bit	7	6	5	4	3	2	1	0
0	RESERVED	PRDFAIL	DISABLE	SWAP	RESERVED			
1	IDENT	Reserved						
2	POWER CYCLE DELAY						FAILURE INDICATION	WARNING INDICATION
3	POWER OFF DURATION						FAILURE REQUESTED	WARNING REQUESTED

- A FAILURE INDICATION bit set to one indicates that a failed condition was detected by the enclosure and that the visual indication of enclosure failure is enabled. A FAILURE INDICATION bit set to zero indicates that a failed condition was not detected by the enclosure.
- A WARNING INDICATION bit set to one indicates that a warning condition was detected by the enclosure and that the visual indication of enclosure warning is enabled. A WARNING INDICATION bit set to zero indicates that a warning condition was not detected by the enclosure.
- A FAILURE REQUESTED bit set to one indicates that a failed condition has been requested by an application client with the Enclosure Control diagnostic page and that the visual indication of enclosure failure is enabled. A FAILURE REQUESTED bit set to zero indicates that a failed condition has not been requested by an application client.
- A WARNING REQUESTED bit set to one indicates that a warning condition has been requested by an application client with the Enclosure Control diagnostic page and that the visual indication of enclosure warning is enabled. A WARNING REQUESTED bit set to zero indicates that a warning condition has not been requested by an application client.

8.6.3 Front Panel LEDs

Table 201 describes the normal behavior of the front panel LEDs and their functions.

Table 199. Front Panel LED Behavior

Status	LED	Color	LED Behavior	Blink rate
Powered on	Power Button	Green	Solid	
Power off	Power Button	Green	off	
Identification	System ID	Blue	Blink 10s to Solid	2Hz
System good	System Status	Green	Solid	
System Warning	System Status	Amber	Solid	
System Critical	System Status	Amber	Blinking	2Hz

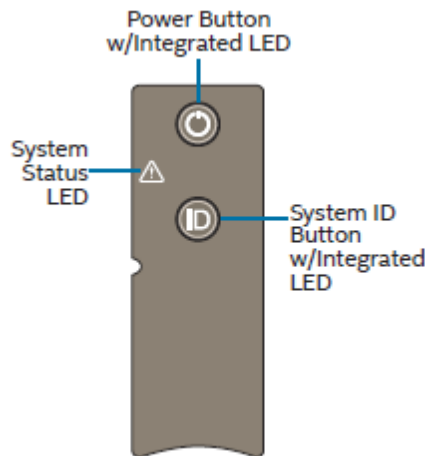


Figure 3. Front Panel

9. Firmware Update

The PCSD firmware images include the bootloader image, main firmware image, initialization string data, and boot configuration data concatenated into one binary file.

The binary file for the firmware image always begins with a header, this information allows the firmware to use the first packet to detect whether the new file is valid or not, and to select the correct destination partition. The firmware will only accept 4K & 32K data packet size during the firmware update process, any other size the firmware will abort the command.

The firmware images can be updated in the field in two ways:

- SES Download Microcode Control diagnostic page (0Eh). Support for this page includes Download Microcode Mode 07h and Mode 0Eh/0Fh
- SPC Write Buffer command Mode 07h and Mode 0Eh/0Fh

Firmware Download Procedure

The expander flash part holds two firmware images, during a firmware update only one of the images is updated. After reset and during booting, the bootloader checks the CRC-32 of the boot configuration images (image0 and image1). If the CRC-32 of both images is valid, bootloader selects the active image to execute. If the CRC-32 of only one image is valid, bootloader selects the valid one to execute. If neither is valid, bootloader stops.

When downloading the firmware, user can choose any of the following 2 in-band download methods, and follow the 3 steps below:

1. The host downloads a new application image to the inactive image partition. Firmware supports 2 main modes to download images, including:
 - a. Send Diagnostic command (OpCode 1Dh) Download Microcode Control diagnostic page (Page Code 0Eh)
 - b. Download Microcode Mode 07h and Mode 0Eh/0Fh.
 - c. Write Buffer command (OpCode 3Bh) Mode 07h and Mode 0Eh/0Fh.
2. Reset the SEP device by issuing one of the following:
 - a. A power cycle
 - b. The String out diagnostic page soft reset command.
 - c. The String out diagnostic page hard reset command.
3. Check the active firmware version and Scan all devices from host side after updating.

Download Firmware: Upon receipt of the first firmware download command, the firmware verifies the binary image header included in the first download packet. This image is then downloaded in a series of packets using the above commands. The data size of these packets must be in 4K or 32K size, the firmware will abort the command with other data sizes. New firmware image will not be executed until the next enclosure power cycle or reboot.

Reboot: Firmware will return command status before reboot. After the reboot firmware will check for the cause of the reboot. If new firmware image is downloaded previously, it will validate the CRC-32 of the new image. If the validation is successful, it will switch to and start executing the new image.

Appendix A. Reference Documents

Refer to the following documents for additional information:

- *Intel® Storage System JBOD2312S3SP Hardware User's Guide*
- *Intel® Storage Server System JBOD2312S3SP Service Guide*
- *Intel® High Availability Storage User Guide*
- *T10.org SAS Protocol Layer - 3 (SPL-3) Date: 13 May 2014*
- *T10.org SCSI Architecture Model - 5 (SAM-5)*
- *American National Standard, Information Technology – Serial Attached SCSI – 3 (SAS-3). Project T10/2212-D, Revision 05, 31 Jan 2013*
- *American National Standard, Information Technology – SAS Protocol Layer – 2 (SPL-2). Project T10/2228-D, Revision 05, 10 May 2012*
- *INCITS SCSI Primary Commands - 4 (SPC-4). Revision 36f. March 11, 2013*
- *INCITS SCSI-3 Enclosure Services Command Set – 3 (SES-3). Revision 05. November 20, 2012*
- *Information technology - SAS Protocol Layer - 3, Revision 06e 04 February 2014*
- SMP_utils package for the Serial Attached SCSI (SAS) Serial Management Protocol (SMP):
http://sg.danny.cz/sg/smp_utils.html

Appendix B. Glossary

AC	Alternating Current
ACA	Auto Contingent Allegiance
ACC	Access Control Commands
APP	Application
BYP	Bypass
CDB	Command Descriptor Block
CONS	Consistency
CPLD	Complex Programmable Logic Device
CRC	Cyclic Redundant Check
CRIT	Critical
DC	Direct Current
EIP	Extended Instruction Pointer
EMM	Entitlement Management Message
EVPD	Enable Vital Product Data
FP	Front Panel
FWDL	Firmware Download
GPIO	General Purpose Input/Output
HISUP	Hierarchical Support
ID	Identification
IDENT	Identity
INVOP	Invalid Operation Requested
JBOD	Just A Bunch Of Disks
LED	Light Emitting Diode
LBA	Logical Block Addressing
LLBAA	Long LBA Accepted
LSB	Least Significant Bit
LUNS	Logical Unit Numbers
MSB	Most Significant Bit
MULTIP	Multi-Port
NACA	Normal Auto Contingent Allegiance
OT	Over Temperature
OV	Over Voltage
OVERTMP	Over Temperature
PCSD	Platform Collaboration & Service Division (Intel Corp)
PHY	Physical (layer)
PIV	Protocol Identifier Valid
PMC	PMC-Sierra, Inc.
PRDFAIL	Predicted Failure
PWM	Pulse Width Modulation
RAID	Redundant Array of Independent Disks
REQSTD	Requested
RMB	Removable Medium Bit
RMV	Remove

SCSI Enclosure Services Programming Guide

RQST	Request
RST	Reset
RSVD	Reserved
SAM	SCSI Architecture Model
SAS	Serial Attached SCSI
SATA	Serial Advanced Technology Attachment
SCCS	SCSI Controller Commands
SCSI	Small Computer Systems Interface
SEEPROM	Serial Electrically Erasable Programmable Read Only Memory
SES	SCSI Enclosure Services
SGPIO	Serial General Purpose Input/Output
SI	System Information
SMP	Serial Management Protocol
SoC	System on a Chip
SPC	SCSI Primary Commands
SSC	SCSI Stream Commands
SSP	Serial SCSI Protocol
SSSF	SAS/SATA Store and Forward
STP	Serial ATA Tunneled Protocol
SXP	SAS Expander
TEMP	Temperature
TLR	Transport Layer Retries
TPGS	Target Port Group Support
Tsa	Temperature Swing Adsorption
UT	Under Temperature
VPD	Vital Product Data
VS	Vendor Specific
WBUS	Wide Bus