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Subject: SAS requests and confirmations between layers

Introduction

The following proposal is an attempt to reconcile all of the SAS requests and confirmations between layers. This proposal was developed by examining the tables in clause 4.3.3, each of the state machine figures and text for the phy, link, port, and transport layers in the SAS draft standard in order to check for correctness and consistency. Redundant and incorrect table entries have been deleted. Corrections and state references have been added. Other proposed modifications resulting from this review are included in 03-024r0 Port layer description modifications and the Maxtor SAS letter ballot comments document. The following proposal is "drop-in replacement text" for the 4.3.3 subclause based on SAS-r03.

4.3.3 Requests and confirmations between state machines

4.3.3.1 Requests and confirmations between the phy layer and other layers

Table a shows the requests from the management application layer to the phy layer.

Table a – Requests from management application layer to phy layer

Phy layer state machine(s)	<-Request-- (application to phy)	Application layer
SATA host emulation (SP22)	Enter Partial	Management
SATA host emulation (SP22)	Enter Slumber	Management
SATA host emulation (SP23)	Exit Partial	Management
SATA host emulation (SP23)	Exit Slumber	Management
OOB sequence (all)	Power-on Reset, Hard Reset, or Management Reset	Management

Table b shows the confirmations from the phy layer to the link layer or the expander function.

Table b – Confirmations from phy layer to expander function

Phy layer state machine(s)	--Confirmation-> (phy to expander)	Expander function
OOB sequence (SP1)	Broadcast Event Notify (Phy Not Ready)	expander function
OOB sequence (SP7)	Broadcast Event Notify (SATA Spinup Hold)	expander function

Table c shows the confirmations from the phy layer to the link layer and from the link layer to the port layer.

Table c – Confirmations from phy layer to the link layer, and link layer to port layer

Phy layer state machine(s)	--Confirmation-> (phy to link)	Link layer state machine(s)	--Confirmation-> (link to port)	Port layer state machine(s)
dword synchronization (SP_DWS0)	Enable Disable Link Layer (Disable)	link identification and hard reset (all) link (part 1, all)	Enable Disable Link Layer (Disable)	overall control (all) phy manager (all)
dword synchronization (SP_DWS3)	Enable Disable Link Layer (SAS Enable)	link identification and hard reset (SL_IR_TIR1, SL_IR_RIF1, SL_IR_IRC1) link (part 1, SL0)	Enable Disable Link Layer (SAS Enable)	overall control (PL_OC1, PL_OC2)
dword synchronization (SP_DWS3)	Enable Disable Link Layer (SATA Enable)	link identification and hard reset (SL_IR_TIR1, SL_IR_RIF1, SL_IR_IRC1) link (part 1, SL0)	Enable Disable Link Layer (SATA Enable)	overall control (PL_OC1, PL_OC2)

4.3.3.2 Requests from the management layer to the link layer and confirmations from the link layer to the port layer, expander function, and management layer

Table d shows the requests from the management application layer to the link layer.

Table d – Requests from management application layer to link layer

Link layer state machine(s)	<-Request-- (application to link)	Application layer
link identification and hard reset (SL_IR_TIR1)	Tx HARD_RESET	management
link identification and hard reset (SL_IR_TIR1)	Tx IDENTIFY Address Frame	management

Table e shows the confirmations from the link layer to the management application layer.

Table e – Confirmations from link layer to expander function and management application layer

Link layer state machine(s)	--Confirmation-> (link to application)	Application layer
link identification and hard reset (SL_IR_IRC2)	Broadcast Event Notify (Identification Sequence Complete)	expander function
link identification and hard reset (SL_IR_IRC1)	HARD_RESET Received	management
link identification and hard reset (SL_IR_TIR3)	HARD_RESET Transmitted	management
identification and hard reset (SL_IR_IRC2)	Phy Enabled	management
identification and hard reset (SL_IR_IRC1)	Phy Disabled	management
link identification and hard reset (SL_IR_IRC2)	Identify Sequence Complete	management
identification and hard reset (SL_IR_IRC2)	Identify Timeout	management
identification and hard reset (SL_IR_RIF1, _RIF2)	Address Frame Failed	management
link (part 1) (SL0, SL1)	Change Received	management

Table f shows the confirmations from the link layer to the port layer.

Table f – Confirmations from link layer to port layer

Link layer state machine(s)	--Confirmation-> (link to port)	Port layer state machine(s)
identification and hard reset (SL_IR_IRC2)	Phy Enabled	overall control (PL_OC1) phy manager (PL_PM1)
identification and hard reset (SL_IR_IRC1)	Phy Disabled	overall control (PL_OC2), phy manager (all states)
SAS link (part 1) (SL1)	Open Failed (Retry)	phy manager (PL_PM2)
SAS link (part 1) (SL1)	Open Failed (Port Layer Request)	phy manager (PL_PM2)
SAS link (part 1) (SL1, SL2)	Connection Opened (SSP Source Opened)	overall control (PL_OC2), phy manager (PL_PM1, PL_LM2)
SAS link (part 1) (SL1, SL2)	Connection Opened (STP Source Opened)	PL_OC2, PL_PM1, PL_PM2
SAS link (part 1) (SL1, SL2)	Connection Opened (SMP Source Opened)	PL_OC2, PL_PM1, PL_PM2
SAS link (part 1) (SL1, SL2)	Connection Opened (SSP Destination Opened)	PL_OC2, PL_PM1, PL_PM2
SAS link (part 1) (SL1, SL2)	Connection Opened (STP Destination Opened)	PL_OC2, PL_PM1, PL_PM2
SAS link (part 1) (SL1, SL2)	Connection Opened (SMP Destination Opened)	PL_OC2, PL_PM1, PL_PM2
frame transmission (SSP_TF4)	DONE Transmitted	phy manager (PL_PM3)

4.3.3.3 Requests and confirmations between the link layer, port layer, and SSP transport layer

Table g shows the requests from the SSP transport layer to the port layer and from the port layer to the link layer.

Table g – Requests from SSP transport layer to port layer, and port layer to SAS link layer

Link layer state machine(s)	<-Request-- (port to link)	Port layer state machine(s)	<-Request-- (transport to port)	Transport layer state machine(s)
SAS link (part 1) (SL0)	Open Connection	phy manager (PL_PM2)		
		overall control (PL_OC2)	Cancel	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)
SAS link (part 1) (SL1)	Stop Arb	phy manager (PL_PM2)	-- or --	
frame transmission (SSP_TF1)	Close Connection	overall control (PL_OC2)		
SAS link (part 1) (SL2)	Accept_Reject Opens (Accept SSP)	overall control (PL_OC2)	Accept_Reject Opens (Accept SSP)	SSP initiator device (ST_IFR1), SSP target device (ST_TFR1)
SAS link (part 1) (SL2)	Accept_Reject Opens (Reject SSP)	overall control (PL_OC2)	Accept_Reject Opens (Reject SSP)	ST_IFR1, ST_TFR1
		overall control (PL_OC2, PL_OC1)	Transmit Frame (Interlocked)	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)
frame transmission (SSP_TF1)	Tx Frame (Balance Required)	phy manager (PL_PM3, part 2)		
		overall control (PL_OC2, PL_OC1)	Transmit Frame (Non-interlocked)	ST_ISF1, ST_TTS2
frame transmission (SSP_TF1)	Tx Frame (Balance Not Required)	phy manager (PL_PM3, part 2)		

Table h shows the confirmations from the SAS link layer to the port layer and from the port layer to the SSP transport layer.

Table h – Confirmations from SAS link layer to port layer, and port layer to SSP transport layer

Link layer state machine(s)	--Confirmation-> (link to port)	Port layer state machine(s)	--Confirmation-> (port to transport)	Transport layer state machine(s)
identification and hard reset (SL_IR_IRC2)	HARD_RESET Received	overall control (all) phy manager (all)		
		overall control (PL_OC1)	HARD_RESET Received	SSP initiator device (ST_IFR1), SSP target device (ST_TFR1)
SAS link (part 1) (SL3, SL4, SL5)	Connection Closed (Break Received), Close Timeout), (Link Broken), or (Normal)	overall control (PL_OC2)	Cancel Acknowledge (after receiving a Cancel request only)	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)
SAS link (part 1) (SL3, SL4, SL5)	Connection Closed (Break Received), Close Timeout), (Link Broken), or (Normal)	overall control (PL_OC2)	Connection Failed (before receiving a Frame Transmitted confirmation only)	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)
		overall control (PL_OC1)	Transmission Status (No Phys In Port)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Bad Destination)	phy manager (PL_PM2)	PL_PM2 to PL_OC2 Unable To Connect	
		overall control (PL_OC2)	Transmission Status (Open Failed – Bad Destination)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Break Received)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Break Received)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Connection Rate Not Supported)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Connection Rate Not Supported)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (No Destination)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – No Destination)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Open Timeout Occurred)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed - Open Timeout Occurred)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Pathway Blocked)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Pathway Blocked)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Protocol Not Supported)	phy manager (PL_PM2)		

		overall control (PL_OC2)	Transmission Status (Open Failed – Protocol Not Supported)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (STP Resources Busy)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – STP Resources Busy)	ST_ISF1, ST_TTS2
SAS link (part 1) (SL1)	Open Failed (Wrong Destination)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Wrong Destination)	ST_ISF1, ST_TTS2

Table i shows the confirmations from the SSP link layer to the port layer and from the port layer to the SSP transport layer.

Table i – Confirmations from SSP link layer to port layer, and port layer to SSP transport layer

Link layer state machine(s)	--Confirmation-> (link to port)	Port layer state machine(s)	--Confirmation-> (port to transport)	Transport layer state machine(s)
frame transmission (SSP_TF3)	Frame Transmitted	phy manager (PL_PM3, part 2)	Transmission Status (Frame Transmitted)	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)
frame transmission (SSP_TIM1)	ACK/NAK Timeout	phy manager (PL_PM3, part 2)	Transmission Status (ACK/NAK Timeout)	ST_ISF1, ST_TTS2
frame transmission (SSP_TF2)	Credit Timeout	phy manager (PL_PM3, part 2)	Transmission Status (Credit Timeout)	ST_ISF1, ST_TTS2
frame transmission (SSP_TIM1)	ACK Received	phy manager (PL_PM3, part 2)	ACK Received	ST_ISF1, ST_TTS2
frame transmission (SSP_TIM1)	NAK Received	phy manager (PL_PM3, part 2)	NAK Received	ST_ISF1, ST_TTS2
frame transmission (SSP_D1)	Done Received (Close Connection)	phy manager (PL_PM3)	Transmission Status (Done Received Close Connection)	ST_ISF1, ST_TTS2
frame transmission (SSP_D1)	Done Received (ACK/NAK Timeout)	phy manager (PL_PM3)	Transmission Status (Done Received ACK/NAK Timeout)	ST_ISF1, ST_TTS2
frame transmission (SSP_D1)	Done Received (Credit Timeout)	phy manager (PL_PM3)	Transmission Status (Done Received Credit Timeout)	ST_ISF1, ST_TTS2
frame transmission (SSP_D1)	Done Timeout	phy manager (PL_PM3)	Transmission Status (Done Timeout)	ST_ISF1, ST_TTS2
frame reception (SSP_RF1)	Frame Received (ACK/NAK Balanced)	phy manager (PL_PM3, part 2)	Frame Received (ACK/NAK Balanced)	SSP initiator device (ST_IFR1), SSP target device (ST_TFR1)
frame reception (SSP_RF1)	Frame Received (ACK/NAK Unbalanced)	phy manager (PL_PM3, part 2)	Frame Received (ACK/NAK Unbalanced)	ST_IFR1, ST_TFR1
frame reception (SSP_TAN1)	ACK Transmitted	phy manager (PL_PM3, part 2)	ACK Transmitted	SSP initiator device (ST_ISF1), SSP target device (ST_TTS2)

4.3.3.4 Requests and confirmations between the link layer, port layer, and SMP transport layer

Table j shows the requests from the SMP transport layer to the port layer and from the port layer to the SAS and SMP link layers.

Table j – Requests from SMP transport layer to port layer, and port layer to SAS/SMP link layers

Link layer state machine(s)	<-Request-- (port to link)	Port layer state machine(s)	<-Request-- (transport to port)	Transport layer state machine(s)
SAS link (part 1) (SL0)	Open Connection	phy manager (PL_PM2)		
SAS link (part 1) (SL1)	Stop Arb	phy manager (PL_PM2)		
SAS link (part 1) (SL2)	Accept_Reject Opens (Accept SMP)	overall control (PL_OC2)	Accept_Reject Opens (Accept SMP)	SMP target device (MT_TD1)
SAS link (part 1) (SL2)	Accept_Reject Opens (Reject SMP)	overall control (PL_OC2)	Accept_Reject Opens (Reject SMP)	SMP target device (MT_TD1)
		overall control (PL_OC2), (PL_OC1)	Transmit Frame (SMP)	SMP initiator device (MT_ID2), SMP target device (MT_TD2)
SMP initiator device (SMP_IL1) SMP target device (SMP_TL2)	Tx Frame (SMP)	phy manager (PL_PM3, part 2)		
SMP initiator device (SMP_IL3)	SMP Transmit Break	overall control (PL_OC2)	SMP Transmit Break	SMP initiator device (MT_ID3)

Table k shows the confirmations from the link layer to the port layer and from the port layer to the SMP transport layer.

Table k – Confirmations from link layer to port layer, and port layer to SMP transport layer

Link layer state machine(s)	--Confirmation-> (link to port)	Port layer state machine(s)	--Confirmation-> (port to transport)	Transport layer state machine(s)
identification and hard reset (SL_IR_IRC1)	HARD_RESET Received	overall control (all) phy manager (all)		
		overall control (PL_OC1)	HARD_RESET Received	SMP initiator device (all), SMP target device (all)
SMP initiator device (SMP_IL2) SMP target device (SMP_TL2)	Frame Transmitted	phy manager (PL_PM2)		
		overall control (PL_OC)	Transmission Status (Frame Transmitted)	SMP initiator device (MT_ID2), SMP target device (MT_TD2)
SMP initiator device (SMP_IL3) SMP target device (SMP_TL1)	Frame Received (SMP)	phy manager (PL_PM3, part 2)	Frame Received (SMP)	SMP initiator device (MT_ID3), SMP target device (MT_TD1)
(SMP_IL3) (SMP_TL1)	Frame Received (SMP Failure)	phy manager (PL_PM3, part 2)	Frame Received (SMP Failure)	MT_ID3, MT_TD1
SAS link (part 1) (SL3, SL4)	Connection Closed (Break Received)	overall control (PL_OC2)	Connection Closed (Break Received)	SMP initiator device (MT_ID2), SMP target device (MT_TD2)
SAS link (part 1) (SL4)	Connection Closed (Close Timeout)	overall control (PL_OC2)	Connection Closed (Close Timeout)	MT_ID2, MT_TD2
SAS link (part 1) (SL5)	Connection Closed (Link Broken)	overall control (PL_OC2)	Connection Closed (Link Broken)	MT_ID2, MT_TD2

SAS link (part 1) (SL4)	Connection Closed (Normal)	overall control (PL_OC2)	Connection Closed (Normal)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Bad Destination)	phy manager (PL_PM2)	PL_PM2 to PL_OC2 Unable To Connect	
		overall control (PL_OC2)	Transmission Status (Open Failed – Bad Destination)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Break Received)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Break Received)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Connection Rate Not Supported)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Connection Rate Not Supported)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (No Destination)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – No Destination)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Open Timeout Occurred)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed - Open Timeout Occurred)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Pathway Blocked)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Pathway Blocked)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Protocol Not Supported)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Protocol Not Supported)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (STP Resources Busy)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – STP Resources Busy)	MT_ID2, MT_TD2
SAS link (part 1) (SL1)	Open Failed (Wrong Destination)	phy manager (PL_PM2)		
		overall control (PL_OC2)	Transmission Status (Open Failed – Wrong Destination)	MT_ID2, MT_TD2

4.3.3.5 Requests and confirmations between the SSP transport layer and the SCSI application layer

Table I shows the requests from the SCSI application layer to the SSP transport layer.

Table l – Requests from the SCSI application layer to the SSP transport layer

Transport layer state machine(s)	<-Request-- (application to transport)	Application layer
initiator device (ST_ISF1)	Send SCSI Command	initiator device
initiator device (ST_ISF1)	Send Task Management Request	initiator device
initiator device (ST_IFR1)	Accept_Reject Opens (Accept)	initiator device
initiator device (ST_IFR1)	Accept_Reject Opens (Reject)	initiator device
target device (ST_TTS1)	Send SCSI Command Complete	target device
target device (ST_TTS1)	Task Management Function Executed	target device
target device (ST_TTS1)	Send Data-In	target device
target device (ST_TTS1)	Receive Data-Out	target device
target device (ST_TFR1)	Accept_Reject Opens (Accept)	target device
target device (ST_TFR1)	Accept_Reject Opens (Reject)	target device

Table m shows the confirmations from the SSP transport layer to the SCSI application layer.

Table m – Confirmations from the SSP transport layer to the SCSI application layer

Transport layer state machine(s)	--Confirmation-> (transport to application)	Application layer
initiator device (ST_IPR1)	Command Complete Received	initiator device
initiator device (ST_IPR1)	Received Task Management Function Executed	initiator device
target device (ST_TFR1)	SCSI Command Received	target device
target device (ST_TFR1)	Task Management Request Received	target device
target device (ST_TTS2)	Data-In Delivered	target device
target device (ST_TTS4)	Data-Out Received	target device
target device (ST_TTS2)	Nexus Lost	target device

4.3.3.6 Requests and confirmations between the SMP transport layer and the management application layer

Table n shows the requests from the management application layer to the SMP transport layer.

Table n – Requests from the management application layer to the SMP transport layer

Transport layer state machine(s)	<-Request-- (application to transport)	Application layer
initiator device (MT_ID1)	Send/Receive Frame Pair	initiator device
target device (MT_TD2)	Tx SMP Frame	target device
target device (MT_TD1)	Accept_Reject Opens (Accept SMP)	target device
target device (MT_TD1)	Accept_Reject Opens (Reject SMP)	target device

Table o shows the confirmations from the SMP transport layer to the management application layer.

Table o – Confirmations from the SMP transport layer to the management application layer

Transport layer state machine(s)	--Confirmation-> (transport to application)	Application layer
initiator device (MT_ID2)	Open Failed	initiator device
initiator device (MT_ID3)	SMP Frame Receive Time-out	initiator device
initiator device (MT_ID3)	SMP Frame Tx/Rcv Failure	initiator device
initiator device (MT_ID3)	SMP Frame Pair Sent/Received	initiator device
target device (MT_TD1)	SMP Frame Received	target device
target device (MT_TD1)	SMP Connection Closed	target device