To: T10 Technical Committee
From: Steven Fairchild, HP (steve.Fairchild@hp.com)
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Subject: Proposal to allow an initiator based configuration of the SAS topology

This is a multi-part proposal that:

- Modifies the Identify Frame format.
- Modifies the SMP Request/Response format.
- Modifies the SMP Discover function to re-use the Identify Frame payload and support a shift in discovery from a “by cloud” mechanism to a “by Phy” mechanism.
- Modifies the SMP Report General function to remove the bit mask fields and add route fields.
- Deletes the SMP functions; Report Phy and Report Phy Device Names, because their information is provided in the modified Discover payload.
- Adds the SMP functions; Report Route Information and Configure Route Information, to facilitate the implementation of an initiator based topology discovery.
- Add support for a new device type, an Edge Router, which can be used to simplify the building of an edge cloud.
- Add discussion on guidelines for an initiator to discover and configure the topology.

The purpose for the recommended changes is to reduce the complexity of the expander devices by shifting the burden of topology discovery and configuration to one or more initiators. While not all the changes are required to accomplish the initiator-based configuration, in total they simplify the topology discovery. The details of the changes follow.

Modify the Identify Frame format

from:

Byte	7	6	5	4	3	2	1	0
0	Reserved				ADDRESS FRAME TYPE (0h)			
1	PHY IDENTIFIER							
2	Reserved				MAXIMUM PHYSICAL LINK RATE			
3	DEVICE TYPE		STP INITIATOR	STP TARGET	SSP INITIATOR	SSP TARGET	SMP INITIATOR	SMP TARGET
4	DEVICE NAME							
11								
12	(MSB)	Reserved						
27								(LSB)
28	(MSB)	CRC						
31								(LSB)

to:

Byte	7	6	5	4	3	2	1	0
0	Reserved				ADDRESS FRAME TYPE (0h)			
1	Reserved							
2	PHY IDENTIFIER							
3	Reserved							
4	SAS ADDRESS							
11								
12	ROUTE	ADDRESS DECODE			Reserved	DEVICE TYPE		
13	Reserved	LINK STATE			CURRENT PHY LINK RATE			
14	PROG MIN PHY LINK RATE				MIN PHY LINK RATE			
15	PROG MAX PHY LINK RATE				MAX PHY LINK RATE			
16	Reserved				SSP INITIATOR	STP INITIATOR	SMP INITIATOR	Reserved
17	Reserved				SSP TARGET	STP TARGET	SMP TARGET	SATA TARGET
18	(MSB)	Reserved						
27								(LSB)
28	(MSB)	CRC						
31								(LSB)

The DEVICE TYPE field indicates the type of device containing the phy, and is defined in Table 1. A device, which is capable of being both an end device and an expander device, shall only report its expander device type in this field.

Table 1. Device Types

DEVICE TYPE	Device type
000b	End device only
001b	Edge expander device
010b	Fanout expander device
011b	Edge route expander device
100b-111b	Reserved

The ADDRESS DECODE field indicates the method of address decode support by this phy and is defined in Table 2. A device that is capable of supporting different decode mechanisms internally. A device which is capable of supporting multiple decode mechanisms should report the most capable method.

Table 2. Address Decode

ADDRESS DECODE	Address Decode
000b	None
001b	Subtractive
010b	Table
011b	Auto, self-discovery
100b-111b	Reserved

The ROUTE field indicates the content of the frame is valid for routing. The value will always be 1b for an Identify frame.

The CURRENT PHY LINK RATE field indicates the current physical link rate negotiated on this phy and is defined in Table 3.

Table 3. Current Physical Link Rate

CURRENT PHY LINK RATE	Current physical link rate
0000b – 0010b	Reserved
0011b	1,5 Gbps
0100b	3,0 Gbps
0101b – 1111b	Reserved

The LINK STATE field indicates the current state of the physical link on this phy and will always be 000b for an Identify frame.

The MIN PHY LINK RATE field indicates the minimum physical link rate supported on this phy and is defined in Table 4.

Table 4. Physical Link Rate

PHY LINK RATE	Physical Link Rate
0000b – 0010b	Reserved
0011b	1,5 Gbps
0100b	3,0 Gbps
0101b – 1111b	Reserved

The PROG MIN PHY LINK RATE field indicates the minimum physical link rate programmed on this phy and is defined in Table 4.

The MAX PHY LINK RATE field indicates the maximum physical link rate supported on this phy and is defined in Table 4.

The PROG MAX PHY LINK RATE field indicates the maximum physical link rate programmed on this phy and is defined in Table 4.

The SMP INITIATOR bit indicates the device is an SMP initiator device or SMP target/initiator device.

The STP INITIATOR bit indicates the device is an STP initiator device or STP target/initiator device.

The SSP INITIATOR bit indicates the device is an SSP initiator device or SSP target/initiator device.

The SATA TARGET bit indicates the device is an SATA target device or SATA target/initiator device.

The SMP TARGET bit indicates the device is an SMP target device or SMP target/initiator device.

The STP TARGET bit indicates the device is an STP target device or STP target/initiator device.

The SSP TARGET bit indicates the device is an SSP target device or SSP target/initiator device.

Modify the SMP Request/Response Format

from:

Byte	7	6	5	4	3	2	1	0
0	INFORMATION UNIT TYPE (40h)							
1	Reserved							
23								
24	FUNCTION							
25	ADDITIONAL REQUEST BYTES							
m								
	Fill bytes, if needed							
n - 3	(MSB) CRC							
n								(LSB)

to:

Byte	7	6	5	4	3	2	1	0
0	INFORMATION UNIT TYPE (40h)							
1	FUNCTION							
2	Reserved							
3								
4	ADDITIONAL REQUEST BYTES							
m								
	Fill bytes, if needed							
n - 3	(MSB) CRC							
n								(LSB)

and from:

Byte	7	6	5	4	3	2	1	0
0	INFORMATION UNIT TYPE (41h)							
1	Reserved							
23								
24	FUNCTION RESULT							
25	ADDITIONAL RESPONSE BYTES							
m								
	Fill bytes, if needed							
n - 3	(MSB) CRC							
n								(LSB)

to:

Byte	7	6	5	4	3	2	1	0
0	INFORMATION UNIT TYPE (41h)							
1	FUNCTION RESULT							
2	Reserved							
3								
4	ADDITIONAL RESPONSE BYTES							
m								
	Fill bytes, if needed							
n - 3	(MSB) CRC							
n								(LSB)

Note: The reason for the change is to reduce the overall size of the SMP payload. This change is not critical to the overall proposal. If accepted, then all SMP request and response frames will need to be adjusted. The editing involved in not reflected in this proposal.

Modify the SMP Discover Format

from:

Table x defines the request format.

Table x. DISCOVER request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (00h)							
1	Reserved							
3								

Table y defines the response format.

Table y. DISCOVER response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
3								
4	(MSB)	DEVICE NAME VALID BITMASK						
11								(LSB)
12	(MSB)	ATTACHED FANOUT EXPANDER BITMASK						
19								(LSB)
20	Reserved							
31								
32	(MSB)	DEVICE NAME 0						
39								(LSB)
…	…							
536	(MSB)	DEVICE NAME 63						
543								(LSB)
544	(MSB)	CRC						
547								(LSB)

to:

Table x defines the request format.

Table x. DISCOVER request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (00h)							
1	Reserved							
2								
3	PHY IDENTIFIER							
4	Reserved							
6								

The PHY IDENTIFIER field indicates the physical link for which the Discover information is being requested.

Table y defines the response format.

Table y. DISCOVER response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
2								
3	Reserved				ADDRESS FRAME TYPE (0h)			
4	Reserved							
5	PHY IDENTIFIER							
6	Reserved							
7	SAS ADDRESS							
14								
15	ROUTE	ADDRESS DECODE			Reserved	DEVICE TYPE		
16	Reserved	LINK STATE			CURRENT PHY LINK RATE			
17	PROG MIN PHY LINK RATE				MIN PHY LINK RATE			
18	PROG MAX PHY LINK RATE				MAX PHY LINK RATE			
19	Reserved				SSP INITIATOR	STP INITIATOR	SMP INITIATOR	Reserved
20	Reserved				SSP TARGET	STP TARGET	SMP TARGET	SATA TARGET
21	(MSB)	Reserved						
26								(LSB)
27	(MSB)	CRC						
30								(LSB)

The ADDRESS FRAME TYPE field is retained for commonality with the Identify frame.

The PHY IDENTIFIER field indicates the physical link for which the Discover information is being requested.

The SAS ADDRESS field contains the device name.

The DEVICE TYPE field indicates the type of device containing the phy, and is defined in Table 1. A device, which is capable of being both an end device and an expander device, shall only report its expander device type in this field.

Table 1. Device Types

DEVICE TYPE	Device type
000b	End device only
001b	Edge expander device
010b	Fanout expander device
011b	Edge route expander device
100b-111b	Reserved

The ADDRESS DECODE field indicates the method of address decode support by this phy and is defined in Table 2. A device that is capable of supporting different decode mechanisms internally. A device which is capable of supporting multiple decode mechanisms should report the most capable method. Auto decode is the most capable, Subtractive decode is the least capable.

Table 2. Address Decode

ADDRESS DECODE	Address Decode
000b	None
001b	Subtractive
010b	Table
011b	Auto, self-discovery
100b-111b	Reserved

The ROUTE field indicates the content of the frame is valid for routing. The 0b value indicates the route has been determined to be in violation of connection rules.

The CURRENT PHY LINK RATE field indicates the current physical link rate negotiated on this phy and is defined in Table 3.

Table 3. Current Physical Link Rate

CURRENT PHY LINK RATE	Current physical link rate
0000b	Phy does not exist
0001b	Rate unknown
0010b	Phy disabled
0011b	1,5 Gbps
0100b	3,0 Gbps
0101b – 1111b	Reserved

The LINK STATE field indicates the current state of the physical link on this phy.

Table 4. Link State

LINK STATE	Link State
000b	Active
001b	Inactive
010b	Failed
011b	OOB in Progress
100b	Spinup Hold OOB
101b	Release Spinup Hold OOB
110b – 111b	Reserved

The MIN PHY LINK RATE field indicates the minimum physical link rate supported on this phy and is defined in Table 5.

Table 5. Physical Link Rate

PHY LINK RATE	Physical Link Rate
0000b – 0010b	Reserved
0011b	1,5 Gbps
0100b	3,0 Gbps
0101b – 1111b	Reserved

The PROG MIN PHY LINK RATE field indicates the minimum physical link rate programmed on this phy and is defined in Table 5.

The MAX PHY LINK RATE field indicates the maximum physical link rate supported on this phy and is defined in Table 5.

The PROG MAX PHY LINK RATE field indicates the maximum physical link rate programmed on this phy and is defined in Table 5.

The SMP INITIATOR bit indicates the device is an SMP initiator device or SMP target/initiator device.

The STP INITIATOR bit indicates the device is an STP initiator device or STP target/initiator device.
The SSP INITIATOR bit indicates the device is an SSP initiator device or SSP target/initiator device.
The SATA TARGET bit indicates the device is an SATA target device or SATA target/initiator device.
The SMP TARGET bit indicates the device is an SMP target device or SMP target/initiator device.
The STP TARGET bit indicates the device is an STP target device or STP target/initiator device.
The SSP TARGET bit indicates the device is an SSP target device or SSP target/initiator device.

Modify the SMP Report General format

from:

Table x defines the request format.

Table x. REPORT GENERAL request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (01h)							
1	Reserved							
3								

Table y defines the response format.

Table y. REPORT GENERAL response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
2	NUMBER OF PHYS							
3	INPUT PHY IDENTIFIER							
4	Reserved							
15								
16	(MSB)	ACTIVE PHY BITMASK						
23								(LSB)
24	(MSB)	ATTACHED FANOUT EXPANDER BITMASK						
31								(LSB)
32	(MSB)	ATTACHED EDGE EXPANDER BITMASK						
39								(LSB)
40	(MSB)	ATTACHED SAS INITIATOR BITMASK						
47								(LSB)
48	(MSB)	ATTACHED SAS TARGET BITMASK						
53								(LSB)
54	(MSB)	ATTACHED SATA BITMASK						
75								(LSB)
76	(MSB)	PHY RATE MULTIBITMASK						
83								(LSB)
84	(MSB)	FUNCTIONS SUPPORTED BITMASK						
115								(LSB)

to:

Table x defines the request format.

Table x. REPORT GENERAL request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (01h)							
1	Reserved							
6								

Table y defines the response format.

Table y. REPORT GENERAL response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
2								
3	NUMBER OF PHYS							
4	INPUT PHY IDENTIFIER							
5	MAXIMUM ROUTE SLOT							
6	MAXIMIM ROUTE INDEX							
7	(MSB)							
10	CRC							(LSB)

The NUMBER OF PHYS field contains the number of phys in the device.

The INPUT PHY IDENTIFIER field contains the identifier of the phy through which the REPORT GENERAL request was received.

The MAXIMUM ROUTE SLOT field contains the maximum number of route slots for an edge router or fanout device. The number of route slots shall be at least equal to the number of phys on the device.

The MAXIMUM ROUTE INDEX field contains the maximum number of route indexes for an edge router or fanout device. The number of route indexes shall be greater than or equal to the number of phys on the device for an edge router. The number of route indexes shall be greater than or equal to the maximum supported devices in a single edge cloud for a fanout device (currently this is 64).

Delete the SMP functions; Report Phy and Report Phy Devices

Note: These functions are no longer needed; because their functionality has been consolidate into the Identify frame and Discover response.

Add the SMP function: Report Route Information

The REPORT ROUTE INFORMATION function returns the route table information for a specific route slot and route index within an edge route expander device or fanout expander device. Edge expander devices or end devices do not need to support this function. This function is used primarily as a diagnostic tool to resolve topology routing issues.

Table x defines the request format.

Table x. REPORT ROUTE INFORMATION request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (04h)							
1	Reserved							
2								
3	ROUTE SLOT							
4	ROUTE INDEX							
5	Reserved							
6								

The ROUTE SLOT field indicates the route slot for which the Report Route information is being requested. The value must be in the range of 0 to MAXIMUM ROUTE SLOT or a function reject response shall occur.

The ROUTE INDEX field indicates the route index for which the Report Route information is being requested. The value must be in the range of 0 to MAXIMUM ROUTE INDEX or a function reject response shall occur.

Table y defines the response format.

Table y. REPORT ROUTE INFORMATION response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
2								
3	ROUTE SLOT							
4	ROUTE INDEX							
5	PHY IDENTIFIER							
6	Reserved							
7	SAS ADDRESS							
14								
15	ROUTE	Reserved						
16	Reserved				CURRENT PHY LINK RATE			
17	Reserved							
18								
19	Reserved				SSP INITIATOR	STP INITIATOR	SMP INITIATOR	Reserved
20	Reserved				SSP TARGET	STP TARGET	SMP TARGET	SATA TARGET
21	(MSB)	Reserved						
26								(LSB)
27	(MSB)	CRC						
30								(LSB)

The ROUTE SLOT field indicates which slot in a route table is being returned. This value shall match the value in the request.

The ROUTE INDEX field indicates which index in a route table is being returned. This value shall match the value in the request.

The PHY IDENTIFIER field indicates the physical link referenced by this route table entry.

The SAS ADDRESS field contains the device name reference by this route table entry.

The ROUTE field indicates the content of the frame referenced by this route table entry is valid for routing. The 0b value indicates the route has been determined to be in violation of connection rules.

The CURRENT PHY LINK RATE field indicates the current physical link rate referenced by this route table entry.

The SMP INITIATOR bit indicates the device referenced by this route table entry is an SMP initiator device or SMP target/initiator device.

The STP INITIATOR bit indicates the device referenced by this route table entry is an STP initiator device or STP target/initiator device.

The SSP INITIATOR bit indicates the device referenced by this route table entry is an SSP initiator device or SSP target/initiator device.

The SATA TARGET bit indicates the device referenced by this route table entry is an SATA target device or SATA target/initiator device.

The SMP TARGET bit indicates the device referenced by this route table entry is an SMP target device or SMP target/initiator device.

The STP TARGET bit indicates the device referenced by this route table entry is an STP target device or STP target/initiator device.

The SSP TARGET bit indicates the device referenced by this route table entry is an SSP target device or SSP target/initiator device.

Add the SMP function: Configure Route Information

The CONFIGURE ROUTE INFORMATION function sets the route table information for a specific route slot and route index within an edge route expander device or fanout expander device. Edge expander devices or end devices do not need to support this function. This function is used to establish the route table within an edge route expander device or fanout expander device.

Table x defines the request format.

Table x. CONFIGURE ROUTE INFORMATION request

Byte	7	6	5	4	3	2	1	0
0	FUNCTION (80H)							
1	Reserved							
2								
3	ROUTE SLOT							
4	ROUTE INDEX							
5	PHY IDENTIFIER							
6	Reserved							
7	SAS ADDRESS							
14								
15	ROUTE	Reserved						
16	Reserved				CURRENT PHY LINK RATE			
17	Reserved							
18								
19	Reserved				SSP INITIATOR	STP INITIATOR	SMP INITIATOR	Reserved
20	Reserved				SSP TARGET	STP TARGET	SMP TARGET	SATA TARGET
21	(MSB)	Reserved						
26								(LSB)
27	(MSB)	CRC						
30								(LSB)

The ROUTE SLOT field indicates the route slot for which the Configure Route information is being configured. The value must be in the range of 0 to MAXIMUM ROUTE SLOT or a function reject response shall occur.

The ROUTE INDEX field indicates the route index for which the Configure Route information is being configured. The value must be in the range of 0 to MAXIMUM ROUTE INDEX or a function reject response shall occur.

The PHY IDENTIFIER field indicates the physical link to be saved in this route table entry.

The SAS ADDRESS field contains the device name to be saved in this route table entry.

The ROUTE field indicates whether the content of the frame is valid for routing. The 0b value indicates the route has been determined to be in violation of connection rules. The 1b value indicates the route has been determined to be valid. This bit is to be saved in this route table entry.

The CURRENT PHY LINK RATE field indicates the current physical link to be saved in this route table entry.

The SMP INITIATOR bit reflects the value to be saved in this route table entry to indicate whether the device is an SMP initiator device or SMP target/initiator device.

The STP INITIATOR bit reflects the value to be saved in this route table entry to indicate whether the device is an STP initiator device or STP target/initiator device.

The SSP INITIATOR bit reflects the value to be saved in this route table entry to indicate whether the device is an SSP initiator device or SSP target/initiator device.

The SATA TARGET bit reflects the value to be saved in this route table entry to indicate whether the device is an SATA target device or SATA target/initiator device.

The SMP TARGET bit reflects the value to be saved in this route table entry to indicate whether the device is an SMP target device or SMP target/initiator device.

The STP TARGET bit reflects the value to be saved in this route table entry to indicate whether the device is an STP target device or STP target/initiator device.

The SSP TARGET bit reflects the value to be saved in this route table entry to indicate whether the device is an SSP target device or SSP target/initiator device.

Table y defines the response format.

Table y. CONFIGURE ROUTE INFORMATION response

Byte	7	6	5	4	3	2	1	0
0	FUNCTION RESULT							
1	Reserved							
2								
3	ROUTE SLOT							
4	ROUTE INDEX							
5	PHY IDENTIFIER							
6	Reserved							
7	SAS ADDRESS							
14								
15	ROUTE	Reserved						
16	Reserved				CURRENT PHY LINK RATE			
17	Reserved							
18								
19	Reserved				SSP INITIATOR	STP INITIATOR	SMP INITIATOR	Reserved
20	Reserved				SSP TARGET	STP TARGET	SMP TARGET	SATA TARGET
21	(MSB)	Reserved						
26								(LSB)
27	(MSB)	CRC						
30								(LSB)

The ROUTE SLOT field indicates which slot in a route table is being returned. This value shall match the value in the request.

The ROUTE INDEX field indicates which index in a route table is being returned. This value shall match the value in the request.

The PHY IDENTIFIER field indicates the physical link referenced by this route table entry.

The SAS ADDRESS field contains the device name reference by this route table entry.

The ROUTE field indicates the content of the frame is valid for routing. The 0b value indicates the route has been determined to be in violation of connection rules.

The CURRENT PHY LINK RATE field indicates the current physical link rate negotiated on this phy and is defined in Table 1.

Table 1. Current Physical Link Rate

CURRENT PHY LINK RATE	Current physical link rate
0000b	Phy does not exist
0001b	Rate unknown
0010b	Phy disabled
0011b	1,5 Gbps
0100b	3,0 Gbps
0101b – 1111b	Reserved

The SMP INITIATOR bit indicates the device is an SMP initiator device or SMP target/initiator device.

The STP INITIATOR bit indicates the device is an STP initiator device or STP target/initiator device.

The SSP INITIATOR bit indicates the device is an SSP initiator device or SSP target/initiator device.

The SATA TARGET bit indicates the device is an SATA target device or SATA target/initiator device.

The SMP TARGET bit indicates the device is an SMP target device or SMP target/initiator device.

The STP TARGET bit indicates the device is an STP target device or STP target/initiator device.

The SSP TARGET bit indicates the device is an SSP target device or SSP target/initiator device.

Add a new device type: Edge Router

edge route expander device: An edge expander device that presents simple routing capability to a fanout expander device, but complex routing capability to an edge expander. This class of expander device may be used to connect edge expanders and create larger topologies.

change section 4.1.7 from:

There are two classes of expander devices:

a) fanout expander devices: expanders that contain complex routing capability; and

b) edge expander devices: expanders that only contain simple routing capability.

to:

There are three classes of expander devices:

a) fanout expander devices: expanders that contain complex routing capability; and

b) edge expander devices: expanders that only contain simple routing capability.

c) edge route expander devices: expanders that contain a hybrid routing capability.

change section 4.1.9 from:

No more than one fanout expander device shall be included in a SAS domain. The fanout expander device may be attached to up to 64 edge expanders, initiator ports, or target ports.

Each edge expander device may be attached to no more than one fanout expander device. Each edge expander device may be attached to up to 64 initiator ports or target ports.

An edge expander device may be attached to another edge expander device only if there are no other expanders in the SAS domain.

to:

No more than one fanout expander device shall be included in a SAS domain. The fanout expander device may be attached to up to 64 edge expanders, initiator ports, or target ports.

Each edge expander device may be attached to no more than one fanout expander device. Each edge expander device may be attached to up to 64 initiator ports or target ports.

An edge expander device may be attached to another edge expander device only if there are no other expanders in the SAS domain.

An edge route expander device may be attached to no more than one fanout expander device, and up to N edge expanders, initiator ports, or target ports. If connected to a fanout expander device and one or more edge expanders, the edge route expander will present itself as an edge expander to the fanout expander device and as a fanout expander device to each edge expander device.

change section 4.8.4.1:

Fanout expander devices must perform additional discovery for each attached edge expander device in order to establish a routing table.

to:

Fanout expander devices and edge route devices require additional discovery for each attached edge expander device in order to establish a routing table.

change section 7.6.3:

After learning that it is attached to an edge expander device, a fanout expander device shall use the SMP DISCOVER function (see **Error! Reference source not found.**) to retrieve the list of device names to which the edge expander device is attached.

After receiving a CHANGE primitive sequence from an edge expander device, the fanout expander device shall use the SMP DISCOVER function to obtain an updated list of device names from that edge expander device.

to:

A fanout expander device may require configuration by an initiator before it can perform its routing function. As an initiator traverses the topology it shall use the SMP DISCOVER function to build the necessary routing information, which shall then be used to configure the fanout expander device. The configuration information is presented to the fanout expander device using multiple SMP CONFIGURE ROUTE INFORMATION functions.

After receiving a CHANGE primitive sequence from an expander, the initiator rebuilds the topology to update the list of SAS ADDRESSes for the fanout expander device.

7.6.4 Edge route expander device specific rules

An edge route expander device may require configuration by an initiator before it can perform its routing function. As an initiator traverses the topology it shall use the SMP DISCOVER function to build the necessary routing information, which shall then be used to configure the edge route expander device. The configuration information is presented to the edge route expander device using multiple SMP CONFIGURE ROUTE INFORMATION functions.

After receiving a CHANGE primitive sequence from an expander, the initiator rebuilds the topology to update the list of SAS ADDRESSes for the edge route expander device.

Guidelines for an initiator to discover and configure the SAS topology

To simplify the edge expander devices, edge route expander devices and fanout expander devices within the SAS topology, it is desirable to provide a mechanism for initiators to configure the topology. The algorithm presented defines a method where any and all initiators in the topology may configure the topology without requiring any form of coordination between the initiators.

There are two major components of the algorithm; the method used to traverse the topology and the mechanism used to update the route information in the topology.

The initiator traverses the topology by entering each expander and accessing each phy using the SMP Discover function in an ascending order. When the last phy in the current expander is encountered, the initiator enters the next expander encountered on the next sequential phy and begins the process again. The result is to group end devices by expander. The SAS addresses compiled are then organized without collapsing empty or duplicate phys.

Once the SAS addresses are compiled, the initiator shall update each of the edge route expander devices and fanout expander devices within the topology. There is no configuration required for the edge expanders. The initiator shall update the near edge route expander device prior to exiting to configure the fanout expander device and far edge route expander devices.

Within each edge route expander device or fanout expander device an organized route table shall exist that the initiator will update to establish the topology route. To avoid issues with multiple initiators having to coordinate the update operation, the route table shall be updated identically, independent of which initiator could perform the operation. Since the time to complete a discovery and configuration cycle is relatively small, there is no need to prevent an initiator from participating.

The mechanism used to update the edge route expander device and fanout expander device is the SMP Configure Route Information function. The content of the request payload in SMP Configure Route Information function shall be consistent regardless of which initiator makes the request.