SM HBA API Overview

An overview of the draft T11. SM HBA API for the T10 SAS WG

Rev 0
July 8, 2004

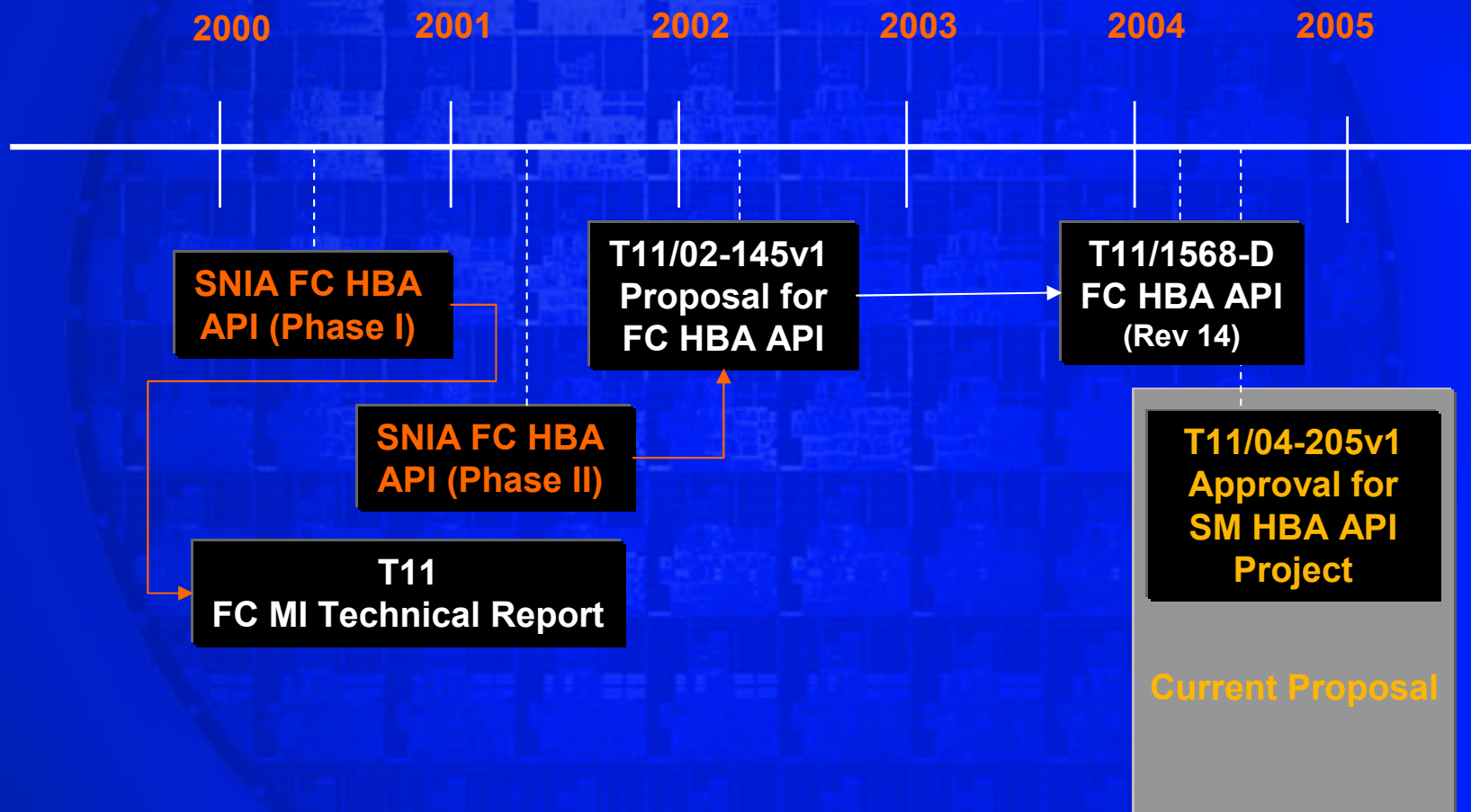intel.

Agenda

- **HBA-API Background**
  - **FC HBA API, SNIA and T11.5 History**
  - **Functional Overview**
- **SM-HBA General Concepts & Status**
  - **SM HBA Project and Scope**
  - **Relationship to T10 and SAS**
  - **SM-HBA Concepts & Functional Enhancements**
- **Anticipated Elements of SM-HBA**
  - **Proposed Generic Port Structures**
  - **Proposed Statistics Structures**
  - **SAS Expander Device Management Functions**

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HBA-API Background

- **SM-HBA is based on FC-HBA**
  - Fibre channel host-bus adapter management
- **SNIA developed Phase I of the FC-HBA-API specification.**
- **T11.5 developed Phase II of the FC-HBA Standard**
  - 1568-D forwarded to INCITS and BSR-9 forwarded to ANSI in April '04
  - http://www.t11.org/index.htm for additional details.
- **Provides reporting of discovery and attributes of the HBA & domain**
- **Adopted by fibre channel management applications & HBA vendors**
- **Provides the basic support for SMI (Storage Management Initiative) FC-HBA Profile providers**

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HBA API Timeline SNIA and T11.5

2000   2001   2002   2003   2004   2005

SNIA FC HBA API (Phase I)

SNIA FC HBA API (Phase II)

T11 FC MI Technical Report

T11/02-145v1 Proposal for FC HBA API

T11/1568-D FC HBA API (Rev 14)

T11/04-205v1 Approval for SM HBA API Project
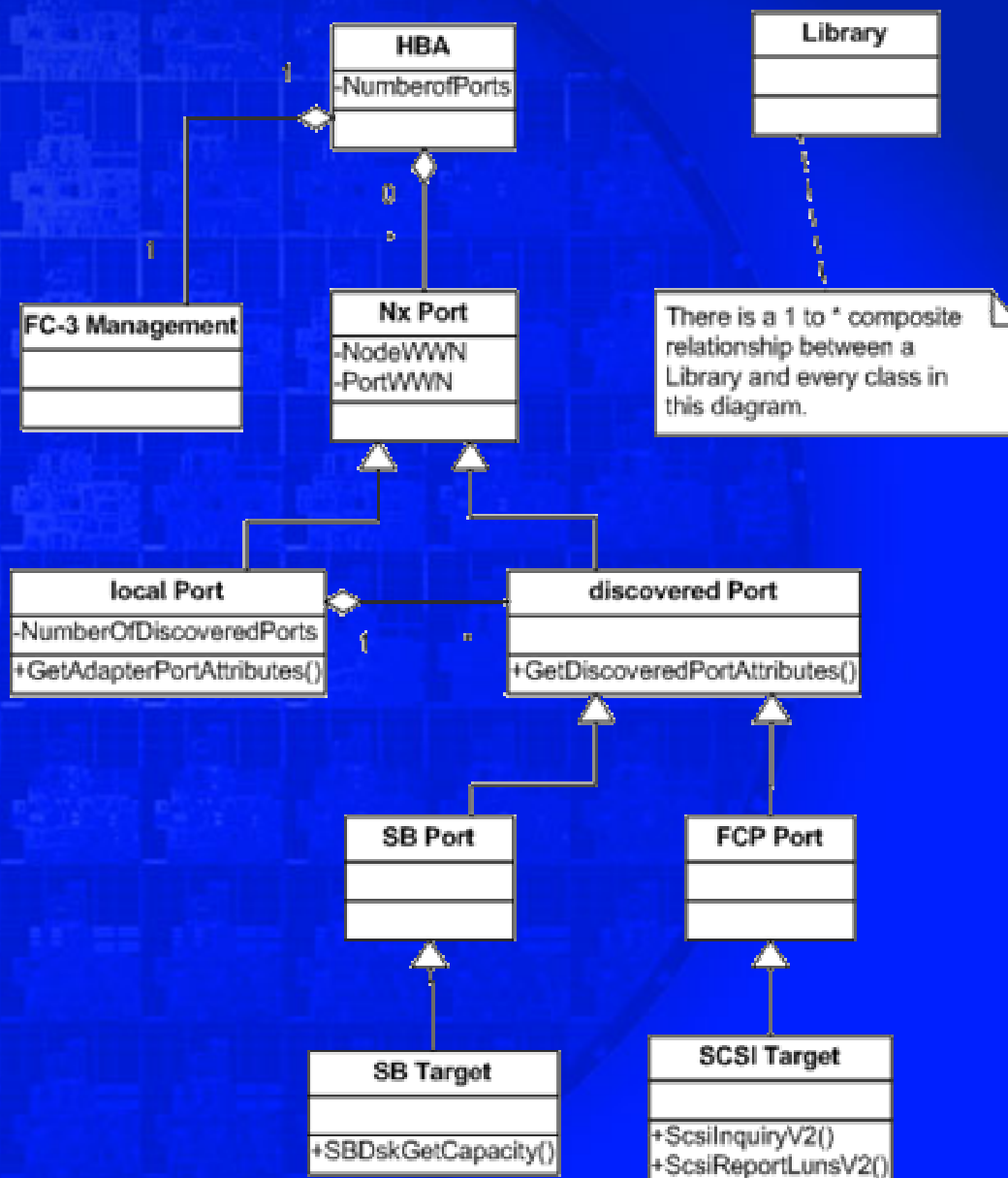
Current Proposal

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FC HBA Functional Overview

- **FC HBA API Phase 1 supports:**
  - Local HBA and discovered FC Target Nx Ports
  - Reporting Nx Port statistics
  - Reporting of target Persistent Bindings
  - Several specific FC fabric management (FC-MI) Extended Link Service (ELS) requests including ELS CT Pass-thru

- **FC HBA API Phase 2 additions:**
  - Get and set persistent bindings
  - Set target persistent bindings
  - Asynchronous event callback
  - Target events registration (HBA, Port, Link)
  - FC4 statistics reporting
  - Single byte (SB) target device support

FC HBA API Structure (UML)

- ## Local Nx Ports
  - A physical port within the HBA

- ## Discovered Nx Ports
  - Nx Port targets discovered through a local Nx Port
  - FCP Port
    - A discovered target port that supports the FCP (SCSI) protocol
  - SB Port
    - A discovered target port that supports the SB (single byte) protocol

HBA
-NumberofPorts

Library

FC-3 Management

Nx Port
-NodeWWN
-PortWWN

There is a 1 to * composite relationship between a Library and every class in this diagram.

local Port
-NumberOfDiscoveredPorts
+GetAdapterPortAttributes()

discovered Port
+GetDiscoveredPortAttributes()

SB Port

FCP Port

SB Target
+SBDskGetCapacity()

SCSI Target
+ScsiInquiryV2()
+ScsiReportLunsV2()

Agenda

- **General Introduction:**
  - **FC HBA API, SNIA and T11.5 History**
  - **Functional Overview**
- **SM-HBA General Concepts & Status** ✓
  - **SM HBA Project and Scope**
  - **Relationship to T10 and SAS**
  - **SM-HBA Concepts & Functional Enhancements**
- **Anticipated Elements of SM-HBA:**
  - **Proposed Generic Port Structure**
  - **Proposed Statistics Structure**
  - **SAS Expander Device Management Functions**

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SM HBA Project

- **Next generation T11.5 Storage Management API**
- **T11.5 project #1695 approved by INCITS June '04**
- **SM-HBA WG:**
  - Chair: George Penokie
  - Technical Editor: Krithivas Ramamurthy
  - Secretary: Vinod Bhat
  - T10 Liaison: Bob Sheffield
- **Discovery and management of:**
  - FC *and SAS* HBAs,
  - Elements of service delivery subsystem (fabric, expander devices),
  - FCP, SSP, SMP, STP and SATA target devices.
- **Vendor independent management of storage devices**
- **SM-HBA proposal based on FC HBA API Phase 2:**
  - ++ SAS HBA API specific data structures and functions
  - ++ Specific improvements for FC Management

Scope SM HBA API

SM HBA API is a standard API for the management of HBAs that support fibre channel and/or SAS protocols, and the use of fibre channel and SAS capabilities for discovery and management of the components of those protocol domains. The SM-HBA standard defines interfaces for the following capabilities:

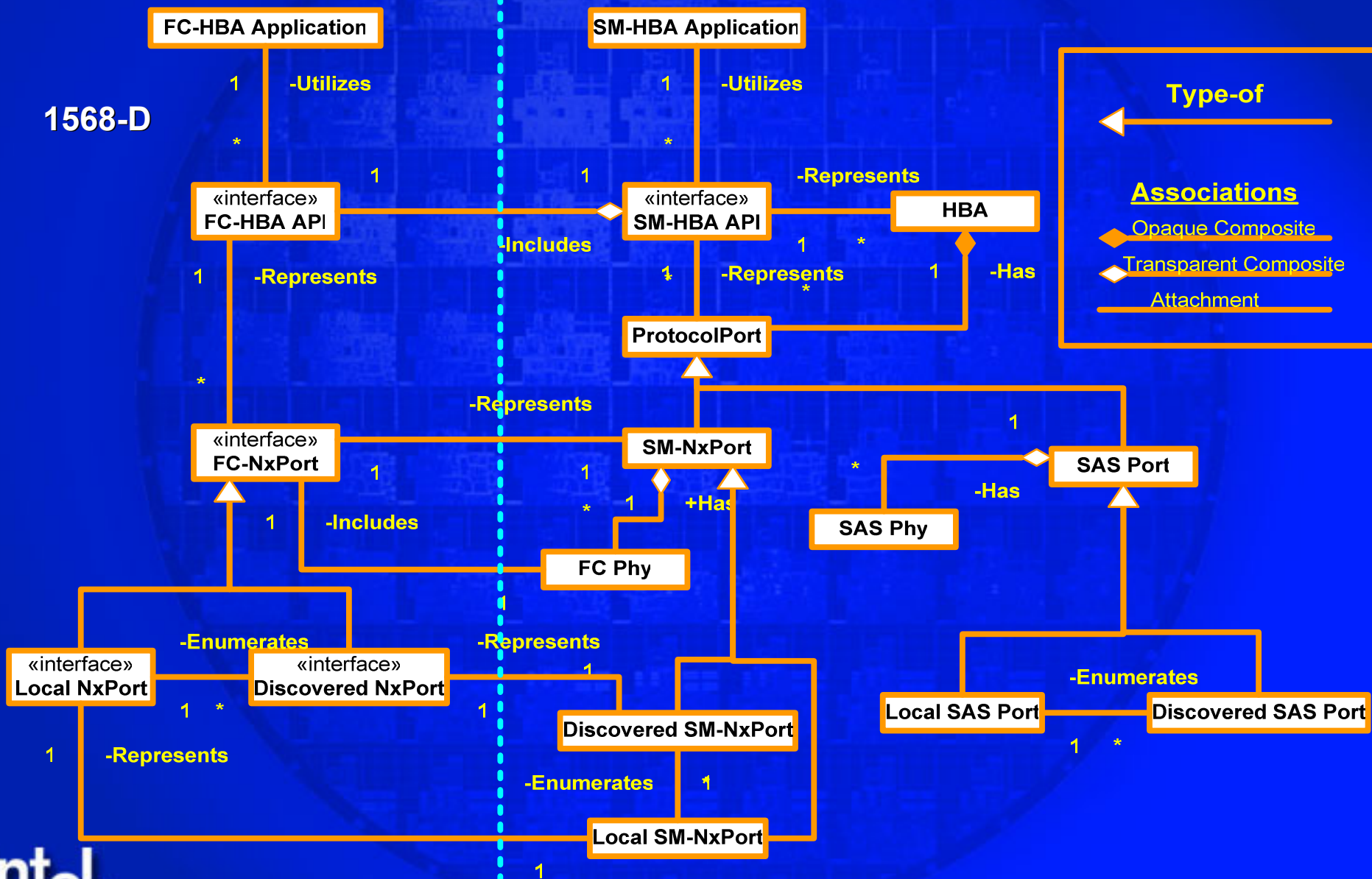| SM-HBA	Function		
HBA & End Ports	Monitoring & control of descriptive & operational characteristics		
	Statistics monitoring (Includes storage access traffic)		
	Selective reporting of configuration, status and events (includes transport)		
Transport (service delivery subsystem)	FC	• Access to general fabric services (FC-GS-4) • Access to the extended link services (ELS) to comply with the manageability profile for HBAs recommended in FC-MI (see FC-MI)	
	SAS	Access SAS management protocol (SMP) services for expander device management	
Domain Resources		FC	SAS
	Discovery and enumeration	FCP-2, SB	SSP, SMP, STP, & SATA
	Monitoring & control of availability & representation		

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Interoperability

App / HW	FC-HBA Management Application	SM-HBA Management Application
Fibre Channel HBA	• FC HBA API Library (1568-D) • SM-HBA API Library	• FC HBA API Library (1568-D) • SM-HBA API Library
SAS HBA	**X**	• SM-HBA API Library

SM-HBA and SAS

- **T11.5 defines storage/network management interfaces**
  - non transport-specific (so may include SAS)
- **SM-HBA draws upon SAS-1.1**
  - Structure & Attributes
  - Domain-specific management requirements
- **T10 SAS WG is encouraged to contribute to SM-HBA**
- **SM-HBA is a superset of FC-HBA that handles SAS**
- **SM-HBA *may* include IOCTL definitions for Driver I/F**
- **SM-HBA base = FC-HBA (1568-D)**
  - All new elements added through proposals

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SM HBA API Concepts (UML)

1568-D

FC-HBA Application

SM-HBA Application

1 -Utilizes

1 -Utilizes

*

*

1

1

«interface»
FC-HBA API

«interface»
SM-HBA API

-Includes

-Represents

HBA

1

1 *

1 -Has

1

1

-Represents

-Represents

ProtocolPort

1 *

*

-Represents

«interface»
FC-NxPort

SM-NxPort

SAS Port

1

1

1

*

* 1

+Has

-Has

SAS Phy

-Includes

FC Phy

SAS Phy

-Enumerates

-Represents

«interface»
Local NxPort

«interface»
Discovered NxPort

1

1 *

1

Discovered SM-NxPort

Local SAS Port

Discovered SAS Port

-Enumerates

-Represents

1

1 *

1

-Enumerates

Local SM-NxPort

1

Type-of

Associations

Opaque Composite

Transparent Composite

Attachment

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SM-HBA Core Port Types

- **Local Port:**
  - **Represents a physical SAS or FC port attached to the HBA**
- **Discovered Port**
  - **Represents a single target SAS or FC discovered on a Local Port.**
- **FCP_Port:**
  - **Discovered target device that supports the FCP (SCSI) protocol and associated bindings.**
    - **Note: How to distinguish Initiator and Target FCP_Ports?**
- **SSP (Serial SCSI Protocol) Port:**
  - **Discovered target device that supports the SAS (SCSI) protocol and associated bindings.**
- **STP (Serial ATA Tunneling Protocol) Port:**
  - **Discovered SATA target device that supports the STP protocol and associated bindings.**
- **SMP (Serial Management Protocol) Port:**
  - **Discovered SAS expander devices that supports the SMP Protocol.**
- **SATA Port ??**
  - **Discovered SATA Devices.   (Open. Not part of T11/04-205v1 Proposal)**

Agenda

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  - **SM HBA Project and Scope**
  - **Relationship to T10 and SAS**
  - **SM-HBA Concepts & Functional Enhancements**
- **Specifics: ✓**
  - **Proposed Generic Port Structure**
  - **Proposed Statistics Structure**
  - **SAS Expander Management Functions**

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SM-HBA
Data Structure Enhancements

Data Structures and Attributes:

- **PORTS**: Definition of a Generic HBA_PortAttributes (Section 6.4): ✓
  - FC_Port (Nx_Port) attributes defined by 1568-D will not change.
  - Support/Addition of SAS Port attributes.
    - Definition of SAS PHY Attribute. New.

- **STATISTICS**: Definition of a Generic Port Statistics. (Section 6.5) ✓
  - End Port (FC-0, FC-1 & FC-2) Statistics defined by 1568-D will not change.
    - Addition of SAS Port/Phy level Statistics. New
  - Statistics FC-4 may be made generic to include SSP, STP and SMP.

- **TARGET PORT**: Definition of Target_Port : (Section 6.6) ✓
  - FCP_Port attributes defined by 1568-D may not change.
    - Persistent binding FCP Port enhancements (if any).
  - Addition of SSP, SMP, STP and SATA Bindings.
  - Possible HBA_BINDING structure definition.

- **EVENTS**: Polled Event and Asynchronous Event Notifications: (Section 6.9 & 6.10) ✓
  - FC Link events and structures supported by 1568-D will not change.
  - Addition of SAS Specifics (e.g. Broadcast SES)

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SM-HBA
Data Structure Enhancements

Data Structures and Attributes:

- **Basic Attribute Types & Status Return Types (Section 6.1 & 6.2):**
  - Additions (e.g. additional return status)

- **HBA Attribute (Section 6.3):**
  - HBA_Adapter_Attributes may not change. For, SAS NodeWWN is optional.

- **SB_Attributes, FC-3 Management Attributes and Library Attributes:**
  - No change (Section 6.7 & 6.8)

- **Library Attributes (Section 6.11):**
  - Additions (e.g. SAS Expander Management Functions)

Ports
(Generic HBA_PortAttributes)

- **Preserve Old Structures and Old Function Calls.**

Common Attributes
PortWWN
PortSymbolicName[]
OSDeviceName[]
NumberofDiscoveredPorts
PortType

- **Define New Structures and New Function Calls that return those data structures.**

N_Port, NL_Port, F_Port, FL_Port, L_Port, PTP

SAS Edge Expander, Fanout Expander, SAS End Device or Unknown

FC Specific
NodeWWN
PortFcID
PortState
PortSupportedClassOfService
PortSupportedFC4Types
PortActiveFC4Types
PortSupportedSpeed
PortSpeed
PortMaxFrameSize
FabricName

SAS Specific

HBA_SASPortAttributes {
    HBA_SASPORTPROTOCOL   PortProtocol;
    HBA_SASPORTMODE   PortMode;
    HBA_UINT32   NumberofPhys;
} HBA_SASPORTATTRIBUTES,
*PHBA_SASPORTATTRIBUTES;

Restructure into separate Common and Protocol-Specific Elements.

Ports
SAS Phy Attributes (New)

```
typedef struct HBA_SASPhyAttributes {

    HBA_SASPHYIDENTIFIER   PhyIdentifier;
                            AttachedDeviceType;
    HBA_SASPHYSPEED         NegotiatedLinkRate;
    HBA_SASPHYSPEED         HardwareMinLinkRate;
    HBA_SASPHYSPEED         ProgrammedMinLinkRate;
    HBA_SASPHYSPEED         HardwareMaxLinkRate;
    HBA_SASPHYSPEED         ProgrammedMaxLinkRate;
    HBA_UINT32              PhyChangeCount;
    HBA_UINT32              MaximumFrameSize; Relevant?
    HBA_UNIT32              MinimumFrameSize; Relevant ?
} HBA_SASPHYATTRIBUTES,
*PHBA_SASPHYATTRIBUTES;
```

Phy structure based on the SMP Discover Response (Section 10.4.3.5)
Also consider 04-172r0: SAS-1.1 More counters

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Statistics

- **Re-Definition of HBA_PortStatistics to include support for FC0/FC1/FC2 and SAS Link level statistics.**

- **Definition of HBA_ProtocolStatistics (currently it is HBA_FC4Statistics) to support the following protocols:**
  - **FC4, SSP, STP and SMP.**
  - **Additional consideration would be to expand the scope of HBA_ProtocolStatistics to align with DMTF CR 1384 on Block level statistics.**

Statistics

HBA_PortStatistics

FC Statistics
SecondsSinceLastReset
TxFrames
TxWords
RxFrames
RxWords
…………
…………
InvalidCRCCount

SAS Statistics
SecondsSinceLastReset
TxFrames
TxWords
RxFrames
RxWords
INVALID DWORD COUNT,
RUNNING DISPARITY ERROR COUNT,
LOSS OF DWORD SYNCHRONIZATION COUNT
PHY RESET PROBLEM COUNT
(Work in Progress)

Add SAS-specific Port and Phy statistics

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Events
(SAS Specific)

- **Similarities in Event management between SAS and FC. Existing mechanism suffices.**
  - HBA_GetEventBuffer()
  - HBA_RegisterForAdapter[Add||Port|PortStat|]Events(),
  - HBA_RegisterFor[Target|Link]Events()
  - HBA_RemoveCallBack()

- **Events Types are different. Implies that SAS Event Attributes need to be defined.**
  - **Broadcast SES**
  - **Broadcast CHANGE**
  - **Broadcast (Reserved #)**

  Add SAS-specific Event reporting

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SM-HBA
Functional Enhancements - I

HBA and Port Information Functions: (Section 7.3)

- **HBA_GetAdapterPortAttributes(), HBA_GetDiscoveredPortAttributes() and HBA_GetPortAttributesByWWN() return proposed Generic Port structure.**
  - **HBA_GetPhyAttributes:**
    - **Returns SAS Phy Attributes for a specified Phy on a specific local or discovered SAS Port**
      - Applicable to FC Ports?

- **HBA_GetPortStatistics() return proposed Generic Statistics Structure.**
  - **HBA_GetPhyStatistics() returns the Generic Statistics Structure for SAS Ports**

- **HBA_GetFC4Statistics() may change to HBA_GetProtocolStatistics() for FC-FS & SSP/STP/SMP protocol mappings.**

SM-HBA
Functional Enhancements - II

Fabric/Network/Link Management functions: (Section 7.8)

- **FC Fabric (FC-MI and FC GS-4) in 1568-D: <u>no change</u>**
- **Addition of SAS Expanded Management Services:**
  - **Expander Generic:**
    - **Report General()**
    - **Report Manufacturer Information()**
  - **Specific Phy:**
    - **Discover()**
    - **Report Phy Error Log()**
    - **Report Phy Sata()**
    - **Route Table:**
      - Report Route Information()
      - Configure Route Information()
    - **Phy Control()**

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SM-HBA
Functional Enhancements - II

Fabric/Network/Link Management functions: (Section 7.8)

- **HBA_SendSMPReportGeneral**
  - Returns SMP Report General attributes for the specified expander
- **HBA_SendSMPReportManInfo**
  - Returns SMP Report Manufacturing Information for the specified expander
- **HBA_SendSMPDiscover**
  - Returns SMP Discover attributes for the specified expander
- **HBA_SendSMPPassThru**
  - Sends any SAS SMP Request to a SMP Target device Port specified by Port WWN and attached to a local SAS Port
  - Allows SAS expander configuration.
  - Not SCSI Pass through.

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SM-HBA
Functional Enhancements - III

Target (FCP/SSP/STP/SATA) & SCSI Inquiry Information Functions: (Section 7.4 & 7.5)

- HBA_GetBindingCapability, HBA_[Get/Set]BindingSupport: No Change
- HBA_GetFCPTargetMappingV2() may evolve into HBA_GetTargetMappingV3 to include FCP, SSP and STP Targets.
- HBA_[Get/Set]FCPPersistentBindingV2() may evolve into HBA_[Get/Set]PersistentBindingV3() to include FCP, SSP and STP Targets.
- HBA_Remove[All]PersistentBinding will take in a HBA_BINDING structure as input (instead of HBA_FCPBINDING2)
- HBA_GetFCPStatistics() may evolve into HBA_GetProtocolStatisticsV3()
- SSP & FCP Targets continue to be identified through HBA_SCSIReportLuns(…) functions. Addition of STP and SATA Targets:
  - HBA_SendSTPIdentifyDevice()
    - Returns STP/SATA Identify Device attributes based on the local HBA Port WWN and STP Target device Port WWN
    - Supports identification of STP and direct attached SATA target devices.

> **May have a generic binding (FCP/SSP/STP) structure.**

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