
**Information technology — Storage
management —**

**Part 7:
Host elements**

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of document should be noted (see www.iso.org/directives).

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Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by SNIA (as Storage Management Technical Specification, Part 7 Host Elements, Version 1.8.0, Revision 5) and drafted in accordance with its editorial rules. It was adopted, under the JTC 1 PAS procedure, by Joint Technical Committee ISO/IEC JTC 1, *Information technology*.

This second edition cancels and replaces the first edition (ISO/IEC 24775-7:2014), which has been technically revised.

The main changes compared to the previous edition are as follows:

- USAGE text was revised to address code (now included in the front matter for all SNIA specifications)
- All recipes and their references were deleted.
- Instances of subprofile were changed to profile. In the annex, instances of subprofile were changed to component profile (TSG meeting voice vote).
- Profile versions and related text were updated. (TSG meeting voice vote).
- Indications have been replaced by DMTF Indications, and all affected clauses updated. (TSG meeting voice vote).
- Instances of Experimental within profiles already labeled as Experimental were removed to avoid confusion and redundancy. (Editorial change)
- CIM/XML was changed to CIM-XML (Response to ballot comments).

- Annex: SMI-S Information Model.
- The CIM schema version was changed to 2.51 for V1.8.0 Rev3.
- Disk Partition Profile
 - Added descriptions of the references in CIM_BasedOn (Partition to Extent), CIM_BasedOn (Partition to Partition), CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition) and CIM_SystemDevice (System to LogicalDisk).
 - Made CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition) and CIM_SystemDevice (System to LogicalDisk) Conditional (rather than Optional), since CIM_LogicalDisk is Optional Storage HBA Profile (SMI TWG Reviews).
 - Fixed the version numbers on the Related Profiles to match what the profiles claim.
 - Added Descriptions to the references in CIM_ProductElementComponent, CIM_Realizes and CIM_SystemDevice.
- FC HBA Profile
 - Removed the profile content and added text re it being Deprecated (CORE-SMIS-SCR-000).
- Host Discovered Resources Profile
 - Promoted the maturity level from DRAFT to EXPERIMENTAL for update to remove SNIA_ classes and use DMTF CIM_ classes.
 - Added the related profiles table to the spec.
 - Moved NameFormat from LogicalDevice to LogicalDisk to match the mof.
 - Moved NameNamespace from LogicalDevice to LogicalDisk to match the mof.
 - Added descriptions on the References for CIM_HostedAccessPoint and CIM_SystemDevice.
 - Marked the SB Multipath Management Related Profile as Deprecated (SMIS-180-Errata-SCR00002).
- Host Hardware RAID Controller Profile
 - Fixed the version numbers on the Related Profiles to match what the profiles claim.
 - Added two ElementSoftwareIdentity associations to cover the 3 SoftwareIdentity classes (one Mandatory and one Optional).
 - Added descriptions on the References for CIM_AssociatedAlarm, CIM_ProductPhysicalComponent, CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice), CIM_Realizes (Associates PhysicalPackage to PortController) and CIM_SAPAvailableForElement.
 - Fixed the description of Dependent in CIM_ControlledBy.
 - Added Key properties to the CIM_SoftwareIdentity CIM Element tables.
 - Changed the version of the profile to 1.7.0.
- iSCSI Initiator
 - Removed all occurrences of “(Host Hardware RAID Controller)” (CORE-SMIS-SCR-000).
 - Removed MATURITY="Draft" from the Launch In Context supported profile.
 - Added Descriptions for References in 2 CIM_BindsTo associations, CIM_ControlledBy, 2 CIM_DeviceSAPImplementations and CIM_ElementSoftwareIdentity.
 - Added Descriptions for References in 2 CIM_EndpointOfNetworkPipes, CIM_NetworkPipeComposition, CIM_ProductPhysicalComponent and CIM_Realizes.

- Added Descriptions for references in CIM_SAPAvailableForElement.
- Added Keys to CIM_PhysicalPackage.
- Changed the Central Class from PortController to CIM_ComputerSystem (TSG-SMIS-SCR00333).
- Memory Configuration Profile
 - Updated due to class and property name changes in DMTF Multi-type Memory profile (SMIS-170-Draft-SCR00006).
 - Introduced staged request concept.
 - Added use cases.
 - Addressed comments from internal and partner reviews.
 - Changed diagrams approved in Core TWG 3/23/15.
 - Changed SystemCreateClassName in class CIM_MemoryConfigurationService to SystemCreationClassName.
 - Changed RemainingCapacity in class CIM_ResourcePool to CurrentlyConsumedResource.
 - Changed ChangeableType in class CIM_MemoryAllocationSettingData to ResourceType.
 - Fixed the description of Replication in class CIM_MemoryAllocationSettingData.
 - Added a description for ChannelCount in class CIM_MemoryAllocationSettingData.
- Persistent Memory Configuration Profile
 - Added new material (most of profile content) to manage NVDIMMs (SMIS-170-Draft-SCR00006).
 - Changed diagrams approved in Core TWG 3/23/15- Changed RemainingCapacity in class CIM_ResourcePool to Reserved.
 - Changed SecurityFeatures in class CIM_PersistentMemoryCapabilities to SecurityFeatures.
 - Removed ChannelCount in class CIM_PersistentMemoryNamespaceSettingData, since it is not in the mof and not referenced anywhere in the profile text.
 - Added three methods to CIM_PersistentMemoryService to support the profile text.
 - Fixed the ManagedElement reference in CIM_ElementConformsToProfile.
 - Fixed the references in CIM_SystemDevice.
 - Fixed the references in CIM_BasedOn.
- SB Multipath Management Profile
 - Promoted the maturity level from DRAFT to EXPERIMENTAL for update to remove SNIA_ classes and use DMTF CIM_ classes (TSG-SMIS-SCR00315.001).
 - Added reference to SMI-S Version 1.6.1 Revision 5. No content in this deprecated profile SB Multipath.
- SCSI Multipath Management Profile
 - Added keys to CIM_SCSIMultipathConfigurationCapabilities and CIM_SCSIMultipathSettings (SMIS-170-Draft-SCR00006).
- Annex A (informative) SMI-S Information Model
 - DMTF's CIM schema version changed to 2.45.0.
- References

- Added DMTF DSP1054 v1.2.2, Indications Profile (and changed version to 1.2.2 throughout book).
- Updated DSP 1071, Multi-type System Memory Profile reference here and in profiles.
- Added reference to DSP 1119, 1.0.0b Diagnostics Job Control Profile.
- Removed reference to DSP 1119\.
- Removed 2.3.

A list of all parts in the ISO/IEC 24775 series can be found on the ISO website.

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INTENDED AUDIENCE

This document is intended for use by individuals and companies engaged in developing, deploying, and promoting interoperable multi-vendor SANs through the Storage Networking Industry Association (SNIA) organization.

CHANGES TO THE SPECIFICATION

Each publication of this specification is uniquely identified by a three-level identifier, comprised of a version number, a release number and an update number. The current identifier for this specification is version 1.8.0. Future publications of this specification are subject to specific constraints on the scope of change that is permissible from one publication to the next and the degree of interoperability and backward compatibility that should be assumed between products designed to different publications of this standard. The SNIA has defined three levels of change to a specification:

- **Major Revision:** A major revision of the specification represents a substantial change to the underlying scope or architecture of the SMI-S API. A major revision results in an increase in the version number of the version identifier (e.g., from version 1.x.x to version 2.x.x). There is no assurance of interoperability or backward compatibility between releases with different version numbers.
- **Minor Revision:** A minor revision of the specification represents a technical change to existing content or an adjustment to the scope of the SMI-S API. A minor revision results in an increase in the release number of the specification's identifier (e.g., from x.1.x to x.2.x). Minor revisions with the same version number preserve interoperability and backward compatibility.
- **Update:** An update to the specification is limited to minor corrections or clarifications of existing specification content. An update will result in an increase in the third component of the release identifier (e.g., from x.x.1 to x.x.2). Updates with the same version and minor release levels preserve interoperability and backward compatibility.

TYPOGRAPHICAL CONVENTIONS

Maturity Level

In addition to informative and normative content, this specification includes guidance about the maturity of emerging material that has completed a rigorous design review but has limited implementation in commercial products. This material is clearly delineated as described in the following sections. The typographical convention is intended to provide a sense of the maturity of the affected material, without altering its normative content. By recognizing the relative maturity of different sections of the standard, an implementer should be able to make more informed decisions about the adoption and deployment of different portions of the standard in a commercial product.

This specification has been structured to convey both the formal requirements and assumptions of the SMI-S API and its emerging implementation and deployment lifecycle. Over time, the intent is that all content in the specification will represent a mature and stable design, be verified by extensive implementation experience, assure consistent support for backward compatibility, and rely solely on content material that has reached a similar level of maturity. Unless explicitly labeled with one of the subordinate maturity levels defined for this specification, content is assumed to satisfy these requirements and is referred to as "Finalized". Since much of the evolving specification

content in any given release will not have matured to that level, this specification defines three subordinate levels of implementation maturity that identify important aspects of the content's increasing maturity and stability. Each subordinate maturity level is defined by its level of implementation experience, its stability and its reliance on other emerging standards. Each subordinate maturity level is identified by a unique typographical tagging convention that clearly distinguishes content at one maturity model from content at another level.

Experimental Maturity Level

No material is included in this document unless its initial architecture has been completed and reviewed. Some content included in this document has complete and reviewed design, but lacks implementation experience and the maturity gained through implementation experience. This content is included in order to gain wider review and to gain implementation experience. This material is referred to as “Experimental”. It is presented here as an aid to implementers who are interested in likely future developments within the SMI specification. The contents of an Experimental profile may change as implementation experience is gained. There is a high likelihood that the changed content will be included in an upcoming revision of the specification. Experimental material can advance to a higher maturity level as soon as implementations are available. Figure 1 is a sample of the typographical convention for Experimental content.

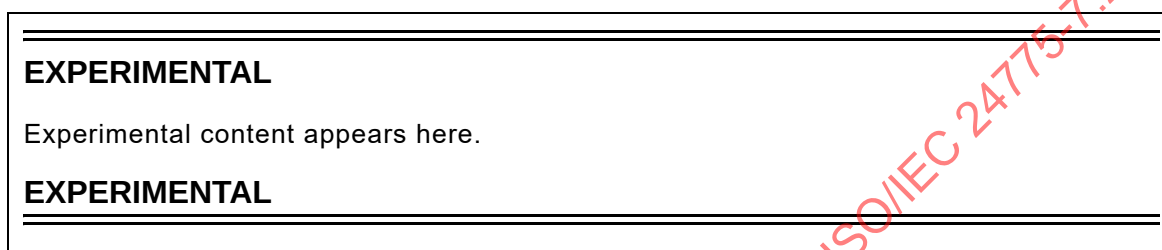


Figure 1 - Experimental Maturity Level Tag

Implemented Maturity Level

Profiles for which initial implementations have been completed are classified as “Implemented”. This indicates that at least two different vendors have implemented the profile, including at least one provider implementation. At this maturity level, the underlying architecture and modeling are stable, and changes in future revisions will be limited to the correction of deficiencies identified through additional implementation experience. Should the material become obsolete in the future, it must be deprecated in a minor revision of the specification prior to its removal from subsequent releases. Figure 2 is a sample of the typographical convention for Implemented content.

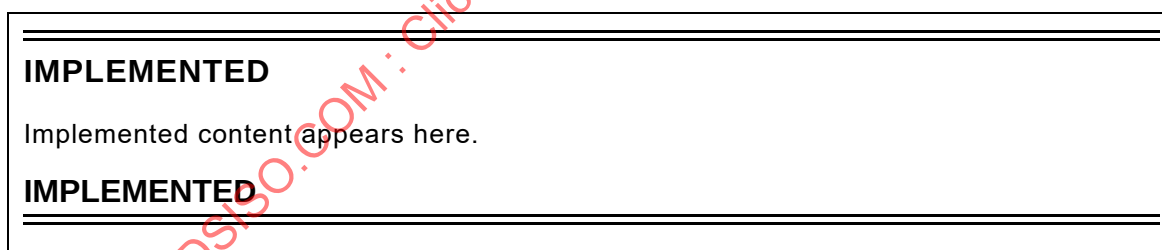


Figure 2 - Implemented Maturity Level Tag

Stable Maturity Level

Once content at the Implemented maturity level has garnered additional implementation experience, it can be tagged at the Stable maturity level. Material at this maturity level has been implemented by three different vendors, including both a provider and a client. Should material that has reached this maturity level become obsolete, it may only be deprecated as part of a minor revision to the specification. Material at this maturity level that has been deprecated may only be removed from the specification as part of a major revision. A profile that has reached this maturity level is guaranteed to preserve backward compatibility from one minor specification revision to the next. As a result, Profiles at or above the Stable

maturity level shall not rely on any content that is Experimental. Figure 3 is a sample of the typographical convention for Implemented content.

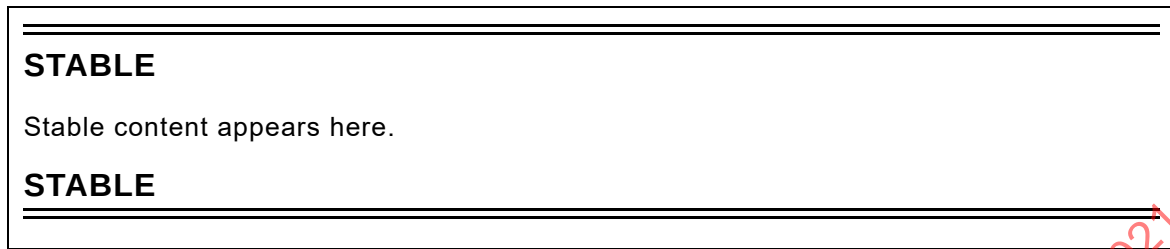


Figure 3 - Stable Maturity Level Tag

Finalized Maturity Level

Content that has reached the highest maturity level is referred to as “Finalized.” In addition to satisfying the requirements for the Stable maturity level, content at the Finalized maturity level must solely depend upon or refine material that has also reached the Finalized level. If specification content depends upon material that is not under the control of the SNIA, and therefore not subject to its maturity level definitions, then the external content is evaluated by the SNIA to assure that it has achieved a comparable level of completion, stability, and implementation experience. Should material that has reached this maturity level become obsolete, it may only be deprecated as part of a major revision to the specification. A profile that has reached this maturity level is guaranteed to preserve backward compatibility from one minor specification revision to the next. Over time, it is hoped that all specification content will attain this maturity level. Accordingly, there is no special typographical convention, as there is with the other, subordinate maturity levels. Unless content in the specification is marked with one of the typographical conventions defined for the subordinate maturity levels, it should be assumed to have reached the Finalized maturity level.

Deprecated Material

Non-Experimental material can be deprecated in a subsequent revision of the specification. Sections identified as “Deprecated” contain material that is obsolete and not recommended for use in new development efforts. Existing and new implementations may still use this material, but shall move to the newer approach as soon as possible. The maturity level of the material being deprecated determines how long it will continue to appear in the specification. Implemented content shall be retained at least until the next revision of the specialization, while Stable and Finalized material shall be retained until the next major revision of the specification. Providers shall implement the deprecated elements as long as it appears in the specification in order to achieve backward compatibility. Clients may rely on deprecated elements, but are encouraged to use non-deprecated alternatives when possible.

Deprecated sections are documented with a reference to the last published version to include the deprecated section as normative material and to the section in the current specification with the replacement. Figure 4 contains a sample of the typographical convention for deprecated content.



Figure 4 - Deprecated Tag

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Contents

List of Figures	15
List of Tables	17
Foreword	23
1 Scope	25
2 Normative References	27
2.1 Overview	27
2.2 Approved references	27
2.3 References under development	27
3 Terms, Definitions, Symbols, Abbreviations, and Conventions	29
3.1 General	29
3.2 Terms and Definitions	29
4 Disk Partition Profile	31
4.1 Description	31
4.2 Health and Fault Management Considerations	37
4.3 Supported Profiles and Packages	38
4.4 Methods of the Profile	38
4.5 Client Considerations and Recipes	39
4.6 CIM Elements	39
5 FC HBA Profile	49
6 Storage HBA Profile	51
6.1 Synopsis	51
6.2 Description	51
6.3 Implementation	51
6.4 Methods of the Profile	57
6.5 Use Cases	58
6.6 CIM Elements	58
7 Host Discovered Resources Profile	63
7.1 Description	63
7.2 Health and Fault Management Considerations	68
7.3 Cascading Considerations	68
7.4 Extrinsic Methods of the Profile	68
7.5 Use Cases	69
7.6 CIM Elements	69
8 Host Hardware RAID Controller Profile	79
8.1 Synopsis	79
8.2 Description	80
8.3 Implementation	80
8.4 Methods	94
8.5 Use Cases	94
8.6 CIM Elements	94
9 iSCSI Initiator Profile	109
9.1 Description	109
9.2 Health and Fault Management Considerations	112
9.3 Methods of the Profile	112
9.4 Use Cases	112
9.5 CIM Elements	113

10	SCSI Multipath Management Profile	125
10.1	Description	125
10.2	Health and Fault Management Considerations	128
10.3	Methods of the Profile	128
10.4	Use Cases	129
10.5	CIM Elements	129
11	SB Multipath Management Profile	137
12	Memory Configuration Profile	139
12.1	Synopsis	139
12.2	Description	139
12.3	Implementation	141
12.4	Methods	143
12.5	Use Cases	148
12.6	CIM Elements	153
13	Persistent Memory Configuration Profile	161
13.1	Synopsis	161
13.2	Overview	161
13.3	Implementation	163
13.4	Methods	164
13.5	Use Cases	171
13.6	CIM Elements	175
	Annex A (informative) SMI-S Information Model	183
	Annex B (Informative) Host Profile Deployment Guidelines	185

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LIST OF FIGURES

Figure 1 - Experimental Maturity Level Tag	10
Figure 2 - Implemented Maturity Level Tag	10
Figure 3 - Stable Maturity Level Tag	11
Figure 4 - Deprecated Tag	11
Figure 5 - Disk Partition Class Hierarchy	32
Figure 6 - Disk Partition Class Diagram	33
Figure 7 - Disk MBR Partition Example	34
Figure 8 - MBR Partition Instance Diagram	35
Figure 9 - MBR and VTOC Partition Instance Diagram	36
Figure 10 - Partition Instance Diagram for Size/Address Rules	37
Figure 11 - Model Overview	52
Figure 12 - Profile Registration Profile	53
Figure 13 - Software Inventory Profile in Storage HBA	55
Figure 14 - HBA Card with Physical Classes	56
Figure 15 - Host Discovered Resources Block Diagram	64
Figure 16 - Host Discovered Resources Class Diagram	66
Figure 17 - Single SPI Disk Model	66
Figure 18 - Three FCP Logical Unit Instance Diagram	67
Figure 19 - ATA Discovered Resource Model	67
Figure 20 - SB Host Discovered Resources	68
Figure 21 - Host Hardware RAID Controller Package Diagram	80
Figure 22 - Host Hardware RAID resources scoped to HHRC ComputerSystem	81
Figure 23 - Alarms in Host Hardware RAID Controller	82
Figure 24 - Profile Registration with Host Hardware RAID Controller and Base Server Profiles	83
Figure 25 - Implementation of Physical Asset Profile	84
Figure 26 - Block Services Package in Host Hardware RAID Controller	85
Figure 27 - DAPort Profile in Host Hardware Controller	87
Figure 28 - Software Inventory Profile in Host Hardware RAID Controller	87
Figure 29 - Initiator Port profiles and Disk Drive Lite Profile	88
Figure 30 - Model for Imported Disks	89
Figure 31 - Imported Virtual Volumes	90
Figure 32 - Device "Pass Through" Example	91
Figure 33 - Example of Mutli-Function Controllers	93
Figure 34 - iSCSI Product and Package Model	110
Figure 35 - iSCSI Sessions and Connections Model	111
Figure 36 - iSCSI Initiator Node	112
Figure 37 - Multipath Management Class Diagram	126
Figure 38 - Four Path Instance Diagram	127
Figure 39 - Memory Configuration Class Diagram	140
Figure 40 - Use Case - Profile Registration	148
Figure 41 - Use Case - Memory Configuration Capabilities	149
Figure 42 - Use Case - Memory Capability Discovery	149
Figure 43 - Use Case - Allocation	150
Figure 44 - Use Case - Allocation Complete	151

Figure 45 - Use Case - Before Deallocation	152
Figure 46 - Use Case - After Deallocation	152
Figure 47 - Persistent Memory Configuration: Class Diagram.....	162
Figure 48 - Use Case: Profile Registration	172
Figure 49 - Use Case - Detect Capabilities.....	173
Figure 50 - Use Case - Create Namespace.....	174
Figure B.1 Profile Registration and FC HBA Profiles	186
Figure B.2 Profile Registration and Storage HBA Profiles	187
Figure B.3 Profile Registration and Host Hardware RAID Controller Profiles	188
Figure B.4 Deploying FC HBA with Storage HBA (SAS) Profiles	189

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LIST OF TABLES

Table 1 - Capabilities Properties.....	36
Table 2 - CIM Elements for Disk Partition.....	39
Table 3 - SMI Referenced Properties/Methods for CIM_BasedOn (Partition to Extent).....	40
Table 4 - SMI Referenced Properties/Methods for CIM_BasedOn (Partition to Partition).....	41
Table 5 - SMI Referenced Properties/Methods for CIM_DiskPartition	41
Table 6 - SMI Referenced Properties/Methods for CIM_DiskPartitionConfigurationCapabilities	42
Table 7 - SMI Referenced Properties/Methods for CIM_DiskPartitionConfigurationService	42
Table 8 - SMI Referenced Properties/Methods for CIM_ElementCapabilities	43
Table 9 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (DiskPartitionConfigura- tionService to Disk Partition RegisteredProfile)43	43
Table 10 - SMI Referenced Properties/Methods for CIM_GPTDiskPartition	43
Table 11 - SMI Referenced Properties/Methods for CIM_GenericDiskPartition	44
Table 12 - SMI Referenced Properties/Methods for CIM_HostedService	44
Table 13 - SMI Referenced Properties/Methods for CIM_InstalledPartitionTable (Capabilities to Extent).....	45
Table 14 - SMI Referenced Properties/Methods for CIM_InstalledPartitionTable (Capabilities to Partition).....	45
Table 15 - SMI Referenced Properties/Methods for CIM_LogicalDisk	45
Table 16 - SMI Referenced Properties/Methods for CIM_LogicalDiskBasedOnPartition (LogicalDisk to Parti- tion)46	46
Table 17 - SMI Referenced Properties/Methods for CIM_StorageExtent.....	46
Table 18 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to Extent)	47
Table 19 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to LogicalDisk).....	47
Table 20 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to Partition)	47
Table 21 - SMI Referenced Properties/Methods for CIM_VTOCDiskPartition	48
Table 22 - Related Profiles for Storage HBA.....	51
Table 23 - CIM_PortController	57
Table 24 - CIM_SystemDevice	58
Table 25 - CIM Elements for Storage HBA.....	58
Table 26 - SMI Referenced Properties/Methods for CIM_ControlledBy	59
Table 27 - SMI Referenced Properties/Methods for CIM_PortController	59
Table 28 - SMI Referenced Properties/Methods for CIM_Product	60
Table 29 - SMI Referenced Properties/Methods for CIM_ProductElementComponent	60
Table 30 - SMI Referenced Properties/Methods for CIM_Realizes.....	60
Table 31 - SMI Referenced Properties/Methods for CIM_SystemDevice.....	61
Table 32 - Related Profiles for HostDiscoveredResources	63
Table 33 - CIM Elements for Host Discovered Resources	69
Table 34 - SMI Referenced Properties/Methods for CIM_ATAInitiatorTargetLogicalUnitPath	70
Table 35 - SMI Referenced Properties/Methods for CIM_ATAProtocolEndpoint	71
Table 36 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (LogicalDevice to Host Discovered Resources RegisteredProfile)71	71
Table 37 - SMI Referenced Properties/Methods for CIM_HostedAccessPoint	72
Table 38 - SMI Referenced Properties/Methods for CIM_LogicalDevice (LogicalDevice)	72
Table 39 - SMI Referenced Properties/Methods for CIM_LogicalDisk (LogicalDevice)	72
Table 40 - SMI Referenced Properties/Methods for CIM_SCSIArbitraryLogicalUnit (LogicalDevice).....	73
Table 41 - SMI Referenced Properties/Methods for CIM_SCSIInitiatorTargetLogicalUnitPath	74
Table 42 - SMI Referenced Properties/Methods for CIM_SCSIProtocolEndpoint.....	74
Table 43 - SMI Referenced Properties/Methods for CIM_StorageExtent (LogicalDevice).....	75
Table 44 - SMI Referenced Properties/Methods for CIM_SystemDevice.....	75

Table 45 - SMI Referenced Properties/Methods for CIM_TapeDrive (LogicalDevice)	75
Table 46 - SMI Referenced Properties/Methods for CIM_SBInitiatorTargetLogicalUnitPath	76
Table 47 - SMI Referenced Properties/Methods for CIM_SBProtocolEndpoint	77
Table 48 - Related Profiles for Host Hardware RAID Controller	79
Table 49 - CIM Elements for Host Hardware RAID Controller	94
Table 50 - SMI Referenced Properties/Methods for CIM_AlarmDevice	96
Table 51 - SMI Referenced Properties/Methods for CIM_AssociatedAlarm	96
Table 52 - SMI Referenced Properties/Methods for CIM_ComputerSystem (Host Hardware RAID Controller)97	
Table 53 - SMI Referenced Properties/Methods for CIM_ComputerSystemPackage (Associates PhysicalPackage to ComputerSystem)97	
Table 54 - SMI Referenced Properties/Methods for CIM_ControlledBy	98
Table 55 - SMI Referenced Properties/Methods for CIM_ElementCapabilities (ImplementationCapabilities to System)98	
Table 56 - SMI Referenced Properties/Methods for CIM_ImplementationCapabilities (ImplementationCapabilities)99	
Table 57 - SMI Referenced Properties/Methods for CIM_LogicalIdentity	99
Table 58 - SMI Referenced Properties/Methods for CIM_MediaAccessDevice	100
Table 59 - SMI Referenced Properties/Methods for CIM_PortController	100
Table 60 - SMI Referenced Properties/Methods for CIM_Product	101
Table 61 - SMI Referenced Properties/Methods for CIM_ProductPhysicalComponent	101
Table 62 - SMI Referenced Properties/Methods for CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice)101	
Table 63 - SMI Referenced Properties/Methods for CIM_ProtocolControllerForUnit (Volume)	102
Table 64 - SMI Referenced Properties/Methods for CIM_Realizes (Associates PhysicalPackage to PortController)102	
Table 65 - SMI Referenced Properties/Methods for CIM_SAPAvailableForElement	103
Table 66 - SMI Referenced Properties/Methods for CIM_SCSIProtocolController	103
Table 67 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Driver)	103
Table 68 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (FCode/BIOS)	104
Table 69 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Firmware)	104
Table 70 - SMI Referenced Properties/Methods for CIM_StorageExtent	104
Table 71 - SMI Referenced Properties/Methods for CIM_SystemComponent	105
Table 72 - SMI Referenced Properties/Methods for CIM_SystemDevice (Associates System to AlarmDevice)105	
Table 73 - SMI Referenced Properties/Methods for CIM_SystemDevice (Associates controller system to PortController)106	
Table 74 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to SCSIProtocolController) .106	
Table 75 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Driver)	107
Table 76 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Firmware or FCode/BIOS)107	
Table 77 - Supported Profiles for iSCSI Initiator	109
Table 78 - iSCSI Terminology	109
Table 79 - OperationalStatus Values	112
Table 80 - CIM Elements for iSCSI Initiator	113
Table 81 - SMI Referenced Properties/Methods for CIM_BindsTo (TCPProtocolEndpoint to IPProtocolEndpoint)114	
Table 82 - SMI Referenced Properties/Methods for CIM_BindsTo (iSCSIProtocolEndpoint to TCPProtocolEndpoint)114	
Table 83 - SMI Referenced Properties/Methods for CIM_ComputerSystem	114
Table 84 - SMI Referenced Properties/Methods for CIM_ControlledBy	115

Table 85 - SMI Referenced Properties/Methods for CIM_DeviceSAPImplementation (EthernetPort to IPProtocolEndpoint)115	
Table 86 - SMI Referenced Properties/Methods for CIM_DeviceSAPImplementation (EthernetPort to iSCSIProtocolEndpoint)116	
Table 87 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity.....	116
Table 88 - SMI Referenced Properties/Methods for CIM_EndpointOfNetworkPipe (Between iSCSI Session and iSCSIProtocolEndpoint)116	
Table 89 - SMI Referenced Properties/Methods for CIM_EndpointOfNetworkPipe (Between iSCSI connection and TCPProtocolEndpoint)117	
Table 90 - SMI Referenced Properties/Methods for CIM_InstalledSoftwareIdentity	117
Table 91 - SMI Referenced Properties/Methods for CIM_NetworkPipeComposition	117
Table 92 - SMI Referenced Properties/Methods for CIM_PhysicalPackage	118
Table 93 - SMI Referenced Properties/Methods for CIM_PortController	118
Table 94 - SMI Referenced Properties/Methods for CIM_Product	118
Table 95 - SMI Referenced Properties/Methods for CIM_ProductPhysicalComponent	119
Table 96 - SMI Referenced Properties/Methods for CIM_Realizes	119
Table 97 - SMI Referenced Properties/Methods for CIM_SAPAvailableForElement	119
Table 98 - SMI Referenced Properties/Methods for CIM_SCSIProtocolController	120
Table 99 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity	120
Table 100 - SMI Referenced Properties/Methods for CIM_SystemDevice (to EthernetPort)	120
Table 101 - SMI Referenced Properties/Methods for CIM_SystemDevice (to PortController)	121
Table 102 - SMI Referenced Properties/Methods for CIM_SystemDevice (to ProtocolController).....	121
Table 103 - SMI Referenced Properties/Methods for CIM_iSCSIConnection	121
Table 104 - SMI Referenced Properties/Methods for CIM_iSCSISession.....	123
Table 105 - CIM Elements for SCSI Multipath Management.....	129
Table 106 - SMI Referenced Properties/Methods for CIM_ConcreteComponent.....	130
Table 107 - SMI Referenced Properties/Methods for CIM_ConcreteDependency	130
Table 108 - SMI Referenced Properties/Methods for CIM_ElementCapabilities	131
Table 109 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (SCSIPathConfigurationService to SCSI Multipath Management RegisteredProfile)131	
Table 110 - SMI Referenced Properties/Methods for CIM_ElementSettingData	131
Table 111 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Driver).....	132
Table 112 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (MP API Plugin)	132
Table 113 - SMI Referenced Properties/Methods for CIM_HostedService	132
Table 114 - SMI Referenced Properties/Methods for CIM_MemberOfCollection	133
Table 115 - SMI Referenced Properties/Methods for CIM_Product	133
Table 116 - SMI Referenced Properties/Methods for CIM_SCSIMultipathConfigurationCapabilities.....	133
Table 117 - SMI Referenced Properties/Methods for CIM_SCSIMultipathSettings.....	134
Table 118 - SMI Referenced Properties/Methods for CIM_SCSIPathConfigurationService.....	134
Table 119 - SMI Referenced Properties/Methods for CIM_SCSITargetPortGroup	135
Table 120 - SMI Referenced Properties/Methods for CIM_ServiceAvailableToElement.....	135
Table 121 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Driver)	136
Table 122 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (MP API Plugin)	136
Table 123 - Related Profiles	139
Table 124 - Operations: CIM_MemoryConfigurationService	143
Table 125 - CIM_MemoryConfigurationService.AllocateFromPool() Method: Return Code Values.....	143
Table 126 - CIM_MemoryConfigurationService.AllocateFromPool() Method: Parameters	144
Table 127 - CIM_MemoryConfigurationService.ReturnToPool() Method: Return Code Values.....	144
Table 128 - CIM_MemoryConfigurationService.ReturnToPool() Method: Parameters.....	144
Table 129 - Operations: CIM_ResourcePool.....	145

Table 130 - Operations: CIM_MemoryCapabilities	145
Table 131 - Operations: CIM_MemoryConfigurationCapabilities	145
Table 132 - Operations: CIM_MemoryAllocationSettingData	146
Table 133 - Operations: CIM_ElementCapabilities	146
Table 134 - Operations: CIM_ServiceAffectsElement	146
Table 135 - Operations: CIM_ConcreteComponent	147
Table 136 - Operations: CIM_ElementAllocatedFromPool	147
Table 137 - Operations: CIM_HostedService	147
Table 138 - Operations: CIM_ElementSettingData	147
Table 139 - Operations: CIM_ElementConformsToProfile	148
Table 140 - CIM Elements	153
Table 141 - Class: CIM_RegisteredProfile	153
Table 142 - Class: CIM_MemoryConfigurationService	154
Table 143 - Class: CIM_ResourcePool	154
Table 144 - Class: CIM_MemoryCapabilities	155
Table 145 - Class: CIM_MemoryConfigurationCapabilities	155
Table 146 - Class: CIM_MemoryAllocationSettingData	156
Table 147 - Class: CIM_ElementSettingData - Use 1	157
Table 148 - Class: CIM_ElementSettingData - Use 2	157
Table 149 - Class: CIM_HostedService	158
Table 150 - Class: CIM_ElementAllocatedFromPool	158
Table 151 - Class: CIM_ConcreteComponent	159
Table 152 - Class: CIM_ElementCapabilities use 1	159
Table 153 - Class CIM_ElementCapabilities use 2	160
Table 154 - Related Profiles	161
Table 155 - Operations: CIM_ResourcePool	164
Table 156 - Operations: CIM_PersistentMemoryCapabilities	165
Table 157 - Operations: CIM_PersistentMemoryService	165
Table 158 - AllocateFromPool() Method: Return Code Values	166
Table 159 - AllocateFromPool() Method: Parameters	166
Table 160 - ReturnToPool() Method: Return Code Values	166
Table 161 - ReturnToPool() Method: Parameters	167
Table 162 - ModifyNamespace() Method: Return Code Values	167
Table 163 - ModifyNamespace() Method: Parameters	168
Table 164 - Operations: CIM_PersistentConfigurationCapabilities	168
Table 165 - Operations: CIM_PersistentMemoryNamespace	168
Table 166 - Operations: CIM_PersistentMemoryNamespaceSettingData	169
Table 167 - Operations: CIM_ElementCapabilities	169
Table 168 - Operations: CIM_ServiceAffectsElement	170
Table 169 - Operations: CIM_ConcreteComponent	170
Table 170 - Operations: CIM_ElementAllocatedFromPool	170
Table 171 - Operations: CIM_HostedService	170
Table 172 - Operations: CIM_ElementSettingData	171
Table 173 - Operations: CIM_ElementConformsToProfile	171
Table 174 - Operations: CIM_SystemDevice	171
Table 175 - CIM Elements for Persistent Memory Configuration	175
Table 176 - Class: CIM_RegisteredProfile	175
Table 177 - Class: CIM_ResourcePool	176
Table 178 - Class: CIM_PersistentMemoryCapabilities	176

Table 179 - Class: CIM_PersistentMemoryService	177
Table 180 - Class: CIM_PersistentConfigurationCapabilities	177
Table 181 - Class: CIM_PersistentMemoryNamespace	178
Table 182 - Class: CIM_PersistentMemoryNamespaceSettingData	178
Table 183 - CIM_ElementCapabilities	179
Table 184 - CIM_ElementCapabilities	179
Table 185 - Class: CIM_ServiceAffectsElement	180
Table 186 - Class: CIM_ConcreteComponent	180
Table 187 - Class: CIM_ElementAllocatedFromPool	180
Table 188 - Class: CIM_HostedService	180
Table 189 - Class CIM_ElementSettingData	181
Table 190 - Class: CIM_ElementConformsToProfile	181
Table 191 - Class: CIM_SystemDevice	182
Table 192 - Class: CIM_BasedOn	182

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FOREWORD

The host-based storage portion of the Storage Management Technical Specification contains profiles and other clauses for management of host-based storage devices. Host-based storage devices provide storage capabilities to a host computer system. Examples of these devices include Fiber Channel Host Bus Adapters, Serial Attached SCSI Host Bus Adapters, RAID Controllers, JBODs (Just-A-Bunch-Of-Disks) and Operating System-discovered storage resources. The host-based profiles describe the manageability required for each device and the connectivity to the host computer system. The host-based profiles leverage existing profiles within this specification, as well as other profiles from the Distributed Management Task Force, where applicable, to create a comprehensive management model.

Parts of this Standard

This standard is subdivided in the following parts:

- *Storage Management Technical Specification, Part 1 Overview, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 4 Block Devices, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 5 Filesystems, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 6 Fabric, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 7 Host Elements, 1.8.0 Rev 4*
- *Storage Management Technical Specification, Part 8 Media Libraries, 1.8.0 Rev 4*

SNIA Web Site

Current SNIA practice is to make updates and other information available through their web site at <http://www.snia.org>

SNIA Address

Requests for interpretation, suggestions for improvement and addenda, or defect reports are welcome. They should be sent via the SNIA Feedback Portal at <http://www.snia.org/feedback/> or by mail to the Storage Networking Industry Association, 4360 Arrows West Drive, Colorado Springs, Colorado 80907, U.S.A.

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1 Scope

The host-base storage portion of the Storage Management Technical Specification defines management profiles for autonomous, component and abstract profiles for management of host-based storage devices. The autonomous profiles describe the management of a stand-alone host-based storage entity. The component profiles describe management of aspects of host-based storage entities that may be used by other autonomous profiles. Finally, this section describes abstract profiles that may be used as a basis for creating additional Host-based autonomous profiles.

This version of the Host-based Storage portion of the Storage Management Technical Specification includes autonomous profiles:

- "The Host Discovered Resources Profile

This profile defines the model for the storage devices presented to an operating system running on a host computer system. In addition, this profile describes the map of storage associated to a host-computer system that a client application can discover.

- "The Fibre Channel HBA Profile

This profile defines the model and functions of a Fibre Channel HBA that exports block storage to a host computer system from a SAN device (Fibre Channel switch, array, tape library, etc.).

- iSCSI Initiator Profile

This profile defines the model and functions necessary to manage an iSCSI initiator.

Component profiles used by autonomous profiles to describe aspects of host-based storage elements and services. The component profiles defined in this version of the specification include:

- Host Hardware RAID Controller Profile

This profile defines the model and functions of a host-based RAID controller that exports block storage to a host computer system from locally attached storage devices (internal hard drives, JBODs, etc.)

- Storage HBA Profile

This profile defines the model and functions of a SAS, SATA, SPI, or Fibre Channel HBA that exports storage to a host computer system from a SAN device (Fibre Channel switch, array, tape library, etc.).

- Disk Partition Profile

The Disk Partition profile models partition (or slice) configuration services provided by operating systems on some platforms.

- SB Multipath Management Profile

The SB Multipath Management Profile models paths (connections between host controllers and device ports) for environments supporting the SB (Single Byte) command protocol.

- SCSI Multipath Management Profile

The SCSI Multipath Management profile models paths (connections between host controllers, device ports, and logical units) for environments supporting the SCSI command protocol.

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2 Normative References

2.1 Overview

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

2.2 Approved references

Systems Management: Data Storage Management (XDSM) API - ISBN: 1-85912-190-X

DMTF DSP1054 Indications Profile 1.2.2

http://www.dmtf.org/sites/default/files/standards/documents/DSP1054_1.2.2.pdf

2.3 References under development

EXPERIMENTAL

DMTF documents that are works in progress.

DMTF DSP1002, Diagnostics Profile 2.1.0

http://dmf.org/sites/default/files/standards/documents/DSP1002_2.1.0a.pdf

DMTF DSP 1071, Multi-type System Memory Profile 1.0.0

http://www.dmtf.org/sites/default/files/standards/documents/DSP1071_1.0.0.pdf

DMTF DSP1104, FC HBA Diagnostics Profile 1.1.0a

http://dmf.org/sites/default/files/standards/documents/DSP1104_1.1.0a.pdf

EXPERIMENTAL

Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4

Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4

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3 Terms, Definitions, Symbols, Abbreviations, and Conventions

3.1 General

For the purposes of this document, the terms, definitions, symbols, abbreviations, and conventions given in *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4* and the following apply.

3.2 Terms and Definitions

3.2.1

Fibre Channel

a serial I/O bus capable of supporting multiple protocols, including access to open system storage (FCP protocol), access to mainframe storage (**FICON**^{™1} protocol), and IP

3.2.2

Host Bus Adapter (HBA)

an I/O adapter that connects a host I/O bus to a computer's memory system

3.2.3

host computer system

any computer system to which disks, disk subsystems, or file servers are attached and accessible for data storage and I/O.

3.2.4

JBOD

an acronym for "Just a Bunch Of Disks." A cabinet or enclosure of disks

3.2.5

logical disk

block storage on which file systems are built

A logical disk would be formatted for a particular file system.

3.2.6

Operating System (OS)

software that manages the resources of a host computer system.

3.2.7

RAID

an Acronym for Redundant Array of Independent Disks, a family of techniques for managing multiple disks to deliver desirable cost, data availability, and performance characteristics to host environments

3.2.8

storage device enclosure

a cabinet or enclosure of storage media devices.

Note 1 to entry: Example: JBOD

3.2.9

storage volume

unit of capacity served from a block storage device

1.FICON[™] is an example of a suitable product available commercially. This information is given for the convenience of users of this standard and does not constitute an endorsement of this product by SNIA or any standards organization.

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EXPERIMENTAL

4 Disk Partition Profile

4.1 Description

4.1.1 Synopsis

Profile Name: Disk Partition (Component Profile)

Version: 1.6.0

Organization: SNIA

Central Class: DiskPartitionConfigurationService

Scoping Class: Base Server ComputerSystem

Related Profiles: Not defined in this document.

4.1.2 Overview

This profile models partition (or slice) configuration services provided by operating systems on some platforms. Some operating systems do not use this type of partitioning. On the operating systems that do, the operating system disk drivers treat partitions as virtual disks. The types of valid partitions are determined by the operating system and the partitioning tools.

We need to consider several operating system variants related to operating system partitions

- On some platforms (e.g., Solaris, Windows), a raw disk volume needs to be partitioned before an application (i.e., a filesystem) uses it. There may be just a single partition on the volume. In these platforms, there is not a name that represents an entire disk volume if that disk volume has multiple partitions.
- On other platforms (e.g., Linux), an application resides on a partition or on the entire disk volume.
- Different operating systems have incompatible partitioning approaches and on-disk data structures (e.g. disk labels or partition tables). This specification refers to these approaches as styles. Each style may be supported by multiple operating systems, and most operating systems support multiple styles. The styles supported in this profile are MBR (used on all operating systems running on X86 hardware), vtoc (Solaris and other operating systems with a BSD heritage), and GPT (an emerging style that supports multi-terabyte disk volumes).
- Some styles support multiple tiers of partitions - a partition at one tier may have sub-partitions. On Windows, extended partitions are also a second tier with MBR partitions at each tier.
- Some operating systems utilize two tiers of partitions with different styles at different tiers. For example, BSD-derived Unix variants running on X86 platforms: the lower tier is the X86 BIOS-supported MBR partitions; BSD-style slices can be installed on one of the MBR partitions.
- Some operating systems (AIX, HP_UX) have no equivalent to partitioning.
- Some partition styles have a fixed number of partitions (dependent on the partition type); the user can't create or delete partitions, just adjust the properties of one of the pre-defined partitions.

A partitioned disk volume has an associated partition table. The partition table contains information about the partitions on the disk volume – the starting address, length, and (in some cases) the type of the partition. In certain cases, a partition table can be associated with a partition; allowing multiple tiers of partitions.

In order for storage applications (e.g., logical volume managers, filesystems, databases) to use a disk volume, the operating system provides a name for the volume. These names appear to be filenames but are part of one (or a few) special namespaces managed by the operating system. Windows drive letters and Unix /dev/ directories are examples of the special namespaces. Any extent that is consumable by storage applications is modeled as LogicalDisk; the LogicalDisk.Name property provides this special filename. The exported extent resulting from a partition is a LogicalDisk; on systems that do not require partitions, each usable disk volume has a LogicalDisk instance that models the operating system name. Extents that are not available for storage applications are modeled as StorageExtent (or StorageExtent subclasses other than LogicalDisk) instances and have a name derived from the underlying hardware and partition number.

Operating systems may have different partition styles. The most common style is the MBR (Master Boot Record) style used on x86 PCs. This style supports four primary partitions on a disk volume with an optional second-tier (extended/logical partitions). Solaris uses a style called VTOC that is derived from and similar to BSD partitions. VTOC supports eight partitions. On Solaris X86, VTOC is installed in one X86 MBR primary partition for compatibility with other x86 operating systems. GPT is a new set of interfaces for x86 64-bit environments and includes a partitioning style. Of particular note is that GPT partitions can exceed the two-terabyte limit associated with other partition styles. So many vendors are migrating towards GPT as an option for supporting larger volumes. This profile includes separate specialized subclasses for MBR, VTOC, and GPT partitions. Their relationship is summarized in Figure 7: "Disk Partition Class Hierarchy".

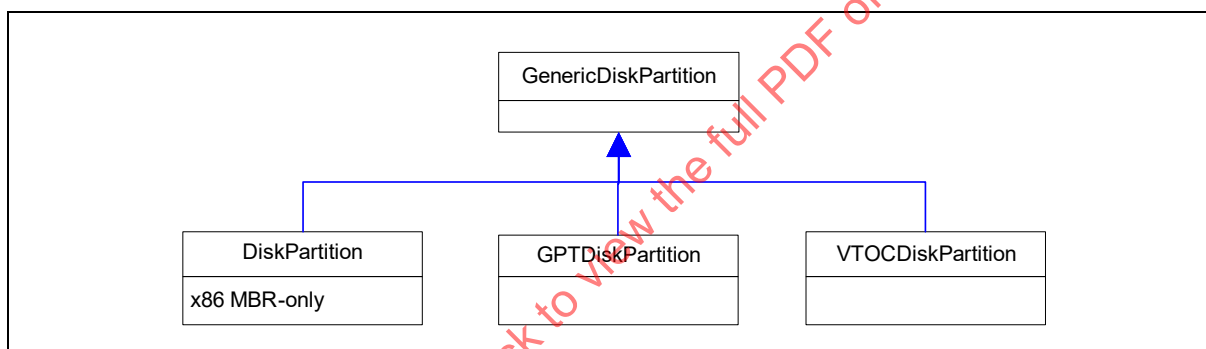


Figure 7 - Disk Partition Class Hierarchy

This profile includes a partition configuration service class that allows a client to create partition tables and modify partitions. It also includes a partition configuration capabilities class that describes the partition configuration capabilities of the system. Separate capabilities instances describe each partition style supported on the system. There shall be one instance of **DiskPartitionConfigurationService**, as shown in Figure 8: "Disk Partition Class Diagram".

All references to **ComputerSystem** in the Disk Partition Profile implies a single instance for a customer server or storage system as defined in the Base Server Profile. See Annex A: (Informative) Host Profile Deployment Guidelines, 1.6.0 Rev 3 for information on the use of host profiles with Base Server profile.

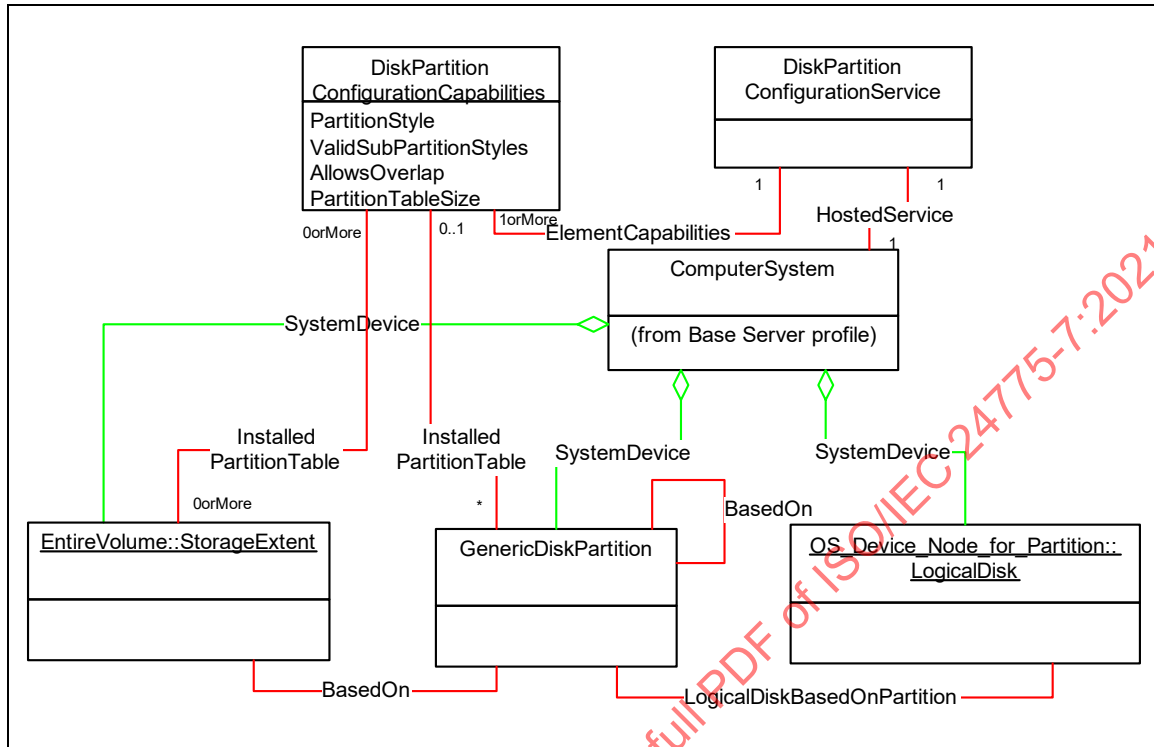


Figure 8 - Disk Partition Class Diagram

4.1.3 Background on X86 MBR Partitions

The terminology used in X86 partition applications is somewhat confusing and masks the actual configurations. The MBR style supports two tiers of partitions; up to four partitions at the entire disk volume tier and up to four partitions within each of these top-tier partitions. An MBR *primary* partition is a top-tier partition that is not sub-partitioned. An MBR *extended* partition is a top-tier partition that is sub-partitioned. An MBR *logical* partition is a sub-partition of an extended partition.

Figure 9: "Disk MBR Partition Example" represents the actual layout of an MBR drive with three usable partitions – with Windows/DOS driver letter names.

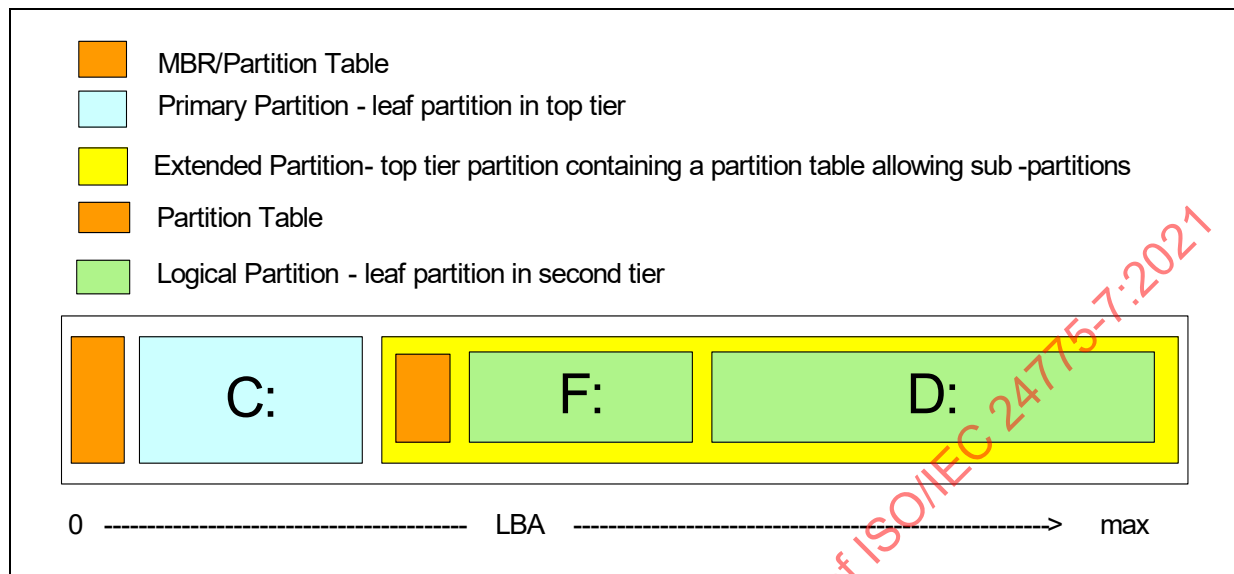


Figure 9 - Disk MBR Partition Example

C: is a primary partition and F: and D: are logical partitions that share an extended partition. Note that the partitions drive letters (C:, F:, and D:) are not in alphabetical order; the assignment of drive letters under Windows/DOS is decoupled from the partitioning logic.

Figure 10: "MBR Partition Instance Diagram" is an instance diagram of the SMI-S classes describing this configuration. Technically, the MBR/Partition tables could be considered to be small partitions. operating systems generally hide these sectors and treat the effective disk volume as starting just after the MBR. Rather than complicate the SMI-S model, these MBR areas are just ignored and the consumable block size is reduced by the appropriate value (the PartitionTableSize property of DiskPartitionConfigurationCapabilities). In the SMI-S model, the InstalledPartitionTable association to the containing extent indicates the presence of a disk label and/or partition table. In Figure 10: "MBR Partition Instance Diagram", the extent representing the entire disk volume (on the lower left) and the top-tier partition to the right each contain a partition table and are each associated to DiskPartitionConfigurationCapabilities via an InstalledPartitionTable association.

In Figure 10: "MBR Partition Instance Diagram" the StorageExtent at the lower left represents the entire disk volume and the two "top-tier" partitions are based on this extent. The LogicalDisk instances at the top represent the consumable partitions C:, F:, and D:.

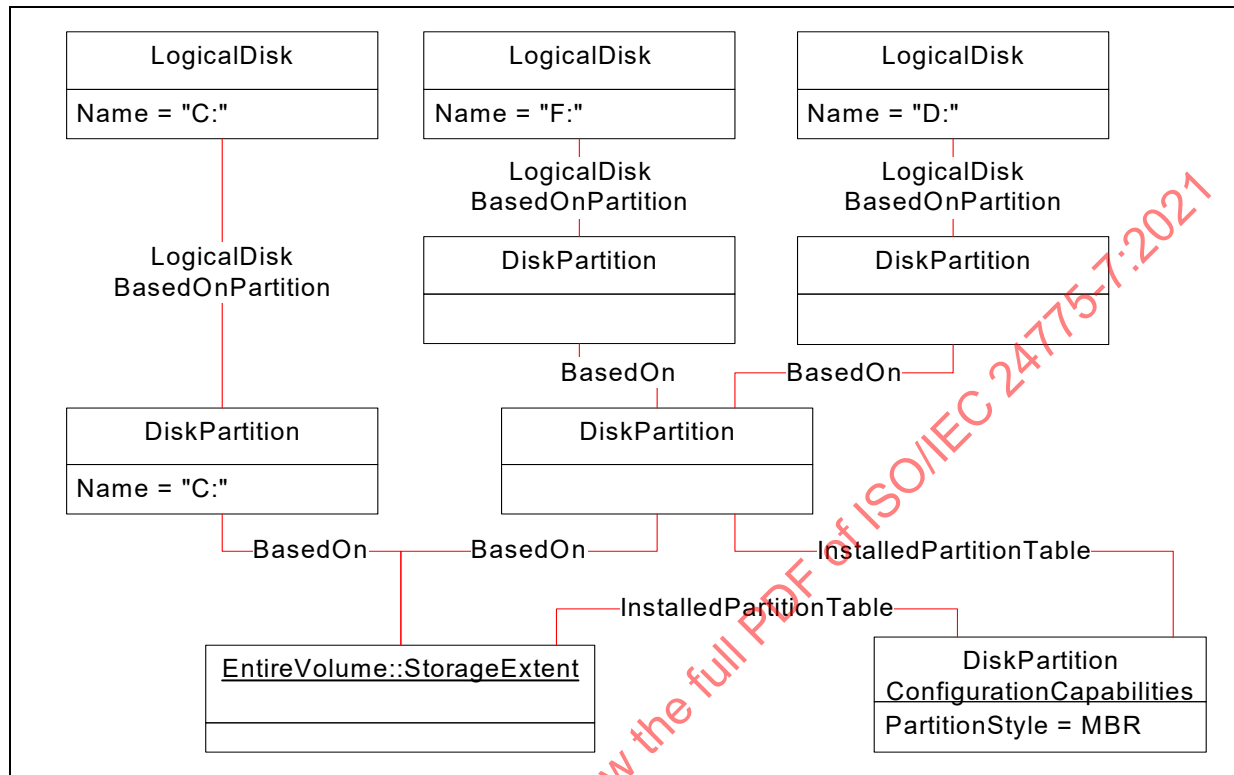


Figure 10 - MBR Partition Instance Diagram

Figure 11: "MBR and VTOC Partition Instance Diagram" models a similar configuration where the one top-tier partition contains a Solaris X86 installation. In this case, the instrumentation instantiates two instances of DiskPartitionConfigurationCapabilities, one for the top-tier MBR partition table and one for the vtoc partition table.

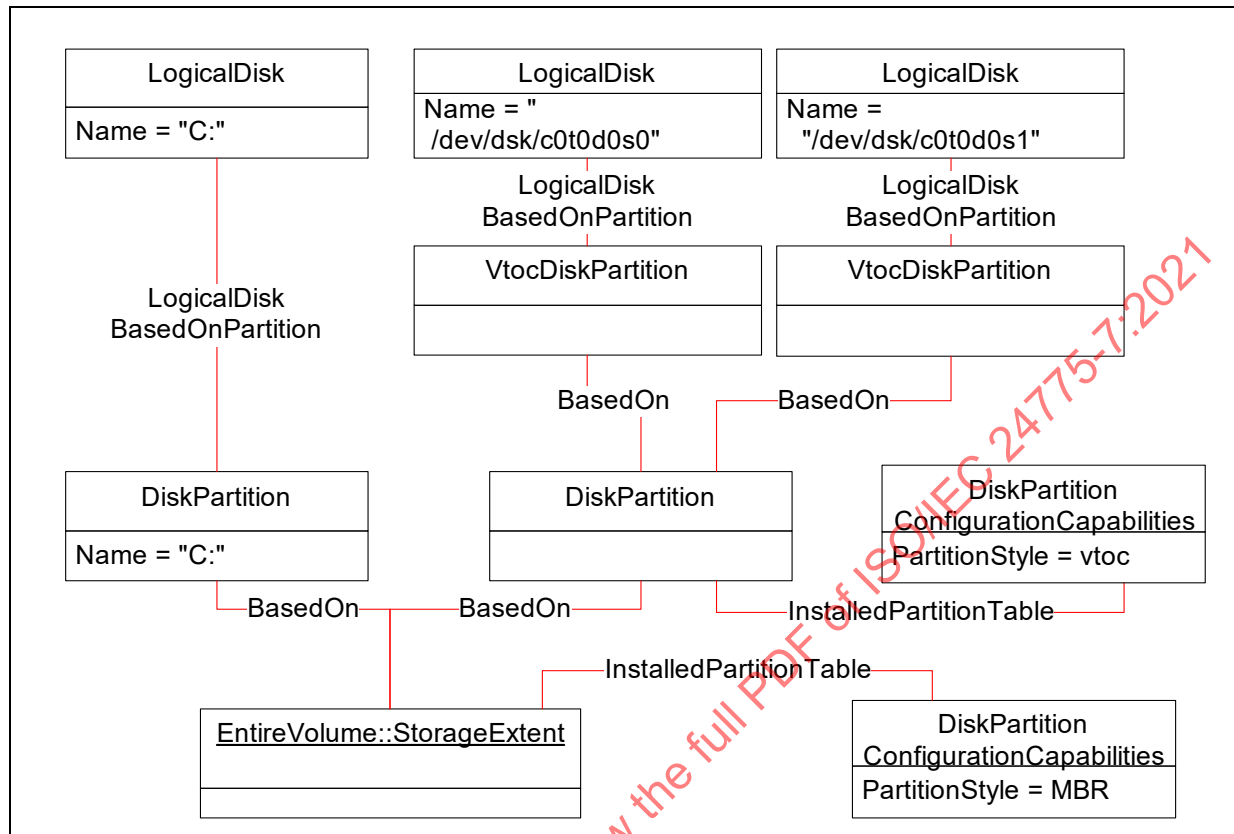


Figure 11 - MBR and VTOC Partition Instance Diagram

Table 1 summarizes likely values for capabilities properties and suggested Name properties on various operating systems

Table 1 - Capabilities Properties

Property	X86 MBR	vtoc	GPT			
			Win	Linux	Solaris SPARC	Solaris X86
Overlap Allowed	Depends on applications	true	false			
MaxCapacity	2 terabytes (2 ³² blocks)	2 terabytes	2 ⁶⁴ blocks			
MaxNumberOfPartitions	4	8	128	15	127	127

The sizes and starting/ending addresses shall be consistent between the associated LogicalDisk, DiskPartition, and LogicalDisk instances. Figure 12: "Partition Instance Diagram for Size/Address Rules" shows the classes with size information.

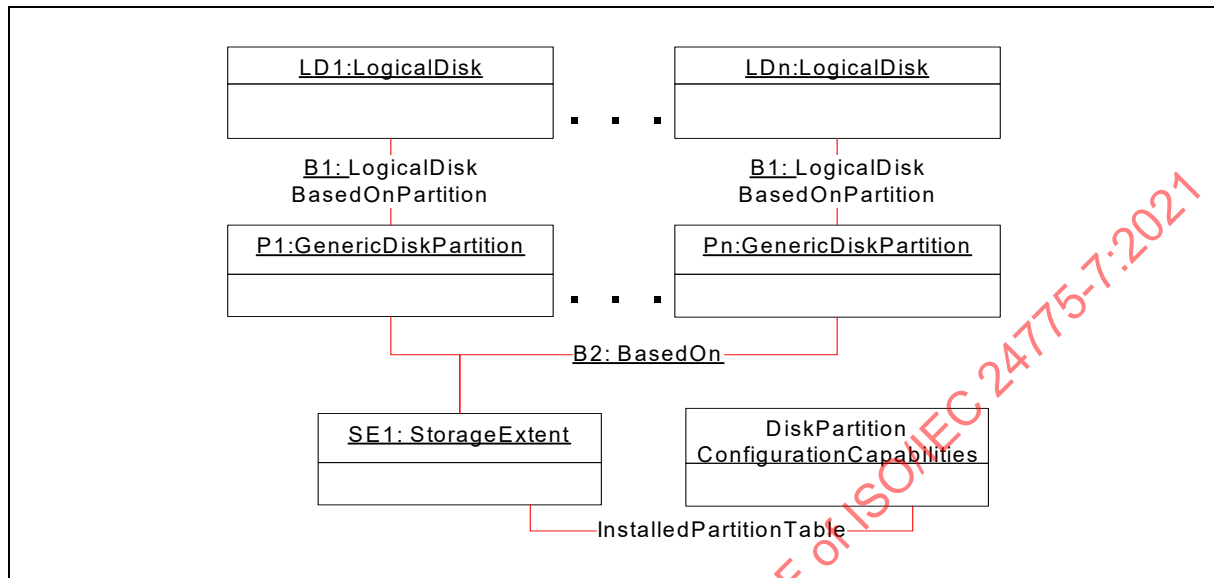


Figure 12 - Partition Instance Diagram for Size/Address Rules

In this diagram, partitions P1,... Pn are all based on the same underlying disk volume (or partition) SE1.

- The NumberOfBlocks shall be the same for a LogicalDisk and its underlying partition (for example, LD1 and P1 in the diagram).
- The StartingAddress in the LogicalDiskBasedOnPartition associations (B1 in the diagram) between a LogicalDisk and its underlying partition shall be 0. The EndingAddress in this association shall be one less than NumberOfBlocks from either the LogicalDisk or partition.
- The NumberOfBlocks for each partition (P1, ... Pn) shall be equal to the values of EndingAddress-StartingAddress+1 of the underlying BasedOn association (B2 in the diagram).
- DiskPartitionConfigurationCapabilities.PartitionTableSize shall hold the total number of blocks consumed by metadata (volume label, boot record, and partition tables) for the associated StorageExtent. For MBR and VTOC styles, this is a fixed value. For GPT, this value could in theory be larger for large extents. Separate instances of DiskPartitionConfigurationCapabilities shall be instantiated as needed to allow different values of PartitionTableSize.
- The size of maintenance tracks or cylinders shall not be included StorageExtent.NumberOfBlocks. This size may be included in DiskPartitionConfigurationCapabilities.PartitionTableSize.
- If DiskPartitionConfigurationCapabilities.OverlapAllowed is false, then the sum of the NumberOfBlocks properties for all partitions plus DiskPartitionConfigurationCapabilities.PartitionTableSize shall not exceed the value of NumberOfBlocks for the underlying StorageExtent. Other than that, there is no guaranteed relationship between StorageExtent.NumberOfBlocks and the sum of the NumberOfBlock values for partitions BasedOn the StorageExtent.

4.2 Health and Fault Management Considerations

No health information is required in LogicalDisk or partition instances. Clients should assume that the health-related properties of the underlying StorageExtent apply to all partitions and LogicalDisks based on that extent.

4.3 Supported Profiles and Packages

Not defined in this document

4.4 Methods of the Profile

4.4.1 SetPartitionStyle

This method installs a partition table on an extent of the specified partition style, creates DiskPartition instances if SettingStyleInstantiatedPartitions is non-zero, and BasedOn associations between the underlying extent and the new partition instances. As a side effect, the usable block size of the underlying extent is reduced by the block size of the metadata reserved by the partition table and associated metadata. This size is in the PartitionTableSize property of the associated DiskPartitionConfigurationCapabilities instance.

```
uint32 SetPartitionStyle (
    [IN, Description (
        "A reference to the extent (volume or partition) where "
        "this style (partition table) will be installed.")]
    CIM_StorageExtent REF Extent,

    [IN, Description (
        "A reference to the "
        "DiskPartitionConfigurationCapabilities instance "
        "describing the desired partition style.")]
    CIM_DiskPartitionConfigurationCapabilities REF PartitionStyle );
```

4.4.2 CreateOrModifyPartition

This method creates a new partition if the Partition parameter is null or modifies the partition specified. If the starting and ending address parameters are null, the resulting partition will occupy the entire underlying extent. If a the DeviceFileName parameter is non-null, a LogicalDisk instance is created and associated via LogicalDiskBasedOnPartition to the partition. The underlying extent shall be associated to a capabilities class describing the installed partition style (partition table); this association is established using

```
uint32 CreateOrModifyPartition (
    [IN, Description (
        "A reference to the underlying extent the partition is "
        "base on.")]
    CIM_StorageExtent REF extent,

    [IN, Description (
        "The starting block number.")]
    uint64 StartingAddress,

    [IN, Description (
        "The ending block number.")]
    uint64 EndingAddress,

    [IN, Description (
        "The platform-specific special file name to be assigned ")
```

```

        "to the LogicalDisk instance BasedOn the new "
        "DiskPartition instance.")]
string DeviceFileName,

[IN, OUT, Description (
    "A reference an existing partition instance to modify or "
    "null to request a new partition.")]
CIM_GenericDiskPartition REF Partition);

```

Intrinsic delete operation will delete the disk partition and all storage extents that are Dependent on the disk partition.

4.5 Client Considerations and Recipes

4.5.1 Client Considerations

A client discovers partition configuration support by looking for instances of DiskPartitionConfigurationService. If no service instances are available, then this operating system does not support disk partitions and the client can assume that any LogicalDisk instance is consumable by applications (such as volume managers or filesystems). For operating systems that do support partitioning, the client can discover whether a particular extent is partitioned by looking for a InstalledPartitionTable instance associated with the extent. The client can discover the existing partition configuration by following BasedOn associations between the extent and GenericDiskPartition instances.

For each discovered service, there shall be one or more instances of DiskPartitionConfigurationCapabilities. There is exactly one capabilities instance per Partition Style. If multiple capabilities instances are discovered, the client should look at the PartitionStyle property to determine the services that apply to entire disk volumes and those that apply to partitions.

4.5.2 Recipes

No recipes are included in this version of the standard.

4.6 CIM Elements

4.6.1 Overview

Table 2 describes the CIM elements for Disk Partition.

Table 2 - CIM Elements for Disk Partition

Element Name	Requirement	Description
4.6.2 CIM_BasedOn (Partition to Extent)	Mandatory	The disk partitions that are dependent on a storage extent.
4.6.3 CIM_BasedOn (Partition to Partition)	Mandatory	The disk partitions that are dependent on a disk partition.
4.6.4 CIM_DiskPartition	Optional	
4.6.5 CIM_DiskPartitionConfigurationCapabilities	Mandatory	
4.6.6 CIM_DiskPartitionConfigurationService	Mandatory	
4.6.7 CIM_ElementCapabilities	Mandatory	
4.6.8 CIM_ElementConformsToProfile (DiskPartitionConfigurationService to Disk Partition RegisteredProfile)	Mandatory	Ties the DiskPartitionConfigurationService to the registered profile for Disk Partition.

Table 2 - CIM Elements for Disk Partition

Element Name	Requirement	Description
4.6.9 CIM_GPTDiskPartition	Optional	
4.6.10 CIM_GenericDiskPartition	Mandatory	
4.6.11 CIM_HostedService	Mandatory	
4.6.12 CIM_InstalledPartitionTable (Capabilities to Extent)	Mandatory	The disk partition capabilities for disk partitions that are dependent on a storage extent.
4.6.13 CIM_InstalledPartitionTable (Capabilities to Partition)	Mandatory	The disk partition capabilities for disk partitions that are dependent on a storage extent.
4.6.14 CIM_LogicalDisk	Optional	
4.6.15 CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition)	Conditional	Conditional Requirement: Required if CIM_LogicalDisk is instantiated. The logical disks that are dependent on a disk partition.
4.6.16 CIM_StorageExtent	Mandatory	
4.6.17 CIM_SystemDevice (System to Extent)	Mandatory	The storage extent managed by a Base Server profile computer system.
4.6.18 CIM_SystemDevice (System to LogicalDisk)	Conditional	Conditional Requirement: Required if CIM_LogicalDisk is instantiated. The logical disk that is managed by a Base Server profile computer system.
4.6.19 CIM_SystemDevice (System to Partition)	Mandatory	The disk partition managed by a Base Server profile computer system.
4.6.20 CIM_VTOCDiskPartition	Optional	
SELECT * FROM CIM_InstCreation WHERE SourceInstance ISA CIM_GenericDiskPartition	Mandatory	Partition Creation.
SELECT * FROM CIM_InstDeletion WHERE SourceInstance ISA CIM_GenericDiskPartition	Mandatory	Partition Deletion.

4.6.2 CIM_BasedOn (Partition to Extent)

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 3 describes class CIM_BasedOn (Partition to Extent).

Table 3 - SMI Referenced Properties/Methods for CIM_BasedOn (Partition to Extent)

Properties	Flags	Requirement	Description & Notes
StartingAddress		Mandatory	
EndingAddress		Mandatory	
Dependent		Mandatory	Reference to a CIM_GenericDiskPartition that is based on the Antecedent
Antecedent		Mandatory	Reference to a CIM_StorageExtent

4.6.3 CIM_BasedOn (Partition to Partition)

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 4 describes class CIM_BasedOn (Partition to Partition).

Table 4 - SMI Referenced Properties/Methods for CIM_BasedOn (Partition to Partition)

Properties	Flags	Requirement	Description & Notes
StartingAddress		Mandatory	
EndingAddress		Mandatory	
Antecedent		Mandatory	Reference to a CIM_GenericDiskPartition
Dependent		Mandatory	Reference to a CIM_GenericDiskPartition that is based on the Antecedent

4.6.4 CIM_DiskPartition

CIM_DiskPartition (MBR) is subclassed from CIM_GenericDiskPartition.

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 5 describes class CIM_DiskPartition.

Table 5 - SMI Referenced Properties/Methods for CIM_DiskPartition

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
NumberOfBlocks		Optional	
NameFormat		Optional	
NameNamespace		Optional	
PartitionSubtype		Optional	
PartitionType		Optional	
PrimaryPartition		Optional	

4.6.5 CIM_DiskPartitionConfigurationCapabilities

Created By: Static

Modified By: Static
 Deleted By: Static
 Requirement: Mandatory

Table 6 describes class CIM_DiskPartitionConfigurationCapabilities.

Table 6 - SMI Referenced Properties/Methods for CIM_DiskPartitionConfigurationCapabilities

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Shall specify the unique identifier for an instance of this class within the Implementation namespace.
ElementName		Mandatory	User friendly name.
PartitionStyle		Mandatory	The partition style (i.e partition table type) associated with this capabilities instance.
ValidSubPartitionStyles		Optional	Some partitions can act as a container for other partitions.
MaxNumberOfPartitions		Mandatory	The maximum number of partitions that can be BasedOn the Underlying extent.
MaxCapacity		Mandatory	The largest partition size (in blocks) of this style supported on this platform.
OverlapAllowed		Mandatory	The platform supports partitions with overlapping address ranges.
PartitionTableSize		Mandatory	The number of blocks occupied by the partition table and other metadata.

4.6.6 CIM_DiskPartitionConfigurationService

Created By: Static
 Modified By: Static
 Deleted By: Static
 Requirement: Mandatory

Table 7 describes class CIM_DiskPartitionConfigurationService.

Table 7 - SMI Referenced Properties/Methods for CIM_DiskPartitionConfigurationService

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
Name		Mandatory	
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
PartitioningSchemes		Optional	Describes the partitioning schemes supported by the platform.
SetPartitionStyle()		Mandatory	
CreateOrModifyPartition()		Mandatory	

4.6.7 CIM_ElementCapabilities

Created By: Static
 Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 8 describes class CIM_ElementCapabilities.

Table 8 - SMI Referenced Properties/Methods for CIM_ElementCapabilities

Properties	Flags	Requirement	Description & Notes
ManagedElement		Mandatory	Reference to the DiskPartitionConfigurationService.
Capabilities		Mandatory	Reference to the DiskPartitionConfigurationCapabilities.

4.6.8 CIM_ElementConformsToProfile (DiskPartitionConfigurationService to Disk Partition RegisteredProfile)

The CIM_ElementConformsToProfile ties DiskPartitionConfigurationService to the registered profile for Disk Partition.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 9 describes class CIM_ElementConformsToProfile (DiskPartitionConfigurationService to Disk Partition RegisteredProfile).

Table 9 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (DiskPartitionConfigurationService to Disk Partition RegisteredProfile)

Properties	Flags	Requirement	Description & Notes
ManagedElement		Mandatory	A DiskPartitionConfigurationService instance that represents the Disk Partition.
ConformantStandard		Mandatory	RegisteredProfile instance describing the Disk Partition profile.

4.6.9 CIM_GPTDiskPartition

CIM_GPTDiskPartition (GPT) is subclassed from CIM_GenericDiskPartition.

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 10 describes class CIM_GPTDiskPartition.

Table 10 - SMI Referenced Properties/Methods for CIM_GPTDiskPartition

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	

Table 10 - SMI Referenced Properties/Methods for CIM_GPTDiskPartition

Properties	Flags	Requirement	Description & Notes
DeviceID		Mandatory	
Name		Mandatory	
NumberOfBlocks		Optional	
PartitionType		Optional	

4.6.10 CIM_GenericDiskPartition

GenericDiskPartition is used for subclassing the various partition styles, including MBR, GPT, and VTOC.

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 11 describes class CIM_GenericDiskPartition.

Table 11 - SMI Referenced Properties/Methods for CIM_GenericDiskPartition

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
NumberOfBlocks		Optional	

4.6.11 CIM_HostedService

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 12 describes class CIM_HostedService.

Table 12 - SMI Referenced Properties/Methods for CIM_HostedService

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to the ComputerSystem in Base Server.
Dependent		Mandatory	Reference to the DiskPartitionConfigurationService.

4.6.12 CIM_InstalledPartitionTable (Capabilities to Extent)

Created By: Static

Modified By: Static
 Deleted By: Static
 Requirement: Mandatory

Table 13 describes class CIM_InstalledPartitionTable (Capabilities to Extent).

Table 13 - SMI Referenced Properties/Methods for CIM_InstalledPartitionTable (Capabilities to Extent)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a CIM_StorageExtent
Antecedent		Mandatory	Reference to a CIM_DiskPartitionConfigurationCapabilities

4.6.13 CIM_InstalledPartitionTable (Capabilities to Partition)

Created By: Static
 Modified By: Static
 Deleted By: Static
 Requirement: Mandatory

Table 14 describes class CIM_InstalledPartitionTable (Capabilities to Partition).

Table 14 - SMI Referenced Properties/Methods for CIM_InstalledPartitionTable (Capabilities to Partition)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a CIM_GenericDiskPartition
Antecedent		Mandatory	Reference to a CIM_DiskPartitionConfigurationCapabilities

4.6.14 CIM_LogicalDisk

Created By: Extrinsic: CreateOrModifyPartition
 Modified By: Static
 Deleted By: Static
 Requirement: Optional

Table 15 describes class CIM_LogicalDisk.

Table 15 - SMI Referenced Properties/Methods for CIM_LogicalDisk

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
NameFormat		Mandatory	OS Device Name.
NameNamespace		Mandatory	OS Device Namespace.

Table 15 - SMI Referenced Properties/Methods for CIM_LogicalDisk

Properties	Flags	Requirement	Description & Notes
OperationalStatus		Mandatory	
NumberOfBlocks		Optional	

4.6.15 CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition)

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Required in CIM_LogicalDisk is instantiated.

Table 16 describes class CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition).

Table 16 - SMI Referenced Properties/Methods for CIM_LogicalDiskBasedOnPartition (LogicalDisk to Partition)

Properties	Flags	Requirement	Description & Notes
StartingAddress		Mandatory	Shall be 0.
EndingAddress		Mandatory	Shall be one less than NumberOfBlocks from either the LogicalDisk or Partition.
Dependent		Mandatory	Reference to CIM_LogicalDisk
Antecedent		Mandatory	Reference to CIM_GenericDiskPartition

4.6.16 CIM_StorageExtent

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 17 describes class CIM_StorageExtent.

Table 17 - SMI Referenced Properties/Methods for CIM_StorageExtent

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
OperationalStatus		Mandatory	
NumberOfBlocks		Optional	

4.6.17 CIM_SystemDevice (System to Extent)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 18 describes class CIM_SystemDevice (System to Extent).

Table 18 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to Extent)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to the ComputerSystem in Base Server
PartComponent		Mandatory	

4.6.18 CIM_SystemDevice (System to LogicalDisk)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Required in CIM_LogicalDisk is instantiated.

Table 19 describes class CIM_SystemDevice (System to LogicalDisk).

Table 19 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to LogicalDisk)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to the ComputerSystem in Base Server.
PartComponent		Mandatory	Reference to CIM_LogicalDisk

4.6.19 CIM_SystemDevice (System to Partition)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 20 describes class CIM_SystemDevice (System to Partition).

Table 20 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to Partition)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to the ComputerSystem in Base Server.
PartComponent		Mandatory	

4.6.20 CIM_VTOCDiskPartition

CIM_VTOCDiskPartition (VTOC) is subclassed from CIM_GenericDiskPartition.

Created By: Extrinsic: CreateOrModifyPartition

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 21 describes class CIM_VTOCDiskPartition.

Table 21 - SMI Referenced Properties/Methods for CIM_VTOCDiskPartition

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
NumberOfBlocks		Optional	
AsciiLabel		Optional	
Flags		Optional	
Tag		Optional	

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DEPRECATED

5 FC HBA Profile

The functionality of the FC HBA profile has been subsumed by 6 Storage HBA Profile.

See the latest version of this profile in SMI-S Version 1.6.1 Revision 5

DEPRECATED

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6 Storage HBA Profile

6.1 Synopsis

Profile Name: Storage HBA (Component Profile)

Version: 1.6.1

Organization: SNIA

Central Class: PortController

Scoping Class: ComputerSystem

Related Profiles: Table 22 describes the related profiles for Storage HBA.

Table 22 - Related Profiles for Storage HBA

Profile Name	Organization	Version	Requirement	Description
Software Inventory	SNIA	1.0.0	Mandatory	
Software Update	DMTF	1.0.0	Optional	
Physical Asset	DMTF	1.0.2	Optional	
FC HBA Diagnostics	DMTF	1.1.0a	Optional	See DSP1104, version 1.1.0a
Diagnostic Job Control	DMTF	1.0.0b	Conditional	Conditional requirement: Required if the FC HBA Diagnostics profile is supported. See DSP1119, version 1.1.0b
Indications	DMTF	1.2.2	Mandatory	See DSP1054, version 1.2.2
SAS Initiator Ports	SNIA	1.7.0	Support for at least one is mandatory.	Conditional requirement: Required if the FC HBA Diagnostics profile is supported.
FC Initiator Ports	SNIA	1.7.0		Conditional requirement: Required if the FC HBA Diagnostics profile is supported.
FCoE Initiator Ports	SNIA	1.7.0		Conditional requirement: Required if the FC HBA Diagnostics profile is supported.

6.2 Description

The Storage HBA Profile represents the manageable elements of an HBA and optionally, the storage connected to it. An HBA can be connected to disks contained within a server's internal drive cage or an external drive enclosure or array. The profile does not include enclosure management of storage devices connected to the HBA. Storage device enclosure management is performed via the Storage Enclosure Profile.

This profile further describes how the classes are to be used to satisfy various use cases and offers suggestions to agent implementers and client application developers. Only the classes unique to a HBA are described by this profile. Other classes that are common to other profiles, reference to by the Storage HBA Profile, may be found in their respective section within this standard, DMTF specifications, or the DMTF CIM schema specification.

6.3 Implementation

6.3.1 Health and Fault Management Consideration

Not defined in this document

6.3.2 Cascading Considerations

Not defined in this document

6.3.3 Storage HBA Model Overview

The PortController class is the central class of the Storage HBA Profile. It represents an instance of an HBA. The PortController shall be associated to one or more instances of LogicalPort (defined in initiator port profiles) using the ControlledBy association. The PortController shall be associated to the ComputerSystem (from a referencing profile) using the SystemDevice association. The PortController shall also be associated to Product using the ProductElementComponent association; properties of Product provide information about the HBAs manufacturer and model.

6.3.3.1 PhysicalPackage Requirements

When the instrumentation is representing a physical HBA (as opposed to virtual HBA in a guest virtual machine), PortController shall be associated to PhysicalPackage (or a subclass such as Card), as shown in Figure 13. Physical Package shall be associated to PortController via Realizes and Product via ProductPhysicalComponent. If the instrumentation is running in a guest virtual machine and representing a virtual HBA, PhysicalPackage, Realizes, and ProductPhysicalComponent shall not be instantiated. See 6.3.12 for additional virtual system considerations.

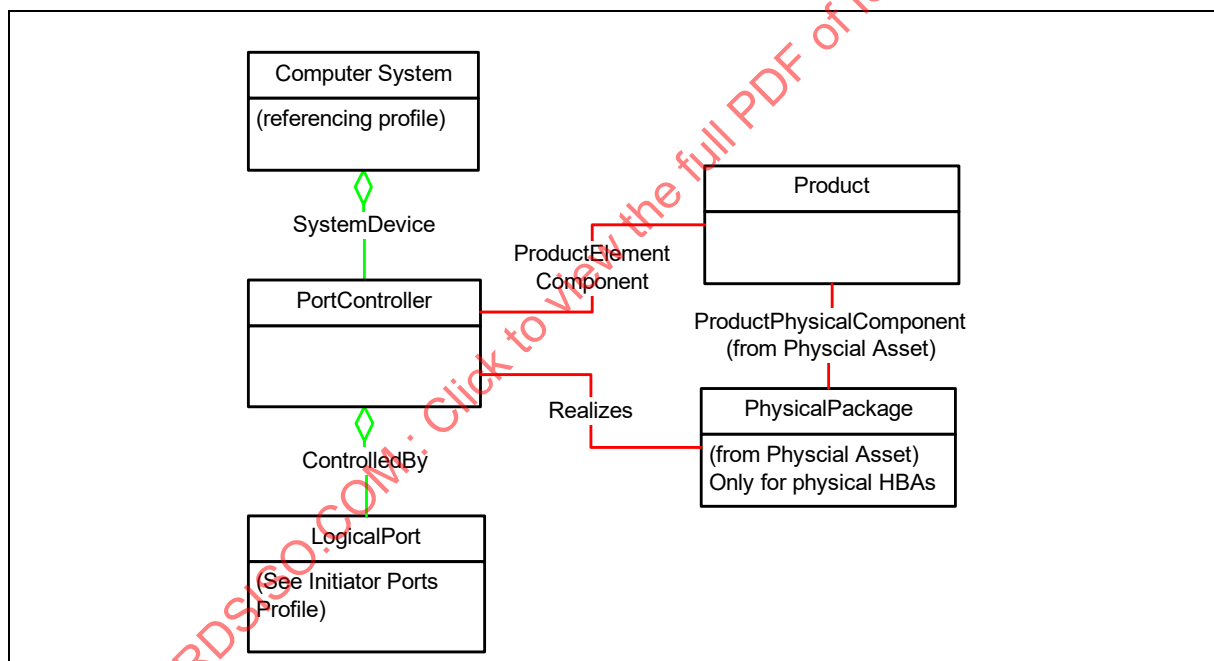


Figure 13 - Model Overview

6.3.4 CIM ComputerSystem

In Storage HBA, the ComputerSystem Class in the diagrams represents the host containing the HBA and is not defined as part of this profile. Typically, this ComputerSystem will be defined as part of a shim profile or the Base Server Profile. Many of the other classes in the Storage HBA Profile are associated to the instance of ComputerSystem that represents the Host. This includes drives, logical ports, and physical cards.

6.3.5 Profile Registration Profile

For the Storage HBA Profile, the scoping class methodology of profile registration shall be used, as required by the Server Profile. The scoping class is the ComputerSystem in the referencing profile.

Overview

However, an implementation may use the central class methodology of profile registration from the Server Profile. The central class of the Storage HBA Profile is the instance of CIM_PortController. The instance of RegisteredProfile in the Interop namespace shall have an association to the instance of CIM_PortController in the implementation namespace, as shown in Figure 14.

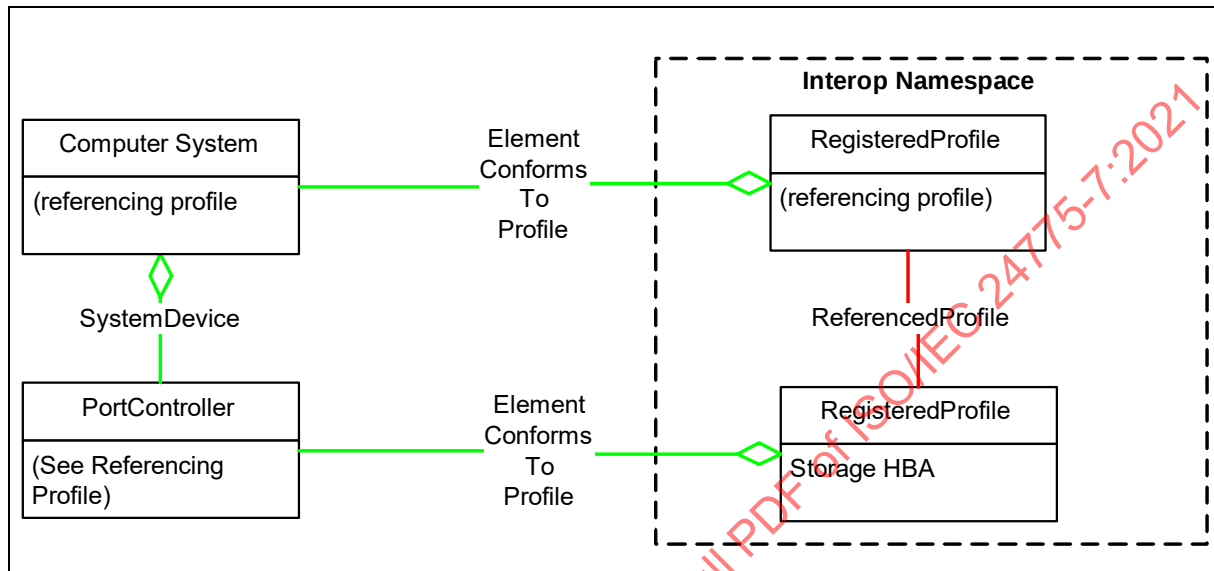


Figure 14 - Profile Registration Profile

6.3.6 Generic Initiator Ports Profile

6.3.6.1 Overview

The Storage HBA Profile utilizes specializations of the Generic Initiator Ports Profile to model the back-end ports of the HBA that are connected to the storage managed by the HBA.

6.3.6.2 CIM_LogicalPort

CIM_LogicalPort is defined in initiator port profiles and represents the logical transport port on the back-end of the HBA that is connected to the storage. This storage could be a drive cage housed inside the host or a storage device enclosure, like a JBOD. The LogicalPort class is intended to model the transport for storage commands in an abstract and agnostic manner. For example, the LogicalPort could represent a Parallel SCSI, SAS, SATA, PATA, or FC port depending on the controller implementation. Thus, the instance of this class shall be sub-classed to SPIPort, SASPort, FCPort or ATAPort depending on the subclass that best represents the transport type the HBA supports for the backend port. The implementation shall not instantiate LogicalPort.

6.3.6.3 CIM_ProtocolEndpoint

The ProtocolEndpoint class represents both ends of the logical data path between the HBA and storage where the storage protocol is transmitted. ProtocolEndpoints for the interface to disks are part of initiator ports profiles.

Like LogicalPort, the ProtocolEndpoint class is intended to model the management of storage protocol in an abstract manner. For example, the ProtocolEndpoint could represent a SCSI, ATA or SB protocol. Thus, the instance of the ProtocolEndpoint shall be subclassed to SCSIProtocolEndpoint, ATAProtocolEndpoint or SBProtocolEndpoint.

6.3.7 Software Inventory Profile

6.3.7.1 Overview

For the Storage HBA Profile, the SoftwareIdentity class from the Software Inventory Profile (DMTF) is required to model various software and firmware entities related to an HBA. Each SoftwareIdentity instance shall be associated via InstalledSoftwareIdentity to the referencing ComputerSystem and via ElementSoftwareIdentity to the PortController.

6.3.7.2 Physical HBA Considerations

The implementation shall use the Software Inventory Profile to model the firmware for the HBA. The SoftwareIdentity instance representing the driver software shall include 10 (Firmware) in the Classifications property. In the context of this profile, "Firmware" refers to firmware installed in and running on the HBA itself.

If the HBA has a separate entity for the BIOS or FCode from the firmware, the implementation may use the Software Inventory Profile to represent the BIOS/FCode. The SoftwareIdentity instance representing the driver software shall include 11 (BIOS/FCode) in the Classifications property. In the context of this profile, "BIOS/FCode" refers to BIOS/FCode extensions installed in and running on the HBA itself. Typically, these extensions are related to boot support.

The implementation shall use the Software Inventory Profile to model the driver software that interfaces with the HBA. As used here, the term "Driver" applies to software (or firmware) installed in the system OS that enables OS support for the HBA.

- If the HBA is installed in a system (a hypervisor or a general-purpose system) following a typical open-system architecture, drivers are components the OS running on the server and provide support for various devices. The Driver SoftwareIdentity in this profile models the driver(s) which enable support for the HBA.
- If the HBA is installed in a general purpose system that does not have something called drivers (for example, some mainframe OSes), then the Driver SoftwareIdentity in this profile models the OS components which enable support for the HBA.
- If the HBA is installed in a hypervisor and the hypervisor implementation is considered firmware rather than an OS, then the Driver SoftwareIdentity represents the subset of that firmware which enables support for the HBA.

In some cases, the driver is an embedded component of the OS (or RTOS or firmware) and is not independently versioned. In this case, the implementation shall populate SoftwareIdentity version information with the version information from the OS.

The use-case for requiring driver version numbers is that there may be dependencies between version numbers of the driver component of the hypervisor and the driver component running in the guest VM. Requiring each allows a client application to track these versions and report inconsistencies.

6.3.7.3 Virtual HBA Considerations

The implementation shall use the Software Inventory Profile, shown in Figure 15, to model the driver software that interfaces with the HBA. As used here, the term “Driver” applies to software installed in the virtual system OS, enabling the OS to interface to the virtual HBAs.

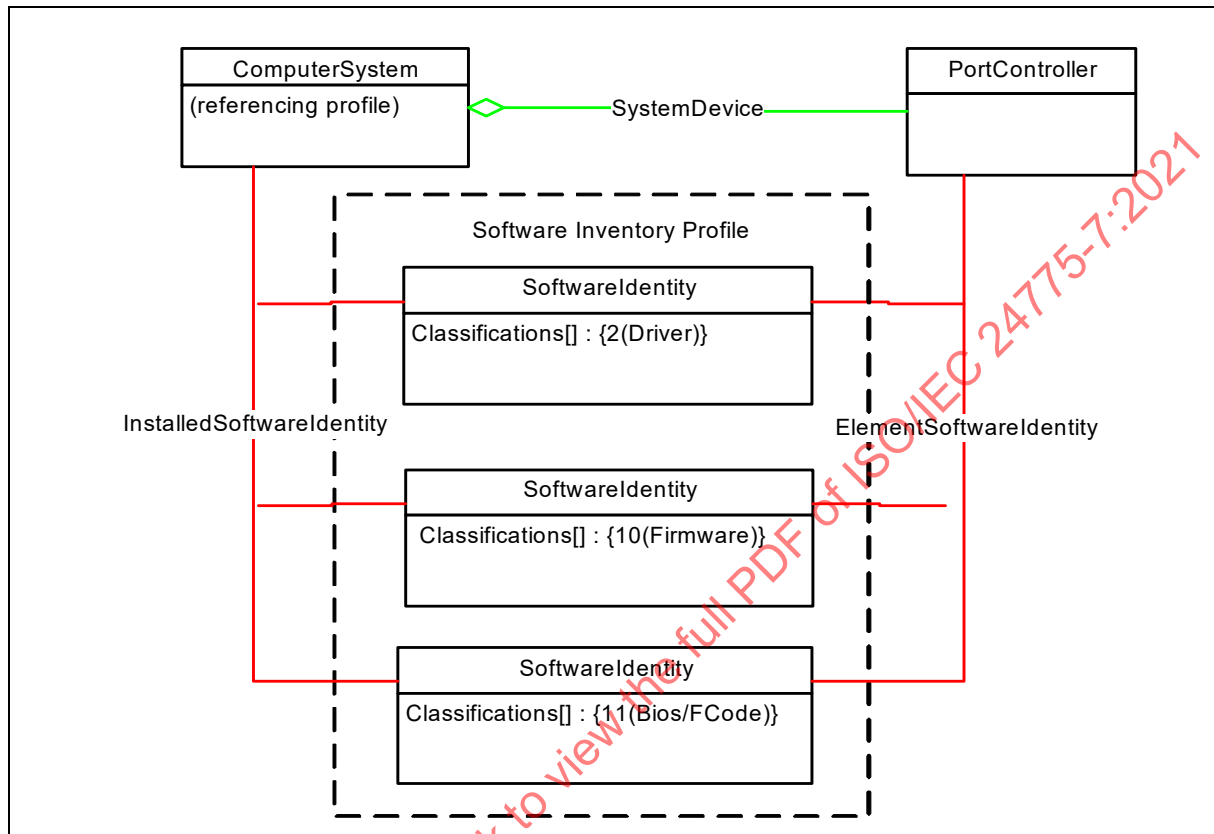


Figure 15 - Software Inventory Profile in Storage HBA

6.3.8 Software Update Profile

The implementation may optionally use the DMTF Software Update Profile to provide an interface for updating HBA software or firmware.

6.3.9 HBA Hot Swap Events

The implementation may optionally support asynchronous notification of HBA inserts and removals using the InstCreation and InstDeletion indications (see Table 25, “CIM Elements for Storage HBA,”).

6.3.10 Physical Asset Profile

The physical representation of the controller is optional. The Physical Asset Profile defines the set of classes and subclasses for describing the physical assets of a managed component. Most HBAs can be described as a physical card or chip on a motherboard. Therefore, at a minimum, the implementation shall include an instance of a subclass of PhysicalComponent or PhysicalPackage. For example, the CIM_Card class is a subclass of CIM_PhysicalPackage. The implementation may choose CIM_Card to represent a physical RAID controller card. In this case, the instance of CIM_Card is associated to the top-level controller CIM_PortController via the CIM_Realizes association.

General FC HBA Considerations

Other physical classes such as Slots are optional, provided the sub-elements are consistent with the Physical Asset Profile. Figure 16 illustrates an HBA Card with Physical Classes.

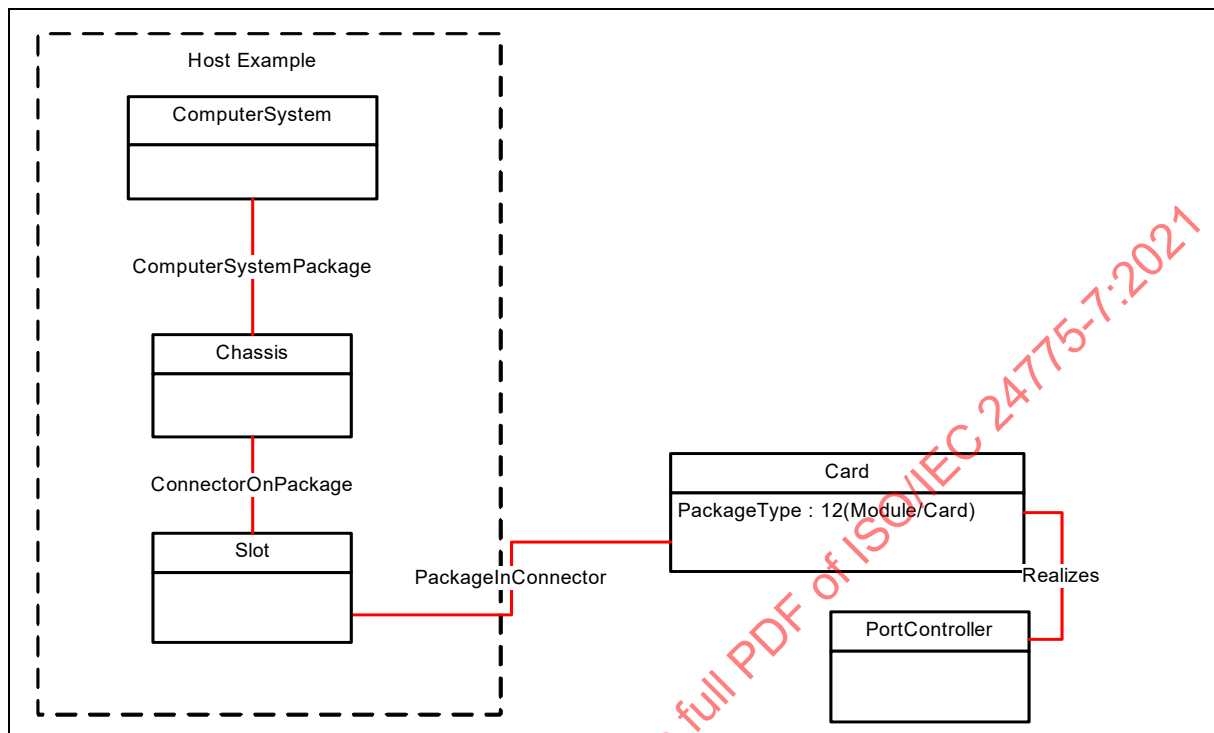


Figure 16 - HBA Card with Physical Classes

6.3.11 Modeling Attached Disk, Tape, and Optical Drives

Attached devices may be modeled using the optional remote elements model in 13.3.2 Remote Device Models.

6.3.12 Virtual System Considerations

In the “usual” configuration without any system virtualization, the instrumentation is directly working with physical HBAs which are not shared with guest virtual machines (VMs). In this case, PhysicalPackage (or a subclass) is mandatory as described in 6.3.3.1.

In a virtual system configuration, the requirements differ for the hypervisor and guest VMs.

- In a hypervisor context, PhysicalPackage (or a subclass) is mandatory as described in 6.3.3.1
- In a guest VM, PhysicalPackage shall not be instantiated.

A future version of this profile will reference emerging profiles that define how virtual HBAs are allocated and mapped to physical HBAs.

6.3.13 Fibre Channel HBAs

6.3.13.1 General FC HBA Considerations

The FC Initiator Ports Profile specialization of Generic Initiator Ports Profile is mandatory.

6.3.13.2 Physical FC HBA Considerations

In this version of the standard, implementers should use the FC HBA Profile to model physical FC HBAs, except for those used in a hypervisor context. Physical FC HBAs in a hypervisor should be modeled using this profile.

EXPERIMENTAL

6.3.14 FC HBA Diagnostics Profile

The FC HBA Diagnostics Profile is a DMTF profile that supports diagnostic tests on fibre channel HBAs. Support for the profile would only occur if the Storage HBA supports fibre channel ports and is optional in any case. The diagnostic tests supported include an Echo and Ping test for testing access to storage devices, as well as tests on the HBA itself.

When the FC HBA Diagnostics Profile is supported, there will be an instance of CIM_FCHBADiagnosticTest associated (via CIM_HostedService) to the Base Server system. That diagnostic test instance will have a CIM_AvailableDiagnosticService association to the Storage HBA PortController.

EXPERIMENTAL

6.4 Methods of the Profile

6.4.1 Overview

This section details the requirements for supporting intrinsic operations and extrinsic methods for the CIM elements defined by this profile.

6.4.2 Profile Conventions for Operations

Table 23 lists operations and requirements for CIM_PortController.

Table 23 - CIM_PortController

Operation	Requirement	Message
GetInstance	Mandatory	None
ModifyInstance	Unspecified	None
Associators	Unspecified	None
AssociatorNames	Unspecified	None
References	Unspecified	None
ReferenceNames	Unspecified	None
EnumerateInstances	Unspecified	None
EnumerateInstanceNames	Unspecified	None

Physical FC HBA Considerations

Table 24 lists operations and requirements for CIM_SystemDevice.

Table 24 - CIM_SystemDevice

Operation	Requirement	Message
GetInstance	Mandatory	None
ModifyInstance	Unspecified	None
Associators	Unspecified	None
AssociatorNames	Unspecified	None
References	Unspecified	None
ReferenceNames	Unspecified	None
EnumerateInstances	Unspecified	None
EnumerateInstanceNames	Unspecified	None

6.5 Use Cases

Not defined in this document

6.6 CIM Elements

6.6.1 Overview

Table 25 describes the CIM elements for Storage HBA.

Table 25 - CIM Elements for Storage HBA

Element Name	Requirement	Description
6.6.2 CIM_ControlledBy	Mandatory	Associates PortController and LogicalPort.
6.6.3 CIM_PortController	Mandatory	Represents the logical aspects of the HBA. Associated to RegisteredProfile.
6.6.4 CIM_Product	Mandatory	
6.6.5 CIM_ProductElementComponent	Mandatory	
6.6.6 CIM_Realizes	Optional	
6.6.7 CIM_SystemDevice	Mandatory	Associates System to PortController.
SELECT * FROM CIM_InstCreation WHERE SourceInstance ISA CIM_PortController	Optional	PortController (HBA) Creation. See 6.3.9 HBA Hot Swap Events.
SELECT * FROM CIM_InstDeletion WHERE SourceInstance ISA CIM_PortController	Optional	PortController (HBA) Removal. See 6.3.9 HBA Hot Swap Events.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host1'	Optional	Controller firmware is older than required.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host2'	Optional	Controller firmware is older than recommended.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host3'	Optional	Controller is okay.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host4'	Optional	Controller is not okay.

Physical FC HBA Considerations

Table 25 - CIM Elements for Storage HBA

Element Name	Requirement	Description
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host5'	Optional	Bus rescan complete.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Host6'	Optional	Disk initialize failed.
SELECT * FROM CIM_AlertIndication WHERE OwningEntity='SNIA' and MessageID='Core11'	Optional	Drive not responding.

6.6.2 CIM_ControlledBy

Associates PortController and LogicalPort.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 26 describes class CIM_ControlledBy.

Table 26 - SMI Referenced Properties/Methods for CIM_ControlledBy

Properties	Flags	Requirement	Description & Notes
DeviceNumber		Optional	The number of the port, relative to the PortController. This is sometimes referred to as the bus number.
Dependent		Mandatory	Reference to LogicalPort.
Antecedent		Mandatory	Reference to PortController.

6.6.3 CIM_PortController

Represents the logical aspects of the HBA.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Shall be associated to RegisteredProfile using ElementConformsToProfile association. The RegisteredProfile instance shall have RegisteredName set to 'Storage HBA', RegisteredOrganization set to 'SNIA', and RegisteredVersion set to '1.6.1'.

Table 27 describes class CIM_PortController.

Table 27 - SMI Referenced Properties/Methods for CIM_PortController

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	

Table 27 - SMI Referenced Properties/Methods for CIM_PortController

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
DeviceID		Mandatory	

6.6.4 CIM_Product

Requirement: Mandatory

Table 28 describes class CIM_Product.

Table 28 - SMI Referenced Properties/Methods for CIM_Product

Properties	Flags	Requirement	Description & Notes
ElementName		Mandatory	
Name		Mandatory	
IdentifyingNumber		Mandatory	
Vendor		Mandatory	
Version		Mandatory	

6.6.5 CIM_ProductElementComponent

Requirement: Mandatory

Table 29 describes class CIM_ProductElementComponent.

Table 29 - SMI Referenced Properties/Methods for CIM_ProductElementComponent

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to a CIM_Product
PartComponent		Mandatory	Reference to a CIM_PortController

6.6.6 CIM_Realizes

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 30 describes class CIM_Realizes.

Table 30 - SMI Referenced Properties/Methods for CIM_Realizes

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a CIM_PortController
Antecedent		Mandatory	Reference to a CIM_PhysicalPackage

Physical FC HBA Considerations

6.6.7 CIM_SystemDevice

Associates System to PortController.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 31 describes class CIM_SystemDevice.

Table 31 - SMI Referenced Properties/Methods for CIM_SystemDevice

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to a CIM_ComputerSystem
PartComponent		Mandatory	Reference to a CIM_PortController

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7 Host Discovered Resources Profile

7.1 Description

7.1.1 Synopsis

Profile Name: Host Discovered Resources (Component Profile)

Version: 1.7.0

Organization: SNIA

Central Class: LogicalDevice

Scoping Class: Base Server ComputerSystem

Related Profiles: Table 32 describes the related profiles for HostDiscoveredResources.

Table 32 - Related Profiles for HostDiscoveredResources

Profile Name	Organization	Version	Requirement	Description
SCSI Multipath Management	SNIA	1.6.0	Optional	
SB Multipath Management	SNIA	1.0.0	Optional	Deprecated
Disk Partition	SNIA	1.6.0	Optional	
Launch In Context	DMTF	1.0.0	Optional	
Indications	DMTF	1.2.2	Mandatory	See DSP1054, version 1.2.2

7.1.2 Overview

The Host Discovered Resources Profile allows a client application to discover the storage hardware resources attached to a host system, the logical storage resources available through the OS, and the relationship between these hardware and logical resources. The hardware resources include host adapters and storage devices. The logical resources include the OS special files that represent storage devices. In some cases, there is a one-to-one relationship between the logical and physical device. But multipath and disk partitioning introduce resource fan-in and fan-out that are also modeled in this profile.

Figure 17: "Host Discovered Resources Block Diagram" depicts the relationship between the Host Discovered Resources Profile and these other profiles. The areas with the shaded background are covered by the Host Discovered Resources Profile – including partitioned and multipath storage.

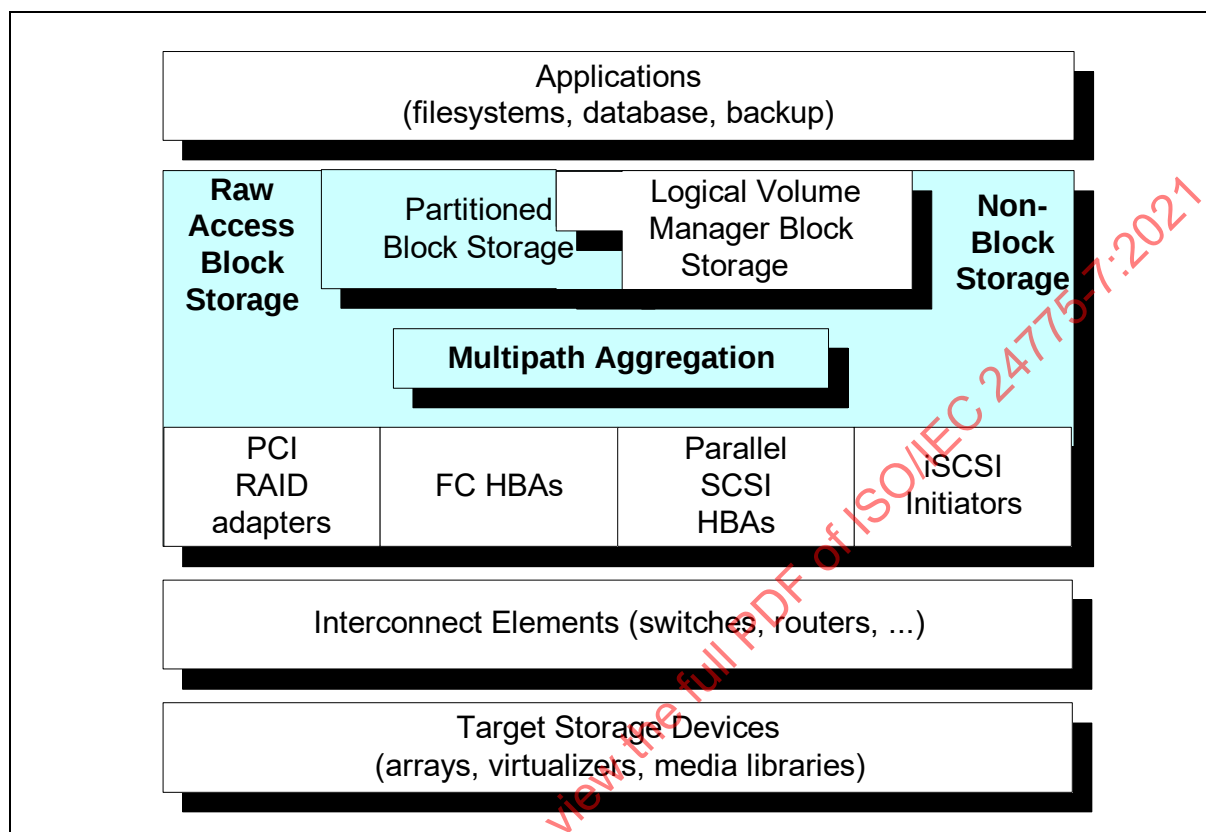


Figure 17 - Host Discovered Resources Block Diagram

Applications and Logical Volume Manager are consumers of Host Discovered Resources. The diagram depicts how an application can use Logical Volume Manager resources or use Host Discovered Resources directly. For example, a server may have some filesystems using LVM volumes and some filesystems using OS volumes.

The blocks at the bottom of the diagram represent resources (HBAs and target devices) for which the Host Discovered Resources Profile provides a host view. Note that interconnect elements between the HBAs and target devices are not part of the Host Discovered Resources Profile.

The Host Discovered Resources Profile provides a minimal amount of information about the discovered hardware resources; this includes the connectivity and correlatable IDs. The Host Discovered Resources Profile does not act as the canonical profile for any particular hardware resource; even host-resident elements like FC HBAs, iSCSI initiators, and Logical Volume Managers have separate profiles. The correlatable IDs exposed by The Host Discovered Resources Profile allow an application to associate host-discovered resources with resources from these other profiles.

For example, an array profile can describe the redundancy characteristics and performance statistics of a RAID volume. But the array profile will use a SCSI logical unit identifier as the volume's name. By combining information from the array and host-discovered resources profiles, a client can display the host special file name(s) associated with that volume. This additional name information can help the administrator (or client software) determine which applications are associated with volumes.

All references to ComputerSystem in the Host Discovered Resources Profile implies a single instance for a customer server or storage system as defined in the Base Server Profile. See Annex A: (Informative) Host Profile Deployment Guidelines, 1.6.0 Rev 3 for information on the use of host profiles with Base Server profile.

7.1.3 Host Disk Extent Class Name Conventions

The Host Discovered Resources Profile uses several different CIM classes to represent disk extents. **LogicalDisk** models an extent exposed by the OS to applications such as filesystems, databases, or logical volume managers. **GenericDiskPartition** represents a partition or slice of a disk as supported directly by the OS. **StorageVolume** represents disks or virtual volumes exported from disk arrays and virtualizers in the array or virtualizer profiles. **StorageExtent** represents disk extents that do fit these other classes; these will be intermediate extents that are neither consumed volumes nor exported logical disks.

Note that Logical Volume Managers are described in a separate profile. Logical Volume Managers may also expose partitions, but these are independent of partitions integrated into some OSes. The Host Discovered Resources Profile just addresses OS partitions.

To make it easier for clients of this profile, all consumable storage exported by this profile are modeled as instances of LogicalDisk.

The functionality of host resources discovery is broken into three areas:

- Disk partition discovery and management - see 4 Disk Partition Profile.
- Multipath Management - see 10 SCSI Multipath Management Profile.
- Discovery of Hardware Resources - see 7.1.4.

7.1.4 Discovered Hardware Resources

This profile presents a view of discovered resources with a common model based on the various command sets used in I/O devices - SCSI, ATA, or SB. Ports are modeled as instances of SCSIProtocolEndpoint, ATAProtocolEndpoint, or SBProtocolEndpoint - representing the use of the command set(s) used with the port.

The Host Discovered Resource Profile could be implemented using standard APIs (such as an HBA, SCSI, or iSCSI API) to create a generic model of the host-storage controllers and storage attached to those controllers. The model includes elements also exposed by HBA and storage agents; the details are included in these other profiles. A client uses correlatable IDs to equate objects from different agents.

The correlatable IDs for logical units (LogicalDisk, StorageExtent, TapeDrive) are the identifiers assigned by the hosting operating system (see *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4, 7 Correlatable and Durable Names, 7.6.6 "Operating System Device Names"* for the name requirements for OS names of disk logical units). An implementation of this profile shall also provide the correlatable names associated with the underlying devices. The requirements specified in *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4, 7 Correlatable and Durable Names, 7.6.2 "Standard Formats for Logical Unit Names"* applies, but instead of using the Name and NameNamespace properties, the information is contained in the OtherIdentifyingInfo and IdentifyingDescriptions array properties. The valid strings for IdentifyingDescriptions are exactly those described for NameNamespace in *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4, 7 Correlatable and Durable Names, 7.6.2 "Standard Formats for Logical Unit Names"*.

This profile is restricted to discovery of I/O devices and does not include remote filesystems. The SCSI, ATA, and SB models are discussed separately.

Model for SCSI Protocol Resources

The SCSI protocol is used in several transports - Fibre Channel, iSCSI, Parallel SCSI (SPI), and Serial Attached SCSI (SAS). SCSI Protocol includes initiator and target ports, and logical units (RAID volumes, tape drives) in a many-to-many-to-many relationship - in other words, an initiator port may connect to many target ports (and vice versa), and each target device many have many logical units connected to initiator and target ports.

Figure 18: "Host Discovered Resources Class Diagram" is a class diagram for Host Discovered Resources. SCSIProtocolEndpoint represents the SCSI logical port, either initiator or target. The transports type (e.g., FC, iSCSI) is specified in SCSIProtocolEndpoint ConnectionType property.

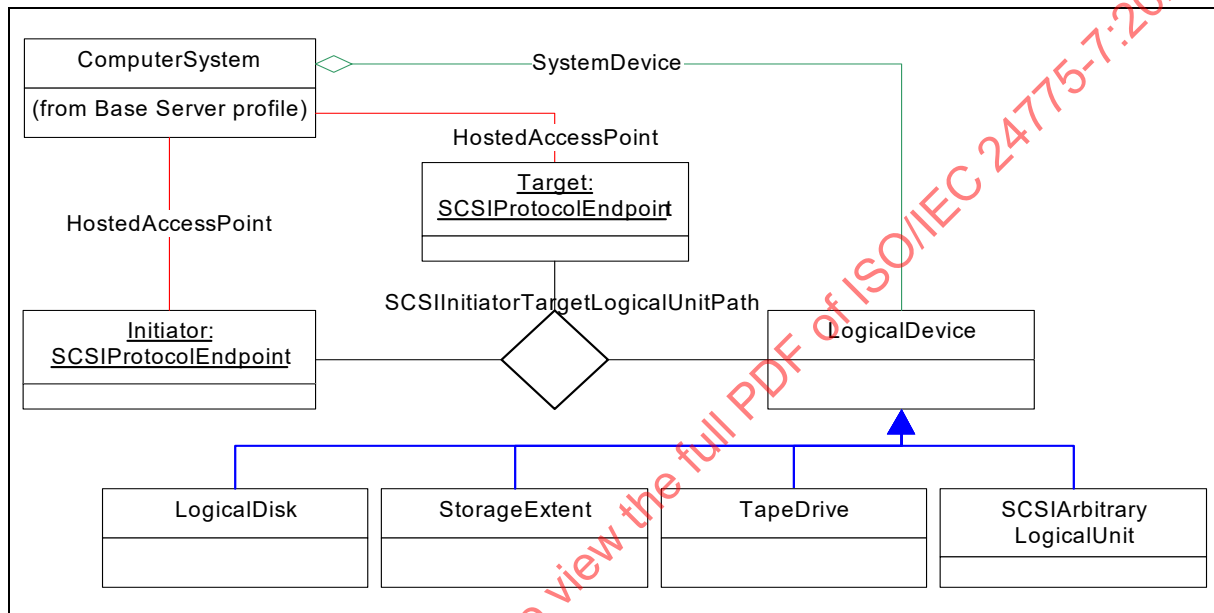


Figure 18 - Host Discovered Resources Class Diagram

The initiator ProtocolEndpoint and each target ProtocolEndpoint and LogicalDevice are associated by SCSIInitiatorTargetLogicalUnitPath.

Consider a few concrete cases. Figure 19: "Single SPI Disk Model" depicts the model for a single parallel SCSI disk. In general, Host APIs cannot differentiate a "real" disk from a virtual disk as exposed by a RAID controller, so the StorageExtent subclass of LogicalDevice is used.

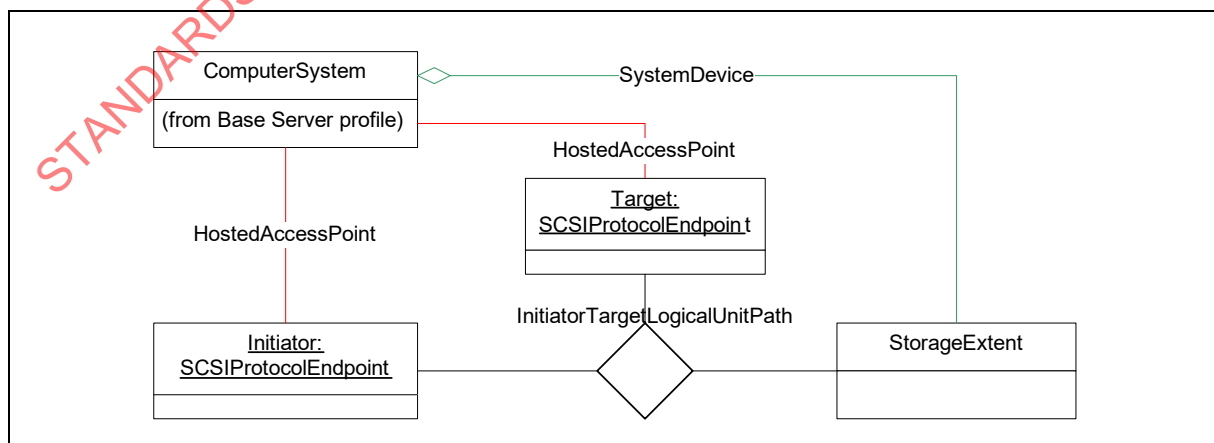


Figure 19 - Single SPI Disk Model

Figure 20: "Three FCP Logical Unit Instance Diagram" depicts a Fibre Channel RAID controller exposing three virtual disks to a single host/initiator port. There is a single initiator and target that share access to three StorageExtent instances.

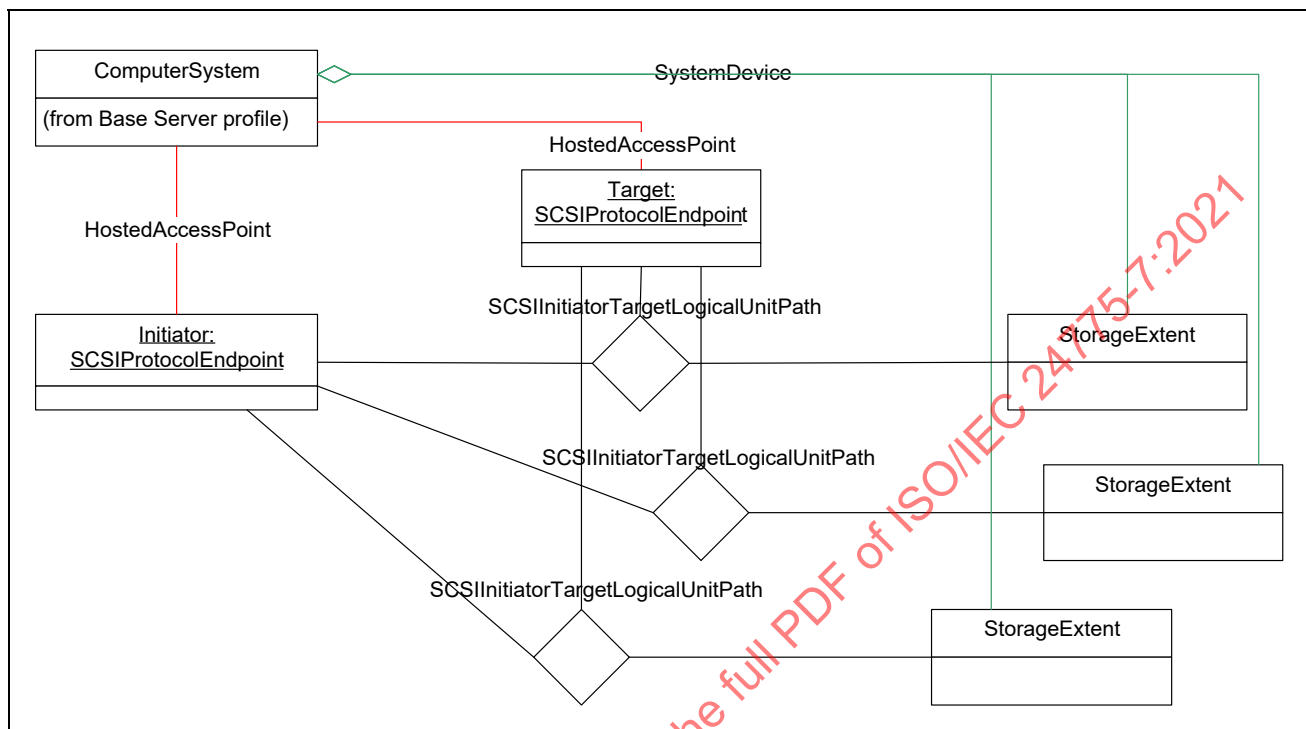


Figure 20 - Three FCP Logical Unit Instance Diagram

The Multipath Profile describes more complicated multipath configurations. See Figure 40: "Four Path Instance Diagram".

Model for ATA Protocol Resources

The model for ATA, shown in Figure 21, uses a ConnectivityCollection of ATAProtocolEndpoints.

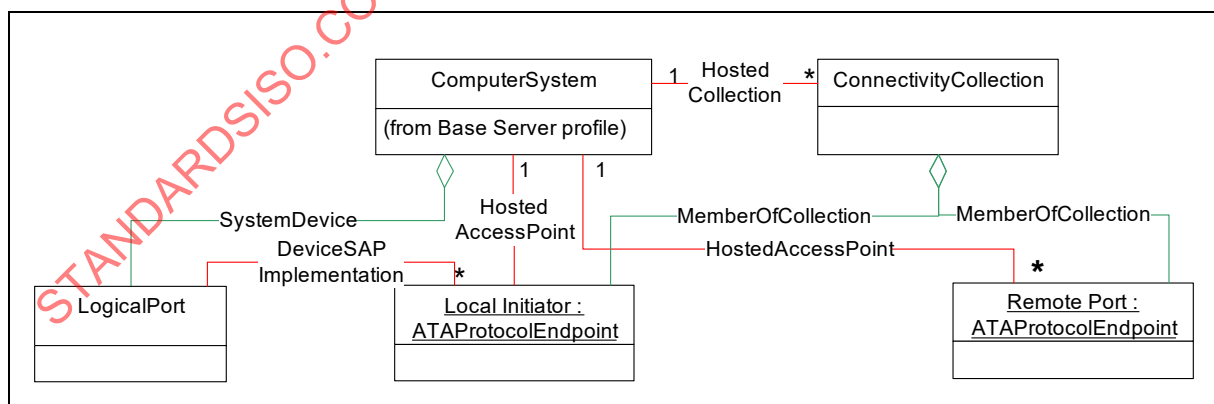


Figure 21 - ATA Discovered Resource Model

Model for SB Protocol Resources

The SB protocol is used in the Fibre Channel FC-SB-x transport. SB protocol includes initiator ("channel image") and target ports, and a logical units (ECKD volumes, tape drives) in a many-to-many-to-many relationship - in other words, an initiator port may connect to many target ports (and vice versa), and each

target device may have many logical units connected to initiator and target ports. Figure 22: "SB Host Discovered Resources" provides a general controller/device SB model. LogicalDevice subclasses model different types of SB logical unit, e.g., TapeDrive. SBProtocolEndpoint represents the SB logical port, either initiator or target. The transports type (e.g., FC) is specified in SBProtocolEndpoint ConnectionType property. The initiator ProtocolEndpoint and each target ProtocolEndpoint and LogicalDevice are associated by SBInitiatorTargetLogicalUnitPath. Each SBLogicalDevice is contained within a one SBCUImage.

Figure 22: "SB Host Discovered Resources" depicts SB Host Discovered Resources.

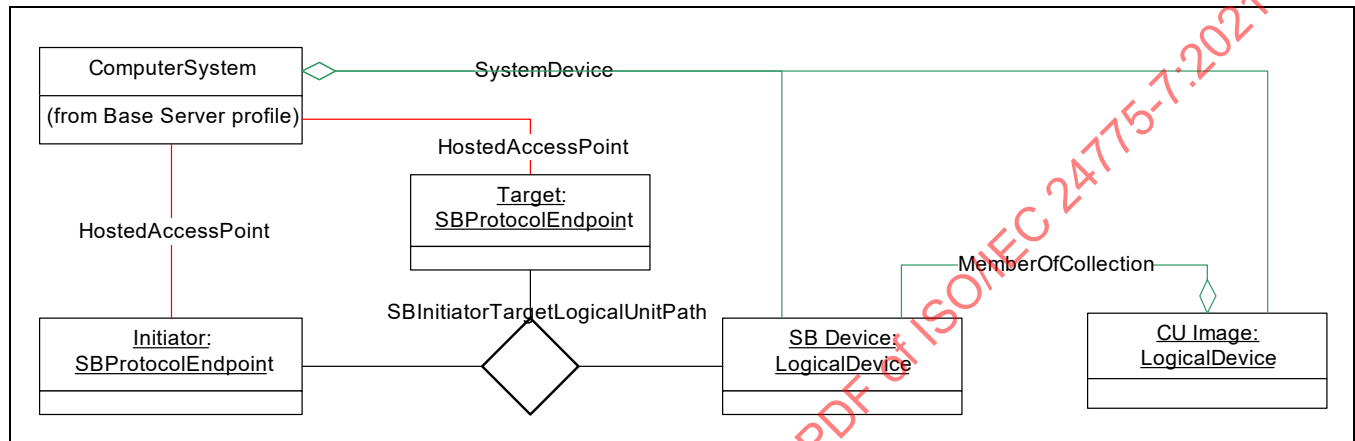


Figure 22 - SB Host Discovered Resources

Associating Hardware and OS Devices

There are two variations for disks and virtual disks - configurations with or without disk partitions.

- 1) With no partitions, each discovered (virtual) disk is modeled as LogicalDisk
- 2) With disk partitions, each partition exposed to an application or LVM is modeled as LogicalDisk. Any disk (or intermediate partition) that contains partitions is modeled as StorageExtent. DiskPartition instances are modeled between the StorageExtents and LogicalDisks. For more details, see 4 Disk Partition Profile. The requirement for disk partitions is reflected by the presence of DiskPartition-ConfigurationCapabilities.

Tape drive configurations are similar to case 1 above, with TapeDrive rather than LogicalDisk.

7.2 Health and Fault Management Considerations

Not defined in this document

7.3 Cascading Considerations

Not defined in this document

7.4 Extrinsic Methods of the Profile

StorageConfigurationService.ScsiScan

This method requests that the system rescan SCSI devices for changes in their configuration. If called on a general-purpose host, the changes are reflected in the list of devices available to applications (for example, the UNIX 'device tree').

This operation can be disruptive; optional parameters allow the caller to limit the scan to a single or set of SCSI device elements. All parameters are optional; if parameters other than Job are passed in as null, a full scan is invoked. If the caller specifies a connection type, the scan is limited to that connection type.

Job - a reference to a Job

ConnectionType - The type of connection (transport, such as FC or iSCSI), constrains the scan to initiator ports of this type. Only used if the Initiators parameter is null.

OtherConnectionType - The connection type if the ConnectionType parameter is Other.

Initiators - A list of references to initiators. Scanning will be limited to SCSI targets attached to these initiators. If this parameter is null and connection is specified, all initiators of that connection type are scanned. If this parameter and ConnectionType are null, all targets on all system initiators are probed.

Targets - A list of names or numbers for targets. These should be formatted to match the appropriate connection type. For example, PortWWNs would be specified for Fibre Channel targets.

LogicalUnits - A list of SCSI logical unit numbers representing logical units hosted on the targets specified in the Targets argument.

ScsiScan() support is optional. Support for ScsiScan() can be determined based on the inclusion of "SCSI Scan" in the SupportedAsynchronousActions array in StorageConfigurationCapabilities.

7.5 Use Cases

Not defined in this document

7.6 CIM Elements

7.6.1 Overview

Table 33 describes the CIM elements for Host Discovered Resources.

Table 33 - CIM Elements for Host Discovered Resources

Element Name	Requirement	Description
7.6.2 CIM_ATAInitiatorTargetLogicalUnitPath	Optional	Associates initiator and target ATAProtocolEndpoints to a logical unit.
7.6.3 CIM_ATAProtocolEndpoint	Optional	
7.6.4 CIM_ElementConformsToProfile (LogicalDevice to Host Discovered Resources RegisteredProfile)	Mandatory	Ties the LogicalDevice to the registered profile for Host Discovered Resources.
7.6.5 CIM_HostedAccessPoint	Mandatory	This association links all ProtocolEndpoints to the Base Server profile computer system.
7.6.6 CIM_LogicalDevice (LogicalDevice)	Mandatory	Represents a block logical unit that is exposed to applications such as file systems without being partitioned.
7.6.7 CIM_LogicalDisk (LogicalDevice)	Optional	Represents a block logical unit that is exposed to applications such as file systems without being partitioned.
7.6.8 CIM_SCSIArbitraryLogicalUnit (LogicalDevice)	Optional	A SCSI Logical Unit that exists only for management.
7.6.9 CIM_SCSIInitiatorTargetLogicalUnitPath	Optional	Associates initiator and target SCSIProtocolEndpoints to a logical unit.
7.6.10 CIM_SCSIProtocolEndpoint	Optional	
7.6.11 CIM_StorageExtent (LogicalDevice)	Optional	Represents a block logical unit in the host that is partitioned before being exposed to applications.
7.6.12 CIM_SystemDevice	Mandatory	This association links LogicalDevices to the Base Server profile computer system.

Table 33 - CIM Elements for Host Discovered Resources

Element Name	Requirement	Description
7.6.13 CIM_TapeDrive (LogicalDevice)	Optional	Represents a tape drive logical unit in the host.
7.6.14 CIM_SBInitiatorTargetLogicalUnitPath	Optional	Associates initiator and target SBProtocolEndpoints to a logical unit.
7.6.15 CIM_SBProtocolEndpoint	Optional	
SELECT * FROM CIM_InstCreation WHERE SourceInstance ISA CIM_SCSIInitiatorTargetLogicalUnitPath	Mandatory	Path creation.
SELECT * FROM CIM_InstDeletion WHERE SourceInstance ISA CIM_SCSIInitiatorTargetLogicalUnitPath	Mandatory	Path deletion.
SELECT * FROM CIM_InstModification WHERE SourceInstance ISA CIM_SCSIInitiatorTargetLogicalUnitPath AND SourceInstance.CIM_SCSIInitiatorTargetLogicalUnitPath: :State <> PreviousInstance.CIM_SCSIInitiatorTargetLogicalUnitPat h::State	Mandatory	CQL -Path State change.
SELECT * FROM CIM_InstModification WHERE SourceInstance ISA CIM_SCSIInitiatorTargetLogicalUnitPath AND SourceInstance.CIM_SCSIInitiatorTargetLogicalUnitPath: :AdministrativeWeight <> PreviousInstance.CIM_SCSIInitiatorTargetLogicalUnitPat h::AdministrativeWeight	Mandatory	CQL -Path AdministrativeWeight change.
SELECT * FROM CIM_InstModification WHERE SourceInstance ISA CIM_SCSIInitiatorTargetLogicalUnitPath AND SourceInstance.CIM_SCSIInitiatorTargetLogicalUnitPath: :AdministrativeOverride <> PreviousInstance.CIM_SCSIInitiatorTargetLogicalUnitPat h::AdministrativeOverride	Mandatory	CQL -Path AdministrativeOverride change.

7.6.2 CIM_ATAInitiatorTargetLogicalUnitPath

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 34 describes class CIM_ATAInitiatorTargetLogicalUnitPath.

Table 34 - SMI Referenced Properties/Methods for CIM_ATAInitiatorTargetLogicalUnitPath

Properties	Flags	Requirement	Description & Notes
State		Mandatory	
LogicalUnit		Mandatory	A reference to a LogicalDevice.
Initiator		Mandatory	A reference to the initiator CIM_ATAProtocolEndpoint.
Target		Mandatory	A reference to the target CIM_ATAProtocolEndpoint.

7.6.3 CIM_ATAProtocolEndpoint

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 35 describes class CIM_ATAProtocolEndpoint.

Table 35 - SMI Referenced Properties/Methods for CIM_ATAProtocolEndpoint

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
Name	C	Mandatory	
ProtocolIFType		Mandatory	
ConnectionType		Mandatory	
Role		Mandatory	

7.6.4 CIM_ElementConformsToProfile (LogicalDevice to Host Discovered Resources Registered-Profile)

The CIM_ElementConformsToProfile ties LogicalDevice to the registered profile for Host Discovered Resources.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 36 describes class CIM_ElementConformsToProfile (LogicalDevice to Host Discovered Resources RegisteredProfile).

Table 36 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (LogicalDevice to Host Discovered Resources RegisteredProfile)

Properties	Flags	Requirement	Description & Notes
ManagedElement		Mandatory	A LogicalDevice instance that represents the Host Discovered Resources.
ConformantStandard		Mandatory	RegisteredProfile instance describing the Host Discovered Resources profile.

7.6.5 CIM_HostedAccessPoint

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 37 describes class CIM_HostedAccessPoint.

Table 37 - SMI Referenced Properties/Methods for CIM_HostedAccessPoint

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a ProtocolEndpoint
Antecedent		Mandatory	Reference to a Computer System

7.6.6 CIM_LogicalDevice (LogicalDevice)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 38 describes class CIM_LogicalDevice (LogicalDevice).

Table 38 - SMI Referenced Properties/Methods for CIM_LogicalDevice (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	Opaque identifier.
ElementName		Mandatory	User-friendly name.
Name	C	Mandatory	OS device name.
OtherIdentifyingInfo	C	Mandatory	The correlatable ID of the underlying logical unit.
IdentifyingDescriptions	C	Mandatory	
OperationalStatus		Mandatory	

7.6.7 CIM_LogicalDisk (LogicalDevice)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 39 describes class CIM_LogicalDisk (LogicalDevice).

Table 39 - SMI Referenced Properties/Methods for CIM_LogicalDisk (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	Opaque identifier.

Table 39 - SMI Referenced Properties/Methods for CIM_LogicalDisk (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
ElementName		Mandatory	User-friendly name.
Name	C	Mandatory	OS device name.
NameFormat	C	Mandatory	Shall be 12 (OS Device Name).
NameNamespace	C	Mandatory	Shall be 8 (OS Device Namespace).
OtherIdentifyingInfo	C	Mandatory	The correlatable ID of the underlying logical unit.
IdentifyingDescriptions	C	Mandatory	
OperationalStatus		Mandatory	

7.6.8 CIM_SCSIArbitraryLogicalUnit (LogicalDevice)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 40 describes class CIM_SCSIArbitraryLogicalUnit (LogicalDevice).

Table 40 - SMI Referenced Properties/Methods for CIM_SCSIArbitraryLogicalUnit (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	Opaque identifier.
ElementName		Mandatory	User-friendly name.
Name	C	Mandatory	OS device name.
OtherIdentifyingInfo	C	Mandatory	The correlatable ID of the underlying logical unit.
IdentifyingDescriptions	C	Mandatory	
OperationalStatus		Mandatory	

7.6.9 CIM_SCSIInitiatorTargetLogicalUnitPath

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 41 describes class CIM_SCSIInitiatorTargetLogicalUnitPath.

Table 41 - SMI Referenced Properties/Methods for CIM_SCSIInitiatorTargetLogicalUnitPath

Properties	Flags	Requirement	Description & Notes
OSDeviceName		Optional	
AdministrativeWeight	M	Mandatory	
State		Mandatory	
AdministrativeOverride		Mandatory	
LogicalUnit		Mandatory	A reference to a LogicalDevice.
Initiator		Mandatory	A reference to the initiator CIM_SCSIProtocolEndpoint.
Target		Mandatory	A reference to the target CIM_SCSIProtocolEndpoint.

7.6.10 CIM_SCSIProtocolEndpoint

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 42 describes class CIM_SCSIProtocolEndpoint.

Table 42 - SMI Referenced Properties/Methods for CIM_SCSIProtocolEndpoint

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
Name	C	Mandatory	
ProtocolIFType		Mandatory	Shall be 1 (Other).
ConnectionType		Mandatory	
Role		Mandatory	

7.6.11 CIM_StorageExtent (LogicalDevice)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 43 describes class CIM_StorageExtent (LogicalDevice).

Table 43 - SMI Referenced Properties/Methods for CIM_StorageExtent (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	Opaque identifier.
ElementName		Mandatory	User-friendly name.
Name	C	Mandatory	OS device name.
NameFormat	C	Mandatory	Shall be 12 (OS Device Name).
NameNamespace	C	Mandatory	Shall be 8 (OS Device NameSpace).
OtherIdentifyingInfo	C	Mandatory	The correlatable ID of the underlying logical unit.
IdentifyingDescriptions	C	Mandatory	
OperationalStatus		Mandatory	

7.6.12 CIM_SystemDevice

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 44 describes class CIM_SystemDevice.

Table 44 - SMI Referenced Properties/Methods for CIM_SystemDevice

Properties	Flags	Requirement	Description & Notes
PartComponent		Mandatory	Reference to a Logical Device subclass
GroupComponent		Mandatory	Reference to a Computer System

7.6.13 CIM_TapeDrive (LogicalDevice)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 45 describes class CIM_TapeDrive (LogicalDevice).

Table 45 - SMI Referenced Properties/Methods for CIM_TapeDrive (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	

Table 45 - SMI Referenced Properties/Methods for CIM_TapeDrive (LogicalDevice)

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
DeviceID		Mandatory	Opaque identifier.
ElementName		Mandatory	User-friendly name.
Name	C	Mandatory	OS device name.
OtherIdentifyingInfo	C	Mandatory	The correlatable ID of the underlying logical unit.
IdentifyingDescriptions	C	Mandatory	
OperationalStatus		Mandatory	

7.6.14 CIM_SBInitiatorTargetLogicalUnitPath

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 46 describes class CIM_SBInitiatorTargetLogicalUnitPath.

Table 46 - SMI Referenced Properties/Methods for CIM_SBInitiatorTargetLogicalUnitPath

Properties	Flags	Requirement	Description & Notes
OSDeviceName		Optional	
UsePreferredPath		Optional	Boolean indicating whether preferred path processing is required.
PreferredPath		Optional	Boolean indicating whether this is a preferred path.
PathGroupState		Optional	One of 'Unknown', 'Path grouping not supported', 'Reset', 'Grouped', 'Ungrouped'.
PathGroupMode		Optional	One of 'Unknown', 'None', 'Single path', 'Multipath' (Single path and multipath only valid if PathGroupState is grouped).
PathGroupID		Optional	String containing the ID from the OS, only valid if PathGroupState is Grouped.
LogicalUnit		Mandatory	A reference to a LogicalDevice.
Initiator		Mandatory	A reference to the initiator CIM_SBProtocolEndpoint.
Target		Mandatory	A reference to the target CIM_SBProtocolEndpoint.

7.6.15 CIM_SBProtocolEndpoint

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 47 describes class CIM_SBProtocolEndpoint.

Table 47 - SMI Referenced Properties/Methods for CIM_SBProtocolEndpoint

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
Name	C	Mandatory	
ProtocolIFType		Mandatory	
ConnectionType		Mandatory	
Role		Mandatory	

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8 Host Hardware RAID Controller Profile

8.1 Synopsis

Profile Name: Host Hardware RAID Controller (Component Profile)

Version: 1.7.0

Organization: SNIA

Central Class: ComputerSystem

Scoping Class: ComputerSystem

Related Profiles: Table 48 describes the related profiles for Host Hardware RAID Controller.

Table 48 - Related Profiles for Host Hardware RAID Controller

Profile Name	Organization	Version	Requirement	Description
Physical Asset	DMTF	1.0.2	Mandatory	
Block Services	SNIA	1.8.0	Mandatory	
Disk Drive Lite	SNIA	1.7.0	Optional	
Software Inventory	SNIA	1.0.0	Mandatory	Experimental.
Software Update	DMTF	1.0.0	Optional	
Extent Composition	SNIA	1.7.0	Optional	
Disk Sparing	SNIA	1.7.0	Optional	
DA Target Ports	SNIA	1.4.0	Mandatory	
Erase	SNIA	1.7.0	Optional	Experimental.
Copy Services	SNIA	1.5.0	Optional	Deprecated
Replication Services	SNIA	1.7.0	Optional	
Storage Enclosure	SNIA	1.7.0	Optional	Model for External Disk Enclosures.
Thin Provisioning	SNIA	1.7.0	Optional	
Block Storage Views	SNIA	1.7.0	Optional	
FC Initiator Ports	SNIA	1.7.0	Support for at least one is mandatory.	
SAS Initiator Ports	SNIA	1.7.0		
Indications	DMTF	1.2.2	Mandatory	See DSP1054, version 1.2.2

The Host Hardware RAID Controller Profile describes classes, properties, and other profiles necessary to manage a host-based RAID controller. The central class and the scoping Class is the ComputerSystem representing the controller.

8.2 Description

The Host Hardware RAID Controller Profile is intended to represent the manageable elements of a host-based RAID controller and the storage it controls. A RAID controller may manage disks contained within a server's internal drive cage or an external drive enclosure.

The Host Hardware RAID Controller Profile may be used to model manageability for software-based RAID included in drivers. However, manageability for volume manager-based RAID, running on a host operating system, is out of scope for the Host Hardware RAID Controller Profile.

Figure 23, "Host Hardware RAID Controller Package Diagram" shows the relationship between the Host Hardware RAID Profile and its key component profiles.

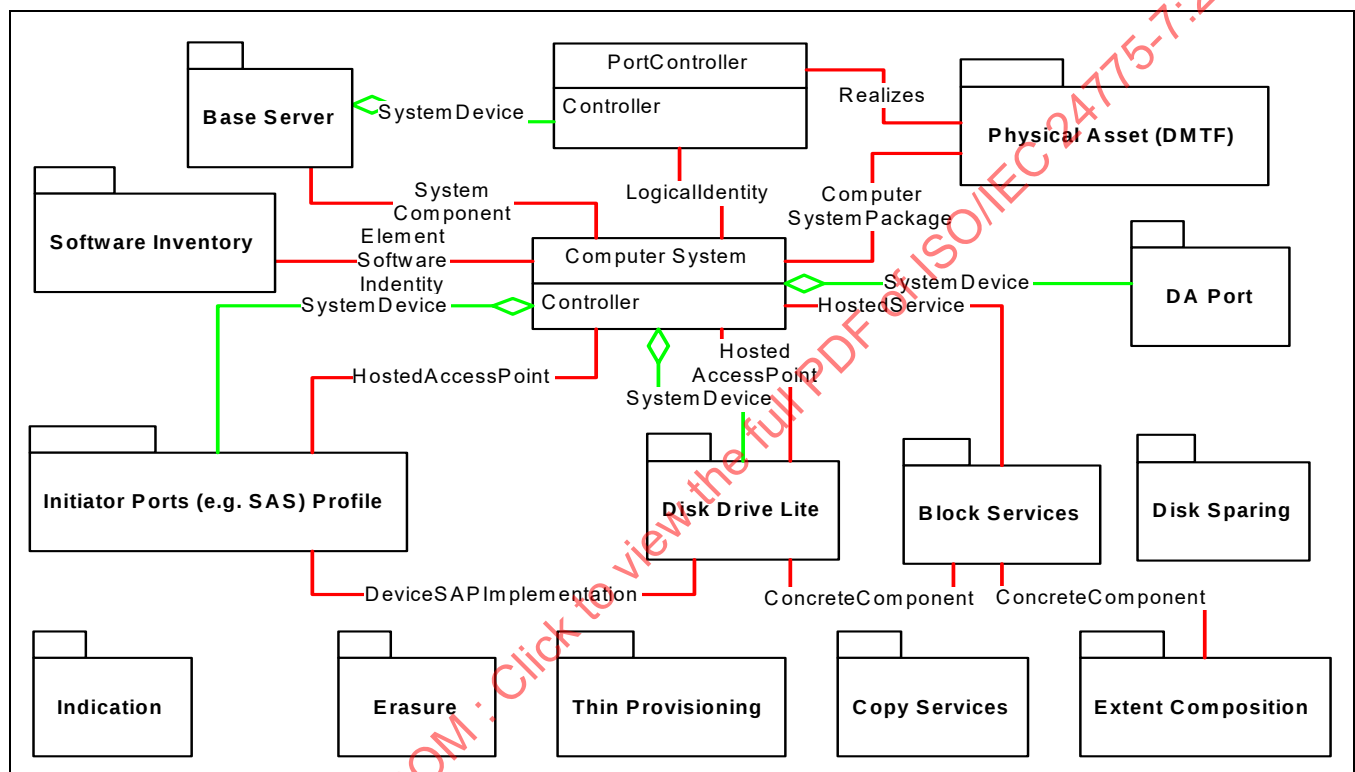


Figure 23 - Host Hardware RAID Controller Package Diagram

8.3 Implementation

8.3.1 Relationship to autonomous profiles

Although the Host Hardware RAID Controller Profile includes a ComputerSystem instance, it is a component profile, intended to be referenced by a separate profile modeling the host system that contains the RAID controller. In most cases, the Base Server Profile (see *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4 30 Base Server Profile*). will be the referencing profile. The ComputerSystems from the Host Hardware RAID Controller Profile and its referencing profile are associated using CIM_SystemComponent.

All references to ComputerSystem in the Host Hardware RAID Controller Profile imply a single instance for a customer server or storage system as defined in the Base Server Profile. See Annex B (Informative) Host Profile Deployment Guidelines for information on the use of host profiles with Base Server profile.

8.3.2 CIM_PortController

The PortController class represents an instance of a RAID controller and controllers the backend port to the storage managed by this controller. An implementation of Host Hardware RAID Controller Profile shall associate PortController to the instance of ComputerSystem that represents the host in the referencing profile, using the SystemDevice association. Also, the PortController shall be associated to the ComputerSystem that represents the controller using the LogicalIdentity association. Finally, the PortController shall be associated to one or more instances of LogicalPort using the ControlledBy association.

8.3.3 CIM_ComputerSystem

In the Host Hardware RAID Controller Profile, the ComputerSystem Class within this profile represents the RAID controller itself.

The ComputerSystem that represents the RAID controller system acts as the principal class of the profile. Many of the other classes in the Host Hardware RAID Controller Profile that together act as a host-based RAID controller are scoped to the instance of ComputerSystem that represents the controller. This includes attached storage pools, volumes, drives, configuration services, logical ports, and physical cards. Any implementation shall instantiate an instance of ComputerSystem associated to PortController using the LogicalIdentity association. Also, the implementation shall include the value 30 (Host-Based RAID controller) in the Dedicated property”.

Figure 24 illustrates the relationship between the Base Server ComputerSystem and the Host Hardware RAID Controller system, and the relationship of devices defined by this profile to the Host Hardware RAID Controller system.

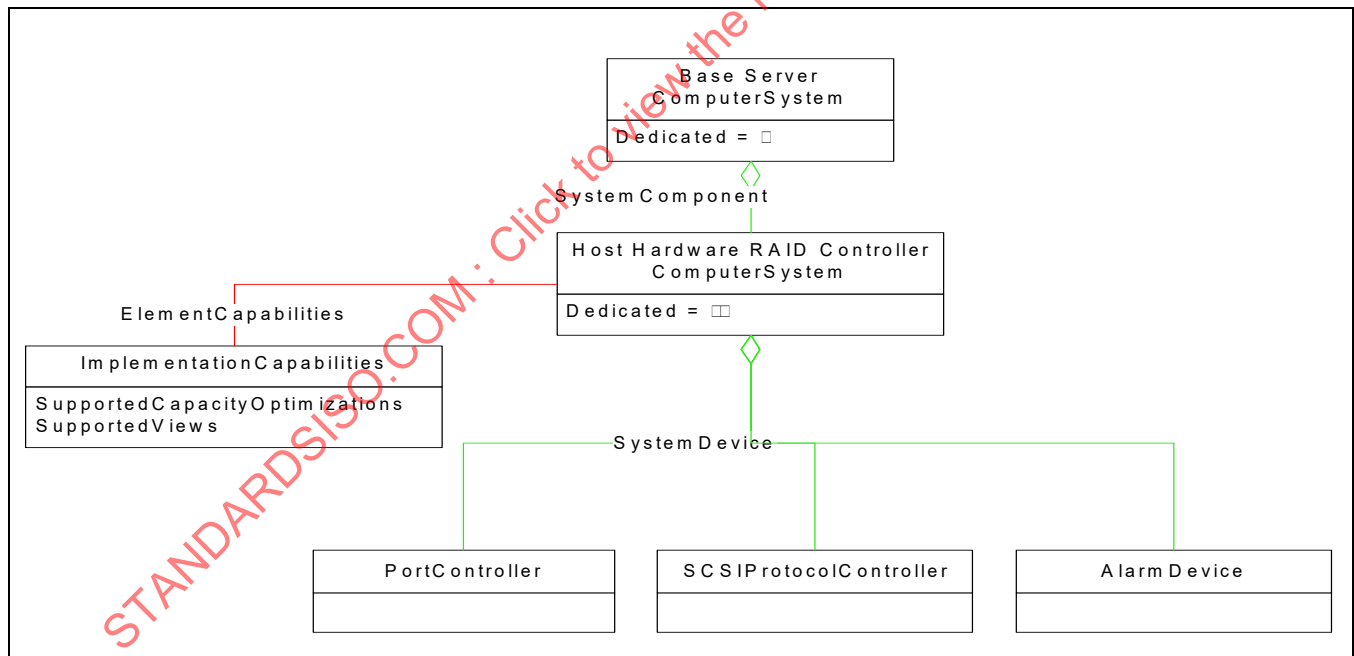


Figure 24 - Host Hardware RAID resources scoped to HHRC ComputerSystem

Figure 24 also illustrates the **ImplementationCapabilities** associated to the Host Hardware RAID Controller ComputerSystem. These capabilities identify the capacity optimization techniques and views supported by the implementation. Note that the Block Storage Views also calls for an instance of **ViewCapabilities** to identify the views supported. However, the supported views are greater than those supported in a Host Hardware RAID Controller configuration. The **SupportedViews** property of

ImplementationCapabilities limits the possible views supported to those that make sense in the context of a Host Hardware RAID Controller implementation.

8.3.4 CIM_AlarmDevice

Some Host-based RAID controllers have a visual or audible alarm, as shown in Figure 25, to indicate when some event has occurred on the system, like a degraded RAID StorageVolume. CIM_AlarmDevice may be implemented to represent an alarm device on the RAID controller.

Determination: The implementation may create an instance of CIM_AlarmDevice that represents an alarm device associated to ComputerSystem that represents the controller using the SystemDevice association. Alarms may be either visual (i.e., LEDs on the controller) or audible, thus implementation shall set the value of the appropriate boolean property to TRUE in the CIM_AlarmDevice class. For example, if the alarm is an audible alarm, the implementation shall set the value of AudibleAlarm property to TRUE.

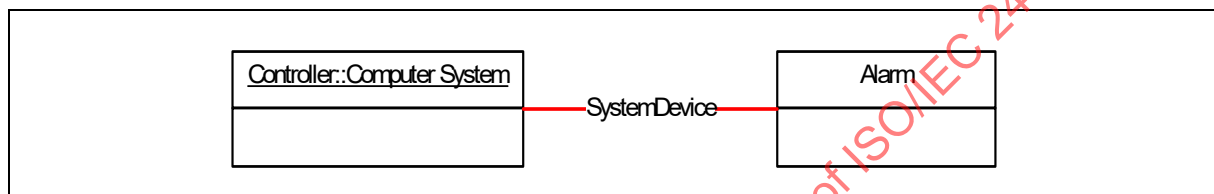


Figure 25 - Alarms in Host Hardware RAID Controller

8.3.5 Server Profile

For the Host Hardware RAID Controller Profile, the SNIA Server Profile is required. Any implementation shall follow the requirements of the SNIA Server Profile (see *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4 35 Server Profile*).

8.3.6 Profile Registration

For the Host Hardware RAID Controller Profile, the scoping class methodology of profile registration shall be used, as required by the server profile, as shown in Figure 26. However, an implementation may use the central class methodology. The scoping class and central class of the Host Hardware RAID Controller profile is the instance of CIM_ComputerSystem that represents the controller.

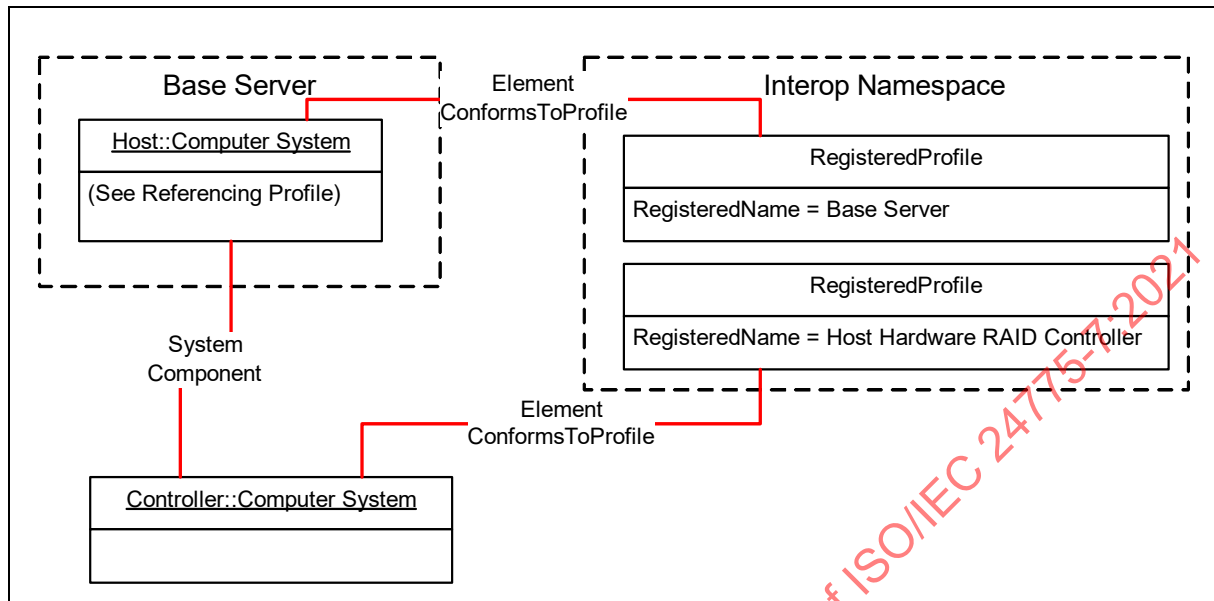


Figure 26 - Profile Registration with Host Hardware RAID Controller and Base Server Profiles

8.3.7 Profile Discovery and Advertisement

The Host Hardware RAID Controller Profile shall be advertised in SLP as “SNIA:Host Hardware RAID Controller”.

8.3.8 Physical Asset Profile

The physical representation of the controller is mandatory and realized by implementing the Physical Asset Profile, shown in Figure 27. The Physical Asset Profile defines the set of classes and subclasses for describing the physical assets of a managed component. Most host-based RAID controllers can be described as a physical card or chip on a motherboard. Therefore, at a minimum, the implementation shall include an instance of a subclass of PhysicalComponent or PhysicalPackage. The PhysicalPackage or PhysicalComponent shall be associated (using Realizes) to the PortController and to the ComputerSystem representing the controller (using ComputerSystemPackage). For example, the CIM_Card class is a subclass of PhysicalPackage. The implementation may choose CIM_Card to represent a physical RAID controller card. In this case, the instance of CIM_Card is associated to the top-level controller CIM_PortController via the Realizes association.

For any instantiation of a subclass of PhysicalComponent or PhysicalPackage class (i.e., CIM_Card), the implementation shall populate the ElementName property with the name of the RAID controller model as described by the manufacturer.

Overview

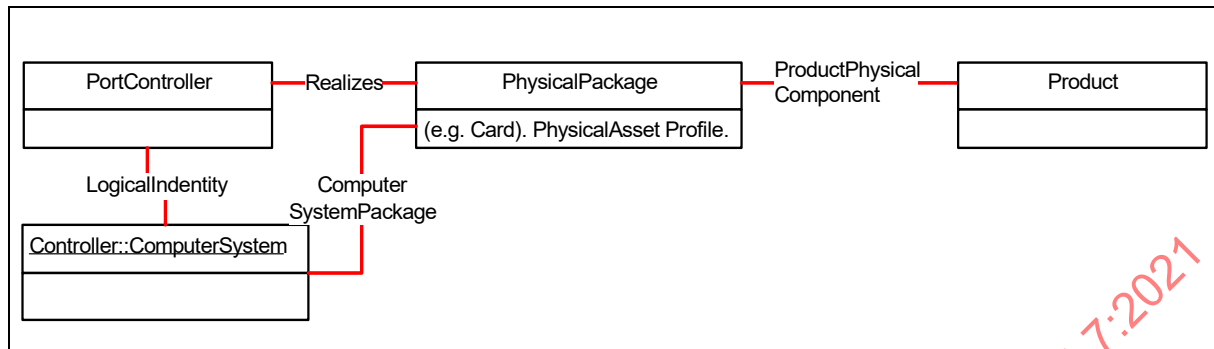


Figure 27 - Implementation of Physical Asset Profile

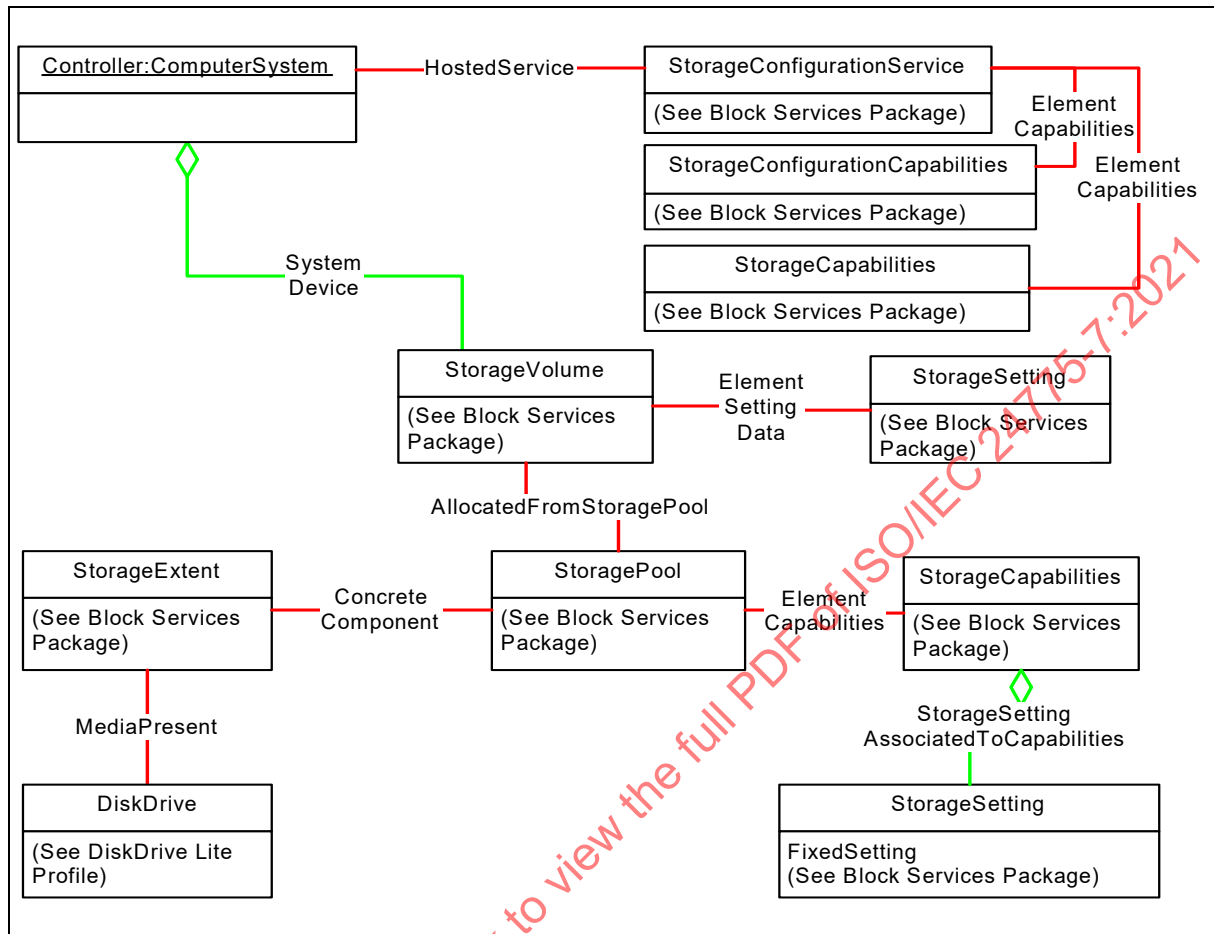
8.3.9 Storage Enclosure Profile

The Storage Enclosure Profile is an optional profile modeling disk enclosures dedicated to a Host Hardware RAID Controller. The associations defined in the Storage Enclosure Profile referencing ComputerSystem should reference the controller ComputerSystem defined in the Host Hardware RAID Controller Profile.

8.3.10 Implementation of Block Services Package

8.3.10.1 Overview

Figure 28 illustrates the Host Hardware RAID Controller use of Block Services. Note that most of the non-system objects must also be associated to the ComputerSystem; these associations are omitted to simplify the diagram.



Storage Capabilities

- SupportedStorageElementTypes shall include the value 2 (StorageVolume).
- SupportedStoragePoolFeatures shall include the value 2 (InExtents) or 3 (Single InPool).
- SupportedStorageElementFeatures shall include the value 3 (StorageVolume Creation), 5 (StorageVolume Modification), 6 (Single InPool) or 10 (InElements).

8.3.10.4 Storage Capabilities

For the initial state of Host Hardware RAID Controller Profile, implementations shall instantiate at least two instances of the StorageCapabilities class.

The first instantiation of StorageCapabilities is used to model the storage capabilities of the controller. The StorageCapabilities instance shall be associated to the StorageConfigurationService using the ElementCapabilities association. This instance allows the client to easily determine the storage capabilities of the controller. This capability is fixed and may change only when new functionality is added to the controller through a firmware change/update.

The second instantiation of StorageCapabilities is associated to a primordial StoragePool using the ElementCapabilities association. This instantiation of StorageCapabilities is required by Block Services Package and defines the range of redundancy capabilities of the primordial StoragePool.

8.3.10.5 Storage Settings

Implementations shall instantiate at least one StorageSetting class associated to the StorageCapabilities (associated to the primordial StoragePool) using the StorageSettingAssociatedToCapabilities association. The StorageSetting class further defines the redundancy capabilities of the primordial StoragePool. This is a "fixed" association, and shall not be modified by the client.

8.3.11 Implementation of DAPort and SCSIProtocolController

RAID controllers make the volumes exported by the controller appear as disks (or disk partitions) to the host operating system - which in turn makes them available to filesystems and databases running on the host. Typically the drivers supporting RAID controllers cause exported volumes to appear in the operating system's "device tree" similarly to an external RAID array: SCSI logical units attached to SCSI target devices.

SCSIProtocolController represents the SCSI target device. StorageVolumes (from the Block Services package) represent the logical units and are associated to SCSIProtocolController with the ProtocolControllerForUnit association. This association has a DeviceNumber that holds the logical unit number for the StorageVolume. The DA Target Port Profile models the simulated SCSI port related to the SCSIProtocolController. The combination of these elements allows an application with existing support for SMI-S to additionally support the Host Hardware RAID profile with minimal changes.

Storage Settings

The model for DA Target Ports and SCSIProtocolController is shown in Figure 29, “DAPort Profile in Host Hardware Controller”.

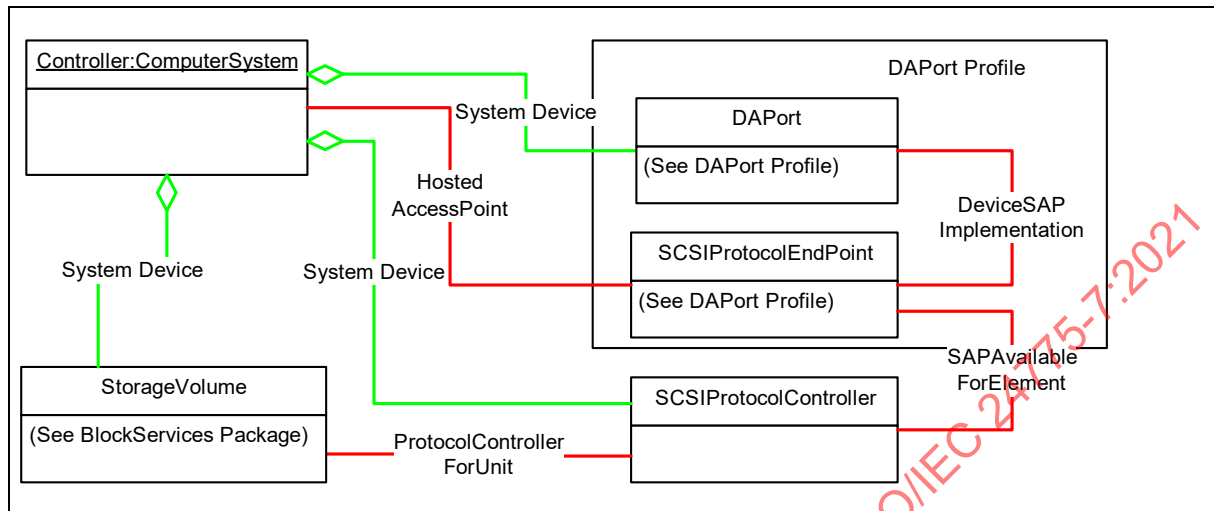


Figure 29 - DAPort Profile in Host Hardware Controller

8.3.12 Implementation of Software Inventory Profile

For the Host Hardware RAID Controller Profile, the SoftwareIdentity class from the Software Inventory Profile is required to model various software entities for a RAID controller, as shown in Figure 30. The implementation shall use the Software Inventory Profile to model the driver software for the RAID controller running on the Host Operating System and the firmware internal to the controller. If the RAID controller has a separate software entity for the BIOS from the firmware, the implementation may use the Software Inventory Profile to represent the BIOS.

To model the driver, firmware and BIOS software for the controller, the implementation shall instantiate an instance of SoftwareIdentity class associated to the top level ComputerSystem that represents the RAID controller, using the ElementSoftwareIdentity association. The SoftwareIdentity instances are differentiated by including the values Driver, Firmware, or FCode/BIOS in the Classifications property.

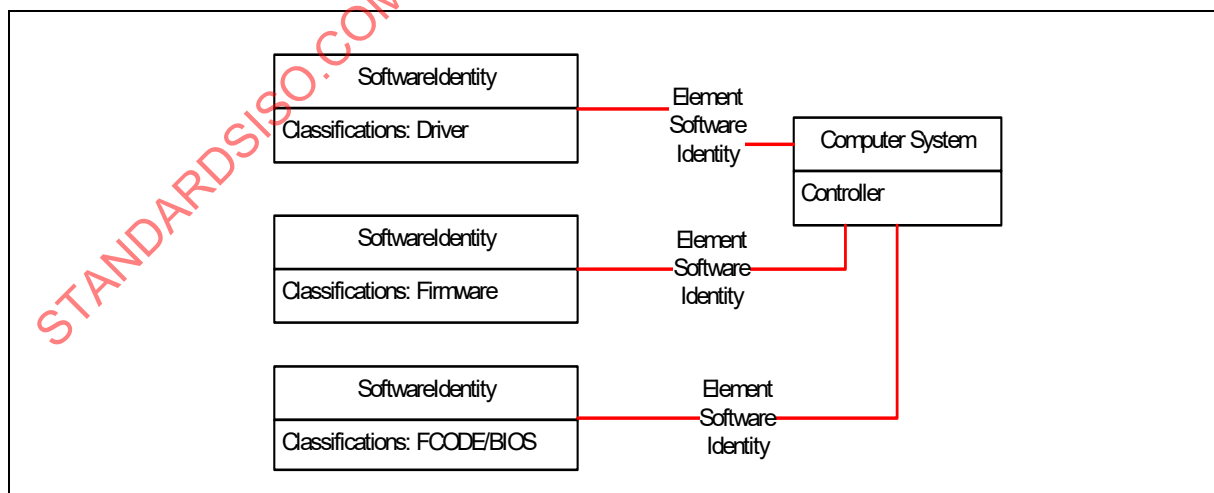


Figure 30 - Software Inventory Profile in Host Hardware RAID Controller

8.3.13 Implementation of Initiator Ports Profiles

8.3.13.1 Overview

The Host Hardware RAID Controller Profile utilizes the initiator ports profiles to model the back-end ports of the controller that are connected to the storage managed by the RAID controller, as shown in Figure 31.

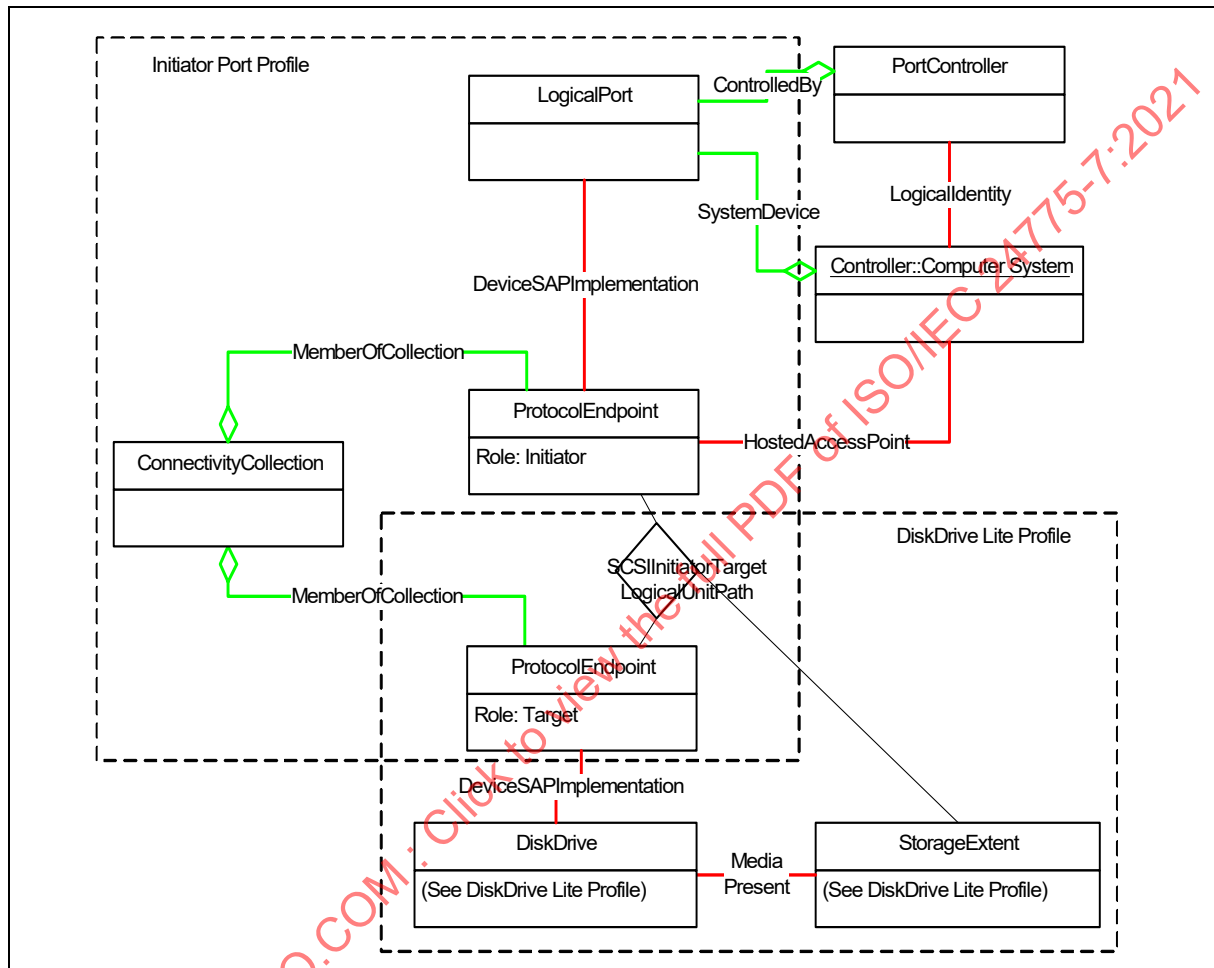


Figure 31 - Initiator Port profiles and Disk Drive Lite Profile

8.3.13.2 CIM_LogicalPort

CIM_LogicalPort represents the logical transport port on the back-end of the controller that is connected to the storage. This storage could be a drive cage housed inside the host or a storage device enclosure, like a JBOD. The LogicalPort class is intended to model the transport for storage commands in an abstract and agnostic manner. For example, the LogicalPort could represent a SCSI, SAS, ATA, or FC port depending on the controller implementation. Thus, the instance of this class shall be sub-classed to SPIPort, SASPort, FCPort or ATAPort depending on the subclass that best represents the transport type the controller supports for the backend port. The implementation shall not instantiate LogicalPort.

8.3.13.3 CIM_ProtocolEndpoint

The ProtocolEndpoint class represents the command set used between the controller and storage where the storage protocol is transmitted.

Overview

Like LogicalPort, the ProtocolEndpoint class is intended to model the storage protocol in an abstract manner. For example, the ProtocolEndpoint could represent a SCSI or ATA protocol. Thus, the instance of the ProtocolEndpoint shall be subclassed to SCSIProtocolEndpoint or ATAProtocolEndpoint.

8.3.14 Models for Imported Storage

8.3.14.1 Overview

In most cases, the storage imported by a Host Hardware Storage Controller is disk drives. It is possible that storage could be imported from another storage system (such as an Array) or non-disk devices (such as tape or optical media drives) could be attached to the RAID controller and passed through to the host.

8.3.14.2 Disks modeled with the Disk Drive Lite Profile

Individual disks are modeled using the Disk Drive Lite Profile (see *Storage Management Technical Specification, Part 4 Block Devices, 1.8.0 Rev 4 10 Disk Drive Lite Profile*). The model for imported disks is illustrated in Figure 32.

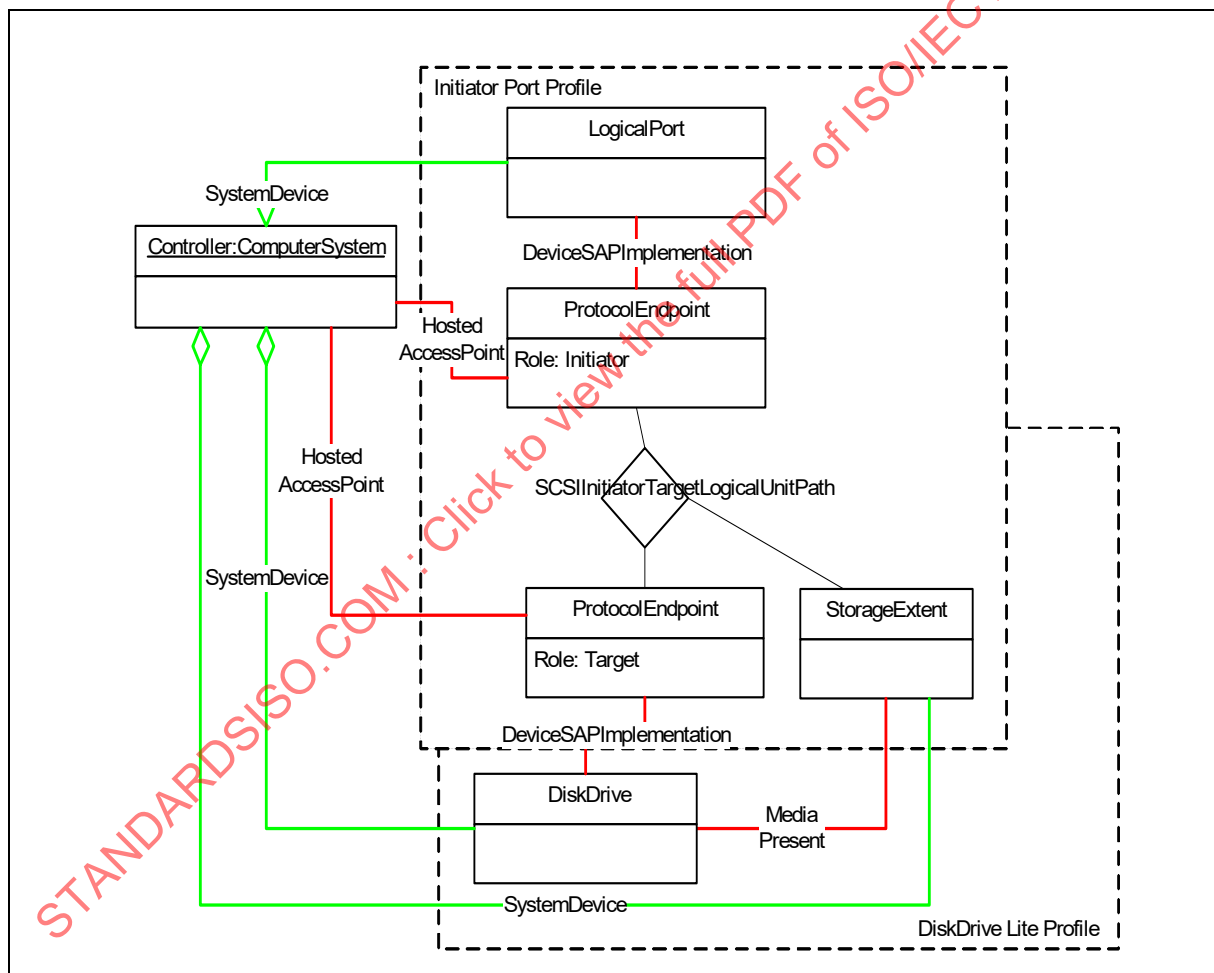


Figure 32 - Model for Imported Disks

To model one disk drive:

- The StorageExtent instance defined in Disk Drive Lite serves as the LogicalDevice defined in the initiator ports profiles

Virtual Volumes/Disks

- The initiator and target ProtocolEndpoint instances (and appropriate associations) defined in the Disk Drive Lite Profile also serve as their equivalents in the Initiator Ports Profiles.

8.3.14.3 Virtual Volumes/Disks

Some host-based RAID controllers may be connected to another system that creates virtual volumes, such as a RAID Array. In this case, the implementation should model the storage from the array using a specialization of the Generic Initiator Port Profile and instantiating instances of StorageExtent to represent the imported volumes. Figure 33 shows this model.

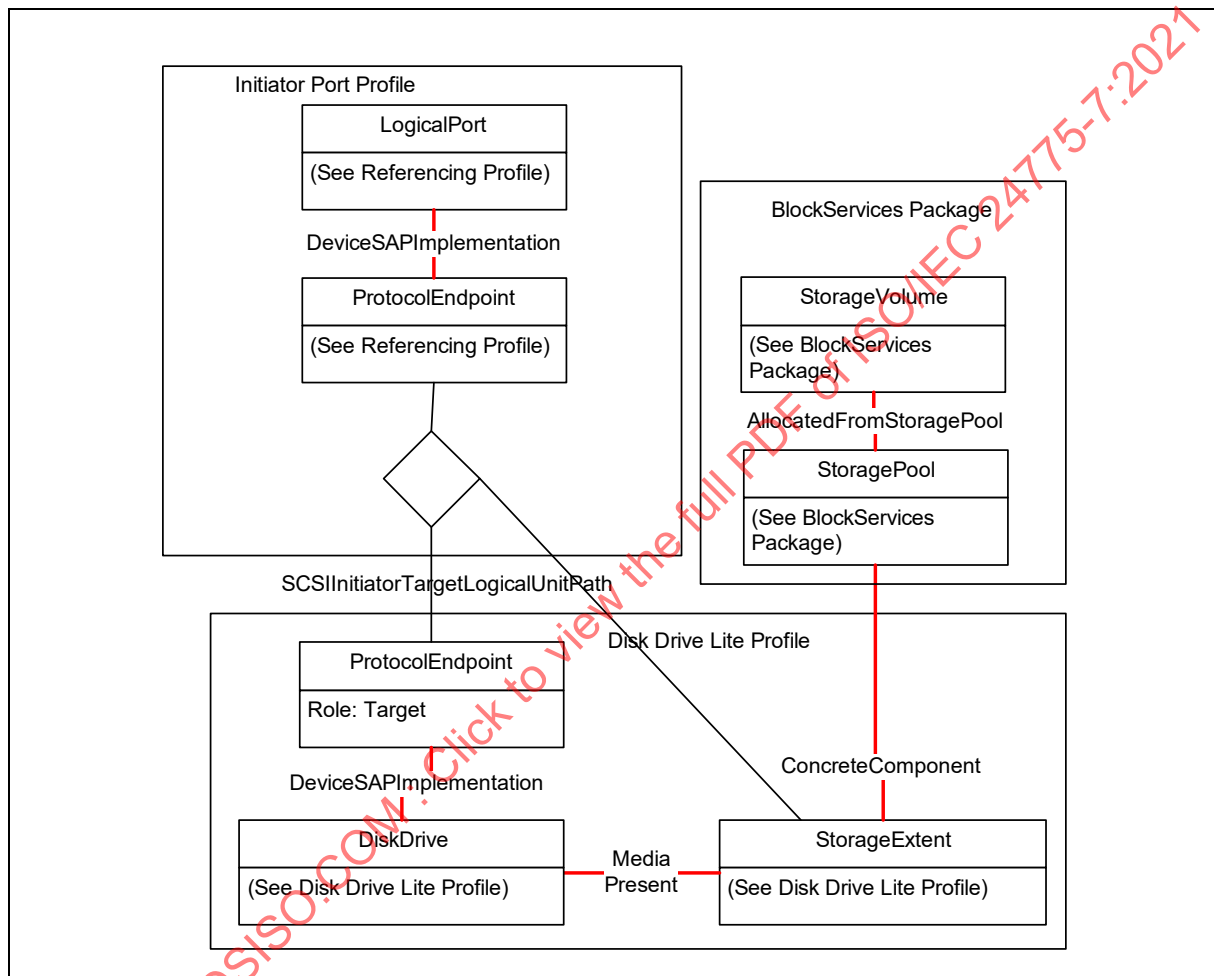


Figure 33 - Imported Virtual Volumes

8.3.14.4 Non-block Devices “Passed Through” with no Block Virtualization

A RAID controller may support attaching non-disk devices (tape or optical drives) and providing support to “pass through” these devices with no additional block virtualization. An instance of a LogicalDevice subclass (such as MediaAccessDevice) models these devices. Since these devices are exposed to the

Non-block Devices “Passed Through” with no Block Virtualization

host OS, this LogicalDevice is associated to the SCSIProtocolController (see 8.3.11 Implementation of DAPort and SCSIProtocolController). Figure 34 shows this model.

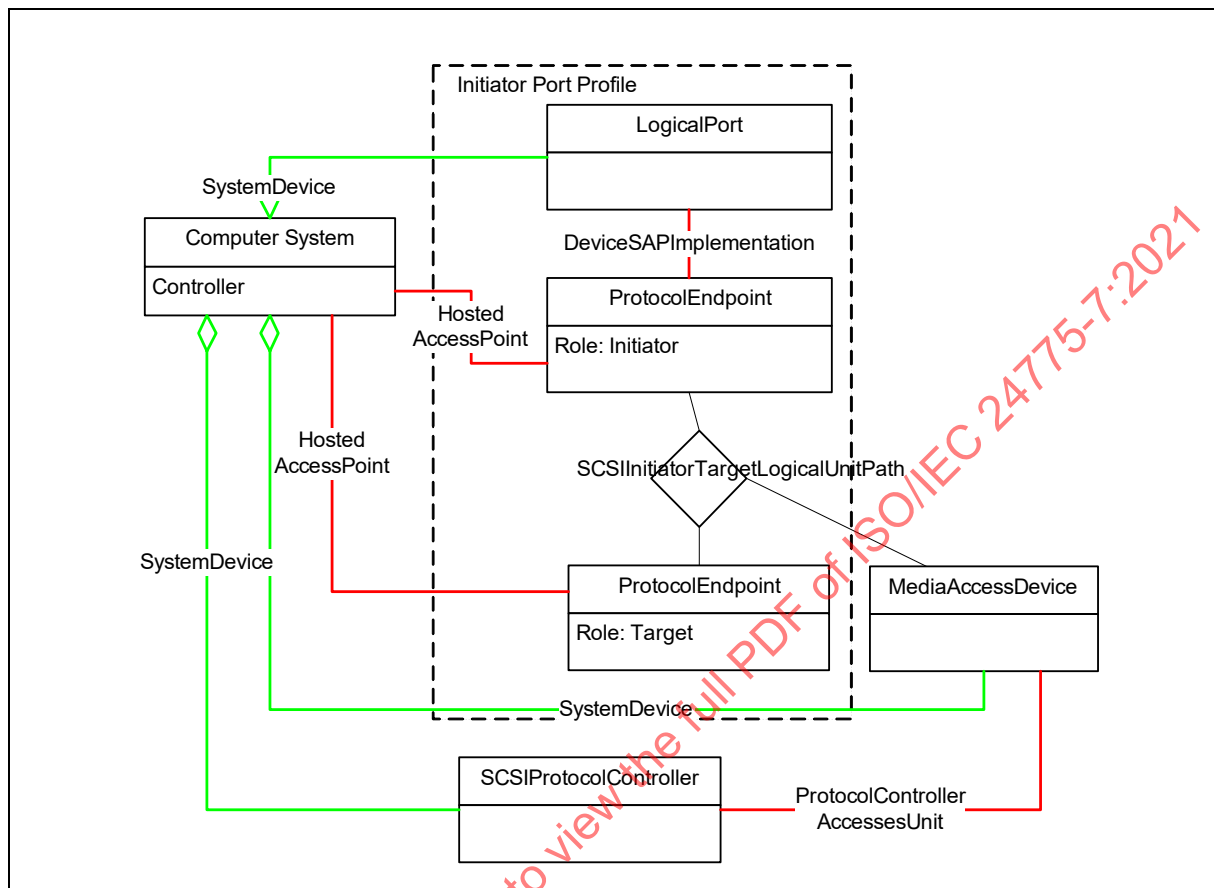


Figure 34 - Device “Pass Through” Example

8.3.15 Implementation of Extent Composition Profile

The Extent Composition Profile allows a Host Hardware RAID Controller Profile to expose the underlying storage composition of StoragePools and StorageVolumes. Composition of a StoragePool or StorageVolume is expressed through the use of StorageExtents associated to StoragePools and StorageExtents arranged in a hierarchical fashion.

For Host Hardware RAID Controller Profile, the use of the Extent Composition Profile is optional. However, the expectation is that most implementations will implement the Extent Composition Profile.

8.3.16 Disk Sparing

Many host-based RAID controllers have the ability to provide on-line, reserved storage components used to replace failed storage components. In the Host Hardware RAID Controller Profile, this behavior is modeled using the Disk Sparing Profile. If a controller supports on-line disk spares, then the implementation shall conditionally model this behavior using the Disk Sparing Profile.

Determination: At least one member of the primordial StorageExtents shall be associated to an instance of StorageRedundancySet. In turn, at least one or more of the StorageExtents that comprise a StoragePool or StorageVolume shall be associated to the same StorageRedundancySet.

8.3.17 Multi-function controllers

Many host-based RAID controllers support both RAID and non-RAID functionality on separate ports within the same controller card. If a controller supports multi-functional ports then the implementation shall conditionally model this behavior using multiple primordial storage pools. See Figure 35.

Determination: Each primordial storage pool shall represent a set of RAID or non-RAID storage attached to the RAID or non-RAID port. The CIM_StorageCapabilities class associated to the primordial storage pool shall signify which pools have RAID capabilities and which do not. The following CIM_StorageCapabilities properties and values shall be used to signify non-RAID primordial storage pool:

- PackageRedundancy(Min/Max/Default) = 0
- DataRedundancy(Min/Max/Default) = 1
- ExtentStripeLengthDefault = 1
- UserDataStripeDepthDefault = null
- ParityLayoutDefault = nul

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Non-block Devices “Passed Through” with no Block Virtualization

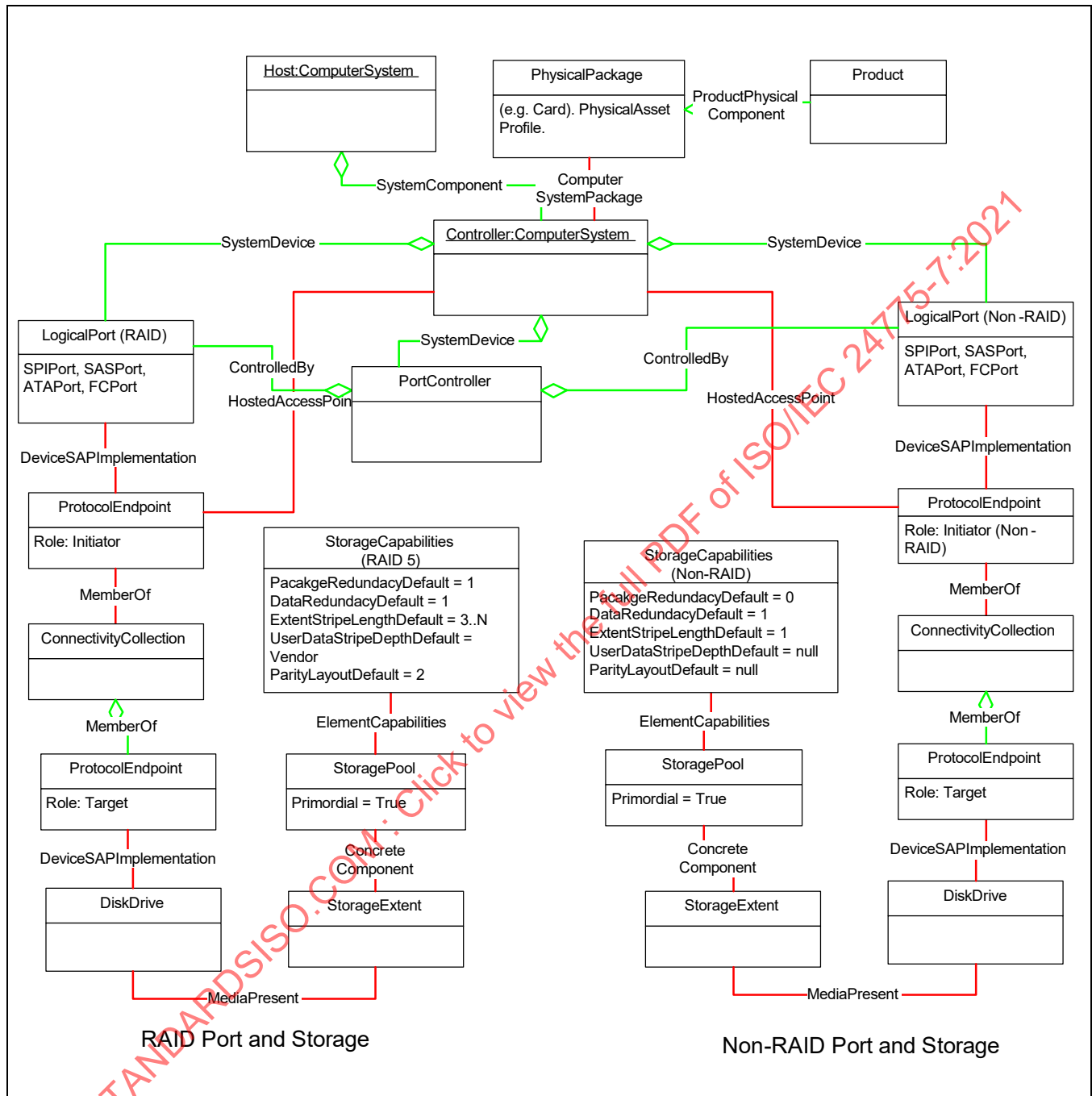


Figure 35 - Example of Multi-Function Controllers

8.3.18 Health and Fault Management Consideration

Not defined in this document.

8.3.19 Cascading Considerations

Not defined in this document.

8.4 Methods

8.4.1 Extrinsic Methods of the Profile

8.4.1.1 AlarmDevice.SetAlarmIndicator

This method is used to enable/disable the audible or visual alarm indicator for the controller.

8.4.1.2 AlarmDevice.SetAlarmState

This method is used to set the state of the alarm. For the Host Hardware RAID Controller Profile the supported RequestedState parameters are:

- Off: Turns the alarm off for the current event, will alarm again for next event, state will automatically change from "off".
- Alternating: Turns the alarm on and off in an alternating fashion. This may be used to test the alarm.

8.4.2 Intrinsic Methods of this Profile

The profile supports read methods and association traversal. Specifically, the list of intrinsic operations supported are as follows:

- GetInstance
- Associators
- AssociatorNames
- References
- ReferenceNames
- EnumerateInstances
- EnumerateInstanceNames

8.5 Use Cases

No recipes are included in this version of the standard.

8.6 CIM Elements

8.6.1 Overview

Table 49 describes the CIM elements for Host Hardware RAID Controller.

Table 49 - CIM Elements for Host Hardware RAID Controller

Element Name	Requirement	Description
8.6.2 CIM_AlarmDevice	Optional	Represents indicator LEDs.
8.6.3 CIM_AssociatedAlarm	Optional	Associates AlarmDevice and LogicalPort.
8.6.4 CIM_ComputerSystem (Host Hardware RAID Controller)	Mandatory	System that represents the Host Hardware RAID controller. Associated to RegisteredProfile.
8.6.5 CIM_ComputerSystemPackage (Associates PhysicalPackage to ComputerSystem)	Mandatory	Associates controller ComputerSystem and PhysicalPackage from the Physical Asset profile.
8.6.6 CIM_ControlledBy	Mandatory	Associates PortController to LogicalPorts.

AlarmDevice.SetAlarmState

Table 49 - CIM Elements for Host Hardware RAID Controller

Element Name	Requirement	Description
8.6.7 CIM_ElementCapabilities (ImplementationCapabilities to System)	Optional	Associates the conformant Host Hardware RAID Controller ComputerSystem to the CIM_ImplementationCapabilities supported by the implementation.
8.6.8 CIM_ImplementationCapabilities (ImplementationCapabilities)	Optional	The capabilities of the profile implementation.
8.6.9 CIM_LogicalIdentity	Mandatory	Used to associate the ComputerSystem representing the controller with PortController.
8.6.10 CIM_MediaAccessDevice	Mandatory	Represents a tape or optical drive.
8.6.11 CIM_PortController	Mandatory	Serves as a component of the server ComputerSystem and is associated to the controller ComputerSystem.
8.6.12 CIM_Product	Mandatory	Asset information about the RAID controller.
8.6.13 CIM_ProductPhysicalComponent	Mandatory	Associates Product and PhysicalPackage.
8.6.14 CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice)	Mandatory	Associates SCSIProtocolController to StorageExtent or MediaAccessDevice.
8.6.15 CIM_ProtocolControllerForUnit (Volume)	Mandatory	Associated ProtocolController to StorageVolume.
8.6.16 CIM_Realizes (Associates PhysicalPackage to PortController)	Mandatory	Associates PortController and PhysicalPackage from the Physical Asset profile.
8.6.17 CIM_SAPAvailableForElement	Mandatory	Associates SCSIProtocolController to the DAPort ProtocolEndpoint.
8.6.18 CIM_SCSIProtocolController	Mandatory	Represents the target/device aspects of storage exported by the RAID controller.
8.6.19 CIM_SoftwareIdentity (Driver)	Mandatory	Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes Driver.
8.6.20 CIM_SoftwareIdentity (FCode/BIOS)	Optional	Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes FCODE/BIOS.
8.6.21 CIM_SoftwareIdentity (Firmware)	Optional	Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes Firmware.
8.6.22 CIM_StorageExtent	Optional	Models an imported volume from an external array.
8.6.23 CIM_SystemComponent	Mandatory	Associates ComputerSystems representing the hosting system and the RAID controller.
8.6.24 CIM_SystemDevice (Associates System to AlarmDevice)	Optional	Associates System to AlarmDevice.
8.6.25 CIM_SystemDevice (Associates controller system to PortController)	Mandatory	Associates controller system to PortController.
8.6.26 CIM_SystemDevice (System to SCSIProtocolController)	Mandatory	Links SCSIProtocolController to the controller system.
8.6.27 CIM_ElementSoftwareIdentity (Driver)	Mandatory	Associates the CIM_ComputerSystem for the RAID Controller and SoftwareIdentity Driver instance.
8.6.28 CIM_ElementSoftwareIdentity (Firmware or FCode/BIOS)	Optional	Associates the CIM_ComputerSystem for the RAID Controller and SoftwareIdentity Firmware or FCode/BIOS instance.

AlarmDevice.SetAlarmState

Table 49 - CIM Elements for Host Hardware RAID Controller

Element Name	Requirement	Description
SELECT * FROM CIM_InstCreation WHERE SourceInstance ISA CIM_ComputerSystem	Mandatory	Addition of a new Host Hardware RAID controller instance.
SELECT * FROM CIM_InstDeletion WHERE SourceInstance ISA CIM_ComputerSystem	Mandatory	Deletion of an Host Hardware RAID controller instance.

8.6.2 CIM_AlarmDevice

Represents indicator LEDs.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 50 describes class CIM_AlarmDevice.

Table 50 - SMI Referenced Properties/Methods for CIM_AlarmDevice

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
VisibleAlarm		Mandatory	
AudibleAlarm		Mandatory	
Urgency		Mandatory	
SetAlarmState()		Mandatory	
SetAlarmIndicator()		Mandatory	

8.6.3 CIM_AssociatedAlarm

Associates AlarmDevice and LogicalPort.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 51 describes class CIM_AssociatedAlarm.

Table 51 - SMI Referenced Properties/Methods for CIM_AssociatedAlarm

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to an AlarmDevice
Dependent		Mandatory	Reference to a LogicalPort

AlarmDevice.SetAlarmState

8.6.4 CIM_ComputerSystem (Host Hardware RAID Controller)

System that represents the Host Hardware RAID controller.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Shall be associated to RegisteredProfile using ElementConformsToProfile association. The RegisteredProfile instance shall have RegisteredName set to 'Host Hardware RAID Controller', RegisteredOrganization set to 'SNIA', and RegisteredVersion set to '1.7.0'.

Table 52 describes class CIM_ComputerSystem (Host Hardware RAID Controller).

Table 52 - SMI Referenced Properties/Methods for CIM_ComputerSystem (Host Hardware RAID Controller)

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
Name		Mandatory	Identifier for the Host Hardware RAID Controller.
NameFormat		Mandatory	Format for Name property. Shall be 'HID' for a hardware ID or 'Other'.
ElementName		Mandatory	User friendly name.
Dedicated		Mandatory	Shall include 30 (Host-Based RAID controller).
PrimaryOwnerContact	M	Optional	Contact a details for owner.
PrimaryOwnerName	M	Optional	Owner of the Host Hardware RAID.

8.6.5 CIM_ComputerSystemPackage (Associates PhysicalPackage to ComputerSystem)

Associates controller ComputerSystem and PhysicalPackage from the Physical Asset profile. Overrides the definition in the PhysicalAsset profile to clarify that this association references the controller and not the hosting ComputerSystem.

Requirement: Mandatory

Table 53 describes class CIM_ComputerSystemPackage (Associates PhysicalPackage to ComputerSystem).

**Table 53 - SMI Referenced Properties/Methods for CIM_ComputerSystemPackage (Associates Physical-
Package to ComputerSystem)**

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to ComputerSystem with Dedicated=30 (Host-based RAID controller).
Antecedent		Mandatory	

8.6.6 CIM_ControlledBy

Associates PortController to LogicalPorts.

Created By: Static

AlarmDevice.SetAlarmState

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 54 describes class CIM_ControlledBy.

Table 54 - SMI Referenced Properties/Methods for CIM_ControlledBy

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to LogicalPort.
Antecedent		Mandatory	Reference to PortController.

8.6.7 CIM_ElementCapabilities (ImplementationCapabilities to System)

Associates the conformant Host Hardware RAID Controller ComputerSystem to the CIM_ImplementationCapabilities supported by the implementation.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 55 describes class CIM_ElementCapabilities (ImplementationCapabilities to System).

Table 55 - SMI Referenced Properties/Methods for CIM_ElementCapabilities (ImplementationCapabilities to System)

Properties	Flags	Requirement	Description & Notes
Capabilities		Mandatory	The ImplementationCapabilities.
ManagedElement		Mandatory	The conformant Host Hardware RAID Controller ComputerSystem that has ImplementationCapabilities.

8.6.8 CIM_ImplementationCapabilities (ImplementationCapabilities)

The capabilities (features) of the profile implementation.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

AlarmDevice.SetAlarmState

Table 56 describes class CIM_ImplementationCapabilities (ImplementationCapabilities).

Table 56 - SMI Referenced Properties/Methods for CIM_ImplementationCapabilities (ImplementationCapabilities)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	An opaque, unique id for the implementation capability of an implementation.
ElementName		Optional	A provider supplied user-friendly name for this CIM_ImplementationCapabilities element.
SupportedCapacityOptimizations		Mandatory	This array of strings lists the capacity optimization techniques that are supported by the implementation. Valid string values are "none" "SNIA:Thin Provisioning" "SNIA:Data Compression" "SNIA:Data Deduplication".
SupportedViews		Mandatory	This array of strings lists the view classes that are supported by the implementation. Valid string values are "none" "SNIA:VolumeView" "SNIA:DiskDriveView" "SNIA:StoragePoolView" "SNIA:ReplicaPairView".

8.6.9 CIM_LogicalIdentity

Associates the ComputerSystem representing the controller and the PortController.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 57 describes class CIM_LogicalIdentity

Table 57 - SMI Referenced Properties/Methods for CIM_LogicalIdentity

Properties	Flags	Requirement	Description & Notes
SameElement		Mandatory	Reference to the ComputerSystem representing the controller.
SystemElement		Mandatory	Reference to the PortController.

8.6.10 CIM_MediaAccessDevice

Represents a tape or optical drive.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

AlarmDevice.SetAlarmState

Table 58 describes class CIM_MediaAccessDevice.

Table 58 - SMI Referenced Properties/Methods for CIM_MediaAccessDevice

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
Name		Mandatory	
OperationalStatus		Mandatory	Shall be 2 5 6 8 10 11 (Okay or Predictive Failure or Error or Starting or Stopping or Stopped).
LocationIndicator		Optional	

8.6.11 CIM_PortController

Serves as a component of the server ComputerSystem and is associated to the controller ComputerSystem.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 59 describes class CIM_PortController.

Table 59 - SMI Referenced Properties/Methods for CIM_PortController

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
ControllerType		Mandatory	Shall be 1 or 4 (Other or FC).
OtherControllerType		Conditional	Conditional requirement: For non-FC, PortController.OtherControllerType is mandatory. Shall be SPI or SAS or ATA or SAS/SATA.

8.6.12 CIM_Product

Asset information about the RAID controller.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

AlarmDevice.SetAlarmState

Table 60 describes class CIM_Product.

Table 60 - SMI Referenced Properties/Methods for CIM_Product

Properties	Flags	Requirement	Description & Notes
Name		Mandatory	Shall have the same value as PhysicalPackage.Model.
IdentifyingNumber		Mandatory	Shall have the same value as PhysicalPackage.SerialNumber.
Vendor		Mandatory	Shall have the same value as PhysicalPackage.Manufacturer.
Version		Mandatory	Shall have the same value as PhysicalPackage.Version. Represents a version for the physical element.
ElementName		Mandatory	

8.6.13 CIM_ProductPhysicalComponent

Associates Product and PhysicalPackage.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 61 describes class CIM_ProductPhysicalComponent.

Table 61 - SMI Referenced Properties/Methods for CIM_ProductPhysicalComponent

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to a Product
PartComponent		Mandatory	Reference to a PhysicalPackage

8.6.14 CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice)

Associates SCSIProtocolController to StorageExtent or MediaAccessDevice.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 62 describes class CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice).

Table 62 - SMI Referenced Properties/Methods for CIM_ProtocolControllerForUnit (Extent or MediaAccess-Device)

Properties	Flags	Requirement	Description & Notes
DeviceNumber		Mandatory	Logical Unit Number of the associated Device. Shall be formatted as unseparated uppercase hexadecimal digits, with no leading 0x.
DeviceAccess		Optional	The access rights granted to the referenced logical unit as exposed through referenced ProtocolController.

AlarmDevice.SetAlarmState

Table 62 - SMI Referenced Properties/Methods for CIM_ProtocolControllerForUnit (Extent or MediaAccessDevice)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to a SCSIProtocolController.
Dependent		Mandatory	Reference to a StorageExtent or MediaAccessDevice.

8.6.15 CIM_ProtocolControllerForUnit (Volume)

Associated ProtocolController to StorageVolume.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 63 describes class CIM_ProtocolControllerForUnit (Volume).

Table 63 - SMI Referenced Properties/Methods for CIM_ProtocolControllerForUnit (Volume)

Properties	Flags	Requirement	Description & Notes
DeviceNumber		Mandatory	Address (e.g., LUN) of the associated Device. Shall be formatted as unseparated uppercase hexadecimal digits, with no leading 0x.
DeviceAccess		Optional	The access rights granted to the referenced logical unit as exposed through referenced ProtocolController.
Antecedent		Mandatory	
Dependent		Mandatory	Reference to a StorageVolume.

8.6.16 CIM_Realizes (Associates PhysicalPackage to PortController)

Associates PortController and PhysicalPackage from the Physical Asset profile.

Requirement: Mandatory

Table 64 describes class CIM_Realizes (Associates PhysicalPackage to PortController).

Table 64 - SMI Referenced Properties/Methods for CIM_Realizes (Associates PhysicalPackage to PortController)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a PortController.
Antecedent		Mandatory	Reference to a PhysicalPackage.

8.6.17 CIM_SAPAvailableForElement

Associates SCSIProtocolController to the DAPort ProtocolEndpoint.

Created By: Static

Modified By: Static

Deleted By: Static

AlarmDevice.SetAlarmState

Requirement: Mandatory

Table 65 describes class CIM_SAPAvailableForElement.

Table 65 - SMI Referenced Properties/Methods for CIM_SAPAvailableForElement

Properties	Flags	Requirement	Description & Notes
ManagedElement		Mandatory	Reference to a SCSIProtocolController.
AvailableSAP		Mandatory	Reference to a SCSIProtocolEndpoint.

8.6.18 CIM_SCSIProtocolController

Represents the target/device aspects of storage exported by the RAID controller.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 66 describes class CIM_SCSIProtocolController.

Table 66 - SMI Referenced Properties/Methods for CIM_SCSIProtocolController

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	

8.6.19 CIM_SoftwareIdentity (Driver)

Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes Driver.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 67 describes class CIM_SoftwareIdentity (Driver).

Table 67 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Driver)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Key.
Classifications		Mandatory	Shall include 2 (Driver).

AlarmDevice.SetAlarmState

8.6.20 CIM_SoftwareIdentity (FCode/BIOS)

Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes FCODE/BIOS.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 68 describes class CIM_SoftwareIdentity (FCode/BIOS).

Table 68 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (FCode/BIOS)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Key.
Classifications		Mandatory	Shall include 11 (FCode/BIOS).

8.6.21 CIM_SoftwareIdentity (Firmware)

Override SoftwareIdentity from Software Inventory profile to assure Classifications property includes Firmware.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 69 describes class CIM_SoftwareIdentity (Firmware).

Table 69 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Firmware)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Key.
Classifications		Mandatory	Shall include 10 (Firmware).

8.6.22 CIM_StorageExtent

Created By: External

Modified By: External

Deleted By: External

Requirement: Optional

Table 70 describes class CIM_StorageExtent.

Table 70 - SMI Referenced Properties/Methods for CIM_StorageExtent

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	

AlarmDevice.SetAlarmState

Table 70 - SMI Referenced Properties/Methods for CIM_StorageExtent

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
DeviceID		Mandatory	
BlockSize		Mandatory	
NumberOfBlocks		Mandatory	The number of blocks as reported by the hardware.
ConsumableBlocks		Mandatory	The number of usable blocks.
Primordial		Mandatory	Shall be true.
OperationalStatus		Mandatory	

8.6.23 CIM_SystemComponent

Associates ComputerSystems representing the hosting system and the RAID controller.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 71 describes class CIM_SystemComponent.

Table 71 - SMI Referenced Properties/Methods for CIM_SystemComponent

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	ComputerSystem with Dedicated=0 (Not Dedicated) hosting controllers.
PartComponent		Mandatory	ComputerSystem with Dedicated=30 (Host-based RAID controller) representing a controller.

8.6.24 CIM_SystemDevice (Associates System to AlarmDevice)

Associates System to AlarmDevice.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 72 describes class CIM_SystemDevice (Associates System to AlarmDevice).

Table 72 - SMI Referenced Properties/Methods for CIM_SystemDevice (Associates System to AlarmDevice)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to ComputerSystem with Dedicated=30 (Host-based RAID controller).
PartComponent		Mandatory	

AlarmDevice.SetAlarmState

8.6.25 CIM_SystemDevice (Associates controller system to PortController)

Associates controller system to PortController.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 73 describes class CIM_SystemDevice (Associates controller system to PortController).

Table 73 - SMI Referenced Properties/Methods for CIM_SystemDevice (Associates controller system to PortController)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to ComputerSystem with Dedicated = 30 (Host-based RAID controller).
PartComponent		Mandatory	

8.6.26 CIM_SystemDevice (System to SCSIProtocolController)

Links SCSIProtocolController to the controller system.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 74 describes class CIM_SystemDevice (System to SCSIProtocolController).

Table 74 - SMI Referenced Properties/Methods for CIM_SystemDevice (System to SCSIProtocolController)

Properties	Flags	Requirement	Description & Notes
PartComponent		Mandatory	
GroupComponent		Mandatory	Reference to ComputerSystem with Dedicated = 30 (Host-based RAID controller).

8.6.27 CIM_ElementSoftwareIdentity (Driver)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 75 describes class CIM_ElementSoftwareIdentity (Driver).

AlarmDevice.SetAlarmState

Table 75 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Driver)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to the Driver SoftwareIdentity.
Dependent		Mandatory	Reference to the Host Hardware RAID Controller Computer System.

8.6.28 CIM_ElementSoftwareIdentity (Firmware or FCode/BIOS)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 76 describes class CIM_ElementSoftwareIdentity (Firmware or FCode/BIOS).

Table 76 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Firmware or FCode/BIOS)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to a Firmware or FCode/BIOS SoftwareIdentity.
Dependent		Mandatory	Reference to the Host Hardware RAID Controller Computer System.

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AlarmDevice.SetAlarmState

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9 iSCSI Initiator Profile

9.1 Description

9.1.1 Synopsis

Profile Name: iSCSI Initiator (Autonomous Profile)

Version: 1.1.0

Organization: SNIA

Central Class: CIM_ComputerSystem

Scoping Class: CIM_ComputerSystem

Related Profiles: Table 77 describes the supported profiles for iSCSI Initiator.

Table 77 - Supported Profiles for iSCSI Initiator

Profile Name	Organization	Version	Requirement	Description
iSCSI Initiator Ports	SNIA	1.7.0	Optional	
LaunchInContext	SNIA	1.0.0	Optional	

9.1.2 Overview

An iSCSI initiator is the hardware and driver combination that acts as a client to an iSCSI target device. iSCSI initiators may utilize general –purpose Network Interface Cards (NICs) or hardware optimized for storage such as TCP Offload Engines (TOEs). iSCSI initiators may be running on a customer server or the “back end” of a bridge or virtualizer.

iSCSI terminology, shown in Table 78, spans SCSI and network concepts and introduces new terms. Table 78 is a summary of some key iSCSI terms, their equivalent CIM classes, and definitions (from the IETF iSCSI RFC).

Table 78 - iSCSI Terminology

iSCSI Term	CIM Class Name	Notes
Network Entity	ComputerSystem	The Network Entity represents a device or gateway that is accessible from the IP network. A Network Entity shall have one or more Network Portals, each of which can be used to gain access to the IP network by some iSCSI Nodes contained in that Network Entity.
Session	iSCSISession	The group of TCP connections that link an initiator with a target form a session (loosely equivalent to a SCSI I-T nexus). TCP connections can be added and removed from a session. Across all connections within a session, an initiator sees one and the same target.
Connection	iSCSIConnection	A connection is a TCP connection. Communication between the initiator and target occurs over one or more TCP connections. The TCP connections carry control messages, SCSI commands, parameters, and data within iSCSI Protocol Data Units (iSCSI PDUs).
SCSI Port	iSCSIProtocolEndpoint	A SCSI Port using an iSCSI service delivery subsystem. A collection of Network Portals that together act as a SCSI initiator or target.

Table 78 - iSCSI Terminology (Continued)

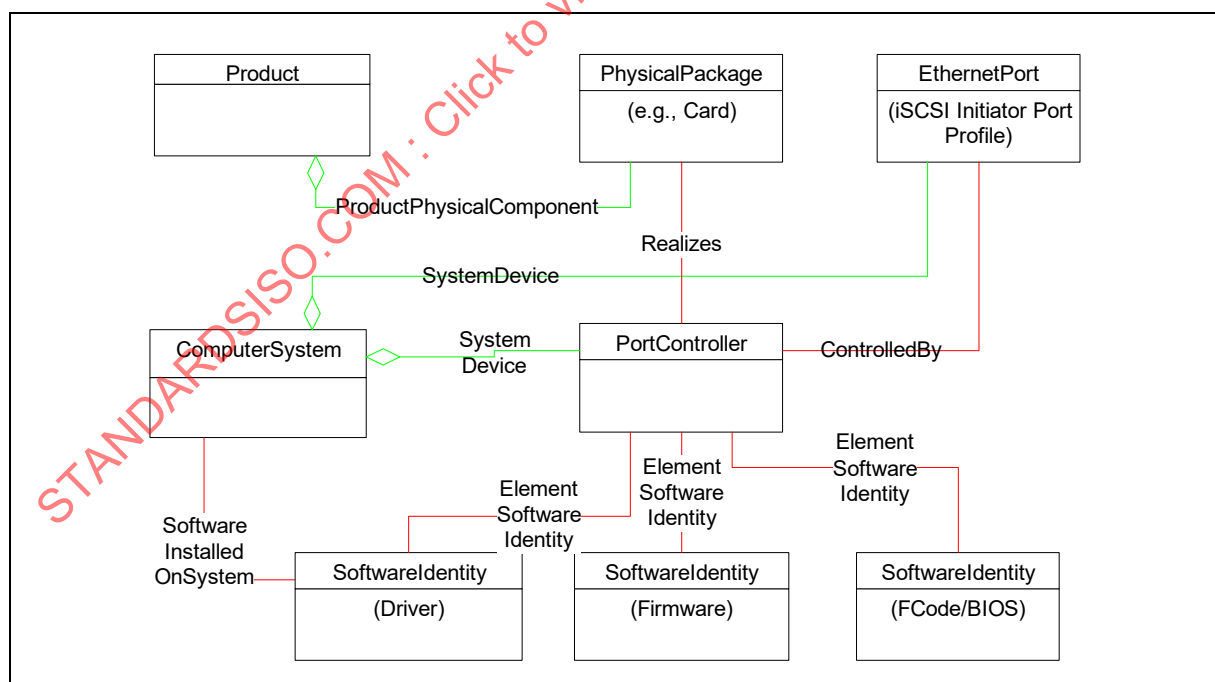
Network Portal	TCPProtocolEndpoint, IPProtocolEndpoint, EthernetPort	The Network Portal is a component of a Network Entity that has a TCP/IP network address and that may be used by an iSCSI Node within that Network Entity for the connection(s) within one of its iSCSI sessions. A Network Portal in an initiator is identified by its IP address. A Network Portal in a target is identified by its IP address and its listening TCP port.
Node	SCSIProtocolController	The iSCSI Node represents a single iSCSI initiator or iSCSI target. There are one or more iSCSI Nodes within a Network Entity. The iSCSI Node is accessible via one or more Network Portals. An iSCSI Node is identified by its iSCSI Name. The separation of the iSCSI Name from the addresses used by and for the iSCSI Node allows multiple iSCSI nodes to use the same address, and the same iSCSI node to use multiple addresses.

This profile requires the iSCSI Initiator Port Profile (see *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4, 15 iSCSI Initiator Port Profile*) that includes classes (EthernetPort, iSCSIProtocolEndpoint) that model SCSI ports and network portals.

Figure 36: "iSCSI Product and Package Model" models the relationships between the iSCSI port classes and physical and product classes. A single iSCSI card may contain multiple Ethernet ports. PhysicalPackage subclass Card models an add-in card with multiple Ethernet ports. Other PhysicalPackage subclasses may be used to model Ethernet ports embedded on a mainboard. PortController models a common management interface to multiple Ethernet ports.

ComputerSystem models the system hosting the initiator components. This is the same instance as iSCSI Network Entity in Figure 36: "iSCSI Product and Package Model".

An implementation includes single instances of PhysicalPackage, Product, and PortController, plus SoftwareIdentity instances for the driver, firmware, and Fcode/BIOS. The Product instance may be shared across cards with the same make and model

**Figure 36 - iSCSI Product and Package Model**

9.1.3 Sessions and Connections

A session is an active communication stream between an iSCSI initiator port and an iSCSI target port. However, any given session may contain part or all of the TCP/IP addresses within a Portal Group. Conceptually, a Portal Group is a pool of addresses which may be used to create/receive a session.

The implementation may optionally model iSCSI sessions and connections with instances of iSCSISession and iSCSIConnection classes associate to iSCSIProtocolEndpoint and TCPProtocolEndpoint (respectively) using EndpointOfNetworkPipe association.

Figure 37 shows the iSCSI Sessions and Connections Model.

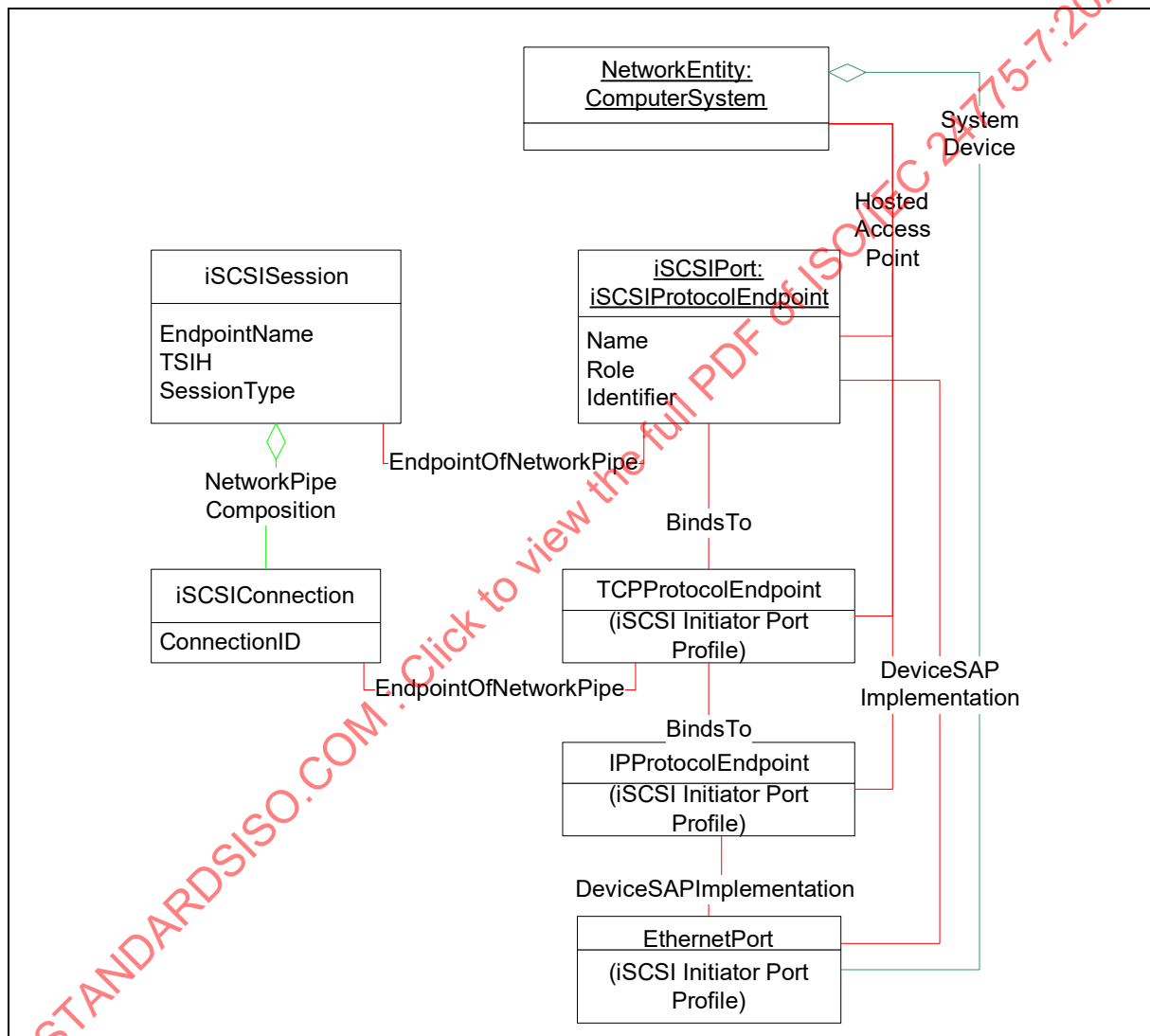


Figure 37 - iSCSI Sessions and Connections Model

There should be a single instance of SCSIProtocolController representing the initiator iSCSI node, shown in Figure 38. This is associated via SystemDevice to the ComputerSystem. See Figure 36: "iSCSI Product and Package Model".

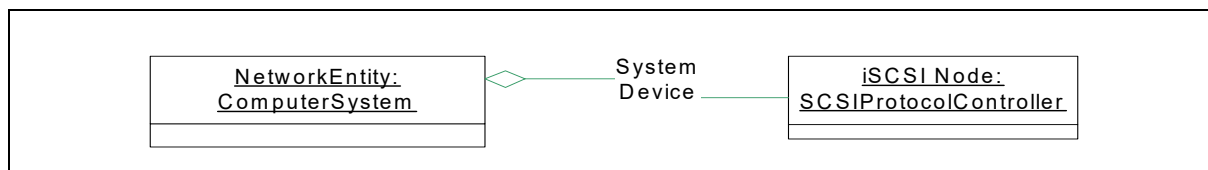


Figure 38 - iSCSI Initiator Node

9.1.4 Durable Names and Correlatable IDs of the Profile

The Name property for the iSCSI node (SCSIProtocolController) shall be a compliant iSCSI name as described in *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4 7.8* and NameFormat shall be set to "iSCSI Name".

The Name property for iSCSIProtocolEndpoint shall be a compliant iSCSI name as described in *Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4 7.8* and ConnectionType shall be set to "iSCSI".

The Name property for EthernetPort shall be a compliant iSCSI name as described in *Storage Management Technical Specification, Part 2 Common Architecture, 1.8.0 Rev 4, 7.8*.

9.2 Health and Fault Management Considerations

The status of an Ethernet port may be determined by the value of the OperationalStatus property. Table 79 defines the possible states that shall be supported for EthernetPort.OperationalStatus. The main OperationalStatus shall be the first element in the array.

Table 79 - OperationalStatus Values

OperationalStatus	Description
OK	Port is online
Error	Port has a failure
Stopped	Port is disabled
InService	Port is in Self Test

9.3 Methods of the Profile

Not defined in this document

9.4 Use Cases

Not defined in this version of the standard.

9.5 CIM Elements

9.5.1 Overview

Table 80 describes the CIM elements for iSCSI Initiator.

Table 80 - CIM Elements for iSCSI Initiator

Element Name	Requirement	Description
9.5.2 CIM_BindsTo (TCPProtocolEndpoint to IPProtocolEndpoint)	Mandatory	
9.5.3 CIM_BindsTo (iSCSIProtocolEndpoint to TCPProtocolEndpoint)	Mandatory	
9.5.4 CIM_ComputerSystem	Mandatory	Associated to RegisteredProfile.
9.5.5 CIM_ControlledBy	Optional	
9.5.6 CIM_DeviceSAPImplementation (EthernetPort to IPProtocolEndpoint)	Optional	
9.5.7 CIM_DeviceSAPImplementation (EthernetPort to iSCSIProtocolEndpoint)	Optional	
9.5.8 CIM_ElementSoftwareIdentity	Mandatory	
9.5.9 CIM_EndpointOfNetworkPipe (Between iSCSI Session and iSCSIProtocolEndpoint)	Mandatory	
9.5.10 CIM_EndpointOfNetworkPipe (Between iSCSI connection and TCPProtocolEndpoint)	Mandatory	
9.5.11 CIM_InstalledSoftwareIdentity	Optional	
9.5.12 CIM_NetworkPipeComposition	Mandatory	
9.5.13 CIM_PhysicalPackage	Mandatory	
9.5.14 CIM_PortController	Optional	
9.5.15 CIM_Product	Mandatory	
9.5.16 CIM_ProductPhysicalComponent	Mandatory	
9.5.17 CIM_Realizes	Mandatory	
9.5.18 CIM_SAPAvailableForElement	Mandatory	
9.5.19 CIM_SCSIProtocolController	Mandatory	
9.5.20 CIM_SoftwareIdentity	Optional	
9.5.21 CIM_SystemDevice (to EthernetPort)	Mandatory	
9.5.22 CIM_SystemDevice (to PortController)	Mandatory	
9.5.23 CIM_SystemDevice (to ProtocolController)	Mandatory	
9.5.24 CIM_iSCSIConnection	Optional	
9.5.25 CIM_iSCSISession	Mandatory	
SELECT * FROM CIM_InstCreation WHERE SourceInstance ISA CIM_PortController	Optional	PortController (HBA) Creation.
SELECT * FROM CIM_InstDeletion WHERE SourceInstance ISA CIM_PorController	Optional	PortController (HBA) Removal.

9.5.2 CIM_BindsTo (TCPProtocolEndpoint to IPProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 81 describes class CIM_BindsTo (TCPProtocolEndpoint to IPProtocolEndpoint).

Table 81 - SMI Referenced Properties/Methods for CIM_BindsTo (TCPProtocolEndpoint to IPProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a TCPProtocolEndpoint
Antecedent		Mandatory	Reference to an IPProtocolEndpoint

9.5.3 CIM_BindsTo (iSCSIProtocolEndpoint to TCPProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 82 describes class CIM_BindsTo (iSCSIProtocolEndpoint to TCPProtocolEndpoint).

Table 82 - SMI Referenced Properties/Methods for CIM_BindsTo (iSCSIProtocolEndpoint to TCPProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to an iSCSIProtocolEndpoint
Antecedent		Mandatory	Reference to a TCPProtocolEndpoint

9.5.4 CIM_ComputerSystem

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Shall be associated to RegisteredProfile using ElementConformsToProfile association. The RegisteredProfile instance shall have RegisteredName set to 'iSCSI Initiator', RegisteredOrganization set to 'SNIA', and RegisteredVersion set to '1.1.0'.

Table 83 describes class CIM_ComputerSystem.

Table 83 - SMI Referenced Properties/Methods for CIM_ComputerSystem

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	
Name		Mandatory	The name of the host containing the iSCSI initiator.

Table 83 - SMI Referenced Properties/Methods for CIM_ComputerSystem

Properties	Flags	Requirement	Description & Notes
ElementName		Mandatory	
NameFormat		Mandatory	
OtherIdentifyingInfo	C	Mandatory	
OperationalStatus		Mandatory	
Dedicated		Mandatory	Shall be "Not Dedicated".
OtherDedicatedDescriptions		Optional	

9.5.5 CIM_ControlledBy

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 84 describes class CIM_ControlledBy.

Table 84 - SMI Referenced Properties/Methods for CIM_ControlledBy

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to an EthernetPort
Antecedent		Mandatory	Reference to a PortController

9.5.6 CIM_DeviceSAPImplementation (EthernetPort to IPProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 85 describes class CIM_DeviceSAPImplementation (EthernetPort to IPProtocolEndpoint).

Table 85 - SMI Referenced Properties/Methods for CIM_DeviceSAPImplementation (EthernetPort to IPProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to an EthernetPort
Dependent		Mandatory	Reference to an IPProtocolEndpoint

9.5.7 CIM_DeviceSAPImplementation (EthernetPort to iSCSIProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 86 describes class CIM_DeviceSAPImplementation (EthernetPort to iSCSIProtocolEndpoint).

Table 86 - SMI Referenced Properties/Methods for CIM_DeviceSAPImplementation (EthernetPort to iSCSIProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to an EthernetPort
Dependent		Mandatory	Reference to an iSCSIProtocolEndpoint

9.5.8 CIM_ElementSoftwareIdentity

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 87 describes class CIM_ElementSoftwareIdentity.

Table 87 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to a SoftwareIdentity
Dependent		Mandatory	Reference to a PortController

9.5.9 CIM_EndpointOfNetworkPipe (Between iSCSI Session and iSCSIProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 88 describes class CIM_EndpointOfNetworkPipe (Between iSCSI Session and iSCSIProtocolEndpoint).

Table 88 - SMI Referenced Properties/Methods for CIM_EndpointOfNetworkPipe (Between iSCSI Session and iSCSIProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to an iSCSIProtocolEndpoint
Dependent		Mandatory	Reference to an iSCSISession

9.5.10 CIM_EndpointOfNetworkPipe (Between iSCSI connection and TCPProtocolEndpoint)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 89 describes class CIM_EndpointOfNetworkPipe (Between iSCSI connection and TCPProtocolEndpoint).

Table 89 - SMI Referenced Properties/Methods for CIM_EndpointOfNetworkPipe (Between iSCSI connection and TCPProtocolEndpoint)

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to an iSCSIConnection
Antecedent		Mandatory	Reference to a TCPProtocolEndpoint

9.5.11 CIM_InstalledSoftwareIdentity

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 90 describes class CIM_InstalledSoftwareIdentity.

Table 90 - SMI Referenced Properties/Methods for CIM_InstalledSoftwareIdentity

Properties	Flags	Requirement	Description & Notes
InstalledSoftware		Mandatory	
System		Mandatory	

9.5.12 CIM_NetworkPipeComposition

Requirement: Mandatory

Table 91 describes class CIM_NetworkPipeComposition.

Table 91 - SMI Referenced Properties/Methods for CIM_NetworkPipeComposition

Properties	Flags	Requirement	Description & Notes
PartComponent		Mandatory	Reference to an iSCSIConnection
GroupComponent		Mandatory	Reference to an iSCSISession

9.5.13 CIM_PhysicalPackage

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 92 describes class CIM_PhysicalPackage.

Table 92 - SMI Referenced Properties/Methods for CIM_PhysicalPackage

Properties	Flags	Requirement	Description & Notes
CreationClassName		Mandatory	Key.
Tag		Mandatory	Key.
Manufacturer		Mandatory	Maps to IMA_PHBA_PROPERTIES.vendor.
Model		Mandatory	Maps to IMA_PHBA_PROPERTIES.model.

9.5.14 CIM_PortController

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 93 describes class CIM_PortController.

Table 93 - SMI Referenced Properties/Methods for CIM_PortController

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
ControllerType		Mandatory	

9.5.15 CIM_Product

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 94 describes class CIM_Product.

Table 94 - SMI Referenced Properties/Methods for CIM_Product

Properties	Flags	Requirement	Description & Notes
ElementName		Mandatory	
Name		Mandatory	
IdentifyingNumber		Mandatory	Maps to IMA_PHBA_PROPERTIES, serialNumber.
Vendor		Mandatory	Maps to IMA_PHBA_PROPERTIES, vendor.
Version		Mandatory	Maps to IMA_PHBA_PROPERTIES, hardwareVersion.

9.5.16 CIM_ProductPhysicalComponent

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 95 describes class CIM_ProductPhysicalComponent.

Table 95 - SMI Referenced Properties/Methods for CIM_ProductPhysicalComponent

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to a Product.
PartComponent		Mandatory	PhysicalPackage.

9.5.17 CIM_Realizes

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 96 describes class CIM_Realizes.

Table 96 - SMI Referenced Properties/Methods for CIM_Realizes

Properties	Flags	Requirement	Description & Notes
Dependent		Mandatory	Reference to a PortController.
Antecedent		Mandatory	Reference to a PhysicalPackage.

9.5.18 CIM_SAPAvailableForElement

Requirement: Mandatory

Table 97 describes class CIM_SAPAvailableForElement.

Table 97 - SMI Referenced Properties/Methods for CIM_SAPAvailableForElement

Properties	Flags	Requirement	Description & Notes
AvailableSAP		Mandatory	Reference to an iSCSIProtocolEndpoint.
ManagedElement		Mandatory	Reference to a SCSIProtocolController.

9.5.19 CIM_SCSIProtocolController

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 98 describes class CIM_SCSIProtocolController.

Table 98 - SMI Referenced Properties/Methods for CIM_SCSIProtocolController

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	
SystemName		Mandatory	
CreationClassName		Mandatory	
DeviceID		Mandatory	
ElementName		Mandatory	iSCSI Alias.
Name	CD	Mandatory	Maps to IMA_NODE_PROPERTIES.name.
NameFormat		Mandatory	

9.5.20 CIM_SoftwareIdentity

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 99 describes class CIM_SoftwareIdentity.

Table 99 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	
VersionString		Mandatory	Maps to IMA_PHBA_PROPERTIES, driverVersion/firmwareVersion/optionRomVersion as per the Classifications property.
Manufacturer		Mandatory	Maps to IMA_PHBA_PROPERTIES.vendor.
Classifications		Mandatory	Either 'Driver', 'Firmware', or 'BIOS/FCode' (2, 10, or 11).

9.5.21 CIM_SystemDevice (to EthernetPort)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 100 describes class CIM_SystemDevice (to EthernetPort).

Table 100 - SMI Referenced Properties/Methods for CIM_SystemDevice (to EthernetPort)

Properties	Flags	Requirement	Description & Notes
PartComponent		Mandatory	
GroupComponent		Mandatory	

9.5.22 CIM_SystemDevice (to PortController)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 101 describes class CIM_SystemDevice (to PortController).

Table 101 - SMI Referenced Properties/Methods for CIM_SystemDevice (to PortController)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	
PartComponent		Mandatory	

9.5.23 CIM_SystemDevice (to ProtocolController)

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 102 describes class CIM_SystemDevice (to ProtocolController).

Table 102 - SMI Referenced Properties/Methods for CIM_SystemDevice (to ProtocolController)

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	
PartComponent		Mandatory	

9.5.24 CIM_iSCSIConnection

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Optional

Table 103 describes class CIM_iSCSIConnection.

Table 103 - SMI Referenced Properties/Methods for CIM_iSCSIConnection

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	
ConnectionID		Mandatory	
MaxReceiveDataSegmentLength		Mandatory	Maps to IMA_GetMaxRecvDataSegmentLengthProperties, IMA_SetMaxRecvDataSegmentLength.
MaxTransmitDataSegmentLength		Mandatory	

Table 103 - SMI Referenced Properties/Methods for CIM_iSCSIConnection

Properties	Flags	Requirement	Description & Notes
HeaderDigestMethod		Mandatory	
OtherHeaderDigestMethod		Optional	
DataDigestMethod		Mandatory	
OtherDataDigestMethod		Optional	
ReceivingMarkers		Mandatory	
SendingMarkers		Mandatory	
ActiveiSCSIVersion		Mandatory	
AuthenticationMethodUsed		Mandatory	Maps to IMA_GetInUseInitiatorAuthMethods.
MutualAuthentication		Mandatory	

9.5.25 CIM_iSCSISession

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 104 describes class CIM_iSCSI_Session.

Table 104 - SMI Referenced Properties/Methods for CIM_iSCSI_Session

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	
Directionality		Mandatory	
SessionType		Mandatory	
TSIH		Mandatory	
EndPointName		Mandatory	Maps to IMA_TARGET_PROPERTIES, name.
CurrentConnections		Mandatory	
InitialR2T		Mandatory	Maps to IMA_GetInitialR2TProperties, IMA_SetInitialR2T.
ImmediateData		Mandatory	Maps to IMA_GetImmediateDataProperties, IMA_SetImmediateData.
MaxOutstandingR2T		Mandatory	Maps to IMA_GetMaxOutstandingR2TProperties, IMA_SetMaxOutstandingR2T.
MaxUnsolicitedFirstDataBurstLength		Mandatory	Maps to IMA_GetMaxFirstBurstLengthProperties, IMA_SetMaxFirstBurstLength.
MaxDataBurstLength		Mandatory	Maps to IMA_GetMaxBurstLengthProperties, IMA_SetMaxBurstLength.
DataSequenceInOrder		Mandatory	Maps to IMA_GetDataSequenceInOrderProperties, IMA_SetDataSequenceInOrder.
DataPDUInOrder		Mandatory	Maps to IMA_GetDataPDUInOrderProperties, IMA_SetDataPDUInOrder.
ErrorRecoveryLevel		Mandatory	Maps to IMA_GetErrorRecoveryLevelProperties, IMA_SetErrorRecoveryLevel.
MaxConnectionsPerSession		Mandatory	Maps to IMA_GetMaxConnectionsProperties, IMA_SetMaxConnections.
DefaultTimeToWait		Mandatory	Maps to IMA_GetDefaultTime2WaitProperties, IMA_SetDefaultTime2Wait.
DefaultTimeToRetain		Mandatory	Maps to IMA_GetDefaultTime2RetainProperties, IMA_SetDefaultTime2Retain.

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10 SCSI Multipath Management Profile

10.1 Description

10.1.1 Synopsis

Profile Name: SCSI Multipath Management (Component Profile)

Version: 1.6.0

Organization: SNIA

Central Class: SCSIPathConfigurationService

Scoping Class: Base Server ComputerSystem

Related Profiles: Not defined in this document:

10.1.2 Overview

Multipath access to SCSI devices is handled in a similar way on many operating systems. As viewed from host adapters, each combination of host adapter (initiator) port, target device port, and logical unit appears to be a separate logical unit. For example, each path to a multipath device appears to be a separate device. Multipath drivers aggregate these into a single device that acts to storage applications like a single path device, but provides administrative interfaces for load balancing and failback.

Host Discovered Resources incorporates multipath logic as part of the mapping from logical (operating system) resources to hardware resources. If the discovered block storage has a single path, then LogicalIdentity associates the discovered StorageVolume instance with the OS/Partition StorageExtent/LogicalDisk representing the underlying volume. The subclass of StorageExtent follows the extent naming conventions described in 7.1.3.

The rest of the examples in this section use LogicalDisks since multipath disk arrays are more common, but the same approach can be extended to other storage types. For example, a TapeDrive can model multipath access to a tape drive.

MultipathConfigurationCapabilities allows clients to determine which features and capabilities are exposed. SCSIPathConfigurationService may provide methods for management load balancing and failback. A system may have multiple multipath drivers with different capabilities and interfaces – each

driver is modeled with a separate instance of `MultipathConfigurationCapabilities` and `SCSIPathConfigurationService`, as illustrated in Figure 39: "Multipath Management Class Diagram".

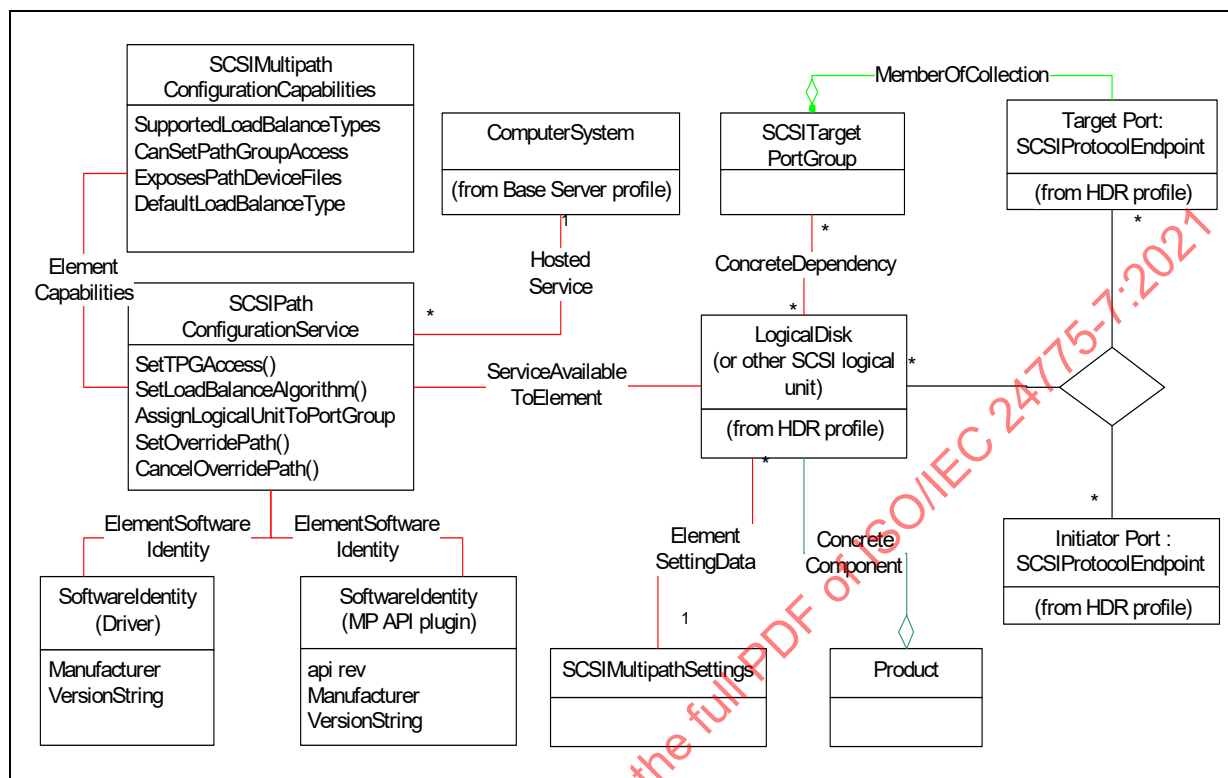


Figure 39 - Multipath Management Class Diagram

All references to ComputerSystem in the SCSI Multipath Management Profile implies a single instance for a customer server or storage system as defined in the Base Server Profile. See Annex A: (Informative) Host Profile Deployment Guidelines, 1.6.0 Rev 3 for information on the use of host profiles with Base Server profile.

Figure 40: "Four Path Instance Diagram" shows the relationship of target and initiator ports

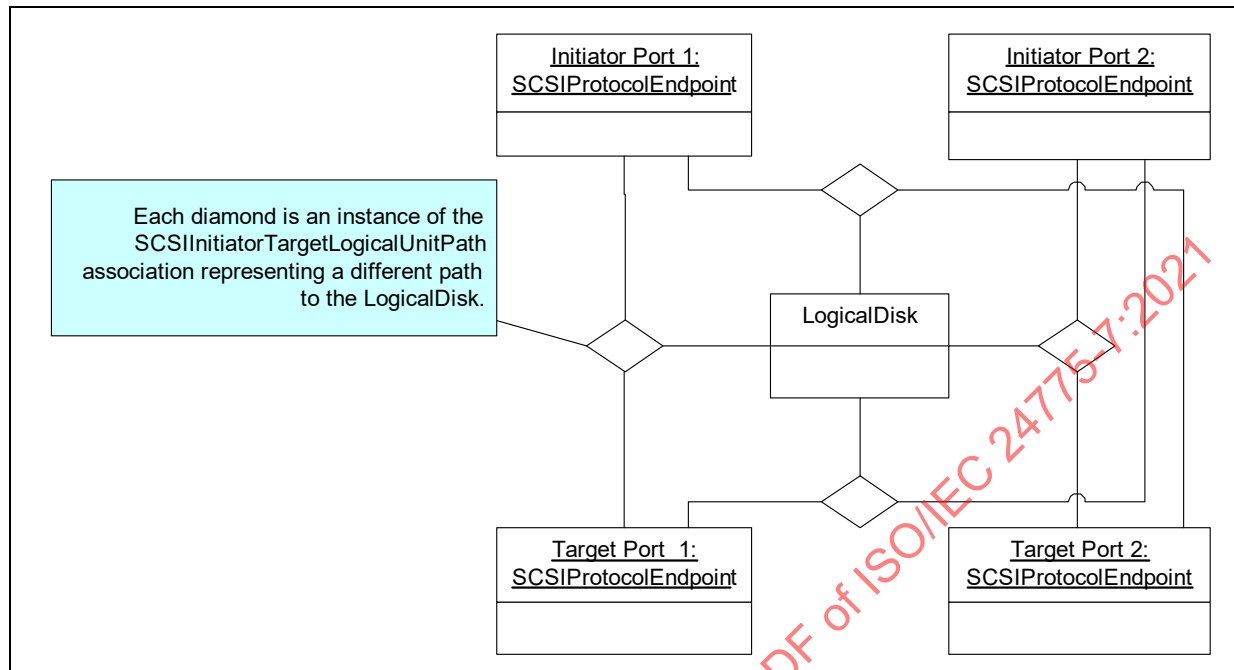


Figure 40 - Four Path Instance Diagram

(SCSIProtocolEndpoint instances) and a disk (LogicalDisk) with four paths. SCSIInitiatorTargetLogicalUnitPath instances represent each path and associate each permutation of initiator SCSIProtocolEndpoint, target SCSIProtocolEndpoint, and the LogicalDisk.

10.1.3 Asymmetric Multipath Target Devices

Some devices implement asymmetric multipath access, i.e., in non-failover mode, each LUN is only available through certain target ports, but can be accessed through other ports during failover. The SMI-S model uses the SPC-3 interface for asymmetric access. This model has target port groups – collections of target ports sharing a common access state for a group of logical units. Multipath drivers for asymmetric access devices optionally provide an interface to “failback” after a failover condition has been corrected. The SMI-S interface follows the SPC-3 interface; the caller shall specify the desired access state for each target port group (TargetPortGroup). This interface is the SetTPGAccess method of SCSIPathConfigurationService. Driver support for this method (and other methods and capabilities) is indicated by properties of MultipathConfigurationCapabilities.

In the past, devices exposed vendor-specific SCSI multipath interfaces. As such, drivers with device-specific logic were shipped with target devices, logical volume managers, and HBAs. The SPC-3 has been enhanced to allow more interoperability and operating systems are including multipath support for any target that complies with the standards. However, there are still cases where a single customer host includes multiple multipath drivers, each with different capabilities and interfaces. And a single target device may be connected in such a way that multiple multipath drivers are involved at multiple places in the driver stack.

The SNIA Multipath Management API provides an interoperable interface to multipath driver features. Each multipath driver includes a corresponding plug-in for the multipath API. The SNIA Multipath Management Profile utilizes the Multipath API to interface to each multipath driver and provide all the associations from the discovered hardware resources to the consumable operating system resources.

The instrumentation shall instantiate SCSIInitiatorTargetLogicalUnitPath instances representing each path to SCSI logical units (LogicalDevice subclasses) attached to the hosting system.

The instrumentation shall instantiate at least one instance of `SCSIMultipathConfigurationCapabilities` for each multipath API plug-in registered on the system.

If the multipath API plug-ins provide support for interfaces to change load balancing and force failover, the instrumentation should support these methods.

10.2 Health and Fault Management Considerations

This profile specifies logical paths between elements (ports and logical units). The health and fault management information for these elements is specified in the profiles for those elements - for example, port profiles.

10.3 Methods of the Profile

10.3.1 Implementation Requirements

All methods are part of `SCSIPathConfigurationService` and are optional.

10.3.2 `SCSIPathConfigurationService.SetTPGAccess`

This method allows a client to manually failover or fallback. The parameters are:

- `LogicalDevice` - A reference to an instance of a subclass of `LogicalDevice` representing a SCSI logical unit where the command shall be sent.
- `TargetPortGroups` - Array of references to instances of `SCSITargetPortGroup`. All the referenced `TargetPortGroup` instances shall be part of the same target device
- `AccessStates[]` - An array of desired access states. Each access state in this array is the desired access state for the `SCSITargetPortGroup` in the corresponding entry in the `TargetPortGroups` parameter. The `Active` value is not part of SPC-3; it is a convenience for clients that are not sure whether to specify `Active/Optimized` or `Active/Non-optimized`. The instrumentation selects a value based on historic information, knowledge of the target configuration, or trial and error. Note that `SCSITargetPortGroup.AccessState` includes the value 'Transitioning' that is excluded here - a caller cannot request transitioning, though it may be reported by a target device.

10.3.3 `SCSIPathConfigurationService.SetLoadBalanceAlgorithm`

This method requests that the target change the load balance algorithm for the referenced `LogicalDevice` instance. The parameters are:

- `LogicalDevice` - a reference to an instance of a subclass of `LogicalDevice` representing a SCSI logical unit.
- `LoadBalanceAlgorithm` - The desired load balance algorithm - possible values are "Unknown", "Other", "No Load Balancing", "Round Robin", "Least Blocks", "Least IO", or "Product Specific"
- `OtherLoadBalanceAlgorithm` - When `LoadBalanceAlgorithm` is 'Other', this parameter specifies a description of the load balancing algorithm. When `LoadBalanceAlgorithm` is 'Product Specific', this property provides a string specifying the vendor/product/version of the `ManagedElement`.

10.3.4 `SCSIPathConfigurationService.AssignLogicalUnitToPortGroup`

This method allows an administrator to assign a logical unit to a target port group. Each LU is typically associated with two target port groups, one in active state and one in standby state. The result of this method is that the LU associations change to a pair of target port groups. Only valid if the target device supports asymmetric access state and `SCSIMultipathConfigurationCapabilities.SupportsLuAssignment` is set. The parameters are:

- `LogicalDevice` - a reference to an instance of a subclass of `LogicalDevice` representing a SCSI logical unit.

- TargetPortGroup - A reference to a target port group. The Target Port Group should be in an active state.

10.3.5 SCSIPathConfigurationService.SetOverridePath

This method allows an administrator to temporarily disable load balancing for a specific logical unit. The path specified as a parameter shall have its AdministrativeOverride property set to 'Overriding' and all I/O to the logical unit shall be directed to this path. All other paths to this logical unit shall have AdministrativeOverride set to 'Overridden'. There is one parameter:

- Path - A reference to a SCSIInitiatorTargetLogicalUnitPath.

10.3.6 SCSIPathConfigurationService.CancelOverridePath

This method clears an override path as set in SetOverridePath and load balancing is enabled. All paths to the logical unit specified as a parameter shall have AdministrativeOverride property set to 'No override in effect'. There is one parameter:

- Path - A reference to a SCSIInitiatorTargetLogicalUnitPath.

After an override is canceled, the previous load balance algorithm should be restored.

10.4 Use Cases

Not defined in this version of the standard.

10.5 CIM Elements

10.5.1 Overview

Table 105 describes the CIM elements for SCSI Multipath Management.

Table 105 - CIM Elements for SCSI Multipath Management

Element Name	Requirement	Description
10.5.2 CIM_ConcreteComponent	Mandatory	Associates Product and LogicalDevice subclass instances representing SCSI logical units.
10.5.3 CIM_ConcreteDependency	Mandatory	Associates SCSTargetPortGroup to LogicalDevice subclass instances representing SCSI logical units.
10.5.4 CIM_ElementCapabilities	Mandatory	Associates SCSIMultipathConfigurationCapabilities and SCSIPathConfigurationService.
10.5.5 CIM_ElementConformsToProfile (SCSIPathConfigurationService to SCSI Multipath Management RegisteredProfile)	Mandatory	Ties the SCSIPathConfigurationService to the registered profile for SCSI Multipath Management.
10.5.6 CIM_ElementSettingData	Mandatory	Associates SCSIMultipathSettings and LogicalDevice subclass instances representing SCSI logical units.
10.5.7 CIM_ElementSoftwareIdentity (Driver)	Mandatory	Associates SCSIPathConfigurationService and the Driver SoftwareIdentity instance.
10.5.8 CIM_ElementSoftwareIdentity (MP API Plugin)	Mandatory	Associates SCSIPathConfigurationService and the MP API Plugin SoftwareIdentity instance.
10.5.9 CIM_HostedService	Mandatory	Associates SCSIPathConfigurationService and the ComputerSystem from Base Server.
10.5.10 CIM_MemberOfCollection	Mandatory	Associates SCSTargetPortGroup and SCSIProtocolEndpoint.
10.5.11 CIM_Product	Mandatory	Models a Product as defined in MP API.

Table 105 - CIM Elements for SCSI Multipath Management

Element Name	Requirement	Description
10.5.12 CIM_SCSIMultipathConfigurationCapabilities	Mandatory	A class derived from Capabilities that models the capabilities of a multipath driver.
10.5.13 CIM_SCSIMultipathSettings	Mandatory	Settings related to management of multiple paths to SCSI devices.
10.5.14 CIM_SCSIPathConfigurationService	Mandatory	A class providing methods related to management of multiple paths to SCSI devices.
10.5.15 CIM_SCSITargetPortGroup	Mandatory	Models SCSI Target Port Groups.
10.5.16 CIM_ServiceAvailableToElement	Mandatory	Associates SCISIPathConfigurationService with instances representing SCSI logical units.
10.5.17 CIM_SoftwareIdentity (Driver)	Mandatory	Driver.
10.5.18 CIM_SoftwareIdentity (MP API Plugin)	Mandatory	MP API Plugin.

10.5.2 CIM_ConcreteComponent

Associates Product and LogicalDevice subclass instances representing SCSI logical units.

Requirement: Mandatory

Table 106 describes class CIM_ConcreteComponent.

Table 106 - SMI Referenced Properties/Methods for CIM_ConcreteComponent

Properties	Flags	Requirement	Description & Notes
GroupComponent		Mandatory	Reference to Product.
PartComponent		Mandatory	Reference to LogicalDevice subclass representing a SCSI logical unit.

10.5.3 CIM_ConcreteDependency

Associates SCSTargetPortGroup to LogicalDevice subclass instances representing SCSI logical units.

Requirement: Mandatory

Table 107 describes class CIM_ConcreteDependency.

Table 107 - SMI Referenced Properties/Methods for CIM_ConcreteDependency

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to LogicalDevice subclass representing a SCSI logical unit.
Dependent		Mandatory	Reference to SCSTargetPortGroup.

10.5.4 CIM_ElementCapabilities

Associates SCSTMultipathConfigurationCapabilities and SCSTIPathConfigurationService.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 108 describes class CIM_ElementCapabilities.

Table 108 - SMI Referenced Properties/Methods for CIM_ElementCapabilities

Properties	Flags	Requirement	Description & Notes
Capabilities		Mandatory	Reference to SCSI Multipath Configuration Capabilities.
ManagedElement		Mandatory	Reference to SCSI Path Configuration Service.

10.5.5 CIM_ElementConformsToProfile (SCSI Path Configuration Service to SCSI Multipath Management Registered Profile)

The CIM_ElementConformsToProfile ties SCSI Path Configuration Service to the registered profile for SCSI Multipath Management.

Created By: Static

Modified By: Static

Deleted By: Static

Requirement: Mandatory

Table 109 describes class CIM_ElementConformsToProfile (SCSI Path Configuration Service to SCSI Multipath Management Registered Profile).

Table 109 - SMI Referenced Properties/Methods for CIM_ElementConformsToProfile (SCSI Path Configuration Service to SCSI Multipath Management Registered Profile)

Properties	Flags	Requirement	Description & Notes
ManagedElement		Mandatory	A SCSI Path Configuration Service instance that represents the SCSI Multipath Management.
ConformantStandard		Mandatory	Registered Profile instance describing the SCSI Multipath Management profile.

10.5.6 CIM_ElementSettingData

Associates SCSI Multipath Settings and LogicalDevice subclass instances representing SCSI logical units.

Requirement: Mandatory

Table 110 describes class CIM_ElementSettingData.

Table 110 - SMI Referenced Properties/Methods for CIM_ElementSettingData

Properties	Flags	Requirement	Description & Notes
SettingData		Mandatory	Reference to SCSI Multipath Settings.
ManagedElement		Mandatory	Reference to LogicalDevice subclass representing a SCSI logical unit.

10.5.7 CIM_ElementSoftwareIdentity (Driver)

Associates SCSI Path Configuration Service and the Driver SoftwareIdentity instance.

Created By: External

Modified By: External

Deleted By: External
Requirement: Mandatory

Table 111 describes class CIM_ElementSoftwareIdentity (Driver).

Table 111 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (Driver)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to Driver SoftwareIdentity.
Dependent		Mandatory	Reference to the SCSIPathConfigurationService.

10.5.8 CIM_ElementSoftwareIdentity (MP API Plugin)

Associates SCSIPathConfigurationService and the MP API Plugin SoftwareIdentity instance.

Created By: External
Modified By: External
Deleted By: External
Requirement: Mandatory

Table 112 describes class CIM_ElementSoftwareIdentity (MP API Plugin).

Table 112 - SMI Referenced Properties/Methods for CIM_ElementSoftwareIdentity (MP API Plugin)

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to MP API Plugin SoftwareIdentity.
Dependent		Mandatory	Reference to the SCSIPathConfigurationService.

10.5.9 CIM_HostedService

Associates SCSIPathConfigurationService and the ComputerSystem from Base Server.

Created By: External
Modified By: External
Deleted By: External
Requirement: Mandatory

Table 113 describes class CIM_HostedService.

Table 113 - SMI Referenced Properties/Methods for CIM_HostedService

Properties	Flags	Requirement	Description & Notes
Antecedent		Mandatory	Reference to ComputerSystem in Base Server.
Dependent		Mandatory	Reference to SCSIPathConfigurationService.

10.5.10 CIM_MemberOfCollection

Associates SCISITargetPortGroup and SCSIProtocolEndpoint representing a target port.

Requirement: Mandatory

Table 114 describes class CIM_MemberOfCollection.

Table 114 - SMI Referenced Properties/Methods for CIM_MemberOfCollection

Properties	Flags	Requirement	Description & Notes
Collection		Mandatory	Reference to SCSITargetPortGroup.
Member		Mandatory	Reference to a target SCSIProtocolEndpoint.

10.5.11 CIM_Product

Models a Product as defined in MP API.

Requirement: Mandatory

Table 115 describes class CIM_Product.

Table 115 - SMI Referenced Properties/Methods for CIM_Product

Properties	Flags	Requirement	Description & Notes
ElementName		Mandatory	
Name		Mandatory	
IdentifyingNumber		Mandatory	
Vendor		Mandatory	
Version		Mandatory	

10.5.12 CIM_SCSIMultipathConfigurationCapabilities

A class derived from Capabilities that models the capabilities of a multipath driver.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 116 describes class CIM_SCSIMultipathConfigurationCapabilities.

Table 116 - SMI Referenced Properties/Methods for CIM_SCSIMultipathConfigurationCapabilities

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Key.
ElementName		Mandatory	Unique ID for the capabilities instance.
SupportedLoadBalanceTypes		Mandatory	
CanSetTPGAccess		Mandatory	
ExposesPathDeviceFiles		Mandatory	
DefaultLoadBalanceType		Mandatory	

10.5.13 CIM_SCSIMultipathSettings

A class derived from CIM_SettingData describing settings related to management of multiple paths to SCSI devices. It is associated to one of more instances of subclasses of LogicalDevice that represent SCSI logical units.

Requirement: Mandatory

Table 117 describes class CIM_SCSIMultipathSettings.

Table 117 - SMI Referenced Properties/Methods for CIM_SCSIMultipathSettings

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Key.
Asymmetric		Mandatory	Indicates whether the associated logical unit has asymmetric multipath access.
CurrentLoadBalanceType		Mandatory	
OtherCurrentLoadBalanceType		Conditional	Conditional requirement: support for CurrentLoadBalanceType of 'Other'.
AutoFailbackEnabled		Mandatory	
PollingRateMax		Optional	
CurrentPollingRate		Optional	

10.5.14 CIM_SCSIPathConfigurationService

A class derived from CIM_Service providing methods related to management of multiple paths to SCSI devices.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 118 describes class CIM_SCSIPathConfigurationService.

Table 118 - SMI Referenced Properties/Methods for CIM_SCSIPathConfigurationService

Properties	Flags	Requirement	Description & Notes
SystemCreationClassName		Mandatory	The scoping System CreationClassName.
SystemName		Mandatory	The scoping System Name.
CreationClassName		Mandatory	The name of the concrete subclass.
Name		Mandatory	Uniquely identifies the Service.
SetTPGAccess()		Conditional	Conditional requirement: support for SetTPGAccess method.
SetLoadBalanceAlgorithm()		Optional	
AssignLogicalUnitToPortGroup()		Optional	
SetOverridePath()		Conditional	Conditional requirement: support for override path methods.
CancelOverridePath()		Conditional	Conditional requirement: support for override path methods.

10.5.15 CIM_SCSITargetPortGroup

A class derived from SystemSpecificCollection that models SCSI Target Port Groups. SCSITargetPortGroup is part of the model for devices with asymmetric access to logical units - access is optimized for a subset of target ports. SCSITargetPortGroup is aggregated to SCSIProtocolEndpoints that expose a common access state.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 119 describes class CIM_SCSITargetPortGroup.

Table 119 - SMI Referenced Properties/Methods for CIM_SCSITargetPortGroup

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	Opaque and unique identifier.
ElementName		Optional	A user-friendly name.
AccessState		Optional	Access to all associated logical units through all aggregated ports share this access state.
SupportsLuAssignment		Mandatory	Indicates whether the implementation provides an interface to reassign logical units to target port groups.
ExplicitFailover		Mandatory	Indicates the implementation provides an interface to explicitly request activation of a TPG.
Preferred		Optional	Indicates that access to the associated logical units through ports in this TPG is preferred over access through other ports.
Identifier		Optional	An integer identifier for the TPG.

10.5.16 CIM_ServiceAvailableToElement

Associates SCSIPathConfigurationService with instances representing SCSI logical units.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 120 describes class CIM_ServiceAvailableToElement.

Table 120 - SMI Referenced Properties/Methods for CIM_ServiceAvailableToElement

Properties	Flags	Requirement	Description & Notes
ServiceProvided		Mandatory	Reference to SCSIPathConfigurationService.
UserOfService		Mandatory	Reference to LogicalDevice subclass representing a SCSI logical unit.

10.5.17 CIM_SoftwareIdentity (Driver)

SoftwareIdentity representing the Driver software.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 121 describes class CIM_SoftwareIdentity (Driver).

Table 121 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (Driver)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	The name used to identify this SoftwareIdentity.
VersionString		Mandatory	Software Version should be in the form [Major], [Minor].[Revision] or [Major].[Minor][letter][revision].
Manufacturer		Mandatory	Manufacturer of this Software.
Classifications		Mandatory	Shall be 2 (Driver).

10.5.18 CIM_SoftwareIdentity (MP API Plugin)

SoftwareIdentity representing the MP API plugin software.

Created By: External

Modified By: External

Deleted By: External

Requirement: Mandatory

Table 122 describes class CIM_SoftwareIdentity (MP API Plugin).

Table 122 - SMI Referenced Properties/Methods for CIM_SoftwareIdentity (MP API Plugin)

Properties	Flags	Requirement	Description & Notes
InstanceID		Mandatory	The name used to identify this SoftwareIdentity.
VersionString		Mandatory	Software Version should be in the form [Major], [Minor].[Revision] or [Major].[Minor][letter][revision].
Manufacturer		Mandatory	Manufacturer of this Software.
Classifications		Mandatory	Shall be 1 (Other).
ClassificationDescriptions		Mandatory	Shall be 'MP API Plugin'.

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11 SB Multipath Management Profile

See the last version of this profile in SMI-S Version 1.6.1. Revision 5.

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12 Memory Configuration Profile

12.1 Synopsis

Profile Name: Memory Configuration (Component Profile)

Version: 1.0.0

Organization: SNIA

Central Class: MemoryConfigurationService

Scoping Class: ComputerSystem

Related Profiles: Table 123 describes the related profiles for the Memory Configuration Profile:

Table 123 - Related Profiles

Profile Name	Organization	Version	Requirement	Description
Profile Registration	DMTF	1.1.0	Mandatory	
Multi-type System Memory	DMTF	1.0.0	Mandatory	DMTF DSP1071

12.2 Description

12.2.1 Overview

Memory subsystems which offer logical configuration options are candidates for management using the Memory Configuration Profile. This profile describes memory resource pools which serve to group memory resources with like characteristics. For example, a system containing both volatile memory modules and battery backed persistent memory modules might group the logical capacity on these memory modules into two separate pools. A configuration service provides allocation, deallocation and assignment related operations for a pool. An allocation operation reserves some amount of capacity from a pool and assigns it to the system. A deallocation returns allocated capacity to the pool to be reused. Assignment indicates that access to an allocated memory resource is to be restricted in some way. Consider the case of memory being assigned as a cache; access to the cache would likely be restricted to hardware or software performing the caching operation and not generally available to the system. Finally the profile describes various means for a system to advertise the memory configuration options it supports. Availability of memory configuration features is contingent upon a number of factors including the capabilities of the system memory modules, the memory controller features and the features of the BIOS, operating system or other memory management software.

12.2.2 Class Diagram

Figure 41 shows the Memory Configuration Profile class hierarchy. For simplicity, the prefix CIM_ has been removed from the names of the classes.

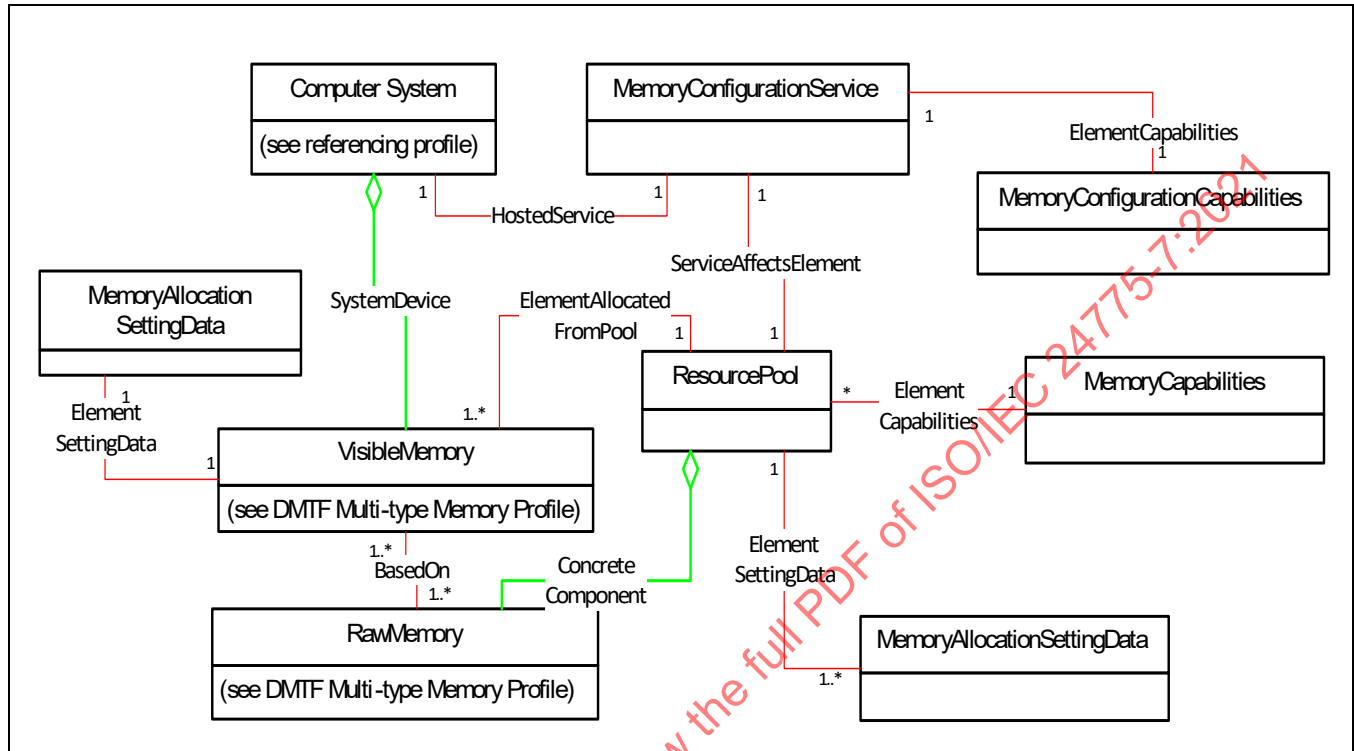


Figure 41 - Memory Configuration Class Diagram

12.2.3 MemoryConfigurationService

The MemoryConfigurationService is the central class of the profile. It models the system's support for modifying a system's logical memory configuration.

12.2.4 ResourcePool(Memory)

ResourcePool instances aggregate memory capacity with like capabilities.

12.2.5 MemoryConfigurationCapabilities & MemoryCapabilities

The profile supports run-time detection of memory features. MemoryConfigurationCapabilities advertises the system's support for modification of the logical memory configuration. MemoryCapabilities indicates the capabilities of the memory modules and other system components.

12.2.6 MemoryAllocationSettingData

MemoryAllocationSettingData records the parameters used during an allocation or assignment operation.

12.2.7 Registered Profile

Figure 41 includes CIM_RegisteredProfile which is expected to be implemented per the Profile Registration Profile (*Storage Management Technical Specification, Part 3 Common Profiles, 1.8.0 Rev 4 Clause 36 Profile Registration Profile*).

12.2.8 DMTF: Multi-type System Memory Profile

RawMemory and VisibleMemory classes are described in detail in the DMTF Multi-type System Memory Profile. A RawMemory instance represents the unconfigured (primordial) capacity of a given memory module. RawMemory instances are the constituents of a (memory) ResourcePool. VisibleMemory instances model memory capacity that has been allocated (concrete) from a (memory) ResourcePool.

12.3 Implementation

12.3.1 CIM_ResourcePool (memory)

Implementations of this profile shall contain at least one instance of CIM_ResourcePool. CIM_ResourcePool pools are primordial in nature, containing unprepared or unassigned capacity. It is presumed that CIM_RawMemory instances that together constitute a given CIM_ResourcePool are compatible such that they can be manipulated in aggregate by a MemoryConfigurationService. This profile does not mandate any specific level of compatibility between members of a ResourcePool.

12.3.2 Determining Pool Capacity

The capacity of a (memory) ResourcePool instance shall be the total unconfigured capacity of the pool's constituent CIM_RawMemory instances. Any capacity gains or losses due to device usage/configuration (e.g., replication, metadata) shall not be included in the capacity reported for the pool.

12.3.3 CIM_MemoryCapabilities

Implementations of this profile shall include at least one instance of CIM_MemoryCapabilities. Each instance shall describe the capabilities of one or more instances of CIM_ResourcePools as determined by the CIM_ElementCapabilities association.

12.3.4 CIM_MemoryConfigurationService

Implementations of this profile shall contain at least one instance of CIM_MemoryConfigurationService. Instances of this class shall conditionally support allocation, deallocation and assignment of memory resources from associated (see 12.3.8 CIM_ServiceAffectsElement) CIM_ResourcePools. Availability of any given extrinsic shall be determined by examining the CIM_MemoryConfigurationCapabilities instance to which it is associated (CIM_ElementCapabilities).

12.3.5 CIM_MemoryConfigurationCapabilities

Implementations of this profile shall contain at least one instance of CIM_MemoryConfigurationCapabilities. Each instance shall be associated with one or more instances of CIM_MemoryConfigurationService via a CIM_ElementCapabilities association.

12.3.6 CIM_MemoryAllocationSettingData

The availability of CIM_MemoryAllocationSettingData instances is conditional. Whenever CIM_MemoryConfigurationService extrinsics are used to allocate a CIM_VisibleMemory instance, a companion instance of CIM_MemoryAllocationSettingData shall be available. The companion instance shall be the goal setting used in the AllocateFromPool extrinsic method (see 12.4.2.2 CIM_MemoryConfigurationService.AllocateFromPool()).

When an allocation operation results in a staged request that requires some triggering event (e.g., a reboot) an instance of CIM_MemoryAllocationSettingData shall exist to represent the staged request. These instances are associated with the impacted CIM_ResourcePool rather than a CIM_VisibleMemory instance.

Specify Allocation Properties

12.3.6.1 Specify Allocation Properties

Workload performance for a given memory region is influenced by the properties specified in the CIM_MemoryAllocationSettingData instance at memory region creation time.

12.3.7 CIM_ElementCapabilities

CIM_ElementCapabilities shall associate the CIM_MemoryConfigurationCapabilities to CIM_MemoryConfigurationService. Capabilities so associated shall describe the extrinsic method support offered by the service instance. The characteristics attribute of CIM_ElementCapabilities is not used.

CIM_ElementCapabilities shall associate CIM_MemoryCapabilities to CIM_ResourcePoolCapabilities so associated describe the memory module and related platform memory features that determine configurability. The characteristics attribute of CIM_ElementCapabilities is not used.

12.3.8 CIM_ServiceAffectsElement

CIM_ServiceAffectsElement associations shall relate CIM_MemoryConfigurationService instances with the CIM_ResourcePool(s) they are able to operate on.

12.3.9 CIM_ConcreteComponent

CIM_RawMemory instances pooled together for management purposes are represented by CIM_ResourcePool instances. CIM_RawMemory instances shall be associated with a CIM_ResourcePool instance by the CIM_ConcreteComponent association.

12.3.10 CIM_ElementAllocatedFromPool

CIM_VisibleMemory instances are created from resources managed in aggregate as a CIM_ResourcePool. CIM_VisibleMemory instances shall be associated to the CIM_ResourcePool from which they draw their resources by a CIM_ElementAllocatedFromPool association.

12.3.11 CIM_HostedService

An instance of the CIM_HostedService shall associate a CIM_MemoryConfigurationService with the CIM_ComputerSystem where its underlying configuration (software and hardware) facilities are located.

12.3.12 CIM_ElementSettingData

CIM_ElementSettingData represents the relationship between an allocated memory extent and the settings supplied during its creation. An instance of CIM_ElementSettingData shall exist between CIM_VisibleMemory and an associated CIM_MemoryAllocationSettingData instance. For these instances IsCurrent shall be set to 1 "Is Current". IsNext shall be set to 2 "Is Not Next". The value IsDefault is determined by the implementation.

CIM_ElementSettingData shall also be used to associate staged CIM_MemoryAllocationSetting instances to the ResourcePool that hosts the resources impacted by the CIM_MemoryAllocationSetting instance. Once the allocation transitions from a staged "request" to an actual CIM_VisibleMemory instance this association no longer exists. For these instances IsCurrent shall be set to 2 "Is Not Current". IsNext shall be set to 1 "Is Next". The value IsDefault is determined by the implementation.

12.3.13 CIM_ElementConformsToProfile

CIM_ElementConformsToProfile shall associate a RegisteredProfile instance representing the MemoryConfigurationService profile to the central class of the profile CIM_MemoryConfigurationService.

12.4 Methods

12.4.1 Overview

This clause details the requirements for supporting intrinsic operations and extrinsic methods for the CIM elements defined by this profile.

12.4.2 CIM_MemoryConfigurationService

12.4.2.1 Overview

Implementations of this profile shall support the operations listed in Table 124 for CIM_MemoryConfigurationService. Each operation shall be supported as defined in DMTF DSP0200 *CIM Operations over HTTP*.

Table 124 - Operations: CIM_MemoryConfigurationService

Operation	Requirement	Messages
GetInstance	Mandatory	None
Associators	Mandatory	None
AssociatorNames	Mandatory	None
References	Mandatory	None
ReferenceNames	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.2.2 CIM_MemoryConfigurationService.AllocateFromPool()

The AllocateFromPool() method is used to configure unprepared, raw memory resources resulting in one or more system visible memory regions. Support for this method is signaled by its inclusion in the SupportedAsynchronousActions attribute in CIM_MemoryConfigurationCapabilities. Return values are listed in Table 125.

Table 125 - CIM_MemoryConfigurationService.AllocateFromPool() Method: Return Code Values

Value	Description
0	Request was successfully executed
1	Request was successfully staged for future execution.
2	Method is not supported in this implementation
2	Unknown
3	Timeout
4	Failed
5	Invalid parameter
4096	Request was successfully staged for future execution
4097	Insufficient Resources
4098	Inconsistent Parameters
4099	Request did not complete in its entirety and partial results could not be undone

CIM_MemoryConfigurationService.ReturnToPool()

AllocateFromPool() parameters are listed in Table 126:

Table 126 - CIM_MemoryConfigurationService.AllocateFromPool() Method: Parameters

Qualifiers	Name	Type	Description
IN, REQ	Pool	CIM_ResourcePool REF	The pool of memory resources from which to allocate the visible memory region.
IN, REQ	Goal[]	string	One or more embedded instances of CIM_MemoryAllocationSetting which describe the allocation request.
OUT	Extents[]	CIM_VisibleMemory REF	If the return code is 0, this value shall contain references to the created VisibleMemory instances. When the request is successful but has been staged for future execution or an error occurs, this parameter is not used.

12.4.2.3 CIM_MemoryConfigurationService.ReturnToPool()

The ReturnToPool() method deletes an instance of CIM_VisibleMemory, returning capacity to the CIM_ResourcePool from which it originated, as shown in Table 127.

Table 127 - CIM_MemoryConfigurationService.ReturnToPool() Method: Return Code Values

Value	Description
0	Request was successfully executed
1	Request was successfully staged for future execution
2	Method is not supported in this implementation
3	Unknown
4	Timeout
5	Failed
4096	Request was successfully staged for future execution
4099	Request did not complete in its entirety and partial results could not be undone

ReturnToPool() parameters are listed in Table 128:

Table 128 - CIM_MemoryConfigurationService.ReturnToPool() Method: Parameters

Qualifiers	Name	Type	Description
IN, REQ	MemoryExtent[]	CIM_VisibleMemory REF	The instance to deallocate

CIM_MemoryConfigurationService.ReturnToPool()

12.4.3 CIM_ResourcePool (memory)

Table 129 lists operations and requirements for CIM_ResourcePool.

Table 129 - Operations: CIM_ResourcePool

Operation	Requirement	Messages
GetInstance	Mandatory	None
Associators	Mandatory	None
AssociatorNames	Mandatory	None
References	Mandatory	None
ReferenceNames	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.4 CIM_MemoryCapabilities

Implementations of this profile shall support the operations listed in Table 130 for the CIM_MemoryCapabilities class.

Table 130 - Operations: CIM_MemoryCapabilities

Operation	Requirement	Messages
GetInstance	Mandatory	None
Associators	Mandatory	None
AssociatorNames	Mandatory	None
References	Mandatory	None
ReferenceNames	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.5 CIM_MemoryConfigurationCapabilities

Implementations of this profile shall support the operations listed in Table 131 for the CIM_MemoryConfigurationCapabilities class.

Table 131 - Operations: CIM_MemoryConfigurationCapabilities

Operation	Requirement	Messages
GetInstance	Mandatory	None
Associators	Mandatory	None
AssociatorNames	Mandatory	None
References	Mandatory	None
ReferenceNames	Mandatory	None
EnumerateInstances	Mandatory	None

CIM_MemoryConfigurationService.ReturnToPool()

Table 131 - Operations: CIM_MemoryConfigurationCapabilities

Operation	Requirement	Messages
EnumerateInstanceNames	Mandatory	None

12.4.6 CIM_MemoryAllocationSettingData

Table 132 lists operations and requirements for CIM_MemoryAllocationSettingData.

Table 132 - Operations: CIM_MemoryAllocationSettingData

Operation	Requirement	Messages
GetInstance	Mandatory	None
Associators	Mandatory	None
AssociatorNames	Mandatory	None
References	Mandatory	None
ReferenceNames	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None
DeleteInstance	Optional	

12.4.7 CIM_ElementCapabilities

Table 133 lists operations and requirements for CIM_ElementCapabilities.

Table 133 - Operations: CIM_ElementCapabilities

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.8 CIM_ServiceAffectsElement

Table 134 lists operations and requirements for CIM_ServiceAffectsElement.

Table 134 - Operations: CIM_ServiceAffectsElement

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

CIM_MemoryConfigurationService.ReturnToPool()

12.4.9 CIM_ConcreteComponent

Table 135 lists operations and requirements for CIM_ConcreteComponent.

Table 135 - Operations: CIM_ConcreteComponent

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.10 CIM_ElementAllocatedFromPool

Table 136 lists operations and requirements for CIM_ElementAllocatedFromPool

Table 136 - Operations: CIM_ElementAllocatedFromPool

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.11 CIM_HostedService

Table 137 lists operations and requirements for CIM_HostedService.

Table 137 - Operations: CIM_HostedService

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.4.12 CIM_ElementSettingData

Table 138 lists operations and requirements for CIM_ElementSettingData.

Table 138 - Operations: CIM_ElementSettingData

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

CIM_MemoryConfigurationService.ReturnToPool()

12.4.13 CIM_ElementConformsToProfile

Table 139 lists operations and requirements for CIM_ElementConformsToProfile.

Table 139 - Operations: CIM_ElementConformsToProfile

Operation	Requirement	Messages
GetInstance	Mandatory	None
EnumerateInstances	Mandatory	None
EnumerateInstanceNames	Mandatory	None

12.5 Use Cases

12.5.1 Advertising Profile Conformance

Figure 42 shows how an instance of CIM_RegisteredProfile is used to indicate the presence of a conforming implementation of the Memory Configuration Profile and to identify instances of its central class CIM_MemoryConfigurationService

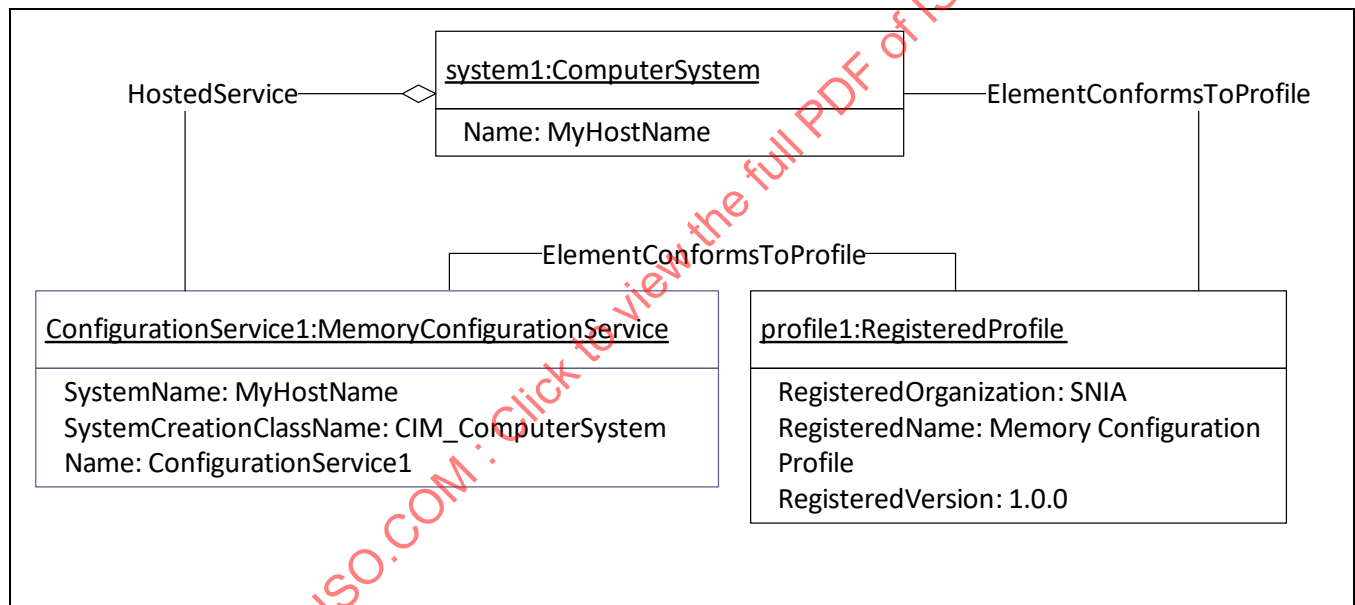


Figure 42 - Use Case - Profile Registration

12.5.2 Determine Support for Memory Configuration

One of several possible ways to determine configuration capabilities is to enumerate MemoryConfigurationCapabilities instances and examine the SupportedOperations attribute. If the desired configuration capability is located in the SupportedOperations list, the service instance offering this capability is located using the ElementCapabilities association. Figure 43 illustrates the case where the MemoryConfigurationService advertises support for memory allocation.

CIM_MemoryConfigurationService.ReturnToPool()

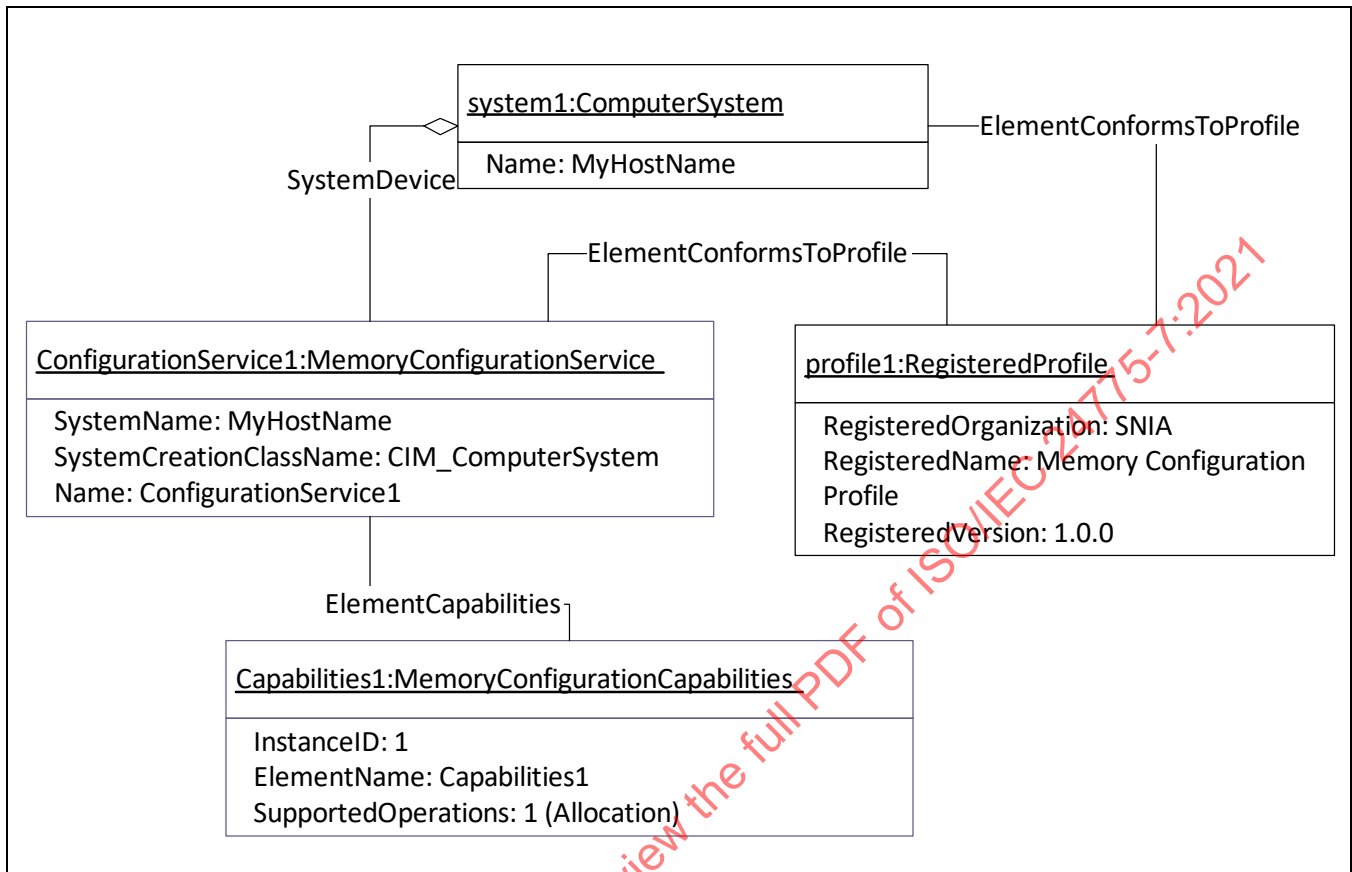


Figure 43 - Use Case - Memory Configuration Capabilities

12.5.3 Determine Support for Memory Features

A client seeking memory resources with specific capabilities can enumerate instances of CIM_MemoryCapabilities. For example, if a client is looking for memory with persistent characteristics it can examine the MemoryModes attribute looking for the persistent value. If a MemoryCapabilities instance with the persistent capability is found the CIM_ElementCapabilities association is used to locate the memory resource pool. An instance diagram for this use case is shown in Figure 44.

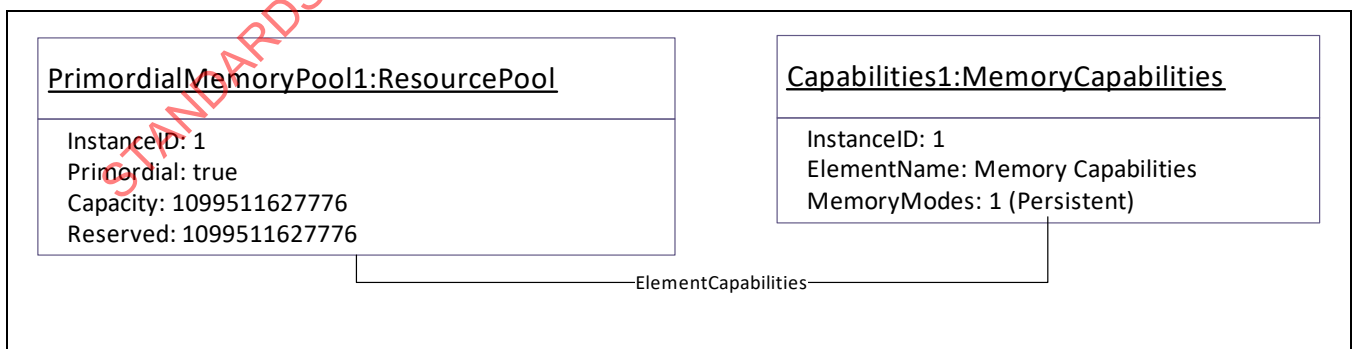


Figure 44 - Use Case - Memory Capability Discovery

CIM_MemoryConfigurationService.ReturnToPool()

12.5.4 Determine Available Capacity

Capacity available for allocation for a given pool is determined by enumerating instances of CIM_ResourcePool and subtracting the Reserved attribute from the Capacity attribute, as shown in Figure 44.

12.5.5 Allocate Capacity

Clients wishing to allocate capacity from a (memory) CIM_ResourcePool can locate the MemoryConfigurationService that handles allocation requests by following the CIM_ServiceAffectsElement association from the pool to the service. Once the service is located the AllocateFromPool method is used to request an allocation. The end result of the allocation is the appearance of a CIM_VisibleMemory instance along with a CIM_MemoryAllocationSettingData instance. The CIM_VisibleMemory instance is associated to the CIM_ResourcePool by an ElementAllocatedFromPool association. The CIM_ResourcePool.Reserved value is updated to reflect the allocation. In some cases the allocation request may require a reset or other event to complete. In this case the AllocateFromPool call results in a CIM_MemoryAllocationSetting instance associated with the CIM_ResourcePool until the triggering event occurs. The cases where a triggering event is required is given in Figure 45, the completed allocation is shown in Figure 46.

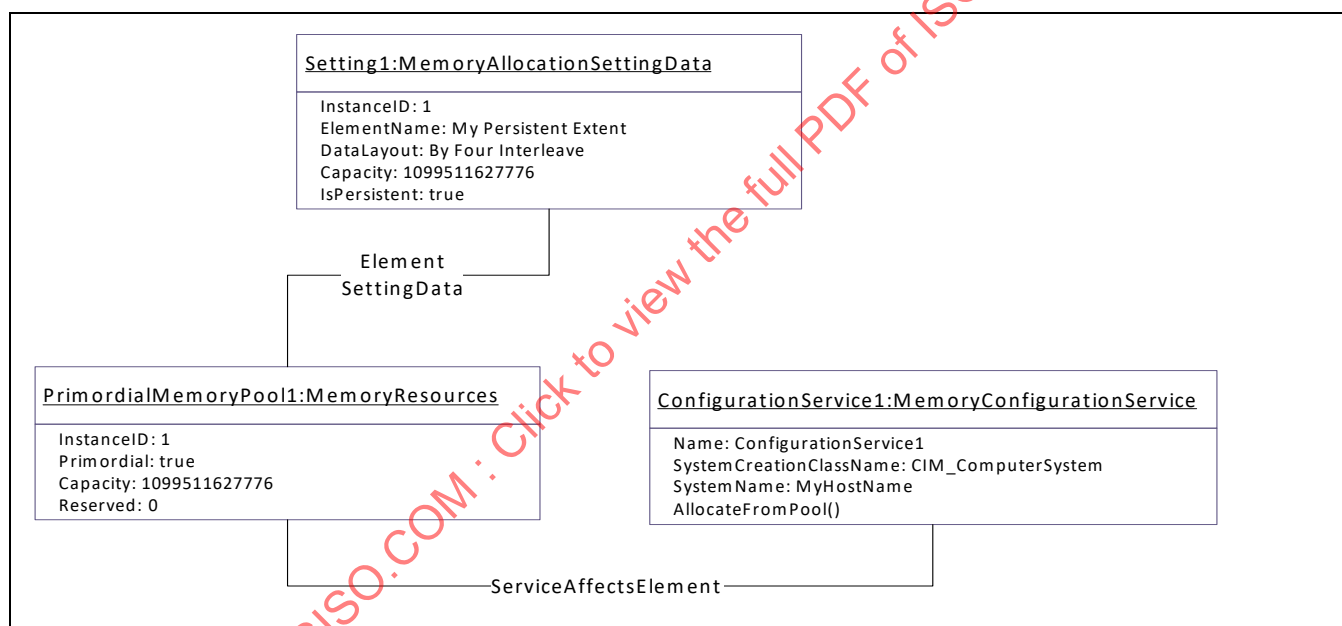


Figure 45 - Use Case - Allocation

CIM_MemoryConfigurationService.ReturnToPool()

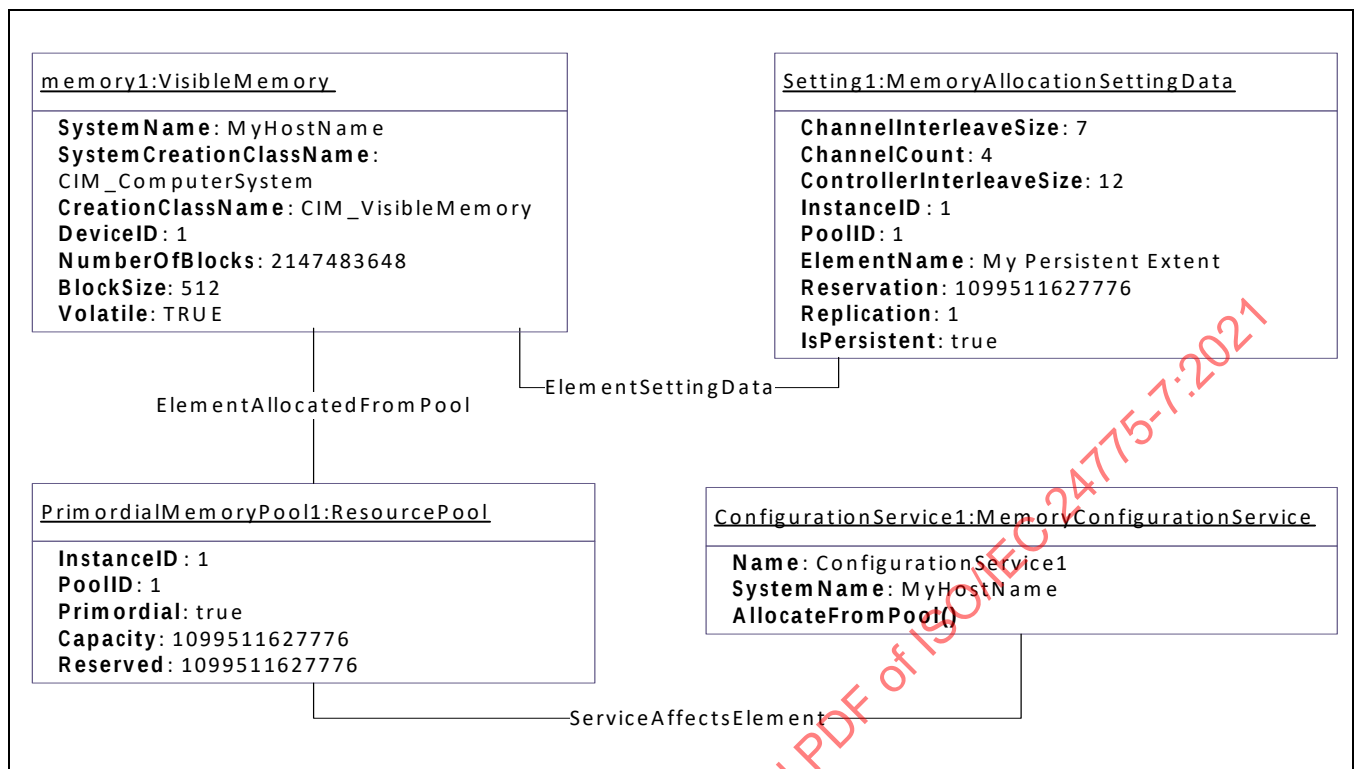


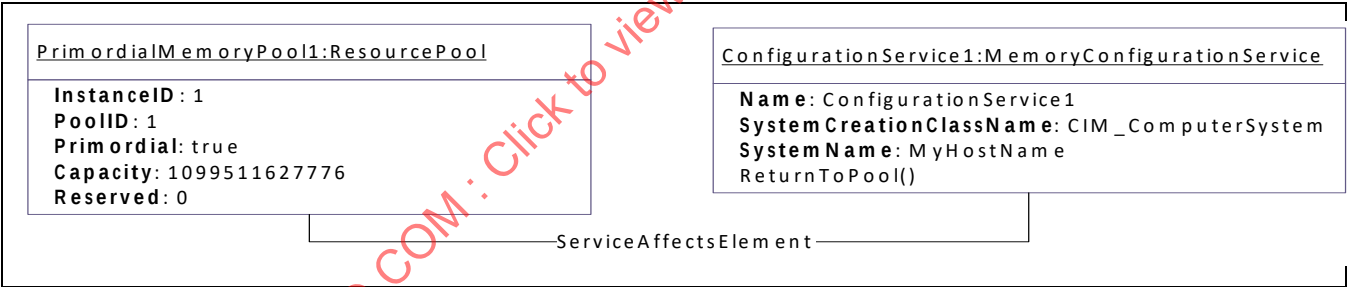
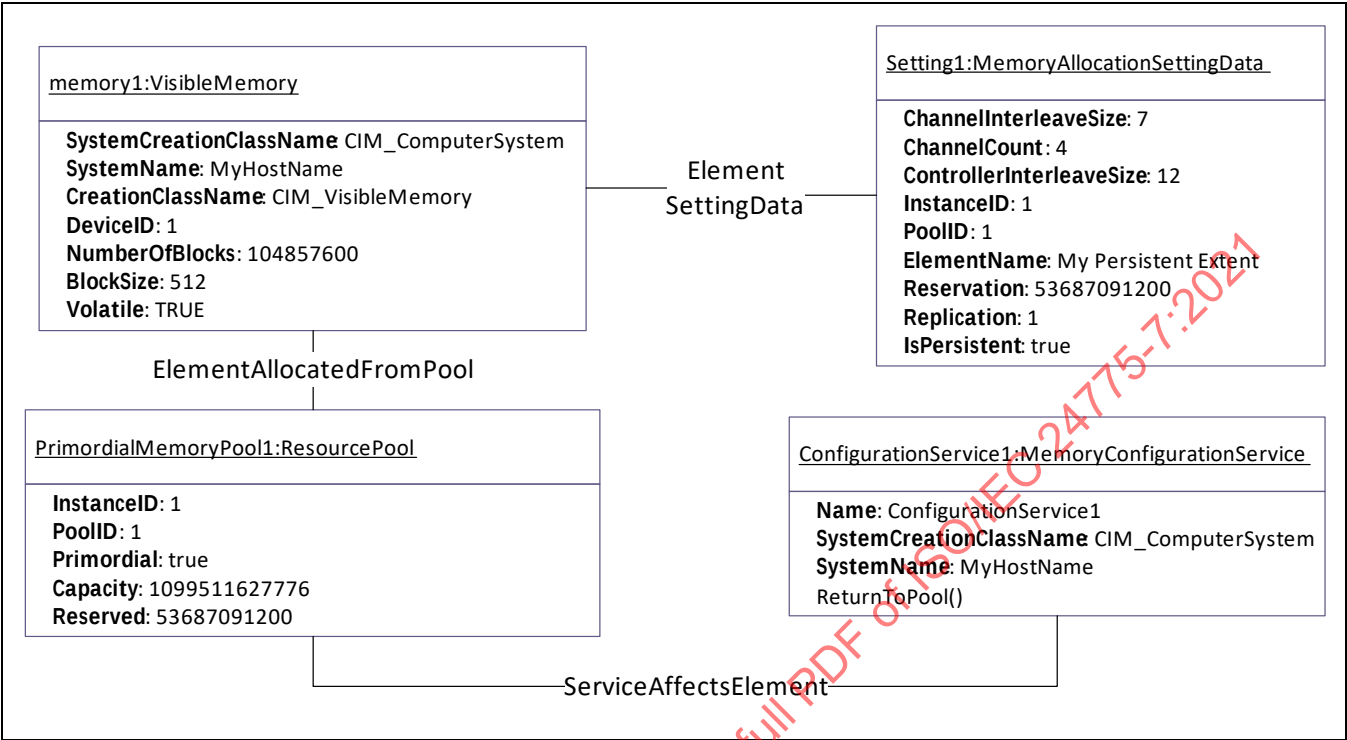
Figure 46 - Use Case - Allocation Complete

12.5.6 Deallocate Capacity

Clients wishing to deallocate a CIM_VisibleMemory instance first locate the pool from which it was allocated (ElementAllocatedFromPool to ResourcePool). Refer to Figure 47. Secondly locate the MemoryConfigurationService instance associated with the pool (ServiceAffectsElement to MemoryConfigurationService). The ReturnToPool() method on the MemoryConfigurationService is then called with a reference to the VisibleMemory instance to be deleted. As with allocate, the deallocation may require a triggering event such as a device or system reset to take effect.

CIM_MemoryConfigurationService.ReturnToPool()

Figure 47 and Figure 48 depict the model before and after deallocation.



12.5.7 Delete a Pending Request

An allocation request that has not taken place because it requires a state transition of some kind (e.g., a system reset) can be deleted by using the intrinsic DeleteInstance() method on the MemoryAllocationSettingData instance that represents the request.