
# Swordfish Scalable Storage Management API Specification

## Swordfish Working Draft Notice

## Version 1.0.4 Working Draft

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# Revision History

| Date | Revision | Notes |
|---|---|---|
| 19 September 2016 | 1.0.0 | Initial Release |
| 12 October 2016 | 1.0.1 | Errata release for general clean up and formatting consistency |
| 1 November 2016 | 1.0.2 | Errata release to change multiple collections' types from collections (arrays) to ResourceCollections to conform to Redfish usage guidelines<br>Change multiple collections' types from collections (arrays) to ResourceCollections to conform to Redfish usage guidelines and move NavigationProperties from Links section. |
| 24 January 2017 | 1.0.3 | Errata release to move complex types and enum to versioned namespace<br>Schedule schema: add property<br>json schema fix (Swordfish to swordfish)<br>Specification enhancements, multiple areas<br>User's guide: multiple new use cases and new document section |
| 25 April 2017 | 1.0.4 | Errata release with minor updates to schema: move FileShare collection, integrate DMTF and SNIA versions of Volume, fix incorrect property references and update descriptions. Update mockups. User's guide: Update cross-references. |

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# Table of Contents

# 1 Abstract

The Swordfish Scalable Storage Management API ("Swordfish") defines a RESTful interface and a standardized data model to provide a scalable, customer-centric interface for managing storage and related data services. It extends the Redfish Scalable Platforms Management API Specification (DSP0266) from the DMTF.

# 2 Scope

Swordfish defines a comprehensive, RESTful API for storage management that addresses block storage, file systems, object storage, and storage network infrastructure. It is centered around common operational and business concerns of storage management, including:

- Configuration and provisioning
- Monitoring
- Event and log management
- Performance assessment
- Diagnostics
- Fault detection and remediation
- Security
- Accounting and resource consumption

Swordfish's storage model is built around well-defined classes of service, which provide a means to map high-level business goals and objectives to specific, storage-based actions and requirements, in a clear and consistent way that can be applied uniformly across a broad spectrum of storage configurations and storage types (e.g., block storage, file systems, object stores). Common storage management functionality covered by class of service includes snapshots, replication, mapping and masking, and provisioning.

The Redfish specification provides the protocols and a core set of data models and behaviors for the management of systems. It defines the elements and behaviors that are mandatory for all Redfish implementations. Additionally it defines additional elements and behaviors that can be chosen by system vendors or manufacturers. The specifications also defines points at which OEM (system vendor) extensions can be provided by a given implementation. The specifications specifies normative requirements for Redfish Services and associated materials, such as Redfish Schema files. The Redfish specifications does not set requirements for Redfish clients, but will indicate what a Redfish client should do in order to access and utilize a Redfish Service successfully and effectively.

The Swordfish specification defines additional data models and behaviors for the management of storage systems and storage infrastructure. A Swordfish implementation shall conform to all requirements specified in the Redfish specifications.

Swordfish is suitable for a wide range of storage, from small-scale object drives, integrated RAID cards or RBODs providing storage services, to external disk arrays or file servers, to infrastructure providing storage services for converged, hyperscale and large scale cloud environments.

This document defines the Swordfish Scalable Storage Management API.

# 3 Normative References

# 3.1 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.

# 3.2 Approved references

Table 1: Approved normative references

| Tag | Title (Version) | Author | URL |
|---|---|---|---|
| ISO-8601 | Data elements and interchange formats -- Information interchange -- Representation of dates and times -- Part 1: Basic rules | ISO/IEC | http://www.iso.org/iso/home/store/catalogue_ics/catalogue_detail_ics.htm?csnumber=70907 |
| ISO-Direct | ISO/IEC Directives, Part 2 Principles and rules for the structure and drafting of ISO and IEC documents (Seventh Edition, 2016) | ISO/IEC | http://isotc.iso.org/livelink/livelink/ fetch/2000/2122/4230450/4230456/ ISO_IEC_Directives *Part_2 Principles_and_rules_for_the structure_and_drafting_of_ISO_and_IEC* documents_-*2016*%287th_edition%29_-_PDF.pdf?nodeid=17667902&vernum=-2 |
| Redfish | Redfish Scalable Platforms Management API Specification (v1.0.4) | DMTF | http://www.dmtf.org/sites/default/files/standards/documents/DSP0266_1.0.4.pdf |
| OData | Open Data Protocol (v. 4.0) | OASIS | https://www.oasis-open.org/standards#odatav4.0 |
| RFC3986 | Uniform Resource Identifier (URI): Generic Syntax (2005) | The Internet Society | http://www.rfc-base.org/txt/rfc-3986.txt |

| Tag | Title (Version) | Author | URL |
|---|---|---|---|
| CSDL | Common Schema Definition Language (4.0) | OASIS | http://docs.oasis-open.org/odata/odata/v4.0/odata-v4.0-part3-csdl.html |
| ITIL | ITIL Glossary (2011) | ITIL | https://www.axelos.com/Corporate/media/ Files/Glossaries/ ITIL_2011_Glossary_GB-v1-0.pdf |
| Units | The Unified Code for Units of Measure (v2.0.1) | Regenstrief Institute, Inc. and the UCUM Organization | http://unitsofmeasure.org/trac |
| TLS | Transport Layer Security (TLS) Protocol Version 1.2 | IETF | https://www.ietf.org/rfc/rfc5246.txt |
| SPC-4 | SCSI Primary Commands - 4 (SPC-4) INCITS 513-2015 | T10 | http://www.techstreet.com/cgi-bin/joint.cgi/incits |

## 3.3 References under development

None defined in this document.

## 3.4 Other references

None defined in this document.

# 4 Terms and Definitions

## 4.1 Overview

In this document, some terms have a specific meaning beyond the normal English meaning. Those terms are defined in this clause. New terms, frequently used Redfish terms.

# 4.2 Swordfish-specific Terms

## 4.2.1 Definitions

The following terms are used in this document.

Table 2: Swordfish terms

| Term | Definition |
|---|---|
| Entity | An element in a model that represents resources. The element may be either a type declaration or a model instance representing an instance of the resource. |
| Entity Instance | A model element that represents the information and behaviors of a particular instance of an entity. |
| Entity Type | A model element that specifies the structure, information and behaviors of an entity. |
| Instance | See Entity Instance. |
| OData service | A REST-based service that allows resources, identified using Uniform Resource Locators (URLs) and defined in a model, to be published and edited by Web clients using simple HTTP messages. |
| Metamodel | A model that defines the semantics for the construction of a model. |
| Model | A set of entities and the relationships between them that define the semantics, behavior and state of that set. |
| Resource | A named item of interest. The item may be be a collection of other items. A resource may be assigned a URI that allows it to receive and process messages. A particular instance of a resource is represented in the model by an entity instance. The type of a resource is represented in the model by an entity type. |
| Schema | A formal language representation of a model that conforms to a metamodel. |
| Service Document | The term Service Document is used to refer to a particular resource that is directly accessed via the OData service entry point. This resource serves as a starting point for locating and accessing the other resources and associated metadata that together make up an instance of a Swordfish Service. See also OData Service Document |
| Swordfish service | A service that is a Redfish service and that implements Swordfish extensions to the Redfish model that conform to the requirements of this document. |

## 4.2.2 Symbols and abbreviated terms

None in this document.

# 4.3 Reference to Redfish terms

Many terms in this document were originally defined in the Redfish Specification. Some of the more common terms and definitions are reproduced here, as an aid to the reader.

Table 3: Redfish terms

| Term | Definition (as of 24 January 2017) |
|---|---|
| OData | The Open Data Protocol, as defined in OData-Protocol. |

| Term | Definition (as of 24 January 2017) |
|---|---|
| OData Service Document | The name for a resource that provides information about the Service Root. The Service Document provides a standard format for enumerating the resources exposed by the service that enables generic hypermedia-driven OData clients to navigate to the resources of the Redfish Service. See also Service Document |
| Redfish Schema | The CSDL defintion of Redfish resources. |
| Redfish service | An OData service that conforms to requirements of the Redfish specification. |
| Redfish Service Entry Point | Also referred to as "Service Entry Point". An URI through which a particular instance of a Redfish Service is accessed. A Redfish Service may have more than one Service Entry Point |
| Request | A message from a Client to a Server. It consists of a request line (which includes the Operation), request headers, an empty line and an optional message body. |
| Service Root | The term Service Root is used to refer to a particular resource that is directly accessed via the Redfish service entry point. This resource serves as a starting point for locating and accessing the other resources and associated metadata that together make up an instance of a Redfish Service. |

## 4.4 Keywords (normative language terms)

This document conforms to ISO/IEC Directives, Part 2 for keyword usage. The most common terms and their intended meanings are summarized below.

Table 4: Normative language terms

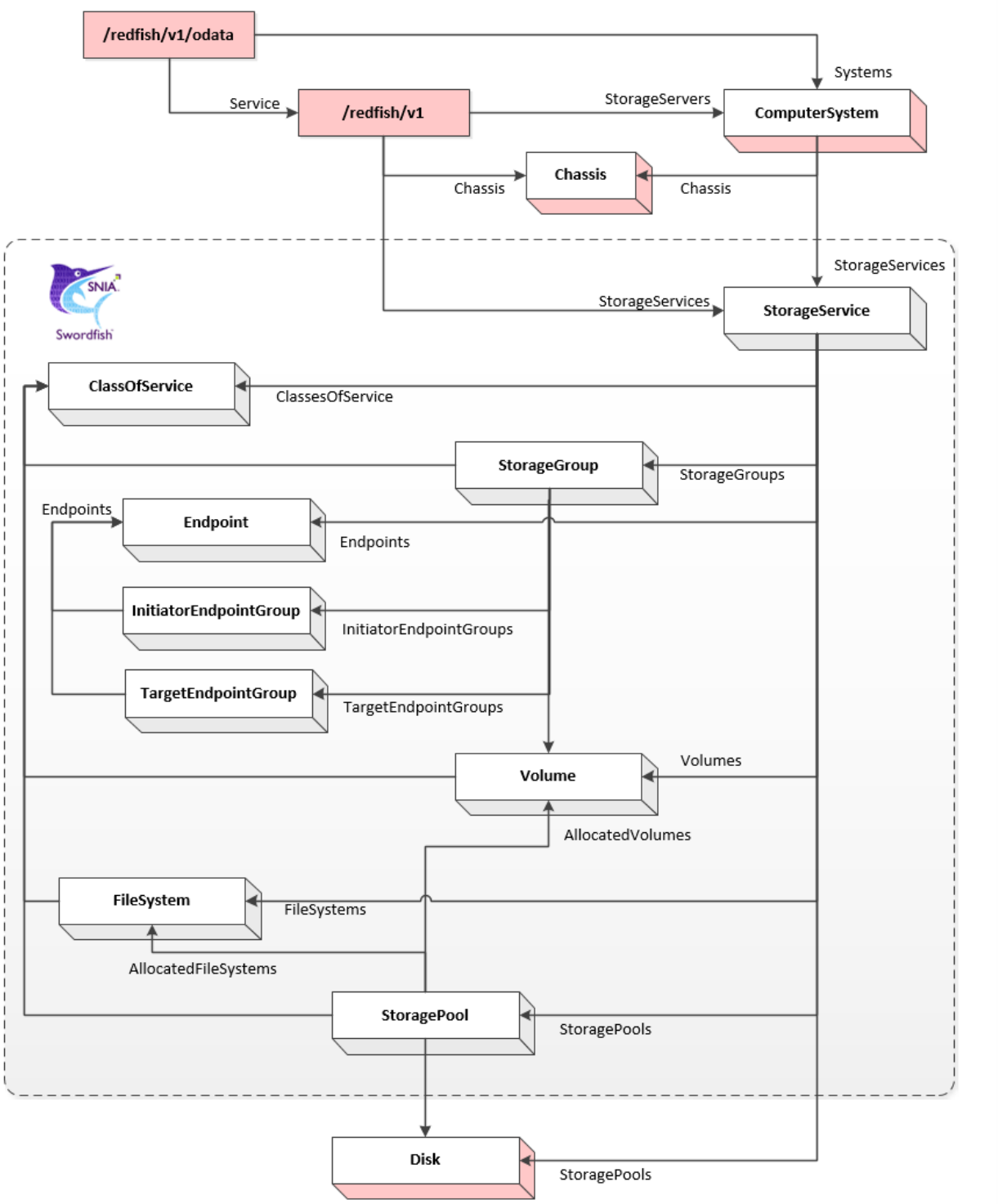
| Term(s) | Meaning |
|---|---|
| shall / shall not | Used to identify objectively verifiable criteria to be fulfilled and from which no deviation is permitted if compliance with the document is to be claimed |
| should / should not | Used to identify a suggested possible choice or course of action deemed to be particularly suitable without necessarily mentioning or excluding others |
| may / need not | Used to convey consent or liberty (or opportunity) to do something |
| can / cannot | Expected or conceivable material, physical or causal outcome |
| must | Identifies a constraint or obligation on the user of the document, typically due to one or more legal requirements or laws of nature, that is not stated as a provision of the standard<br>*NB:* "must" is not an alternative for "shall", and should only be used for constraints that arise from outside this standard |

# 5 Swordfish Overview

# 5.1 Introduction

The Swordfish Scalable Storage Management API ("Swordfish") defines a RESTful interface and a standardized data model to provide a scalable, customer-centric interface for managing storage and related data services. It extends the Redfish Scalable Platforms Management API Specification (DSP0266) from the DMTF.

# 5.2 Relation to Redfish



The Swordfish service interface extends the Redfish service interface. As such, a Swordfish service is a Redfish service and includes all required elements of the Redfish model.

Storage systems managed by the Swordfish storage service are located in the `ServiceRoot` (and `ServiceContainer`) via the `StorageSystems` resource collection. They are modeled using Redfish `ComputerSystems`. The physical infrastructure is modeled using Redfish `Chassis`.

Each Swordfish `StorageService` is located in the `ServiceRoot` (and `ServiceContainer`) via the `StorageServices` resource collection. All Swordfish defined instances are located through `StorageService` intances. A Swordfish management client may focus entirely on entities defined by the Swordfish schema.

The combined Redfish and Swordfish models defines information requirements and constraints on the values that are used as input or output of the operations supported by the Swordfish interface. The Swordfish interface relies on the operations specified by the OData REST protocol (#normative-references). Additional operations (known as Actions) are also defined by the model. The information content is defined by a schema specified using the Common Schema Definition Language (CSDL) (#normative-references) defined by the OData organization within OASIS (https://www.oasis-open.org/).

Each Swordfish service is accessed via well known URLs on the system supporting the Swordfish Service. Since Swordfish is an extension of Redfish, these URLs are the same as for accessing the Redfish defined aspects of the service.

## 5.2.1 The ServiceRoot and ServiceContainer entities

### 5.2.1.1 Overview

A **GET** of `/redfish/v1` will return the `ServiceRoot` entity. A **GET** of `/redfish/v1/odata` will return the `ServiceContainer` instances that represents the OData service document. Each of these instances provides links to the remainder of the system.

The following are the elements utilized for Swordfish management.

- `Systems`: A reference to a Systems resource collection;
- `Chassis`: A reference to a Chasis resource collection;
- `StorageSystems`: A reference to a StorageSystems resource collection;
- `StorageServices`: A reference to a StorageServices resource collection.

### 5.2.1.2 The Systems resource collection

A resource collection that references a set of `ComputerSystem` resources that each represents a general purpose application server. Each `ComputerSystem` resource will have an entry with the value of "ApplicationServer" in its `HostingRoles` property. A particular `ComputerSystem` resource can be in both the StorageSystems collection and the Systems collection.

### 5.2.1.3 The Chassis resource collection

A resource collection that references a set of `Chassis` resources. Each Chassis resource represents physical containers, (i.e. sheet-metal confined spaces and logical zones like racks, enclosures, chassis and all other containers). Subsystems (like sensors), which operate outside of a system's data plane (meaning the resources are not accessible to software running on the system) are linked either directly or indirectly through this resource.

### 5.2.1.4 The StorageSystems resource collection

A reference to a `ComputerSystemCollection` with members of type `ComputerSystem` that support storage services. These

`ComputerSystem` resources represent systems that support Swordfish storage management services. They will have an entry with the value of "StorageServer" in their `HostingRoles` property.A resource collection that references a set of `ComputerSystem` resources that each represents a storage server. Each `ComputerSystem` resource will have an entry with the value of "StorageServer" in its `HostingRoles` property. A particular `ComputerSystem` resource can be a member of both the `StorageSystems` resource collection and the `Systems` resource collection.

#### 5.2.1.5 The StorageServices resource collection

A reference to a `StorageServiceCollection` with members that are of type `StorageService`. A resource collection that references a set of `StorageService` resources. Each `StorageService` resource represents the resources and behaviors supported by that storage service.

# 5.3 Storage Services

## 5.3.1 The StorageService resource

The storage service is hosted on a storage system and exposes logical storage, associated resources and related functionality. Storage service resources can be found in the service root or service container via the `StorageServices` resource collection.

The following are the principal properties of `StorageService` that point to resources managed or defined by the storage service:

- `ClassesOfService`: A reference to a resource collection that specifies the supported `ClassOfService` resources.
- `ClientEndpointGroups`: A reference to a resource collection that collects `ClientEndpointGroup` resources.
- `Drives`: A reference to a resource collection that collects `Drive` resources used for storage.
- `Enclosures`: A reference to a resource collection that collects Chassis resources that contain storage related resources.
- `Endponts`: A reference to a resource collection that collects`Endpoint` resources used to access storage.
- `FileSystems`: A reference to a resource collection that collects `FileSystem` resources.
- `ServerEndpointGroups`: A reference to a resource collection that collects `ServerEndpointGroup` resources.
- `StorageGroups`: A reference to a resource collection that collects `StorageGroup` resources.
- `StoragePools`: A reference to a resource collection that collects `StorageGroup` resources.
- `Volumes`: A reference to a resource collection that collects `Volume` resources.
- `HostingSystem`: A reference to the `ComputerSystem` instance that hosts this `StorageService`.

The following properties each include a set of attributes that each describe a range of capabilities that the storage service can support for a particular kind of service.

- `DataProtectionLoSCapabilities`: Replicas that protects data from loss.
- `DataSecurityLoSCapabilities`: Data security service level requirements. The data security characteristics enable the storage system to be used in an environment where compliance with an externally-specified security standard or standards is required. Examples of such standards include FIPS-140, HIPAA and PCI.
- `DataStorageLoSCapabilities`: Provisioning and access characteristics for storage of the data.
- `IOConnectivityLoSCapabilities`: IO connectivity requirements for access to the data.
- `IOPerformanceLoSCapabilities`: IO performance requirements for access to the data.

In each of the above, not all combinations of attribute values are likely to be supported by the storage service.

Known supported combinations of attribute values are used to construct entries in the `LinesOfService` array property. Not all attributes of a line of service entry need be specified (i.e. some may be Null). If an attribute has no value, the storage service may choose any supported values when provisioning for that entry. Otherwise, the line of service attribute values specifies the kind or level of service

to be provided.

# 5.4 The ClassOfService resource

A class of service represents a choice of utility or warranty offered to customers by a service. (ITIL uses the term `service option`. See the Normative References.)

Each `ClassOfService` resource is a uniquely named description of the characteristics of one choice of utility or warranty for a service. Each `ClassOfService` is a description of the kind and quality of service to provide and is not intended to describe how the service provides that service.

Each `ClassOfService` is defined by an aggregation of lines of service. Supported lines of service are listed in the corresponding capabilities attributes of the storage service, (see above).

Currently defined lines of service are:

- Data Protection: Describes the characteristics of a replica that protects data from loss.
- Data Security: Describe data security service level requirements. The data security characteristics enable the storage system to be used in an environment where compliance with an externally-specified security standard or standards is required. Examples of such standards include FIPS-140, HIPAA and PCI.
- Data Storage: Describes provisioning and access characteristics for storage of the data.
- IO Connectivity: Describes IO connectivity requirements for access to the data.
- IO Performance: Describes the IO performance requirements for access to the data under a particular workload.

Some advertised `ClassOfService` resources are created by the service implementation. These are generally not changeable and are intrinsic to the implementation.

A service may support creation or modification of `ClassOfService` resources. All must be consistent with the capabilities of the service.

# 5.5 The Endpoint resource

Endpoints represent one end of a protocol specific connection that supports sending or receiving messages according to a particular protocol.

# 5.6 The Endpoint Collection resource

The `Endpoint` Group is resource collection that references a set of `Endpoint` resources.

# 5.7 The EndpointGroup resource

The `EndpointGroup` is a resource that represents a set of `Endpoint` resources that have the same management characteristics and which will all have the same access state.

# 5.8 The EndpointGroupCollection resource

The `EndpointGroupCollection` is resource collection that references a set of `EndpointGroup` resources.

# 5.9 The StorageGroup resource

StorageGroups represent a set of volumes that are managed as a group with the same consistency requirements. The volumes of a storage group are collectively exposed or hidden to a set of clients.

The set of volumes is specified by the `Volumes` attribute, which is a resource collection that references volumes.

The set of client endpoints to which the volumes can be exposed is specified by the `ClientEndpointGroups`attribute. The `ClientEndpointGroup` resource specifies a collection of `EndpointGroup` resources.

The set of server endpoints to which the volumes can be exposed is specified by the `ServerEndpointGroups`attribute. The `ServerEndpointGroup` resource specifies a collection of `EndpointGroup` resources.

# 5.10 The StoragePool resource

The `StoragePool` resource represents unassigned storage capacity that can be used to produce storage volumes or other storage pools, which conform to one or more classes of service.

The following are the principal properties of `StoragePool` that are used to identify resources provisioned or supported by the storage pool:

- `ClassesOfService`: A reference to a resource collection that specifies the set `ClassOfService` resources that can be specified when provisioning resources from the storage pool.
- `AllocatedVolumes`: A reference to a resource collection that collects `Volume` resources that have been provisioned from the storage pool.
- `AllocatedPools`: A reference to a resource collection that collects `StoragePool` resources that have been provisioned from the storage pool.
- `DefaultClassOfService`: A reference to the default `ClassOfService` resources used for provisioning from the storage pool.

# 5.11 The Volume resource

`Volume` resource represents a block-addressable container of storage, sometimes referred to as a "Logical Unit", "LU", "LUN", or "StorageVolume" in the storage industry. Volumes optionally adhere to a `ClassOfService`, which defines added functionality. Examples include:

- Access capabilities
- Capacity and capacity sources
- Consumption tracking (e.g., LowSpaceWarningThresholdPercents)
- Replication details
- StorageGroup Information

## 5.12 The FileSystem resource

This `FileSystem` resource represents a file system. File systems represent file-addressable capacity that are conformant to a `ClassOfService`. Each `FileSystem` may contain a collection of `FileShares` that can be presented to hosts.

# 6 Data model

## 6.1 Swordfish extensions to Redfish

### 6.1.1 Overview

Redfish has added two properties to the ServiceRoot that provide access to Swordfish resources.

The first is `StorageSystems`. This property references a collection of `ComputerSystem` resources that each support Swordfish functionality. Each such `ComputerSystem` shall have:

- an entry in its `HostingRoles` property with the value of `StorageServer`
- at least one entry in its `StorageServices.Members` property.

The second is `StorageServices`. This property references a collection of `StorageService` resources. It provides the client an efficient means to search across all `StorageService` resources, regardless of which `ComputerSystem` is supporting the service.

### 6.1.2 Swordfish and Redfish specific OEM or vendor extensions

The Swordfish and Redfish models are extended by subclassing the `OEM` `ComplexTypes` that are defined in the Swordfish and Redfish schemas.

### 6.1.3 OData specific OEM or vendor extensions

In addition to extending the Redfish model as described above. An OEM may extend the Redfish `ServiceContainer` by defining a new `EntityContainer` that extends the ServiceContainer found in the Redfish ServiceRoot_v1.xml file, (see OData EntityContainer).

> Note: This has the same semantics as subclassing in a typical object oriented environment.

An OEM extended implementation of the Swordfish service would access OEM extensions to `EntityContainer` via the service entry-point `/redfish/v1/odata`.

## 6.2 Entity Sets

The Swordfish model does not currently expose any explicitly defined entity sets. OData specifies that an entity set is defined for each NavigationProperty that is defined as a collection and that has the ContainsTarget attribute set to true. In all other cases, Swordfish assumes that an entity set is defined globally within the implementation for each entity type. This is effectively the same as if the entity

sets were explicitly defined in the ServiceRoot entity container.

# 6.3 Addressing entities within a collection

An instance (entity) of an EntityType is uniquely identified within its entity set by its key. The URI for the reference may specify the key using one of two general strategies

1. OData recommends specifying the key value within parenthesis following the path segment that identifies the referencing entity set. (See clause "Canonical URL" in in OData)
2. Redfish common practice is to use an alternative form that adds a path segment having the value of the key following the path segment that identifies the referencing collection. (See clause "Alternate Key-as-Segment Syntax" in OData.)

A Swordfish implementation shall support both strategies.

# 6.4 Addressing members of a ResourceCollection

Redfish specifies that subclasses of ResourceCollection shall include a Members collection property (See clause "Collection resource response" in DSP0266)

Redfish allows a POST request to a ResourceCollection to be equivalent to the same POST request to the Members property of that ResourceCollection.
For a particular ResourceCollection, if a Swordfish implementation supports either form, it shall support both.

It is common practice in Redfish to also eliminate the Members property from any request URI that navigates through a type hierarchy that includes a Member within a ResourceCollection. Care should be taken when defining and using a ResourceCollection subclass to not introduce ambiguities when an explicit reference to a Members property is dropped from a request URI.

# 6.5 Schema repository

The primary online source for the Swordfish schema shall be co-located on the DMTF schema site with the Redfish schema: http://redfish.dmtf.org/schemas/swordfish Developers may also download the schema as part of the Swordfish bundle from snia.org (refer to snia.org/swordfish for pointers to the bundle locations).

Implementations should refer either to the versions available on the dmtf.org site or to locally provided instances of the schema.

# 6.6 Referencing other schemas

Swordfish directly reference the following Redfish schemas. - Chassis - ChassisCollection - ComputerSystem - ComputerSystemCollection - Drive - Endpoint - EthernetInterface - EventService - Location - RedfishExtensions - Redundancy - ResourceTask - Schedule - ServiceContainer - ServiceRoot

Other Redfish schema may be added by inference or directly to implementations. Examples are available in the Swordfish mockups.

# 7 Schema Considerations

## 7.1 Schema Introduction and Overview

A complete Swordfish implementation includes a Redfish-defined Service Root, is instantiated upon a StorageSystem/ComputerSystem, and runs on a Redfish Chassis. At the same time, a storage client may focus entirely on the storage schema instantiations and never interact with the Redfish portion of an implementation.

Swordfish is defined in terms of schema extended from Redfish which are defined below. This section provides additional definition and context for these schema.

## 7.2 Common schema attributes

The following table lists common schema attributes used in the definition of Swordfish, for details see CSDL

Table 5: Schema attributes

| Name | Applies to | Description |
|---|---|---|
| Abstract | ComplexType, EntityType | If true, the entity may not be instantiated |
| BaseType | ComplexType, EntityType | Names an inherited element. |
| DefaultValue | Property | The value of a property if not explicitly set |
| Name | All | The name of the schema element |
| Nullable | NavigationProperty, Property | If false, the qualified property shall have a value. The default value is true. A navigation property whose Type attribute specifies a collection shall not specify Nullable=false, as the collection always exists, but may just be empty. *Note: Null is not itself a value, but is an indication of no value.* |
| Type | Property | The type of the element |

## 7.3 Default values and NULLABLE attributes

The interaction of `Nullable` and `DefaultValue` needs to be clearly understood by both implementers and client developers. The possible combinations of are summarized in Table 6. The table contains:

- **Nullable**: True, if a given property may be NULL
- **DefaultValue**: True, if a default value is provided for a given property
- **Client**: True, if a client value is supplied for a given property in a query or response
- **Result**: The resultant value of the given property. One of:
  - *C*: The client-provided value
  - *D*: The default value
  - *Null*: Null
  - *I*: Implementation defined
  - *Error*: Error state

Table 6: Default and Nullable Interaction

| Nullable | DefaultValue | Client | Value |
|---|---|---|---|
| T | T | T | C |
| T | T | F | D |
| T | F | T | C |
| T | F | F | I or Null |
| F | T | T | C |
| F | T | F | D |
| F | F | T | C |
| F | F | F | I or Error |

# 7.4 Common schema annotations

The following table lists common annotation used in the definition of Swordfish, for details see OData Capabilities Vocabulary, OData Core Vocabulary, OData Measures Vocabulary, and Redfish Extensions,

Table 7: Schema annotations

| Name | Applies to | Description |
|---|---|---|
| AllowableValues | Parameter | The set of allowable values for a parameter |
| AutoExpand | NavigationProperty | If true, return expand the target element |
| AutoExpandReferences | NavigationProperty | If true, return references to the target element |
| ConformanceLevel | EntityContainer | Specifies OData conformance level |
| Deprecated | All | Specifies that the element may be removed in future major revisions, but shall continue to be supported as specified in the current revision. |
| Description | All | A brief description of a model element |
| LongDescription | All | A normative description of a model element |
| Maximum | Parameter, Property | Maximum value that an integer property or parameter may have |
| Minimum | Parameter, Property | Minimum value that an integer property or parameter may have |
| Pattern | Parameter, Property | Specifies a pattern that the value shall match |
| Permissions | NavigationProperty, Property | Access permission for the property. |
| Required | NavigationProperty, Property | If true, property is required to be supported by the service. The default is optional. |
| RequiredIOnCreate | NavigationProperty, Property | If true, property is required on creation |
| Unit | Property | The unit of measure for the value. |

## 7.5 Schema repository

The primary online source for the Swordfish schema shall be co-located on the DMTF schema site with the Redfish schema: http://redfish.dmtf.org/schemas/swordfish Developers may also download the schema as part of the Swordfish bundle from snia.org (refer to snia.org/swordfish for pointers to the bundle locations).

Implementations should refer either to the versions available on the dmtf.org site or to locally provided instances of the schema.

## 7.6 Referencing other schemas

Swordfish directly references the following Redfish schemas:

| Redfish Schema |
|---|
| Chassis |
| ChassisCollection |
| ComputerSystem |
| ComputerSystemCollection |
| Drive |
| Endpoint |
| EthernetInterface |
| EventService |
| Location |
| RedfishExtensions |
| Redundancy |
| ResourceTask |
| Schedule |
| ServiceContainer |
| ServiceRoot |

Other Redfish schema may be added by inference or directly to implementations. Examples are available in the Swordfish mockups.

# 8 Implementation requirements

## 8.1 Security

This document generally adheres to the security requirements defined in the Redfish Specification. It extends the Redfish security model in one important way:

- Swordfish implementations shall implement TLS version 1.2 or greater.

# 8.2 General constraints

The Swordfish service interface extends the Redfish service interface. As such, a Swordfish service is a Redfish service and all required elements of the Redfish model shall be present in a Swordfish model.

Swordfish functionality shall not conflict with any previously defined Redfish functionality but it may add to or extend it, and it may add additional constraints on Redfish functionality.

Additionally, any functionality desired in a Swordfish implementation that is specified in Redfish shall follow the requirements as specified in the Redfish specification.

# 8.3 Discovering Swordfish resources

Each Swordfish implementation supports the following well-known URLs, as defined in Redfish. Specifically:

- `/Redfish`, which contains one or more version properties for the integrated Swordfish and Redfish implementation, starting with `v1`.
- `/Redfish/v1`, which addresses a `ServiceRoot` instance, which defines the Redfish default principal starting information for version 1 implementation of an integrated Redfish and Swordfish service. A GET operation to it shall retrieve the value of an instance of a `ServiceRoot` `EntityType` as defined in the ServiceRoot_v1.xml file.
- `/Redfish/v1/odata`, which addresses a `ServiceContainer` instance, which defines OData conformant principal starting information for the same version 1 implementation of an integrated Redfish and Swordfish service. A GET operation shall retrieve the value of an instance of a `ServiceContainer` `EntityContainer` as defined in the ServiceRoot_v1.xml file.

> Note: Since the `ServiceContainer` is required to return an `@odata.context` value of `/redfish/v1`, all other elements accessed via it will be the same elements found via the `ServiceRoot`.

> Note: A Swordfish service is a Redfish service with extensions to support storage management. No additional service entry-points are necessary.

Both the `ServiceRoot` and `ServiceContainer` contain a resource collection named `Systems` that lists `ComputerSystem` instances. A `ComputerSystem` instance that supports Swordfish defined services will have a value of "StorageServer" in an entry of its `HostingRoles` property.

The `ServiceContainer` additionally has a Service attribute that references the `ServiceRoot` resource.

Regardless of starting point, the property values of the `ServiceRoot` instance enable navigation to all other resources exposed by the Swordfish service.

# 8.4 ClassOfService requirements

Each `ClassOfService` shall include at least one line of service. The providing server shall assure that the line of service values of a `ClassOfService` collectively represent a supported choice of service.

# 8.5 StorageSystems requirements

This property of the `ServiceRoot` references a collection of `ComputerSystem` resources that each support Swordfish functionality. Each `ComputerSystem` included in the `StorageSystems` entry in the `ServiceRoot` shall have:

- an entry in its `HostingRoles` property with the value of `StorageServer`
- at least one entry in its `StorageServices.Members` property.

## 8.6 Entity Sets

The Swordfish model does not currently expose any explicitly defined entity sets. OData specifies that an entity set is defined for each NavigationProperty that is defined as a collection and that has the ContainsTarget attribute set to true. In all other cases, Swordfish assumes that an entity set is defined globally within the implementation for each entity type. This is effectively the same as if the entity sets were explicitly defined in the ServiceRoot entity container.

## 8.7 Addressing entities within a collection

An instance (entity) of an EntityType is uniquely identified within its entity set by its key. The URI for the reference may specify the key using one of two general strategies

1. OData recommends specifying the key value within parenthesis following the path segment that identifies the referencing entity set. (See clause "Canonical URL" in in OData)
2. Redfish common practice is to use an alternative form that adds a path segment having the value of the key following the path segment that identifies the referencing collection. (See clause "Alternate Key-as-Segment Syntax" in OData.)

A Swordfish implementation shall support both strategies.

## 8.8 Addressing members of a ResourceCollection

Redfish specifies that subclasses of ResourceCollection shall include a Members collection property (See clause "Collection resource response" in DSP0266)

Redfish allows a POST request to a ResourceCollection to be equivalent to the same POST request to the Members property of that ResourceCollection. For a particular ResourceCollection, if a Swordfish implementation supports either form, it shall support both.

It is common practice in Redfish to also eliminate the Members property from any request URI that navigates through a type hierarchy that includes a Member within a ResourceCollection. Care should be taken when defining and using a ResourceCollection subclass to not introduce ambiguities when an explicit reference to a Members property is dropped from a request URI.

# 9 Swordfish type definitions

## 9.1 Overview

The following sections define the schema and type definitions that make up a Swordfish implementation. Each data type or entity within the schema includes a description that defines its implementation requirements and their interaction.

# 9.2 ClassOfService 1.0.0

This resource shall define a service option composed of one or more service options. ITIL defines a service option as a choice of utility or warranty for a service.

| | | |
|---|---|---|
| **ClassOfServiceVersion** | string, null<br><br>*read-write* | The version describing the creation or last modification of this service option specification. The string representing the version shall be in the form: M + '.' + N + '.' + U Where: M - The major version (in numeric form). N - The minor version (in numeric form). U - The update (e.g. errata or patch in numeric form). |
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **LinesOfService** { | object, null<br><br>*read-write* | The value of this property shall define the required choices of utility or warranty. |
| **DataProtectionLinesOfService** [ {} ] | array<br><br>*read-write* | The value shall be a set of data protection service options. Within a class of service, one data protection service option shall be present for each replication session. |
| **DataSecurityLinesOfService** [ {} ] | array<br><br>*read-write* | The value shall be a set of data security service options. |
| **DataStorageLinesOfService** [ {} ] | array<br><br>*read-write* | The value shall be a set of data protection service options. |
| **IOConnectivityLinesOfService** [ {} ] | array<br><br>*read-write* | The value shall be a set of IO connectivity service options. Within a class of service, at most one IO connectivity service option may be present for a value of AccessProtocol. |
| **IOPerformanceLinesOfService** [ {} ] | array<br><br>*read-write* | The value shall be a set of IO performance service options. |

| | | |
|---|---|---|
| } | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.3 ClassOfServiceCollection

This collection shall contain references to all ClassOfService resource instances sharing the same parent resource.

| | | |
|---|---|---|
| **Description** | null *read-write* | |
| **Members** [ { | array *read-only* | The value of each member entry shall reference a ClassOfService resource. |
| **ClassOfServiceVersion** | string, null *read-write* | The version describing the creation or last modification of this service option specification. The string representing the version shall be in the form: M + '.' + N + '.' + U Where: M - The major version (in numeric form). N - The minor version (in numeric form). U - The update (e.g. errata or patch in numeric form). |
| **Description** | null *read-write* | |
| **Id** | *read-only* | |
| **Identifier** | null *read-write* | The value shall be unique within the managed ecosystem. |
| **LinesOfService** {} | object, null *read-write* | The value of this property shall define the required choices of utility or warranty. |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } ] | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.4 DataProtectionLoSCapabilities 1.0.0

The capabilities to protect data from loss by the use of a replica. The requirements shall be met collectively by the communication path and the replica. There should be one instance associated to a class of service for each replica. Each replica independently should have a class of service that describes its characteristics.

| | | |
|---|---|---|
| **Description** | null *read-write* | |
| **Id** | *read-only* | |
| **Identifier** | null *read-write* | The value shall be unique within the managed ecosystem. |
| **Links** { | object *read-only* | The value of this property shall contains links to other resources that are not contained in this resource. |
| **Oem** | *read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |

| | | |
|---|---|---|
| **SupportedReplicaOptions** [ {} ] | array<br><br>*read-write* | The collection shall contain known and supported replica Classes of Service. |
| } | | |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **SupportedDataProtectionLinesOfService** [ { | array<br><br>*read-write* | The collection shall contain known and supported DataProtectionLinesOfService. |
| **IsIsolated** | boolean, null<br><br>*read-write* | True shall indicate that the replica is in a separate fault domain from its source. The default value of this property is false. |
| **MinLifetime** | number, null<br><br>*read-write* | The value of each entry shall be an ISO 8601 duration that shall specify the minimum supported lifetime. Note: The maximum number of replicas can be determined using this value together with the replicaSchedule. |
| **Name** | null<br><br>*read-write* | |
| **RecoveryGeographicObjective** | string, null<br><br>*read-write* | The value specifies the geograhic scope of the failure domain. *See Property Details, below, for more information about this property.* |
| **RecoveryPointObjective** | string, null<br><br>*read-write* | The value of each entry shall be an ISO 8601 duration that shall specify a bound on the the amount of source data that can be lost on failure. |
| **RecoveryTimeObjective** | string, null<br><br>*read-write* | The maximum time required to access an alternate replica shall be less than this time interval. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **ReplicaAccessLocation** {} | object, null<br><br>*read-write* | This value shall be used if the data access location of the replica is required to be at a specific location. Note 1: The location value may be granular. Note 2: A value may be required for some regulatory compliance. |
| **ReplicaClassOfService** {} | object, null<br><br>*read-write* | The value shall reference the class of service that defines the required service levels of the replica. |
| **ReplicaType** | string, null<br><br>*read-write* | The type of replica shall conform to this value. *See Property Details, below, for more information about this property*. |
| **Schedule** {} | object, null<br><br>*read-write* | If a replica is made periodically, the value shall define the schedule. |
| } ] | | |
| **SupportedMinLifetime** [ {} ] | array<br><br>*read-write* | The value of each entry shall be an ISO 8601 duration that shall specify the minimum lifetime or the replica. |
| **SupportedRecoveryGeographicObjectives** [ {} ] | array<br><br>*read-write* | The value of each entry shall specify a supported failure domain. |
| **SupportedRecoveryPointObjectiveSeconds** [ {} ] | array<br><br>*read-write* | The value of each entry shall specify a supported time interval defining the maximum source information that may be lost on failure |
| **SupportedRecoveryTimeObjectives** [ {} ] | array<br><br>*read-write* | The value of each entry shall specify a supported expectation for time to access an alternate replica. |
| **SupportedReplicaTypes** [ {} ] | array<br><br>*read-write* | The value of each entry shall specify a supported replica type |
| **SupportsIsolated** | boolean, null<br><br>*read-write* | A value of true shall indicate that allocating a replica in a separate fault domain is supported. The default value for this property is false. |

### 9.4.1 Property Details

#### 9.4.1.1 RecoveryGeographicObjective:

| string | Description |
|---|---|
| Datacenter | A facility that provides communication, power, or cooling infrastructure to a co-located set of servers, networking and storage. |
| Rack | A container within a datacenter that provides communication, power, or cooling to a set of components. |
| RackGroup | A set of racks that may share common communication, power, or cooling. |
| Region | A set of resources that are required to be either geographically or politically isolated from resources not in the resources. |
| Row | A set of adjacent racks or rackgroups that may share common communication, power, or cooling. |
| Server | Components of a CPU/memory complex that share the same infrastructure. |

#### 9.4.1.2 RecoveryTimeObjective:

| string | Description |
|---|---|
| Immediate | Access to synchronous replicas shall be instantaneous. |
| Nearline | Access to a replica shall be consistent with switching access to a different path through a different front-end interconnection infrastructure. Some inconsistency may occur. A restore step may be required before recovery can commence. |
| Offline | Access to a replica may take a significant amount of time. No direct connection to the replica is assumed. Some inconsistency loss may occur. A restore step is likely to be required. |
| Online | Access to a synchronous replica shall be consistent with switching access to a different path the same front-end interconnect. A restore step shall not be required. |

#### 9.4.1.3 ReplicaType:

| string | Description |
|---|---|
| Clone | This enumeration literal shall indicate that replication shall create a point in time, full copy the source. |
| Mirror | This enumeration literal shall indicate that replication shall create and maintain a copy of the source. |
| Snapshot | This enumeration literal shall indicate that replication shall create a point in time, virtual copy of the source. |
| TokenizedClone | This enumeration literal shall indicate that replication shall create a token based clone. |

## 9.5 DataSecurityLoSCapabilities 1.0.0

This resource may be used to describe data security capabilities.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **Id** | *read-only* | |
| **Identifier** | null<br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **SupportedAntivirusEngineProviders** [ {} ] | array<br>*read-write* | The entry values shall specify supported AntiVirus providers. |
| **SupportedAntivirusScanPolicies** [ {} ] | array<br>*read-write* | The enumeration literal shall specify supported policies that trigger an AntiVirus scan. |
| **SupportedChannelEncryptionStrengths** [ {} ] | array<br>*read-write* | The enumeration literal shall specify supported key sizes in a symmetric encryption algorithm (AES) for transport channel encryption. |
| **SupportedDataSanitizationPolicies** [ {} ] | array<br>*read-write* | The enumeration literal shall specify supported data sanitization policies. |
| **SupportedDataSecurityLinesOfService** [ { | array<br>*read-write* | The collection shall contain supported DataSecurity service options. |
| **AntivirusEngineProvider** | string, null<br>*read-write* | The value shall specify an AntiVirus provider. |
| **AntivirusScanPolicies** [ {} ] | array<br>*read-write* | The enumeration literal shall specify the policy for triggering an AntiVirus scan. |

| | | |
|---|---|---|
| **ChannelEncryptionStrength** | string, null<br><br>*read-write* | The enumeration literal shall specify a key size in a symmetric encryption algorithm for transport channel encryption. *See Property Details, below, for more information about this property.* |
| **DataSanitizationPolicy** | string, null<br><br>*read-write* | The enumeration literal shall specify the data sanitization policy. *See Property Details, below, for more information about this property.* |
| **HostAuthenticationType** | string, null<br><br>*read-write* | The enumeration literal shall specify the authentication type for hosts (servers) or initiator endpoints. *See Property Details, below, for more information about this property.* |
| **MediaEncryptionStrength** | string, null<br><br>*read-write* | The enumeration literal shall specify a key size in a symmetric encryption algorithm for media encryption. *See Property Details, below, for more information about this property.* |
| **Name** | null<br><br>*read-write* | |
| **SecureChannelProtocol** | string, null<br><br>*read-write* | The enumeration literal shall specify the protocol that provide encrypted communication. *See Property Details, below, for more information about this property.* |
| **UserAuthenticationType** | string, null<br><br>*read-write* | The enumeration literal shall specify the authentication type for users (or programs). *See Property Details, below, for more information about this property.* |
| } ] | | |
| **SupportedHostAuthenticationTypes** [ {} ] | array<br><br>*read-write* | The enumeration literal shall specify supported authentication types for hosts (servers) or initiator endpoints. |
| **SupportedMediaEncryptionStrengths** [ {} ] | array<br><br>*read-write* | The enumeration literal shall specify supported key sizes in a symmetric encryption algorithm (AES) for media encryption. |
| **SupportedSecureChannelProtocols** [ {} ] | array<br><br>*read-write* | The enumeration literal shall specify supported protocols that provide encrypted communication. |

| | | |
|---|---|---|
| **SupportedUserAuthenticationTypes** [ {} ] | array<br><br>*read-write* | The enumeration literal shall specify supported authentication types for users (or programs). |

## 9.5.1 Property Details

### 9.5.1.1 ChannelEncryptionStrength:

| string | Description |
|---|---|
| Bits_0 | This enumeration literal specifies that there is no key. |
| Bits_112 | This enumeration literal specifies a 3DES 112 bit key. |
| Bits_128 | This enumeration literal specifies an AES 128 bit key. |
| Bits_192 | This enumeration literal specifies an AES 192 bit key. |
| Bits_256 | This enumeration literal specifies an AES 256 bit key. |

### 9.5.1.2 DataSanitizationPolicy:

| string | Description |
|---|---|
| Clear | This enumeration literal specifies to sanitize data in all user-addressable storage locations for protection against simple non-invasive data recovery techniques. |
| CryptographicErase | This enumeration literal specifies to leverages the encryption of target data by enabling sanitization of the target data's encryption key. This leaves only the ciphertext remaining on the media, effectively sanitizing the data by preventing read-access. For more information, see NIST800-88 and ISO/IEC 27040. |
| None | This enumeration literal specifies no sanitization. |

### 9.5.1.3 HostAuthenticationType:

| string | Description |
|---|---|
| None | This enumeration literal specifies No authentication. |
| PKI | This enumeration literal specifies a Public Key Infrastructure. Customers with the highest assurance requirements roll PKI out to hosts and users (it is more common for hosts than users. User PKI-based authentication has significant operational complications and administrative overheads, e.g., smart cards may be involved. |
| Password | This enumeration literal specifies Password/shared-secret: Absent an distributed authentication infrastructure, this is what is typically done. |
| Ticket | This enumeration literal specifies Ticket-based (e.g., Kerberos): This is the most common class of authentication infrastructure used in enterprises. Kerberos is the best known example, and Windows usage of that via Active Directory is so widely deployed as to be a de facto standard. In other areas (e.g., academia) there are comparable ticket-based systems. |

### 9.5.1.4 MediaEncryptionStrength:

| string | Description |
|---|---|
| Bits_0 | This enumeration literal specifies that there is no key. |

| string | Description |
|---|---|
| Bits_112 | This enumeration literal specifies a 3DES 112 bit key. |
| Bits_128 | This enumeration literal specifies an AES 128 bit key. |
| Bits_192 | This enumeration literal specifies an AES 192 bit key. |
| Bits_256 | This enumeration literal specifies an AES 256 bit key. |

#### 9.5.1.5 SecureChannelProtocol:

| string | Description |
|---|---|
| IPsec | This enumeration literal specifies Internet Protocol Security (IPsec), as defined by IETF RFC 2401. |
| None | This enumeration literal specifies no encryption. |
| RPCSEC_GSS | This enumeration literal specifies RPC access to the Generic Security Services Application Programming Interface (GSS-API), as defined by IETF RPC 2203. |
| TLS | This enumeration literal specifies Transport Layer Security (TLS), as defined by IETF RFC 5246. |

#### 9.5.1.6 UserAuthenticationType:

| string | Description |
|---|---|
| None | This enumeration literal specifies No authentication. |
| PKI | This enumeration literal specifies a Public Key Infrastructure. Customers with the highest assurance requirements roll PKI out to hosts and users (it is more common for hosts than users. User PKI-based authentication has significant operational complications and administrative overheads, e.g., smart cards may be involved. |
| Password | This enumeration literal specifies Password/shared-secret: Absent an distributed authentication infrastructure, this is what is typically done. |
| Ticket | This enumeration literal specifies Ticket-based (e.g., Kerberos): This is the most common class of authentication infrastructure used in enterprises. Kerberos is the best known example, and Windows usage of that via Active Directory is so widely deployed as to be a de facto standard. In other areas (e.g., academia) there are comparable ticket-based systems. |

## 9.6 DataStorageLoSCapabilities 1.0.0

Each instance of DataStorageLoSCapabilities describes capabilities of the system to support various data storage service options.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |

| | | |
|---|---|---|
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **SupportedAccessCapabilities** [ {} ] | array<br><br>*read-write* | Each entry specifies a storage access capability. |
| **SupportedDataStorageLinesOfService** [ { | array<br><br>*read-write* | The collection shall contain known and supported DataStorageLinesOfService. |
| **IsSpaceEfficient** | boolean, null<br><br>*read-write* | A value of true shall indicate that the storage is compressed or deduplicated. The default value for this property is false. |
| **Name** | null<br><br>*read-write* | |
| **ProvisioningPolicy** | string, null<br><br>*read-write* | The enumeration literal shall define the provisioning policy for storage. *See Property Details, below, for more information about this property.* |
| **RecoveryTimeObjectives** | null<br><br>*read-write* | The enumeration literal specifies the time after a disaster that the client shall regain conformant service level access to the primary store, typical values are 'immediate' or 'offline'. The expectation is that the services required to implement this capability are part of the advertising system. |
| } ] | | |
| **SupportedProvisioningPolicies** [ {} ] | array<br><br>*read-write* | This collection specifies supported storage allocation policies. |

| | | |
|---|---|---|
| **SupportedRecoveryTimeObjectives** [ {} ] | array<br><br>*read-write* | This collection specifies supported expectations for time to access the primary store after recovery. |
| **SupportsSpaceEfficiency** | boolean, null<br><br>*read-write* | The value specifies whether storage compression or deduplication is supported. The default value for this property is false. |

### 9.6.1 Property Details

#### 9.6.1.1 ProvisioningPolicy:

| string | Description |
|---|---|
| Fixed | This enumeration literal specifies storage shall be fully allocated. |
| Thin | This enumeration literal specifies storage may be over allocated. |

## 9.7 DriveCollection

An instance of this resource shall reference the set of Drive resources known in the scope of its use.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each entry of this property shall reference a Drive resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

## 9.8 EndpointCollection

An instance of this resource shall reference the set of Endpoint resources known in the scope of its use.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an Endpoint resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.9 EndpointGroup 1.0.0

An EndpointGroup represents a collection of endpoints that are managed as a unit. By grouping together a collection of Endpoints, the EndpointGroup allows a collection of entities from differing sources or hosts to be manipulated uniformly and efficiently.

For any given EndpointGroup, all of its endpoints act exclusively as either server endpoints or client endpoints, as indicated by the value of the EndpointType property. Similarly, each Endpoint within a group has the same AccessState.

A server or client may define multiple EndpointGroup entities that access the same set of resources or functionality. A group may be designated as preferred, which signifies that access should be directed through its members in preference to the Endpoints listed in other EndpointGroups. If the value of EndpointType is Server, an EndpointGroup entity can be used to represent target port group as defined by SCSI. In that mode, the value of the TargetEndpointGroupIdentifier should correspond to the target port group number. (See clause "Device Identification VPD page" as defined in the SCSI Primary Commands specification.)

| | | |
|---|---|---|
| **AccessState** | string, null<br><br>*read-write* | Access to all associated resources through all aggregated endpoints shall share this access state. *See Property Details, below, for more information about this property.* |
| **Description** | null<br><br>*read-write* | |
| **Endpoints** { | object, null<br><br>*read-write* | The value of each entry shall reference an Endpoint resource. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an Endpoint resource. |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **GroupType** | string, null *read-write* | The group contains only endpoints of a given type Client/Initiator or Server/Target. If this endpoint group represents a SCSI target group, the value of GroupType shall be Server. *See Property Details, below, for more information about this property.* |
| **Id** | *read-only* | |
| **Identifier** | null *read-write* | The value shall be unique within the managed ecosystem. |
| **Links** { | object *read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **Oem** | *read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| } | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Preferred** | boolean, null *read-write* | A value of True in this property shall indicate that access to the associated resource through the endpoints in this endpoint group is preferred over access through other endpoints. The default value for this property is false. |

| | | |
|---|---|---|
| **TargetEndpointGroupIdentifier** | number, null<br><br>*read-write* | If this endpoint group represents a SCSI target group, the value of this property shall contain a SCSI defined identifier for this group, which corresponds to the TARGET PORT GROUP field in the REPORT TARGET PORT GROUPS response and the TARGET PORT GROUP field in an INQUIRY VPD page 85 response, type 5h identifier. See the INCITS SAM-5 specification. |

## 9.9.1 Property Details

### 9.9.1.1 AccessState:

| string | Description |
|---|---|
| NonOptimized | In the context of this enumeration literal, each endpoint shall be in an Active/NonOptimized state. |
| Optimized | In the context of this enumeration literal, each endpoint shall be in an Active/Optimized state. |
| Standby | In the context of this enumeration literal, each endpoint shall be in a Standby state. |
| Transitioning | In the context of this enumeration literal, at least one endpoint shall be transitioning to a new AccesState. |
| Unavailable | In the context of this enumeration literal, each endpoint shall be in an unavailable state. |

### 9.9.1.2 GroupType:

| string | Description |
|---|---|
| Client | The group contains the client (initiator) endpoints. |
| Server | The group contains the server (target) endpoints. |

# 9.10 EndpointGroupCollection

An instance of this resource shall reference the set of Endpoint group resources known in the scope of its use.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-only* | The value of each member entry shall reference an endpoint group resource. |
| **AccessState** | string, null<br><br>*read-write* | Access to all associated resources through all aggregated endpoints shall share this access state. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Endpoints** {} | object, null<br><br>*read-write* | The value of each entry shall reference an Endpoint resource. |
| **GroupType** | string, null<br><br>*read-write* | The group contains only endpoints of a given type Client/Initiator or Server/Target. If this endpoint group represents a SCSI target group, the value of GroupType shall be Server. *See Property Details, below, for more information about this property*. |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Preferred** | boolean, null<br><br>*read-write* | A value of True in this property shall indicate that access to the associated resource through the endpoints in this endpoint group is preferred over access through other endpoints. The default value for this property is false. |
| **TargetEndpointGroupIdentifier** | number, null<br><br>*read-write* | If this endpoint group represents a SCSI target group, the value of this property shall contain a SCSI defined identifier for this group, which corresponds to the TARGET PORT GROUP field in the REPORT TARGET PORT GROUPS response and the TARGET PORT GROUP field in an INQUIRY VPD page 85 response, type 5h identifier. See the INCITS SAM-5 specification. |
| } ] | | |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

## 9.10.1 Property Details

### 9.10.1.1 AccessState:

| string | Description |
|---|---|
| NonOptimized | In the context of this enumeration literal, each endpoint shall be in an Active/NonOptimized state. |
| Optimized | In the context of this enumeration literal, each endpoint shall be in an Active/Optimized state. |
| Standby | In the context of this enumeration literal, each endpoint shall be in a Standby state. |
| Transitioning | In the context of this enumeration literal, at least one endpoint shall be transitioning to a new AccesState. |
| Unavailable | In the context of this enumeration literal, each endpoint shall be in an unavailable state. |

### 9.10.1.2 GroupType:

| string | Description |
|---|---|
| Client | The group contains the client (initiator) endpoints. |
| Server | The group contains the server (target) endpoints. |

# 9.11 FileShare 1.0.0

This resource shall be used to represent a shared set of files with a common directory structure.

| | | |
|---|---|---|
| **CASupported** | boolean, null<br>*read-write* | The value of this property shall indicate that Continuous Availability is supported. Client/Server mediated recovery from network and server failure with application transparency. This property shall be NULL unless the FileSharingProtocols property includes SMB. The default value for this property is false. |
| **DefaultAccessPrivileges** [ {} ] | array<br>*read-only* | The value of this property shall be an array containing entries for the default access privileges for the file share. Each entry shall specify a defaul access privilege. The types of default access can include Read, Write, and/or Execute. |
| **Description** | null<br>*read-write* | |

| | | |
|---|---|---|
| **EthernetInterfaces** | *read-only* | The value shall be a link to an EthernetInterfaceCollection with members that provide access to the file share. |
| **ExecuteSupport** | boolean, null<br>*read-only* | The value of this property shall indicate whether Execute access is supported by the file share. The default value for this property is false. |
| **FileSharePath** | string, null<br>*read-only* | The value of this property shall be a path (relative to the file system root) to the exported file or directory on the file system where this file share is hosted. |
| **FileShareQuotaType** | string, null<br>*read-write* | If FileShareQuotaType is present, a value of Soft shall specify that quotas are not enforced, and a value of Hard shall specify that writes shall fail if the space consumed would exceed the value of the FileShareTotalQuotaBytes property. *See Property Details, below, for more information about this property.* |
| **FileShareRemainingQuotaBytes** | number, null (By)<br>*read-write* | If present, the value of this property shall indicate the remaining number of bytes that may be consumed by this file share. |
| **FileShareTotalQuotaBytes** | number, null (By)<br>*read-write* | If present, the value of this property shall indicate the maximum number of bytes that may be consumed by this file share. |
| **FileSharingProtocols** [ {} ] | array<br>*read-only* | This property shall be an array containing entries for the file sharing protocols supported by this file share. Each entry shall specify a file sharing protocol supported by the file system. |
| **Id** | *read-only* | |
| **Links** { | object<br>*read-only* | This property shall contain links to other resources that are related to this resource. |

| | | |
|---|---|---|
| **ClassOfService** {} | object, null<br><br>*read-write* | This value shall be a link to the ClassOfService for this file share. |
| **FileSystem** {} | object, null<br><br>*read-write* | The value shall be a link to the file system containing the file share. |
| **Oem** | <br><br>*read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| } | | |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the percentages of file share capacity at which low space warning events are be issued. A LOW_SPACE_THRESHOLD_WARNING event shall be triggered each time the remaining file share capacity value becomes less than one of the values in the array. The following shall be true: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes) |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **RootAccess** | boolean, null<br><br>*read-only* | The value of this property shall indicate whether Root access is allowed by the file share. The default value for this property is false. |
| **Status** | null<br><br>*read-write* | This value of this property shall indicate the status of the file share. |
| **WritePolicy** | string, null<br><br>*read-write* | The value of this property shall define how writes are replicated to the shared source. *See Property Details, below, for more information about this property.* |

## 9.11.1 Property Details

#### 9.11.1.1 FileShareQuotaType:

| string | Description |
|---|---|
| Hard | This value shall indicate that quotas are enabled and enforced. |
| Soft | This value shall indicate that quotas are enabled but not enforced. |

#### 9.11.1.2 WritePolicy:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

## 9.12 FileShareCollection

This resource shall contain a collection of references to FileSystem resource instances.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-only* | This property shall contain references to the members of this FileSystem collection. |
| **CASupported** | boolean, null<br><br>*read-write* | The value of this property shall indicate that Continuous Availability is supported. Client/Server mediated recovery from network and server failure with application transparency. This property shall be NULL unless the FileSharingProtocols property includes SMB. The default value for this property is false. |
| **DefaultAccessPrivileges** [ {} ] | array<br><br>*read-only* | The value of this property shall be an array containing entries for the default access privileges for the file share. Each entry shall specify a defaul access privilege. The types of default access can include Read, Write, and/or Execute. |
| **Description** | null<br><br>*read-write* | |
| **EthernetInterfaces** | <br><br>*read-only* | The value shall be a link to an EthernetInterfaceCollection with members that provide access to the file share. |

| | | |
|---|---|---|
| **ExecuteSupport** | boolean, null<br><br>*read-only* | The value of this property shall indicate whether Execute access is supported by the file share. The default value for this property is false. |
| **FileSharePath** | string, null<br><br>*read-only* | The value of this property shall be a path (relative to the file system root) to the exported file or directory on the file system where this file share is hosted. |
| **FileShareQuotaType** | string, null<br><br>*read-write* | If FileShareQuotaType is present, a value of Soft shall specify that quotas are not enforced, and a value of Hard shall specify that writes shall fail if the space consumed would exceed the value of the FileShareTotalQuotaBytes property. *See Property Details, below, for more information about this property.* |
| **FileShareRemainingQuotaBytes** | number, null (By)<br><br>*read-write* | If present, the value of this property shall indicate the remaining number of bytes that may be consumed by this file share. |
| **FileShareTotalQuotaBytes** | number, null (By)<br><br>*read-write* | If present, the value of this property shall indicate the maximum number of bytes that may be consumed by this file share. |
| **FileSharingProtocols** [ {} ] | array<br><br>*read-only* | This property shall be an array containing entries for the file sharing protocols supported by this file share. Each entry shall specify a file sharing protocol supported by the file system. |
| **Id** | <br><br>*read-only* | |
| **Links** {} | object<br><br>*read-only* | This property shall contain links to other resources that are related to this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the percentages of file share capacity at which low space warning events are be issued. A LOW_SPACE_THRESHOLD_WARNING event shall be triggered each time the remaining file share capacity value becomes less than one of the values in the array. The following shall be true: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes) |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **RootAccess** | boolean, null<br>*read-only* | The value of this property shall indicate whether Root access is allowed by the file share. The default value for this property is false. |
| **Status** | null<br>*read-write* | This value of this property shall indicate the status of the file share. |
| **WritePolicy** | string, null<br>*read-write* | The value of this property shall define how writes are replicated to the shared source. *See Property Details, below, for more information about this property.* |
| } ] | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

## 9.12.1 Property Details

### 9.12.1.1 FileShareQuotaType:

| string | Description |
|---|---|
| Hard | This value shall indicate that quotas are enabled and enforced. |
| Soft | This value shall indicate that quotas are enabled but not enforced. |

### 9.12.1.2 WritePolicy:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |

| string | Description |
|---|---|
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

# 9.13 FileSystem 1.0.1

Add ImportedShares.

| | | |
|---|---|---|
| **AccessCapabilities** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the supported IO access capabilities. Each entry shall specify a current storage access capability. |
| **BlockSizeBytes** | number, null (By)<br><br>*read-only* | The value of this property shall be the block size of the file system in bytes. |
| **Capacity** { | object, null<br><br>*read-write* | The value of this property shall be the capacity allocated to the file system in bytes. |
| **Data** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned user data. |
| **IsThinProvisioned** | boolean, null<br><br>*read-write* | If the value is false, the capacity shall be fully allocated. The default value shall be false. |
| **Metadata** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned system (non-user accessible) data. |
| **Snapshot** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned snapshot or backup data. |

| | | |
|---|---|---|
| } | | |
| **CapacitySources** [ { | array<br><br>*read-write* | This property shall be an array containing entries for all the capacity sources for the file system. Each entry shall provide capacity allocation information from a named resource. |
| **ProvidedCapacity** {} | object, null<br><br>*read-write* | The value shall be the amount of space that has been provided from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidedClassOfService** {} | object, null<br><br>*read-write* | The value shall reference the provided ClassOfService from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidingDrives** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing drive or drives. |
| **ProvidingPools** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing storage pool or storage pools. |
| **ProvidingVolumes** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing volume or volumes. |
| } ] | | |
| **CasePreserved** | boolean, null<br><br>*read-write* | This property shall indicate that the case of file names is preserved by the file system. A value of True shall indicate that case of file names shall be preserved. |
| **CaseSensitive** | boolean, null<br><br>*read-write* | This property shall indicate that case sensitive file names are supported by the file system. A value of True shall indicate that file names are case sensitive. |
| **CharacterCodeSet** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the character sets or encodings supported by the file system. Each entry shall specify a character set encoding supported by the file system. |

| | | |
|---|---|---|
| **ClusterSizeBytes** | number, null (By)<br><br>*read-write* | This value shall specify the minimum file allocation size imposed by the file system. This minimum allocation size shall be the smallest amount of storage allocated to a file by the file system. Under stress conditions, the file system may allocate storage in amounts smaller than this value. |
| **Description** | null<br><br>*read-write* | |
| **ExportedShares** { | object, null<br><br>*read-write* | This property shall be an array of exported file shares of this file system. Each entry shall define an exported file share of this file system. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | This property shall contain references to the members of this FileSystem collection. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Id** | <br><br>*read-only* | |
| **ImportedShares** *(v1.0+)* [ { | array<br><br>*read-only* | The value shall be an array of imported file shares. |
| **CASupported** | boolean, null<br><br>*read-write* | The value of this property shall indicate that Continuous Availability is supported. Client/Server mediated recovery from network and server failure with application transparency. This property shall be NULL unless the FileSharingProtocols property includes SMB. The default value for this property is false. |

| | | |
|---|---|---|
| **DefaultAccessPrivileges** [ {} ] | array<br><br>*read-only* | The value of this property shall be an array containing entries for the default access privileges for the file share. Each entry shall specify a defaul access privilege. The types of default access can include Read, Write, and/or Execute. |
| **Description** | null<br><br>*read-write* | |
| **EthernetInterfaces** | <br><br>*read-only* | The value shall be a link to an EthernetInterfaceCollection with members that provide access to the file share. |
| **ExecuteSupport** | boolean, null<br><br>*read-only* | The value of this property shall indicate whether Execute access is supported by the file share. The default value for this property is false. |
| **FileSharePath** | string, null<br><br>*read-only* | The value of this property shall be a path (relative to the file system root) to the exported file or directory on the file system where this file share is hosted. |
| **FileShareQuotaType** | string, null<br><br>*read-write* | If FileShareQuotaType is present, a value of Soft shall specify that quotas are not enforced, and a value of Hard shall specify that writes shall fail if the space consumed would exceed the value of the FileShareTotalQuotaBytes property. *See Property Details, below, for more information about this property.* |
| **FileShareRemainingQuotaBytes** | number, null (By)<br><br>*read-write* | If present, the value of this property shall indicate the remaining number of bytes that may be consumed by this file share. |
| **FileShareTotalQuotaBytes** | number, null (By)<br><br>*read-write* | If present, the value of this property shall indicate the maximum number of bytes that may be consumed by this file share. |
| **FileSharingProtocols** [ {} ] | array<br><br>*read-only* | This property shall be an array containing entries for the file sharing protocols supported by this file share. Each entry shall specify a file sharing protocol supported by the file system. |
| **Id** | <br><br>*read-only* | |

| | | |
|---|---|---|
| **Links** {} | object<br><br>*read-only* | This property shall contain links to other resources that are related to this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the percentages of file share capacity at which low space warning events are be issued. A LOW_SPACE_THRESHOLD_WARNING event shall be triggered each time the remaining file share capacity value becomes less than one of the values in the array. The following shall be true: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes) |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **RootAccess** | boolean, null<br><br>*read-only* | The value of this property shall indicate whether Root access is allowed by the file share. The default value for this property is false. |
| **Status** | null<br><br>*read-write* | This value of this property shall indicate the status of the file share. |
| **WritePolicy** | string, null<br><br>*read-write* | The value of this property shall define how writes are replicated to the shared source. *See Property Details, below, for more information about this property.* |
| } ] | | |
| **Links** { | object<br><br>*read-only* | This property shall contain links to other resources that are related to this resource. |
| **ClassOfService** {} | object, null<br><br>*read-write* | This value shall be a link to the ClassOfService for this file system. |

| | | |
|---|---|---|
| **Oem** | *read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| **ReplicaCollection** [ {} ] | array<br>*read-only* | This property shall be an array of links to replicas for this file system. Each entry shall be a link to a replica for this file system. |
| } | | |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br>*read-write* | This property shall be an array containing entries for the percentages of file system capacity at which low space warning events are be issued. A LOW_SPACE_THRESHOLD_WARNING event shall be triggered each time the remaining file system capacity value becomes less than one of the values in the array. The following shall be true: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes) |
| **MaxFileNameLengthBytes** | number, null (By)<br>*read-write* | If specified, this value shall specify the maximum length of a file name within the file system. |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **RemainingCapacity** { | object, null<br>*read-write* | The value of this property shall be the remaining capacity allocated to the file system in bytes. |
| **Data** {} | object, null<br>*read-write* | The value shall be capacity information relating to provisioned user data. |
| **IsThinProvisioned** | boolean, null<br>*read-write* | If the value is false, the capacity shall be fully allocated. The default value shall be false. |

| | | |
|---|---|---|
| **Metadata** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned system (non-user accessible) data. |
| **Snapshot** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned snapshot or backup data. |
| } | | |
| **ReplicaInfo** { | object, null<br><br>*read-write* | If this file system is a replica, this value shall describe its replication attributes. This value shall not be present if this file system is not a replica. A file system may be both a source and a replica. |
| **ConsistencyEnabled** | boolean, null<br><br>*read-only* | If true, consistency shall be enabled across the source and its associated target replica(s). The default value for this property is false. |
| **ConsistencyState** | string, null<br><br>*read-write* | The ConsistencyState enumeration literal shall indicate the current state of consistency. *See Property Details, below, for more information about this property.* |
| **ConsistencyStatus** | string, null<br><br>*read-write* | The ConsistencyStatus enumeration literal shall specify the current status of consistency. Consistency may have been disabled or is experiencing an error condition. *See Property Details, below, for more information about this property.* |
| **ConsistencyType** | string, null<br><br>*read-write* | The ConsistencyType enumeration literal shall indicate the consistency type used by the source and its associated target group. *See Property Details, below, for more information about this property.* |
| **FailedCopyStopsHostIO** | boolean, null<br><br>*read-only* | If true, the storage array shall stop receiving data to the source element if copying to a remote element fails. The default value for this property is false. |
| **PercentSynced** | number, null (%)<br><br>*read-only* | Specifies the percent of the work completed to reach synchronization. Shall not be instantiated if implementation is not capable of providing this information. If related to a group, then PercentSynced shall be an average of the PercentSynced across all members of the group. |

| | | |
|---|---|---|
| **Replica** | null<br><br>*read-write* | The value shall reference the resource that is the source of this replica. |
| **ReplicaPriority** | string, null<br><br>*read-write* | The enumeration literal shall specify the priority of background copy engine I/O to be managed relative to host I/O operations during a sequential background copy operation. *See Property Details, below, for more information about this property.* |
| **ReplicaProgressStatus** | string, null<br><br>*read-write* | The ReplicaProgressStatus enumeration literal shall specify the status of the session with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaReadOnlyAccess** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements are read only to the host. *See Property Details, below, for more information about this property.* |
| **ReplicaRecoveryMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the copy operation continues after a broken link is restored. *See Property Details, below, for more information about this property.* |
| **ReplicaRole** | string, null<br><br>*read-write* | The ReplicaRole enumeration literal shall represent the source or target role of this replica as known to the containing resource. *See Property Details, below, for more information about this property.* |
| **ReplicaSkewBytes** | number, null (By)<br><br>*read-only* | Applies to Adaptive mode and it describes maximum number of bytes the SyncedElement (target) can be out of sync. If the number of out-of-sync bytes exceeds the skew value, ReplicaUpdateMode shall be switched to synchronous. |
| **ReplicaState** | string, null<br><br>*read-write* | The ReplicaState enumeration literal shall specify the state of the relationship with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaType** | string, null<br><br>*read-write* | The ReplicaType enumeration literal shall describe the intended outcome of the replication. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **ReplicaUpdateMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the target elements will be updated synchronously or asynchronously. *See Property Details, below, for more information about this property.* |
| **RequestedReplicaState** | string, null<br><br>*read-write* | The last requested or desired state for the relationship. The actual state of the relationship shall be represented by ReplicaState. When RequestedState reaches the requested state, this property shall be null. *See Property Details, below, for more information about this property.* |
| **SyncMaintained** | boolean, null<br><br>*read-only* | If true, Synchronization shall be maintained. The default value for this property is false. |
| **UndiscoveredElement** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements involved in a copy operation are undiscovered. An element is considered undiscovered if its object model is not known to the service performing the copy operation. *See Property Details, below, for more information about this property.* |
| **WhenActivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the point-in-time copy was taken or when the replication relationship is activated, reactivated, resumed or re-established. This property shall be null if the implementation is not capable of providing this information. |
| **WhenDeactivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is deactivated. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenEstablished** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is established. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenSuspended** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is suspended. Do not instantiate this property if implementation is not capable of providing this information. |

| | | |
|---|---|---|
| **WhenSynced** | string, null<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the elements were synchronized. |
| **WhenSynchronized** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is synchronized. Do not instantiate this property if implementation is not capable of providing this information. |
| } | | |

## 9.13.1 Property Details

### 9.13.1.1 ConsistencyState:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target shall be consistent. |
| Inconsistent | This enumeration literal shall indicate that the source and target are not required to be consistent. |

### 9.13.1.2 ConsistencyStatus:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target are consistent. |
| Disabled | This enumeration literal shall indicate that the source and target have consistency disabled. |
| InError | This enumeration literal shall indicate that the source and target are not consistent. |
| InProgress | This enumeration literal shall indicate that the source and target are becoming consistent. |

### 9.13.1.3 ConsistencyType:

| string | Description |
|---|---|
| SequentiallyConsistent | This enumeration literal shall indicate that the source and target shall be sequentially consistent. |

### 9.13.1.4 FileShareQuotaType:

| string | Description |
|---|---|
| Hard | This value shall indicate that quotas are enabled and enforced. |
| Soft | This value shall indicate that quotas are enabled but not enforced. |

### 9.13.1.5 ReplicaPriority:

| string | Description |
|---|---|
| High | Copy engine I/O shall have a higher priority than host I/O. |
| Low | Copy engine I/O shall have a lower priority than host I/O. |
| Same | Copy engine I/O shall have the same priority as host I/O. |
| Urgent | Regardless of the host I/O requests, the Copy operation shall be performed as soon as possible. |

### 9.13.1.6 ReplicaProgressStatus:

| string | Description |
|---|---|
| Aborting | This enumeration literal shall indicate that replication has an abort in progress. |
| Completed | This enumeration literal shall indicate that the request is completed. Data flow is idle. |
| Detaching | This enumeration literal shall indicate that replication has a detach in progress. |
| Dormant | This enumeration literal shall indicate that the data flow is inactive, suspended or quiesced. |
| FailingBack | This enumeration literal shall indicate that replication is undoing the result of failover. |
| FailingOver | This enumeration literal shall indicate that replication is in the process of switching source and target. |
| Fracturing | This enumeration literal shall indicate that replication has a fracture in progress. |
| Initializing | This enumeration literal shall indicate that replication is in the process of establishing source/replica relationship and the data flow has not started. |
| Mixed | This enumeration literal shall indicate that replication status is mixed across element pairs in a replication group. Generally, the individual statuses need to be examined. |
| Pending | This enumeration literal shall indicate that the flow of data has stopped momentarily due to limited bandwidth or a busy system. |
| Preparing | This enumeration literal shall indicate that replication has preparation in progress. |
| RequiresActivate | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be activated before further copy operations can be issued. |
| RequiresDetach | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be detached before further copy operations can be issued. |
| RequiresFracture | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be fractured before further copy operations can be issued. |
| RequiresResume | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resumed before further copy operations can be issued. |
| RequiresResync | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resynced before further copy operations can be issued. |
| RequiresSplit | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be split before further copy operations can be issued. |
| Restoring | This enumeration literal shall indicate that replication has a restore in progress. |
| Resyncing | This enumeration literal shall indicate that replication has resynchronization in progess. |
| Splitting | This enumeration literal shall indicate that replication has a split in progress. |
| Suspending | This enumeration literal shall indicate that replication has a copy operation in the process of being suspended. |
| Synchronizing | This enumeration literal shall indicate that replication has synchronization in progress. |
| Terminating | This enumeration literal shall indicate that the replication relationship is in the process of terminating. |

#### 9.13.1.7 ReplicaReadOnlyAccess:

| string | Description |
|---|---|
| Both | Both the source and the target elements shall be read only to the host. |
| ReplicaElement | The replica element shall be read-only to the host. |
| SourceElement | The source element shall be read-only to the host. |

#### 9.13.1.8 ReplicaRecoveryMode:

| string | Description |
|---|---|
| Automatic | The copy operation shall resume automatically. |
| Manual | The ReplicaState shall be set to Suspended after the link is restored. It is required to issue the Resume operation to continue. |

#### 9.13.1.9 ReplicaRole:

| string | Description |
|---|---|
| Source | This enumeration literal shall indicate a source element. |
| Target | This enumeration literal shall indicate target element. |

#### 9.13.1.10 ReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |

| string | Description |
|---|---|
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

### 9.13.1.11 ReplicaType:

| string | Description |
|---|---|
| Clone | This enumeration literal shall indicate that replication shall create a point in time, full copy the source. |
| Mirror | This enumeration literal shall indicate that replication shall create and maintain a copy of the source. |
| Snapshot | This enumeration literal shall indicate that replication shall create a point in time, virtual copy of the source. |
| TokenizedClone | This enumeration literal shall indicate that replication shall create a token based clone. |

### 9.13.1.12 ReplicaUpdateMode:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

### 9.13.1.13 RequestedReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |

| string | Description |
|---|---|
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

#### 9.13.1.14 UndiscoveredElement:

| string | Description |
|---|---|
| ReplicaElement | This enumeration literal shall indicate that the replica element is undiscovered. |
| SourceElement | This enumeration literal shall indicate that the source element is undiscovered. |

#### 9.13.1.15 WritePolicy:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

## 9.14 FileSystemCollection

This resource shall contain a collection of references to FileSystem resource instances.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **Members** [ { | array<br><br>*read-only* | This property shall contain references to the members of this FileSystem collection. |
| **AccessCapabilities** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the supported IO access capabilities. Each entry shall specify a current storage access capability. |
| **BlockSizeBytes** | number, null (By)<br><br>*read-only* | The value of this property shall be the block size of the file system in bytes. |
| **Capacity** {} | object, null<br><br>*read-write* | The value of this property shall be the capacity allocated to the file system in bytes. |
| **CapacitySources** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for all the capacity sources for the file system. Each entry shall provide capacity allocation information from a named resource. |
| **CasePreserved** | boolean, null<br><br>*read-write* | This property shall indicate that the case of file names is preserved by the file system. A value of True shall indicate that case of file names shall be preserved. |
| **CaseSensitive** | boolean, null<br><br>*read-write* | This property shall indicate that case sensitive file names are supported by the file system. A value of True shall indicate that file names are case sensitive. |
| **CharacterCodeSet** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the character sets or encodings supported by the file system. Each entry shall specify a character set encoding supported by the file system. |
| **ClusterSizeBytes** | number, null (By)<br><br>*read-write* | This value shall specify the minimum file allocation size imposed by the file system. This minimum allocation size shall be the smallest amount of storage allocated to a file by the file system. Under stress conditions, the file system may allocate storage in amounts smaller than this value. |
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **ExportedShares** {} | object, null<br><br>*read-write* | This property shall be an array of exported file shares of this file system. Each entry shall define an exported file share of this file system. |
| **Id** | <br><br>*read-only* | |
| **ImportedShares** [ {} ] | array<br><br>*read-only* | The value shall be an array of imported file shares. |
| **Links** {} | object<br><br>*read-only* | This property shall contain links to other resources that are related to this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | This property shall be an array containing entries for the percentages of file system capacity at which low space warning events are be issued. A LOW_SPACE_THRESHOLD_WARNING event shall be triggered each time the remaining file system capacity value becomes less than one of the values in the array. The following shall be true: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes) |
| **MaxFileNameLengthBytes** | number, null (By)<br><br>*read-write* | If specified, this value shall specify the maximum length of a file name within the file system. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **RemainingCapacity** {} | object, null<br><br>*read-write* | The value of this property shall be the remaining capacity allocated to the file system in bytes. |

| | | |
|---|---|---|
| **ReplicaInfo** {} | object, null<br><br>*read-write* | If this file system is a replica, this value shall describe its replication attributes. This value shall not be present if this file system is not a replica. A file system may be both a source and a replica. |
| } ] | | |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.15 HostedStorageServices

A Collection of Hosted Storage Service resource instances.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-write* | The value of each member entry shall reference a StorageService resource. |
| **Actions** {} | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **ClassesOfService** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference a ClassOfService supported by this service. |
| **ClientEndpointGroups** {} | object, null<br><br>*read-write* | The value of each entry in the array shall reference an EndpointGroup. |
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **Drives** {} | object<br><br>*read-write* | A collection that indicates all the drives managed by this storage service. |
| **Endpoints** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference an Endpoint managed by this service. |
| **FileSystems** {} | object<br><br>*read-write* | An array of references to FileSystems managed by this storage service. |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | Contains links to other resources that are related to this resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Redundancy** [ {} ] | array<br><br>*read-only* | Redundancy information for the storage subsystem |
| **ServerEndpointGroups** {} | object, null<br><br>*read-write* | The value of each entry in the array shall reference a EndpointGroup. |
| **Status** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **StorageGroups** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference a StorageGroup. |
| **StoragePools** {} | object<br><br>*read-write* | An array of references to StoragePools. |
| **StorageSubsystems** | <br><br>*read-only* | The value shall be a link to a collection of type StorageCollection having members that represent storage subsystems managed by this storage service. |
| **Volumes** {} | object<br><br>*read-write* | An array of references to Volumes managed by this storage service. |
| } ] | | |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.16 IOConnectivityLoSCapabilities 1.0.0

Each instance of IOConnectivityLoSCapabilities describes capabilities of the system to support various IO Connectivity service options.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |

| | | |
|---|---|---|
| **MaxSupportedIOPS** | number, null<br><br>*read-write* | The value shall be the maximum IOPS that a connection can support. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **SupportedAccessProtocols** [ {} ] | array<br><br>*read-write* | Access protocols supported by this service option. NOTE: SMB+NFS* requires that SMB and at least one of NFSv3 or NFXv4 are also selected, (i.e. {'SMB', 'NFSv4', 'SMB+NFS*'}). |
| **SupportedIOConnectivityLinesOfService** [ { | array<br><br>*read-write* | The collection shall contain known and supported IOConnectivityLinesOfService. |
| **AccessProtocols** [ {} ] | array<br><br>*read-write* | The Enumeration Literal shall specify the Access protocol for this service option. NOTE: If multiple protocols are specified, the corresponding MaxSupportedIOPS governs the max achieved across all protocol uses. This may be less than the sum of the individual max values, which may be specified by individual Line of Service entries. |
| **MaxIOPS** | number, null<br><br>*read-write* | The value shall be the maximum IOs per second that the connection shall allow for the selected access protocol. |
| **Name** | null<br><br>*read-write* | |
| } ] | | |

# 9.17 IOPerformanceLoSCapabilities 1.0.0

Each instance of IOPerformanceLoSCapabilities shall describe the capabilities of the system to support various IO performance service options.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **IOLimitingIsSupported** | boolean, null<br><br>*read-write* | If true, the system should limit IOPS to MaxIOOperationsPerSecondPerTerabyte * (Volume Size in Terabytes). Otherwise, the system shall not inforce a limit. The default value for this property is false. |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **MaxSamplePeriod** | string, null<br>(s)<br><br>*read-write* | The value shall be an ISO 8601 duration specifying the maximum sampling period over which average values are calculated. |
| **MinSamplePeriod** | string, null<br>(s)<br><br>*read-write* | The value shall be an ISO 8601 duration specifying the minimum sampling period over which average values are calculated. |
| **MinSupportedIoOperationLatencyMicroseconds** | number, null<br>(us)<br><br>*read-write* | The value shall be the minimum supported average IO latency in microseconds calculated over the SamplePeriod |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **SupportedIOPerformanceLinesOfService** [ { | array<br><br>*read-write* | The value shall be a collection supported IO performance service options. |

| | | |
|---|---|---|
| **AverageIOOperationLatencyMicroseconds** | number, null (us) *read-write* | The value shall be the expected average IO latency in microseconds calculated over sample periods (see SamplePeriodSeconds). |
| **IOOperationsPerSecondIsLimited** | boolean, null *read-write* | If true, the system should not allow IOPS to exceed MaxIoOperationsPerSecondPerTerabyte * VolumeSize. Otherwise, the system shall not enforce a limit. The default value for this property is false. |
| **IOWorkload** {} | object, null *read-write* | The value shall be a description of the expected workload. The workload provides the context in which the values of MaxIOOperationsPerSecondPerTerabyte and AverageIOOperationLatencyMicroseconds are expected to be achieveable. |
| **MaxIOOperationsPerSecondPerTerabyte** | number, null (1/s/TBy) *read-write* | The value shall be the amount of IOPS a volume of a given committed size in Terabytes can support. This IOPS density value is useful as a metric that is independent of capacity. Cost is a function of this value and the AverageIOOperationLatencyMicroseconds. |
| **Name** | null *read-write* | |
| **SamplePeriod** | string, null *read-write* | The value shall be an ISO 8601 duration specifying the sampling period over which average values are calculated. |
| } ] | | |
| **SupportedIOWorkloads** [ { | array *read-write* | The value shall be a collection of supported workloads. |
| **Components** [ {} ] | array *read-write* | The value shall be an array of IO workload component descriptions. |
| **Name** | string, null *read-write* | The value shall be a name of the workload. It should be constructed as OrgID:WorkloadID. Examples: ACME:DSS, ACME:DSS-REP, ACME:Exchange, ACME:OLTP, ACME:OLTP-REPA. An organization may define a set of well known workloads. |
| } ] | | |

# 9.18 StorageGroup 1.0.0

The primary purposes of the collection shall be to govern access to the storage by clients or to add service requirements for the members of the collection. Access to the collected storage by a specified set of hosts shall be made available or unavailable atomically. Requirements specified by the class of service shall be satisfied by each collected element to which they apply. The storage group may contain: block, file, or object storage; local storage system access points through which the collection is made available; and hosts, or host access points to which the collection is made available.

| | | |
|---|---|---|
| **AccessState** | null<br><br>*read-write* | The value of this property shall describe the access characteristics of this storage group. All associated logical units through all aggregated ports shall share this access state. |
| **Actions** { | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **#StorageGroup.ExposeVolumes** {} | object<br><br>*read-write* | Exposes the storage of this group via the target endpoints named in the ServerEndpointGroups to the initiator endpoints named in the ClientEndpointGroups. The property VolumesAreExposed shall be set to true when this action is completed. |
| **#StorageGroup.HideVolumes** {} | object<br><br>*read-write* | Hide the storage of this group from the initiator endpoints named in the ClientEndpointGroups. The property VolumesAreExposed shall be set to false when this action is completed. |
| **Oem** {} | object<br><br>*read-write* | |
| } | | |
| **ClientEndpointGroups** { | object, null<br><br>*read-write* | An array of references to ClientEndpointGroups that contain the Endpoints that may be used by clients to make requests to the storage exposed by this StorageGroup. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an endpoint group resource. |
| **Name** | <br><br>*read-only* | |

| | | |
|---|---|---|
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Description** | null<br>*read-write* | |
| **Id** | *read-only* | |
| **Identifier** | null<br>*read-write* | The value shall be unique within the managed ecosystem. |
| **Links** { | object<br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **ChildStorageGroups** [ {} ] | array<br>*read-write* | An array of references to StorageGroups are incorporated into this StorageGroup |
| **ClassOfService** {} | object, null<br>*read-write* | The ClassOfService that all storage in this StorageGroup conforms to. |
| **Oem** | *read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| **ParentStorageGroups** [ {} ] | array<br>*read-only* | An array of references to StorageGroups that incorporate this StorageGroup |
| } | | |
| **MembersAreConsistent** | boolean, null<br>*read-only* | The value of this property shall be set to true if all members are in a consistent state. The default value for this property is false. |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **ReplicaInfos** [ { | array<br>*read-only* | This property shall describe the replication relationship between this storage group and a corresponding source and/or target storage group. |
| **ConsistencyEnabled** | boolean, null<br>*read-only* | If true, consistency shall be enabled across the source and its associated target replica(s). The default value for this property is false. |
| **ConsistencyState** | string, null<br>*read-write* | The ConsistencyState enumeration literal shall indicate the current state of consistency. *See Property Details, below, for more information about this property.* |
| **ConsistencyStatus** | string, null<br>*read-write* | The ConsistencyStatus enumeration literal shall specify the current status of consistency. Consistency may have been disabled or is experiencing an error condition. *See Property Details, below, for more information about this property.* |
| **ConsistencyType** | string, null<br>*read-write* | The ConsistencyType enumeration literal shall indicate the consistency type used by the source and its associated target group. *See Property Details, below, for more information about this property.* |
| **FailedCopyStopsHostIO** | boolean, null<br>*read-only* | If true, the storage array shall stop receiving data to the source element if copying to a remote element fails. The default value for this property is false. |
| **PercentSynced** | number, null (%)<br>*read-only* | Specifies the percent of the work completed to reach synchronization. Shall not be instantiated if implementation is not capable of providing this information. If related to a group, then PercentSynced shall be an average of the PercentSynced across all members of the group. |
| **Replica** | null<br>*read-write* | The value shall reference the resource that is the source of this replica. |

| | | |
|---|---|---|
| **ReplicaPriority** | string, null<br><br>*read-write* | The enumeration literal shall specify the priority of background copy engine I/O to be managed relative to host I/O operations during a sequential background copy operation. *See Property Details, below, for more information about this property.* |
| **ReplicaProgressStatus** | string, null<br><br>*read-write* | The ReplicaProgressStatus enumeration literal shall specify the status of the session with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaReadOnlyAccess** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements are read only to the host. *See Property Details, below, for more information about this property.* |
| **ReplicaRecoveryMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the copy operation continues after a broken link is restored. *See Property Details, below, for more information about this property.* |
| **ReplicaRole** | string, null<br><br>*read-write* | The ReplicaRole enumeration literal shall represent the source or target role of this replica as known to the containing resource. *See Property Details, below, for more information about this property.* |
| **ReplicaSkewBytes** | number, null (By)<br><br>*read-only* | Applies to Adaptive mode and it describes maximum number of bytes the SyncedElement (target) can be out of sync. If the number of out-of-sync bytes exceeds the skew value, ReplicaUpdateMode shall be switched to synchronous. |
| **ReplicaState** | string, null<br><br>*read-write* | The ReplicaState enumeration literal shall specify the state of the relationship with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaType** | string, null<br><br>*read-write* | The ReplicaType enumeration literal shall describe the intended outcome of the replication. *See Property Details, below, for more information about this property.* |
| **ReplicaUpdateMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the target elements will be updated synchronously or asynchronously. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **RequestedReplicaState** | string, null<br><br>*read-write* | The last requested or desired state for the relationship. The actual state of the relationship shall be represented by ReplicaState. When RequestedState reaches the requested state, this property shall be null. *See Property Details, below, for more information about this property.* |
| **SyncMaintained** | boolean, null<br><br>*read-only* | If true, Synchronization shall be maintained. The default value for this property is false. |
| **UndiscoveredElement** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements involved in a copy operation are undiscovered. An element is considered undiscovered if its object model is not known to the service performing the copy operation. *See Property Details, below, for more information about this property.* |
| **WhenActivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the point-in-time copy was taken or when the replication relationship is activated, reactivated, resumed or re-established. This property shall be null if the implementation is not capable of providing this information. |
| **WhenDeactivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is deactivated. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenEstablished** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is established. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenSuspended** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is suspended. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenSynced** | string, null<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the elements were synchronized. |

| | | |
|---|---|---|
| **WhenSynchronized** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is synchronized. Do not instantiate this property if implementation is not capable of providing this information. |
| } ] | | |
| **ServerEndpointGroups** { | object, null<br><br>*read-write* | An array of references to ServerEndpointGroups that contain the Endpoints that may be used by the storage service to receive requests from clients for storage exposed by this StorageGroup. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an endpoint group resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Status** | null<br><br>*read-write* | |
| **Volumes** { | object, null<br><br>*read-write* | An array of references to Volumes managed by this StorageGroup. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-write* | The value of each member entry shall reference a Volume resource. |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **VolumesAreExposed** | boolean, null<br>*read-only* | The value of this property shall be set to true if storage volumes are exposed to the initiator endpoints. The default value for this property is false. |

## 9.18.1 Property Details

### 9.18.1.1 ConsistencyState:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target shall be consistent. |
| Inconsistent | This enumeration literal shall indicate that the source and target are not required to be consistent. |

### 9.18.1.2 ConsistencyStatus:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target are consistent. |
| Disabled | This enumeration literal shall indicate that the source and target have consistency disabled. |
| InError | This enumeration literal shall indicate that the source and target are not consistent. |
| InProgress | This enumeration literal shall indicate that the source and target are becoming consistent. |

### 9.18.1.3 ConsistencyType:

| string | Description |
|---|---|
| SequentiallyConsistent | This enumeration literal shall indicate that the source and target shall be sequentially consistent. |

### 9.18.1.4 ReplicaPriority:

| string | Description |
|---|---|
| High | Copy engine I/O shall have a higher priority than host I/O. |
| Low | Copy engine I/O shall have a lower priority than host I/O. |
| Same | Copy engine I/O shall have the same priority as host I/O. |
| Urgent | Regardless of the host I/O requests, the Copy operation shall be performed as soon as possible. |

### 9.18.1.5 ReplicaProgressStatus:

| string | Description |
|---|---|
| Aborting | This enumeration literal shall indicate that replication has an abort in progress. |
| Completed | This enumeration literal shall indicate that the request is completed. Data flow is idle. |
| Detaching | This enumeration literal shall indicate that replication has a detach in progress. |
| Dormant | This enumeration literal shall indicate that the data flow is inactive, suspended or quiesced. |
| FailingBack | This enumeration literal shall indicate that replication is undoing the result of failover. |
| FailingOver | This enumeration literal shall indicate that replication is in the process of switching source and target. |
| Fracturing | This enumeration literal shall indicate that replication has a fracture in progress. |
| Initializing | This enumeration literal shall indicate that replication is in the process of establishing source/replica relationship and the data flow has not started. |
| Mixed | This enumeration literal shall indicate that replication status is mixed across element pairs in a replication group. Generally, the individual statuses need to be examined. |
| Pending | This enumeration literal shall indicate that the flow of data has stopped momentarily due to limited bandwidth or a busy system. |
| Preparing | This enumeration literal shall indicate that replication has preparation in progress. |
| RequiresActivate | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be activated before further copy operations can be issued. |
| RequiresDetach | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be detached before further copy operations can be issued. |
| RequiresFracture | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be fractured before further copy operations can be issued. |
| RequiresResume | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resumed before further copy operations can be issued. |
| RequiresResync | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resynced before further copy operations can be issued. |
| RequiresSplit | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be split before further copy operations can be issued. |
| Restoring | This enumeration literal shall indicate that replication has a restore in progress. |
| Resyncing | This enumeration literal shall indicate that replication has resynchronization in progess. |
| Splitting | This enumeration literal shall indicate that replication has a split in progress. |
| Suspending | This enumeration literal shall indicate that replication has a copy operation in the process of being suspended. |
| Synchronizing | This enumeration literal shall indicate that replication has synchronization in progress. |
| Terminating | This enumeration literal shall indicate that the replication relationship is in the process of terminating. |

### 9.18.1.6 ReplicaReadOnlyAccess:

| string | Description |
|---|---|
| Both | Both the source and the target elements shall be read only to the host. |
| ReplicaElement | The replica element shall be read-only to the host. |
| SourceElement | The source element shall be read-only to the host. |

### 9.18.1.7 ReplicaRecoveryMode:

| string | Description |
|---|---|
| Automatic | The copy operation shall resume automatically. |
| Manual | The ReplicaState shall be set to Suspended after the link is restored. It is required to issue the Resume operation to continue. |

### 9.18.1.8 ReplicaRole:

| string | Description |
|---|---|
| Source | This enumeration literal shall indicate a source element. |
| Target | This enumeration literal shall indicate target element. |

### 9.18.1.9 ReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |

| string | Description |
|---|---|
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

### 9.18.1.10 ReplicaType:

| string | Description |
|---|---|
| Clone | This enumeration literal shall indicate that replication shall create a point in time, full copy the source. |
| Mirror | This enumeration literal shall indicate that replication shall create and maintain a copy of the source. |
| Snapshot | This enumeration literal shall indicate that replication shall create a point in time, virtual copy of the source. |
| TokenizedClone | This enumeration literal shall indicate that replication shall create a token based clone. |

### 9.18.1.11 ReplicaUpdateMode:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

### 9.18.1.12 RequestedReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |

| string | Description |
|---|---|
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

#### 9.18.1.13 UndiscoveredElement:

| string | Description |
|---|---|
| ReplicaElement | This enumeration literal shall indicate that the replica element is undiscovered. |
| SourceElement | This enumeration literal shall indicate that the source element is undiscovered. |

# 9.19 StorageGroupCollection

This collection shall contain references to all StorageGroup resource instances sharing the same parent resource.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-only* | The value of each member entry shall reference a StorageGroup resource. |
| **AccessState** | null<br><br>*read-write* | The value of this property shall describe the access characteristics of this storage group. All associated logical units through all aggregated ports shall share this access state. |
| **Actions** {} | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **ClientEndpointGroups** {} | object, null<br><br>*read-write* | An array of references to ClientEndpointGroups that contain the Endpoints that may be used by clients to make requests to the storage exposed by this StorageGroup. |

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **MembersAreConsistent** | boolean, null<br><br>*read-only* | The value of this property shall be set to true if all members are in a consistent state. The default value for this property is false. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **ReplicaInfos** [ {} ] | array<br><br>*read-only* | This property shall describe the replication relationship between this storage group and a corresponding source and/or target storage group. |
| **ServerEndpointGroups** {} | object, null<br><br>*read-write* | An array of references to ServerEndpointGroups that contain the Endpoints that may be used by the storage service to receive requests from clients for storage exposed by this StorageGroup. |
| **Status** | null<br><br>*read-write* | |
| **Volumes** {} | object, null<br><br>*read-write* | An array of references to Volumes managed by this StorageGroup. |

| | | |
|---|---|---|
| **VolumesAreExposed** | boolean, null<br><br>*read-only* | The value of this property shall be set to true if storage volumes are exposed to the initiator endpoints. The default value for this property is false. |
| } ] | | |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.20 StoragePool 1.0.0

A container of data storage capable of providing capacity conforming to one of its supported classes of service. The storage pool does not support IO to its data storage.

| | | |
|---|---|---|
| **AllocatedPools** { | object, null<br><br>*read-write* | The value of this property shall contain a reference to the collection of storage pools allocated from this storage pool. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference a StoragePool resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |

| | | |
|---|---|---|
| **AllocatedVolumes** { | object, null<br><br>*read-write* | The value of this property shall contain a reference to the collection of volumes allocated from this storage pool. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-write* | The value of each member entry shall reference a Volume resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **BlockSizeBytes** | number, null (By)<br><br>*read-only* | Maximum size in bytes of the blocks which form this Volume. If the block size is variable, then the maximum block size in bytes should be specified. If the block size is unknown or if a block concept is not valid (for example, with Memory), enter a 1. |
| **Capacity** { | object, null<br><br>*read-write* | The value of this property shall provide an information about the actual utilization of the capacity within this storage pool. |
| **Data** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned user data. |
| **IsThinProvisioned** | boolean, null<br><br>*read-write* | If the value is false, the capacity shall be fully allocated. The default value shall be false. |

| | | |
|---|---|---|
| **Metadata** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned system (non-user accessible) data. |
| **Snapshot** {} | object, null<br><br>*read-write* | The value shall be capacity information relating to provisioned snapshot or backup data. |
| } | | |
| **CapacitySources** [ { | array<br><br>*read-only* | Fully or partially consumed storage from a source resource. Each entry shall provide capacity allocation data from a named source resource. |
| **ProvidedCapacity** {} | object, null<br><br>*read-write* | The value shall be the amount of space that has been provided from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidedClassOfService** {} | object, null<br><br>*read-write* | The value shall reference the provided ClassOfService from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidingDrives** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing drive or drives. |
| **ProvidingPools** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing storage pool or storage pools. |
| **ProvidingVolumes** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing volume or volumes. |
| } ] | | |
| **ClassesOfService** { | object, null<br><br>*read-write* | This property shall contain references to all classes of service supported by this storage pool. Capacity allocated from this storage pool shall conform to one of the referenced classes of service. |

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference a ClassOfService resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** { | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **DefaultClassOfService** {} | object, null<br><br>*read-write* | If present, this property shall reference the default class of service for entities allocated from this storage pool. If the ClassesOfService collection is not empty, then the value of this property shall be one of its entries. If not present, the default class of service of the containing StorageService entity shall be used. |
| **Oem** | <br><br>*read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| } | | |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | Each time the following value is less than one of the values in the array the LOW_SPACE_THRESHOLD_WARNING event shall be triggered: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes). |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Status** | null<br>*read-write* | |

# 9.21 StoragePoolCollection

This collection shall contain references to all StoragePool resource instances sharing the same parent resource.

| | | |
|---|---|---|
| **Description** | null<br>*read-write* | |
| **Members** [ { | array<br>*read-only* | The value of each member entry shall reference a StoragePool resource. |
| **AllocatedPools** {} | object, null<br>*read-write* | The value of this property shall contain a reference to the collection of storage pools allocated from this storage pool. |
| **AllocatedVolumes** {} | object, null<br>*read-write* | The value of this property shall contain a reference to the collection of volumes allocated from this storage pool. |
| **BlockSizeBytes** | number, null<br>(By)<br>*read-only* | Maximum size in bytes of the blocks which form this Volume. If the block size is variable, then the maximum block size in bytes should be specified. If the block size is unknown or if a block concept is not valid (for example, with Memory), enter a 1. |
| **Capacity** {} | object, null<br>*read-write* | The value of this property shall provide an information about the actual utilization of the capacity within this storage pool. |

| | | |
|---|---|---|
| **CapacitySources** [ {} ] | array<br><br>*read-only* | Fully or partially consumed storage from a source resource. Each entry shall provide capacity allocation data from a named source resource. |
| **ClassesOfService** {} | object, null<br><br>*read-write* | This property shall contain references to all classes of service supported by this storage pool. Capacity allocated from this storage pool shall conform to one of the referenced classes of service. |
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | Each time the following value is less than one of the values in the array the LOW_SPACE_THRESHOLD_WARNING event shall be triggered: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes). |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Status** | null<br><br>*read-write* | |
| } ] | | |
| **Name** | <br><br>*read-only* | |

| | | |
|---|---|---|
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.22 StorageService 1.0.1

Collection of resources that the system can make available to one or more host systems. The collection can contain: block, file, or object storage; local system access points through which the collection is made available; hosts, or host access points to which the collection is made available.

| | | |
|---|---|---|
| **Actions** { | object<br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **#StorageService.SetEncryptionKey** {} | object<br>*read-write* | This defines the name of the custom action supported on this resource. |
| **Oem** {} | object<br>*read-write* | |
| } | | |
| **ClassesOfService** { | object, null<br>*read-write* | The value of each enty in the array shall reference a ClassOfService supported by this service. |
| **Description** | null<br>*read-write* | |
| **Members** [ {} ] | array<br>*read-only* | The value of each member entry shall reference a ClassOfService resource. |
| **Name** | <br>*read-only* | |
| **Oem** | <br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |

| | | |
|---|---|---|
| **ClientEndpointGroups** { | object, null<br><br>*read-write* | The value of each entry in the array shall reference an EndpointGroup. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an endpoint group resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Description** | null<br><br>*read-write* | |
| **Drives** { | object<br><br>*read-write* | A collection that indicates all the drives managed by this storage service. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each entry of this property shall reference a Drive resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

| | | |
|---|---|---|
| } | | |
| **Endpoints** { | object, null<br><br>*read-write* | The value of each enty in the array shall reference an Endpoint managed by this service. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference an Endpoint resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **FileSystems** { | object<br><br>*read-write* | An array of references to FileSystems managed by this storage service. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | This property shall contain references to the members of this FileSystem collection. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |

| | | |
|---|---|---|
| **Id** | *read-only* | |
| **Identifier** | null<br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** { | object<br>*read-only* | Contains links to other resources that are related to this resource. |
| **DataProtectionLoSCapabilities** {} | object, null<br>*read-write* | The value shall reference the data protection capabilities of this service. |
| **DataSecurityLoSCapabilities** {} | object, null<br>*read-write* | The value shall reference the data security capabilities of this service. |
| **DataStorageLoSCapabilities** {} | object, null<br>*read-write* | The value shall reference the data storage capabilities of this service. |
| **DefaultClassOfService** {} | object, null<br>*read-write* | If present, this property shall reference the default class of service for entities allocated by this storage service. This default may be overridden by the DefaultClassOfService property values within contained StoragePools. |
| **HostingSystem** | null<br>*read-write* | The value shall reference the ComputerSystem that hosts this service. |
| **IOConnectivityLoSCapabilities** {} | object, null<br>*read-write* | The value shall reference the IO connectivity capabilities of this service. |
| **IOPerformanceLoSCapabilities** {} | object, null<br>*read-write* | The value shall reference the IO performance capabilities of this service. |

| | | |
|---|---|---|
| **Oem** | *read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| } | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Redundancy** [ {} ] | array<br>*read-only* | Redundancy information for the storage subsystem |
| **ServerEndpointGroups** { | object, null<br>*read-write* | The value of each entry in the array shall reference a EndpointGroup. |
| **Description** | null<br>*read-write* | |
| **Members** [ {} ] | array<br>*read-only* | The value of each member entry shall reference an endpoint group resource. |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **Status** | null<br>*read-write* | |

| | | |
|---|---|---|
| **StorageGroups** { | object, null<br><br>*read-write* | The value of each enty in the array shall reference a StorageGroup. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference a StorageGroup resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **StoragePools** { | object<br><br>*read-write* | An array of references to StoragePools. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference a StoragePool resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |
| **StorageSubsystems** *(v1.0+)* | <br><br>*read-only* | The value shall be a link to a collection of type StorageCollection having members that represent storage subsystems managed by this storage service. |

| | | |
|---|---|---|
| **Volumes** { | object<br><br>*read-write* | An array of references to Volumes managed by this storage service. |
| **Description** | null<br><br>*read-write* | |
| **Members** [ {} ] | array<br><br>*read-write* | The value of each member entry shall reference a Volume resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| } | | |

# 9.23 StorageServiceCollection

An instance of this resource shall reference the set of StorageService resources known in the scope of its use.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-only* | The value of each member entry shall reference a StorageService resource. |
| **Actions** {} | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **ClassesOfService** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference a ClassOfService supported by this service. |

| | | |
|---|---|---|
| **ClientEndpointGroups** {} | object, null<br><br>*read-write* | The value of each entry in the array shall reference an EndpointGroup. |
| **Description** | null<br><br>*read-write* | |
| **Drives** {} | object<br><br>*read-write* | A collection that indicates all the drives managed by this storage service. |
| **Endpoints** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference an Endpoint managed by this service. |
| **FileSystems** {} | object<br><br>*read-write* | An array of references to FileSystems managed by this storage service. |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | Contains links to other resources that are related to this resource. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Redundancy** [ {} ] | array<br><br>*read-only* | Redundancy information for the storage subsystem |

| | | |
|---|---|---|
| **ServerEndpointGroups** {} | object, null<br><br>*read-write* | The value of each entry in the array shall reference a EndpointGroup. |
| **Status** | null<br><br>*read-write* | |
| **StorageGroups** {} | object, null<br><br>*read-write* | The value of each enty in the array shall reference a StorageGroup. |
| **StoragePools** {} | object<br><br>*read-write* | An array of references to StoragePools. |
| **StorageSubsystems** | <br><br>*read-only* | The value shall be a link to a collection of type StorageCollection having members that represent storage subsystems managed by this storage service. |
| **Volumes** {} | object<br><br>*read-write* | An array of references to Volumes managed by this storage service. |
| } ] | | |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.24 StorageSystemCollection

An instance of this resource shall reference the set of ComputerSystem resources known in the scope of its use and and that has a HostingRoles entry with a value of 'StorageServer'.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |

| | | |
|---|---|---|
| **Members** [ {} ] | array<br><br>*read-only* | The value of each member entry shall reference a ComputerSystem resource that shall have a HostingRoles entry with a value of 'StorageServer'. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

# 9.25 Volume 1.1.1

This resource shall be used to represent a volume, virtual disk, logical disk, LUN, or other logical storage for a Redfish implementation.

| | | |
|---|---|---|
| **AccessCapabilities** *(v1.1+)* [ {} ] | array<br><br>*read-write* | Each entry shall specify a current storage access capability. |
| **Actions** { | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **#Volume.Initialize** {} | object<br><br>*read-write* | This defines the name of the custom action supported on this resource. |
| **Oem** {} | object<br><br>*read-write* | |
| } | | |
| **AllocatedPools** *(v1.1+)* [ { | array<br><br>*read-only* | The value of this property shall contain references to all storage pools allocated from this volume. |
| **AllocatedPools** {} | object, null<br><br>*read-write* | The value of this property shall contain a reference to the collection of storage pools allocated from this storage pool. |

| | | |
|---|---|---|
| **AllocatedVolumes** {} | object, null<br><br>*read-write* | The value of this property shall contain a reference to the collection of volumes allocated from this storage pool. |
| **BlockSizeBytes** | number, null (By)<br><br>*read-only* | Maximum size in bytes of the blocks which form this Volume. If the block size is variable, then the maximum block size in bytes should be specified. If the block size is unknown or if a block concept is not valid (for example, with Memory), enter a 1. |
| **Capacity** {} | object, null<br><br>*read-write* | The value of this property shall provide an information about the actual utilization of the capacity within this storage pool. |
| **CapacitySources** [ {} ] | array<br><br>*read-only* | Fully or partially consumed storage from a source resource. Each entry shall provide capacity allocation data from a named source resource. |
| **ClassesOfService** {} | object, null<br><br>*read-write* | This property shall contain references to all classes of service supported by this storage pool. Capacity allocated from this storage pool shall conform to one of the referenced classes of service. |
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value identifies this resource. The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | Each time the following value is less than one of the values in the array the LOW_SPACE_THRESHOLD_WARNING event shall be triggered: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes). |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Status** | null<br>*read-write* | |
| } ] | | |
| **BlockSizeBytes** | number, null (By)<br>*read-only* | This property shall contain size of the smallest addressable unit of the associated volume. |
| **Capacity** *(v1.1+)* { | object, null<br>*read-write* | Information about the utilization of capacity allocated to this storage volume. |
| **Data** {} | object, null<br>*read-write* | The value shall be capacity information relating to provisioned user data. |
| **IsThinProvisioned** | boolean, null<br>*read-write* | If the value is false, the capacity shall be fully allocated. The default value shall be false. |
| **Metadata** {} | object, null<br>*read-write* | The value shall be capacity information relating to provisioned system (non-user accessible) data. |
| **Snapshot** {} | object, null<br>*read-write* | The value shall be capacity information relating to provisioned snapshot or backup data. |
| } | | |

| | | |
|---|---|---|
| **CapacityBytes** | number, null (By)<br><br>*read-only* | This property shall contain the size in bytes of the associated volume. |
| **CapacitySources** *(v1.1+)* [ { | array<br><br>*read-write* | Fully or partially consumed storage from a source resource. Each entry provides capacity allocation information from a named source resource. |
| **ProvidedCapacity** {} | object, null<br><br>*read-write* | The value shall be the amount of space that has been provided from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidedClassOfService** {} | object, null<br><br>*read-write* | The value shall reference the provided ClassOfService from the ProvidingDrives, ProvidingVolumes or ProvidingPools. |
| **ProvidingDrives** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing drive or drives. |
| **ProvidingPools** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing storage pool or storage pools. |
| **ProvidingVolumes** {} | object, null<br><br>*read-write* | If present, the value shall be a reference to a contributing volume or volumes. |
| } ] | | |
| **Description** | null<br><br>*read-write* | |
| **Encrypted** | boolean, null<br><br>*read-write* | This property shall contain a boolean indicator if the Volume is currently utilizing encryption or not. |

| | | |
|---|---|---|
| **EncryptionTypes** [ {} ] | array<br><br>*read-write* | This property shall contain the types of encryption used by this Volume. |
| **Id** | <br><br>*read-only* | |
| **Identifiers** [ {} ] | array<br><br>*read-only* | This property shall contain a list of all known durable names for the associated volume. |
| **Links** { | object<br><br>*read-only* | The Links property, as described by the Redfish Specification, shall contain references to resources that are related to, but not contained by (subordinate to), this resource. |
| **ClassOfService** {} | object, null<br><br>*read-write* | This property shall contain a reference to the ClassOfService that this storage volume conforms to. |
| **Drives** [ {} ] | array<br><br>*read-only* | The value of this property shall be a reference to the resources that this volume is associated with and shall reference resources of type Drive. This property shall only contain references to Drive entities which are currently members of the Volume, not hot spare Drives which are not currently a member of the volume. |
| **Oem** | <br><br>*read-write* | This object represents the Oem property. All values for resources described by this schema shall comply to the requirements as described in the Redfish specification. |
| } | | |
| **LowSpaceWarningThresholdPercents** *(v1.1+)* [ {} ] | array<br><br>*read-write* | Each time the following value is less than one of the values in the array the LOW_SPACE_THRESHOLD_WARNING event shall be triggered: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes). |
| **Manufacturer** *(v1.1+)* | string, null<br><br>*read-only* | This property shall contain a value that represents the manufacturer or implementer of the storage volume. |
| **MaxBlockSizeBytes** *(v1.1+)* | number, null (By)<br><br>*read-only* | This property shall contain size of the largest addressable unit of this storage volume. |

| | | |
|---|---|---|
| **Model** *(v1.1+)* | string, null<br><br>*read-only* | The value is assigned by the manufacturer and shall represents a specific storage volume implementation. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Operations** [ { | array<br><br>*read-only* | This property shall contain a list of all currently running on the Volume. |
| **AssociatedTask** | <br><br>*read-only* | A reference to the task associated with the operation if any. |
| **OperationName** | string, null<br><br>*read-only* | The name of the operation. |
| **PercentageComplete** | number, null<br><br>*read-only* | The percentage of the operation that has been completed. |
| } ] | | |
| **OptimumIOSizeBytes** | number, null (By)<br><br>*read-only* | This property shall contain the optimum IO size to use when performing IO on this volume. For logical disks, this is the stripe size. For physical disks, this describes the physical sector size. |
| **ReplicaInfos** *(v1.1+)* [ { | array<br><br>*read-only* | This property shall describe the replica relationship between this storage volume and a corresponding source and/or target volume. |
| **ConsistencyEnabled** | boolean, null<br><br>*read-only* | If true, consistency shall be enabled across the source and its associated target replica(s). The default value for this property is false. |

| | | |
|---|---|---|
| **ConsistencyState** | string, null<br><br>*read-write* | The ConsistencyState enumeration literal shall indicate the current state of consistency. *See Property Details, below, for more information about this property.* |
| **ConsistencyStatus** | string, null<br><br>*read-write* | The ConsistencyStatus enumeration literal shall specify the current status of consistency. Consistency may have been disabled or is experiencing an error condition. *See Property Details, below, for more information about this property.* |
| **ConsistencyType** | string, null<br><br>*read-write* | The ConsistencyType enumeration literal shall indicate the consistency type used by the source and its associated target group. *See Property Details, below, for more information about this property.* |
| **FailedCopyStopsHostIO** | boolean, null<br><br>*read-only* | If true, the storage array shall stop receiving data to the source element if copying to a remote element fails. The default value for this property is false. |
| **PercentSynced** | number, null (%)<br><br>*read-only* | Specifies the percent of the work completed to reach synchronization. Shall not be instantiated if implementation is not capable of providing this information. If related to a group, then PercentSynced shall be an average of the PercentSynced across all members of the group. |
| **Replica** | null<br><br>*read-write* | The value shall reference the resource that is the source of this replica. |
| **ReplicaPriority** | string, null<br><br>*read-write* | The enumeration literal shall specify the priority of background copy engine I/O to be managed relative to host I/O operations during a sequential background copy operation. *See Property Details, below, for more information about this property.* |
| **ReplicaProgressStatus** | string, null<br><br>*read-write* | The ReplicaProgressStatus enumeration literal shall specify the status of the session with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaReadOnlyAccess** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements are read only to the host. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **ReplicaRecoveryMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the copy operation continues after a broken link is restored. *See Property Details, below, for more information about this property.* |
| **ReplicaRole** | string, null<br><br>*read-write* | The ReplicaRole enumeration literal shall represent the source or target role of this replica as known to the containing resource. *See Property Details, below, for more information about this property.* |
| **ReplicaSkewBytes** | number, null (By)<br><br>*read-only* | Applies to Adaptive mode and it describes maximum number of bytes the SyncedElement (target) can be out of sync. If the number of out-of-sync bytes exceeds the skew value, ReplicaUpdateMode shall be switched to synchronous. |
| **ReplicaState** | string, null<br><br>*read-write* | The ReplicaState enumeration literal shall specify the state of the relationship with respect to Replication activity. *See Property Details, below, for more information about this property.* |
| **ReplicaType** | string, null<br><br>*read-write* | The ReplicaType enumeration literal shall describe the intended outcome of the replication. *See Property Details, below, for more information about this property.* |
| **ReplicaUpdateMode** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the target elements will be updated synchronously or asynchronously. *See Property Details, below, for more information about this property.* |
| **RequestedReplicaState** | string, null<br><br>*read-write* | The last requested or desired state for the relationship. The actual state of the relationship shall be represented by ReplicaState. When RequestedState reaches the requested state, this property shall be null. *See Property Details, below, for more information about this property.* |
| **SyncMaintained** | boolean, null<br><br>*read-only* | If true, Synchronization shall be maintained. The default value for this property is false. |
| **UndiscoveredElement** | string, null<br><br>*read-write* | The enumeration literal shall specify whether the source, the target, or both elements involved in a copy operation are undiscovered. An element is considered undiscovered if its object model is not known to the service performing the copy operation. *See Property Details, below, for more information about this property.* |

| | | |
|---|---|---|
| **WhenActivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the point-in-time copy was taken or when the replication relationship is activated, reactivated, resumed or re-established. This property shall be null if the implementation is not capable of providing this information. |
| **WhenDeactivated** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is deactivated. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenEstablished** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is established. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenSuspended** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is suspended. Do not instantiate this property if implementation is not capable of providing this information. |
| **WhenSynced** | string, null<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the elements were synchronized. |
| **WhenSynchronized** | string, null (%)<br><br>*read-only* | The value shall be an ISO 8601 conformant time of day that specifies when the replication relationship is synchronized. Do not instantiate this property if implementation is not capable of providing this information. |
| } ] | | |
| **Status** | <br><br>*read-write* | |
| **StorageGroups** *(v1.1+)* [ { | array<br><br>*read-only* | The value of this property shall contain references to all storage groups that include this volume. |

| | | |
|---|---|---|
| **AccessState** | null<br><br>*read-write* | The value of this property shall describe the access characteristics of this storage group. All associated logical units through all aggregated ports shall share this access state. |
| **Actions** {} | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **ClientEndpointGroups** {} | object, null<br><br>*read-write* | An array of references to ClientEndpointGroups that contain the Endpoints that may be used by clients to make requests to the storage exposed by this StorageGroup. |
| **Description** | null<br><br>*read-write* | |
| **Id** | <br><br>*read-only* | |
| **Identifier** | null<br><br>*read-write* | The value shall be unique within the managed ecosystem. |
| **Links** {} | object<br><br>*read-only* | This structure shall contain references to resources that are not contained within this resource. |
| **MembersAreConsistent** | boolean, null<br><br>*read-only* | The value of this property shall be set to true if all members are in a consistent state. The default value for this property is false. |
| **Name** | <br><br>*read-only* | |
| **Oem** | <br><br>*read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **ReplicaInfos** [ {} ] | array<br><br>*read-only* | This property shall describe the replication relationship between this storage group and a corresponding source and/or target storage group. |

| | | |
|---|---|---|
| **ServerEndpointGroups** {} | object, null<br><br>*read-write* | An array of references to ServerEndpointGroups that contain the Endpoints that may be used by the storage service to receive requests from clients for storage exposed by this StorageGroup. |
| **Status** | null<br><br>*read-write* | |
| **Volumes** {} | object, null<br><br>*read-write* | An array of references to Volumes managed by this StorageGroup. |
| **VolumesAreExposed** | boolean, null<br><br>*read-only* | The value of this property shall be set to true if storage volumes are exposed to the initiator endpoints. The default value for this property is false. |
| } ] | | |
| **VolumeType** | string, null<br><br>*read-write* | This property shall contain the type of the associated Volume. *See Property Details, below, for more information about this property.* |

## 9.25.1 Property Details

### 9.25.1.1 ConsistencyState:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target shall be consistent. |
| Inconsistent | This enumeration literal shall indicate that the source and target are not required to be consistent. |

### 9.25.1.2 ConsistencyStatus:

| string | Description |
|---|---|
| Consistent | This enumeration literal shall indicate that the source and target are consistent. |
| Disabled | This enumeration literal shall indicate that the source and target have consistency disabled. |
| InError | This enumeration literal shall indicate that the source and target are not consistent. |
| InProgress | This enumeration literal shall indicate that the source and target are becoming consistent. |

### 9.25.1.3 ConsistencyType:

| string | Description |
|---|---|
| SequentiallyConsistent | This enumeration literal shall indicate that the source and target shall be sequentially consistent. |

### 9.25.1.4 ReplicaPriority:

| string | Description |
|---|---|
| High | Copy engine I/O shall have a higher priority than host I/O. |
| Low | Copy engine I/O shall have a lower priority than host I/O. |
| Same | Copy engine I/O shall have the same priority as host I/O. |
| Urgent | Regardless of the host I/O requests, the Copy operation shall be performed as soon as possible. |

### 9.25.1.5 ReplicaProgressStatus:

| string | Description |
|---|---|
| Aborting | This enumeration literal shall indicate that replication has an abort in progress. |
| Completed | This enumeration literal shall indicate that the request is completed. Data flow is idle. |
| Detaching | This enumeration literal shall indicate that replication has a detach in progress. |
| Dormant | This enumeration literal shall indicate that the data flow is inactive, suspended or quiesced. |
| FailingBack | This enumeration literal shall indicate that replication is undoing the result of failover. |
| FailingOver | This enumeration literal shall indicate that replication is in the process of switching source and target. |
| Fracturing | This enumeration literal shall indicate that replication has a fracture in progress. |
| Initializing | This enumeration literal shall indicate that replication is in the process of establishing source/replica relationship and the data flow has not started. |
| Mixed | This enumeration literal shall indicate that replication status is mixed across element pairs in a replication group. Generally, the individual statuses need to be examined. |
| Pending | This enumeration literal shall indicate that the flow of data has stopped momentarily due to limited bandwidth or a busy system. |
| Preparing | This enumeration literal shall indicate that replication has preparation in progress. |
| RequiresActivate | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be activated before further copy operations can be issued. |
| RequiresDetach | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be detached before further copy operations can be issued. |
| RequiresFracture | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be fractured before further copy operations can be issued. |
| RequiresResume | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resumed before further copy operations can be issued. |
| RequiresResync | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be resynced before further copy operations can be issued. |
| RequiresSplit | This enumeration literal shall indicate that the requested operation has completed, however, the synchronization relationship needs to be split before further copy operations can be issued. |
| Restoring | This enumeration literal shall indicate that replication has a restore in progress. |
| Resyncing | This enumeration literal shall indicate that replication has resynchronization in progess. |

| string | Description |
|---|---|
| Splitting | This enumeration literal shall indicate that replication has a split in progress. |
| Suspending | This enumeration literal shall indicate that replication has a copy operation in the process of being suspended. |
| Synchronizing | This enumeration literal shall indicate that replication has synchronization in progress. |
| Terminating | This enumeration literal shall indicate that the replication relationship is in the process of terminating. |

#### 9.25.1.6 ReplicaReadOnlyAccess:

| string | Description |
|---|---|
| Both | Both the source and the target elements shall be read only to the host. |
| ReplicaElement | The replica element shall be read-only to the host. |
| SourceElement | The source element shall be read-only to the host. |

#### 9.25.1.7 ReplicaRecoveryMode:

| string | Description |
|---|---|
| Automatic | The copy operation shall resume automatically. |
| Manual | The ReplicaState shall be set to Suspended after the link is restored. It is required to issue the Resume operation to continue. |

#### 9.25.1.8 ReplicaRole:

| string | Description |
|---|---|
| Source | This enumeration literal shall indicate a source element. |
| Target | This enumeration literal shall indicate target element. |

#### 9.25.1.9 ReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |

| string | Description |
|---|---|
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

### 9.25.1.10 ReplicaType:

| string | Description |
|---|---|
| Clone | This enumeration literal shall indicate that replication shall create a point in time, full copy the source. |
| Mirror | This enumeration literal shall indicate that replication shall create and maintain a copy of the source. |
| Snapshot | This enumeration literal shall indicate that replication shall create a point in time, virtual copy of the source. |
| TokenizedClone | This enumeration literal shall indicate that replication shall create a token based clone. |

### 9.25.1.11 ReplicaUpdateMode:

| string | Description |
|---|---|
| Active | This enumeration literal shall indicate Active-Active (i.e. bidirectional) synchronous updates. |
| Adaptive | This enumeration literal shall indicate that an implementation may switch between synchronous and asynchronous modes. |
| Asynchronous | This enumeration literal shall indicate Asynchronous updates. |
| Synchronous | This enumeration literal shall indicate Synchronous updates. |

### 9.25.1.12 RequestedReplicaState:

| string | Description |
|---|---|
| Aborted | This enumeration literal shall indicate that the copy operation is aborted with the Abort operation. The Resync Replica operation can be used to restart the copy operation. |
| Broken | This enumeration literal shall indicate that the relationship is non-functional due to errors in the source, the target, the path between the two or space constraints. |
| Failedover | This enumeration literal shall indicate that the reads and writes are sent to the target element. The source element may not be reachable. |

| string | Description |
|---|---|
| Fractured | This enumeration literal shall indicate that the Target is split from the source. The target may not be consistent. |
| Inactive | This enumeration literal shall indicate that data flow has stopped, writes to source element shall not be sent to target element. |
| Initialized | This enumeration literal shall indicate that the link to enable replication is established and source/replica elements are associated, but the data flow has not started. |
| Invalid | This enumeration literal shall indicate that the storage server is unable to determine the state of the replication relationship, for example, after the connection is restored; however, either source or target elements have an unknown status. |
| Mixed | This enumeration literal shall indicate the ReplicaState of GroupSynchronized. The value indicates the StorageSynchronized relationships of the elements in the group have different ReplicaState values. |
| Partitioned | This enumeration literal shall indicate that the state of replication relationship can not be determined, for example, due to a connection problem. |
| Prepared | This enumeration literal shall indicate that initialization is completed, however, the data flow has not started. |
| Restored | This enumeration literal shall indicate that the source element was restored from the target element. |
| Skewed | This enumeration literal shall indicate that the target has been modified and is no longer synchronized with the source element or the point-in-time view. |
| Split | This enumeration literal shall indicate that the target element was gracefully (or systematically) split from its source element -- consistency shall be guaranteed. |
| Suspended | This enumeration literal shall indicate that the data flow between the source and target elements has stopped. Writes to source element shall be held until the relationship is Resumed. |
| Synchronized | This enumeration literal shall indicate that for Mirror, Snapshot, or Clone replication, the target represents a copy of the source. |
| Unsynchronized | This enumeration literal shall indicate that not all the source element data has been copied to the target element. |

### 9.25.1.13 UndiscoveredElement:

| string | Description |
|---|---|
| ReplicaElement | This enumeration literal shall indicate that the replica element is undiscovered. |
| SourceElement | This enumeration literal shall indicate that the source element is undiscovered. |

### 9.25.1.14 VolumeType:

| string | Description |
|---|---|
| Mirrored | The volume is a mirrored device. |
| NonRedundant | The volume is a non-redundant storage device. |
| RawDevice | The volume is a raw physical device without any RAID or other virtualization applied. |
| SpannedMirrors | The volume is a spanned set of mirrored devices. |
| SpannedStripesWithParity | The volume is a spanned set of devices which uses parity to retain redundant information. |
| StripedWithParity | The volume is a device which uses parity to retain redundant information. |

# 9.26 VolumeCollection

This collection shall contain references to all Volume resource instances sharing the same parent resource.

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Members** [ { | array<br><br>*read-write* | The value of each member entry shall reference a Volume resource. |
| **AccessCapabilities** [ {} ] | array<br><br>*read-write* | Each entry shall specify a current storage access capability. |
| **Actions** {} | object<br><br>*read-only* | The Actions property shall contain the available actions for this resource. |
| **AllocatedPools** [ {} ] | array<br><br>*read-only* | The value of this property shall contain references to all storage pools allocated from this volume. |
| **BlockSizeBytes** | number, null (By)<br><br>*read-only* | This property shall contain size of the smallest addressable unit of the associated volume. |
| **Capacity** {} | object, null<br><br>*read-write* | Information about the utilization of capacity allocated to this storage volume. |
| **CapacityBytes** | number, null (By)<br><br>*read-only* | This property shall contain the size in bytes of the associated volume. |
| **CapacitySources** [ {} ] | array<br><br>*read-write* | Fully or partially consumed storage from a source resource. Each entry provides capacity allocation information from a named source resource. |

| | | |
|---|---|---|
| **Description** | null<br><br>*read-write* | |
| **Encrypted** | boolean, null<br><br>*read-write* | This property shall contain a boolean indicator if the Volume is currently utilizing encryption or not. |
| **EncryptionTypes** [ {} ] | array<br><br>*read-write* | This property shall contain the types of encryption used by this Volume. |
| **Id** | <br><br>*read-only* | |
| **Identifiers** [ {} ] | array<br><br>*read-only* | This property shall contain a list of all known durable names for the associated volume. |
| **Links** {} | object<br><br>*read-only* | The Links property, as described by the Redfish Specification, shall contain references to resources that are related to, but not contained by (subordinate to), this resource. |
| **LowSpaceWarningThresholdPercents** [ {} ] | array<br><br>*read-write* | Each time the following value is less than one of the values in the array the LOW_SPACE_THRESHOLD_WARNING event shall be triggered: Across all CapacitySources entries, percent = (SUM(AllocatedBytes) - SUM(ConsumedBytes))/SUM(AllocatedBytes). |
| **Manufacturer** | string, null<br><br>*read-only* | This property shall contain a value that represents the manufacturer or implementer of the storage volume. |
| **MaxBlockSizeBytes** | number, null (By)<br><br>*read-only* | This property shall contain size of the largest addressable unit of this storage volume. |
| **Model** | string, null<br><br>*read-only* | The value is assigned by the manufacturer and shall represents a specific storage volume implementation. |

| | | |
|---|---|---|
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |
| **Operations** [ {} ] | array<br>*read-only* | This property shall contain a list of all currently running on the Volume. |
| **OptimumIOSizeBytes** | number, null (By)<br>*read-only* | This property shall contain the optimum IO size to use when performing IO on this volume. For logical disks, this is the stripe size. For physical disks, this describes the physical sector size. |
| **ReplicaInfos** [ {} ] | array<br>*read-only* | This property shall describe the replica relationship between this storage volume and a corresponding source and/or target volume. |
| **Status** | *read-write* | |
| **StorageGroups** [ {} ] | array<br>*read-only* | The value of this property shall contain references to all storage groups that include this volume. |
| **VolumeType** | string, null<br>*read-write* | This property shall contain the type of the associated Volume. *See Property Details, below, for more information about this property.* |
| } ] | | |
| **Name** | *read-only* | |
| **Oem** | *read-write* | The value of this string shall be of the format for the reserved word *Oem*. |

## 9.26.1 Property Details

#### 9.26.1.1 VolumeType:

| string | Description |
|---|---|
| Mirrored | The volume is a mirrored device. |
| NonRedundant | The volume is a non-redundant storage device. |
| RawDevice | The volume is a raw physical device without any RAID or other virtualization applied. |
| SpannedMirrors | The volume is a spanned set of mirrored devices. |
| SpannedStripesWithParity | The volume is a spanned set of devices which uses parity to retain redundant information. |
| StripedWithParity | The volume is a device which uses parity to retain redundant information. |