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A Deep Dive Sea Trek With SNIA Swordfish™

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Disclaimer

- The information in this presentation represents a snapshot of work in progress within SNIA
- This information is subject to change without notice.
- For additional information, see the SNIA website: www.snia.org/swordfish

Abstract

- Swordfish™ is an extension of the DMTF Redfish® specification developed by the Storage Networking Industry Association (SNIA) to provide a unified approach for the management of storage equipment and services in converged, hyper-converged, hyperscale and cloud infrastructure environments, making it easier for IT administrators and DevOps to integrate scalable solutions into their data centers.

- This session builds on the intro sessions to Redfish and Swordfish, presenting more detail about the Swordfish Class of Service concepts, structure and usage;
- A look at Swordfish schema (both CSDL and JSON),
- Usage of the two Swordfish Service Configurations,
- A preview of the emerging Swordfish profile definition work.

Swordfish Concepts

Primary Swordfish Elements

- ClassOfService
  - A choice of utility or warranty offered to customers by a service. Defined by selecting from available LinesOfService.
- StorageService:
  - Represents a service that provides ClassOfService based provisioning, management, and monitoring for logical storage and associated resources
- StoragePools
  - Storage capacity that can be used to produce volumes or other storage pools with a specified class of service.
- Volume
  - Block addressable storage that is conformant to a ClassOfService.
- StorageGroup
  - A set of volumes that are managed as a group; e.g., with the same consistency requirements.
- Filesystem
  - File-addressable storage that is conformant to a ClassOfService.
- Fileshare
  - A shared set of files with a common directory structure that is exported for use by remote systems.

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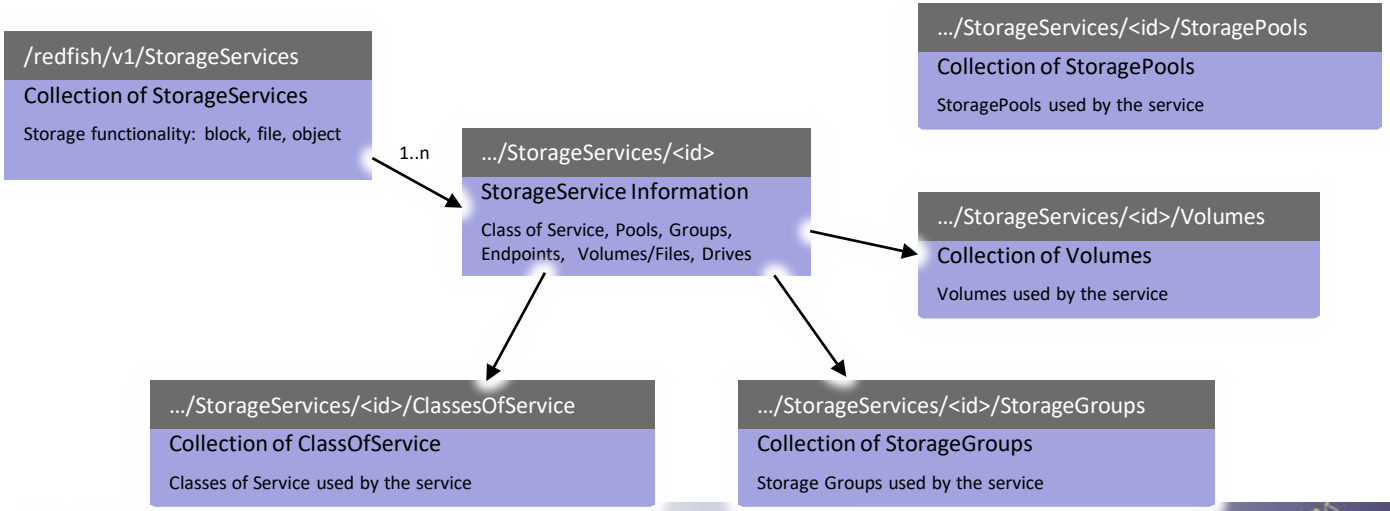
Storage Services

- Contains a list of Storage Service instances that manage the different storage related functionality
- Focus of StorageService is on the logical aspects of the storage (such as classes of service, volumes, file systems / file shares, storage pools)



Class of Service

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Why Class of Service

- Modern volumes, file systems, and object stores are often built on complex, multiply layered algorithms and implementations
  - The internals of storage servers are quite complex and vary by product
- Configuration of these elements, can be complex and may require detailed implementation and implementations can change over time with unexpected consequences
- Class of Service addresses these concerns.
- An implementation advertises a set of supported configuration options that will deliver desired levels of service in terms that are meaningful to the user.
- Provisioning a resource to a Class of Service allows each user to get expected levels of service while enabling each implementation to set the configuration correctly to deliver the requested levels of service.

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Class of Service

- Swordfish introduces provisioning based on a requested class of service
  - A Class of Service specifies one or more desired levels of service
- Implementation independence
  - Ex 1: Same level of performance might be delivered using a single drive with faster drive technology or via striping multiple drives.
  - Ex 2: Thin provisioning via various vendor specific techniques
  - Ex 3: The best connectivity choices for throughput and bandwidth vary with implementation
  - Ex 4: Where and how to best protect storage
- Class of Service based systems are expected to monitor compliance and to creates notifications when out of conformance

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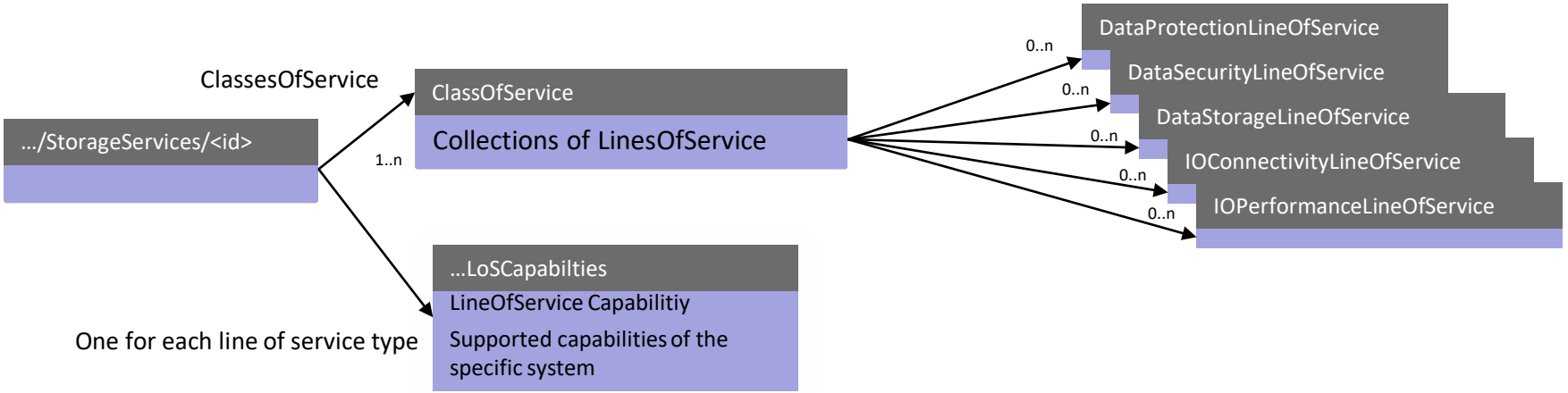
Defining Classes of Service

- Classes of Service are composed of Lines of Service
  - Types: Data Protection, Data Security, Data Storage, Connectivity, Performance
    - Properties of each are constrained by …LoSCapabilities



Capability Types (XXXLoSCapabilities)

- Data Protection – replicas for recovery
  - Type of replica, schedule, geographic requirements
- Data Security – encryption, authentication, anti-virus, sanitization
- Data Storage – high availability, R/W access, thin provisioning
  - Recovery time requirements, thick/thin provisioning
- IO Connectivity – storage interface characteristics
  - Connection type, media class
- IO Performance – workload description
  - Guaranteed workload / latency, workload throttling

Simple Example:

- Use a single capability property to create two possible classes of service
  - IOConnectivityLoSCapabilities. SupportedAccessProtocols (e.g., drive type)
- Create LinesOfService that includes this property
- Create two classes of service: One for NVMe drives, one for SAS / SATA drives

Example: Two Classes Of Service

```
"@odata.id":
"/redfish/v1/StorageServices/1/ClassesOfService/HighCapacity",
  "@odata.type":
"#ClassOfService_1_0_0.ClassOfService",
  "Name": "HighCapacity",
  "Description": "HighCapacity Class Of Service (SATA)",
  "Id": "HighCapacity",
  "ClassOfServiceVersion": "1.01.00",
  "Status": { "State": "Enabled", "Health": "OK",},
  "LinesOfService": {
    "IOConnectivityLineOfService": {
      "Name": "Serial Attached ATA",
      "AccessProtocol": "SATA"
    }
}
```

```
"@odata.context":
"/redfish/v1/$metadata#StorageServices/1/ClassesOfService/HighPerformance",
  "@odata.id":
"/redfish/v1/StorageServices/1/ClassesOfService/HighPerformance",
  "@odata.type":
"#ClassOfService_1_0_0.ClassOfService",
  "Name": "HighPerformance",
  "Description": "HighPerformance Class Of Service (NVMe SSDs)",
  "ClassOfServiceVersion": "1.01.00",
  "Status": { "State": "Enabled", "Health": "OK",},
  "LinesOfService": {
    "IOConnectivityLineOfService": {
      "Name": "NVMe",
      "AccessProtocol": "NVMe"
    }
  }
```

Using Classes Of Service

- Once ClassesOfService exist (either pre-existing from vendor or constructed from capabilities -> LinesOfService -> ClassesOfService):
  - Create StoragePools using specified Classes of Service
  - When allocating volumes, use the StoragePools' Class of Service attributes to determine which to use to request capacity

Example: Create Volume

```
`POST /redfish/v1/StorageServices(1)/Volumes/`
   {
     "Name": “Volume56",
     "CapacityBytes": 1099511627776,
      "Links": {
         "ClassOfService": {"odata.id":
          "/redfish/v1/StorageServices(1)/ClassesofService(HighPerformance)"}
       }
   }
```

See Swordfish User’s Guide for more context.
Link available at www.snia.org/swordfish

Schema Primer

Schema File Types

- Currently two types of schema files exist: CSDL and JSON
- CSDL (one file with all versions)
  - Common Schema Definition Language
  - XML formatted
  - Standardized by OASIS to support the OData standard
- JSON (one file per version)
  - Follows http://json-schema.org/ format
  - Generated by scripts from the CSDL schemas
- Both sets of schemas are functionally equivalent
- Using one type over the other is a matter of preference on the part of the developer
- **NOTE: Both Redfish and Swordfish are adding OpenAPI support**

Schema File Rules

- Each resource (entity type) is described by a single schema file (in CSDL)
  - Each schema file may pull in external definitions
  - In JSON, a version is created for each file version (including unversioned)
- Schema files also contain additional supporting structures (e.g., ComplexTypes, Enums)
  - Shared structures are referenced by the namespace they are defined in: An Enum in the Resource_v1.xml file would be referenced as Resource.Enum
- Redfish and OData Annotations define and constrain schema elements
- Schema contain a set of OData properties to provide additional identifying information
  - Each response contains an “@odata.type” property to provide top level decoding information
    - “@odata.type” is broken down as “#Namespace.Entity”
    - Example: “#Volume.v1_2_0. Volume” means it’s a “Volume” entity in the “Volume.v1_2_0” namespace

Using Schema Files

- Generic clients may dynamically parse schema files as they are interacting with a service in order to automatically build data models
- Purpose built clients may not necessarily read schema files directly
  - Developers may reference schema files when writing these clients to understand what resources and properties are available
- All standard schema files are (re-)published on the DMTF website
    - DMTF schema published directly
    - SNIA schema “republished”
    - OEM schema may also be (and are recommended by SNIA Scalable Storage Management TWG to be) “republished” on the DMTF site
  - Clients and services may have local copies

CSDL Schema Example

```
<edmx:Edmx xmlns:edmx="http://docs.oasis-open.org/odata/ns/edmx" Version="4.0">

  <edmx:Reference Uri="http://docs.oasis-open.org/.../Org.OData.Core.V1.xml">
    <edmx:Include Namespace="Org.OData.Core.V1" Alias="OData"/>
  </edmx:Reference>
  <edmx:Reference Uri="http://docs.oasis-open.org/.../Org.OData.Capabilities.V1.xml">
    <edmx:Include Namespace="Org.OData.Capabilities.V1" Alias="Capabilities"/>
  </edmx:Reference>
  <edmx:Reference Uri="http://redfish.dmtf.org/schemas/v1/Resource_v1.xml">
    <edmx:Include Namespace="Resource.v1_0_0"/>
  </edmx:Reference>
  <edmx:Reference Uri="http://redfish.dmtf.org/schemas/v1/RedfishExtensions_v1.xml">
    <edmx:Include Namespace="RedfishExtensions.v1_0_0" Alias="Redfish"/>
  </edmx:Reference>

  <edmx:DataServices>

    <Schema xmlns="http://docs.oasis-open.org/odata/ns/edm" Namespace="Session">
      <EntityType Name="Session" BaseType="Resource.v1_0_0.Resource" Abstract="true">
        <Annotation Term="OData.Description" String="..."/>
        <Annotation Term="OData.LongDescription" String="..."/>
      </EntityType>
    </Schema>
```

CSDL Schema Example (cont.)

```
<Schema xmlns="http://docs.oasis-open.org/odata/ns/edm" Namespace="Session.v1_0_0">
  <Annotation Term="Redfish.OwningEntity" String="DMTF"/>
  <Annotation Term="Capabilities.InsertRestrictions">
      <Record> <PropertyValue Property="Insertable" Bool="false"/> </Record>
   </Annotation>
  <EntityType Name="Session" BaseType="Session.Session">
    <Property Name="UserName" Type="Edm.String">
      <Annotation Term="OData.Permissions" EnumMember="OData.Permission/Read"/>
      <Annotation Term="Redfish.RequiredOnCreate"/>
      <Annotation Term="OData.Description" String="..."/>
      <Annotation Term="OData.LongDescription" String="..."/>
    </Property>
    <NProperty Name="Password" Type="Edm.String">
      <Annotation Term="OData.Permissions" EnumMember="OData.Permission/Read"/>
      <Annotation Term="Redfish.RequiredOnCreate"/>
      <Annotation Term="OData.Description" String="..."/>
      <Annotation Term="OData.LongDescription" String="..."/>
    </Property>
  </EntityType>
</Schema>
```

CSDL Schema Example (cont.)

```
    <Schema xmlns="http://docs.oasis-open.org/odata/ns/edm" Namespace="Session.v1_1_0">
      <EntityType Name="Session" BaseType="Session.v1_0_0.Session">
        <Property Name="Actions" Type="Session.v1_1_0.Actions" Nullable="false">
          <Annotation Term="OData.Description" String="..."/>
          <Annotation Term="OData.LongDescription" String="..."/>
        </Property>
      </EntityType>

      <ComplexType Name="Actions">
        <Annotation Term="OData.AdditionalProperties" Bool="false"/>
        <Annotation Term="OData.Description" String="..."/>
        <Annotation Term="OData.LongDescription" String="..."/>
        <Property Name="Oem" Type="Session.v1_1_0.OemActions" Nullable="false"/>
      </ComplexType>

      <ComplexType Name="OemActions">
        <Annotation Term="OData.AdditionalProperties" Bool="true"/>
        <Annotation Term="OData.Description" String="..."/>
        <Annotation Term="OData.LongDescription" String="..."/>
      </ComplexType>
    </Schema>
  </edmx:DataServices>
</edmx:Edmx>
```

JSON Schema Example

```
{
    "$schema": "http://redfish.dmtf.org/schemas/v1/redfish-schema.v1_2_0.json",
    "title": "#Session.v1_1_0.Session",
    "$ref": "#/definitions/Session",
    "definitions": {
        "Session": {
            "type": "object",
            "additionalProperties": false,
            "properties": {
                "@odata.context": { "$ref": "http://.../odata.4.0.0.json#/definitions/context" },
                "@odata.id": { "$ref": "http://.../odata.4.0.0.json#/definitions/id" },
                "@odata.type": { "$ref": "http://.../odata.4.0.0.json#/definitions/type" },
                "Oem": {
                    "$ref": "http://.../Resource.json#/definitions/Oem",
                    "description": "...",
                    "longDescription": "..."
                },
                "Id": {
                    "$ref": "http://.../Resource.json#/definitions/Id",
                    "readonly": true
                },
```

JSON Schema Example (cont.)

```
"Description": {
    "anyOf": [
        {"$ref": "http://.../Resource.json#/definitions/Description"},
        {"type": "null"}
    ],
    "readonly": true
},
"Name": {
    "$ref": "http://.../Resource.json#/definitions/Name",
    "readonly": true
},
"UserName": {
    "type": [ "string", "null" ],
    "readonly": true,
    "description": "...",
    "longDescription": "..."
},
"Password": {
    "type": [ "string", "null" ],
    "readonly": true,
    "description": "...",
    "longDescription": "..."
},
```

JSON Schema Example (cont.)

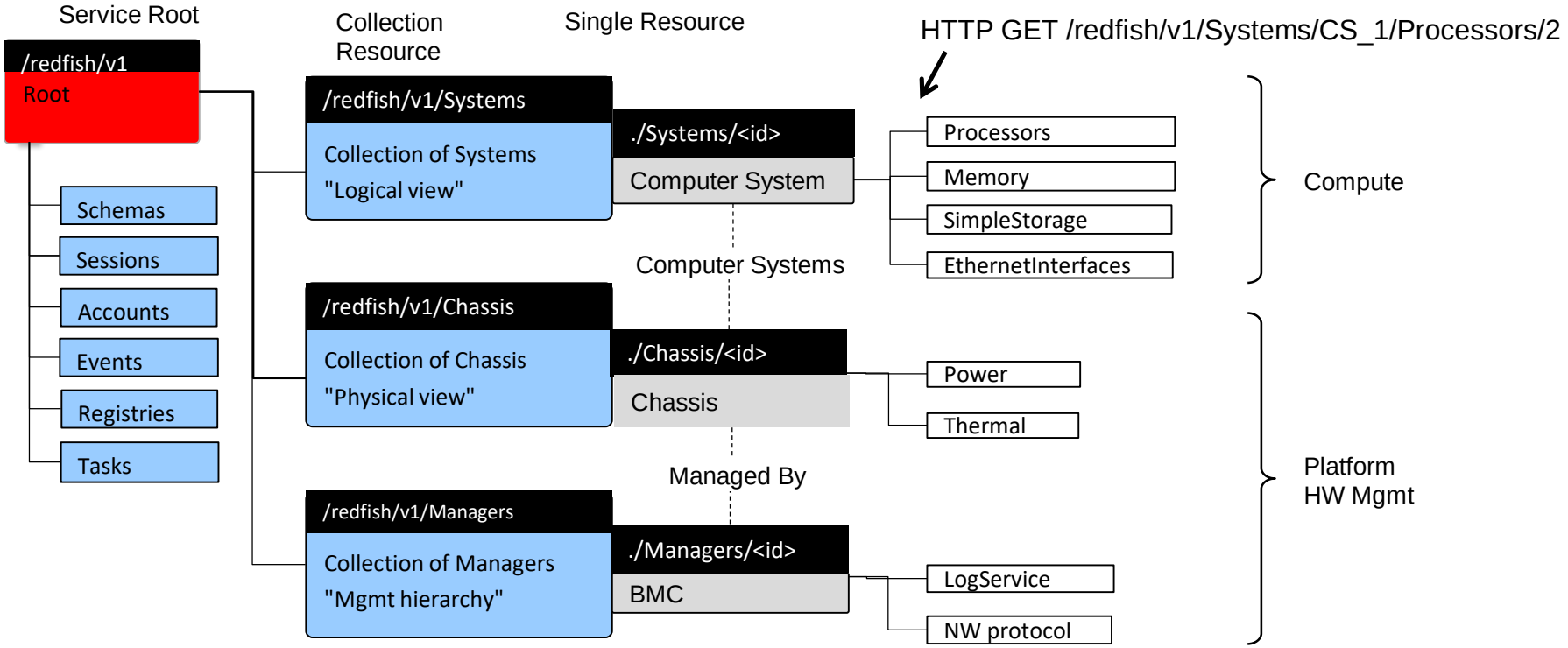
```
            "Actions": {
                "type": "object",
                "additionalProperties": false,
                "properties": {
                    "Oem": {
                        "type": "object",
                        "additionalProperties": true,
                        "properties": {},
                        "description": "...",
                        "longDescription": "..."
                    }
                },
                "description": "...",
                "longDescription": "..."
            }
        },
        "required": [ "Id", "Name" ],
        "requiredOnCreate": [ "UserName", "Password" ],
        "description": "...",
        "longDescription": "..."
    }
}
```

Deploying Swordfish: ISC and HSC Configurations

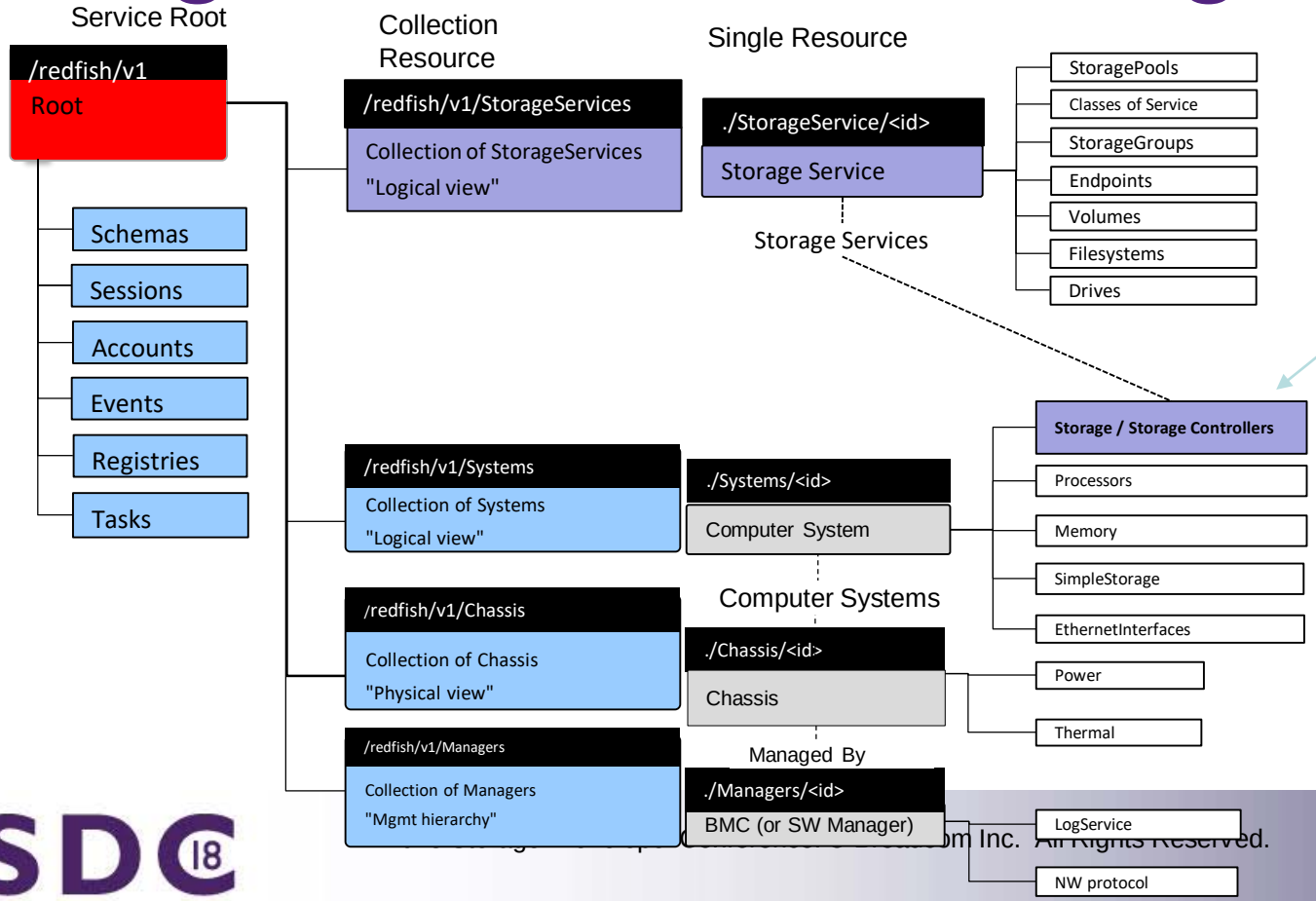
Storage Deployment Options

- Direct-attach progression:
  - Server with direct connect drives
    - Use SimpleStorage
  - Server with either HBA with connected drives or RAID card with small # of drives
    - Use Storage+Volume+Drives
  - Increase scale (# of drives) or functionality
    - Use Storage + StorageServices == Swordfish (ISC)
- Standalone Configurations:
  - External storage, SDS, Layered or composed systems
  - Use HSC (Swordfish)

Starting with Redfish: Basic Compute

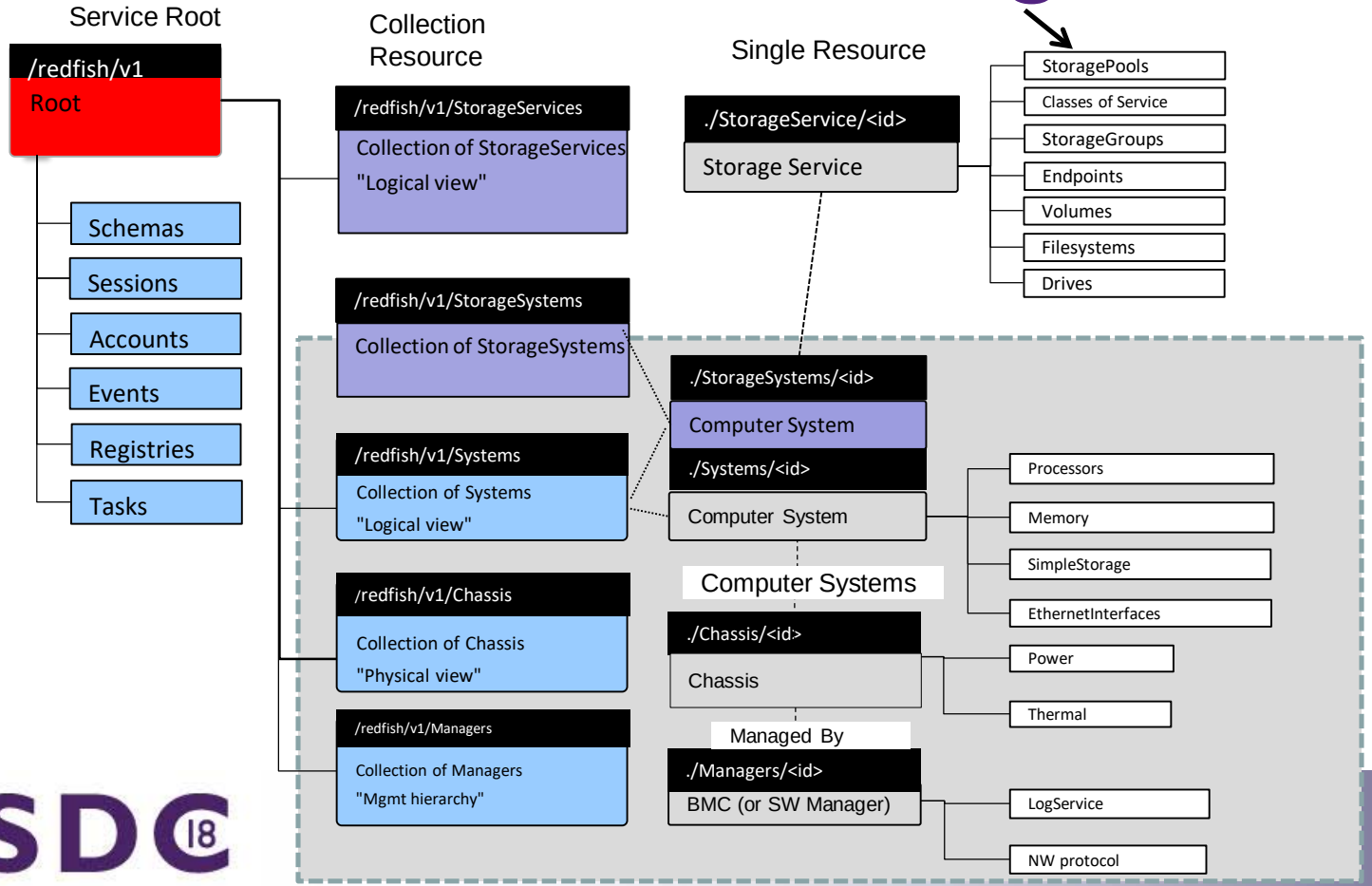


Integrated Service Configuration



The Storage/StorageController in ComputerSystem hosts the StorageServices. It is capable of creating StorageServices and additional Swordfish functionality.

Hosted Service Configuration



A StorageSystem *is* an instance of a ComputerSystem (with a small set of additional properties defined).

Features and Profiles

How Do Clients Determine Which Swordfish Implementations They Can Support?

- Runtime: clients can look for advertised implemented features
- During development, look at detailed profiles that map to these features

- Features and profiles used for:
  - "Advertising" implemented functionality
  - Clients use to determine what features to require for different configurations
  - Certification / Conformance requirements, testing
    - Swordfish CTP Certification
    - (Future) OCP, ODCC Storage
    - (Planned) EnergyStar Requirements: Orthogonal to functionality profiles
      - Energy and power metrics
      - Controls for on-demand instrumentation

Advertised Features

- For supported service types…
  - Services == block, file, object
- Features define coarse-grained sets of required functionality:
  - Standard Features:
    - Discovery / Inventory
    - Events
    - Performance Instrumentations
    - Basic Provisioning
  - Advanced Features:
    - Local replication provisioning
    - Remote replication provisioning
    - Advanced Configuration Management
    - Mapping and Masking for Provisioning

Profiles

- Profiles are detailed descriptions for storage service (provider) implementers, inputs to tests, etc., that describe down to the individual property level what functionality is required in order to advertise features
- There will be multiple profile definitions, for different types of storage configurations, that map to the same feature: Block.Provisioning, File.Provisioning
- Profiles are predominantly a development tool

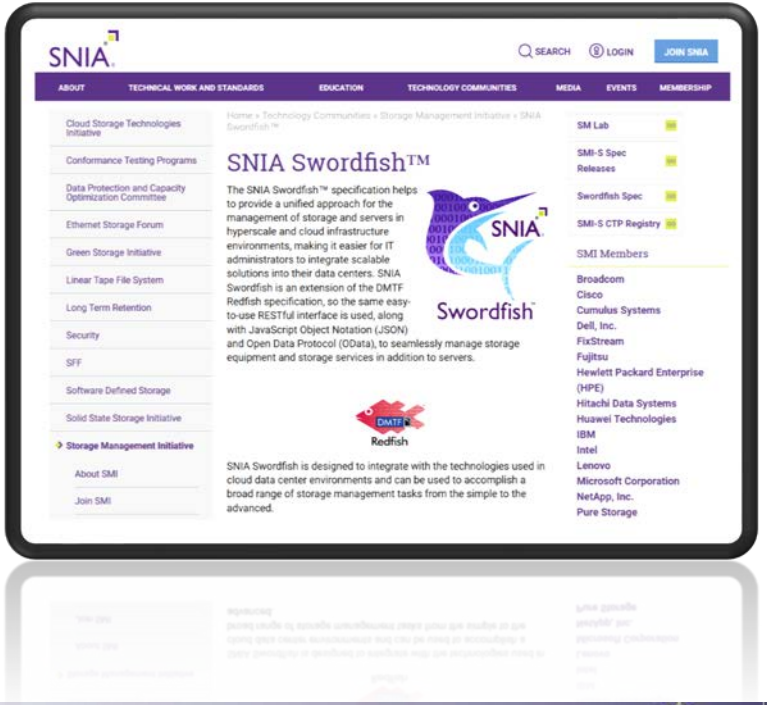
Swordfish Specs and Technical Content... In 2018

- v1.0.6 Technical Position Release in (WIP in Feb 2018, TP in May 2018)
  - Introduction of two StorageSystem models:
    - Hosted Service Configuration and Integrated Service Configuration
  - Schema updates, Spec section additions, User's guide updates: new use cases for on-demand replicas
- Q4 2018 Releases:
  - Updated Swordfish mockups: swordfishmockups.com
  - v1.0.7 Swordfish WIP Release:
    - Enhanced Class of Service Capabilities for Spare Capacity Management, Rebuild Management, Volume types
  - White Paper for Spare Management
  - WIP Profile Development: Basic Swordfish Support
- Future Functionality
  - Storage-specific security roles
  - Enhanced profiles for SNIA Alliance partner organizations
  - Functionality alignment across DMTF, NVMExpress/NVMe-MI and SNIA
  - Object Storage

Resources

Swordfish Info: www.snia.org/swordfish

- Resources
  - Specifications
  - User's Guide
  - GitHub for Swordfish Tools
  - Practical Guide
  - Other Documentation
- Swordfish Mockups Site
  - ISC and HSC configurations
  - Block vs file configurations
  - Small and large configurations
- Education/Community
  - Whitepapers, Presentations
  - YouTube shorts & Webinars
- Participate
  - Join SNIA and the SSM TWG
  - Implement



Open Source Tools and Infrastructure Development

- Available: http://github.com/snia
  - Swordfish Emulator Extensions
    - Extends the Redfish emulator – adds all Swordfish schema (behave like dynamic objects)
  - Basic Swordfish Web Client
    - Discover, display and edit Swordfish services
  - DataDog and Power BMI Client Sample Dashboards
    - Sample implementations show integration concepts with sample code:
    - PowerBI: Point-in-time dashboard; Datadog: Data trending dashboard

Documentation and Supporting Materials

- Online Practical Guide
  - SNIA Swordfish Practical Guide
- Swordfish School:
  - Swordfish School Playlist (YouTube)
- Swordfish API Specification
- Webcasts

How to Participate: Shaping the Standard

- Find pointers to the latest technical content:
  - http://snia.org/swordfish
  - http://www.snia.org/publicreview#swordfish
- Join the SSM TWG
  - By joining the SNIA and SSM TWG, you can shape the standard: https://members.snia.org/apps/org/workgroup/ssmtwg
- Through the SNIA feedback portal, providing feedback on “Work In Progress”
  - As the group produces “Works In Progress”, you can provide feedback at http://www.snia.org/feedback

Q&A