SDC
STORAGE DEVELOPER CONFERENCE
SNIA ■ SANTA CLARA, 2016

Swordfish Deep-Dive: Scalable Storage Management

Richelle Ahlvers

Principal Storage Management Architect
Broadcom Limited

SNIA Scalable Storage Management (SSM) Technical Work Group Chair

Abstract

- Building on the concepts presented in the Introduction to Swordfish (and Redfish) sessions, this session will go into more detail on the new Swordfish API specification:
  - The SNIA's Scalable Storage Management Technical Work Group (SSM TWG) has just released an open industry standard specification for storage management that defines a customer centric interface for the purpose of managing storage and related data services. This specification builds on the DMTF's Redfish specification using RESTful methods and JSON formatting.

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

The Swordfish Approach

- ***The What:***
  - Refactor and leverage SMI-S schema into a simplified model that is client oriented
  - Move to Class of Service based provisioning and monitoring
  - Cover block, file and object storage
  - Extend traditional storage domain coverage to include converged environments (covering servers, storage and fabric together)
- ***The How:***
  - Leverage and extend DMTF Redfish Specification
  - Build using DMTF's Redfish technologies
    - RESTful interface over HTTPS in JSON format based on OData v4
  - Implement Swordfish as an extension of the Redfish API

Who is Developing Swordfish?

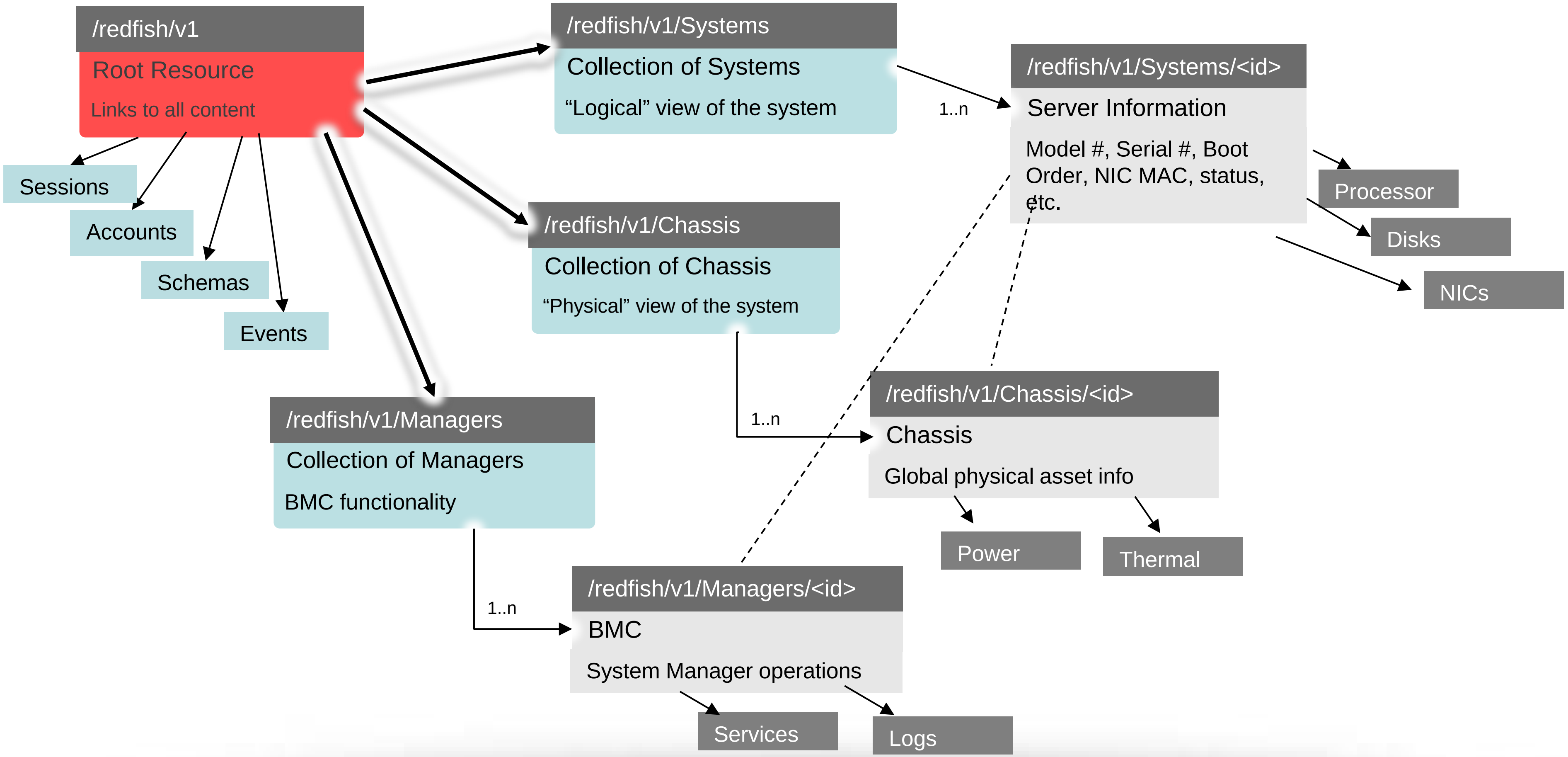
- SNIA Scalable Storage Management Technical Work Group (SSM TWG)
  - SSM is the group, Swordfish is the Spec
  - Provisional TWG formed in October 2015 to investigate / scope work
  - Scalable Storage Management (SSM) TWG chartered in December 2015
- Companies Engaged in Technical Development:
  - ***Broadcom***, Brocade, Compellent / ***Dell***, ***EMC***, Fujitsu, ***HPE***, Huawei, IBM, ***Inova***, ***Intel***, ***Microsoft***, NEC, ***NetApp***, ***Nimble Storage***, Pure Storage, RedHat, SK Hynix, Tintri, Toshiba, VMTurbo, ***VMware*****,** WD

Functionality Included in the Swordfish v1.0 API Specification

- Block storage
  - Provisioning with **class of service** control
  - Volume Mapping and Masking
  - Replication
  - Capacity and health metrics
- File system storage
  - Adds File System and File Share
  - Leverages all other concepts – provisioning with class of service, replication, …
- Additional content
  - Object drive storage

Starting with Redfish: An Overview

Redfish Resource Map



/redfish/v1
Root Resource
Links to all content

Sessions
Accounts
Schemas
Events

/redfish/v1/Systems
Collection of Systems
“Logical” view of the system

1..n

/redfish/v1/Systems/<id>
Server Information
Model #, Serial #, Boot Order, NIC MAC, status, etc.

Processor
Disks
NICs

/redfish/v1/Chassis
Collection of Chassis
“Physical” view of the system

1..n

/redfish/v1/Chassis/<id>
Chassis
Global physical asset info

Power
Thermal

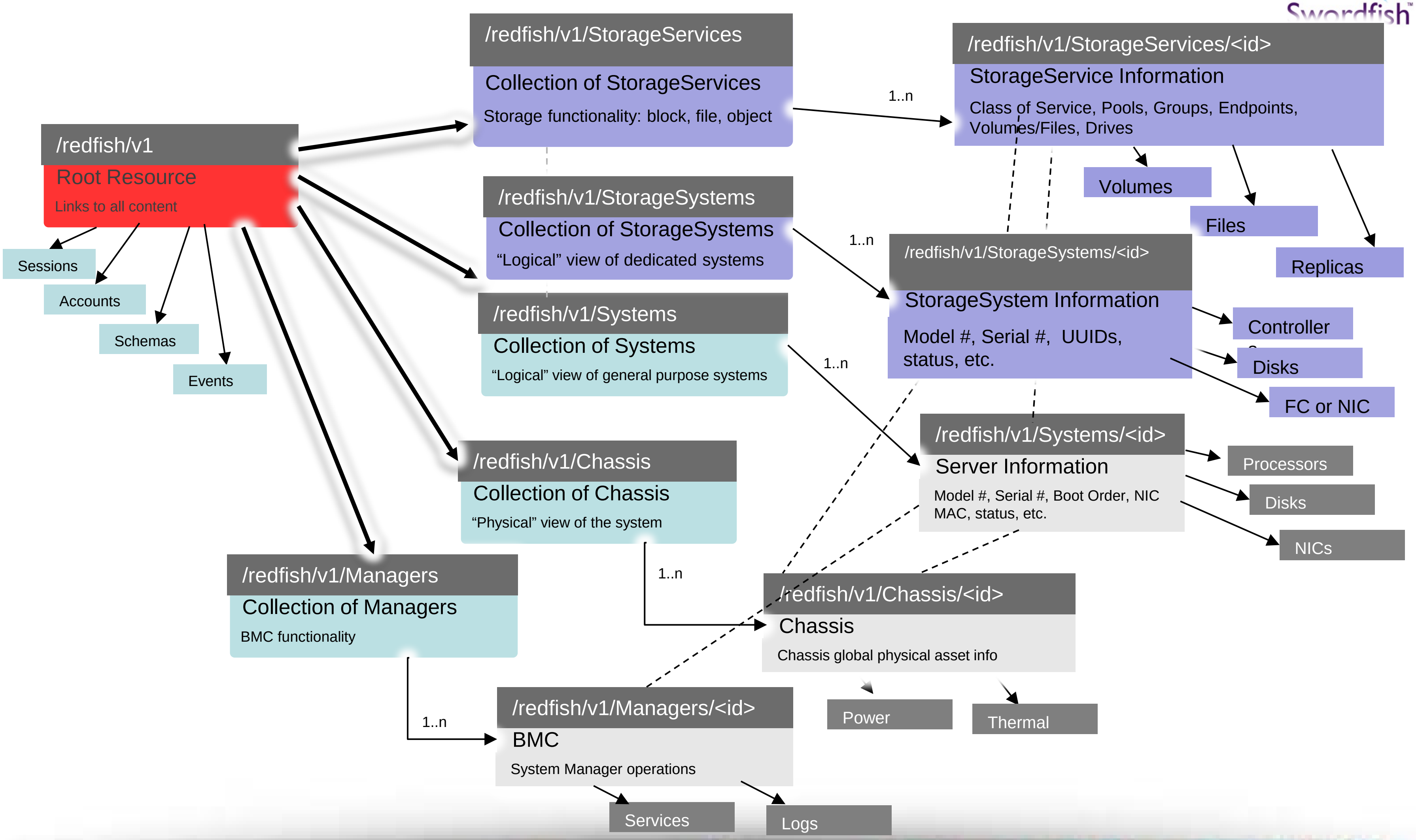
/redfish/v1/Managers
Collection of Managers
BMC functionality

1..n

/redfish/v1/Managers/<id>
BMC
System Manager operations

Services
Logs

Adding Storage to Redfish…



/redfish/v1

Root Resource

Links to all content

Sessions

Accounts

Schemas

Events

/redfish/v1/StorageServices

Collection of StorageServices

Storage functionality: block, file, object

1..n

/redfish/v1/StorageServices/<id>

StorageService Information

Class of Service, Pools, Groups, Endpoints, Volumes/Files, Drives

Volumes

Files

Replicas

/redfish/v1/StorageSystems

Collection of StorageSystems

“Logical” view of dedicated systems

1..n

/redfish/v1/StorageSystems/<id>

StorageSystem Information

Model #, Serial #, UUIDs, status, etc.

Controller

Disks

FC or NIC

/redfish/v1/Systems

Collection of Systems

“Logical” view of general purpose systems

1..n

/redfish/v1/Systems/<id>

Server Information

Model #, Serial #, Boot Order, NIC MAC, status, etc.

Processors

Disks

NICs

/redfish/v1/Chassis

Collection of Chassis

“Physical” view of the system

1..n

/redfish/v1/Chassis/<id>

Chassis

Chassis global physical asset info

Power

Thermal

/redfish/v1/Managers

Collection of Managers

BMC functionality

1..n

/redfish/v1/Managers/<id>

BMC

System Manager operations

Services

Logs

What is in the Swordfish Bundle?

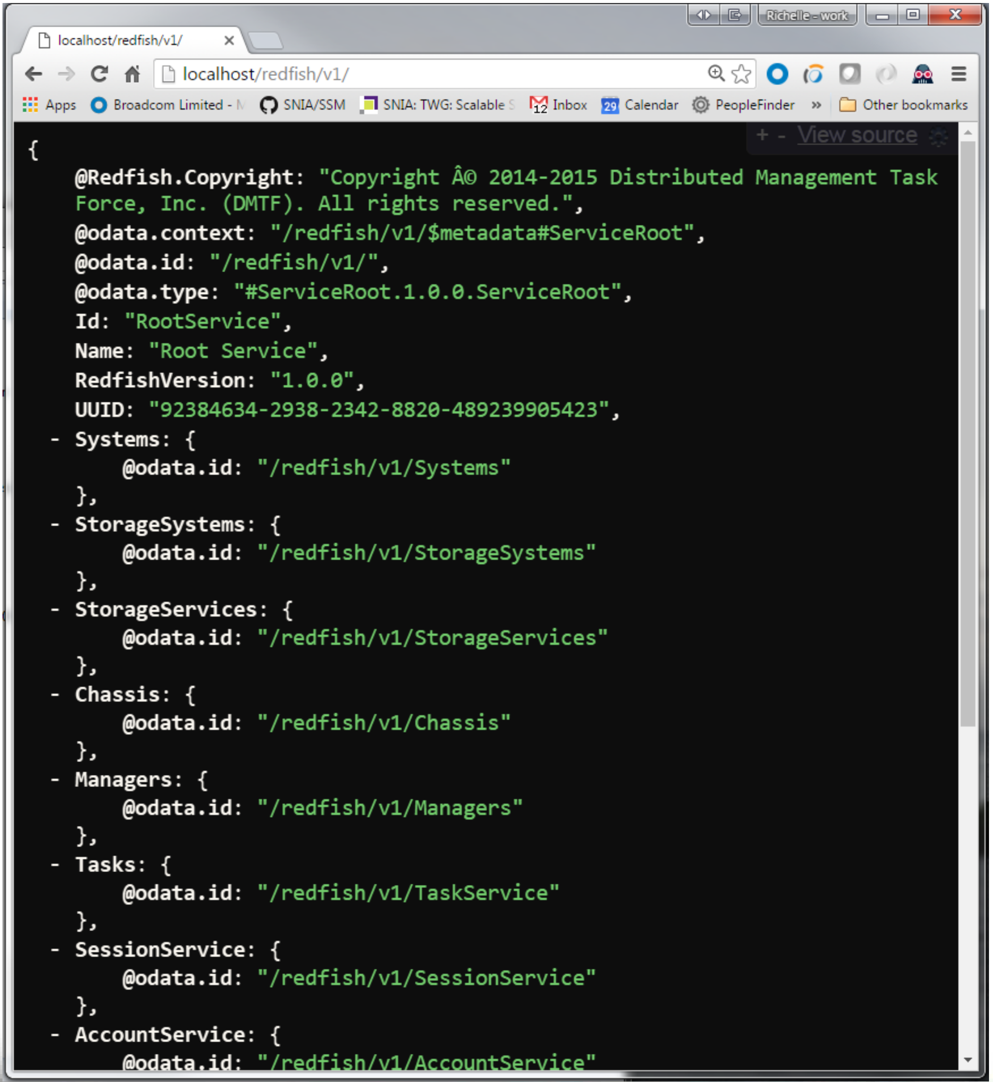
- Technical Specification
  - Normative requirements for storage implementations
  - Documents storage-specific extensions and schema
  - *Note: does not include leveraged Redfish protocol or schema information*
- User’s Guide
  - Use cases with best practices, common tasks – education for users of the Swordfish API
- Schema
  - CSDL / XML format
  - JSON format
- Mockups
  - Multiple configurations
  - Documentation to help with installation and usage

Getting Started with Swordfish

- As a work tool, the Technical Work Group (TWG) has developed “mockups” (snapshots of a state in time) of different types of systems
- These are available as part of the WIP releases and will be published on an ongoing basis as new functionality is added to show samples to supplement documentation

Overview of Swordfish Mockups

- Explore “mockups” of the Swordfish data model in a typical implementation
- Navigate via links through the model to various resources
- SNIA mockups show two examples of block storage systems
  - Simple: A small external array
  - Complex: all of the elements in the block storage model, with remote replication
- .. and an example of a file server with multiple file shares



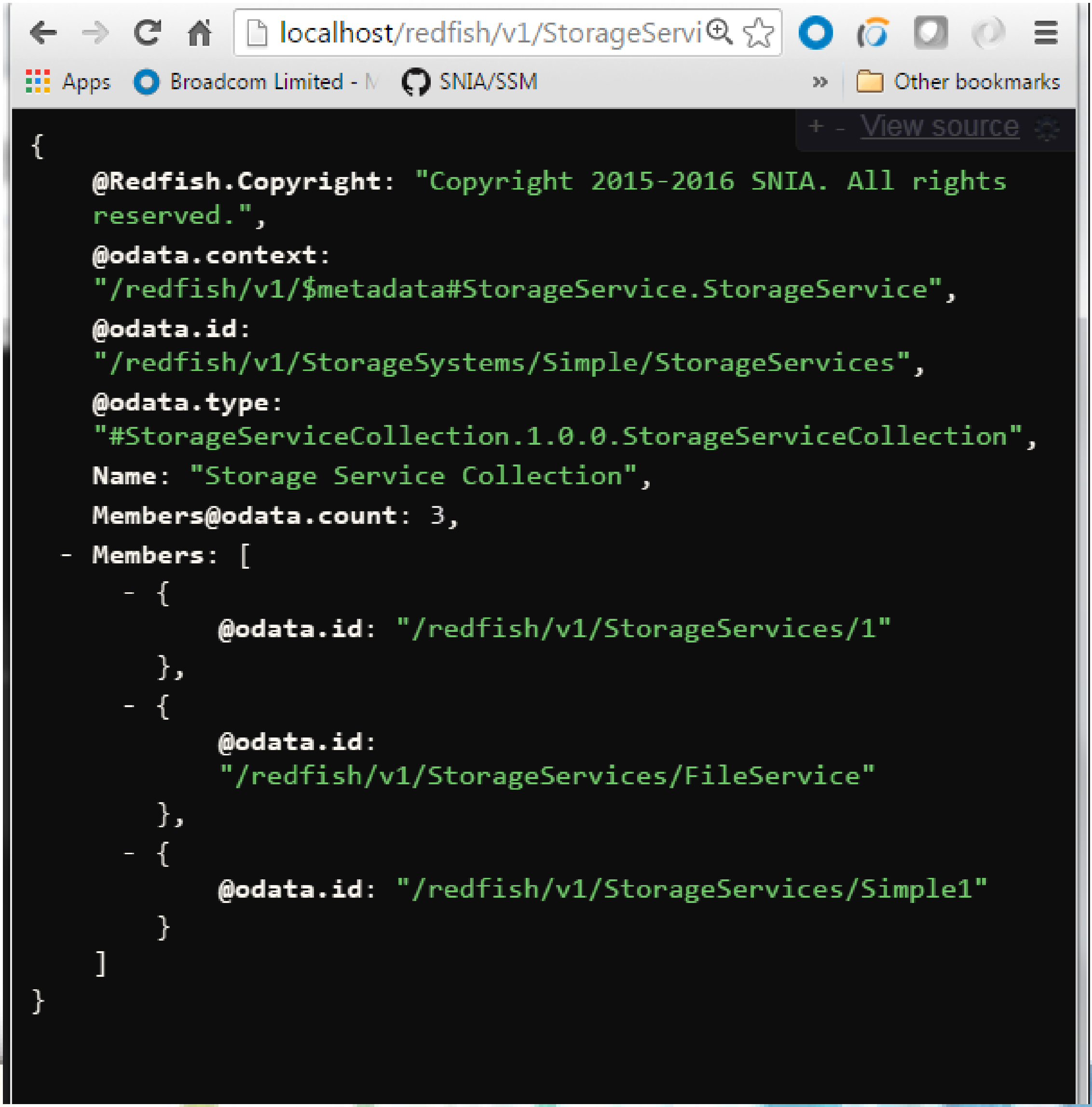
```
{
    @Redfish.Copyright: "Copyright Â© 2014-2015 Distributed Management Task
    Force, Inc. (DMTF). All rights reserved.",
    @odata.context: "/redfish/v1/$metadata#ServiceRoot",
    @odata.id: "/redfish/v1/",
    @odata.type: "#ServiceRoot.1.0.0.ServiceRoot",
    Id: "RootService",
    Name: "Root Service",
    RedfishVersion: "1.0.0",
    UUID: "92384634-2938-2342-8820-489239905423",
  - Systems: {
        @odata.id: "/redfish/v1/Systems"
    },
  - StorageSystems: {
        @odata.id: "/redfish/v1/StorageSystems"
    },
  - StorageServices: {
        @odata.id: "/redfish/v1/StorageServices"
    },
  - Chassis: {
        @odata.id: "/redfish/v1/Chassis"
    },
  - Managers: {
        @odata.id: "/redfish/v1/Managers"
    },
  - Tasks: {
        @odata.id: "/redfish/v1/TaskService"
    },
  - SessionService: {
        @odata.id: "/redfish/v1/SessionService"
    },
  - AccountService: {
        @odata.id: "/redfish/v1/AccountService"
```

Navigating through the Mockups…

- Select the …./redfish/v1/Storage/Services link to see the “Collection” of Storage Services
- Click the “…/StorageServices/Simple” link to see the details of the Simple mockup or …

  “…/StorageServices/1” to see the details of the complex storage service mockup

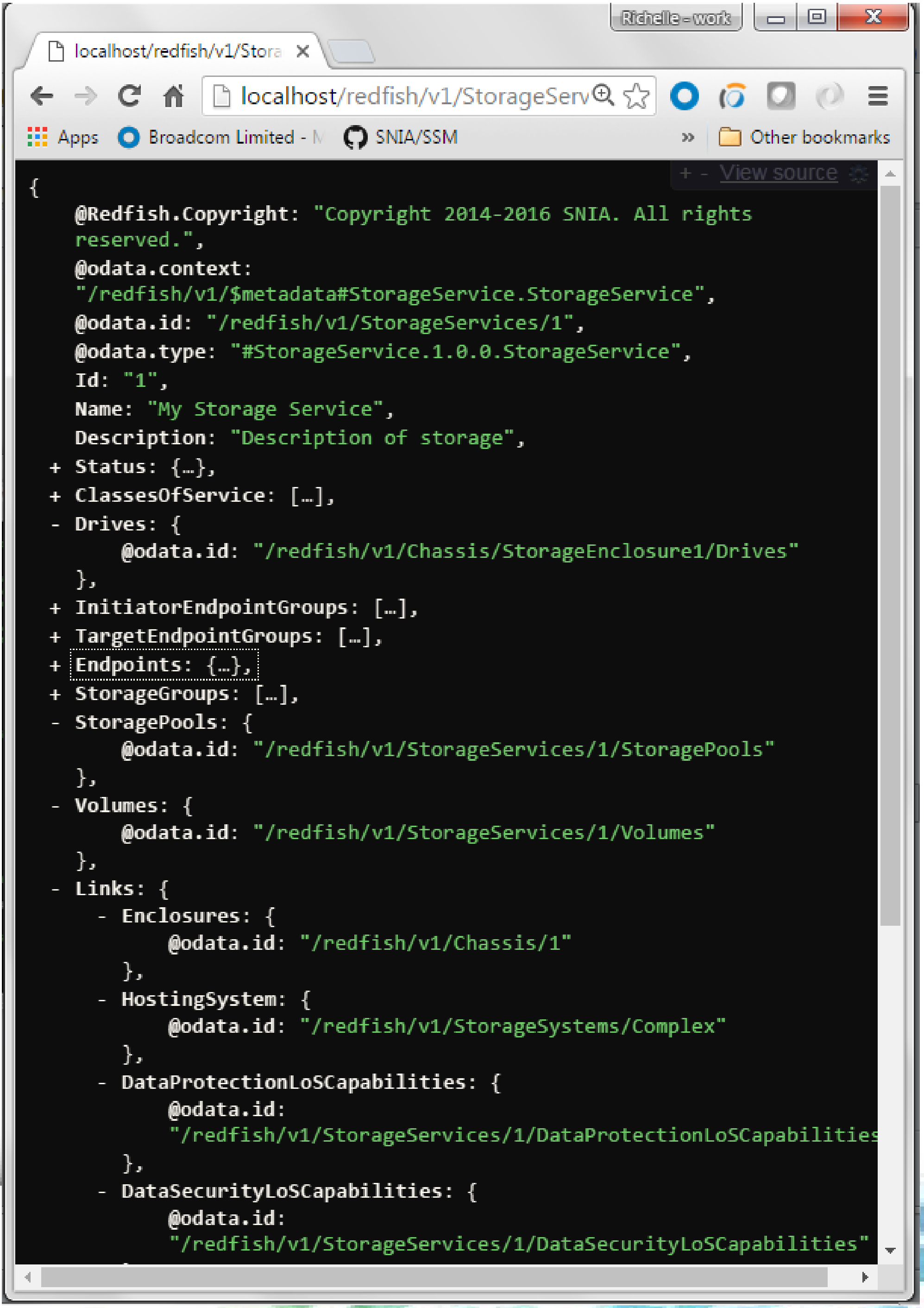
  “…/StorageServices/FileService” to see the filesystem mockup



```
{
    @Redfish.Copyright: "Copyright 2015-2016 SNIA. All rights
    reserved.",
    @odata.context:
    "/redfish/v1/$metadata#StorageService.StorageService",
    @odata.id:
    "/redfish/v1/StorageSystems/Simple/StorageServices",
    @odata.type:
    "#StorageServiceCollection.1.0.0.StorageServiceCollection",
    Name: "Storage Service Collection",
    Members@odata.count: 3,
  - Members: [
      - {
            @odata.id: "/redfish/v1/StorageServices/1"
        },
      - {
            @odata.id:
            "/redfish/v1/StorageServices/FileService"
        },
      - {
            @odata.id: "/redfish/v1/StorageServices/Simple1"
        }
    ]
}
```

What’s in a Storage Service? (Block)

- Available Classes Of Service
- Volumes
- Pools
- Groups
- Endpoints
- …
- Pointer to resources (system, chassis,..)

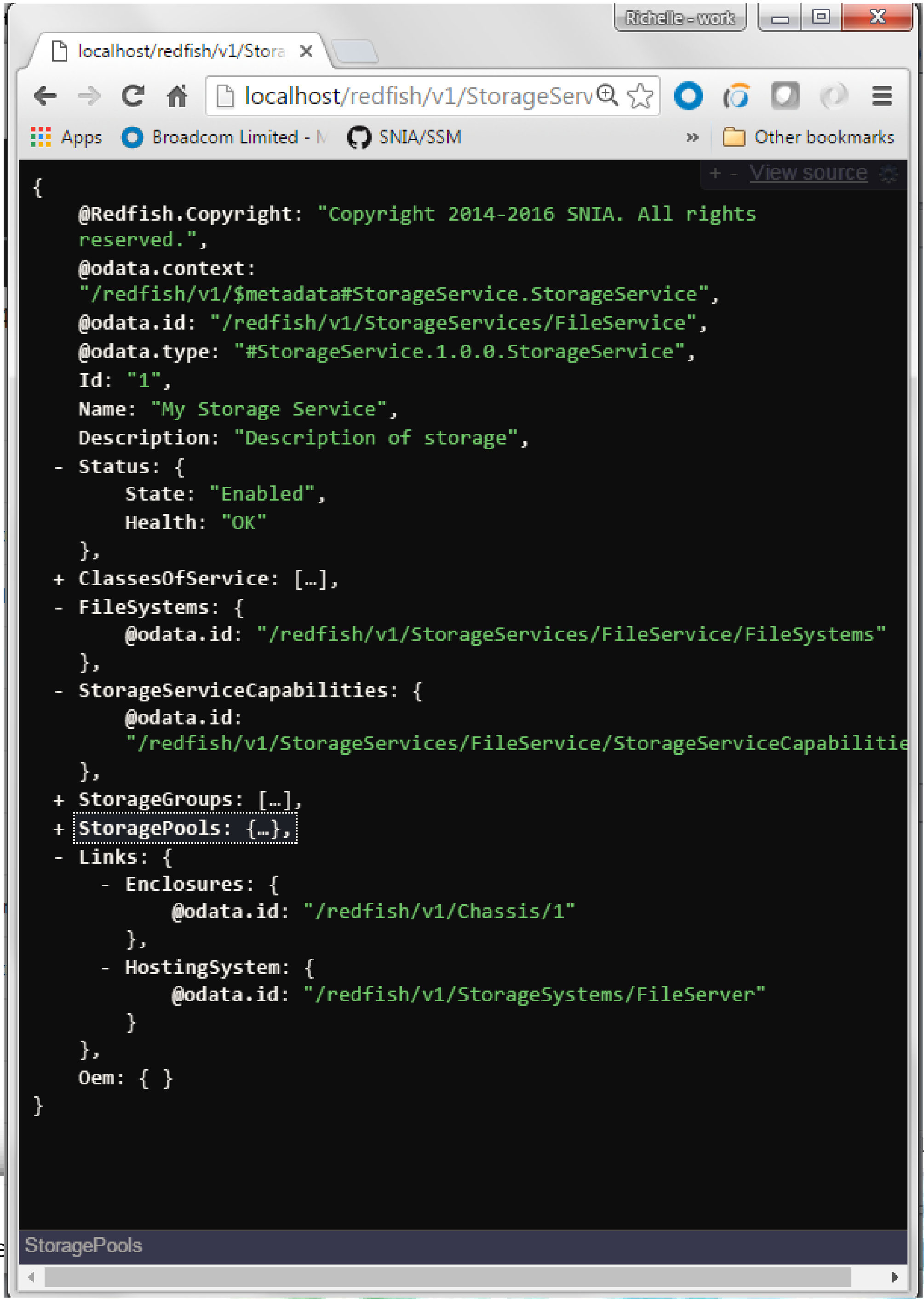


```
{
    @Redfish.Copyright: "Copyright 2014-2016 SNIA. All rights
    reserved.",
    @odata.context:
    "/redfish/v1/$metadata#StorageService.StorageService",
    @odata.id: "/redfish/v1/StorageServices/1",
    @odata.type: "#StorageService.1.0.0.StorageService",
    Id: "1",
    Name: "My Storage Service",
    Description: "Description of storage",
  + Status: {…},
  + ClassesOfService: […],
  - Drives: {
        @odata.id: "/redfish/v1/Chassis/StorageEnclosure1/Drives"
    },
  + InitiatorEndpointGroups: […],
  + TargetEndpointGroups: […],
  + Endpoints: {…},
  + StorageGroups: […],
  - StoragePools: {
        @odata.id: "/redfish/v1/StorageServices/1/StoragePools"
    },
  - Volumes: {
        @odata.id: "/redfish/v1/StorageServices/1/Volumes"
    },
  - Links: {
      - Enclosures: {
            @odata.id: "/redfish/v1/Chassis/1"
        },
      - HostingSystem: {
            @odata.id: "/redfish/v1/StorageSystems/Complex"
        },
      - DataProtectionLoSCapabilities: {
            @odata.id:
            "/redfish/v1/StorageServices/1/DataProtectionLoSCapabilities
        },
      - DataSecurityLoSCapabilities: {
            @odata.id:
            "/redfish/v1/StorageServices/1/DataSecurityLoSCapabilities"
```

What’s in a Storage Service? (File)

Same structure:

- Available Classes Of Service
- ***File systems***
- Pools
- Groups
- Endpoints
- …
- Pointer to resources (system, chassis, block service or drives)

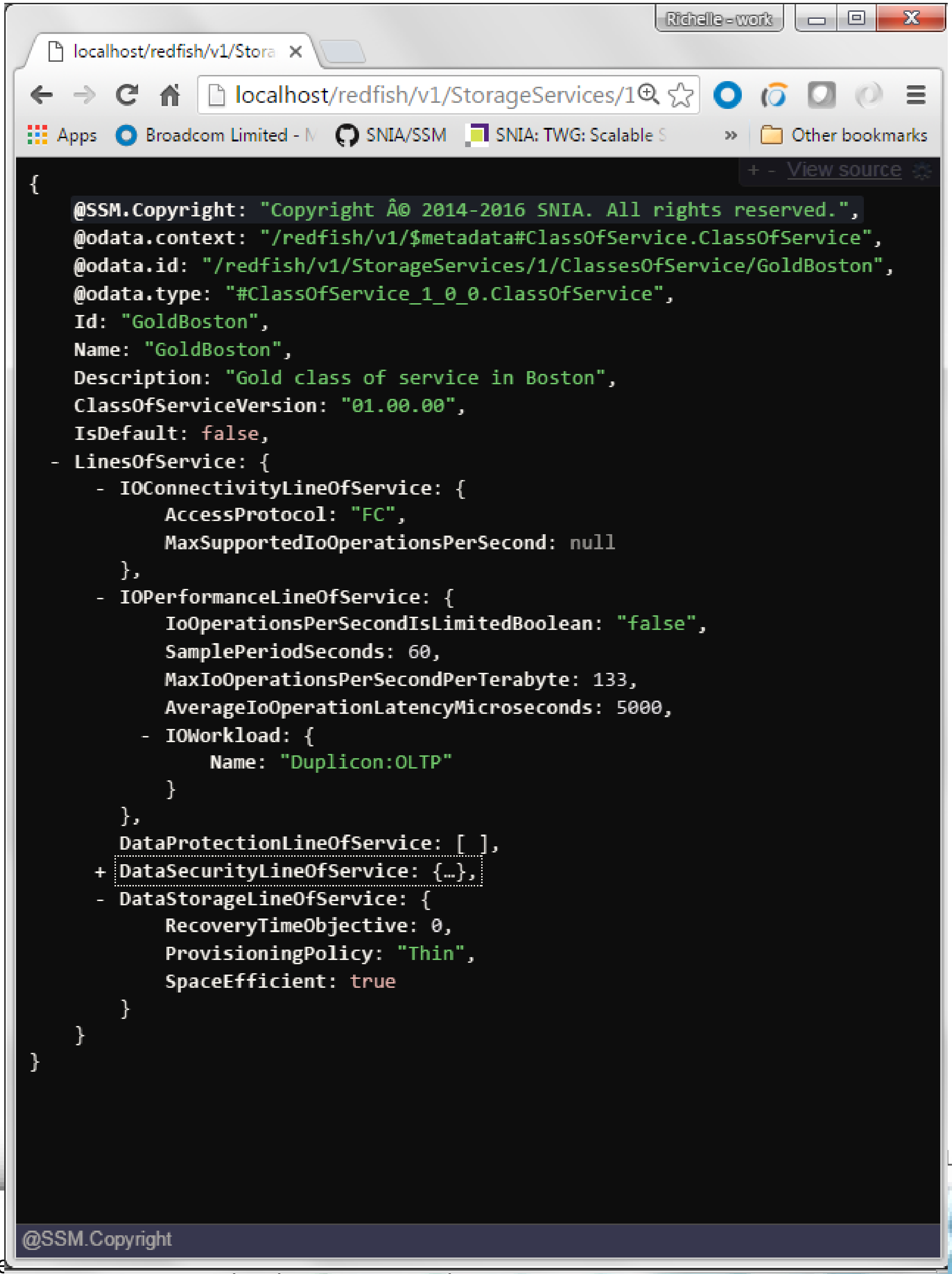


```
{
    @Redfish.Copyright: "Copyright 2014-2016 SNIA. All rights
    reserved.",
    @odata.context:
    "/redfish/v1/$metadata#StorageService.StorageService",
    @odata.id: "/redfish/v1/StorageServices/FileService",
    @odata.type: "#StorageService.1.0.0.StorageService",
    Id: "1",
    Name: "My Storage Service",
    Description: "Description of storage",
  - Status: {
        State: "Enabled",
        Health: "OK"
    },
  + ClassesOfService: […],
  - FileSystems: {
        @odata.id: "/redfish/v1/StorageServices/FileService/FileSystems"
    },
  - StorageServiceCapabilities: {
        @odata.id:
        "/redfish/v1/StorageServices/FileService/StorageServiceCapabilitie
    },
  + StorageGroups: […],
  + StoragePools: {…},
  - Links: {
      - Enclosures: {
            @odata.id: "/redfish/v1/Chassis/1"
        },
      - HostingSystem: {
            @odata.id: "/redfish/v1/StorageSystems/FileServer"
        }
    },
    Oem: { }
}
```

Look in More Detail at… Classes Of Service

Storage Service contains defined classes of service

- .. Which are defined from Lines of Service
  - .. Which are constructed from LoS Capabilities

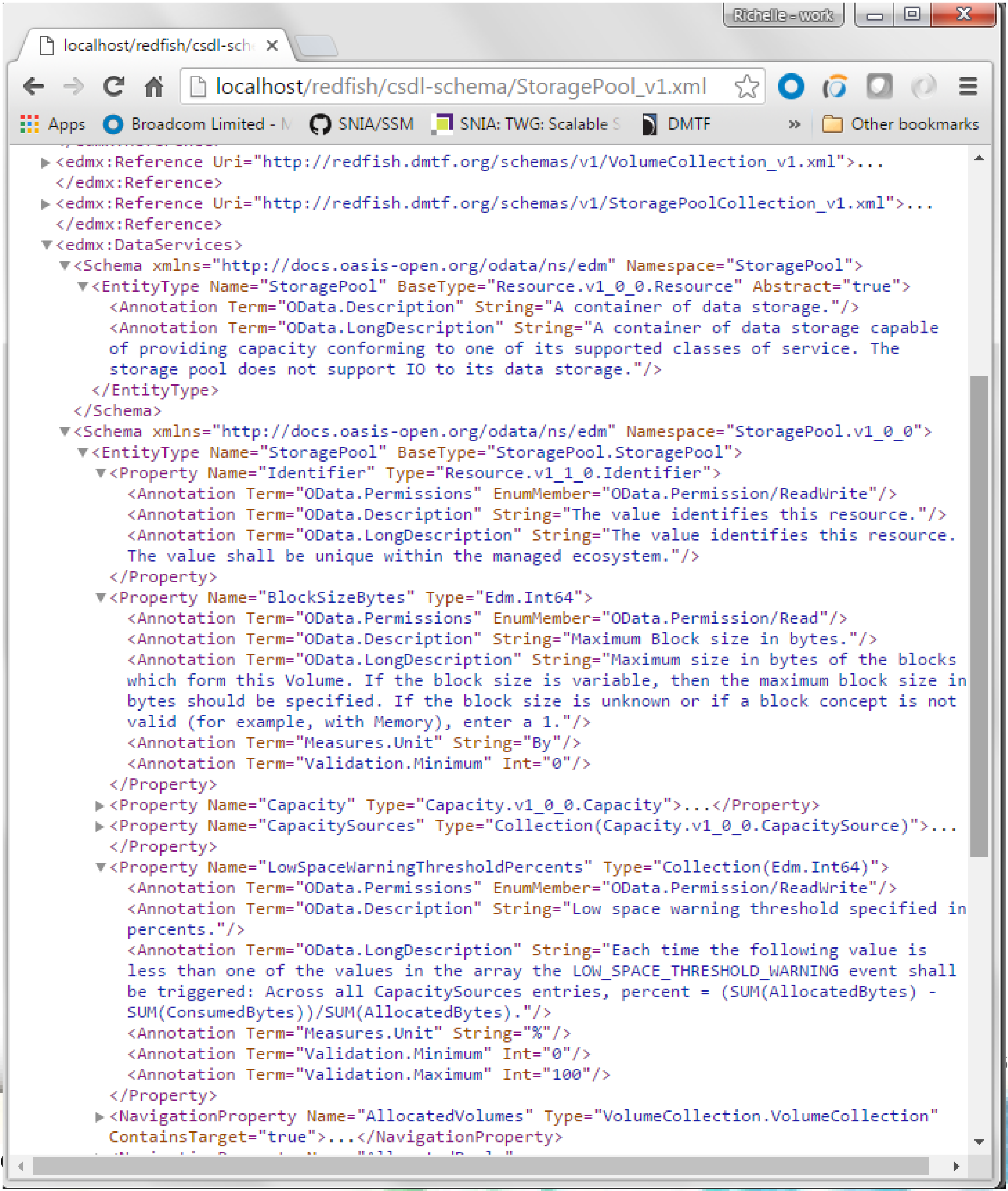


```
{
    @SSM.Copyright: "Copyright Â© 2014-2016 SNIA. All rights reserved.",
    @odata.context: "/redfish/v1/$metadata#ClassOfService.ClassOfService",
    @odata.id: "/redfish/v1/StorageServices/1/ClassesOfService/GoldBoston",
    @odata.type: "#ClassOfService_1_0_0.ClassOfService",
    Id: "GoldBoston",
    Name: "GoldBoston",
    Description: "Gold class of service in Boston",
    ClassOfServiceVersion: "01.00.00",
    IsDefault: false,
  - LinesOfService: {
      - IOConnectivityLineOfService: {
            AccessProtocol: "FC",
            MaxSupportedIoOperationsPerSecond: null
        },
      - IOPerformanceLineOfService: {
            IoOperationsPerSecondIsLimitedBoolean: "false",
            SamplePeriodSeconds: 60,
            MaxIoOperationsPerSecondPerTerabyte: 133,
            AverageIoOperationLatencyMicroseconds: 5000,
          - IOWorkload: {
                Name: "Duplicon:OLTP"
            }
        },
        DataProtectionLineOfService: [ ],
      + DataSecurityLineOfService: {…},
      - DataStorageLineOfService: {
            RecoveryTimeObjective: 0,
            ProvisioningPolicy: "Thin",
            SpaceEfficient: true
        }
    }
}
```

@SSM.Copyright

Schema Overview

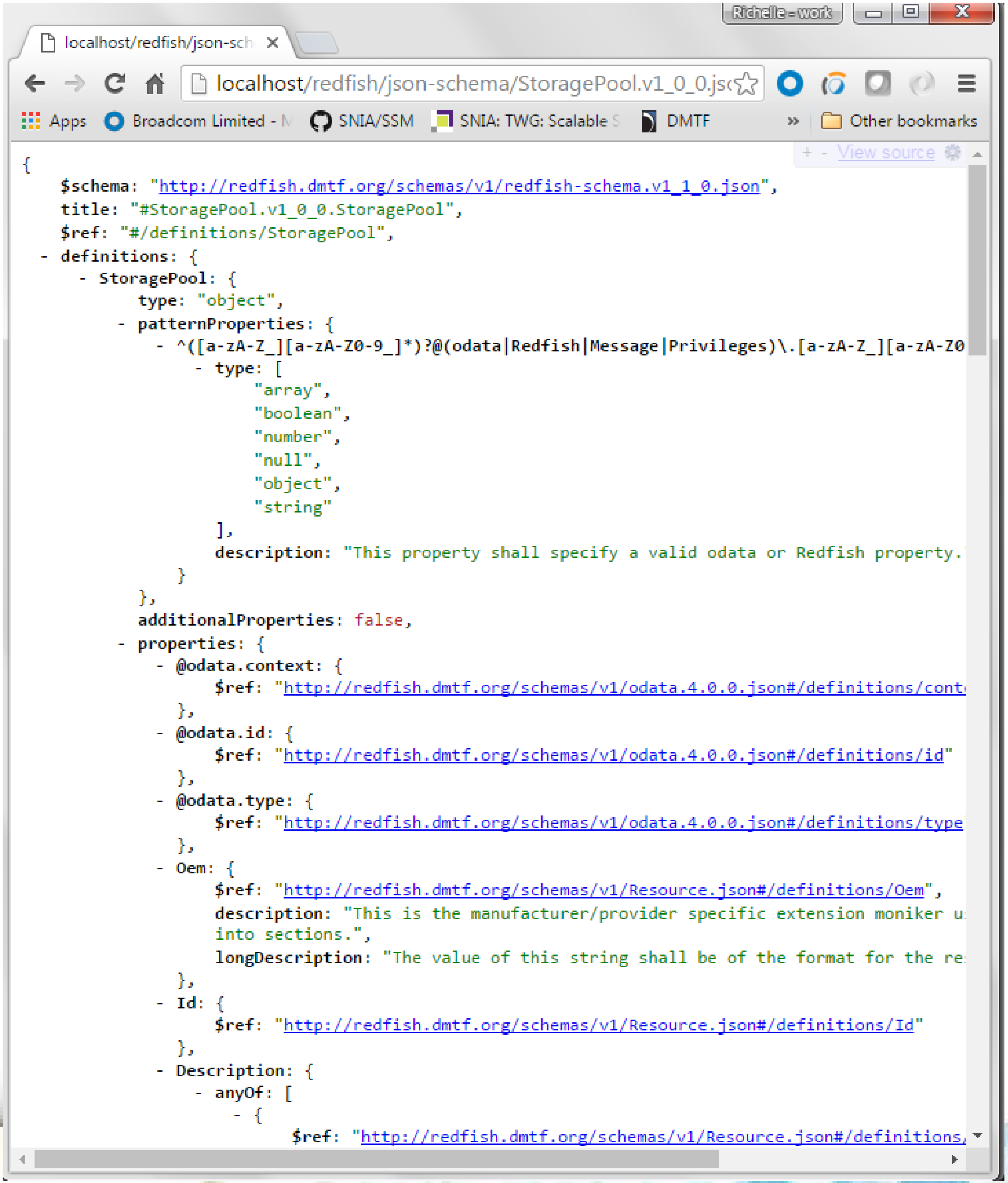
- Two types of schema: CSDL and JSON
- Schema includes annotations to constrain REST and OData clients



```
▶<edmx:Reference Uri="http://redfish.dmtf.org/schemas/v1/VolumeCollection_v1.xml">...
</edmx:Reference>
▶<edmx:Reference Uri="http://redfish.dmtf.org/schemas/v1/StoragePoolCollection_v1.xml">...
</edmx:Reference>
▼<edmx:DataServices>
  ▼<Schema xmlns="http://docs.oasis-open.org/odata/ns/edm" Namespace="StoragePool">
    ▼<EntityType Name="StoragePool" BaseType="Resource.v1_0_0.Resource" Abstract="true">
        <Annotation Term="OData.Description" String="A container of data storage."/>
        <Annotation Term="OData.LongDescription" String="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."/>
      </EntityType>
    </Schema>
  ▼<Schema xmlns="http://docs.oasis-open.org/odata/ns/edm" Namespace="StoragePool.v1_0_0">
    ▼<EntityType Name="StoragePool" BaseType="StoragePool.StoragePool">
      ▼<Property Name="Identifier" Type="Resource.v1_1_0.Identifier">
          <Annotation Term="OData.Permissions" EnumMember="OData.Permission/ReadWrite"/>
          <Annotation Term="OData.Description" String="The value identifies this resource."/>
          <Annotation Term="OData.LongDescription" String="The value identifies this resource.
          The value shall be unique within the managed ecosystem."/>
        </Property>
      ▼<Property Name="BlockSizeBytes" Type="Edm.Int64">
          <Annotation Term="OData.Permissions" EnumMember="OData.Permission/Read"/>
          <Annotation Term="OData.Description" String="Maximum Block size in bytes."/>
          <Annotation Term="OData.LongDescription" String="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."/>
          <Annotation Term="Measures.Unit" String="By"/>
          <Annotation Term="Validation.Minimum" Int="0"/>
        </Property>
      ▶<Property Name="Capacity" Type="Capacity.v1_0_0.Capacity">...</Property>
      ▶<Property Name="CapacitySources" Type="Collection(Capacity.v1_0_0.CapacitySource)">...
        </Property>
      ▼<Property Name="LowSpaceWarningThresholdPercents" Type="Collection(Edm.Int64)">
          <Annotation Term="OData.Permissions" EnumMember="OData.Permission/ReadWrite"/>
          <Annotation Term="OData.Description" String="Low space warning threshold specified in
          percents."/>
          <Annotation Term="OData.LongDescription" String="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)."/>
          <Annotation Term="Measures.Unit" String="%"/>
          <Annotation Term="Validation.Minimum" Int="0"/>
          <Annotation Term="Validation.Maximum" Int="100"/>
        </Property>
      ▶<NavigationProperty Name="AllocatedVolumes" Type="VolumeCollection.VolumeCollection"
        ContainsTarget="true">...</NavigationProperty>
```

JSON Schema

- JSON Schema are generated from CSDL schema



```
{
    $schema: "http://redfish.dmtf.org/schemas/v1/redfish-schema.v1_1_0.json",
    title: "#StoragePool.v1_0_0.StoragePool",
    $ref: "#/definitions/StoragePool",
  - definitions: {
      - StoragePool: {
            type: "object",
          - patternProperties: {
              - ^([a-zA-Z_][a-zA-Z0-9_]*)?@(odata|Redfish|Message|Privileges)\.[a-zA-Z_][a-zA-Z0
                  - type: [
                        "array",
                        "boolean",
                        "number",
                        "null",
                        "object",
                        "string"
                    ],
                    description: "This property shall specify a valid odata or Redfish property.
                }
            },
            additionalProperties: false,
          - properties: {
              - @odata.context: {
                    $ref: "http://redfish.dmtf.org/schemas/v1/odata.4.0.0.json#/definitions/conte
                },
              - @odata.id: {
                    $ref: "http://redfish.dmtf.org/schemas/v1/odata.4.0.0.json#/definitions/id"
                },
              - @odata.type: {
                    $ref: "http://redfish.dmtf.org/schemas/v1/odata.4.0.0.json#/definitions/type
                },
              - Oem: {
                    $ref: "http://redfish.dmtf.org/schemas/v1/Resource.json#/definitions/Oem",
                    description: "This is the manufacturer/provider specific extension moniker u
                    into sections.",
                    longDescription: "The value of this string shall be of the format for the re
                },
              - Id: {
                    $ref: "http://redfish.dmtf.org/schemas/v1/Resource.json#/definitions/Id"
                },
              - Description: {
                  - anyOf: [
                      - {
                            $ref: "http://redfish.dmtf.org/schemas/v1/Resource.json#/definitions/
```

Progress throughout 2016…

- v0.5 Work in Progress released March 2016
  - Initial WIP release
- v0.6 Work in Progress released May 2016
  - First draft Block storage schema
- v0.8 Work in Progress (July 2016)
  - Seamless alignment with Redfish
  - File Systems, Object Drive (Chassis Type)
- v0.9 Work in Progress (August 2016)
  - First draft of Specification and User's Guide
- **v1.0 Specification (September 2016)**
  - **Sent Final Specification to SNIA Technical Council***

**** Publicly available after SNIA IP review process complete***

What’s Next?

- Expanding block and file capability:
  - Event Support
  - Performance Metrics
- Object Storage
- Implementer’s Guide
- Expanded User’s Guide
  - Additional use cases
  - Additional management domains
- Expanded storage-specific user roles
- Profile development
- …

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

End-User Engagement

- Get more information about applying for a select position on the newly forming SNIA Executive Storage Management Customer Panel
  - Email storagemanagement@snia.org for more information

SNIA Swordfish™

- Enter to win a Phantom 3 Drone
  - Fill out entry form, return to Storage Management Initiative (SMI) table
- Look for winner beginning 9/26 at http://www.snia.org/swordfish
- Visit SNIA SMI at Microsoft Ignite Booth #2371, 9/26 – 9/30, Atlanta

THANK YOU