STORAGE DEVELOPER CONFERENCE

SDC 22

Fremont, CA
September 12-15, 2022

BY Developers FOR Developers

A SNIA Event

Building a SNIA Swordfish™ Implementation: Tips and Tricks

Chris Lionetti, SNIA Secretary, HPE

Objective

To provide an overview of their experience developing an initial Swordfish implementation. This session will provide an overview of lessons learned through the initial proof-of-concept through development phases and will include recommendations to other implementers of areas that may require additional focus.

Learning Objectives

- Discuss how to develop a Swordfish storage management model
- Provide an overview of a Swordfish implementation
- Give insight into best practices for developing a Swordfish implementation

The SNIA Swordfish™ Approach

- Develop the management model
  - provide information that the client needs (Discovery)
  - What a client needs to accomplish (Configuration & Management)

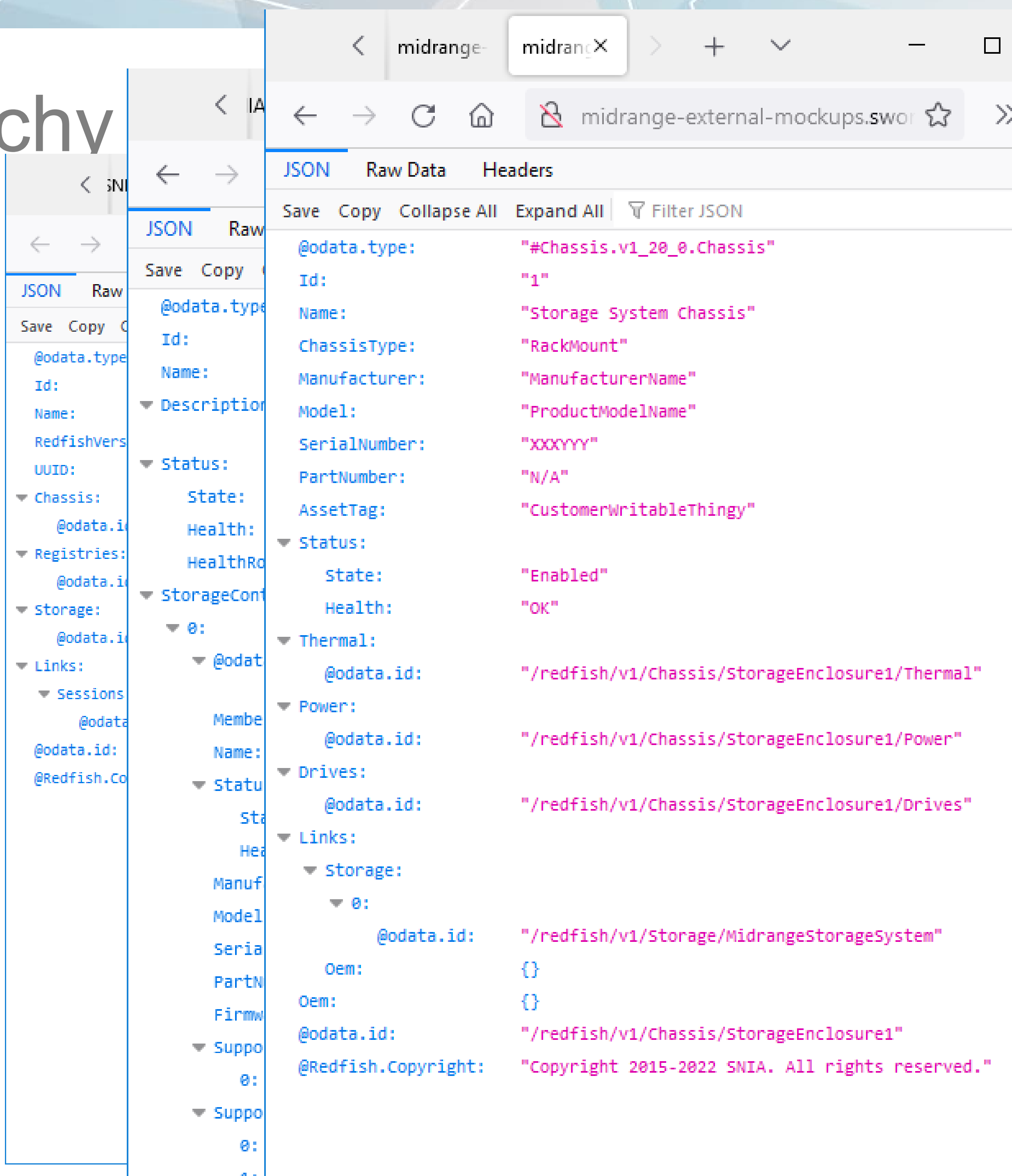
- Covers far more than just block and relevant virtualization and mapping operations

- Traditional storage domain coverage & converged environments
  - covering servers, storage and fabric together

- Implement the Swordfish API as an ***extension*** of the Redfish API
  - Built using DMTF's Redfish technologies
  - Lightweight RESTful interface over HTTPS using JSON

Overview of Swordfish Hierarchy

- Explore the Swordfish data model to see potential / typical implementation
- Navigate the model to learn about, and see, various resources
  - Treat this as a file system that you can explore
  - @odata.id shows you your present locations or links to other assets
- Many SNIA mockups show examples how to implement both classic SAN, DAS, and NVMe



```
@odata.type:          "#Chassis.v1_20_0.Chassis"
Id:                   "1"
Name:                 "Storage System Chassis"
ChassisType:          "RackMount"
Manufacturer:         "ManufacturerName"
Model:                "ProductModelName"
SerialNumber:         "XXXYYY"
PartNumber:           "N/A"
AssetTag:             "CustomerWritableThingy"
▼ Status:
    State:            "Enabled"
    Health:           "OK"
▼ Thermal:
    @odata.id:        "/redfish/v1/Chassis/StorageEnclosure1/Thermal"
▼ Power:
    @odata.id:        "/redfish/v1/Chassis/StorageEnclosure1/Power"
▼ Drives:
    @odata.id:        "/redfish/v1/Chassis/StorageEnclosure1/Drives"
▼ Links:
  ▼ Storage:
    ▼ 0:
        @odata.id:    "/redfish/v1/Storage/MidrangeStorageSystem"
    Oem:              {}
Oem:                  {}
@odata.id:            "/redfish/v1/Chassis/StorageEnclosure1"
@Redfish.Copyright:   "Copyright 2015-2022 SNIA. All rights reserved."
```

```
@odata.type
Id:
Name:
RedfishVers
UUID:
▼ Chassis:
    @odata.i
▼ Registries:
    @odata.i
▼ Storage:
    @odata.i
▼ Links:
  ▼ Sessions
      @odata
@odata.id:
@Redfish.Co
```

```
@odata.type
Id:
Name:
▼ Description

▼ Status:
    State:
    Health:
    HealthRo
▼ StorageCont
  ▼ 0:
    ▼ @odat

      Membe
      Name:
    ▼ Statu
        Sta
        Hea
      Manuf
      Model
      Seria
      PartN
      Firmw
    ▼ Suppo
        0:
    ▼ Suppo
        0:
```

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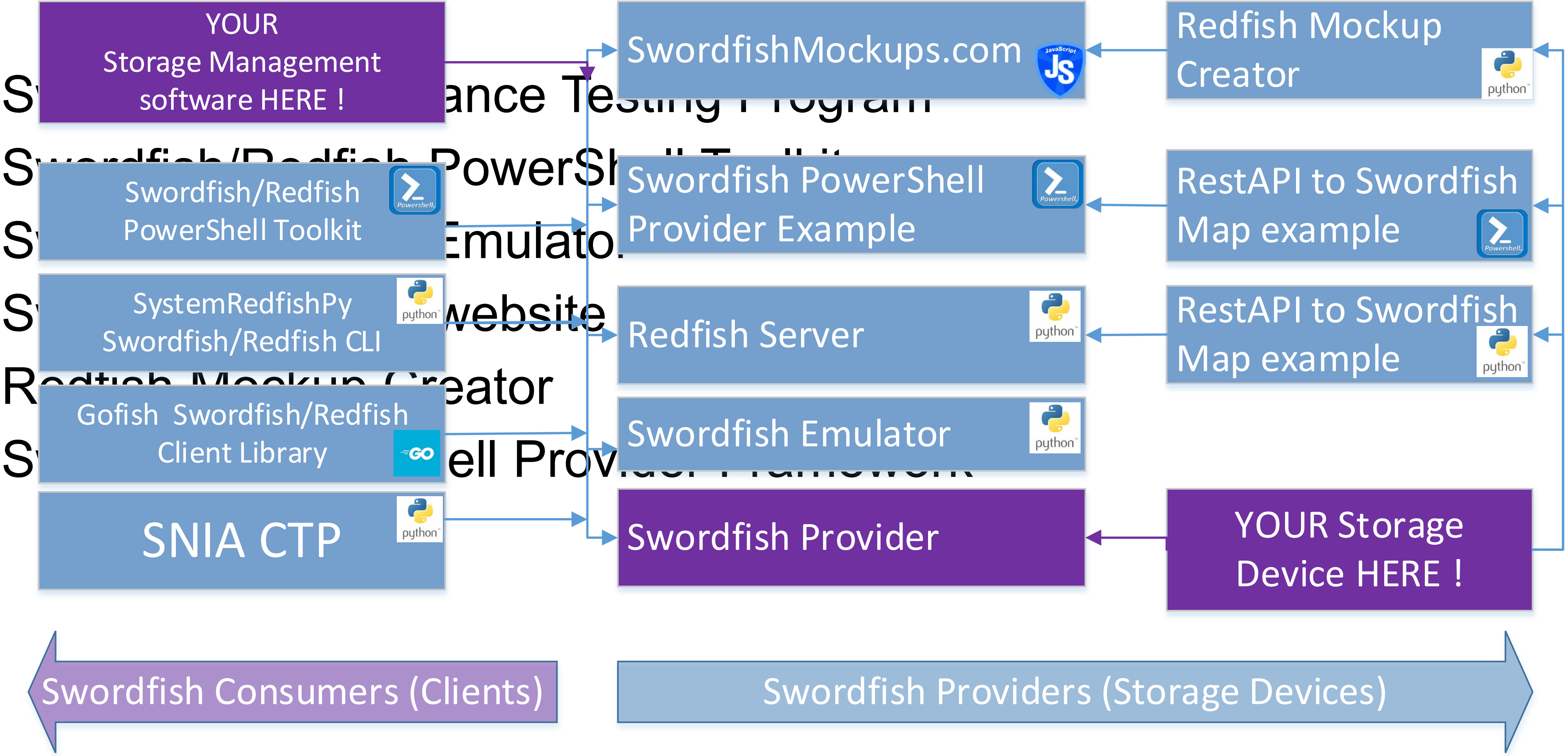
Which Tools are right for you!

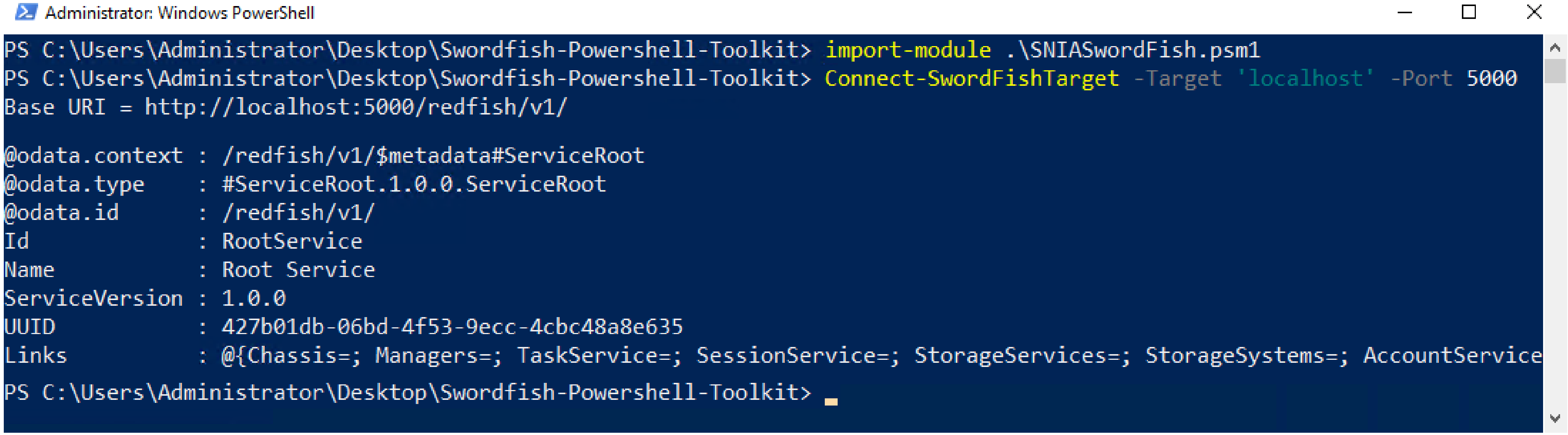
- S ance Testing Program
- Swordfish/Redfish PowerShell Toolkit
- S Emulato
- S website
- Redfish Mockup Creator
- S ell Provider Framework



YOUR Storage Management software HERE !
Swordfish/Redfish PowerShell Toolkit
Powershell
SystemRedfishPy Swordfish/Redfish CLI
python
Gofish Swordfish/Redfish Client Library
GO
SNIA CTP
python
SwordfishMockups.com
JavaScript JS
Swordfish PowerShell Provider Example
Powershell
Redfish Server
python
Swordfish Emulator
python
Swordfish Provider
Redfish Mockup Creator
python
RestAPI to Swordfish Map example
Powershell
RestAPI to Swordfish Map example
python
YOUR Storage Device HERE !
Swordfish Consumers (Clients)
Swordfish Providers (Storage Devices)

WHAT IS THE POWERSHELL TOOLKIT?

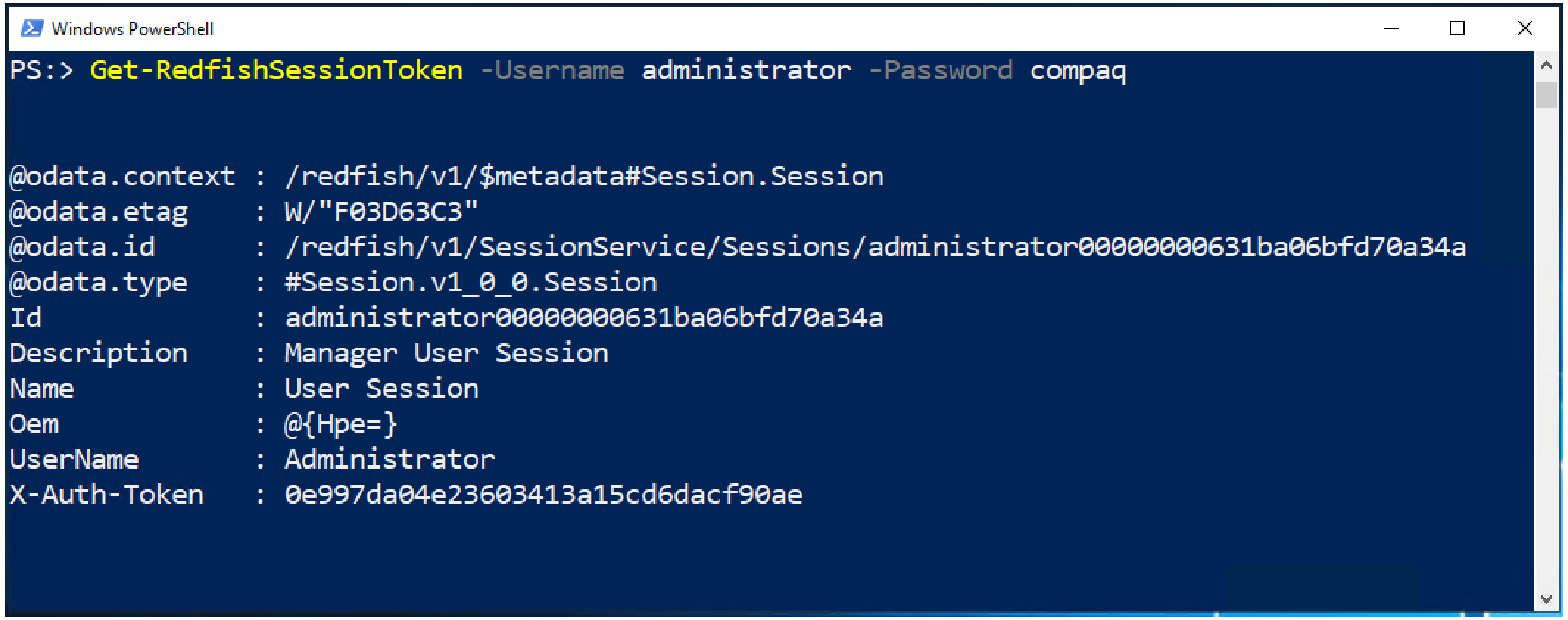
- Open source project between HPE and Pure Storage
    - https://github.com/SNIA/Swordfish-Powershell-Toolkit
- Supported on Windows Server, Linux and macOS
    - Can query a Swordfish Target, a Redfish Server, or a Swordfish/Redfish simulator
- PowerShell wrapper for REST API calls to Redfish and Swordfish



```
PS C:\Users\Administrator\Desktop\Swordfish-Powershell-Toolkit> import-module .\SNIASwordFish.psm1
PS C:\Users\Administrator\Desktop\Swordfish-Powershell-Toolkit> Connect-SwordFishTarget -Target 'localhost' -Port 5000
Base URI = http://localhost:5000/redfish/v1/

@odata.context : /redfish/v1/$metadata#ServiceRoot
@odata.type    : #ServiceRoot.1.0.0.ServiceRoot
@odata.id      : /redfish/v1/
Id             : RootService
Name           : Root Service
ServiceVersion : 1.0.0
UUID           : 427b01db-06bd-4f53-9ecc-4cbc48a8e635
Links          : @{Chassis=; Managers=; TaskService=; SessionService=; StorageServices=; StorageSystems=; AccountService

PS C:\Users\Administrator\Desktop\Swordfish-Powershell-Toolkit> _
```

What about authentication?

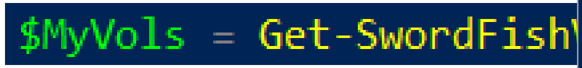
- This requires the used of the authorization Token
  - Can be retrieved using the `Get-RedfishSessionToken` command
  - Requires username and password, and will include in Body
  - Redfish call made to `‘/Redfish/v1/SessionService/sessions’`
- Retrieval of Token causes commands to include correct token header.



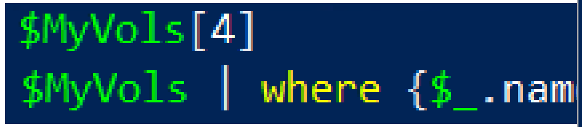
```
PS:> Get-RedfishSessionToken -Username administrator -Password compaq


@odata.context : /redfish/v1/$metadata#Session.Session
@odata.etag    : W/"F03D63C3"
@odata.id      : /redfish/v1/SessionService/Sessions/administrator00000000631ba06bfd70a34a
@odata.type    : #Session.v1_0_0.Session
Id             : administrator00000000631ba06bfd70a34a
Description    : Manager User Session
Name           : User Session
Oem            : @{Hpe=}
UserName       : Administrator
X-Auth-Token   : 0e997da04e23603413a15cd6dacf90ae
```

PowerShell Toolkit - Objects

- Everything is returned as objects (and neste
  - Cast to Variable
  - Can filter by properties, or access like ar
  - Can dig deeper into single values
  - And you can even cast the Variable BAC

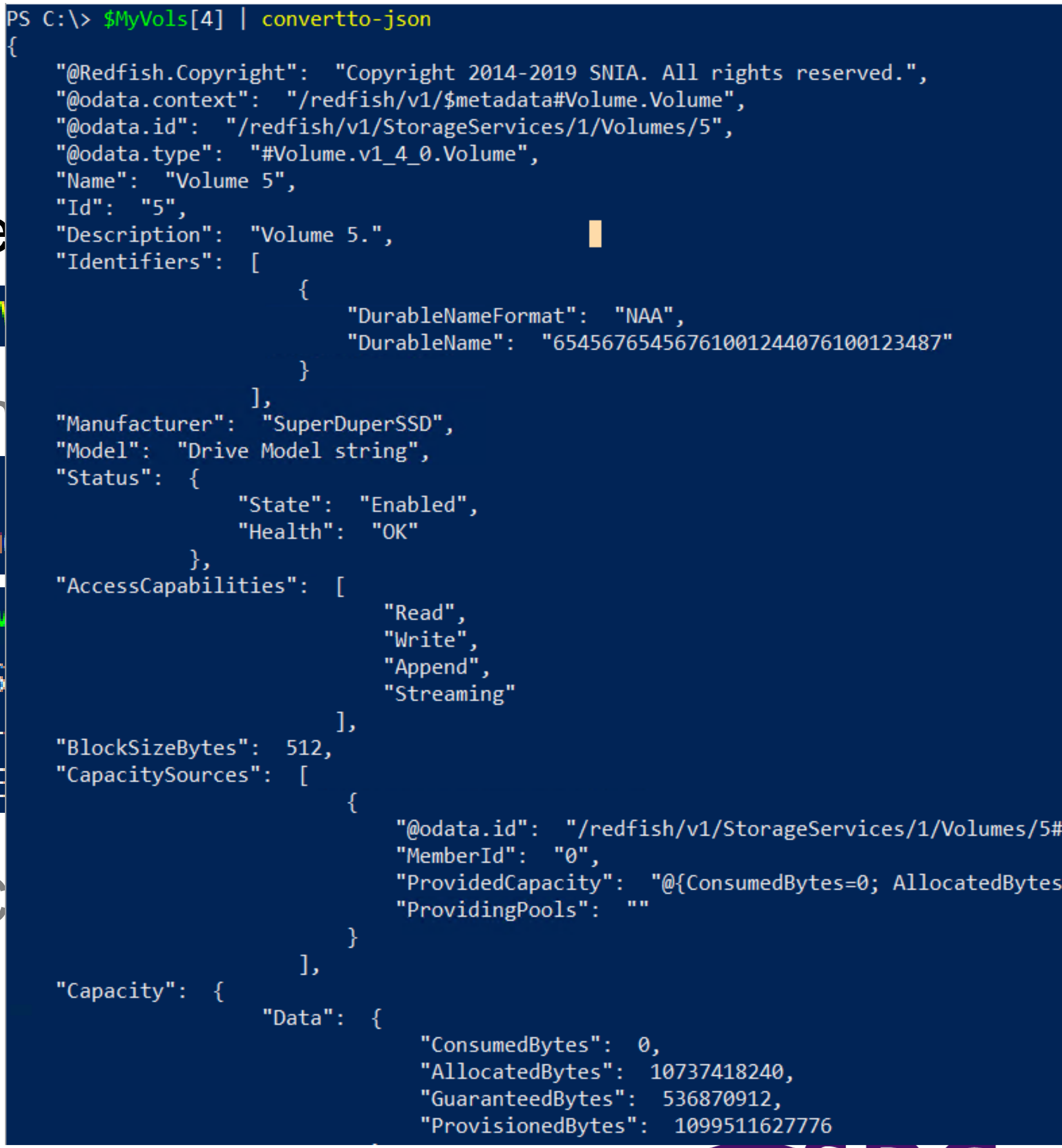


```
$MyVols = Get-SwordFish
```



```
$MyVols[4]
$MyVols | where {$_.nam
```

```
$MyV
    S
    _
    E
```

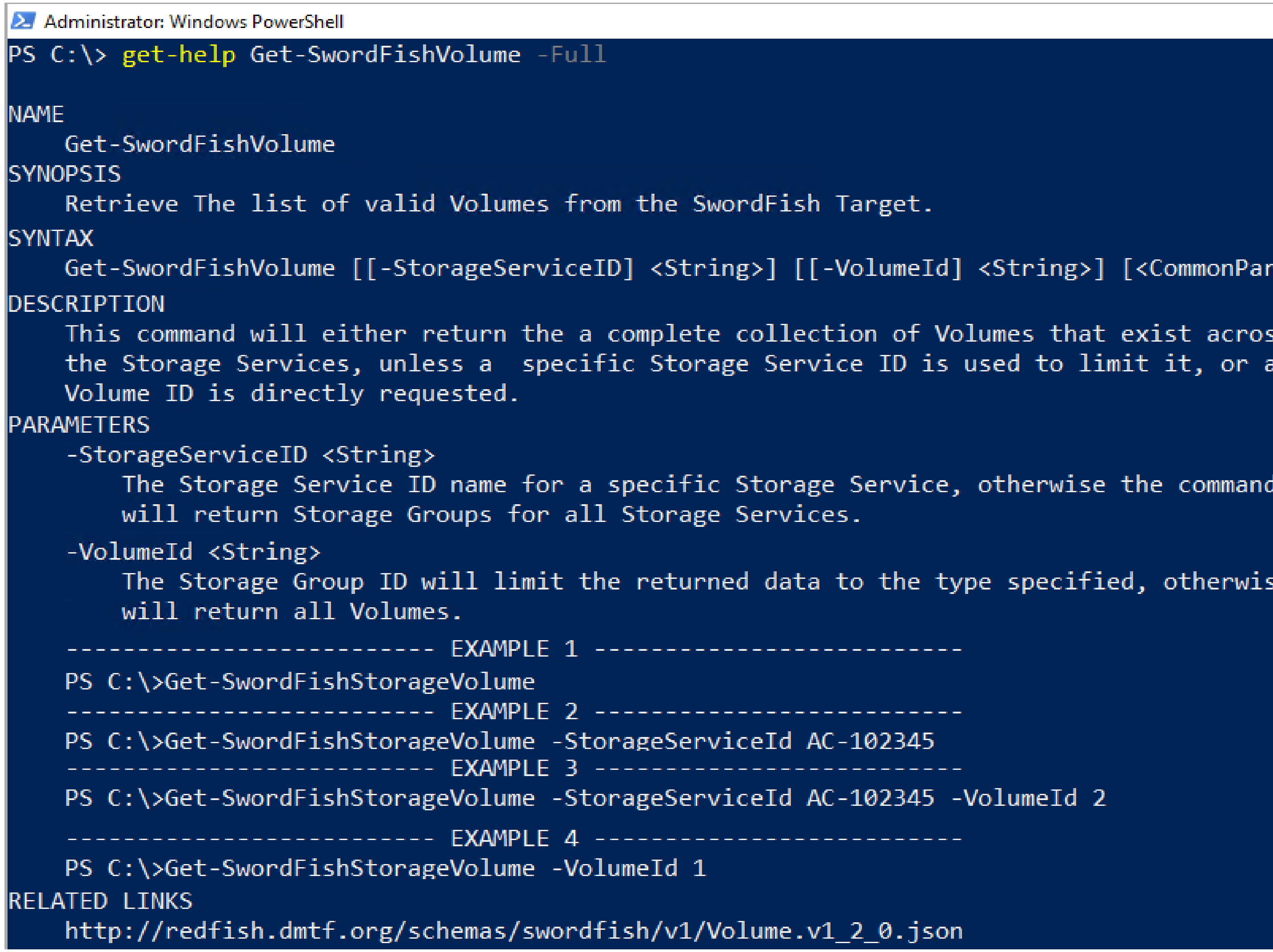


```
PS C:\> $MyVols[4] | convertto-json
{
    "@Redfish.Copyright":  "Copyright 2014-2019 SNIA. All rights reserved.",
    "@odata.context":  "/redfish/v1/$metadata#Volume.Volume",
    "@odata.id":  "/redfish/v1/StorageServices/1/Volumes/5",
    "@odata.type":  "#Volume.v1_4_0.Volume",
    "Name":  "Volume 5",
    "Id":  "5",
    "Description":  "Volume 5.",
    "Identifiers":  [
                        {
                            "DurableNameFormat":  "NAA",
                            "DurableName":  "65456765456761001244076100123487"
                        }
                    ],
    "Manufacturer":  "SuperDuperSSD",
    "Model":  "Drive Model string",
    "Status":  {
                   "State":  "Enabled",
                   "Health":  "OK"
               },
    "AccessCapabilities":  [
                               "Read",
                               "Write",
                               "Append",
                               "Streaming"
                           ],
    "BlockSizeBytes":  512,
    "CapacitySources":  [
                            {
                                "@odata.id":  "/redfish/v1/StorageServices/1/Volumes/5#
                                "MemberId":  "0",
                                "ProvidedCapacity":  "@{ConsumedBytes=0; AllocatedBytes
                                "ProvidingPools":  ""
                            }
                        ],
    "Capacity":  {
                     "Data":  {
                                  "ConsumedBytes":  0,
                                  "AllocatedBytes":  10737418240,
                                  "GuaranteedBytes":  536870912,
                                  "ProvisionedBytes":  1099511627776
```

PowerShell Command Help

- Get a list of valid commands
- Get Help on a specific command
  - Option to show examples
  - Option to show All
- Verbose option to see raw transactions

- To see more detailed examples against real hardware, look in the Examples Folder.



```
PS C:\> get-help Get-SwordFishVolume -Full

NAME
    Get-SwordFishVolume
SYNOPSIS
    Retrieve The list of valid Volumes from the SwordFish Target.
SYNTAX
    Get-SwordFishVolume [[-StorageServiceID] <String>] [[-VolumeId] <String>] [<CommonPar
DESCRIPTION
    This command will either return the a complete collection of Volumes that exist acros
    the Storage Services, unless a  specific Storage Service ID is used to limit it, or a
    Volume ID is directly requested.
PARAMETERS
    -StorageServiceID <String>
        The Storage Service ID name for a specific Storage Service, otherwise the command
        will return Storage Groups for all Storage Services.
    -VolumeId <String>
        The Storage Group ID will limit the returned data to the type specified, otherwis
        will return all Volumes.
    -------------------------- EXAMPLE 1 --------------------------
    PS C:\>Get-SwordFishStorageVolume
    -------------------------- EXAMPLE 2 --------------------------
    PS C:\>Get-SwordFishStorageVolume -StorageServiceId AC-102345
    -------------------------- EXAMPLE 3 --------------------------
    PS C:\>Get-SwordFishStorageVolume -StorageServiceId AC-102345 -VolumeId 2

    -------------------------- EXAMPLE 4 --------------------------
    PS C:\>Get-SwordFishStorageVolume -VolumeId 1
RELATED LINKS
    http://redfish.dmtf.org/schemas/swordfish/v1/Volume.v1_2_0.json
```

What you v

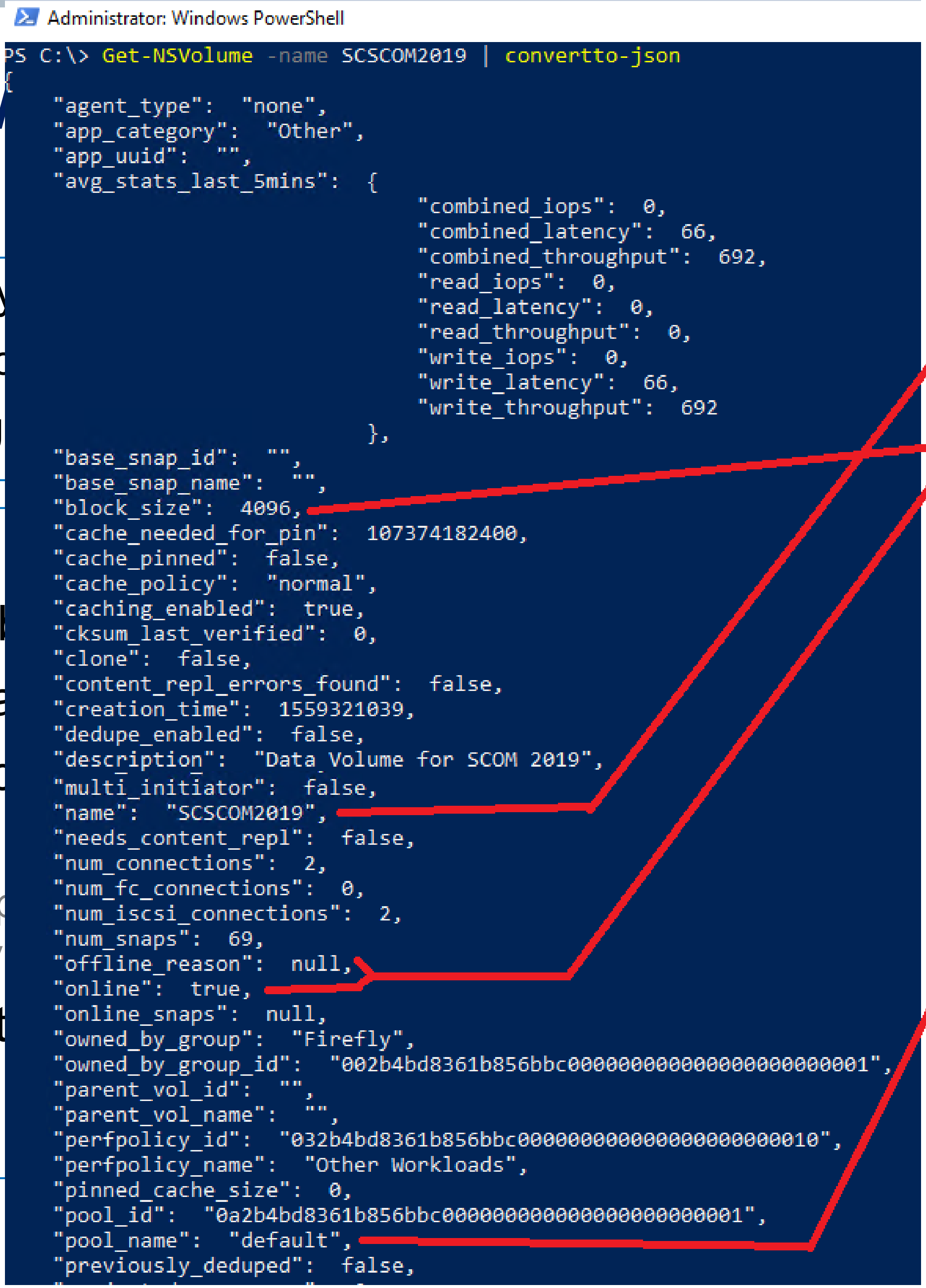
- RestAPI Documentation to y
- PowerShell Toolkit that expo
- Basic PowerShell knowledg

Steps

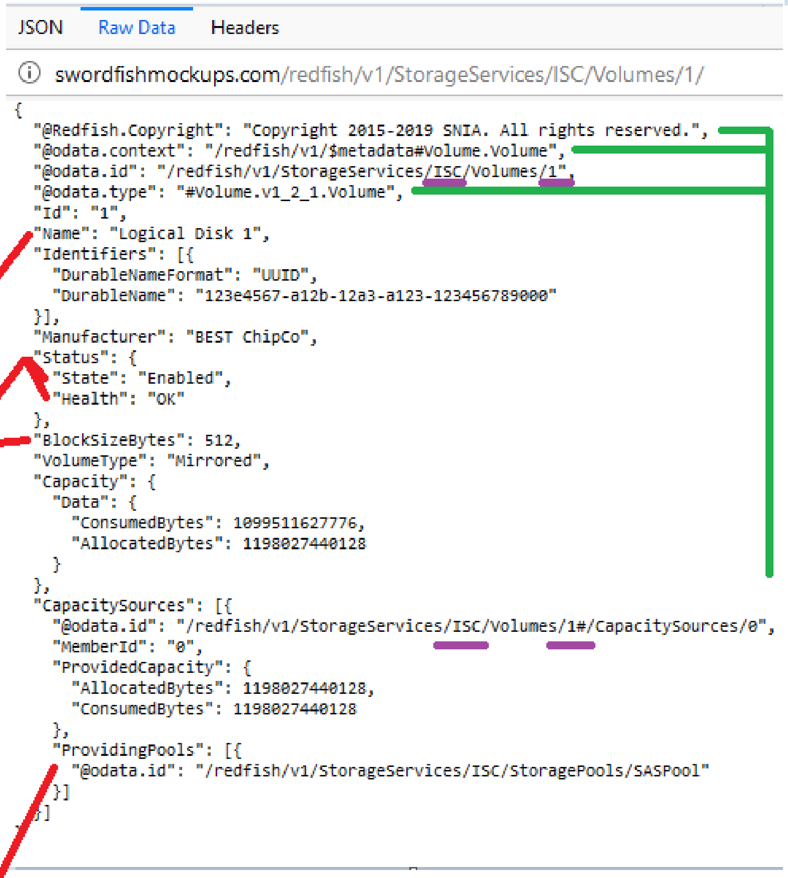
1. Retrieve the Volume Ol
2. Hold it side-by-side to a
3. Look for Matches and d similarities

   i.e. You may show the sp need to know to multiply

4. Go through the rest of t using your results.



```
PS C:\> Get-NSVolume -name SCSCOM2019 | convertto-json
{
    "agent_type":  "none",
    "app_category":  "Other",
    "app_uuid":  "",
    "avg_stats_last_5mins":  {
                                 "combined_iops":  0,
                                 "combined_latency":  66,
                                 "combined_throughput":  692,
                                 "read_iops":  0,
                                 "read_latency":  0,
                                 "read_throughput":  0,
                                 "write_iops":  0,
                                 "write_latency":  66,
                                 "write_throughput":  692
                             },
    "base_snap_id":  "",
    "base_snap_name":  "",
    "block_size":  4096,
    "cache_needed_for_pin":  107374182400,
    "cache_pinned":  false,
    "cache_policy":  "normal",
    "caching_enabled":  true,
    "cksum_last_verified":  0,
    "clone":  false,
    "content_repl_errors_found":  false,
    "creation_time":  1559321039,
    "dedupe_enabled":  false,
    "description":  "Data Volume for SCOM 2019",
    "multi_initiator":  false,
    "name":  "SCSCOM2019",
    "needs_content_repl":  false,
    "num_connections":  2,
    "num_fc_connections":  0,
    "num_iscsi_connections":  2,
    "num_snaps":  69,
    "offline_reason":  null,
    "online":  true,
    "online_snaps":  null,
    "owned_by_group":  "Firefly",
    "owned_by_group_id":  "002b4bd8361b856bbc000000000000000000000001",
    "parent_vol_id":  "",
    "parent_vol_name":  "",
    "perfpolicy_id":  "032b4bd8361b856bbc000000000000000000000010",
    "perfpolicy_name":  "Other Workloads",
    "pinned_cache_size":  0,
    "pool_id":  "0a2b4bd8361b856bbc000000000000000000000001",
    "pool_name":  "default",
    "previously_deduped":  false,
```



swordfishmockups.com/redfish/v1/StorageServices/ISC/Volumes/1/

```
{
  "@Redfish.Copyright": "Copyright 2015-2019 SNIA. All rights reserved.",
  "@odata.context": "/redfish/v1/$metadata#Volume.Volume",
  "@odata.id": "/redfish/v1/StorageServices/ISC/Volumes/1",
  "@odata.type": "#Volume.v1_2_1.Volume",
  "Id": "1",
  "Name": "Logical Disk 1",
  "Identifiers": [{
    "DurableNameFormat": "UUID",
    "DurableName": "123e4567-a12b-12a3-a123-123456789000"
  }],
  "Manufacturer": "BEST ChipCo",
  "Status": {
    "State": "Enabled",
    "Health": "OK"
  },
  "BlockSizeBytes": 512,
  "VolumeType": "Mirrored",
  "Capacity": {
    "Data": {
      "ConsumedBytes": 1099511627776,
      "AllocatedBytes": 1198027440128
    }
  },
  "CapacitySources": [{
    "@odata.id": "/redfish/v1/StorageServices/ISC/Volumes/1#/CapacitySources/0",
    "MemberId": "0",
    "ProvidedCapacity": {
      "AllocatedBytes": 1198027440128,
      "ConsumedBytes": 1198027440128
    },
    "ProvidingPools": [{
      "@odata.id": "/redfish/v1/StorageServices/ISC/StoragePools/SASPool"
    }]
  }]
}
```

Some values are hardcoded per spec

Other values are partially hardcoded with known values added

STEP 1

CREATE A STATIC READ ONLY MODEL

- Use Text Editor / Web Server of choice
- Treat the Redfish/Swordfish model as simple folder structure, each returns static page.

  /redfish/v1/storage/MyArray/

  /redfish/v1/storage/MyArray/volumes

  /redfish/v1/storage/MyArray/volumes/volumeX

- Is read only, but lets you ensure mapping operation is correct.

Tip: You don’t implement ALL features. Most are optional

STEP 2

CONVERT STATIC VALUES TO DYNAMIC VALUES

- You can pick/choose/prioritized values to convert from static
- Detection and presentation of new volumes simply means adding new folders, and modifying the volumes collection to point to those new folders.
- Still a read-only model, still external to the array and acts as a proxy agent.

STEP 3

IMPLEMENT CONTROLLED ACCESS

- Ensure that you have implemented the SessionService
  - create your first CRUD operation; Obtain a Token
    - Requires a body of ‘username and password’
  - Require header that contains the Token for all folders except

    /redfish/v1/

    /redfish/v1/sessionservices/session
  - Require content-type of ‘Application-json’

Tip: This is a basic Redfish function. Work no differently than any Server. Don’t get overloaded on all the OPTIONAL ways that you can authenticate, go simple and add in the future on another sprint if desired.

STEP 4

START IMPLEMENTING READ/WRITE VALUES

- Start adding support for POST (Update) type commands that include in the body fields that can be changed.
- Implement these one at a time, testing each one to ensure only valid values are accepted/acceptable
- Pay attention to return codes on failed operations

Tip : Just because the spec says a field may be read/write doesn't mean YOUR implementation has to support a write value for that field.

STEP 5

ALLOW FOR RESOURCE DELETION

- Allow for those resources which can be deleted to be deleted via a Rest DELETE operation.

STEP 6

ALLOW FOR CREATION OF RESOURCES

- Require support for POST (Create) operations
- You must choose what happens when all required fields are not given
  - Does the command fail and return an error
  - Success and implement logic to provide values for those fields

STEP 7

IMPLEMENT ACTIONS

- Some actions like sanitization of drives are controlled via Actions

STEP 8

IMPLEMENT YOUR PROXY AGENT AS EITHER A CONTAINER, OR ON-ARRAY FEATURE

- This step is optional, since Swordfish and Redfish both fully support using the Proxy Agent model
- Consider the security of the Proxy Agent;
- Swordfish / Redfish implementation is not exclusive of the device native Rest API. Both can co-exist.

STEP 9

PASS CTP TEST IN SNIA INNOVATION LAB

- Win Fame, Fortune, and the Respect of your peers
- Use as a development tool and final test pass for your implementation
- Consider returning to Step 1 to implement new features/values as a agile model sprint

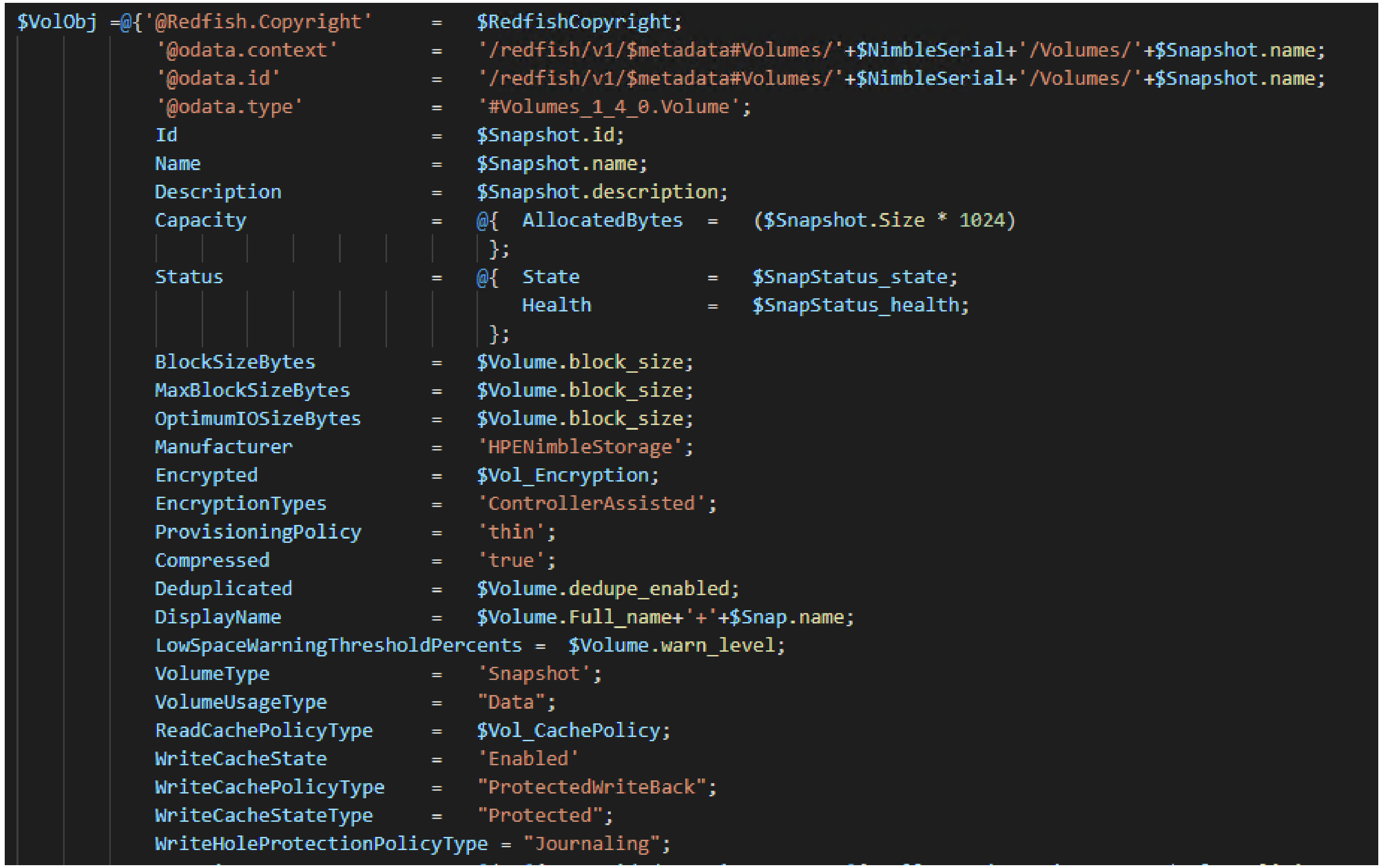
Create a File Structure to match Swordfish

- Using PowerShell you can create a function for each thing you wish to express in SwordFish.

- Make a master script that runs you function against all things in your device.

- Create PowerShell Objects that can be converted to JSON as saved as Index.json files.

- In example to right, Variables all start with '$' and constants are shown in brown.

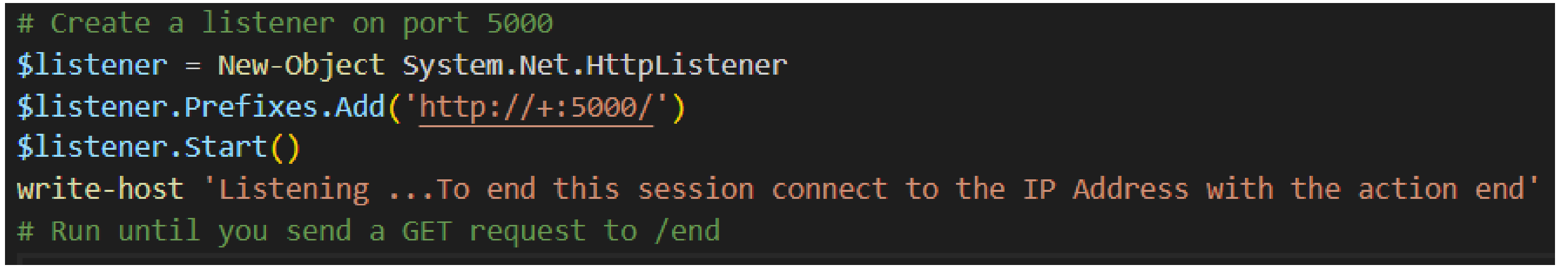


```
$VolObj =@{'@Redfish.Copyright'          =  $RedfishCopyright;
           '@odata.context'             =  '/redfish/v1/$metadata#Volumes/'+$NimbleSerial+'/Volumes/'+$Snapshot.name;
           '@odata.id'                  =  '/redfish/v1/$metadata#Volumes/'+$NimbleSerial+'/Volumes/'+$Snapshot.name;
           '@odata.type'                =  '#Volumes_1_4_0.Volume';
           Id                           =  $Snapshot.id;
           Name                         =  $Snapshot.name;
           Description                  =  $Snapshot.description;
           Capacity                     =  @{  AllocatedBytes  =   ($Snapshot.Size * 1024)
                                             };
           Status                       =  @{  State           =   $SnapStatus_state;
                                               Health          =   $SnapStatus_health;
                                             };
           BlockSizeBytes               =  $Volume.block_size;
           MaxBlockSizeBytes            =  $Volume.block_size;
           OptimumIOSizeBytes           =  $Volume.block_size;
           Manufacturer                 =  'HPENimbleStorage';
           Encrypted                    =  $Vol_Encryption;
           EncryptionTypes              =  'ControllerAssisted';
           ProvisioningPolicy           =  'thin';
           Compressed                   =  'true';
           Deduplicated                 =  $Volume.dedupe_enabled;
           DisplayName                  =  $Volume.Full_name+'+'+$Snap.name;
           LowSpaceWarningThresholdPercents =  $Volume.warn_level;
           VolumeType                   =  'Snapshot';
           VolumeUsageType              =  "Data";
           ReadCachePolicyType          =  $Vol_CachePolicy;
           WriteCacheState              =  'Enabled'
           WriteCachePolicyType         =  "ProtectedWriteBack";
           WriteCacheStateType          =  "Protected";
           WriteHoleProtectionPolicyType = "Journaling";
```

SEE HTTPS://GITHUB.COM/CHRIS-LIONETTI/SWORDFISHMOCKUP

How to Serve Swordfish…It’s a Cookbook!

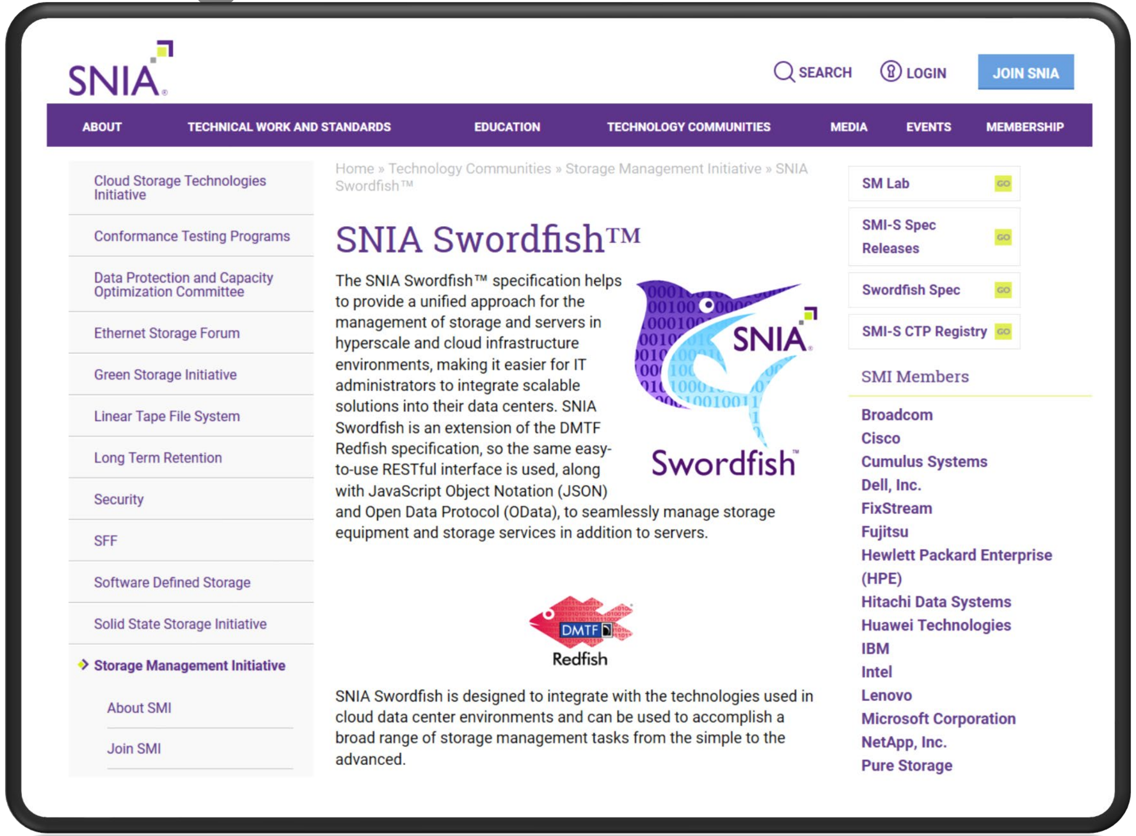
- Codebase Assumes that you have created a Mockup that runs against the output of that mockup.
  - The Mockup can be directed to pull live information for each Swordfish request.
- Code is hidden command in the Mockup called ‘Listener.ps1’



```
# Create a listener on port 5000
$listener = New-Object System.Net.HttpListener
$listener.Prefixes.Add('http://+:5000/')
$listener.Start()
write-host 'Listening ...To end this session connect to the IP Address with the action end'
# Run until you send a GET request to /end
```

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



Home » Technology Communities » Storage Management Initiative » SNIA Swordfish™

SNIA Swordfish™

The SNIA Swordfish™ specification helps to provide a unified approach for the management of storage and servers in hyperscale and cloud infrastructure environments, making it easier for IT administrators to integrate scalable solutions into their data centers. SNIA Swordfish is an extension of the DMTF Redfish specification, so the same easy-to-use RESTful interface is used, along with JavaScript Object Notation (JSON) and Open Data Protocol (OData), to seamlessly manage storage equipment and storage services in addition to servers.

SNIA Swordfish is designed to integrate with the technologies used in cloud data center environments and can be used to accomplish a broad range of storage management tasks from the simple to the advanced.

SMI Members

Broadcom
Cisco
Cumulus Systems
Dell, Inc.
FixStream
Fujitsu
Hewlett Packard Enterprise (HPE)
Hitachi Data Systems
Huawei Technologies
IBM
Intel
Lenovo
Microsoft Corporation
NetApp, Inc.
Pure Storage

Next Steps

- Develop a Swordfish Mockup of your own & submit it to the Swordfish TWG;
  - Feedback on spec adherence to validate your mockup.
  - Can be posted as an additional example (your discretion) in the SwordfishMockups.com.

- Submit a Storage Device for testing to the CTP
- Join SNIA and the SSM TWG & help define the Schema;
  - Ensure the Schema is defined sufficiently to represent your desired implementation
    - WE ARE ALWAYS LOOKING FOR FEEDBACK REGARDING YOUR IMPLEMENTATION MAPING TO SWORDFISH !
  - Full NVMe Enablement: Functionality alignment across DMTF, NVMExpress/NVMe-MI and SNIA for NVMe use cases
  - Enhanced profile support for SNIA Alliance partner organizations

- Help define the future of this Swordfish Consumer.
  - SwordFish™ PowerShell Toolkit and follow-on Windows Admin Client Module.
  - notable projects; Swordfish DataDog implementation & PowerBI
  - A GoLang Client library called GoFish; An EmberJS Client
  - Looking for more integration points (what can you come up with)

Where to Find More Info..

SNIA Swordfish™

- Swordfish Standards
  - Schemas, Specs, Mockups, User and Practical Guide`s, … https://www.snia.org/swordfish
- Swordfish Specification Forum
  - Ask and answer questions about Swordfish
  - http://swordfishforum.com/
- Scalable Storage Management (SSM) TWG
  - Technical Work Group that defines Swordfish
  - Influence the next generation of the Swordfish standard
  - Join SNIA & participate: https://www.snia.org/member_com/join-SNIA
- Join the SNIA Storage Management Initiative
  - Unifies the storage industry to develop and standardize interoperable storage management technologies
  - https://www.snia.org/forums/smi/about/join

DMTF Redfish™

- Redfish Standards
  - Specifications, whitepapers, guides,… https://www.dmtf.org/standards/redfish

Open Fabric Management Framework

- OFMF Working Group (OFMFWG)
  - Description & Links https://www.openfabrics.org/working-groups/
- OFMFWG mailing list subscription
  - https://lists.openfabrics.org/mailman/listinfo/ofmfwg
- Join the Open Fabrics Alliance
  - https://www.openfabrics.org/membership-how-to-join/

NVM Express

- Specifications https://nvmexpress.org/developers/
- Join: https://nvmexpress.org/join-nvme/

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Light Slide Title

- Bullets 1
  - Bullets 2
    - Bullets 3
      - Bullets 4
        - Bullets 5

Dark Slide Title

- Bullets 1
  - Bullets 2
    - Bullets 3
      - Bullets 4
        - Bullets 5

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