STORAGE DEVELOPER CONFERENCE
SDC 21
BY Developers FOR Developers
Virtual Conference
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Accelerating NVMe/NVMe-oF Redfish/Swordfish development

With Distributed Endpoint Manager

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Agenda

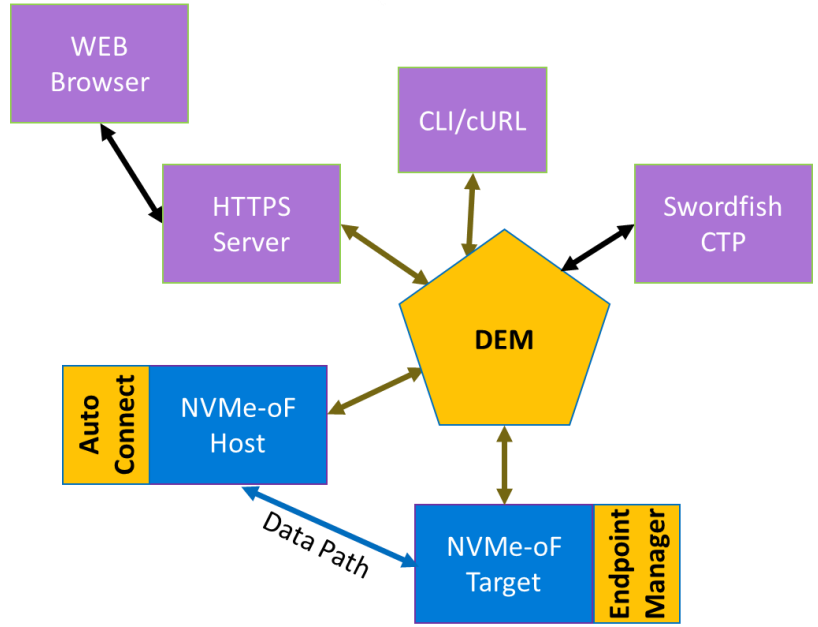
- Introduction to Distributed Endpoint Manager (DEM)
- Resource Management - NVMe/NVMe-oF
- NVMe/NVMe-oF Resources in Swordfish World
- Dive into DEM
- DEM with Swordfish CTP
- Call to action

Disclaimer

- SNIA Swordfish for NVMe/NVMe-oF is evolving
- NVM Express for managing NVMe-oF is evolving
- DEM tool is also evolving

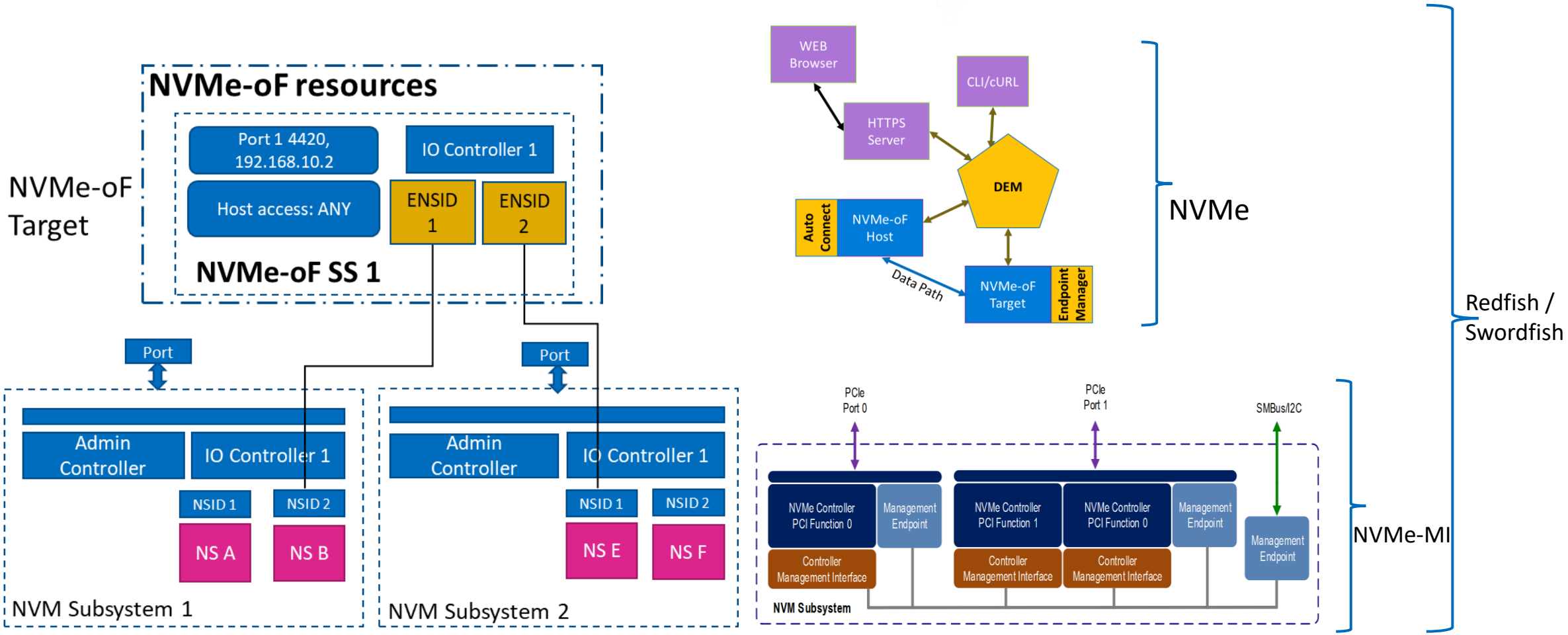
What is DEM – Distributed Endpoint Manager

- Open-source project for Managing NVMe-oF resources
  - Enumeration
  - Configuration & Event Notification
  - Providing Log Pages to hosts
- Specifications:
  - NVMe-*
  - DMTF Redfish & SNIA Swordfish
- Why DEM?



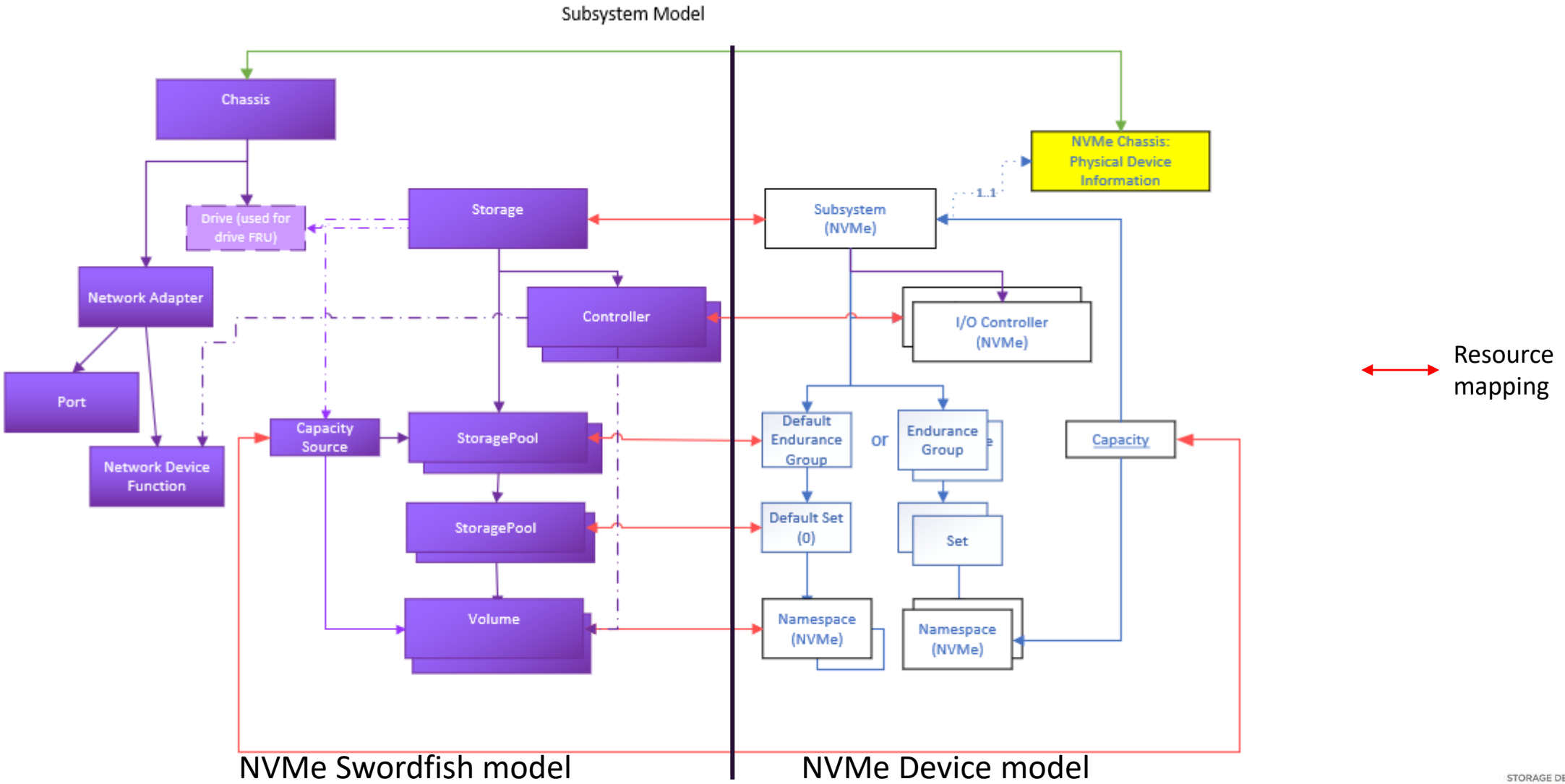
Resource Management - NVMe/NVMe-oF

NVMe/NVMe-oF resources

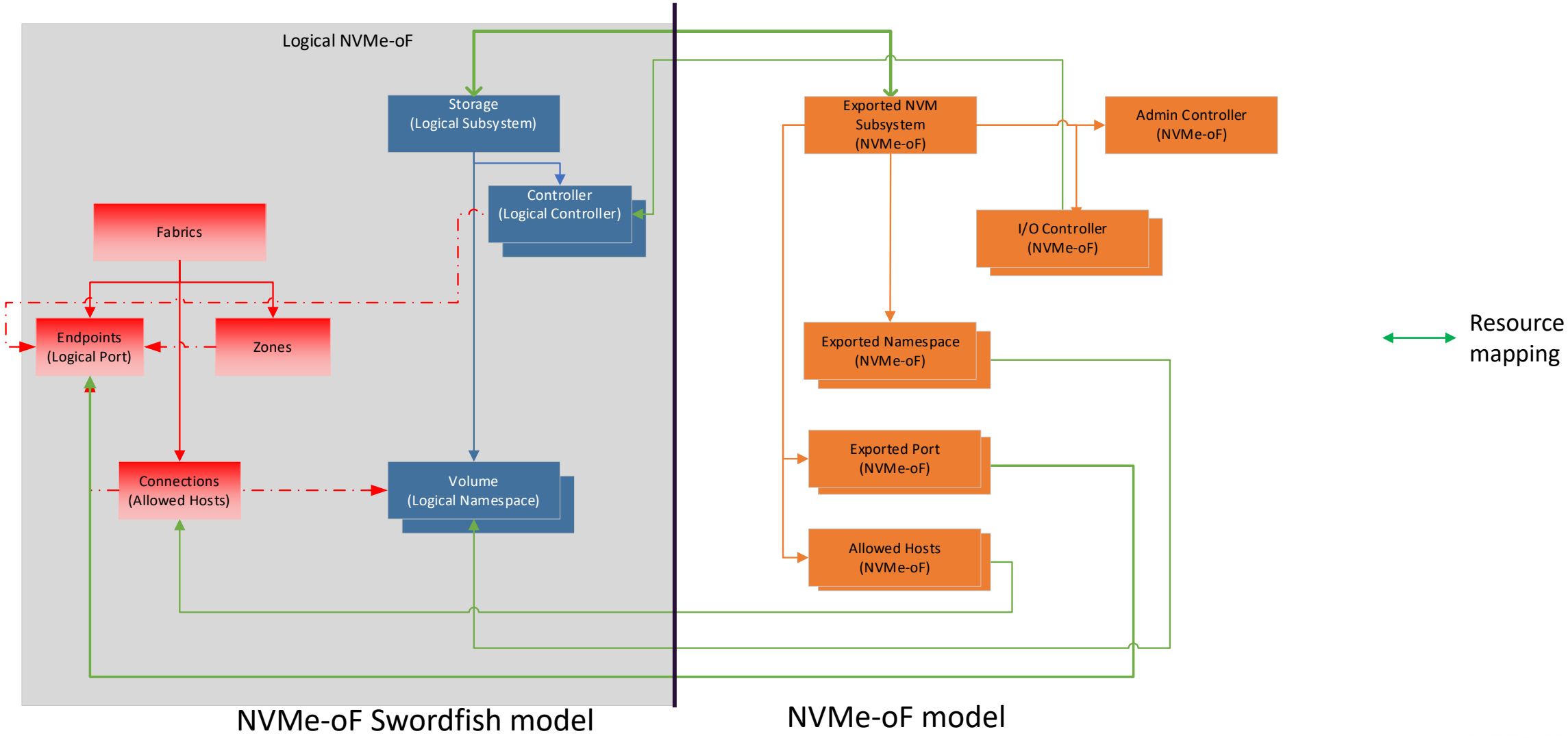


NVMe/NVMe-oF Resources in Swordfish World

Swordfish NVMe Device Model



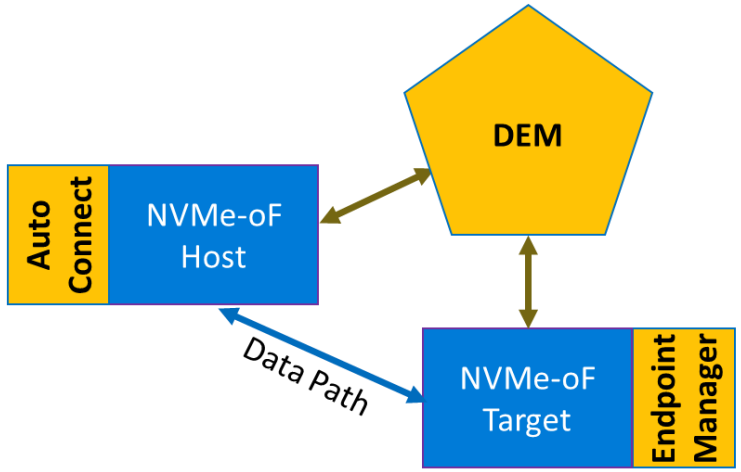
Swordfish NVMe-oF Model: Target Subsystem



Dive into DEM – Distributed Endpoint Manager

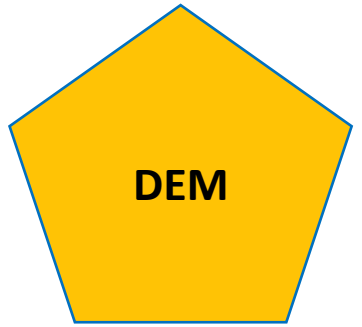
DEM Architecture

- Components of DEM- Distributed Endpoint Manager
  - DEM - A central entity for managing NVMe-oF Target Endpoint & Hosts
  - EM - Endpoint Manager
  - AC – Auto Connect (optional)



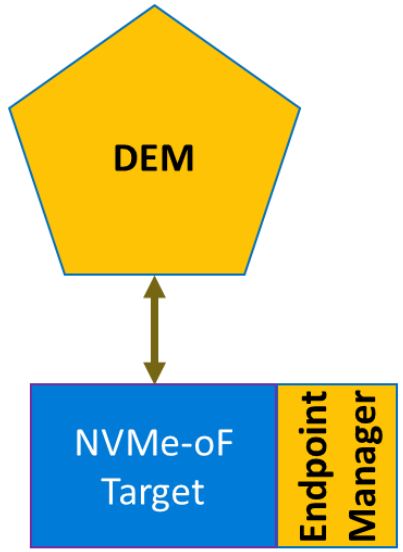
DEM – Central Entity

- Centralized, efficient and dynamic configuration of NVMe-oF resources
- Configures NVMe-oF resources from a centralized entity
- Get underlying resources on each Target system
- Collects Discovery Log Pages from each NVMe-oF Target
- Hosts/NVMe-oF initiators can retrieve provisioned Discovery Log Pages from DEM which is the central entity
- Gets notifications for changes to NVMe-oF resources
- Interpreter – Swordfish to NVMe



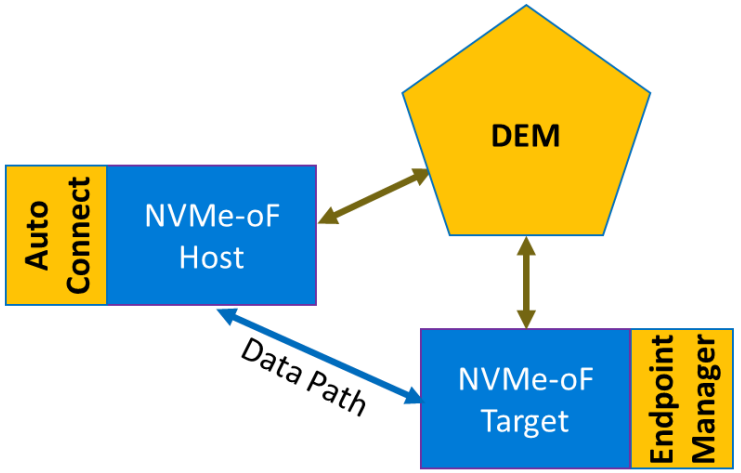
EM - Endpoint Manager

- EM is where NVMe-oF Targets are configured
- Provides available underlying resources information to DEM
- Provide Discovery Log Pages for NVMe-oF Target
- Gets configuration information from DEM
- Configures NVMe-oF resources

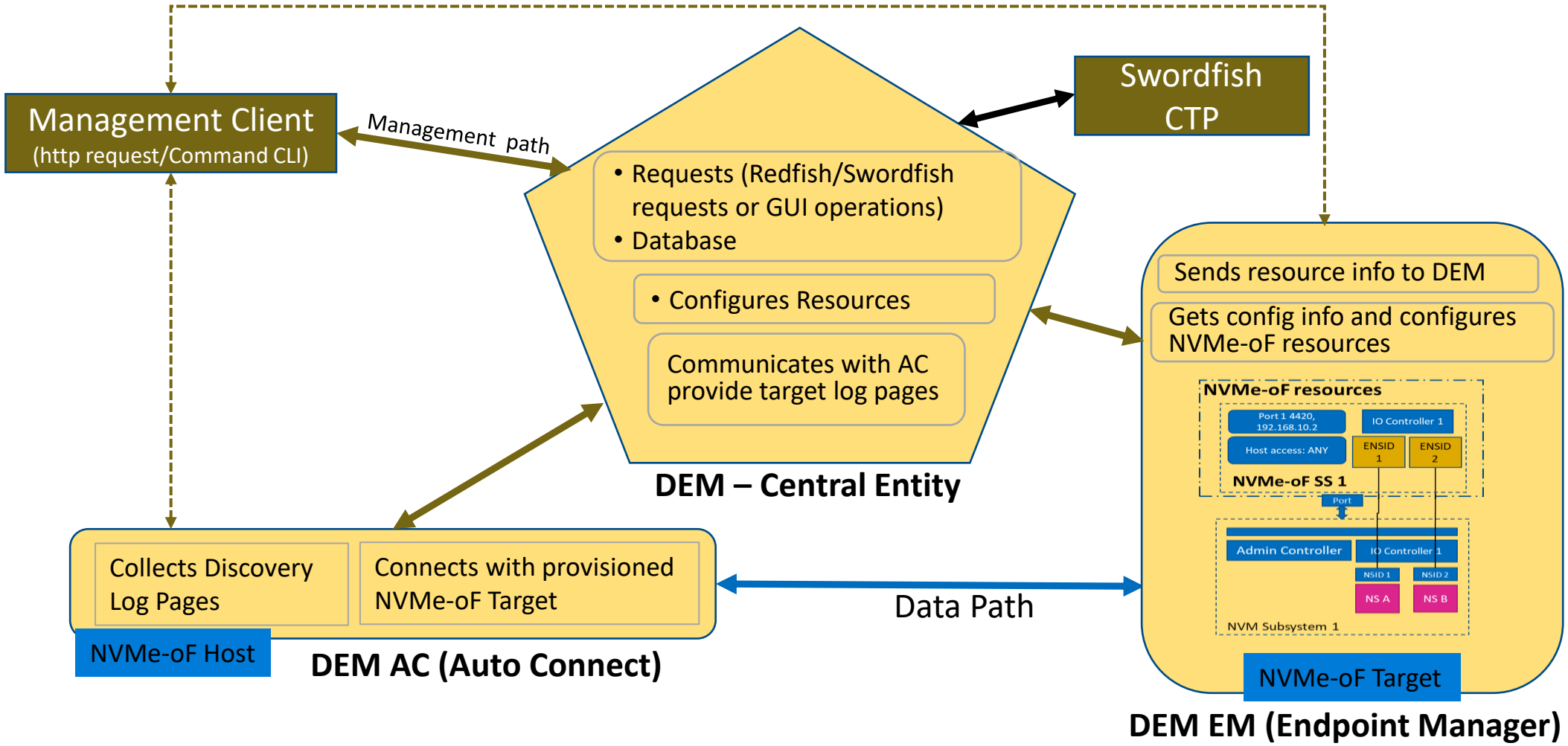


AC – Auto Connect

- Auto Connect resides on an NVMe-oF Host/Initiator
- Connects with DEM, collects Discovery Log Pages
- Connects with the NVMe-oF target that is provisioned for this host



DEM – Components Interface



DEM – Operations

- Get List of available NVM resources (like Namespaces)
- Get List of fabrics that can be used for NVMe-oF subsystem
- Create/Delete NVMe-oF Subsystems
- Add/Remove Namespace from a NVMe-oF Subsystems
- Manage fabrics Transport Configuration of NVMe-oF Subsystem
- Manage Host access rights of NVMe-oF Subsystems

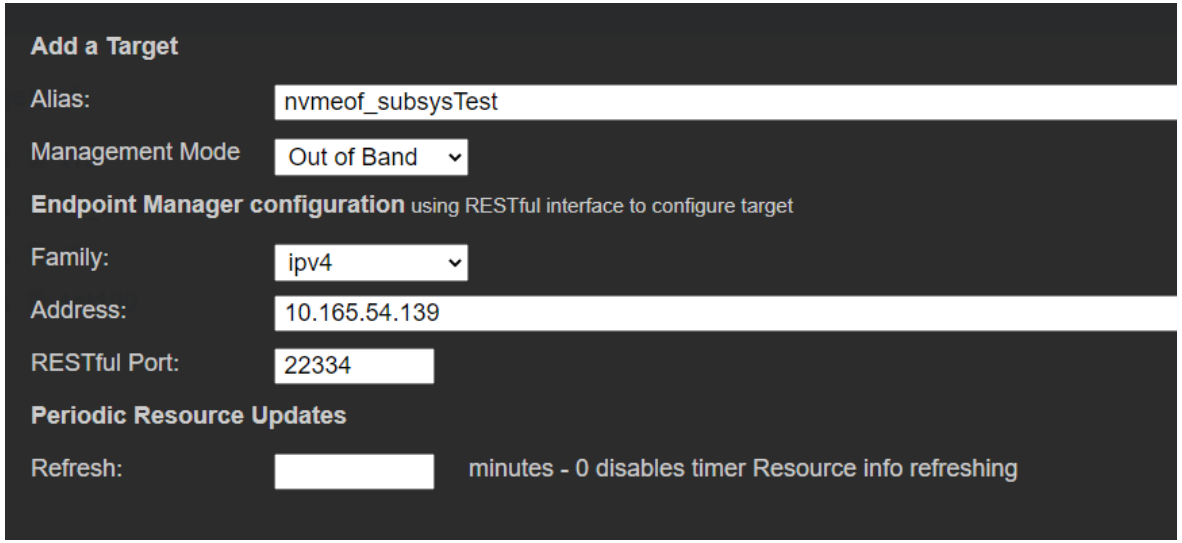
DEM – Operations

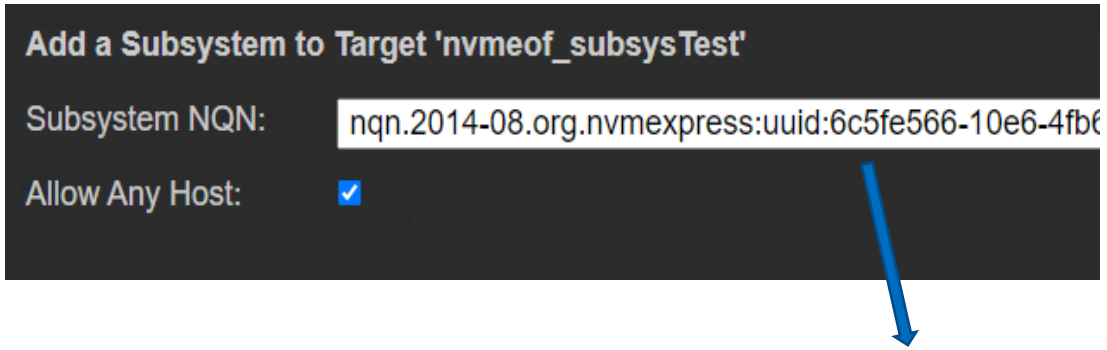
- Get List of available NVM resources
- Get List of fabrics that can be used for NVMe-oF subsystem

```
$ sudo ./dem-em -p 22334
Using port 22334
Starting daemon on port 22334, serving '/'
enumerate_interfaces(172) adding interface for rdma ipv4 192.168.22.1
create_device(689) adding device nvme1n1
create_device(689) adding device nvme0n1
create_device(693) adding device nullb0
handle_http_request(758) GET /nsdev
handle_http_request(758) GET /interface
```


DEM – Operations

- Create/Delete NVMe-oF Subsystems

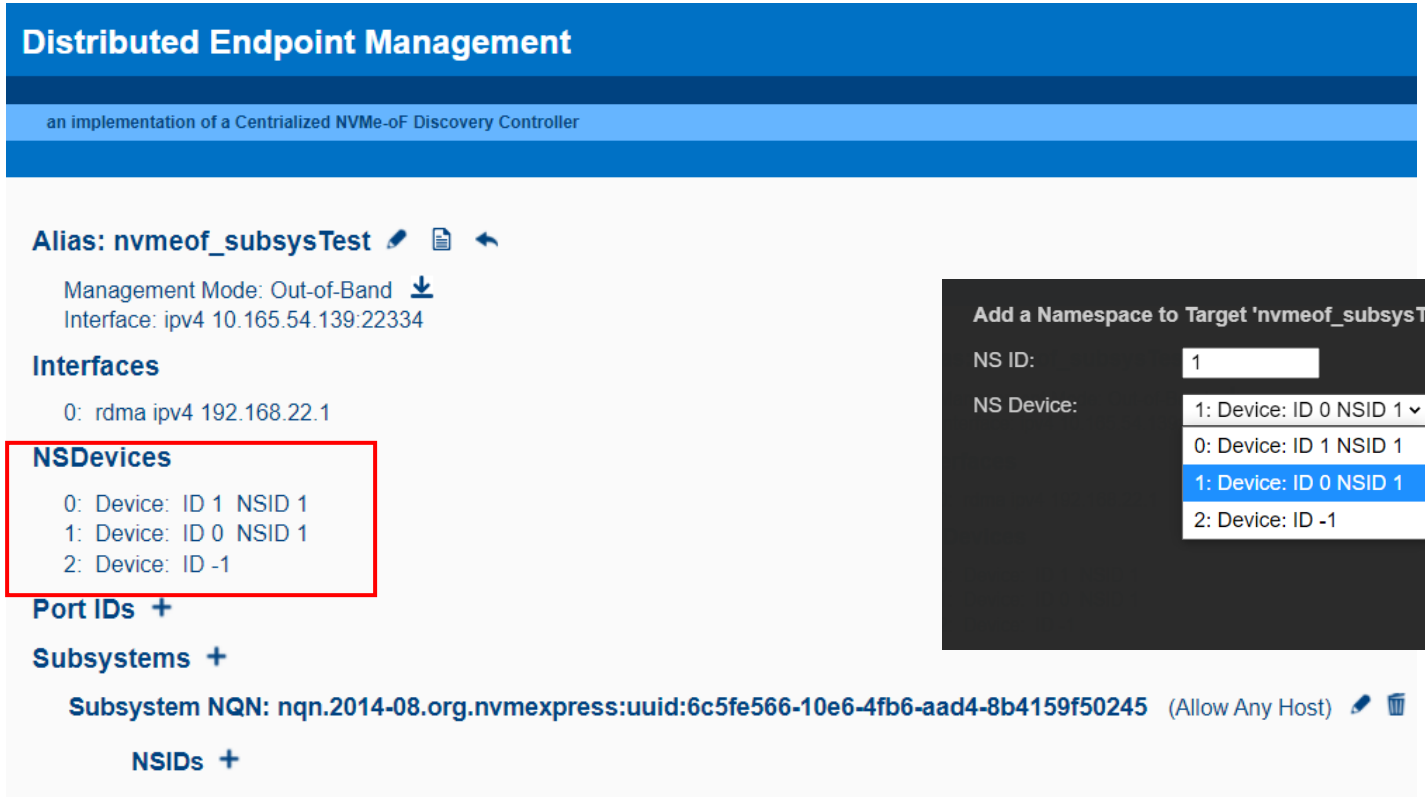


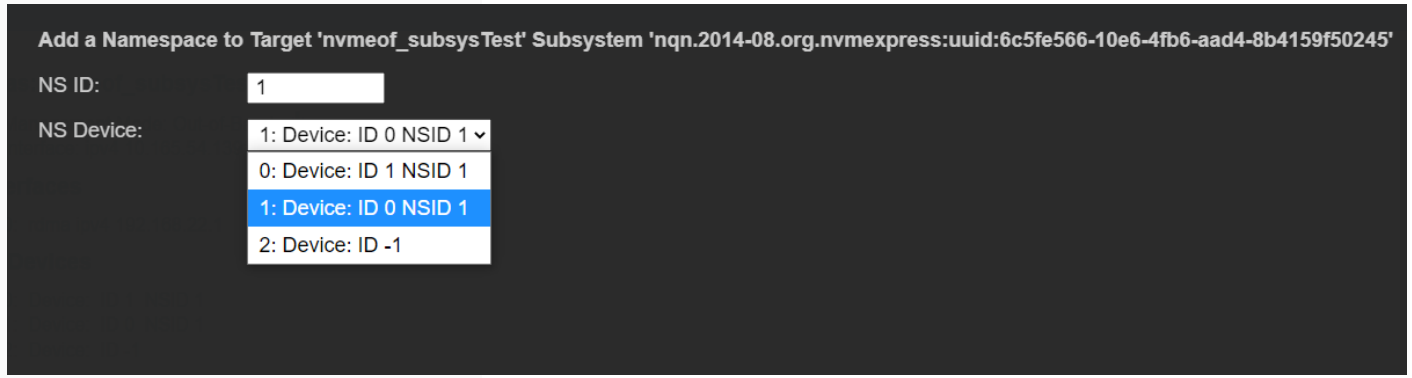


nqn.2014-08.org.nvmexpress:uuid:6c5fe566-10e6-4fb6-aad4-8b4159f50245

DEM – Operations

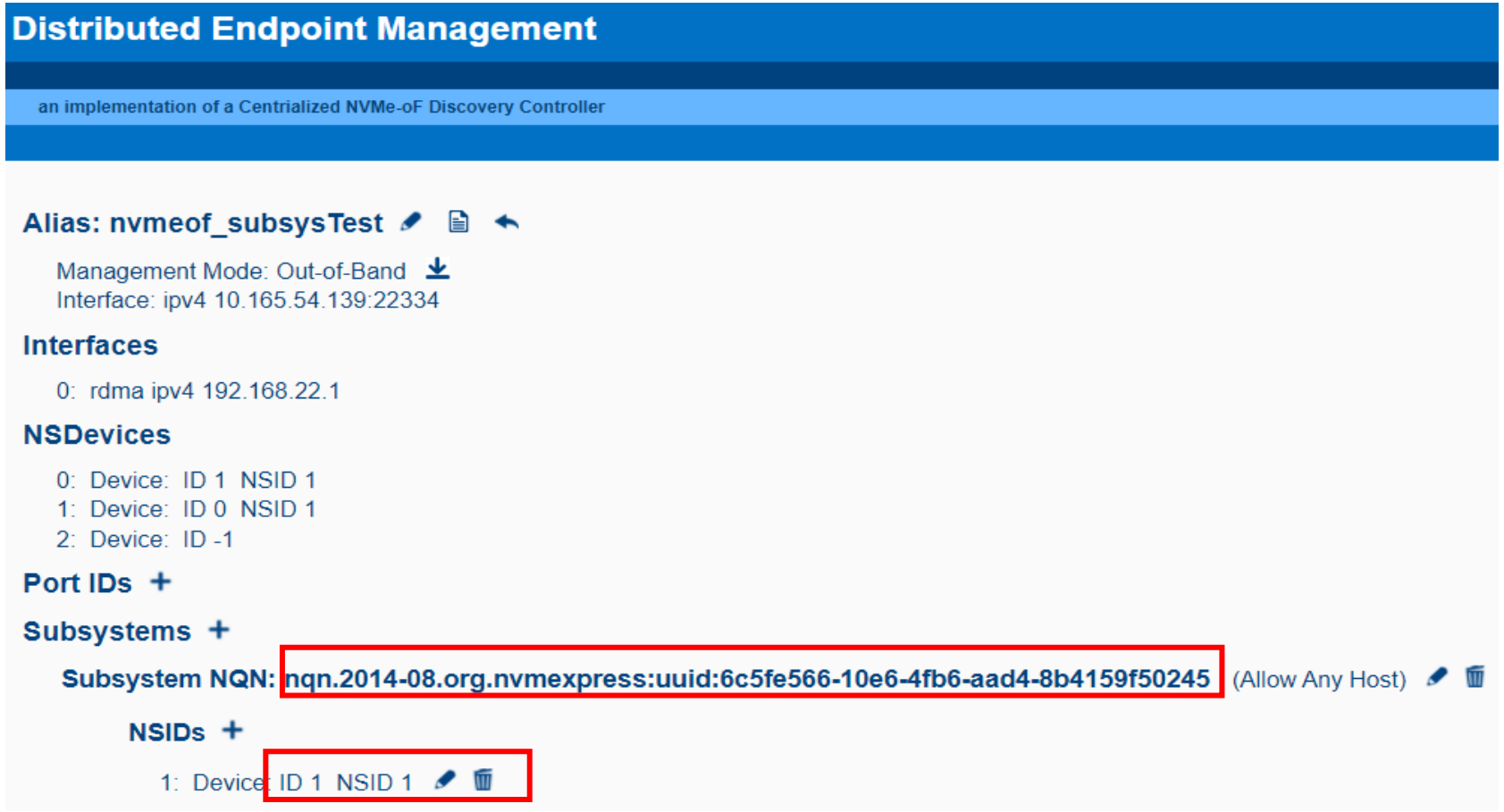
- Add/Remove Namespace from a NVMe-oF Subsystems





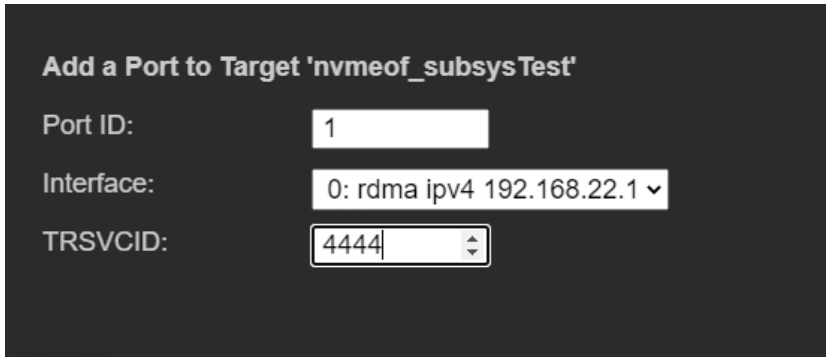
DEM – Operations

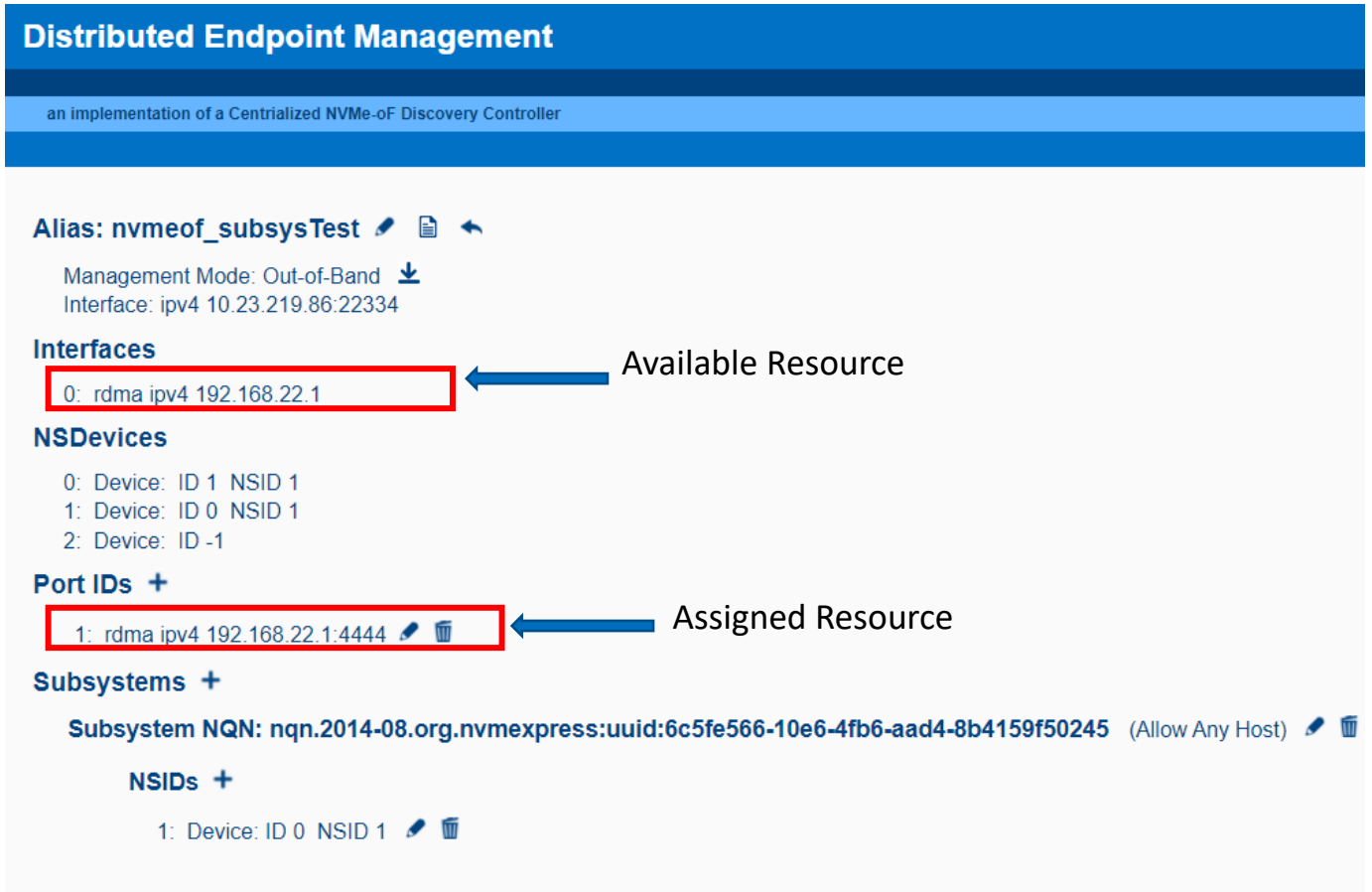
- Add/Remove Namespace from a NVMe-oF Subsystems



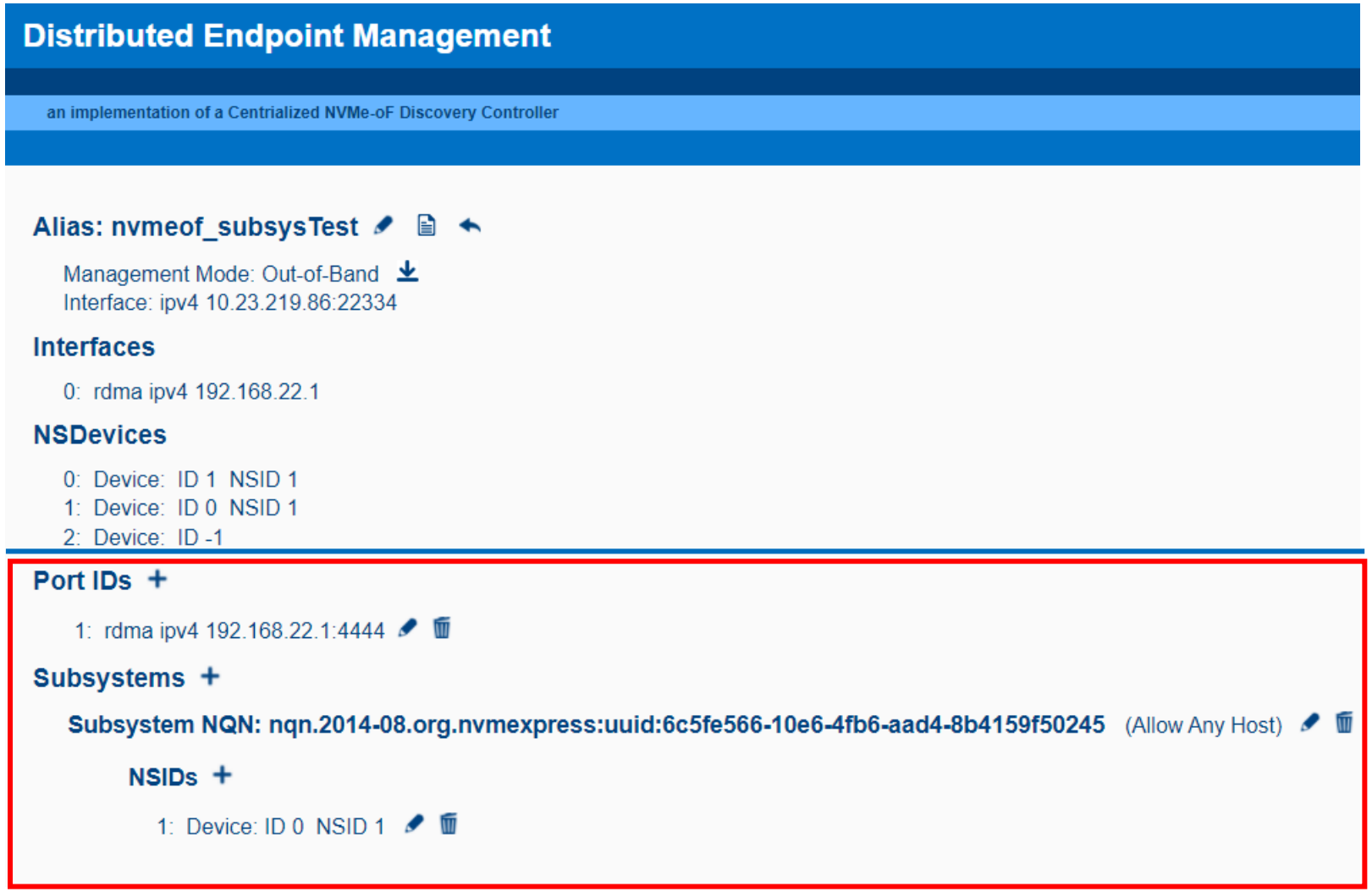
DEM – Operations

- Manage fabrics Transport Configuration of NVMe-oF Subsystem



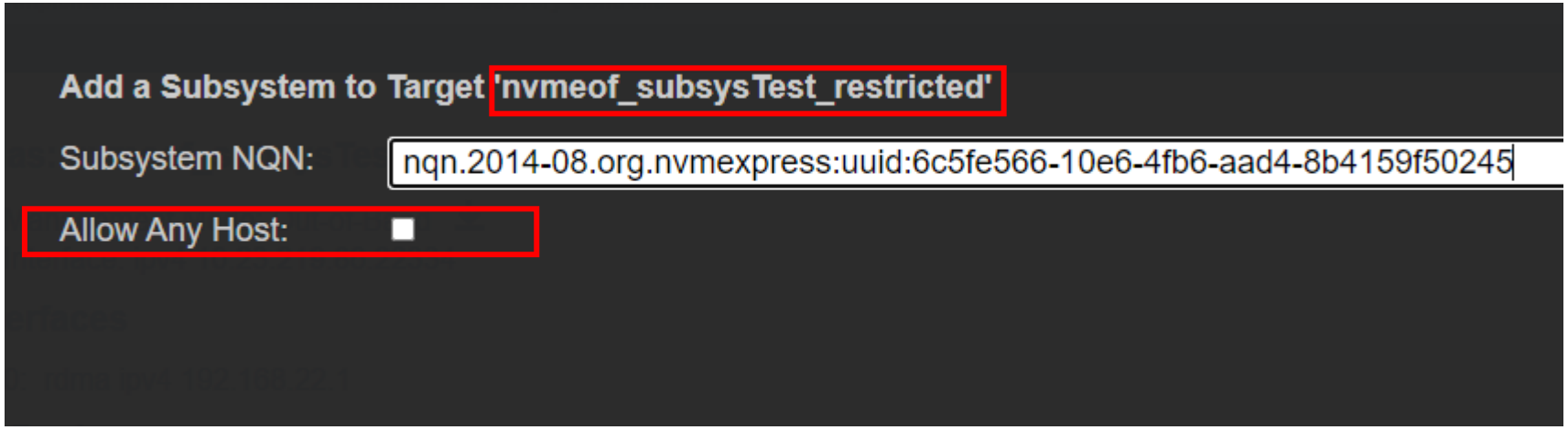


DEM – NVMe-oF Subsystem Unrestricted



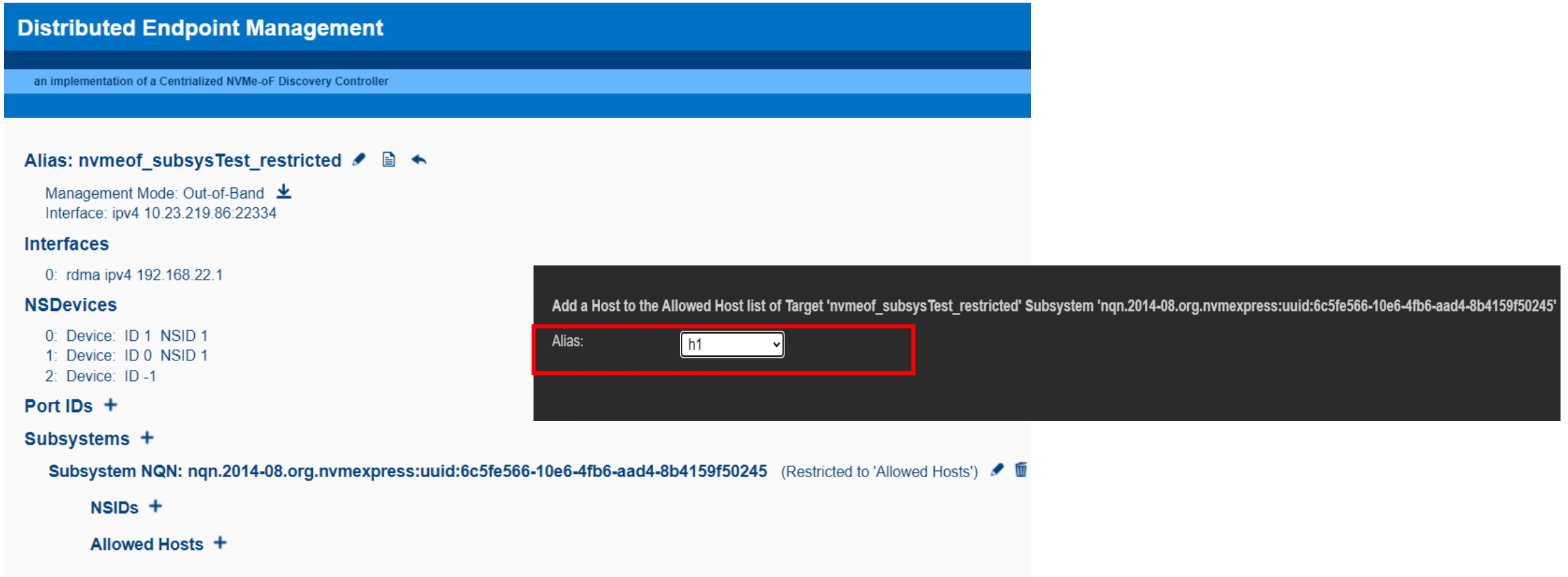
DEM – Operations

- Create/Delete NVMe-oF Subsystems - **Restricted**

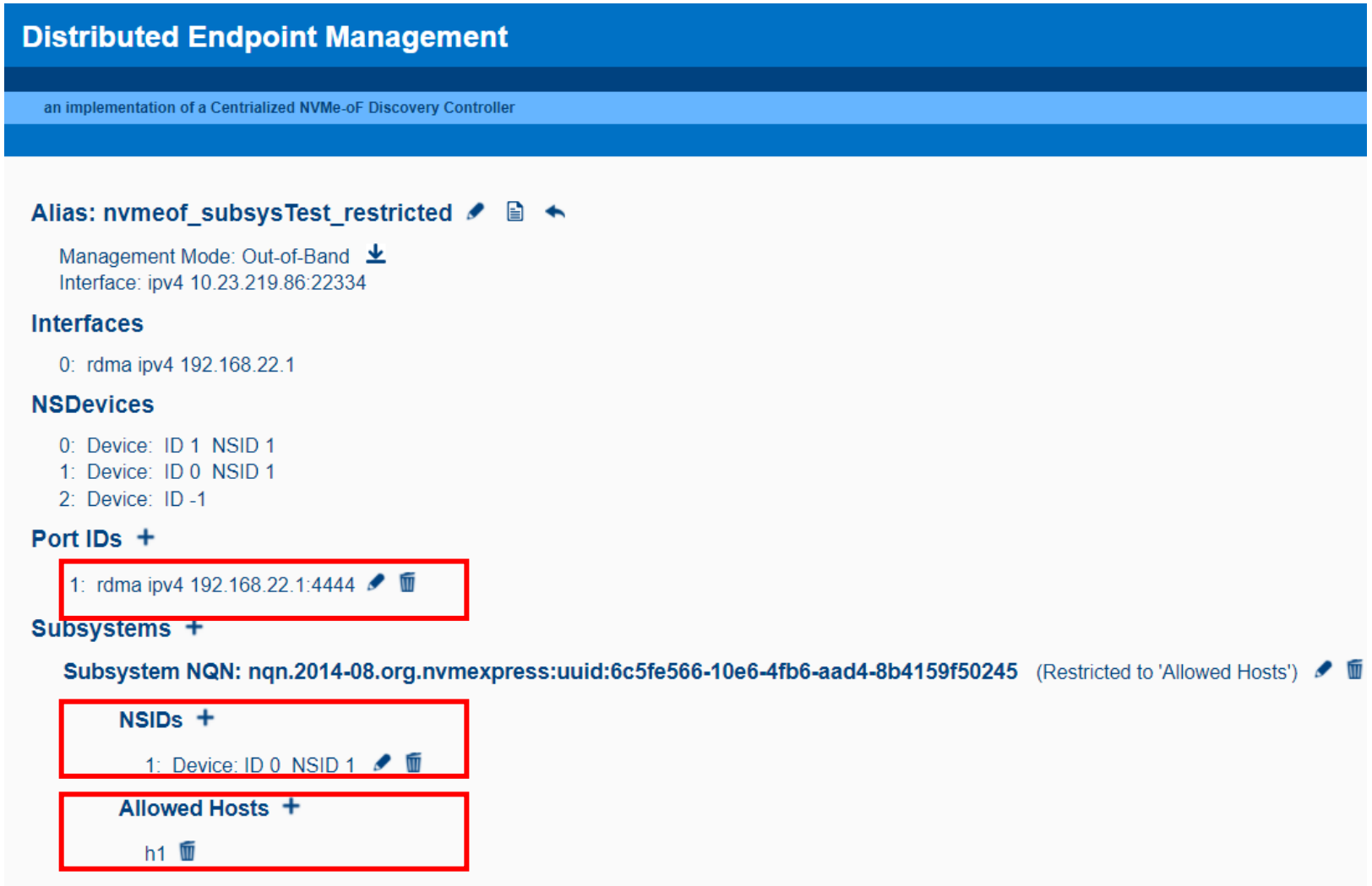


DEM – Operations

- Manage Host access rights of **Restricted** NVMe-oF Subsystems



DEM – NVMe-oF Subsystem **Restricted**



Swordfish resource example

NVMe-oF Subsystems


```
{
  "@Redfish.Copyright": "Copyright 2014-2020 SNIA. All rights reserved.",
  "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest",
  "@odata.type": "#Storage.v1_10_0.Storage",
  "Id": "1",
  "Name": "nvmeof_SS1",
  "Description": "An NVM Express Subsystem is an NVMe device that contains one or more NV
  "Status": {
    "State": "Enabled",
    "Health": "OK",
    "HealthRollup": "OK"
  },
  "Identifiers": [{
    "DurableNameFormat": "NQN",
    "DurableName": "nqn.2014-08.org.nvmexpress:uuid:6c5fe566-10e6-4fb6-aad4-8b4159f50245"
  }],
  "Controllers": {
    "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest/Controllers"
  },
  "Volumes": {
    "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest/Volumes"
  },
  "Links": {
      "Endpoints": [
          {
              "@odata.id": "/redfish/v1/Fabrics/NVMe-oF/Endpoints/NVMeSubsystemEndpoint1"
          },
          {
              "@odata.id": "/redfish/v1/Fabrics/NVMe-oF/Endpoints/NVMeSubsystemEndpoint2"
          }
      ]
```



```
{
  "@Redfish.Copyright": "Copyright 2014-2020 SNIA. All rights reserved.",
  "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest/Volumes/LogicalNamespace1",
  "@odata.type": "#Volume.v1_5_0.Volume",
  "Id": "1",
  "Name": "LogicalNamespace1",
  "LogicalUnitNumber": 1,

  "Status": {
    "State": "Enabled"
  },

  "ProvidingPools": {
    "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest/StoragePools/NVMe-oFStoragePool"
  }
}
```



```
"ConnectedEntities": [{
    "EntityType": "StorageSubsystem",
    "EntityRole": "Target",
    "EntityLink": {
       "@odata.id": "/redfish/v1/Storage/nvmeof_subsysTest"
    },
  },
  {
    "EntityType": "NetworkController",
    "EntityRole": "Target",
    "EntityLink": {
      "@odata.id": "/redfish/v1/Chassis/Sys-1Chassis/NetworkAdapters/1/N
    }
  }
],
"IPTransportDetails": [{
  "TransportProtocol": "RDMA",
  "IPv4Address": {
    "Address": "192.168.22.1"
  },
  "Port": 4444
}],
```


Interfaces

0: rdma ipv4 192.168.22.1

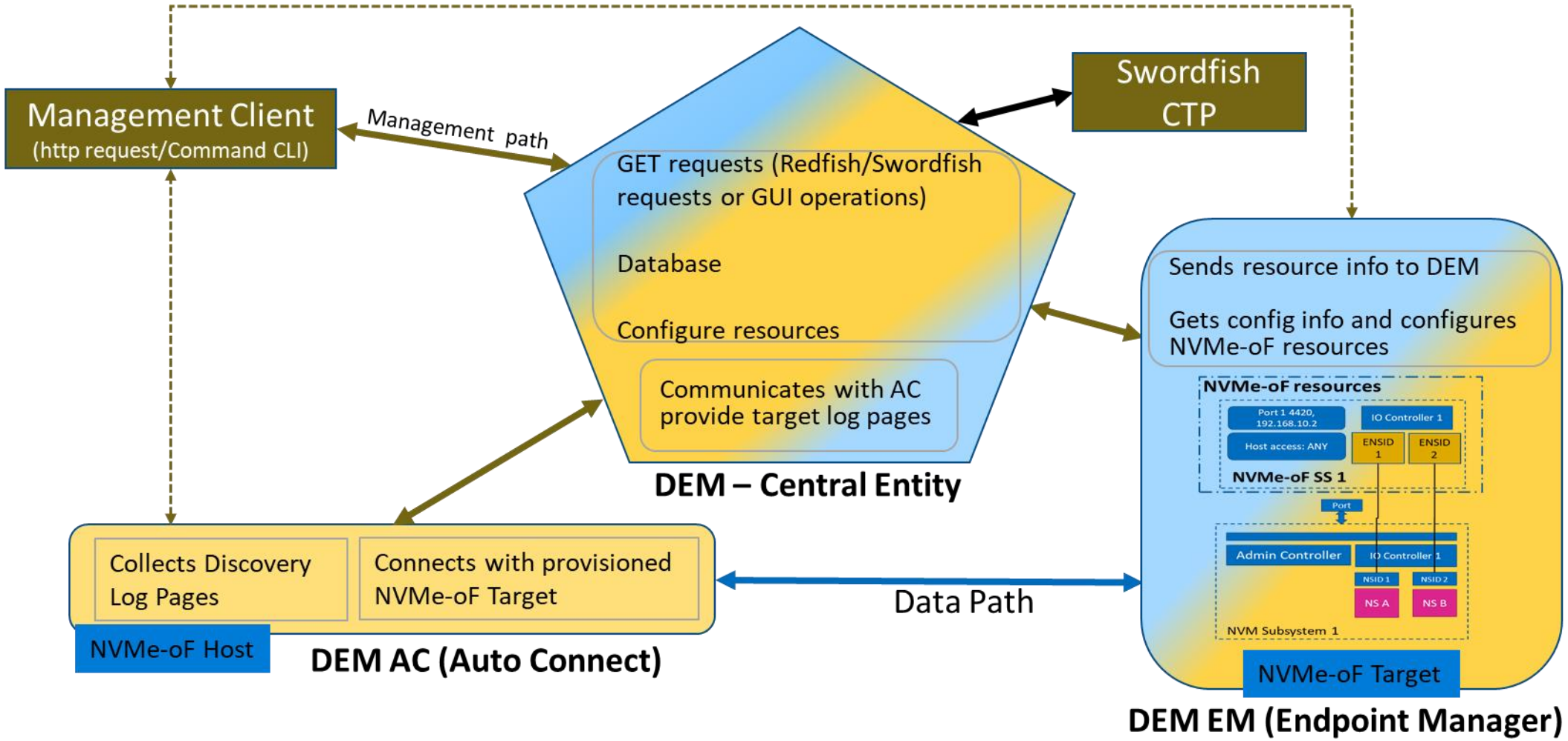
DEM Complies with Swordfish CTP

Compliance Test Program

DEM & Swordfish CTP

- Open-source test suite to validate conformance to SNIA's storage management specifications
- Validates that a company's products conform to a particular version of the Swordfish Scalable Storage Management API Specification for storage management
- Details at https://www.snia.org/swordfish-ctp

DEM – Where is Swordfish interface?



DEM & Swordfish CTP

CTP

```
 python3 run_snia_test.py  --user none
 --password none --authtype None  http://10.165.54.139:22345 servicetest
Redfish-Service-Validator 2.0.2
Redfish-Interop-Validator 2.0.0
Redfish-Protocol-Validator 1.0.4
Redfish-URI-Validator 1.0.1
profiles 1.2.2
registries 1.0.2
openapi latest
Redfish-Service-Validator Set To 2.0.2
D       tests/complexeval.py
D       tests/schema.py
D       tests/simpleeval.py
D       tests/testdata/payloads/simple.json
D       tests/testdata/payloads/simple_bad.json
D       tests/testdata/schemas/ExampleResource_v1.xml
D       tests/testdata/schemas/Example_v1.xml
HEAD is now at c00294c... Merge pull request #417 from DMTF/2.0.2-Tagging
Redfish-Interop-Validator Set To 2.0.0
HEAD is now at ece58f8... 2.0.0 versioning
Redfish-Protocol-Validator Set To 1.0.4
HEAD is now at d6f3289... 1.0.4 versioning
Redfish-URI-Validator Set To 1.0.1
HEAD is now at 366b6ad... Merge pull request #15 from DMTF/1.0.1-Tagging
Creating test_dir...
Copying framework...
Test Level: servicetest
Basic Service Test
Copying tool Redfish-Service-Validator
Copying tool Redfish-Interop-Validator
Copying... SwordfishDiscovery.json SwordfishDiscovery
Copying config...
Adding test snia_suite/Redfish-Service-Validator to test runner
Adding test snia_suite/SwordfishDiscovery to test runner
Adding test snia_suite/Redfish-Interop-Validator to test runner

Running tests...
----------------------------------------------------------------------
```

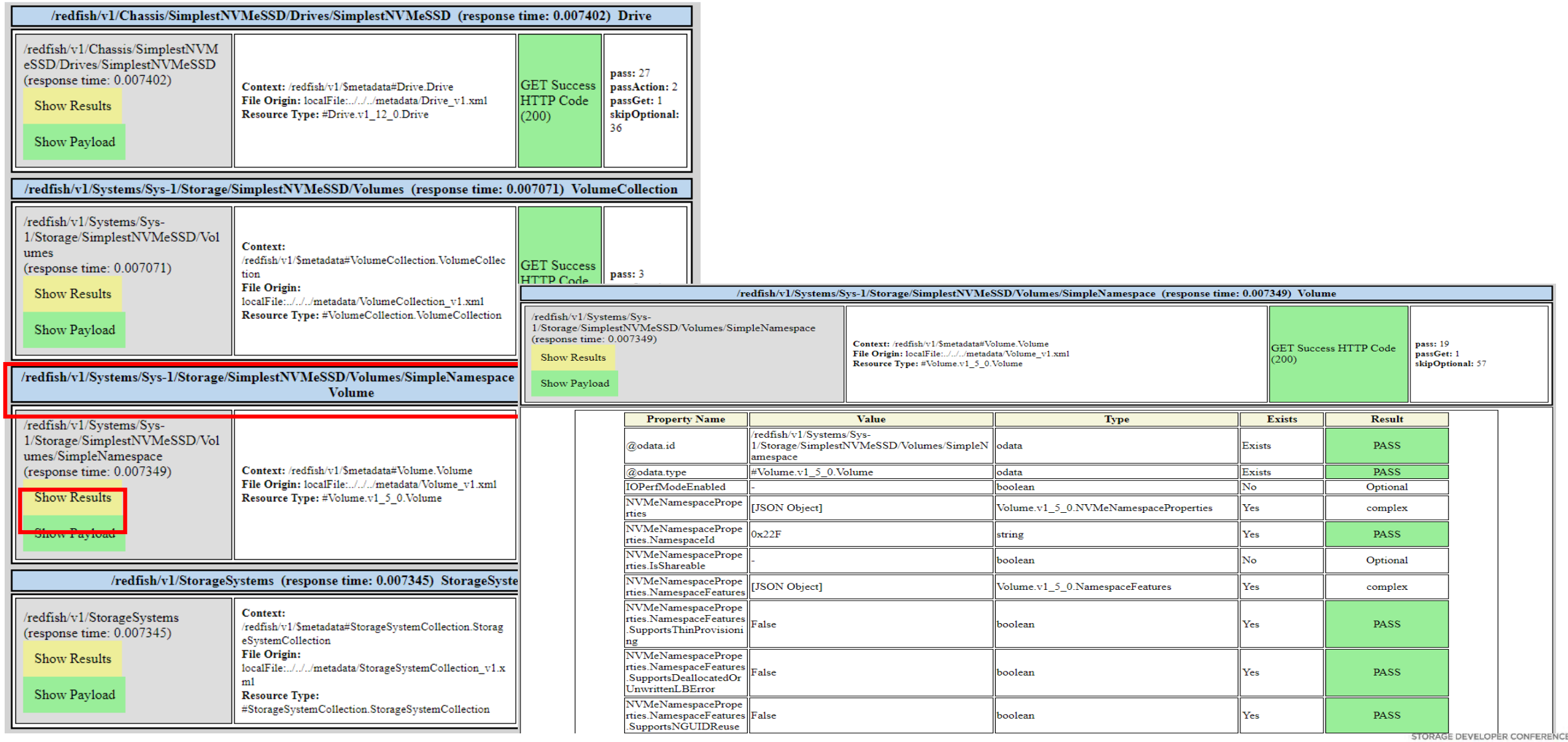
DEM

```
[New Thread 0x7fffebfff700 (LWP 14121)]
handle_http_request(997) GET /redfish/v1/$metadata
handle_http_request(997) GET /redfish/v1
handle_http_request(997) GET /redfish/v1/
handle_http_request(997) GET /redfish/v1/Storage
handle_http_request(997) GET /redfish/v1/StorageSystems
handle_http_request(997) GET /redfish/v1/Systems
handle_http_request(997) GET /redfish/v1/Chassis
handle_http_request(997) GET /redfish/v1/SessionService
handle_http_request(997) GET /redfish/v1/Registries
handle_http_request(997) GET /redfish/v1/SessionService/Sessions
handle_http_request(997) GET /redfish/v1/Registries/AdvertisedFeatures.v1_0_0
handle_http_request(997) GET /redfish/v1/Registries/AdvertisedFeatures.v1_0_0.json
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Controllers
handle_http_request(997) GET /redfish/v1/Chassis/SimplestNVMeSSD/Drives/SimplestNVMeSSD
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes
handle_http_request(997) GET /redfish/v1/Chassis/SimplestNVMeSSD
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Controllers/NVMeIOContr
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace
handle_http_request(997) GET /redfish/v1/Systems/Sys-1
handle_http_request(997) GET /redfish/v1/Systems/Sys-1/Storage
handle_http_request(997) GET /redfish/v1/Chassis/SimplestNVMeSSD/Drives
handle_http_request(997) GET /redfish/v1/SessionService/Sessions/1234567890ABCDEF
handle_http_request(997) GET /redfish/v1
```


Swordfish CTP test results sample

/redfish/v1/ (response time: 0.006936) ServiceRoot			
/redfish/v1/ (response time: 0.006936) Show Results Show Payload	**Context:** /redfish/v1/$metadata#ServiceRoot.ServiceRoot **File Origin:** localFile:../../../metadata/ServiceRoot_v1.xml **Resource Type:** #ServiceRoot.v1_9_0.ServiceRoot	GET Success HTTP Code (200)	**pass:** 11 **passGet:** 1 **skipOptional:** 22
/redfish/v1/Registries (response time: 0.007929) MessageRegistryFileCollection			
/redfish/v1/Registries (response time: 0.007929) Show Results Show Payload	**Context:** /redfish/v1/$metadata#MessageRegistryFileCollection. MessageRegistryFileCollection **File Origin:** localFile:../../../metadata/MessageRegistryFileCollection _v1.xml **Resource Type:** #MessageRegistryFileCollection.MessageRegistryFileC ollection	GET Success HTTP Code (200)	**pass:** 3 **passGet:** 1 **skipOptional:** 1
/redfish/v1/Registries/AdvertisedFeatures.v1_0_0 (response time: 0.006797) MessageRegistryFile			
/redfish/v1/Registries/AdvertisedF eatures.v1_0_0 (response time: 0.006797) Show Results Show Payload	**Context:** /redfish/v1/$metadata#MessageRegistryFile.MessageRe gistryFile **File Origin:** localFile:../../../metadata/MessageRegistryFile_v1.xml **Resource Type:** #MessageRegistryFile.v1_1_3.MessageRegistryFile	GET Success HTTP Code (200)	**pass:** 8 **passGet:** 1 **skipOptional:** 3 **unvalidated:** 1
/redfish/v1/Registries/AdvertisedFeatures.v1_0_0.json (response time:)			
/redfish/v1/Registries/AdvertisedF eatures.v1_0_0.json (response time:) Show Results Show Payload	**Context:** **File Origin:** None **Resource Type:**	GET Failure HTTP Code (0)	**problemReso urce:** 1

Swordfish CTP test results sample...Continued



/redfish/v1/Chassis/SimplestNVMeSSD/Drives/SimplestNVMeSSD (response time: 0.007402) Drive

/redfish/v1/Chassis/SimplestNVMeSSD/Drives/SimplestNVMeSSD (response time: 0.007402) Show Results Show Payload	**Context:** /redfish/v1/$metadata#Drive.Drive **File Origin:** localFile:../../../metadata/Drive_v1.xml **Resource Type:** #Drive.v1_12_0.Drive	GET Success HTTP Code (200)	**pass:** 27 **passAction:** 2 **passGet:** 1 **skipOptional:** 36

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes (response time: 0.007071) VolumeCollection

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes (response time: 0.007071) Show Results Show Payload	**Context:** /redfish/v1/$metadata#VolumeCollection.VolumeCollection **File Origin:** localFile:../../../metadata/VolumeCollection_v1.xml **Resource Type:** #VolumeCollection.VolumeCollection	GET Success HTTP Code	**pass:** 3

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace Volume

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace (response time: 0.007349) Show Results Show Payload	**Context:** /redfish/v1/$metadata#Volume.Volume **File Origin:** localFile:../../../metadata/Volume_v1.xml **Resource Type:** #Volume.v1_5_0.Volume		

/redfish/v1/StorageSystems (response time: 0.007345) StorageSyste

/redfish/v1/StorageSystems (response time: 0.007345) Show Results Show Payload	**Context:** /redfish/v1/$metadata#StorageSystemCollection.StorageSystemCollection **File Origin:** localFile:../../../metadata/StorageSystemCollection_v1.xml **Resource Type:** #StorageSystemCollection.StorageSystemCollection		

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace (response time: 0.007349) Volume

/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace (response time: 0.007349) Show Results Show Payload	**Context:** /redfish/v1/$metadata#Volume.Volume **File Origin:** localFile:../../../metadata/Volume_v1.xml **Resource Type:** #Volume.v1_5_0.Volume	GET Success HTTP Code (200)	**pass:** 19 **passGet:** 1 **skipOptional:** 57

Property Name	Value	Type	Exists	Result
@odata.id	/redfish/v1/Systems/Sys-1/Storage/SimplestNVMeSSD/Volumes/SimpleNamespace	odata	Exists	PASS
@odata.type	#Volume.v1_5_0.Volume	odata	Exists	PASS
IOPerfModeEnabled	-	boolean	No	Optional
NVMeNamespaceProperties	[JSON Object]	Volume.v1_5_0.NVMeNamespaceProperties	Yes	complex
NVMeNamespaceProperties.NamespaceId	0x22F	string	Yes	PASS
NVMeNamespaceProperties.IsShareable	-	boolean	No	Optional
NVMeNamespaceProperties.NamespaceFeatures	[JSON Object]	Volume.v1_5_0.NamespaceFeatures	Yes	complex
NVMeNamespaceProperties.NamespaceFeatures.SupportsThinProvisioning	False	boolean	Yes	PASS
NVMeNamespaceProperties.NamespaceFeatures.SupportsDeallocatedOrUnwrittenLBError	False	boolean	Yes	PASS
NVMeNamespaceProperties.NamespaceFeatures.SupportsNGUIDReuse	False	boolean	Yes	PASS

To Summarize

- DEM is a prototype for NVMe-oF resource management
- Complies with Swordfish CTP based on an emulated system
- Currently supported on Linux

- NVM Express Consortium & SNIA Swordfish are evolving for adding NVMe-oF resource management.

- DEM is :
  - Tying SNIA Swordfish and NVMe so that it can interpret between Swordfish and NVMe
  - Evolving with NVMe and SNIA Swordfish SPECs

https://github.com/linux-nvme/nvme-dem
https://github.com/linux-nvme/nvme-dem/wiki

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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