Agenda

- Resource Overview
- Direct Attached Storage Model Map
- Examples (of Direct Attached Storage)
  - SATA Drives with Single Storage Controller
  - Single RAID Controller
  - High Availability (HA) RAID Controllers
Resource Overview

- **Storage**: A representation of a storage sub-system
  - Contains sets of Volumes, Drives, and Storage Controllers
  - Storage Controller information is an array of objects in the Storage resource
    - Describes the protocols supported by the controller, the speed of the controller interface, and manufacturer information about the controller
- **Drive**: The physical media for the data
  - Manufacturer information about the drive (part number, serial number, etc)
  - Capability information about the drive (size, protocol, encryption, etc)
  - Contains control aspects (secure erase and LED setting)
- **Volume**: The logical construct used by the OS/hypervisor
  - Contains status about a volume (what drives contribute to the volume, size information, identifier information, etc)
  - Allows a client to control the volume (initialization, encryption settings, etc)
Direct Attached Storage Model Map

- Computer System
- Storage Collection
- Storage
- Volume Collection
- Volume
- Drive
- Chassis

1:N

Entity Resource Collection
Entity Resource Instance
Subordinate Resource
Related Resource

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SATA Drives with Single Storage Controller

- Computer System
- Storage Collection
  - 1:N to Storage
  - Storage
    - 1:N to Volume Collection
      - 1:N to Volume
        - 1:N to Drive
          - SAT-1 Drive
            - 1:N to SAT-1 Controller
              - SAT-1 Controller
                - N:N to Chassis

Entity
- Resource Collection
- Resource Instance
- Subordinate Resource
- Related Resource

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SATA Storage Resource Example

```json
{
    "@odata.context": "/redfish/v1/$metadata#Storage.Storage",
    "@odata.type": 
"#Storage.v1_1_0.Storage",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1",
    "Id": "1",
    "Name": "Local Storage Controller",
    "Status": { "State": "Enabled", "Health": "OK", "HealthRollup": "OK" },
    "Drives": [
        { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/35D38F11ACEF7BD3" },
        { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3F5A8C54207B7233" },
        { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/32ADF365C6C1B7BD" },
        { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }
    ],
    "Volumes": { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes" }
}
```
SATA Storage Resource Example (cont)

Storage Controller Array

Identifier Info

Manufacturer Info

Capability Info

```
"StorageControllers": [
  {
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/0",
    "@odata.type": "#Storage.v1_1_0.StorageController",
    "MemberId": "0",
    "Status": { "State": "Enabled", "Health": "OK" },
    "Identifiers": [
      { "DurableNameFormat": "NAA", "DurableName": "345C59DBD970859C" }
    ],
    "Manufacturer": "Contoso",
    "Model": "3Gbps SATA",
    "SerialNumber": "2M220100SL",
    "PartNumber": "CT18754",
    "FirmwareVersion": "1.0.0.7",
    "SpeedGbps": 3,
    "SupportedControllerProtocols": [ "AHCI" ],
    "SupportedDeviceProtocols": [ "SATA" ]
  }
]
```
SATA Drive Resource Example

```json
{
    "@odata.context": "/redfish/v1/$metadata#Drive.Drive",
    "@odata.type": "#Drive.v1_1_0.Drive",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2",
    "Id": "3D58ECBC375FD9F2",
    "Name": "Drive Sample",
    "IndicatorLED": "Lit",
    "Status": { "State": "Enabled", "Health": "OK" },
    "CapacityBytes": 899527000000,
    "FailurePredicted": false,
    "Protocol": "SATA",
    "MediaType": "HDD",
    "Manufacturer": "Contoso",
    "SerialNumber": "1234568",
    "PartNumber": "C123-1111",
    "Identifiers": [
        { "DurableNameFormat": "NAA", "DurableName": "32ADF365C6C1B7BD" }
    ],
    "EncryptionAbility": "None",
    "EncryptionStatus": "Unencrypted",
    "RotationSpeedRPM": 15000,
    "BlockSizeBytes": 512,
    "CapableSpeedGbs": 3,
    "NegotiatedSpeedGbs": 3,
    "Links": {
        "Volumes": [
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1" }
        ]
    }
}
```
SATA Volume Resource Example

```json
{
    "@odata.context": "/redfish/v1/$metadata#Volume.Volume",
    "@odata.type": "#Volume.v1_0_0.Volume",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1",
    "Id": "1",
    "Name": "Volume 1",
    "Status": { "State": "Enabled", "Health": "OK" },
    "Encrypted": false,
    "VolumeType": "RawDevice",
    "CapacityBytes": 899527000000,
    "Identifiers": [
        { "DurableNameFormat": "UUID", "DurableName": "38f1818b-111e-463a-aa19-fa54f792e468" }
    ],
    "Links": {
        "Drives": [
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }
        ]
    },
    "Actions": {
        "#Volume.Initialize": {
            "target": "/redfish/v1/Systems/3/Storage/RAIDIntegrated/Volumes/1/Actions/Volume.Initialize",
            "InitializeType@Redfish.AllowableValues": [ "Fast", "Slow" ]
        }
    }
}
```

Volume Status

- **Drives Used by the Volume**
- **Unique Identifier of the Volume**
- **Actions for the Volume**

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Single RAID Controller

- Computer System
- Storage Collection
  - 1:N
  - Storage
  - Volume Collection
    - 1:N
    - Volume
    - Drive
      - SAS Drive
      - Mirrored Volume
        - 1:N
        - RAID Controller
        - 1:N
        - Related Resource
        - Subordinate Resource
        - Resource Collection
        - Resource Instance

Chassis

Entity

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Single RAID Storage Resource Example

```json
{
  "@odata.context": "/redfish/v1/$metadata#Storage.Storage",
  "@odata.type": "#Storage.v1_1_0.Storage",
  "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1",
  "Id": "1",
  "Name": "Local Storage Controller",
  "Status": { "State": "Enabled", "Health": "OK", "HealthRollup": "OK" },
  "Drives": [
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/35D38F11ACEF7BD3" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3F5A8C54207B7233" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/32ADF365C6C1B7BD" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }
  ],
  "Volumes": { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes" },
...
```

No changes from SATA example
Single RAID Storage Resource Example (cont)

... "StorageControllers": [
    {
        "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/0",
        "@odata.type": "#Storage.v1_1_0.StorageController",
        "MemberId": "0",
        "Status": { "State": "Enabled", "Health": "OK" },
        "Identifiers": [
            { "DurableNameFormat": "NAA", "DurableName": "345C59DBD970859C" }
        ],
        "Manufacturer": "Contoso",
        "Model": "12Gbs Integrated RAID",
        "SerialNumber": "2M220100SL",
        "PartNumber": "CT18754",
        "FirmwareVersion": "1.0.0.7",
        "SpeedGbps": 12,
        "SupportedControllerProtocols": [ "PCIe" ],
        "SupportedDeviceProtocols": [ "SAS", "SATA" ]
    }
]
Single RAID Drive Resource Example

```
{
    "@odata.context": "/redfish/v1/$metadata#Drive.Drive",
    "@odata.type": "#Drive.v1_1_0.Drive",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2",
    "Id": "3D58ECBC375FD9F2",
    "Name": "Drive Sample",
    "IndicatorLED": "Lit",
    "Status": { "State": "Enabled", "Health": "OK" },
    "CapacityBytes": 899527000000,
    "FailurePredicted": false,
    "Protocol": "SAS",
    "MediaType": "HDD",
    "Manufacturer": "Contoso",
    "SerialNumber": "1234568",
    "PartNumber": "C123-1111",
    "Identifiers": [ { "DurableNameFormat": "NAA", "DurableName": "32ADF365C6C1B7BD" } ],
    "EncryptionAbility": "SelfEncryptingDrive",
    "EncryptionStatus": "Unlocked",
    "RotationSpeedRPM": 15000,
    "BlockSizeBytes": 512,
    "CapableSpeedGbs": 12,
    "NegotiatedSpeedGbs": 12,
    "Links": {
        "Volumes": [ { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1" } ]
    }
}
```
Single RAID Volume Resource Example

```json
{
    "@odata.context": "/redfish/v1/$metadata#Volume.Volume",
    "@odata.type": "#Volume.v1_0_0.Volume",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1",
    "Id": "1",
    "Name": "Volume 1",
    "Status": { "State": "Enabled", "Health": "OK" },
    "Encrypted": false,
    "VolumeType": "Mirrored",
    "CapacityBytes": 899527000000,
    "Identifiers": [ { "DurableNameFormat": "UUID", "DurableName": "38f1818b-111e-463a-aa19-fa54f792e468" } ],
    "Links": {
        "Drives": [
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3F5A8C54207B7233" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/32ADF365C6C1B7BD" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }
        ],
    },
    "Actions": {
        "#Volume.Initialize": {
            "target": "/redfish/v1/Systems/3/Storage/RAIDIntegrated/Volumes/1/Actions/Volume.Initialize",
            "InitializeType@Redfish.AllowableValues": [ "Fast", "Slow" ]
        }
    }
}
```

Changes from SATA example
HA RAID Storage Resource Example

{  
  "@odata.context": "/redfish/v1/$metadata#Storage.Storage",
  "@odata.type": "/#Storage.v1_1_0.Storage",
  "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1",
  "Id": "1",
  "Name": "Local Storage Controller",
  "Status": { "State": "Enabled", "Health": "OK", "HealthRollup": "OK" },
  "Drives": [
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/35D38F11ACEF7BD3" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3F5A8C54207B7233" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/32ADF365C6C1B7BD" },
    { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }  
  ],
  "Volumes": { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes" },
...

No changes from Single RAID
HA RAID Storage Resource Example (cont)

Changes from Single RAID

"StorageControllers": [
    {
        "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/0",
        ...
    },
    {
        "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/1",
        ...
    }
],

"Redundancy": [
    {
        "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1#/Redundancy/0",
        "MemberId": "Redundancy",
        "Mode": "Failover",
        "MaxNumSupported": 2,
        "MinNumNeeded": 1,
        "Status": { "State": "Enabled", "Health": "OK" },
        "RedundancySet": [
            {
                "@odata.id": "redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/0",
            },
            {
                "@odata.id": "redfish/v1/Systems/437XR1138R2/Storage/1#/StorageControllers/1"
            }
        ]
    }
]
HA RAID Drive Resource Example

```json
{
    "@odata.context": "/redfish/v1/$metadata#Drive.Drive",
    "@odata.type": "#Drive.v1_1_0.Drive",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2",
    "Id": "3D58ECBC375FD9F2",
    "Name": "Drive Sample",
    "IndicatorLED": "Lit",
    "Status": { "State": "Enabled", "Health": "OK" },
    "CapacityBytes": 899527000000,
    "FailurePredicted": false,
    "Protocol": "SAS",
    "MediaType": "HDD",
    "Manufacturer": "Contoso",
    "SerialNumber": "1234568",
    "PartNumber": "C123-1111",
    "Identifiers": [ { "DurableNameFormat": "NAA", "DurableName": "32ADF365C6C1B7BD" } ],
    "EncryptionAbility": "SelfEncryptingDrive",
    "EncryptionStatus": "Unlocked",
    "RotationSpeedRPM": 15000,
    "BlockSizeBytes": 512,
    "CapableSpeedGbs": 12,
    "NegotiatedSpeedGbs": 12,
    "Links": {
        "Volumes": [ { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1" } ]
    }
}
```

No changes from Single RAID
HA RAID Volume Resource Example

{  
    "@odata.context": "/redfish/v1/$metadata#Volume.Volume",
    "@odata.type": "#Volume.v1_0_0.Volume",
    "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Volumes/1",
    "Id": "1",
    "Name": "Volume 1",
    "Status": { "State": "Enabled", "Health": "OK" },
    "Encrypted": false,
    "VolumeType": "Mirrored",
    "CapacityBytes": 899527000000,
    "Identifiers": [ { "DurableNameFormat": "UUID", "DurableName": "38f1818b-111e-463a-aa19-fa54f792e468" } ],
    "Links": {
        "Drives": [  
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3F5A8C54207B7233" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/32ADF365C6C1B7BD" },
            { "@odata.id": "/redfish/v1/Systems/437XR1138R2/Storage/1/Drives/3D58ECBC375FD9F2" }
        ]
    },
    "Actions": {  
        "#Volume.Initialize": {
            "target": "/redfish/v1/Systems/3/Storage/RAIDIntegrated/Volumes/1/Actions/Volume.Initialize",
            "InitializeType@Redfish.AllowableValues": [ "Fast", "Slow" ]
        }
    }
}

No changes from Single RAID
Thank you for watching!

- Redfish Standards
  - Schemas, Specs, Mockups, White Papers, FAQ, Educational Material & more
    - [http://www.dmtf.org/standards/redfish](http://www.dmtf.org/standards/redfish)

- Redfish Developer Hub
  - Redfish Interactive Explorer, Hosted Schema at Namespace & other links
    - [http://redfish.dmtf.org](http://redfish.dmtf.org)

- SPMF (WG that defines Redfish)
  - Companies involved, Upcoming Schedules & Future work, Charter, Information on joining.
    - [http://www.dmtf.org/standards/spmf](http://www.dmtf.org/standards/spmf)