



**SDC** 18

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[www.storagedeveloper.org](http://www.storagedeveloper.org)

# Redfish Ecosystem For Storage

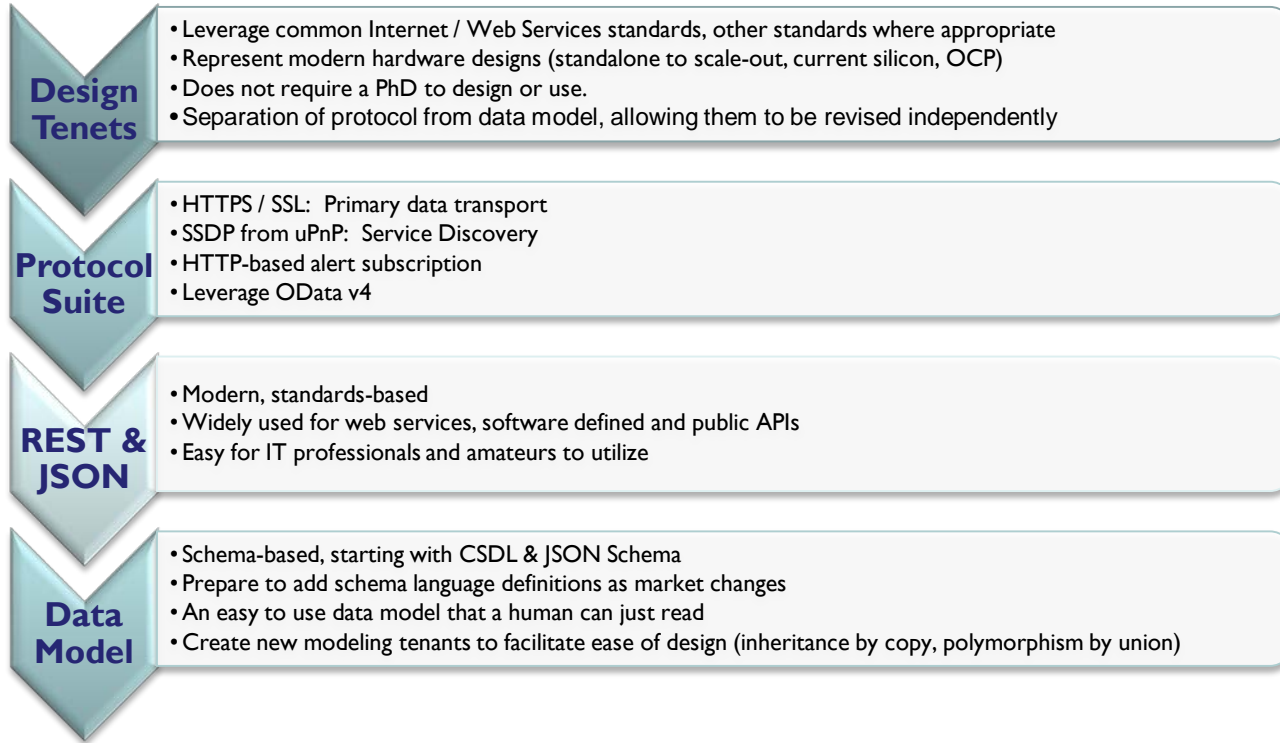
Jeff Hilland

Distinguished Technologist Manageability,  
Hewlett Packard Enterprise  
President, DMTF

# Disclaimer

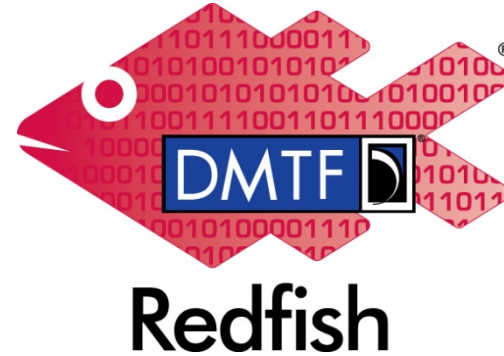
- ❑ The information in this presentation represents a snapshot of work in progress within the DMTF.
- ❑ This information is subject to change without notice. The standard specifications remain the normative reference for all information.
- ❑ For additional information, see the DMTF website.

# A Hybrid IT Management Solution



# What is Redfish?

- **Industry Standard Software Defined Management for Converged, Hybrid IT**
  - HTTPS in JSON format based on OData v4
  - Schema-backed but human-readable
  - Equally usable by Apps, GUIs and Scripts
  - Extensible, Secure, Interoperable
- **Version 1 focused on Servers**
  - A secure, multi-node capable replacement for IPMI-over-LAN
  - Represent full server category: Rackmount, Blades, HPC, Racks, Future
  - Intended to meet OCP Remote Machine Management requirement
- **Expand scope over time to rest of IT infrastructure**
  - Additional features coming out approximately every 4 months
  - Working with SNIA to cover more advanced Storage (Swordfish)
  - Working with The Green Grid & ASHRAE to cover Facilities (Power/Cooling)
  - Work with the IETF to cover some level of Ethernet Switching



# DMTF Redfish Forum

Co-Chairs: Jeff Autor (HPE), Mike Raineri (Dell)

## Redfish Forum Leadership Companies



## Redfish Supporting Companies

American Megatrends Inc, ARM Inc, Artesyn Embedded Technologies, Cray Inc., Flex, Fujitsu, Huawei, IBM, Insyde Software Corp, Mellanox Technologies, Microsemi/Microchip, NetApp, OSISOFT LLC, Quanta Computer, Solarflare Communications, Toshiba, Western Digital Corporation

## Redfish Industry Alliance Partners & efforts

OCP (Open Compute Project) – Collaborating on profile definition  
UEFI – Collaborating on Firmware Update and Host Interface work  
SNIA – Collaborating on Storage modeling / alignment between SNIA SSM and Redfish  
TGG – Pursuing relationship to work on Power/Cooling (existing DMTF Alliance Partner)  
IETF – working on Switch modeling (no official alliance)

ASHRAE – American Society of Heating, Refrigerating and Air Conditioning Engineers  
BBF – Broadband Forum  
Gen-Z – Gen-Z Consortium  
PICMG – Open Modular Computing for IIoT  
NVMe – NVMe-MI

# Timeline of Redfish® Specification

- The DMTF Redfish technology
  - Sep 2014: SPMF Formed in DMTF.
  - Aug 2015: Redfish Specification with base models (v1.0)
  - May 2016: Models for BIOS, disk drives, memory, storage, volume (2016.1)
  - Aug 2016: Models for endpoint, fabric, switch, PCIe device, zone, software/firmware inventory & update (2016.2)
  - Dec 2016: Adv. communications devices (multi-function NICs), host interface (KCS replacement), privilege mapping (2016.3)
  - May 2017: Composability (2017.1), WIP for Telemetry
  - Aug 2017: Location, errata (2017.2), WIPs for Ethernet Switching, DCIM, OCP & Profiles
  - Dec 2017: Profiles, Query parameters, errata (2017.3), Feb 2018 – WIP for Redfish Device Enablement
  - Mar 2018: LDAP/AD, SSE, Assembly, minor enhancements & errata
  - Sept 2018: **OpenAPI**, Telemetry, Jobs, Schedule, Compose II, Message II
- Alignment with other standard organizations
  - Aug 2016: SNIA releases first model for network storage services (Swordfish)
  - Working open YANG Redfish mapping algorithm for Ethernet Switch
  - DMTF created work registers with **UEFI**, TGG, OCP, ASHRAE, Broadband Forum, ETSI-NFV, NVMe, PICMG, GenZ, ODCC for work on applying Redfish



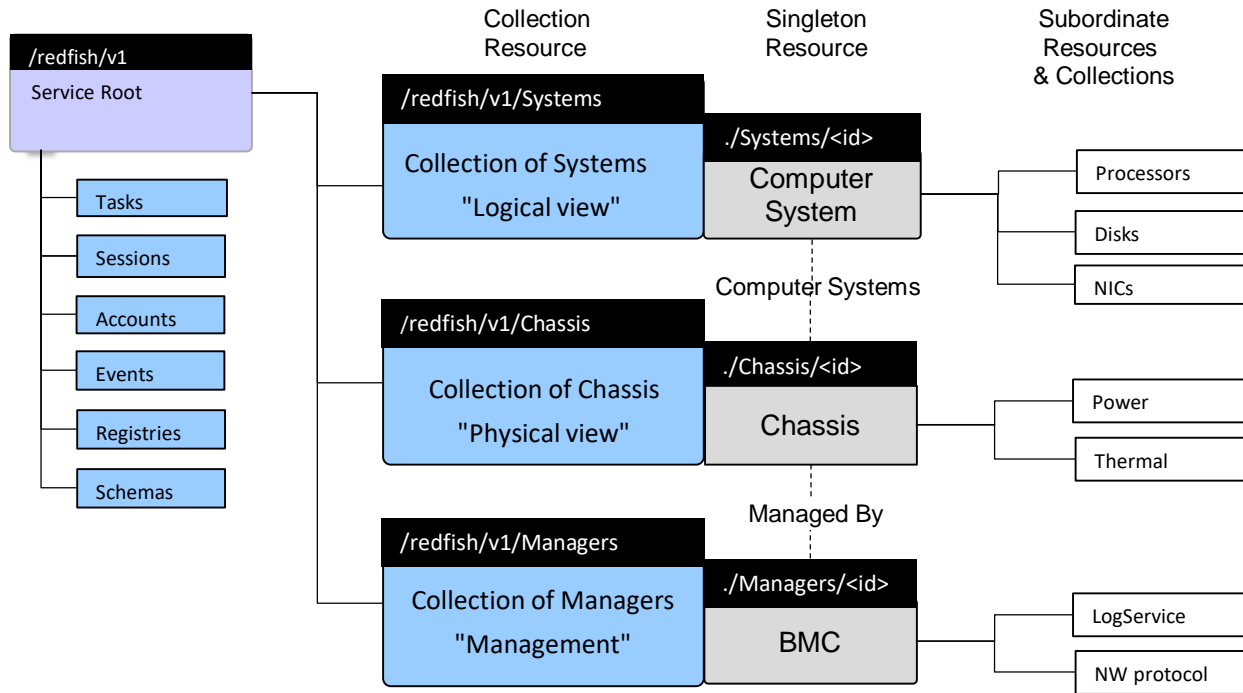
the green grid™



I E T F™



# Redfish Resource Map (simplified)

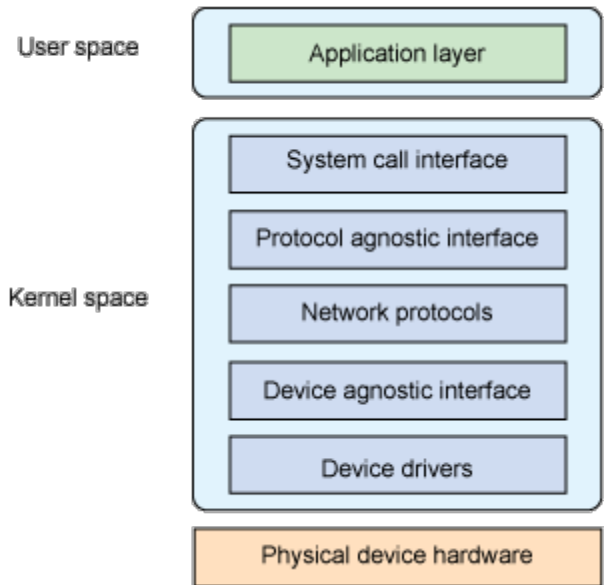


**GET <http://<ip-addr>/redfish/v1/Systems/{id}/Processors/{id}>**

Use the Redfish Resource Explorer ([redfish.dmtf.org](http://redfish.dmtf.org)) to explore the resource map

# Host Interface

- ❑ Replacement for IPMI KCS, etc.
- ❑ Exposes a NIC from Management Controller to OS
  - ❑ SMBIOS records provide information to allow kernel access
- ❑ Same access in-band as out-of-band
  - ❑ Kernel mode or user mode accessible
  - ❑ Encouraging OS vendors to begin consuming Redfish data.
  - ❑ This means you can get to the iLO homepage from the OS.
  - ❑ This means you can write your tools for the iLO homepage or Redfish and run them in the host OS.
  - ❑ Anything that accesses the out of band can be run on the host OS to access to local management subsystem.

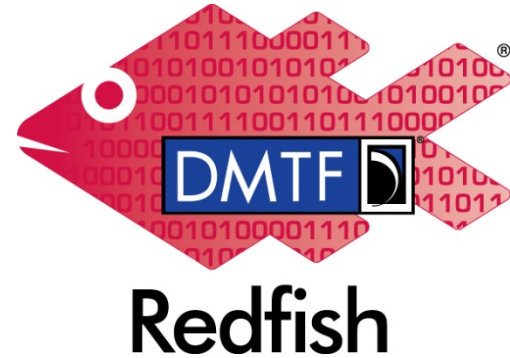




# Interoperability Profiles: Goals

- ❑ An “Interoperability Profile” provides a common ground for Service implementers, client software developers, and users
  - ❑ A profile would apply to a particular category or class of product (e.g. “Front-end web server”, “NAS”, “Enterprise-class database server”)
  - ❑ It specifies Redfish implementation requirements, but **is not** intended to mandate underlying hardware/software features of a product
  - ❑ Provides a target for implementers to meet customer requirements
  - ❑ Provide baseline expectations for client software developers utilizing Redfish
  - ❑ Enable customers to easily specify Redfish functionality / conformance in RFQs
- ❑ Create a machine-readable Profile definition
  - ❑ Document must be human-readable
  - ❑ Can be created by dev/ops personnel and non-CS professionals
- ❑ Enable authoring of Profiles by DMTF, partner organizations, and others
- ❑ Create open source tools to document and test conformance

# Redfish Storage Model



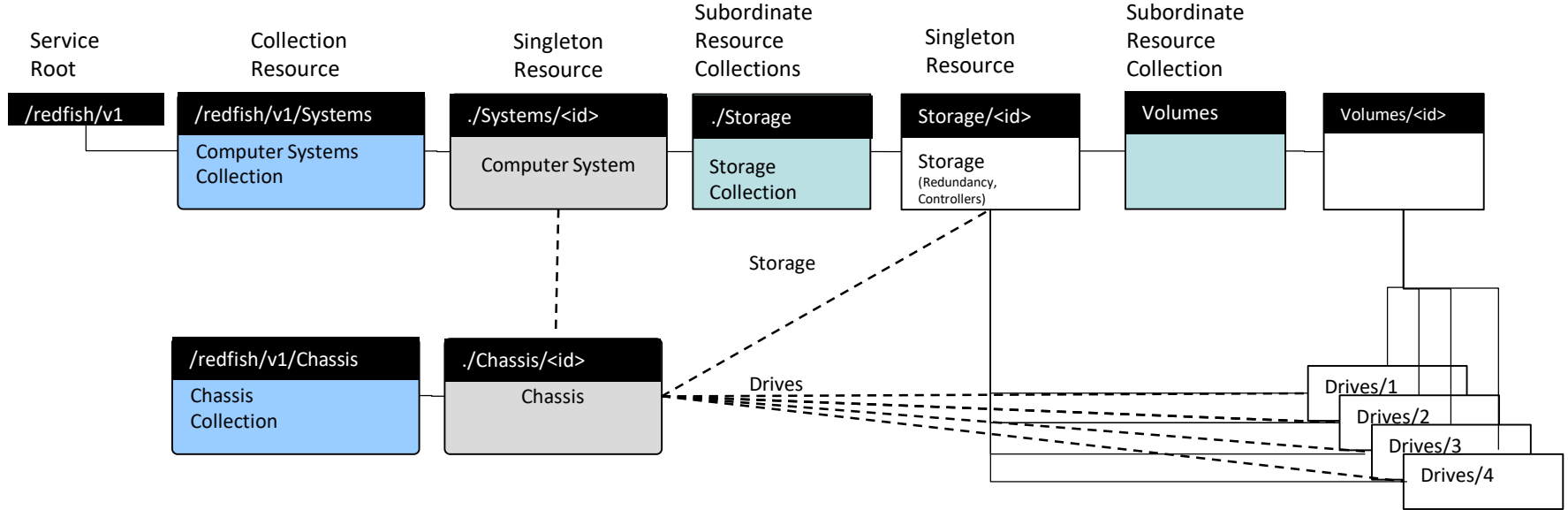
a.k.a.:

- ❑ Local Storage
- ❑ Server Storage
- ❑ Storage “Lite”

# Storage 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.)

# Storage in Redfish



Note that the Volumes are in Collections off of the Storage resource, drives are in arrays off of the storage resource and optionally the Chassis.



## Redfish Device Enablement (RDE)

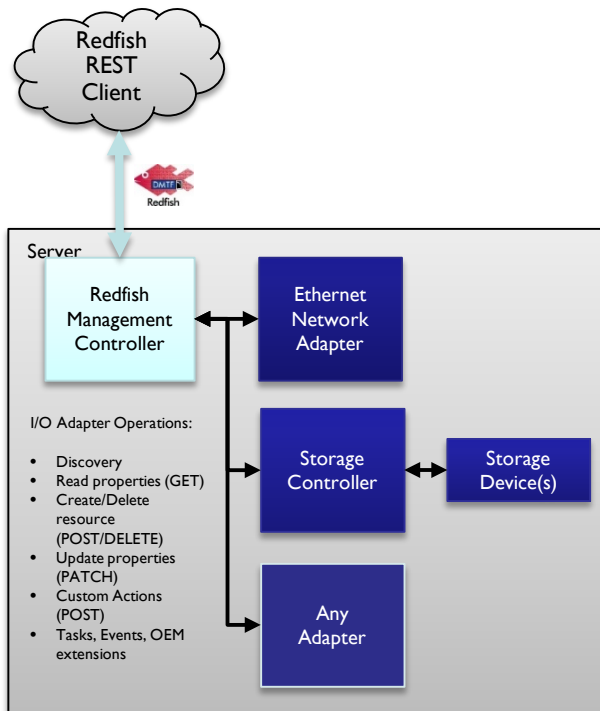
Or “How you can fill all that storage stuff out without creating a lock step firmware dependency between the management controller firmware and the storage firmware”

# Redfish Device Enablement: PLDM

## Redfish Providers

PMCIWG developing a standard to enable a server Management Controller to present a Redfish-conformant management of I/O Adapters without building in code specific to each adapter family/vendor/model.

- Support adapter “self-contained, self-describing” including value-add (OEM) properties
- New managed devices (and device classes) do not require Management Controller firmware updates
- Support a range of capabilities from primitive to advanced devices (lightweight/low bandwidth options)
- Leveraging PLDM, a provider architecture is being specified that can binary encode the data in a small enough format for devices to understand and support.
- MC acts as a broker to encode/decode the data to/from the provider
- PLDM works over I2C & PCIe VDM. Additional mappings under consideration.



# RDE Discovery & Registration

Discovery is PLDM based

- ❑ Devices are discovered using PLDM (which uses MCTP) and determines that it supports RDE (PLDM Type 6)
- ❑ MC uses RDE to negotiate parameters with the device.
  - ❑ Concurrency, Operations Supported, Provider Name
- ❑ MC uses RDE to negotiate channel parameters on each channel
  - ❑ Asynchrony, Max Chunk Size

Registration leverages Platform Data Record

- ❑ MC queries device for PDRs and any Associations and Actions
  - ❑ PDR = Platform Data Record. Equates to one or more Redfish Resources
- ❑ And gets Schema Identities and versions for the PDR
  - ❑ Can get a Resource ETag
- ❑ And Retrieves any Dictionary for the PDR
  - ❑ Dictionaries may be truncated to only what device supports

# RDE BEJ – Translating JSON to binary using dictionaries

- ❑ RDE's BEJ (Binary Encoded JSON) is a binary representation of the JSON payload using the algorithm specified
- ❑ Dictionaries are the key
- ❑ So the dictionary is used to turn each of these into a compact form.
  - ❑ RDE uses the dictionary to take the JSON Body and turn it into binary
  - ❑ Includes how to nest objects, handle annotations and other Redfish nuances
  - ❑ Roughly a 10:1 compression in early analysis
- ❑ DMTF will publish Dictionaries for all DMTF Schema on the website
  - ❑ Program to generate dictionaries will be made open source



# RDE Operations

- RDE has slightly different terms than HTTP in the spec

HTTP Operation	RDE Operation
GET	Read
PUT	Replace
PATCH	Update
POST	Action or Create
DELETE	Delete
HEAD	Read Headers

- RDE supports multiple outstanding operations, tasks and

Command	Usage
RDEOperationInit	Begin an Operation
SupplyCustomRequestParameters	Provide additional parameters for Operations
RetrieveCustomResponseParameters	Get additional response data
RDEOperationStatus	Check up on an active Operation
RDEOperationComplete	Finalize an Operation
RDEOperationKill	Cancel an Operation
RDEOperationEnumerate	See what Operations are active
MultipartSend, MultipartReceive	Bulk data transfer

# So how does all this fit together?



- ❑ Before a Client ever Contacts the Redfish Service:
  - ❑ The Management Controller uses MCTP to enumerate the devices
    - ❑ This is dependent on the Medium (I2C, PCIe, etc.)
  - ❑ MC then uses PLDM for next phase of discovery
  - ❑ PLDM support for Type 6 (RDE) is discovered as being supported!
  - ❑ RDE Discovery takes place over PLDM
  - ❑ RDE Device Registration
    - ❑ Get all the Resources, Actions, and Entity Associations
    - ❑ MC Retrieves the Dictionaries
- ❑ The MC is now ready to handle operations to and from the device

# So how does all this fit together?



- ❑ Request comes in for client
- ❑ MC determines that the URI equates to an RDE provider.
- ❑ MC translates HTTP headers that need to be passed down
- ❑ The MC translates the JSON body into BEJ using the dictionaries.
- ❑ MC initiates the operation to the device.
- ❑ Device processes the request
- ❑ MC takes the response, reassembles it and translates from BEJ to JSON using the dictionaries.
- ❑ MC formulates HTTP Response and sends to Client

# Additional information about RDE

- ❑ RDE also handles Tasks, specifies how Events are handled, and has information on handling OEM sections.
- ❑ There are state machine examples and tables.
- ❑ Binary Format for dictionaries is specified
- ❑ There are examples of
  - ❑ what a Redfish tree would look like,
  - ❑ how the PDR would look like for that tree,
  - ❑ Examples of what a dictionary would look like
  - ❑ Example of BEJ encode/decode.

# In Summary

- ❑ Redfish, along with the DMTF alliance partners, is working to define interoperable software defined hybrid IT management for servers, storage, networking, power/cooling, fabrics and more
- ❑ And is solving problems from composition to resource managers, aggregation engines
- ❑ As well as plumbing the mechanisms inside the box to be self contained and self describing

# Can't Miss: SNIA Swordfish™ Events

- ❑ Hands-on Workshop, Tuesday, 9/25
  - ❑ Mezzanine, 2:50 p.m. and 5:00 – 7:00 p.m.
  - ❑ Visit interactive workstations and see actual implementations
  - ❑ Work with open source development tools
- ❑ BoF, Monday, 9/24
  - ❑ Winchester, 7:00 p.m. – 9:00 p.m.
  - ❑ Discussions from adoption to integration
  - ❑ Have a beer and get your questions ready!



# Redfish Developer Hub: [redfish.dmtf.org](https://redfish.dmtf.org)



## Resources

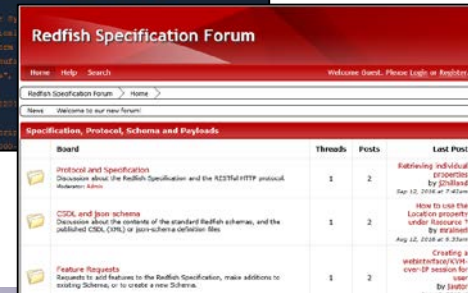
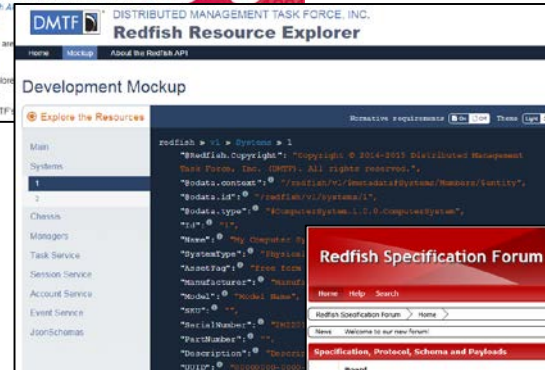
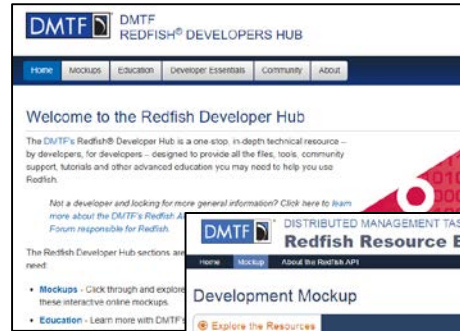
- Schema Index
- Specifications
- GitHub for Redfish Tools
- Registries
- Other Documentation

## Mockups

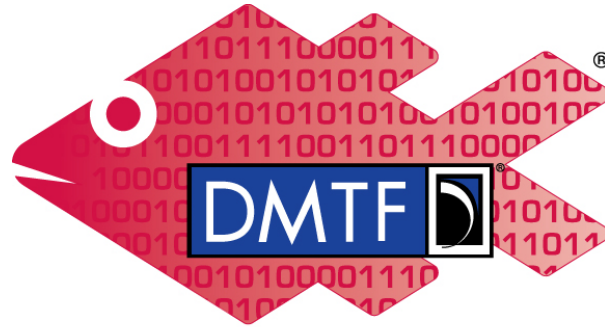
- Simple Rack-mounted Server
- Bladed System
- Proposed OCP Redfish Profile
- More being added

## Education/Community

- Redfish User Forum
- Whitepapers, Presentations
- YouTube shorts & Webinars



# Thank you!



## Redfish

