



Redfish Power Distribution 2021

DMTF Redfish Forum – DCIM Task Force

WORK IN PROGRESS

Version 0.8 – April 2021



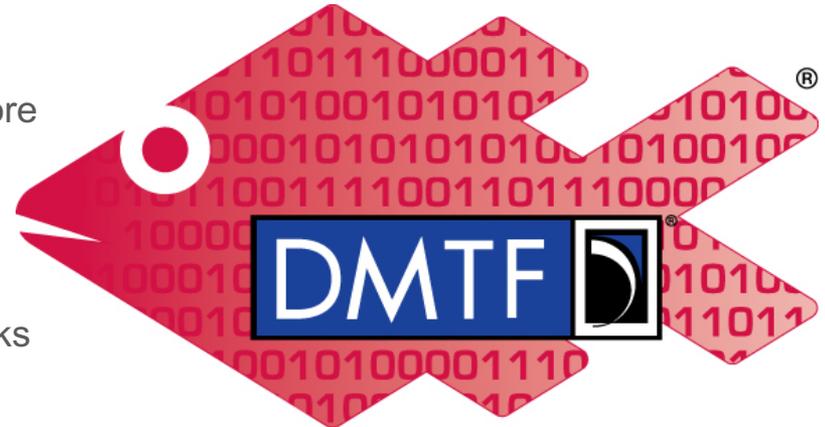
Disclaimer

- 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: www.dmtf.org

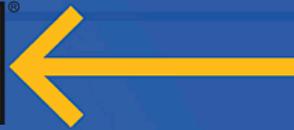


Getting involved in Redfish

- Redfish Standards page
 - Schemas, Specs, Mockups, White Papers & more
 - <http://www.dmtf.org/standards/redfish>
- Redfish Developer Portal
 - Redfish Interactive Resource Explorer
 - Educational material, documentation & other links
 - <http://redfish.dmtf.org>
- Redfish User Forum
 - User forum for questions, suggestions and discussion
 - <http://www.redfishforum.com>
- DMTF Feedback Portal
 - Provide feedback or submit proposals for Redfish standards
 - <https://www.dmtf.org/standards/feedback>
- DMTF Redfish Forum
 - Join the DMTF to get involved in future work
 - <http://www.dmtf.org/standards/spmf>



Redfish



Redfish existing support for Power Distribution products

- Power Distribution equipment models released in 2019.4
- Some minor enhancements during 2020
 - Additional **Sensor** types and properties
 - Incremental additions to **PowerDistribution** schema
- Leveraged the support to refactor Power and Thermal support
 - Replaced with **PowerSubsystem** and **ThermalSubsystem**
 - Released in 2020.4
- DCIM Task Force continues work to extend coverage
 - Additional Power Distribution product categories
 - UPS and other backup power systems
 - Additional topics to further model a data center or facility
- This presentation discusses the Task Force's work-in-progress topics



Datacenter Power mapping

- Redfish enables power distribution to be modeled from the datacenter edge all the way down to the IT platforms
 - Using existing Redfish models and the additional proposals outlined here
- Bridge from facility-level distribution to “IT-centric” rack-level power distribution products
 - Links connect distribution gear to IT endpoints (power supplies, etc.)
 - User-defined properties to show manually entered connectivity
 - Common *Location* object definitions to locate gear within a room and rack
- Power Domain model to group equipment served or affected by different sets of distribution gear



ELECTRICAL BUS MODEL



NEW Electrical Bus Model

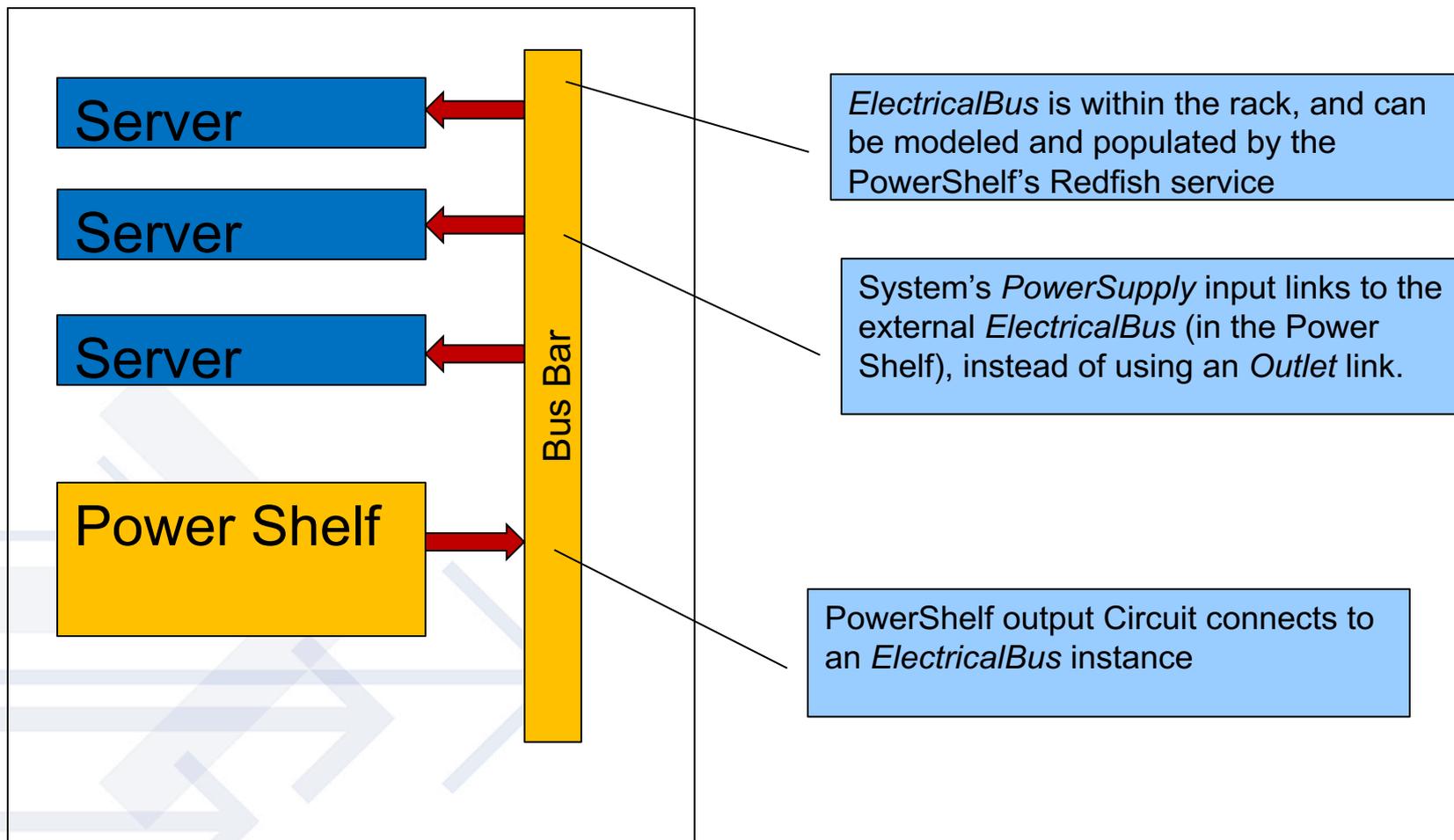
- Large-scale power equipment can be connected through “busses”
 - Bus bars (within a rack), busways (row of racks), etc.
- These differ from our Circuit model in two ways:
 - Can be a many-to-many relationship (Circuit model is one-to-many)
 - Multiple “producers” and “consumers” can attach to a bus
 - External bus equipment is likely unmanaged
 - May simply be conductors and connectors
- A Redfish **Circuit** instance connects to an **ElectricalBus** instance
 - Either on the “input” or “output” side of the Redfish-managed equipment
 - The metrics for that connection are both valid and useful
 - And can be different for each piece of equipment connected to the bus
 - Information about which bus is connected is useful
 - User-entered “bus name” can allow personnel and software to follow the connection path through the infrastructure



NEW ElectricalBus schema

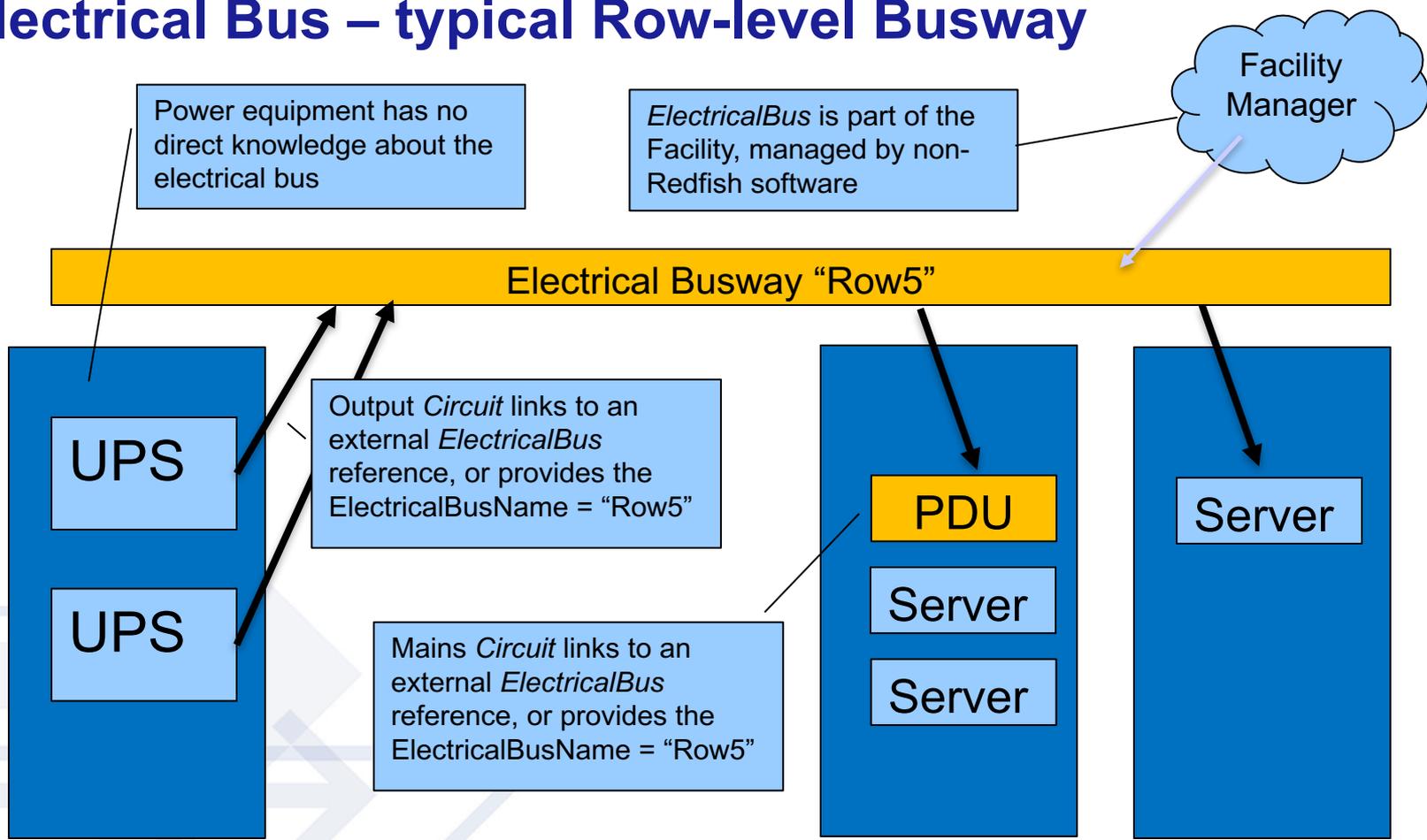
- Resource Collection of **ElectricalBus** schema appears in two places
- Facility **ElectricalBusCollection**
 - For busways or other types that interconnect racks of gear
 - Facility manager / aggregator would be the “owner” of the bus
- PowerDistribution **ElectricalBusCollection**
 - For Power Shelves or other intra-rack bus types
 - **PowerDistribution** resource instance owns the bus
 - Shows links or allows user to list “consuming” equipment
 - Allows self-contained model without requiring **Facility** model
- Three levels of equipment linking:
 - *ElectricalBusName* – User-defined string value for unmanaged busses
 - *ElectricalBusManagerUri* – User-defined URI to any non-Redfish management console
 - *ElectricalBus* – Read/Write array of links to an external ElectricalBus

Electrical Bus diagram – Rack-level Bus Bar





Electrical Bus – typical Row-level Busway





Electrical Bus mockup

```
{
  "@odata.type": "ElectricalBus.v1_0_0.ElectricalBus",
  "@odata.id": "/redfish/v1/Facilities/Room237/ElectricalBusses/Row5",
  "Id": "Row5",
  "Name": "Row 5"
  "BusType": "OverheadBusway",
  "Model": "BigYellow",
  "CapacityAmps": 300,
  "Location": {},
  "ConsumingEquipment": [ {
    "@odata.id": "192.168.4.44/redfish/v1/PowerEquipment/RackPDUs/1"
  } ],
  "SourceEquipment": [ {
    "@odata.id": "192.168.4.40/redfish/v1/PowerEquipment/FloorPDUs/Row5"
  } ],
  "ConsumingEquipmentNames": [
    "AD53454",
    "ServerRow5-Rack3",
    "ServerRow5-Rack4"
  ],
  "SourceEquipmentNames": [
    "FloorPDU-Row5"
  ],
}
```

This *ElectricalBus* is part of the Facility

Links to Redfish-managed *Consuming* and *Source* PowerDistribution resources – likely references to external Redfish services

EquipmentNames allow users to manually add non-Redfish PDUs to help complete the electrical model



UPDATED Circuit schema – connections to ElectricalBus

```
{
  "@odata.type": "#Circuit.v1_4_0.Circuit",
  "Id": "BusOutput",
  "Name": "Bus Output Circuit",
  "Status": { < Status object > },
  "CircuitType": "Branch",
  "PhaseWiringType": "TwoPhase3Wire",
  "NominalVoltage": "AC240V",
  "RatedCurrentAmps": 16,
  "BreakerState": "Normal",
  "PowerState": "On",
  "ElectricalBusName": "Row5",
  "ElectricalBusManagerUri": "192.168.1.44/login.html",
  "Links": {
    "ElectricalBus": {
      "@odata.id": "192.168.1.44/redfish/v1/Facilities/Room237/ElectricalBusses/Row5"
    }
  }
}
```

Wiring types and ratings are applicable.
May want to add a receptacle type of "Bus"

Three possible levels of support for identifying the electrical bus: Redfish resource link, manual text Name, link to non-Redfish management interface (all three properties may apply)



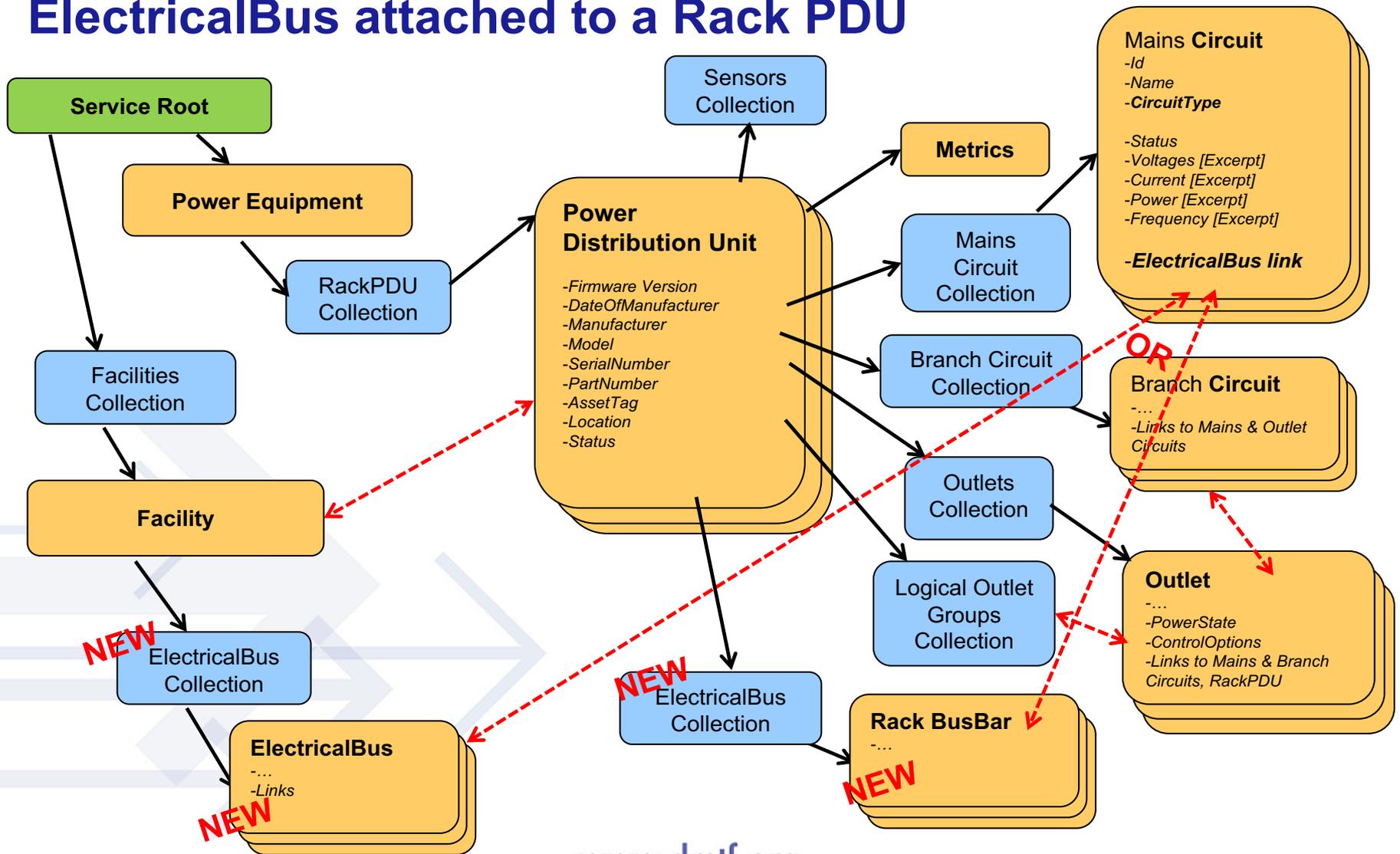
UPDATED PowerSupply schema for ElectricalBus

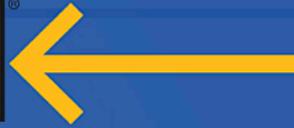
```
{
  "@odata.type": "#PowerSupply.v1_2_0.PowerSupply",
  "Id": "Bay1",
  "Name": "Power Supply Bay 1",
  "Status": {
    "State": "Enabled",
    "Health": "Warning"
  },
  "Model": "RKS-440DC",
  "Manufacturer": "Contoso Power",
  "FirmwareVersion": "1.00",
  "SerialNumber": "3488247",
  "PartNumber": "23456-133",
  "ElectricalBusName": "Row5",
  "ElectricalBusManagerUri": "192.168.1.44/login.html",
  "Links": {
    "ElectricalBus": {
      "@odata.id": "192.168.1.44/redfish/v1/Facilities/Room237/ElectricalBusses/Row5"
    }
  }
}
```

Three possible levels of support for identifying the electrical bus: Redfish resource link, manual text Name, link to non-Redfish management interface (all three properties may apply)



ElectricalBus attached to a Rack PDU



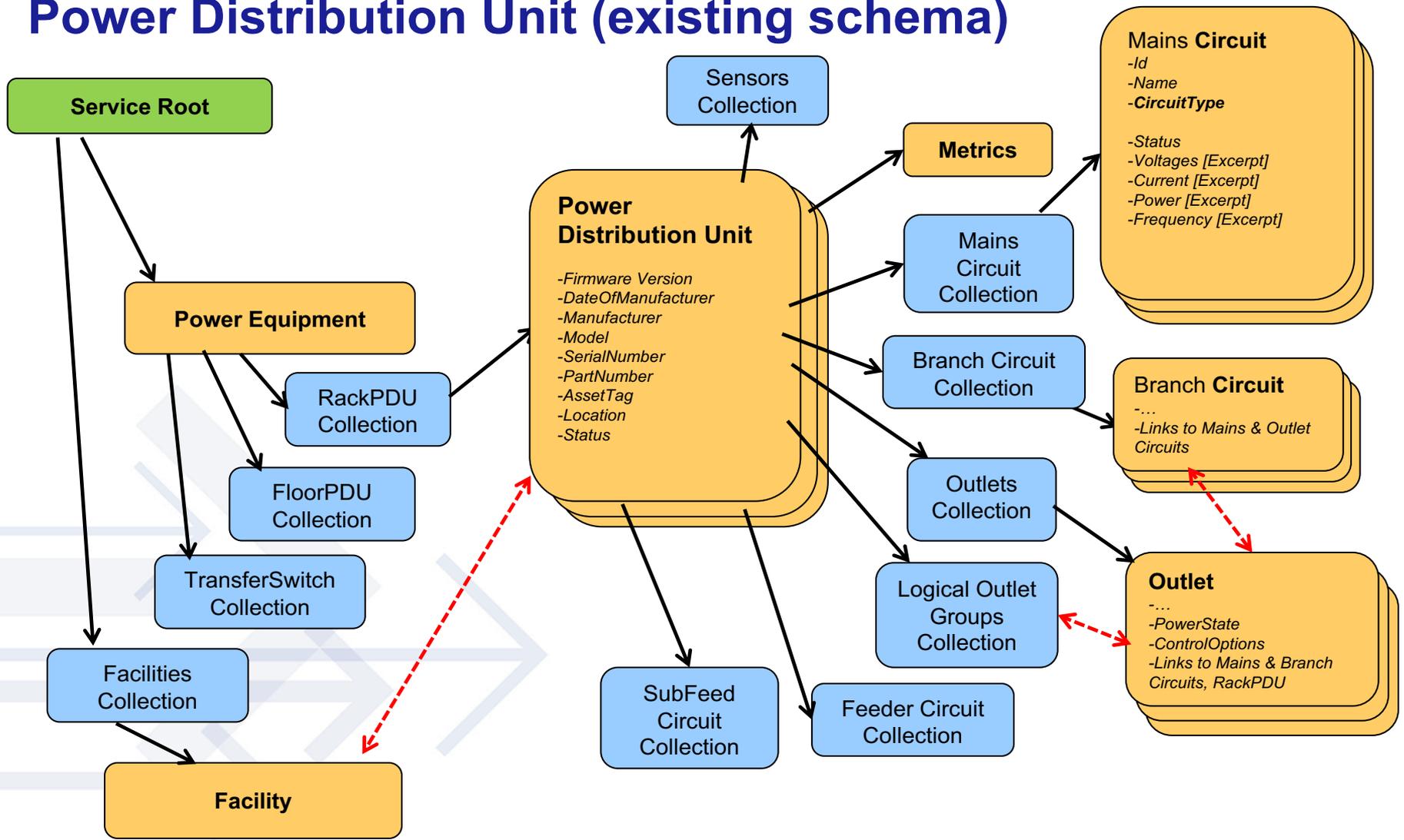


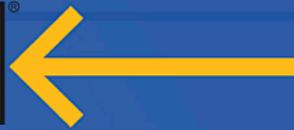
Additional product category support

POWER DISTRIBUTION UNIT



Power Distribution Unit (existing schema)



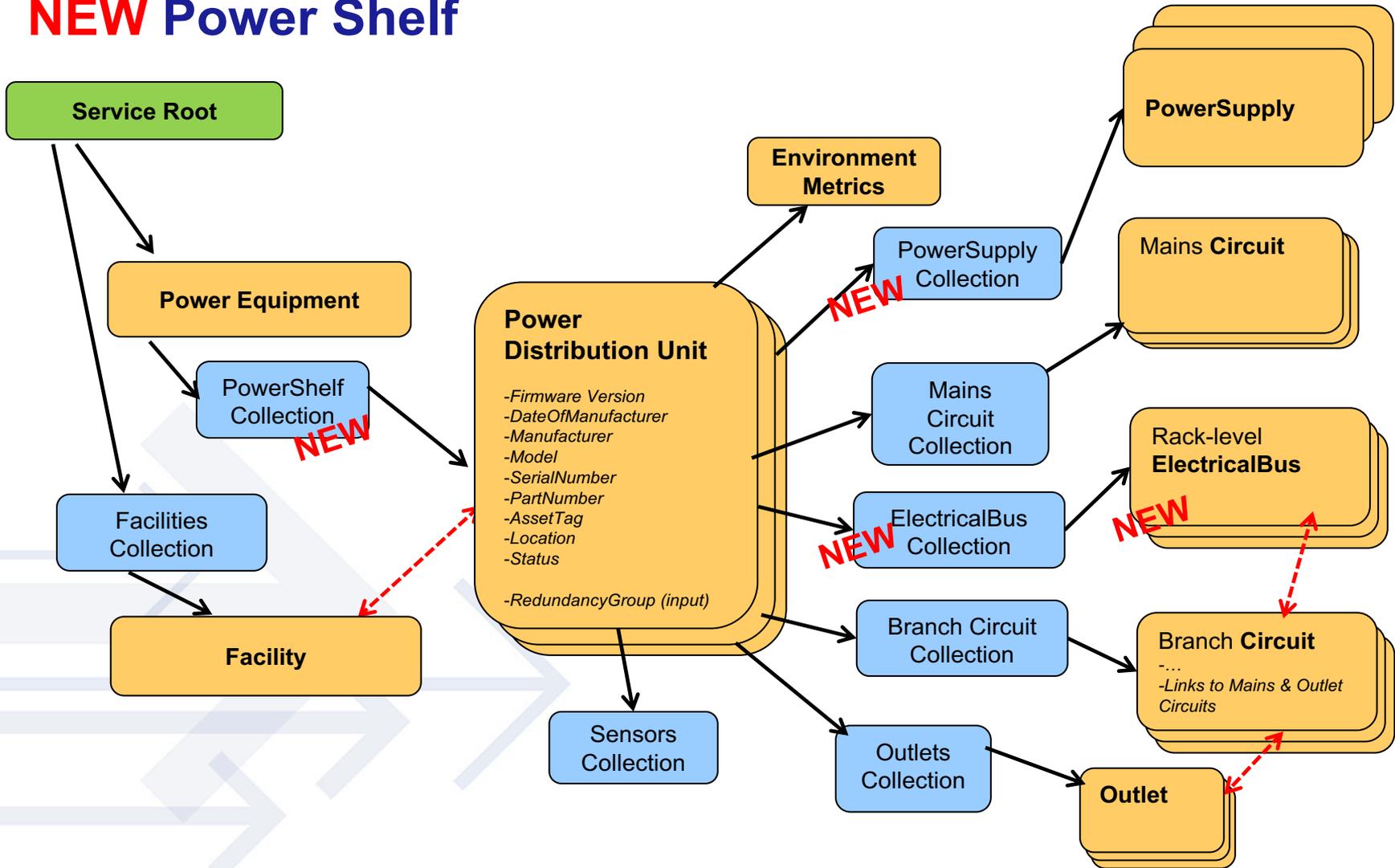


NEW Power Shelf

- Product category not covered by existing Power Distribution model
 - Feedback received that requested support
- A power distribution unit intended to feed a rack or similar group of equipment from a common output bus
 - May have one or multiple input circuits for redundancy
 - If common source(s), these are *Mains Circuit(s)*
 - May show further connection to an **ElectricalBus** instance
 - May contain pluggable power supplies
 - Adds a subordinate resource collection of **PowerSupply** to the model
 - Typically a single, common output circuit
 - Output likely connects to an “owned” **ElectricalBus**
 - **Power shelf could provide user-entered links to connected equipment**
 - May have secondary outputs for 120V “convenience outlets”



NEW Power Shelf



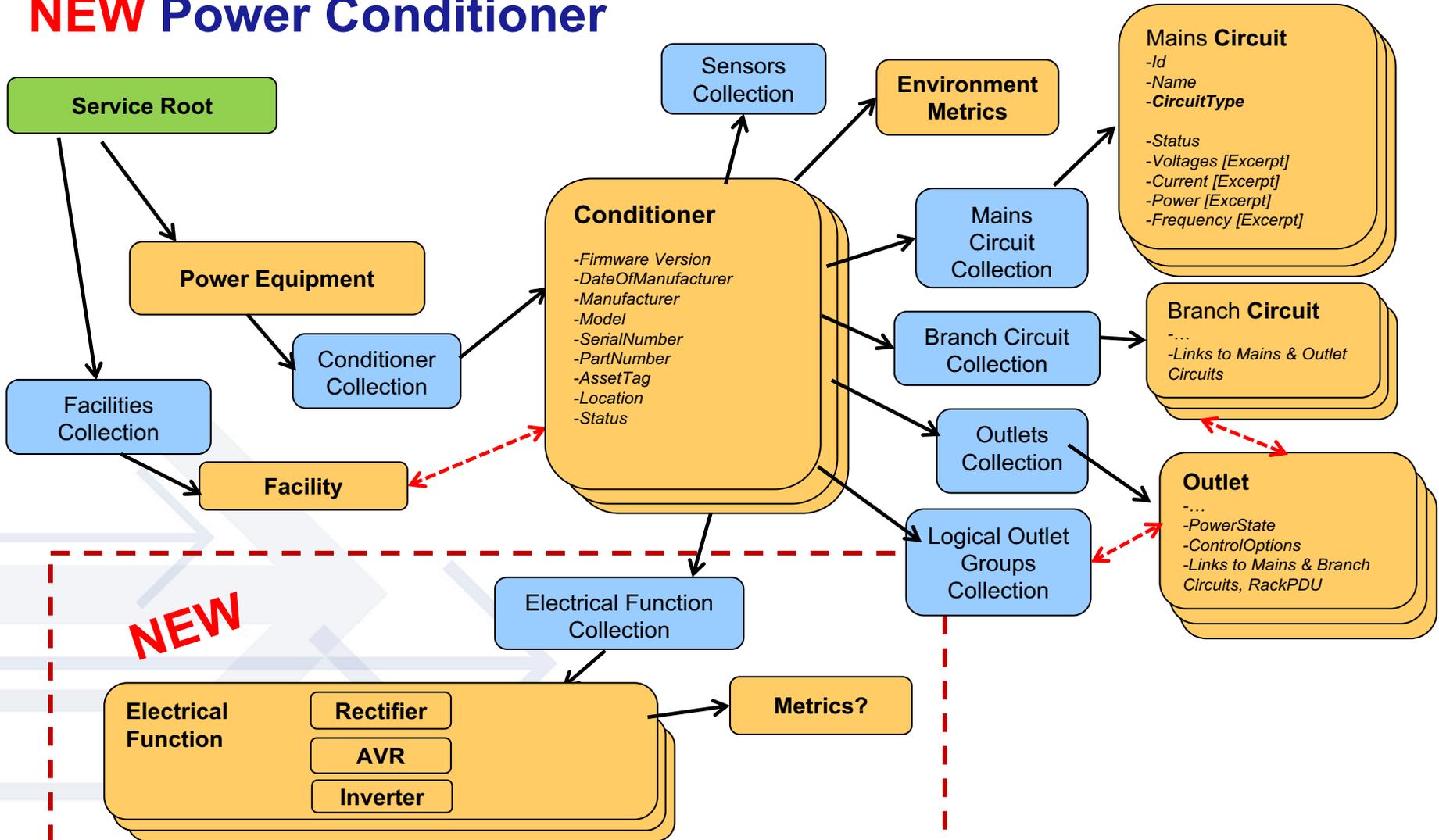


NEW Power Conditioner

- Another product category not covered by existing model
 - Also known as a “line conditioner”
- A power distribution unit with additional power conditioning circuitry
 - Improves the quality of the power for the devices attached to its output
 - May be a standalone device, or the functionality may be a feature of another piece of equipment
- Add **ElectricalFunction** resource collection to describe the components that provide this additional functionality



NEW Power Conditioner



NEW



NEW ElectricalFunction

- Equipment that provides electrical functions or features for the unit
- Resource collection as multiple subsystems may be present, working in parallel (capacity and/or redundancy), or divided by function
- Each **ElectricalFunction** includes one or more of the following functions, represented by objects within the resource:
 - Inverter
 - Rectifier
 - Automatic Voltage Regulator (AVR)
 - Charger – specific to backup power equipment
 - Bypass – specific to backup power equipment



NEW ElectricalFunction schema

```
{
  "@odata.type": "#ElectricalFunction.v1_0_0.ElectricalFunction",
  "Id": "Charger",
  "Name": "Charger module",
  "Status": {
    "State": "Enabled",
    "Health": "Warning"
  },
  "Model": "RKS-440DC",
  "Manufacturer": "Contoso Power",
  "FirmwareVersion": "1.00",
  "SerialNumber": "3488247",
  "PartNumber": "23456-133",
  "SparePartNumber": "93284-133",
  "LocationIndicatorActive": false,
  "Charger": {
    "ChargeState": "Charging"
  },
  "Bypass": { <bypass properties TBD > },
  "Rectifier": { <rectifier properties TBD > },
  "Inverter": { <inverter properties TBD > },
  "VoltageRegulator": { <AVR properties TBD > }
}
```

Typical Redfish properties for a subsystem that may be a self-contained, removable module

Objects for each of the 5 types of electrical functions that may be supported



UPS support

BACKUP POWER SYSTEMS

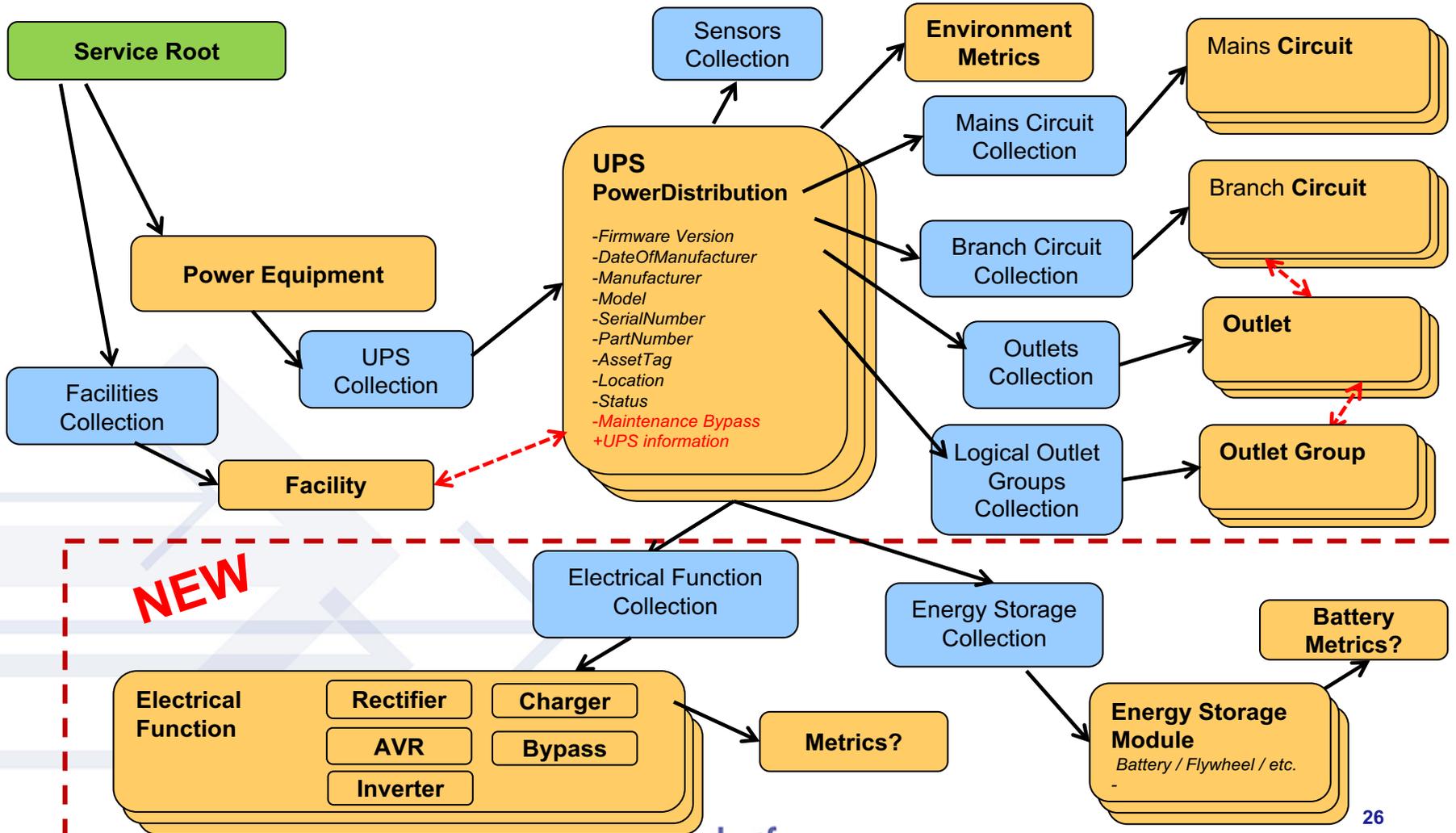


NEW UPS / Backup Power System

- Product category not covered by existing Power Distribution model
- A power distribution unit with energy storage
 - Will need to add capacity related properties to **PowerDistribution**
- Adds **EnergyStorage** resource collection for the devices that provide backup power when utility power is unavailable, which may include:
 - Batteries, Flywheels, Capacitors
- Battery-based energy storage may require additional resources to comprehend large-scale battery systems
 - A separate Metrics resource may be warranted for batteries
- Uses **ElectricalFunction** resource collection to house the components required to service the energy storage units



NEW UPS / Backup Power system



NEW



Energy Storage Devices

- Device that stores energy for use as a backup source, using a variety of technologies, including batteries, flywheels, capacitors, etc.
- Resource collection allowing a potential large number of devices
- Each device may include a number of components
 - This area needs significant work and input from subject matter experts
- Expect at least one “metrics” resource
 - EnvironmentMetrics would have Temperature, Humidity, etc.
 - Create a BatteryMetrics to hold all “performance” related metrics?
 - Voltage
 - ChargePercent



NEW EnergyStorageDevice schema

```
{
  "@odata.type": "#EnergyStorageDevice.v1_0_0.EnergyStorageDevice",
  "Name": "Battery #1",
  "Status": {
    "State": "Enabled",
    "Health": "ok"
  },
  "EnergyStorageType": "Battery",
  "Model": "RKS-440DC",
  "Manufacturer": "Contoso Power",
  "FirmwareVersion": "1.00",
  "SerialNumber": "3488247",
  "PartNumber": "23456-133",
  "SparePartNumber": "93284-133",
  "BatteryChemistry": "LithiumIronPhosphate",
  "CapacityRatedAmpHours": 14000,
  "CapacityActualAmpHours": 12550,
  "MaxDischargeRateAmps": 20,
  "StateOfHealthPercent": 91,
  "ChargePercent": 73,
  "ChargeState": "Charging",
  "LocationIndicatorActive": false,
  "InstallDate": "2020-01-11T08:00:00Z",
  "LastServiceDate": "2021-03-29T08:00:00Z",
  "ReplaceDate": "2023-01-11T08:00:00Z",
  "Metrics": {
    "@odata.id": "/redfish/v1/PowerEquipment/RackUPSS/Rack4/EnergyStorageDevices/1/Metrics"
  }
}
```

Typical Redfish properties for a subsystem that may be a self-contained, removable module

Energy storage and battery-specific properties. Feedback requested

Service, Install, Replacement dates

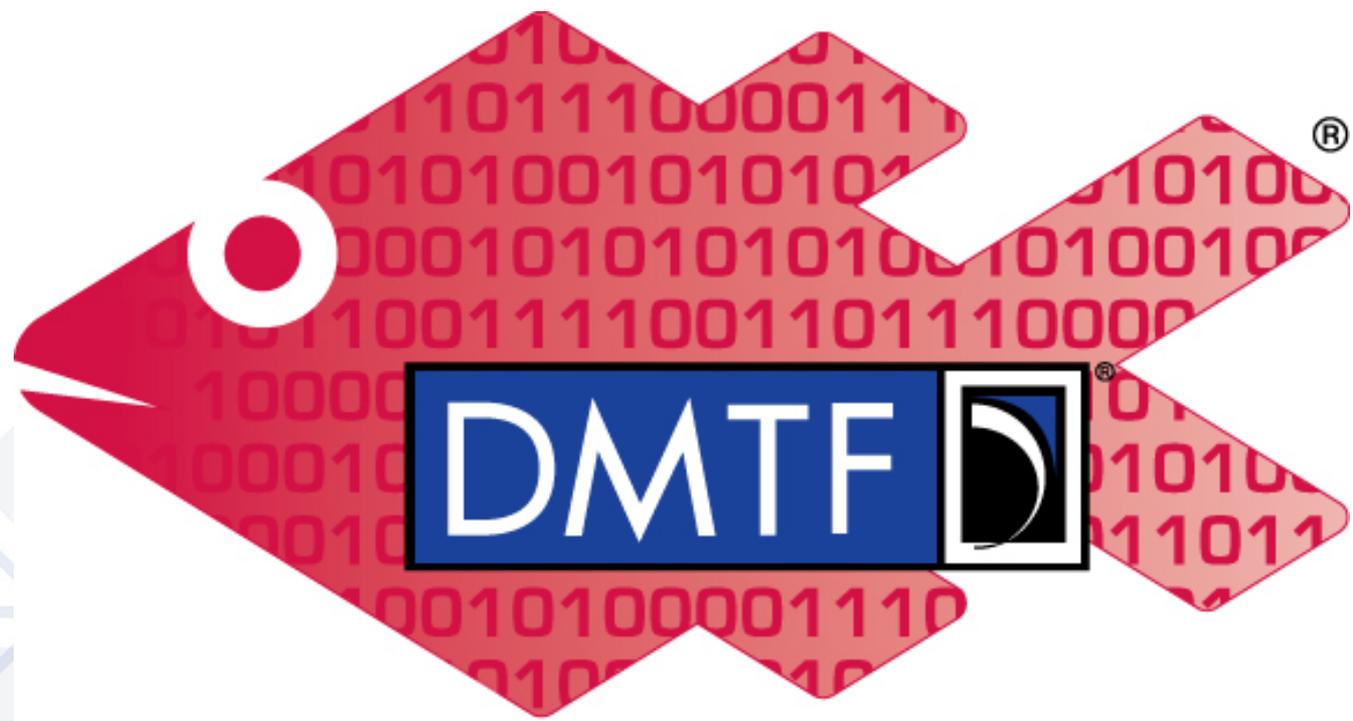


Energy Storage feedback topics

- How to model large battery devices
 - Want to leverage same model for “small” (non-coin-cell) battery instances
 - What’s the product / component boundaries?
 - Need to model down at least to the replaceable units
 - Are ratings always in Amp-hours? Or in VA or other measurement units?
- Is there enough commonality to use a generic **EnergyStorageDevice** schema with a “Type” property to indicate the technology?
 - Status, energy capacity, vendor/model data should all be common
 - For example, **Circuit** is common, and uses *CircuitType* to differentiate
 - But we created **Outlet**, which shares many properties, for clarity
- Should create category-based resource collections for EnergyStorage?
 - Separate collections for “Batteries”, “Flywheels”, etc.?
 - Assumes a generic EnergyStorageDevice schema, not tech-specific
- Need expert input, especially on non-battery systems (flywheel, etc.)



Q&A & Discussion



Redfish