presented by

American Megatrends

Out of Band BIOS Remote Management

UEFI US Fall Plugfest – September 20 - 22, 2016

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Agenda

- Introduction
- UEFI Building Blocks
- Creating a Solution
- Demo
- Call to Action

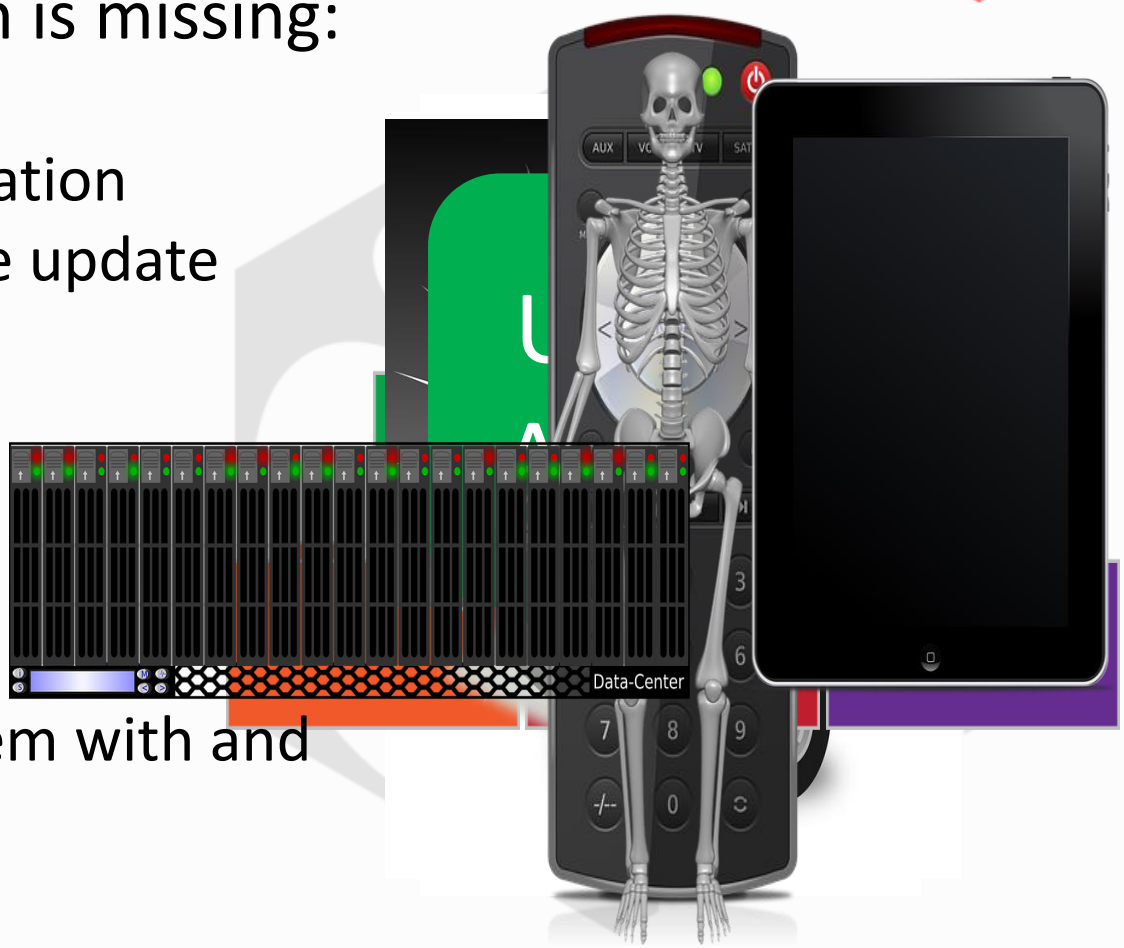
Introduction

Introduction

- Corporations need methods to configure and deploy many systems on their network
- Currently, configuring the firmware, updates and OS Deployment can be:
  - Annoying
  - Time consuming
  - Can cause costly downtime
  - May require operating system based tools
  - Difficulty rises with the number of systems
  - Each system requires individual attention
- Current industry solutions are proprietary and do not offer a unified solution for multiple hardware vendors

Industry Needs

- But the ecosystem is missing:
  - Bare metal
  - Remote configuration
  - Remote firmware update
  - Security
  - Scalability
  - Migration
  - Cloning
  - Scripting
  - Solution for system with and without BMC

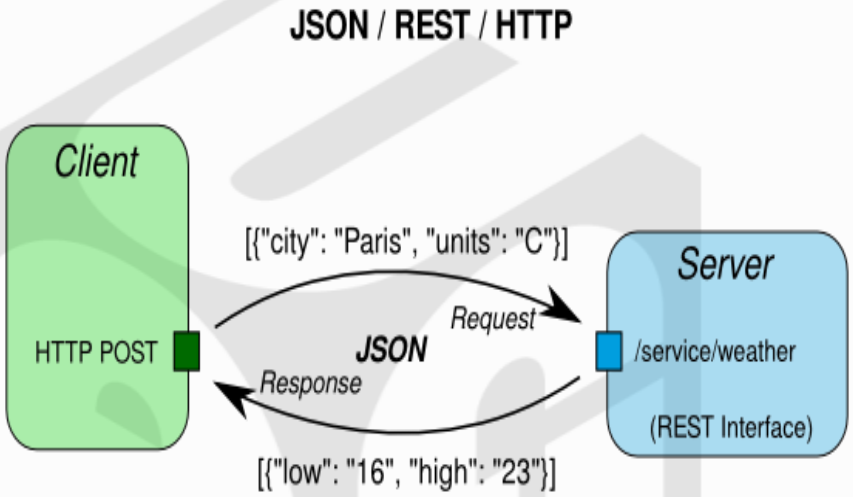


Industry Standard Initiative

- Combining several industry standards together offers a highly manageable solution:
  - **UEFI** Specification from http://uefi.org/
  - **REST** Software Architectural “style” from http://www.w3.org
  - **JSON** is a data-interchange format from http://www.json.org/
  - **oData (open data protocol)** that defines the best practice for building and consuming RESTful APIs from OASIS.
  - **Redfish** from https://www.dmtf.org/

What is REST?

- **RE**presentational **S**tate **T**ransfer
- Scalable Software Architectural "style"
- Standardized operations (RESTful Interface)
  - HTTP GET, POST, PUT, and DELETE
  - Practical implementations add HTTP PATCH, HEAD
- Standardized operands (nouns)
  - Resources uniquely identified by URIs
- Stateless, atomic operations
  - No client/application context stored server



What is JSON?

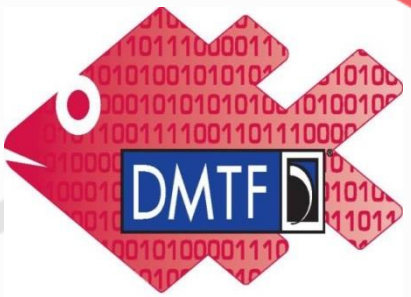
- **J**ava **S**cript **O**bject **N**otation
- Lightweight data-interchange format
  - Easy for humans to read and edit
  - Easy for machines to parse and generate
- Much smaller grammar than XML
  - XML good for “documents”
  - JSON better for “data structures” used in programming languages

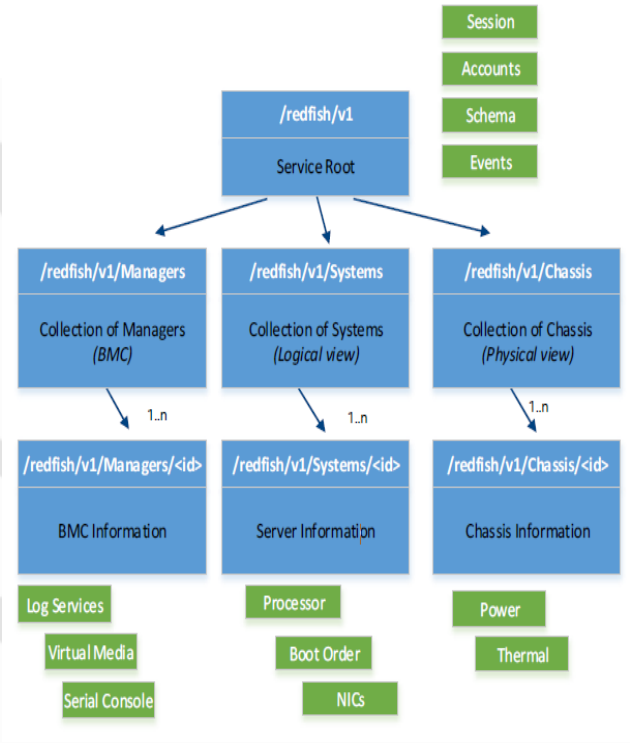
What is oData?

- Open Data Protocol (oData) is an open protocol which allows the creation and consumption of query-able and interoperable RESTFul APIs in a standard way
- Microsoft initiated oData in 2007
  - Version 1/2/3 defined by MS
  - Version 4+ moved to OASIS
- Multiple open source projects available to support oData based schemas

What is Redfish?

- Architectural successor to previous manageability interfaces
- Industry Standard
  - DMTF* Scalable Platforms Management Forum (SPMF)
  - www.dmtf.org/standards/redfish
- Technology for Management Controller (BMC) to expose RESTful interface for management clients
- Redfish allows RESTful interfaces:
  - JSON format
  - Secure (HTTPs)
  - Multi-node and aggregated rack-level servers capable
  - Schema-backed, human readable output
- UEFI firmware communicates with BMC using Redfish standard for typical BIOS-BMC data exchange
  - For systems without BMC, network communication with an oData server can be done instead

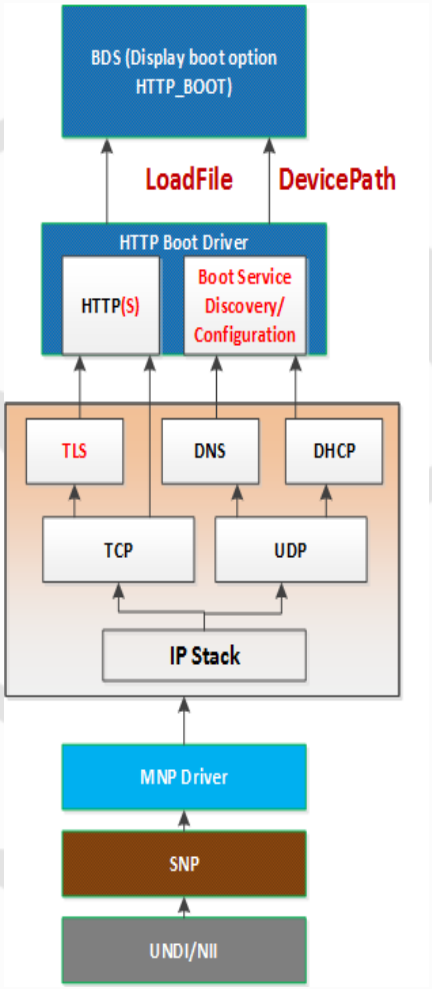




UEFI Building Blocks

UEFI Highlights

- Network Stack
  - UNDI / SNP / MNP / IPV4 / IPV6 / TCP / UDP / ARP / DHCP
  - DNS (IPv4 / IPv6)
  - HTTP (IPv4 / IPv6)
  - TLS (for HTTPs)
  - HTTP Boot Wire Protocol
- EFI REST Protocol support
- UEFI Configuration Language Keywords



UEFI Native HTTP(S)

- **HTTP Support**
  - **Native support for HTTP**
- **HTTPS Support**
  - **Native support for secure data transfer through HTTPS**
- **Both can be used to transfer data and go to specific URIs**

BIOS REST Support

- New in UEFI v2.5, *EFI_REST_PROTOCOL* interface to communicate with REST servers
- Uses *EFI_HTTP_UTILITY_PROTOCOL* to build/parse HTTP headers
- Standard pre-boot access to a RESTful API and Redfish like interface:

```
typedef struct _EFI_REST_PROTOCOL {
        EFI_REST_SEND_RECEIVE SendReceive; // Provides an HTTP-like interface to send and receive resources from a REST service.
        EFI_REST_GET_TIME GetServiceTime; // (Optional) Returns the current time of the REST service.
        } EFI_REST_PROTOCOL;

typedef  EFI_STATUS  (EFIAPI *EFI_REST_SEND_RECEIVE)(
        IN EFI_REST_PROTOCOL *This,
        IN EFI_HTTP_MESSAGE *RequestMessage,
        OUT EFI_HTTP_MESSAGE *ResponseMessage );
```

- Abstracts the communication to application/driver that wants to use the REST service.
- The *EFI_REST_PROTOCOL* Instance can be installed for in-band communication with BMC as well as instance for communicating via Network with oData Server.

UEFI Configuration Language Keywords (Mapping Language)

- UEFI 2.5 recommends representing questions by configuration language
- Unique keywords defined in a separate configuration language for each question's prompt field
- These question keywords are unique strings and allow identification of the questions
- Generic drivers can implement support by using the "x-UEFI" Language
- Can be used to transfer question details in JSON format for Redfish based configuration

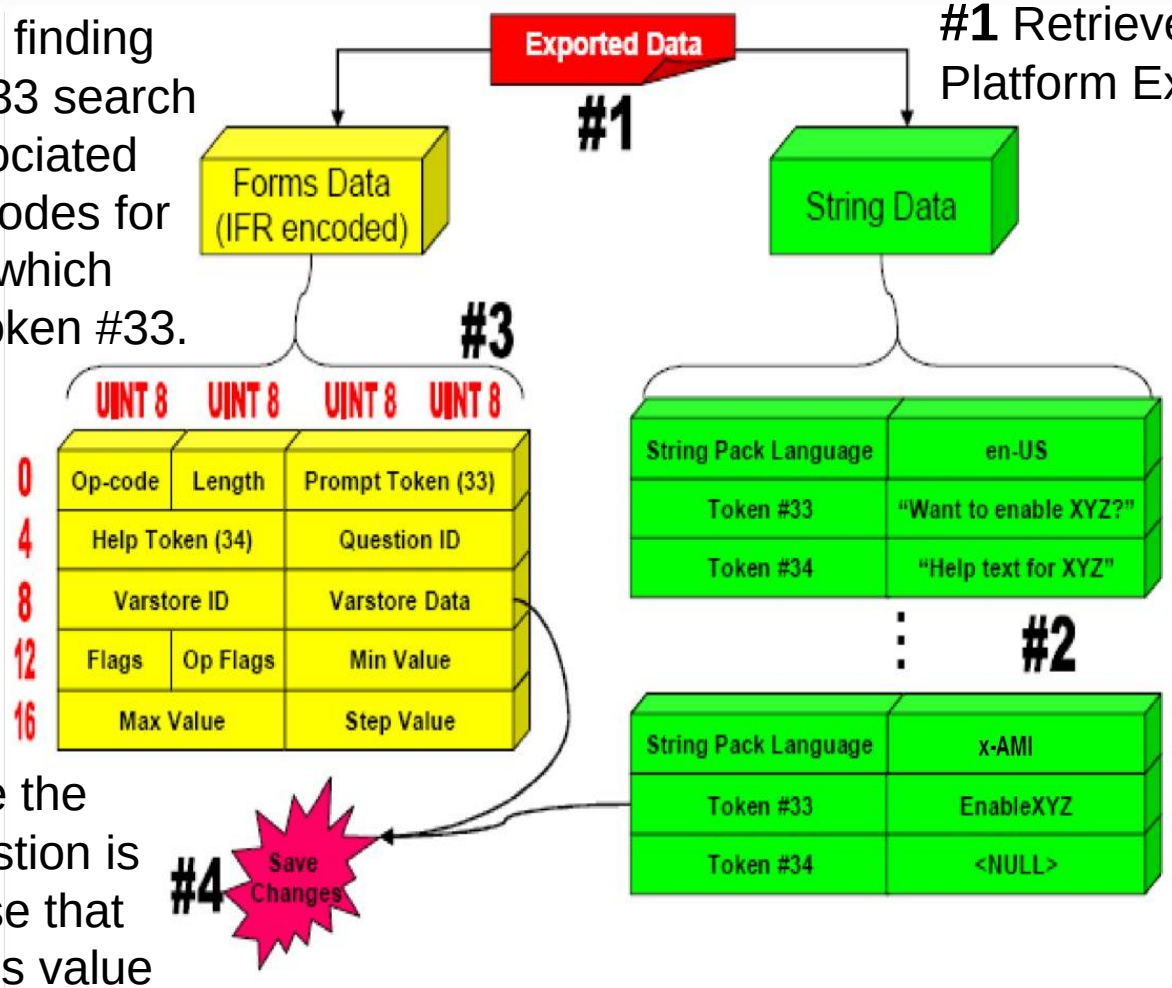
Creating a Solution

OOB Firmware Configuration: Introduction

- BIOS Firmware Configuration are traditionally done in-band in the BIOS environment or using OS tools
- The configuration is stored in NVRAM as blob of Binary data
  - Configuration data now needs to be properly matched with individual setup questions
- OOB Firmware Configuration allows configuring the BIOS firmware remotely via a Management Controller using Redfish
- With the following considerations
  - Redfish compliant configuration representation
  - Configuration need be managed independent of BIOS versions
  - Configuration can be maintained for different system models

UEFI Configuration Language Keywords (Mapping Language)

#3 After finding token #33 search the associated IFR opcodes for prompt which refers token #33.



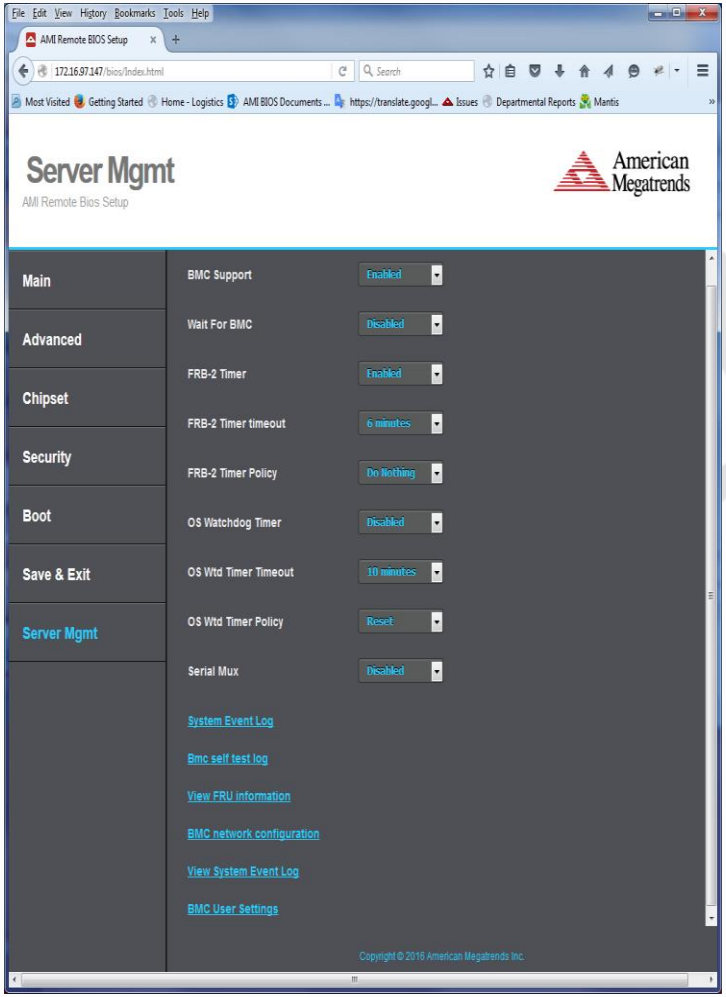
#1 Retrieve the Platform Exported Data

#2 Search token with the keyword in the configuration language (e.g EnableXYZ in x-UEFI or x-AMI)

#4 Once the IFR question is found use that questions value to read or write.

OOB Firmware Configuration: Remote firmware UI

- Remote Firmware Setup UI application hosted by BMC or oData server
- HTML5 pages are pushed from BIOS to BMC or oData server
- BMC or oData server parse setup question details to show controls and get/set the values
- HTML5 provides an easy customization capability



OOB Firmware Configuration: VFR Data

- Uefi Configuration Language Codes (Mapping Language) and VFR

Unifile and SD file

```
#string STR_ACPI_AUTO_PROMPT          #language eng "Enable ACPI Auto Configuration"
                                      #language x-AMI "ACPI004“
checkbox varid = SETUP_DATA.AcpiAuto,
                    prompt = STRING_TOKEN(STR_ACPI_AUTO_PROMPT),
                    help = STRING_TOKEN(STR_ACPI_AUTO_HELP),
                    flags = 0,
                    default = DEFAULT_AUTO_ACPI,
                    default = DEFAULT_AUTO_ACPI, defaultstore = AmiMfgDefault,
endcheckbox;


#string STR_ACPI_S4_PROMPT            #language eng "Enable Hibernation"
                                                  #language x-AMI "ACPI002"
checkbox varid = SETUP_DATA.AcpiHibernate,
                    prompt = STRING_TOKEN(STR_ACPI_S4_PROMPT),
                    help = STRING_TOKEN(STR_ACPI_S4_HELP),
                    default = DEFAULT_SS4,
                    default = DEFAULT_SS4, defaultstore = AmiMfgDefault,
endcheckbox;
```

OOB Firmware Configuration: JSON Data

- BIOS Setup Question Information as JSON

<Server>/redfish/v1/Registries/BiosAttributeRegistry0ACAK.0.19.0.json


```
……
 {
       "AttributeName": "ACPI001",
       "DefaultValue": "S3 (Suspend to RAM)",
       "DisplayName": "ACPI Sleep State",
       "HelpText": "Select the highest ACPI sleep state the system will enter when the SUSPEND
button is pressed.",
       "ReadOnly": false,
       "Type": "Enumeration",
       "Value": [
         {
           "ValueDisplayName": "Suspend Disabled",
           "ValueName": "Suspend Disabled"
         },
         {
           "ValueDisplayName": "S1 (CPU Stop Clock)",
           "ValueName": "S1 (CPU Stop Clock)"
         },
         {
           "ValueDisplayName": "S3 (Suspend to RAM)",
           "ValueName": "S3 (Suspend to RAM)"
         }
       ]
  },
```

OOB Firmware Configuration: JSON Config Data

- BIOS Configuration

<Server>/redfish/v1/Systems/Self/Bios

```
…….
 "AttributeRegistry": "BiosAttributeRegistry0ACAK.0.19.0",
……
 "Attributes": {
    "ACPI001": "S1 (CPU Stop Clock)",
    "ACPI002": true,
    "ACPI003": false,
    "ACPI004": false,
……
```

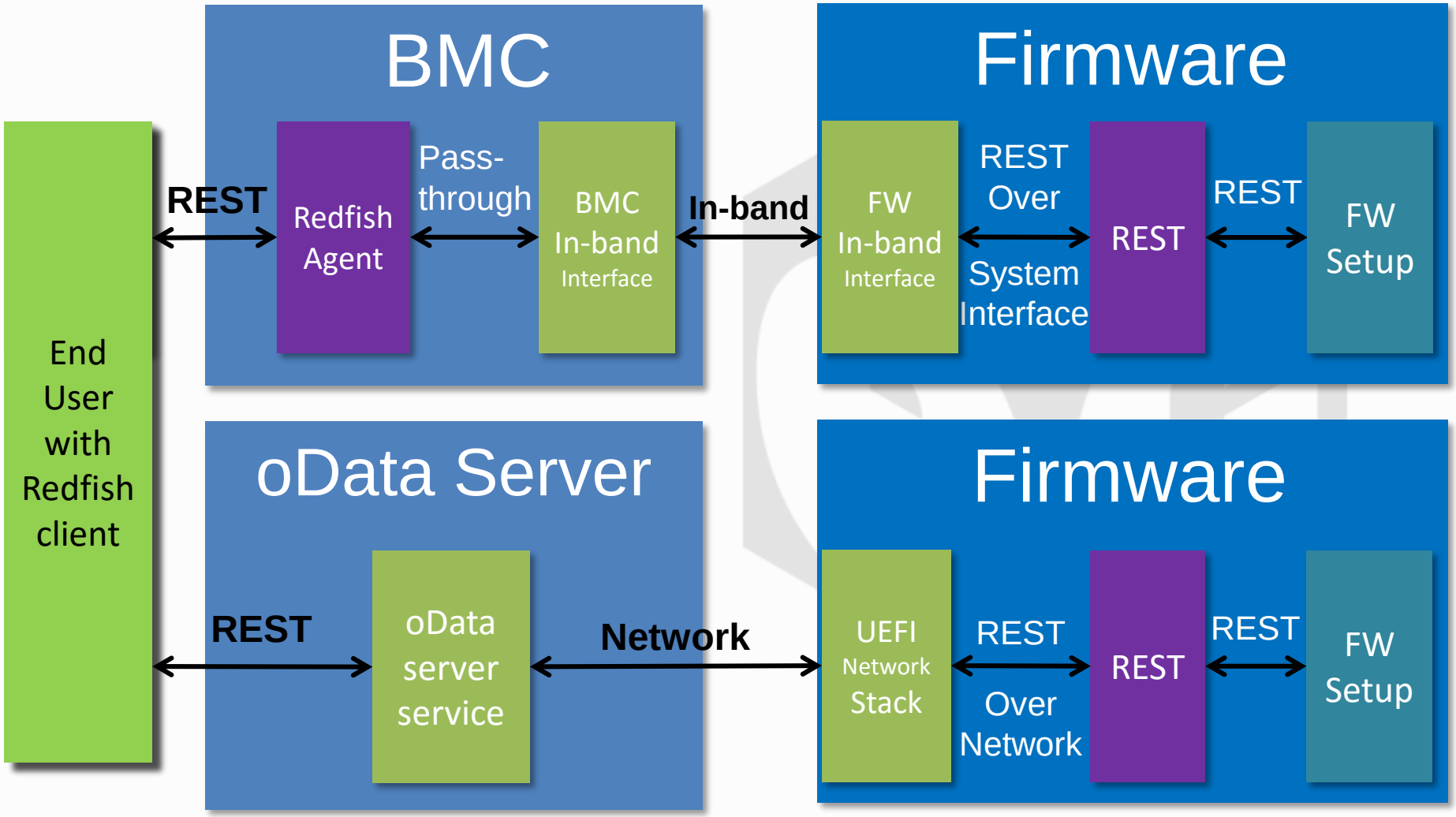
OOB Firmware Configuration: JSON Change Config Data

- Bios Configuration Setting Object from Remote Client

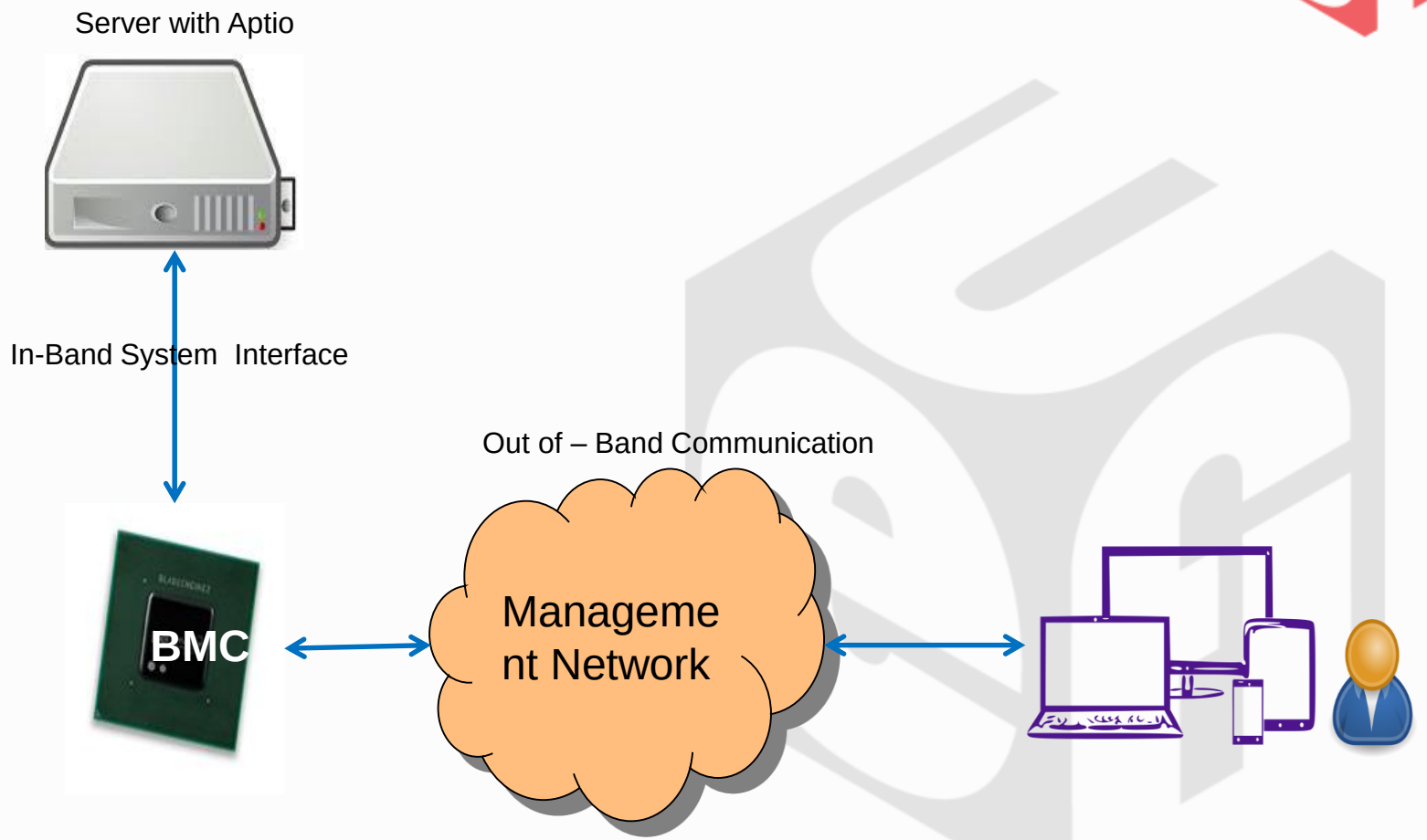
<Server>/redfish/v1/Systems/Self/Bios/SD

```
……
 "Attributes": {
    "ACPI002": false,
……
```

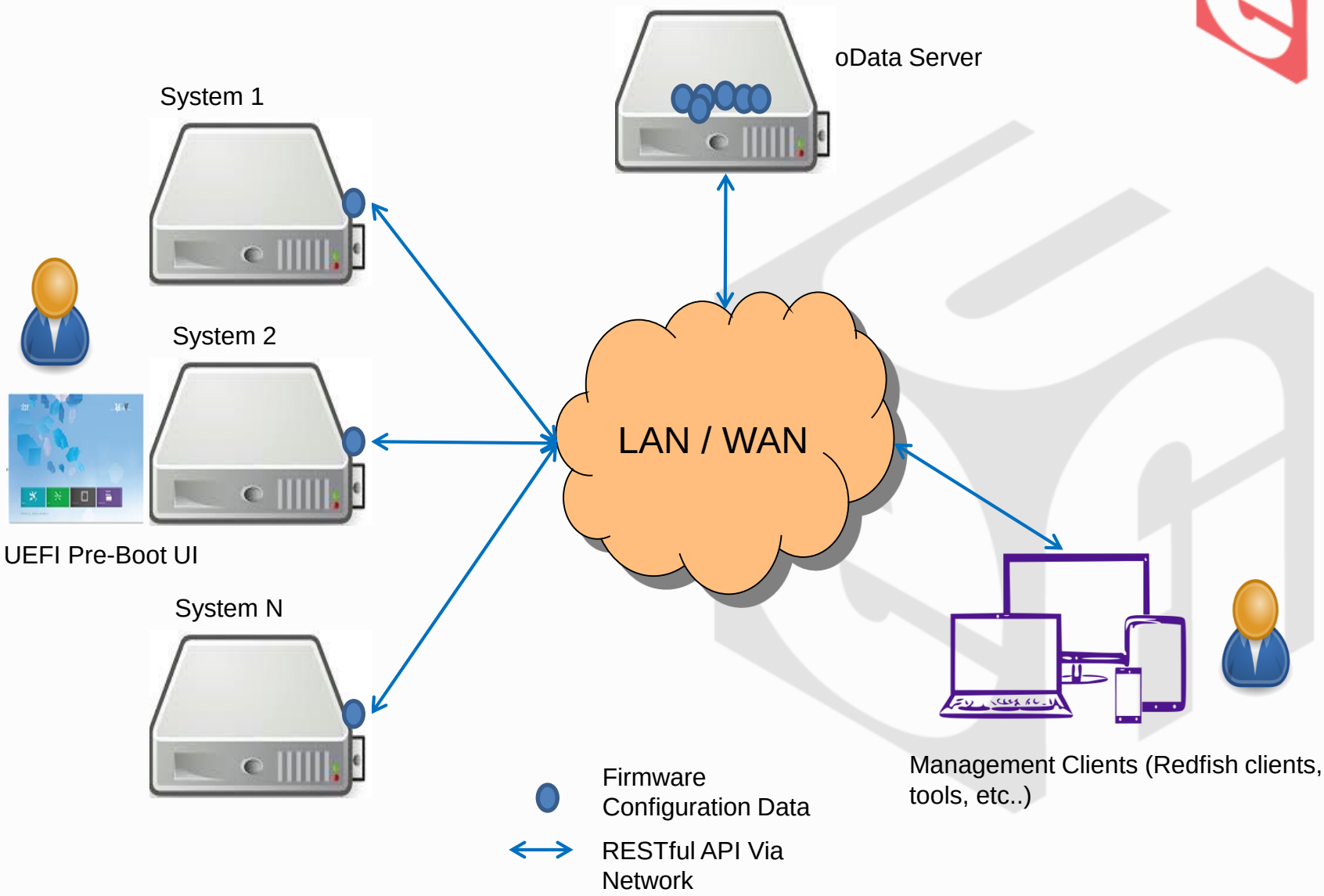
Communication Block Diagrams



OOB Firmware Management with BMC

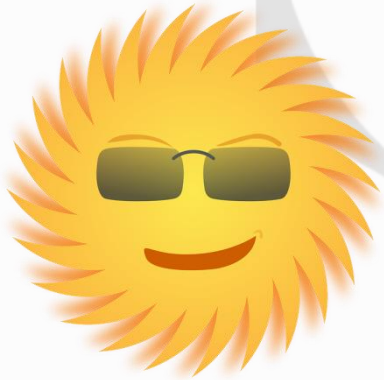


Firmware Configuration with oData



Extending Solutions for Additional Features

- Using oData server or BMC solutions can be created beyond firmware configuration:
  - OS deployment
  - Firmware update deployment
  - System cloning
  - Diagnostic deployment on demand
  - OS remote backup and restore
- Since all interfaces are abstract, end user organizations can create their own tools and make IT admins happy



Demo

Demo Video

- In video demo, non-BMC firmware management will be shown including:
- Changing firmware settings of a target desktop
- Changing firmware settings of a target laptop
- Pushing changes made locally on target machines to oData server
- Pushing changes made remotely on the oData server to target machines

Call to Action

Call to Action

- OEMs should get involved and read the specifications and add support accordingly
- End customers should get involved and ask their OEMs for Redfish based solutions
- The industry should work together to create an ecosystem where more advanced solutions can be created
- Everyone should get involved in the UEFI and other specifications to continue the evolution

Thanks for attending the
UEFI US Fall Plugfest 2016

For more information on the Unified EFI Forum and UEFI Specifications, visit
http://www.uefi.org

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