IDF16
INTEL DEVELOPER FORUM

Accelerating Firmware Development With UEFI Advanced Features

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STTS001

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experience what's inside™

Agenda

- Latest UEFI & ACPI Specifications
- Redfish RESTful Use Case in Data Center
- Apply Key Features to UEFI Development
- Summary

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Latest UEFI & ACPI Specifications

- UEFI 2.6
- ACPI 6.1
- UEFI Shell 2.2
- UEFI PI 1.4
- UEFI PI Packaging 1.1

http://uefi.org/specifications

UEFI 2.5 Networking

- Boot from HTTP(S) (HTTP API, HTTP Helper API, DNS v4/v6, RAMDISK, …)
- Wi-Fi (EAP, Extensible Authentication Protocol, Support)
- TLS, Transport Layer Security
- Bluetooth®
- Redfish REST Protocol

www.uefi.org

What’s New – UEFI 2.6

Network Enhancements

- Wireless MAC Connection II Protocol
- RAMDISK Protocol

RAS

- Common Platform Error Record (CPER) Extension for ARM*

User Interface

- Human Interface Infrastructure (HII) Font Ex, Glyph Generator, Image Ex and Image Generator Protocols

I/O

- SD/eMMC Pass Thru Protocol
- Non-identity Mapped Address Translations in PCI Root Bridge and I/O Protocols

www.uefi.org

What’s New – ACPI 6.1

Persistent Memory

- NFIT Updates
- NFIT Root Device _DSM

RAS

- APEI Extension for ARM*
- ERST/EINJ max wait time

Management

- Graceful Shutdown Clarifications
- Wireless Power Calibration Device

I/O

- Interrupt-signaled Events

UEFI & ACPI specification updates help in accelerating firmware development

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Redfish RESTful Use Case in Data Center

What is Redfish?

- Industry standard - www.dmtf.org/standards/redfish
- DMTF* Scalable Platforms Management Forum (SPMF) provides specification, schema, mockup, whitepaper, FAQ & resource browser

Managing multi-code servers via a RESTful API

- Built on modern tool chain (HTTPS, JSON, OData)

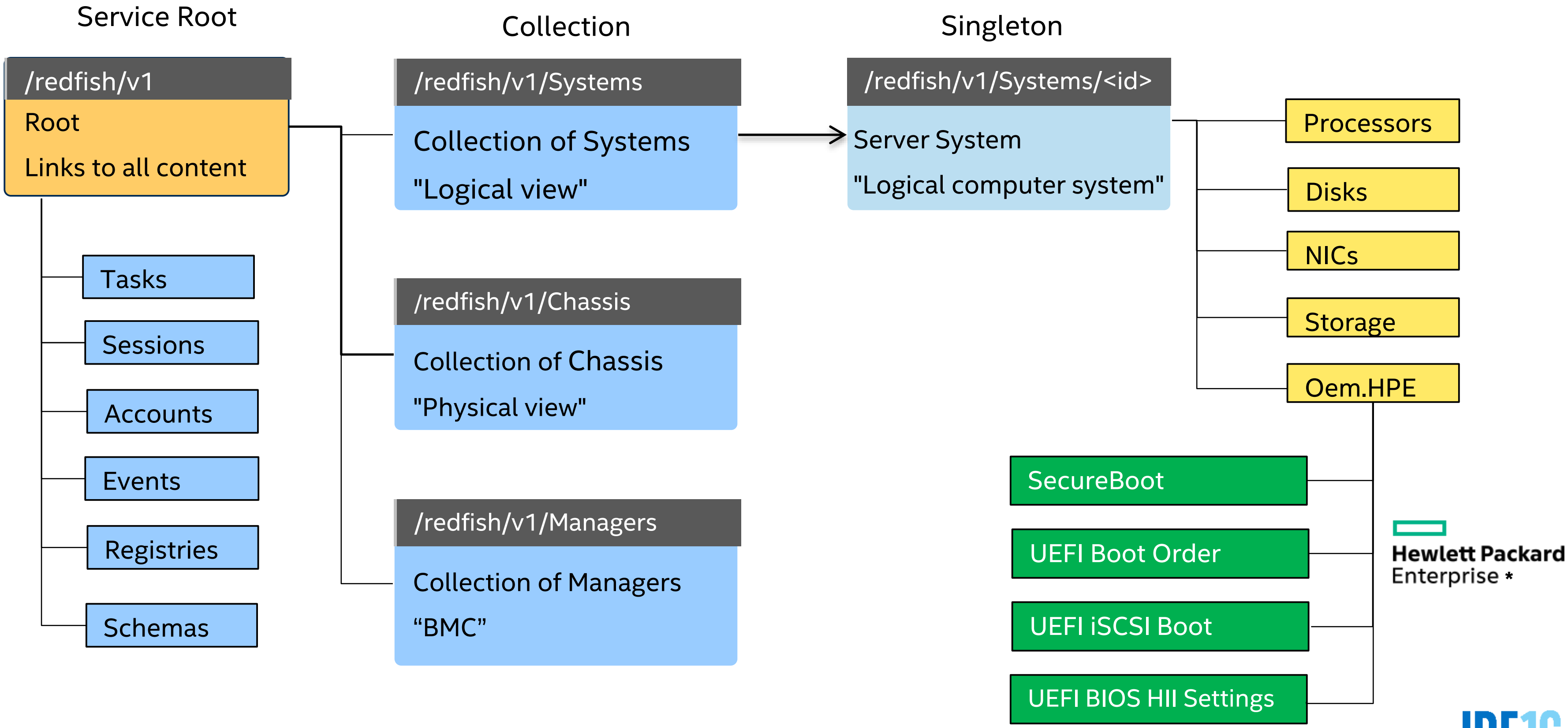
Client Python* code

```
rawData = urllib.urlopen(‘https://192.168.0.1/redfish/v1/Systems/1’)
jsonData = json.loads(rawData)
print( jsonData[‘SerialNumber’] )
```

Output

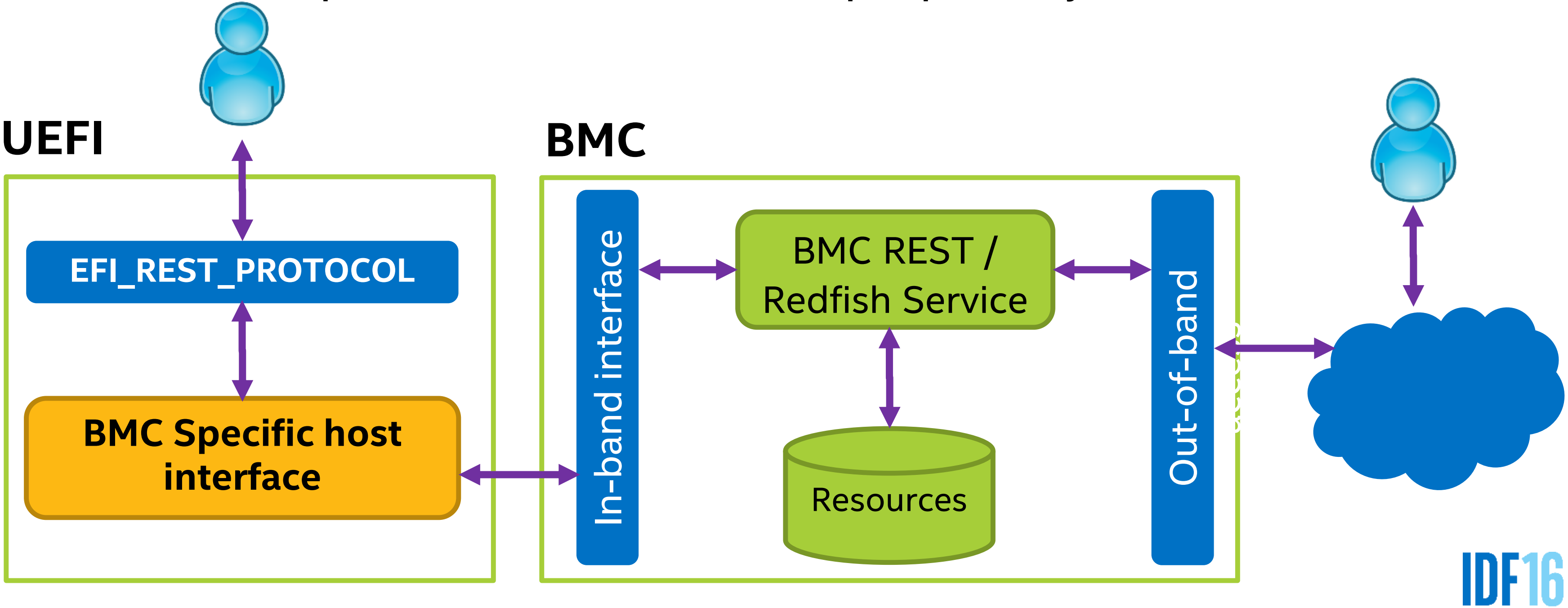
```
0AB8012GQ0
```

Redfish Resource Map

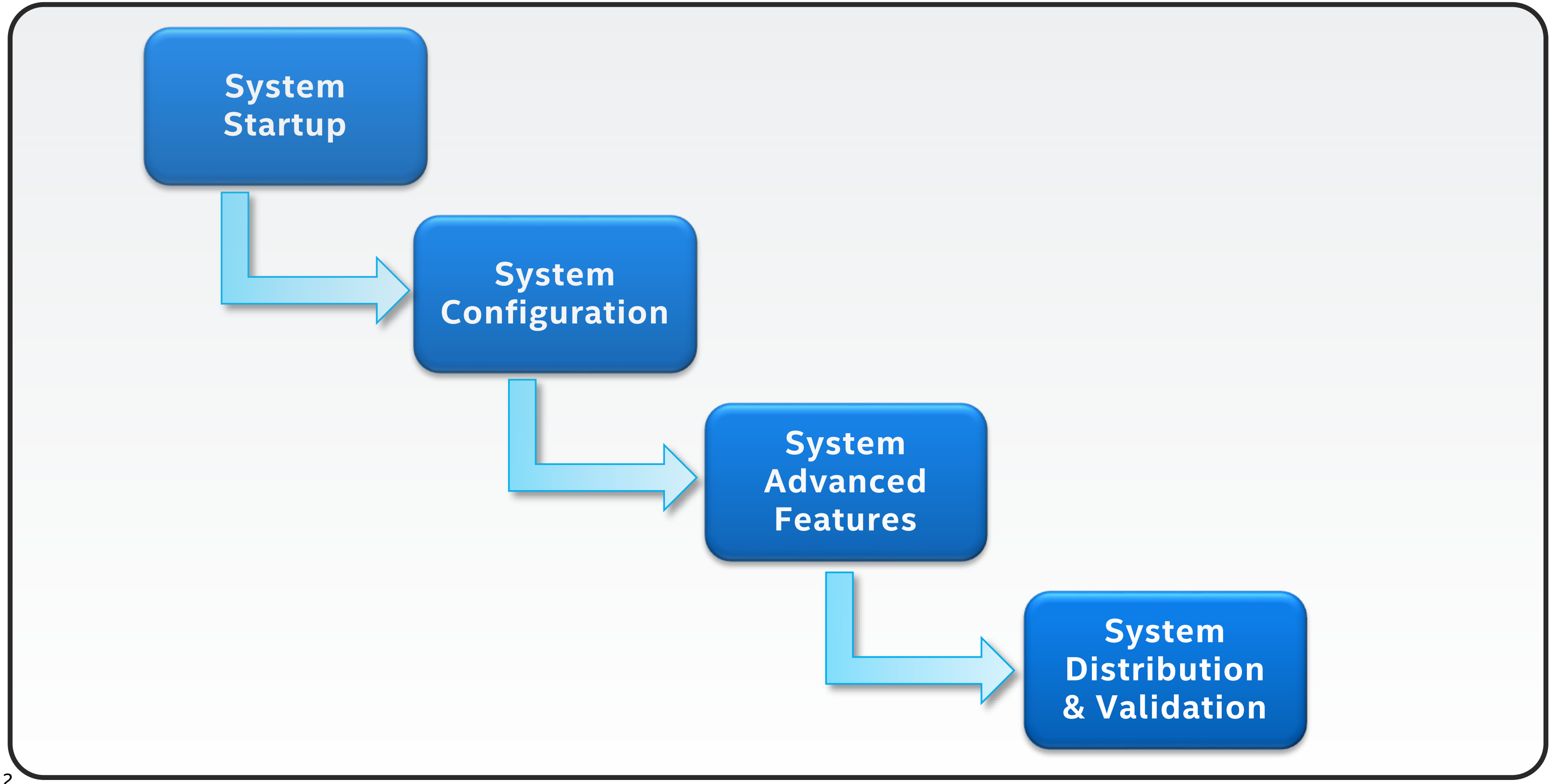


UEFI REST Protocol

- New in UEFI v2.5
- Standard pre-boot in-band access to a RESTful API, like Redfish
- Abstracts BMC-specific access methods (proprietary)



UEFI Firmware Development Process

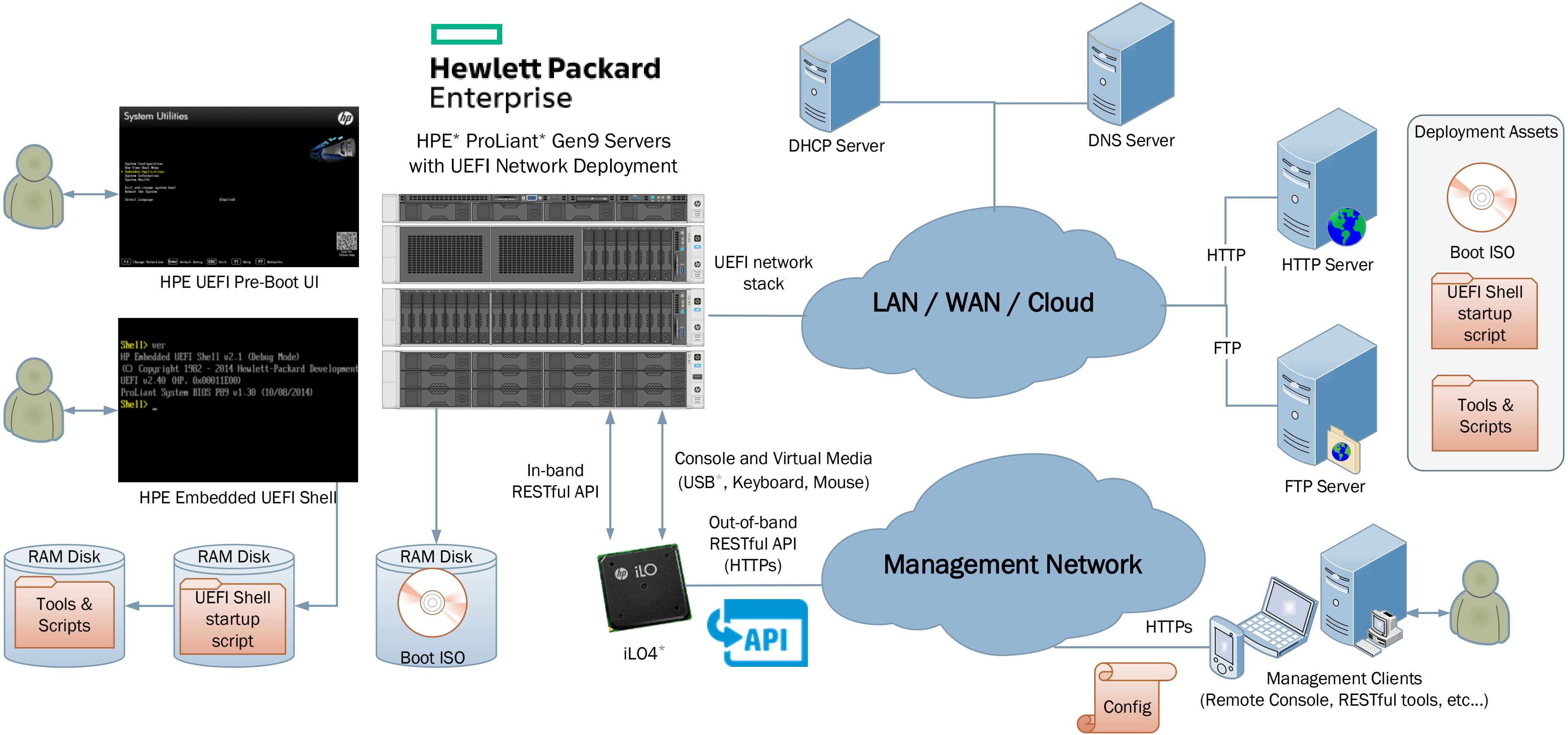

System Startup

System Configuration

System Advanced Features

System Distribution & Validation

UEFI Deployment Solution on HPE* Servers

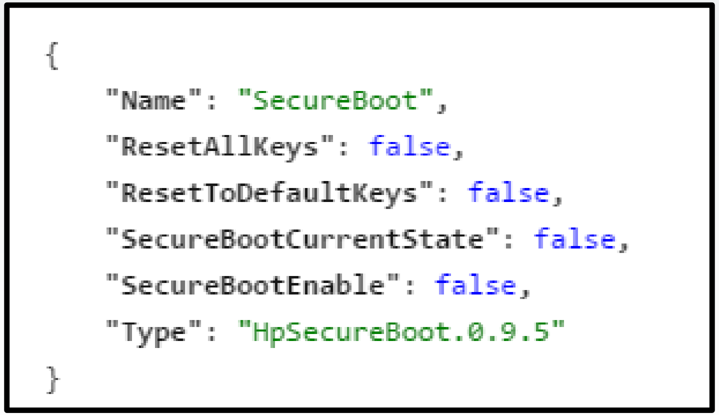


```
Shell> ver
HP Embedded UEFI Shell v2.1 (Debug Mode)
(C) Copyright 1982 - 2014 Hewlett-Packard Development
UEFI v2.40 (HP, 0x00011E00)
ProLiant System BIOS P89 v1.30 (10/08/2014)
Shell> _
```

Hewlett Packard Enterprise* Redfish Example: Secure Boot

GET @ /redfish/v1/systems/1/secureboot

- Enable/Disable Secure Boot
- Reset all Secure Boot variables to defaults
- Clear all keys (Setup Mode)

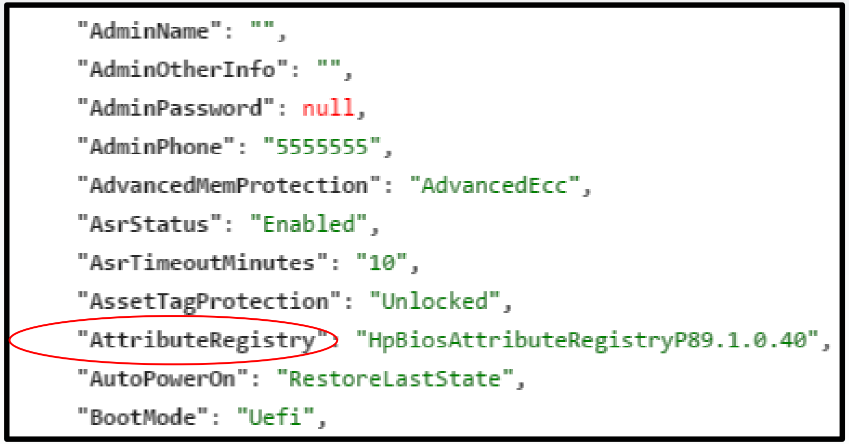


```
{
    "Name": "SecureBoot",
    "ResetAllKeys": false,
    "ResetToDefaultKeys": false,
    "SecureBootCurrentState": false,
    "SecureBootEnable": false,
    "Type": "HpSecureBoot.0.9.5"
}
```

Hewlett Packard Enterprise* Redfish Example: UEFI BIOS HII Settings

GET @ /redfish/v1/systems/1/bios

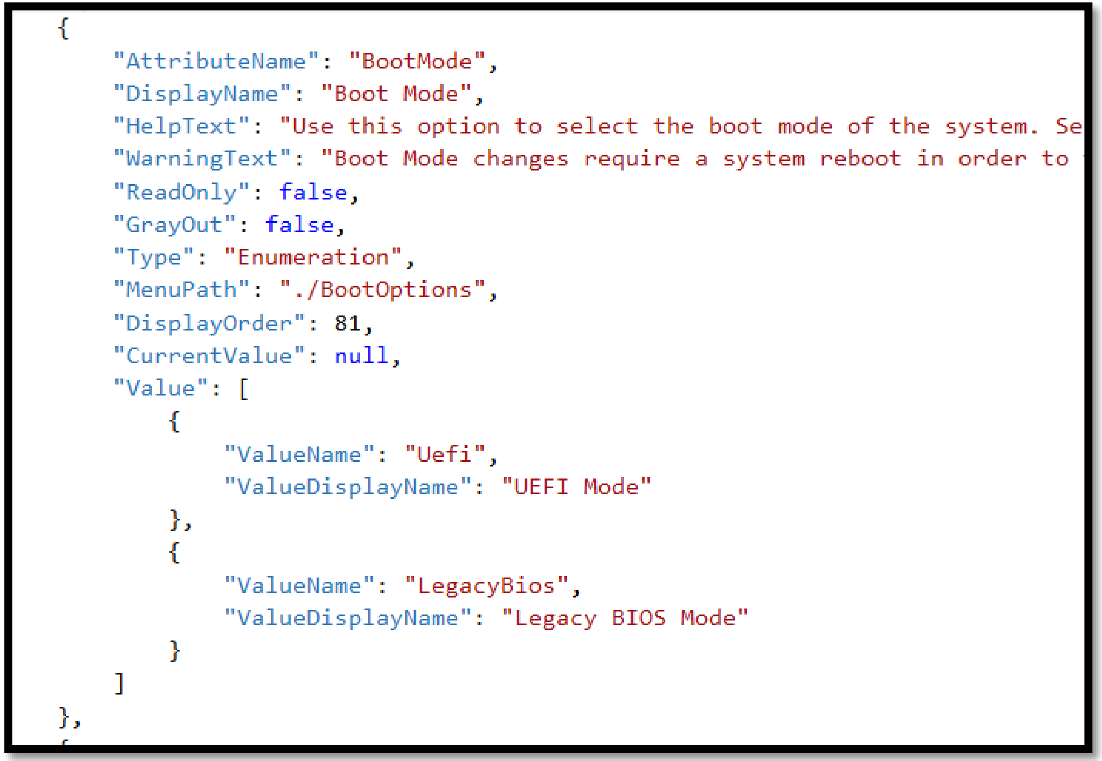
- All UEFI BIOS settings HII (name/values)
- HII meta-data in Attribute Registry
- Name/value pairs used to lookup meta-data in Attribute Registry



```
"AdminName": "",
"AdminOtherInfo": "",
"AdminPassword": null,
"AdminPhone": "5555555",
"AdvancedMemProtection": "AdvancedEcc",
"AsrStatus": "Enabled",
"AsrTimeoutMinutes": "10",
"AssetTagProtection": "Unlocked",
"AttributeRegistry": "HpBiosAttributeRegistryP89.1.0.40",
"AutoPowerOn": "RestoreLastState",
"BootMode": "Uefi",
```

Hewlett Packard Enterprise* Redfish Example: UEFI BIOS HII Settings

GET @ /redfish/v1/registries/HpBiosAttributeRegistryP89.1.0.40



```
{
    "AttributeName": "BootMode",
    "DisplayName": "Boot Mode",
    "HelpText": "Use this option to select the boot mode of the system. Se
    "WarningText": "Boot Mode changes require a system reboot in order to
    "ReadOnly": false,
    "GrayOut": false,
    "Type": "Enumeration",
    "MenuPath": "./BootOptions",
    "DisplayOrder": 81,
    "CurrentValue": null,
    "Value": [
        {
            "ValueName": "Uefi",
            "ValueDisplayName": "UEFI Mode"
        },
        {
            "ValueName": "LegacyBios",
            "ValueDisplayName": "Legacy BIOS Mode"
        }
    ]
},
```

Sample UEFI Shell Deployment Script (startup)

```
# Create FAT32 RAM Disk
ramdisk -c -s 512 -v MYRAMDISK -t F32
FS0:


# Download provisioning OS files from HTTP to RAM Disk
webclient -g http://repo.hpe.com/deploy/efilinux.efi
webclient -g http://repo.hpe.com/deploy/deploy.kernel
webclient -g http://repo.hpe.com/deploy/deploy.ramdisk


# Start provisioning OS
efilinux.efi -f deploy.kernel initrd=deploy.ramdisk
```

A use case of accelerating firmware development with UEFI advanced features

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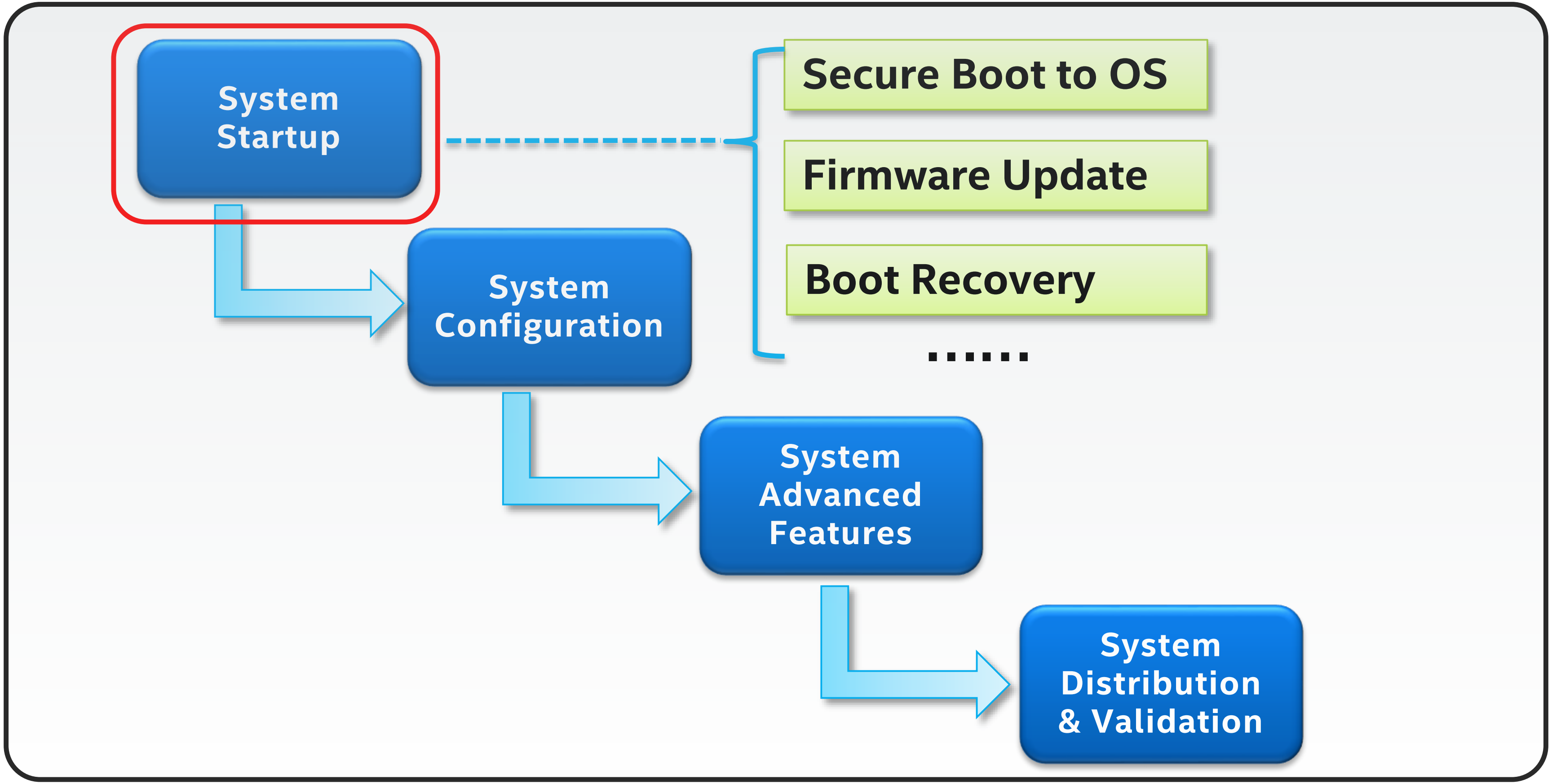
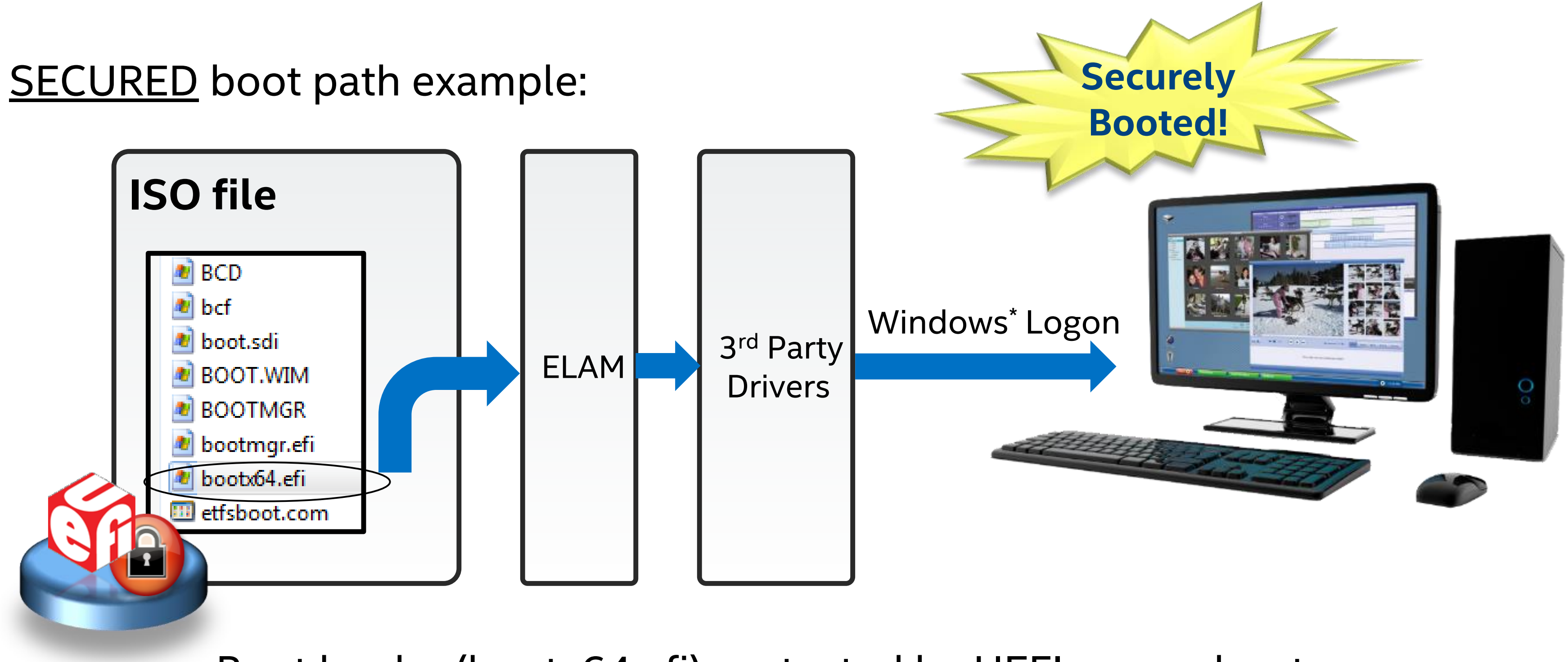
Apply Key Features to UEFI Development



Initial - UEFI Secure Boot

SECURED boot path example:



Securely Booted!

ISO file

- BCD
- bcf
- boot.sdi
- BOOT.WIM
- BOOTMGR
- bootmgr.efi
- bootx64.efi
- etfsboot.com

ELAM

3rd Party Drivers

Windows* Logon

- Boot loader (bootx64.efi) protected by UEFI secure boot
- Early Launch Anti-Malware (ELAM) protected by Boot loader
- Rootkit malware can no longer bypass anti-malware inspection

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Advanced – Customized UEFI Secure Boot

Deployment

Initial	Advanced
Platform Specific PK$_{pub}$ Clear	Standardized solution to customize the secure boot keys
Setup Mode User Mode	Setup Mode User Mode Audit Mode Deployed Mode

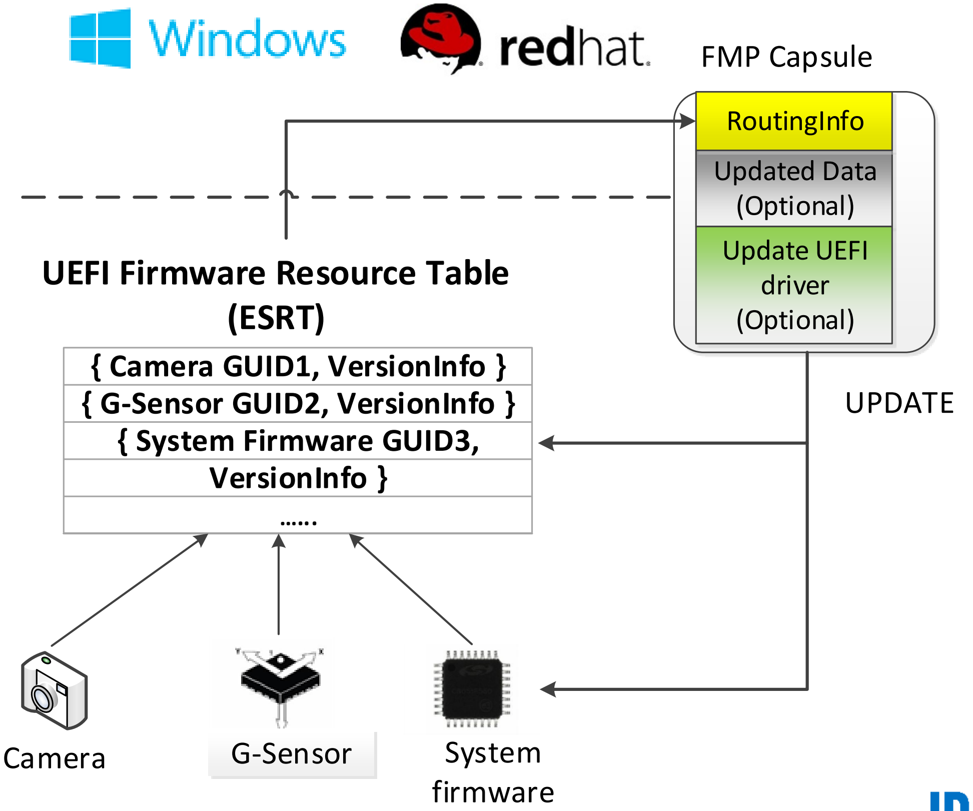
Benefits

• No specific solution	Security
• Higher utilization	Flexibility
• Verification status	Extensibility

Customized UEFI Secure Boot reduces the security risk introduced by platform specific solutions. Working w/ OS vendors on interoperability and readiness.

Secure Firmware Update

- Firmware update protected by:
  - OS verify the update driver when creating capsule
  - UEFI secure boot verify capsule payload before performing update
- What's new:
  - ESRT
  - FMPv3
  - FMP capsule



UEFI Firmware Resource Table (ESRT)

{ Camera GUID1, VersionInfo }

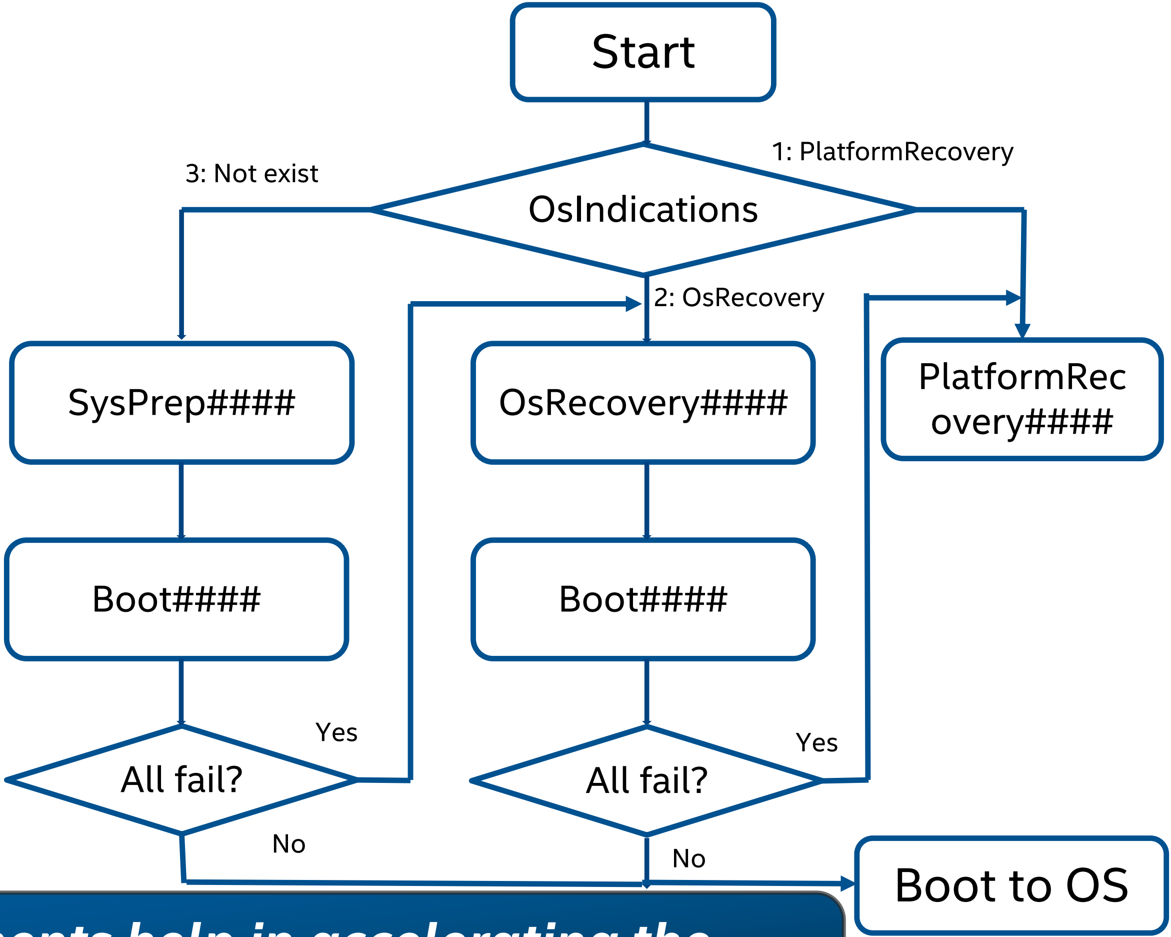
{ G-Sensor GUID2, VersionInfo }

{ System Firmware GUID3, VersionInfo }

……

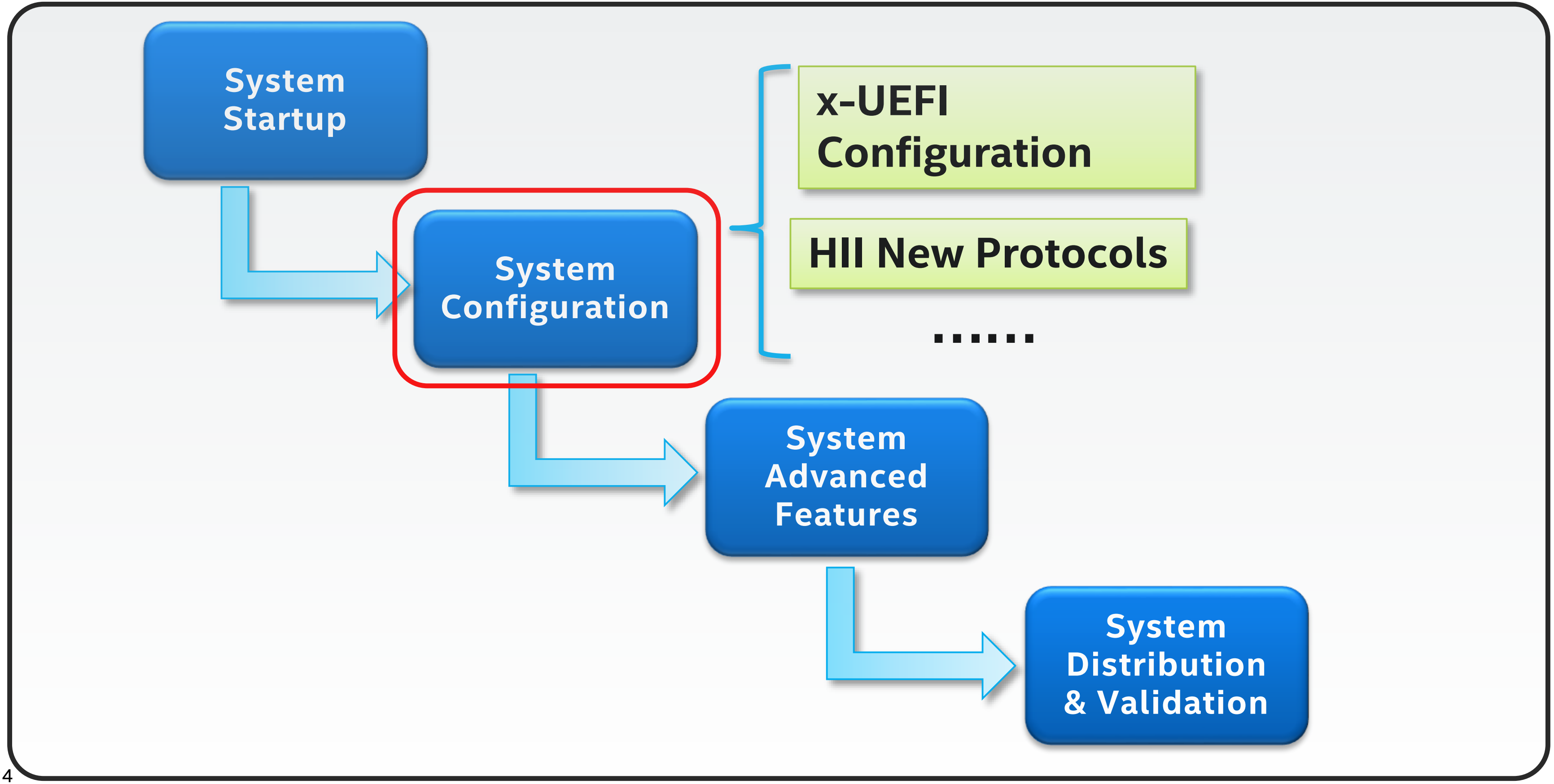
Boot Recovery

- What's new
  - OS defined recovery
  - Platform defined recovery
  - Recovery policy protected by authentication
    - OsRecoveryOrder
    - dbrDefault, dbr
  - Default platform recovery supported



Security enhancements help in accelerating the system startup stage

Apply Key Features to UEFI Development



System Startup

System Configuration

x-UEFI Configuration

HII New Protocols

......

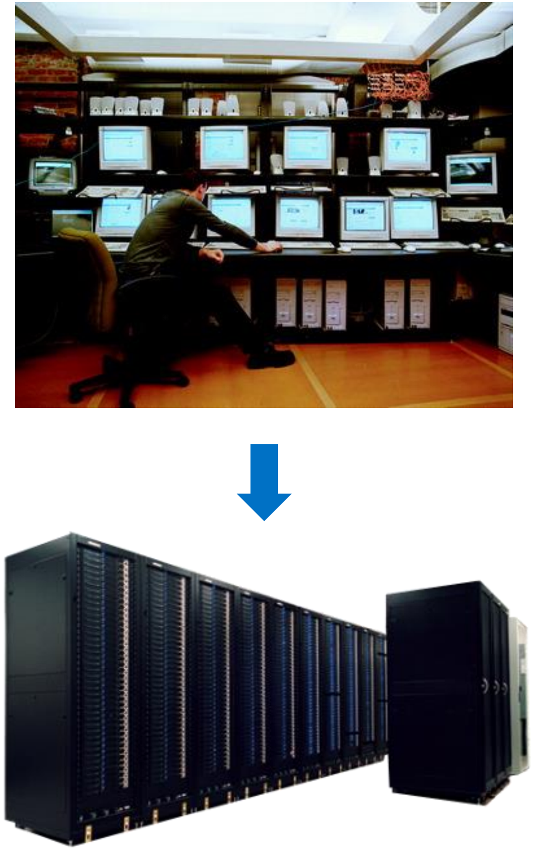
System Advanced Features

System Distribution & Validation

x-UEFI Scriptable Configuration

- Based on keywords defined in different namespaces
- Leverages existing UEFI HII infrastructure

- Key elements:
  - x-UEFI language
  - Keyword Handler Protocol



x-UEFI Usage Example

```
iSCSIInitiatorName
```

VFR file

```
string  varid    = ISCSI_CONFIG_IFR_NVDATA.InitiatorName,
            prompt   = STRING_TOKEN(STR_ISCSI_CONFIG_INIT_NAME),
```

UNI file

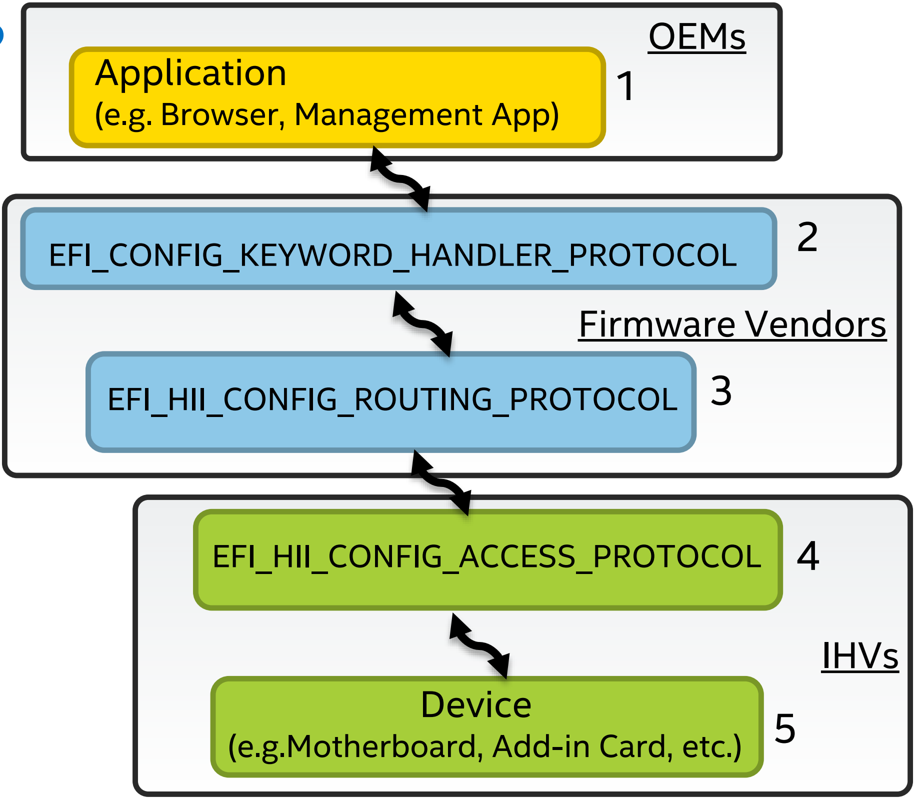
```
#string STR_ISCSI_CONFIG_INIT_NAME   #language en-US "iSCSI Initiator Name"
#string STR_ISCSI_CONFIG_INIT_NAME   #language x-UEFI "iSCSIInitiatorName"
```

Script file

```
IScsiScript -i iqn.edkii.intel.com
```

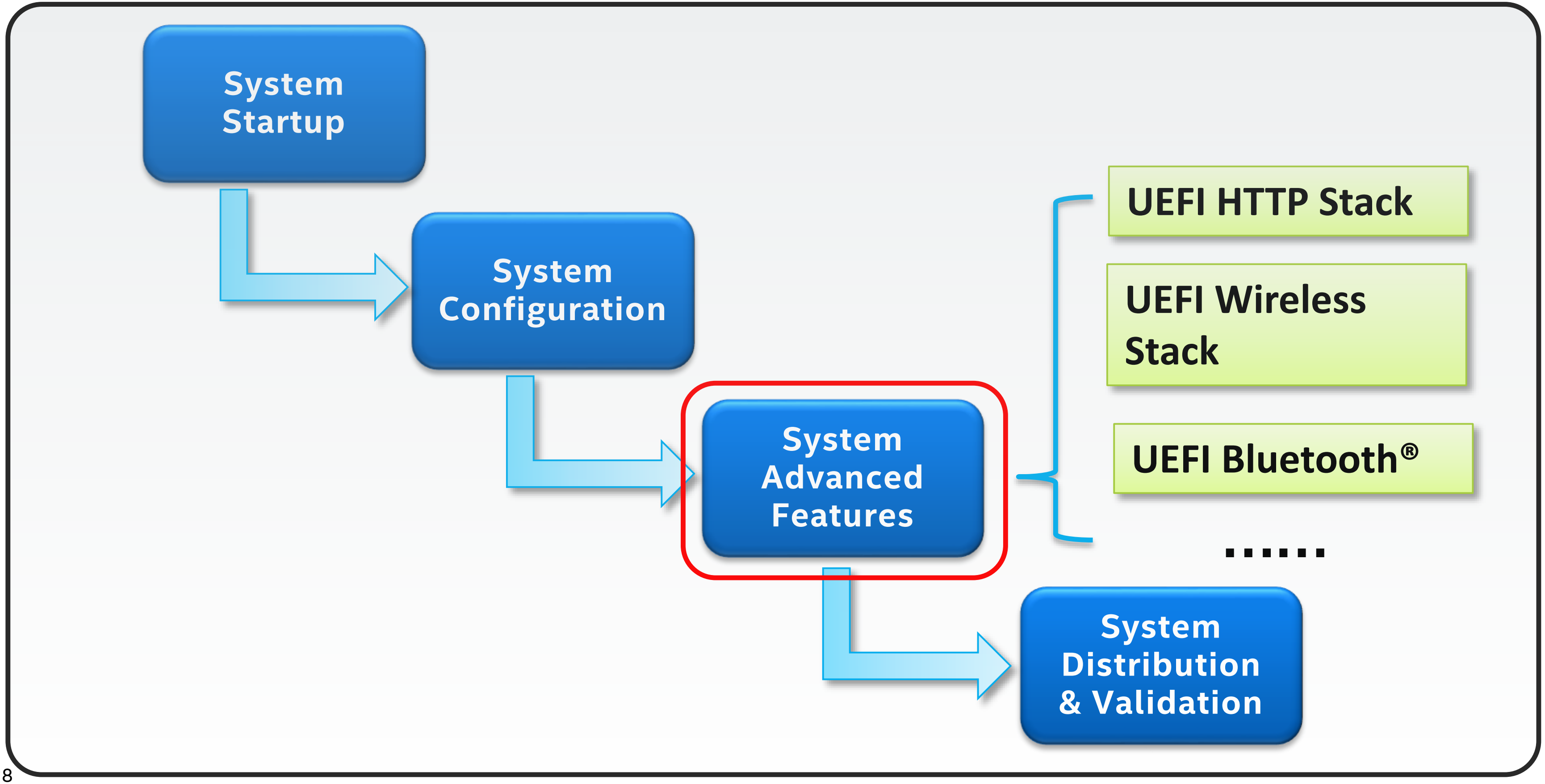
How to Implement x-UEFI?

- OEMs …
  - Get keywords definition from http://www.uefi.org/confignamespace
  - Use KeywordHandler.GetData/SetData
- Firmware vendors …
  - Get HII updates from Intel® UEFI Development Kit (Intel® UDK) 2015
- IHVs …
  - Define and register x-UEFI keywords
  - Support keyword setting in ConfigAccess.RouteConfig


OEMs
Application
(e.g. Browser, Management App)
1
EFI_CONFIG_KEYWORD_HANDLER_PROTOCOL
2
Firmware Vendors
EFI_HII_CONFIG_ROUTING_PROTOCOL
3
EFI_HII_CONFIG_ACCESS_PROTOCOL
4
IHVs
Device
(e.g.Motherboard, Add-in Card, etc.)
5

Configuration enhancements help in accelerating the in-band startup during the system configuration stage

Apply Key Features to UEFI Development



System Startup

System Configuration

System Advanced Features

System Distribution & Validation

UEFI HTTP Stack

UEFI Wireless Stack

UEFI Bluetooth®

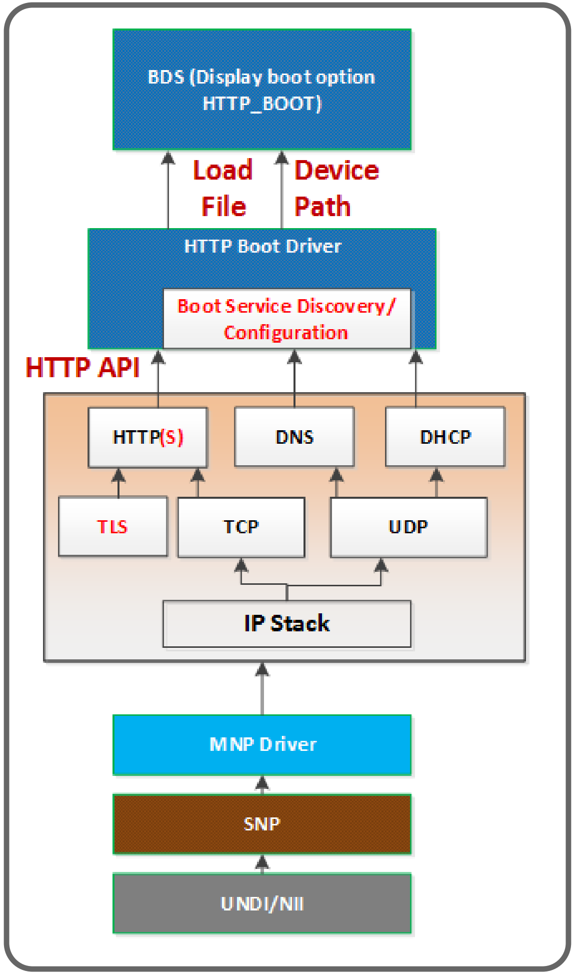
……

UEFI HTTP Stack

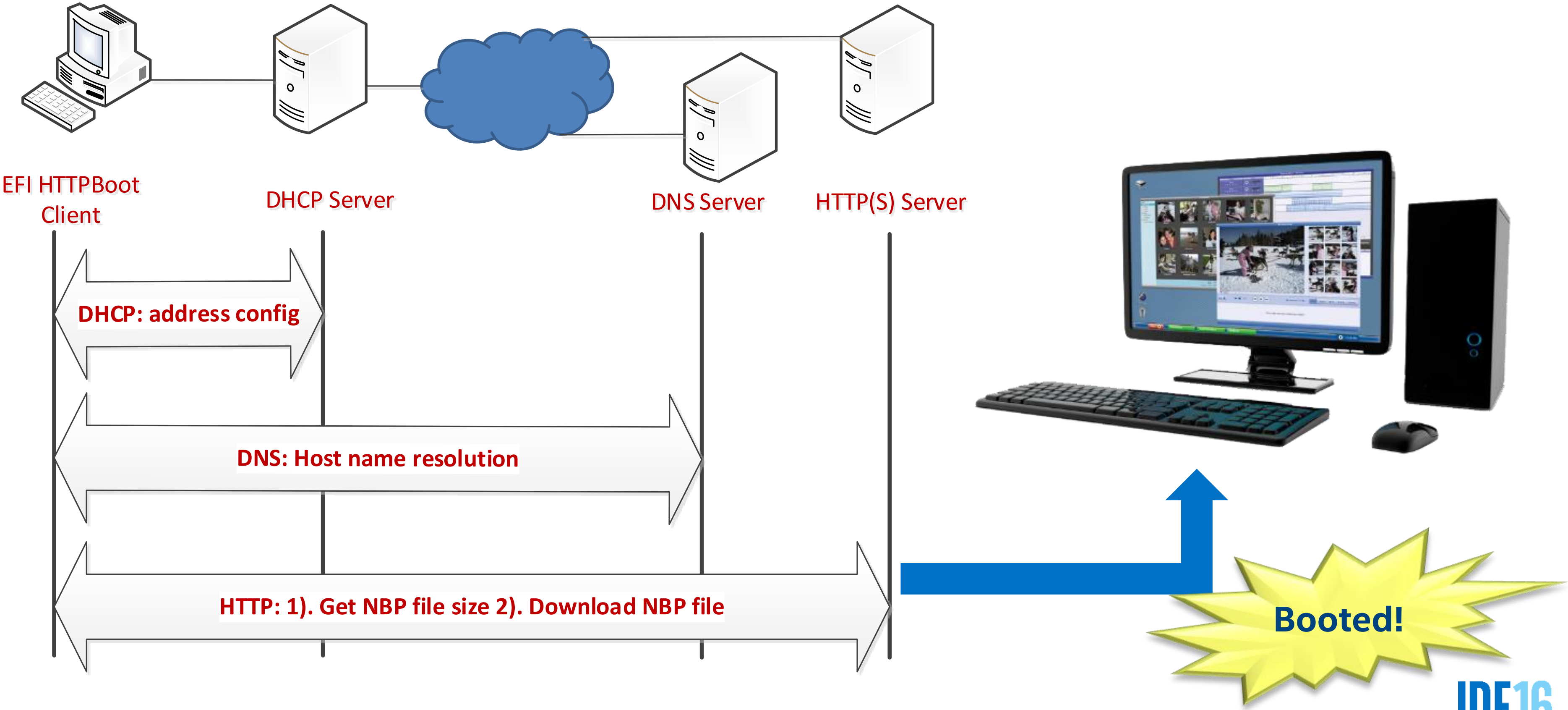
New Modules

Driver	Library
HTTP Boot Driver HTTP Driver HTTP Utilities Driver TLS Driver	HTTP Library TlsLib Library OpenslTlsLib Library

- Flexible Network Deployment
- Home Environment Support
- Corporate Environment Support



HTTP(S) Boot Flow



EFI HTTPBoot Client

DHCP Server

DNS Server

HTTP(S) Server

DHCP: address config

DNS: Host name resolution

HTTP: 1). Get NBP file size 2). Download NBP file

Booted!

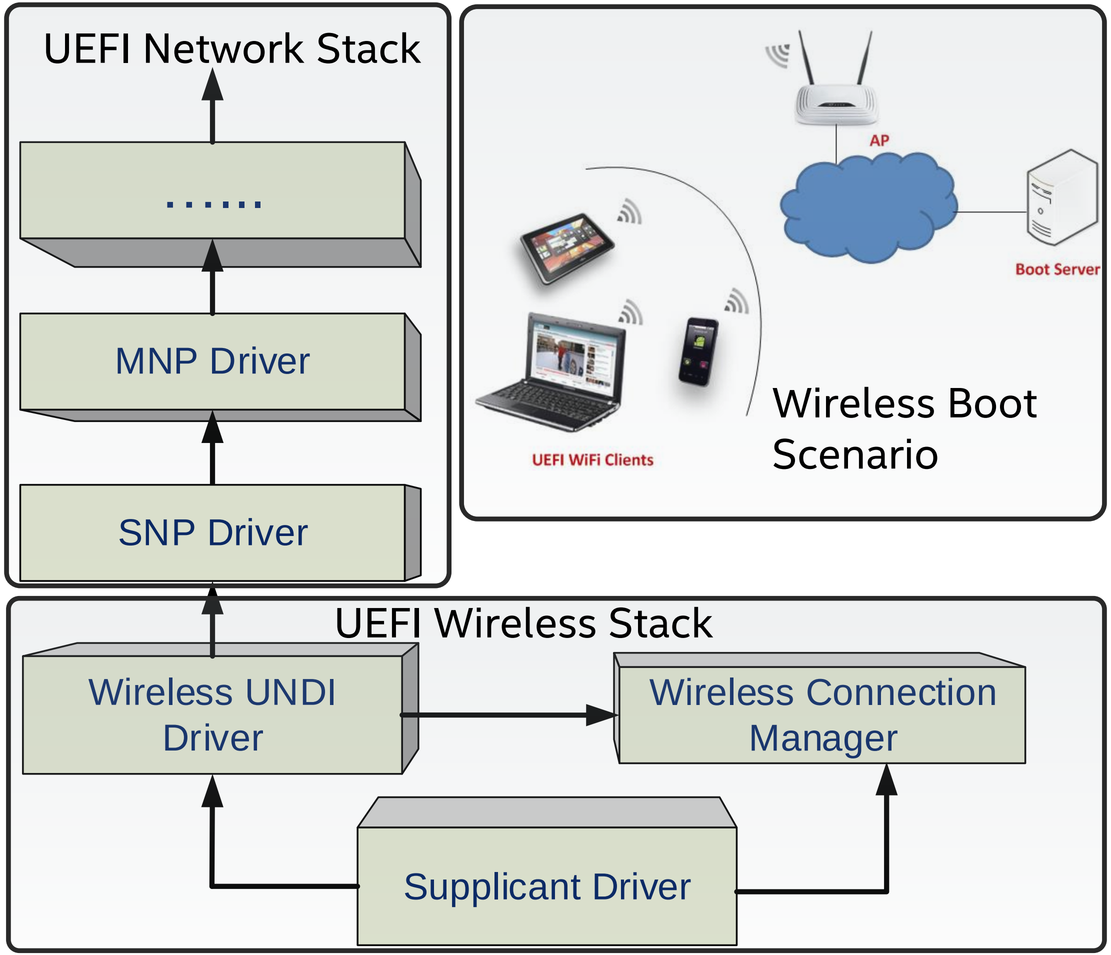
DEMO – UEFI HTTP(S) Boot

- STEP 0: Configure TLS certificate
  - For HTTPS
- STEP 1: Configure Boot URI
  - Enter Device Manager
  - Select a particular NIC
  - Enter HTTP boot Configuration
  - Enter Boot URI and save changes
- STEP 2: Find boot option
  - Enter Boot Manager
  - Select new added boot option
- STEP 3: Boot to Windows* Pre-installation Environment image

TLS is still a patch. Cert management is not secured so far. Want to work w/ the community to harden and OS vendors for interoperability.

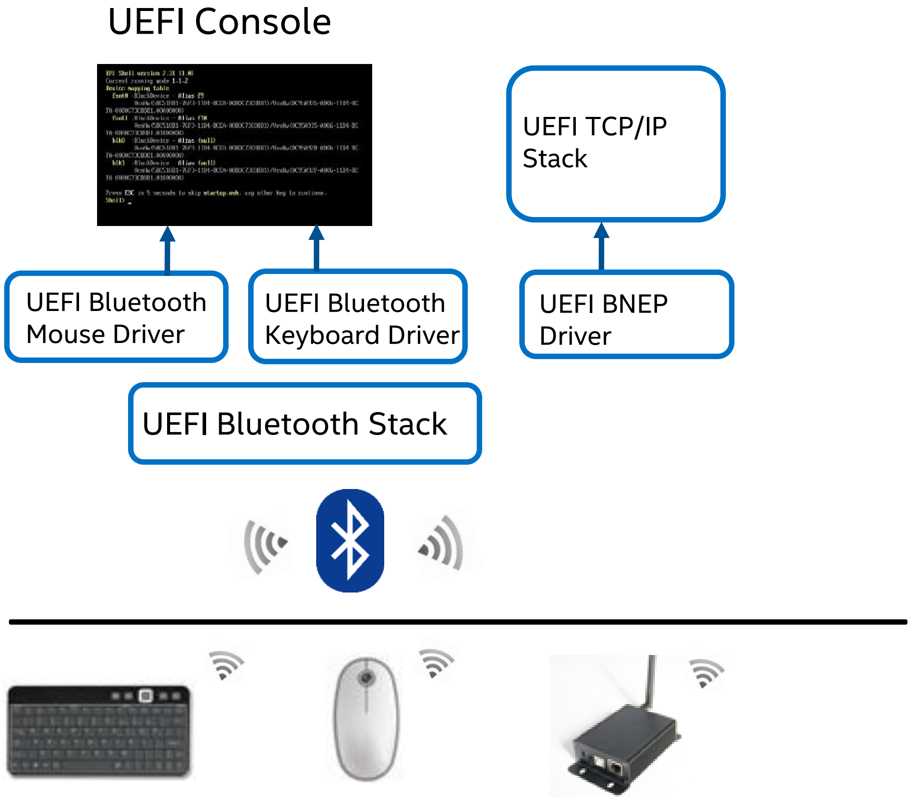
UEFI Wireless Stack

- 802.11 compliant wireless stack:
  - Connection manager using HII
  - Generic supplicant capability includes
    - PSK authentication
    - EAP 802.1x authentication
  - CCMP encryption



UEFI Bluetooth®

- Produce generic I/O interface:
  - UEFI device drivers can easily deliver rich services
- UEFI Bluetooth® Stack Layer:
  - Bluetooth® host controller
  - Bluetooth® bus
  - Bluetooth® service



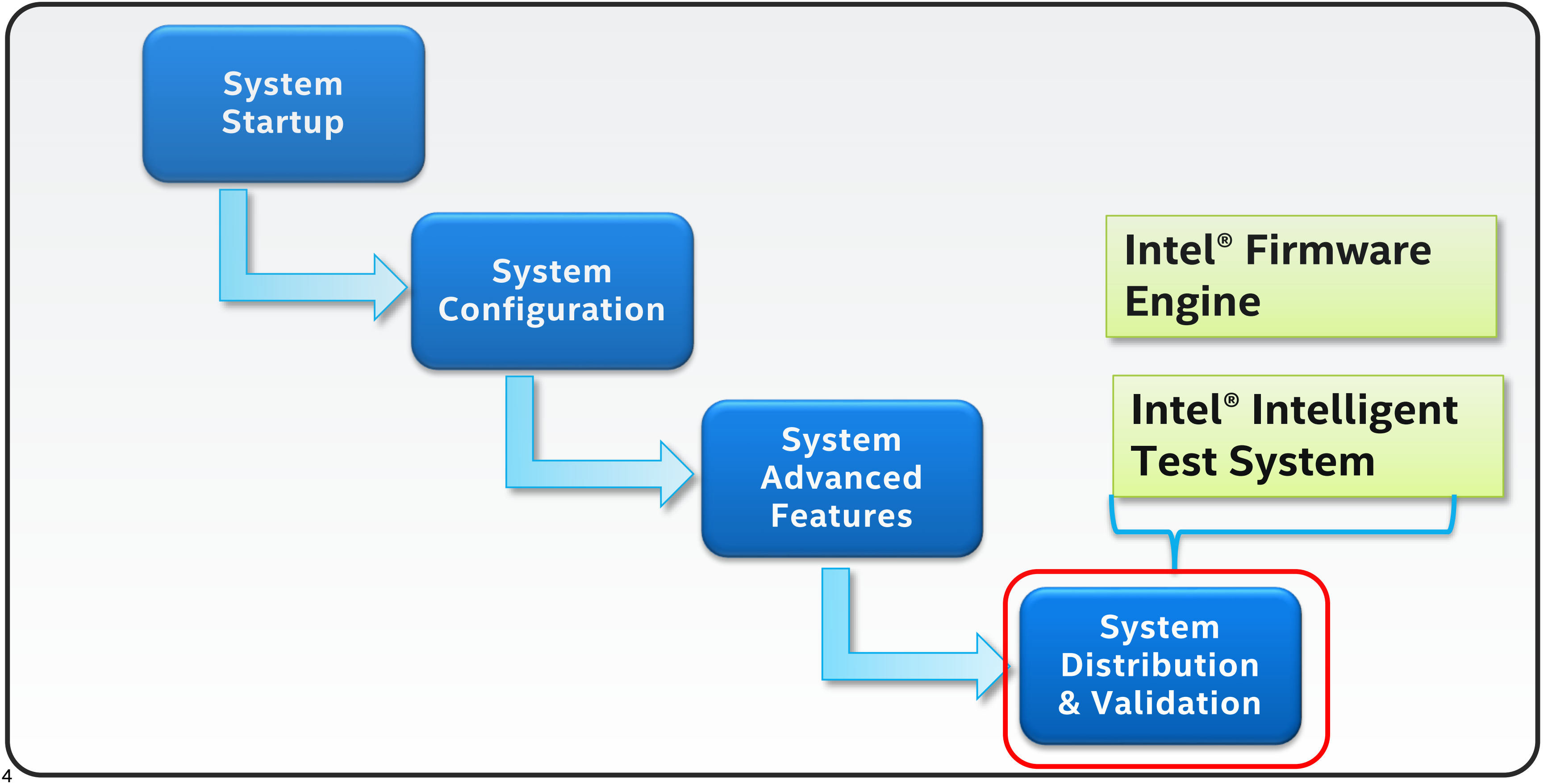
UEFI Console

```
EFI Shell version 2.31 [1.0]
Current running mode 1.1.2
Device mapping table
  fsnt0 :BlockDevice - Alias f9
          VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A935-A006-11D4-BC
FA-0080C73C8881,00000000)
  fsnt1 :BlockDevice - Alias f10
          VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A935-A006-11D4-BC
FA-0080C73C8881,01000000)
  blk0  :BlockDevice - Alias (null)
          VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A928-A006-11D4-BC
FA-0080C73C8881,00000000)
  blk1  :BlockDevice - Alias (null)
          VenHw(58C518B1-76F3-11D4-BCEA-0080C73C8881)/VenHw(0C95A92F-A006-11D4-BC
FA-0080C73C8881,01000000)

Press ESC in 5 seconds to skip startup.nsh, any other key to continue.
Shell> _
```

Leverage the connectivity enhancement during the stage of enabling advanced feature

Apply Key Features to UEFI Development



System Startup

System Configuration

System Advanced Features

System Distribution & Validation

Intel® Firmware Engine

Intel® Intelligent Test System

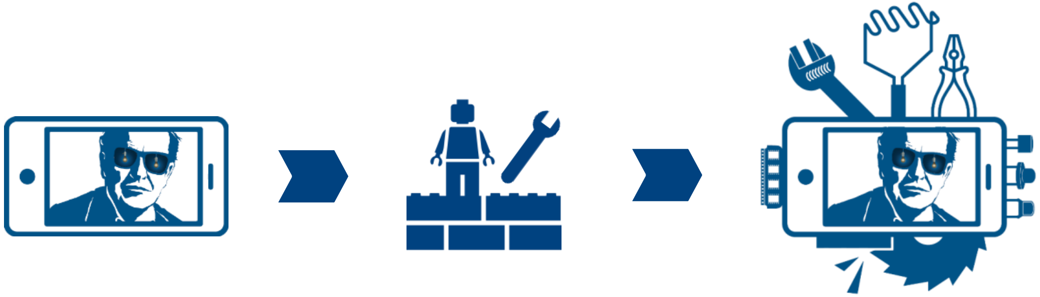
Intel® Firmware Engine

Quickly generate royalty-free firmware for IoT devices without source code

Extensible binary firmware framework

Start from validated reference designs

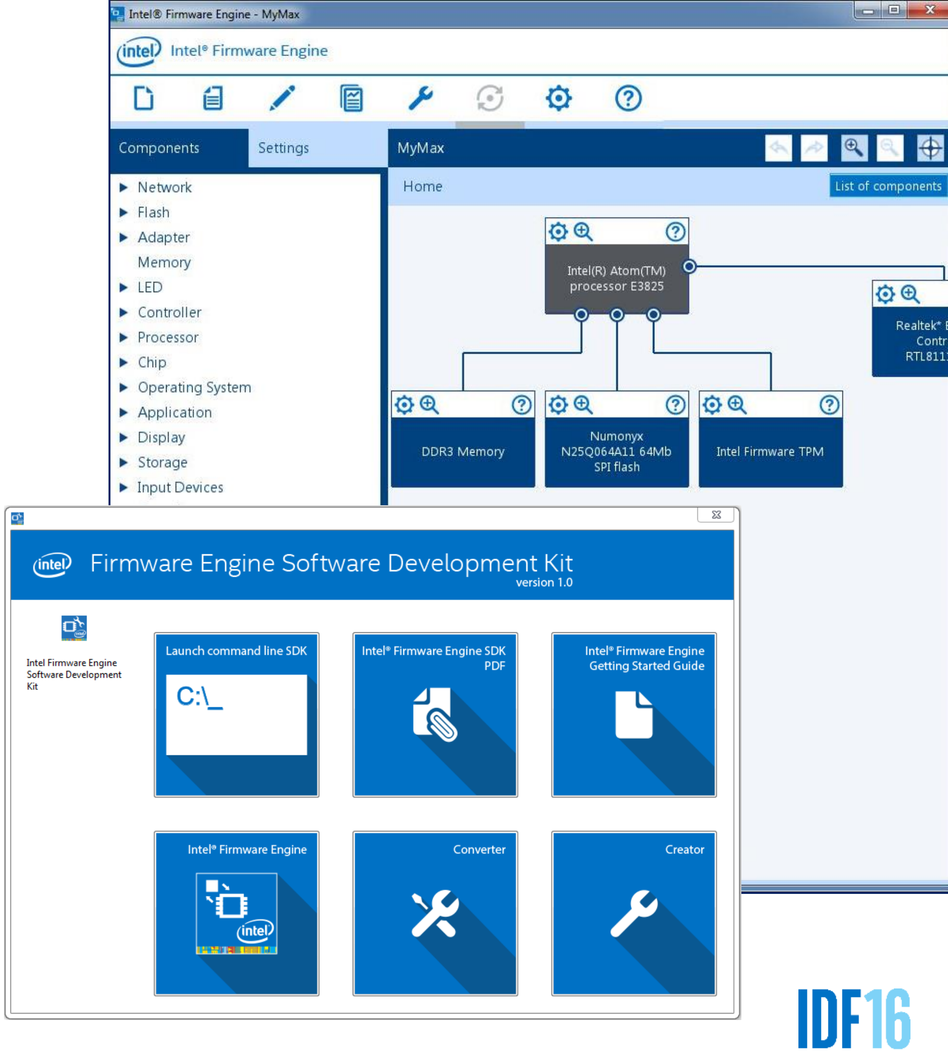
GUI development for faster time to market



Available now at intel.com/firmwareengine

Intel® Firmware Engine

- Application, SDK and open hardware platforms available for download at intel.com/firmwareengine
- Intel® Firmware Engine 2.0 just released
- Updated SDK due April 2016
- Additional platforms from the Intel IoT roadmap are under development



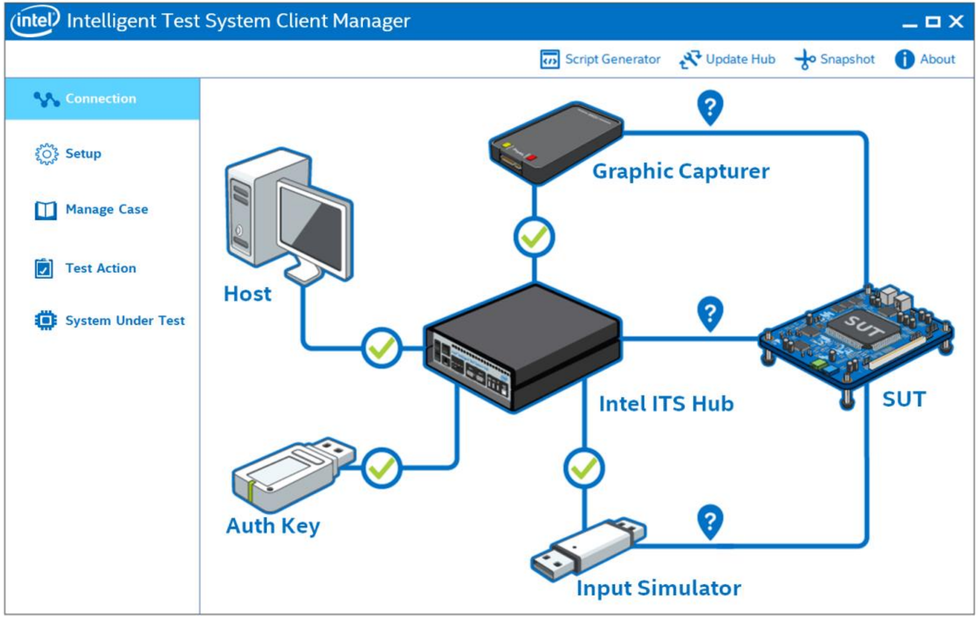
Intel® Intelligent Test System (Intel® ITS)

Scalable hardware/software test framework

Test automation, device control & UEFI code coverage

Reduce costs & improve validation efficiency

Intel® Firmware Engine and Intel® ITS simplify firmware distribution and validation



Available now at intel.com/intel-its

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Summary and Next Steps

- UEFI & ACPI specification updates help in accelerating firmware development
- Redfish used RESTful management in modern data center is a good use case of accelerating firmware development with UEFI advanced features
- More enhancements in security, configuration, networking are ready to be adopted
- Intel® Firmware Engine and Intel® Intelligent Test System simplify firmware distribution and validation

Next Steps:

- Adopt UEFI 2.6 implementations with UEFI advanced features
- Adopt Redfish implementations in servers and management software
- Working with the community more deeply to continue improving security, interoperability and readiness of UEFI advanced features

Additional Sources of Information

- A PDF of this presentation is available from our Technical Session Catalog: www.intel.com/idfsessionsSZ
- This URL is also printed on the top of Session Agenda Pages in the Pocket Guide.

- More web-based info:
  - Intel® Architecture Firmware Resource Center: firmware.intel.com
  - UEFI Forum Learning Center: uefi.org/learning_center
  - UEFI and ACPI Specifications: www.uefi.org/specs/
  - Redfish Specification: www.dmtf.org/standards/redfish

Intel EDK II & UEFI Developer Survey

Intel Software is conducting a survey to improve EDK II & UEFI development tools. We want to know about your compiler preferences, debug methods, and what we can do for the future of firmware.

http://intelcustomer.az1.qualtrics.com/SE/?SID=SV_6lJbxG5BYFFMPSl&Source=IDF

Other Technical Sessions

Session ID	Title	Day	Time	Room
✓ STTS001	Accelerating Firmware Development With UEFI Advanced Features	Wed	13:15	Auditorium
STTS002	Enhancing Real-time Communication User Experience on Internet with Intel® Collaboration Suite for WebRTC	Wed	14:30	Auditorium
STTS003	Planning and Predicting Big Data and IoT Solutions	Wed	15:45	Auditorium

✓ = DONE

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No computer system can be absolutely secure.

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Rev. 1/14/16

Backup

What’s New – UEFI Shell 2.2

- Network updates
- Allow **Execute()** to not nest new shells
- Add command line parameter to auto exit
- **setvar** command re-factor
- New command features

  `dh, disconnect, comp, dmem, cls, reset, pci, bcfg, dmpstore`

What’s New – PI Packaging 1.1

- Convey PCD settings with discrete sub-settings
- Localized name to a package
- Convey detailed Protocol/PPI/GUIDs produces information
- Convey usage for PCDs from binary modules
- Convey detailed Protocol/PPI/GUIDs consumes information
- Convey PCD display information
- Convey enumeration-like information for PCD (allow string)
- Abstract type support
- Convey detailed BY_START/TO_START interaction
- Convey install/produce limit information about Protocol/PPI/GUIDs

Sample Configuration Script Using HPREST Tool

```
# Login to iLO
hprest login https://clientilo.domain.com -u username -p password

# Configure UEFI network settings (Use Auto and DHCP defaults)
hprest set PreBootNetwork=Auto --selector HpBios.
hprest set Dhcpv4=Enabled

# Configure UEFI Shell startup script from URL
hprest set UefiShellStartup=Enabled
hprest set UefiShellStartupLocation=NetworkLocation
hprest set UefiShellStartupUrl=http://192.168.1.1/deploy/startup.nsh

# Set one-time-boot to Embedded UEFI Shell
hprest set Boot/BootSourceOverrideEnabled=Once --selector ComputerSystem.
hprest set Boot/BootSourceOverrideTarget=UefiShell

# Save and reboot server
hprest commit --reboot=ON
```