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UEFI & EDK II Training

UEFI AND PLATFORM INITIALIZATION (PI) BOOT FLOW & OVERVIEW

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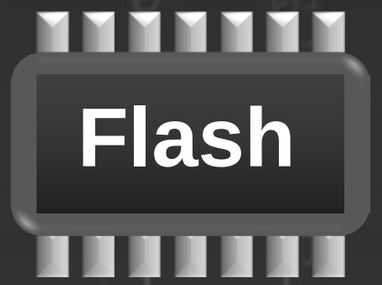
LESSON OBJECTIVE

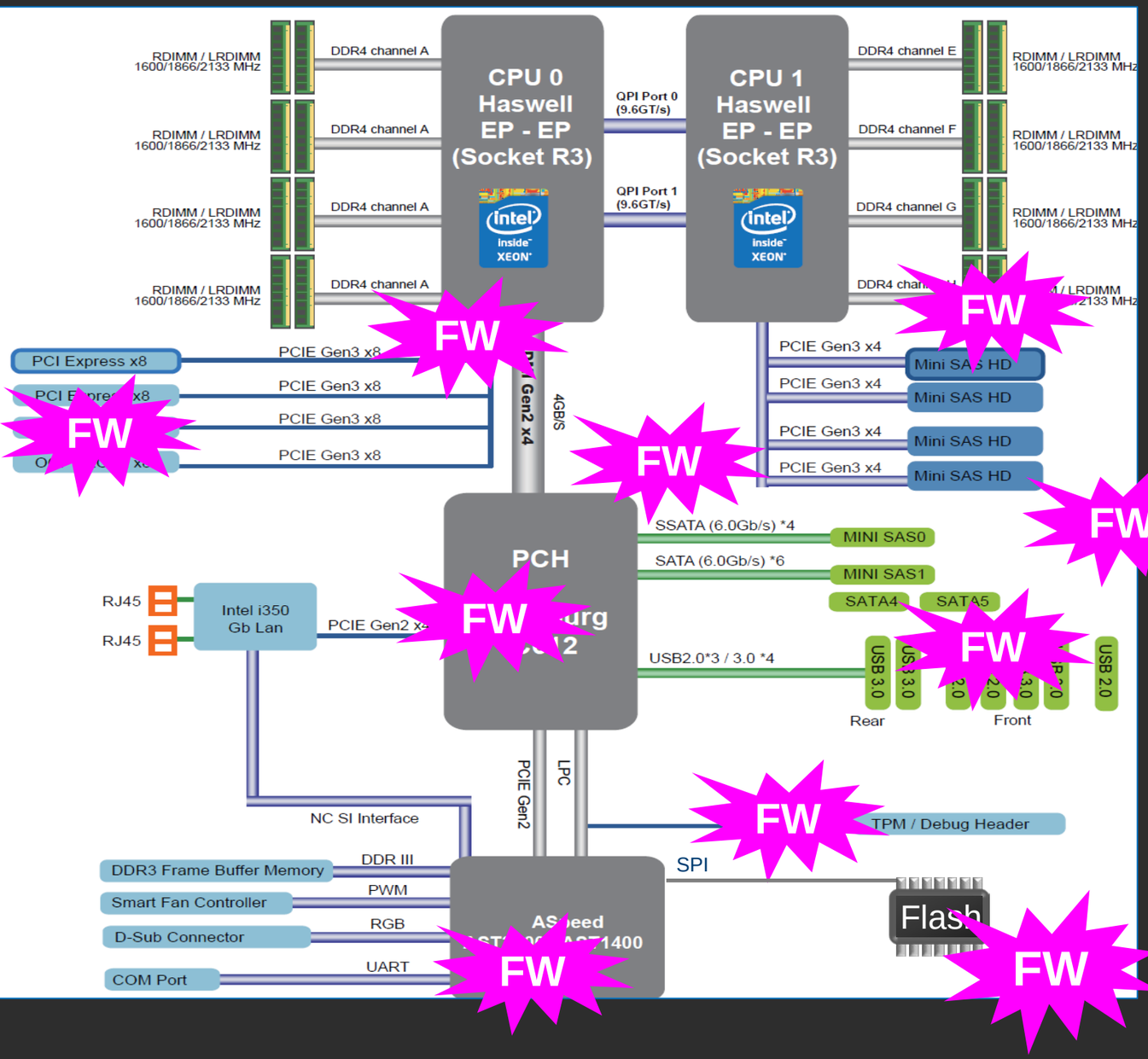
- Where is the System Firmware
- Review UEFI Platform Initialization Boot Flow Process
- What about Management Mode (Formerly Known as SMM)
- What is Intel® Firmware Support Package (Intel® FSP)
- The UEFI.org Forum & Tianocore.org

WHERE IS THE FIRMWARE

Where is the UEFI Firmware on a platform



Firmware is Everywhere

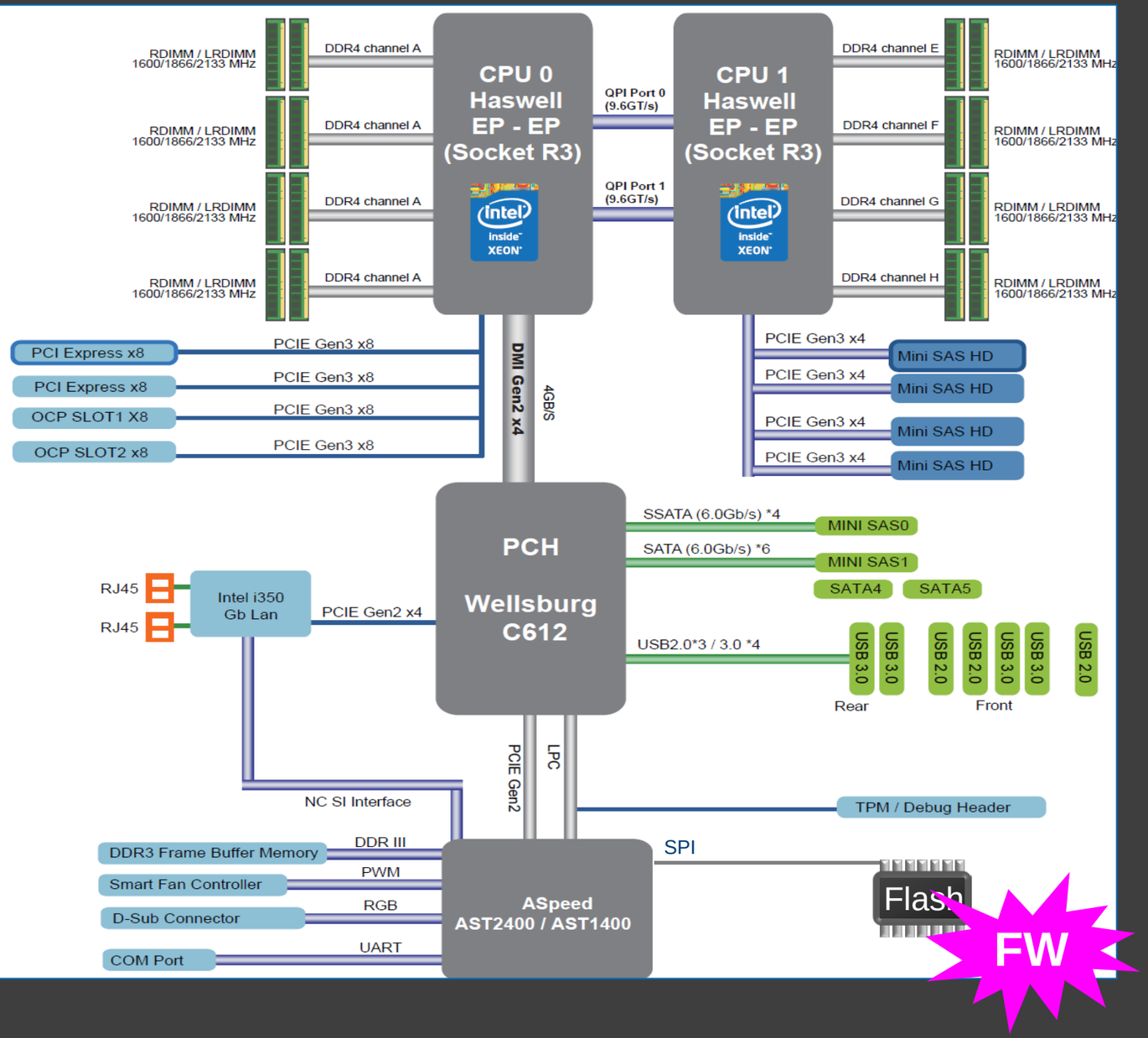


- GBe NIC, WiFi, Bluetooth, WiGig
- Baseband (3G, LTE) Modems
- Sensor Hubs
- NFC, GPS Controllers
- HDD/SSD
- Keyboard and Embedded Controllers
- Battery Gauge
- Baseboard Management Controllers (BMC)
- Graphics/Video
- USB Thumb Drives, keyboards/mice
- Chargers, adapters
- TPM, security coprocessors
- Routers, network appliances

Main system firmware (BIOS, UEFI firmware, coreboot)

Image source

Firmware is Everywhere



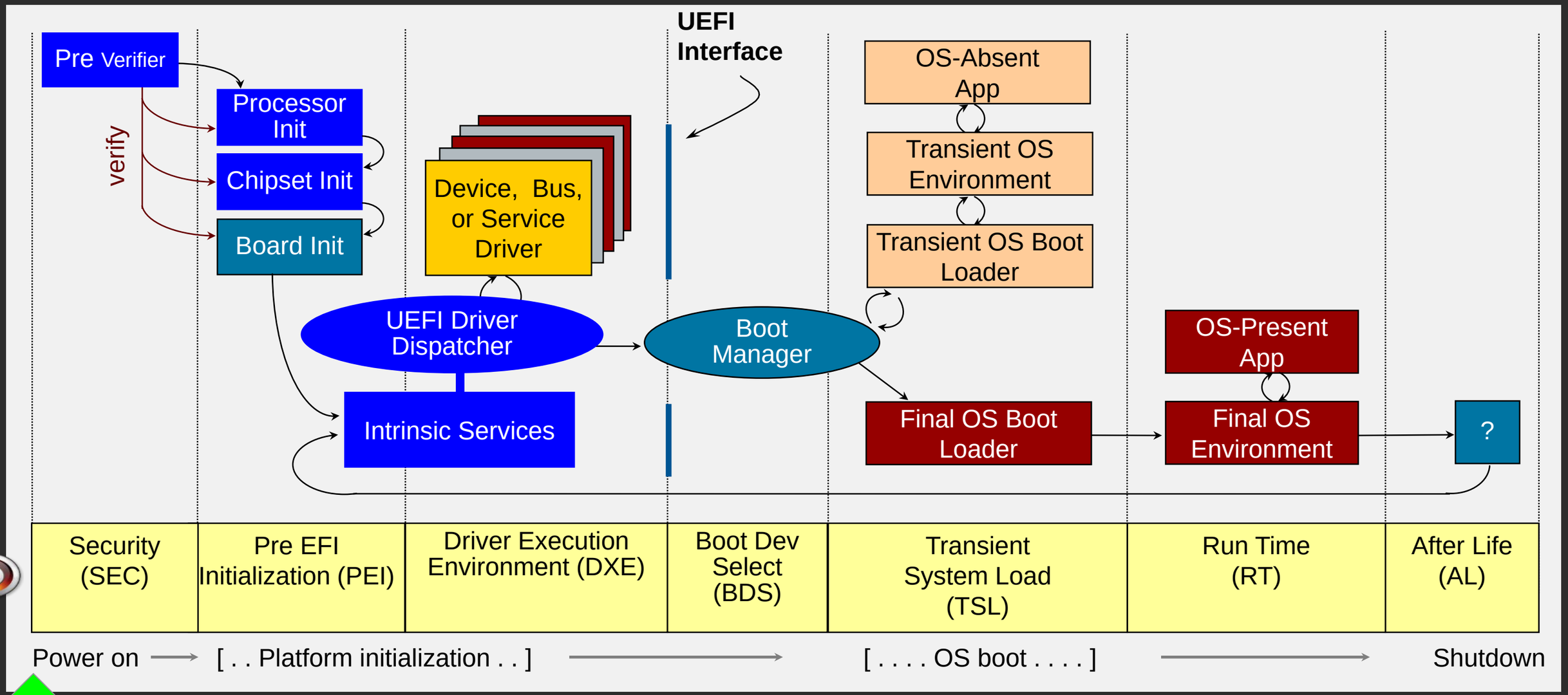
Main system firmware (BIOS, UEFI firmware, coreboot)

Image source

UEFI BOOT EXECUTION FLOW

Starting at the processor reset vector

UEFI – PI & EDK II BOOT FLOW - SEC

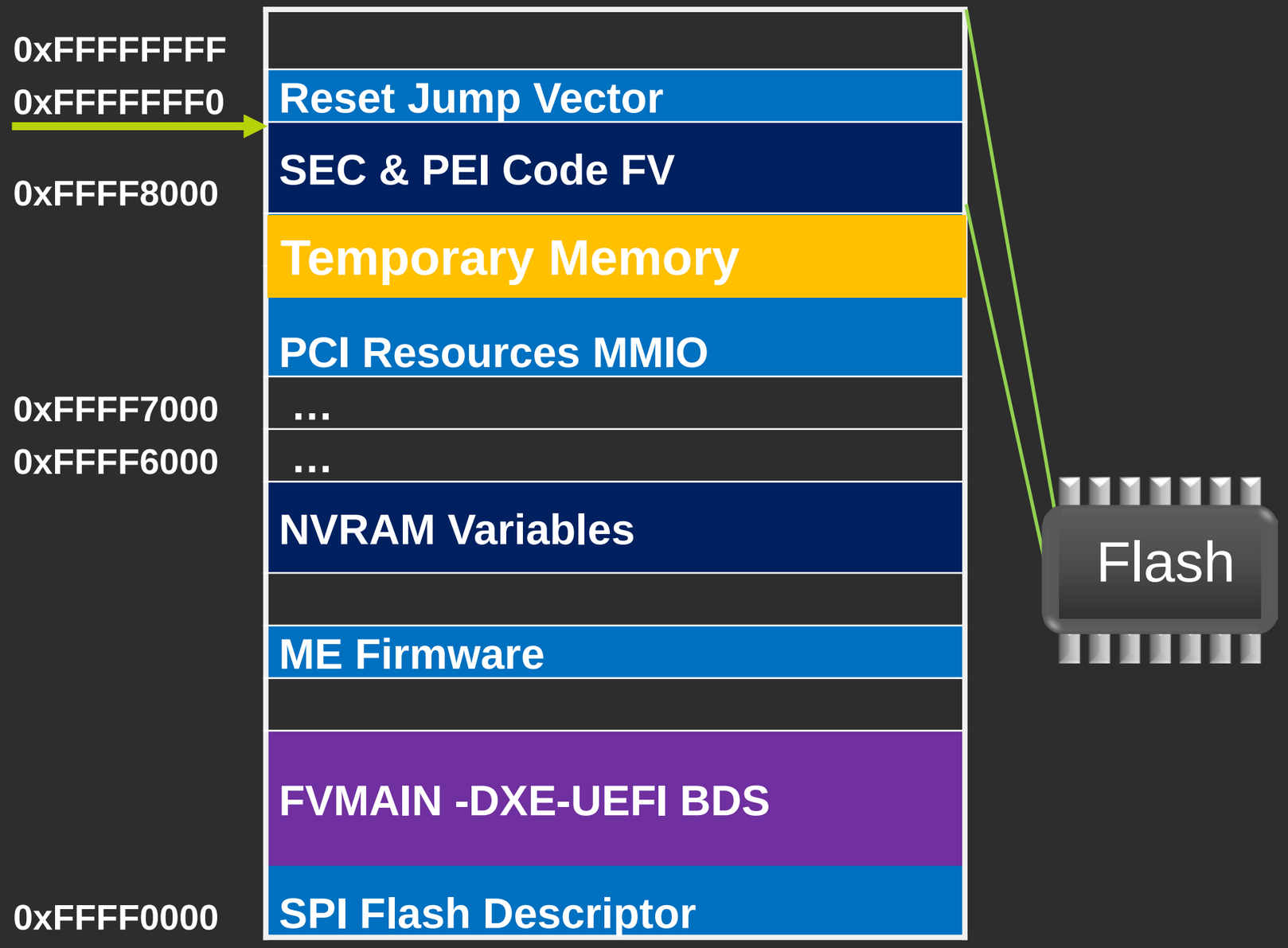


System Reset Vector
Stage 7 on IA

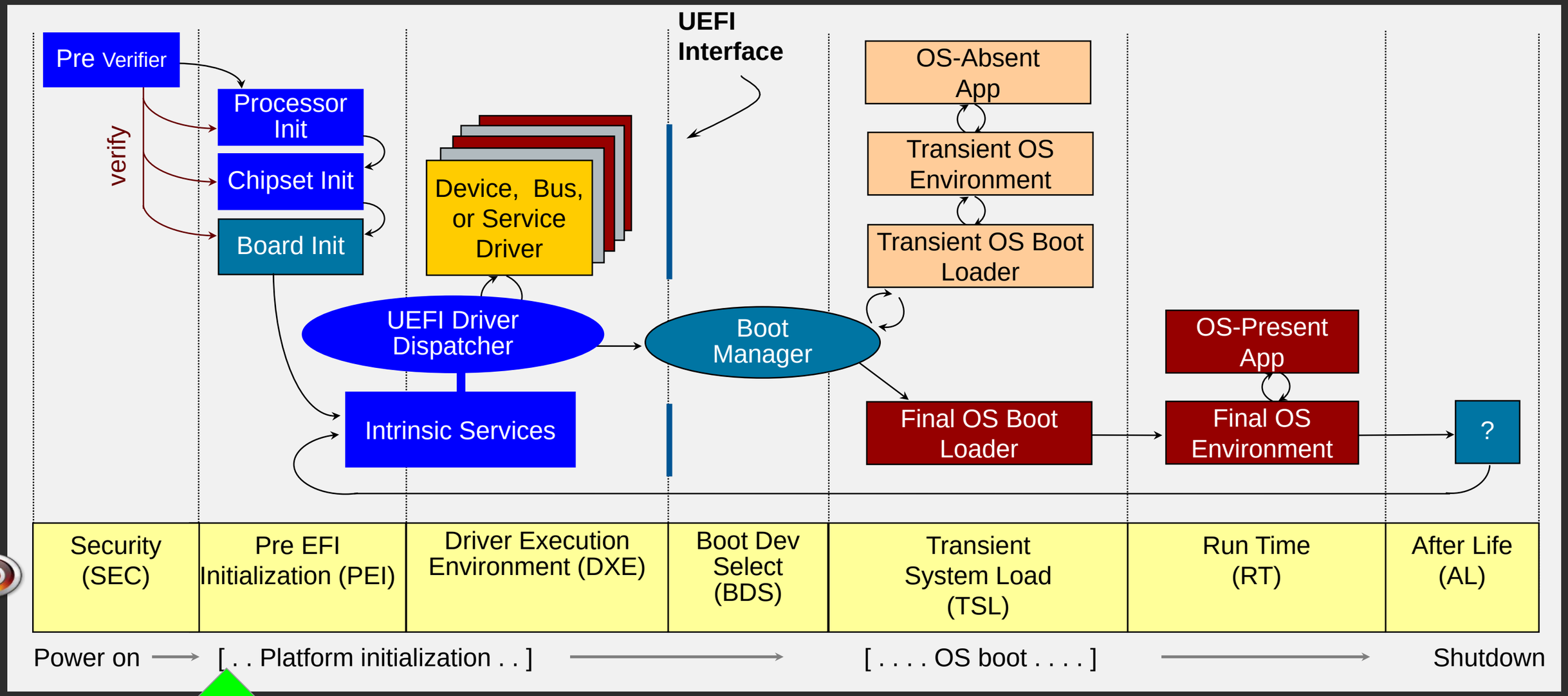
PRE-MEMORY INIT

Address space

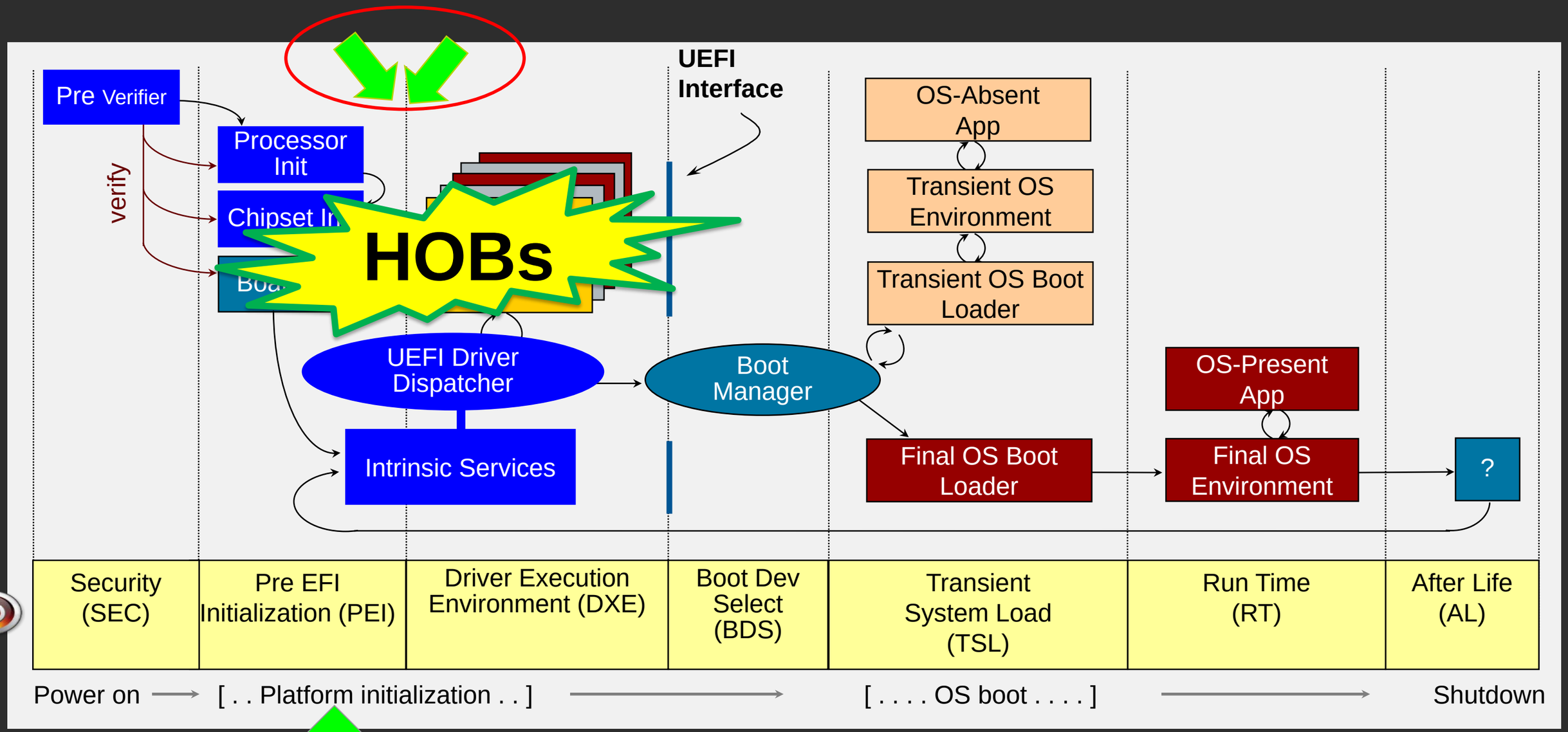
Reset 16 bit address
`0xFFFF:0000`



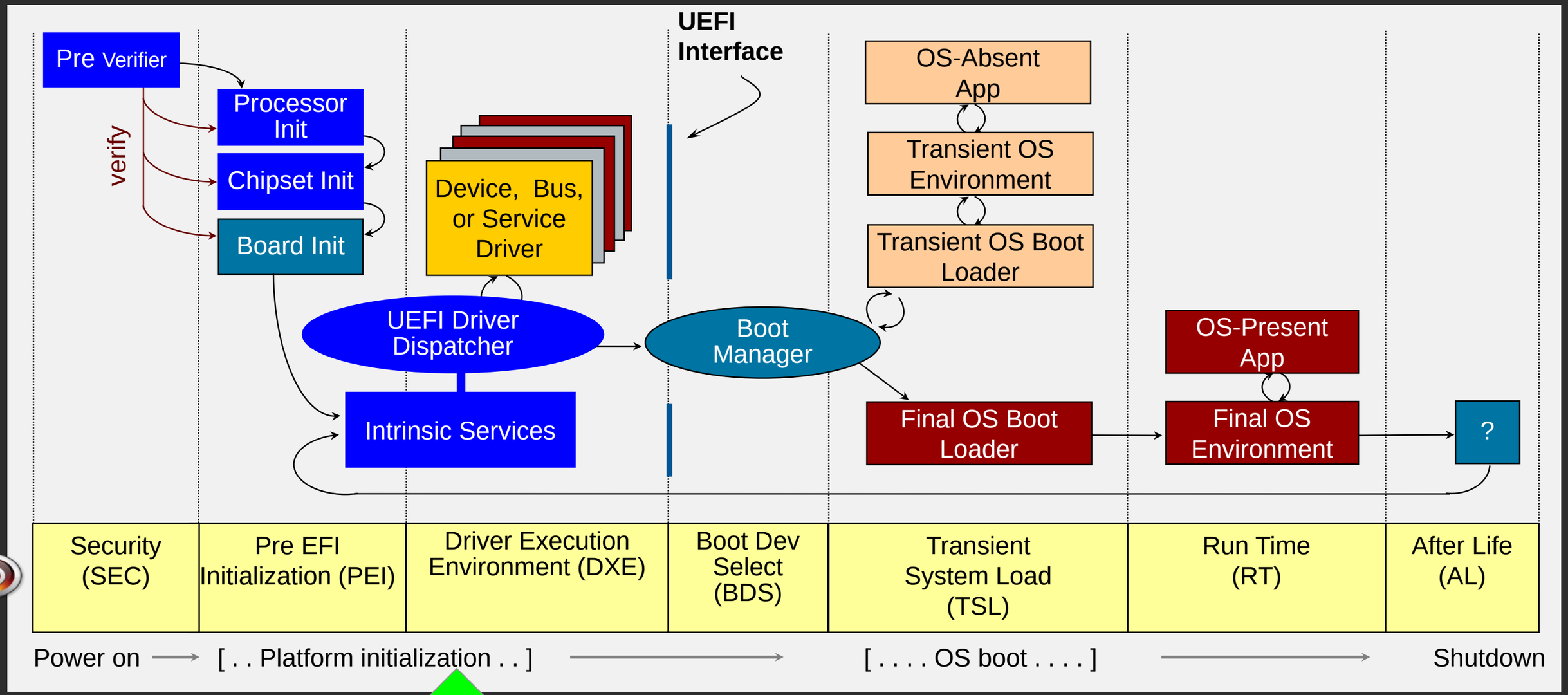
UEFI – PI & EDK II BOOT FLOW - PEI



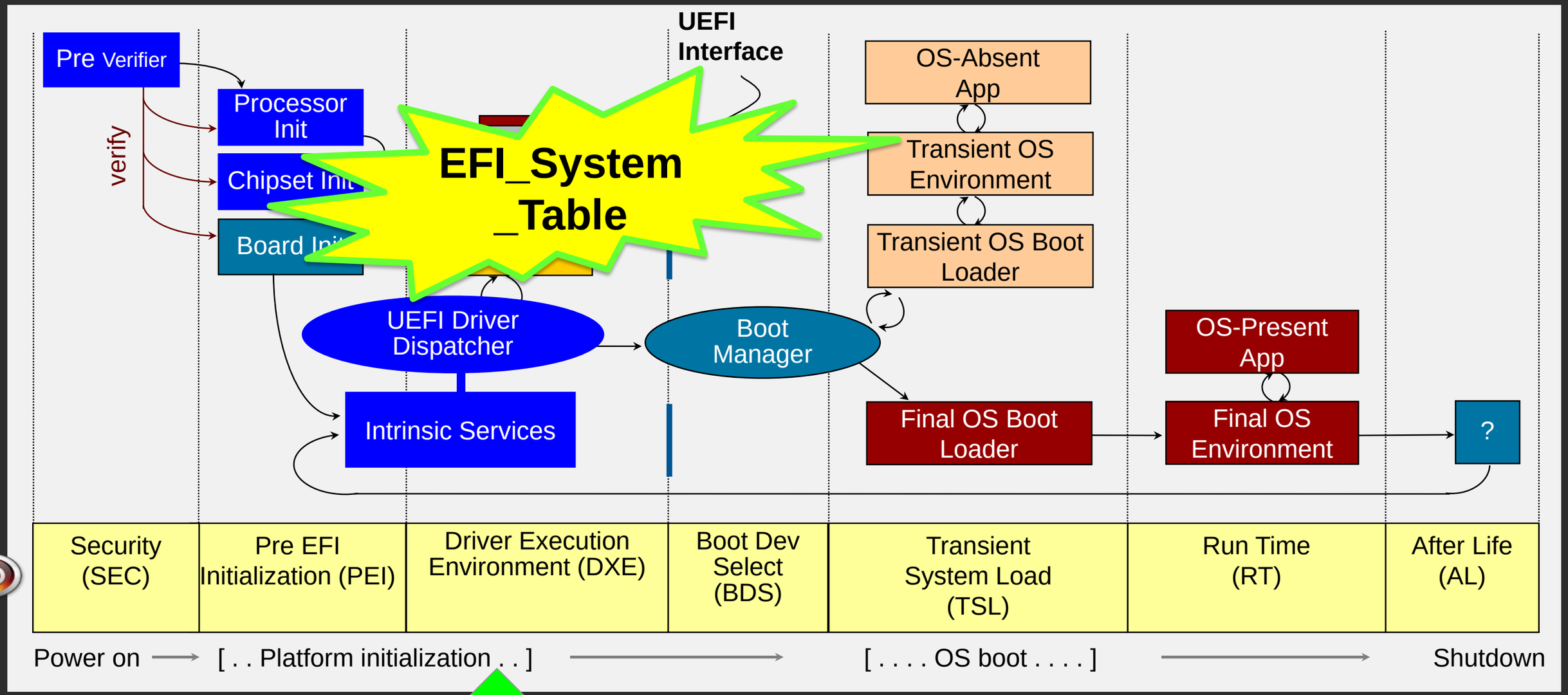
UEFI – PI & EDK II BOOT FLOW - DXEIPL



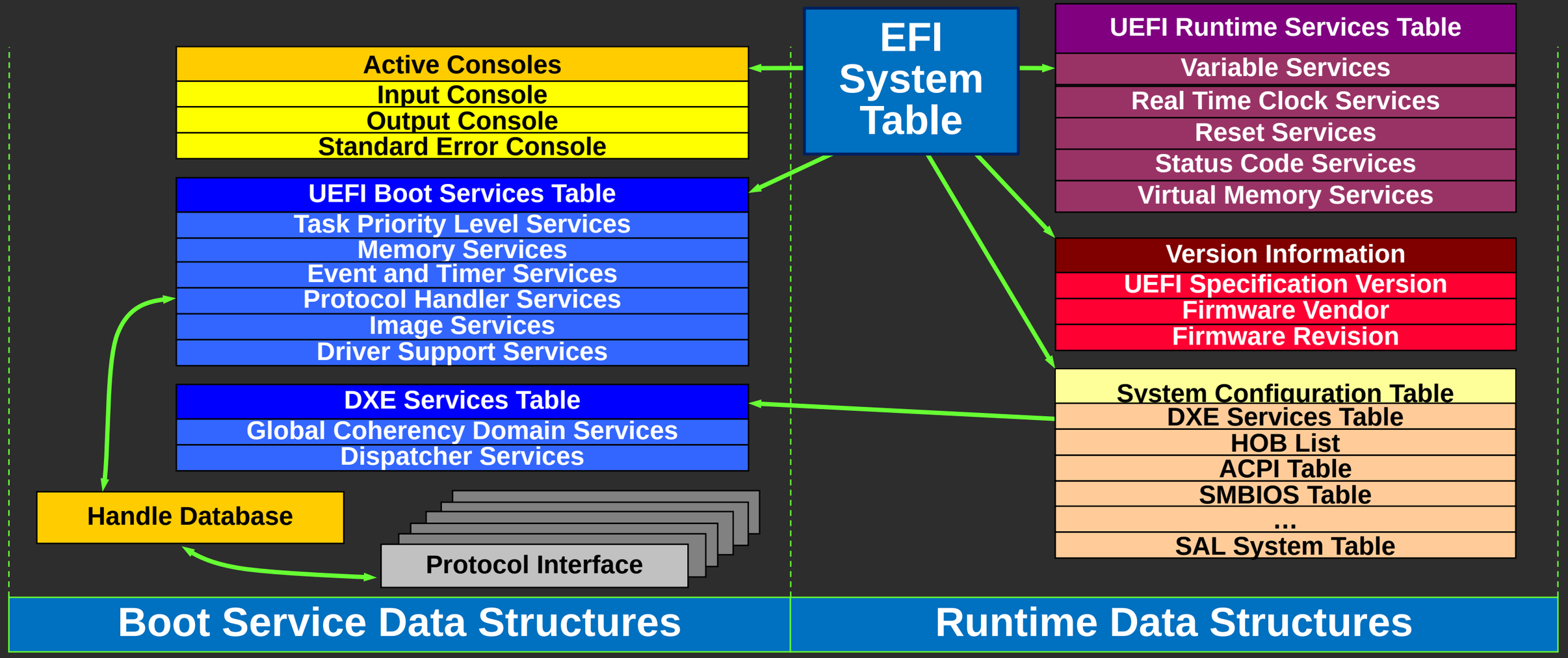
UEFI – PI & EDK II BOOT FLOW – DXE



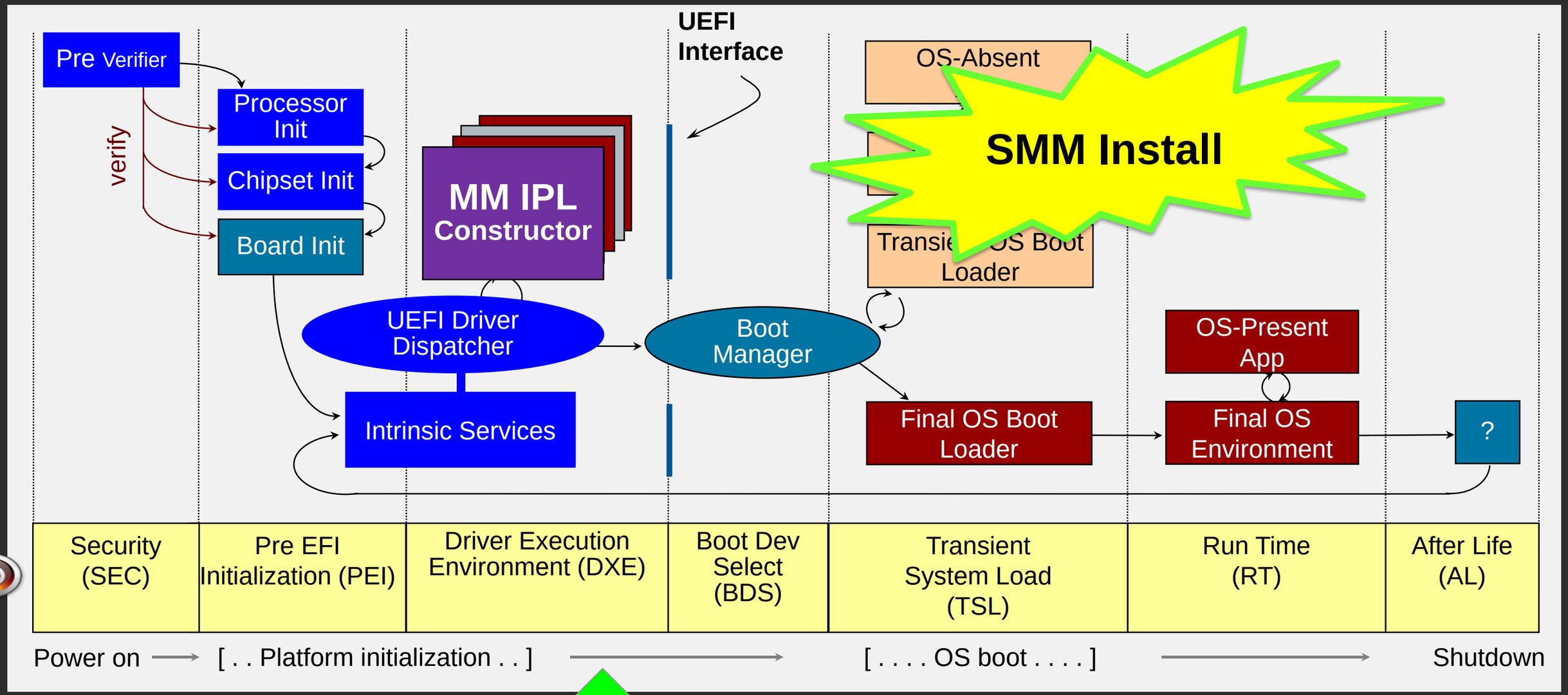
UEFI – PI & EDK II BOOT FLOW – DXE



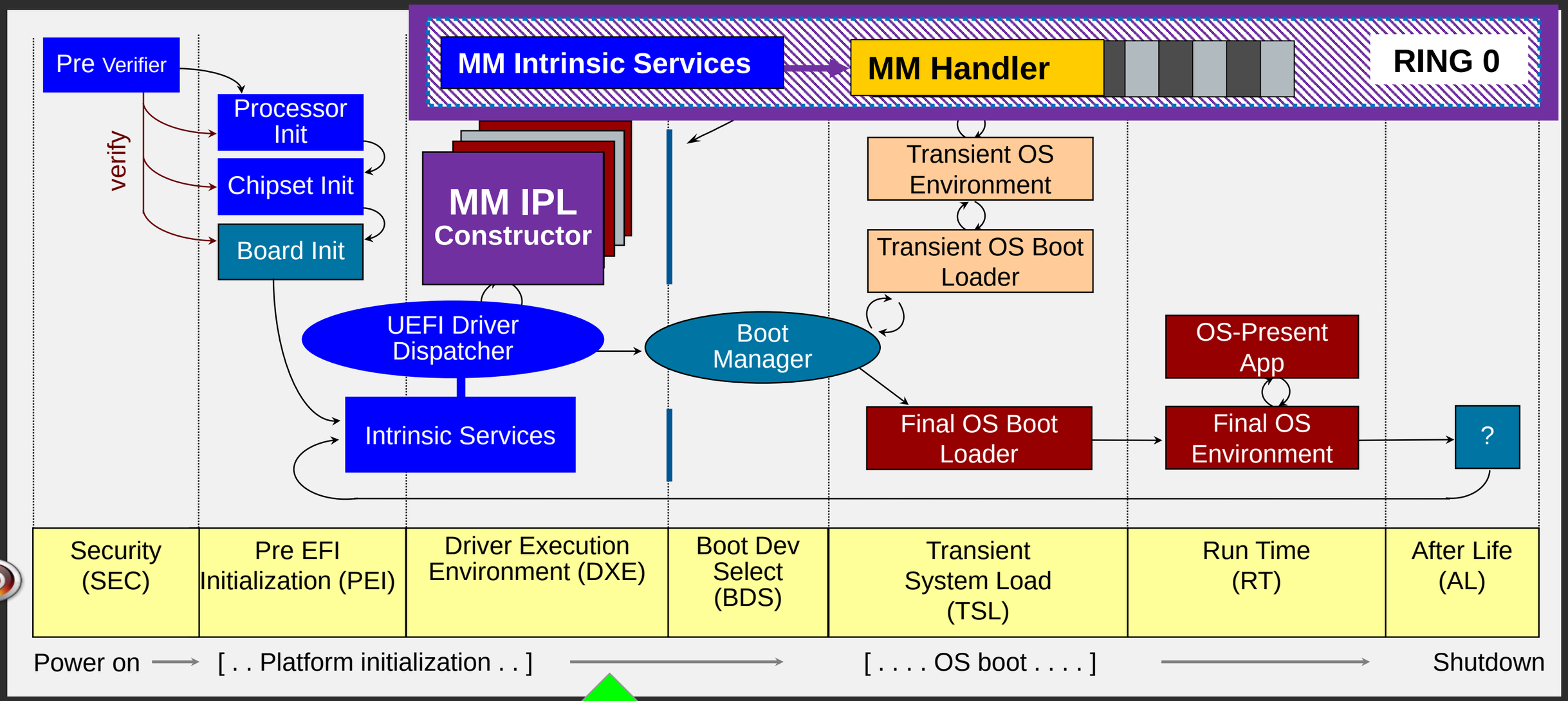
UEFI SYSTEM TABLE



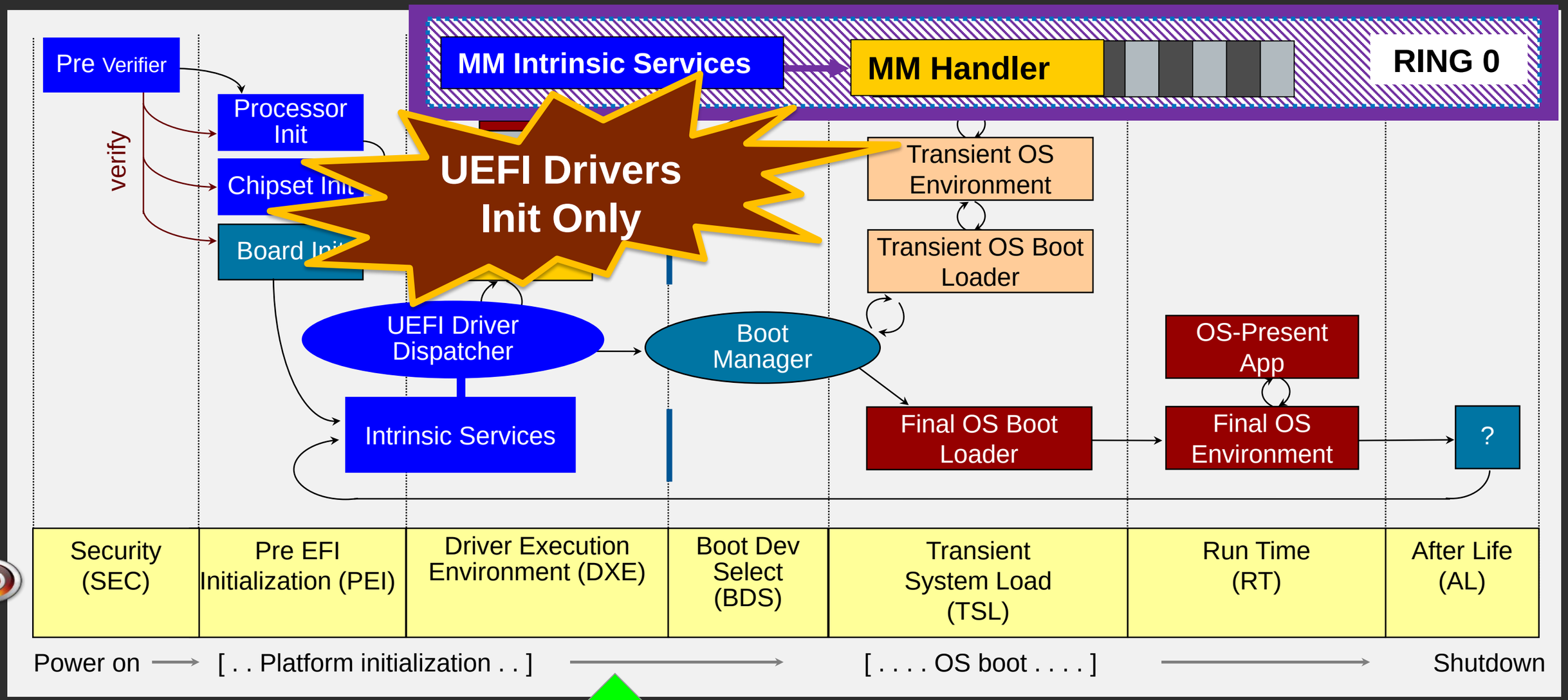
UEFI - PI & EDK II BOOT FLOW - SMM



UEFI - PI & EDK II BOOT FLOW - SMM



UEFI – PI & EDK II BOOT FLOW – DXE UEFI



UEFI Terminology

Protocols

- Interfaces consisting of functions and data structures named by a GUID and stored in the Handle Database

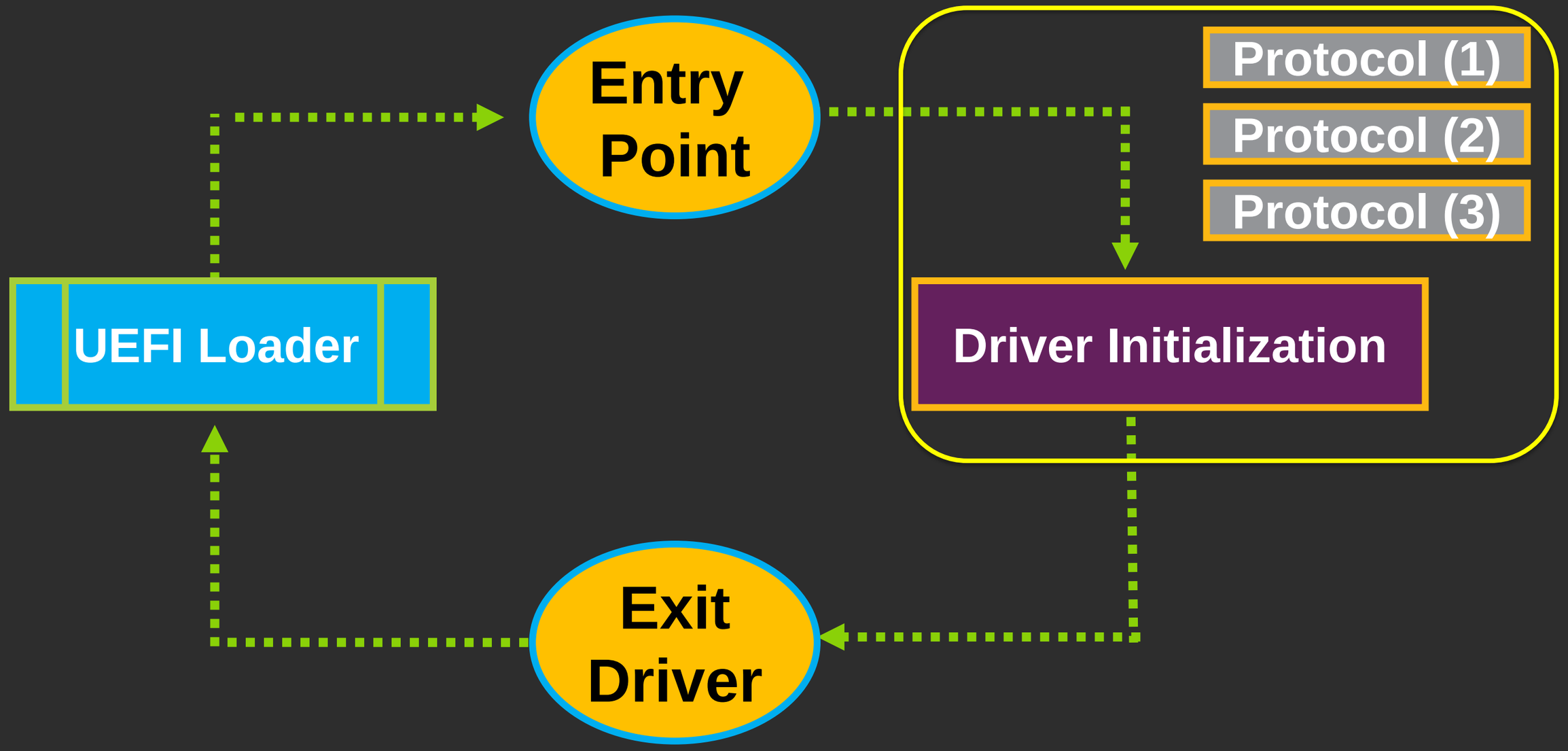
Handle Database

- Everything in the platform system gets a handle, drivers, devices, Images, etc.

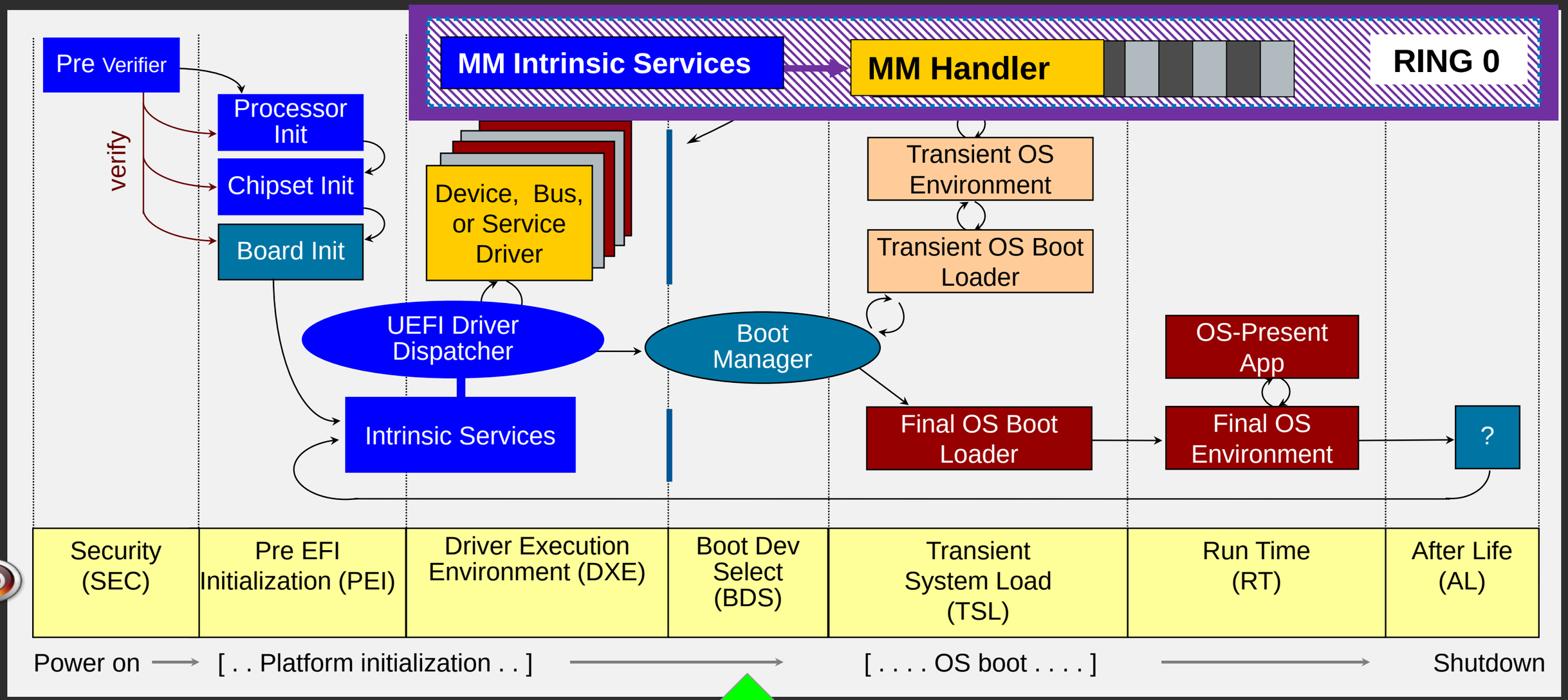
GUIDs

- The UEFI Platform only knows items in the Handle Database by its GUID

DXE Dispatcher Installs Drivers



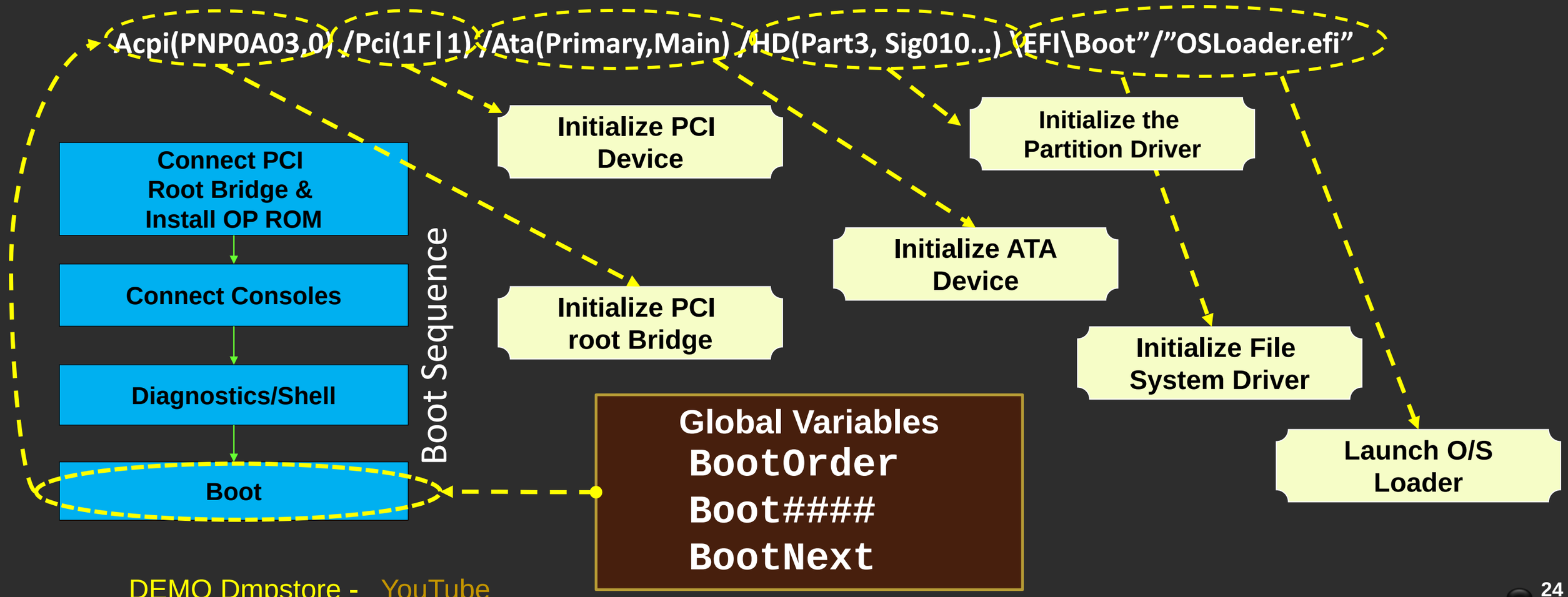
UEFI – PI & EDK II BOOT FLOW – BDS



UEFI DEVICE PATH AND GLOBAL VARIABLES

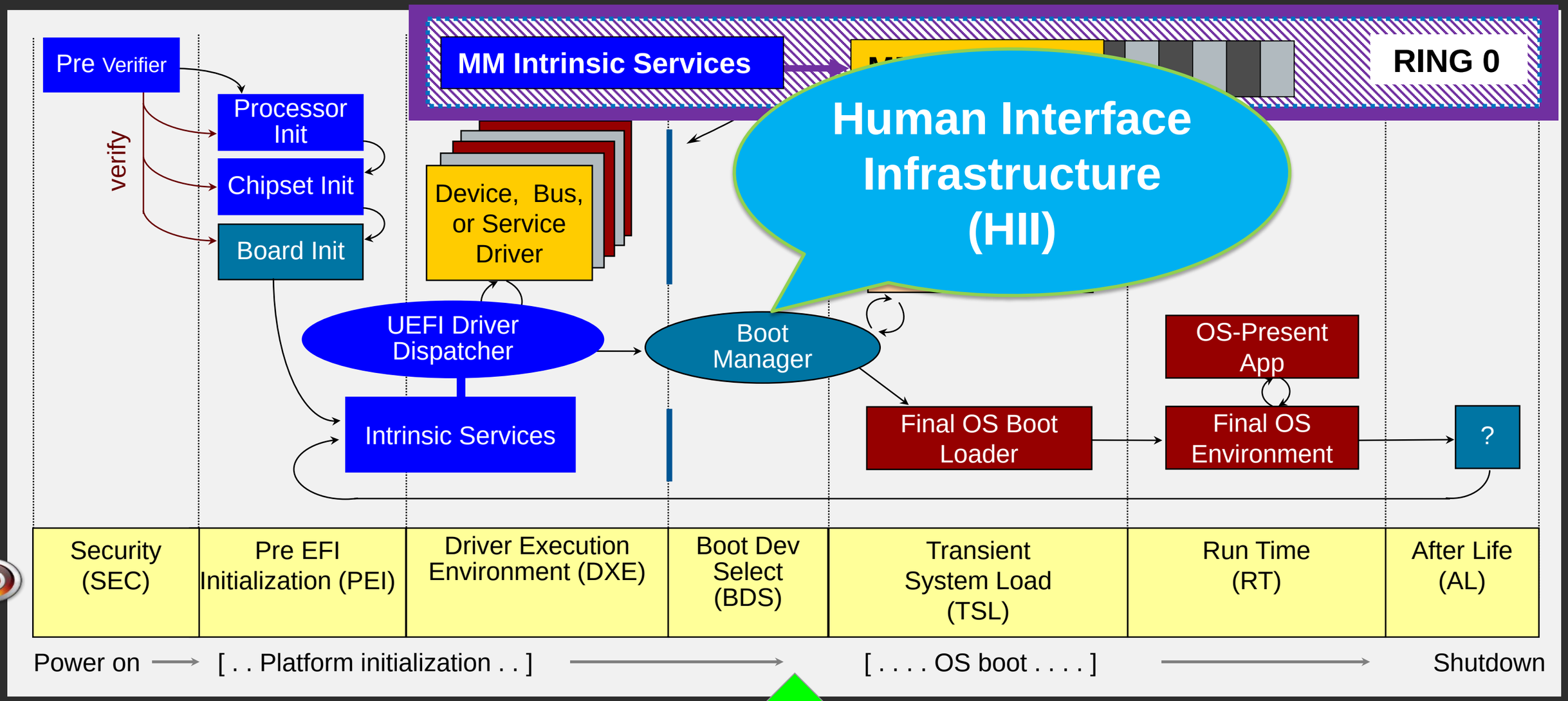
The UEFI Device Path describes a boot target

- Binary description of the physical location of a specific target

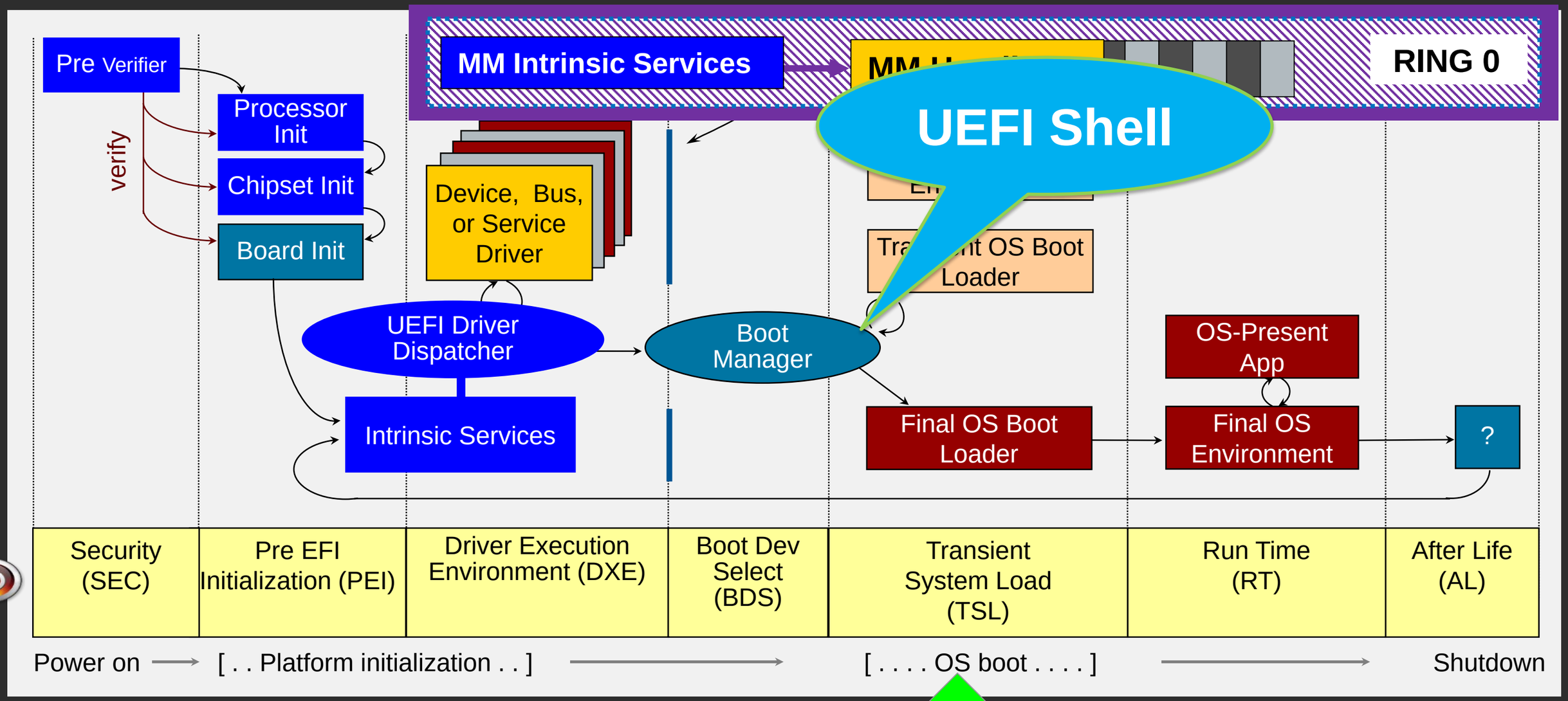


DEMO Dmpstore - YouTube

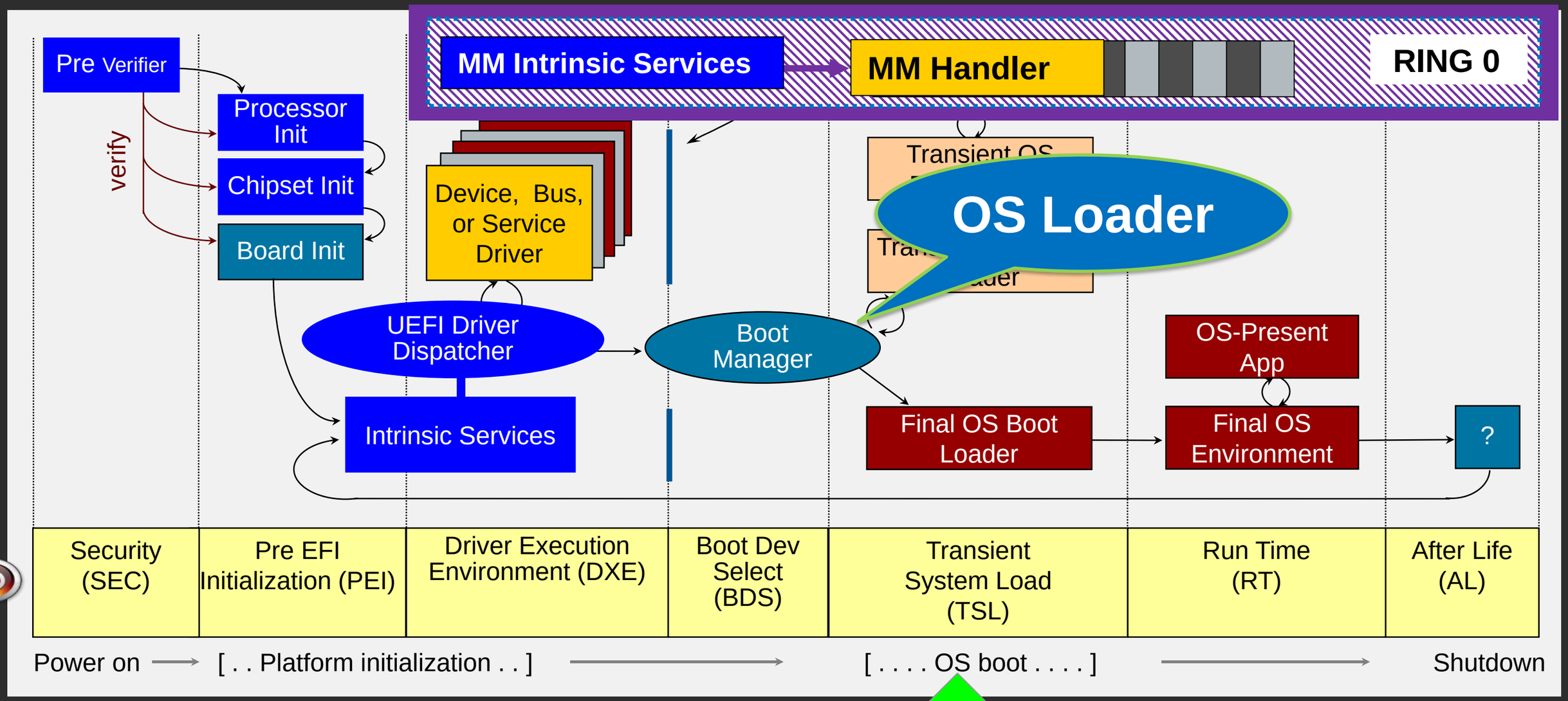
UEFI – PI & EDK II BOOT FLOW – HII



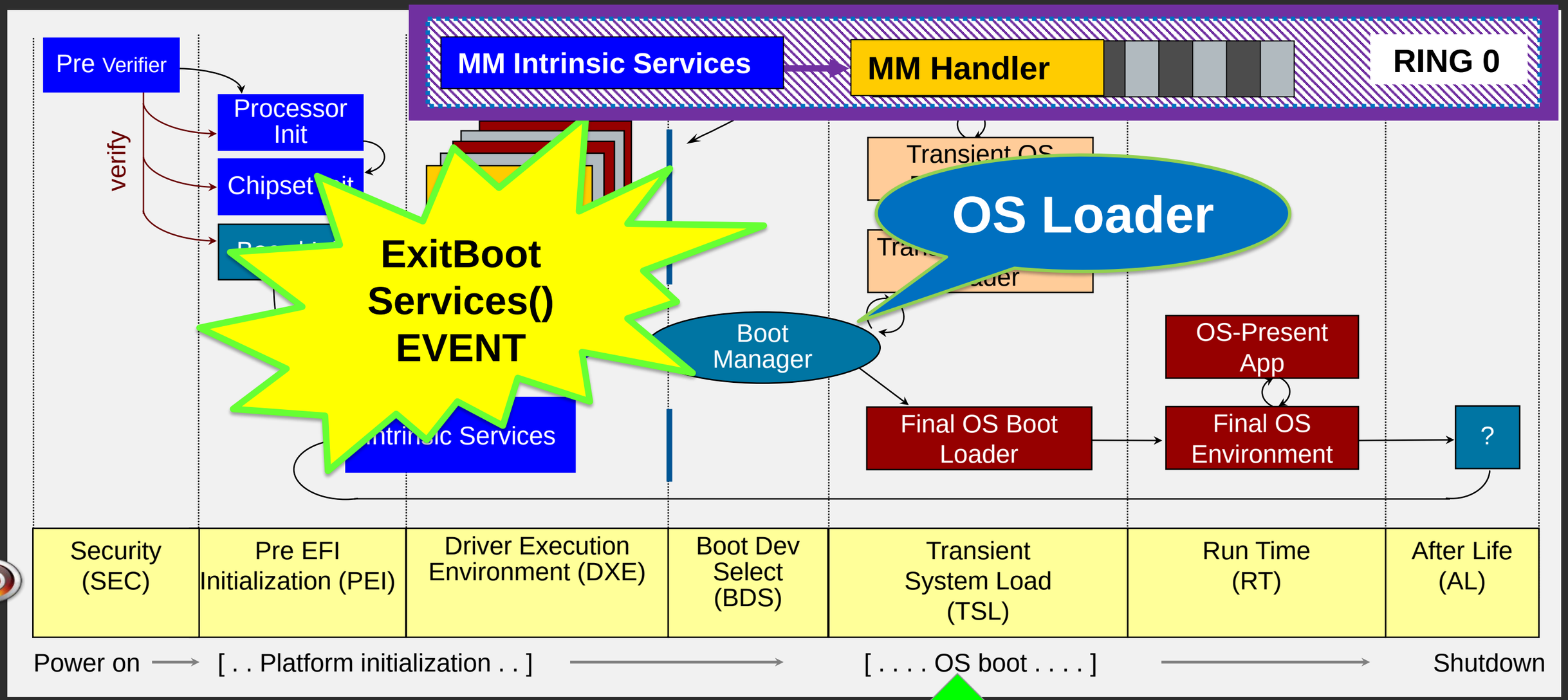
UEFI – PI & EDK II BOOT FLOW – TSL



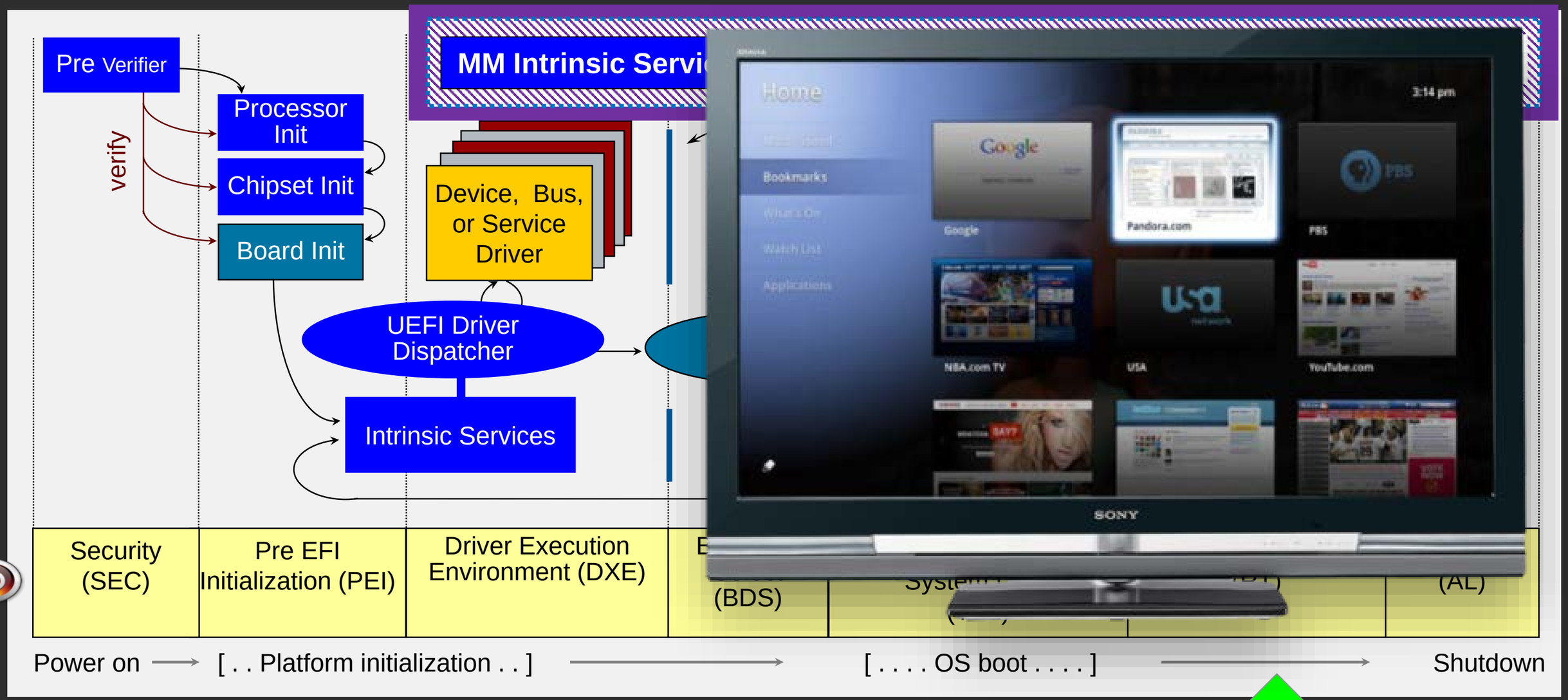
UEFI – PI & EDK II BOOT FLOW – BOOT LOADER



UEFI - PI & EDK II BOOT FLOW - EVENT



UEFI - PI & EDK II BOOT FLOW - BOOT UEFI OS



THE INTEL® FIRMWARE SUPPORT PACKAGE (INTEL® FSP)

What is Intel® Firmware Support Package?

Includes:

- A binary firmware device (FD) file - contains multiple FSP Modules
- An integration guide
- A rebasing tool
- A Boot Setting File (BSF) or YAML file for Configuration of the Updatable Product Data (UPD)

What Does Intel® FSP Provide?

- Provides silicon initialization code:
  - Initializes processor core, chipset as explained in BIOS Writers' Guide
  - Is relocatable in ROM
  - Can be configured for platform customization
- Boot loader agnostic and can be easily integrated with many options:
  - Open source boot loaders: UEFI –EDK II, Coreboot, U-boot, etc.
  - RTOS
  - Others

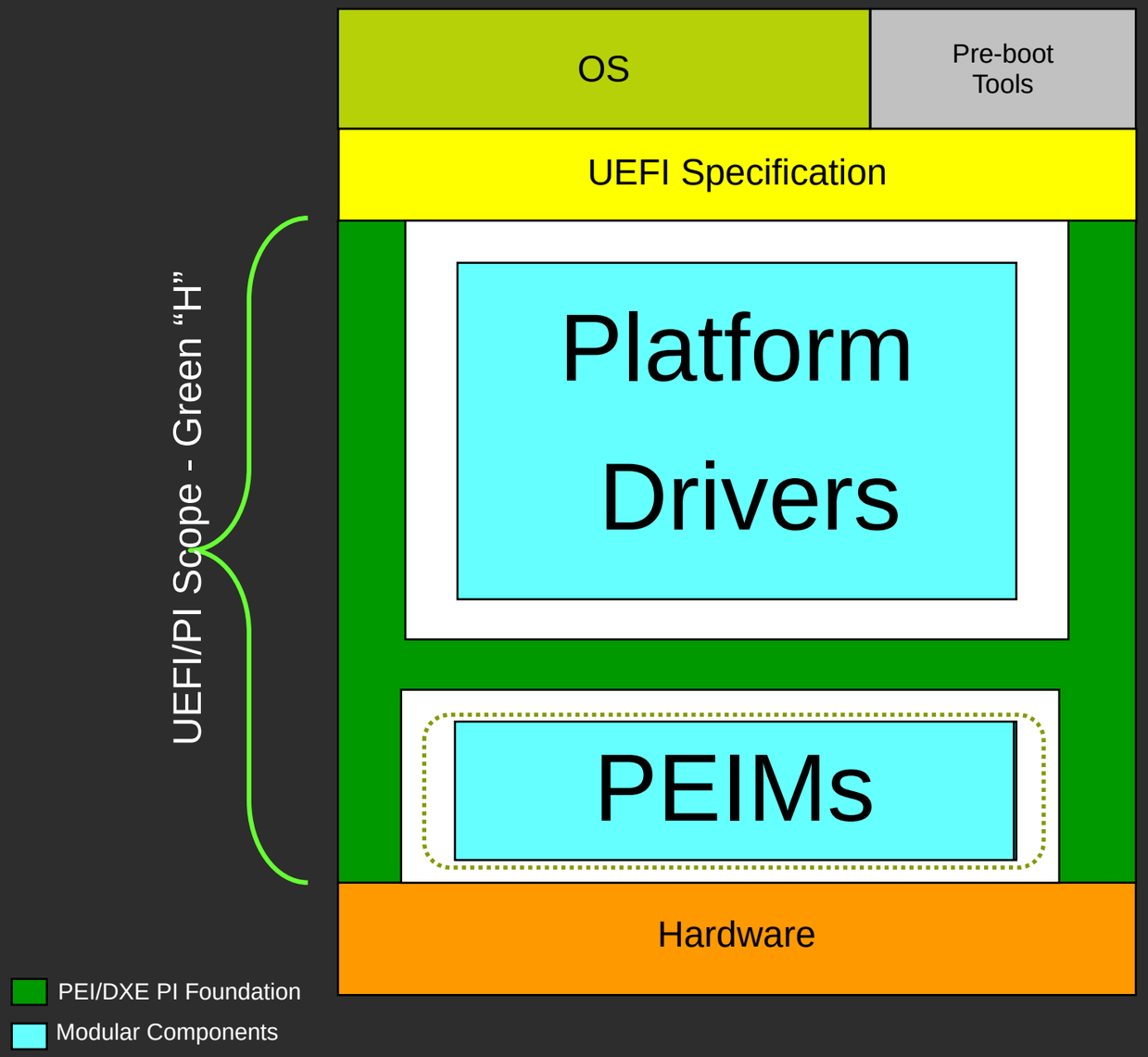
Intel FSP is currently available for the many Intel hardware-producing divisions

See: About Intel FSP (Intel® FSP 2.3 July 2021)

White Paper Example: Open Braswell - Design and Porting Guide

Intel® FSP is NOT a stand-alone boot-loader

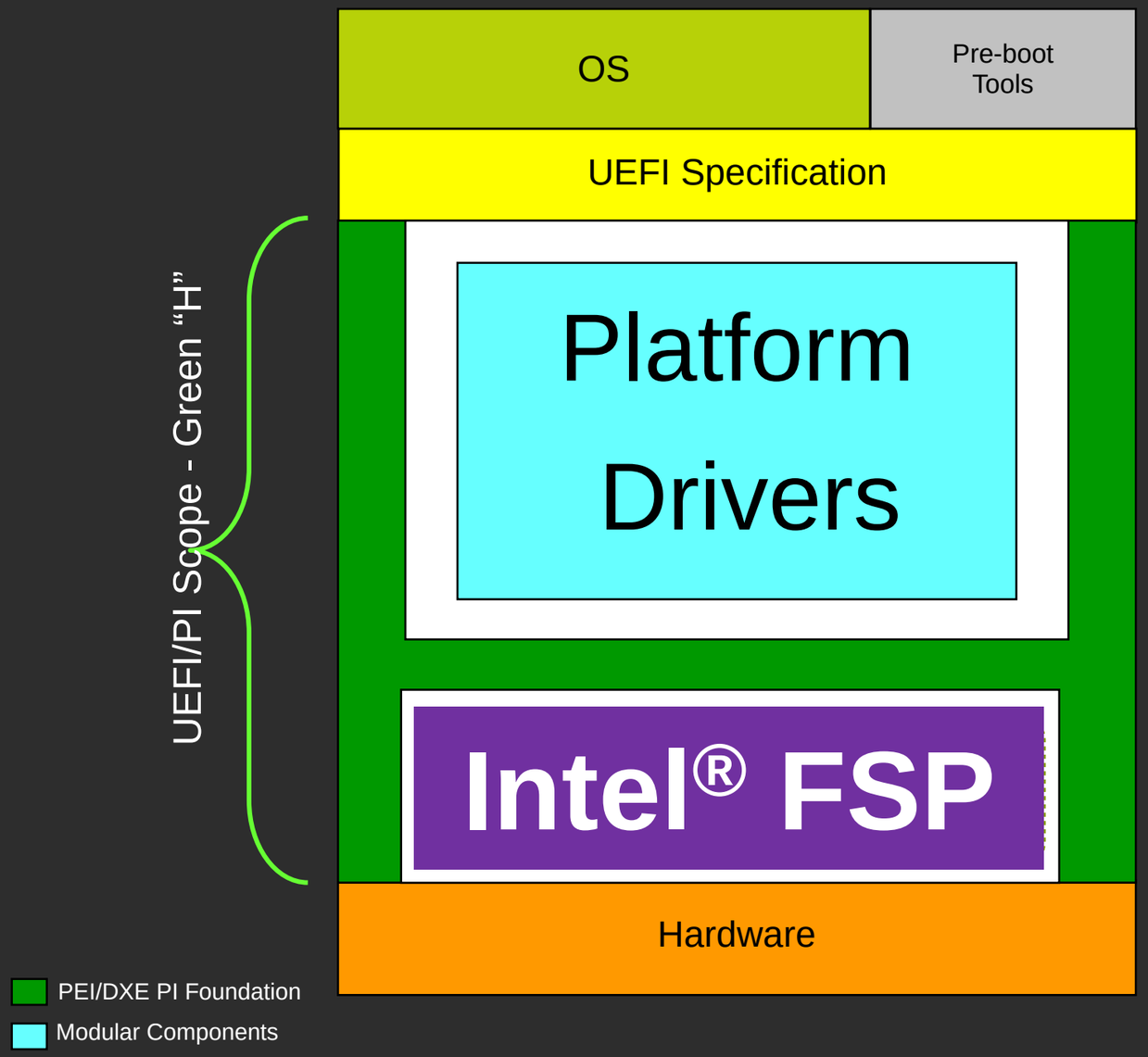
Intel® FSP to Open Source EDK II



EDK II provides the framework ("Green H")

Intel® Firmware Support Package (Intel® FSP) provides low level of silicon initialization

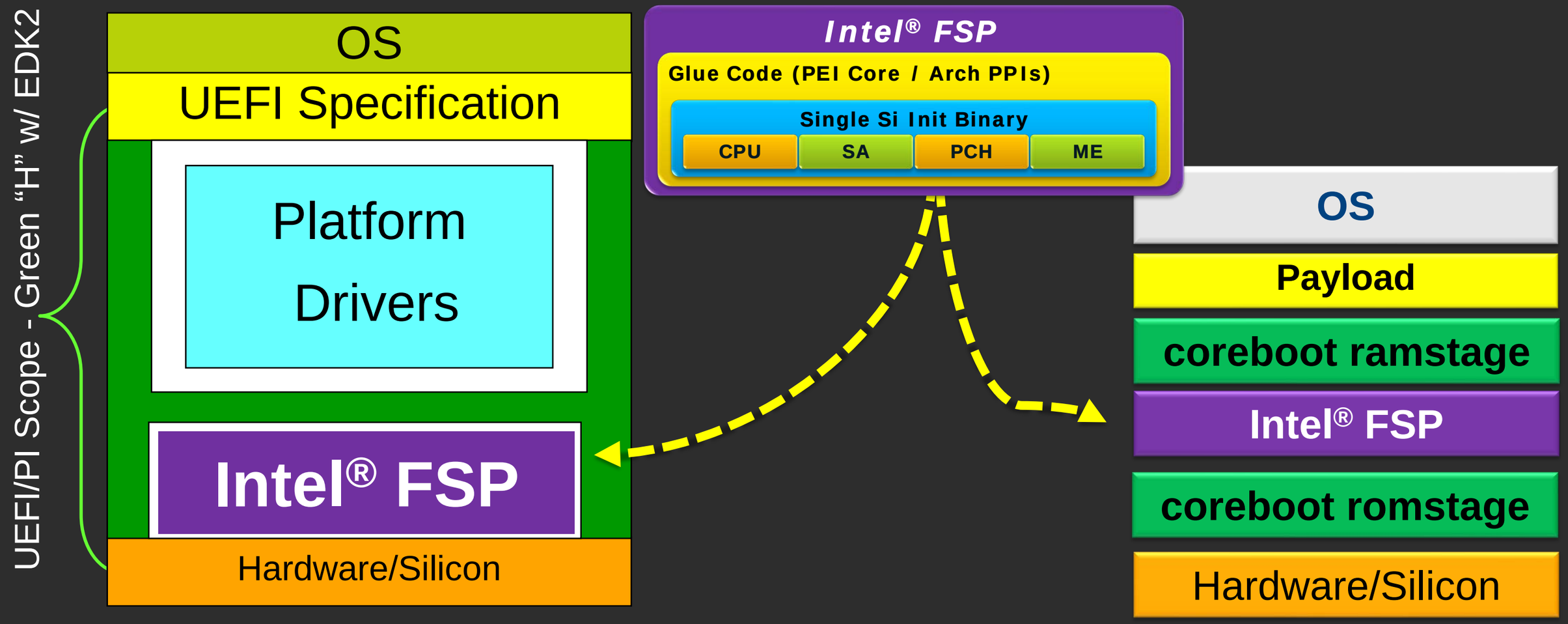
Intel® FSP to Open Source EDK II



EDK II provides the framework ("Green H")

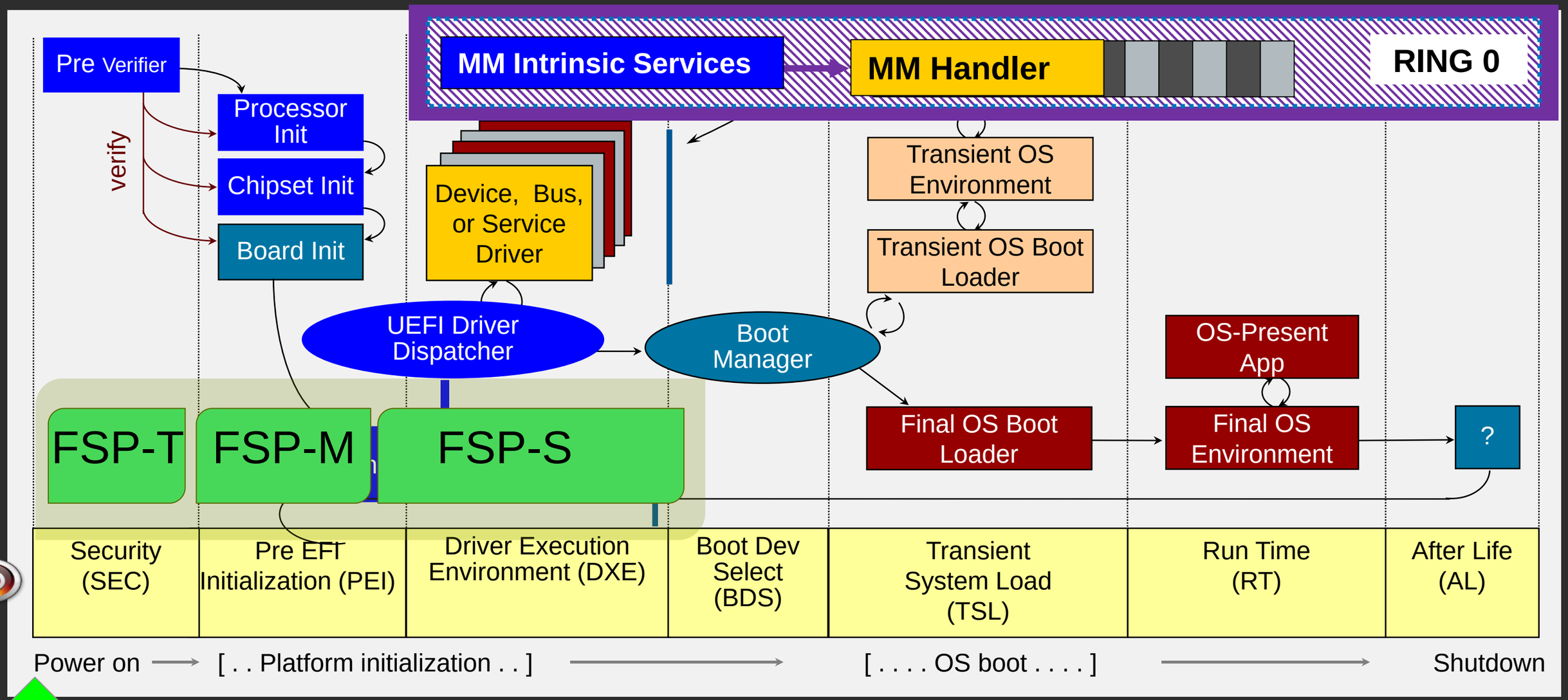
Intel® Firmware Support Package (Intel® FSP) provides low level of silicon initialization

Intel® FSP "Produced" to "Consuming" Intel® Architecture Firmware

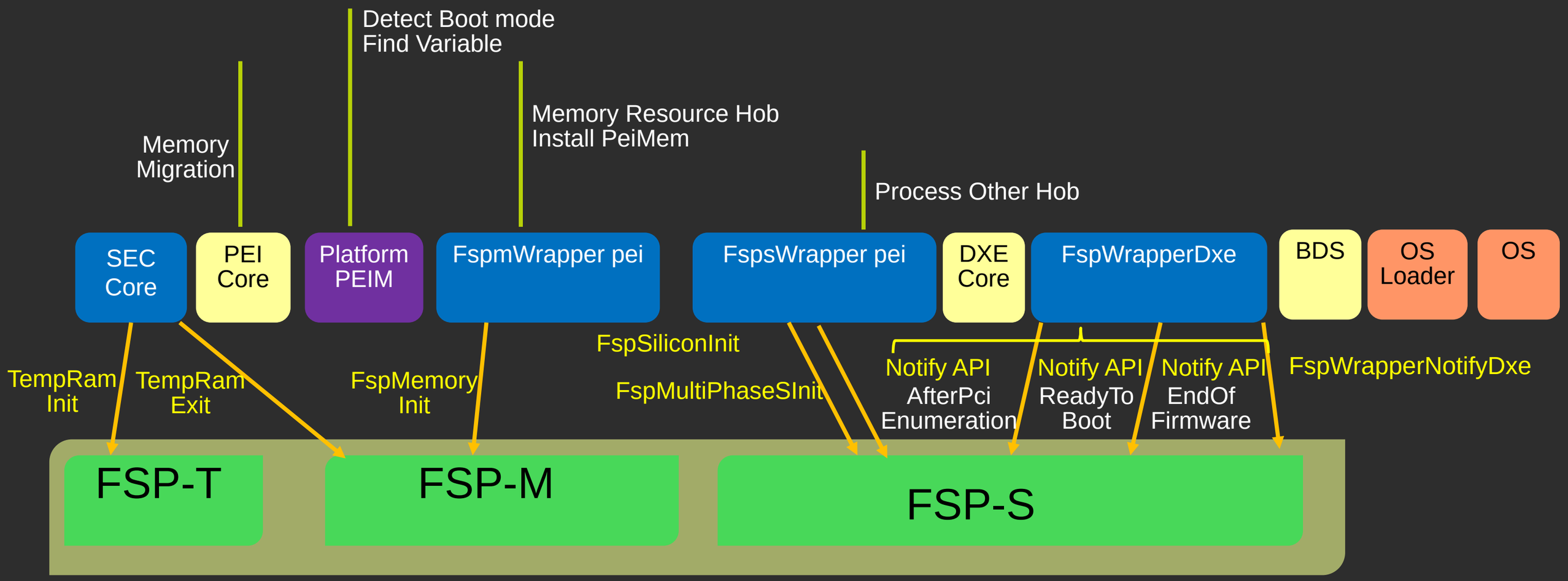


Intel FSP is independent of the bootloader solutions

UEFI – PI & EDK II BOOT FLOW – FSP



Boot Flow with UEFI & Intel® FSP



Original Source: Using the Intel® FSP with EDK II (2.0) Fig 4. – This now shows a 6th API added in FSP 2.2

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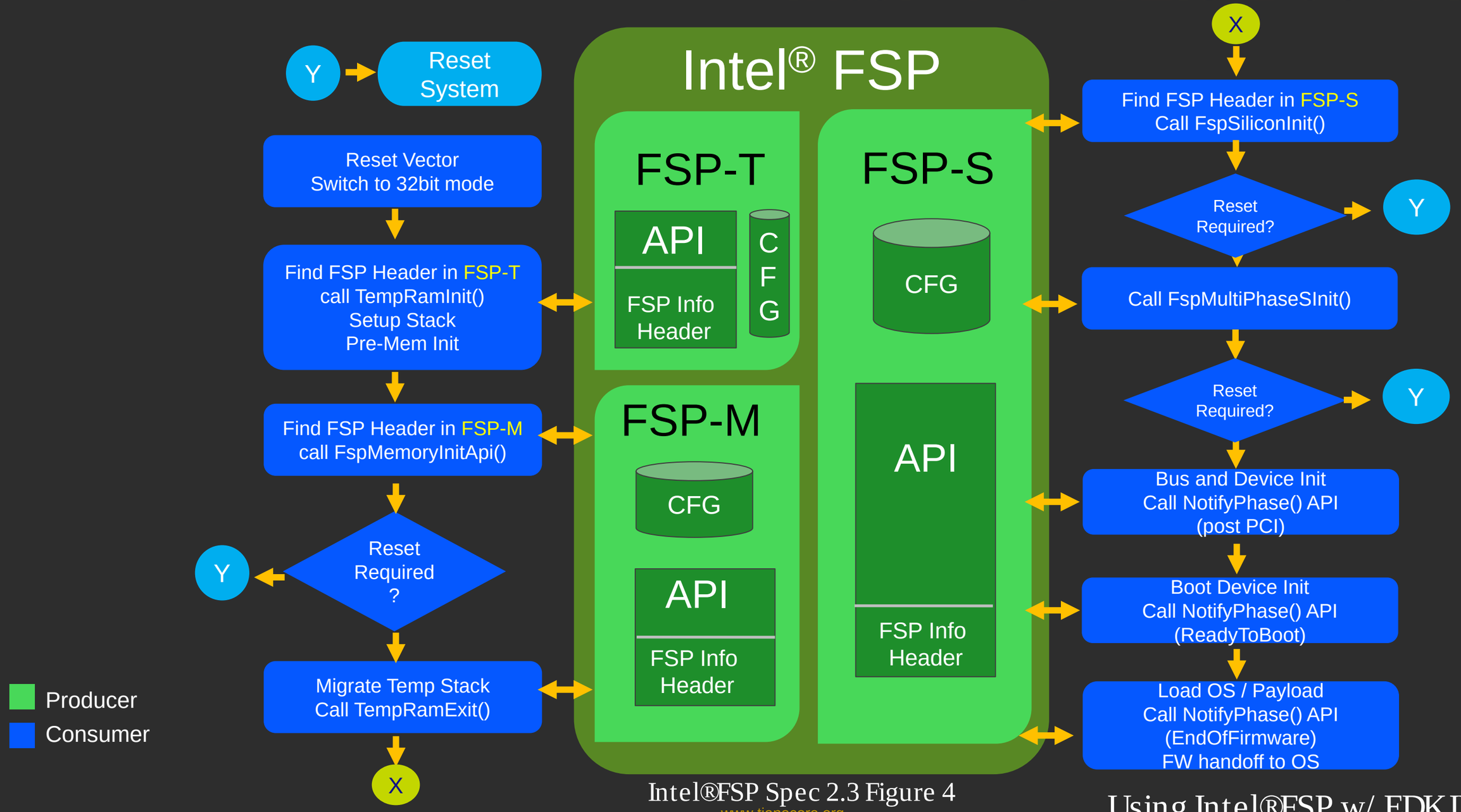
Intel® FSP v2.3 Boot Flow



Intel®FSP Spec 2.3 Figure 4

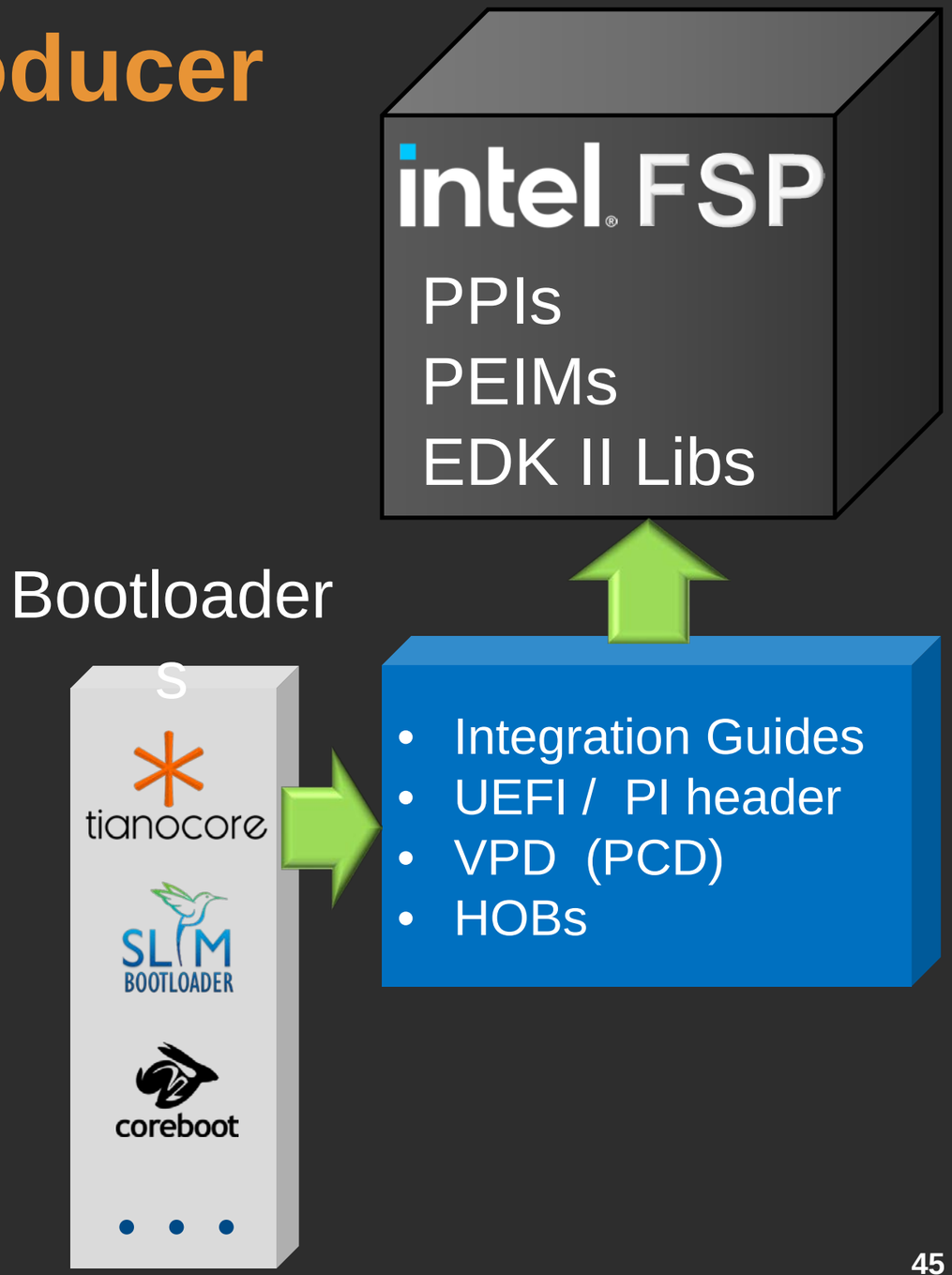
Using Intel®FSP w/ EDKII: PDF

Intel® FSP Producer

- Examples of binary instances on http://www.intel.com/fsp w/integration guides
  - This includes hardware initialization code that is EDK II based PEI Modules (PEIM's)
- Modules are encapsulated as a UEFI PI firmware volume w/ extra header
- Configure w/Vital Product Data (VPD)-style Platform Configuration Data (PCD) externalized from the modules
- Resultant output state reported via UEFI Platform Initialization (PI) Hand Off Block (HOB)

Intel® Firmware Support Package (Intel® FSP) External Architecture Specification (EAS) v2.3 Link v2.0

Resource: https://software.intel.com/content/www/us/en/develop/articles/intel-firmware-support-package.html



WHAT'S NEW IN THE UEFI SPECIFICATIONS?

LATEST UEFI SPECIFICATIONS

Http://uefi.org

Unified Extensible Firmware Interface Forum

UEFI Specification	UEFI Shell Specification	UEFI PI Specification	Self Certification Test	PI Distro Package Specification	ACPI Specification
Current v2.9 March 2021	Current v2.2 January 2016	Current v1.7A April 2020	Current v2.7B April 2015	Current v1.1 January 2016	Current v6.4 January 2021

Added definitions for Compute Express Link (CXL)* Spec version 2.0

New ACPI entry: CXL Early Discovery Table (CEDT)

ACPI – PRM Spec

https://uefi.org/specsandtesttools

Compute Express Link

https://www.computeexpresslink.org/

Each Table must be the same version FW Test Suite For ACPI Testing wiki.ubuntu.com/FirmwareTestSuite/

EDK II - Open Source

Community Development

- Stable Tag Releases- cycle of releasing stable versions of EDK II Firmware
- Adding UEFI Spec updates and new key features and bug fixes
- Three phases of development
  - Development phase
  - Soft Feature Freeze
  - Hard Feature Freeze

More Information on Stable Tag Releases:
TianoCore Wiki

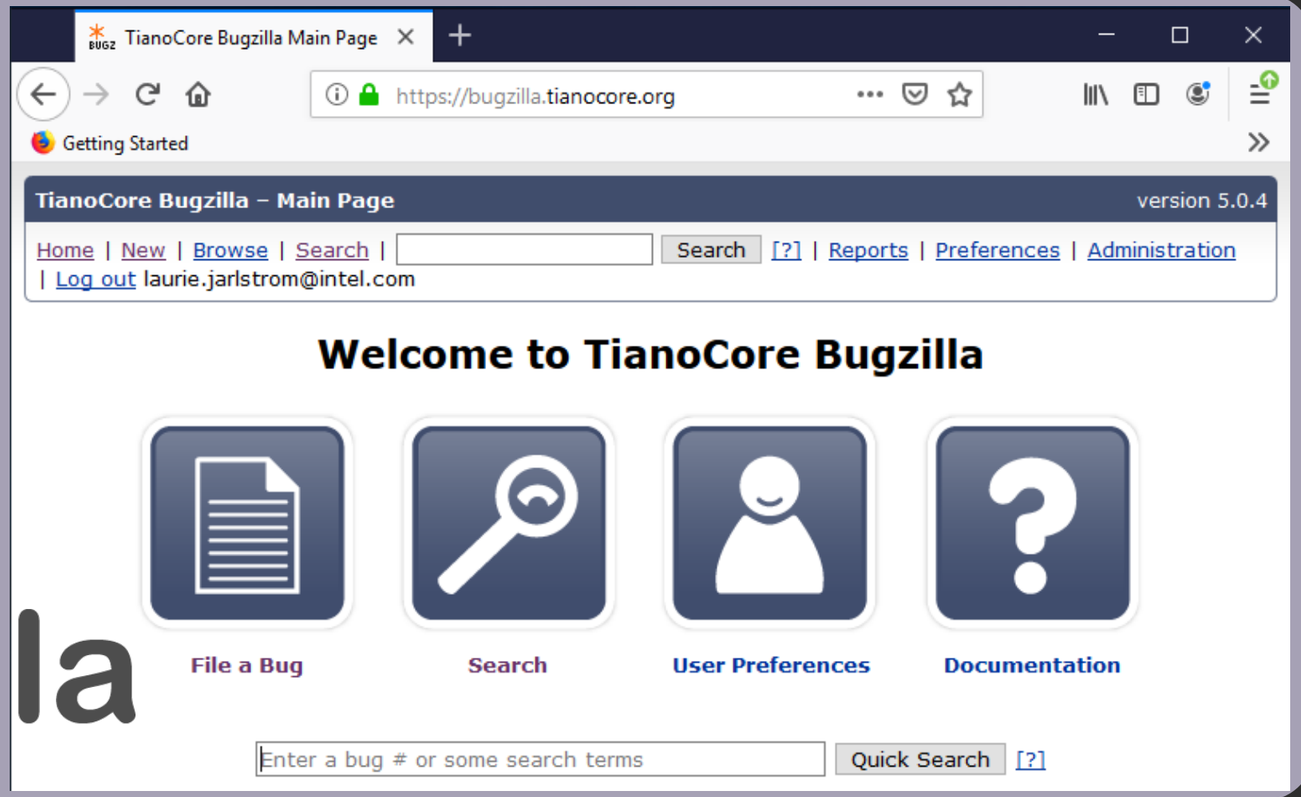
Tag: edk2-stable202202 Features:
edk2 releases Stable tag

Report a bug on Bugzilla

Create a user account https://bugzilla.tianocore.org/

Search if bug “already” reported

File New Report – Pick a product – fill out form for the bug



Bugzilla

Summary

- The System Firmware is a binary image that starts execution as the reset vector & is typically a SPI device
- UEFI & PI Boot Flow Process, SEC, PEI, DXE, BDS, TSL, OS
- System Management Mode is in Ring 0 in the System FW
- Intel® FSP will initialize the processor, chipset and memory
- The UEFI.org & Tianocore.org for Specs and Open source

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Questions?

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ACKNOWLEDGEMENTS