UEFI Overview

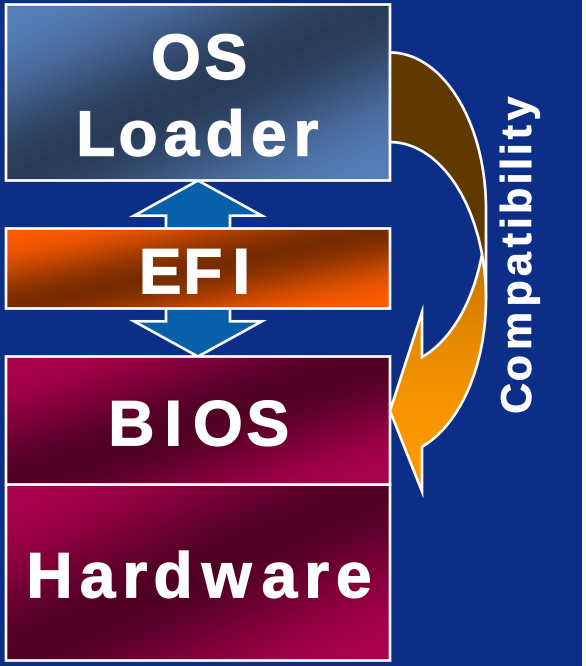
May 16th, 2007

Michael A. Rothman

Intel / Chair of UEFI Configuration Sub-team

A look at EFI

- Interface specification
  - Implementation agnostic
- Abstracts BIOS from OS
  - Decouples development
- Compatible by design
  - Evolution, not revolution
- Modular and extensible
  - OS-Neutral value add
- Provide efficient Option ROM Replacement
  - Common source for multiple CPU architectures



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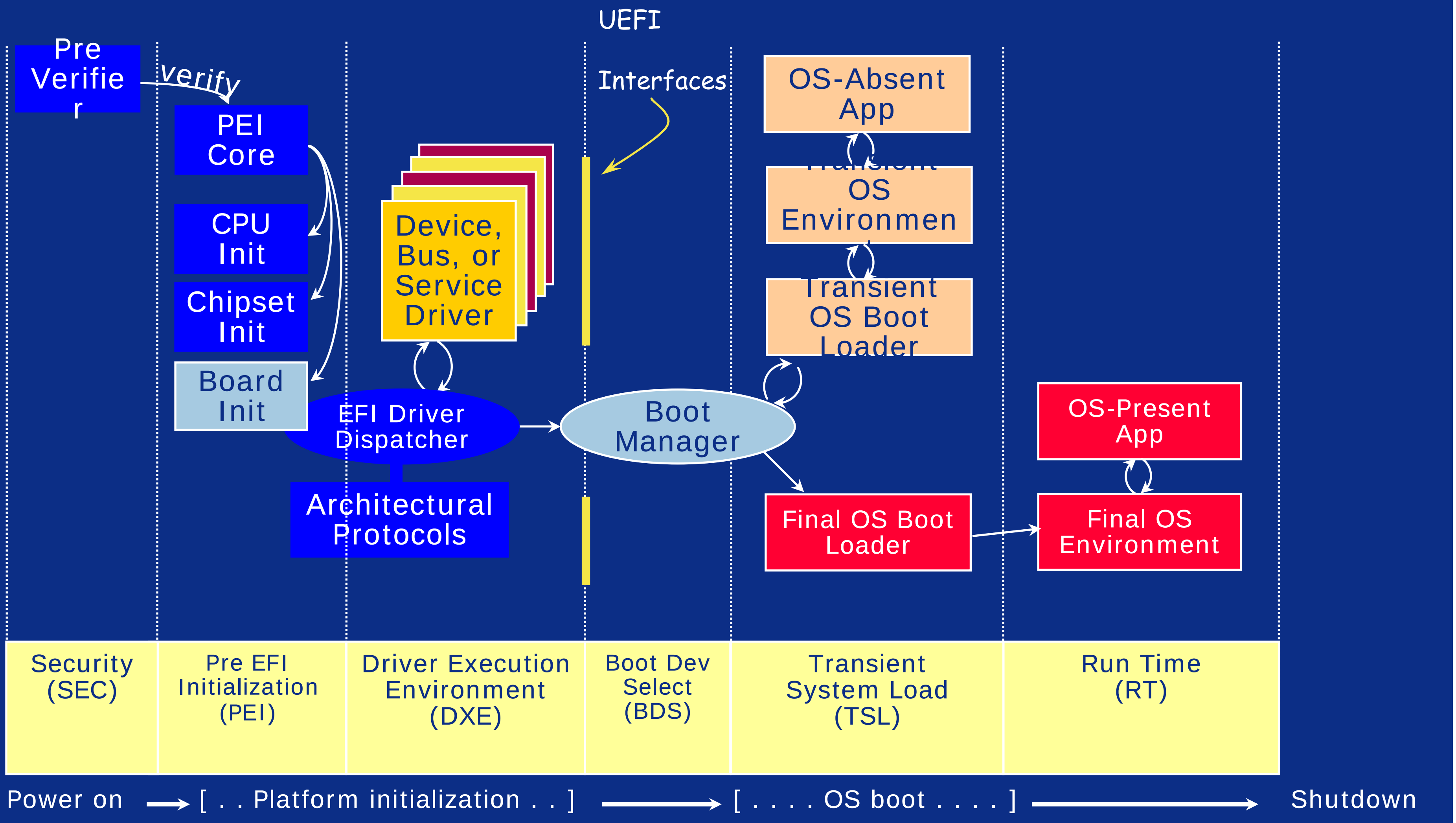
A couple steps forward



UEFI

Interfaces

Pre Verifie r

verify

PEI Core

CPU Init

Chipset Init

Board Init

Device, Bus, or Service Driver

EFI Driver Dispatcher

Architectural Protocols

Boot Manager

OS-Absent App

Transient OS Environmen

Transient OS Boot Loader

Final OS Boot Loader

OS-Present App

Final OS Environment

Security (SEC)

Pre EFI Initialization (PEI)

Driver Execution Environment (DXE)

Boot Dev Select (BDS)

Transient System Load (TSL)

Run Time (RT)

Power on → [. . Platform initialization . .] → [. . . . OS boot . . . .] → Shutdown

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Unified EFI Forum, Inc.

A Firmware Standards Organization Gets Created

A Washington non-profit Corporation

- Develops, promotes and manages evolution of Unified EFI Specification
- Continue to drive low barrier for adoption

Promoter members:

- AMD, AMI, Apple, Dell, HP, IBM, Insyde, Intel, Lenovo, Microsoft, Phoenix

More information: www.uefi.org

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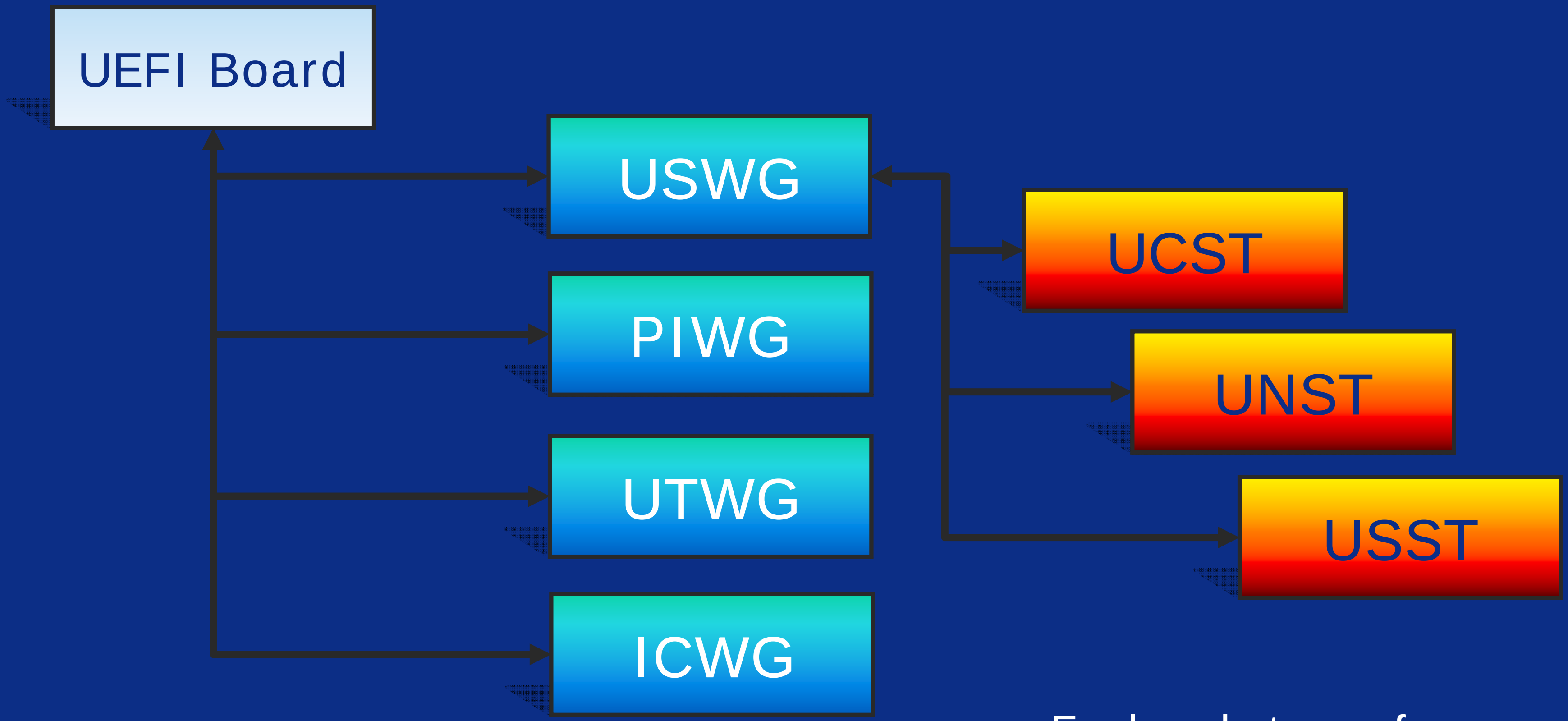
How the Forum Works



UEFI Board

USWG

PIWG

UTWG

ICWG

UCST

UNST

USST

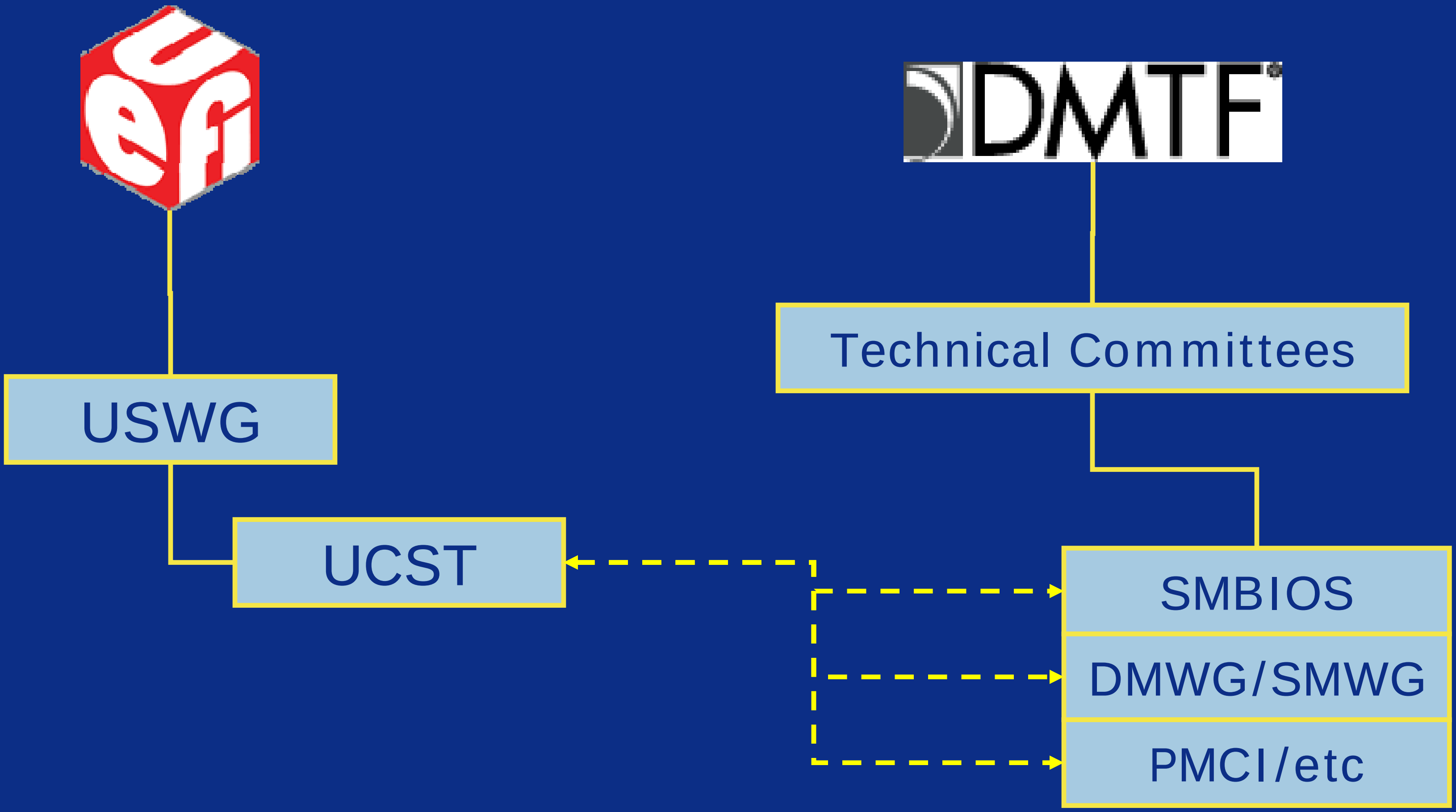
Publications/Decisions ratified by the board

Each work group approves/delivers different content to the public.

Each sub-team focuses on specific topics and contributes material to the work group.

UEFI Relationships In Industry

Relationship with DMTF



USWG

UCST

Technical Committees

SMBIOS

DMWG/SMWG

PMCI/etc

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Concept Review - Protocols

Read Keystroke Example

Legacy

INT 16h	AH = 10h	Input
	AH = Scan code	Output
	AL = ASCII character	Output

Caller Sample Code

```
mov ax, 1000h
int 16h
```

Handler Sample Code

```
cmp ah, 10h
jz  HandleExtReadKey
cmp ah, 11h
jz  CheckForKey
;; Do more checking

HandleExtReadKey:
;; Do real work here
mov ax
ret
```

UEFI/Framework

Simple Text Input Protocol	ReadKeyStroke	Protocol
	Reset	
	WaitForKey	
	This, &Key	Input
	Key = EFI_INPUT_KEY	Output

Caller Sample Code

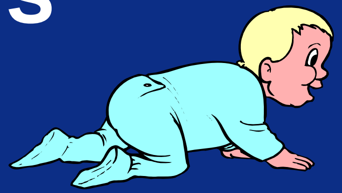
```
TextIn->ReadKeystroke (TextIn, &Key);
```

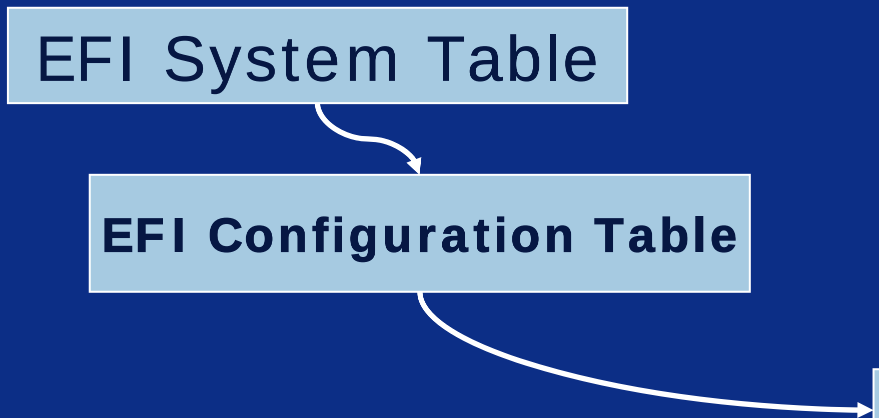
Handler Sample Code

```
ReadKeyStrokeHandler (
  IN  EFI_SIMPLE_TEXT_INPUT_PROTOCOL  *This,
  OUT EFI_INPUT_KEY                   *Key
  )
{
// Do real work here
}
```

*Other names and brands may be claimed as the property of others

Moving Data from pre-boot into O/S runtime





EFI System Table

EFI Configuration Table

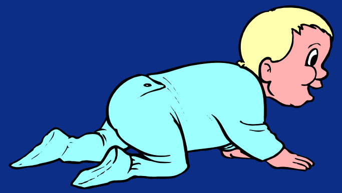
GUID	Pointer
Table A GUID	Address A
Table B GUID	Address B
⋮	⋮
Table Y GUID	Address Y
Table Z GUID	Address Z

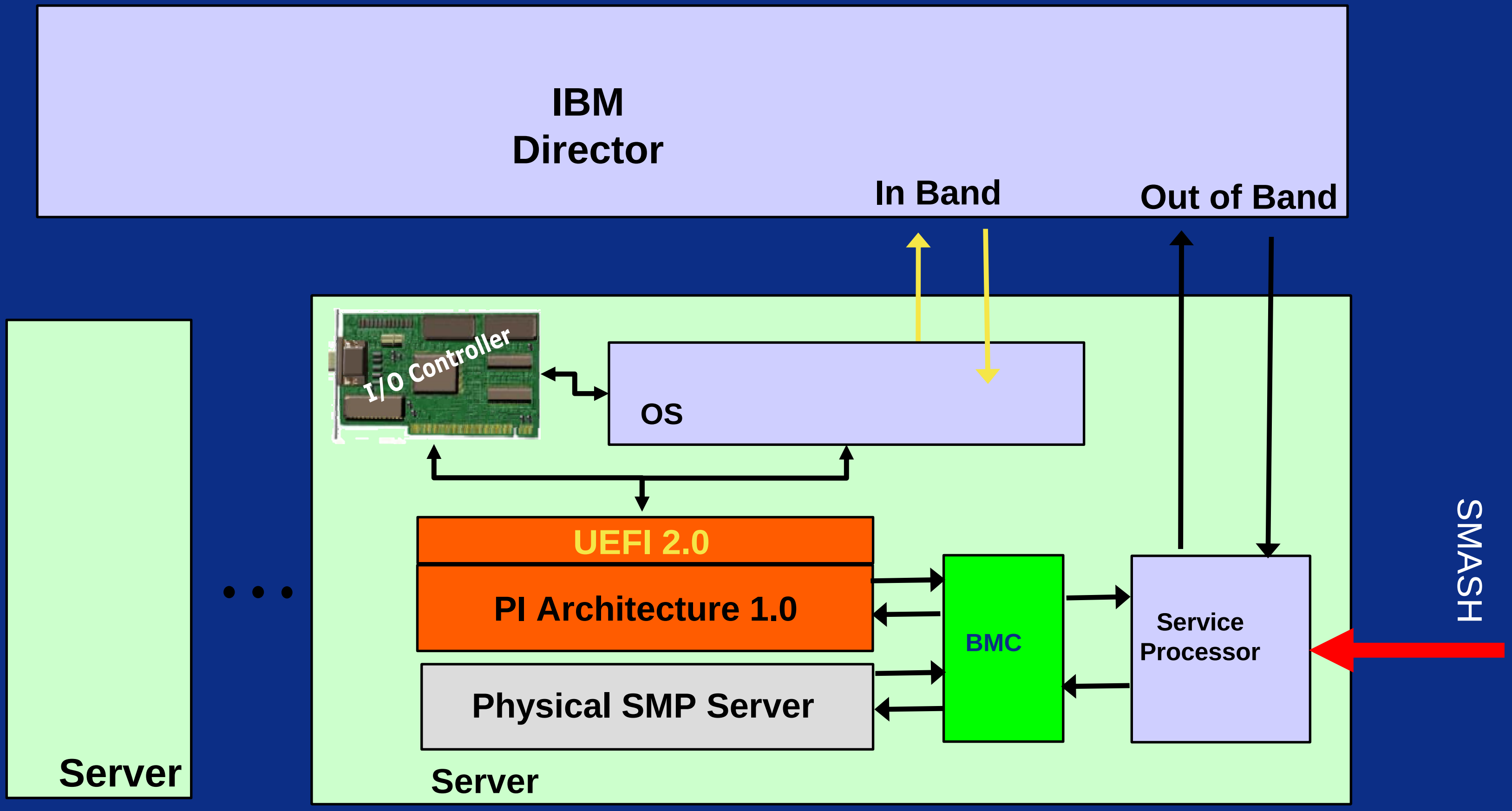
Problem Statement

- No standard/interoperable mechanism to address pre-boot based issues like:
  - Localization
    - Standard delivery of string packages
  - Fonts
    - Create standard glyph support along with optional font styles
  - Shared Configuration Infrastructure
    - Alleviate the burden for many configuration engines in a system (e.g. add-in device no longer needs to delay boot or poll for hot-keys, etc)
- Should be able to also address:
  - Human -> Machine system configuration
    - Think Setup
  - Machine -> Machine system configuration
    - Think Automation

UEFI Interactions

- Interaction Component View



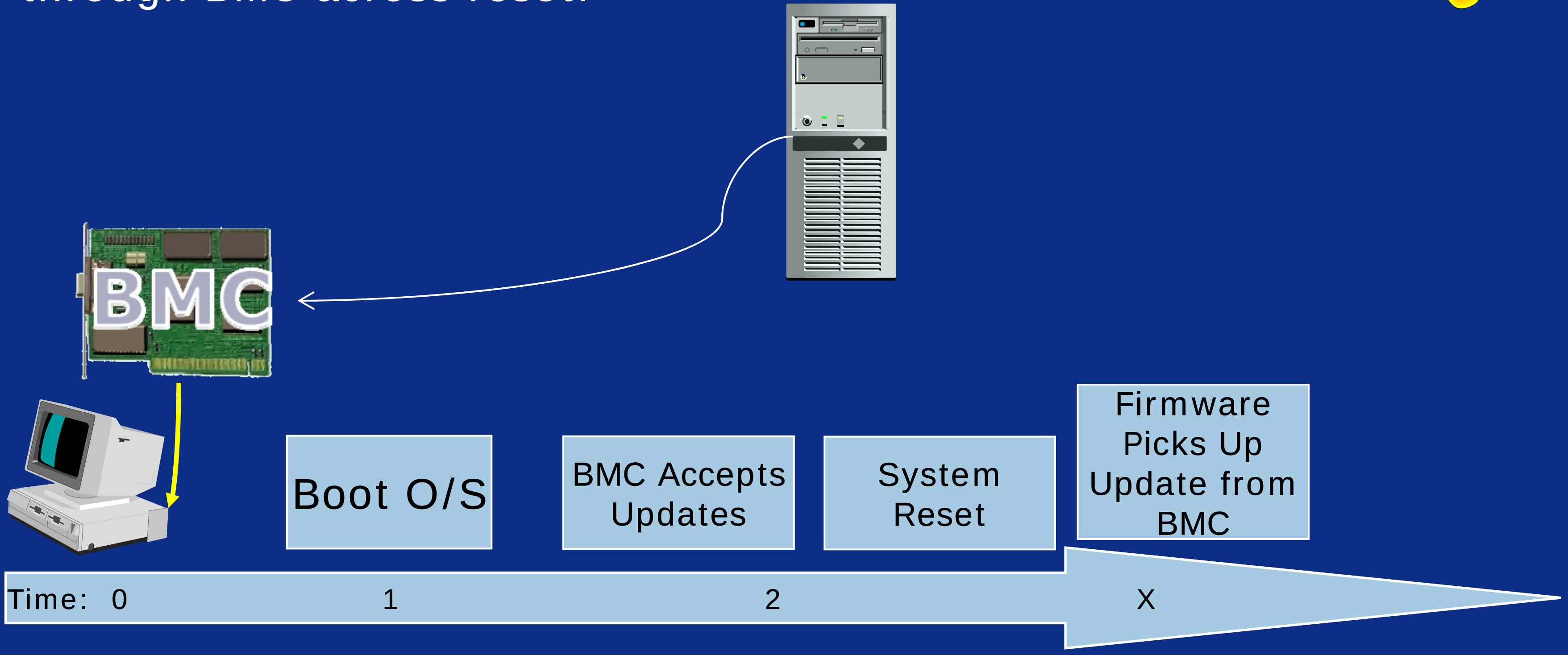


Local Configuration / Manageability

*Other names and brands may be claimed as the property of others

Interactions with BMC

- Local Interactions / with data being handed to firmware through BMC across reset.



Boot O/S

BMC Accepts Updates

System Reset

Firmware Picks Up Update from BMC

Time: 0 1 2 X

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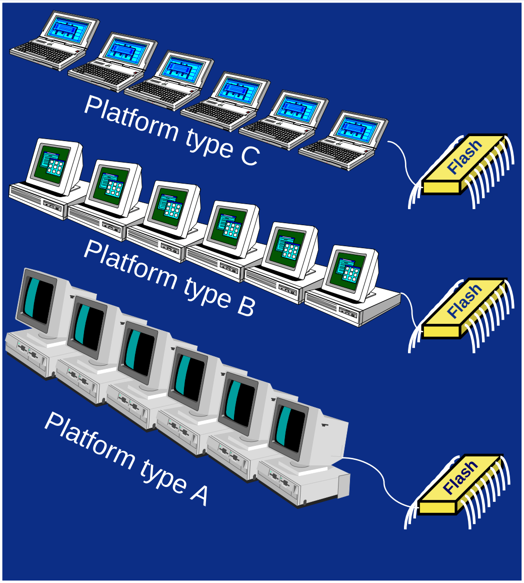
Configure Heterogeneous Targets



Three classes of platforms each with different configuration maps in their FLASH

Settings Keyword	Option Keyword/Value Pairs	FLASH Map Offset
HT_ENABLE	Enable=1, Disable=0	0x00
COM1_ENABLE	Enable=1, Disable=0	0x01
COM1_ADDRESS	0x2e8, 0x2f8, 0x3e8, 0x3f8	0x02
COM1_IRQ	0x03, 0x04	0x04
	⋮	

Platform C Tag Definitions

Settings Keyword	Option Keyword/Value Pairs	FLASH Map Offset
HT_ENABLE	Enable=1, Disable=0	0x23
COM1_ENABLE	Enable=1, Disable=0	0x18
COM1_ADDRESS	0x2e8, 0x2f8, 0x3e8, 0x3f8	0x19
COM1_IRQ	0x03, 0x04	0x1B
	⋮	

Platform B Tag Definitions

Settings Keyword	Option Keyword/Value Pairs	FLASH Map Offset
HT_ENABLE	Enable=1, Disable=0	0x14
COM1_ENABLE	Enable=1, Disable=0	0x10
COM1_ADDRESS	0x2e8, 0x2f8, 0x3e8, 0x3f8	0x11
COM1_IRQ	0x03, 0x04	0x13
	⋮	

Platform A Tag Definitions

Large Corporate Customer
Platform Schema Definition

0	0x00
1	0x01
2	0x02F8
3	
4	0x03
⋮	
n	0x00

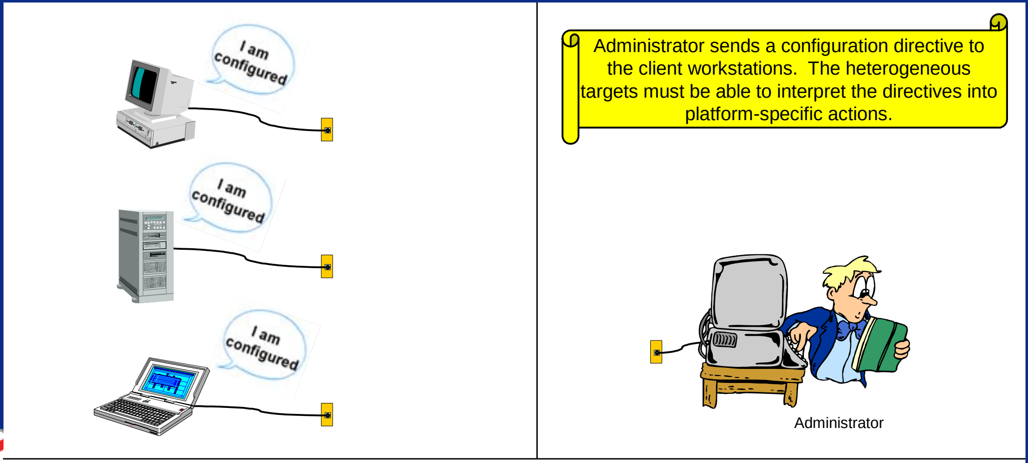
Platform C

0	0x00
⋮	
18	0x01
19	0x2E8
1A	
1B	0x04
⋮	
23	0X03
⋮	
n	0X00

Platform B

0	0x00
⋮	
10	0x01
11	0x02F8
12	
13	0x04
14	0x01
⋮	
n	0x00

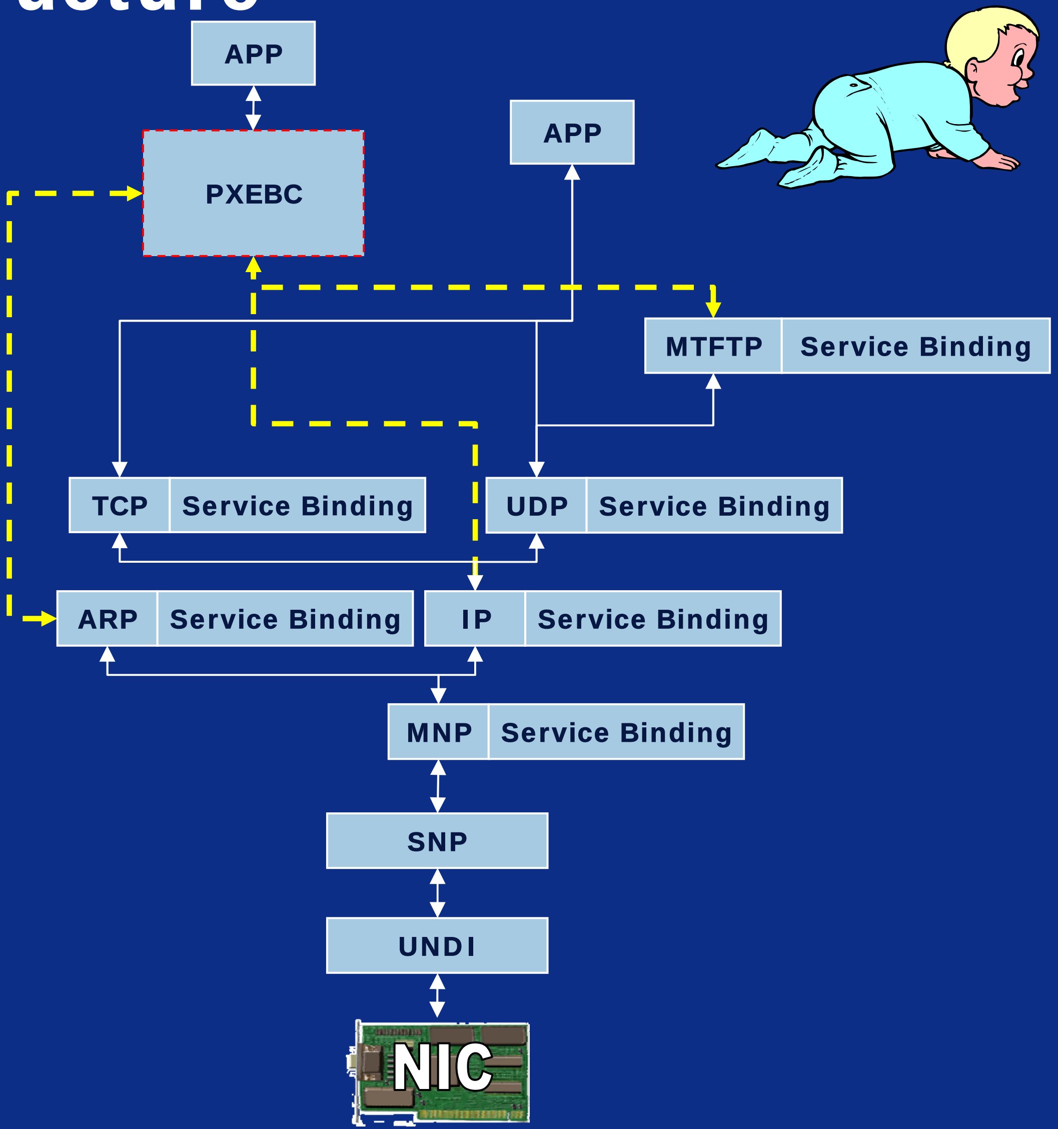
Platform A



Administrator sends a configuration directive to the client workstations. The heterogeneous targets must be able to interpret the directives into platform-specific actions.

Platform Configuration / Manageability

Network Infrastructure



APP

PXEBC

APP

MTFTP | Service Binding

TCP | Service Binding

UDP | Service Binding

ARP | Service Binding

IP | Service Binding

MNP | Service Binding

SNP

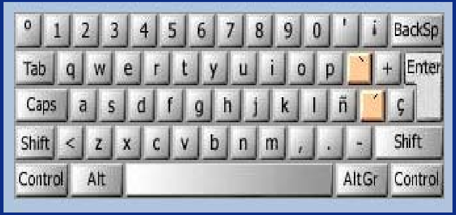
UNDI

Remote Configuration / Manageability

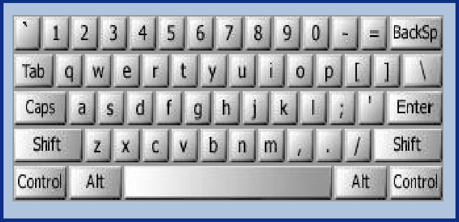
*Other names and brands may be claimed as the property of others

UEFI Configuration/Manageability Infrastructure

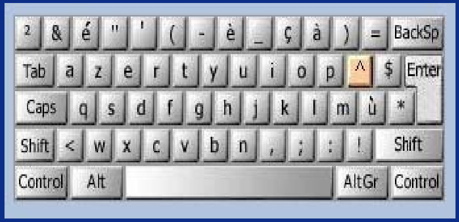
- Keyboard Localization


º 1 2 3 4 5 6 7 8 9 0 ' ¡ BackSp
Tab q w e r t y u i o p ` + Enter
Caps a s d f g h j k l ñ ´ ç
Shift < z x c v b n m , . - Shift
Control Alt AltGr Control

Spanish


` 1 2 3 4 5 6 7 8 9 0 - = BackSp
Tab q w e r t y u i o p [ ] \
Caps a s d f g h j k l ; ' Enter
Shift z x c v b n m , . / Shift
Control Alt Alt Control

US English


² & é " ' (- è _ ç à) = BackSp
Tab a z e r t y u i o p ^ $ Enter
Caps q s d f g h j k l m ù *
Shift < w x c v b n , ; : ! Shift
Control Alt AltGr Control

French

- String/Text Localization

String ID #4	String Representation	H	E	L	L	O		W	O	R	L	D	
	Unicode Encoding	0x0048	0x0045	0x004C	0x004C	0x004F	0x0020	0x0057	0x004F	0x0052	0x004C	0x0044	0x0000

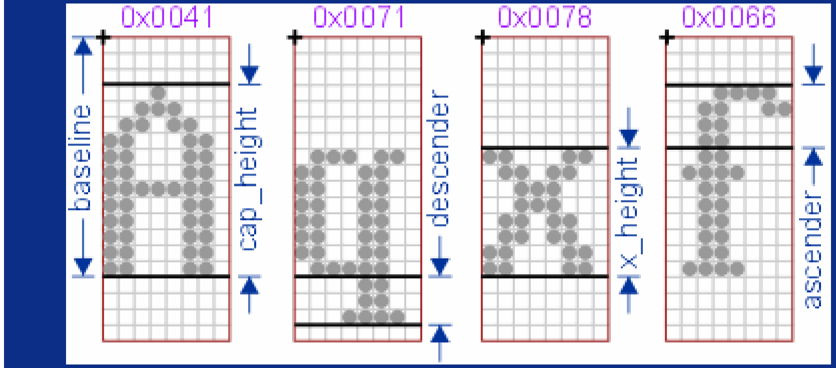
String ID #4	String Representation	H	O	L	A		M	U	N	D	O	
	Unicode Encoding	0x0048	0x004F	0x004C	0x0041	0x0020	0x004D	0x0055	0x004E	0x0044	0x004F	0x0000

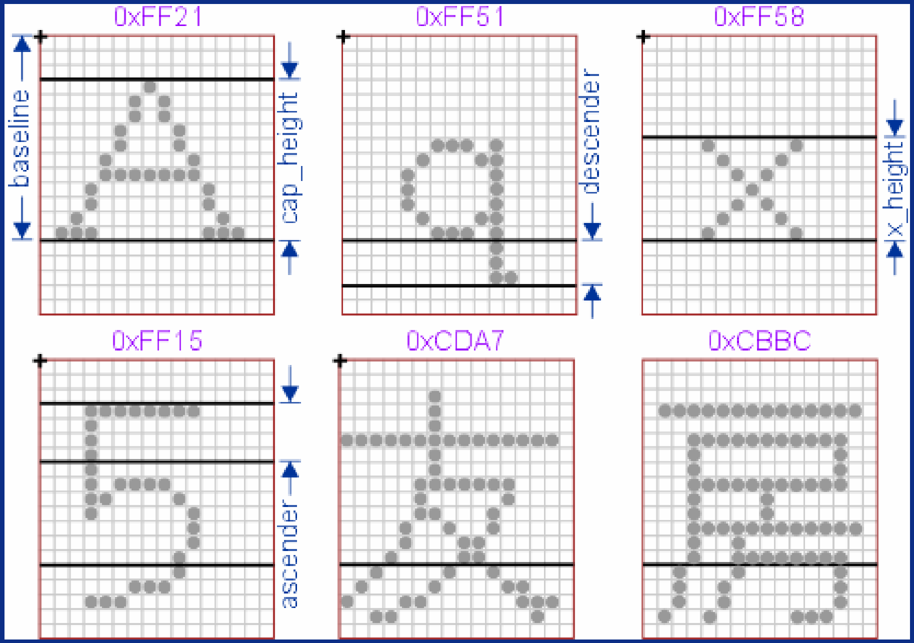
String ID #4	String Representation	你	好	世	界	
	Unicode Encoding	0x4F60	0x597D	0x4E16	0x754C	0x0000

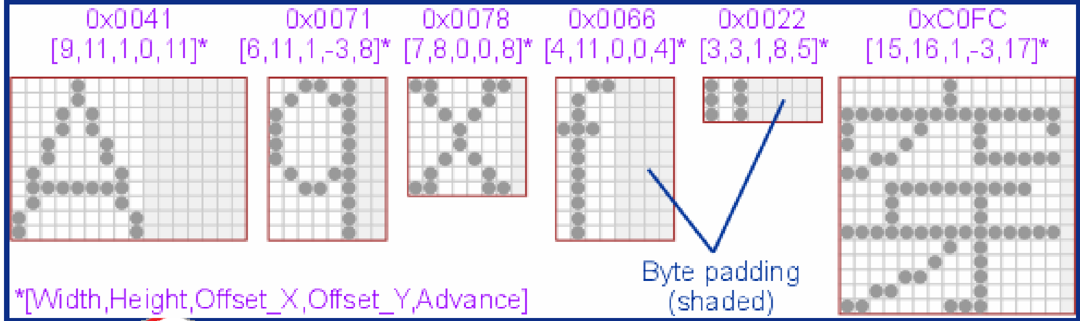
*Other names and brands may be claimed as the property of others

Glyph Support

- Dependent on Int10h character support? No....

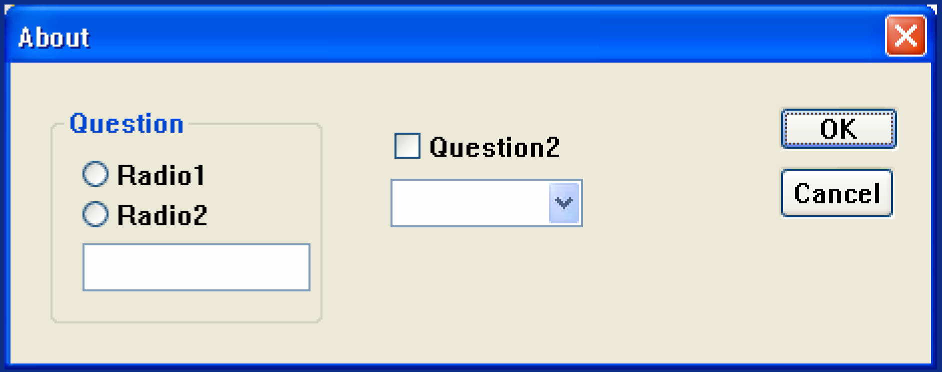






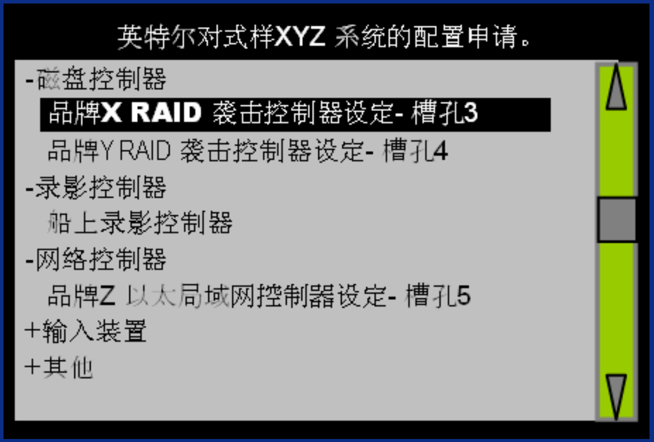
Using Forms

- Forms-based model for setup question descriptions
  - Must meet BIOS requirements
    - Scalable UI display support (Server Front Panel to local high resolution monitor).
    - Small encoding size
  - Encoding that is Self Describing
  - Position Independent
  - Can support scripting
  - Extensible syntax



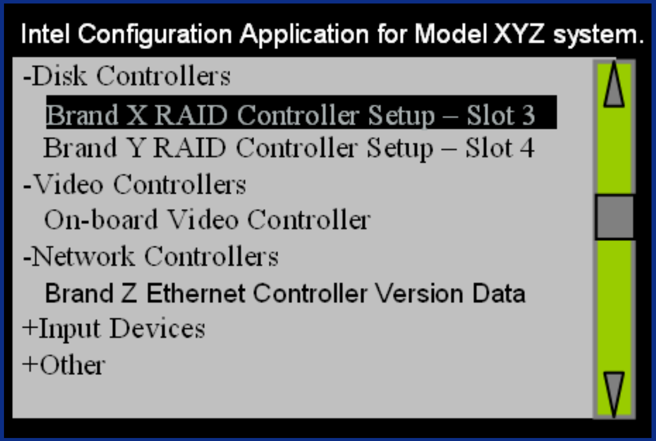
- Exact look and feel defined by the browser and not defined in UEFI 2.1.
  - Developer/OEM/IHV defines questions to ask and what strings to display
  - Browser determines “how” to display the questions

Defining a User Interface – leave to OEM / IBV



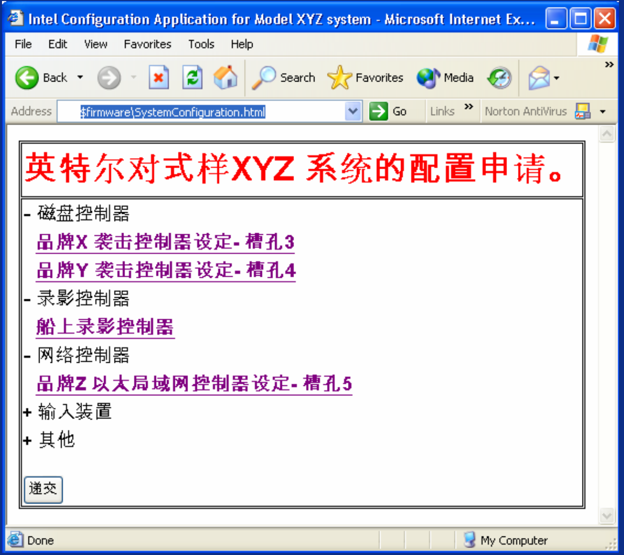
英特尔对式样XYZ 系统的配置申请。

-磁盘控制器
  品牌X RAID 袭击控制器设定- 槽孔3
  品牌Y RAID 袭击控制器设定- 槽孔4
-录影控制器
  船上录影控制器
-网络控制器
  品牌Z 以太局域网控制器设定- 槽孔5
+输入装置
+其他



Intel Configuration Application for Model XYZ system.

-Disk Controllers
  Brand X RAID Controller Setup – Slot 3
  Brand Y RAID Controller Setup – Slot 4
-Video Controllers
  On-board Video Controller
-Network Controllers
  Brand Z Ethernet Controller Version Data
+Input Devices
+Other

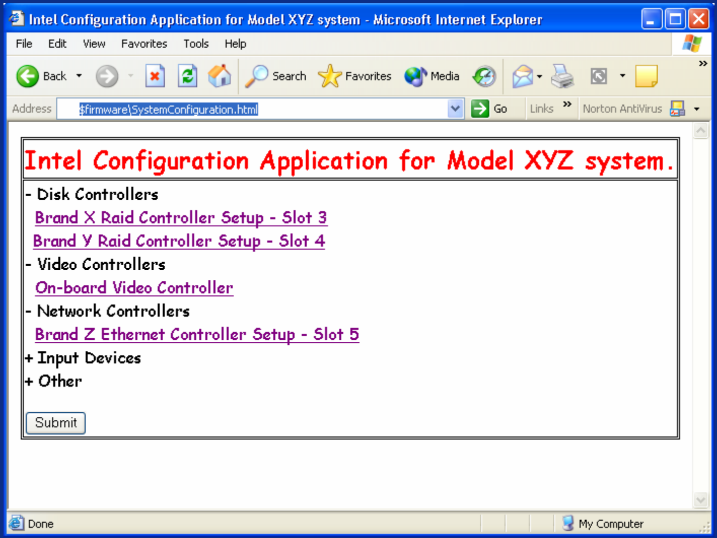


Intel Configuration Application for Model XYZ system - Microsoft Internet Ex...

$firmware\SystemConfiguration.html

英特尔对式样XYZ 系统的配置申请。

- 磁盘控制器
  品牌X 袭击控制器设定- 槽孔3
  品牌Y 袭击控制器设定- 槽孔4
- 录影控制器
  船上录影控制器
- 网络控制器
  品牌Z 以太局域网控制器设定- 槽孔5
+ 输入装置
+ 其他



Intel Configuration Application for Model XYZ system - Microsoft Internet Explorer

$firmware\SystemConfiguration.html

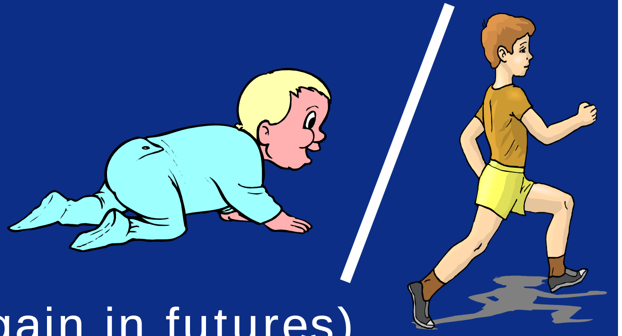
Intel Configuration Application for Model XYZ system.

- Disk Controllers
  Brand X Raid Controller Setup - Slot 3
  Brand Y Raid Controller Setup - Slot 4
- Video Controllers
  On-board Video Controller
- Network Controllers
  Brand Z Ethernet Controller Setup - Slot 5
+ Input Devices
+ Other

Configuration / Manageability Infrast

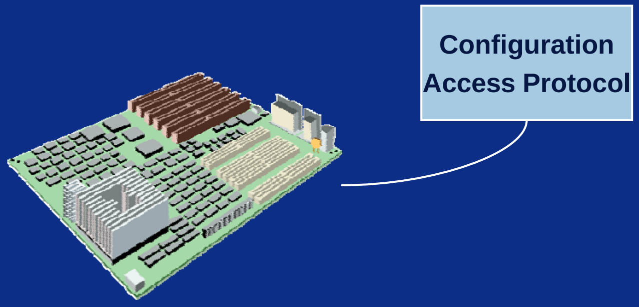
*Other names and brands may be claimed as the property of others

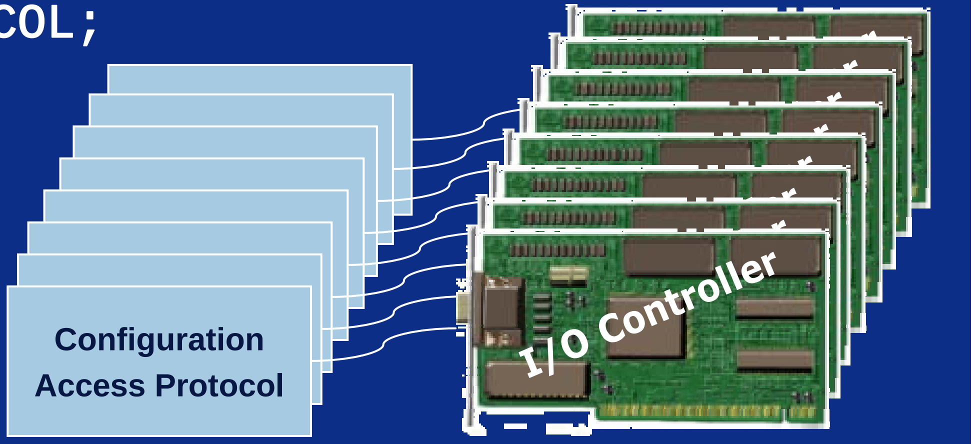
UEFI Interactions



- Device Access APIs (usable today – talk about again in futures)…

```
typedef struct {
  EFI_HII_EXTRACT_CONFIG      ExtractConfig;
  EFI_HII_ROUTE_CONFIG        RouteConfig;
  EFI_HII_FORM_CALLBACK       Callback;
} EFI_HII_CONFIG_ACCESS_PROTOCOL;
```



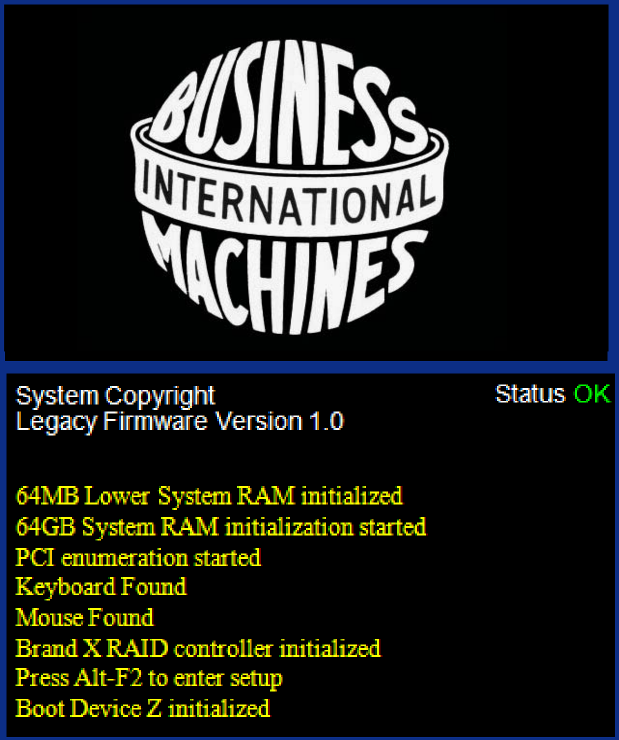


Local Configuration / Manageability

Backup

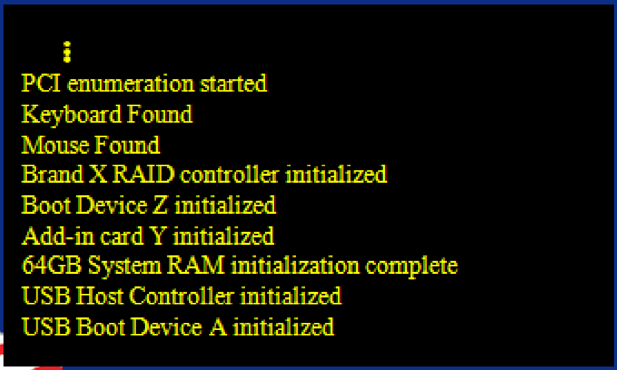
UEFI Interactions

Way it has worked

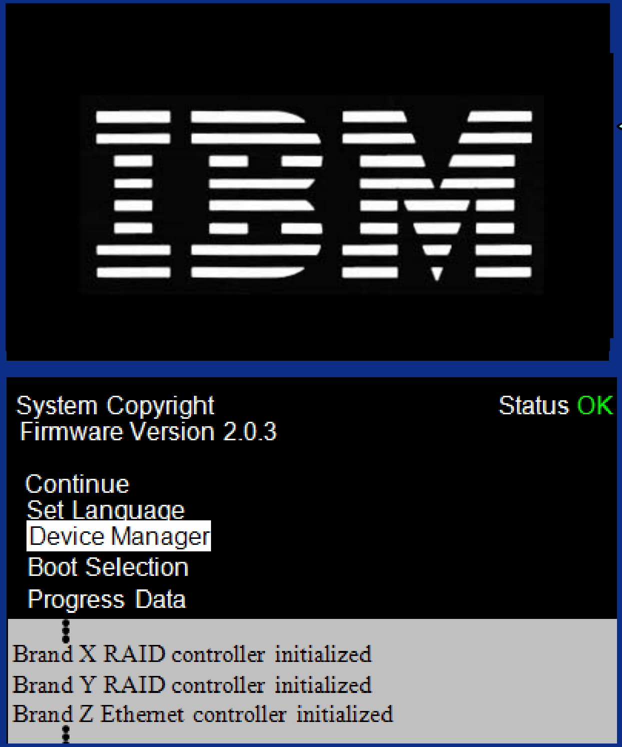


```
System Copyright                                  Status OK
Legacy Firmware Version 1.0

64MB Lower System RAM initialized
64GB System RAM initialization started
PCI enumeration started
Keyboard Found
Mouse Found
Brand X RAID controller initialized
Press Alt-F2 to enter setup
Boot Device Z initialized
```

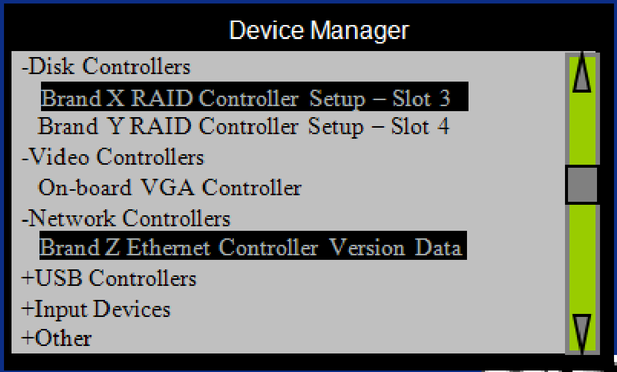


```
   ⋮
PCI enumeration started
Keyboard Found
Mouse Found
Brand X RAID controller initialized
Boot Device Z initialized
Add-in card Y initialized
64GB System RAM initialization complete
USB Host Controller initialized
USB Boot Device A initialized
```

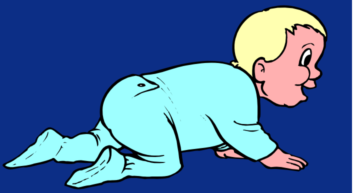


```
System Copyright                                  Status OK
Firmware Version 2.0.3

Continue
Set Language
Device Manager
Boot Selection
Progress Data
   ⋮
Brand X RAID controller initialized
Brand Y RAID controller initialized
Brand Z Ethernet controller initialized
   ⋮
```



```
                  Device Manager
-Disk Controllers
   Brand X RAID Controller Setup – Slot 3
   Brand Y RAID Controller Setup – Slot 4
-Video Controllers
   On-board VGA Controller
-Network Controllers
   Brand Z Ethernet Controller Version Data
+USB Controllers
+Input Devices
+Other
```



Way it can work

Local Configuration / Manageability

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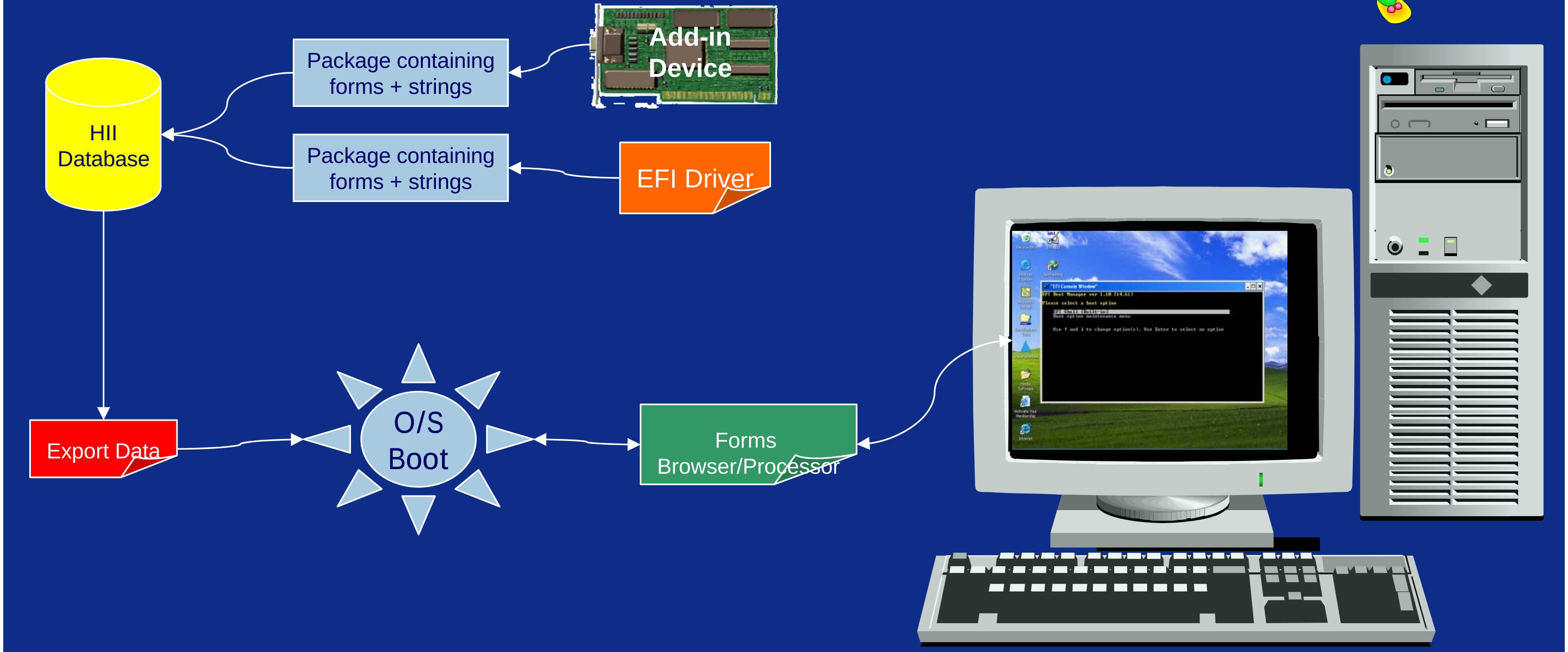
UEFI Interactions

- Local Interactions – Exporting up to the O/S



```
EFI Boot Manager ver 1.10 [14.61]

Please select a boot option

    EFI Shell [Built-in]
    Boot option maintenance menu

    Use ↑ and ↓ to change option(s). Use Enter to select an option
```

Local Configuration / Manageability

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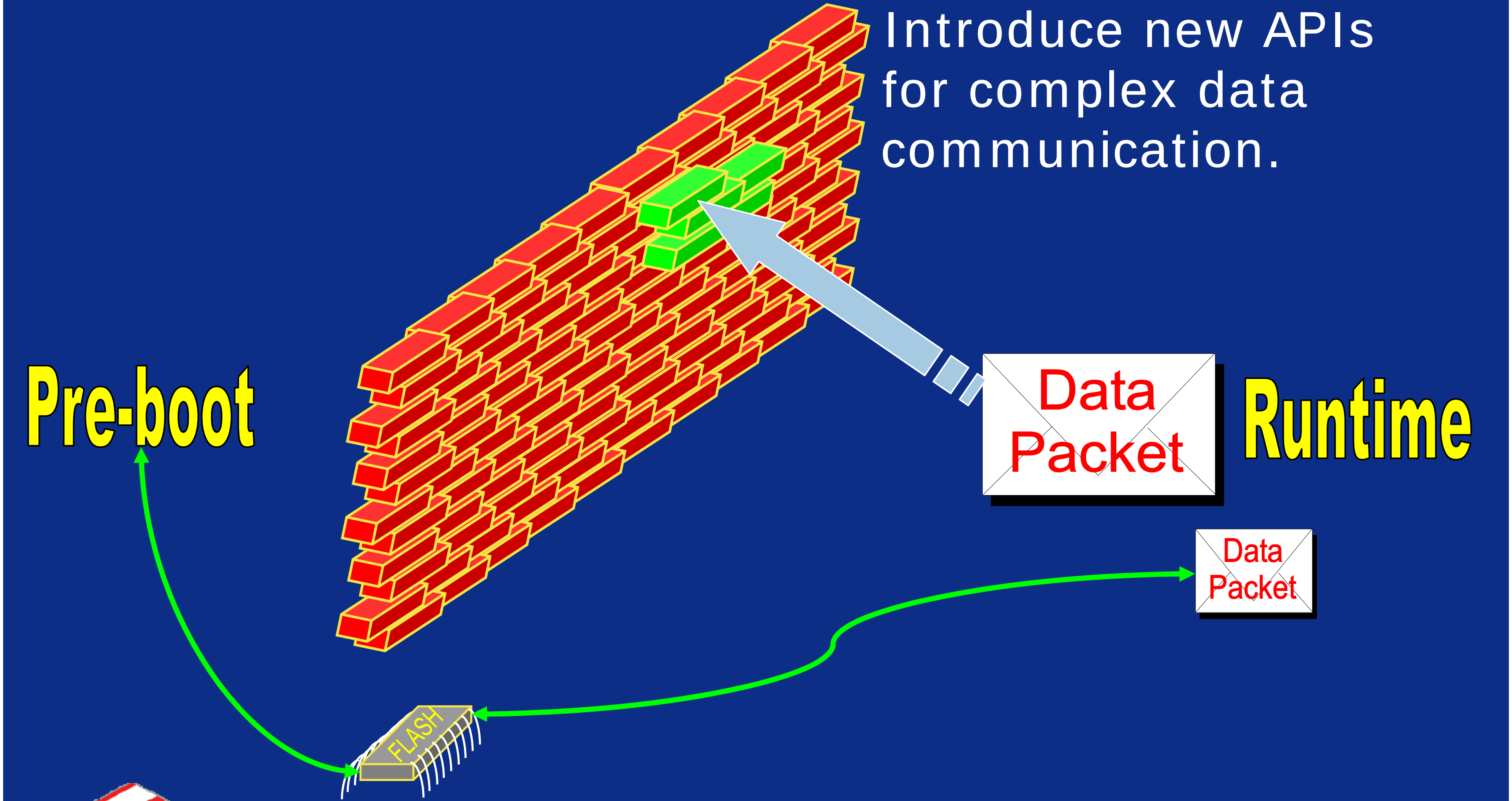
Moving Data through Capsules



Introduce new APIs for complex data communication.

Local Configuration / Manageability

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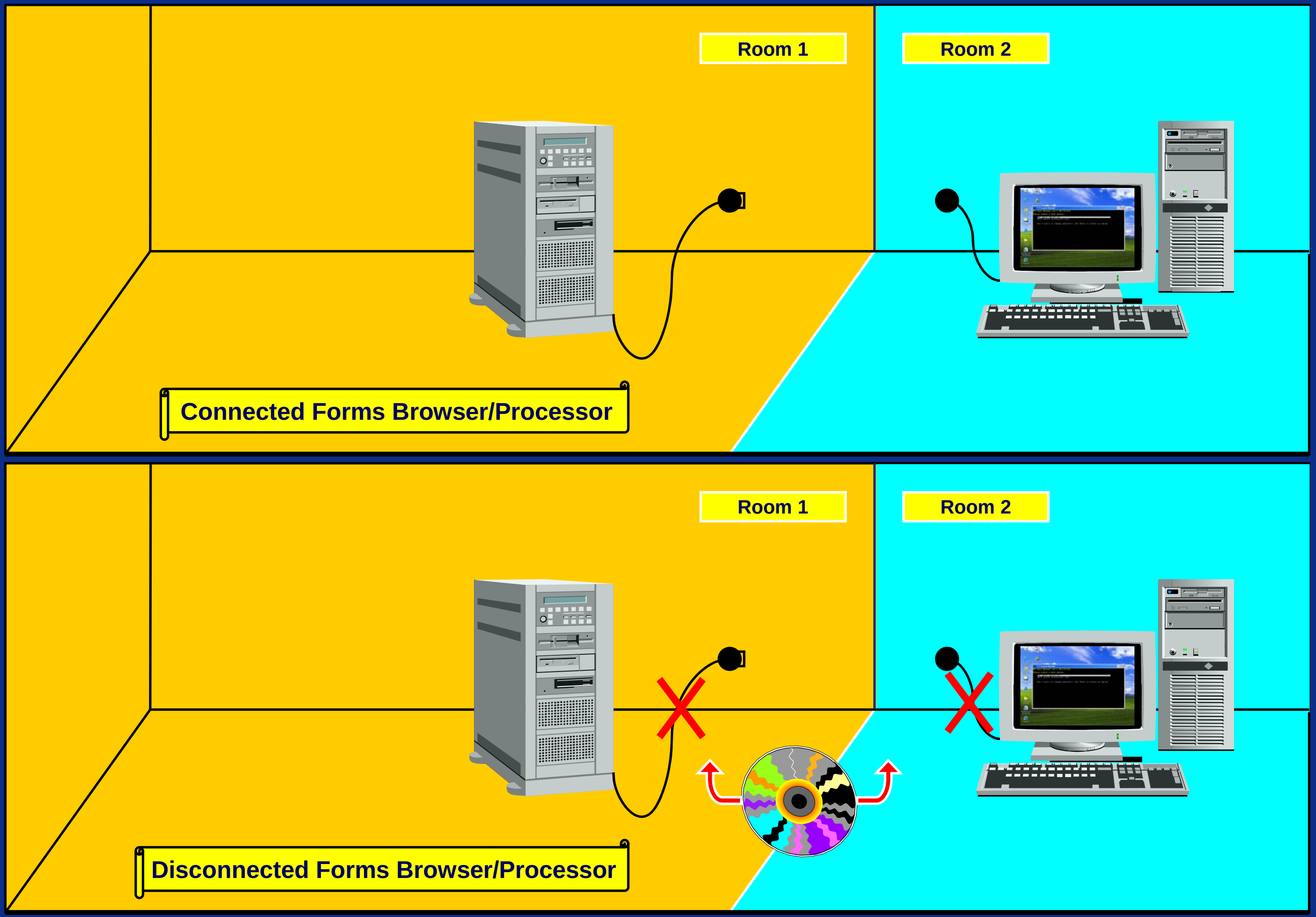
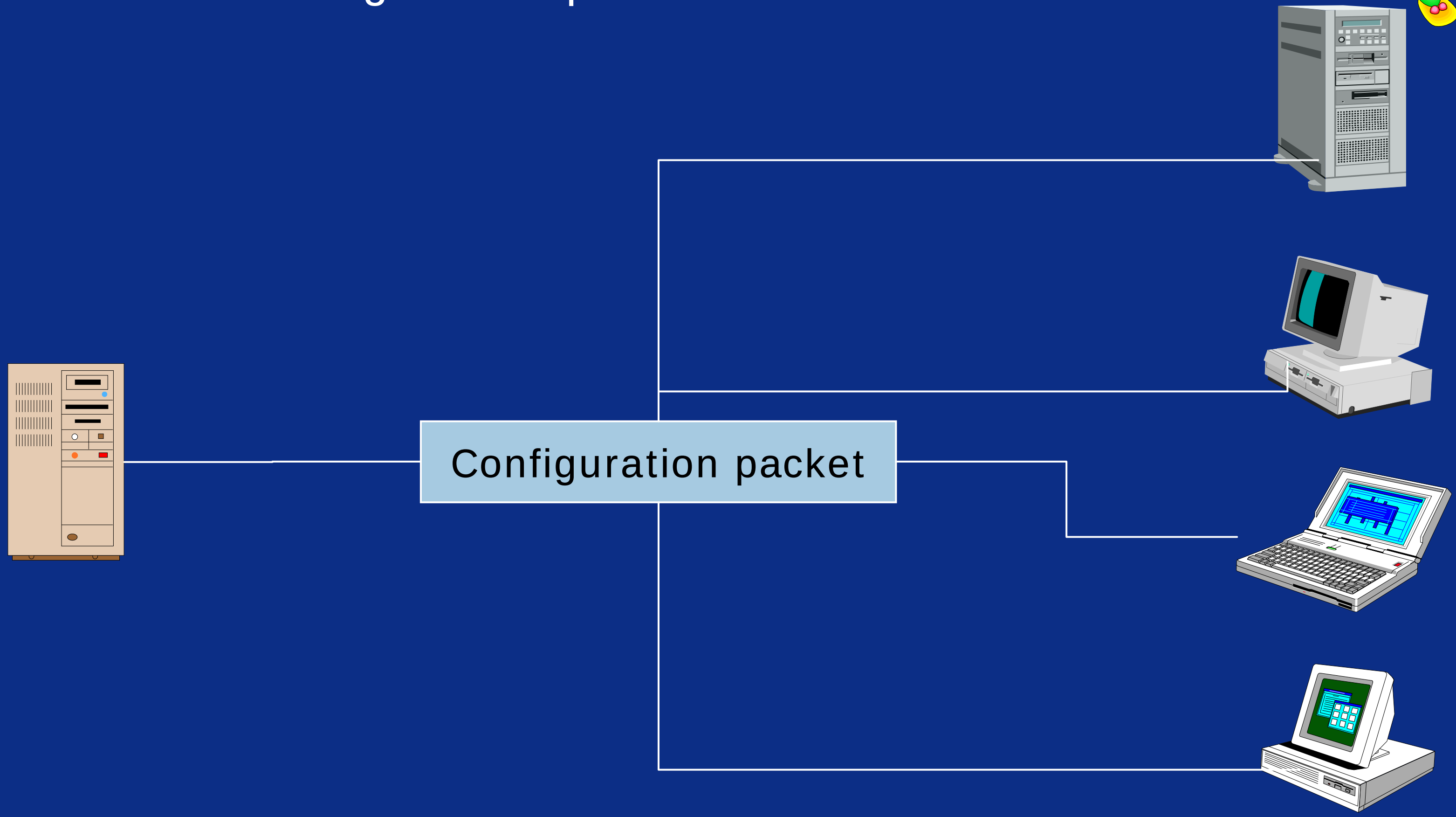
Configuration Portability


Room 1
Room 2
Connected Forms Browser/Processor
Room 1
Room 2
Disconnected Forms Browser/Processor

*Other names and brands may be claimed as the property of others

Network-based Configuration Interactions

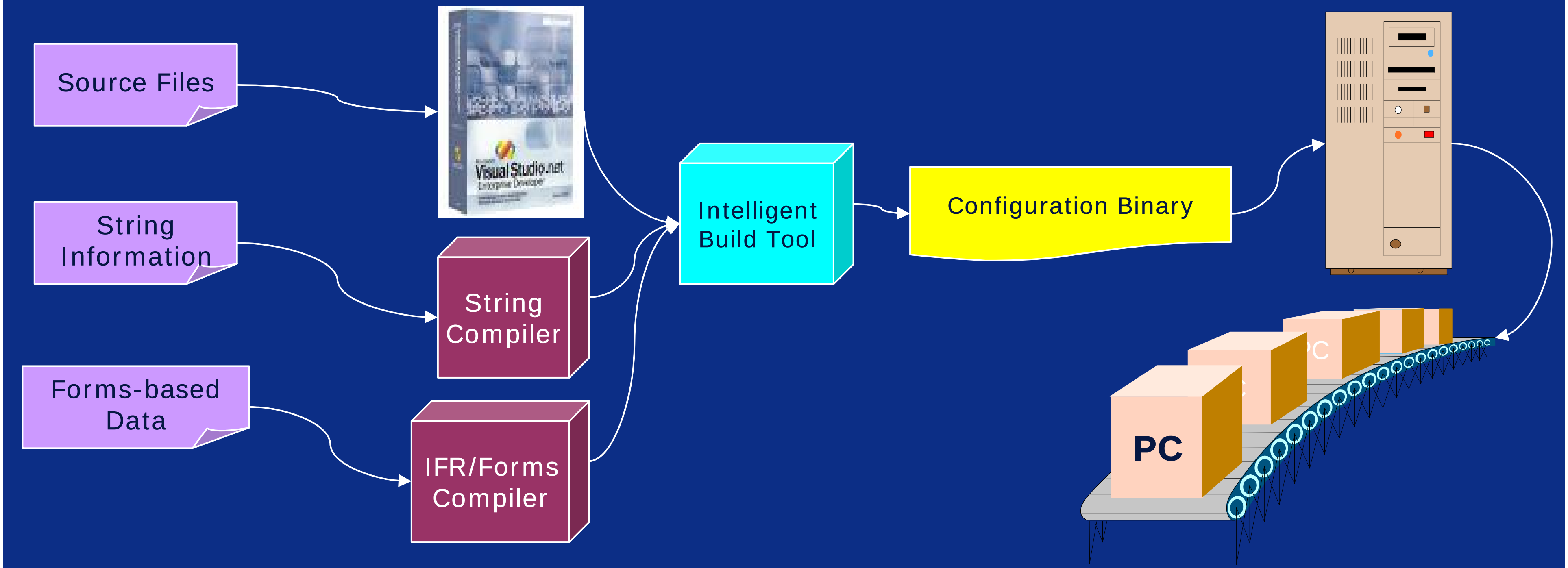
- Construction of configuration packets



Configuration packet

*Other names and brands may be claimed as the property of others

UEFI Interactions



Source Files

String Information

Forms-based Data

String Compiler

IFR/Forms Compiler

Intelligent Build Tool

Configuration Binary

Remote Configuration / Manageability

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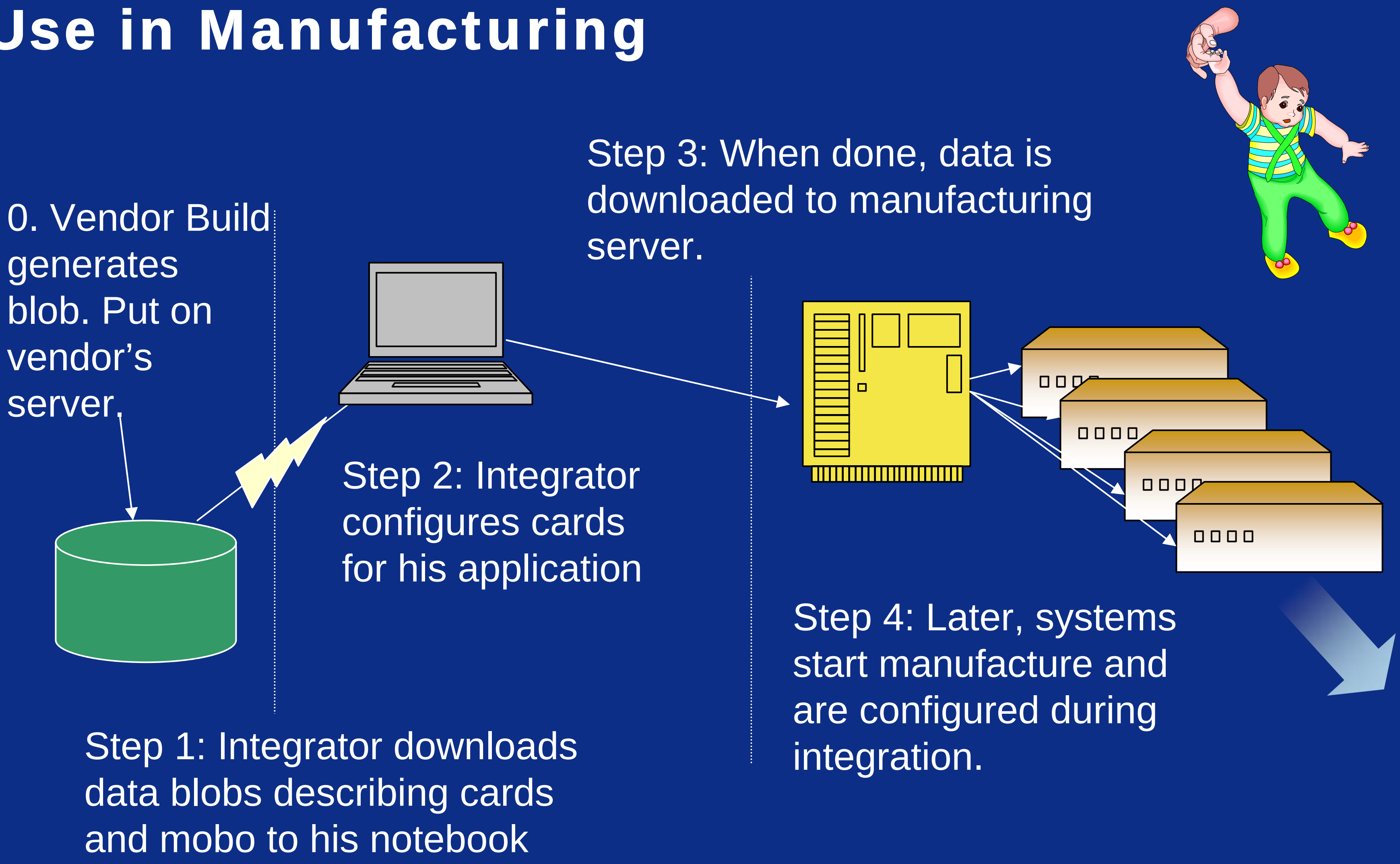
Use in Manufacturing



0. Vendor Build generates blob. Put on vendor's server.

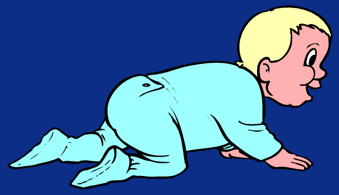
Step 1: Integrator downloads data blobs describing cards and mobo to his notebook

Step 2: Integrator configures cards for his application

Step 3: When done, data is downloaded to manufacturing server.

Step 4: Later, systems start manufacture and are configured during integration.

UEFI Overview



In – UEFI 2.1 target

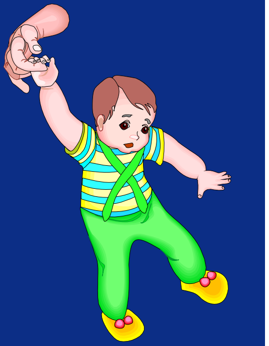
- Produce configuration infrastructure specification (What everyone is reviewing now)
- Purpose:
  - Enable IHVs to have a standard to write against for purposes of HW config.
  - Enable Industry (OEM/IBV/etc) for **proprietary** platform configuration and display mechanisms within the pre-boot and extend this into O/S runtime enablement.
  - Other functional extensions are possible....

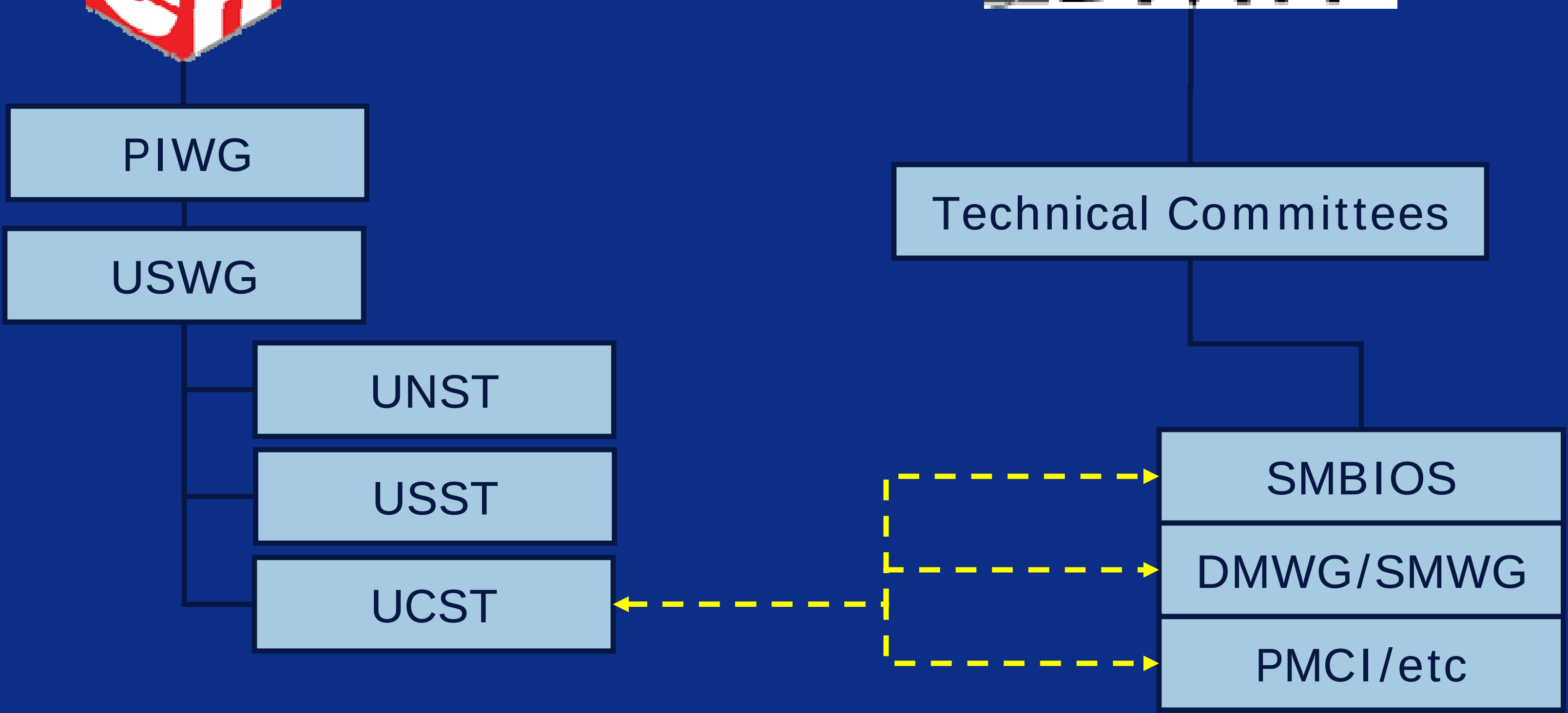
UEFI Configuration Sub-team (UCST)

Stage 2 – to be worked on (UEFI 2.2 or whitepaper or both)

- Using the efforts in Stage 1, further describe how to move from a proprietary platform config mechanism to an environment which mixes multiple proprietary and standard namespace-based ones.
  - Issues to work on:
    - Refining our description of how exactly to determine the config keyword from a pre-existing namespace (e.g. CLP) and apply it to the platform.
    - Challenge will be if existing namespaces are insufficient in describing a “keyword”, get it so that they do, or establish some whitepaper material for guiding people on how to do it.
    - There is an open challenge to avoid creating our own namespace for many reasons – but it is always an option, just not one I relish the thought of doing.

UEFI & DMTF Work Register -Now Approved-





PIWG

USWG

UNST

USST

UCST

Technical Committees

SMBIOS

DMWG/SMWG

PMCI/etc

DMTF Register Actions

- Drive UEFI representation through schema, profile(s) and mapping specification(s) to ensure that the proper support (such as configuration capabilities and namespace requirements) exists for both traditional BIOS as well as UEFI standards.
  - CIM Schema 2.16 (3Q2007)
  - BIOS Profile 1.0 (3Q2007)
  - BIOS SM CLP Mapping Specification 1.0 (3Q2007)
  - Investigate and Contribute to BIOS Profile(s).
- Promote relevant DMTF material back into the UEFI 2.2 specification. (1Q2008)
- Inclusion of updates as appropriate to the upcoming DASH Management Initiative updates.
  - Inclusion of BIOS Profile in DASH 1.1 (4Q2007)

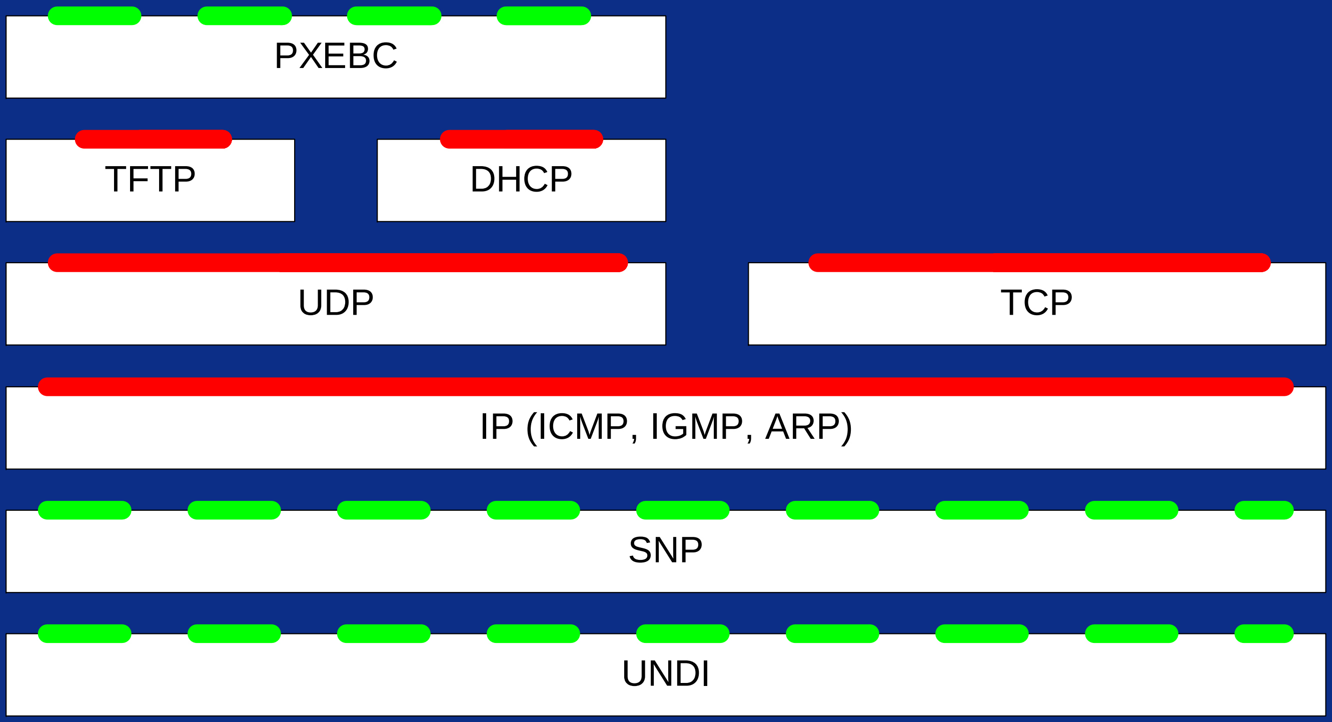
Futures

*Other names and brands may be claimed as the property of others

DMTF Register Actions - II

- Collaboration on appropriate UEFI requirements on specifications developed within DMTF Working Groups. This includes:
  - System and Option ROM Identifiers
  - Command/Response strings
- This would result in the following specifications that would need to be shared with UEFI:
  - SM CLP Specification Updates & Work in Progress Drafts
  - SM CLP Mapping Specification Updates & Work in Progress Drafts
  - CIM Schema Work in Progress Drafts
  - DMTF Profile Work in Progress Drafts
- This would result in the following specifications that would need to be shared with DMTF:
  - UEFI Specification Updates & Work in Progress Drafts

Protocol Diagram



Red (solid) lines are new (for UEFI **2.0**) network protocol APIs that can be accessed by multiple applications and drivers at the same time.

Green (broken) lines are existing network protocol APIs (from EFI **1.1** or earlier) that can only be accessed by one application or driver at a time.

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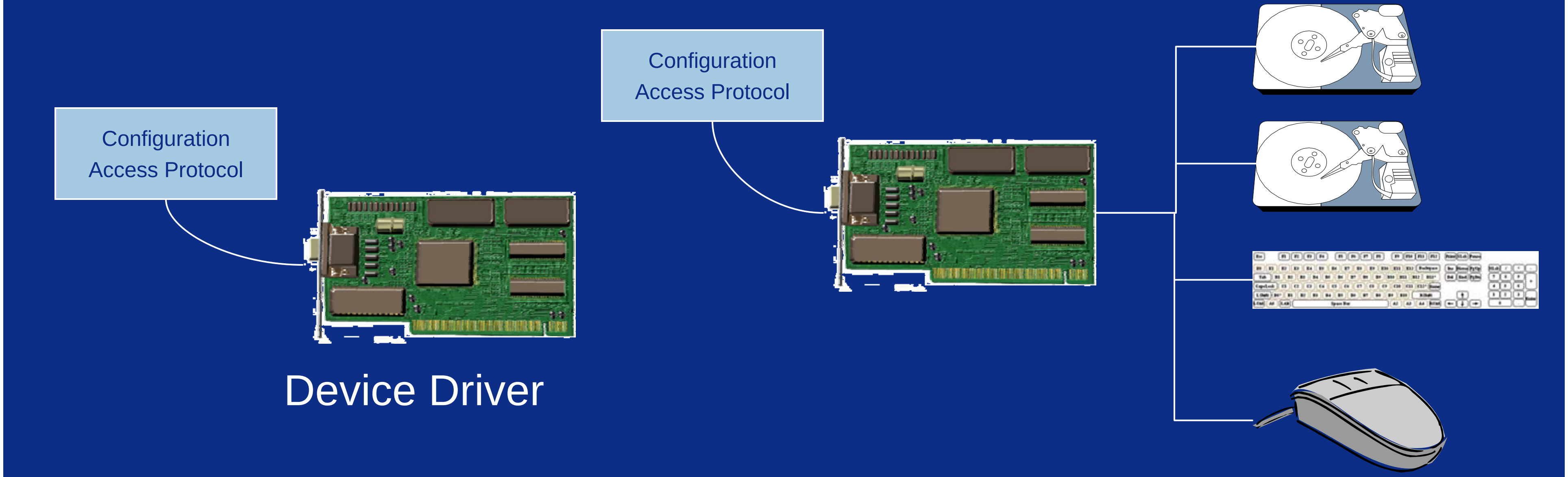
Driver Model Relationship



Configuration Access Protocol

Configuration Access Protocol

Device Driver

BUS Driver

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