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UEFI & EDK II Training

Platform Configuration Database (PCD)

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LESSON OBJECTIVE

- Define Platform Configuration Database (PCD) and explain the syntax
- Differentiate types of PCDs
- Explain how changing a PCD value affects output
- Evaluate the results of a PCD value modification
- Special PCDs

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PCD Overview

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EDK II PCD's Purpose and Goals

Documentation : MdeModulePkg/Universal/PCD/Dxe/Pcd.inf

Purpose

- Establishes platform common definitions
- Build-time/Run-time aspects
- Binary Editing Capabilities

Goals

- Simplify porting
- Easy to associate with a module or platform

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EDK II PCD’s Purpose and Goals

Documentation : MdeModulePkg/Universal/PCD/Dxe/Pcd.inf

```
////////////////////////////////////////////////////////////////////////////////
//                                                                            //
//                      Introduction of PCD database                          //
//                                                                            //
////////////////////////////////////////////////////////////////////////////////

1, Introduction
   PCD database hold all dynamic type PCD information. The structure of PEI PCD
   database is generated by build tools according to dynamic PCD usage for
   specified platform.

2, Dynamic Type PCD
   Dynamic type PCD is used for the configuration/setting which value is determined
   dynamic. In contrast, the value of static type PCD (FeatureFlag, FixedPcd,
   PatchablePcd) is fixed in final generated FD image in build time.
```

See Link above to view the entire documentation

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PCD Types

FixedAtBuild

Dynamic

DyanmicEx

PatchableInModule

FeatureFlag

DynamicHii

DynamicVpd

Syntax Examples

```
[pcdsFeatureFlag.common] [pcdsFixedAtBuild.IA32]
[PcdsFixedAtBuild, PcdsPatchableInModule, PcdsDynamic,
PcdsDynamicEx]
```

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UEFI Platform Initialization (PI) 1.x Spec & PCDs

PEI

- PCD PEIM produces PCD database
- Two PCD PPIs: `PCD_PPI` and `EFI_PEI_PCD_PPI`

DXE

- DXE Driver Manages PCDs
- Two PCD Protocols: `PCD_PROTOCOL` and `EFI_PCD_PROTOCOL`

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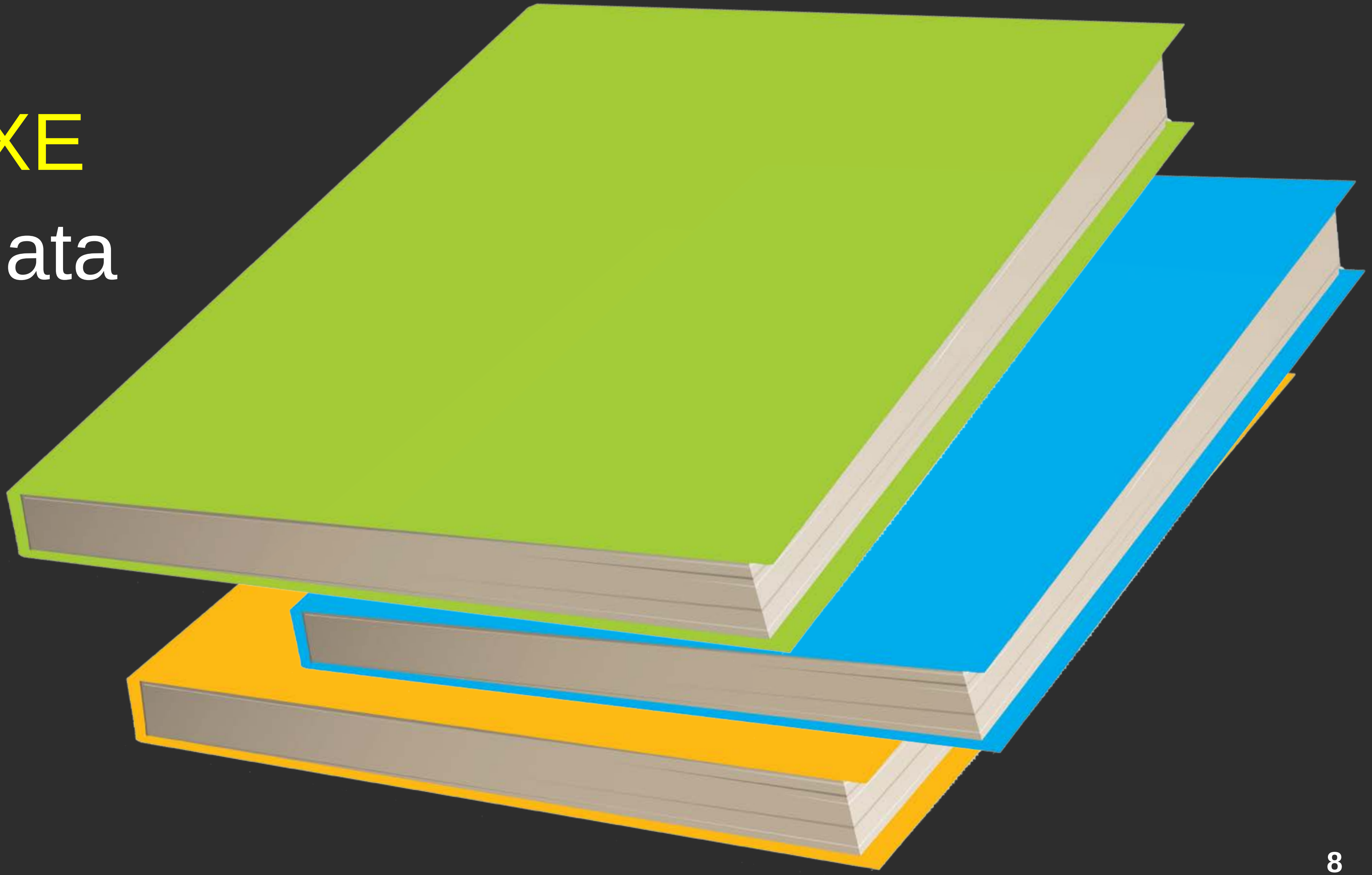
PCD Library

- Provides interface for PCDs
- PCD PPI - PEI
- PCD Protocol – DXE
- Allows access to data



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PCD Library Calls: PCD Protocol and PCD PPI Functions

Example of different Functions:

```
PcdGetXX()
PcdSetXX()
PcdGetExXX()
PcdSetExXX()
PcdToken()
PCDSetSku()
PcdGetNextToken()
PcdGetNextTokenSpace()
CallBackOnSet()
CancelCallBack()
```

Where “XX” =

```
8
16
32
Size
Ptr
Boolean
```

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PCD Syntax

PCDs can be located anywhere within the Workspace even though a different package will use those PCDs for a given project

.DEC	.INF	.DSC
Define PCD	Reference PCD	Modify PCD
Package	Module	Platform

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PCD Syntax example

PCD defined in the DEC file from any package

```
[Guids.common]
PcdTokenSpaceGuidName={ 0xXXXXXXXX, 0xXXXX, 0xXXXX, { 0xXX, . . .}}

 .  .  .
[Pcds...]
PcdTokenSpaceGuidName.PcdTokenName|Value[|DatumType[|MaxSize]]|Token
```

PCD usage listed in INF file for module

```
[…Pcd…]
PcdTokenSpaceGuidName.PcdTokenName|[Value]
```

Value of PCD set in Platform DSC

```
[Pcds...]
PcdTokenSpaceGuidName.PcdTokenName|Value[|DatumType[|MaximumDatumSize]]
```

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PCD Variable Example

Defined MdeModulePkg/MdeModulePkg.dec

DEC

```
[PcdsFixedAtBuild, PcdsPatchableInModule]
gEfiMdeModulePkgTokenSpaceGuid.PcdMaxVariableSize|0x400|UINT32|0x30000003
```

Referenced

INF

MdeModulePkg/Universal/Variable/RuntimeDxe/VariableRuntimeDxe.inf

```
[Pcd]
  gEfiMdeModulePkgTokenSpaceGuid.PcdMaxVariableSize ## CONSUMES
```

Modified OvmfPkg/OvmfPkgX64.dsc

DSC

```
[PcdsFixedAtBuild]
gEfiMdeModulePkgTokenSpaceGuid.PcdMaxVariableSize|0x008400
```

Used

C

MdeModulePkg/Universal/Variable/RuntimeDxe/Variable.c // max NV variable size

```
 mVariableModuleGlobal->MaxVariableSize = PcdGet32 (PcdMaxVariableSize);
```

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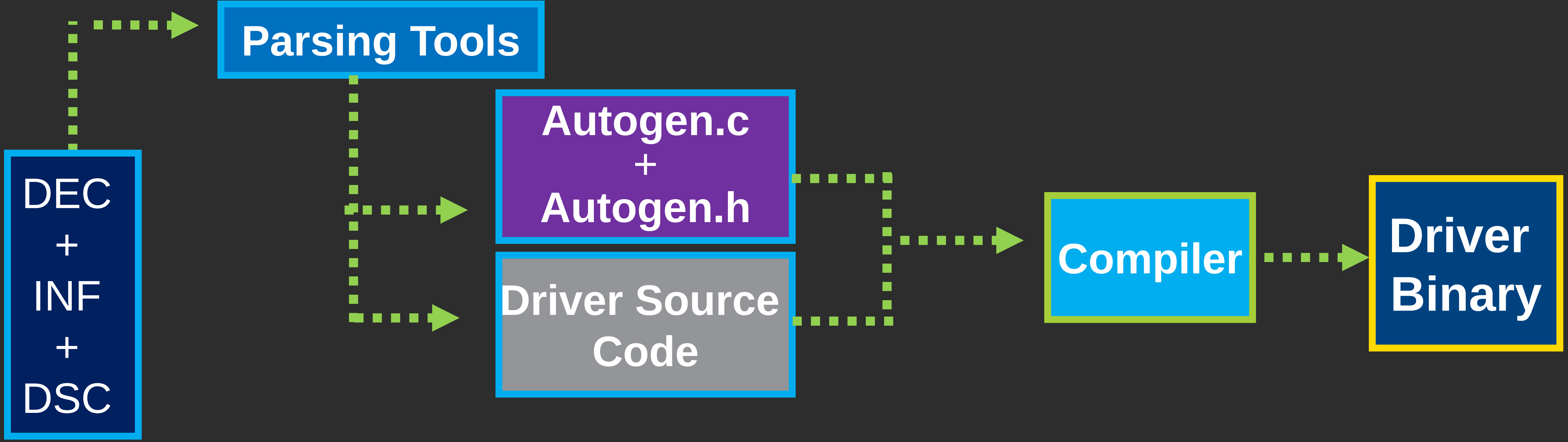
PCD Driver



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Fixed PCD AutoGen files

Example : MdeModulePkg\Universal\Variable\RuntimeDxe\VariableRuntimeDxe

Autogen.h

```
#define _PCD_TOKEN_PcdMaxVariableSize  250U
#define _PCD_SIZE_PcdMaxVariableSize 4
#define _PCD_GET_MODE_SIZE_PcdMaxVariableSize  _PCD_SIZE_PcdMaxVariableSize
#define _PCD_VALUE_PcdMaxVariableSize  0x8400U
extern const  UINT32  _gPcd_FixedAtBuild_PcdMaxVariableSize;
#define _PCD_GET_MODE_32_PcdMaxVariableSize  _gPcd_FixedAtBuild_PcdMaxVariableSize
```

Autogen.c

```
// Definition of PCDs used in this module
. . .
GLOBAL_REMOVE_IF_UNREFERENCED const UINT32 _gPcd_FixedAtBuild_PcdMaxVariableSize =
   _PCD_VALUE_PcdMaxVariableSize;
```

What about a Dynamic PCDs?

- Only can be Set and changed during Boot time.
- PCD can be set with the library Set: LibPcdSet…
- PCD can be retrieved with the library Get: LibPcdGet…

Example: Use the variable `PcdPlatformBootTimeOut` defined for the platform time in seconds before booting, modified for a value of 03 seconds

Dynamic PCD

DEC

Defined

MdeModulePkg/MdeModulePkg.dec

```
[PcdsDynamic]
gEfiMdePkgTokenSpaceGuid.PcdPlatformBootTimeOut|0xffff|UINT16|0x
```

DSC

Modified

OvmfPkg/OvmfPkg.dsc

```
[PcdsDynamicDefault]
  gEfiMdePkgTokenSpaceGuid.PcdPlatformBootTimeOut|03
```

C

Setting

OvmfPkg/Library/PlatformBootManagerLib/BdsPlatform.c

```
PcdStatus = PcdSet16S (PcdPlatformBootTimeOut,
               GetFrontPageTimeoutFromQemu ());
```

C

Used

OvmfPkg/Library/QemuBootOrderLib/QemuBootOrderLib.c

```
Timeout = PcdGet16 (PcdPlatformBootTimeOut);
```

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Dynamic PCD Autogen Files

Example Module: (OvmfPkg\Library\PlatformBootManagerLib)

Autogen.h

```
• • •

#define _PCD_SET_MODE_16_PcdPlatformBootTimeOut(Value) \
 LibPcdSet16(_PCD_TOKEN_PcdPlatformBootTimeOut, ( Value ))
#define _PCD_SET_MODE_16_S_PcdPlatformBootTimeOut(Value) \
 LibPcdSet16S(_PCD_TOKEN_PcdPlatformBootTimeOut, ( Value ))
```

Example Module: (MdeModulePkg/Universal/PCD/Dxe/Pcd)

Autogen.c

```
DXE_PCD_DATABASE_INIT gDXEPcdDbInit = {
• • •
 /* LocalTokenNumberTable */
• • •
 offsetof(DXE_PCD_DATABASE, Init.PcdPlatformBootTimeOut_*1) | PCD_TYPE_DATA | PCD_DATUM_TYPE_UINT16,
• • •
   { 0x3U }        /*  PcdPlatformBootTimeOut_*1 [1] */,
```

*1 GUID of PCD Variable **PcdPlatformBootTimeOut**

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Special PCDS

Multi-Structure PCD	• C data structure and assign the value to each sub-field directly
Multi-Sku PCD	• Multiple configurations generated at build time & set @ run time, (PI Spec Vol 3 chap. 8)
DefaultStores PCD	• Support the default stores concept in UEFI specification, (UEFI, HII Chap. 32)

Multiple "C" Data Structure as PCDs

Example: SMBIOS Type 0 Data Structure PCD Defined

edk2-platforms/Features/Intel/SystemInformation/ SmbiosFeaturePkg.dec

```
gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation| \
{0x0}|SMBIOS_TABLE_TYPE0|0xD0000001 {
    <HeaderFiles>
      IndustryStandard/SmBios.h  --->  MdePkg/Include/IndustryStandard/SmBios.h
    <Packages>
      MdePkg/MdePkg.dec
      SystemInformation/SmbiosFeaturePkg/SmbiosFeaturePkg.dec
  }
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.Vendor|0x1
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosVersion|0x2
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosSegment|0xF000
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosReleaseDate|0x3
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosSize|0xFF
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosCharacteristics.\
     PciIsSupported|1
  gSmbiosFeaturePkgTokenSpaceGuid.PcdSmbiosType0BiosInformation.BiosCharacteristics.\
     PlugAndPlayIsSupported|1

     . . .
```

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Multiple “C” Data Structure as PCDs

Example: SMBIOS Type 0 Data Structure “C” Data structure in `SmBios.h`

https://github.com/tianocore/edk2/.../MdePkg/Include/IndustryStandard/SmBios.h

```
/// BIOS Information (Type 0).
///
typedef struct {
  SMBIOS_STRUCTURE          Hdr;
  SMBIOS_TABLE_STRING       Vendor;
  SMBIOS_TABLE_STRING       BiosVersion;
  UINT16                    BiosSegment;
  SMBIOS_TABLE_STRING       BiosReleaseDate;
  UINT8                     BiosSize;
  MISC_BIOS_CHARACTERISTICS BiosCharacteristics;
  UINT8                     BIOSCharacteristicsExtensionBytes[2];
  UINT8                     SystemBiosMajorRelease;
  UINT8                     SystemBiosMinorRelease;
  UINT8                     EmbeddedControllerFirmwareMajorRelease;
  UINT8                     EmbeddedControllerFirmwareMinorRelease;
  EXTENDED_BIOS_ROM_SIZE    ExtendedBiosSize;
} SMBIOS_TABLE_TYPE0;
```

Names in the “C” data structure match the names in the PCDs

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Multi-SKU PCD

DSC File – SKU Set at BUILD time

```
. . .
SKUID_IDENTIFIER = ?

[SkuIds]
0|DEFAULT
4|BoardX
0x42|BoardY

[PcdsDynamicDefault.common.BoardX]
gBoardModuleTokenSpaceGuid.PcdGpioPin|0x8
gBoardModuleTokenSpaceGuid.PcdGpioInitValue|\
        {0x00, 0x04, 0x02, 0x04, ...}

[PcdsDynamicDefault.common.BoardY]
gBoardModuleTokenSpaceGuid.PcdGpioPin|0x4
gBoardModuleTokenSpaceGuid.PcdGpioInitValue|\
        {0x00, 0x02, 0x01, 0x02, ...}
```

SKU PCD Set Dynamically

```
BoardXBoardDetect( VOID)
{
. . .
  if (LibPcdGetSku () != 0) {
    return EFI_SUCCESS;
  }
  if (IsBoardX ()) {
     LibPcdSetSku (BoardIdIsBoardX);
     ASSERT (LibPcdGetSku() ==
              BoardIdIsBoardX);
  }
  return EFI_SUCCESS;
}
```

Default Stores PCD

DSC File –

```
.  .  .
VPD_TOOL_GUID  = 8C3D856A-9 . . .

[DefaultStores]
0|STANDARD
1|MANUFACTURING
2|SAFE


[PcdsDynamicExVpd.common.DEFAULT]
  gEfiMdeModulePkgTokenSpaceGuid.PcdNvStoreDefaultValueBuffer|*
[PcdsDynamicEx.common.DEFAULT.STANDARD]
  gOemSkuTokenSpaceGuid.PcdSetupData.CloudProfile|0x0
  gOemSkuTokenSpaceGuid.PcdSetupData.Use1GPageTable|0x1
[PcdsDynamicEx.common.DEFAULT.MANUFACTURING]
  gOemSkuTokenSpaceGuid.PcdSetupData.CloudProfile|0x1
  gOemSkuTokenSpaceGuid.PcdSetupData.Use1GPageTable|0x0
```

- Special PCD to support the default stores concept in UEFI specification
- Can be Dynamically set

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Summary

- Define Platform Configuration Database (PCD) and explain the syntax
- Differentiate types of PCDs
- Explain how changing a PCD value affects output
- Evaluate the results of a PCD value modification
- Special PCDs

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Questions?

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ACKNOWLEDGEMENTS

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PCD Dynamic and DynamicEx

PCD DynamicEx (follows PI 1.x Spec)

- Referenced using Token Number and GUID
- Required for modules that are distributed as binaries
- The size is slightly larger compare with Dynamic

PCD Dynamic

- Referenced only by a Token Number without a GUID
- Useful for modules that are build from sources
- Reduce the size overhead of using PCDs

Dynamic PCD is size optimized compared to DynamicEX when modules are build from source