

TABLE OF CONTENTS

[UEFI_Driver_HII_Win_Lab_Guide](#)

[UEFI Driver Wizard – Adding HII Labs](#)

[Lab 1. Adding Strings and Forms to Setup HII for User Configuration](#)

[a. Setup for Lab adding HII](#)

[b. Edit Driver for adding HII](#)

[Lab 2. Updating HII to Save Data Settings](#)

[Lab 3. Updating your driver to initialize data from the VFR data to the HII Database](#)

[Lab 4. Updating the Menu: Reset Button](#)

[Lab 5. Updating the Menu: Pop-up Box](#)

[Lab 6. Updating the Menu: Creating a String to Name a Saved Configuration](#)

[Lab 7. Updating the Menu: Numeric Entry](#)

[Lab 8. Updating your Driver for Interactive Call Backs](#)

[Lab 9. Add code to your driver when Call Back events occur for Interactive Items](#)

[Lab 10. Adding an Additional Form Page](#)

[Lab 11. Adding Communication from Driver to Console through HII](#)

[Lab Setup](#)

[Microsoft Windows 10 – Visual Studio command prompt](#)

[Reference](#)

[Microsoft Windows and Visual Studio Matrix](#)

[Glossary of UEFI Terms and Acronyms](#)

[Helpful Links](#)



UEFI DRIVER HII WIN LAB GUIDE

UEFI and EDK II Base Training

Lab and Reference Guide

Assumes Windows 10

DRAFT FOR REVIEW

04/28/2025 10:25:39

Revision 01.0

Contributed by

Laurie Jarlstrom, Intel Corporation

Acknowledgements

Redistribution and use in source (original document form) and 'compiled' forms (converted to PDF, epub, HTML and other formats) with or without modification, are permitted provided that the following conditions are met:

1. Redistributions of source code (original document form) must retain the above copyright notice, this list of conditions and the following disclaimer as the first lines of this file unmodified.
2. Redistributions in compiled form (transformed to other DTDs, converted to PDF, epub, HTML and other formats) must reproduce the above copyright notice, this list of conditions and the following disclaimer in the documentation and/or other materials provided with the distribution.

THIS DOCUMENTATION IS PROVIDED BY TIANOCORE PROJECT "AS IS" AND ANY EXPRESS OR IMPLIED WARRANTIES, INCLUDING, BUT NOT LIMITED TO, THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE ARE DISCLAIMED. IN NO EVENT SHALL TIANOCORE PROJECT BE LIABLE FOR ANY DIRECT, INDIRECT, INCIDENTAL, SPECIAL, EXEMPLARY, OR CONSEQUENTIAL DAMAGES (INCLUDING, BUT NOT LIMITED TO, PROCUREMENT OF SUBSTITUTE GOODS OR SERVICES; LOSS OF USE, DATA, OR PROFITS; OR BUSINESS INTERRUPTION) HOWEVER CAUSED AND ON ANY THEORY OF LIABILITY, WHETHER IN CONTRACT, STRICT LIABILITY, OR TORT (INCLUDING NEGLIGENCE OR OTHERWISE) ARISING IN ANY WAY OUT OF THE USE OF THIS DOCUMENTATION, EVEN IF ADVISED OF THE POSSIBILITY OF SUCH DAMAGE.

Copyright (c) 2018, Intel Corporation. All rights reserved.

Revision History

Revision	Revision History	Date
01.0	Initial release.	July 2018

UEFI DRIVER WIZARD – ADDING HII



Lab 1. Adding Strings and Forms to Setup HII for User Configuration

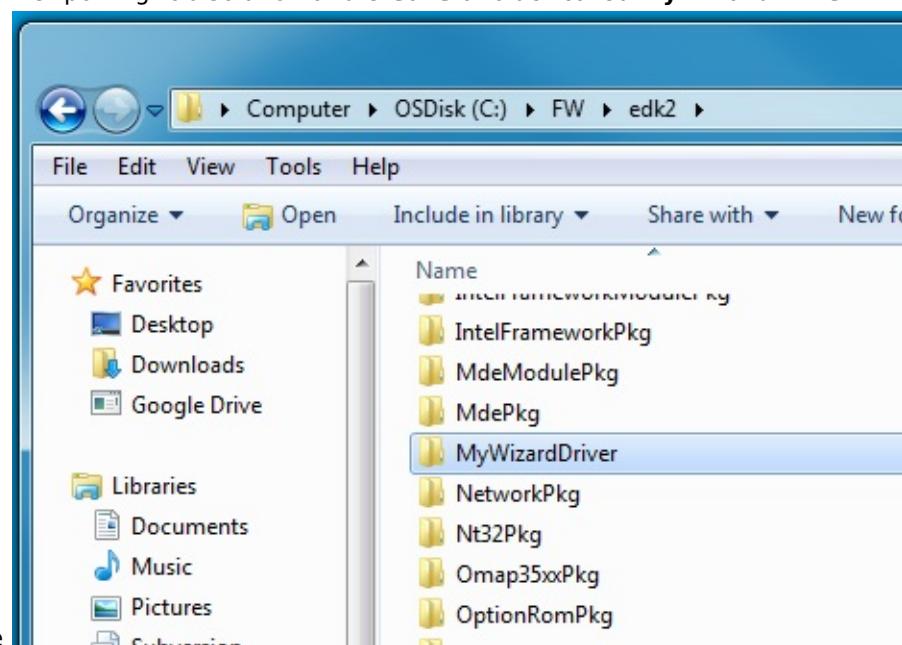
In this lab, you'll learn how to use HII to add strings and forms to a firmware setup menu for user configuration. Once you've complete this lab, your end result will match Figure 1.



Figure 1 My Wizard Driver menu with strings and forms

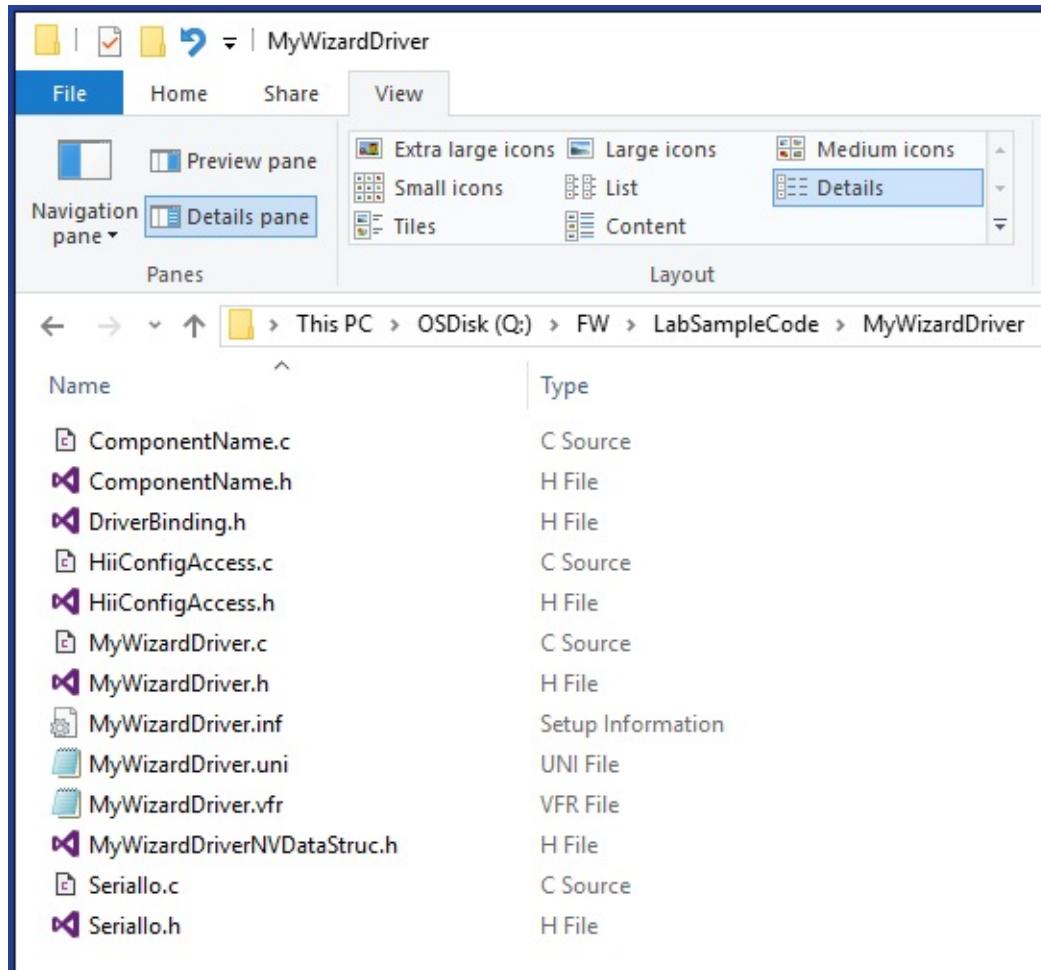
Lab 1 a. Setup for Lab adding HII

1. Complete [Lab Setup](#) to configure for building with Visual Studio.
2. Start with LAB 6. on Driver porting Lab solution and **create** a folder called **MyWizardDriver** in the



3. Now, **locate** and **open**: C:\FW\LabSampleCode\MyWizardDriver

4. Copy the following Files to C:\FW\edk2\MyWizardDriver



5. Open Visual Studio Command Prompt

```
Developer Command Prompt for VS2013
C:\Program Files (x86)\Microsoft Visual Studio 12.0>
```

6. Type CD C:\fw\edk2

```
Developer Command Prompt for VS2013
C:\Program Files (x86)\Microsoft Visual Studio 12.0>cd \
C:\>cd c:\fw
c:\fw>cd edk2
```

7. Type Edksetup (This is only needed if starting out with a **new** Visual Studio Command Prompt Window)

```
c:\fw\edk2>edksetup
PATH      = c:\fw\edk2\BaseTools\Bin\Win32;C:\Program Files (x86)\Micro
udio 12.0\Common7\IDE\CommonExtensions\Microsoft\TestWindow;C:\Program Files (x8
Ks\F#\3.1\Framework\v4.0\;C:\Program Files (x86)\MSBuild\12.0\bin;C:\Program Fil
oft Visual Studio 12.0\Common7\IDE\;C:\Program Files (x86)\Microsoft Visual Stud
C:\Program Files (x86)\Microsoft Visual Studio 12.0\Common7\Tools;C:\windows\Mid
ework\v4.0.30319;C:\Program Files (x86)\Microsoft Visual Studio 12.0\VC\VCPackag
a\Local\Microsoft\WindowsApps;C:\Users\ljarlstr\AppData\Roaming\npm;C:\Users\ljarl
ocal\Pandoc\

WORKSPACE      = c:\fw\edk2
EDK_TOOLS_PATH      = c:\fw\edk2\BaseTools
BASE_TOOLS_PATH      = c:\fw\edk2\BaseTools
EDK_TOOLS_BIN      = c:\fw\edk2\BaseTools\Bin\Win32
CONF_PATH      = c:\fw\edk2\Conf

!!! WARNING !!! NASM_PREFIX environment variable is not set
Found nasm.exe, setting the environment variable to C:\nasm\

!!! WARNING !!! No CYGWIN_HOME set, gcc build may not be used !!!

c:\fw\edk2>
```

Lab 1 b. Edit Driver for adding HII

1. **Open** C:\fw\edk2\MyWizardDriver
2. **Open** the following files for updating:
 - o MyWizardDriverNVDataStruc.h
 - o MyWizardDriver.vfr
 - o MyWizardDriver.uni
 - o MyWizardDriver.h
 - o MyWizardDriver.c
 - o MyWizardDriver.inf
3. **Update** the MyWizardDriverNVDataStruc.h file by copying and pasting the following GUID as shown below. This GUID is used to communicate to the HII Database and Browser Engine

```
#define MYWIZARDDRIVER_FORMSET_GUID \
{ \
0x5481db09, 0xe5f7, 0x4158, 0xa5, 0xc5, 0x2d, 0xbe, 0xa4, 0x95, 0x34, 0xff \
}

6
7 #define MYWIZARDDRIVER_VAR_GUID \
8 { \
9     0x363729f9, 0x35fc, 0x40a6, 0xaf, 0xc8, 0xe8, 0xf5, 0x49, 0x11, 0xf1, 0xd6 \
10 }
11
12 #define MYWIZARDDRIVER_FORMSET_GUID \
13 { \
14     0x5481db09, 0xe5f7, 0x4158, 0xa5, 0xc5, 0x2d, 0xbe, 0xa4, 0x95, 0x34, 0xff \
15 }
16
17
18 #pragma pack(1)
19 typedef struct {
20
21     UINT16  MyWizardDriverStringData[20];
22     UINT8   MyWizardDriverHexData;
23     UINT8   MyWizardDriverBaseAddress;
```

4. **Save** MyWizardDriverNVDataStruc.h
5. **Update** the **MyWizardDriver.vfr** file. **Delete** its contents and **replace** it with the following by copying and pasting: You're adding a reference to the GUID and to the NVRAM storage where the configuration will be saved. In fact, you're replacing most of the original .vfr.

```
#include "MyWizardDriverNVDataStruc.h"
formset
guid    = MYWIZARDDRIVER_FORMSET_GUID,
title   = STRING_TOKEN(STR_SAMPLE_FORM_SET_TITLE),
help    = STRING_TOKEN(STR_SAMPLE_FORM_SET_HELP),
classguid = EFI_HII_PLATFORM_SETUP_FORMSET_GUID,

//
// Define a Buffer Storage (EFI_IFR_VARSTORE)
//
varstore MYWIZARDDRIVER_CONFIGURATION, // This is the data structure type
//varid = CONFIGURATION_VARSTORE_ID,      // Optional VarStore ID
name   = MWD_IfrNVData,                // Define referenced name in vfr
guid   = MYWIZARDDRIVER_FORMSET_GUID;   // GUID of this buffer storage
```

6. Continue **adding** the remaining code to MyWizardDriver.vfr. This is a Enable/ Disable question for the setup menu in the form of a Check box.

```
form formid = 1, title = STRING_TOKEN(STR_SAMPLE_FORM1_TITLE);
```

```

subtitle text = STRING_TOKEN(STR_SUBTITLE_TEXT);

subtitle text = STRING_TOKEN(STR_SUBTITLE_TEXT2);
//
// Define a checkbox to enable / disable the device
//
checkbox varid    = MWD_IfrNVData.MyWizardDriverChooseToEnable,
           prompt   = STRING_TOKEN(STR_CHECK_BOX_PROMPT),
           help     = STRING_TOKEN(STR_CHECK_BOX_HELP),
           //
           // CHECKBOX_DEFAULT indicate this checkbox is marked
           // with EFI_IFR_CHECKBOX_DEFAULT
           //
           flags    = CHECKBOX_DEFAULT ,
           key      = 0,
           default  = 1,
endcheckbox;

endform;

endformset;

```

7). Save MyWizardDriver.vfr

8). **Update** MyWizardDriver.uni file. You'll add new strings to support the forms. **Delete** the file's content and **replace** it with the following by copying and pasting:

```

#langdef en "English"

#string STR_SAMPLE_FORM_SET_TITLE          #language en "My Wizard Driver Sample Formset"
#string STR_SAMPLE_FORM_SET_HELP            #language en "Help for Sample Formset"
#string STR_SAMPLE_FORM1_TITLE              #language en "My Wizard Driver"

#string STR_SUBTITLE_TEXT                  #language en "My Wizard Driver Configuration"
#string STR_SUBTITLE_TEXT2                 #language en "Device XYZ Configuration"
#string STR_CHECK_BOX_PROMPT               #language en "Enable My XYZ Device"

#string STR_CHECK_BOX_HELP                #language en "This is the help message for the enable My XYZ device. Check this box to enable this device."

```

9). Save MyWizardDriver.uni

10). **Update** the MyWizardDriver.h file. **Add** the following HII libraries starting at approximately line 41 (as shown below) by copying and pasting:

```

// Added for HII
#include <Protocol/HiiConfigRouting.h>
#include <Protocol/FormBrowser2.h>
#include <Protocol/HiiString.h>
#include <Library/DevicePathLib.h>

```

```

41
42 // Added for HII
43 #include <Protocol/HiiConfigRouting.h>
44 #include <Protocol/FormBrowser2.h>
45 #include <Protocol/HiiString.h>
46 #include <Library/DevicePathLib.h>
47
48 //
49 // Consumed Protocols

```

11). To add a data structure for HII routing and access, **add** the following code at approximately line 75 by copying and pasting after the “extern” statements:

```

#define MYWIZARDDRIVER_DEV_SIGNATURE SIGNATURE_32 ('m', 'w', 'd', 'r')

// Need a Data structure for HII routing and accessing
typedef struct {
    UINT32                               Signature;

    EFI_HANDLE                            Handle;
    MYWIZARDDRIVER_CONFIGURATION          Configuration;
    EFI_HANDLE                            DriverHandle[2];
    EFI_HII_HANDLE                         HiiHandle[2];
    //

    // Consumed protocol
    //

    EFI_HII_DATABASE_PROTOCOL             *HiiDatabase;
    EFI_HII_STRING_PROTOCOL               *HiiString;
    EFI_HII_CONFIG_ROUTING_PROTOCOL      *HiiConfigRouting;
    EFI_FORM_BROWSER2_PROTOCOL           *FormBrowser2;

    //

    // Produced protocol
    //

    EFI_HII_CONFIG_ACCESS_PROTOCOL       ConfigAccess;
}

MYWIZARDDRIVER_DEV;

#define MYWIZARDDRIVER_DEV_FROM_THIS(a) CR (a, MYWIZARDDRIVER_DEV, ConfigAccess, MYWIZARDDRIVER_DEV_SIGNATURE)

#pragma pack(1)
///
/// HII specific Vendor Device Path definition.
///
typedef struct {
    VENDOR_DEVICE_PATH                   VendorDevicePath;
    EFI_DEVICE_PATH_PROTOCOL              End;
} HII_VENDOR_DEVICE_PATH;

#pragma pack()

```

```

73  extern EFI_HII_CONFIG_ACCESS_PROTOCOL gMyWizardDriverHiiConfigAccess;
74
75 #define MYWIZARDDRIVER_DEV_SIGNATURE SIGNATURE_32 ('m', 'w', 'd', 'r') 
76
77 // Need a Data structure for HII routing and accessing
78 typedef struct {
79     UINT32                               Signature;
80
81     EFI_HANDLE                           Handle;
82     MYWIZARDDRIVER_CONFIGURATION        Configuration;
83
84     EFI_HANDLE                           DriverHandle[2];
85     EFI_HII_HANDLE                      HiiHandle[2];
86
87     // Consumed protocol
88
89     EFI_HII_DATABASE_PROTOCOL           *HiiDatabase;
90     EFI_HII_STRING_PROTOCOL            *HiiString;
91     EFI_HII_CONFIG_ROUTING_PROTOCOL   *HiiConfigRouting;
92     EFI_FORM_BROWSER2_PROTOCOL         *FormBrowser2;
93
94     // Produced protocol
95
96
97     EFI_HII_CONFIG_ACCESS_PROTOCOL    ConfigAccess;
98
99 } MYWIZARDDRIVER_DEV;
100
101 #define MYWIZARDDRIVER_DEV_FROM_THIS(a) CR (a, MYWIZARDDRIVER_DEV, Configuration)
102
103 #pragma pack(1)
104 /**
105  /// HII specific Vendor Device Path definition.
106 /**
107 typedef struct {
108     VENDOR_DEVICE_PATH                 VendorDevicePath;
109     EFI_DEVICE_PATH_PROTOCOL          End;
110 } HII_VENDOR_DEVICE_PATH;
111
112 #pragma pack()
113 /**
114 // Include files with function prototypes

```

12). Save MyWizardDriver.h

13). Update MyWizardDriver.c file.

Add local definitions for the form GUID, variable name, and device path for HII at approximately line 13 after the `#include "MyWizardDriver.h"` by coping and pasting the following code.

In this step, you declare a local (to the module “`m`”) variable for the GUID we declared; the NVRAM variable name; driver handles; our configuration data; and the device path support.

```

// Begin code
//HII support
EFI_GUID mMyWizardDriverFormSetGuid = MYWIZARDDRIVER_FORMSET_GUID;

CHAR16 mIfrVariableName[] = L"MWD_IfrNvData";
EFI_HANDLE mDriverHandle[2] = {NULL, NULL};
MYWIZARDDRIVER_DEV *PrivateData = NULL;

// HII support for Device Path
HII_VENDOR_DEVICE_PATH mHiiVendorDevicePath =
{
{
    HARDWARE_DEVICE_PATH,
    HW_VENDOR_DP,
    {
        (UINT8) (sizeof (VENDOR_DEVICE_PATH)),

```

```

        (UINT8) ((sizeof (VENDOR_DEVICE_PATH)) >> 8)
    }
},
MYWIZARDDRIVER_FORMSET_GUID
},
{
END_DEVICE_PATH_TYPE,
END_ENTIRE_DEVICE_PATH_SUBTYPE,
{
    (UINT8) (END_DEVICE_PATH_LENGTH),
    (UINT8) ((END_DEVICE_PATH_LENGTH) >> 8)
}
}
};

// end code

```

14). **Locate** `EFI_STATUS` within the function `MyWizardDriverDriverEntryPoint` in the `MyWizardDriver.c` file (approx. Line 184) and **add** HII local definitions by copying and pasting (as shown below):

```

// HII Locals
EFI_HII_PACKAGE_LIST_HEADER *PackageListHeader;
EFI_HII_DATABASE_PROTOCOL *HiiDatabase;
EFI_HII_HANDLE HiiHandle[2];
EFI_STRING ConfigRequestHdr;
UINTN BufferSize;

178 {
179     EFI_STATUS Status;
180
181     // HII Locals
182     EFI_HII_PACKAGE_LIST_HEADER *PackageListHeader;
183     EFI_HII_DATABASE_PROTOCOL *HiiDatabase;
184     EFI_HII_HANDLE HiiHandle[2];
185     EFI_STRING ConfigRequestHdr;
186     UINTN BufferSize;
187
188     Status = EFI_SUCCESS;
189

```

15). **Locate** the `ASSERT_EFI_ERROR (Status);` statement and the line: `// Retrieve HII Package List Header on ImageHandle` (approximately line 202). Now, **add** the following code to install the configuration access protocol (produced) by copying and pasting (as shown below) before the line: `// Retrieve HII Package List Header on ImageHandle`

```

//Now do HII Stuff
// Initialize the local variables.
ConfigRequestHdr = NULL;

// Initialize driver private data
PrivateData = AllocateZeroPool (sizeof (MYWIZARDDRIVER_DEV));
if (PrivateData == NULL) {
    return EFI_OUT_OF_RESOURCES;
}

PrivateData->Signature = MYWIZARDDRIVER_DEV_SIGNATURE;

PrivateData->ConfigAccess.ExtractConfig = MyWizardDriverHiiConfigAccessExtractConfig;
PrivateData->ConfigAccess.RouteConfig = MyWizardDriverHiiConfigAccessRouteConfig;
PrivateData->ConfigAccess.Callback = MyWizardDriverHiiConfigAccessCallback;

//
// Publish sample Fromset and config access
//
Status = gBS->InstallMultipleProtocolInterfaces (
    &mDriverHandle[0],
    &gEfiDevicePathProtocolGuid,
    &mHiiVendorDevicePath,

```

```

        &gEfiHiiConfigAccessProtocolGuid,
        &PrivateData->ConfigAccess,
        NULL
    );
ASSERT_EFI_ERROR (Status);

PrivateData->DriverHandle[0] = mDriverHandle[0];
// end code

201 ASSERT_EFI_ERROR (Status);
202 //
203 //
204 //Now do HII Stuff
205 //
206 //
207 // Initialize the local variables.
208 ConfigRequestHdr = NULL;
209 //
210 // Initialize driver private data
211 //
212 PrivateData = AllocateZeroPool (sizeof (MYWIZARDDRIVER_DEV));
213 if (PrivateData == NULL) {
214     return EFI_OUT_OF_RESOURCES;
215 }
216
217 PrivateData->Signature = MYWIZARDDRIVER_DEV_SIGNATURE;
218
219 PrivateData->ConfigAccess.ExtractConfig = MyWizardDriverHiiConfigAccess
220 PrivateData->ConfigAccess.RouteConfig = MyWizardDriverHiiConfigAccessRo
221 PrivateData->ConfigAccess.Callback = MyWizardDriverHiiConfigAccessCallb
222
223
224 //
225 // Publish sample Fromset and config access
226 //
227 Status = gBS->InstallMultipleProtocolInterfaces (
228         &mDriverHandle[0],
229         &gEfiDevicePathProtocolGuid,
230         &mHiiVendorDevicePath,
231         &gEfiHiiConfigAccessProtocolGuid,
232         &PrivateData->ConfigAccess,
233         NULL
234     );
235 ASSERT_EFI_ERROR (Status);
236
237 PrivateData->DriverHandle[0] = mDriverHandle[0];
238 //
239 // Retrieve HII Package List Header on ImageHandle
240 //
241 Status = gBS->OpenProtocol (

```

16). Next, **add** code to register a list of HII packages in the HII Database with the HII device path. This requires you to **replace** existing code (see below) by copying and pasting the new code at approx. line 265.

Old Code

```

190          );
191      if (!EFI_ERROR (Status)) {
192          //
193          // Register list of HII packages in the HII Database
194          //
195          Status = HiiDatabase->NewPackageList (
196              HiiDatabase,
197              PackageListHeader,
198              NULL,
199              &HiiHandle
200          );
201          ASSERT_EFI_ERROR (Status);
202      }
203  }
204  Status = EFI_SUCCESS;
205
206  //
mDriverHandle[0],
&HiiHandle[0]

```

New Code

```

257          );
258      if (!EFI_ERROR (Status)) {
259          //
260          // Register list of HII packages in the HII Database
261          //
262          Status = HiiDatabase->NewPackageList (
263              HiiDatabase,
264              PackageListHeader,
265              mDriverHandle[0],
266              &HiiHandle[0]
267          );
268          ASSERT_EFI_ERROR (Status);
269      }
270  }
271  Status = EFI_SUCCESS;

```

17). Next, you'll **add** code to initialize the My Wizard Driver NVRAM variable by copying and pasting the following code **before** the `// Install Driver Supported EFI Version Protocol onto ImageHandle` comment (as shown below at approximately line 273):

```

// Begin code
PrivateData->HiiHandle[0] = HiiHandle[0];

BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);

// IF driver is not part of the Platform then need to get/set defaults for the NVRAM configuration that the driver will use.
Status = gRT->GetVariable (
    &mIfrVariableName,
    &mMyWizardDriverFormSetGuid,
    NULL,
    &BufferSize,
    &PrivateData->Configuration
);
if (EFI_ERROR (Status)) { // Not defined yet so add it to the NV Variables.
    // zero out buffer
    ZeroMem (&PrivateData->Configuration, sizeof (MYWIZARDDRIVER_CONFIGURATION));
    Status = gRT->SetVariable(
        &mIfrVariableName,
        &mMyWizardDriverFormSetGuid,
        EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,
        sizeof (MYWIZARDDRIVER_CONFIGURATION),
        &PrivateData->Configuration // buffer is 000000 now
    );
}
// end code

```

```

270 }
271 Status = EFI_SUCCESS;
272
273 PrivateData->HiiHandle[0] = HiiHandle[0];
274
275 BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
276
277 // IF driver is not part of the Platform then need to get/set defaults for t
278 Status = gRT->GetVariable (
279     mIfrVariableName,
280     &mMyWizardDriverFormSetGuid,
281     NULL,
282     &BufferSize,
283     &PrivateData->Configuration
284 );
285 if (EFI_ERROR (Status)) { // Not defined yet so add it to the NV Variables
286     // zero out buffer
287     ZeroMem (&PrivateData->Configuration, sizeof (MYWIZARDDRIVER_CONFIGURATION));
288     Status = gRT->SetVariable (
289         mIfrVariableName,
290         &mMyWizardDriverFormSetGuid,
291         EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,
292         sizeof (MYWIZARDDRIVER_CONFIGURATION),
293         &PrivateData->Configuration // buffer is 000000 now
294     );
295 }
296 //
297 // Install Driver Supported EFI Version Protocol onto ImageHandle

```

18). **Save** MyWizardDriver.c

19). Now onto the final file, MyWizardDriver.inf. **Add** the following protocols in the [protocols] section that are being used by copying and pasting (as shown below):

```

gEfiHiiStringProtocolGuid          ## CONSUMES
gEfiHiiConfigRoutingProtocolGuid  ## CONSUMES
gEfiFormBrowser2ProtocolGuid      ## CONSUMES
gEfiHiiDatabaseProtocolGuid       ## CONSUMES

48 [Protocols]
49 gEfiDriverBindingProtocolGuid
50 gEfiPciIoProtocolGuid
51 gEfiDriverSupportedEfiVersionProtocolGuid
52 gEfiHiiPackageListProtocolGuid
53 gEfiHiiDatabaseProtocolGuid
54 gEfiComponentName2ProtocolGuid
55 gEfiComponentNameProtocolGuid
56 gEfiHiiConfigAccessProtocolGuid
57 gEfiSimpleTextOutProtocolGuid

58
59
60 gEfiHiiStringProtocolGuid
61 gEfiHiiConfigRoutingProtocolGuid
62 gEfiFormBrowser2ProtocolGuid
63 gEfiHiiDatabaseProtocolGuid
64

```

20). **Save** the MyWizardDriver.inf file. All the files should be saved at this point.

21). **Add** MyWizardDriver.inf to the Nt32Pkg.dsc(See Lab 2building MyWizardDriver from the Driver Porting Lab)

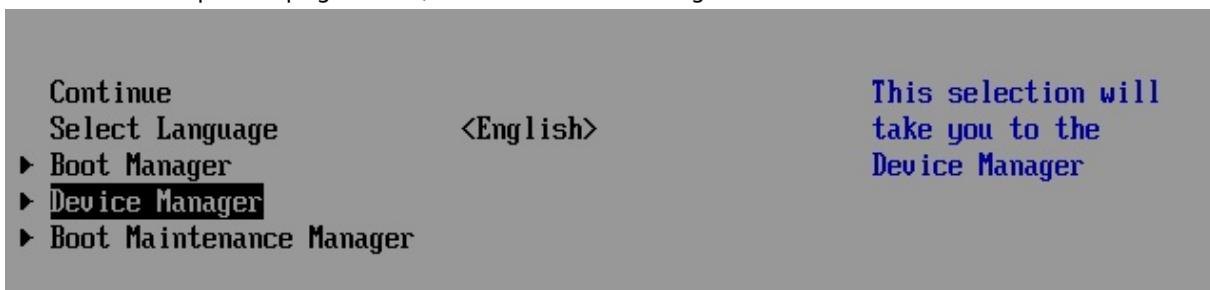
Build and test MyWizardDriver

1. **Re-Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run

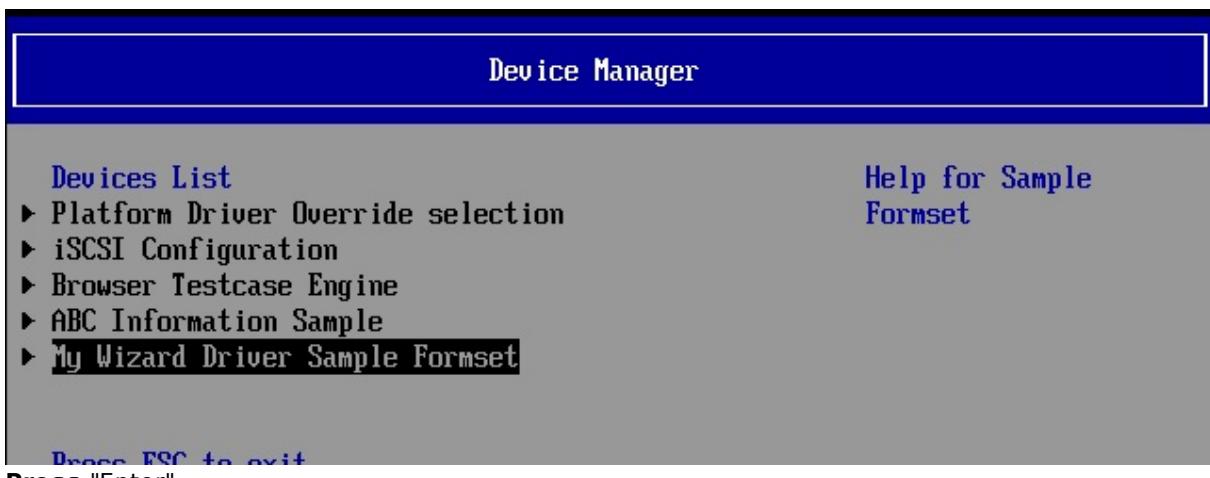
4. **At the UEFI Shell prompt, type** fs0:
5. **Type** Load MyWizardDriver.efi
6. **Press "Enter"** This will load your driver into memory

```
FS0:\> load MyWizardDriver.efi
Image 'FS0:\MyWizardDriver.efi' loaded at 5EB9000 - Success
FS0:\> exit
```

7. **Type** exit
8. Now at the setup front page menu, **select** "Device Manager"



9. **Press "Enter" to enter "Device Manager"**
10. **Inside the Device Manager menu** press **the down to "My Wizard Driver Sample Formset"****
Press "Enter"

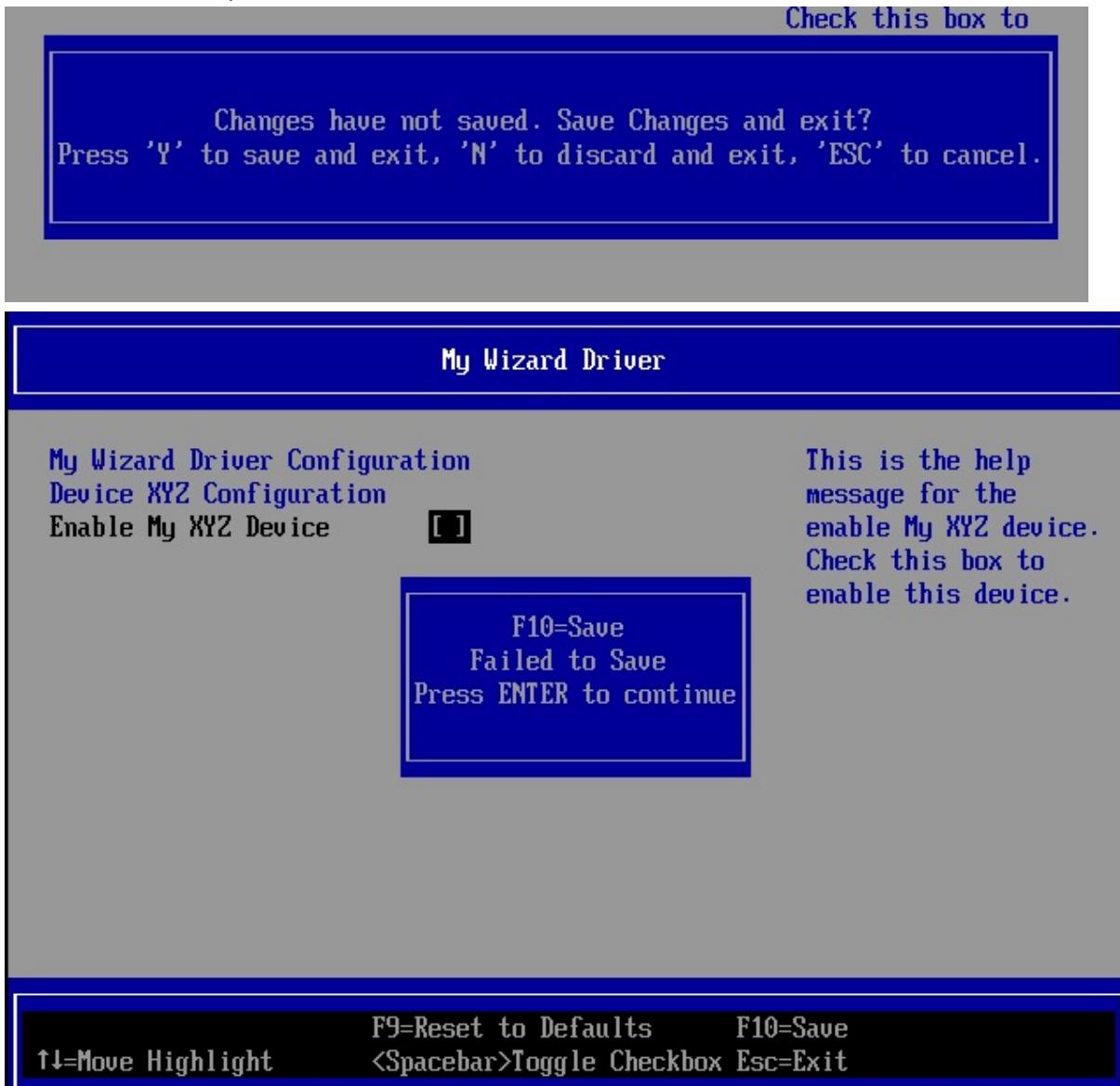


Note: Notice that your form is now displayed with a choice to enable your device. Also notice the titles and help strings that are in the .UNI file you edited.

At this point since the HII configuration routing functions are not functional the values (Enable/Disable) will not be saved to NVRAM. The next lab will update the HII Extract, Route, and call back functions for the HII configuration routing protocol your driver will produce.

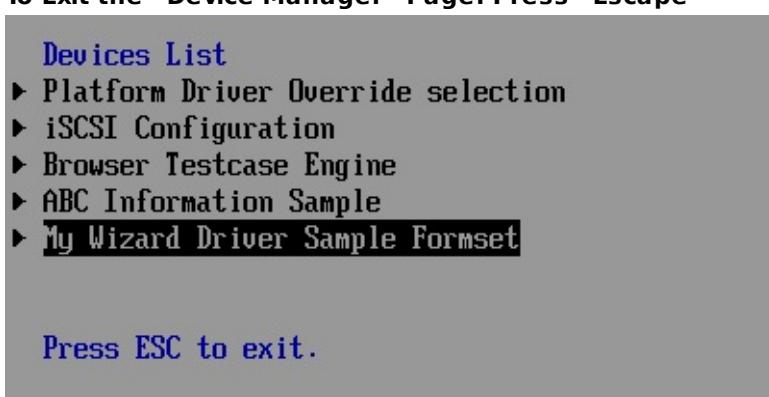
11. **Press** the space bar to Enable and Disable the "Enable My XYZ Device"

12. Press F10 to attempt to save

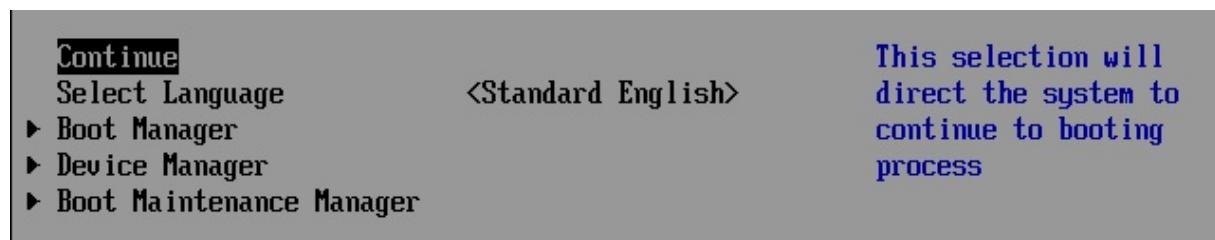


Note: You're not able to save the data changes at this point.

13. Press "Enter"**
 14. Press "Escape", and then "Y" to exit*
 15. To Exit the "Device Manager" Page: Press "Escape"



16. Press Up Arrow to "Continue"**



17. At the Shell prompt type **Reset**

```
FS0:\> reset_
```

18. Press "Enter" to return to the Visual Studio Command Prompt

```
C:\FW\edk2>
```

You've completed the first lab and added strings and forms to setup HII for user configuration. However, **the data is not saved to NVRAM**. In the next lab, you'll learn how to update HII to save data to NVRAM.

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.1A

end of Lab 1

Lab 2. Updating HII to Save Data Settings

In this lab, you'll learn how to modify and update your driver's HII code to save the users settings into NVRAM. The UEFI Driver Wizard created the protocols for your driver to update and interface with the HII browser engine and database. The HII configuration access Protocol functions for MyWizardDriver are in the file C:\fw\edk2\MyWizardDriver\HiiConfigAccess.c. This next lab will install these protocols and update them to save the user data from the HII menus into NVRAM.

1. Update the `MyWizardDriver.c` file

Your driver will need to keep track of the consumed protocols in it's own data structure so it will need to declare local pointers to these and then store them in its own private context data structure.

2. Add the following local variable declarations in the function `MyWizardDriverDriverEntryPoint` Entry Point (as shown below Approx. line 185):

```

EFI_HII_STRING_PROTOCOL      *Hiistring;
EFI_FORM_BROWSER2_PROTOCOL   *FormBrowser2;
EFI_HII_CONFIG_ROUTING_PROTOCOL *HiiConfigRouting;

179  EFI_STATUS  Status;
180
181 // HII Locals
182 EFI_HII_PACKAGE_LIST_HEADER    *PackageListHeader;
183 EFI_HII_DATABASE_PROTOCOL     *HiiDatabase;
184 EFI_HII_HANDLE                HiiHandle[2];
185 EFI_HII_STRING_PROTOCOL       *Hiistring;
186 EFI_FORM_BROWSER2_PROTOCOL    *FormBrowser2;
187 EFI_HII_CONFIG_ROUTING_PROTOCOL *HiiConfigRouting;
188 EFI_STRING                  ConfigRequestHdr;
189 UINTN                        BufferSize;
190
191 Status = EFI_SUCCESS;
192

```

3. Add the following code to locate and store consumed protocols before the `// Publish sample Fromset` and config access comment (as shown below Approx. line 227):

The reason is to Locate the Hii Database, Hii String, Hii Form browser and config routing protocols and store their pointers into the Private context data structure for your driver to access.

```

//Begin code
//
// Locate Hii Database protocol
//
Status = gBS->LocateProtocol (&gEfiHiiDatabaseProtocolGuid, NULL, (VOID **) &HiiDatabase);
if (EFI_ERROR (Status)) {
    return Status;
}
PrivateData->HiiDatabase = HiiDatabase;

//
// Locate HiiString protocol
//
Status = gBS->LocateProtocol (&gEfiHiiStringProtocolGuid, NULL, (VOID **) &Hiistring);
if (EFI_ERROR (Status)) {
    return Status;
}
PrivateData->Hiistring = Hiistring;

//
// Locate Formbrowser2 protocol
//
Status = gBS->LocateProtocol (&gEfiFormBrowser2ProtocolGuid, NULL, (VOID **) &FormBrowser2);
if (EFI_ERROR (Status)) {

```

```

        return Status;
    }

PrivateData->FormBrowser2 = FormBrowser2;

//
// Locate ConfigRouting protocol
//
Status = gBS->LocateProtocol (&gEfiHiiConfigRoutingProtocolGuid, NULL, (VOID **) &HiiConfigRouting);
if (EFI_ERROR (Status)) {
    return Status;
}
PrivateData->HiiConfigRouting = HiiConfigRouting;

//End code

```

```

225
226
227  //
228  // Locate Hii Database protocol
229  //
230  Status = gBS->LocateProtocol (&gEfiHiiDatabaseProtocolGuid, NULL,
231  if (EFI_ERROR (Status)) {
232      return Status;
233  }
234  PrivateData->HiiDatabase = HiiDatabase;
235
236  //
237  // Locate HiiString protocol
238  //
239  Status = gBS->LocateProtocol (&gEfiHiiStringProtocolGuid, NULL,
240  if (EFI_ERROR (Status)) {
241      return Status;
242  }
243  PrivateData->HiiString = HiiString;
244
245  //
246  // Locate Formbrowser2 protocol
247  //
248  Status = gBS->LocateProtocol (&gEfiFormBrowser2ProtocolGuid, NULL,
249  if (EFI_ERROR (Status)) {
250      return Status;
251  }
252  PrivateData->FormBrowser2 = FormBrowser2;
253
254  //
255  // Locate ConfigRouting protocol
256  //
257  Status = gBS->LocateProtocol (&gEfiHiiConfigRoutingProtocolGuid,
258  if (EFI_ERROR (Status)) {
259      return Status;
260  }
261  PrivateData->HiiConfigRouting = HiiConfigRouting;
262
263
264  //
265  // Publish sample Fromset and config access
266  //
267  Status = gBS->InstallMultipleProtocolInterfaces (

```

- 4). Since the Hii Database Protocol was located earlier in the code with the previous code insertion and is no longer necessary, **comment out** the old OpenProtocol code with the " // " (approx. lines 289-298, as shown below) and **add the comment** " // Done above

Make sure not to comment out the second " if (!EFI_ERROR (Status)) { "

```

281     Status = gBS->OpenProtocol (
282             ImageHandle,
283             &gEfiHiiPackageListProtocolGuid,
284             (VOID **) &PackageListHeader,
285             ImageHandle,
286             NULL,
287             EFI_OPEN_PROTOCOL_GET_PROTOCOL
288         );
289 // Done above
290 // if (!EFI_ERROR (Status)) {
291 //     //
292 //     // Retrieve the pointer to the UEFI HII Database Protocol
293 //     //
294 //     Status = gBS->LocateProtocol (
295 //             &gEfiHiiDatabaseProtocolGuid,
296 //             NULL,
297 //             (VOID **) &HiiDatabase
298 //         );
299     if (!EFI_ERROR (Status)) {

```

Note: The earlier `LocateProtocol` code already found the pointer to the Hii Database protocol and stored it to the local pointer variable `HiiDatabase`.

When we added the driver-consumed protocols, we searched via `LocateProtocol` for the Hii Database pointer function. Since we did it above we're now commenting out this code.

5). **Comment out** the matching “ } ” with “ // ” to the if statement (as shown below at approx. line

```

299     if (!EFI_ERROR (Status)) {
300         //
301         // Register list of HII packages in the HII Database
302         //
303         Status = HiiDatabase->NewPackageList (
304                 HiiDatabase,
305                 PackageListHeader,
306                 mDriverHandle[0],
307                 &HiiHandle[0]
308             );
309         ASSERT_EFI_ERROR (Status);
310     // }
311 }
312 Status = EFI_SUCCESS;
310): 313

```

6). **Save** MyWizardDriver.c

7). **Open** C:\fw\edk2\MyWizardDriver\HiiConfigAccess.c.

The Driver Wizard only made dummy functions for the extract, route and callback functions. In order to save the Data passed into the forms from the Hii Browser engine, you will need to port these functions to be functional.

8). **Add** the following extern statements for the form GUID and the NVRam variable (as shown below) these are global to the driver module only hence the beginning lower case “m” is the standard for a global for a module :

```

extern EFI_GUID    mMyWizardDriverFormSetGuid;
extern CHAR16      mIfrVariableName[];

12 #include "MyWizardDriver.h"
13
14 extern EFI_GUID    mMyWizardDriverFormSetGuid;
15 extern CHAR16      mIfrVariableName[];
16
17
18 /**
19 /// HII Config Access Protocol instance

```

- 9). **Locate** `MyWizardDriverHiiConfigAccessExtractConfig` and **replace** line 108, “`return EFI_NOT_FOUND`”, with the following code spread over **Next** pages:

```

95  EFI_STATUS
96  EFIAPI
97  MyWizardDriverHiiConfigAccessExtractConfig (
98    IN CONST  EFI_HII_CONFIG_ACCESS_PROTOCOL  *This,
99    IN CONST  EFI_STRING                    Request,
100   OUT      EFI_STRING                   *Progress,
101   OUT      EFI_STRING                   *Results
102 )
103 {
104   return EFI_NOT_FOUND;
105 }
106
107 /**
99  EFI_STATUS
100 EFIAPI
101 MyWizardDriverHiiConfigAccessExtractConfig (
102  IN CONST  EFI_HII_CONFIG_ACCESS_PROTOCOL  *This,
103  IN CONST  EFI_STRING                    Request,
104  OUT      EFI_STRING                   *Progress,
105  OUT      EFI_STRING                   *Results
106 )
107 {
108  EFI_STATUS          Status;
109  UINTN               BufferSize;
110  MYWIZARDDRIVER_DEV  *PrivateData;
111  EFI_HII_CONFIG_ROUTING_PROTOCOL  *HiiConfigRouting;
112 }

//Begin code
EFI_STATUS          Status;
UINTN               BufferSize;
MYWIZARDDRIVER_DEV  *PrivateData;
EFI_HII_CONFIG_ROUTING_PROTOCOL  *HiiConfigRouting;
EFI_STRING          ConfigRequest;
EFI_STRING          ConfigRequestHdr;
UINTN               Size;
BOOLEAN              AllocatedRequest;
if (Progress == NULL || Results == NULL) {
  return EFI_INVALID_PARAMETER;
}
//
// Initialize the local variables.
//
ConfigRequestHdr = NULL;
ConfigRequest = NULL;
Size = 0;
*Progress = Request;
AllocatedRequest = FALSE;
PrivateData = MYWIZARDDRIVER_DEV_FROM_THIS (This);
HiiConfigRouting = PrivateData->HiiConfigRouting;
//
// Get Buffer Storage data from EFI variable.
// Try to get the current setting from variable.
//
BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
Status = gRT->GetVariable (
  mIfrVariableName,
  &mMyWizardDriverFormSetGuid,
  NULL,
  &BufferSize,
  &PrivateData->Configuration
);
if (EFI_ERROR (Status)) {
  return EFI_NOT_FOUND;
}
if (Request == NULL) {
  DEBUG ((DEBUG_INFO, "\n:: Inside of Extract Config and Request == Null "));
} else {
  ConfigRequest = Request;
}
//
// Convert buffer data to <ConfigResp> by helper function BlockToConfig()
//
Status = HiiConfigRouting->BlockToConfig (
  HiiConfigRouting,
  ConfigRequest,
  (UINT8 *) &PrivateData->Configuration,
  BufferSize,
  Results,
  Progress
);
//
// Free the allocated config request string.
//
if (AllocatedRequest) {
  FreePool (ConfigRequest);
}

```

```

}
//
// Set Progress string to the original request string.
//
if (Request == NULL) {
    *Progress = NULL;
} else if (StrStr (Request, L"OFFSET") == NULL) {
    *Progress = Request + StrLen (Request);
}
return Status;
// End code

```

10). Now **locate** `MyWizardDriverHiiConfigAccessRouteConfig` and **replace** line at approx. 228, with “`return EFI_NOT_FOUND`”, with the following code:

<pre> 146 /** 147 EFI_STATUS 148 EFIAPI 149 MyWizardDriverHiiConfigAccessRouteConfig (150 IN CONST EFI_HII_CONFIG_ACCESS_PROTOCOL *This, 151 IN CONST EFI_STRING Configuration, 152 OUT EFI_STRING *Progress 153) 154 { 155 return EFI_NOT_FOUND; 156 } 157 /** 158 /** 159 160 This function is called to provide results data to the driver. 161 This data consists of a unique key that is used to identify 162 which data is either being passed back or being asked for. </pre>	<pre> 227 /** 228 EFI_STATUS 229 EFIAPI 230 MyWizardDriverHiiConfigAccessRouteConfig (231 IN CONST EFI_HII_CONFIG_ACCESS_PROTOCOL *This, 232 IN CONST EFI_STRING Configuration, 233 OUT EFI_STRING *Progress 234) 235 { 236 EFI_STATUS Status; 237 UINTN BufferSize; 238 MYWIZARDDRIVER_DEV *PrivateData; 239 EFI_HII_CONFIG_ROUTING_PROTOCOL *HiiConfigRouting; 240 241 if (Configuration == NULL Progress == NULL) { 242 return EFI_INVALID_PARAMETER; 243 } </pre>
--	---

```

//Begin code
EFI_STATUS Status;
UINTN      BufferSize;
MYWIZARDDRIVER_DEV *PrivateData;
EFI_HII_CONFIG_ROUTING_PROTOCOL *HiiConfigRouting;

if (Configuration == NULL || Progress == NULL) {
    return EFI_INVALID_PARAMETER;
}

PrivateData = MYWIZARDDRIVER_DEV_FROM_THIS (This);
HiiConfigRouting = PrivateData->HiiConfigRouting;
*Progress = Configuration;

//
// Get Buffer Storage data from EFI variable
//
BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
Status = gRT->GetVariable (
    mIfrrVariableName,
    &mMyWizardDriverFormSetGuid,
    NULL,
    &BufferSize,
    &PrivateData->Configuration
);
if (EFI_ERROR (Status)) {
    return Status;
}

//
// Convert <ConfigResp> to buffer data by helper function ConfigToBlock()
//
BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
Status = HiiConfigRouting->ConfigToBlock (
    HiiConfigRouting,
    Configuration,
    (UINT8 *) &PrivateData->Configuration,
    &BufferSize,
    Progress
);
if (EFI_ERROR (Status)) {
    return Status;
}

```

```

//  

// Store Buffer Storage back to EFI variable  

//  

Status = gRT->SetVariable(  

    mIfrVariableName,  

    &mMyWizardDriverFormSetGuid,  

    EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,  

    sizeof (MYWIZARDDRIVER_CONFIGURATION),  

    &PrivateData->Configuration  

);  

DEBUG ((DEBUG_INFO, "\n:: ROUTE CONFIG Saving the configuration to NVRAM \n"));  
  

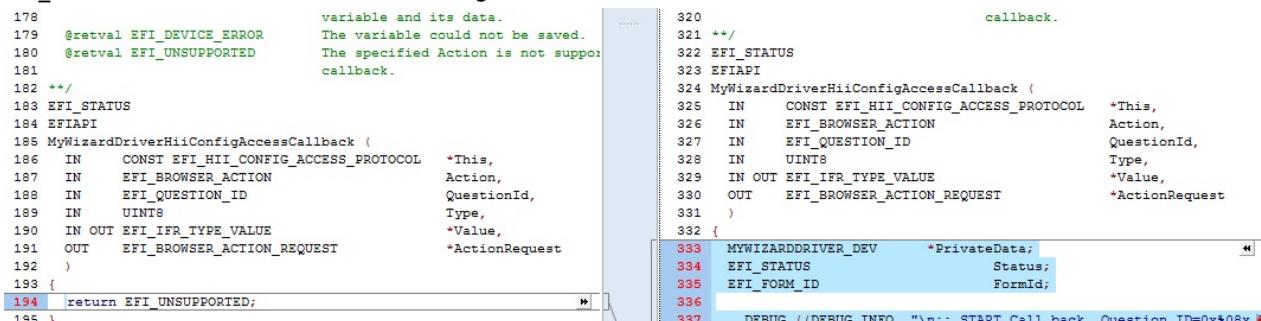
return Status;  
  

//return EFI_NOT_FOUND;  

//end code

```

11). Lastly, **locate** MyWizardDriverHiiConfigAccessCallback and **replace** at approx.** **line 326**, “**return EFI_UNSUPPORTED**;**,” with the following code:



```

178     @retval EFI_DEVICE_ERROR      variable and its data.  

179     @retval EFI_UNSUPPORTED      The variable could not be saved.  

180                                         The specified Action is not supported.  

181                                         callback.  

182 **/  

183 EFI_STATUS  

184 EFIAPI  

185 MyWizardDriverHiiConfigAccessCallback (          .....  

186     IN CONST EFI_HII_CONFIG_ACCESS_PROTOCOL *This,  

187     IN     EFI_BROWSER_ACTION           Action,  

188     IN     EFI_QUESTION_ID            QuestionId,  

189     IN     UINT8                   Type,  

190     IN OUT EFI_IFR_TYPE_VALUE       *Value,  

191     OUT    EFI_BROWSER_ACTION_REQUEST *ActionRequest  

192 )  

193 {  

194     return EFI_UNSUPPORTED;          ►|  

195 }

```

```

320                                         callback.  

321 **/  

322 EFI_STATUS  

323 EFIAPI  

324 MyWizardDriverHiiConfigAccessCallback (          .....  

325     IN CONST EFI_HII_CONFIG_ACCESS_PROTOCOL *This,  

326     IN     EFI_BROWSER_ACTION           Action,  

327     IN     EFI_QUESTION_ID            QuestionId,  

328     IN     UINT8                   Type,  

329     IN OUT EFI_IFR_TYPE_VALUE       *Value,  

330     OUT    EFI_BROWSER_ACTION_REQUEST *ActionRequest  

331 )  

332 {  

333     MYWIZARDDRIVER_DEV    *PrivateData;          ►|  

334     EFI_STATUS             Status;              ►|  

335     EFI_FORM_ID            FormId;              ►|  

336  

337     DEBUG ((DEBUG_INFO, "\n:: START Call back ,Question ID=0x%08x"));

```

```

//Begin code
MYWIZARDDRIVER_DEV      *PrivateData;
EFI_STATUS                  Status;
EFI_FORM_ID                 FormId;

DEBUG ((DEBUG_INFO, "\n:: START Call back ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));

if (((Value == NULL) && (Action != EFI_BROWSER_ACTION_FORM_OPEN) && (Action != EFI_BROWSER_ACTION_FORM_CLOSE)) ||  

    (ActionRequest == NULL)) {  

    return EFI_INVALID_PARAMETER;  

}

FormId = 0;  

Status = EFI_SUCCESS;  

PrivateData = MYWIZARDDRIVER_DEV_FROM_THIS (This);

return Status;
//end code

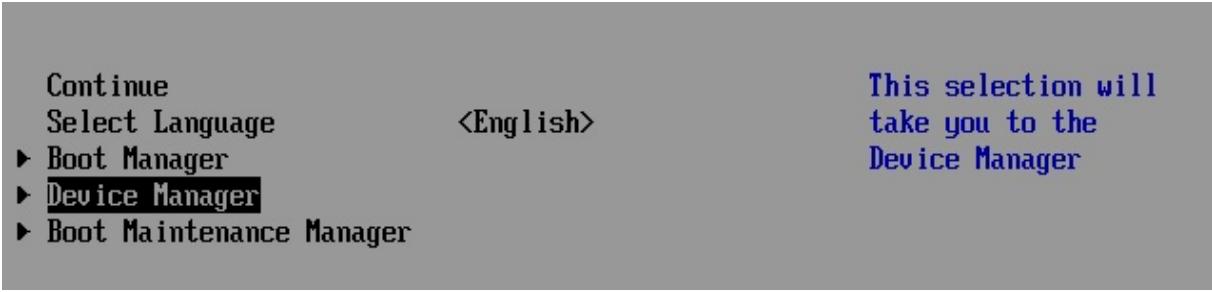
```

12). **Save** HiiConfigAccess.c

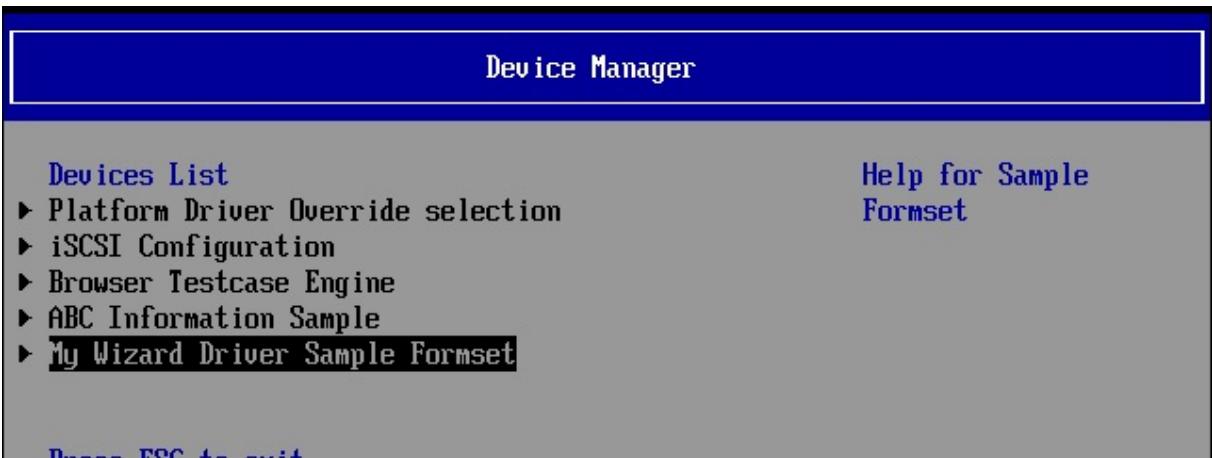
Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. **At the UEFI Shell prompt,type** fs0:
5. **Type** Load MyWizardDriver.efi
6. **Press** “Enter”

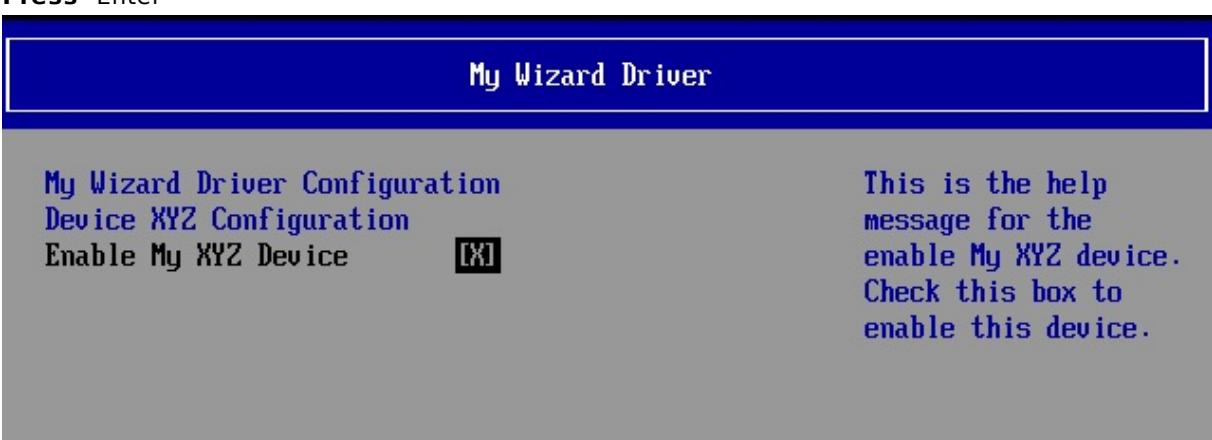
```
FS0:\> load MyWizardDriver.efi
Image 'FS0:\MyWizardDriver.efi' loaded at 5EB9000 - Success
FS0:\> exit_
```

7. Type exit
 8. Now at the setup front page menu, select "Device Manager"
- 
- The screenshot shows the setup front page menu. The "Device Manager" option is highlighted with a blue border. To the right of the menu, a blue callout box contains the text: "This selection will take you to the Device Manager".

9. Press "Enter" to enter "Device Manager"
10. Inside the Device Manager menu press the down to "My Wizard Driver Sample Formset"**
Press "Enter"

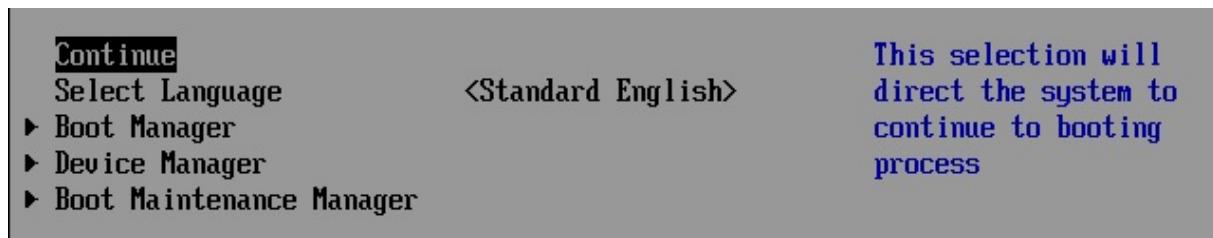


Press "Enter"



Note: Once you hit "Enter", notice that your form is now displayed with a choice to enable your Device. Also notice the titles and help strings that are in the .UNI file you edited.

11. Test by Press the space bar to Enable and Disable the "Enable My XYZ Device" to change its value from: [x] to []
Note: Notice the "configuration changed" message at the menu bottom.
12. Press "F10"
13. Press "Escape" to exit
14. Press "Escape" to exit the "Device Manager" Page
15. Press Up Arrow to "Continue"



16. Press "Enter"

17. At the Shell Prompt type `shell> dmpstore -all`

Notice that enable is selected and saved in NVRam as the value of 0x00:

```
Variable NV+BS '5481DB09-E5F7-4158-A5C5-2DBEA49534FF:MWD_IfrNVData' DataSize = 2
B
00000000: 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 00 *.......
00000010: 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 00 *.......
00000020: 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 00 *.......
```

Shell> _

```
21 #pragma pack(1)
22 typedef struct {
23
24     UINT16 MyWizardDriverStringData[20];
25     UINT8 MyWizardDriverHexData;
26     UINT8 MyWizardDriverBaseAddress;
27     UINT8 MyWizardDriverChooseToEnable;
28 }
29 } MYWIZARDDRIVER_CONFIGURATION;
```

Because our data structure in `MyWizardDriverNvDataStruc.h` is stored in NVRAM with the variable name `MWD_IfrNVData` of type `MYWIZARDDRIVER_CONFIGURATION`, we can see the changes from our menu accessing through our HII forms.

Notice that the enable/disable byte is the last byte in data structure

`MWD_IfrNVData.MyWizardDriverChooseToEnable` where `00 == disable` and `01 == enable`.

18. Type Reset to return to the Visual Studio Command Prompt

FS0:\> reset_

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.2

NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean

End of Lab 2

Lab 3. Updating your driver to initialize data from the VFR data to the HII Database

In this lab, you'll learn how to update your driver to initialize the data according to the defaults set in the .VFR file. Thus when the user enters your driver's menu for the first time, the values will display the defaults according to the .VFR file settings. You will also learn the rich set of HII function calls that are part of the `MdeModulePkg` in the `HiiLib` by reviewing the "MdeModulePkg Document.chm".

Lab 3a. Add HII Library Calls to Your Driver

For this lab you will update the following files: MyWizardDriver.inf, MyWizardDriver.h, and MyWizardDriver.c

1. **Update** the MyWizardDriver.inf file
2. **Add** the following package (as shown below):

The HII Library in the MdeModulePkg has many functions to help with Communication to/from the Hii Database and Hii forms. One function call `HiiSetToDefaults` will compare the default settings from the .VFR file and update the driver's configuration buffer according to the settings in the .VFR file.

```
MdeModulePkg/MdeModulePkg.dec
```

```
22 [Packages]
23   MdePkg/MdePkg.dec
24   MdeModulePkg/MdeModulePkg.dec
```

Note: For other functions from the HII Library, open the .chm file "MdeModulePkg Document.chm" and search for `HiiLib.h`.

- 3). **Add** the following library class (as shown below):

```
HiiLib
39 [LibraryClasses]
40   UefiDriverEntryPoint
41   UefiBootServicesTableLib
42   MemoryAllocationLib
43   BaseMemoryLib
44   BaseLib
45   UefiLib
46   DevicePathLib
47   DebugLib
48   HiiLib
--
```

- 4). **Save** MyWizardDriver.inf

- 5). **Update** the MyWizardDriver.h file

- 6). **Add** the following code (as shown below):

```
#include <Library/HiiLib.h>
42 // Added for HII
43 #include <Protocol/HiiConfigRouting.h>
44 #include <Protocol/FormBrowser2.h>
45 #include <Protocol/HiiString.h>
46 #include <Library/DevicePathLib.h>
47 #include <Library/HiiLib.h>
--
```

- 7). **Save** MyWizardDriver.h

- 8). **Update** the MyWizardDriver.c file

- 9). **Add Locals:** first add 2 locals for your drivers configuration buffer and a boolean flag from the Hii Library calls

Add the following at Approx. Line 190.

```

MYWIZARDDRIVER_CONFIGURATION *Configuration;
BOOLEAN ActionFlag;

180
181 // HII Locals
182 EFI_HII_PACKAGE_LIST_HEADER *PackageListHeader;
183 EFI_HII_DATABASE_PROTOCOL *HiiDatabase;
184 EFI_HII_HANDLE HiiHandle[2];
185 EFI_HII_STRING_PROTOCOL *HiiString;
186 EFI_FORM_BROWSER2_PROTOCOL *FormBrowser2;
187 EFI_HII_CONFIG_ROUTING_PROTOCOL *HiiConfigRouting;
188 EFI_STRING ConfigRequestHdr;
189 UINTN BufferSize;
190 MYWIZARDDRIVER_CONFIGURATION *Configuration;
191 BOOLEAN ActionFlag;

192
193 Status = EFI_SUCCESS;
194

```

10). **Add** the following to the MyWizardDriverDriverEntryPoint entry point function to line 319, approximately after “BufferSize = ” as shown below

```

// Begin code

//
// Initialize configuration data
//
Configuration = &PrivateData->Configuration;
ZeroMem (Configuration, sizeof (MYWIZARDDRIVER_CONFIGURATION));

//
// Try to read NV config EFI variable first
//
ConfigRequestHdr = HiiConstructConfigHdr (&mMyWizardDriverFormSetGuid, mIfrVariableName, mDriverHandle[0]);
ASSERT (ConfigRequestHdr != NULL);
// End code

317
318 BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
319 //
320 // Initialize configuration data
321 //
322 Configuration = &PrivateData->Configuration;
323 ZeroMem (Configuration, sizeof (MYWIZARDDRIVER_CONFIGURATION));
324 //
325 // Try to read NV config EFI variable first
326 //
327 ConfigRequestHdr = HiiConstructConfigHdr (&mMyWizardDriverFormSetGuid, mIfrVa:
328 ASSERT (ConfigRequestHdr != NULL);
329
330
331 // IF driver is not part of the Platform then need to get/set defaults for the
332 Status = gRT->GetVariable (
333     ...

```

FROM

```

317
318 // If driver is not part of the Platform then need to get/set defaults for the NV
319 Status = gRT->GetVariable (
320     mIfvVariableName,
321     &mMyWizardDriverFormSetGuid,
322     NULL,
323     &BufferSize,
324     &PrivateData->Configuration
325 );
326 if (EFI_ERROR (Status)) { // Not defined yet so add it to the NV Variables.
327     // zero out buffer
328     ZeroMem (&PrivateData->Configuration, sizeof (MYWIZARDDRIVER_CONFIGURATION));
329     Status = gRT->SetVariable (
330         mIfvVariableName,
331         &mMyWizardDriverFormSetGuid,
332         EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,
333         sizeof (MYWIZARDDRIVER_CONFIGURATION),
334         &PrivateData->Configuration // buffer is 000000 now
335     );
336 }
337

```

TO

```

330
331
332 // If driver is not part of the Platform then need to get/set defaults for:
333 Status = gRT->GetVariable (
334     mIfvVariableName,
335     &mMyWizardDriverFormSetGuid,
336     NULL,
337     &BufferSize,
338     &Configuration
339 );
340 if (EFI_ERROR (Status)) { // Not defined yet so add it to the NV Variables.
341     // zero out buffer
342     Status = gRT->SetVariable (
343         mIfvVariableName,
344         &mMyWizardDriverFormSetGuid,
345         EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,
346         sizeof (MYWIZARDDRIVER_CONFIGURATION),
347         Configuration // buffer is 000000 now
348     );
349 }
350 // EFI variable for NV config doesn't exist, we should build this variable

```

12). Add the following code to the `MyWizardDriverDriverEntryPoint` entry point code at approximately line 349 before

`// Install Driver Supported EFI Version Protocol onto ImageHandle` You're deleting the "}" and replacing it with the following code (as shown below). With this replacement we are adding an "else" to the "if" statement:

Note the "}" on line 361 is still matching the initial if statement. Make sure you do not have a duplicate "}"

```

//Begin code
//
// EFI variable for NV config doesn't exist, we should build this variable
// based on default values stored in IFR
//
ActionFlag = HiiSetToDefaults (ConfigRequestHdr, EFI_HII_DEFAULT_CLASS_STANDARD);
ASSERT (ActionFlag);
} else {
//
// EFI variable does exist and Validate Current Setting
//
ActionFlag = HiiValidateSettings (ConfigRequestHdr);
ASSERT (ActionFlag);
} // Match if (EFI_ERROR (Status))
FreePool (ConfigRequestHdr);
// end HII
// End code

```

```

347 Configuration // buffer is 000000 now
348 );
349 //
350 // EFI variable for NV config doesn't exist, we should build this variable
351 // based on default values stored in IFR
352 //
353 ActionFlag = HiiSetToDefaults (ConfigRequestHdr, EFI_HII_DEFAULT_CLASS_STANDARD);
354 ASSERT (ActionFlag);
355 } else {
356 //
357 // EFI variable does exist and Validate Current Setting
358 //
359 ActionFlag = HiiValidateSettings (ConfigRequestHdr);
360 ASSERT (ActionFlag);
361 } // Match if (EFI_ERROR (Status))
362 FreePool (ConfigRequestHdr);
363
364
365 // end HII
366 //
367 // Install Driver Supported EFI Version Protocol onto ImageHandle
368 //
369 Status = gBS->InstallMultipleProtocolInterfaces (
370

```

13). Save the `MyWizardDriver.c` file

```

347     Configuration // buffer is 000000 now
348 );
349 //
350 // EFI variable for NV config doesn't exist, we should build this variable
351 // based on default values stored in IFR
352 //
353 ActionFlag = HiiSetToDefaults (ConfigRequestHdr, EFI_HII_DEFAULT_CLASS_STAN
354 ASSERT (ActionFlag);
355 } else {
356 //
357 // EFI variable does exist and Validate Current Setting
358 //
359 ActionFlag = HiiValidateSettings (ConfigRequestHdr);
360 ASSERT (ActionFlag);
361 } // Match if (EFI_ERROR (Status))
362 FreePool (ConfigRequestHdr);
363
364
365 // end HII
366 //
367 // Install Driver Supported EFI Version Protocol onto ImageHandle
368 //
369 Status = gBS->InstallMultipleProtocolInterfaces (
370

```

13). **Save** the MyWizardDriver.c file

Build and test MyWizardDriver

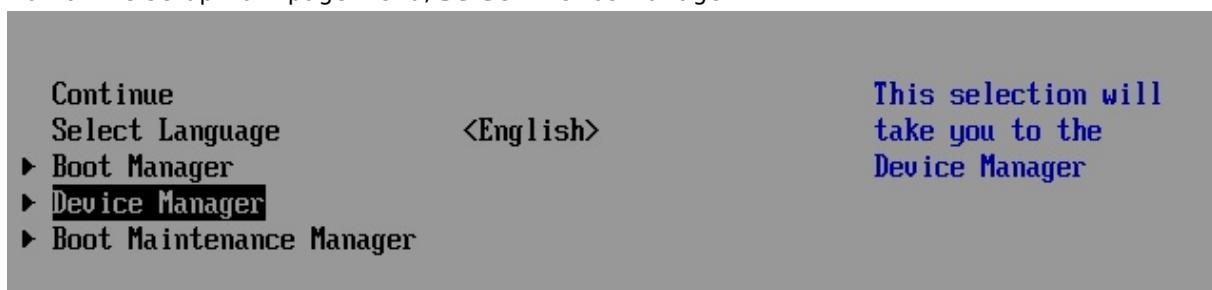
1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. **At the UEFI Shell prompt, type** fs0:
5. **Type** Load MyWizardDriver.efi and then **Press** "Enter"

```

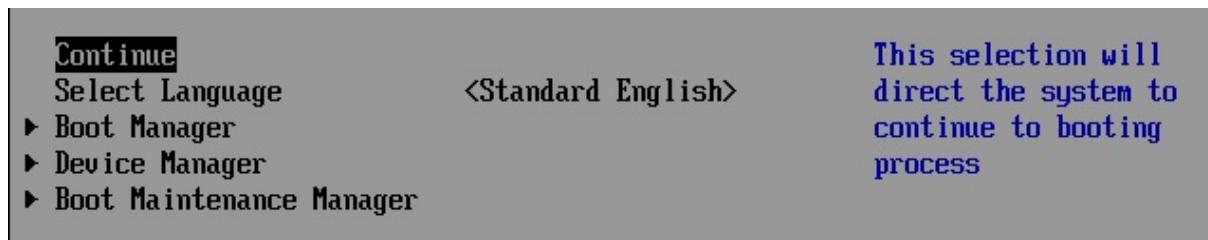
FS0:\> load MyWizardDriver.efi
Image 'FS0:\MyWizardDriver.efi' loaded at 5EB9000 - Success
FS0:\> exit_

```

6. **Type** exit
7. Now at the setup front page menu, **select** "Device Manager"



8. **Press** "Enter" to enter "Device Manager"
9. Inside the Device Manager menu **press** the down to "**My Wizard Driver Sample Formset**"



14. Type "Reset" to return to the Visual Studio Command Prompt

```
FS0:\> reset_
```

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.3 NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean

Lab 3b. Add your Driver to the platform

As of now, your driver needs to be soft loaded each time from the shell prompt. In this lab, you'll update the platform .FDF file to force your driver to load as part of the platform UEFI driver.

1. Open to update: C:\fw\edk2\Nt32Pkg\Nt32Pkg.Fdf
2. Add the following code (as shown below before "`!if $(BUILD_NEW_SHELL) == TRUE`"):
`INF MyWizardDriver/MyWizardDriver.inf`
3. Save Nt32pkg.fdf

Build and test MyWizardDriver

1. Open the Visual Studio Command Prompt
2. Type build
3. Type build run
4. At the UEFI Shell prompt, type "Exit"
5. Now at the setup front page menu, select "Device Manager"



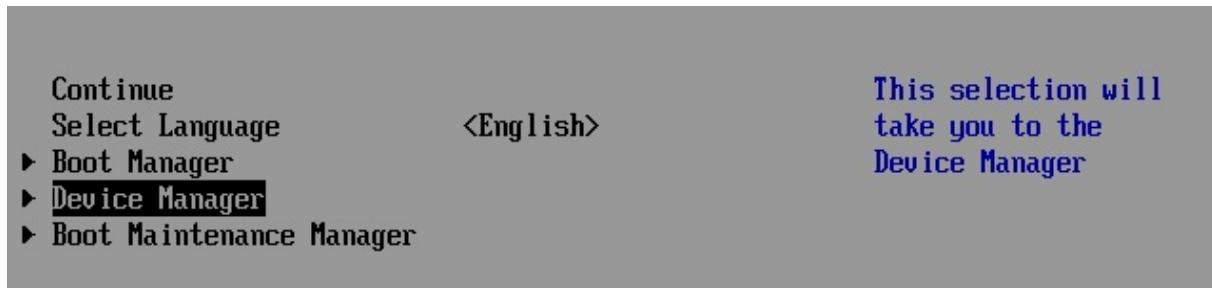
6. Press "Enter" to enter "Device Manager"
7. Inside the Device Manager menu Notice that the My Wizard Driver Sample Formset is added without having to issue the "Load" command from the shell prompt.

1. **Open** to update: C:\fw\edk2\Nt32Pkg\Nt32Pkg.Fdf
2. **Add** the following code (as shown below before “`!if ${BUILD_NEW_SHELL} == TRUE`”):

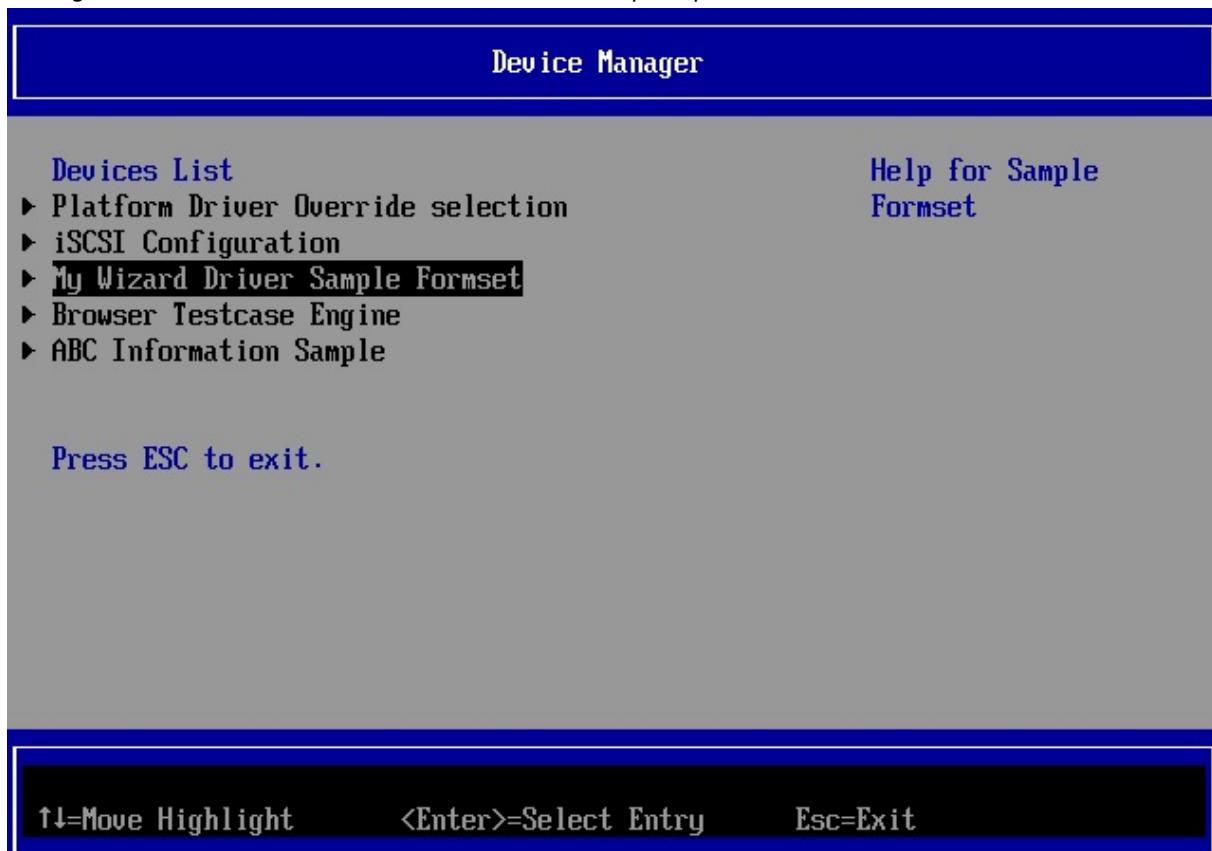
```
INF MyWizardDriver/MyWizardDriver.inf
```
3. **Save** Nt32pkg.fdf

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt,**type** “`Exit`”
5. Now at the setup front page menu, **select** “Device Manager”



6. **Press** “Enter” to enter “**Device Manager**”
7. Inside the Device Manager menu **Notice** that the My Wizard Driver Sample Formset is added without having to issue the “Load” command from the shell prompt.



8. **Press** “Escape” to exit the “Device Manager” Page
9. **Press** Up Arrow to “Continue”

Lab 4. Updating the Menu: Reset Button

In this lab, you'll learn how to add a reset button to your driver's form menu. It's time to add more configuration fields to your menu, enabling users to modify more fields now that you've built a driver that 1) saves data from forms into NVRAM 2) updates data from the .VFR forms and 3) builds into the platform drivers.

The next set of labs will update .VFR, `MyWizardDriver.vfr`, and UNI `MyWizardDriver.uni` string files to incrementally add a reset button (Lab 4), pop-up box (Lab 5), string name (Lab 6), and numeric hex value (Lab 7) to your driver's form menu:

- 1). **Update** the `MyWizardDriver.vfr` file 2). **Add** the following code (as shown below after the "GUID" definition Apprx. Line 29): `MyStandardDefault`,

```

prompt = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT),
attribute = 0x0000; // Default ID: 0000 standard default

27     guid  = MYWIZARDDRIVER_FORMSET_GUID;      // GUID of this buffer storage
28
29 defaultstore MyStandardDefault,
30     prompt      = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT),
31     attribute    = 0x0000;                         // Default ID: 0000 standard default
32

```

- 3). **Add** the following code before the "`endform`" (as shown below Approx. Line 55):

```

resetbutton
defaultstore = MyStandardDefault,
prompt      = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT_RESET),
help       = STRING_TOKEN(STR_STANDARD_DEFAULT_HELP),
endresetbutton;

52     endcheckbox;
53
54
55     resetbutton
56     defaultstore = MyStandardDefault,
57     prompt      = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT_RESET),
58     help       = STRING_TOKEN(STR_STANDARD_DEFAULT_HELP),
59     endresetbutton;
60
61
62 endform;
63
64 endformset;

```

- 4). **Save** `MyWizardDriver.vfr`

- 5). **Update** the `MyWizardDriver.uni` file

- 6). **Add** the following strings at the end of the file to support the "`STR_`" referenced added in the .vfr file:

```

#string STR_STANDARD_DEFAULT_PROMPT      #language en "Standard Default"
#string STR_STANDARD_DEFAULT_PROMPT_RESET  #language en "Reset to Standard Default"
#string STR_STANDARD_DEFAULT_HELP        #language en "This will reset all the Questions to their standard default value"

```

- 7). **Save** `MyWizardDriver.uni`

Build and test MyWizardDriver

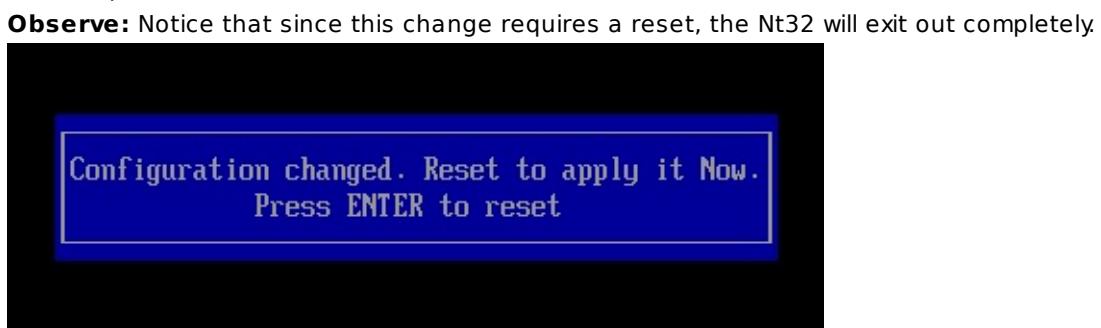
1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt, type **exit**

```
Press ESC in 1 seconds to skip :
Shell> exit_
```

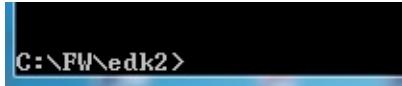
1. Now at the setup front page menu, **select** "Device Manager"
2. **Press** "Enter" to enter "Device Manager"
3. Inside the Device Manager menu **press** the down arrow to "My Wizard Driver Sample Formset"
Press "Enter"
4. **Access** the My Wizard Driver menu and **notice** the item "Reset to Standard Default"



5. **Press Down Arrow** to "Reset to Standard Default"
6. **Press** "Enter" to select
7. **Notice** the "**Configuration changed**" message at the bottom of the menu
8. To Exit **Press** "Escape" then "Y"
9. To Exit the "Device Manager" Page: **Press** "Escape"
10. **Press** Up Arrow to "Continue"



11. **Press** "Enter" to return to the Visual Studio Command Prompt



For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.4

NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 4

Lab 5. Updating the Menu: Pop-up Box

In this lab, you'll learn how to add a pop-up box to your driver's form menu by using the “**oneof**” VFR term. We will also only update the MyWizardDriver.vfr and MyWizardDriver.uni files.

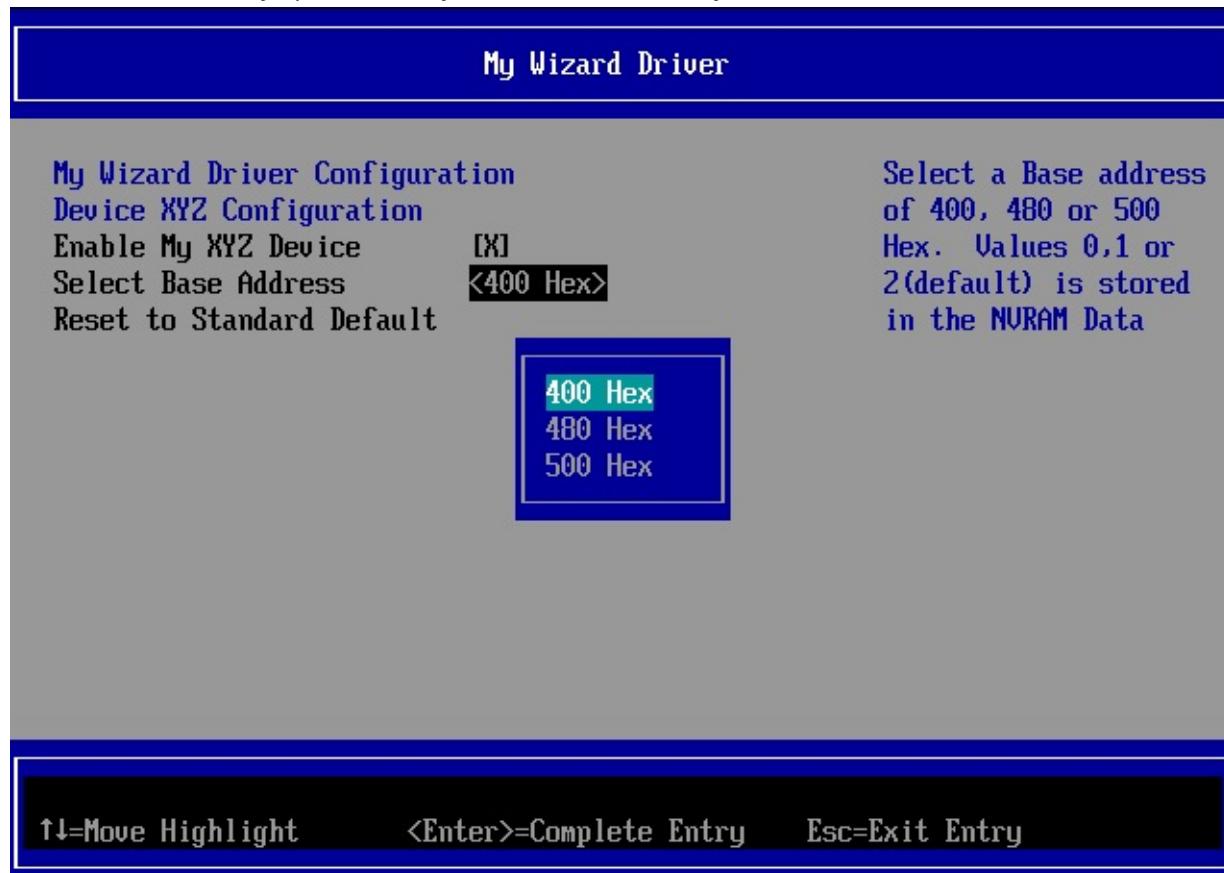


Figure 5 My Wizard Driver with a pop-up box

Background Information The VFR term “**oneof**” will declare a pop-up menu. The user then selects one field that will dictate the value stored in the NVRAM variable. Looking at Figure 5 above, there are three values:

Value	Display	String token
0	500 Hex	STR_ONE_OF_TEXT3
1	480 Hex	STR_ONE_OF_TEXT2
2	400 Hex	STR_ONE_OF_TEXT1

For this lab you will add code to give your driver menu a pop-up menu item by defining a “**oneof**” item. Also, if the device is “**disabled**”, then use the VFR term “**grayoutif**” statement so that the pop-up menu is not accessible and cannot be changed. The browser engine will use the configuration variable `MWD_IfrNVData.MyWizardDriverChooseToEnable` with a value of `0x0` to determine if the device is enabled or disabled

1. **Update** the MyWizardDriver.vfr file
2. **Add** the following code before the “`resetbutton`” statement (approximately line 53)

```
// Begin code
//
// Define oneof (EFI_IFR_ONE_OF)
//
grayoutif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
```

```

oneof name = MyOneOf2,                                // Define reference name for Question
    varid  = MWD_IfrNVData.MyWizardDriverBaseAddress,
    // Use "DataStructure.Member" to reference Buffer Storage
    prompt  = STRING_TOKEN(STR_ONE_OF_PROMPT),
    help    = STRING_TOKEN(STR_ONE_OF_HELP),
    //
    // Define an option (EFI_IFR_ONE_OF_OPTION)
    //
    option text = STRING_TOKEN(STR_ONE_OF_TEXT3), value = 0x0, flags = 0;
    option text = STRING_TOKEN(STR_ONE_OF_TEXT2), value = 0x1, flags = 0;
    //
    // DEFAULT indicate this option will be marked with
    // EFI_IFR_OPTION_DEFAULT
    //
    option text = STRING_TOKEN(STR_ONE_OF_TEXT1), value = 0x2,
        flags = DEFAULT;
endoneof;
endif;
// end code

51             default  = 1,
52         endcheckbox;
53     //
54     // Define oneof (EFI_IFR_ONE_OF)
55     //
56     grayoutif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
57
58     oneof name = MyOneOf2,                                // Define reference
59         varid  = MWD_IfrNVData.MyWizardDriverBaseAddress,
60         // Use "DataStructure.Member" to reference Buffer Storage
61         prompt  = STRING_TOKEN(STR_ONE_OF_PROMPT),
62         help    = STRING_TOKEN(STR_ONE_OF_HELP),
63         //
64         // Define an option (EFI_IFR_ONE_OF_OPTION)
65         //
66         option text = STRING_TOKEN(STR_ONE_OF_TEXT3), value = 0x0, flags = 0;
67         option text = STRING_TOKEN(STR_ONE_OF_TEXT2), value = 0x1, flags = 0;
68         //
69         // DEFAULT indicate this option will be marked with
70         // EFI_IFR_OPTION_DEFAULT
71         //
72         option text = STRING_TOKEN(STR_ONE_OF_TEXT1), value = 0x2,
73             flags = DEFAULT;
74     endoneof;
75     endif;
76
77
78     resetbutton
79     defaultstore = MyStandardDefault,

```

3. Save the MyWizardDriver.vfr file

4. Update the MyWizardDriver.uni file

5. Add the following code to the end of the file (as shown below):

```

// begin code
#string STR_ONE_OF_PROMPT          #language en "Select Base Address"

#string STR_ONE_OF_HELP            #language en "Select a Base address of 400, 480 or 500 Hex. Values 0,1 or 2(default) is stored in the NVRAM Data"

#string STR_ONE_OF_TEXT1           #language en "400 Hex"
#string STR_ONE_OF_TEXT2           #language en "480 Hex"
#string STR_ONE_OF_TEXT3           #language en "500 Hex"

// end code

```

```

33 #string STR_STANDARD_DEFAULT_HELP      #language en "This will reset all the Questions to their standard default value"
34
35 #string STR_ONE_OF_PROMPT           #language en "Select Base Address"
36
37 #string STR_ONE_OF_HELP             #language en "Select a Base address of 400, 480 or 500 Hex. Values 0,1 or 2(default) is stored in the NVRAM Data"
38
39 #string STR_ONE_OF_TEXT1            #language en "400 Hex"
40
41 #string STR_ONE_OF_TEXT2            #language en "480 Hex"
42
43 #string STR_ONE_OF_TEXT3            #language en "500 Hex"

```

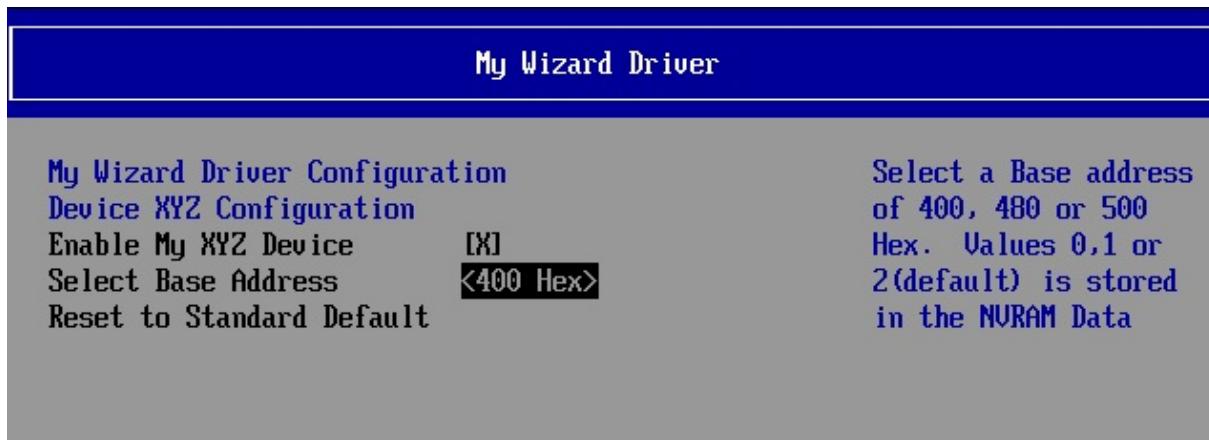
6). Save MyWizardDriver.uni

Build and test MyWizardDriver

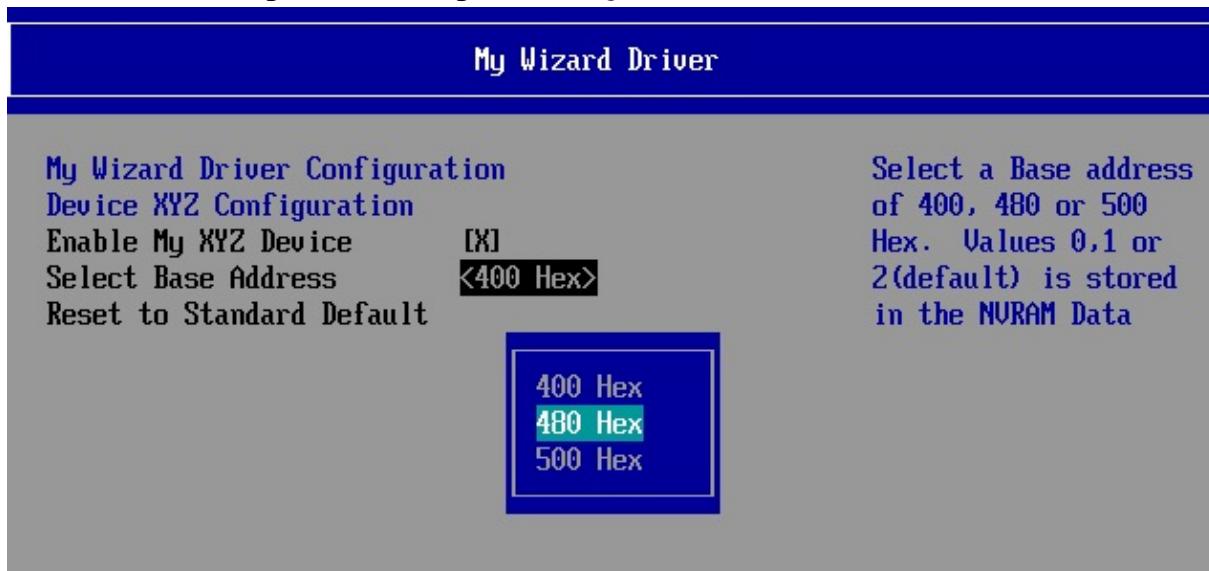
1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt, type **exit**

Press ESC in 1 seconds to skip:
Shell> exit

5. Now at the setup front page menu, **select** "Device Manager"
6. Inside the Device Manager menu **press** the down arrow to "My Wizard Driver Sample Formset"
Press "Enter"
7. **Down Arrow** to "Select Base Address"



- Notice** the Pop up menu
8. **Select** "480 Hex" then **press** "Enter"
 - Observe**: the "**Configuration changed**" message at the bottom



9. **Test** the "grayoutif" by selecting "Enable My XYZ Device" then **press** the "Space" bar to toggle off

or "Disabled".

Notice the "Select Base Address" is now grayed out and not Selectable.



10. Press "Space" again to Enable
11. To Exit Press "Escape" then "Y" or "F10" then "Escape"
12. To Exit the "Device Manager" Page: Press "Escape"
13. Press Up Arrow to "Continue"
14. At the Shell Prompt type: " dmpstore -all "

```
Variable - NV+BS - '5481DB09-E5F7-4158-A5C5-2DBEA49534FF:MWD_IfrNVData'
ze = 0x2B
 00000000: 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 *.....
 00000010: 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 *.....
 00000020: 00 00 00 00 00 00 00 00-00 01 01 *.....
Shell> _
```

```
21 #pragma pack(1)
22 typedef struct {
23
24     UINT16  MyWizardDriverStringData[20];
25     UINT8   MyWizardDriverHexData;
26     UINT8   MyWizardDriverBaseAddress; // This byte is circled in red
27     UINT8   MyWizardDriverChooseable;
28
29 } MYWIZARDDRIVER_CONFIGURATION;
```

15. Observe file MyWizardDriverNVDataStruc.h and the NVRAM `MWD_IfrNVData` variable. By updating `MyWizardDriverNVDataStruc.h`, our data structure stored in NVRAM is named `MWD_IfrNVData` of type `MYWIZARDDRIVER_CONFIGURATION`. **Notice** that the base address byte is the next to the last byte in the data structure `MWD_IfrNVData.MyWizardDriverBaseAddress` where `02 == 400H` , `01 == 480H` , and `00 == 500H`. Notice the NVRAM Variable with the value of `480H` will have a true value of `01`.
16. Type "reset" **at the Shell prompt
17. Press "Enter" to return to the Visual Studio Command Prompt

```
FS0:\> reset_
```

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.5

NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 5

Lab 6. Updating the Menu: Creating a String to Name a Saved Configuration

In this lab, you'll create a string to name a saved configuration that will be stored into the NVRAM variable space. This lab uses the VFR term "string" to prompt the user to enter a string value. The VFR can determine the minimum and maximum number of characters of the string length with the terms "minsize" and "maxsize". Since there is also an enable/disable switch, the VFR can use the "grayoutif" term again to allow or disallow changes to this field.



Figure 6 : Menu with a string item

- Update** the MyWizardDriver.vfr file
- Add** the following code to the location at approx. line 77 and before the "resetbutton" item (as shown below):

```

//
// Define a string (EFI_IFR_STRING) to name the configuration in the
// NVRAM variable
//
grayoutif ideqval MWD_IfrNvData.MyWizardDriverChooseToEnable == 0x0;
string varid      = MWD_IfrNvData.MyWizardDriverStringData,
       prompt     = STRING_TOKEN(STR_MY_STRING_PROMPT),
       help       = STRING_TOKEN(STR_MY_STRING_HELP),
       minsize   = 3,
       maxsize   = 20,
endstring;
endif;

```

```

74      endoneof;
75  endif;
76
77
78      //
79      // Define a string (EFI_IFR_STRING) to name the configuration in the
80      // NVRAM variable
81      //
82
83      //
84  grayoutif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
85
86      string varid = MWD_IfrNVData.MyWizardDriverStringData,
87          prompt = STRING_TOKEN(STR_MY_STRING_PROMPT),
88          help = STRING_TOKEN(STR_MY_STRING_HELP),
89          minsize = 3,
90          maxsize = 20,
91
92      endstring;
93  endif;
94
95      resetbutton
96      defaultstore = MyStandardDefault,
97      prompt = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT_RESET),
98      help = STRING_TOKEN(STR_STANDARD_DEFAULT_HELP),
99  endresetbutton;
100

```

3. **Save** MyWizardDriver.vfr

4. **Update** MyWizardDriver.uni

5. **Add** the following code to the bottom of the file:

```

#string STR_MY_STRING_PROMPT      #language en "Name of Configuration"
#string STR_MY_STRING_HELP       #language en "Enter a name for this configuration. This string can is 3 to 20 character
s"

<-- 
39 #string STR_ONE_OF_TEXT1      #language en "400 Hex"
40
41 #string STR_ONE_OF_TEXT2      #language en "480 Hex"
42
43 #string STR_ONE_OF_TEXT3      #language en "500 Hex"
44
45 #string STR_MY_STRING_PROMPT    #language en "Name of Configuration"
46
47 #string STR_MY_STRING_HELP     #language en "Enter a name for this configuration. This
48
49

```

6). **Save** MyWizardDriver.uni

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt,type **exit**

Press ESC in 1 seconds to skip
Shell> exit_

5. Now at the setup front page menu, **select** “Device Manager”
6. Inside the Device Manager menu **press** the down arrow to “My Wizard Driver Sample Formset”
Press “Enter”

7. **Select** “Name of Configuration” then **Press** “Enter”

Notice the string text pop up menu gets displayed.



8. **Test** the “`minsize`” by only **typing** your choice of a two character string. Then **Press** “Enter”

Notice the an error message validating that you need to enter at least three or more characters.

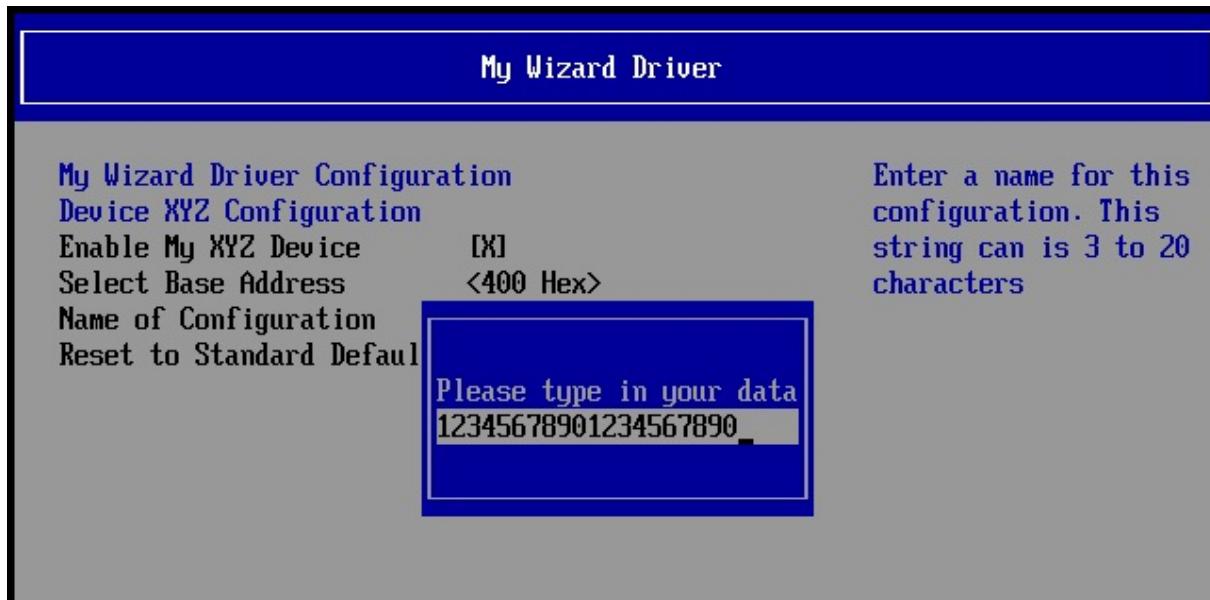


9. **Press** “Enter” to clear the message

10. **Press** “Enter” again to re-enter pop up menu

11. **Test** by **typing** more than “`maxsize`” of 20 characters** **Then** **Press** “Enter” .

Notice** that the Browser only allows the maximum number of 20 characters to be entered with a forced stop. There is no error message but no more characters are allowed to be typed into the pop up menu.



12. Press "Enter"

Notice that the "Configuration changed" message is displayed



13. Test the grayoutif by selecting "Enable My XYZ Device"

14. Press the "Spacebar" to toggle off/disable. Then Press the "Spacebar" again to Enable.

Notice that the "Select Base Address" and "Name of Configuration" fields are now grayed out and not selectable



15. Press "F10" to save.
16. Press "Escape" to exit
17. Press "Escape" to exit the "Device Manager"
18. Select "Continue" and then Press "Enter"
19. At the Shell Prompt, type `dmpstore -all`

Notice the unicode string "12345678901234567890" (or the 20 character value you typed) is now stored because you entered those characters in the HII form menu. This is because the file `WizardDriverNvDataStruc.h` has the data structure stored in NVRAM with the GUID define name `MWD_IfrNvData` of type `MYWIZARDDRIVER_CONFIGURATION`. Notice that string data is the first 20 bytes in the data structure `MWD_IfrNvData.MyWizardDriverStringData`.

```
0000000020: 04 00 00 00 00 10 00 00-0E 00 00 00 00 00 00 00 *.....*
Variable - NU+BS - '5481DB09-E5F7-4158-A5C5-2DBEA49534FF·MWD_IfrNvData' - DataS
ze = 0x2B
0000000000: 31 00 32 00 33 00 34 00-35 00 36 00 37 00 38 00 *1.2.3.4.5.6.7.8.*
0000000010: 39 00 30 00 31 00 32 00-33 00 34 00 35 00 36 00 *9.0.1.2.3.4.5.6.*
0000000020: 37 00 38 00 39 00 30 00-00 01 01 *7.8.9.0....*
```

Shell> _

```
21 #pragma pack(1)
22 typedef struct {
23
24     UINT16 MyWizardDriverStringData[20];
25     UINT8 MyWizardDriverNvData;
26     UINT8 MyWizardDriverBaseAddress;
27     UINT8 MyWizardDriverChooseToEnable;
28 } MYWIZARDDRIVER_CONFIGURATION;
```

20. Type "reset" and then "Enter" at the Shell prompt to return to the Visual Studio Command Prompt

```
FS0:\> reset_
```

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.6

NOTE: Del Directory C:\fw\edk2\Build\NT32\IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 6

Lab 7. Updating the Menu: Numeric Entry

In this lab, you'll learn how to add a numeric entry to your driver menu. This lab uses the VFR term "numeric" that prompts the user to enter a free-form numeric value. The VFR determines the minimum and maximum values with the terms "minimum" and "maximum". Since there is also an enable/disable switch, the VFR uses the "suppressif" term to display or hide this field when disabled. Also this field displays as decimal (default) or hexadecimal with the "flags" switch.



Figure 7 : Menu with Numeric item entry

1. **Update** the MyWizardDriver.vfr file
2. **Add** the following code in the location shown below at approx. Line 90 and before the "resetbutton" item:

```
//  
// Define a numeric free form menu item  
//  
suppressif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;  
numeric varid = MWD_IfrNVData.MyWizardDriverHexData,  
    prompt = STRING_TOKEN(STR_DATA_HEX_PROMPT),  
    help = STRING_TOKEN(STR_NUMERIC_HELP),  
    flags = DISPLAY_UINT_HEX, // Display in HEX format (if not specified, default is in decimal format)  
    minimum = 0,
```

```

87     endstring;
88   endif;
89
90 // 
91 // Define a numeric free form menu item
92 //
93 suppressif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
94   numeric varid = MWD_IfrNVData.MyWizardDriverHexData,
95         prompt = STRING_TOKEN(STR_DATA_HEX_PROMPT),
96         help = STRING_TOKEN(STR_NUMERIC_HELP),
97         flags = DISPLAY_UINT_HEX,      // Display in HEX format (if
98         minimum = 0,
99         maximum = 250,
100        default = 0x22, defaultstore = MyStandardDefault,
101
102   endnumeric;
103 endif;
104
105
106   resetbutton
107   defaultstore = MyStandardDefault,
108   prompt = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT_RESET),

```

3. **Save** MyWizardDriver.vfr

4. **Update** the MyWizardDriver.uni file

5. **Add** the following code to the bottom of the file:

```

#string STR_DATA_HEX_PROMPT      #language en "Enter ZY Base (Hex)"
#string STR_NUMERIC_HELP        #language en "This is the help for entering a Base address in Hex. The valid range in t
his case is from 0 to 250."

```

6). **Save** MyWizardDriver.uni

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt

2. **Type** build

3. **Type** build run

4. At the UEFI Shell prompt,type **exit**

```

Press ESC in 1 seconds to skip :
Shell> exit_

```

5. Now at the setup front page menu, **select** “Device Manager”

6. Inside the Device Manager menu **press** the down arrow to “My Wizard Driver Sample Formset”

Press “Enter”

Notice the value for “Enter ZY Base(Hex)” is `0x22`. Hex is the default because of the VFR field

`“default = 0x22”`

My Wizard Driver Configuration	
Device XYZ Configuration	
Enable My XYZ Device	[X]
Select Base Address	<400 Hex>
Name of Configuration	-
Enter ZY Base (Hex)	[]
Reset to Standard Default	

This is the help for
entering a Base
address in Hex. The
valid range in this
case is from 0 to 250.

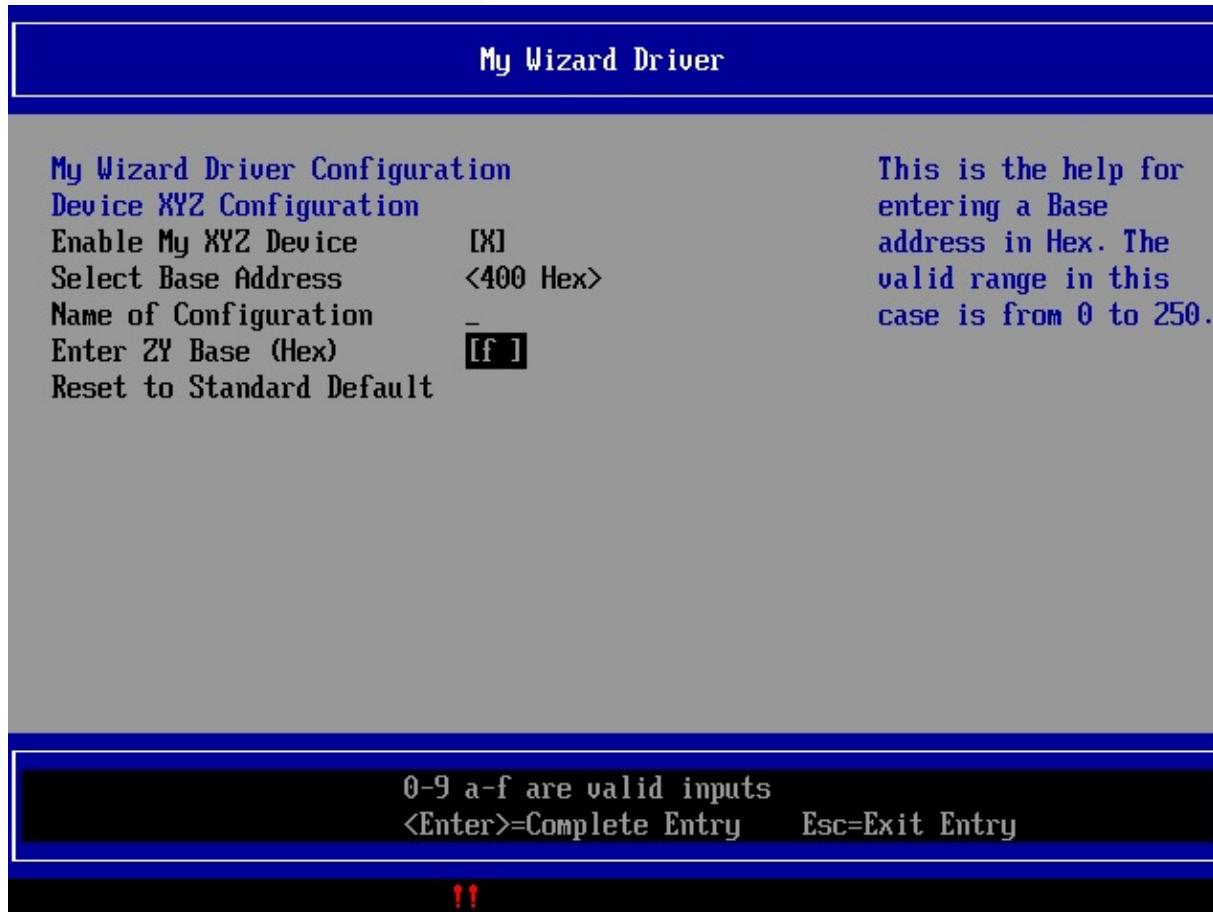
7. **Select** “Enter ZY Base(Hex)” and then **Press** “Enter”

8. **Test** by typing a “`M`” character

Notice that only Numeric characters are allowed and also only values `00` to `0FA` Hex. When values outside the range or non-numeric characters are entered the red “`!!`” sting is displayed at the bottom of the menu.

The string “`!!`” is part of the Browser engine : `MdeModulePkg\Universal\SetupBrowserDxe\SetupBrowserStr.uni`

```
#string INPUT_ERROR_MESSAGE #language en-US "!!"
```



9. **Press** “Enter” again

10. **Test** by typing a value of ‘`99`’ Hex and then **Press** “Enter”

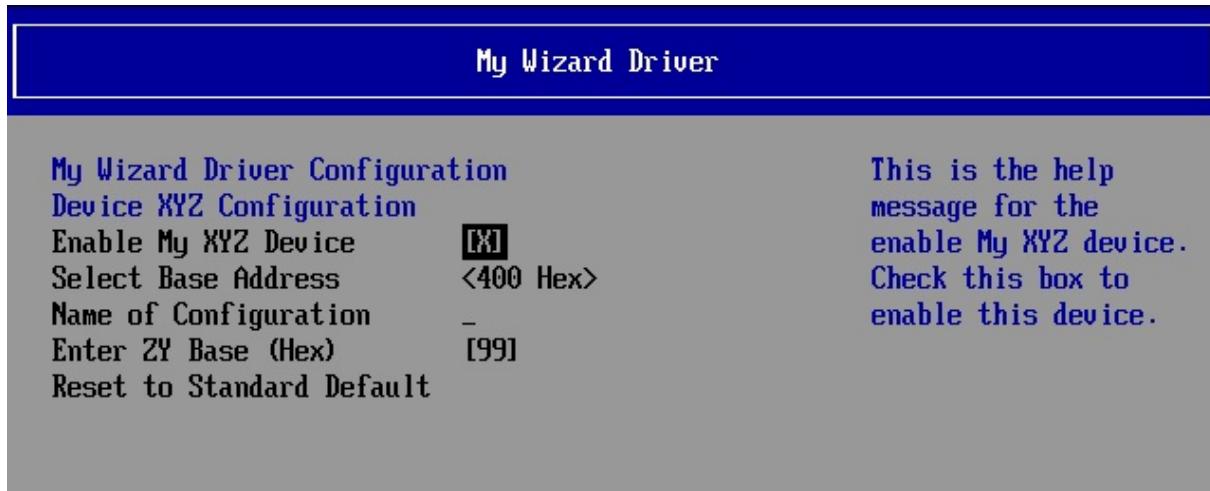
Notice that the “**Configuration changed**” message is displayed.

11. **Test** the “surpressif” by pressing the “spacebar” to “Enable My XYZ Device” then press the “Space” bar to toggle off or “Disabled”.

Notice the “Select Base Address” and “Name of Configuration” fields are now grayed out and not selectable and the “**Enter ZY Base(Hex)**” does not appear at all.



12. Press "Space bar" again to "Enable My XYZ Device" and the "Enter ZY Base(Hex)" is displayed again



13. Press "F10" to save, then "Escape" to exit
14. Press "Escape" to exit the "Device Manager"
15. Select "Continue" and then Press "Enter"
16. At the Shell Prompt, type `dmpstore -all`

Notice by modifying `MyWizardDriverNvDataStruc.h` our data structure stored in NVRAM is named `MWD_IfrNvData` of type `MYWIZARDDRIVER_CONFIGURATION`.

```

00000020. 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 ~.....
Variable - NV+BS - '5481DB09-E5F7-4158-A5C5-2DBEA49534FF:MWD_IfrNVData'
ze = 0x2B
00000000: 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 *.....
00000010: 00 00 00 00 00 00 00 00-00 00 00 00 00 00 00 00 *.....
00000020: 00 00 00 00 00 00 00 00-99 02 01 00 *.....
Shell> _

21 #pragma pack(1)
22 typedef struct {
23
24     UINT16 MyWizardDriverStringData[20];
25     UINT8 MyWizardDriverHexData;
26     UINT8 MyWizardDriverBaseAddress;
27     UINT8 MyWizardDriverChooseToEnable;
28
29 } MYWIZARDDRIVER_CONFIGURATION;

```

17 Type “**reset**” at the Shell prompt and then **Press “Enter”** to return to the Visual Studio Command Prompt

FS0:\> reset_

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.7

NOTE: Del Directory C:\fw\edk2\Build\NT32\IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 7

Lab 8. Updating your Driver for Interactive Call Backs

In this lab, you'll update your driver for interactive call backs. Call backs are a way to communicate changes the user is making in "real time" where your driver needs to intervene as the changes are made and before the user exits the current menu being displayed. These would be exception cases that the driver could interrupt the normal browser engine process.

To add call backs, the file `HiiConfigAccess.c` of your driver will be updated in the function `MyWizardDriverHiiConfigAccessCallback`. This function is called whenever any VFR items have a flag for `INTERACTIVE` set. So far, the previous labs did not have any call back items.

We can see this because there was a "Debug" call made in the `MyWizardDriverHiiConfigAccessCallback` function that never gets called:

- `HiiConfigAccess.c` (line 331)

```
DEBUG ((DEBUG_INFO, "\n:: START Call back ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));
```

Lab 8a. Add the Case statements to the Call back routine

1. **Update** the `HiiConfigAccess.c` file
2. **Add** the following code before `return status`; to include a "case" statement in the call back routine for the "action" passed. | Add the following code at approx. line 343 before:
`return status;`

```
//Begin Code
switch (Action) { // Start switch and passed param Action
case EFI_BROWSER_ACTION_FORM_OPEN: // 3
{
}
break;

case EFI_BROWSER_ACTION_FORM_CLOSE: // 4
{
}
break;

case EFI_BROWSER_ACTION_RETRIEVE: // 2
{
}
break;
//End Code
```

```

340     FormId = 0;
341     Status = EFI_SUCCESS;
342     PrivateData = MYWIZARDDRIVER_DEV_FROM_THIS (This);
343
344
345     switch (Action) { // Start switch and passed param Action
346     case EFI_BROWSER_ACTION_FORM_OPEN: // 3
347     {
348         }
349         break;
350
351     case EFI_BROWSER_ACTION_FORM_CLOSE: // 4
352     {
353         }
354         break;
355
356     case EFI_BROWSER_ACTION_RETRIEVE: // 2
357     {
358         }
359         break;
360
361     case EFI_BROWSER_ACTION_DEFAULT_STANDARD: // 0x1000
362     {
363         }
364         break;
365
366     case EFI_BROWSER_ACTION_DEFAULT_MANUFACTURING: // 0x1001
367     {
368         }
369         break;
370
371     case EFI_BROWSER_ACTION_CHANGING: // 0
372     {
373         }
374         break;
375
376     case EFI_BROWSER_ACTION_CHANGED: // 1
377     {
378         }
379         break;
380
381     default:
382         Status = EFI_UNSUPPORTED;
383         break;
384     } // end switch case on Action
385
386     return Status;
387
388 // return EFI_UNSUPPORTED;
389 }
```

3. Save HiiConfigAccess.c

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt, type **exit**
5. Now at the setup front page menu, **select** "Device Manager"
6. Inside the Device Manager menu **press** the down arrow to "My Wizard Driver Sample Formset"
Press "Enter"
7. **Notice** the debug messages in the Visual Studio Command Prompt - build run Window (**No Debug messages for Call back**)

```

05 00000040 00000031 00000040
06 00000040 00000031 00000040

P1OpenBlock: Could not open '\\.\a:, 2
P1OpenBlock: Could not open '\\.\d:, 5
P1OpenBlock: Could not open '\\.\j:, 2
InstallProtocolInterface: 348C4D62-BFBD-4882-9ECE-C80BB1C4783B 0
InstallProtocolInterface: 348C4D62-BFBD-4882-9ECE-C80BB1C4783B 0

```

8. **Press "Escape" and another "Escape" to exit the "Device Manager"**
9. **Select "Continue" and then Press "Enter"**
10. **Type "reset" at the Shell prompt and then Press "Enter" to return to the Visual Studio Command Prompt**

```

Press ESC in 4 seconds to skip
Shell> reset_

```

Lab 8b. Update the Menu for Interactive items

1. **Update** the MyWizardDriver.vfr file
2. Now, you'll add the flag characteristic `INTERACTIVE` to the string item's flags by using keyword `INTERACTIVE` and `questionid`. **Add** the following code in the location shown below:

Approx. line 83 and line 86

```

questionid = 0x1001,
flags = INTERACTIVE,
76
77 //
78 // Define a string (EFI_IFR_STRING) to name the configuration in the
79 // NVRAM variable
80 //
81     grayoutif ideqval MWD_IfrNvData.MyWizardDriverChooseToEnable == 0x0;
82     string varid = MWD_IfrNvData.MyWizardDriverStringData,
83         questionid = 0x1001,
84         prompt = STRING_TOKEN(STR_MY_STRING_PROMPT),
85         help = STRING_TOKEN(STR_MY_STRING_HELP),
86         flags = INTERACTIVE,
87         minsize = 3,
88         maxsize = 20,
89     endstring;
90 endif;
91

```

3. Include the numeric item by adding the following code in the location shown below, Approx. line 97 and line 100

```

questionid = 0x1111,
| INTERACTIVE ,

```

```

92  //
93  // Define a numeric free form menu item
94  //
95      suppressif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
96      numeric varid = MWD_IfrNVData.MyWizardDriverHexData,
97          questionid = 0x1111,
98          prompt = STRING_TOKEN(STR_DATA_HEX_PROMPT),
99          help = STRING_TOKEN(STR_NUMERIC_HELP),
100         flags = DISPLAY_UINT_HEX | INTERACTIVE, // Display in HEX :
101         minimum = 0,
102         maximum = 250,
103         default = 0x22, defaultstore = MyStandardDefault,
104
105     endnumeric;
106 endif;
107

```

4. **Save** MyWizardDriver.vfr

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt, type **exit**
5. Now at the setup front page menu, **select** "Device Manager"
6. Inside the Device Manager menu **press** the down arrow to "My Wizard Driver Sample Formset"
Press "Enter"
7. Take a moment and **review** the Visual Studio build run command prompt window
8. In the emulation window, **click** on "Name of Configuration" and "Enter ZY Base(Hex)"
9. **Notice** the following in the Visual Studio Command Prompt window:

Every time the browser does anything with the interactive labeled fields there is a call made to your driver's call back function. We can determine which item by the `questionid` and what action by the Action passed to your call back function. Your call back function can then add code to special case when these transitions occur.

Entering Form

```

:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0003
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0003
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002

```

Changing

a Value for Question ID 0x1111

```

:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0003
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0003
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0001
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002

```

Changing

a Value for Question ID 0x1001

```

:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0003
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0003
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0001
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0003
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0003
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0001
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: ROUTE CONFIG Saving the configuration to NVRAM
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0003
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0003
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0000
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0001
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0002
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0002
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: ROUTE CONFIG Saving the configuration to NVRAM
:: START Call back ,Question ID=0x00001001 Type=0x0007 Action=0x0004
:: START Call back ,Question ID=0x00001111 Type=0x0000 Action=0x0004
colInterface: 348C4D62-BFBD-4882-9ECE-C80BB1C4783B 0

```

10. Press "Escape" and another "Escape" to exit the "Device Manager"
11. Select "Continue" and then Press "Enter"
12. Type "reset" at the Shell prompt and then Press "Enter" to return to the Visual Studio Command Prompt

FS0:\> reset_

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.8

NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 8

Lab 9. Add code to your driver when Call Back events occur for Interactive Items

In this lab, you'll update your driver to print debug statements when the HII browser engine calls back into your call back function. Every time the browser does anything with the interactive labeled fields there is a call made to your driver's call back function. We can determine the item by the `questionid` and what action based on the action passed to your call back function. Your call back function can then add code to special case when these transitions occur.

For this lab we will simply add Debug print statements. However, the use of adding call backs to a driver's HII functions adds the capability of providing more manageability and flexibility for the interactions between the user, the browser engine, and your driver code. In a real driver firmware situation, it may be desired to implement more complex features and functionality based upon an item changing.

1. **Update** the `HiiConfigAccess.c` file
2. **Comment out** the `DEBUG` statement with “`//`” in the `MyWizardDriverHiiConfigAccessCallback` call back function approx. line 330:

```

//  
--  
326     MYWIZARDDRIVER_DEV          *PrivateData;  
327     EFI_STATUS                  Status;  
328     EFI_FORM_ID                FormId;  
329  
330 // DEBUG ((DEBUG_INFO, "\n:: START Call back ,Question ID=0  
331  
332  
333  
334     if (((Value == NULL) && (Action != EFI_BROWSER_ACTION_FORM_O

```

3. **Add** a switch case statement of the question ID's to the “Action” switch case of `EFI_BROWSER_ACTION_CHANGING` in the call back function by **adding** a nested switch case code (as shown below at approx. line 372)

```

switch (QuestionId) {  
    case 0x1111:  
        DEBUG ((DEBUG_INFO, "\n:: START Call back- Changing ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));  
        break;  
    case 0x1001:  
        DEBUG ((DEBUG_INFO, "\n:: START Call back- Changing ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));  
        break;  
    default:  
        Status = EFI_UNSUPPORTED;  
        break;  
}

```

```

369
370     case EFI_BROWSER_ACTION_CHANGING: // 0
371     {
372         switch (QuestionId) {
373             case 0x1111:
374                 DEBUG ((DEBUG_INFO, "\n:: START Call back- Changi
375                                         break;
376             case 0x1001:
377                 DEBUG ((DEBUG_INFO, "\n:: START Call back- Changi
378                                         break;
379             default:
380                 Status = EFI_UNSUPPORTED;
381                 break;
382         }
383     }
384     break;
385
386     case EFI_BROWSER_ACTION_CHANGED: // 1
387 }
```

4. **Add** another nested switch case statement of the question ID's to the "Action" switch case of EFI_BROWSER_ACTION_CHANGED in the call back function (as show below at approx. line 388):

```

        switch (QuestionId) {
    case 0x1111:
        DEBUG ((DEBUG_INFO, "\n:: START Call back- Changed ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));
        break;
    case 0x1001:
        DEBUG ((DEBUG_INFO, "\n:: START Call back- Changed ,Question ID=0x%08x Type=0x%04x Action=0x%04x", QuestionId, Type, Action));
        break;
    default:
        Status = EFI_UNSUPPORTED;
        break;
    }

385
386     case EFI_BROWSER_ACTION_CHANGED: // 1
387     {
388         switch (QuestionId) {
389             case 0x1111:
390                 DEBUG ((DEBUG_INFO, "\n:: START Call back- Changed
391                                         break;
392             case 0x1001:
393                 DEBUG ((DEBUG_INFO, "\n:: START Call back- Changed
394                                         break;
395             default:
396                 Status = EFI_UNSUPPORTED;
397                 break;
398         }
399     }
400     break;
401
402     default:
403         Status = EFI_UNSUPPORTED;
404         break;
405     } // end switch case on Action
406
407     return Status;
408 }
```

1. **Save** MyWizardDriver.c

Build and test MyWizardDriver

1. **Open** the Visual Studio Command Prompt

2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt,type **exit**
5. Now at the setup front page menu, **select** “Device Manager”
6. Inside the Device Manager menu **press** the down arrow to “My Wizard Driver Sample Formset”
Press “Enter”
7. **Observe** the Visual Studio Command Prompt - build run Window
Test: changing the “Name of Configuration” and the “Enter ZY Base(Hex)” fields while observing the Visual Studio Command Prompt - build run Window
8. **Switch back** to Visual Studio and notice the changes that you made.

```
InstallProtocolInterface - 546C1d0Z-BFBD-4662-9ECE-C02BDB1C64785D 0
:: START Call back- Changing ,Question ID=0x00001001 Type=0x0007 Action=0x0000
```

Notice: when changing the “Name of Configuration” field

```
:: START Call back- Changing ,Question ID=0x00001001 Type=0x0007 Action=0x0000
:: START Call back- Changed ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back- Changing ,Question ID=0x00001111 Type=0x0000 Action=0x0000
```

Notice: when changing the “Enter ZY Base(Hex)” field

```
:: START Call back- Changing ,Question ID=0x00001001 Type=0x0007 Action=0x0000
:: START Call back- Changed ,Question ID=0x00001001 Type=0x0007 Action=0x0001
:: START Call back- Changing ,Question ID=0x00001111 Type=0x0000 Action=0x0000
:: START Call back- Changed ,Question ID=0x00001111 Type=0x0000 Action=0x0001
:: ROUTE CONFIG Saving the configuration to NVRAM
```

Notice: when Pressing “F10”

9. **Press** “Escape” and another “Escape” to exit the “Device Manager”
10. **Select** “Continue” and then **Press** “Enter”
11. **Type** “reset” at the Shell prompt and then **Press** “Enter” to return to the Visual Studio Command Prompt

```
FS0:\> reset_
```

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.9

NOTE: Del Directory C:\fw\edk2\Build\NT32\IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

End of Lab 9

Lab 10. Adding an Additional Form Page

In this lab, you'll learn how to add another form page to your My Wizard Driver menu by using the " goto " VFR term along with the " form " and " formid " VFR statements. Additionally, use " suppressif " or " grayoutif " to conditionally allow the user to enter your additional forms.

In addition, this lab will show how the "time" and "date" VFR terms are used within the VFR language to special case how the browser engine checks the time instead of your driver manually checking (e.g. leap year).

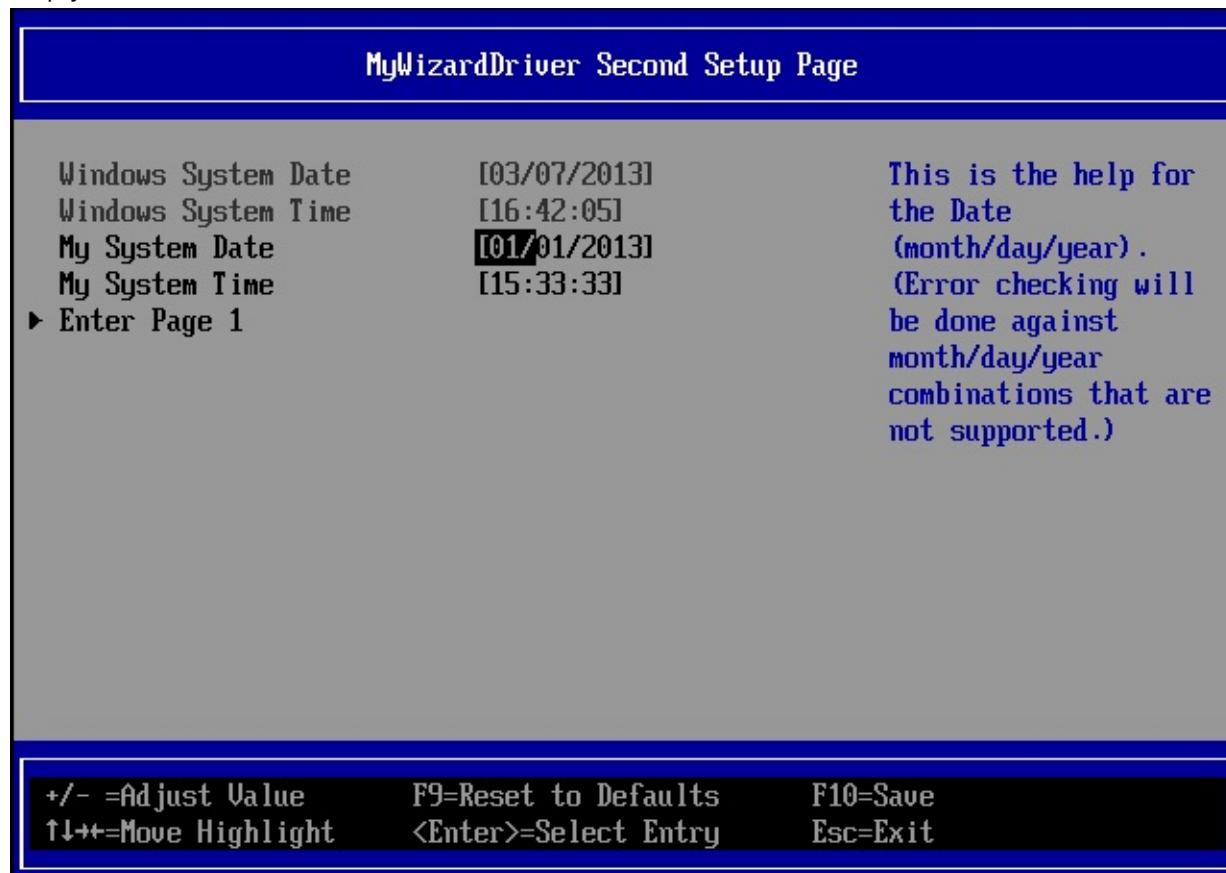


Figure 10: Second setup page

- Update** the MyWizardDriverNVDataStruc.h file
- Add** the following date and time fields to the configuration `typedef` (to to the location shown below):

```
EFI_HII_TIME Time;
EFI_HII_DATE Date;
```

```
21 #pragma pack(1)
22 typedef struct {
23
24     UINT16  MyWizardDriverStringData[20];
25     UINT8   MyWizardDriverHexData;
26     UINT8   MyWizardDriverBaseAddress;
27     UINT8   MyWizardDriverChooseToEnable;
28     EFI_HII_TIME Time;
29     EFI_HII_DATE Date;
30 } MYWIZARDDRIVER_CONFIGURATION;
31
```

- Save** MyWizardDriverNVDataStruc.h
- Update** the MyWizardDriver.uni file

5. Add the following code to the end of the file to update the second page's string:

```
#string STR_FORM2_TITLE          #language en "MyWizardDriver Second Setup Page"
#string STR_DATE_PROMPT         #language en "System Date"
#string STR_DATE_HELP           #language en "This is the help for the Date (month/day/year). (Error checking will be done against month/day/year combinations that are not supported.)"
#string STR_TIME_PROMPT         #language en "System Time"
#string STR_TIME_HELP           #language en "This is the help for the Time (hour/minute/second)."
#string STR_ERROR_POPUP         #language en "You typed in the wrong value!"

#string STR_GOTO_FORM1          #language en "Enter Page 1"
#string STR_GOTO_FORM2          #language en "Enter Page 2"
#string STR_GOTO_HELP           #language en "This is my goto help"

#string STR_MY_DATE_PROMPT      #language en "My System Date"
#string STR_MY_TIME_PROMPT      #language en "My System Time"
```

6). Save MyWizardDriver.uni

7). Update the MyWizardDriver.vfr file

8. Add the “ goto ” VFR item to allow browser to enter another form by adding the following code before the “ endform ” at approx. line 114

```
grayoutif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
    goto 2,
    prompt = STRING_TOKEN(STR_GOTO_FORM2), //SecondSetupPage
    help   = STRING_TOKEN(STR_GOTO_HELP);
endif;

108     resetbutton
109     defaultstore = MyStandardDefault,
110     prompt      = STRING_TOKEN(STR_STANDARD_DEFAULT_PROMPT_RESET),
111     help        = STRING_TOKEN(STR_STANDARD_DEFAULT_HELP),
112     endresetbutton;
113

114     grayoutif ideqval MWD_IfrNVData.MyWizardDriverChooseToEnable == 0x0;
115     goto 2,
116     prompt = STRING_TOKEN(STR_GOTO_FORM2), //SecondSetupPage
117     help   = STRING_TOKEN(STR_GOTO_HELP);
118 endif;

119 endform;
121
```

9). Add the following code between “ endform ” at approx. line 120 and “ endformset ” (the code continues for few pages in this lab guide):

```
// Begin code

form formid = 2,                  // SecondSetupPage,
      title = STRING_TOKEN(STR_FORM2_TITLE);

grayoutif TRUE; // DATE is the date of the Windows Host so can not change it.;
date    year varid = Date.Year, // Note that it is a member of NULL,
       //so the RTC will be the system resource to retrieve and save from
      prompt   = STRING_TOKEN(STR_DATE_PROMPT),
      help     = STRING_TOKEN(STR_DATE_HELP),
      minimum  = 1998,
      maximum  = 2099,
      step     = 1,
      default   = 2010,

      month varid = Date.Month, // Note that it is a member of NULL,
             //so the RTC will be the system resource to retrieve and save from
      prompt   = STRING_TOKEN(STR_DATE_PROMPT),
      help     = STRING_TOKEN(STR_DATE_HELP),
```

```

minimum      = 1,
maximum      = 12,
step         = 1,
default       = 1,

day varid   = Date.Day, // Note that it is a member of NULL,
//so the RTC will be the system resource to retrieve and save from
prompt       = STRING_TOKEN(STR_DATE_PROMPT),
help         = STRING_TOKEN(STR_DATE_HELP),
minimum      = 1,
maximum      = 31,
step         = 0x1,
default       = 1,
enddate;
endif; //grayoutif TRUE DATE

grayoutif TRUE; // TIME - WINDOWS TIME
time    hour varid = Time.Hour, // Note that it is a member of NULL,
//so the RTC will be the system resource to retrieve and save from
prompt       = STRING_TOKEN(STR_TIME_PROMPT),
help         = STRING_TOKEN(STR_TIME_HELP),
minimum      = 0,
maximum      = 23,
step         = 1,
default       = 0,

minute varid = Time.Minute, // Note that it is a member of NULL,
//so the RTC will be the system resource to retrieve and save from
prompt       = STRING_TOKEN(STR_TIME_PROMPT),
help         = STRING_TOKEN(STR_TIME_HELP),
minimum      = 0,
maximum      = 59,
step         = 1,
default       = 0,

second varid = Time.Second, // Note that it is a member of NULL,
//so the RTC will be the system resource to retrieve and save from
prompt       = STRING_TOKEN(STR_TIME_PROMPT),
help         = STRING_TOKEN(STR_TIME_HELP),
minimum      = 0,
maximum      = 59,
step         = 1,
default       = 0,

endtime;
endif; //grayoutif TRUE TIME

date // My Wizard Driver Date
varid = MWD_IfrNVData.Date ,
prompt = STRING_TOKEN(STR_MY_DATE_PROMPT),
help = STRING_TOKEN(STR_DATE_HELP),
flags = STORAGE_NORMAL,
default = 2013/01/01,
enddate;

time // My Wizard Driver Time
name     = MyTimeMWD,
varid   = MWD_IfrNVData.Time,
prompt   = STRING_TOKEN(STR_MY_TIME_PROMPT),
help     = STRING_TOKEN(STR_TIME_HELP),
flags   = STORAGE_NORMAL ,
default = 15:33:33,
endtime;

goto 1,
prompt = STRING_TOKEN(STR_GOTO_FORM1), //MainSetupPage
// this too has no end-op and basically it's a jump to a form ONLY
help   = STRING_TOKEN(STR_GOTO_HELP);

endform;
// End code

```

10). **Save** MyWizardDriver.vfr

Build and test MyWizardDriver

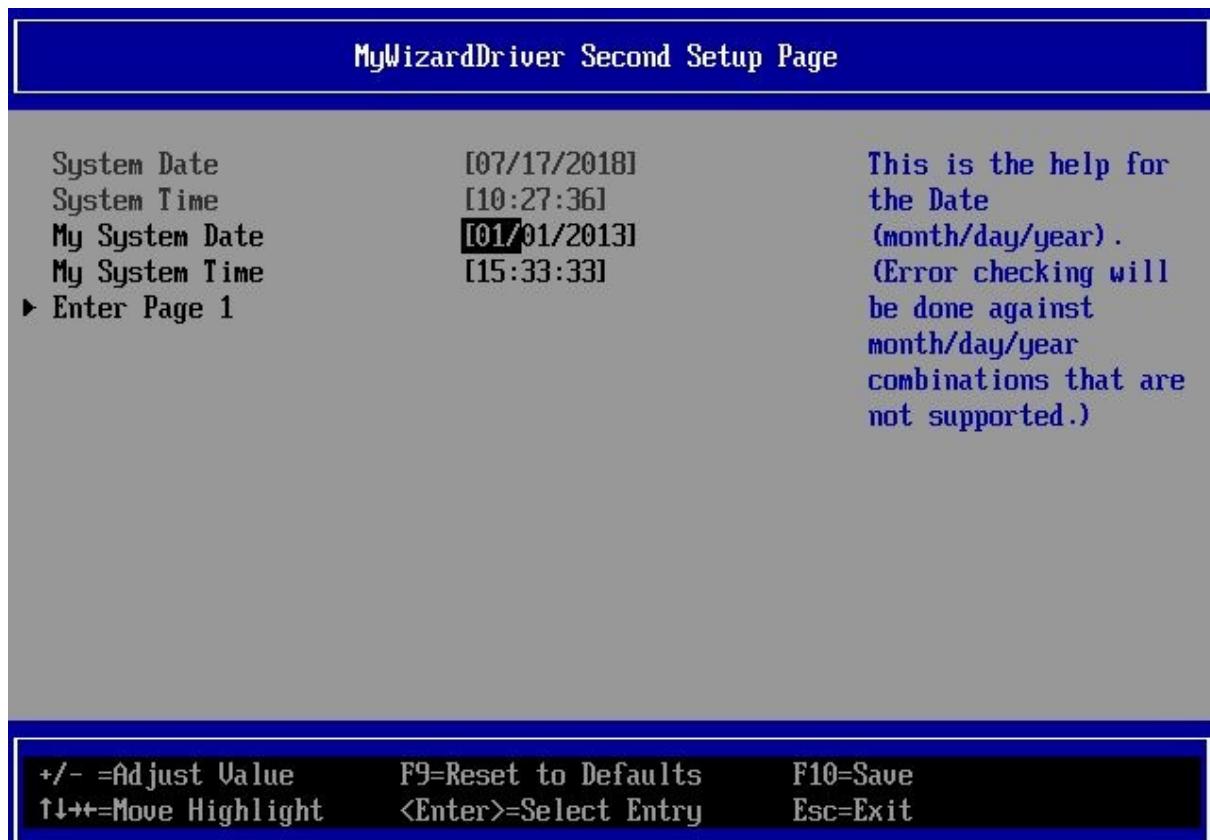
1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. At the UEFI Shell prompt, type **exit**
5. Now at the setup front page menu, **select** "Device Manager"
6. Inside the Device Manager menu **press** the down arrow to "My Wizard Driver Sample Formset"
Press "Enter"



Notice the "Enter Page 2" option. Without `goto` in the `MyWizardDriver.vfr` file, you wouldn't be able to access page two.

7. **Select** "Enter Page 2" and then **Press** "Enter"

Notice how the System Date and Time cannot be modified to any other date/time and is grayed out:



8. **Test** by trying to enter the date 02/30/2013, then try a valid leap year date: 02/29/2012.
 9. **Press** "Down Arrow" to return to Page 1
 10. **Test** the "grayoutif" by going to "Enable My XYZ Device"
 11. **Press** the "Spacebar" to toggle off/disable
- Notice** the "Select Base Address" , "Name of Configuration" and the "Enter Page 2" fields are now grayed out and not selectable



12. **Press** "Space bar" again to Enable
13. **Press** "F10" then "Escape" to save and exit
14. **Press** "Escape" to exit "Device Manager"
15. **Select** "Continue" and then **Press** "Enter"
16. **Type** "reset"

```
FS0:\> reset_
```

at the Shell prompt and then **Press** "Enter" to return to the Visual Studio Command Prompt

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.10

NOTE: Del Directory C:\fw\edk2\Build\NT32\IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

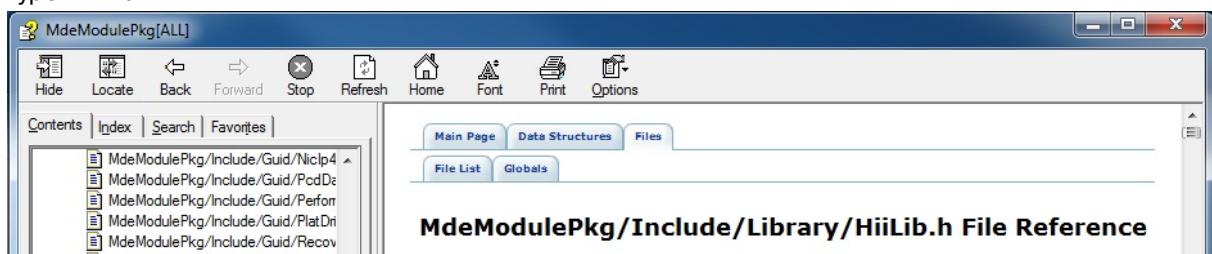
End of Lab 10

Lab 11. Adding Communication from Driver to Console through HII

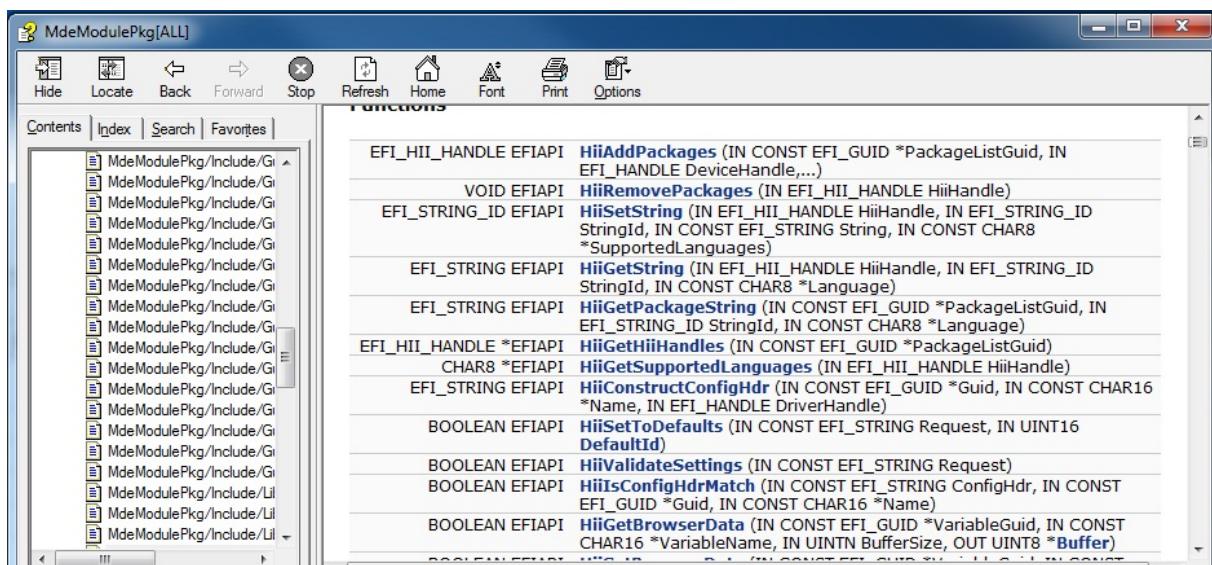
In this lab, you'll add communication from the driver to the console through HII. More specifically, you'll add code to retrieve a string from the HII database and print the string to the console. Then, you'll add the string in French, change the language, and test to ensure the correct language is displayed. The reason the driver should avoid direct string text to the console without the HII support is because there is no localization for text string inside the driver's source code. By using the HII database the strings are tokenized making localization easier.

Examine the MdeModulePkg.Chm for HII

1. Use the .Chm reader and open the MdeModulePkg.Chm. For HII database library functions are in the MdeModulePkg .Chm file. Search on HiiLib.h functions
2. Select the Index tab
3. Type: HiiLib.h



Note: Notice the list of Hii function calls available. To get Strings the `HiiGetString` function can be used.



Add changes to your Driver

1. **Update** the C:\Fw\edk2\Nt32pkg\Nt32pkg.fdf file
2. Make your driver stand alone again. **Remove** (or comment out) the include statement in the Nt32pkg.fdf file:

```
#INF MyWizardDriver/MyWizardDriver.inf
```

```
INF  MdeModulePkg/Universal/Network/IScsiID:  
#INF  MyWizardDriver/MyWizardDriver.inf  
!if ${BUILD_NEW_SHELL} == TRUE  
INF  ShellPkg/Application/Shell/Shell.inf  
!endif
```

3. **Save** Nt32pkg.fdf4. **Update** the MyWizardDriver.uni file

5. Add the following code to the top of the file at approx. line 14 as shown:

```
#langdef fr-FR "Francais"  
12  
13 #langdef en "English"  
14 #langdef fr-FR "Francais"  
15  
16 #string STR_SAMPLE_FORM_SET_TITLE      #language en "My Wizard 1"  
17 #string STR_SAMPLE_FORM_SET_HELP       #language en "Help for S:  
18 #string STR_SAMPLE_FORM1_TITLE        #language en "My Wizard 1"  
19
```

6. **Add** the following code to the end of the file:

```
#string STR_LANGUAGE_TEST_STRING      #language en "Laurie's Test String"  
                                    #language fr-FR "Chaine de test de Laurie"  
  
75  
76 #string STR_MY_TIME_PROMPT        #language en "My System Time"  
77  
78 #string STR_LANGUAGE_TEST_STRING  #language en "Laurie's Test String"  
79                                    #language fr-FR "Chaine de test de Laurie"  
80
```

7). **Save** MyWizardDriver.uni8). **Update** the MyWizardDriver.c file9). **Add** the following local variable for `StringPtr` after “`BOOLEAN ActionFlag;`” and before “`Status = EFI_SUCCESS;`”(as shown below):

```
EFI_STRING StringPtr;  
189  UINTN          BufferSize;  
190  MYWIZARDDRIVER_CONFIGURATION *Configuration;  
191  BOOLEAN         ActionFlag;  
192  EFI_STRING     StringPtr;  
193  Status = EFI_SUCCESS;  
194
```

10). Add the following code after “`FreePool (ConfigRequestHdr);`” (as shown below) to edit the driver’s entry point with a debug and print statement by making a call to the `HiiGetString` for the token to print (at approx line 364):

```
StringPtr      = HiiGetString (HiiHandle[0], STRING_TOKEN (STR_LANGUAGE_TEST_STRING), NULL);  
DEBUG ((EFI_D_INFO, "[MyWizardDriver-Entrypoint] My String was: %s\n", StringPtr));  
Print(L"%s\n", StringPtr);  
  
362  FreePool (ConfigRequestHdr);  
363  
364  StringPtr      = HiiGetString (HiiHandle[0], STRING_TOKEN (STR_LANGUAGE_TEST_ST  
365  DEBUG ((EFI_D_INFO, "[MyWizardDriver-Entrypoint] My String was: %s\n", StringPtr)  
366  Print(L"%s\n", StringPtr);  
367  
368  // end HII  
369  //  
370  // Install Driver Supported EFI Version Protocol onto ImageHandle  
...  
...
```

11). **Save** the MyWizardDriver.c

Build and test Driver

1. **Open** the Visual Studio Command Prompt
2. **Type** build
3. **Type** build run
4. **At the UEFI Shell prompt, type** fs0:
5. **Type** Load MyWizardDriver.efi and then **Press** "Enter"

```
Shell> fs0:
FS0:\> load MyWizardDriver.efi
Laurie's Test String
Image 'FS0:\MyWizardDriver.efi' loaded at 604A000 - Success
FS0:\>
```

Notice that the string's English version is displayed:

6. **Type** Reset and then **Press** "Enter"
7. **Type** "build run" and then **Press** "Enter"
8. **Type** "exit" at the shell prompt
9. **Select Language** and then **Press** "Enter"

NT32 Emulation Environment	1.23 GHz
NT32 Emulated Processor	128 MB RAM
R9 Prime	

Continue	<Standard English>
Select Language	
► Boot Manager	
► Device Manager	
► Boot Maintenance Manager	

This is the option
one adjusts to change
the language for the
current system

10. **Select** "Français" and then **Press** "Enter"

Français
English
Standard Français
Standard English

11. **Select** "Continuer" and then **Press** "Enter"

Continuer	<Français>	Cette sélection dirigera le système pour continuer au charger de procédé
Choisir la Langue		
► Charger le Directeur		
► Directeur d'appareil		
► Directeur d'Entretien		

12. At the Shell Prompt, **type** Fs0:
13. **Type** load MyWizardDriver.efi

```
Press ESC in 4 seconds to skip startup.nsh or any other key to continue
Shell> fs0:
FS0:\> load MyWizardDriver.efi
Chaîne de test de Laurie
Image 'FS0:\MyWizardDriver.efi' loaded at 604A000 - Success
FS0:\> _
```

14. **Type** "reset" and then **Press** "Enter" to return to the Visual Studio Command Prompt

```
FS0:\> reset_
```

For any build issues copy the solution files from C:\Fw\LabSolutions\LessonE.11

NOTE: Del Directory C:\fw\edk2\Build\NT32IA32\DEBUG_VS2010x86\IA32\MyWizardDriver before the Build command to build the MyWizardDriver Clean.

Make sure you update Nt32Pkg.fdf.

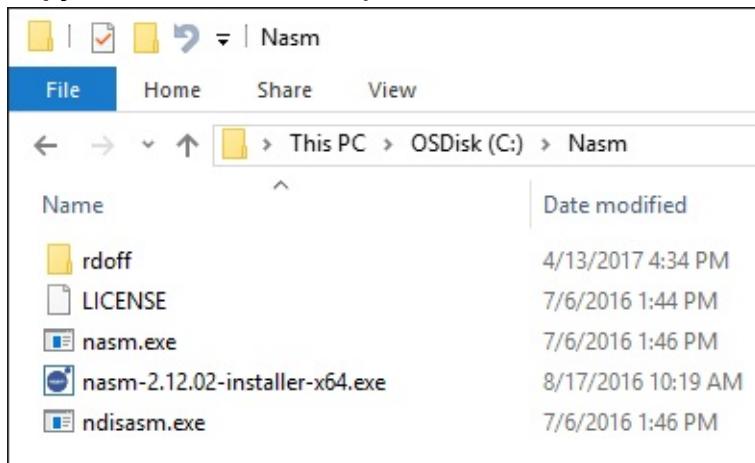
End Lab 11

LAB SETUP WINDOWS

1. Download the [UEFI Training Materials .zip](#) (accept any security notifications)
2. **Click "Open"** and Unzip the file to C: which will take a few minutes
Note: It is highly important that you unzip the file correctly to this location because all the file locations in this training guide follow that format.

```
C:\Fw\Presentations - separate zip file
C:\Fw \Edk2 - Open source tianocore.org EDK II
C:\Fw \DriverWizard - Install .MSI
C:\Fw \LabSampleCode - Solutions for Labs
C:\Fw \Documentation - .chm files and examples
C:\Fw\Nasm - For Assembly compiler
```

3. **Copy** the C:\fw\NASM directory to C:



Pin Visual Studio Command Prompt for Windows

- Pin a Visual Studio Command Prompt for [Windows 10](#)
It will look similar to this “**Visual Studio Command Prompt (201n)**” in the Task bar



Note: this is the prompt that will be used to build the EDK II Labs

Preparing for the BUILD Command

Note: You'll need to repeat this step each time you exit the Visual Studio Command Prompt window. It is recommended that you keep your command prompt open during the training Labs.

1. **Open** Visual Studio Command Prompt
2. **Type** \$ cd c:\fw\edk2 and then **Press "Enter"**

```
Developer Command Prompt for VS2013

C:\Program Files (x86)\Microsoft Visual Studio 12.0>cd \
C:\>cd c:\fw
c:\fw>cd edk2
```

3. **Type** \$ Edksetup and then Press “Enter”

```
c:\ Developer Command Prompt for VS2013

c:\fw\edk2>edksetup
    PATH      = c:\fw\edk2\BaseTools\Bin\Win32;C:\Program Files (x86)\Micro
    udio 12.0\Common7\IDE\CommonExtensions\Microsoft\TestWindow;C:\Program Files (x8
    Ks\F#\3.1\Framework\v4.0\;C:\Program Files (x86)\MSBuild\12.0\bin;C:\Program Fil
    oft Visual Studio 12.0\Common7\IDE\;C:\Program Files (x86)\Microsoft Visual Stud
    C:\Program Files (x86)\Microsoft Visual Studio 12.0\Common7\Tools;C:\windows\Mid
    ework\v4.0.30319;C:\Program Files (x86)\Microsoft Visual Studio 12.0\VC\VCPackag
    files\<vsc>\HTML Help Workshop\;C:\Program Files (x86)\Microsoft Visual Studio 12
    Note: If you see “!!! WARNING !!!...”, don't be alarmed. The "No CYGWIN..." can be ignored at this
    time, BUT make sure "NASM" is found and the _NASM_PREFIX is set to C:\nasm\
a\Local\Microsoft\WindowsApps;C:\Users\ljarlstr\AppData\Roaming\npm;C:\Users\ljarl
ocal\Pandoc\

    WORKSPACE      = c:\fw\edk2
EDK_TOOLS_PATH      = c:\fw\edk2\BaseTools
BASE_TOOLS_PATH      = c:\fw\edk2\BaseTools
EDK_TOOLS_BIN      = c:\fw\edk2\BaseTools\Bin\Win32
    CONF_PATH      = c:\fw\edk2\Conf

!!! WARNING !!! NASM_PREFIX environment variable is not set
    Found nasm.exe, setting the environment variable to C:\nasm\

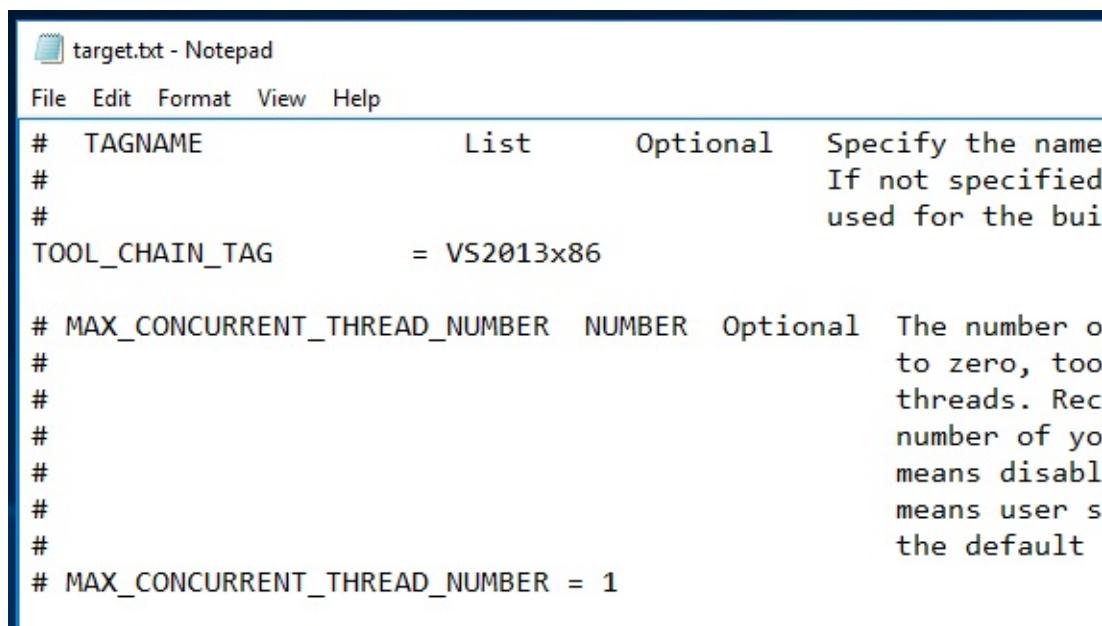
!!! WARNING !!! No CYGWIN_HOME set, gcc build may not be used !!!

c:\fw\edk2>
```

Configuring Build Tools

Note: You only need to edit Target.txt and/or Tools_Def.txt once after the first **edksetup** command after downloading the Training materials .zip file.

1. **Open** Notepad or other text editor that supports UNICODE
2. **Open** C:/fw/edk2/Conf/Target.txt
3. Use the [Microsoft Windows and Visual Studio Matrix](#) and then update `TOOL_CHAIN_TAG` to match your version of Visual Studio
4. **Modify TOOL_CHAIN_TAG** to match your version of Visual Studio.



```

target.txt - Notepad
File Edit Format View Help

# TAGNAME           List      Optional   Specify the name
#                               If not specified
#                               used for the bui
TOOL_CHAIN_TAG          = VS2013x86

# MAX_CONCURRENT_THREAD_NUMBER  NUMBER  Optional   The number o
#                               to zero, too
#                               threads. Rec
#                               number of yo
#                               means disabl
#                               means user s
#                               the default
# MAX_CONCURRENT_THREAD_NUMBER = 1

```

Example:

for Windows 10 64 bit OS and Visual Studio 2013 modify the following in Target.txt

From:

TOOL_CHAIN_TAG = MYTOOLS

to:

TOOL_CHAIN_TAG = VS2013x86

OPTIONAL: Update the `MAX_CONCURRENT_THREAD_NUMBER` By the number of processors on your laptop + 1.

Example: most have Intel® Dual Core with Hyper threading which means $2 \text{ procs} + 2 \text{ HT} + 1 = 5$.

```

# MAX_CONCURRENT_THREAD_NUMBER  NUMBER  Optional   The number
#                               to zero, t
#                               threads. R
#                               number of
#                               means disa
#                               means user
#                               the defaul
# MAX_CONCURRENT_THREAD_NUMBER = 1

```

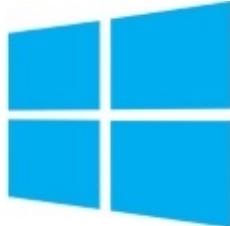
5. **Save** and **close** the text file C:/fw/edk2/conf/target.txt

End of Lab Setup for Windows

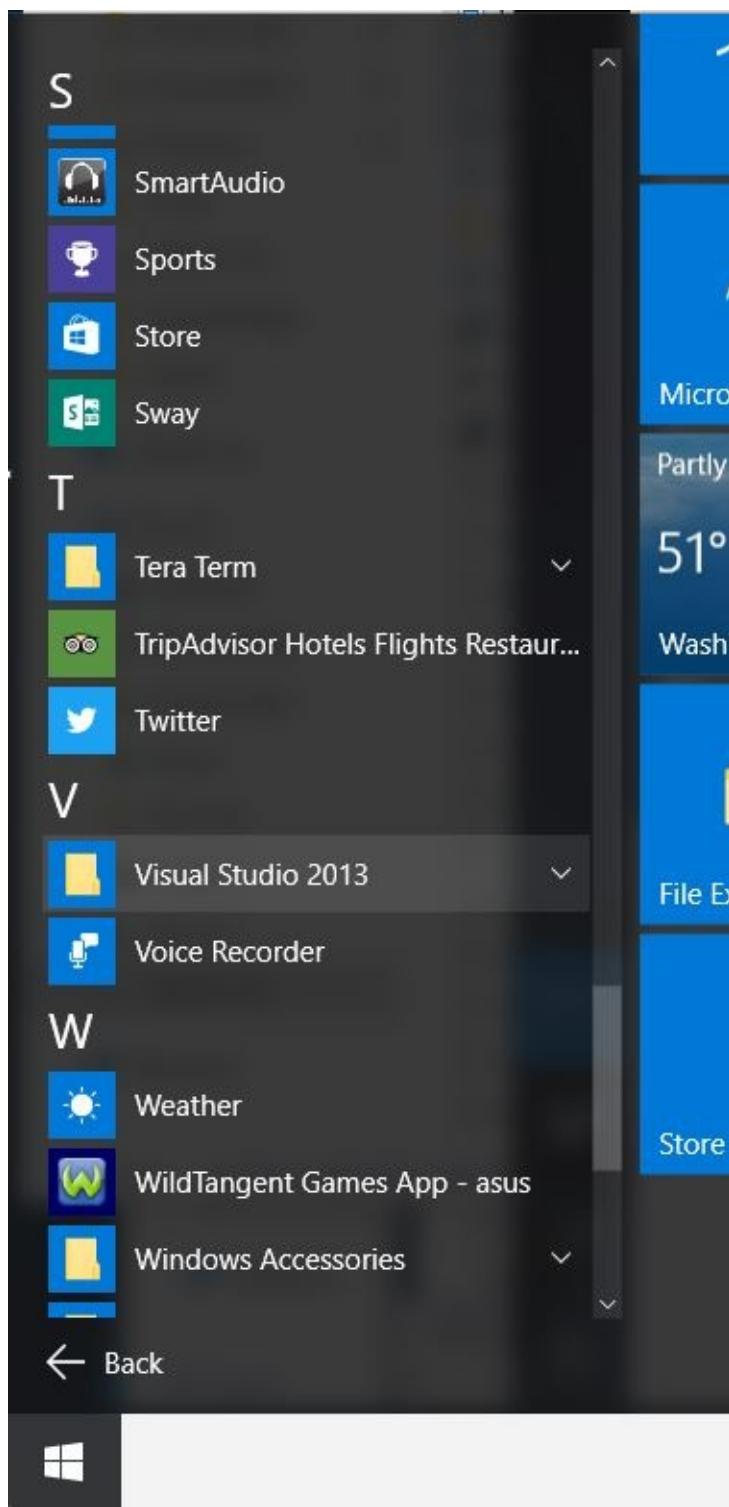
MICROSOFT WINDOWS 10 - VISUAL STUDIO COMMAND PROMPT

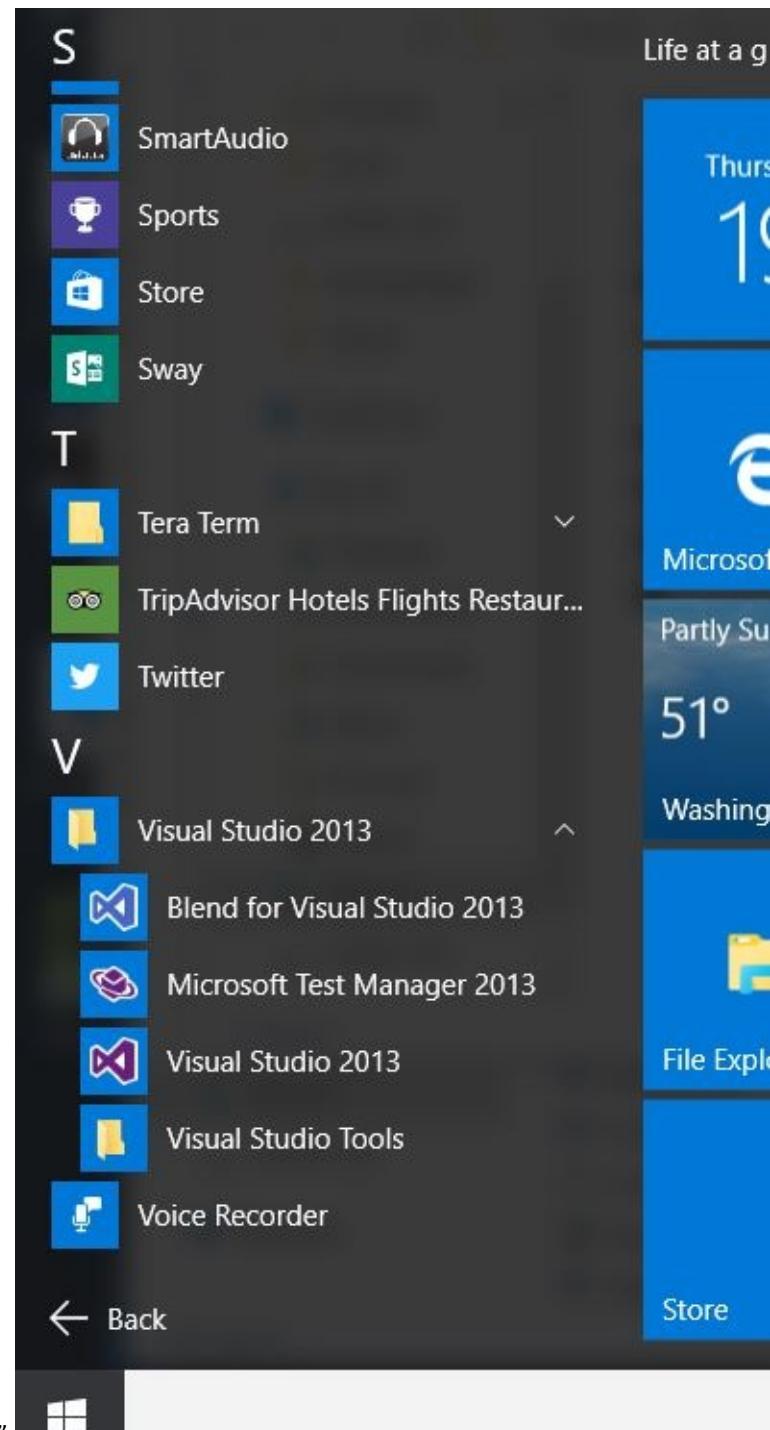
The following steps can be used to Pin the Microsoft Windows 10 – Visual Studio command prompt (201n) to the Task bar at the bottom(default)

1. **Open** Microsoft Visual Studio 2013 command prompt
(NOTE: VS 2013 is used in the following examples but VS 2010, VS 2015 and VS 2017 will be similar)
2. Using the Start menu in Windows 10, **Left-click** on the “Windows Key” Lower Left

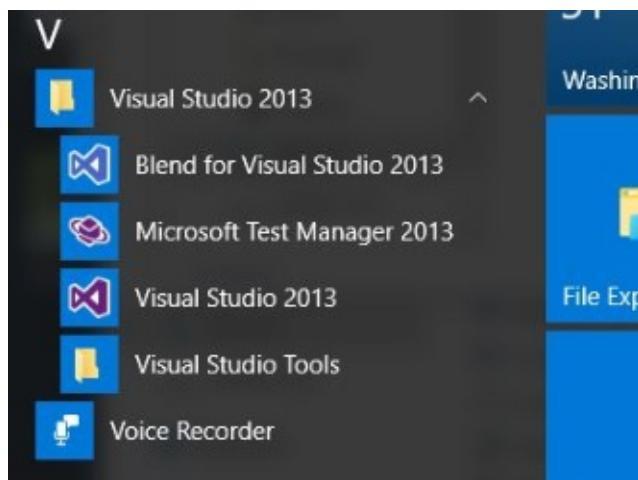


3. **Scroll down** from the scroll bar on the right until “**Visual Studio 2013**” (or your version of VS 201n)

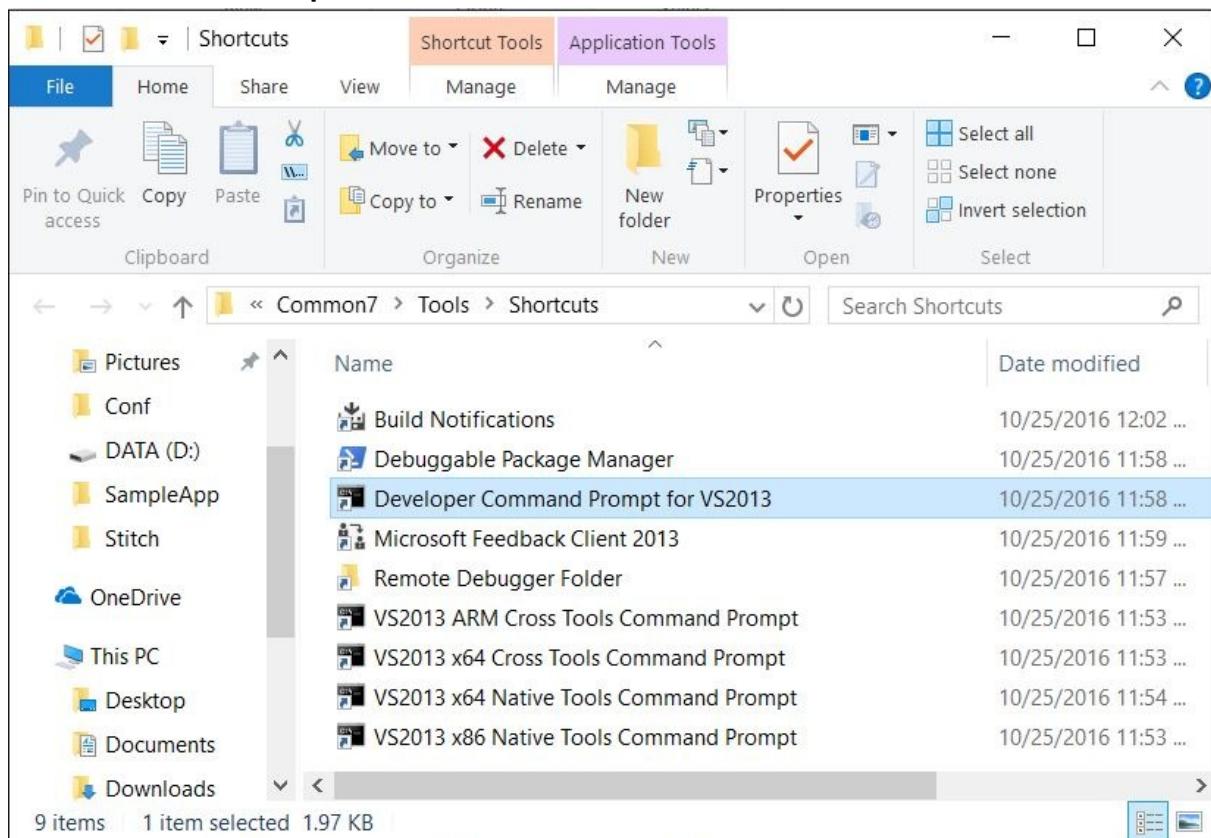




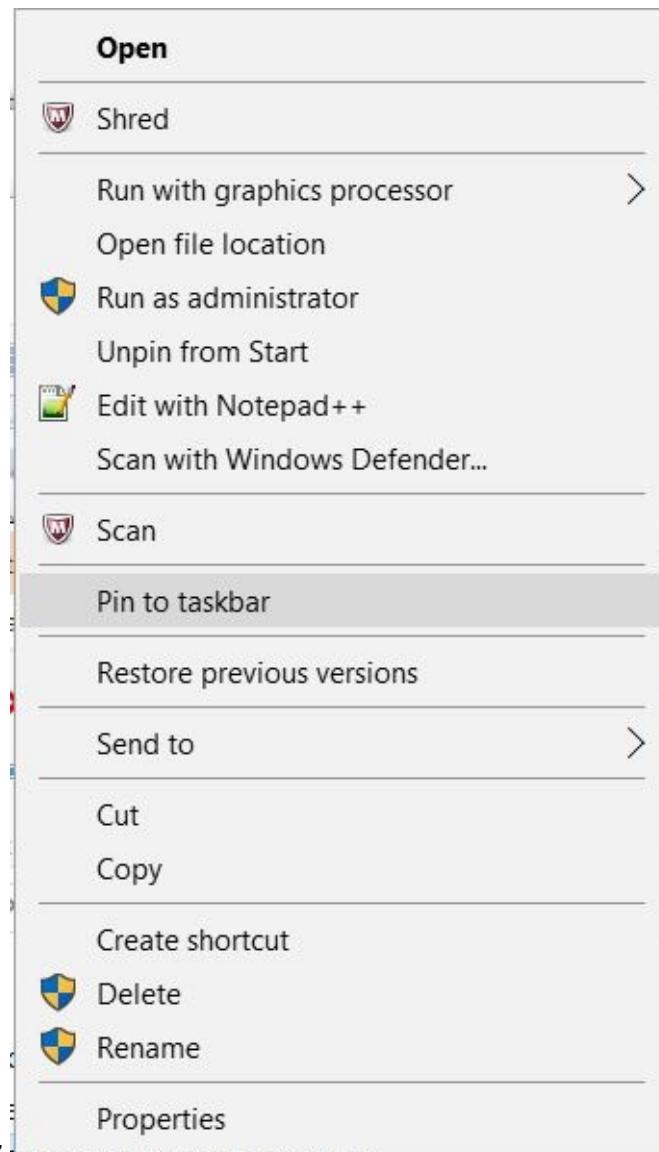
4. **Left Click** "Visual Studio 201n"
5. **Left Click** "Visual Studio Tools"



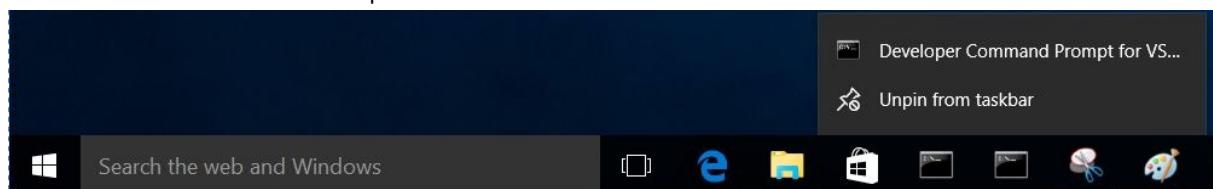
Another window will open



6. **Right Click** on “Developer Command Prompt for VS201n” NOTE: Make sure you are selecting the correct Command prompt for Visual Studio. For VS2013 it is: “Developer Command Prompt for VS2013”

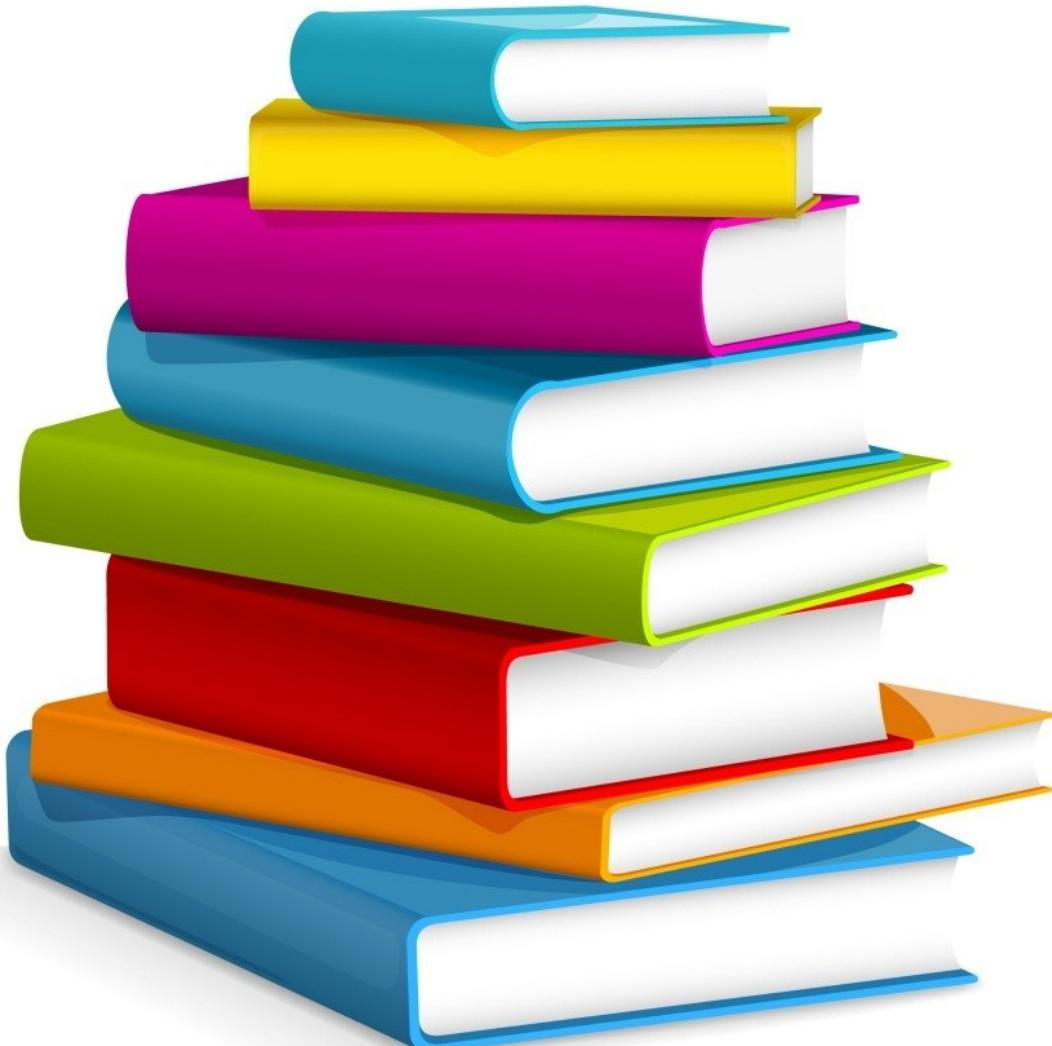


7. **Left Click** on "Pin to taskbar"
8. "Visual Studio Command Prompt" will now be in the task bar.



end of Pin Visual Studio Command Prompt to the Task bar

REFERENCE



MICROSOFT WINDOWS AND VISUAL STUDIO MATRIX

Files C:/fw/edk2/conf/target.txt and tools_def.txt ([Return to Configuring Build Tools](#))

Visual Studio	Version	Win7,Win8 & Win10 x64 OS
VS2005	8.0	target.txt TOOL_CHAIN_TAG = VS2005x86 Requires WinDDK Link16**
VS2008	9.0	target.txt TOOL_CHAIN_TAG = VS2008x86
VS2010	10.0	target.txt TOOL_CHAIN_TAG = VS2010x86
VS2012	11.0	target.txt TOOL_CHAIN_TAG = VS2012x86
VS2013	12.0	target.txt TOOL_CHAIN_TAG = VS2013x86
VS2015	14.0	target.txt TOOL_CHAIN_TAG = VS2015x86
VS2017	15.0	target.txt TOOL_CHAIN_TAG = VS2017x86

Glossary of UEFI Terms and Acronyms

<https://github.com/tianocore/tianocore.github.io/wiki/Acronyms-and-Glossary>

Helpful Links

UEFI Forum	http://www.uefi.org
UEFI Open Source	http://www.tianocore.org
EFI Developer Kit (EDK II)	http://tianocore.github.io/edk2.html
EDK II Documents	http://www.tianocore.org/docs/
UEFI Shell Documents	https://github.com/tianocore/tianocore.github.io/wiki/ShellPkg