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UEFI & EDK II TRAINING

How to Write a UEFI Driver - Porting Lab – Linux & Simics

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See also LabGuide.md for Copy & Paste examples in labs

Lesson Objective

First Setup for Building EDK II, See Lab Setup then Platform Build Lab for Simics

- Compile a UEFI driver template created from UEFI Driver Wizard
- Test driver w/ Simics QSP Board using UEFI Shell 2.0
- Port code in the template driver

Note: Since this is a lab, to follow examples for copy & paste, use the following Markdown link LabGuide.md

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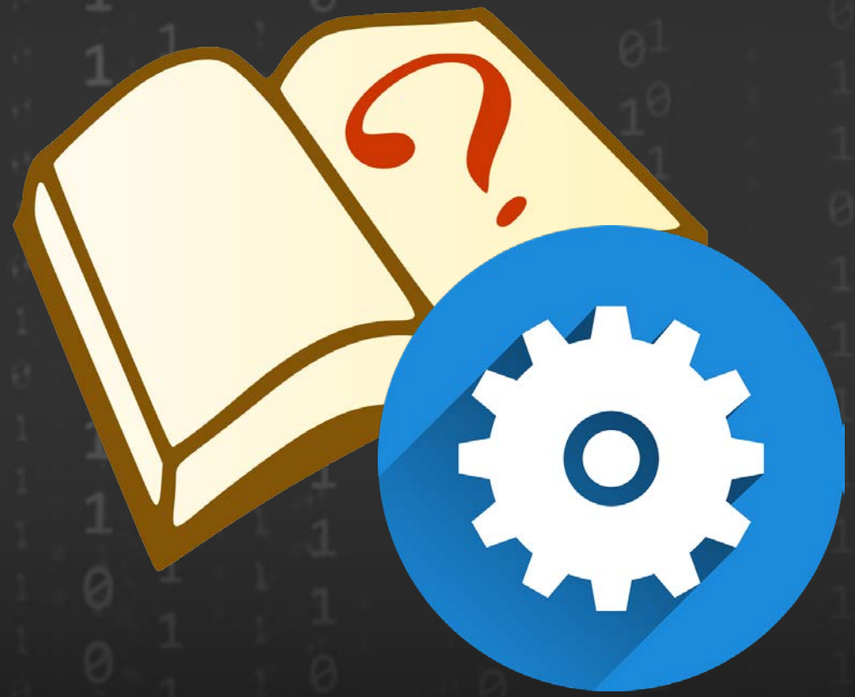
LAB 1: UEFI DRIVER TEMPLATE

Use this lab, if you're not able to create a UEFI Driver Template using the UEFI Driver Wizard.

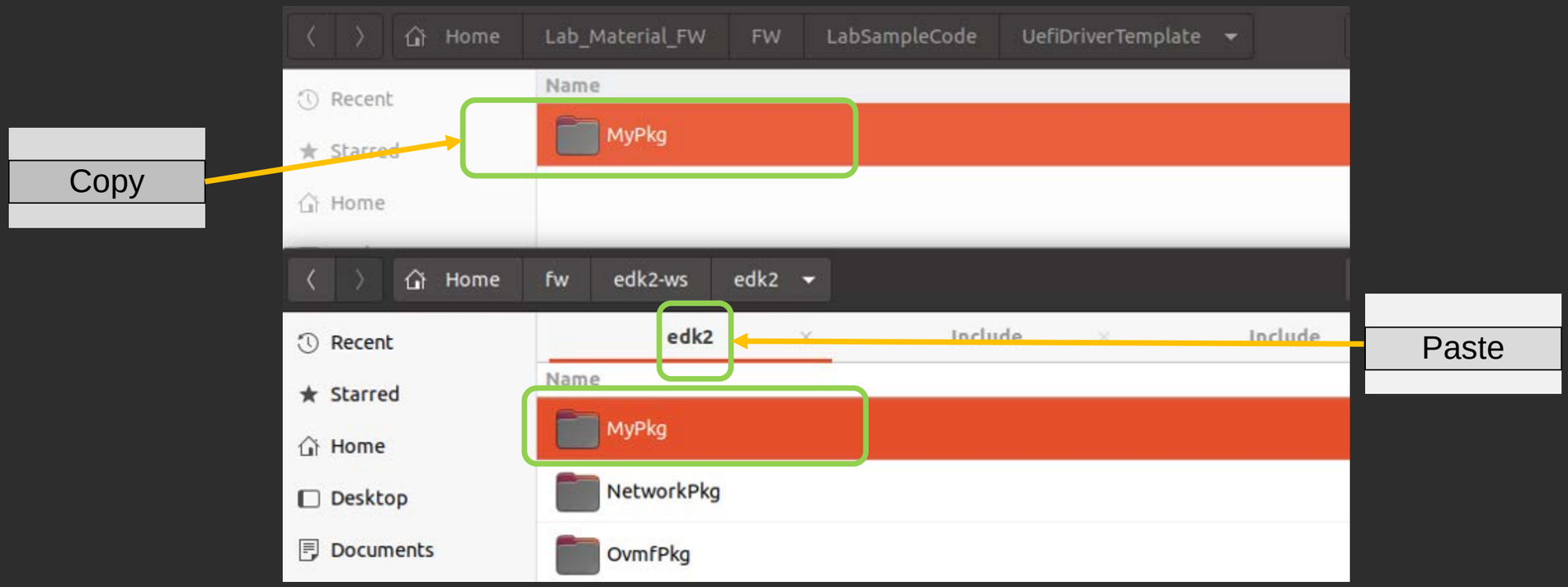
Note: Skip if LAB 1 UEFI Driver Wizard completed successfully



Lab 1: Get UEFI Driver Template

If UEFI Driver Wizard does not work:

1. Copy the directory `MyPkg` from
   `. . ./FW/LabSampleCode/UefiDriverTemplate to ~/fw/edk2-ws/edk2`

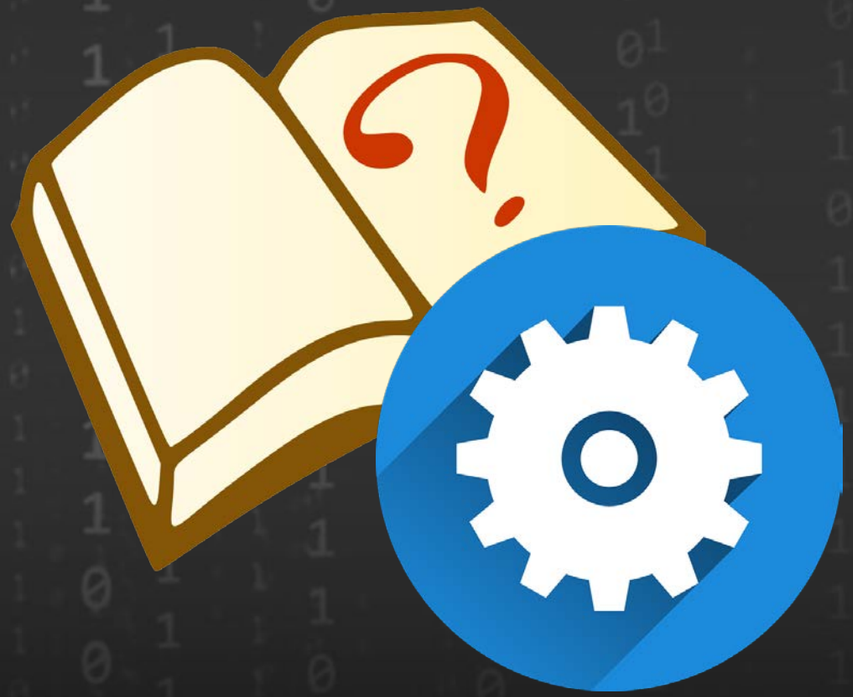


Overwrite If SampleApp Lab Completed

Review UEFI Driver Wizard Lab for protocols produced and which are being consumed

LAB 2: BUILDING A UEFI DRIVER

In this lab, you'll build a UEFI Driver created by the UEFI Driver Wizard. You will include the driver in the Emulator project. Build the UEFI Driver from the Driver Wizard



Compile a UEFI Driver

Two Ways to Compile a Driver	
Standalone	*In a Project*
The build command directly compiles the .INF file	Include the .INF file in the project's .DSC file
Results: The driver's .EFI file is located in the Build directory	Results: The driver's .EFI file is a part of the project in the Build directory

Lab 2: Build the UEFI Driver

Perform Lab Setup then Platform Build Lab for Simics from previous Labs

- **Open**
`edk2-platforms/Platform/Intel/SimicsOpenBoardPkg/BoardX58Ich10/OpenBoardPkg.dsc`

- **Add** the following to the [Components] section:
  Hint: add to the last module in the [Components] section

```
# Add new modules here
   MyPkg/MyWizardDriver/MyWizardDriver.inf
```

- **Save** and close the file `OpenBoardPkg.dsc`

Build Platform BoardX58Ich10

Open another Terminal Prompt in $HOME/fw/edk2-ws
Then CD to edk2 to do edksetup.sh

```
$ cd ~/fw/edk2-ws/edk2
$ . edksetup.sh
```

Then CD to:

```
$ cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel
```

Invoke the Python Build script for Simics OpenBoard QSP

```
$ python build_bios.py -p BoardX58Ich10  -t GCC5
```

Copy

~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/FV/BOARDX58ICH10.fd

To

<SimicsInstallDir>/simics-qsp-x86-6.0.57/targets/qsp-x86/images

Build ERRORS: Copy the solution files from /FW/LabSampleCode/LabSolutions/LessonC.1 to ~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver

Copy UefiAppLab.vhd file

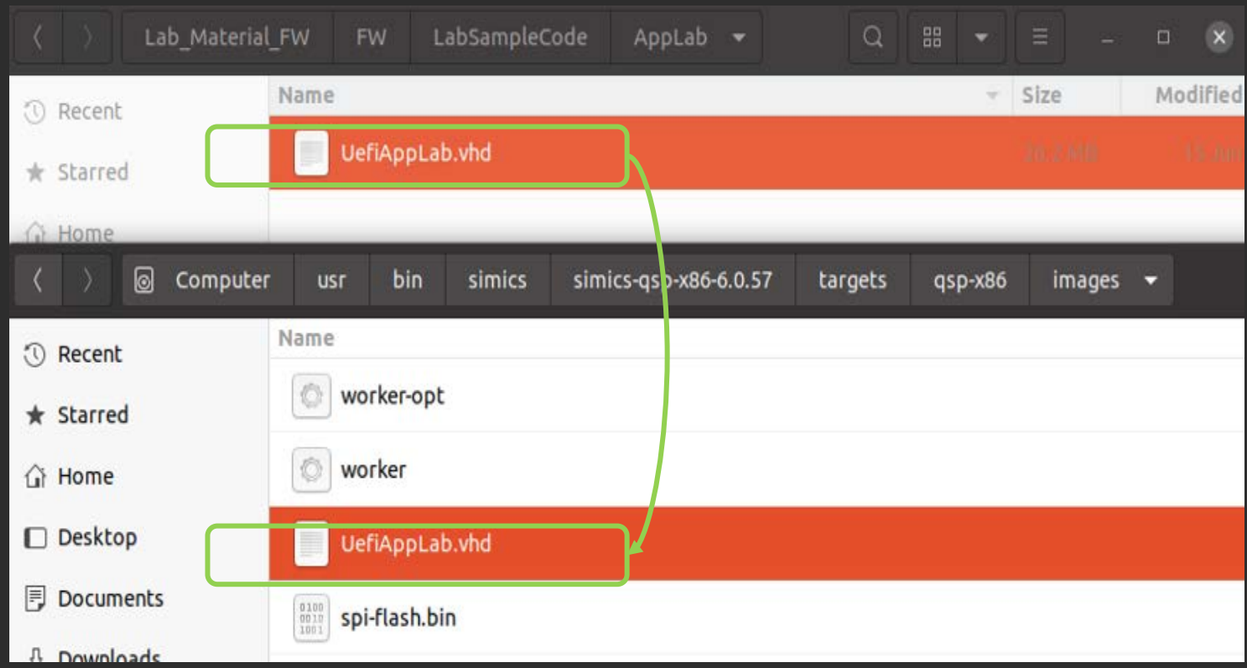
Copy the UefiAppLab.vhd

From:

.../Lab_Material_FW/FW/LabSampleCode/AppLab/UefiAppLab.vhd

To

<SimicsInstallDir>/simics-qsp-x86-6.0.57/targets/qsp-x86/images



Update the Simics Script

Update the Simics Script to Use the UefiAppLab.vhd image as a file system

Edit the file: qsp-modern-core.simics from

<SimicsInstallDir>/simics-qsp-cpu-6.0.4/targets/qsp-x86/qsp-modern-core.simics

Add the following Line:

`$disk1_image="%simics%/targets/qsp-x86/images/UefiAppLab.vhd"`

Before the “`run-command-file`” line

Save qsp-modern-core.simics

File: qsp-modern-core.simics

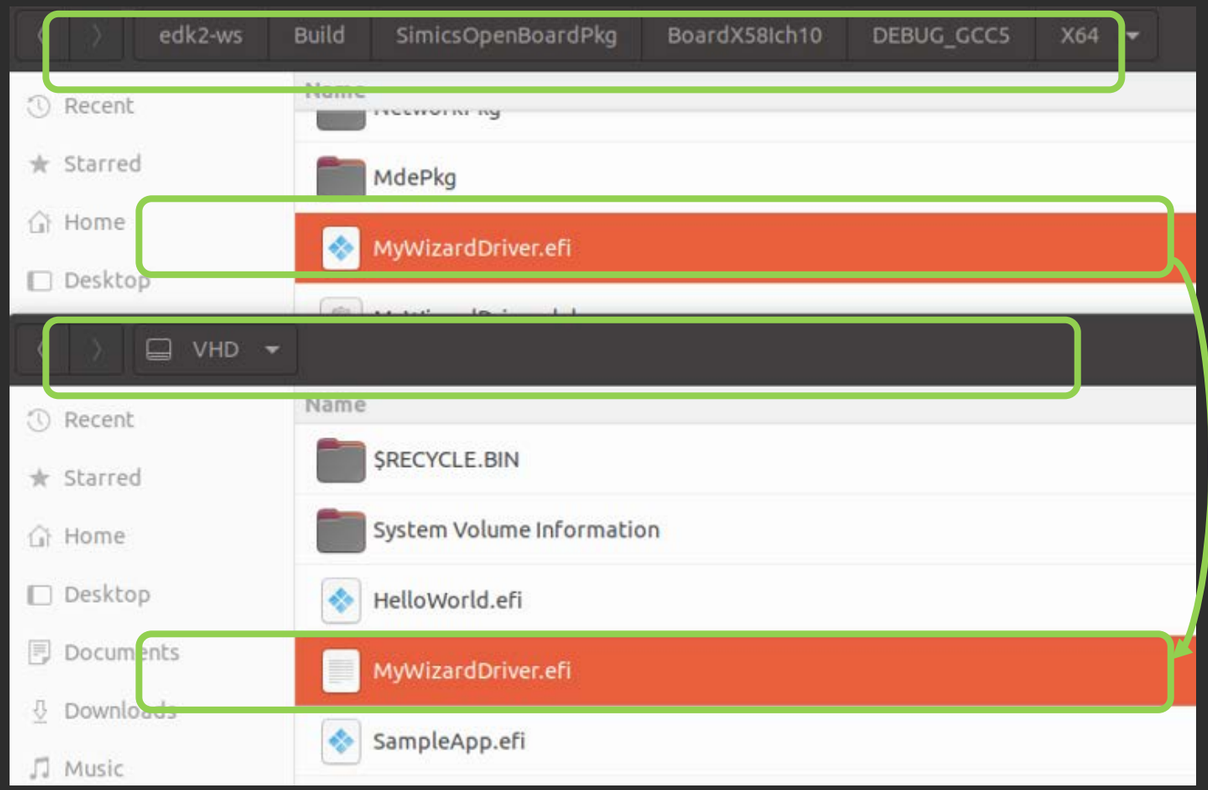
```
Decl{
decl {
! Script that runs the Quick Start Platform (QSP) with a modern
!   processor core.

params from "%simics%/targets/qsp-x86/qsp-clear-linux.simics"
default cpu_comp_class = "x86QSP2"
default num_cores = 2
default num_threads = 2
}
$disk1_image="%simics%/targets/qsp-x86/images/UefiAppLab.vhd“

run-command-file "%simics%/targets/qsp-x86/qsp-clear-linux.simics"
```

Update UefiAppLab.vhd File

Mount the UefiAppLab.vhd using GuestMount: How To Mount VHD Link

Copy MyWizardDriver.efi to the VHD Disk

```
$ cp ~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_VS2015x86/X64/MyWizardDriver.efi ~/VHD
```



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Lab 2: Load Driver

Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

Press “F2” at the logo, then Select “Boot Manger” followed by “EFI Internal Shell”

At the UEFI Shell prompt

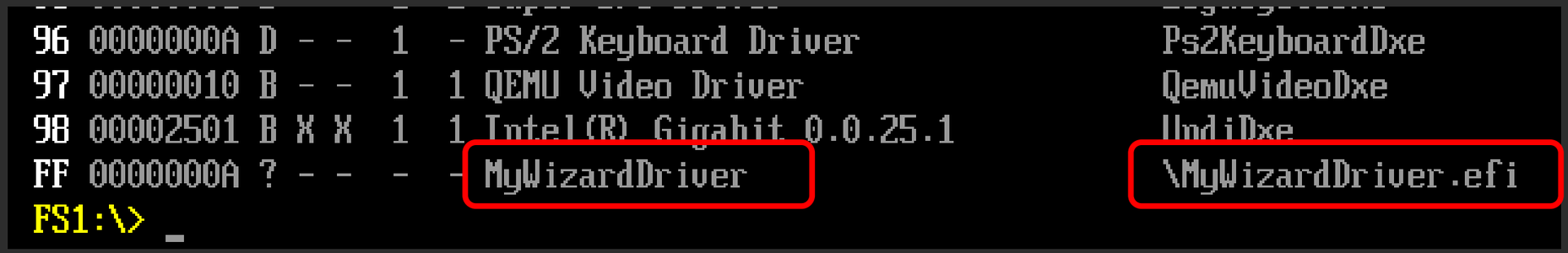
```
Shell> Fs1:
FS1:/> Load MyWizardDriver.efi
```

```
Shell> FS1:
FS1:\> load MyWizardDriver.efi
Image 'FS1:\MyWizardDriver.efi' loaded at DDD3B000 - Success
FS1:\> _
```

Lab 2: Test Driver -drivers

At the shell prompt Type: `FS1:/> drivers`

Verify the UEFI Shell loaded the new driver. The drivers command will display the driver information and a driver handle number (“ff" in the example screenshot)



Lab 2: Test Driver -DH

At the shell prompt using the handle from the drivers command,
Type: `dh -d ff`

Note: The value ff is the driver handle for MyWizardDriver. The handle value may change based on your system configuration.(see example screenshot)

```
FS1:\> dh -d ff
FF: SupportedEfiSpecVersion(0x00020046) ComponentName2 ComponentName DriverBinding HiiPackageList Im
ageDevicePath(..,0xB800)/\MyWizardDriver.efi) LoadedImage(\MyWizardDriver.efi)
   Driver Name [FF]    : MyWizardDriver
   Driver Image Name   : \MyWizardDriver.efi
   Driver Version      : 0000000A
   Driver Type         : <Unknown>
   Configuration       : NO
   Diagnostics         : NO
   Managing            : None
FS1:\> _
```

Lab 2: Test Driver - unload

At the shell prompt using the handle from the drivers command,
Type: `FS1:/ > unload ff`

See example screenshot
Type: `drivers` again

Notice results of unload command

```
FS1:\> unload ff
Unload - Handle [DDFC8418].  [y/n]?
y
Unload - Handle [DDFC8418] Result Success.
FS1:\> _
```

Exit Simics `simics> stop, simics> quit`

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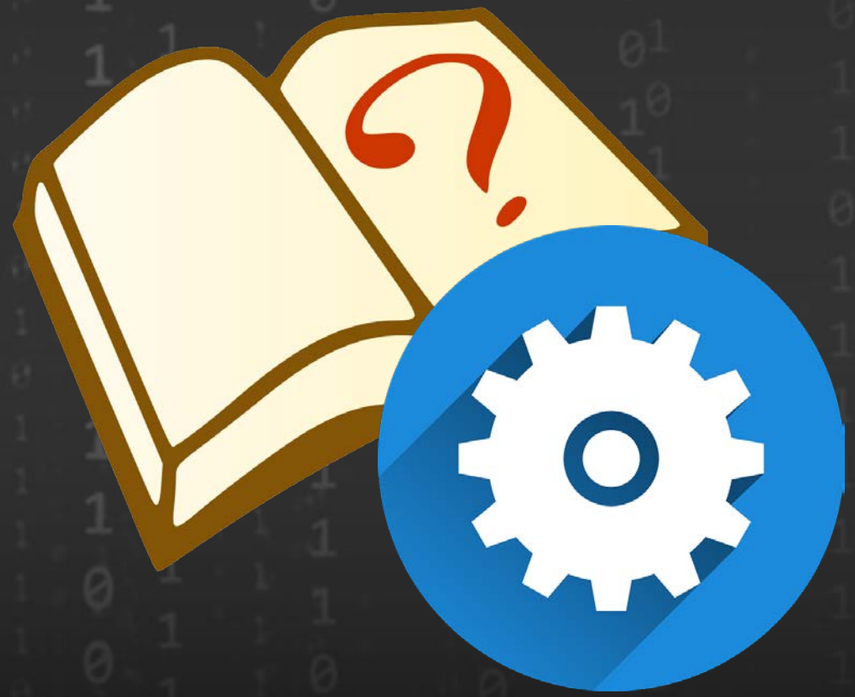
LAB 3: COMPONENT NAME

In this lab, you'll change the information reported to the drivers command using the `ComponentName` and `ComponentName2` protocols.



Lab 3: Component Name

- **Open** `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/ComponentName.c`
- **Change** the string returned by the driver from `MyWizardDriver` to: `UEFI Sample Driver`

```
/// Table of driver names
///
 GLOBAL_REMOVE_IF_UNREFERENCED
 EFI_UNICODE_STRING_TABLE mMyWizardDriverDriverNameTable[] = {
   { "eng;en", (CHAR16 *)L"UEFI Sample Driver" },
   { NULL, NULL }
 };
```

- **Save** and close the file: ~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/ComponentName.c

Lab 3: Build and Test Driver

1. At the Terminal Command Prompt , Re-Build BoardX58Ich10

```
$> cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel/
$> python build_bios.py -p BoardX58Ich10  -t GCC5
```

2. Copy MyWizardDriver.efi from the build directory to the VHD Disk

```
cp ~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/X64/MyWizardDriver.efi ~/VHD
```

3. Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

4. At the Shell, Load Driver

```
Shell> fs1:
FS1:/> load MyWizardDriver.efi
```

```
96 0000000A D - -  1  - PS/2 Keyboard Driver                    Ps2KeyboardDxe
97 00000010 B - -  1  1 QEMU Video Driver                       QemuVideoDxe
98 00002501 B X X  1  1 Intel(R) Gigabit 0.0.25.1               UndiDxe
FF 0000000A ? - -  -  - UEFI Sample Driver                      \MyWizardDriver.efi
FS1:\> _
```

5. Type Drivers `FS1:/> Drivers`

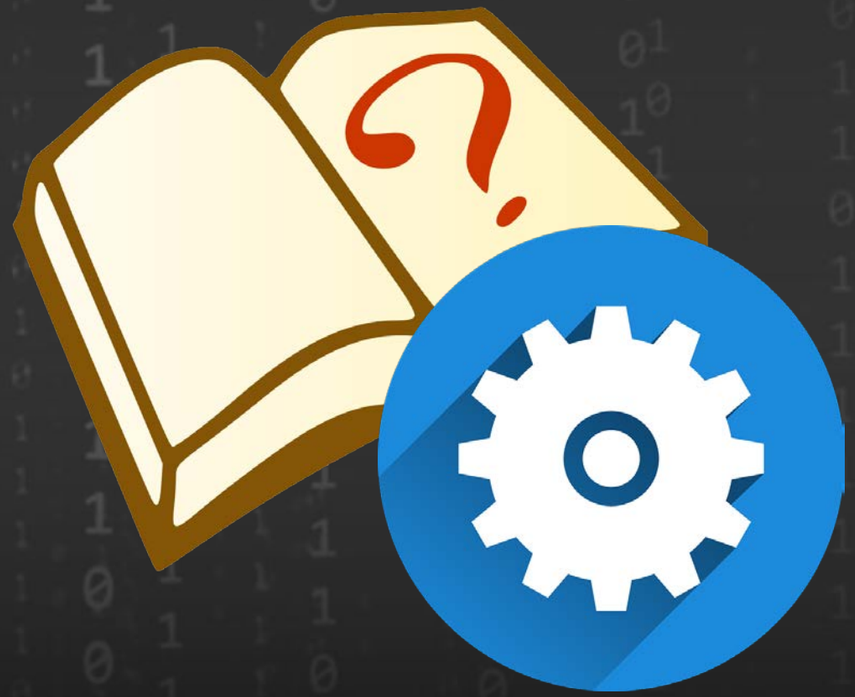
6. Exit Simics `simics> stop, simics> quit`

Notice the Name has changed in the list of drivers

LAB 4: PORTING THE SUPPORTED & START FUNCTIONS

The UEFI Driver Wizard produced a starting point for driver porting … so now what?

In this lab, you'll port the "Supported" and "Start" functions for the UEFI driver



Lab 4: Porting Supported and Start

Review the Driver Binding Protocol

`Supported()`

Determines if a driver supports a controller

`Start()`

Starts a driver on a controller & Installs Protocols

`Stop()`

Stops a driver from managing a controller

Lab 4: The `Supported()` Port

The UEFI Driver Wizard produced a `Supported()` function, but it only returns `EFI_UNSUPPORTED`

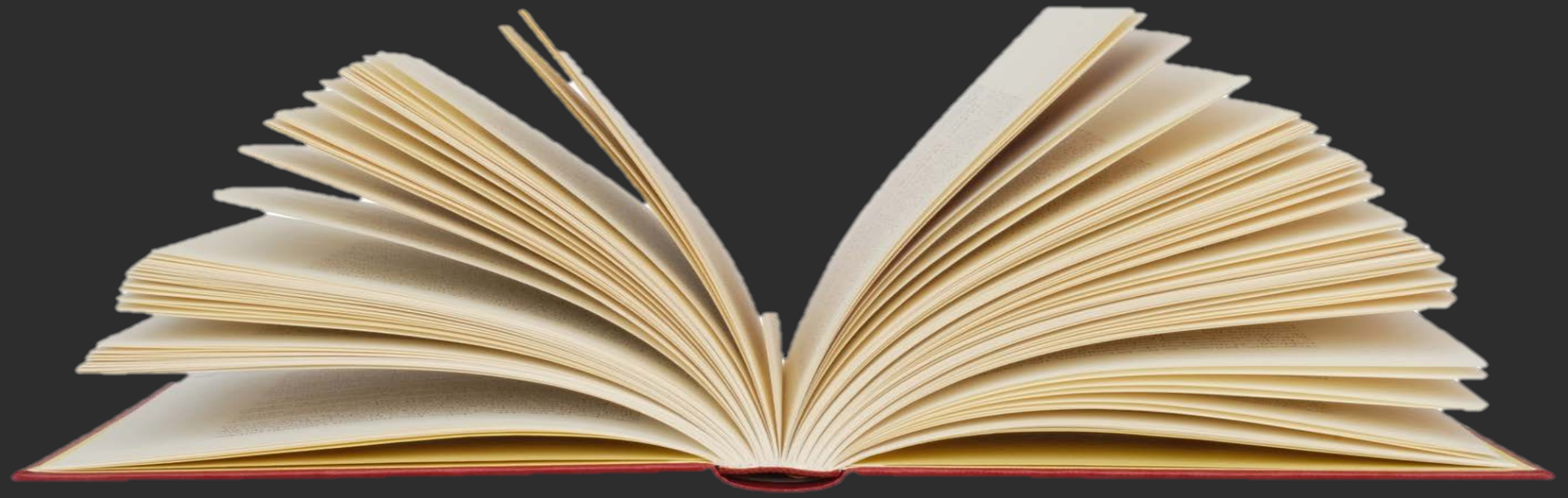
Supported Goals:

- Checks if the driver supports the device for the specified controller handle
- Associates the driver with the Serial I/O protocol
- Helps locate a protocol's specific GUID through UEFI Boot Services' function

Lab 4: Help from Robust Libraries

EDK II has libraries to help with porting UEFI Drivers

- `AllocateZeroPool()` include - [MemoryAllocationLib.h]
- `SetMem16()` include - [BaseMemoryLib.h]



Check the MdePkg with libraries help file (.chm format)

Lab 4: Update Supported

- **Open** `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.c`
- **Locate** `MyWizardDriverDriverBindingSupported()`, the supported function for this driver and comment out the "`//`" in the line: "`return EFI_UNSUPPORTED; `"

```
EFI_STATUS
EFIAPI
MyWizardDriverDriverBindingSupported (
  IN EFI_DRIVER_BINDING_PROTOCOL  *This,
  IN EFI_HANDLE                   ControllerHandle,
  IN EFI_DEVICE_PATH_PROTOCOL     *RemainingDevicePath OPTIONAL
  )
{
  // return EFI_UNSUPPORTED;
}
```

- **copy** and paste (next slide)

This code checks for a specific protocol before returning a status for the supported function (EFI_SUCCESS if the protocol GUID exists).

Lab 4: Update Supported Add Code

Copy & Paste the following code for the supported function `MyWizardDriverDriverBindingSupported()`:

```
  EFI_STATUS                Status;
  EFI_PCI_IO_PROTOCOL       *UsbIo;
  Status = gBS->OpenProtocol (
                 ControllerHandle,
                 &gEfiUsbIoProtocolGuid,
                 (VOID **)&UsbIo,
                 This->DriverBindingHandle,
                 ControllerHandle,
                 EFI_OPEN_PROTOCOL_BY_DRIVER | EFI_OPEN_PROTOCOL_EXCLUSIVE
                 );

  if (EFI_ERROR (Status)) {
     return Status; // Bail out if OpenProtocol returns an error
  }

    // We're here because OpenProtocol was a success, so clean up
     gBS->CloseProtocol (
        ControllerHandle,
        &gEfiUsbIoProtocolGuid,
        This->DriverBindingHandle,
        ControllerHandle
        );

     return Status;
```

Lab 4: Notice UEFI Driver Wizard Includes

- **Open** `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.h`
- **Notice** the following include statement is already added by the driver wizard:

```
// Consumed Protocols
//
#include <Protocol/UsbIo.h>
```

- **Review** the Libraries section and see that UEFI Driver Wizard automatically includes library headers based on the form information. Also, other common library headers were included

```
// Libraries
//
#include <Library/UefiBootServicesTableLib.h>
#include <Library/MemoryAllocationLib.h>
#include <Library/BaseMemoryLib.h>
#include <Library/BaseLib.h>
#include <Library/UefiLib.h>
#include <Library/DevicePathLib.h>
#include <Library/DebugLib.h>
```

Lab 4: Update the Start()

- **Copy & Paste** the following in `MyWizardDriver.c` after the `#include “MyWizardDriver.h”` line:

```
#define  DUMMY_SIZE 100*16          // Dummy buffer
CHAR16    *DummyBufferfromStart = NULL;
```

Locate `MyWizardDriverDriverBindingStart()`, the start function for this driver and comment out the "//" in the line "`return EFI_UNSUPPORTED;` "

```
EFI_STATUS
EFIAPI
MyWizardDriverDriverBindingStart (
  IN EFI_DRIVER_BINDING_PROTOCOL  *This,
  IN EFI_HANDLE                   ControllerHandle,
  IN EFI_DEVICE_PATH_PROTOCOL     *RemainingDevicePath OPTIONAL
  )
{
  // return EFI_UNSUPPORTED;
}
```

Lab 4: Update Start Add Code

Copy & Paste the following code for the start function `MyWizardDriverDriverBindingStart()`:

```
BOOLEAN FirstAlloc = FALSE;

if (DummyBufferfromStart == NULL) {     // was buffer already allocated?
    DummyBufferfromStart = (CHAR16*)AllocateZeroPool (DUMMY_SIZE * sizeof(CHAR16));
    FirstAlloc = TRUE;
}

if (DummyBufferfromStart == NULL) {
    return EFI_OUT_OF_RESOURCES;    // Exit if the buffer isn't there
}

if (FirstAlloc) {
   SetMem16 (DummyBufferfromStart, (DUMMY_SIZE * sizeof(CHAR16)), 0x004A);  // Fill buffer
}
return EFI_SUCCESS;
```

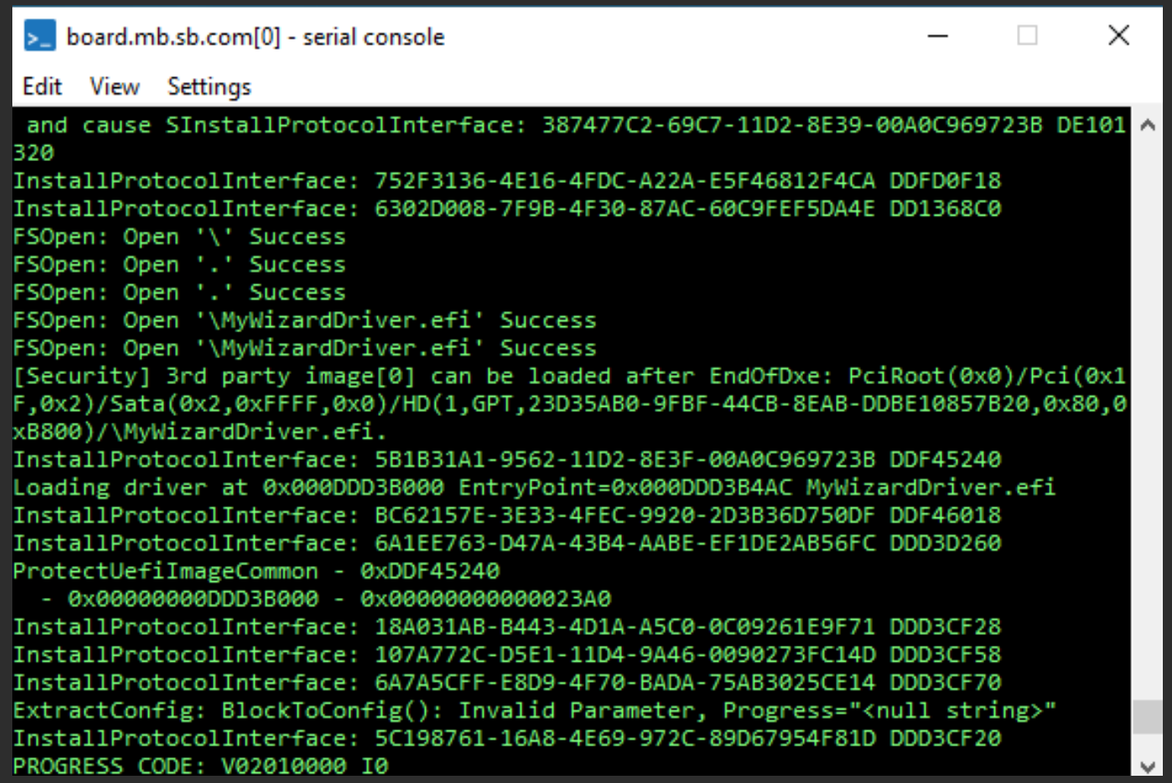
- Notice the Library calls to `AllocateZeroPool()` and `SetMem16()`
- The `Start()` function is where there would be calls to "`gBS-InstallMultipleProtocolInterfaces()`"

Lab 4: Debugging before Testing the Driver

UEFI drivers can use the EDK II debug library

`DEBUG( )` include - `[DebugLib.h]`

`DEBUG()` Macro statements can show status progress interest points throughout the driver code



Simics Serial Console Output Debug Messages

Lab 4: Add Debug Statements Supported()

Copy & Paste the following DEBUG() macros for the supported function:

```
Status = gBS->OpenProtocol(
       ControllerHandle,
       &gEfiUsbIoProtocolGuid,
       (VOID **)&UsbIo,
       This->DriverBindingHandle,
       ControllerHandle,
       EFI_OPEN_PROTOCOL_BY_DRIVER | EFI_OPEN_PROTOCOL_EXCLUSIVE
       );

   if (EFI_ERROR(Status)) {
      DEBUG((DEBUG_INFO, "[MyWizardDriver] Not Supported /n"));
      return Status; // Bail out if OpenProtocol returns an error
   }

   // We're here because OpenProtocol was a success, so clean up
   gBS->CloseProtocol(
       ControllerHandle,
       &gEfiUsbIoProtocolGuid,
       This->DriverBindingHandle,
       ControllerHandle
       );
   DEBUG((DEBUG_INFO, "[MyWizardDriver] *** Supported SUCCESS ***/n"));
   return EFI_SUCCESS;
```

Lab 4: Add Debug Statements `Start()`

Copy & Paste the following DEBUG macro for the Start function just after the `SetMem16` function call

```
if (FirstAlloc) {
    SetMem16(DummyBufferfromStart, (DUMMY_SIZE * sizeof(CHAR16)), 0x004A);
    DEBUG((DEBUG_INFO, "/n*******/n***[MyWizardDriver] Buffer 0x%p  ***/n*******/n",
          DummyBufferfromStart));
}
```

Note: This debug macro displays the memory address of the allocated buffer on the debug console

Save `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.c`

Lab 4: Build and Test Driver

1. At the Terminal Command Prompt , Re-Build BoardX58Ich10

```
$> cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel/
$> python build_bios.py -p BoardX58Ich10  -t GCC5
```

2. Copy MyWizardDriver.efi from the build directory to the VHD Disk

```
cp ~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/X64/MyWizardDriver.efi ~/VHD
```

3. Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

4. At the Shell, Load Driver

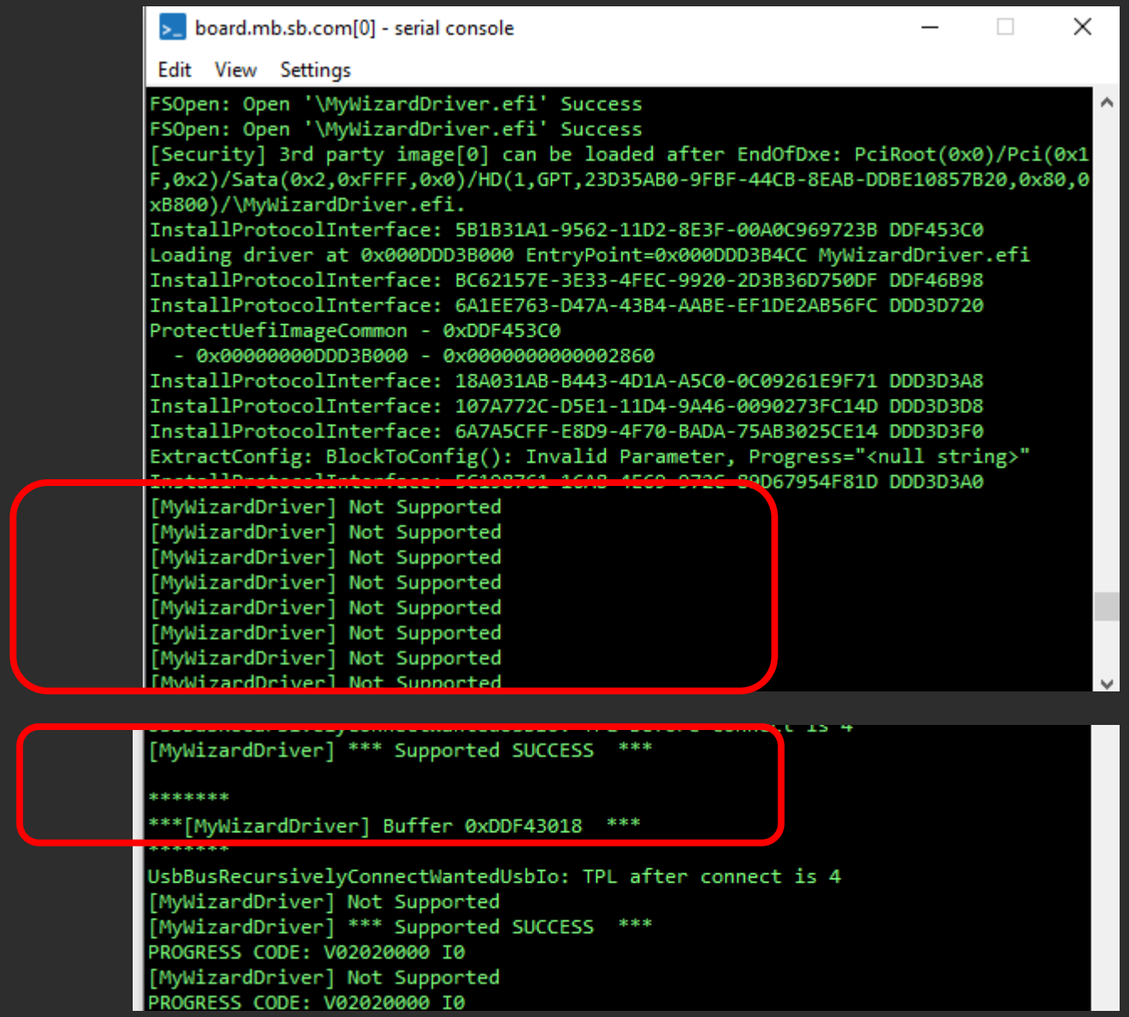
```
Shell> fs1:
FS1:/> load MyWizardDriver.efi
```

```
Shell> fs1:
FS1:\> load MyWizardDriver.efi
Image 'FS1:\MyWizardDriver.efi' loaded at DDD3B000 - Success
FS1:\> _
```

Lab 4: Build and Test Driver

- Check the Simics Com[0] output.
- Notice Debug messages indicate the driver did **not** return EFI_SUCCESS from the “Supported()” function most of the time.
- See that the "Start()" function did get called and a Buffer was allocated.

Exit Simics `simics> stop, simics> quit`

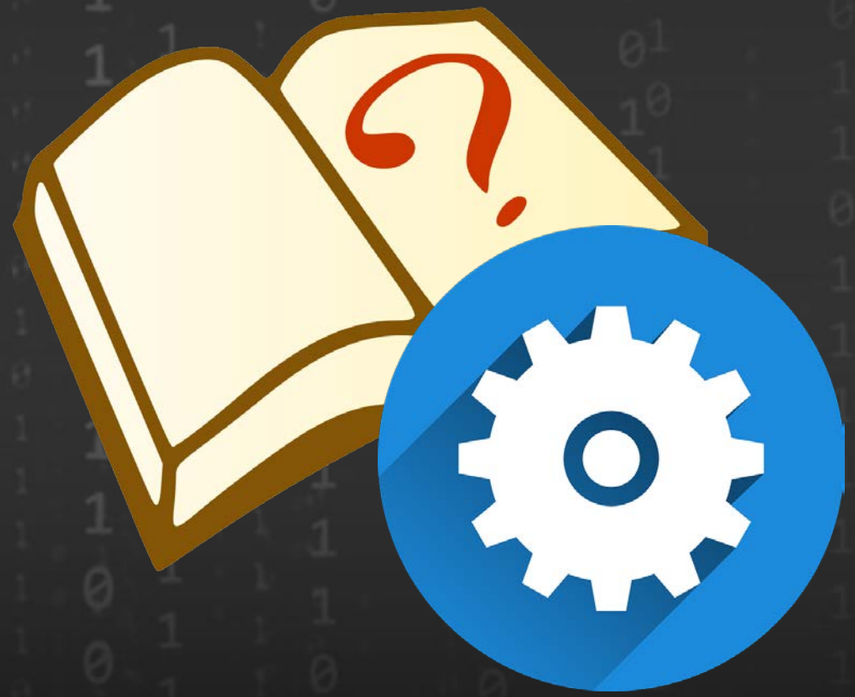


Note: use the right-side scroll bar with mouse to scroll back to see the “Supported SUCCESS”

LAB 5: CREATE A NVRAM VARIABLE

In this lab you'll create a non-volatile UEFI variable (NVRAM), and set and get the variable in the Start function

Use Runtime services to "`SetVariable()`" and "`GetVariable()`"



Lab 5: Adding a NVRAM Variable Steps

1. Create .h file with new `typedef` definition and its own `GUID`
2. Include the new .h file in the driver's top .h file
3. In the `Start()` make a call to a new function to set/get the new NVRam Variable
4. Before `EntryPoint()` add the new function `CreateNVVariable()` to the driver.c file.

Lab 5: Create a new .h file

Create a new file in your editor called: "MyWizardDriverNVDataStruc.h"

Copy, Paste and then **Save** this file in the `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver` Directory

```
#ifndef _MYWIZARDDRIVERNVDATASTRUC_H_
#define _MYWIZARDDRIVERNVDATASTRUC_H_
#include <Guid/HiiPlatformSetupFormset.h>
#include <Guid/HiiFormMapMethodGuid.h>

#define MYWIZARDDRIVER_VAR_GUID /
  { /
    0x363729f9, 0x35fc, 0x40a6, 0xaf, 0xc8, 0xe8, 0xf5, 0x49, 0x11, 0xf1, 0xd6 /
  }
#define MYWIZARDDRIVER_STRING_SIZE   0x1A

#pragma pack(1)
typedef struct {
    UINT16  MyWizardDriverStringData[MYWIZARDDRIVER_STRING_SIZE];
    UINT8   MyWizardDriverHexData;
    UINT8   MyWizardDriverBaseAddress;
    UINT8   MyWizardDriverChooseToEnable;
    CHAR16  *MyWizardDriverNvRamAddress;
 } MYWIZARDDRIVER_CONFIGURATION;

#pragma pack()
#endif
```

Lab 5: Update MyWizardDriver.c

Open “~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.c"

Copy & Paste the following 4 lines after the #include "MyWizardDriver.h" statement:

```
#include "MyWizardDriver.h"

EFI_GUID   mMyWizardDriverVarGuid = MYWIZARDDRIVER_VAR_GUID;

CHAR16     mVariableName[] =   L"MWD_NVData";                  // Use Shell "Dmpstore" to see
MYWIZARDDRIVER_CONFIGURATION   mMyWizDrv_Conf_buffer;
MYWIZARDDRIVER_CONFIGURATION   *mMyWizDrv_Conf = &mMyWizDrv_Conf_buffer;  //use the pointer
```

Lab 5: Update MyWizardDriver.c

Locate "MyWizardDriverDriverBindingStart ()" function

Copy & Paste at the beginning of the start function to declare a local variable

```
    EFI_STATUS                  Status;  // Declare a local variable Status
```

Copy & Paste the 6 lines: 1) new call to "CreateNVVariable();" , 2-6) if statement with DEBUG just before the line "return EFI_SUCCESS" as below:

```
Status = CreateNVVariable();
if (EFI_ERROR(Status)) {
   DEBUG((DEBUG_INFO, "***[MyWizardDriver] NV Variable already created /n"));
}
else {
   DEBUG((DEBUG_INFO, "***[MyWizardDriver] Created NV Variable in the Start /n"));
}

return EFI_SUCCESS;
```

Lab 5: Update MyWizardDriver.c

Copy & Paste the new function before the call to "MyWizardDriverDriverEntryPoint()"

```
EFI_STATUS
EFIAPI
CreateNVVariable()
{
    EFI_STATUS                Status;
    UINTN                  BufferSize;

    BufferSize = sizeof (MYWIZARDDRIVER_CONFIGURATION);
    Status = gRT->GetVariable(
        mVariableName,
        &mMyWizardDriverVarGuid,
        NULL,
        &BufferSize,
        mMyWizDrv_Conf
        );
    if (EFI_ERROR(Status)) {  // Not definded yet so add it to the NV Variables.
        if (Status == EFI_NOT_FOUND) {
            Status = gRT->SetVariable(
                mVariableName,
                &mMyWizardDriverVarGuid,
                EFI_VARIABLE_NON_VOLATILE | EFI_VARIABLE_BOOTSERVICE_ACCESS,
                sizeof (MYWIZARDDRIVER_CONFIGURATION),
                mMyWizDrv_Conf   //  buffer is init before call
                );
            DEBUG((DEBUG_INFO, “***[MyWizardDriver] Variable %s created in NVRam Var/n", mVariableName));
            return EFI_SUCCESS;
        }
    }
    // already defined once
    return EFI_UNSUPPORTED;
}
```

- Note: the `gRT->GetVariable` and `gRT->SetVariable` use Runtime services table
- The Runtime Services Table was not automatically included with the Driver Wizard

Lab 5: Update MyWizardDriver.h

Open "~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.h"

Copy & Paste the following "#include" after the list of library include statements:

```
// Libraries
// . . .
#include <Library/UefiRuntimeServicesTableLib.h>
```

Copy & Paste the following "#include" after the list of protocol include statements:

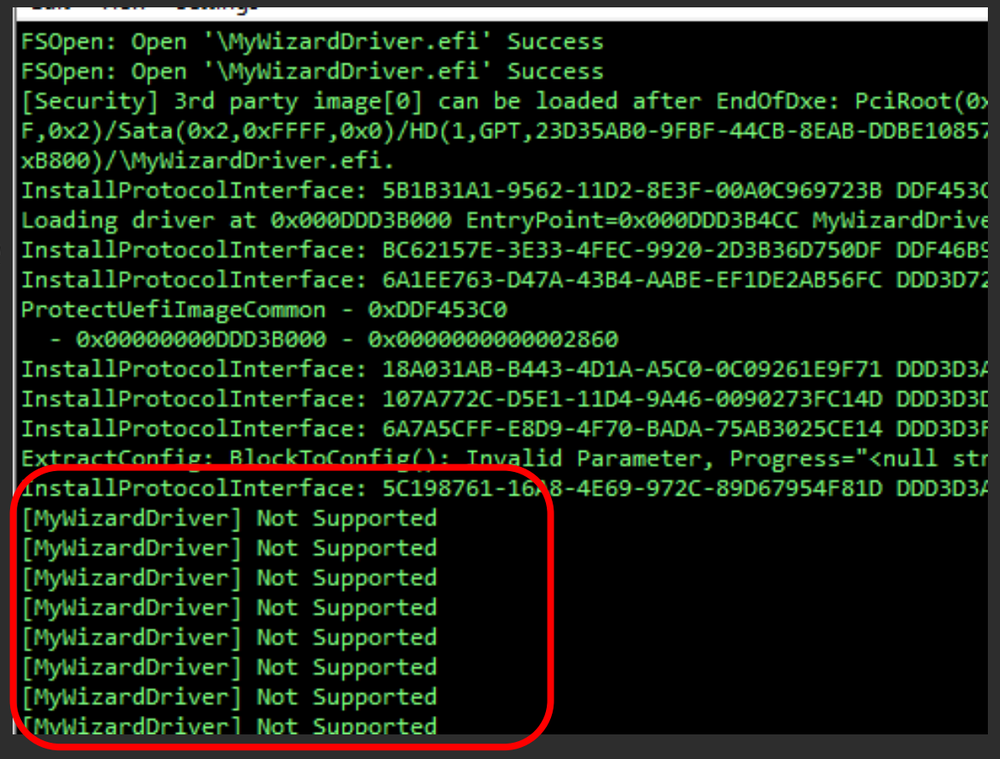
```
// Produced Protocols
// . . .
#include "MyWizardDriverNVDataStruc.h"
```

Save "~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.h"

Lab 5- Improvements(1) MyWizardDriver.c

In Lab 4 every time the Supported function was called a Debug message was printed to the Serial port resulting in many messages to examine. Instead, use a different Debug message type for the “Not Supported” Debug message

In the `MyWizardDriverDriverBindingSupported` function after the call to “`OpenProtocol`” fails use “`DEBUG_VERBOSE`” instead of “`DEBUG_INFO`”
This can be changed by setting the PCD message flag in the DSC file.




```
Status = gBS->OpenProtocol(  . . .
// . . .
if (EFI_ERROR(Status)) {
   DEBUG((DEBUG_VERBOSE, "[MyWizardDriver] Not Supported  /n" ));
   return Status; // Bail out if OpenProtocol returns an error
}
```

Lab 5- Improvements(2) MyWizardDriver.c

It is hard to find the Buffer address in the Debug Message.

Before the call to `CreateNVVariable()` in the `MyWizardDriverDriverBindingStart()` Function add the following:

1. Store the address of the Dummy Buffer in the NVRAM Variable
2. Use “`StrCpyS`” to store the string: “`UEFI-Training-Class-MWD`” to the NVRAM Variable String

```
//  store the address and string value in the NvRam Variable  -
//  this Allows DMPSTORE to display our buffer address
  mMyWizDrv_Conf_buffer.MyWizardDriverNvRamAddress = DummyBufferfromStart;
  StrCpyS(mMyWizDrv_Conf_buffer.MyWizardDriverStringData,
        (MYWIZARDDRIVER_STRING_SIZE * sizeof(CHAR16)),
        L"UEFI-Training-Class-MWD");
```

Save "~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.c"

Lab 5: Build and Test Driver

1. At the Terminal Command Prompt , Re-Build BoardX58Ich10

```
$> cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel/
$> python build_bios.py -p BoardX58Ich10  -t GCC5
```

2. Copy MyWizardDriver.efi from the build directory to the VHD Disk

```
cp ~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/X64/MyWizardDriver.efi ~/VHD
```

3. Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

4. At the Shell, Load Driver

```
Shell> fs1:
FS1:/> load MyWizardDriver.efi
```

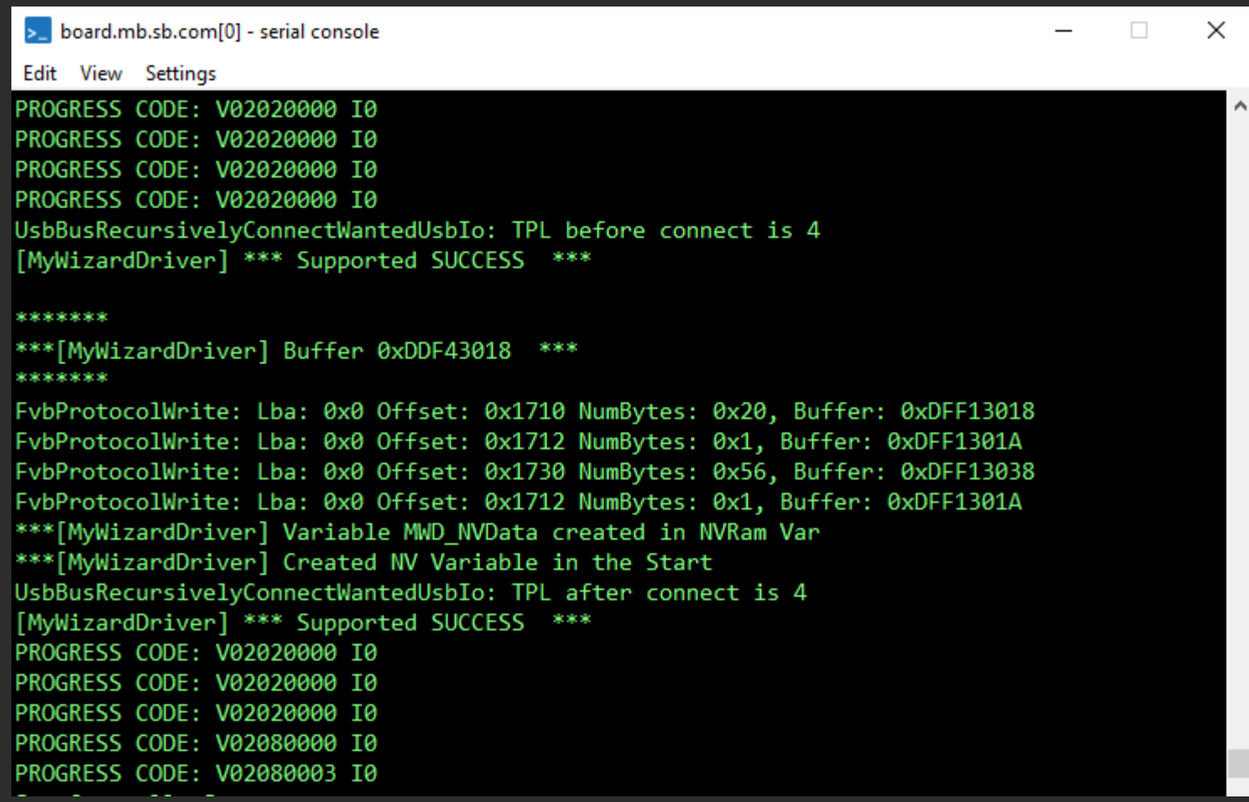
```
Shell> fs1:
FS1:\> load MyWizardDriver.efi
Image 'FS1:\MyWizardDriver.efi' loaded at DDD3B000 - Success
FS1:\> _
```

Lab 5: Verify the Output

Observe the Buffer address returned by the debug statement in the Simics Serial Console window and the new NV Variable was created

Also note, the “[MyWizardDriver] Not Supported” Messages are no longer displayed.

To display these, Set the `PcdDebugPrintErrorLevel|0x80400040` In the DSC file



Note: use the right-side scroll bar with mouse to scroll back to see the “Supported SUCCESS”

Lab 5: Verify Driver

Use the Buffer address pointer in the previous slide then use the “mem” command

At the Shell prompt, type `FS1:/> mem 0ddf43018`

Observe the Buffer is filled with the letter “J" or 0x004A

```
FS1:\> mem 0ddf43018
Memory Address 00000000DDF43018 200 Bytes
  DDF43018: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43028: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43038: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43048: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43058: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43068: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43078: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43088: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43098: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF430A8: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
```

Lab 5: Verify NVRAM Created by Driver

At the Shell prompt, type `FS1:/> dmpstore -all MWD_NVData`

Observe new the NVRAM variable "MWD_NVData" was created and filled with the address of the buffer and the string “UEFI-Training-Class-MWD”

```
FS1:\> dmpstore -all MWD_NVData
Variable NV+BS ’363729F9-35FC-40A6-AFC8-E8F54911F1D6:MWD_NVData’ DataSize = 0x40
  00000000: 55 00 45 00 46 00 49 00-2D 00 54 00 72 00 61 00  *U.E.F.I.-.T.r.a.*
  00000010: 69 00 6E 00 69 00 6E 00-67 00 2D 00 43 00 6C 00  *i.n.i.n.g.-.C.l.*
  00000020: 61 00 73 00 73 00 2D 00-4D 00 57 00 44 00 00 00  *a.s.s.-.M.W.D...*
  00000030: 00 00 00 00 00 00 00 00-18 30 F4 DD 00 00 00 00  *.........0......*
FS1:\> _
```

String

Buffer

Buffer address is: `00 00 DD F4 30 18`

Exit Simics `simics> stop, simics> quit`

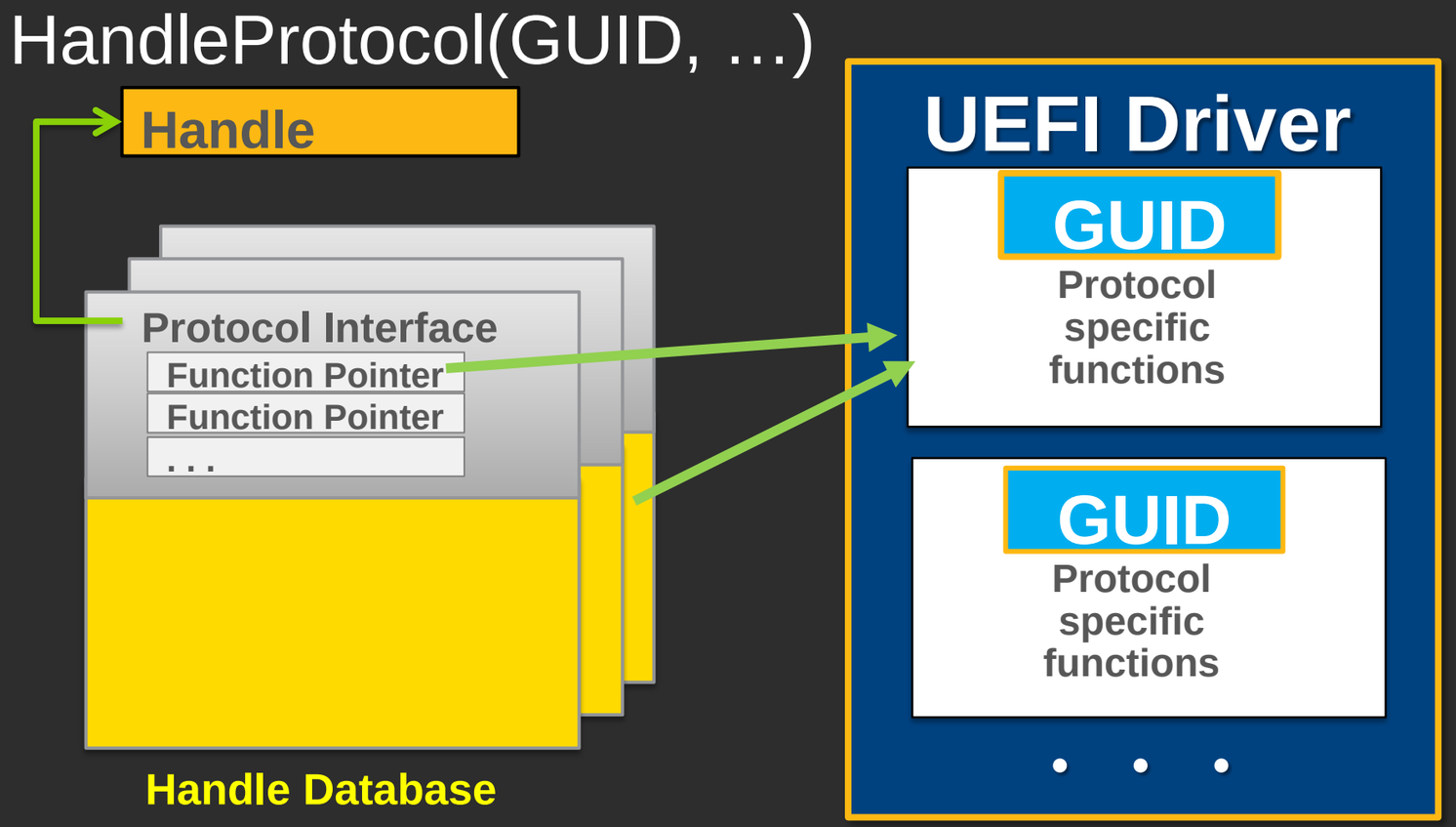
Lab 5: More Porting Needed for the Start

At this point the MyWizardDriver does not manage anything.

The next steps would be to install a protocol to manage the Buffer and NVRAM variable.

Start function

Install Protocols to Handle database



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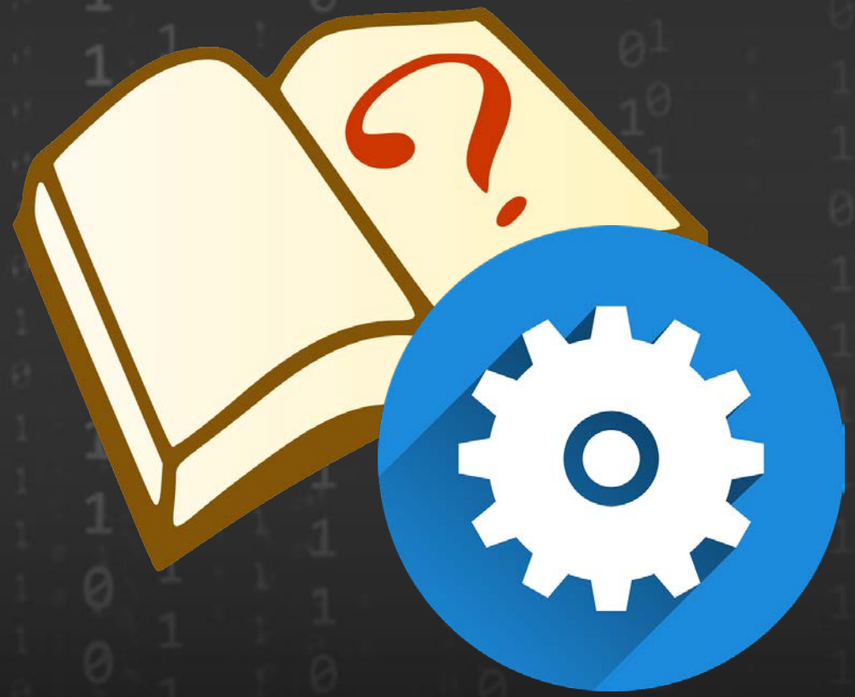
LAB 6: PORT STOP AND UNLOAD

In this lab, you'll port the driver's "Unload" and "Stop" functions to free any resources the driver allocated when it was loaded and started.



Lab 6: Port the Unload function

Open "~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver/MyWizardDriver.c"

Locate "MyWizardDriverUnload ()" function

Copy & Paste the following "if" and "DEBUG" statements before the "return EFI_SUCCESS;" statement.

```
// Do any additional cleanup that is required for this driver
//
if (DummyBufferfromStart != NULL) {
    FreePool(DummyBufferfromStart);
    DEBUG((EFI_D_INFO, "[MyWizardDriver] Unload, clear buffer/n"));
}
DEBUG((DEBUG_INFO, "[MyWizardDriver] Unload success/n"));

return EFI_SUCCESS;
```

Lab 6: Port the Stop function

Locate "MyWizardDriverDriverBindingStop ()" function

Comment out with "//" before the "return EFI_UNSUPPORTED;" statement.

Copy & Paste the following "if" and "DEBUG" statements before the "return EFI_SUCCESS;" statement.

```
if (DummyBufferfromStart != NULL) {
      FreePool(DummyBufferfromStart);
      DEBUG((DEBUG_INFO, "[MyWizardDriver] Stop, clear buffer/n"));
  }
  DEBUG((DEBUG_INFO, "[MyWizardDriver] Stop, EFI_SUCCESS/n"));

  return EFI_SUCCESS;
//  return EFI_UNSUPPORTED;
}
```

Save & Close "MyWizardDriverDriver.c"

Lab 6: Build and Test Driver

1. At the Terminal Command Prompt , Re-Build BoardX58Ich10

```
$> cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel/
$> python build_bios.py -p BoardX58Ich10  -t GCC5
```

2. Copy MyWizardDriver.efi from the build directory to the VHD Disk

```
cp ~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/X64/MyWizardDriver.efi ~/VHD
```

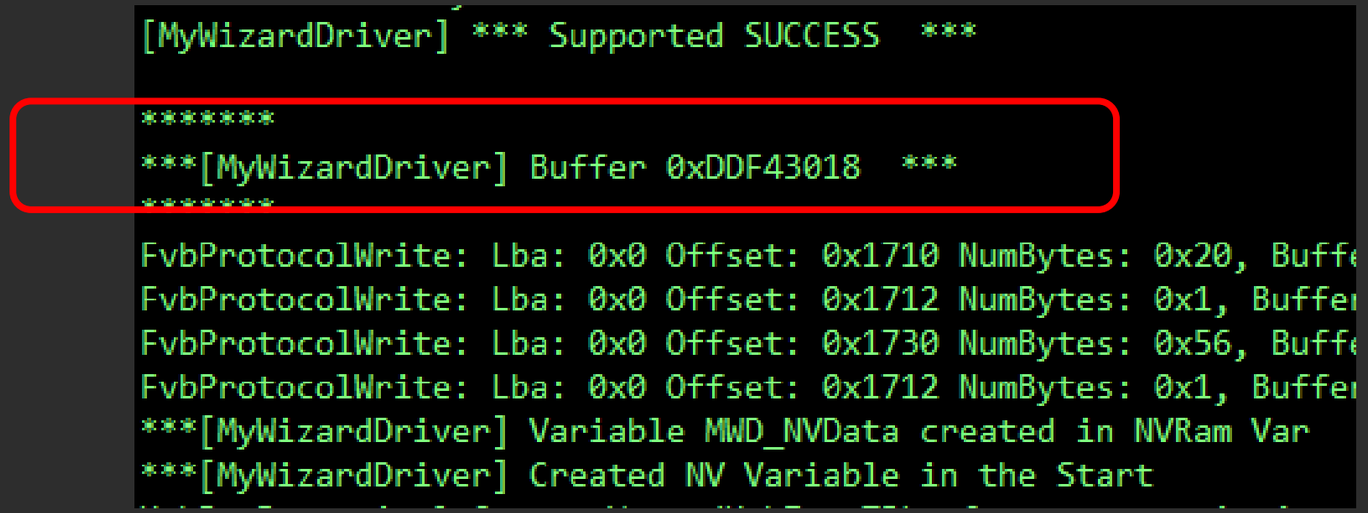
3. Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

4. At the Shell, Load Driver

```
Shell> fs1:
FS1:/> load MyWizardDriver.efi
```

Observe the Buffer address is at `0xDDF43018` as this slide example



Lab 6: Verify Driver

At the Shell prompt, type `FS1:/> drivers`

```
97 00000010 B - -  1  1 QEMU Video Driver
98 00002501 B X X  1  1 Intel(R) Gigabit 0.0.25.1
FF 0000000A ? - -  -  - UEFI Sample Driver
FS1:\> _
```

Observe the handle is “FF" as this slide example

Type: `mem 0xDDF43018`

Observe the buffer was filled with "0x004A“ or “J”

```
FS1:\> mem ddf43018
Memory Address 00000000DDF43018 200 Bytes
  DDF43018: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43028: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43038: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
  DDF43048: 4A 00 4A 00 4A 00 4A 00-4A 00 4A 00 4A 00 4A 00  *J.J.J.J.J.J.J.J.*
```

Lab 6: Verify Unload

At the Shell prompt, type `FS1:/> unload FF`

Observe the DEBUG messages from the Unload in the VS Command Window

Type `Drivers` again to verify

```
FS1:\> unload ff
Unload - Handle [DDF49A18].  [y/n]?
y
Unload - Handle [DDF49A18] Result Success.
FS1:\> _
```

```
FSOpen: Open '\' Success
[MyWizardDriver] Unload, clear buffer
[MyWizardDriver] Unload success
FSOpen: Open '\' Success
```

Lab 6: Verify Unload

At the Shell prompt, type `FS1:/> mem 0xDDF43018`

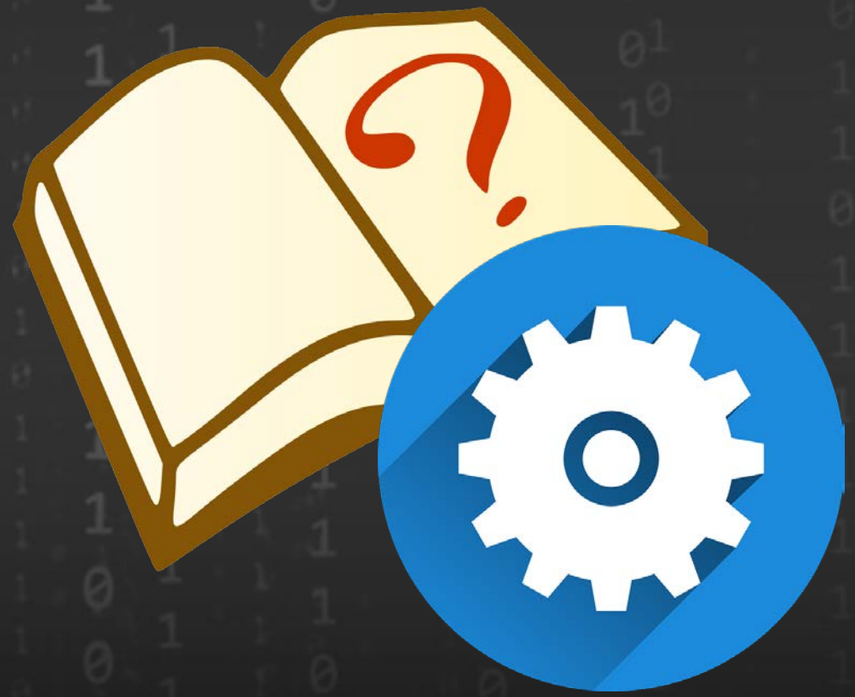
Observe the buffer is now NOT filled

```
FS1:\> mem ddf43018
Memory Address 00000000DDF43018 200 Bytes
  DDF43018: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*
  DDF43028: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*
  DDF43038: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*
  DDF43048: AF AF AF AF AF AF AF AF-AF AF AF AF AF AF AF AF  *................*
```

Exit Simics `simics> stop, simics> quit`

LAB 7: ADD DRIVER TO THE PLATFORM

In this lab, you'll add the My Wizard Driver to the Platform Build.



Lab 7: Build the UEFI Driver

- **Open**

`edk2-platforms/Platform/Intel/SimicsOpenBoardPkg/BoardX58Ich10/OpenBoardPkg.fdf`

- **Add** the following in section [FV.DXEFV] and after the Shell.inf:

```
INF  ShellPkg/Application/Shell/Shell.inf
INF  MyPkg/MyWizardDriver/MyWizardDriver.inf
```

- **Save and close** the file `OpenBoardPkg.fdf`
- Optional - Update file `~/fw/edk2-ws/edk2/MyPkg/MyWizardDriver.uni` for `FORM_SET_TITLE and FORM1_TITLE,` strings , Then Save. (Be Creative)

- **Build** the Simics BoardX58Ich10

```
$> cd ~/fw/edk2-ws/edk2-platforms/Platform/Intel
$> python build_bios.py -p BoardX58Ich10  -t GCC5
```

Copy

`~/fw/edk2-ws/Build/SimicsOpenBoardPkg/BoardX58Ich10/DEBUG_GCC5/FV/BOARDX58ICH10.fd`

To

`<SimicsInstallDir>/simics-qsp-x86-6.0.57/targets/qsp-x86/images`

Lab 7: Verify Driver Got Installed

Run the `qsp-modern-core` script from the Simics Terminal Command Prompt :

```
$> ./simics targets/qsp-x86/qsp-modern-core.simics
simics> run
```

At the Shell prompt, type `Shell> drivers`

```
95 00000001 B - -  1  2 Super I/O Driver                    LegacySioDxe
96 0000000A D - -  1  - PS/2 Keyboard Driver                Ps2KeyboardDxe
97 00000010 B - -  1  1 QEMU Video Driver                   QemuVideoDxe
98 0000000A ? - -  -  - UEFI Sample Driver                  MyWizardDriver
99 00002501 B X X  1  1 Intel(R) Gigabit 0.0.25.1           UndiDxe
Shell> _
```

Observe the handle is “98" as this slide example

Lab 7: Verify NVRAM Created by Driver

At the Shell prompt, type `FS1:/> dmpstore -all MWD_NVData`

Observe new the NVRAM variable "MWD_NVData" was created and filled with the address of the buffer and the string “UEFI-Training-Class-MWD”

```
Shell> dmpstore -all MWD_NVDATA
Variable NV+BS '363729F9-35FC-40A6-AFC8-E8F54911F1D6:MWD_NVData' DataSize = 0x40
  00000000: 55 00 45 00 46 00 49 00-2D 00 54 00 72 00 61 00  *U.E.F.I.-.T.r.a.*
  00000010: 69 00 6E 00 69 00 6E 00-67 00 2D 00 43 00 6C 00  *i.n.i.n.g.-.C.l.*
  00000020: 61 00 73 00 73 00 2D 00-4D 00 57 00 44 00 00 00  *a.s.s.-.M.W.D...*
  00000030: 00 00 00 00 00 00 00 00-18 50 FF DD 00 00 00 00  *.........P......*
Shell> _
```

String

Buffer

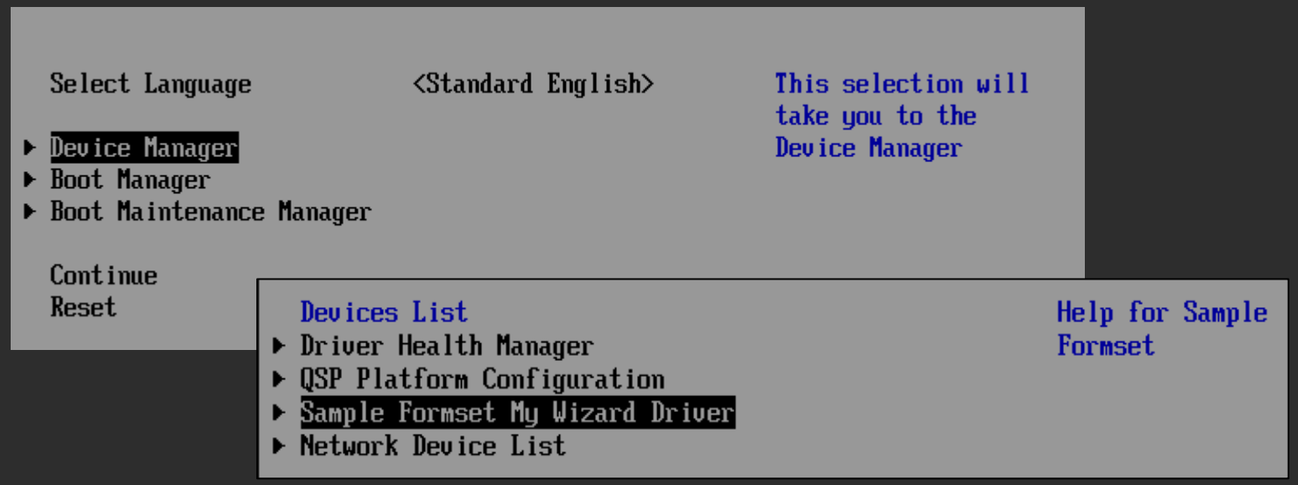
Buffer address is: `00 00 DD FF 50 18`

At the Shell prompt, type `FS1:/> Mem DDFF5018` to Verify Buffer is still set to “J”s

Lab 7: Verify Driver Form Menu in Setup

At the Shell prompt, type `FS1:/> Exit`
This will exit back to setup, Then type “Escape”, then Select “Device Manager” and then “Sample Formset . . .”

This is the Form for the MyDriverWizard



This can be updated to get user data for configuration of your driver that then gets stored in the NVRAM MWD_NVRam date

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Additional Porting

Adding strings and forms to setup (HII)

Install produced protocols

Hardware initialization

Refer to the UEFI Drivers Writer’s Guide for more tips– Pdf link

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Summary

- Compile a UEFI driver template created from UEFI Driver Wizard
- Test driver w/ Simics QSP Board using UEFI Shell 2.0
- Port code into the template driver

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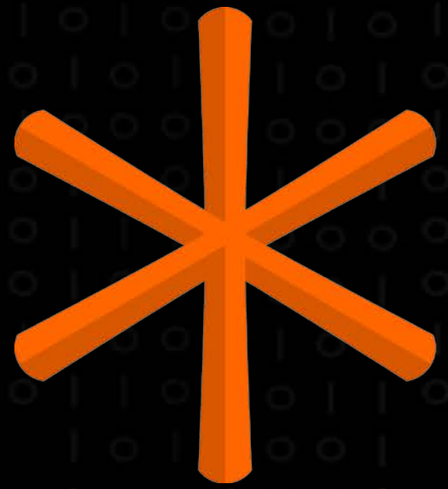
Questions?

Return to Main Training Page

Return to Training Table of contents for next presentation link



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ACKNOWLEDGEMENTS