

UEFI & EDK II Training

EDK II Debugging

tianocore.org



Lesson Objective

- Debugging Overview
- Using PCDs to Configure DebugLib
- Change Compiler & Linker Flags for debugging
- Change the DebugLib instance to modify the debug output
- Debug EDK II using VS Debugger - Demo

DEBUGGING OVERVIEW

Bugs & Generic Debug Methods

Bugs

What's the hardest bug you ever met?

Generic Debug Methods

Print Statements

Assertions

UEFI Shell

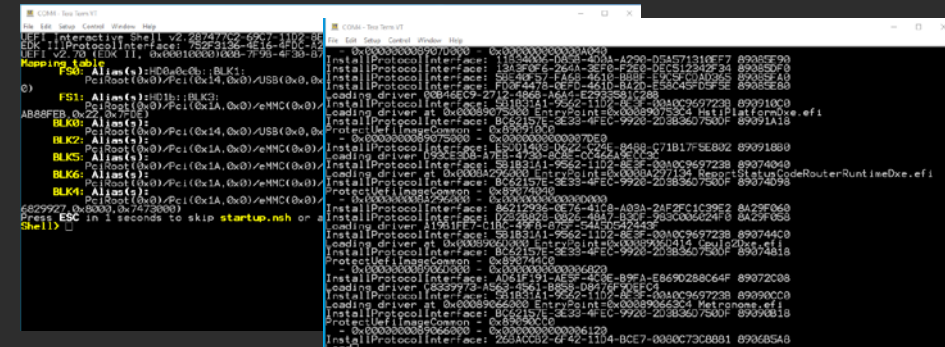
GUI Debuggers



UEFI Debug Methods

Print

DEBUG()
DEBUG_CODE_BEGIN()
DEBUG_CODE_END()



Assertion

ASSERT_EFI_ERROR()/ASSERT()

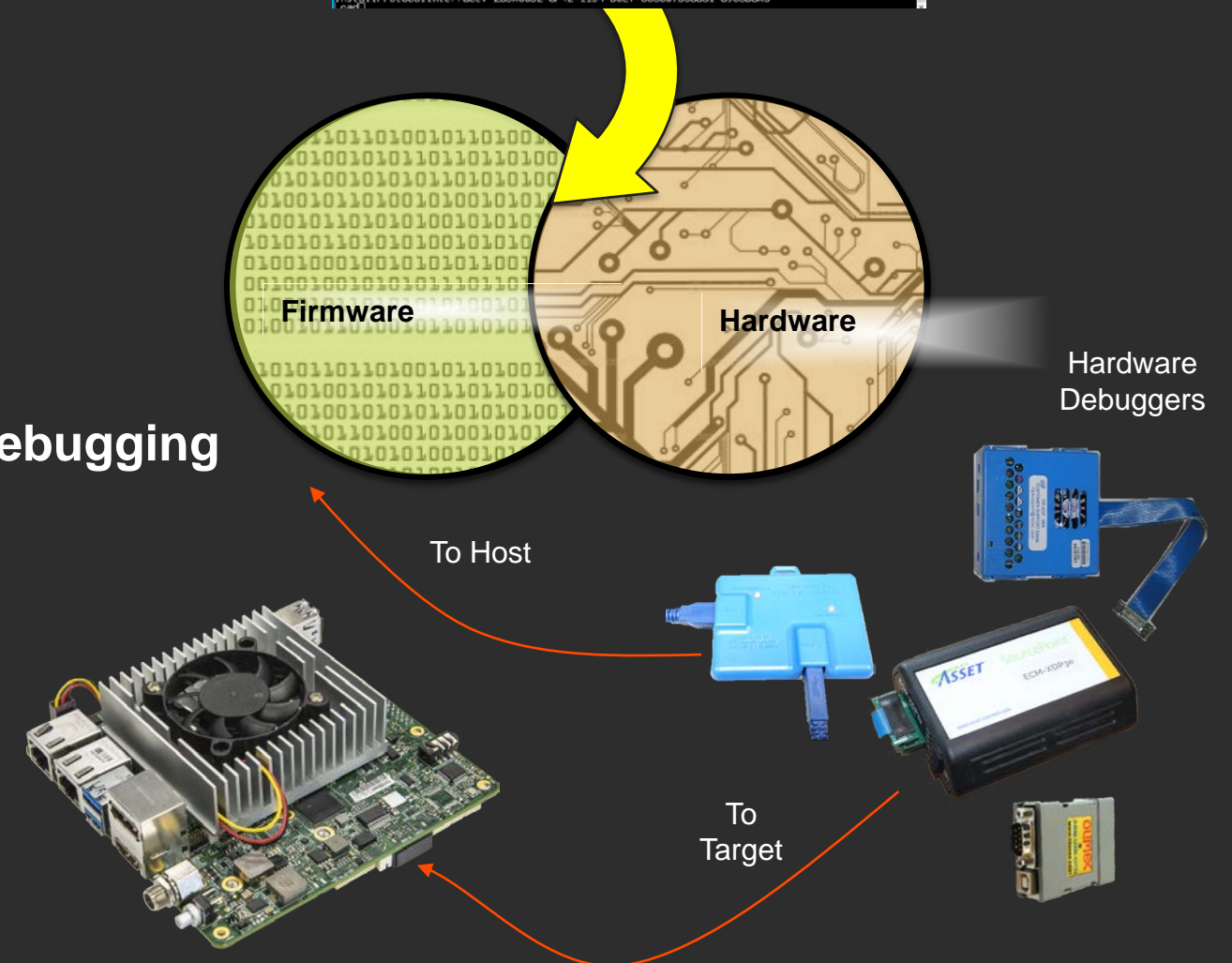
UEFI Shell

Dh, Dmpstore, Mem, MemMap, etc.

GUI debugger

Software/hardware debuggers
GDB, Visual Studio, Asset, Etc.

EDK II Debugging



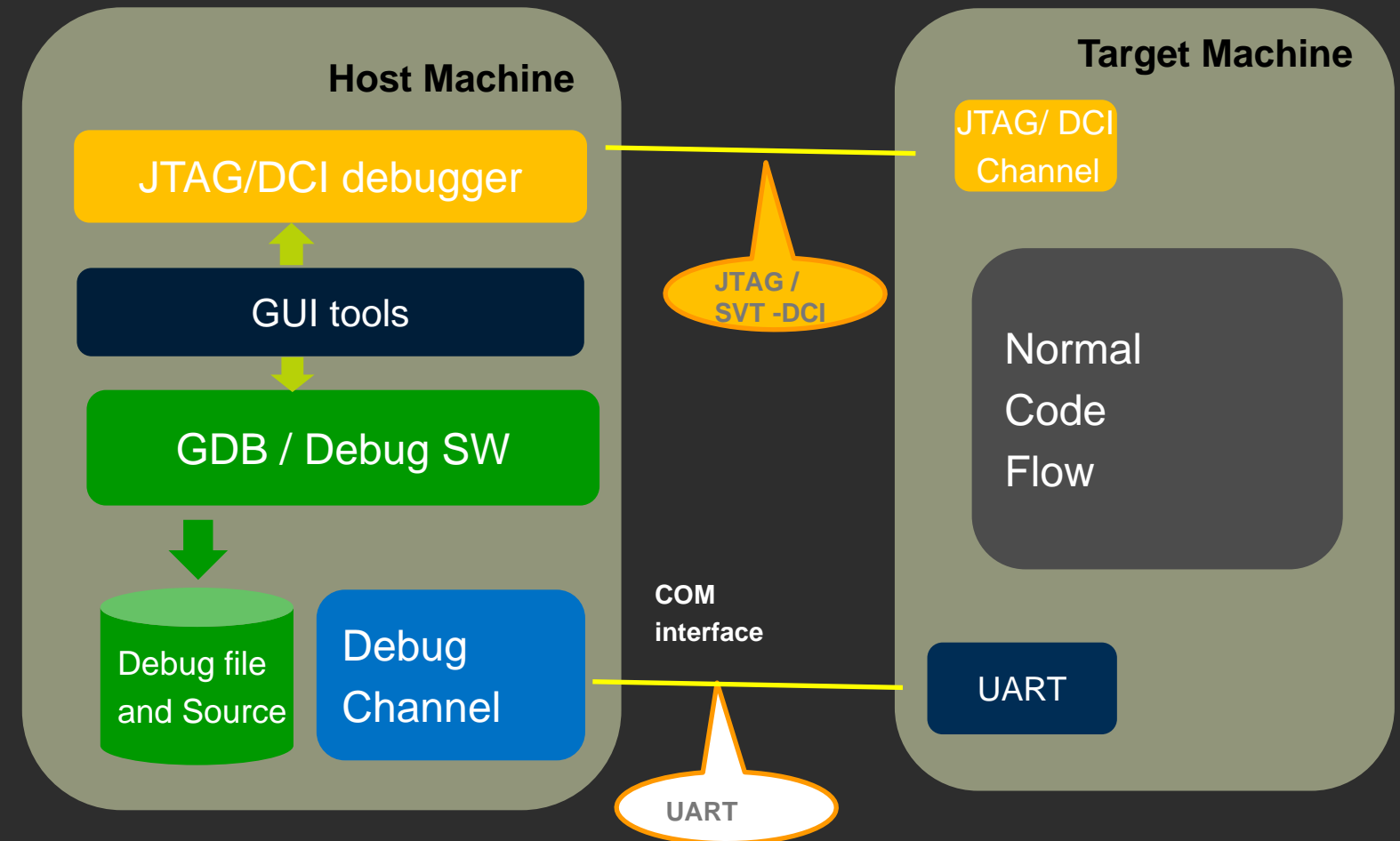
UEFI Debug Methods

Difference for Hardware Debuggers

- Target & host must co-work
Some logic only works with timing/register rules

UEFI/FW Debug steps

- Enable debug
- Add DEBUG macros in code
- Check debug output log
- Find module that has issue
- Trace the module until bug root caused



EDK II DebugLib Library

Add Debug and Assert macros in code

Enable/disable when compiled through PCD, Library Instances & target.txt

Connects a Host to capture debug messages

```
debug.log - Notepad
File Edit Format View Help
Loading PEIM 86D70125-BAA3-4296-A62F-602BEBB9081
Loading PEIM at 0x00007EDD0000 EntryPoint=0x00007EE023A DxeIpl.efi
Install PPI: 1A36E4E7-FAB6-476A-8E75-695A0576FDD7
Install PPI: 0AE8CE5D-E448-4437-A8D7-EBF5F194F731
Loading PEIM 89E549B0-7CFE-449D-9BA3-10D8B2312D71
Loading PEIM at 0x00007ED90000 EntryPoint=0x00007EDB523 S3Resume2Pei.efi
Install PPI: 6D582DBC-DB85-4514-8FCC-5ADF6227B147
Loading PEIM EDADEB9D-DDBA-48BD-9D22-C1C169C8C5C6
Loading PEIM at 0x00007ECD0000 EntryPoint=0x00007ED563E CpuMpPei.efi
Register PPI Notify: F894643D-C449-42D1-8EA8-85BDD8C65BDE
Notify: PPI Guid: F894643D-C449-42D1-8EA8-85BDD8C65BDE, Peim notify entry point: 7ED3C3A
AP Loop Mode is 1
GetMicrocodePatchInfoFromHob: Microcode patch cache HOB is not found.
CPU[0000]: Microcode revision = 00000000, expected = 00000000
Register PPI Notify: 8F9D4825-797D-48FC-8471-845025792EF6
Does not find any stored CPU BIST information from PPI!
APICID - 0x00000000, BIST - 0x00000000
Install PPI: 9E9F374B-8F16-4230-9824-584EE766A97
Install PPI: 5CB9CB3D-31A4-480C-9498-29D269BACFBA
Install PPI: EE16160A-E8BE-47A6-820A-C6900DB0250A
Notify: PPI Guid: EE16160A-E8BE-47A6-820A-C6900DB0250A, Peim notify entry point: 837197
PlatformPei: ClearCacheOnMpServicesAvailable
DiscoverPeimsAndOrderWithApriori(): Found 0x0 PEI FFS files in the 1th FU
DXE IPL Entry
Loading PEIM D6A2CB7F-6A18-4E2F-B43B-9920A733700A
Loading PEIM at 0x00007E9D0000 EntryPoint=0x00007EAD476 DxeCore.efi
Loading DXE CORE at 0x00007E9D0000 EntryPoint=0x00007EAD476
AddressBits=36 5LevelPaging=0 1GPage=0
Pml5=1 Pml4=1 Pdp=64 TotalPage=66
Install PPI: 605EA650-C65C-42E1-BA80-91A52AB618C6
Notify: PPI Guid: 605EA650-C65C-42E1-BA80-91A52AB618C6, Peim notify entry point: 82E2D2
CpuInitLib: MmSystemServices
```

DEBUGGING WITH PCDS

Using PCDs to Configure DebugLib

MdePkg Debug Library Class

```
[PcdsFixedAtBuild. PcdsPatchableInModule]
```

• • •

```
gEfiMdePkgTokenSpaceGuid.PcdDebugPropertyMask|0x1f
```

```
gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x80000040
```

PCDs Set which drivers report errors and change
what messages get printed

PcdDebugPropertyMask Values

Debugging *Features* Enabled

```
#define DEBUG_PROPERTY_DEBUG_ASSERT_ENABLED      0x01
#define DEBUG_PROPERTY_DEBUG_PRINT_ENABLED      0x02
#define DEBUG_PROPERTY_DEBUG_CODE_ENABLED      0x04
#define DEBUG_PROPERTY_CLEAR_MEMORY_ENABLED      0x08
#define DEBUG_PROPERTY_ASSERT_BREAKPOINT_ENABLED 0x10
#define DEBUG_PROPERTY_ASSERT_DEADLOOP_ENABLED  0x20
```

Default value in OvmfPkg is 0x2f

Default value in EmulatorPkg is 0x1f

Determines which debugging features are enabled

PcdDebugPrintErrorLevel Values

Debug Messages Displayed

```
#define DEBUG_INIT      0x00000001 // Initialization
#define DEBUG_WARN      0x00000002 // Warnings
#define DEBUG_LOAD      0x00000004 // Load events
#define DEBUG_FS        0x00000008 // EFI File system
#define DEBUG_POOL      0x00000010 // Alloc & Free's Pool
#define DEBUG_PAGE      0x00000020 // Alloc & Free's Page
#define DEBUG_INFO      0x00000040 // Verbose
#define DEBUG_DISPATCH  0x00000080 // PEI/DXE Dispatchers
#define DEBUG_VARIABLE  0x00000100 // Variable
#define DEBUG_BM        0x00000400 // Boot Manager
#define DEBUG_BLKIO      0x00001000 // BlkIo Driver
#define DEBUG_NET        0x00004000 // SNP / Network Io Driver
#define DEBUG_UNDI       0x00010000 // UNDI Driver
#define DEBUG_LOADFILE   0x00020000 // Load File
#define DEBUG_EVENT      0x00080000 // Event messages
#define DEBUG_GCD        0x00100000 // Global Coherency Database changes
#define DEBUG_CACHE      0x00200000 // Memory range cache-ability changes
#define DEBUG_VERBOSE    0x00400000 // Detailed debug messages that may
                                // significantly impact boot performance
#define DEBUG_ERROR      0x80000000 // Error
```

Aliases EFI_D_INIT == DEBUG_INIT, etc..

Determines which messages we want to print

DebugLib Marco Examples

```
#define DEBUG(Expression)
do {
    if (DebugPrintEnabled ()) {
        _DEBUG (Expression);
    }
} while (FALSE)
```

Config by PCD
PcdDebugPropertyMask

```
VOID
EFIAPI
DebugPrint (
    IN UINTN          ErrorLevel,
    IN CONST CHAR8    *Format,
    ...
)
```

Config by PCD
PcdDebugPrintErrorLevel

```
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "Port CMD/DEVSLEP = %08x / %08x\n", PortCmd, PortDevSlep));
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "IDENTIFY DEVICE: [77] = %04x, [78] = %04x, [79] = %04x\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "DevSlep feature is not supported for device at port [%d] PortMultiplier [%d]!\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "DevSlep set feature for device at port [%d] PortMultiplier [%d] - %r\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "Read Log Ext at port [%d] PortMultiplier [%d] - %r\n", Port, PortMultiplier, Status));
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "DevSlepTiming: Supported(%d), Deto(%d), Madt(%d)\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "Enabled DevSlep feature at port [%d] PortMultiplier [%d], Port CMD/DEVSLEP = %08x / %08x\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "CMD_PUIS_SET_DEVICE_SPINUP for device at port [%d] PortMultiplier [%d] - %r!\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "Read LBA 0 for device at port [%d] PortMultiplier [%d] - %r!\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_ERROR, "Read IDD failed for device at port [%d] PortMultiplier [%d] - %r!\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "IDENTIFY DEVICE: [0] = %016x, [2] = %016x, [83] = %016x, [86] = %016x\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "%a PUIS feature at port [%d] PortMultiplier [%d] - %r!\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((EFI_D_WARN,
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "IDENTIFY DEVICE: [0] = %016x, [2] = %016x, [83] = %016x, [86] = %016x\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_ERROR, "Spin up standby device failed - %r\n", Status));
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_INFO, "port [%d] port multitplier [%d] has a [%a]\n",
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((EFI_D_ERROR, "Calculate Mode Fail, Status = %r\n", Status));
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((EFI_D_ERROR, "Set transfer Mode Fail, Status = %r\n", Status));
AhciMode.c (edk2\mdemodulepkg\bus\ata\ataatapipassthru): DEBUG ((DEBUG_ERROR, "PUIS enable/disable failed, Status = %r\n", Status));
AhciPei.c (edk2\mdemodulepkg\bus\ata\ahcipei): DEBUG ((DEBUG_INFO, "%a: Enters.\n", __FUNCTION__));
AhciPei.c (edk2\mdemodulepkg\bus\ata\ahcipei): DEBUG ((DEBUG_ERROR, "%a: Fail to get the current boot mode.\n", __FUNCTION__));
AhciPei.c (edk2\mdemodulepkg\bus\ata\ahcipei): DEBUG ((DEBUG_ERROR, "%a: Failed to locate AtaAhciHostControllerPpi.\n", __FUNCTION__));
```

Changing PCD Values

Change all instances of a PCD in platform DSC

```
[PcdsFixedAtBuild.IA32]  
gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x00000000
```

Change a single module's PCD values in DSC

```
MyPath/MyModule.inf {  
<PcdsFixedAtBuild>  
gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0x80000000  
}
```

Minimize message output and minimize size increase

Other Debug Related Libraries

ReportStatusCodeLib – Progress codes

`gEfiMdePkgTokenSpaceGuid.PcdReportStatusCodePropertyMask`

PostCodeLib – Enable Post codes

`gEfiMdePkgTokenSpaceGuid.PcdPostCodePropertyMask`

PerformanceLib – Enable Measurement

`gEfiMdePkgTokenSpaceGuid.PcdPerformanceLibraryPropertyMask`

Demo – Adding Debug Statements

Adding debug statements to the previous lab's SampleApp UEFI Shell application

Demo: Add debug statements to SampleApp

The following code was added after the “EFI_INPUT_KEY KEY;” statement: and before the first Print() statement as shown in the screen shot below:

```
DEBUG ((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n") );
DEBUG ((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n") );

DEBUG ((DEBUG_INIT,      " 0x%08x USING DEBUG DEBUG_INIT\n", (UINTN)(DEBUG_INIT)) );
DEBUG ((DEBUG_WARN,      " 0x%08x USING DEBUG DEBUG_WARN\n", (UINTN)(DEBUG_WARN)) );
DEBUG ((DEBUG_LOAD,      " 0x%08x USING DEBUG DEBUG_LOAD\n", (UINTN)(DEBUG_LOAD)) );
DEBUG ((DEBUG_FS,        " 0x%08x USING DEBUG DEBUG_FS\n", (UINTN)(DEBUG_FS)) );
DEBUG ((DEBUG_POOL,      " 0x%08x USING DEBUG DEBUG_POOL\n", (UINTN)(DEBUG_POOL)) );
DEBUG ((DEBUG_PAGE,      " 0x%08x USING DEBUG DEBUG_PAGE\n", (UINTN)(DEBUG_PAGE)) );
DEBUG ((DEBUG_INFO,      " 0x%08x USING DEBUG DEBUG_INFO\n", (UINTN)(DEBUG_INFO)) );
DEBUG ((DEBUG_DISPATCH,  " 0x%08x USING DEBUG DEBUG_DISPATCH\n", (UINTN)(DEBUG_DISPATCH)));
DEBUG ((DEBUG_VARIABLE,  " 0x%08x USING DEBUG DEBUG_VARIABLE\n", (UINTN)(DEBUG_VARIABLE)));
DEBUG ((DEBUG_BM,        " 0x%08x USING DEBUG DEBUG_BM\n", (UINTN)(DEBUG_BM)) );
DEBUG ((DEBUG_BLKIO,     " 0x%08x USING DEBUG DEBUG_BLKIO\n", (UINTN)(DEBUG_BLKIO)) );
DEBUG ((DEBUG_NET,       " 0x%08x USING DEBUG DEBUG_NET\n", (UINTN)(DEBUG_NET)) );
DEBUG ((DEBUG_UNDI,      " 0x%08x USING DEBUG DEBUG_UNDI\n", (UINTN)(DEBUG_UNDI)) );
DEBUG ((DEBUG_LOADFILE,  " 0x%08x USING DEBUG DEBUG_LOADFILE\n", (UINTN)(DEBUG_LOADFILE)));
DEBUG ((DEBUG_EVENT,     " 0x%08x USING DEBUG DEBUG_EVENT\n", (UINTN)(DEBUG_EVENT)) );
DEBUG ((DEBUG_GCD,       " 0x%08x USING DEBUG DEBUG_GCD\n", (UINTN)(DEBUG_EVENT)) );
DEBUG ((DEBUG_CACHE,     " 0x%08x USING DEBUG DEBUG_CACHE\n", (UINTN)(DEBUG_CACHE)) );
DEBUG ((DEBUG_VERBOSE,   " 0x%08x USING DEBUG DEBUG_VERBOSE\n", (UINTN)(DEBUG_VERBOSE)) );
DEBUG ((DEBUG_ERROR,     " 0x%08x USING DEBUG DEBUG_ERROR\n", (UINTN)(DEBUG_ERROR)) );
```

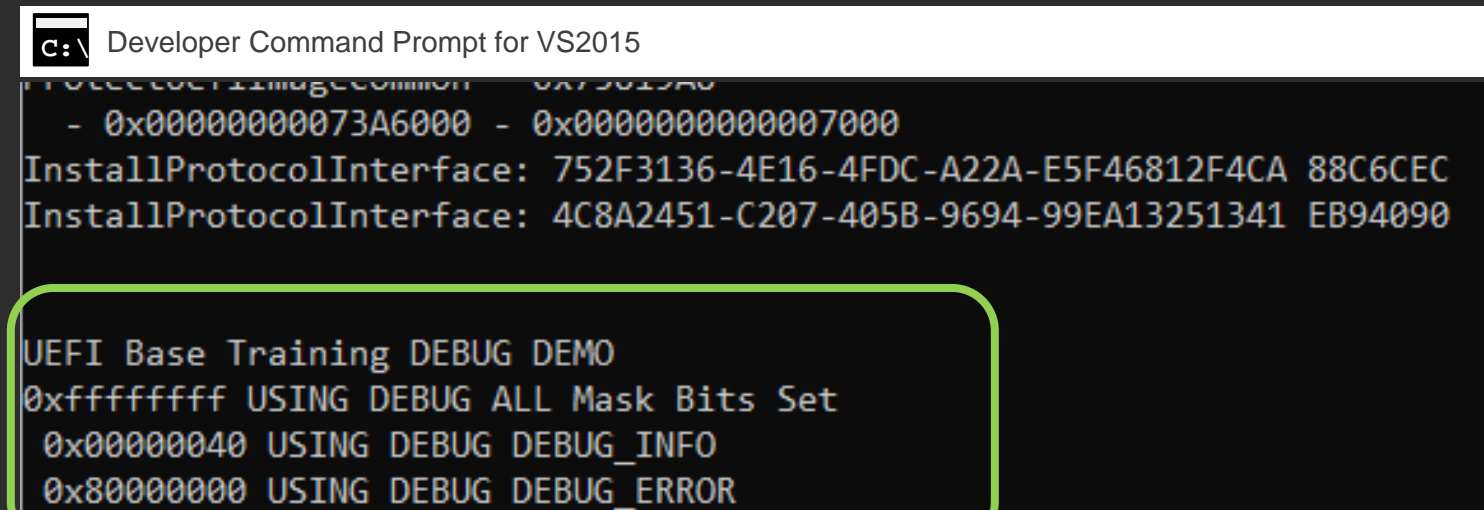
Demo: Run and Test Result

Run the application from the shell

```
Shell> SampleApp
```

Check the VS Debug output

Visual Studio command prompt window output



```
c:\> Developer Command Prompt for VS2015  
UEFI Base Training DEBUG DEMO  
- 0x00000000073A6000 - 0x00000000000007000  
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 88C6CEC  
InstallProtocolInterface: 4C8A2451-C207-405B-9694-99EA13251341 EB94090  
  
UEFI Base Training DEBUG DEMO  
0xffffffff USING DEBUG ALL Mask Bits Set  
0x00000040 USING DEBUG DEBUG_INFO  
0x80000000 USING DEBUG DEBUG_ERROR
```

Demo: Change PCDs for SampleApp

The following was added to EmulatorPkg.dsc

```
SampleApp/SampleApp.inf {  
  <PcdsFixedAtBuild>  
    gEfiMdePkgTokenSpaceGuid.PcdDebugPropertyMask|0xff  
    gEfiMdePkgTokenSpaceGuid.PcdDebugPrintErrorLevel|0xffffffff  
}
```


Demo: Build, Run and Test Result

Run the application from the shell

```
Shell> SampleApp
```

Check the VS Debug output

Visual Studio command prompt window output

```
C:\> Developer Command Prompt for VS2015
UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set
0x00000001 USING DEBUG DEBUG_INIT
0x00000002 USING DEBUG DEBUG_WARN
0x00000004 USING DEBUG DEBUG_LOAD
0x00000008 USING DEBUG DEBUG_FS
0x00000010 USING DEBUG DEBUG_POOL
0x00000020 USING DEBUG DEBUG_PAGE
0x00000040 USING DEBUG DEBUG_INFO
0x00000080 USING DEBUG DEBUG_DISPATCH
0x00000100 USING DEBUG DEBUG_VARIABLE
0x00000400 USING DEBUG DEBUG_BM
0x00001000 USING DEBUG DEBUG_BLKIO
0x00004000 USING DEBUG DEBUG_NET
0x00010000 USING DEBUG DEBUG_UNDI
0x00020000 USING DEBUG DEBUG_LOADFILE
0x00080000 USING DEBUG DEBUG_EVENT
0x00080000 USING DEBUG DEBUG_GCD
0x00080000 USING DEBUG DEBUG_CACHE
0x00080000 USING DEBUG DEBUG_VERBOSE
0x80000000 USING DEBUG DEBUG_ERROR
```

CHANGING FLAGS

Changing Compiler & Linker Flags

Precedence for Debug Flags Hierarchy

DSC [BuildOptions] section
(platform scope)

INF [BuildOptions]
section

DSC <BuildOptions>
under a specific module

1. Tools_def.txt
2. DSC [BuildOptions] section (platform scope)
3. INF [BuildOptions] section (module scope)
4. DSC <BuildOptions> under a specific module

Example from Microsoft* compiler to turn off optimization

“/O2” to “/O1” requires “/Od /O1” flags

Change common flags in platform DSC

```
[BuildOptions]
DEBUG_*_IA32_CC_FLAGS = /Od /Oy-
```

Change a single module's flags in DSC

```
MyPath/MyModule.inf {
<BuildOptions>
    DEBUG_*_IA32_CC_FLAGS = /Od /Oy-
}
```

DebugLib USAGE

The DebugLib Class Interface

MdePkg\Include\Library\DebugLib.h

Macros

(where PCDs are checked)

```
ASSERT (Expression)  
DEBUG (Expression)  
ASSERT_EFI_ERROR (StatusParameter)  
ASSERT_PROTOCOL_ALREADY_INSTALLED(...)
```

Advanced Macros

```
DEBUG_CODE (Expression)  
DEBUG_CODE_BEGIN() & DEBUG_CODE_END()  
DEBUG_CLEAR_MEMORY(...)
```



DebugLib Instances (1)

Implementation

BaseDebugLibSerialPort

- Instance of DebugLib
- Uses SerialPortLib class to send debug output to serial port
- Default for many platforms: BaseDebugLibNull
- OVMF uses it with Switch DEBUG_ON_SERIAL_PORT



DebugLib Instances (2)

Implementation

UefiDebugLibConOut UefiDebugLibStdErr

- Instances of DebugLib (for apps and drivers)
- Send all debug output to console/debug console



DebugLib Instances (3)

Implementation

PeiDxeDebugLibReportStatusCode

- Sends ASCII String specified by Description Value to the ReportStatusCode()
- May also use the SerialPortLib class to send debug output to serial port
- BaseDebugLibNull - Resolves references

Default for most platforms



DebugLib Instances (4)

Implementation

BaseDebugLibNull

- Resolves references
- Return Success

Instance to use to disable Debug



Changing Library Instances

Change common library instances in the platform DSC by module type

```
[LibraryClasses.common.IA32]  
DebugLib|MdePkg/Library/BaseDebugLibNull/BaseDebugLibNull.inf
```

Change a single module's library instance in the platform DSC

```
MyPath/MyModule.inf {  
  <LibraryClasses>  
  DebugLib|MdePkg/Library/BaseDebugLibSerialPort.inf  
}
```

Demo – Library Instances for Debugging

Changing specific debug library instances.

Demo: Using Library Instances for Debugging

The following was added to EmulatorPkg.dsc changing the library instances

```
SampleApp/SampleApp.inf {  
  <LibraryClasses>  
    DebugLib|MdePkg/Library/UefiDebugLibConOut/UefiDebugLibConOut.inf  
}
```

Demo: Debug Output in the Console

Application from the shell

```
Shell> SampleApp
```

See that the output from the Debug statements now goes to the console

Debug output to console

```
Shell> sampleapp
```

```
UEFI Base Training DEBUG DEMO
0xffffffff USING DEBUG ALL Mask Bits Set
0x00000040 USING DEBUG DEBUG_INFO
0x80000000 USING DEBUG DEBUG_ERROR
System Table: 0xB7A7C018
```

```
Press any Key to continue :
```

EmulatorPkg

Demo: Debugging EDK II with VS Debugger

SampleApp.c has an
“ASSERT_EFI_ERROR” statement added

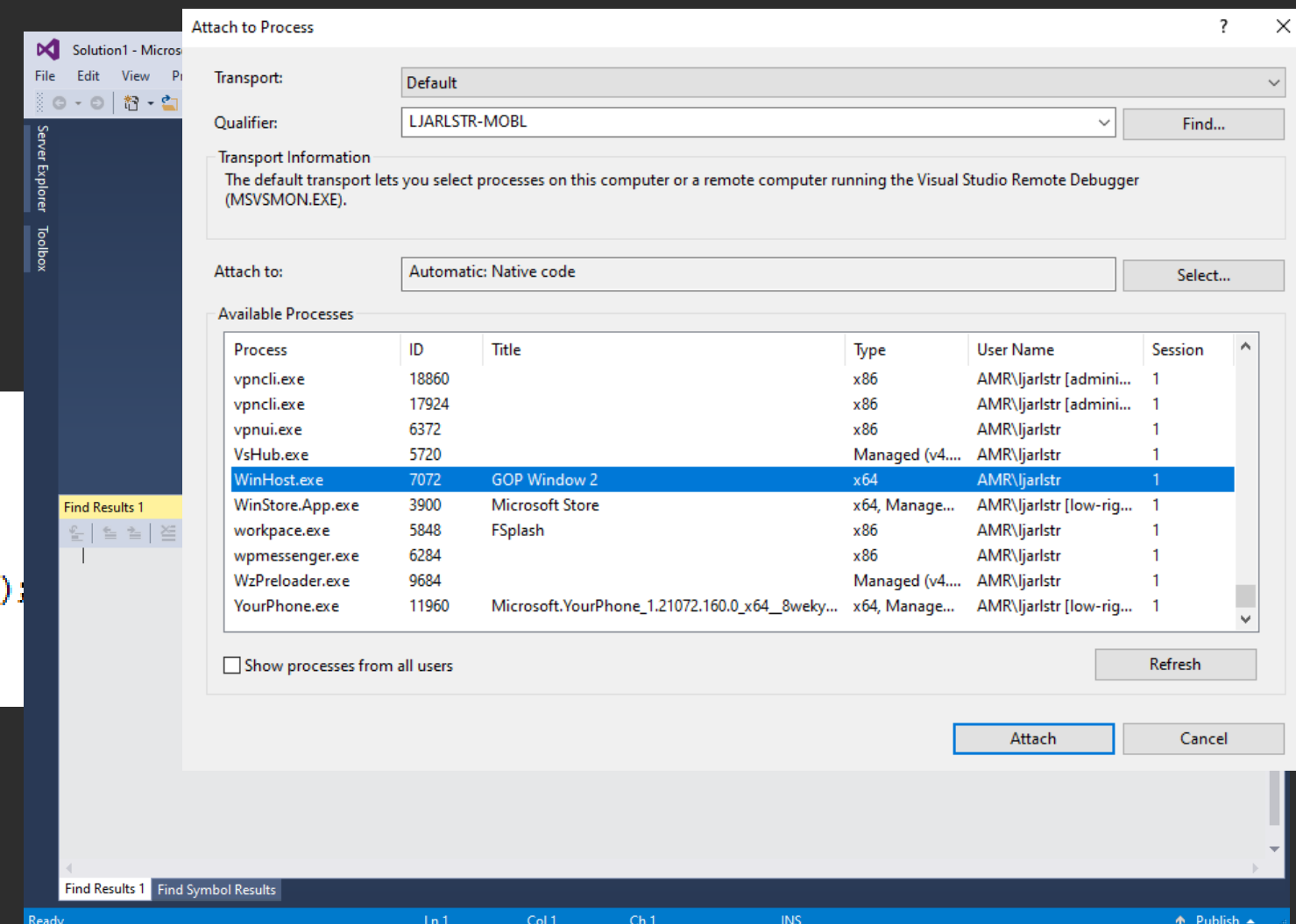
```
EFI_STATUS      Status;
Status = EFI_NO_RESPONSE;
...
ASSERT_EFI_ERROR(Status);
```

```
EFI_STATUS Status;
Status = EFI_NO_RESPONSE; // or any EFI Error
```

```
DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));
```

```
ASSERT_EFI_ERROR(Status);
```

Visual Studio enable the WinHost for
Debugging



Demo: Debug with VS - ASSERT

Application from the shell

```
Shell> SampleApp
```

Assert in VS Command Prompt

Visual Studio command prompt window output

```
Developer Command Prompt for VS2015 - runEmulator.bat
InstallProtocolInterface: 5B1B31A1-9562-11D2-8E3F-00A0C969723B 1D55B83F440
LoadLibraryEx (
  c:\fw\edk2-ws\Build\EmulatorX64\DEBUG_VS2015x86\X64\SampleApp\SampleApp\DEBUG\SampleApp.DLL,
  NULL, DONT_RESOLVE_DLL_REFERENCES)
Loading driver at 0x1D55B7E4000 EntryPoint=0x00077441000 SampleApp.efi
InstallProtocolInterface: BC62157E-3E33-4FEC-9920-2D3B36D750DF 1D55B840018
ProtectUefiImageCommon - 0x5B83F440
- 0x0000001D55B7E4000 - 0x0000000000000E000
InstallProtocolInterface: 752F3136-4E16-4FDC-A22A-E5F46812F4CA 1D557D8D628

UEFI Base Training DEBUG DEMO
0xFFFFFFFF USING DEBUG ALL Mask Bits Set

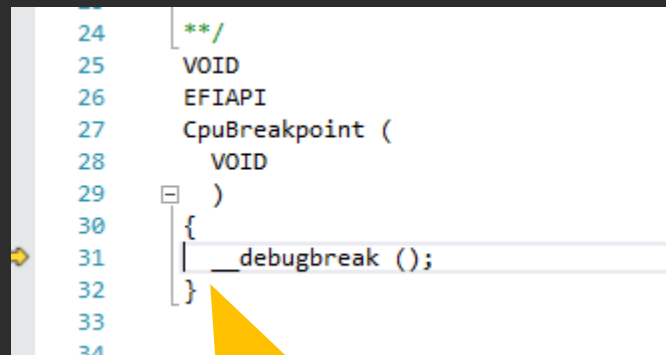
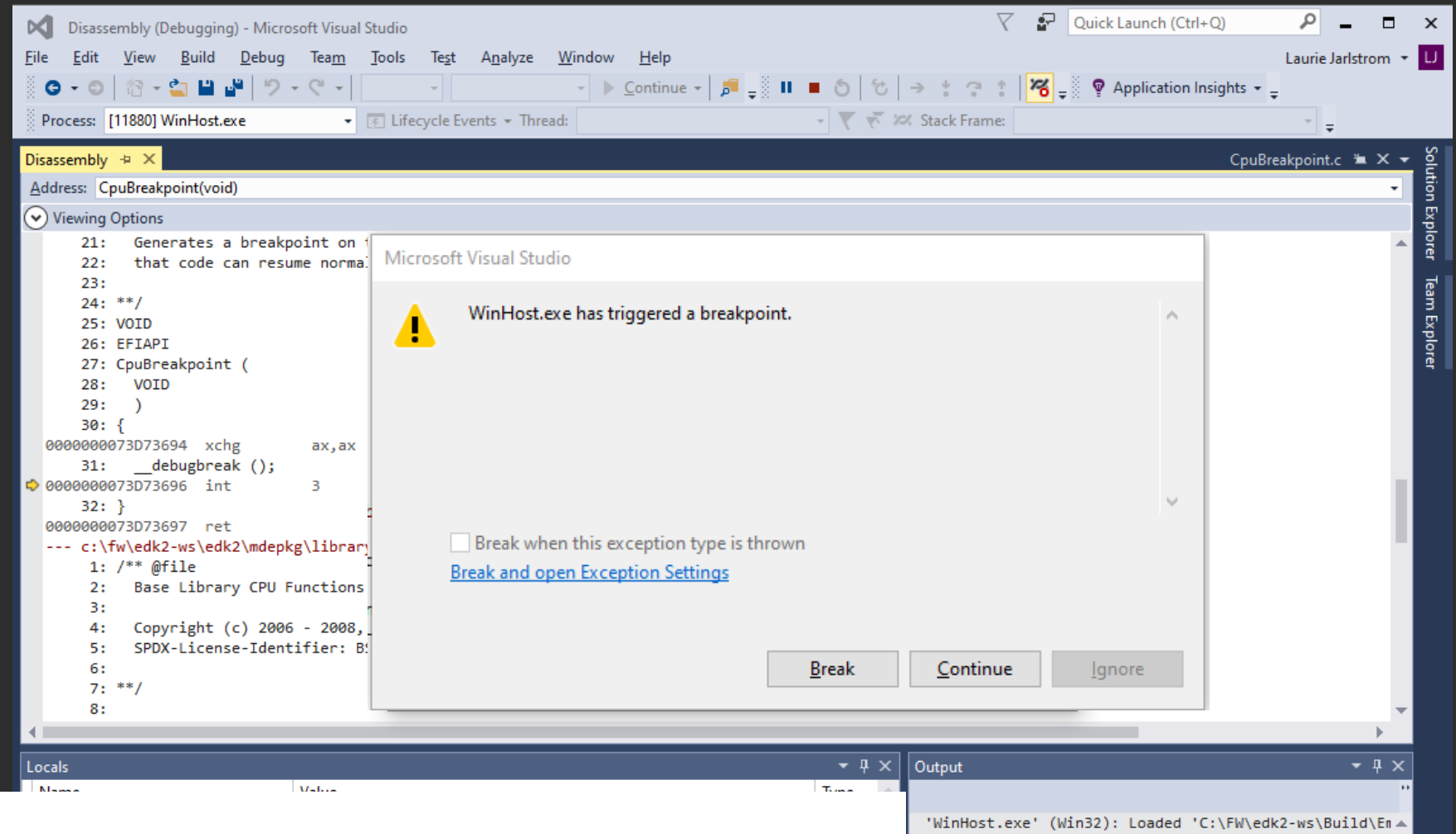
ASSERT_EFI_ERROR (Status = No Response)

DXE_ASSERT!: [SampleApp] c:\fw\edk2-ws\edk2\SampleApp\SampleApp.c (51): !EFI_ERROR (Status)
```

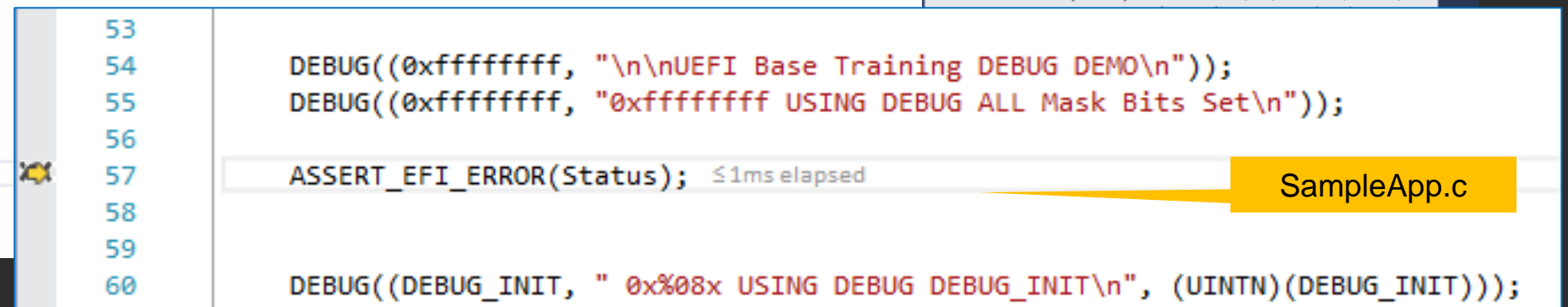
Lab 5: Debug with VS - ASSERT

Windows* VS Debugger

“F5” to continue
“Shift F5” to Stop
debugging



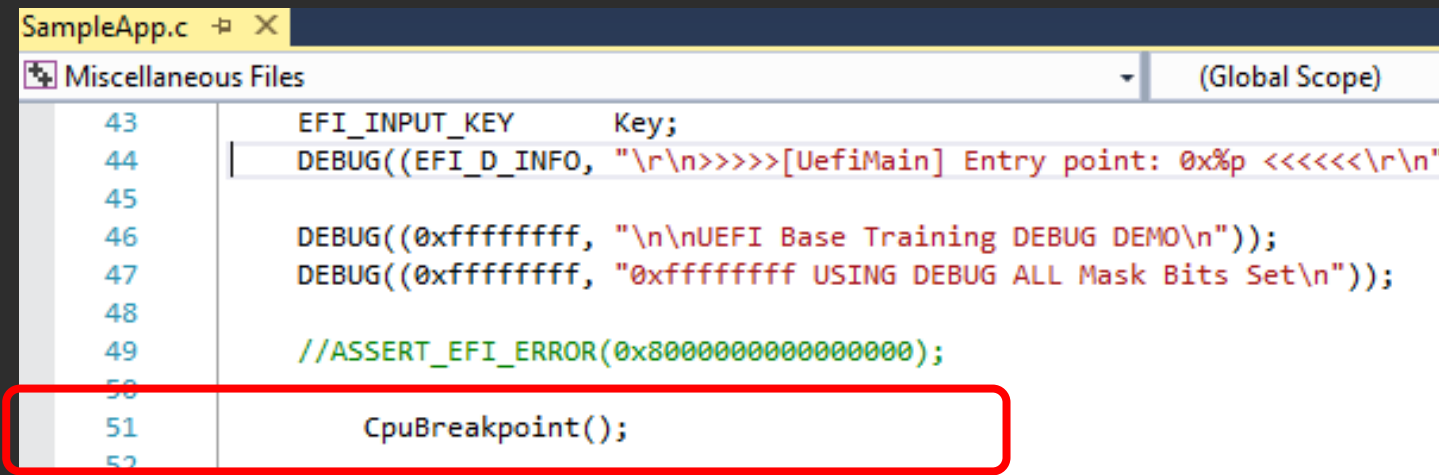
“F10” - Step over 2-3 times



Demo: Debug with VS - CpuBreakpoint

SampleApp.c with “CpuBreakpoint();” Statement and commented out the “ASSERT”

CpuBreakpoint();

A screenshot of the Visual Studio code editor showing a file named SampleApp.c. The editor window has a tab for SampleApp.c and a sidebar on the left showing 'Miscellaneous Files'. The code is displayed in a light blue theme. Line 43 contains 'EFI_INPUT_KEY Key;'. Line 44 contains a DEBUG statement: 'DEBUG((EFI_D_INFO, "\r\n>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n"'. Line 45 is empty. Line 46 contains 'DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));'. Line 47 contains 'DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));'. Line 48 is empty. Line 49 contains a commented-out ASSERT statement: '//ASSERT_EFI_ERROR(0x8000000000000000);'. Line 50 is empty. Line 51 contains 'CpuBreakpoint();' and is highlighted with a red rectangular box. Line 52 is empty. The status bar at the bottom right indicates '(Global Scope)'.

```
43  EFI_INPUT_KEY    Key;
44  DEBUG((EFI_D_INFO, "\r\n>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n"
45
46  DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
47  DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));
48
49  //ASSERT_EFI_ERROR(0x8000000000000000);
50
51  CpuBreakpoint();
52
```

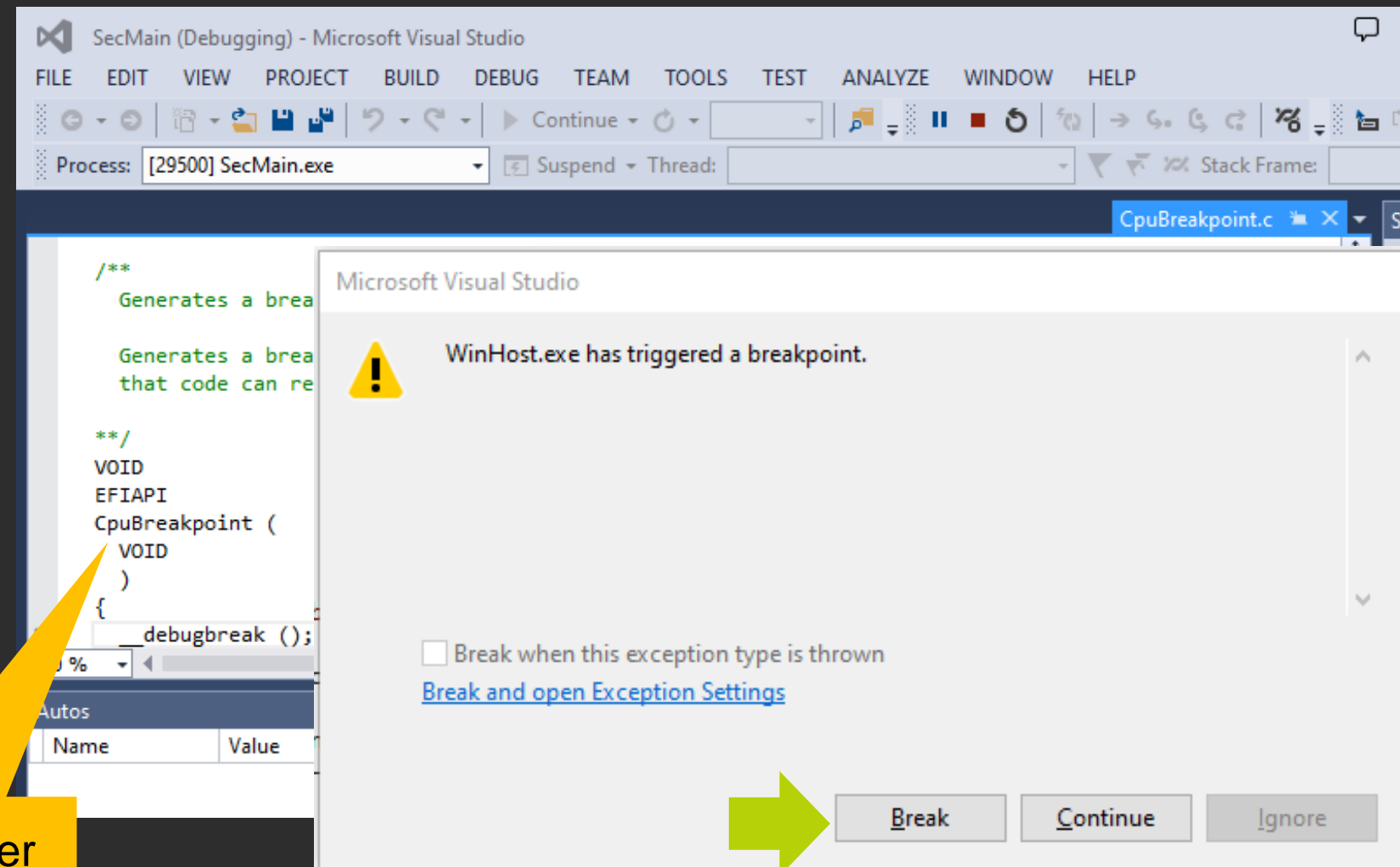
Demo: Debug with VS

Application from the shell

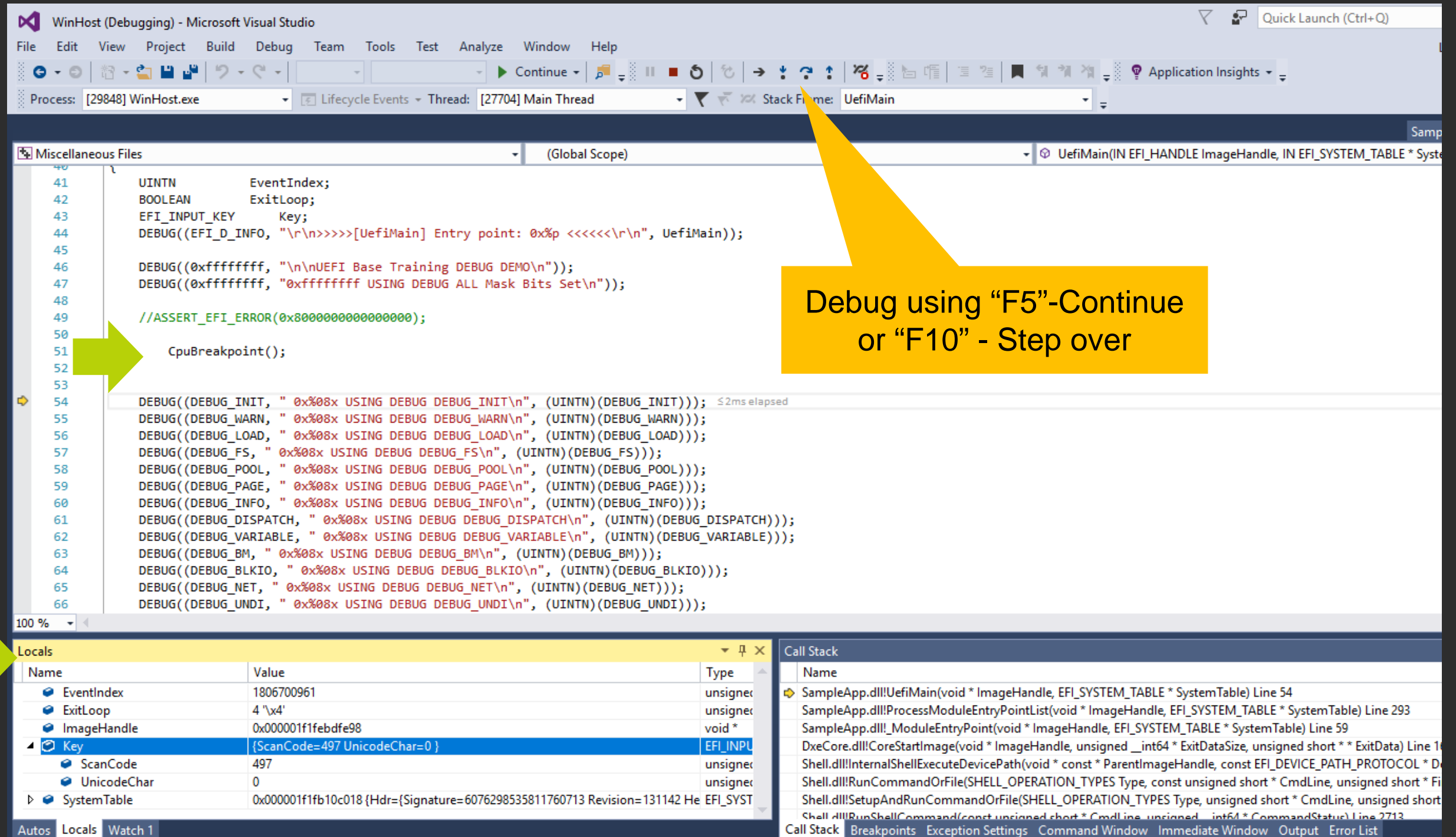
```
Shell> SampleApp
```

VS Debugger pop up,
Press “F10” until
SampleApp.c shows

“F10” - Step over



Demo Windows Visual Studio Debugger



WinHost (Debugging) - Microsoft Visual Studio

File Edit View Project Build Debug Team Tools Test Analyze Window Help

Process: [29848] WinHost.exe Lifecycle Events Thread: [27704] Main Thread Stack Frame: UefiMain

Miscellaneous Files (Global Scope) UefiMain(IN EFI_HANDLE ImageHandle, IN EFI_SYSTEM_TABLE * SystemTable)

```

41  UINTN      EventIndex;
42  BOOLEAN    ExitLoop;
43  EFI_INPUT_KEY  Key;
44  DEBUG((EFI_D_INFO, "\r\n>>>>[UefiMain] Entry point: 0x%p <<<<<\r\n", UefiMain));
45
46  DEBUG((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n"));
47  DEBUG((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\n"));
48
49  //ASSERT_EFI_ERROR(0x8000000000000000);
50
51  CpuBreakpoint();
52
53
54  DEBUG((DEBUG_INIT, " 0x%08x USING DEBUG DEBUG_INIT\n", (UINTN)(DEBUG_INIT)));
55  DEBUG((DEBUG_WARN, " 0x%08x USING DEBUG DEBUG_WARN\n", (UINTN)(DEBUG_WARN)));
56  DEBUG((DEBUG_LOAD, " 0x%08x USING DEBUG DEBUG_LOAD\n", (UINTN)(DEBUG_LOAD)));
57  DEBUG((DEBUG_FS, " 0x%08x USING DEBUG DEBUG_FS\n", (UINTN)(DEBUG_FS)));
58  DEBUG((DEBUG_POOL, " 0x%08x USING DEBUG DEBUG_POOL\n", (UINTN)(DEBUG_POOL)));
59  DEBUG((DEBUG_PAGE, " 0x%08x USING DEBUG DEBUG_PAGE\n", (UINTN)(DEBUG_PAGE)));
60  DEBUG((DEBUG_INFO, " 0x%08x USING DEBUG DEBUG_INFO\n", (UINTN)(DEBUG_INFO)));
61  DEBUG((DEBUG_DISPATCH, " 0x%08x USING DEBUG DEBUG_DISPATCH\n", (UINTN)(DEBUG_DISPATCH)));
62  DEBUG((DEBUG_VARIABLE, " 0x%08x USING DEBUG DEBUG_VARIABLE\n", (UINTN)(DEBUG_VARIABLE)));
63  DEBUG((DEBUG_BM, " 0x%08x USING DEBUG DEBUG_BM\n", (UINTN)(DEBUG_BM)));
64  DEBUG((DEBUG_BLKIO, " 0x%08x USING DEBUG DEBUG_BLKIO\n", (UINTN)(DEBUG_BLKIO)));
65  DEBUG((DEBUG_NET, " 0x%08x USING DEBUG DEBUG_NET\n", (UINTN)(DEBUG_NET)));
66  DEBUG((DEBUG_UNDI, " 0x%08x USING DEBUG DEBUG_UNDI\n", (UINTN)(DEBUG_UNDI)));

```

100 %

Locals

Name	Value	Type
EventIndex	1806700961	unsigned int
ExitLoop	4 '\x4'	unsigned char
ImageHandle	0x000001f1febdfe98	void *
Key	{ScanCode=497 UnicodeChar=0}	EFI_INPUT_KEY
ScanCode	497	unsigned short
UnicodeChar	0	unsigned char
SystemTable	0x000001f1fb10c018 {Hdr={Signature=6076298535811760713 Revision=131142 He EFI_SYST	EFI_SYSTEM_TABLE

Autos Locals Watch 1

Call Stack

Name
SampleApp.dll!UefiMain(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 54
SampleApp.dll!ProcessModuleEntryPointList(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 293
SampleApp.dll!ModuleEntryPoint(void * ImageHandle, EFI_SYSTEM_TABLE * SystemTable) Line 59
DxeCore.dll!CoreStartImage(void * ImageHandle, unsigned __int64 * ExitDataSize, unsigned short * ExitData) Line 14
Shell.dll!InternalShellExecuteDevicePath(void * const * ParentImageHandle, const EFI_DEVICE_PATH_PROTOCOL * DevicePath) Line 14
Shell.dll!RunCommandOrFile(SHELL_OPERATION_TYPES Type, const unsigned short * CmdLine, unsigned short * ExitData) Line 14
Shell.dll!SetupAndRunCommandOrFile(SHELL_OPERATION_TYPES Type, unsigned short * CmdLine, unsigned short * ExitData) Line 14
Shell.dll!RunShellCommand(const unsigned short * CmdLine, unsigned __int64 * CommandStatus) Line 2713

Call Stack Breakpoints Exception Settings Command Window Immediate Window Output Error List

Summary

- Debugging Overview
- Using PCDs to Configure DebugLib
- Change Compiler & Linker Flags for debugging
- Change the DebugLib instance to modify the debug output
- Debug EDK II using VS Debugger - Demo

Questions?



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BACK UP

ISSUE:

Debugging in Emulator with Windows 7/10 and Visual Studio does not work?

Symptom: With Windows 7 a `CpuBreakpoint()` or `ASSERT` just exits with an error from the “Build Run” command.

Link to fix this issue:

https://github.com/tianocore/tianocore.github.io/wiki/NT32#Debugging_in_Nt32_Emulation_with_Windows_7_and_Visual_Studio_does_not_work

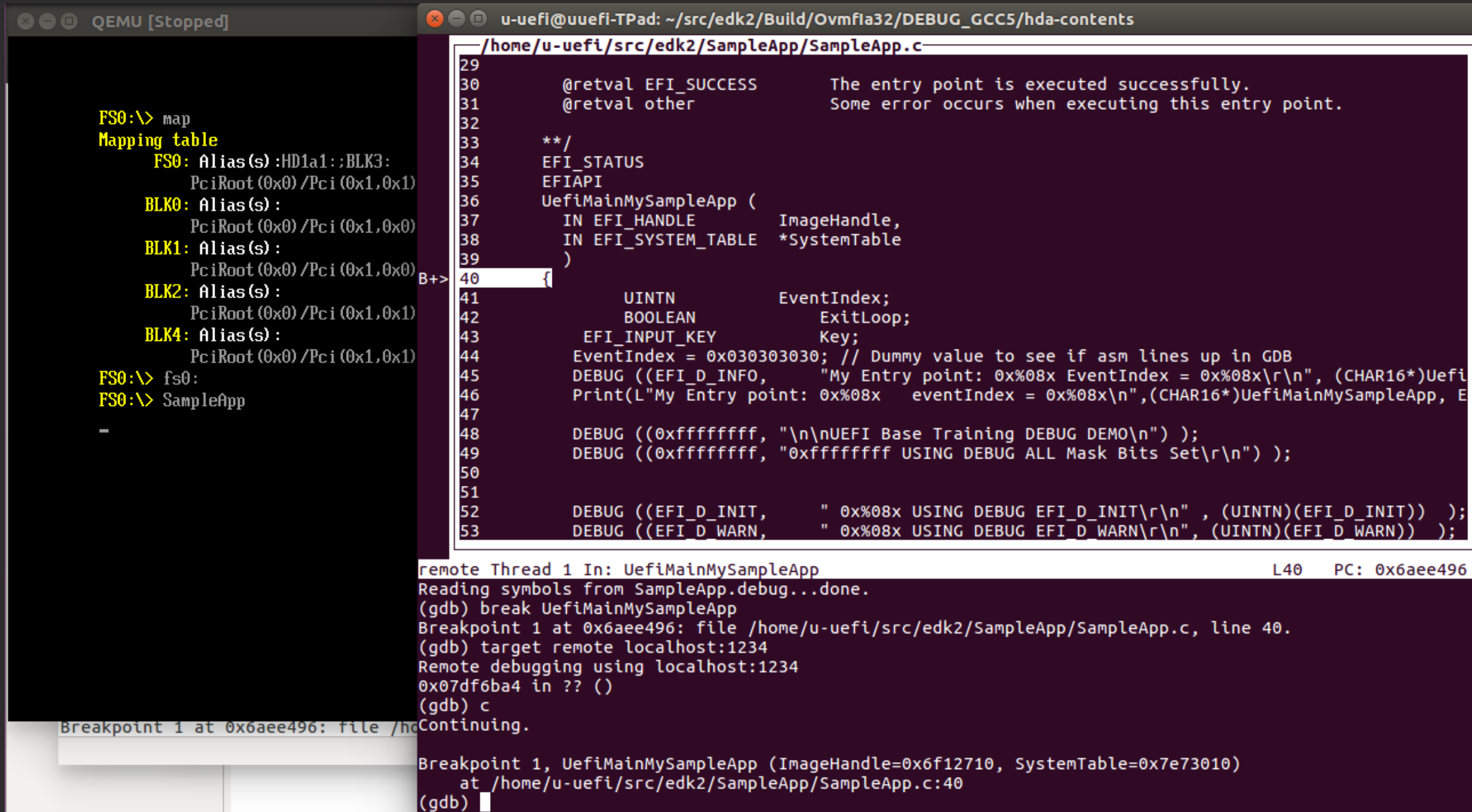
1. Run the RegEdt32
2. Navigate to the HKEY_LOCAL_MACHINE\SOFTWARE\Wow6432Node\Microsoft\Windows NT\CurrentVersion\AeDebug
3. Add a string value entry called "Auto" with a value of "1"

Windows 10 Visual Studio may not have this issue

LINUX EXAMPLE

GDB and QEMU using \$ gdb --tui

The GDB window will look similar to this



The screenshot shows two windows. The left window is titled 'QEMU [Stopped]' and displays the output of the 'map' command, showing memory mappings for FS0, BLK0, BLK1, BLK2, and BLK4. The right window is titled 'u-uefi@uuefi-TPad: ~/src/edk2/Build/OvmfIa32/DEBUG_GCC5/hda-contents' and shows the source code of 'SampleApp.c' with a breakpoint set at line 40. The GDB console at the bottom shows the process of setting a breakpoint, connecting to the remote target, and continuing execution.

```

FS0:\> map
Mapping table
FS0: Alias(s) :HD1a1::BLK3:
PciRoot (0x0) /Pci (0x1,0x1)
BLK0: Alias(s) :
PciRoot (0x0) /Pci (0x1,0x0)
BLK1: Alias(s) :
PciRoot (0x0) /Pci (0x1,0x0)
BLK2: Alias(s) :
PciRoot (0x0) /Pci (0x1,0x1)
BLK4: Alias(s) :
PciRoot (0x0) /Pci (0x1,0x1)
FS0:\> fs0:
FS0:\> SampleApp
-

/home/u-uefi/src/edk2/SampleApp/SampleApp.c
29
30     @retval EFI_SUCCESS      The entry point is executed successfully.
31     @retval other            Some error occurs when executing this entry point.
32
33     **/
34     EFI_STATUS
35     EFIAPI
36     UefiMainMySampleApp (
37         IN EFI_HANDLE        ImageHandle,
38         IN EFI_SYSTEM_TABLE  *SystemTable
39     )
40     {
41         UINTN        EventIndex;
42         BOOLEAN      ExitLoop;
43         EFI_INPUT_KEY Key;
44         EventIndex = 0x03030303; // Dummy value to see if asm lines up in GDB
45         DEBUG ((EFI_D_INFO,      "My Entry point: 0x%08x EventIndex = 0x%08x\r\n", (CHAR16*)Uefi
46         Print(L"My Entry point: 0x%08x   eventIndex = 0x%08x\n", (CHAR16*)UefiMainMySampleApp, E
47
48         DEBUG ((0xffffffff, "\n\nUEFI Base Training DEBUG DEMO\n") );
49         DEBUG ((0xffffffff, "0xffffffff USING DEBUG ALL Mask Bits Set\r\n") );
50
51
52         DEBUG ((EFI_D_INIT,      " 0x%08x USING DEBUG EFI_D_INIT\r\n" , (UINTN)(EFI_D_INIT)) );
53         DEBUG ((EFI_D_WARN,      " 0x%08x USING DEBUG EFI_D_WARN\r\n" , (UINTN)(EFI_D_WARN)) );

remote Thread 1 In: UefiMainMySampleApp                                L40    PC: 0x6aee496
Reading symbols from SampleApp.debug...done.
(gdb) break UefiMainMySampleApp
Breakpoint 1 at 0x6aee496: file /home/u-uefi/src/edk2/SampleApp/SampleApp.c, line 40.
(gdb) target remote localhost:1234
Remote debugging using localhost:1234
0x07df6ba4 in ?? ()
(gdb) c
Continuing.

Breakpoint 1, UefiMainMySampleApp (ImageHandle=0x6f12710, SystemTable=0x7e73010)
at /home/u-uefi/src/edk2/SampleApp/SampleApp.c:40
(gdb)

```