UEFI Development Exploration 48 – Building a UEFI Shell Environment (Boot Disk and UEFI Shell in VirtualBox)

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When doing UEFI experiments, 32-bit programs can be tested using TianoCore's simulation environment. 64-bit programs can be tested on the actual machine using a boot disk or using a virtual machine .

It is very simple to make a boot disk. However, the boot file I saved previously was lost. I might as well make it again and record the process.

1 Make a boot disk under UEFI BIOS

The startup file can be obtained by compiling ShellPkg. Open the VS command line, enter the EDK directory, execute edksetup.bat, and enter the following command:

build -a IA32 -a X64 -p ShellPkg\ShellPkg.dsc -b RELEASE

In the Build\Shell\RELEASE_VS2015x86 directory of EDK, complete shell executable files for 32-bit and 64-bit will be generated.

Then follow these steps:

1) Format the USB drive to FAT32 (FAT and FAT16 are also acceptable, but are rarely used nowadays);

2) Create an efi\boot folder in the root directory of the USB drive;

3) Rename the two 32-bit and 64-bit shell executable files (both named Shell.efi) to bootx32.efi and bootx64.efi respectively, and copy them to the efi\boot directory of the USB flash drive.

Insert the prepared USB flash drive into the computer, and choose to boot from the USB flash drive when starting the computer (each BIOS is slightly different, the common ones are to press F11 to select the boot item, or enter the Bios Setup setting to boot from the USB flash drive), and you can enter the UEFI shell.

2. Make a UEFI boot disk under Legacy BIOS

According to my experience, since 2011, all major PC manufacturers have switched from Legacy BIOS to UEFI BIOS, and now it is difficult to find machines that only support Legacy BIOS on the market. However, considering some special cases, such as my company, there are still many Legacy BIOS machines used to test shipped cards, and the test programs are also developed under UEFI, so it is necessary to run the UEFI execution environment under Legacy BIOS.

EDK2 provides DUET (Developer's UEFI Emulation), which is a UEFI emulator based on the Legacy BIOS system, and is designed to provide a UEFI operating environment that can run on the Legacy BIOS. It supports the boot mode based on MBR (Master Boot Record, located in the boot area of the first sector), and enters the UEFI execution environment after booting.

For detailed information, please refer to the ReadMe.txt file in DuetPkg under EDK . It mainly involves modifying the MBR and making boot files in the USB flash drive. The specific steps are as follows:

1) **Compile DuetPkg .** Open the VS command line and enter the EDK working directory. Taking the author's working environment as an example, enter the following command:

C:\MyWorkspace>edksetup.bat
C:\MyWorkspace>build -p DuetPkg\DuetPkgIa32.dsc -a IA32 -t VS2015x86
or
C:\MyWorkspace> build -p DuetPkg\DuetPkgX64.dsc -a X64 -t VS2015x86

After executing the above command, PostBuild.bat under DuetPkg will be automatically executed.

2) Create a boot disk. Note that this step will erase the data in the USB drive, so be sure to save the data in the USB drive before operation. Insert the USB drive into the computer, enter the DuetPkg directory under the EDK working directory, run edksetup.bat, and execute the following command to write to the MBR:

C:\MyWorkspace\DuetPkg> CreateBootDisk.bat usb e: FAT32 IA32
or
C:\MyWorkspace\DuetPkg> CreateBootDisk.bat usb e: FAT32 X64

Eject the USB drive, unplug it and reinsert it, and copy the UEFI file to the USB drive using the following command:

C:\MyWorkspace\DuetPkg> CreateBootDisk.bat usb e: FAT32 IA32 step2
or
C:\MyWorkspace\DuetPkg> CreateBootDisk.bat usb e: FAT32 X64 step2

Check the contents of the USB flash drive. After executing this command, the root directory of the USB flash drive has an additional file called efildr20, which is used to boot the system into the UEFI environment. In addition, the directory efi\boot and the bootia32.efi or bootx64.efi in this directory are added.

The Readme.txt also provides the method of making a floppy disk. This is already a very old device. Readers who have the conditions can try it according to the document.

3. Use a virtual machine to build a UEFI Shell environment

In the previous blog, we used EDK's OVMF and the virtual machine Qemu to build a debugging environment. Qemu is very flexible and can be started by replacing the bios file provided by EDK.

Qemu is very powerful, but its use is relatively complicated. In many cases, we just need a UEFI shell environment to test the operation of the program. Here is a method to use VirtualBox to build a test environment. The steps are as follows:

1) Create a vhd file as a hard disk image. You can use the disk management that comes with Windows , or use the tool that comes with VirtualBox to create a vhd file. Here we use the latter method, as shown in the figure:

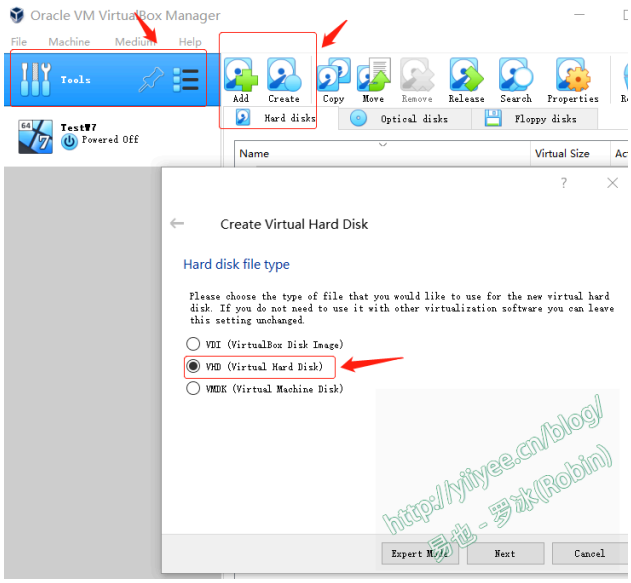

Figure 1 Creating a vhd image

2) Mount the vhd image and format it as FAT32. The operating system mounts the vhd image as a hard disk. You can use the Windows built-in disk management tool to process it, or you can use DiskGenius to process the partition:

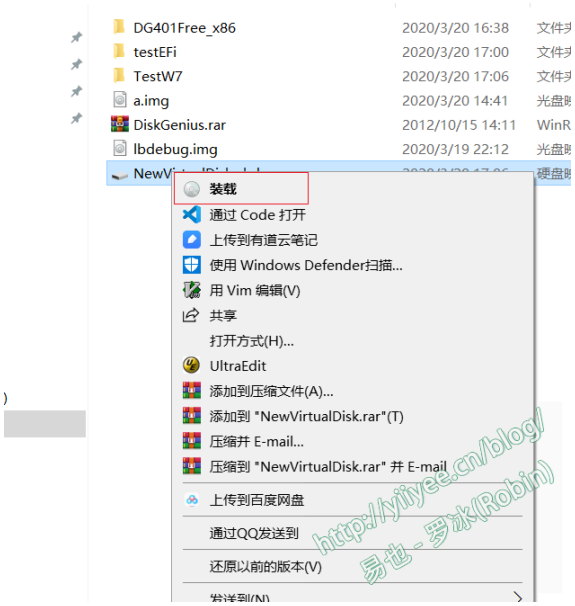

Figure 2: Mounting the vhd image

Figure 3 Formatting the vhd image disk

3) Eject the vhd image. After formatting, the vhd file will be displayed as a disk partition. Copy the UEFI executable file to be tested and eject the loaded disk.

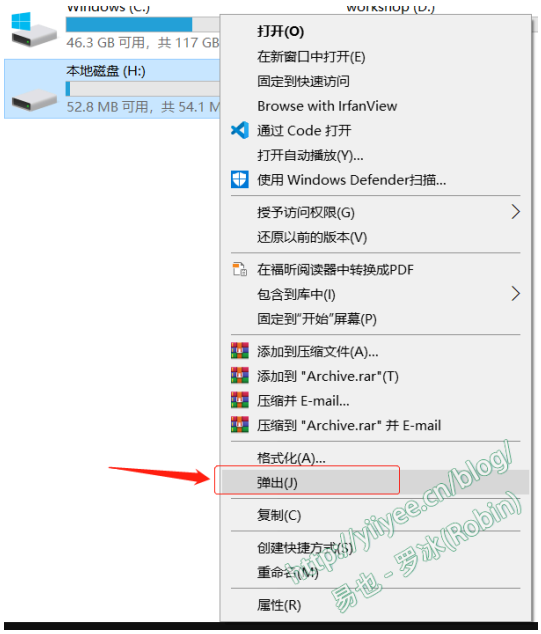

Figure 4 Pop up vhd image

4) Create a virtual machine in VirtualBox. Do not add a hard disk when creating it. After the creation is successful, enable the EFI option in the Motherboard option page of Settings-System. And add the vhd file just prepared as its hard disk as follows.

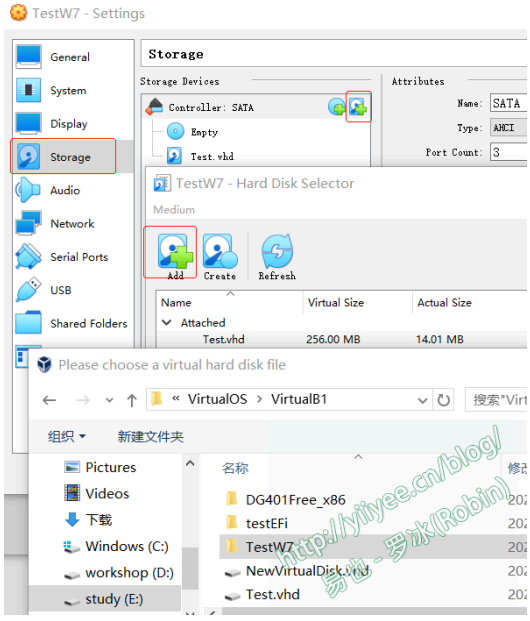

Figure 5 Adding a hard disk file to the virtual machine

At this point, the UEFI shell environment of the virtual machine has been set up. Start the virtual machine and enter the uefi shell. The hard disk just added is loaded with the link name of fs0:. Try running the following code:

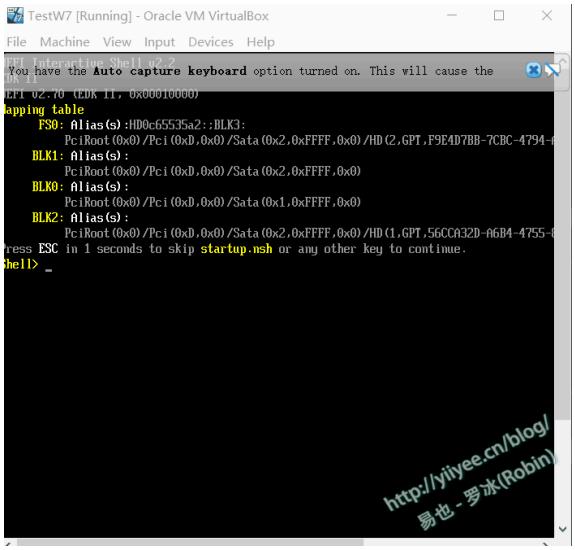

Figure 6 Effect

In summary, there are two ways to build a UEFI shell environment for testing: one is to experiment on an actual machine through a boot disk. The way to make a boot disk is different for UEFI BIOS and Leagy BIOS; the other is to run the UEFI shell directly on a virtual machine. Qemu and VirtualBox are commonly used. The former is powerful and has a high degree of freedom, while the latter is simpler and more convenient. During the experiment, you can freely choose the construction method according to your own situation.

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