

UEFI Development

UEFI Driver Model, Protocols and Apps

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UEFI Images

- UEFI applications and drivers are compiled into images
- An UEFI image is executable (PE/COFF) code
- Images can be loaded into memory and unloaded from there (removed)
- A loaded image can be started (The entry point is called)

Drivers VS Applications

Applications

- An application is executed from the beginning of its entry point to its end
- Possibly with side effects (I/O, etc)

Drivers

- A driver exposes a service to be used asynchronously by others.
- 'Others' may be apps, drivers or timer events

Protocols

- Protocols are data structures that contain function pointers
- They can also have data members (e.g. version numbers)
- These pointers should point to the implementation provided by some driver

Example 1: EFI_SIMPLE_FILE_SYSTEM_PROTOCOL

```
typedef struct
_EFI_SIMPLE_FILE_SYSTEM_PROTOCOL {
    UINT64      Revision;
    EFI_VOLUME_OPEN OpenVolume;
} EFI_SIMPLE_FILE_SYSTEM_PROTOCOL;
```

```
typedef
EFI_STATUS
(EFIAPI *EFI_VOLUME_OPEN) (
    IN EFI_SIMPLE_FILE_SYSTEM_PROTOCOL    * This,
    OUT EFI_FILE                          **Root
);
```

Handles

- The handle database is the most important data structure in the DXE phase
- In each handle there may be any number of protocols and images installed
- A GUID uniquely identifies a resource within a handle
- In a given handle there can be only one resource with a given GUID

The Boot Services Table

Is a set of functions that is globally accessible.

They can be used to:

- Find resources in the handle database
- Load, start and unload images
- Create and start timers
- Many other things

Header `UefiBootServicesTableLib.h` declares a global pointer `gBS` to this table

Example 2: Using the EFI_SIMPLE_FILE_SYSTEM_PROTOCOL

```
EFI_HANDLE Handle = NULL;
EFI_SIMPLE_FILE_SYSTEM_PROTOCOL *FSProtocol = NULL;
EFI_FILE_PROTOCOL *RootDir = NULL;
EFI_FILE_PROTOCOL *File = NULL;
```

```
EFI_STATUS Status = gBS->LocateHandle (
    AllHandles,
    &gEfiSimpleFileSystemProtocol,
    NULL,
    &BufferSize,
    &Handle
);
```

```
Status = gBS->OpenProtocol (
    Handle,
    &gEfiSimpleFileSystemProtocol,
    (VOID **) &FSProtocol,
    ImageHandle,
    NULL,
    EFI_OPEN_PROTOCOL_GET_PROTOCOL
);
```

```
Status = FSProtocol->OpenVolume (
    FSProtocol,
    &RootDir
);
```

```
Status = RootDir->Open (
    RootDir,
    &File,
    L"FileName.txt",
    EFI_FILE_MODE_READ,
    EFI_FILE_VALID_ATTR
);
```

```
Status = File->Read (
    File,
    &BufferSize,
    Buffer
);
```


Driver development

A driver that follows the “UEFI driver model” exposes an entry point, an unload function (optional but recommended) and installs at least:

- The `EFI_DRIVER_BINDING_PROTOCOL`
- The `EFI_SUPPORTED_EFI_VERSION_PROTOCOL`
- The `EFI_COMPONENT_NAME_PROTOCOL`
- The `EFI_COMPONENT_NAME2_PROTOCOL`

Installing the protocols

The driver's entry point:

```
EFI_STATUS
EFIAPI
MyDriverEntry (
    IN EFI_HANDLE ImageHandle,
    IN EFI_SYSTEM_TABLE *SystemTable
)
{
    EFI_STATUS Status = gBS->InstallMultipleProtocolInterfaces (
        &ImageHandle,
        &gEfiDriverSupportedEfiVersionProtocolGuid,
        &gMyDriverSupportedEfiVersion,
        &gEfiDriverBindingProtocolGuid,
        &gMyDriverDriverBinding,
        &gEfiComponentNameProtocolGuid,
        &gMyDriverComponentName,
        &gEfiComponentName2ProtocolGuid,
        &gMyDriverComponentName2,
        NULL
    );

    return Status;
}
```

The EFI_DRIVER_BINDING_PROTOCOL

Contains 3 functions:

Supported():

- Should check if the a handle provides access to a supported device

Start():

- Should install the protocols that make the driver's services available

Stop():

- Should undo everything Start() does

Finding supported devices

Supported(): returns EFI_SUCCESS if ControllerHandle has a reference to a device the driver can manage.

Otherwise it returns EFI_UNSUPPORTED.

Supported() is called for each HANDLE in the handle database on driver initialization, and when new devices are attached.

```
EFI_STATUS
EFIAPI
MyDriverSupported (
    IN EFI_DRIVER_BINDING_PROTOCOL *This,
    IN EFI_HANDLE                  ControllerHandle,
    IN EFI_DEVICE_PATH_PROTOCOL    *RemainingDevicePath
)
{
    EFI_STATUS Status = EFI_SUCCESS;
    BOOLEAN     ThereIsADevice = FALSE;

    Status = DoesHandleContainsAnyMyDevice (
        ControllerHandle,
        &ThereIsADevice
    );

    if (EFI_ERROR (Status)) {
        MaybeHandleError (Status, ControllerHandle);
    }

    if (ThereIsADevice) {
        return EFI_SUCCESS;
    }

    return EFI_UNSUPPORTED;
}
```

Registering driver services

In construction

```
EFI_STATUS
EFIAPI
MyDriverStart (
    IN EFI_DRIVER_BINDING_PROTOCOL *This,
    IN EFI_HANDLE                  ControllerHandle,
    IN EFI_DEVICE_PATH_PROTOCOL    *RemainingDevicePath
)
{
    EFI_STATUS      Status      = EFI_SUCCESS;
    MY_IO_PROTOCOL *MyIOProtocol = NULL;

    Status = InitializeMyIOProtocol (
        &MyIOProtocol
    );

    Status = gBS->InstallMultipleProtocolInterfaces (
        ControllerHandle,
        &gMyIOProtocolGuid
        MyIOProtocol,
        NULL
    );

    return EFI_SUCCESS;
}
```