本章将探索内核级DLL模块注入实现原理，DLL模块注入在应用层中通常会使用`CreateRemoteThread`直接开启远程线程执行即可，驱动级别的注入有多种实现原理，而其中最简单的一种实现方式则是通过劫持EIP的方式实现，其实现原理可总结为，挂起目标进程，停止目标进程EIP的变换，在目标进程开启空间，并把相关的指令机器码和数据拷贝到里面去，然后直接修改目标进程EIP使其强行跳转到我们拷贝进去的相关机器码位置，执行相关代码后，然后再次跳转回来执行原始指令集。

在内核模式中实现这一过程大体可分为如下步骤;

- 1.通过`PsLookupProcessByProcessId`将进程`PID`转为`EProcess`结构
- 2.通过`KeStackAttachProcess`附加到目标进程
- 3.通过`GetUserModule`得到当前进程中`Ntdll.dll`模块的基址
- 4.通过`GetModuleExport`得到`Ntdll.dll`模块内`LdrLoadDll`函数基址
- 5.通过`ZwGetNextThread`得到当前线程句柄
- 6.通过`PsSuspendThread`暂停当前线程运行
- 7.此时通过`GetWow64Code`生成特定的加载代码，并放入`ZwAllocateVirtualMemory`生成的内存中
- 8.修改当前EIP的值指向`newAddress`内存地址
- 7.通过`PsResumeThread`恢复线程执行，让其执行我们的`ShellCode`代码
- 8.最后调用`KeUnstackDetachProcess`脱离目标进程，并释放句柄

首先需要定义一个标准头文件，并将其命名为`lyshark.h`其定义部分如下所示，此部分内容摘录于微软官方文档，如果需要了解结构体内的含义，请去自行查阅微软官方文档;

```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com

#include <ntifs.h>
#include <windef.h>
#include <intrin.h>
#include <ntimage.h>
#include <ntstrsafe.h>

// 线程结构体偏移值
#define MAXCOUNTS 0x200
#define INITIALSTACKOFFSET 0x28
#define WOW64CONTEXTOFFSET 0x1488
#define WOW64_SIZE_OF_80387_REGISTERS 80
#define WOW64_MAXIMUM_SUPPORTED_EXTENSION 512

// 导出函数
NTKERNELAPI PPEB NTAPI PsGetProcessPeb(IN PEPROCESS Process);

// 定义自定义函数指针
typedef PVOID(NTAPI* PPsGetThreadTeb)(IN PETHREAD Thread);
typedef PVOID(NTAPI* PPsGetProcessWow64Process)(_In_ PEPROCESS Process);
typedef NTSTATUS(NTAPI* PPsResumeThread)(PETHREAD Thread, OUT PULONG
PreviousCount);
typedef NTSTATUS(NTAPI* PPsSuspendThread)(IN PETHREAD Thread, OUT PULONG
PreviousSuspendCount OPTIONAL);
```

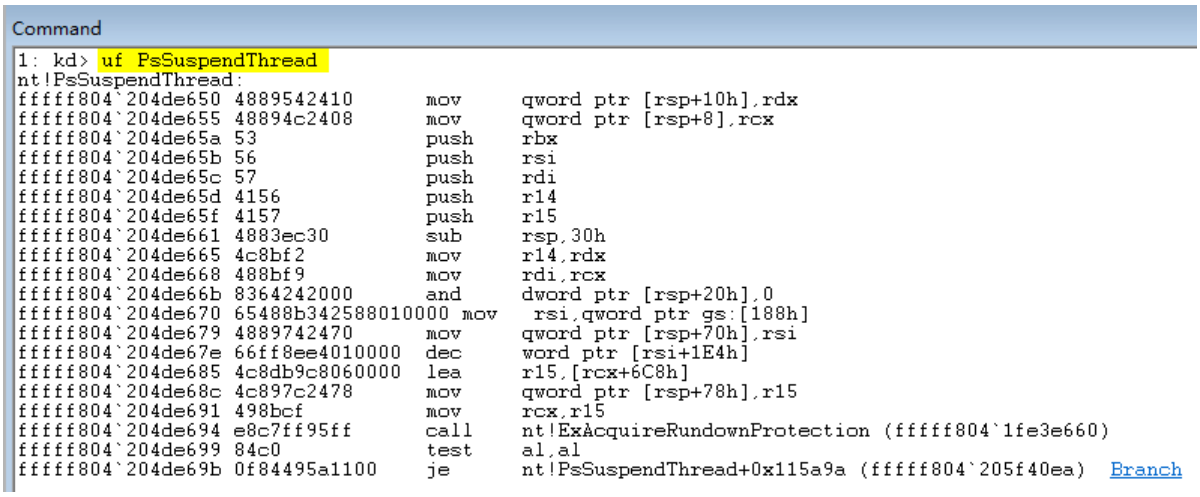
```
typedef NTSTATUS(NTAPI* PZwGetNextThread)(_In_ HANDLE ProcessHandle, _In_ HANDLE
ThreadHandle, _In_ ACCESS_MASK DesiredAccess, _In_ ULONG HandleAttributes, _In_
ULONG Flags, _Out_ PHANDLE NewThreadHandle);

// 存放全局函数指针的变量
PPsGetThreadTeb g_PsGetThreadTeb = NULL;
PPsResumeThread g_PsResumeThread = NULL;
PPsSuspendThread g_PsSuspendThread = NULL;
PZwGetNextThread g_ZwGetNextThread = NULL;
PPsGetProcessWow64Process g_PsGetProcessWow64Process = NULL;

// 定义微软结构体
typedef struct _PEB_LDR_DATA32
{
    ULONG Length;
    UCHAR Initialized;
    ULONG SsHandle;
    LIST_ENTRY32 InLoadOrderModuleList;
    LIST_ENTRY32 InMemoryOrderModuleList;
    LIST_ENTRY32 InInitializationOrderModuleList;
} PEB_LDR_DATA32, *PPEB_LDR_DATA32;

typedef struct _PEB_LDR_DATA
{
    ULONG Length;
    UCHAR Initialized;
    PVOID SsHandle;
    LIST_ENTRY InLoadOrderModuleList;
    LIST_ENTRY InMemoryOrderModuleList;
    LIST_ENTRY InInitializationOrderModuleList;
} PEB_LDR_DATA, *PPEB_LDR_DATA;

typedef struct _LDR_DATA_TABLE_ENTRY32
{
    LIST_ENTRY32 InLoadOrderLinks;
    LIST_ENTRY32 InMemoryOrderLinks;
    LIST_ENTRY32 InInitializationOrderLinks;
    ULONG DllBase;
    ULONG EntryPoint;
    ULONG SizeOfImage;
    UNICODE_STRING32 FullDllName;
    UNICODE_STRING32 BaseDllName;
    ULONG Flags;
    USHORT LoadCount;
    USHORT TlsIndex;
    LIST_ENTRY32 HashLinks;
    ULONG TimeDateStamp;
} LDR_DATA_TABLE_ENTRY32, *PLDR_DATA_TABLE_ENTRY32;

typedef struct _LDR_DATA_TABLE_ENTRY
{
    LIST_ENTRY InLoadOrderLinks;
    LIST_ENTRY InMemoryOrderLinks;
    LIST_ENTRY InInitializationOrderLinks;
    PVOID DllBase;
    PVOID EntryPoint;
```

```
    ULONG SizeOfImage;
    UNICODE_STRING FullDllName;
    UNICODE_STRING BaseDllName;
    ULONG Flags;
    USHORT LoadCount;
    USHORT TlsIndex;
    LIST_ENTRY HashLinks;
    ULONG TimeDateStamp;
} LDR_DATA_TABLE_ENTRY, *PLDR_DATA_TABLE_ENTRY;

typedef struct _PEB32
{
    UCHAR InheritedAddressSpace;
    UCHAR ReadImageFileExecOptions;
    UCHAR BeingDebugged;
    UCHAR BitField;
    ULONG Mutant;
    ULONG ImageBaseAddress;
    ULONG Ldr;
    ULONG ProcessParameters;
    ULONG SubSystemData;
    ULONG ProcessHeap;
    ULONG FastPebLock;
    ULONG AtlThunkSListPtr;
    ULONG IFEOKey;
    ULONG CrossProcessFlags;
    ULONG UserSharedInfoPtr;
    ULONG SystemReserved;
    ULONG AtlThunkSListPtr32;
    ULONG ApiSetMap;
} PEB32, *PPEB32;

typedef struct _PEB
{
    UCHAR InheritedAddressSpace;
    UCHAR ReadImageFileExecOptions;
    UCHAR BeingDebugged;
    UCHAR BitField;
    PVOID Mutant;
    PVOID ImageBaseAddress;
    PPEB_LDR_DATA Ldr;
    PVOID ProcessParameters;
    PVOID SubSystemData;
    PVOID ProcessHeap;
    PVOID FastPebLock;
    PVOID AtlThunkSListPtr;
    PVOID IFEOKey;
    PVOID CrossProcessFlags;
    PVOID KernelCallbackTable;
    ULONG SystemReserved;
    ULONG AtlThunkSListPtr32;
    PVOID ApiSetMap;
} PEB, *PPEB;

typedef struct _KLDR_DATA_TABLE_ENTRY
{
```

```
    LIST_ENTRY InLoadOrderLinks;
    PVOID ExceptionTable;
    ULONG ExceptionTableSize;
    PVOID GpValue;
    ULONG UnKnow;
    PVOID DllBase;
    PVOID EntryPoint;
    ULONG SizeOfImage;
    UNICODE_STRING FullDllName;
    UNICODE_STRING BaseDllName;
    ULONG Flags;
    USHORT LoadCount;
    USHORT __Unused5;
    PVOID SectionPointer;
    ULONG CheckSum;
    PVOID LoadedImports;
    PVOID PatchInformation;
} KLDR_DATA_TABLE_ENTRY, *PKLDR_DATA_TABLE_ENTRY;

typedef struct _WOW64_FLOATING_SAVE_AREA
{
    DWORD ControlWord;
    DWORD StatusWord;
    DWORD TagWord;
    DWORD ErrorOffset;
    DWORD ErrorSelector;
    DWORD DataOffset;
    DWORD DataSelector;
    BYTE RegisterArea[WOW64_SIZE_OF_80387_REGISTERS];
    DWORD Cr0NpxState;
} WOW64_FLOATING_SAVE_AREA;

typedef struct _WOW64_CONTEXT
{
    DWORD padding;
    DWORD ContextFlags;
    DWORD Dr0;
    DWORD Dr1;
    DWORD Dr2;
    DWORD Dr3;
    DWORD Dr6;
    DWORD Dr7;
    WOW64_FLOATING_SAVE_AREA FloatSave;
    DWORD SegGs;
    DWORD SegFs;
    DWORD SegEs;
    DWORD SegDs;
    DWORD Edi;
    DWORD Esi;
    DWORD Ebx;
    DWORD Edx;
    DWORD Ecx;
    DWORD Eax;
    DWORD Ebp;
    DWORD Eip;
    DWORD SegCs;
```

```
    DWORD EFlags;
    DWORD Esp;
    DWORD SegSs;
    BYTE ExtendedRegisters[WOW64_MAXIMUM_SUPPORTED_EXTENSION];
} WOW64_CONTEXT, *PWOW64_CONTEXT;

// 自定义注入结构体
typedef struct _INJECT_BUFFER
{
    UCHAR Code[0x200];
    UNICODE_STRING Path;
    UNICODE_STRING32 Path32;
    wchar_t Buffer[488];
    PVOID ModuleHandle;
    ULONG Complete;
    NTSTATUS Status;
    ULONG64 orgRipAddress;
    ULONG64 orgRip;
} INJECT_BUFFER, *PINJECT_BUFFER;
```

SearchOPcode 特征码定位基址: 在注入之前我们需要通过 `SearchOPcode()` 函数动态的寻找几个关键函数的基址，以 `PsSuspendThread` 函数的寻找为例，通过 `WinDBG` 我们可以定位到该函数，该函数模块在 `ntoskrnl.exe` 中，且无法直接通过 `MmGetSystemRoutineAddress` 拿到，为了能通过代码拿到该函数的入口地址，我提取 `fffff804204de668` 到 `fffff804204de670` 位置处的特征码，由于 `fffff804204de668` 距离 `PsSuspendThread` 函数开头只有 `24` 字节，所以直接通过 `-24` 即可得到。



通过调用 `SearchOPcode()` 并传入机器码即可直接拿到 `PsSuspendThread` 的入口地址，根据上述方式我们需要分别得到 `PsSuspendThread`， `PsResumeThread` 这几个函数的内存基址，这些函数的具体作用如下所示；

- PsSuspendThread() 用于暂停或者挂起线程
- PsResumeThread() 用于恢复线程

其次还需要通过 `MmGetSystemRoutineAddress` 函数动态的得到 `ZwGetNextThread`，`PsGetThreadTeb`， `PsGetProcessWow64Process` 这几个函数的基址，这些函数的具体作用如下所示；

- ZwGetNextThread() 用于获取下一个活动线程
- PsGetThreadTeb() 用于获取线程TEB结构
- PsGetProcessWow64Process() 判断当前进程是否为32位

完整代码如下所示，运行这段代码将定位到我们所需的所有内核函数的基址信息；

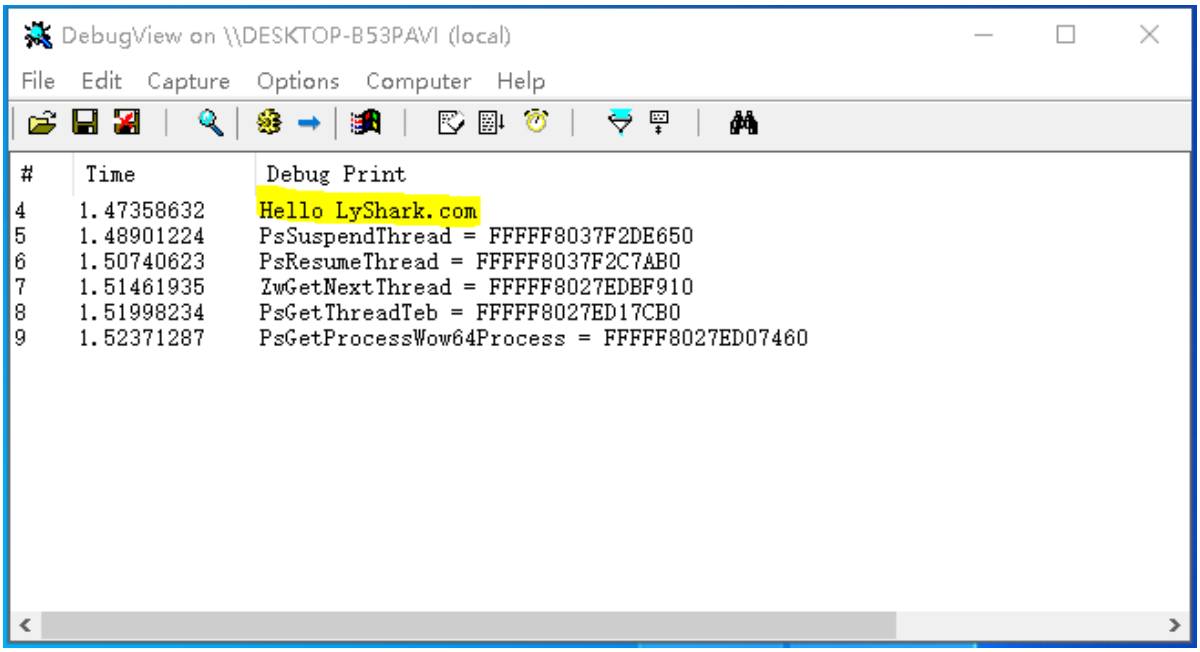
```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com
#include "lyshark.h"

// 内核特征码定位函数封装
// 参数1: 传入驱动句柄
// 参数2: 传入驱动模块名
// 参数3: 传入节表名称
// 参数4: 传入待搜索机器码字节数组
// 参数5: 传入机器码长度
// 参数6: 基址修正字节数
PVOID SearchOPcode(PDRIVER_OBJECT pObj, PWCHAR DriverName, PCHAR sectionName,
PUCHAR opCode, DWORD len, DWORD offset)
{
    PVOID dllBase = NULL;
    UNICODE_STRING uniDriverName;
    PKLDR_DATA_TABLE_ENTRY firstentry;

    // 获取驱动入口
    PKLDR_DATA_TABLE_ENTRY entry = (PKLDR_DATA_TABLE_ENTRY)pObj->DriverSection;

    firstentry = entry;
    RtlInitUnicodeString(&uniDriverName, DriverName);

    // 开始遍历
    while ((PKLDR_DATA_TABLE_ENTRY)entry->InLoadOrderLinks.Flink != firstentry)
    {
        if (entry->FullDllName.Buffer != 0 && entry->BaseDllName.Buffer != 0)
        {
            // 如果找到了所需模块则将其基地址返回
            if (RtlCompareUnicodeString(&uniDriverName, &(entry->BaseDllName),
FALSE) == 0)
            {
                dllBase = entry->DllBase;
                break;
            }
        }
        entry = (PKLDR_DATA_TABLE_ENTRY)entry->InLoadOrderLinks.Flink;
    }

    if (dllBase)
    {
        __try
        {
            // 载入模块基地址
            PIMAGE_DOS_HEADER ImageDosHeader = (PIMAGE_DOS_HEADER)dllBase;
            if (ImageDosHeader->e_magic != IMAGE_DOS_SIGNATURE)
            {
                return NULL;
            }

            // 得到模块NT头以及Section节头
```

```
            PIMAGE_NT_HEADERS64 pImageNtHeaders64 = (PIMAGE_NT_HEADERS64)
((PUCHAR)dllBase + ImageDosHeader->e_lfanew);
            PIMAGE_SECTION_HEADER pSectionHeader = (PIMAGE_SECTION_HEADER)
((PUCHAR)pImageNtHeaders64 + sizeof(pImageNtHeaders64->Signature) +
sizeof(pImageNtHeaders64->FileHeader) + pImageNtHeaders64-
>FileHeader.SizeOfOptionalHeader);

            PUCHAR endAddress = 0;
            PUCHAR starAddress = 0;

            // 寻找符合条件的节
            for (int i = 0; i < pImageNtHeaders64->FileHeader.NumberOfSections;
i++)
            {
                if (memcmp(sectionName, pSectionHeader->Name, strlen(sectionName)
+ 1) == 0)
                {
                    starAddress = pSectionHeader->VirtualAddress +
(PUCHAR)dllBase;
                    endAddress = pSectionHeader->VirtualAddress + (PUCHAR)dllBase
+ pSectionHeader->SizeOfRawData;
                    break;
                }
                pSectionHeader++;
            }

            if (endAddress && starAddress)
            {
                // 找到会开始寻找特征
                for (; starAddress < endAddress - len - 1; starAddress++)
                {
                    // 验证访问权限
                    if (MmIsAddressValid(starAddress))
                    {
                        DWORD i = 0;
                        for (; i < len; i++)
                        {
                            // 判断是否为通配符'*'
                            if (opCode[i] == 0x2a)
                            {
                                continue;
                            }

                            // 找到了一个字节则跳出
                            if (opCode[i] != starAddress[i])
                            {
                                break;
                            }

                        }
                        // 找到次数完全匹配则返回地址
                        if (i == len)
                        {
                            return starAddress + offset;
                        }
                    }
```

```
                }
            }
        }
        __except (EXCEPTION_EXECUTE_HANDLER) {}
    }

    return NULL;
}

NTSTATUS UnDriver(PDRIVER_OBJECT driver)
{
    return STATUS_SUCCESS;
}

NTSTATUS DriverEntry(IN PDRIVER_OBJECT Driver, PUNICODE_STRING RegistryPath)
{
    DbgPrint("Hello LyShark.com \n");

    /*
    0: kd> uf PsSuspendThread
    nt!PsSuspendThread:
    fffff804`204de650 4889542410      mov     qword ptr [rsp+10h],rdx
    fffff804`204de655 48894c2408      mov     qword ptr [rsp+8],rcx
    fffff804`204de65a 53              push    rbx
    fffff804`204de65b 56              push    rsi
    fffff804`204de65c 57              push    rdi
    fffff804`204de65d 4156            push    r14
    fffff804`204de65f 4157            push    r15
    fffff804`204de661 4883ec30        sub     rsp,30h
    fffff804`204de665 4c8bf2          mov     r14,rdx
    fffff804`204de668 488bf9          mov     rdi,rcx
    fffff804`204de66b 8364242000      and     dword ptr [rsp+20h],0
    fffff804`204de670 65488b342588010000 mov   rsi,qword ptr gs:[188h]
    fffff804`204de679 4889742470      mov     qword ptr [rsp+70h],rsi
    fffff804`204de67e 66ff8ee4010000  dec     word ptr [rsi+1E4h]
    fffff804`204de685 4c8db9c8060000  lea     r15,[rcx+6C8h]
    fffff804`204de68c 4c897c2478      mov     qword ptr [rsp+78h],r15
    fffff804`204de691 498bcf          mov     rcx,r15
    fffff804`204de694 e8c7ff95ff      call    nt!ExAcquireRundownProtection
(fffff804`1fe3e660)
    fffff804`204de699 84c0            test    al,al
    fffff804`204de69b 0f84495a1100    je      nt!PsSuspendThread+0x115a9a
(fffff804`205f40ea)  Branch
    */
    UCHAR SuspendOpCode[] = { 0x48, 0x8b, 0xf9, 0x83, 0x64, 0x24, 0x20, 0x00,
0x65, 0x48, 0x8b, 0x34, 0x25, 0x88, 0x01 };

    /*
    0: kd> uf PsResumeThread
    nt!PsResumeThread:
    fffff804`204c7ab0 48895c2408      mov     qword ptr [rsp+8],rbx
    fffff804`204c7ab5 4889742410      mov     qword ptr [rsp+10h],rsi
    fffff804`204c7aba 57              push    rdi
    fffff804`204c7abb 4883ec20        sub     rsp,20h
    fffff804`204c7abf 488bda          mov     rbx,rdx
    fffff804`204c7ac2 488bf9          mov     rdi,rcx
```

```
    fffff804`204c7ac5 e8ee4fa5ff      call    nt!KeResumeThread
(fffff804`1ff1cab8)
    fffff804`204c7aca 65488b142588010000 mov   rdx,qword ptr gs:[188h]
    fffff804`204c7ad3 8bf0            mov     esi,eax
    fffff804`204c7ad5 83f801          cmp     eax,1
    fffff804`204c7ad8 7521            jne     nt!PsResumeThread+0x4b
(fffff804`204c7afb)  Branch
    */
    UCHAR ResumeOpCode[] = { 0x48, 0x8b, 0xf9, 0xe8, 0xee, 0x4f, 0xa5, 0xff,
0x65, 0x48, 0x8b, 0x14, 0x25, 0x88 };

    // 特征码检索PsSuspendThread函数基址
    g_PsSuspendThread = (PPsSuspendThread)SearchOPcode(Driver, L"ntoskrnl.exe",
"PAGE", SuspendOpCode, sizeof(SuspendOpCode), -24);
    DbgPrint("PsSuspendThread = %p \n", g_PsSuspendThread);

    // 特征码检索PsResumeThread基址
    g_PsResumeThread = (PPsResumeThread)SearchOPcode(Driver, L"ntoskrnl.exe",
"PAGE", ResumeOpCode, sizeof(ResumeOpCode), -18);
    DbgPrint("PsResumeThread = %p \n", g_PsResumeThread);

    // 动态获取内存中的ZwGetNextThread基址
    UNICODE_STRING ZwGetNextThreadString =
RTL_CONSTANT_STRING(L"ZwGetNextThread");
    g_ZwGetNextThread =
(PZwGetNextThread)MmGetSystemRoutineAddress(&ZwGetNextThreadString);
    DbgPrint("ZwGetNextThread = %p \n", g_ZwGetNextThread);

    // 动态获取内存中的PsGetThreadTeb基址
    UNICODE_STRING PsGetThreadTebString = RTL_CONSTANT_STRING(L"PsGetThreadTeb");
    g_PsGetThreadTeb =
(PPsGetThreadTeb)MmGetSystemRoutineAddress(&PsGetThreadTebString);
    DbgPrint("PsGetThreadTeb = %p \n", g_PsGetThreadTeb);

    // 动态获取内存中的PsGetProcessWow64Process基址
    UNICODE_STRING PsGetProcessWow64ProcessString =
RTL_CONSTANT_STRING(L"PsGetProcessWow64Process");
    g_PsGetProcessWow64Process =
(PPsGetProcessWow64Process)MmGetSystemRoutineAddress(&PsGetProcessWow64ProcessStr
ing);
    DbgPrint("PsGetProcessWow64Process = %p \n", g_PsGetProcessWow64Process);

    Driver->DriverUnload = UnDriver;
    return STATUS_SUCCESS;
}
```

编译并运行如上代码片段，则会输出我们所需函数的入口地址，输出效果图如下所示；



GetUserModule 获取模块基址: 此函数的功能是获取到当前内核下特定模块的基址，函数接收三个参数，在入口`DriverEntry`位置通过`KeStackAttachProcess`附加到进程空间内，如果是32位进程则通过`PsGetProcessWow64Process`得到进程的PEB结构，如果是64位则通过`PsGetProcessPeb`得到PEB进程环境块的目的是为了解析`PLIST_ENTRY32`链表，通过`RtlCompareUnicodeString`对比模块是否符合要求，如果符合则在此链表中取出`LdrDataTableEntry32->DllBase`模块基址并返回给调用者，其完整代码片段如下所示;

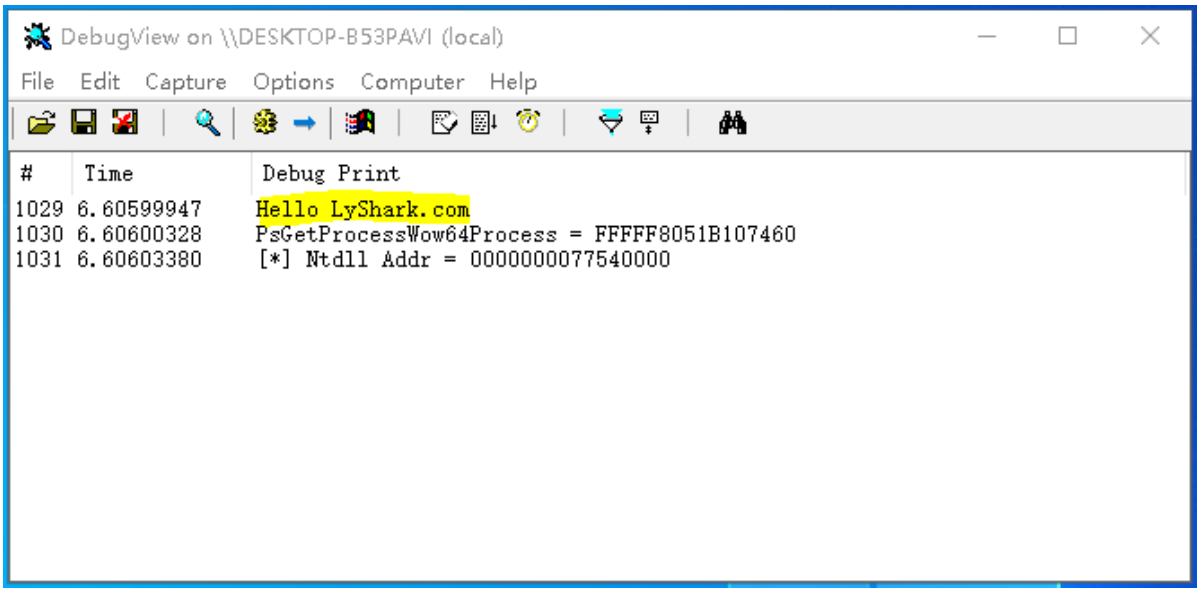
- 1.通过`KeStackAttachProcess`附加到用户层进程空间内
- 2.通过各种函数获取到进程`PEB`进程环境块
- 3.遍历`PLIST_ENTRY32`链表，判断`ModuleName`是否所需
- 4.获取`LdrDataTableEntry32->DllBase`中的模块基址

```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com

#include "lyshark.h"

// 得到当前用户进程下的模块基址
// 参数1：传入用户EProcess结构
// 参数2：传入模块名
// 参数3：是否32位
PVOID GetUserModule(IN PEPROCESS EProcess, IN PUNICODE_STRING ModuleName, IN
BOOLEAN IsWow64)
{
    if (EProcess == NULL)
        return NULL;
    __try
    {
        // 执行32位
        if (IsWow64)
        {
            // 获取32位下的PEB进程环境块
            PPEB32 Peb32 = (PPEB32)g_PsGetProcessWow64Process(EProcess);
```

```
            if (Peb32 == NULL)
                return NULL;

            if (!Peb32->Ldr)
                return NULL;

            // 循环遍历链表 寻找模块
            for (PLIST_ENTRY32 ListEntry = (PLIST_ENTRY32)
((PPEB_LDR_DATA32)Peb32->Ldr)->InLoadOrderModuleList.Flink;
                ListEntry != &((PPEB_LDR_DATA32)Peb32->Ldr)-
>InLoadOrderModuleList;
                ListEntry = (PLIST_ENTRY32)ListEntry->Flink)
            {
                UNICODE_STRING UnicodeString;
                PLDR_DATA_TABLE_ENTRY32 LdrDataTableEntry32 =
CONTAINING_RECORD(ListEntry, LDR_DATA_TABLE_ENTRY32, InLoadOrderLinks);

                // 初始化模块名
                RtlUnicodeStringInit(&UnicodeString, (PWCH)LdrDataTableEntry32-
>BaseDllName.Buffer);

                // 对比模块名是否符合
                if (RtlCompareUnicodeString(&UnicodeString, ModuleName, TRUE) ==
0)
                    return (PVOID)LdrDataTableEntry32->DllBase;
            }
        }
        // 执行64位
        else
        {
            // 得到64位PEB进程环境块
            PPEB Peb = PsGetProcessPeb(EProcess);
            if (!Peb)
                return NULL;

            if (!Peb->Ldr)
                return NULL;

            // 开始遍历模块
            for (PLIST_ENTRY ListEntry = Peb->Ldr->InLoadOrderModuleList.Flink;
                ListEntry != &Peb->Ldr->InLoadOrderModuleList;
                ListEntry = ListEntry->Flink)
            {
                // 得到表头
                PLDR_DATA_TABLE_ENTRY LdrDataTableEntry =
CONTAINING_RECORD(ListEntry, LDR_DATA_TABLE_ENTRY, InLoadOrderLinks);

                // 判断是否是所需要的模块
                if (RtlCompareUnicodeString(&LdrDataTableEntry->BaseDllName,
ModuleName, TRUE) == 0)
                    return LdrDataTableEntry->DllBase;
            }
        }
    }
    __except (EXCEPTION_EXECUTE_HANDLER){}
```

```
    return NULL;
}

NTSTATUS UnDriver(PDRIVER_OBJECT driver)
{
    return STATUS_SUCCESS;
}

NTSTATUS DriverEntry(IN PDRIVER_OBJECT Driver, PUNICODE_STRING RegistryPath)
{
    DbgPrint("Hello LyShark.com \n");

    // 动态获取内存中的PsGetProcessWow64Process基址
    UNICODE_STRING PsGetProcessWow64ProcessString =
RTL_CONSTANT_STRING(L"PsGetProcessWow64Process");
    g_PsGetProcessWow64Process =
(PPsGetProcessWow64Process)MmGetSystemRoutineAddress(&PsGetProcessWow64ProcessStr
ing);
    DbgPrint("PsGetProcessWow64Process = %p \n", g_PsGetProcessWow64Process);

    PEPROCESS pEprocess = NULL;
    DWORD pid = 6084;

    // 根据PID得到进程Eprocess结构
    if (NT_SUCCESS(PsLookupProcessByProcessId((HANDLE)pid, &pEprocess)))
    {
        // 初始化结构
        UNICODE_STRING ntdllString = RTL_CONSTANT_STRING(L"Ntdll.dll");

        KAPC_STATE kApc = { 0 };

        // 附加到进程内
        KeStackAttachProcess(pEprocess, &kApc);

        // 获取NTDLL的模块基地址
        PVOID ntdll_address = GetUserModule(pEprocess, &ntdllString, TRUE);
        if (ntdll_address != NULL)
        {
            DbgPrint("[*] Ntdll Addr = %p \n", ntdll_address);
        }

        // 取消附加
        KeUnstackDetachProcess(&kApc);

        // 递减计数
        ObDereferenceObject(pEprocess);
    }

    Driver->DriverUnload = UnDriver;
    return STATUS_SUCCESS;
}
```

运行如上这段程序，则会取出进程ID为`6084`中`Ntdll.dll`的模块基址，输出效果图如下所示；



GetModuleExport 取导出表函数基址: 此函数的功能是获取到当前内核下特定模块中的特定函数（内存中）基址，函数接收两个参数，在入口 `DriverEntry` 位置通过 `KeStackAttachProcess` 附加到进程空间内，通过解析 `IMAGE_DIRECTORY_ENTRY_EXPORT` 导出表取出导出函数名，此处需要注意如果函数名指针小于等于 `0xFFFF` 则说明是序号导出，如果大于 `0xFFFF` 则说明是名字导出，判断名字是否一致，如果一致则返回当前内存的 `ModuleBase` 模块基址加上 `pAddressOfFuncs[OrdIndex]` 相对偏移，从而获取到内存中的绝对地址，完整代码片段如下所示;

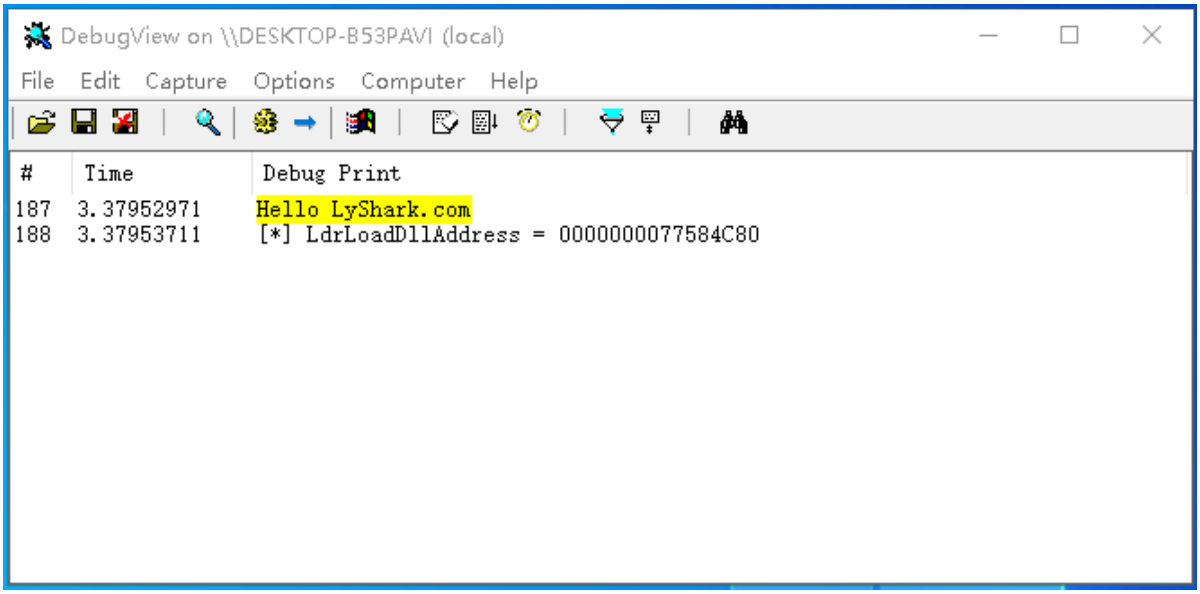
```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com

#include "lyshark.h"

// 根据函数名得到导出表地址
// 参数1: 传入模块入口地址
// 参数2: 传入导出函数名
PVOID GetModuleExport(IN PVOID ModuleBase, IN PCCHAR FunctionName)
{
    PIMAGE_DOS_HEADER ImageDosHeader = (PIMAGE_DOS_HEADER)ModuleBase;
    PIMAGE_NT_HEADERS32 ImageNtHeaders32 = NULL;
    PIMAGE_NT_HEADERS64 ImageNtHeaders64 = NULL;
    PIMAGE_EXPORT_DIRECTORY ImageExportDirectory = NULL;
    ULONG ExportDirectorySize = 0;
    ULONG_PTR FunctionAddress = 0;

    if (ModuleBase == NULL)
        return NULL;

    __try
    {
        // 判断是否是DOS头
        if (ImageDosHeader->e_magic != IMAGE_DOS_SIGNATURE)
        {
            return NULL;
        }

        // 获取PE结构节NT头
```

```
        ImageNtHeaders32 = (PIMAGE_NT_HEADERS32)((PUCHAR)ModuleBase +
ImageDosHeader->e_lfanew);
        ImageNtHeaders64 = (PIMAGE_NT_HEADERS64)((PUCHAR)ModuleBase +
ImageDosHeader->e_lfanew);

        // 判断是否是64位
        if (ImageNtHeaders64->OptionalHeader.Magic ==
IMAGE_NT_OPTIONAL_HDR64_MAGIC)
        {
            // 如果是64位则执行如下
            ImageExportDirectory = (PIMAGE_EXPORT_DIRECTORY)(ImageNtHeaders64-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].VirtualAddress +
(ULONG_PTR)ModuleBase);
            ExportDirectorySize = ImageNtHeaders64-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].Size;
        }
        else
        {
            // 如果32位则执行如下
            ImageExportDirectory = (PIMAGE_EXPORT_DIRECTORY)(ImageNtHeaders32-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].VirtualAddress +
(ULONG_PTR)ModuleBase);
            ExportDirectorySize = ImageNtHeaders32-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].Size;
        }

        // 取出导出表Index，名字，函地址等
        PUSHORT pAddressOfOrds = (PUSHORT)(ImageExportDirectory-
>AddressOfNameOrdinals + (ULONG_PTR)ModuleBase);
        PULONG  pAddressOfNames = (PULONG)(ImageExportDirectory->AddressOfNames +
(ULONG_PTR)ModuleBase);
        PULONG  pAddressOfFuncs = (PULONG)(ImageExportDirectory-
>AddressOfFunctions + (ULONG_PTR)ModuleBase);

        // 循环导出表
        for (ULONG i = 0; i < ImageExportDirectory->NumberOfFunctions; ++i)
        {
            USHORT OrdIndex = 0xFFFF;
            PCHAR  pName = NULL;

            // 说明是序号导出
            if ((ULONG_PTR)FunctionName <= 0xFFFF)
            {
                // 得到函数序号
                OrdIndex = (USHORT)i;
            }
            // 说明是名字导出
            else if ((ULONG_PTR)FunctionName > 0xFFFF && i <
ImageExportDirectory->NumberOfNames)
            {
                // 得到函数名
                pName = (PCHAR)(pAddressOfNames[i] + (ULONG_PTR)ModuleBase);
                OrdIndex = pAddressOfOrds[i];
            }

            else
```

```
                return NULL;

            // 判断函数名是否符合
            if (((ULONG_PTR)FunctionName <= 0xFFFF && (USHORT)
((ULONG_PTR)FunctionName) == OrdIndex + ImageExportDirectory->Base) ||
                ((ULONG_PTR)FunctionName > 0xFFFF && strcmp(pName, FunctionName)
== 0))
            {
                // 得到完整地址
                FunctionAddress = pAddressOfFuncs[OrdIndex] +
(ULONG_PTR)ModuleBase;
                break;
            }
        }
    }
    __except (EXCEPTION_EXECUTE_HANDLER){}

    return (PVOID)FunctionAddress;
}

NTSTATUS UnDriver(PDRIVER_OBJECT driver)
{
    return STATUS_SUCCESS;
}

NTSTATUS DriverEntry(IN PDRIVER_OBJECT Driver, PUNICODE_STRING RegistryPath)
{
    DbgPrint("Hello LyShark.com \n");

    PEPROCESS pEprocess = NULL;
    DWORD pid = 6084;

    // 根据PID得到进程Eprocess结构
    if (NT_SUCCESS(PsLookupProcessByProcessId((HANDLE)pid, &pEprocess)))
    {
        KAPC_STATE kApc = { 0 };

        // ntdll.dll模块基址
        PVOID ntdll_address = (PVOID)0x0000000077540000;

        // 附加到进程内
        KeStackAttachProcess(pEprocess, &kApc);

        // 取模块中LdrLoadDll函数基址
        PVOID LdrLoadDllAddress = GetModuleExport(ntdll_address, "LdrLoadDll");

        DbgPrint("[*] LdrLoadDllAddress = %p \n", LdrLoadDllAddress);

        // 取消附加
        KeUnstackDetachProcess(&kApc);

        // 递减计数
        ObDereferenceObject(pEprocess);
    }

    Driver->DriverUnload = UnDriver;
```

```
    return STATUS_SUCCESS;
}
```

编译并运行如上代码片段，即可获取到进程6084号，ntdll.dll模块中LdrLoadDll的内存地址，其输出效果图如下所示；



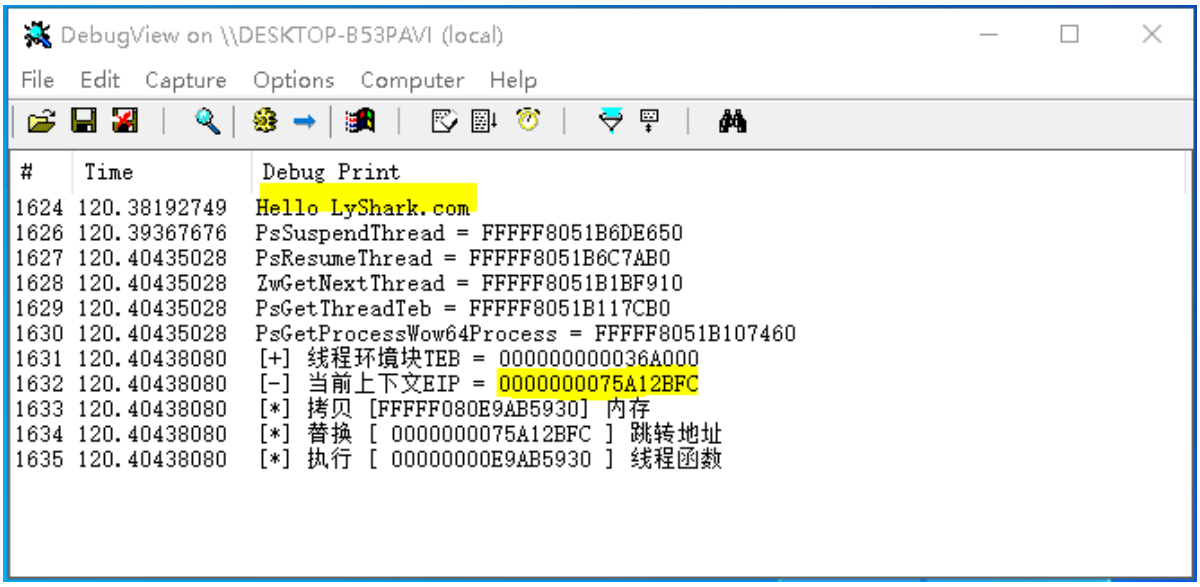
GetCurrentContext 获取当前线程上下文: 此函数的功能是获取附加进程内当前线程的上下文地址，函数接收一个参数，内部通过PsLookupProcessByProcessId得到进程EProcess结构体，通过KeStackAttachProcess附加到进程内，调用g_ZwGetNextThread获取当当前线程上下文，函数ObReferenceObjectByHandle用于将Handle转换为线程对象，之后再通过g_PsSuspendThread暂停线程后，即可通过各类函数获取到该线程的绝大部分信息，最终在调用结束时记得调用g_PsResumeThread恢复线程的运行，并KeUnstackDetachProcess脱离附加，解析上下文环境完整代码如下所示；

```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com

#include "lyshark.h"

// ShellCode 注入线程函数
NTSTATUS GetCurrentContext(ULONG pid, PVOID* allcateAddress)
{
    PEPROCESS pEprocess = NULL;

    // 根据PID得到进程Eprocess结构
    if (NT_SUCCESS(PsLookupProcessByProcessId((HANDLE)pid, &pEprocess)))
    {
        KAPC_STATE kApc = { 0 };

        // 附加到进程内
        KeStackAttachProcess(pEprocess, &kApc);

        HANDLE threadHandle = NULL;

        // 得到当前正在运行的线程上下文
```

```
        if (NT_SUCCESS(g_ZwGetNextThread((HANDLE)-1, (HANDLE)0, 0x1FFFFF, 0x240,
0, &threadHandle)))
        {
            PVOID threadObj = NULL;

            // 在对象句柄上提供访问验证，如果可以授予访问权限，则返回指向对象的正文的相应指针。
            NTSTATUS state = ObReferenceObjectByHandle(threadHandle, 0x1FFFFF,
*PsThreadType, KernelMode, &threadObj, NULL);
            if (NT_SUCCESS(state))
            {
                // 暂停线程
                g_PsSuspendThread(threadObj, NULL);

                __try
                {
                    // 得到TEB
                    PVOID pTeb = g_PsGetThreadTeb(threadObj);
                    if (pTeb)
                    {
                        DbgPrint("[+] 线程环境块TEB = %p \n", pTeb);

                        // 得到当前线程上下文
                        /* WOW64CONTEXTOFFSET = TlsSlots + 8
                            0: kd> dt _TEB
                            nt!_TEB
                            + 0x000 NtTib            : _NT_TIB
                            + 0x1258 StaticUnicodeString : _UNICODE_STRING
                            + 0x1268 StaticUnicodeBuffer : [261] Wchar
                            + 0x1472 Padding3 : [6] UChar
                            + 0x1478 DeallocationStack : Ptr64 Void
                            + 0x1480 TlsSlots : [64] Ptr64 Void
                            + 0x1680 TlsLinks : _LIST_ENTRY
                            + 0x1690 Vdm : Ptr64 Void
                            + 0x1698 ReservedForNtRpc : Ptr64 Void
                            + 0x16a0 DbgSsReserved : [2] Ptr64 Void
                        */

                        PWOW64_CONTEXT  pCurrentContext = (PWOW64_CONTEXT)(*
(ULONG64*)((ULONG64)pTeb + WOW64CONTEXTOFFSET));
                        DbgPrint("[-] 当前上下文EIP = %p \n", pCurrentContext-
>Eip);

                        // 检查上下文是否可读
                        ProbeForRead((PVOID)pCurrentContext,
sizeof(pCurrentContext), sizeof(CHAR));

                        UCHAR Code[] = {
                            0xb8, 0x0, 0x0, 0x0, 0x0,        // mov eax, orgEip
                            0x58,                            // pop eax
                            0xc3                             // ret
                        };

                        // 将ShellCode拷贝到InjectBuffer中等待处理
                        RtlCopyMemory(allcateAddress, Code, sizeof(Code));
                        DbgPrint("[*] 拷贝 [%p] 内存 \n", allcateAddress);;
```

```
                        // 修改代码模板，将指定位置替换为我们自己的代码
                        *(ULONG*)((PUCHAR)allcateAddress + 1) = pCurrentContext-
>Eip;
                        DbgPrint("[*] 替换 [ %p ] 跳转地址 \n", pCurrentContext-
>Eip);

                        // 执行线程
                        pCurrentContext->Eip = (ULONG)(ULONG64)(allcateAddress);
                        DbgPrint("[*] 执行 [ %p ] 线程函数 \n", pCurrentContext-
>Eip);
                    }
                }
                __except (EXCEPTION_EXECUTE_HANDLER) {}

                // 恢复线程
                g_PsResumeThread(threadObj, NULL);
                ObDereferenceObject(threadObj);
            }
            NtClose(threadHandle);
        }

        // 关闭线程
        KeUnstackDetachProcess(&kApc);
        ObDereferenceObject(pEprocess);
    }
    return STATUS_SUCCESS;
}

NTSTATUS UnDriver(PDRIVER_OBJECT driver)
{
    UNREFERENCED_PARAMETER(driver);
    return STATUS_SUCCESS;
}

NTSTATUS DriverEntry(IN PDRIVER_OBJECT Driver, PUNICODE_STRING RegistryPath)
{
    DbgPrint("Hello LyShark.com \n");

    UNREFERENCED_PARAMETER(RegistryPath);

    // 初始化基址
    InitAddress(Driver);

    ULONG ProcessID = 4904;
    PVOID AllcateAddress = NULL;
    DWORD create_size = 1024;

    // 申请堆 《内核远程堆分配与销毁》核心代码
    NTSTATUS Status = AllocMemory(ProcessID, create_size, &AllcateAddress);

    // 执行ShellCode线程注入
    Status = GetCurrentContext(ProcessID, &AllcateAddress);

    Driver->DriverUnload = UnDriver;
    return STATUS_SUCCESS;
}
```

运行如上代码片段，则将输出进程 `ID=4904` 的当前进程内，线程上下文RIP地址，输出效果如下图所示；



KernelInjectDLL 驱动注入: 如上代码中我们已经找到了驱动注入时所需用到的关键函数，那么实现代码就变得很容易了，驱动注入的实现方式有很多种，不论哪一种其实现的难度并不在于代码本身，而在于某些结构如何正确的被找到，一旦结构被找到原理方面的代码可以说非常容易获取到，如下这段完整代码则是驱动注入的一个简化版，如果你觉得不方便完全可以自行添加IOCTL控制器让其更易于使用，此处为了节约篇幅不在增加冗余代码，代码已做具体分析和备注。

此注入驱动核心实现代码如下所示，其中 `SearchOPcode` 用于在内核模块中寻找符合条件的内存地址，`GetNativeCode` 则用于生成一段可被调用的 `ShellCode` 代码，此代码执行的目的就是将DLL动态装载到对端内存中，`SetThreadStartAddress` 则用于填充执行线程结构信息，`GetUserModule` 用户获取进程内特定模块的基址，`GetModuleExport` 用于在模块内寻找特定函数的基址，`KernelInjectDLL` 则是最终注入函数，其首先将线程暂停，并注入生成的 `ShellCode`，然后恢复线程让 `ShellCode` 跑起来，当 `ShellCode` 跑起来后将会自动的将特定目录下的DLL拉起来，以此来实现动态加载的目的。

```
// 署名权
// right to sign one's name on a piece of work
// PowerBy: LyShark
// Email: me@lyshark.com

#include "lyshark.h"

// 内核特征码定位函数封装
PVOID SearchOPcode(PDRIVER_OBJECT pObj, PWCHAR DriverName, PCHAR sectionName,
PUCHAR opCode, int len, int offset)
{
    PVOID dllBase = NULL;
    UNICODE_STRING uniDriverName;
    PKLDR_DATA_TABLE_ENTRY firstentry;

    // 获取驱动入口
    PKLDR_DATA_TABLE_ENTRY entry = (PKLDR_DATA_TABLE_ENTRY)pObj->DriverSection;

    firstentry = entry;
    RtlInitUnicodeString(&uniDriverName, DriverName);

    // 开始遍历
```

```
    while ((PKLDR_DATA_TABLE_ENTRY)entry->InLoadOrderLinks.Flink != firstentry)
    {
        // 如果找到了所需模块则将其基地址返回
        if (entry->FullDllName.Buffer != 0 && entry->BaseDllName.Buffer != 0)
        {
            if (RtlCompareUnicodeString(&uniDriverName, &(entry->BaseDllName),
FALSE) == 0)
            {
                dllBase = entry->DllBase;
                break;
            }
        }
        entry = (PKLDR_DATA_TABLE_ENTRY)entry->InLoadOrderLinks.Flink;
    }

    if (dllBase)
    {
        __try
        {
            // 载入模块基地址
            PIMAGE_DOS_HEADER ImageDosHeader = (PIMAGE_DOS_HEADER)dllBase;
            if (ImageDosHeader->e_magic != IMAGE_DOS_SIGNATURE)
            {
                return NULL;
            }
            // 得到模块NT头
            PIMAGE_NT_HEADERS64 pImageNtHeaders64 = (PIMAGE_NT_HEADERS64)
((PUCHAR)dllBase + ImageDosHeader->e_lfanew);

            // 获取节表头
            PIMAGE_SECTION_HEADER pSectionHeader = (PIMAGE_SECTION_HEADER)
((PUCHAR)pImageNtHeaders64 + sizeof(pImageNtHeaders64->Signature) +
sizeof(pImageNtHeaders64->FileHeader) + pImageNtHeaders64-
>FileHeader.SizeOfOptionalHeader);

            PUCHAR endAddress = 0;
            PUCHAR starAddress = 0;

            // 寻找符合条件的节
            for (int i = 0; i < pImageNtHeaders64->FileHeader.NumberOfSections;
i++)
            {
                // 寻找符合条件的表名
                if (memcmp(sectionName, pSectionHeader->Name, strlen(sectionName)
+ 1) == 0)
                {
                    // 取出开始和结束地址
                    starAddress = pSectionHeader->VirtualAddress +
(PUCHAR)dllBase;
                    endAddress = pSectionHeader->VirtualAddress + (PUCHAR)dllBase
+ pSectionHeader->SizeOfRawData;
                    break;
                }
                // 遍历下一个节
                pSectionHeader++;
            }
```

```
            if (endAddress && starAddress)
            {
                // 找到会开始寻找特征
                for (; starAddress < endAddress - len - 1; starAddress++)
                {
                    // 验证访问权限
                    if (MmIsAddressValid(starAddress))
                    {
                        int i = 0;
                        for (; i < len; i++)
                        {
                            // 判断是否为通配符'*'
                            if (opCode[i] == 0x2a)
                                continue;

                            // 找到了一个字节则跳出
                            if (opCode[i] != starAddress[i])
                                break;
                        }
                        // 找到次数完全匹配则返回地址
                        if (i == len)
                        {
                            return starAddress + offset;
                        }
                    }
                }
            }
        }
        __except (EXCEPTION_EXECUTE_HANDLER) {}
    }

    return NULL;
}

// 生成64位注入代码
PINJECT_BUFFER GetNativeCode(PVOID LdrLoadDll, PUNICODE_STRING DllFullPath,
ULONGLONG orgEip)
{
    SIZE_T Size = PAGE_SIZE;
    PINJECT_BUFFER InjectBuffer = NULL;
    UCHAR Code[] = {
        0x41, 0x57,                                 // push r15
        0x41, 0x56,                                 // push r14
        0x41, 0x55,                                 // push r13
        0x41, 0x54,                                 // push r12
        0x41, 0x53,                                 // push r11
        0x41, 0x52,                                 // push r10
        0x41, 0x51,                                 // push r9
        0x41, 0x50,                                 // push r8
        0x50,                                       // push rax
        0x51,                                       // push rcx
        0x53,                                       // push rbx
        0x52,                                       // push rdx
        0x55,                                       // push rbp
        0x54,                                       // push rsp
        0x56,                                       // push rsi
```

```
        0x57,                                   // push rdi
        0x66, 0x9C,                             // pushf
        0x48, 0x83, 0xEC, 0x26,                 // sub rsp, 0x28
        0x48, 0x31, 0xC9,                       // xor rcx, rcx
        0x48, 0x31, 0xD2,                       // xor rdx, rdx
        0x49, 0xB8, 0, 0, 0, 0, 0, 0, 0, 0,     // mov r8, ModuleFileName
offset +38
        0x49, 0xB9, 0, 0, 0, 0, 0, 0, 0, 0,     // mov r9, ModuleHandle
offset +48
        0x48, 0xB8, 0, 0, 0, 0, 0, 0, 0, 0,     // mov rax, LdrLoadDll
offset +58
        0xFF, 0xD0,                             // call rax
        0x48, 0xBA, 0, 0, 0, 0, 0, 0, 0, 0,     // mov rdx, COMPLETE_OFFSET
offset +70
        0xC7, 0x02, 0x7E, 0x1E, 0x37, 0xC0,     // mov [rdx], CALL_COMPLETE
        0x48, 0xBA, 0, 0, 0, 0, 0, 0, 0, 0,     // mov rdx, STATUS_OFFSET
offset +86
        0x89, 0x02,                             // mov [rdx], eax
        0x48, 0x83, 0xC4, 0x26,                 // add rsp, 0x28
        0x66, 0x9D,                             // popf
        0x5F,                                   // pop rdi
        0x5E,                                   // pop rsi
        0x5C,                                   // pop rsp
        0x5D,                                   // pop rbp
        0x5A,                                   // pop rdx
        0x5B,                                   // pop rbx
        0x59,                                   // pop rcx
        0x58,                                   // pop rax
        0x41, 0x58,                             // pop r8
        0x41, 0x59,                             // pop r9
        0x41, 0x5A,                             // pop r10
        0x41, 0x5B,                             // pop r11
        0x41, 0x5C,                             // pop r12
        0x41, 0x5D,                             // pop r13
        0x41, 0x5E,                             // pop r14
        0x41, 0x5F,                             // pop r15
        0x50,                                   // push rax
        0x50,                                   // push rax
        0x48, 0xB8, 0, 0, 0, 0, 0, 0, 0, 0,     // mov rax, orgEip offset +130
        0x48, 0x89, 0x44, 0x24, 0x08,           // mov [rsp+8],rax
        0x58,                                   // pop rax
        0xC3                                    // ret
    };

    // 在当前进程内分配内存空间
    if (NT_SUCCESS(ZwAllocateVirtualMemory(ZwCurrentProcess(), &InjectBuffer, 0,
&Size, MEM_COMMIT, PAGE_EXECUTE_READWRITE)))
    {
        // 初始化路径变量与长度参数
        PUNICODE_STRING UserPath = &InjectBuffer->Path;
        UserPath->Length = DllFullPath->Length;
        UserPath->MaximumLength = DllFullPath->MaximumLength;
        UserPath->Buffer = InjectBuffer->Buffer;

        RtlUnicodeStringCopy(UserPath, DllFullPath);
```

```
        // 将ShellCode拷贝到InjectBuffer中等待处理
        memcpy(InjectBuffer, Code, sizeof(Code));

        // 修改代码模板，将指定位置替换为我们自己的代码
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 38) = (ULONGLONG)UserPath;
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 48) = (ULONGLONG)& InjectBuffer-
>ModuleHandle;
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 58) = (ULONGLONG)LdrLoadDll;
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 70) = (ULONGLONG)& InjectBuffer-
>Complete;
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 86) = (ULONGLONG)& InjectBuffer-
>Status;
        *(ULONGLONG*)((PUCHAR)InjectBuffer + 130) = orgEip;

        return InjectBuffer;
    }
    return NULL;
}

// 生成32位注入代码
PINJECT_BUFFER GetWow64Code(PVOID LdrLoadDll, PUNICODE_STRING DllFullPath, ULONG
orgEip)
{
    SIZE_T Size = PAGE_SIZE;
    PINJECT_BUFFER InjectBuffer = NULL;

    UCHAR Code[] = {
        0x60,                                   // pushad
        0x9c,                                   // pushfd
        0x68, 0, 0, 0, 0,                       // push ModuleHandle
offset +3
        0x68, 0, 0, 0, 0,                       // push ModuleFileName
offset +8
        0x6A, 0,                                // push Flags
        0x6A, 0,                                // push PathToFile
        0xE8, 0, 0, 0, 0,                       // call LdrLoadDll
offset +17
        0xBA, 0, 0, 0, 0,                       // mov edx, COMPLETE_OFFSET
offset +22
        0xC7, 0x02, 0x7E, 0x1E, 0x37, 0xC0,     // mov [edx], CALL_COMPLETE
        0xBA, 0, 0, 0, 0,                       // mov edx, STATUS_OFFSET
offset +33
        0x89, 0x02,                             // mov [edx], eax
        0x9d,                                   // popfd
        0x61,                                   // popad
        0x50,                                   // push eax
        0x50,                                   // push eax
        0xb8, 0, 0, 0, 0,                       // mov eax, orgEip
        0x89, 0x44, 0x24, 0x04,                 // mov [esp+4],eax
        0x58,                                   // pop eax
        0xc3                                    // ret
    };

    /*
```

```
    如下代码中通过定义Code并写入调用模块加载的汇编指令集，通过运用ZwAllocateVirtualMemory在当前进程也就是附加到对端以后的进程内动态开辟了一块长度为Size的内存空间并赋予了PAGE_EXECUTE_READWRITE读写执行属性，
    由于Code代码无法直接使用，则此处调用RtlCopyMemory将指令拷贝到了InjectBuffer其目的是用于后续的填充工作，最后通过*(ULONG*)((PUCHAR)InjectBuffer + 3)的方式将需要使用的函数地址，
    模块信息等依次填充到汇编代码的指定位置，并返回InjectBuffer指针。
    */

    // 在当前进程内分配内存空间
    if (NT_SUCCESS(ZwAllocateVirtualMemory(ZwCurrentProcess(), &InjectBuffer, 0, &Size, MEM_COMMIT, PAGE_EXECUTE_READWRITE)))
    {
        // 初始化路径变量与长度参数
        PUNICODE_STRING32 pUserPath = &InjectBuffer->Path32;
        pUserPath->Length = DllFullPath->Length;
        pUserPath->MaximumLength = DllFullPath->MaximumLength;
        pUserPath->Buffer = (ULONG)(ULONG_PTR)InjectBuffer->Buffer;

        // 将ShellCode拷贝到InjectBuffer中等待处理
        memcpy((PVOID)pUserPath->Buffer, DllFullPath->Buffer, DllFullPath->Length);
        memcpy(InjectBuffer, Code, sizeof(Code));

        // 修改代码模板，将指定位置替换为我们自己的代码
        *(ULONG*)((PUCHAR)InjectBuffer + 3) = (ULONG)(ULONG_PTR)& InjectBuffer->ModuleHandle;
        *(ULONG*)((PUCHAR)InjectBuffer + 8) = (ULONG)(ULONG_PTR)pUserPath;
        *(ULONG*)((PUCHAR)InjectBuffer + 17) = (ULONG)((ULONG_PTR)LdrLoadDll - ((ULONG_PTR)InjectBuffer + 17) - 5 + 1);
        *(ULONG*)((PUCHAR)InjectBuffer + 22) = (ULONG)(ULONG_PTR)& InjectBuffer->Complete;
        *(ULONG*)((PUCHAR)InjectBuffer + 33) = (ULONG)(ULONG_PTR)& InjectBuffer->Status;
        *(ULONG*)((PUCHAR)InjectBuffer + 44) = orgEip;
        return InjectBuffer;
    }

    return NULL;
}

// 设置线程执行地址
NTSTATUS SetThreadStartAddress(PETHREAD pEthread, BOOLEAN isWow64, PVOID LdrLoadDll, PUNICODE_STRING DllFullPath, PINJECT_BUFFER *allcateAddress)
{
    __try
    {
        // 判断是32位则执行
        if (isWow64)
        {
            // 得到线程TEB
            PVOID pTeb = g_PsGetThreadTeb(pEthread);
            if (pTeb)
            {
                // 得到当前线程上下文
                PWOW64_CONTEXT  pCurrentContext = (PWOW64_CONTEXT)(*(ULONG64*)((ULONG64)pTeb + WOW64CONTEXTOFFSET));
```

```
                // 检查上下文是否可读
                ProbeForRead((PVOID)pCurrentContext, sizeof(pCurrentContext),
sizeof(CHAR));

                // 生成注入代码
                PINJECT_BUFFER newAddress = GetWow64Code(LdrLoadDll, DllFullPath,
pCurrentContext->Eip);
                if (newAddress)
                {
                    // 替换上下文地址到内存中
                    newAddress->orgRipAddress = (ULONG64)& (pCurrentContext-
>Eip);
                    newAddress->orgRip = pCurrentContext->Eip;
                    *allcateAddress = newAddress;
                    pCurrentContext->Eip = (ULONG)(ULONG64)(newAddress);
                }
                return STATUS_SUCCESS;
            }
        }
        // 执行64位代码
        else
        {
            // 验证地址是否可读取
            if (MmIsAddressValid((PVOID)* (ULONG64*)((ULONG64)pEthread +
INITIALSTACKOFFSET)))
            {
                // 当前TID
                PKTRAP_FRAME pCurrentTrap = (PKTRAP_FRAME)(*(ULONG64*)
((ULONG64)pEthread + INITIALSTACKOFFSET) - sizeof(KTRAP_FRAME));

                // 生成注入代码
                PINJECT_BUFFER newAddress = GetNativeCode(LdrLoadDll,
DllFullPath, pCurrentTrap->Rip);
                if (newAddress)
                {
                    // 替换当前RIP地址
                    newAddress->orgRipAddress = (ULONG64)& (pCurrentTrap->Rip);
                    newAddress->orgRip = pCurrentTrap->Rip;
                    *allcateAddress = newAddress;
                    pCurrentTrap->Rip = (ULONG64)newAddress;
                }
            }
            return STATUS_SUCCESS;
        }
    }
    __except (EXCEPTION_EXECUTE_HANDLER) {}

    return STATUS_UNSUCCESSFUL;
}

// 得到当前用户进程下的模块基址
PVOID GetUserModule(IN PEPROCESS EProcess, IN PUNICODE_STRING ModuleName, IN
BOOLEAN IsWow64)
{
    if (EProcess == NULL)
```

```
        return NULL;
    __try
    {
        // 执行32位
        if (IsWow64)
        {
            // 获取32位下的PEB进程环境块
            PPEB32 Peb32 = (PPEB32)g_PsGetProcessWow64Process(EProcess);
            if (Peb32 == NULL)
                return NULL;

            if (!Peb32->Ldr)
                return NULL;

            // 循环遍历链表 寻找模块
            for (PLIST_ENTRY32 ListEntry = (PLIST_ENTRY32)
((PPEB_LDR_DATA32)Peb32->Ldr)->InLoadOrderModuleList.Flink;
                ListEntry != &((PPEB_LDR_DATA32)Peb32->Ldr)-
>InLoadOrderModuleList;
                ListEntry = (PLIST_ENTRY32)ListEntry->Flink)
            {
                UNICODE_STRING UnicodeString;
                PLDR_DATA_TABLE_ENTRY32 LdrDataTableEntry32 =
CONTAINING_RECORD(ListEntry, LDR_DATA_TABLE_ENTRY32, InLoadOrderLinks);

                // 初始化模块名
                RtlUnicodeStringInit(&UnicodeString, (PWCH)LdrDataTableEntry32-
>BaseDllName.Buffer);

                // 对比模块名是否符合
                if (RtlCompareUnicodeString(&UnicodeString, ModuleName, TRUE) ==
0)
                    return (PVOID)LdrDataTableEntry32->DllBase;
            }
        }
        // 执行64位
        else
        {
            // 得到64位PEB进程环境块
            PPEB Peb = PsGetProcessPeb(EProcess);
            if (!Peb)
                return NULL;

            if (!Peb->Ldr)
                return NULL;

            // 开始遍历模块
            for (PLIST_ENTRY ListEntry = Peb->Ldr->InLoadOrderModuleList.Flink;
                ListEntry != &Peb->Ldr->InLoadOrderModuleList;
                ListEntry = ListEntry->Flink)
            {
                // 得到表头
                PLDR_DATA_TABLE_ENTRY LdrDataTableEntry =
CONTAINING_RECORD(ListEntry, LDR_DATA_TABLE_ENTRY, InLoadOrderLinks);

                // 判断是否是所需要的模块
```

```
                if (RtlCompareUnicodeString(&LdrDataTableEntry->BaseDllName,
ModuleName, TRUE) == 0)
                    return LdrDataTableEntry->DllBase;
            }
        }
    }
    __except (EXCEPTION_EXECUTE_HANDLER){}

    return NULL;
}

// 根据函数名得到导出表地址
PVOID GetModuleExport(IN PVOID ModuleBase, IN PCCHAR FunctionName)
{
    PIMAGE_DOS_HEADER ImageDosHeader = (PIMAGE_DOS_HEADER)ModuleBase;
    PIMAGE_NT_HEADERS32 ImageNtHeaders32 = NULL;
    PIMAGE_NT_HEADERS64 ImageNtHeaders64 = NULL;
    PIMAGE_EXPORT_DIRECTORY ImageExportDirectory = NULL;
    ULONG ExportDirectorySize = 0;
    ULONG_PTR FunctionAddress = 0;

    if (ModuleBase == NULL)
        return NULL;

    __try
    {
        // 判断是否是DOS头
        if (ImageDosHeader->e_magic != IMAGE_DOS_SIGNATURE)
        {
            return NULL;
        }

        // 获取PE结构节NT头
        ImageNtHeaders32 = (PIMAGE_NT_HEADERS32)((PUCHAR)ModuleBase +
ImageDosHeader->e_lfanew);
        ImageNtHeaders64 = (PIMAGE_NT_HEADERS64)((PUCHAR)ModuleBase +
ImageDosHeader->e_lfanew);

        // 判断是否是64位
        if (ImageNtHeaders64->OptionalHeader.Magic ==
IMAGE_NT_OPTIONAL_HDR64_MAGIC)
        {
            // 如果是64位则执行如下
            ImageExportDirectory = (PIMAGE_EXPORT_DIRECTORY)(ImageNtHeaders64-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].VirtualAddress +
(ULONG_PTR)ModuleBase);
            ExportDirectorySize = ImageNtHeaders64-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].Size;
        }
        else
        {
            // 如果32位则执行如下
            ImageExportDirectory = (PIMAGE_EXPORT_DIRECTORY)(ImageNtHeaders32-
>OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].VirtualAddress +
(ULONG_PTR)ModuleBase);
```

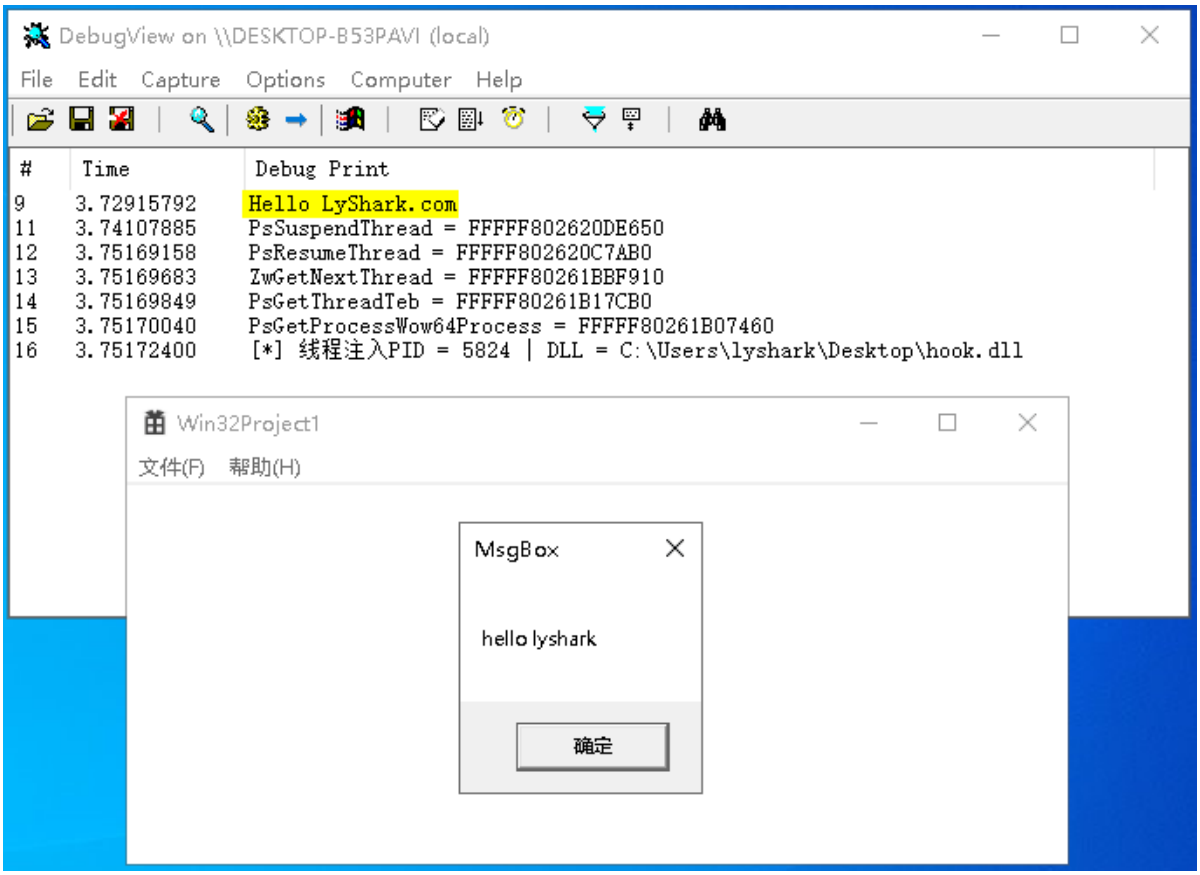
```
            ExportDirectorySize = ImageNtHeaders32->OptionalHeader.DataDirectory[IMAGE_DIRECTORY_ENTRY_EXPORT].Size;
        }

        // 取出导出表Index，名字，函地址等
        PUSHORT pAddressOfOrds = (PUSHORT)(ImageExportDirectory->AddressOfNameOrdinals + (ULONG_PTR)ModuleBase);
        PULONG  pAddressOfNames = (PULONG)(ImageExportDirectory->AddressOfNames + (ULONG_PTR)ModuleBase);
        PULONG  pAddressOfFuncs = (PULONG)(ImageExportDirectory->AddressOfFunctions + (ULONG_PTR)ModuleBase);

        // 循环导出表
        for (ULONG i = 0; i < ImageExportDirectory->NumberOfFunctions; ++i)
        {
            USHORT OrdIndex = 0xFFFF;
            PCHAR  pName = NULL;

            // 说明是序号导出
            if ((ULONG_PTR)FunctionName <= 0xFFFF)
            {
                // 得到函数序号
                OrdIndex = (USHORT)i;
            }
            // 说明是名字导出
            else if ((ULONG_PTR)FunctionName > 0xFFFF && i < ImageExportDirectory->NumberOfNames)
            {
                // 得到函数名
                pName = (PCHAR)(pAddressOfNames[i] + (ULONG_PTR)ModuleBase);
                OrdIndex = pAddressOfOrds[i];
            }

            else
                return NULL;

            // 判断函数名是否符合
            if (((ULONG_PTR)FunctionName <= 0xFFFF && (USHORT)((ULONG_PTR)FunctionName) == OrdIndex + ImageExportDirectory->Base) ||
                ((ULONG_PTR)FunctionName > 0xFFFF && strcmp(pName, FunctionName) == 0))
            {
                // 得到完整地址
                FunctionAddress = pAddressOfFuncs[OrdIndex] + (ULONG_PTR)ModuleBase;
                break;
            }
        }
    }
    __except (EXCEPTION_EXECUTE_HANDLER){}

    return (PVOID)FunctionAddress;
}

// DLL模块注入线程函数
```

```
NTSTATUS KernelInjectDLL(ULONG pid, PUNICODE_STRING DllFullPath, PINJECT_BUFFER*
allcateAddress)
{
    PEPROCESS pEprocess = NULL;

    // 根据PID得到进程Eprocess结构
    if (NT_SUCCESS(PsLookupProcessByProcessId((HANDLE)pid, &pEprocess)))
    {
        KAPC_STATE kApc = { 0 };

        // 附加到进程内
        KeStackAttachProcess(pEprocess, &kApc);

        // 得到Ntdll.dll模块基址
        UNICODE_STRING ntdllString = RTL_CONSTANT_STRING(L"Ntdll.dll");
        PVOID NtdllAddress = GetUserModule(pEprocess, &ntdllString,
g_PsGetProcessWow64Process(pEprocess) != 0);
        if (!NtdllAddress)
        {
            // 失败了则直接脱离附加
            KeUnstackDetachProcess(&kApc);
            ObDereferenceObject(pEprocess);
            return STATUS_UNSUCCESSFUL;
        }

        // 得到LdrLoadDLL模块的基址
        PVOID LdrLoadDll = GetModuleExport(NtdllAddress, "LdrLoadDll");
        if (!LdrLoadDll)
        {
            KeUnstackDetachProcess(&kApc);
            ObDereferenceObject(pEprocess);
            return STATUS_UNSUCCESSFUL;
        }

        HANDLE threadHandle = NULL;

        // 得到当前正在运行的线程上下文
        if (NT_SUCCESS(g_ZwGetNextThread((HANDLE)-1, (HANDLE)0, 0x1FFFFF, 0x240,
0, &threadHandle)))
        {
            PVOID threadObj = NULL;

            // 在对象句柄上提供访问验证，如果可以授予访问权限，则返回指向对象的正文的相应指针。
            NTSTATUS state = ObReferenceObjectByHandle(threadHandle, 0x1FFFFF,
*PsThreadType, KernelMode, &threadObj, NULL);
            if (NT_SUCCESS(state))
            {
                // 暂停线程
                g_PsSuspendThread(threadObj, NULL);

                // 设置线程ShellCode代码
                SetThreadStartAddress(threadObj,
g_PsGetProcessWow64Process(pEprocess) != 0, LdrLoadDll, DllFullPath,
allcateAddress);

                // 恢复线程
```

```
                g_PsResumeThread(threadObj, NULL);
                ObDereferenceObject(threadObj);
            }
            NtClose(threadHandle);
        }

        // 关闭线程
        KeUnstackDetachProcess(&kApc);
        ObDereferenceObject(pEprocess);
    }
    return STATUS_SUCCESS;
}

NTSTATUS UnDriver(PDRIVER_OBJECT driver)
{
    UNREFERENCED_PARAMETER(driver);
    return STATUS_SUCCESS;
}

NTSTATUS DriverEntry(IN PDRIVER_OBJECT Driver, PUNICODE_STRING RegistryPath)
{
    DbgPrint("Hello LyShark.com \n");

    UNREFERENCED_PARAMETER(RegistryPath);

    // ------------------------------------------------------------------------
    // 初始化
    // ------------------------------------------------------------------------
    UCHAR SuspendOpCode[] = { 0x48, 0x8b, 0xf9, 0x83, 0x64, 0x24, 0x20, 0x00,
0x65, 0x48, 0x8b, 0x34, 0x25, 0x88, 0x01 };
    UCHAR ResumeOpCode[] = { 0x48, 0x8b, 0xf9, 0xe8, 0xee, 0x4f, 0xa5, 0xff,
0x65, 0x48, 0x8b, 0x14, 0x25, 0x88 };

    // 特征码检索PsSuspendThread函数基址
    g_PsSuspendThread = (PPsSuspendThread)SearchOPcode(Driver, L"ntoskrnl.exe",
"PAGE", SuspendOpCode, sizeof(SuspendOpCode), -24);
    DbgPrint("PsSuspendThread = %p \n", g_PsSuspendThread);

    // 特征码检索PsResumeThread基址
    g_PsResumeThread = (PPsResumeThread)SearchOPcode(Driver, L"ntoskrnl.exe",
"PAGE", ResumeOpCode, sizeof(ResumeOpCode), -18);
    DbgPrint("PsResumeThread = %p \n", g_PsResumeThread);

    // 动态获取内存中的ZwGetNextThread基址
    UNICODE_STRING ZwGetNextThreadString =
RTL_CONSTANT_STRING(L"ZwGetNextThread");
    g_ZwGetNextThread =
(PZwGetNextThread)MmGetSystemRoutineAddress(&ZwGetNextThreadString);
    DbgPrint("ZwGetNextThread = %p \n", g_ZwGetNextThread);

    // 动态获取内存中的PsGetThreadTeb基址
    UNICODE_STRING PsGetThreadTebString = RTL_CONSTANT_STRING(L"PsGetThreadTeb");
    g_PsGetThreadTeb =
(PPsGetThreadTeb)MmGetSystemRoutineAddress(&PsGetThreadTebString);
    DbgPrint("PsGetThreadTeb = %p \n", g_PsGetThreadTeb);
```

```
    // 动态获取内存中的PsGetProcessWow64Process基址
    UNICODE_STRING PsGetProcessWow64ProcessString =
RTL_CONSTANT_STRING(L"PsGetProcessWow64Process");
    g_PsGetProcessWow64Process =
(PPsGetProcessWow64Process)MmGetSystemRoutineAddress(&PsGetProcessWow64ProcessStr
ing);
    DbgPrint("PsGetProcessWow64Process = %p \n", g_PsGetProcessWow64Process);

    // ------------------------------------------------------------------------
    // 注入代码
    // ------------------------------------------------------------------------

    ULONG ProcessID = 984;
    UNICODE_STRING InjectDllPath =
RTL_CONSTANT_STRING(L"C:\\Users\\lyshark\\Desktop\\hook.dll");
    PINJECT_BUFFER AllcateAddress = NULL;

    // 执行线程注入
    NTSTATUS Status = KernelInjectDLL(ProcessID, &InjectDllPath,
&AllcateAddress);
    if (Status == STATUS_SUCCESS)
    {
        DbgPrint("[*] 线程注入PID = %d | DLL = %wZ \n", ProcessID, InjectDllPath);
    }

    Driver->DriverUnload = UnDriver;
    return STATUS_SUCCESS;
}
```

首先你需要自行准备好一个DLL文件，此处我的是`hook.dll`将文件放入到桌面，然后设置`ProcessID`指定进程ID，设置`InjectDllPath`指定DLL路径，签名后将驱动加载起来，此时你会看到`WinDBG`中的输出，且应用层的进程也会弹出`hello lyshark`的消息，说明注入成功了，如下图所示；


DebugView on \\DESKTOP-B53PAVI (local)
File Edit Capture Options Computer Help
Time Debug Print
9 3.72915792 Hello LyShark.com
11 3.74107885 PsSuspendThread = FFFFF802620DE650
12 3.75169158 PsResumeThread = FFFFF802620C7AB0
13 3.75169683 ZwGetNextThread = FFFFF80261BBF910
14 3.75169849 PsGetThreadTeb = FFFFF80261B17CB0
15 3.75170040 PsGetProcessWow64Process = FFFFF80261B07460
16 3.75172400 [*] 线程注入PID = 5824 | DLL = C:\Users\lyshark\Desktop\hook.dll
Win32Project1
文件(F) 帮助(H)
MsgBox
hello lyshark
确定