永恒之蓝 原理及其分析

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永恒之蓝

要理解永恒之蓝，必须先了解SMB及其他存在的几个bug，永恒之蓝就是利用SMB的bug和巧妙内存构造进而实现利用
首先什么是SMB?
服务器消息块（Server Message Block，缩写为SMB），又称网络文件共享系统（Common Internet File System，缩写为CIFS, /ˈsɪfs/），一种应用层网络传输协议，由微软开发，主要功能是使网络上的机器能够共享计算机文件、打印机、串行端口和通讯等资源。它也提供经认证的进程间通信机能。它主要用在装有Microsoft Windows的机器上，在这样的机器上被称为Microsoft Windows Network。经过Unix服务器厂商重新开发后，它可以用于连接Unix服务器和Windows客户机，执行打印和文件共享等任务。与功能类似的网络文件系统（NFS）相比，NFS的消息格式是固定长度，而CIFS的消息格式大多数是可变长度，这增加了协议的复杂性。CIFS消息一般使用NetBIOS或TCP协议发送，分别使用不同的端口139或445，当前倾向于使用445端口。CIFS的消息包括一个信头（32字节）和消息体（1个或多个，可变长）。

关于SMB的一些基础知识

首先，SMB命令由客户端和服务器之间的SMB消息交换组成，通过资料，我们可以按照会话管理(Session management)分类，存在6种SMB子命令

Session management	Transaction subprotocol
SMB_COM_NEGOTIATE	SMB_COM_TRANSACTION
SMB_COM_SESSION_SETUP_ANDX	SMB_COM_TRANSACTION_SECONDARY
SMB_COM_TREE_CONNECT	SMB_COM_TRANSACTION2
SMB_COM_TREE_CONNECT_ANDX	SMB_COM_TRANSACTION2_SECONDARY
SMB_COM_TREE_DISCONNECT	SMB_COM_NT_TRANSACT
SMB_COM_LOGOFF_ANDX	SMB_COM_NT_TRANSACT_SECONDARY

其命令码分别为
SMB_COM_TRANSACTION（命令码为0x25）
SMB_COM_TRANSACTION_SECONDARY（命令码为0x26）
SMB_COM_TRANSACTION2（命令码为0x32）
SMB_COM_TRANSACTION2_SECONDARY（命令码为0x33）
SMB_COM_NT_TRANSACT（命令码为0xA0）
SMB_COM_NT_TRANSACT_SECONDARY（命令码为0xA1）

如果transaction消息大于SMB消息（由会话参数中的MaxBufferSize确定），则为客户端必须使用一个或多个SMB_COM_ TRANSACT_SECONDARY命令（SMB头中具有相同的TID，UID，PID和MID）发送

SMB_COM_TRANSACTION2 structure

```
SMB_Parameters
  {
  UCHAR  WordCount;
  Words
    {
    USHORT TotalParameterCount;
    USHORT TotalDataCount;      (2 bytes)
    USHORT MaxParameterCount;
    USHORT MaxDataCount;
    UCHAR  MaxSetupCount;
    UCHAR  Reserved1;
    USHORT Flags;
```

SMB_COM_NT_TRANSACT structure

```
SMB_Parameters
  {
  UCHAR  WordCount;
  Words
    {
    UCHAR  MaxSetupCount;
    USHORT Reserved1;
    ULONG  TotalParameterCount;
(4 bytes)  ULONG  TotalDataCount;
    ULONG  MaxParameterCount;
    ULONG  MaxDataCount;
    ULONG  ParameterCount;
    ULONG  ParameterOffset;
```

而对于多条命令，在传输过程中，以最后一条命令判断其命令的类型，期间数据及其大小进行叠加，则存在
如果最后一个命令是SMB_COM_TRANSACTION_SECONDARY，则服务器将子命令作为TRANS_ *执行。
如果最后一个命令是SMB_COM_TRANSACTION2_SECONDARY，则服务器执行子命令TRANS2_ *。
如果最后一个命令是SMB_COM_NT_TRANSACT_SECONDARY，则服务器执行子命令为NT_TRANSACT_ *。

SMB的几个BUG

SrvOs2FeaListSizeToNt()中类型转化错误

在使用SMB_COM_TRANSACTION2子命令中使用FEA（完全扩展属性）时，我们需要在SMB_COM_TRANSACTION2子命令请求中发送FEA_LIST，当处理SMB_COM_TRANSACTION2子命令请求FEA_LIST时，**Windows需要将FEA_LIST转换为NTFEA_LIST列表，则在将FEA_LIST转换为NTFEA_LIST时计算数据大小是存在类型转化错误**

```
int __stdcall SrvOs2FeaListSizeToNt(_DWORD *feaList)
{
  _WORD *v1; // eax
  unsigned int v2; // edi
  unsigned int v3; // esi
  int v4; // ebx
  int v6; // [esp+Ch] [ebp-4h]

  v1 = feaList;
  v6 = 0;
  v2 = (unsigned int)feaList + *feaList;
  v3 = (unsigned int)(feaList + 1);
  if ( (unsigned int)(feaList + 1) < v2 )
  {
    while ( v3 + 4 < v2 )
    {
      v4 = *(unsigned __int16 *)(v3 + 2) + *(unsigned __int8 *)(v3 + 1);
      if ( v4 + v3 + 4 + 1 > v2 )
        break;
      if ( RtlSizeTAdd(v6, (v4 + 12) & 0xFFFFFFFC, &v6) < 0 )
        return 0;
      v3 += v4 + 5;
      if ( v3 >= v2 )
        return v6;
      v1 = feaList;
    }
    *v1 = v3 - (_WORD)v1;
  }
  return v6;
}
```

这里看汇编更加明了

```
PAGE:0002F506 loc_2F506:                              ; CODE XREF: SrvOs2FeaListSizeT
PAGE:0002F506                                         ; SrvOs2FeaListSizeToNt(x)+37↑j
PAGE:0002F506                 sub     esi, eax
PAGE:0002F508                 mov     [eax], si
PAGE:0002F50B
PAGE:0002F50B loc_2F50B:                              ; CODE XREF: SrvOs2FeaListSizeT
```

可以看到，在转化过程中，函数计算对应FEA_LIST长度时， 刚开始为DWORD，之后对size更新赋值时，是按WORD进行赋值，并且高位并未检测。此时，如果我们发送的FEA_LIST中SizeOfListInBytes=0x10000，但我们有效的FEA数据为0x4000，由于高位不清空，通过计算，得到列表大小为0x140000，此时outlen仅为0x4000

```
  v11 = 0;
  v4 = FEAList;
  outputlen = SrvOs2FeaListSizeToNt(FEAList);
  *a3 = outputlen;
  if ( !outputlen )
  {
    *a4 = 0;
    return -1063718657;
  }
  Des = (FEA_LIST *)SrvAllocateNonPagedPool(outputlen, 21);
  *a2 = Des;
  if ( Des )
  {
    v8 = (SMB_FEA *)((char *)FEAList + FEAList->SizeOfListInBytes - 5);
    Src = (SMB_FEA *)&FEAList->FEAList;
    if ( &FEAList->FEAList > (int *)v8 )
```

之后利用远大于实际列表大小的值进行循环

```
while ( ! ( * source_position & 0x7F ) )
      {
        v12 = dest_position;
        v11 = ( signed __int16 ) source_position;
        dest_position = (_DWORD * )SrvOs2FeaToNt(dest_position, source_position);
        source_position += ( unsigned __int8 ) source_position [ 1 ] + * ((_WORD * )sc
        if ( source_position > v8 )
        {
          dest_position = v12;
          goto LABEL_13;
        }
      }
```

在循环体中存在SrvOs2FeaToNt，**特别在第二次memcopy过程中，由于存在堆缓冲区的参与，可能导致堆的缓冲区溢出操作**

```
unsigned int __stdcall SrvOs2FeaToNt(int Des, SMB_FEA *Src)
{
  int v2; // esi
  _BYTE *v3; // ebx
  unsigned int result; // eax

  v2 = Des;
  *(_BYTE *)(Des + 4) = Src->ExtendedAttributeFlag;
  *(_BYTE *)(Des + 5) = Src->AttributeNameLengthInBytes;
  *(_WORD *)(Des + 6) = *(_WORD *)((char *)&Src->AttributeNameLengthInBytes + 1);
   memmove((void *)(Des + 8), (char *)&Src->AttributeNameLengthInBytes + 3, LOBYTE(Src->AttributeNameLengthInBytes));
  v3 = (_BYTE *)(*(unsigned __int8 *)(Des + 5) + Des + 8);
  *v3++ = 0;
  _memmove(v3, (char *)&Src->AttributeValueLengthInBytes + *(unsigned __int8 *)(v2 + 5), *(unsigned __int16 *)(v2 + 6));
  result = (unsigned int)&v3[*(unsigned __int16 *)(Des + 6) + 3] & 0xFFFFFFFC;
  *(_DWORD *)v2 = ((unsigned int)&v3[*(unsigned __int16 *)(v2 + 6) + 3] & 0xFFFFFFFC) - v2;
  return result;
```

此时，如果成功的设置堆的结构，溢出之后就会破坏并覆盖之后的内存块，导致代码执行

消息类型转化错误

通常SMB_COM_TRANSACTION命令后面必须跟SMB_COM_TRANSACTION_SECONDARY命令，SMB_COM_TRANSACTION2命令必须是是SMB_COM_TRANSACTION2_SECONDARY命令，SMB_COM_NT_TRANS命令必须跟随SMB_COM_NT_TRANS_SECONDARY命令。
但是如果第一个SMB消息要发送的事务数据还没有完成，此时服务器并不做检测，我们就可以发送任何类型的消息(**只要TID，UID，PID和MID匹配**)来完成这个事务。
由上基础知识可知服务器使用最后一个SMB_COM _ * _ SECONDARY命令来确定事务类型。因此，我们可以将任何事务类型转换为SMB_COM_TRANSACTION或SMB_COM_TRANSACTION2。

，该知识在我们利用TRANS2_OPEN2发送大量事务数据（> = 0x10000字节）有用。因为只有SMB_COM_NT_TRANS请求TotalDataCount字段使用4个字节（其他使用2个字节），所以该漏洞利用必须启动一个事务然后发送SMB_COM_NT_TRANS命令之后发送最后一个SMB_COM_TRANSACTION2_SECONDARY命令确定该事物类型，进而存在之后FEA_LIST的结构

SESSION_SETUP_AND_X请求格式混乱

在SMB_COM_SESSION_SETUP_ANDX请求中，存在两种格式的请求包，而这两种请求包的依靠
WordCount的值来确定，下图为WordCount分别为0xC和0xD的两种格式

在进行传输时，如果发送的代码中WordConut为12，包含 CAP_EXTENDED_SECURITY字段，但却没有FLAGS2_EXTENDED_SECURITY字段，将会导致服务器将以处理13类型请求的方式去处理类型 12的请求包，通过构造畸形包，从而进入错误的函数,该函数会申请nonpagepool,

```
BlockingSessionSetupAndX()
{
    // ...

    // check word count
    if (! (request->WordCount == 13 || (request->WordCount == 12 && (request->Capablilities & CAP_EXTENDED_SECURITY))) ) {
        // error and return
    }

    // ...

    if ((request->Capablilities & CAP_EXTENDED_SECURITY) && (smbHeader->Flags2 & FLAGS2_EXTENDED_SECURITY)) {
        // this request is Extend Security request
        GetExtendSecurityParameters();  // extract parameters and data to variables
        SrvValidateSecurityBuffer();  // do authentication
    }
    else {
        // this request is NT Security request
        GetNtSecurityParameters();  // extract parameters and data to variables
        SrvValidateUser();  // do authentication
    }
```

```
    //...
}
```

之后释放形成hole，在越界覆盖时正好覆盖的也是这个内存。

漏洞利用及其调试

其永恒之蓝的利用主要包括三部分:

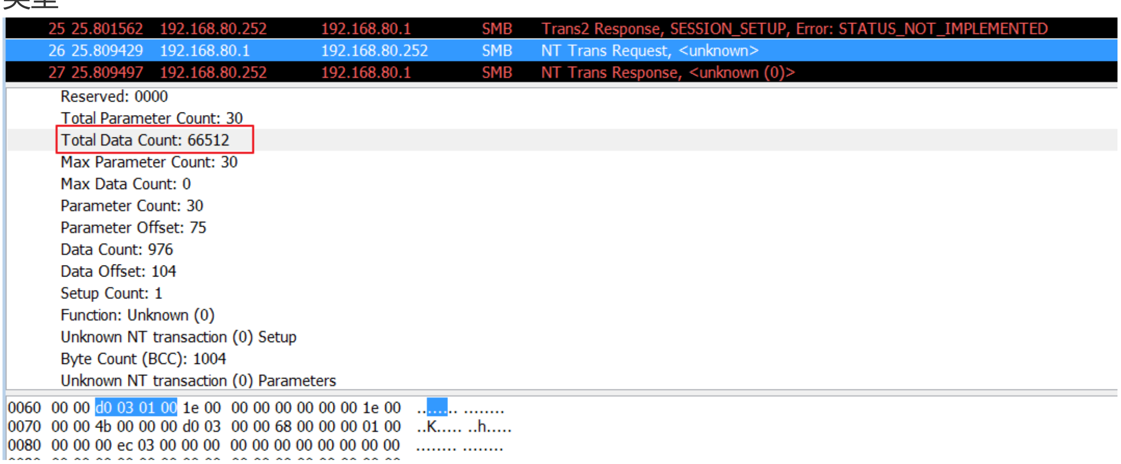
1. MS17-010的引发内存写
   2.绕过内存写的长度限制
   3.攻击数据的内存布局
   环境搭建:
   https://bbs.pediy.com/thread-247994.htm（即使是64位环境最好也下32位py，防止出错）

调试

我们知道程序通过调用srv!SrvSmbOpen2函数触发漏洞，下断点

```
bp srv!SrvSmbOpen2+0x79 “.printf \” feasize: %p indatasize: %p fealist
```

得到数据大小为0x103d0，该大小和我们发送的SMB_COM_NT_TRANS数据大小一致，并且由于该大小大于0xffff大小，所以之后的消息和该消息会合并，并通过最后一条消息确定类型



之后通过发送SMB_COM_TRANSACTION2_SECONDARY命令促使Windows需要将FEA_LIST转换为NTFEA_LIST列表，我们查看转化，此时高位并未清0

```
kd> bp 93d6b508
kd> g
Breakpoint 1 hit
srv!SrvOs2FeaListSizeToNt+0x60:
93d6b508 668930          mov     word ptr [eax],si
WARNING: Whitespace at start of path element
WARNING: Whitespace at end of path element

kd>
```

```
Memory
Virtual: 0x95b350d8          Display format: Byte          Previous   Next
95b350d8 00 00 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .......................
95b350ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .......................
95b35106 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .......................
95b3511d 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  .......................
```

得到最后size大小为

```
kd> p
srv!SrvOs2FeaListSizeToNt+0x63:
93d6b50b 8b45fc          mov     eax,dword ptr [ebp-4]

kd>
```

```
Memory
Virtual: 0x95b350d8          Display format: Byte
95b350d8 5d ff 01 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ]...
95b350ef 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ....
```

之后返回得到的大小

```
ecx   ac0c60e2
eax   10fe8
ebp   9280bb7c
```

之后利用该大小分配内存

```c
outputlen = SrvOs2FeaListSizeToNt(a1);
*a3 = outputlen;
if ( !outputlen )
{
  *a4 = 0;
  return -1063718657;
}
Des = (_DWORD *)SrvAllocateNonPagedPool(outputlen, 21);
```

这里我们得到分配内存为

```
Loading unloaded module list
........
kd> bp srv!SrvOs2FeaListToNt+0x33
breakpoint 0 redefined
WARNING: Whitespace at start of path element
WARNING: Whitespace at end of path element
kd> bp srv!SrvOs2FeaToNt+04d ".printf \"MOV2: dst: %p src: %p size: %p\\n\",ebx,eax,poi(esp+8);g;"
kd> g
Breakpoint 0 hit
srv!SrvOs2FeaListToNt+0x33:
83a9d598 e85125feff      call    srv!SrvAllocateNonPagedPool (83a7faee)
kd> p
srv!SrvOs2FeaListToNt+0x38:
83a9d59d 8b4d0c          mov     ecx,dword ptr [ebp+0Ch]

kd>
```

```
eax   85df6008
ebp   954e7b7c
eip   83a9d59d
cs    8
efl   282
esp   954e7b70
ss    10
dr0   0
dr1   0
dr2   0
dr3   0
dr6   ffff0ff0
dr7   400
```

0x85df008

通过下断点

bp srv!SrvOs2FeaToNt+04d ".printf "MOV2: dst: %p src: %p size: %p\n",ebx,eax,poi(esp+8);g;"

然后观察在第二次对内存进行操作

```c
unsigned int __stdcall SrvOs2FeaToNt(int a1, int a2)
{
  int v2; // esi
  _BYTE *v3; // ebx
  unsigned int result; // eax

  v2 = a1;
  *(_BYTE *)(a1 + 4) = *(_BYTE *)a2;
  *(_BYTE *)(a1 + 5) = *(_BYTE *)(a2 + 1);
  *(_WORD *)(a1 + 6) = *(_WORD *)(a2 + 2);
  _memmove((void *)(a1 + 8), (const void *)(a2 + 4), *(unsigned __int8 *)(a2 + 1));
  v3 = (_BYTE *)(*(unsigned __int8 *)(a1 + 5) + a1 + 8);
  *v3++ = 0;
  _memmove(v3, (const void *)(*(unsigned __int8 *)(v2 + 5) + a2 + 5), *(unsigned __int16 *)(v2 + 6));
  result = (unsigned int)&v3[*(unsigned __int16 *)(a1 + 6) + 3] & 0xFFFFFFFC;
  *(_DWORD *)v2 = ((unsigned int)&v3[*(unsigned __int16 *)(v2 + 6) + 3] & 0xFFFFFFFC) - v2;
  return result;
}
```

```
MOV2: dst: 85df7c0d src: ac0a8c8a size: 00000000
MOV2: dst: 85df7c19 src: ac0a8c8f size: 00000000
MOV2: dst: 85df7c25 src: ac0a8c94 size: 00000000
MOV2: dst: 85df7c31 src: ac0a8c99 size: 00000000
MOV2: dst: 85df7c3d src: ac0a8c9e size: 00000000
MOV2: dst: 85df7c49 src: ac0a8ca3 size: 00000000
MOV2: dst: 85df7c55 src: ac0a8ca8 size: 00000000
MOV2: dst: 85df7c61 src: ac0a8cad size: 00000000
MOV2: dst: 85df7c6d src: ac0a8cb2 size: 0000f383
MOV2: dst: 85e06ff9 src: ac0b803a size: 000000a8
```

计算0x85df008+0x10fe8 = 0x85EFFF0,所以看到最后一次的越界操作

所以在最后一次会得到size=0xa8，此时，我们可以通过

ba e1 srv!SrvOs2FeaToNt+0x4d ".if(poi(esp+8) != a8){gc} .else {}"

下断点

可以查看到的内存情况

```
srv!SrvOs2FeaToNt+0x4d:
83a9d278 ff15e0c0a883     call    dword ptr [srv!_imp__memmove (83a8c0e0)]
WARNING: Whitespace at start of path element
WARNING: Whitespace at end of path element
kd> dc esp
9548bb38  859acff9 95f7403a 000000a8 859acff8  ....:@..........
9548bb48  95f74039 00000000 95f640d8 95f74035  9@.......@..5@..
9548bb58  95f84030 9548bb7c 83a9d603 859acff0  0@..|.H.........
9548bb68  95f74035 87e6c360 95f640b4 95f64008  5@..`....@...@..
9548bb78  95f74035 9548bbb4 83ab6602 859acff0  5@....H..f......
9548bb88  9548bbbc 9548bba8 9548bbac 87e6c360  ..H...H...H.`...
9548bb98  95f64008 00000002 95f640b4 95f640d8  .@.......@...@..
9548bba8  00010fe8 00000000 00000000 9548bc00  ..............H.
```

查看内存信息

```
kd> !pool 859acff9
Pool page 859acff9 region is Nonpaged pool
*8599c000 : large page allocation, Tag is LSdb, size is 0x11000 bytes
            Pooltag LSdb : data buffer
```

接下来就是如何通过构造执行代码

查看此时内存，注意这两个被覆盖的内存

```
            Pooltag LStr : transaction
kd> dc 85978ff9 -1
85978ff8  00000000 00000001 00011000 00000000  ................
85979008  00000000 00000000 00000008 00000000  ................
85979018  c144d000 85979160 00010ea0 00000000  ..D.`...........
85979028  8597903c 00000000 0000fff7 87677c60  <...........`|g.
85979038  859790a4 00000000 10040060 00000000  ........`.......
85979048  85979160 85979000 00010ea0 00000160  `...........`...
85979058  0003fd79 0003fd7a 0003fd7b 0003fd7c  y...z...{...|...
85979068  0003fd7d 0003fd7e 0003fd7f 0003fd80  }...~...........
kd> dc 95f8b03a -1
95f8b039  00000000 00000000 00000000 00000000  ................
95f8b049  0000ffff 00000000 0000ffff 00000000  ................
95f8b059  00000000 00000000 00000000 00000000  ................
95f8b069  ffdff100 00000000 00000000 ffdff020  ................
95f8b079  ffdff100 ffffffff 10040060 00000000  ........`.......
95f8b089  ffdfef80 00000000 ffd00010 ffffffff  ................
95f8b099  ffd00118 ffffffff 00000000 00000000  ................
95f8b0a9  00000000 00000000 10040060 00000000  ........`.......
```

1

2

通过资料，发现覆盖内存在srvnet中，其中包含两个重要域

1处位置为srvnet_recv结构,该处为smb断开时寻找函数地址并执行

2处位置为接收缓冲区MDL，用于操作tcp栈写入伪造的对象

查看ffdff000地址，为win32固定地址，并且通过！pte查看

```
kd> !pte ffdff000
                    VA ffdff000
PDE at C0603FF0            PTE at C07FEFF8
contains 000000000018A063  contains 00000000001E3163
pfn 18a       ---DA--KWEV   pfn 1e3       -G-DA--KWEV
```

发现其地址存在可写可执行属性

所以基本流程就可以确定
构造流程就是通过覆盖2处位置，操作tcp栈写入伪造结构和shellcode到ffdfef80+80即FFDFF000，通过smb释放通过1处地址对应函数地址进而执行shellcode

> 这里解释: 从断开到执行shellcode的流程:
> 在smb断开时，会调用SrvNetWskReceiveComplete调用SrvNetCommonReceiveHandler，SrvNetCommonReceiveHandler会存在获取函数指针并调用的操作，而该地址就是我们shellcode的地址,用IDA查看相应流程
>
> ```
> signed int __stdcall SrvNetWskReceiveComplete(int a1, PIRP Irp, _DWORD *a3)
> {
>   ULONG_PTR v3; // ebx
>   _DWORD *v4; // esi
>   int v5; // edi
>   _IRP *v6; // ST04_4
>   _DWORD *v7; // eax
>   _DWORD *v8; // edx
>   _DWORD *v9; // ecx
>   PIRP Irpa; // [esp+18h] [ebp+Ch]
>   KIRQL Irp_3; // [esp+1Bh] [ebp+Fh]
>   char v13; // [esp+1Fh] [ebp+13h]
>
>   v3 = Irp->IoStatus.Information;
>   v4 = a3;
>   v5 = a3[9];
>   v6 = Irp;
>   Irpa = (PIRP)Irp->IoStatus.Status;
>   v13 = 0;
>   IoFreeIrp(v6);
>   if ( Irpa )
>   {
>     SrvNetFreeBuffer(v4);
>     SrvNetDisconnectConnectionWithIndication(v5, 0);
>   }
>   else
>   {
>     v4[5] = v3;
>     v4[7] = 0;
>     v4[9] = 0;
>     Irp_3 = KfAcquireSpinLock((PKSPIN_LOCK)(v5 + 360));
>     v7 = (_DWORD *)(v5 + 160);
>     if ( (_DWORD *)*v7 == v7 )
>       v13 = 1;
>     v8 = *(_DWORD **)(v5 + 164);
>     v9 = v4 + 1;
>     *v9 = v7;
>     v9[1] = v8;
>     *v8 = v4 + 1;
>     *(_DWORD *)(v5 + 164) = v4 + 1;
>     if ( v13 )
>       SrvNetIndicateData(v5, 1);
>     KfReleaseSpinLock((PKSPIN_LOCK)(v5 + 360), Irp_3);
>   }
>   return -1073741802;
> }
> ```
>
> ===>

```
void __stdcall SrvNetIndicateData(int NewIrql, char a2)
{
  _DWORD *v2; // ebx
  _DWORD *v3; // edi
  _DWORD *v4; // esi
  int v5; // eax
  _DWORD *v6; // ecx
  signed int v7; // eax
  _DWORD *v8; // ecx
  _DWORD *v9; // eax
  ULONG v10; // ST1C_4
  _DWORD *v11; // ecx
  _DWORD *v12; // eax
  int v13; // [esp+4h] [ebp-8h]
  ULONG v14; // [esp+8h] [ebp-4h]

  v14 = 0;
  v13 = 0;
  v2 = (_DWORD *)NewIrql;
  if ( !a2 )
    HIBYTE(NewIrql) = KfAcquireSpinLock((PKSPIN_LOCK)(NewIrql + 360));
  v3 = v2 + 40;
  while ( (_DWORD *)*v3 != v3 )
  {
    v4 = (_DWORD *)(*v3 - 4);
    if ( v4[9] )
      break;
    v4[9] = v4;
    v5 = v4[1];
    v6 = (_DWORD *)v4[2];
    *v6 = v5;
    *(_DWORD *)(v5 + 4) = v6;
    v7 = SrvNetCommonReceiveHandler(v2, v4[5], v4[5], (int)&v13, 1056, v4[3], 1, (int)v4, (int)&v14);
    if ( v7 >= 0 || v7 == -1073741802 )
    {
```

===>

```
    a2,
    a6);
}
v10 = NewIrql[75];
++NewIrql[93];
v33 = v10;
if ( a2 >= a3 )
  a2 = a3;
v11 = NewIrql[91];
if ( v11 )
{
  if ( NewIrql[2] == 3 )
  {
    v12 = (*(int (__stdcall **)(_DWORD, _DWORD, int, unsigned int, unsigned int, int, int, int, int))(v11 + 4))(
            NewIrql[42],
            NewIrql[43],
            a5,
            a2,
            a3,
            a4,
            a6,
            a8,
            a9);
    if ( WPP_GLOBAL_Control != &WPP_GLOBAL_Control
      && *((_DWORD *)WPP_GLOBAL_Control + 8) & 0x200
```

shellcode

调试验证

下断点: ba e1 srvnet!SrvNetWskReceiveComplete+0x13 ".if(poi(esi+0x24) == ffdff020) {} .else {gc}"

==> srvnet!SrvNetCommonReceiveHandler

最后根据调用下段 srvnet!SrvNetCommonReceiveHandler+0x91

此时查看

```
srvnet!SrvNetCommonReceiveHandler+0x91:
3fc1e28d ff5004          call    dword ptr [eax+4]
3fc1e290 8bf8            mov     edi,eax
3fc1e292 a10060c28f      mov     eax,dword ptr [srvnet!WPP_GLOBAL_Control (8fc26000)]
```

```
kd>
Command   Disassembly

Memory
Virtual: eax+4          Display format: Byte     Previous  Next
ffdff194 f1 f1 df ff 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ...................
ffdff1a7 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ...................
ffdff1ba 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00 00  ...................
ffdff1cd 00 00 00 00 00 00 00 00 00 00 00 f0 01 d0 ff ff ff ff ff  ...................

Watch
Typecast  Loc
Name
```

即为shellcode

EternalBlue 载荷功能

首先明确:
在内存里的非分页池结构中。非分页池没有池的头部。因此池和池之间的内存空间是紧密相联的，可以在**上一个池后分配一个紧密相连的池**，这个池属于驱动分配并含有驱动的数据。因此，必须通过操纵池后被溢出的池。EternalBlue使用的技术就是控制SRVNET驱动的缓冲区结构。

通过之前控制发送SESSION_SETUP_AND_X消息，通过二者之间的大小控制偏移，得到得到指定的nonpagealloc
然后在通过在适当偏移控制alloc的申请位置，之后在释放，然后利用SMB_COM_NT_TRANS和SMB_COM_TRANSACTION2_SECONDARY填充之前释放的地址，进行覆盖
为了观察释放和申请的位置，我们分别在srv和srvnet下断

bp SrvFreeNonPagedPool+0x3 ".printf"SrvFreeNonPagedPool free Nopage:%p\n",eax;g;"
bp srv!SrvOs2FeaListToNt+0x38 ".printf "NTFeaList StartAddress: %p \n NTFeaList EndAddress: %p \n" , eax, eax+0x10fe8;g;"
bp srv!SrvOs2FeaToNt+0x4d ".if poi(esp+8)>0{.printf"Current NTFea Record-> StartAddress:%p \t\t EndAddress:%p\t\tNtFilaValueLength:%p\n",esi,ebx+poi(esp+8),poi(esp+8);g;}.else{gc}"
bp srvnet!SrvNetAllocatePoolWithTag+0x1b ".if @edi=0x0000000{.if @esi=0x00011000 {.printf"The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: %p; Size: %p;\n",eax,esi;g}.else{gc}} .else{gc}"
bp srv!SrvAllocateNonPagedPool+0xe3 ".if @esi>0x0000f000 {.printf"\n srv!SrvAllocateNonPagedPool Address %p \t RequestSize: %p;\n\n",eax,esi;g}.else{gc}"


```
 srv!SrvAllocateNonPagedPool Address 85b83000    RequestSize: 0000ffeb;

The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85b93000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85bc1000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85bd2000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85be3000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85c0b000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85c79000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85c8a000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85c9b000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85cac000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85cbd000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85cce000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85cdf000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85cf0000; Size: 00011000;
SrvFreeNonPagedPool free Nopage:85a5a000
SrvFreeNonPagedPool free Nopage:85a5a000

 srv!SrvAllocateNonPagedPool Address 85d01000    RequestSize: 00010fec;

The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85d12000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85d23000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85d34000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85d45000; Size: 00011000;
The srvnet!SrvNetAllocatePoolWithTag NumGrooms Allocation-> Address: 85d56000; Size: 00011000;
SrvFreeNonPagedPool free Nopage:85869890
SrvFreeNonPagedPool free Nopage:85b83000
SrvFreeNonPagedPool free Nopage:9401edd0
SrvFreeNonPagedPool free Nopage:9401e008
SrvFreeNonPagedPool free Nopage:85a60390
SrvFreeNonPagedPool free Nopage:85d01000
SrvFreeNonPagedPool free Nopage:85a88b10
SrvFreeNonPagedPool free Nopage:85b81440

 srv!SrvAllocateNonPagedPool Address 85d01000    RequestSize: 00010fe8;

NTFeaList StartAddress: 85d01008
 NTFeaList EndAddress: 85d11ff0
SrvFreeNonPagedPool free Nopage:85b75000
Current NTFea Record-> StartAddress:85d02c64         EndAddress:85d11ff0         NtFilaValueLength:0000f383
Current NTFea Record-> StartAddress:85d11ff0         EndAddress:85d120a1         NtFilaValueLength:000000a8
SrvFreeNonPagedPool free Nopage:85d01000
SrvFreeNonPagedPool free Nopage:8743a990
SrvFreeNonPagedPool free Nopage:85b78000
SrvFreeNonPagedPool free Nopage:85a88b10
SrvFreeNonPagedPool free Nopage:85b72000
```

至此，笔者认为对于该过程已经叙述完毕，不过由于笔者知识浅薄，有些地方可能理解错误，如果有不当或不对的地方，请指出。

参考链接:
https://yi0934.github.io/cve/ms17-010.html
https://github.com/worawit/MS17-010
http://blogs.360.cn/post/nsa-eternalblue-smb.html
https://www.cnblogs.com/zhang293/p/8328017.html
https://www.cnblogs.com/yuzly/p/10480438.html
http://blog.nsfocus.net/vulnerabilities-srv-sys/