漏洞基础

分析文档的编写

1. 漏洞原因
2. 漏洞影响
    - 可执行代码、拒绝服务、...
3. 影响范围
    - xp、win7、IIS、SQL Server XXX、...
4. 修复方案

相关指令

```
call $+5
pop ebp     ; 用于重定位

push eax
retn        ; call eax

jmp esp     ; 跳板 -> jmp register  win10：0x7ffa4512
```

二进制截断

针对一些格式化输入，打入shellcode的时候要避免使用一些值，以免被格式化输入函数给截断。

比如：`0x0c`、`0x0b`、`0x20`、`0x0d`、`0x0a`等，一个简易的shellcode变形方法如下：

```
# -*- coding: utf-8 -*-

import argparse
import struct

xor_value = 0

# 命令行解析
def get_parser():
    parser = argparse.ArgumentParser()
    parser.add_argument('file', help='Source file', type=str)
    parser.add_argument('-o', dest='target', required=True, help='Destination
file', type=str)
    return parser

# 异或测试
def found_xor_byte(data, filter_list=[]):
    ret_xor_data = []
    for i in range(0x0, 0x100):
```

```
            found = True
            change_data = [i ^ item for item in data]      # 对data进行异或操作
            # 如果在过滤列表中，继续
            for item in change_data:
                if item in filter_list:
                    found = False
                    break
            if found:
                global xor_value
                xor_value = i
                ret_xor_data = change_data
                break
    return ret_xor_data

if __name__ == '__main__':
    parser = get_parser()
    args = parser.parse_args()
    # 获取解析命令行参数
    source_file = args.file
    target_file = args.target

    # 设置相关过滤序列
    myfilter = [0x0c, 0x0b, 0x20, 0x0d, 0x0a]
    xor_data = 0
    # 打开源文件并读取内容
    try:
        with open(source_file, 'rb') as f:
            data = f.read()
            # 进行异或测试
            xor_data = found_xor_byte(data, filter_list=myfilter)
            if xor_data.count != 0:
                # 打开目标文件进行写入
                try:
                    with open(target_file, 'wb') as ff:
                        for item in xor_data:
                            ff.write(struct.pack('B', item))
                        print("写入成功，异或值：%#x" % xor_value)
                except IOError:
                    print(target_file, "写入失败")
    except IOError:
        print(source_file, "文件不存在")

    print("Done")
```

保护

1. GS安全检查
    - 在进入函数时，使用一个`全局变量的值 ^ ebp`后存入栈上（在返回之后上面），在函数返回时`拿出此值在 ^ ebp`后对比，如果不相等则报错

- 在进入函数的第一个`call`设置此值，此值跟系统时间、线程ID、进程ID、系统环境等信息有关
- 此值成为**Security Cookie**
- 绕过GS：如果是利用溢出覆盖返回地址的话，要想办法只对**Security Cookie**之后的值开始覆盖

2. DEP保护
   - 数据执行保护，没有可执行属性的内存中不能执行代码（会触发`0xc0000005`异常）
   - 绕过DEP：想办法首先调用一次`VirtualProtect`修改内存属性，然后跳转到执行代码
3. 随机基址
   - 需要可执行程序拥有重定位表并开启随机基址
   - 为了防止利用固定地址进行溢出攻击
   - 没有太通用的有效攻击方式
   - 尽量使用通用跳板

攻击方式

栈溢出

一般覆盖调用函数的返回地址或者栈中会被调用的函数指针

示例

Strcpy函数没有进行缓冲区长度的检查，造成缓冲区溢出

```
WSAStartup(0x101u, &WSAData);
v3 = socket(2, 1, 0);
v4 = v3;
if ( v3 < 0 )
{
  v5 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, v3);
  v6 = (ostream *)ostream::operator<<(v5, aSocketCreating);
  v7 = (void *)ostream::operator<<(v6, 10);
  sub_4012B0(v7, (void (__cdecl *)(void *))sub_4012D0);
  exit(1);
}
*(_WORD *)&name.sa_data[2] = 2;
*(_WORD *)&name.sa_data[4] = htons(7777u);
*(_DWORD *)&name.sa_data[6] = htonl(0);
if ( bind(v4, (struct sockaddr *)((char *)&name + 4), 16) )// bind: 0.0.0.0:7777
{
  v8 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, aBindingStreamS);
  v9 = (void *)ostream::operator<<(v8, 10);
  sub_4012B0(v9, (void (__cdecl *)(void *))sub_4012D0);
}
v10 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, asc_409088);
v11 = (void *)ostream::operator<<(v10, 10);
sub_4012B0(v11, (void (__cdecl *)(void *))sub_4012D0);
v12 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, aExploitTargetS);
v13 = (void *)ostream::operator<<(v12, 10);
sub_4012B0(v13, (void (__cdecl *)(void *))sub_4012D0);
v14 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, asc_409088);
v15 = (void *)ostream::operator<<(v14, 10);
sub_4012B0(v15, (void (__cdecl *)(void *))sub_4012D0);
listen(v4, 4);
*(_DWORD *)&name.sa_family = 16;
client_socket = accept(v4, (struct sockaddr *)((char *)&addr + 4), (int *)&name);
if ( client_socket != -1 )
{
  while ( 1 )
  {
    memset(&buf, 0, 512u);
    v17 = recv(client_socket, &buf, 512, 0);
    if ( v17 < 0 )
    {
      v18 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, aReadingStreamM);
      v19 = (void *)ostream::operator<<(v18, 10);
      sub_4012B0(v19, (void (__cdecl *)(void *))sub_4012D0);
      v17 = 0;
    }
    sub_401000(&buf);
    if ( !v17 )
    {
```

目标首先创建socket，绑定IP端口为0.0.0.0:7777，进行监听，而后recv接收数据，长度最多512字节，之后数据转向sub_401000处理

```
void *__cdecl sub_401000(const char *recv_data)
{
  ostream *v1; // eax
  void *v2; // eax
  ostream *v3; // eax
  void *v4; // eax
  ostream *v5; // eax
  void *v6; // eax
  char buf; // [esp+8h] [ebp-C8h]

  strcpy(&buf, recv_data);
  v1 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, asc_40904C);
  v2 = (void *)ostream::operator<<(v1, 10);
  sub_4012B0(v2, (void (__cdecl *)(void *))sub_4012D0);
  v3 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, aReceived);
  v4 = (void *)ostream::operator<<(v3, 10);
  sub_4012B0(v4, (void (__cdecl *)(void *))sub_4012D0);
  v5 = (ostream *)ostream::operator<<((ostream *)&dword_409A68, &buf);
  v6 = (void *)ostream::operator<<(v5, 10);
  return sub_4012B0(v6, (void (__cdecl *)(void *))sub_4012D0);
}
```

在sub_401000函数中，对recv的数据进行了strcpy拷贝，但没检查缓冲区长度，可以进行缓冲区溢出攻击

堆溢出

堆溢出难度比较高，在堆上没法锁定地址，需要学会利用周围的环境，比如：

- 在特定条件下，尽可能的利用堆溢出去覆盖栈上返回地址
- FILE结构体（第一个成员是一个缓冲区，且必须是在全局，受随机基址影响）
- IAT表项（将缓冲区设为IAT表项并将后续的IAT填为shellcode，当有API调用的时候就会执行，此时需要IAT可写可执行）
- ...

示例：虚表攻击

覆盖虚表指针，在发生虚调用的时候就可以操控虚表项转向自己的流程

1. 逆向分析

   首先动态申请空间，构造CMyString类对象两个

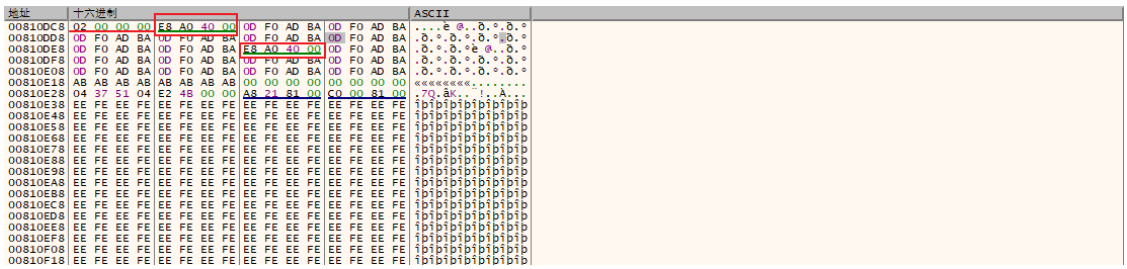
```
.text:00401030 envp            = dword ptr  0Ch
.text:00401030
.text:00401030 ; FUNCTION CHUNK AT .text:004097C0 SIZE 00000015 BYTES
.text:00401030
.text:00401030 ; __unwind { // _main_SEH
.text:00401030                 push    0FFFFFFFFh
.text:00401032                 push    offset _main_SEH
.text:00401037                 mov     eax, large fs:0
.text:0040103D                 push    eax
.text:0040103E                 mov     large fs:0, esp
.text:00401045                 push    ecx
.text:00401046                 push    ebx
.text:00401047                 push    esi
.text:00401048                 push    76              ; unsigned int
.text:0040104A                 call    ??2@YAPAXI@Z    ; 分配76字节空间
.text:0040104F                 add     esp, 4
.text:00401052                 mov     [esp+18h+CMyString_obj_ptr], eax ; 分配的空间地址
.text:00401056                 test    eax, eax
.text:00401058                 mov     [esp+18h+var_4], 0
.text:00401060                 jz      short loc_401081
.text:00401062                 push    offset CMyString_Destructor ; void (__thiscall *)(void *)
.text:00401067                 push    offset CMyString_Constructor ; void (__thiscall *)(void *)
.text:0040106C                 lea     esi, [eax+4]
.text:0040106F                 push    2               ; int
.text:00401071                 push    36              ; unsigned int
.text:00401073                 push    esi             ; void *
.text:00401074                 mov     dword ptr [eax], 2 ; new出来的是两个对象，每个对象36个字节（4字节虚表指针、32字节buf）
.text:0040107A                 call    ??_L@YGXPAXIHP6EX0@Z1@Z ; `eh vector constructor iterator'(void *,uint,int,void (*)(void *),void (*)(void *))
.text:0040107F                 jmp     short loc_401083
.text:00401081 ; ---------------------------------------------------------------------------
.text:00401081
.text:00401081 loc_401081:                             ; CODE XREF: _main+30↑j
.text:00401081                 xor     esi, esi
.text:00401083
.text:00401083 loc_401083:                             ; CODE XREF: _main+4F↑j
.text:00401083                 push    offset aR       ; "r+"
.text:00401088                 push    offset aPwdTxt  ; "pwd.txt"
.text:0040108D                 mov     [esp+20h+var_4], 0FFFFFFFFh
.text:00401095                 call    _fopen          ; FILE *fp = fopen("pwd.txt", "r+")
.text:0040109A                 mov     ebx, eax
.text:0040109C                 add     esp, 8
.text:0040109F                 test    ebx, ebx
.text:004010A1                 jnz     short loc_4010B7
.text:004010A3                 pop     esi
.text:004010A4                 or      eax, 0FFFFFFFFh
.text:004010A7                 pop     ebx
0000106F 0040106F: _main+3F (Synchronized with Hex View-1)
```

   然后打开文件，分别去读文件内容到两个CMyString类对象的缓冲区中，最后判断是否相等

```
.text:00401088                 push    offset aPwdTxt  ; "pwd.txt"
.text:0040108D                 mov     [esp+20h+var_4], 0FFFFFFFFh
.text:00401095                 call    _fopen          ; FILE *fp = fopen("pwd.txt", "r+")
.text:0040109A                 mov     ebx, eax
.text:0040109C                 add     esp, 8
.text:0040109F                 test    ebx, ebx
.text:004010A1                 jnz     short loc_4010B7
.text:004010A3                 pop     esi
.text:004010A4                 or      eax, 0FFFFFFFFh
.text:004010A7                 pop     ebx
.text:004010A8                 mov     ecx, [esp+10h+var_C]
.text:004010AC                 mov     large fs:0, ecx
.text:004010B3                 add     esp, 10h
.text:004010B6                 retn
.text:004010B7 ; ---------------------------------------------------------------------------
.text:004010B7
.text:004010B7 loc_4010B7:                             ; CODE XREF: _main+71↑j
.text:004010B7                 mov     eax, [esi]
.text:004010B9                 push    edi
.text:004010BA                 mov     ecx, esi
.text:004010BC                 call    dword ptr [eax] ; CMyString_obj_ptr[0].GetBuf()
.text:004010BE                 push    eax
.text:004010BF                 push    offset aS       ; "%s"
.text:004010C4                 push    ebx             ; FILE *
.text:004010C5                 call    _fscanf         ; fscanf(fp, "%s", CMyString_obj_ptr[0].buf)
.text:004010CA                 mov     edx, [esi+24h]
.text:004010CD                 lea     edi, [esi+24h]
.text:004010D0                 add     esp, 0Ch
.text:004010D3                 mov     ecx, edi
.text:004010D5                 call    dword ptr [edx] ; CMyString_obj_ptr[1].GetBuf()
.text:004010D7                 push    eax
.text:004010D8                 push    offset aS       ; "%s"
.text:004010DD                 push    ebx             ; FILE *
.text:004010DE                 call    _fscanf         ; fscanf(fp, "%s", CMyString_obj_ptr[1].buf)
.text:004010E3                 mov     eax, [esi]
.text:004010E5                 add     esp, 0Ch
.text:004010E8                 mov     ecx, esi
.text:004010EA                 call    dword ptr [eax] ; CMyString_obj_ptr[0].GetBuf()
.text:004010EC                 mov     edx, [edi]
.text:004010EE                 push    eax
.text:004010EF                 mov     ecx, edi
.text:004010F1                 call    dword ptr [edx] ; CMyString_obj_ptr[1].GetBuf()
.text:004010F3                 push    eax
.text:004010F4                 call    strcmp          ; strcmp(CMyString_obj_ptr[1].buf, CMyString_obj_ptr[0].buf)
.text:004010F9                 add     esp, 8
.text:004010FC                 test    eax, eax
000010C4 004010C4: _main+94 (Synchronized with Hex View-1)
```

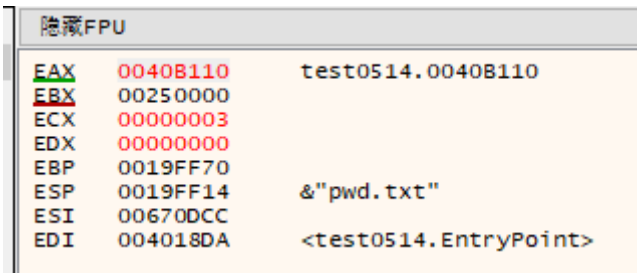
2. 漏洞利用

   很明显可以看出，读取文件内容时，没有检查缓冲区长度，存在缓冲区溢出的可能

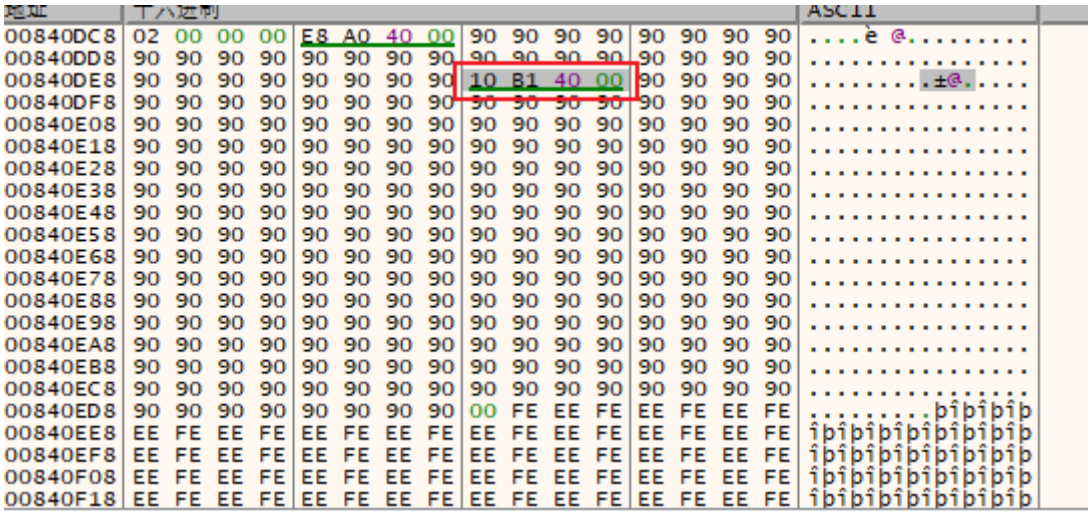


在堆上，可以看到两个对象的内存分布（红线为对象个数，红框为虚表指针，红框之后就是CMyString的buf缓冲区）

而后进过调试每次打开文件的`FILE *fp`一直不变为



构造shellcode，将第二个CMyString对象的虚表填为`FILE *fp`的地址，之后当第二个CMyString对象调用虚函数的时候，会将`FILE *fp`的地址作为虚表从中查找虚函数（本例中会调用虚表的第一个表项，而`FILE`结构的第一个成员为文件读取的缓冲区，也刚好可以执行到shellcode）



之后在对shellcode进行改造，执行代码即可