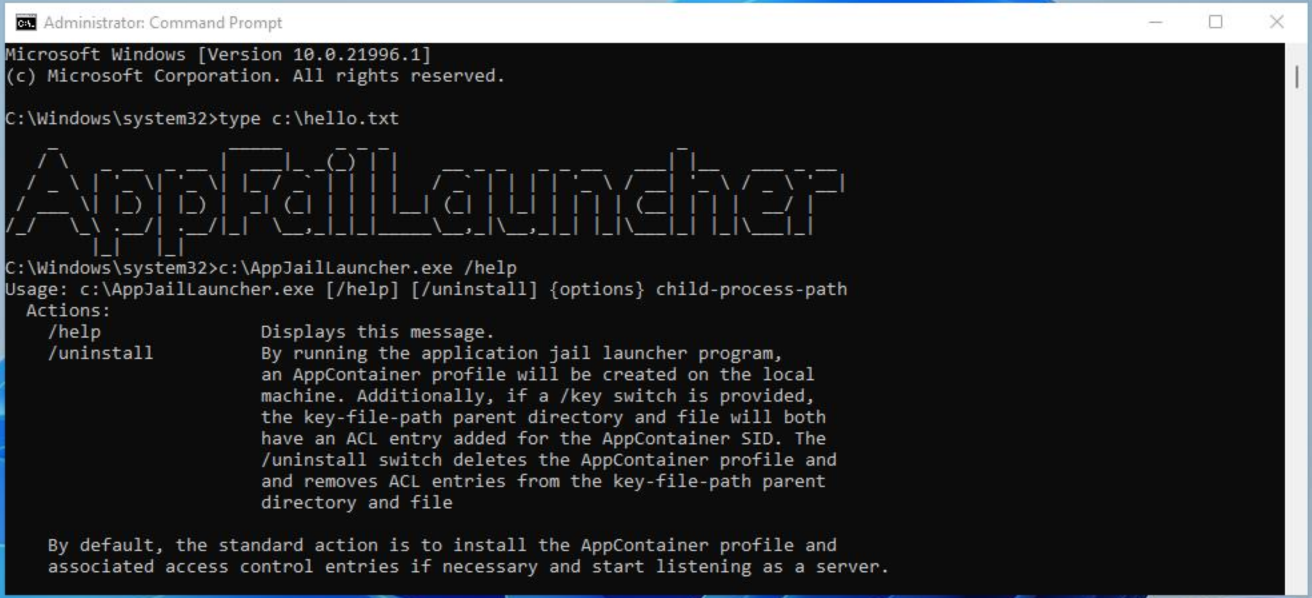
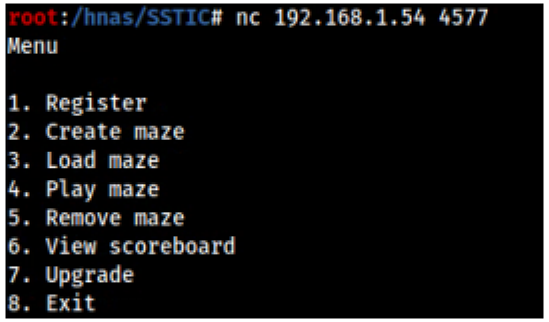
AppJailLauncher



```
Microsoft Windows [Version 10.0.21996.1]
(c) Microsoft Corporation. All rights reserved.

C:\Windows\system32>type c:\hello.txt
    _                _____     _ _ _                           _
   / \   _ __  _ __ |  ___|_ _(_) | |    __ _ _   _ _ __   ___| |__   ___ _ __
  / _ \ | '_ \| '_ \| |_ / _` | | | |   / _` | | | | '_ \ / __| '_ \ / _ \ '__|
 / ___ \| |_) | |_) |  _| (_| | | | |__| (_| | |_| | | | | (__| | | |  __/ |
/_/   \_\ .__/| .__/|_|  \__,_|_|_|_____\__,_|\__,_|_| |_|\___|_| |_|\___|_|
        |_|   |_|
C:\Windows\system32>c:\AppJailLauncher.exe /help
Usage: c:\AppJailLauncher.exe [/help] [/uninstall] {options} child-process-path
  Actions:
    /help                Displays this message.
    /uninstall           By running the application jail launcher program,
                         an AppContainer profile will be created on the local
                         machine. Additionally, if a /key switch is provided,
                         the key-file-path parent directory and file will both
                         have an ACL entry added for the AppContainer SID. The
                         /uninstall switch deletes the AppContainer profile and
                         and removes ACL entries from the key-file-path parent
                         directory and file

    By default, the standard action is to install the AppContainer profile and
    associated access control entries if necessary and start listening as a server.
```

SSTIC Challenge

- Windows pwnable !
- Spawned by AppJailLauncher



```
root:/hnas/SSTIC# nc 192.168.1.54 4577
Menu

1. Register
2. Create maze
3. Load maze
4. Play maze
5. Remove maze
6. View scoreboard
7. Upgrade
8. Exit
```

AppJailLauncher is akin to a simple version of xinetd for Windows but with sandboxing enabled for the spawned child processes. The sandboxing is accomplished via AppContainers.

Source: https://thalium.github.io/blog/posts/sstic_infra_windows/

AppContainer Isolation

- Isolate application from logon user, devices, files, network & window
- Create a new unique “user”: AppContainer SID for an application
- Capabilities to allow access to specific objects
- Less Privileged AppContainer (LPAC): restricted AC

AppJailLauncher

- Create an AppContainer profile with no capability

- Allow read access to the flag (*cmdline parameter /key*)
- Job to limit process execution time (*cmdline parameter /timeout*)

- On connection:
  - Spawn the challenge process in the AC (with Low Integrity)
  - Redirect stdin, stdout, stderr to the client socket

AppJailLauncher Security

The SSTIC organizers forked AppJailLauncher and made some improvements:

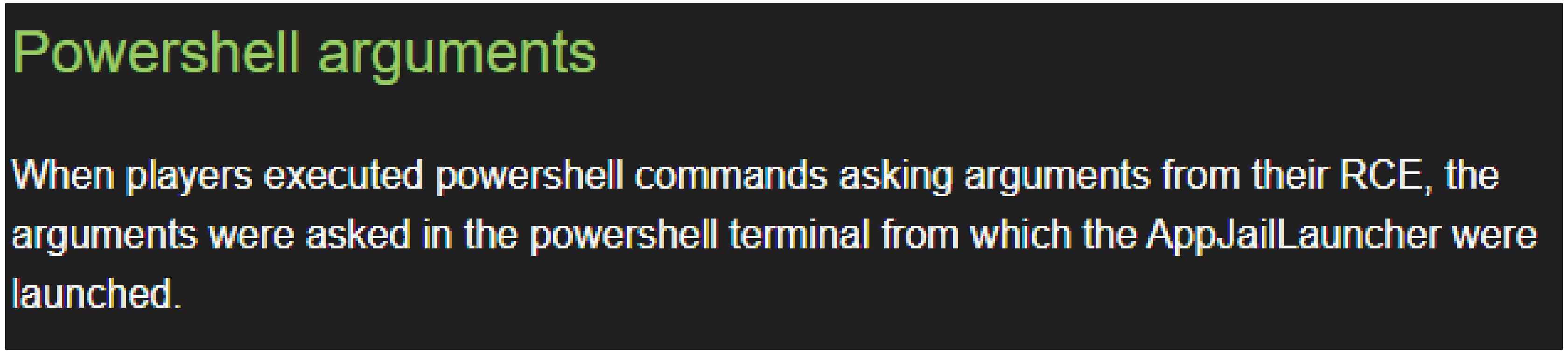
✓Creates temporary new AC SID on connection (10 min timeout)
- Previously, all the spawned challenges shared the same AC SID so after RCE, a malicious player can access other players processes (DoS)

✓Limits resources by default:
- Execution to 2 minutes
- Memory to 100 MB of RAM
- Maximum of 2 parallel processes

- Temporary writable folders for players (one for each player)
  - ❑Not reviewed

From https://thalium.github.io/blog/posts/sstic_infra_windows/

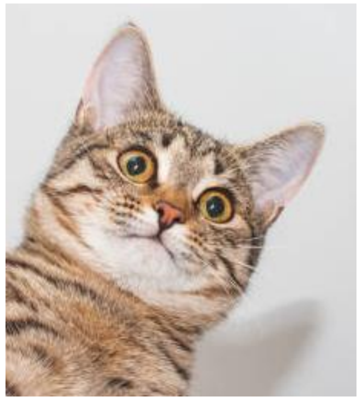
Thalium Blogpost



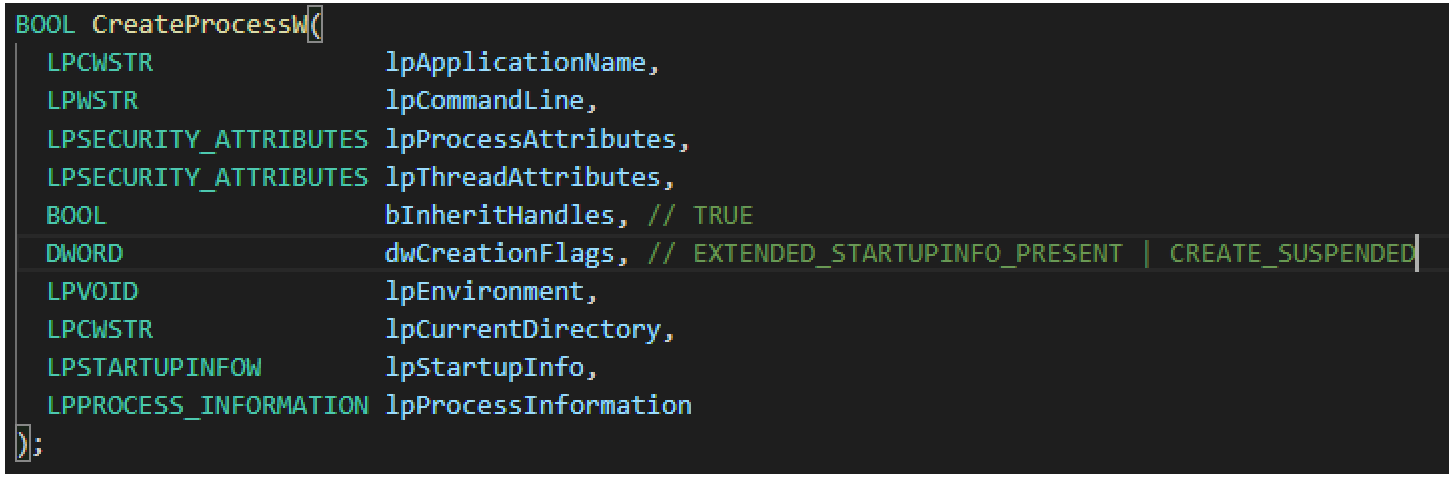
Powershell arguments

When players executed powershell commands asking arguments from their RCE, the arguments were asked in the powershell terminal from which the AppJailLauncher were launched.

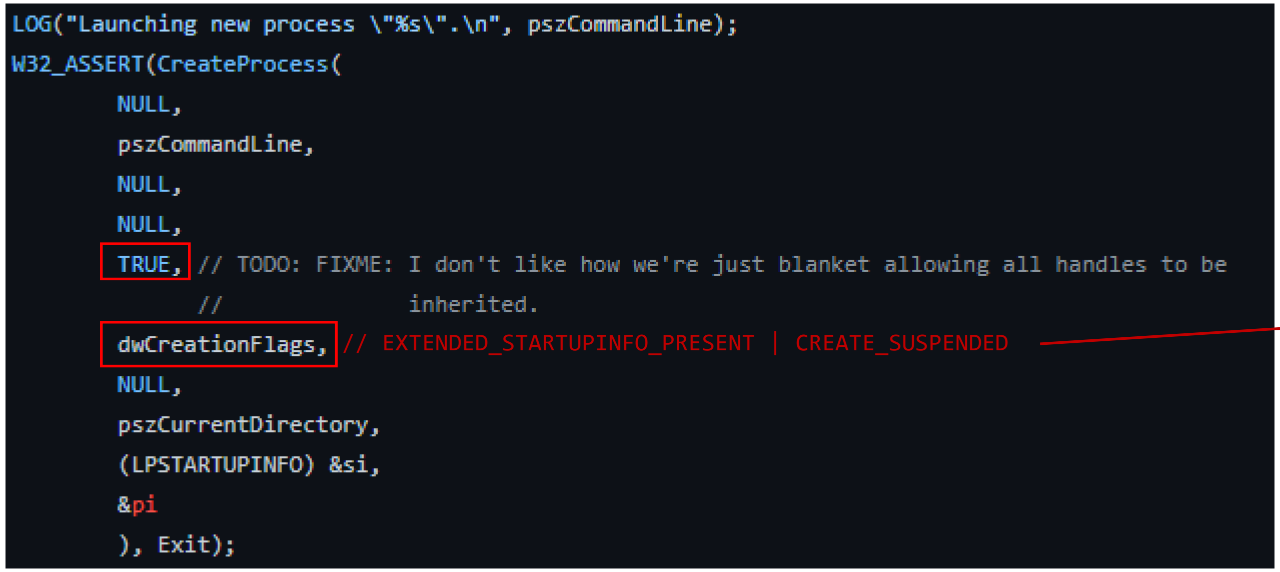
What ?



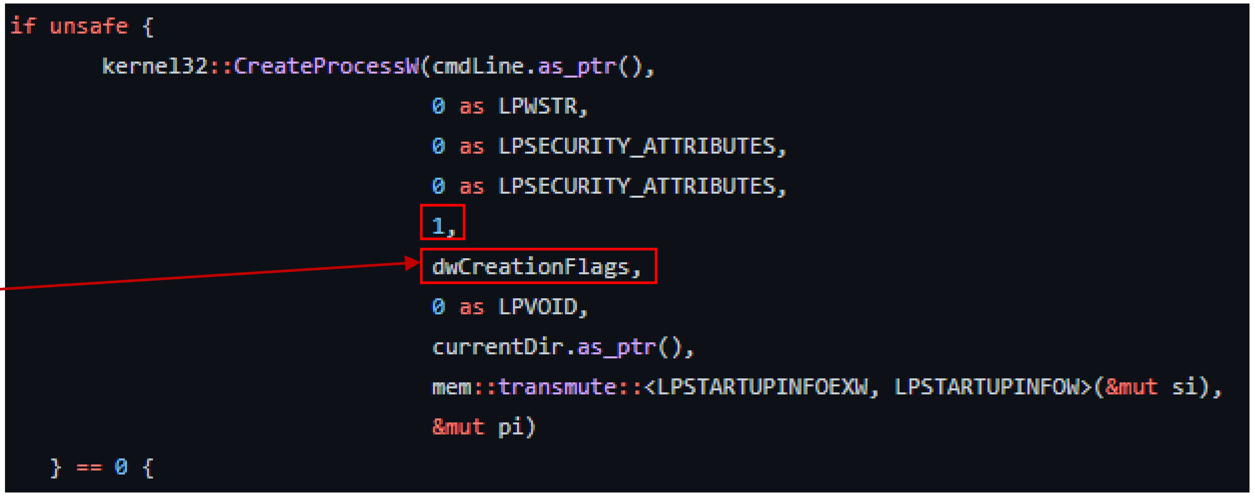
Vulnerability



```
BOOL CreateProcessW(
  LPCWSTR               lpApplicationName,
  LPWSTR                lpCommandLine,
  LPSECURITY_ATTRIBUTES lpProcessAttributes,
  LPSECURITY_ATTRIBUTES lpThreadAttributes,
  BOOL                  bInheritHandles, // TRUE
  DWORD                 dwCreationFlags, // EXTENDED_STARTUPINFO_PRESENT | CREATE_SUSPENDED
  LPVOID                lpEnvironment,
  LPCWSTR               lpCurrentDirectory,
  LPSTARTUPINFOW        lpStartupInfo,
  LPPROCESS_INFORMATION lpProcessInformation
);
```



```
LOG("Launching new process \"%s\".\n", pszCommandLine);
W32_ASSERT(CreateProcess(
        NULL,
        pszCommandLine,
        NULL,
        NULL,
        TRUE, // TODO: FIXME: I don't like how we're just blanket allowing all handles to be
              //              inherited.
        dwCreationFlags, // EXTENDED_STARTUPINFO_PRESENT | CREATE_SUSPENDED
        NULL,
        pszCurrentDirectory,
        (LPSTARTUPINFO) &si,
        &pi
        ), Exit);
```



```
if unsafe {
       kernel32::CreateProcessW(cmdLine.as_ptr(),
                                0 as LPWSTR,
                                0 as LPSECURITY_ATTRIBUTES,
                                0 as LPSECURITY_ATTRIBUTES,
                                1,
                                dwCreationFlags,
                                0 as LPVOID,
                                currentDir.as_ptr(),
                                mem::transmute::<LPSTARTUPINFOEXW, LPSTARTUPINFOW>(&mut si),
                                &mut pi)
   } == 0 {
```

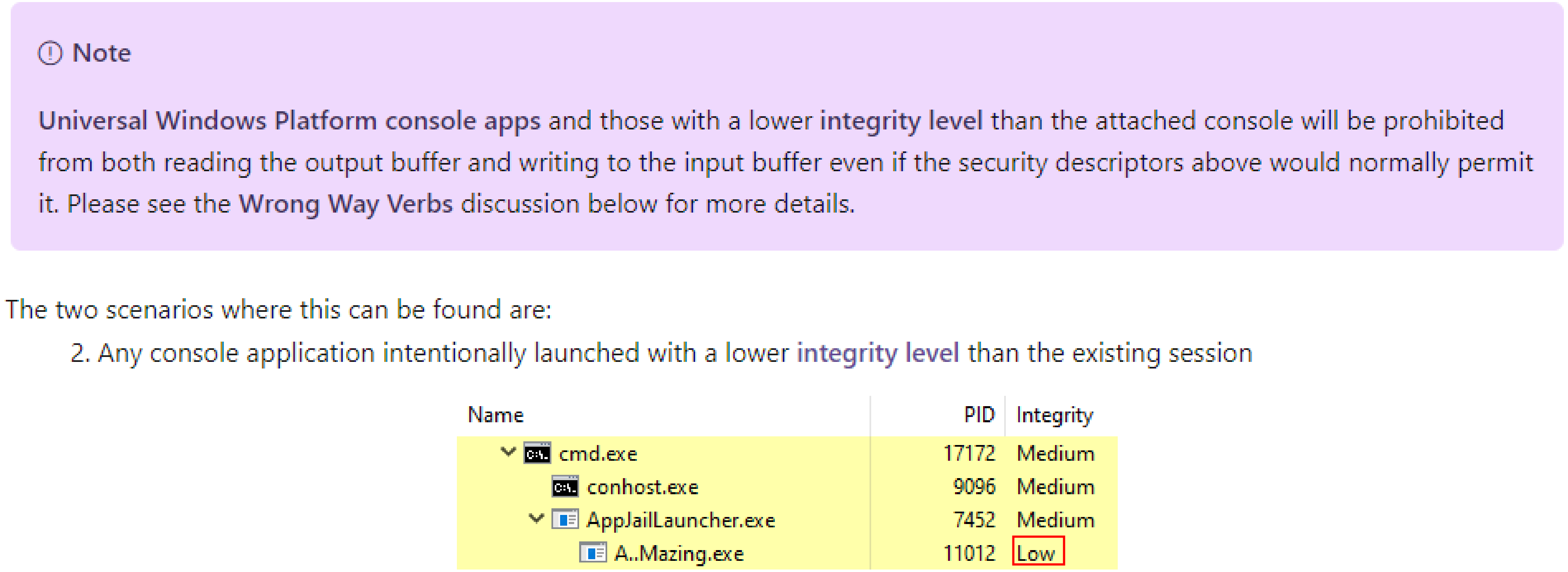
Basically you still have access to the console

AppJailLauncher exploit plan

- Console on Windows (condrv) uses multiple handles
  - \Input (stdin) is inherited
  - \Output (stout, stderr) are inherited
  - \Reference is duplicated by the kernel at process creation (passed in *ProcessParameters*)
  - \Connect is created at process creation to use input/output **using \Reference handle**
  - To interact with Input/Output, you need a valid \Connect handle

- So you can control the parent console
- Exploit plan:
  - Send a Control+C event to close AppJailLauncher
  - Write a command to \Input and enjoy unsandboxed code execution!

Wait a minute!



ⓘ Note

Universal Windows Platform console apps and those with a lower **integrity level** than the attached console will be prohibited from both reading the output buffer and writing to the input buffer even if the security descriptors above would normally permit it. Please see the **Wrong Way Verbs** discussion below for more details.

The two scenarios where this can be found are:

2. Any console application intentionally launched with a lower **integrity level** than the existing session

Name	PID	Integrity
cmd.exe	17172	Medium
conhost.exe	9096	Medium
AppJailLauncher.exe	7452	Medium
A..Mazing.exe	11012	Low

- https://docs.microsoft.com/en-us/windows/console/console-buffer-security-and-access-rights

Microsoft made console open source

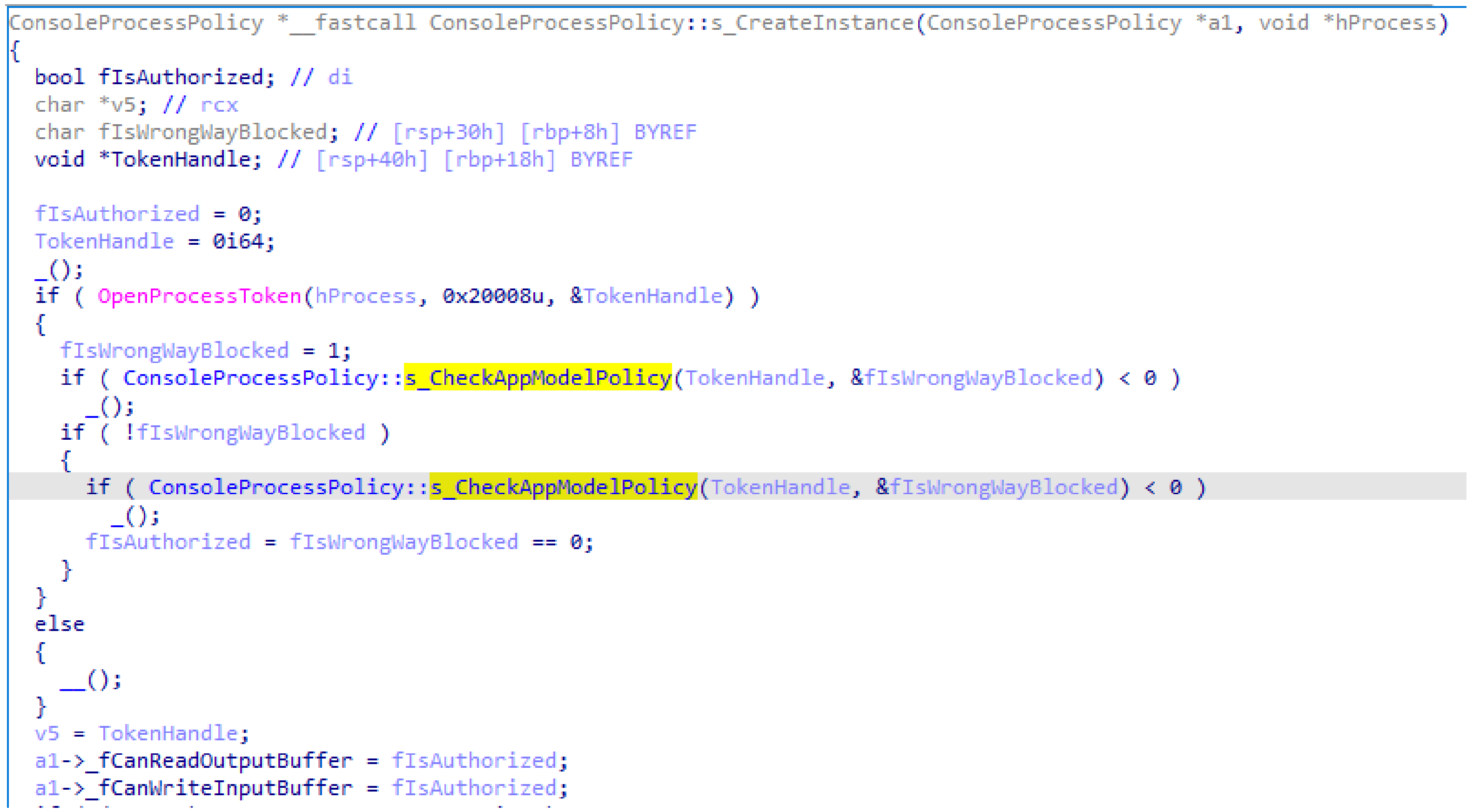
- Integrity level is checked to block write access to Console Input ☹

```
ConsoleProcessPolicy ConsoleProcessPolicy::s_CreateInstance(const HANDLE hProcess)
{
    bool fCanReadOutputBuffer = false;
    bool fCanWriteInputBuffer = false;
    // First check AppModel Policy:
    LOG_IF_FAILED(Microsoft::Console::Internal::ProcessPolicy::CheckAppModelPolicy(hToken.get(), fIsWrongWayBlocked));

    // If we're not restricted by AppModel Policy, also check for Integrity Level below our own.
    if (!fIsWrongWayBlocked)
    {
        LOG_IF_FAILED(Microsoft::Console::Internal::ProcessPolicy::CheckIntegrityLevelPolicy(hToken.get(), fIsWrongWayBlocked));
    }

    // If we're not blocking wrong way verbs, adjust the read/write policies to permit read out and write in.
    if (!fIsWrongWayBlocked)
    {
        fCanReadOutputBuffer = true;
        fCanWriteInputBuffer = true;
    }
// ...
}
```

- https://github.com/microsoft/terminal/blob/main/src/server/ProcessPolicy.cpp#L27

Let’s check the binary (21H1)

Where is the integrity level check ?



```
ConsoleProcessPolicy *__fastcall ConsoleProcessPolicy::s_CreateInstance(ConsoleProcessPolicy *a1, void *hProcess)
{
  bool fIsAuthorized; // di
  char *v5; // rcx
  char fIsWrongWayBlocked; // [rsp+30h] [rbp+8h] BYREF
  void *TokenHandle; // [rsp+40h] [rbp+18h] BYREF

  fIsAuthorized = 0;
  TokenHandle = 0i64;
  _();
  if ( OpenProcessToken(hProcess, 0x20008u, &TokenHandle) )
  {
    fIsWrongWayBlocked = 1;
    if ( ConsoleProcessPolicy::s_CheckAppModelPolicy(TokenHandle, &fIsWrongWayBlocked) < 0 )
      _();
    if ( !fIsWrongWayBlocked )
    {
      if ( ConsoleProcessPolicy::s_CheckAppModelPolicy(TokenHandle, &fIsWrongWayBlocked) < 0 )
        _();
      fIsAuthorized = fIsWrongWayBlocked == 0;
    }
  }
  else
  {
    __();
  }
  v5 = TokenHandle;
  a1->_fCanReadOutputBuffer = fIsAuthorized;
  a1->_fCanWriteInputBuffer = fIsAuthorized;
```

_*_: Removed some names for simplicity_

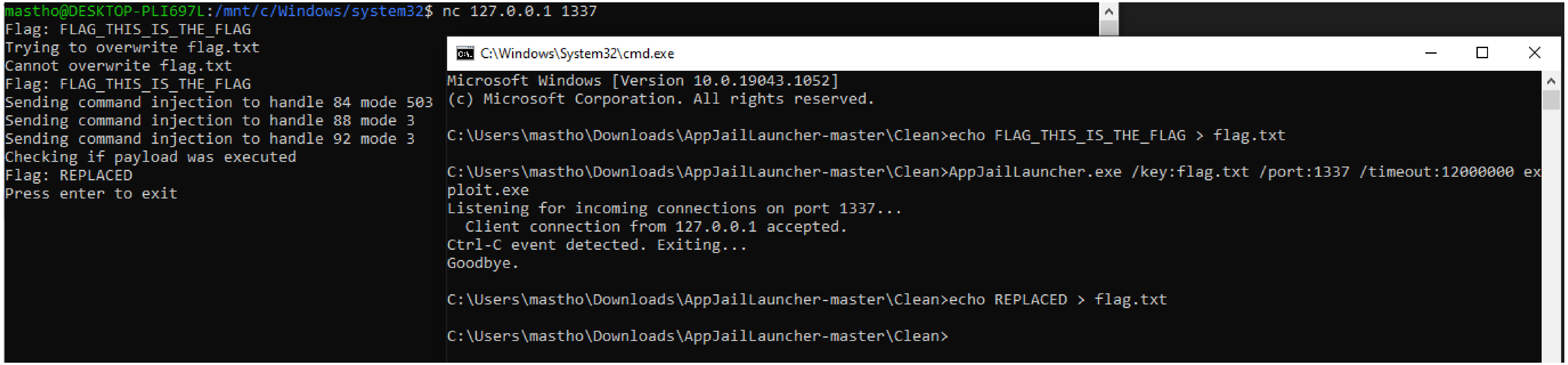
Exploitability

Windows Version	Can access console	Can write input buffer
Before 1803	No (AC can’t create connection)	No
1803	Yes	No (Check Integrity)
1809	Yes	No (Check Integrity)
1903	Yes	No (Check Integrity)
1909	Yes	No (Check Integrity)
2004	Yes	Yes
20H2	Yes	Yes
21H1 (current version)	Yes	Yes
Windows 11	Yes	No (Fixed again)

Writing to the console is fixed and disabled but escaping may be possible using other commands (AddConsoleAlias)

Demo !

Demo !



```
mastho@DESKTOP-PLI697L:/mnt/c/Windows/system32$ nc 127.0.0.1 1337
Flag: FLAG_THIS_IS_THE_FLAG
Trying to overwrite flag.txt
Cannot overwrite flag.txt
Flag: FLAG_THIS_IS_THE_FLAG
Sending command injection to handle 84 mode 503
Sending command injection to handle 88 mode 3
Sending command injection to handle 92 mode 3
Checking if payload was executed
Flag: REPLACED
Press enter to exit
```

C:\Windows\System32\cmd.exe

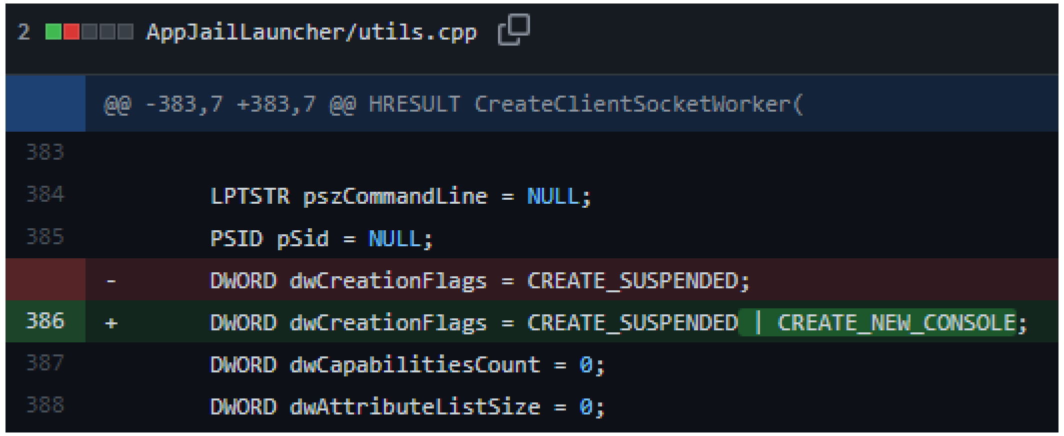
```
Microsoft Windows [Version 10.0.19043.1052]
(c) Microsoft Corporation. All rights reserved.

C:\Users\mastho\Downloads\AppJailLauncher-master\Clean>echo FLAG_THIS_IS_THE_FLAG > flag.txt

C:\Users\mastho\Downloads\AppJailLauncher-master\Clean>AppJailLauncher.exe /key:flag.txt /port:1337 /timeout:12000000 ex
ploit.exe
Listening for incoming connections on port 1337...
  Client connection from 127.0.0.1 accepted.
Ctrl-C event detected. Exiting...
Goodbye.

C:\Users\mastho\Downloads\AppJailLauncher-master\Clean>echo REPLACED > flag.txt

C:\Users\mastho\Downloads\AppJailLauncher-master\Clean>
```

Left as an exercise for the reader:

“ During the competition, this command was launched with Powershell. ”

AppJailLauncher Fix

- Process Creation Flags
  - **CREATE_NEW_CONSOLE**
  - The *new process* has a new console, instead of inheriting its parent's console (the default).

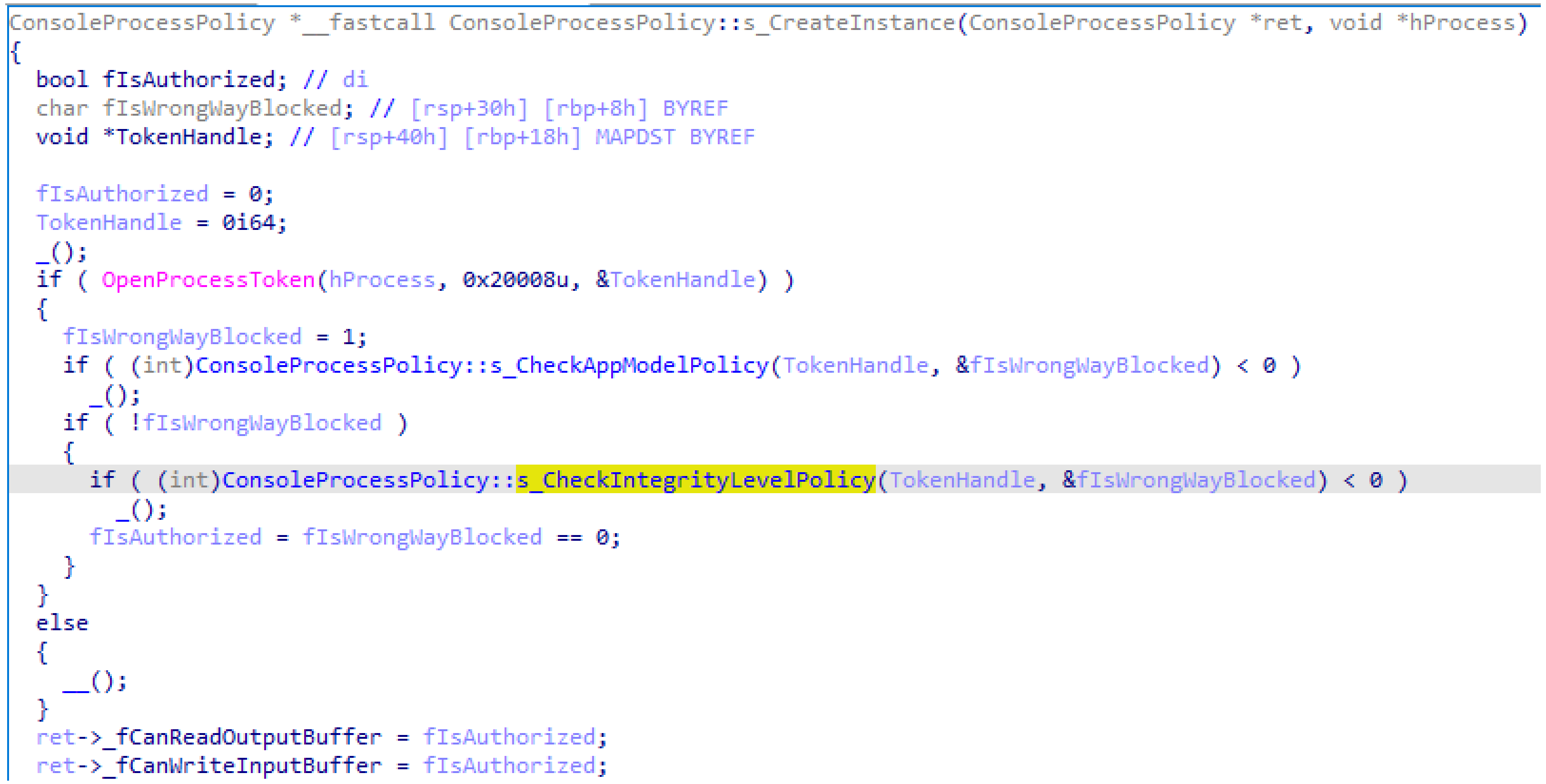


```
2 AppJailLauncher/utils.cpp
@@ -383,7 +383,7 @@ HRESULT CreateClientSocketWorker(

        LPTSTR pszCommandLine = NULL;
        PSID pSid = NULL;
-       DWORD dwCreationFlags = CREATE_SUSPENDED;
+       DWORD dwCreationFlags = CREATE_SUSPENDED | CREATE_NEW_CONSOLE;
        DWORD dwCapabilitiesCount = 0;
        DWORD dwAttributeListSize = 0;
```

Without the parent console \Reference, inherited Input/Output are unusable.
Commit: 4764645 and dd37034

Microsoft Fix

- October 2021: CVE-2021-41346



```
ConsoleProcessPolicy *__fastcall ConsoleProcessPolicy::s_CreateInstance(ConsoleProcessPolicy *ret, void *hProcess)
{
  bool fIsAuthorized; // di
  char fIsWrongWayBlocked; // [rsp+30h] [rbp+8h] BYREF
  void *TokenHandle; // [rsp+40h] [rbp+18h] MAPDST BYREF

  fIsAuthorized = 0;
  TokenHandle = 0i64;
  _();
  if ( OpenProcessToken(hProcess, 0x20008u, &TokenHandle) )
  {
    fIsWrongWayBlocked = 1;
    if ( (int)ConsoleProcessPolicy::s_CheckAppModelPolicy(TokenHandle, &fIsWrongWayBlocked) < 0 )
      _();
    if ( !fIsWrongWayBlocked )
    {
      if ( (int)ConsoleProcessPolicy::s_CheckIntegrityLevelPolicy(TokenHandle, &fIsWrongWayBlocked) < 0 )
        _();
      fIsAuthorized = fIsWrongWayBlocked == 0;
    }
  }
  else
  {
    __();
  }
  ret->_fCanReadOutputBuffer = fIsAuthorized;
  ret->_fCanWriteInputBuffer = fIsAuthorized;
```

Links

- AppJailLauncher console escape exploit:

https://gist.github.com/masthoon/3b3b60dcb7f8687dc7336bcbe3236700

- POC CVE-2021-41346

https://gist.github.com/masthoon/85fab432527329f17a040b311fc1f2a2