Password attack tools

Passwords are currently used as the main method to authenticate a user to the system. After a user submits the correct username and password, the system will allow a user to login and access its functionality based on the authorization given to that username.

The following three factors can be used to categorize authentication types:

- **Something you know**: This is usually called the first factor of authentication. A password is categorized in this type. In theory, this factor should only be known by the authorized person. In reality, this factor can easily be leaked or captured; therefore, it is not advisable to use this method to authenticate users to the sensitive system.
- **Something you have**: This is usually called the second factor of authentication. Several examples of this factor are security tokens, cards, and so on. After you prove to the system that you have the authentication factor, you are allowed to login. The drawback of this factor is that it is prone to the cloning process.
- **Something you are**: This is usually called the third factor of authentication. This factor is the most secure one as compared to the previous factors, but already there are several published attacks against this factor. Biometric and retina scans can be classified in this factor.

To have more security, people usually use more than one factor together. The most common combination is to use the first and second factors of authentication. As this combination uses two factors of authentication, it is usually called a two-factor authentication.

Unfortunately, based on our penetration testing experiences, password-based authentication is still widely used. As a penetration tester, you should check for the password security during your penetration testing engagement.

According to how the password attack is done, this process can be differentiated into the following types:

- **Offline attack**: In this method, the attacker gets the hash file from the target machine and copies it to the attacker's machine. The attacker then uses the password-cracking tool to crack the password. The advantage of using this method is that the attacker doesn't need to worry about the password-blocking mechanism available in the target machine because the process is done locally.
- **Online attack**: In this method, the attacker tries to login to the remote machine using the guessed credentials. This technique may trigger the remote machine to block the attacker machine after several failed password guess attempts.

Offline attack tools

The tools in this category are used for offline password attacks. Usually, these tools are used to do vertical privilege escalation because you may need a privilege account to get the password files.

Why do you need other credentials when you already have a privilege credential? When doing penetration testing to a system, you may find that the privilege account may not have the configuration to run the application. If this is the case, then you can't test it. However, after you log in as a regular user, you are able to run the application correctly. This is one of the reasons why you need to get other credentials.

Note

Nowadays, passwords are stored as password hashes; the password is processed with a one-way `hash` function. This function works on the idea that it is relatively easy for the input to be hashed, but it is almost impossible to restore the original plaintext from the hash.

Back in the old days, passwords were stored as plaintext. If an attacker is able to get the password file, the attacker will be able to get the password easily. Today, even though the attacker is able to get the password file, the password is hashed. So, the password cannot be obtained easily.

Password cracking works by guessing a password, then hashing that password with a `hash` algorithm, and then comparing it with the existing hash. If they match, then the password is correct.

Another case is where after you have exploited an SQL injection vulnerability, you are able to dump a database and find that the credentials are stored using hashing. To help you get information from hash, you can use the tools in this category.

Note

In one of our penetration testing projects, we were able to dump a database containing a username and password for an e-mail system. We then used that information to log in to a key person's e-mail address in the organization. We managed to get the credential information for various critical systems.

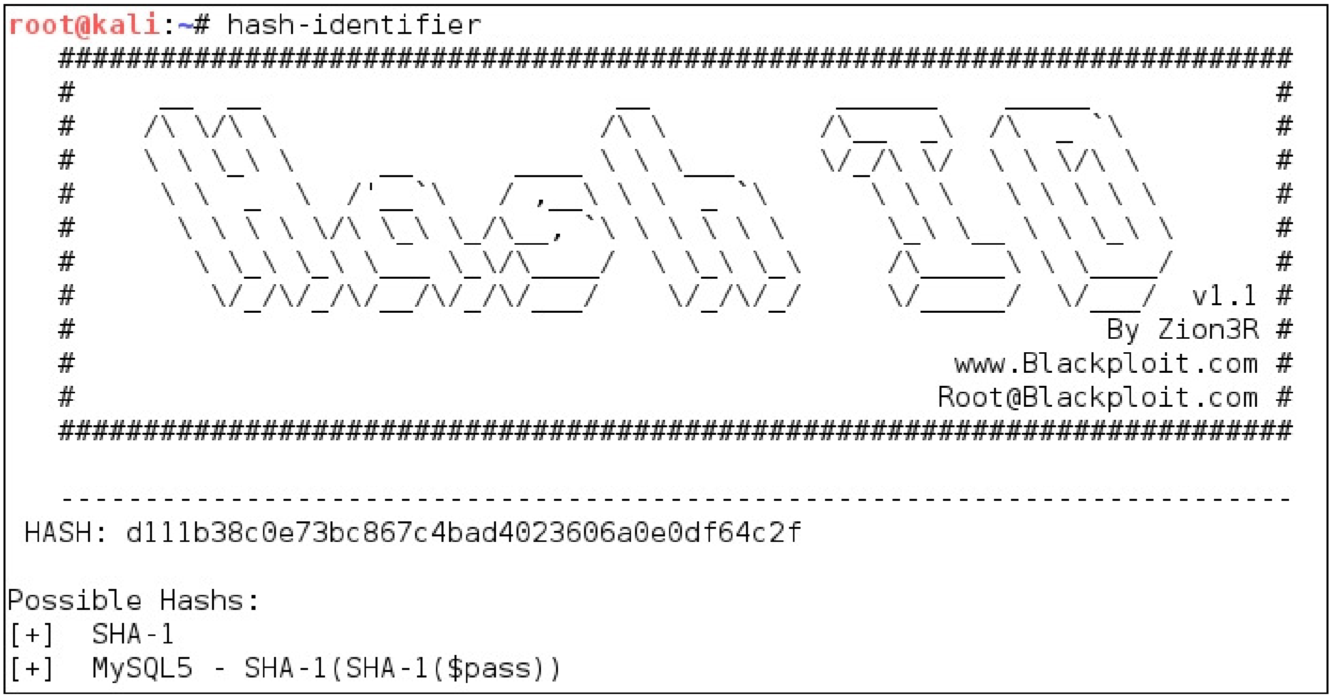
hash-identifier

The hash-identifier tool can be used to identify a password hash type. Before you can crack a password hash, you need to determine its type in order to give the correct algorithm for the password cracker. To find the encryption algorithms supported by the hash-identifier tool, you can consult its website located at http://code.google.com.db19.linccweb.org/p/hash-identifier/.

Suppose, we have the following hash:

```
d111b38c0e73bc867c4bad4023606a0e0df64c2f
```

To identify this hash, just type `hash-identifier` and input the hash in the **HASH** field. The following screenshot shows the result:



```
root@kali:~# hash-identifier
   #########################################################################
   #     __  __                     __           ______    _____           #
   #    /\ \/\ \                   /\ \         /\__  _\  /\  _ `\         #
   #    \ \ \_\ \     __      ____ \ \ \___     \/_/\ \/  \ \ \/\ \        #
   #     \ \  _  \  /'__`\   / ,__\ \ \  _ `\      \ \ \   \ \ \ \ \       #
   #      \ \ \ \ \/\ \_\ \_/\__, `\ \ \ \ \ \      \_\ \__ \ \ \_\ \      #
   #       \ \_\ \_\ \___ \_\/\____/  \ \_\ \_\     /\_____\ \ \____/      #
   #        \/_/\/_/\/__/\/_/\/___/    \/_/\/_/     \/_____/  \/___/  v1.1 #
   #                                                             By Zion3R #
   #                                                    www.Blackploit.com #
   #                                                   Root@Blackploit.com #
   #########################################################################

   -------------------------------------------------------------------------
 HASH: d111b38c0e73bc867c4bad4023606a0e0df64c2f

Possible Hashs:
[+]  SHA-1
[+]  MySQL5 - SHA-1(SHA-1($pass))
```

We can see that the program identified the hash as a **SHA-1** type hash. Now let's use this information to crack the hash using Hashcat.

Beware that this program may not always identify the hash correctly. The following is an example:

```
HASH: 8846f7eaee8fb117ad06bdd830b7586c
Possible Hashs:
[+]  MD5
[+]  Domain Cached Credentials - MD4(MD4(($pass)).(strtolower($username)))
```

The program identifies the hash as `MD5` or `MD4` , but the correct algorithm is `NTLM` .

Hashcat

Hashcat is a free multithreaded password-cracking tool. Currently, it can be used to crack more than 80 algorithms (http://hashcat.net/hashcat/#features-algos). Hashcat is a CPU-based password cracker; it is slower than the **Graphical Processing Unit**-based (**GPU**) password cracker.

There are six attack modes supported by Hashcat:

- **Straight**: The program will use each line from a text file as the password candidate. This is the default attack mode. The other name of this mode is dictionary attack.
- **Combination**: Hashcat will combine each word in the dictionary. For example, if we have the following words in the dictionary:

  - password
  - 01

  Hashcat will create the following password candidates:

  - passwordpassword
  - password01
  - 01password
  - 0101

- **Toggle case**: The program will generate all the possible combinations of upper and lowercase variants of each word in the dictionary.
- **Brute force**: The program will try all combinations from a keyspace. This attack mode is being replaced by the mask attack. For example, if we specify the password candidates of two-character length and charset A-Z, Hashcat will generate the password candidates from AA to ZZ.

- **Permutation**: The program will create all the permutations of the word. For example, in the dictionary, we have AB as the word. The permutation of this is as follows:
    - AB
    - BA
- **Table-lookup**: For each word in the dictionary, the program automatically generates masks. You can get more information about this attack mode at http://hashcat.net/wiki/doku.php?id=table_lookup_attack.

Before you can use Hashcat, you need the dictionary containing the words. The following are several sites that provide dictionaries:

- http://www.skullsecurity.org/wiki/index.php/Passwords
- http://cyberwarzone.com/cyberwarfare/password-cracking-mega-collection-password-cracking-word-lists
- http://hashcrack.blogspot.de/p/wordlist-downloads_29.html
- http://packetstormsecurity.com/Crackers/wordlists/
- http://blog.g0tmi1k.com/2011/06/dictionaries-wordlists.html
- http://www.md5decrypter.co.uk/downloads.aspx

Let's try to use Hashcat in practice.

If you start Hashcat with `--help` as the option, you will see the Hashcat help information. This information is very useful if you forget the options.

Suppose we get a password file (`test.hash`) containing the following hash:

```
5f4dcc3b5aa765d61d8327deb882cf99
```

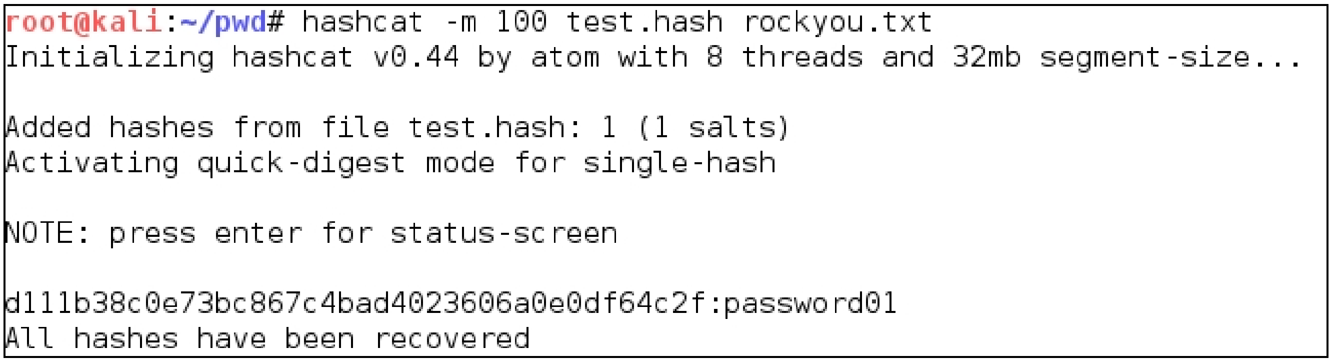
We will use the `rockyou.txt` dictionary. Just put these two files in the same directory. Here, we use `pwd` as the directory name.

To crack it with Hashcat using the default attack mode, we input the following command:

```
hashcat -m 100 test.hash rockyou.txt
```

The `-m 100` option will inform the program to use `SHA-1` as the hash type.

The following screenshot shows the result of this process:



```
root@kali:~/pwd# hashcat -m 100 test.hash rockyou.txt
Initializing hashcat v0.44 by atom with 8 threads and 32mb segment-size...

Added hashes from file test.hash: 1 (1 salts)
Activating quick-digest mode for single-hash

NOTE: press enter for status-screen

d111b38c0e73bc867c4bad4023606a0e0df64c2f:password01
All hashes have been recovered
```

Based on the previous screenshot, we can see that we have managed to get the password for that hash. The password is `password01` .

The default mode will find the correct password faster if the password exists in the dictionary. If not, then you can try the other attack mode.

In the Hashcat family of password-cracking tools, there are other tools that can be used to crack passwords. Those tools use GPU to crack the password, so you need to have GPU on your computer. Remember that they will not work in a VM; you need to have direct access to the physical hardware. Also, the graphics card needs to support CUDA (for NVidia cards) or OpenCL (for AMD cards). The Hashcat GPU-based tools are as follows:

- `oclhashcat-lite` : This is a GPU-based password cracker. This is the fastest password cracker in the Hashcat family, but it has limited support for the password hash algorithm (around 30 algorithms). The `oclhashcat-lite` tool is only able to crack a single hash using the markov attack, brute force attack, and mask attack.
- `oclhashcat-plus` : This is a GPU-based password cracker. It supports most hashing algorithms. It is optimized for dictionary attacks against multiple hashes. The `oclhashcat-plus` tool can use the following attack modes: brute force attack (implemented as mask attack), combinator attack, dictionary attack, hybrid attack, mask attack, and rule-based attack.

Note

You can consult the following resources to know more about some of the attacks:

- Hybrid attack (https://hashcat.net/wiki/doku.php?id=hybrid_attack)
- Mask attack (http://hashcat.net/wiki/doku.php?id=mask_attack)
- Rule-based attack (http://hashcat.net/wiki/doku.php?id=rule_based_attack)

RainbowCrack

RainbowCrack is a tool that can be used to crack a password hash using the rainbow tables. It works by implementing the time-memory tradeoff technique developed by Philippe Oechslin.

Note

If you want to know more about this technique, you can consult the paper written by Philippe Oechslin titled *Making a Faster Cryptanalytic Time-Memory Trade-Off*. This paper can be downloaded from the following link:

http://lasec.epfl.ch/pub/lasec/doc/Oech03.pdf

This method differs from the brute force attack. In the brute force attack method, the attacker computes the hash from the supplied password one by one. The resulting hash is then compared to the target hash. If both hashes match, the password supplied is correct. If the hashes don't match, it means that the supplied password is not the correct key.

The other difference is in their performance. The brute force technique is much slower compared to the time-memory tradeoff technique because the attacker needs to compute the hash and do the hash matching process. While in the time-memory tradeoff technique, the hash is already precomputed and the attacker only needs to do the hash matching process, which is a fast operation.

Note

Remember that RainbowCrack is slow and not multithreaded. There is a modified version of rcrack that supports multithreading and acceleration using CUDA-enabled graphic cards:

https://www.freerainbowtables.com/en/download/

Kali Linux includes three RainbowCrack tools that must be run in sequence to make things work:

- `rtgen` : This tool is used to generate the rainbow tables. Sometimes, this process is called the precomputation stage. The rainbow tables contain plaintext, hash, hash algorithm, charset, and plaintext length range. The precomputation stage is a time-consuming process, but once the precomputation is finished, the password cracker tool will have a much faster performance compared to the brute force cracker. The `rtgen` tool supports the following hash algorithms: `LanMan` , `NTLM` , `MD2` , `MD4` , `MD5` , `SHA1` , and `RIPEMD160` .
- `rtsort` : This tool is used to sort the rainbow tables generated by `rtgen` .
- `rcrack` : This tool is used to look up the rainbow tables to find the hash.

To start the `rtgen` tool, use the console to execute the following command:

```
# rtgen
```

This will display a simple usage instruction and two examples for creating the rainbow tables on your screen.

For our exercise, we are going to create two rainbow tables with the following characteristics:

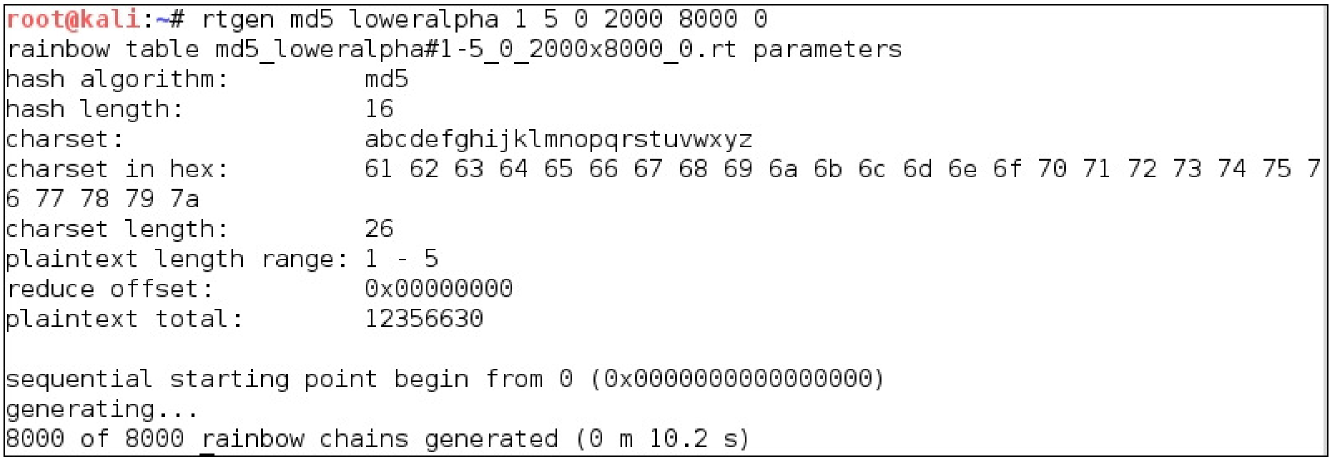
- hash algorithm: `md5`
- charset: `loweralpha`
- plaintext_len_min: `1`
- plaintext_len_max: `5`
- rainbow_table_index: `0`
- rainbow_ chain_length: `2000`

- rainbow_chain_count: `8000`
- part_index: `0`

To create these rainbow tables, give the following command:

```
# rtgen md5 loweralpha 1 5 0 2000 8000 testing
```

The following screenshot shows the result of this command line:



```
root@kali:~# rtgen md5 loweralpha 1 5 0 2000 8000 0
rainbow table md5_loweralpha#1-5_0_2000x8000_0.rt parameters
hash algorithm:         md5
hash length:            16
charset:                abcdefghijklmnopqrstuvwxyz
charset in hex:         61 62 63 64 65 66 67 68 69 6a 6b 6c 6d 6e 6f 70 71 72 73 74 75 7
6 77 78 79 7a
charset length:         26
plaintext length range: 1 - 5
reduce offset:          0x00000000
plaintext total:        12356630

sequential starting point begin from 0 (0x0000000000000000)
generating...
8000 of 8000 rainbow chains generated (0 m 10.2 s)
```

The first rainbow table will be saved in the `md5_loweralpha#1-5_0_2000x8000_0.rt` file under the `/usr/share/rainbowcrack/` directory.

To generate the second rainbow table, give the following command:

```
# rtgen md5 loweralpha 1 5 1 2000 8000 0
```

It takes around 3 minutes to generate these two rainbow tables on my system. The result will be saved in the `md5_loweralpha#1-5_1_2000x8000_0.rt` file.

Beware that if you generate your own rainbow tables, it may take a very long time and require a lot of disk space. You can use the `Winrtgen` (http://www.oxid.it/downloads/winrtgen.zip) program to estimate the required time to generate the rainbow tables.

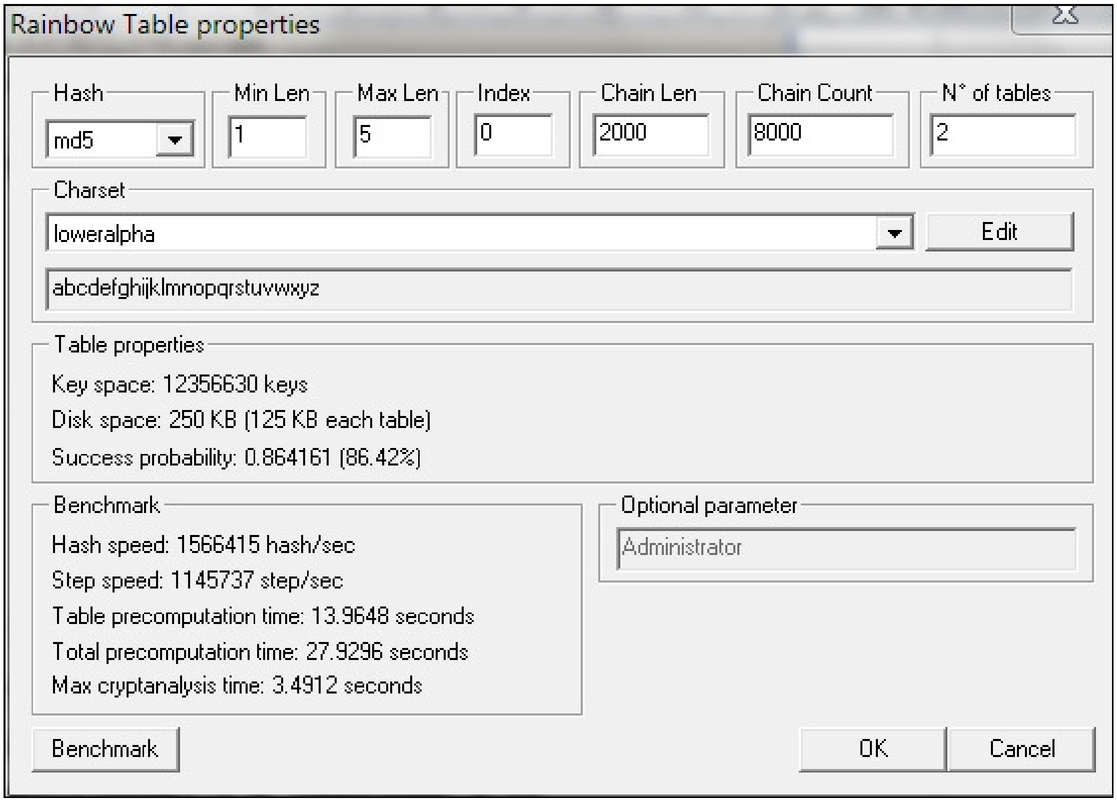
Note

`Winrtgen` is a Windows-based program, so you need to run it in the Wine environment.

If you don't want to generate your own rainbow tables, another alternative is that you can get them from various sites on the Internet, such as the following sites:

- http://www.freerainbowtables.com/en/tables/
- http://rainbowtables.shmoo.com/

The following is a screenshot of `Winrtgen` :



Rainbow Table properties

Hash: md5

Min Len: 1

Max Len: 5

Index: 0

Chain Len: 2000

Chain Count: 8000

N° of tables: 2

Charset: loweralpha

abcdefghijklmnopqrstuvwxyz

Table properties

Key space: 12356630 keys

Disk space: 250 KB (125 KB each table)

Success probability: 0.864161 (86.42%)

Benchmark

Hash speed: 1566415 hash/sec

Step speed: 1145737 step/sec

Table precomputation time: 13.9648 seconds

Total precomputation time: 27.9296 seconds

Max cryptanalysis time: 3.4912 seconds

Optional parameter: Administrator

After successfully creating the rainbow tables, the next step is to sort the tables. You can use the `rtsort` tool for this purpose.

To start the `rtsort` command line, use the console to execute the following command:

```
# rtsort
```

This will display a simple usage instruction and example on your screen. In our exercise, we are going to sort the first rainbow table as follows:

```
# rtsort md5_loweralpha#1-5_0_2000x8000_0.rt

md5_loweralpha#1-5_0_2000x8000_0.rt:
1176928256 bytes memory available
loading rainbow table...
sorting rainbow table by end point...
writing sorted rainbow table...
```

We do the same process for the second rainbow table file:

```
# rtsort md5_loweralpha#1-5_1_2000x8000_0.rt

md5_loweralpha#1-5_1_2000x8000_0.rt:
1177255936 bytes memory available
loading rainbow table...
sorting rainbow table by end point...
writing sorted rainbow table...
```

The `rtsort` tool will save the result in the original file.

Note

Do not interrupt the `rtsort` program; otherwise, the rainbow table being processed will get damaged.

Next, we want to use the generated rainbow tables to crack an `MD5` password hash of five characters length. Bear in mind that because we only use two rainbow tables, the success rate is around 86 percent.

To start the `rcrack` command line, use the console to execute the following command:

```
# rcrack
```

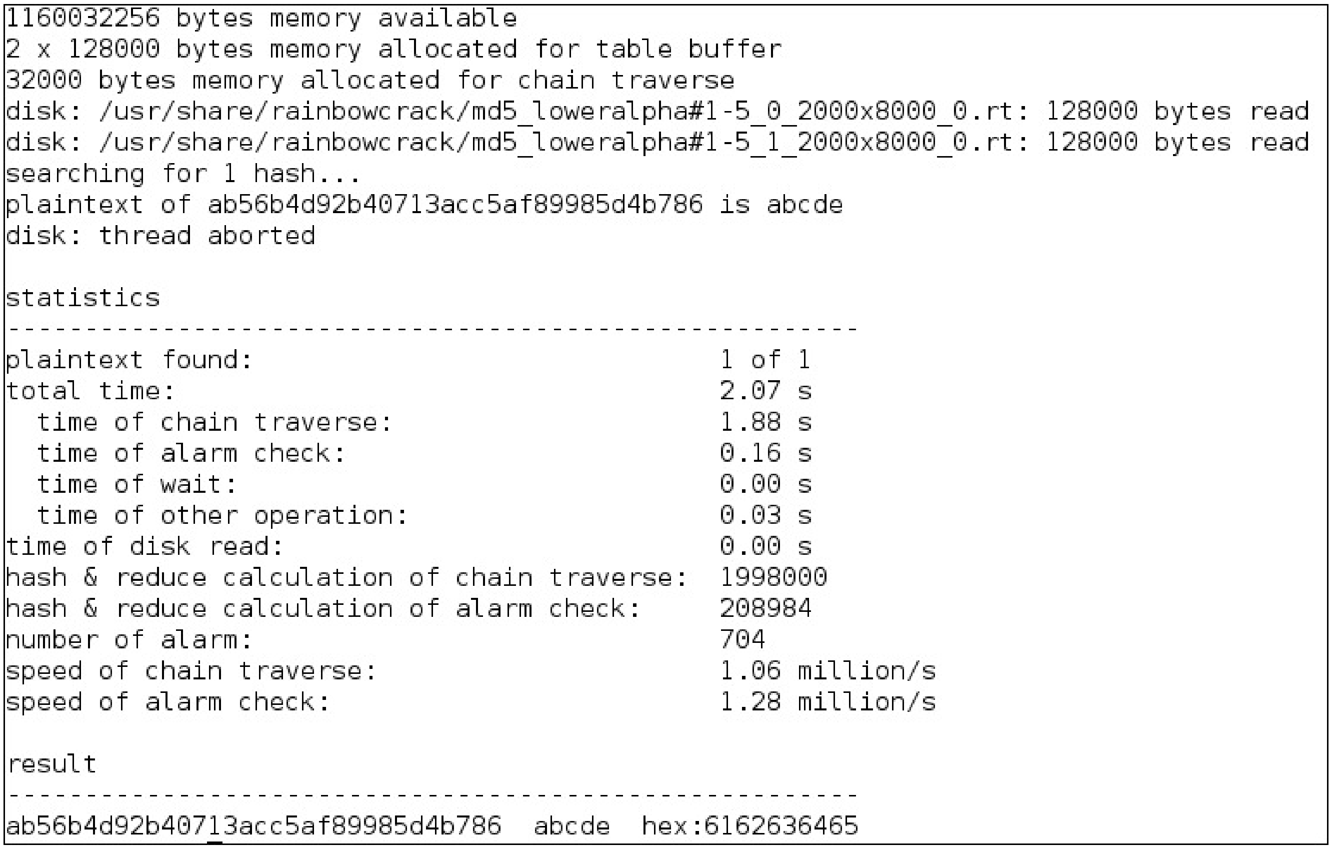
This will display a simple usage instruction and example on your screen.

As our exercise, we are going to crack an `MD5` hash of the `abcde` string. The `MD5` hash value of this string is `ab56b4d92b40713acc5af89985d4b786` .

Let's use `rcrack` to crack this:

```
# rcrack /usr/share/rainbowcrack/*.rt -h ab56b4d92b40713acc5af89985d4b786
```

The following screenshot shows the result of this command line:



```
1160032256 bytes memory available
2 x 128000 bytes memory allocated for table buffer
32000 bytes memory allocated for chain traverse
disk: /usr/share/rainbowcrack/md5_loweralpha#1-5_0_2000x8000_0.rt: 128000 bytes read
disk: /usr/share/rainbowcrack/md5_loweralpha#1-5_1_2000x8000_0.rt: 128000 bytes read
searching for 1 hash...
plaintext of ab56b4d92b40713acc5af89985d4b786 is abcde
disk: thread aborted

statistics
-------------------------------------------------------
plaintext found:                          1 of 1
total time:                               2.07 s
  time of chain traverse:                 1.88 s
  time of alarm check:                    0.16 s
  time of wait:                           0.00 s
  time of other operation:                0.03 s
time of disk read:                        0.00 s
hash & reduce calculation of chain traverse: 1998000
hash & reduce calculation of alarm check:    208984
number of alarm:                          704
speed of chain traverse:                  1.06 million/s
speed of alarm check:                     1.28 million/s

result
-------------------------------------------------------
ab56b4d92b40713acc5af89985d4b786  abcde  hex:6162636465
```

Based on the preceding result, we can see that `rcrack` is able to find the plaintext of the given hash value. It took only 2 seconds to get the correct key.

Note

There is an improved version of rcrack called `rcracki_mt` (https://www.freerainbowtables.com/en/download/). This tool supports hybrid and indexed tables. It is also multithreaded.

samdump2

To extract password hashes from the Windows 2K/NT/XP/Vista SAM database registry file, you can use `samdump2` (http://sourceforge.net/projects/ophcrack/files/samdump2/). With `samdump2` , you don't need to give the **System Key** (**SysKey**) first to get the password hash. SysKey is a key used to encrypt the hashes in the **Security Accounts Manager** (**SAM**) file. It was introduced and enabled in Windows NT Service Pack 3.

To start `samdump2` , use the console to execute the following command:

```
# samdump2
```

This will display a simple usage instruction on your screen.

Note

There are several ways to get the Windows password hash:

- The first method is by using the `samdump2` program utilizing the Windows system and SAM files. These are located in the `c:\%windows%\system32\config` directory. This folder is locked for all accounts if Windows is running. To overcome this problem, you need to boot up a Linux Live CD such as Kali Linux and mount the disk partition containing the Windows system. After this, you can copy the system and SAM files to your Kali machine.
- The second method is by using the `pwdump` program and its related variant tools from the Windows machine to get the password hash file.
- The third method is by using the `hashdump` command from the meterpreter script as shown in the previous chapter. To be able to use this method, you need to exploit the system and upload the meterpreter script first.

For our exercise, we are going to dump the Windows XP `SP3` password hash. We assume that you already have the system and SAM files and have stored them on your home directory as `system` and `sam`.

The following command is used to dump the password hash using `samdump2`:

```
# samdump2 system sam -o test-sam
```

The output is saved to the `test-sam` file. The following is the `test-sam` file content:

```
Administrator:500:e52cac67419a9a22c295285c92cd06b4:b2641aea8eb4c00ede89cd2b7
c78f6fb:::
Guest:501:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:
::
HelpAssistant:1000:383b9c42d9d1900952ec0055e5b8eb7b:0b742054bda1d884809e12b1
0982360b:::
SUPPORT_388945a0:1002:aad3b435b51404eeaad3b435b51404ee:a1d6e496780585e33a9dd
d414755019a:::
tedi:1003:aad3b435b51404eeaad3b435b51404ee:31d6cfe0d16ae931b73c59d7e0c089c0:
::
```

You can then supply the `test-sam` file to the password crackers, such as `John` or `Ophcrack`.

John

John the Ripper (http://www.openwall.com/john/) is a tool that can be used to crack the password hash. Currently, it can crack more than 40 password hash types, such as `DES`, `MD5`, `LM`, `NT`, `crypt`, `NETLM`, and `NETNTLM`. One of the reasons to use `John` instead of the other password cracking tools described in this chapter is that `John` is able to work with the `DES` and `crypt` encryption algorithms.

To start the `John` tool, use the console to execute the following command:

```
# john
```

This will display the `John` usage instruction on your screen.

`John` supports the following four password cracking modes:

- **Wordlist mode**: In this mode, you only need to supply the wordlist file and the password file to be cracked. A wordlist file is a text file containing the possible passwords. There in only one word on each line. You can also use a rule to instruct `John` to modify the words contained in the wordlist according to the rule. To use wordlist, just give the `--wordlist=<wordlist_name>` option. You can create your own wordlist or you can obtain it from other people. There are many sites that provide wordlists. For example, the wordlist from the Openwall Project, which can be downloaded from http://download.openwall.net/pub/wordlists/.
- **Single crack mode**: This mode has been suggested by the author of `John` and is to be tried first. In this mode, `John` will use the login names, **Full Name** field, and users' home directory as the password candidates. These password candidates are then used to crack the password of

the account it was taken from or to crack the password hash with the same salt. As a result, it is much faster compared to the wordlist mode.

- **Incremental mode**: In this mode, `John` will try all the possible character combinations as the password. Although it is the most powerful cracking method, if you don't set the termination condition, the process will take a very long time. The examples of termination conditions are setting a short password limit and using a small character set. To use this mode, you need to assign the incremental mode in the configuration file of `John` . The predefined modes are `All` , `Alnum` , `Alpha` , `Digits` , and `Lanman` , or you can define your own mode.
- **External mode**: With this mode, you can use the external cracking mode to be used by `John` . You need to create a configuration file section called `[List.External:MODE]` , where `MODE` is the name you assign. This section should contain functions programmed in a subset of C programming language. Later, `John` will compile and use this mode. You can read more about this mode at http://www.openwall.com/john/doc/EXTERNAL.shtml.

If you don't give the cracking mode as an argument to `John` in the command line, it will use the default order. First, it will use the single crack mode, then the wordlist mode, and after that it will use the incremental mode.

Before you can use `John` , you need to obtain the password files. In the Unix world, most of the systems right now use the `shadow` and `passwd` files. You may need to login as `root` to be able to read the `shadow` file.

After you get the password files, you need to combine these files so that `John` can use them. To help you on this, `John` already provides you with the tool called `unshadow` .

The following is the command to combine the `shadow` and `passwd` files. For this, I use the `/etc/shadow` and `/etc/passwd` files from the Metasploitable 2 virtual machine and put them in a directory called `pwd` with the name `etc-shadow` and `etc-passwd` , respectively:

```
# unshadow etc-passwd etc-shadow > pass
```

The following is the snippet of the `pass` file content:

```
root:$1$/avpfBJ1$x0z8w5UF9Iv./DR9E9Lid.:0:0:root:/root:/bin/bash
sys:$1$fUX6BPOt$Miyc3UpOzQJqz4s5wFD9l0:3:3:sys:/dev:/bin/sh
klog:$1$f2ZVMS4K$R9XkI.CmLdHhdUE3X9jqP0:103:104::/home/klog:/bin/false
msfadmin:$1$XN10Zj2c$Rt/zzCW3mLtUWA.ihZjA5/:1000:1000:msfadmin,,,:
/home/msfadmin:/bin/bash
postgres:$1$Rw35ik.x$MgQgZUuO5pAoUvfJhfcYe/:108:117:PostgreSQL
administrator,,,:/var/lib/postgresql:/bin/bash
user:$1$HESu9xrH$k.o3G93DGoXIiQKkPmUgZ0:1001:1001:just a user,111,,:/home
/user:/bin/bash
service:$1$kR3ue7JZ$7GxELDupr5Ohp6cjZ3Bu//:1002:1002:,,,:/home/service:
/bin/bash
```

Note

You may want to remove the lines whose second field is empty to speed up the cracking process. Those lines don't have a password.

To crack the password file, just give the following command, where `pass` is the password list file you have just generated:

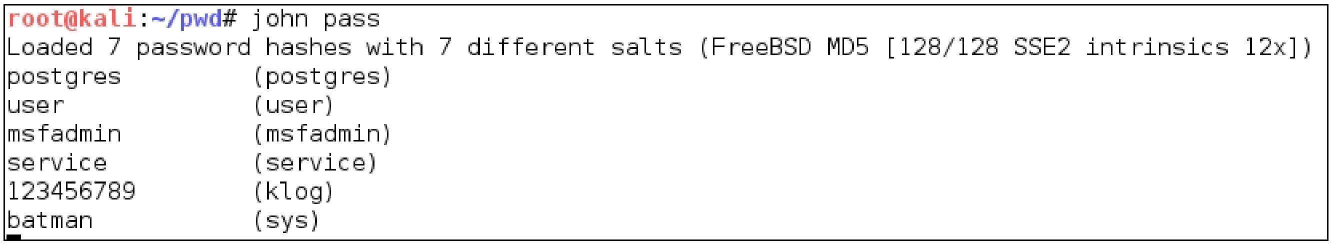
```
# john pass
```

If `John` managed to crack the passwords, it will store those passwords in the `john.pot` file.

To see the passwords, you can give the following command:

```
# john --show pass
```

In this case, `John` cracks the passwords quickly as shown in the following screenshot:



```
root@kali:~/pwd# john pass
Loaded 7 password hashes with 7 different salts (FreeBSD MD5 [128/128 SSE2 intrinsics 12x])
postgres         (postgres)
user             (user)
msfadmin         (msfadmin)
service          (service)
123456789        (klog)
batman           (sys)
```

The following table is the list of cracked passwords:

Username	Password
postgres	postgres
user	user
msfadmin	msfadmin
service	service
klog	123456789
sys	batman

Of the seven passwords listed in the `pass` file, `John` managed to crack six passwords. Only the password of `root` cannot be cracked instantly.

Note

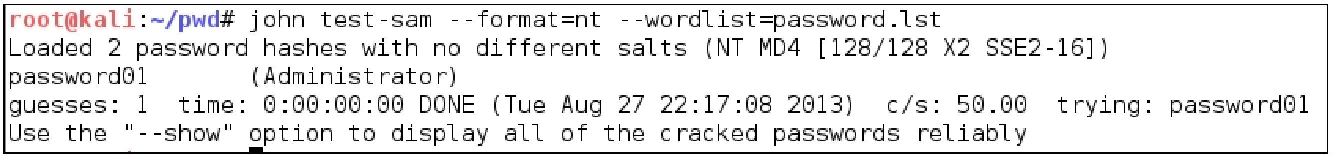
To clear up the `John` cache, you may want to delete the `/root/.john/john.pot` file.

If you want to crack the Windows password, first you need to extract the Windows password hashes (`LM` and/or `NTLM`) in the `pwdump` output format from the Windows system and SAM files. You can consult http://www.openwall.com/passwords/pwdump to see several of these utilities. One of them is `samdump2` provided in Kali Linux.

To crack the Windows hash obtained from `samdump2` using a `password.lst` wordlist, you can use the following command:

```
# john test-sam --wordlist=password.lst --format=nt
```

The following screenshot shows the password obtained by John:



```
root@kali:~/pwd# john test-sam --format=nt --wordlist=password.lst
Loaded 2 password hashes with no different salts (NT MD4 [128/128 X2 SSE2-16])
password01       (Administrator)
guesses: 1  time: 0:00:00:00 DONE (Tue Aug 27 22:17:08 2013)  c/s: 50.00  trying: password01
Use the "--show" option to display all of the cracked passwords reliably
```

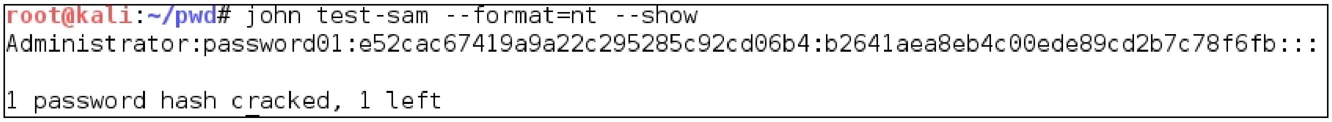
The `password.lst` file content is as follows:

```
password01
```

To see the result, give the following command:

```
# john test-sam  --format=nt --show
```

The following screenshot shows a snippet of the password obtained:



```
root@kali:~/pwd# john test-sam --format=nt --show
Administrator:password01:e52cac67419a9a22c295285c92cd06b4:b2641aea8eb4c00ede89cd2b7c78f6fb:::

1 password hash cracked, 1 left
```

John was able to obtain the administrator password of a Windows machine but was unable to crack the password for the user, tedi .

Johnny

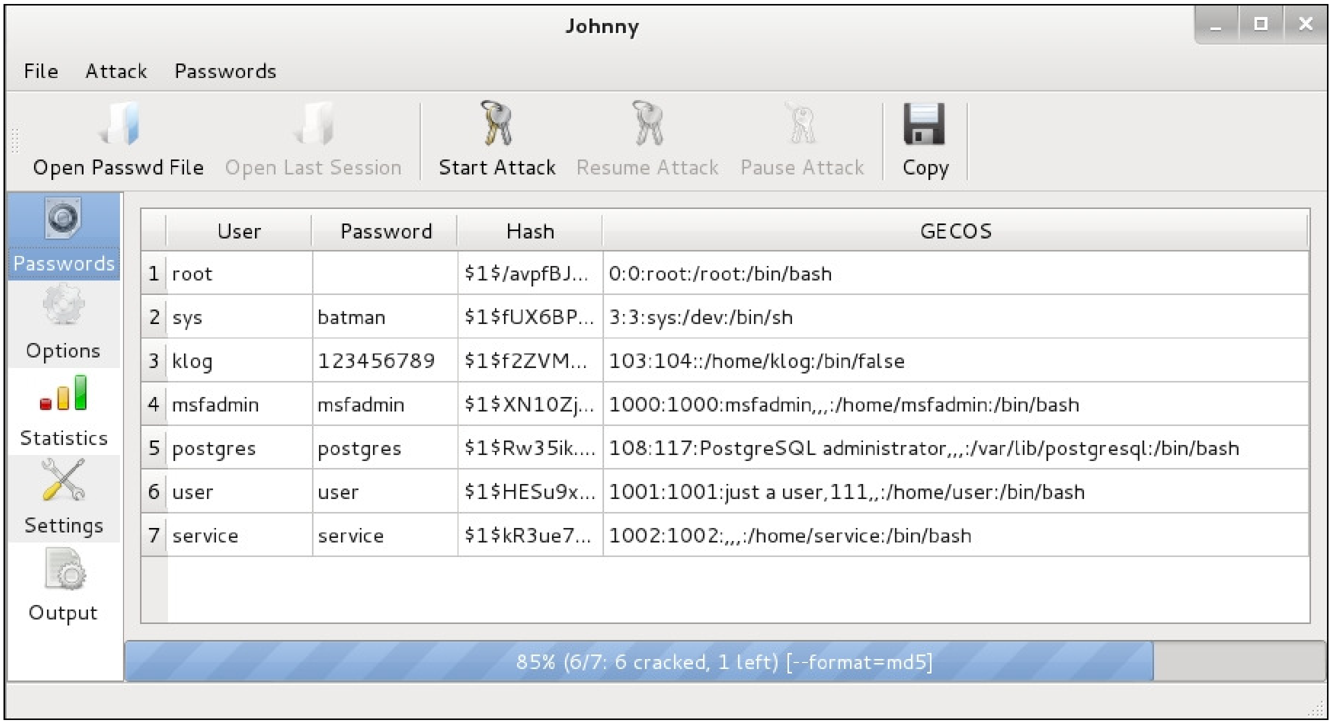
If you find the John command line to be daunting, you can be thankful to Johnny (http://openwall.info/wiki/john/johnny). It is a graphical user interface for John . Using Johnny , you may not need to type the John command-line options.

To start Johnny , open a console and type the following command:

```
# johnny
```

You will then see the **Johnny** window.

The following screenshot shows the result of cracking the same Metasploitable 2 hashes:



	User	Password	Hash	GECOS
1	root		1/avpfBJ...	0:0:root:/root:/bin/bash
2	sys	batman	$1$fUX6BP...	3:3:sys:/dev:/bin/sh
3	klog	123456789	$1$f2ZVM...	103:104::/home/klog:/bin/false
4	msfadmin	msfadmin	$1$XN10Zj...	1000:1000:msfadmin,,,:/home/msfadmin:/bin/bash
5	postgres	postgres	$1$Rw35ik....	108:117:PostgreSQL administrator,,,:/var/lib/postgresql:/bin/bash
6	user	user	$1$HESu9x...	1001:1001:just a user,111,,:/home/user:/bin/bash
7	service	service	$1$kR3ue7...	1002:1002:,,,:/home/service:/bin/bash

85% (6/7: 6 cracked, 1 left) [--format=md5]

From the preceding screenshot, we know that Johnny is able to find the same passwords as John .

Ophcrack

Ophcrack is a rainbow-tables-based password cracker that can be used to crack the Windows LM and NTLM password hashes. It comes as a command line and graphical user interface program. Just like the RainbowCrack tool, Ophcrack is based on the time-memory tradeoff method.

Note

The **LAN Manager** (**LM**) hash is the primary hash that is used to store user passwords prior to Windows NT. To learn more about LM hash, you can go to http://technet.microsoft.com/en-us/library/dd277300.aspx.

The **NT LAN Manager** (**NTLM**) hash is the successor of LM hash. It provides authentication, integrity, and confidentiality to users. NTLM Version 2 was introduced in Windows NT SP4 with enhanced security features, such as protocol hardening and the ability for a server to authenticate the client. Microsoft no longer recommends this hash type to be used, as can be read from http://msdn.microsoft.com/en-us/library/cc236715(v=PROT.10).aspx.

You can learn more about the NTLM hash from http://msdn.microsoft.com/en-us/library/cc236701(v=PROT.10).aspx.

To start the Ophcrack command line, use the console to execute the following command:

```
# ophcrack-cli
```

This will display the Ophcrack usage instruction and example on your screen.

To start Ophcrack GUI, use the console to execute the following command:

```
# ophcrack
```

This will display the Ophcrack GUI page.

Before you can use Ophcrack, you need to grab the rainbow tables from the Ophcrack site (http://ophcrack.sourceforge.net/tables.php). Currently, there are three tables that can be downloaded for free:

- **Small XP table**: This comes as a 308-MB compressed file. It has a 99.9 percent success rate and contains the character set of numeric, small, and capital letters. You can download it from http://downloads.sourceforge.net/ophcrack/tables_xp_free_small.zip.
- **Fast XP table**: This has the same success rate and character set as the small XP tables, but it is faster compared to the small XP tables. You can get it from http://downloads.sourceforge.net/ophcrack/tables_xp_free_fast.zip.
- **Vista table**: This has a 99.9 percent success rate, and currently, it is based on the dictionary words with variations. It is a 461-MB compressed file. You can get it from http://downloads.sourceforge.net/ophcrack/tables_vista_free.zip.

As an example, we use the `xp_free_fast` tables, and I have extracted and put the files in the `xp_free_small` directory. The Windows XP password hash file is stored in the `test-sam` file in the `pwdump` format.

We used the following command to crack the Windows password hashes obtained earlier:

```
# ophcrack -d fast -t fast -f test-sam
```

The following output shows the cracking process:

```
Four hashes have been found in test-sam:
Opened 4 table(s) from fast.
0h  0m  0s; Found empty password for user tedi (NT hash #1)
0h  0m  1s; Found password D01 for 2nd LM hash #0
0h  0m 13s; Found password PASSWOR for 1st LM hash #0in table XP free fast
#1 at column 4489.
0h  0m 13s; Found password password01 for user Administrator (NT hash #0)
0h  0m 13s; search (100%); tables: total 4, done 0, using 4; pwd found 2/2.
```

And the following are the results of `ophrack` :

```
Results:
username / hash                  LM password    NT password
Administrator                    PASSWORD01     password01
tedi                             *** empty ***  *** empty ***
```

You can see that Ophcrack is able to obtain all of the passwords for the corresponding users.

Crunch

Crunch (http://sourceforge.net/projects/crunch-wordlist/) is a tool used to create wordlists based on user criteria. This wordlist is then used during the password-cracking process.

To start Crunch, use the console to execute the following command:

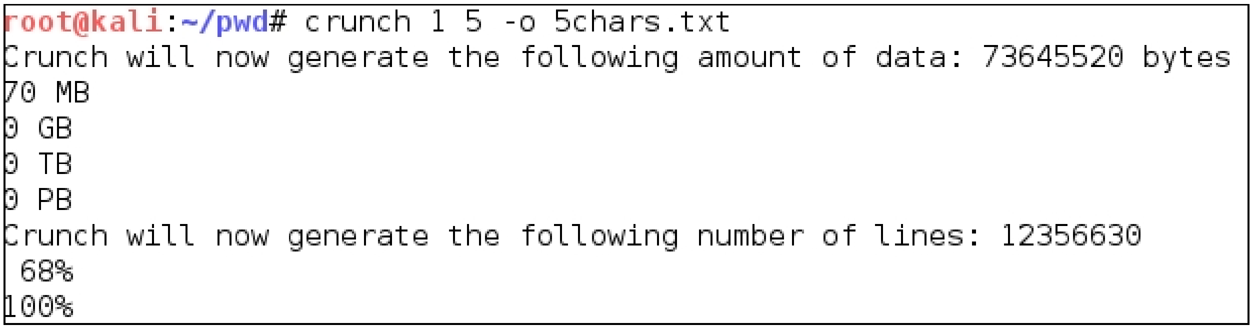
```
# crunch
```

This will display the Crunch usage instruction and example on your screen.

For our first exercise, we will create a wordlist of five characters and save the result in the `5chars.txt` file. The following is the command to do this:

```
# crunch 1 5 -o 5chars.txt
```

The following screenshot shows the output of this command:



```
root@kali:~/pwd# crunch 1 5 -o 5chars.txt
Crunch will now generate the following amount of data: 73645520 bytes
70 MB
0 GB
0 TB
0 PB
Crunch will now generate the following number of lines: 12356630
 68%
100%
```

The following is the `5chars.txt` file content:

```
a
b
c
...
zzzzx
zzzzy
zzzzz
```

Based on the preceding file content, Crunch will create a text file with contents from `a` to `zzzzz` .

In our next exercise, we will create a wordlist of lowercase letters and numbers with lengths from `1` to `4` . The result will be saved in the `wordlist.lst` file.

The command to do this action is as follows:

```
# crunch 1 4 -f /usr/share/crunch/charset.lst lalpha-numeric -o wordlist.lst
```

The following is the output of this command:

```
Crunch will now generate the following amount of data: 8588664 bytes
8 MB
0 GB
0 TB
0 PB
Crunch will now generate the following number of lines: 1727604
100%
```

It took my machine around 1.5 minutes to generate the `wordlist.lst` file. The following is the `wordlist.lst` file content:

```
a
b
c
...
9997
9998
9999
```

Online attack tools

In the previous section, we discussed several tools that can be used to crack passwords in the offline mode. In this section, we will discuss some password attacking tools that must be used while you are connected to the target machine.

We will discuss the tools that can be used for the following purposes:

- Generating wordlists
- Finding the password hash

- Online password attack tool

The first two tools are used to generate wordlists from the information gathered in the target website, while the other one is used to search the password hash in the online password hash service database.

The online password attack tool will try to login to the remote service just like a user login using the credentials provided. The tool will try to login many times until the correct credentials are found.

The drawback of this technique is that because you connect directly to the target server, your action may be noticed and blocked. Also, because the tool utilizes the login process, it will take a longer time to run compared to the offline attack tools.

Even though the tool is slow and may trigger a blocking mechanism, network services such as SSH, Telnet, and FTP usually can't be cracked using offline password cracking tools. You may want to be very careful when doing an online password attack; especially, when you brute force an **Active Directory** (**AD**) server, you may block all the user accounts. You need to check the password and lockout policy first, and then try only one password for all accounts, so you do not end up blocking accounts.

CeWL

The **Custom Word List** (**CeWL**) (http://www.digininja.org/projects/cewl.php) generator is a tool that will spider a target **Uniform Resource Locator** (**URL**) and create a unique list of the words found on that URL. This list can then be used by password cracker tools such as John the Ripper.

The following are several useful options in CeWL:

- `--depth N` or `-d N` : This sets the spider depth to `N` ; the default value is `2`
- `--min_word_length N` or `-m N` : This is the minimum word length; the default length is 3
- `--verbose` or `-v` : This gives a verbose output
- `--write` or `-w` : This is to write an output to a file

Note

If you get a problem running CeWL in Kali with an error message: **Error: zip/zip gem not installed**, use `gem install zip/zip` to install the required gem.

To fix this problem, just follow the suggestions to install `zip gem` :

```
gem install zip
Fetching: zip-2.0.2.gem (100%)
Successfully installed zip-2.0.2
1 gem installed
Installing ri documentation for zip-2.0.2...
Installing RDoc documentation for zip-2.0.2...
```

Let's try to create a custom wordlist from a target website; the following is the CeWL command to be used:

```
cewl -w target.txt http://www.target.com
```

After some time, the result will be created. In Kali, the output is stored in the `/usr/share/cewl` directory.

The following is an abridged content of the `target.txt` file:

```
Device
dataset
sauerlo
Sauer
agentChange
ouput
fileWrite
oBy
strips
```

```
mThe
270
Specialforces
Damian
GoD
zERo
zine
Disney
N00bz
xThe
Cracked
Question
Marc
Doudiet
Swiss
Strafor
Electric
Alchemy
```

Hydra

Hydra is a tool that can be used to guess or crack the login username and password. It supports numerous network protocols, such as HTTP, FTP, POP3, and SMB. It works by using the username and password provided and tries to log in to the network service in parallel; by default, it will log in using 16 connections to the same host.

To start Hydra, use the console to execute the following command:

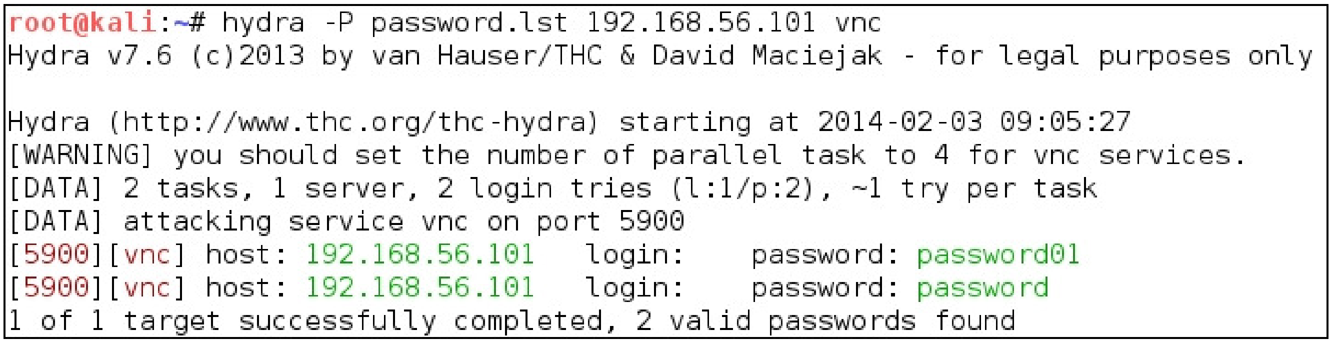
```
# hydra
```

This will display the Hydra usage instruction on your screen.

In our exercise, we will brute force the password for a VNC server located in `192.168.56.101` and use the passwords contained in the `password.lst` file. The command to do this is as follows:

```
# hydra -P password.lst 192.168.56.101 vnc
```

The following screenshot shows the result of this command:



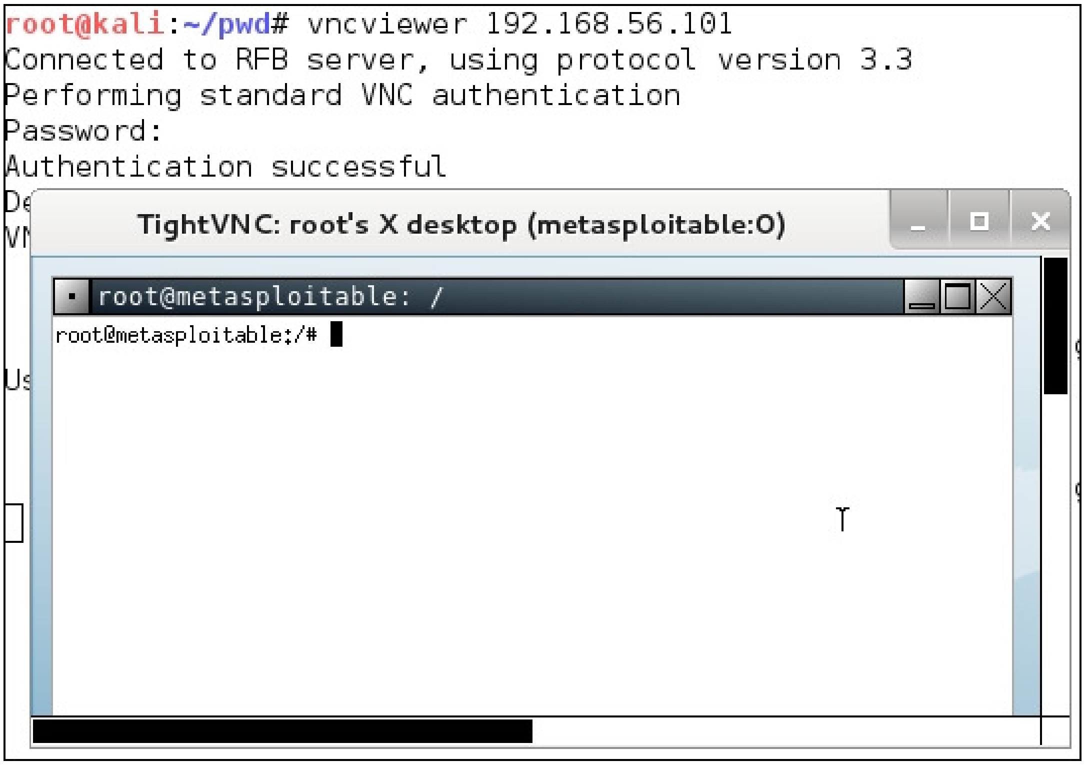
```
root@kali:~# hydra -P password.lst 192.168.56.101 vnc
Hydra v7.6 (c)2013 by van Hauser/THC & David Maciejak - for legal purposes only

Hydra (http://www.thc.org/thc-hydra) starting at 2014-02-03 09:05:27
[WARNING] you should set the number of parallel task to 4 for vnc services.
[DATA] 2 tasks, 1 server, 2 login tries (l:1/p:2), ~1 try per task
[DATA] attacking service vnc on port 5900
[5900][vnc] host: 192.168.56.101   login:   password: password01
[5900][vnc] host: 192.168.56.101   login:   password: password
1 of 1 target successfully completed, 2 valid passwords found
```

From the preceding screenshot, we can see that Hydra was able to find the VNC passwords. The passwords used on the target server are `password01` and `password` .

To verify whether the passwords obtained by Hydra are correct, just run `vncviewer` to the remote machine and use the passwords found.

The following screenshot shows the result of running `vncviewer` :



```
root@kali:~/pwd# vncviewer 192.168.56.101
Connected to RFB server, using protocol version 3.3
Performing standard VNC authentication
Password:
Authentication successful
De
VN
```

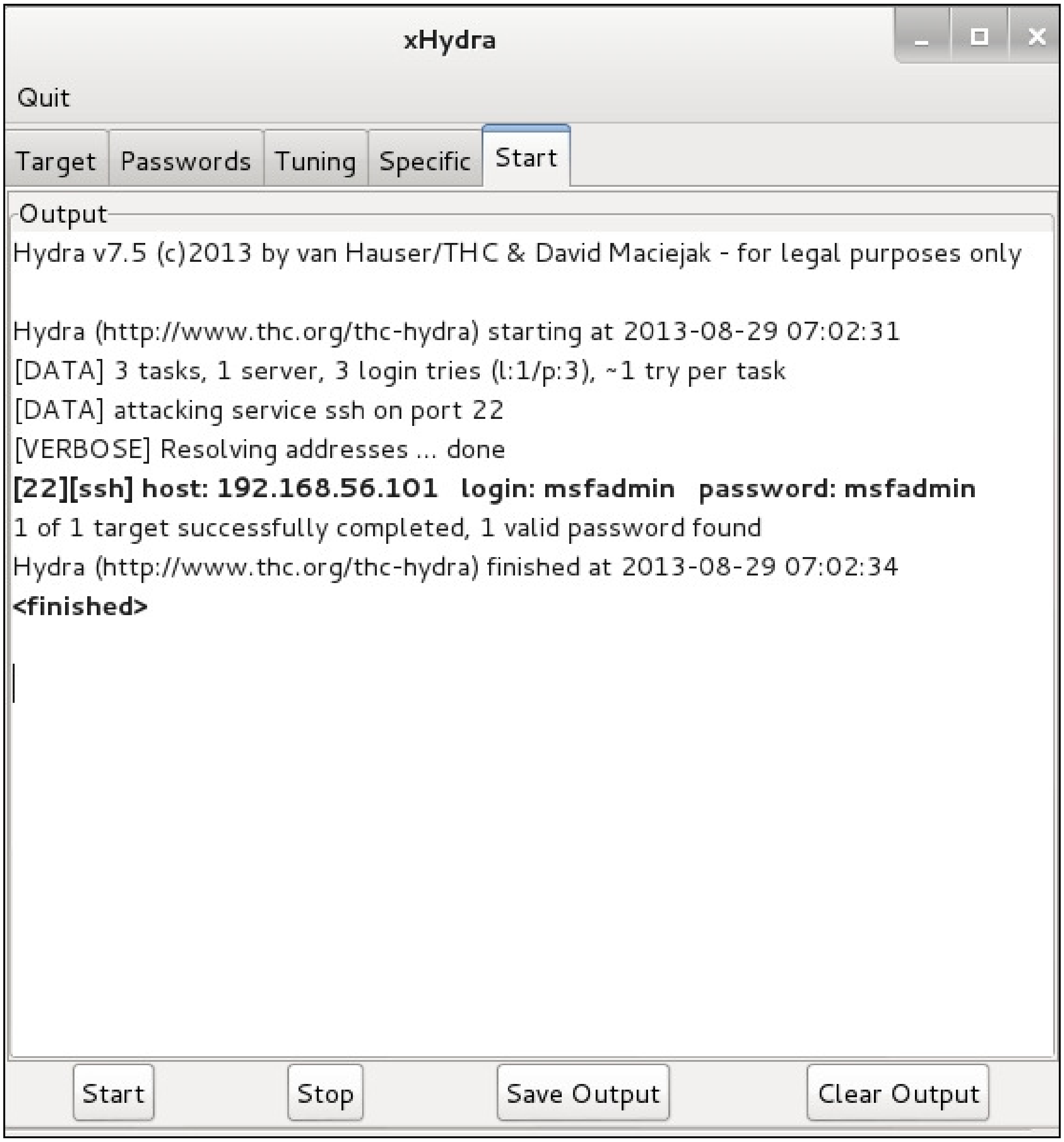
```
root@metasploitable:/#
```

From the preceding screenshot, we can see that we are able to log in to the VNC server using the cracked passwords, and, we got the VNC root credential. Fantastic!

Besides using the Hydra command line, you can also use the Hydra GUI by executing the following command:

```
# xhydra
```

The following screenshot shows the result of running the Hydra GTK to attack an SSH service on the target:



```
Hydra v7.5 (c)2013 by van Hauser/THC & David Maciejak - for legal purposes only

Hydra (http://www.thc.org/thc-hydra) starting at 2013-08-29 07:02:31
[DATA] 3 tasks, 1 server, 3 login tries (l:1/p:3), ~1 try per task
[DATA] attacking service ssh on port 22
[VERBOSE] Resolving addresses ... done
[22][ssh] host: 192.168.56.101   login: msfadmin   password: msfadmin
1 of 1 target successfully completed, 1 valid password found
Hydra (http://www.thc.org/thc-hydra) finished at 2013-08-29 07:02:34
<finished>
```

From our experience, you may find `xhydra` but the options can't be customized according to your need. For example, to check for VNC, you can't set the username; unfortunately, `xhydra` won't allow you to not set the username.

Medusa

Medusa is another online password cracker for network services. It has the characteristics of being speedy, massively parallel, and modular. Currently, it has modules for the following services: CVS, FTP, HTTP, IMAP, MS-SQL, MySQL, NCP (NetWare), PcAnywhere, POP3, PostgreSQL, rexec, Rlogin, rsh, SMB, SMTP (VRFY), SNMP, SSHv2, SVN, Telnet, VmAuthd, VNC, and a generic wrapper module.

Note

You can find the differences between Medusa and Hydra at

http://foofus.net/goons/jmk/medusa/medusa-compare.html.

During our penetration testing engagement, we usually run Medusa and Hydra to get more complete information about the targets.

To start the Medusa cracker, use the console to execute the following command:

```
# medusa
```

This will display the Medusa usage instructions on your screen.

The useful options in Medusa are as follows:

- `-u` or `-U [FILE]` : This is for reading the username or username list file.
- `-h` or `-H [FILE]` : This is for reading the hostname or hostname list file.
- `-p` or `-P [FILE]` : This is for reading the password or password list file.
- `-M` : This is the name of the module to be used. You can use the `-d` option to find the module names.
- `-O` : This is the output file.
- `-v` : This is the verbose level. We found that by setting the `-v 4` option, we only got the successful credential's list.

Let's run Medusa to crack the VNC password as we did earlier by giving the following command:

```
# medusa -u root -P password.lst -h 192.168.56.101 -M vnc -v 4
```

The following is the result of running this command:

```
Medusa v2.0 [http://www.foofus.net] (C) JoMo-Kun / Foofus Networks
<jmk@foofus.net>

ACCOUNT FOUND: [vnc] Host: 192.168.56.101 User: root Password: password
[SUCCESS]
```

Medusa is only able find one VNC password, while Hydra is able to find two VNC passwords.