

# Exploring OpenSSH: Hands-On Workshop for Beginners

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**Hack.lu 2024 - Luxembourg**

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William Robinet (Conostix S.A.) - 2024-10-22

Matrix Room: <https://t.ly/wjSQU> – GitHub Repository: <https://t.ly/QrHP4>

Wi-Fi SSID: *workshop* – Wi-Fi password: *hacklu2024*

# Before we begin 1/2

## Workshop resources

Matrix Room:

[https://matrix.to/#/#Hack.lu\\_2024-OpenSSH\\_Workshop:matrix.org](https://matrix.to/#/#Hack.lu_2024-OpenSSH_Workshop:matrix.org)

Used to exchange links and commands.

Workshop repository:

<https://github.com/wllm-rbnt/hacklu-2024-openssh-workshop>

```
git clone https://github.com/wllm-rbnt/hacklu-2024-openssh-workshop.git
cd hacklu-2024-openssh-workshop
```

Shorter URLs:

- Matrix Room -> <https://t.ly/wjSQU>
- Repository -> <https://t.ly/QrHP4>

# Before we begin 2/2

Slides are written in Markdown

Get the *PDF/HTML* versions or use *patat* to render the presentation in your terminal

Go to release page <https://github.com/jaspervdj/patat/releases> and download version 0.12.0.1

or

```
wget https://github.com/jaspervdj/patat/releases/download/v0.12.0.1/patat-v0.12.0.1-linux-x86_64.tar.gz
tar xzf patat-v0.12.0.1-linux-x86_64.tar.gz patat-v0.12.0.1-linux-x86_64/patat
patat-v0.12.0.1-linux-x86_64/patat hacklu-2024-openssh-workshop.patat.md
```

The Markdown version can be converted to PDF & HTML by using the provided *ws\_gen* script (*pandoc* & *chromium* must be installed first)

# About me

- Introduced to Open Source & Free Software around the end of the 90's
- CompSci studies, work in IT at Conostix S.A. - AS197692
- Open Source contributions:
  - ssldump improvements (build system, bug fixes, JSON output, IPv6 & ja3(s), ...)
  - asn1template: painless ASN.1 editing
- Conference workshops & presentations
- 🎸 🎧 🗣️ 📝 ...
- Contact info
  - GitHub: <https://github.com/wllm-rbnt>
  - Mastodon: <https://infosec.exchange/@wr>

# Local Machine Setup

## Docker Installation

Reference documentation: <https://docs.docker.com/engine/install/>

This will provide `docker compose v2` command (with a space).

On Debian 12 (bookworm), the following command will provide `docker-compose v1` command (with a dash).

```
sudo apt install docker.io docker-compose
```

On Ubuntu 24.10, the `docker compose v2` command can be installed directly:

```
sudo apt install docker.io docker-compose-v2
```

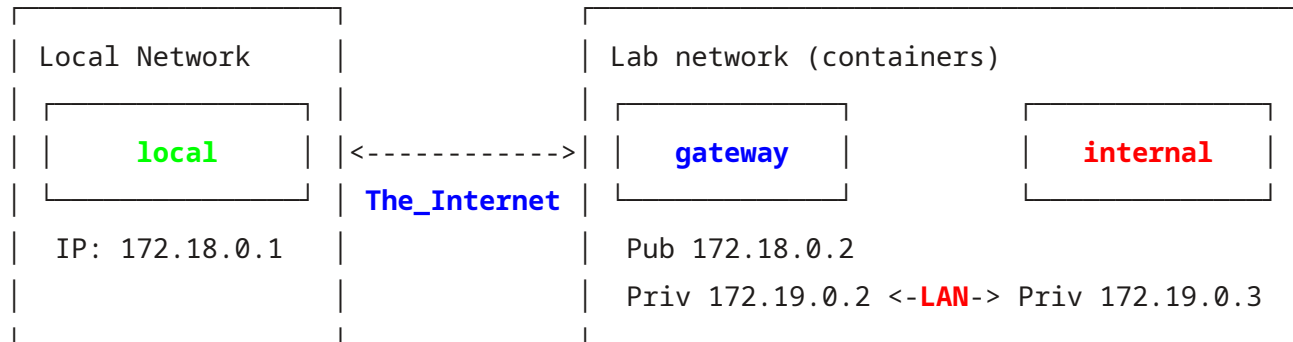
On Rocky Linux 9, install `docker-ce` with `docker compose v2` command:

```
sudo dnf config-manager --add-repo https://download.docker.com/linux/rhel/docker-ce.repo
sudo dnf -y install docker-ce docker-ce-cli containerd.io docker-compose-plugin
sudo systemctl --now enable docker
```

## Various other tools

We will use netcat (`netcat-traditional` on Debian/Ubuntu), curl, Wireshark (or tcpdump).

# Labs Network Layout



(IP addresses may differ from your Docker setup)

Your *local* machine can reach gateway server over ‘The Internet’

- *local* machine is your personal laptop or VM. It is located “somewhere on the Internet” It is able to reach gateway on TCP port 22 (on 172.18.0.2)
- **Lab network** is a remote private LAN (172.19.0.0/16 in this case)
- On this remote LAN, gateway is privately known as 172.19.0.2.
- gateway is connected to another machine named **internal** (172.19.0.3)

# Username and Passwords

2 users exist on each container: *root* and *user*.

Passwords are the same as usernames. *user* has **sudo** access on each machine (no password required).

## Shell commands

Shell commands are prefixed by a prompt designating the machine on which the command shall be run:

```
(local)$ <local command>  
(gateway)$ <remote command on gateway machine>  
(internal)$ <remote command on internal machine>
```

## IP addresses

- IP addresses are configured statically when you execute `start_containers.sh`
- 3 IP addresses will appear during this workshop
  - <gateway\_pub>
  - <gateway\_priv>
  - <internal\_priv>

# Labs Containers (1/2)

- 2 containers will be used during this workshop, one for *gateway* and a second for *internal*
- Build and start containers with:

```
(local)$ cd docker  
(local)$ ./build_containers.sh  
(local)$ ./start_containers.sh
```

- Print setup information:

```
(local)$ ./get_info.sh
```

- Stop containers with:

```
(local)$ ./stop_containers.sh
```

- Cleanup the whole Docker setup: **WARNING this will remove all containers, images and networks from your local Docker setup**

```
(local)$ ./docker_wipe.sh  
(local)$ sudo systemctl restart docker
```



## Labs Containers (2/2)

Pre-built versions of the containers (provided via USB drives) can be loaded from the `docker/images/` directory with the following command:

```
(local)$ cd docker  
(local)$ ./load_images.sh
```

Locally built container images, can be exported to files in the `docker/images/` directory with the following command:

```
(local)$ cd docker  
(local)$ ./save_images.sh
```

# Illustration: Telnet is not secure

- A *telnet* server is listening on *gateway*, TCP port 23
- Start a traffic capture on TCP port 23 in another terminal:

```
(local)$ sudo apt install wireshark  
(local)$ sudo wireshark
```

- Start a capture on your main network interface (*eth0*) or *any*
- Then, in another shell, run the *telnet* client on your local machine:

```
(local)$ sudo apt install telnet  
(local)$ telnet 172.18.0.2
```

- Login, *user* Password, *user*
- Finally, right-click on the first TCP packet that belongs to this connection (port 23), then *Follow -> TCP Stream*

## Two main issues:

- Cleartext message exchange: vulnerable to traffic sniffing tcpdump/wireshark on traffic path (firewall, router)
- Insecure authentication: vulnerable to Man-In-The-Middle attack Ettercap (another machine on same LAN), proxy software on an intermediate router/firewall

Same goes for FTP, HTTP, SMTP, ...

# SSH History & Implementations

SSH stands for Secure **S**hell

## Protocol Versions

- [SSH-1.0](#) 1995, by Tatu Ylönen, researcher at Helsinki University of Technology
- [SSH-2.0](#) 2006, IETF Standardization RFC 4251-4256
- [SSH-1.99](#) Retro-compatibility pseudo-version, Old client/New Server
- [SSH3](#) (?) Experimental implementation using HTTP/3 (QUIC)

## Implementations

- OpenSSH on Unices, Client & Server for GNU/Linux, \*BSD, MacOS, ...
- OpenSSH on MS Windows
- Terminal & File transfer clients for MS Windows: PuTTY, MobaXterm, WinSCP, FileZilla, ...
- Dropbear, Lightweight implementation, for embedded-type Linux (or other Unices) systems
- On mobile: ConnectBot for Android, Termius for Apple iOS
- Network Appliances, OpenSSH or custom implementation

# Focus on OpenSSH Tool suite (on GNU/Linux)

- Focus on the OpenSSH tool suite, a project started in 1999
- Clients & Server software
- This is the reference opensource version for many OSes
- It is based on modern cryptography algorithms and protocols
- It is widely available out-of-the-box
- It contains a wide range of tools (remote shell, file transfer, key management, ...)
- Automation friendly (Ansible, or custom scripts)
- Main tools
  - *ssh* - Remote terminal access
  - *scp* - File transfer
  - *sftp* - FTP-like file transfer
- Helpers
  - *ssh-keygen* - Public/Private keypair generation
  - *ssh-copy-id* - Key deployment script
  - *ssh-agent* - Key management daemon (equivalent to PuTTY's pageant.exe)
  - *ssh-add* - Key/Agent management tool

# Documentation

Online manual pages

- Listing of **C**ommand **L**ine man pages:

```
$ man -k ssh
```

- Listing client's configuration options:

```
$ man ssh_config
```

- Listing server's configuration options (the *openssh-server* package must be installed):

```
$ man sshd_config
```

- CLI help, in your terminal, just type
  - `ssh` for the client
  - `/usr/sbin/sshd --help` for the server
  - `ssh-keygen --help` for the key management tool
  - ...

# First Login (1/2) - Commands, tcpdump & fingerprints

Syntax is: `ssh <username>@<host>`, where can be a hostname or an IP address

Username and password are the same as the one from the telnet example: - Username: *user* / Password: *user*

- Start a traffic capture on TCP port 22 in another terminal, traffic is **encrypted**:

```
(local)$ sudo tcpdump -n -i any -XXX tcp and port 22
```

- Retrieve the server keys fingerprints through a secure channel:

<https://github.com/wllm-rbnt/hacklu-2024-openssh-workshop/blob/main/fingerprints.txt>

# First Login (2/2) - Connection & host authentication

Type the following in a local terminal on your machine:

```
(local)$ ssh user@<gateway_pub>
```

or

```
(local)$ ssh -o VisualHostKey=true user@<gateway_pub>
```

The authenticity of host '172.18.0.2 (172.18.0.2)' can't be established.

ED25519 key fingerprint is SHA256:HFofTLfh2W/1IR3+g0sXGAcRs4ZnVsWwGKmb0zeMefk.

```
+--[ED25519 256]--+
```

```
|      . +B=*o |
|      o ooBX.o |
|      o oo=0o=. |
|      + o..= o.* |
|      . S .o o o= |
|      o . o.. |
|      = o   |
|      = *   |
|      + oE  |
```

```
+-----[SHA256]-----+
```

This key is not known by any other names.

Are you sure you want to continue connecting (yes/no/[fingerprint])?

- Type *yes* to accept and go on with user authentication, or *no* to refuse and disconnect immediately
- or type the *fingerprint* you received from the secure channel If the fingerprint you entered matches the one that is printed, the system will proceed with user authentication



# Known hosts fingerprint databases

Remote Host Authentication is performed only on first connection

`~/.ssh/known_hosts` is then populated with host reference and corresponding key fingerprint

`/etc/ssh/ssh_known_hosts` can be used as a system-wide database of know hosts

Hosts references can be stored as clear text (IP or hostname) or the corresponding hash (see *HashKnownHosts* option)

## Host keys location on OpenSSH server

```
(gateway)$ ls -l /etc/ssh/ssh_host*.pub
-rw----- 1 root root  513 May 23 12:39 /etc/ssh/ssh_host_ecdsa_key
-rw-r--r-- 1 root root  179 May 23 12:39 /etc/ssh/ssh_host_ecdsa_key.pub
-rw----- 1 root root  411 May 23 12:39 /etc/ssh/ssh_host_ed25519_key
-rw-r--r-- 1 root root   99 May 23 12:39 /etc/ssh/ssh_host_ed25519_key.pub
-rw----- 1 root root 2602 May 23 12:39 /etc/ssh/ssh_host_rsa_key
-rw-r--r-- 1 root root  571 May 23 12:39 /etc/ssh/ssh_host_rsa_key.pub
```

## Computing fingerprints of host keys

```
(gateway)$ for i in $(ls -l /etc/ssh/ssh_host*.pub); do ssh-keygen -lf $i; done
256 SHA256:gbF30TEqv4ucpI3VFIEjq0dnrji5woxacnPe+N9mFX8 root@460a6cac3a3c (ECDSA)
256 SHA256:/hUA0roJsQzhM4f9qSZxcBLqEYqmoPi03pVX2fQUxrg root@460a6cac3a3c (ED25519)
3072 SHA256:D0gvg+2kFzvrljqiqi00EZ23tnQN3H/+oB3cqmq0VZHWiQ root@460a6cac3a3c (RSA)
```

Note: use `ssh-keygen -lvf <public_key_file>` to generate the visual ASCII art representation of a key

# Configuration (1/2)

## Configuration files

Client:

- Per-user client configuration: `~/.ssh/config`
- System-wide client configuration: `/etc/ssh/ssh_config`
- System-wide local configuration: `/etc/ssh/ssh_config.d/*`

Server:

- Server configuration: `/etc/ssh/sshd_config`
- Server local configuration: `/etc/ssh/sshd_config.d/*`

## Configuration options

- Client configuration options: `$ man ssh_config`
- Server configuration options: `$ man sshd_config`

# Configuration (2/2) - Per host client configuration

Client configuration options can be specified per host

Example:

Type following in your local `~/ .ssh/config`:

```
Host gateway
  Hostname <gateway_pub>
  User user
```

Tips: Printing the “would be applied” configuration

The `-G` parameter cause `ssh` to print the configuration that would be applied for a given connection (without actually connecting)

```
(local)$ ssh -G gateway
```

The following command should output your username:

```
(local)$ ssh -G gateway | grep user
user user
```

# Tips

## Increase verbosity

Launch ssh commands with `-v` parameter in order to increase verbosity, and help with debugging

Example:

```
(local)$ ssh -v user@<gateway_pub>  
OpenSSH_8.4p1 Debian-5+deb11u2, OpenSSL 1.1.1w 11 Sep 2023  
debug1: Reading configuration data /home/user/.ssh/config  
debug1: Reading configuration data /etc/ssh/ssh_config  
[...]
```

## Escape character

The escape character can be used to pass out-of-band commands to ssh client

- By default `~`, must be at beginning of a new line
- Commands:
  - Quit current session `~.`
  - List Forwarded connections `~#`
  - Decrease the verbosity (LogLevel) `~V`
  - Increase the verbosity (LogLevel) `~v`
- Repeat `~` char in order to type it ( `~~` )

# Public Key Authentication (1/2)

## Main Authentication Methods

- *Password* authentication
- *Public/Private key* authentication
  - Used for password-less authentication (passphrase may be required to unlock private key)

## Lab

- Generate a new key pair on your local system (with or without a passphrase):

```
(local)$ ssh-keygen -f ~/.ssh/my-ssh-key
```

- Install your public key on the remote server:

```
(local)$ ssh-copy-id -i ~/.ssh/my-ssh-key.pub user@<gateway_pub>
```

**Note:** `ssh-copy-id` copies the public key from `~/.ssh/my-ssh-key.pub` to the remote machine in `~/.ssh/authorized_keys`

# Public Key Authentication (2/2)

- Login again with your new key pair:

```
(local)$ ssh -i ~/.ssh/my-ssh-key user@<gateway_pub>
```

- Reference your key pair in your personal local configuration file (~/.ssh/config):

```
Host gateway
  Hostname <gateway_pub>
  User user
  IdentityFile ~/.ssh/my-ssh-key
```

# Authentication Agent (1/2)

The Authentication Agent can hold access to private keys, thus eliminating the need to enter passphrase at each use

Start the agent:

```
(local)$ ssh-agent | tee ssh-agent-env.sh
SSH_AUTH_SOCK=/tmp/ssh-KwTc17ZieUKD/agent.1193973; export SSH_AUTH_SOCK;
SSH_AGENT_PID=1193974; export SSH_AGENT_PID;
echo Agent pid 1193974;
(local)$ source ssh-agent-env.sh
Agent pid 1193974
```

# Authentication Agent (2/2)

Load private key into the agent:

```
(local)$ ssh-add ~/.ssh/my-ssh-key  
Enter passphrase for /home/user/.ssh/my-ssh-key: *****  
Identity added: my-ssh-key (user@local)
```

Connect to remote machine:

```
(local)$ ssh user@<gateway_pub>
```

Going further, [keychain](#) can be used to manage ssh-agent & keys across logins sessions



# Remote Command Execution (1/2)

Simple command execution:

```
(local)$ ssh user@<gateway_pub> hostname
```

With redirection to local file:

```
(local)$ ssh user@<gateway_pub> hostname > hostname.txt
```

# Remote Command Execution (2/2)

With redirection to remote file:

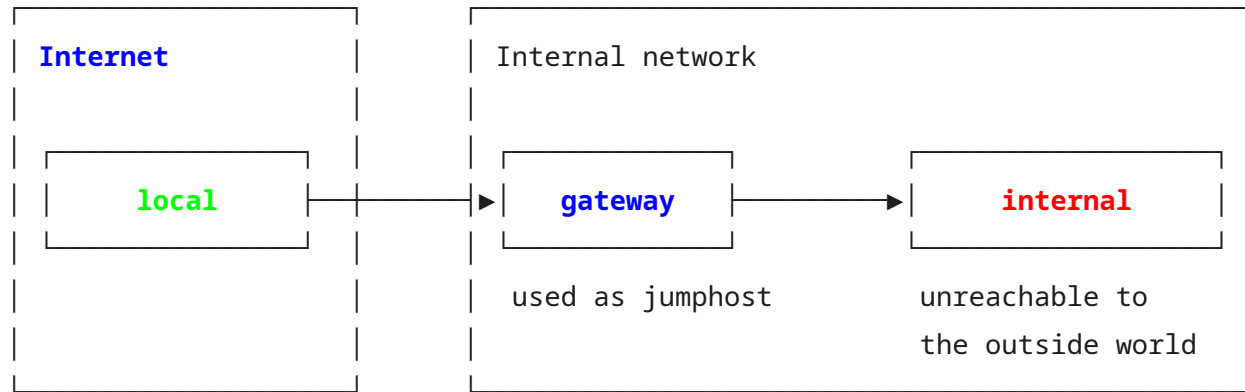
```
(local)$ ssh user@<gateway_pub> "hostname > hostname.txt"
```

With pipes:

```
(local)$ echo blabla | ssh user@<gateway_pub> "cat - | tr 'a-z' 'A-Z'"
```

# Jumphost (1/2)

A Jump Host is a machine used as a relay to reach another, otherwise possibly unreachable, machine. This unreachable machine is named internal-machine



*Lab objective:* Connect to *internal* from your local machine via SSH with a single command

# Jumphost (2/2)

Lab setup:

- First, copy your public key to the remote server (gateway):

```
(local)$ scp .ssh/my-ssh-key.pub user@<gateway_pub>:
```

- Login to the remote server then copy your public key to the destination machine:

```
(local)$ ssh user@<gateway_pub>  
(gateway)$ ssh-copy-id -f -i my-ssh-key.pub <internal_priv>
```

- Connect to the remote machine with a single command:

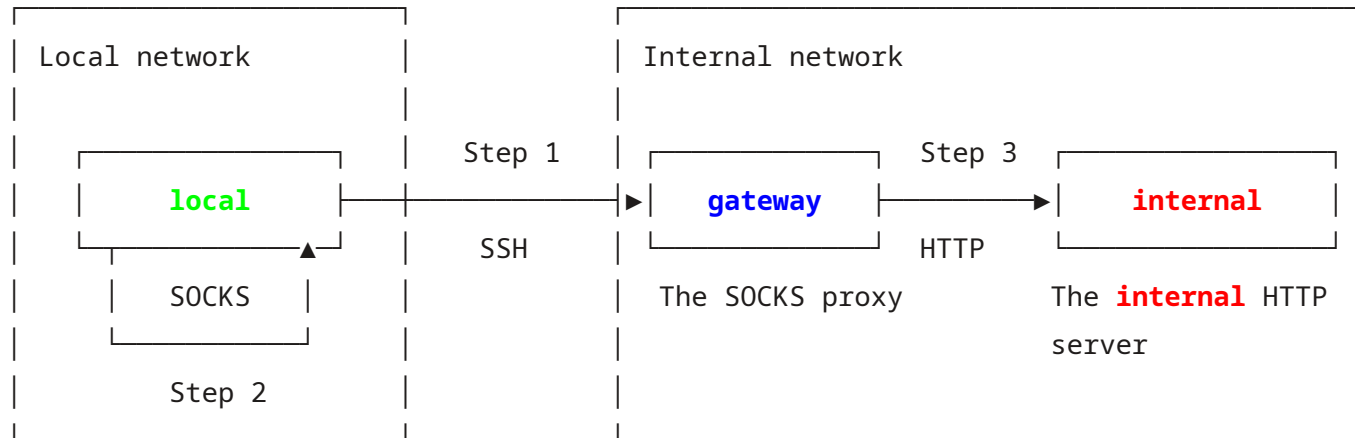
```
(local)$ ssh -J user@<gateway_pub> user@<internal_priv>
```

**Note:** *internal* host key fingerprints available at <https://github.com/wllm-rbnt/hacklu-2024-openssh-workshop/blob/main/fingerprints.txt>

# SOCKS proxy (1/2)

A SOCKS server proxies TCP connections to arbitrary IP addresses and ports

With SOCKS 5, DNS queries can be performed by the proxy on behalf of the client



*Lab objective:* Reach the internal HTTP server at `http://secret-intranet` (running on internal) through a SOCKS proxy running on *gateway*

# SOCKS proxy (2/2)

- Start a local SOCKS Proxy by establishing an SSH connection to *gateway* with parameter `-D`:

```
(local)$ ssh -D 1234 user@<gateway_pub>
```

- Check, locally, for listening TCP port with

```
(local)$ ss -tpln | grep :1234
```

- Configure your local browser to use local TCP port 1234 as a SOCKS proxy
- Configure your local browser to send DNS queries through the SOCKS proxy (tick the option in configuration)
- Point your browser to `http://secret-intranet` or Try it with curl:

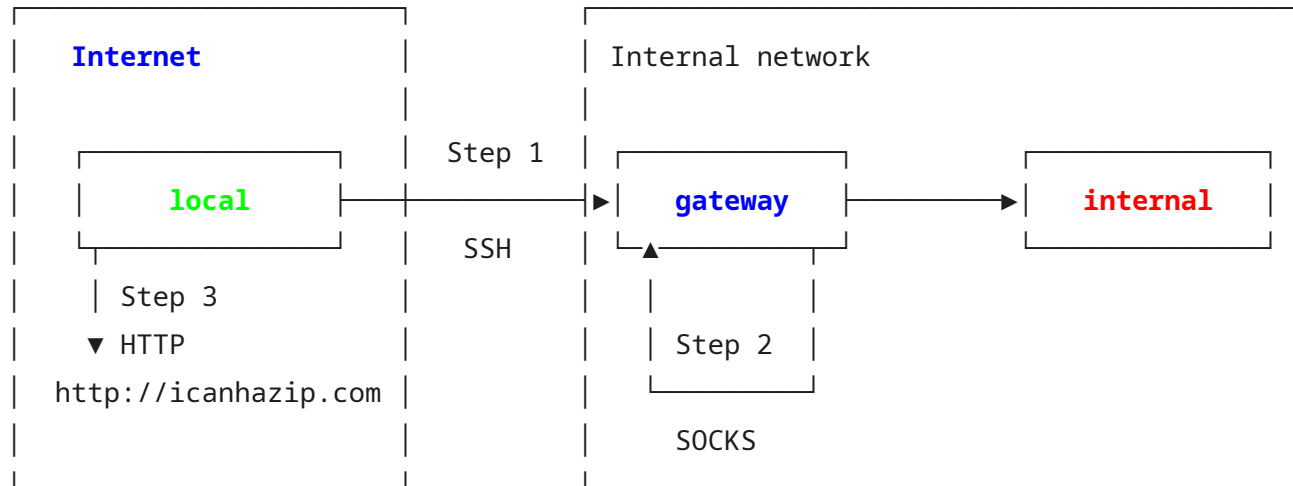
```
(local)$ http_proxy=socks5h://127.0.0.1:1234 curl http://secret-intranet
```

This is the secret Intranet on **internal** machine listening on 127.0.0.1 port 80.

- Bonus: look at your local traffic with *tcpdump*, you shouldn't see any DNS exchanges

# Reverse SOCKS proxy (1/2)

A reverse SOCKS proxy setup allows a remote machine to use your local machine as a SOCKS proxy



*Lab objective:* Reach the external HTTP server at **http://icanhazip.com** from *gateway* through a SOCKS proxy running on your local machine

# Reverse SOCKS proxy (2/2)

Setup:

- Start a remote SOCKS Proxy by establishing an SSH connection to *gateway* with parameter -R:

```
(local)$ ssh -R 1234 user@<gateway_pub>
```

- Check, on *gateway*, for listening TCP port with

```
(gateway)$ ss -tpln | grep :1234
```

- Point your curl on *gateway* to **http://icanhazip.com** though the SOCKS proxy listening on 127.0.0.1<sub>32</sub>

```
(gateway)$ http_proxy=socks5h://127.0.0.1:1234 curl http://icanhazip.com
```

<Conference public IP address>



# LocalForward (1/2)

A *LocalForward* creates a locally listening TCP socket that is connected over SSH to a TCP port reachable in the network scope of a remote machine

*Lab objective:* Create and connect local listening TCP socket on port 8888 to TCP port 80 on 127.0.0.1 in the context of *gateway*

Setup:

- Configure the forwarding while connecting to *gateway* through SSH with `-L` parameter:

```
(local)$ ssh -L 8888:127.0.0.1:80 user@<gateway_pub>
```

# LocalForward (2/2)

-L parameter syntax:

```
<local_port>:<remote_IP>:<remote_port>
```

can be extended to

```
<local_IP>:<local_port>:<remote_IP>:<remote_port>
```

- SSH is now listening on TCP port 8888 on your local machine, check with:

```
(local)$ ss -tpln
```

- Point your browser to **http://127.0.0.1:8888** You should see something like:

Hello world ! This is gateway listening on 127.0.0.1 port 80.

# RemoteForward (1/2)

A *RemoteForward* creates a listening TCP socket on a remote machine that is connected over SSH to a TCP port reachable in the network scope of the local machine

*Lab objective:* Create a TCP socket on *gateway* on port 8123 and connect it to a locally listening netcat on TCP port 1234

Setup:

- Start a listening service on localhost on your local machine on TCP port 1234:

```
(local)$ nc -l -p 1234 -s 127.0.0.1 # if you use netcat-traditional
```

or

```
(local)$ nc -l 127.0.0.1 1234 # if you use netcat-openbsd
```

- Check that it's listening with `ss` (`netstat` replacement on GNU/Linux):

```
(local)$ ss -tpln | grep 1234
```

- Configure the forwarding on TCP port 8123 while connecting to *gateway* with `-R` parameter:

```
(local)$ ssh -R 8123:127.0.0.1:1234 user@<gateway_pub>
```

- `ssh` is now listening on TCP port 8123 on *gateway*

# RemoteForward (2/2)

-R parameter syntax:

```
<remote_port>:<local_IP>:<local_port>
```

can be extended to

```
<remote_IP>:<remote_port>:<local_IP>:<local_port>
```

- Check its listening status on gateway:

```
(gateway)$ ss -tpln | grep 8123
```

- Connect to the forwarded service on remote machine on port 8123 with netcat:

```
(gateway)$ nc 127.0.0.1 8123
```

- Both netcat instances, local & remote, should be able to communicate with each other

**Note:** reverse proxy SOCKS is a special use case of -R

# X11 Forwarding

*Lab objective:* Start a graphical application on *gateway*, and get the visual feedback locally

*Setup:*

- Connect to *gateway* with `-X` parameter:

```
(local)$ ssh -X user@<gateway_pub>
```

- Then, start a graphical application on the remote machine:

```
(gateway)$ xmessage "This is a test !" &!
```

- Check processes on *gateway* and *local* machine:

```
(gateway|local)$ ps auxf
```

**Notes:**

- On a Linux local client, the XOrg graphical server is used
- On a Windows machine use:
  - VcXsrv: <https://sourceforge.net/~vcxsrv/>
  - or Xming: <https://sourceforge.net/~xming/>

# Connection to Legacy Systems (1/4)

## Host key algorithm mismatch

```
(local)$ ssh -p 4022 user@<gateway_pub>
```

```
Unable to negotiate with 172.18.0.2 port 4022: no matching host key type found. Their offer: ssh-rsa
```

```
(local)$ ssh -o HostKeyAlgorithms=ssh-rsa -p 4022 user@<gateway_pub>
```

- Listing known host key algorithms:

```
(local)$ ssh -Q key
```

# Connection to Legacy Systems (2/4)

## Wrong key exchange algorithm

```
(local)$ ssh -p 4023 user@<gateway_pub>  
Unable to negotiate with 172.18.0.2 port 4023: no matching key exchange method found. Their offer: diffie-  
hellman-group1-sha1,kex-strict-s-v00@openssh.com
```

```
(local)$ ssh -o KexAlgorithms=diffie-hellman-group1-sha1 -p 4023 user@<gateway_pub>
```

- Listing known key exchange algorithms:

```
(local)$ ssh -Q kex
```

# Connection to Legacy Systems (3/4)

## Wrong cipher

```
(local)$ ssh -p 4024 user@<gateway_pub>
```

```
Unable to negotiate with 172.18.0.2 port 4024: no matching cipher found. Their offer: aes256-cbc
```

```
(local)$ ssh -o Ciphers=aes256-cbc -p 4024 user@<gateway_pub>
```

- Listing known ciphers:

```
(local)$ ssh -Q cipher
```



# Connection to Legacy Systems (4/4)

## Wrong public key signature algorithm

Disclaimer: **This one is broken with the current Docker containers**

```
(local)$ ssh -p 4025 -i ~/.ssh/mykey user@<gateway_pub>  
Received disconnect from 172.18.0.2 port 4025:2: Too many authentication failures  
Disconnected from 172.18.0.2 port 4025
```

```
"debug1: send_pubkey_test: no mutual signature algorithm" (with ssh -v)
```

```
(local)$ ssh -o PubkeyAcceptedAlgorithms=ssh-rsa -i ~/.ssh/mykey user@<gateway_pub>
```

- Listing known public key sig algorithms:

```
(local)$ ssh -Q key-sig
```

or

```
(local)$ ssh -Q PubkeyAcceptedAlgorithms
```

# SSH Tarpit

- The legitimate SSH server is running on port 22 on *gateway*
- endlessh, a simple honeypot, is running on port 2222 on *gateway* for demonstration purpose
- Try to connect to port 2222 with

```
(local)$ ssh user@<gateway_pub> -p 2222
```

- Check both ports with netcat:

```
(local)$ nc -nv <gateway_pub> 22
(UNKNOWN) [<gateway_pub>] 22 (ssh) open
SSH-2.0-OpenSSH_9.2p1 Debian-2
```

```
(local)$ nc -nv <gateway_pub> 2222
(UNKNOWN) [<gateway_pub>] 2222 (?) open
XkZ?NK>-h5xs#/OSF
SU6Jv
6%n[;
M5I'R8.W}wgE?"DhADl"jp"$x#4;Z
wT%mJK_15(Nf]Iw_
$2'ZUmQ2YgdyXnI,
\7_c.f4@bQHcY>N'y
[...]
```

# tmux - terminal multiplexer

tmux can be used to keep interactive shell tasks running while you're disconnected

- Installation: `$ sudo apt install tmux`
- Create a tmux session: `$ tmux`
- List tmux sessions: `$ tmux ls`
- Attach to first session: `$ tmux a`
- Attach to session by index #: `$ tmux a -t 1`
- Commands inside a session:
  - `Ctrl-b d`: detach from session
  - `Ctrl-b c`: create new window
  - `Ctrl-b n / Ctrl-b p`: switch to next/previous window
  - `Ctrl-b % / Ctrl-b "`: split window vertically/horizontally
  - `Ctrl-b <arrow keys>`: move cursor across window panes
  - `Ctrl-[ + <arrow keys>`: browse current pane backlog, press return to quit
- Documentation: `$ man tmux`

# References

- [OpenSSH](#)
- [SSH History \(Wikipedia\)](#)
- [SSH Mastery by Michael W. Lucas](#)
- [SSH Mastery @BSDCAN 2012](#)
- [A Visual Guide to SSH Tunnels](#)
- [SSH Kung Fu](#)
- [The Hacker's Choice SSH Tips & Tricks](#)
- [Why port 22 ?](#)

**Thanks for your attention !**