Building an IPS solution for inline usage during Red Teaming

Repurposing defensive technologies for offensive Red Team operations

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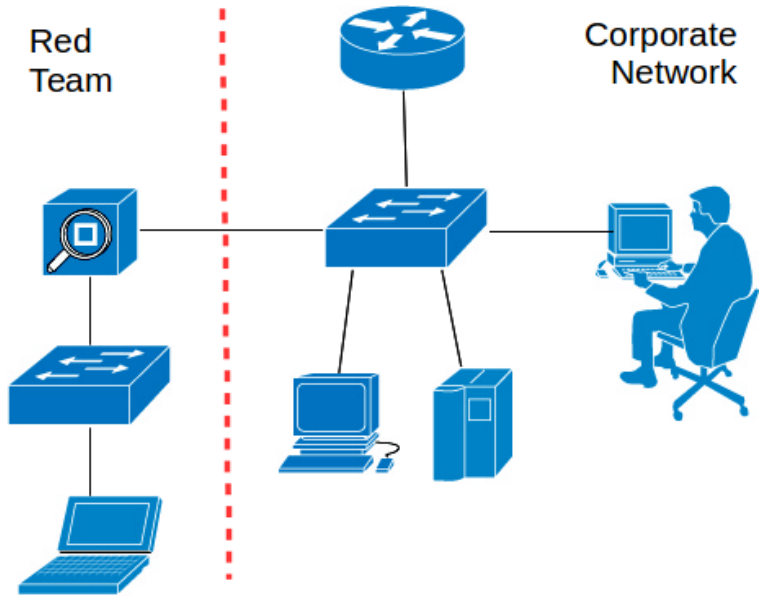
Outline

The idea

- Originally from Deloitte.



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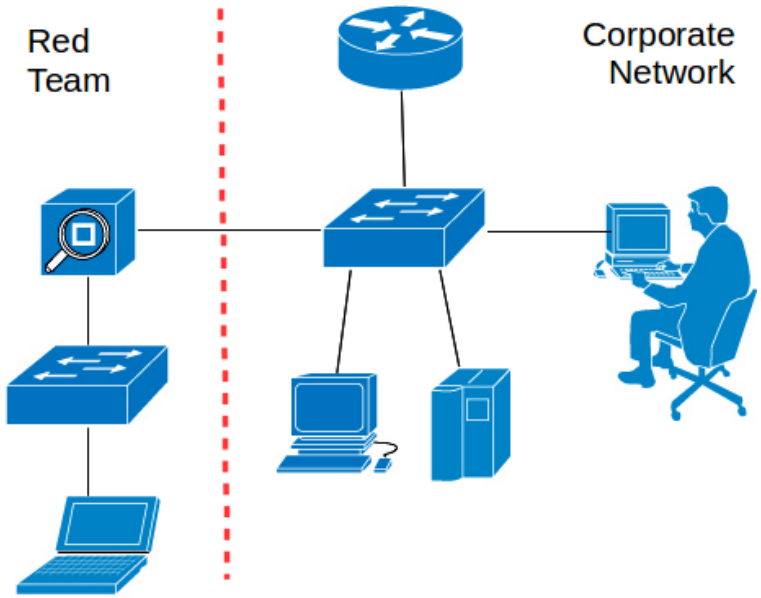

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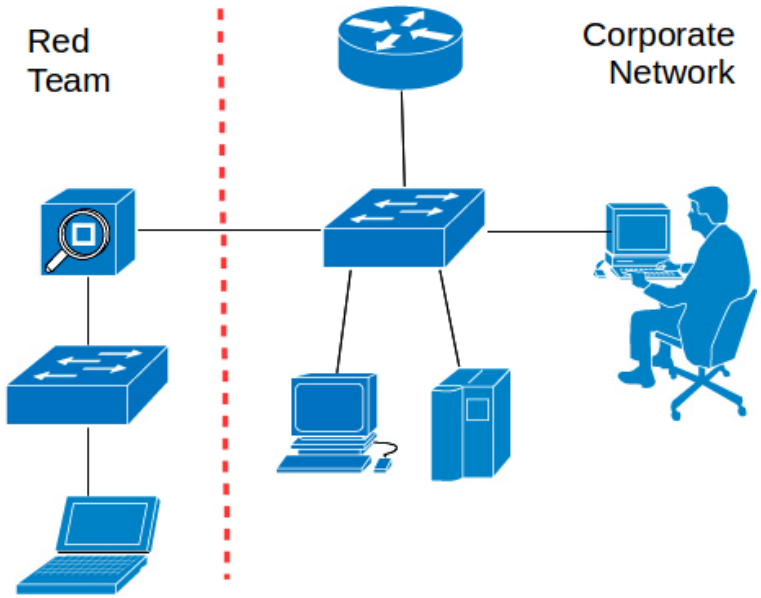
- For use during penetration tests (Red Teaming)
- Prevent the attackers from doing detectable mistakes



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1. How can outgoing traffic be filtered and sanitised by an IPS?
2. How can incoming traffic be handled to evade investigation and detection?

Types of IDS/IPS engines

Network based

- Deployed either to listen to replica of the traffic or inline.
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- Imposes some difficulty with managing multiple instances on multiple computers.

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In our case a network-based solution would do the job.
But should it be signature or anomaly based?

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Passively

- Different Operating systems behave in different ways for things not standardised in RFC.
- Some examples include TTL and initial TCP window size.

OS	TTL	TCP window (B)
Windows 7	128	8192
Windows 10	128	8192
Kali Linux	64	29200

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Actively

- By doing active scans against them.
- More about to follow.

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IPS Engine	TTL handling	TCP window handling
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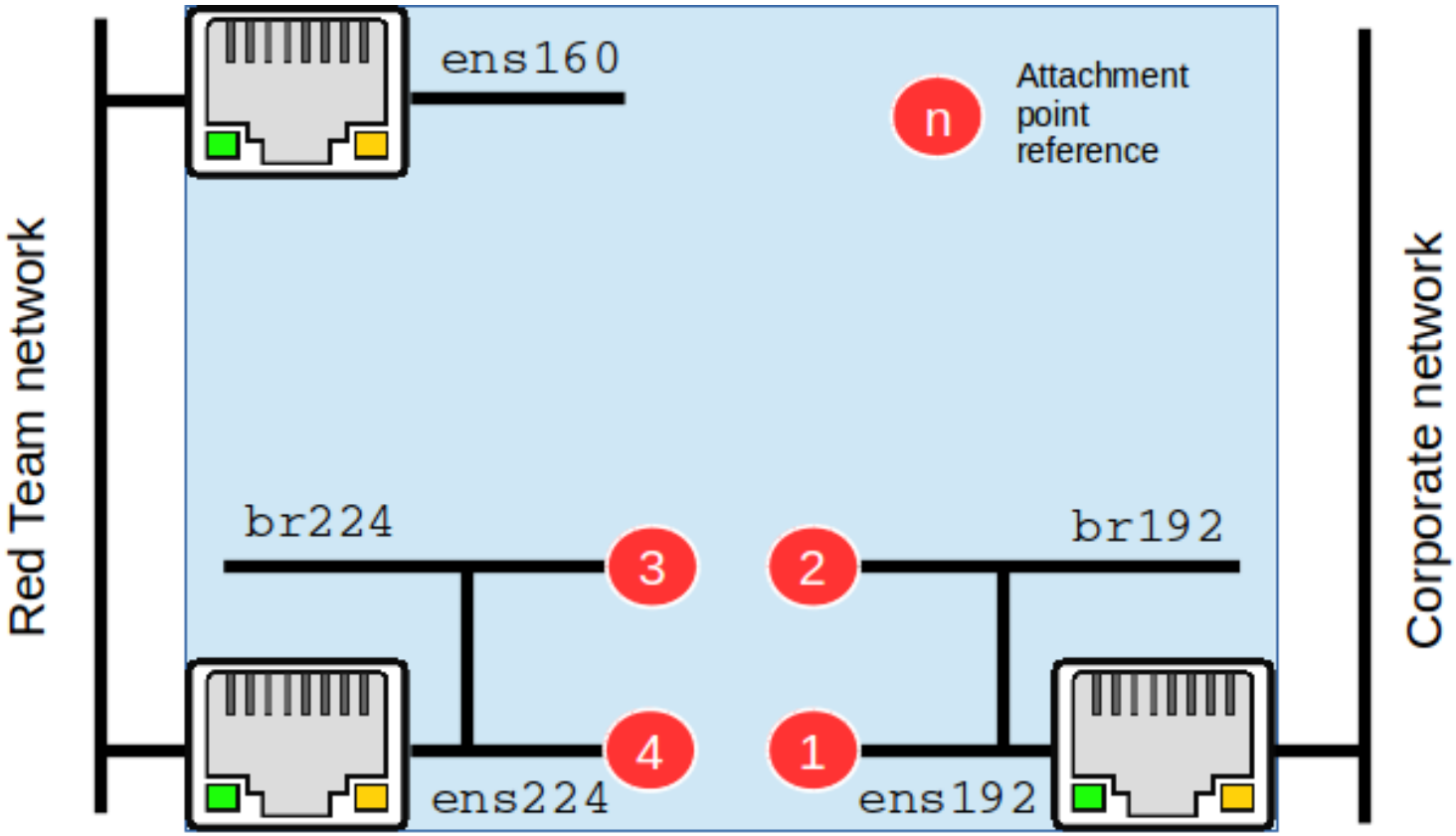
And that means scripting, triggered by a rule!
Including executing commands from the system shell!

```
drop tcp 10.0.0.200 any -> any any (msg:"TCP SYN for
inspection by LUA"; flags:S; sid 1000002; rev:001;
luajit:tcpinspect.lua;)
```

How did the IPS get connected to the network?

There was a need for a solution that did not require scripting... But how did it get attached in this transparent device?



Active detection

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- Service and version detection

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- `Nmap` sends a variety of probing packets
  - ICMP
  - TCP
  - UDP
- results of different tests are combined to create an individual fingerprint
- known OS/fingerprint mappings are stored in a database

Nmap OS fingerprint format

```
SCAN(V=5.05BETA1%D=8/23%OT=22%CT=1%CU=42341%PV=N%DS=0%DC=L%G=Y%TM=4A91CB90%
     P=i686-pc-linux-gnu)
SEQ(SP=C9%GCD=1%ISR=CF%TI=Z%CI=Z%II=I%TS=A)
OPS(O1=M400CST11NW5%O2=M400CST11NW5%O3=M400CNNT11NW5%
    O4=M400CST11NW5%O5=M400CST11NW5%O6=M400CST11)
WIN(W1=8000%W2=8000%W3=8000%W4=8000%W5=8000%W6=8000)
ECN(R=Y%DF=Y%T=40%W=8018%O=M400CNNSNW5%CC=N%Q=)
T1(R=Y%DF=Y%T=40%S=O%A=S+%F=AS%RD=0%Q=)
T2(R=N)
T3(R=Y%DF=Y%T=40%W=8000%S=O%A=S+%F=AS%O=M400CST11NW5%RD=0%Q=)
T4(R=Y%DF=Y%T=40%W=0%S=A%A=Z%F=R%O=%RD=0%Q=)
T5(R=Y%DF=Y%T=40%W=0%S=Z%A=S+%F=AR%O=%RD=0%Q=)
T6(R=Y%DF=Y%T=40%W=0%S=A%A=Z%F=R%O=%RD=0%Q=)
T7(R=Y%DF=Y%T=40%W=0%S=Z%A=S+%F=AR%O=%RD=0%Q=)
U1(R=Y%DF=N%T=40%IPL=164%UN=0%RIPL=G%RID=G%RIPCK=G%RUCK=G%RUD=G)
IE(R=Y%DFI=N%T=40%CD=S)
```

Nmap OS detection

```
$ sudo nmap -O 10.0.0.220

Starting Nmap 7.01 ( https://nmap.org ) at 2017-02-06 21:47 CET
Nmap scan report for 10.0.0.220
Host is up (0.000063s latency).
Not shown: 999 closed ports
PORT   STATE SERVICE
22/tcp open  ssh
MAC Address: 00:0C:29:40:E7:6A (VMware)
Device type: general purpose
Running: Linux 3.X|4.X                          # OS detection correct
OS CPE: cpe:/o:linux:linux_kernel:3 cpe:/o:linux:linux_kernel:4
OS details: Linux 3.2 - 4.0
Network Distance: 1 hop

OS detection performed. Please report any incorrect results at https://nmap.org/submit/ .
Nmap done: 1 IP address (1 host up) scanned in 3.20 seconds
```

Listing 1: Inspecting a Ubuntu machine with kernel 4.4.0-59-generic

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  - simulates networks of low-interaction honeypots
  - **Personality engine** to simulate TCP/IP stack
  - `apt-get install honeyd`

Simulating a Windows XP machine with honeyD

```
1  create winxp
2  set winxp personality "Microsoft Windows XP Professional"
3  set winxp default tcp action reset
4  set winxp default udp action reset
5  set winxp default icmp action closed
6  add winxp udp port 123 open
7  add winxp tcp port 3389 proxy 10.0.0.60:3389
8  add winxp tcp port 22 proxy $ipsrc:22
9  add winxp tcp port 23 "/etc/honeypot/scripts/fake_telnet.sh"
10
11 bind 10.0.0.200 winxp
```

Listing 2: honeyd.conf

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  1. statically mapping well-known ports to their services
  2. attempting to interact with the services to obtain more details:
     - application name
     - version number
     - **OS family**

Nmap service and version detection

```
$ sudo nmap -sV 10.0.0.205

Starting Nmap 7.01 ( https://nmap.org ) at 2017-02-06 22:39 CET
Nmap scan report for 10.0.0.205
Host is up (0.000047s latency).
Not shown: 998 closed ports
PORT   STATE SERVICE VERSION
22/tcp open  ssh     OpenSSH 7.2p2 Ubuntu 4ubuntu2.1 (Ubuntu Linux; protocol 2.0)
80/tcp open  http    Apache httpd 2.4.18 ((Ubuntu))
MAC Address: 00:0C:29:16:3C:76 (VMware)
Service Info: OS: Linux; CPE: cpe:/o:linux:linux_kernel

Service detection performed. Please report any incorrect results at https://nmap.org/
    submit/ .
Nmap done: 1 IP address (1 host up) scanned in 8.10 seconds
```

Listing 3: Inspecting a Ubuntu machine with and ssh service and apache running

How can service detection be evaded?

- Beacons are connecting to CnC server through port 80
- Port 80 is suspicious

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→ **Can we detect an `Nmap` scan and temporary close port 80?**

How does Nmap perform a service scan?

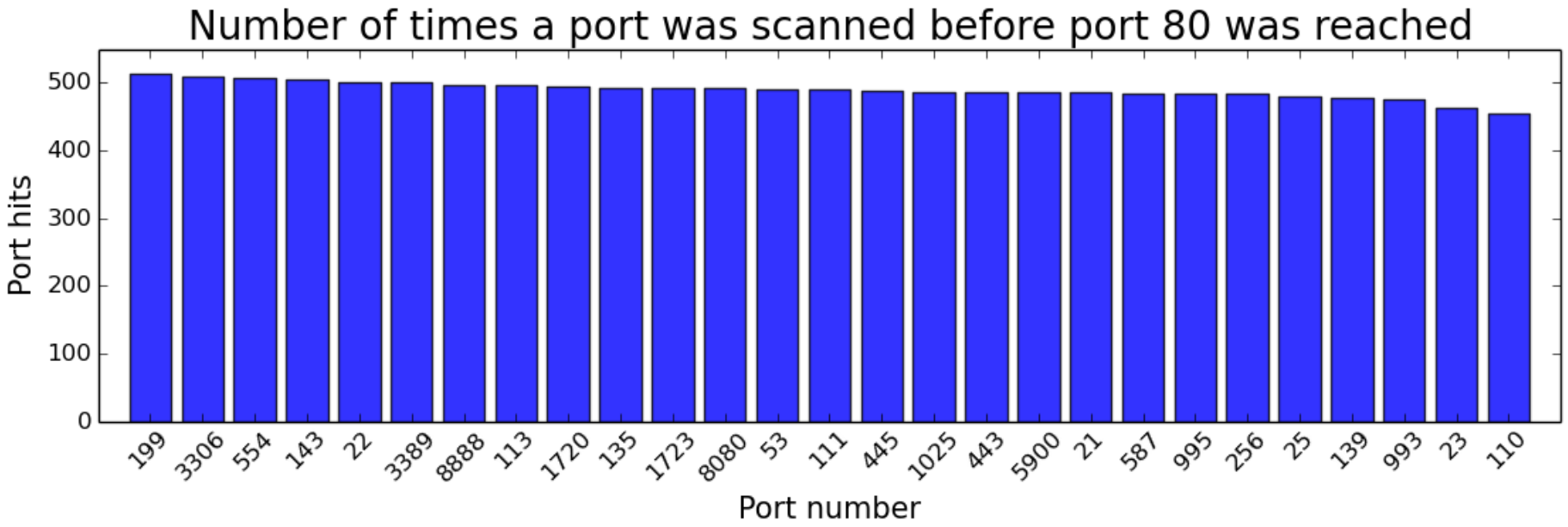

Figure: Result of 1000 Nmap scans

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- Port knocking:
  - listening to secret sequences of port connections
  - opening another port, if a certain sequence is detected
  - `knockD` is a very flexible port knocking daemon

Configuring knockD

```
1 # closing port 22 if 2222, 3333 and 4444 are knocked
2 [opencloseSSH]
3     sequence      = 2222,3333,4444
4     seq_timeout   = 15
5     tcpflags      = syn,ack
6     start_command = iptables -A INPUT -s %IP% -p tcp --syn --dport 22 -j ACCEPT
7     cmd_timeout   = 10
8     stop_command  = iptables -D INPUT -s %IP% -p tcp --syn --dport 22 -j ACCEPT
```

Listing 4: knockd.conf

Configuring knockD

```
1 # close port 80 if either of 199, 3306, 554, ... is knocked
2 [close80]
3     sequence      = 199/3306/554/143/22/3389/8888/...
4     seq_timeout   = 15
5     tcpflags      = syn,ack
6     start_command = iptables -A INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
7     cmd_timeout   = 10
8     stop_command  = iptables -D INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
```

Listing 5: knockd.conf

Configuring knockD

```
1  # separate rule for each port
2  [close80_199]
3      sequence      = 199
4      seq_timeout   = 15
5      tcpflags      = syn,ack
6      start_command = iptables -A INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
7      cmd_timeout   = 10
8      stop_command  = iptables -D INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
9  [close80_3306]
10     sequence      = 3306
11     seq_timeout   = 15
12     tcpflags      = syn,ack
13     start_command = iptables -A INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
14     cmd_timeout   = 10
15     stop_command  = iptables -D INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
16 ...
```

Listing 6: knockd.conf

Configuring knockD

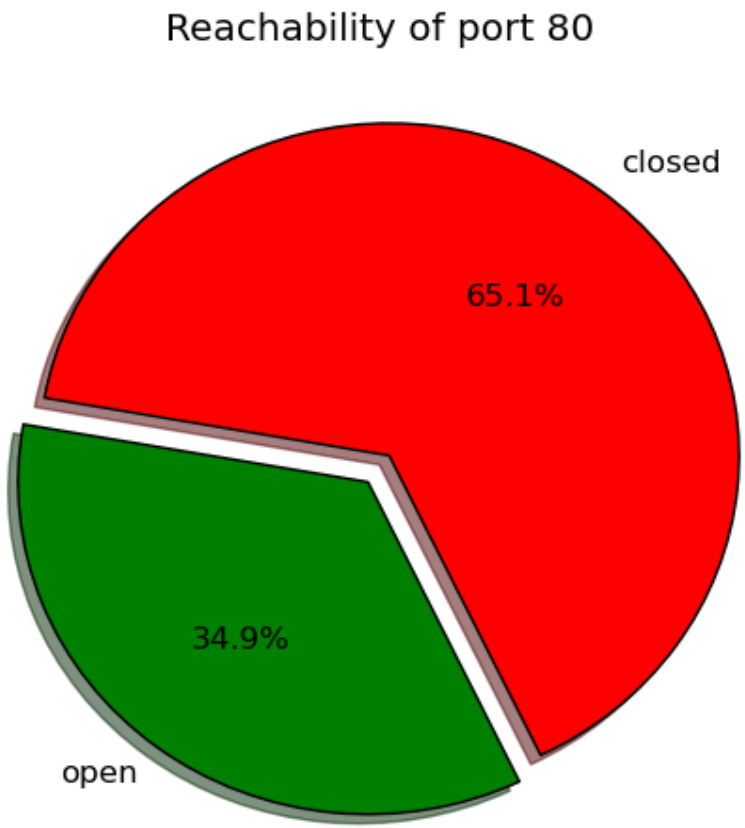
```
1  # rules for all possible permutations
2  [close80_199_3306]
3      sequence      = 199,3306
4      seq_timeout   = 15
5      tcpflags      = syn,ack
6      start_command = iptables -A INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
7      cmd_timeout   = 10
8      stop_command  = iptables -D INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
9  [close80_199_554]
10     sequence      = 199,554
11     seq_timeout   = 15
12     tcpflags      = syn,ack
13     start_command = iptables -A INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
14     cmd_timeout   = 10
15     stop_command  = iptables -D INPUT -s %IP% -p tcp -m multiport --dports 80 -j REJECT
16 ...
```

Listing 7: knockd.conf

Configuring knockD

- running multiple instances of knockD with different rules
- multiple sequences can be detected in parallel
- if Nmap starts scanning with port 80, it cannot be hidden

Reliability



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- We were able to implement a transparent solution which can protect the attacker from being easily detected.
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- Future work
  - Improving reliability of hiding port 80
  - Replace the functionality of external daemons by Lua scripts

Demo

Questions?