XFLTReaT: a new dimension in tunnelling

Balazs Bucsay / @xoreipeip

Senior Security Consultant @ NCC Group

Bio / Balazs Bucsay

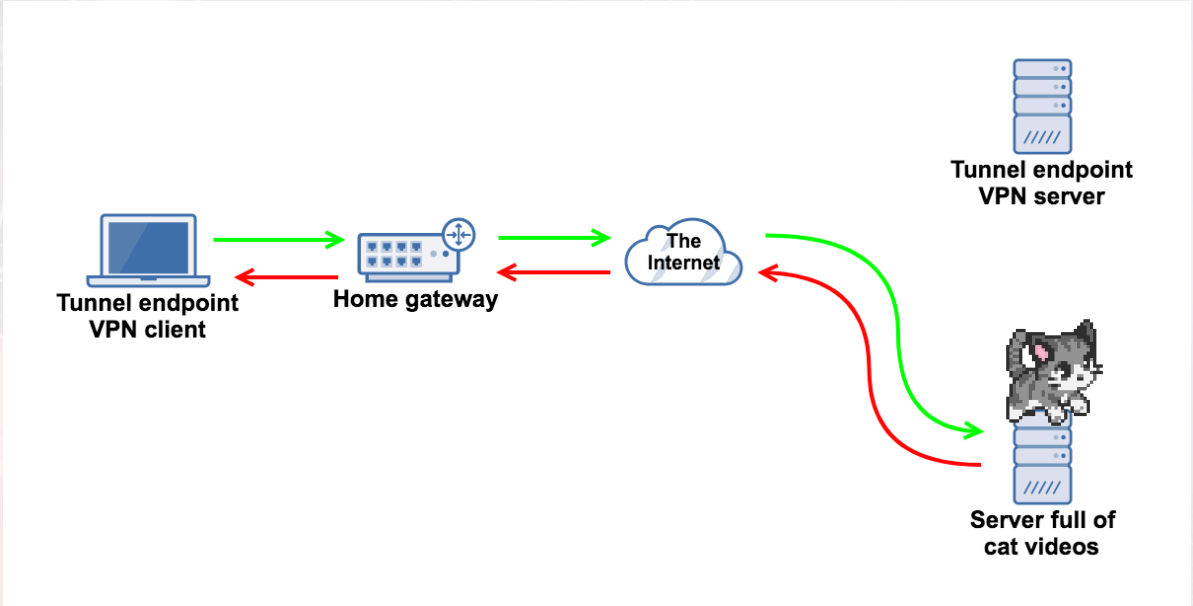
- **Hungarian hacker**
- **Senior Security Consultant @ NCC Group**
- **Strictly technical certificates: OSCE, OSCP, OSWP, GIAC GPEN, CREST CCT/2**
- **Lots of experience in offensive security**
- **Started with ring0 debuggers and disassemblers in 2000 (13 years old)**
- **Major projects:**
  - GI John (2009) – Hacktivity
  - Chw00t (2015) – PHDays, DeepSec, Hacktivity
  - XFLTReaT (2017) – HITB GSEC, Shakacon
- **Twitter: @xoreipeip**
- **Linkedin: https://www.linkedin.com/in/bucsayb**

Presentations

- Talks around the world:
  - Honolulu (HI) / Shakacon
  - Atlanta (GA) / Hacker Halted
  - Moscow (RU) / PHDays
  - Oslo (NO) / HackCon
  - Vienna (AT) / DeepSec
  - Budapest (HU) / Hacktivity
  - London (UK) / Inf. Gov. & eDiscovery Summit
  - There is some more space here…


Tunnels

Without a tunnel



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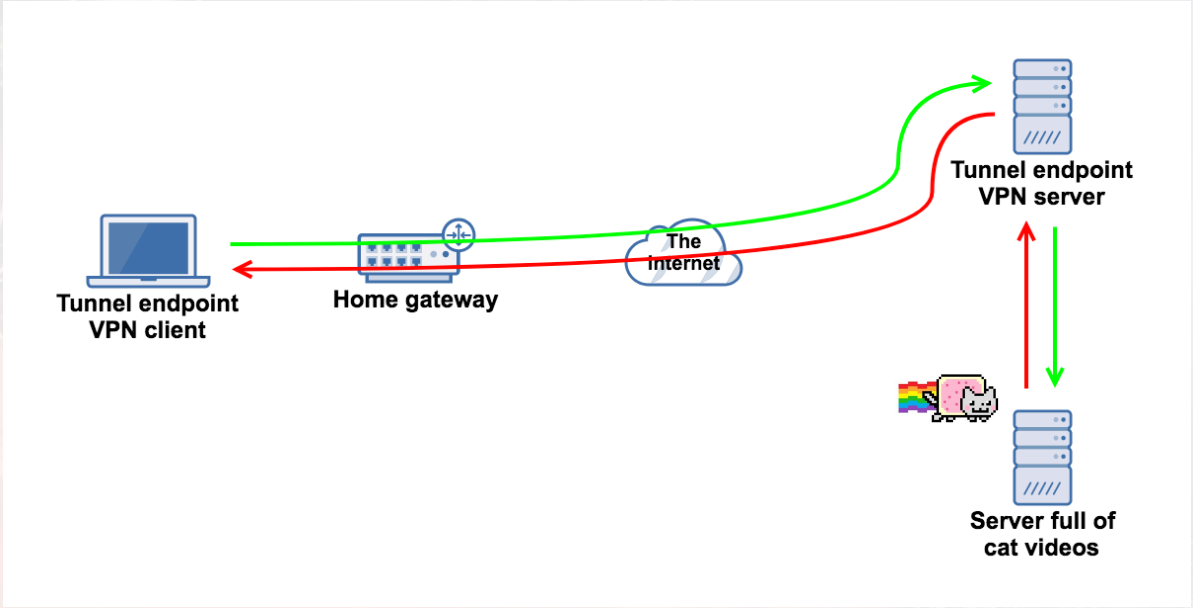
With a tunnel



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Why would one use tunnels?

- **Work VPN – to access the corporate internal network**
- **Hide real IP address**
  - Whistle-blowers/Journalists to communicate anonymously
  - Torrent
- **ISPs filtering some ports (secure IMAP, SMTPS, NetBIOS, …)**
- **Bypass corporate proxy policy**
- **Bypass captive portals!?**
- **What about you?**

Have you done … tunnelling?

Protocol	Tool		
TCP			

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Protocol	Tool		
TCP	OpenVPN	Cisco AnyConnect	
UDP			

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ICMP	Hans	Ping Tunnel	ICMPTx
DNS			

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Have you done … tunnelling?

Protocol	Tool		
TCP	OpenVPN	Cisco AnyConnect	
UDP	OpenVPN		
ICMP	Hans	Ping Tunnel	ICMPTx
DNS	iodine	DNSCat*	Ozymandns
HTTP CONNECT	Proxifier	OpenVPN	
Pure HTTP	?		
TLS v1.2	?		
TLS v1.2 with Kerberos auth	?		

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Two days on a ferry

(Port TCP/443 unfiltered)

10 hour flight to Japan

(ICMP unfiltered)

At the airport

(DNS unfiltered)

What did I see?

Get tired of:

- As many protocols as many solutions
- Hard to modify the existing ones
- No modularity
- Portability issues
- Configuration issues
- Unsupported/EoL tools
- No automation at all
- It is just hard, but it does not have to be!

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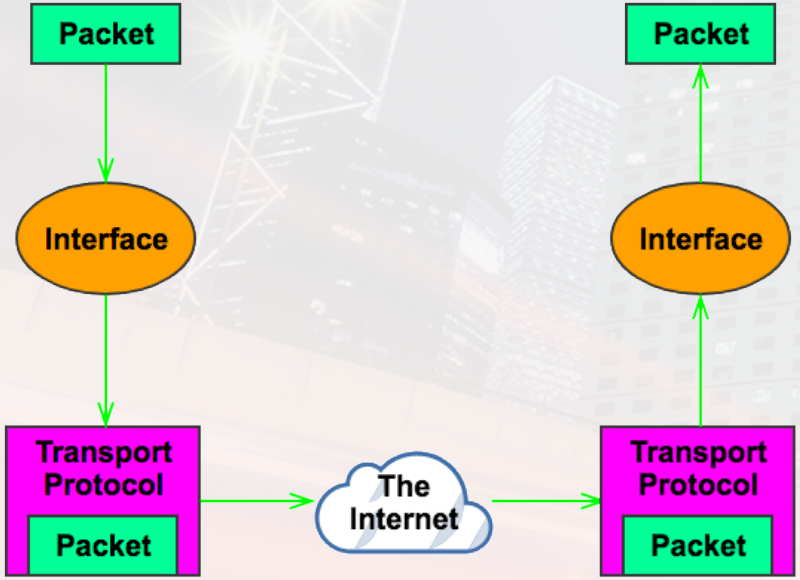
XFLTReaT

The beast was born!

Tunnelling theory 101 / MTU



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What is XFLTReaT?

XFLTReaT (say exfil-treat or exfiltrate)

- **Tunnelling framework**
- **Open-source (will be released soon)**
- **Python based**
- **OOP**
- **Modular**
- **Multi client**
- **Plug and Play (at least as easy as it can be)**
- **Check functionality**

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Easy, modular, plug & play

- **Install:**
  - **git clone & pip install**
  - **edit config**
  - **run**
- **Tunnels, encryption, authentication etc. are modular**
- **Plug and play:**
  - **Copy new module into modules/, support files to support/**
  - **edit config**
  - **run**

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Framework, as it is

You do not have to:

- Set up the routing
- Handle multiple users
- Create and set up an interface or interfaces
- Care about encryption, authentication or encoding

You only have to:

- Encapsulate your packets into your protocol
- Implement protocol related things

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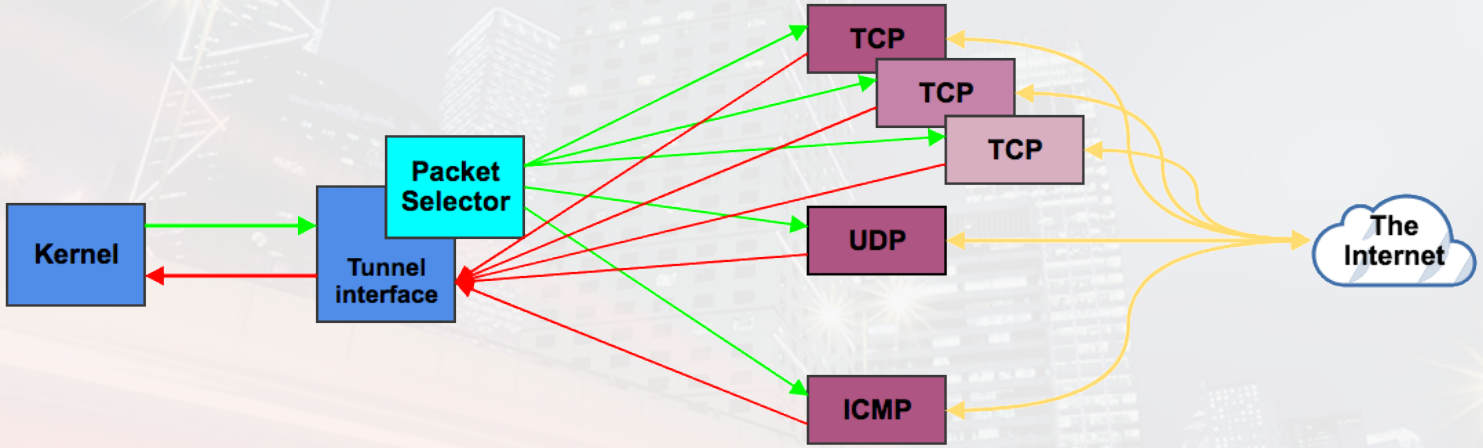
Check functionality

- Easy way to figure out, which protocol is not filtered on the network
- Automated approach: No deep knowledge is needed
- Client sends a challenge over the selected (or all) modules to the server
- If the server responses with the solution:
  - We know that the server is up and running
  - The specific module/protocol is working over the network
  - Connection can be made

One interface to rule them all



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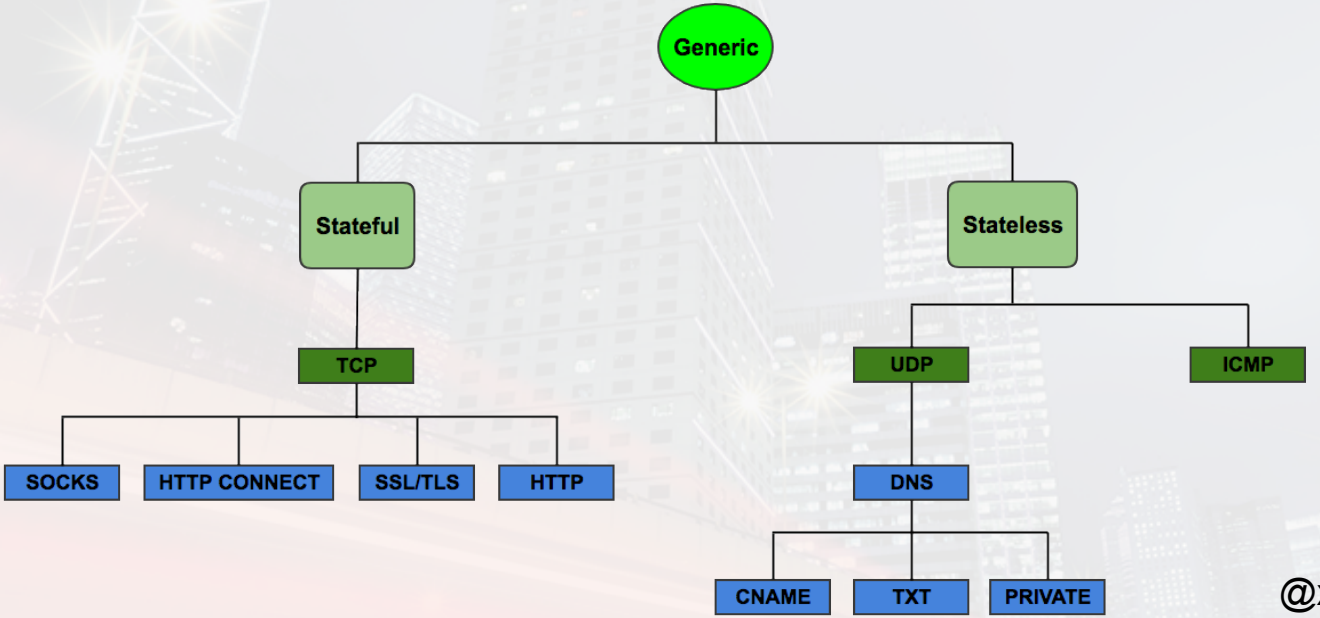
Ease of development

Module tree



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Ease of use/development

- **Only web traffic allowed?**

Ease of use/development

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- **Only ICMP type 0 allowed?**

Ease of use/development

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- HTTP should work, but only with special header?

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- HTTPS allowed but only with TLS v1.2?

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- Special authentication over HTTP proxy?

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Ease of use/development

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- HTTP should work, but only with special header? Set the header in source
- HTTPS allowed but only with TLS v1.2? Copy TLS module, set it to 1.2 only
- Special authentication over HTTP proxy? Implement the auth, change the config
- Want to send data over text/SMS? Handle connection with your phone from a module
- PROTIP: just use the source!

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DEMO

A few technical details

- TCP is pretty easy
  - New connection/new thread for all users
- UDP introduced new challenges
  - Stateless - One socket for all users
  - Sender address needs to be checked
- ICMP
  - Just like UDP it is stateless as well
  - Identifier and sequence tracking (for NAT/Firewalls)
  - As many request as many answers

DNS module

- The DNS module is not 100% yet
- Zonefile support included
- Supports A/CNAME, PRIVATE and NULL records (easily extendable)
- Tested with Bind9
- Auto tune functionality checks:
  - Which is the best encoding and length for upstream
  - Which is the best encoding, length and record type down downstream
- Example: NULL record with no encoding with 300bytes downstream

DNS bottlenecks – Wall of Text

- Just like ICMP – as many requests as many responses
- NULL/PRIVATE etc. records have 2^16 bytes payload size
- Recommended maximum size of a DNS packet on UDP: 512 or less
  - Different implementations -> different hardcoded limits
  - Bigger packets should be transmitted over TCP
  - Answer packet: (IP+UDP+DNS header) + question+answer
  - Fragmentation needs to be done (MTU/MSS)
- Some DNS solutions
  - Switch to TCP then send bigger UDP packets (VMWare)
  - Impatient DNS servers send server failure answers

Offense

- **Bypass basic obstacles**
  - Specific ports are unfiltered (TCP / UDP)
  - DNS allowed
  - ICMP allowed
- **Bypass not that basic obstacles**
  - Specific protocol allowed (IPS or any other active device in place)
  - Special authentication required
- **Exfiltrate information from internal networks**
- **Get unfiltered internet access**

Defense for companies

Check your network settings

- **Check functionality**
- **Try to exfiltrate data – check whether your active network device can catch it**

Captive portals

- **Drop all packets that are addressed to external until not authenticated**
- **All DNS query should have the same response (the portal)**

Defense for companies

No solution is 100% secure

- **Do not route your network to the internet**
  - Disable all traffic between the internet and internal network
- **Use HTTP Proxy and enforce it**
  - Whitelist ports (80 and 443, would you need anything else?)
  - Blacklist websites (does not really help on XFLTReaT)
- **DNS**
  - Filter external DNS queries if possible (let HTTP proxy do the resolving)

Defense for companies

No solution is 100% secure

- **Do you have an inventory? (IP, owner, purpose, location)**
- **Do baselining (Use Netflow or Bro)**
  - Check relation between IPs
  - What are the top talker source IPs (bytes, packets, flows)?
  - What are the top destination IPs (bytes, packets, flows)?
- **Any unusual activity should generate an alert/be blocked when you are done**


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Release

Release

- **Will be released on Github after the talk**

http://xfltreat.info
https://github.com/earthquake/XFLTReaT

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TODO

- Multi OS support
- More modules (DNS available, but work in progress)
- Encryption and authentication modules
- Adding more comments to the code

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Q&A - Thank you for your attention

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