Secure Linux VPN Use

By Xe1phix

@Xe1phix | Xe1phix's GnuPG Key | Xe1phix @protonmail.ch | Telegram @Xe1phix

Archive.org @Xe1phix | Bitchute @Xe1phix

PeerTube.Video @Xe1phix | Open.Tube @Xe1phix | PeerTube.LinuxRocks @Xe1phix | PeerTube.Live @Xe1phix

Who Am I?

- Linux Systems Administrator/Engineer (LPIC-1, Linux+, LPIC-2)
- I have studied Linux for 12 years
- My Linux library contains over 200 books
- I have given talks at 10 infosec conferences
- InfoSec Career – Primary Focus:
  - Linux System Hardening/Security
  - Linux Memory Forensics & Malware Analysis
  - Linux Digital Forensics & Incident Response (DFIR)
  - Linux Intrusion Detection Systems (IDS)
  - Linux Network Intrusion Detection Systems (NIDS)

Xe1phix – InfoSec Work

- Gitlab | Pastebin | Gist | Github |
- Telegram | Matrix | Briar | Session | Libera.chat | Jitsi | Discord |
- Twitter | Gettr | LinkedIn | Reddit | ProtonMail | Gmail |
- Archive.org | Bitchute | YouTube | PeerTube.video | PeerTube.live |
- Libre.Video | LinuxRocks | OpenTube | P2PTube | DTube |
- Write.as | Asciinema | Instructables | SoundCloud | Giphy | DeviantAr
- ParrotSec | Whonix | Kali | I2P | StackOverflow | StackExchange |
- WilderSecurity |
- GnuPG Key | Keybase.io | ProtonMail Public Key |
- https://gitlab.com/xe1phix/xe1phix-linux-infosec-professional

Firejail Features:

- Seccomp-BPF (Restrict System Call)
- AppArmor Confinement
- User Namespaces (CLONE_NEWUSER)
- Mount namespaces (CLONE_NEWNS)
- Chroot Containers
- PID Namespaces (CLONE_NEWPID)
- OverlayFS
- Linux rlimits (Resource Allocation)
- Grsecurity Support
- CGroupV2 (Linux Control Groups)
- Berkeley Packet Filter (BPF) Support)
- Extended Berkeley Packet Filter (eBPF) Support
- NoGroup
- NoNewPrivs
- NoRoot (User Namespace Mounts)
- IPC Namespaces (CLONE_NEWIP) - isolate certain interprocess communication (IPC) resources
- Filesystem Containers

Firejail Security Sandbox

```
$ firejail --version
firejail version 0.9.27

Compile time support:
    - AppArmor support is enabled
    - AppImage support is enabled
    - chroot support is enabled
    - file and directory whitelisting support is enabled
    - file transfer support is enabled
    - firetunnel support is enabled
    - networking support is enabled
    - overlayfs support is enabled
    - private-home support is enabled
    - seccomp-bpf support is enabled
    - user namespace support is enabled
    - X11 sandboxing support is enabled
```

Xe1phix - Firejail Cheatsheet Template

https://gitlab.com/xe1phix/Xe1phix-Firejail#firejail-features

- Filesystem Containers
- Linux Capabilities (POSIX 1003.1e)
- Whitelist Linux Capabilities (POSIX 1003.1e
- Blacklist Linux Capabilities (POSIX 1003.1e)
- Audit Linux Capabilities (POSIX 1003.1e)
- Network Namespaces (CLONE_NEWNET)
- Protocol Filtering (unix, inet and inet6)
- UTS Namespaces (CLONE_NEWUTS)
- Overlayfs Filesystems
- Private Mounting
- Bind Mounts
- TmpFS Mounting (Temporary Filesystem)
- Read-Only | File(s) & Directories
- Read-Write | File(s) & Directories
- NoExec (No Execution)
- Blacklist | File(s) & Directories
- Whitelist | File(s) & Directories
- Blacklist External Devices
- Blacklist 3D
- Blacklist /dev/
- Blacklist /mnt/
- Blacklist /media/
- Read-Only Bind Mounts
- X11 Sandboxing
- Xpra Support
- Xephyr Server Support
- Network Interface Support: | macvlan, Bridged Interfaces, VLANs
- TUN Network Driver Support (Ethernet Virtual Network Interface)
- TAP Network Driver Support (Wireless Virtual Network Interface)
- Trustworthy DNS (Enforced)
- Netfilter (IPTables) Packet Filtering/Firewall
- Bridged Network Interfaces
- VLAN Network Interfaces
- NoNet (Isolate Network Interface In Its Own Namespace)
- EncFS and SSHFS
- Traffic Shaping
- Sandbox Auditing
- System Call Tracing
- DNS Auditing

Understanding namespace isolation

Namespaces are a kernel security feature that was introduced in Linux kernel version 2.4.19, all the way back in 2002. A namespace allows a process to have its own set of computer resources that other processes can't see. They're especially handy for times when you might have multiple customers sharing resources on the same server. The processes for each user will have their own namespaces. Currently, there are seven types of namespaces:

- **Mount (mnt)**: This is the original namespace, which was introduced in Linux kernel 2.4.19. At the time, this was the only namespace. This allows each process to have its own root filesystem that no other processes can see, unless you choose to share it. This is a good way of preventing information leakage.
- **UTS**: The UTS namespace allows each process to have its own unique hostname and domain name.
- **PID**: Every running process can have its own set of PID numbers. PID namespaces can be nested so that a parent namespace can see the PIDs of child namespaces. (Note that child namespaces can't see into the parent namespaces.)
- **Network (net)**: This allows you to create a whole virtual network for each process. Each virtual network can have its own subnets, virtual network interfaces, routing tables, and firewalls.
- **Interprocess Communication (ipc)**: This also prevents data leakage by preventing two processes from sharing the same memory space. Each running process can access its own memory space, but other processes will be blocked.
- **Control group (cgroup)**: This namespace hides the identity of the cgroup that a process is a member of.
- **User**: The User namespace allows a user to have different levels of privilege on different processes. For example, a user could have root-level privileges on one process, but only normal-user privileges on another process.

Mount namespaces (`CLONE_NEWNS`, Linux 2.4.19) isolate the set of filesystem mount points seen by a group of processes. Thus, processes in different mount namespaces can have different views of the filesystem hierarchy. With the addition of mount namespaces, the `mount()` and `umount()` system calls ceased operating on a global set of mount points visible to all processes on the system and instead performed operations that affected just the mount namespace associated with the calling process.

Network namespaces (`CLONE_NEWNET`, started in Linux ~~2.4.19~~ 2.6 and largely completed by about Linux 2.6.29) provide isolation of the system resources associated with networking. Thus, each network namespace has its own network devices, IP addresses, routing tables, `/proc/net` directory, port numbers, and so on.

PID namespaces (`CLONE_NEWPID`, Linux 2.6.24) isolate the process ID number space. In other words, processes in different PID namespaces can have the same PID. One of the main benefits of PID namespaces is that containers can be migrated between hosts while keeping the same process IDs for the processes inside the container. PID namespaces also allow each container to have its own `init` (PID 1), the "ancestor of all processes" that manages various system initialization tasks and reaps orphaned child processes when they terminate.

User namespaces (`CLONE_NEWUSER`, started in Linux 2.6.23 and completed in Linux 3.8) isolate the user and group ID number spaces. In other words, a process's user and group IDs can be different inside and outside a user namespace. The most interesting case here is that a process can have a normal unprivileged user ID outside a user namespace while at the same time having a user ID of 0 inside the namespace. This means that the process has full root privileges for operations inside the user namespace, but is unprivileged for operations outside the namespace.

UTS namespaces (`CLONE_NEWUTS`, Linux 2.6.19) isolate two system identifiers—`nodename` and `domainname`—returned by the `uname()` system call; the names are set using the `sethostname()` and `setdomainname()` system calls. In the context of containers, the UTS namespaces feature allows each container to have its own hostname and NIS domain name. This can be useful for initialization and configuration scripts that tailor their actions based on these names. The term "UTS" derives from the name of the structure passed to the `uname()` system call: `struct utsname`. The name of that structure in turn derives from "UNIX Time-sharing System".

IPC namespaces (`CLONE_NEWIPC`, Linux 2.6.19) isolate certain interprocess communication (IPC) resources, namely, System V IPC objects and (since Linux 2.6.30) POSIX message queues. The common characteristic of these IPC mechanisms is that IPC objects are identified by mechanisms other than filesystem pathnames. Each IPC namespace has its own set of System V IPC identifiers and its own POSIX message queue filesystem.

CAP_SETPCAP	Without VFS support for capabilities:

Filtering Linux Capabilities

Capability Name	Meaning
CAP_ALL	CAP_ALL is not a real capability, but was coded into `gradm` to represent all capabilities. Therefore to denote dropping of all capabilities, but CAP_SETUID, -CAP_ALL and +CAP_SETUID would be used.
CAP_CHOWN	In a system with the [_POSIX_CHOWN_RESTRICTED] option defined, this overrides the restriction of changing file ownership and group ownership.
CAP_DAC_OVERRIDE	Override all DAC access, including ACL execute access if [_POSIX_ACL] is defined. Excluding DAC access covered by CAP_LINUX_IMMUTABLE.
CAP_DAC_READ_SEARCH	Overrides all DAC restrictions, regarding read and search on files and directories, including ACL restrictions, if [_POSIX_ACL] is defined. Excluding DAC access covered by CAP_LINUX_IMMUTABLE.
CAP_FOWNER	Overrides all restrictions about allowed operations on files, where file owner ID must be equal to the user ID, except where CAP_FSETID is applicable. It doesn't override MAC and DAC restrictions.
CAP_FSETID	Overrides the following restrictions, that the effective user ID shall match the file owner ID, when setting the S_ISUID and S_ISGID bits on that file; that the effective group ID (or one of the supplementary group IDs) shall match the file owner ID when setting the S_ISGID bit on that file; that the S_ISUID and S_ISGID bits are cleared on successful return from `chown(2)` (not implemented).
CAP_KILL	Overrides the restriction, that the real or effective user ID of a process, sending a signal, must match the real or effective user ID of the process receiving the signal.
CAP_SETGID	▪ Allows `setgid(2)` manipulation. ▪ Allows `setgroups(2)`. ▪ Allows forged gids on socket credentials passing.
CAP_SETUID	▪ Allows `set*uid(2)` manipulation (including fsuid). ▪ Allows forged pids on socket credentials passing.
	▪ Transfer any capability in your permitted set to any pid, remove any capability in your permitted set from any pid. With VFS support for capabilities (neither of above, but) ▪ Add any capability from current's capability bounding set to the current process' inheritable set ▪ Allow taking bits out of capability bounding set. ▪ Allow modification of the securebits for a process.
CAP_LINUX_IMMUTABLE	Allow modification of S_IMMUTABLE and S_APPEND file attributes.
CAP_NET_BIND_SERVICE	▪ Allows binding to TCP/UDP sockets below 1024. ▪ Allows binding to ATM VCIs below 32.
CAP_NET_BROADCAST	Allow broadcasting, listen to multicast.
CAP_NET_ADMIN	▪ Allow interface configuration. ▪ Allow administration of IP firewall, masquerading and accounting. ▪ Allow setting debug option on sockets. ▪ Allow modification of routing tables. ▪ Allow setting arbitrary process / process group ownership on sockets. ▪ Allow binding to any address for transparent proxying. ▪ Allow setting TOS (type of service). ▪ Allow setting promiscuous mode. ▪ Allow clearing driver statistics. ▪ Allow multicasting. ▪ Allow read/write of device–specific registers. ▪ Allow activation of ATM control sockets.
CAP_NET_RAW	▪ Allow use of RAW sockets. ▪ Allow use of PACKET sockets.
CAP_IPC_LOCK	▪ Allow locking of shared memory segments. ▪ Allow `mlock` and `mlockall` (which doesn't really have

CAP_IPC_OWNER	Override IPC ownership checks.
CAP_SYS_MODULE	Insert and remove kernel modules – modify kernel without limit.
CAP_SYS_RAWIO	▪ Allow ioperm/iopl access ▪ Allow sending USB messages to any device via */proc/bus/usb'*
CAP_SYS_CHROOT	Allow use of `chroot()`.
CAP_SYS_PTRACE	Allow `ptrace()` of any process.
CAP_SYS_PACCT	Allow configuration of process accounting.
CAP_SYS_ADMIN	▪ Allow configuration of the secure attention key. ▪ Allow administration of the random device. ▪ Allow enabling/disabling tagged queuing on SCSI controllers and sending arbitrary SCSI commands. ▪ Allow setting encryption key on loopback filesystem. ▪ Allow setting zone reclaim policy.
CAP_SYS_BOOT	▪ Allow use of `reboot()` ▪ Allow use of `kexec()` syscall
CAP_SYS_NICE	▪ Allow raising priority and setting priority on other (different UID) processes. ▪ Allow use of FIFO and round–robin (realtime) scheduling on own processes and setting the scheduling algorithm used by another process.
CAP_SYS_RESOURCE	▪ Override resource limits. Set resource limits. ▪ Override quota limits ▪ Override reserved space on ext2 filesystem ▪ Modify data journaling mode on ext3 filesystem (uses journaling resources). NOTE: ext2 honors fsuid when checking for resource overrides, so you can override using fsuid too. ▪ Override size restrictions on IPC message queues. ▪ Allow more than 64Hz interrupts from the real–time clock. ▪ Override max number of consoles on console allocation. ▪ Override max number of keymaps.
CAP_SYS_TIME	▪ Allow manipulation of system clock. ▪ Allow `irix_stime` on mips. ▪ Allow setting the real–time clock.
CAP_SYS_TTY_CONFIG	▪ Allow configuration of tty devices. ▪ Allow `vhangup()` of tty.
CAP_MKNOD	Allow the privileged aspects of `mknod()`.
CAP_LEASE	Allow taking of leases on files.
CAP_AUDIT_WRITE	Allow emitting auditing messages.
CAP_AUDIT_CONTROL	Allow administration of the kernel's auditing system.
CAP_SETFCAP	Allow the setting of file capabilities.
CAP_MAC_OVERRIDE	Override MAC access. The base kernel enforces no MAC policy. An LSM may enforce a MAC policy and if it does and it chooses to implement capability based overrides of that policy, this is the capability it should use to do so.
CAP_MAC_ADMIN	Allow MAC configuration or state changes. The base kernel requires no MAC configuration. An LSM may enforce a MAC policy, and if it does and it chooses to implement capability based checks on modifications to that policy or the data required to maintain it, this is the capability it should use to do so.
CAP_SYSLOG	Allow configuring the kernel's syslog (printk behaviour).

```
--caps.drop=capability,capability,capability
       Define a custom blacklist Linux capabilities filter.

       Example:
       $ firejail --caps.drop=net_broadcast,net_admin,net_raw

--net=none
       Enable a new, unconnected network namespace. The only interface
       available in the new namespace is a new loopback interface
       (lo). Use this option to deny network access to programs that
       don't really need network access.

--net=tap_interface
       Enable a new network namespace and connect it to this ethernet
       tap interface using the standard Linux macvlan driver. If the
       tap interface is not configured, the sandbox will not try to
       configure the interface inside the sandbox. Please use --ip,
       --netmask and --defaultgw to specify the configuration.

       Example:
       $ firejail --net=tap0 --ip=10.10.20.80 --netmask=255.255.255.0
       --defaultgw=10.10.20.1 firefox
```

AppArmor - Overview

AppArmor - kernel enhancement to confine programs to a limited set of resources.

AppArmor confinement is provided via **profiles** loaded into the kernel via **apparmor_parser**(8),

AppArmor can operate in two modes: **enforcement**, and **complain or learning**:

- **enforcement** - Profiles loaded in enforcement mode will result in enforcement of the policy defined in the profile as well as reporting policy violation attempts to syslogd.

- **complain** - Profiles loaded in "complain" mode will not enforce policy. Instead, it will report policy violation attempts. This mode is convenient for developing profiles. To manage complain mode for individual profiles the utilities **aa-complain**(8) and **aa-enforce**(8) can be used. These utilities take a

ERRORS

When a confined process tries to access a file it does not have permission to access, the kernel will report a message through audit, similar to:

```
audit(1386511672.612:238): apparmor="DENIED" operation="exec"
  parent=7589 profile="/tmp/sh" name="/bin/uname" pid=7605
  comm="sh" requested_mask="x" denied_mask="x" fsuid=0 ouid=0

audit(1386511672.613:239): apparmor="DENIED" operation="open"
  parent=7589 profile="/tmp/sh" name="/bin/uname" pid=7605
  comm="sh" requested_mask="r" denied_mask="r" fsuid=0 ouid=0

audit(1386511772.804:246): apparmor="DENIED" operation="capable"
  parent=7246 profile="/tmp/sh" pid=7589 comm="sh" pid=7589
  comm="sh" capability=2  capname="dac_override"
```

```
┌─[root@parrotseckiosk-optiplex990]─[/home/parrotseckiosk/
└──╼ #aa-status --verbose
apparmor module is loaded.
183 profiles are loaded.
145 profiles are in enforce mode.
   /etc/cron.daily/slocate.cron
   /etc/cron.daily/tmpwatch
   /usr/NX/bin/nxclient
   /usr/X11R6/bin/acroread
   /usr/bin/apropos
   /usr/bin/evolution-2.10
   /usr/bin/fam
   /usr/bin/gaim
   /usr/bin/i2prouter
   /usr/bin/i2prouter//sanitized_helper
   /usr/bin/lxc-start
   /usr/sbin/sshd
   /usr/sbin/sshd//passwd
   /usr/sbin/unbound
   /usr/sbin/useradd
   /usr/sbin/useradd//pam_tally2
   /usr/sbin/userdel
   /usr/sbin/vsftpd
   /usr/sbin/xinetd
   apt-cacher-ng
   avahi-daemon
   dhclient
   dhclient-script
   dhcpcd
   firejail-default
   identd
   klogd
   system_i2p
   system_i2p//sanitized_helper
   system_tor
   tcpdump
   thunderbird
   thunderbird//browser_java
   thunderbird//browser_openjdk
   thunderbird//gpg
   thunderbird//sanitized_helper
   torbrowser_firefox
   torbrowser_tor
   virt-aa-helper
```

Apparmor - Status

Apparmor – Parser + Enforce

```
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #cp -v /usr/share/apparmor/extra-profiles/usr.sbin.dhcpd /etc/apparmor.d/
'/usr/share/apparmor/extra-profiles/usr.sbin.dhcpd' -> '/etc/apparmor.d/usr.sbin.dhcpd'
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #apparmor_parser --verbose -r /etc/apparmor.d/usr.sbin.dhcpd
Replacement succeeded for "/usr/sbin/dhcpd".
```

```
┌─[✗]─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #aa-enforce /etc/apparmor.d/usr.sbin.dhcpd
Setting /etc/apparmor.d/usr.sbin.dhcpd to enforce mode.
```

```
┌─[root@ParrotSec-Kiosk]─[/home/xe1phix]
└──╼ #/etc/init.d/apparmor reload
Reloading apparmor configuration (via systemctl): apparmor.service.
```

```
└──╼ $firejail --list
216203:parrotseckiosk::firejail --dns=172.98.193.62 --dns=193.138.218.74 --apparmor --protocol=unix,inet,netlink --seccomp --nonewprivs
 --caps.drop=all --shell=none --whitelist=~/.mozilla --private-tmp --private-dev --netfilter --nogroups --nodvd /usr/bin/firefox
```

```
└──╼ $firemon --apparmor 216203
  AppArmor: firejail-default enforce
```

```
└──╼ $firejail --apparmor.print=1243548
1243548:parrotseckiosk::/usr/local/bin/firejail /usr/bin/firefox
  AppArmor: firejail-default enforce
```

Firejail – Print Apparmor

```
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #firejail --list
193119:parrotsec-kiosk::firejail --profile=/etc/firejail/firefox.profile --protocol=unix,in
et,netlink,packet --dns=193.138.218.74 --dns=10.8.0.1 --dns=139.99.96.146 /usr/bin/firefox
┌─[xe1phix@parrot]─[~]
└──╼ $firejail --apparmor.print=3414
3414:xe1phix::firejail --profile=/etc/firejail/firefox.profile --protocol=unix,inet,netlink,packet
--dns=10.64.0.1 --dns=194.242.2.2 /usr/bin/firefox
  AppArmor: firejail-default enforce
```

```
capability net_admin,
/etc/NetworkManager/NetworkManager.conf r,
/etc/NetworkManager/VPN/ r,
/etc/NetworkManager/conf.d/ r,
/etc/NetworkManager/dispatcher.d/ r,
/etc/NetworkManager/dispatcher.d/pre-down.d/ r,
/etc/NetworkManager/dispatcher.d/pre-up.d/ r,
/etc/NetworkManager/system-connections/ r,
/etc/NetworkManager/system-connections/* rw,
/etc/dhcp/dhclient.conf r,
/etc/hostname r,
/etc/network/interfaces r,
/etc/network/interfaces.d/ r,
/etc/udev/udev.conf r,
/sbin/dhclient Px,
/sys/bus/ r,
/sys/class/ r,
/sys/class/net/ r,
```

NetworkManager AppArmor

The best and most reliable VPN Services for your Privacy

We have compared 185 different VPN providers, but our strict criteria left only the two best providers. Our recommended providers are operating outside the USA or other Five Eyes countries, use a strong encryption, accept Crypto currencies or cash payments, support OpenVPN, have a no logging policy and have a long history of operating.

Mullvad: 60 Euro Yearly

Win | Android | iOS | Mac | Linux | Bitcoin | Cash

Based in Sweden. Operating since 2009. Accepts Bitcoin, BCH and Cash. Native desktop and mobile clients are available for Android and iOS and are easy to use. Money back guarantee for 30 days.

Amount of servers in Oct 2021: 763 VPN servers, in 38 different countries. Source

ProtonVPN: Limited free version available, otherwise 48 EUR Yearly

Freemium | Win | Android | iOS | Mac | Linux | Bitcoin

Based in Switzerland. Operating since 2016. Accepts Bitcoin, but you need an existing account or contact their support team in advance. Easy to use native desktop and mobile clients are available for Android and iOS.

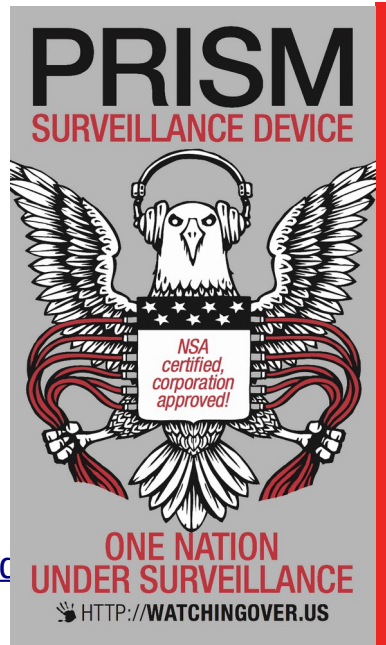
Amount of servers in Oct 2021: 1200+ VPN servers available in 55 different countries. Source

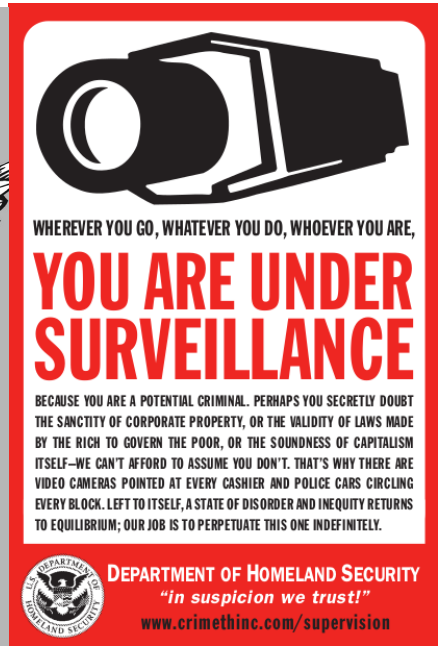
Mullvad Activism

Mullvad (Amagicom AB) offers a VPN service with a focus on the right to privacy and freedom of expression without censorship, both upheld in the UN's Universal Declaration of Human Rights (articles 12 and 19) and the European Convention on Human Rights (articles 8 and 10).

- European Court of Human Rights passes legislation to make mass surveillance official against human rights:
- **[European Court of Human Rights - mass surveillance announcement]**

- Data Collection Techniques | Whonix Wiki
- Surveillance Capabilities | Whonix Wiki
- Abusive ISPs [OpenNIC Wiki]
- https://www.privacytools.io/providers/vpn/#mullvad
- https://prism-break.org/en/all/#vpn
- Privacy is A Universal Right | Mullvad Blog
- https://mullvad.net/en/blog/2020/6/25/results-available-audit-mullvad-app/
- Debian-Privacy-Server-Guide
- Rebel-Alliance-Tech-Manual
- Tradecraft DOs and DON'Ts
- A Declaration of The Independence of Cyberspace | Electronic Frontier Found





Mullvad Features

- No logging policy
- Open source clients
- WireGuard support

MULLVAD VPN

- Mullvad Android client available on F-Droid.

GET IT ON F-Droid

- Built-in killswitch to block internet connections outside of the VPN.

https://www.privacytools.io/providers/vpn/#mullvad

Abusive ISPs

These are Internet Service Providers that have been found to tamper with your DNS (or OpenNIC related) traffic, do note that this list is only for previously mentioned abuse, nothing else.

Is my ISP intercepting DNS traffic?

Some abusive ISPs will intercept DNS traffic on port 53 and return results from their own servers instead. This makes access to alternative TLDs difficult, and is a privacy concern as it allows the ISPs to carry out more detailed logging of the domains you resolve.

Some OpenNIC DNS servers also listen on an alternative port (generally 5353) which is less likely to be tampered with by ISPs.

To test if an ISP is tampering with DNS traffic, you can use the dig command from the `dnsutils` package. Select a server from the Tier 2 page which supports an alternative port. In my example I have used `106.186.17.181`. First, try querying for the root zone (`.`) on the default port:

```
dig SOA . @106.186.17.181
...
.       58346   IN      SOA     a.root-servers.net. nstld.verisign-grs.com. 2015080300 1800 900 604800 86400
```

You can see from the returned SOA above that the DNS request has been hijacked by the ISP as `a.root-servers.net` is not an OpenNIC DNS server. If the SOA you get looks more like the one below, then your ISP is probably not hijacking your DNS requests.

Now try again on the alternative port:

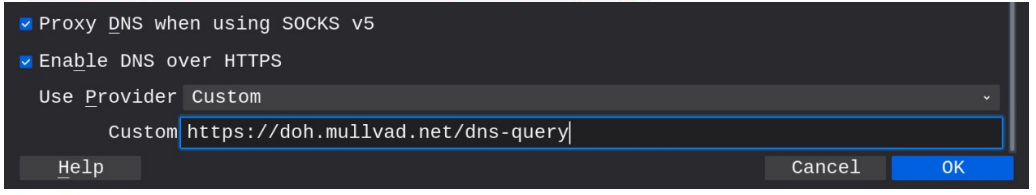
```
dig SOA . @106.186.17.181 -p 5353
...
.       86319   IN      SOA     ns0.opennic.glue. hostmaster.opennic.glue. 2015080301 1800 900 604800 3600
```

You can see that the SOA returned is OpenNIC's, meaning no hijacking has taken place on the alternative port. If this result differs from the previous result or the first result times out with `connection timed out; no servers could be reached`, then your ISP is likely to be hijacking DNS.

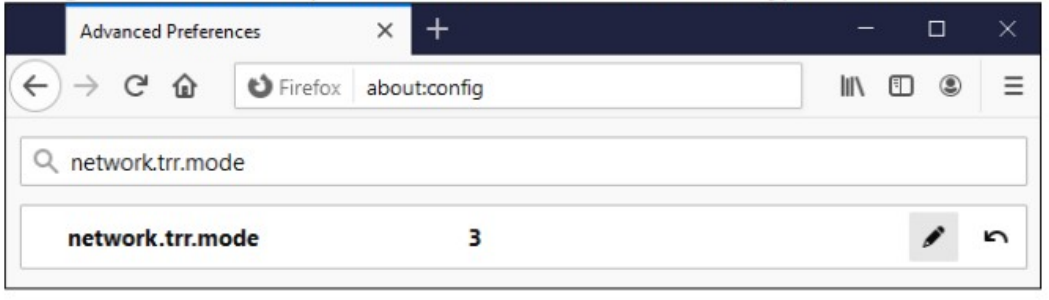
How to use our DNS service

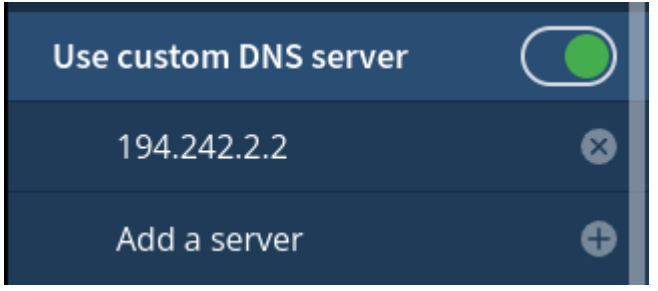
Firefox

1. In a Firefox browser window, click the **menu button** and choose **Options** or **Preferences**.
2. In the search box, type "**network**", then click on the **Settings** button in the results.
3. At the bottom, check the box next to **Enable DNS over HTTPS**.
4. Next to **Use Provider**, choose **Custom**.
5. In the text box that appears, enter `https://doh.mullvad.net/dns-query` or `https://adblock.doh.mullvad.net/dns-query`



6. Click OK.
7. In the address bar of the browser, type in `about:config` and hit Enter.
8. If a warning pops up, click "Accept the Risk and Continue".
9. In the search box, type `network.trr.mode`
10. Change the value to **3** and press **Enter**. (this will disable the unencrypted fallback).





DoT only uses port **853**, while DoH uses port **443**.

Without ad blocking

doh.mullvad.net has address 194.242.2.2
doh.mullvad.net has address 193.19.108.2
doh.mullvad.net has IPv6 address 2a07:e340::2

With ad blocking

adblock.doh.mullvad.net has address 194.242.2.3
adblock.doh.mullvad.net has address 193.19.108.3
adblock.doh.mullvad.net has IPv6 address 2a07:e340::3

Systemd – systemd-resolved

1. Open a Terminal.
2. Make sure that systemd-resolved is enabled by running this command:
   `sudo systemctl enable systemd-resolved`
3. Open the Settings app and go to Network. Click on the settings icon for your connected network. On the IPv4 and IPv6 tabs, turn off Automatic next to DNS, and leave the DNS field blank, then click on Apply. Disable and enable the network using the on/off button to make sure it takes effect.
4. Edit the following file with nano or your favorite text editor:
   `sudo nano /etc/systemd/resolved.conf`
   Add the following lines in the bottom under [Resolve]. Select a DNS option by removing the first # in front of the one you want to use:
   #DNS=194.242.2.2#dns.mullvad.net
   #DNS=194.242.2.3#adblock.dns.mullvad.net
   #DNS=194.242.2.4#base.dns.mullvad.net
   #DNS=194.242.2.5#extended.dns.mullvad.net
   #DNS=194.242.2.9#all.dns.mullvad.net
   DNSSEC=no
   DNSOverTLS=yes
   Domains=~.

Systemd – systemd-resolved cont

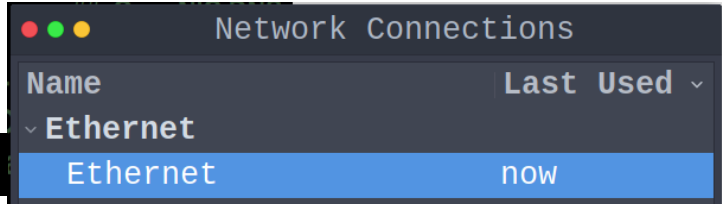
5. Save the file by pressing Ctrl + O and then Enter, and then Ctrl +X on your keyboard.
6. Create a symbolic link to the file using the following command in the Terminal:
   `sudo ln -sf /run/systemd/resolve/stub-resolv.conf /etc/resolv.conf`
7. Restart systemd-resolved by running this command:
   `sudo systemctl restart systemd-resolved`
8. Restart NetworkManager with this command:
   `sudo systemctl restart NetworkManager`
9. Verify the DNS settings with:
   `resolvectl status`

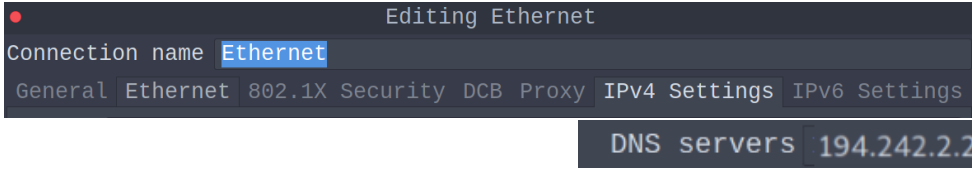
In case it doesn't work, change to this setting in/etc/systemd/resolved.conf:

DNSOverTLS=opportunistic

Mullvad DNS Servers

```
┌─[xe1phix@parrot]─[~]
└──╼ $nmcli connection edit Wired\ connection\ 1
nmcli> set ipv4.dns 194.242.2.2
nmcli> save
Connection '                ' (68cff872-a2c1-4c0d-8349-e30d5c5e3808) successfully updated.
└──╼ $nmcli -g ip4.dns connection show Ethernet
194.242.2.2
└──╼ $firejail --dns=194.242.2.2
```






```
┌─[xe1phix@parrot]─[~]
└──╼ $firejail --profile=/etc/firejail/firefox.profile --protocol=unix,inet,netlink,packet
--dns=10.8.0.1 --dns=194.242.2.2 /usr/bin/firefox
┌─[xe1phix@parrot]─[~]
└──╼ $firejail --dns.print=3985
Switching to pid 3988, the first child process inside the sandbox
nameserver 10.8.0.1
nameserver 194.242.2.2
┌─[xe1phix@parrot]─[~]
└──╼ $firejail --dns.print=3414
Switching to pid 3417, the first child process inside the sandbox
nameserver 10.64.0.1
nameserver 194.242.2.2
```

NetworkManager

```
└─# nmcli general status
STATE      CONNECTIVITY  WIFI-HW  WIFI     WWAN-HW  WWAN
connected  full          enabled  enabled  enabled  enabled
```

```
┌─[parrotsec-kiosk@parrot]─[~]
└─$ nmcli con show
NAME             UUID                                  TYPE      DEVICE
Ethernet         4c335b2b-2cd4-4078-a7c1-e2c6f018f07f  ethernet  eth0
mullvad_se_sto   37c91a90-e8fa-444e-9fc9-9ca680c87997  vpn       --
```

```
##-============================-##
##   [+] Bring The connection Down:
##-============================-##
nmcli con down "Wired connection 1"
```

```
└─# rfkill list
└─# rfkill block all
└─# rfkill unblock all
```

```
┌─[parrotsec-kiosk@parrot]─[~]
└─$ nmcli radio all off
```

```
iw reg set US
iwconfig wlan0 txpower 25
```

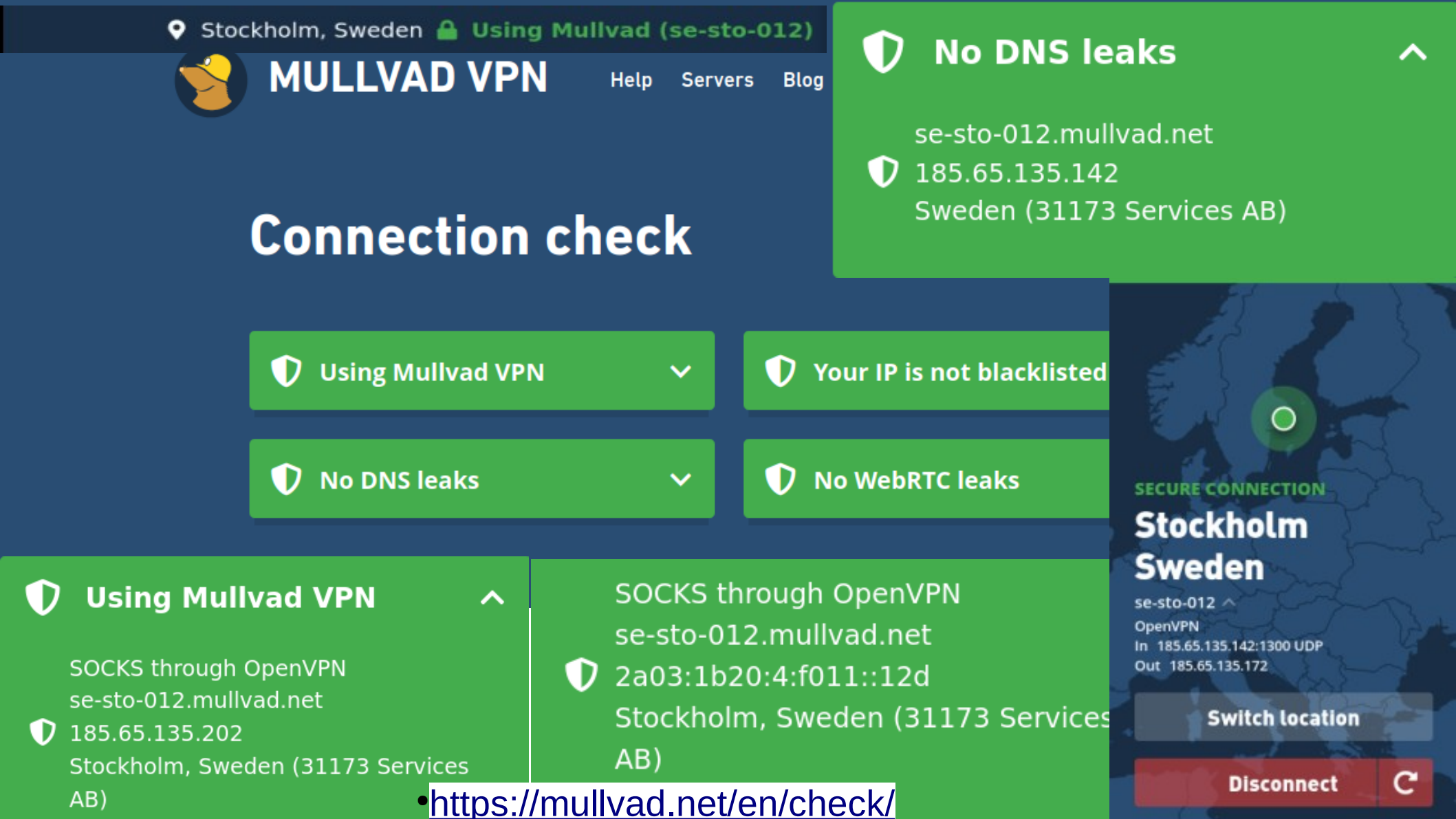
```
iw dev wlan0 station dump
iw dev wlan0 scan | less
iwlist wlan0 scanning | egrep "ESSID|Channel"
iwconfig wlan0 mode monitor channel 3
iw scan
```

```
nmcli> set ipv6.method ignore
nmcli> set 802-3-ethernet.wake-on-lan ignore
nmcli> set ipv6.never-default yes
nmcli> set connection.autoconnect no
nmcli> set ipv6.ignore-auto-dns yes
nmcli> set ipv6.dhcp-send-hostname no
nmcli> set ipv4.dns 194.242.2.2
nmcli> set ipv6.ignore-auto-routes yes
```

What are DNS leaks?

A DNS server is the first point of contact that your browser makes when you try to access information over the Internet. This is the case for every URL you visit, every file you download, and every image that loads on a website, including ads.

The DNS server therefore knows which pages you are visiting and which resources you are looking at, and as a result, you are constantly leaking information to your DNS server provider about your activity. Our DNS leaks guide has information on how to prevent this.



- https://mullvad.net/en/check/

```
└─ $curl https://am.i.mullvad.net/connected
You are connected to Mullvad (server se-mma-024). Your IP address is 141.98.255.154
```

FAQ | Port check | Torrent check | API

```
$ curl https://am.i.mullvad.net/connected
You are connected to Mullvad (server se-sto-012). Your IP address is 185.65.135.202
```

```
$ curl https://am.i.mullvad.net/ip
185.65.135.202
```

```
$ curl https://am.i.mullvad.net/city
Stockholm
```

```
$ curl https://am.i.mullvad.net/country
Sweden
```

- https://mullvad.net/en/check/

```
$ curl https://am.i.mullvad.net/json
{
  "ip": "[redacted]",
  "country": "Sweden",
  "city": null,
  "longitude": [redacted],
  "latitude": [redacted],
  "mullvad_exit_ip": true,
  "mullvad_exit_ip_hostname": "se2-wireguard",
  "mullvad_server_type": "SOCKS through WireGuard",
  "blacklisted": {
    "blacklisted": false,
    "results": [
      {
        "name": "Project Honeypot",
        "link": "https://www.projecthoneypot.org/about_us.php",
        "blacklisted": false
      },
      {
        "name": "Spamhaus",
        "link": "https://www.spamhaus.org/organization/",
        "blacklisted": false
```

DNS Leak Test

With insufficient configuration, it is possible that the browser's DNS requests will be sent to the ISP DNS server directly, and not sent through the VPN or Proxy. Thus, a malicious website will be able to find out the name of your real ISP, and the ISP will know your endpoint IP and which sites you visit.

DNS Leak Test shows which DNS servers your browser uses to resolve domain names. This test attempts to resolve 100 randomly generated domain names asynchronously, 50 with A record (IPv4-only) and 50 with both A and AAAA records (IPv4+IPv6).

Your IP Address :			
IP Address	185.65.135.191		
ISP	31173 Services AB		
Location	Sweden, Stockholm		
DNS Leak Test :			
Test Results	Found 2 Servers, 1 ISP, 1 Location		
Your DNS Servers	IP Address :	ISP :	Location :
	185.65.135.131	31173 Services AB	Sweden, Stockholm
	2a03:1b20:4:f011::1d	31173 Services AB	Sweden, Stockholm

My IP Address :

IP address	185.65.135.191
Hostname	n/a

IP Address Location :

Country	Sweden (SE)
State/Region	Stockholm County (AB)
City	Stockholm
ISP	31173 Services AB
ASN	39351
Timezone	Europe/Stockholm
Local Time	Wed, 30 Sep 2020 09:09:20 +0200
Latitude/Longitude	59.3287,18.0717

IPv6 Leak Test :

IPv6 Address	2a03:1b20:4:f011::1d more

WebRTC Leak Test :

Local IP address	n/a
Public IP address	n/a

Fetching Mullvad GPG Keys Using GPG And SKS Keyservers

```
└─ $gpg --keyserver pool.sks-keyservers.net --recv-keys A1198702FC3E0A09A9AE5B75D5A1D4F266DE8DDF
gpg: key D5A1D4F266DE8DDF: "Mullvad (code signing) <admin@mullvad.net>" not changed
gpg: Total number processed: 1
gpg:              unchanged: 1
└─ $gpg --keyid-format 0xlong --fingerprint 0xA1198702FC3E0A09A9AE5B75D5A1D4F266DE8DDF
pub   rsa4096/0xD5A1D4F266DE8DDF 2016-10-27 [SC]
      Key fingerprint = A119 8702 FC3E 0A09 A9AE  5B75 D5A1 D4F2 66DE 8DDF
uid                   [  full  ] Mullvad (code signing) <admin@mullvad.net>
sub   rsa4096/0xC187D22C089EF64E 2016-10-27 [E]
sub   rsa4096/0xA26581F219C8314C 2016-10-27 [S]
```

Xe1phix-GnuPG-[Mullvad]-Trust-Verified-Signatures.sh

https://mullvad.net/en/help/verifying-signatures/

Securely Fetching Mullvads GPG Signing Key Using Curl (TLS)

```
└─ #curl --verbose --progress-bar --ssl-reqd --url https://www.mullvad.net/static/mullvad
-code-signing.asc --output mullvad-code-signing.asc
*   Trying 45.83.220.101:443...
* TCP_NODELAY set
* Connected to www.mullvad.net (45.83.220.101) port 443 (#0)
* ALPN, offering h2
* ALPN, offering http/1.1
* successfully set certificate verify locations:
*   CAfile: /etc/ssl/certs/ca-certificates.crt
  CApath: /etc/ssl/certs
* SSL connection using TLSv1.2 / ECDHE-RSA-CHACHA20-POLY1305
* ALPN, server accepted to use h2
* Server certificate:
*  subject: CN=mullvad.net
*  start date: Sep 14 06:32:35 2020 GMT
*  expire date: Dec 13 06:32:35 2020 GMT
*  subjectAltName: host "www.mullvad.net" matched cert's "www.mullvad.net"
*  issuer: C=US; O=Let's Encrypt; CN=Let's Encrypt Authority X3
*  SSL certificate verify ok.
```

Verifying The Mullvad Binary

```
└──╼ $gpg --keyid-format 0xlong -v --verify MullvadVPN-2020.5_amd64.deb.asc Mul
lvadVPN-2020.5_amd64.deb
gpg: Signature made Thu 25 Jun 2020 03:42:23 AM CDT
gpg:                using RSA key CA83A46153BC58D69518ED49A26581F219C8314C
gpg: using subkey 0xA26581F219C8314C instead of primary key 0xD5A1D4F266DE8DDF
gpg: using subkey 0xA26581F219C8314C instead of primary key 0xD5A1D4F266DE8DDF
gpg: using pgp trust model
gpg: Good signature from "Mullvad (code signing) <admin@mullvad.net>" [full]
gpg: using subkey 0xA26581F219C8314C instead of primary key 0xD5A1D4F266DE8DDF
gpg: binary signature, digest algorithm SHA256, key algorithm rsa4096
```

Xe1phix-GnuPG-[Mullvad]-Trust-Verified-Signatures.sh

https://mullvad.net/en/help/verifying-signatures/

Mullvad – OpenVPN Details

Mullvad's OpenVPN servers

Our OpenVPN servers have the following characteristics:

- 4096 bit RSA certificates (with SHA512) are used for server authentication
- 4096 bit Diffie-Hellman parameters are used for key exchange
- DHE is utilized for perfect forward secrecy
- all available data channel ciphers on all ports are offered, including AES-256-GCM (default), AES-256-CBC, and BF-CBC
- re-keying is performed every 60 minutes.

https://mullvad.net/en/what-is-vpn/

OpenVPN In-depth Analysis

CVE-2019-14899

Published 2019-12-11T15:15:00

A vulnerability was discovered in Linux, FreeBSD, OpenBSD, MacOS, iOS, and Android that allows a malicious access point, or an adjacent user, to determine if a connected user is using a VPN, make positive inferences about the websites they are visiting, and determine the correct sequence and acknowledgement numbers in use, allowing the bad actor to inject data into the TCP stream. This provides everything that is needed for an attacker to hijack active connections inside the VPN tunnel.

The victim device connects to the access point, which for most of our testing was a laptop running create_ap. The victim device then establishes a connection with their VPN provider.

The access point can then determine the virtual IP of the victim by sending SYN-ACK packets to the victim device across the entire virtual IP space (the default for OpenVPN is 10.8.0.0/24). When a SYN-ACK is sent to the correct virtual IP on the victim device, the device responds with a RST; when the SYN-ACK is sent to the incorrect virtual IP, nothing is received by the attacker.

To quickly demonstrate this difference, we use the nping commands on the AP device running create_ap. The source IP is the gateway of our AP, the destination IP is the virtual IP assigned to the tun interface by the VPN client, ap0 is the interface create_ap created on the attacker device, and the destination MAC is the victim's wireless MAC

To mitigate CVE-2019-14899, Linux clients have two possible solutions:

- Enable strict reverse path filtering:

```
sysctl net.ipv4.conf.all.rp_filter=1
```

- Employ IPTables:

```
iptables -t raw \! -i tun0 -d 10.0.0.0/8 -j DROP
```

[CVE-2019-14899]

> OpenVPNs uses TLS control channels.
  Which are signed, and every packet on the
  control channel is authenticated
  using SHA256 HMAC signatures.
  and a unique ID for replay protection.

> The Server and Client certificates
  are hashed using SHA256 fingerprints.

> OpenVPN Servers Require the clients certificate
  is signed using a key based on RFC3280 TLS rules.

> After OpenVPN negotiates a TLS session, a new set
  of keys for protecting the tunnel data channel
  is generated and exchanged over the TLS session.

> TUN/TAP virtual network interface is created
> Which facilitates virtual point-to-point IP connection.
  Once either side of the tunnel hits the 20s TTL
  without any pings, the connection is terminated.

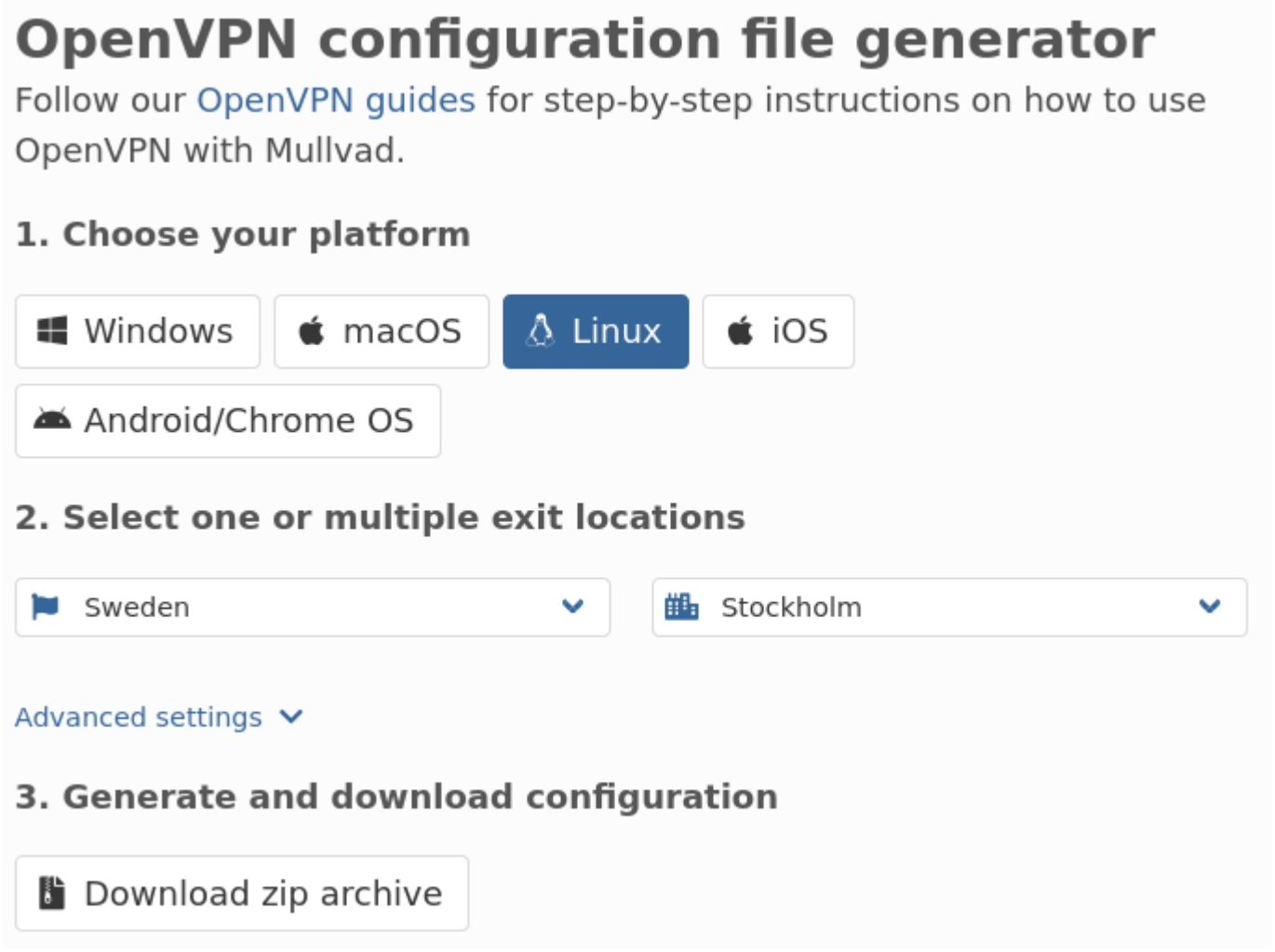
> A TUN/TAP virtual network interface is created
> Which facilitates virtual point-to-point IP connection.
> Once either side of the tunnel hits the 20s TTL
  without any pings, the connection is terminated

> subjectAltName and issuerAltName X.509 extensions are supported.

OpenVPN – Connection Types

- **Point to Point :** the most commonly used VPN. PPTP VPNs are used by remote users to connect them to the VPN network using their existing internet connection. This is a useful VPN for both business users and home users.
- **Site to Site :** is mostly used in corporate based operations. The fact that many companies have offices located both nationally and internationally, a Site-to-Site VPN is used to connect the network of the main office location to multiple offices. This is also known as an Intranet based VPN.

Note: It is generally a bad idea to use TCP for VPN connections, unless your connection to the server is very stable. High reliability sounds great in theory but any disruption (packet drop, lag spikes, etc...) to the connection will potentially snowball into a $TCPMeltdown.



- https://mullvad.net/en/account/#/openvpn-config/

Mullvad – DNS Server + OpenVPN And WireGuard SOCKS Proxy Servers

```
## ------------------------------------------------------------------------------------------ ##
##     [+]  OpenVPN SOCKS5  ( OpenVPN Virtual Tunnel Interface )
## ------------------------------------------------------------------------------------------ ##
OpenVPN SOCKS5 Host Address: 10.8.0.1
OpenVPN SOCKS5 Port Address: 1080



## ------------------------------------------------------------------------------------------ ##
##     [+]  WireGuard SOCKS5 ( WireGuard Virtual Tunnel Interface )
## ------------------------------------------------------------------------------------------ ##
WireGuard SOCKS5 Host Address:  10.64.0.1
WireGuard SOCKS5 Port Address:  1080
```

- https://mullvad.net/en/help/socks5-proxy/

Mullvad – Copying Certificates

Copy the following files to **/etc/openvpn/** (use `sudo`):

- mullvad_ca.crt
- mullvad_xx.conf
- mullvad_userpass.txt

```
#cp -v mullvad_ca.crt /etc/openvpn/ && cp -v mullvad_se_sto.conf /etc/openvpn/ &&
 cp -v mullvad_userpass.txt /etc/openvpn/ && cp -v update-resolv-conf /etc/openvpn/
'mullvad_ca.crt' -> '/etc/openvpn/mullvad_ca.crt'
'mullvad_se_sto.conf' -> '/etc/openvpn/mullvad_se_sto.conf'
'mullvad_userpass.txt' -> '/etc/openvpn/mullvad_userpass.txt'
'update-resolv-conf' -> '/etc/openvpn/update-resolv-conf'
```

- https://mullvad.net/en/help/linux-openvpn-installation/
- https://mullvad.net/en/account/#/openvpn-config/

Mullvad – Immutable Bits:

```
echo "##-==========================================-##"
echo "##    [+] Turn on The Immutable Bit For The VPN Keys & Certs:          "
echo "##-==========================================-##"
chattr +i /etc/openvpn/mullvad_ca.crt
chmod -v 0644 mullvad_ca.crt
chown -v root mullvad_ca.crt
chattr +i /etc/openvpn/mullvad_crl.pem
chmod -v 0644 mullvad_crl.pem
chmod ug+r mullvad_userpass.txt
chown -v root mullvad_userpass.txt
```

```
┌─[root@parrot]─[/]
└──╼ #lsattr -l /etc/openvpn/mullvad_ca.crt
/etc/openvpn/mullvad_ca.crt  Immutable
┌─[root@parrot]─[/]
└──╼ #chattr +i /etc/openvpn/mullvad_se_sto.conf
┌─[root@parrot]─[/]
└──╼ #lsattr -l /etc/openvpn/mullvad_se_sto.conf
/etc/openvpn/mullvad_se_sto.conf Immutable
┌─[root@parrot]─[/]
└──╼ #chattr +i /etc/openvpn/mullvad_userpass.txt
┌─[root@parrot]─[/]
└──╼ #lsattr -l /etc/openvpn/mullvad_userpass.txt
/etc/openvpn/mullvad_userpass.txt Immutable
```

Loading The Virtual TUN/TAP Interface

```
┌─[✗]─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #modprobe --verbose tun
insmod /lib/modules/5.8.0-2parrot1-amd64/kernel/drivers/net/tun.ko
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #modinfo tun
filename:       /lib/modules/5.8.0-2parrot1-amd64/kernel/drivers/net/tun
description:    Universal TUN/TAP device driver
```

```
┌─[✗]─[root@parrot]─[/etc/openvpn]
└──╼ #sudo /usr/sbin/openvpn --mktun --dev tun0
2021-07-07 18:56:06 TUN/TAP device tun0 opened
2021-07-07 18:56:06 Persist state set to: ON
```

Loading The OpenVPN Config

```
└──╼ $sudo openvpn --config /etc/openvpn/mullvad_se_sto.conf
Wed Sep 30 10:17:01 2020 VERIFY OK: depth=2, C=SE, ST=Gotaland, L=Gothenburg, O=Amagicom AB
, OU=Mullvad, CN=Mullvad Root CA v2, emailAddress=security@mullvad.net
Wed Sep 30 10:17:01 2020 VERIFY OK: depth=1, C=SE, ST=Gotaland, O=Amagicom AB, OU=Mullvad,
CN=Mullvad Intermediate CA v3, emailAddress=security@mullvad.net
Wed Sep 30 10:17:01 2020 VERIFY KU OK
Wed Sep 30 10:17:01 2020 Validating certificate extended key usage
Wed Sep 30 10:17:01 2020 ++ Certificate has EKU (str) TLS Web Server Authentication, expect
s TLS Web Server Authentication
Wed Sep 30 10:17:01 2020 VERIFY EKU OK
Wed Sep 30 10:17:01 2020 VERIFY OK: depth=0, C=SE, ST=Gotaland, O=Amagicom AB, OU=Mullvad,
CN=se-sto-007.mullvad.net, emailAddress=security@mullvad.net
Wed Sep 30 10:17:01 2020 WARNING: 'link-mtu' is used inconsistently, local='link-mtu 1557',
 remote='link-mtu 1558'
Wed Sep 30 10:17:01 2020 WARNING: 'comp-lzo' is present in remote config but missing in loc
al config, remote='comp-lzo'
Wed Sep 30 10:17:01 2020 Control Channel: TLSv1.3, cipher TLSv1.3 TLS_CHACHA20_POLY1305_SHA
256, 4096 bit RSA
Wed Sep 30 10:17:01 2020 [se-sto-007.mullvad.net] Peer Connection Initiated with [AF_INET]1
85.65.135.137:1194
Wed Sep 30 10:17:02 2020 SENT CONTROL [se-sto-007.mullvad.net]: 'PUSH_REQUEST' (status=1)
```

OpenVPN – Restart After Suspend

/etc/systemd/system/openvpn-reconnect.service

```
[Unit]
Description=Restart OpenVPN after suspend

[Service]
ExecStart=/usr/bin/pkill --signal SIGHUP --exact openvpn

[Install]
WantedBy=sleep.target
```

OpenVPN-Reconnect.service

Route configuration fails with systemd-networkd

When using **systemd-networkd** to manage network connections and attempting to tunnel all outgoing traffic through the VPN, OpenVPN may fail to add routes. This is a result of systemd-networkd attempting to manage the tun interface before OpenVPN finishes configuring the routes. When this happens, the following message will appear in the OpenVPN log.

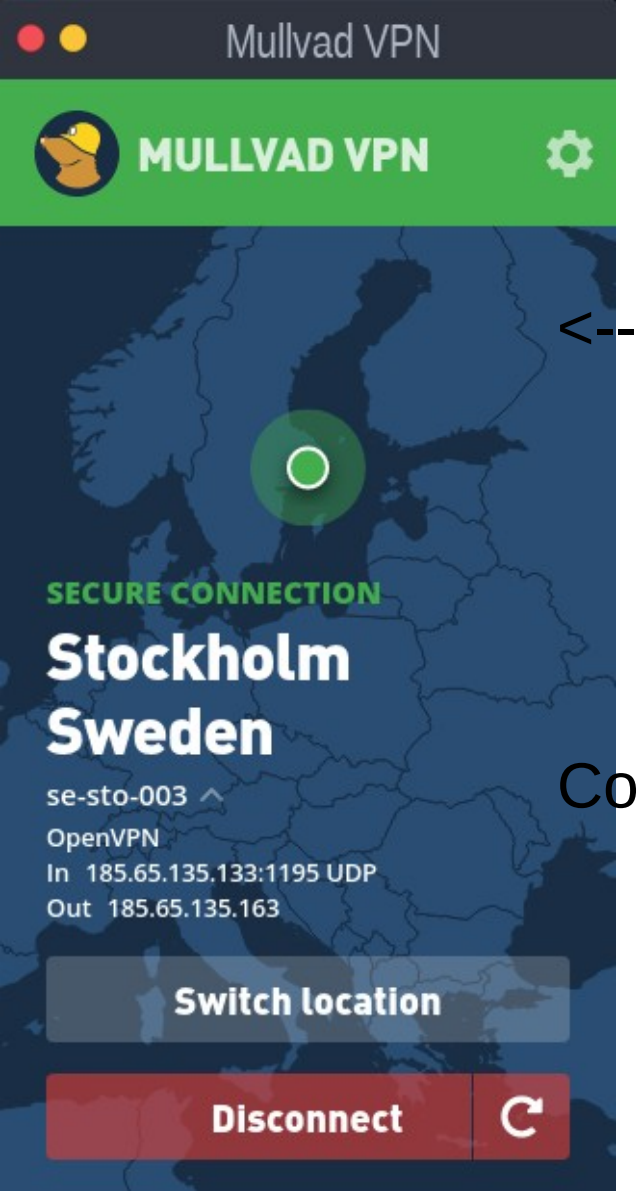
```
openvpn[458]: RTNETLINK answers: Network is unreachable
openvpn[458]: ERROR: Linux route add command failed: external program exited with error status: 2
```

With systemd-233 (currently in **testing**), systemd-networkd can be configured to ignore the tun connections and allow OpenVPN to manage them. To do this, create the following file:

/etc/systemd/network/90-tun-ignore.network

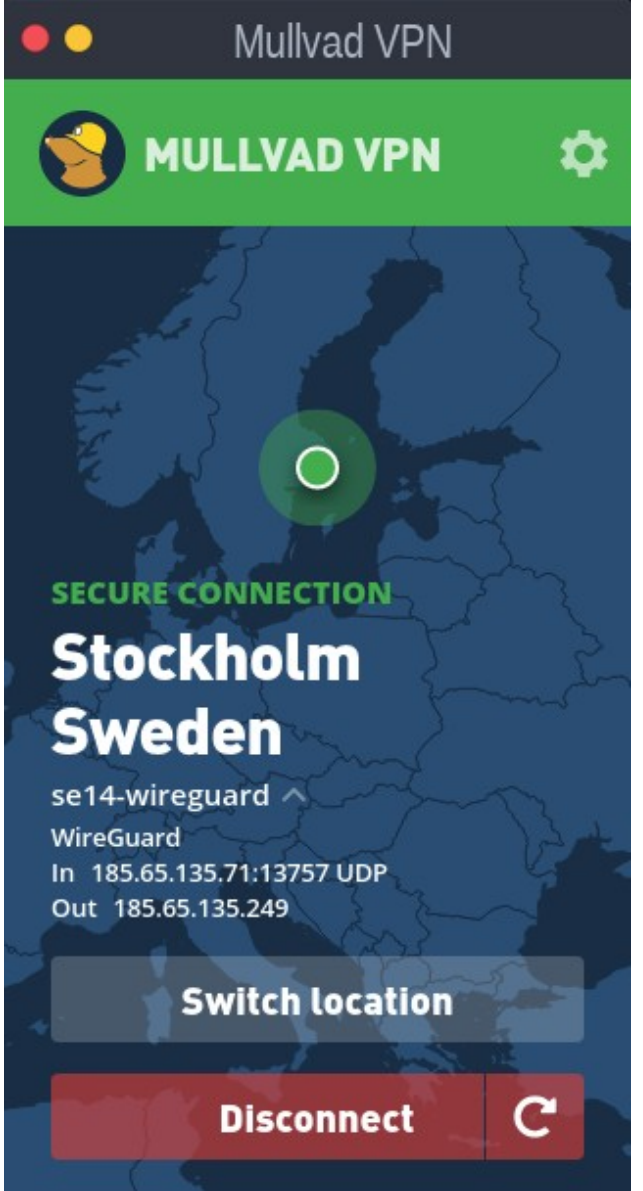
```
[Match]
Name=tun*

[Link]
Unmanaged=true
```

90-tun-ignore.network



<--Connected Via OpenVPN

Connected Via Wireguard-->



Mullvad - Configure Firefox

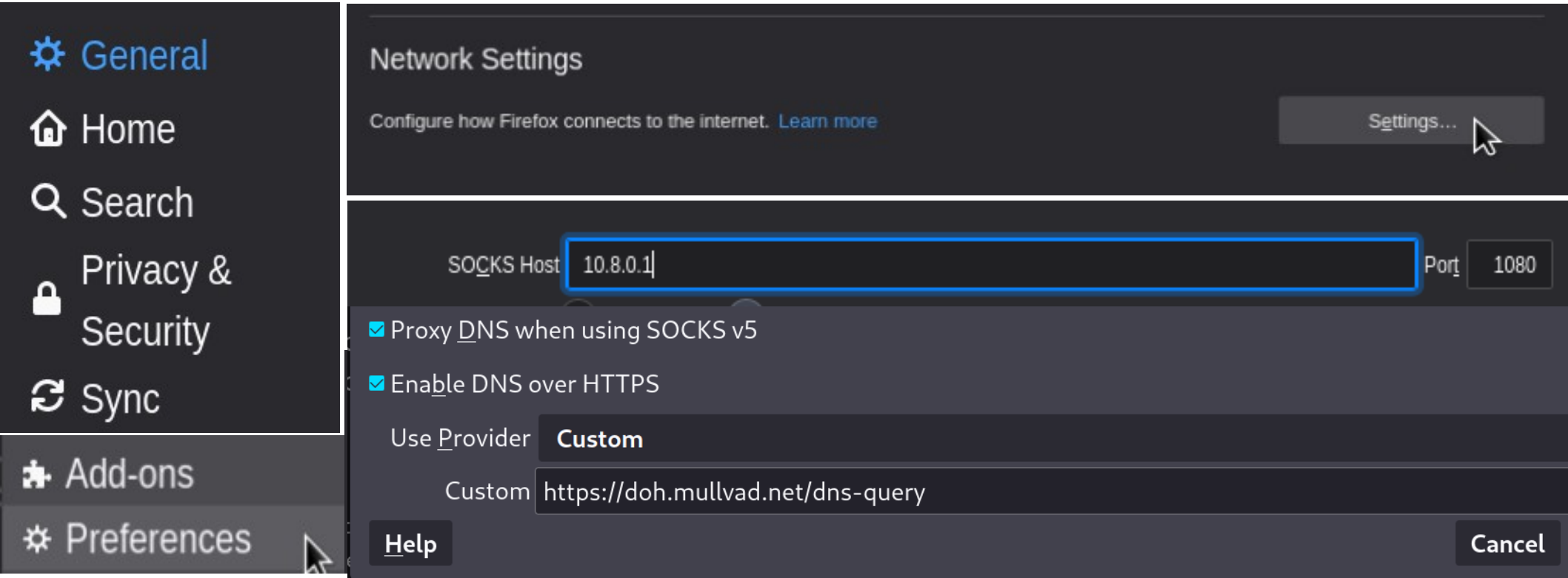
1. In the **Firefox menu**, click on **Edit** (on some operating systems, click Tools).
2. Click on **Preferences** (on some operating systems, click Options).
3. Scroll down to **Network Proxy**.
4. Click on **Settings**.
5. Select **Manual proxy configuration**.
6. Make sure **HTTP/SSL** and **FTP proxy** fields are **empty**.
7. In the **SOCKS Host:** field, enter **10.8.0.1** with port **1080**.
8. Click on **SOCKS v5** and enable **Remote DNS** or tick **Proxy DNS when using SOCKS v5**.
9. Click on **OK**.

https://mullvad.net/en/help/socks5-proxy/#get-started

Firefox users

You are at risk of leaking DNS requests to Cloudflare, no matter which Mullvad setup you have. To prevent this, open Firefox Options > General > Network settings > Settings, then **deselect** “Enable DNS over HTTPS.”

You can then visit am.i.mullvad.net to easily check whether or not you’re leaking information.



Mullvad – NetworkManager Setup

Click on the Network icon.

Click on **VPN-Connections** > **Configure VPN**.

Click on **Add**.

Select **Import a saved vpn configuration**.

Navigate to where you saved the downloaded file, select it and then click **open**.

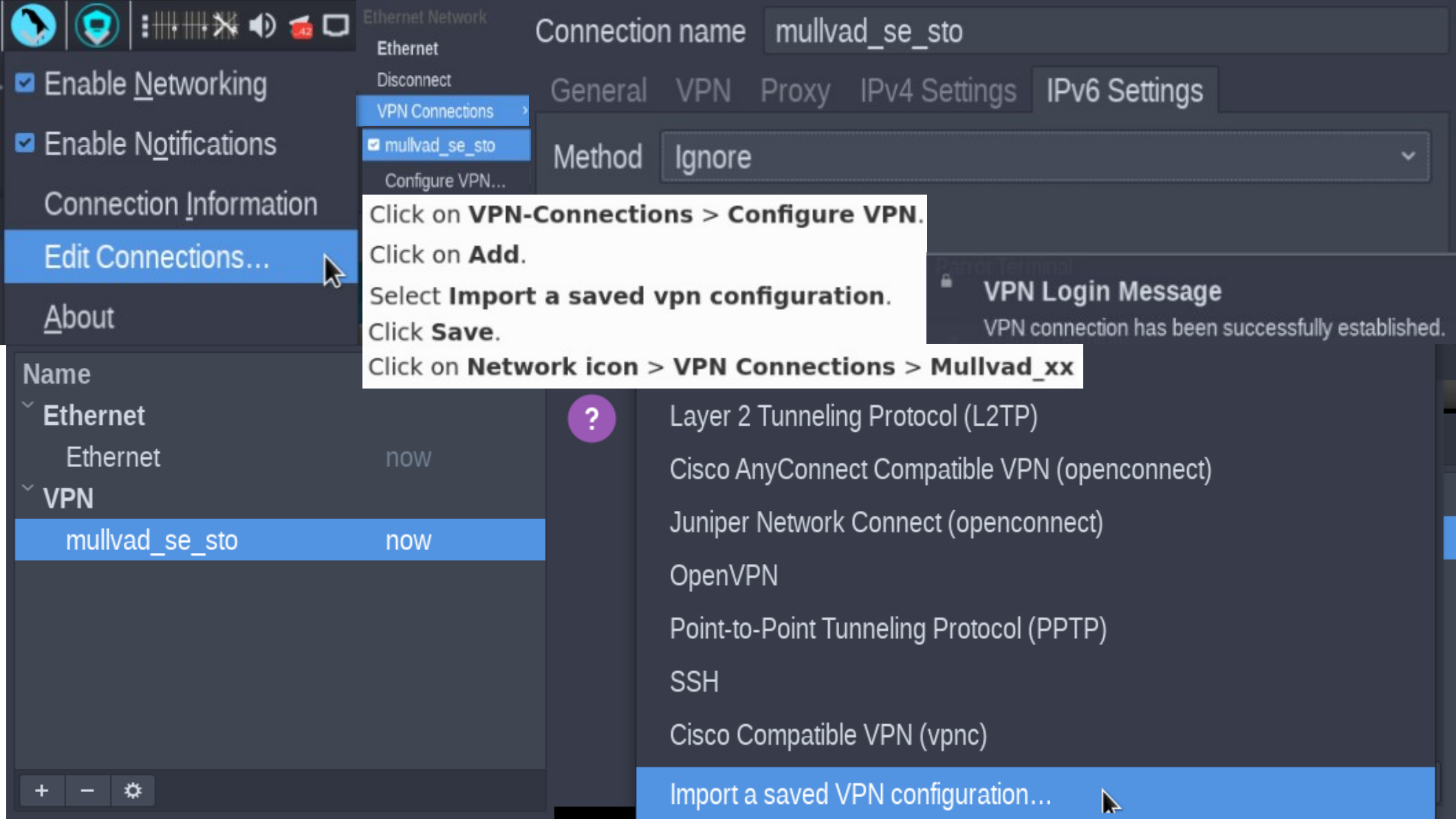
In the user name field, enter your Mullvad account number.

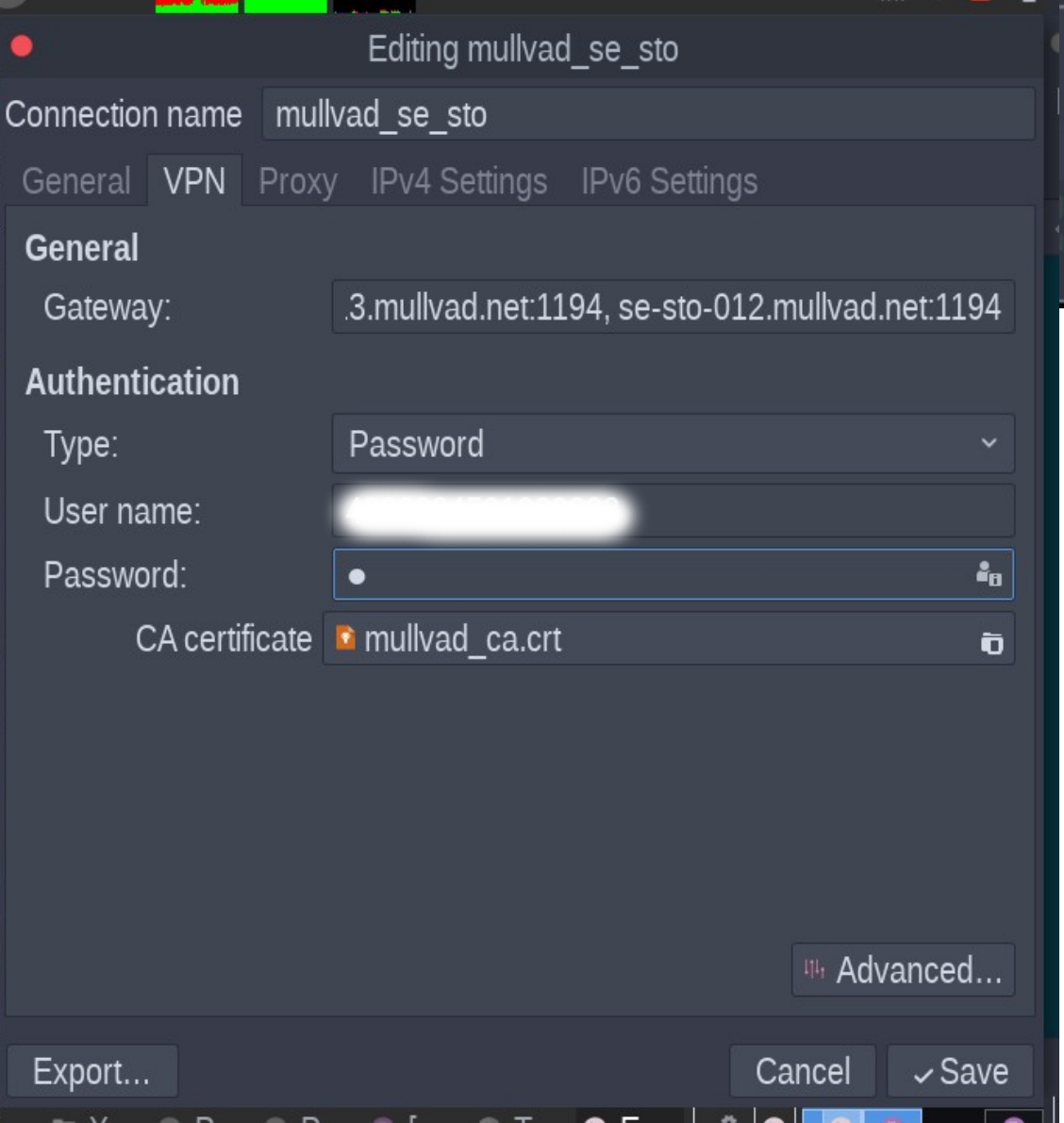
In the password field, enter "**m**".

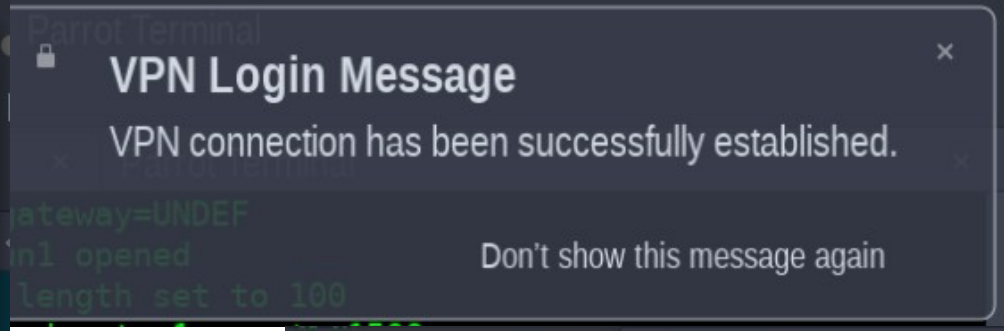
Click **Save**.

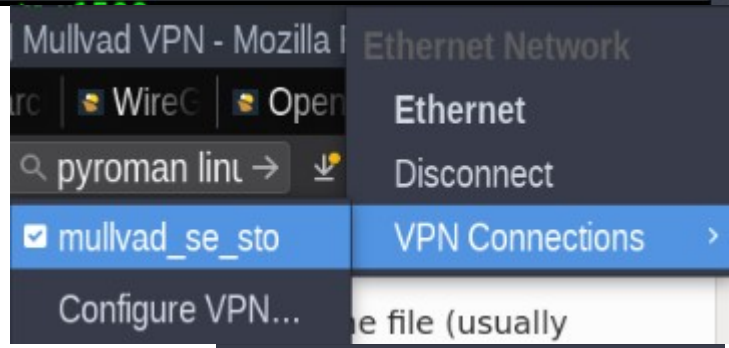
Click on **Network icon** > **VPN Connections** > **Mullvad_xx**

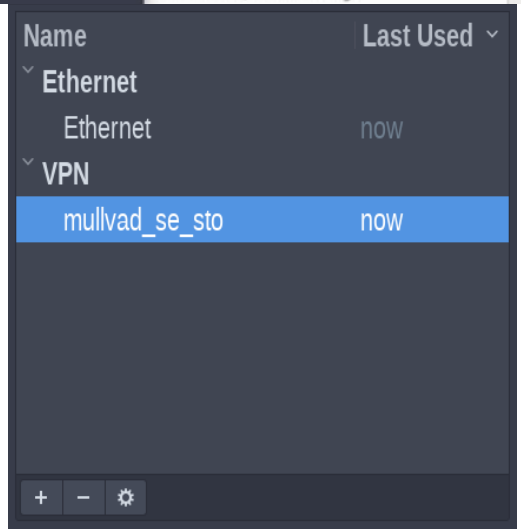
https://mullvad.net/en/help/linux-openvpn-installation/

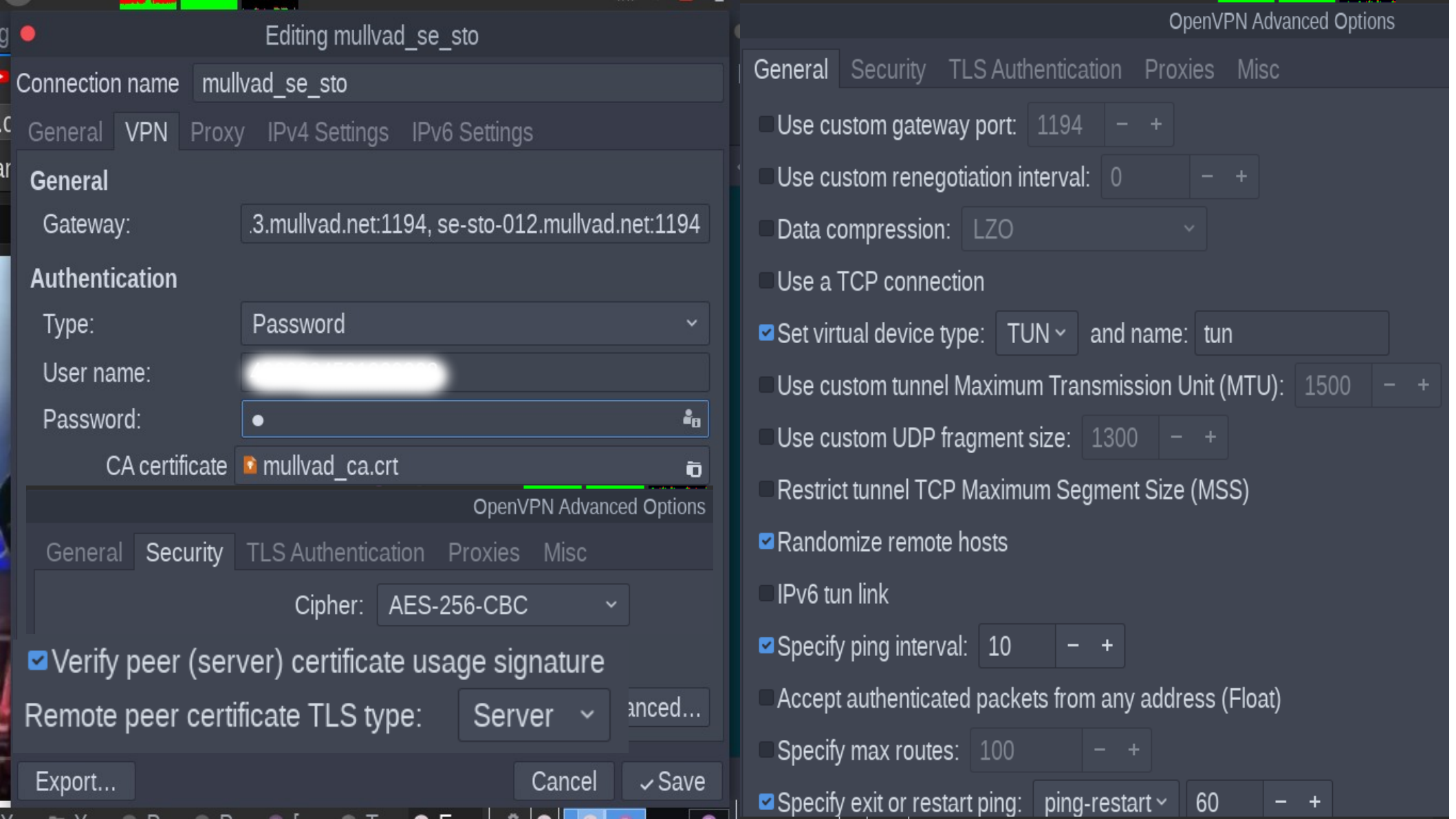

Enable Networking
Enable Notifications
Connection Information
Edit Connections...
About
Ethernet Network
Ethernet
Disconnect
VPN Connections
mullvad_se_sto
Configure VPN...
Connection name
mullvad_se_sto
General
VPN
Proxy
IPv4 Settings
IPv6 Settings
Method
Ignore
Click on VPN-Connections > Configure VPN.
Click on Add.
Select Import a saved vpn configuration.
Click Save.
Click on Network icon > VPN Connections > Mullvad_xx
VPN Login Message
VPN connection has been successfully established.
Name
Ethernet
Ethernet
now
VPN
mullvad_se_sto
now
Layer 2 Tunneling Protocol (L2TP)
Cisco AnyConnect Compatible VPN (openconnect)
Juniper Network Connect (openconnect)
OpenVPN
Point-to-Point Tunneling Protocol (PPTP)
SSH
Cisco Compatible VPN (vpnc)
Import a saved VPN configuration...


Editing mullvad_se_sto
Connection name
mullvad_se_sto
General
VPN
Proxy
IPv4 Settings
IPv6 Settings
General
Gateway:
.3.mullvad.net:1194, se-sto-012.mullvad.net:1194
Authentication
Type:
Password
User name:
Password:
CA certificate
mullvad_ca.crt
Advanced...
Export...
Cancel
Save


Parrot Terminal
VPN Login Message
VPN connection has been successfully established.
Don't show this message again


Mullvad VPN - Mozilla
WireG
Open
pyroman linu
mullvad_se_sto
Configure VPN...
Ethernet Network
Ethernet
Disconnect
VPN Connections
e file (usually


Name
Last Used
Ethernet
Ethernet
now
VPN
mullvad_se_sto
now

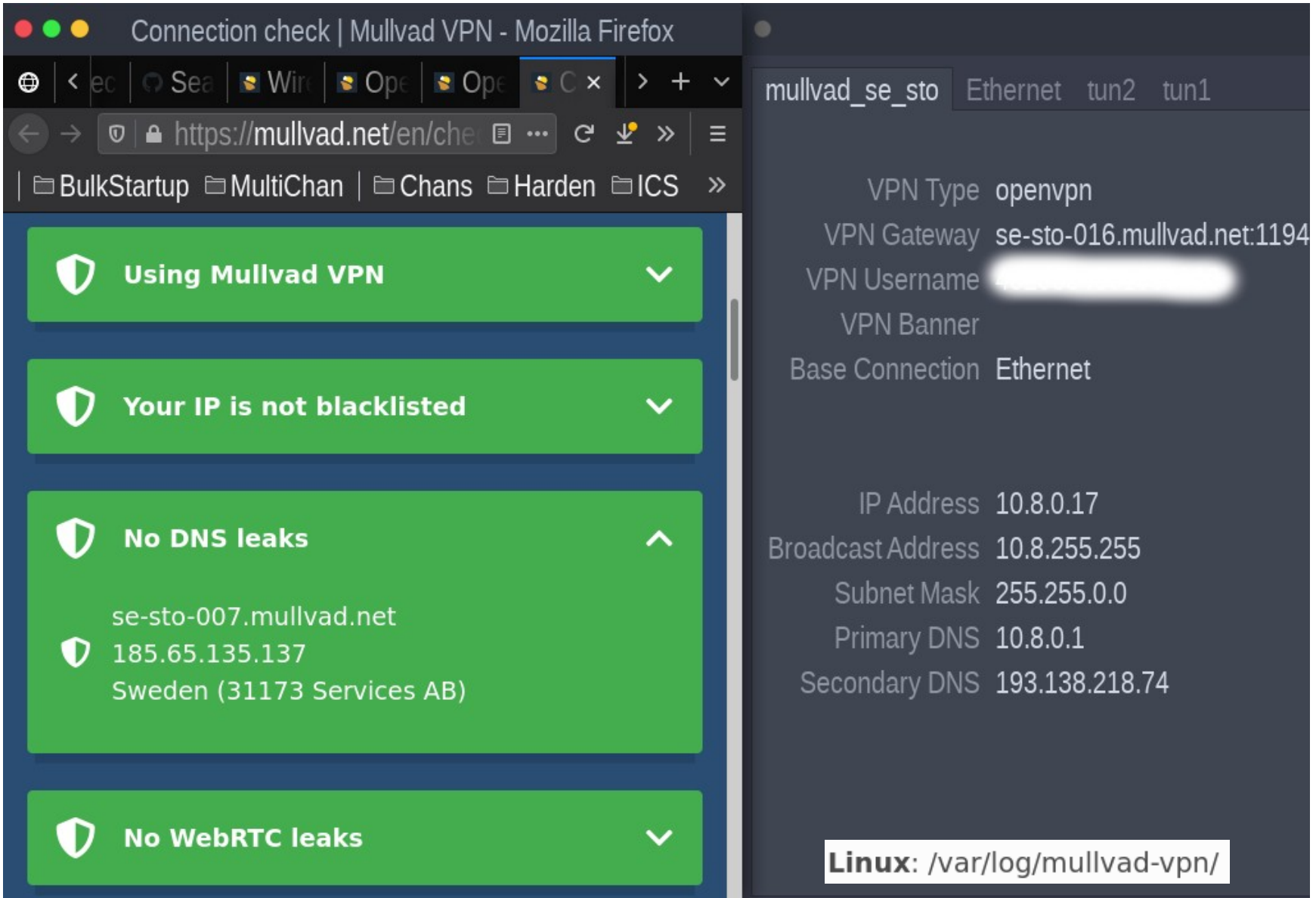

Editing mullvad_se_sto
Connection name
mullvad_se_sto
General
VPN
Proxy
IPv4 Settings
IPv6 Settings
General
Gateway:
.3.mullvad.net:1194, se-sto-012.mullvad.net:1194
Authentication
Type:
Password
User name:
Password:
CA certificate
mullvad_ca.crt
OpenVPN Advanced Options
General
Security
TLS Authentication
Proxies
Misc
Cipher:
AES-256-CBC
Verify peer (server) certificate usage signature
Remote peer certificate TLS type:
Server
anced...
Export...
Cancel
Save
OpenVPN Advanced Options
General
Security
TLS Authentication
Proxies
Misc
Use custom gateway port:
1194
Use custom renegotiation interval:
0
Data compression:
LZO
Use a TCP connection
Set virtual device type:
TUN
and name:
tun
Use custom tunnel Maximum Transmission Unit (MTU):
1500
Use custom UDP fragment size:
1300
Restrict tunnel TCP Maximum Segment Size (MSS)
Randomize remote hosts
IPv6 tun link
Specify ping interval:
10
Accept authenticated packets from any address (Float)
Specify max routes:
100
Specify exit or restart ping:
ping-restart
60

nmcli – Show Mullvad Connection

```
└──╼ #nmcli connection show mullvad_se_sto
connection.id:                          mullvad_se_sto
connection.uuid:                        37c91a90-e8fa-444e-9fc9-9ca680c87997
connection.stable-id:                   --
connection.type:                        vpn
connection.interface-name:              --
connection.autoconnect:                 no
connection.autoconnect-priority:        0
connection.autoconnect-retries:         -1 (default)
connection.multi-connect:               0 (default)
connection.auth-retries:                -1
connection.timestamp:                   1601480718
connection.read-only:                   no
connection.permissions:                 user:parrotsec-kiosk
```

nmcli – Examine VPN Connection

```
vpn.service-type:                       org.freedesktop.NetworkManager.openvpn
vpn.user-name:                          --
vpn.data:                               ca = /etc/openvpn/mullvad_ca.crt, cipher = AES-256-
vpn.secrets:                            <hidden>
vpn.persistent:                         no
vpn.timeout:                            0
proxy.method:                           none
proxy.browser-only:                     no
proxy.pac-url:                          --
proxy.pac-script:                       --
GENERAL.NAME:                           mullvad_se_sto
GENERAL.UUID:                           37c91a90-e8fa-444e-9fc9-9ca680c87997
GENERAL.DEVICES:                        eth0
GENERAL.IP-IFACE:                       eth0
```


Connection check | Mullvad VPN - Mozilla Firefox
https://mullvad.net/en/che
BulkStartup
MultiChan
Chans
Harden
ICS
Using Mullvad VPN
Your IP is not blacklisted
No DNS leaks
se-sto-007.mullvad.net
185.65.135.137
Sweden (31173 Services AB)
No WebRTC leaks
mullvad_se_sto
Ethernet
tun2
tun1
VPN Type openvpn
VPN Gateway se-sto-016.mullvad.net:1194
VPN Username
VPN Banner
Base Connection Ethernet
IP Address 10.8.0.17
Broadcast Address 10.8.255.255
Subnet Mask 255.255.0.0
Primary DNS 10.8.0.1
Secondary DNS 193.138.218.74
Linux: /var/log/mullvad-vpn/

Mullvad – Post Quantum Cryptography

In 2017, we used New Hope. Now we switched to one of the finalists in the NIST post-quantum cryptography competition instead. We will continue to follow the ongoing standardization, and we might support other algorithms in the future.

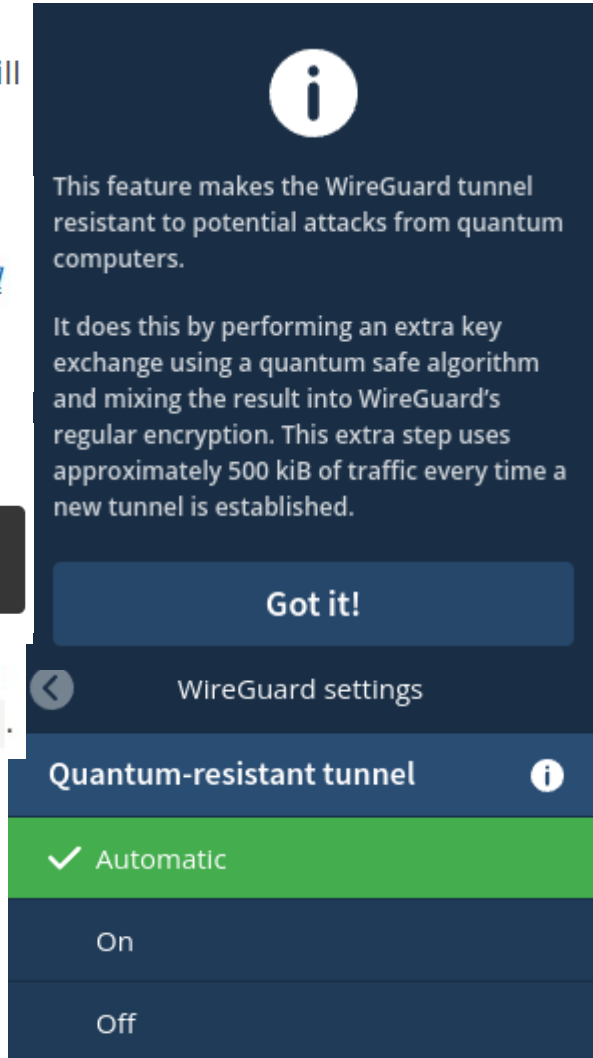
August 24, 2023 Comments Requested on Three Draft FIPS for Post-Quantum Cryptography

- Draft FIPS 203, *Module-Lattice-Based Key-Encapsulation Mechanism Standard*
- Draft FIPS 204, *Module-Lattice-Based Digital Signature Standard*
- Draft FIPS 205, *Stateless Hash-Based Digital Signature Standard*

If you want to try it out, fire up your terminal/console and run the following command:

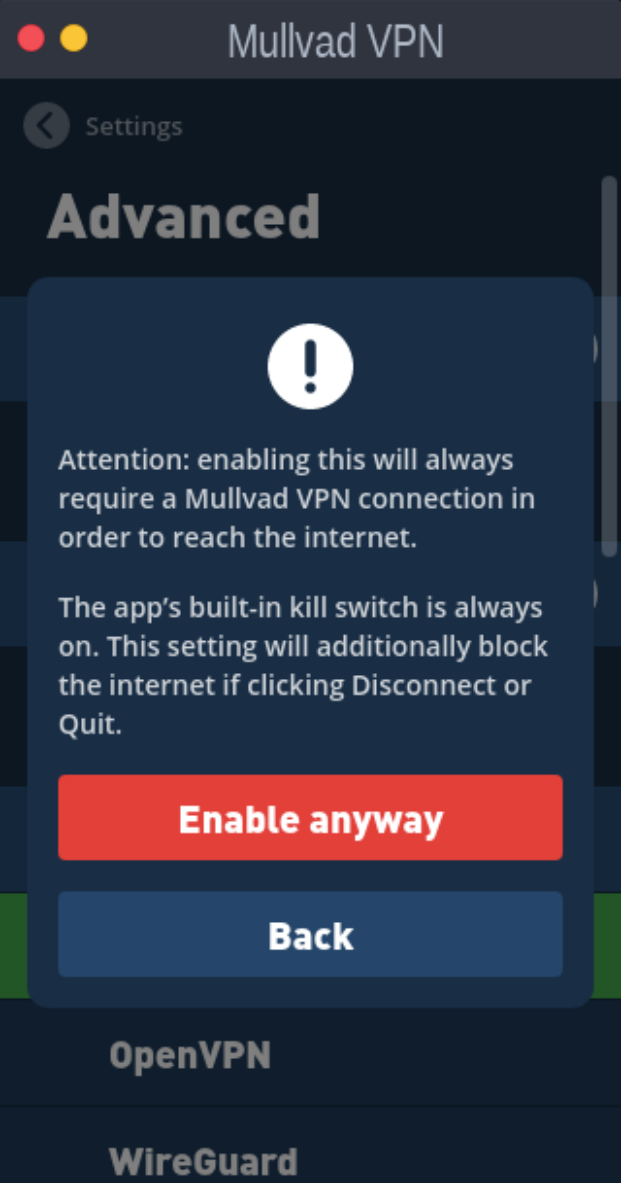
```
mullvad tunnel wireguard quantum-resistant-tunnel set on
```

To verify if it works you can check that the GUI now says “QUANTUM SECURE CONNECTION” in green. And the CLI command `mullvad status -v` should print `Quantum resistant tunnel: yes`.



https://csrc.nist.gov/projects/post-quantum-cryptography

Enable Mullvad KillSwitch

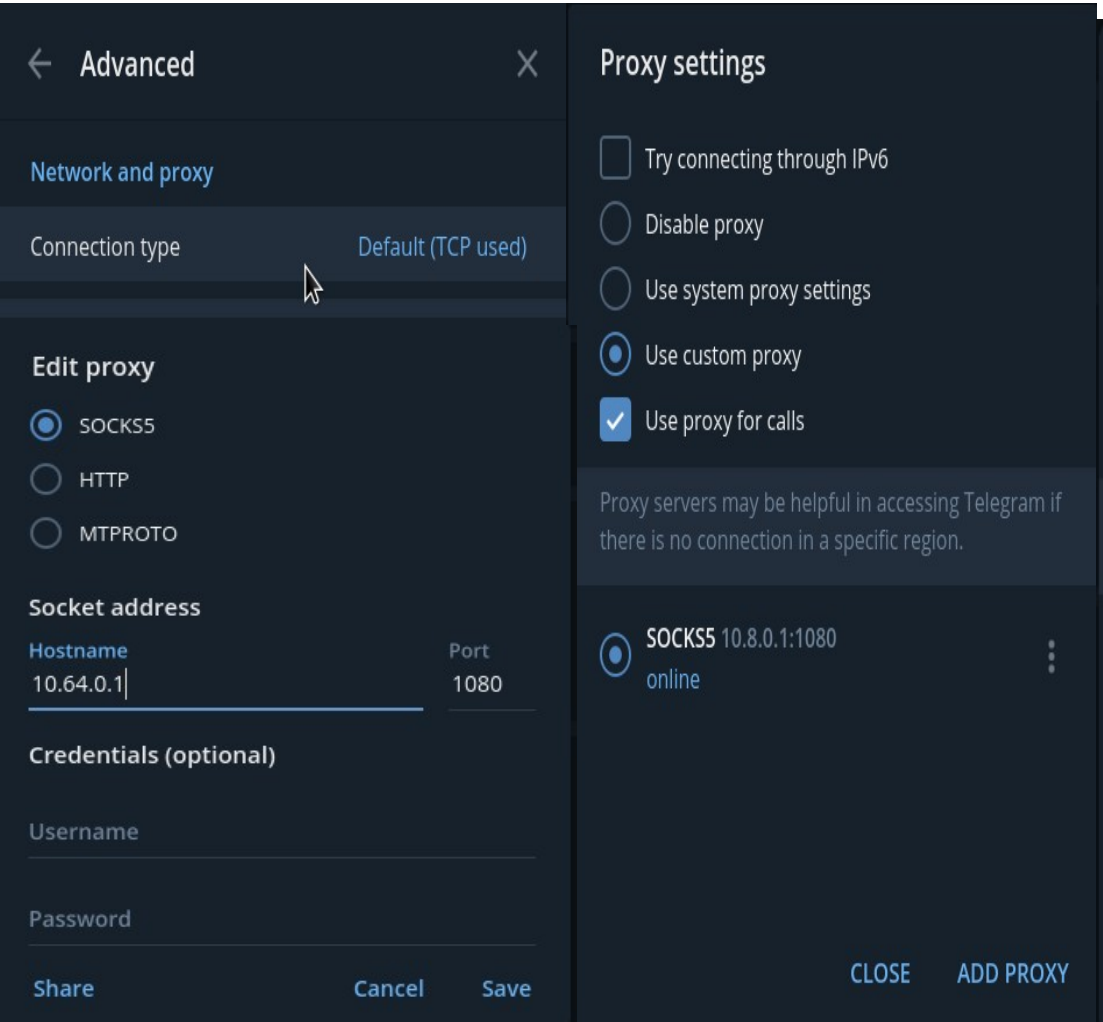


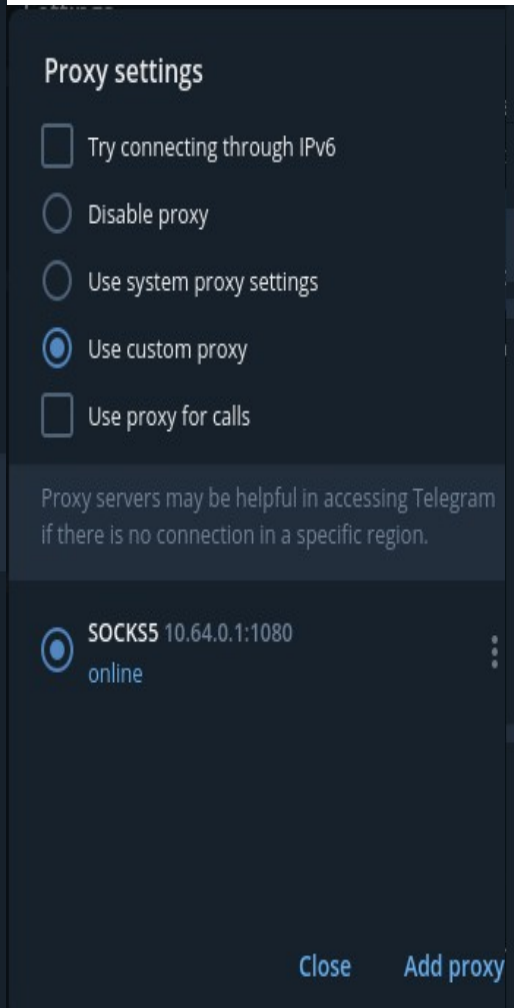
Enabling Kill Switch Via IPTables

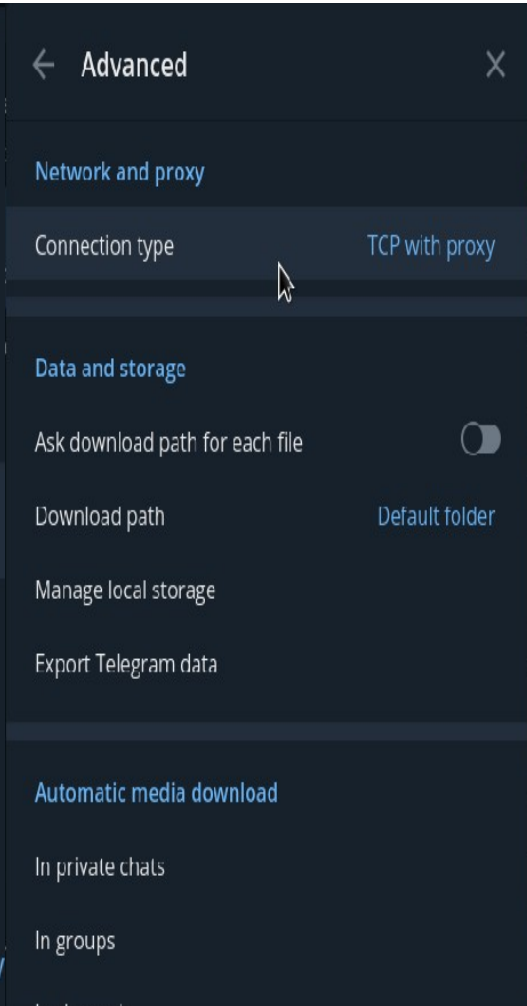
```
sudo iptables -P OUTPUT DROP
sudo iptables -A OUTPUT -o tun+ -j ACCEPT
sudo iptables -A INPUT -i lo -j ACCEPT
sudo iptables -A OUTPUT -o lo -j ACCEPT
sudo iptables -A OUTPUT -d 255.255.255.255 -j ACCEPT
sudo iptables -A INPUT -s 255.255.255.255 -j ACCEPT
sudo iptables -A OUTPUT -o eth+ -p udp -m multiport --dports 53,1300:1302,1194:1197 -d
141.98.255.0/24,193.138.218.0/24,45.83.220.0/24,185.213.152.0/24,185.213.154.0/24,185.65.135.0
/24,185.65.134.0/24 -j ACCEPT
sudo iptables -A OUTPUT -o eth+ -p tcp -m multiport --dports 53,443 -d
141.98.255.0/24,193.138.218.0/24,45.83.220.0/24,185.213.152.0/24,185.213.154.0/24,185.65.135.0
/24,185.65.134.0/24 -j ACCEPT
sudo iptables -A OUTPUT -o eth+ ! -d 193.138.218.74 -p tcp --dport 53 -j DROP
sudo ip6tables -P OUTPUT DROP
sudo ip6tables -A OUTPUT -o tun+ -j ACCEPT
```

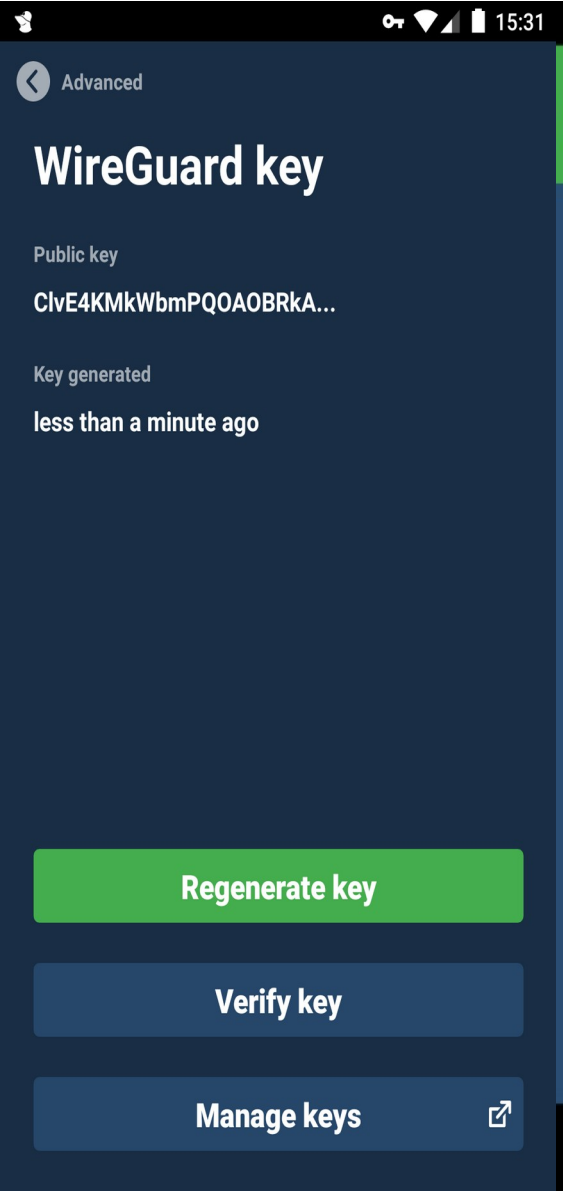
https://mullvad.net/en/help/linux-openvpn-installation/

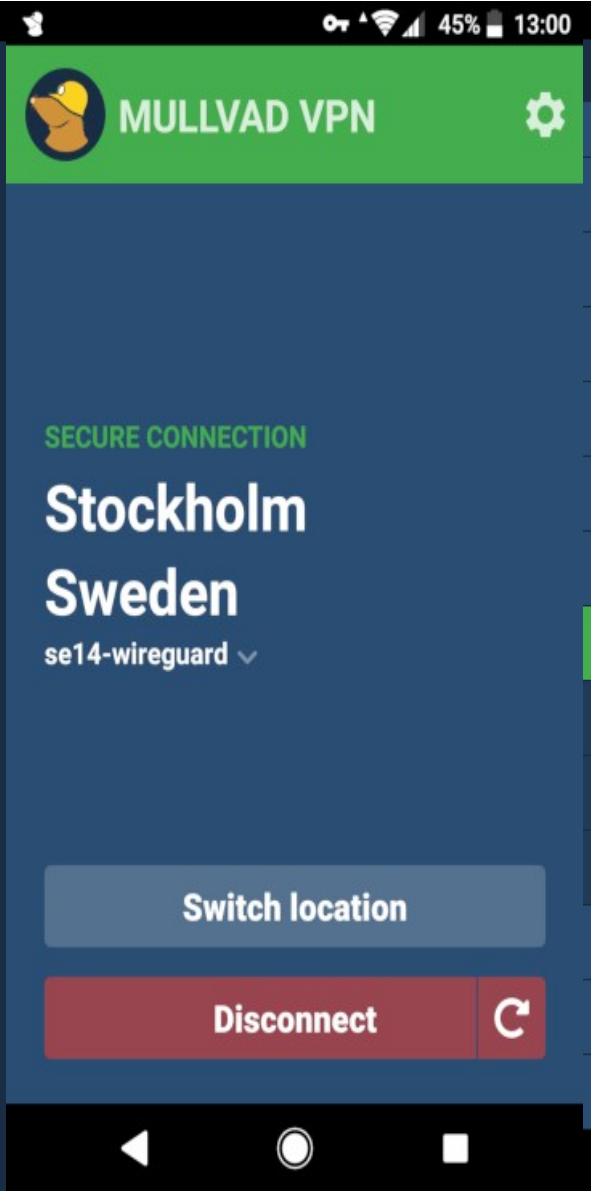
Mullvad – Telegram SOCKS5 Proxy

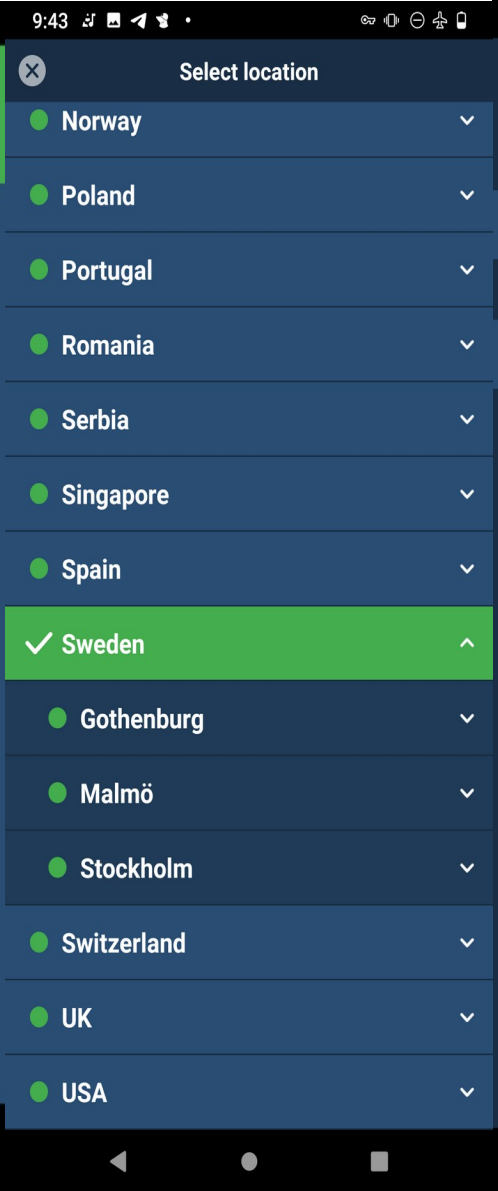


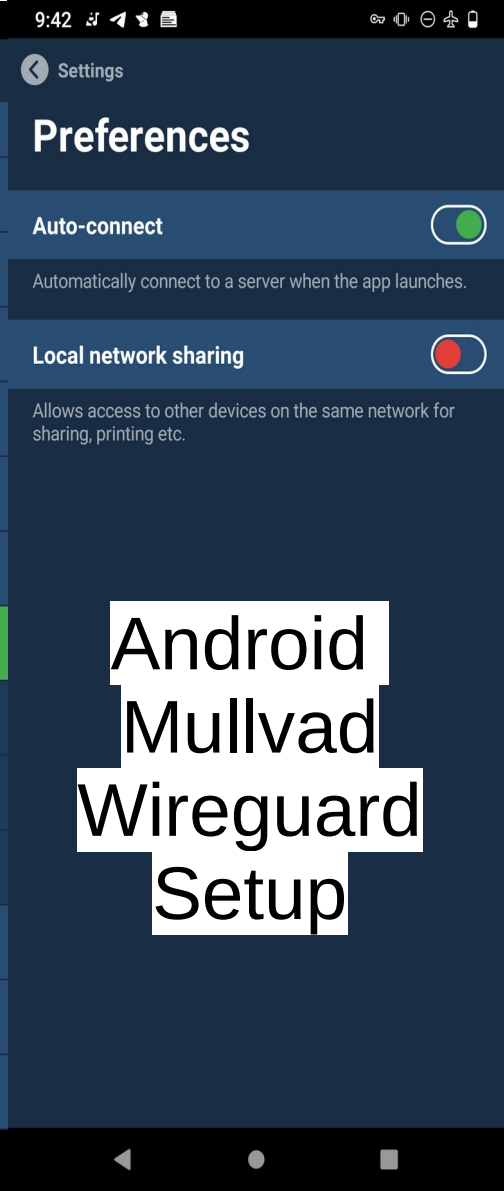


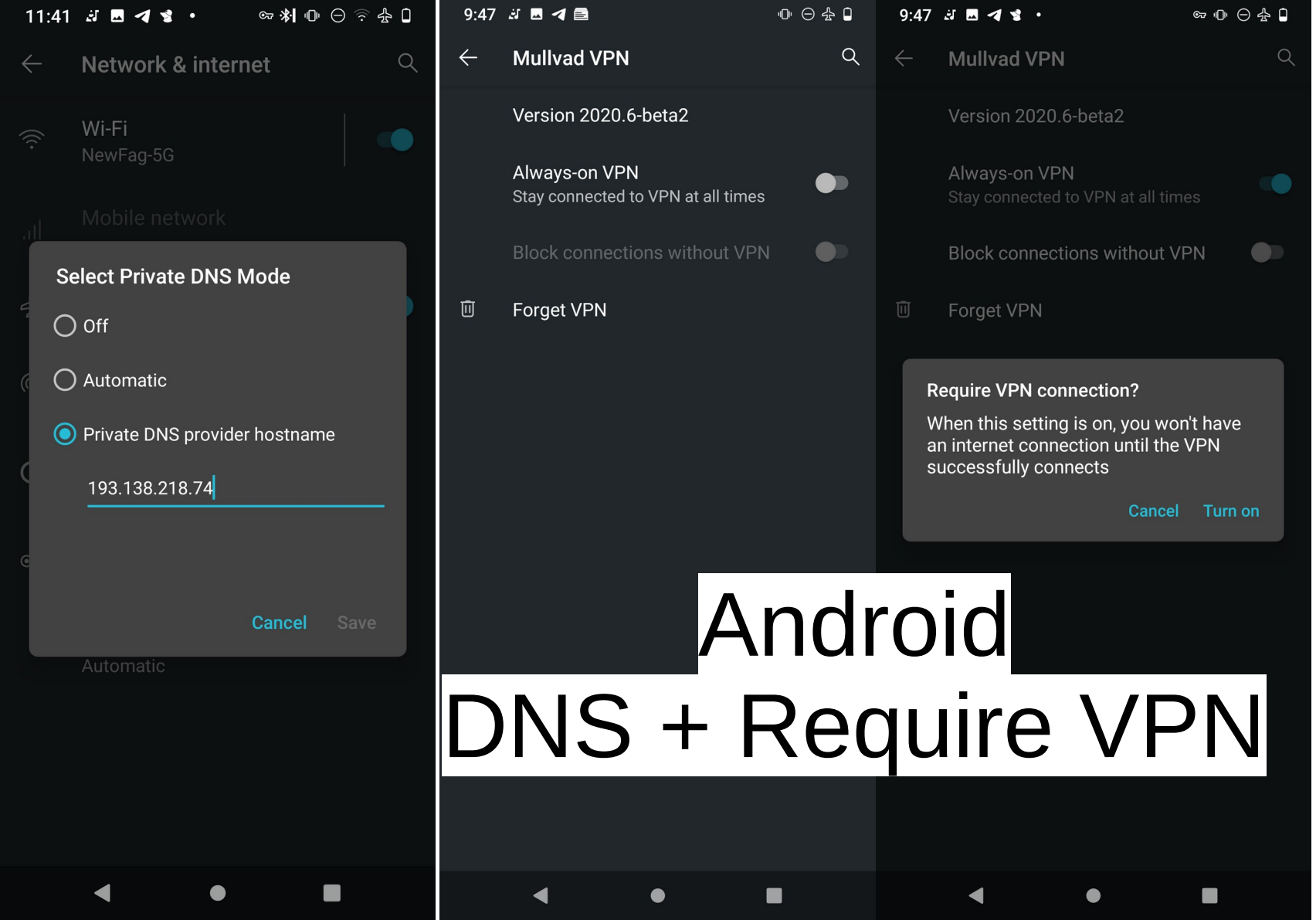


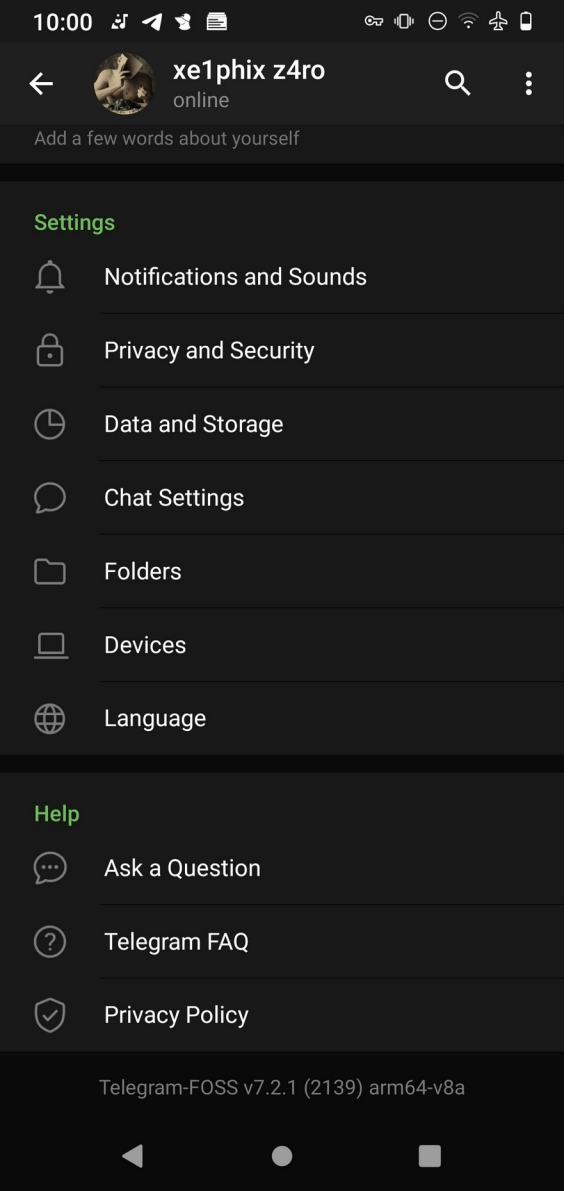

15:31
Advanced
WireGuard key
Public key
ClvE4KMkWbmPQOAOBRkA...
Key generated
less than a minute ago
Regenerate key
Verify key
Manage keys

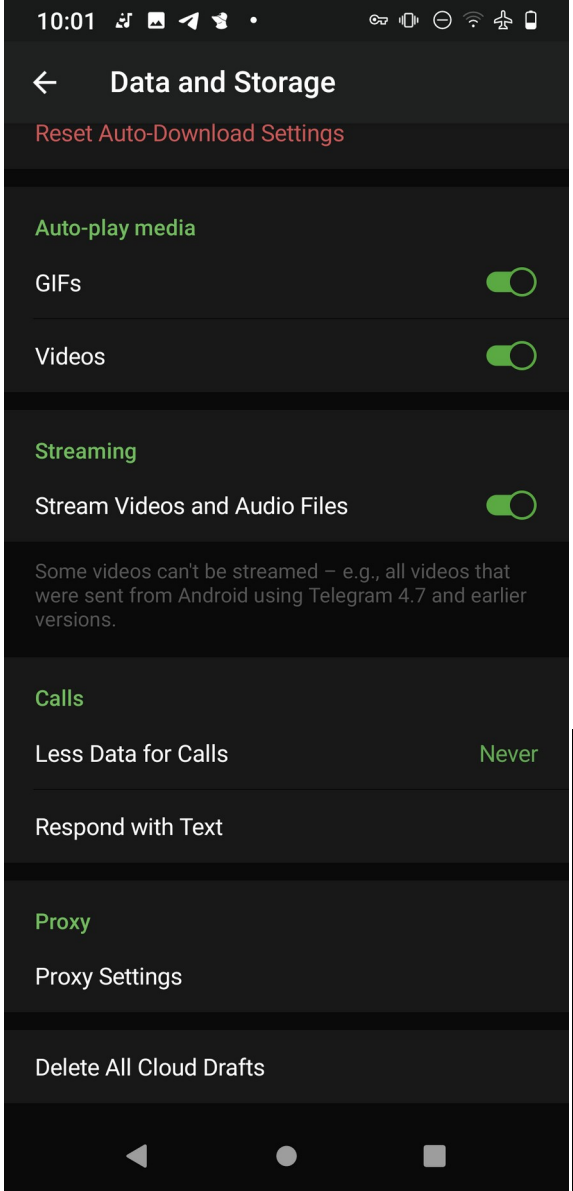

45% 13:00
MULLVAD VPN
SECURE CONNECTION
Stockholm
Sweden
se14-wireguard
Switch location
Disconnect

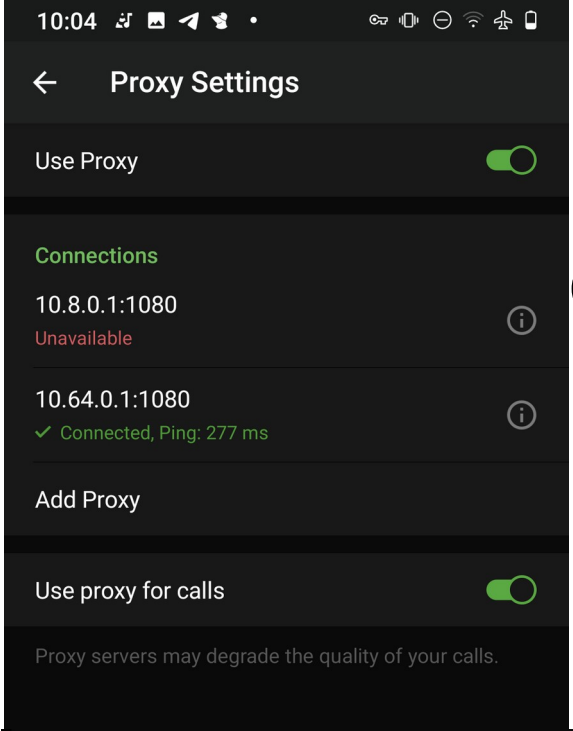

9:43
Select location
Norway
Poland
Portugal
Romania
Serbia
Singapore
Spain
Sweden
Gothenburg
Malmö
Stockholm
Switzerland
UK
USA


9:42
Settings
Preferences
Auto-connect
Automatically connect to a server when the app launches.
Local network sharing
Allows access to other devices on the same network for sharing, printing etc.
Android Mullvad Wireguard Setup

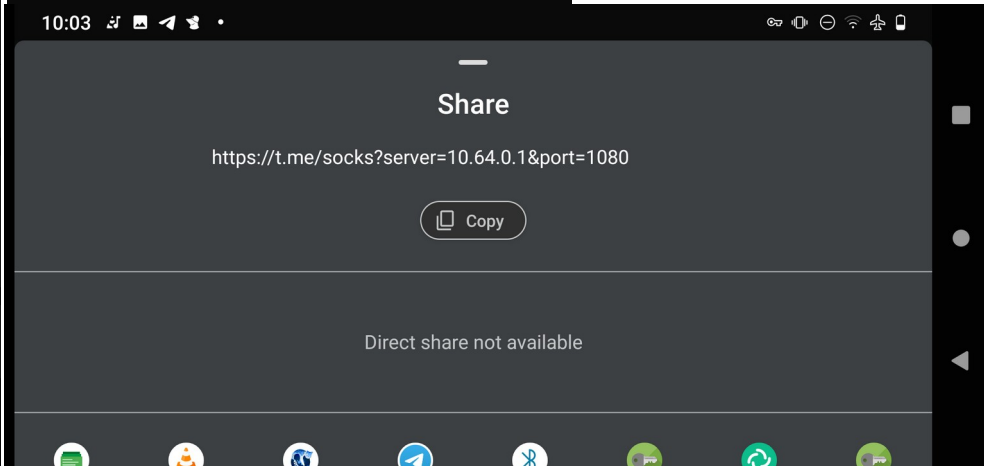

11:41
Network & internet
Wi-Fi
NewFag-5G
Mobile network
Select Private DNS Mode
Off
Automatic
Private DNS provider hostname
193.138.218.74
Cancel
Save
Automatic
9:47
Mullvad VPN
Version 2020.6-beta2
Always-on VPN
Stay connected to VPN at all times
Block connections without VPN
Forget VPN
9:47
Mullvad VPN
Version 2020.6-beta2
Always-on VPN
Stay connected to VPN at all times
Block connections without VPN
Forget VPN
Require VPN connection?
When this setting is on, you won't have an internet connection until the VPN successfully connects
Cancel
Turn on
Android
DNS + Require VPN







Android Wireguard Telegram Configuration

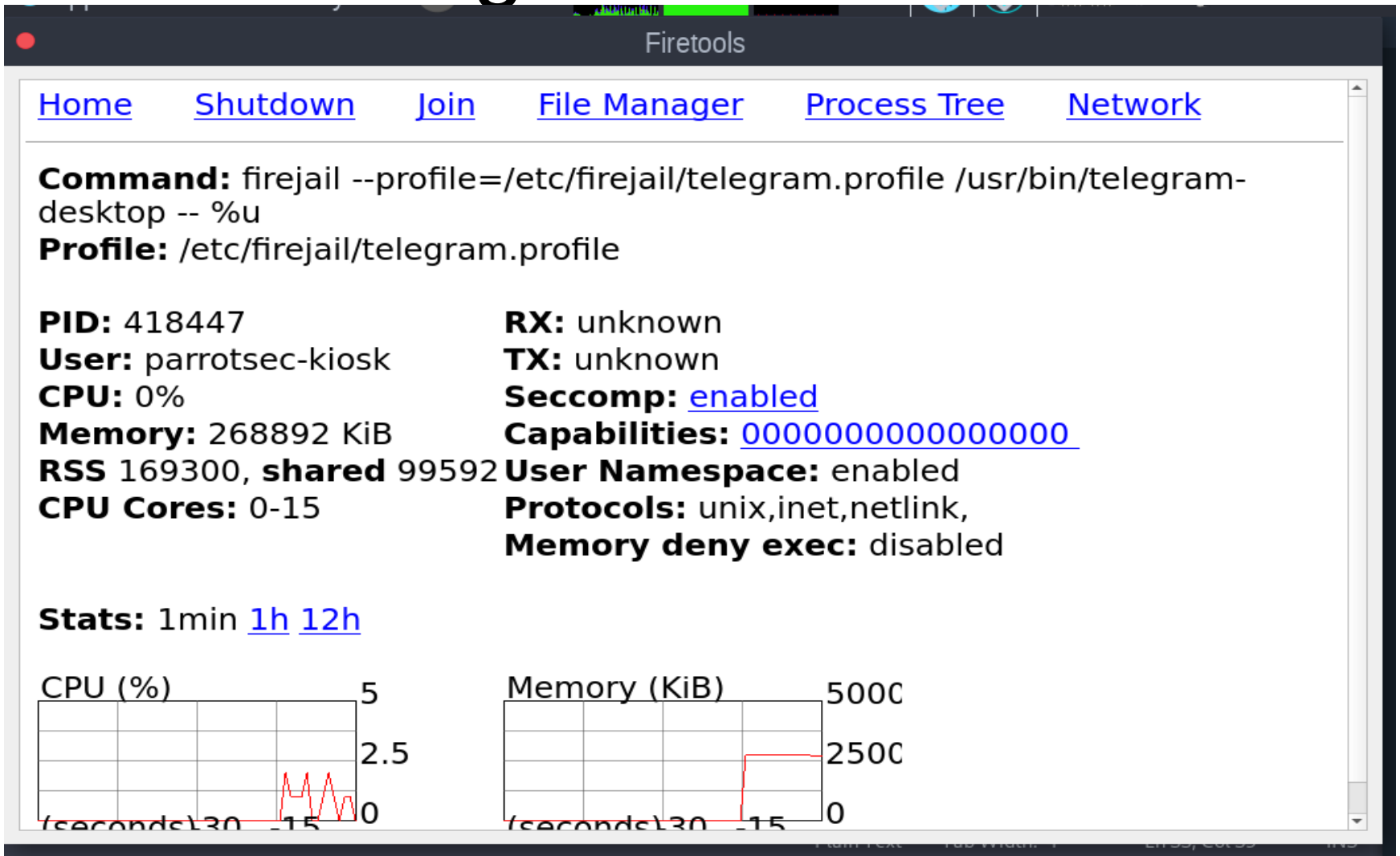


##-==-##
[+] Connect To Telegram Using SOCKS5 Proxy Connections
##-==-##

##-==================================-##
[+] Connect To Telegram Using Wireguard
##-==================================-##
https://t.me/socks?server=10.64.0.1&port=1080

##-==================================-##
[+] Connect To Telegram Using OpenVPN
##-==================================-##
https://t.me/socks?server=10.8.0.1&port=1080

Telegram - Firetools



```
owner @{HOME}/.local/share r,
owner @{HOME}/.local/share/TelegramDesktop/ rwk,
owner @{HOME}/.local/share/TelegramDesktop/** rwkl,
owner @{HOME}/.icons/** r,
owner @{HOME}/.cache/** rwk,

# home files
owner @{HOME}/ r,
owner @{HOME}/* rwk,

# shared libraries
/usr/lib/** rm,

# /proc
owner @{PROC}/*/cmdline r,
```

Telegram – AppArmor Profile

```
noblacklist ${HOME}/.TelegramDesktop
noblacklist ${HOME}/.local/share/TelegramDesktop
mkdir ${HOME}/.TelegramDesktop
mkdir ${HOME}/.local/share/TelegramDesktop
whitelist ${DOWNLOADS}
whitelist ${HOME}/.TelegramDesktop
whitelist ${HOME}/.local/share/TelegramDesktop
include whitelist-common.inc
include whitelist-runuser-common.inc
include whitelist-usr-share-common.inc
include whitelist-var-common.inc

include disable-common.inc
include disable-devel.inc
include disable-exec.inc
include disable-interpreters.inc
include disable-programs.inc
include disable-shell.inc
include disable-xdg.inc
```

Telegram - Firejail

Telegram – Firejail 2

```
seccomp
apparmor
caps.drop all
netfilter
nodvd
nonewprivs
noroot
notv
protocol unix,inet,netlink
shell none

disable-mnt
private-cache
private-etc ca-certificates,crypto-policies,fonts,ld.so.cache,l
ocaltime,machine-id,pki,pulse,resolv.conf,ssl
private-tmp
seccomp.block-secondary
```

qBittorrent – Anonymous Mode v2

- Disables Local Peer Discovery
- Disables DHT
- Disables UPnP & NAT-PMP
- Only talks to http(s) trackers via (any) proxy
- Only talks to udp trackers via SOCKS5/I2P proxy
- The peer-ID will no longer include the client's fingerprint
- The user-agent will be reset to an empty string
- Other identifying information will not be exposed to the public directly, such as IP, listening port, etc.
- The announced port used to be `0` but changed to `1` for versions using libtorrent 1.2.5 or later, since some trackers would fail the announce for `0`.

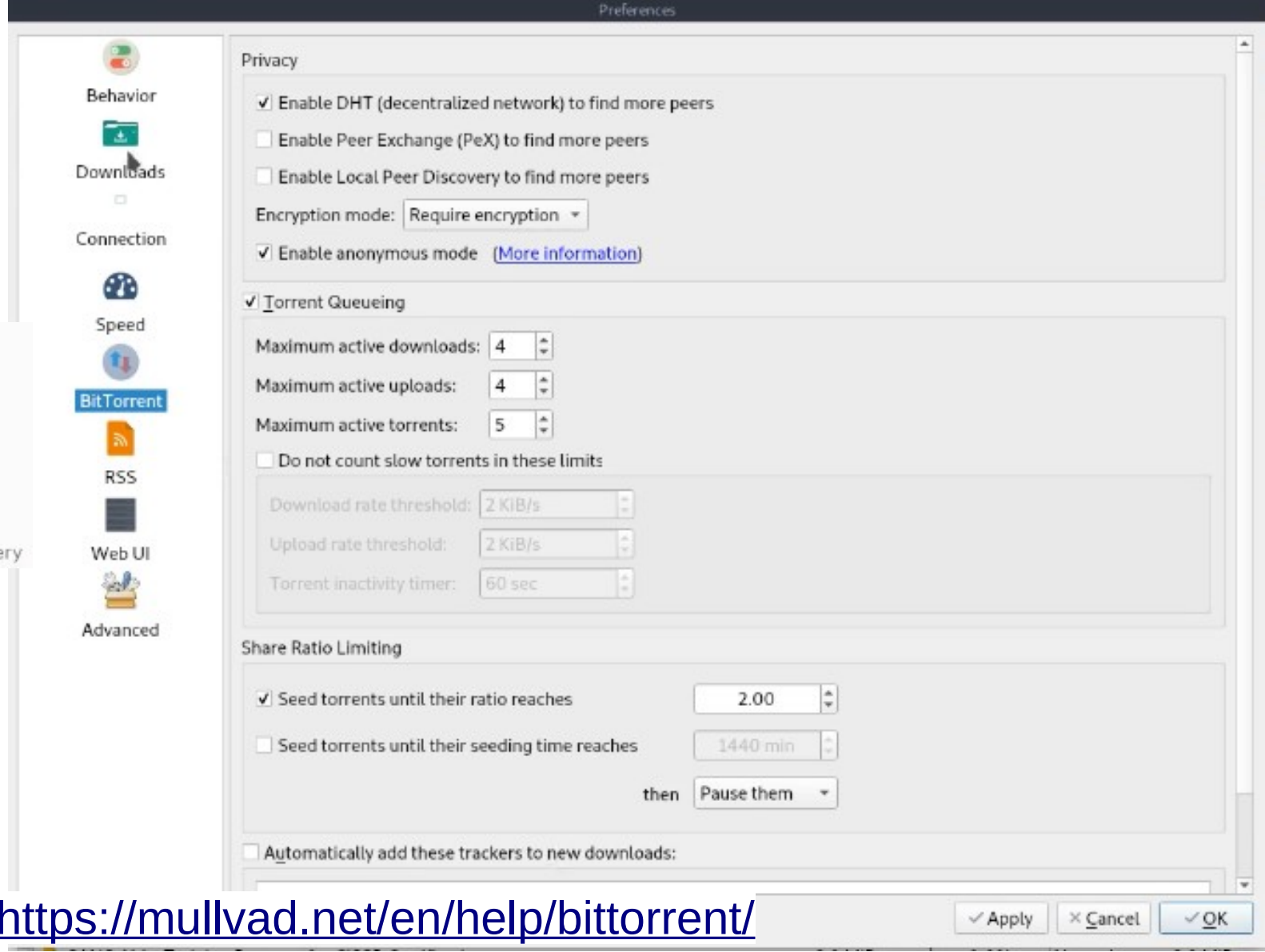
Qbittorrent

1. Click on **Tools** followed by **Options** (Alt-O).
2. Click on **Connection**.
3. Click on BitTorrent
4. Enable (Check) Enable anonymous mode
5. Disable (Uncheck) Enable DHT
6. Disable (Uncheck) Enable PeX
7. Disable (Uncheck) Enable Local peer discovery
8. Click on **Connection**
9. For Enabled protocol: Use the drop-down bar and select **TCP**
10. Under **Proxy Server** change Type to **SOCKS5**.
11. Change **Host:** to **10.8.0.1**.
12. Change **Port** to **1080**.
13. Checkmark the box next to **use proxy for peer connections**.
14. Checkmark the box next to **Disable connections not supported by proxies**.
15. Disable (Uncheck) Use PNP / NAT - PMP
16. Click on **Connection**

To

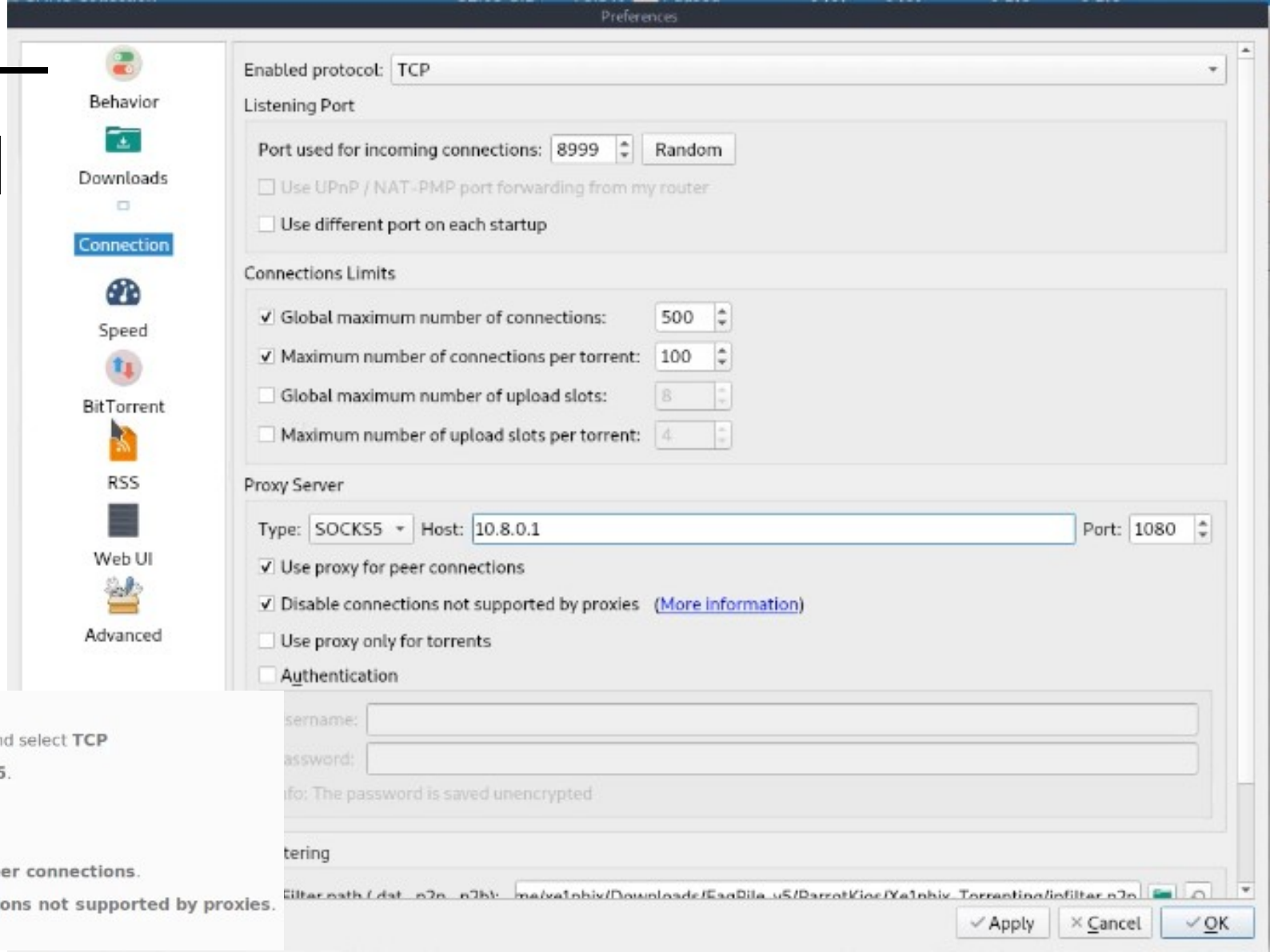
- https://mullvad.net/en/help/bittorrent/

1. Click on **Tools** followed by **Options** (Alt-O).
2. Click on **Connection**.
3. Click on BitTorrent
4. Enable (Check) Enable anonymous mode
5. Disable (Uncheck) Enable DHT
6. Disable (Uncheck) Enable PeX
7. Disable (Uncheck) Enable Local peer discovery



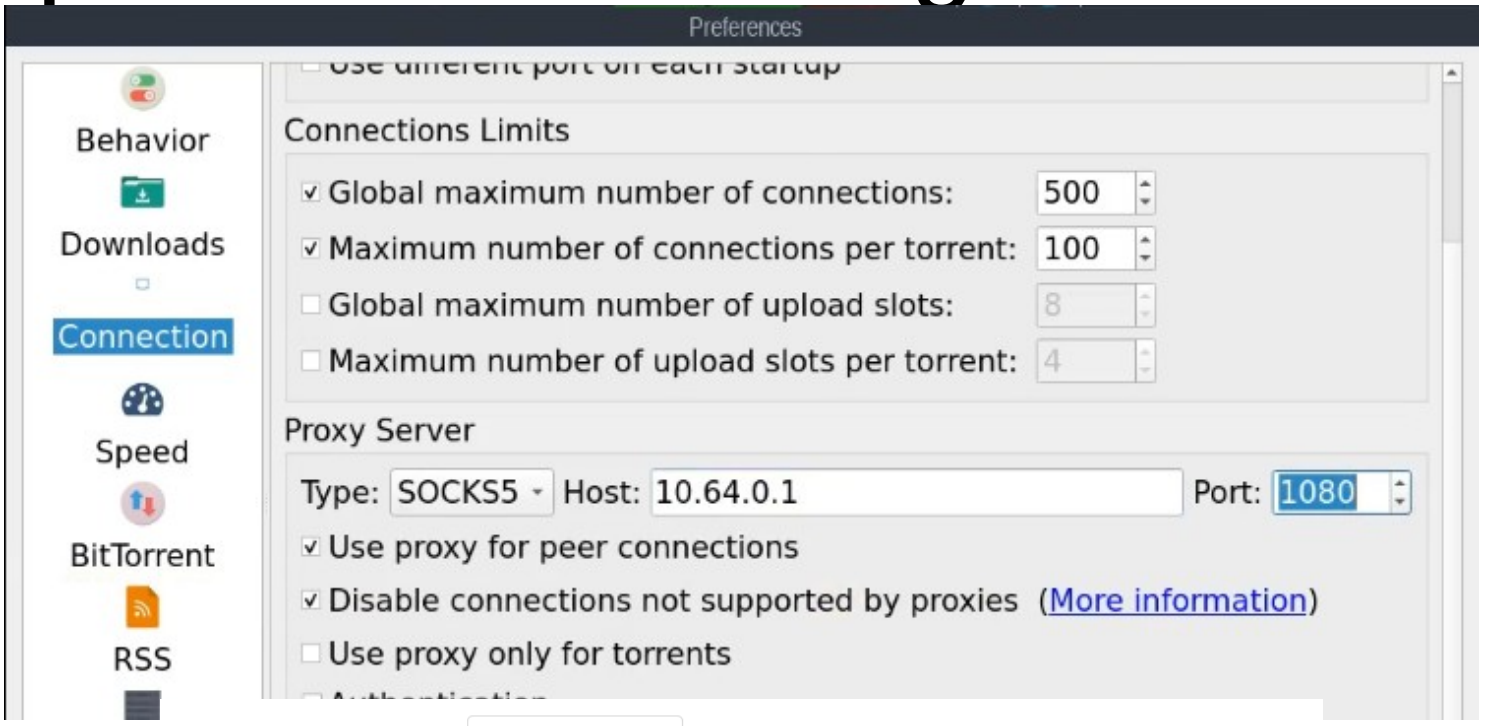
- https://mullvad.net/en/help/bittorrent/

qBittorrent – OpenVPN SOCKS5 Proxy



8. Click on **Connection**
9. For Enabled protocol: Use the drop-down bar and select **TCP**
10. Under **Proxy Server** change Type to **SOCKS5**.
11. Change **Host:** to **10.8.0.1**.
12. Change **Port** to **1080**.
13. Checkmark the box next to **use proxy for peer connections**.
14. Checkmark the box next to **Disable connections not supported by proxies**.
15. Disable (Uncheck) Use PNP / NAT - PMP

qBittorrent – Wireguard VPN



FAQ | Port check | Torrent check | API

Use this to check if your torrent client is leaking your actual IP address.

No leaks detected

Detected IP addresses

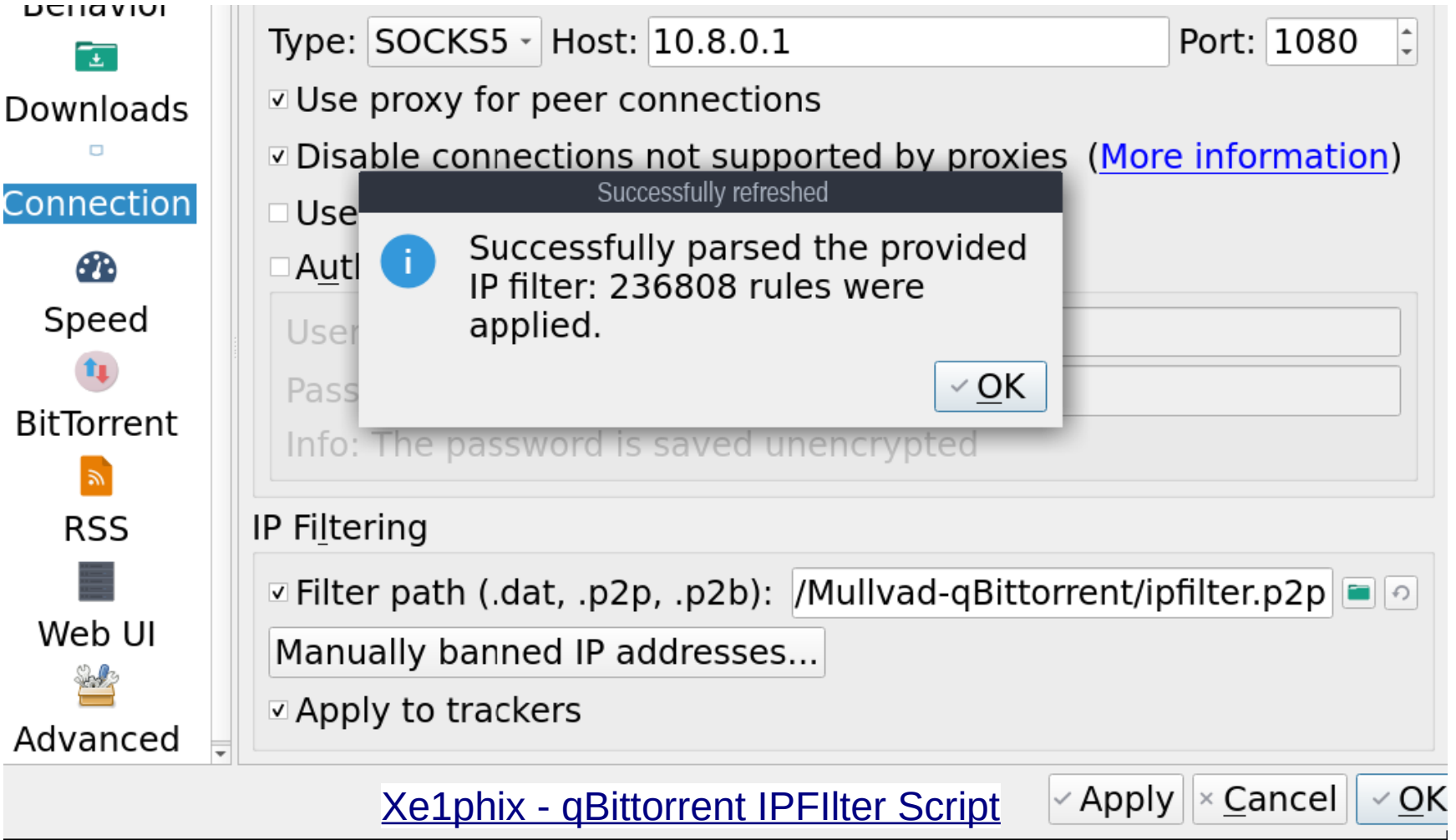
- 185.65.135.168 - 31173 Services AB (Sweden) **Mullvad IP: se-sto-008**

Fetch IP Filter For qBittorrent

```
└──╼ $wget -O - http://list.iblocklist.com/\?list\=ydxerpxkpcfqjaybcssw\&fileformat\=p2p\&a
rchiveformat\=gz | gunzip > ~/ipfilter.p2p
--2020-09-29 05:03:08--  http://list.iblocklist.com/?list=ydxerpxkpcfqjaybcssw&fileformat=p
2p&archiveformat=gz
Resolving list.iblocklist.com (list.iblocklist.com)... 54.175.167.220
Connecting to list.iblocklist.com (list.iblocklist.com)|54.175.167.220|:80... connected.
HTTP request sent, awaiting response... 302 Found
Location: http://cdn1.iblocklist.com/files/7rcwpdsg7s6t9l5774gk/ydxerpxkpcfqjaybcssw.gz [fo
llowing]
--2020-09-29 05:03:09--  http://cdn1.iblocklist.com/files/7rcwpdsg7s6t9l5774gk/ydxerpxkpcfq
jaybcssw.gz
Resolving cdn1.iblocklist.com (cdn1.iblocklist.com)... 165.227.124.62
Connecting to cdn1.iblocklist.com (cdn1.iblocklist.com)|165.227.124.62|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 3664582 (3.5M) [application/x-gzip]
Saving to: ‘STDOUT’

-                   100%[=========================>]   3.49M  9.40MB/s    in 0.4s

2020-09-29 05:03:09 (9.40 MB/s) - written to stdout [3664582/3664582]
```

[Xe1phix - qBittorrent IPFIlter Script]

qBittorrent - Applying IPFilters



qBittorrent – Firejail Profile

```
apparmor
caps.drop all
machine-id
netfilter
nodvd
nogroups
nonewprivs
noroot
nosound
notv
nou2f
novideo
protocol unix,inet,netlink
seccomp
shell none

private-bin python*,qbittorrent
private-dev
```

```
include allow-python2.inc
include allow-python3.inc

include disable-common.inc
include disable-devel.inc
include disable-exec.inc
include disable-interpreters.inc
include disable-passwdmgr.inc
include disable-programs.inc
include disable-shell.inc

mkdir ${HOME}/.cache/qBittorrent
mkdir ${HOME}/.config/qBittorrent
mkfile ${HOME}/.config/qBittorrentrc
mkdir ${HOME}/.local/share/data/qBittorrent
whitelist ${DOWNLOADS}
whitelist ${HOME}/.cache/qBittorrent
whitelist ${HOME}/.config/qBittorrent
whitelist ${HOME}/.config/qBittorrentrc
whitelist ${HOME}/.local/share/data/qBittorrent
include whitelist-common.inc
```

qBittorrent – Firejail Profile

OpenVPN – Packet Capture

```
└─ #tshark -i any -f 'udp port 1194'
Running as user "root" and group "root". This could be dangerous.
Capturing on 'any'
    1 0.000000000 173.22.75.86 → 193.138.218.136 OpenVPN 58 MessageType: P_CONTROL_HARD_RESET_CLIENT_V2
    2 0.128643529 193.138.218.136 → 173.22.75.86 OpenVPN 70 MessageType: P_CONTROL_HARD_RESET_SERVER_V2
    3 0.128865762 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
    4 0.128944171 173.22.75.86 → 193.138.218.136 TLSv1 267 Client Hello
    5 0.272074537 193.138.218.136 → 173.22.75.86 TLSv1.3 1244 Server Hello, Change Cipher Spec, Application Data, Application Data
    6 0.272276797 193.138.218.136 → 173.22.75.86 TLSv1.3 1232 Continuation Data
    7 0.272276872 193.138.218.136 → 173.22.75.86 TLSv1.3 1232 Continuation Data
    8 0.272329335 193.138.218.136 → 173.22.75.86 TLSv1.3 851 Continuation Data
    9 0.272372003 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   10 0.272395651 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   11 0.272421831 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   12 0.273627595 173.22.75.86 → 193.138.218.136 TLSv1.3 619 Change Cipher Spec, Application Data, Application Data, Application Data
   13 0.404691384 193.138.218.136 → 173.22.75.86 TLSv1.3 228 Application Data, Application Data
```

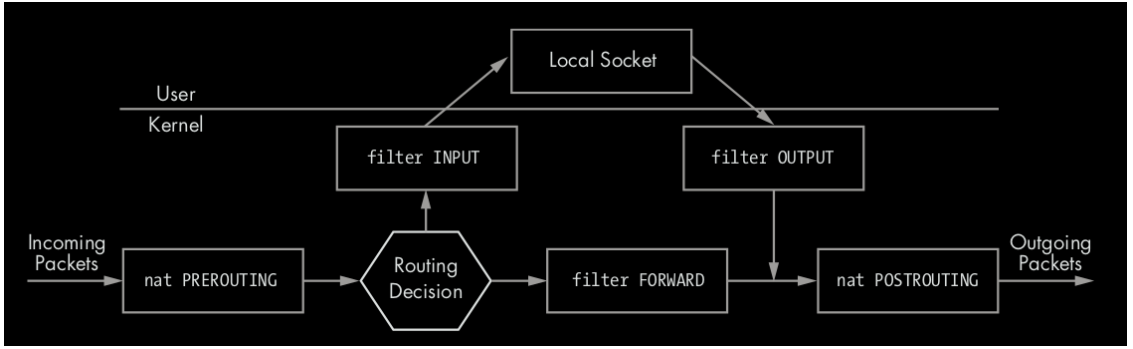
```
└─ #tcpdump -vn -i any 'port 1194'
tcpdump: data link type LINUX_SLL2
tcpdump: listening on any, link-type LINUX_SLL2 (Linux cooked v2), snapshot length 262144 bytes
23:24:11.394485 eth0  Out IP (tos 0x0, ttl 64, id 31803, offset 0, flags [DF], proto UDP (17), length 42)
    173.22.75.86.60526 > 193.138.218.133.1194: UDP, length 14
23:24:11.515617 eth0  In  IP (tos 0x0, ttl 47, id 43676, offset 0, flags [DF], proto UDP (17), length 54)
    193.138.218.133.1194 > 173.22.75.86.60526: UDP, length 26
23:24:11.515794 eth0  Out IP (tos 0x0, ttl 64, id 31818, offset 0, flags [DF], proto UDP (17), length 50)
    173.22.75.86.60526 > 193.138.218.133.1194: UDP, length 22
23:24:11.515841 eth0  Out IP (tos 0x0, ttl 64, id 31819, offset 0, flags [DF], proto UDP (17), length 251)
    173.22.75.86.60526 > 193.138.218.133.1194: UDP, length 223
23:24:11.645779 eth0  In  IP (tos 0x0, ttl 47, id 43696, offset 0, flags [DF], proto UDP (17), length 1228)
    193.138.218.133.1194 > 173.22.75.86.60526: UDP, length 1200
```

IPTables – Load Modules

```
┌─[✗]─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #modprobe --verbose tun
insmod /lib/modules/5.8.0-2parrot1-amd64/kernel/drivers/net/tun.ko
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #modinfo tun
filename:       /lib/modules/5.8.0-2parrot1-amd64/kernel/drivers/net/tun
description:    Universal TUN/TAP device driver
```

```
┌─[✗]─[root@parrot]─[/etc/openvpn]
└──╼ #sudo /usr/sbin/openvpn --mktun --dev tun0
2021-07-07 18:56:06 TUN/TAP device tun0 opened
2021-07-07 18:56:06 Persist state set to: ON
```

```
┌─[root@parrot]─[/home/parrotsec-kiosk]
└──╼ #sudo /usr/sbin/openvpn --rmtun --dev tun0
2021-07-07 18:52:11 TUN/TAP device tun0 opened
2021-07-07 18:52:11 Persist state set to: OFF
```



IPTables

```
##-==========================================-##
##    [+] Drop All Input Packets That Are in An Invalid ctstate:
##-==========================================-##
/sbin/iptables -A INPUT -m state --state INVALID -j LOG --log-prefix "DROP INVALID " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -m state --state INVALID -j DROP
/sbin/iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
/sbin/iptables -A INPUT -m conntrack --ctstate NEW,RELATED,ESTABLISHED -j ACCEPT
##-==========================================-##
##    [+] Drop All Output Packets That Are in An Invalid ctstate:
##-==========================================-##
/sbin/iptables -A OUTPUT -m conntrack --ctstate INVALID -j LOG --log-prefix "Invalid ctstate: Blocked: " --log-uid
/sbin/iptables -A OUTPUT -m conntrack --ctstate INVALID -j DROP
/sbin/iptables -A OUTPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
```

Xe1phix-IPTables-Custom-Script.sh

IPTables – Drop WebRTC

```
/sbin/iptables -A INPUT -p udp --dport 3478 -j LOG --log-prefix "DROP WebRTC"
/sbin/iptables -A INPUT -p udp --dport 3478 -j DROP
/sbin/iptables -A INPUT -p udp --dport 3479 -j LOG --log-prefix "DROP WebRTC"
/sbin/iptables -A INPUT -p udp --dport 3479 -j DROP
/sbin/iptables -A INPUT -p tcp --dport 3478 -j LOG --log-prefix "DROP WebRTC" -
/sbin/iptables -A INPUT -p tcp --dport 3478 -j DROP
/sbin/iptables -A INPUT -p tcp --dport 3479 -j LOG --log-prefix "DROP WebRTC" -
/sbin/iptables -A INPUT -p tcp --dport 3479 -j DROP
```

TCP FIN, XMAS, and NULL Scans

The FIN, XMAS, and NULL scans operate on the principle that any TCP stack (that adheres to the RFC) should respond in a particular way if a surprise TCP packet that does not set the SYN, ACK, or RST control bits is received on a port. If the port is closed, then TCP responds with a RST/ACK, but if the port is open, TCP does not respond with *any* packet at all.

NULL Scan

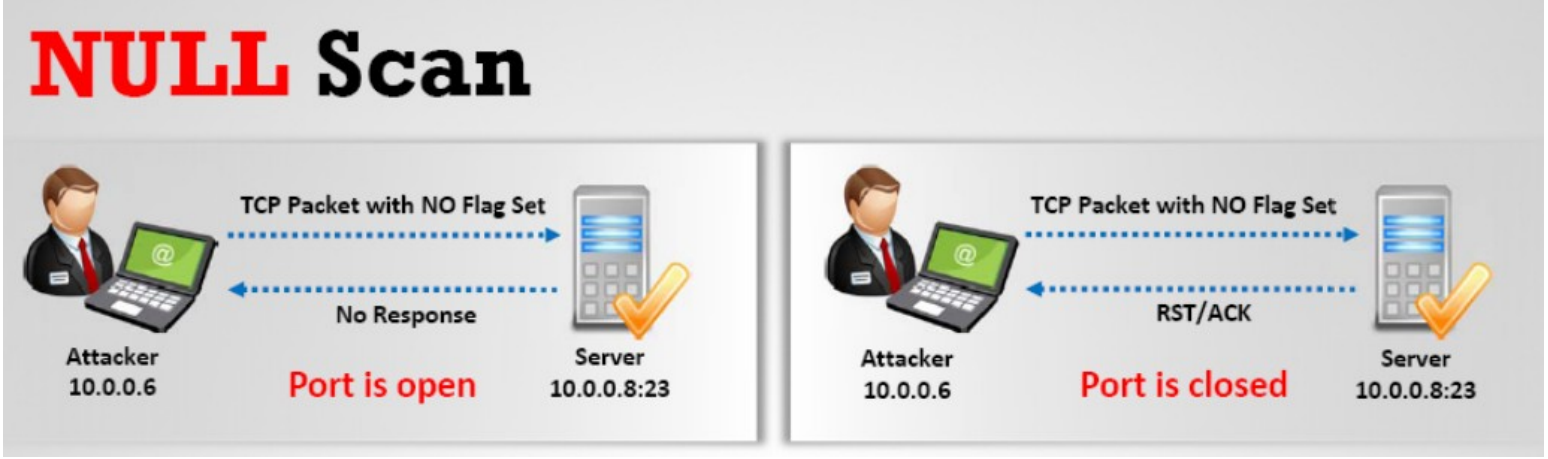
- NULL scan, attackers send a TCP frame to a remote host with NO Flags

FIN Scan

- FIN scan sends a TCP frame to a remote device with FIN flag set

Xmas Scan

- Xmas scan sends a TCP frame to a remote device with URG, ACK, RST, SYN, and FIN flags set



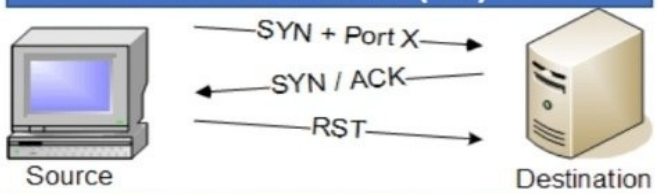

```
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL NONE -j LOG --log-prefix "IPT: Null Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL NONE -j DROP
/sbin/iptables -A INPUT -s 255.0.0.0/8 -j LOG --log-prefix "Spoofed source IP!" --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -s 255.0.0.0/8 -j DROP
```

- Xmas scan sends a TCP frame to a remote device with URG, ACK, RST, SYN, and FIN flags set

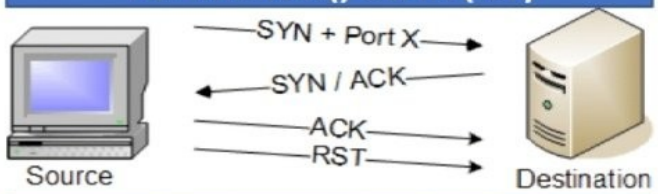
```
/sbin/iptables -N check-flags
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL FIN,URG,PSH -m limit --limit 5/minute -j LOG --log-level alert --log-prefix "NMAP-XMAS:"
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL FIN,URG,PSH -j DROP
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL ALL -m limit --limit 5/minute -j LOG --log-level 1 --log-prefix "XMAS:"
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL ALL -j DROP
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL SYN,RST,ACK,FIN,URG -m limit --limit 5/minute -j LOG --log-level 1 --log-prefix "XMAS-PSH:"
/sbin/iptables -A check-flags -p tcp --tcp-flags ALL SYN,RST,ACK,FIN,URG -j DROP
```

Identifying Open Ports with Nmap

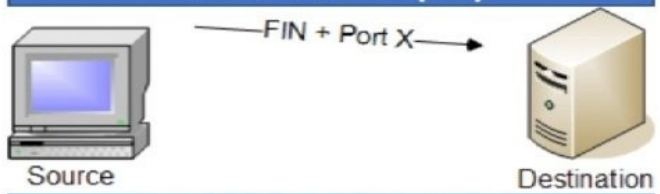
TCP SYN SCAN (-sS)



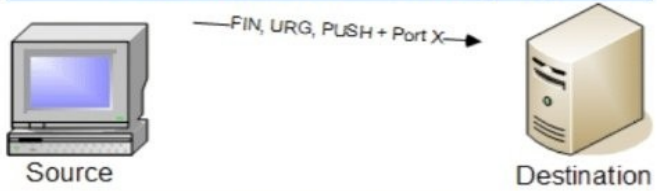
TCP connect() SCAN (-sT)



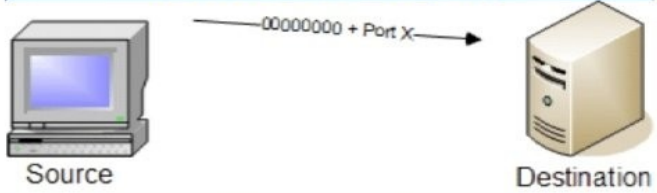
TCP FIN SCAN (-sF)



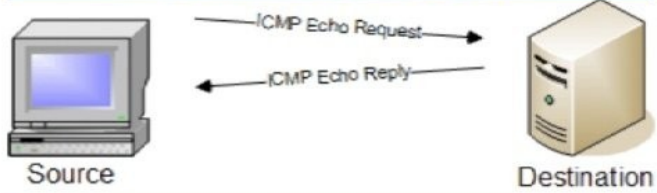
TCP XMAS TREE SCAN (-sX)



TCP NULL SCAN (-sN)

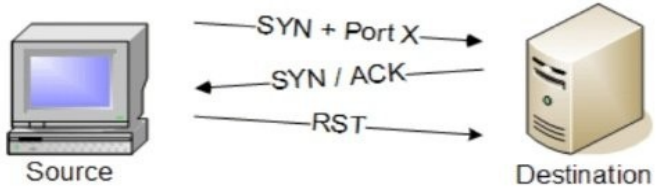


TCP PING SCAN (-sP)

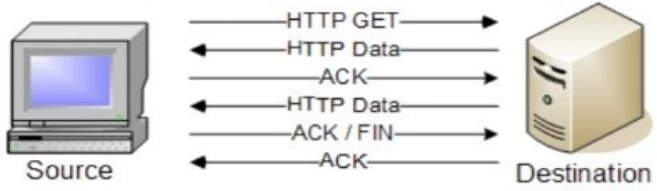


VERSION DETECTION SCAN (-sV)

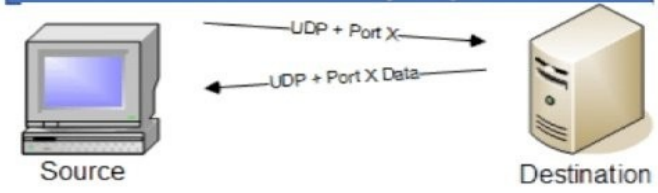
Version scan identifies open pots with a TCP SYN scan...



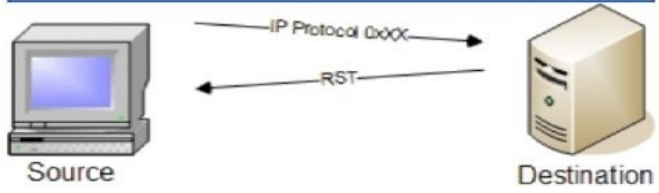
...and then queries the port with a customized signature.



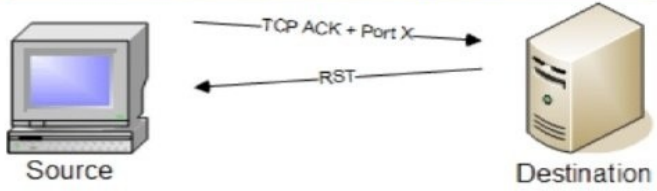
UDP SCAN (-sU)



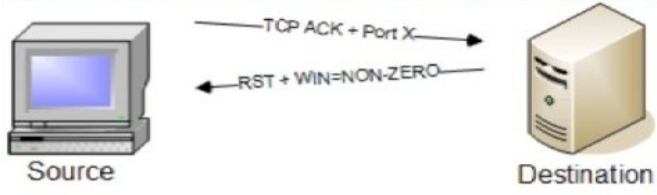
IP PROTOCOL SCAN (-sO)



TCP ACK SCAN (-sA)



TCP WINDOW SCAN (-sW)



IPTables – Blocking Port Scans

```
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL ALL -j LOG --log-prefix "IPT: All Flags " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL ALL -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL ACK,RST,SYN,FIN -j LOG --log-prefix "IPTables: Bad SF Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags ALL ACK,RST,SYN,FIN -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN SYN,FIN -j LOG --log-prefix "IPTables: Bad SF Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN SYN,FIN -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,RST SYN,RST -j LOG --log-prefix "IPT: Bad SR Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,RST SYN,RST -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,PSH SYN,FIN,PSH -j LOG --log-prefix "IPT: Bad SFP Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,PSH SYN,FIN,PSH -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,RST SYN,FIN,RST -j LOG --log-prefix "IPT: Bad SFR Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,RST SYN,FIN,RST -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,RST,PSH SYN,FIN,RST,PSH -j LOG --log-prefix "IPT: Bad SFRP Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags SYN,FIN,RST,PSH SYN,FIN,RST,PSH -j DROP
/sbin/iptables -A INPUT -p tcp --tcp-flags FIN FIN -j LOG --log-prefix "IPT: Bad F Flag " --log-ip-options --log-tcp-options
/sbin/iptables -A INPUT -p tcp --tcp-flags FIN FIN -j DROP
```

Xe1phix-IPTables-Custom-Script.sh

IP6Tables

```
##-==============================-##
##    [+] Drop + Reject all IPv6 Traffic:
##-==============================-##
/sbin/ip6tables -P INPUT DROP
/sbin/ip6tables -P OUTPUT DROP
/sbin/ip6tables -A OUTPUT -j REJECT
/sbin/ip6tables -P FORWARD DROP
/sbin/ip6tables -A FORWARD -j REJECT
##-==========================================-##
##    [+] Block All IPv6 Packets VIA IPTables As Well:
##-==========================================-##
/sbin/iptables -A INPUT -p ipv6 -j DROP
/sbin/iptables -A OUTPUT -p ipv6 -j DROP
/sbin/iptables -A FORWARD -p ipv6 -j DROP
/sbin/ip6tables -A OUTPUT -d fd00::/8 -j BLOCK
```

Brief List of IPv6 Weaknesses

- Man in the middle with spoofed ICMPv6 neighbor advertisement.
- Man in the middle with spoofed ICMPv6 router advertisement.
- Man in the middle using ICMPv6 redirect or ICMPv6 too big to implant route.
- Man in the middle to attack mobile IPv6 but requires ipsec to be disabled.
- Man in the middle with rogue DHCPv6 server.
- Traffic flooding with ICMPv6 router advertisement, neighbor advertisement, neighbor solicitation, multicast listener discovery, or smurf attack.
- Denial of Service which prevents new IPv6 attack on the network.
- Denial of Service which is related to fragmentation.
- Traffic flooding with ICMPv6 neighbor solicitation and a lot of crypto stuff to make CPU target busy.

IPv6 Attack Cheatsheet

A Complete Guide on IPv6 Attack and Defense

```
The THC IPV6 ATTACK TOOLKIT comes already with lots of effective attacking
tools:
 - parasite6: ICMPv6 neighbor solitication/advertisement spoofer, puts you
   as man-in-the-middle, same as ARP mitm (and parasite)
 - alive6: an effective alive scanng, which will detect all systems
   listening to this address
 - dnsdict6: parallized DNS IPv6 dictionary bruteforcer
 - fake_router6: announce yourself as a router on the network, with the
   highest priority
 - redir6: redirect traffic to you intelligently (man-in-the-middle) with
   a clever ICMPv6 redirect spoofer
 - toobig6: mtu decreaser with the same intelligence as redir6
 - detect-new-ip6: detect new IPv6 devices which join the network, you can
   run a script to automatically scan these systems etc.
 - dos-new-ip6: detect new IPv6 devices and tell them that their chosen IP
   collides on the network (DOS).
 - trace6: very fast traceroute6 with supports ICMP6 echo request and TCP-SYN
 - flood_router6: flood a target with random router advertisements
 - flood_advertise6: flood a target with random neighbor advertisements
 - fuzz_ip6: fuzzer for IPv6
 - implementation6: performs various implementation checks on IPv6
 - implementation6d: listen daemon for implementation6 to check behind a FW
 - fake_mld6: announce yourself in a multicast group of your choice on the n
 - fake_mld26: same but for MLDv2
 - fake_mldrouter6: fake MLD router messages
 - fake_mipv6: steal a mobile IP to yours if IPSEC is not needed for
authentication
 - fake_advertiser6: announce yourself on the network
 - smurf6: local smurfer
 - rsmurf6: remote smurfer, known to work only against linux at the moment
 - exploit6: known IPv6 vulnerabilities to test against a target
 - denial6: a collection of denial-of-service tests againsts a target
 - thcping6: sends a hand crafted ping6 packet
 - sendpees6: a tool by willdamn@gmail.com, which generates a neighbor
   solicitation requests with a lot of CGAs (crypto stuff ;-) to keep the
   CPU busy. nice.
and about 25 more tools for you to discover :-)
```

Smurf attack

Flood the target with network traffic amplification. Send ICMPv6 echo requests to 'FF02::1' with the spoofed source from the attack target.

```
$ sudo ./smurf6 eth0 TARGETIPv6ADDR
```

Router Advertisement MITM 👍

Announce yourself as a router and become the default router.

```
$ sudo ./fake_router26 eth0
```
'fake_router26 -h' have many interesting options

Neighbor Advertisement

Flood the local network with neighbor advertisements. The performance on IPv6 host neighbor tables will degrade and cause a DoS.

```
$ sudo ./flood_advertise6 eth0 TARGETIPv6ADDR
$ sudo ./na6 -i eth0 --target TARGETIPv6ADDR --dst-address ff02::1
--override -E 1:2:3:4:5:6 --loop --verbose
```

Neighbor Solicitation 👍

Flood the network with neighbor solicitations. If no target is supplied, query address will be 'ff02::1'.

```
$ sudo ./flood_solicitate6 eth0 TARGETIPv6ADDR
```

Firewall audit & Filter bypass tests

Performs various access control & bypass attempts to check implementations.

```
$ sudo ./firewall6 -H eth0 TARGETIPv6ADDR DSTPORT
```
Option '-u' for UDP

Disable an Existing Router

Impersonate the local router and send a Router Advertisement with a "Router Lifetime" small value. The victim host will remove the router from the 'default routers list'.

```
$ sudo ./ra6 -i eth0 --src-address ROUTERADDR --dst-address TARGETIPv6ADDR
--lifetime 0 --loop 1 --verbose
```

[IPv6 Attack Toolkit Github]

Sysctl – IPv6

```
└─# sysctl -w net.ipv6.conf.default.autoconf=0
net.ipv6.conf.default.autoconf = 0
└─# sysctl -w net.ipv6.conf.all.autoconf=0
net.ipv6.conf.all.autoconf = 0
```

```
┌─[✗]─[root@parrot]─[/home/parrotsec]
└─# sysctl -w net.ipv6.conf.all.disable_ipv6=1
net.ipv6.conf.all.disable_ipv6 = 1
└─# sysctl -w net.ipv6.conf.default.disable_ipv6=1
net.ipv6.conf.default.disable_ipv6 = 1
```

```
Load in sysctl settings from the file specified or /etc/sysctl.conf
#sysctl --load=/etc/sysctl.d/40-ipv6.conf
```

IPv6 Module Parameters

Sysctl
40-ipv6.conf
sysctl.conf

```
## touch /etc/sysctl.d/40-ipv6.conf

net.ipv6.conf.all.disable_ipv6 = 1
net.ipv6.conf.default.disable_ipv6 = 1
net.ipv6.conf.eth0.disable_ipv6 = 1
net.ipv6.conf.lo.disable_ipv6 = 1

net.ipv6.conf.all.forwarding = 0
net.ipv6.conf.default.forwarding = 0
net.ipv6.conf.eth0.forwarding = 0
net.ipv6.conf.lo.forwarding = 0

net.ipv6.conf.all.accept_ra = 0
net.ipv6.conf.default.accept_ra = 0
net.ipv6.conf.eth0.accept_ra = 0
net.ipv6.conf.lo.accept_ra = 0

net.ipv6.conf.all.router_solicitations = 0
net.ipv6.conf.default.router_solicitations = 0
net.ipv6.conf.eth0.router_solicitations = 0
net.ipv6.conf.lo.router_solicitations = 0
```

40-ipv6.conf

```
net.ipv6.conf.all.accept_dad = 0
net.ipv6.conf.default.accept_dad = 0
net.ipv6.conf.eth0.accept_dad = 0
net.ipv6.conf.lo.accept_dad = 0

net.ipv6.conf.all.dad_transmits = 0
net.ipv6.conf.default.dad_transmits = 0
net.ipv6.conf.eth0.dad_transmits = 0
net.ipv6.conf.lo.dad_transmits = 0

net.ipv6.conf.all.accept_redirects = 0
net.ipv6.conf.default.accept_redirects = 0
net.ipv6.conf.eth0.accept_redirects = 0
net.ipv6.conf.lo.accept_redirects = 0

net.ipv6.conf.all.autoconf = 0
net.ipv6.conf.default.autoconf = 0
net.ipv6.conf.eth0.autoconf = 0
net.ipv6.conf.lo.autoconf = 0
```

IPTables - OpenVPN

```
##-=======================================================-##
##     [+] Allow Packets Through The Tun/Tap Virtual VPN Interface Only:
##-=======================================================-##
/sbin/iptables -I INPUT -o tun+ -j ACCEPT
/sbin/iptables -I OUTPUT -o tun+ -j ACCEPT
/sbin/iptables -A INPUT ! -i tun+ -j DROP
/sbin/iptables -A OUTPUT ! -o tun+ -j DROP
```

```
/sbin/iptables -A INPUT -i tun+ -s 10.64.0.0/24 --dport 1080 -j ACCEPT
/sbin/iptables -A OUTPUT -i tun+ -d 10.64.0.0/24 --dport 1080 -j ACCEPT
/sbin/iptables -A INPUT -i tun+ -s 10.8.0.0/24 --dport 1080 -j ACCEPT
/sbin/iptables -A INPUT -i tun+ -s 10.8.0.0/24 --dport 1194 -j ACCEPT
/sbin/iptables -A OUTPUT  -i tun+ -d 10.8.0.0/24 --dport 1080 -j ACCEPT
/sbin/iptables -A OUTPUT  -i tun+ -d 10.8.0.0/24 --dport 1194 -j ACCEPT
/sbin/iptables -A FORWARD -i tun+ -s 10.8.0.0/24 --dport 1080 -j ACCEPT
/sbin/iptables -A FORWARD -i tun+ -s 10.8.0.0/24 --dport 1194 -j ACCEPT
```

IPTables – Policy For Loop

```
# Whitelist
for x in `grep -v ^# $WHITELIST | awk '{print $1}'`; do
        echo "Allowing $x..."
        $IPTABLES -A INPUT -t filter -s $x -j ACCEPT
done


# Blacklist
for x in `grep -v ^# $BLACKLIST | awk '{print $1}'`; do
        echo "Denied $x..."
        $IPTABLES -A INPUT -t filter -s $x -j DROP
done
```

IPTables – Save + Restore

```
#iptables-save > /etc/iptables/rules.v4
#iptables-restore < /etc/iptables/rules.v4
#ip6tables-save > /etc/iptables/rules.v6
#ip6tables-restore < /etc/iptables/rules.v6
#ls /etc/iptables/rules.v*
/etc/iptables/rules.v4  /etc/iptables/rules.v6
```

IPSet – Git Clone

```
└──╼ $git clone https://github.com/firehol/blocklist-ipsets
Cloning into 'blocklist-ipsets'...
remote: Enumerating objects: 7536, done.
remote: Counting objects: 100% (1559/1559), done.
remote: Compressing objects: 100% (662/662), done.
remote: Total 7536 (delta 1044), reused 1222 (delta 897), pack-reused 5977
Receiving objects: 100% (7536/7536), 28.06 MiB | 6.54 MiB/s, done.
Resolving deltas: 100% (3919/3919), done.
```

https://github.com/firehol/blocklist-ipsets

IPSet – Enabling Lists

```
└──╼ #update-ipsets enable dshield dshield_top_1000 et_compromised et_spamhaus spamhaus_dro
p spamhaus_edrop malwaredomainlist snort_ipfilter talosintel_ipfilter firehol_level4 fireho
l_level3 firehol_level2 firehol_level1
dshield: Enabling dshield...
dshield_top_1000: Enabling dshield_top_1000...
et_compromised: Enabling et_compromised...
et_spamhaus: Enabling et_spamhaus...
spamhaus_drop: Enabling spamhaus_drop...
spamhaus_edrop: Enabling spamhaus_edrop...
malwaredomainlist: Enabling malwaredomainlist...
snort_ipfilter: Enabling snort_ipfilter...
talosintel_ipfilter: Enabling talosintel_ipfilter...
firehol_level4: Enabling firehol_level4...
firehol_level3: Enabling firehol_level3...
firehol_level2: Enabling firehol_level2...
firehol_level1: Enabling firehol_level1...
```

```
┌──[root@parrot]─[/home/parrotsec-kiosk/Downloads]
└─── #update-ipsets --verbose

Mon May 17 22:20:27 CDT 2021: /usr/sbin/update-ipsets

Getting list of active ipsets...
Found these ipsets active:
                                    |
                           dshield| parsing attributes:
                                  | 11243360/10 mins passed, downloading...
                                  | fetch: 'http://feeds.dshield.org/block.txt'
                                  | running downloader 'geturl'
                                  | curl  'http://feeds.dshield.org/block.txt'
  % Total    % Received % Xferd  Average Speed   Time    Time     Time  Current
                                 Dload  Upload   Total   Spent    Left  Speed
100  1125  100  1125    0     0   7450      0 --:--:-- --:--:-- --:--:--  7450
                                  | HTTP/200 OK
                                  | downloaded successfully
                                  | saving downloaded file
                                  | forced reprocessing (ignoring download status)
                                  | converting with 'dshield_parser'
                                  | parsing attributes:
                                  |  SAVED  no need to load ipset in kernel
                                  | version 1, 17 subnets, 5120 unique IPs
```

IPSet – Custom Bash For Loop

```
for IP in $(cat /etc/ipset/snort_ipfilter.restore)
    do
        ipset -A Snort $IP
    done
```

https://github.com/firehol/blocklist-ipsets

IPSet – List Blacklist IPs

```
#ipset list
Name: Snort
Type: hash:ip
Revision: 4
Header: family inet hashsize 1024 maxelem 65536
Size in memory: 28280
References: 1
Number of entries: 836
Members:
23.129.64.209
27.69.166.251
2.50.24.70
112.238.151.252
92.222.92.152
117.194.161.66
```

IPSet – Saving Rules
+ Listing IPTables Rule

```
└──  #ipset save
create Snort hash:ip family inet hashsize 1024 maxelem 65536
add Snort 23.129.64.209
add Snort 27.69.166.251
add Snort 2.50.24.70
add Snort 112.238.151.252
```

```
└──  #iptables -L
# Warning: iptables-legacy tables present, use iptables-legacy to see them
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
DROP       all  --  anywhere             anywhere             match-set Snort src
```

https://github.com/firehol/blocklist-ipsets

FWSnort – Fetch Rules

```
└─ #fwsnort --update-rules
[+] Downloading latest rules into /etc/fwsnort/snort_rules/--2021-07-22 10:42:41--  http://rules.emergingthreats.net/open/snort-2.9.0/emerging-all.rules
Resolving rules.emergingthreats.net (rules.emergingthreats.net)... 52.5.252.216, 23.21.164.163
Connecting to rules.emergingthreats.net (rules.emergingthreats.net)|52.5.252.216|:80... connected.
HTTP request sent, awaiting response... 200 OK
Length: 18266286 (17M) [text/plain]
Saving to: ‘emerging-all.rules’

emerging-all.rules        100%[=====================================>]  17.42M  14.6MB/s    in 1.2s

2021-07-22 10:42:42 (14.6 MB/s) - ‘emerging-all.rules’ saved [18266286/18266286]

--2021-07-22 10:42:42--  https://rules.emergingthreats.net/fwrules/emerging-IPTABLES-ALL.rules
Resolving rules.emergingthreats.net (rules.emergingthreats.net)... 23.21.164.163, 52.5.252.216
Connecting to rules.emergingthreats.net (rules.emergingthreats.net)|23.21.164.163|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 88177 (86K) [text/plain]
Saving to: ‘emerging-IPTABLES-ALL.rules’

emerging-IPTABLES-ALL.rul 100%[=====================================>]  86.11K  --.-KB/s    in 0.04s

2021-07-22 10:42:42 (2.04 MB/s) - ‘emerging-IPTABLES-ALL.rules’ saved [88177/88177]

[+] Finished.
```

FWSnort – IPTables Script

```
┌─[root@parrotseckiosk-optiplex990]─[/var/lib/fwsnort]
└──╼ #fwsnort --ipt-list
[+] Listing FWSNORT_INPUT chain...
Chain FWSNORT_INPUT (1 references)
 pkts bytes target     prot opt in     out     source               destination
    0     0 RETURN     all  --  *      *       96.43.137.99         0.0.0.0/0
    0     0 RETURN     all  --  *      *       204.12.217.19        0.0.0.0/0
 1599 7390K FWSNORT_INPUT_ESTAB  tcp  --  *      *       0.0.0.0/0            0.0.0.0/0            ctstate ESTABLISHED
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp STRING match  "|5353535353435343 53ffd06668|" ALGO name bm TO 65535 STRING match  "|665389e19568a41a|" ALGO name bm F
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|0b|" ALGO name bm F
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|1f00|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|1f00|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|1f00|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|1f00|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|2000|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|2000|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|2000|" ALGO name bm
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp dpt:139 STRING match  "|c84f324b7016d30112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|2000|" ALGO name bm
    0     0 LOG        udp  --  *      *      !192.168.1.0/24       192.168.1.0/24       udp spts:1024:65535 dpts:1024:65535 length 28:48 STRING match  "|e30d|" ALGO name bm TO 44 /* sid:2003311; msg:ET P2P Ed
    0     0 LOG        udp  --  *      *       192.168.1.0/24      !192.168.1.0/24       udp spts:1024:65535 dpts:1024:65535 length 53 STRING match  "|e30a|" ALGO name bm TO 44 /* sid:2003312; msg:ET P2P Edonk
    0     0 LOG        udp  --  *      *      !192.168.1.0/24       192.168.1.0/24       udp spt:41170 length 28:76 STRING match  "|3d4ad9|" ALGO name bm TO 45 /* sid:2009097; msg:ET P2P Manolito Connection (1
    0     0 LOG        udp  --  *      *       192.168.1.0/24      !192.168.1.0/24       udp dpt:3544 STRING match  "|fe80000000000000800054455245444f|" ALGO name bm FROM 63 TO 79 /* sid:2003155; msg:ET POLICY
    0     0 LOG        udp  --  *      *       0.0.0.0/0            0.0.0.0/0            udp STRING match  "UK00760S7G10" ALGO name bm TO 65535 /* sid:2001597; msg:ET POLICY Netop Remote Control Usage; classty
    0     0 LOG        udp  --  *      *       192.168.1.0/24      !192.168.1.0/24       udp dpt:69 STRING match  "|0003|" ALGO name bm TO 44 /* sid:2008117; msg:ET TFTP Outbound TFTP Data Transfer; classtype:
    0     0 LOG        udp  --  *      *       192.168.1.0/24      !192.168.1.0/24       udp dpt:69 STRING match  "|0004|" ALGO name bm TO 44 /* sid:2008118; msg:ET TFTP Outbound TFTP ACK; classtype:policy-vio
    0     0 LOG        udp  --  *      *       192.168.1.0/24      !192.168.1.0/24       udp dpt:69 STRING match  "|0005|" ALGO name bm TO 44 /* sid:2008119; msg:ET TFTP Outbound TFTP Error Message; classtype:
```

```
┌─[root@parrotseckiosk-optiplex990]─[/var/lib/fwsnort]
└──╼ #iptables -L
Chain INPUT (policy ACCEPT)
target     prot opt source               destination
FWSNORT_INPUT  all  --  anywhere             anywhere

Chain FORWARD (policy ACCEPT)
target     prot opt source               destination
FWSNORT_FORWARD  all  --  anywhere             anywhere

Chain OUTPUT (policy ACCEPT)
target     prot opt source               destination
FWSNORT_OUTPUT  all  --  anywhere             anywhere

Chain FWSNORT_FORWARD (1 references)
target     prot opt source               destination
RETURN     all  --  buygetpromo.com      anywhere
RETURN     all  --  anywhere             buygetpromo.com
RETURN     all  --  204.12.217.19        anywhere
RETURN     all  --  anywhere             204.12.217.19
FWSNORT_FORWARD_ESTAB  tcp  --  anywhere             anywhere            ctstate ESTABLISHED
LOG        udp  --  anywhere             anywhere            udp STRING match  "|535353535343534353ffd0
6668|" ALGO name bm TO 65535 STRING match  "|665389e19568a41a|" ALGO name bm FROM 55 TO 65535 /* sid:200
9285; msg:ET SHELLCODE Bindshell2 Decoder Shellcode (UDP); classtype:shellcode-detect; reference:url,doc
.emergingthreats.net/2009285; rev:2; FWS:1.6.8; */ LOG level warning ip-options prefix "[1] SID2009285 "
LOG        udp  --  anywhere             192.168.1.0/24      udp dpt:139 STRING match  "|c84f324b7016d3
0112785a47bf6ee188|" ALGO name bm TO 65535 STRING match  "|0b|" ALGO name bm FROM 44 TO 45 /* sid:200869
```

FWSnort – Save + Restore

```
    Rules added: 25798
[+] Finished.
```

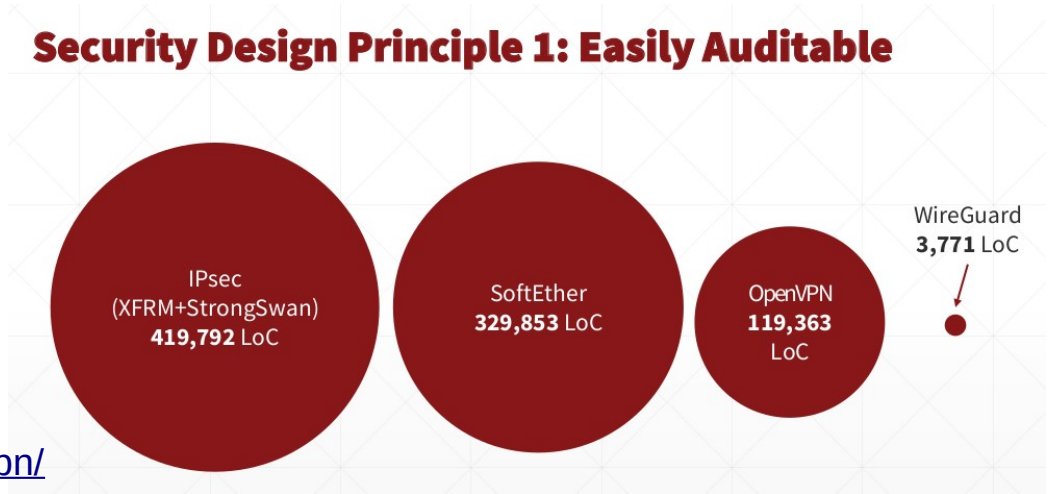
```
└──╼ #iptables-save > /etc/iptables/FWSnort.rules
```

```
┌─[root@parrotseckiosk-optiplex990]─[/var/lib/fwsnort]
└──╼ #iptables-restore < /etc/iptables/FWSnort.rules
```

Mullvad's WireGuard servers

Our WireGuard servers utilize the following protocols and primitives:

- ChaCha20 for symmetric encryption, authenticated with Poly1305, using RFC7539's AEAD construction
- Curve25519 for ECDH
- BLAKE2s for hashing and keyed hashing, as described in RFC7693
- SipHash24 for hashtable keys
- HKDF for key derivation, as described in RFC5869
- Noise_IK handshake from Noise, building on the work of CurveCP, NaCL, KEA+, SIGMA, FHMQV, and HOMQV.



https://mullvad.net/en/what-is-vpn/

WIREGUARD®
FAST, MODERN, SECURE VPN TUNNEL

WireGuard configuration file generator

Follow our WireGuard guides for step-by-step instructions on how to use WireGuard with Mullvad.

1. Choose your platform

Windows | macOS | Linux | iOS | Android/Chrome OS

2. Generate a WireGuard key

Generate key — No key generated

Manage keys

3. Select one or multiple exit locations

USA | Denver, CO | us10-wireguard

Advanced settings

Multihop

enable

Select an entry server

Sweden | Stockholm | se2-wireguarc

Server connection protocol

IPv4 IPv6

Tunnel traffic

both Only IPv4 Only IPv6

Custom port

51820

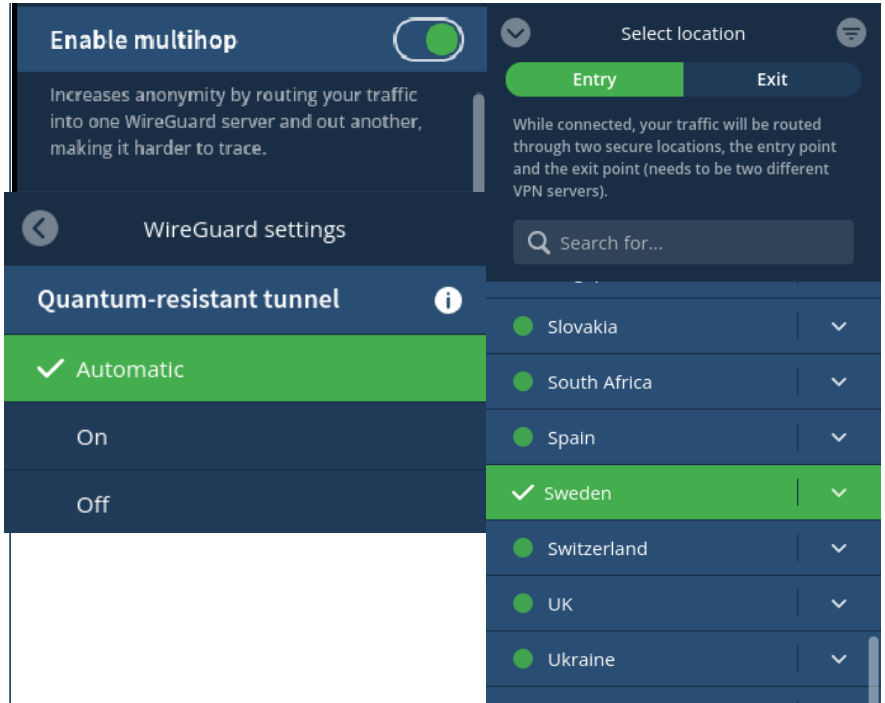
Enable kill switch (Linux only)

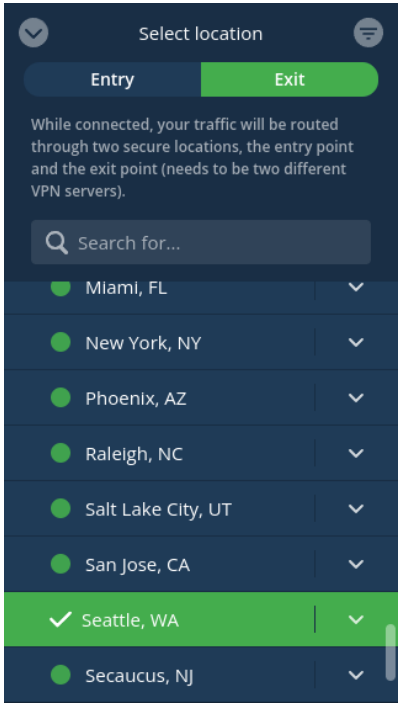
Multihop - Another layer of security

Even though a standard, single-hop VPN configuration will be adequate for the majority of users, incoming/outgoing traffic correlation may still be possible. Multihop adds another level of security for those concerned where the correlating of in and outgoing traffic over several locations (with different ISP and hosting providers) and preferably nations, becomes even more difficult.

How

For instance, if you are connected to se1-wireguard.mullvad.net and then want to exit via us3-wireguard.mullvad.net, you would configure your browser/program to use us3-wg.socks5.mullvad.net on port 1080 as your exit node.

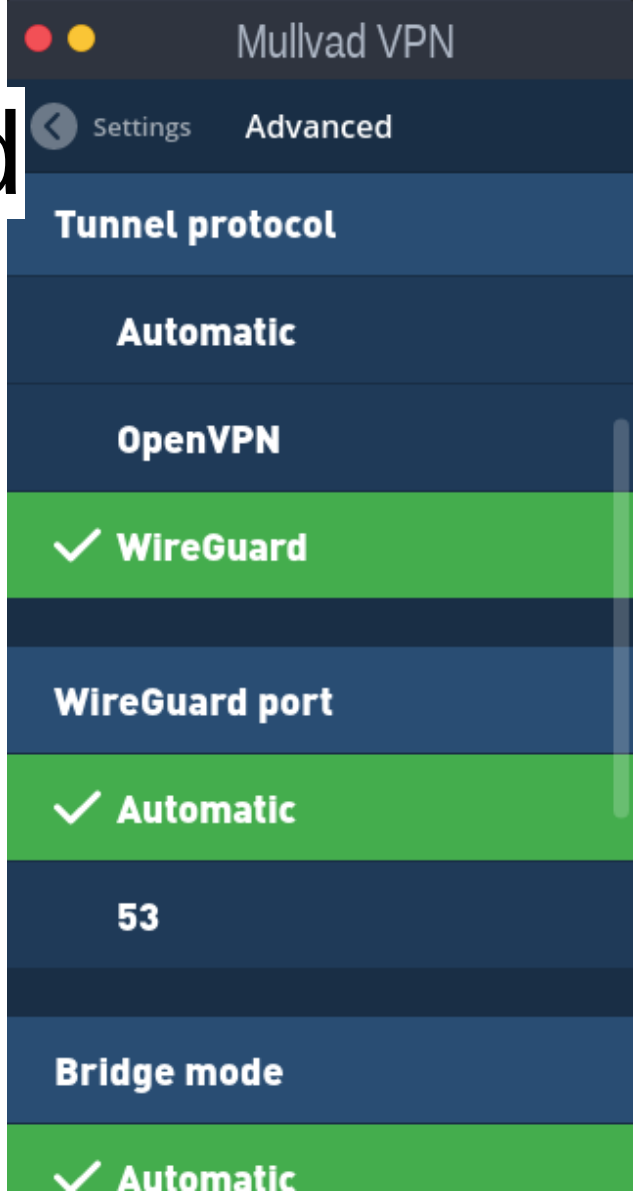




Using WireGuard

1. Click on the **gear icon.**
2. Click on **Advanced**.
3. Under **Tunnel protocol**, select **WireGuard**.

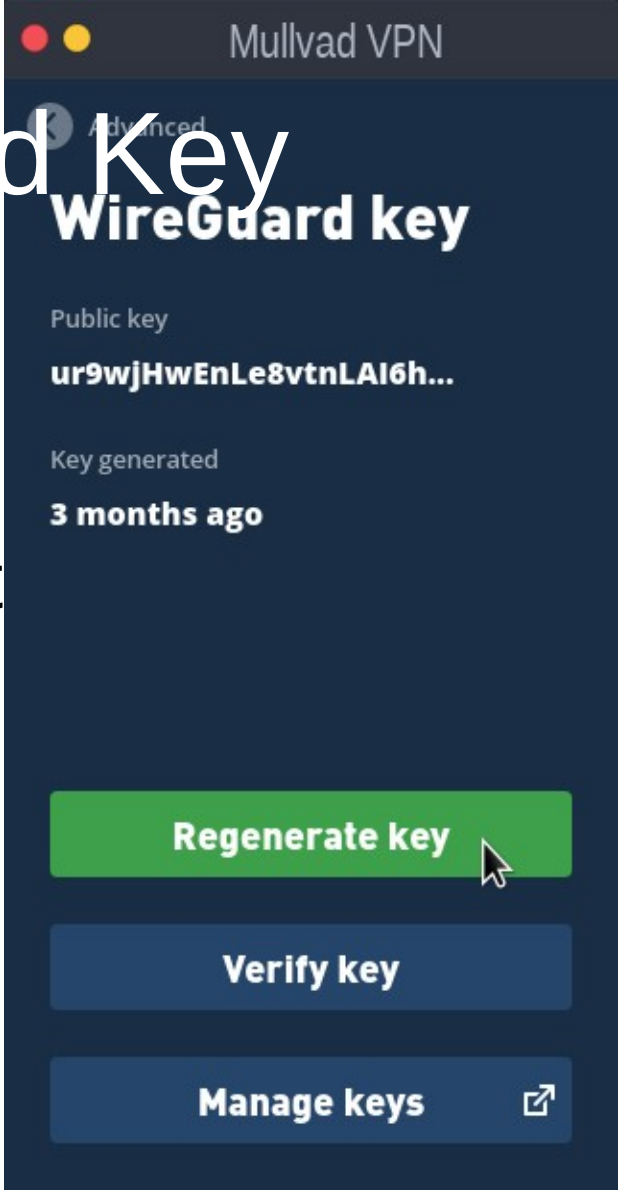
WireGuard is the default protocol.



https://mullvad.net/en/help/how-turn-wireguard-mullvad-app/

Regenerate WireGuard Key

- **Regenerate key**: Replace your current key. This will also replace your internal static IP address.
- **Verify key**: This will verify your current key.
- **Manage keys**: Open your account page on our website so you can get an overview of all your keys.



Mullvad - WireGuard Configuration Script:

```
##-============================================-##
##    [+] Run The Mullvad - WireGuard Configuration Script:
##-============================================-##
curl -LO https://mullvad.net/media/files/mullvad-wg.sh
chmod +x ./mullvad-wg.sh
./mullvad-wg.sh
```

Executing Mullvads WireGuard Configuration Script:

```
└──╼ #chmod +x mullvad-wg.sh
┌─[root@parrot]─[/home/parrotsec-kiosk/Downloads/Scripts/ParrotLinux-Publ
pdated/[05-11-20]/Xe1phix-[Mullvad]/Xe1phix-Mullvad-[Wireguard]-(Configs)
└──╼ #./mullvad-wg.sh
[?] Please enter your Mullvad account number: [redacted]
[+] Contacting Mullvad API for server locations.
[+] Using existing private key.
[+] Contacting Mullvad API.
[+] Writing WriteGuard configuration files.
[+] Success. The following commands may be run for connecting to Mullvad:
- Melbourne, Australia:
  $ wg-quick up mullvad-au3
- Melbourne, Australia:
  $ wg-quick up mullvad-au4
- Sydney, Australia:
  $ wg-quick up mullvad-au10
- Sydney, Australia:
  $ wg-quick up mullvad-au11
- Sydney, Australia:
  $ wg-quick up mullvad-au12
- Sydney, Australia:
  $ wg-quick up mullvad-au14
- Sydney, Australia:
  $ wg-quick up mullvad-au1
- Sydney, Australia:
  $ wg-quick up mullvad-au2
- Sydney, Australia:
```

Setting Wireguard Directory Permissions

```
##-==========================================-##
##    [+] Set Strict Permissions For The Wireguard Directory:
##-==========================================-##
## ------------------------------------------ ##
##    [?] So Only Root Can Read Them
## ------------------------------------------ ##
chown root:root -R /etc/wireguard
chmod 600 -R /etc/wireguard
```

```
##-==========================================-##
##    [+] Start WireGuard automatically on boot:
##-==========================================-##
systemctl enable wg-quick@mullvad-se4

##-==========================-##
##    [+] Turn on WireGuard
##-==========================-##
wg-quick up mullvad-se4

##-==========================-##
##    [+] Turn off WireGuard
##-==========================-##
wg-quick down mullvad-se4
```

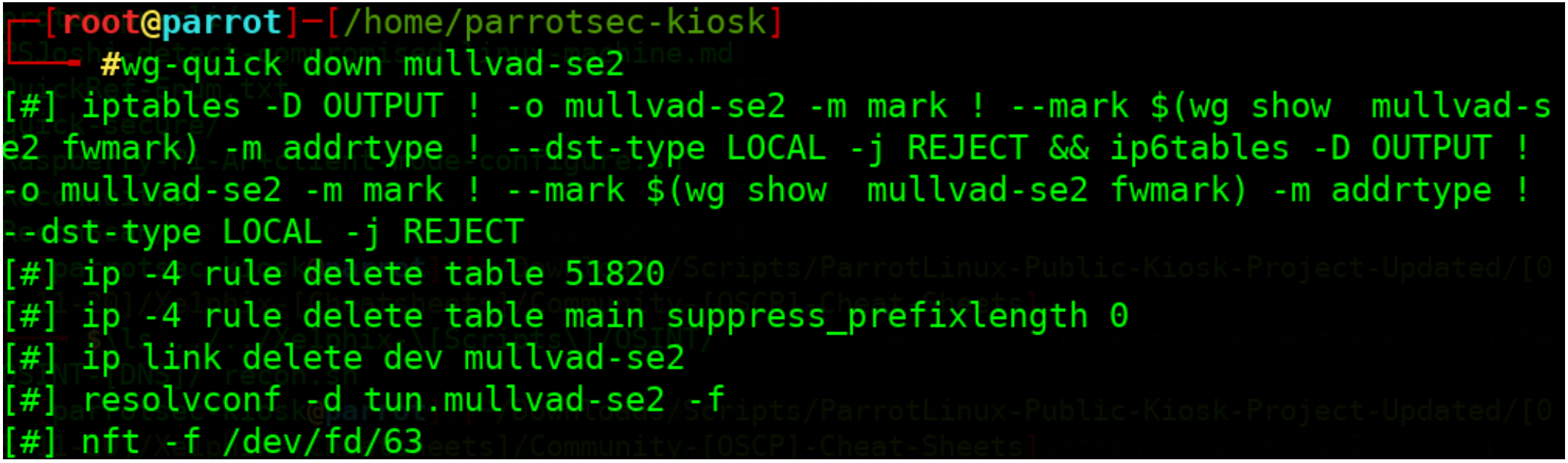
```
┌─[parrotsec-kiosk@parrot]─[~]
└──╼ $ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet 192.168.1.101  netmask 255.255.255.0  broadcast 192.168.1.255
        ether [redacted]  txqueuelen 1000  (Ethernet)
        RX packets 110525696  bytes 154223654529 (143.6 GiB)
        RX errors 0  dropped 2971  overruns 0  frame 0
        TX packets 60166078  bytes 15588710581 (14.5 GiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 20  memory 0xe1500000-e1520000

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 76017  bytes 6290667 (5.9 MiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 76017  bytes 6290667 (5.9 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

mullvad-se2: flags=209<UP,POINTOPOINT,RUNNING,NOARP>  mtu 1420
        inet [redacted]  netmask 255.255.255.255  destination [redacted]
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 1000  (UNSPEC)
        RX packets 4572595  bytes 6355760108 (5.9 GiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3382508  bytes 357405840 (340.8 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

```
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #wg show all
interface: mullvad-se2
  public key: [redacted]
  private key: (hidden)
  listening port: 39401
  fwmark: 0xca6c

peer: [redacted]
  endpoint: [redacted]:51820
  allowed ips: 0.0.0.0/0
  latest handshake: 1 minute, 51 seconds ago
  transfer: 2.73 GiB received, 126.99 MiB sent
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #wg show
show    showconf
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #wg showconf mullvad-se2
[Interface]
ListenPort = 39401
FwMark = 0xca6c
PrivateKey = [redacted]

[Peer]
PublicKey = [redacted]
AllowedIPs = 0.0.0.0/0
Endpoint = [redacted]:51820
```

Setting The Wireguard Interface Up

```
└─── #wg-quick up mullvad-se2
[#] ip link add mullvad-se2 type wireguard
[#] wg setconf mullvad-se2 /dev/fd/63
[#] ip -4 address add [redacted]/32 dev mullvad-se2
[#] ip link set mtu 1420 up dev mullvad-se2
[#] resolvconf -a tun.mullvad-se2 -m 0 -x
[#] wg set mullvad-se2 fwmark 51820
[#] ip -4 route add 0.0.0.0/0 dev mullvad-se2 table 51820
[#] ip -4 rule add not fwmark 51820 table 51820
[#] ip -4 rule add table main suppress_prefixlength 0
[#] sysctl -q net.ipv4.conf.all.src_valid_mark=1
[#] nft -f /dev/fd/63
[#] systemd-resolve -i mullvad-se2 --set-dns=193.138.218.74 --set-domain=~.
[#] iptables -I OUTPUT ! -o mullvad-se2 -m mark ! --mark $(wg show mullvad-se2 fwmark) -m a
ddrtype ! --dst-type LOCAL -j REJECT && ip6tables -I OUTPUT ! -o mullvad-se2 -m mark ! --ma
rk $(wg show mullvad-se2 fwmark) -m addrtype ! --dst-type LOCAL -j REJECT
```

Setting The Wireguard Interface Down



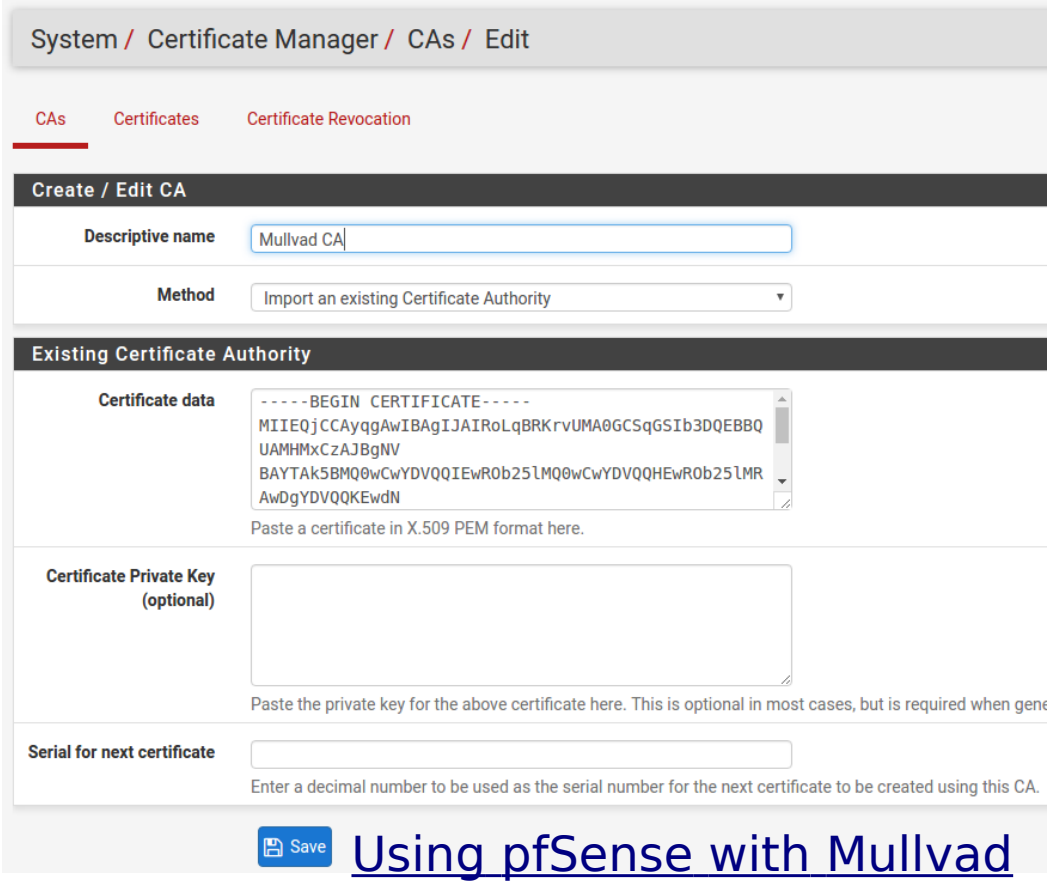
Wireguard – Packet Capturing

```
┌─[✗]─[root@parrotseckiosk-optiplex990]─[/home/parrotseckiosk/Downloads]
└──╼ #tcpdump -vn -i 2 -w Wireguard2.pcap
tcpdump: listening on wg-mullvad, link-type RAW (Raw IP), snapshot length 262144 bytes
^C1522 packets captured
1522 packets received by filter
0 packets dropped by kernel
```

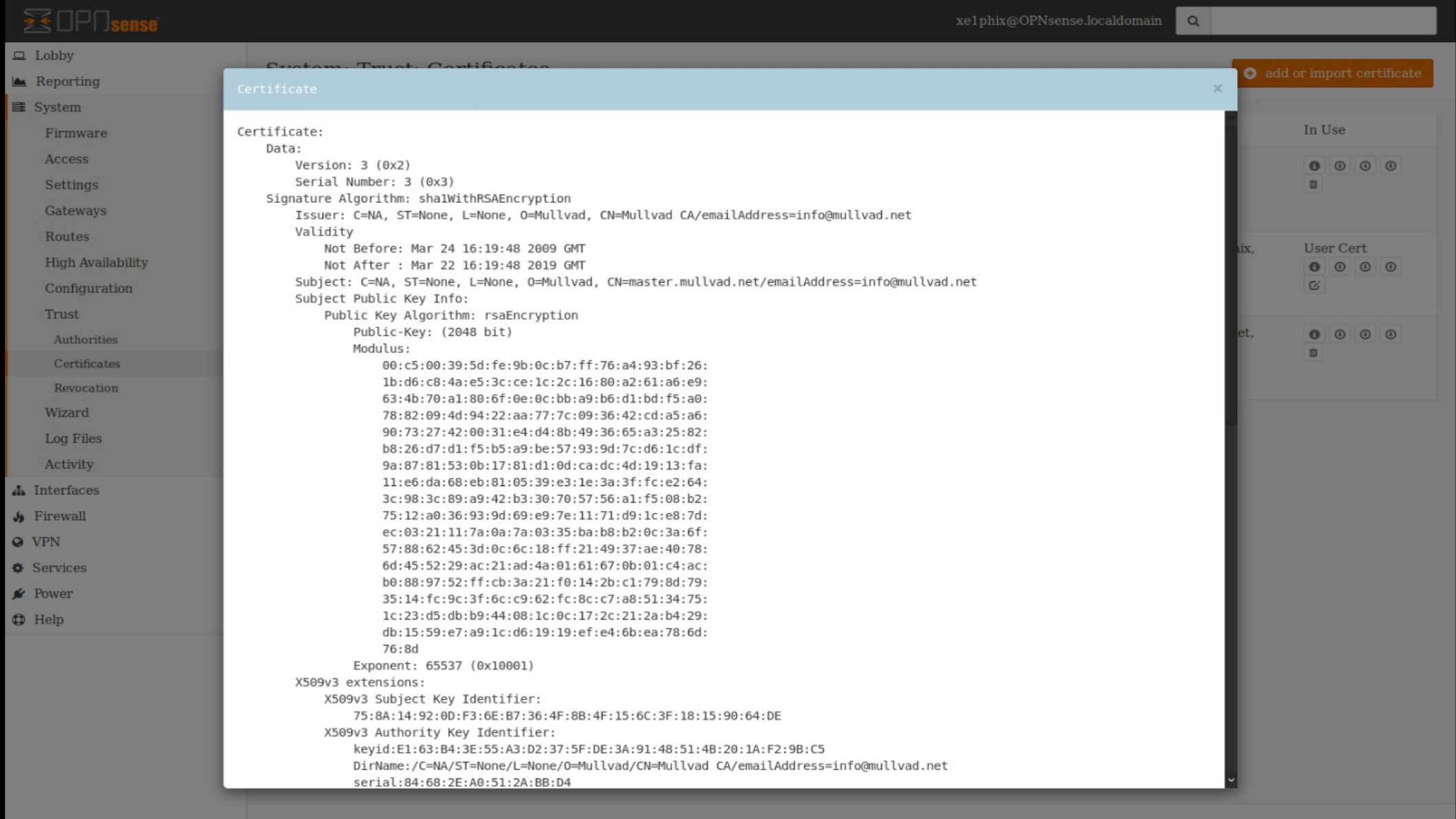
```
└──╼ #tcpdump -vn -i any 'port 51820'
tcpdump: data link type LINUX_SLL2
tcpdump: listening on any, link-type LINUX_SLL2 (Linux cooked v2), snapshot length 262144 bytes
23:18:49.592702 eth0  Out IP (tos 0x88, ttl 64, id 49418, offset 0, flags [none], proto UDP (17), length 176)
    173.22.75.86.35865 > 193.138.218.80.51820: UDP, length 148
23:18:49.725905 eth0  In  IP (tos 0x0, ttl 47, id 3184, offset 0, flags [none], proto UDP (17), length 120)
    193.138.218.80.51820 > 173.22.75.86.35865: UDP, length 92
23:18:49.726272 eth0  Out IP (tos 0x0, ttl 64, id 49439, offset 0, flags [none], proto UDP (17), length 124)
    173.22.75.86.35865 > 193.138.218.80.51820: UDP, length 96
23:18:49.726291 eth0  Out IP (tos 0x0, ttl 64, id 49440, offset 0, flags [none], proto UDP (17), length 124)
    173.22.75.86.35865 > 193.138.218.80.51820: UDP, length 96
└──╼ #tshark -i any -f 'port 51820'
Running as user "root" and group "root". This could be dangerous.
Capturing on 'any'
    1 0.000000000 193.138.218.82 → 173.22.75.86 WireGuard 140 Transport Data, receiver=0x3AB8D0E6, counter=19, datalen=64
    2 0.000137455 173.22.75.86 → 193.138.218.82 WireGuard 140 Transport Data, receiver=0xF118CCB1, counter=64, datalen=64
    3 0.000321491 173.22.75.86 → 193.138.218.82 WireGuard 428 Transport Data, receiver=0xF118CCB1, counter=65, datalen=352
    4 0.010524773 173.22.75.86 → 193.138.218.82 WireGuard 172 Transport Data, receiver=0xF118CCB1, counter=66, datalen=96
    5 0.010535063 173.22.75.86 → 193.138.218.82 WireGuard 172 Transport Data, receiver=0xF118CCB1, counter=67, datalen=96
    6 0.010540163 173.22.75.86 → 193.138.218.82 WireGuard 156 Transport Data, receiver=0xF118CCB1, counter=68, datalen=80
    7 0.060060201 193.138.218.82 → 173.22.75.86 WireGuard 140 Transport Data, receiver=0x3AB8D0E6, counter=20, datalen=64
    8 0.060190618 173.22.75.86 → 193.138.218.82 WireGuard 140 Transport Data, receiver=0xF118CCB1, counter=69, datalen=64
```

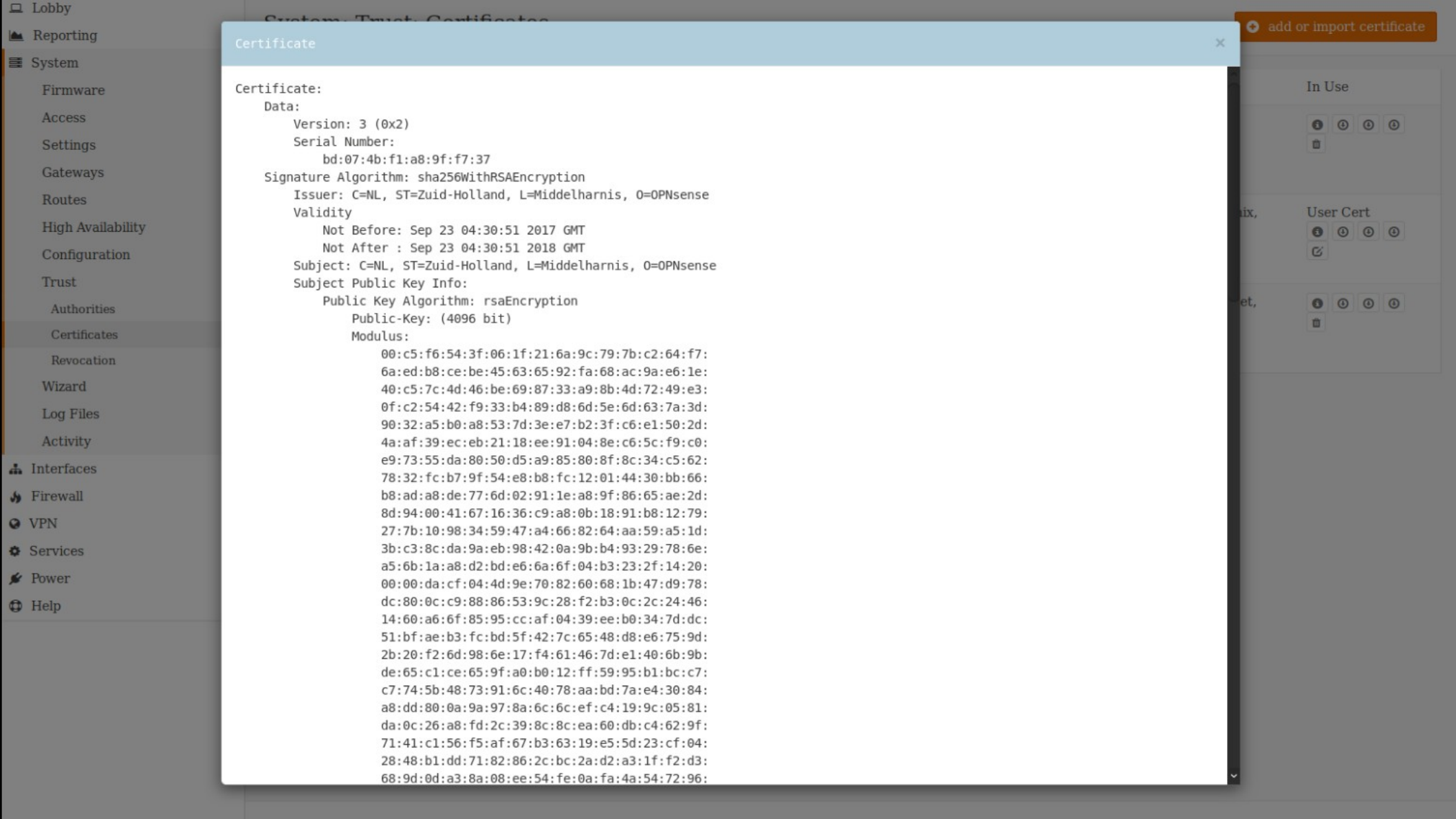
Add the Ca.crt to the Certificate Manager

1. Log in to your pfSense device click on "System" -> "Cert. manager" -> "CAs" and then click on "+Add"
2. Edit the descriptive name and name it Mullvad CA .
3. Set the Method to **Import an existing Certificate Authority**
4. Paste the certificates found in mullvad_ca.crt that was extracted earlier into the "Certificate data" field.
5. Click on Save.

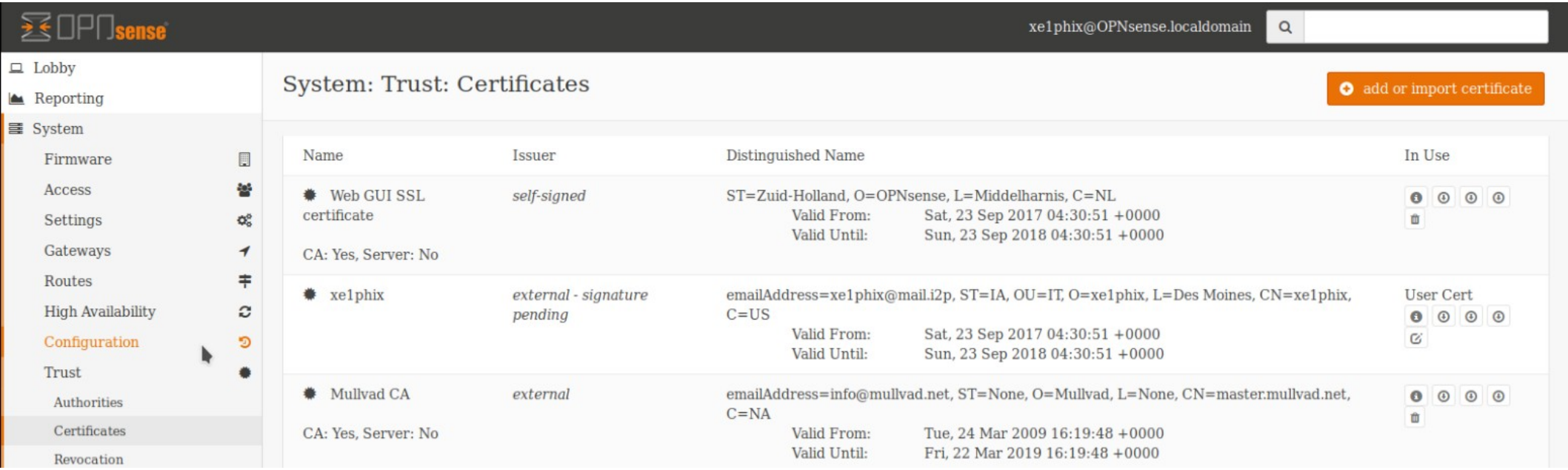


Using pfSense with Mullvad


xe1phix@OPNsense.localdomain
Lobby
Reporting
System
Firmware
Access
Settings
Gateways
Routes
High Availability
Configuration
Trust
Authorities
Certificates
Revocation
Wizard
Log Files
Activity
Interfaces
Firewall
VPN
Services
Power
Help
add or import certificate
In Use
User Cert
Certificate
Certificate:
Data:
Version: 3 (0x2)
Serial Number: 3 (0x3)
Signature Algorithm: sha1WithRSAEncryption
Issuer: C=NA, ST=None, L=None, O=Mullvad, CN=Mullvad CA/emailAddress=info@mullvad.net
Validity
Not Before: Mar 24 16:19:48 2009 GMT
Not After : Mar 22 16:19:48 2019 GMT
Subject: C=NA, ST=None, L=None, O=Mullvad, CN=master.mullvad.net/emailAddress=info@mullvad.net
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
Public-Key: (2048 bit)
Modulus:
00:c5:00:39:5d:fe:9b:0c:b7:ff:76:a4:93:bf:26:
1b:d6:c8:4a:e5:3c:ce:1c:2c:16:80:a2:61:a6:e9:
63:4b:70:a1:80:6f:0e:0c:bb:a9:b6:d1:bd:f5:a0:
78:82:09:4d:94:22:aa:77:7c:09:36:42:cd:a5:a6:
90:73:27:42:00:31:e4:d4:8b:49:36:65:a3:25:82:
b8:26:d7:d1:f5:b5:a9:be:57:93:9d:7c:d6:1c:df:
9a:87:81:53:0b:17:81:d1:0d:ca:dc:4d:19:13:fa:
11:e6:da:68:eb:81:05:39:e3:1e:3a:3f:fc:e2:64:
3c:98:3c:89:a9:42:b3:30:70:57:56:a1:f5:08:b2:
75:12:a0:36:93:9d:69:e9:7e:11:71:d9:1c:e8:7d:
ec:03:21:11:7a:0a:7a:03:35:ba:b8:b2:0c:3a:6f:
57:88:62:45:3d:0c:6c:18:ff:21:49:37:ae:40:78:
6d:45:52:29:ac:21:ad:4a:01:61:67:0b:01:c4:ac:
b0:88:97:52:ff:cb:3a:21:f0:14:2b:c1:79:8d:79:
35:14:fc:9c:3f:6c:c9:62:fc:8c:c7:a8:51:34:75:
1c:23:d5:db:b9:44:08:1c:0c:17:2c:21:2a:b4:29:
db:15:59:e7:a9:1c:d6:19:19:ef:e4:6b:ea:78:6d:
76:8d
Exponent: 65537 (0x10001)
X509v3 extensions:
X509v3 Subject Key Identifier:
75:8A:14:92:0D:F3:6E:B7:36:4F:8B:4F:15:6C:3F:18:15:90:64:DE
X509v3 Authority Key Identifier:
keyid:E1:63:B4:3E:55:A3:D2:37:5F:DE:3A:91:48:51:4B:20:1A:F2:9B:C5
DirName:/C=NA/ST=None/L=None/O=Mullvad/CN=Mullvad CA/emailAddress=info@mullvad.net
serial:84:68:2E:A0:51:2A:BB:D4


Lobby
Reporting
System
Firmware
Access
Settings
Gateways
Routes
High Availability
Configuration
Trust
Authorities
Certificates
Revocation
Wizard
Log Files
Activity
Interfaces
Firewall
VPN
Services
Power
Help
add or import certificate
In Use
User Cert
Certificate
Certificate:
Data:
Version: 3 (0x2)
Serial Number:
bd:07:4b:f1:a8:9f:f7:37
Signature Algorithm: sha256WithRSAEncryption
Issuer: C=NL, ST=Zuid-Holland, L=Middelharnis, O=OPNsense
Validity
Not Before: Sep 23 04:30:51 2017 GMT
Not After : Sep 23 04:30:51 2018 GMT
Subject: C=NL, ST=Zuid-Holland, L=Middelharnis, O=OPNsense
Subject Public Key Info:
Public Key Algorithm: rsaEncryption
Public-Key: (4096 bit)
Modulus:
00:c5:f6:54:3f:06:1f:21:6a:9c:79:7b:c2:64:f7:
6a:ed:b8:ce:be:45:63:65:92:fa:68:ac:9a:e6:1e:
40:c5:7c:4d:46:be:69:87:33:a9:8b:4d:72:49:e3:
0f:c2:54:42:f9:33:b4:89:d8:6d:5e:6d:63:7a:3d:
90:32:a5:b0:a8:53:7d:3e:e7:b2:3f:c6:e1:50:2d:
4a:af:39:ec:eb:21:18:ee:91:04:8e:c6:5c:f9:c0:
e9:73:55:da:80:50:d5:a9:85:80:8f:8c:34:c5:62:
78:32:fc:b7:9f:54:e8:b8:fc:12:01:44:30:bb:66:
b8:ad:a8:de:77:6d:02:91:1e:a8:9f:86:65:ae:2d:
8d:94:00:41:67:16:36:c9:a8:0b:18:91:b8:12:79:
27:7b:10:98:34:59:47:a4:66:82:64:aa:59:a5:1d:
3b:c3:8c:da:9a:eb:98:42:0a:9b:b4:93:29:78:6e:
a5:6b:1a:a8:d2:bd:e6:6a:6f:04:b3:23:2f:14:20:
00:00:da:cf:04:4d:9e:70:82:60:68:1b:47:d9:78:
dc:80:0c:c9:88:86:53:9c:28:f2:b3:0c:2c:24:46:
14:60:a6:6f:85:95:cc:af:04:39:ee:b0:34:7d:dc:
51:bf:ae:b3:fc:bd:5f:42:7c:65:48:d8:e6:75:9d:
2b:20:f2:6d:98:6e:17:f4:61:46:7d:e1:40:6b:9b:
de:65:c1:ce:65:9f:a0:b0:12:ff:59:95:b1:bc:c7:
c7:74:5b:48:73:91:6c:40:78:aa:bd:7a:e4:30:84:
a8:dd:80:0a:9a:97:8a:6c:6c:ef:c4:19:9c:05:81:
da:0c:26:a8:fd:2c:39:8c:8c:ea:60:db:c4:62:9f:
71:41:c1:56:f5:af:67:b3:63:19:e5:5d:23:cf:04:
28:48:b1:dd:71:82:86:2c:bc:2a:d2:a3:1f:f2:d3:
68:9d:0d:a3:8a:08:ee:54:fe:0a:fa:4a:54:72:96:

OPNSense – Import Mullvad Certificate

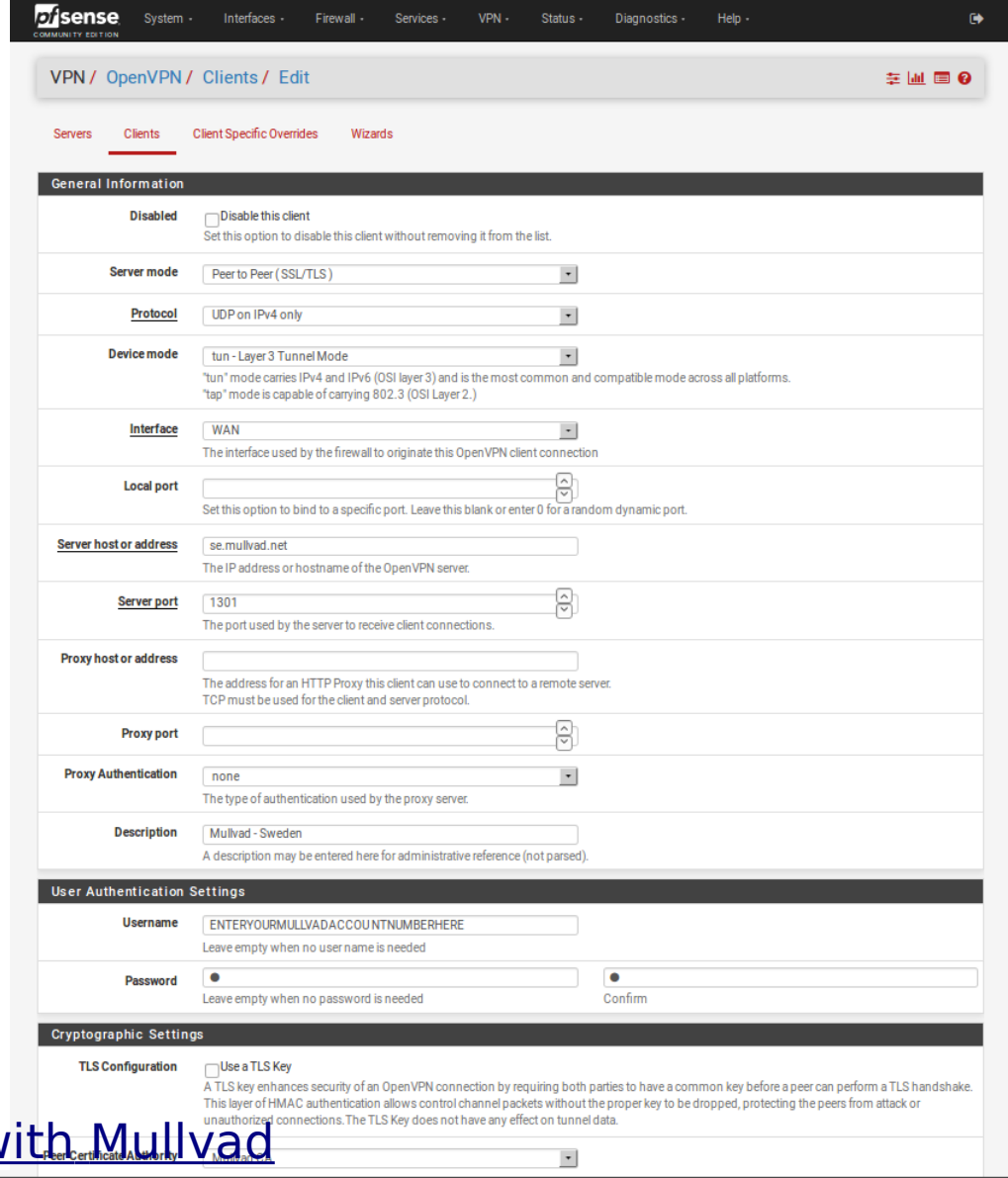


Add a VPN connection

This example will make use of **se**.mullvad.net. You can of course replace this server with any other country, region, or specific server that you wish to use. See our list of available servers.

Click on VPN -> OpenVPN -> Clients and then click on +Add

1. Set Server Mode to: Peer to Peer (SSL/TLS)
2. Set **Protocol** to: **UDP on IPV4 only**
3. Set **Device mode** to: **tun Layer 3 Tunnel Mode**
4. Set **Interface** to: **WAN**
5. Set **Server host** to: **se.mullvad.net**
6. Set **Server port** to: **1301**
7. Set Description to: Mullvad Sweden
8. Set your **mullvad account number as Username** under User Authentication Settings **(make sure it does not contain any spaces)**
9. set M as Password under User Authentication Settings
10. Set **TLS Configuration** to: **Unchecked**
11. Set Peer: **Certificate Authority** to: **Mullvad CA**
12. Set Client Certificate to: None (Username or Password required)
13. Set Encryption Algorithm to: **AES-256-GCM**
14. Set Enable Negotiate Cryptographic Parameters to: Checked
15. Add AES-256-GCM to the Allowed NCP Encryption Algorithms field.
16. Set **Auth digest Algorithm** to: **SHA384**
17. Set **Compression** to: **No LZO Compression** [Legacy style, comp-lzo no]
18. In the **Custom options** field, paste: **remote-cert-tls server**
19. Set UDP Fast I/O to : checked
20. Set Send/Recieve buffer to 1.00 MiB
21. Click Save.



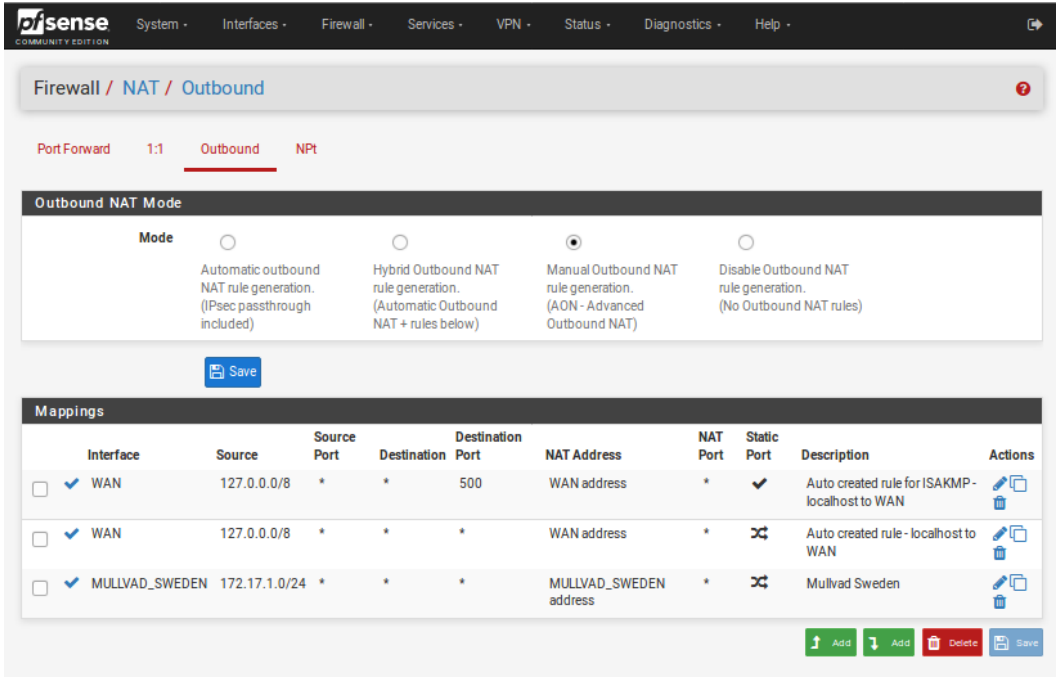
Add an Interface and NAT Rules

Add an Interface

1. Click on **Interfaces** -> **Assignments**
2. Use the Drop-down menu for the Available network ports: and select ovpnc* and then click on **+Add**
3. Click on the New interface name, it is usually named OPT1 or OPT2.
4. Set **Enable: Enable Interface** to be **checked**
5. Click on Save.

Add NAT rules

1. Click on Firewall -> NAT -> Outbound and then select Mode: "Manual Outbound NAT rule Generation (AON) and then click on Save.
2. Copy the entry that contains your local IP address (The one that does not contain port 500 nor 127.0.0.0 , In this example 172.17.1.0/24 is used, for you this will most like differ and will probably be 192.168.1.0/24) by clicking on the Copy icon found under Actions to the right of the NAT entry (Add a new mapping based on this one)
3. Click on the Pen icon (Edit mapping) and change so that interface is the mullvad one and write a description.
4. Make sure that both **Disabled** and **do not NAT** are **unchecked**
5. Delete the other rules that contain your local IP that exists via WAN , (keep the 127.0.0.0) This will ensure that you can not reach the internet if the VPN tunnel is down from your clients behind the pfSense router.
6. Click on Save.



[Using pfSense with Mullvad]

PFSense – Mullvad DoH DNS

DNS

1. Click on Services
2. Click on DHCP server
3. Set DNS server 1 to: 193.138.218.74
4. Set DNS server 2 to: 10.8.0.1
5. Click on Save

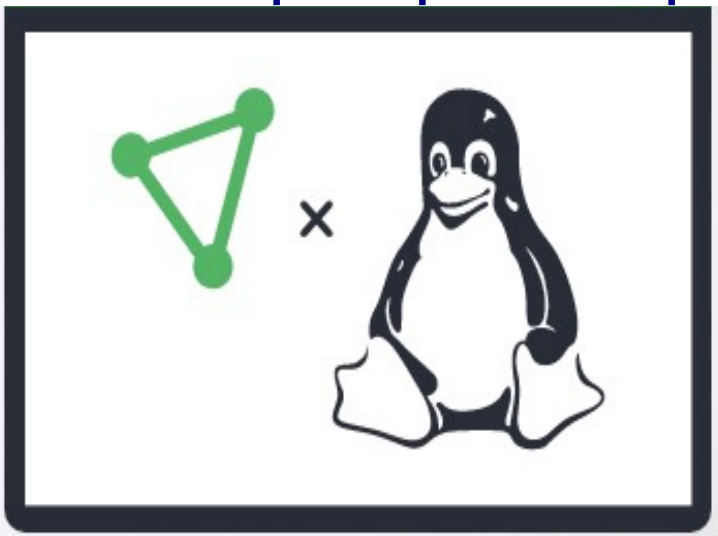
After you have completed these steps, click on VPN -> OpenVPN -> **Related status** icon and then click on the **Restart openvpn Service** found under Service to reload it all. Then on your client computers, go to https://ifconfig.co to see that they are working as intended.

ProtonVPN

- ProtonVPN
  - https://www.privacytools.io/providers/vpn/#protonvpn
  - https://protonvpn.com

ProtonVPN's Linux

Graphical User Interface



  - https://github.com/ProtonVPN
    - https://github.com/ProtonVPN/protonvpn-cli
    - https://github.com/ProtonVPN/linux-cli-community

ProtonVPN

Strong Encryption

We use only **the highest strength encryption** to protect your Internet connection. This means all your network traffic is encrypted with AES-256, key exchange is done with 4096-bit RSA, and HMAC with SHA384 is used for message authentication.

Strong Protocols

We use only **VPN protocols which are known to be secure** - IKEv2/IPSec and OpenVPN. ProtonVPN does not have any servers that support PPTP and L2TP/IPSec, even though they are less costly to operate. By using ProtonVPN, you can be confident that your VPN tunnel is protected by the most reliable protocol.

No Logs Policy

Under Swiss law, we are **not obligated to save any user connection logs**, nor can we be forced to perform targeted logging on specific users. This allows us to ensure that your private browsing history does, in fact, stay private and cannot be turned over to a third-party under any circumstances. Our no logs policy applies to all our users, including anyone using our free VPN.

Features

DNS Management

DNS Leak Protection

ProtonVPN-CLI features a DNS Leak Protection feature, which makes sure that your online traffic uses ProtonVPN's DNS Servers. This prevents third parties (like your ISP) from being able to see your DNS queries (and, therefore, your browsing history).

ProtonVPN-CLI accomplishes this by updating the `/etc/resolv.conf` file when you connect to a VPN server, and makes sure that only ProtonVPN's DNS Server is written in this file. It will also backup the previous state of `/etc/resolv.conf` to revert all changes upon disconnection.

Please note that if you change your network (e.g., if you connect to a different WiFi hotspot) without first disconnecting, `/etc/resolv.conf` will likely be updated, which would remove ProtonVPN's DNS Servers. This could cause DNS leaks, so to keep your data safe, use `protonvpn reconnect` after changing your network.

Custom DNS

You can also make a custom DNS server your default for all your ProtonVPN connections. ProtonVPN-CLI lets you add up to 3 custom DNS Servers.

Enabling Custom DNS

To configure custom DNS Servers, use the `protonvpn configure` command, then press `4` to choose DNS Management. Then press `2` to choose that you want to configure a custom DNS Server. Now enter the IP addresses of up to 3 DNS Servers you want to use and confirm with Enter.

Disabling DNS Management

If you don't want ProtonVPN-CLI to do any changes to your DNS, you can do this as well. This will cause ProtonVPN-CLI to not touch `/etc/resolv.conf` and your device will always use the DNS servers configured by you or through your network.

Disabling any DNS management

To enable DNS Leak Protection use the `protonvpn configure` command, then pre
choose DNS Management. Then press `3` to disable any DNS management.

IPv6 Leak Protection

ProtonVPN-CLI features an IPv6 Leak Protection feature. It makes sure that your IPv6 address is not leaked when you connect to a ProtonVPN server.

This feature is enabled by default, and for security reasons, it can't be disabled.

It works by detecting the IPv6 address, backing it up, and removing it from the default interface. When disconnecting, it adds the IPv6 address back to the default interface and deletes the backup.

Kill Switch and Always-on VPN

ProtonVPN applications offer a **built-in Kill Switch feature** or the **Always-on VPN feature**. In the event that you lose connection with the VPN server, Kill Switch blocks all network traffic, while Always-on automatically re-establishes a connection to a VPN server. These features prevent a VPN server disconnect from inadvertently compromising your privacy by revealing your true IP address.

Open Source

Founded by MIT and CERN scientists, ProtonVPN believes in transparency and peer review. Our apps are 100% open source, so anyone can examine our code. This transparency means that you can have confidence that our apps are doing what they are supposed to be doing, and only what they are supposed to be doing. You can see the code for all our apps on GitHub. Learn More

DNS Leak Prevention

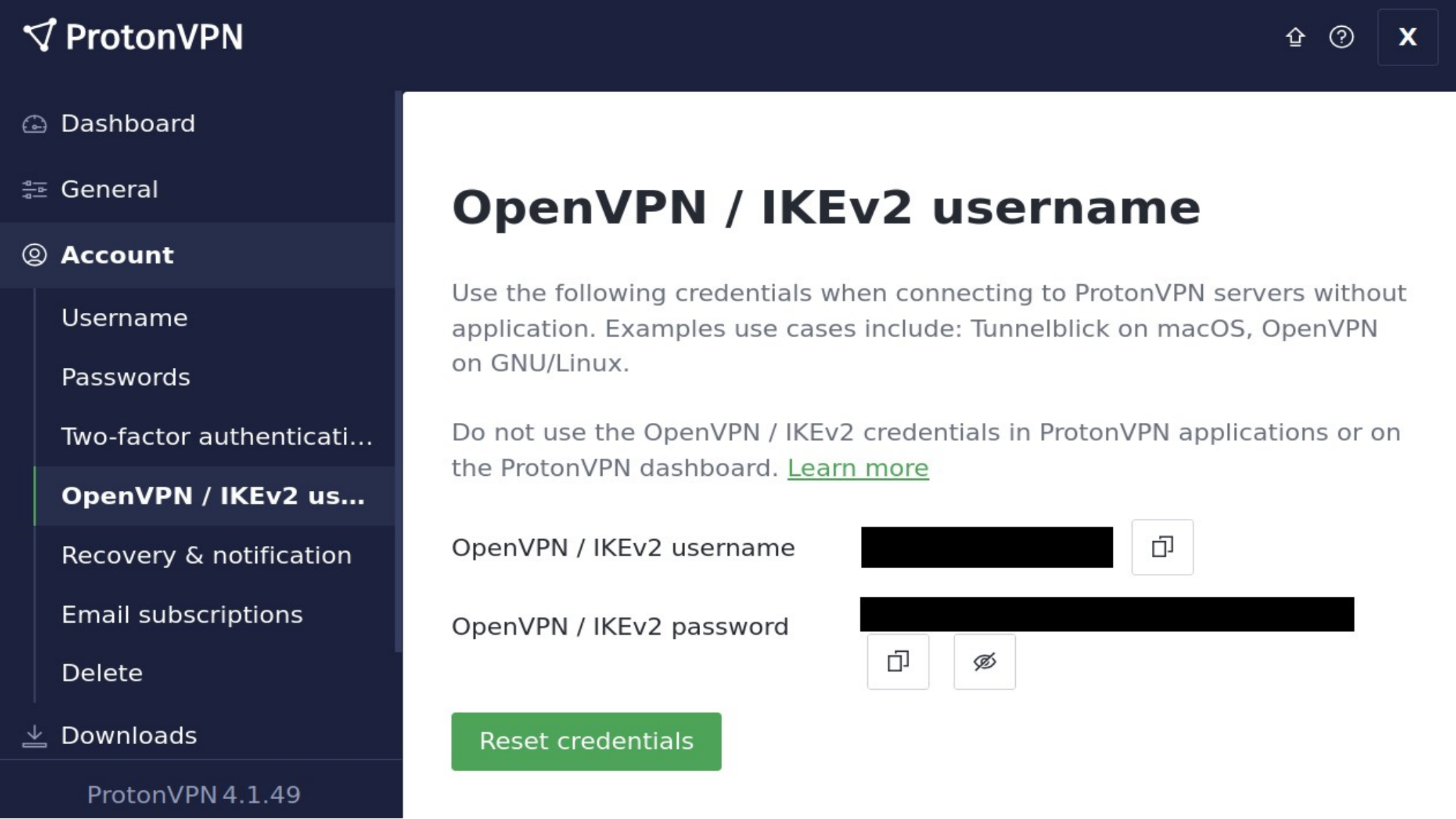
ProtonVPN doesn't just protect your browsing traffic, **we also protect your DNS queries**. By routing your DNS queries through the encrypted tunnel and not relying on third-party DNS providers, we ensure that your browsing activity cannot be exposed by leaks from DNS queries.

```
echo "## ------------------------------------------------------------------------------ ##"
echo "##     [+]  Downloading The ProtonVPN Code Signing Key:"
echo "##\_____________________________________________________________________________/##"
curl --verbose --progress-bar --tlsv1.2 --ssl-reqd --url https://repo.protonvpn.com/debian/public_key.asc --output ~/ProtonVPN-Public-Key.asc
echo "## ------------------------------------------------------------------------------ ##"
echo "##     [+]  Importing The ProtonVPN Code Signing Key:"
echo "##\_____________________________________________________________________________/##"
gpg --keyid-format 0xlong --import public_key.asc
echo "## ------------------------------------------------------------------------------ ##"
echo "##     [+]  Fingerprinting The ProtonVPN Code Signing Key..."
echo "##\_____________________________________________________________________________/##"
gpg --keyid-format 0xlong --fingerprint 0x0x71EB474019940E11
gpg --keyid-format 0xlong --fingerprint 0xA88441BD4864F95BEE08E63A71EB474019940E11
echo "## ------------------------------------------------------------------------------ ##"
echo "##                  [+]  ProtonVPN GPG Fingerprints (Verified):                   "
echo "##\_____________________________________________________________________________/##"
echo
echo "## ------------------------------------------------------------------------------ ##"
echo "      Key fingerprint = A884 41BD 4864 F95B EE08  E63A 71EB 4740 1994 0E11       "
echo "## ------------------------------------------------------------------------------ ##"
echo "            A884 41BD 4864 F95B EE08  E63A 71EB 4740 1994 0E11                  "
echo "            A884 41BD 4864 F95B EE08  E63A 71EB 4740 1994 0E11                  "
echo "## ------------------------------------------------------------------------------ ##"
echo "       [?]  See https://protonvpn.com/support/official-linux-client-arch/"
echo "## ------------------------------------------------------------------------------ ##"
echo "## ------------------------------------------------------------------------------ ##"
echo "##     [+]  Signing The ProtonVPN Code Signing Key..."
echo "##\_____________________________________________________________________________/##"
gpg --lsign 0xA88441BD4864F95BEE08E63A71EB474019940E11
```

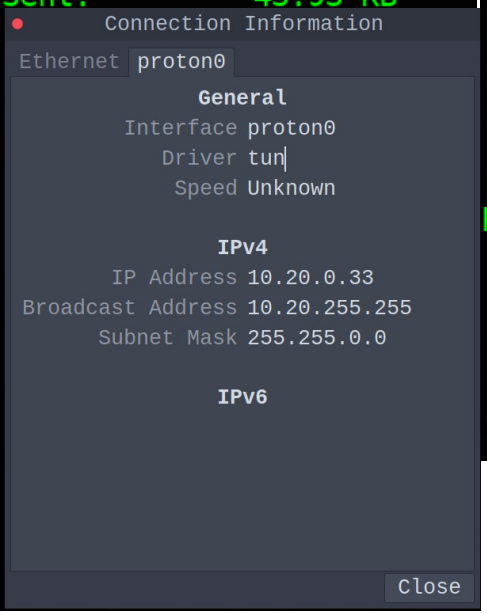
```
└── $curl --verbose --progress-bar --tlsv1.3 --ssl-reqd --url https://repo.protonvpn.com/debian/public_key.asc
*   Trying 104.26.9.21:443...
* Connected to repo.protonvpn.com (104.26.9.21) port 443 (#0)
* ALPN, offering h2
* ALPN, offering http/1.1
* successfully set certificate verify locations:
*  CAfile: /etc/ssl/certs/ca-certificates.crt
*  CApath: /etc/ssl/certs
* TLSv1.3 (OUT), TLS handshake, Client hello (1):
* TLSv1.3 (IN), TLS handshake, Server hello (2):
* TLSv1.3 (IN), TLS handshake, Encrypted Extensions (8):
* TLSv1.3 (IN), TLS handshake, Certificate (11):
* TLSv1.3 (IN), TLS handshake, CERT verify (15):
* TLSv1.3 (IN), TLS handshake, Finished (20):
* TLSv1.3 (OUT), TLS change cipher, Change cipher spec (1):
* TLSv1.3 (OUT), TLS handshake, Finished (20):
* SSL connection using TLSv1.3 / TLS_AES_256_GCM_SHA384
* ALPN, server accepted to use h2
* Server certificate:
*  subject: C=US; ST=California; L=San Francisco; O=Cloudflare, Inc.; CN=sni.cloudflaressl.com
*  start date: Jul  8 00:00:00 2021 GMT
*  expire date: Jul  7 23:59:59 2022 GMT
*  subjectAltName: host "repo.protonvpn.com" matched cert's "*.protonvpn.com"
*  issuer: C=US; O=Cloudflare, Inc.; CN=Cloudflare Inc ECC CA-3
*  SSL certificate verify ok.
* Using HTTP2, server supports multi-use
* Connection state changed (HTTP/2 confirmed)
* Copying HTTP/2 data in stream buffer to connection buffer after upgrade: len=0
* Using Stream ID: 1 (easy handle 0x5634538a96d0)
> GET /debian/public_key.asc HTTP/2
> Host: repo.protonvpn.com
```

```
┌─[root@parrotseckiosk-optiplex990]─[/home/parrotseckiosk/Downloads]
└──╼ #protonvpn init
```

```
                                    [ -- PROTONVPN-CLI INIT -- ]

ProtonVPN uses two different sets of credentials, one for the website and official apps where the username is most
likely your e-mail, and one for connecting to the VPN servers.

You can find the OpenVPN credentials at https://account.protonvpn.com/account.

--- Please make sure to use the OpenVPN credentials ---

Enter your ProtonVPN OpenVPN username:
Enter your ProtonVPN OpenVPN password:
Confirm your ProtonVPN OpenVPN password:

Please choose your ProtonVPN Plan
1) Free
2) Basic
3) Plus
4) Visionary
Your plan: 1

Choose the default OpenVPN protocol.
OpenVPN can act on two different protocols: UDP and TCP.
UDP is preferred for speed but might be blocked in some networks.
TCP is not as fast but a lot harder to block.
Input your preferred protocol. (Default: UDP)

1) UDP
2) TCP

Your choice: 1

You entered the following information:
Username:
Password:
Tier: Free
Default protocol: UDP

Is this information correct? [Y/n]: Y
Writing configuration to disk...

Done! Your account has been successfully initialized.
```


ProtonVPN
X
Dashboard
General
Account
Username
Passwords
Two-factor authenticati...
OpenVPN / IKEv2 us...
Recovery & notification
Email subscriptions
Delete
Downloads
ProtonVPN 4.1.49
OpenVPN / IKEv2 username
Use the following credentials when connecting to ProtonVPN servers without application. Examples use cases include: Tunnelblick on macOS, OpenVPN on GNU/Linux.
Do not use the OpenVPN / IKEv2 credentials in ProtonVPN applications or on the ProtonVPN dashboard. Learn more
OpenVPN / IKEv2 username
OpenVPN / IKEv2 password
Reset credentials

```
#protonvpn status
Status:          Connected
Time:            0:00:11
IP:              217.23.3.92
Server:          NL-FREE#1
Features:        Normal
Protocol:        UDP
Kill Switch:     Disabled
Country:         Netherlands
City:            None
Load:            94%
Received:        53.42 KB
Sent:            43.93 KB
```




```
#ifconfig -a
eth0: flags=4163<UP,BROADCAST,RUNNING,MULTICAST>  mtu 1500
        inet [redacted]  netmask 255.255.248.0  broadcast [redacted]
        ether [redacted]  txqueuelen 1000  (Ethernet)
        RX packets 26601869  bytes 30559580029 (28.4 GiB)
        RX errors 0  dropped 302  overruns 0  frame 0
        TX packets 4574340  bytes 786584361 (750.1 MiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
        device interrupt 20  memory 0xe1500000-e1520000

lo: flags=73<UP,LOOPBACK,RUNNING>  mtu 65536
        inet 127.0.0.1  netmask 255.0.0.0
        loop  txqueuelen 1000  (Local Loopback)
        RX packets 4817  bytes 648231 (633.0 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 4817  bytes 648231 (633.0 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0

proton0: flags=4305<UP,POINTOPOINT,RUNNING,NOARP,MULTICAST>  mtu 1500
        inet 10.20.0.33  netmask 255.255.0.0  destination 10.20.0.33
        unspec 00-00-00-00-00-00-00-00-00-00-00-00-00-00-00-00  txqueuelen 500  (UNSPEC)
        RX packets 1821  bytes 592142 (578.2 KiB)
        RX errors 0  dropped 0  overruns 0  frame 0
        TX packets 3203  bytes 348758 (340.5 KiB)
        TX errors 0  dropped 0 overruns 0  carrier 0  collisions 0
```

https://github.com/ProtonVPN/linux-cli-community/blob/master/USAGE.md

ProtonVPN – DNS Leak Protection

```
└──╼ #protonvpn configure
What do you want to change?

1) Username and Password
2) ProtonVPN Plan
3) Default Protocol
4) DNS Management
5) Kill Switch
6) Split Tunneling
7) Purge Configuration

Please enter your choice or leave empty to quit: 4

DNS Leak Protection makes sure that you always use ProtonVPN's DNS servers.
For security reasons this option is recommended.

1) Enable DNS Leak Protection (recommended)
2) Configure Custom DNS Servers
3) Disable DNS Management

Please enter your choice or leave empty to quit: 1
```

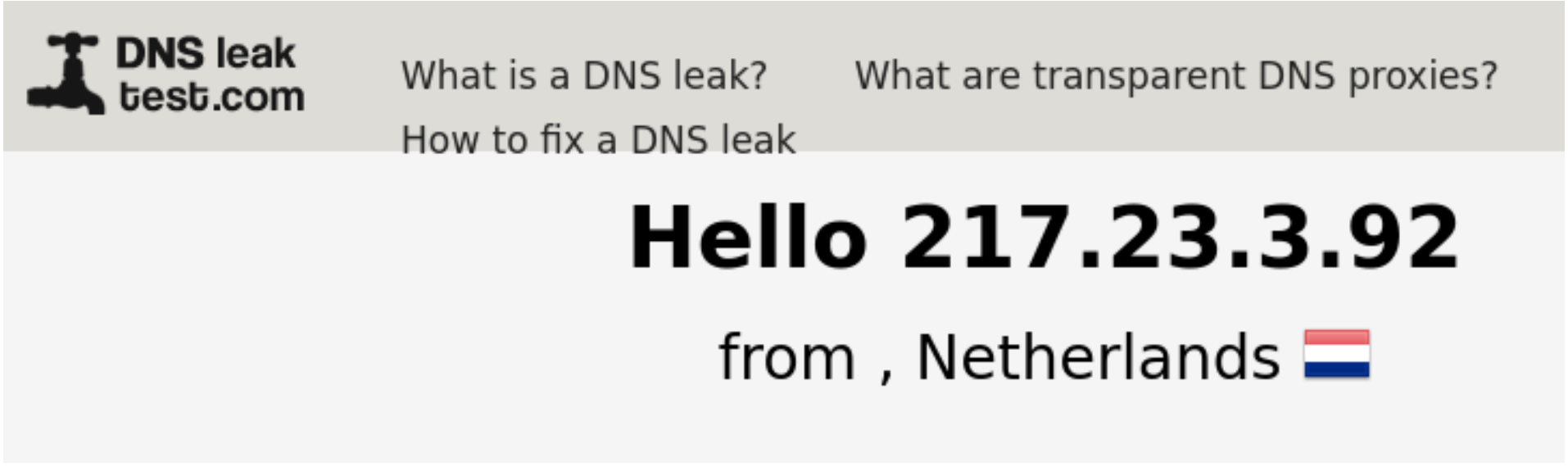
https://github.com/ProtonVPN/linux-cli-community/blob/master/USAGE.md

ProtonVPN – Enable Kill Switch

```
└──╼ #protonvpn configure
What do you want to change?

1) Username and Password
2) ProtonVPN Plan
3) Default Protocol
4) DNS Management
5) Kill Switch
6) Split Tunneling
7) Purge Configuration

Please enter your choice or leave empty to quit: 5

The Kill Switch will block all network traffic
if the VPN connection drops unexpectedly.

Please note that the Kill Switch assumes only one network interface being active.

1) Enable Kill Switch (Block access to/from LAN)
2) Enable Kill Switch (Allow access to/from LAN)
3) Disable Kill Switch

Please enter your choice or leave empty to quit: 1

Kill Switch configuration updated.
```

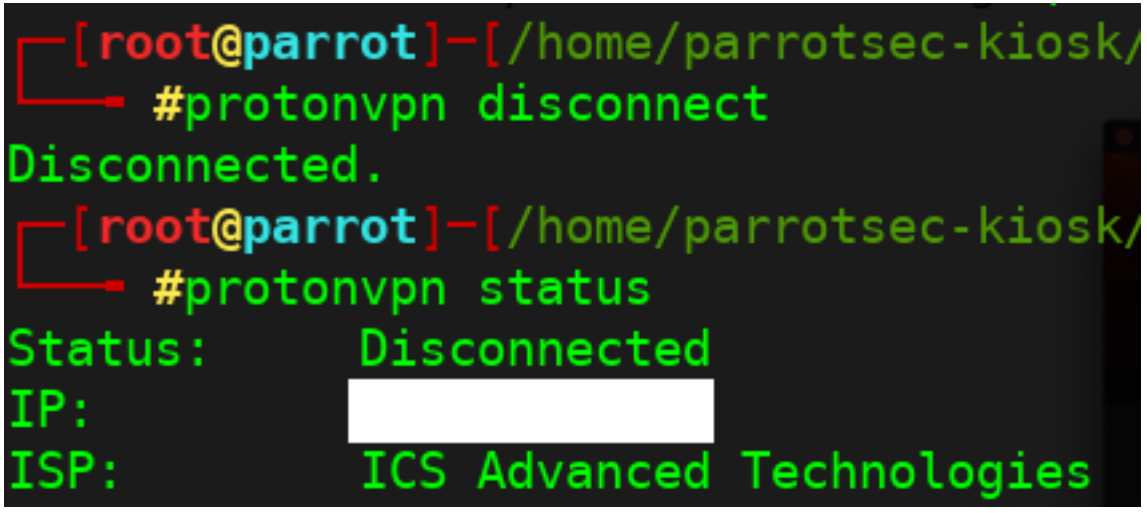
https://github.com/ProtonVPN/linux-cli-community/blob/master/USAGE.md

ProtonVPN – DNSLeakTest



https://github.com/ProtonVPN/linux-cli-community/blob/master/USAGE.md

ProtonVPN - Disconnect



https://github.com/ProtonVPN/linux-cli-community/blob/master/USAGE.md

Journalctl

```
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #systemctl list-unit-files --type=service |  grep enabled
networking.service                          disabled        enabled
NetworkManager-dispatcher.service           enabled         enabled
NetworkManager-wait-online.service          enabled         enabled
NetworkManager.service                      enabled         enabled
┌──[✗]─[root@parrot]─[/home/parrotsec-kiosk]
└─── #journalctl --since "yesterday"
```

```
└─── #journalctl -u NetworkManager.service
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #journalctl -u openvpn.service
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #journalctl -u systemd-resolved.service
┌──[root@parrot]─[/home/parrotsec-kiosk]
└─── #journalctl --disk-usage
Archived and active journals take up 4.1G in the file system.
```

```
## Display 500 most recent journalctl entries (with paging)
journalctl -n 500
```

Journalctl Cheatsheet

```
journalctl --list-boots | head          ## ------------------------------------------------ ##
                                        ## Show a list of IDs, and the timestamps of boots
                                        ## ------------------------------------------------ ##
journalctl -k                           ## kernel messages
                                        ## ------------------------------------------------ ##
journalctl -k -f                        ## Follow kernel messages
                                        ## ------------------------------------------------ ##
journalctl -u NetworkManager.service    ## Show messages for the unit NetworkManager
                                        ## ------------------------------------------------ ##
journalctl -f -u NetworkManager.service ## Follow service
                                        ## ------------------------------------------------ ##
journalctl -u httpd.service             ## Show messages for the unit httpd
                                        ## ------------------------------------------------ ##
journalctl -k -b -1                     ## view the boot logs
                                        ## ------------------------------------------------ ##
journalctl /dev/sda                     ## All logs of the kernel device node `/dev/sda`
                                        ## ------------------------------------------------ ##
journalctl -u systemd-networkd          ## Show messages for the unit systemd-networkd
                                        ## ------------------------------------------------ ##
journalctl -u auditd.service            ## Show messages for the unit auditd
                                        ## ------------------------------------------------ ##
journalctl --list-boots                 ## check only boot messages
                                        ## ------------------------------------------------ ##
journalctl -b $BootID                   ## Show boot messages for a selected boot ID
                                        ## ------------------------------------------------ ##
```

Lsof Cheatsheet 2

Show process that use internet connection at the moment

```
lsof -P -i -n
```

Show process that use specific port number

```
lsof -i tcp:443
```

Lists all listening ports together with the PID of the associated process

```
lsof -Pan -i tcp -i udp
```

List all open ports and their owning executables

```
lsof -i -P | grep -i "listen"
```

Show all open ports

```
lsof -Pnl -i
```

```
└─ #lsof +D /var/log
COMMAND      PID USER   FD   TYPE DEVICE  SIZE/OFF   NODE NAME
systemd-j    466 root   63u   REG   0,26 134217728 885160 /var/log/journal/52e38e44c61345b7b00c11e48e79f827/system.journal
systemd-j    466 root   66u   REG   0,26   8388608 885161 /var/log/journal/52e38e44c61345b7b00c11e48e79f827/user-1000.journal
fail2ban-   1073 root    3w   REG   0,26      2338 725109 /var/log/fail2ban.log
lightdm     1074 root    6w   REG   0,26      5750 777051 /var/log/lightdm/lightdm.log
Xorg        1091 root    1w   REG   0,26     17757 777052 /var/log/lightdm/x-0.log
Xorg        1091 root    2w   REG   0,26     17757 777052 /var/log/lightdm/x-0.log
Xorg        1091 root    6w   REG   0,26     69772 777055 /var/log/Xorg.0.log
mullvad-d 436402 root    3w   REG   0,26      5920 884127 /var/log/mullvad-vpn/daemon.log
```

```
└─ #lsof -iTCP -sTCP:ESTABLISHED
COMMAND     PID          USER   FD   TYPE  DEVICE SIZE/OFF NODE NAME
Telegram   2560 parrotseckiosk   42u  IPv4 5786431      0t0  TCP 192.168.1.101:36390->149.154.175.51:https (ESTABLISHED)
Telegram   2560 parrotseckiosk   47u  IPv4 6757561      0t0  TCP 192.168.1.101:51636->149.154.175.50:https (ESTABLISHED)
Telegram   2560 parrotseckiosk   57u  IPv4 6128828      0t0  TCP 192.168.1.101:37756->149.154.175.51:https (ESTABLISHED)
firefox  582761 parrotseckiosk  122u  IPv4 6967670      0t0  TCP 192.168.1.101:33956->ec2-35-155-44-228.us-west-2.compute.amazonaws.com:https (ESTABLISHED)
firefox  582761 parrotseckiosk  144u  IPv4 7188861      0t0  TCP 192.168.1.101:38414->185-70-42-42.protonmail.ch:https (ESTABLISHED)
firefox  582761 parrotseckiosk  169u  IPv4 7271230      0t0  TCP 192.168.1.101:43238->ec2-18-200-77-145.eu-west-1.compute.amazonaws.com:https (ESTABLISHED)
firefox  582761 parrotseckiosk  170u  IPv4 7271235      0t0  TCP 192.168.1.101:43240->ec2-18-200-77-145.eu-west-1.compute.amazonaws.com:https (ESTABLISHED)
firefox  582761 parrotseckiosk  312u  IPv4 7217745      0t0  TCP 192.168.1.101:33368->ec2-54-232-131-104.sa-east-1.compute.amazonaws.com:https (ESTABLISHED)
```

```
└─ #lsof -c Telegram
COMMAND   PID          USER   FD      TYPE             DEVICE  SIZE/OFF   NODE NAME
Telegram 2560 parrotseckiosk  cwd       DIR               0,36        52  11522 /home/parrotseckiosk/.local/share/TelegramDesktop
Telegram 2560 parrotseckiosk  rtd       DIR               0,26       312    256 /
Telegram 2560 parrotseckiosk  txt       REG               0,36 105740848 313881 /home/parrotseckiosk/Downloads/Telegram/Telegram
Telegram 2560 parrotseckiosk  mem       REG               0,24           313881 /home/parrotseckiosk/Downloads/Telegram/Telegram
```

```
└─ #lsof -p $(pgrep firefox)
COMMAND    PID          USER   FD      TYPE             DEVICE SIZE/OFF    NODE NAME
firefox 582761 parrotseckiosk  cwd       DIR               0,65      300       2 /home/parrotseckiosk
firefox 582761 parrotseckiosk  rtd       DIR               0,26      312     256 /
firefox 582761 parrotseckiosk  txt       REG               0,26   658808   23747 /usr/lib/firefox/firefox
firefox 582761 parrotseckiosk  mem       REG               0,24            23747 /usr/lib/firefox/firefox
```

```
└─ #lsof -p $(pgrep qbittorrent)
COMMAND     PID          USER   FD      TYPE             DEVICE SIZE/OFF   NODE NAME
qbittorre 11156 parrotseckiosk  cwd       DIR              0,133      240      2 /home/parrotseckiosk
qbittorre 11156 parrotseckiosk  rtd       DIR               0,26      312    256 /
qbittorre 11156 parrotseckiosk  txt       REG              0,115  8911176     38 /usr/bin/qbittorrent
```

Fuser Cheatsheet

```
## ------------------------------------------------------------------------------------------------ ##
    fuser /var/log/daemon.log       ## Show which processes use the file
## ------------------------------------------------------------------------------------------------ ##
    fuser -v /home/$User            ## Show which processes are used in the home directory
## ------------------------------------------------------------------------------------------------ ##
    fuser -ki $File                 ## Kills a process that is locking a file
## ------------------------------------------------------------------------------------------------ ##
    fuser -k -HUP $File             ## Kills a process with specific signal
## ------------------------------------------------------------------------------------------------ ##
    fuser -v 53/udp                 ## Show what PID is listening on specific port
## ------------------------------------------------------------------------------------------------ ##
    fuser -mv /var/www              ## Show all processes using the named filesystems or block device
## ------------------------------------------------------------------------------------------------ ##
```

Xe1phix-[FUser]-Cheatsheet

Kill Cheatsheet

```
## ------------------------------------------------------------------------------------------------------------------------ ##
    kill -s TERM $PID              ## (15) TERM (software termination signal)
## ------------------------------------------------------------------------------------------------------------------------ ##
    killall -1 $Service            ## (1) HUP (hang up)
## ------------------------------------------------------------------------------------------------------------------------ ##
    kill -SIGHUP $PID              ## (1) HUP (hang up)
## ------------------------------------------------------------------------------------------------------------------------ ##
    pkill -9 $Service              ## (9) KILL (noncatchable, nonignorable)
## ------------------------------------------------------------------------------------------------------------------------ ##
    kill -SIGKILL $PID             ## (9)  SIGKILL (Kill signal)
## ------------------------------------------------------------------------------------------------------------------------ ##
    killall -9 $Service            ## (9)  SIGKILL (Kill signal)
## ------------------------------------------------------------------------------------------------------------------------ ##
    pkill -TERM -u $User           ## (15) TERM (software termination signal)
## ------------------------------------------------------------------------------------------------------------------------ ##
    kill -SIGTERM $PID             ## (15) SIGTERM (Termination signal.)
## ------------------------------------------------------------------------------------------------------------------------ ##
    fuser -k -TERM -m /home        ## (15) Kill every process accessing /home
## ------------------------------------------------------------------------------------------------------------------------ ##
    fuser -mk /dev/sdc             ## (15) Kill all processes using /dev/sdc
## ------------------------------------------------------------------------------------------------------------------------ ##
    kill $(lsof -t /home)          ## (15) Kill all processes with open files in /home.
    kill `lsof -t /home`           ## (15) Kill all processes with open files in /home.
## ------------------------------------------------------------------------------------------------------------------------ ##
```

PID Cheatsheet

```
## ------------------------------------------------------------------------------------------ ##
   pgrep -u $User          ## Find the process ID of user
## ------------------------------------------------------------------------------------------ ##
   pcat -v $PID            ## Displays the location of each memory region that is being copied
## ------------------------------------------------------------------------------------------ ##
   pmap -d $PID            ## Provide Libraries loaded by a running process with pmap
## ------------------------------------------------------------------------------------------ ##
   pidstat -p $PID         ## Gather resource consumption details for a specific target process
## ------------------------------------------------------------------------------------------ ##
```

STrace Cheatsheet

```
## ------------------------------------------------------------------------------ ##
   strace -T                        ## Display syscall duration In the output
## ------------------------------------------------------------------------------ ##
   strace -c                        ## See what time is spend and where
## ------------------------------------------------------------------------------ ##
   strace -f                        ## Track process including forked child processes
## ------------------------------------------------------------------------------ ##
   strace -e open                   ## Monitor Opening of Files
## ------------------------------------------------------------------------------ ##
   strace -P $Path                  ## Track a process when interacting with a path
## ------------------------------------------------------------------------------ ##
   strace -o $File.txt              ## Log strace output to a file
## ------------------------------------------------------------------------------ ##
   strace -e trace=$File -p $PID    ## Trace File Activity
## ------------------------------------------------------------------------------ ##
   strace -e trace=$Desc -p $PID    ## Trace File Descriptor
## ------------------------------------------------------------------------------ ##
   strace -e trace=$Ipc             ## Track communication between processes (IPC)
## ------------------------------------------------------------------------------ ##
   strace -e trace=$Signal          ## Track process signal handling (like HUP, exit)
## ------------------------------------------------------------------------------ ##
   strace -e trace=$File            ## Track file related syscalls
## ------------------------------------------------------------------------------ ##
   strace -e trace=process          ## Track process calls (like fork, exec)
## ------------------------------------------------------------------------------ ##
   strace -e trace=memory           ## Track Memory syscalls
## ------------------------------------------------------------------------------ ##
   strace -e trace=network          ## Track Network syscalls
## ------------------------------------------------------------------------------ ##
```

SS – Socket Statistics

```
┌─[root@parrotseckiosk-optiplex990]─[/home/parrotseckiosk/Downloads/PDFs/Archive.org/LinuxBooks]
└──╼ #ss -o state established '( dport = :https or sport = :https )'
Netid  Recv-Q   Send-Q     Local Address:Port       Peer Address:Port   Process
tcp    0        0          192.168.1.101:34252      185.70.42.42:https
tcp    0        0          192.168.1.101:47300     52.37.190.150:https   timer:(keepalive,5min15sec,0)
tcp    0        0          192.168.1.101:38692     89.187.183.13:https
tcp    0        0          192.168.1.101:57918      3.211.86.134:https   timer:(keepalive,7min9sec,0)
 192.168.1.101:42748        149.154.175.51:https     users:(("Telegram",pid=2560,fd=59))
 192.168.1.101:33266       142.250.191.206:https     users:(("firefox",pid=582761,fd=153))
 192.168.1.101:33956         35.155.44.228:https     users:(("firefox",pid=582761,fd=122))
 192.168.1.101:40238       173.194.162.198:https     users:(("firefox",pid=582761,fd=233))
 192.168.1.101:33368        54.232.131.104:https     users:(("firefox",pid=582761,fd=312))
 192.168.1.101:54940        149.154.175.50:https     users:(("Telegram",pid=2560,fd=46))
 192.168.1.101:38414          185.70.42.42:https     users:(("firefox",pid=582761,fd=144))
 192.168.1.101:42674        149.154.175.51:https     users:(("Telegram",pid=2560,fd=42))
```

```
 #ss -tlup --ipv4
     Local Address:Port                          Peer Address:Port          Process
          0.0.0.0:5355                               0.0.0.0:*              users:(("systemd-resolve",pid=711,fd=11))
     127.0.0.53%lo:domain                            0.0.0.0:*              users:(("systemd-resolve",pid=711,fd=16))
192.168.1.101%eth0:49213                             0.0.0.0:*              users:(("qbittorrent",pid=11156,fd=26))
      127.0.0.1%lo:49213                             0.0.0.0:*              users:(("qbittorrent",pid=11156,fd=23))
     127.0.0.53%lo:domain                            0.0.0.0:*              users:(("systemd-resolve",pid=711,fd=17))
192.168.1.101%eth0:49213                             0.0.0.0:*              users:(("qbittorrent",pid=11156,fd=25))
      127.0.0.1%lo:49213                             0.0.0.0:*              users:(("qbittorrent",pid=11156,fd=20))
          0.0.0.0:5355                               0.0.0.0:*              users:(("systemd-resolve",pid=711,fd=12))
```

PS Cheatsheet

```
##-==========================================-##
##   [+] show top 10 process eating memory
##-==========================================-##
ps auxf | sort -nr -k 4 | head -10
```

```
##-==========================================-##
##   [+] show top 10 process eating CPU
##-==========================================-##
ps auxf | sort -nr -k 3 | head -10
```

```
##-==============================================-##
##   [+] Print User, Service And Num of Processes
##-==============================================-##
ps -ef | awk '{print $1}' | sort | uniq -c | sort -nr
```

```
##-==========================================-##
##   [+] Find Processes Being Run As Root
##-==========================================-##
ps -ef | awk '$1 == "root" && $6 != "?" {print}'
```

Xe1phix–[PS]-Cheatsheet

```
##-========================================-##
##   [+] show top 10 process eating memory
##-========================================-##
ps auxf | sort -nr -k 4 | head -10


##-========================================-##
##   [+] show top 10 process eating CPU
##-========================================-##
ps auxf | sort -nr -k 3 | head -10


##-========================================-##
##   [+] Show Every Process Running As Root
##-========================================-##
ps -U root -u root u


##-========================================-##
##   [+] List All Threads For A process:
##-========================================-##
ps -C firefox -L -o pid,tid,pcpu,state
```

```
##-================================================-##
##   [+] Print User, Service And Num of Processes
##-================================================-##
ps -ef | awk '{print $1}' | sort | uniq -c | sort -nr


##-========================================-##
##   [+] Print The Process ID of Rsyslogd
##-========================================-##
ps -C rsyslogd -o pid


##-==============================-##
##   [+] Print sshd Daemon PID
##-==============================-##
ps -ef | awk '/sshd/ {print $2}'


##-========================================-##
##   [+] Find The sshd Daemon, And Kill It
##-========================================-##
kill $(ps -ef | awk '/sshd/ {print $2}')


##-============================================-##
##   [+] PSTree - Graphical list of processes
##-============================================-##
pstree --arguments --show-pids --show-pgids --show-parents


##-================================================-##
##   [+] Print User, Service And Num of Processes
##-================================================-##
ps -ef | awk '{print $1}' | sort | uniq -c | sort -nr
```

```
##-======================================-##
##   [+] Find Processes Being Run As Root
##-======================================-##
ps -ef | awk '$1 == "root" && $6 != "?" {print}'


##-================================-##
##   [+] Indepth Group Statistics
##-================================-##
ps -eo pid,command,size,vsize,%mem,gid,sgid,egid,fgid,sgroup,rgroup,group,fgroup,egroup,tpgid,tgid,flags


##-============================================-##
##   [+] Stack Statistics, esp eip nwchan etc...
##-============================================-##
ps -eo pid,uid,user,command,vsize,esp,eip,stackp,nwchan,lwp,psr,nlwp,flags


##-====================================-##
##   [+] Verbose User & UID Statistics
##-====================================-##
ps -eo uid,fuid,suid,ruid,euid,fuser,suser,user,uname,ruser,euser,command


##-====================================-##
##   [+] Verbose Mem & Cpu Statistics
##-====================================-##
ps -eo uid,gid,user,group,command,size,vsize,sz,%mem,%cpu,flags
##-============================================-##
##   [+] Display any tcp connections to apache
##-============================================-##
for i in `ps aux | grep httpd | awk '{print $2}'`; do lsof -n -p $i | grep ESTABLISHED; done;
```

[Xe1phix-[PS]-Cheatsheet]

```
## ------------------------------ ##
##    [?] Extract PCAP Data:
## ------------------------------ ##
capinfos $File.pcap
tcpslice -r $File.pcap
tcpstat $File.pcap
tcpprof -S lipn -P 30000 -r $File.pcap
tcpflow -r $File.pcap
tcpxtract -f $File.pcap -o $Dir/
tcpick -a -C -r $File.pcap
ngrep -I $File.pcap
nfdump -r $File.pcap
chaosreader -ve $File.pcap
tshark -r $File.pcap
tcpdump -r $File.pcap
bro -r $File.pcap
snort -r $File.pcap
```

Xe1phix-[PCAP]-Cheatsheet

tcpflow: Reassemble input packet data to TCP data segments

This utility will perform TCP reassembly, then output each side of the TCP data flows to separate files. This is essentially a scalable, command-line equivalent to Wireshark's "Follow | TCP Stream" feature. Additionally, tcpflow can perform a variety of decoding and post-processing functions on the resulting flows.

Usage:

```
$ tcpflow <options> -r <input file> ⏎
  -o <output path>
```

Common command-line parameters:

-r	Read from specified pcap file (can be used multiple times for multiple files)
-l	Read from multiple pcap files (with wildcards)
-o	Place output files into specified directory

Examples:

```
$ tcpflow -r infile.pcap  -o /tmp/output/
$ tcpflow -l *.pcap -o /tmp/output/
```

ngrep: Display metadata and context from packets that match a specified regular expression pattern

While grep is a very capable tool for ASCII input, it does not understand the pcap file format. ngrep performs the same function but against the Layer 4 – Layer 7 payload in each individual packet. It does not perform any TCP session reassembly, so matches are made against individual packets only.

Usage:

```
$ ngrep -I <input file> <options> ⏎
  <pattern> <bpf filter>
```

Common command-line parameters:

-I	Read from specified pcap file
-O	Write matching packets to specified pcap file
-i	Case-insensitive search
-v	Invert match – only show packets that do not match the search pattern
-t	Show timestamp from each matching packet

Note: The BPF filter is an optional parameter

Examples:

```
$ ngrep -I infile.pcap 'RETR' 'tcp and port 21'
$ ngrep -I infile.pcap -i 'l33tAUTH'
```

nfdump: Process NetFlow data from nfcapd-compatible files on disk

Files created by nfcapd (live collector) or nfpcapd (pcap-to-NetFlow distillation) are read, parsed, and displayed by nfdump. Filters include numerous observed and calculated fields, and outputs can be customized to unique analysis requirements.

Usage:

```
$ nfdump (-R <input directory path> |
          -r <nfcapd file> ) ⏎
  <options> <filter>
```

Common command-line parameters:

-r	Read from the specified single file
-R	Recursively read from the specified directory tree
-t	Specify time window in which to search (Use format: YYYY/MM/DD.hh:mm:ss-YYYY/MM/DD.hh:mm:ss)
-o	Output format to use (line, long, extended, or custom with fmt:<format string>)
-O	Output sort ordering (tstart, bytes, packets, more)
-a	Aggregate output on source IP+port, destination IP+port, layer 4 protocol
-A	Comma-separated custom aggregation fields

Filter syntax:

host	IP address or FQDN
net	Netblock in CIDR notation
proto	Layer 4 protocol (tcp, udp, icmp, etc)
as	Autonomous System number

Parameters such as host, net, and port can be applied in just one direction with the src or dst modifiers. Primitives can be combined with and, or, or not, and order can be enforced with parenthesis.

Filter examples:

- proto tcp and port 80
- proto udp and dst host 8.8.8.8
- src host 1.2.3.4 and (dst net 10.0.0.0/8 or dst net 172.16.0.0/12)
- src as 32625 (Note: Not all collections include ASNs)

Custom output formatting:

Format strings for the custom output format option (-o 'fmt:<format string>')consist of format tags, including but not limited to those below.

%ts	Start time	%sa	Source IP address
%te	End time	%da	Destination IP address
%td	Duration (In seconds)	%sp	Source port (TCP or UDP)
%pr	Layer 4 protocol		
%dp	Destination port (TCP or UDP; formatted as type.code for ICMP)		
%sap	Source IP address and port		
%dap	Destination IP address and port		
%pkt	Packet count		
%byt	Byte count		
%flg	TCP flags (sum total for flow)		
%bps	Bits per second (average)		
%pps	Packets per second (average)		
%bpp	Bytes per packet (average)		

Custom aggregation:

Records displayed can be aggregated (tallied) on user-specified fields including but not limited to those below:

proto	Layer 4 protocol
srcip	Source IP address
dstip	Destination IP address
srcport	TCP or UDP source port
dstport	TCP or UDP destination port
srcnet	Source netblock in CIDR notation
dstnet	Destination netblock in CIDR notation

Examples:

```
$ nfdump -r nfcapd.201703271745 ⏎
  -o long 'proto tcp and port 53'
$ nfdump -R /var/log/netflow/2017/03/ ⏎
  -o 'fmt:%sa %da %pr' -A srcip,dstip,proto
  'dst net 66.35.59.0/24'
$ nfdump -R /var/log/netflow/2016/ ⏎
  -O tstart 'proto tcp and port 4444'
```

tshark: Command-line access to nearly all Wireshark features

For all of Wireshark's features, the ability to access them from the command line provides scalable power to the analyst. Whether building repeatable commands into a script, looping over dozens of input files, or performing analysis directly within the shell, `tshark` packs nearly all of Wireshark's features in a command-line utility.

Usage:

```
$ tshark -n -r <input file> <options> ⏎
  -Y '<display filter>'
```

Common command-line parameters:

- `-n` Prevent DNS lookups on IP addresses
- `-r` Read from specified pcap file
- `-w` Write packet data to a file
- `-Y` Specify Wireshark-compatible display filter
- `-T` Specify output mode (`fields`, `text` (default), `pdml`, etc.)
- `-e` When used with `-T fields`, specifies a field to include in output tab-separated values (can be used multiple times)
- `-G` Specify glossary to display (`protocols`, `fields`, etc.) – shows available capabilities via command line, suitable for `grep`'ing, etc.

Display filter resources:

See the `wireshark-filter` man page for more command-line details on how to construct display filters.

Examples:

```
$ tshark -n -r infile.pcap ⏎
   -Y 'http.host contains "google"' ⏎
   -T fields -e ip.src -e http.host ⏎
   -e http.user_agent
$ tshark -n -r infile.pcap ⏎
   -Y 'ssl.handshake.certificates' ⏎
   -w just_certificates.pcap
```

tcpxtract: Carve reassembled TCP streams for known header and footer bytes to attempt file reassembly

This is the TCP equivalent to the venerable `foremost` and `scalpel` disk/memory carving utilities. `tcpxtract` will reassemble each TCP stream, then search for known start/end bytes in the stream, writing out matching sub-streams to disk. It is not protocol-aware, so it cannot determine metadata such as filenames and cannot handle protocol content consisting of non-contiguous byte sequences. Notably, `tcpxtract` cannot parse SMB traffic, encrypted payload content, or chunked-encoded HTTP traffic. Parsing compressed data requires signatures for the compressed bytes rather than the corresponding plaintext.

Usage:

```
$ tcpxtract -r <input file> <options>
```

Common command-line parameters:

- `-f` Read from specified pcap file
- `-c` Configuration (signature) file to use
- `-o` Place output files into specified directory

Signature format:

- `file_ext(max_size, start_bytes, end_bytes);`

Signature examples:

- `gif(3000000, \x47\x49\x46\x38\x37\x61, \x00\x3b);`
- `rpm(400000000, \xed\xab\xee\xdb);`

Example:

```
• tcpxtract -f infile.pcap ⏎
  -c rpm-tcpxtract.conf  -o ./
```

capinfos: Calculate and display high-level summary statistics for an input pcap file

This utility displays summary metadata from one or more source pcap files. Reported metadata includes but is not limited to start/end times, hash values, packet count, and byte count.

Usage:

```
$ capinfos <options> <input file 1> ⏎
  <input file 2> <...>
```

Common command-line parameters:

- `-A` Generate all available statistics
- `-T` Use "table" output format instead of list format

Examples:

```
$ capinfos -A infile.pcap
$ capinfos -A -T infile2.pcap
$ capinfos -A *.pcap
```

mergecap: Merge two or more pcap files

When faced with a large number of pcap files, it may be advantageous to merge a subset of them to a single file for more streamlined processing. This utility will ensure the packets written to the output file are chronological.

Usage:

```
$ mergecap <options> -w <output file> ⏎
  <input file 1> <input file 2> ⏎
  <input file n>
```

Common command-line parameters:

- `-w` New pcap file to create, containing merged data
- `-s` Number of bytes per packet to retain

Example:

```
$ mergecap -w new.pcap infile1.pcap ⏎
  infile2.pcap
```

Switch	Syntax	Description
-i any	tcpdump -i any	Capture from all interfaces
-i eth0	tcpdump -i eth0	Capture from specific interface (Ex Eth0)
-c	tcpdump -i eth0 -c 10	Capture first 10 packets and exit
-D	tcpdump -D	Show available interfaces
-A	tcpdump -i eth0 -A	Print in ASCII
-w	tcpdump -i eth0 -w tcpdump.txt	To save capture to a file
-r	tcpdump -r tcpdump.txt	Read and analyze saved capture file
-n	tcpdump -n -I eth0	Do not resolve host names
-nn	tcpdump -n -i eth0	Stop Domain name translation and lookups (Host names or port names)
tcp	tcpdump -i eth0 -c 10 -w tcpdump.pcap tcp	Capture TCP packets only
port	tcpdump -i eth0 port 80	Capture traffic from a defined port only
host	tcpdump host 192.168.1.100	Capture packets from specific host
net	tcpdump net 10.1.1.0/16	Capture files from network subnet
src	tcpdump src 10.1.1.100	Capture from a specific source address
dst	tcpdump dst 10.1.1.100	Capture from a specific destination address
<service>	tcpdump http	Filter traffic based on a port number for a service
<port>	tcpdump port 80	Filter traffic based on a service
port range	tcpdump portrange 21-125	Filter based on port range
-S	tcpdump -S http	Display entire packet
ipv6	tcpdunp -IPV6	Show only IPV6 packets
-d	tcpdump -d tcpdump.pcap	display human readable form in standard output
-F	tcpdump -F tcpdump.pcap	Use the given file as input for filter
-I	tcpdump -I eth0	set interface as monitor mode
-L	tcpdump -L	Display data link types for the interface
-N	tcpdump -N tcpdump.pcap	not printing domian names
-K	tcpdump -K tcpdump.pcap	Do not verify checksum
-p	tcpdump -p -i eth0	Not capturing in promiscuous mode

Protocols		
arp	ip6	slip
ether	link	tcp
fddi	ppp	tr
icmp	radio	udp
ip	rarp	wlan

TCP Flags	
tcp-urg	tcp-rst
tcp-ack	tcp-syn
tcp-psh	tcp-fin

ICMP Types
icmp-routeradvert
icmp-routersolicit
icmp-timxceed
icmp-paramprob
icmp-tstamp
icmp-tstampreply
icmp-ireq
icmp-ireqreply
icmp-maskreq
icmp-maskreply
icmp-echoreply
icmp-unreach
icmp-sourcequench
icmp-redirect
icmp-echo

TShark

```
└─# tshark -f 'udp port 53'
Running as user "root" and group "root". This could be dangerous.
Capturing on 'eth0'
    1 0.000000000 173.22.75.86 → 172.98.193.62 DNS 82 Standard query 0x8ec9 A mullvad.net OPT
    2 0.000146254 173.22.75.86 → 172.98.193.62 DNS 82 Standard query 0xb449 A mullvad.net OPT
    3 3.485878486 172.98.193.62 → 173.22.75.86 DNS 98 Standard query response 0xb449 A mullvad.net A 45.83.220.101 OPT
    4 3.485878539 172.98.193.62 → 173.22.75.86 DNS 98 Standard query response 0x8ec9 A mullvad.net A 45.83.220.101 OPT
    5 5.685797805 173.22.75.86 → 172.98.193.62 DNS 92 Standard query 0x7433 A ipv4.am.i.mullvad.net OPT
    6 5.685958160 173.22.75.86 → 172.98.193.62 DNS 92 Standard query 0xefef A ipv4.am.i.mullvad.net OPT
    7 6.244646320 172.98.193.62 → 173.22.75.86 DNS 108 Standard query response 0x7433 A ipv4.am.i.mullvad.net A 193.138.218.116 OPT
    8 6.244831467 172.98.193.62 → 173.22.75.86 DNS 108 Standard query response 0xefef A ipv4.am.i.mullvad.net A 193.138.218.116 OPT
```

```
└─# tshark -f 'port 6697'
Running as user "root" and group "root". This could be dangerous.
Capturing on 'eth0'
    1 0.000000000 173.22.75.86 → 46.16.175.175 TCP 74 59506 → 6697 [SYN] Seq=0 Win=64240 Len=0 MSS=1460 SACK_PERM=1 TSval=385395196 TSecr=0 WS=1024
    2 0.141689554 46.16.175.175 → 173.22.75.86 TCP 74 6697 → 59506 [SYN, ACK] Seq=0 Ack=1 Win=65160 Len=0 MSS=1460 SACK_PERM=1 TSval=2818019368 TSecr=385395196 WS=128
    3 0.141762839 173.22.75.86 → 46.16.175.175 TCP 66 59506 → 6697 [ACK] Seq=1 Ack=1 Win=64512 Len=0 TSval=385395338 TSecr=2818019368
    4 0.442294136 173.22.75.86 → 46.16.175.175 TLSv1 369 Client Hello
```

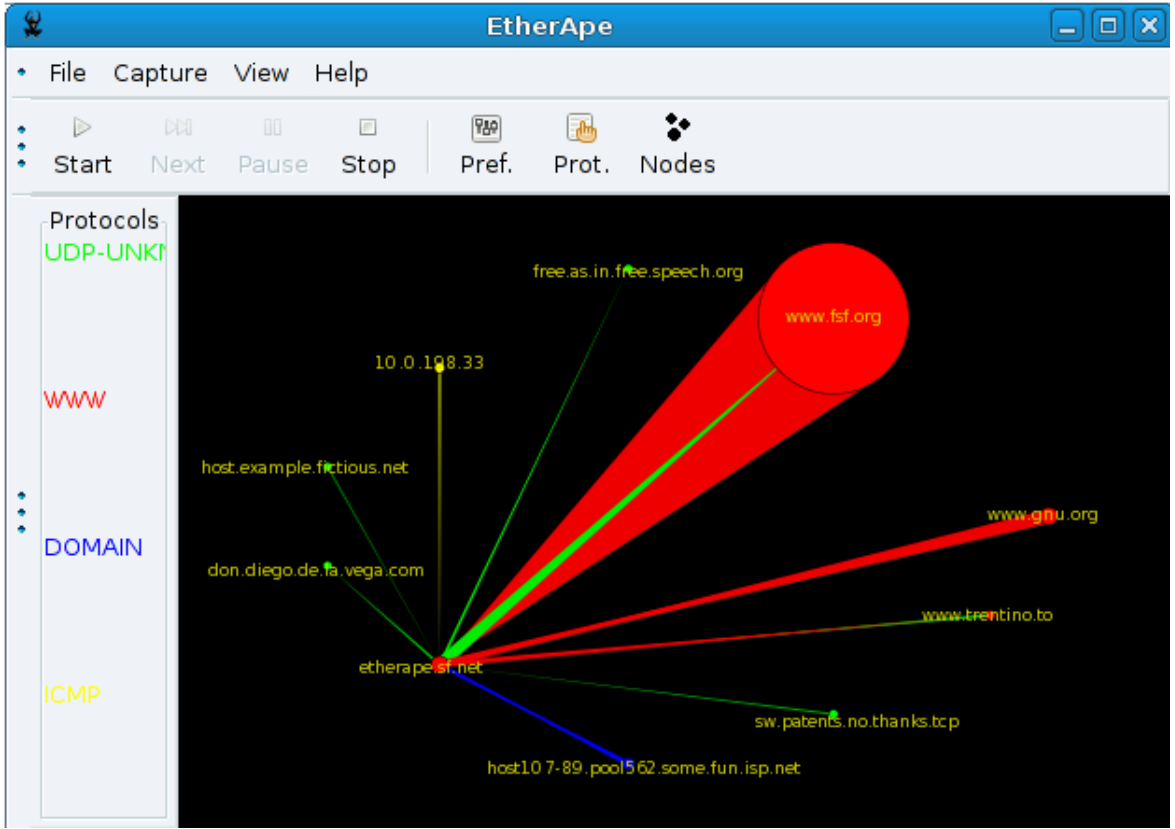
```
└─# tshark -i any -f 'udp port 1194'
Running as user "root" and group "root". This could be dangerous.
Capturing on 'any'
    1 0.000000000 173.22.75.86 → 193.138.218.136 OpenVPN 58 MessageType: P_CONTROL_HARD_RESET_CLIENT_V2
    2 0.128643529 193.138.218.136 → 173.22.75.86 OpenVPN 70 MessageType: P_CONTROL_HARD_RESET_SERVER_V2
    3 0.128865762 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
    4 0.128944171 173.22.75.86 → 193.138.218.136 TLSv1 267 Client Hello
    5 0.272074537 193.138.218.136 → 173.22.75.86 TLSv1.3 1244 Server Hello, Change Cipher Spec, Application Data, Application Data
    6 0.272276797 193.138.218.136 → 173.22.75.86 TLSv1.3 1232 Continuation Data
    7 0.272276872 193.138.218.136 → 173.22.75.86 TLSv1.3 1232 Continuation Data
    8 0.272329335 193.138.218.136 → 173.22.75.86 TLSv1.3 851 Continuation Data
    9 0.272372003 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   10 0.272395651 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   11 0.272421831 173.22.75.86 → 193.138.218.136 OpenVPN 66 MessageType: P_ACK_V1
   12 0.273627595 173.22.75.86 → 193.138.218.136 TLSv1.3 [tshark CheatSheet] Application Data, Application Data, Application Data
   13 0.404691384 193.138.218.136 → 173.22.75.86 TLSv1.3 [illegible] Application Data
```

Xe1phix - TCPick - Cheatsheet

```
##-=============================================================================-##
     tcpick -i eth0 -C                          ## display the connection status:
##-=============================================================================-##
     tcpick -i eth0 -C -yP -h -a                ## display the payload and packet headers:
##-=============================================================================-##
     tcpick -i eth0 -C -bCU -T1 "port 25"       ## display client data only of the first smtp connection:
##-=============================================================================-##
     tcpick -i eth0 -wR "port ftp-data"         ## download a file passively:
##-=============================================================================-##
     tcpick -i eth0 "port 80" -wRub             ## log http data in unique files
##-=============================================================================-##
```

Xe1phix-[TCPick]-Cheatsheet

Etherape – Traffic Graphs



Protocol detail dialog

EtherApe: Protocols

Protocol	Port	Inst Traffic	Accum Traffic	Avg Size	Last Heard	Packets
DOMAIN	53	0 bps	1,21 Kbytes	207 bytes	13" ago	6
ICMP	-	2,35 Kbps	784 bytes	98 bytes	0" ago	8
UDP-UNKNOWN	-	16,89 Kbps	54,74 Kbytes	132 bytes	0" ago	425
WWW	80	264 bps	54,60 Kbytes	478 bytes	2" ago	117

Node detail dialog

etherape.sf.net

Resolved Name: etherape.sf.net
Numeric Name: 192.168.1.22

	Total	Inbound	Outbound
Instantaneous	31,53 Kbps	14,52 Kbps	17,01 Kbps
Accumulated	503,83 Kbytes	411,83 Kbytes	92,00 Kbytes
Average size	397 bytes	680 bytes	139 bytes

Protocol	Port	Inst Traffic	Accum Traffic	Avg Size	Last Heard	Packets
DOMAIN	53	2,87 Kbps	7,17 Kbytes	99 bytes	1" ago	74
HTTP-ALT	8080	0 bps	56 bytes	56 bytes	24" ago	1
NTP	123	736 bps	368 bytes	92 bytes	1" ago	4
WWW	80	27,92 Kbps	496,24 Kbytes	416 bytes	0" ago	1221

Xe1phix Tutorial Videos

- https://archive.org/details/@xe1phix
- https://youtube.com/@xe1phix/videos
- https://www.bitchute.com/channel/U0QCI90XuSH9/