

# WireGuard

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# WireGuard Introduction

- Simple and fast VPN solution
  - Low overhead
  - Deep integration with Linux kernel
  - Over UDP
- Peer to Peer
- Secure
- Built-in Roaming
  - Connections keep alive even if the underlay network change

# TUN/TAP

- TAP

- Layer 2
- More overhead(L2)
- Transfer any protocol
- Support L2+ services

- TUN

- Layer 3
- Less Overhead(L3)
- Only IPv4 , IPv6
- Support L3+ services

# Installation

- <https://www.wireguard.com/install/>
- Linux kernel  $\geq$  3.10
- CentOS
  - `$ sudo curl -Lo /etc/yum.repos.d/wireguard.repo https://copr.fedorainfracloud.org/coprs/jdoss/wireguard/repo/epel-7/jdoss-wireguard-epel-7.repo`
  - `$ sudo yum install epel-release`
  - `$ sudo yum install wireguard-dkms wireguard-tools`
- FreeBSD
  - In kernel implementation for FreeBSD 13 (faster!)
  - `$ pkg install wireguard`

# Tools

- Provided by WireGuard
  - wg
    - Set and retrieve configuration of WireGuard interface
  - wg-quick
    - Set up a WireGuard interface simply
- System tools
  - ip / ifconfig
    - Setup wg interfaces
  - Systemd
    - Auto start after boot

# Setup by hand (Linux)

- Add interface
  - `$ ip link add dev wg0 type wireguard`
- Setup ip
  - `$ ip address add dev wg0 192.168.2.1/24`
  - `$ ip address add dev wg0 192.168.2.1 peer 192.168.2.2`
- Setup wg configurations
  - `$ wg setconf wg0 myconfig.conf`
  - `$ wg set wg0 listen-port 51820 private-key /path/to/private-key peer  
ABCDEF... allowed-ips 192.168.88.0/24 endpoint 209.202.254.14:8172`
- Start interface
  - `$ ip link set up dev wg0`

# Setup by configuration

- Configuration file
  - `/etc/wireguard/wg0.conf`
- Start interface
  - `$ systemctl enable wg-quick@wg0`
  - `$ wg-quick up wg0`

# Example Configurations – Client

```
[Interface]
Address = 10.113.0.4/16
PrivateKey = [CLIENT PRIVATE KEY]

[Peer]
PublicKey = [SERVER PUBLICKEY]
AllowedIPs = 10.113.0.0/16, 10.123.45.0/24, 1234:4567:89ab::/48
Endpoint = [SERVER ENDPOINT]:51820
PersistentKeepalive = 25
```



# Example Configurations – Server

```
[Interface]
Address = 10.113.0.254/16
ListenPort = 51820
PrivateKey = [SERVER PRIVATE KEY]

# note - substitute eth0 in the following lines to match the Internet-facing interface
PostUp = iptables -A FORWARD -i %i -j ACCEPT; iptables -t nat -A POSTROUTING -o eth0 -
j MASQUERADE
PostDown = iptables -D FORWARD -i %i -j ACCEPT; iptables -t nat -D POSTROUTING -o eth0
-j MASQUERADE

[Peer]
# client foo
PublicKey = [FOO's PUBLIC KEY]
PresharedKey = [PRE-SHARED KEY]
AllowedIPs = 10.113.0.1/32, 10.113.1.0/24

[Peer]
# client bar
PublicKey = [BAR's PUBLIC KEY]
AllowedIPs = 10.113.0.2/32, 10.113.2.0/24
```

# Configuration – Interface

- Address (optional)
  - IP address and netmask of the interface
- ListenPort
  - Wg service listen port
- PrivateKey
  - Private key of the interface
- PreUp / PreDown / PostUp / PostDown
  - Run shell scripts before / after interface up / down
  - E.g.
    - Setup firewall rules

# Configuration – Peer

- **PublicKey**
  - Public key of the peer
- **AllowedIPs**
  - IP addresses that are allowed to pass through this peer
- **Endpoint (Optional)**
  - Location of the peer
  - Wg will also use the previous connections to detect this configuration
- **PersistentKeepalive (Optional)**
  - By default, Wg send packs only if there are data to be send
  - Send packs to peer periodically to bypass NAT or Firewall
- **PresharedKey (Optional)**
  - Pre-shared key for additional symmetric encryption

# Generate Key Pair

- Key pair
  - `$ wg genkey > privatekey`
  - `$ wg pubkey < privatekey > publickey`
- Pre-shared key
  - `$ wg genpsk > preshared`

# Cryptokey Routing

- WireGuard will add routing rules to system routing table according to the configurations
- Once packets go inside WireGuard, it is routed according to

## Cryptokey Routing

- When sending packets, the list of allowed IPs behaves as a sort of routing table
- When receiving packets, the list of allowed IPs behaves as a sort of access control list

# Built-in Roaming

- When the client connects to server, server record the IP of client, and communicate with client by this IP
- When client (or even server) change its IP, it sends data to the peer and the peer will update the IP
- Both client and server send encrypted data to the most recent IP endpoint for which they authentically decrypted data. Thus, there is full IP roaming on both ends

# Example – Build a Bridge VPN Server

- Follow the setup guide and build a Wg peer as a VPN server
- Enable ip forwarding
  - `sysctl net.ipv4.ip_forward=1`
- Setup NAT so clients can connect to internet through the VPN server
  - Add these lines to `wg0.conf`
    - `PostUp = iptables -A FORWARD -i %i -j ACCEPT; iptables -t nat -A POSTROUTING -o eth0 -j MASQUERADE`
    - `PostDown = iptables -D FORWARD -i %i -j ACCEPT; iptables -t nat -D POSTROUTING -o eth0 -j MASQUERADE`

# Connect from mobile

- For mobile app, user can use QR-Code to import configuration file, instead of copy-paste private key from other ways
  - `$ qrencode -t ansiutf8 < wgconfig.conf`



# User authentication

- Every peer has its own private key for identity authentication
- Integration with other authentication system (like LDAP) may need other software support
  - For now, WireGuard only provide simple tunnel connections between peers

# Reference

- <https://www.wireguard.com/>
- <https://www.wireguard.com/quickstart/>
- <https://wiki.archlinux.org/index.php/WireGuard>