OpenWRT NetBird
version 23

Latest version:
https://raw.githubusercontent.com/egc112/OpenWRT-egc-add-on/main/notes/OpenWRT%20Netbird.pdf

This is a W.I.P., comments are welcome.

Introduction

NetBird is a modern, fully open-source Zero Trust VPN that provides a simple and secure way to connect users, devices, and services. It is built on WireGuard®, offering fast, encrypted peer-to-peer networking without the complexity of traditional VPN setups.
Unlike some alternatives, NetBird is fully open source and allows the entire control plane to be self-hosted. This can give full control over your networking infrastructure and data, and avoids dependency.

You can use it for remote access to your home network, to connect multiple routers and other clients (phone/PC/Mac etc.) and when setup as exit node also as a remote VPN.

Usually you can do the same by setting up your own WireGuard server and clients.
WireGuard Server Setup Guide
WireGuard Client Setup Guide

But this only works if you have at least a public IP address on one side of the connection.
If you are behind CGNAT, so do not have a public IPv4 address and also do not have a public IPv6 address (check with: *ifstatus wan6*) or using IPv6 is not applicable then you have to involve a third party as man-in-the-middle.
This can be a VPN provider which supports port forwarding (e.g. ProtonVPN), or you can rent a Virtual Private Server (I have an Oracle VPS which can be had for free, see at the bottom of this guide), or use things like NetBird, Zerotier (also layer 2), Cloudflared, Tailscale or ngrok and there are more.

I favor NetBird because it is fully open source and has some advantages over Tailscale, but it still is a commercial third party however a free tier is available which is sufficient for small to medium sized networks with up to 5 users (admins) and 100 peers (routers, VPS, client PC, phone, etc.).
Big advantage of NetBird is that it is fully open source and you can self host the control plane (Dashboard) in which case you are your own third party, self hosting the control plane is outside the scope of this paper.

Start with viewing: https://docs.netbird.io/how-to/getting-started
All the docs can be found at: https://docs.netbird.io/

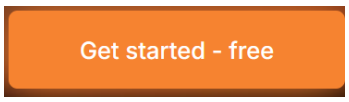
A NetBird wiki is in the works

A very useful OpenWRT thread for discussion and support: https://forum.openwrt.org/t/netbird-support-discussion-thread/237831

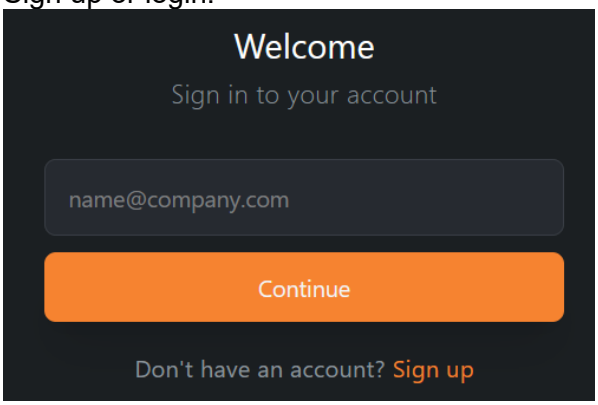
Table of Contents

Make a free account on NetBird

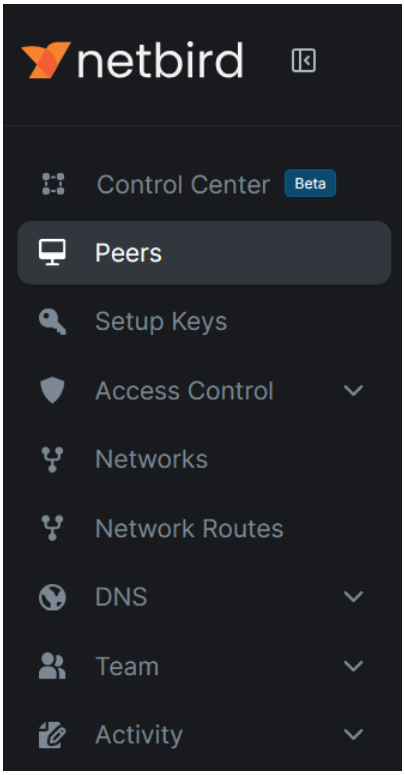
go to: http://netbird.io

Click: 

Sign up or login:



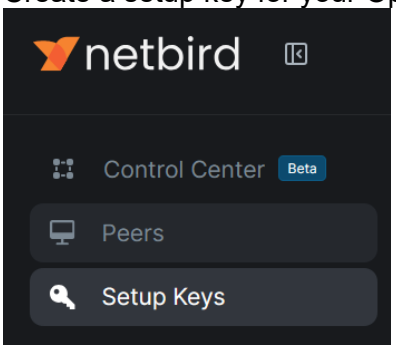
Now you are connected to your NetBird Dashboard the central administration (https://app.netbird.io):



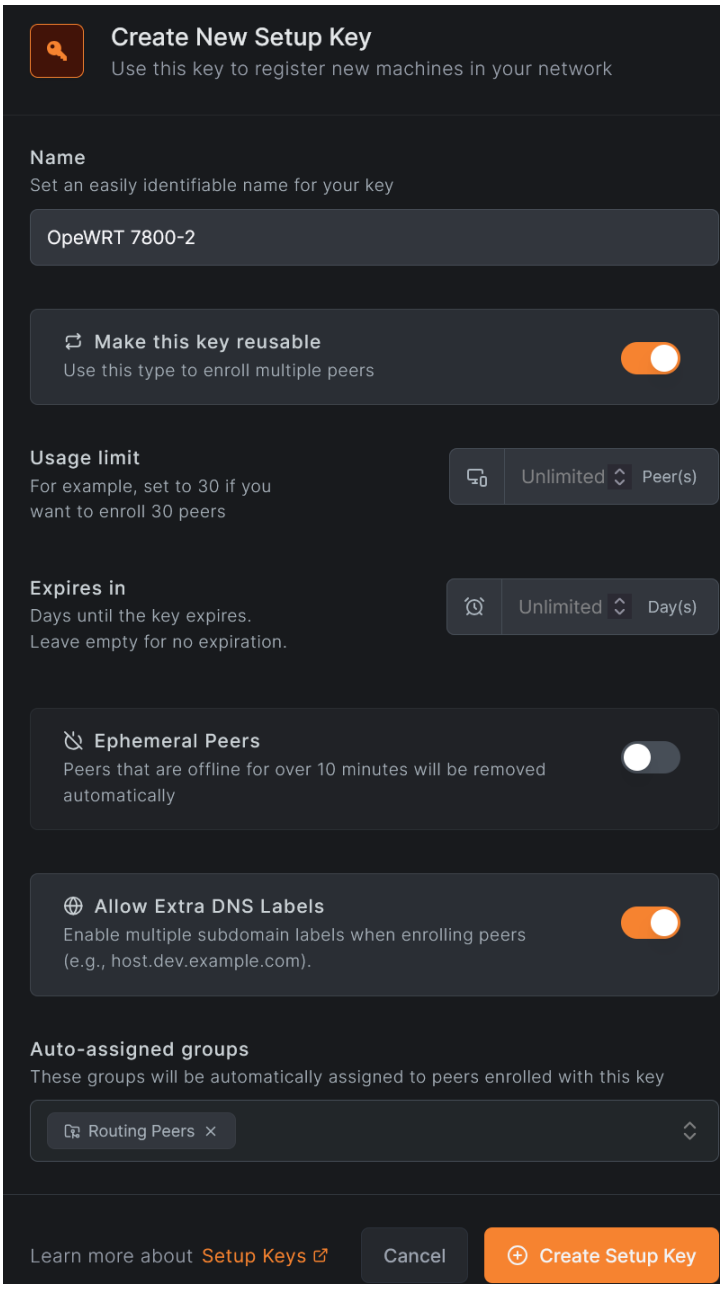
MFA (Multi Factor Authentication)

If you click on your Icon in the upper right hand corner > Profile Settings: you can enable NetBird MFA for added security.

Create a setup key for your OpenWRT router: **NetBird Dashboard** > **Setup Keys**:



Fill in the name of your router and change the other items, shown are my settings, when done Click *Create Setup Key.*



Copy and store the setup key

Install NetBird on OpenWRT router

NetBird is a rather large package around 12 MB written in Go so make sure your storage is sufficient, if you install it as a package it will take up double this storage, if your storage is not sufficient then make a new build using e.g. the firmware selector and *customize installed packages* adding *netbird*.
If you already have a running build then a very hand tool to make a list for the firmware selector is owut (*owut list*).
You can even use it for upgrading and adding a package like netbird (*owut upgrade --add netbird*).

Installing package
opkg (24.10):
opkg update
opkg install netbird

apk (25.12 and higher):
apk update
apk add netbird

NetBird is added as a service to OpenWRT which can be called from */etc/init.d/netbird*
See *service netbird help* for commands but the regular commands are available
Make the NetBird service start at boot up with *service netbird enable* but this should be done automatically.
Having the service start is imperative for the right config path as that is set in the service profile.

The NetBird executable is stored in */usr/bin/netbird.*
You can use *netbird help* to see the available commands e.g.:
netbird up/down/status etc.

The config file (>0.55) is stored in */root/.config/netbird,* you might add this path to */etc/sysupgrade.conf*, so that it is included in the backup!

Setup on Router with SSO login

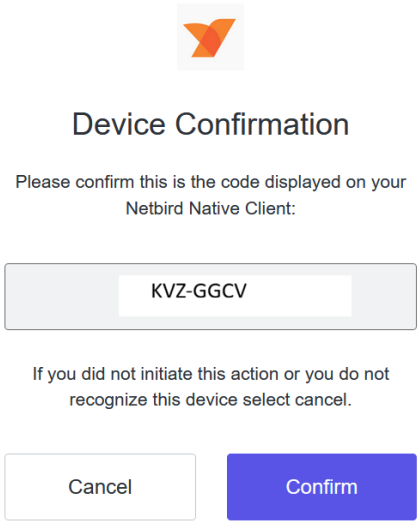
After installing NetBird check that the OpenWRT service is running with *service netbird status,* if this is the case you can Run UP command to log in with SSO (interactive login): *netbird up*

You will see the following text on the console:

```
Please do the SSO login in your browser.
If your browser didn't open automatically, use this URL to log in:

https://login.netbird.io/activate?user_code=ZKZX-AACCV
```

On your PC where you have opened the NetBird dashboard use your browser to login with the link (user_code) from the routers console and you should see:

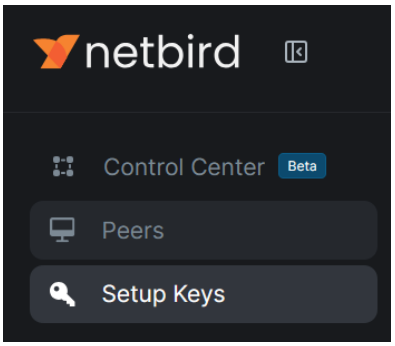


Confirm the device and go to your NetBird Dashboard where you should see the new Peer been added

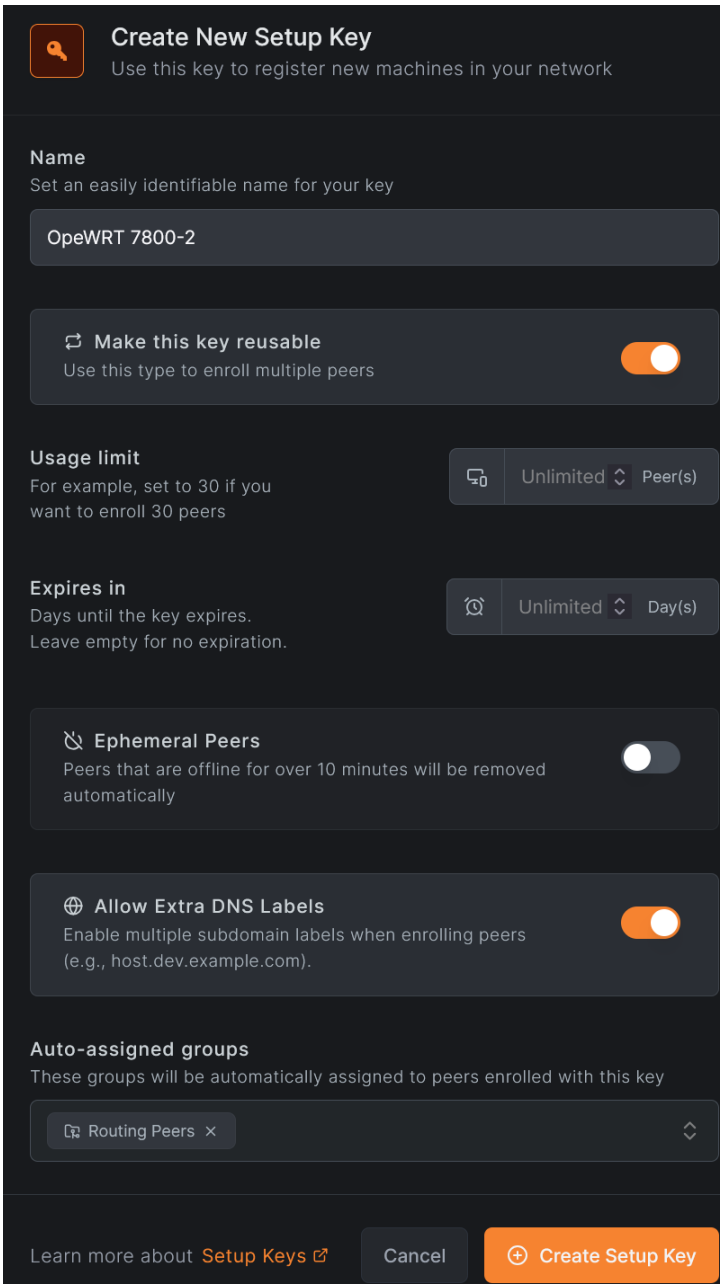
If this is successful proceed to Post installation, Network setup and Firewall setup
I
If this does **not** work go to the next section, Setup on router with key and manually make a peer key on the Dashboard and use that peer key to setup NetBird.

Setup on router with manual made key

Create a setup key for your OpenWRT router: **NetBird Dashboard** > **Setup Keys**:



Fill in the name of your router and change the other items, shown are my settings, when done Click *Create Setup Key.*

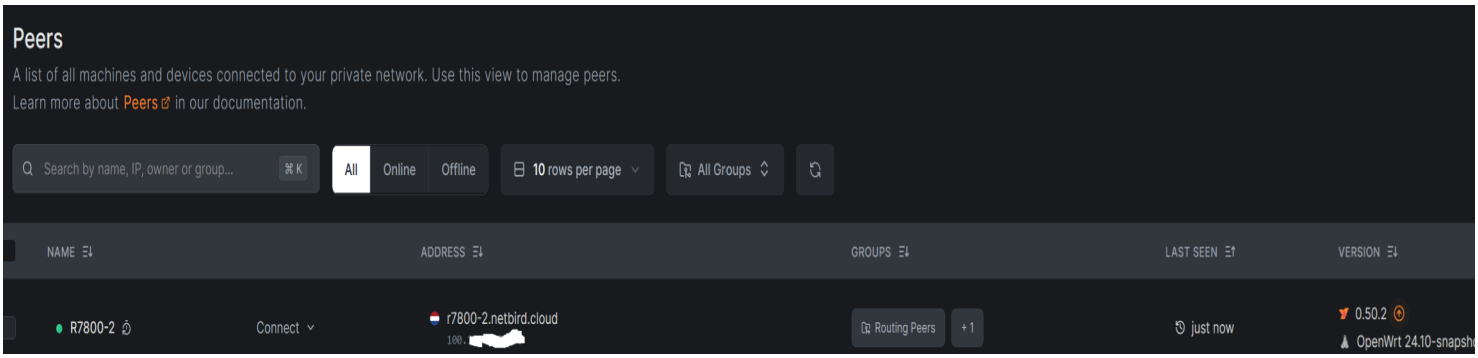


Copy and store the setup key

Head back to the console of the router and execute:
netbird up --setup-key <key from previous step>

After some time you will see:
root@R7800-2:~# netbird up --setup-key E20033F4-0XXXXXXXXXXXXXXX
Connected
root@R7800-2:~#

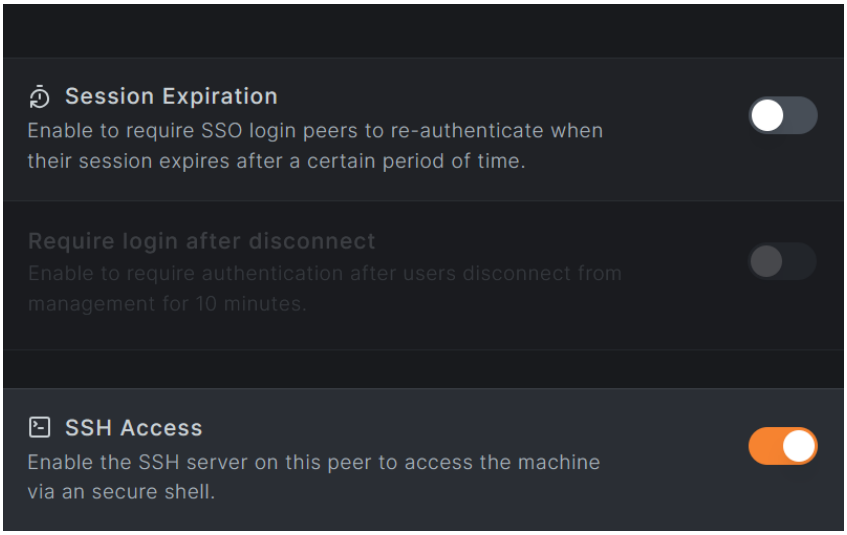
In your Dashboard you can now see the installed peer



with ifconfig or ip address show on the router, you should see the new interface (device) wt0
I
Check NetBird status with: *netbird status* and *service netbird status* both should output: *running*.
If not reboot and check again

Post installation

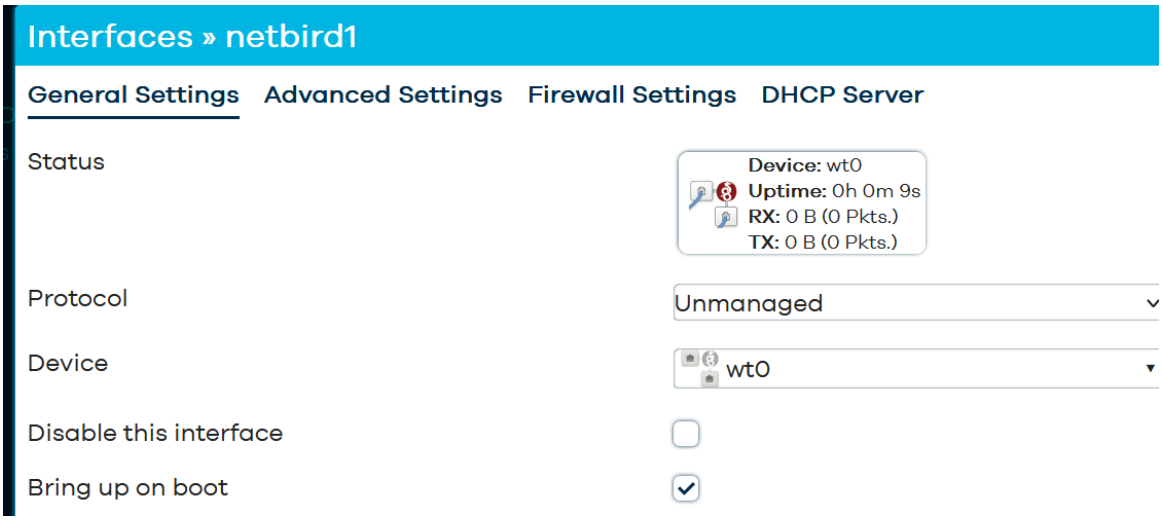
Open the Peer in the Dashboard by clicking on it in and change the settings.
You might want to disable Session Expiration and Enable SSH Access:



Network setup

Create a new unmanaged interface via LuCi: **Network** > **Interfaces** > **Add new interface**

- Name: **netbird1**
- Protocol: **Unmanaged**
- Device: wt**0** **#**For compatibility e.g. with e.g. PBR always name your interface e.g. **wtX**



/etc/config/network:

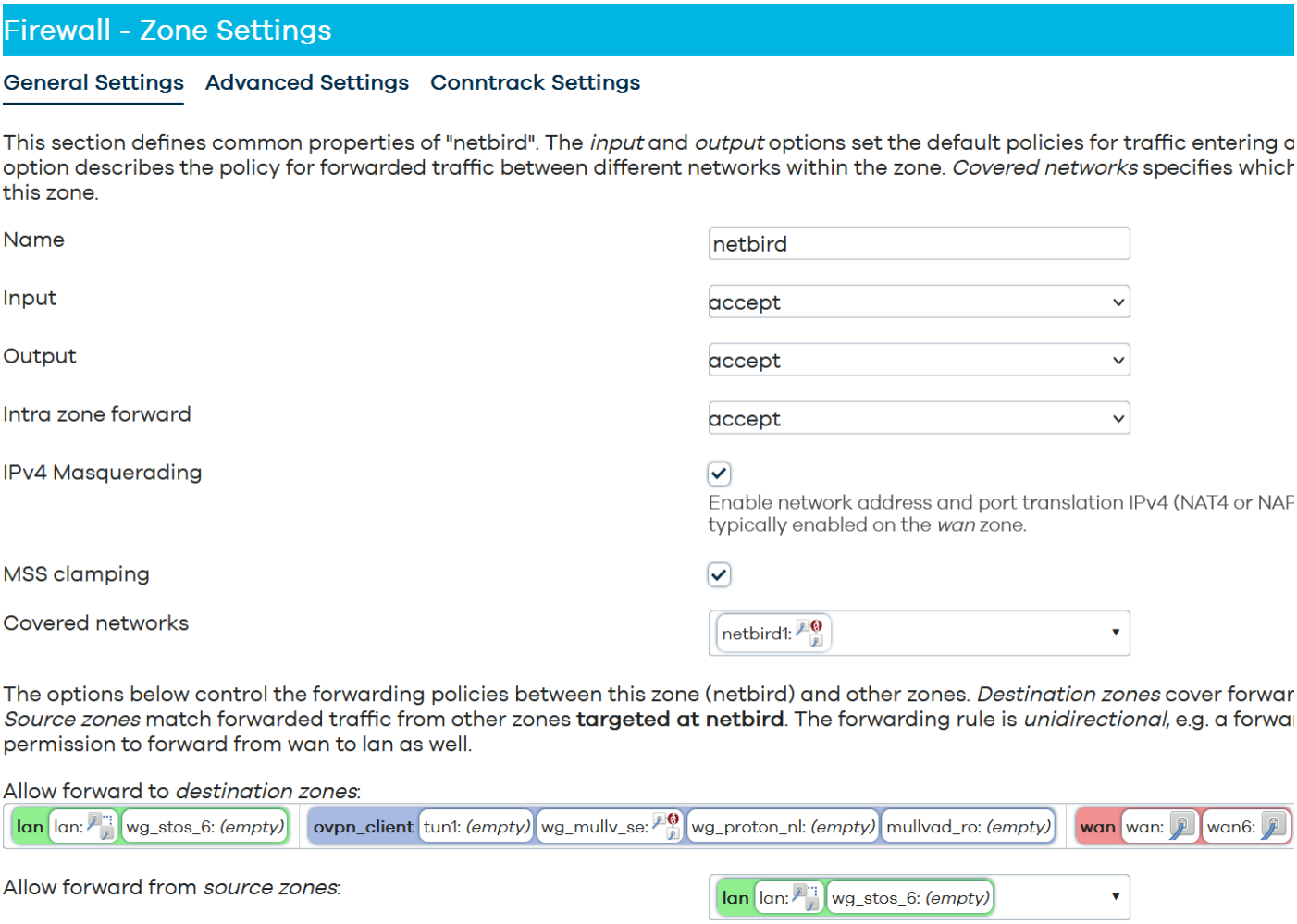
```
config interface 'netbird1'
        option proto 'none'
        option device 'wt0'
```

Firewall setup

Create a new firewall zone via LuCi: **Network** → **Firewall** → **Zones** → **Add**

- Name: **netbird**
- Input: **ACCEPT** (default)
- Output: **ACCEPT** (default)
- Forward: **ACCEPT**
- Masquerading: **on** (might not be necessary)
- MSS Clamping: **on** (might not be necessary when using 0.59.12)
- Covered networks: **netbird1**
- Allow forward to destination zones: Select your **LAN** (and/or other internal zones or WAN if you plan on using this device as an exit node), as this is an exit node **WAN** is selected, if you are going to use a VPN and traffic form the exit node should go via this VPN then also add the VPN interface!
- Allow forward from source zones: Select your **LAN** (and/or other internal zones or leave it blank if you do not want to route LAN traffic to other NetBird hosts)

Click ***Save & Apply***



/etc/config/firewall:

```
config zone
        option name 'netbird'
        option input 'ACCEPT'
        option output 'ACCEPT'
        option forward 'ACCEPT'
        option masq '1'
        option mtu_fix '1'
        list network 'netbird1'

config forwarding
        option src 'netbird'
        option dest 'lan'

config forwarding
        option src 'lan'
        option dest 'netbird'

# As this is an exit node traffic from netbird to wan is allowed
config forwarding
        option src 'netbird'
        option dest 'wan'
```

In the end ***reboot*** the router or do *service network restart*, *service firewall restart* and *service netbird restart*.

Check and Troubleshoot

Interface

ip address show wt0

```
31: wt0: <POINTOPOINT,NOARP,UP,LOWER_UP> mtu 1280 qdisc noqueue state UNKNOWN group
default qlen 1000
    link/none
    inet 100.105.224.116/16 brd 100.105.255.255 scope global wt0
       valid_lft forever preferred_lft forever
```

Routing

ip route

```
default via 192.168.0.1 dev wan proto static src 192.168.0.9
100.105.0.0/16 dev wt0 proto kernel scope link src 100.105.224.116
```

Status

netbird status --detail to get a detailed status report which also will show if you have a fast P2P connection or a relayed connection.

Info

service netbird info to get the info from the OpenWRT ubus service e.g. the NB_STATE_DIR, *service netbird status* will show if the service is running. Use *service netbird help* for more commands

WireGuard

wg show this shows the connections to peers and the Allowed IPs which should also show the subnet routes if you made any.

Log

cat /var/log/netbird/client.log

You can increase the log level by starting NetBird with *--log-level notice|debug*
(see: https://docs.netbird.io/get-started/cli)

OpenWRT Forum

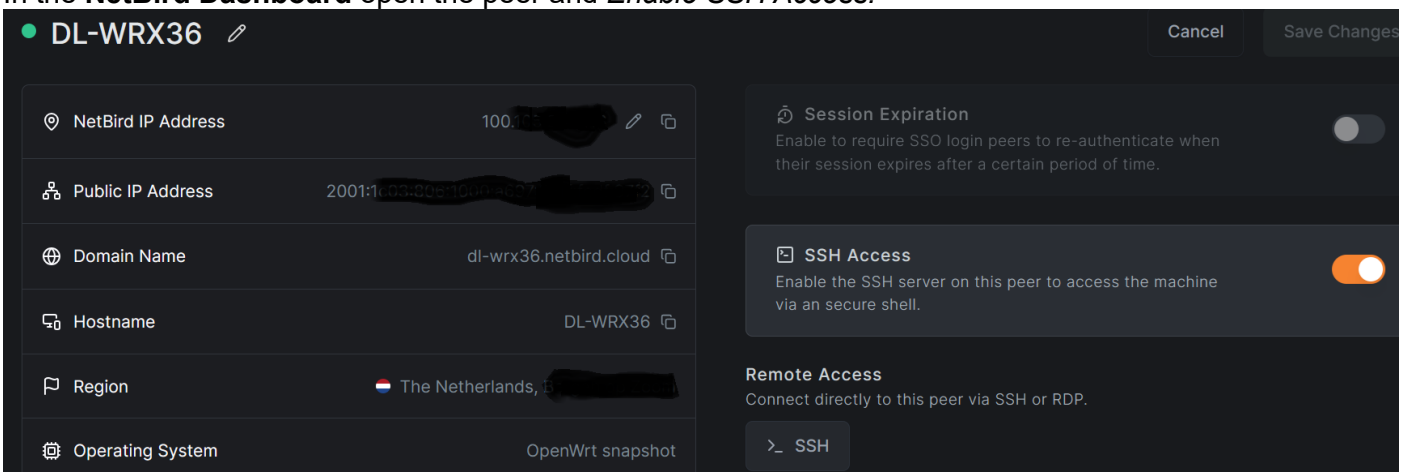
https://forum.openwrt.org/t/netbird-support-discussion-thread/237831/1

Online

See: https://docs.netbird.io/help/troubleshooting-client

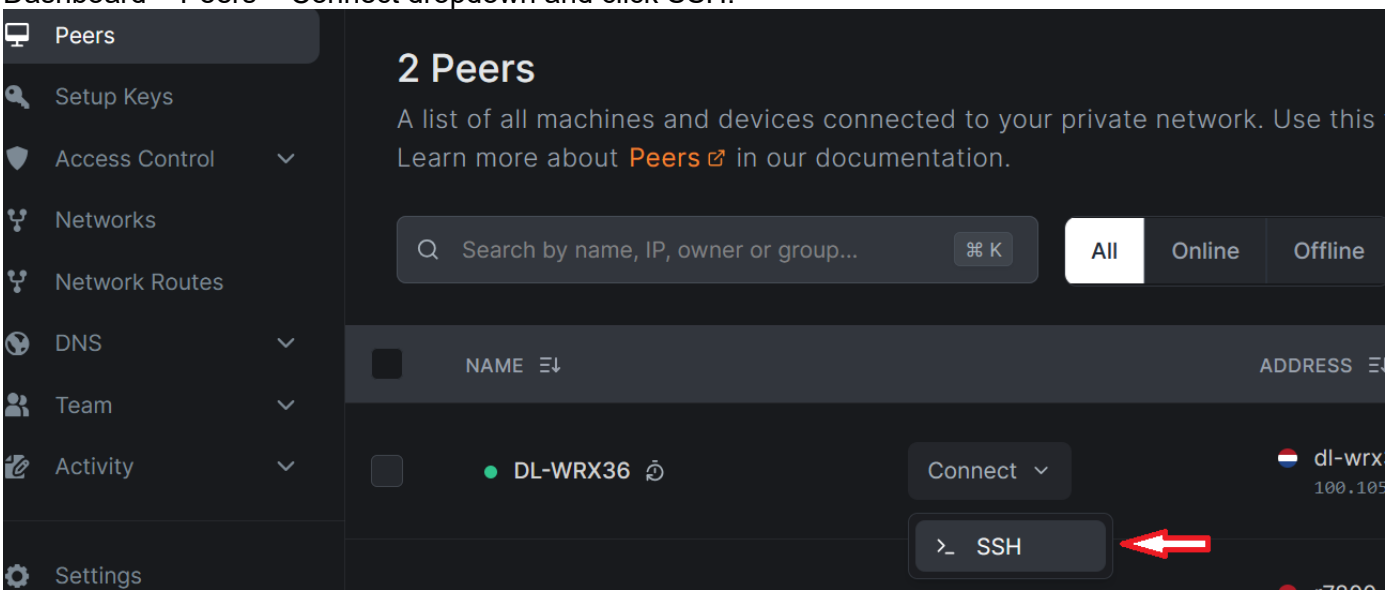
Allow SSH access from Dashboard

In the **NetBird Dashboard** open the peer and *Enable SSH Access:*

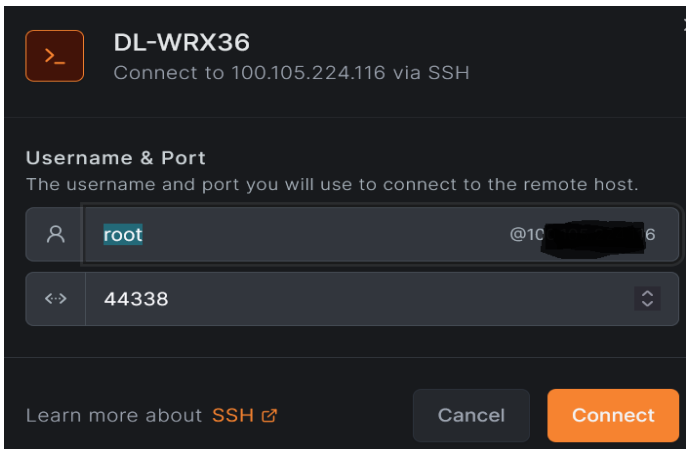


On the router
Make sure SSH is allowed (https://github.com/netbirdio/netbird/issues/2632):
netbird down
netbird up --allow-server-ssh

On your NetBird dashboard you should now be able to SSH into your router:
Dashboard > Peers > Connect dropdown and click SSH:



Connect with the default port 44338 to the in NetBird included SSH server:

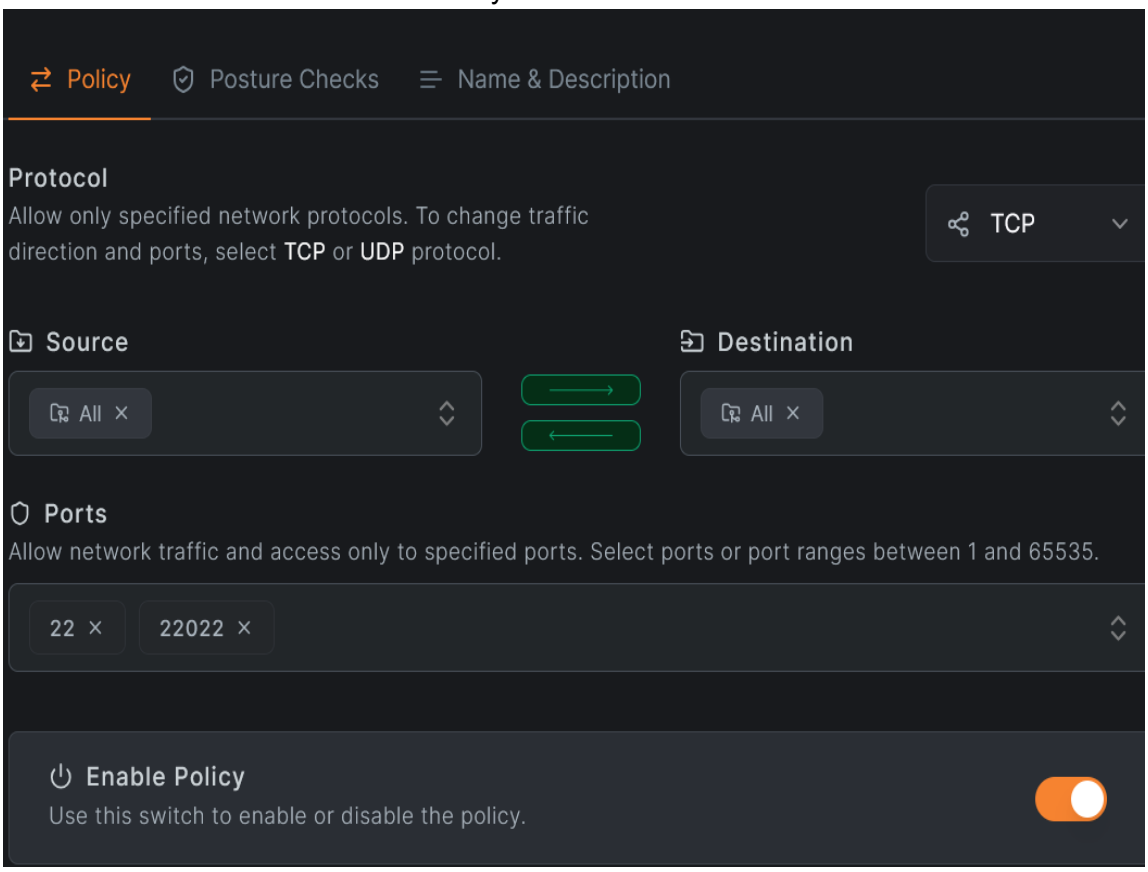


Changes Starting with version 0.60
https://docs.netbird.io/manage/peers/ssh

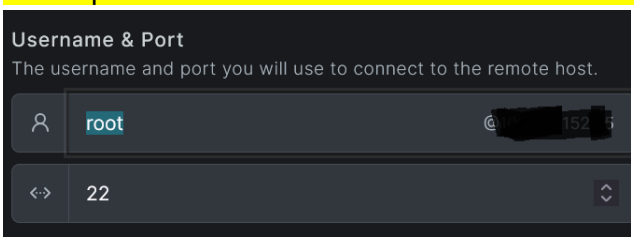
https://forum.netbird.io/t/upcoming-breaking-change-to-netbird-ssh/292

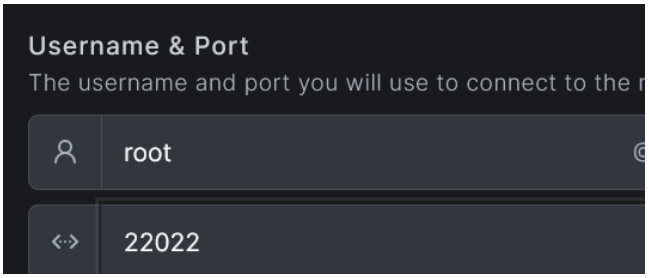
You need to start NetBird with:
netbird up --allow-server-ssh --disable-ssh-auth --enable-ssh-root

Furthermore you need to add an Access policy for port 22 and port 22022 (when using the Standard Dropbear SSH) in the NetBird Dashboard:
Access Control > Policies > Add Policy:



Start the SSH with user root and port 22.
If you have Dropbear running (which is the default in OpenWRT) instead of OpenSSH (sshd) then you need to use port 22022 and also make an Access Policy for port 22022





Create Routes

See: https://docs.netbird.io/how-to/routing-traffic-to-private-networks

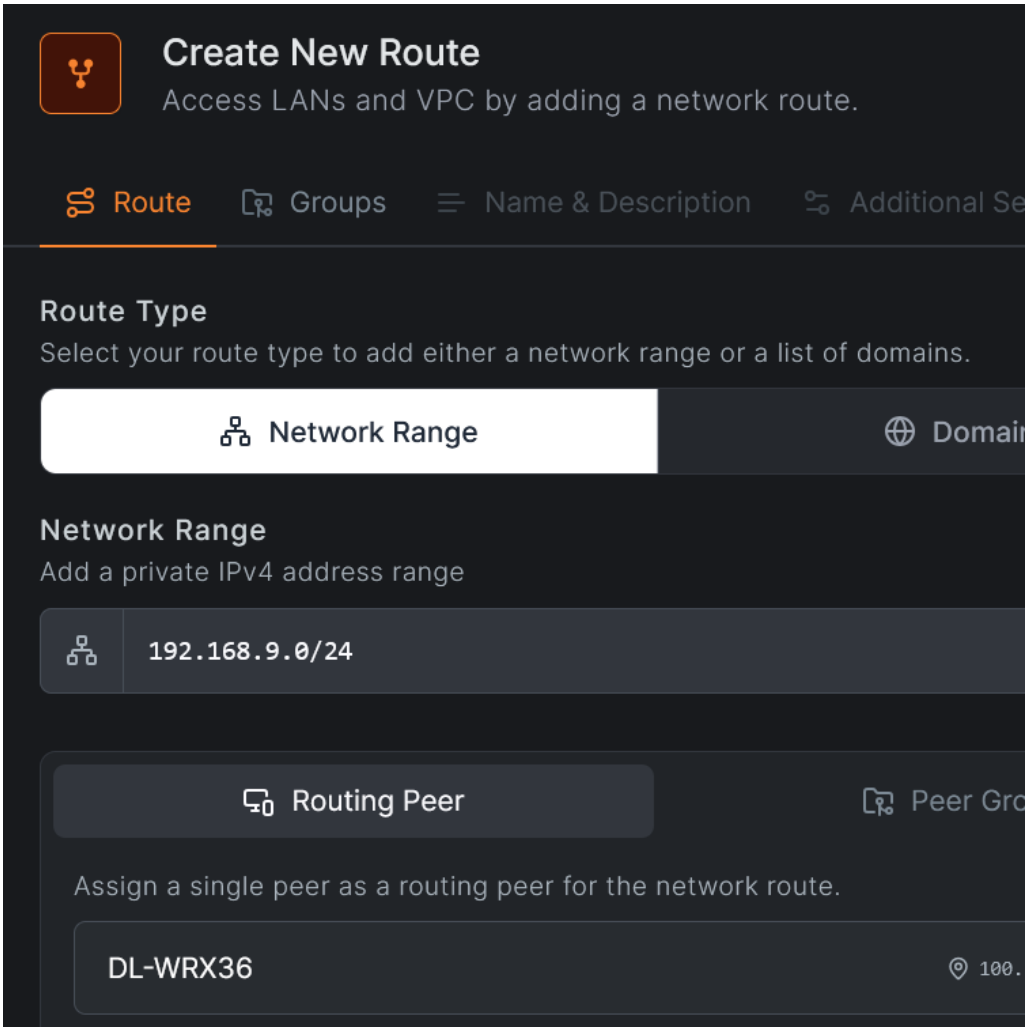
Note for routing between your peers it is imperative that all involved subnets are unique!

My DL-WRX36 has subnet 192.168.9.0/24.
I will create a routing rule to create a route for this 192.168.9.0/24 subnet to my DL-WRX36 and push that route to all peers.
Those pushed routes are pushed to an alternate routing table on all peers, this table is usually called netbird.

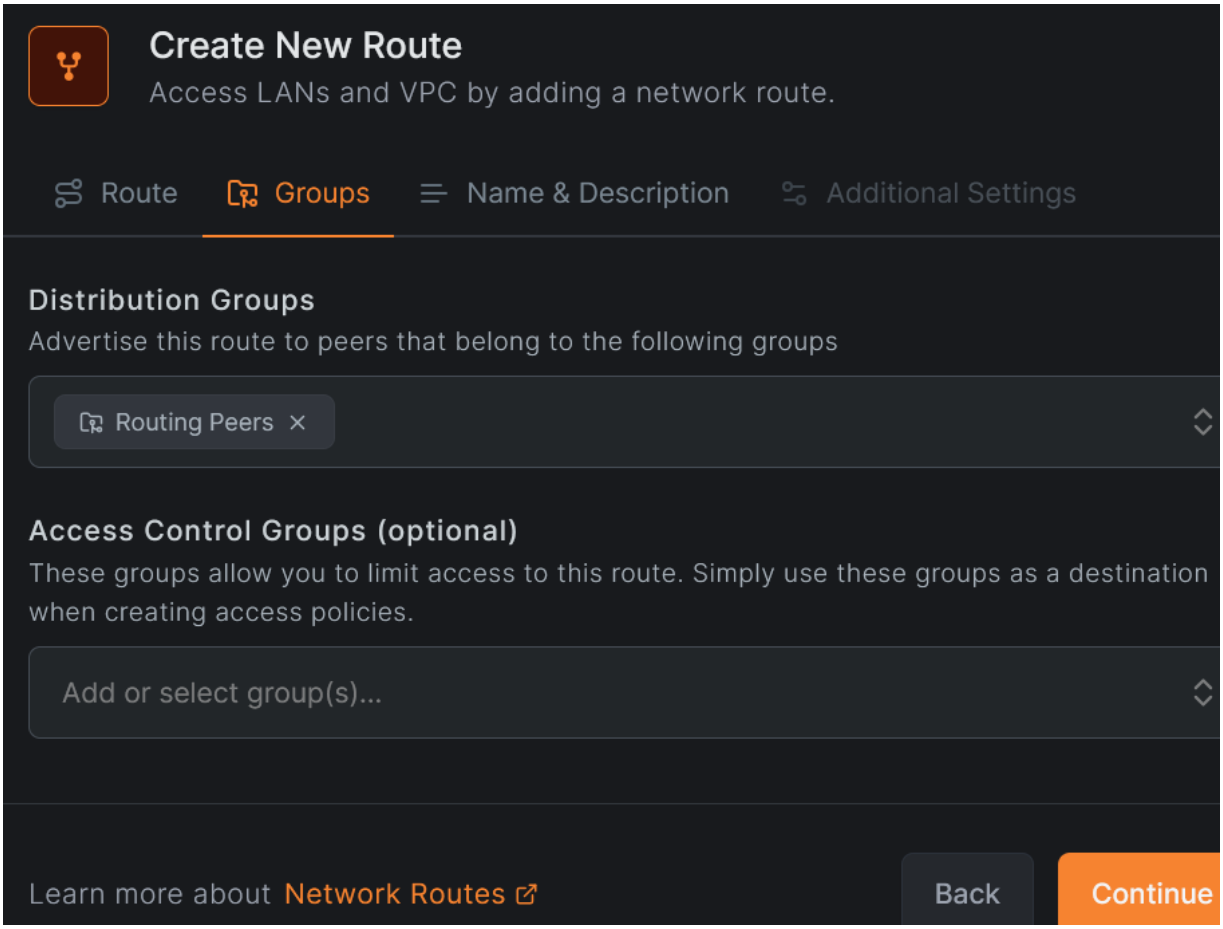
Lets go:

NetBird Dashboard> Network Routes > Add Route

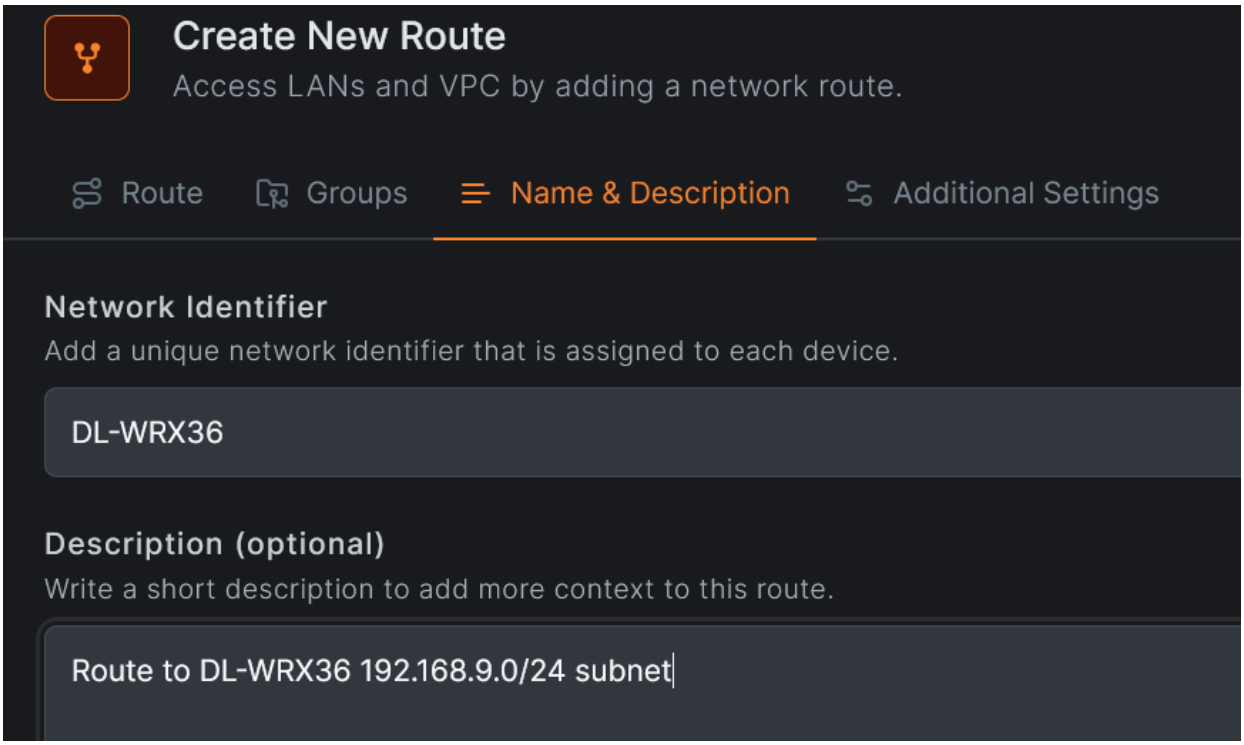
Add the network range to my DL-WRX36:



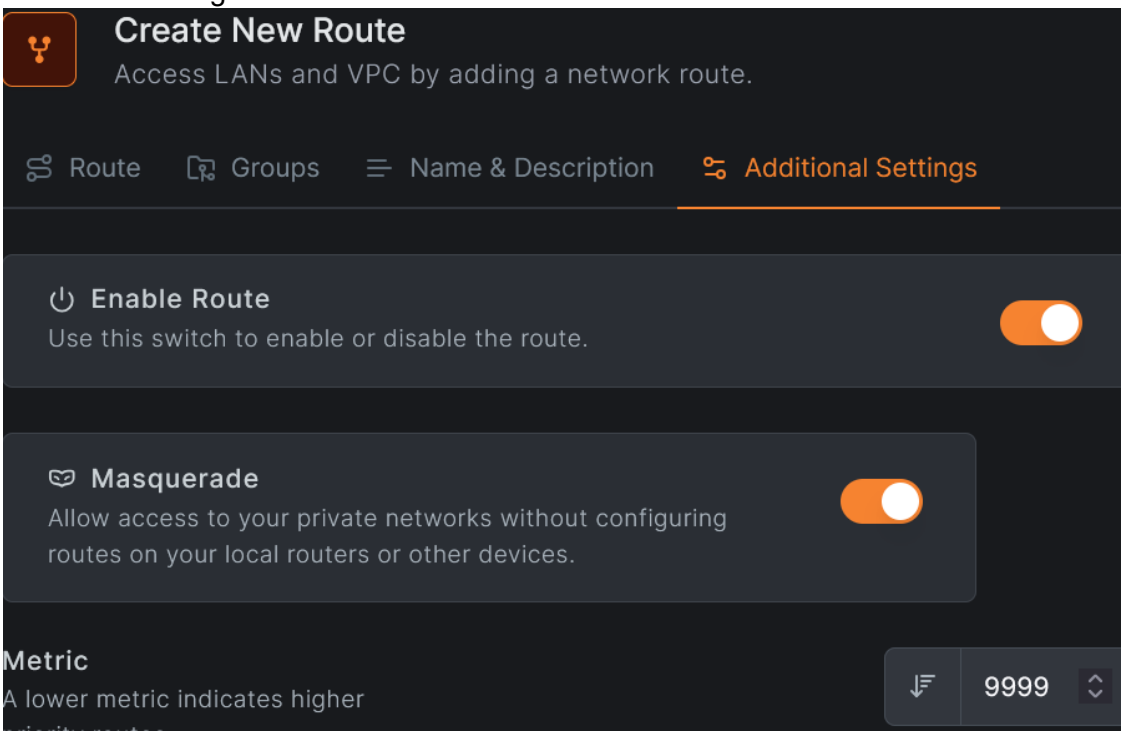
Advertise this route to all my peers:



Name and description:



Additional settings:



You might need to restart NetBird on all peers

On my Oracle VPS I can now see the rules and the alternate routing table created by NetBird:
ubuntu@vps-egc:~$ *ip rule show*
0: from all lookup local
105: from all lookup main suppress_prefixlength 0
110: not from all fwmark 0x1bd00 lookup netbird
32766: from all lookup main
32767: from all lookup default
ubuntu@vps-egc:~$

ubuntu@vps-egc:~$ *ip route show table netbird*
192.168.9.0/24 dev wt0
ubuntu@vps-egc:~$

wg show should also show the 192.168.9.0/24 added to the rcorrect peer:

ubuntu@vps-egc:~$ *sudo wg show*
peer: < peer key >
endpoint: [XXXXX:fedf]:33423
allowed ips: 100.211.224.116/32, 192.168.9.0/24
latest handshake: 42 seconds ago
transfer: 1.41 KiB received, 2.00 KiB sent
persistent keepalive: every 25 seconds

peer: < peer key >
endpoint: [XXXX:1000:bea5:11ff:fe3e]:51555
allowed ips: 192.168.5.0/24, 100.211.152.75/32
latest handshake: 1 minute, 39 seconds ago
transfer: 156 B received, 392 B sent
persistent keepalive: every 25 seconds

So from my oracle VPS there now is a route to my DL-WRX36 subnet

Create Networks

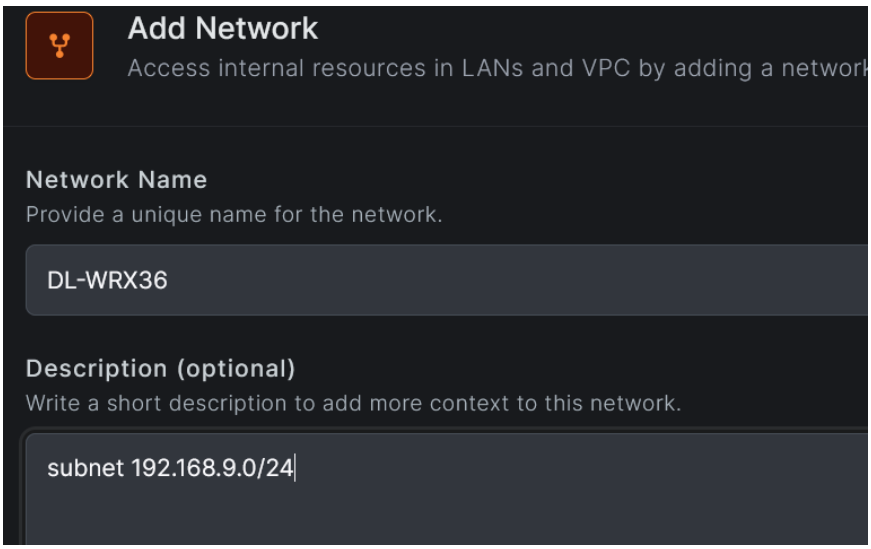
See: https://docs.netbird.io/how-to/networks

As I have just a few routers and a VPS to connect I use `Network Routes` which is simpler then using Networks.
Networks is new and has finer grained control but needs more work to setup and lacks support for exit nodes so that has still to be done with Network Routes.

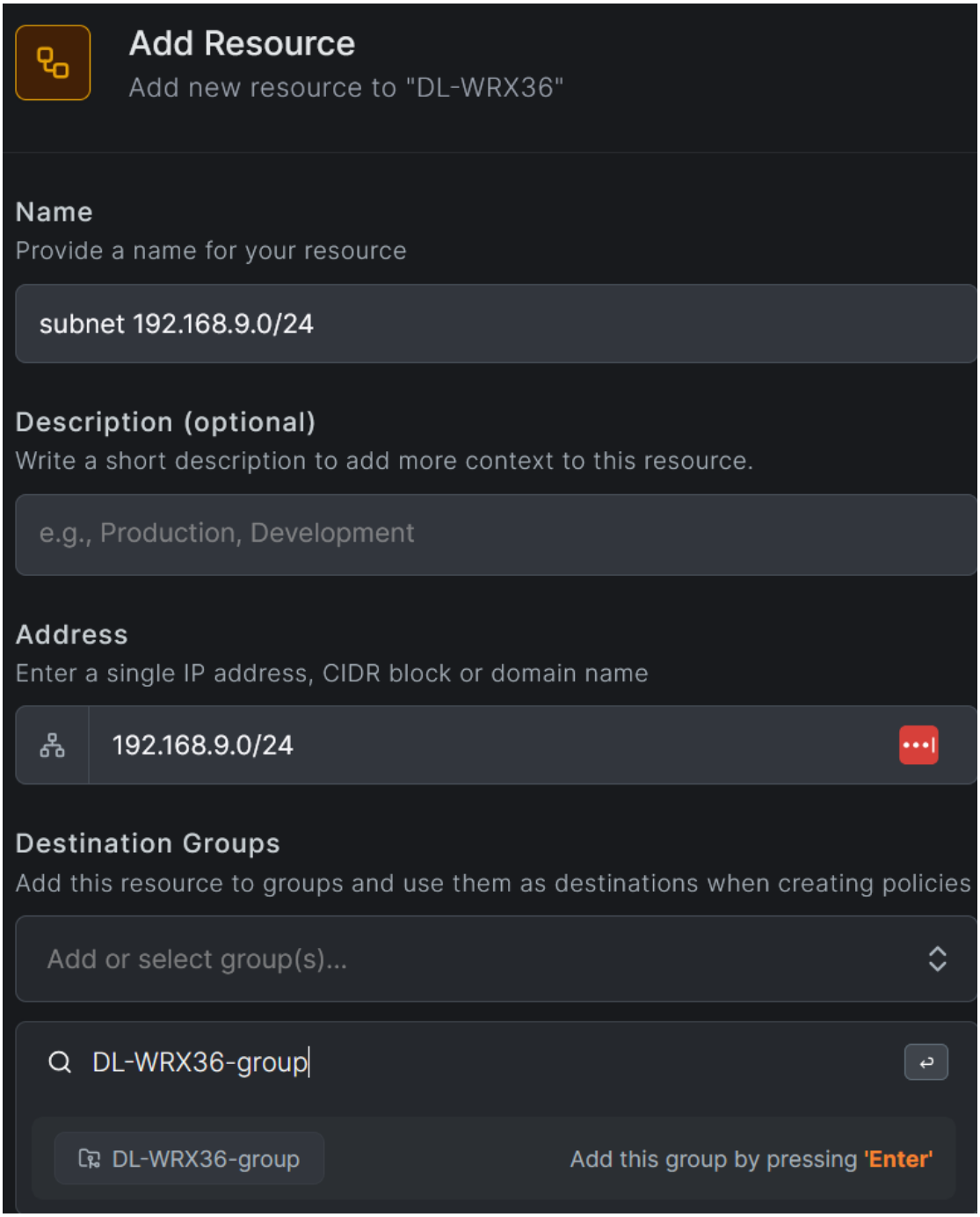
For OpenWRT the networks are often simple, so basically a Network has one routing peer which is the router or appliance in that network which holds the NetBird connection. This connects NetBird with the resources of the routing peer so basically the subnet or an IP address of a server which is running on this subnet. In this case I have my subnet as resource.

The access is controlled by Access Policies more on that later.

Start with creating a new Network e.g. the Network of my DL-WRX36 router which has subnet 192.168.9.0/24 and I want everyone to have access to this subnet:

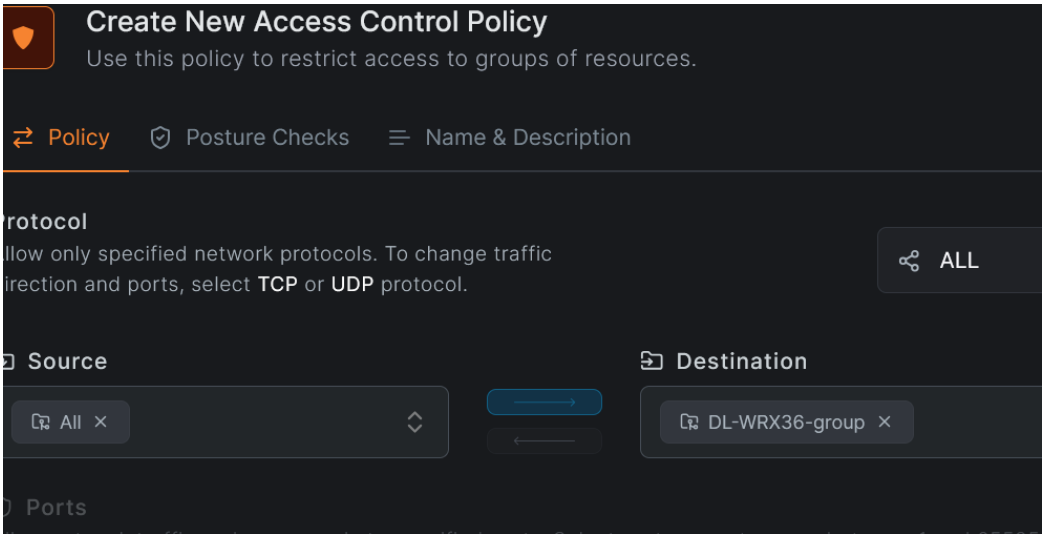


Proceed with making a new Resource:
Fill in name and address, under Destination Groups (these are the Access Control List > Groups) make a new group which later will hold our routing peer (added later to this the Access Control Destination group). Just enter the text for the new group e.g. DL-WRX36-group

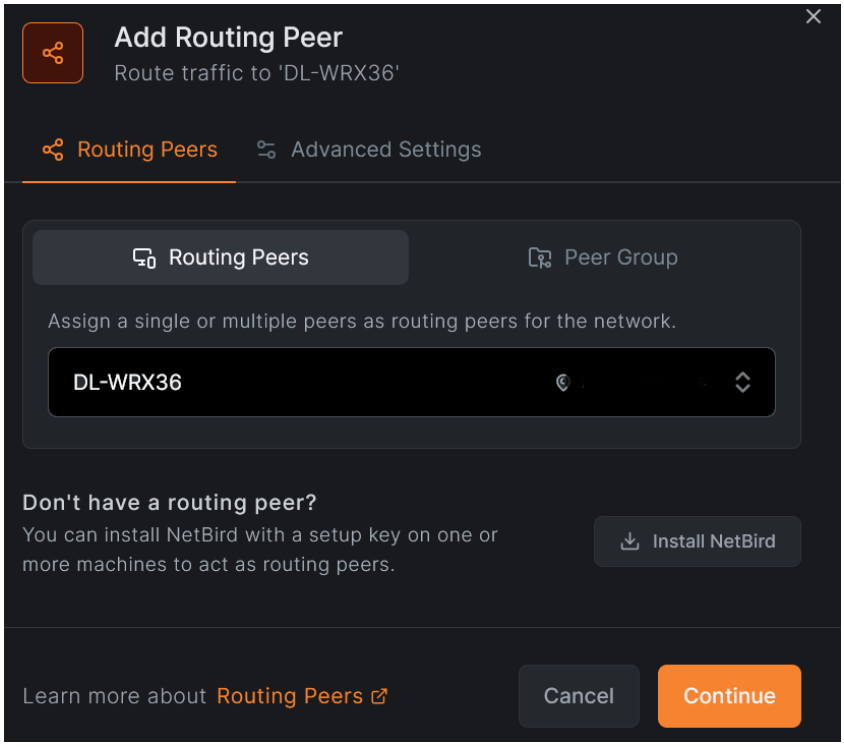


Proceed with making an Access Policy.
The destination is automatically your newly created Destination group (we will later add our peer to this Access group).
As Source I use `All` as everything in my network can have access but you can restrict it to your liking.

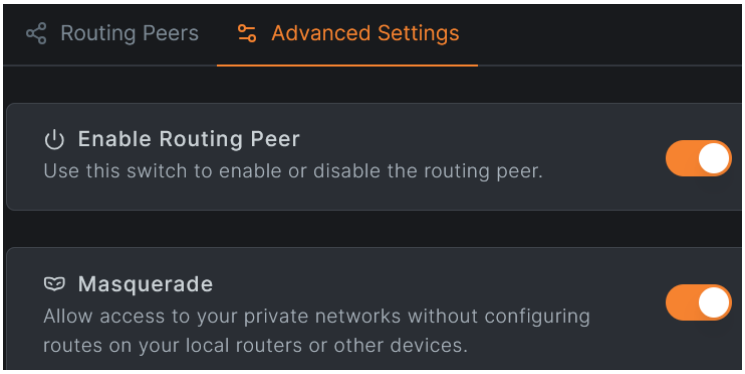
Note:
For every resource you have to make an Access Policy as the Destination Group you added is not automatically added to the `All` group



Proceed with adding a Routing Peer which is of course my DL-WRX36 peer:

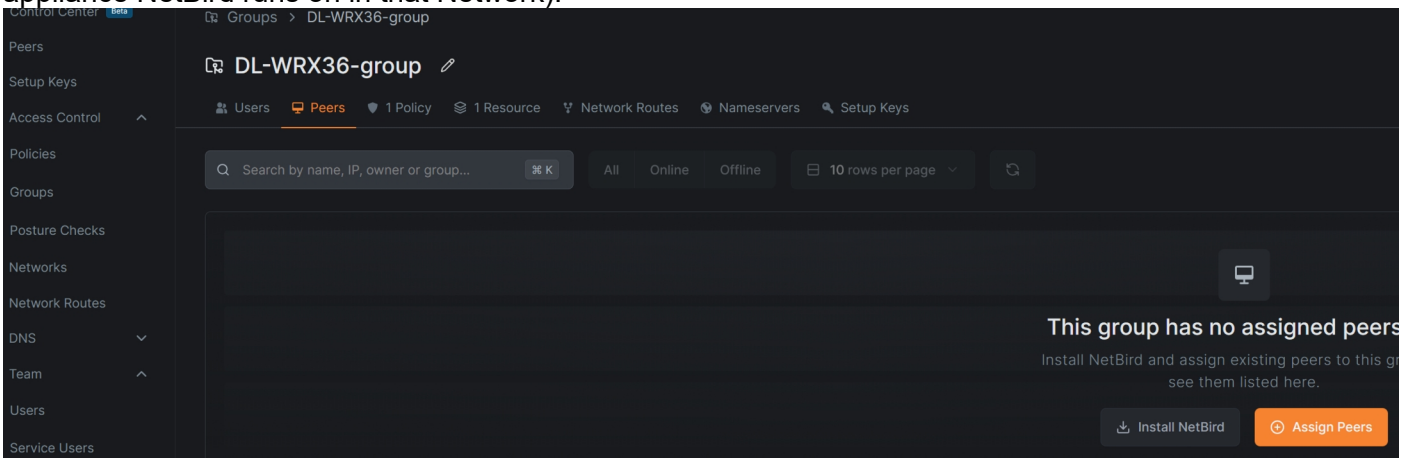


On Advanced settings enable Masquerading:



The last step is to add the DL-WRX36 peer to the Access Control Group DL-WRX36-group.

Goto Access Control > Groups and open the DL-WRX36 -group > Peers and assign you peer (the router or appliance NetBird runs on in that Network):

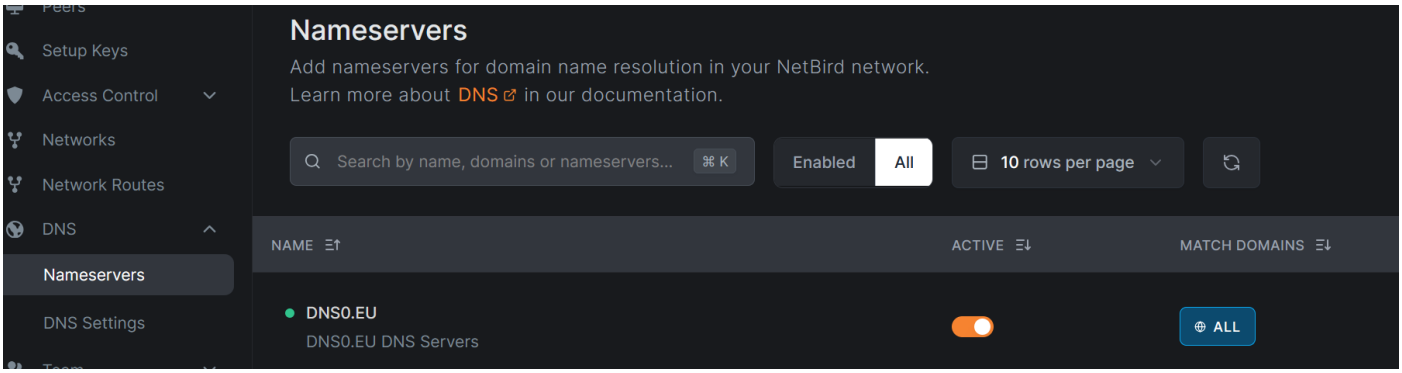


What I found confusing is that when making a resource you have to add the destination group.
The Destination group is an Access List group to control access and it is only possible to control access by group and not by individual peer so you have to make a new Access control group and add your peer later to that group.

DNS settings

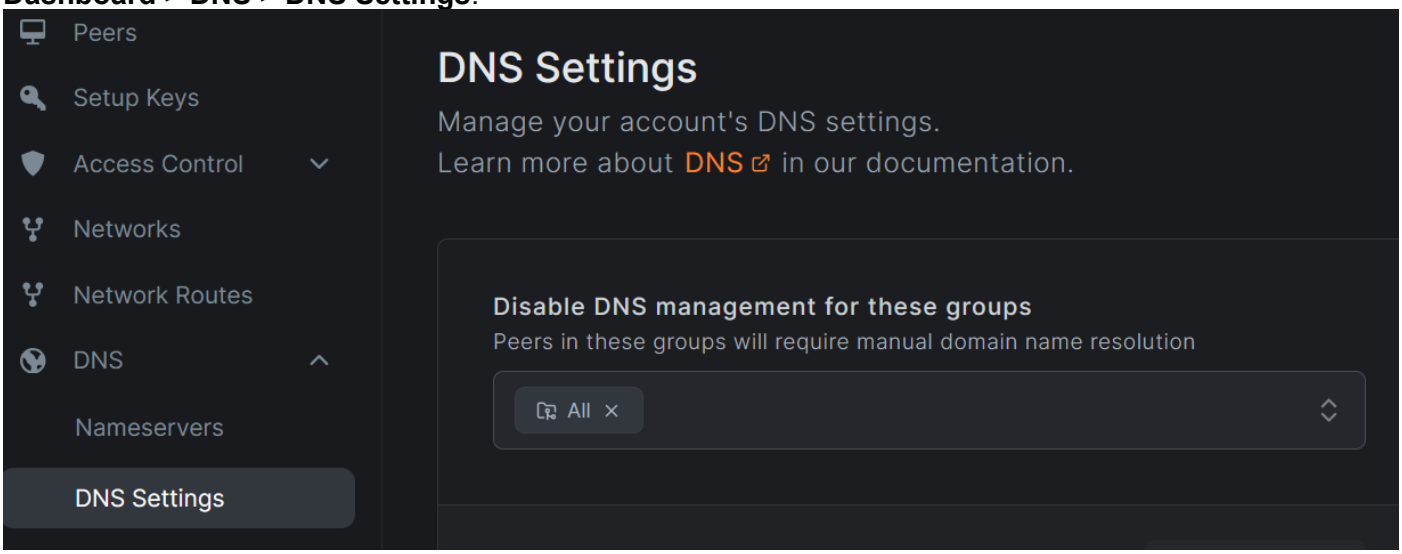
See:
https://docs.netbird.io/how-to/manage-dns-in-your-network
https://forum.openwrt.org/t/using-netbird-with-dnsmasq/218358/3?u=egc

NetBird by default runs its own DNS server on the peers, this is included in the NetBird executable and is used by default.
So make sure you set a Nameserver under DNS settings:
Dashboard > DNS > Nameservers:



I have chosen the DNS0.EU nameserver but you can choose others from a list or add your own.

If you do not want to use the NetBird DNS on your peers than you can disable it:
Dashboard > DNS > DNS Settings:



In this example I have disabled it for all peers, so all peers are using their own DNS settings and servers.

If you have one central DNS server you can set the NetBird name (e.g. mywrx36.netbird.cloud) of that server as Nameserver

Create Exit node

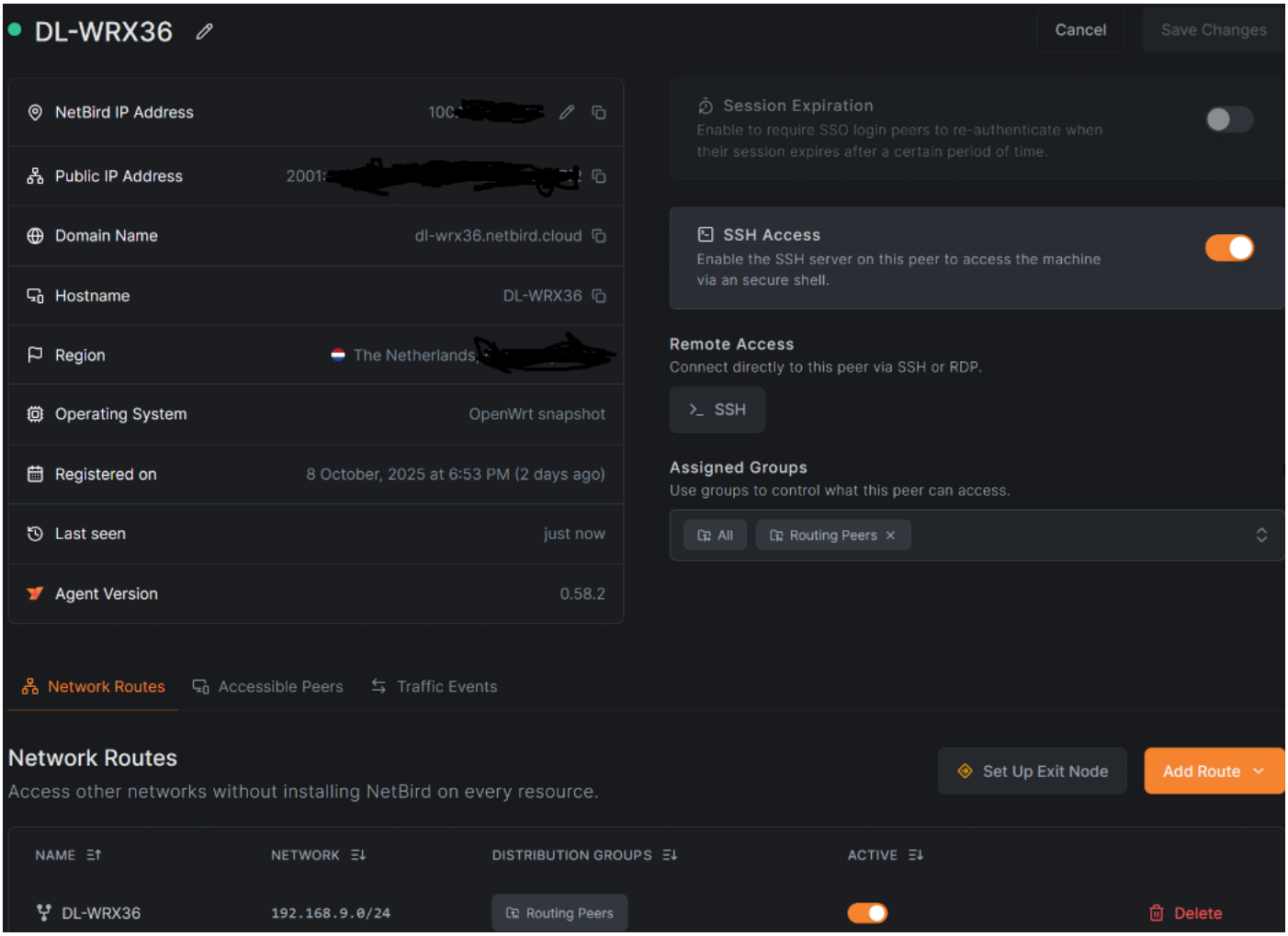
An exit node is a peer which acts as a VPN server other designated peers route all their traffic via the exit node.

On the exit node it is important that the firewall allows forwarding from **netbird** to **wan**, see paragraph about firewall.

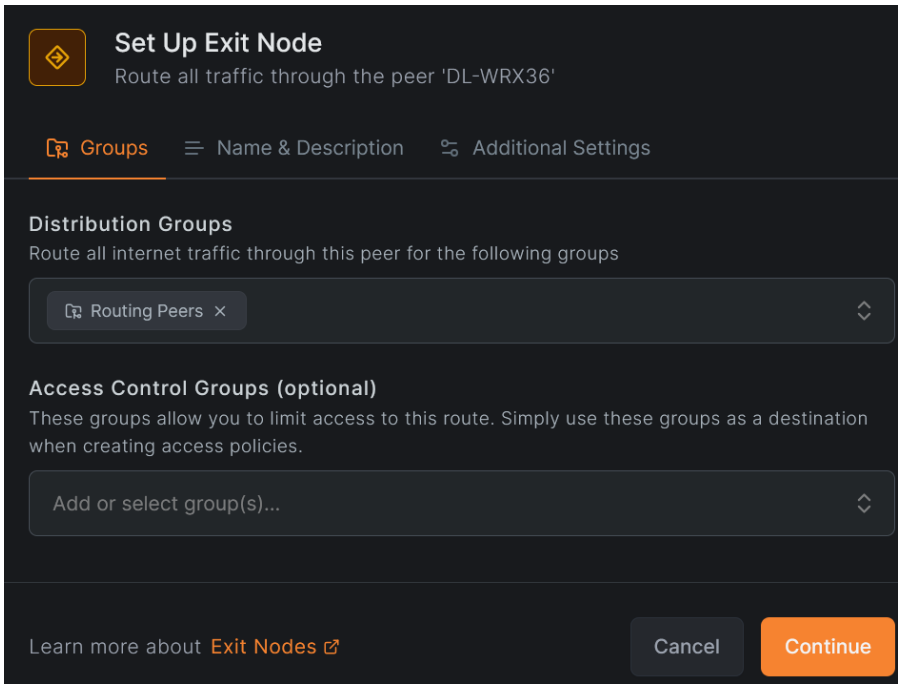
NetBird documentation: https://netbird.io/knowledge-hub/netbird-network-routes, scroll down to he bottom.

Log in in the NetBird dashboard

Peers > Click on the peer you want to be the exit node > On the overview page scroll to the bottom and click **Setup Exit node**

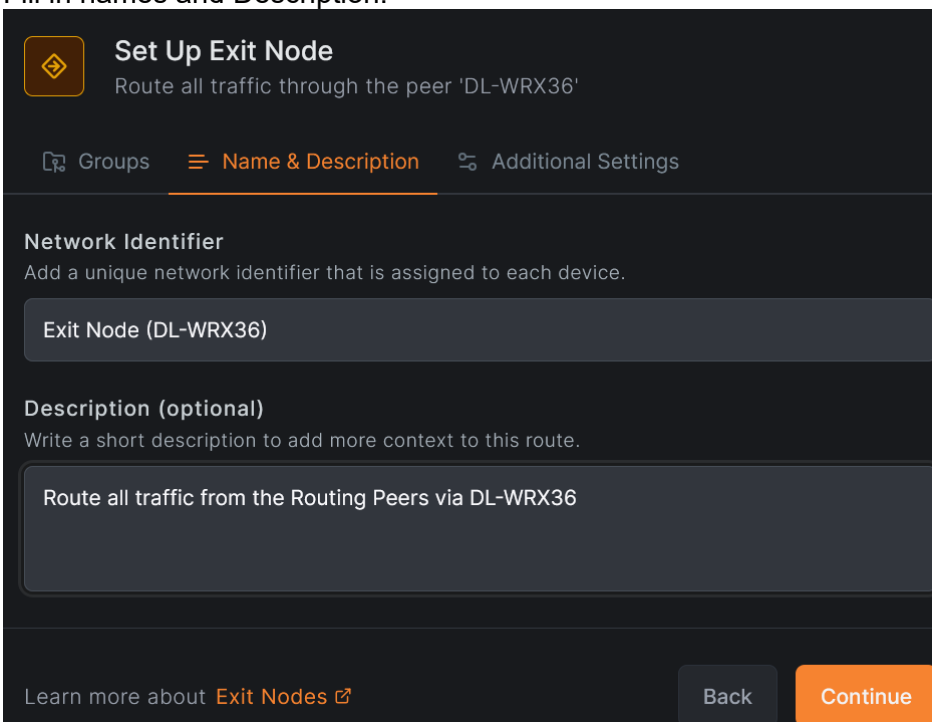


Under **Groups** add the peers you want to use the exit node, I had created a group **Routing Peers** and I want all those peers to use this router as exit node



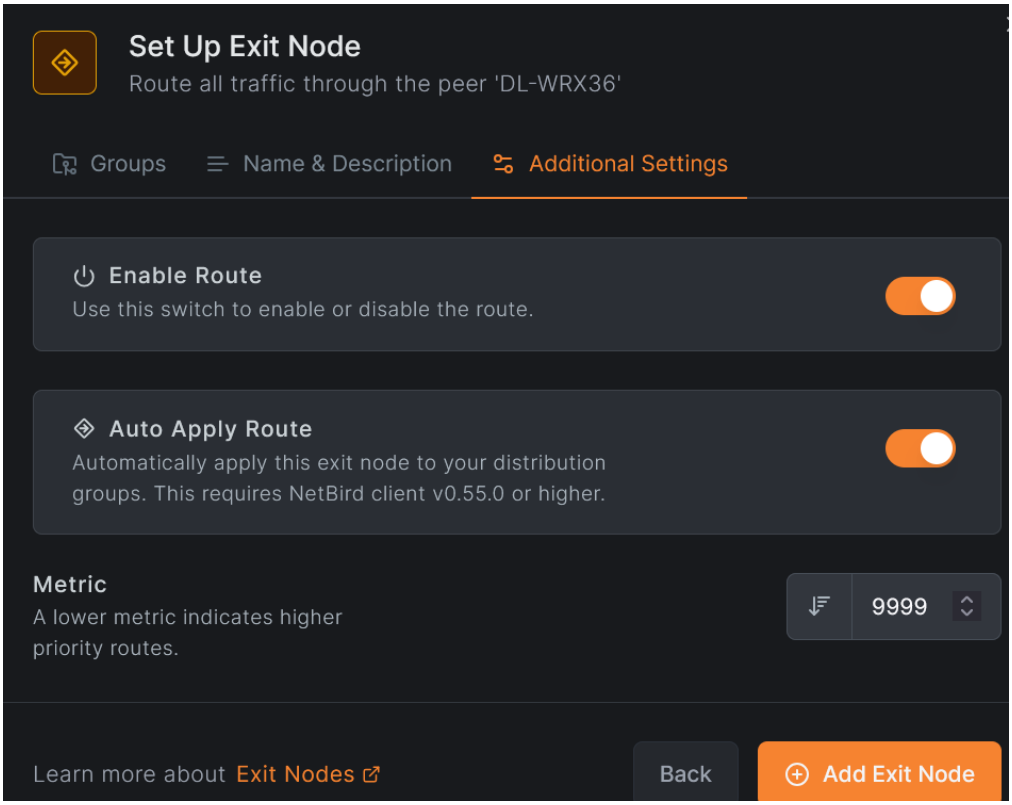
Continue

Fill in names and Description:



Continue

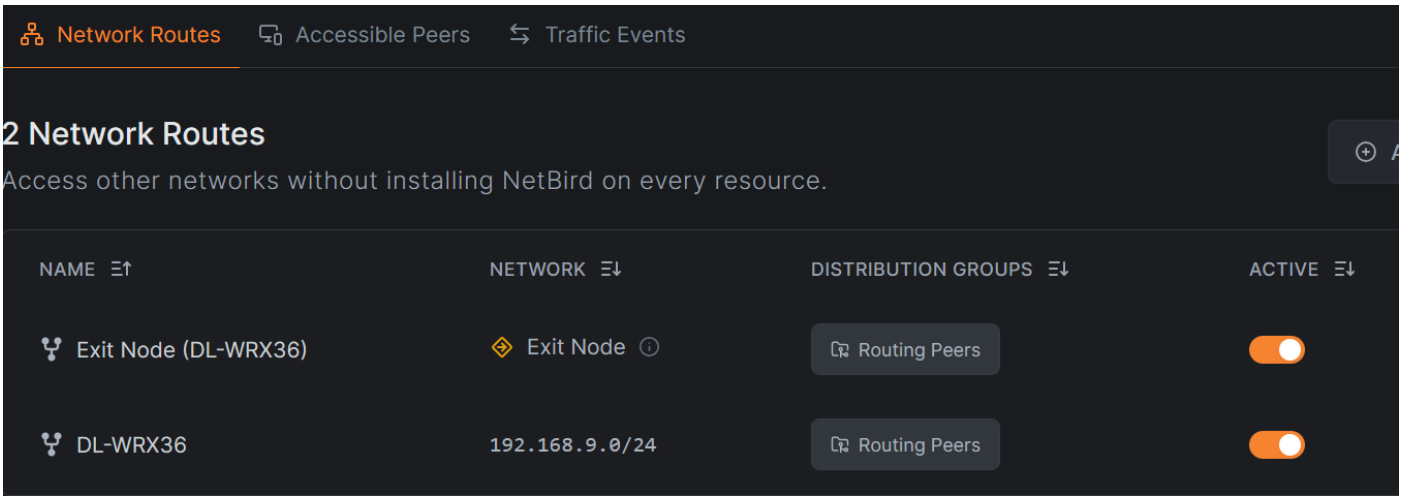
Enable Route and Auto Apply Route



Add Exit Node

My DL-WRX36 is running Snapshot with NetBird 0.58 (you can see it on the overview page if you click on the Peer) so all routes are applied automatically.

My DL-WRX36 now has set a route to its own subnet (which is 192.168.9.0/24), pushed to all the Routing peers en an Exit node which pushes a default route to all the routing peers.



You can check on one of the other routing peers e.g. my R7800-2 where you can see the pushed default route and the pushed route to reach the DL-WRX36:

root@R7800-2:~# *ip route show table netbird*
```
default dev wt0
192.168.9.0/24 dev wt0
```

Now all traffic from the R7800-2 (and all its LAN clients are routed) via NetBird interface, which is actually your WireGuard interface and *wg show* will show you how the routing is taking place via the exit node

Support

For support and questions see the NetBird support thread:
https://forum.openwrt.org/t/netbird-support-discussion-thread/237831/8

Known Problems

SSH-Access from Dashboard

Enabling Lazy Connections might stop SSH access from the Dashboard (Settings > Clients):
https://netbird.io/knowledge-hub/lazy-connections
https://forum.openwrt.org/t/netbird-support-discussion-thread/237831/44?u=egc

Policy Based Routing (PBR) together with NetBird

Policy based routing can be used to route traffic via different routes according to source and/or destination. It can be useful if you have set your peer (router) to use an exit node which means all traffic is routed via the specified exit node and you want to route some traffic via the WAN instead of the exit node.

You can setup this up manually but it is often easier to install the PBR app.

To work together with the PBR app, add to the PBR config (**version 1.2.X** and higher):
/etc/config/pbr:
```
option uplink_ip_rules_priority '99'
```

or from command line:
```
uci set pbr.config.uplink_ip_rules_priority="99"
uci commit pbr
service pbr restart
```

This will make sure the PBR ip rules will come before the NetBird rules (>100).

For checking rules and routes see Check and Troubleshoot section.

If everything rusn you should see something like this:
```
root@R7800-2:~# ip rule show
0:      from all lookup local
97:     from all sport 52199 lookup pbr_wan
97:     from all lookup main suppress_prefixlength 1
98:     from all fwmark 0x20000/0xff0000 lookup pbr_netbird1
99:     from all fwmark 0x10000/0xff0000 lookup pbr_wan
105:    from all lookup main suppress_prefixlength 0
110:    not from all fwmark 0x1bd00 lookup netbird
32766:  from all lookup main
32767:  from all lookup default
```

Note the still existing NetBird rules and the PBR rules **before** the Netbird rules, so these take precedence.

Netbird starts rather late so you might need to restart PBR (*service pbr restart*) after setting up or after a reboot

Install on Oracle VPS with Ubuntu (24.04)

sudo apt-get update
sudo apt install ca-certificates curl gnupg -y
curl -sSL https://pkgs.netbird.io/debian/public.key | sudo gpg --dearmor --output /usr/share/keyrings/netbird-archive-keyring.gpg
echo 'deb [signed-by=/usr/share/keyrings/netbird-archive-keyring.gpg] https://pkgs.netbird.io/debian stable main' | sudo tee /etc/apt/sources.list.d/netbird.list

sudo apt-get update
sudo apt-get install netbird
 # only for the GUI
#sudo apt-get install netbird-ui

netbird up –setup-key <setup-key made on dashboard> --allow-server-ssh

Log on Ubuntu: *cat /var/log/netbird/client.log*

SSH access note that the user name is usually: *ubuntu*

For (SSH) Access add thes firewall rules

sudo iptables -I INPUT 3 -p udp --dport 3478 -j ACCEPT # NetBird TURN
sudo iptables -I INPUT 4 -p tcp --dport 44338 -j ACCEPT # SSH service port from NetBird

sudo iptables -I INPUT 5 -p udp --dport 51820 -j ACCEPT # NetBird WireGuard
#sudo iptables -t nat -I POSTROUTING -o wt0 -j MASQUERADE #To Masquerade traffic ?
#sudo iptables -t nat -I POSTROUTING -o ens3 -j MASQUERADE #To Masquerade traffic ?

Make persistent:
`sudo netfilter-persistent save`

vcn-XXX > Security > Default Security List for vcn-XXX > Security rules:

☐	No	0.0.0.0/0	UDP	All	3478
☐	No	0.0.0.0/0	TCP	All	44338
☐	No	0.0.0.0/0	UDP	All	51820

Throughput improvements via transport layer offloading

Tuning two features may show improved throughput:

- `rx-udp-gro-forwarding`: Enables UDP Generic Receive Offload (GRO) forwarding, which aggregates incoming UDP packets to reduce CPU overhead on receive.
- `rx-gro-list`: If disabled (off), it prevents multiple flows from being aggregated simultaneously which simplifies flow handling and performance on some workloads.

From command line:
1. Install "ethtool":
```
apk update
apk add ethtool
```

2. Apply the changes:
Substitute "wan" below for your WAN interface.</WRAP>
```
ethtool -K wan rx-gro-list off
ethtool -K wan rx-udp-gro-forwarding on
```

3. Test the changes before and after before committing them permanently with something similar to the following commands.
You want to verify:

- Packet aggregation is working as measured by reduced packets/sec on the wire with GRO enabled (verify with tools like: `ethtool -S <interface> | grep udp` or `netstat -su`)

- CPU usage is reduced. Lower CPU usage on the receiver compared to same test with `rx-udp-gro-forwarding` turned off
- High throughput is achieved near line rate (e.g., 1 Gbps, 10Gbps, etc) without packetloss. You need iperf3 for proper measurement

Setup Oracle free OpenVPN cloud server

https://www.youtube.com/watch?v=E-CLtExRzX8
https://mateo.cogeanu.com/2020/wireguard-vpn-pihole-on-free-oracle-cloud/

References

NetBird support thread: https://forum.openwrt.org/t/netbird-support-discussion-thread/237831/8
Upgrade from 0.50 to 0.58: https://github.com/netbirdio/netbird/issues/4322

NetBird Releases

https://github.com/netbirdio/netbird/releases

Configuration

See: https://docs.netbird.io/get-started/cli

Flags are for using on the command line e.g. *netbird up --flag* if these are also config items then it will be stored in the config in /root/.config/netbird/default.json so ther is no need to add the flag again.
Most flags can also be set as Environment variable with syntax NB_FLAG and using underscores instead of hyphens e.g.: *export NB_FLAG=1* or set in the environment in the init script: *procd_append_param env NB_DISABLE_SSH_CONFIG="1"*

Disable SSH Authorization per user

flag (command line): --disable-ssh-auth
env param: NB_DISABLE_SSH_AUTH=1
config: `"DisableSSHAuth": true,`

Enable SSH root user

flag: --enable-ssh-root
env param: NB_ENABLE_SHH_ROOT
config: `EnableSSHRoot": true,`

Disable Netbird DNS, this disables the writing to resolv.conf

config: `"DisableDNS": true,`

Disable SSH integration with OpenSSH, this disables the writing of `/etc/ssh/ssh_config.d/99-netbird.conf`:

flag: - --disable-ssh-config
env param: NB_DISABLE_SSH_CONFIG=1
config: "DisableSSHConfig": true

Addendum 1

/root/.config/netbird/defaultjson:


```
{
    "PrivateKey": "kDJR2ykm0=",
    "PreSharedKey": "",
    "ManagementURL": {
        "Scheme": "https",
        "Opaque": "",
        "User": null,
        "Host": "api.netbird.io:443",
        "Path": "",
        "RawPath": "",
        "OmitHost": false,
        "ForceQuery": false,
        "RawQuery": "",
        "Fragment": "",
        "RawFragment": ""
    },
    "AdminURL": {
        "Scheme": "https",
        "Opaque": "",
        "User": null,
        "Host": "app.netbird.io:443",
        "Path": "",
        "RawPath": "",
        "OmitHost": false,
        "ForceQuery": false,
        "RawQuery": "",
        "Fragment": "",
        "RawFragment": ""
    },
    "WgIface": "wt0",
    "WgPort": 51820,
    "NetworkMonitor": null,
    "IFaceBlackList": [
        "wt0",
        "wt",
        "utun",
        "tun0",
        "zt",
        "ZeroTier",
        "wg",
        "ts",
        "Tailscale",
        "tailscale",
        "docker",
        "veth",
        "br-",
        "lo"
    ],
    "DisableIPv6Discovery": false,
    "RosenpassEnabled": false,
    "RosenpassPermissive": false,
    "ServerSSHAllowed": true,
    "EnableSSHRoot": true,
    "EnableSSHSFTP": null,
    "EnableSSHLocalPortForwarding": null,
    "EnableSSHRemotePortForwarding": null,
```

```
    "DisableSSHAuth": true,
    "SSHJWTCacheTTL": null,
    "DisableClientRoutes": false,
    "DisableServerRoutes": false,
    "DisableDNS": true,
    "DisableFirewall": false,
    "BlockLANAccess": false,
    "BlockInbound": false,
    "DisableNotifications": true,
    "DNSLabels": null,
    "SSHKey": "-----BEGIN PRIVATE KEY-----\nMC4CA\n-----END PRIVATE KEY-----\n",
    "NATExternalIPs": null,
    "CustomDNSAddress": "",
    "DisableAutoConnect": false,
    "DNSRouteInterval": 60000000000,
    "ClientCertPath": "",
    "ClientCertKeyPath": "",
    "LazyConnectionEnabled": false,
    "MTU": 1280
}
```

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