Deep-dive: IPSec & Xauth mode-config

Your guide to IPSec and VPNs

Presenter information

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About Unimus

Disaster recovery
(configuration backup)

Configuration management
(change diffs, network-wide auditing, etc.)

Automation
(mass reconfiguration, config-push, etc.)

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Why are we talking about IPSec Xauth mode-config?

Note for posterity

- If you find this presentation online in a .pdf, please watch the video
- Proper explanations to every slide and much more information available

https://www.youtube.com/c/TomasKirnak/videos

Presentation agenda

- How does IPSec work?
- Configuration examples

- Xauth mode-config vs. other options

- Configuring MikroTik AC
- Configuring client

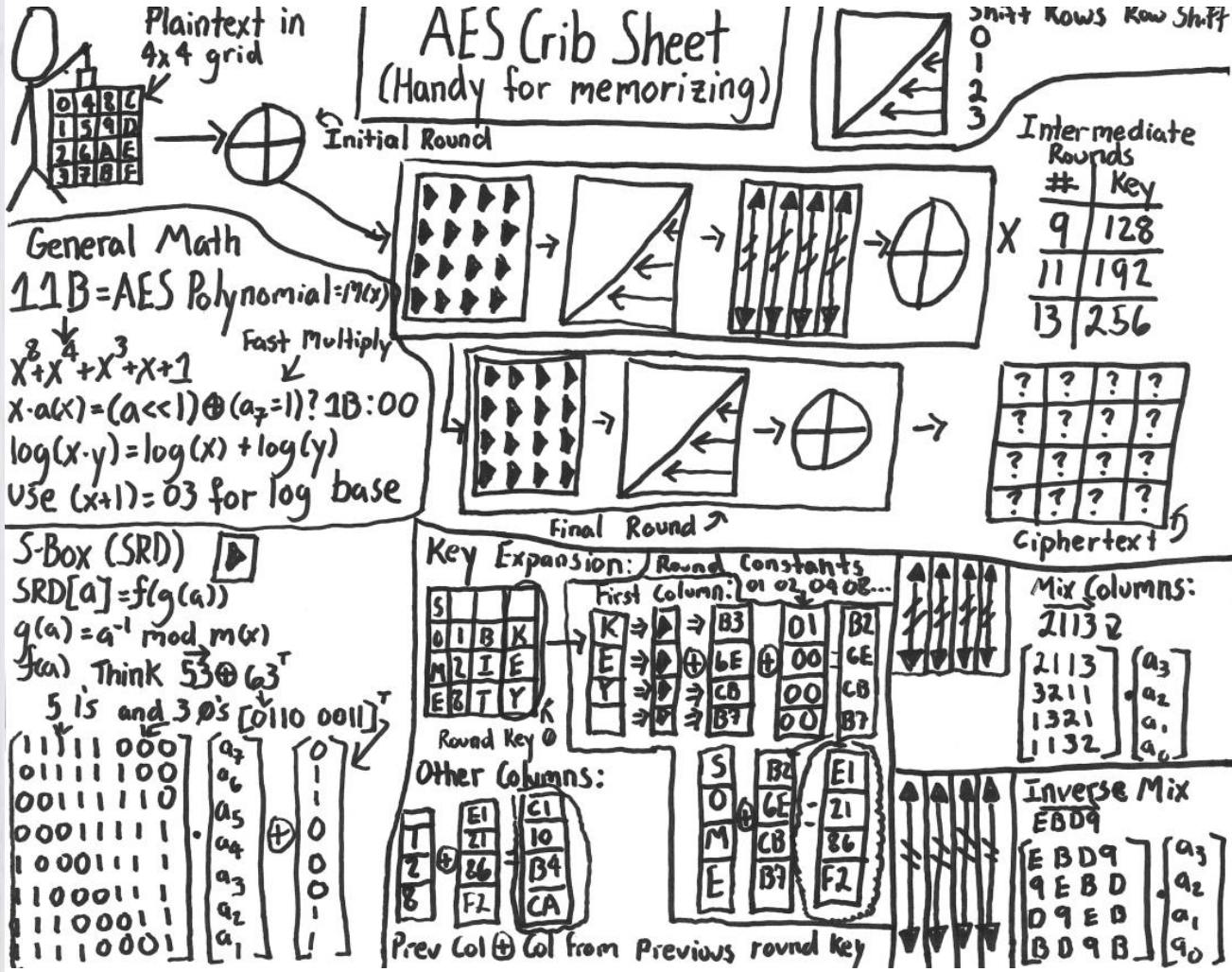
- Security and other misc. bits

Before we start

- This presentation deals specifically with Road-Warriors (remote, roaming clients)
- Site-to-site tunneling should NOT use Xauth mode-config
- But what you learn about IPSec here will be useful for any (and all) IPSec- related things

Part 1:

How does IPSec work?



What is IPSec?

- IPSec is a standard for secure communication over public networks
- Specifically, IPSec allows us to ensure payload integrity, and / or encrypt the payload.

IPSec functions

- Integrity validation
  IPSec AH (Authentication Header)

- Payload encryption (can also validate)
  IPSec ESP (Encapsulating Security Payload)

IPSec session

- To provide these functions, and IPSec session needs to be established.

- To establish an IPSec session – 2 phases
  - Phase 1 – IKE – Internet Key exchange
  - Phase 2 – IPSec

IKE

- Phase 1 (IKE) is responsible for the initial IPSec session establishment
- After Phase 1 is successfully negotiated, the 2 peers can start sending IPSec traffic to each other
- To establish an IKE session, a shared secret is required (PSK, cert, key, etc.)

IPSec traffic

- IPSec policies are responsible for telling the IPSec service which traffic should be encrypted – and how.

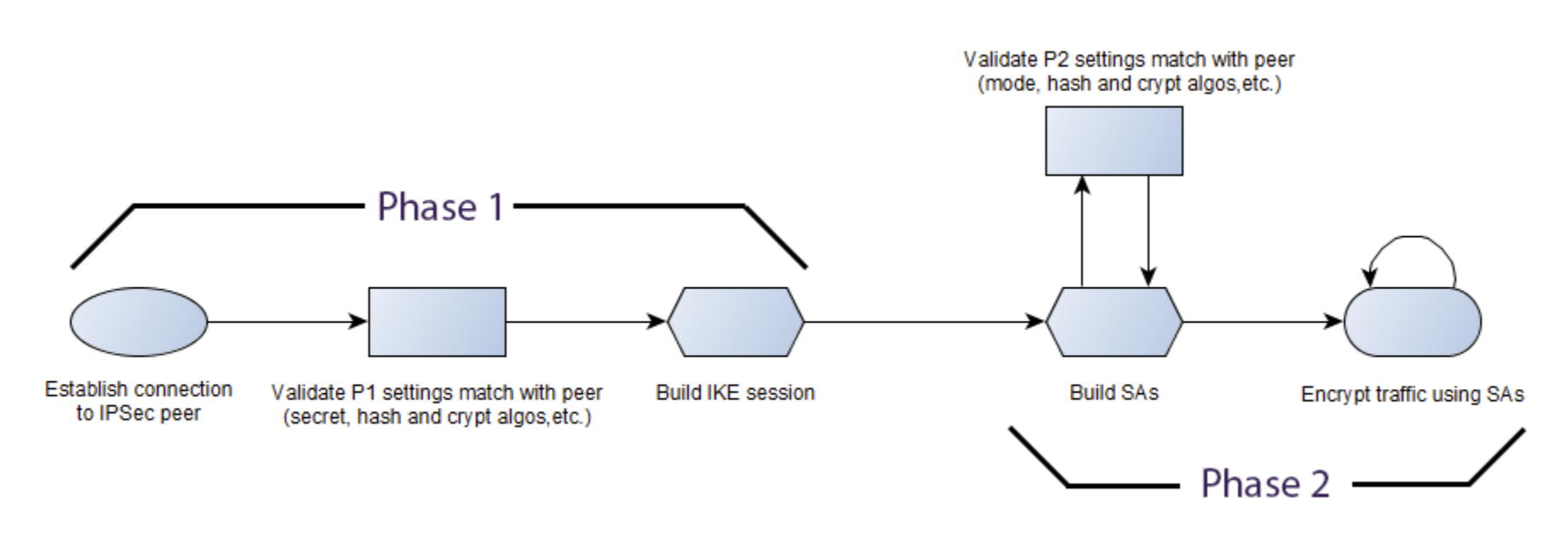
- IPSec policies are like an IPSec routing table – they decide which traffic should go to what peer, and how it should be encrypted.

How is traffic encrypted?

- SAs (security associations) are responsible for encrypting traffic.
- After IKE is negotiated, SAs are built, and then traffic is encrypted.
- IPSec = not that hard right?

Visualizing IPSec

- Visualizing the IPSec process



- Note: this is vastly simplified

In RouterOS

- Please note, that in RouterOS, having some matching traffic is required for the IPSec process to kick in.

- In other words, there needs to be some traffic matching an IPSec policy, before anything is done.

Closer look at Phase 2

- Lets take a closer look at Phase 2, and the IPSec policies.

- IPSec policies dictate:
  - What traffic is to be processed by IPSec
  - To which peer should the traffic go
  - What to do with the traffic (auth vs. crypt)
  - How to process the traffic (transport vs. tunnel mode)

IPSec modes

- We mentioned modes (transport vs. tunnel), lets talk about this

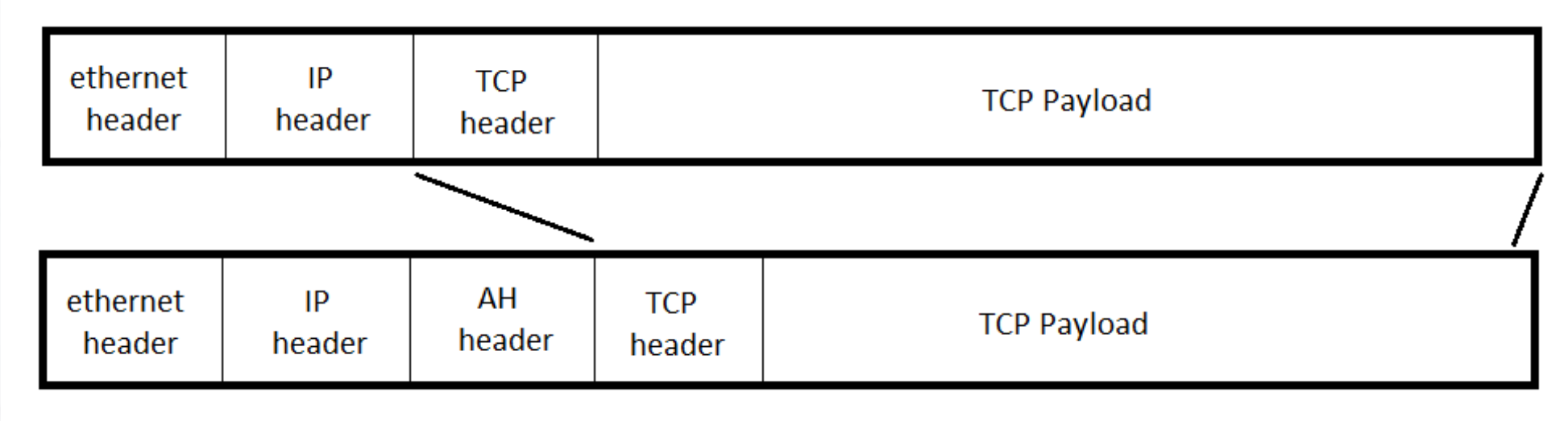
- IPSec Phase 2 supports 2 modes:
  - Transport mode
  - Tunnel mode

Transport vs. Tunnel

- Transport mode
  - Secures a data stream
  - Encapsulates L4 datagram
- Tunnel mode
  - Tunnels traffic
  - Encapsulates entire L3 packet

Transport mode

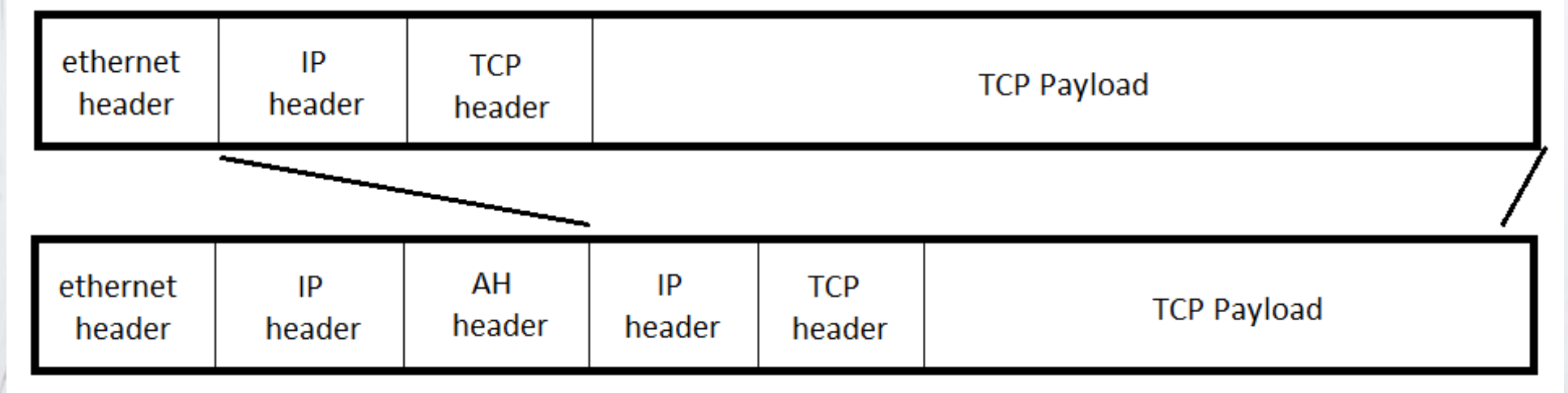
- Only the payload of the packed is encapsulated and secured



- Transport mode is used to secure host-to-host / end-to-end traffic

Tunnel mode

- The whole IP packet is encrypted



- Therefore, tunnel mode can be used for VPN by itself

Last part

- IPSec proposal – crypt configuration
- This tells RouterOS which crypto / hashing algorithms to use on our traffic
- Basically – how secure do we want this VPN to be

RouterOS sum-up

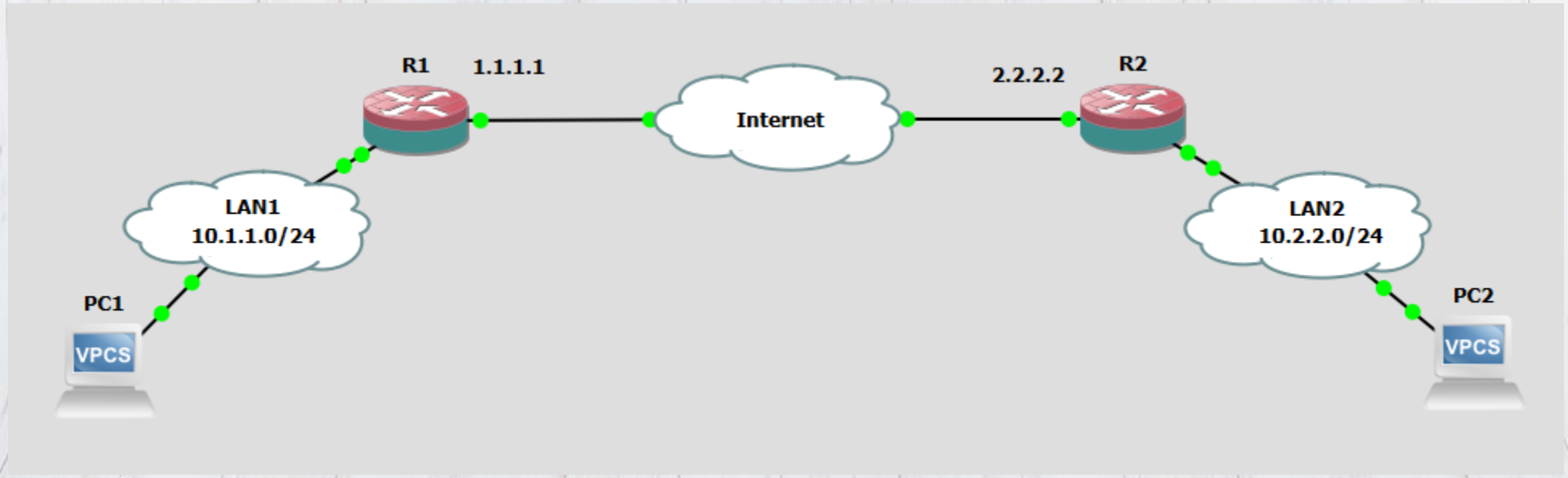
- /ip ipsec peer
  Defines Phase 1 settings for our our IPSec peers

- /ip ipsec policy
  Defines what traffic to process, and how to process it

- /ip ipsec proposal
  Defines what crypto / hashing algos to use

Let’s see an example

- To understand this, lets visualize it:



- Basic site-to-site VPN

In tunnel mode

R1

```
# create peer (Phase 1)
/ip ipsec peer
add address=2.2.2.2/32 dh-group=modp2048
dpd-interval=10s dpd-maximum-failures=3 enc-
algorithm=aes-256 hash-algorithm=sha512
secret=superSecret

# create policy (Phase 2)
/ip ipsec policy
add dst-address=10.2.2.0/24 sa-dst-address=2.2.2.2
sa-src-address=1.1.1.1 src-address=10.1.1.0/24
tunnel=yes

# traffic in IPSec tunnel must not be NATed
/ip firewall nat
add action=accept chain=srcnat dst-
address=10.2.2.0/24
```

R2

```
# create peer (Phase 1)
/ip ipsec peer
add address=1.1.1.1/32 dh-group=modp2048 dpd-
interval=10s dpd-maximum-failures=3 enc-
algorithm=aes-256 hash-algorithm=sha512
secret=superSecret

# create policy (Phase 2)
/ip ipsec policy
add dst-address=10.1.1.0/24 sa-dst-address=1.1.1.1
sa-src-address=2.2.2.2 src-address=10.2.2.0/24
tunnel=yes

# traffic in IPSec tunnel must not be NATed
/ip firewall nat
add action=accept chain=srcnat dst-
address=10.1.1.0/24
```

In transport mode

R1

```
# IPSec setup
/ip ipsec peer
add address=2.2.2.2/32 dh-group=modp2048 dpd-
interval=10s dpd-maximum-failures=3 enc-algorithm=aes-
256 hash-algorithm=sha512 secret=superSecret
/ip ipsec policy
add dst-address=2.2.2.2/32 protocol=gre src-
address=1.1.1.1/32

# GRE to tunnel the traffic
/interface gre
add clamp-tcp-mss=no dont-fragment=inherit
keepalive=10s,3 mtu=1400 name=gre-tunnel1 remote-
address=2.2.2.2

# routing
/ip address
add address=10.255.0.1/24 interface=gre-tunnel1
/ip route
add distance=1 dst-address=10.2.2.0/24 gateway=10.255.0.2
```

R2

```
# IPSec setup
/ip ipsec peer
add address=1.1.1.1/32 dh-group=modp2048 dpd-
interval=10s dpd-maximum-failures=3 enc-algorithm=aes-
256 hash-algorithm=sha512 secret=superSecret
/ip ipsec policy
add dst-address=1.1.1.1/32 protocol=gre src-
address=2.2.2.2/32

# GRE to tunnel the traffic
/interface gre
add clamp-tcp-mss=no dont-fragment=inherit
keepalive=10s,3 mtu=1400 name=gre-tunnel1 remote-
address=1.1.1.1

# routing
/ip address
add address=10.255.0.2/24 interface=gre-tunnel1
/ip route
add distance=1 dst-address=10.1.1.0/24 gateway=10.255.0.1
```

Note on the setups

- In previous setups, we used the default proposal
- Please note the default should be adjusted for better security

```
# adjust how traffic is encrypted

/ip ipsec proposal
set [ find default=yes ] auth-algorithms=sha256 enc-algorithms=aes-128-cbc
pfs-group=modp2048
```

Tunnel vs. Transport 2

- So what should you use for site-to-site VPNs?
- If possible, always use IPSec transport mode, with an underlying tunnel
- Why – because you get an interface
  (IPSec policies to drive traffic in Tunnel mode aren't an interface)
- Having an interface allows you to do OSPF, torch, easier firewalling, etc.

Part 2:

What about road warriors?

Oh what a day…

- Previous cases dealt with a site-to-site VPN
- However, just as often we need to support Road-Warriors - remote, roaming clients
- This means we now want a client-to-site setup
- This is not a network anymore, just a single client – often behind NAT

Our options

- We have multiple options here:
  - PPTP (please don't)
  - SSTP
  - OVPN
  - L2TP / IPSec
  - IPSec Xauth mode-config
  - IKEv2

Why Xauth mode-config?

- Support in ALL major OS (including mobile)
- Not TCP-based
- Support for keys, certs or a PSK

- Configuration push
  Routes, DNS, etc.

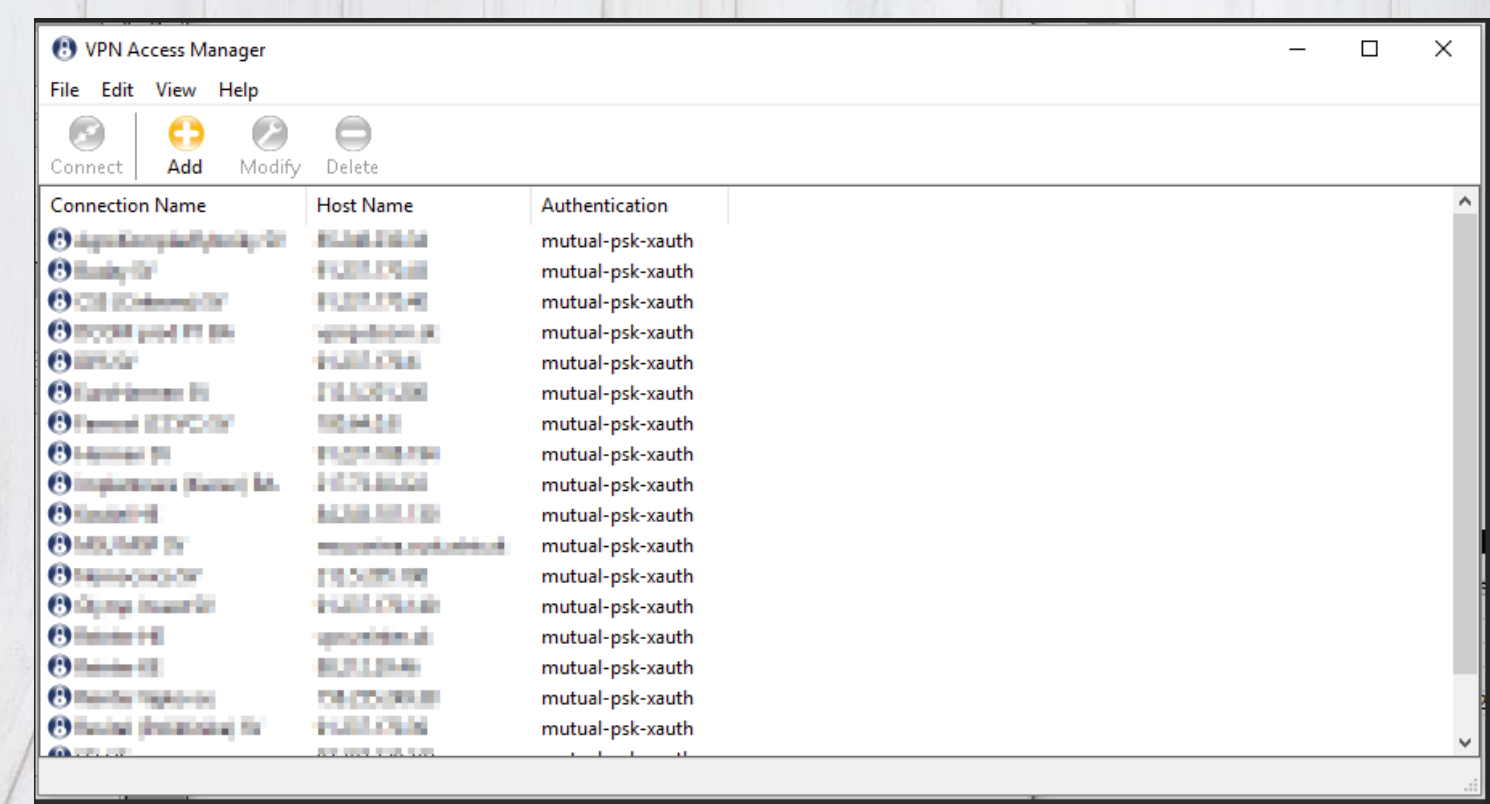
- GREAT free client software
  Shrew VPN client

What do road-warriors need?

- We really really want to push settings to road-warriors
- Specifically:
  Routes (which traffic should go to VPN)
  DNS (so they can resolve local hostnames)
- Let’s discuss why…

Managing VPNs…

- Having the ability to export / import VPN profiles is a great time-saving feature
- Imagine having to configure this manually
- Sending a profile file to import for a non-IT user is MUCH easier than configuring the OS-included VPN

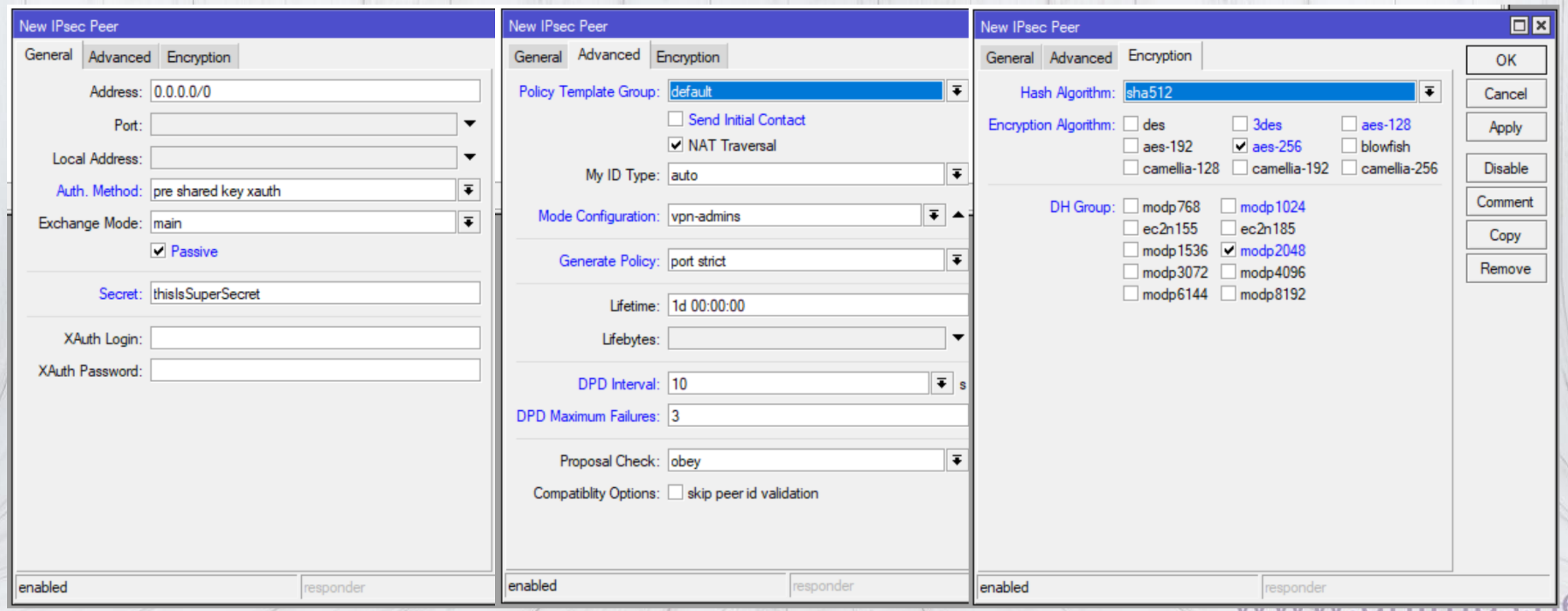


Which client to use?

- We will be using Shrew VPN client for the rest of this presentation
- Great, free, available for all major OS
  TONS of features, support for all we need here
- On mobile, use the OS built-in client

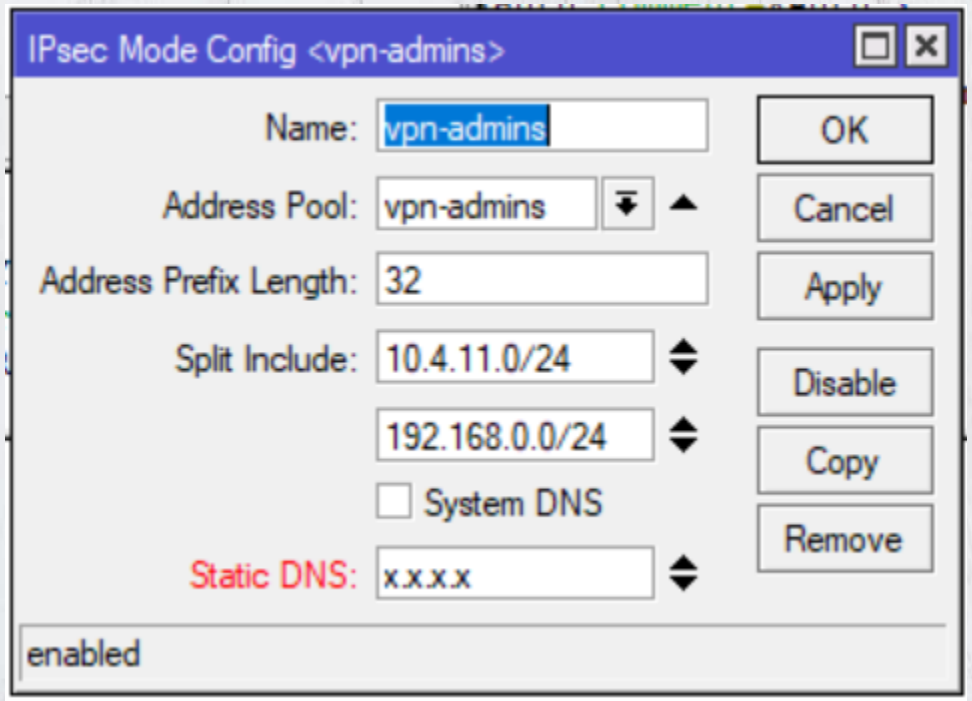
How to configure this?

- Let's see how to configure an Xauth mode-config AC on RouterOS



How to push config to clients

- To push config to clients, we just need to specify a mode-config config

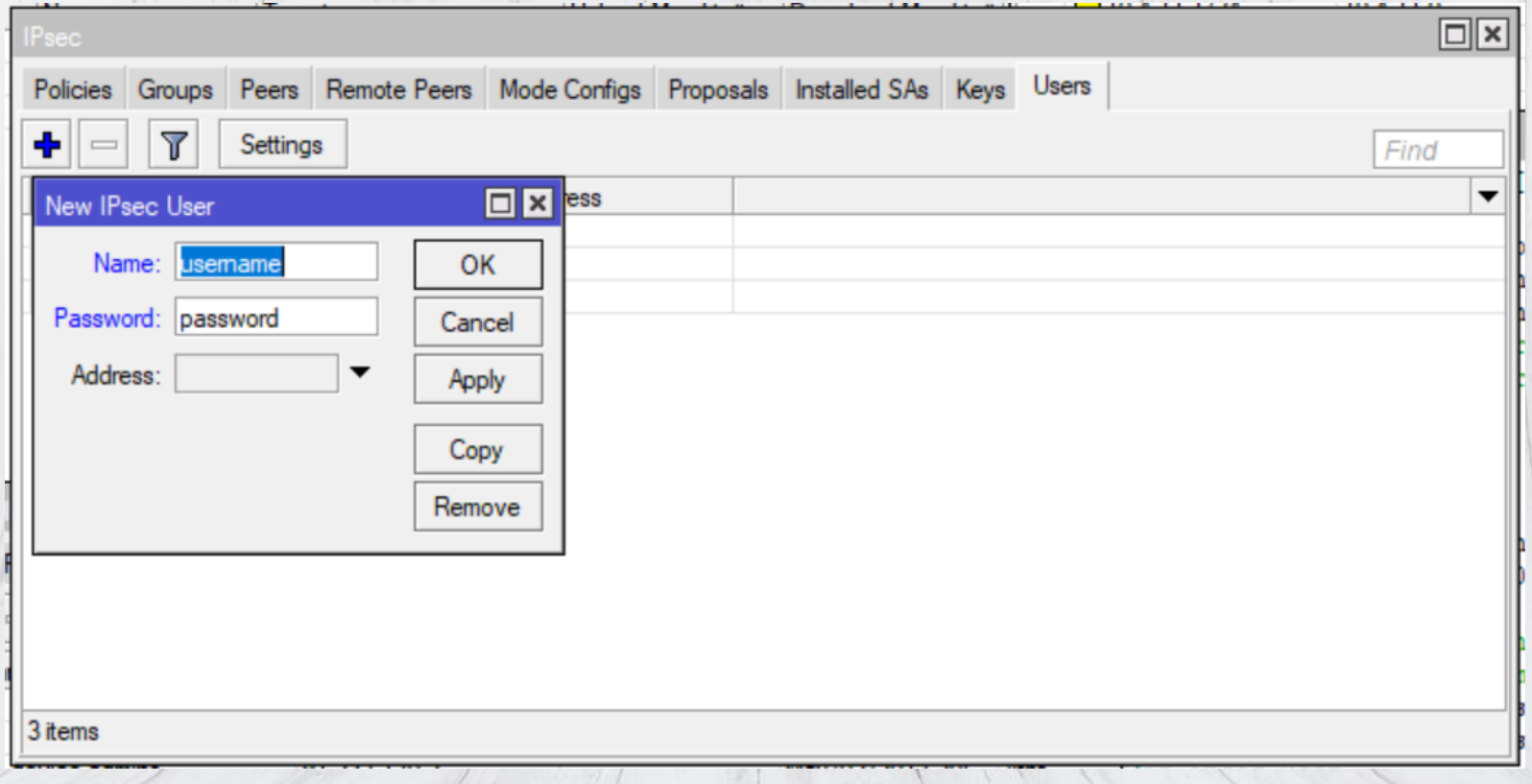


What about IPSec policy?

- Policy will be generated automatically
- generate-policy=port-strict in the Peer configuration will take care of this

Last step – our warriors

Now we can generate our Xauth users:

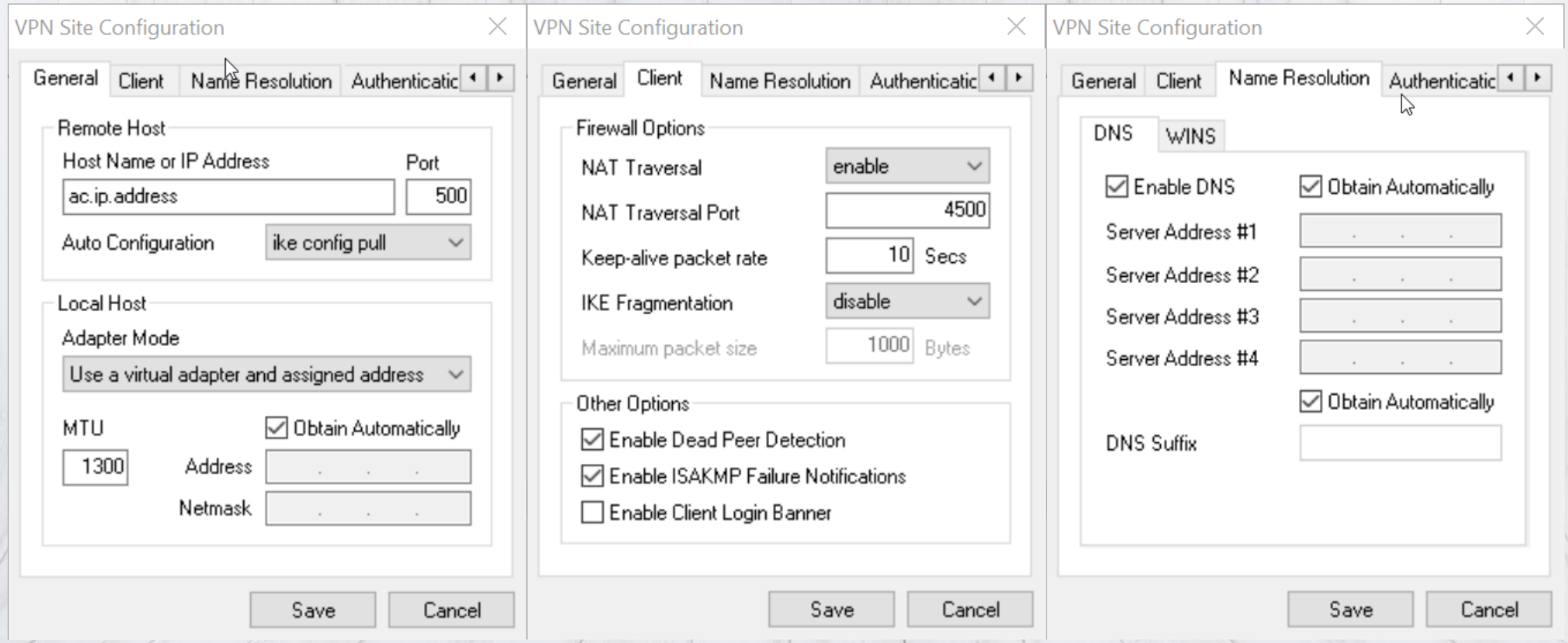


You can also do Radius auth!

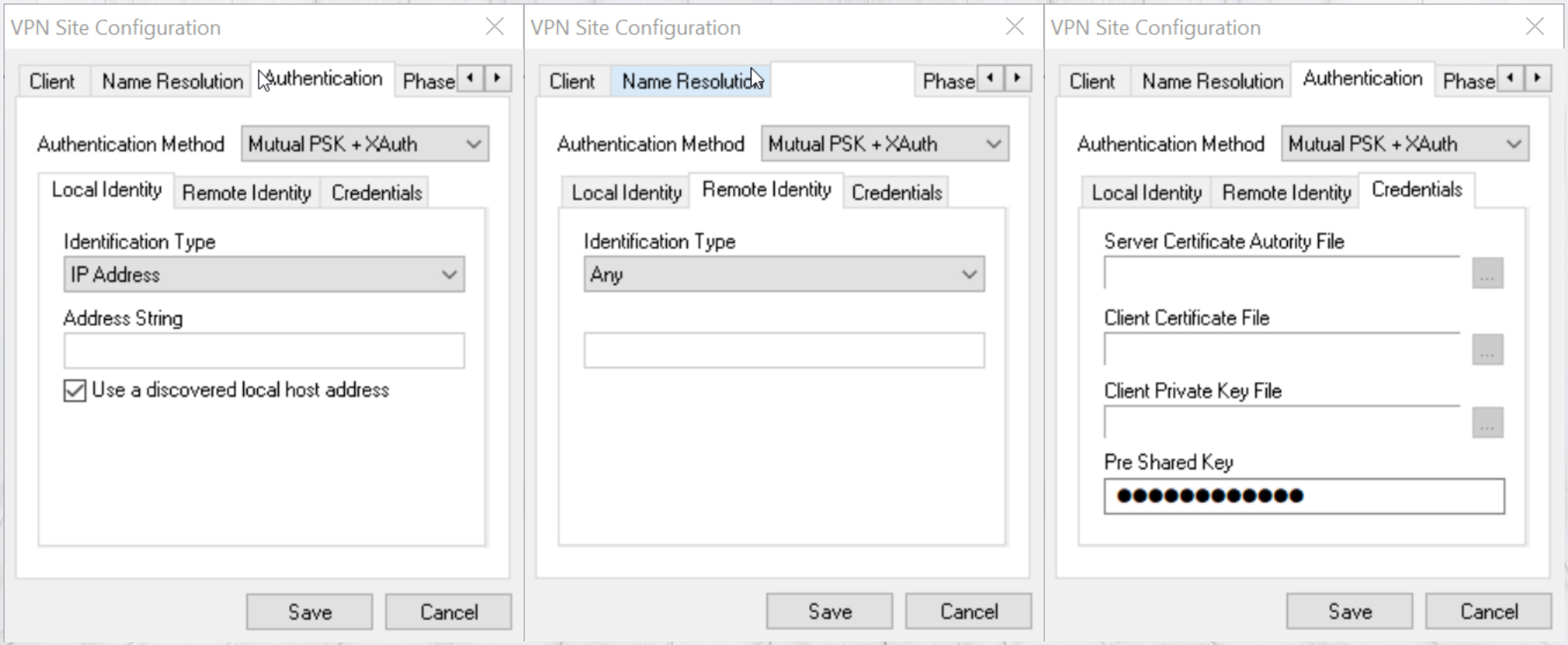
Full AC config

```
# Peer
/ip ipsec peer
add address=0.0.0.0/0 auth-method=pre-shared-key-xauth dpd-interval=10s dh-group=modp2048
dpd-maximum-failures=3 enc-algorithm=aes-256 generate-policy=port-strict hash-algorithm=sha512
mode-config=vpn-admins passive=yes secret=ipsec-secret send-initial-contact=no


# mode-config
/ip pool
add name=vpn-admins ranges=10.255.254.0/24

/ip ipsec mode-config
add address-pool=vpn-admins name=vpn-admins split-include=10.4.11.0/24,192.168.0.0/24 system-
dns=no dns=x.x.x.x


# user
/ip ipsec user
add name=username password=password


# adjust how traffic is encrypted
/ip ipsec proposal
set [ find default=yes ] auth-algorithms=sha256 enc-algorithms=aes-128-cbc pfs-group=modp2048
```

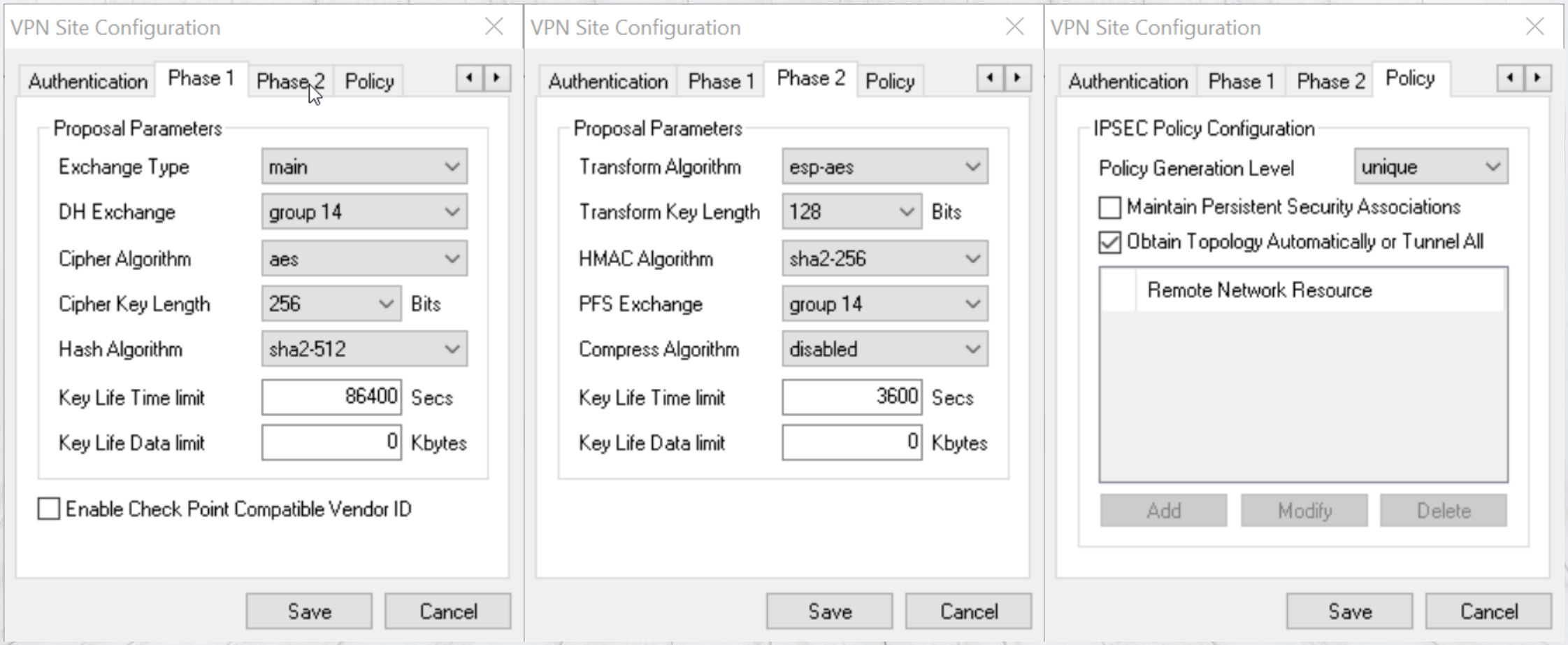
How to configure client 1



How to configure client 2

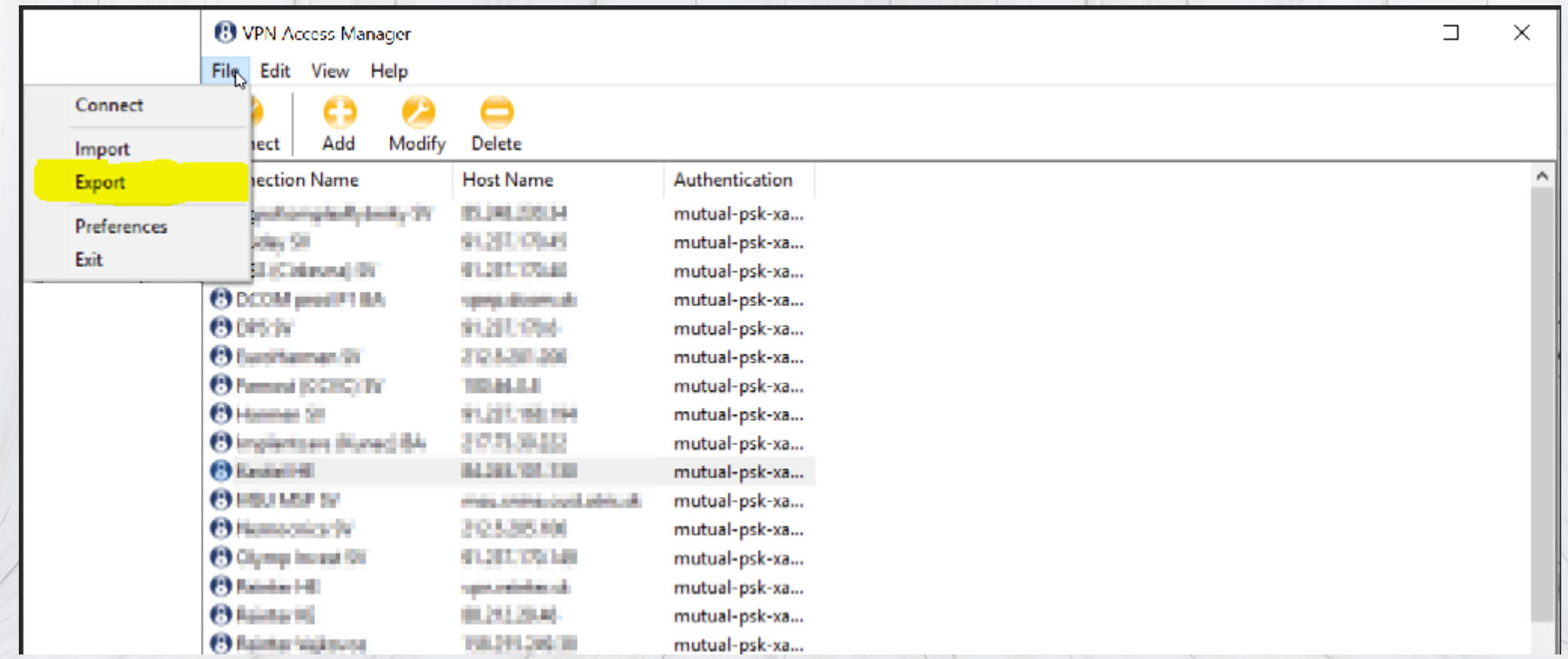


How to configure client 3



Export config

- Export your config, send it to the Road Warrior



Part 3:

Security and other misc. bits

Error 404
Funny image not found...

Firewall rules

- Firewall input rules to allow IPSec traffic are simple

```
add action=accept chain=inut comment=IKE
dst-port=500 protocol=udp
add action=accept chain=inut comment=NAT-T
dst-port=4500 protocol=udp
add action=accept chain=input protocol=ipsec-esp
```

Routing note

- If you have a bigger routed network (OSPF, BGP, whatever) remember to add proper routes
- IPSec policies will route traffic on the AC, but the rest of the network has to know that traffic for IPSec road-warriors (the IP pool) needs to be routed to the AC

Where to learn more?

- Basics of encryption
  https://youtu.be/12Q3Mrh03Gk
  https://youtu.be/NOs34_-eREk

- How does Diffie-Hellman work?
  https://youtu.be/ESPT_36pUFc

- How does AES work?
  http://www.moserware.com/2009/09/stick-figure-guide-to-advanced.html

Additional resources

Things to watch/listen to

My other presentations and talks

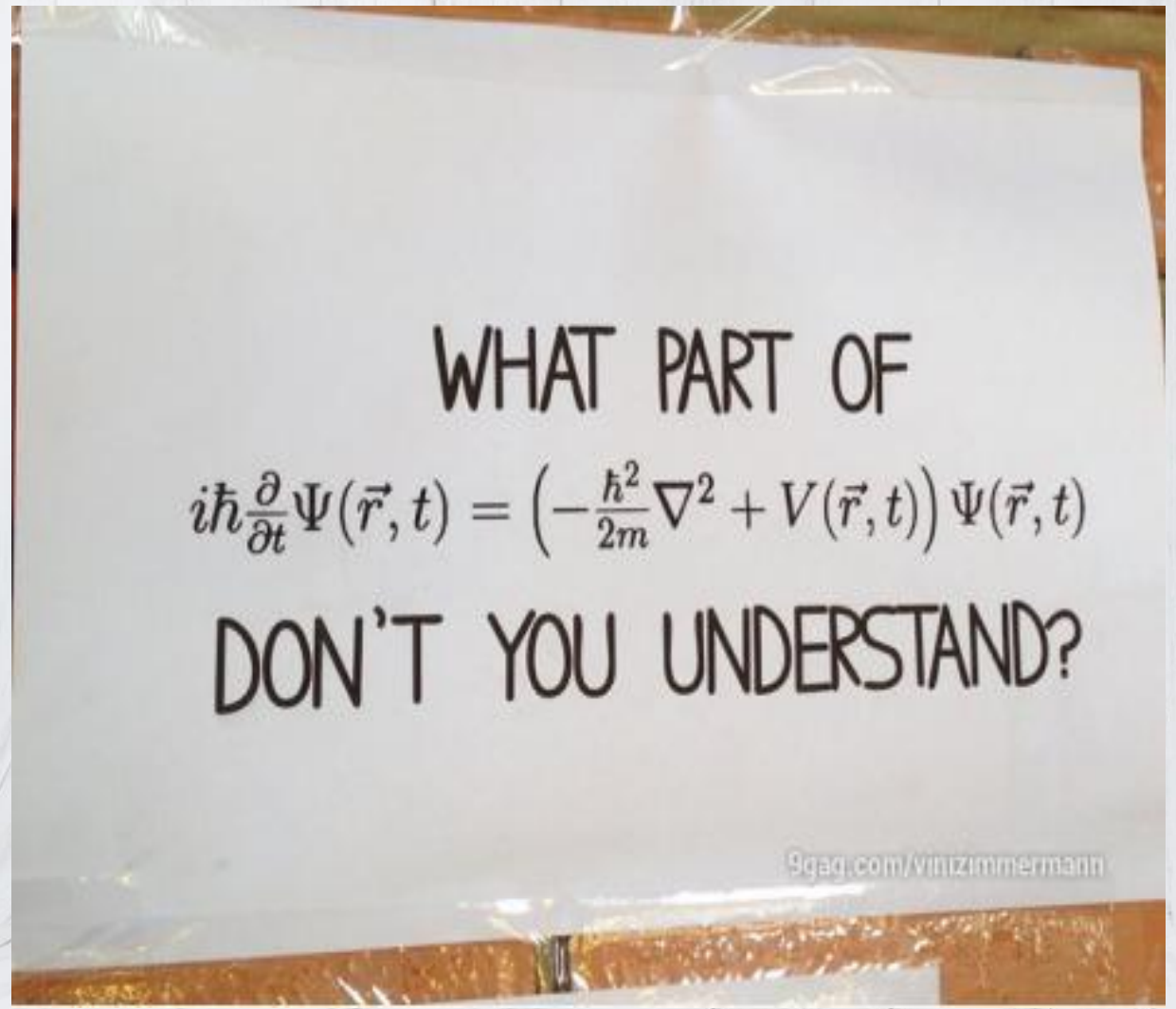
- Find all my other MUM presentations and more on:
  https://www.youtube.com/c/TomasKirnak/videos

  Load Balancing / Mangle deep dive
  L2TP / IPSec deep dive
  MLPS / VPLS / MTU deep dive
  Monitoring / SNMP deep dive
  Automation deep-dive
  etc.

TheBrothersWISP

- I am a part of The Brothers WISP
- We do a bi-weekly networking podcast
  http://thebrotherswisp.com
- Give us a listen if you feel like it!

Thank you very much for your attention!



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