IPsec based VPN

Using libreswan

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Today's Topics

1. Quick IPsec primer
2. Libreswan configuration examples
3. Building your own tunnels

IPsec Primer

The IKE daemon (pluto)

- Internet Keying Exchange (“IKE”) daemon in userland
  - IKE is the “command channel” of IPsec
  - Peer authentication
  - Connection parameter negotiation
  - IPsec symmetric encryption key generation
  - Injecting/removing keys and policies from the kernel IPsec state (SPD and SAD)
  - IKE itself is encrypted!
  - IKE does not encrypt the data!

Kernel IPsec

- kernel level IPsec packet encrypter and decrypter
  - does not depend on routing
- Userland and kernel talk to each other via netlink/XFRM
  - See also “ip xfrm state” and “ip xfrm pol”
- iptables rules via:
  - -m policy -- dir in|out --pol ipsec [--reqid XXX]

The IKE protocol

- IKEv1 (1998) and IKEv2 (2005)
- Runs over UDP port 500
- And over UDP 4500 for NAT_TRAVERSAL
- Creates Security Associations (SA)
  - IKE SA (Parent SA or “Phase 1”)
    - Authentication: PreSharedKey, RSA, X509, GSSAPI
  - IPsec SA (Child SA or “Phase 2”)
    - Negotiation of IP address ranges, crypto params

The IPsec protocol

- Encapsulated Secure Payload (**ESP**)
  - Protocol 50 (not port 50)
  - Can be encapsulated in a UDP 4500 packet
    - Called **ESPinUDP**
  - **Tunnel Mode** (full IP packet in ESP packet)
  - Transport Mode (Encrypt packet itself)
    - Don't use
- Authenticated Header (AH) [don't use]
  - Protocol 51 (not port 51)
- IPcomp [don't use]

Installing libreswan

- dnf | yum | apt-get install libreswan
- Enable the “ipsec” service
  - Via chkconfig or systemctl, etc
- Start the “ipsec” service
  - ipsec start (will expand to init system)

- For client side GUI, install NetworkManager plugin:
  - NetworkManager-libreswan-gnome

IPsec tunnel with PSK

```
# /etc/ipsec.d/yourtunnel.conf
conn YourTunnel
    # you can also use hostnames
    left=193.110.157.124
    right=194.111.228.1
    authby=secret
    auto=start

# /etc/ipsec.d/yourtunnel.secret
193.110.157.124 194.111.228.1 PSK \
   “YourSharedS3cr3t”
```

subnet-to-subnet

```
# /etc/ipsec.d/yourtunnel.conf
conn YourTunnel
    # you can also use hostnames
    left=193.110.157.124
    leftsubnet=192.168.0.0/16
    right=194.111.228.1
    rightsubnet=10.0.0.0/8
    authby=secret
    auto=start

(same /etc/ipsec.d/yourtunnel.secret)
```

Subnet extrusion

- Reroute a part of your network to elsewhere
  # /etc/ipsec.d/yourtunnel.conf
  conn YourTunnel
      # Amsterdam has 193.110.157.0/24
      left=193.110.157.1
      leftsubnet=0.0.0.0/0
      # my DSL machine in Toronto
      right=76.20.157.65
      rightsubnet=193.110.157.16/28
      authby=secret
      auto=start

Using RSA instead of PSK

- Generate RSA keys on both machines:
  - ipsec newhostkey
- Display public RSA key:
  - ipsec showhostkey --left (or –right)
- Exchange public RSA keys over email
- Make up an “ID”, like “Paul” and “Nikos”

Libreswan config with RSA

- # /etc/ipsec.d/yourtunnel.conf
  conn YourTunnel
      # you can also use hostnames
      left=193.110.157.124
      leftid=@Paul
      leftrsasigkey=0x1234567890[...]
      right=194.111.228.1
      rightid=@Nikos
      rightrsasigkey=0x9876543210[...]
      authby=rsasig
      auto=start

  # no secret entry required – stored in NSS DB

Libreswan config with RSA

- # /etc/ipsec.d/yourtunnel.conf
  conn YourTunnel
      left=193.110.157.124
      leftid=@Paul
      leftrsasigkey=0x1234567890[...]
      right=194.111.228.1
      rightid=@Nikos
      rightrsasigkey=0x9876543210[...]
      authby=rsasig
      auto=start

  # no secret file needed – stored in NSS DB

On demand tunnel

```
# /etc/ipsec.d/yourtunnel.conf
conn YourTunnel
    # you can also use hostnames
    left=193.110.157.124
    leftid=@Paul
    leftrsasigkey=0x1234567890[...]
    right=194.111.228.1
    rightid=@Nikos
    rightrsasigkey=0x9876543210[...]
    authby=rsasig
    auto=ondemand
```

Dynamic IP configuration

```
# /etc/ipsec.d/yourtunnel.conf
conn YourTunnel
    left=%defaultroute
    leftid=@Paul
    leftrsasigkey=0x1234567890[...]
    right=%any
    rightid=@Nikos
    rightrsasigkey=0x9876543210[...]
    authby=rsasig
    auto=add
     rekey=no
```

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IKEv1 XAUTH with X.509

```
# /etc/ipsec.d/yourtunnel.conf
# also known as “Cisco IPsec” or “RSA XAUTH”
conn YourTunnel
    left=vpn.example.com
    leftid=%fromcert
    leftcert=friendlyname (comes from PKCS#12)
    leftxauthserver=yes
    leftmodecfgserver=yes
    #
    right=%any
    rightaddresspool=100.64.0.1-100.64.0.254
    rightxauthclient=yes
    rightmodecfgclient=yes
    rightsubnet=0.0.0.0/0
    #
    modecfgpull=yes
    modecfgdns1=10.1.2.3
    modecfgdomain=”example.com”
    authby=rsasig
    auto=add
```

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IKEv1 XAUTH with PSK

```
# /etc/ipsec.d/yourtunnel.conf
# also known as “Cisco IPsec” or “PSK XAUTH”
conn YourTunnel
    left=%defaultroute
    leftid=@GroupName
    leftxauthclient=yes
    leftmodecfgclient=yes
    leftxauthusername=pwouters
    right=vpn.corp.com
    rightxauthserver=yes
    rightmodecfgserver=yes
    rightsubnet=0.0.0.0/0
    modecfgpull=yes
    remote_peer_type=cisco
    aggrmode=yes
    ikelifetime=24h (workaround for bad Cisco's)
    salifetime=24h  (workaround for bad Cisco's)
    ike=aes256sha1;modp1024,aes256-sha1;modp1024
    esp=aes-sha1
    authby=secret
    auto=add
```

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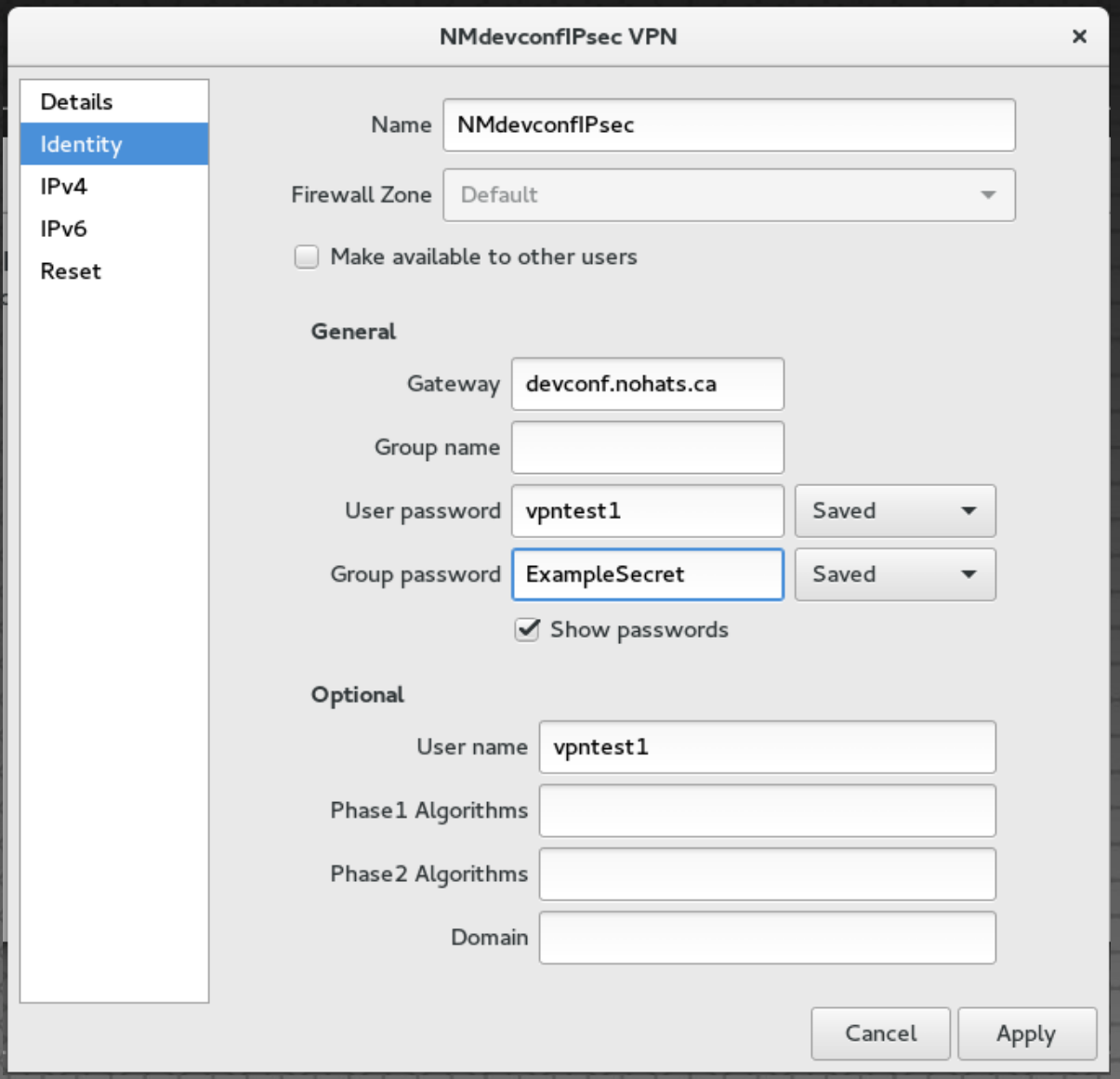
Try NetworkManager plugin



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Libreswan commands

- ipsec auto --add yourconn
- ipsec auto --delete yourconn
- ipsec auto --down yourconn
- ipsec auto --up yourconn
-
- ipsec stop | start | restart
- ipsec whack --listen (run on network change)

Libreswan commands

- ipsec verify (quick system check)
- ipsec whack --trafficstatus (brief overview)
- ipsec status (ridiculous dump for developers)
- ipsec barf (snapshot including logs, system, etc)

- ipsec import /path/to/file.p12
- certutil -d sql:/etc/ipsec.d/ -L

But our true goal

Opportunistic Encryption

- Encrypt the entire internet with IPsec
  - (been trying since 1995 with FreeS/WAN)
- Authenticated if possible
  - One-sided authenticated if client desires
  - GSSAPI, DNSSEC, LetsEncrypt-CA
    (if you don't trust any of these, write a bitcoin auth plugin for us)
- Unauthenticated if all else fails
  - but don't tell user we encrypted at all

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If you want to try OE

- (for now, no NAT support, coming soon)
- cd /etc/ipsec.d/
- wget github.com/libreswan/libreswan/examples/oe-upgrade-authnull.conf
- echo “0.0.0.0/0” >> /etc/ipsec.d/policies/private-or-clear
- ipsec restart
- ping oe.libreswan.org
- ipsec whack --trafficstatus
  or browse to http://oe.libreswan.org/

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Questions?

Contact:
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