ITIS 6240
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Project 2 – Setting up a VPN Server

The objective of the project is to setup a VPN server and connect to it. For this, we are using the Strongswan tool available for Linux. We have to generate keys, certificate, export the certificate to the client machine and then connect using IKEv2 with a predefined username and password.

Step 1: Install Strongswan and other needed utilities

```
onf plugins/sshkey.conf plugins/pem.conf plugins/openssl.conf plugins/fips-prf.conf plugins/gmp.conf
plugins/curve25519.conf plugins/xcbc.conf plugins/cmac.conf plugins/hmac.conf plugins/attr.conf plug
s/kernel-libipsec.conf plugins/kernel-netlink.conf plugins/resolve.conf plugins/socket-default.conf
plugins/stroke.conf plugins/vici.conf plugins/updown.conf plugins/xauth-generic.conf plugins/dhcp.co
f plugins/counters.conf '/usr/share/strongswan/templates/config/plugins'
/bin/mkdir -p '/usr/share/strongswan/templates/config'
/usr/bin/install -c -m 644 strongswan.conf '/usr/share/strongswan/templates/config'
ake[4]: Leaving directory '/home/ubuntu/strongswan-5.7.1/conf'
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1/conf'
ake[2]: Leaving directory '/home/ubuntu/strongswan-5.7.1/conf'
aking install in init
ake[2]: Entering directory '/home/ubuntu/strongswan-5.7.1/init'
aking install in systemd
ake[3]: Entering directory '/home/ubuntu/strongswan-5.7.1/init/systemd'
ake[4]: Entering directory '/home/ubuntu/strongswan-5.7.1/init/systemd'
ake[4]: Nothing to be done for 'install-exec-am'.
/bin/mkdir -p '/lib/systemd/system'
/usr/bin/install -c -m 644 strongswan.service '/lib/systemd/system'
ake[4]: Leaving directory '/home/ubuntu/strongswan-5.7.1/init/systemd'
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1/init/systemd'
ake[3]: Entering directory '/home/ubuntu/strongswan-5.7.1/init'
ake[4]: Entering directory '/home/ubuntu/strongswan-5.7.1/init'
ake[4]: Nothing to be done for 'install-exec-am'.
ake[4]: Nothing to be done for 'install-data-am'.
ake[4]: Leaving directory '/home/ubuntu/strongswan-5.7.1/init'
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1/init'
ake[2]: Leaving directory '/home/ubuntu/strongswan-5.7.1/init'
aking install in testing
ake[2]: Entering directory '/home/ubuntu/strongswan-5.7.1/testing'
ake[3]: Entering directory '/home/ubuntu/strongswan-5.7.1/testing'
ake[3]: Nothing to be done for 'install-exec-am'.
ake[3]: Nothing to be done for 'install-data-am'.
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1/testing'
ake[2]: Leaving directory '/home/ubuntu/strongswan-5.7.1/testing'
aking install in scripts
ake[2]: Entering directory '/home/ubuntu/strongswan-5.7.1/scripts'
ake[3]: Entering directory '/home/ubuntu/strongswan-5.7.1/scripts'
ake[3]: Nothing to be done for 'install-exec-am'.
ake[3]: Nothing to be done for 'install-data-am'.
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1/scripts'
ake[2]: Leaving directory '/home/ubuntu/strongswan-5.7.1/scripts'
ake[2]: Entering directory '/home/ubuntu/strongswan-5.7.1'
ake[3]: Entering directory '/home/ubuntu/strongswan-5.7.1'
ake[3]: Nothing to be done for 'install-exec-am'.
ake[3]: Leaving directory '/home/ubuntu/strongswan-5.7.1'
ake[2]: Leaving directory '/home/ubuntu/strongswan-5.7.1'
ake[1]: Leaving directory '/home/ubuntu/strongswan-5.7.1'
buntu@ip-172-31-28-71:~/strongswan-5.7.1$
```

I used the following commands to install the needed tools:

sudo apt-get install build-essential
sudo apt-get install libgmp3-dev
sudo apt-get install libssl-dev
sudo apt-get install -y libgcrypt11-dev
sudo apt install -y iptables-persistent

Then I downloaded the Strongswan from the following link
wget https://download.strongswan.org/strongswan-5.7.1.tar.bz2
tar xjvf strongswan-5.7.1.tar.bz2; cd strongswan-5.7.1
./configure --prefix=/usr --sysconfdir=/etc -with-random-device=/dev/urandom –enable-all
Sudo make
Sudo make install

Step 2: Create a Certificate Authority and Keys

I created a folder for theVPN Certificates and then used the following commands:

mkdir vpn-certs
cd vpn-certs
ipsec pki --gen --type rsa --size 4096 --outform pem > server-root-key.pem

Then for securing the key,
chmod 600 server-root-key.pem

```
buntu@ip-172-31-13-9:~$ mkdir vpn-certs
buntu@ip-172-31-13-9:~$ cd vpn-certs
buntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --gen --type rsa --size 4096 --outf
rm pem > server-root-key.pem
buntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --self --ca --lifetime 3650 \
 --in server-root-key.pem \
 --type rsa --dn "C=US, O=VPN Server, CN=VPN Server Root CA" \
 --outform pem > server-root-ca.pem
buntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --gen --type rsa --size 4096 --outf
rm pem > server-root-key.pem
buntu@ip-172-31-13-9:~/vpn-certs$ chmod 600 server-root-key.pem
buntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --self --ca --lifetime 3650 \
 --in server-root-key.pem \
 --type rsa --dn "C=US, O=VPN Server, CN=VPN Server Root CA" \
 --outform pem > server-root-ca.pem
buntu@ip-172-31-13-9:~/vpn-certs$
```

ipsec pki --self --ca --lifetime 3650 --in server-root-key.pem --type rsa --dn "C=US, O=VPN Server, CN=VPN Server Root CA" --outform pem > server-root-ca.pem

```
ubuntu@ip-172-31-13-9: ~/vpn-certs
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --gen --type rsa --size 4096 --ou
orm pem > server-root-key.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --self --ca --lifetime 3650 \
> --in server-root-key.pem \
> --type rsa --dn "C=US, O=VPN Server, CN=VPN Server Root CA" \
> --outform pem > server-root-ca.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --gen --type rsa --size 4096 --ou
orm pem > server-root-key.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ chmod 600 server-root-key.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --self --ca --lifetime 3650 \
> --in server-root-key.pem \
> --type rsa --dn "C=US, O=VPN Server, CN=VPN Server Root CA" \
> --outform pem > server-root-ca.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --gen --type rsa --size 4096 --ou
orm pem > vpn-server-key.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$ ipsec pki --pub --in vpn-server-key.pem \
> --type rsa | ipsec pki --issue --lifetime 1825 \
> --cacert server-root-ca.pem \
> --cakey server-root-key.pem \
> --dn "C=US, O=VPN Server, CN=ec2-18-221-9-7.us-east-2.compute.amazonaws.com"
> --san ec2-18-221-9-7.us-east-2.compute.amazonaws.com \
> --flag serverAuth --flag ikeIntermediate \
> --outform pem > vpn-server-cert.pem
ubuntu@ip-172-31-13-9:~/vpn-certs$
```

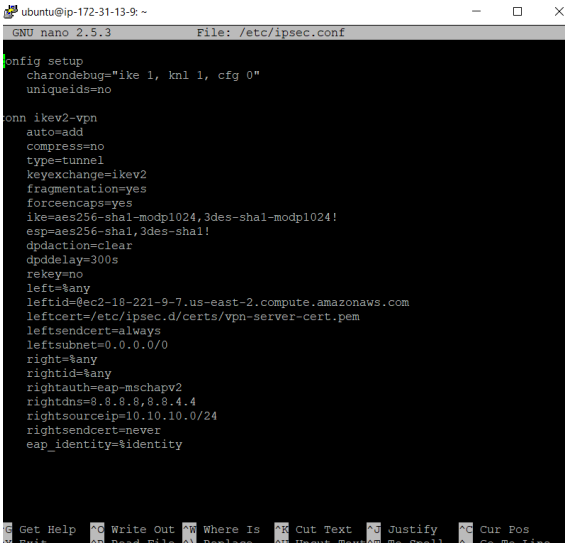
ipsec pki --gen --type rsa --size 4096 --outform pem > vpn-server-key.pem

$ ipsec pki --pub --in vpn-server-key.pem --type rsa | ipsec pki --issue --lifetime 1825 \

$ --cacert server-root-ca.pem --cakey server-root-key.pem \
$ --dn "C=US, O=VPN Server, CN= ec2-18-221-9-7.us-east-2.compute.amazonaws.com" \
$ –san ec2-18-221-9-7.us-east-2.compute.amazonaws.com \
$ --flag serverAuth --flag ikeIntermediate --outform pem > vpn-server-cert.pem

Step 3 : Configuring Strong Swan

I did this by configuring ipsec.conf and ipsec.secrets



Then I reloaded the settings using sudo ipsec reload.

Step 4: Configuration of the firewall and some other stuff

I used the following commands to configure the firewall

$sudo iptables -P INPUT ACCEPT
$ sudo iptables -P FORWARD ACCEPT
$ sudo iptables -F
$ sudo iptables -Z
$ sudo iptables -A INPUT -m state --state ESTABLISHED,RELATED -j ACCEPT
$ sudo iptables -A INPUT -p tcp --dport 22 -j ACCEPT
$ sudo iptables -A INPUT -i lo -j ACCEPT
$ sudo iptables -A INPUT -p udp --dport 500 -j ACCEPT
$ sudo iptables -A INPUT -p udp --dport 4500 -j ACCEPT
$ sudo iptables -A FORWARD --match policy --pol ipsec --dir in --proto esp -s 10.10.10.10/24 -j ACCEPT
$ sudo iptables -A FORWARD --match policy --pol ipsec --dir out --proto esp -d 10.10.10.10/24 -j ACCEPT
$ sudo iptables -t nat -A POSTROUTING -s 10.10.10.10/24 -o eth0 -m policy --pol ipsec --dir out -j ACCEPT
$ sudo iptables -t nat -A POSTROUTING -s 10.10.10.10/24 -o eth0 -j MASQUERADE
$ sudo iptables -t mangle -A FORWARD --match policy --pol ipsec --dir in -s 10.10.10.10/24 -o eth0 -p tcp -m tcp --tcp-flags SYN,RST SYN -m tcpmss --mss 1361:1536 -j TCPMSS --set-mss 1360
$ sudo iptables -A INPUT -j DROP
$ sudo iptables -A FORWARD -j DROP

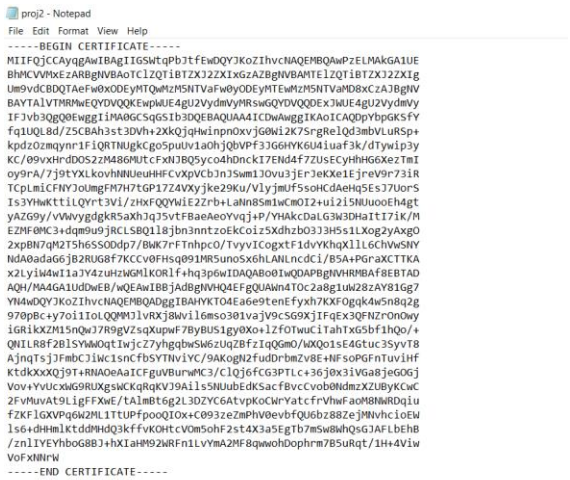
I edited the following file:
sudo nano /etc/syctl.conf

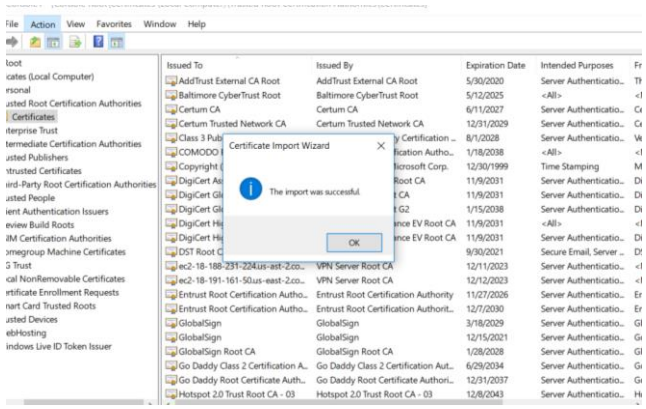
Uncomment belo lines to enable packet forwarding for IPv4 and prevent mitm attacks.

net.ipv4.ip_forward=1
net.ipv4.conf.all.accept_redirects = 0
net.ipv4.conf.all.send_redirects = 0
net.ipv4.ip_no_pmtu_disc = 1

Step 5: Setting up the Client side

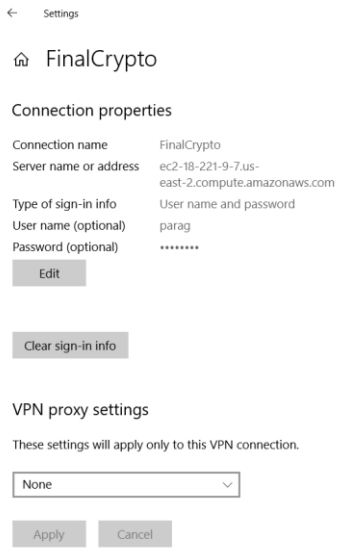
Then I copied the CA key to my local system and installed the certificate.

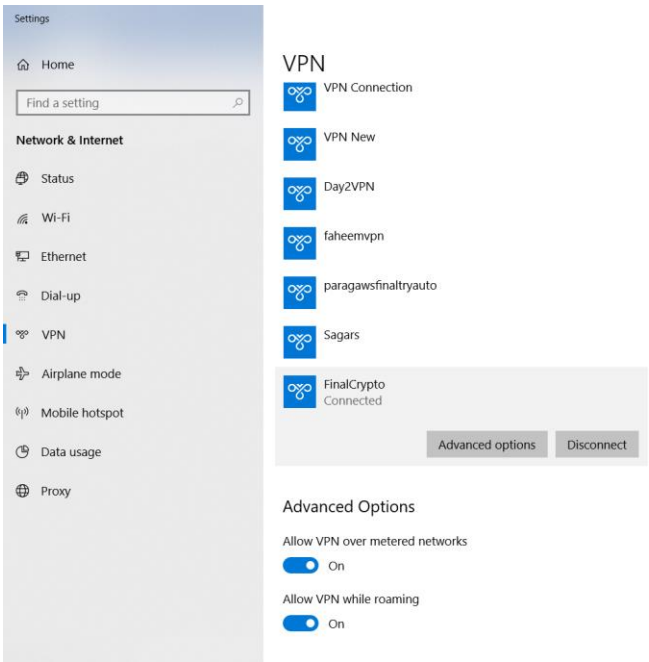




Step 6: Establishing Connection

Then I created a VPN connection and configured it as seen in the screenshots.





After connecting it to the VPN server, my system was assigned a different IP as seen in the Screenshots:

10.10.10.1

```
Autoconfiguration Enabled . . . . : Yes

reless LAN adapter Local Area Connection* 3:

 Media State . . . . . . . . . . . : Media disconnected
 Connection-specific DNS Suffix  . :
 Description . . . . . . . . . . . : Microsoft Wi-Fi Direct Virtual Adapter #2
 Physical Address. . . . . . . . . : 74-40-BB-38-6D-F5
 DHCP Enabled. . . . . . . . . . . : Yes
 Autoconfiguration Enabled . . . . : Yes

P adapter FinalCrypto:

 Connection-specific DNS Suffix  . :
 Description . . . . . . . . . . . : FinalCrypto
 Physical Address. . . . . . . . . :
 DHCP Enabled. . . . . . . . . . . : No
 Autoconfiguration Enabled . . . . : Yes
 IPv4 Address. . . . . . . . . . . : 10.10.10.1(Preferred)
 Subnet Mask . . . . . . . . . . . : 255.255.255.255
 Default Gateway . . . . . . . . . :
 DNS Servers . . . . . . . . . . . : 8.8.8.8
                                     8.8.4.4
 NetBIOS over Tcpip. . . . . . . . : Enabled

reless LAN adapter Wi-Fi:

 Connection-specific DNS Suffix  . :
 Description . . . . . . . . . . . : Realtek RTL8822BE 802.11ac PCIe Adapter
 Physical Address. . . . . . . . . : 74-40-BB-38-6D-F5
 DHCP Enabled. . . . . . . . . . . : Yes
 Autoconfiguration Enabled . . . . : Yes
 Link-local IPv6 Address . . . . . : fe80::1168:ab8:9407:1470%9(Preferred)
 IPv4 Address. . . . . . . . . . . : 172.20.1.31(Preferred)
 Subnet Mask . . . . . . . . . . . : 255.255.0.0
 Lease Obtained. . . . . . . . . . : Thursday, December 13, 2018 1:05:33 PM
 Lease Expires . . . . . . . . . . : Friday, December 14, 2018 11:09:59 PM
 Default Gateway . . . . . . . . . : 172.20.1.1
 DHCP Server . . . . . . . . . . . : 172.20.1.1
 DHCPv6 IAID . . . . . . . . . . . : 74727611
 DHCPv6 Client DUID. . . . . . . . : 00-01-00-01-23-73-B5-4F-B4-B6-B6-E9-D8-ED
 DNS Servers . . . . . . . . . . . : 172.20.1.1
 NetBIOS over Tcpip. . . . . . . . : Enabled

\Users\P>
```

The assignment of the IPs is seen from the Server logs below.

```
[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (544 bytes

[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (544 bytes

[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (544 bytes

[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (176 bytes

[NET] received packet: from 173.95.57.197[4500] to 172.31.13.9[4500] (76 bytes

[ENC] parsed IKE_AUTH request 2 [ EAP/RES/ID ]
[IKE] received EAP identity 'parag'
[IKE] initiating EAP_MSCHAPV2 method (id 0xB0)
[ENC] generating IKE_AUTH response 2 [ EAP/REQ/MSCHAPV2 ]
[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (108 bytes

[NET] received packet: from 173.95.57.197[4500] to 172.31.13.9[4500] (140 byte

[ENC] parsed IKE_AUTH request 3 [ EAP/RES/MSCHAPV2 ]
[ENC] generating IKE_AUTH response 3 [ EAP/REQ/MSCHAPV2 ]
[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (140 bytes

[NET] received packet: from 173.95.57.197[4500] to 172.31.13.9[4500] (76 bytes

[ENC] parsed IKE_AUTH request 4 [ EAP/RES/MSCHAPV2 ]
[IKE] EAP method EAP_MSCHAPV2 succeeded, MSK established
[ENC] generating IKE_AUTH response 4 [ EAP/SUCC ]
[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (76 bytes)
[NET] received packet: from 173.95.57.197[4500] to 172.31.13.9[4500] (92 bytes

[ENC] parsed IKE_AUTH request 5 [ AUTH ]
[IKE] authentication of '172.20.1.31' with EAP successful
[IKE] authentication of 'ec2-18-221-9-7.us-east-2.compute.amazonaws.com' (myse
) with EAP
[IKE] IKE_SA ikev2-vpn[1] established between 172.31.13.9[ec2-18-221-9-7.us-ea
-2.compute.amazonaws.com]...173.95.57.197[172.20.1.31]
[IKE] peer requested virtual IP %any
[IKE] assigning virtual IP 10.10.10.1 to peer 'parag'
[IKE] CHILD_SA ikev2-vpn{1} established with SPIs c5eac45f_i baa68ea6_o and TS
,0.0.0/0 === 10.10.10.1/32
[ENC] generating IKE_AUTH response 5 [ AUTH CPRP(ADDR DNS DNS) SA TSi TSr N(MO
KE_SUP) N(NO_ADD_ADDR) ]
[NET] sending packet: from 172.31.13.9[4500] to 173.95.57.197[4500] (236 bytes

[IKE] sending keep alive to 173.95.57.197[4500]
```

Thus I got the new IP in the Class A of the ip addresses as seen in the Screenshots and successfully setup a VPN server.