Practical Network Defense

Third Assignment - University "La Sapienza"

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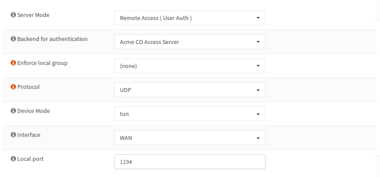
2020-13-06

1 Scope and Initial Considerations

The scope of this assignment is to setup a **Virtual Private Network** through **OpenVPN** in **OPNSense** to allow three authenticated *Road Warriors* to access the internal subnetworks of **ACME Co.**, and to grant the usage of a **proxy server** on machine located at **100.100.6.3** - which corresponds to domain **proxy.acme.group27** to the very same authenticated internal clients of the network to reach the **WAN** outside the **Main Firewall**.
Since these tasks are going to allow connections from the outside - even if authenticated and thus probably secured - it is a good idea to make sure, as a first step, that every user on each of the internal machines is protected by a strong password, and we will probably also have to confirm that the SSH protocol on each machine behaves as we expect it to behave - some of the *root* accounts are already disabled by SSH on some machines, but some are still accepting connections based on basic authentication.
The next paragraphs will only deal with the two services we want to setup in the target network - **VPN** and **proxy server**.

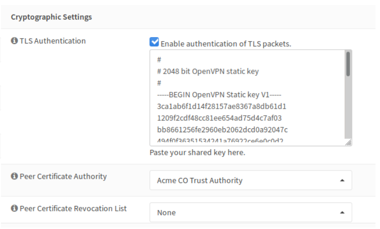
2 VPN Setup

We can define the **road warriors**, in our case, as a set of three users - *Becca, Huck and Jim* - which we want to be able to authenticate and then connect to the internal subnetworks in the **ACME Co.** target network from the **WAN** interface on the **Main router** via a **Virtual Private Network**.
To this end, in order to setup a **VPN** on the **Main router**, we exploit the **OPNSense** administration panel and then navigate to **VPN** $->$ **OpenVPN** $->$ **Servers**, where we can **add a new server** to which the **road warriors** will refer to authenticate and configure their **VPN**. **Figure 1, 2, 3** show the server we created and all the parameters - protocol, port, cryptographic and tunnel settings - that we chose to adopt.



Server Mode	Remote Access (User Auth)
Backend for authentication	Acme CO Access Server
Enforce local group	(none)
Protocol	UDP
Device Mode	tun
Interface	WAN
Local port	1194

Figure 1: VPN Server's general settings with protocol and port.



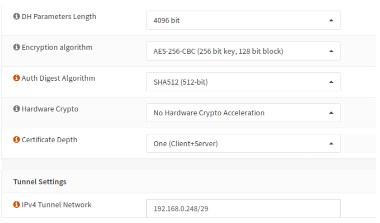
Cryptographic Settings

TLS Authentication	✓ Enable authentication of TLS packets.
Peer Certificate Authority	Acme CO Trust Authority
Peer Certificate Revocation List	None

```
#
# 2048 bit OpenVPN static key
#
-----BEGIN OpenVPN Static key V1-----
3ca1ab6f1d14f28157ae8367a8db61d1
1209f2cdf48cc81ee654ad75d4c7af03
bb8661256fe2960eb2062dcd0a92047c
```

Paste your shared key here.

Figure 2: VPN Server's crypto settings (1).



DH Parameters Length	4096 bit
Encryption algorithm	AES-256-CBC (256 bit key, 128 bit block)
Auth Digest Algorithm	SHA512 (512-bit)
Hardware Crypto	No Hardware Crypto Acceleration
Certificate Depth	One (Client+Server)

Tunnel Settings

IPv4 Tunnel Network	192.168.0.248/29

Figure 3: VPN Server's crypto settings (2) and IP tunneling address.

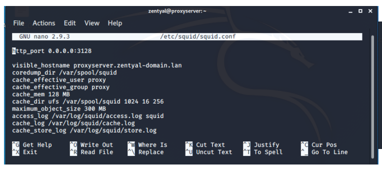
Also, under **System** $->$ **Servers** we setup a new *Acme CO Access Server* which will be exploited to actually access the **VPN Server**, exploiting an access strategy based on a *Local Database + Timebased One Time Password*, with the **OTP** being provided by *Google Authenticator* and thus having length 6. Before actually implementing the **VPN**, it is also necessary to define the authentication system and how the three users will be able to actually access, but this is discussed in the fourth paragraph.
In order to grant the **road warriors** to only access through **SSH** protocol the *internal machines* - i.e., machines on *Internal Servers* and *Clients* subnetworks - the rules at the **Main firewall** had to be changed as follows:

- at **WAN** interface, a **Pass** rule was added to accept every connection from any source on destination port **1194** for procotol **UDP**, so to enable connections with **OpenVPN Server**;
- a new interface, **OpenVPN**, was automatically generated by **OPNSense** once the **OpenVPN Server** was created: here, the firewall allows only connections with source IP address *192.168.0.248/29* (being the one specified in the **IP Tunneling** field of our server) to perform the users' authentication, and then connections with same source IP address and destination IP address being either in the *Internal Servers* or in the *Clients* subnetworks on destination port 22.

Similar rules had also to be added on the interfaces of the **Internal router** to allow hosts in the two target subnetworks to accept connections with the **VPN**.

3 Proxy Setup

We want to setup a **proxy service** at **proxy.acme.group27** that can be exploited only by *authenticated* users located in the *Clients* subnetwork. For the sake of simplicity, the users we will accept and authenticate are the same we have defined previously for the **road warriors** set.
The setup is carried out entirely in the **proxy.acme.group27** machine, and even if this machine gives us the chance to setup an *HTTP Squid Proxy service* through **zentyal** administration panel, we decide to setup **Squid** directly via the *squid.conf* file as pictured in **Figure 4** (next page).
We decide to implement a **non-transparent proxy** given the requirements for the service, so that the users in the *Clients* subnet will have to manually configure their browsers.
The service can be accessed, as anticipated in the previous assignment, on port **3128** via **HTTP**. Apart from defining several default **acl**s for different safe ports, we define an **acl** named **Clients_net** to identify the target *Clients* subnetwork, and an **acl** named **authenticated** which identifies users that have been successfully **authenticated** through module **basic_ncsa_auth** (**Figure 5**).
Notice that every user-password pair is stored under the file */etc/squid/passwd*, this and the whole authentication procedure will be discussed on the next paragraph.
At this point, with line *http_access allow Clients_net authenticated* we grant access to users that are in the desired internal subnet and that have been successfully authenticated. Every other connection is denied through default line *http_access deny all*, and reply access is allowed if not denied before as default.
As pictured in the detail on **Figure 6**, as requested by the assignment the **proxy service** holds a **cache** and **log file** for it, as well as an **access.log** file to log all the accesses and operations performed by the authenticated users.
The firewall rules were already setup so that this service could be available from the *Clients* subnetwork and so that its machine had Internet access. So, in order to visit one of white-listed websites - **cybersecurity.uniroma1.it** which has IP address **151.100.17.12** - we only need to start the daemon of the **Squid** service via command *systemctl start squid* after having it enabled, and then setup the *Firefox Browser* on the Kali machine so that it knows how to contact the service: *Firefox − > Preferences − > Network Settings − > Settings − > Manual proxy configuration* with the very well known values (100.100.6.3 and 3128 as port) to be exploited with all protocols.
Results are showed in the sixth paragraph.



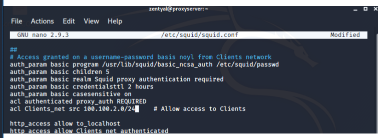
```
GNU nano 2.9.3                    /etc/squid/squid.conf

http_port 0.0.0.0:3128

visible_hostname proxyserver.zentyal-domain.lan
coredump_dir /var/spool/squid
cache_effective_user proxy
cache_effective_group proxy
cache_mem 128 MB
cache_dir ufs /var/spool/squid 1024 16 256
maximum_object_size 300 MB
access_log /var/log/squid/access.log squid
cache_log /var/log/squid/cache.log
cache_store_log /var/log/squid/store.log

^G Get Help    ^O Write Out   ^W Where Is    ^K Cut Text    ^J Justify     ^C Cur Pos
^X Exit        ^R Read File   ^\ Replace     ^U Uncut Text  ^T To Spell    ^_ Go To Line
```

Figure 4: Beginning of the squid.conf file with the 3128 port specified.

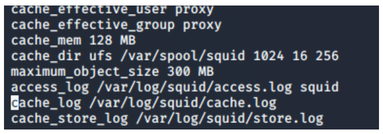


```
GNU nano 2.9.3                    /etc/squid/squid.conf                    Modified

##
# Access granted on a username-password basis noyl from Clients network
auth_param basic program /usr/lib/squid/basic_ncsa_auth /etc/squid/passwd
auth_param basic children 5
auth_param basic realm Squid proxy authentication required
auth_param basic credentialsttl 2 hours
auth_param basic casesensitive on
acl authenticated proxy_auth REQUIRED
acl Clients_net src 100.100.2.0/24    # Allow access to Clients

http_access allow to_localhost
http_access allow Clients_net authenticated
```

Figure 5: acls defined to restrict the access to the service.



```
cache_effective_user proxy
cache_effective_group proxy
cache_mem 128 MB
cache_dir ufs /var/spool/squid 1024 16 256
maximum_object_size 300 MB
access_log /var/log/squid/access.log squid
cache_log /var/log/squid/cache.log
cache_store_log /var/log/squid/store.log
```

Figure 6: Configuring log files for cache and accesses to the service.

4 Authentication

4.1 VPN Authentication

4.2 Proxy Authentication

5 Tests

5.1 Testing the VPN

5.2 Testing the Proxy service

6 Final remarks