Project: Configuration of Certification Authority and Implementation of Transport Layer Security over HTTP

Course: Cybersecurity, law and Ethics

Code: CSE487

Sec: 01.

Semester: Summer 2022.

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Date of Submission: 03-08-2022

Apache web server configuration:

- sudo apt-get update
- Sudo apt-get install apache2
- To continue enter y

To see Ip address write

- ifconfig

To start apache2 server write

- sudo systemctl start apache2

To start apache2 server write

- sudo systemctl stop apache2

To restart apache2 server write

- sudo systemctl restart apache2

To edit index.html

- cd var/www
- sudo nano index.html

DNS server configuration:

- sudo apt install bind9

To see all the file, write:

- ls

To configure IP address

- sudo nano/etc/hosts

To verify file content

- cat /etc/hosts

To check host name

- hostname

To see dns domain name

- Dnsdomainname

We have to config the“named.conf.options” file

- sudo nano named.conf.options

Then insert the code below

```
21          dnssec-validation auto;
22
23          listen-on-v6 { any; };
24
25          recursion yes;
26          listen-on {192.168.28.96;};
27          allow-transfer {none;};
28
29          forwarders {
30                  8.8.8.8;
31                  8.8.4.4;
32          };
33
34
35 };
36
```

We have to config the “named.conf.local” file

- sudo nano named.conf.local

```
//
// Do any local configuration here
//

// Consider adding the 1918 zones here, if they are not used in your
// organization
//include "/etc/bind/zones.rfc1918";
//forward lookup zone
zone "acme1.com" IN{
        type master;
        file "/etc/bind/db.nahian.local";
};

//reverse lookup zone

zone "28.168.192.in-addr.arpa" IN{
        type master;
        file "/etc/bind/db.2.0.10";
};
```

To check the configurations

- Named-checkconf

Next we have to config the “db.nahian.local” file

- sudo nano db.nahian.local

```
;
; BIND data file for local loopback interface
;
$TTL    604800
@       IN      SOA     ns1.acme1.com. root.acme1.com. (
                              2         ; Serial
                         604800         ; Refresh
                          86400         ; Retry
                        2419200         ; Expire
                         604800 )       ; Negative Cache TTL
;
@       IN      NS      ns1.acme1.com.
ns1     IN      A       192.168.28.96
www     IN      A       192.168.28.96
@       IN      AAAA    fe80::a91d:b90a:4d15:5b8f
```

Next, we have to config the “db.2.0.10” file

- sudo nano db.2.0.10

```
;
; BIND reverse data file for local loopback interface
;
$TTL    604800
@       IN      SOA     ns1.acme1.com. root.acme1.com. (
                              1         ; Serial
                         604800         ; Refresh
                          86400         ; Retry
                        2419200         ; Expire
                         604800 )       ; Negative Cache TTL
;
@       IN      NS      ns1.acme1.com.
96      IN      PTR     ns1.acme1.com.
96      IN      PTR     www.acme1.com.
```


To restart the DNS server

- Sudo service bind9 restart

To check our DNS server is active or not

- Sudo service bind9 status

To find www.acme1.com

- nslookup www.acme1.com

To permanent the edit name server and resolv.conf file,we have to remove the resolv.conf file

- sudo rm /etc/resolv.conf

Then we will link a resolv.conf which is under systemd and result folder

- Sudo ln -sf /run/systemd/resolve/resolv.conf /etc/resolv.conf

Now we have to edit “resolv.conf” file under etc

- Sudo nano /etc/resolv.conf

If nameserver is not here then we have to add the nameserver

```
1 nameserver 192.168.28.96
2 search acme1.com
3
```

- nslookup www.acme1.com

Now we can see it resolved and it coming from our server

```
nahian@nahian:~$ nslookup www.acme1.com
Server:         192.168.28.96
Address:        192.168.28.96#53

Non-authoritative answer:
Name:   www.acme1.com
Address: 35.186.238.101
```

- ping www.acme1.com

```
nahian@nahian:~$ ping www.acme1.com
PING www.acme1.com (35.186.238.101) 56(84) bytes of data.
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=1 ttl=115 time=55.8 ms
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=2 ttl=115 time=153 ms
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=3 ttl=115 time=55.7 ms
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=4 ttl=115 time=61.8 ms
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=5 ttl=115 time=58.2 ms
64 bytes from 101.238.186.35.bc.googleusercontent.com (35.186.238.101): icmp_seq
=6 ttl=115 time=57.7 ms
```

Firewall Configuration:

To enable uncomplicated firewall

- sudo ufw enable

To allow bind9

- sudo ufw allow Bind9

To check status

- sudo ufw status
- sudo apt install ssh

To allow some others ports

- sudo ufw allow 21
- sudo ufw allow 10
- sudo ufw allow 20

For generate certificates

Moving to the root using

- sudo -i

See tree of files inside the root:

- tree

Creating directory:

- mkdir -p ca/{root-ca,sub-ca,server}/{private,certs,newcerts,crl,csr}

Changing the root of ca and sub ca private folder

- chmod -v 700 ca/{root-ca,sub-ca,server}/private

Creating file index in both root ca and sub ca

- touch ca/{root-ca,sub-ca}/index

Generating hexadecimal random number of 16 character

writing serial number of root ca

- openssl rand -hex 16 > ca/root-ca/serial

writing serial number of sub ca

- openssl rand -hex 16 > ca/sub-ca/serial

moving to ca directory

- cd ca

1. Generating private key for root ca, sub ca and server

- openssl genrsa -aes256 -out root-ca/private/ca.key 4096
- openssl genrsa -aes256 -out sub-ca/private/sub-ca.key 4096
- openssl genrsa -out server/private/server.key 2048

Reviewing the change

- tree

Creating root ca.configcd

- sudo nano root-ca/root-ca.conf

Inserting the code

- code: 1. root-ca.conf code

- Save and exit
- tree

Moving inside root-ca

- cd root-ca

2. Generating root certificates

- openssl req -config root-ca.conf -key private/ca.key -new -x509 -days 3650 -sha256 -extensions v3_ca -out certs/ca.crt

Ensuring that the certificate has been created

properly • openssl x509 -noout -in certs/ca.crt -text

Moving a step back and then to sub-ca

- cd ../sub-ca

Creating sub-ca.config

- sudo nano sub-ca.conf

Inserting the code into sub-ca.config file

- code: 2. sub-ca.conf code
- Saving and exiting

Seeing the directory once again

- tree

Requesting for sub ca certificate signing request.

- openssl req -config sub-ca.conf -new -key private/sub-ca.key -sha256 -out csr/sub-ca.csr

Moving to the previous folder

- cd –

Signing the request of sub ca by root ca

- openssl ca -config root-ca.conf -extensions v3_intermediate_ca -days 3650 -notext -in ../sub-ca/csr/sub-ca.csr -out ../sub-ca/certs/sub ca.crt
- to confirm insert y

See directory

- Tree
- →.pem file has been generated

See the list of signing

- cat index
- →Root ca signed sub ca

Seeing detail

- openssl x509 -noout -text -in ../sub-ca/certs/sub-ca.crt

3. Configuring server

Moving to server

- cd ../server
- sudo nano server.conf

Generating certificate signing request from server

- openssl req -config server.conf -key private/server.key -new -sha256 -out csr/server.csr

- cd ../sub-ca

Sub ca signing certificate request of server

- openssl ca -config sub-ca.conf -extensions server_cert -days 3650 -notext -in ../server/csr/server.csr -extensions req_ext -extfile ../server/server.conf -out ../server/certs/server.crt

Seeing detail

- cat index
- cd ../server/certs

Now, concating sub-ca.crt and server.crt and naming the new file chained.crt

- cat server.crt ../../sub-ca/certs/sub-ca.cert > chained.crt
- openssl x509 -noout -text -in server.crt

Next, we have to config the 000-default.conf file

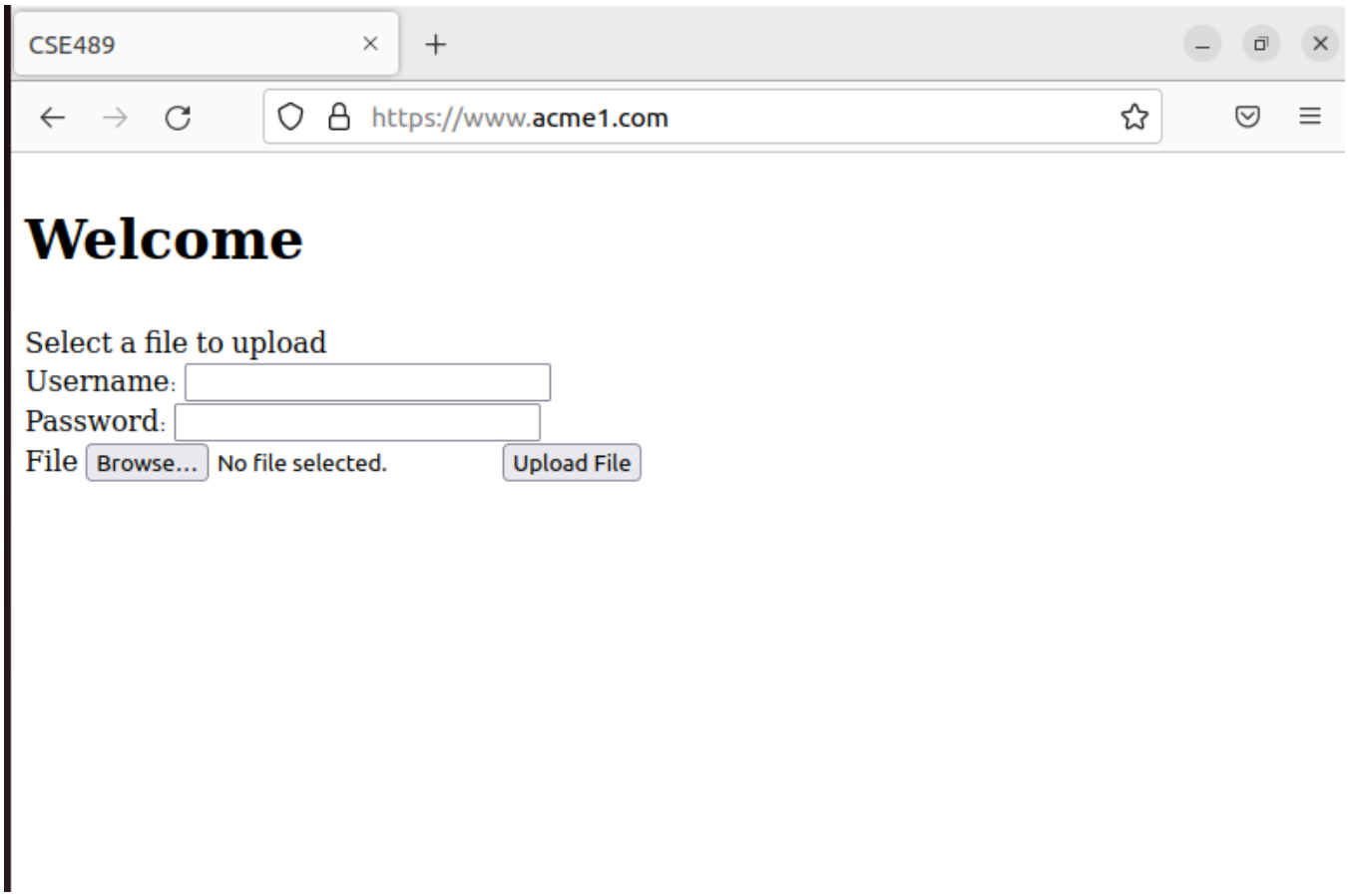
```
<VirtualHost *:443 *:333 *:480>
        SSLEngine on
        SSLCertificateFile /root/ca/server/certs/chained.crt
        SSLCertificateKeyFile /root/ca/server/private/server.key
        servername www.acme1.com
        Documentroot /var/www/html
</VirtualHost>

<VirtualHost *:80>
        servername www.acme1.com
        #Redirect permanent / https://www.acme1.com
</VirtualHost>


```

Copying the “ca.crt” and “sub-ca.crt” into home

- cd ca/root-ca/certs
- cp ca.crt /home/nahian/certs

- cd
- cd ca/sub-ca/certs
- cp sub-ca.crt /home/nahian/certs

Now on the browser Settings → privacy and security → view certificate → authorities → import → select the file →open → select purpose → {view: to see the certificate} → OK



Codes of ROOT CA & SUB-CA

ROOT_CA:

[ca]

#/root/ca/root-ca/root-ca.conf
#see man ca
default_ca = CA_default

[CA_default]

dir = /root/ca/root-ca
certs = $dir/certs
crl_dir = $dir/crl
new_certs_dir = $dir/newcerts

database = $dir/index
serial = $dir/serial
RANDFILE = $dir/private/.rand
private_key = $dir/private/ca.key
certificate = $dir/certs/ca.crt

crlnumber = $dir/crlnumber
crl = $dir/crl/ca.crl
crl_extensions = crl_ext
default_crl_days = 30
default_md = sha256

name_opt = ca_default
cert_opt = ca_default
default_days = 365

```
preserve = no
policy = policy_strict


[ policy_strict ]

countryName = supplied
stateOrProvinceName = supplied
organizationName = match
organizationalUnitName = optional
commonName = supplied
emailAddress = optional


[ policy_loose ]

countryName = optional
stateOrProvinceName = optional
localityName = optional
organizationName = optional
organizationalUnitName = optional
commonName = supplied
emailAddress = optional


[ req ]

# Options for the req tool, man req.

default_bits = 2048
distinguished_name = req_distinguished_name
string_mask = utf8only
default_md = sha256

# Extension to add when the -x509 option is used.
x509_extensions = v3_ca


[ req_distinguished_name ]

countryName = Country Name (2 letter code)
stateOrProvinceName = State or Province Name
localityName = Locality Name
0.organizationName = Organization Name
organizationalUnitName = Organizational Unit Name
commonName = Common Name
emailAddress = Email Address
```

countryName_default = BD
stateOrProvinceName_default = Dhaka
0.organizationName_default = NNS
commonName_default = RootCA

[v3_ca]

Extensions to apply when creating root ca
Extensions for a typical CA, man x509v3_config

subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always,issuer
basicConstraints = critical, CA:true
keyUsage = critical, digitalSignature, cRLSign, keyCertSign

[v3_intermediate_ca]

Extensions to apply when creating intermediate or sub-ca

Extensions for a typical intermediate CA, same man as above

subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always,issuer

#pathlen:0 ensures no more sub-ca can be created below an intermediate

basicConstraints = critical, CA:true, pathlen:0
keyUsage = critical, digitalSignature, cRLSign, keyCertSign

[server_cert]

Extensions for server certificates

basicConstraints = CA:FALSE
nsCertType = server
nsComment = "OpenSSL Generated Server Certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid,issuer:always
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = serverAuth

SUB_CA:

```
[ca]

#/root/ca/sub-ca
#see man ca

default_ca = CA_default


[CA_default]

dir = /root/ca/sub-ca
certs = $dir/certs
crl_dir = $dir/crl


new_certs_dir = $dir/newcerts
database = $dir/index
serial = $dir/serial
RANDFILE = $dir/private/.rand



private_key = $dir/private/sub-ca.key
certificate = $dir/certs/sub-ca.crt



crlnumber = $dir/crlnumber
crl = $dir/crl/ca.crl
crl_extensions = crl_ext
default_crl_days = 30


default_md = sha256


name_opt = ca_default
cert_opt = ca_default
default_days = 365
preserve = no
policy = policy_loose
```

[policy_strict]

countryName = supplied
stateOrProvinceName = supplied
organizationName = match
organizationalUnitName = optional
commonName = supplied
emailAddress = optional

[policy_loose]

countryName = optional
stateOrProvinceName = optional

localityName = optional
organizationName = optional
organizationalUnitName = optional
commonName = supplied
emailAddress = optional

[req]

 # Options for the req tool, man req.

default_bits = 2048
distinguished_name = req_distinguished_name
string_mask = utf8only
default_md = sha256

 # Extension to add when the -x509 option is used.

x509_extensions = v3_ca

[req_distinguished_name]

countryName = Country Name (2 letter code)
stateOrProvinceName = State or Province Name
localityName = Locality Name
0.organizationName = Organization Name
organizationalUnitName = Organizational Unit Name

commonName = Common Name emailAddress = Email Address
countryName_default = BD
stateOrProvinceName_default = Dhaka
0.organizationName_default = NNS
commonName_default = SubCA

[v3_ca]

Extensions to apply when createing root ca
Extensions for a typical CA, man x509v3_config

subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always,issuer

basicConstraints = critical, CA:true
keyUsage = critical, digitalSignature, cRLSign, keyCertSign

[v3_intermediate_ca]

Extensions to apply when creating intermediate or sub-ca
Extensions for a typical intermediate CA, same man as above

subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid:always,issuer

#pathlen:0 ensures no more sub-ca can be created below an intermediate

basicConstraints = critical, CA:true, pathlen:0
keyUsage = critical, digitalSignature, cRLSign, keyCertSign

[server_cert]

Extensions for server certificates

basicConstraints = CA:FALSE
nsCertType = server
nsComment = "OpenSSL Generated Server Certificate"
subjectKeyIdentifier = hash
authorityKeyIdentifier = keyid,issuer:always
keyUsage = critical, digitalSignature, keyEncipherment
extendedKeyUsage = serverAuth

Server

```
[ req ]
default_bits = 2048
distinguished_name = req_distinguished_name
req_extensions = req_ext
prompt = no

[ req_distinguished_name ]
countryName = BD
stateOrProvinceName = Dhaka
organizationName = NNS
commonName = www.acme1.com

[ req_ext ]
subjectAltName = @alt_names

[ alt_names ]
DNS.1 = nahian.local
DNS.2 = www.acme1.com
IP.1 = 192.168.28.96
```