

### BASICS

Checking version

```
openssl version -a
```

How fast it runs on the system using four CPU cores and testing RSA algorithm

```
openssl speed -multi 4 rsa
```

Get basic help

```
openssl help
```

Generate 20 random bytes and show them on screen

```
openssl rand -hex 20
```

### ENCODING / DECODING

Encoding a file using Base64

```
openssl base64 -in file.data
```

Encoding some text using Base64

```
echo -n "some text" | openssl base64
```

Base64 decode a file with output to another file

```
openssl base64 -d -in encoded.data -out decoded.data
```

### WORKING WITH HASHES

List digest algorithms available

```
openssl list -digest-algorithms
```

Hash a file using SHA256

```
openssl dgst -sha256 file.data
```

Hash a file using SHA256 with its output in binary form (no output hex encoding)

*No ASCII or encoded characters will be printed out to the console, just pure bytes. You can append ' | xxd'*

```
openssl dgst -binary -sha256 file.data
```

Hash text using SHA3-512

```
echo -n "some text" | openssl dgst -sha3-512
```

Create HMAC - SHA384 of a file using a specific key in bytes

```
openssl dgst -SHA384 -mac HMAC -macopt hexkey:369bd7d655 file.data
```

Create HMAC - SHA512 of some text

```
echo -n "some text" | openssl dgst -mac HMAC -macopt hexkey:36-9bd7d655 -sha512
```

### ASYMMETRIC ENCRYPTION

### ASYMMETRIC ENCRYPTION (cont)

Encrypt a file using RSA public key

```
openssl rsautl -encrypt -inkey pubkey.key -pubin -in cleartext.file -out ciphertext.file
```

Decrypt a file using RSA private key

```
openssl rsautl -decrypt -inkey pub_priv.key -in ciphertext.file -out decrypted.file
```

Create private key using the P-224 elliptic curve

```
openssl ecparam -name secp224k1 -genkey -out ecpriv.key
```

Encrypt private key using 3DES algorithm

```
openssl ec -in ecP384priv.key -des3 -out ecP384priv_enc.key
```

### SYMMETRIC ENCRYPTION

List all supported symmetric encryption ciphers

```
openssl enc -list
```

Encrypt a file using an ASCII encoded password provided and AES-128 algorithm

```
openssl enc -aes-128-ecb -in cleartext.file -out ciphertext.file -pass pass:thisisthepassword
```

Decrypt a file using AES-256-CBC and a keyfile

```
openssl enc -d -aes-256-cbc -in ciphertext.file -out cleartext.file -pass file:./key.file
```

Encrypt a file using a specific encryption key (K) provided as hex digits

```
openssl enc -aes-128-ecb -in cleartext.file -out ciphertext.file -K 1881807b2d1b3d22f14e9ec52563d981 -nosalt
```

Encrypt a file using ARIA 256 in CBC block cipher mode using a specific encryption key (K:256 bits) and initialization vector (iv:128 bits)

```
openssl enc -aria-256-cbc -in cleartext.file -out ciphertext.file -K f92d2e986b7a2a01683b4c40d0cbcf6feaa669ef2bb5ec3a25ce85d9548 -iv 470bc29762496046882b61ecee68e07c -nosalt
```

Encrypt a file using Camellia 192 algorithm in COUNTER block cipher mode with key and iv provided

```
openssl enc -camellia-192-ctr -in cleartext.file -out ciphertext.file -K 6c7a1b3487d28d3bf444186d7c529b48d67dd6206c7a1b34 -iv 470bc29762496046882b61ecee68e07c
```

### DIGITAL SIGNATURES

Generate DSA parameters for the private key. 2048 bits length

```
openssl dsaparam -out dsaparam.pem 2048
```

Generate DSA public-private key for signing documents and protect it using AES128 algorithm

```
openssl gendsa -out dsaprivatekey.pem -aes-128-cbc dsaparam.pem
```

Copy the public key of the DSA public-private key file to another file

```
openssl dsa -in dsaprivatekey.pem -pubout -out dsapublickey.pem
```

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List elliptic curves available

```
openssl ecparam -list_curves
```

Create 4096 bits RSA public-private key pair

```
openssl genrsa -out pub_priv.key 4096
```

Display detailed private key information

```
openssl rsa -text -in pub_priv.key -noout
```

Encrypt public-private key pair using AES-256 algorithm

```
openssl rsa -in pub_priv.key -out encrypted.key -aes256
```

Remove keys file encryption and save them to another file

```
openssl rsa -in encrypted.key -out cleartext.key
```

Copy the public key of the public-private key pair file to another file

```
openssl rsa -in pub_priv.key -pubout -out pubkey.key
```

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### DIGITAL SIGNATURES (cont)

To print out the contents of a DSA key pair file

```
openssl dsa -in dsaprivatekey.pem -text -noout
```

Signing the sha-256 hash of a file using RSA private key

```
openssl dgst -sha256 -sign rsakey.key -out signature.data
document.pdf
```

Verify a SHA-256 file signature using a public key

```
openssl dgst -sha256 -verify publickey.pem -signature signature.data
original.file
```

Signing the sha3-512 hash of a file using DSA private key

```
openssl pkeyutl -sign -pkeyopt digest:sha3-512 -in document.docx -
inkey dsaprivatekey.pem -out signature.data
```

Verify DSA signature

```
openssl pkeyutl -verify -sigfile dsasignature.data -inkey dsakey.pem -
in document.docx
```

Create a private key using P-384 Elliptic Curve

```
openssl ecparam -name secp384r1 -genkey -out ecP384priv.key
```

Encrypt private key using 3DES algorithm

```
openssl ec -in ecP384priv.key -des3 -out ecP384priv_enc.key
```

Sign a PDF file using Elliptic Curves with the generated key

```
openssl pkeyutl -sign -inkey ecP384priv_enc.key -pkeyopt
digest:sha3-512 -in document.pdf -out signature.data
```

Verify the file's signature. If it's ok you must receive "Signature Verified Successfully"

```
openssl pkeyutl -verify -in document.pdf -sigfile signature.data -inkey
ecP384priv_enc.key
```

### DIGITAL CERTIFICATES

Generating a CSR file and a 4096 bits RSA key pair

```
openssl req -newkey rsa:4096 -keyout private.key -out request.csr
```

Display Certificate Signing Request ( CSR ) content

```
openssl req -text -noout -in request.csr
```

Display the public key contained in the CSR file

```
openssl req -pubkey -noout -in request.csr
```

Creating a Certificate Signing Request ( CSR ) using an existing private key. *This can be useful when you need to renew the public digital certificate without changing the private key.*

```
openssl req -new -key private.key -out request.csr
```

Create EC P384 curve parameters file to generate a CSR using Elliptic Curves in the next step.

```
openssl genpkey -genparam -algorithm EC -out EC_params.pem -
pkeyopt ec_paramgen_curve:secp384r1 -pkeyopt
ec_param_enc:named_curve
```

### DIGITAL CERTIFICATES (cont)

Create a CSR file using Elliptic Curve P384 parameters file created in the previous step. *Instead of using RSA keys.*

```
openssl req -newkey ec:EC_params.pem -keyout EC_P384_priv.key
-out EC_request.csr
```

Create a self-signed certificate, a new 2048 bits RSA key pair with one year of validity

```
openssl req -newkey rsa:2048 -nodes -keyout priv.key -x509 -days
365 -out cert.crt
```

Create and sign a new certificate using the CSR file and the private key for signing ( you must have a openssl.cnf file prepared )

```
openssl ca -in request.csr -out certificate.crt -config
./CA/config/openssl.cnf
```

Display PEM format certificate information

```
openssl x509 -text -noout -in cert.crt
```

Display certificate information in Abstract Syntax Notation One (ASN.1)

```
openssl asn1parse -in cert.crt
```

Extract the certificate's public key

```
openssl x509 -pubkey -noout -in cert.crt
```

Extract the public key's modulus in the certificate

```
openssl x509 -modulus -noout -in cert.crt
```

Extract the domain certificate from an HTTPS/TLS connection

```
openssl s_client -connect domain.com:443 | openssl x509 -out
certificate.crt
```

Convert a certificate from PEM to DER format

```
openssl x509 -inform PEM -outform DER -in cert.crt -out cert.der
```

Checking whether the certificate public key matches a private key and request file. One step per file. Must match in the output hashes.

```
openssl x509 -modulus -in certificate.crt -noout | openssl dgst -
sha256
```

```
openssl rsa -modulus -in private.key -noout | openssl dgst -sha256
```

```
openssl req -modulus -in request.csr -noout | openssl dgst -sha256
```

### WORKING WITH TLS PROTOCOL

List all cipher suites supported

```
openssl ciphers -V 'ALL'
```

List all cipher suites supported with AES

```
openssl ciphers -V 'AES'
```

List all cipher suites supporting CAMELLIA & SHA256 algorithms.

```
openssl ciphers -V 'CAMELLIA+SHA256'
```

TLS connection to a server using port 443 (HTTPS)

```
openssl s_client -connect domain.com:443
```



### WORKING WITH TLS PROTOCOL (cont)

TLS connection to a server using v1.2

```
openssl s_client -tls1_2 -connect domain.com:443
```

TLS connection & disable v1.0

```
openssl s_client -no_tls1 domain.com:443
```

TLS connection using a specific cipher suite

```
openssl s_client -cipher DHE-RSA-AES256-GCM-SHA384
domain.com:443
```

TLS connection displaying all certificates provided by server

```
openssl s_client -showcerts domain.com:443
```

Setting up a listening port to receive TLS connections using a certificate, the private key & supporting only TLS 1.2

```
openssl s_server -port 443 -cert cert.crt -key priv.key -tls1_2
```

Extract the domain certificate from an HTTPS/TLS connection

```
openssl s_client -connect domain.com:443 | openssl x509 -out
certificate.crt
```

*nmap command:* Display enabled cipher-suites over an HTTPS/TLS Connection

```
nmap --script ssl-enum-ciphers -p 443 domain.com
```

*nmap command:* Display enabled cipher-suites over a TLS (HTTPS) Connection using SNI. (*change it to desired IP & domain name*)

```
nmap --script ssl-enum-ciphers --script-
args=tls.servername=domain.com 172.67.129.11
```

### PERSONAL SECURITY ENVIRONMENTS ( PSE )

Convert a certificate from PEM (base64) to DER (binary) format

```
openssl x509 -in certificate.pem -outform DER -out certificate.der
```

Insert certificate & private key into PKCS #12 format file. These files can be imported in windows certificate manager or to a Java Key Store (jks) file

```
openssl pkcs12 -export -out cert_key.p12 -inkey private.key -in
certificate.crt
```

To show the contents of a PKCS #12 file

```
openssl pkcs12 -in cert_key.p12
```

Convert the .p12 file into a Java Key Store. *This commnad uses java keytool instead of openssl.*

```
keytool -importkeystore -destkeystore javakeystore.jks -srkeystore
cert_key.p12 -srcstoretype pkcs12
```

Convert PEM certificate to PKCS #7 format

```
openssl crl2pkcs7 -nocrl -certfile certificate.crt -out cert.p7b
```

Convert a PKCS #7 file from PEM to DER

```
openssl pkcs7 -in cert.p7b -outform DER -out p7.der
```

### SIMPLE CA CONFIGURATION FILE ( openssl.cnf )

```
[ ca ]
default_ca = CA_default

[ CA_default ]
dir = ./personalCA
database = $dir/index.txt
new_certs_dir = $dir/newcerts

certificate = $dir/cacert.pem
serial = $dir/serial
rand_serial = yes
private_key = $dir/private/cakey.pem
RANDFILE = $dir/private/.rand

default_days = 365
default_crl_days= 30
default_md = SHA256

policy = policy_any
email_in_dn = no

name_opt = ca_default
cert_opt = ca_default
copy_extensions = none

[ policy_any ]
countryName = supplied
stateOrProvinceName = optional
organizationName = optional
organizationalUnitName = optional
commonName = supplied
emailAddress = optional
```

### FINAL NOTES

- All openssl commands were tested using OpenSSL version 1.1.1f
- All nmap commands were tested using nmap version 7.80. nmap is compiled using openssl libraries.
- The default format for almost all operations in openssl is PEM, however you can always specify a DER format using arguments or export to other formats with appropriate commands indicated on the document.

