

# TorComm - Secure P2P Communication

Documentation

Taha Canturk  
kibnakanoto@protonmail.com

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# 1 Networking

## 1.1 one on one

## 1.2 groupchat

# 2 Cryptography

The key communication protocol used is Elliptic Cryptography Diffie Hellman (*ECDH*)

The encryption protocol used is Elliptic Cryptography Integrated Encryption Scheme (*ECIES*)

There are currently 140 cryptographic protocols to choose from. the protocol consists of all cryptographic algorithms required for a secure communication

i.e. Hashing algorithm, cipher algorithm, cipher mode, verification algorithm, elliptic curve

## 2.1 All Protocols

```
SECP256K1_ECIES_ECDSA_AES256_CBC_SHA256
SECP256K1_ECIES_ECDSA_AES192_CBC_SHA256
SECP256K1_ECIES_ECDSA_AES128_CBC_SHA256
SECP256K1_ECIES_ECDSA_AES256_GCM_SHA256
SECP256K1_ECIES_ECDSA_AES192_GCM_SHA256
SECP256K1_ECIES_ECDSA_AES128_GCM_SHA256
SECP256K1_ECIES_HMAC_AES256_CBC_SHA256
SECP256K1_ECIES_HMAC_AES192_CBC_SHA256
SECP256K1_ECIES_HMAC_AES128_CBC_SHA256
SECP256K1_ECIES_HMAC_AES256_GCM_SHA256
SECP256K1_ECIES_HMAC_AES192_GCM_SHA256
SECP256K1_ECIES_HMAC_AES128_GCM_SHA256
SECP256K1_ECIES_ECDSA_CHACHA20_SHA256
SECP256K1_ECIES_HMAC_CHACHA20_SHA256
SECP256R1_ECIES_ECDSA_AES256_CBC_SHA256
SECP256R1_ECIES_ECDSA_AES192_CBC_SHA256
SECP256R1_ECIES_ECDSA_AES128_CBC_SHA256
SECP256R1_ECIES_ECDSA_AES256_GCM_SHA256
SECP256R1_ECIES_ECDSA_AES192_GCM_SHA256
SECP256R1_ECIES_ECDSA_AES128_GCM_SHA256
SECP256R1_ECIES_HMAC_AES256_CBC_SHA256
SECP256R1_ECIES_HMAC_AES192_CBC_SHA256
SECP256R1_ECIES_HMAC_AES128_CBC_SHA256
SECP256R1_ECIES_HMAC_AES256_GCM_SHA256
SECP256R1_ECIES_HMAC_AES192_GCM_SHA256
SECP256R1_ECIES_HMAC_AES128_GCM_SHA256
SECP256R1_ECIES_ECDSA_CHACHA20_SHA256
SECP256R1_ECIES_HMAC_CHACHA20_SHA256
SECP521R1_ECIES_ECDSA_AES256_CBC_SHA256
SECP521R1_ECIES_ECDSA_AES192_CBC_SHA256
SECP521R1_ECIES_ECDSA_AES128_CBC_SHA256
SECP521R1_ECIES_ECDSA_AES256_GCM_SHA256
SECP521R1_ECIES_ECDSA_AES192_GCM_SHA256
SECP521R1_ECIES_ECDSA_AES128_GCM_SHA256
SECP521R1_ECIES_HMAC_AES256_CBC_SHA256
SECP521R1_ECIES_HMAC_AES192_CBC_SHA256
SECP521R1_ECIES_HMAC_AES128_CBC_SHA256
SECP521R1_ECIES_HMAC_AES256_GCM_SHA256
SECP521R1_ECIES_HMAC_AES192_GCM_SHA256
SECP521R1_ECIES_HMAC_AES128_GCM_SHA256
SECP521R1_ECIES_ECDSA_CHACHA20_SHA256
SECP521R1_ECIES_HMAC_CHACHA20_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES256_CBC_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES192_CBC_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES128_CBC_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES256_GCM_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES192_GCM_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES128_GCM_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES256_CBC_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES192_CBC_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES128_CBC_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES256_GCM_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES192_GCM_SHA256
BRAINPOOL256R1_ECIES_HMAC_AES128_GCM_SHA256
BRAINPOOL256R1_ECIES_ECDSA_CHACHA20_SHA256
BRAINPOOL256R1_ECIES_HMAC_CHACHA20_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES256_CBC_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES192_CBC_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES128_CBC_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES256_GCM_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES192_GCM_SHA256
BRAINPOOL512R1_ECIES_ECDSA_AES128_GCM_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES256_CBC_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES192_CBC_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES128_CBC_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES256_GCM_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES192_GCM_SHA256
BRAINPOOL512R1_ECIES_HMAC_AES128_GCM_SHA256
BRAINPOOL512R1_ECIES_ECDSA_CHACHA20_SHA256
BRAINPOOL512R1_ECIES_HMAC_CHACHA20_SHA256
BRAINPOOL256R1_ECIES_ECDSA_AES256_CBC_SHA512
BRAINPOOL256R1_ECIES_ECDSA_AES192_CBC_SHA512
BRAINPOOL256R1_ECIES_ECDSA_AES128_CBC_SHA512
BRAINPOOL256R1_ECIES_ECDSA_AES256_GCM_SHA512
BRAINPOOL256R1_ECIES_ECDSA_AES192_GCM_SHA512
BRAINPOOL256R1_ECIES_ECDSA_AES128_GCM_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES256_CBC_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES192_CBC_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES128_CBC_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES256_GCM_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES192_GCM_SHA512
BRAINPOOL256R1_ECIES_HMAC_AES128_GCM_SHA512
BRAINPOOL256R1_ECIES_ECDSA_CHACHA20_SHA512
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BRAINPOOL512R1_ECIES_ECDSA_AES256_CBC_SHA512
BRAINPOOL512R1_ECIES_ECDSA_AES192_CBC_SHA512
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BRAINPOOL512R1_ECIES_ECDSA_AES128_GCM_SHA512
BRAINPOOL512R1_ECIES_HMAC_AES256_CBC_SHA512
BRAINPOOL512R1_ECIES_HMAC_AES192_CBC_SHA512
BRAINPOOL512R1_ECIES_HMAC_AES128_CBC_SHA512
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BRAINPOOL512R1_ECIES_HMAC_AES192_GCM_SHA512
BRAINPOOL512R1_ECIES_HMAC_AES128_GCM_SHA512
BRAINPOOL512R1_ECIES_ECDSA_CHACHA20_SHA512
BRAINPOOL512R1_ECIES_HMAC_CHACHA20_SHA512
```

## 3 Errors

Everything about errors and error codes are stored in `errors.h` file.

networking related errors are stored in `log/network.log` and other bugs (mainly cryptographic) is stored in `log/errors.log`

## 4 Blocking

### 4.1 Algorithm

blocking an ip address code is in `comm.cpp`, the algorithm is as follows:

```
1
2 Generate(iv) # 12-byte iv
3 key = 32-byte key from keys file
4 pepper = 32-byte pepper from keys file
5
6 # encrypt ip
7 encrypted = AES-256-CBC(key=key, data=ip, iv=iv)
8
9 # store encrypted ip in blocked file
10 write(encrypted + " " + iv, "blocked")
```

Figure 1: Block

## 5 Key Protector

### 5.1 What Is It

The Key protector app in security folder is used to secure a 32-byte symmetric key, 2-byte port key, 32-byte pepper. The output is in a file named `keys`. The data in this file is used for securing the local data. It needs a 4-32 byte password generated and stored by you.

To set the password, execute the `key` file which would generate the `get_keys` executable which is the key protector program. Store a copy of `get_keys` in somewhere secure if you don't want to lose it. If you lose the `get_keys` and don't have the `keys` file, then your key is forever lost.

#### 5.1.1 What is the keys used for

The key is used for securing any personal data stored on the device. Such as the configuration file for each session. If you're texting somebody and want to save their ip address so you can conveniently text them again without re-entering the ip address and reconfiguring the communication session, the ip and other data needs to be encrypted and stored. The 2-byte port key is used for encrypting the ports in configuration files

### 5.2 Algorithm

The C++ code is in `security/key.cpp`, but the basic idea is as following:

### 5.3 Security

since 2/3-bytes of the pepper is not stored in the *get\_keys* file, they need to be guessed with every password that is entered. If we say 3 bytes of the data needs to be guessed. then the number of combinations in password is multiplied with  $256^3$ .

e.g. if you have a 4-digit pin as your password, then there are  $10^4$  combinations in your password. Then the total number of combinations in password is  $(256^3)(10^4) = 167772160000$ .

This doesn't mean that your password needs to be smaller, it should still be 6-16 characters of numbers, small/capital letters, and symbols.

```

1
2 Generate key, pepper, iv
3 Ask user for 4-32 byte password
4 # chacha cipher function: chacha(data, key, iv)
5 result = pepper  $\oplus$  password
6 # Use sha256(result) as symmetric key to encrypt key using chacha
7 encrypted key = chacha(key, sha256(result), iv)
8 Store sha256(result) as sha256(sha256(result))
9 Generate exe for getting key (get_keys):
10     Store sha256(sha256(result)), iv, encrypted key, pepper (excluding 3-bytes)
11
12     Ask user for password:
13         Guess 3 bytes of password of unknown pepper
14         result = pepper  $\oplus$  password
15         Compute sha256(sha256(result)) and compare with stored sha256(sha256(
16         result)).
17         if no match:
18             Continue guessing all possible 3-bytes
19
20         if user guessed more than once:
21             If guessed 3 or 6 times and while guess count is smaller than 7:
22                 Pause for 10s
23             Else if Every 5 guesses:
24                 Pause for 30s
25             Sleep(random(1s,5s)) # make it a random range so that timing attacks aren
26             't possible
27
28         If not valid match:
29             If more than 10 password inputs made:
30                 Delete everything in current directory
31                 ask user for password again and repeat process.
32         Else:
33             # Decrypt encrypted key using sha256(result) as key with chacha
34             algorithm
35             decrypted key = chacha(encrypted key, sha256(result), iv)
36
37             Write decrypted key to file
38
39             set key, pepper, iv, password, and every other array stored in ram to
40             zero
41
42

```

Figure 2: Key Protector