CipherChat

A Secure, Decentralized Chat Application

Group: K.O.D Inc
Members: Ottor Mills
Kenneth Anglin
Nicoy Smith
David Thomas

Motivation

In today's world the internet has become a hotbed of hacking plots at data harvesting. CipherChat was created based on the premise that everyone should be entitled to their privacy regardless of how ignorant that individual may be.

Tools Used

The following languages contributed to completion of this project

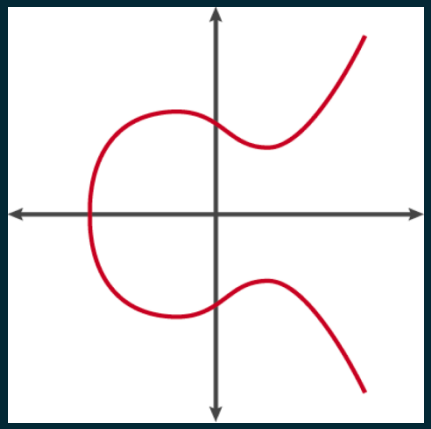
1. JavaScript (Server & Client)
2. Dart (Client)
3. SQL (Server & Client)
4. Bash Scripting Language (Server)

Cryptography

CipherChat is Made Secure through the implementation of the following cryptographic technologies:

- Hypertext Transfer Protocol Secure
- Elliptic Curve Diffie Hellman Key Exchange Protocol
- Elliptic Curve Digital Signature Algorithm
- Advanced Encryption Standard (256 bit)

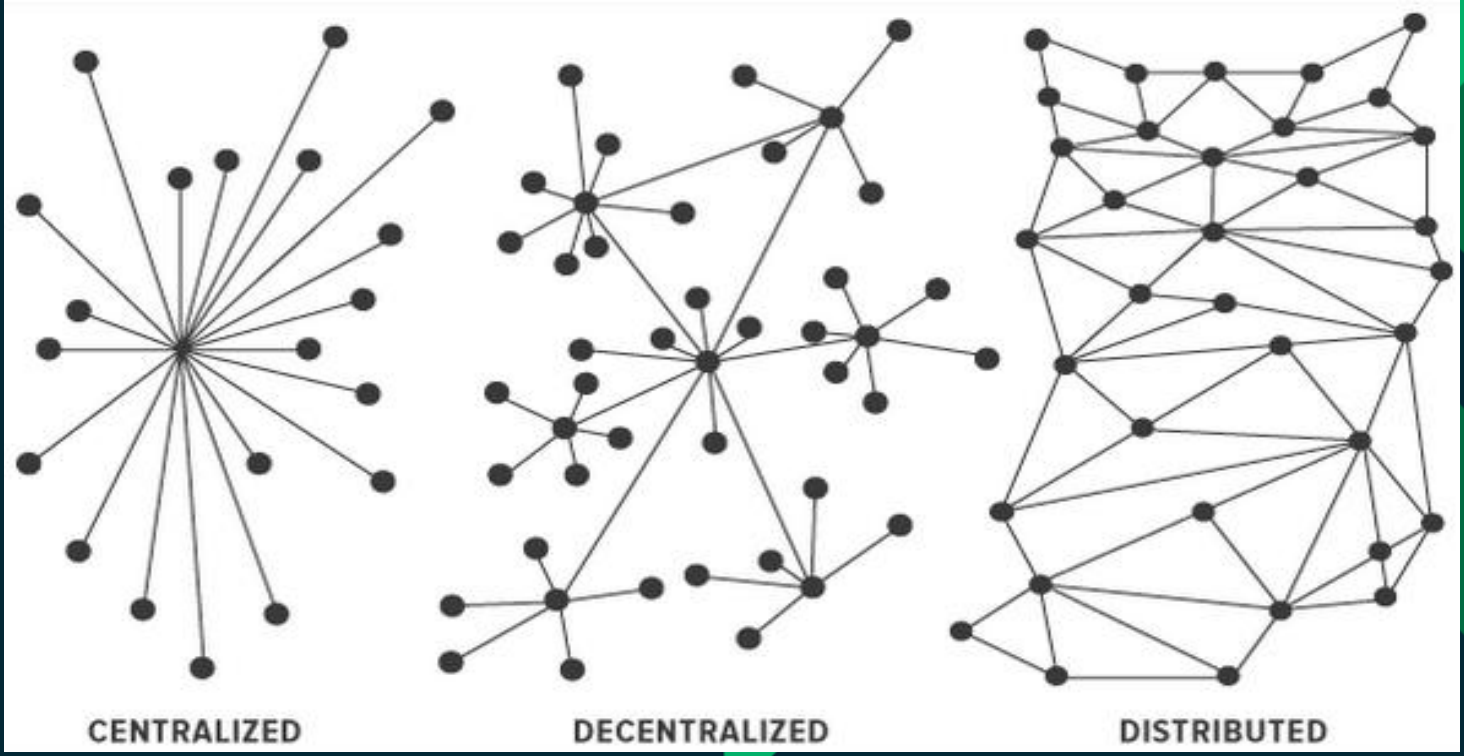
Chosen Elliptic Curve



SECP256k1

Used by government agencies and many cryptocurrencies due to special properties

Why Decentralization?



Decentralization creates a system which naturally more reliable and allows average individuals to benefit, rather than a single entity.

Elliptic Curve Diffie Hellman

Bob

Bob picks private key β

$1 \leq \beta \leq n-1$

Computes

$B = \beta G \%p$

Receives

$A = (x_A, y_A)$

Computes

$P = \beta\alpha G \%p$

Eve

$y^2 = x^3 + ax + b$

p

a

b

G

n

h

A

B

$P = ?$

Alice

Alice picks private key α

$1 \leq \alpha \leq n-1$

Computes

$A = \alpha G \%p$

Receives

$B = (x_B, y_B)$

Computes

$P = \alpha\beta G \%p$

Method

1. Multiple clients connect to a CipherChat server
2. Clients exchange public keys using ECDH
3. Messages are encrypted using the generated symmetric key and AES
4. Messages are signed using ECDSA Signing
5. The encrypted message is sent to the server
6. The server verifies the authenticity of the message using the signature (ECDSA Verification)
7. Server saves the authenticated message
8. The other peer(s) sends requests to the server and receive the latest messages
9. The received messages are decrypted using the symmetric key and AES

Diffie Hellman Vulnurability

Although Diffie Hellman can defend against passive attackers it is vulnerable to Man in the Middle Attack. In this case the server may function as two or more separate peers, decrypting and re-encrypting message before sending them to the intended recipient.

Current Solution

1. Host and use your own server

This vulnerability will addressed later in this presentation

Load Balanced Servers

```
const handler = function(req, res){
    req.pipe(request({ url: servers[currentServer] + req.url })).pipe(res);
    currentServer = (currentServer + 1) % servers.length;
};
```

```
otto@ottor-HP-Notebook:~/Apps/Mobile-Application-Tech-Year-3-Semester-2/SWEN3004/SERVER$ ./status.sh
info:    Forever processes running
data:        uid  command script          forever pid   id logfile                        uptime
data:    [0] UGtU ./node  loadBalancer.js 11285   11294    /home/otto/.forever/UGtU.log 0:0:0:14.618
data:    [1] gGik ./node  server.js       11312   11340    /home/otto/.forever/gGik.log 0:0:0:11.547
data:    [2] cP-w ./node  server.js       11351   11372    /home/otto/.forever/cP-w.log 0:0:0:10.868
data:    [3] pSha ./node  server.js       11383   11396    /home/otto/.forever/pSha.log 0:0:0:10.128
```

CipherChat Servers are designed to be scalable. Multiple instances can be ran simultaneously on separate threads with each instance handling tasks asynchronously, maximizing efficiency

Open Source

Food for Thought

1. Why should anyone trust applications if they cannot prove for themselves that it is secure?
2. Applications should be secure by design and not by policy!

CipherChat is Open Source. By design, CipherChat is trustless if a known server is used for each conversation (else MITM vulnerability) and will evolve to be trustless regardless of which server is used.

https://github.com/CipherChat/CipherChat/

Live Demonstration

Future Improvements

1. Use of websockets instead of polling
2. Restrict Public Key Exchange to face-to-face interaction only
3. Create more incentives for person to host their own CipherChat servers
4. Notifications
5. Make app multilingual
6. Allow for the parsing of more complex data such as images and videos

<u>Distant Future</u>

1. Facilitate the sending of any currency (using crypto)
2. Blockchain
3. Free Decentralized Applets (Cab Hailing, Package Delivery etc.)

Thank you for your kind attention!