Performance Improvement in I2P using SSL

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***Abstract*— The 'Darknet' is a part of the deep web as it's contents are not accessible through search engines. But it is also anonymous cyber space. This anonymity is usually achieved using TOR-The Onion Router. Another darknet system (or 'privacy network') called I2P is growing in popularity. Although many users use TOR, there appears to be a precise shift towards I2P. I2P is original short for "Invisible Internet Project" which offers a range of improvements such as email, file sharing & storage plug-ins and other social applications like blogging and chatting. All information is wrapped with many layers of encryption (like AES).**

In this paper we will study about the mechanism which will provide more security and efficiency to current I2P system and also comparison with existing anonymous systems.

***Index Terms*— Darknet, Anonymous Network, TOR, I2P,I2P Crypto, Encryption Mechanism, SSL.**

I. INTRODUCTION

A Darknet is a hidden network. It is a routed allocation of IP address space that cannot be discovered by any usual means. It is used to refer to both a non-public network and the collective portion of Internet address space that has been configured in that manner.Tor, Freenet and I2P are popular softwares used to access darknet. You can access darknet sites only if the traffic is routing through anonymizing networks (like TOR and I2P). Another purpose of darknet is to provide a venue for private communication when public communication is undesirable, dangerous or not permitted.

I2P is an anonymous network. It is a network within a network. It is supposed to protect communication from monitoring by third parties such as ISPs. I2P is used by people who care about their privacy: activists, oppressed people, journalists and whistleblowers, as well as the average person.[8]

This paper organized as follows: Section II briefly discuss about Invisible Internet Project. Section III Issues with existing anonymous systems. Section IV discusses proposed approach. Section V draws some conclusions

II. INVISIBLE INTERNET PROJECT

There are several concepts for understanding working of I2P Protocol.[5]

The netDb:

I2P uses the netDb as distributed database.It is only maintained by superpeers (floodfill peers) and it contains all needed information to make the network operate.

Two types of information are stored in netDb :

- ***routerInfo*** entities, which contain all the information needed to contact a particular router.
- ***leaseSets***, which give details of particular destination. Which contains all information needed to contact the destination.

Tunnel:

They are unidirectional path through several routers, which means that the sending path and the receiving path are different. (for example Bob and Alice want to communicate through I2P, they actually require 4 tunnels). After a definite quantity of your time, tunnels get expired. Tunnels are checked every time to get rid of failing tunnels. The default lifetime is set to 10 minutes. The length of a tunnel hop varies accordingly. Tunnels can be exploratory or client. There are two type of tunnels. One is inbound and the other is outbound tunnels that is proposed by I2P.

Inbound and outbound tunnels are automatically built when I2P is started. It is also important to notice that connections to tunnels are only valid for nodes (systems) over which I2P has an installed paths.

Working of I2P Communication:

Once the messages are sent, to anonymize them each client has their I2P router build a few inbound and outbound tunnels - a sequence of peers that pass messages in one direction to and from the client, respectively.

In other words, when someone wants to send a message to other one, the peer passes that message out one among their outbound tunnels targeting one of the other peer's inbound tunnels, finally reaching the destination. Every participant within the network chooses the length of those tunnels, and in doing so, makes a tradeoffs between anonymity, latency, and throughput in keeping with their own needs.

For The first time when a client wants to contact with another client, they send a request query to the fully distributed "network database" - a custom structured distributed hash table (DHT) which is based on the Kademlia algorithm. This is often done to find the other client's inbound tunnels efficiently, however subsequent messages between them usually includes that data so no further network database lookups are required.

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III. ISSUES WITH EXISTING ANONYMOUS SYSTEMS

- ***TOR:***

Properties	*Drawbacks*
Uses Circuit Switched Network	Wastage of Bandwidth
Uses bidirectional tunnel	MITM
Plain text communication between exit node and target server	Eavesdropping
Centralized System	Can easily target

- ***Existing I2P:***

Properties	*Drawbacks*
Provides layered encryption	Overhead on every nodes
Uses four different algorithms.	Time consuming process
Uses AES encryption	Single fault vulnerability
Doesn't use SSL	Can't pass HTTPS traffic

The cryptographic algorithms used within I2P are reduced to minimum to deal with the need of the system

- Symmetric algorithm
- Asymmetric algorithm
- Signing algorithm
- Hashing algorithm

For various types of communication I2P uses different cryptographic algorithms in a layered way. It uses following communication levels:[2]

- Inter router communication.
- Tunnel messages.
- Garlic messages.

- ***Inter router communication***

The lowest level of communication between routers is inter router communication.Routers select an short-lived session key through Diffie-Hellman exchange.By using router's DSA key each router authenticates to the next router. A hash of each packet is used for local integrity checking.

- ***Tunnel messages***

Exchange of messages are done at middle layer of the I2P stack. Tunnel messages use their own AES256/CBC encryption with an explicit IV and passed over the transporting routers. Verification of messages is done at the tunnel endpoint with an additional SHA256 hash.

- ***Garlic messages***

It is top layer of encryption which combine the full path.It is uses another encryption sceme.Messages are passed in the form of garlic which are encrypted with ElGamanl/AES+SessionTags.Contents of a single message contains multiple cloves of garlic.Cloves contains messages with instructions for delivery.The client's router put message into a garlic,encrypt it to ElGamal public key published in receiver's leaseset and forward it through the appropriate tunnels.The delivery instructions are attached to each clove includes the ability to request that clove be forwarded locally to router or tunnel.

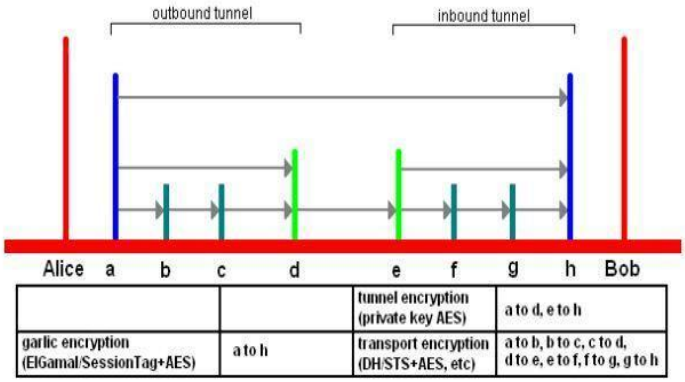
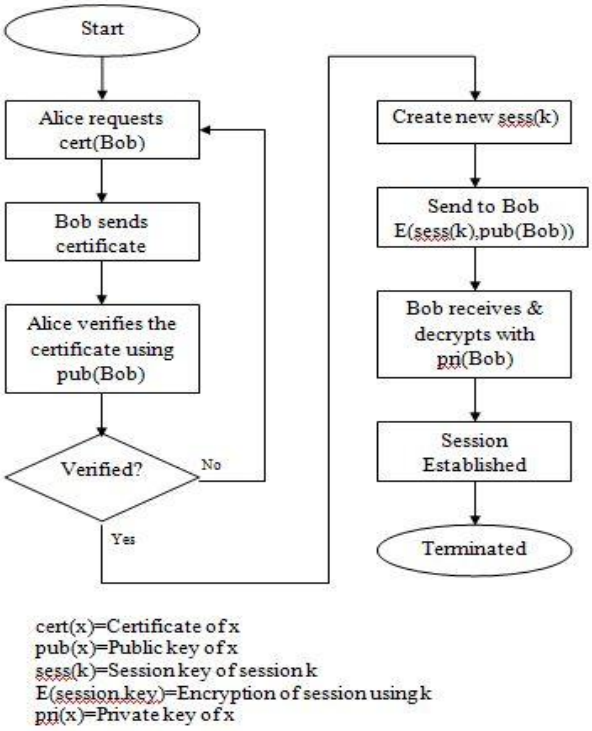


Figure 1 Encryption Layers in I2P

IV. PROPOSED APPROACH

Phases of Proposed Approach:

- ***SSL Handshake***



- ***End to End Communication***

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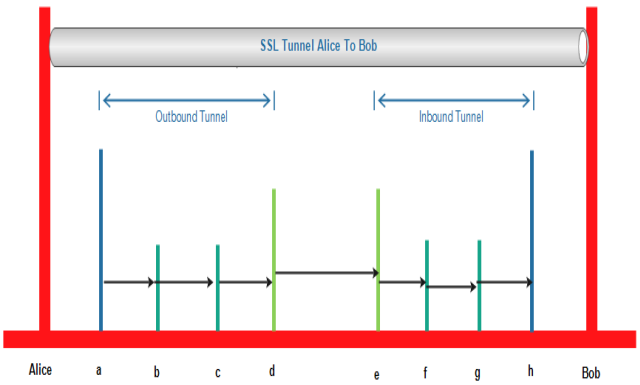

Once the connection between Alice and Bob is established traffic will be encrypted end to end using session key.

1. The encrypted packet will be sent from Alice's outbound tunnel passing through different peers to the inbound tunnel of Bob.
2. Only Bob can decrypt the received packet using pre shared session key.

V. CONCLUSION

Based on the study it can be concluded that, traffic in I2P is encrypted in layered approach. Each & every router (peer) has to encrypt and decrypt incoming and outgoing traffic. It's tedious task for every router to encrypt & decrypt. It may be vulnerable for traffic analysis attack.

So from the analysis we can think to provide more security to I2P by integrating SSL in it so that from the beginning traffic can be flow in encrypted secure format. Currently I2P is not allowing secure traffic. It does not pass HTTPS traffic. If we use SSL in I2P ,It will increase performance and improve security.

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