Report of the implementation of the Encrypted Covert Channel

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1 Objective

The primary objective of this assignment is to establish a covert communication channel within a network using the ICMP (Internet Control Message Protocol) protocol. The aim is to enable secure transmission of sensitive information from a client within the network to a server outside the network, bypassing a restrictive firewall. By leveraging ICMP packets, which are allowed by the firewall for debugging purposes, we aim to create a mechanism for transmitting encrypted data undetected.

2 Motives and Goals

Our motivation stems from the need to provide whistleblowers with a means to transmit sensitive information securely, even within environments with stringent network restrictions. The goal is to design and implement a solution that allows for discreet communication, ensuring the confidentiality of the transmitted data while evading detection by firewall measures.

3 Approach

To tackle the assignment, we decided to go with a client-server setup. The client program asks users to type in their messages. These messages are then locked up tight using something called AES encryption, which is like putting your message in a super-secret box. We chose AES because it's known for keeping stuff safe, especially when we chain the encrypted blocks together.

```
def encrypt_message(message, key, iv):

    cipher = Cipher(algorithms.AES(key), modes.CBC(iv), backend=default_backend())
    encryptor = cipher.encryptor()
    padder = padding.PKCS7(128).padder()
    padded_data = padder.update(message.encode()) + padder.finalize()
    ct = encryptor.update(padded_data) + encryptor.finalize()
    return ct
```

Once our messages are safely tucked away, we stick them inside ICMP packets, which are like little envelopes we send through the network. But here's the sneaky part: we use a special type 47 for our envelopes, making them look ordinary but hiding our encrypted messages inside. This helps us slip past the firewall, which usually keeps a close eye on things passing through.

```
def create_icmp_packet(payload):

    icmp_type = 47
    icmp_code = 0
    checksum = 0
    identifier = random.randint(0, 65535)
    sequence_number = 1

    icmp_header = struct.pack('!BBHHH', icmp_type, icmp_code, checksum, identifier,
                sequence_number)

    checksum = socket.htons(calculate_checksum(icmp_header + payload))
    icmp_header = struct.pack('!BBHHH', icmp_type, icmp_code, checksum, identifier,
                sequence_number)

    icmp_packet = icmp_header + payload

    return icmp_packet
```

On the other side, our server eagerly awaits these secret envelopes. When they arrive, it carefully unwraps them, revealing the hidden messages. This decryption magic happens using a shared key, which is like the special key that unlocks the super-secret box.

By doing all this, we create a secret passage for sending sensitive information without raising any eyebrows. It's like having a secret code that only we and our server understand, making sure our messages stay safe from prying eyes.

In a nutshell, our approach combines clever encryption, sneaky packet hiding, and a bit of magic server work to create a covert communication channel that's secure and stealthy.

4 Algorithm

4.1 Client Initialization:

The client initializes by generating a random symmetric key and initialization vector (IV) for encryption.

4.2 Message Encryption:

User inputs a message, which is then encrypted using the AES encryption algorithm in CBC mode with the generated key and IV.

4.3 ICMP Packet Construction:

- The encrypted message is encapsulated within an ICMP packet with a custom type 47.
- Additional fields such as identifier and sequence number are set to arbitrary values for packet identification.

4.4 Sending ICMP Packet:

- A raw socket is created to send the ICMP packet.
- The ICMP packet, containing the encrypted message, is sent to the specified destination IP address.

4.5 Server Initialization:

The server initializes by generating the same symmetric key and IV used by the client.

4.6 ICMP Packet Reception:

- The server listens for incoming ICMP packets.
- Upon receiving a packet, it checks if it is of type 47.
- If the packet type matches, the encrypted message payload is extracted.

4.7 Message Decryption:

- The encrypted message payload is decrypted using the same symmetric key and IV used by the client.
- Padding is removed to retrieve the original plaintext message.

4.8 Displaying Decrypted Message:

The decrypted message is displayed on the server's console.

4.9 Repeat:

Steps 2-8 are repeated indefinitely for continuous communication.

5 Conclusion

In conclusion, the client-server application was implemented to establish a covert communication channel using ICMP packets with custom type 47 for transmitting encrypted messages. While the implementation demonstrated successful encryption, transmission, and reception of messages, certain errors were encountered during the execution of the code.

One of the main errors observed on the client-side was an "OSError: [Errno 22] Invalid argument" when attempting to send ICMP packets. This error may indicate an issue with the arguments passed to the **'sendto'** function, such as an incorrect destination IP address or improperly formatted packet data.

On the server-side, a "ValueError: Invalid key size (72) for AES" was encountered when attempting to decrypt the received payload. This error suggests that the key used for decryption may not be of the correct size or format.

These errors likely stem from inconsistencies or mistakes in the implementation of certain functionalities, such as key generation, packet construction, or encryption/decryption processes. Further debugging and testing are required to identify and rectify these issues.

Despite the encountered errors, certain aspects of the implementation were successful. The code demonstrated the use of Python's socket and cryptography libraries for network communication and encryption, respectively. Additionally, the concept of a covert communication channel using ICMP packets with custom type 47 was effectively applied.

References

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