

Obfs2

Pluggable Transports documentation series.*

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ABSTRACT

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Tor, Bridge, Scary, Obscuration, Censorship, Circumvention, Pluggable Transport

PREAMBLE

This paper is part of a paper documentation series about Pluggable Transports (PTs) [3], how they work and their strengths and weaknesses.

1 INTRODUCTION

During the history of digital networks, we have been confronted more and more with the phenomenon of internet censorship and blocking by governments [4]. So, over the years, more and more circumvention tools were developed and also have been blocked due to deep packet inspections and the detailed analysis of its content. This lead us to, so-called, *Pluggable Transports (PTs)* [3], which help to bypass censorship attempts by transforming the traffic between client and server, in such a ways that it looks like innocent traffic.

In this paper, we will talk about *obfs2*, a protocol obfuscation layer for TCP protocols. We will show how it works, what we can do with it and which strengths and weaknesses it has.

1.1 Outline

TODO

2 OBFS2

Obfs2 is a protocol obfuscation layer for TCP protocols, to keep a third party from telling what protocol is in use based on message contents [2]. It's the continuation of brl's ssh obfuscation protocol [2] [1].

2.1 Overview

The protocol consists of two phases.

- First: The parties establish keys
- Second: The parties exchange superenciphered traffic.

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2.2 Notation

Given are two parties: the 'initiator' (INIT), which opens the connection and can mostly be associated with a client, and the 'responder' (RESP), which accepts the connection and can mostly be associated with a server.

We use the following primitives,

- $H(x)$ is SHA256 of x
- $H^n(x)$ is $H(x)$ called iteratively n times
- $Enc(K,s)$ is the AES-CTR-128 encryption of s using K as key

notation

- $x \parallel y$ is the concatenation of x and y
- $UINT32(n)$ is the 4 byte value of n in big-endian (network) order
- $SR(n)$ is n bytes of strong random data
- $WR(n)$ is n bytes of weaker random data
- "xyz" is the ASCII characters 'x', 'y', and 'z', not NUL-terminated
- $s[:n]$ is the first n bytes of s
- $s[n:]$ is the last n bytes of s

and constants

- `MAGIC_VALUE` = 0x2BF5CA7E
- `SEED_LENGTH` = 16
- `MAX_PADDING` = 8192
- `HASH_ITERATIONS` = 100000

as well as

- `KEYLEN` = 16 is the length of the key used by $Enc(K,s)$
- `IVLEN` = 16 is the length of the IV used by $Enc(K,s)$
- `HASHLEN` = 32 is the length of the output of $H()$
- $MAC(s, x) = H(s \parallel x \parallel s)$

according to [2]. A "byte" is an 8-bit octet and we require that $HASHLEN \geq KEYLEN + IVLEN$.

2.3 The key establishment phase

The key establishment phase consists of several substeps.

2.3.1 The given values. Given are the constants `MAGIC_VALUE`, `SEED_LENGTH`, `MAX_PADDING` and `HASH_ITERATIONS` and the lengths `KEYLEN`, `IVLEN` and `HASHLEN`.

2.3.2 Generating initial values. The 'initiator' (see listing 1) generate a seed, a padding key and a random `PADLEN` in range from 0 through `MAX_PADDING` (inclusive).

Listing 1: Generate INIT seed and padding key [2].

```
1 INIT_SEED = SR(SEED_LENGTH)
2 INIT_PAD_KEY = MAC("Initiator_obfuscation_padding", INIT_SEED)[:KEYLEN]
3 PADLEN = R([0:MAX_PADDING])
```

The 'responder' (see listing 2) do it in the same way.

Listing 2: Generate RESP seed and padding key [2].

```
1 RESP_SEED = SR(SEED_LENGTH)
2 RESP_PAD_KEY = MAC("Responder_obfuscation_padding", RESP_SEED)[:KEYLEN]
3 PADLEN = R([0:MAX_PADDING])
```

2.3.3 *Init messages.* After generating the initial values [2], the initiator (see listing 3) sends

Listing 3: INIT's init message [2].

```
1 INIT_SEED | Enc(INIT_PAD_KEY, UINT32(MAGIC_VALUE)
| UINT32(PADLEN) | WR(PADLEN))
```

encrypted by the key information given by the SEED, to the responder (see listing 4), which do it likewise.

Listing 4: RESP's init message [2].

```
1 RESP_SEED | Enc(RESP_PAD_KEY, UINT32(MAGIC_VALUE)
| UINT32(PADLEN) | WR(PADLEN))
```

After receiving the SEED from the other party, each party decrypts the other party's padding key value and the next 8 bytes.

It checks the MAGIC_VALUE and the PADLEN value for conclusiveness and close the connection immediately in case of invalidity, otherwise, it read the remaining PADLEN bytes of padding data and discard them.

3 CONCLUSIONS

A APPENDIX

REFERENCES

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