



UNIVERSITY OF ???

PHD THESIS

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**Possible solutions to implement email  
transfer offering anonymity towards  
third parties**

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# Chapter 1

## Introduction

This document describes a solution, which should offer anonymity against third parties when sending emails based on SMTP and the respective client protocols (e.g. IMAPv4 or POP3). This seemed to bother very few peoples up until information in Echelon became public due to an investigation by a committee of the european parliament in 2001[4]. Things settled again with local peaks up until a whistle blower named Edward Snowden disclosed 200000 documents proofing activities of the NSA and other secret services. This led to the “2013 mass surveillance disclosures” and damaged the reputation of the american nation in many countries[29].

### 1.1 Overview over the current situation

SMTP as defined in RFC5321[12] is as of today (2013) state of the art transmission protocol for electronic mail. It is standardized in its current version since 2008 and is one of the few protocols, which is marked as "Standard". While the protocol delivers reliable mail transfer between two endpoint (mail servers) the anonymity of the message content towards any mail server is not given (For a detailed analysis see Analysis of current situation).

Anonymity against third party is not given due to the following facts.

- There is not always an encryption available between a mail user agent (MUA) and the outgoing mail server.
- There is no way to guarantee that a mail transfer between two SMTP hosts is encrypted.
- There is no always an encryption available between a SMTP host and the MUA of the recipient.

- Encryption based on top level protocols (such as S/MIME or PGP) do hide the message content. The sender, recipient, the subject and some technical information (eg. MIME-Headers) are always in plain available and not protected as such.
- Even if there is a reliable encryption between all endpoints and none of the intermediate servers are compromised sender and recipients might still be identified thru traffic analysis.

Keeping the message content confidential is more and more relevant in these days. The more the importance of mail transfer in today's economy is growing the more is confidentiality and reliability a topic. Unfortunately Secret Services have already discovered the significance of today's mail traffic and start to analyse those. With the presence of Secret Services in the internet, actively investigating data the importance of a reliable data channel for today's messages has become increasingly important.

Quick wins such as the use of "Onion Router Networks" (such as TOR) do not offer any additional security since the message content would be revealed in full to an eventual exit node and any mail server on its way to the recipient.

## 1.2 Problem statement

This work is an approach to extend the existing mail routing based on SMTP by an intermediate layer, which should offer anonymity against third party.

This work delivers the following results:

- A throughout analysis of current technology and its weaknesses.  
Although the Simple Mail Transfer Protocol (SMTP) is a well-implemented and well proven technology its weaknesses are well known. The SMTP protocol was originally defined in RFC821[23] by Johnathan B. Postel. At this time internet was only available to universities, some mayor companies and governments. The objective of Simple Mail Transfer Protocol (SMTP) is to transfer mail reliably and efficiently[23, p. 1]. Confidentiality or having a tamper proof protocol was no design goal. Over the years many standards arose trying to close some of the gaps. Some of them are being used but most of them are not very common.
- An analysis of possible approaches to improve the current standards.  
Many standards and technologies do exist these days addressing parts of the issues mentioned above. A throughout research should be carried out to identify how can these technologies be combined to achieve the subsequent goals. Furthermore technology advanced. Namely in the field

of cryptography new possibilities and ideas arose (such as new encryption classes [eg. elliptic curves] or the idea of crypto puzzles). Another field of research which emerged in the analysis of traffic flow is handled under the term “Big Data” where not single events but the sum of events is handled.

- A RFC document describing an approach offering a significant quality improvement of the existing solutions, which could be accepted by the internet community.
- A prototype reflecting at least the minimum baseline of the RFC document to reflect prove its functionality.

A prototype should be offered to show the feasibility. The Prototype should be a reference implementation and offer a quick way to use the new technology. It should be distributed under the LGPL license to simplify distribution of the technology.



## Chapter 2

# Ground theory

### 2.1 Mail Transport

### 2.2 Anonymity

### 2.3 Identification and data signage

### 2.4 Encryption

### 2.5 Mix cascades

### 2.6 Remailers

Agents which do accept Mails from one party and forward it to another party while modifying its content well known under the name of “Remailers”. Wikipedia [28] lists four types of Remailers.

Pseudonymous Remailers (or Type-0-Remailers) are remailers that establish a pseudonymity. This means that the senders Email-Address is removed and replaced by a pseudonymous E-Mailadress under the remailers control. This sender address may be used as an ordinary email-Adress to reeach the original sender of the mail. These types of Remailers allow to send mails while one or both recipients do not know their counterpart. The message (or at least parts of it) might be encrypted but do not have to be. For someone controlling the Remailer it will always be possible to make a link between the pseudonymous mail address and a original mailadress. So pseudonymity is only granted towards people not controlling the remailer. Furthermore a person or organisation might

be able to discover the Information tuple of Sender and pseudonymous email by analyzing messages and their timely context. So this remailer system is susceptible for traffic analysis.

Cypherpunk-Remailers (or Type-1-Remailers) do function a bit different. They take an encrypted message which was encrypted using the public key of the server, decrypt it and send it to a recipient. The original senders identity gets lost. A reply to a cypherpunk message is not possible. Messages sent to a cypherpunk server might contain messages to other cypherpunk remailers. This daisy-chaining of cypherpunk-nodes allows hiding the original sender-receiver-tuple from a single node. The first node knows only the the originating sender while the last node knows only the final recipient. All intermediate notes do only know the nodes they were linking. However if having traffic information of the entry and exit nodes the tuple might be discovered by traffic analysis.

Mixmaster remailer (or type-2-remailer) FIXME

Mixminion remailer (or type-3-remailer) FIXME

### **2.6.1 Ethics of the Internet**

[26, p. 1]

### **2.6.2 Possible legal issues**

One of the first questions I have been asked when working for this topic was: Is this legal? The question is important but not easy at all. The mail system is a global spanning network coming across almost any country of the world. Some of these countries consider almost any kind of secret as illegal as long as the country itself is not able to capture it. Some countries consider it as perfectly legal and some will generally accept its presence as long as the country or establishment is not endangered due to its usage.

My personal unscientific point is: I do not care. In my country it is definitely legal as long as I am a well behaved citizen (as long as I do not missuse this system to plan or do illegal actions). There are already proprietary systems available which offer the same functionality. All I do is adding this functionality to the common system instead of reinventing the wheel. There are however many very good reasons to have such a system. Correspondence about my health, my business relations, my friends or my family (to give just a couple of examples) should be kept private even in an open world. The misuse of information would cause tremendous damage and several events in time (which have been mentioned earlier) showed that there are many secret services and other players using any kind of information to achieve their own goals or the goals of associates. They do this regardless of any country borders or regulations.



Since I have no means of controlling the flow of messages in the internet or the hubs where a mail is running thru I consider it as fair to generate an addon to compensate the lack of control in the existing system. Exactly as a car – the system may be legal or illegal and it depends on the users whether he wants to use it or not and in what way.

To some extend the system is related to a remailer system. One of the most famous pseudonymous remailers. Wikipedia



## Chapter 3

# Current situation

As of today the de facto standard for asynchronous mail transfer is SMTP as defined in RFC5321[12] and its predecessors. While the transfer protocol SMTP is quite compact, the protocol is enhanced with several standards for encryption, multimedia support and similar. A mail client offers today various support for a lot of sub-protocols. The following list is an excerpt of related sub-protocols which are either related to transport, reliability, identification or encryption.

### 3.1 Implemented protocols

#### 3.1.1 SMTP

[12]

##### 3.1.1.1 Mail transport

[13]

##### 3.1.1.2 encryption

#### 3.1.2 MIME

[6] [7] [8] [9] [10]

#### 3.1.3 S/MIME

[25]

### **3.1.4 PGP**

[24]

### **3.1.5 Sender Policy Framework**

[31] [11]

### **3.1.6 Sender ID**

[30]

### **3.1.7 DNS**

[3]

#### **3.1.7.1 DNSSEC**

[14]

### **3.1.8 Transport Protocols**

#### **3.1.8.1 IPv4**

[22] [19] [27] [20] [17] [15] [16] [21, p. 3]

#### **3.1.8.2 IPv6**

[2]

#### **3.1.8.3 TCP**

### **3.1.9 POP3**

[18]

### **3.1.10 IMAPv4**

[1]

## **Chapter 4**

# **Analysis of current situation**

**4.1 Current state of common Technology**

**4.2 Current state of available Technology**

**4.3 Missing Gap**

**4.4 Skeleton of Mails and mail transfer**



## **Chapter 5**

# **Designing an approach**

### **5.1 Defining system boundaries**

### **5.2 Basic Requirements of an approach**





## **Chapter 6**

# **Specifying a target solution**



## Chapter 7

# Verification of solution

### 7.1 User acceptance of the target system

From a perspective of a user Collected requirements to a mail system:

Requirement	cliteria	Weight
The System should transport mails fast under normal conditions	Mails should travel with at least 1MB/min	5
The System should transport mails reliable	Mails should always arrive or their status should be retrievable	9
The System should offer anonymity against spying from third parties	Neither original sender nor final destination or any part of the message content should be determinable by any part of the system except for the original sender and the final recipient.	9
The system must be easy to handle		8
The system must be easy to install	Installation should be almost a "single-click"-Thing. Details should be copied or accessed from the existing configurations.	5
<i>continued on next page</i>		

<i>continued from previous page</i>		
Requirement	cliteria	Weight

Table 7.1: User acceptance requirements

## 7.2 Admin acceptance of the target system

Collected requirements to a mail system from an admin perspective:

Requirement	Criteria	weight
The System should transport mails fast under normal conditions	Mails should travel with at least 10MB/min	5
The System should transport mails reliable	Mails should always arrive or their status should be retrievable	9

## 7.3 Possible attacks to the system

### 7.3.1 Generic DoS attacks

### 7.3.2 Attacks on the users anonymity

### 7.3.3 Reputaional attacks

#### 7.3.3.1 Misuse for sending spam

# Definitions

**Local MTA** A local Mail Transfer Agent. This transfer agent reads mails to be sent to a remote account from a local storage and sends it to a MSA.

**MRA** A local Mail receiving Agent. This agent pulls either mails from a local MDA. An MDA might offer the possibility for a push pull delivery.

**MSA** A local Mail Sending Agent. This agent accepts mails to be sent to a remote MTA.

**MUA** A Mail User Agent. This user agent reads mails from a local storage and allows a user to read existing mails, create and modify mails.

**Privacy** From the Oxford English Dictionary: “

1. The state or condition of being withdrawn from the society of others, or from the public interest; seclusion. The state or condition of being alone, undisturbed, or free from public attention, as a matter of choice or right; freedom from interference or intrusion.
2. Private or retired place; private apartments; places of retreat.
3. Absence or avoidance of publicity or display; a condition approaching to secrecy or concealment. Keeping of a secret.
4. A private matter, a secret; private or personal matters or relations; The private parts.
5. Intimacy, confidential relations.
6. The state of being privy to some act.

”[5, FIXME]

In this work privacy is related to definition two. Mails should be able to be handled as a virtual private place where no one knows who is talking to whom and about what or how frequent (except for directly involved people).



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