

E-Mail Header Injections  
An Analysis of the World Wide Web

by  
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## ABSTRACT

E-mail header injection vulnerability is a class of vulnerability that has been around for a long time but has not made its way to popular literature. It can be considered as the email equivalent of HTTP Header Injection Vulnerability. Email injection is possible when the mailing script fails to check for the presence of email headers in the form fields that take in email addresses. The vulnerability exists in the reference implementation of the mail function in popular languages like PHP and python. With the proper injection string, this vulnerability can be exploited to inject additional headers and/or modify existing headers in an E-mail message.

To understand and quantify the prevalence of E-Mail Header Injection vulnerabilities, we used a black-box testing approach, where we crawled 'x' URLs in order to find the URLs which contained form fields. Our system used this data feed to classify the forms which had e-mail fields which could be fuzzed with malicious payloads. Amongst the 's' forms fuzzed, our system was able to find 'y' vulnerable URLs among 'z' domains, which proves that the threat is/isn't widespread and deserves future research attention.

*To my mother and father, for giving me the life I dreamt of,  
To my sister, who constantly made me do better just to keep up with her,  
To my family in Phoenix, for always being there,  
To God, for making me so lucky, for letting me be strong when I had nothing, and  
making me believe when no one else would have.*

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## Chapter 1

### INTRODUCTION

The World Wide Web has single handedly brought about a change in the way we use computers. The ubiquitous nature of the Web has made it possible for the general public to access it anywhere, and on multiple devices like Phones, Laptops, Personal Digital Assistants, and even on TVs and cars. While this rapid pace of development has improved the speed of dissemination of information, it does come at a cost. Attackers Email Injection - Secure PHP Wiki (2010) This section will have a brief overview about the project. What the problem is, and What we aim to achieve.

**Structure of document** This document is divided logically into the following sections:

- Chapter 2 discusses the background of E-Mail Header Injection, a brief history of the vulnerability, and proceeds onto enumerate the languages and platforms affected by this vulnerability.
- Chapter 3 discusses the System design, and enunciates the architecture and the components of the system, along with a detailed test plan to validate the system. It also enumerates the issues faced, and the assumptions made.
- Chapter 4 briefly describes the experimental setup and sheds light on how we overcame the issues and assumptions discussed in the previous section.
- Chapter 5 presents our findings, and our analysis of the said findings.

- Chapter 6 continues the discussion of the results, the lessons learned over the course of the project, limitations, and a suitable mitigation strategy to overcome the vulnerability.
- Chapter 7 explores related work in the area, and clearly shows how and why our research is different.
- Chapter 8 wraps up the document, with ideas to expand the research in this area.

In summary, we make the following contributions:

- A black-box approach to detecting the presence of E-Mail header injection vulnerability in a web application.
- A detection and classification tool based on the above approach, that will automatically detect such E-Mail Header Injection vulnerabilities in a web application.
- A quantification of the presence of such vulnerabilities on the World Wide Web, based on a expansive crawl across the Web, including 'x' URLs and 'y' forms.

## Chapter 2

### E-MAIL HEADER INJECTION BACKGROUND

#### 2.1 Problem Background

This section describes the background of the vulnerability.

#### 2.2 History of E-Mail Injection

This section describes the history of the vulnerability.

#### 2.3 Languages Affected

This section describes the popular languages which exhibit this type of vulnerability.

- PHP - Describe which functions/params are affected
- Java - Describe which functions/params are affected
- Python - Describe which functions/params are affected

#### 2.4 Potential Impact

This section describes the impact of the vulnerability, and how wide/far-reaching the effects could be.

## Chapter 3

### SYSTEM DESIGN

#### 3.1 Our Approach to the Problem

This section will describe the approach we have taken. Will discuss about blackbox testing, and why we chose it.

#### 3.2 System Architecture

This will have a diagram of our architecture, including all 8 components.

#### 3.3 System Components

This will discuss in detail about the components of the system, like the following:

##### *3.3.1 Crawler*

Describe the functionality of the Crawler

##### *3.3.2 Form Parser*

Describe the functionality of the Form Parser

##### *3.3.3 E-Mail Field Checker*

Describe the functionality of the E-Mail Field Checker

##### *3.3.4 Fuzzer*

Describe the functionality of the Fuzzer

**Non-Malicious Payload** Describes what the regular payload is.

**Malicious Payload** Describes what the malicious payloads are.

### *3.3.5 E-Mail Analyzer*

Describe the functionality of the E-Mail Analyzer

### *3.3.6 Database*

## 3.4 Test Plan

This section will describe the test plan for the project, and will explain what was tested, and how our system conforms to the requirements.

## 3.5 Design Issues

This section will describe the issues we might face with the approach that we have chosen, and the design decisions.

## 3.6 Assumptions

This discusses the assumptions that we have made while building the system, examples include:

1. Crawler is not blocked by the firewalls.
2. The Crawler feed is an ideal representation of the World Wide Web.

## Chapter 4

### EXPERIMENTAL SETUP

#### 4.1 System Configuration

Will briefly describe the servers used for the experiments.

#### 4.2 Platforms and Software

Will briefly describe the platform, (ie) Ubuntu 14.04, and the softwares that were used for the experiments. (eg) Postfix, Apache, MySQL, etc.

#### 4.3 Languages used

Will very briefly (maybe one paragraph) describe what we used to create the system. (Python 2) Will also describe the limitation of Python, (GIL basically), and point to next section.

#### 4.4 Celery Queues

Will briefly describe how Celery and rabbitMQ help us to overcome the GIL, and do tasks in parallel.

## Chapter 5

### DATA ANALYSIS AND RESULTS

This section will have tables, images and charts.

#### 5.1 Data

Will display a table/graph with the data, then go on to explain what the fields/-graphs mean.

##### *5.1.1 URLs crawled*

##### *5.1.2 Forms collected*

##### *5.1.3 Forms with E-Mail Fields*

##### *5.1.4 E-Mail received from Forms*

##### *5.1.5 Fuzzed Forms*

## Chapter 6

### DISCUSSION

#### 6.1 Lessons Learned

Describes what we learned from this particular project.

#### 6.2 Limitations of the Project

Describes what limitations were present, stuff like:

- CAPTCHAs
- JavaScript Apps
- Blogs powered by WordPress/Drupal
- Mail libraries

#### 6.3 How to prevent this attack

Describes how to prevent this attack, stuff like:

- Use Mail Libraries
- CMS
- Input Validation



## Chapter 7

### RELATED WORK

This will be a detailed section on the papers that are related to our work, \*but\* important thing is to show why our work is different from prior work in this area. Also, can/will add references to the blogs and books that describe this attack :)

## Chapter 8

### CONCLUSION

Conclude with what the results were, whether the vulnerability was widespread or not, and how (if needed) this can be alleviated.

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APPENDIX A  
CODE SNIPPETS