

Faculty of Mathematics and Computer Science

Heidelberg University

Master thesis

in Computer Science

submitted by

Stefan Machmeier

born in Heidelberg

1996

Honeypot Implementation

in a

Cloud Environment

This Master thesis has been carried out by Stefan Machmeier

at the

Engineering Mathematics and Computing Lab

under the supervision of

Herrn Prof. Dr. Vincent Heuveline

(Titel der Masterarbeit - deutsch):

(Title of Master thesis - english):

Contents

Acronyms	III
List of Figures	IV
List of Tables	V
1 Introduction	1
1.1 Problem description	1
1.2 Justification, motivation and benefits	1
1.3 Research questions	1
1.4 Limitations	1
2 Background	2
2.1 Cloud Computing	2
2.1.1 Definition of Cloud Computing	2
2.1.2 Service models	3
2.1.3 Deployment models	3
2.1.4 Cloud Security	3
2.1.5 HeiCloud	3
2.2 Honeypots	3
2.2.1 Definition of a Honeypot	3
2.2.2 Honeynets	4
2.2.3 Legal Issues	4
2.3 Intrusion Detection System	4
3 Previous Work	5
3.1 The Bait'n'Switch Honeypot	5
3.2 Intrusion Trap System	5
3.3 Honeycomb	5
3.4 Honeypots in a cloud environment	5
4 Practical Work	6
4.1 Attack vectors	6
4.1.1 Primer	6
4.2 Proposed Honeypots	6
4.2.1 Cowire	6
4.2.2 Dionaea	6
4.2.3 Honeyd	6

4.3	Concept	6
4.3.1	HoneyTrap	6
4.4	Implementation	6
5	Experimental Work	7
5.1	SNORT	7
6	Evaluation	8
6.1	T-Pot	8
6.2	Analyzation	8
7	Conclusion	9
7.1	Future work	9
	Bibliography	I

Acronyms

HTTP Hypertext Transfer Protocol

IaaS Infrastructure-as-a-Service

NIST National Institute of Standards and Technology

PaaS Platform-as-a-Service

SaaS Software-as-a-Service

List of Figures

List of Tables

1 Introduction

1.1 Problem description

1.2 Justification, motivation and benefits

1.3 Research questions

1.4 Limitations

2 Background

This chapter concludes the fundamental knowledge that is needed to comprehend the upcoming practical work. Firstly, an introduction to cloud computing will be held. Next, a thorough understanding of honeypots is given. Lastly, we introduce some concepts of intrusion detection systems.

2.1 Cloud Computing

Nowadays it is one of the well-known keywords and has been used by vary large companies such as Google, or Amazon, however, the term “cloud computing” dates back to the late 1996, when a small group of technology executives of Compaq Computer framed new business ideas around the Internet.[Reg20] In this section, we want to give basic understandings of cloud computing, and give a short introduction to HeiCloud.

2.1.1 Definition of Cloud Computing

Considering the definition of Brian Hayes, cloud computing is “a shift in the geography of computation” [Hay08]. Thus, computational workload is moved away from local instances towards services and data centers that provide the need of users [AFG⁺10].

Considering the definition of the National Institute of Standards and Technology (NIST), cloud computing “is a model for enabling ubiquitous, convenient, on-demand network access to a shared pool of configurable computing resources (e.g., networks, servers, storage, applications, and services) that can be rapidly provisioned and released with minimal management effort or service provider interaction.” NIST the geographical shift, but also mentions the . Moreover, the term is composed of five essential characteristics, three service models (see 2.1.2), and four deployment models (see 2.1.3).

On-demand-self-service refers to the unilaterally provision computing capabilities. Consumers can acquire server time and network storage on demand without a human interaction.

Broad network access characterizes the access of capabilities of the network through standard protocols such as Hypertext Transfer Protocol (HTTP). Heterogeneous thin and thick client platforms should be supported.

Resource pooling allows the provider's computing resources to be pooled across several consumers. A multi-tenant model with different physical and virtual resources are assigned on demand.

Rapid elasticity

Measured service

2.1.2 Service models

Software-as-a-Service (SaaS)

Platform-as-a-Service (PaaS)

Infrastructure-as-a-Service (IaaS)

2.1.3 Deployment models

Private Cloud

Community Cloud

Public Cloud

Hybrid Cloud

2.1.4 Cloud Security

[NCM12]

2.1.5 HeiCloud

2.2 Honeypots

The first public honeypot [Spi03]

2.2.1 Definition of a Honeypot

On the Internet there are a dozen of definitions for honeypots. Thus, to cope with all the subtle differences, we want to take a closer look at some of the definitions and narrow down our own one.

Spitzner defines honeypots as a “security resource whose value lies in being probed, attacked, or compromised.”[Spi03]

High-interaction honeypots

Low-interaction honeypots

Pure honeypots

2.2.2 Honeynets

[Spi03]

2.2.3 Legal Issues

[Spi03]

2.3 Intrusion Detection System

3 Previous Work

3.1 The Bait'n'Switch Honeyplot

[PD05]

3.2 Intrusion Trap System

[PD05]

3.3 Honeycomb

[PD05]

3.4 Honeyplots in a cloud environment

[KPM⁺21]

4 Practical Work

4.1 Attack vectors

4.1.1 Primer

4.2 Proposed Honeypots

4.2.1 Cowire

4.2.2 Dionaea

4.2.3 Honeyd

4.3 Concept

4.3.1 HoneyTrap

4.4 Implementation

5 Experimental Work

Connect results of Honeypots with NIDS/IDS to update rules.

5.1 SNORT

6 Evaluation

6.1 T-Pot

6.2 Analyzation

7 Conclusion

7.1 Future work

Bibliography

- [AFG⁺10] Michael Armbrust, Armando Fox, Rean Griffith, Anthony D. Joseph, Randy Katz, Andy Konwinski, Gunho Lee, David Patterson, Ariel Rabkin, Ion Stoica, and Matei Zaharia. A view of cloud computing. *Communications of the ACM*, 53(4):50–58, April 2010.
- [Hay08] Brian Hayes. Cloud computing, 2008.
- [KPM⁺21] Christopher Kelly, Nikolaos Pitropakis, Alexios Mylonas, Sean McKeown, and William J. Buchanan. A comparative analysis of honeypots on different cloud platforms. *Sensors*, 21(7):2433, April 2021.
- [NCM12] SR Nithin Chandra and TM Madhuri. Cloud security using honeypot systems. *International Journal of Scientific & Engineering Research*, 3(3):1, 2012.
- [PD05] G. Schaefer P. Diebold, A. Hess. A honeypot architecture for detecting and analyzing unknown network attacks, February 2005.
- [Reg20] Antonio Regalado. Who coined 'cloud computing'?, Feb 2020.
- [Spi03] Lance Spitzner. *Honeypots - Tracking Hackers*. Addison-Wesley, Amsterdam, 2003.