Threat Identification Using Active DNS Measurements

AIMS 2018: Ph.D. track

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November 13, 2018

University of Twente, Design and Analysis of Communication Systems

Who am I?

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HELLO
My name is
Olivier

- Bachelor Electrical Engineering @University of Twente

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    - A First Look at HTTP(S) Intrusion Detection Using NetFlow/IPFIX (IM 2015)

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    - Student Network Twente (SNT)

Introduction

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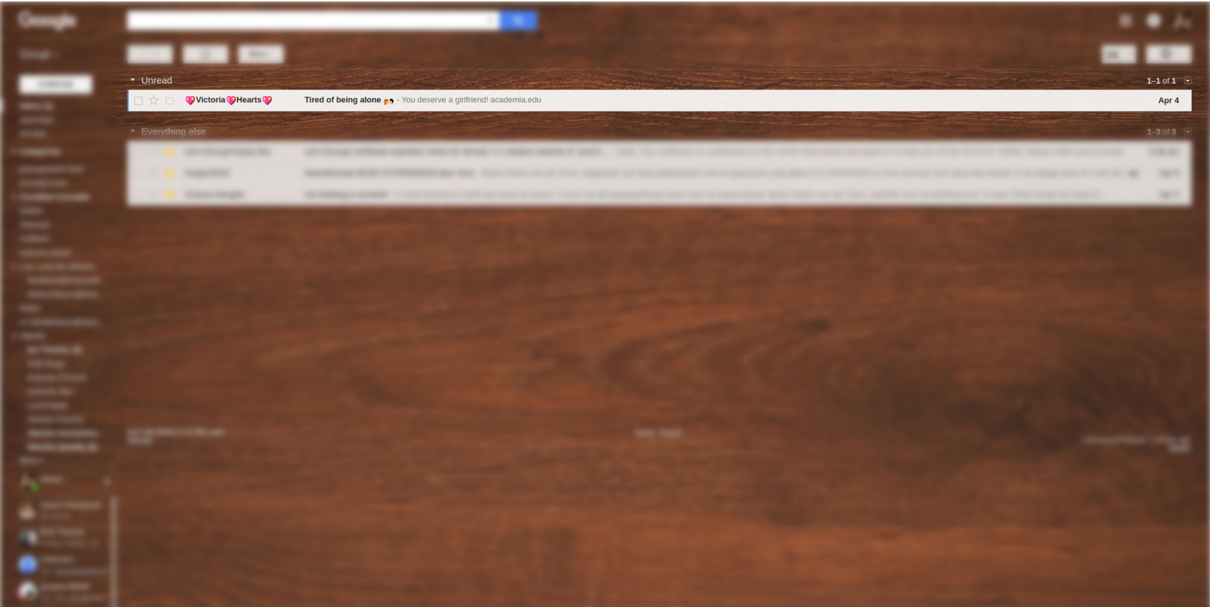
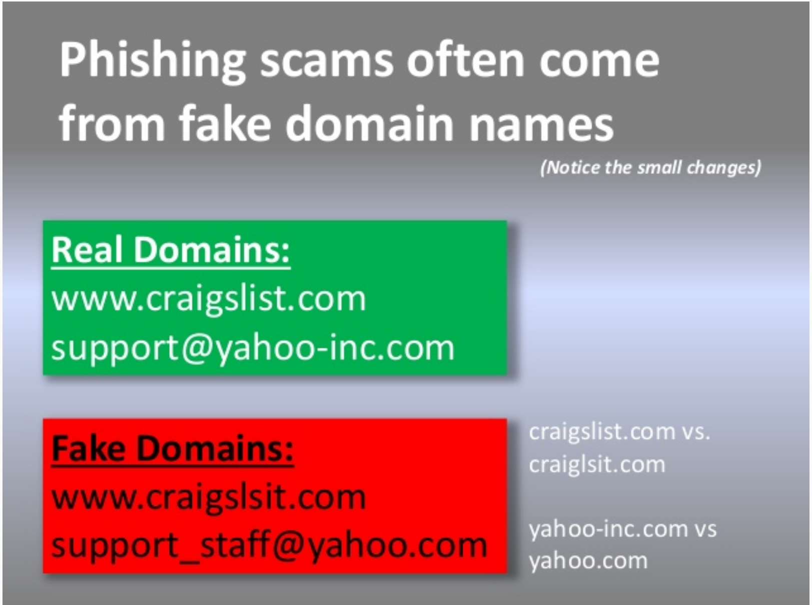


Unread 1–1 of 1

□ ☆ 💖Victoria💖Hearts💖 **Tired of being alone** 👫 - You deserve a girlfriend! academia.edu **Apr 4**

Everything else 1–3 of 3

Introduction



Phishing scams often come from fake domain names

(Notice the small changes)

Real Domains:

www.craigslist.com

support@yahoo-inc.com

Fake Domains:

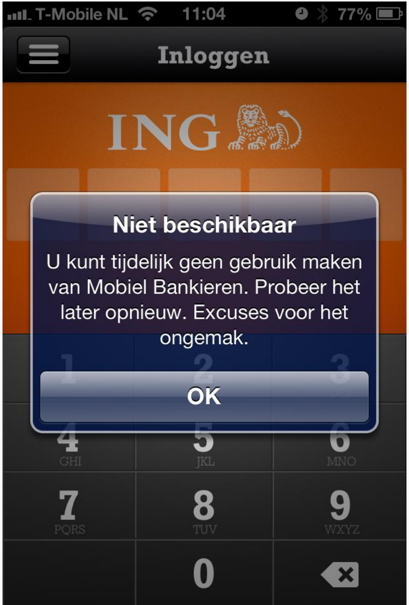
www.craigslsit.com

support_staff@yahoo.com

craigslist.com vs.
craiglsit.com

yahoo-inc.com vs
yahoo.com

Introduction



Niet beschikbaar

U kunt tijdelijk geen gebruik maken van Mobiel Bankieren. Probeer het later opnieuw. Excuses voor het ongemak.

Introduction

What do DDoS, phishing and spam attacks have in common?

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They leave traces...

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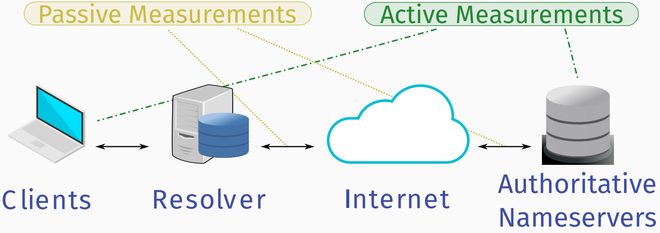
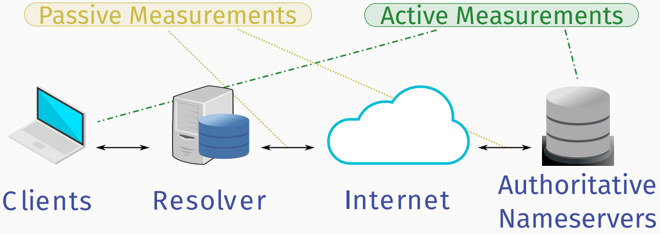
They leave traces... in the DNS!

Introduction



Passive DNS measurements

Introduction



Passive DNS measurements

- Detailed DNS usage
- Usage biases
- Time series are difficult

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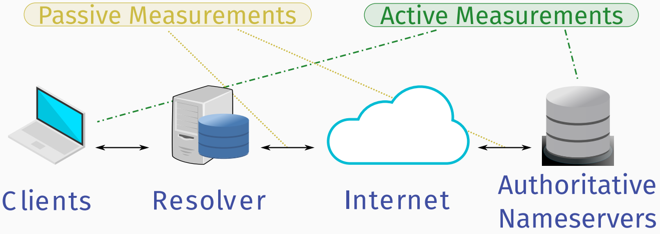

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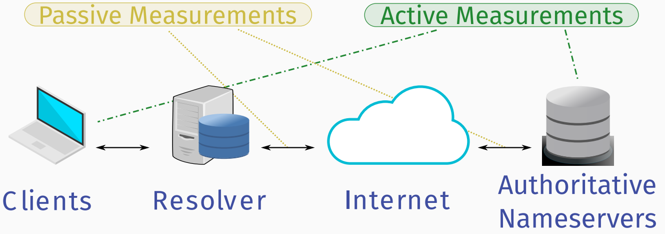
Active DNS measurements

Introduction



Passive DNS measurements

- Detailed DNS usage
- Usage biases
- Time series are difficult

Active DNS measurements

- Greater overview
- Possibility of a time-advantage
- Less detailed than passive measurements

Introduction

Our proposal:

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Our proposal:

Pro-active threat identification of malicious domains through active DNS measurements.

Research questions

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RQ_M: How can we use active DNS measurements to pro-actively identify malicious domains, and what are the benefits of such an approach?

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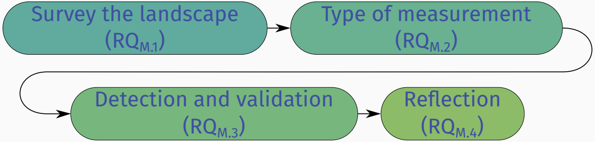

Survey the landscape ($RQ_{M.1}$)
Type of measurement ($RQ_{M.2}$)
Detection and validation ($RQ_{M.3}$)
Reflection ($RQ_{M.4}$)

Sub-research question 1

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$\mathrm{RQ}_{M.1}$: Which attacks make use of DNS and how do they use it?

- Survey literature

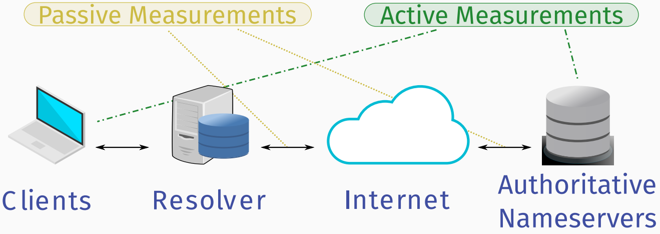
Sub-research question 1

We would like to detect all attacks. However, not all attacks make use of the DNS.

$\text{RQ}_{\text{M.1}}$: Which attacks make use of DNS and how do they use it?

- Survey literature
- Interview experts in the field

Sub-research question 2



Answering **RQ$_{M.1}$** gives a list of attacks which makes use of the DNS in some way.

There are (roughly) two types of DNS measurements, active and passive.

Sub-research question 2

$RQ_{M.2}$: What are the strengths and weaknesses of both types of DNS measurements with respect to the attacks?

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As a starting point we want to use Entrada and OpenINTEL to analyse how well both approaches fare in the detection of the surveyed attacks.

Sub-research question 3

We want to be able to perform detections on the entire DNS namespace.

Attacks are dynamic, therefore our detection method needs to be dynamic too.

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$RQ_{M.3}$: How can we perform efficient, large-scale, detections using Machine Learning and how do we validate these detections?

- Evaluate different classifier algorithms

Sub-research question 3

We want to be able to perform detections on the entire DNS namespace.

Attacks are dynamic, therefore our detection method needs to be dynamic too.

$RQ_{M.3}$: How can we perform efficient, large-scale, detections using Machine Learning and how do we validate these detections?

- Evaluate different classifier algorithms
- Compare results with established blacklists

Sub-research question 4

At this point we have a list of bad domains.

Are we able to infer identifiable information about the parties behind the domains by clustering domains together?

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$\text{RQ}_{\text{M.4}}$: What additional information can be obtained by clustering similar domain-configurations together?

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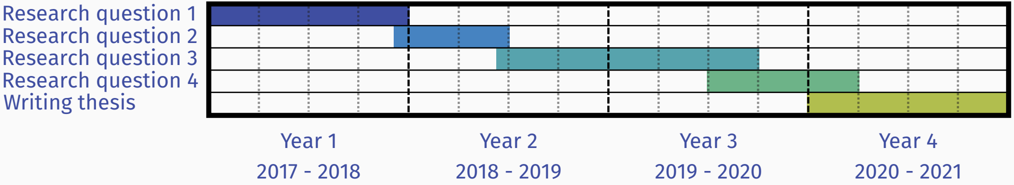
$\text{RQ}_{\text{M.4}}$: What additional information can be obtained by clustering similar domain-configurations together?

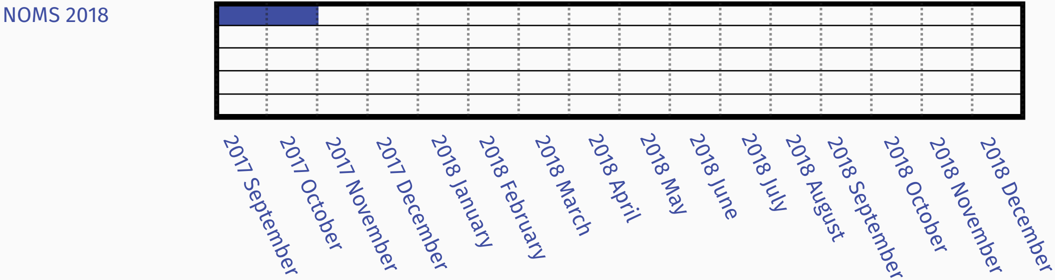
Cluster domains with similar configurations together, then analyse the similarities and differences.

Planning

Planning: Global



Planning: NOMS 2018

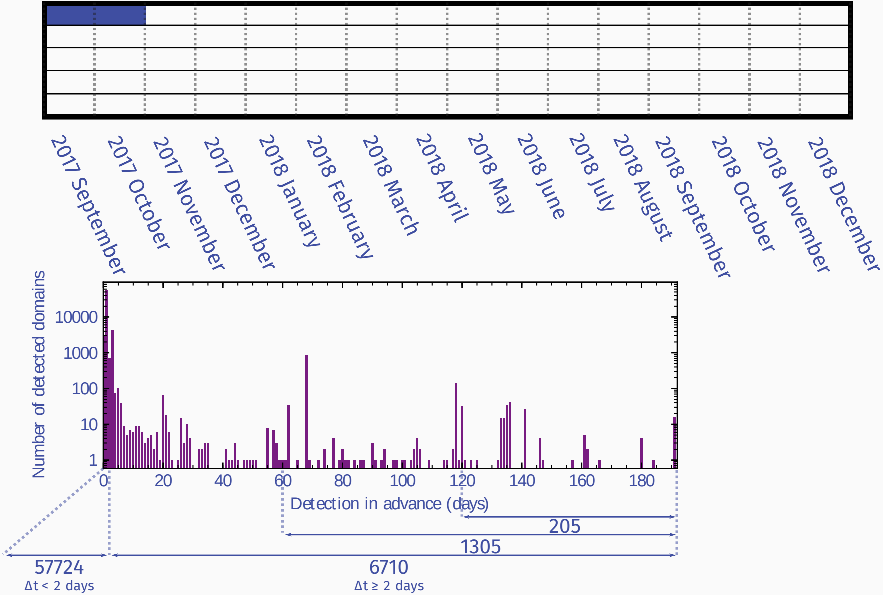


NOMS 2018 – September & October 2017 (Published)

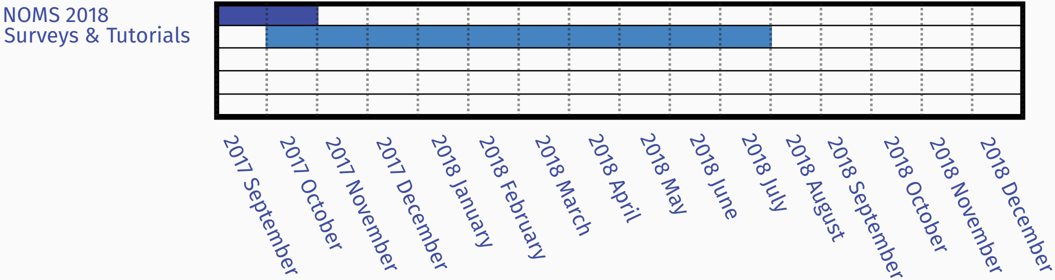
Detection of Snowshoe Spam by using active DNS measurements. Snowshoe Spam domains using SPF typically feature many records.

Planning: NOMS 2018

NOMS 2018



Planning: Surveys & Tutorials

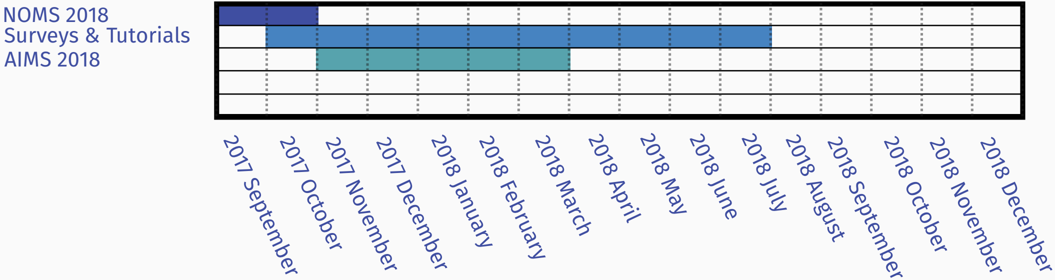


Surveys & Tutorials – October 2017, July 2018 (WIP)

Survey paper looking at state-of-the-art attack detection using either active, or passive, DNS measurements.

Based on research question **$\text{RQ}_{\text{M.1}}$**.

Planning: AIMS 2018

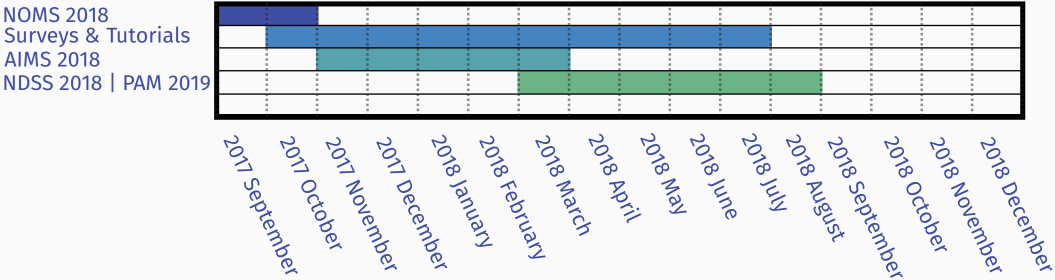


AIMS 2018 – November 2017, March 2018 (Accepted)

Ph.D. project proposal for the TIDE project.

Formal definition of the research questions.

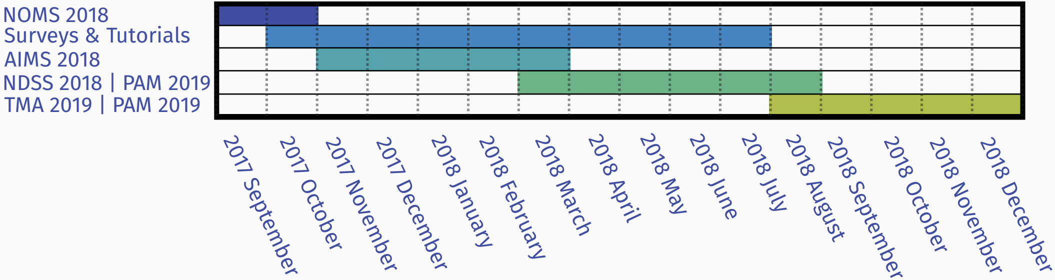
Planning: NDSS 2018 | PAM 2019



NDSS 2018 | PAM 2019 – March 2018, August 2018 (Planned)

Paper about the detection of malware code in DNS TXT resource records.

Planning: TMA 2019



TMA 2019 | PAM 2019 – August 2018, December 2018 (Planned)

Measurement paper. Here we want to put the theories learned from the survey into practice.

Based on research question **RQ$_{M.2}$**.

Conclusion

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We want to make the Internet a safer place by pro-actively identifying malicious DNS domains.

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- Do you have recommendations on how to validate a predictive blacklist?

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- What attacks can’t we miss in our research?
- Do you have recommendations on how to validate a predictive blacklist?
- How would you use such a predictive blacklist?

Extra slides

Why active DNS measurements?

Why study active DNS measurements? And not go with passive DNS measurements like everyone else?

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- Approach for primer domains.

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Why study active DNS measurements? And not go with passive DNS measurements like everyone else?

- Approach for primer domains.
- We believe that the configuration of a domain can give a real insight into the purpose of a domain.