Identifying Infections with Spamming Malware in a Network, based on Analysis of DNS MX Requests

Bas Vlaszaty
Bas.Vlaszaty@os3.nl

Universiteit van Amsterdam

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Acknowledgement

Research conducted at Quarantainenet BV, supervised by Casper Joost Eyckelhof

Outline

- Introduction
- Research Question
- Background
  - DNS MX
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  - Frequency
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Introduction

Spam:

Introduction

Spam:

"Unsolicited means that the Recipient has not granted verifiable permission for the message to be sent. Bulk means that the message is sent as part of a larger collection of messages, all having substantively identical content."
- Spamhaus

Introduction(2)

Spam worldwide problem

- Global email: 150-200 billion per day

Sources: Symantec and Radicati Group

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- Global email: 150-200 billion per day
- Almost 2/3 is spam
- Most spam blocked by spamfilters
- Average business user receives 85 emails a day, 10 are spam.

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Introduction(3)

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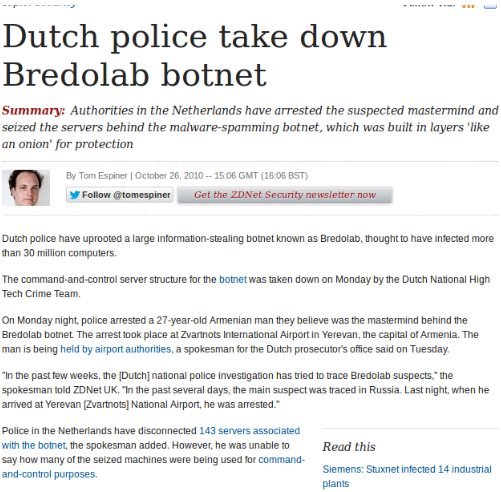
- Reputation loss, costs for bandwidth, energy

Introduction(4)



Topic: Security Follow via:

Dutch police take down Bredolab botnet

***Summary:** Authorities in the Netherlands have arrested the suspected mastermind and seized the servers behind the malware-spamming botnet, which was built in layers 'like an onion' for protection*

By Tom Espiner | October 26, 2010 -- 15:06 GMT (16:06 BST)

Dutch police have uprooted a large information-stealing botnet known as Bredolab, thought to have infected more than 30 million computers.

The command-and-control server structure for the botnet was taken down on Monday by the Dutch National High Tech Crime Team.

On Monday night, police arrested a 27-year-old Armenian man they believe was the mastermind behind the Bredolab botnet. The arrest took place at Zvartnots International Airport in Yerevan, the capital of Armenia. The man is being held by airport authorities, a spokesman for the Dutch prosecutor's office said on Tuesday.

"In the past few weeks, the [Dutch] national police investigation has tried to trace Bredolab suspects," the spokesman told ZDNet UK. "In the past several days, the main suspect was traced in Russia. Last night, when he arrived at Yerevan [Zvartnots] National Airport, he was arrested."

Police in the Netherlands have disconnected 143 servers associated with the botnet, the spokesman added. However, he was unable to say how many of the seized machines were being used for command-and-control purposes.

Read this

Siemens: Stuxnet infected 14 industrial plants

Introduction(5)

What to do?

- Prevention

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- Prevention
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- Different sensors
- Accumulate score
- Restrict network acces, put machine in quarantaine

Research question

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`Is it possible to identify a machine that is in infected with spamming malware by analysing DNS MX requests?`

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- Domain Name System

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- Comparable to De Telefoongids, you can look up a person and you will get back the phone number belonging to the person.

DNS MX

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- MX requests are specific for mail address
- Which server to deliver mail to
- Compare to the Gouden Gids, which will return an address so you know where to send your mail to.

Dataset

Data from 3 different institutes. Clients of Quarantainenet.

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Structure: [Timestamp, source ip, requested domain]

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- Spam blacklists (dnsbl.sorbs.net, cbl.abuseat.org, bl.spamcop.net, zen.spamhaus.org)
- Reports of issues by customers

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Create tools to analyse this
Try to match findings with these tools to verification data
(Incidents, reports, spam blocklists)

Frequency analysis

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- This results in activity plots

Frequency graph

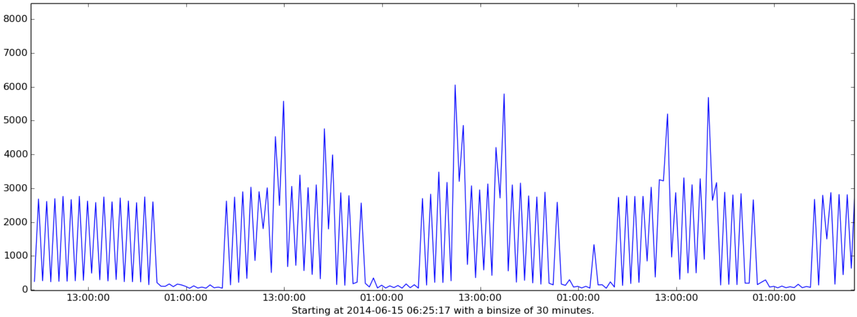

Figure: Daily pattern

Periodicity

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- Autocorrelation: Cross correlating with itself shifted by lag.
- Similarity of $f(x)$ with $f(x+t)$, where t is called the "lag"

Periodicity example

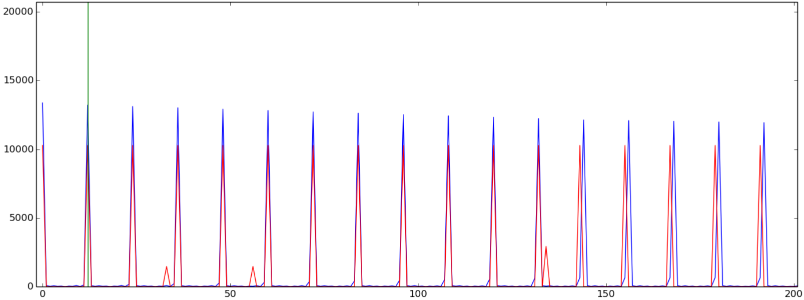

Figure: Autocorrelation good result

Entropy analysis

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- $H(X) = -\sum_{x} p(x) \log p(x).$

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- Entropy will go down when spam run is in progress
- Based on Shannon entropy, given by:
- $H(X) = -\sum_{x} p(x) \log p(x).$
- Higher entropy means the data is more random.

Flow analysis

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Flow analysis

- Idea based on "Detection of Spam Hosts and Spam Bots Using Network Flow Traffic Modeling"
- Flow is a session of activity.
- Requests have to be close together to belong to the same flow
- $dt = 1$ minute
- If there is more then 1 minute of "silence", the current flow ends and a new one will be started at the next activity

Results

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- Customer reports?

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Truth very limited:

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- Spam databases?
- Correlation with incident logs?

Frequency result A

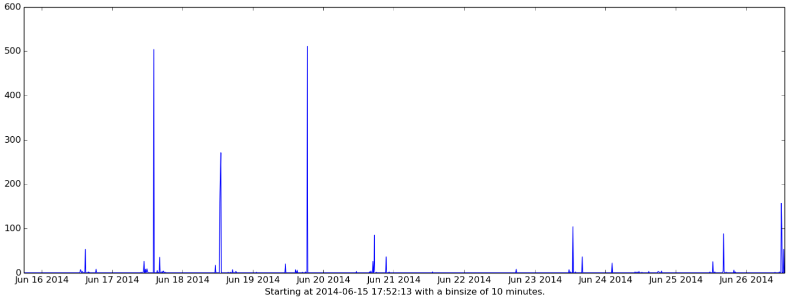

Figure: Frequency result A

Frequency result B

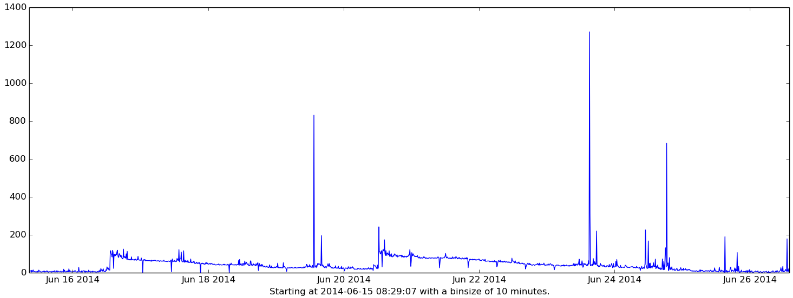

Figure: Frequency result B

Frequency result C

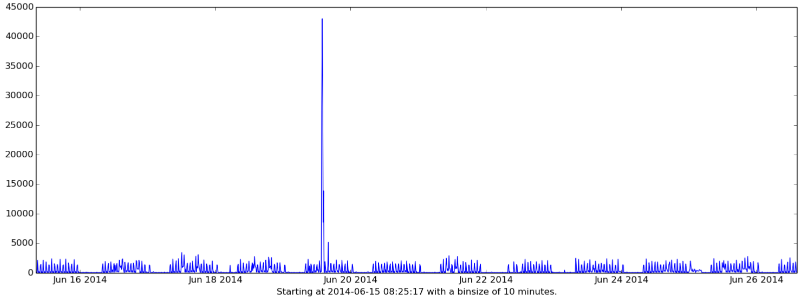

Figure: Frequency result C

Frequency spamrun ip

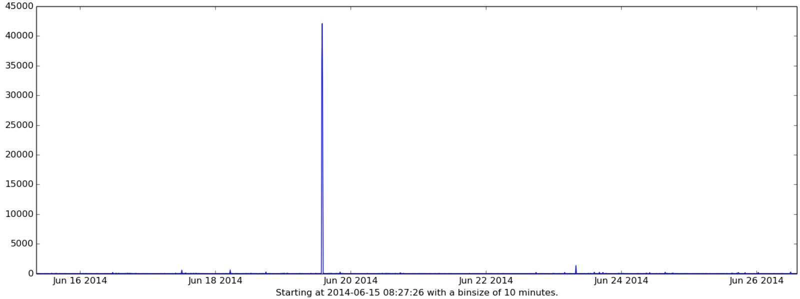

Figure: Frequency spamrun ip

Periodicity result

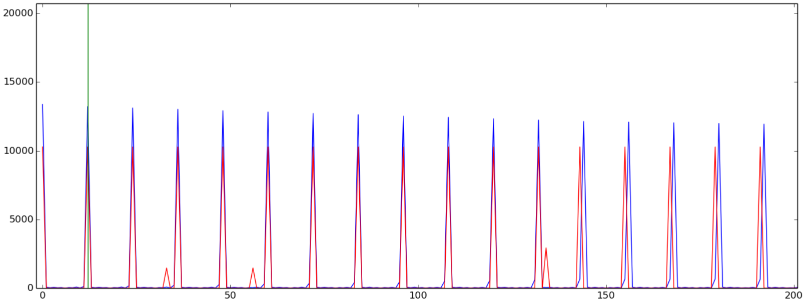

Figure: Periodicity Good example

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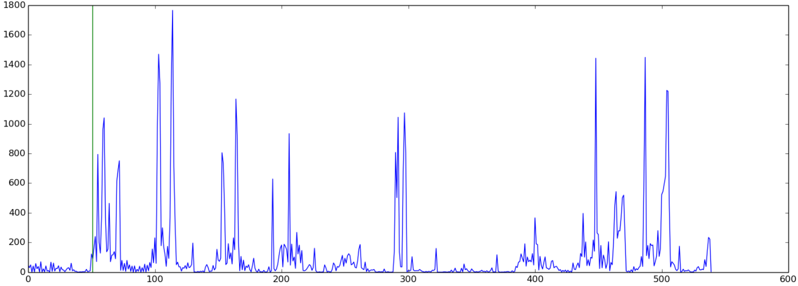

Figure: Periodicity Bad example

Entropy A

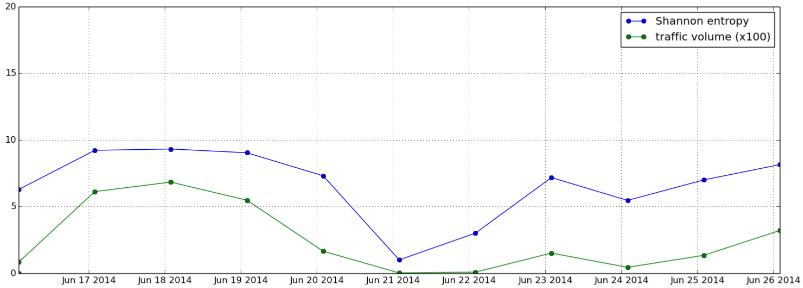

Figure: Entropy A

Entropy B

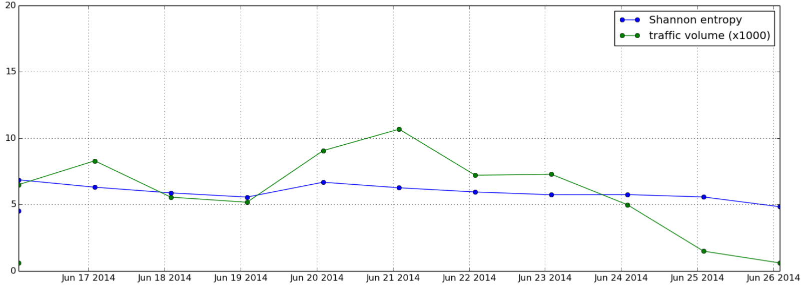

Figure: Entropy B

Entropy C

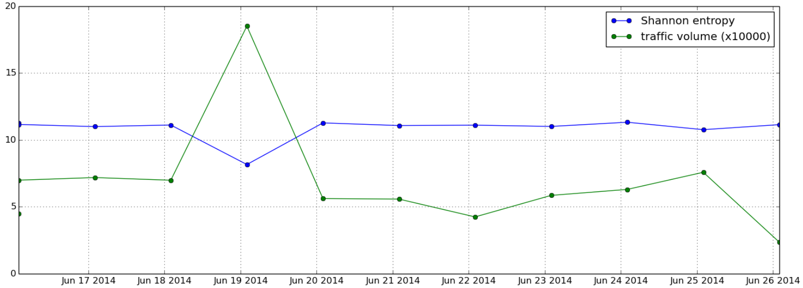

Figure: Entropy C

Results flow analysis

Dataset	# records	# Flows	Flows >10	Ratio
Set A	308	108	27	0.25
Set B	67.386	3356	1305	0.39
Set C	1.975.765	12240	2474	0.20

Table: Number of flows

Results from flow analysis C

Host	# Duration	Volume	Rate (req/s)
B	1456	**100983**	**69.36**
B	311	1376	4.42
A	509	**21920**	**43.06**
C	5083	3054	0.60
C	4242	2466	0.58
C	4857	2815	0.58
C	2387	1198	0.50
C	4689	3414	0.73
C	3844	2193	0.57
C	1172	2946	2.51
C	3853	2184	0.57
C	2258	1021	0.45

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- Entropy analysis shows the results described in the previous research.
- Flows very good way to look at traffic. Can detect interesting events with ease.

Conclusion contd.

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- In principle only mailservers should be doing DNS MX requests, so all other machines potential suspects.
- DNS MX detection can serve as additional evidence in classification, but is not strong enough by itself.
- All results gained from a small dataset with one spamrun. Not enough examples of bad behaviour for good classification.

Questions?

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