Further Aspects of Passive DNS

Datamining, visualization and alternative implementations

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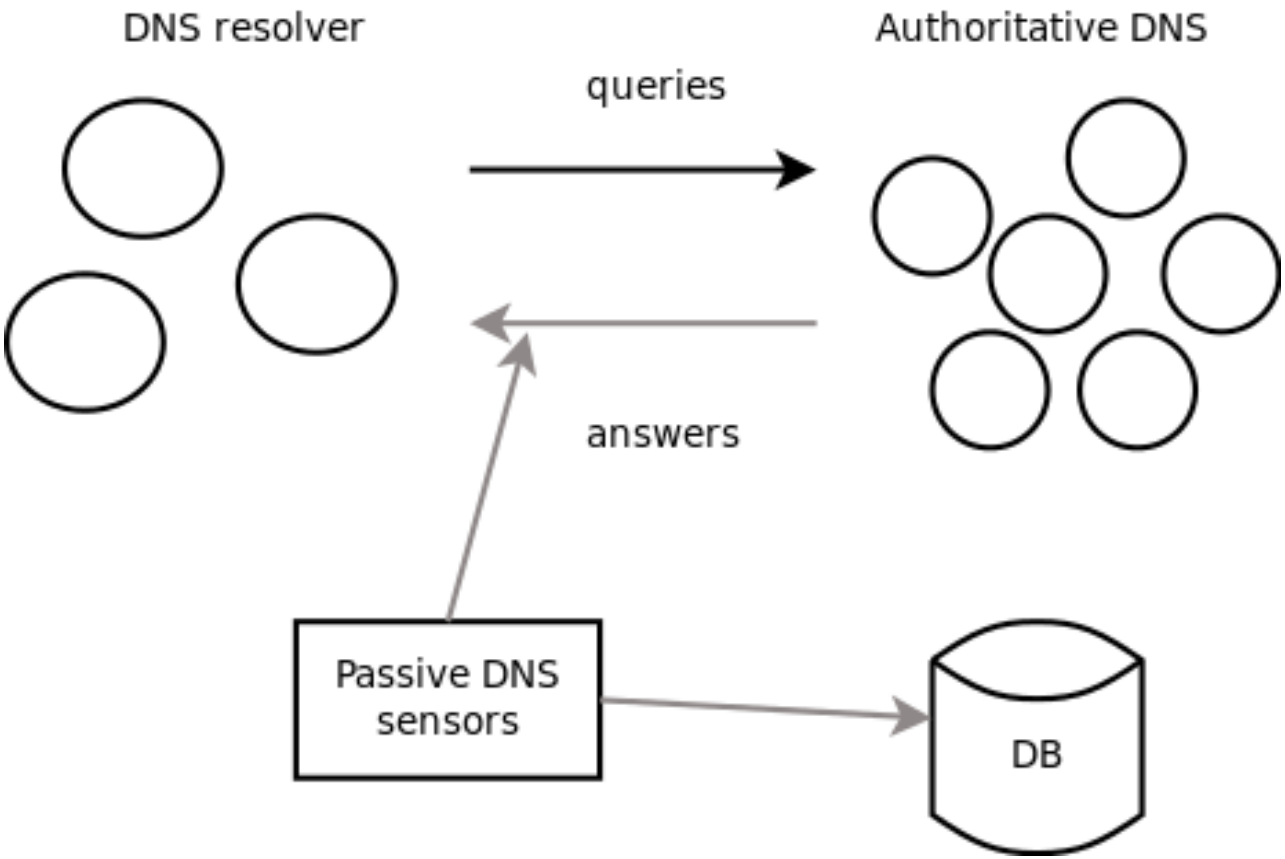
Disclaimer

- Passive DNS is a technique to collect only valid answers from authoritative or caching nameservers
- By its design, privacy is preserved (e.g. no source IP addresses from resolvers are captured[1])
- DNS data collected is only publicly known DNS data
- The research is done in the sole purpose to detect malicious IP/domains or content to better protect users
- Passive DNS implementations are subject to local rules

[1] Except if an application abuses DNS answers to track back their users.

"Passive DNS is to DNS ops as NetFlow is to net ops."
John Kristoff

Passive DNS - how it works



What's the purpose? Some examples...

Detection of shared compromised web hosting - the enisa.eu case

- Regularly malicious links are posted on compromised systems
- What are the other services or domains hosted on the same A/AAAA record?
- What happens to "infected" redirect (because the web hosting server is infected)?
- How Passive DNS can help?

EG (Egypt being offline)

- Discover non resolvable domains using nameserver in Egypt
- Interesting discovery *randomstring*.medicpills.ru ($\rightarrow$ less spam?)
- BIT.LY case is similar (when Libya was offline)
- Passive DNS helps to find interdependecies among services

Malware infection

- History of a domain name in conjunction with Netflow records
- Find shorted lived domain names
- Get back the A/AAAA records
- and find infected PCs in your Netflow.
- Quick win!

Passive DNS implementations

- BFK (F. Weimer[a]) passive dns
- **CIRCL pdns-toolkit**[b]
- **CERT.at passive dns**[c]
- CERT.ee passive dns

[a] Presented at FIRST 2005
[b] `github.com/adulau/pdns-toolkit/`
[c] access upon request

- CERT.lv passive dns
- ISC DNSDB[a]
- The University of Auckland DNS History Database Project (DHDB)
- Team Cymru passive dns

[a] `https://dnsdb.isc.org/`

Passive DNS design comparison - an ecosystem

	CIRCL pdns-toolkit	**CERT.at passive dns**
datastore	Redis	PostgreSQL + memcached
storage	memory	hybrid
exhaustive	-	+
space efficient	++	+
input	pcap, dnscap output	nmsg
open source	yes	ask

Some statistics from the CERT.at Passive DNS...

Storing Passive DNS - CIRCL.lu perspective

- Implementing the storage of a Passive DNS can be challenging
- Starting from standard RDBMS and then moved to a key-value store
- We learned to hate[2] hard disk drive and to love random access memory
- Loving memory is great especially when it's now cheap and addressable in 64bits

[2] exception → only used for data store snapshot

Passive DNS + Ranked domains - Where visualization can help

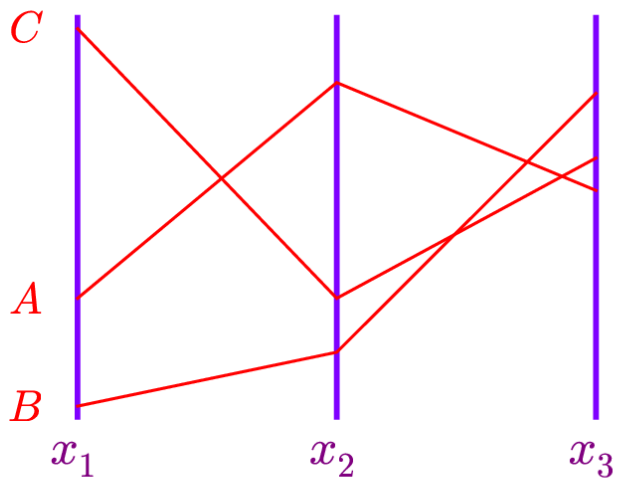
- Now, we have 50 millions lines of ranked hostname...

```
...
www.stopacta.info.
www.vista-care.com.
breadworld.com.
o-o.resolver.A.B.C.D.5xevqnwsds5zdq34.metricz.\
l.google.com.
www.thechinagarden.com.
smtp10.dti.ne.jp.
...
```

Why visualization?

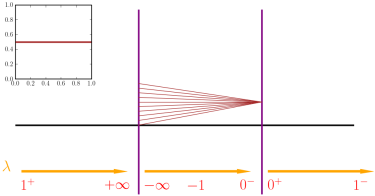
- Understand big data
- Find stuff we cannot guess

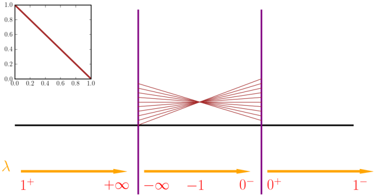
Choosing Parallel Coordinates

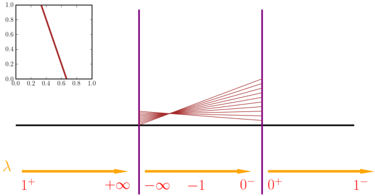


- Display as much dimensions wanted (yes, **as many**)
- Display as much data wanted (I mean it!)

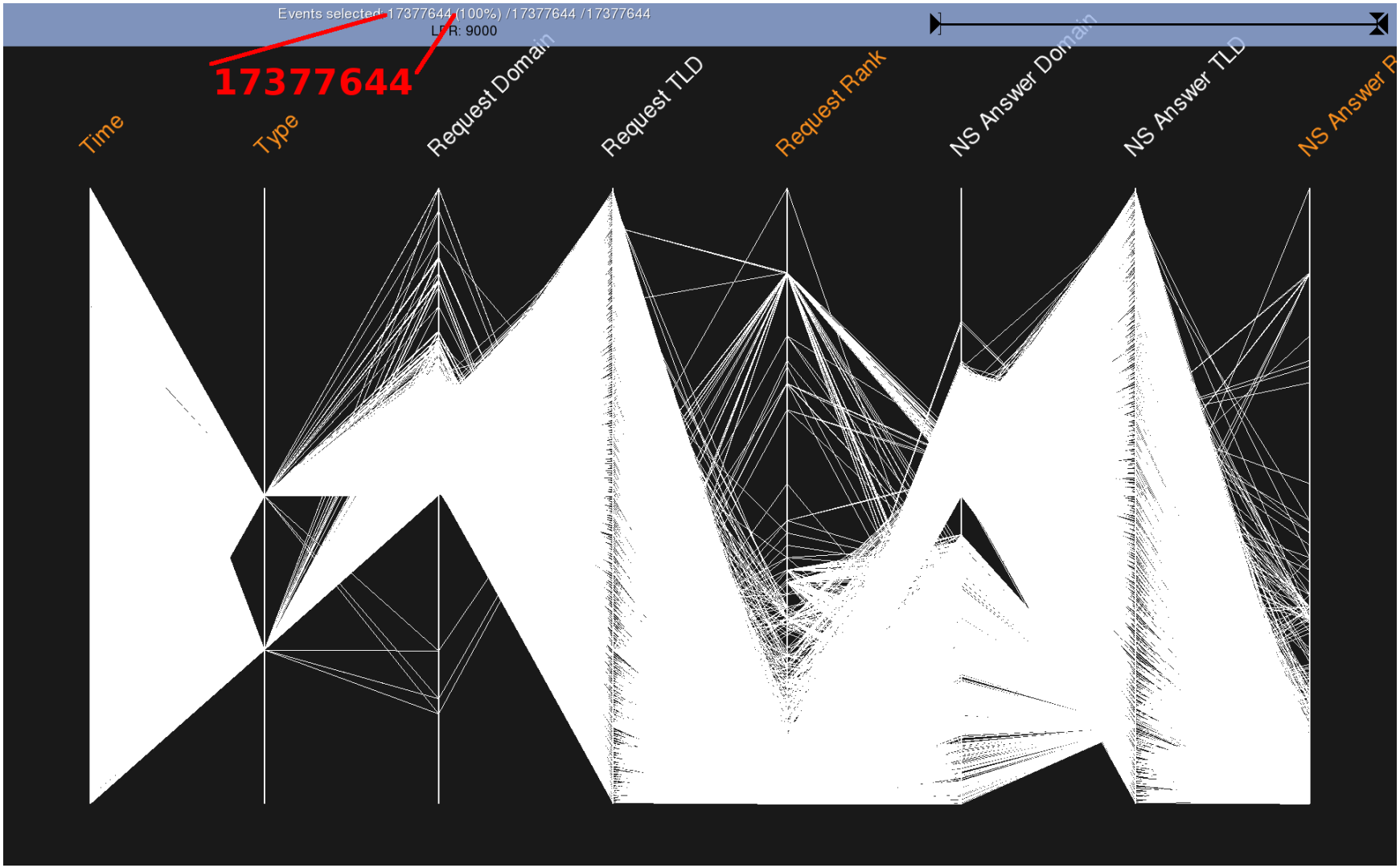
Interesting patterns



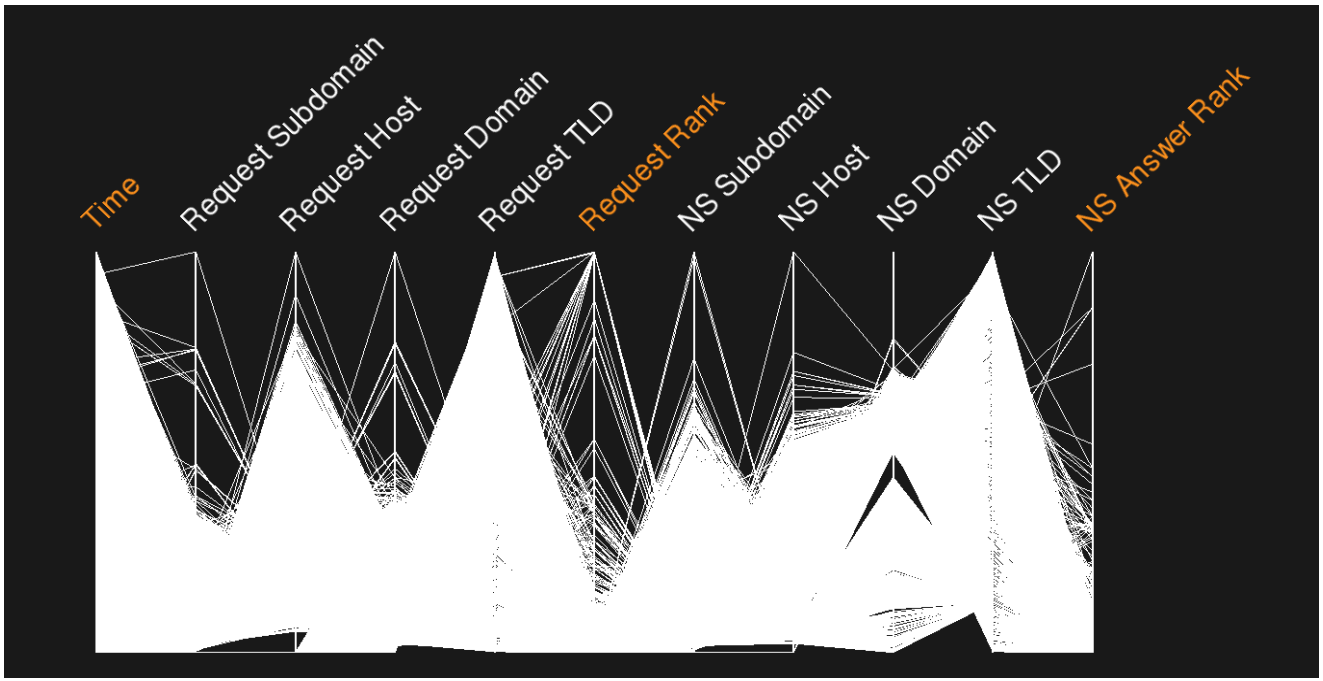




Picvizing a CIRCL passive DNS dataset



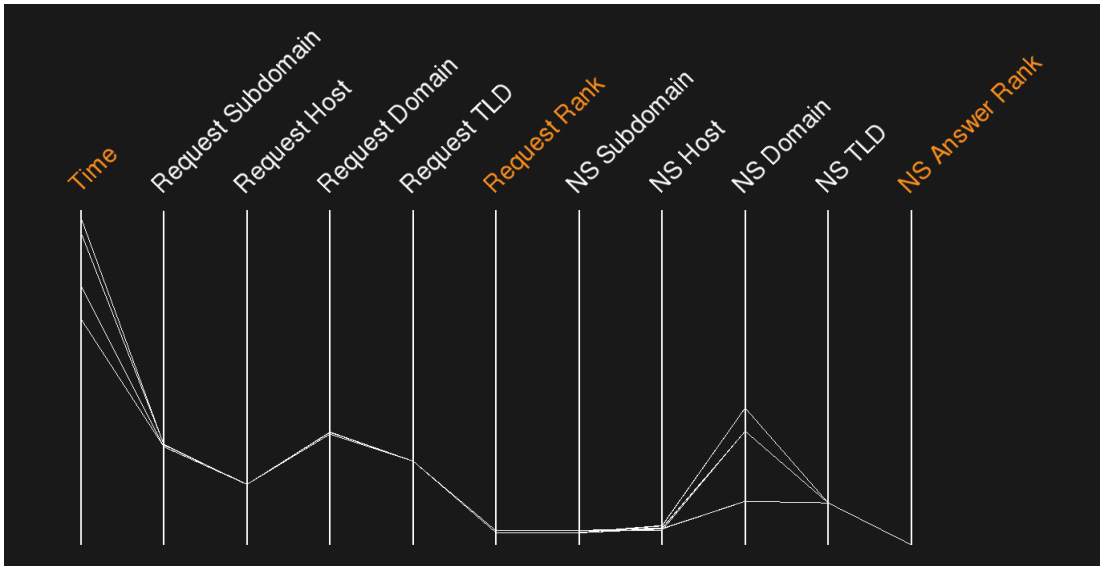
Picviz with subdomains split



Reward: highest is youtube

Subdomain entropy

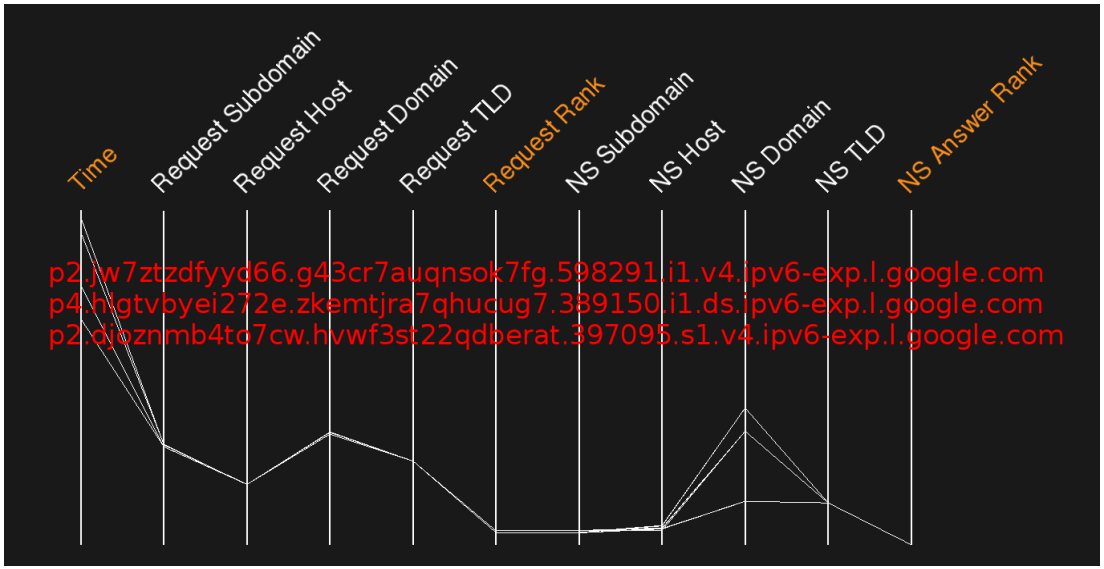
Only one sub-domain has an entropy[3] >4.8



[3] Shannon entropy

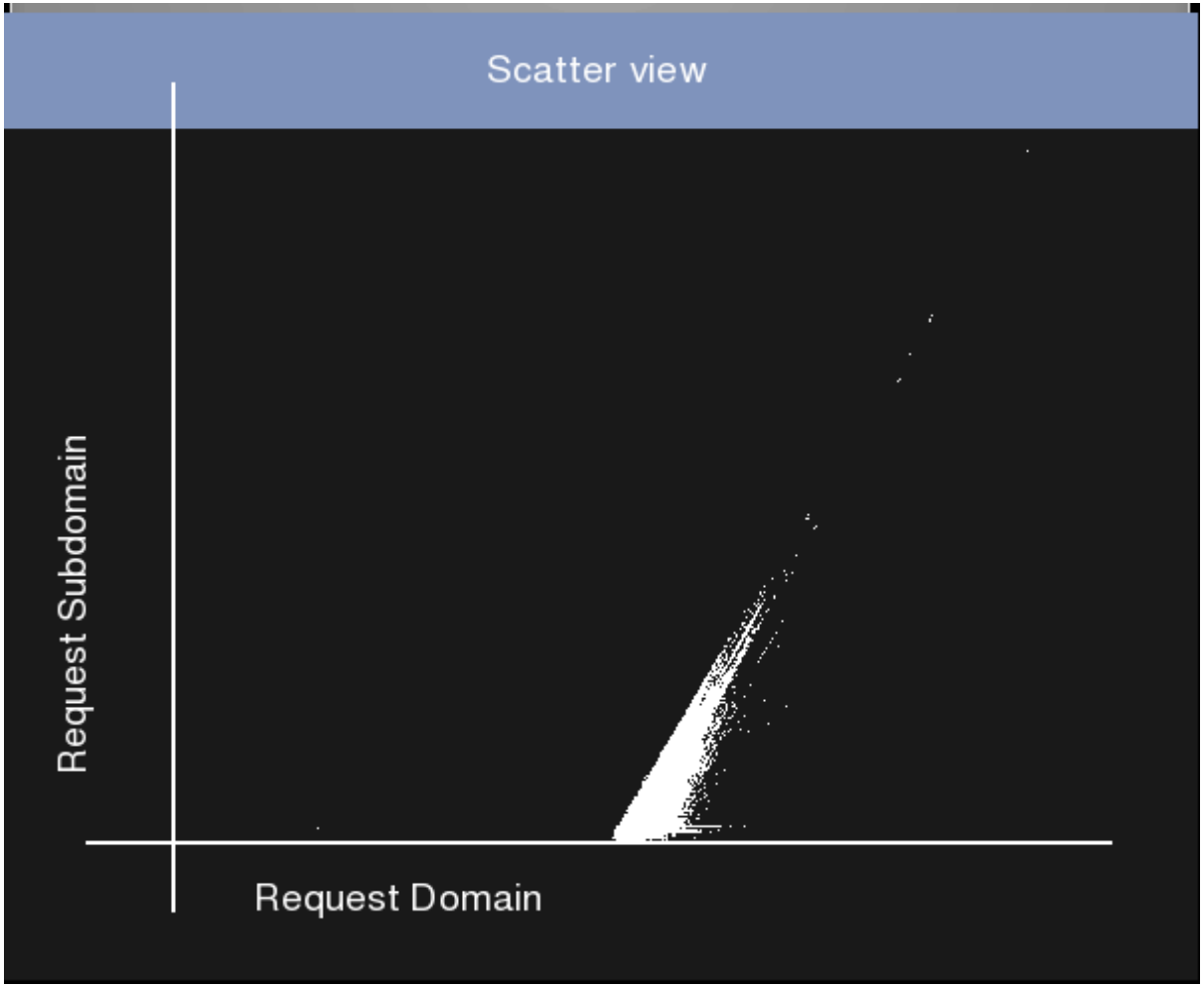
Subdomain entropy

Only one sub-domain has an entropy[4] >4.8

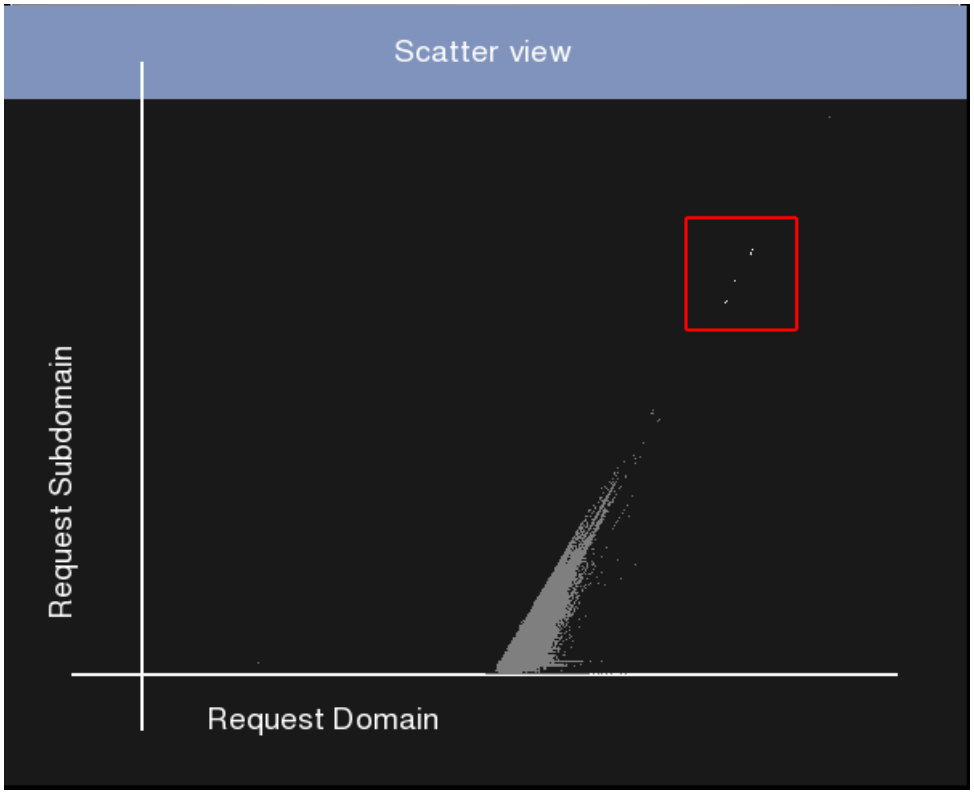


[4] Shannon entropy

Scatter plot - finding outliers



Scatter plot - finding outliers - covert channel?

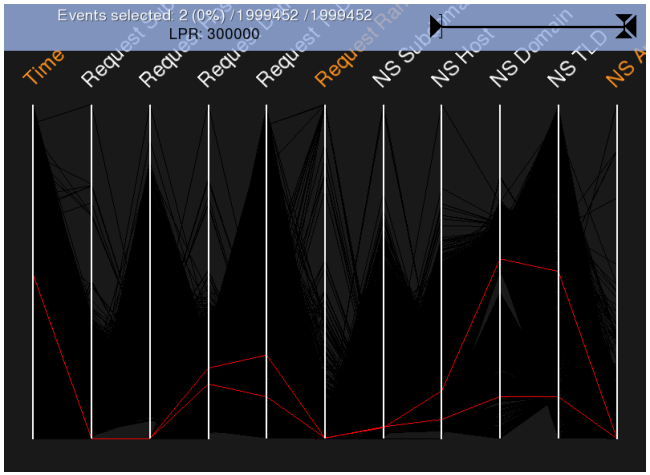


030066363663643937306531[..].36393764313333653763.lbl8.mailshell.net
t10000.u1318235395163.s203679668[..]-1329.zv6lit-null.zrdtd-1311.zr6td-null.results.potaroo.net
030030643038316639653 86[..].643065613438373465 33.lbl8.mailshell.net

Searching for Zeus

Using the broad Polish CERT regex

`[a-z0-9]{32,48}\.(ru|com|biz|info|org|net)`



- We get some cool domains:
  - cg79wo20kl92doowfn01oqpo9mdieowv5tyj.com
  - eef795a4eddaf1e7bd79212acc9dde16.net
- but more important we got a visualization profile to find outliers not matching the regexp

Conclusion

- Passive DNS is an infinite source of security data mining
- A team of passive DNS is at your services, contact us!
- (adequate) Visualization is an appropriate way to discover unknown malicious or suspicious services
- This finally helps CSIRTs to act earlier on the incidents
- Common output format for different implementations (work in progress)

Q&A

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