ICANN

Statistical Analysis of DNS Abuse in gTLDs (SADAG)

Background, Methodology, and Planned Research

SIDN and Delft U. of Technology | ICANN 58 | 10 March 20

Agenda

- Introduction from ICANN: Background of Study
- Presentation on Methodology and Planned Research from SIDN and Delft University of Technology (TU-Delft)
- Q & A

Study Background

2009

- Mitigating Malicious Conduct: New gTLD Program Explanatory Memorandum

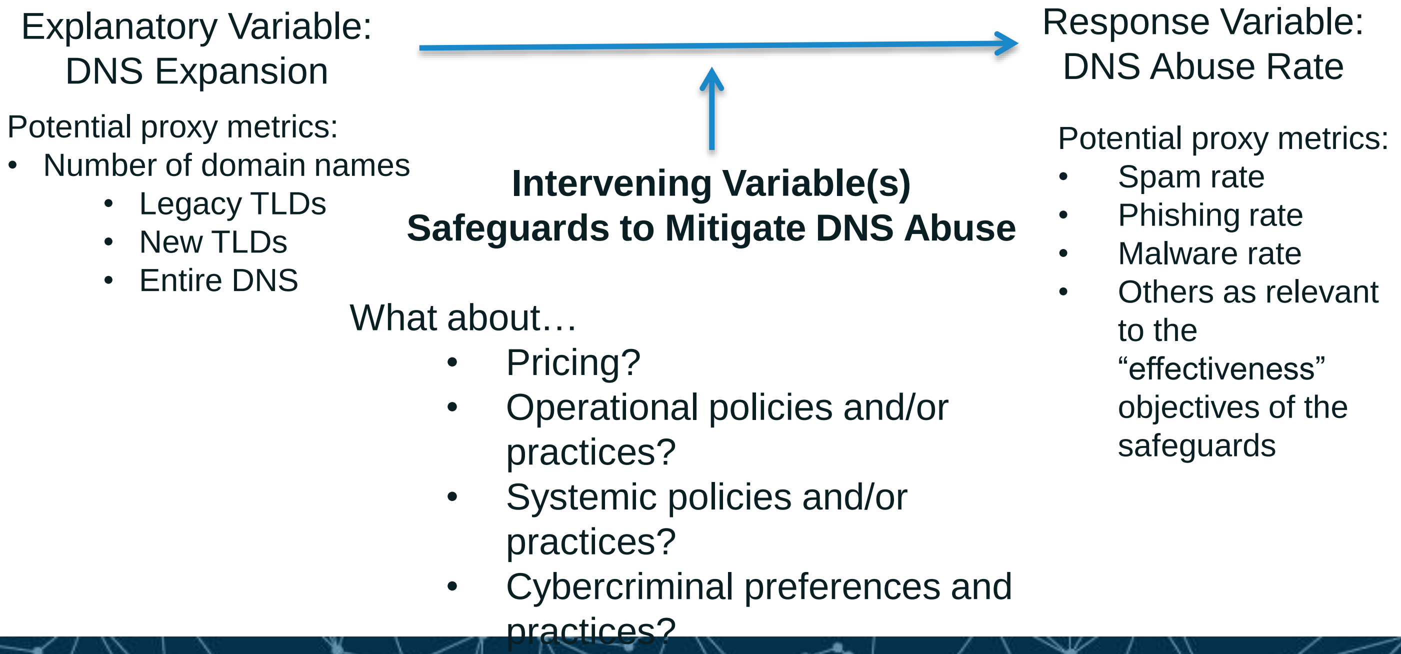
Question	Recommendation(s)
1) How do we ensure that bad actors do not run registries?	1. Vet registry operators
2) How do we ensure integrity and utility of registry information?	2. Require DNSSEC Deployment 3. Prohibit “wildcarding” 4. Encourage removal of “orphan glue” records
3) How do we ensure more focused efforts on combating identified abuse?	5. Require “Thick” WHOIS records 6. Centralize Zone File access 7. Document registry- and registrar-level abuse contacts and policies 8. Provide an expedited registry security request process
4) How do we provide an enhanced control framework for TLDs with intrinsic potential for malicious conduct?	9. Create a draft framework for a high security zone verification program

Study Background

2016

- New gTLD Program Safeguards Against DNS Abuse: Revised Report
  - Research aid to Competition, Consumer Trust, and Choice Review Team
  - How to measure effectiveness of safeguards?

Base Research Model



Explanatory Variable:
DNS Expansion

Potential proxy metrics:

- Number of domain names
  - Legacy TLDs
  - New TLDs
  - Entire DNS

Response Variable:
DNS Abuse Rate

Potential proxy metrics:

- Spam rate
- Phishing rate
- Malware rate
- Others as relevant to the "effectiveness" objectives of the safeguards

Intervening Variable(s)
Safeguards to Mitigate DNS Abuse

What about…

- Pricing?
- Operational policies and/or practices?
- Systemic policies and/or practices?
- Cybercriminal preferences and practices?

Study Background

2016 -2017

- Competition, Consumer Choice, and Trust Review Team
  - Mandated by AoC to examine "effectiveness of…safeguards put in place to mitigate issues involved in…the expansion [of the top-level domain space]"
  - Required comprehensive descriptive statistics as **baseline measure** of abuse rates in new compared to legacy gTLDs
  - CCTRT recommends ongoing measurement of abuse to answer fundamental question:

What explains the variation in abuse rates in TLDs?

- RFP issued August 2016
- SIDN contracted November 2016
- Research began December 2016
- Final report expected June 2017

Big Project!
Tight Timeframe!
Need Data!

Statistical Analysis of DNS Abuse in gTLDs (SADAG)

Methodology and Planned Research

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Project

Statistical Analysis of DNS Abuse in gTLDs (SADAG)

Consortium: SIDN and TU Delft

Requested by: Competition, Consumer Choice, and Trust Review Team

Goal

- Comprehensive statistical comparison of rates of DNS abuse in new and legacy gTLDs
  - Spam
  - Phishing
  - Malware
  - Botnet Command-and-Control

- Statistical analysis of potential relationship with abuse drivers
  - DNSSEC
  - Other drivers as identified by future Review Teams

Motivation

- New Generic Top-Level Domain (gTLD) Program enabled hundreds of new generic top-level domains
- Safeguards built into the Program intended to mitigate rates of abusive, malicious, and criminal activity in these new gTLDs

Current data providers (1)

Domain Blacklists

- Anti Phishing Working Group
  - Phishing URLs
- StopBadware
  - Malware URLs
- Secure Domain Foundation
  - Malware URLs (Command & Control, EXE, Compromised)
  - Phishing URLs
  - Highly suspect domains
  - Bad Faith domains

Current data providers (2)

WHOIS data

- Whois XML API
  - All new gTLDs
  - Subset of legacy gTLDs

Domain data

- Zone files
  - Per gTLD
  - Per day
  - 3 year period

gTLD groups

Legacy gTLDs

- E.g. .com, .org, .net, asia, .biz etc.

New gTLDs

- Part of the New gTLD program
- E.g. amsterdam, .xyz

Study component	# Legacy gTLDs	Source
TLD level aggregation	17	Zone files
Maliciously registered vs. compromised domains	9	WHOIS data
Registrar aggregation	9	WHOIS data

Data limitations

WHOIS data

- Collection method
  - No continuous scanning
  - Might be missing short-lived domains

More Data Requested!

- Abuse feeds
    - Phishing
    - Malware
    - Botnet C&C
    - Spam

- Uptimes

Security metrics

- Concentration of malicious content:
  - Number of unique domains
    - E.g. **malicious.com**

Security metrics

- Concentration of malicious content:
  - Number of unique domains
    - E.g. malicious.com
  - Number of FQDNs
    - E.g. **123.malicious.com**, **456.malicious.com**, **789.malicious.com, (…)**

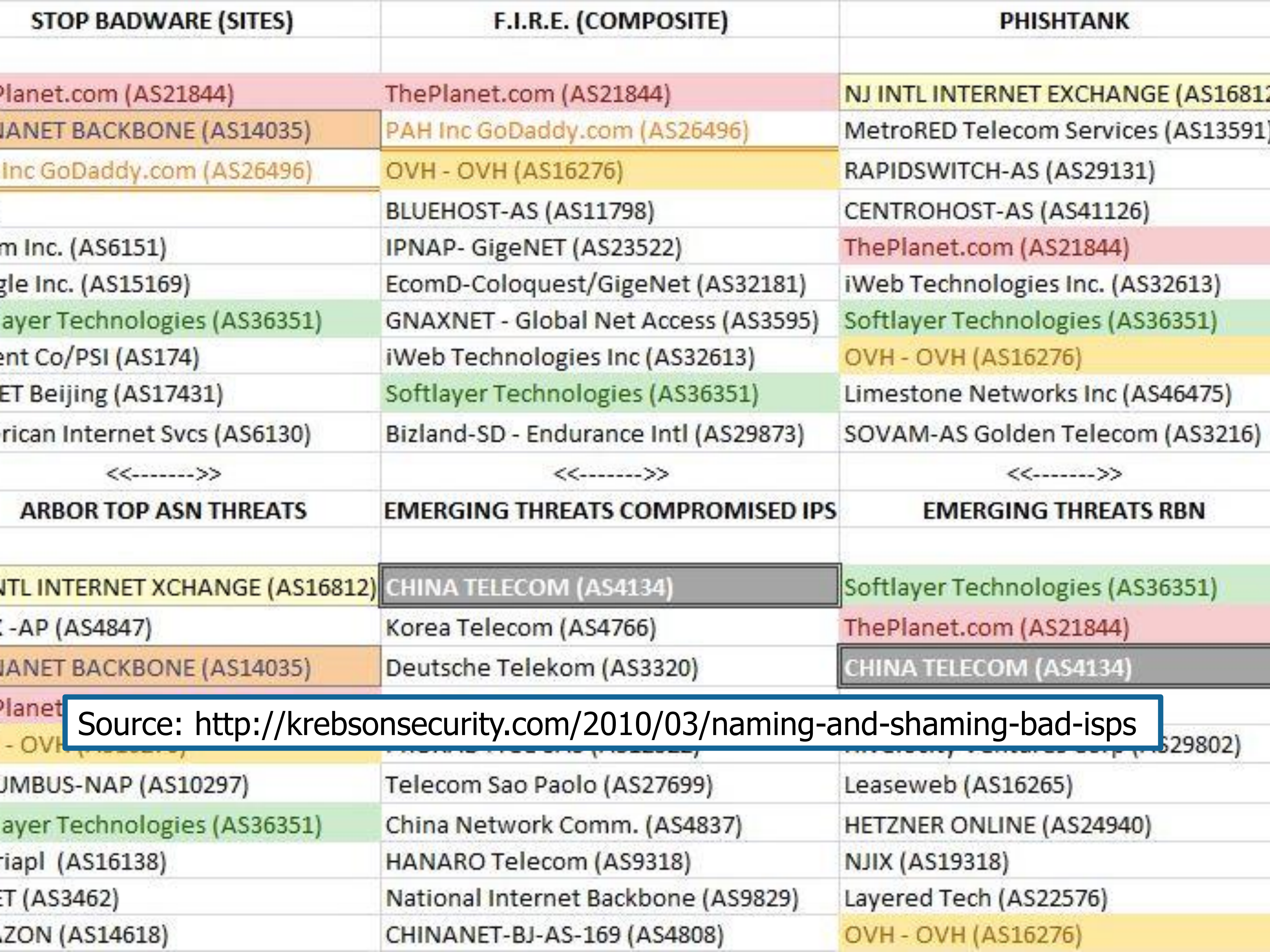
Security metrics

– Concentration of malicious content:

- Number of unique domains
  - E.g. malicious.com

- Number of FQDNs
  - E.g. 123.malicious.com, 456.malicious.com, 789.malicious.com, (…)

- Number of URLs
  - E.g. **malicious.com/wp-content/file.php**, **malicious.com/wp-content/gate.php**, **(…)**



STOP BADWARE (SITES)	F.I.R.E. (COMPOSITE)	PHISHTANK
Planet.com (AS21844)	ThePlanet.com (AS21844)	NJ INTL INTERNET EXCHANGE (AS1681
IANET BACKBONE (AS14035)	PAH Inc GoDaddy.com (AS26496)	MetroRED Telecom Services (AS13591)
Inc GoDaddy.com (AS26496)	OVH - OVH (AS16276)	RAPIDSWITCH-AS (AS29131)
	BLUEHOST-AS (AS11798)	CENTROHOST-AS (AS41126)
m Inc. (AS6151)	IPNAP- GigeNET (AS23522)	ThePlanet.com (AS21844)
gle Inc. (AS15169)	EcomD-Coloquest/GigeNet (AS32181)	iWeb Technologies Inc. (AS32613)
ayer Technologies (AS36351)	GNAXNET - Global Net Access (AS3595)	Softlayer Technologies (AS36351)
ent Co/PSI (AS174)	iWeb Technologies Inc (AS32613)	OVH - OVH (AS16276)
ET Beijing (AS17431)	Softlayer Technologies (AS36351)	Limestone Networks Inc (AS46475)
rican Internet Svcs (AS6130)	Bizland-SD - Endurance Intl (AS29873)	SOVAM-AS Golden Telecom (AS3216)
<<------->>	<<------->>	<<------->>
ARBOR TOP ASN THREATS	**EMERGING THREATS COMPROMISED IPS**	**EMERGING THREATS RBN**
NTL INTERNET XCHANGE (AS16812)	CHINA TELECOM (AS4134)	Softlayer Technologies (AS36351)
-AP (AS4847)	Korea Telecom (AS4766)	ThePlanet.com (AS21844)
IANET BACKBONE (AS14035)	Deutsche Telekom (AS3320)	CHINA TELECOM (AS4134)
Planet		
- OVH		29802)
UMBUS-NAP (AS10297)	Telecom Sao Paolo (AS27699)	Leaseweb (AS16265)
ayer Technologies (AS36351)	China Network Comm. (AS4837)	HETZNER ONLINE (AS24940)
riapl (AS16138)	HANARO Telecom (AS9318)	NJIX (AS19318)
ET (AS3462)	National Internet Backbone (AS9829)	Layered Tech (AS22576)
ZON (AS14618)	CHINANET-BJ-AS-169 (AS4808)	OVH - OVH (AS16276)

Source: http://krebsonsecurity.com/2010/03/naming-and-shaming-bad-isps

Security metrics

Size matters!

Size estimates

- Size of a TLD can be used as an explanatory factor for the concentrations of abused domains

- Size of a TLD could be interpreted as the “attack surface” size for cybercriminals.

- Number of 2nd–level domains registered in each gTLD (zone files)

- Limitation: There is a large portion of domains in new gTLDs with NS records that do not resolve yet
  - Solution: active measurement to determine domains in use per gTLD

Size estimates

- Number of 2nd–level domains registered in each registrar (WHOIS data)

- Limitation: single entity can have multiple different names, e.g. , we found a registrar using 52 distinct name variations
  - Solution: an additional entity resolution step to try to group together the different names of a single registrar (58% reduction)

- Limitation: missing WHOIS data

Compromised versus maliciously registered domains

– Definitions:

  - Maliciously registered domain – domain registered by a miscreant for malicious purposes
  - Compromised domain – domain registered by a legitimate user and hacked by a miscreant
  - Third party domains – domains of legitimate services that tend to be misused by miscreants (e.g. file sharing services, blog post services, URL shortening services)

– For compromised domains, the TLD size could be interpreted as the "attack surface" size for cybercriminals.

– For malicious registrations, the TLD size could serve as a proxy for the "popularity" of the TLD. What makes it popular?

Distinguishing between compromised and maliciously registered domains

- Distinguishing between compromised and maliciously registered domains is critical because they require different mitigation actions by different intermediaries
- Assumption: maliciously registered domains are involved in a criminal activity within a short time after the registration
- Limitation: (lack of) WHOIS data, maliciously registered domains involved in a criminal activity within a longer time after the registration, or delayed blacklisting
  - Solution: more advanced machine learning approach (requires more “features” and the “ground truth” data)

Future work

- Incorporate more blacklist feeds

- Analyze abuse per:
  - Reseller
  - Privacy / proxy service (if data available)
  - Geographic region

- Analysis of the time-to-live of domain names
  - Requires uptime data

- Inferential analysis of potential relationship with abuse drivers

Schedule

- Final report available early June 2017

Questions?