Characterizing and Mitigating Phishing Attacks at ccTLD Scale

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5: .IE Registry **6**: University of Twente **7**: University of Grenoble Alps

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Outline

Phishing is a major threat on the Internet

- FBI: 300k complaints, US$160 million in losses in 2022 [1]
- One of most important cyber threats for national security – EU ENISA, US CISA [2, 3]
- Phishing deceive users to provide private data

Phishing at Three ccTLDs

1. First time 3 ccTLDs come together to analyze phishing:
   -  The Netherlands' `.nl` (SIDN)
   -  Ireland's `.ie` (.IE Registry)
   -  Belgium's `.be` (DNSBelgium)
2. Longitudinal study (10 years)
3. Complete view of the zones
   - ccTLD registries are responsible for running their countries' zone

Expanding phishing characterization with full zone view:

	Previous Works	Ours
Time	1 year	4–10 years
Companies	10	1233
Domains	1.4k	28.7k

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ccTLDs compared

ccTLD	.nl	.ie	.be
# Domains	6.1M	330.1k	1.7M
Reg. Policy	Open	Restricted	Open
Country Population	17.5M	4.9M	11.5M

Table 1: ccTLDs overview.

- Restricted registration : check Irish ID, passport, or business in Ireland
- Open registration ( ): anyone can register a domain

Datasets: Phishing blocklist

	 .nl	 .ie	 .be
Domains	25,389	555	2,810
Period	∼10 years	∼4 years	∼4 years
Years	2013–2023	2019–2023	2019–2023

Table 2: Netcraft phishing blocklist dataset

We triangulate the blocklist dataset with ccTLDs' private datasets:

- historical registration database
- Web measurements
- DNS measurements

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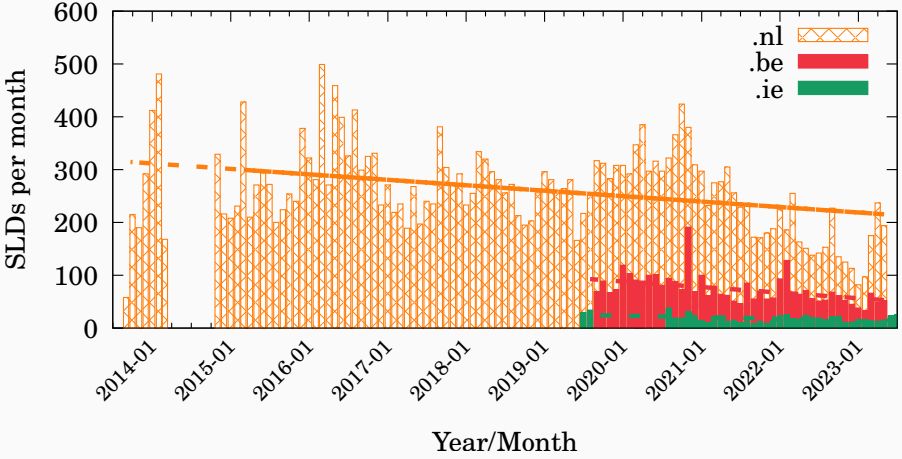
Phishing domains per month

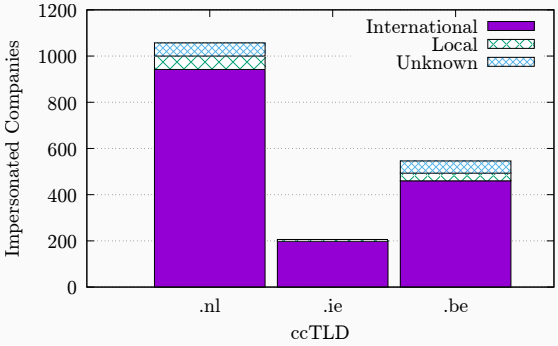


SLD: Second-level domain (`example.nl`)

Outline

Do they target mostly national companies?

- Citizens have trust in their ccTLDs
  - Govs use it
- Do attackers exploit this trust for phishing?



- Most impersonated companies are **International**
- So most attackers **do not seem to care which TLD they use.**
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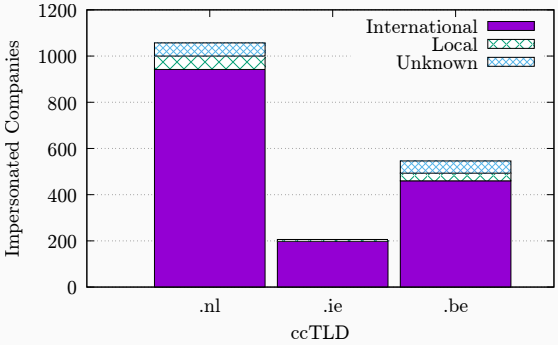

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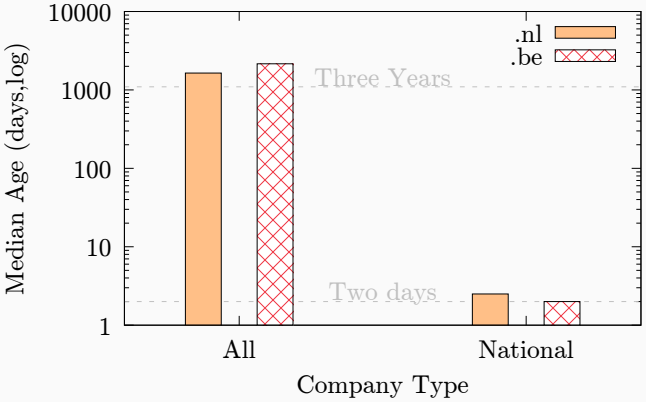
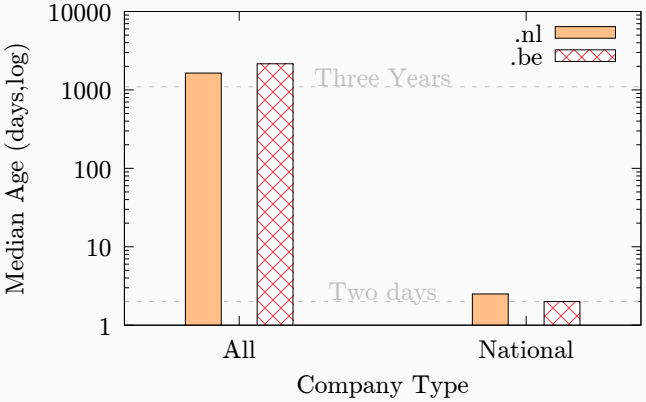
National companies vs International Companies



We see a pattern:

1. **International** companies impersonated with old domains
2. **National** companies impersonated with new domains

National companies vs International Companies



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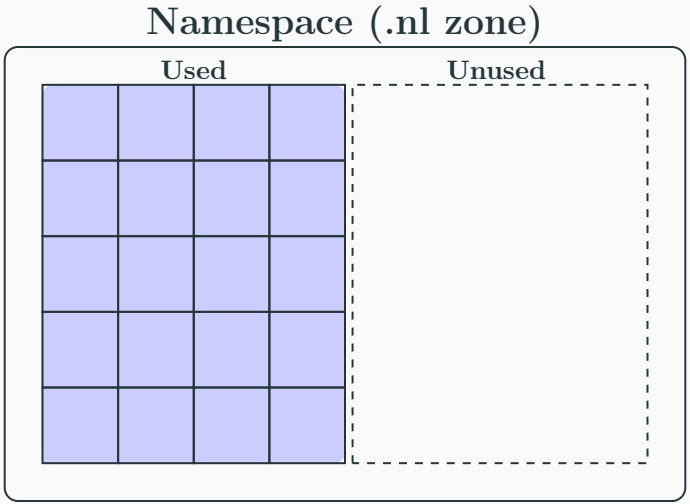
Two Attack Strategies



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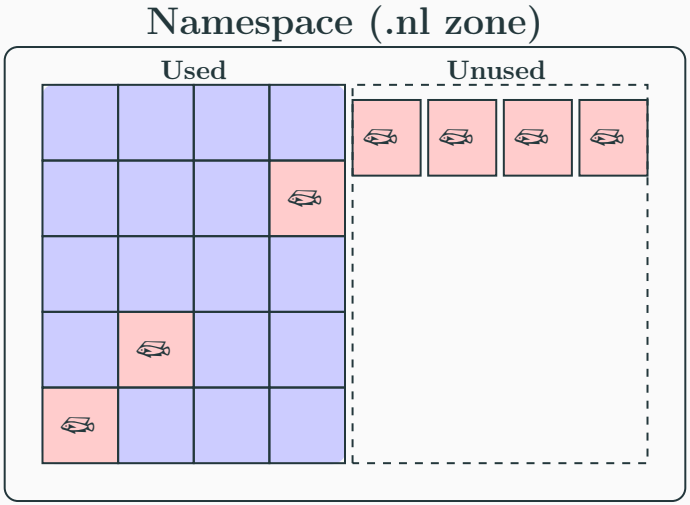

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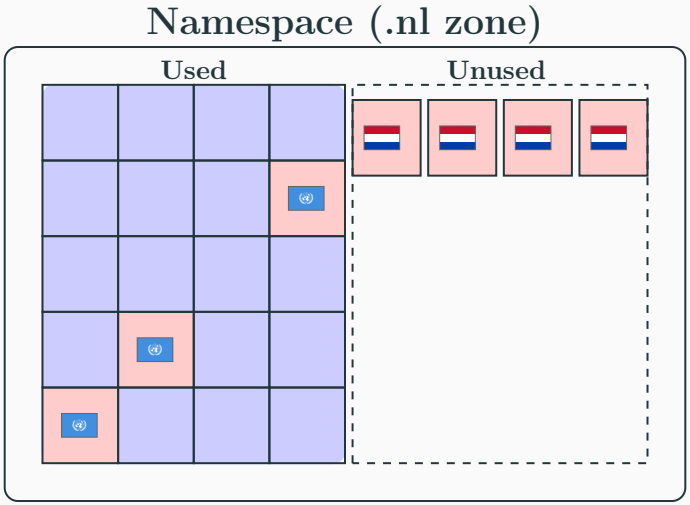
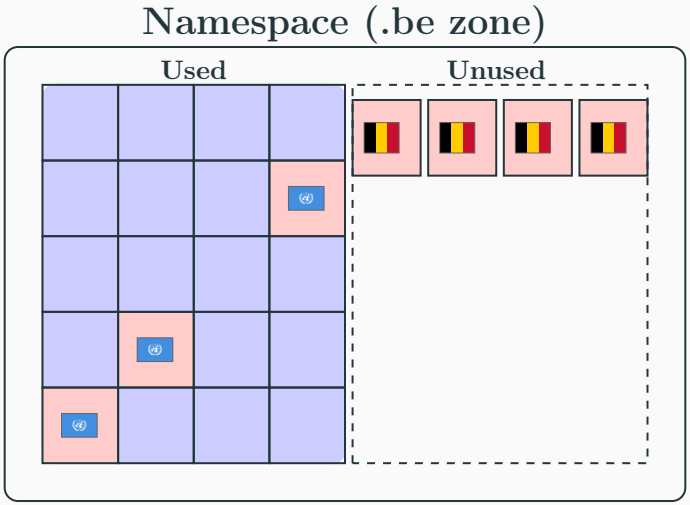


Same for .be



Two Attack Strategies

Target	ING bank	Apple
Domain	`activate-creditcard.nl`	`pastries-AMS.nl`
Domain Type	New	Old (compromised)
Costs	✓ Reg, DNS, Hosting	✗ Free
Likely attacker	“Local”	“International”
Share	20%	80%

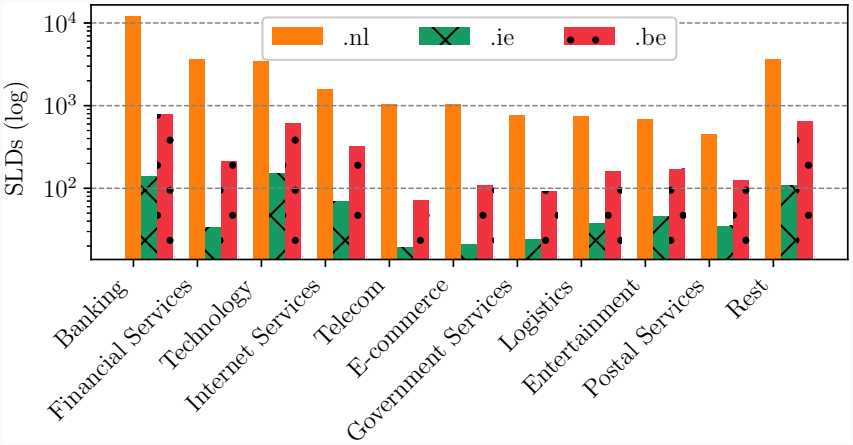
Table 3: Local and International attack strategies

Top 10 impersonated companies (.nl zone)

Rank	Company	Domains	Median Age (days)
1	Microsoft	2,319	2,251
2	PayPal	2,134	1,751
3	ING	1,815	1
4	ICS	1,410	2
5	Apple	1,276	1,775
6	ABN AMRO	1,259	1
7	Google	1,236	1,416
8	Rabobank	1,222	1
9	Webmail Users	1,054	2,247
10	Netflix	756	1,653

Top 10 impersonated companies in phishing attacks on the .nl zone ().

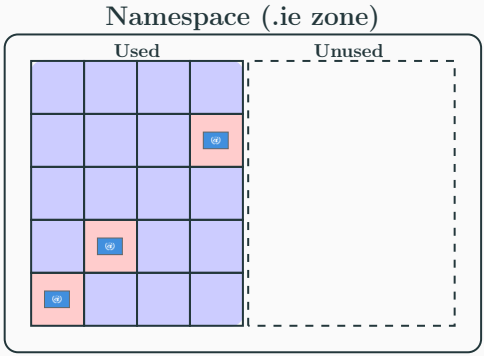
Most Popular Market Segments



But what about Ireland?

Only two new phishing domains

- `.ie` = restricted registration policy
- Restricted policy prevents part of the phishing attacks
  - But cannot prevent compromised domain names

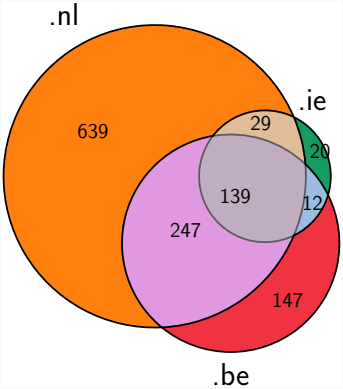


Outline

Impersonated companies per ccTLD

139 companies found in the 3 ccTLDS

- Microsoft
- Apple
- Google
- FeDex
- Banco Santander
- Maersk
- Full list in [4]
  - extended version of the paper

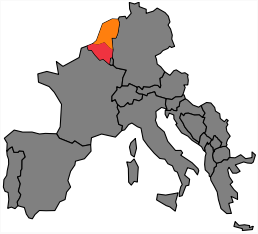


Venn diagram of impersonated companies.

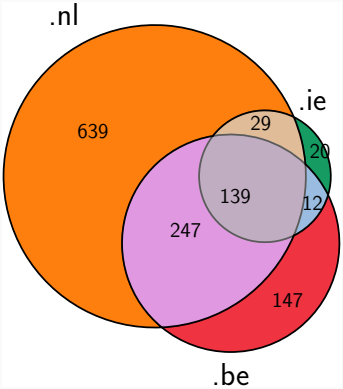
Impersonated companies per ccTLD

247 companies found in `.nl` and `.be`

- Many companies operate in both countries
- Cultural, language, and economic ties



- Rest intersections in paper



Venn diagram of impersonated companies.

Outline

From characterization to Mitigation

- Phishing mitigation ***is not*** a single event
- Different parties can mitigate it independently
  - registrant (example.nl) → Registrar (GoDaddy) → Registry (SIDN)

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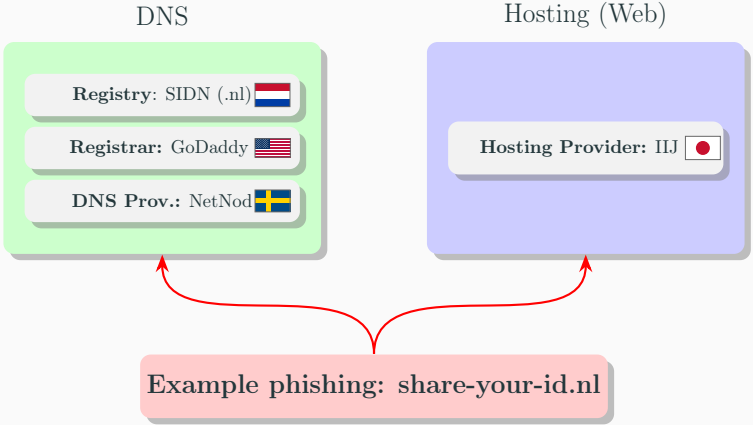
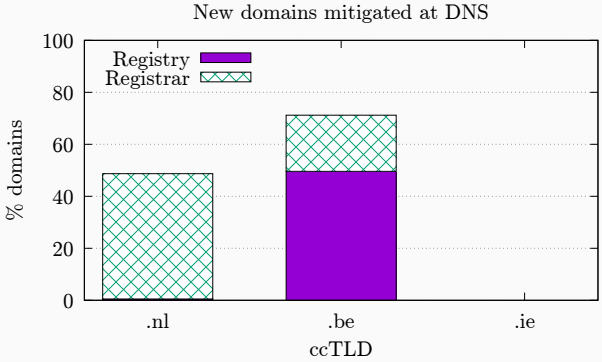
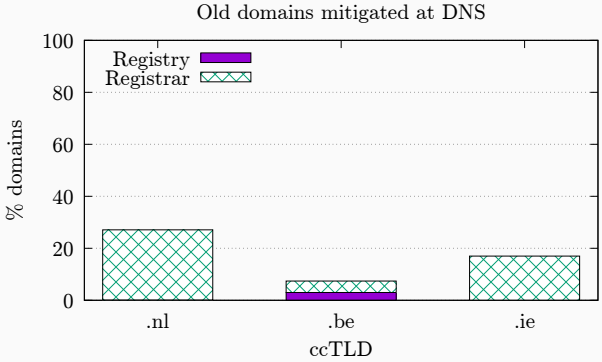


DNS mitigation and ccTLD policy: new domains



- `.be` suspend new domains ASAP
- `.nl` notifies registrars, hosting who take action
- Rest is mitigated at Web level

Phishing Mitigation at DNS: Old Domains



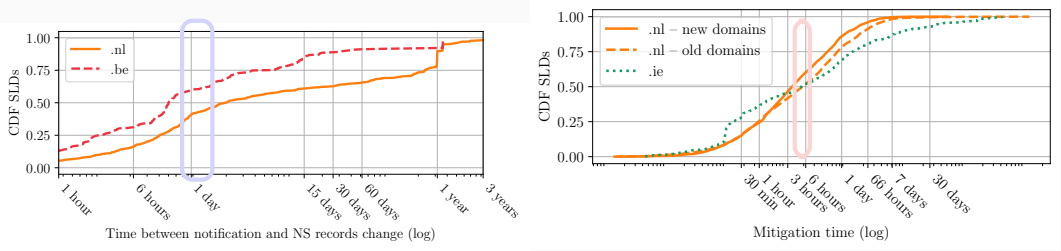
- Most old domains are compromised
  - Web mitigation is preferred
- Exceptions: aged domains

DNS vs Web Mitigation speed

Web mitigation is faster than DNS mitigation

DNS: 50–60% first 24h

Web: 50–60% first 6h



(a) DNS mitigation: Domain suspension

(b) Web mitigation

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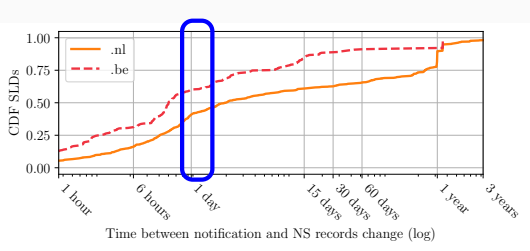
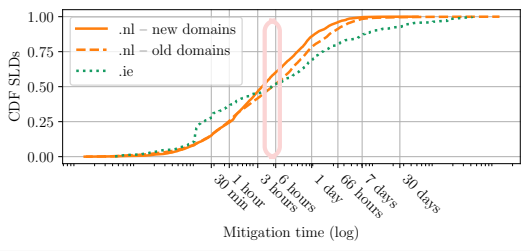


(c) DNS mitigation: Domain suspension



(d) Web mitigation

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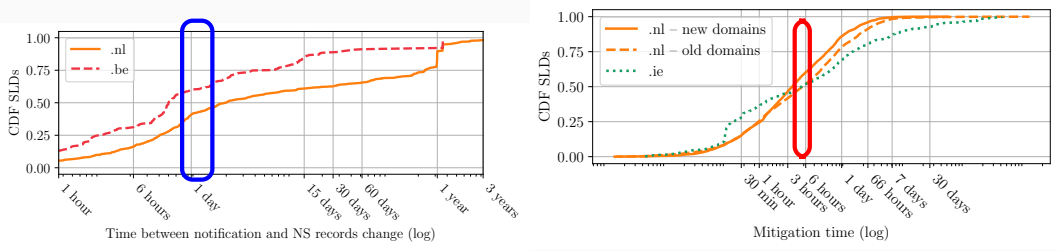

(e) DNS mitigation: Domain suspension

(f) Web mitigation

Outline

Call for Action

1. More research on compromised domains
   - Most phishing is compromised (80%)
   - Most research focuses on new domains
2. Revisit registration and abuse policies for registries
   - Registries discussing results internally

Summary

Three EU ccTLDs on the largest phishing characterization study

1. Two main attacker types:
   - National companies → new domains
   - Intl' → old, compromised domains
2. Policy impact on mitigation:
   - `.ie`'s restricted registration prevents new phishing domains
   - `.be` registry does most of DNS mitigation.
   - `.nl`'s registrars do most of DNS mitigation
3. Call for action on compromised domains

Real phishing victims in the Netherlands go on the record
Source: NOS.nl

References i

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[4] Giovane C. M. Moura, Thomas Daniels, Maarten Bosteels, Sebastian Castro, Moritz Müller, Thymen Wabeke, Thijs van den Hout, Maclej Korczyński, and G. Smaragdakis.
***Characterizing and Mitigating Phishing Attacks at ccTLD Scale (extended)*, volume EWI-TR-2024-1.**

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