INFERMAL: Inferential Analysis of Maliciously Registered Domains

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Exposing the Roots of DNS Abuse: A Data-Driven Analysis of Key Factors Behind Phishing Domain Registrations

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ACM CCS'25 - upcoming

Motivation

- Cybercriminals exploit domains for: phishing, malware, spam, botnets
- Constantly register new domains to fuel attacks
- Prior studies show **high abuse** in specific registrars and TLDs
- No comprehensive research on **factors influencing** malicious registrations

Goal

- Investigate domain abuse from the **attacker's perspective**
- Identify factors driving malicious domain registrations

Approach – overview

- Scope: Maliciously registered phishing domains

- Features: 73 features encompassing three latent factors:
  1. Registration attributes
  2. Proactive verification
  3. Reactive security practices

- GLM regression analysis:
  1. Relationship between features and the concentration of phishing domains at the registrar-TLD level
  2. Features are favored by attackers alone or also by legitimate users

Datasets

- Phishing: APWG, PhishTank, OpenPhish
- Benign domain names: ICANN CZDS, Google CT logs, etc.
- Features:
  1. TLD-List (e.g., domain registration costs, discounts, free features) *
  2. Manually collected data (e.g., free API, API create user account, API register domain, restrictions)
  3. Active measurements (uptimes)

- Active WHOIS and DNS measurements

* https://tld-list.com/

Maliciously registered phishing and benign domains

- 534 K bloclisted URLs (Aug 2023 – Jan 2024)
- **108 K** domain names

- Excluding domains of benign services
- Active measurements (DNS, WHOIS) over one month to verify if the takedown occurred
- **28 K** registered maliciously

- Mapping between domains and daily-collected registration features
- **14 K** maliciously registered (165 TLDs, 31 registrars)

- Benign dataset of 15.4 K domains under 259 TLDs originating from 38 registrars

Rank	Registrar	TLD	#Domains
1.	NameSilo	`top`	1,807
2.	NameSilo	`com`	852
3.	GoDaddy	`com`	832
4.	Hostinger	`online`	764
5.	NameSilo	`info`	513
6.	Hostinger	`com`	479
7.	Namecheap	`com`	479
8.	Alibaba Cloud	`com`	327
9.	NameSilo	`xyz`	233
10.	Hostinger	`cloud`	225
11.	NameSilo	`buzz`	222
12.	Sav	`com`	211
13.	Alibaba Cloud	`shop`	197
14.	NameSilo	`us`	191
15.	Hostinger	`site`	179
16.	NameSilo	`life`	178
17.	NameSilo	`sbs`	171
18.	Hostinger	`shop`	156
19.	NameSilo	`cc`	149
20.	Alibaba Cloud	`top`	148

20 most frequently observed registrar/TLD pairs in our dataset of maliciously registered domain names

Selected features

1. Registration attributes

   - **Free API**: the registrar APIs enable users to search, purchase, and manage domains
   - **Free bulk search**: the capability to search domains in bulk
   - **Available payment methods**: 24 boolean features for each payment method, including PayPal, Bitcoin, etc.
   - **Retail pricing:** domain name registration prices
   - **Discounts:** deducting a fixed amount or % from the regular price
   - **Pricing terms:** might apply only to a limited number of domains or new customers
   - **Free web hosting, free DNS, free email account:** included for free in each domain registration

Selected features

2. Proactive verification

- **Operational validation of the registrant contact details**: Test whether contact details (email/phone) are verified during account creation or before domain purchase.

- **Domain registration warnings and restrictions**: three labels defined:
    i. `9e86e6d5d4c676441da` (the first 20 characters of the MD5hash of "DNS abuse"),
    ii. `office365-my-account`
    iii. `facebook-login-page`

  For each registrar-TLD pair, we proceed to the payment prompt.

- **Registration restrictions**: 14 boolean features, e.g., local presence required, ID required, professionals only

Selected features

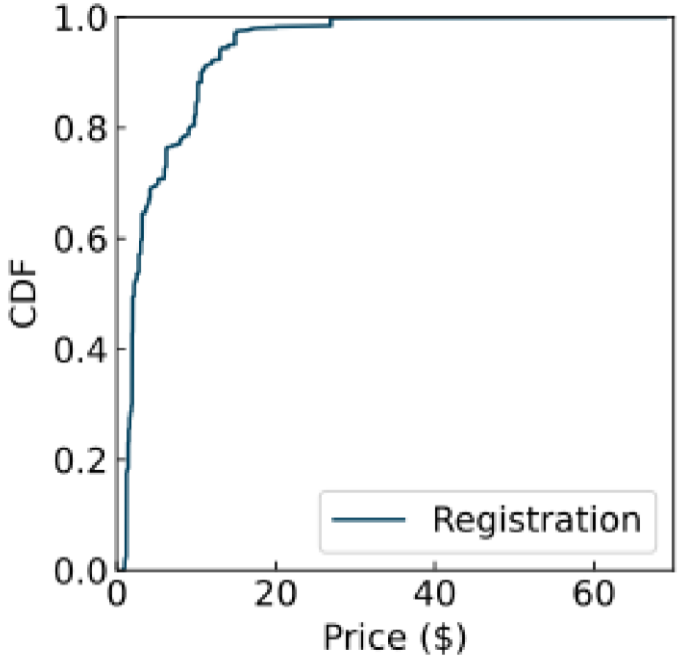
3. Reactive security practices: malicious domain name uptimes (with and without notifications)

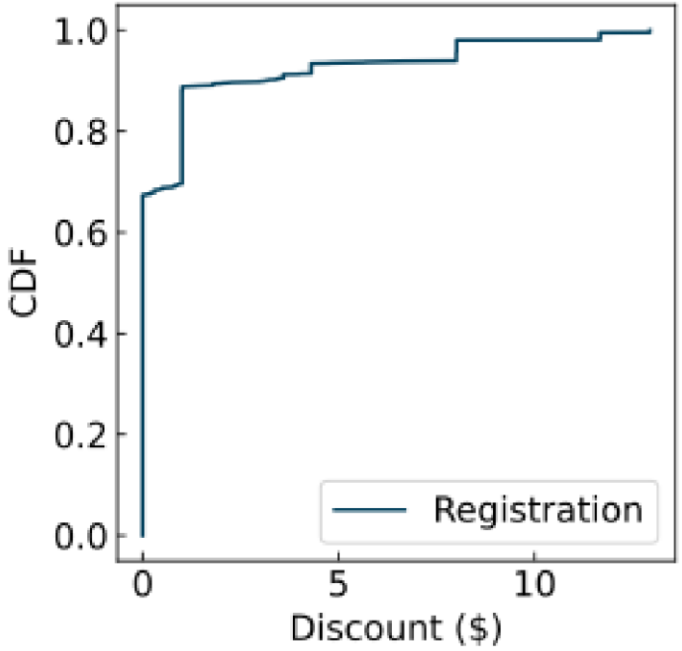
   - WHOIS/DNS measurements
   - 5 minutes, 15 m, 30 m, 1 hour, 2 h, 3 h, 4 h, 5 h, 6 h, 12 h, 24 h, 36 h, and 48 h after blocklisting, and then every 12 hours
   - for a subset of maliciously registered domain names, notifications are sent to registrars

Descriptive Analysis of Features

Prices and discounts: Registration

- Prices range from $0.78 to $69, with nearly 50% costing $2 or less

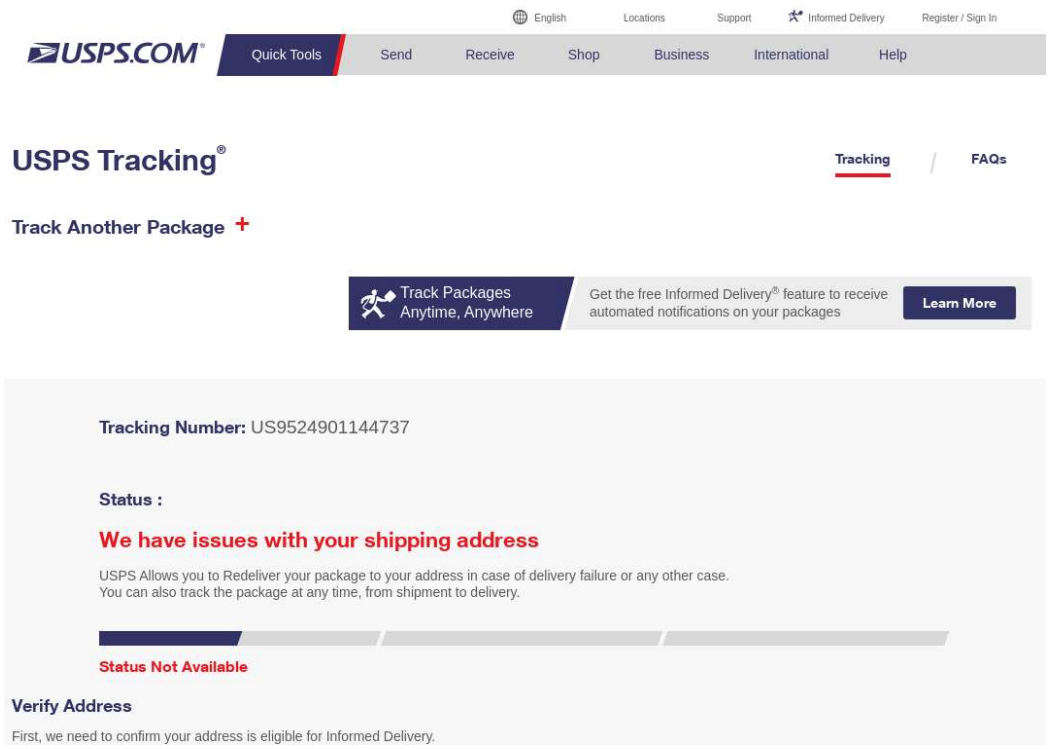




Descriptive Analysis of Features

Prices and discounts: Registration

- Examples of expensive domains include usps.bar ($69), support-fb.sh ($59.99), and dhlcenter.net ($56)



Descriptive Analysis of Features

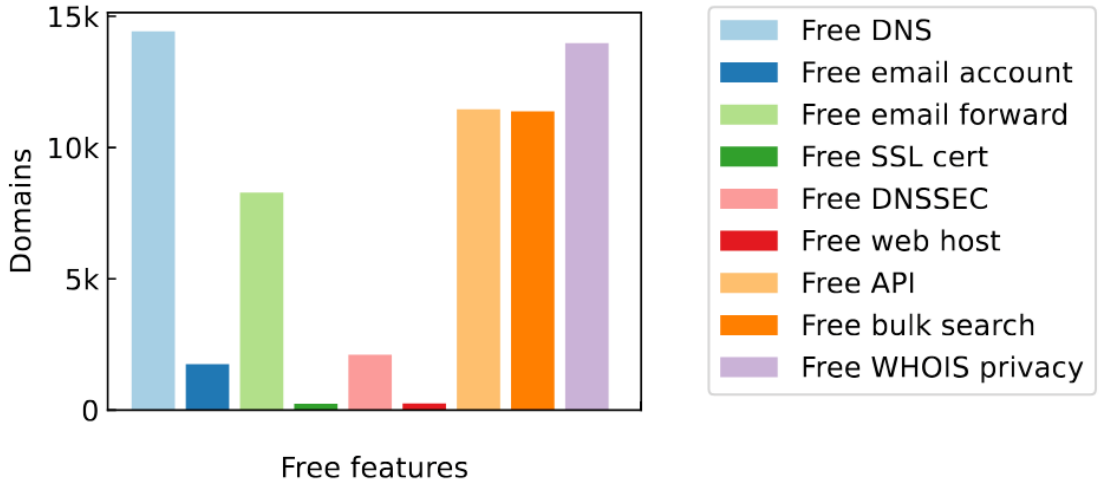
Registration prices and discounts:

- Registration prices may be subject to various terms (e.g., 4,423, reduced registration prices were valid for one domain), discounts to new customers only

Descriptive Analysis of Features

Free features

- A free API is offered by 16 of the 31 registrars we examined
- Four registrars permit the automated account creation (e.g., as a subaccount under an existing API user)
- 18 registrars offer a "bulk search" to check availability and prices for 20 to 10 K+



Driving Factors of Domain Abuse

Model 1: Relationship between features and the concentration of phishing domains at the **registrar-TLD** level

Driver	Type	Correlation with abuse counts	Increase
Retail registration price	Numerical	Weak positive	1$↓ (6.6%↑)
Retail registration discounts	Numerical	Positive	1$↓ (49%↑)
Cryptocurrency payment(s) available	Boolean	Positive	30%
APIs to register domains or to create accounts available	Boolean	Strong positive	401%

Economic Incentives

Discounts: Attaches are more price sensitive, Mean price of benign domains ($8.62) is higher compared to $4.71 of malicious ones

What about Benign Domains?

Role of Free Services

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Account creation and Management

Role of Free Services

these bundled features are attractive to both malicious and legitimate users.

Driver	Correlation with abuse counts	Correlation with abuse counts	Increase
Free DNS service	Boolean	Positive	205%
Free hosting service	Boolean	Positive	88%
Presence of restrictions (e.g., commitment required, local presence, professionals only)	Boolean	Negative	63%
Validation of email/phone present	Boolean	Negative	70%
Shorter uptimes	Numerical	Statistically significant but negligible correlation	~0%

Proactive Upfront Checks

Driver	Correlation with abuse counts	Correlation with abuse counts	Increase
Free DNS service	Boolean	Positive	205%
Free hosting service	Boolean	Positive	88%
Presence of restrictions (e.g., commitment required, local presence, professionals only)	Boolean	Negative	63%
Validation of email/phone present	Boolean	Negative	70%
Shorter uptimes	Numerical	Statistically significant but negligible correlation	~0%

Stringent registration restrictions (e.g., local presence, ID required, content restrictions, etc.) 62 less abuse, while legitimate registrants, faced with a more rigorous process, are less likely to choose less restrictive registrars.

Discussion and Considerations

- Key factors driving malicious domain registrations from the **attacker's perspective**.

- Results should be interpreted with caution and may or may not be generalized into actions by registrars or TLDs.

- Some factors are combined and involve a variety of features.

- 401%? Come from a statistical model that looks at many factors at once. That 401% figure doesn't exist in isolation; it reflects the impact of offering an API *while holding all the other factors in the model constant*. If you added or removed other factors from the model, the number would change.

Discussion and Considerations

- Variables that are used in this study are combined: registration restrictions or the consolidation of payment methods into three categories—cryptocurrency, bank transfer, and digital wallets.

- Consider the economic implications, the impact on legitimate users, and the likely response of attackers to adjustments, the result of partial/full implementation.

Contact information

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Questions