Compromised or Attacker-Owned: A Large Scale Classification and Study of Hosting Domains of Malicious URLs

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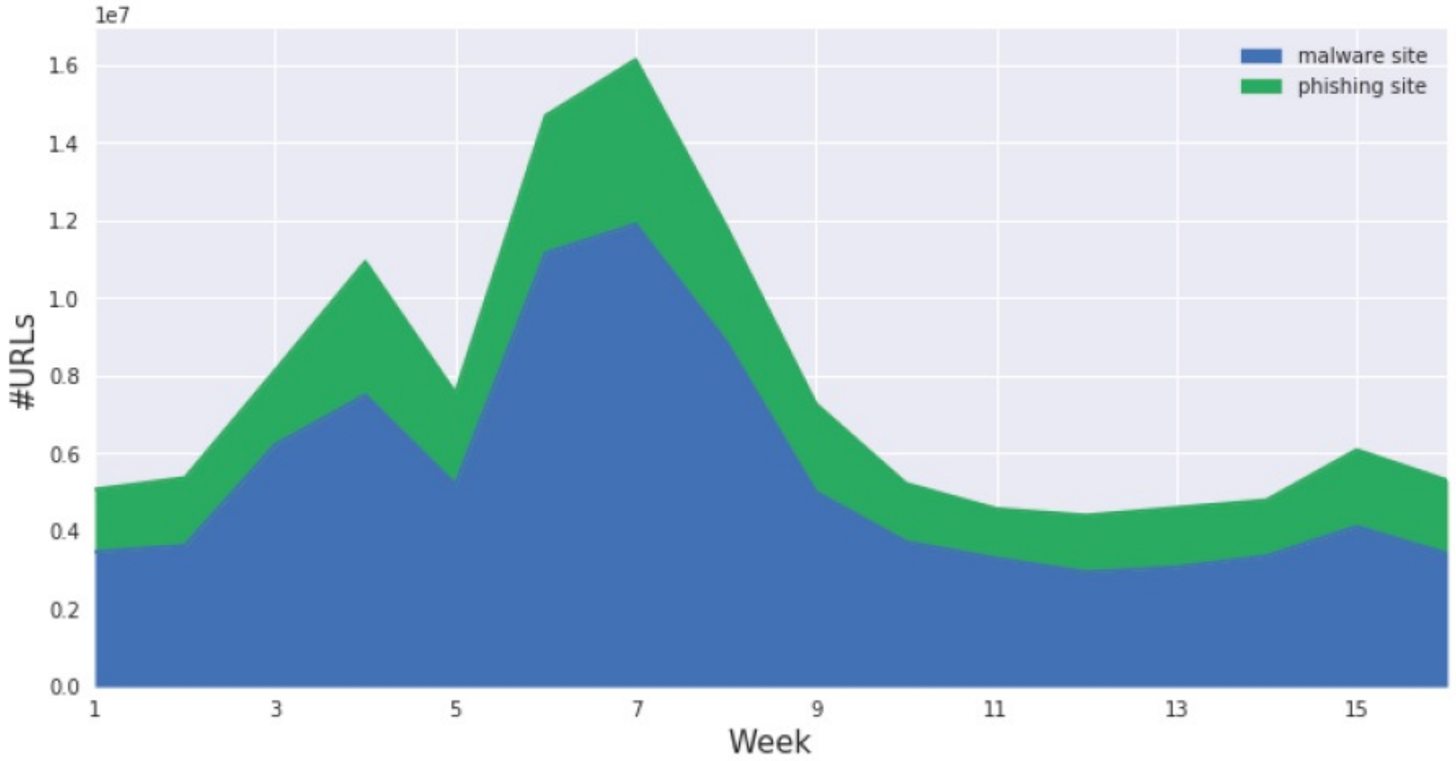
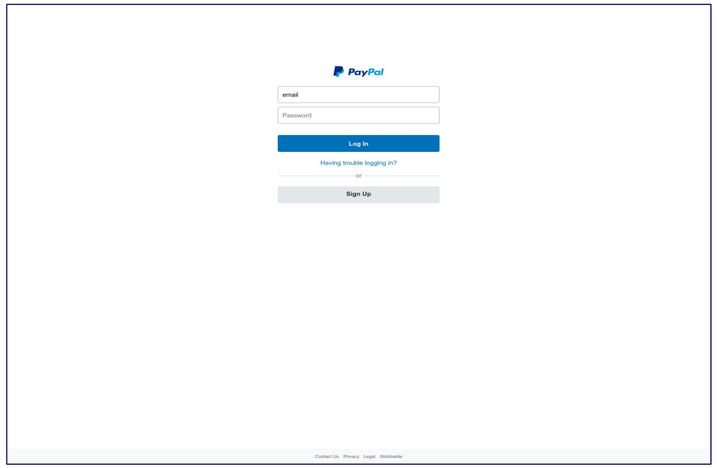
Malicious URLs from VirusTotal Feed



276K Malicious URLs/Week

How are these malicious sites hosted?

Compromised vs. Attacker-Owned



paypnl-son.shop (attack)

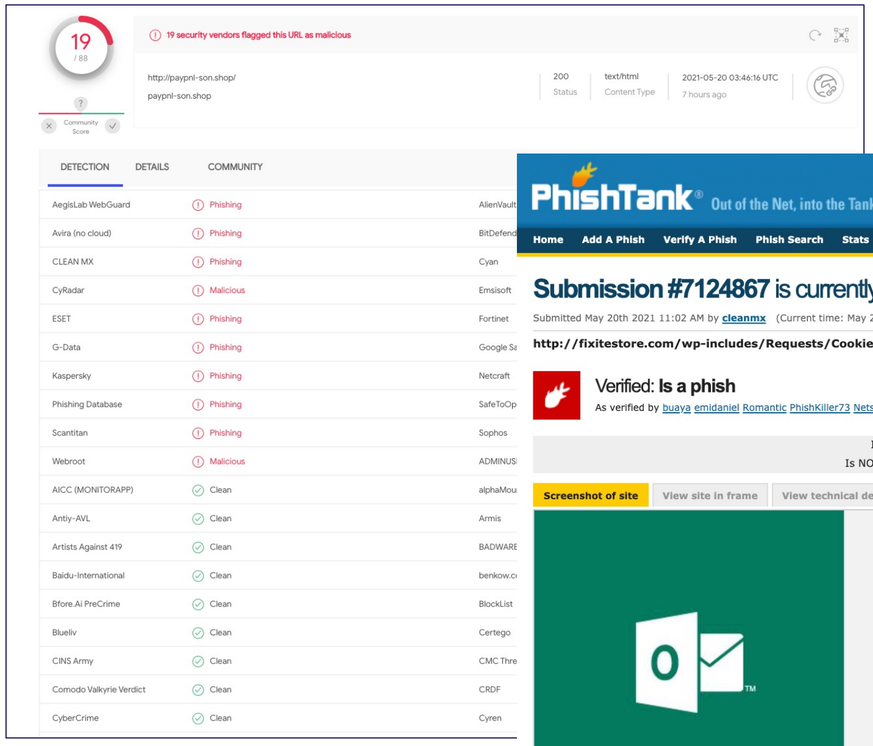
app-garden.com (bengin)

aaa.app-garden.com (compromised)

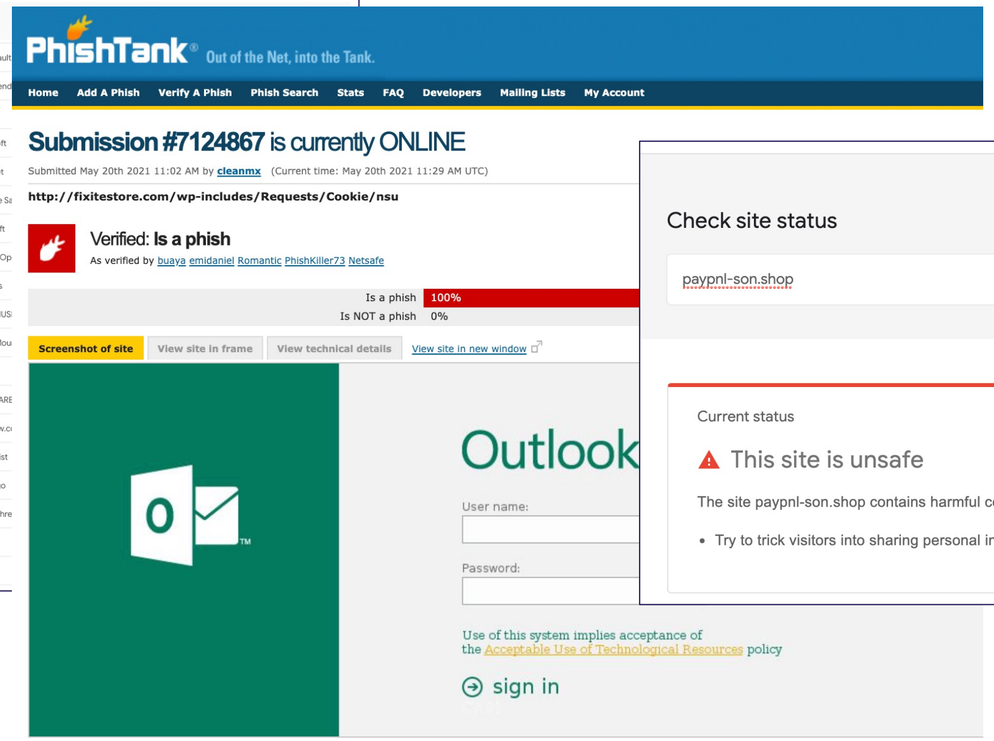
Why Distinguish Hosting Types?

- Different mitigation actions by different intermediaries
- Fine-grained blocking with minimal collateral damage
- Towards building better domain reputation systems

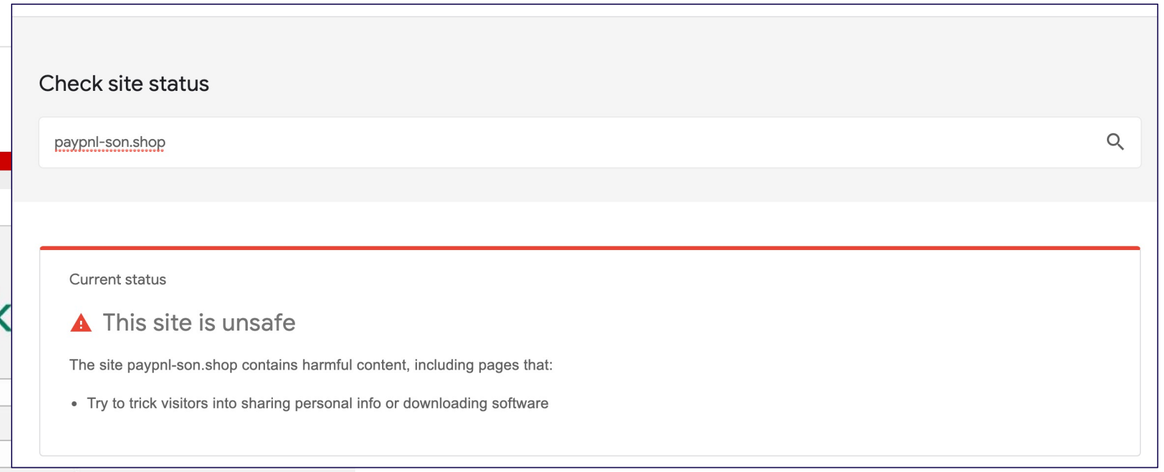
Current Status of Blacklists



VirusTotal

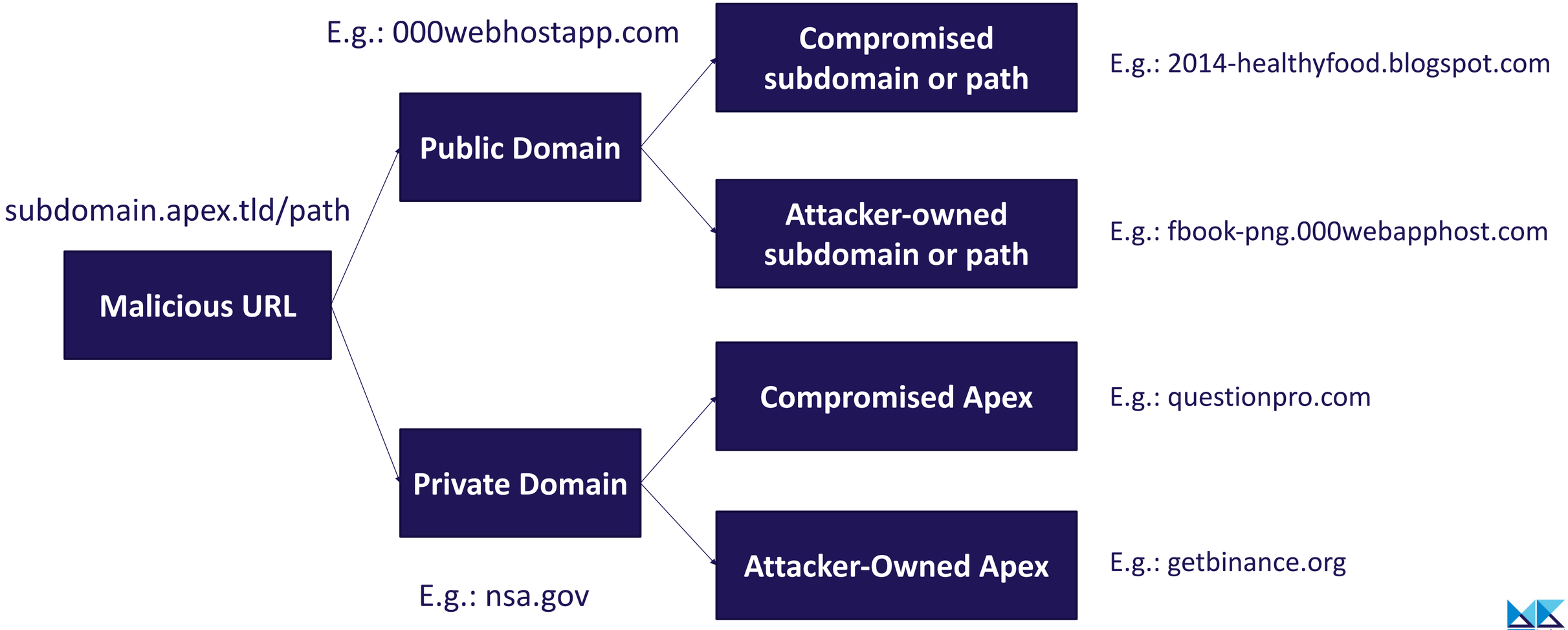


PhishTank

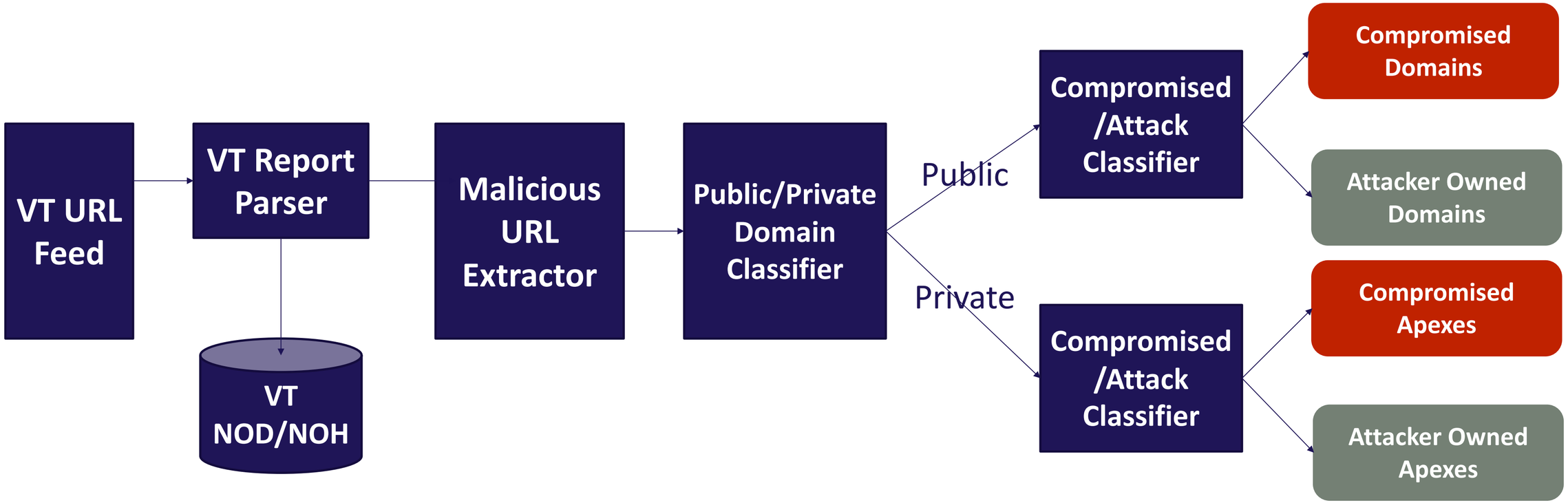


Google Safe Browsing

Malicious Hosting Types



Machine Learning Pipeline Design



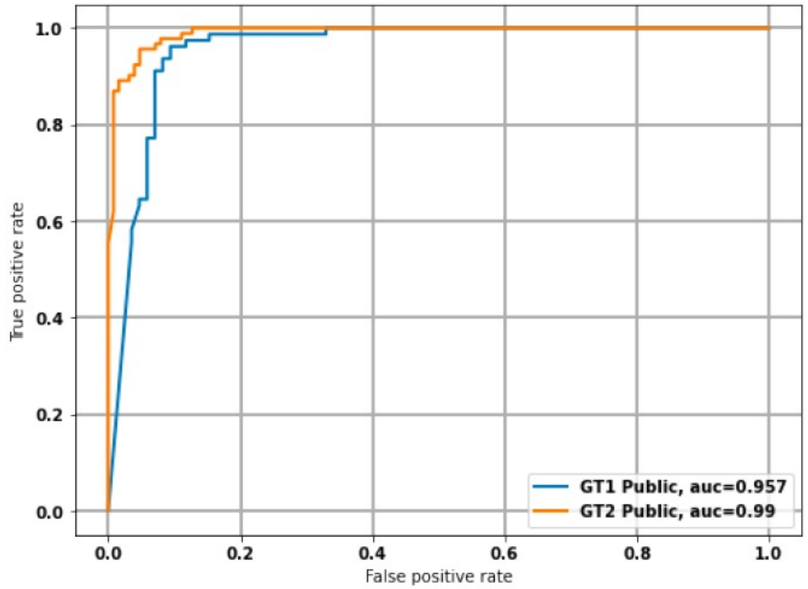
Datasets – VT URLs

- Study Period: Aug. 2019 to Nov. 2019

- Total number of URLs: 800+ million

Dataset	Malicious URLs	Malicious Apexes
Dataset1: Aug. 2019	3,434,226	373,238
Dataset2: Oct. 2019	4,398,584	358,762

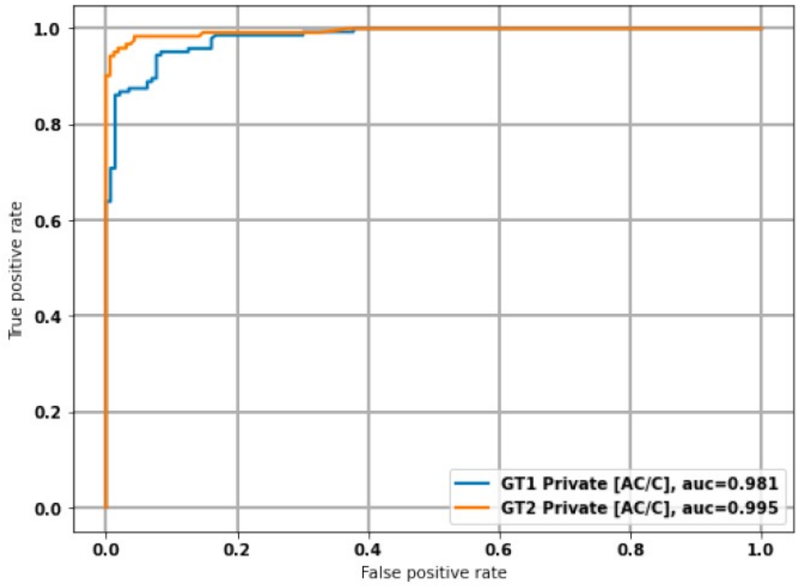
Public/Private Classifier



ROC Curve

- Key observations for feature engineering
  - Subdomain diversity
  - Variation and volume of scans
- Performance
  - Accuracy: 97.2%
  - Precision: 97.7%
  - Recall: 95.6%

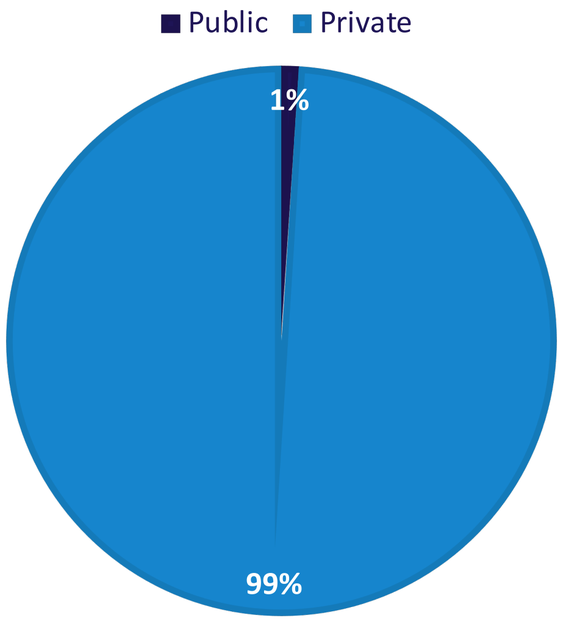
Compromised/Attacker-Owned Classifier



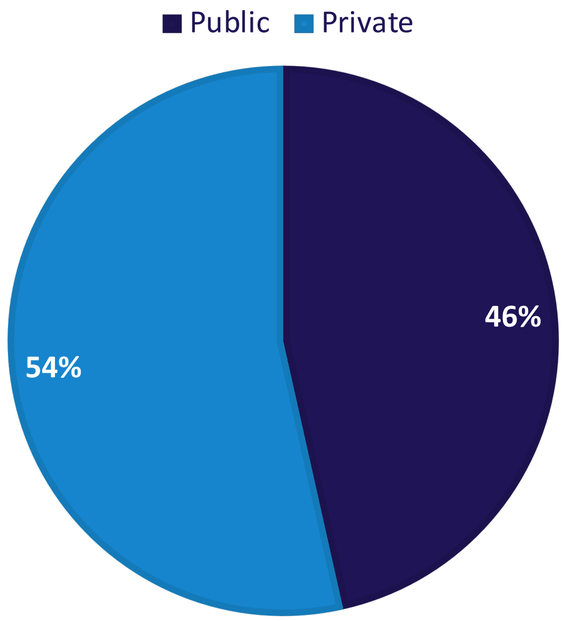
ROC Curve

- Key observations for feature engineering
  - Deviations in the hosting infrastructure
  - Lexical formation of URLs
  - Scan diversity
- Performance
  - Accuracy: 96.4%
  - Precision: 99.1%
  - Recall: 92.6%

Distribution of Attack Types – Malicious Apexes/URLs

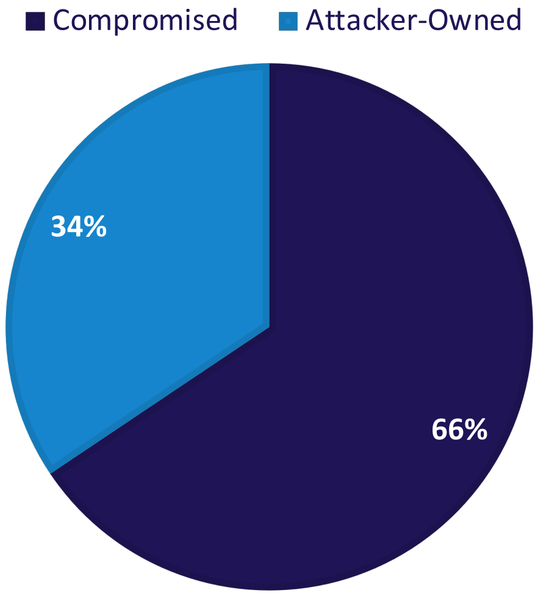


Malicious Apexes

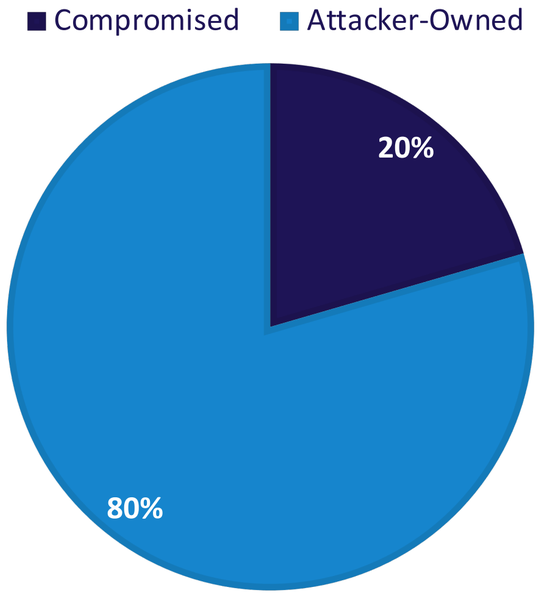


Malicious Websites

Distribution of Attack Types – Compromised/Attack

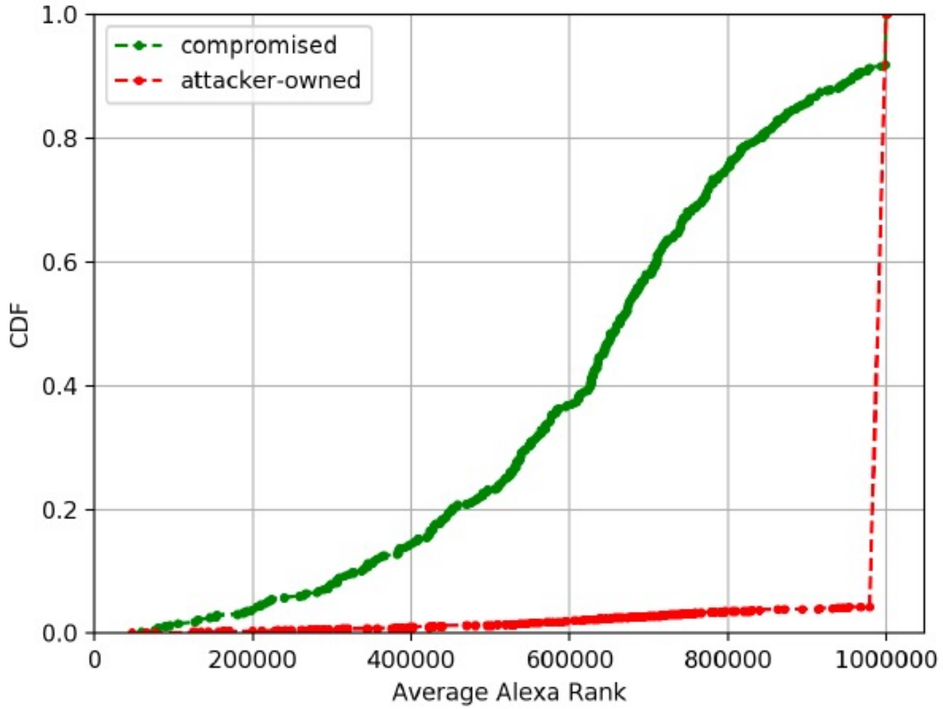


Private Malicious Websites

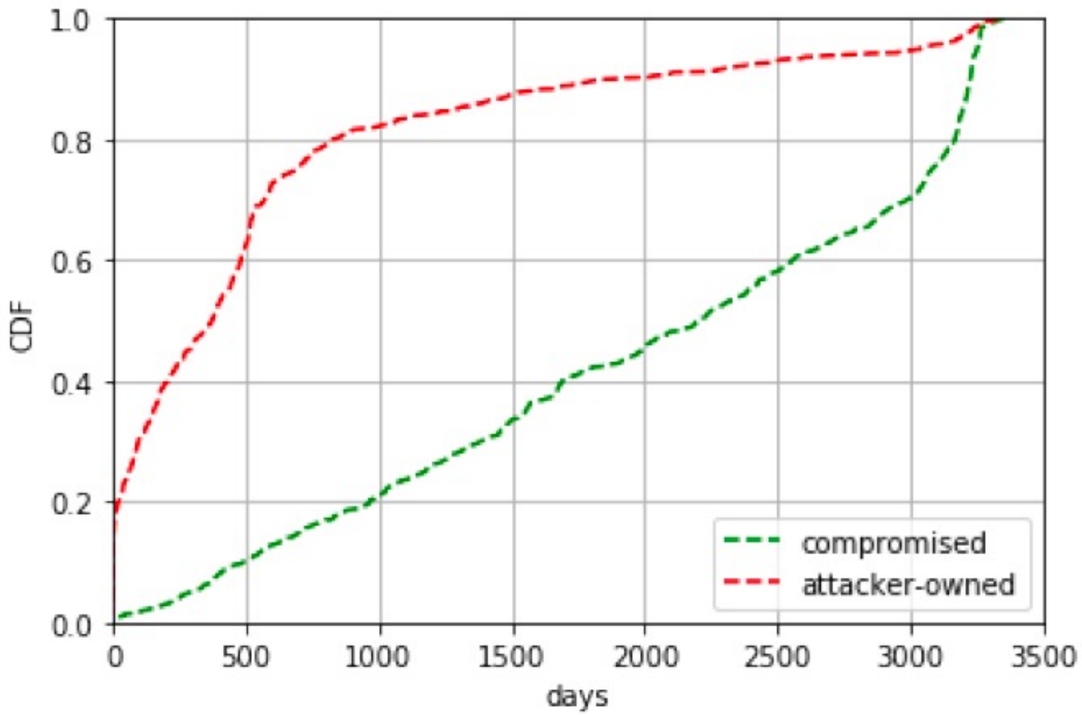


Public Malicious Websites

Properties of Compromised/Attack Websites

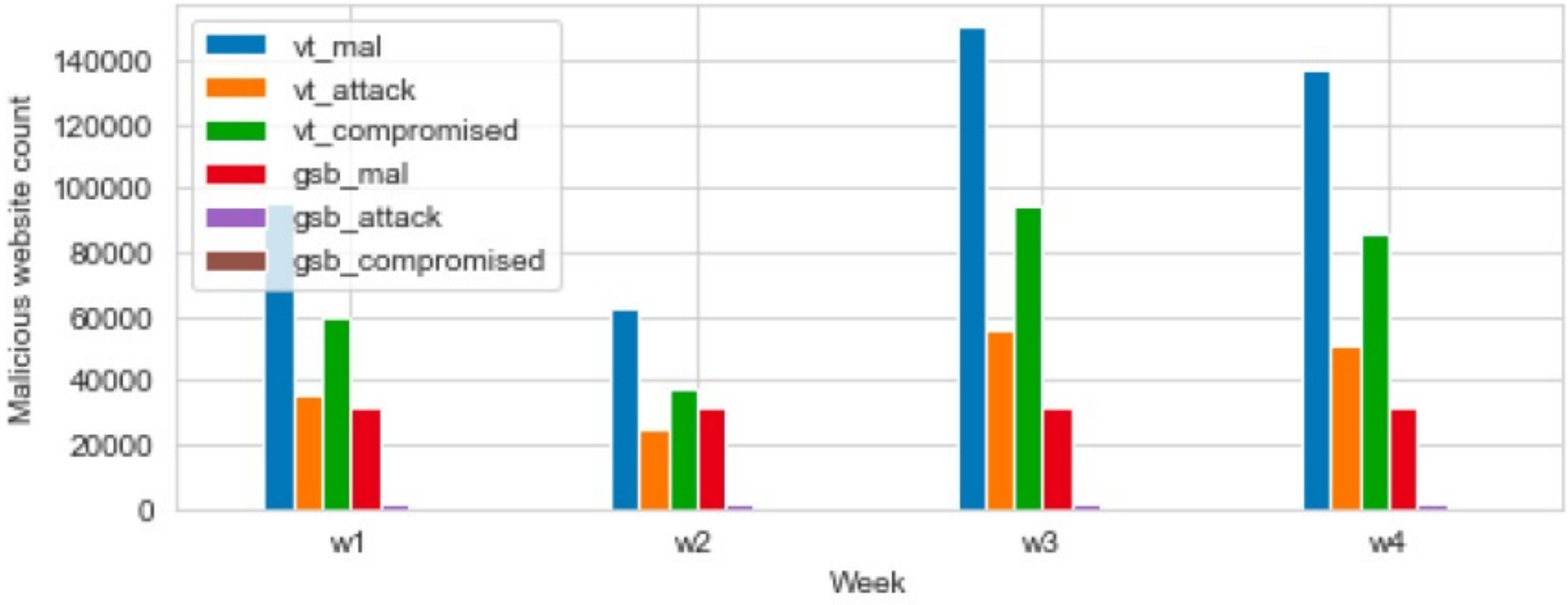


Popularity of Domain



Gap Between Registration and Attack Time

Comparing against GSB



Conclusions

- Content agnostic detection of various hosting types
  - Public vs. Private classifier
  - Compromised vs. Attacker-owned classifiers
- 81.7% malicious websites are hosted on apexes that attacks do not own
  - More needs to be done to secure benign websites and public domains
- Future work
  - Continuous evaluation of malicious URL types
  - Integration with existing blacklists and reputations systems

Thank You!

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