Unresolved Issues

Prevalence, Persistence, and Perils of Lame Delegations

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What are Lame Delegations?

A lame delegation is when a nameserver delegated authority over a domain is unable to provide authoritative answers for that domain.

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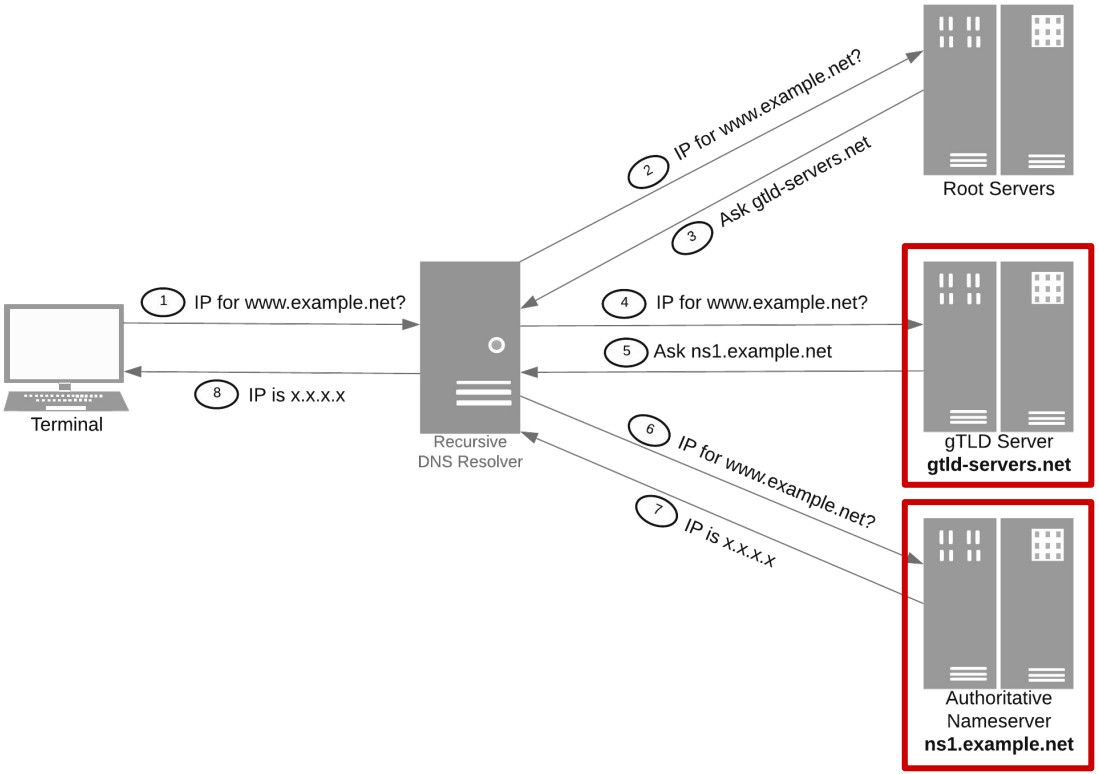
  - Lame delegated domains result in queries to nameservers that are not authoritative
  - 12% of traffic to GoDaddy servers are for domains for which they are not authoritative
- Potential for security risks.
  - Potential for hijacking

Lame Delegations in Practice



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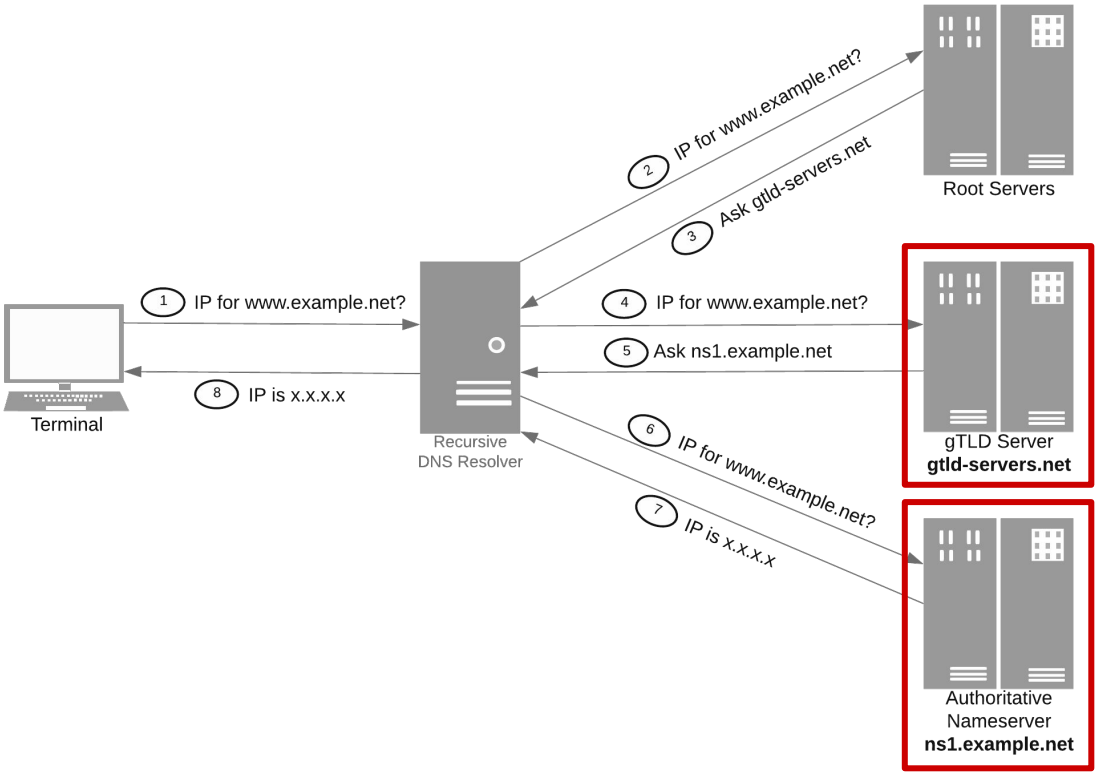

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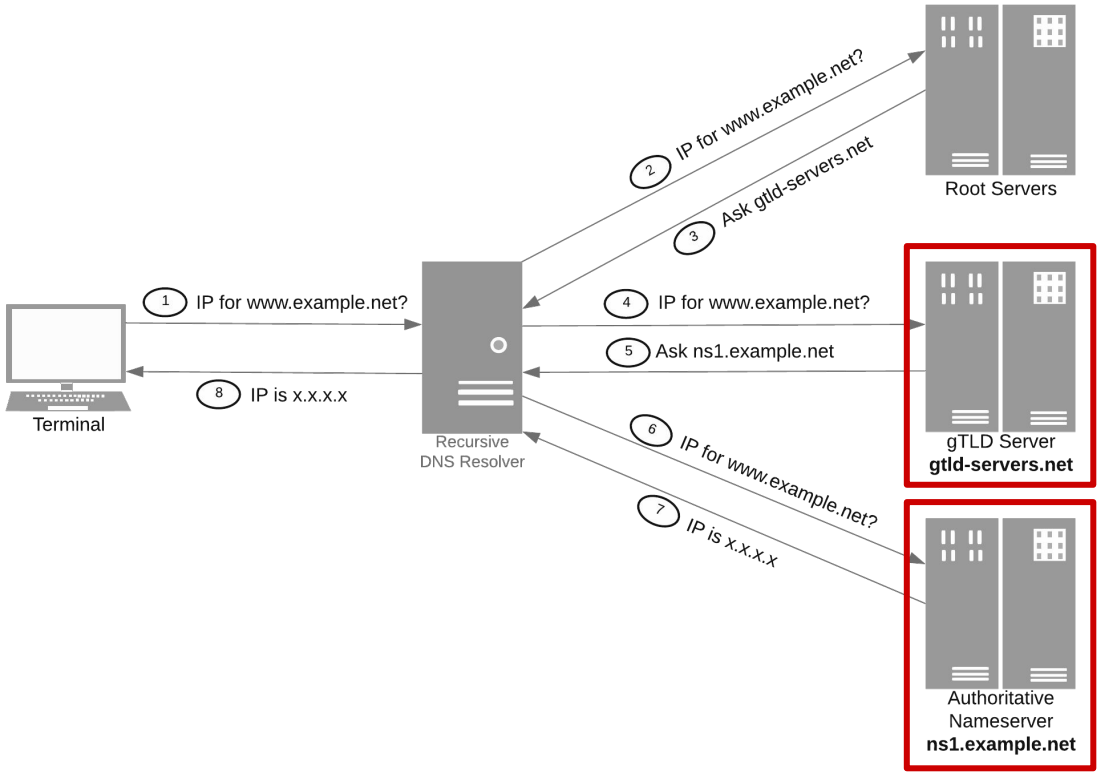

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Misconfigured NS
Unreachable/Unavailable

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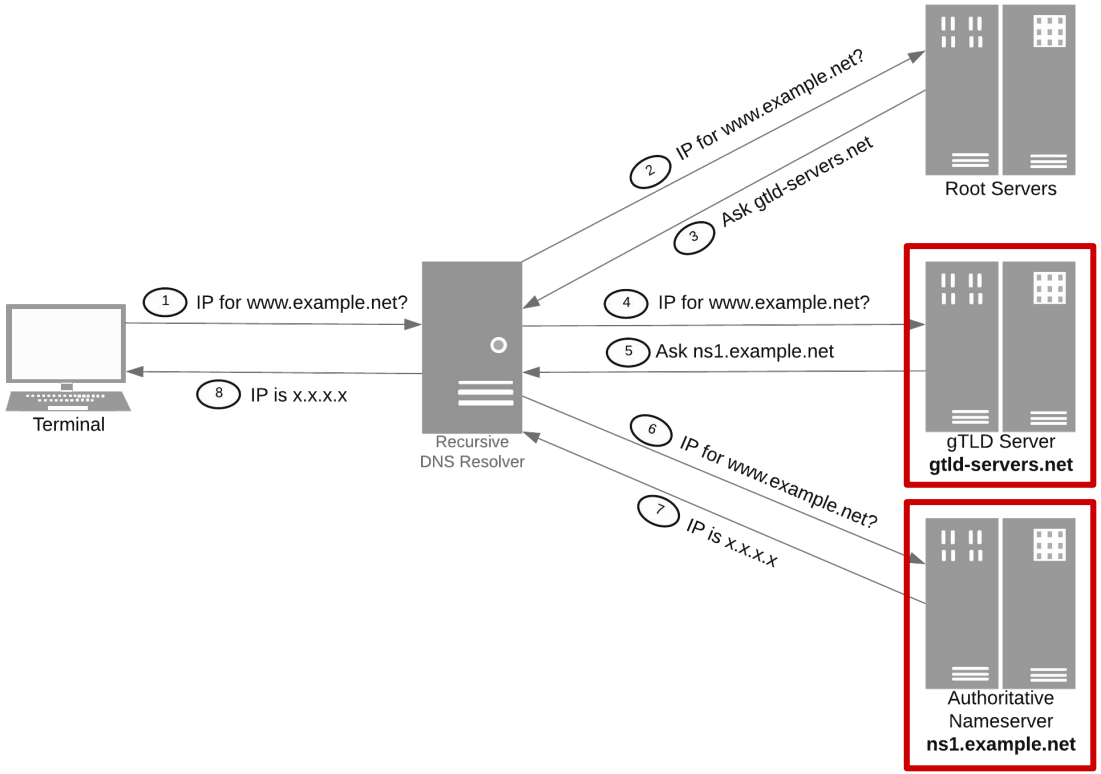

Passive Analysis

Incorrect NS listed

Active Measurement

Misconfigured NS
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Lame Delegations: Passive Analysis

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- Longitudinal analysis using nine years of TLD zone files

Data Set: Eight Years of TLD Zone Files

DNS Coffee --- https://dns.coffee

- Daily snapshot of TLD zone files over **9 years**
- As of October 2020, collects and analyzes ~1250 TLDs
- Includes legacy gTLDs, new gTLDs, and three ccTLDs

Domains	Nameservers (NS)	IPv4 (A)	IPv6 (AAAA)
499.3 M	19.9 M	5.1 M	91.9 k

Lame Delegations: Passive Analysis

- Longitudinal analysis using nine years of TLD zone files
- Use *“static resolution”* to determine if nameserver can be resolved.
- Conservative assumptions. Lower bound of lame delegations.

“Static Resolution” of Zone Files

NS and A Records from Zone Files  “Resolvable” Time Periods for Nameservers

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“Static Resolution” of Zone Files

NS and A Records from Zone Files → “Resolvable” Time Periods for Nameservers

- Conservative Assumptions
  - Assume nameserver is “resolvable” when in doubt

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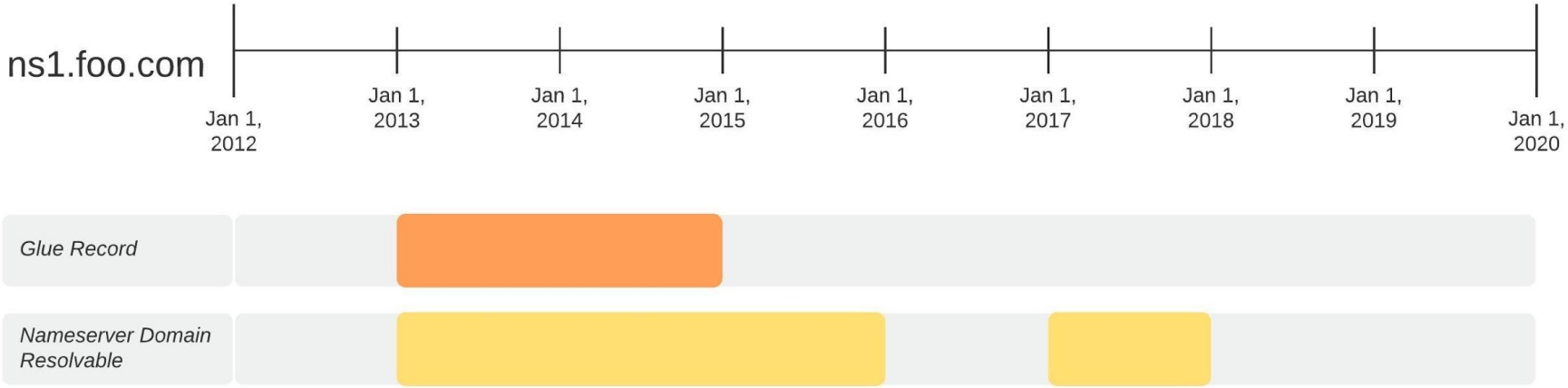
Nameserver Resolvable Time Periods



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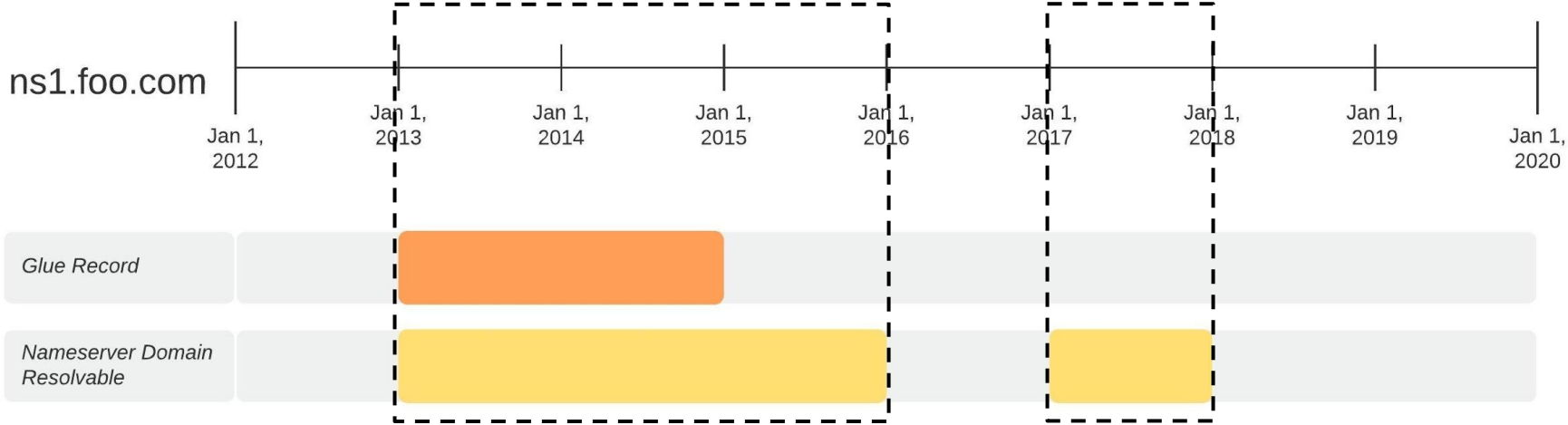

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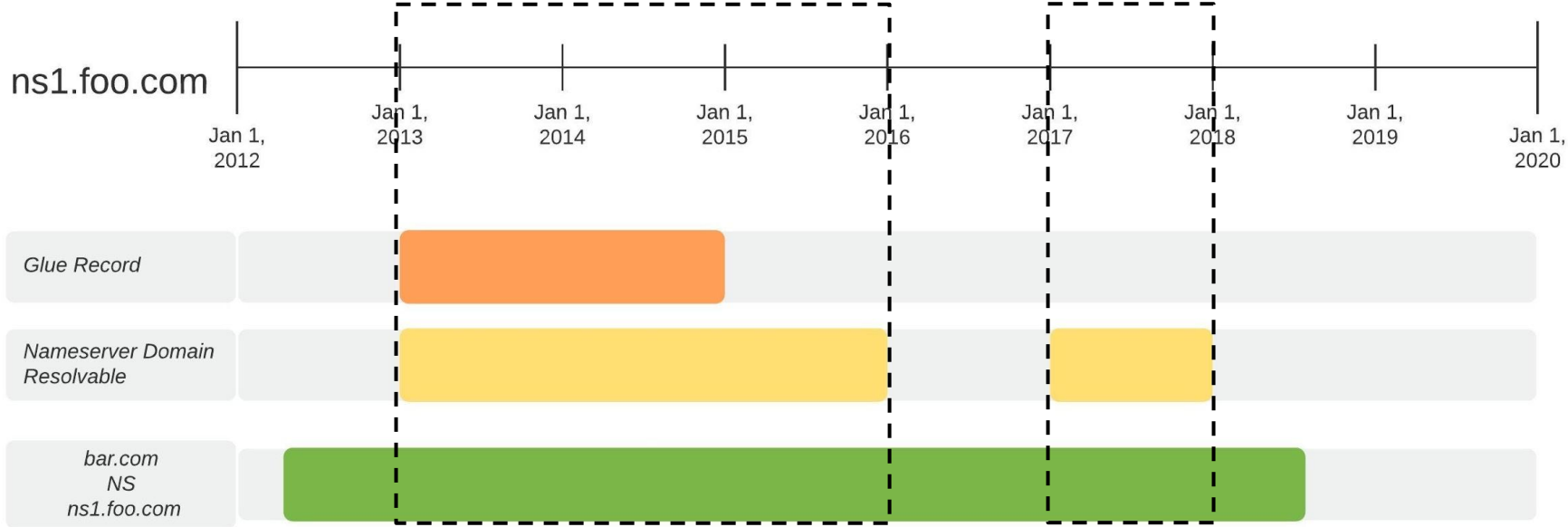

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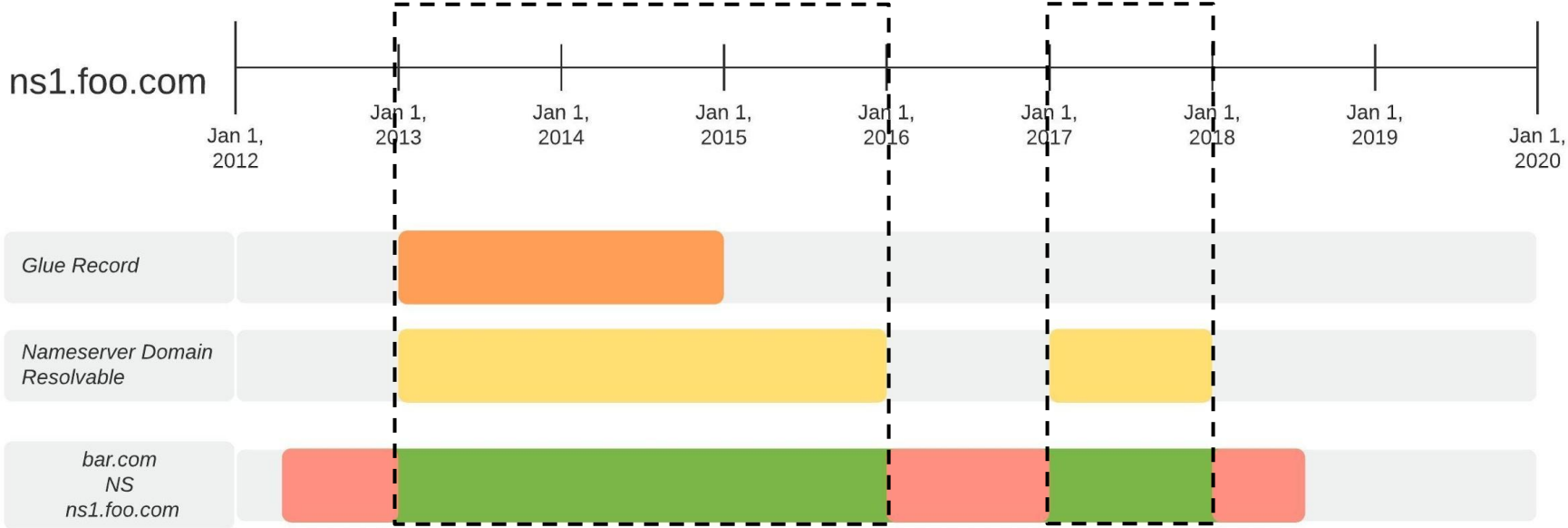

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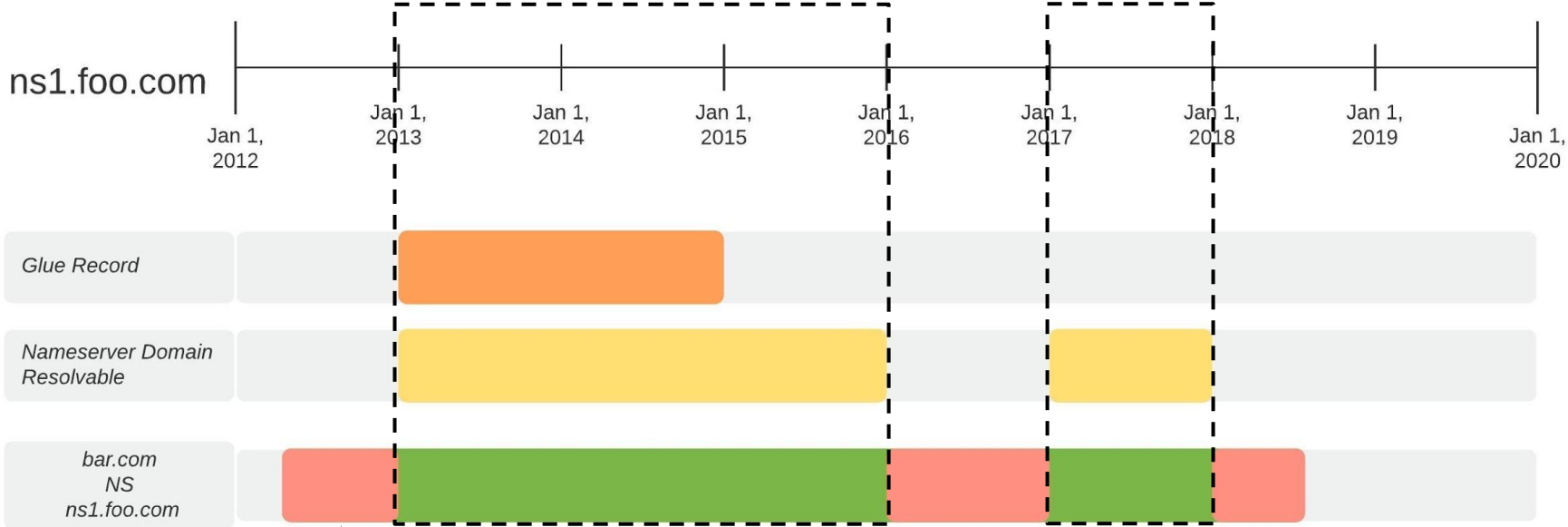

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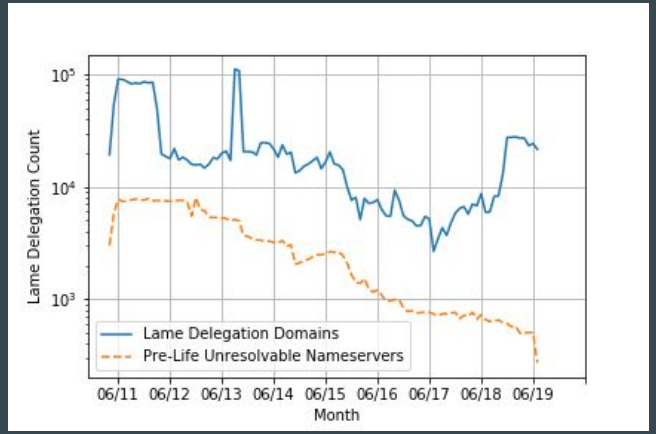

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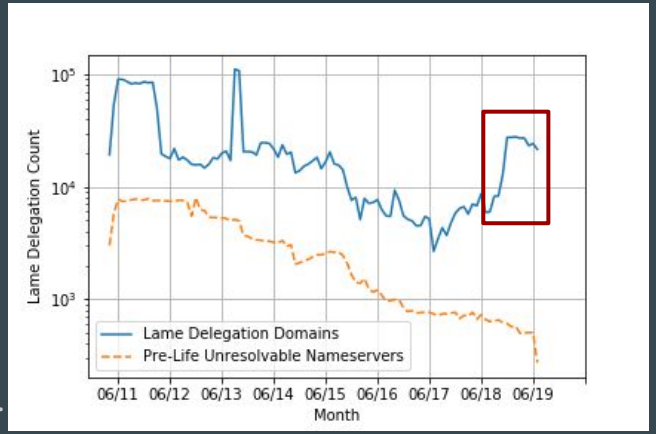
  - ns5.dsndun.net instead of ns5.dnsdun.net
  - ~20,000 domains lame delegated for nearly a year in 2018-19.



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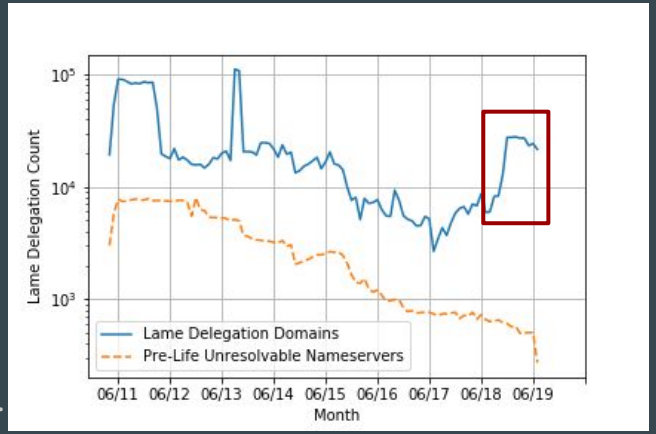

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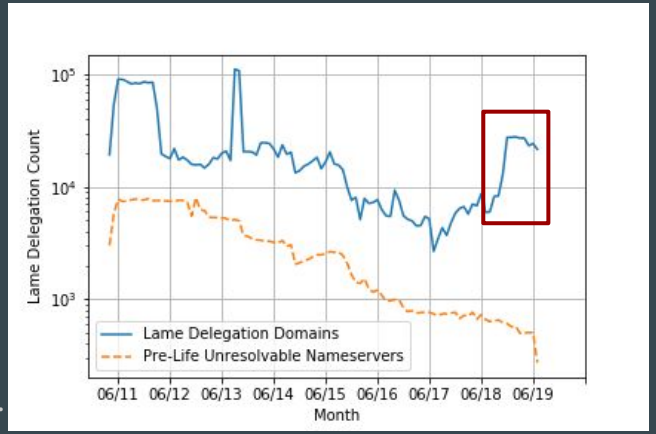

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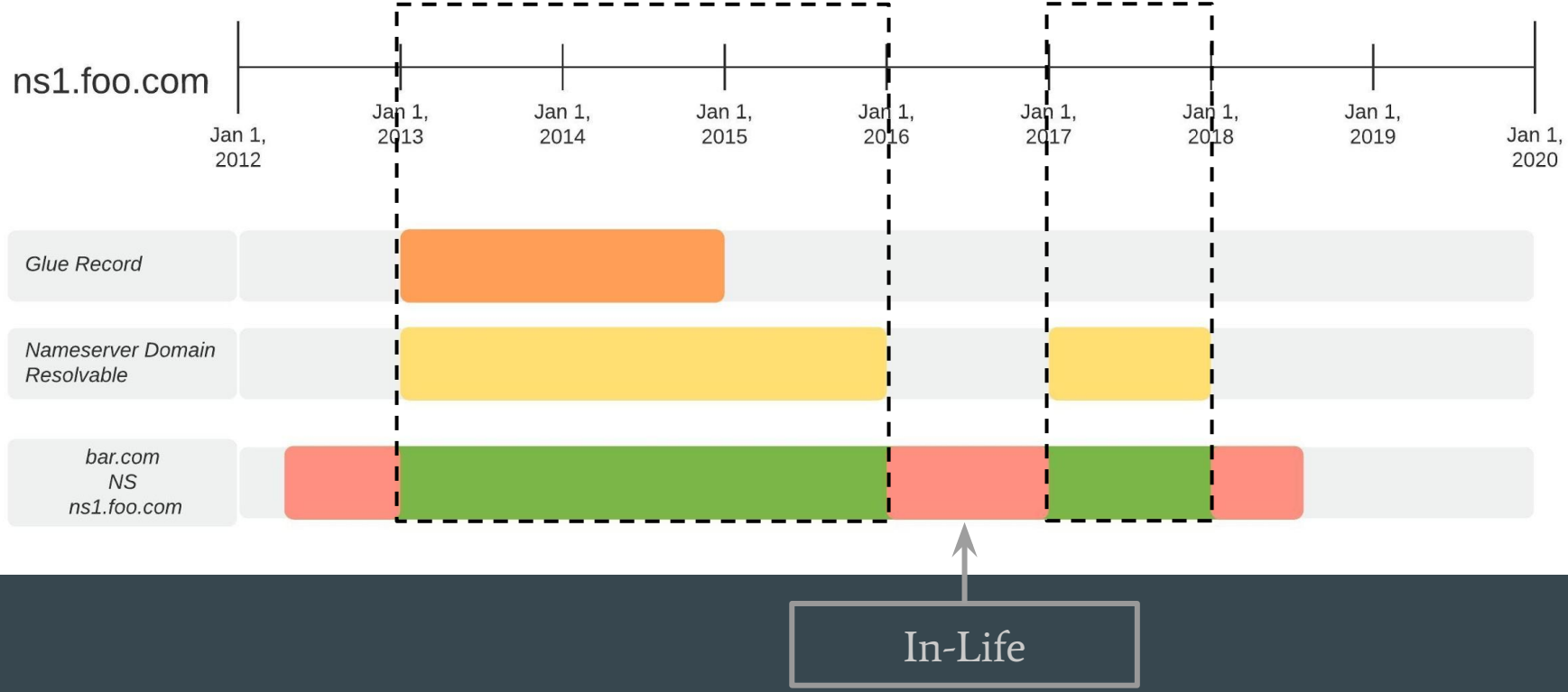

In-Life: Conficker Working Group Saga

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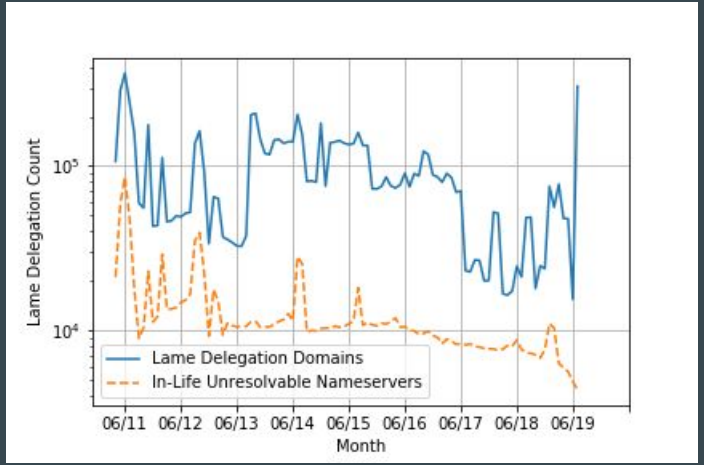

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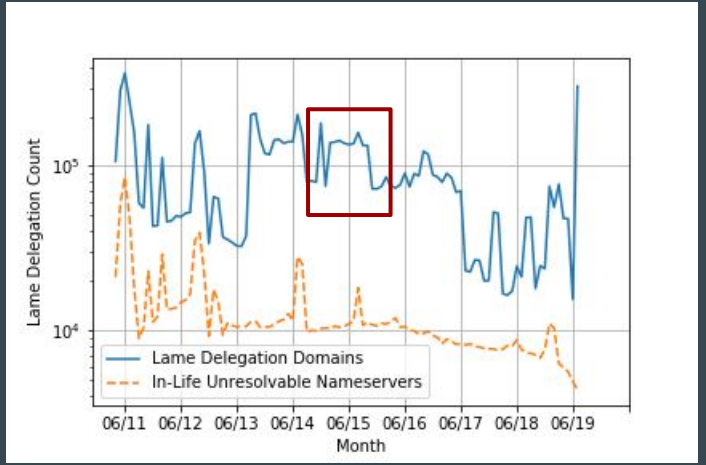

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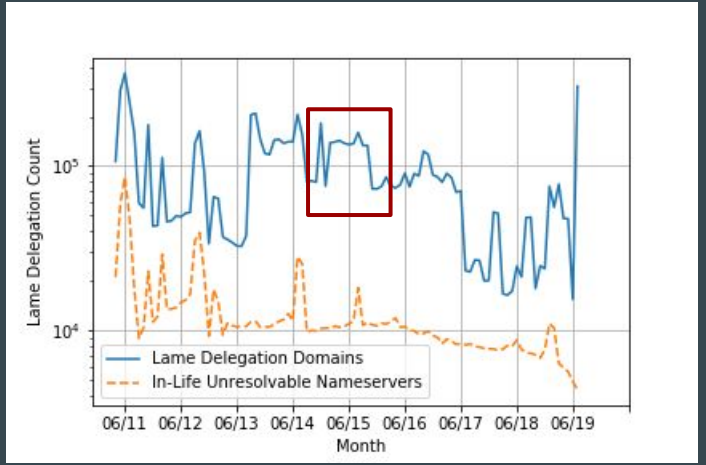

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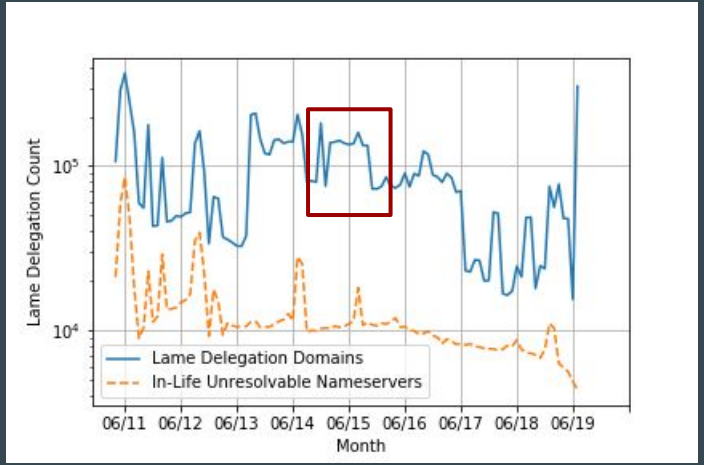

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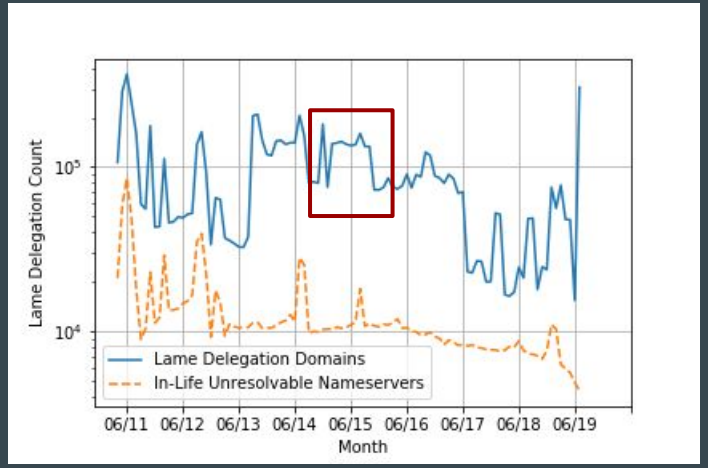
  - Registration for conficker-sinkhole.com lapses. Renewed during the grace period.



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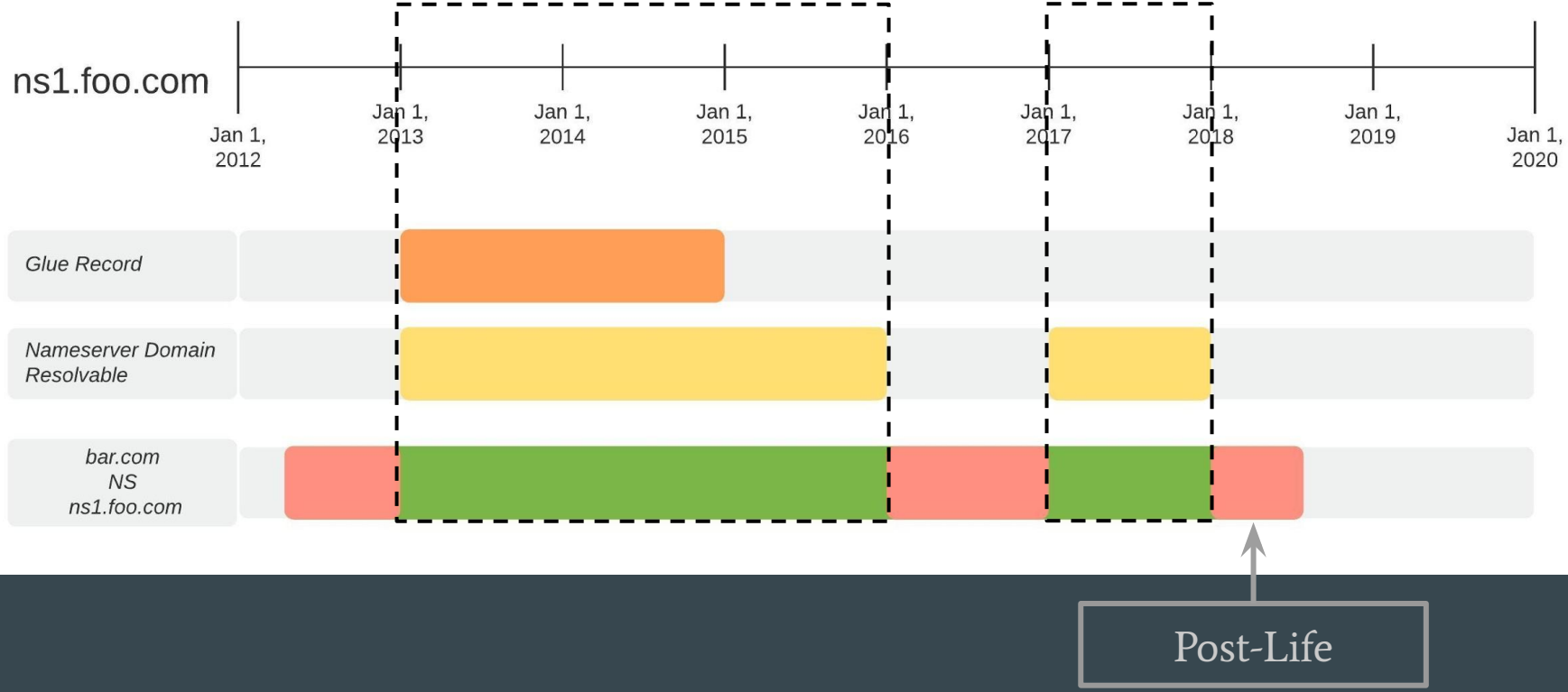

Post-Life

- Nameserver stop beings resolvable
    - Domain expires. Not renewed.
- Nameserver was never resolvable

Post-Life: TLD Anomaly

Unresolvable Nameservers by TLD	
Nameserver TLD	**# Post-Life Unresolvable NS (% of Total in TLD)**
.com	85,899 (1.00%)
.net	24,997 (1.45%)
.org	17,438 (1.77%)
.info	10,207 (0.86%)
ccTLDs	4,920 (0.73%)
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- **48%** of all nameservers ending *.biz* are never resolvable.
- The *.biz* registry has no visibility since nameservers are referenced in other TLDs. So not a *.biz* issue.

Example of .biz post-life unresolvable nameserver

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whitecounty.net
NS
ns1.hemc.net
ns2.internetemc.com

nameserver change
on July 01, 2019

whitecounty.net
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Functioning alternate nameservice can hide underlying delegation issues.

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- Undocumented registrar practice to get around EPP constraints.
- Lame Delegations not due to domain owner actions but registrar actions.
- Creates lame delegations and security risks!
- Tens of thousands of domains affected
- Actors exploiting these vulnerable domains!

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  - Entire .net (13.1M domains), and .org (10M domains)
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  - Target NS queries to up to 5 IP resolutions for nameserver
- Allows us to identify partially lame domains!

Active Measurement Results

	.com	ngTLDs	.net	.org	**Total**
Domains Queried	**13 M**	**13 M**	**13.1 M**	**10 M**	**49.1 M**
Fully Lame	8.7%	9.6%	10.5%	9.2%	9.5%
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- Lame Delegations even in popular domains
  - archive.org -- Alexa 200 domain -- has a lame delegation

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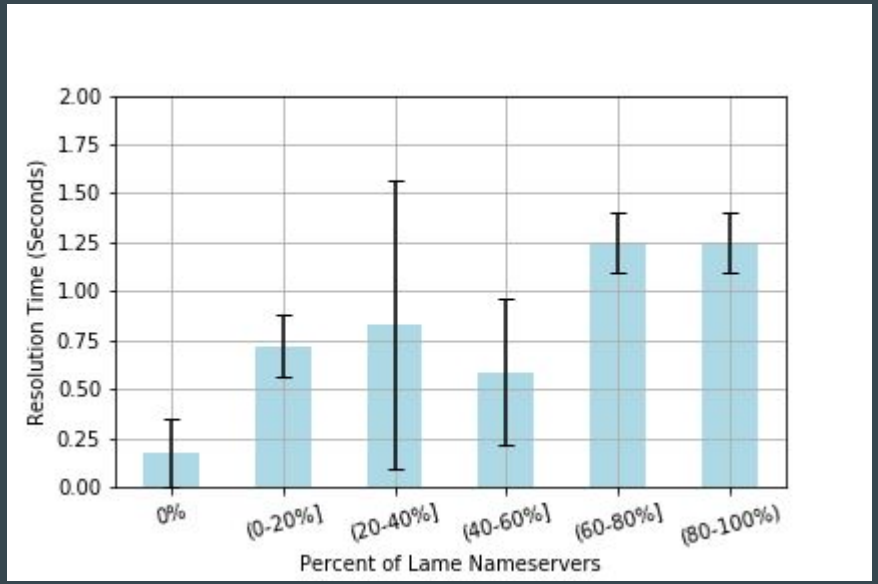
- Functioning alternate nameservice can hide broken delegations from domain owner.

Fully Lame Delegated Nameservers: By TLD

Lame Nameservers by TLD		
Nameserver TLD	**# Queried NS**	**Fully Lame NS**
.com	176,897	57,137 (32.3%)
.net	97,160	30,896 (31.8%)
.org	38,825	14,792 (38.1%)
.info	2,690	731 (27.2%)
ccTLDs	65,041	16,585 (25.5%)
ngTLDs	40,792	19,213 (47.1%)
.biz	14,311	10,533 (73.6%)

Increase in Resolution Time

- Lame delegated domains show 3.7x increase in resolution time.



More Details and Analysis in Paper...

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  - 15% of domains actively queried have a lame delegation
  - Redundancy can mask lame delegations from domain owner
- Lame delegations are also created due to systematic issues unrelated to domain owner misconfiguration
  - Unintended consequences of registrar practices
- Impacts of lame delegations
  - Cause unnecessary query load
  - Increase resolution time
  - Can put domains at risk of hijack

Thanks!

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