The Modality of Mortality in Domain Names

An In-depth Study of Domain Lifetimes

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Agenda

1. Introduction & study details
2. What % of new domains survive a week?
3. How fast new domains die?
4. Causes of death
5. Impact of new gTLDs, ccTLDs, etc.
6. Summary & takeaways

Introduction: BIG data

- **Passive DNS sensors** deployed world-wide
- **Data volume**: 2TB of streaming data per day
- **DNSDB**: historical pDNS database since 2010
- **Newly Observed Domains (NOD)**: real-time notifications of newly observed effective second-level domains

Introduction: BIG questions

- **Are popular assertions correct?**
  - *"95% of new domains are junky and malicious"*
  - *"they live nasty, cruel, and short lives"*
  - *"they are quickly destroyed by the registrars"*
  - *"it is all because of the new gTLDs!"*
- **Why should I care?**

Study details: measuring NOD lifecycle

- **Idea**: measure all NODs during their first 7 days of life
  - data cleanup: drop wildcard TLDs (e.g. .pw) and incomplete measurements
- For each NOD (e.g. domain.com), repeatedly query:
  - **delegator**: usually the TLD name server (e.g. a.gtld-servers.net)
  - **authoritative NS**: the server delegated for the zone (e.g. ns.domain.com)
  - **DNSBLs**: Spamhaus, SURBL, Swinog URIBL
- Make **20 repetitions** per NOD in **increasing** time intervals
  - 0 sec., +1024s (~17 min), +2048s (~34 min), +4096s (~68 min), …, 7 days
- Consider **only the first** cause of domain death

Background: Effective Second-Level Domains

e.g. for FQDN = *lb5.azure-app.cloudapp.net*

- Theory:

  -- Top-Level Domain (TLD): *.net*
  -- Second-Level Domain (SLD): *cloudapp.net*

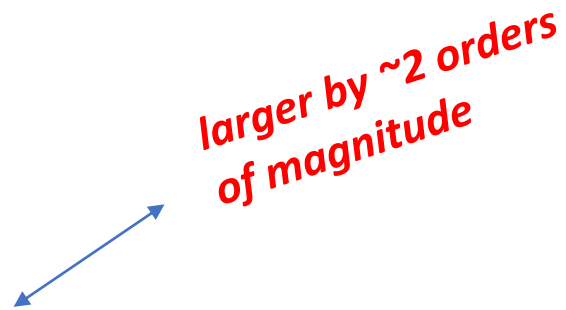
- Practice:

  -- effective TLD: *.cloudapp.net*
  -- effective SLD: *azure-app.cloudapp.net*

More info: see https://publicsuffix.org/

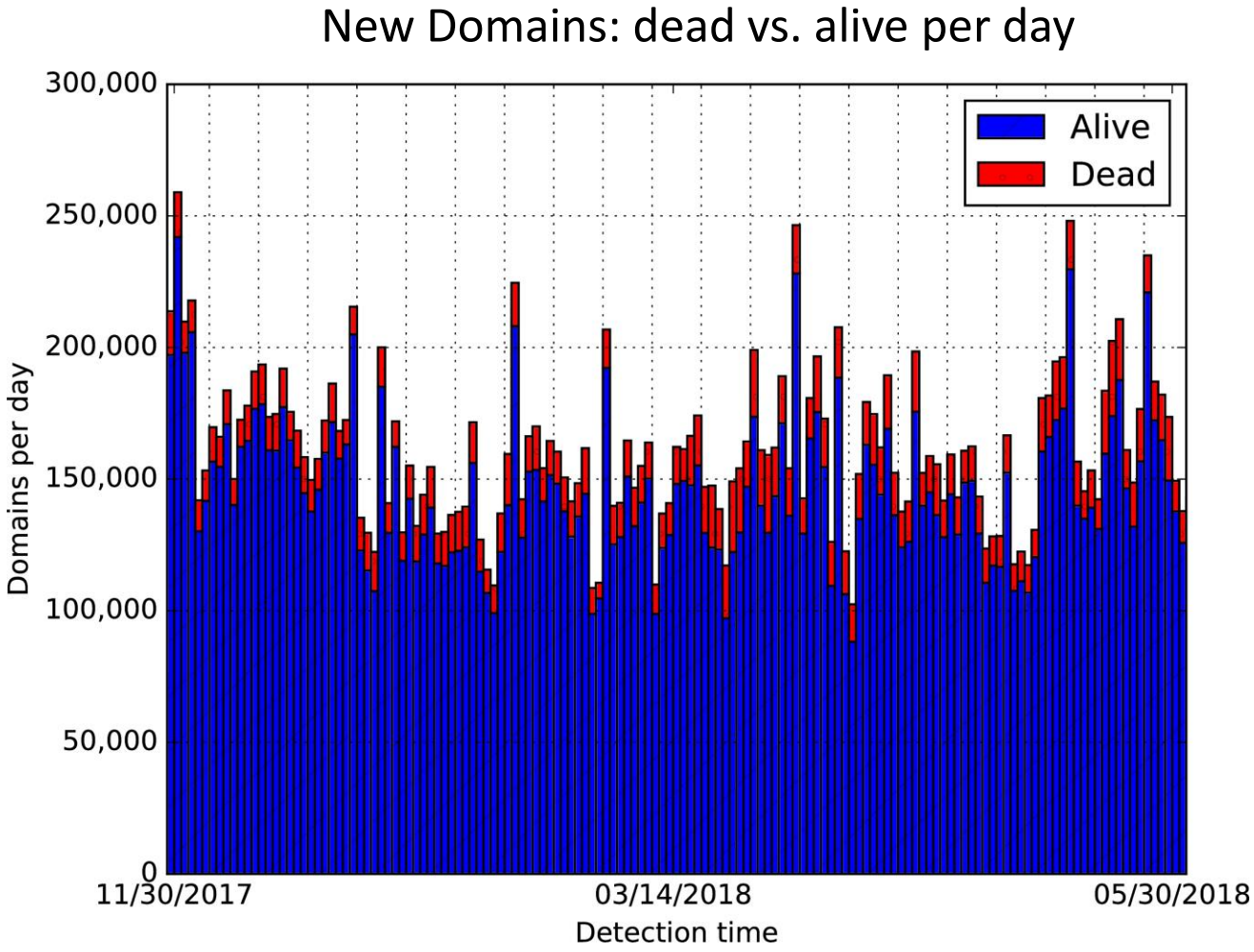
Background: NOD vs. NOH

- **NOD:** Newly Observed Domains
  - effective SLDs, e.g. *example.com*
  - use case: protecting brands
  - March 2018 avg: >2 NODs / sec, or **>150K NODs / day**
- **NOH:** Newly Observed Hosts
  - FQDNs (hostnames), e.g. printer4.example.com
  - use case: detecting domain shadowing
  - March 2018 avg: >150 NOHs / sec, or **>12,000K NOHs / day**



What % survives?

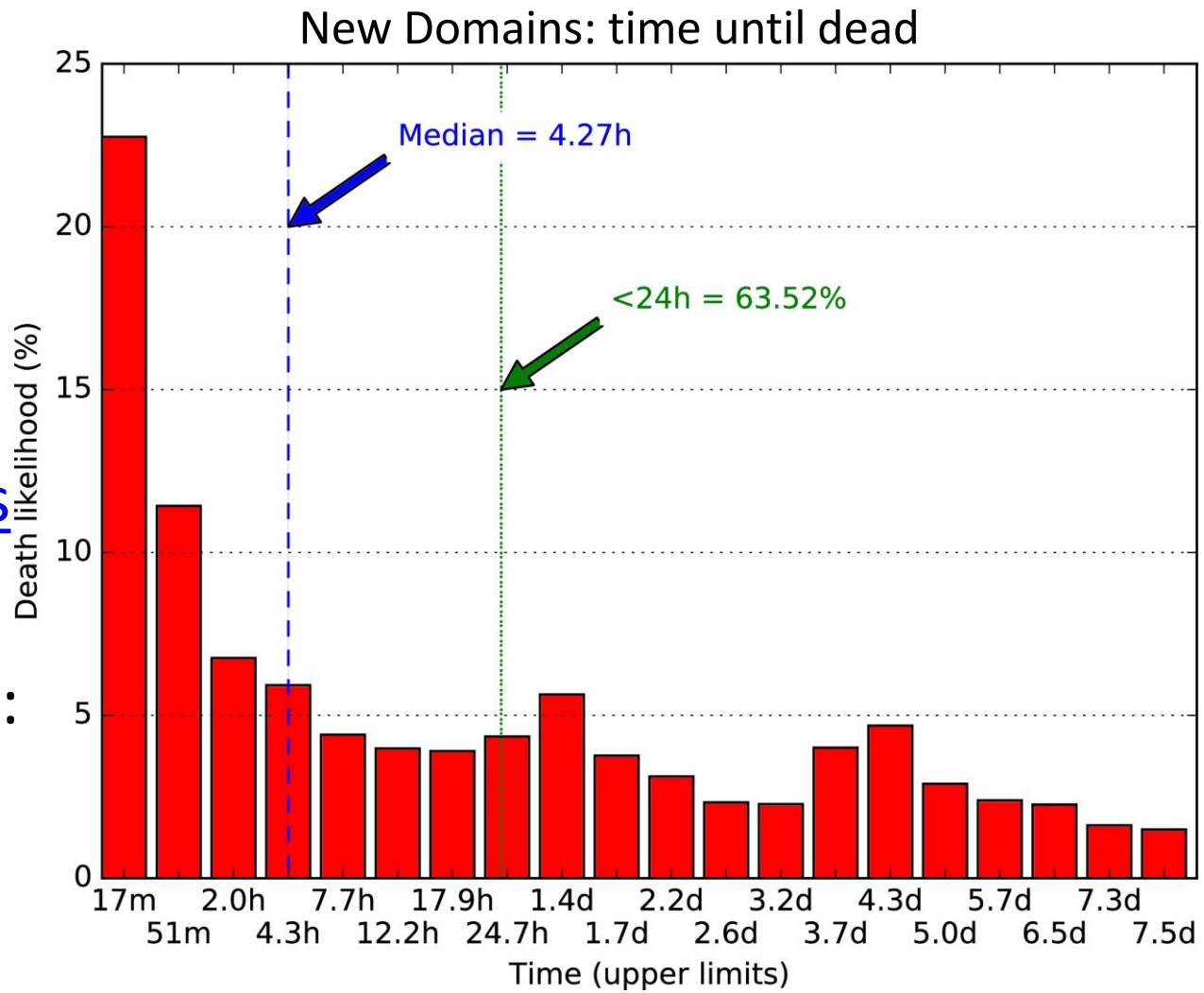
- Evaluating 23.8M NODs (after cleanup – slide 5)
- Time span: 11/2017 - 05/2018
- 21.6M survived (90.7% of all NODs)
- 2.2M “dead” in under a week (9.3% of all NODs)



How fast do they die?

(drill-down into 2.2M NODs)

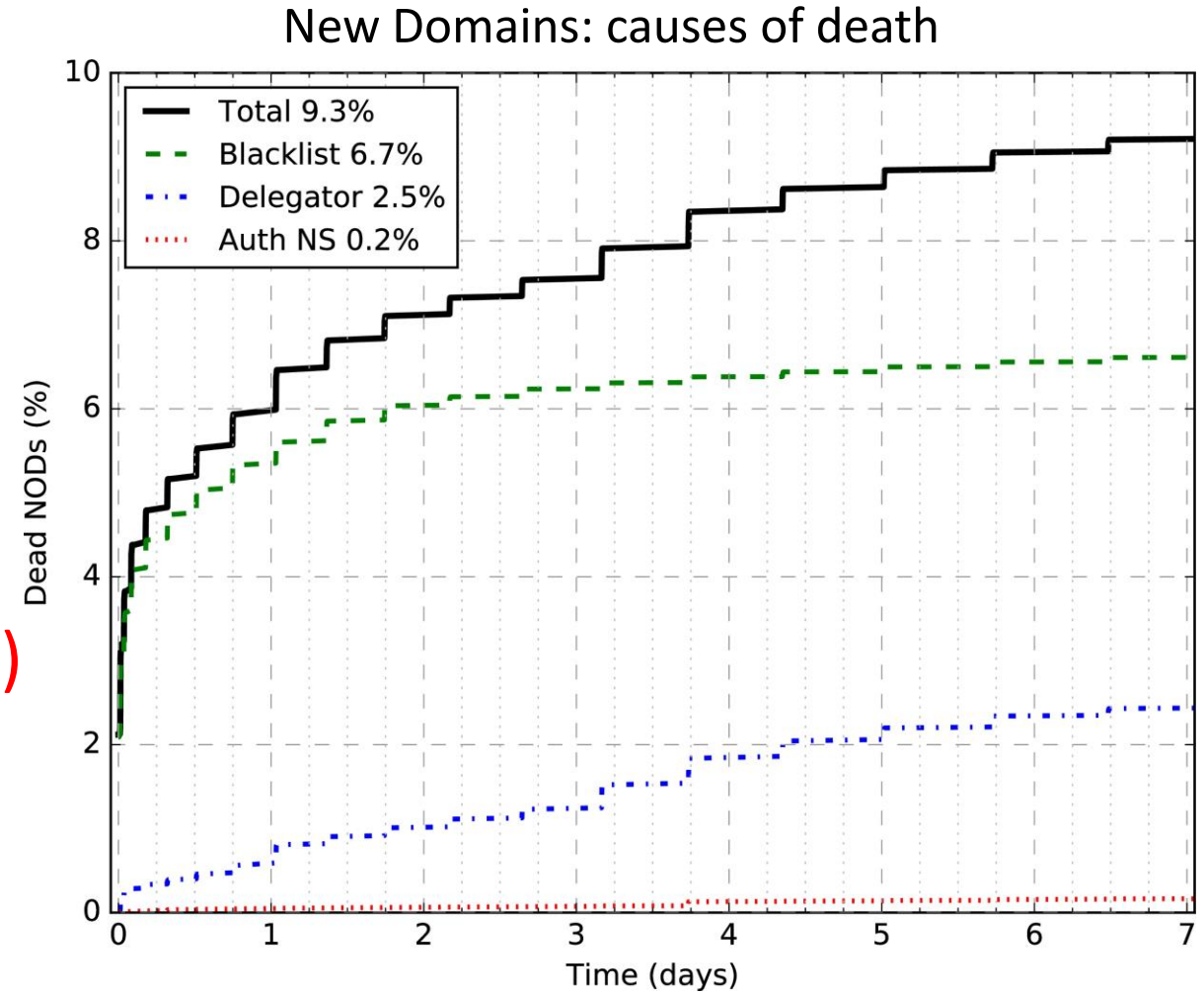
- "The newer the domain, the more likely to die <u>really</u> fast
- Majority will die <u>in under 5 hours</u>
- >60% will die <u>in under 24 hours</u>
- Three "modes" in mortality rates:
  0-2h 1-1.5d 4-4.5d



Causes of death

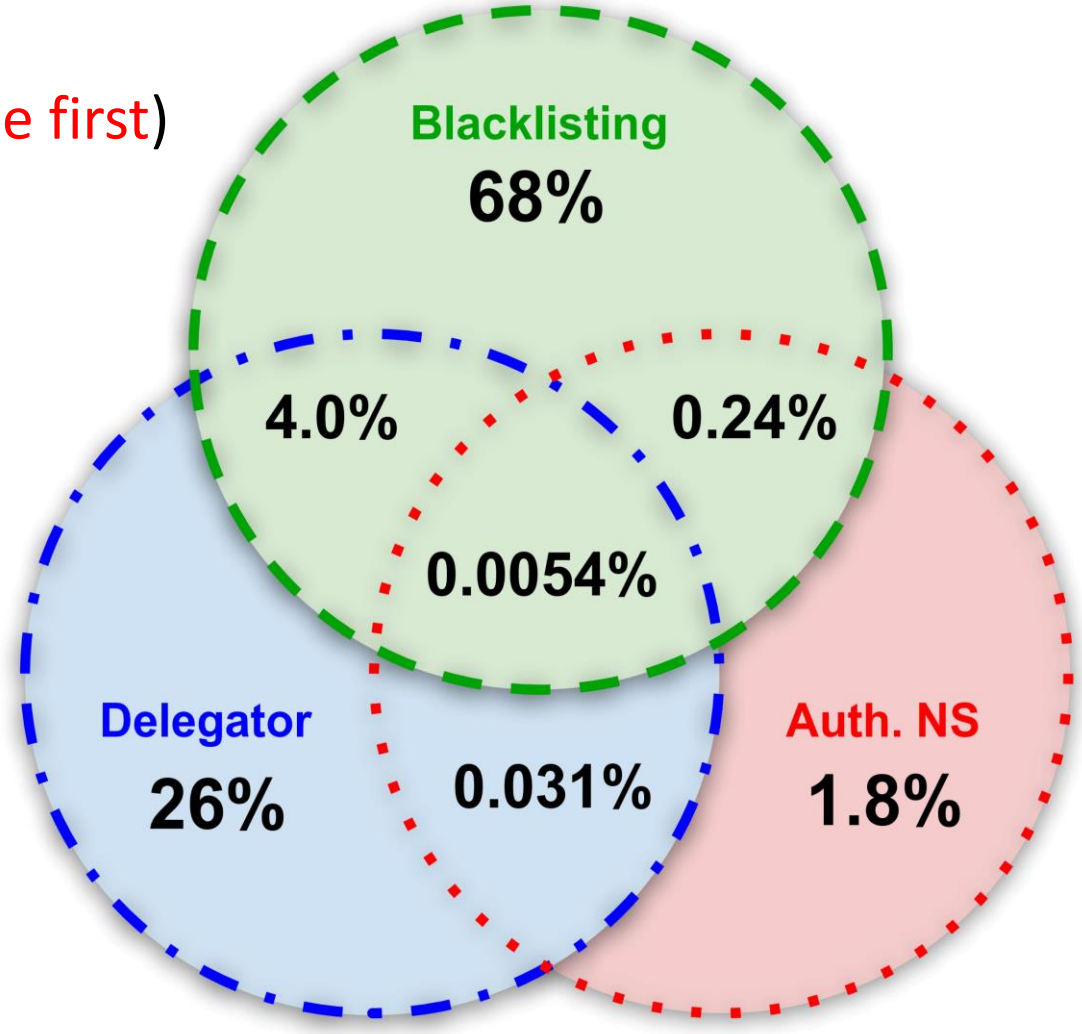
(only the first one)

- Blacklisting is the major cause (6.7% of NODs)
- Delegators (TLDs) are the second largest cause (2.5% of NODs)
- NODs are rarely “killed” at the authoritative NS level (0.2% NODs)
- Each cause has different time characteristics



Intersections

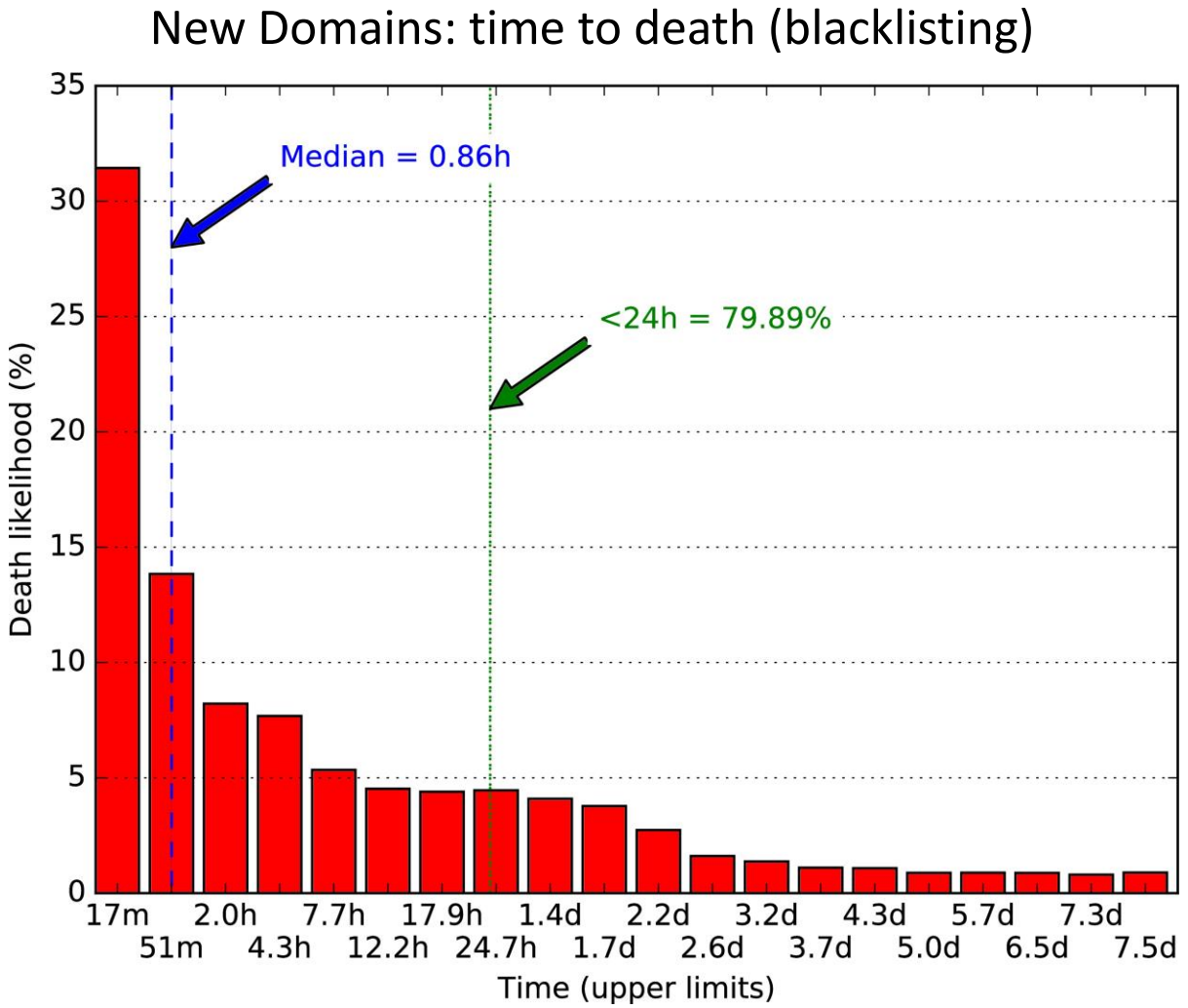
(ignoring which was the first)



Blacklisting kills fast

(drill-down into 147,400 NODs)

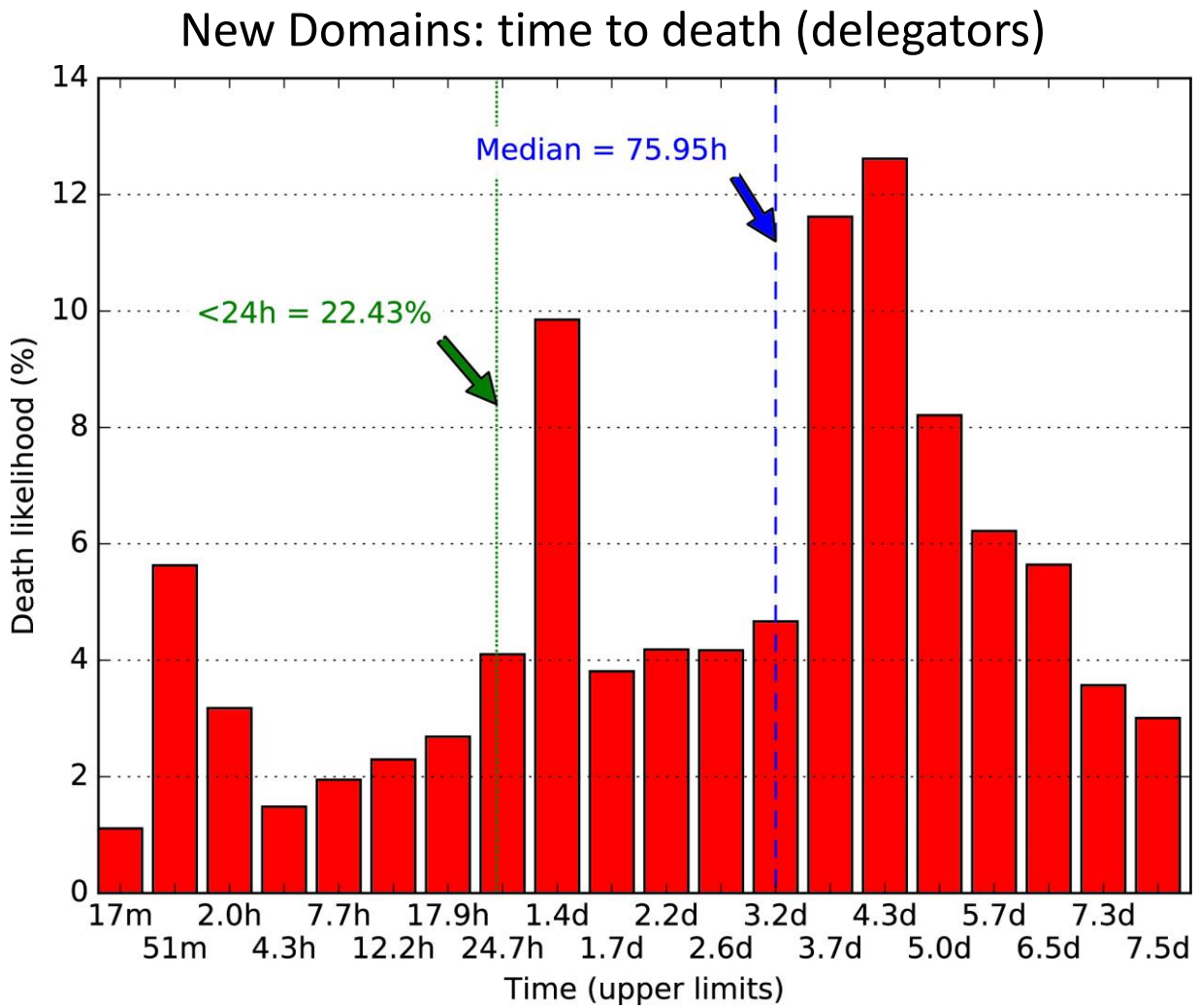
- In most cases, DNSBL will effectively kill a NOD in <1h
- >79% of NOD blacklisting happens in the first 24 hours
- No peaks, simple distribution



Deaths at delegators

(drill-down into 55K NODs)

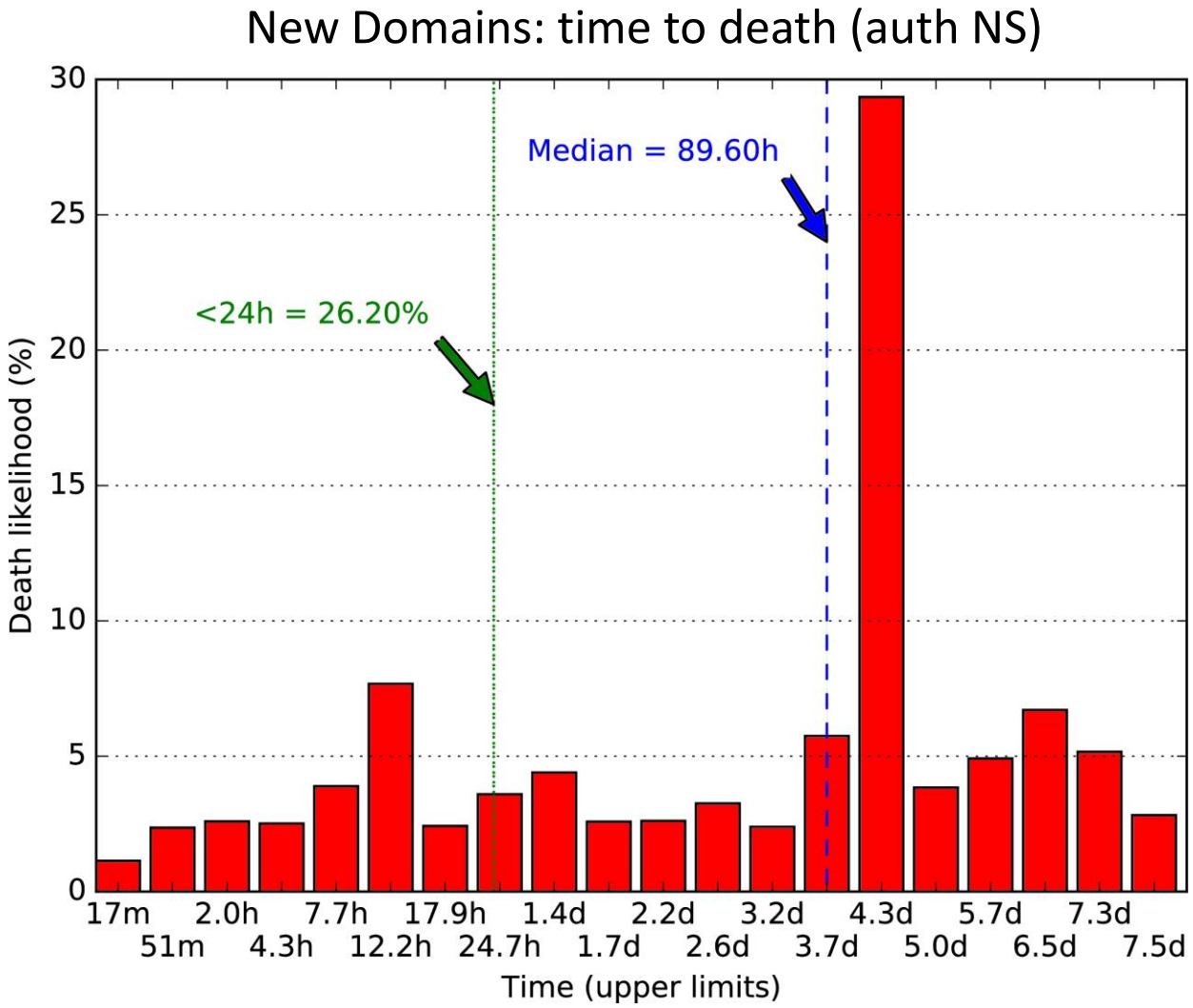
- Huge peaks at ~1h, ~1.5d, ~4d - impact of automated procedures?
- Delegators are much slower than DNSBLs: median ~2.2 days
- Only <22% deleted in <24h



Authoritative NS

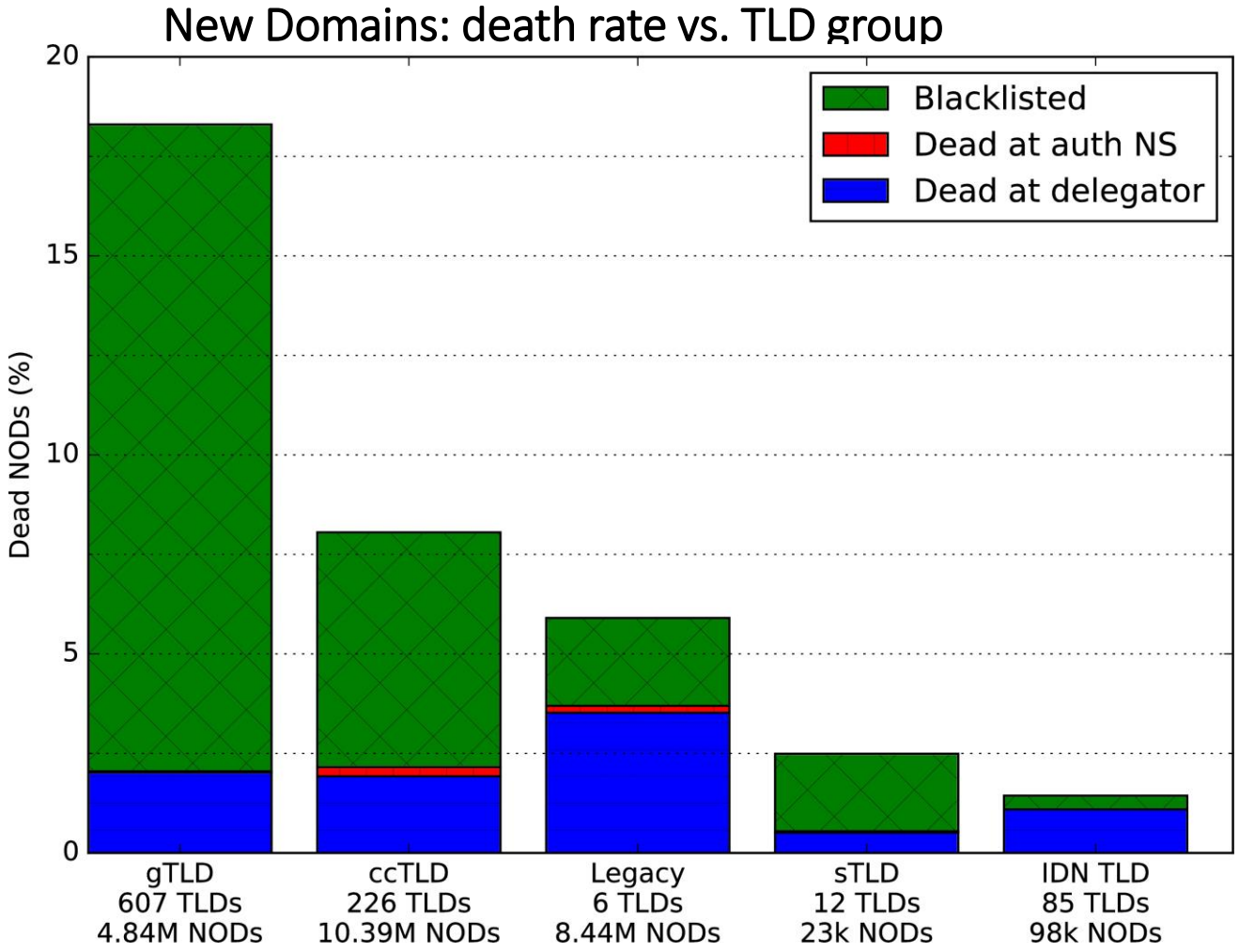
(drill-down into 4,400 NODs)

- Huge peak around 4 days, smaller around 12h
- Deaths at authoritative NS rare & slow: median ~3.7 days
- <27% of deaths at auth NS happen in <24h

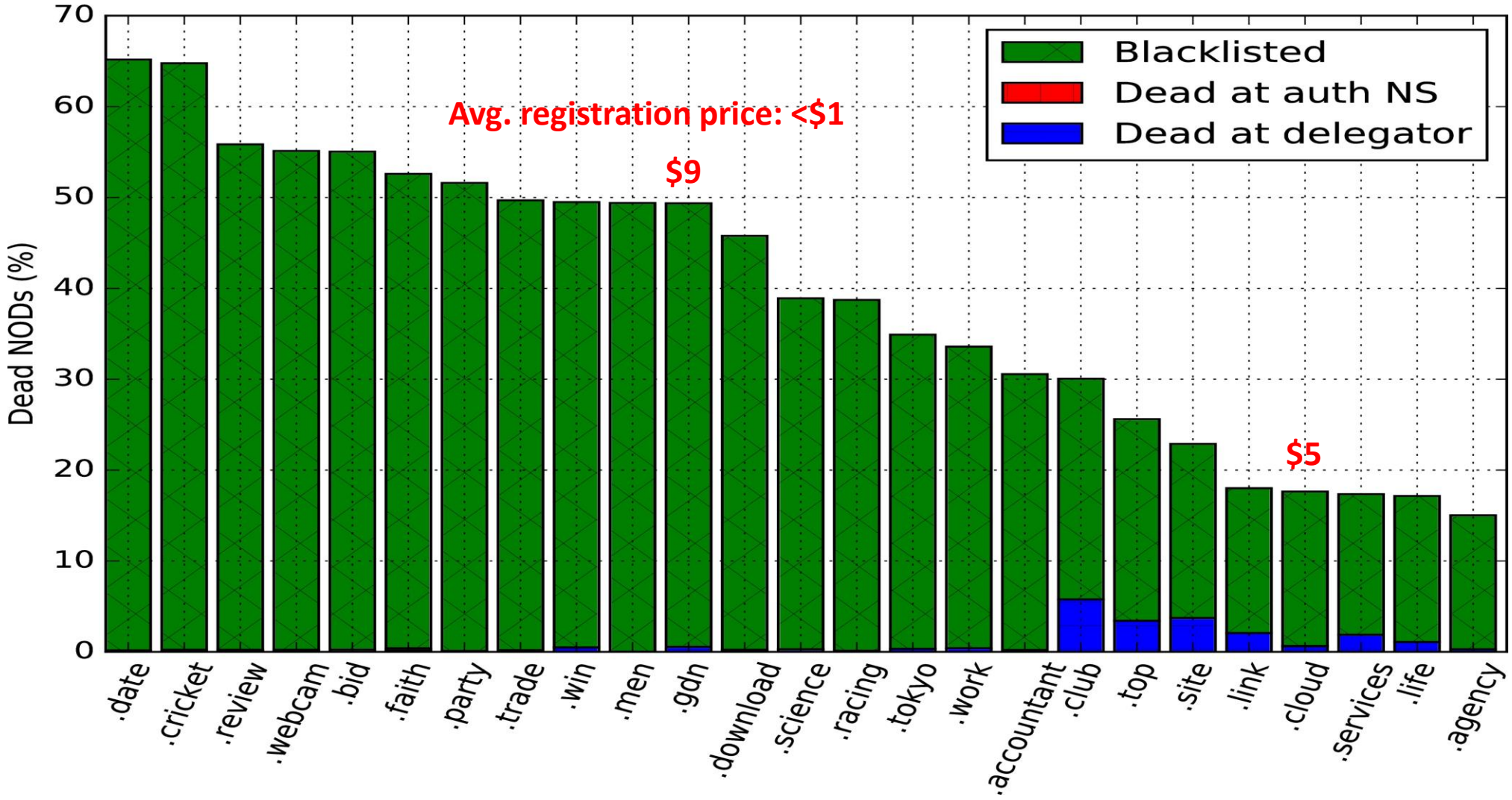


Impact of TLD Type

- Almost 1/5 of new gTLD domains die fast, usually due to blacklists
- Domains under Legacy TLDs usually die at the delegator
- 6.2% of domains in ccTLDs die fast, but these include .tk, .gq, etc.
- Domains in IDN and sponsored TLDs least likely to die fast (<2.5%)

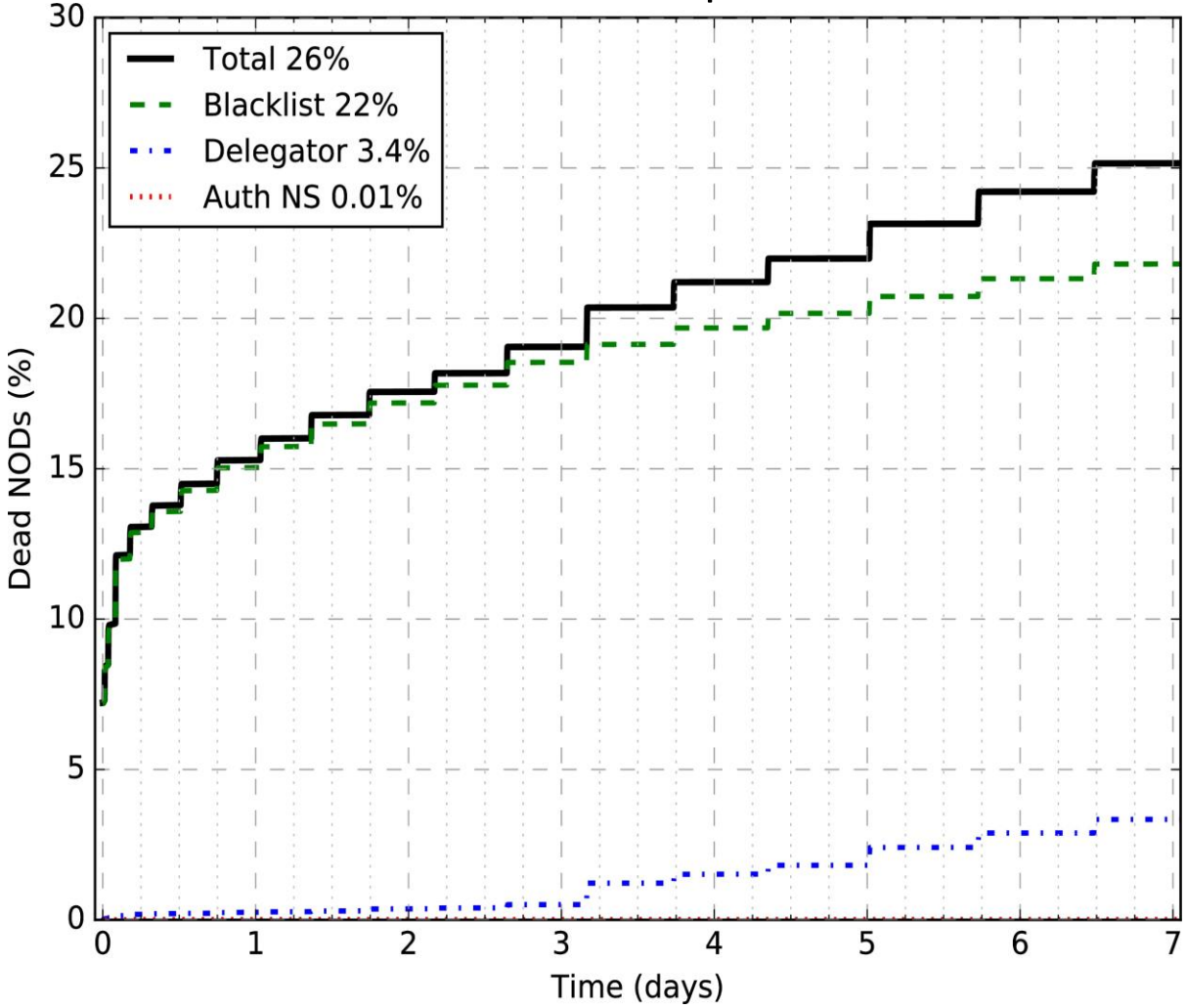


New Domains: top 25 gTLDs by death rate



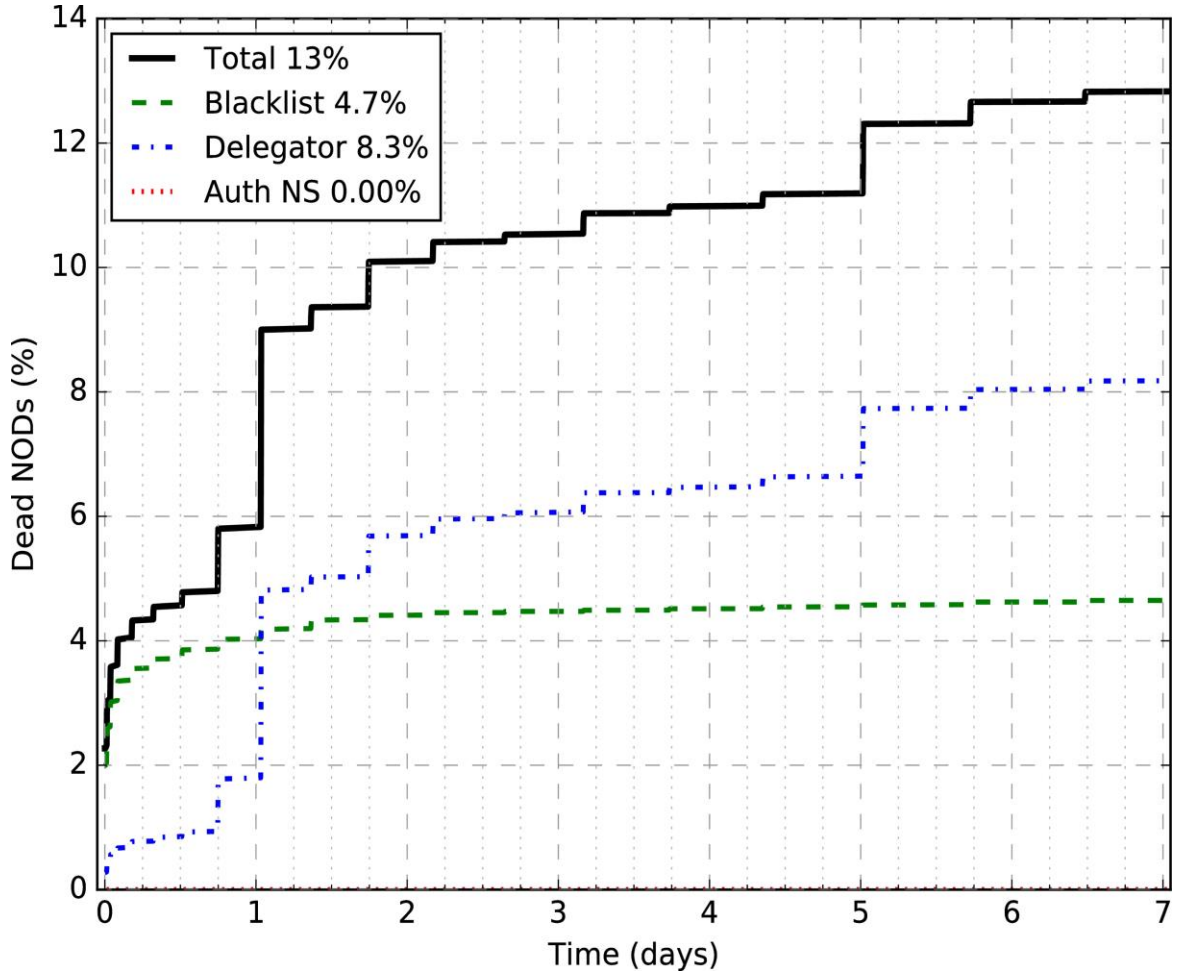
.top

New Domains under .top: causes of death

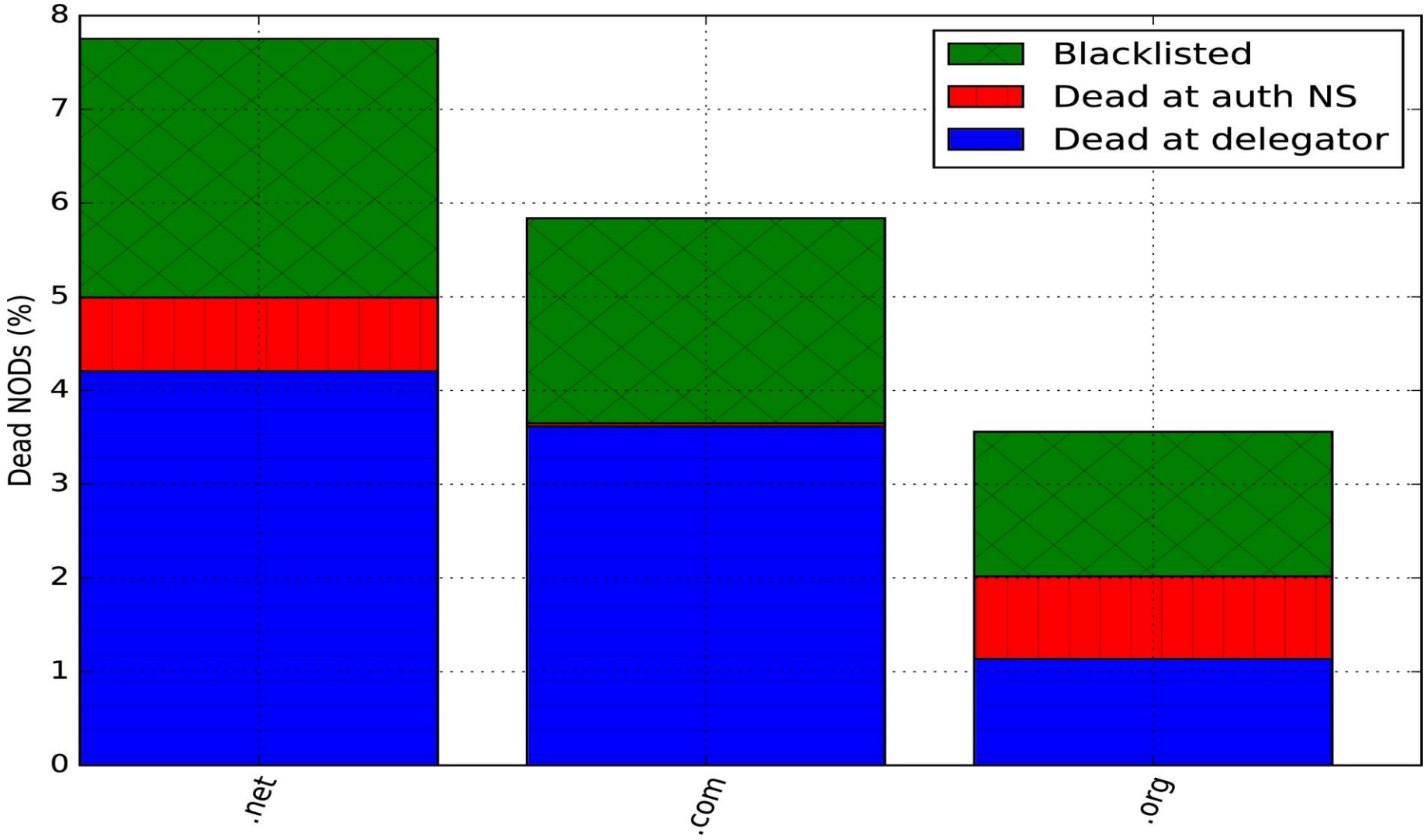


.xyz

New Domains under .xyz: causes of death

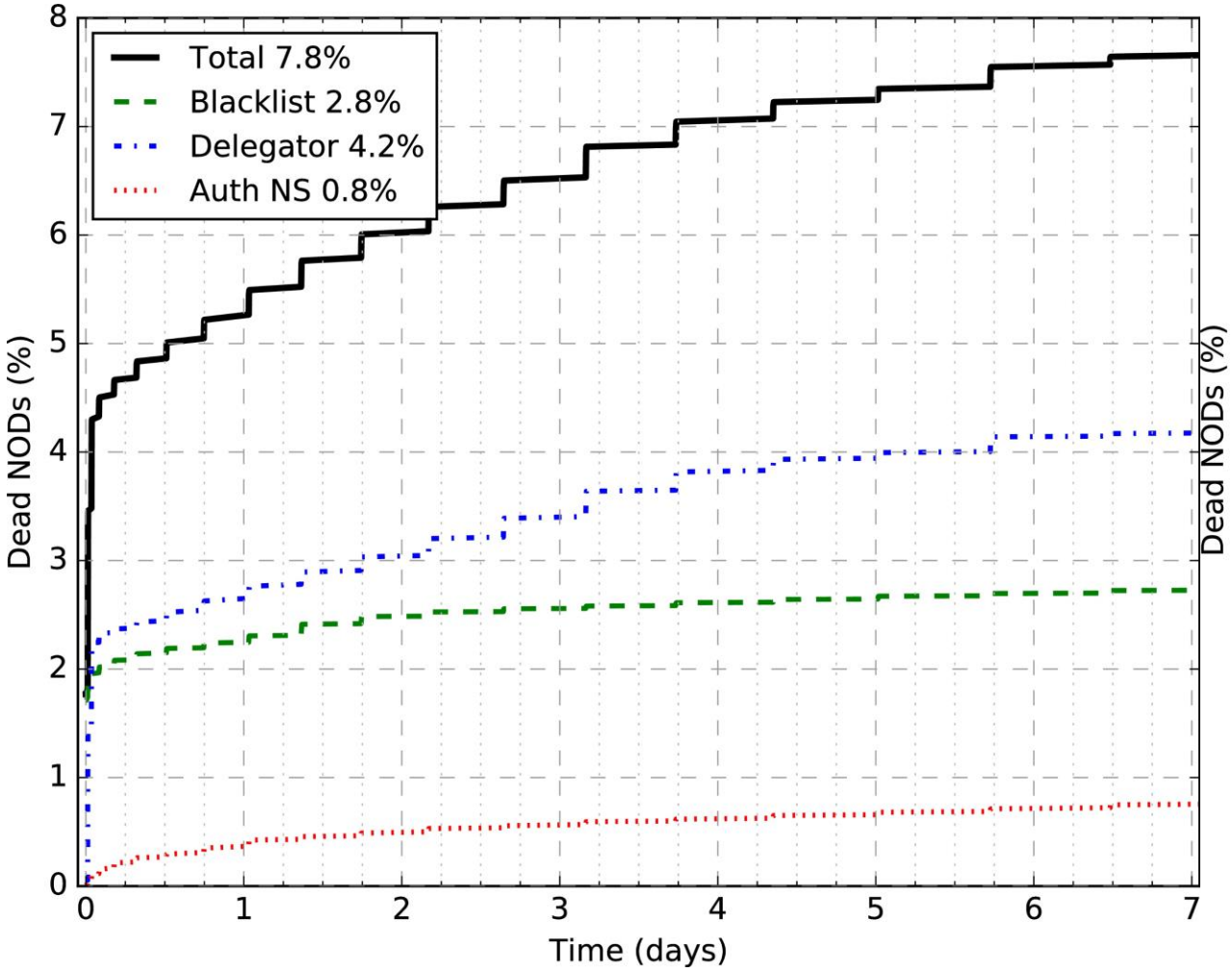


New Domains: top 25 Legacy TLDs by death rate



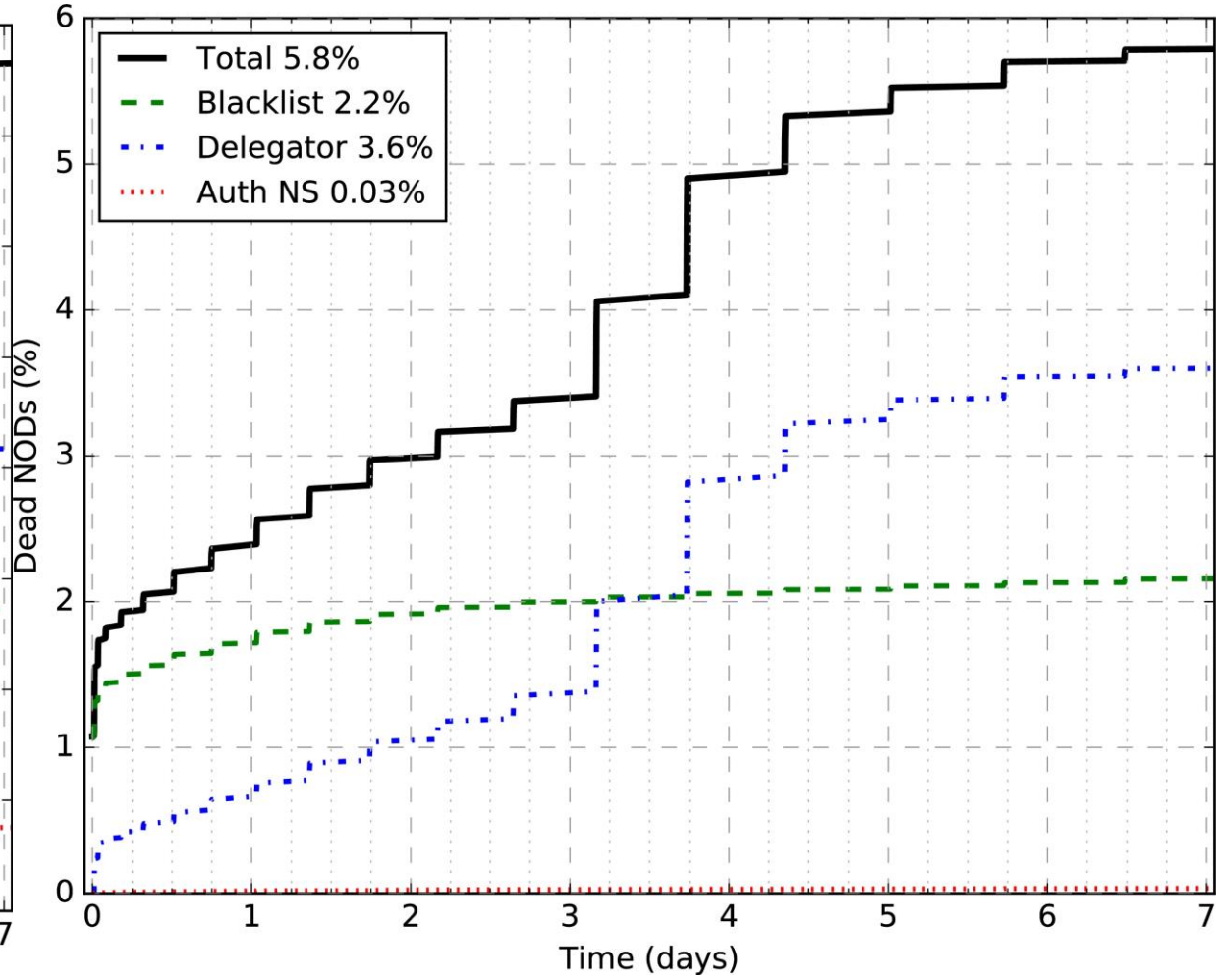
.net

New Domains under .net: causes of death

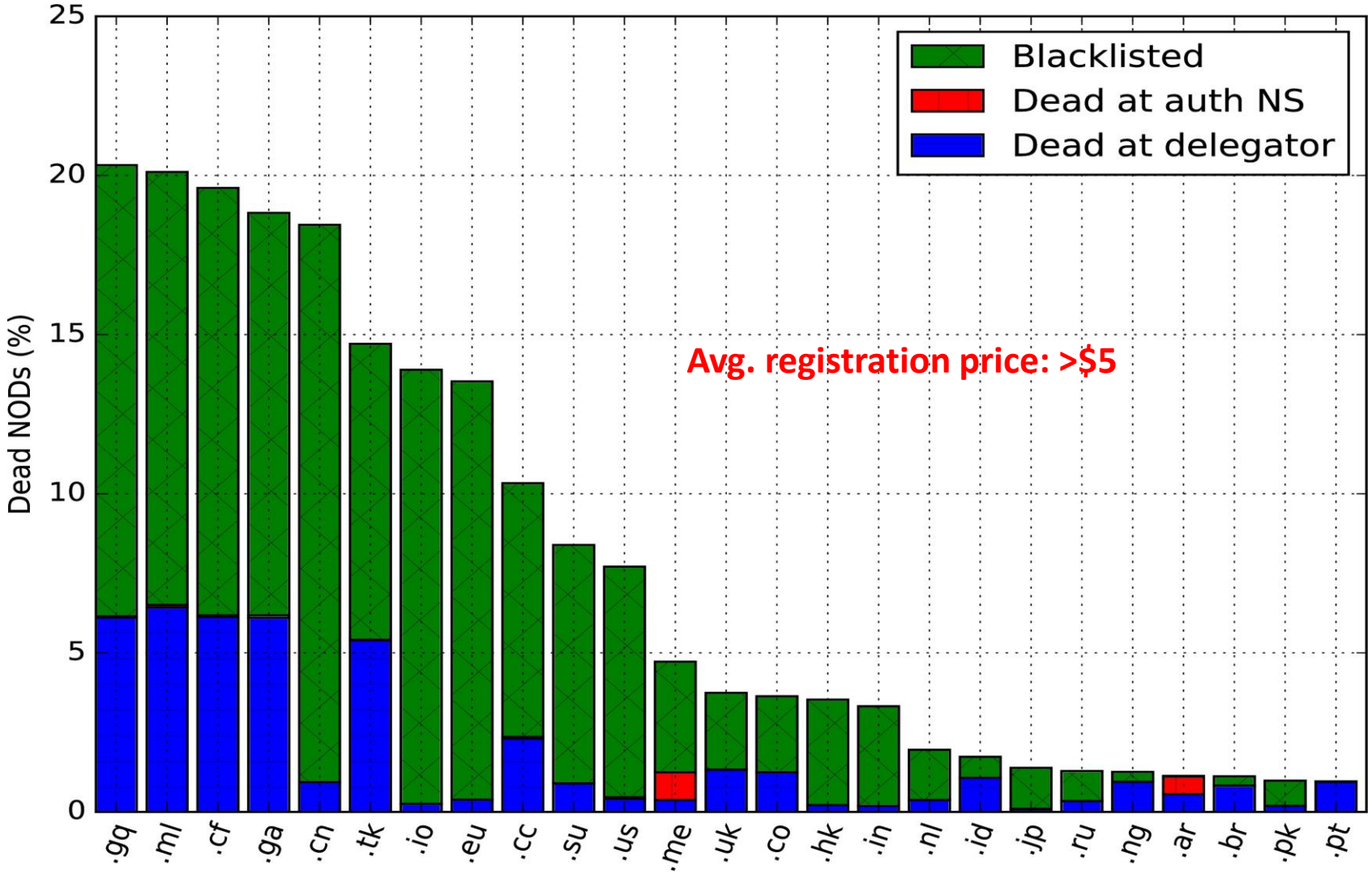


.com

New Domains under .com: causes of death

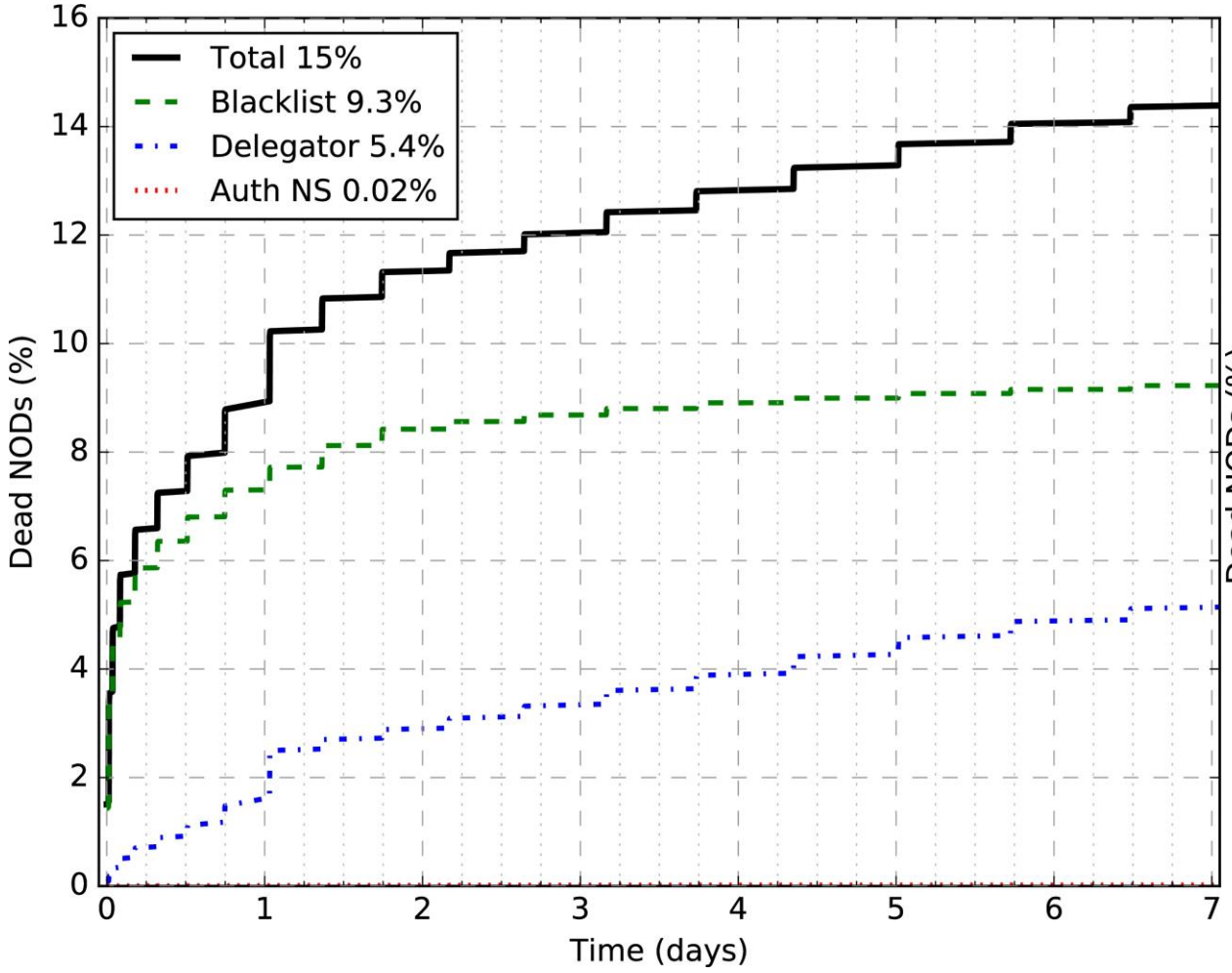


New Domains: top 25 ccTLDs by death rate



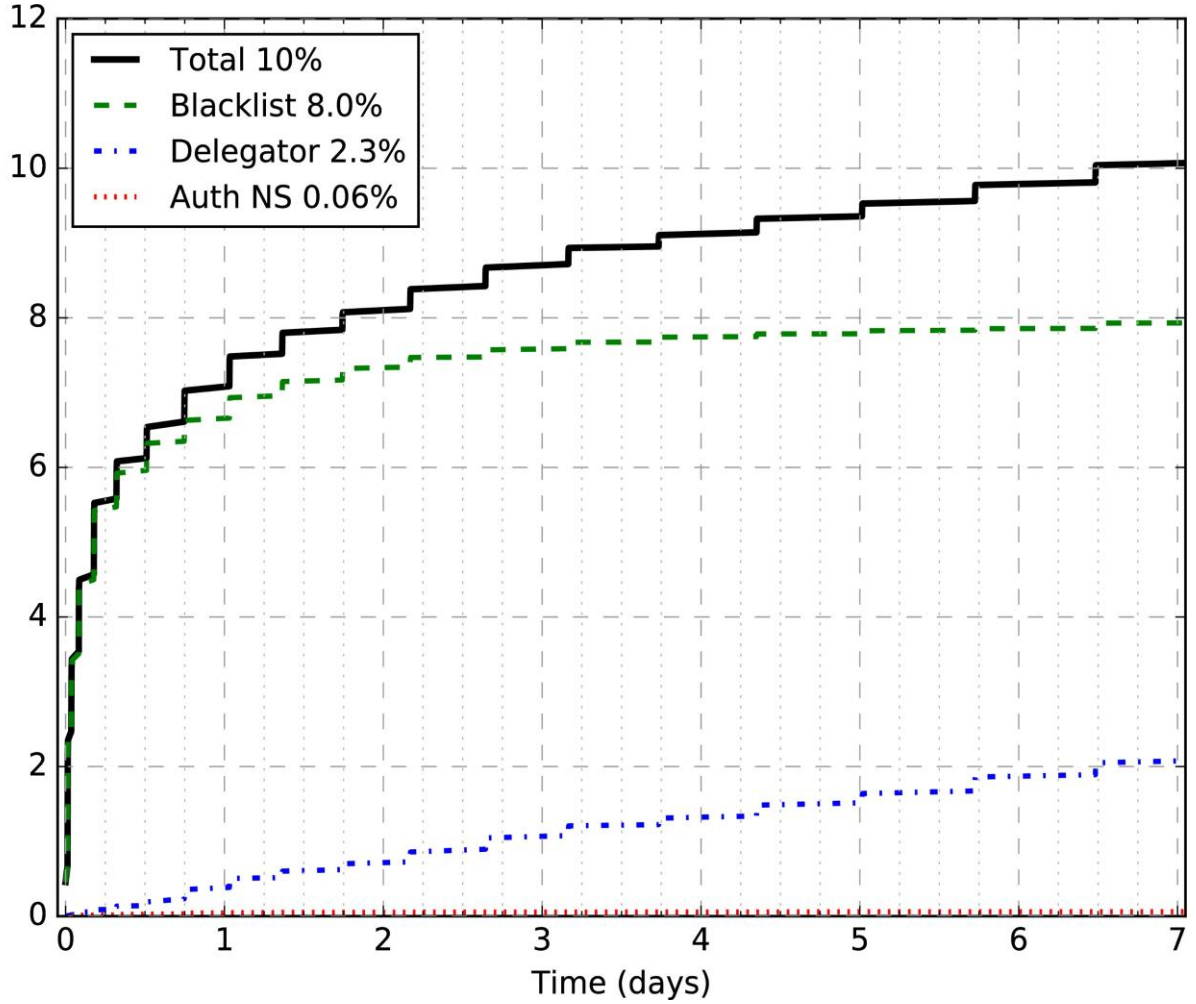
.tk

New Domains under .tk: causes of death



.cc

New Domains under .cc: causes of death



Summary & Takeaways

- NOD death rate varies among TLDs, **8.4% on average**
  - ...but some TLDs have >50% death rate
- Majority of NOD deaths **happen in <5h** on average
  - ...but blacklists kill in <2h
- **Blacklisting** is the main cause of NODs becoming effectively dead
  - delegators seem to use automated procedures (>1h, >1d, >4d)
  - NODs are rarely killed at their authoritative NS (0.2% avg.)
- Domains **under the new gTLDs** are much more likely to die fast (~⅕)