draft-moura-dnsop-authoritative-recommendations-03

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Draft History

- This is an **Informational** draft
- **Today:** first time presented at DNSOP
- Versions and mailing list discussion:
  - **-03 (2019-03-11)**: (minor changes from -02)
  - **-02 (2019-03-08):** link list thread (no responses)
  - **-01 (2018-12-20):** link list thread (no responses)
  - **-00 (2018-11-28):** link list thread
- Github link:
  - `https://github.com/gmmoura/draft-moura-dnsop-authoritative-recommendations`

Context

- 13 people that have had 5 research papers:
  - Draft authors + Ricardo de O Schmidt, Wouter B. de Vries, Moritz Müller, Lan Wei, Cristian Hesselman, Jan Harm Kuipers, Pieter-Tjerk de Boer and Aiko Pras.
- Relevant papers with *recommendations* backed by large-scale, Internet-wide measurements:
  - 4x ACM IMC
  - 1x PAM
- However, papers tend to be *long*, *detailed* – they explain *why*

This draft:

```
papers=[]
papers.append(Moura16b)
papers.append(Mueller17b)
papers.append(Schmidt17a)
papers.append(Vries17b)
papers.append(Moura18b)

for p in papers:
  recommendations = TLDR(p) #great filter :-)
  print(recommendations)
```

- Tangile,direct language to OPs folks interested on *what* to do
- Reader is referred to papers to understand *why*

Recommendations in a nutshell

- R1: Use equaly strong IP anycast in every authoritative server to achieve even load distribution [1]
- R2: Routing Can Matter More Than Locations [2]
- R3: Collecting Detailed Anycast Catchment Maps Ahead of Actual Deployment Can Improve Engineering Designs [3]
- R4: When under stress, employ two strategies [4]
- R5: Consider longer time-to-live values whenever possible [5]
- R6: Shared Infrastructure Risks Collateral Damage During Attacks [4]

R1: Use equaly strong IP anycast in every authoritative server to achieve even load distribution

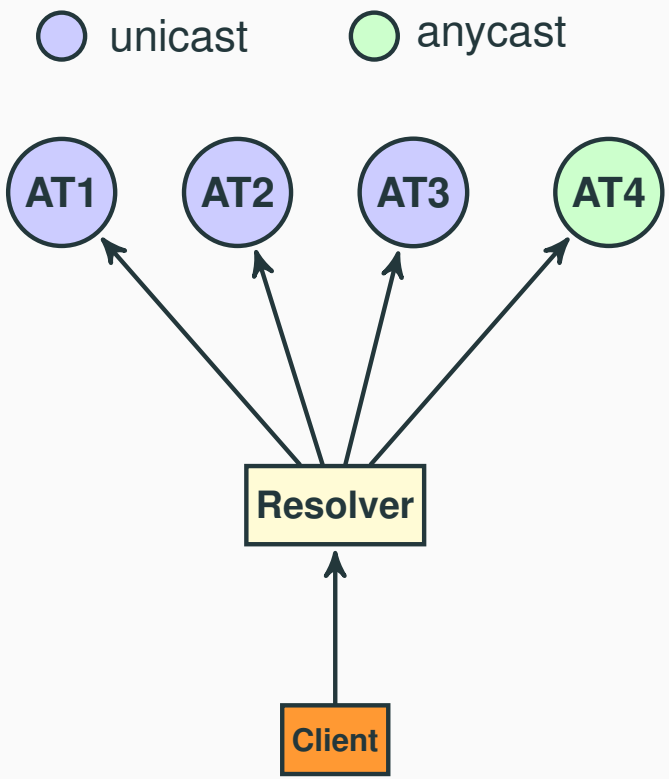

Figure 1: Clients, Resolver and authoritatives relationship.

- **Auth goal**: serve resolvers with *shortest* RTT
- Resolver **has to choose** from AT1–AT4

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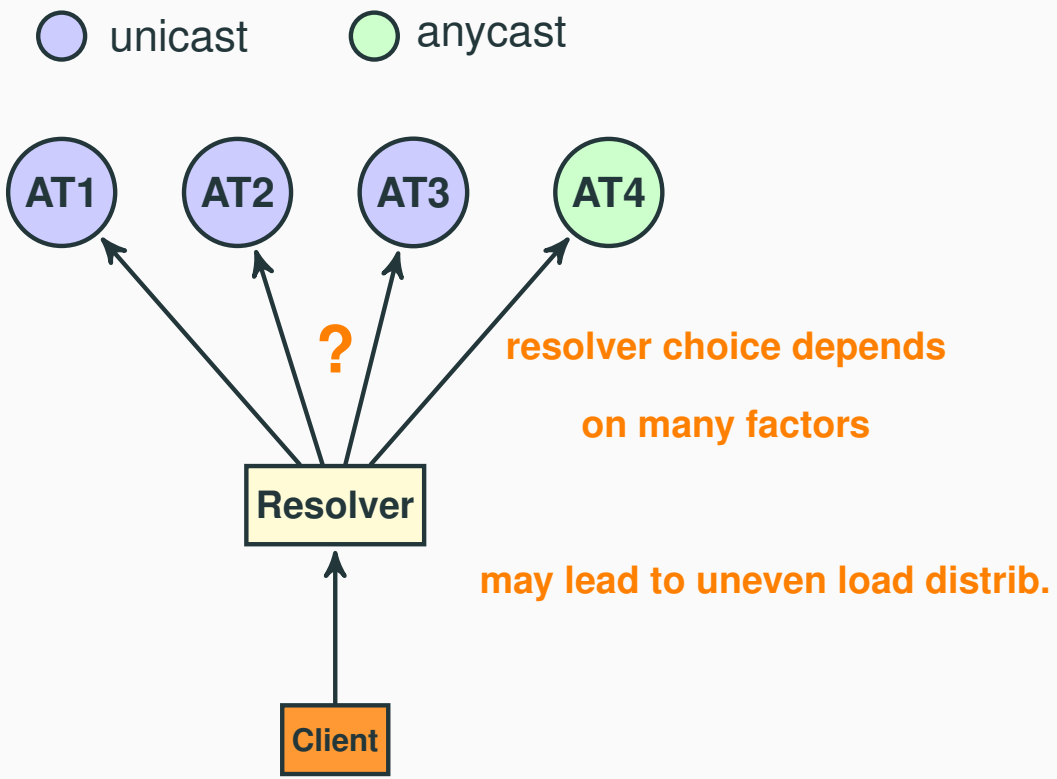

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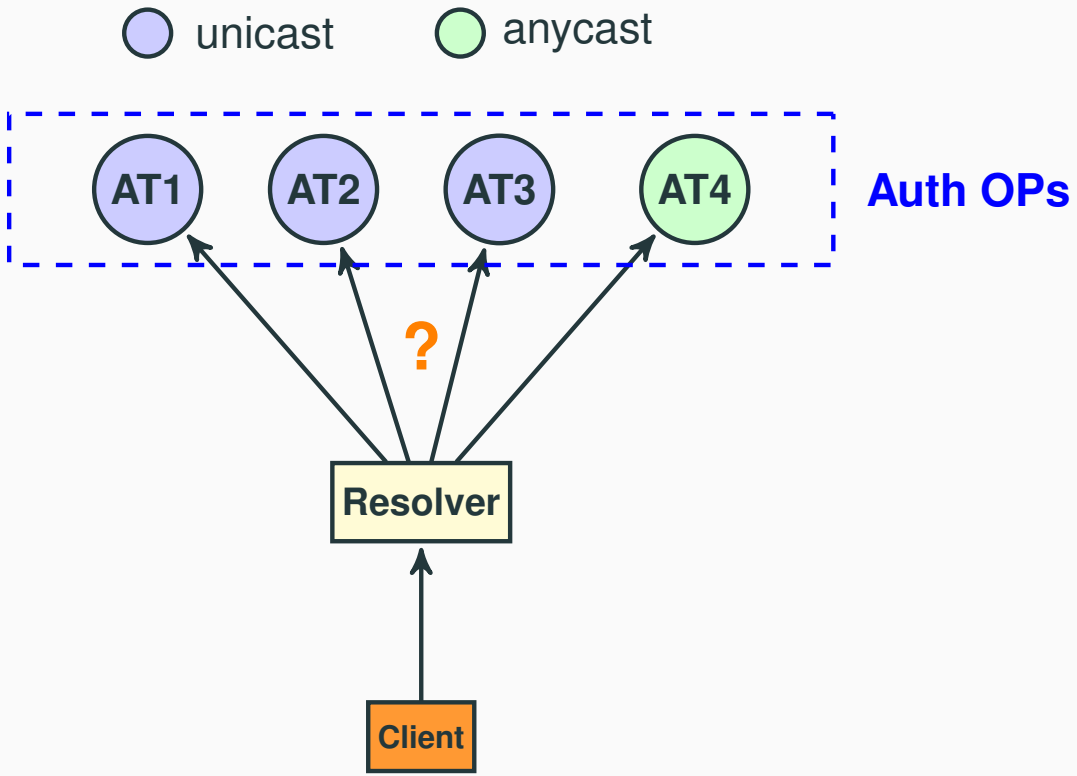

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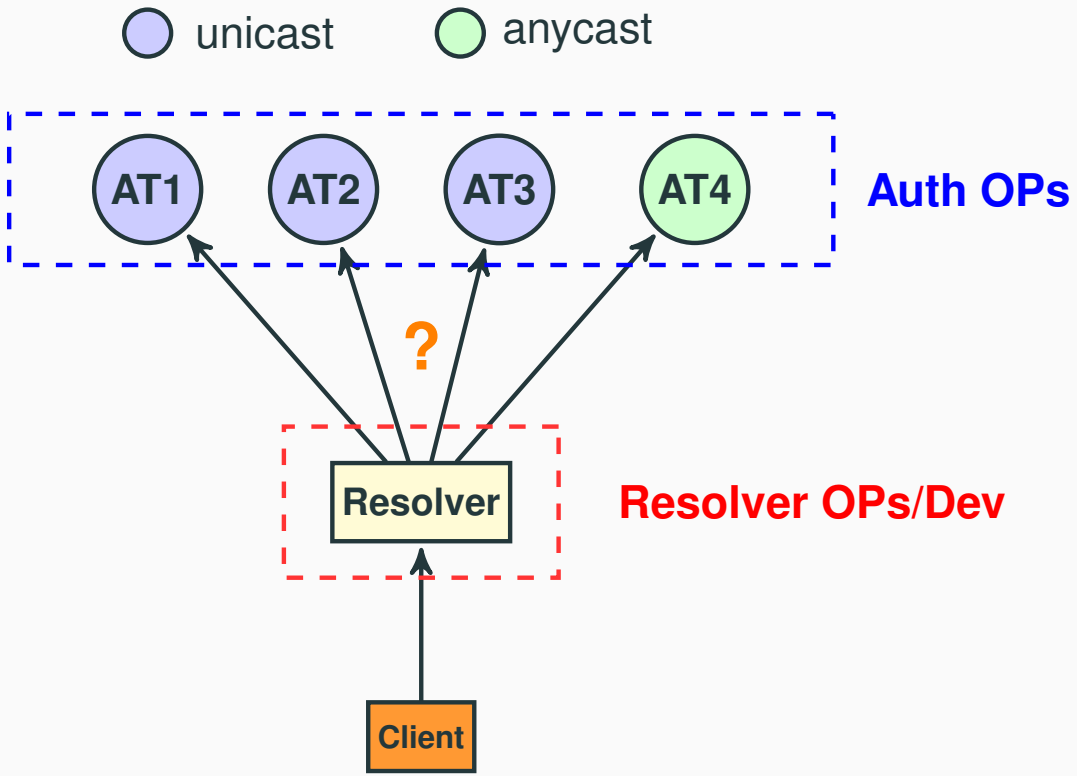

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R1: Use equaly strong IP anycast in every authoritative server to achieve even load distribution

- Finding using Atlas, `.nl`, and DITL (Root DNS) datas [1] :
  1. Resolvers query *all* available authoritatives
  2. However, their load distribution is uneven: closer authoritatives get *more* queries – but not all
- Implications:
  - For an auth operator, the latency of *all* authoritative matter
  - Unicast, by definition, cannot deliver good global performance
  - [1] recommends then use anycast in *all* NS records, equally strong (peering and capacity), and phase out unicast.
  - This has been applied in `.nl`.

R2: Routing Can Matter More Than Locations

- When choosing an anycast DNS provider, people always ask "how many sites/instances" it has
- People sometimes assume more sites/instances lead to better client's experience (lower RTT)
- [2] shows that this is not always true, and that *routing* can matter more than number of locations. For example:
  - `c-root`: 8 locations.
  - `k-root`: 33 locations
  - `l-root`: 144 locations
  - Their **median RTT: 30–32 ms** to 7.9k Atlas probes

R2: Routing Can Matter More Than Locations

- Why? BGP is agnostic to geographical distance
- [2] thus recommends to consider routing and connectivity when engineering DNS anycast services
- They show that 12 sites is enough to provide good global latency
- However, more sites may be helpful in case of DDoS [4]

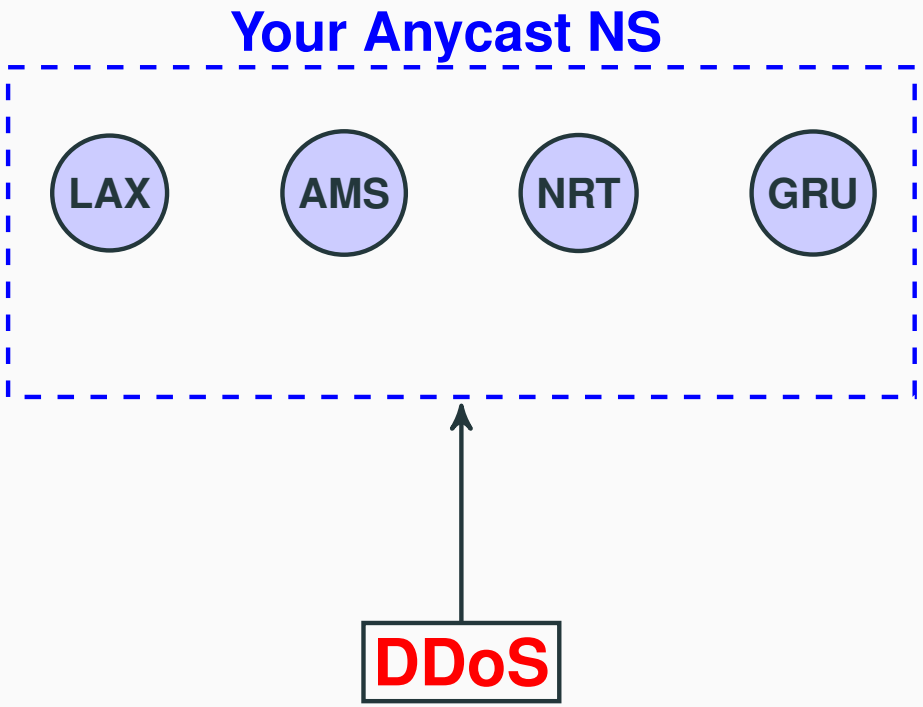
R3: Collecting Detailed Anycast Catchment Maps Ahead of Actual Deployment Can Improve Engineering Designs

- Say you run an anycast service with *n* instances
- Say you want to add 1 more instance in SFO
- How will that affect traffic among your other locations?
  - Very hard to predict
  - BGP maps clients to locations

R3: Collecting Detailed Anycast Catchment Maps Ahead of Actual Deployment Can Improve Engineering Designs

- Solution: detailed anycast catchment maps
- [3] present a tool (Verfploeter) that does that using ICMP
- They predicted `b-root` catchments and query loads:
  - Load predict going to `b-root` LAX instance: 81.6%
  - Actual load: 81.4%.
- OPs: you can use it on a test prefix, announced from the same locations as your production network; run it with different configurations and make informed choices
- To date: running on a testbed, B-root, and a large unnamed operator.

R4: When under stress, employ two strategies



- BGP will map traffic to locations
- What to do? Depends on the attack
  1. **Do nothing and let LAX become a degraded absorber**
  2. **Withdraw/prepend routes to shift traffic**
- Best option depends on attack and NS specifics

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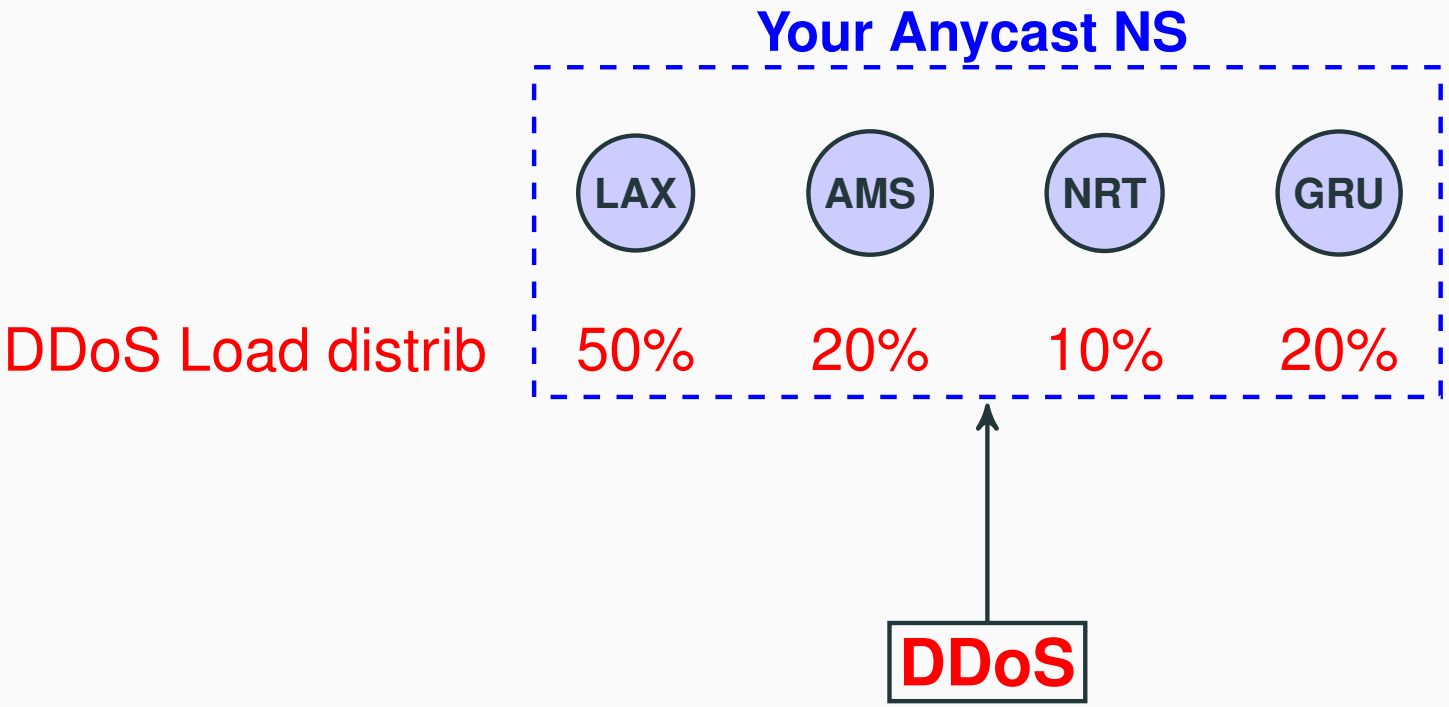

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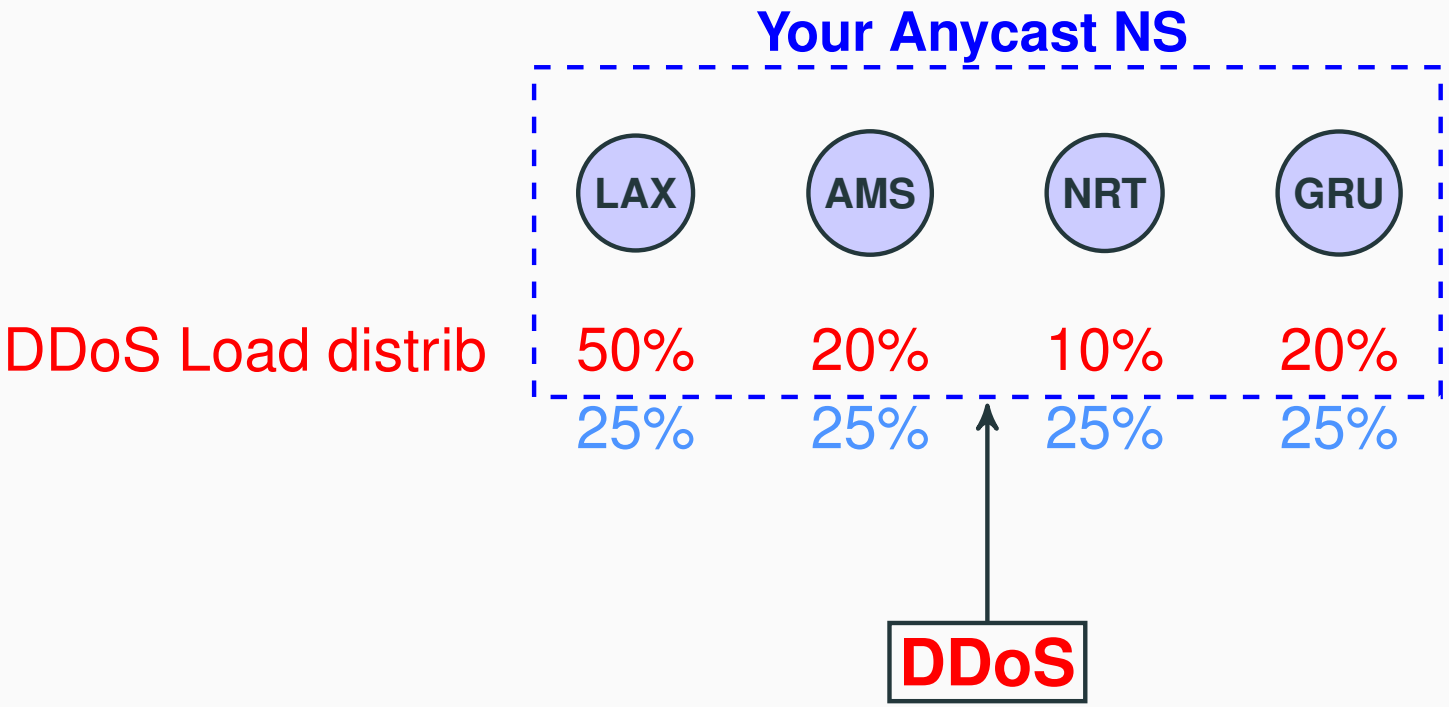

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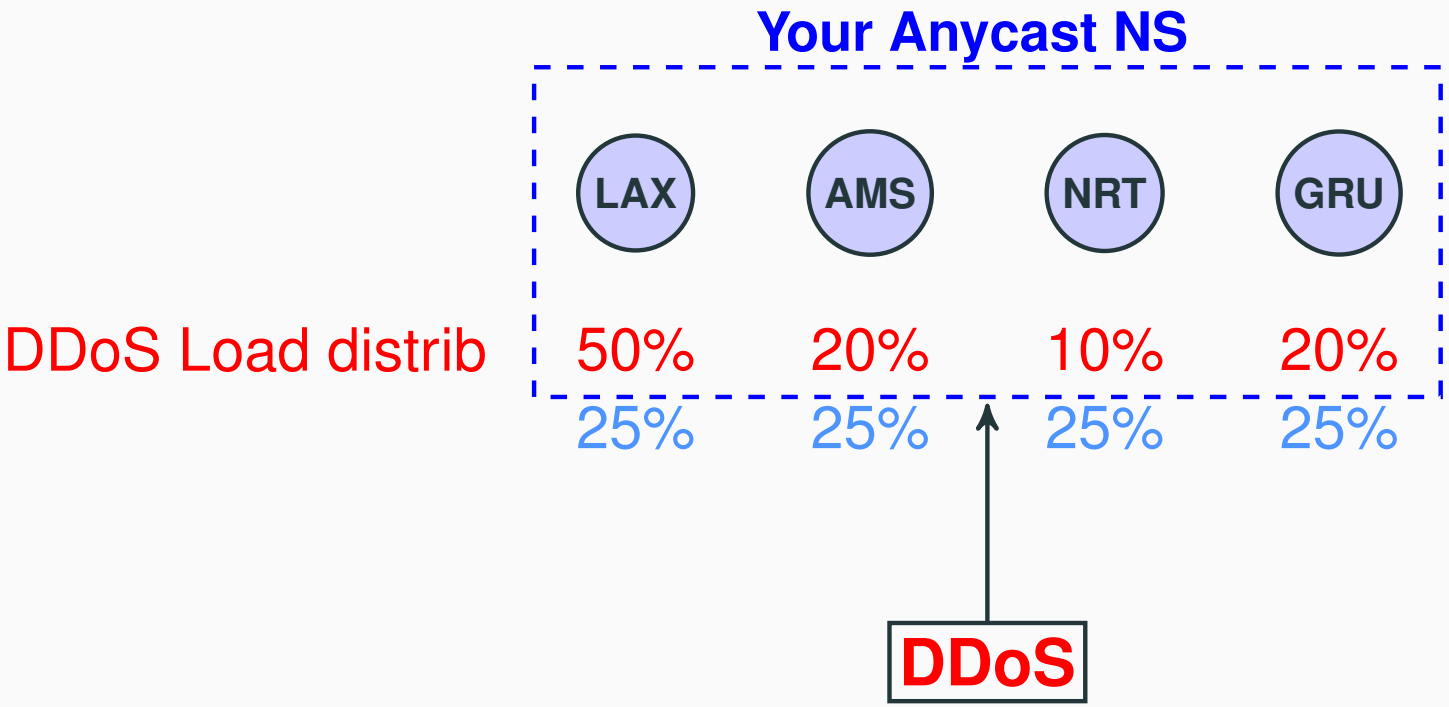

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R5: Consider longer TTL values whenever possible

- TTLs set how long queries should remain in resolver's cache
  - Sort of "ephemeral replication"
- They also emulate DDoS attacks (50-100% packet loss)

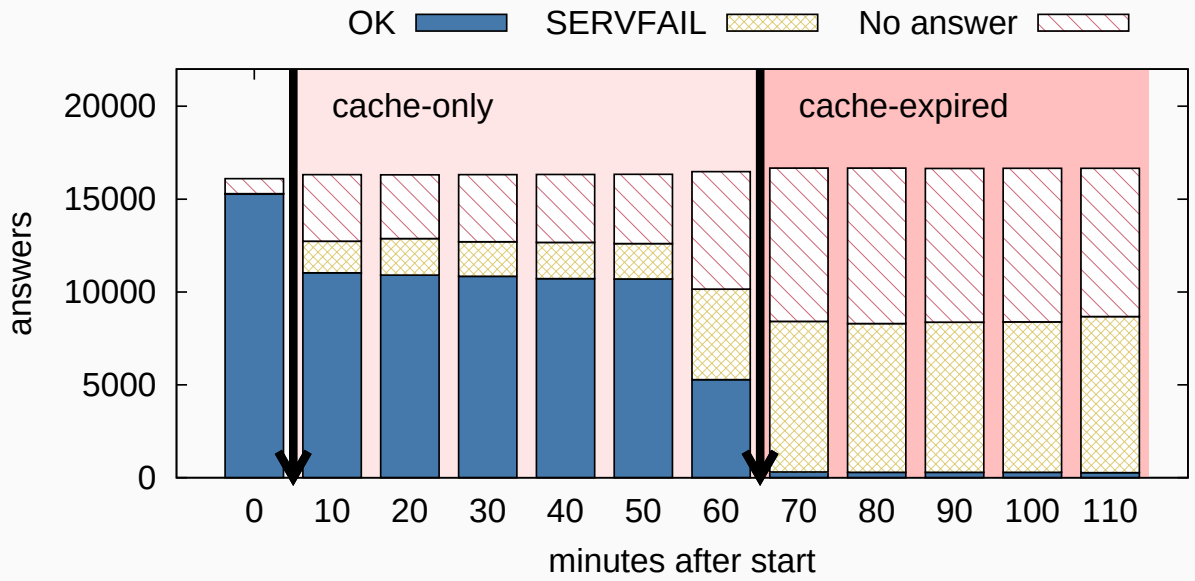

Figure 2: TTL: 1h; 100% Packet loss after $t = 10$min

R5: Consider longer TTL values whenever possible

- Caching is a *key* component of resolver's resilience
- Retries as well – to the point that resolvers may "hammer" authoritatives
- As such, [5] recommend longer TTLs whenever possible

R6: Shared Infrastructure Risks Collateral Damage During Attacks

- Be careful when hiring/engineering DNS services: co-location implies you shared some (parts of the) infrastructure
- [4] found that co-located `.nl` sites suffered during DDoS against Roots
- Dyn 2016 Attack shows the same
- OPS: be aware of shared infrastructure risk

Questions?

- Draft on GitHub: https://github.com/gmmoura/draft-moura-dnsop-authoritative-recommendations

References I

[1] M. Müller, G. C. M. Moura, R. de O. Schmidt, and J. Heidemann, “Recursives in the wild: Engineering authoritative DNS servers,” in *Proceedings of the ACM Internet Measurement Conference*, London, UK, 2017, pp. 489–495. [Online]. Available: http://www.isi.edu/%7ejohnh/PAPERS/Mueller17b.html

[2] R. d. O. Schmidt, J. Heidemann, and J. H. Kuipers, “Anycast latency: How many sites are enough?” in *Proceedings of the Passive and Active Measurement Workshop*. Sydney, Australia: Springer, Mar. 2017, p. to appear, awarded Best Paper. [Online]. Available: http://www.isi.edu/%7ejohnh/PAPERS/Schmidt17a.html

References II

[3] W. B. de Vries, R. de O. Schmidt, W. Hardaker, J. Heidemann, P.-T. de Boer, and A. Pras, “Verfploeter: Broad and load-aware anycast mapping,” in *Proceedings of the ACM Internet Measurement Conference*, London, UK, 2017. [Online]. Available: http://www.isi.edu/%7ejohnh/PAPERS/Vries17b.html

[4] G. C. M. Moura, R. de O. Schmidt, J. Heidemann, W. B. de Vries, M. Müller, L. Wei, and C. Hesselman, “Anycast vs. DDoS: Evaluating the November 2015 root DNS event,” Nov. 2016. [Online]. Available: https://www.isi.edu/%7ejohnh/PAPERS/Moura16b.html

References III

[5] G. C. M. Moura, J. Heidemann, M. Müller, R. de O. Schmidt, and M. Davids, “When the dike breaks: Dissecting DNS defenses during DDoS,” in *Proceedings of the ACM Internet Measurement Conference*, Oct. 2018. [Online]. Available: https://www.isi.edu/%7ejohnh/PAPERS/Moura18b.html