

# DNS Monitoring with Anteat

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# This talk

- Based on a technical report
  - **Old but Gold: Prospecting TCP to Engineer DNS Anycast (extended)**
  - <https://www.isi.edu/~johnh/PAPERS/Moura20a.pdf>
- We show how rich is DNS over TCP for anycast engineering
- We presented this report at DNS-OARC34, for full video check:
  - [https://youtu.be/K\\_3zTY3gAgo?list=PLCAxS3rufJ1eZ3q9IcQ2QFT4fwasAqttL&t=3754](https://youtu.be/K_3zTY3gAgo?list=PLCAxS3rufJ1eZ3q9IcQ2QFT4fwasAqttL&t=3754)
- Today: more focus on the tool (Anteater)
- For DNS/TPC RTT background: check OARC34 presentation and technical report.

## Latency is key in DNS (but hard to measure)

- Authoritative OPs will use whatever tools to reduce latency:
  1. multiple NSes
  2. Anycast
  3. Peering/IXPs
  4. ...
- But is **hard to know** client's latency:
  1. Ripe Atlas, Thousand Eyes: good but not complete coverage
  2. Verfploeter [1]: requires ICMP measurements
    - Verfploeter is ran typically daily, as it is expensive
    - Difficult to apply to IPv6 (hitlist)

# What if there was a better way ?

- A method that:
  - Comes from *real-clients*
  - Works well with IPv6
  - Requires *no extra* measurements (passive only)
- Well, there is one: **DNS over TCP (DNSTCP)**
  - RTT measured from handshake (or takedown)
  - we've been using for 1.5 years at SIDN (.nl)
  - helped to solve several issues
  - fulfills all the above

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## TCP RTT history: old but gold

- TCP RTT estimation has been used since 1996 [2]
- Widely used in passive analysis of HTTP (FB uses it [5])
- It has been applied on DNS multiple times:
  - Roy Arends (2012)
  - Casey Deccio (2018)
  - Maciej Andzinski [3] (2019)
  - Our tech report (2020) [4]

## So what's NEW with our work?

- extensive and comprehensive methodology validation
  - Is the TCP data representative?
  - Are the UDP and TCP latency comparable?
- acted upon the data with 4 operators (Anycast A, B, B-Root, and Google)
  - We identify several use cases and issues
  - We manipulated BGP to fix those issues
  - We document it carefully
- use in real-time within .nl to detect anomalies
  - Route leaks
- Release our monitoring tool (Anteater) open source:
  - <https://github.com/SIDN/anteater>

TCP traffic **MUST**:

1. Provide enough **coverage** (spatial and temporal)
  - you know, most DNS traffic is still UDP
2. provide **similar latency** to UDP
  - so we can generalize the results



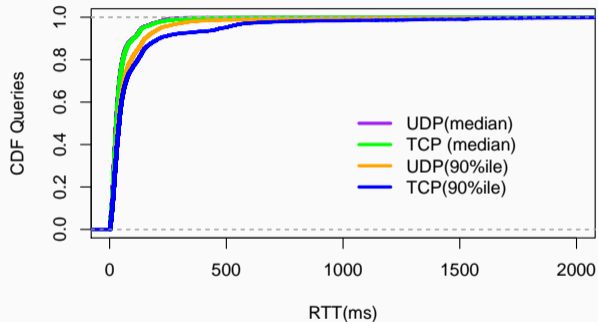
# Is DNS traffic representative?

	Queries		Resolvers		ASes	
	Anycast A	Anycast B	Anycast A	Anycast B	Anycast A	Anycast B
Total	5 237 454 456	5 679 361 857	2 015 915	2 005 855	42 253	42 181
IPv4	4 005 046 701	4 245 504 907	1 815 519	1 806 863	41 957	41 891
UDP	3 813 642 861	4 128 517 823	1 812 741	1 804 405	41 947	41 882
TCP	191 403 840	116 987 084	392 434	364 050	18 784	18 252
<i>ratio TCP</i>	5.02%	2.83%	21.65%	20.18%	44.78%	43.58%
IPv6	1 232 407 755	1 433 856 950	200 396	198 992	7 664	7 479
UDP	1 160 414 491	1 397 068 097	200 069	198 701	7 662	7 478
TCP	71 993 264	36 788 853	47 627	4 6190	3 391	3 354
<i>ratio TCP</i>	6.2%	2.63%	23.81%	23.25%	44.26%	44.85%

**Table 1:** DNS usage for two authoritative services of .nl (Oct. 15–22, 2019).

- 5% of clients, 20% of resolvers, and 44% of ASes
- You get this for free

## DNS: TCP vs UDP latency are comparable



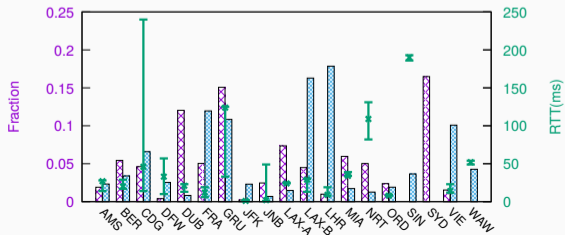
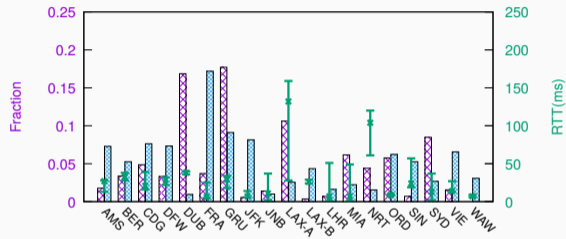
**Figure 1:** L-Root: CDF of median and 90%ile RTT for DNS/UDP and DNS/TCP.

## OK, so what can we do with it?

- DNS/TCP provides enough VPs
- Has similar latency than UDP
- Measure real clients
- No costs
- Easily copes with IPv6
- Requires no extra measurements
- Can be run in real time

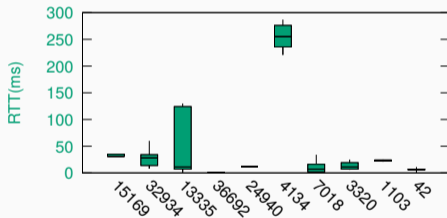
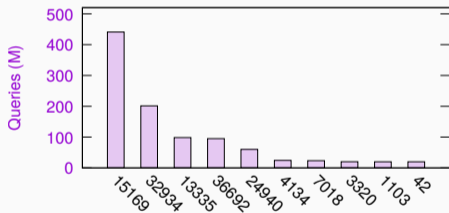
# Prioritizing Analysis: by Site

Anycast B: IPv4 and IPv6 RTT per site



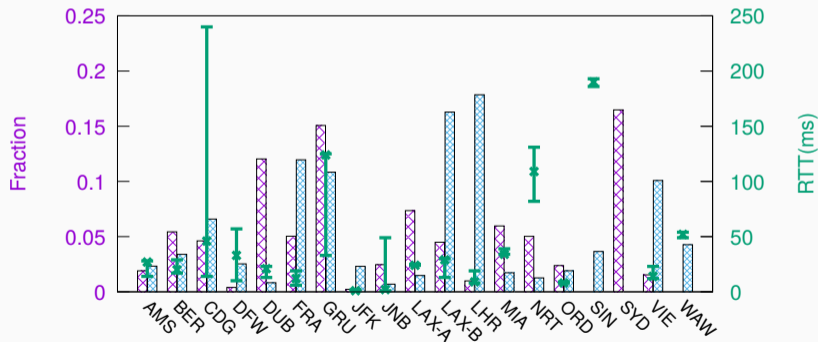
# Prioritizing Analysis: by client AS

Anycast B: IPv6 queries and RTT per client AS



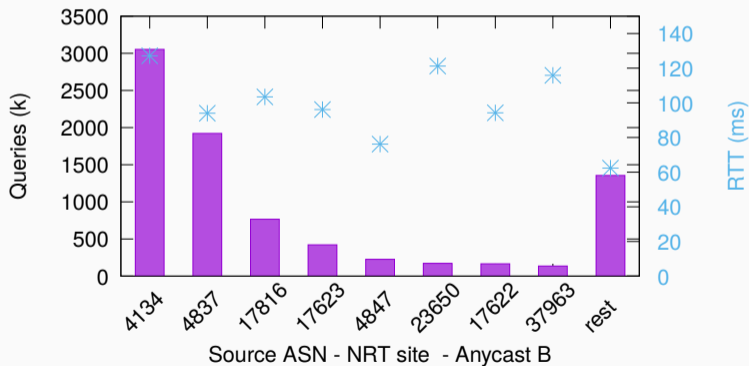
## Problems: Distant Lands

- A client is mapped by BPG to far distant anycast sites
- Some sites have a large RTT value or spread (CDG, SIN, NRT)
- We can see that using DNS/TCP RTT



## Solutions: Distant Lands (NRT)

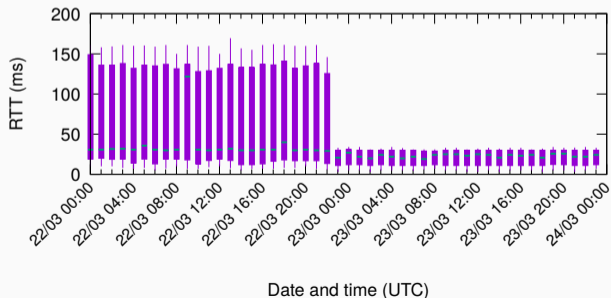
- Causes: No presence/direct peer with Chinese ISPs
- Chinese int'l connections can exhibit congestion [6]
- Fix: site in China (OPs clients may not be comfortable) or direct peer (\$)



**Figure 2:** Anycast B, Japan site (NRT): Top 8 querying ASes are Chinese, and responsible for

## Problems: prefer customer to another continent

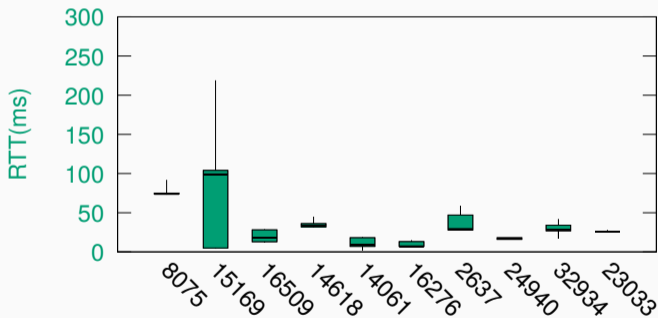
- Common BGP policy: prefer customer
  - if AS can satisfy route via customer, so be it
- But sometimes it takes clients to another continent
- We found Comcast (US, AS7922) reaching Anycast B via GRU site (Brazil)
- We contacted the Operator; fixed with right BGP community





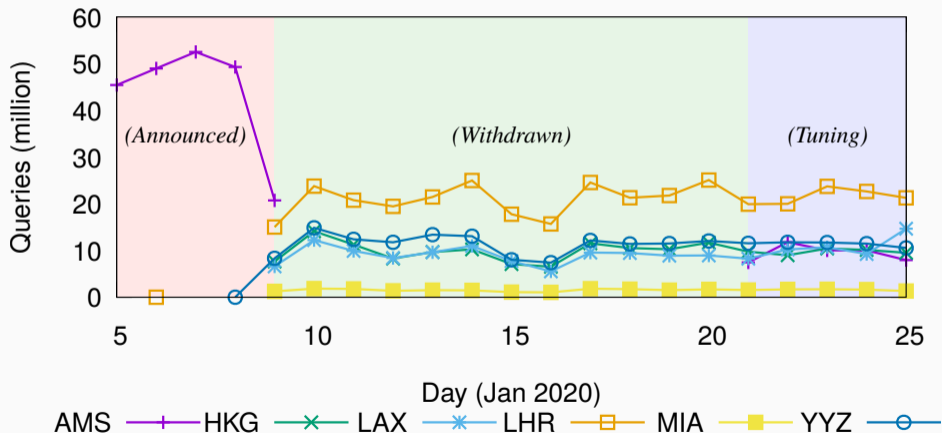
## Problem: Anycast Polarization

- We found that MS (8075) and Google (15169) had high latencies to Anycast A
- And they are the top 2 client ASES



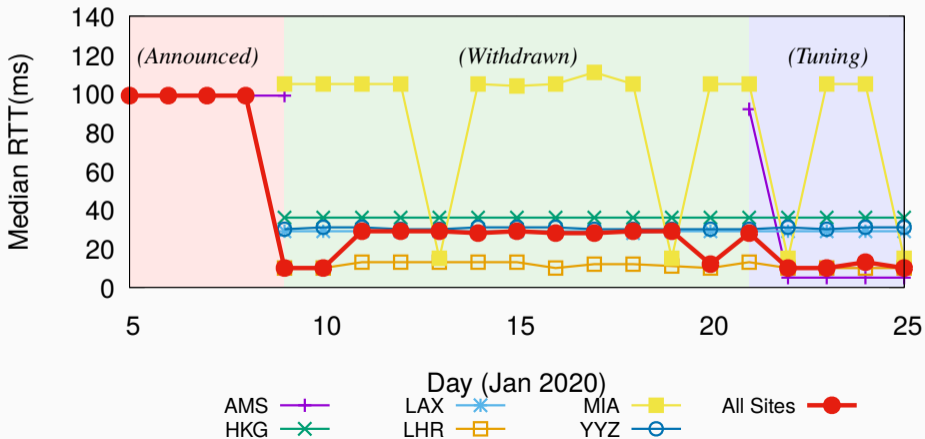
## Problem: Google Polarized → high latency

- All Google Traffic was going to AMS site only : RTT 100ms

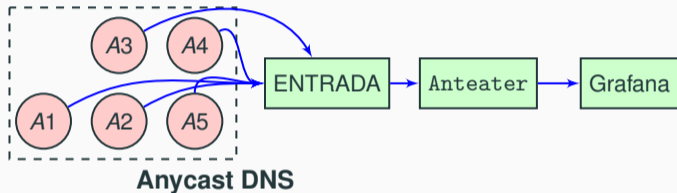


## Solution: Depolarizing traffic from Google (BGP)

- We fixed the issue with BGP manipulations
- Median latency: from 100ms to 10ms.



## Near-real time Anycast Monitoring: Anteater



**Figure 6:** DNS/TCP RTT near real-time monitoring at .nl

<https://github.com/SIDN/anteater>

## DEMO



- DNS/RTT are useful for Anycast Engineering
- We document Anycast Polarization, and shed latency in 90ms
- We've been using it for over 1.5 year at SIDN (.nl)
- We've released Anteater open source! Download it
  - <https://github.com/SIDN/anteater>
- Tech report: <https://www.isi.edu/~johnh/PAPERS/Moura20a.html>

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