# Comparison of RRL in BIND, Knot DNS and NSD

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# Background

- In March an L.root-servers.net node in Hamburg was being used in an amplification attack
- Mitigated with NSD RRL
- Felt that the decrease in outbound traffic was smaller than we expected
- Decided to do some comparison testing of the different RRL implementations

# Comparison

- Compared RRL performance in the following implementations
  - BIND9 (9.9.2)
  - BIND10 (20130503)
  - Knot DNS (1.2)
  - NSD3 (3.2.15)
  - NSD4 (4.0.0b4)

# Lab

- Used the OARC lab for this work
  - Uncontentious place for others to bring their data
  - Others can easily be given access to what I did to run it for themselves
  - Many thanks to Keith, William and Geoff for making this work

# Lab environment

- 3 servers
  - Query generator
  - Nameserver
  - Response collector
- Running Ubuntu 12.04
- GigE switch

# Queries

- 25 minutes of traffic captured at ham01
- 5 x 5 minute pcaps
- Stripped out TCP
- Replayed toward the nameserver with tcpreplay
- Static route to L-root pointed at the nameserver

# Nameservers

- Installed Non-RRL and RRL builds of all nameservers (except Knot, in 1.2 it's built in by default so I used the Ubuntu package)
- Ran each nameserver with Non-RRL and RRL configurations. Config files were kept as simple as possible. Didn't optimize for performance, only care about RRL.
- Configured with L-root service addresses

# Response Collector

- Nameserver default route pointed at the collector
- Collected responses with tcpdump

# Tests

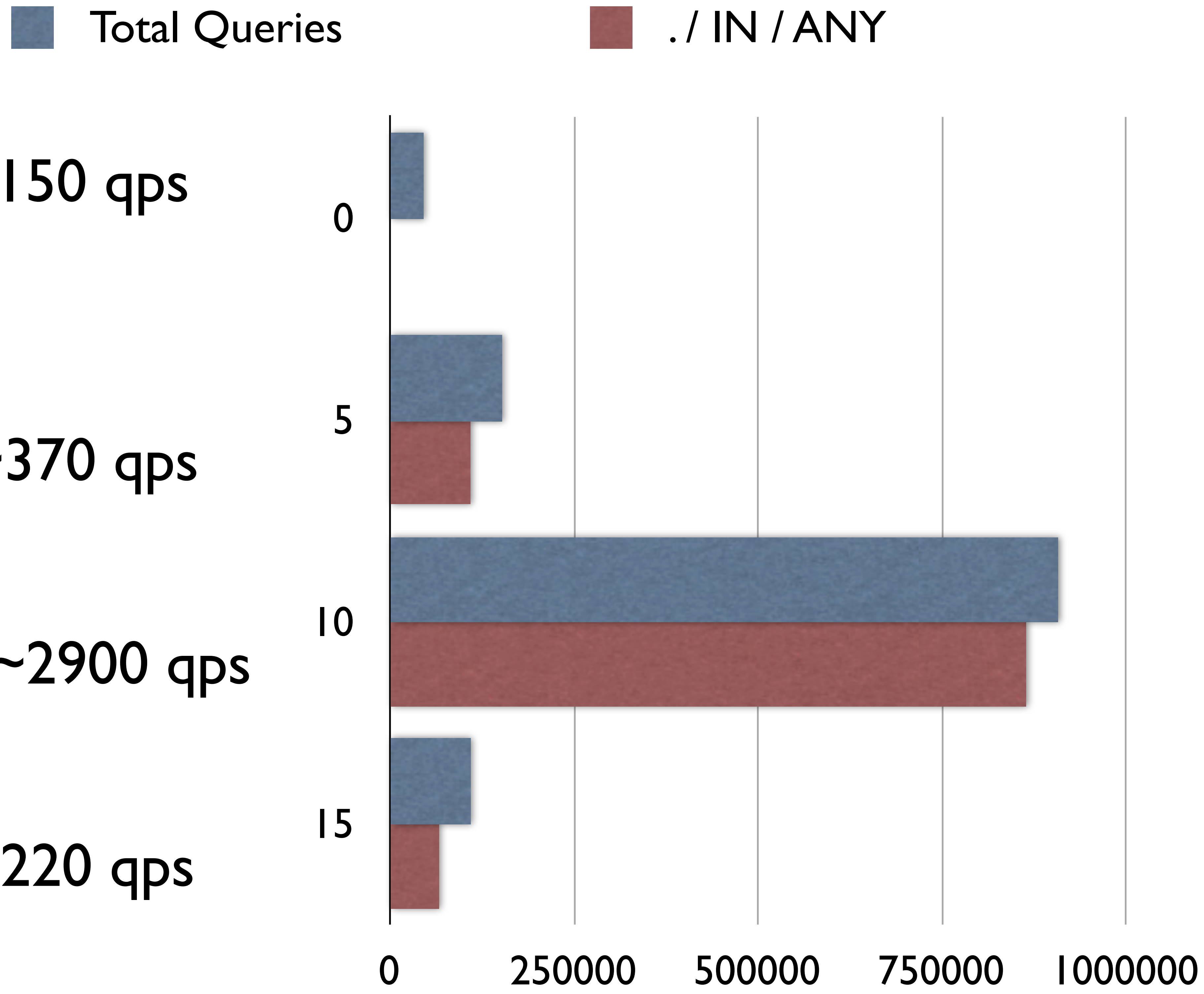
- BIND9 and BIND10 use the Redbarn spec
- Knot and NSD don't
- Comparing nameservers configured with
  - No RRL
  - RRL enabled with that implementations defaults
  - RRL enabled with the Redbarn defaults
    - 5/s vs 200/s

# Attack Queries

- Directed at L.root-servers.net
- IPv4 UDP
- Hit ham01.l.root-servers.org node
- Querying for: `./IN/ANY?`
- Typical packet:

```
192.0.2.1.54321 > 199.7.83.42.53: 123+ [1au] ANY? . (28)
```

# Attack Query Distribution



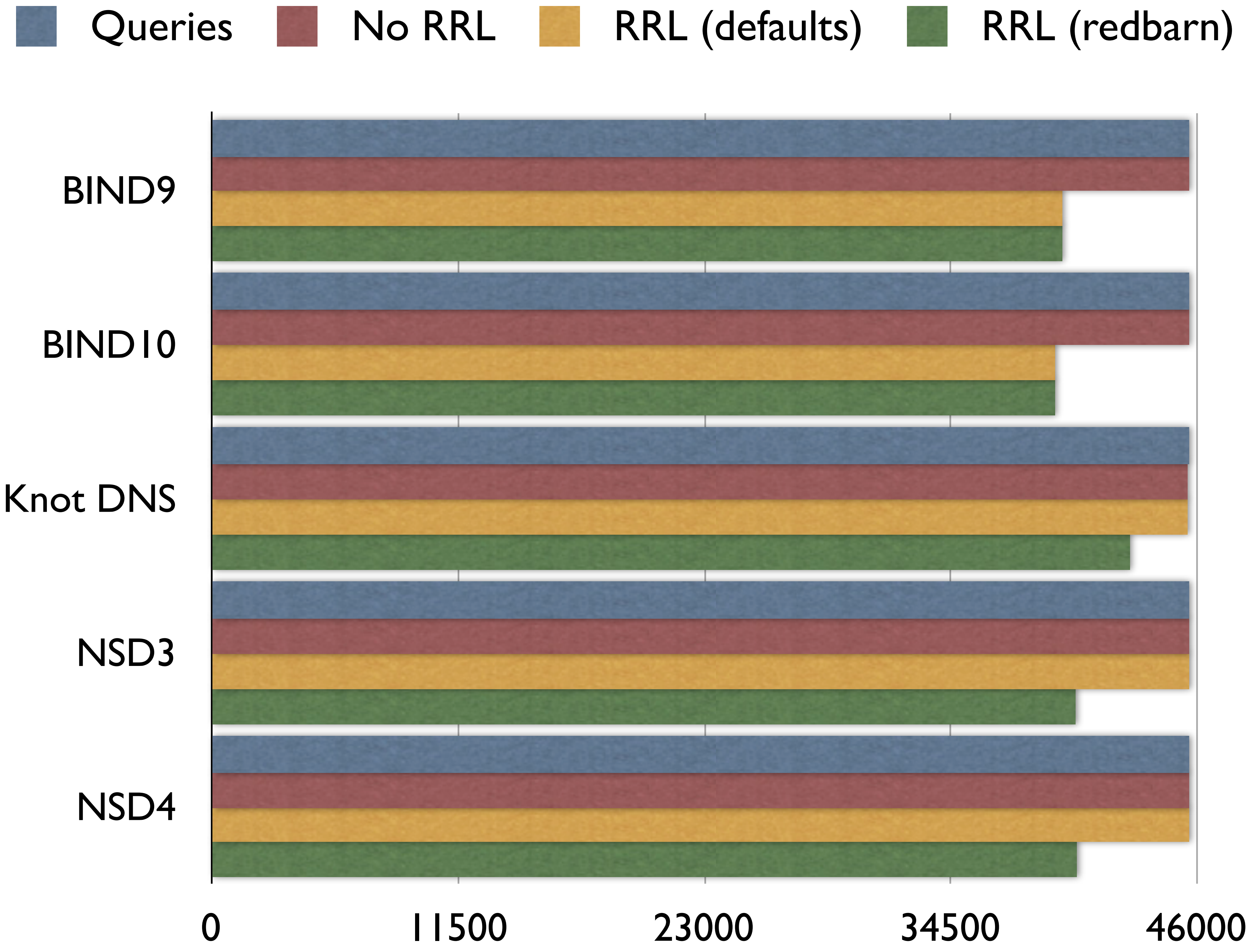
Baseline, ~150 qps

1 source, ~370 qps

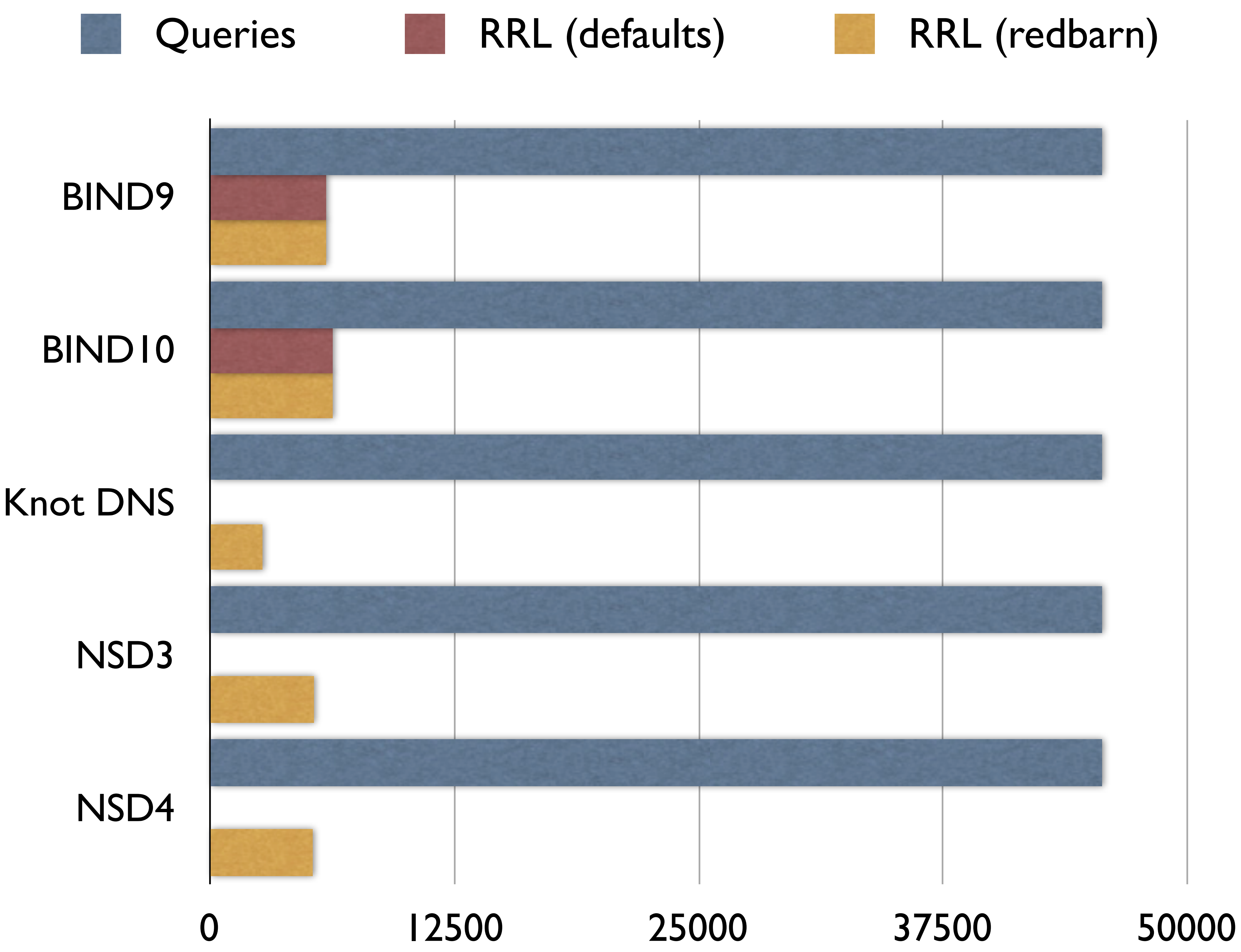
3 sources, ~2900 qps

1 source, ~220 qps

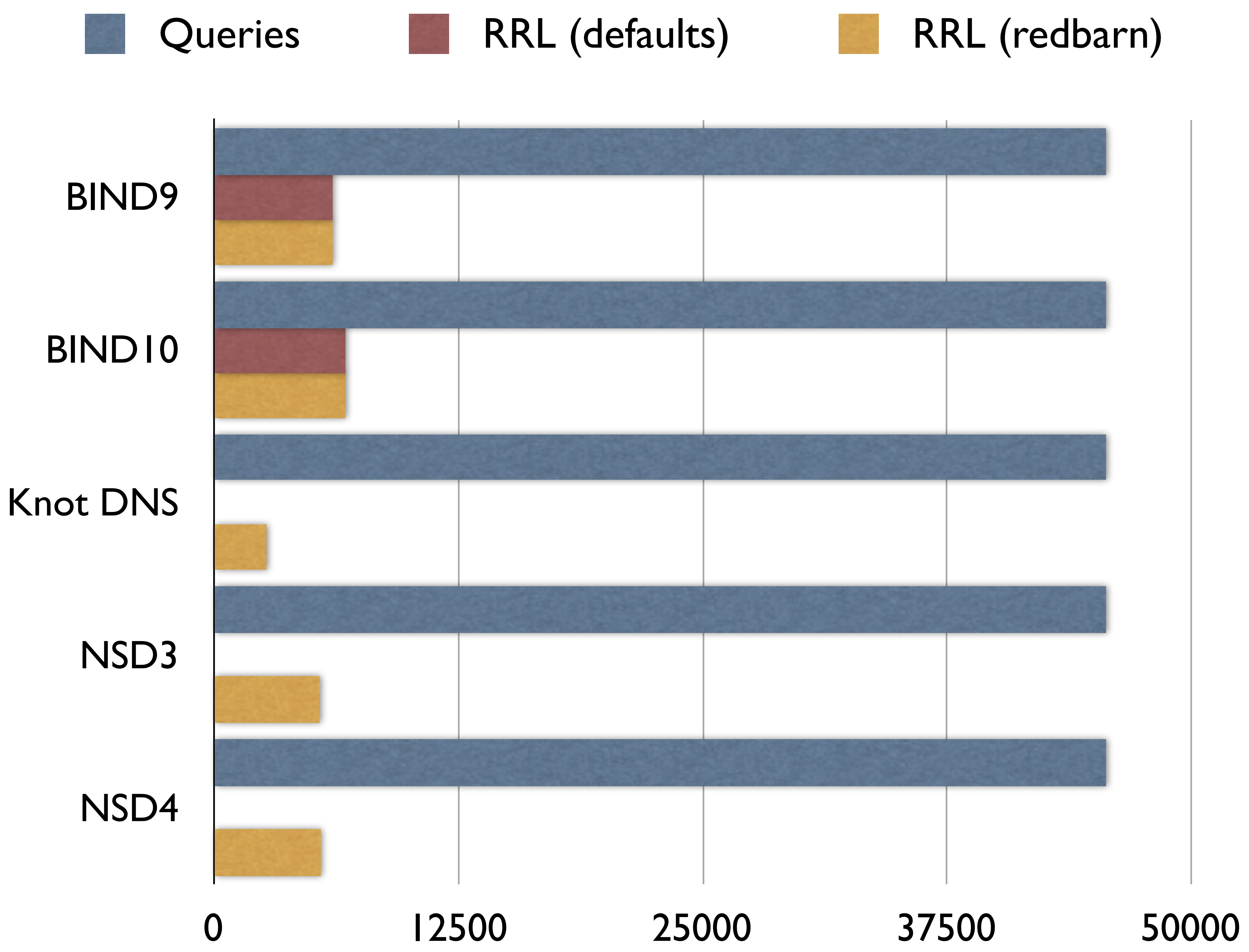
# Responses with ~45k queries / 5 minutes



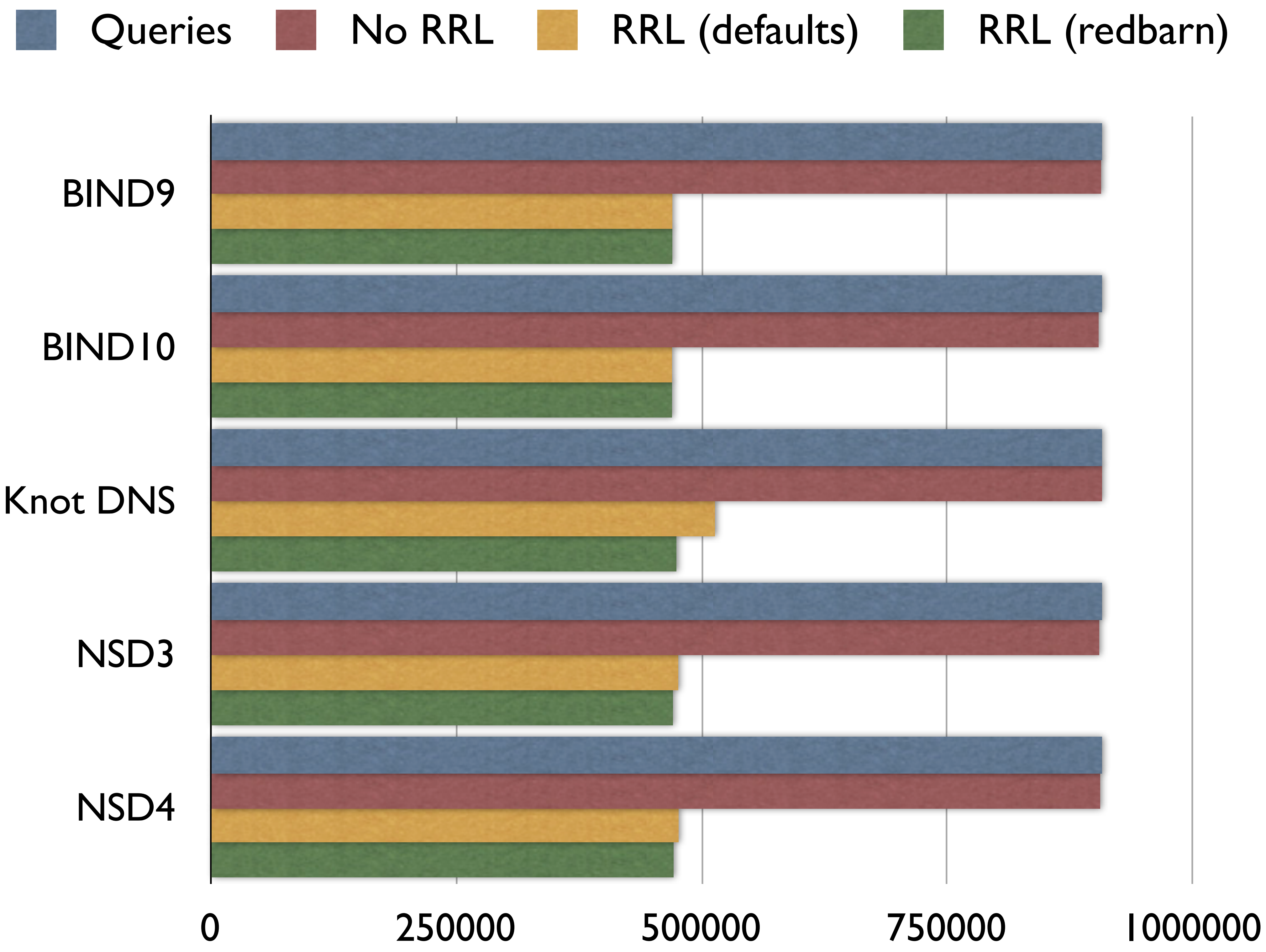
# RRL Drops with ~45k queries / 5 minutes



# RRL Slips with ~45k queries / 5 minutes



# Responses with ~900k queries / 5 minutes



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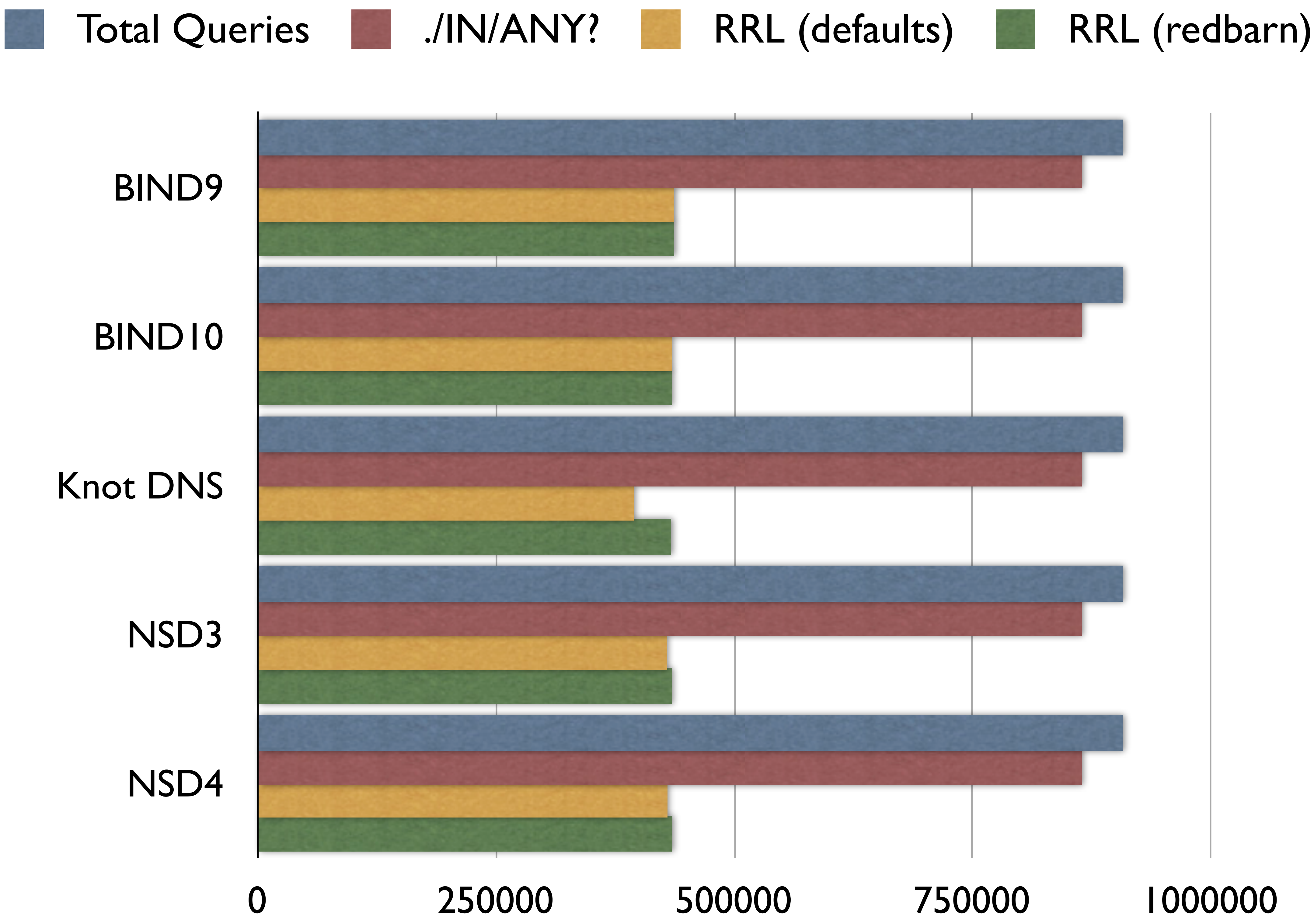

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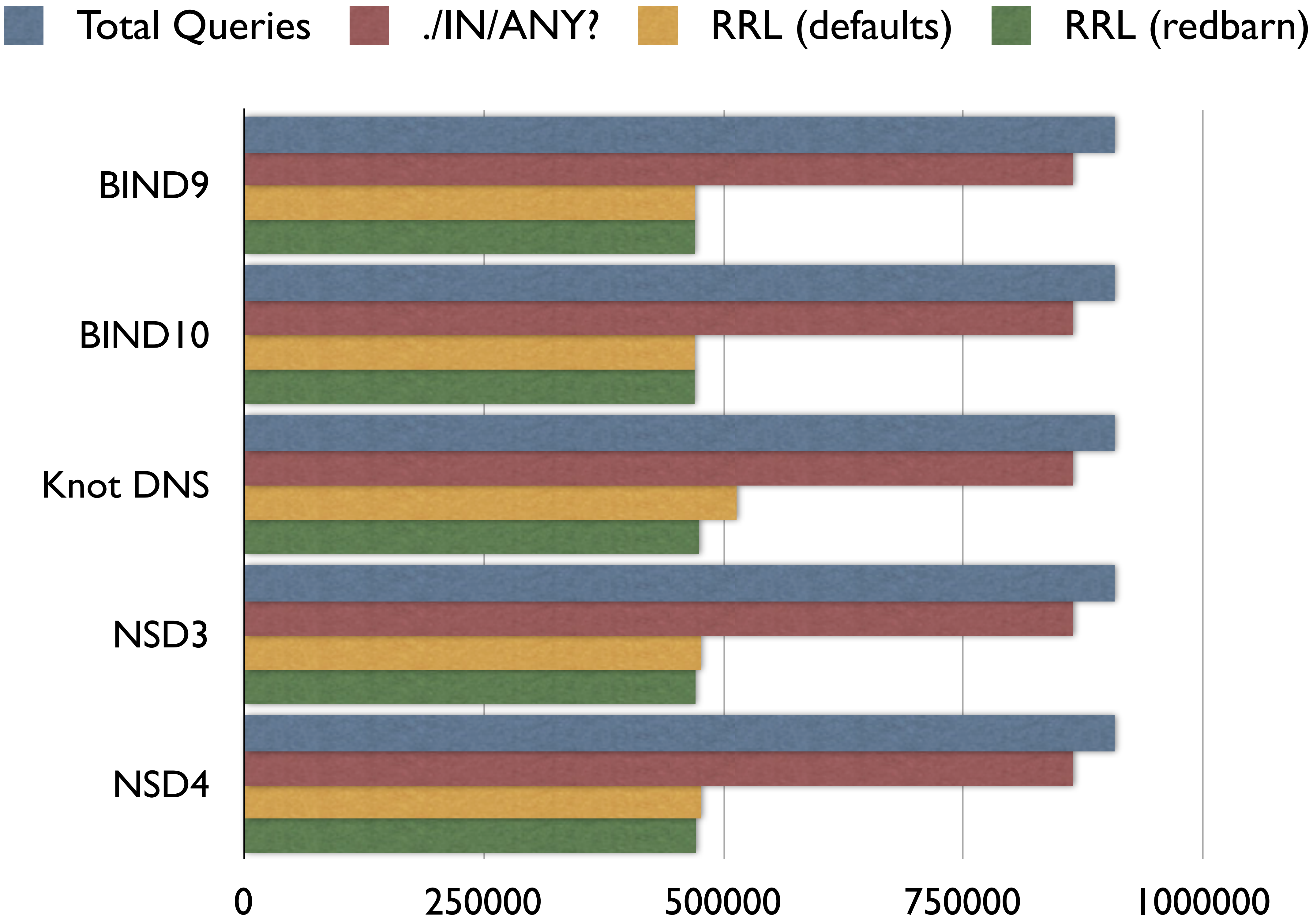

# Conclusions?

- For this very small sample the different RRL implementations seem pretty similar
  - Redbarn RRL does more when the traffic level is low
  - Less difference as traffic ramps up

# Further Work

- Repeat testing with more attack data
    - Got some you can push to OARC?
- Repeat testing with synthesized attack data
- Look at what impact running RRL has on other aspects of operation, RAM/CPU usage, etc
- Publish method and more results

# Questions?

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