Parent vs. Child-Centric Resolver Interoperability Testing

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Outline

- Parent vs. child
  - NS
  - Glue
  - DELEG
- Interop
  - Child
  - Parent
- Performance

Wonders of DNS

Parent vs. Child NS

- @parent
  `NS **ns1**.disjoint.superdns.nl`
- @child
  `NS **ns2**.disjoint.superdns.nl`
  `RRSIG NS`
- Examples – https://superdns.nl/
- RIPE 80 slides

Parent vs. Child NS: Data

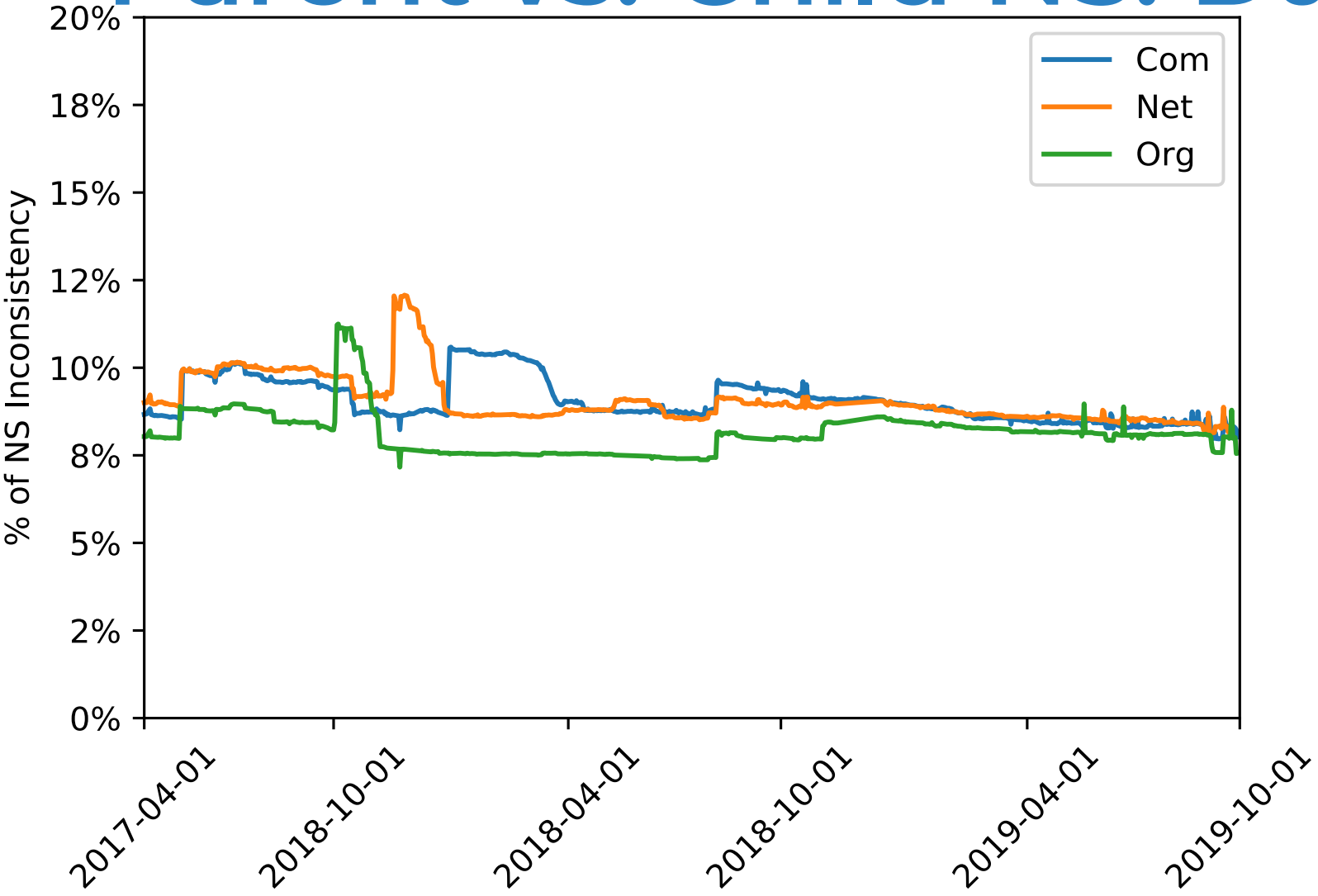


Fig. 7: NS inconsistency ($P = C$) from 2017-04-01 until 2019-10-01

8 %

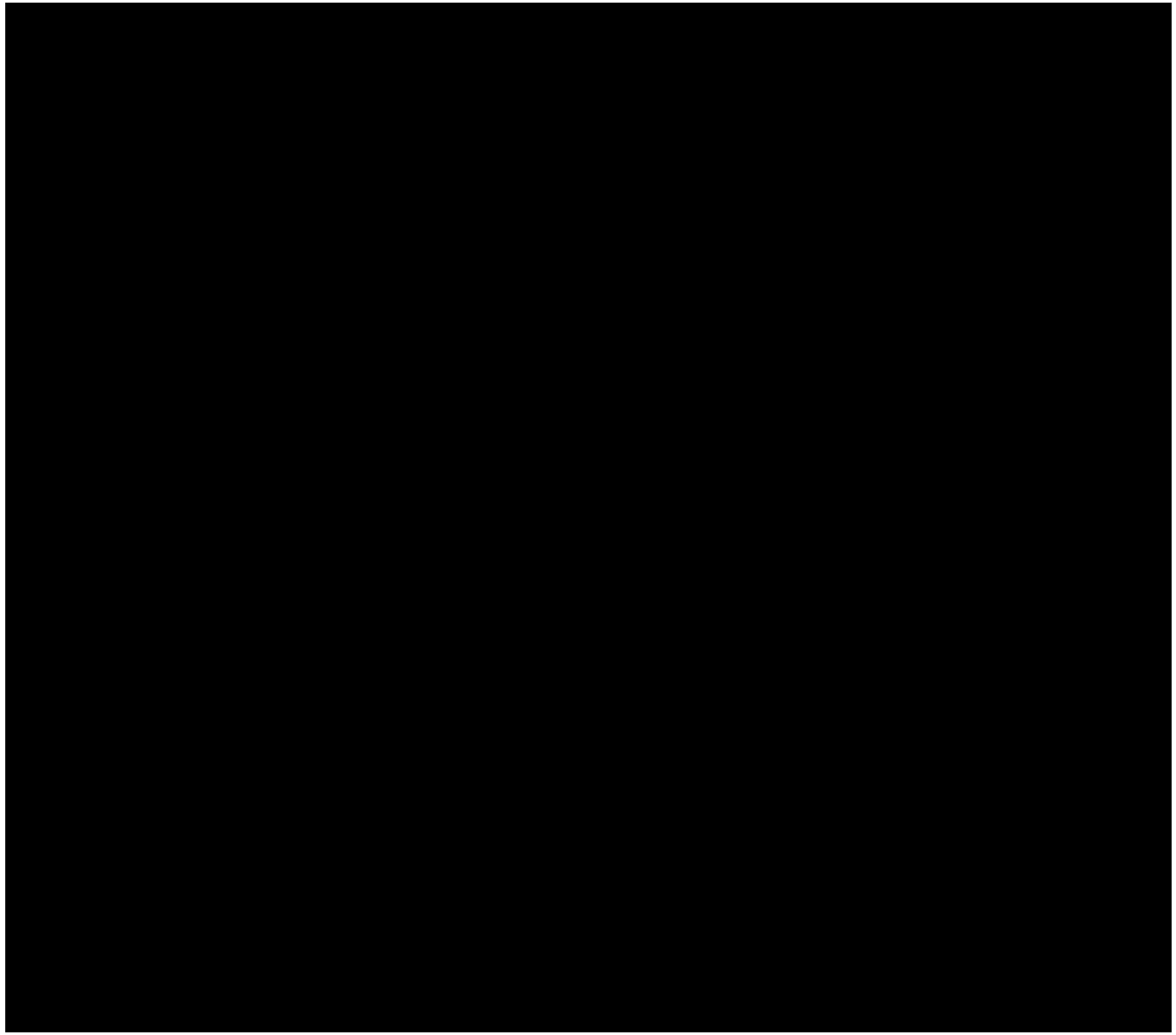
Raffaele Sommese, Giovane C. M. Moura, Mattijs Jonker, Roland van Rijswijk-Deij, Alberto Dainotti, KC Claffy, Anna Sperotto.

When parents and children disagree: Diving into DNS delegation inconsistency.

Proceedings of the Passive and Active Measurement Workshop. Eugene, OR, USA, Mar. 2020

https://par.nsf.gov/servlets/purl/10186683

If DNS was a drink …



Parent vs. Child Glue

- @parent

```
ns1.sub.test. 86400 A  192.0.2.1
```

- @child

```
ns1.sub.test. 600   A  203.0.113.55
ns1.sub.test. 600   RRSIG A
```

Motivation

Why parent-centric BIND?

Parent Must Work

- No way around

Load-balancers

- @parent

```
test 86400 NS glb1
test 86400 NS glb2
test 86400 NS glb3
```

- @child

```
test      0 NS glb3
```

- @child

```
test      0 NS glb3nxdnonsense
```

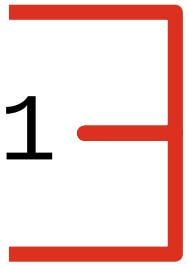
Child Failure Modes

- Timeout
- REFUSED/FORMERR
- NXDOMAIN
- NODATA
- DNSSEC validation failure
- CNAME
- Parent/child inconsistency

Glue & Shared Cache

- @ parent

```
sub       NS ns1.sub
ns1.sub A  192.0.2.1
test      NS ns1.sub
```



- BIND CVE-2025-40778
  - Glue ⇒ global DNS cache
  - Not scoped per delegation
    - Quick patch – reject **sibling** glue

Sibling Glue

- Sibling – RFC 9471 Section 2.2
  - "… is not strictly required for resolution, since the **resolver can make follow-on queries** to the sibling zone to resolve the name server addresses"
- Cyclic – Section 2.3
  - "… cyclic dependency can only be broken when the delegating name server includes glue for the sibling domain in a referral response."
  - "222 out of 209 000 000 delegations"
  - **~ 1 out of 1 000 000**

cd. – 2025-12-09

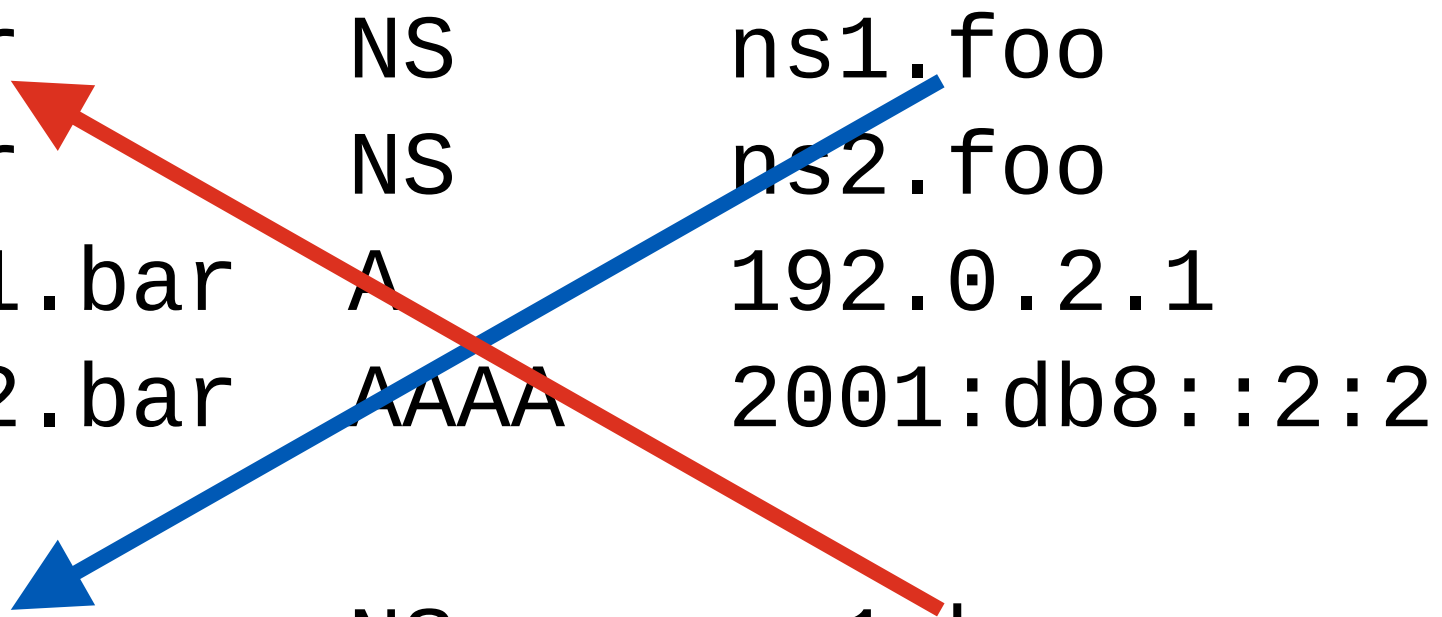
- @root

```
cd.     NS    ns-root-21.scpt-network.net.
cd.     NS    ns-root-22.scpt-network.net.
cd.     NS    ns-root-23.scpt-network.net.
```

- @cd

```
cd.     NS    gransy-anycast2.nic.cd.
cd.     NS    gransy-anycast1.nic.cd.
cd.     NS    pch.nic.cd.
```

Cyclic Sibling Glue



```
bar          NS      ns1.foo
bar          NS      ns2.foo
ns1.bar      A       192.0.2.1
ns2.bar      AAAA    2001:db8::2:2


foo          NS      ns1.bar
foo          NS      ns2.bar
ns1.foo      A       192.0.2.3
ns2.foo      AAAA    2001:db8::2:4
```

`cd.` – 2025-12-09

- `cd. NS scpt-network.net.`
  - Cyclic dependencies
  - Sibling glue **required**
- Broken by "quick patch" (CVE-2025-40778)
  - single `cd.` domain in the whole test data set …

DELEG

- Always parent centric
- https://datatracker.ietf.org/doc/draft-ietf-deleg/

BIND Goes Parent-Centric

Traditional BIND

- Up to 9.21.20
- RFC 2181
  - section 5.4.1. Ranking data
- Did **not** proactively query child-side NS
  - Use whatever is in the cache

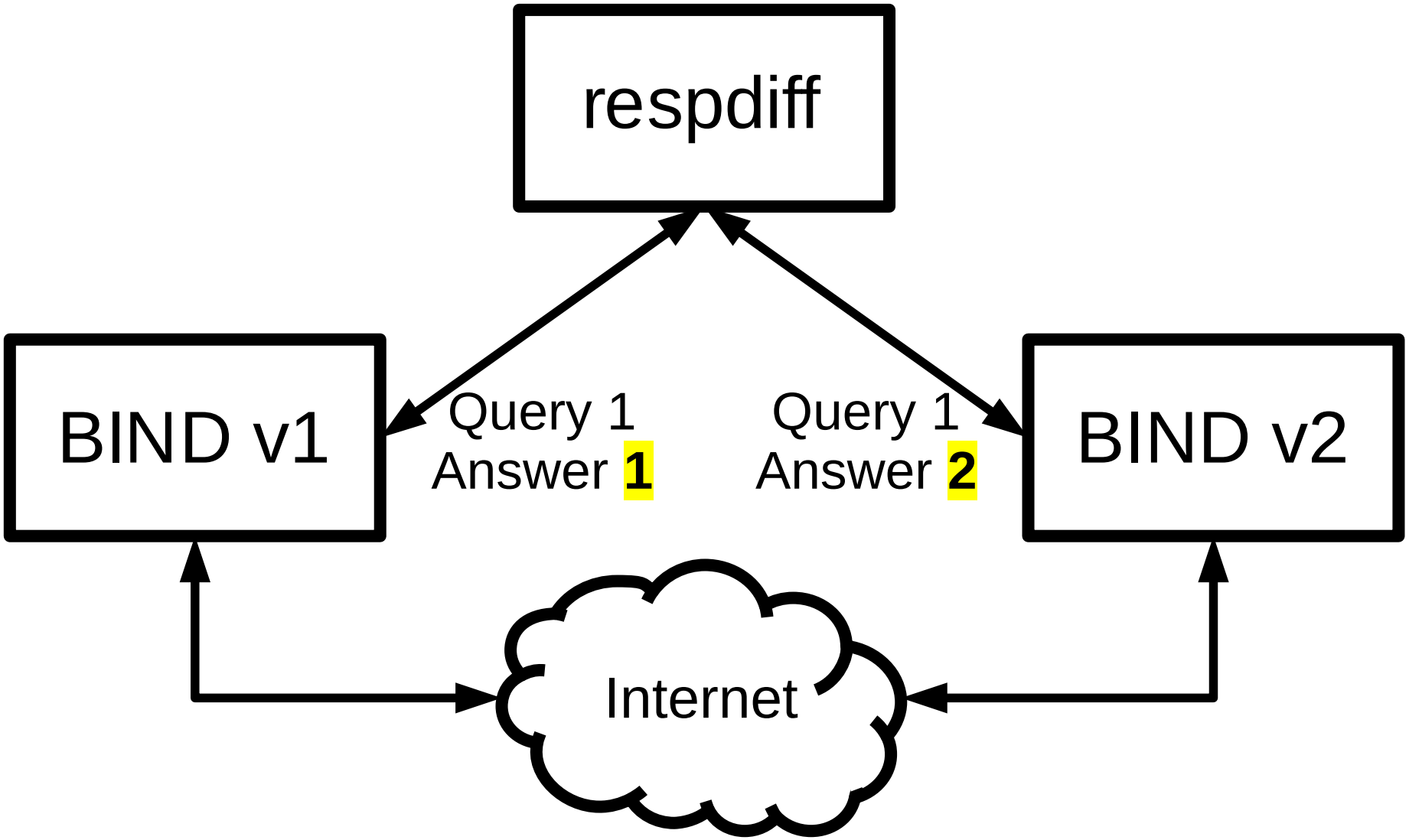
Parent-Centric BIND

- Since 9.21.21
- Many bugfixes
- More to come
- Comparison
  - a925af7ce6 – parent-centric
  - 37e7fbf010 – original resolver

Parent-Centric BIND

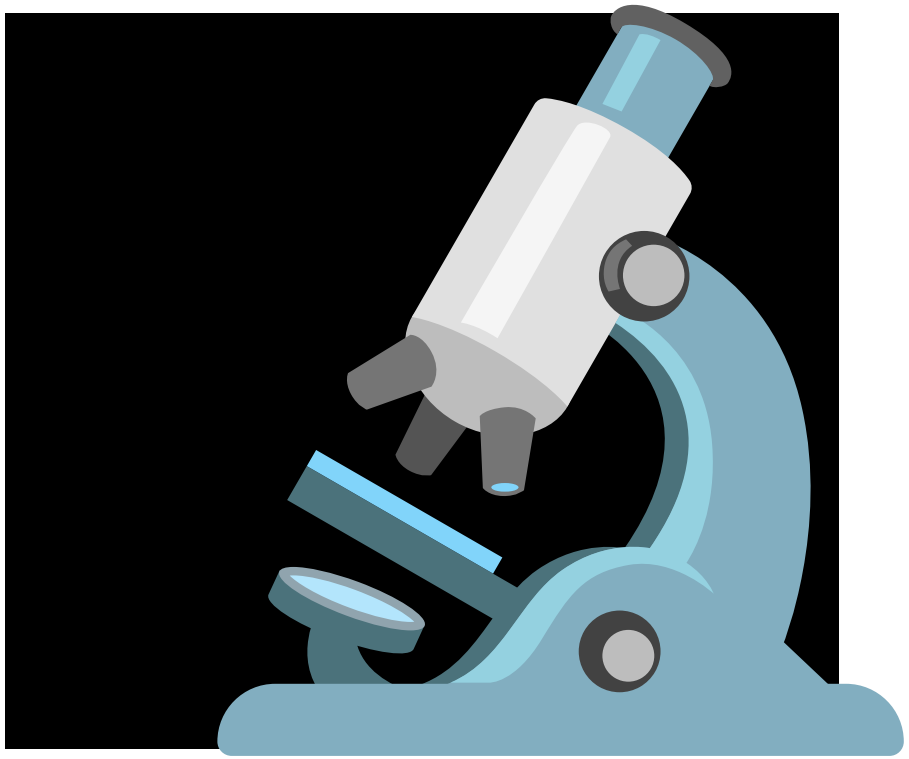
- Parent NS and glue ⇒ referral cache
  - Scoped to referral owner
  - Cross-domain glue spoofing impossible
- Child NS ⇒ DNS cache
  - Sent back to clients
- Query name minimization ON
  - *But* see above

Interop test – respdiff



Interop test – respdiff

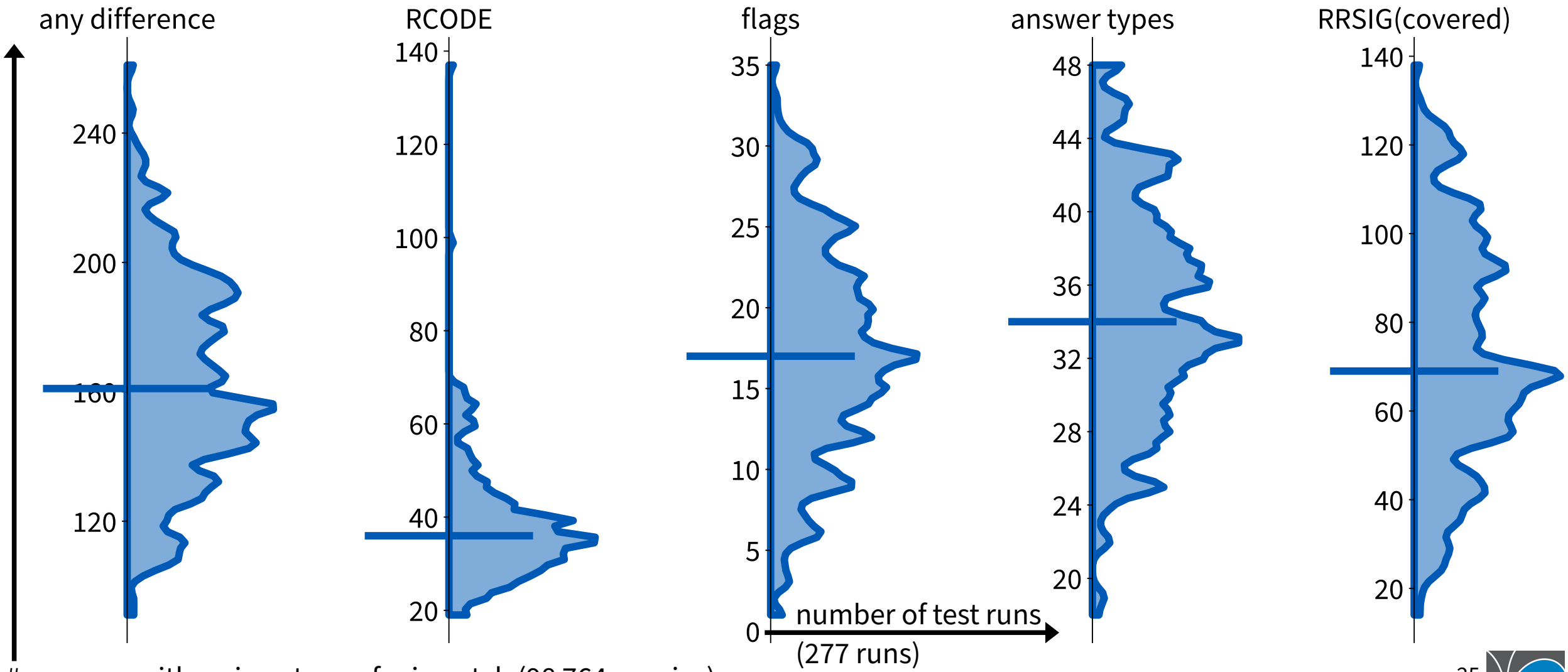
- Response Differences
- OARC 30 – slides, video
- Very **very** ***very*** noisy test



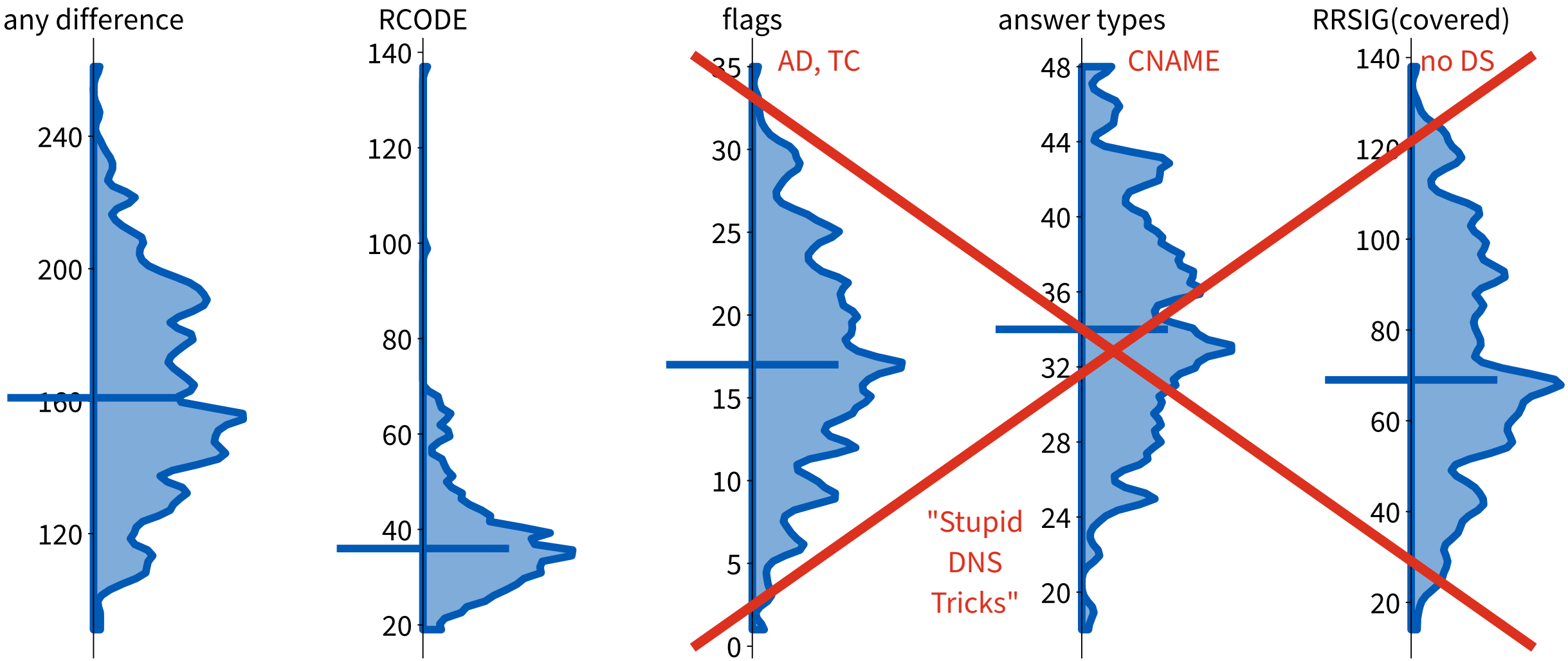
Respdiff disagreements

- 98 764 unique queries
- 277 test repetitions
- Three variants
  - child-child (same version twice, 37e7fbf010)
  - parent-parent (a925af7ce6)
  - child-parent (child = reference = "must be right")

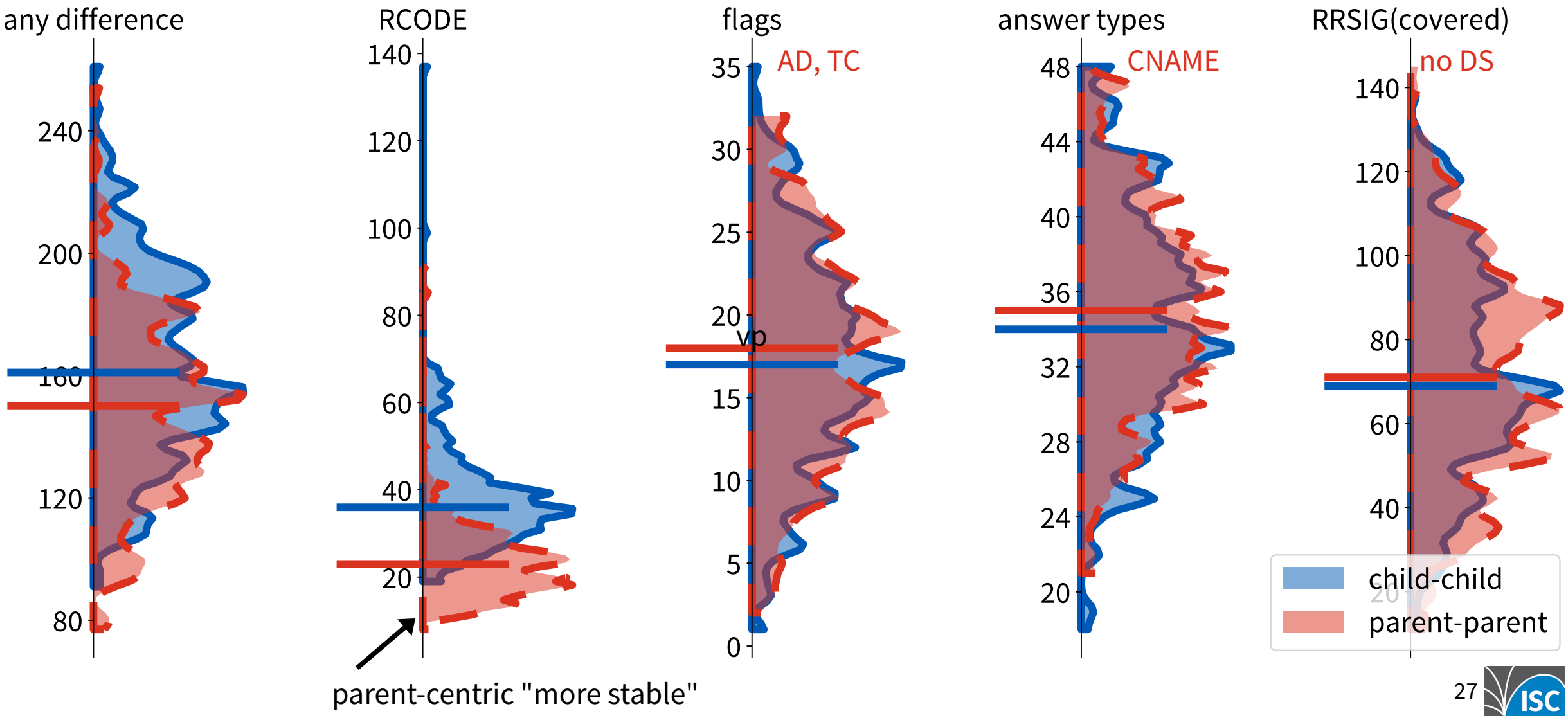
The Noise: child-child



The Noise: child-child

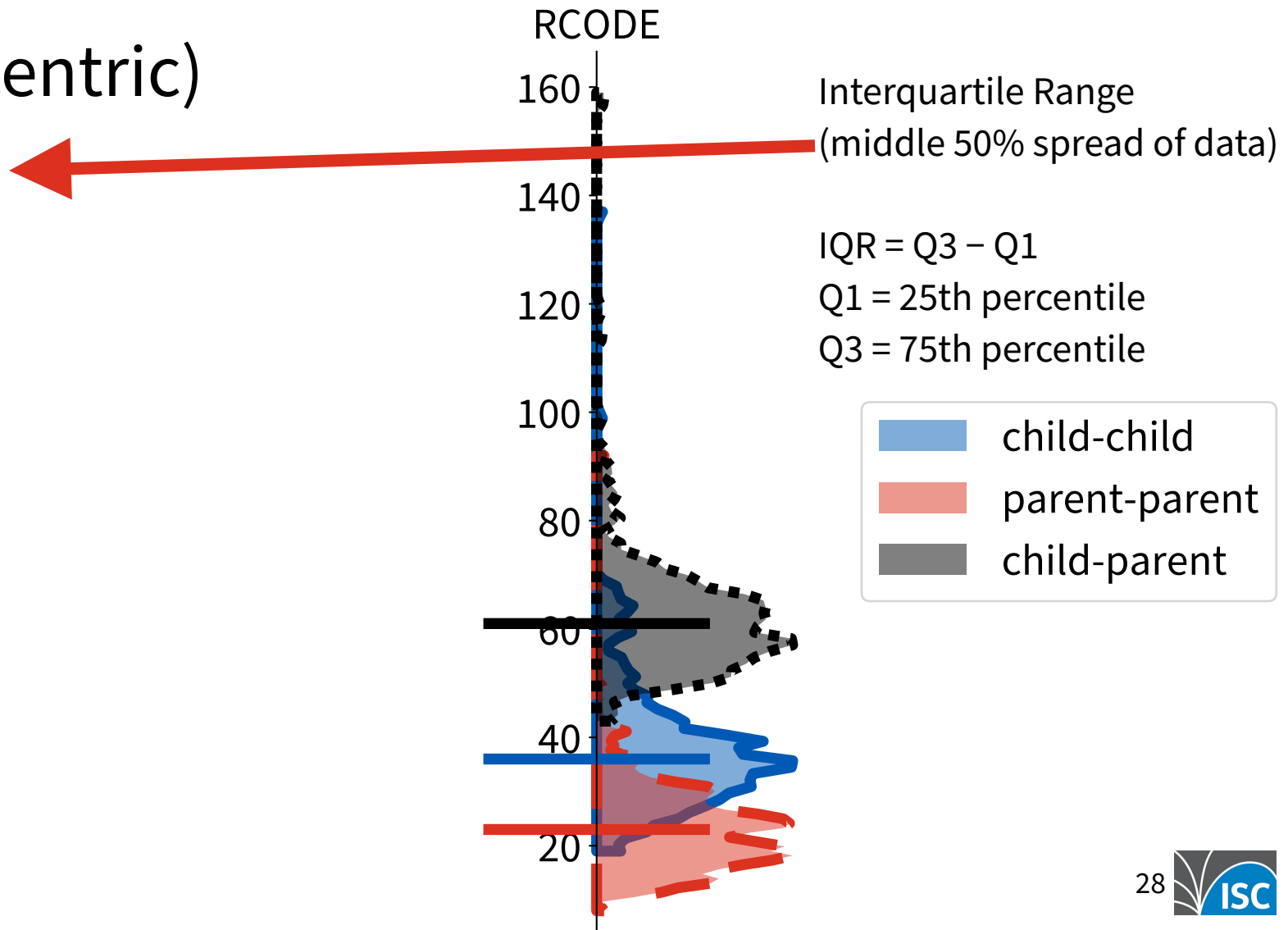


The Noise

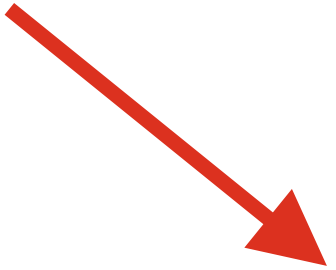

any difference
240
200
160
120
80
RCODE
140
120
100
80
60
40
20
parent-centric "more stable"
flags
AD, TC
35
30
25
20
vp
15
10
5
0
answer types
CNAME
48
44
40
36
32
28
24
20
RRSIG(covered)
no DS
140
120
100
80
60
40
20
child-child
parent-parent

Parent-child disagreements

- SERVFAIL (on child-centric)
  - ⇒ NOERROR 45
  - ⇒ NXDOMAIN 14
- NOERROR
  - ⇒ SERVFAIL 24
  - ⇒ NXDOMAIN 0
- NXDOMAIN
  - ⇒ NOERROR 14
  - ⇒ SERVFAIL 0



One Permanent Failure



- 1 / 98 764 unique queries
- `pubmed.ncbi.nlm.nih.gov.` **HTTPS**
  - **Unresolvable for parent-centric**
- `pubmed.ncbi.nlm.nih.gov. A`
  - Works even with parent-centric
- Huh?

pubmed.ncbi.nlm.nih.gov

- nih.gov. NS ns.nih.gov.
  nih.gov. NS ns2.nih.gov.
  nih.gov. NS ns3.nih.gov.
- ncbi.nlm.nih.gov. NS ns.nih.gov.
  ncbi.nlm.nih.gov. NS ns2.nih.gov.
  ncbi.nlm.nih.gov. NS ns3.nih.gov.
  ncbi.nlm.nih.gov. NS lhcns1.nlm.nih.gov.
  ncbi.nlm.nih.gov. NS lhcns2.nlm.nih.gov.
  ncbi.nlm.nih.gov. NS dns1-ncbi.ncbi.nlm.nih.gov.
  ncbi.nlm.nih.gov. NS dns2-ncbi.ncbi.nlm.nih.gov.

pubmed.ncbi.nlm.nih.gov

- `NS ns.nih.gov.`
  `NS ns2.nih.gov.`
  `NS ns3.nih.gov.`
  - Timeout for QTYPE=HTTPS
- `NS lhcns1.nlm.nih.gov.`
  `NS lhcns2.nlm.nih.gov.`
  `NS dns1-ncbi.ncbi.nlm.nih.gov.`
  `NS dns2-ncbi.ncbi.nlm.nih.gov.`
  - Answer for QTYPE=HTTPS
- Child-side never seen by resolver!

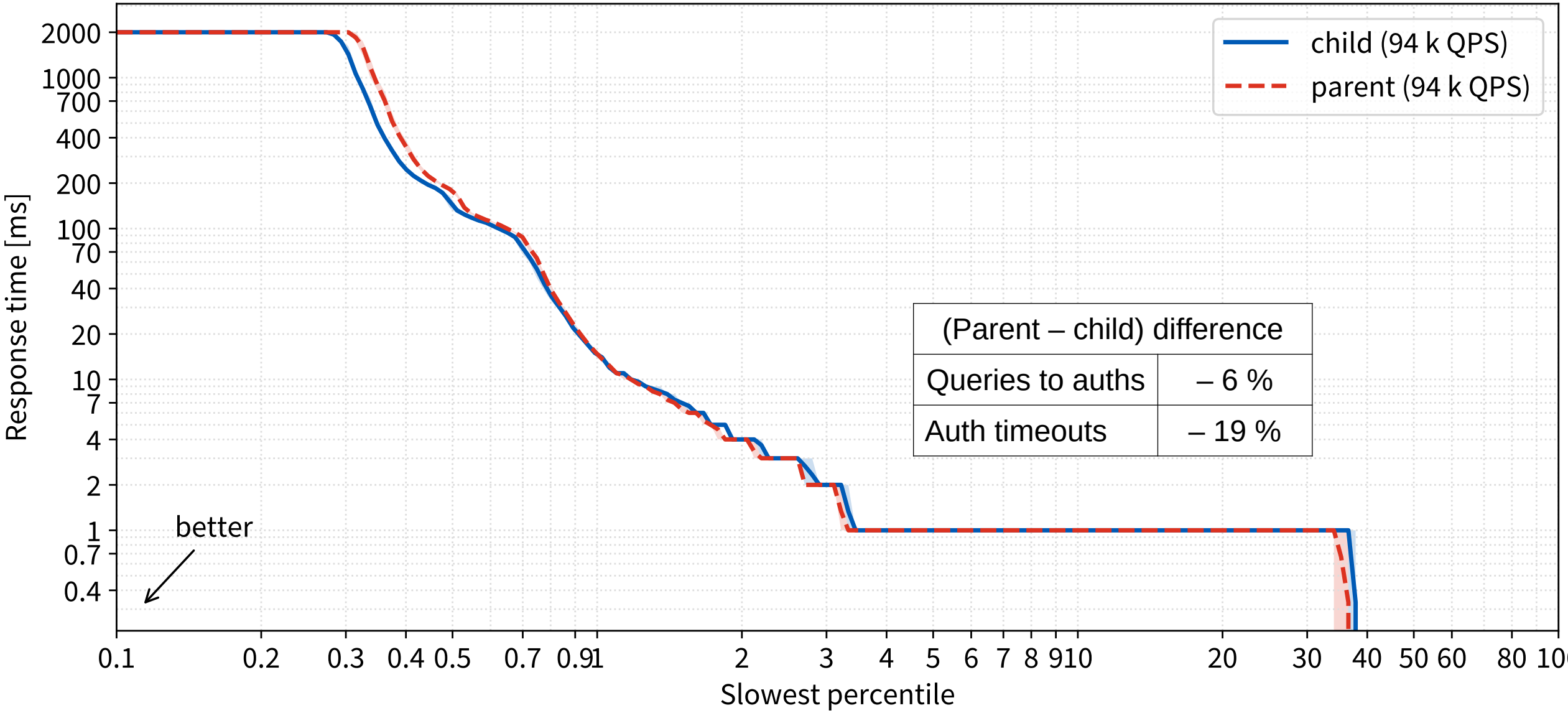
One Permanent Failure

- Child-side NS 'works better'
  - Thanks to **retries** and server selection
- dig @8.8.8.8 pubmed.ncbi.nlm.nih.gov HTTPS
  - ⇒ SERVFAIL
  - Hey, we did not break it … first!

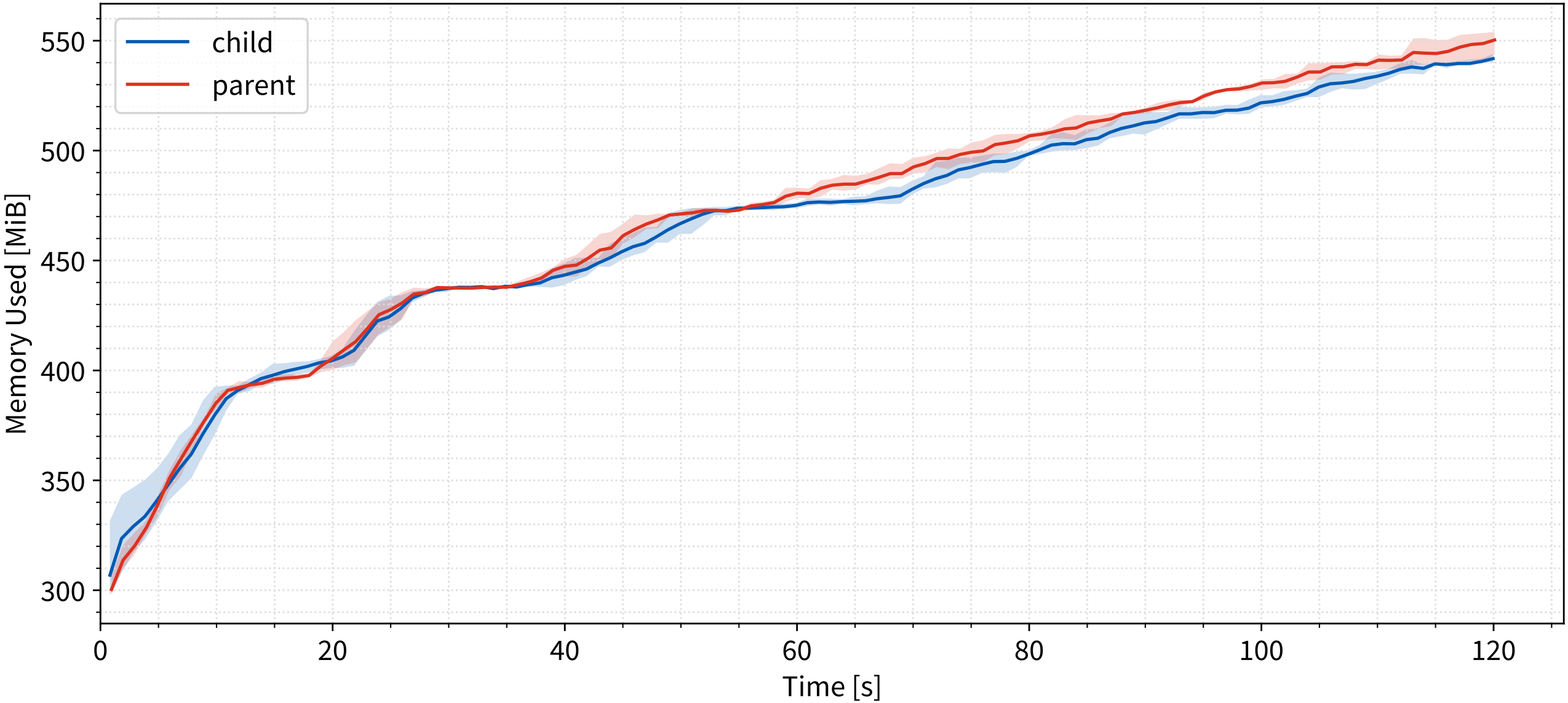
Performance

Beware of bugs

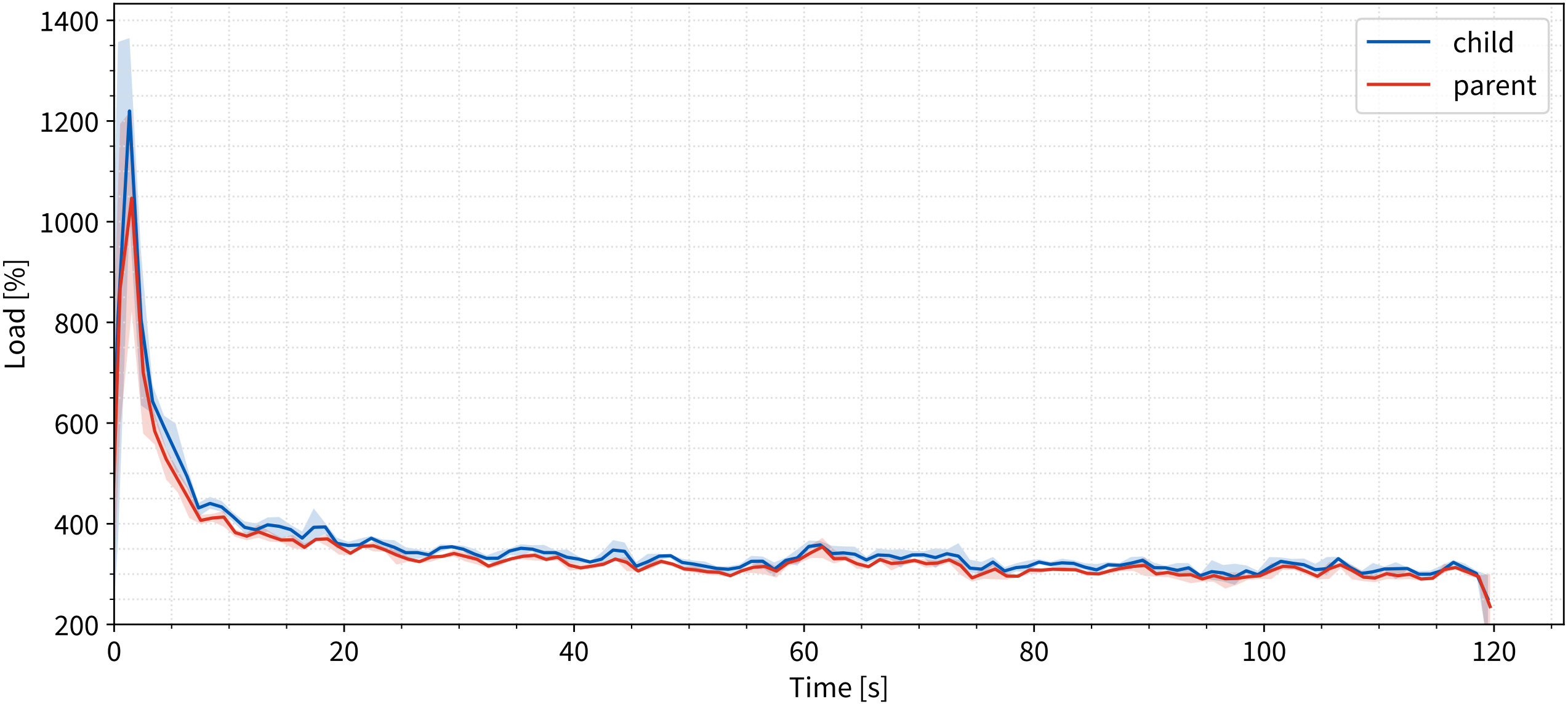
Response latency – a bug



Memory usage



CPU usage


1400
1200
1000
800
600
400
200
Load [%]
0
20
40
60
80
100
120
Time [s]
child
parent

Conclusion

- Interop
  - Works!
  - Resolves "more" than child-centric
  - New permanent breakage – single query
- Performance
  - Bugs! Bugs! Bugs!

Thank you!

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- Code https://gitlab.isc.org