APNIC 36 CONFERENCE

XI'AN, CHINA
20 - 30 August 2013

Measuring DNSSEC Use

Geoff Huston

APNIC Labs

Our Questions…

- What proportion of the Internet's users will perform DNSSEC validation if they are presented with a signed domain?
- Where are these DNSSEC-validating users?
- What is the performance overhead of serving signed names?
- What happens when the DNSSEC signature is not valid?

The Experiment

Three URLs:

the good (DNSSEC signed)

the bad (invalid DNSSEC signature)

the control (no DNSSEC at all)

And an online ad system to deliver the test to a large pseudo-random set of clients

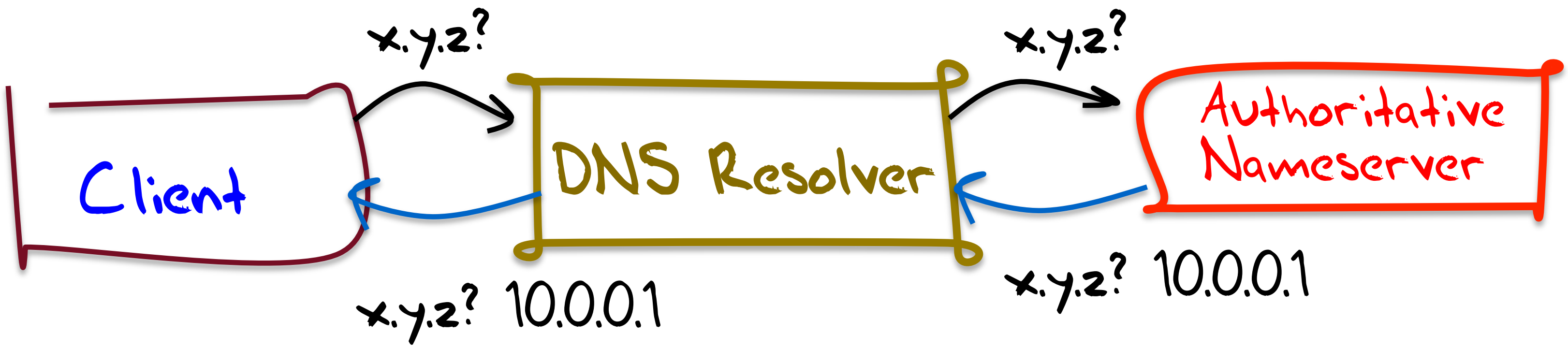
Experimental Nits

- DNS caching is (for our experiment) evil !
  - But massive Signed Zones are a PITA!
  - And we wanted a very simple approach That Just Worked

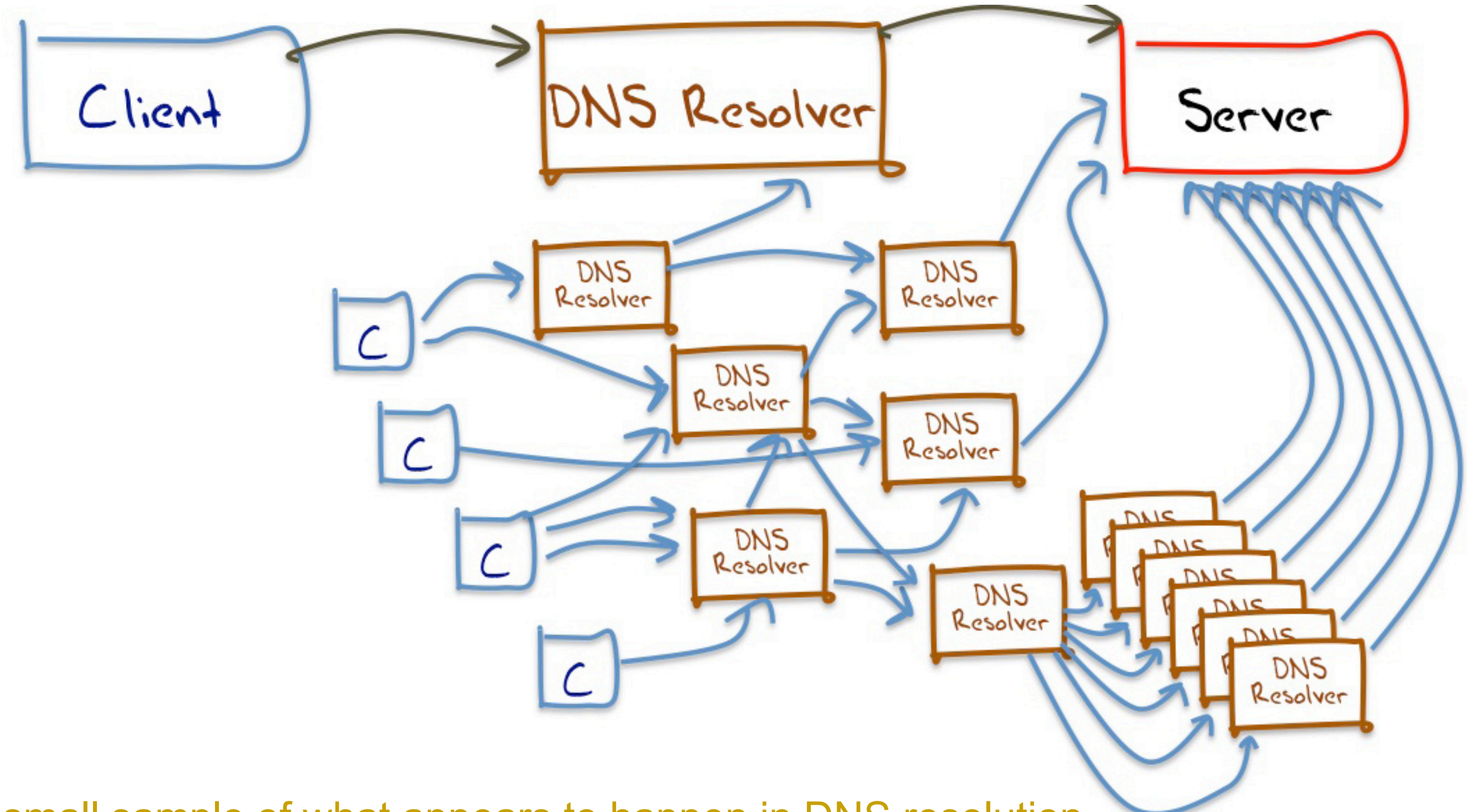
- So we opted to use a more modest set of 1M signed subdomains
  - And cycled though these subdomains over a >24 hour period
  - As long as the resolvers honor the cache TTL of the DNSSEC RRs then resolver caching is avoided and all queries will head to our authoritative server

Understanding DNS Resolvers is "tricky"

What we would like to think happens in DNS resolution!



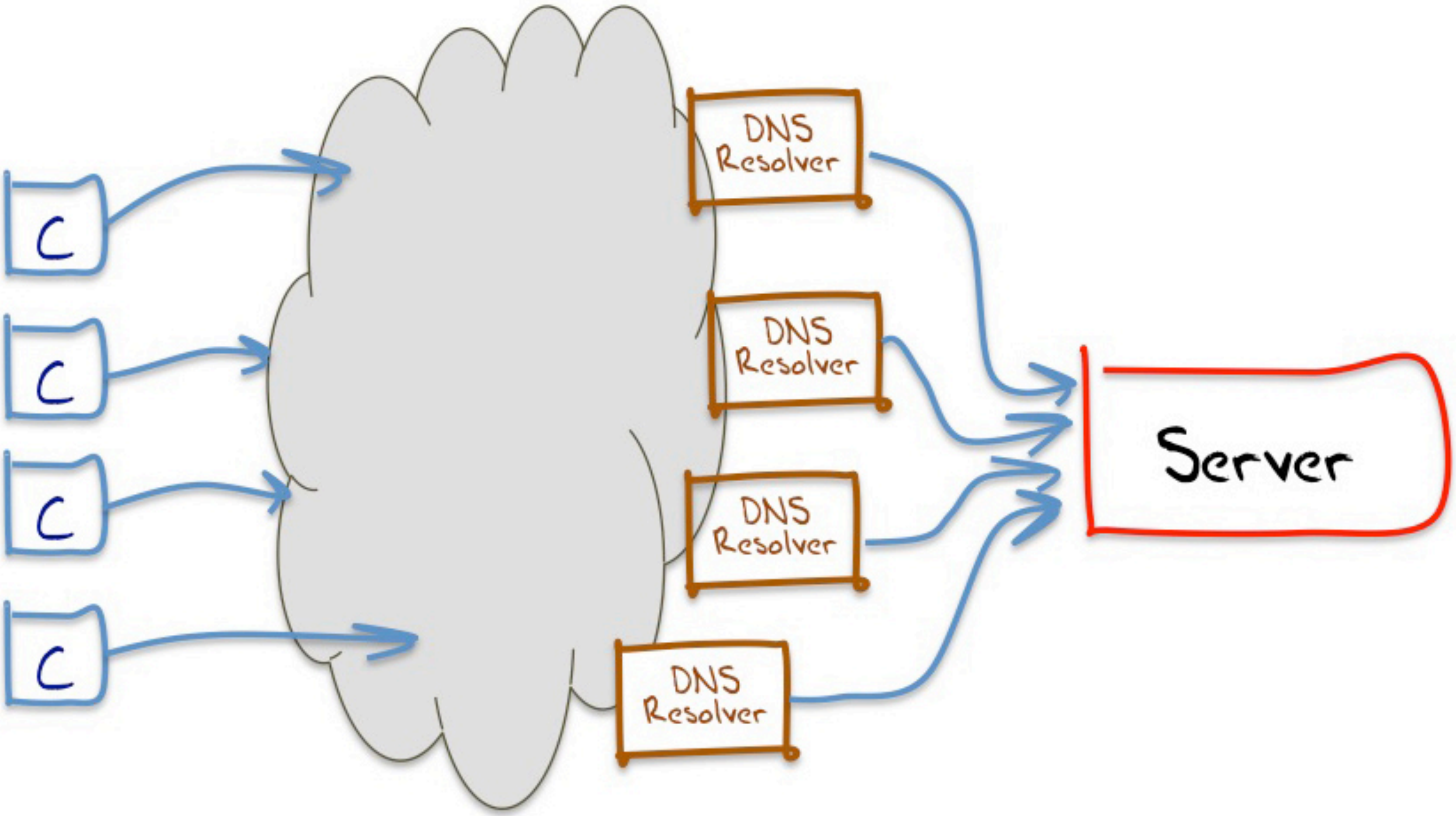
Understanding DNS Resolvers is "tricky"



A small sample of what appears to happen in DNS resolution

Understanding DNS Resolvers is "tricky"

The best model we can use for DNS resolution



This means…

That it is hard to talk about "all resolvers"

- We don't know the ratio of the number of resolvers we cannot see compared to the resolvers we can see from the perspective of an authoritative name server
- We can only talk about "visible resolvers"

This means…

And there is an added issue with DNSSEC:

- It can be hard to tell the difference between a visible resolver performing DNSSEC validation and an occluded validating resolver performing validation via a visible non-validating forwarder

(Yes, i know it's a subtle distinction, but it makes looking at RESOLVERS difficult!)

This means…

It’s easier to talk about end clients rather than resolvers, and whether these end clients use / don’t use a DNS resolution service that performs DNSSEC validation

On to Some Results

May 2013

- Presented: 2,637,091 experiments to clients
- Reported: 2,498,497 experiments that ran to “completion”

Web results for clients:

- Did Not Fetch invalidly signed object: **8.4%**
- Fetched all URLs: **91.6%**

That means…

That 8.4% of clients use DNSSEC validating resolvers, because these clients did not fetch the object that had the invalid DNSSEC signature

Right?

Well, sort of, but we can learn more if we look at the logs of the DNS queries…

Refining these Results

May 2013

- Presented: 2,637,091 experiments
- Reported: 2,498,497 experiments that ran to “completion”

Web + DNS query log results for clients:

- Performed DNSSEC signature validation and did not fetch the invalidly signed object: **8.3%**
- Fetched DNSSEC RRs, but then retrieved the invalidly signed object anyway: **4.3%**
- Did not have a DNSSEC clue at all - only fetched A RRs: **87.4%**

That means…

That 8.3% of clients appear to be performing DNSSEC validation and not resolving DNS names when the DNSSEC signature cannot be validated

A further 4.3% of clients are using a mix of validating and non-validating resolvers, and in the case of a validation failure turn to a non-validating resolver!

Another observation from the data

Clients who used Google's Public DNS servers: **7.2%**

- Exclusively Used Google's P-DNS: **5.3%**
- Used a mix of Google's P-DNS and other resolvers: **1.9%**

Where is DNSSEC? – The Top 20

Rank	CC	Count	% D	% x	% A	Country
[illegible]	[illegible]	[illegible]	77.92	3.38	[illegible]	Sweden
[illegible]	[illegible]	[illegible]	58.85	4.90	[illegible]	Slovenia
[illegible]	[illegible]	652	43.87	6.90	[illegible]	Luxembourg
[illegible]	[illegible]	26,665	38.28	4.04	[illegible]	[illegible]
[illegible]	[illegible]	2,456	37.01	6.29	[illegible]	[illegible]
[illegible]	[illegible]	30,827	33.20	8.08	[illegible]	[illegible]
[illegible]	[illegible]	46,151	30.26	8.34	[illegible]	[illegible]
8	JM	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
9	IE	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
10	BB	[illegible]	[illegible]	[illegible]	74.24	Barbados
11	ID	[illegible]	[illegible]	[illegible]	67.55	Indonesia
12	UA	[illegible]	[illegible]	[illegible]	65.60	Ukraine
13	ZA	[illegible]	[illegible]	[illegible]	69.48	South Africa
14	TR	[illegible]	[illegible]	[illegible]	79.84	Turkey
15	US	[illegible]	[illegible]	[illegible]	79.11	United States
16	EG	[illegible]	[illegible]	[illegible]	75.01	Egypt
17	GH	973	14.59	8.12	77.29	Ghana
18	AZ	7,409	14.55	30.34	55.11	Azerbaijan
19	BR	179,424	14.43	6.13	79.44	Brazil
20	PS	2,893	14.00	36.85	49.15	Occupied Palestinian T.

% of clients who appear to use DNSSEC-validating resolvers

% of clients who use a mix of DNSSEC-validating resolvers and non-validating resolvers

% of clients who use non-validating resolvers

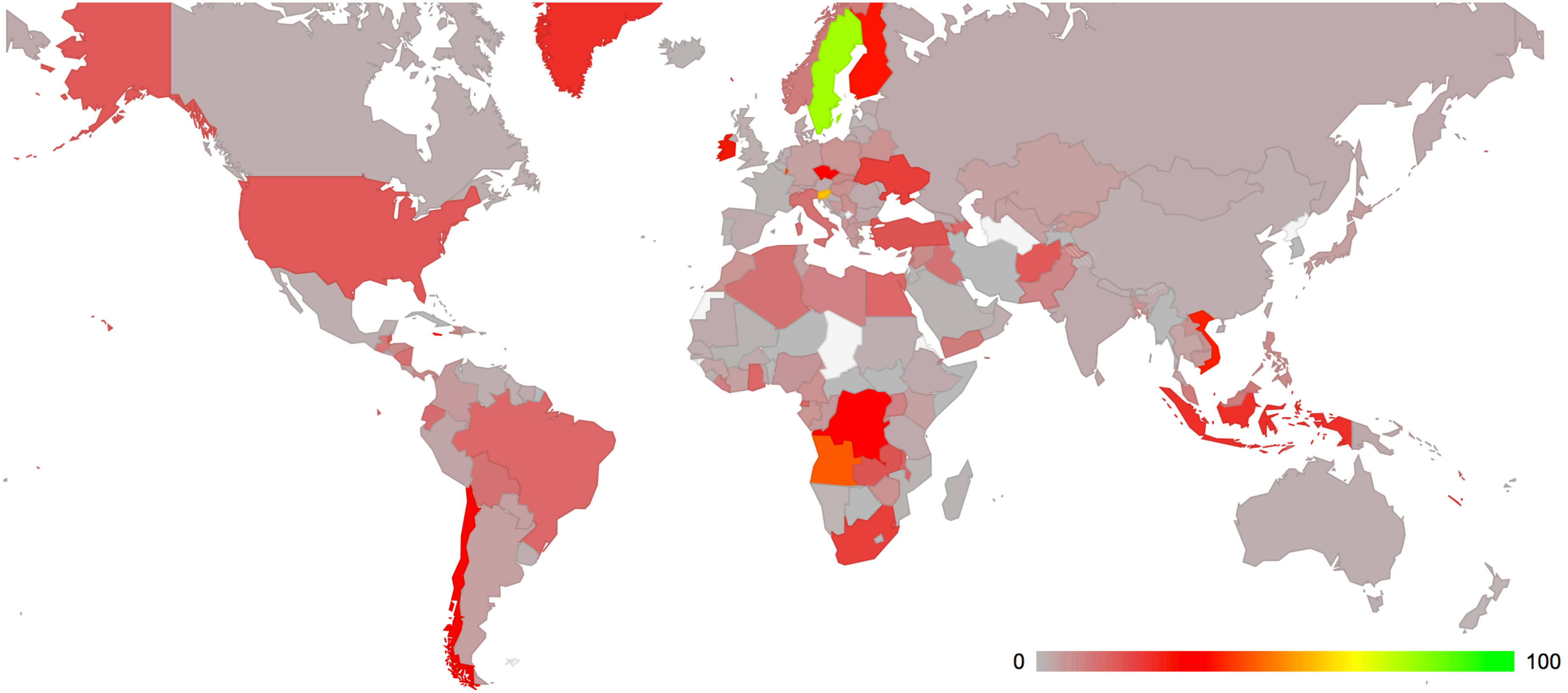
When we geo-locate clients to countries, what proportion of these clients: Perform DNSSEC validation? Retrieve some DNSSEC RRs? Do not retrieve any DNSSEC RRs?

Where is DNSSEC? – The Top 20

Rank	CC	Count	% D	% x	% A	Country
1	SE	5,349	77.92	3.38	18.70	Sweden
2	SI	4,758	58.85	4.90	36.25	Slovenia
3	LU	652	43.87	6.90	49.23	Luxembourg
4	VN	26,665	38.28	4.04	57.69	Vietnam
5	FI	2,456	37.01	16.29	46.70	Finland
6	CZ	30,827	33.20	8.08	58.72	Czech Republic
7	CL	46,151	30.26	8.34	61.41	Chile
8	JM	1,545	28.22	3.11	68.67	Jamaica
9	IE	8,079	27.94	3.11	68.96	Ireland
10	BB	1,312	24.24	1.52	74.24	Barbados
11	ID	54,816	23.87	8.58	67.55	Indonesia
12	UA	26,399	21.65	12.75	65.60	Ukraine
13	ZA	2,969	21.15	9.36	69.48	South Africa
14	TR	49,498	18.06	2.10	79.84	Turkey
15	US	140,234	17.32	3.57	79.11	United States
16	EG	36,061	14.68	10.32	75.01	Egypt
17	GH	973	14.59	8.12	77.29	Ghana
18	AZ	7,409	14.55	30.34	55.11	Azerbaijan
19	BR	179,424	14.43	6.13	79.44	Brazil
20	PS	2,893	14.00	36.85	49.15	Occupied Palestinian T.

When we geo-locate clients to countries, what proportion of these clients: Perform DNSSEC validation? Retrieve some DNSSEC RRs? Do not retrieve any DNSSEC RRs?

The Mapped view of DNSSEC Use



% of users who use DNSSEC-validating resolvers

Is Google's P-DNS a Factor?

Rank	CC	Count	% D		%AG	%SG	%NG	Country
1	SE	5,349	77.92	->	1.78	0.19	98.03	Sweden
2	SI	4,758	[illegible]	[illegible]	7.89	[illegible]	[illegible]	Slovenia
3	LU	652	[illegible]	[illegible]	1.40	[illegible]	[illegible]	Luxembourg
4	VN	26,665	[illegible]	[illegible]	**96.66**	[illegible]	**1.09**	**Vietnam**
5	FI	2,456	[illegible]	[illegible]	2.64	[illegible]	[illegible]	[illegible]
6	CZ	30,827	[illegible]	[illegible]	11.71	[illegible]	[illegible]	[illegible]
7	CL	46,151	[illegible]	[illegible]	3.62	[illegible]	[illegible]	[illegible]
8	JM	1,545	[illegible]	[illegible]	**91.74**	[illegible]	[illegible]	[illegible]
9	IE	8,079	[illegible]	[illegible]	12.18	[illegible]	[illegible]	[illegible]
10	BB	1,312	24.24	->	7.86	[illegible]	[illegible]	[illegible]
11	ID	54,816	23.87	->	[illegible]	[illegible]	[illegible]	[illegible]
12	UA	26,399	21.65	->	[illegible]	[illegible]	78.01	Ukraine
13	ZA	2,969	21.15	->	[illegible]	[illegible]	93.47	South Africa
14	TR	49,498	18.06	->	[illegible]	[illegible]	**3.41**	**Turkey**
15	US	140,234	17.32	->	[illegible]	[illegible]	91.98	United States of America
16	EG	36,061	14.68	->	[illegible]	[illegible]	**3.84**	**Egypt**
17	GH	973	14.59	->	[illegible]	[illegible]	26.06	Ghana
18	AZ	7,409	14.55	->	**71.24**	**26.72**	**2.04**	**Azerbaijan**
19	BR	179,424	14.43	->	**50.31**	**7.08**	**42.61**	**Brazil**
20	PS	2,893	14.00	->	40.49	59.51	0.00	Occupied Palestinian T.

% of validating clients who exclusively use Google's P-DNS

% of clients who use a mix of Google's P-DNS and other resolvers

% of clients who do not use Google's P-DNS service

Of those clients who perform DNSSEC validation, what resolvers are they using: All Google P-DNS? Some Google P-DNS? No Google P-DNS?

Is Google's P-DNS a Factor?

Rank	CC	Count	% D		%AG	%SG	%NG	Country
1	SE	5,349	77.92	->	1.78	0.19	98.03	Sweden
2	SI	4,758	58.85	->	7.89	0.21	91.89	Slovenia
3	LU	652	43.87	->	1.40	0.00	98.60	Luxembourg
4	VN	26,665	38.28	->	96.66	2.25	1.09	Vietnam
5	FI	2,456	37.01	->	2.64	0.33	97.03	Finland
6	CZ	30,827	33.20	->	11.71	3.99	84.30	Czech Republic
7	CL	46,151	30.26	->	3.62	0.45	95.92	Chile
8	JM	1,545	28.22	->	91.74	0.69	7.57	Jamaica
9	IE	8,079	27.94	->	12.18	0.93	86.89	Ireland
10	BB	1,312	24.24	->	7.86	0.31	91.82	Barbados
11	ID	54,816	23.87	->	68.36	12.63	19.01	Indonesia
12	UA	26,399	21.65	->	19.84	2.15	78.01	Ukraine
13	ZA	2,969	21.15	->	5.73	0.80	93.47	South Africa
14	TR	49,498	18.06	->	93.25	3.33	3.41	Turkey
15	US	140,234	17.32	->	7.28	0.73	91.98	United States of America
16	EG	36,061	14.68	->	86.28	9.88	3.84	Egypt
17	GH	973	14.59	->	59.86	14.08	26.06	Ghana
18	AZ	7,409	14.55	->	71.24	26.72	2.04	Azerbaijan
19	BR	179,424	14.43	->	50.31	7.08	42.61	Brazil
20	PS	2,893	14.00	->	40.49	59.51	0.00	Occupied Palestinian T.

Of those clients who perform DNSSEC validation, what resolvers are they using: All Google P-DNS? Some Google P-DNS? No Google P-DNS?

DNSSEC by Networks – the Top 25

Rank	AS	Count	% D	%x	%A	%G	AS Name
1	AS39651	710	98.73	0.14	1.13	0.71	Com Hem, SE
			97.77	2.23	0.00	0.49	Colombia Movil,CO
			.71	1. 4	1.14	2.34	ERA lska Telefonia, PL
			6.76	0. 4	2.40	1.24	T-2 Slo SI
			96.74	0.	2.41	1.07	Kabel BW Gm
			96.72	0.	2.41	53	Telekom Slovenij
			96.44	1.	2.47	6	Linkem spa, IT
			96.05	0.	3.26		Elisa Oyj, EU
			94.70	1.	3.77	1	Eircom, IE
10	AS6849	4,596	92.43	2.	5.42	3.	UKRTELECOM, UA
11	AS3301	1,445	91.56	1.	6.99	1.4	TeliaSonera, SE
12	AS5610	6,889	90.58	2.	.94		Czech Rep., CZ
13	AS7922	24,12		2.	.36		US
14	AS22047	15,27					, CL
15	AS1257	79					
16	AS38511	1,22					, ID
17	AS2519	52					
18	AS1759	56				2.06	TeliaSonera, FI
19	AS2819	73				20.85	GTSCZ GTS Czech, CZ
20	AS45899	14,30				97.76	VNPT, VN
21	AS27738	950				4.60	Ecuadortelecom, EC
22	AS12301	6,885	42.96	3.59	53.45	5.71	Invitel Tavkozlesi HU
23	AS4230	1,327	37.91	17.48	44.61	59.44	EMBRATEL-EMPRESA, BR
24	AS34170	1,169	36.36	55.18	8.47	72.00	AZTELEKOM Azerbaijan Tele, AZ
25	AS7552	3,708	35.92	5.02	59.06	96.47	Vietel, VN

% of clients who appear to use DNSSEC-validating resolvers

% of clients who use a mix of DNSSEC-validating resolvers and non-validating resolvers

% of clients who use non-validating resolvers

% of validating clients who exclusively use Google's P-DNS

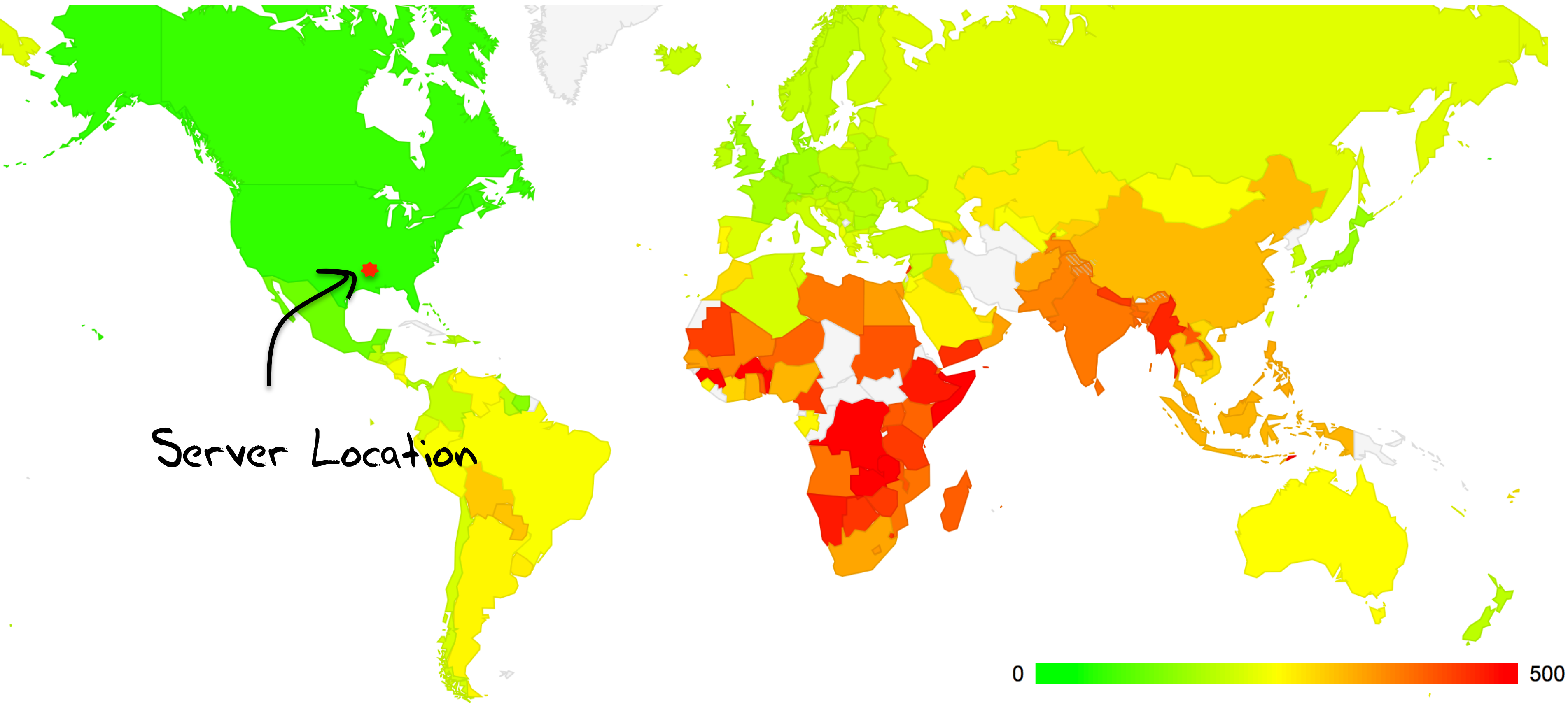
DNSSEC by Networks – the Top 25

Rank	AS	Count	% D	%x	%A	%G	AS Name
1	AS39651	710	98.73	0.14	1.13	0.71	Com Hem, SE
2	AS27831	627	97.77	2.23	0.00	0.49	Colombia Movil,CO
3	AS12912	1,486	97.71	1.14	1.14	2.34	ERA Polska Telefonia, PL
4	AS34779	834	96.76	0.84	2.40	1.24	T-2 Slovenia, SI
5	AS29562	582	96.74	0.86	2.41	1.07	Kabel BW GmbH, DE
6	AS5603	1,372	96.72	0.87	2.41	0.53	Telekom Slovenije, SI
7	AS198471	730	96.44	1.10	2.47	99.86	Linkem spa, IT
8	AS719	583	96.05	0.69	3.26	1.07	Elisa Oyj, EU
9	AS5466	2,093	94.70	1.53	3.77	1.21	Eircom, IE
10	AS6849	4,596	92.43	2.15	5.42	3.55	UKRTELECOM, UA
11	AS3301	1,445	91.56	1.45	6.99	1.44	TeliaSonera, SE
12	AS5610	6,889	90.58	2.48	6.94	4.97	TO2 Telefonica Czech Rep., CZ
13	AS7922	24,129	89.57	2.07	8.36	1.09	Comcast Cable, US
14	AS22047	15,274	88.61	9.68	1.71	1.12	VTR BANDA ANCHA, CL
15	AS1257	795	86.29	1.38	12.33	1.60	TELE2, SE
16	AS38511	1,221	79.36	4.18	16.46	10.84	PT Remala Abadi, ID
17	AS2519	523	57.36	3.82	38.81	0.67	VECTANT, JP
18	AS1759	562	51.78	26.51	21.71	2.06	TeliaSonera, FI
19	AS2819	734	48.37	15.53	36.10	20.85	GTSCZ GTS Czech, CZ
20	AS45899	14,306	45.93	3.16	50.91	97.76	VNPT, VN
21	AS27738	950	45.79	40.11	14.11	4.60	Ecuadortelecom, EC
22	AS12301	6,885	42.96	3.59	53.45	5.71	Invitel Tavkozlesi HU
23	AS4230	1,327	37.91	17.48	44.61	59.44	EMBRATEL-EMPRESA, BR
24	AS34170	1,169	36.36	55.18	8.47	72.00	AZTELEKOM Azerbaijan Tele, AZ
25	AS7552	3,708	35.92	5.02	59.06	96.47	Vietel, VN

DNS Performance

How can we measure the time taken to resolve each of the three DNSSEC domain name types (signed, unsigned, badly signed)?

Absolute Measurements don't make much sense…



Average RTT from Client to Server by country of origin (ms)

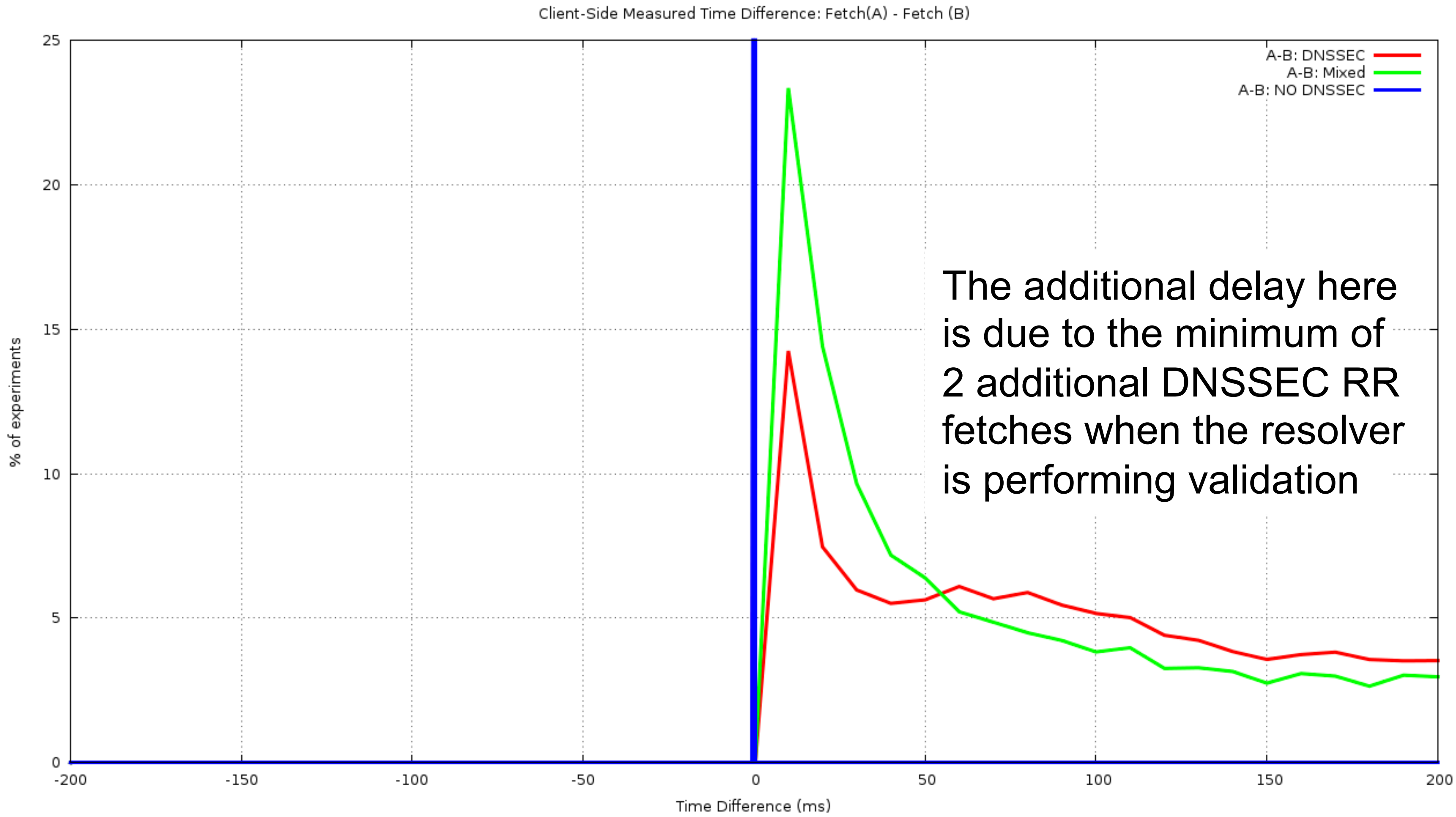
Relative Measurements …

Let's define the FETCH TIME as the time at the authoritative server from the first DNS query for an object to the HTTP GET command for the same object

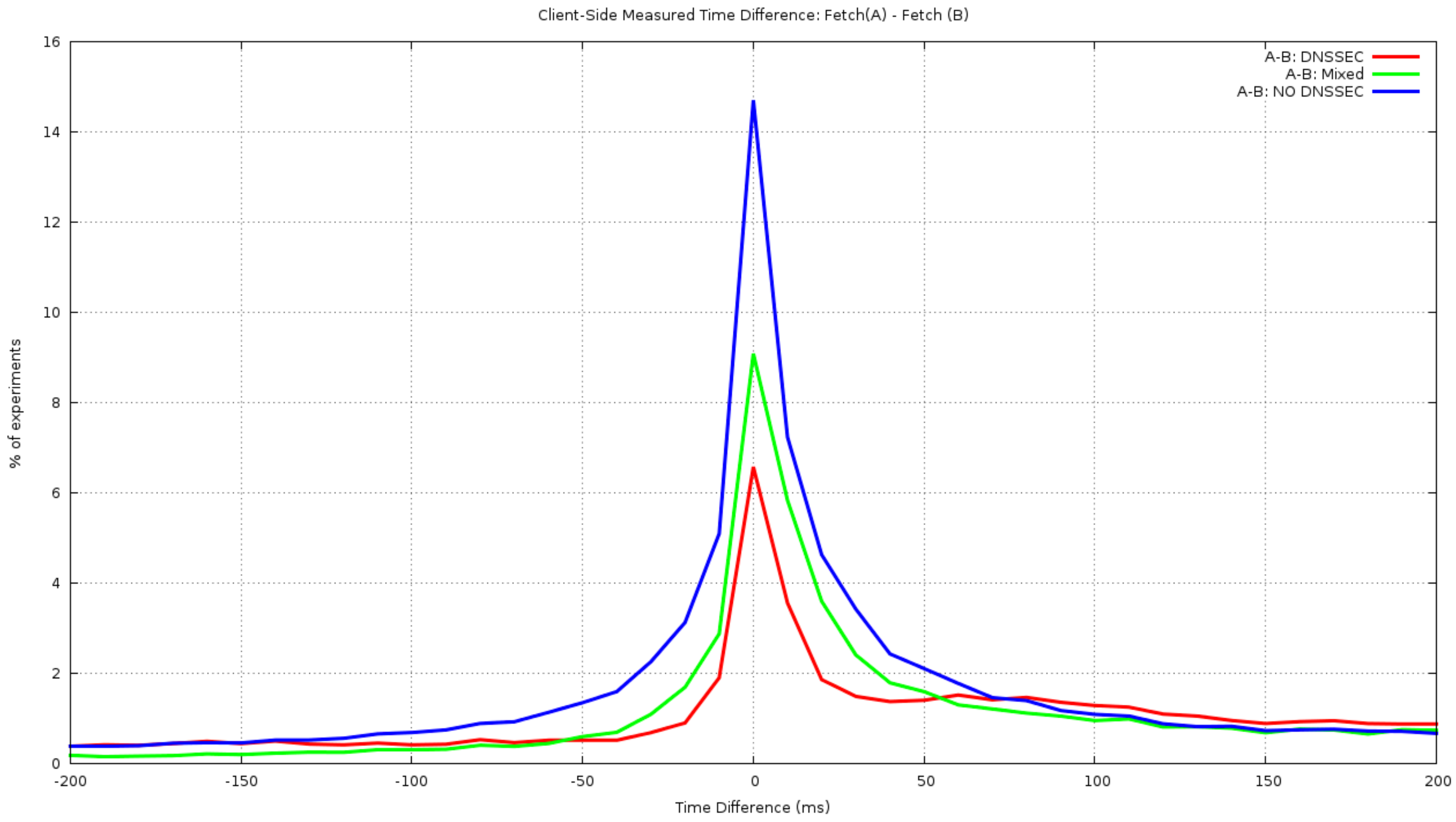
- This time should reflect the DNS resolution time and a single RTT interval for the TCP handshake

If the "base" fetch time is the time to load an unsigned DNSSEC object, then how much longer does it take to load an object that is DNSSEC-signed?

Theory…


Client-Side Measured Time Difference: Fetch(A) - Fetch (B)
A-B: DNSSEC
A-B: Mixed
A-B: NO DNSSEC
% of experiments
Time Difference (ms)
25
20
15
10
5
0
-200
-150
-100
-50
0
50
100
150
200
The additional delay here is due to the minimum of 2 additional DNSSEC RR fetches when the resolver is performing validation

Result



Client-Side Measured Time Difference: Fetch(A) - Fetch (B)
A-B: DNSSEC
A-B: Mixed
A-B: NO DNSSEC
% of experiments
Time Difference (ms)
16
14
12
10
8
6
4
2
0
-200
-150
-100
-50
0
50
100
150
200

Well…

- That didn't work as intended!
- The client is running a Flash Engine, and it appears when when you use action code to load up additional URLS then:
  - The order that the flash engine performs the load is not the same as the order in the action code!
  - There appears to be an explicit scheduling interval between name resolution phase and the scheduling of the object fetch
  - Flash Engines appear to use a scheduler that is difficult to understand from this data!

Well…

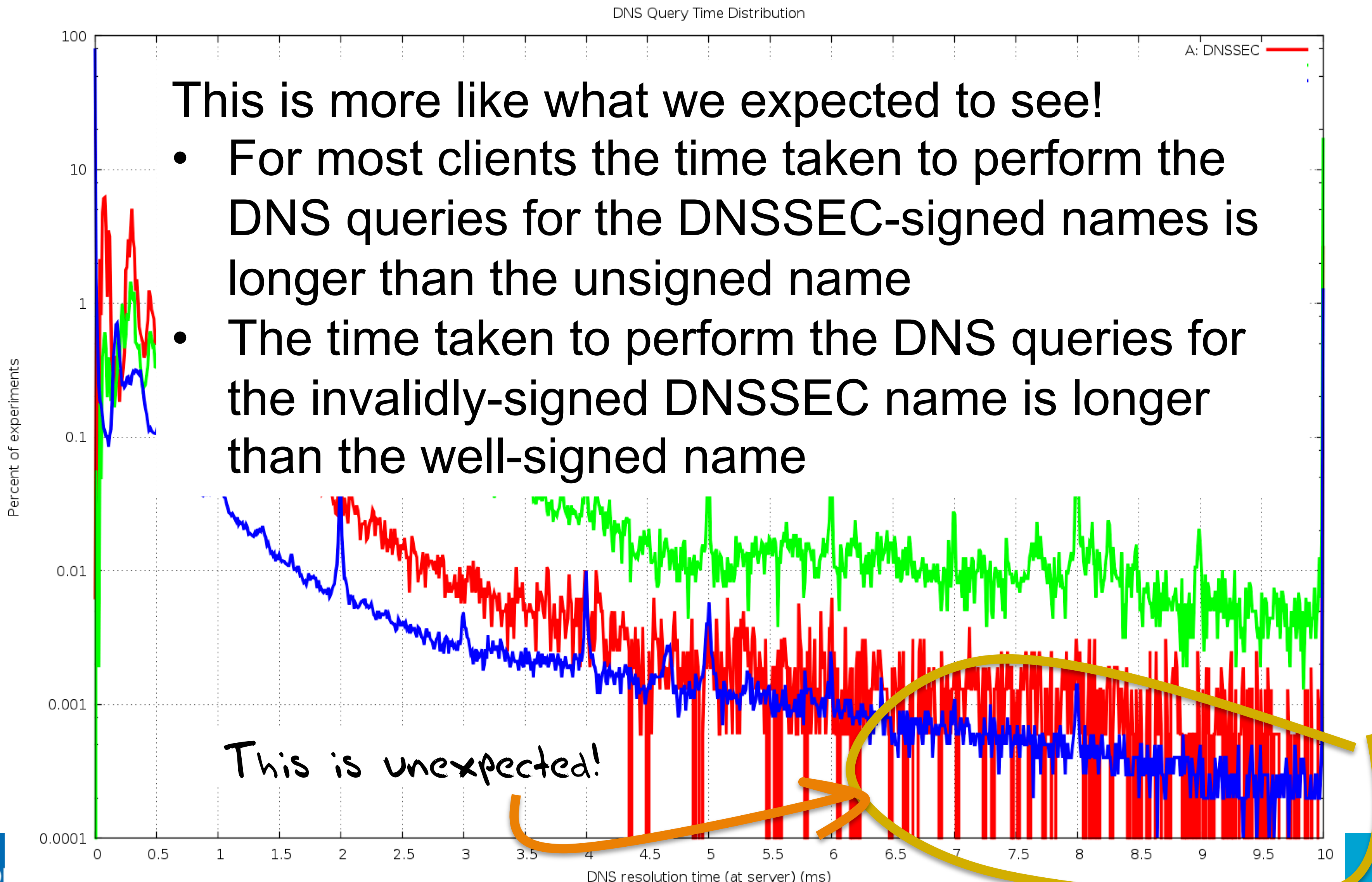
- There is a slight left/right difference in this data, but its difficult to conclude that fetches of DNSSEC-signed objects is consistently slower for clients using DNSSEC-resolving resolvers
- So lets focus on the DNS queries
  - And measure the elapsed time from the first seen to the last seen DNS query for each instance of the experiment

DNS Query Time

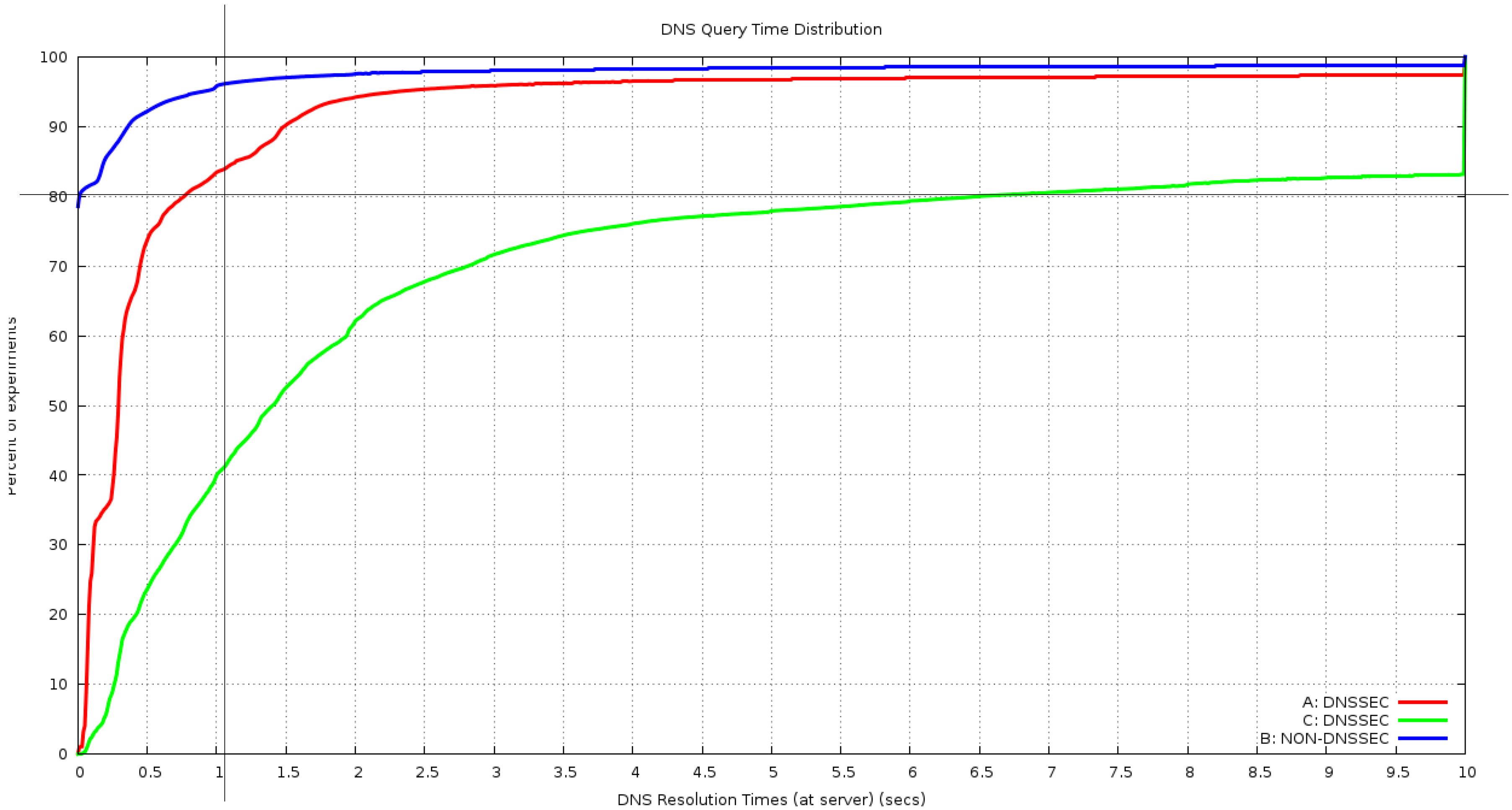
DNS Query Time

This is more like what we expected to see!

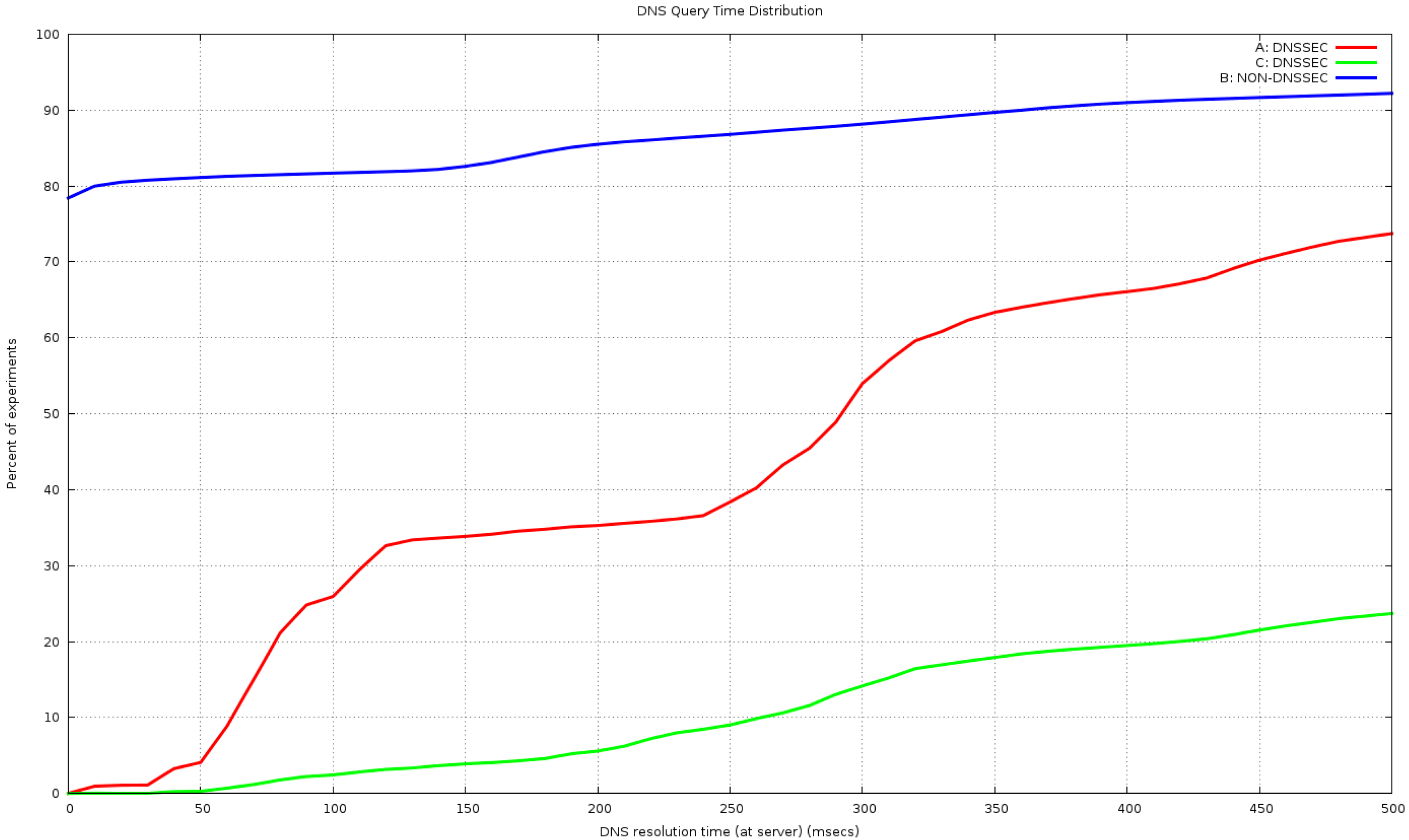
- For most clients the time taken to perform the DNS queries for the DNSSEC-signed names is longer than the unsigned name
- The time taken to perform the DNS queries for the invalidly-signed DNSSEC name is longer than the well-signed name



Cumulative Time Distribution



The first ½ second



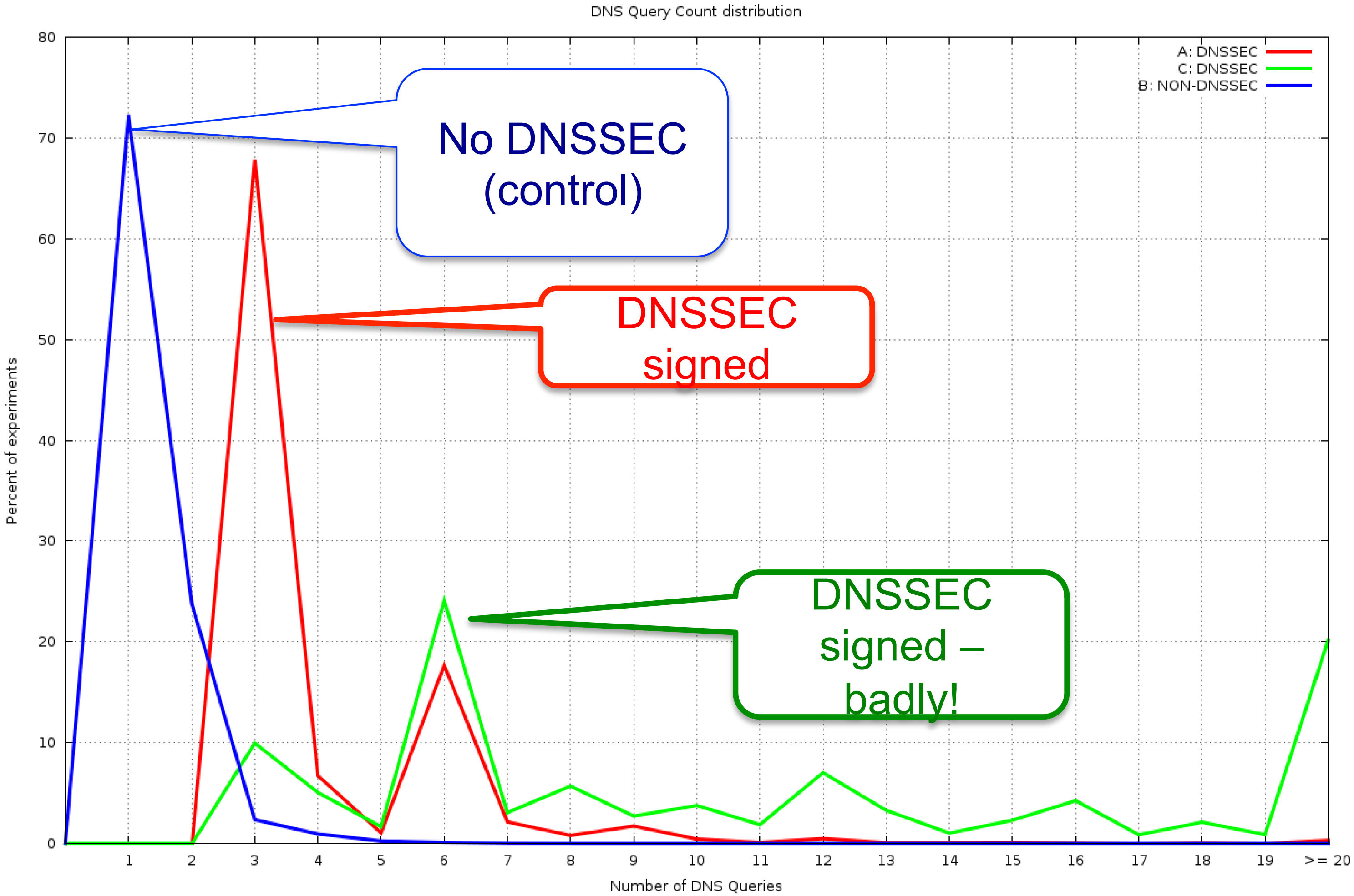
What can we say?

- DNSSEC takes longer
  - Which is not a surprise
  - Additional queries for DS and DNSKEY RRs
  - At a minimum that's 2 DNS query/answer intervals
    - Because it appears that most resolvers serialise and perform resolution then validation
- Badly-Signed DNSSEC takes even longer
  - Resolvers try hard to find a good validation path
  - And the SERVFAIL response causes clients to try subsequent resolvers in their list

At the other end…

Lets look at performance from the perspective of an Authoritative Name server who serves DNSSEC-signed domain names

DNS Query count per Domain Name



DNSSEC Performance

At the Authoritative Name Server:

Serving DNSSEC-signed zones = More Queries!

- The Authoritative server will now see additional queries for the DNSKEY and DS RRs for a zone, in addition to the A (and AAAA) queries

2,637,091 launched experiments

4,222,352 unsigned name queries
7,394,794 signed name queries
12,213,677 badly-signed name queries

What if everybody was doing it?

For the control name there are 1.6 queries per experiment

The total profile of queries for the control DNS name was:

3.4M A queries

0.4M AAAA queries

0.4M Other (NS, MX, ANY, SOA, CNAME, TXT, A6) queries

For the signed name, only 12.6% of clients use DNSSEC-aware resolvers, so the theory (2 additional queries per name) says we will see 4.8M queries

But we saw 7.4M queries for the signed DNS Name

- If 12.6% of clients' resolvers using DNSSEC generate an additional 3.1M queries for a signed domain name, what if every DNS resolver was DNSSEC aware?
- That would be 25M queries in the context of our experiment

A DNSSEC signed zone would see 6 times the query level of an unsigned zone if every resolver performed DNSSEC validation

Good vs Bad for Everyone

If 12.6% of clients performing some form of DNSSEC validation generate 12.2M queries for a badly-signed name, compared to the no-DNSSEC control level of 4.2M queries, what would be the query load if every resolver performed DNSSEC validation for the same badly signed domain?

- In our case that would be 63M queries

A badly-signed DNSSEC signed zone would seen 15 times the query level of an unsigned zone if every resolver performed DNSSEC validation

Response Sizes

What about the relative traffic loads at the server?

In particular, what are the relative changes in the traffic profile for responses from the Authoritative Server?

DNS Response Sizes

Control (no DNSSEC)

Query: 124 octets
Response: 176 octets

DNSSEC-Signed

Query: (A Record) 124 octe
Response: 951 Octets

Query: (DNSKEY Record) 80 octets
Response: 342 Octets

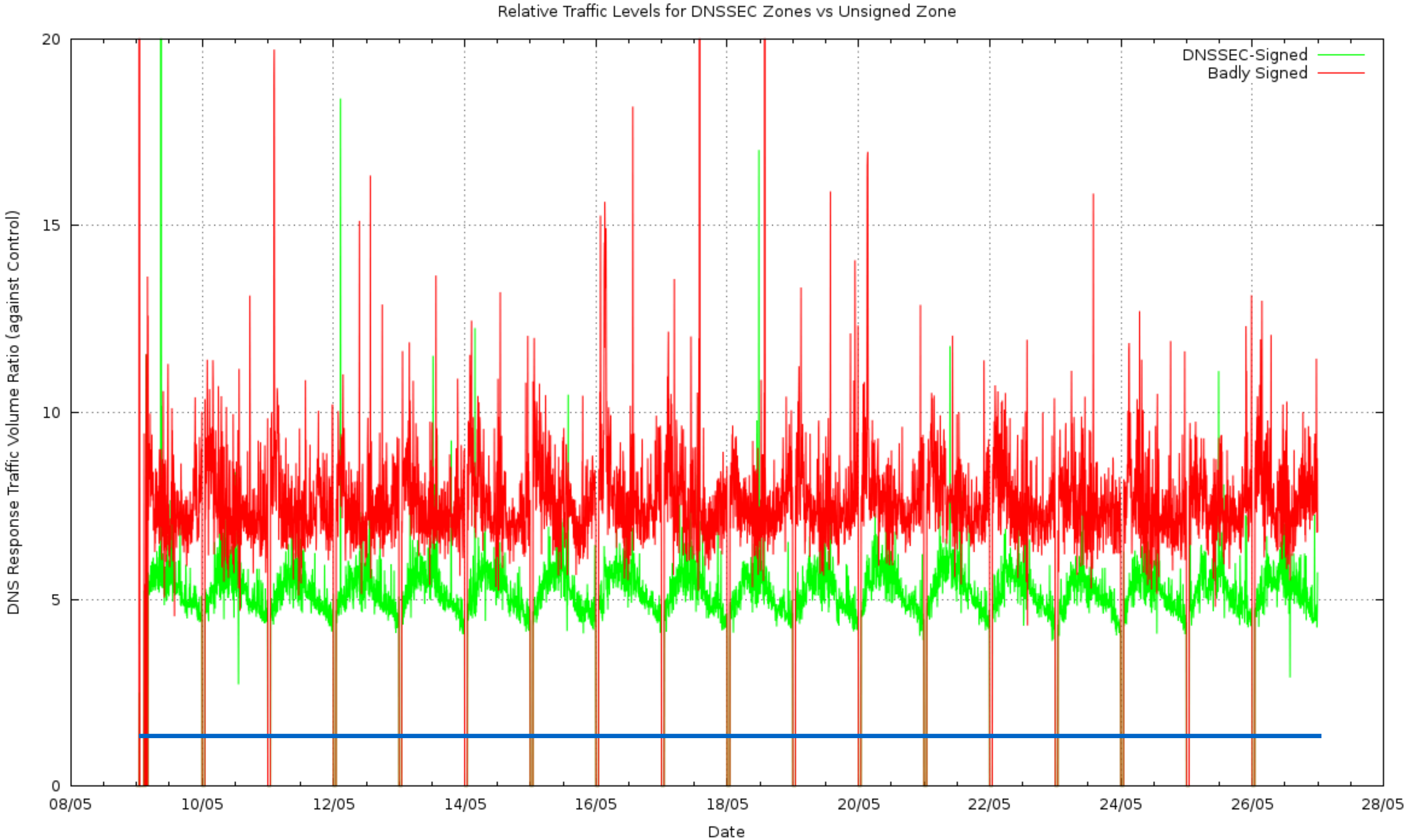
Query: (DS Record) 80 octets
Response: 341 Octets

Total: Query: 284 octets
Total Response: 1634 octets

These are not constant sizes – the DNS packet sizes of responses relate to the particular name being resolver, the number of keys being used, and the key size

So these numbers are illustrative of what is going on, but particular cases will vary from these numbers

Measurement – Response Traffic Volume



Interpreting Traffic Data

- The validly-signed domain name appears to generate 5x the traffic volume in responses as compared to the unsigned domain name

- The badly-signed domain name appears to generate 7.5x the traffic volume in responses

- What's contributing to this?
  1. Setting the DNSSEC OK bit in a query to the signed zone raises the response size from 176 to 951 octets
  2. Performing DNSSEC signature validation adds a minimum of a further 683 octets in DS and DNSKEY responses

What if you just sign your domain?

Lets start with the hypothetical question: How much more traffic will you be generating at the Authoritative Server if you sign your domain and NO resolvers perform DNSSEC validation?

76% of clients use resolvers who pass our server queries with EDNS0 + DNSSEC OK flag set

69% of queries for the unsigned zone

75% of queries for the signed zone

83% of queries for the badly-signed zone

(aside: why are these proportions different for each of these zones?)

If you just sign your zone and no resolvers are performing DNSSEC validation

Then from the May data, 69% of queries elicit a larger response then the total outbound traffic load is **4x** the traffic load of an unsigned zone

But we saw a rise of **5x** – why?

That's because 12.6 % of clients are also performing DNSSEC validation

What if everybody was doing it?

If 12.6% of clients performing some form of DNSSEC validation for a signed zone generate around 5 times the traffic as compared to an unsigned zone, then what if every resolver performed DNSSEC validation?

An authoritative server for a DNSSEC signed zone would've seen 13 times the traffic level of an unsigned zone if every resolver performed DNSSEC validation

A badly-signed DNSSEC zone would seen 31 times the traffic level of an unsigned zone

DNSSEC means more Server Grunt

- Its probably a good idea to plan the serve the worst case: a badly signed zone

- In which case you may want to consider provisioning the authoritative name servers with processing capacity to handle 15x the query load, and 30x the generated traffic load that you would need to serve an unsigned zone

It could be better than this…

"Real" performance of DNSSEC could be a lot better than what we have observed here

- We have deliberately negated any form of resolver caching
  - Every client receives a "unique" signed URL, and therefore every DNS resolver has to to perform A, DS and DNSKEY fetches for the unique label
  - The Ad placement technique constantly searches for "fresh eyeballs", so caching is not as efficient as it could be
  - Conventional DNS caching would dramatically change this picture
    - Our 16 day experiment generated 12,748,834 queries
    - A 7 day TTL would cut this to a (roughly estimated) 2M queries

And it could be a whole lot worse!

- For the invalid DNSSEC case we deliberately limited the impact of invalidity on the server
  - DNSSEC invalidity is not handled consistently by resolvers
  - Some resolvers will perform an exhaustive check of all possible NS validation paths in the event of DNSSEC validation failure

    See "Roll Over and Die" (http://www.potaroo.net/ispcol/2010-02/rollover.html)

  - In this experiment we used a single NS record for the invalidly signed domains
  - If we had chosen to use multiple nameservers, or used a deeper-signed label path, or both, on the invalid label, then the query load would've been (a lot?) higher
- Resolver caching of invalidly signed data is also unclear – so a break in the DNSSEC validation material may also change the caching behaviour of resolvers, and increase load at the server

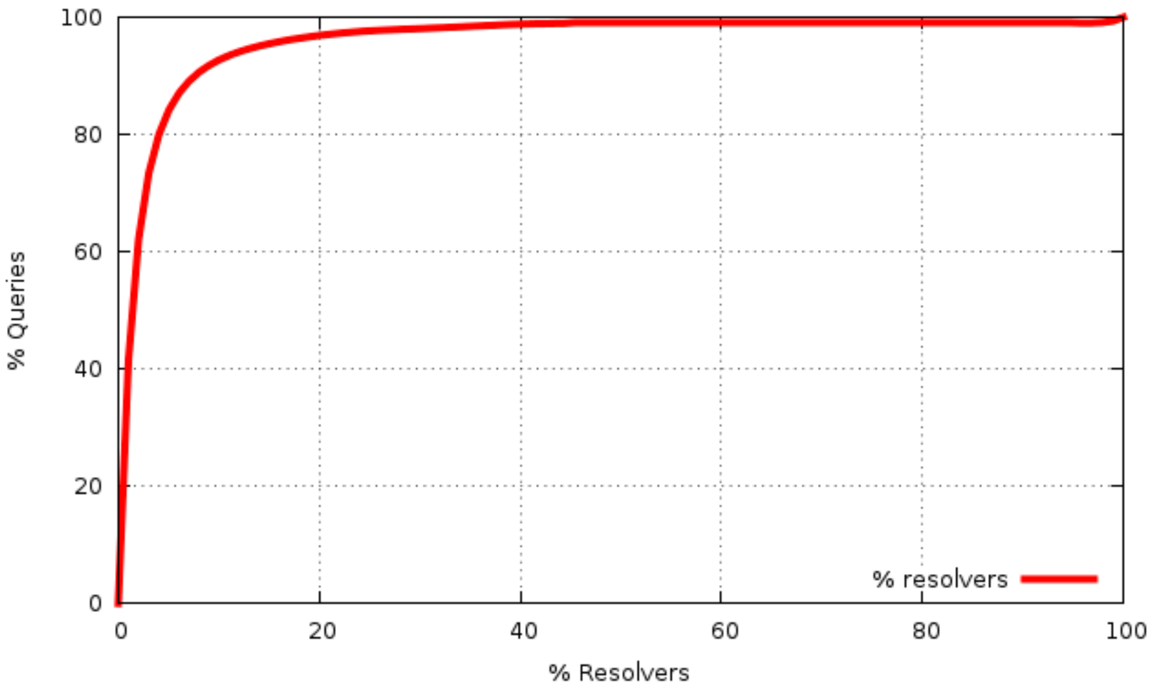
Some things to think about

- DNSSEC generates very large responses from very small queries
  - Which makes it a highly effective DDOS amplifier
  - Is relying on BCP38 going to work?
  - Do we need to think about DNS over TCP again?
  - But how many resolvers/firewalls/other middleware stuff support using TCP for DNS?
  - What's the impact on the authoritative server load and caching recursive resolver load when moving from UDP to TCP?

Some things to think about

Resolver / Client Distribution

- 1% of visible resolvers provide the server with 58% of the seen queries
- A few resolvers handle a very significant proportion of the total query volume
- But there are an awful lot of small, old, and poorly maintained resolvers running old code out there too!



Some things to think about

- Google's Public DNS is currently handling queries from 7.5% of the Internet's end client population
  - That's around 1 in 13 users
  - In this time of heightened awareness about corporate and state surveillance, and issues around online anonymity and privacy, what do we think about this level of use of Google's Public DNS Service?

Some things to think about

Is the DNS borked?

Why do 20% of clients use resolvers that make >1 DNS query for a simple unsigned uncached domain name?

- Is the DNS resolver ecosystem THAT broken that 1 in 5 clients use resolvers that generate repeat queries gratuitously?
- And is it reasonable that 1 in 20 clients take more than 1 second to resolve a simple DNS name?

Some things to think about

SERVFAIL is not just a “DNSSEC validation is busted” signal

- clients start walking through their resolver set asking the same query
- Which delays the client and loads the server
  - The moral argument: Failure should include a visible cost!
  - The expedient argument: nothing to see here, move along!

Maybe we need some richer signaling in the DNS for DNSSEC validation failure

Some things to think about

Olde code never seems to die out

We still see A6 queries!

So what about Key rollover and RFC5011 support?

- How many resolvers don't support RFC5011 in their key management?
- We don't know because we can't get resolvers to signal their capability
- If we roll the TA, and if resolvers have hand-installed trust, and don't implement RFC5011 signalling
  - How many will say "broken DNSSEC" when the old sigs expire?
  - How many will re-query per NS high in the tree to the authoritative servers?
  - What percentage of worldwide DNSSEC will do this?

Some things to think about

- Why do up to 80% of queries have EDNS0 and the DNSSEC OK flag set, yet only 8.3% of clients perform DNSSEC validation?
- How come we see relatively more queries with the DNSSEC OK flag set for queries to domains in signed zones?

So where are we?

User Measurement provides a rich feedback channel about how technology is being deployed - there is much more to learn here about the behaviour of the DNS

And much to think about in terms of security, robustness, scalability and performance of the DNS

Thanks!

Questions?