Living in a DNSSEC enabled world

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UKNOF19, Leeds, April 2011

Outline

- The DNS Root
- A bit of History
- Several DNSSEC operational incidents
- Tools and Recommendations
- NOTE: This is the impact of DNSSEC for the network and systems types. DNS Admins will need to go much deeper.

DNS Root Myths

- Where all DNS Queries begin!

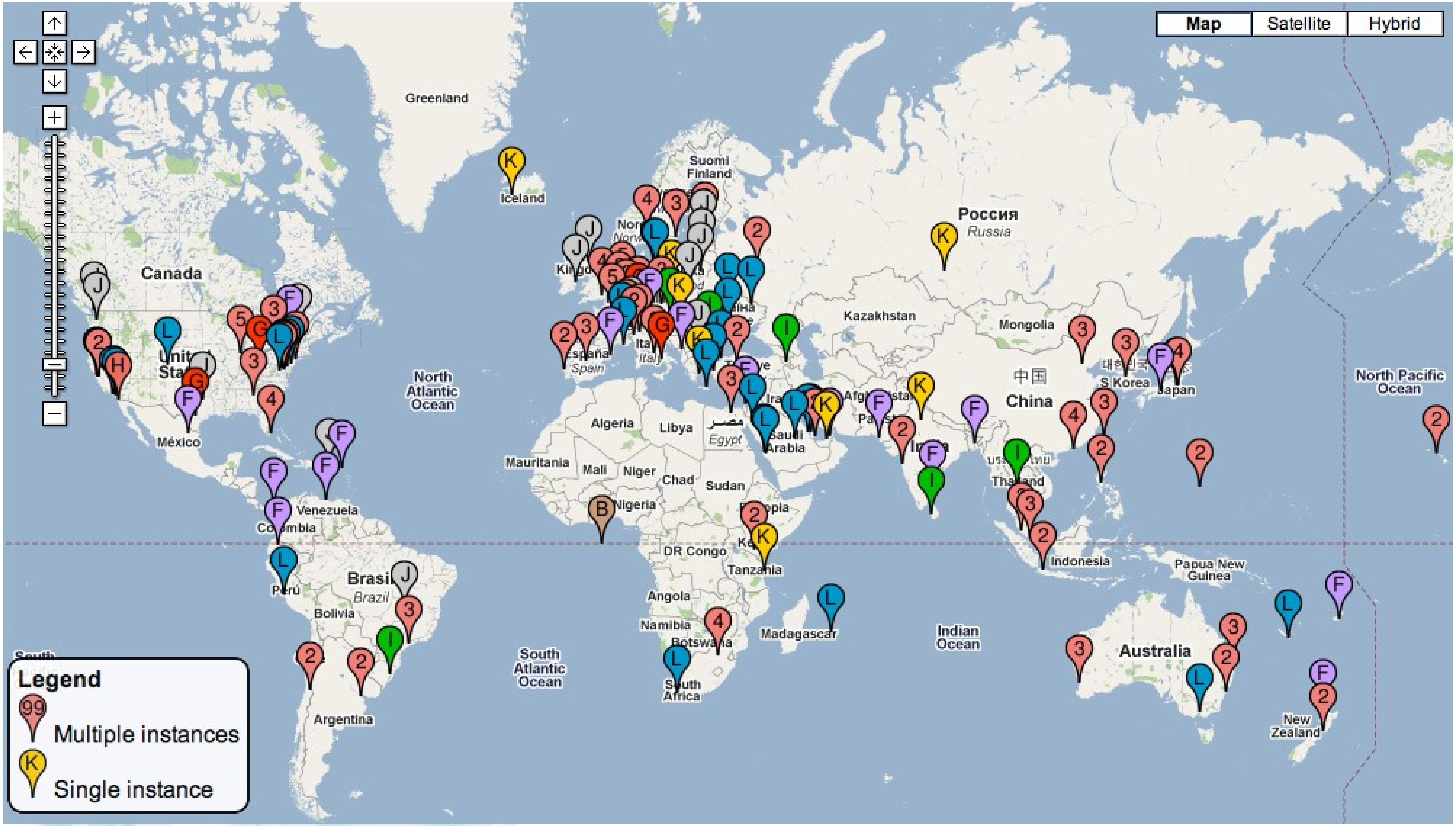
  Well, if you don't have anything cached

- Holds all the "IMPORTANT" zones

  Only needs to hold "."

- Consists of 13 servers, A-Root through M-Root

  13 Instances, but MANY more servers



DNS Root Servers January 2011

And then came DNSSEC

- DNSSEC signing the root was a BIG deal
- Months of planning
- Repeated DITLs (Day in the Life)
- Then added the DURZ (Deliberately Unvalidatable Root Zones)
- Finally fully formally signed on July 15, 2010

And of course the TLDs

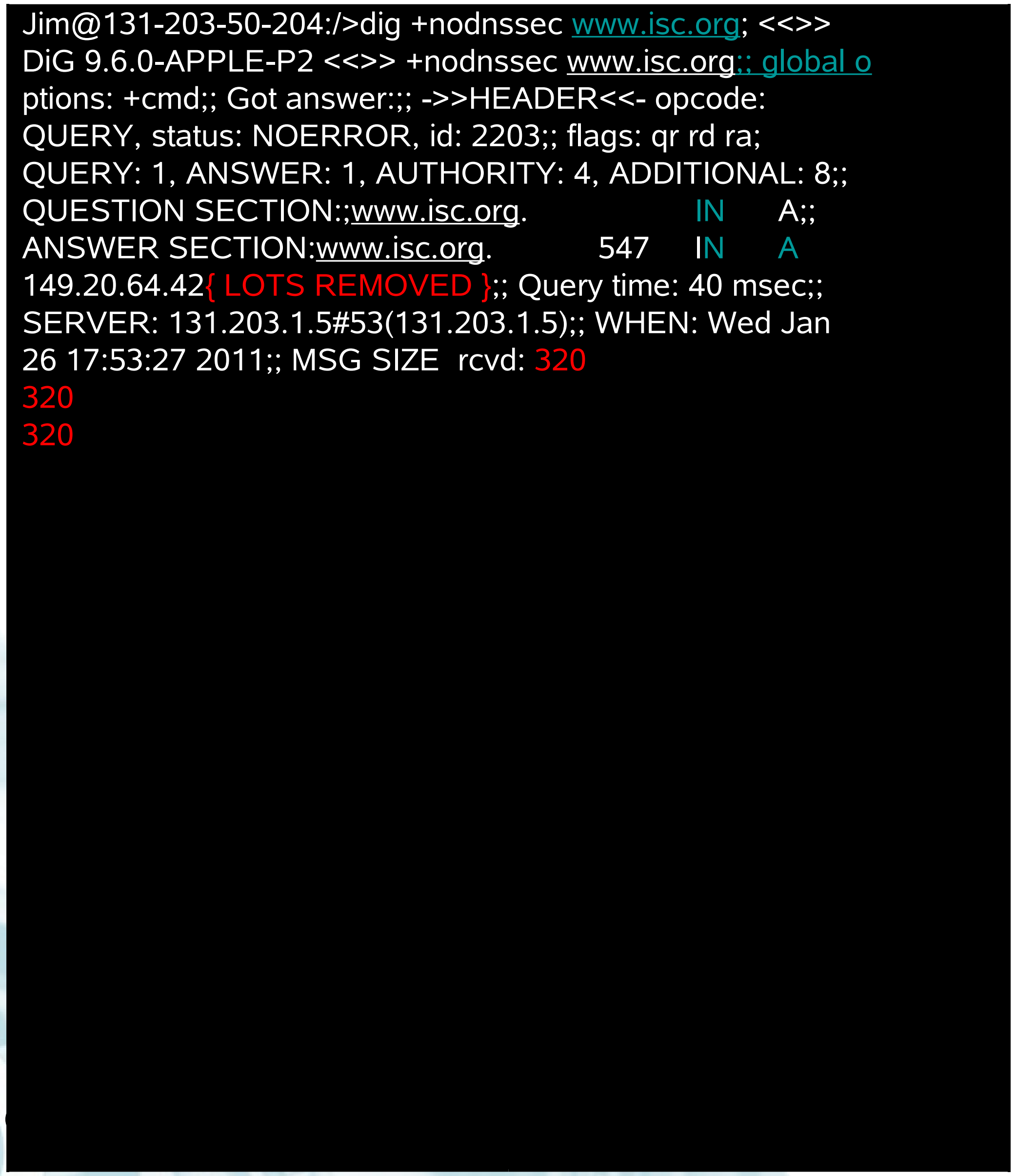
- Many TLDs and ccTLDs signed already
  - .com, .org, .net, .edu, .gov
  - .uk, .se, .au, .jp, .cz, .fr
  - many more (though some may still be in testing)
- .co.uk planned end of April 2011

Network Impact of DNSSEC

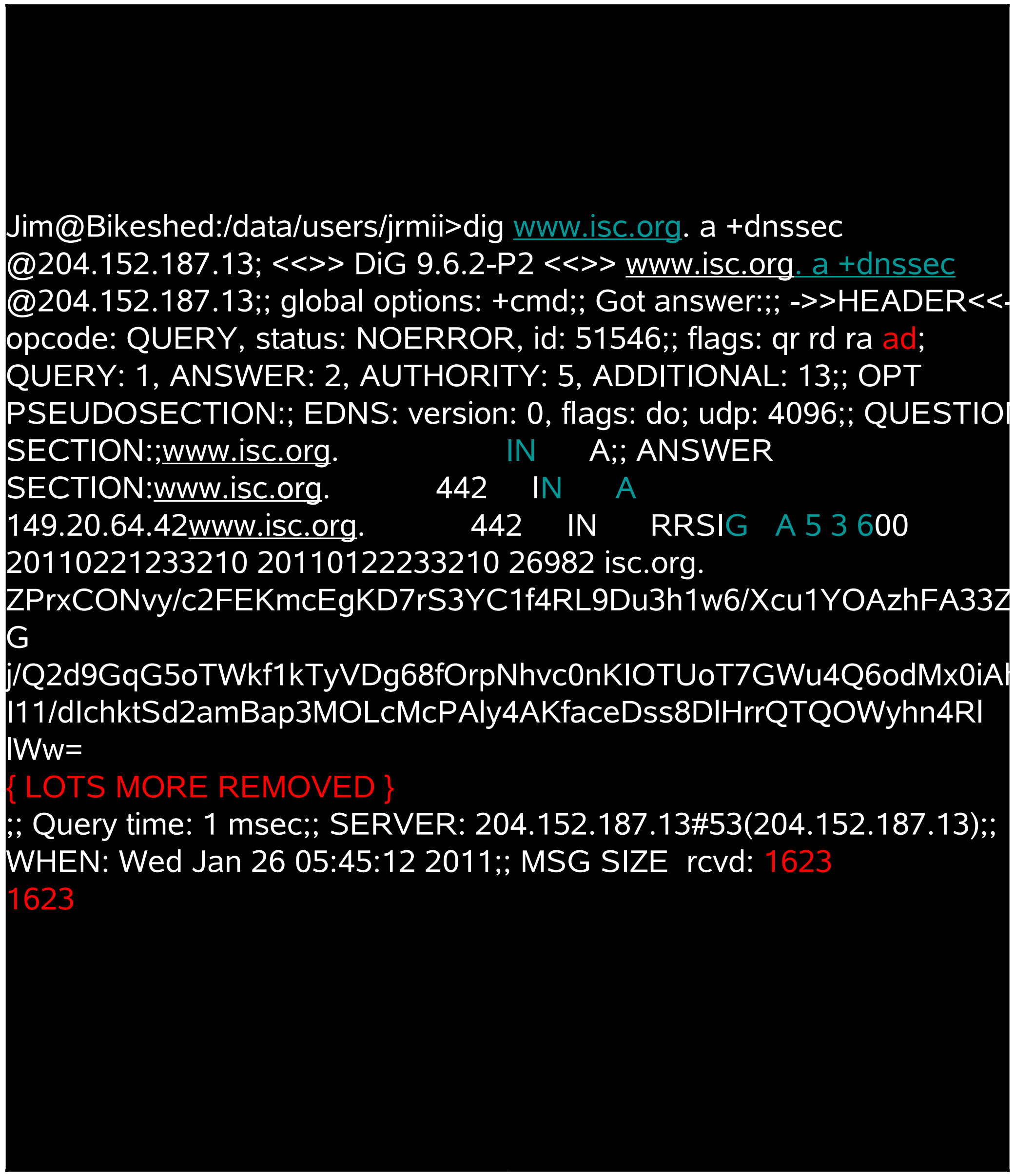
- Signed DNS responses are BIG
  - Have DS, NSEC, DNSKEY, & RRSig data
  - Dramatically increases query response sizes
  - 512 byte UDP packets just don’t cut it
  - EDNS0 is no longer “nice to have”

Just how much bigger?

- Without DNSSEC



```
Jim@131-203-50-204:/>dig +nodnssec www.isc.org; <<>>
DiG 9.6.0-APPLE-P2 <<>> +nodnssec www.isc.org;; global o
ptions: +cmd;; Got answer:;; ->>HEADER<<- opcode:
QUERY, status: NOERROR, id: 2203;; flags: qr rd ra;
QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 8;;
QUESTION SECTION:;www.isc.org.                IN      A;;
ANSWER SECTION:www.isc.org.           547     IN      A
149.20.64.42{ LOTS REMOVED };; Query time: 40 msec;;
SERVER: 131.203.1.5#53(131.203.1.5);; WHEN: Wed Jan
26 17:53:27 2011;; MSG SIZE  rcvd: 320
320
320
```



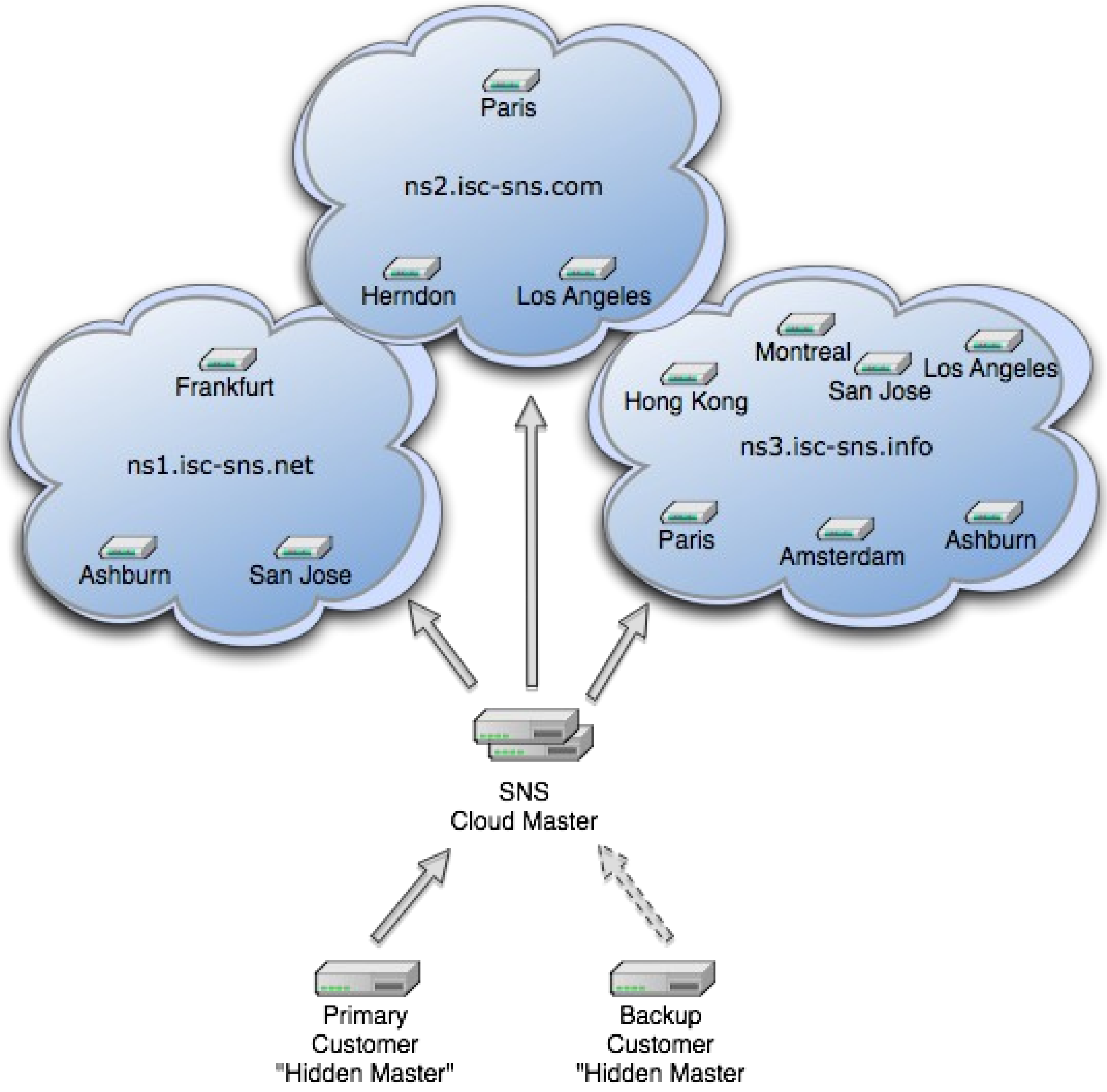
```
Jim@Bikeshed:/data/users/jrmii>dig www.isc.org. a +dnssec
@204.152.187.13; <<>> DiG 9.6.2-P2 <<>> www.isc.org. a +dnssec
@204.152.187.13;; global options: +cmd;; Got answer:;; ->>HEADER<<-
opcode: QUERY, status: NOERROR, id: 51546;; flags: qr rd ra ad;
QUERY: 1, ANSWER: 2, AUTHORITY: 5, ADDITIONAL: 13;; OPT
PSEUDOSECTION:; EDNS: version: 0, flags: do; udp: 4096;; QUESTIO
SECTION:;www.isc.org.                IN      A;; ANSWER
SECTION:www.isc.org.           442     IN      A
149.20.64.42www.isc.org.           442     IN      RRSIG   A 5 3 600
20110221233210 20110122233210 26982 isc.org.
ZPrxCONvy/c2FEKmcEgKD7rS3YC1f4RL9Du3h1w6/Xcu1YOAzhFA33Z
G
j/Q2d9GqG5oTWkf1kTyVDg68fOrpNhvc0nKIOTUoT7GWu4Q6odMx0iA
I11/dIchktSd2amBap3MOLcMcPAly4AKfaceDss8DlHrrQTQOWyhn4Rl
lWw=
{ LOTS MORE REMOVED }
;; Query time: 1 msec;; SERVER: 204.152.187.13#53(204.152.187.13);;
WHEN: Wed Jan 26 05:45:12 2011;; MSG SIZE  rcvd: 1623
1623
```

EDNS0

- Extension Mechanisms for DNS-RFC 2671
  - Allows for bigger DNS messages
  - Uses IP Fragments
  - Recommended maximum of 4K
  - NOT on by default in all firewalls
  - NOT a given in all home “routers”

ISC Secondary Name Service (SNS)

- Provide both free (SNS-PB) and SLA-Backed (SNS-Com) DNS Secondary Service
- 3 separate AnyCast Clouds with multiple providers
- Largely IPv6 Enabled
- Fully DNSSEC capable



Simple DNSSEC Failure Behavior

- Content provider DNSSEC signs their zones and gets proper DS records installed
- End user tries to look up FQDN in that zone (eg, www.foo.org) and it fails
- End user believes that www.foo.org is “down”

Simple DNSSEC Failure Cause

- Client unwittingly sets the bits to allow validation
- {Firewall, middlebox, CPE} not EDNS0-compliant
- {Firewall, middlebox, CPE, host firewall} explicitly blocks IPv4 Fragments
- Recursive resolver not DNSSEC capable or doesn’t have the root anchors installed

More Obscure Failure Behavior

- We host a large multi-national Internet property in SNS
- Their zones were NOT signed
- Some users couldn’t successfully resolve records in that domain.

The cause of that more obscure failure

- The zone of the content provider were NOT signed
- NS records for the zone referenced records that WERE in a signed zone
- The resultant responses popped above the 512 byte limit, and we’re back at the same behavior as the simple case

Key Rollover

- Periodically the Signing Keys (KSK/ZSK) should be changed
- During the period while ANY server could be passing out the old key, both the old and new keys are included in responses
- Yup, that response just got bigger!
- This mostly impacts places where EDNS0 is enabled, but a “conservative” (often 1K) limit is chosen

But I don’t have a problem.... really!

- You sure? Use the OARC Reply Size test!

```
Jim@131-203-50-204:/>dig +short rs.dns-oarc.net
txtrst.x4091.rs.dns-oarc.net.rst.x3837.x4091.rs.dns-
oarc.net.rst.x3843.x3837.x4091.rs.dns-oarc.net."Tested
at 2011-01-26 03:52:33 UTC""202.53.189.253 sent EDNS
buffer size 4096""202.53.189.253 DNS reply size limit is
at least 4091"
```

```
c.net.rst.x490.x485.x476.rs.dns-oarc.net."68.87.76.181 DNS reply size
```

BIND

- Has been doing EDNS0 since 8.3.0
- Got DNSSEC (bis) in 9.3.0
- BUT has known flaws for anything before 9.4-ESV
- It’s highly recommended that you run 9.8.0, 9.7.3 or 9.6-ESV-R4

Key Take Aways

- Make sure your BIND install is 9.7.3 or 9.6-ESV
- Make sure all your network elements that touch DNS can do EDNS0 and allow 4K responses
- Make sure any network security elements allow IP Fragments
- Use the reply size tester to validate your systems and to identify customer problems

References

- DNS Root Servers

  http://www.root-servers.org/

  http://www.root-dnssec.org/
- DNSSEC

  http://dnssec.net/
- Test Tools

  https://www.dns-oarc.net/oarc/services/replysizetest
- Name Server (BIND)

  http://www.isc.org

  http://www.isc.org/software/bind/versions

Acknowledgements

- Jim Martin, Peter Losher, ISC
  - (based on previous NZNOG & NANOG talks)
- https://www.dns-oarc.net/files/workshop-201103/JotPowers.pdf

Questions?

- While you're thinking of questions:
  - If you want to peer with F-Root, talk to Emma Smith here, or send mail to peering@isc.org
  - We host public-benefit organizations through our Hosted@ and SNS-PB programs. Contact {hosted,sns}@isc.org
  - Remember ISC is a public-benefit and survives through donations, forum memberships, SNS-Com and support contracts.
  - We appreciate any help, and need it to keep doing good work!