Troubleshooting DNS with dig

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https://www.isc.org

Presentation Outline

1 Why not just use ping?

2 Digging daily Business

3 Let's get ~~dirty~~ nerdy.

4 Digging in the Wild

Why not just use ping?

Message ID									
QR	OPCODE	AA	TC	RD	RA	RE	AD	CD	RCODE
QDCOUNT									
ANCOUNT									
NSCOUNT									
ARCOUNT									

Table 1: DNS Message Format

- QR - query (0) or response (1)

- OPCODE - type

- AA - auth. answer

- TC - truncation

- RD - recursion desired

- RA - recursion available

- RE - reserved for future use

- AD - authenticated data (DNSSEC)

- CD - checking disabled (DNSSEC)

- RCODE - response type

The three Worlds of DNS[1]

- Enterprise-influenced
- User-influenced
- Internet Infrastructure

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[1] https://www.thousandeyes.com/resources/2018-global-dns-performance-benchmark-report
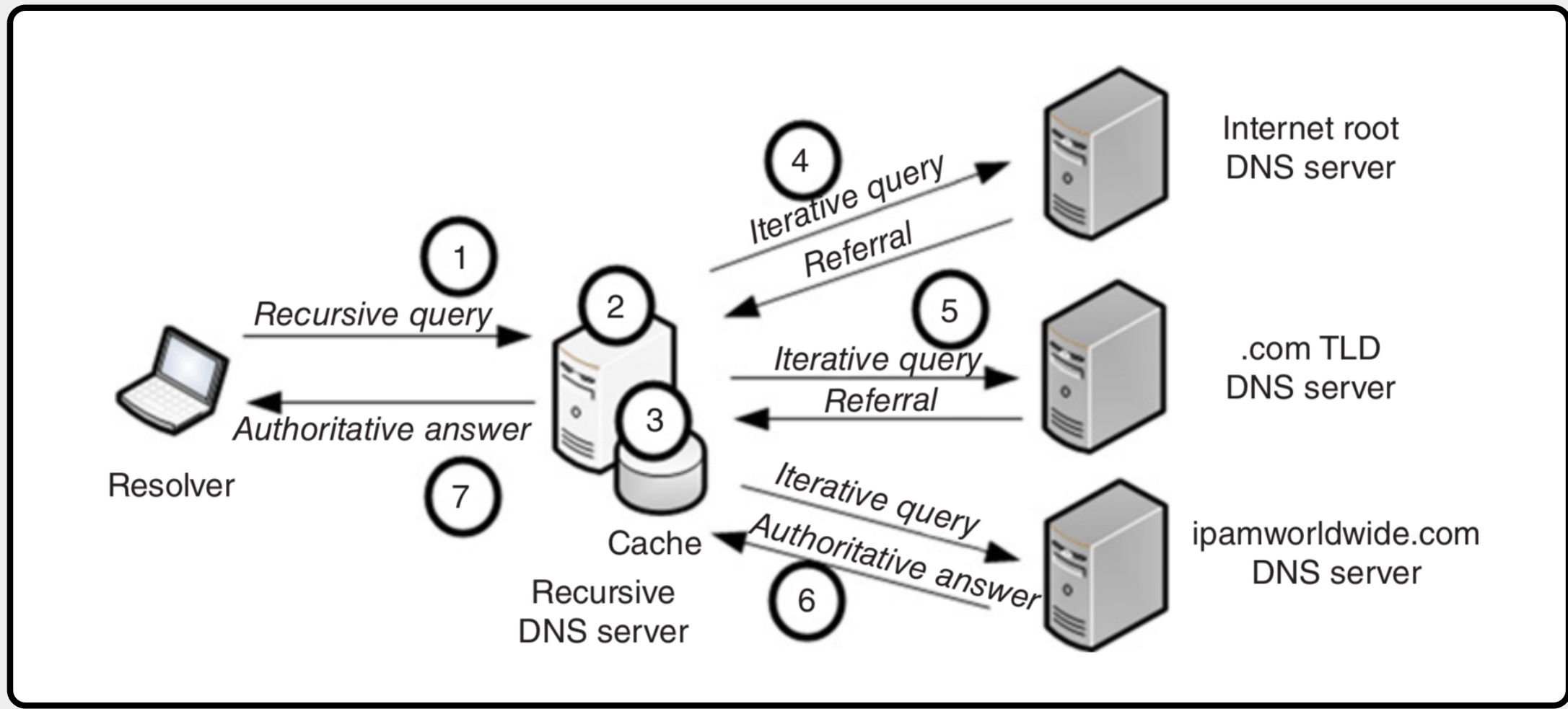
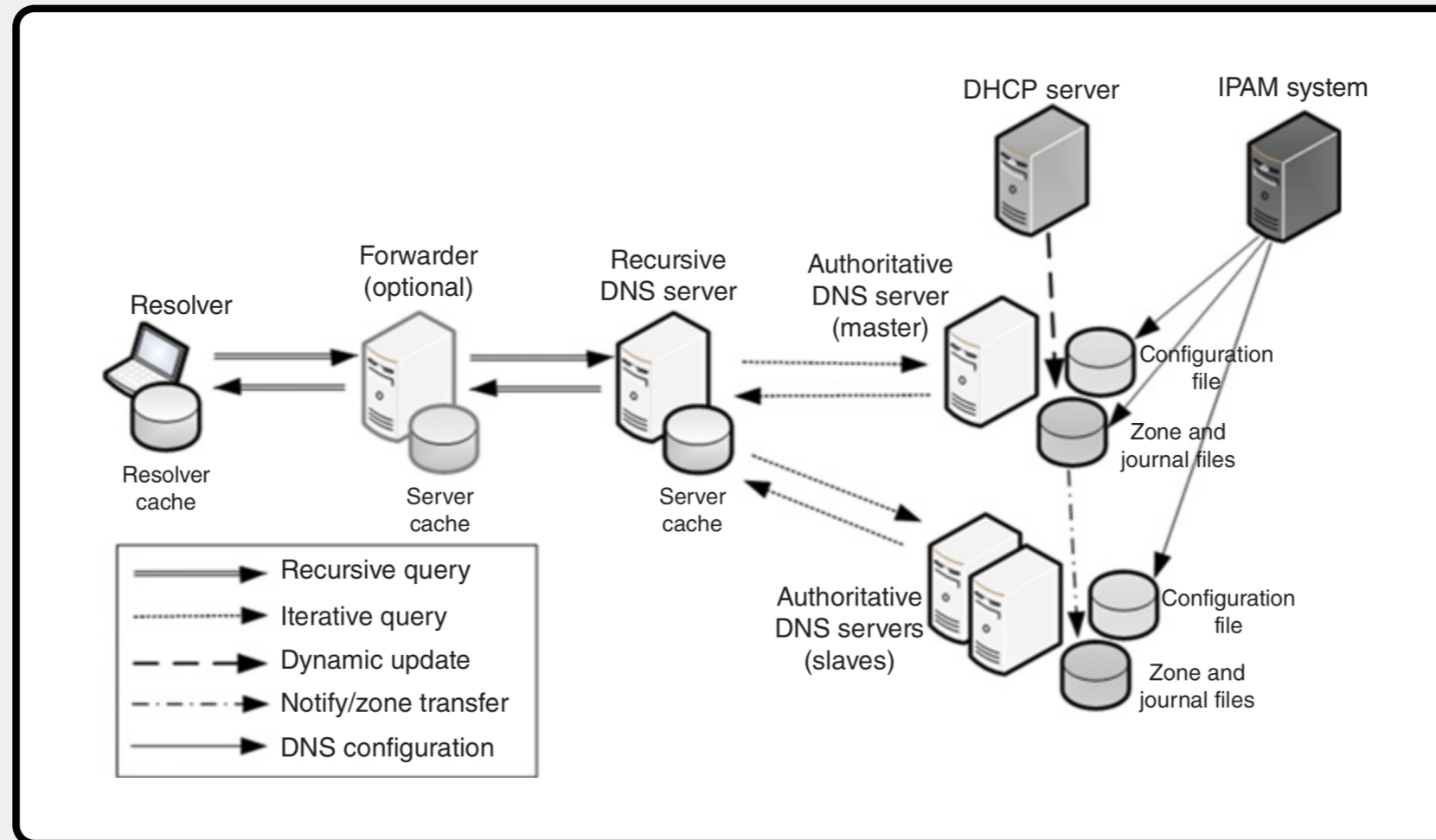Figure 1: Recursive, Iterative, Referral & Authoritative

Figure 2: DNS Data Sources & Flows

[3] DNS Security Management, Dooley/Rooney, Wiley-IEEE Press, ISBN: 978-1-119-32827-8

DNS Response Codes[4]

- **NOERROR** No Error
- **FORMERR** Format Error (unable to interpret Query)
- **SERVFAIL** Server or Feature Problem
- **NXDOMAIN** FQDN doesn't exist
- **NOTIMPL** Not implemented
- **REFUSED** Action refused, e.g. Zone Transfer or DDNS
- **NotAuth** Server not authoritative for Zone
- **NotZone** Name not contained in Zone
- **prereq** YXDomain, YXRRSet, NXRRSet

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[4]Pro DNS and BIND, Aitchison, Apress, ISBN: 978-1-430-23048-9

Typical "DNS Issues"

- Client's TCP/IP Config.
  - ► e.g. Cache, NetBIOS, WINS, hosts, resolv.conf
- Authoritative vs. Recursive
  - ► e.g. A from Authoritative & PTR from Recursive
- The trailing Dot
  - ► host.2nd-level.tld.root-label
- Round Robin

Digging daily Business

Domain Information Groper (dig)[5]

- Performs DNS Lookups and displays the Answers
- Other Lookup Tools tend to have less Functionality
- No interactive Mode, just Arguments
- Batch Mode for Reading Lookup Requests from a File

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[5]BIND DNS Administration Reference, Reed, Reed Media Services, ISBN: 978-1-937-51603-1

Name-to-Address Mapping

```
1    $ dig @2606:4700:4700::64 isc.org. AAAA
2
3    ; <<>> DiG 9.10.6 <<>> @2606:4700:4700::64 isc.org. AAAA
4    ; (1 server found)
5    ;; global options: +cmd
6    ;; Got answer:
7    ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 49554
8    ;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1
9
10   ;; OPT PSEUDOSECTION:
11   ; EDNS: version: 0, flags:; udp: 1452
12   ;; QUESTION SECTION:
13   ;isc.org.        IN   AAAA
14
15   ;; ANSWER SECTION:
16   isc.org.     16   IN   AAAA   2001:4f8:1:f::66
17
18   ;; Query time: 47 msec
19   ;; SERVER: 2606:4700:4700::64#53(2606:4700:4700::64)
20   ;; WHEN: Wed June 10 19:00:00 CEST 2020
21   ;; MSG SIZE  rcvd: 71
```

Listing 1: Name-to-Address Mapping

```
1   $ dig @2606:4700:4700::64 -x 2001:4f8:1:f::66
2
3   ; <<>> DiG 9.10.6 <<>> @2606:4700:4700::64 -x 2001:4f8:1:f::66
4   ; (1 server found)
5   ;; global options: +cmd
6   ;; Got answer:
7   ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 45058
8   ;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1
9
10  ;; OPT PSEUDOSECTION:
11  ; EDNS: version: 0, flags:; udp: 1452
12  ;; QUESTION SECTION:
13  ;6.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.0.0.0.1.0.0.0.8.f.4.0.1.0.0.2.ip6.arpa. IN PTR
14
15  ;; ANSWER SECTION:
16  6.6.0.0.0.0.0.0.0.0.0.0.0.0.0.0.f.0.0.0.1.0.0.0.8.f.4.0.1.0.0.2.ip6.arpa. 7200 IN PTR www.isc.org.
17
18  ;; Query time: 1319 msec
19  ;; SERVER: 2606:4700:4700::64#53(2606:4700:4700::64)
20  ;; WHEN: Wed June 10 19:00:00 CEST 2020
21  ;; MSG SIZE  rcvd: 198
```

Listing 2: Address-to-Name Mapping

```
1  # dig @2606:4700:4700::64 isc.org. MX +nostat +noquestion +noadditional +noauthority +noedns
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 6786
4  ;; flags: qr rd ra ad; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0
5
6  ;; ANSWER SECTION:
7  isc.org.     373 IN  MX  10 mx.pao1.isc.org.
```

Listing 3: Digging recursive DNS

```
1  # dig @2001:500:60::30 isc.org. MX +nostat +noquestion +noadditional +noauthority +noedns +norecurse
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 27203
4  ;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 4, ADDITIONAL: 8
5
6  ;; ANSWER SECTION:
7  isc.org.     7200  IN  MX  10 mx.pao1.isc.org.
```

Listing 4: Digging authoritative DNS

DIGGING FOR STATS

```
1  # dig @129.78.64.2 sydney.edu.au. NS +noquestion +noadditional +noauthority +noanswer +noedns +norecurse
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 22911
4  ;; flags: qr aa; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 2
5
6  ;; Query time: 415 msec
7  ;; SERVER: 129.78.64.2#53(129.78.64.2)
8  ;; WHEN: Wed June 10 19:00:00 CEST 2020
9  ;; MSG SIZE  rcvd: 125
```

Listing 5: Digging for Stats

DIGGING FOR ZONE TRANSFER

```
1   # dig @2001:db8:b00b::53 isc.org. axfr
2   [...]
3   isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608753789 1200 180 1209600 3600
4   isc.org.    86400 IN  NS  ns1.isc.org.
5   isc.org.    3600  IN  AAAA  2001:db8:cafe::100
6   ns1.isc.org.    86400 IN  A 192.168.8.92
7   ns1.isc.org.    86400 IN  AAAA  2001:db8:b00b::53
8   ns1.isc.org.    86400 IN  AAAA  2001:db8:cafe::53
9   xn--bjrn-jrgen-fcb0f.isc.org. 3600 IN AAAA  2001:db8:cafe::9876
10  isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608753789 1200 180 1209600 3600
11  ;; Query time: 0 msec
12  ;; SERVER: 2001:db8:b00b::53#53(2001:db8:b00b::53)
13  ;; WHEN: Wed June 10 19:00:00 CEST 2020
14  ;; XFR size: 9 records (messages 1, bytes 348)
```

Listing 6: Digging for Zone Transfer

```
1   # dig isc.org. AAAA -4 +noall +additional
2
3   ; <<>> DiG 9.11.7 <<>> isc.org. AAAA -4 +noall +additional
4   ;; global options: +cmd
5   ns1.isc.org.     86400 IN  A 192.168.8.92
6   ns1.isc.org.     86400 IN  AAAA  2001:db8:cafe::53
7   ns1.isc.org.     86400 IN  AAAA  2001:db8:b00b::53
```

Listing 7: Digging the Internet Protocol (IPv4)

```
1   # dig isc.org. AAAA -6 +noall +additional
2
3   ; <<>> DiG 9.11.7 <<>> isc.org. AAAA -6 +noall +additional
4   ;; global options: +cmd
5   ns1.isc.org.     86400 IN  AAAA  2001:db8:b00b::53
6   ns1.isc.org.     86400 IN  AAAA  2001:db8:cafe::53
7   ns1.isc.org.     86400 IN  A 192.168.8.92
```

Listing 8: Digging the Internet Protocol (IPv6)

DIGGING SPECIFIC PORTS

```
1   options {
2      listen-on port 9876 {
3         192.168.8.0/24;
4         127.0.0.0/8;
5      };
6   };
```

Listing 9: named.conf

```
1   # dig @192.168.8.92 isc.org. AAAA -p 9876 +noall +answer
2
3   ; <<>> DiG 9.10.6 <<>> @192.168.8.92 isc.org. AAAA -p 9876 +noall +answer
4   ; (1 server found)
5   ;; global options: +cmd
6   isc.org.     3600   IN   AAAA   2001:db8:cafe::100
```

Listing 10: Digging specific Ports

Digging internationalized Domain Names (IDN)[6]

```
1   # dig björn-jürgen.isc.org. AAAA +nostats +noauthority +norecurse +noedns
2   [...]
3   ;; ->>HEADER<<- opcode: QUERY, status: NXDOMAIN, id: 65127
4   ;; flags: qr aa; QUERY: 1, ANSWER: 0, AUTHORITY: 1, ADDITIONAL: 0
5
6   ;; QUESTION SECTION:
7   ;bj\195\182rn-j\195\188rgen.isc.org. IN AAAA
```

Listing 11: Digging internationalized Domain Names

```
1   # dig `idn --quiet -a björn-jürgen.isc.org.` AAAA +nostats +noauthority +norecurse +noadditional +noedns
2   [...]
3   ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 55926
4   ;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 3
5
6   ;; QUESTION SECTION:
7   ;xn--bjrn-jrgen-fcb0f.isc.org.  IN  AAAA
8
9   ;; ANSWER SECTION:
10  xn--bjrn-jrgen-fcb0f.isc.org. 3600 IN AAAA  2001:db8:cafe::9876
```

Listing 12: Digging internationalized Domain Names

[6]Alternative DNS Servers, Mens, UIT Cambridge Ltd., ISBN: 978-0-954-45299-5

LET'S GET ~~DIRTY~~ NERDY.

DIGGING WITHOUT EDNS[7] SUPPORT

```
1  # dig customer.biz. AAAA +nostat +noquestion +noadditional +noauthority +norecurse
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: FORMERR, id: 56938
4  ;; flags: qr; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1
5
6  ;; OPT PSEUDOSECTION:
7  ; EDNS: version: 0, flags:; udp: 4096
8  ; COOKIE: ab269fbf4c794e3c (echoed)
```

Listing 13: Digging without EDNS Support

```
1  # dig customer.biz. AAAA +nostat +noquestion +noadditional +noauthority +norecurse +noedns
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 54667
4  ;; flags: qr aa ra; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 0
5
6  ;; ANSWER SECTION:
7  customer.biz.           600      IN      AAAA     2001:db8:fb0a::8d24:fb0a
```

Listing 14: Digging without EDNS Support and +noedns

[7]Extension Mechanisms for DNS

OARC's DNS Reply Size Test Server[8]

```
1   # dig +short rs.dns-oarc.net TXT
2   rst.x4090.rs.dns-oarc.net.
3   rst.x4060.x4090.rs.dns-oarc.net.
4   rst.x4066.x4060.x4090.rs.dns-oarc.net.
5   "2001:1438:2:13::11 DNS reply size limit is at least 4090"
6   "2001:1438:2:13::11 sent EDNS buffer size 4096"
```

Listing 15: Reply Size Test

[8] https://www.dns-oarc.net/oarc/services/replysizetest

Remember the Flags?

- AA – Answer from primary/secondary Name Server (authoritative answer)
- RD – Client requested recursive Search (recursion desired)
- RA – Name Server is willing to perform recursive Search (recursion available)
- AD – Name Server has validated the Signature (authenticated data)
- CD – Client requested to not perform Validation (checking disabled)
- DO – Client requested to perform Validation (EDNS: dnssec ok)

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[9]DNSSEC Mastery, Lucas, Tilted Windmill Press, ISBN: 978-1-484-92447-1

```
 1  # dig @2001:500:60::30 isc.org. MX +nostat +noquestion +noadditional +noauthority +norecurse +dnssec
 2  [...]
 3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 5946
 4  ;; flags: qr aa; QUERY: 1, ANSWER: 2, AUTHORITY: 5, ADDITIONAL: 17
 5
 6  ;; OPT PSEUDOSECTION:
 7  ; EDNS: version: 0, flags: do; udp: 4096
 8  ;; ANSWER SECTION:
 9  isc.org.      7200   IN   MX   10 mx.pao1.isc.org.
10  isc.org.      7200   IN   RRSIG MX 13 2 7200 20200603231151 20200504224259 27566 isc.org. CZSPNUbLrZsDMeLFQgzMm...
```

Listing 16: Digging DNSSEC against authoritative DNS

```
 1  # dig @2606:4700:4700::64 isc.org. MX +nostat +noquestion +noadditional +noauthority +dnssec
 2  [...]
 3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 54999
 4  ;; flags: qr rd ra ad; QUERY: 1, ANSWER: 2, AUTHORITY: 0, ADDITIONAL: 1
 5
 6  ;; OPT PSEUDOSECTION:
 7  ; EDNS: version: 0, flags: do; udp: 1452
 8  ;; ANSWER SECTION:
 9  isc.org.      4842   IN   MX   10 mx.pao1.isc.org.
10  isc.org.      4842   IN   RRSIG MX 13 2 7200 20200603231151 20200504224259 27566 isc.org. CZSPNUbLrZsDMeLFQgzMm...
```

Listing 17: Digging DNSSEC against recursive DNS

```
1  # dig @2001:500:60::30 isc.org. DNSKEY +nostat +noquestion +noadditional +noauthority +dnssec
2  [...]
3  ;; ANSWER SECTION:
4  isc.org.    7200  IN  DNSKEY  257 3 13 zEoOfseNFDM+E8spu7RR2Ar/GzFqAehe4yapWLiv6McIUF6xmI5GcIQ3 +uLAizS2c...
5  isc.org.    7200  IN  DNSKEY  256 3 13 1CS+VQcRn4lGTK+b3wDjVO0hFDx4DV7s3Q1Fwxuq9ahd255FRny4f4vd ZOMMMxpbR...
```

Listing 18: Digging DNSSEC for Keys

```
1  # dig @2001:500:60::30 isc.org. DNSKEY +nostat +noquestion +noadditional +noauthority +dnssec +multiline
2  [...]
3  ;; ANSWER SECTION:
4  isc.org.    7200 IN DNSKEY 257 3 13 (
5         zEoOfseNFDM+E8spu7RR2Ar/GzFqAehe4yapWLiv6...
6         ) ; KSK; alg = ECDSAP256SHA256 ; key id = 7250
7  isc.org.    7200 IN DNSKEY 256 3 13 (
8         1CS+VQcRn4lGTK+b3wDjVO0hFDx4DV7s3Q1Fwxuq9...
9         ) ; ZSK; alg = ECDSAP256SHA256 ; key id = 27566
```

Listing 19: Digging DNSSEC for Keys with +multiline

```
1   # dig @2606:4700:4700::64 fail01.dnssec.works. AAAA +nostat +noquestion +noadditional +noauthority
2   [...]
3   ;; ->>HEADER<<- opcode: QUERY, status: SERVFAIL, id: 1759
4   ;; flags: qr rd ra; QUERY: 1, ANSWER: 0, AUTHORITY: 0, ADDITIONAL: 1
5
6   ;; OPT PSEUDOSECTION:
7   ; EDNS: version: 0, flags:; udp: 1452
```

Listing 20: Digging broken DNSSEC

```
1   # dig @2606:4700:4700::64 fail01.dnssec.works. AAAA +nostat +noquestion +noadditional +noauthority +cdflag
2   [...]
3   ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 55986
4   ;; flags: qr rd ra cd; QUERY: 1, ANSWER: 1, AUTHORITY: 0, ADDITIONAL: 1
5
6   ;; OPT PSEUDOSECTION:
7   ; EDNS: version: 0, flags:; udp: 1452
8   ;; ANSWER SECTION:
9   fail01.dnssec.works.   3450   IN   AAAA   2a01:198:2b6:1000:203:2dff:fe29:8424
```

Listing 21: Digging broken DNSSEC with +cdflag

[10]https://dnssec.works/

Name Server Identifier (NSID)

- Multiple Name Servers share single IP Address (anycast, load balancing, etc.)
- Difficult to tell which of a Pool of Name Servers has answered particular Query
- EDNS OPT Pseudo Record (RFC 5001[11])

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[11]https://tools.ietf.org/html/rfc5001

```
1  # dig @2620:fe::fe isc.org aaaa +nostat +noquestion +noadditional +noauthority +nsid
2  [...]
3  ;; OPT PSEUDOSECTION:
4  ; EDNS: version: 0, flags:; udp: 512
5  ; NSID: 72 65 73 32 31 31 2e 66 72 61 2e 72 72 64 6e 73 2e 70 63 68 2e 6e 65 74 ("res211.fra.rrdns.pch.net")
6  ;; ANSWER SECTION:
7  isc.org.    51  IN  AAAA  2001:4f8:1:f::66
```

Listing 22: Digging for the NSID

```
1  # dig @2620:fe::fe isc.org aaaa +nostat +noquestion +noadditional +noauthority +nsid
2  [...]
3  ;; OPT PSEUDOSECTION:
4  ; EDNS: version: 0, flags:; udp: 512
5  ; NSID: 72 65 73 31 31 30 2e 66 72 61 2e 72 72 64 6e 73 2e 70 63 68 2e 6e 65 74 ("res110.fra.rrdns.pch.net")
6  ;; ANSWER SECTION:
7  isc.org.    60  IN  AAAA  2001:4f8:1:f::66
```

Listing 23: Digging for the NSID 1h later

DIGGING IN THE WILD

Digging with Files

```
1   2620:fe::fe
2   2620:fe::10
3   2620:0:ccc::2
4   2620:0:ccd::2
```

Listing 24: dns-servers.txt

```
1   isc.org
2   icann.org
3   denic.de
4   afrinic.net
```

Listing 26: dns-zones.txt

```
1   #!/bin/bash
2   servers='dns-servers.txt'
3   zones='dns-zones.txt'
4   parameters='+time=1 +tries=1 +noall +stats'
5   for dns in `cat $servers`
6   do
7     for zone in `cat $zones`
8     do
9     printf "working on $zone with $dns" && \
10           dig @$dns $zone $parameters | \
11           egrep -i "query time"
12    done
13  done
```

Listing 25: dig-bulk.sh

```
1   /dig-bulk.sh
2   working on isc.org with 2620:fe::fe;; Query time: 58 msec
3   working on icann.org with 2620:fe::fe;; Query time: 135 msec
4   working on denic.de with 2620:fe::fe;; Query time: 42 msec
5   working on afrinic.net with 2620:fe::fe;; Query time: 68 msec
6   working on isc.org with 2620:fe::10;; Query time: 53 msec
7   working on icann.org with 2620:fe::10;; Query time: 53 msec
8   working on denic.de with 2620:fe::10;; Query time: 51 msec
9   working on afrinic.net with 2620:fe::10;; Query time: 297 msec
10  working on isc.org with 2620:0:ccc::2;; Query time: 114 msec
11  working on icann.org with 2620:0:ccc::2;; Query time: 106 msec
12  working on denic.de with 2620:0:ccc::2;; Query time: 47 msec
13  [...]
```

Listing 27: Digging with Files

DIGGING WITH LOOPS

```
1  # while [ 1 ]; do printf "$(date +%F-%T) " && dig isc.org. AAAA +short +time=1 +tries=1; done
```

Listing 28: Digging with Loops

```
 1  2020-06-10-19:00:28 2001:db8:cafe::100
 2  2020-06-10-19:00:28 2001:db8:cafe::100
 3  2020-06-10-19:00:28
 4  ; <<>> DiG 9.11.7 <<>> isc.org. AAAA +short +time=1 +tries=1
 5  ;; global options: +cmd
 6  ;; connection timed out; no servers could be reached
 7  2020-06-10-19:00:30
 8  ; <<>> DiG 9.11.7 <<>> isc.org. AAAA +short +time=1 +tries=1
 9  ;; global options: +cmd
10  ;; connection timed out; no servers could be reached
11  2020-06-10-19:00:32 2001:db8:cafe::100
12  2020-06-10-19:00:33 2001:db8:cafe::100
```

Listing 29: Digging with Loops

DIGGING FOR TIME

```
1   google.com
2   youtube.com
3   facebook.com
4   google.de
5   amazon.de
6   ebay.de
7   wikipedia.org
8   [...]
```

Listing 30: top-domains.txt

```
1   # dig -f top-domains.txt +noall +stats | awk '/Query/{sum+=$4}END{print "Total Query Time: "sum" msec"}'
2   Total Query Time: 514 msec
```

Listing 31: Digging for Time

DIGGING DNS VIEWS

```
 1  view "internal" {
 2    match-clients {
 3      !key "VIEW100897";
 4      key "VIEW100895";
 5      127.0.0.2/32;
 6      2001:db8:affe::/64;
 7    };
 8    zone "isc.org" {...};
 9    recursion no;
10    allow-query { 2001:db8:affe::/64; 127.0.0.2/32; };
11  };
```

Listing 32: Digging DNS Views (named.conf)

```
 1  view "external" {
 2    match-clients {
 3      !key "VIEW100895";
 4      key "VIEW100897";
 5      127.0.0.3/32;
 6      "any";
 7    };
 8    zone "isc.org" {...};
 9    recursion no;
10    allow-query { "any"; 127.0.0.3/32; };
11  };
```

Listing 34: Digging DNS Views (named.conf)

```
 1  key "VIEW100895" {
 2    algorithm "hmac-md5";
 3    secret "j+AlWmDPKDHxRCGiu3WWbA==";
 4  };
```

Listing 33: Key "internal" View

```
 1  key "VIEW100897" {
 2    algorithm "hmac-md5";
 3    secret "g8cZ4RBvQv9QD9nav2naDg==";
 4  };
```

Listing 35: Key "external" View

Digging with Source Address

```
1  # dig isc.org. AAAA +nostat +noquestion +noadditional +noauthority +noedns +norecurse -b 127.0.0.2
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 20089
4  ;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 3
5
6  ;; ANSWER SECTION:
7  isc.org.    3600  IN  AAAA  2001:db8:affe::100
```

Listing 36: Digging with Source Address ("internal" View)

```
1  # dig isc.org. AAAA +nostat +noquestion +noadditional +noauthority +noedns +norecurse -b 127.0.0.3
2  [...]
3  ;; ->>HEADER<<- opcode: QUERY, status: NOERROR, id: 3816
4  ;; flags: qr aa; QUERY: 1, ANSWER: 1, AUTHORITY: 1, ADDITIONAL: 2
5
6  ;; ANSWER SECTION:
7  isc.org.    3600  IN  AAAA  2001:db8:cafe::100
```

Listing 37: Digging with Source Address ("external" View)

DIGGING WITH KEYS

```
1  # dig isc.org AXFR -y "hmac-md5:VIEW100895:j+AlWmDPKDHxRCGiu3WWbA==" +nostats
2  [...]
3  isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608743523 1200 180 1209600 3600
4  isc.org.    86400 IN  NS  ns1.isc.org.
5  isc.org.     3600  IN  AAAA  2001:db8:affe::100
6  ns1.isc.org.    86400 IN  A 192.168.8.92
7  ns1.isc.org.    86400 IN  AAAA  2001:db8:affe::53
8  isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608743523 1200 180 1209600 3600
9  view100895.   0 ANY TSIG  hmac-md5.sig-alg.reg.int. 1589729192 300 16 p6pveAor0jevoie0/mv8cQ== 19079 NOERROR 0
```

Listing 38: Digging with Keys ("internal" View)

```
1  # dig isc.org AXFR -y "hmac-md5:VIEW100897:g8cZ4RBvQv9QD9nav2naDg==" +nostats
2  [...]
3  isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608743523 1200 180 1209600 3600
4  isc.org.    86400 IN  NS  ns1.isc.org.
5  isc.org.     3600  IN  AAAA  2001:db8:cafe::100
6  ns1.isc.org.    86400 IN  A 192.168.8.92
7  ns1.isc.org.    86400 IN  AAAA  2001:db8:cafe::53
8  isc.org.    3600  IN  SOA ns1.isc.org. dns.isc.org. 608743523 1200 180 1209600 3600
9  view100897.   0 ANY TSIG  hmac-md5.sig-alg.reg.int. 1589729261 300 16 EDM9243cgXaR1oC3YDtlNQ== 24301 NOERROR 0
```

Listing 39: Digging with Keys ("external" View)

- List of Name Servers
- Default Options
- Transport Options (TCP, EDNS)
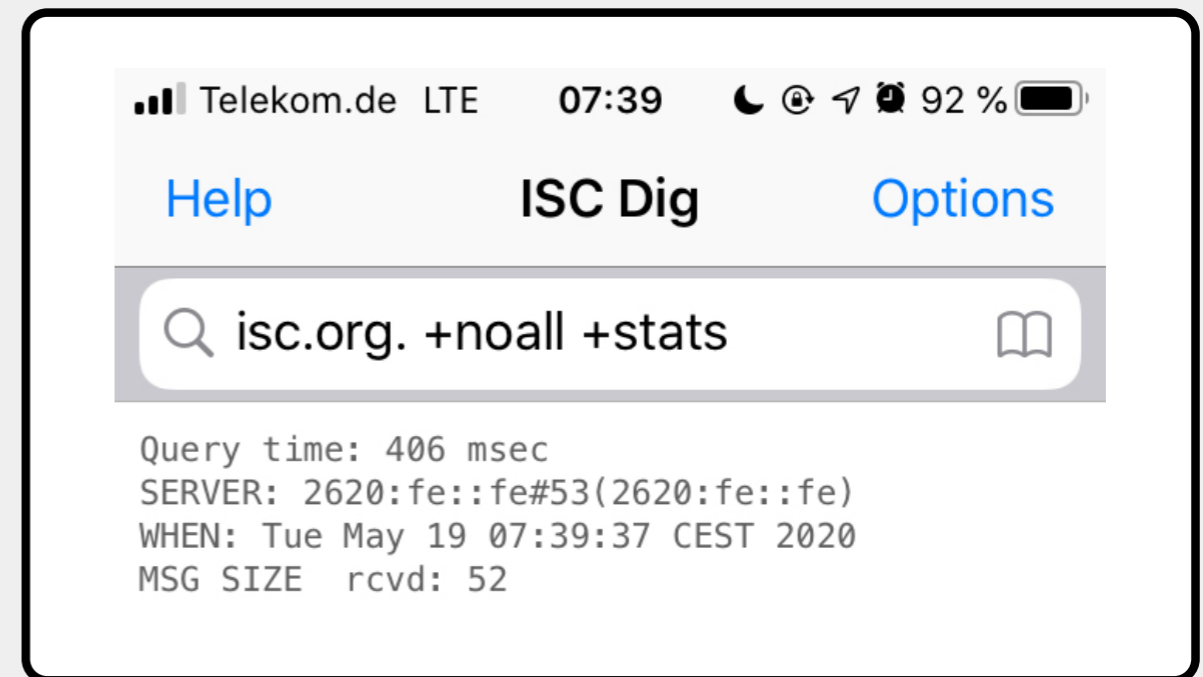- DNSSEC Options
- Output Options
- Sharing the Output
- Bookmarks

Figure 3: Digging on the iPhone

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[12] https://apps.apple.com/us/app/isc-dig/id1115648880

THANK YOU FOR YOUR TIME.

Thank you!

- Main website: https://www.isc.org
- Software downloads: https://www.isc.org/download
  or https://downloads.isc.org

- Presentations: https://www.isc.org/presentations
- Main GitLab: https://gitlab.isc.org