Multi-Vantage Point DNS Diagnostics and Measurement

Casey Deccio, Verisign Labs

NANOG 67, Chicago

June 14, 2016
DNS Name Resolution in a Nutshell

- Stub resolver queries recursive resolver for a name.
- Recursive resolver asks authoritative servers.
- Authoritative servers refer recursive resolvers to server that can answer.
- Answers are propagated back to stub.
The Path Between Stub and Authoritative

**Paths**
- Recursive resolver(s)
- Middleboxes
- Firewalls
- NATs
- IPv4/IPv6 network paths / anycast
- Authoritative servers

**Potential Issues**
- TCP/UDP connectivity
- Response latency
- Path/server EDNS capabilities: version, options, flags
- DNSSEC records
- Large/fragmented packets
- Record types
- Response correctness and consistency

stub resolver

example.com

authoritative servers
Authoritative DNS Queries with DNSViz: `dnsviz probe -A`

- Queries issued towards authoritative servers
  (optionally, following referrals all the way from root)
- All server addresses queried
  - IPv4/IPv6
  - UDP/TCP

```
$ dnsviz probe -A example.com > output.json
```
Recursive DNS Queries with DNSViz (default): dnsviz probe

- Queries issued towards recursive servers (all the way to the root, by default)
- Default recursive servers used if none specified.

```bash
$ dnsviz probe -s 192.0.2.1,192.0.2.2,2001:db8::1 \ example.com > output.json
```
DNSViz Web Interface – Authoritative or Recursive Analysis

- Select “authoritative” or “recursive” analysis from analysis form.
Example – Authoritative View

dnskey alg=8, id=31589

dnskey alg=8, id=31406

dnskey alg=8, id=43547

dnskey alg=8, id=64680

e.g., example.com/A

e.g., example.com/SOA

e.g., example.com/CNAME

e.g., example.com/NS

e.g., example.com/AAAA

e.g., example.com

(2016-03-16 19:59:46 UTC)
Example – Recursive View #1

example.com
(2016-03-16 19:59:46 UTC)
Example – Recursive View #2

Problem:
- No DNSSEC records returned
Example – Recursive View #3

Problem:
- No RRSIG records returned to cover NSEC(3)
Measuring from Other Vantage Points

• Considerations
  • Platform access – full shell vs. API
  • Queries/tests – canned vs. custom
  • Availability of probes
    • Number
    • Location
  • Synchronous vs. asynchronous execution
  • Sequential progressive diagnostics
DNS Looking Glass – Over HTTP

- Client encapsulates requests using JSON.
- Requests are sent to HTTP server as data to HTTP POST request.
  - DNS message and remote server/port are included.
- HTTP server issues DNS queries specified (in parallel).
- Responses are returned from HTTP server as content of HTTP response.
DNSViz Proof-of-concept Looking Glass

- Client/server components included with DNSViz source:
  - https://github.com/dnsviz/dnsviz
- Server:
  - contrib/dnsviz-lg.cgi
    (requires DNSViz installation)
- Client:
  - contrib/digviz
    (behaves similar to ISC dig)

$ digviz +lg=http://dns-lg-example.com/dnsviz-lg.cgi @192.0.2.1
Authoritative DNS Queries Using a Looking Glass: `dnsviz probe -A -u <URL>`

- Queries issued towards authoritative servers (optionally, all the way from root)
- All servers addresses queried
  - IPv4/IPv6
  - UDP/TCP

```
$ dnsprobe -A -u http://dns-lg-example.com/ \example.com > output.json
```
Recursive DNS Queries Using a Looking Glass:
dnsviz probe -u <URL>

- Queries issued towards recursive servers (all the way to the root, by default)

```
$ dnsprobe -A -u http://dns-lg-example.com/lg.cgi
   -s 192.0.2.1,192.0.2.2,2001:db8::1
example.com > output.json
```
DNSViz Web Interface – Third-party Looking Glass

- Select “third-party” location from analysis form.
- Server uses HTTP-based DNS looking glass.
DNSViz Web Interface – Client-side Looking Glass

- Select “third-party” location from analysis form.
- Java app(let) connects to server using WebSocket.
- Diagnostic DNS queries issued from Java app(let).
Summary

- DNS name resolution paths can be diverse.
- A multi-perspective analysis can help understand general resolver experience.
- DNSViz allows a flexible platform for multi-vantage point DNS diagnostics and measurement:
  - Recursive and authoritative diagnostic analysis
  - Command-line diagnostic tools
  - Web-based diagnostic tools
  - Looking glass software
- Resources:
  - https://github.com/dnsviz/dnsviz
  - http://dnsviz.net/