Analysis of DNS Resolver Performance Measurements

Hamza Boulakhrif
hamza.boulakhrif@os3.nl
System and Network Engineering

Supervisors:
Willem Toorop - willem@nlnetlabs.nl
Yuri Schaeffer - yuri@nlnetlabs.nl
Introduction

- Domain Name System
- Internet Building Block
- Distributed Tree structure
  - Delegations
  - Responsibility
  - Ownership
Introduction

- DNS Authoritatives
- DNS Resolvers

Figure 1: http://www.technicalinfo.net/
Related Work


Research Question

What is the performance of different DNS resolver implementations?

Can a method be devised to measure the performance of DNS resolver implementations objectively?

What are corner cases of the DNS resolver implementations measured?
Scope

- Measurement on Open Source Resolvers
- Devise method to perform measurements
- Setup environment with different resolvers
- Write code to extract data from measurements

- Measurements will not be performed on hardware
- Analysis of DNS Resolver code is also not performed
Approach

- Devise method for measurements
- Setup environment (in OS3 lab)
  - Resolvers
  - Tools
  - Code
- Perform measurements
- Analyse results
- Uncover (possible) corner cases
Measurement Method

- Challenges devising a method for measuring DNS Resolvers
  - Recursiveness
  - Extraction of information
  - Benchmarking
Measurement Method

- Measure in terms of time (time per query)
- Real World, in other words, the Internet
  - Not biased
  - Diversity of queries
- Changing nature of the Internet

- Unbound
  - NLnet Labs
- BIND
  - Internet Systems Consortium
- PowerDNS
  - PowerDNS.COM
Measurement Method
Measurement Method

- PCAP for storing DNS traffic
  - All data you need
  - Easy to parse
- Nominum Query Trace
- Python to Analyse
  - DPKT library
  - Matplotlib library
Results of Measurements

- Analysis by comparison
- Analysis by division

Dataset:

- A Records: 255,167
- AAAA Records: 227
- MX Records: 31,432
- PTR Records: 57,315
- SRV Records: 29,782

Total: 373,923
Results of Measurements DNS

Histogram Response times resolvers

- Unbound Total: 373821
- BIND Total: 366851
- PowerDNS Total: 373923

Amsterdam, 03/07/15
BIND

Histogram Response times BIND

- No Error Total: 305298
- ServFail Total: 3899
- NX Domain Total: 57654
PowerDNS

Amsterdam, 03/07/15
Results of Measurements DNSSEC

- Changed packets to perform DNSSEC

- Dataset:

- 4.5% is DNSSEC

Total: 373,923

Amsterdam, 03/07/15
Results of Measurements DNSSEC

Histogram Response times resolvers

Number of queries

Time (Seconds)

Unbound Total: 373818
BIND Total: 366629
PowerDNS Total: 373923

Amsterdam, 03/07/15
Results of Measurements Unbound

Histogram Response times Unbound DNSSEC

Amsterdam, 03/07/15
Results of Measurements BIND

Histogram Response times BIND DNSSEC

Amsterdam, 03/07/15
Corner Cases

- Cases where resolvers act differently
  - Same Query
  - Different response

- Most corner cases
  - No Error No data
  - ServFail
Corner Case Examples

- PowerDNS result in ServFail
- Unbound and BIND result in NoError NoData

```
dig italiancookingandliving.com MX
```

- Not entirely clear who is right
  - If the same domain name exists with different type
  - If no other records exists
Corner Case Examples

- BIND results in ServFail
- Unbound and PowerDNS result in NoError

```
dig 102.163.171.69.in-addr.arpa PTR
```

- It is a mistery why Unbound and PowerDNS are able to resolve.
Corner Case Examples

- Unbound results in ServFail
- BIND and PowerDNS result in NoError

\texttt{dig s38.ck.koramgame.com A}

- There are 10 CNAMEs
Conclusion

- PowerDNS
  - Performance
  - Short timers
  - Sometimes too lenient
- BIND
  - Performance
  - A bit longer timers
  - Strict
- Unbound
  - Performance
  - Variable timers (can be very long)
  - Lenient
- DNS Resolvers are not always about performance
  - Other variables
Future Work

- Devise other methods for measuring DNS resolvers
- Measure using different dataset
- Investigate corner cases
Questions