Student assignment

Topic: Measuring energy consumption of the DNS - a critical part of the Internet's infrastructure

Date: August 2013

Description

The Domain Name System (DNS) is a critical part of the Internet’s infrastructure. It performs the vital service of translating human-readable names like “www.google.com” to machine-readable IP addresses. Without DNS 99.9% of users perceive the Internet to be "broken". Since the Internet has become one of our primary needs, it is necessary to have some insight into “the costs” of the Internet infrastructure. The footprint of ICT is around 2% of the total global footprint - roughly equal to that of the aviation industry - a large part of which is caused by the Internet and the functionalities it provides. Making the Internet more energy-efficient can thus make quite a difference, especially when the ICT-footprint is expected to grow larger.

Looking specifically at the DNS part of the Internet infrastructure, there are two perspectives; authoritative DNS servers handle requests for distinct domains (e.g. all requests for "surfnet.nl"). Recursive caching name servers (commonly called "resolvers") on the other hand handle any request and talk to authoritative name servers in the process. These resolvers play a vital role in keeping the DNS robust and responsive, as they cache responses so users get answers quicker and the traffic to authoritative name servers stays manageable. It is quite common for ISPs and large organisations like universities to have one or more resolvers that are shared by all their users.

The goal of this project is to gain more insight into the energy expenditure of DNS resolvers. There are several reasons we would like to learn more about this:

• Aggregating resolver functionality at a higher level in a network (for example: rather than each university having their own resolver, instead using a resolver that is offered by the network provider of all these universities) may be more energy efficient.
• There are several major vendors of DNS software; which is the most efficient one and what could we save by using that particular software?
• DNS resolvers are potentially memory-heavy applications; can tuning the configuration to use more or less memory for the cache lead to better performance from an energy-expenditure perspective?

During the project we would like to examine at least the following DNS software:

• BIND from the Internet Systems Consortium (http://www.isc.org/downloads/bind/ -- open source)
• Unbound from NLnet Labs (http://unbound.net/ -- open source)
• Microsoft DNS (as included in Windows Server 2012)

For these measurements we will use real-life DNS data collected on SURFnet’s network. The measurements will be performed in the Software Energy Footprint Lab (SEFLab), a collaboration between the Software Improvement Group (www.sig.eu) and the Hogeschool van Amsterdam. In this lab several servers are equipped with power sensors in the powerlines. This enables us to relate power use attributed to the different hardware components to the DNS software running on the server.

If time permits, we would also like to measure the difference in energy expenditure when DNSSEC is enabled; DNSSEC is a security extension to the DNS that relies on (computationally expensive) cryptography.
Possible extensions or other directions for the work include a more formal analysis of the source code of at least one DNS software package to create a model-based estimate of energy-expenditure and to validate this model using real data. We welcome students to discuss the content, depth and length of the assignment further.

**Knowledge/skills**

Students are encouraged to have the following knowledge/skills:

- Knowledge about networking/DNS
- Knowledge about statistics/statistical methods
- An interest in energy-efficient engineering ("Green IT")
- Familiarity with basic UNIX/Linux system administration
- Familiarity with Windows Server system administration

You will be working for and paid a placement fee by SURFnet. In addition you will be working in the SEFLab together with researchers from the HvA and SIG.

**Contact**

If you are interested in the assignment and would like to apply, please contact:

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