TUM-2097 Project 1: IPv6 over DNS

General Information

For this project, your overall task is to gain some experience with DNS, IPv6 and Iodine and to demonstrate your skills by enhancing Iodine. You are encouraged to do this project as a team of two students (working alone is also acceptable, working in teams of more than two students is not). This is a Master-level project and good **C programming skills are mandatory for parts of the project**, so make sure you have at least one team member who can do it!

This exercise consists of five parts. For the first three parts and the last part you are supposed to submit a written report (PDF) in English. Each part has a different deadline and weight for the overall course grade (as indicated).

For your investigation, we suggest you look at tools such as `ping6`, `dig`, `6tunnel`, `miredo`, `wireshark` and of course `iodine` itself. Finding out how to install, use and evaluate the output of these tools is part of the project.

You must submit your reports (and a diff of the changes to iodine's source code for the last project) via Subversion by **November 8th**, **November 15th 2011**, **December 15th 2011**, **January 15th 2012** and **February 1st** respectively. Late submissions will receive a score of zero unless you notify the instructor about a valid reason (such as sickness) **prior** to the deadline.

You will need to sign up for a Subversion repository using your "LRZ Kennung". Subversion will be used for the submission of your PDF reports and your project code. Furthermore, you will need to submit an SSH key to Subversion for access to your virtual machine (unless you prefer to obtain/use your own hosting). Detailed instructions will be made available on the course website shortly; in the meantime, please make sure you have an "LRZ Kennung", and are familiar with Subversion and `ssh` (including `ssh-keygen` and related tools).

1 Project Plan (5%) – November 8th

Prepare a project plan that gives details about your approach, and lists intermediate milestones which allow yourself to assess whether you progress as planned. The project plan includes the information of who works together, project milestones, and how coordination of you with your team member is planned.

2 IPv6 today (10%) – November 15th

Download a list of the top 100,000 websites from `http://grothoff.org/christian/teaching/2011/2097/top100k.txt`.

1. Perform a DNS lookup for each of these sites. How many support IPv6 directly today? (Just give the total number.)
2. Setup an IPv6 tunnel on your system. Which of the authoritative DNS resolvers for the 100k domains respond to IPv6 DNS requests?
3. For all those webservers that supported IPv6, ping the webservers using both ICMPv4 and ICMPv6 and determine the MTU. Compare the MTUs and round-trip times for IPv4 and IPv6 in your report, including a visualization (i.e. using `gnuplot`).

You are responsible for not DoS-ing TUM's nameservers in the process of this exercise (i.e., do **not** do all 100k requests in parallel...).

3 Your own Site (5%) – December 15th

For this excercise, you are to setup your own domain name and get ready for using Iodine. Some of the steps in this part of the exercise are covered in Grothoff's Iodine presentation.

1. Register a domain name (unless you already own one). Any domain name will do. Make sure you can modify DNS records.
2. Obtain root control of a (possibly virtual) host with global IPv4 and IPv6 connectivity (ideally you should have at least two IPv6 addresses, but one will do if you cannot get two). Various cloud providers offer such accounts cheaply. You will not need significant amounts of bandwidth or storage for the project, so any cheap plan should do as long as you do have root rights and your own IPs.
3. Setup A and AAAA records for your host under your domain. If you are using an existing domain, simply create a new subdomain. You are not expected to host your own DNS resolver for this (use your provider's DNS interface). Setup a special "tunnel" subdomain where you point the NS record to your (virtual) host.
4. Run a simple HTTP server on your host with a static site for demonstration purposes. Include the URL in your report.
5. Run `iodined` on your virtual host. Setup your firewall for forwarding with NAT for IPv4.
6. Test your setup by dropping your existing default route, adding a host route to your nameserver and tunneling your IP traffic via DNS.
7. Measure the performance (latency, throughput) of your IPv4-over-DNS tunnel. Describe your measurement method and results in your report.

While we encourage each student to register a domain name (ideally one you can use professionally in the future), to obtain virtual hosting in the Cloud and to setup appropriate A and AAAA DNS records, we do offer an alternative that is free of charge — but less educational. Teams are allowed to contact Andreas Korsten for temporary virtual hosting in the "`net.in.tum.de`-cloud". Andreas Korsten will also setup an appropriate NS-entry in a subdomain.

4 Tunnel IPv6 over DNS with Iodine (25%) – February 1st

IPv6 support in Iodine is currently lacking. Specifically, there are two components to implement for full IPv6 support in Iodine:

1. Creating virtual interfaces with IPv6 addresses and tunneling IPv6-traffic over DNS. The user could configure this by simply providing an IPv6 address instead of an IPv4 address on the command-line.
2. Use (and offer) DNS over UDPv6 instead of UDPv4 for the Iodine-Iodined communication.

You should create patches to Iodine that address one or even both of these issues (the first one being more relevant in practice today). The GNUnet codebase contains example code for creating IPv6 VTUNs in the `svn/gnunet/src/vpn/` directory. Submit your patch, which should include appropriate updates to the Iodine documentation, for grading. You are also encouraged to submit your patch to the Iodine project. If your patch is accepted by Iodine's maintainer, you automatically get full points (for the entire project, not just this part).

5 Final Asssessment Report (5% Bonus) – February 11th

Write a final assessment report in which you reflect the approach you took to solve the assignment. What would you do differently now? Which recommendations do you give to persons that would have to solve the assignment in the future?