

Autonomous Systems and public databases

RES841

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1 Internet and Autonomous Systems

The goal of this lab is to explore a part of the Internet Topology with experimental methods and to look at databases available on the Web that allow to picture out the Internet topology. The successive questions will help you explore the surroundings of the school's autonomous system (AS 1712) and another AS (AS 2607 – *Slovak Academy Network*).

You will use a web browser and the `traceroute` tool from the lab machine (the tool is called `tracert` under Microsoft Windows). You will not need to use the virtualized environment, as virtual machines do not have access to the Internet. You will use your browser to look at the contents of databases such as the one built by the BGP (*Border Gateway Protocol*) routing protocol, which is in charge of propagating paths between autonomous systems.

1.1 Using traceroute

`traceroute` is a tool that displays the IP addresses and names of the intermediate routers that are met on the path to a destination. `traceroute` works by sending multiple, successive and independent requests. The first request identifies the first router on its path towards the destination, then the second request identifies the second router met on its path, etc.

1. From your local machine, try to find the path towards the domain `stanford.edu` (Stanford University, California). You will get a list of routers, each of them being identified by its IP address and its DNS name (first column on each line). Routers are often given names that contain a hint on their location. For example the first letters of the city they are located in, or a three letters code (e.g. `jfk`) that correspond to IATA codes of a close airport.
2. Can you represent the USA part of the path towards Stanford on the following map ? (you can use an IP address localization service, a database of IATA codes, google maps, ...)



1.2 Public databases and tools

Internet is divided in several Autonomous Systems, and discovering the internal topology of an AS is difficult, or impossible if it is not published by its owner. The communications lines that interconnect AS, however, are available thanks to the routing tables that are exchanged through the inter-AS routing protocol (BGP) and to public registries such as RADb. Peering information is partly stored in databases such as *peeringdb*, etc. This information is partly made available by certain websites.

For instance, the webpage <http://www.robtex.com/as/as1712.html> gives you some information about AS 1717 that corresponds to the school (ENST). Using the tabs at the top of the page, you can access various information:

- the *Peer* section displays information about the direct connections of the AS. You can, for example, see here that AS 1712 has two direct connections with AS 2200 and AS 3356 (same as represented on the pie-chart above)
- the *Graph* section shows you the connections between AS 1712 and its neighbors, as well as the two-hops neighbors
- the *BGP* section shows you how the AS identifies itself to the public. The Telecom ParisTech AS is only composed of a single IP network, but an AS can comprise multiple networks.

A second type of tools made available by some operators and AS administrators are called *Looking Glasses*. They are simple web pages (or online tools made available through telnet) that allow to explore BGP records and to launch commands such as `traceroute` from within the AS. The initial goal of these tools is to help solving BGP-related problems and to help deploy new border routers.

The <http://www.bgp4.as/looking-glasses> website lists several such tools. If you try to visit some of these sites, you will notice that some of them allow you to launch a `traceroute`, some AS give you the results of a tool called `lft` that is an enhanced version of `traceroute` that displays AS numbers that routers belong to.

3. If we want to know the topology of the Internet, can you see why it is useful to be able to launch `traceroute` from multiple sources ? You can take examples on small graphs to illustrate the situation.

1.3 Exploring the path between AS 2607 and AS 1712

AS 2607 corresponds to the *Slovak Academy Network* (SANET) network that provides a *looking glass* at the address : (<http://www.six.sk/lg.php>).

4. Using the `trace` option, find the path towards the machine `137.194.2.34` that belongs to the school network.

You will see that the tool provides an indication of the AS numbers, however this information is not always correct (e.g. the RENATER AS number is 2200). To find the AS number that corresponds to an IP address, the *whois* tool, you can use the *whois* tool. Whois is another public database that contains essentially administrative information about autonomous systems.

To query this database, you have two main options. From the unix command line, you can type: `whois -h whois.cymru.com A.B.C.D` to find information on the owner of the IP address `A.B.C.D`. This will query the copy of the database that is made available on the `whois.cymru.com` server. You can obtain the same information using the website <http://whois.cymru.com/>.

5. Draw the real graph of the AS that are traversed between the two networks
6. Using the website <http://whois.cymru.com/>, if you query an IP address and tick the *prefix* box, you can also display the network IP addresses and prefix size.

From your local machine, not execute a `traceroute` towards the looking glass server (`CVT-Bratislava.sanet2.sk`).

7. Compare the results. Are the forward and reverse paths the same?

You can note that `traceroute` gives delay measures for each link. This delay represents the time require for a message to do the round trip between the origin and the target.

8. Considering that most links on the route are optical fibers and that the signal travels at the speed of light, can you evaluate the theoretical propagation delay between the routers?
9. What, in your opinion, influences the delay ?

1.4 Interconnection between 5 autonomous systems

Now, you will use all these tools to find the graph that interconnects the following AS: AS 1712 (ENST), AS 2607 (SANET) and AS 513 (CERN, Switzeland). You can complete the information by looking at the page <http://www.cidr-report.org/cgi-bin/as-report?as=AS1712>. You can replace 1712 in the URL by any AS number.

10. Draw the graph of interconnection of these AS. Do you think you can identify all AS-level routes between these three AS this way ?