In the name of God

Sharif University of Technology
Department of Computer Engineering

CE 693: Advanced Computer Networks

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Homework 4

Please email your answers/report in **PDF format** to Mr. Jafari "mjafari@ce.sharif.edu" and CC me at "kharrazi@sharif.edu". The HW file name should be **"Your Lastname-693-HW-4"**. It should be used as the subject of your email, too. In order for us not to miss your homework please follow the formatting. This homework is due by **Day 3rd, 11:59 PM**. You are also supposed to have a face-to-face delivery, the time of which will be announced later.

Measuring Internet topology with BGP Updates [1]

A network topology consists of the interconnection and arrangement of equipment (routers, links) that makes up the network. The complete topology of the Internet is unknown. Yet knowing the structure of the Internet is crucial in designing simulation/evaluation environments to test new protocols, in understanding the nature of how different networks interconnect, in searching for weak points and analyzing resilience of the Internet, and in provisioning for future growth patterns. To deal with this problem, researchers perform measurements to infer the structure of the Internet graph on various levels. In this problem we will infer the AS-level (ISP-level) topology of the Internet graph. In particular, for each AS in the Internet, we will determine which other ASes are connected to it. This is a simpler problem than determining how many times ASes peer with one another, or determining the router-level Internet topology, or inferring what routing policies are used at each router, etc.

The University of Oregon Route Views project (www.routeviews.org) maintains eBGP peering sessions with routers in a number of ASes. Route Views maintains historical records of BGP routing updates logged on each of these sessions. Analyzing these routing updates can provide insights into stability of the global routing system, distribution of addresses, and the structure of the Internet topology. Here, we will study the structure of the AS-level topology.

Initial setup:

Routing updates (UPDATES) and BGP table snapshots (RIBS) are located at http://archive.routeviews.org/bgpdata/. Download the first BGP table snapshot from November 1 2011.

You can convert the snapshot to human-readable format by using libbgpdump at www.ris.ripe.net/source/bgpdump/libbgpdump-1.4.99.12.tar.gz

Analysis:

1. Using the vantage point 12.0.1.63 (one of the AT&T feeds) plot the CDF of AS outdegree (the number of links adjacent to an AS), over all ASes in the Internet.

[1] Obtained from an earlier assignment given in CS598 Advanced Internetworking, Fall 2008 at UIUC by Matthew Caesar.

2. Using the vantage point 12.0.1.63 how many ASes are there in the Internet on November 1 2011? How fast is this number growing over time (explain your methodology for arriving at this number you may have to look at RIBS on multiple dates).

3. Using the vantage point 12.0.1.63, how large are Internet routing tables (in terms of number of prefixes) on November 1 2011? How fast is this number growing?

4. Using the vantage point 12.0.1.63, how many links (inter-AS adjacencies) are there in the Internet?

5. Using all vantage points in the trace, how many links are there in the Internet? Using all vantage points, how many ASes are there in the Internet? Are these answers different from your answers above? Explain why your results are different, or why they are the same.

6. Download the *UPDATE* file from the same time frame you downloaded the RIBs file . (a) How many links and ASes are there in the Internet? (b) Name one reason why you might expect the number of links to increase when you look at updates instead of RIB snapshots. (c) Name one reason why you might expect the number of links to decrease when you look at updates instead of RIB snapshots.

Submission: Your PDF file should include:

1. A write-up that describe your methodology and observation with related graphs. Avoid printing one graph per page. Logical organization of content (text and graphs) is expected!

2. Submit your scripts or codes.