Paths Recording based on Traceroute

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1. Introduction

Nowadays, people around the world can easily communicate with each other on the internet. One of the most significant reasons making this miracle come true is the large-geographical-distance computer network. It is called Wide Area Network (WAN) [1].

WAN are achieved by internet backbones and internet access points. The former refers to high speed fiber optic networks that carry traffic between major cities, and the latter denotes the interchanges between the backbones.

Internet backbones are usually built by national/international internet service provider [1]. Practically, if a message is sent internationally, it must go though all three levels of Internet Service Provider (ISP), namely, local ISP, regional ISP, and also national/international ISP.

For investigating the network connections, a simple and common way is Ping. Ping is a standard application that are frequently used for internet speed test [2]. When pinging an IP address, it means to send test messages from local computer to a remote target with an IP address, such as a computer, a web site, or other devices [2]. It determines if the target is currently online. Other information like speed or reliability can be offered as well [2].

Consider that we send a test message to a far enough location (WAN used) and record the paths it takes, such that the paths will show how the networks connect.

2. Description

a. Goal

In this project, we are aiming at finding the portion of the network. The paths of the packets transmission though WAN will be recorded using Traceroute to ping an IP address of a far location.

b. Tool

The main software used is Traceroute, which is designed for displaying the route and measuring transit delays of packets across an IP network [3]. We here use Open Visual Trace Route, vision 1.7.1.

c. Methodology

Basically, use Traceroute to ping a IP address and record the paths.

Repeat several times, and then gather the path to draw the diagram.

d. Variables

The remote location to be pinged is in Seattle WA with IP address 146.79.254.10

3. Experimental Results

We repeated to ping 146.79.254.10 for 13 times. The packets did not go through the same paths every time. After eliminating the same results, three diagrams are left. They are shown as follow.

a. Vienna→Macon→an unknown city→Seattle

1	United St...	Vienna	38.8318	-77.2888	184.191.6...
2	United St...	Vienna	38.8318	-77.2888	100.123.2...
3	United St...	Vienna	38.8318	-77.2888	100.121.2...
4	United St...	Macon	32.7288	-83.6865	68.1.0.242
5	*	*	32.7288	-83.6865	*
5	*	*	32.7288	-83.6865	*
7	United St...	(Unknown)	37.751	-97.822	209.160.6...
8	United St...	Fairfax	38.8791	-77.3766	66.36.224....
9	United St...	(Unknown)	37.751	-97.822	209.160.6...
...	United St...	Seattle	47.3824	-122.31...	198.49.22...
...	United St...	Lynnwood	47.8049	-122.28...	146.129.2...
...	United St...	Seattle	47.6344	-122.34...	146.79.25...

The packets start at Vienna, pass by Macon and an unknown city, eventually arrive at Seattle.

b. Vienna→Macon→the unknown city → Fairfax → the unknown city → Seattle

1	United St...	Vienna	38.8318	-77.2888	184.191.6...
2	United St...	Vienna	38.8318	-77.2888	100.123.2...
3	United St...	Vienna	38.8318	-77.2888	100.121.2...
4	United St...	Macon	32.7288	-83.6865	68.1.0.242
5	*	*	32.7288	-83.6865	*
5	*	*	32.7288	-83.6865	*
7	United St...	(Unknown)	37.751	-97.822	209.160.6...
8	*	*	37.751	-97.822	*
9	United St...	(Unknown)	37.751	-97.822	209.160.6...
...	United St...	Seattle	47.3824	-122.31...	198.49.22...
...	*	*	47.3824	-122.31...	*
...	United St...	Seattle	47.6344	-122.34...	146.79.25...

The packets start at Vienna. After going by Macon and an unknown city, they return to Virginia at Fairfax. Then, they pass by the unknown city again, and arrive Seattle.

c. Vienna→Macon→Houston→the unknown city→Fairfax→the unknown city→Seattle

1	United St...	Vienna	38.8318	-77.2888	184.191.6...
2	United St...	Vienna	38.8318	-77.2888	100.123.2...
3	United St...	Vienna	38.8318	-77.2888	100.121.2...
4	United St...	Macon	32.7288	-83.6865	68.1.0.242
5	United St...	Houston	29.7482	-95.4909	4.31.174.61
6	*	*	29.7482	-95.4909	*
7	United St...	(Unknown)	37.751	-97.822	209.160.6...
8	United St...	Fairfax	38.8791	-77.3766	66.36.224....
9	United St...	(Unknown)	37.751	-97.822	209.160.6...
...	United St...	Seattle	47.3824	-122.31...	198.49.22...
...	United St...	Lynnwood	47.8049	-122.28...	146.129.2...
...	United St...	Seattle	47.6344	-122.34...	146.79.25...

The packets start at Vienna. Similar to b, but they make a larger circle, and return to Virginia at Fairfax after going by Macon, Houston, the unknown city. Then, they pass by the unknown city again, and arrive Seattle.

4. Discussion

a. Results Discussion

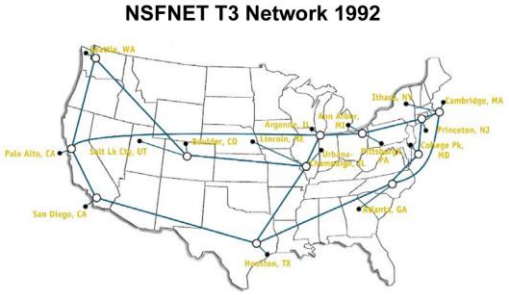
Form the national ISP's point view, we found some backbones. If we use V for Vienna, F for Fairfax, M for Macon, H for Houston, U for the unknown city, and S for Seattle, then the connection

between two cities like Fairfax and Macon can be written as the two initials like FM. Thus, the found backbones read VM, MH, MU, HU, UF, UC. Apparently, those cities can be considered as the internet access points.

Besides national ISP, regional or local ISPs as well have a critical role to play in this case. There are two similarities among the three diagrams. The first one is that the messages take the path made by two segments before leave Vienna. The second one is that the messages take the path stopped by Lynwood to reach the destination after arriving Seattle. Clearly, regional or local ISPs contribute to the communication.

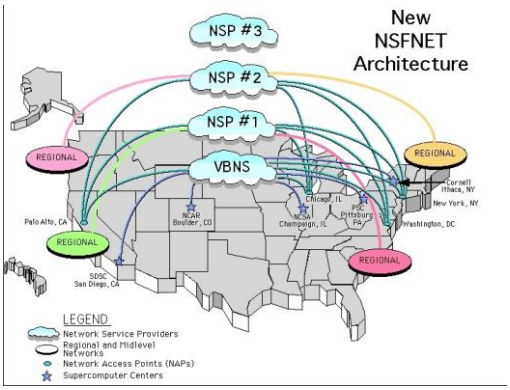
b. Further Discussion

The diagrams of results seem like to associate with the first internet backbone: NSFNET. Initially, the agency created this TCP/IP-based network to link supercomputing centers funded by the National Science Network together and allow researchers across the country to use them [4]. Nevertheless, NSF decided not to limit NSFNET to only this purpose, allowing the network to be used for a wide variety of academic purposes [5]. As a result, the NSFNET became the internet's "backbone," the high-speed, long-distance network that allowed different parts of the internet to communicate [5]. The picture [4] blew illustrates the NSFNET in 1992.

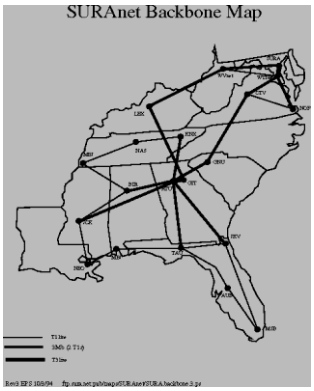


Based on this picture, we might take a guess about the unknown city, which could be Boulder CO.

Schools that didn't have a direct connection to the NSFNET worked together to build regional networks that linked them to each other and to the nearest NSF node [5]. They were called NSFNET regional network. The following picture [4] shows the backbones by the line and the regional networks by ellipses.



The pink ellipse covering Seattle area is call NorthWestNet [4], founded in 1987, and the dark pink ellipse represents SURAnet providing service for Alabama, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, South Carolina, Tennessee, Virginia, and West Virginia as shown blew [6].



This Map could somehow explain why our messages always pass by Macon GA after leaving Vienna.

5. Summary

In this project, we used Traceroute to Ping the IP address 146.79.254.10,

and record the path that test messages take to draw the diagram of used networks. According to the results, we have found several internet backbones between cities. Then, we tried to understand the reasons why the paths were taken. We believe that they are related to NSFNET, which provides connections to link the people in America.

Overall, the path recorded by Traceroute presents partially network connection. That is a good example for understanding how the world is linked by internet.

References

[1] I. Englander, The Architecture of Computer Hardware, Systems Software, & Networking: An Information Technology Approach, John Wiley & Sons, January 2014.

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[5] "Vox," [Online]. Available: https://www.vox.com/a/internet-maps. [Accessed 28 11 2018].

[6] [Online]. Available: http://www.eng.auburn.edu/~rayh/pres/sura.html. [Accessed 28 11 2018].