How To Use Traceroute to Troubleshoot Network Problems

By: Phil Davis
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Traceroute is a command-line tool included with Windows, macOS, Linux, and other operating systems. Along with the ping command, it's an important tool for understanding Internet connection problems, including packet loss and high latency.

If you're having trouble connecting to a website, traceroute can help you find the location of the problem. It can also help visualize the path traffic takes between your computer and a web server. Running traceroute produces a list of computers on the network and the time to get from one computer to the next. If there is a hiccup or interruption in transferring data, the traceroute will show where along the chain the problem occurred.

The original traceroute program was written by Van Jacobson in 1987 for use in the Unix operating system.

Internet Network Tiers

Traceroute provides visibility to the path that a network request traces on its way to the ultimate destination. If you start exploring these paths you will encounter three tiers of very large backbone networks that can be defined like this:

Tier 1: The most common definition of a tier 1 network is one that can reach every other network on the Internet without purchasing IP transit or paying settlements. By this definition, a tier 1 network is a transit-free network that peers with every other tier-1 network. But not all transit-free networks are tier 1 networks. It is possible to become transit-free by paying for peering or agreeing to settlements.

Tier 2: A network that peers with some networks, but still purchases IP transit or pays settlements to reach at least some portion of the Internet.

Tier 3: A network that solely purchases transit from other networks to reach the Internet.

You can learn more about the network tiers from these articles: Tier 1 network - Wikipedia and Tier 2 network - Wikipedia.

How to Run a Traceroute Using Windows 10

Note: Windows 10 uses a version of traceroute called tracert.

1. Type **cmd** in the start menu search box.
2. **Right-click** cmd.exe and select **Run as Administrator**.
3. Type **tracert WEBSITE/IP** and hit enter. Replace Website/IP with the website you want to trace to or the ip you want to trace to.

example: tracert google.com

Traceroute to google.com over a maximum of 30 hops:

```
1      1 ms      <1 ms      <1 ms    192.168.1.1
2      6 ms       2 ms       2 ms    192.168.0.1
3     13 ms       9 ms      10 ms    10.0.0.10
4     20 ms      17 ms      18 ms    4.53.46.65
5      *         21 ms      17 ms    ae-2-3606.ear2.miami2.level3.net [4
6     29 ms      16 ms      17 ms    google-level3-60g.miami.level3.net
7     24 ms      18 ms      19 ms    108.170.253.1
8     17 ms      16 ms      18 ms    216.239.57.171
9     16 ms      17 ms      17 ms    mia09s16-in-f14.1e100.net [172.217.
```

How to Run a Traceroute Using macOS

1. Launch **Network Utility** using Spotlight Search.
2. Select the **Traceroute** tab.
3. **Enter** the internet address.
4. Click **Trace**.

Traceroute to google.com 64 hops max, 72 byte packets

```
1   192.168.1.1 (192.168.1.1)   0.717 ms   0.273 ms   0.260 ms
2   192.168.0.1 (192.168.0.1)   1.169 ms   0.944 ms   1.348 ms
3   10.0.0.10 (10.0.0.10)    12.973 ms    9.089 ms   8.794 ms
4   4.53.46.65 (4.53.46.65)    14.739 ms   23.138 ms   16.039 ms
5   * * *
6   google-level3-60g.miami.level3.net (4.68.71.178)   15.361 ms
7   108.170.249.17 (108.170.249.17)   16.730 ms   36.659 ms   19.700
8   108.170.227.1 (108.170.227.1)   19.762 ms   16.185 ms   15.914 ms
9   mia07s48-in-f14.1e100.net (172.217.8.110)   15.908 ms   16.822 m
```

Example of a Tier 3 Router Problem

Step 3 > 4 The Tier 3 router input is taking 4.365 sec.

Step 4 > 5 The Tier 3 router output is taking 3.223 sec.

```
1  192.168.1.1 (192.168.1.1)  0.821 ms   0.298 ms   0.278 ms
2  192.168.0.1 (192.168.0.1)  1.319 ms   1.859 ms   0.845 ms
3  * * 10.0.0.10 (10.0.0.10)  4365.581 ms
4  * 4.53.46.65 (4.53.46.65)  3223.271 ms   154.288 ms
5  * * *
6  * * *
7  * * 108.170.253.17 (108.170.253.17)  1727.129 ms
8  216.239.59.125 (216.239.59.125)  19.761 ms * *
9  mia09s01-in-f14.1e100.net (172.217.2.78)  1426.383 ms   21.679
```