As you have just learned, **ping** is a network tool that is used to test whether a host on a network is reachable. It works by repeatedly sending test data packets and measuring the **round-trip latency time** for the packets to go to the destination and return. **Trace** (also called **traceroute** or **tracert**)shows the route the packet took showing each hop from router to router while traveling from the source server (the starting location) to the destination server.

We will use the **ping** and **trace** tools at <http://network-tools.com/> to investigate packet routing and latency times and to answer the following question:

*Does geographical distance between the source and the destination on the network affect latency?*

**Directions.** Investigate the ping and route times for each of these universities before answering the questions below. Choose ping or trace from the left side of <http://network-tools.com/> and type in the university server name into the text box and hit enter or the Go button. Note that the test packets are sent from the network-tools server, not your own location. Read the discussion questions below before you do the activity to note what to pay attention to.

| **University Server Name** | **Location** | **Ping: Average RTT**  **Trial 1** | **Ping: Average RTT**  **Trial 2** | **Ping: Average RTT**  **Trial 3** | **Trace: number of hops Trial 1** | **Trace: number of hops Trial 2** | **Trace: number of hops Trial 3** |
| --- | --- | --- | --- | --- | --- | --- | --- |
| mit.edu | U.S. East Coast |  |  |  |  |  |  |
| stanford.edu | U.S. West Coast |  |  |  |  |  |  |
| ox.ac.uk | United Kingdom |  |  |  |  |  |  |
| kyoto-u.ac.jp | Japan |  |  |  |  |  |  |
| usp.br | Brazil |  |  |  |  |  |  |

**Discussion Questions:**

1. Did any of the servers lose packets or time out? Some servers will block ping and trace for security reasons which are seen as time outs. Were there any surprising locations in the hops that the packet went through?
2. Did different trials have different results for the same destination? Do packets always get routed in the same way?
3. Can you guess where the network-tools server is located based on the latency data you collected? Can you confirm your guess using trace or whois or networklookup (which gives you information about who owns a server)?
4. Select one route and specify all the directly-connected computing devices along the route which form a path between the sender and the receiver. How many hops are taken on this path? List each device on this path.
5. How does the number of hops in the trace affect latency (the round trip time seen in ping)?
6. How does geographical distance affect latency? What are some other factors that may be affecting latency?