

Lesson 1

Learning objective

- Understand that servers on the Internet are located across the planet

Lesson summary: In this lesson pupils revisit what they learnt in Year 3 as they discuss the difference between the Internet and the WWW. They then extend their learning by using 'traceroute' to see information about the path data is taking across the Internet when they request a web page.

Introduction: Remind pupils that in Year 3 they learnt about their school's LAN (local area network) and the difference between the Internet and the World Wide Web (WWW). Ask pupils to discuss the following two questions with a partner to determine what they can recall from that unit.

What's the difference between the Internet and the WWW?

The Internet is the infrastructure of all the computers and other devices such as servers and routers networked together to form the Internet, and the WWW is the collection of web pages held on the Internet in servers.

How do we view web pages on the Internet?

- 1 *Write a web site's address into a browser, such as Internet Explorer.*
- 2 *The browser uses this address to find out the location of the server on the Internet, which has the web page and sends a message to that server asking to view the web page. This sever could be anywhere in the world.*
- 3 *The server sends the web page back and the browser displays it.*

Guide a discussion with your pupils covering the questions above to help ensure pupils recall the main points as given in italics. (You may wish to use the graphics from the Year 3 unit to accompany this discussion). **Particularly focus on the second question** and write up the steps for viewing a web page as shown above. *Model this using the classroom computer running a browser by entering the address of a webpage in the browser and talking through that when you press return the message is being sent to the server (an always on computer) on the Internet holding the web page, and the web page information is then being sent back to be displayed.*

Introducing Traceroute: Explain to pupils that traceroute is a tool that allows us to track where in the world the **servers** are that are holding the web pages we want to view. Traceroute also enables us to see the routes across the globe these web pages may take in getting to us. Traceroute works by sending a message (a small packet of data) to the server holding the web page and this message sends back information about where it has traveled to and the route it has taken to get there. How cool!

Modeling the use of traceroute to pupils:

Explain that traceroute is available as a tool on computers or via websites and that we are going to use a website version as this uses Google maps to illustrate to us the route our message has taken on a map. Load <http://en.dnstools.ch/visual-traceroute.html>, as shown below:

Traceroute on a map ⓘ About

Traceroute determines which IP-Router the data packets take to get to the target computer. However, traceroute does not always show the actual route. The result may be influenced by firewalls, flawed implementation of IP-stacks, Network Address Translation and IP tunnels.

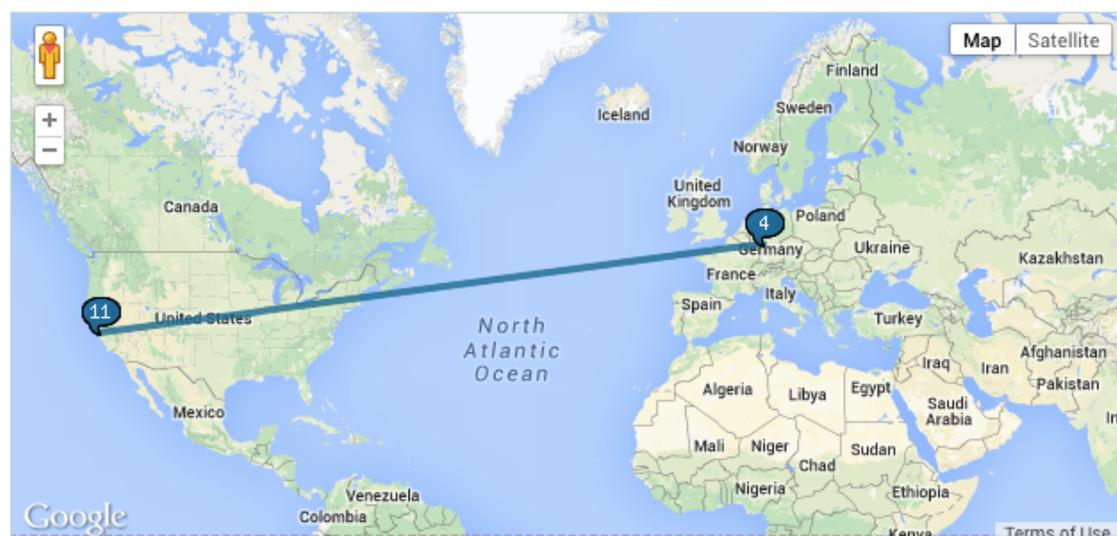
Parallel to the traceroute query, locations of the nodes are also determined and represented on the map.

Host (Domain /IP) Trace

[microsoft.com](#) or [bluewin.ch](#)

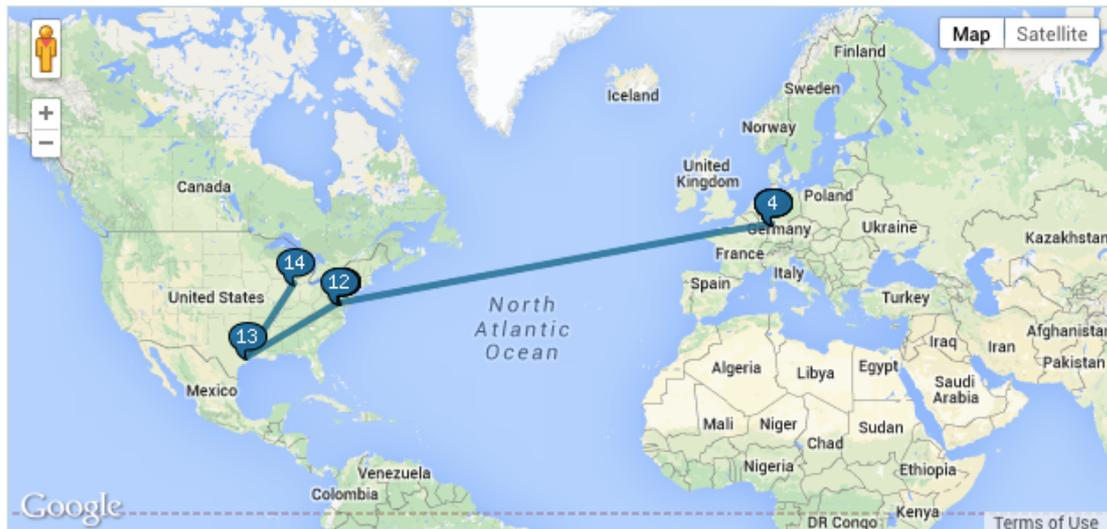
Enter the website domain here.

Enter a domain (www.Google.com) and press trace. Show the visualisation of the route which the traceroute message has taken in finding the server hosting the Google web page. The traceroute results for **Google.com** appear below; we can see the server is based in California.



PRIMARY COMPUTING.co.uk

Below are the results for www.primarycomputing.co.uk, which you can see are hosted in Texas.



Why Frankfurt? After modeling a couple of searches pupils might start to question the route displayed, as this always starts at Frankfurt and pupils aren't likely to be in Frankfurt! **Can pupils think why this might be?** Hint: As we are using this web site for traceroute this web site must be hosted somewhere...

Guide a discussion to explain that this web site is hosted on a server in Frankfurt so all the traces start from there. If you want to prove this you can use a different online traceroute tool (<http://traceroute.monitis.com>) to trace the route to this web site we have been using <http://en.dnstools.ch/visual-traceroute.html> which will show it as being in Frankfurt, Germany!

Pupil challenge (pairs/small groups): Who can find the greatest number of different countries (and/or American states) that their data has travelled through and to?

Pupils should now have the opportunity to enter a range of different website addresses into traceroute to see how many different countries they can find web pages to be stored in, as well as how many different countries they can show their traceroute data has travelled through.

Explain that given a large number of the returned locations will be based in the United States, as this is where a lot of web sites are hosted, they can also see how many different states of America they can 'collect' (You might have to explain the concept of American states!)

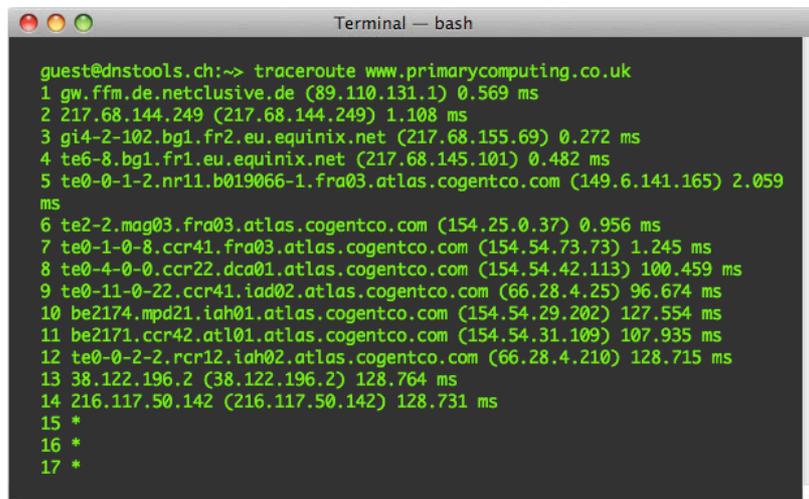
Pupils should make a table, similar to the one below, and complete it with the website address that they entered into traceroute and the countries/states the data travelled through.

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Web site URL	Countries/American states data passed through
www.google.com	America - California
www.bbc.co.uk	

Differentiation

Stretch: Traceroute also returns information about how long the data has taken to travel between different points on its journey (called hops). This information is presented in the table below the map visualisation, as shown below.



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Terminal — bash
guest@dnstools.ch:~> traceroute www.primarycomputing.co.uk
 1 gw ffm.de.netclusive.de (89.110.131.1) 0.569 ms
 2 217.68.144.249 (217.68.144.249) 1.108 ms
 3 gi4-2-102.bg1.fr2.eu.equinix.net (217.68.155.69) 0.272 ms
 4 te6-8.bg1.fr1.eu.equinix.net (217.68.145.101) 0.482 ms
 5 te0-0-1-2.nr11.b019066-1.fra03.atlas.cogentco.com (149.6.141.165) 2.059
ms
 6 te2-2.mag03.fra03.atlas.cogentco.com (154.25.0.37) 0.956 ms
 7 te0-1-0-8.ccr41.fra03.atlas.cogentco.com (154.54.73.73) 1.245 ms
 8 te0-4-0-0.ccr22.dca01.atlas.cogentco.com (154.54.42.113) 100.459 ms
 9 te0-11-0-22.ccr41.iad02.atlas.cogentco.com (66.28.4.25) 96.674 ms
10 be2174.mpd21.iah01.atlas.cogentco.com (154.54.29.202) 127.554 ms
11 be2171.ccr42.atl01.atlas.cogentco.com (154.54.31.109) 107.935 ms
12 te0-0-2-2.rcr12.iah02.atlas.cogentco.com (66.28.4.210) 128.715 ms
13 38.122.196.2 (38.122.196.2) 128.764 ms
14 216.117.50.142 (216.117.50.142) 128.731 ms
15 *
16 *
17 *
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Can pupils spot the fastest and slowest times between hops? Can pupils think how there might be a relationship between the times (fastest/slowest) and the distances between the hops? *It is likely shorter times will be for when the data has travelled less distance maybe?*

Support: Provide a list of web sites linking to your topic for less able pupils to enter into traceroute. *You could perform a traceroute on these prior to the lesson and write the names of the countries they are hosted in on different pieces of paper. Pupils could then match the country to the web site using traceroute.*

Plenary: Ask each group/pair of pupils at a time to feedback information they found from their use of traceroute. They should share the web address they traced, the location of the server holding this web page and any information on the route the data took. Challenge each new group to have a location that a previous group hasn't already said! As pupils do this, have Google Maps open on the interactive whiteboard and enter the location information that pupils are providing so pupils can see the location and it's relation to the UK.

Questions to aid assessment:

What is the difference between the Internet and the WWW?

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How do we view web pages on the Internet?

What different devices are there on the Internet?

What is traceroute and how does it work?

How have we used traceroute in this lesson?

What information has traceroute provided us?

Why does the traceroute signal travel to different countries?

Which countries/states did your data travel through?