

Solutions

Chapter 4: Understanding networks

Activity: Networks and handshakes, page 55

Table 4.2 How many connections are there?

For 6 computers, 15 cables are needed.

For 7 computers, 21 cables are needed.

1 45

Number of computers	Cables
2	1
3	3
4	6
5	10
6	15
7	21
8	28
9	36
10	45

3 The procedure is known as ‘Fill down’. The formula pattern is established by selecting the first cells. A hidden algorithm examines the change in content between adjacent cells and uses this to extend the pattern to other cells.

4 4950

Class activity: If the Internet was string and your messages were toilet rolls ..., page 62

The students represent routers and the string represents wired connections between routers. Data on the Internet is split into packets, corresponding to our toilet rolls. Messages may be sent on many hops between routers/switches. If a route is busy, routers search for an alternative route. This may be longer in distance but faster in delivery time. The separate packets are numbered and are reassembled in correct sequence at their destination. This is the same as the behaviour of students in our simulation.

Knowledge probe: A data packet journey, pages 62–3

A message is split into smaller data packets. Routers inspect the IP address of the packet’s final destination and from this determine the preferred next hop using stored tables of the unique MAC (hardware) addresses of each connected router. This process is repeated by each router until the packets reach the final destination, where they are reassembled in their correct sequence.

So to summarise this analogy: the contents represent our data, and the box containing it represents a IP data packet. The address on the box represents a destination IP address but delivery to that address depends on lots of separate hops along the way. By looking at the

final (IP) address each hop figures out the next hop (using MAC addresses). The person who receives the parcel is like the MAC address of the final computer.

Web probe: Tracing a packet around the world, page 64

- 3 Approximately 14 000 km
- 4 TTL (time-to-live) is part of the TCP/IP protocol. It is either a number or a time that indicates when a packet should be considered as 'lost' because it did not reach its destination within the time allowed.

In brief: this trace tool works by identifying the IP addresses of each hop along the way to the destination network address.

In detail: Information sent over the Internet is broken down into formatted blocks of data called packets. Each packet contains a 'time-to-live' number. Most packets are sent with a TTL of 60 to 120 hops.

After each hop made by a packet the TTL number is reduced by one. If the TTL is zero and still hasn't reached its destination, the packet is discarded and the sending computer is sent a 'delivery failed' message. This prevents packets from endlessly looping around the Internet, never finding their destinations.

The trace tool works by increasing the TTL value of each successive packet sent. The first packet is sent with a TTL value of only 1 so that it will only make one hop to a router before its TTL runs out. The returning 'delivery failed' message will contain the IP address of that router, allowing its rough geographic location to be identified. The next packet is sent with a TTL value of 2, and so on. In this way a 'delivery failed' message will come from each hop. These returning packets are used to produce a list of IP addresses the packets have travelled through on their way to the final destination.

Note that we cannot be sure all the packets take the same route so the method is only an approximation.

Review, page 66

Identify

- 1 A network switch possesses an important advantage over a hub: it can look at an address being sent to it and identify the correct destination port or computer, rather than transmitting it to all connected computers as a hub does.
- 2 Routers keep track of which device a data package has come from as well as the best choice for the device it should send it to next, based on MAC (Ethernet) addresses it stores in tables.
- 3 Twisted pair copper wire UTP cables have four twisted pairs of copper wires to reduce signal interference between them. These are used to connect each computer to a hub, switch or router.

Optical fibres use light pulses over glass fibres. They also allow multiple signals to travel over the one fibre by using many wavelengths of light.

Each fibre has a thin flexible glass thread, the diameter of a human hair, around which is wrapped another transparent surface which reflects light pulses back into this central core.

Analyse

- 4** Advantage 1: Speed: a message arrives faster because being split into many segments each can travel along the least congested route at any time.

Advantage 2: Security: in the case of a catastrophic destruction of any part of the network, alternative routes exist for delivery.

- 5** A data packet could loop around the Internet forever if delivery failed for any reason without the sender being aware of it. Each packet is given a TTL (time-to-live) number. This is an integer stating the maximum number of hops allowed before the sender is notified.

Investigate

- 6** A good interactive online resource can be found at:
<https://www.submarinecablemap.com/>

Five main international cables connect Australia to cyberspace and global voice networks and carry 99% of Australia's total Internet traffic.

Major cables are:

- Sydney–New Guinea (Australia Papua New Guinea 2 cable)
- Sydney–Madang (PIPE Pacific cable)
- Paddington–Hawaii (Telstra Endeavour cable)
- Perth–Diego Garcia (Australia West Express cable)
- Sydney–United States (Hawaiki cable)
- Paddington/Oxford falls–Maryuyama, Japan (Australia–Japan cable)
- Perth–many (SeeWeMe cable)
- Perth–Singapore (Indigo cable)
- Onslow, WA–Singapore (Trident cable)
- Perth–Jakarta (Australia–Singapore cable)