The TCP/IP model

4.1.7 · Networks · revision notes

How the 4-layer TCP/IP model (application, transport, internet, link) handles sending data across a network, what each layer does, which protocols work at each layer and why a layered model is useful. Expect 'State', 'Describe the role of…' and 'Explain' questions, and occasionally a longer answer about how the layers work together.

Key facts

- Layers, top to bottom: application, transport, internet, link
- Transport: TCP (packets, sequence numbers, reliable delivery, reordering)
- Link: Ethernet, Wi-Fi (sending signals across the physical network)
- Receiving: data goes up the layers and each layer removes its header
- Application: HTTP, HTTPS, FTP, SMTP, POP3, IMAP
- Internet: IP (IP addresses, routing); routers work at this layer
- Sending: data goes down the layers and each layer adds a header
- Benefits: layers are independent and follow agreed standards

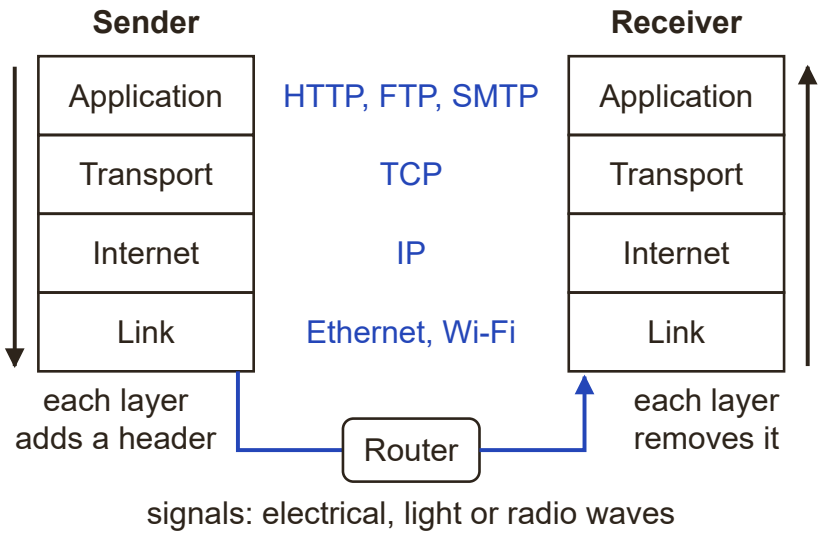
Notes

The four layers

- The TCP/IP model splits the job of sending data into four layers. From the top: **application, transport, internet, link**.
- **Application layer**: provides network services to the applications that the user runs, e.g. a web browser or an email client. Protocols: HTTP, HTTPS, FTP, SMTP, POP3, IMAP.
- **Transport layer**: splits the data into packets and numbers them, makes sure every packet arrives (resending any that are lost) and puts the packets back in order. Protocol: TCP.
- **Internet layer**: adds the source and destination IP addresses to each packet and routes the packets between networks. Protocol: IP. Routers work at this layer.
- **Link layer**: sends the data across the physical network that the device is connected to, as electrical signals, light or radio waves, using the hardware addresses of the devices. Protocols: Ethernet, Wi-Fi.

How data moves through the layers

- On the sending computer, data passes **down** the layers. Each layer adds its own header to the data it receives from the layer above.
- The data travels across the network as signals. Each router on the way reads the destination IP address to decide where to forward the packet.
- On the receiving computer, data passes **up** the layers. Each layer removes its header and passes the rest up, until the application receives the original data.



Data goes down the layers on the sending computer, across the network, then up the layers on the receiving computer.

- Each layer only passes data to the layers directly above and below it.

Why use layers?

- Each layer is independent, so one layer can be changed without changing the others. For example, moving from Ethernet to Wi-Fi changes only the link layer, and the web browser still works.
- Each layer follows agreed standards, so hardware and software from different manufacturers can work together.
- Splitting a complex job into smaller parts makes networks easier to design and develop, and faults easier to find.

How to answer each type of question

State the layers, or identify the layer for a protocol

1 to 2 marks | Grade 3

1. Learn the order with a memory aid (see Shortcuts).
2. Match each protocol to its layer: the Internet Protocol works at the internet layer, and the Transmission Control Protocol at the transport layer.

Example. (a) State the four layers of the TCP/IP model, in order, starting with the top layer. (2)
(b) State the layer at which the Internet Protocol (IP) operates. (1)

Model answer.

(a) Application, transport, internet, link: all four layers named (1); in the correct order, from the top (1)

(b) The internet layer (1)

Describe the role of a layer

2 marks | Grade 5

1. Say what the layer does to the data: splits, numbers, addresses, routes or transmits it.
2. Naming the protocol used at that layer adds useful detail.

Example. Describe the role of the transport layer in the TCP/IP model. (2)

Model answer. It splits the data into packets and gives each packet a sequence number (1). It checks that all the packets arrive, has any lost packets resent and puts the packets back in the correct order (1).

Explain the benefits of a layered model

2 to 4 marks | Grade 6

1. State a benefit: independent layers, agreed standards, or easier development and fault finding.
2. Explain its effect with an example, e.g. changing to Wi-Fi does not need a new web browser.

Example. Explain **two** benefits of using a layered model such as the TCP/IP model. (4)

Model answer. Each layer is independent of the others (1), so one layer can be changed without changing the rest, e.g. changing from Ethernet to Wi-Fi does not need a new web browser (1). Each layer follows agreed standards (1), so hardware and software made by different manufacturers can work together (1).

Describe how data is sent through the layers 3 to 4 marks **Grade 7**

1. Start at the top on the sending computer and work down, saying what each layer does and adds.
2. Name the protocol at each layer.
3. If the question covers the receiver too, say that the headers are removed as the data passes back up.

Example. A user sends an email.
Describe how the layers of the TCP/IP model handle the email on the user's computer. (4)

Model answer. At the application layer, the email client uses SMTP to send the email, passing it to the transport layer (1). The transport layer (TCP) splits it into packets and adds a header with a sequence number to each packet (1). The internet layer (IP) adds the source and destination IP addresses to each packet (1). The link layer adds the hardware addresses for the local network and sends the packets as signals, e.g. using Ethernet or Wi-Fi (1).

Don't lose marks

- Putting the layers in the wrong order, e.g. internet above transport.
- Using names from other network models, such as 'physical layer' or 'network layer'. Use the four names in the specification.
- Saying the transport layer adds IP addresses (the internet layer does), or that the internet layer resends lost packets (TCP at the transport layer does).
- Explaining the benefit of layers as 'it is easier' without saying why or giving an example.
- Forgetting that the process is reversed on the receiving computer.

More tips

Memory tricks

- Top to bottom: 'All Trains In London' = application, transport, internet, link.
- Each protocol's name gives its layer away: Transmission Control Protocol → transport; Internet Protocol → internet.
- Down to send, up to receive. Headers go on in the order transport, internet, link, and come off in the order link, internet, transport.
- Routers only need to look as far up as the internet layer, because the IP address is all they need.

Exam technique

- Learn one key verb per layer: application provides services, transport splits and checks, internet addresses and routes, link transmits.
- Name a protocol when you describe a layer: it shows that you understand what the layer does.
- For the benefits of layers, the independence point with a concrete example (Ethernet to Wi-Fi, browser unchanged) is a reliable 2 marks.
- In a longer answer, go through the layers in order: top to bottom on the sender, bottom to top on the receiver.

What each grade needs

What you need to be able to do, from the first marks up to the top grade.

Grade 3

Name the four layers in order

From the top: application, transport, internet, link.

Grade 4

Match protocols to the layers

HTTP, HTTPS, FTP, SMTP, POP3 and IMAP are application; TCP is transport; IP is internet; Ethernet and Wi-Fi are link.

Grade 5

Describe the role of each layer

Say what each layer does to the data, e.g. the internet layer adds IP addresses and routes packets.

Grade 6

Explain benefits of a layered model

Layers are independent, so one can change without affecting the others, and standards let products from different makers work together.

Grade 7

Describe how data passes through the layers

Down the layers on the sender, with each adding a header, then up the layers on the receiver, with each removing one.

Grade 8

Apply the model to an unfamiliar situation

For example, switching from Ethernet to Wi-Fi changes only the link layer, so the web browser is unaffected.

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