The concept of layers

Computer systems (Paper 1) · revision notes

Why network protocols are organised into layers, each with its own job, and the benefits this brings. Questions ask what a layer is and why layering is useful, often by applying the idea to a change such as new hardware; the 4-layer TCP/IP model is a helpful example to base your answers on.

Key facts

- Layer = a division of network communication with its own job and protocols
- TCP/IP model: application, transport, internet, link
- Each layer only communicates with the layers directly above and below it
- Benefits: change one layer without affecting others; simpler to develop; products from different manufacturers work together; easier to find faults

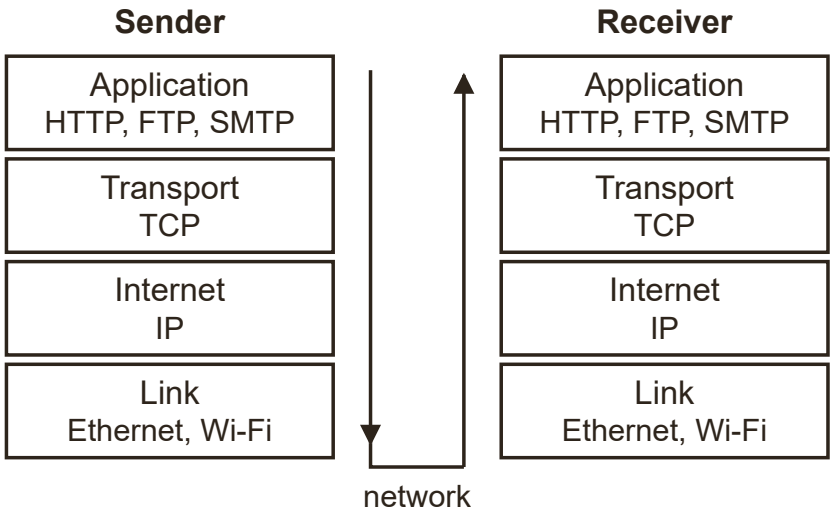
Notes

What a layer is

- Network communication is complicated, so it is divided into **layers**. Each layer has a **specific job** and its own **protocols** for that job.
- A layer only communicates with the layers **directly above and below** it. It uses the services of the layer below and provides a service to the layer above.
- A layer does not need to know how the other layers do their jobs. This is an example of **abstraction**.

An example: the TCP/IP model

- **Application layer**: provides network services to applications, e.g. HTTP, HTTPS, FTP, SMTP, POP and IMAP.
- **Transport layer**: splits data into packets and makes sure they arrive correctly, e.g. TCP.
- **Internet layer**: adds IP addresses and routes packets between networks, e.g. IP.
- **Link layer**: sends data across the physical network hardware, e.g. Ethernet or Wi-Fi.



Data goes down the layers at the sender and up the layers at the receiver

- When data is sent, it passes **down** the layers and each layer adds its own header. At the receiver it passes **up** the layers and each layer reads and removes its header. Grade 8+ only

Benefits of layers

- **Self-contained**: one layer can be changed or improved without affecting the others, e.g. a new type of cable (link layer) does not need new web browsers (application layer).
- **Breaks a complex problem into smaller parts**, so developers can concentrate on one layer without needing to know how the others work.
- **Products work together**: hardware and software from different manufacturers can be combined, as long as each follows the standards and protocols for its layer.
- **Easier to find and fix faults**, because each layer has a clearly defined job.

How to answer each type of question

State what a layer is and one benefit

1 to 2 marks | Grade 4

1. Layer: a division of network communication with a specific job.
2. Benefit: give a clear, specific benefit, e.g. 'one layer can be changed without affecting the others'.

Example. (a) State what is meant by a layer in networking. [1]
(b) State **one** benefit of dividing network communication into layers. [1]

Model answer.

(a) A division of network communication (a group of protocols) that has a specific job (1)
(b) One layer can be changed without affecting the other layers (1)

Explain two benefits of layers

4 marks | Grade 6

1. Name the benefit (1 mark).
2. Explain its effect, ideally with an example (1 mark).
3. Choose two clearly different benefits.

Example. Explain **two** benefits of using layers in network protocols. [4]

Model answer. Each layer is self-contained (1), so a layer can be updated, e.g. to use a new type of cable, without changing the other layers (1). Hardware and software from different manufacturers can work together (1), as long as each follows the protocols for its layer (1).

Apply layers to a scenario

2 to 3 marks | Grade 7

1. Decide which layer the change belongs to: connections and cables are at the bottom, apps at the top.
2. Say that the layers are independent and each only communicates with the layers next to it.
3. Conclude what does, or does not, need to change.

Example. A laptop is running a video call app. The laptop is unplugged from an Ethernet cable and connects to Wi-Fi instead.
Explain how the use of layers means the app does not need to be changed to work over either connection. [3]

Model answer. The type of connection is handled by the lowest (link) layer, while the app works at the top (application) layer (1). The layers are independent and each only communicates with the layers next to it (1), so the app uses the same services from the layer below whichever connection is used, and does not need to know which one it is (1).

Don’t lose marks

- Saying layers make data travel faster. The benefits are about design, compatibility and maintenance.
- Writing 'it is easier' with no explanation. Say what is easier and why, e.g. faults are easier to find because each layer has one job.
- Saying every layer communicates with every other layer. Each only uses the layer directly below it and serves the layer directly above it.

More tips

Memory tricks

- TCP/IP layers from top to bottom: 'All Trains In London' = Application, Transport, Internet, Link.
- Layers are like a parcel service: the sender packs, the depot sorts, the van delivers. Each does its own job, and one can change without the others changing.
- Top layers are about apps; bottom layers are about hardware.

Exam technique

- Link each benefit to an example: a new cable, a new app, or equipment from a different manufacturer.
- Questions often describe an unfamiliar change: decide which layer it affects first.
- Use the words 'independent', 'self-contained' and 'protocols for each layer'.
- OCR will not ask you to name the TCP/IP layers or say what each one does. Learn what a layer is and the benefits of layering; use the TCP/IP model only as your example.

What each grade needs

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

Grade 4 — **Describe what a layer is**
A division of network communication with a specific job, which uses the layer below and serves the layer above.

Grade 5 — **State benefits of using layers**
Layers are self-contained, so they can be changed or developed separately.

Grade 6 — **Explain two benefits of layers in detail**
E.g. a change to one layer does not affect the others, so new hardware works without changing applications.

Grade 7 — **Apply layers to an unfamiliar scenario**
E.g. explain why a browser still works when a laptop switches from Ethernet to Wi-Fi.

Grade 8 — **Explain how data passes through the layers**
At the sender each layer adds its header on the way down; at the receiver each layer removes its header on the way up.

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