Protocols

4.1.6 · Networks · revision notes

What a network protocol is, why protocols are needed and what each protocol on the specification does: Ethernet, Wi-Fi, TCP/IP, HTTP, HTTPS, FTP and the email protocols SMTP, POP3 and IMAP. Expect 'State the protocol…', 'Explain why…' and 'Describe the role of…' questions, often set in an everyday context.

Key facts

- Protocol: a set of rules for how data is transmitted between devices
- TCP: splits data into numbered packets, checks they all arrive, resends lost ones, puts them in order
- HTTP: requests and sends web pages; HTTPS: the same, but encrypted
- SMTP: sends email (client to server, and server to server)
- IMAP: email stays on the server and is kept the same on every device
- Ethernet: wired LAN connections; Wi-Fi: wireless LAN connections
- IP: adds IP addresses to packets and routes them between networks
- FTP: transfers files between a client and a server
- POP3: downloads email to one device (usually deleted from the server)

Notes

What protocols are and why they are needed

- A **protocol** is a set of rules that govern how data is transmitted between devices on a network.
- Protocols set out things such as how data is formatted and addressed, how it is split into packets, how errors are detected and what happens when data is lost.
- Devices and software from different manufacturers can only communicate if they follow the same rules, so protocols are agreed standards.

Network protocols

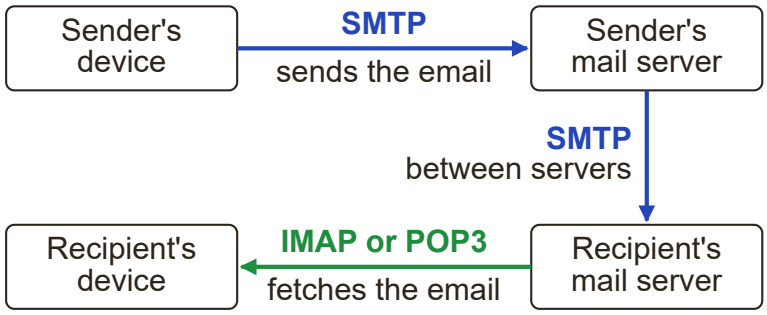
- **Ethernet**: the protocol for wired connections on a LAN.
- **Wi-Fi**: the protocol for wireless connections on a LAN, using radio waves.
- **TCP (Transmission Control Protocol)**: splits data into packets and numbers them, checks that every packet arrives (the receiver sends acknowledgements), has lost or damaged packets resent and puts the packets back in order.
- **IP (Internet Protocol)**: adds the source and destination IP addresses to each packet and routes each packet across networks to its destination.
- TCP and IP work together, so they are known as **TCP/IP**.

Web pages and files

- **HTTP (Hypertext Transfer Protocol)**: used by a web browser to request web pages from a web server, and by the server to send them back.
- **HTTPS (Hypertext Transfer Protocol Secure)**: HTTP with encryption, so data such as passwords and card details cannot be read if it is intercepted. It also checks the website's identity using a digital certificate.
- **FTP (File Transfer Protocol)**: used to transfer files between a client and a server, e.g. uploading a website's files to a web server.

Email protocols

- **SMTP (Simple Mail Transfer Protocol)**: sends email from an email client to a mail server, and between mail servers.
- **POP3 (Post Office Protocol 3)**: downloads email from the mail server to one device, and usually deletes it from the server.
- **IMAP (Internet Message Access Protocol)**: keeps email on the mail server, so the same messages and folders can be seen on several devices.



SMTP sends email; IMAP or POP3 fetches it from the recipient's mail server.

How to answer each type of question

State the protocol used for a task 1 mark each **Grade 4**

1. Look for the key idea in the task: sending email (SMTP), reading email on several devices (IMAP), uploading files (FTP), a secure web page (HTTPS).
2. The abbreviation is enough unless the question asks for the full name.

Example. State the protocol used for each of these tasks.
(i) Uploading new pages for a website to a web server (1)
(ii) Sending an email from a laptop to a mail server (1)
(iii) Viewing a web page in a browser with the data encrypted (1)

Model answer.

(i) FTP (1)
(ii) SMTP (1)
(iii) HTTPS (1)

Explain why protocols are needed

2 marks | Grade 5

1. Say that devices made by different manufacturers, running different software, need to communicate.
2. Say that protocols are rules they all follow, e.g. for formatting and addressing data, so each device understands the data it receives.

Example. Explain why network protocols are needed. (2)

Model answer. Devices made by different manufacturers, running different software, need to communicate with each other (1). Protocols are agreed rules, e.g. for how data is formatted and addressed, so every device sends data in a way that the receiving device can understand (1).

Explain the choice of protocol in a context

2 marks | Grade 6

1. Say what the protocol does.
2. Link it to the need in the scenario, e.g. several devices, or sensitive data.

Example. Priya reads her email on her phone, her tablet and her laptop.
Explain why her email software should use IMAP rather than POP3. (2)

Model answer. With IMAP, emails are kept on the mail server (1), so Priya sees the same emails and folders on all three devices, whereas with POP3 an email downloaded to one device may not be available on the others (1).

Describe the role of TCP (or IP)

3 to 4 marks | Grade 7

1. TCP: splits the data into packets, adds sequence numbers, uses acknowledgements, resends lost packets, reassembles in order.
2. IP: adds the source and destination IP addresses and routes each packet.
3. Keep the two jobs separate: IP does not make sure that packets arrive or arrive in order.

Example. Describe the role of the Transmission Control Protocol (TCP) when a large file is sent across the internet. (4)

Model answer. TCP splits the file into packets (1) and gives each packet a sequence number (1). The receiving computer sends acknowledgements, and any packets that are lost or damaged are sent again (1). The packets are put back into the correct order using their sequence numbers (1).

Don’t lose marks

- Saying SMTP is used to receive or read email. SMTP sends email; POP3 and IMAP fetch it.
- Saying IP makes sure that packets arrive in the right order. That is the job of TCP.
- Saying HTTPS makes a website safe. It encrypts data in transit and checks the site's certificate, but it does not stop fake websites or malware.

- Defining a protocol as 'a rule' or 'a program'. It is a set of rules for transmitting data.
- Mixing up FTP and HTTP: FTP transfers files between a client and a server; HTTP transfers web pages to a browser.

More tips

Memory tricks

- SMTP: S for send. POP3 pops the email off the server onto one device; IMAP keeps it on the server for every device.
- HTTPS: S for secure, which means encrypted.
- TCP = Transmission Control: it controls delivery (every packet, in the right order).
  IP = Internet Protocol: it deals with addresses and routes.
- FTP: F for files.

Exam technique

- Learn each protocol as a pair: its name and a one-line description of its job.
- In a scenario, pick out each stage (connecting, browsing, paying, emailing) and name the right protocol for each.
- When explaining HTTPS, mention encryption AND what it protects against (data being read if it is intercepted).
- Write both sides in comparisons, e.g. 'POP3 downloads…, whereas IMAP keeps…'.

What each grade needs

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

Grade 3 — **Define a network protocol**
A protocol is a set of rules that govern how data is transmitted between devices.

Grade 4 — **Match protocols to tasks**
For example, SMTP sends email, FTP transfers files and HTTP requests web pages.

Grade 5 — **Explain why protocols are needed**
Devices from different manufacturers must follow the same rules to understand the data they exchange.

Grade 5 — **Explain why HTTPS is used**
It encrypts data sent between a browser and a web server, so intercepted data cannot be read.

Grade 6 — **Compare POP3 and IMAP**
POP3 downloads emails to one device; IMAP keeps them on the server so that every device shows the same emails.

Grade 7 — **Describe the roles of TCP and IP**
TCP splits data into numbered packets and makes sure they all arrive in order; IP addresses and routes the packets.

Grade 8 — **Explain which protocols a scenario uses**
Name the protocol for each stage and justify it, e.g. HTTPS for a payment and IMAP for reading email on several devices.

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