

Exercise walk-through

Methods of error detection ■ 2.2

eXercise

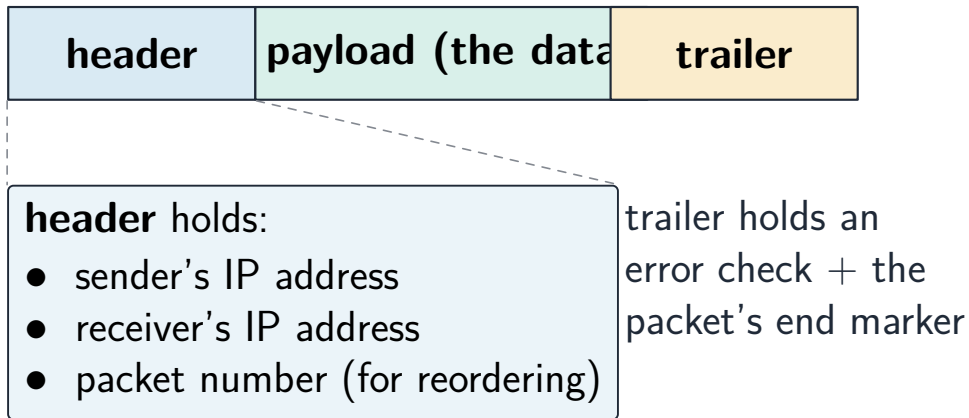
You must be able to

- work out a parity bit and detect a parity error
- describe checksum, echo check and ARQ
- describe a check digit and the errors it catches

Method — Parity and ARQ

- **even parity:** total number of 1s must be even; add a parity bit to make it so.
- **ARQ:** receiver sends an acknowledgement; no positive one before the timeout → resend.

Method — Parity and ARQ



A packet with a trailer that holds an error check

Method — Networks: name it, then say what it does

LAN or WAN? A **local area network (LAN)** 局域网 covers a small area such as one building and its cabling belongs to the owner. A **wide area network (WAN)** 广域网 covers a large geographical area and uses third-party communication links; the internet is the largest WAN.

The hardware, and what each does:

Device	What it does
network interface card (NIC) 网卡	gives the device its MAC address and lets it connect
switch 交换机	joins devices on one LAN and sends a frame only to the port of the device it is addressed to, using a look-up table of MAC addresses
router 路由器	joins different networks, reads IP addresses and forwards packets towards the right network
wireless access point 无线接入点	lets Wi-Fi devices join the wired network
modem 调制解调器	converts between the computer's digital signal and the analogue signal a telephone line carries

Method — Networks: name it, then say what it does

MAC address or IP address? The **MAC address** 物理地址 is fixed in the hardware and identifies the device itself on the local network; it is written as six pairs of hexadecimal digits, such as 00-1C-B3-4F-25-FE. The **IP address** 网际协议地址 identifies the device's position on a network and can change when the device moves to another network. A switch works with MAC addresses; a router works with IP addresses.

Wired or wireless? Wired is faster, more reliable and more secure, because the signal cannot be picked up outside the building; wireless allows movement, needs no cabling and is cheaper to install, but is slower, can be blocked by walls and must be encrypted with a network key.

Method — Networks: name it, then say what it does

Worked example. A school connects 30 computers in one room and links them to the internet. Which devices does it need, and why? A NIC in each computer to connect it; a switch to join the computers in the room, because it sends each frame only to the addressed device and so wastes no bandwidth; a router to connect the room's network to the internet, because it forwards packets between different networks using IP addresses; and a wireless access point if tablets must also join.

Practice 2.1 ■ 1 mark

State what a parity bit is used for.

Solution 2.1

Worked steps

to detect an error in a byte after transmission **B1**.

Practice 2.2 ■ 1 mark

State one error a check digit can detect.

Solution 2.2

Method: Parity and ARQ

Worked steps

any of: an incorrect digit; a transposition error; a missing/extra digit **B1**.

Practice 2.3 ■ 2 marks

Give two differences between a LAN and a WAN.

Solution 2.3

Worked steps

Any two of: a LAN covers a small area such as one building while a WAN covers a large geographical area; a LAN's cabling belongs to the owner while a WAN uses third-party links; a LAN is usually faster **B2**.

Practice 2.4 ■ 2 marks

Identify the device that uses MAC addresses to send data only to the correct port, and the device that connects two different networks.

Solution 2.4

Method: Networks: name it, then say what it does

Worked steps

A switch **B1**; a router **B1**.

Practice 2.5 ■ 2 marks

Give two advantages of a wired connection over a wireless one.

Solution 2.5

Method: Networks: name it, then say what it does

Worked steps

Any two of: it is faster; it is more reliable, with fewer dropouts; it is more secure, because the signal cannot be picked up outside the building **B2**.

Exam-style 3.1 ■ 1 mark

Using **even** parity, the parity bit for the data 1101001 is:

A 0

B 1

C either

D none

Solution 3.1

Method: Parity and ARQ

A 0



B 1

C either

D none

Worked steps

A. 1101001 already has four 1s (even), so the even-parity bit is 0.

Exam-style 3.2 ■ 2 marks

Data is checked using a checksum.

- (a) Describe how a checksum detects an error.
- (b) Explain why a parity check might fail to detect an error.

Solution 3.2

Method: Parity and ARQ

Worked steps

- (a) the checksum is calculated from the data before sending and re-calculated at the receiver **M1**; if the two values differ, an error has occurred **A1**.
- (b) if two bits flip, the number of 1s may still be correct **M1**, so the parity check passes despite the error **A1**.

Exam-style 3.3 ■ 2 marks

Describe how Automatic Repeat reQuest (ARQ) ensures data arrives correctly.

Solution 3.3

Method: Parity and ARQ

Worked steps

- (a) A LAN **B1**, because the computers are in one building over a small area and the office owns the cabling **B1**.
- (b) Network interface card (NIC) **B1**; switch **B1**; router **B1**.
- (c) A MAC address is fixed in the hardware by the manufacturer and identifies the device itself **B1**; an IP address identifies where the device is on a network and can change when it joins a different network **B1**; a switch uses MAC addresses within the LAN while a router uses IP addresses between networks **B1**.
- (d) Benefit: visitors can move around and no cabling is needed for them **B1**.

Solution 3.3

Drawback: it is slower or less secure, and walls can weaken the signal **B1**.

(e) Without a key anyone within range could join the network **B1** and could intercept the data being transmitted, so the key encrypts the traffic and keeps outsiders out **B1**.

Exam-style 3.3 ■ 2 marks

A small office has eight computers, a printer and an internet connection.

- (a) Identify the type of network the eight computers form, and justify your answer.
- (b) Complete the table by naming the device that performs each task.

Task	Device
gives each computer a MAC address and connects it to the network	
sends data only to the port of the computer it is addressed to	
connects the office network to the internet	

Exam-style 3.3 ■ 2 marks

- (c) Explain the difference between a MAC address and an IP address.
- (d) The office adds Wi-Fi for visitors' laptops. Give one benefit and one drawback compared with wired connections.
- (e) Explain why the Wi-Fi should use a network key.

Solution 3.3

Method: Networks: name it, then say what it does

Worked steps

- (a) A LAN **B1**, because the computers are in one building over a small area and the office owns the cabling **B1**.
- (b) Network interface card (NIC) **B1**; switch **B1**; router **B1**.
- (c) A MAC address is fixed in the hardware by the manufacturer and identifies the device itself **B1**; an IP address identifies where the device is on a network and can change when it joins a different network **B1**; a switch uses MAC addresses within the LAN while a router uses IP addresses between networks **B1**.
- (d) Benefit: visitors can move around and no cabling is needed for them **B1**.

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