

Exercise walk-through

Network hardware ■ 3.4

eXercise

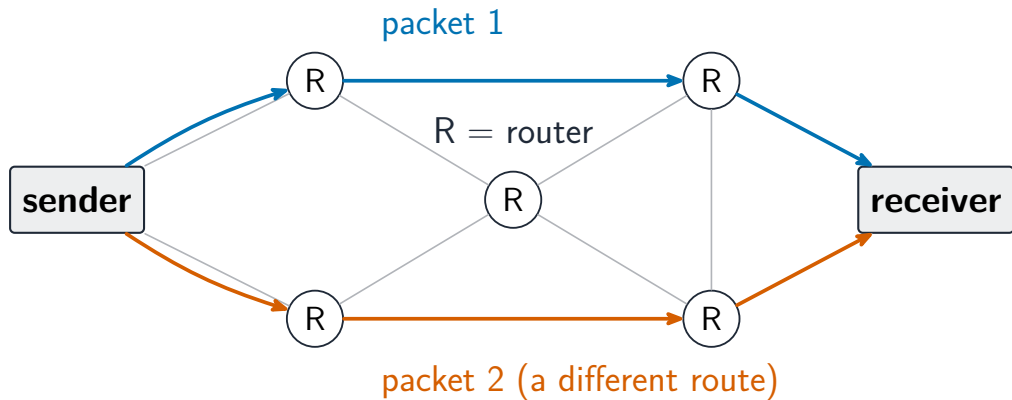
You must be able to

- state the function of a NIC
- compare a MAC address and an IP address
- describe the function of a router

Method — Network hardware

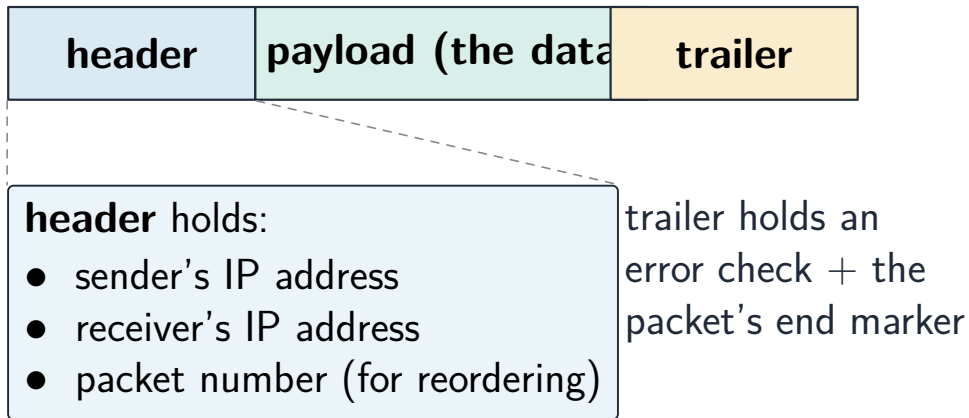
- **NIC:** lets a device join a network; holds a built-in MAC address.
- **MAC:** identifies one physical device, set by the maker, does not change.
- **IP:** given by the network, can change.

Method — Network hardware



Routers forwarding packets to a receiver

Method — Network hardware



Network hardware routes data split into packets

Method — Input, output and sensors: name the device, then say what it does

An **input device** 输入设备 puts data into a system; an **output device** 输出设备 presents the result. A **sensor** 传感器 is an input device that measures a physical quantity continuously and sends readings to a microprocessor.

Sensor	What it measures	A typical use
temperature	how hot or cold	central heating, an oven, a greenhouse
light	brightness	automatic street lights, a phone screen
infrared / motion	movement or a broken beam	burglar alarm, automatic door
pressure	force per unit area	a car seat sensor, a burglar alarm mat
humidity / moisture	water in air or soil	a greenhouse, a washing machine
pH	acidity	a pond or a chemical process
proximity	how close an object is	parking sensors, a robot

Method — Input, output and sensors: name the device, then say what it does

How a monitoring or control system works. The sensor sends readings continuously; the **analogue-to-digital converter (ADC)** turns them into digital values the microprocessor can use; the microprocessor **compares** each reading with a stored value. In a **monitoring** 监控 system it only warns or records. In a **control** 控制 system it also acts, sending a signal (through a **digital-to-analogue converter** and an actuator) to change something, so the process repeats in a loop.

Worked example. Describe how a greenhouse keeps its temperature at 25 °C. The temperature sensor sends readings continuously; the ADC converts each to digital; the microprocessor compares the reading with the stored value of 25 °C; if the reading is above it, the microprocessor sends a signal to open the window (or start a fan); if it is below, it closes the window and turns on the heater; the process repeats continuously.

Practice 2.1 ■ 1 mark

State the function of a network interface card (NIC).

Solution 2.1

Worked steps

it lets a device join a network and send/receive data **B1**.

Practice 2.2 ■ 1 mark

State the function of a router.

Solution 2.2

Worked steps

it connects different networks and forwards packets towards the right network **B1**.

Practice 2.3 ■ 3 marks

Identify a suitable sensor for each: an automatic door, a greenhouse watering system, a burglar alarm.

Solution 2.3

Method: Input, output and sensors: name the device, then say what it does

Worked steps

Automatic door: infrared or motion (or pressure) sensor **B1**; greenhouse watering: moisture or humidity sensor **B1**; burglar alarm: infrared, pressure or motion sensor **B1**.

Practice 2.4 ■ 1 mark

State the purpose of an analogue-to-digital converter in a monitoring system.

Solution 2.4

Method: Input, output and sensors: name the device, then say what it does

Worked steps

It converts the analogue readings from the sensor into digital values that the micro-processor can process **B1**.

Practice 2.5 ■ 2 marks

Explain the difference between a monitoring system and a control system.

Solution 2.5

Method: Input, output and sensors: name the device, then say what it does

Worked steps

A monitoring system only records the readings or gives a warning **B1**; a control system also sends signals that change the process, so the readings themselves change **B1**.

Exam-style 3.1 ■ 1 mark

A MAC address is best described as:

- A** given by the network and changeable
- B** a unique number set by the maker, identifying a device
- C** the same as a packet number
- D** a web address

Solution 3.1

- A** given by the network and changeable
- B** a unique number set by the maker, identifying a device 
- C** the same as a packet number
- D** a web address

Worked steps

B. A MAC address is a unique number set by the maker.

Exam-style 3.2 ■ 2 marks

A device connects to a network.

- (a) State two differences between a MAC address and an IP address.
- (b) Explain how a router uses the IP address in a packet.

Solution 3.2

Method: Network hardware

Worked steps

- (a) a MAC address is set by the maker and does not change; an IP address is given by the network and can change **B1 B1**.
- (b) the router reads the receiver's IP address in the packet header **M1**; and forwards the packet towards that network **A1**.

Exam-style 3.3 ■ 2 marks

A car park uses a computer system to manage its spaces.

- (a) Identify a suitable sensor to detect a car arriving at the barrier, and a suitable input device to read the driver's ticket.
- (b) Identify a suitable output device to tell drivers how many spaces are free.
- (c) Describe how the microprocessor uses the sensor readings to decide whether to raise the barrier.
- (d) Explain why the system needs an analogue-to-digital converter.
- (e) State whether this is a monitoring system or a control system, and justify your answer.
- (f) The car park adds a camera that reads number plates. Give the name of this technology and describe one benefit for the car park.

Solution 3.3

Method: Input, output and sensors: name the device, then say what it does

Worked steps

- (a) A pressure sensor in the road, or an infrared sensor across the entrance (B1); a barcode or magnetic-stripe reader, or a keypad, for the ticket (B1).
- (b) An LED display (or a monitor / screen) showing the number of free spaces (B1).
- (c) The sensor sends readings continuously to the microprocessor (B1); the ADC converts them to digital (B1); the microprocessor compares the reading with the stored value that means “a car is waiting”, and checks that the count of free spaces is above zero (B1); if both are satisfied it sends a signal to the actuator to raise the barrier and subtracts one from the free-space count (B1).

Solution 3.3

- (d) The sensor produces a continuously varying analogue signal **B1**, but the microprocessor can only work with digital values, so the signal must be converted **B1**.
- (e) A control system **B1**, because the microprocessor does not only record the data: it sends a signal that operates the barrier and changes what happens **B1**.
- (f) Automatic number plate recognition, a form of optical character recognition **B1**; any one benefit: drivers do not need a ticket, so entry is faster; the car park can charge automatically or detect a stolen car **B1**.