

3.4 Network hardware

Name: _____ Class: _____ Date: _____ Total: 26 marks

KEY WORDS control 控制 • network interface card 网络接口卡 • router 路由器
• network hardware 网络硬件 • sensor 传感器

Objective

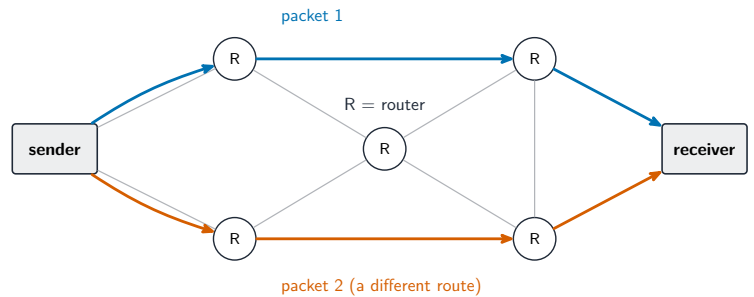
Build the skills to answer exam questions on **network hardware** 网络硬件 — the **NIC** 网络接口卡, **MAC** and **IP addresses**, and the **router** 路由器.

You must be able to:

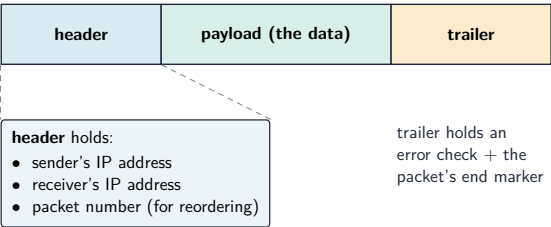
- state the function of a NIC
- compare a MAC address and an IP address
- describe the function of a router

1 Worked examples

■ Network hardware



A router connects networks and forwards packets using their IP addresses



Network hardware routes data split into packets

- **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.

■ 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

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.

2 Practice

2.1 State the function of a network interface card (NIC). [1]

2.2 State the function of a router. [1]

2.3 Identify a suitable sensor for each: an automatic door, a greenhouse watering system, a burglar alarm. [3]

2.4 State the purpose of an analogue-to-digital converter in a monitoring system. [1]

2.5 Explain the difference between a monitoring system and a control system. [2]

3 Exam-style questions

3.1 A MAC address is best described as: [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

3.2 A device connects to a network.

(a) State two differences between a MAC address and an IP address. [2]

(b) Explain how a router uses the IP address in a packet. [2]

3.3 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. [2]

(b) Identify a suitable output device to tell drivers how many spaces are free. [1]

(c) Describe how the microprocessor uses the sensor readings to decide whether to raise the barrier. [4]

(d) Explain why the system needs an analogue-to-digital converter. [2]

(e) State whether this is a monitoring system or a control system, and justify your answer. [2]

(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. [2]

Solutions

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

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

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

2.4 It converts the analogue readings from the sensor into digital values that the microprocessor can process.

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

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

3.2 (a) a MAC address is set by the maker and does not change; an IP address is given by the network and can change.

(b) the router reads the receiver's IP address in the packet header; and forwards the packet towards that network.

3.3 (a) A pressure sensor in the road, or an infrared sensor across the entrance; a barcode or magnetic-stripe reader, or a keypad, for the ticket.

(b) An LED display (or a monitor / screen) showing the number of free spaces.

(c) The sensor sends readings continuously to the microprocessor; the ADC converts them to digital; 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; if both are satisfied it sends a signal to the actuator to raise the barrier and subtracts one from the free-space count.

(d) The sensor produces a continuously varying analogue signal, but the microprocessor can only work with digital values, so the signal must be converted.

(e) A control system, because the microprocessor does not only record the data: it sends a signal that operates the barrier and changes what happens.

(f) Automatic number plate recognition, a form of optical character recognition; any one benefit: drivers do not need a ticket, so entry is faster; the car park can charge automatically or detect a stolen car.