



Gurukul Technicals Institute

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FREE EBOOK

HARDWARE, NETWORKING AND REPAIR

Networking Practical

Make LAN cables, set IP addresses and configure a Wi-Fi router

INSIDE THIS BOOK

- Networks and the devices that build them
- Network cables, categories and connectors
- Colour codes: T568A and T568B
- Crimping a straight-through cable
- Testing cables and finding faults
- ...and 5 more chapters, practice questions and a glossary

Beginner to intermediate

Hardware and networking students and office technicians

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Networking Practical

A hands-on guide to small office and home networks. You will make and test your own LAN cables, understand IP addresses, subnet masks, gateways and DNS, set static and automatic addresses in Windows, use ipconfig, ping and tracert to find faults, set up a Wi-Fi router safely and share files and printers.

WHO IT IS FOR	Hardware and networking students and office technicians
LEVEL	Beginner to intermediate
SUBJECT AREA	Hardware, networking and repair
WHAT IS INSIDE	10 chapters, practice questions with answers, and a glossary

HOW TO USE IT

Read one chapter at a time and try the examples as you go: on a computer, at your workbench or in your notebook. The boxes give tips, safety points and short activities. When you finish, test yourself with the practice questions and check your answers at the end. Words you may not know are explained in the glossary.



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Networks and the devices that build them

A **network** is a group of computers and other devices joined together so they can share things: files, printers and an internet connection. A network inside one home, office, school or shop is called a **LAN**, a local area network. The internet is a huge network of networks that joins LANs all over the world.

Every LAN, small or large, is built from a few kinds of boxes. Learn what each one does and many network faults become easier to find.

Switch

A **switch** is a box with many network ports, often 5, 8, 16 or 24. Each computer, printer or other device plugs into one port with a cable. The switch passes data only to the port where it needs to go, so many devices can talk at the same time. Each port has a small light called a **link light**. It glows when a working device is joined, and often blinks when data flows.

Router

A **router** joins two different networks. In a home or office, it joins your LAN to the internet. It also decides which device on the LAN each incoming piece of data belongs to.

The box most people call a "router" usually does several jobs at once. It is a router, a small switch with a few LAN ports, a Wi-Fi access point, and a DHCP server that hands out addresses (you will meet DHCP later).

Access point

An **access point** adds Wi-Fi to a wired network. It plugs into a switch or router with a cable and lets phones and laptops join without wires. Offices use extra access points to cover rooms where the main router's Wi-Fi is weak.

Modem and ONT

The internet reaches a building through the service provider's line. A **modem** turns the signal on a telephone or cable line into data the router understands. For **fibre** broadband, which carries data as light through a thin glass strand, the box is called an **ONT**, optical network terminal. Many internet companies now supply one box that is an ONT, a router and a Wi-Fi access point together.

Device	Main job	Where you see it
Switch	Joins many wired devices in one LAN	Office racks, computer labs
Router	Joins the LAN to the internet	Every home and office
Access point	Adds Wi-Fi to a wired network	Ceilings and walls of offices
Modem or ONT	Connects to the provider's line	Where the internet line enters

EXAMPLE

A computer lab in Ghaziabad has 20 computers. Each one is joined by cable to a 24-port switch. The switch is joined to the router, and the router to the fibre ONT. One broadband connection serves the whole lab.

DID YOU KNOW

Older networks used a **hub** instead of a switch. A hub copied all data to every port, so devices kept getting in each other's way. Switches replaced hubs years ago.

REMEMBER

Follow the path of the data: computer, cable, switch, router, ONT or modem, internet. When the internet fails, the fault is somewhere on that path.

Network cables, categories and connectors

Most wired LANs use **twisted-pair** cable. Inside the outer plastic cover, called the **jacket**, are eight thin copper wires arranged in four pairs. The two wires of each pair are twisted round each other. The twists cancel out much of the electrical noise from nearby cables and machines.

The usual type is **UTP**, unshielded twisted pair. **STP** or **FTP** cable has an extra metal foil or braid as a shield, for places with heavy electrical noise, such as near large motors.

Colours of the pairs

The four pairs are coloured orange, green, blue and brown. In each pair, one wire is the solid colour and the other is white with a stripe of that colour, called **white-orange**, **white-green** and so on.

Cable categories

Cables are graded in **categories**, written **Cat**. The category is printed on the jacket every metre or so.

Category	Common use	Speed it supports
Cat5e	Offices and homes	1 Gbps up to 100 m
Cat6	New offices and labs	1 Gbps up to 100 m; 10 Gbps over shorter runs
Cat6a	Faster networks	10 Gbps up to 100 m

Gbps means gigabits per second. One gigabit is a thousand million bits. For most small offices, Cat5e or Cat6 is plenty. A single cable run from switch to device should be no longer than **100 metres** in all.

Solid and stranded

- **Solid** cable has one thick copper core in each wire. It is used for long, fixed runs inside walls and ceilings.

- **Stranded** cable has many thin strands in each wire. It bends easily, so it is used for short **patch cords** from the wall socket to the computer.

The RJ45 connector

The plug at each end is the **RJ45** connector, a clear plastic plug with eight gold contacts and a springy **clip** that locks it into the socket. The proper technical name is 8P8C, eight positions with eight contacts, but almost everyone says RJ45. Plugs for solid and stranded wire are made slightly differently, so buy the kind that matches your cable.

TIP

Some cheap cable is made of aluminium coated with copper, sold as **CCA**. It breaks more easily and does not meet the category standards. Look for pure copper cable for any lasting installation.

EXAMPLE

Rohan buys a 305-metre box of Cat6 cable for wiring an office in Noida. He uses the solid cable for runs inside the walls to wall sockets, and buys ready-made stranded patch cords to join each computer to its socket.

TRY THIS

Strip 5 cm of jacket from a scrap piece of cable. Count the wires, name each colour, and feel how tightly each pair is twisted. Compare a Cat5e and a Cat6 scrap if you have both. Cat6 often has a plastic spine in the middle that keeps the pairs apart.

CHAPTER 3

Colour codes: T568A and T568B

The eight wires must go into the eight contacts of the RJ45 plug in a fixed order. Two standard orders are used, called **T568A** and **T568B**. Both work equally well. What matters is using them correctly at both ends.

Numbering the pins

Hold the plug with the clip underneath, the gold contacts on top and the open end where the cable goes facing you. Pin 1 is on your left and pin 8 on your right.

The two orders

Pin	T568A	T568B
1	White-green	White-orange
2	Green	Orange
3	White-orange	White-green
4	Blue	Blue
5	White-blue	White-blue
6	Orange	Green
7	White-brown	White-brown
8	Brown	Brown

Look closely and you will see that T568B is just T568A with the orange and green pairs swapped. Pins 4, 5, 7 and 8 are the same in both.

Straight-through and crossover

- A **straight-through** cable has the same order at both ends, usually T568B at both ends. It joins a computer to a switch, router or wall socket. This is the cable you will make most often.
- A **crossover** cable has T568A at one end and T568B at the other. It was once needed to join two computers directly, or two switches.

Most network ports made in recent years can sense which kind of cable is joined and adjust by themselves. This feature is called **Auto MDI-X**. So today a straight-through cable works almost everywhere, and crossover cables are rarely needed.

REMEMBER

Pick one standard for the whole building and stick to it. Many installers use T568B, and so does this book. Mixing A and B on one cable by mistake makes a crossover cable.

A way to remember T568B

Think of four pairs in the order **orange, green, blue, brown**. Orange and brown each sit together, white wire first. Blue sits in the middle, solid wire first. Green is split, one wire on each side of the blue pair:

1. White-orange, orange (pins 1 and 2)
2. White-green (pin 3)
3. Blue, white-blue (pins 4 and 5)
4. Green (pin 6)
5. White-brown, brown (pins 7 and 8)

The split green pair is on purpose, and beginners often get it wrong. Check pins 3 and 6 on every cable you make.

EXAMPLE

Simran is wiring a cable for her uncle's shop in Ludhiana. She writes the T568B order on a small card: WO, O, WG, B, WB, G, WBr, Br. She keeps the card beside her until she can arrange the wires from memory.

TRY THIS

Without looking at the table, write the T568B order on paper. Then write T568A by swapping the orange and green pairs. Check both against the table.

CHAPTER 4

Crimping a straight-through cable

Crimping means pressing the RJ45 plug onto the cable with a special tool, so that its gold contacts cut into the wires and hold them firmly.

What you need

- Cat5e or Cat6 cable
- Two RJ45 plugs that match the cable, and two spare
- A **crimping tool** for 8-pin plugs (most also have a cutter and a stripper)
- Optional: two plastic **boots**, the soft covers that protect the clip
- A cable tester (next chapter)

SAFETY

The blades of cutters and crimping tools are sharp. Keep fingers away from the blades, cut away from your body, and pick up the tiny wire offcuts so nobody steps on them. Younger students should work with an adult watching.

Step by step

1. **Cut** the cable to the length you need, with a straight, clean cut. Add a little extra length; a cable that is too short is useless.
2. **Slide on the boots** now, if you are using them, with the narrow end facing the middle of the cable. You cannot fit them after crimping.
3. **Strip** about 3 cm of the outer jacket. Turn the stripper gently round the cable once and pull the jacket off. Do not cut into the coloured wires; a nick can break later.
4. **Untwist** the pairs and straighten each wire between your fingers. Cut off the plastic spine and any thread inside.
5. **Arrange** the wires in the T568B order, pin 1 on the left, holding them flat and side by side.
6. **Trim** the wires straight across with the cutter, leaving about 12 to 13 mm from the end of the jacket. All eight ends must be level.
7. **Insert** the wires into the plug, clip underneath, pushing firmly until each wire touches the far end. Look through the tip of the plug; you should see eight copper ends right at the front.
8. **Check** the colour order through the clear plastic once more, and check that the jacket has gone inside the plug, past the small wedge at the back.

9. **Crimp:** put the plug into the 8-pin slot of the tool and squeeze the handles hard until they close fully.
10. **Pull gently** on the plug. It must not move.
11. Repeat at the other end with the same order, then slide the boots over the plugs.

Why each step matters

Mistake	What goes wrong
Wires too long, jacket outside the plug	Wires pull loose; the cable fails later
Wires too short	Some contacts do not reach the copper
Ends not level	One or two wires do not connect
Wrong order	Cable fails or runs slowly
Crimp not fully closed	Loose contacts, cable works and then stops

EXAMPLE

Faizan makes ten cables for a cyber café in Aligarh. The first two fail the test. Looking closely, he sees that the white-green wire slipped back while he pushed the wires in. After that he checks the tip of every plug before crimping, and the other eight pass first time.

TIP

If a plug is crimped wrongly, you cannot reuse it. Cut it off just behind the plug and start again. This is why you should always carry spare plugs and a little extra cable length.

CHAPTER 5

Testing cables and finding faults

Never fit a new cable without testing it. A **cable tester** checks every wire in a few seconds.

Using a basic tester

A basic tester has two parts: the **main unit** and a smaller **remote unit**. Each has a row of lights numbered 1 to 8, and often a light marked **G** for the shield of shielded cable.

1. Plug one end of the cable into the main unit and the other end into the remote unit.
2. Switch on the tester. Many have a slow and a fast mode; use slow so you can follow the lights.
3. Watch the lights. On a good straight-through cable, light 1 glows on both units together, then light 2 on both, and so on up to 8.

The tester runs a battery, often a 9 V battery, so replace it when the lights grow dim. The tester's leaflet explains exactly how its lights show each fault.

Reading the results

What you see	Fault	Fix
All lights 1 to 8 in step on both units	Good straight-through cable	Fit it
One light never glows	Open: one wire not connected	Re-crimp the end with the problem
Lights out of step (1 on main, 3 on remote)	Wires in the wrong order, or a crossover cable	Check both ends against the colour code
Two or more lights glow at the same time	Short: two wires touching	Cut off and re-crimp
No lights at all	Tester battery flat, or cable broken	Change battery; test another cable

An **open** is a broken path. A **short** is a path where two wires touch that should not.

DID YOU KNOW

A basic tester cannot find a **split pair**. This happens when someone uses a colour order of their own, the same at both ends. Every wire reaches the matching pin, so every light glows in order, but the two wires sharing a twist are not on a matching pair of pins. The cable then picks up noise and may run slowly or drop out. This is why the T568A and T568B orders must be followed exactly.

Testing a cable that is already fitted

To test a cable that runs through a wall, plug the main unit into the wall socket at one end and the remote unit into the socket at the other end, using two short, known-good patch cords.

Other quick checks

- **Link lights:** if the light on the switch port and the computer's network port stays off, the cable, the port or the device is faulty. Swap in a known-good cable to find out which.
- **Windows status:** a red cross or "Network cable unplugged" means Windows sees no working cable at all.

EXAMPLE

At a school in Varanasi, one computer has no network, though its cable passed the tester last month. Nisha moves it to a different switch port and the link light comes on. The fault was the switch port, not the cable.

TRY THIS

Make one cable on purpose with pins 3 and 6 swapped at one end. Test it and note which lights go out of step. Then cut off that end and crimp it correctly.

IP addresses, subnet masks, gateways and DNS

Every device on a network needs an address, just as every house needs a postal address for letters to reach it. On most networks this is an **IPv4 address**. IP stands for Internet Protocol, the set of rules devices use to send data to each other.

What an IPv4 address looks like

An IPv4 address is four numbers separated by dots, such as **192.168.1.25**. Each number is from 0 to 255. Each of the four parts is called an **octet**, because the computer stores it as eight bits.

Newer networks also use **IPv6**, which has much longer addresses written with letters and numbers. This book uses IPv4, which almost every small network still uses.

The subnet mask

An address has two parts: the **network part**, shared by every device on the same LAN, and the **host part**, which is different for each device. The **subnet mask** says where one part ends and the other begins.

The most common mask on small networks is **255.255.255.0**. The 255s mark the network part, and the 0 marks the host part. So with this mask:

- 192.168.1.25 and 192.168.1.40 are on the **same** network (192.168.1).
- 192.168.1.25 and 192.168.0.40 are on **different** networks, and cannot talk directly.

The same mask is often written as **/24**, because the first 24 bits are the network part.

On a 255.255.255.0 network, the last number can be 1 to 254 for devices. The address ending in .0 names the network itself, and the one ending in .255 is the **broadcast** address, used to send to every device at once.

The default gateway

The **default gateway** is the address of the router. When a computer wants to reach anything outside its own network, such as a website, it sends the data to the gateway. On many home networks it is 192.168.1.1 or 192.168.0.1. If the gateway setting is wrong, the LAN still works but the internet does not.

DNS

People remember names like `python.org`; computers need numbers. **DNS**, the Domain Name System, works like a phone directory that turns names into IP addresses. A computer asks a **DNS server** each time it meets a new name. Usually the router or internet company provides one. Some well-known public DNS servers are 8.8.8.8 and 1.1.1.1.

Private address ranges

Three ranges are kept for use inside private networks. They are never used on the public internet, so every home and office can reuse them.

Range	Common use
10.0.0.0 to 10.255.255.255	Large offices and companies
172.16.0.0 to 172.31.255.255	Medium networks
192.168.0.0 to 192.168.255.255	Homes and small offices

The router has one address on the internet side and shares it with all the private devices inside.

EXAMPLE

Kiran's laptop shows the address 192.168.1.37, mask 255.255.255.0, gateway 192.168.1.1. Her printer is 192.168.1.50, so it is on the same network. Her friend's laptop shows 192.168.0.12; it is on a different network and cannot reach Kiran's printer.

REMEMBER

Four settings make a network connection work: IP address, subnet mask, default gateway and DNS server. When something does not work, check all four.

CHAPTER 7

DHCP and static addresses

A device can get its four settings in two ways: automatically from the network, or typed in by hand.

DHCP: automatic addresses

DHCP, Dynamic Host Configuration Protocol, hands out settings automatically. On a small network, the router is usually the **DHCP server**. When a phone or computer joins, it asks for settings, and the router replies with an IP address, a subnet mask, a gateway and a DNS server.

The router hands out addresses from a range called the **pool**, for example 192.168.1.100 to 192.168.1.199. Each address is given on a **lease**, which means it is lent for a time and renewed while the device stays connected. Because of this, a device may get a different address next week.

DHCP is right for phones, laptops and most office computers. Nobody has to type anything, and two devices are not given the same address.

Static addresses

A **static** address is typed in by hand and never changes. Use static addresses for devices that others need to find at the same address every day: printers, servers and network storage.

Choose a static address **outside** the DHCP pool. If the pool is .100 to .199, you might give the printer .20 and the server .21. Keep a written list so the same address is never used twice.

REMEMBER

Two devices with the same IP address cause an **IP address conflict**. Windows shows a warning, and one or both devices lose the network.

Setting a static address in Windows

1. Press **Windows key + R**, type `ncpa.cpl` and press Enter. The Network Connections window opens.
2. Right-click the adapter you want, such as **Ethernet**, and choose **Properties**.
3. Click **Internet Protocol Version 4 (TCP/IPv4)** once, then click **Properties**.
4. Choose **Use the following IP address** and type the address, the subnet mask and the default gateway.
5. Under **Use the following DNS server addresses**, type a DNS server, often the router's address.
6. Click **OK**, then **Close**.

To go back to automatic settings, choose **Obtain an IP address automatically** and **Obtain DNS server address automatically**.

Windows 11 also has these settings in **Settings, Network & internet**, then the adapter, under **IP assignment**.

The 169.254 warning sign

If a computer set to automatic cannot reach a DHCP server, Windows gives itself an address starting with **169.254**. Seeing 169.254 means "I asked for an address and nobody answered". Check the cable, the switch and whether the router is on.

EXAMPLE

Pooja installs a network printer at a clinic in Nagpur. She sets it to the static address 192.168.1.20, mask 255.255.255.0, gateway 192.168.1.1. The router's DHCP pool starts at .100, so no other device will ever be given .20.

TRY THIS

On a lab computer, set a static address, check that the internet works, then switch back to automatic. Write down each setting before you change it, so you can always put it back.

CHAPTER 8

Checking a network with ipconfig, ping and tracert

Windows has small tools that you type into the **Command Prompt**. Open it by pressing the Windows key, typing `cmd` and pressing Enter. These tools tell you more in ten seconds than ten minutes of guessing.

ipconfig: what are my settings?

Type `ipconfig` and press Enter. For each adapter it shows the IPv4 address, the subnet mask and the default gateway. A shortened example:

Ethernet adapter Ethernet:

```
IPv4 Address. . . . . : 192.168.1.37
Subnet Mask . . . . . : 255.255.255.0
Default Gateway . . . . . : 192.168.1.1
```

Useful forms of the command:

Command	What it does
<code>ipconfig /all</code>	Shows everything, including DNS servers, whether DHCP is on, and the physical address (MAC address)
<code>ipconfig /release</code>	Gives back the address the computer got from DHCP
<code>ipconfig /renew</code>	Asks DHCP for an address again
<code>ipconfig /flushdns</code>	Clears the saved list of names and addresses

A **MAC address** is a fixed number built into every network adapter, shown as six pairs of letters and digits, such as 3C-52-82-1A-7F-09.

ping: can I reach it?

`ping` sends a few small test messages to an address and waits for replies. Type `ping` and then an address or a name:

```
ping 192.168.1.1
```

Good replies look like this:

```
Reply from 192.168.1.1: bytes=32 time=1ms TTL=64
```

Request timed out means no reply came back. **Destination host unreachable** means the computer could not find any way to that address. By default Windows sends four messages. Add `-t` to keep ping until you press **Ctrl + C**, which is handy while you wiggle a cable or walk around with a laptop.

Ping in steps

Ping outwards one step at a time. The first step that fails shows where the fault is.

1. `ping 127.0.0.1` checks the computer's own network software. This special address always means "this computer".
2. Ping the computer's own IP address.
3. Ping the default gateway (the router).
4. Ping a public address, such as `ping 8.8.8.8`.
5. Ping a name, such as `ping python.org`.

If step 4 works but step 5 fails, the internet is fine and **DNS** is the problem.

REMEMBER

Windows computers usually block incoming ping by default, through the Windows firewall. So a ping to another Windows PC can time out even when that PC is working. Routers and printers normally reply.

tracert: which way does the data go?

`tracert` lists every router, called a **hop**, between you and a destination. Type `tracert python.org`. Each line is one hop, with three timings in milliseconds. Lines with stars and "Request timed out" mean that hop did not answer, which is not always a fault; many routers are set not to reply. If nothing answers after hop 1, your own router cannot reach the internet company.

EXAMPLE

Vikas at a travel agency in Agra cannot open any website. `ping 192.168.1.1` works and `ping 8.8.8.8` works, but `ping python.org` fails. `ipconfig /all` shows an old DNS server address that someone typed in by hand long ago. He sets DNS back to automatic, runs `ipconfig /flushdns`, and websites open again.

CHAPTER 9

Setting up a Wi-Fi router

A new router works out of the box, but its default settings are not safe. Spend fifteen minutes setting it up properly.

Opening the router's settings page

1. Join a computer to the router by cable or by its default Wi-Fi.
2. Turn the router over and read the label. It shows the settings page address (often 192.168.0.1 or 192.168.1.1, or a web name), the default username and password, and the default Wi-Fi name and password.
3. Type that address into a web browser and log in.

Some routers are set up from a phone app instead; the label or the box says so. Menu names differ between makers, so look for words like **Wireless**, **Security**, **System** or **Administration**.

SAFETY

If the internet company supplied the router, ask them before you change the **internet** or **WAN** settings. A wrong value there cuts off the connection.

Five settings to change

1. **Admin password.** Change the password for the settings page first. Anyone who knows the default password, printed on thousands of identical routers, could otherwise change your settings.
2. **SSID.** The **SSID** is the Wi-Fi network name that phones show. Choose a name that does not reveal your family name, address or router model, such as **BlueDoor-Office** rather than your flat number.
3. **Security type.** Choose **WPA3-Personal** if all your devices support it, or **WPA2/WPA3** mixed mode if some older devices do not. Use **WPA2-Personal (AES)** if WPA3 is not offered. Never use **WEP**, the old **WPA (TKIP)** or an open network; they are not safe.
4. **Wi-Fi password.** WPA2 allows 8 to 63 characters, but use at least 12. A short made-up phrase works well, such as **MangoTree@Lane7Rains** (make your own; never copy one from a book).
5. **Firmware.** The router's built-in software is called **firmware**. Look for a firmware update option and install updates from the router maker, to close security holes.

More useful settings

- **WPS:** turn off the WPS PIN feature if the router allows it, because it is easier to attack than a strong password.
- **Guest network:** many routers can run a separate guest Wi-Fi, so visitors get internet but cannot see your office computers.
- **DHCP pool:** check the range and keep static addresses outside it.
- **Bands:** a **2.4 GHz** band reaches further through walls; a **5 GHz** band is faster but shorter in range.

REMEMBER

After changing the Wi-Fi name or password, every device must join again with the new details. Write them down for the office before you click Save.

EXAMPLE

Meena sets up a router for a tuition centre in Dehradun. She changes the admin password, names the network TuitionHall-WiFi, picks WPA2/WPA3 because some students have older phones, sets a 14-character password, turns on a guest network for parents, and updates the firmware.

TRY THIS

On a lab router, find each of the five settings above and write down which menu it is in. Do not save changes unless your teacher agrees.

CHAPTER 10

Sharing files and printers, and a troubleshooting table

A LAN becomes useful when people share. Windows can share folders and printers between computers on the same network.

Preparing Windows for sharing

1. Set the network profile to **Private**. Windows keeps sharing off on **Public** networks, such as café or station Wi-Fi, to keep you safe there.
2. Turn on **network discovery** and **file and printer sharing**. In Windows 11 they are in **Settings, Network & internet, Advanced network settings, Advanced sharing settings**. In Windows 10 use **Control Panel, Network and Sharing Center, Change advanced sharing settings**.

Sharing a folder

1. Right-click the folder and choose **Properties**.
2. Open the **Sharing** tab and click **Advanced Sharing**.
3. Tick **Share this folder**. Click **Permissions** to choose who can only read files and who can also change them.
4. Click **OK** twice.

With **password-protected sharing** turned on, others need a username and password that exist on the sharing computer. This keeps strangers on the same network out.

Opening a shared folder

On another computer, open File Explorer and type two backslashes and the computer's name or address in the address bar, such as `\\ACCOUNTS-PC` or `\\192.168.1.30`. The shared folders appear. To keep a share handy, use **Map network drive** to give it a drive letter such as **Z:**.

Sharing a printer

Open the printer's **Printer properties**, go to the **Sharing** tab and tick **Share this printer**. Other computers find it under the same `\\COMPUTER-NAME` address. For a busy office, a printer joined straight to the network with a static address is more reliable, because it does not depend on one computer staying on.

SAFETY

Share only the folders people need, and give read-only permission where nobody needs to change files. Never share the whole C: drive.

Troubleshooting table

Problem	Likely cause	What to try
Link light off	Bad cable or port	Test the cable; try another port
"Network cable unplugged"	Cable loose or broken	Re-seat or replace the cable
Address starts with 169.254	No DHCP reply	Check cable, switch and router; <code>ipconfig /renew</code>
IP address conflict warning	Two devices with one address	Give one a free address outside the pool
Gateway pings but internet fails	Router or provider problem	Restart router and ONT; call the provider

Problem	Likely cause	What to try
ping 8.8.8.8 works, names fail	DNS problem	Set DNS to automatic or a known server; <code>ipconfig /flushdns</code>
Cannot see other computers	Network set to Public	Set Private; turn on network discovery
Shared folder asks for password	Password-protected sharing	Use an account that exists on the sharing PC
Wi-Fi slow far from router	Weak signal	Move closer, try 2.4 GHz, add an access point

EXAMPLE

Two accounts computers in a Surat office cannot see each other. Arjun finds that one PC's network profile is Public. He sets it to Private, turns on network discovery, and the shared accounts backup folder appears.

CHECK YOURSELF

Practice questions

1. What is the difference between a switch and a router?
2. What does an ONT do?
3. Why are the wires in a network cable twisted in pairs?
4. What is the longest single cable run allowed between a switch and a device?
5. Which cable, solid or stranded, would you use for a patch cord, and why?
6. Write the T568B colour order from pin 1 to pin 8.
7. How is T568A different from T568B?
8. What kind of cable has T568A at one end and T568B at the other?
9. What is Auto MDI-X?

10. How much outer jacket should you strip, and how long should the wires be when trimmed?
11. Why must you slide the boots on before crimping?
12. On a cable tester, light 4 never glows. What is the fault?
13. What is a split pair, and why can a basic tester not find it?
14. Are 192.168.1.10 and 192.168.2.10 on the same network if the mask is 255.255.255.0? Explain.
15. What is the job of the default gateway?
16. What does DNS do?
17. Name the three private IPv4 address ranges.
18. Why should a network printer have a static address?
19. A computer shows the address 169.254.12.7. What does this tell you?
20. Which command shows a computer's MAC address and DNS servers?
21. `ping 8.8.8.8` works but `ping python.org` fails. Where is the problem?
22. Why might a ping to another Windows computer time out even when it is working?
23. Name four settings you should change on a new Wi-Fi router.
24. Why does Windows keep sharing off on a Public network?

ANSWER KEY

Answers

- | | |
|---|--|
| 1. A switch joins many devices within one LAN; a router joins the LAN to another network, such as the internet. | 2. It connects the building to a fibre broadband line, turning the light signals into data for the router. |
|---|--|

3. The twists cancel out much of the electrical noise from nearby cables and machines.
4. 100 metres in all.
5. Stranded, because it bends easily and does not break with repeated movement.
6. White-orange, orange, white-green, blue, white-blue, green, white-brown, brown.
7. The orange and green pairs swap places; pins 4, 5, 7 and 8 stay the same.
8. A crossover cable.
9. A feature of modern network ports that senses the kind of cable and adjusts, so a straight-through cable works almost everywhere.
10. Strip about 3 cm of jacket, then trim the wires to about 12 to 13 mm so the jacket goes inside the plug.
11. The boots cannot fit over the plug once it is crimped on.
12. An open: wire 4 is not connected. Re-crimp one end and test again; if it is still open, re-crimp the other end.
13. The wires reach the matching pins, but the two wires of a twisted pair are not on a matching pair of pins. A basic tester checks only that each pin connects to the same pin at the other end, not which wires are twisted together, so every light glows in order.
14. No. With this mask the first three numbers are the network part, and 192.168.1 is different from 192.168.2.
15. It is the router's address, where a computer sends data meant for other networks, such as websites.
16. It turns names like python.org into IP addresses that computers can use.
17. 10.0.0.0 to 10.255.255.255, 172.16.0.0 to 172.31.255.255, and 192.168.0.0 to 192.168.255.255.
18. So every computer can find it at the same address every day; a changing address makes computers lose the printer.
19. The computer asked for an address from DHCP and got no reply.
20. `ipconfig /all`.
21. In DNS, because the internet connection itself works.
22. The Windows firewall usually blocks incoming ping by default.
23. Any four of: the admin password, the SSID, the security type, the Wi-Fi password, the firmware, and turning off WPS PIN.
24. Public networks, such as café Wi-Fi, have strangers on them, so keeping sharing off protects your files.

Glossary

Access point

a device that adds Wi-Fi to a wired network.

Crimping

pressing an RJ45 plug onto a cable with a tool so its contacts grip the wires.

Crossover cable

a cable with T568A at one end and T568B at the other.

DHCP

a system that gives devices their network settings automatically.

DNS

the system that turns names such as python.org into IP addresses.

Default gateway

the router's address, used to reach other networks.

Firmware

the built-in software inside a device such as a router.

IP address

a number such as 192.168.1.25 that identifies a device on a network.

LAN

local area network, a network inside one building or site.

Link light

a small light on a network port that shows a working connection.

MAC address

a fixed number built into every network adapter.

ONT

optical network terminal, the box that connects a building to fibre broadband.

Open

a cable fault where a wire is not connected.

Patch cord

a short, flexible cable from a wall socket or switch to a device.

Private address

an IP address from a range used only inside private networks.

RJ45

the eight-contact plug used on network cables.

Router

a device that joins one network to another, such as a LAN to the internet.

Short

a cable fault where two wires touch that should not.

SSID

the name of a Wi-Fi network.

Static address

an IP address typed in by hand that does not change.

Subnet mask

a number such as 255.255.255.0 that shows which part of an address is the network.

Switch

a device that joins many wired devices in one LAN.

T568B

one of the two standard colour orders for the wires in an RJ45 plug, used throughout this book.

UTP

unshielded twisted pair, the usual network cable.



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