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TEACHERS

Networks and connectivity in the classroom: the teacher pack

Activities, answers and the evidence behind every claim

Every figure was checked against its source on 2 November 2026. Free to use in your classroom.

About this pack

This is the printable companion to the Networks and Connectivity in the Classroom page on techskills.org. It holds everything you need at the front of a class: how to run each activity, the questions to ask, the numbers the games will show so you can check them in advance, and the evidence behind every claim, with its source.

It is balanced on purpose between the desk (the grad cap route) and the field (the hard hat route). Each activity says where it starts, and the two routes into the industry are set out side by side with the same information.

Everything below works in a normal lesson. Most of it needs one projector. Three activities can be run with no devices at all: the starter, the discussion of the two outages, and the layers if you print the table from the pack. The set is balanced on purpose. Send the packet and the school network checker start at a desk, Find the break and Hard hats, masts and cabinets start in the field, and the rest suit both, so you can choose by the room in front of you. Timings are our suggestions from how long each takes to run, so adjust them to your group, and every activity has teacher notes, answers and discussion questions in the downloadable pack. The places, distances, readings and file sizes in the games are invented for teaching, and each activity says so.

Every network, place, distance, reading and file size in these activities is made up. Nothing a student types or ticks in the interactive activities is stored or sent anywhere, and nobody is identified by any of the examples.

For	Teachers and lecturers in schools, colleges and training providers. Written for England; see the curriculum section
Activities	11
Sources	51, each opened and read on 2 November 2026
Produced by	TechSkills, techskills.org

The case for teaching it

We could just say that everything depends on connectivity and leave it there, and plenty of people do. But you are the one standing in front of a room full of students who will check, so here is what the evidence says, including the awkward bits, because the awkward bits are where the good lessons live.

The network is bigger and better than most people think, and it is not finished. Ofcom's 2025 report says gigabit-capable networks reach 87% of UK homes and full fibre 78%, up nine percentage points in a year, and that around 44,000 premises still cannot get a decent connection. The government expects 99% of premises to have access to a gigabit-capable connection by 2032, and it says so as an expectation, not a promise. Somebody has to build the last stretch, and the last stretch is the hardest one.

Out of sight it matters more than it looks. The government says subsea cables carry around 99% of the UK's international data, and the National Protective Security Authority counts communications as one of the 13 sectors of critical national infrastructure. The Telecommunications (Security) Act 2021 put a security framework around public networks, with Ofcom able to enforce it. A network is not just convenient. The country treats it as something that has to keep working.

That is why the people matter. A 2026 government study estimates that advanced connectivity companies employed about 109,400 people in the UK in 2025. It also reports research suggesting that around 60% of telecoms engineers are over 50 and that the sector could face a shortfall of 30,000 engineers over ten years, which are estimates, and we treat them as that. It adds that in network construction, installation and field engineering, shortages cannot easily be made up by hiring from abroad, because the work has to be done in the UK, and that this suggests apprenticeships and other non-degree routes may be especially important. So the honest message for students is not that everyone should go to university and it is not that everyone should climb a mast. It is that this field needs people from every route in, and the routes, with their pay and their sources, are set out below.

The evidence

Fact	Condition	Source
Ofcom's Connected Nations 2025 report says gigabit-capable networks are available to 87% of UK residential premises, up from 83% the year before, and full fibre to 78%, up nine percentage points.	Provider data as at July 2025. Gigabit-capable means download speeds of 1 Gbit/s and above, and can be delivered over full fibre or cable networks.	Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)
The same report gives full fibre availability for residential premises as 79% in England, 71% in Scotland, 78% in Wales and 95% in Northern Ireland.	Provider data as at July 2025.	Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)
Of the premises that can get a gigabit-capable service, 56% have taken one.	Provider data as at July 2025.	Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)

Fact	Condition	Source
Ofcom estimates that around 44,000 UK premises, 0.1%, cannot get a decent broadband connection from a fixed line or fixed wireless, down from 190,000 in 2020.	Ofcom defines a decent connection as a download speed of at least 10 Mbit/s and an upload speed of at least 1 Mbit/s. Counting fixed lines only, it estimates 1% of premises, around 340,000, cannot get one.	Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)
Ofcom reports UK 5G coverage outside of premises from at least one operator of between 94% and 97%, and 4G coverage from at least one operator reaching 96% of the UK landmass.	The 5G figures are operators' predictions rather than measurements. Ofcom's own Map Your Mobile approach gives a lower figure: 88% of the UK landmass has good outdoor coverage from at least one operator.	Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)
Project Gigabit is the government's programme to enable hard to reach communities to access gigabit-capable broadband, and the government expects 99% of premises to have access to a gigabit-capable connection by 2032.	An expectation, not a guarantee. The page defines a gigabit-capable connection as a wired connection capable of download speeds of at least 1 gigabit per second, which is 1,000 megabits per second.	Building Digital UK, GOV.UK, Project Gigabit (Published 1 April 2022, last updated 26 November 2025)
The UK government says subsea fibre-optic cables carry around 99% of the UK's international data.	A figure for the UK, not the world, and the release does not say how it was worked out.	GOV.UK press release, Subsea cable saboteurs face jail and unlimited fines under new security crackdown (Published 22 October 2026)
The government counts communications as one of 13 sectors of critical national infrastructure. The sector includes telecommunications, data centres and cloud infrastructure, broadcast and postal services.	The page does not say that every network asset is critical national infrastructure.	National Protective Security Authority (NPSA), Critical National Infrastructure (Last updated 21 September 2026)
The Telecommunications (Security) Act 2021 sets up a security framework for public telecommunications networks and services, with new security duties on providers and new powers to make regulations, and it strengthens Ofcom's powers to enforce them.	The summary is from the Act's explanatory notes, which help to explain the Act and are not part of it.	legislation.gov.uk (The National Archives), with explanatory notes, Telecommunications (Security) Act 2021 (Royal Assent 17 November 2021)

Fact	Condition	Source
The government's 2026 sector study estimates that advanced connectivity companies employed approximately 109,400 people in the UK in 2025.	It covers only companies in advanced connectivity technologies, such as 5G and 6G, non-terrestrial networks and advanced optical networks, not the whole telecoms workforce. It is an estimate built from company information.	Department for Science, Innovation and Technology (research by Deecon Consulting), Advanced Connectivity Technologies Sector Study 2026 (Published 5 June 2026)
The same study says that secondary research from 2024 indicates around 60% of UK telecoms engineers are aged over 50, and that the sector could face a 30,000-person engineering shortfall over the next 10 years.	The study reports these figures from research it does not name, and says 'could'. It is an estimate, not a count.	Department for Science, Innovation and Technology (research by Deecon Consulting), Advanced Connectivity Technologies Sector Study 2026 (Published 5 June 2026)
The study adds that in network construction, installation and field engineering, shortages cannot easily be offset through overseas hiring because the work must be carried out in the UK, which suggests apprenticeships, retraining and other non-degree pathways may be particularly important.	The study's own suggestion, not a forecast.	Department for Science, Innovation and Technology (research by Deecon Consulting), Advanced Connectivity Technologies Sector Study 2026 (Published 5 June 2026)

Your school or college is a network too

Every school and college has a network, and it is a better teaching resource than any diagram, because students use it every day and can see where it stops working. The Department for Education's digital and technology standards say all schools and colleges should be working towards meeting six core standards by 2030, and five of the six are about the network or what runs on it: broadband, wireless, switching, filtering and monitoring, and cyber security. Cabling has a standards page of its own.

It is worth knowing the headline numbers, because a curious student will ask. The broadband standard says full fibre, with a minimum of 100Mbps down and 30Mbps up for primary schools and the capacity for 1Gbps for secondary schools, all-through schools and colleges, and it says there should be a backup connection of a different type that takes over automatically. The checker later on this page turns the standards into seven questions you can answer in a staff meeting with your IT lead. It is a way to start a conversation, not an audit.

The evidence

Fact	Condition	Source
The Department for Education says all schools and colleges should be working towards meeting six core standards by 2030: broadband internet, wireless network, network switching, digital leadership and governance, filtering and monitoring, and cyber security.	Network cabling has its own standards page but is not marked as one of the six core standards.	Department for Education, Meeting digital and technology standards in schools and colleges (Published 23 March 2022, updated 16 September 2026)
The broadband standard says schools and colleges should use a full fibre connection. Primary schools should have a minimum of 100Mbps download and 30Mbps upload. Secondary schools, all-through schools and further education colleges should have a connection with the capacity to deliver 1Gbps download and upload.	The page says copper connections do not meet this standard.	Department for Education, Broadband internet standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The broadband standard also says schools and colleges should have a backup broadband connection, using different service types, for example a leased line combined with fibre to the premises, with multiple routers to provide automatic failover.		Department for Education, Broadband internet standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)

Starter: follow your message

Before you say the word network, ask everyone to imagine sending a photo to a friend across town. Give them two minutes in silence to list every device, cable, mast and building the photo passes through. Nearly everyone gets the two phones and a vague cloud in the middle. Hardly anyone mentions the cabinet at the end of the street, the cable under it, the mast on the hill or the building full of computers that the cloud actually is.

That is the whole opportunity of this subject. The internet feels like something in the air, and it is not. It is glass in the ground, radio on a mast, boxes in cabinets and software that decides where each piece goes, and every part of it was put there and is looked after by people. Some of them wear a hard hat and some wear a headset, and the network needs both. A student who has worked that out has already noticed the thing this subject most needs noticed.

A ten minute starter: trace one message from your phone to a friend's, and list every cable, mast, box and building it passes through. Nobody has to share anything private.

What this is

A ten minute warm-up with pen and paper. No computers are needed.

What to do

- Ask everyone to imagine sending a photo to a friend across town. For two minutes, in silence, they list every device, cable, mast and building it passes through.
- Next, they circle everything on the list that a person had to install or look after with their hands, and underline everything that is a program or a setting.
- Collect the most surprising items on the board, with no names. Nobody has to read out their own list.

What you should notice

Most lists are all phones and a cloud. The cabinet, the cable in the ground and the mast are real, somebody built them, and somebody is sent when they break.

Time	10 to 15 minutes
You need	Paper and pens. No devices.
Where	Can be done with no devices. Suits both the desk and the field.

Students will be able to

- Name at least five things a message passes through on its way.
- Say which of them are physical, such as cables and masts, and which are software.
- Explain that the internet is a real, physical thing as well as a service.

Running it

- Ask everyone to pick a friend and imagine sending them a photo. Give them two minutes, in silence, to draw or list every device, cable, mast and building the photo passes through between the two phones. Suggest prompts if they stall: the phone itself, the router at home, the street cabinet, a data centre, a mast.

- Ask them to circle everything on their list that a person had to install or maintain with their hands. Then ask them to underline everything that is a program or a setting.
- Collect the most surprising items on the board. Nobody has to read out their own list.
- Finish by asking who built and looks after the circled items and the underlined ones.

Questions to ask

- Which part of the trip did you not know existed?
- Which parts could you see from where you are sitting right now?
- If one of the circled items broke, how would anybody know, and who would be sent?

Watch for

- Some students may not want to name a friend. Say 'someone' and let them keep it anonymous.
- Do not worry about getting the technology exactly right. The point is the idea that a message is a physical trip made possible by real people's work.
- Students will often forget the wireless link in their own pocket. Prompt for it.

Your notes

Game: send the packet

A message has to cross a small network to a server abroad. Find the quickest route, then cut a cable and watch it find another way, or fail to.

What this is

A map of a small, made-up network between your school and a server in another country. Each cable has a length. The page finds the shortest route for a message, draws it, and works out how long light takes in the glass to cover it.

What to do

- With every cable working, read the route the page picks, the total length and the time. It is 5,737 km, which light covers in about 28 milliseconds.
- Under Cut a cable, tick the cable between City hub and Landing station A. Read the new route and see how much longer it is.
- Press Repair every cable. Then tick Landing station A to Server abroad, the first sea cable, and read the new route. Now tick the second sea cable as well.
- Press Repair every cable, then tick Your school to Town exchange, the only cable the school has.

What you should notice

Cutting one cable usually only makes the route longer, because the network has other ways round. Cut the only cable a place has, or both sea cables, and there is no route at all. That is a single point of failure.

Time	25 to 35 minutes
You need	A projector for the whole class, or one device per pair.
Where	Interactive on the page. Needs a screen. Starts at a desk (grad cap).

Students will be able to

- Explain that data travels in pieces along a route made of links, and that the route can change.
- Say what a single point of failure is and spot one on a map.
- Compare two routes by length and by the time light takes.

Running it

- Open the activity with every cable working. Read out the route the page picks, the distance and the one-way time. Ask the class what rule it is using. (The shortest total length of cable.)
- Ask the class which single cable they think the message would hate to lose, then tick it and see. Cutting the cable between the city hub and landing station A makes the route go round by the ring hub, 55 km longer.
- Cut the first sea cable, then the second, and read the new routes. Cutting the first adds 329 km. Cutting both leaves no route.
- Now ask for the cable that would cut the school off completely. (The one between the school and the town exchange: the school has only one.) Ask what the school could buy to fix that.
- Use Repair every cable and ask a pair to find a cut that changes nothing for this message.

Questions to ask

- What does a network gain from having more than one route, and what does it cost?
- Which is more important to this message, the shortest route or the one that is still working? Who decides?
- Where is the single point of failure in your own school's connection, and do you know who would be called?

Watch for

- The places and distances are invented. The route finding is real, but the page counts only the time light takes in glass, and real connections add time in every device on the way.
- Real networks choose routes with rules set by the people who run them and by the networks they connect to, not only the shortest cable. The page uses the shortest cable so the cause of each change is easy to see.
- Students may think cutting a cable stops a message. In a network with other routes, it usually only slows it down.

The answer key: cut each cable in turn

With every cable working the route is Your school, then Town exchange, then City hub, then Landing station A, then Server abroad: 5,737 km, 28.07 ms one way in the glass. The table shows what happens if each cable is cut on its own. The page shows the same numbers.

Cable cut	New route	Length	Time in the glass	Change
Your school to Town exchange (4 km)	No route			School cut off
Town exchange to City hub (38 km)	Your school, Town exchange, North hub, Ring hub, Landing station A, Server abroad	5,802 km	28.39 ms	65 km longer, 0.32 ms slower
Town exchange to North hub (52 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
City hub to North hub (61 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
City hub to Ring hub (70 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
North hub to Ring hub (66 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
City hub to Landing station A (95 km)	Your school, Town exchange, City hub, Ring hub, Landing station A, Server abroad	5,792 km	28.34 ms	55 km longer, 0.27 ms slower
Ring hub to Landing station A (80 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
Ring hub to Landing station B (85 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
North hub to Landing station B (110 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None
Landing station A to Server abroad (5,600 km)	Your school, Town exchange, North hub, Landing station B, Server abroad	6,066 km	29.68 ms	329 km longer, 1.61 ms slower

Cable cut	New route	Length	Time in the glass	Change
Landing station B to Server abroad (5,900 km)	Your school, Town exchange, City hub, Landing station A, Server abroad	5,737 km	28.07 ms	None

Both sea cables cut: no route. The places and distances are invented, and the times count only the time light takes in glass.

Your notes

Lab: how long does light take in a cable?

Light is the fastest thing there is and it still takes time. Work out how long a cable takes, then turn it round: how far away can a server be?

What this is

A calculator for how long light takes to travel along a cable, and the reverse: given a round trip time, how far away can the other end be?

What to do

- In Part one, choose 1,000 km. Read the one way time and the there and back time. Then choose each of the other lengths and watch the numbers.
- Read the line underneath that compares the glass with a vacuum: light is slower in the glass.
- In Part two, slide the round trip time to 20 ms and read the greatest distance the cable can be.

What you should notice

Ten times the length is ten times the delay, and light in glass is slower than light in a vacuum. Even with instant equipment, a long cable means a minimum delay that nothing can remove.

Time	20 to 25 minutes
You need	A projector or one device per pair.
Where	Interactive on the page. Needs a screen. Suits both the desk and the field.

Students will be able to

- Calculate the delay in a cable from its length.
- Explain why distance sets a minimum delay that no equipment can remove.
- Use a round trip time to work out the greatest distance a server could be.

Running it

- Start with 1,000 km and read the one-way time. Ask the class to say it back in their own words: light covers that cable in about five milliseconds.
- Press through the other distances. Ask them to spot the rule: ten times the length, ten times the time.
- Ask why the vacuum time is shorter. (The glass slows the light to about two thirds of its speed in a vacuum.)
- Move to part two. Slide the round trip time to 20 ms and read the greatest distance. Ask what this means for a game server on the other side of the world.
- Finish by asking what a cable builder can do about this delay. (Make the cable shorter. Nothing else removes it.)

Questions to ask

- If light is the fastest thing there is, why can a connection still feel slow?

- Why would a company pay to build a shorter cable?
- What does a round trip time tell you that a download speed does not?

Watch for

- The numbers assume light goes straight along the cable at the speed given in the evidence panel. A real route is not straight, so the real delay is more.
- The page counts only the time light takes in glass. Real connections also wait in every router and switch on the way, and for the other side to reply.
- Students may mix up speed (how fast it goes) with bandwidth (how much it carries). The next activity separates the two.

The numbers the page shows

Length of cable	One way in glass	There and back
1 km	0.005 ms	0.010 ms
10 km	0.05 ms	0.10 ms
100 km	0.49 ms	0.98 ms
1,000 km	4.89 ms	9.79 ms
5,600 km	27.40 ms	54.81 ms
20,000 km	97.87 ms	195.74 ms

The sums use 299,792,458 metres a second for light in a vacuum and a refractive index of 1.467 for the glass. Part two turns it round: a round trip of 20 ms means a cable of no more than about 2,044 km, even with instant equipment.

The evidence

Fact	Condition	Source
Light travels through a vacuum at 299,792,458 metres a second. The metre is defined from this number, so it is exact.		National Institute of Standards and Technology (NIST), CODATA value: speed of light in vacuum (2022 CODATA recommended values)
The Fiber Optic Association says the typical index of refraction of optical fibre is about 1.46, so the speed of light in the fibre is about two thirds of its speed in a vacuum. TeleGeography estimates that light travels about 31% slower in fibre than in free space, which fits an index of around 1.467.	The index varies between fibres. A university student lab measured 1.4606 on one telecom fibre and called it a typical value. This pack uses 1.467, TeleGeography's estimate, in every sum.	The Fiber Optic Association (FOA), Reading an OTDR trace: distance scale (Copyright 2020); TeleGeography (research by Paul Brodsky), The Speed of Light Never Changes, Except When it Does (10 July 2017); Kansas State University, Department of Physics (student poster), Measuring the Speed of Light in an Optical Fiber (Spring 2009)

Fact	Condition	Source
Light is guided down the core of an optical fibre because the cladding around the core traps it there by total internal reflection.		The Fiber Optic Association (FOA), The FOA reference for fiber optics: optical fiber (Copyright 1999 to 2018)

Your notes

Game: find the break

You are the field engineer. A tester has sent a pulse down a cable and timed the echo. Work out where the break is and decide which chamber to open.

What this is

A fibre test trace from a made-up cable. The line is the signal reading along the cable. It falls steadily, steps down a little at each joint, and stops at a break. Your job is to say how far along the break is, and which chamber to open.

What to do

- Read the brief, then look at the trace. Slide the dashed line along under Step one until it sits where the signal stops, and press Check my reading.
- Press Show the working. The tester timed the echo from the break, and the working turns that time into a distance using the speed of light in glass. See that it matches the chart.
- Under Step two, choose which chamber you would open and read what the page says. Then choose another and compare.
- Choose the second fault and the third, and do the same without the working.

What you should notice

The best place to open is the chamber nearest the break, not the break itself, because the chambers are the places a cable can be reached. The distance comes from time and the speed of light, so the maths from the last lab is the whole of a fibre tester.

Time	25 to 35 minutes
You need	A projector for the whole class, or one device per pair.
Where	Interactive on the page. Needs a screen. Starts in the field (hard hat).

Students will be able to

- Read a fibre test trace and say where the signal stops.
- Use the time of an echo and the speed of light in glass to find a distance.
- Choose where to dig, and say why that is the best place.

Running it

- Pick the first fault and read the brief aloud. Ask the class what they would need to know to start digging. (How far along the break is.)
- Show the trace. Ask where the signal stops. Slide the dashed line to the end, then press Check my reading. Reading it off the chart is good to within about a hundred metres.
- Press Show the working. The tester timed the echo: the light went out and came back, so the distance is half the time multiplied by the speed of light in glass. Read the sum together and check it matches the chart.

- Ask which chamber to open. Choose one that is not the nearest and read the answer, then choose the nearest.
- Repeat with the second fault, and give the third to pairs to do alone. Ask them to explain, in one sentence, why the engineer does not just dig at the break.

Questions to ask

- Why is it better to open the nearest chamber than to dig at the exact spot?
- What would make the reading less accurate in real life?
- Which parts of this job are maths, and which are physical work?

Watch for

- The traces and loss figures are invented to show the idea. They are not readings from a real cable.
- A real cable does not run straight and has slack coiled in chambers, so the distance on the tester is along the fibre, not on a map. The page says so under the activity.
- Do not let students think the engineer works alone at a screen. The real work starts when the chamber is opened, and it involves safety, traffic and the people whose service is down.

The answer key

Fault	Cable length	Break at	Echo time	Nearest chamber
The new housing estate	12,400 m	7,940 m (worked out: about 7,940 m)	77.71 microseconds	Chamber 3, 640 m from the break
The village after the storm	8,600 m	3,610 m (worked out: about 3,610 m)	35.33 microseconds	Chamber B, 210 m from the break
The college campus link	18,000 m	14,380 m (worked out: about 14,380 m)	140.73 microseconds	Chamber 5, 1,120 m from the break

The traces and loss figures are invented. A real cable does not run in a straight line and has slack coiled in chambers, so the distance on a real tester is a distance along the fibre.

The evidence

Fact	Condition	Source
A fibre tester works out the distance to a point in the cable by timing a test pulse's round trip, halving it to get the one-way time, and converting that to a distance using the index of refraction of the fibre.	The index set in the tester must be correct for the distance to be correct.	The Fiber Optic Association (FOA), Reading an OTDR trace: distance scale (Copyright 2020)
An optical time domain reflectometer (OTDR) is useful for testing the integrity of fibre optic cables: it can verify splice loss, measure length and find faults.		The Fiber Optic Association (FOA), The FOA reference for fiber optics: OTDRs (Copyright 2008 to 2024)

Fact	Condition	Source
Telecoms field operative is a Level 2 apprenticeship standard with a typical duration of 15 months, not counting the assessment period. Its purpose is to build, provide or repair telecom services on the UK's National Telecom Access Network, and the standard says the majority of time in the role will be spent working outside in all kinds of weather.	Its duties include jointing and splicing new cables, fault identification and rectification of copper or fibre products, and using risk assessments and safe systems of work. Skills England's page date for this standard is 26 August 2022.	Skills England, Telecoms field operative (ST0832), Level 2 (Date updated 26 August 2022)

Your notes

Lab: why does it say four hours?

Speeds are in megabits and files are in bytes. Pick a file, a speed and how many people are sharing, and find out what the sum really says.

What this is

A download calculator. Pick a file, a connection speed and how many people are sharing, and it shows how long the download really takes and the sum behind it.

What to do

- Choose A film, 5 GB, and 100 Mbps, with nobody sharing. Read the time: 400 seconds, about 7 minutes.
- Read the line under the result: 100 megabits a second is 12.5 megabytes a second, because eight bits make a byte.
- Slide Sharing the connection up to about 10 and watch the time grow.
- Choose A game, 50 GB, and 10 Mbps, and read the time. Then read the last line, which shows what happens if bits and bytes are mixed up.

What you should notice

Speeds are quoted in bits and files in bytes, so the real time is eight times longer than the first guess. Sharing slows everyone down by the same share.

Time	20 to 25 minutes
You need	A projector or one device per pair.
Where	Interactive on the page. Needs a screen. Suits both the desk and the field.

Students will be able to

- Convert megabits a second to megabytes a second.
- Work out how long a download takes from its size and a speed.
- Explain why sharing a connection slows down everyone on it.

Running it

- Choose the film at 100 Mbps with nobody sharing. Ask the class to guess the time, then reveal it: 5 gigabytes is 40 gigabits, so at 100 megabits a second it takes 400 seconds, about seven minutes.
- Read the second line aloud: 100 megabits a second is 12.5 megabytes a second. Ask why we divide by eight.
- Slide sharing up. Ask what happens to each person's share, and watch the time grow.
- Switch to the game at 10 Mbps and ask whether a student would leave it downloading overnight.
- Show the third line: if bits and bytes were mixed up the sum would be eight times too quick. Ask where they have seen a number on a box that might be in a different unit from the file.

Questions to ask

- Why do network speeds use bits while file sizes use bytes?
- What do you notice at home when everybody is on a screen at once?
- If you were choosing a connection for a school, would you pick on speed alone? What else matters?

Watch for

- The sums use a gigabyte as a thousand megabytes, as network speeds do. Some computers count differently, and the difference is small.
- Sharing here is split evenly. Real sharing is rarely even, and a real connection also loses a little to overheads. The page does not include either.
- The file sizes are round examples. They are not the sizes of any particular film or game.

Download times with nobody sharing

Speed	A phone app update (0.2 GB)	A film (5 GB)	A game (50 GB)
10 Mbps (1.25 MB a second)	3 minutes	67 minutes	11.1 hours
50 Mbps (6.25 MB a second)	32 seconds	13 minutes	2.2 hours
100 Mbps (12.5 MB a second)	16 seconds	7 minutes	67 minutes
500 Mbps (62.5 MB a second)	3 seconds	80 seconds	13 minutes
1000 Mbps (125 MB a second)	2 seconds	40 seconds	7 minutes

A gigabyte here is a thousand megabytes, and the sharing slider splits the speed evenly, which is a simplification. The file sizes are round examples.

The evidence

Fact	Condition	Source
Broadband speeds are usually advertised in megabits per second.		Ofcom, How to get more from your broadband (Published 19 July 2023, last updated 25 August 2026)
One byte is eight bits, as the National Institute of Standards and Technology defines it.		National Institute of Standards and Technology (NIST), Definitions of the SI units: The binary prefixes (Undated page)
Ofcom gives an example: over broadband with a 10 Mbit/s download speed, downloading a one-hour HD TV episode of 1 GB would take almost 15 minutes.		Ofcom, Connected Nations UK Report 2025 (Published 19 November 2025)
Ofcom says the distance a home is from the telephone exchange, the time of day you go online and the number of people in the home using the internet at the same time can all play a part in slowing down a connection.		Ofcom, Practical tips for improving your broadband speed (Published 22 December 2023, last updated 24 September 2024)

Fact	Condition	Source
Ofcom says a wifi connection will never outperform the broadband service behind it, and that bandwidth is shared between the devices on the network.		Ofcom, Improving your wifi experience (Published 19 February 2024)

Your notes

Diagram: from a message to a signal

The four layers a message passes through, and the physical network underneath them: what can go wrong at each, and the real jobs that do the work, desk-based and hands-on.

What this is

Five tabs, one for each of the four layers a message passes through, plus the physical network underneath them. Each shows what happens, what can go wrong and which jobs in the Career Matrix do that work.

What to do

- Start with tab 1, Application layer. Read what happens, then the three things that can go wrong, then the jobs.
- Move through tabs 2, 3 and 4. At each, ask the class to say what could go wrong before you read the list.
- Open tab 5, The physical network. Look at the hard hat mark on it and read the hands-on route shown beside the jobs.
- Choose a tab and read the real example, if it has one, in the box underneath.

What you should notice

Every message needs all of the layers, and the work moves from screens at the top to hands in the field at the bottom. The same network needs both kinds of people.

Time	20 to 30 minutes
You need	A projector, or the printed table in the teacher pack.
Where	Interactive on the page. Can be done with no devices. Suits both the desk and the field.

Students will be able to

- Put the layers of sending a message in order.
- Give one thing that can go wrong at each stage.
- Name one desk-based job and one hands-on job and say which layer each works on.

Running it

- Read stage 1 aloud and ask the class to say what happens when they press send on a message. Move through the stages with the tabs, asking for what could go wrong before revealing it.
- At each stage ask who does that work. Point out that the people at stage 5 are often outdoors, and the people at stage 1 usually are not, and that a message does not work without both.
- Ask students to put a hand up for the stage they think they would enjoy most, and say why.
- For an unplugged version, print the table from the teacher pack and run it as a card sort: stages, what goes wrong and the jobs, cut up and mixed.

Questions to ask

- Which stage is the hardest to fix when it goes wrong, and why?
- Why does it help to think of a message in stages at all?
- Which stage would your own phone need to change if you moved from Wi-Fi to mobile data?

Watch for

- This is a deliberate simplification. Real networks describe the stages in different ways, and the curriculum uses its own names, shown in the curriculum section. Stages overlap and several run at once.
- The jobs are those the Career Matrix lists for the matching areas of work. They are examples, not the only jobs at each stage.
- Students may think there is only one correct way to divide the stages. Treat it as a way to think, not a fact to memorise.

A deliberate simplification. Real networks overlap the layers and describe them in different ways. The jobs are those the Career Matrix lists for the matching areas of work.

Layer	What happens	What can go wrong	Who does it
1. Application layer (desk)	An app or a website decides what to send: a photo, a page request, a message. It uses a name such as a web address, and the name has to be turned into the number a network uses. This is the layer people see.	Looking up a name fails, so the app cannot find where to send anything. A server is overloaded and answers too slowly. The app and the server do not speak the same version of the same rules.	Software Defined (SDN): NetDevOps Engineer, SDN Architect, Cloud Networking; Enterprise & Unified Communications: UC Engineer, VoIP Specialist, Collaboration Platform Lead, Contact Centre Engineer
2. Transport layer (desk)	A message is cut into pieces, each numbered, so the other end can put them back in order and ask again for any that go missing.	Pieces arrive out of order or not at all and have to be sent again. A busy link delays pieces, so a video stutters. Too many people share one connection and each gets a smaller slice.	Network Engineering: Network Engineer, NOC Analyst, Network Architect, LAN/WAN Specialist
3. Internet layer (desk)	Each piece is given an address and sent to a router, which chooses the next step on the way. If a link has gone, the routers find another way round.	A router has a wrong setting and pieces are sent nowhere. A link is cut and every route that used it has to change. Only one route exists, so there is nothing to change to.	Network Engineering: Network Engineer, NOC Analyst, Network Architect, LAN/WAN Specialist; Software Defined (SDN): NetDevOps Engineer, SDN Architect, Cloud Networking; Network Security & Access Control: Network Security Engineer, Firewall Administrator, Zero Trust Architect, VPN Specialist
4. Link layer (desk and hands-on)	On each hop, a piece is handed to the next device along that one link: a laptop to the Wi-Fi, a switch to a router, a mast to a phone. The rules here depend on whether the link is a cable or radio.	Weak or crowded Wi-Fi. A faulty or badly made cable connector. Too many devices sharing the same radio channel.	Network Engineering: Network Engineer, NOC Analyst, Network Architect, LAN/WAN Specialist; Telecommunications (5G): Telecoms Engineer, Radio Planning Engineer, Field Engineer, Core Network Engineer; IoT & Wireless Tech: IoT Solutions Architect, Wireless Specialist, Satellite Comm Engineer

Layer	What happens	What can go wrong	Who does it
5. The physical network (under the layers) (hands-on)	Underneath the layers is the real thing: glass fibre in the ground and under the sea, copper, masts, antennas and cabinets. Somebody has to put it there, test it and mend it. It is not one of the four layers of the model, but nothing above it works without it.	A cable is cut or damaged. A joint in a fibre is badly made and loses too much light. Weather, a fallen tree or a ship's anchor breaks something.	Digital Infrastructure (Fibre): Fibre Technician, Planning Officer, Submarine Cable Engineer; Telecommunications (5G): Telecoms Engineer, Radio Planning Engineer, Field Engineer, Core Network Engineer; IoT & Wireless Tech: IoT Solutions Architect, Wireless Specialist, Satellite Comm Engineer

The evidence

Fact	Condition	Source
Meta said its DNS servers withdraw their route advertisements if they cannot speak to its data centres. With the whole backbone down they did so, and became unreachable even though they were still working, so the rest of the internet could not find its servers.	Meta's own account. DNS is the system that turns a name such as a website address into the number a network uses.	Meta Engineering (Santosh Janardhan), More details about the October 4 outage (Posted 5 October 2021)
Meta said a command issued during routine maintenance to assess the availability of global backbone capacity unintentionally took down all the connections in its backbone network, effectively disconnecting its data centres globally, and that a bug in its audit tool stopped the command being blocked.	Meta's own account, posted on 5 October 2021. Its first statement the day before described configuration changes on its backbone routers.	Meta Engineering (Santosh Janardhan), More details about the October 4 outage (Posted 5 October 2021); Meta Engineering (Santosh Janardhan), Update about the October 4th outage (Posted 4 October 2021, updated 5 October 2021)
Ofcom says wifi signals weaken as they pass through objects, and that water, metal and glass also block the signal.		Ofcom, Improving your wifi experience (Published 19 February 2024)
In October 2022 a fault on a subsea cable of the SHEFA-2 network, which links Faroe, Shetland, Orkney and the Scottish mainland, was confirmed to be around two to three kilometres off Shetland. The cable ship Cable Vigilance, which had helped fix the link from Faroe, was due to head to Shetland to repair the latest fault.	A local news report quoting the operator. The incidents were believed to be accidents involving fishing vessel gear, and the work depended on what the weather allowed.	Shetland News, Subsea cable fault took place a few kilometres off Shetland, telecoms chief says (25 October 2022)
AQA's GCSE specification, version 1.3, includes the 4 layer TCP/IP model of application layer, transport layer, internet layer and link layer, and Pearson Edexcel's includes the same four layers.	OCR's specification lists 'the concept of layers' without naming them in the lines we read.	AQA, AQA GCSE Computer Science (8525) specification, version 1.3 (16 June 2025); Pearson Edexcel, Pearson Edexcel GCSE Computer Science (1CP2) specification (Issue 1, January 2020)

Your notes

When a network goes quiet

The abstract version of 'single point of failure' slides off most students, so give them two concrete ones. In October 2021 Facebook and its sites disappeared from the internet for several hours. Meta's own account says a command issued during routine maintenance, meant to check how much capacity its backbone network had, unintentionally took down all the connections in it and so disconnected its data centres. Its systems are designed to catch a command like that, and a bug in the audit tool stopped them. Its name servers then took themselves off the internet because they could not reach the data centres, so the rest of the internet could no longer find Facebook. Cloudflare, watching from outside, wrote that it was as if someone had pulled the cables out of the data centres. Getting back in was awkward too: Meta said its normal ways in were down and it sent engineers on site.

The second story is physical. In October 2022 a fault on a subsea cable of the network linking Faroe, Shetland, Orkney and the Scottish mainland was confirmed to be two to three kilometres off Shetland, and a cable ship that had just helped fix the link from Faroe was due to head over to repair it. The operator believed the incidents were accidents involving fishing gear, and the repair depended on the weather. It fits the wider picture: the International Cable Protection Committee says around 150 to 200 subsea cable faults happen worldwide each year and most are accidents involving fishing and anchors, and the government says that when a cable in the UK system breaks a repair vessel is at the scene within eight days.

We have set out what the sources say and nothing more, because the useful lesson is not who is to blame. It is that in both stories something a lot of things depended on failed and there was no quick way round it, and that the fix needed people at a desk and people on a ship or on site. Which is the case for both routes in.

The evidence

Fact	Condition	Source
Meta said a command issued during routine maintenance to assess the availability of global backbone capacity unintentionally took down all the connections in its backbone network, effectively disconnecting its data centres globally, and that a bug in its audit tool stopped the command being blocked.	Meta's own account, posted on 5 October 2021. Its first statement the day before described configuration changes on its backbone routers.	Meta Engineering (Santosh Janardhan), More details about the October 4 outage (Posted 5 October 2021); Meta Engineering (Santosh Janardhan), Update about the October 4th outage (Posted 4 October 2021, updated 5 October 2021)
Meta said its DNS servers withdraw their route advertisements if they cannot speak to its data centres. With the whole backbone down they did so, and became unreachable even though they were still working, so the rest of the internet could not find its servers.	Meta's own account. DNS is the system that turns a name such as a website address into the number a network uses.	Meta Engineering (Santosh Janardhan), More details about the October 4 outage (Posted 5 October 2021)
Meta said its data centres could not be reached through its normal means because their networks were down, and that it sent engineers onsite to debug the issue and restart the systems.	Meta's own account.	Meta Engineering (Santosh Janardhan), More details about the October 4 outage (Posted 5 October 2021)

Fact	Condition	Source
Cloudflare, which runs a large network and saw the event from outside, wrote that at 15:58 UTC on 4 October 2021 it noticed Facebook had stopped announcing the routes to its DNS prefixes, and that it was as if someone had pulled the cables from Facebook's data centres all at once. It wrote that by 21:28 UTC Facebook appeared to be reconnected to the global internet.	Cloudflare describes what it saw from outside and leaves the cause to Facebook.	Cloudflare (Celso Martinho and Tom Strickx), Understanding how Facebook disappeared from the Internet (4 October 2021)
In October 2022 a fault on a subsea cable of the SHEFA-2 network, which links Faroe, Shetland, Orkney and the Scottish mainland, was confirmed to be around two to three kilometres off Shetland. The cable ship Cable Vigilance, which had helped fix the link from Faroe, was due to head to Shetland to repair the latest fault.	A local news report quoting the operator. The incidents were believed to be accidents involving fishing vessel gear, and the work depended on what the weather allowed.	Shetland News, Subsea cable fault took place a few kilometres off Shetland, telecoms chief says (25 October 2022)
The International Cable Protection Committee says approximately 150 to 200 submarine telecommunications cable faults occur globally each year, and around 70% to 80% are caused by accidental human activity, such as commercial fishing and ships' anchors, rather than sabotage.	'Industry data indicates', in the committee's own words, so an industry estimate rather than a count.	International Cable Protection Committee (ICPC), Media enquiries (Updated 20 May 2026)
The Department for Science, Innovation and Technology describes the UK's subsea cable system as underpinned by around 64 cables, and says that when cables break a repair vessel is at the scene within eight days.	'Around 64 cables' is the department's wording for the system behind the UK, not a count of cables that land in the UK. The same release says up to 97% of faults arise from fishing activity or vessels dragging anchors; the page marks that figure with an asterisk whose note we could not find.	Department for Science, Innovation and Technology, GOV.UK press release, Plan to toughen protections for subsea internet cables amid heightened Russian activity (Published 29 May 2026)

Two true stories of a network going quiet: one started with a command run at a desk, the other with a fault on a cable under the sea. What went wrong and what a fix needs.

What this is

A discussion of two true events from the sources on the page: an outage that started with a command in a data centre network, and a fault on a subsea cable. No devices are needed.

What to do

- Read the first story from the page: Meta's own account of its October 2021 outage, and what Cloudflare saw from outside.
- Read the second: the October 2022 fault on a subsea cable off Shetland.
- In pairs, students write what went wrong in each, and who had to put it right, in two columns.
- Ask what the two stories have in common, then take the questions in the teacher notes.

What you should notice

In both stories something many things depended on failed with no quick way round, and the repair needed people: at a desk in one, on a ship in the other.

Time	30 to 40 minutes
You need	The facts below. No devices.
Where	Can be done with no devices. Suits both the desk and the field.

Students will be able to

- State what happened in each story using the sourced facts.
- Explain why a network built with a single point of failure fails in one go.
- Say what the fix needed in each case, and who did it.

Running it

- Read the first story from the page, then the second. Do not tell the class the lesson yet.
- Ask in pairs: what went wrong in each story, and who had to put it right? Collect the answers in two columns, a setting and a ship.
- Ask what the two stories have in common. (A part many things depended on, and no quick way round it.)
- Return to the Send the packet activity if you ran it: ask where the single points of failure were in the made-up network, and how a real organisation tries to avoid them.
- Finish by asking which of the two repairs the students would rather have been part of, and why.

Questions to ask

- Why can a small change in one place affect so many things?
- Who is accountable when a network a lot of people use stops working?
- What would you put in place so that your own school's connection did not depend on one thing?

Watch for

- Stick to what the sources say happened. Do not guess at causes the sources do not state, and do not name anyone as to blame.
- These are real events with real people and companies. Keep the discussion about how networks work and how they are protected, not about the organisations.
- Students may ask whether it could happen to the school. It is fair to say that any network can fail, and that the point of the standards is to make it less likely and quicker to fix.

Your notes

Grad cap and hard hat

Networking is one of the few fields where two routes in are both real, both paid and both short of people. One starts at a desk, with a screen and either a degree or the Level 4 Network Engineer apprenticeship. The other starts in the field, with a Level 2 apprenticeship and a fibre tester, and for some people ends up on a mast. We have put them side by side, the same size and with the same information, because the evidence does not say one is better and a careers conversation should not either.

Three things are worth saying out loud to students. The two routes meet: the example progression routes Skills England lists from Network cable installer include Network engineer, so a hands-on start can lead towards the desk side. The hands-on routes are not a fallback: the cellular network field engineer standard is a Level 4, three-year apprenticeship for people who lead teams on site. And the hands-on routes carry real risks and real rules, which is why they are regulated, and why people who go into them are trained and supervised and not sent up a mast on their first day.

Two ways into the same industry, side by side: a degree or desk route, and the field routes from Level 2 up. What each looks like, how long it takes and where it leads.

What this is

Two routes into networking, side by side in two equal columns: the desk and degree route, and the hands-on route from Level 2. Each shows the apprenticeship standards, their level and length, a day in the job and where the route can lead.

What to do

- Read the left column, the grad cap route, and then the right column, the hard hat route.
- Under the hard hat route, read the four steps from Level 2 to Level 4 and see how long each one typically takes.
- Read the line that says where each route can lead, and the evidence box with its sources.
- Ask the class which route they would choose for a friend who learns best by doing.

What you should notice

The two routes are equal partners, the hands-on route climbs to Level 4, and the two can meet. The example progression routes in the standards link one to the other.

Time	15 to 25 minutes
You need	A projector or one device per pair.
Where	Interactive on the page. Needs a screen. Suits both the desk and the field.

Students will be able to

- Describe a desk route and a hands-on route into networking.
- Say the level and length of at least two of the apprenticeship standards.
- Explain that both routes lead to well-paid, in-demand work and that students can move between them.

Running it

- Show the two columns side by side. Ask students to say, without looking, which they think leads to better paid work. Then read the pay with its source and ask what surprises them.
- Walk up the hands-on ladder from Level 2. Ask what a student could be doing after fourteen months, and what after three years.
- Walk the desk route. Point out the link from the Network Engineer standard to the degree-level route.
- Ask which route would suit a student who learns best by doing, and which would suit one who learns best by reading, and then ask whether the student has to choose once and for all.

Questions to ask

- What would make you choose one route over the other?
- Why might an employer want people from both?
- What could someone on the hands-on route do to move towards the desk route, and the other way round?

Watch for

- The levels and durations are those on the apprenticeship standards at the date shown. Check the standard before advising a student.
- This is general information. Entry requirements, funding and availability vary by employer and region.
- Do not present one route as a lesser one. The evidence does not say so, and the page is built so neither is placed first by default.

Grad cap: the desk and degree route

Often suits someone who enjoys solving problems at a screen, reading specifications and working out why something is not behaving.

Standard	Level and length	A day in the job
Network Engineer (ST0127)	Level 4, typically 24 months	Installing networks, maintaining them and giving technical support to users, working with both hardware and software to find and fix faults.

Where it can lead: Skills England lists digital and technology solutions specialist (integrated degree) as an example progression route from Network engineer.

The evidence

Fact	Condition	Source
Network engineer is a Level 4 apprenticeship standard with a typical duration of 24 months. Its purpose is to install networks, maintain them, and offer technical support to users where necessary, and its example progression route is digital and technology solutions specialist (integrated degree).	The page says this standard is in revision, with a revised version replacing it for new starts from 2 November 2026 and showing the same level and duration.	Skills England, Network engineer (ST0127), Level 4 (Date updated 5 June 2026)

Fact	Condition	Source
The Network Technician occupation supports the design, installation, configuration and monitoring of network systems, from local cabling and switches to cloud-managed networks and wireless deployments.	The page carries a notice that it is not the latest approved version of the apprenticeship.	Skills England, Information communications technician: Network Technician (OCC0973B) (Date updated 30 June 2026)
The T Level in Digital Support and Security has occupational specialisms called Digital infrastructure and Network cabling, aligned to the Network Technician and Network cable installer occupational standards.	The pages say to visit the awarding organisation for current qualification information.	Skills England, T Level in Digital Support and Security: Digital infrastructure (Approved 17 December 2020); Skills England, T Level in Digital Support and Security: Network cabling (Approved 17 December 2020); Skills England, Network cable installer (OCC0485) (Date updated 2 July 2026)

Hard hat: the hands-on route

Often suits someone who likes to see and touch what they build, enjoys working outdoors or at height and is happy to learn on the job from the first day.

Standard	Level and length	A day in the job
Telecoms Field Operative (ST0832)	Level 2, typically 15 months	Building and repairing the telecoms network that runs from the local exchange to homes and businesses: jointing and splicing cables, finding faults and mending them, mostly outside.
Network Cable Installer (ST0485)	Level 3, typically 15 months	Installing, terminating, testing and certifying fibre and copper cabling, and putting network equipment into cabinets.
Cellular Network Field Engineer (CNFE) (ST1299)	Level 4, typically 36 months	Leading teams that install and maintain 4G and 5G equipment on masts, including work at height.
Wireless Communications Rigger (ST0616)	Level 2, typically 18 months	The climbing and rigging that put antennas and cabling on masts and rooftops.

Where it can lead: Skills England lists electrical power networks engineer and network engineer as example progression routes from Network cable installer, so a hands-on start can lead towards the desk side.

The evidence

Fact	Condition	Source
Telecoms field operative is a Level 2 apprenticeship standard with a typical duration of 15 months, not counting the assessment period. Its purpose is to build, provide or repair telecom services on the UK's National Telecom Access Network, and the standard says the majority of time in the role will be spent working outside in all kinds of weather.	Its duties include jointing and splicing new cables, fault identification and rectification of copper or fibre products, and using risk assessments and safe systems of work. Skills England's page date for this standard is 26 August 2022.	Skills England, Telecoms field operative (ST0832), Level 2 (Date updated 26 August 2022)

Fact	Condition	Source
Network cable installer is a Level 3 apprenticeship standard with a typical duration of 15 months. Its role is to install, terminate, test and certify network cable infrastructure, and the standard says the role is physical and often involves lifting and moving heavy equipment.	Its example progression routes are electrical power networks engineer and network engineer. The page says an assessment plan revision will replace the current version for new starts on 28 January 2027.	Skills England, Network cable installer (ST0485), Level 3 (Date updated 2 July 2026)
Cellular network field engineer is a Level 4 apprenticeship standard with a typical duration of 36 months. These engineers install and maintain 4G and 5G electrical and electronic technology on masts, and a duty of the role is to conduct work at height on cell site apparatus.	The standard describes the occupation as highly regulated by Ofcom, the Mast and Tower Safety Group and the Health and Safety Executive.	Skills England, Cellular network field engineer (ST1299), Level 4 (Date updated 9 December 2025)
Wireless communications rigger is a Level 2 apprenticeship standard with a typical duration of 18 months, not counting the assessment period. The standard describes a physically demanding role at height and outdoors, supporting the UK's cellular network.	The standard says all entrants must be at least 18 years old when they start their employment, for insurance reasons, and estimates approximately 1,500 to 2,000 climbers in the industry. It carries no date for that estimate.	Skills England, Wireless communications rigger (ST0616), Level 2 (Date updated 10 December 2025)
The study adds that in network construction, installation and field engineering, shortages cannot easily be offset through overseas hiring because the work must be carried out in the UK, which suggests apprenticeships, retraining and other non-degree pathways may be particularly important.	The study's own suggestion, not a forecast.	Department for Science, Innovation and Technology (research by Deecon Consulting), Advanced Connectivity Technologies Sector Study 2026 (Published 5 June 2026)

Your notes

Eight kinds of networking job

Explore the eight areas of networking work, with the jobs, what each suits and pay with its source. Some have a desk route, some a hard hat route, some both.

What this is

Eight tabs, one for each area of networking work in the Career Matrix. Each shows the jobs, what it suits and the pay with its source, with a desk route and, where one exists, a hands-on route next to it.

What to do

- Look at the eight tabs. The ones with a hard hat mark have a hands-on route as well as a desk one.
- Pick Digital Infrastructure (Fibre). Read both columns: the desk or degree route on the left and the hands-on route on the right.
- Pick Network Security and Access Control and see what there is for a student who prefers a screen.
- Ask each student to write down one job they had not heard of.

What you should notice

Most areas are open to people who enjoy solving problems, and some have a hands-on route as well. Pay is quoted with its own source and is a guide, not a promise.

Time	15 to 20 minutes
You need	A projector or one device per pair.
Where	Interactive on the page. Needs a screen. Suits both the desk and the field.

Students will be able to

- Name at least four different networking jobs.
- Match a student's interests to an area of the field.
- Find an apprenticeship route into one of them.

Running it

- Give the class a minute with the eight tabs and ask them to choose one that sounds interesting. Ask a few to say why.
- Pick a tab with a hard hat mark, such as digital infrastructure, and read both columns: the desk route and the hands-on route. Ask what they notice about the pay and the entry requirements.
- Now pick a desk-only area, such as network security, and ask what route in the Career Matrix shows.
- Ask each student to write the name of one job they had not heard of, and one thing they would like to know about it.

Questions to ask

- Which job here would you not have thought of as a networking job?
- Which would you do if you liked working with your hands?

- Which would you do if you liked solving problems at a screen?

Watch for

- Pay is quoted as the Career Matrix gives it, with its own source and date. It is a guide, never a promise, and it varies by place and employer.
- Do not steer students by stereotype. The page deliberately shows both routes beside each other.

Area	Jobs	Pay, with its source	Best suited to
01. Network Engineering	Network Engineer, NOC Analyst, Network Architect, LAN/WAN Specialist	£27,000 to £85,000+ (IT Jobs Watch: Junior Network Engineer to Network Architect medians; ONS ASHE median £45,079, IT network professionals)	Analytical minds who enjoy the 'plumbing' and flow of digital information.
02. Telecommunications (5G)	Telecoms Engineer, Radio Planning Engineer, Field Engineer, Core Network Engineer	£32,500 to £87,000+ (IT Jobs Watch: Field Telecoms Engineer median to RF Engineer/Core Network Engineer range; ONS ASHE median £39,652, telecoms network installers)	Innovators interested in mobile tech and the future of wireless comms.
03. Digital Infrastructure (Fibre)	Fibre Technician, Planning Officer, Submarine Cable Engineer	£28,500 to £91,500+ (IT Jobs Watch: Fibre Engineer range; Submarine Cable Engineer, ERI Economic Research Institute, no IT Jobs Watch page for this niche title)	Practical problem solvers who enjoy hands-on work in the field.
04. IoT & Wireless Tech	IoT Solutions Architect, Wireless Specialist, Satellite Comm Engineer	£37,000 to £80,000+ (IT Jobs Watch: Communications Engineer median used as proxy for Satellite Comm Engineer, no dedicated listing; IoT Architect and Wireless Network Engineer range)	Developers interested in the intersection of hardware and networking.
05. Software Defined (SDN)	NetDevOps Engineer, SDN Architect, Cloud Networking	£52,500 to £85,000+ (IT Jobs Watch: Software-Defined Networking keyword median; Cloud Network Engineer and Senior Network Architect range)	Coders who want to build the 'intelligence' into the network.
06. Emerging Tech	Quantum Comms Engineer, 6G Researcher, Mesh Network Architect	£60,000 to £110,000+ (no IT Jobs Watch page exists for these niche/speculative titles; proxied via Research Engineer and Research Scientist medians, IT Jobs Watch; UK quantum professionals reported £70,000–£110,000, Quantum Jobs List industry survey)	Researchers who want to build what doesn't exist yet.
07. Network Security & Access Control	Network Security Engineer, Firewall Administrator, Zero Trust Architect, VPN Specialist	£46,000 to £102,000+ (IT Jobs Watch: Network Security Engineer and Firewall Engineer medians; Security Architect used as proxy for Zero Trust Architect)	Defensive thinkers who enjoy building barriers attackers can't get past.

Area	Jobs	Pay, with its source	Best suited to
08. Enterprise & Unified Communications	UC Engineer, VoIP Specialist, Collaboration Platform Lead, Contact Centre Engineer	£32,750 to £70,000+ (IT Jobs Watch: VoIP Engineer England range; Unified Communications Engineer median, no dedicated listing for Collaboration Platform Lead/Contact Centre Engineer)	Practical engineers who enjoy making complex comms systems feel simple to use.

Somebody has to put it in the ground

Every message in the first activity travelled over something somebody installed. Our Career Matrix has a name for the genuinely physical, on-site routes, Hard Hat Tech, and five of our eight career families have one. In Networks there are two. One is telecoms and fibre field work: splicing, testing and repairing the cables that carry broadband and mobile traffic, from a cabinet on a street corner to a mast on a hill. The other is smart buildings: installing and commissioning the fire, security and energy systems that make a building connected.

The real jobs are specific. The telecoms field operative standard describes jointing and splicing new cables, finding faults and mending copper and fibre, and says most of the time is spent working outside in all kinds of weather. The network cable installer standard describes installing, terminating, testing and certifying cabling, and says the role is physical and often involves lifting and moving heavy equipment. The cellular network field engineer standard describes leading teams that install and maintain 4G and 5G equipment on masts. None of these is a job you can do from a sofa, and none of them is a job a computer is about to do.

Safety is part of the work, and teachers should be able to say so honestly. The Work at Height Regulations 2005 say an employer must ensure work is not carried out at height where it is reasonably practicable to do it safely another way. On construction sites, CSCS cards show a worker has the training and qualifications for the job, and most principal contractors require them, although the card is not a legal requirement. The same page says cards are not needed for classroom, workshop or college-based learning, and that short on-site work experience can use a Provisional card. The wireless communications rigger standard says everyone must be at least 18 when they start the employment, for insurance reasons. This page is not safety training, and it must not be used as such.

Somebody has to put the network in the ground, up a mast and inside a building. Here are those careers, with the standards that lead to them.

What this is

The two hands-on routes the Career Matrix lists for Networks: telecoms and fibre field work, and smart buildings. Each card has the jobs, the pay with its source and the apprenticeship standards that lead there.

What to do

- Read the two cards aloud and ask which sounds more like a job a student could picture.
- Open one apprenticeship standard from a link and show the class its duties.
- Read the safety facts under the cards, then the evidence box.

What you should notice

These are skilled, regulated jobs with real pay and real standards, and they are not a lesser route. They also carry real risks, which is why employers train and supervise.

Time	10 to 15 minutes
You need	A projector or the page on a phone.
Where	Needs a screen. Starts in the field (hard hat).

Students will be able to

- Name at least three hands-on networking jobs.
- Say what each does on an ordinary day.
- Find the apprenticeship standard behind one of them.

Running it

- Read the two route cards aloud and ask which sounds more like a job they could picture themselves doing.
- Show the safety facts under the cards and ask why the law asks employers to avoid work at height where they reasonably can.
- Open one standard link and show the class what the duties actually say.
- Ask students who have seen engineers working at a street cabinet or on a mast what they noticed.

Questions to ask

- What does a hands-on networking job give you that a desk job does not, and the other way round?
- What skills would you need besides technical ones?
- Who do you think looks after the network in your own street?

Watch for

- Working at height and in confined spaces carries real risks. This page is not safety training and must not be used as such. Any student who goes on to this work will be trained and supervised by their employer.
- Do not encourage students to approach street cabinets, masts or cables. They are dangerous and usually on someone else's property.

Route	Jobs	Pay, with its source
Telecoms & Fibre Field Engineering: Building and maintaining the UK's physical fibre and mobile network, on-site rather than at a desk.	Network Cable Installer, Telecoms Field Operative, Fibre Jointer, Cellular Network Field Engineer	£23,000 to £60,000 (ITP range for Cellular Network Field Engineer; ONS ASHE median £39,652 for the wider occupation)
Smart Buildings: Installing and commissioning the connected systems that make a building intelligent.	Fire & Security Systems Technician, BEMS Controls Engineer, Building Automation Installer	£37,991+ (median, Security System Installers and Repairers)

The evidence

Fact	Condition	Source
The Work at Height Regulations 2005 say every employer shall ensure that work is not carried out at height where it is reasonably practicable to carry out the work safely otherwise than at height.		legislation.gov.uk (The National Archives), The Work at Height Regulations 2005, regulation 6 (Latest available (revised))
CSCS says a CSCS card shows that individuals working on construction sites have the appropriate training and qualifications for the job they do, that holding one is not a legal requirement, and that most principal contractors and major house builders require workers on their sites to hold one.	The telecoms apprenticeship standards do not themselves say a card is needed. It depends on the site and the employer.	Construction Skills Certification Scheme (CSCS), Frequently asked questions (Undated page)

Fact	Condition	Source
CSCS says cards are not needed for classroom, workshop or college-based learning that does not involve on-site construction work, and that people doing informal on-site work experience for less than three weeks can apply for the Provisional card.		Construction Skills Certification Scheme (CSCS), Frequently asked questions (Undated page)
Wireless communications rigger is a Level 2 apprenticeship standard with a typical duration of 18 months, not counting the assessment period. The standard describes a physically demanding role at height and outdoors, supporting the UK's cellular network.	The standard says all entrants must be at least 18 years old when they start their employment, for insurance reasons, and estimates approximately 1,500 to 2,000 climbers in the industry. It carries no date for that estimate.	Skills England, Wireless communications rigger (ST0616), Level 2 (Date updated 10 December 2025)
Cellular network field engineer is a Level 4 apprenticeship standard with a typical duration of 36 months. These engineers install and maintain 4G and 5G electrical and electronic technology on masts, and a duty of the role is to conduct work at height on cell site apparatus.	The standard describes the occupation as highly regulated by Ofcom, the Mast and Tower Safety Group and the Health and Safety Executive.	Skills England, Cellular network field engineer (ST1299), Level 4 (Date updated 9 December 2025)

Is your school or college network meeting the standards?

Sooner or later a colleague, a governor or an inspector will ask whether the network is up to the standard, and it is far better to know the short version before they do. The Department for Education publishes standards for broadband, wireless, switching, cabling, cyber security, and filtering and monitoring, and the checker below turns the headlines into seven questions you can answer in a few minutes with your IT lead.

Two cautions. The standards are what schools and colleges should be working towards by 2030, and the wireless page says to meet its standard when you upgrade an underperforming or unsupported solution, so a no is a conversation, not a failure. And they are for England and they are updated, so read the current page. The filtering and monitoring standard is the one every teacher should know, because Keeping children safe in education puts a duty on governing bodies and proprietors to ensure appropriate systems are in place and reviewed at least once every academic year. This is general information to help you teach and plan, not technical or legal advice.

A short checker for teachers and IT leads: what the Department for Education expects of a school or college network, with what each standard says.

What this is

A seven question checker for teachers and IT leads about the school or college network. For each question you answer No or Not sure, it shows what the DfE standards say and who to ask.

What to do

- Read question 1 aloud and choose Yes, No or Not sure. Do the same for the other six.
- Read the list of actions that appears at the bottom. Each says who to ask.
- Open the evidence box under it for the source of each standard.

What you should notice

Not sure is a perfectly good answer, and most of the standards are things to work towards, not tests to pass. The checker does not store or send anything.

Time	10 to 15 minutes
You need	A device. Also useful on a staff meeting screen.
Where	Interactive on the page. Needs a screen. Starts at a desk (grad cap).

Students will be able to

- Say what the DfE standards cover for broadband, wireless, switching, cabling and filtering.
- Spot which of them your school needs to look at.
- Know who to ask: the IT lead, the network manager or the supplier.

Running it

- Show the checker on a screen in a staff meeting or with the IT lead in the room. Read each question and ask for a show of hands.

- For each yes, read the line that appears and the evidence box underneath it. Note who needs to be asked.
- End by agreeing one action and one person to ask. The checker is a conversation starter, not an audit.

Questions to ask

- Which standard is new to you?
- Which would be hardest for a small school to meet, and what help is there?
- Does the network help or hold back the lessons we want to run?

Watch for

- This is a summary of what the Department for Education standards say, and the standards are the authority. They are guidance for schools and colleges in England and are updated, so check the page for the current version.
- Nothing you tick is stored or sent anywhere. It is general information, not technical or legal advice.
- Do not ask students to answer for the school's network. It is for staff and the IT lead.

The seven questions

Question	If No or Not sure
Does the school or college reach the internet by full fibre, such as a leased line or fibre to the premises, rather than copper?	Ask your IT lead or supplier what type of connection you have and what speed it can deliver.
Is there a backup connection of a different type that takes over automatically if the main one fails?	Ask whether a second connection exists and whether it would switch over without anyone having to do anything.
Has the wireless signal been checked room by room, and is the standard the DfE names in the plan for the next upgrade?	Ask your IT lead whether there is a coverage survey and when the wireless equipment is next due for replacement.
Do the switches give at least 1Gbps to each desktop, and are the core switches on a UPS, a battery that keeps them running in a power cut?	Ask your network manager or supplier to check the switch ports and the power protection for the core switches.
Does the cabling meet the standard, with Category 6A copper, runs of no more than 90m and OM4 fibre between buildings?	Ask who installed the cabling and whether it was tested and certified. This is not one of the six core standards, so it can wait for a refit.
Does every external connection to the network go through a correctly configured firewall?	Ask your IT lead or supplier to confirm where the firewall sits and when its rules were last reviewed.
Does a named person own filtering and monitoring, and has the provision been reviewed within the last academic year?	Ask your designated safeguarding lead and the senior leader responsible who owns it, and when the last review and checks were recorded.

The evidence

Fact	Condition	Source
The Department for Education says all schools and colleges should be working towards meeting six core standards by 2030: broadband internet, wireless network, network switching, digital leadership and governance, filtering and monitoring, and cyber security.	Network cabling has its own standards page but is not marked as one of the six core standards.	Department for Education, Meeting digital and technology standards in schools and colleges (Published 23 March 2022, updated 16 September 2026)

Fact	Condition	Source
The broadband standard says schools and colleges should use a full fibre connection. Primary schools should have a minimum of 100Mbps download and 30Mbps upload. Secondary schools, all-through schools and further education colleges should have a connection with the capacity to deliver 1Gbps download and upload.	The page says copper connections do not meet this standard.	Department for Education, Broadband internet standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The broadband standard also says schools and colleges should have a backup broadband connection, using different service types, for example a leased line combined with fibre to the premises, with multiple routers to provide automatic failover.		Department for Education, Broadband internet standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The wireless standard says the network should use the latest standard approved by the Wi-Fi Alliance, which the page names as Wi-Fi 7, give a fully functional signal throughout the buildings, and have a way to manage it centrally.	The page says to meet the standard when you need to upgrade an underperforming or unsupported solution.	Department for Education, Wireless network standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The switching standard says switches should provide a minimum of 1Gbps to the user device at the desktop, and that core network switches should be connected to at least one UPS to reduce the impact of outages.		Department for Education, Network switching standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The cabling standard says copper cabling should be Category 6A, the installed cable length should not be greater than 90m, optical fibre should be a minimum 16 core multi-mode OM4, and all connections between buildings should use OM4 optical fibre.	Not marked as one of the six core standards. The page also asks for a minimum 20-year manufacturer's performance warranty on the complete cabling system.	Department for Education, Network cabling standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The cyber security standard says IT support must protect digital technology with a correctly configured boundary firewall or software firewall, including protection against denial of service attacks, and make sure all external connections to the network run through the firewall.		Department for Education, Cyber security standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The Department for Education says filtering is preventative and protects users from accessing illegal, inappropriate and potentially harmful content, while monitoring is reactive, shows what users are doing and does not block users from seeing or doing anything.		Department for Education, Filtering and monitoring standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The filtering and monitoring standard asks schools and colleges to identify and assign roles and responsibilities, review their provision at least annually, block harmful and inappropriate content without unreasonably impacting teaching and learning, and have effective monitoring strategies that meet their safeguarding needs.	The page says no filtering system can be 100% effective.	Department for Education, Filtering and monitoring standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)
The filtering standard says a filtering system should not have a blanket profile for all users and that, as a minimum, student and staff profiles should be in place, and that devices that are not school or college managed should be on a separate virtual network.		Department for Education, Filtering and monitoring standards for schools and colleges (Published 23 March 2022, updated 16 September 2026)

Fact	Condition	Source
Keeping children safe in education says governing bodies and proprietors should ensure their school or college has appropriate filtering and monitoring systems in place and that a review of their effectiveness is carried out at least once every academic year.	Statutory guidance. In the 2026 version this is paragraph 173.	Department for Education, Keeping children safe in education 2026 (Last updated 1 September 2026)

The Translator

Jargon in plain English, with a comparison from school life. Where the comparison stops working, it says so.

Term	In plain English	Think of it like this
5G	The fifth generation of mobile network technology, used by phones and by connected machines.	The latest version of the school's app: it does the same job as before, with new features, and old phones may not run it. Where that stops working: Having 5G on a phone does not mean you always get a faster connection. It depends on the mast, the signal and how many others are on it.
Access point	A device on the ceiling or wall that gives devices a radio connection into the wired network.	A tuck shop hatch: it is where the outside world meets the system, and the queue gets long if it is shared by too many. Where that stops working: A hatch serves one person at a time. An access point serves many, and gets slower as it does.
Backbone	The main high-capacity links that connect the big parts of a network, such as one city to another or a company's data centres to each other.	The main corridor that connects every wing, while the small corridors only connect rooms. Where that stops working: A main corridor is still one corridor. Real backbones have several routes so that one failing does not cut everything off.
Bandwidth	How much data a connection can carry in a second. It is usually written in megabits per second.	The width of a corridor between lessons: wider lets more students through at once. Where that stops working: A wide corridor does not make anyone walk faster. Bandwidth is not the same as delay.
Broadband	A connection to the internet that is always on and fast enough for everyday use. It can be delivered over full fibre, cable or copper.	The main supply pipe into a building: everything else depends on what size it is and what it is made of. Where that stops working: A pipe is one size all the way. A broadband speed is the most you might get, and what you get depends on the time of day and who else is using it.
Chamber	An underground box in the street, or a cabinet at the roadside, where cables can be reached for jointing or repair.	An inspection hatch on a pipe: the one place you can get at it without taking the floor up. Where that stops working: A real chamber can be deep, wet and in the road, which is why opening one is a planned job with traffic and safety arrangements.
Data centre	A building full of computers and the cooling, power and network connections that keep them running. Much of what people call the cloud is run from them.	The school kitchen: you do not see it, but if it stops, nobody has lunch. Where that stops working: A kitchen feeds one school. A data centre serves millions of people in many places at once.
DNS	The system that turns a name you can remember, such as a website's address, into the number a network uses.	The school office looking a student's name up in the register to find their form room. Where that stops working: The register lives in one place. DNS is spread across many servers that pass on questions to one another.

Term	In plain English	Think of it like this
Ethernet	The standard way of connecting devices with a cable, in offices, schools and homes.	The wired phone line in the office that always works, compared with the mobile that sometimes does not. Where that stops working: It needs a cable to every device, which is why people prefer Wi-Fi even when it is slower.
Failover	A spare part or route that takes over automatically when the main one fails.	A substitute teacher who walks in the moment the usual one is off, without anyone sending for them. Where that stops working: A substitute is only a substitute if they know the lesson. A failover that has never been tested may not work when it is needed.
Fibre-optic cable	A cable with a very thin core of glass. Light carries the data along it and is kept inside the core by the glass around it, by total internal reflection.	A torch beam in a long mirrored tube: it stays inside however the tube bends, within limits. Where that stops working: The light in a fibre is pulsed on and off in a pattern that carries the data, and it does not escape from the sides.
Filtering and monitoring	Filtering blocks harmful or inappropriate content before it is seen. Monitoring watches what users do on devices and reports concerns afterwards. They are different, and a school needs both.	A locked cupboard stops a student taking something. A member of staff on duty in the corridor notices what happens. Where that stops working: No filtering system can be 100% effective, which is why the DfE standards also ask for monitoring and a person who owns it.
Firewall	A device or program that checks traffic against a set of rules and decides what to allow in or out.	The school gate with a member of staff on it, who knows who is allowed in. Where that stops working: A gate stops a lot, but not someone who is already inside, which is why networks also check what happens within.
Full fibre	A connection where glass fibre runs all the way into the building, with no copper on the last stretch.	A motorway all the way to the school gate, not a motorway that ends in a country lane. Where that stops working: A gate does not slow a motorway. The speed you get also depends on the equipment at both ends and the service you pay for.
Internet	The worldwide collection of networks that are joined together. The web is one service that runs on it, and so are email and video calls.	The road system is the internet. A shop, a school and a hospital are services that use it. Where that stops working: Roads are one kind of thing. The internet is made of cable, radio and software, and it is run by many separate organisations, not one.
IP address	The number that identifies a device on a network, so packets know where to go.	A postal address: it says where to deliver to, not who lives there. Where that stops working: A house keeps its address for life. A device's address can change, for example when it joins a different Wi-Fi.
LAN and WAN	A local area network covers a small area such as a building. A wide area network covers a big one, such as links between towns. The internet is the biggest wide area network.	A LAN is the school's own corridors. A WAN is the bus routes between schools. Where that stops working: A bus route is run by one company. A WAN can be built from links owned by many.

Term	In plain English	Think of it like this
Latency	How long a packet takes to get there, or there and back. It depends on distance, because light takes time, and on every device on the way.	How long it takes a note to be passed along a row, however wide the corridor is. Where that stops working: A note passed along a row loses time at each person. Light in a cable loses time per kilometre, and each router adds a little more.
Mast	A tall structure with antennas and radio equipment that connects phones to the mobile network.	The tall lamp-post with the loudest speaker in the playground: it is high so that everyone in range can hear it. Where that stops working: A speaker only sends. A mast also listens to every phone near it, and passes what it hears on by fibre or radio.
Megabit and megabyte	A bit is the smallest piece of data, and a byte is eight of them. Speeds are usually quoted in megabits a second and files in megabytes, so the two need converting.	Pounds and pence: the same money written two ways, and easy to mix up if you do not look at the unit. Where that stops working: A pound is always 100 pence. A megabyte is eight megabits, a different factor, so the sum is different.
Network	Two or more devices connected so they can share information, by cable or by radio.	The school's group chat: everyone in it can reach everyone else, and it stops being useful the moment it is cut off from the rest. Where that stops working: A chat is one group. A real network is many groups joined to other groups, and joined to those.
OTDR	A fibre tester. It sends a short pulse of light down a cable and times the reflections that come back, which shows the length and where any joints, losses and breaks are.	Shouting into a long tunnel and timing the echo to tell how far away the end is. Where that stops working: An echo gives you one number. An OTDR draws a whole trace with every joint and break on it.
Packet	A small piece of a message, with an address on it. A big message is cut into many of them, and they are put back in order at the other end.	A long letter sent as separate numbered postcards, each with the address on, which the receiver puts back in order. Where that stops working: Postcards take days. Packets are far quicker, and a lost one is simply sent again without anyone noticing.
Protocol	An agreed set of rules for how two devices talk to each other, such as how to start a conversation, how to number the pieces and how to say they arrived.	The rules of a debate: who speaks first, how long you get, how you say you disagree. Where that stops working: Debate rules can bend. A protocol that is followed even slightly differently by two devices usually means they cannot talk at all.
Router	A device that looks at the address on each packet and chooses the next step on its way, and links one network to another.	A teacher at a corridor junction pointing each student towards the right classroom. Where that stops working: A router decides millions of times a second, and it only knows the next step, not the whole route.
Single point of failure	One part that everything depends on, so that if it fails nothing works.	The only door to a hall: if it jams, nobody gets in or out. Where that stops working: A second door helps only if it opens onto a different corridor. Two doors that both lead through one bottleneck are still one point of failure.

Term	In plain English	Think of it like this
Splice	Joining two ends of fibre or cable so that the signal goes through with as little loss as possible.	Joining two ropes so smoothly that a climber cannot tell where the join is. Where that stops working: A rope join only has to hold. A fibre joint has to carry light, so a tiny speck of dust matters.
Structured cabling	The tidy, planned cabling inside a building: cables to every room, joined at a hub, labelled, tested and certified.	The electrics of a school: hidden in the walls, planned before the building opens and expected to last for decades. Where that stops working: Electrics work or they do not. Network cabling has to be tested to show it meets a standard, and the result is certified.
Subsea cable	A fibre-optic cable laid on the seabed to link countries and carry their internet traffic.	The bridge between two islands: if it closes, everything that crosses it stops or has to go the long way round. Where that stops working: A bridge is above water and can be seen. A cable lies on the seabed and has to be found and lifted by a ship to repair.
Switch	A device that connects the devices inside one network, such as the computers in a room, and passes each packet to the right one.	The corridor outside the classrooms: it joins every door in one building to every other. Where that stops working: A corridor lets everyone hear. A switch sends each packet only to the device it is for.
TCP/IP model	A way of describing what happens to a message in four layers: the application, the transport, the internet and the link. Each layer does one job and hands the result to the next.	An assembly line for a letter: someone writes it, someone numbers the pages, someone writes the address and someone puts it in the van. Where that stops working: A real network does not stop at four neat steps, and some descriptions use more layers. It is a way to think, not a law.
VPN	A way of sending data through a protected tunnel across a public network, so that it is encrypted on the way.	A sealed envelope inside the school bag: the bag can be seen but not the letter. Where that stops working: A sealed envelope still has a name and address on the outside. A VPN hides what is sent but not that a connection exists.
Wi-Fi	A way of connecting devices to a network using radio instead of a cable, over a short distance.	Shouting across a room: it works, but a wall muffles it, and ten people shouting at once makes it harder for everyone. Where that stops working: Radio is not literally shouting, and a good network uses several carefully placed access points rather than one loud one.

The Curriculum Translator

Where it comes from	What the curriculum says	Activities that support it
Computing, national curriculum, primary	"understand computer networks, including the internet; how they can provide multiple services, such as the World Wide Web, and the opportunities they offer for communication and collaboration"	Follow your message, Send the packet, From a message to a signal
Computing, national curriculum, secondary	"understand the hardware and software components that make up computer systems, and how they communicate with one another and with other systems"	Send the packet, From a message to a signal, How long does light take in a cable?
Computing, national curriculum, secondary	"understand a range of ways to use technology safely, respectfully, responsibly and securely, including protecting their online identity and privacy; recognise inappropriate content, contact and conduct, and know how to report concerns"	Is our network meeting the standards?
Maths, national curriculum, primary	"use, read, write and convert between standard units, converting measurements of length, mass, volume and time from a smaller unit of measure to a larger unit, and vice versa, using decimal notation to up to 3 decimal places"	How long does light take in a cable?, Why does it say four hours?, Find the break
Maths, national curriculum, secondary	"use compound units such as speed, unit pricing and density to solve problems"	How long does light take in a cable?, Find the break, Why does it say four hours?, Send the packet
Maths, national curriculum, secondary	"convert between related compound units (speed, rates of pay, prices, density, pressure) in numerical and algebraic contexts"	Why does it say four hours?, How long does light take in a cable?, Find the break
GCSE computer science, DfE subject content: networks and the importance of	"connectivity, both wired and wireless"	From a message to a signal, Why does it say four hours?, Hard hats, masts and cabinets, Find the break
GCSE computer science, DfE subject content: networks and the importance of	"types of network"	Send the packet, From a message to a signal
GCSE computer science, DfE subject content: networks and the importance of	"network security"	Is our network meeting the standards?, Discussion: a setting and a ship, Eight kinds of networking job
GCSE computer science, DfE subject content: networks and the importance of	"the concept of networking protocols"	From a message to a signal, Discussion: a setting and a ship

Where it comes from	What the curriculum says	Activities that support it
GCSE computer science, DfE subject content: networks and the importance of	"layers"	From a message to a signal
AQA GCSE Computer Science 8525, section 3.5	"Describe the 4 layer TCP/IP model: application layer, transport layer, internet layer, link layer."	From a message to a signal
Pearson Edexcel GCSE Computer Science 1CP2, topic 4.1.3	"understand how the internet is structured (IP addressing, routers)"	Send the packet, From a message to a signal
Pearson Edexcel GCSE Computer Science 1CP2, topic 4.1.7	"understand how the 4-layer (application, transport, internet, link) TCP/IP model handles data transmission over a network"	From a message to a signal
Pearson Edexcel GCSE Computer Science 1CP2, topic 4.2.1	"understand the importance of network security, ways of identifying network vulnerabilities (penetration testing, ethical hacking) and methods of protecting networks (access control, physical security, firewalls)"	Is our network meeting the standards?, Discussion: a setting and a ship
OCR GCSE Computer Science J277, section 1.3	"IP addressing and MAC addressing"	Send the packet, From a message to a signal
OCR GCSE Computer Science J277, section 1.3 (guidance)	"A DNS's role in the conversion of a URL to an IP address"	From a message to a signal, Discussion: a setting and a ship
A level computer science, DfE subject content	"characteristics of networks and the importance of networking protocols and standards"	From a message to a signal, Send the packet
Planned, first teaching from 2028	"publish a revised national curriculum in 2027 for first teaching in 2028. We will also update GCSEs, for first teaching from 2029 onwards."	From a message to a signal, Send the packet

Be aware of the limits

- The national curriculum's statement about computer networks and the internet sits in the primary computing programme. The secondary programme says only that students should understand how the components of computer systems communicate with one another and with other systems. No statement in either mentions protocols, IP addresses or DNS, which is why the exam board specifications carry that detail.
- The national GCSE computer science content was updated on 31 March 2025. The update removed 'common network topologies' and the named protocol examples, for exams from summer 2027. AQA's version 1.3 has followed. OCR's version 3.1 of May 2026 still lists topologies and named protocols, and we did not check whether it has a separate change for 2027. Check your own board's current specification.

- We read the AQA, OCR and Pearson Edexcel GCSE specifications. Other boards were not checked. The A level statement is from the DfE's 2014 subject content, so check your board's specification.
- The last row is a plan, not a curriculum. The government's November 2025 response says it will replace the computer science GCSE with a GCSE in computing, publish a revised national curriculum in 2027 for first teaching in 2028, and update GCSEs for first teaching from 2029 onwards. We found no revised programme of study published when we checked.
- Some links are to maths, because that is where the sums behind the activities are taught. If you teach an FE, vocational or apprenticeship course, check your awarding body's specification for the matching content.
- All of this is for England. Scotland, Wales and Northern Ireland have their own curricula, and curriculum documents are reviewed from time to time, so check the current version for your school.

Questions students, parents and colleagues ask

Do you need a degree to work in networking, or is it a hands-on job?

It can be either, and it is worth being straight that the field has both. The desk route includes the Level 4 Network Engineer apprenticeship, which takes a typical 24 months, and Skills England lists a degree-level apprenticeship as an example of where it can lead. The hands-on route starts as low as Level 2 with the telecoms field operative apprenticeship, and goes up through the network cable installer at Level 3 to the cellular network field engineer at Level 4.

The government's 2026 study suggests that, in network construction, installation and field engineering, apprenticeships and other non-degree routes may be particularly important. So the honest answer is that the field needs both kinds of people, and neither is the fallback for the other.

Do students have to be brilliant at maths or coding to work in networking?

No, though it depends which part you mean. The Career Matrix splits the field into eight areas of work. Some, such as software-defined networking, lean on programming. Others, such as fibre and telecoms field work, are learned on the job through an apprenticeship, and a Level 2 route exists for them.

The sums in this pack, such as the speed of light in a cable or how long a download takes, are the kind taught in school maths, and the curriculum section shows which statements they match.

Is working on masts and cables safe?

It has real risks, and it is regulated for that reason. The Work at Height Regulations 2005 say an employer must ensure that work is not carried out at height where it is reasonably practicable to do it safely another way. The cellular network field engineer standard describes the occupation as highly regulated by Ofcom, the Mast and Tower Safety Group and the Health and Safety Executive.

People who go into this work are trained and supervised by their employer. The wireless communications rigger standard also says everyone must be at least 18 when they start the employment, for insurance reasons. This pack is not safety training, and students should never go near street cabinets, masts or cables.

Does a student need a CSCS card for work experience?

CSCS says cards are not needed for classroom, workshop or college-based learning that does not involve on-site construction work, and that people doing informal on-site work experience for less than three weeks can apply for the Provisional card. More widely, CSCS says holding a card is not a legal requirement, but most principal contractors require workers on their sites to hold one.

Whether a placement needs one depends on the site and the employer, so ask the employer and the work experience coordinator before anything is booked.

Are there really jobs? Is there a shortage?

The government's 2026 study estimates about 109,400 people worked for advanced connectivity companies in the UK in 2025, and reports research suggesting that around 60% of UK telecoms engineers are over 50 and that the sector could face a 30,000-person engineering shortfall over ten years. Those are estimates, and the

study does not name the research behind the second figure, so we would not promise a student anything on the strength of them.

What it does say is that field work has to be done in the UK, so shortages cannot easily be made up by hiring from abroad. Treat that as a reason for optimism, not a guarantee of a job.

Does the cloud mean fewer networking jobs?

The cloud is a lot of computers in buildings, and those buildings are joined to everything else by networks. The government counts data centres and cloud infrastructure as part of the communications sector of critical national infrastructure, alongside telecommunications. Somebody has to connect, protect and repair all of it.

Nobody knows exactly how jobs will change, and we would be wary of anyone who says they do. The evidence we have points to a field that is still being built, with the last stretch of fibre and parts of the mobile network still to be built, as the coverage figures show.

Why is the school or home Wi-Fi so slow?

Ofcom lists several causes that are nothing to do with the speed you pay for: the distance from the exchange, the time of day, and how many people are using the connection at the same time. Wi-Fi also adds its own problems. Signals weaken as they pass through objects, and water, metal and glass block them, and the bandwidth is shared between devices.

Ofcom's practical advice is to connect a computer directly by an Ethernet cable where you can, which should give a faster and more reliable connection. For a school or college, the DfE wireless standard says the signal should be fully functional throughout the buildings, which is why a coverage survey comes first.

Why does my broadband say 100 but my download says 12?

Broadband speeds are usually quoted in megabits per second, and file sizes and download speeds on a screen are often in megabytes. One byte is eight bits, so 100 megabits a second is 12.5 megabytes a second. Nothing is wrong. The two numbers are measuring in different units.

Ofcom gives an example of the same kind of sum: over broadband with 10 Mbit/s download, downloading a one-hour HD TV episode of 1 GB would take almost 15 minutes. The Why does it say four hours activity lets students try their own.

How does the internet get to other countries? Is it satellites?

Mostly it is cables on the seabed. The UK government says subsea fibre-optic cables carry around 99% of the UK's international data, and describes the UK's system as underpinned by around 64 cables. They are repaired by ships, and the government says that when a cable breaks a repair vessel is at the scene within eight days.

Faults are mostly accidents. The International Cable Protection Committee says around 150 to 200 happen worldwide each year and most are caused by fishing and ships' anchors, not sabotage.

What does a school or college have to do about filtering and monitoring?

Keeping children safe in education says governing bodies and proprietors should ensure the school or college has appropriate filtering and monitoring systems in place and that their effectiveness is reviewed at least once every academic year. The DfE's standards add that someone should be assigned to own it, that harmful

content should be blocked without unreasonably getting in the way of teaching and learning, and that monitoring strategies should meet the school's safeguarding needs.

The DfE also notes that no filtering system can be 100% effective. For the detail, use the DfE page, and ask your designated safeguarding lead and IT lead who owns it in your school.

Is the curriculum for networks changing?

Yes, in steps, and teachers should know which step they are in. The national GCSE computer science content was updated in March 2025, and it still lists networks, connectivity, network security, protocols and layers. The exam boards' specifications carry more detail, and they do not all say the same thing, so check your board.

The government has also said it will replace the computer science GCSE with a computing GCSE and publish a revised national curriculum in 2027 for first teaching in 2028. That is a plan, not yet a curriculum.

Does every home have good internet now?

Not quite, and it is a good thing to ask students to work out why. Ofcom says gigabit-capable networks reach 87% of UK residential premises and full fibre 78%, with big differences between nations, and that around 44,000 premises still cannot get a decent connection. Of the premises that can get a gigabit-capable service, 56% have taken one.

The government's programme for hard to reach places, Project Gigabit, expects 99% of premises to have access to a gigabit-capable connection by 2032, and says that as an expectation, not a promise.

Sources and how we checked them

Each source was opened and read on 2 November 2026. Where a source warns about its own figures, we pass the warning on.