

5. Computer networks

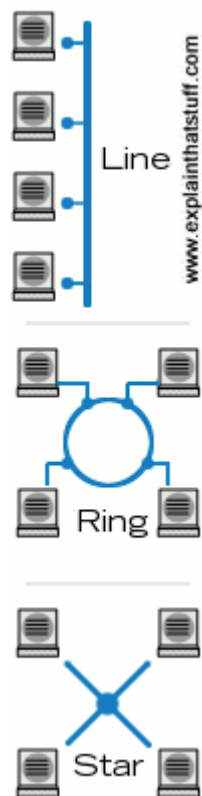
What is a computer network?

A computer network is simply a collection of computer equipment that's connected with wires, optical fibers, or wireless links so the various separate devices (known as **nodes**) can "talk" to one another and swap **data** (computerized information).

Types of networks

Not all computer networks are the same. The network I'm using to link this laptop to my wireless router, printer, and other equipment is the smallest imaginable. It's an example of what's sometimes called a **PAN (personal area network)**—essentially a convenient, one-person network. If you work in an office, you probably use a **LAN (local area network)**, which is typically a few separate computers linked to one or two printers, a scanner, and maybe a single, shared connection to the Internet. Networks can be much bigger than this. At the opposite end of the scale, we talk about **MANs (metropolitan area networks)**, which cover a whole town or city, and **WANs (wide area networks)**, which can cover any geographical area. The Internet is a WAN that covers the entire world but, in practice, it's a network of networks as well as individual computers: many of the machines linked to the Net connect up through LANs operated by schools and businesses.

Rules



Artwork: The three best-known computer network topologies: line (chain/bus), ring, and star.

Computers are all about logic—and logic is all about following rules. Computer networks are a bit like the army: everything in a network has to be arranged with almost military precision and it has to behave according to very clearly defined rules. In a LAN, for example, you can't connect things together any old how: all the nodes (computers and other devices) in the network have to be connected in an orderly pattern known as the network **topology**. You can connect nodes in a simple line (also called a daisy chain or bus), with each connected to the next in line. You can connect them in a star shape with the various machines radiating out from a central controller known as the network server. Or you can link them into a loop (generally known as a ring). All the devices on a network also have to follow clearly defined rules (called **protocols**) when they communicate to ensure they understand one another—for example, so they don't all try to send messages at exactly the same time, which causes confusion.

What makes a network?

To make a network, you need nodes and connections (sometimes called links) between them. Linking up the nodes means making some sort of a temporary or permanent connection between them. In the last decade or so, wireless connections have become one of the most popular ways of doing this, especially in homes. In offices, wired connections are still more commonplace—not least because they are generally faster and more secure and because many newer offices have network cabling already in place.

Apart from computers, peripherals, and the connections between them, what else do you need? Each node on a network needs a special circuit known as a **network card** (or, more formally, a network interface card or

NIC) to tell it how to interact with the network. Most new computers have network cards built in as standard. If you have an older computer or laptop, you may have to fit a separate plug-in circuit board (or, in a laptop, add a PCMCIA card) to make your machine talk to a network. Each network card has its own separate numeric identifier, known as a **MAC (media access control)** code or LAN MAC address. A MAC code is a bit like a phone number: any machine on the network can communicate with another one by sending a message quoting its MAC code. In a similar way, MAC codes can be used to control which machines on a network can access files and other shared resources. For example, I've set up my wireless link to the Internet so that only two MAC codes can ever gain access to it (restricting access to the network cards built into my two computers). That helps to stop other people in nearby buildings (or in the street) hacking into my connection or using it by mistake.

The bigger you make a network, the more extra parts you need to add to make it function efficiently. Signals can travel only so far down cables or over wireless links so, if you want to make a big network, you have to add in devices called **repeaters**—effectively signal boosters. You might also need **bridges, switches,** and **routers**—devices that help to link together networks (or the parts of networks, which are known as segments), regulate the traffic between them, and forward traffic from one part of a network to another part.

Understanding computer networks with layers

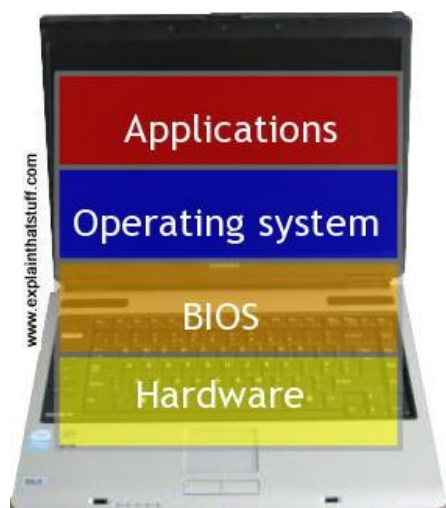


Photo: Computer architecture: We can think of computers in layers, from the hardware and the BIOS at the moment to the operating system and applications at the top. We can think of computer networks in a similar way.

Computers are general-purpose machines that mean different things to different people. Because computers mean different things to different people, it can help us to understand them by thinking of a stack of layers: hardware at the bottom, the operating system somewhere on top of that, then applications running at the highest level. You can "engage" with a computer at any of these levels without necessarily thinking about any of the other layers. Nevertheless, each layer is made possible by things happening at lower levels, whether you're aware of that or not. Things that happen at the higher levels could be carried out in many different ways at the lower levels; for example, you can use a web browser like Firefox (an application) on many different operating systems, and you can run various operating systems on a particular laptop, even though the hardware doesn't change at all.

