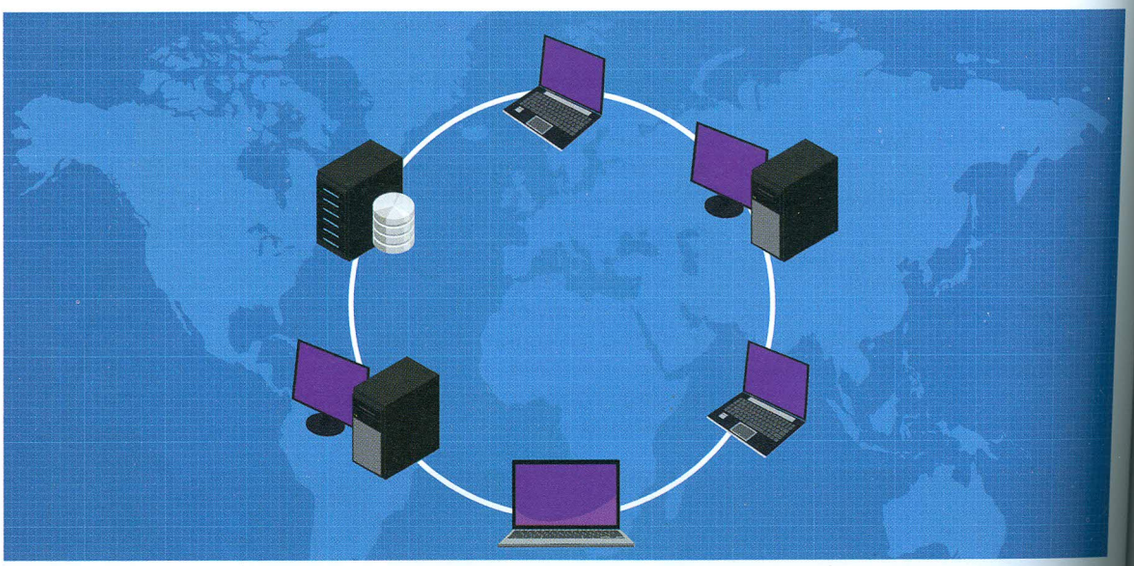
UNIT TEN Networking

1. **Warm-up** Can you give a definition of the Internet? Can you explain how it works?

2. Look at the image below. What does it represent?



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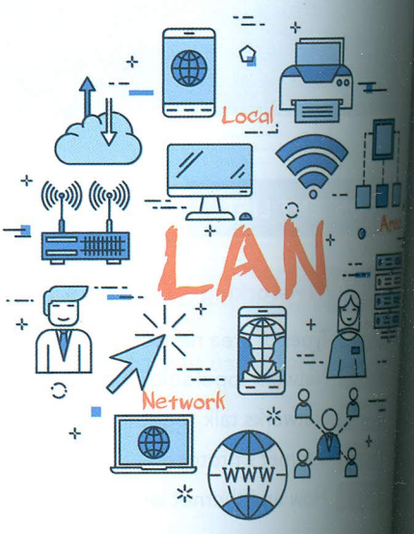
TEXT 1 Types of area networks

There are three main types of networks: local area network (•**LAN**), wide area network (•**WAN**) and metropolitan area network (•**MAN**).

A LAN is made up of •**nodes**, usually two or more computers located in the same building or group of neighbouring buildings. A WAN connect smaller networks over an entire country the entire world. A MAN incorporates elements of both.

Whatever the technology, the goal is the same: to transmit data from one place to another.

To become part of a network a PC uses a •**network interface card** (NIC), or an RJ-45 connector that is part of the motherboard. For portable computers the interface can be in the form of a PC card or USB adapter.



Communications signals pass from the PC's RAM and through the connection to a LAN's backbone[1], the part of the network that carries most traffic. The backbone and the connection leading to and from it might use •**twisted-pair wires**, •**fibre optic cables**, radio waves, and phone and power wiring, so files can move among the computers.

The combination of connector, circuitry, wiring and other hardware determines the network's **bandwidth**.

In a •**client/server network**, one computer is the file server, also called a host computer, which contains programs and data files that can be accessed by other

1. **backbone:** the chief support of a system or organization (*spina dorsale*).

computers. In the network, servers are often faster and more powerful than the PCs as they run a network operating system (NOS). The NOS manages the movements of files and the network's security by maintaining files of users, their passwords, and the driver and directories for which a user has been given access privileges. Some servers specialize in functions other than passing out files.

A print server allows everyone on the network to share a printer. Other specialised servers provide shared access to the Internet, others are designated for network-wide use, such as an email and database server.

Personal computers attached to a server are the clients. These run the gamut[2] from **fat clients**, i.e. computers that run most programs from their own hard drives and use a minimum of network services –, to inexpensive **thin clients** that might have no hard drive at all. They run programs and graphics using their own microprocessors, but depend on a server to access programs and store data. **Dumb terminals** consist of a monitor, a keyboard, and the bare minimum of hardware needed to connect them to the network. They use the server's microprocessor to perform all functions.

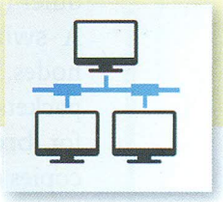
In a **peer-to-peer network** there is no central server. Instead, all computers on the network act as servers to every other node. At the same time, all computers on the network act as clients to all the other PCs. This is the simplest network to install.

Networks in a WAN can be connected by dedicated phone lines, T1 or T3 leased (or private) lines, microwaves, or the Internet itself.

2. **gamut:** the complete range of things of a particular type.

TECHNICAL ENGLISH 094

- **client/server network** rete client/server
- **dumb terminal** terminale passivo
- **fat client** terminale pesante
- **fibre optic cable** cavo in fibra ottica
- **LAN** rete locale di computer
- **MAN** rete metropolitana
- **network interface card** scheda di rete
- **node** nodo
- **peer-to-peer network** rete da pari a pari
- **thin client** terminale leggero
- **twisted-pair wire** doppino
- **WAN** rete di computer diffusa su un'ampia area



3. Read the following questions and underline the words and phrases in TEXT 1 which provide the answers.

1. What is a LAN?
2. What is a WAN?
3. What is a client/server network?
4. What is a peer-to-peer network?
5. What is a server?
6. What is a client?
7. What is a fat client?
8. What is a thin client?

4. Use your answers to compare the pairs of questions above, using *while* or *whereas*, as in the example provided.

While *desktop PCs use a NIC or a RJ-45 to connect to a network, portable computers use a PC card or USB adapter.*
Desktop PCs use a NIC or a RJ-45 to connect to a network, **whereas** *portable computers use a PC card or USB adapter.*

5. PAN, WLAN, VPN: these are the acronyms for other types of network. Do you know them? If not, surf the Internet to find information about these networks.

1. PAN .....
2. WLAN .....
3. VPN .....

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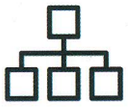
TEXT 2

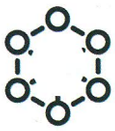
Network topologies explained

The way that data moves from one node to others in a network determines its topology, its virtual shape. The basic computer network topologies are: bus, ring, star, and tree.



Bus

In a bus •**topology** each node is daisy-chained, i.e. connected one right after the other along the same cable, or backbone. Information sent from a node travels along the backbone until it reaches its destination node. Each end of a bus network must be terminated with a resistor to prevent the signal sent by a node across the network from bouncing back when it reaches the end of the cable. The bus network is inexpensive and easy to set up as it doesn't require much cable. However, a damage or failure in the main cable will cause the whole network to fail or become unusable. If more than a few dozen computers are added to a bus network, the network will become slower because of possible collisions. Finally, as every workstation on the network "sees" all of the data on the network, this is a security risk.



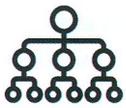
Ring

The ring network has the nodes daisy-chained to a giant ring of cable. Data travels through the ring in the same direction (either "clockwise" or "counter-clockwise") from one node to the next grabbing[1] a •**token** of code that endlessly loops through the network.
The node replaces the token on the ring with the node's data and the address of the node for which it is intended. The message circles through the ring until another node recognizes that the data is addressed to it. As data flow in one direction, transmission is fast and there is no risk of data collisions. However, if the main cable fails or any device is faulty the whole network will fail.

Star

In the star, several nodes are linked to the centre of the star, where there is a hub, switch, or router. Each of them has different capabilities.
A •**hub** receives incoming data packets[2] from different nodes and temporarily places them in a •**memory buffer** if the hub is busy with another packet. The packet received is sent to every other node regardless of the packet's address. Nodes ignore all packets not addressed to them.
A •**switch** functions similarly to a hub, but it knows which of its connections lead to specific nodes. Thus information is sent only to the computers which are supposed to receive it. Some packets (for example, one announcing that another computer has come online) arrive addressed for •**broadcast**. This means that the sending node wants to see the packet, so the switch sends copies of the packet. Switches can send and receive information simultaneously, which makes them faster than hubs.
•**Routers** are similar to switches, except that they do not accept broadcast packets.
Star networks are reliable because if one cable or device fails, then all the others will continue to work. However, they are expensive to install because this type of network uses the most cable (and network cable is expensive). If also new hubs, switches, or routers are required this will lead to extra cost.

1. **grabbing:** taking hold of something in a rough or rude way.
2. **packet:** block of information.



Tree (also called Star bus)
This topology integrates multiple star topologies onto a bus. Nodes in particular areas are connected to hubs (creating stars), and the hubs are connected together along the network backbone (like a bus network). It is one of the most popular topologies with a good reason. It supports future expandability of the network much better than a bus or star topology, it is fault tolerant and - easy to troubleshoot[3]. The installation of new hardware and additional cable makes it very expensive.

3. **troubleshoot:** find and eliminate a problem.

TECHNICAL ENGLISH 096

- **broadcast** trasmissione
- **hub** hub
- **memory buffer** memoria intermedia
- **router** router
- **switch** deviatore
- **token** token
- **topology** topologia

6. Read **TEXT 2** and then fill in the following table.

TOPOLOGY	ADVANTAGES	DISADVANTAGES

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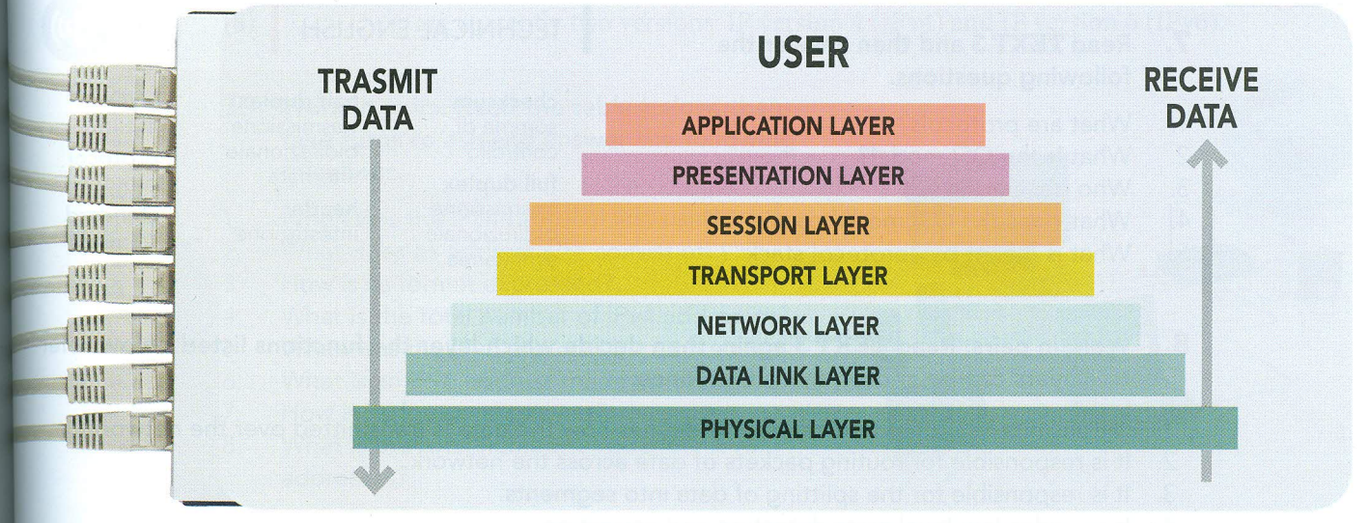
TEXT 3 Network standards and protocols



To be able to transfer data between different computers, it is important to define •**standards** and •**protocols**. Protocols are the formal rules and procedures that need to be followed to allow data to be transmitted, received and correctly interpreted. The Open Systems Interconnection (OSI) model was developed in 1984 by the International Standards Organization (ISO), a global federation of national standards, i.e. organizations representing approximately 130 countries. The OSI model is not a communication standard, an agreed method that determines how data is sent and received, but merely a guideline for developing such standards.

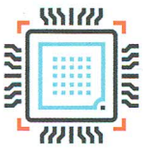
For a message, file, or any data to travel through a network, it must pass through seven •**layers**, all designed to make sure that the data gets to destination intact and accurate. Each layer contains a subset of the functions required to control network communications. At each layer additional information is added to allow the service to be provided. A layered model in this form is called a **protocol stack**.

The first layer, the **application layer**, is the only part of the process that provides service directly to the end user. The layer converts a message's data into bits and attaches a header identifying the sending and receiving computers.

The **presentation layer** translates the message into a language that the receiving computer can understand (often ASCII). This layer also compresses and encrypts the data. It adds another header specifying the language as well as the compression and encryption schemes.

The **session layer** opens communications. It sets boundaries (called "brackets") for the beginning and end of the message and establishes whether the message will be sent •**half duplex**, with each computer taking turns to send and receive it, or •**full duplex**, with both computers sending and receiving at the same time.

The **transport layer** protects the data being sent. It subdivides the data into segments and creates •**checksum** tests – mathematical sums based on the contents of data – that can be later used to determine whether the data was scrambled. It also makes backup copies of the data. The transport •**header** identifies each segment's checksum and its position in the message.



The **network layer** selects a route for the message. It forms segments into packets, counts them, and adds a header containing the sequence of packets and the address of the receiving computer.

The **data link layer** supervises the transportation. It confirms the checksum and then addresses and duplicates the packets. It also keeps a copy of each packet until it receives confirmation from the next point along the route that the packet has arrived undamaged.

The **physical layer** encodes packets into the medium that will carry them (i.e. an analogue signal if the message is going across a telephone line), and sends the packet along that medium.

At the receiving node, the layered process that sent the message on its way is reversed. The message is reconverted into bits, the checksum recalculated, the packets recounted, the message reassembled etc.

7. **Read TEXT 3 and then answer the following questions.**

1. What are protocols?
2. What is the OSI model?
3. Who developed it?
4. What does the OSI model consist of?
5. What is meant by "protocol stack"?

TECHNICAL ENGLISH 098

- **checksum** somma di controllo
- **full duplex** trasmissione bidirezionale simultanea
- **half duplex** trasmissione bidirezionale alternata
- **header** intestazione
- **layer** livello
- **protocol** protocollo
- **standard** standard

8. **Work in pairs. Read TEXT 3 again, then decide which layer the functions listed below refer to. Layers can be chosen more than once.**

1. It transmits bits (ones and zeros) and defines how the data is transmitted over the network.
2. It is responsible for routing packets of data across the network.
3. It is responsible for the splitting of data into segments.
4. It provides low-level error detection and correction.
5. It provides applications the ability to access the services of the other layers, and defines the protocols that applications use to exchange data.
6. It is responsible for routing packets of data across the network.
7. It keeps the communication flowing establishing communication in full duplex or half duplex.
8. It ensures that data is transmitted and received without error, in the correct order and in a timely manner.
9. It ensures that computers speak the same language.
10. It is the layer which is the "closest to the end user".

9. **Read TEXT 4 below carefully, then think of the word which best fits each gap (1-8). Use only one word in each gap.**

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TEXT 4

Internet's protocols

The Internet is a packet-switched network, which means that when you send information across the Internet, the data are broken into small packets. A series of routers sends each packet across the Net individually. After arriving **(1)** ..... the receiving computer, the packets are recombined into their original, unified form. That is the job of two protocols on the Internet: the TCP (Transmission Control Protocol) and the IP (Internet Protocol), commonly referred to as TCP/IP.

For a number of reasons, including hardware limitations, data sent across the Internet must be broken into packets of fewer **(2)** ..... 1,500 characters each. Each packet is given a header. As TCP creates the individual packets, it also calculates and adds to the header a checksum, **(3)** ..... . is a number that TCP uses on the receiving end to determine whether any errors have been introduced into the packet during transmission.

Each packet is put into separate envelopes which contain addressing information telling the Internet **(4)** ..... to send the data. Routers on the way examine the IP envelopes and look at their addresses. These routers determine the **(5)** ..... efficient path for sending each packet to the next router closest to its final destination.

After travelling through a series of routers, the packets arrive. Because the traffic load on the Net changes constantly, the packets might be sent along different routes and arrive **(6)** ..... of order. On arrival, the TCP calculates a checksum for each packet. It then compares it with the one sent in the packet. If the checksums do not match, TCP knows that the data in the packet has been corrupted **(7)** ..... transmission. It then discards the packet and asks the original packet to be retransmitted. If non-corrupt packets are received by the computer to which the information is being sent, TCP reassembles them into the original, unified form.

(8) ..... are currently two versions: IP version 4 (IPv4) and IP version 6 (IPv6).

10. **Work in pairs. Read the table below, then take turns to ask and answer the following questions.**

1. When was the iPv4 protocol first used?
2. What does its address size consist of?
3. How is its format expressed?
4. What is the total number of iPv4 addresses?
5. When was the iPv6 protocol introduced?
6. What is an iPv6 address made up of?
7. How is its format displayed?
8. What is the total number of possible iPv6 addresses?

	Internet Protocol version 4 (IPv4)	Internet Protocol version 6 (IPv6)
Deployed	1981	1999
Address Size	32-bit number, or about four bytes	128-bit number, or about 16 bytes
Address Format	Dotted Decimal Notation separated by commas	Hexadecimal Notation separated by colons
Number of Addresses	2^{32} = ~4,294,967,296	2^{128} = ~340,282,366, 920,938,463,463,374, 607,431,768,211,456

100 TEXT 5

The fondamentals of an Ethernet LAN

A. ☐ If a node detects its own address in a message, instead, it reads the data, checks for errors, and sends an **acknowledgement** to the sender, using the sender's address, which was included as part of the incoming message.

B. ☐ The first sender to detect a collision sends a special signal that jams the network so that all nodes will know that the network is blocked. Transmission from all nodes is halted, and each node waits a random length of time before trying to resend its message. The process repeats itself until one of the nodes sends its message without encountering another node message.

C. ☐ The card listens to be sure that no other signals are being transmitted along the network. It then sends its message to another node through the network card's **transceiver**. Each node's network connection has its own transceiver.

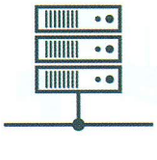
D. [1] Ethernet is not a single product, but rather a technical standard developed for network communications by Xerox, DEC and Intel, which the rest of the computer community have adopted.

E. ☐ All nodes, clients and servers on an Ethernet network are attached to the LAN which branches off a common line as in a bus configuration. Each node has a unique address. When a node (a PC, file server, a print server) needs to send data to another node, it sends the data, or message, through the **network interface card** installed in an expansion slot.

F. ☐ Each node along the bus network inspects the addressing information contained in the message. Nodes to which the message is not addressed ignore it.

G. ☐ The transceiver broadcasts the message in both directions so that it reaches all other nodes on the network. The message includes the addresses of the message destination and source, packets of data to be used for error checking, and the data itself.

H. ☐ Switches and routers use the information to determine where to forward the packet. In a network joined by hubs, the hubs themselves check the address to determine which packets to pay attention to and which to ignore.



I. ☐ When two nodes send messages simultaneously, the collision of the two messages creates a recognizable electrical interference pattern that travels along the bus. The request results in a "busy line" signal, which is detected by the senders.

TECHNICAL ENGLISH 101

- **acknowledgement**
- **network interface card**
  scheda di rete
- **transceiver**
  ricetrasmettitore

11. TEXT 5 consists of eight paragraphs. Read the text and rearrange them in the correct order. Choose from the paragraphs (A-I). There is an extra paragraph that you do not need to use. The first has been done for you as an example.

21st CENTURY SKILLS

This type of exercise tests your ability to understand how the text is logically structured.

1. Before you start reading, try to predict what the text may be about. Use your personal knowledge. What do you already know about the topic?
2. Read each paragraph carefully and underline keywords.
3. Look out for words, such as nouns, pronouns, linking words or adjectives that connect the paragraphs.
4. Read the completed text quickly. Does it make sense?

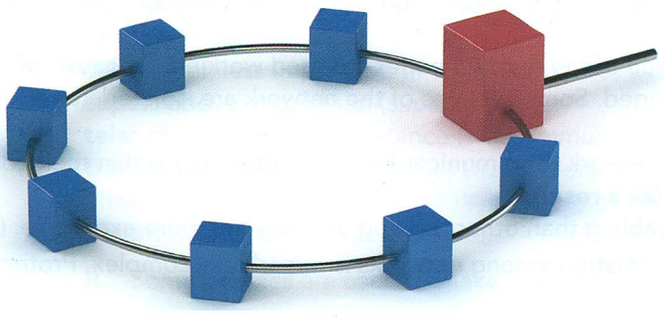
12. **Read the restored text and answer the following questions.**

1. What is an Ethernet network?
2. What type of architecture will be found in an Ethernet network?
3. How does a node send data or messages through the network?
4. How is a message transmitted from node to node?
5. How does a node with a message gain access to the network?
6. What happens if two computers start transmitting messages simultaneously?
7. How will all the other nodes know that the network is blocked?
8. What will these nodes do then?

13. **Read the paragraph below about the Ethernet, then fill in the blanks (1-10). Use the words given in capitals and in brackets to form a word that fits in the space. There is an example given.**

In the Ethernet access method, all nodes on the network operate like a conversation between **(1)** *polite* (POLITENESS) people. When people meet and begin talking at the same time, one must wait until the other has finished. This happens very **(2)** ..... (QUICK) as Ethernet LANs transmit **(3)** ..... (INFORM) at 2GB per second. The protocol **(4)** ..... (STATEMENT) that all computers must sense the bus at all times. When a computer wants to send data or a message, it can do it **(5)** ..... (IMMEDIATE) only if it cannot **(6)** ..... (DETECTION) any data on the bus. If there are other data being transmitted, then the node has to try later. Sometimes two or more computers start transmitting **(7)** ..... . (SIMULTANEOUS) If this happens, we say that a **(8)** ..... (COLLIDE) occurs. All the transmitting computers will receive a "busy line" signal and will have to stop sending data and try again after a random **(9)** ..... (LONG) of time. If a network is **(10)** ..... (HEAVY) loaded, there will be many collisions. As a consequence, the network **(11)** ..... (PERFORM) will deteriorate.

14. **Writing** **The owner of a small firm wants to implement the LAN within his main office. An expert has proposed the solutions below. Write a few paragraphs describing each network topology and highlighting the advantages and disadvantages of each solution.**



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