

TEMA-1-INTRODUCCION-A-REDES.pdf



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Redes



3º Grado en Ingeniería Informática



Facultad de Informática
Universidad Complutense de Madrid

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INTRODUCTION TO COMPUTER NETWORKS

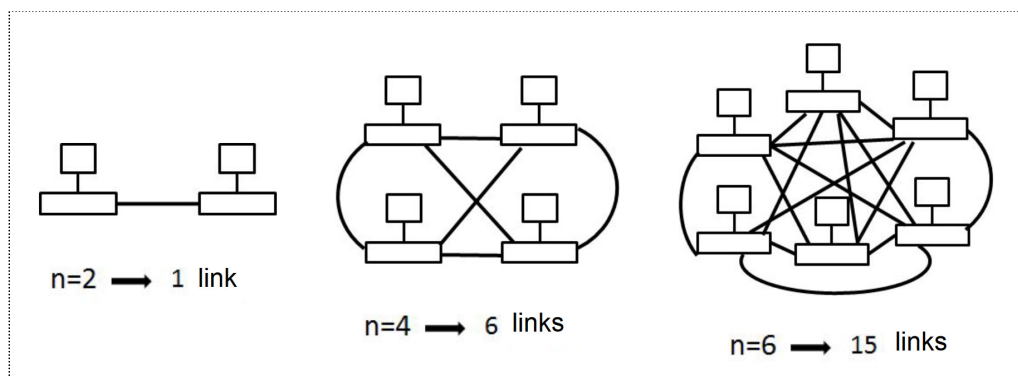
→ NETWORKS

Interconnection of a group of devices (machine, laptop, mobile, router) able to communicate among them

This communication consists of information exchange through some media

→ NETWORK TYPES

- **Point-to-point connection**: simplest way of connection, but involves an exponential increase in number of links as the number of devices increases

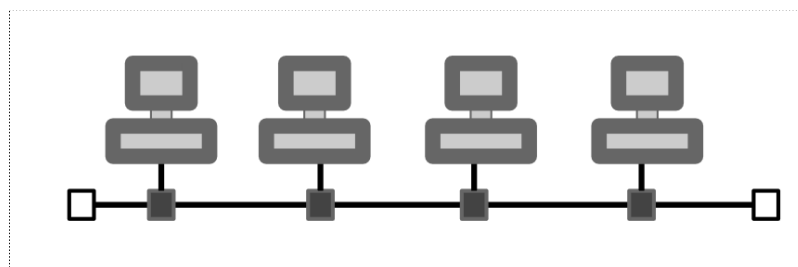


- **Local area network (LAN)**: private, limited coverage area (offices, houses...) and each device has an unique identifier in the network (its address) [messages labeled with destination and origin addresses]
- Types:

- **Broadcast LAN**: devices interconnected through a shared transmission media. If one device sends information, it is broadcast to the rest of the devices. If two or more devices transmit simultaneously, a collision occurs

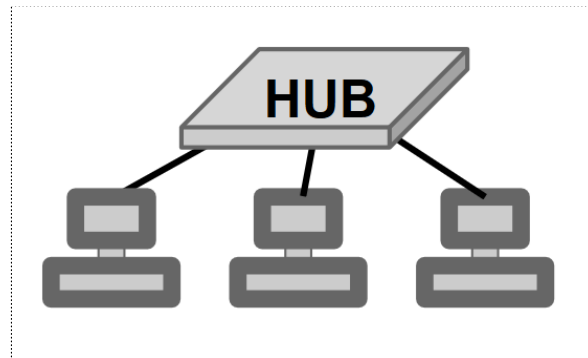
Topologies:

- **Conventional cable**

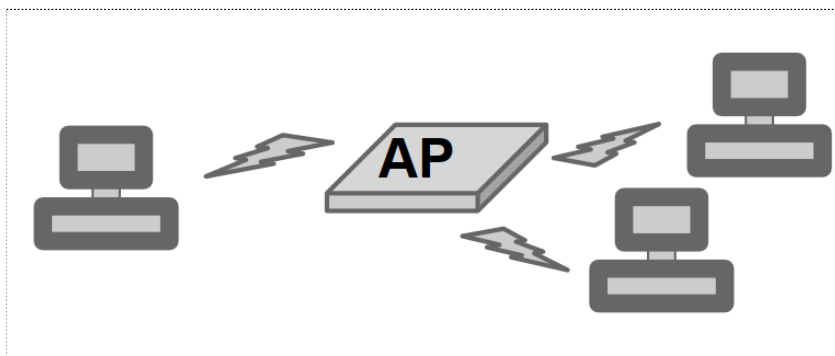


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- **Hub-based**



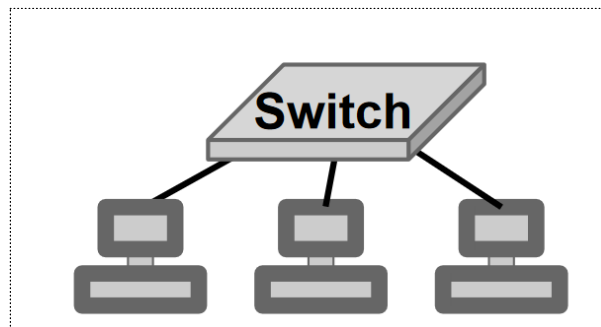
- **Wireless LAN**



- **Switched LAN**: devices interconnected through a switch. Information is only sent to the destination device and no collisions occur

Topologies:

- **Switch-based**



- **Wide area network (WAN)**: cover larger geographic areas (city, country or even worldwide) and they are usually public networks managed by telecom companies



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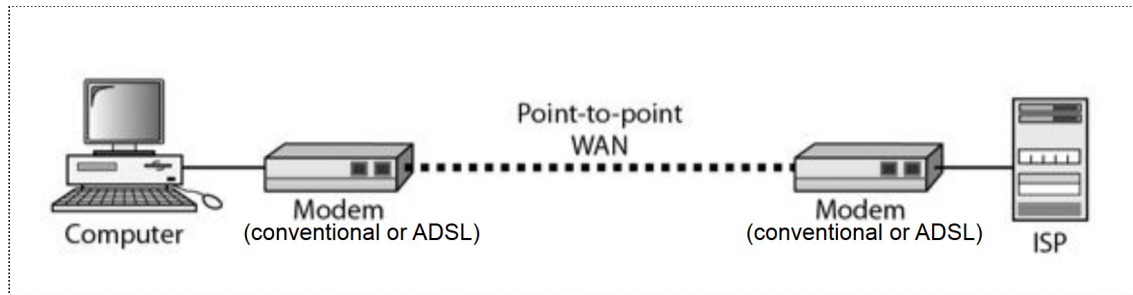
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- 1** Imprime esta hoja
- 2** Recorta por la mitad
- 3** Coloca en un lugar visible para que tus compis puedan escanar y acceder a apuntes

- 4** Llévate dinero por cada descarga de los documentos descargados a través de tu QR

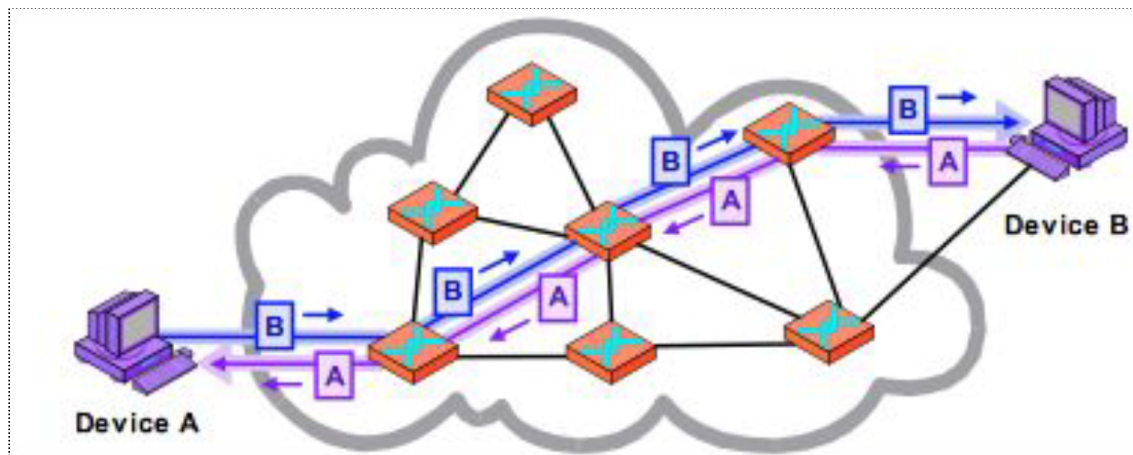


- **Point-to-point:** interconnect two communication devices through a transmission media (air, cable) → ADSL modem



connection

- **Circuit switched WAN:** a dedicated link (circuit) is established between both communicating devices. Switches do not process information, they only establish the circuits needed for communication → PSTN (Public Switched Telephone Network) where telephonic switchboards act as switches for creating the circuit



- **Packet switched WAN:** information is divided into blocks (packets) and switches process them performing two basic functionalities: **routing** (decide most suitable path) and **forwarding** (forward the packet to the following node until reaching destination)
 - **Datagram networks:** each packet is routed independently through the network. Packets contain a header with information about destination and they are routed based on the destination address. Packets with same origin and destination may be routed differently and, consequently, arrive out of order

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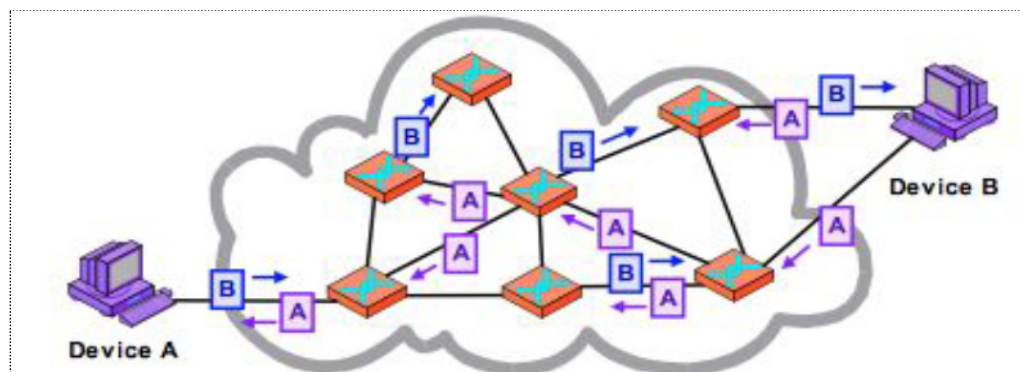
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- **Virtual circuit networks:** a path (virtual circuit) is established between origin and destination addresses through which all the packets will be routed during a connection. Packets are routed based on the circuit they belong to and there is no need to include the full destination address (only the circuit identifier). Packets arrive in order to the destination



→ INTERNET

Interconnection of several LAN or WAN joined by means of routers.

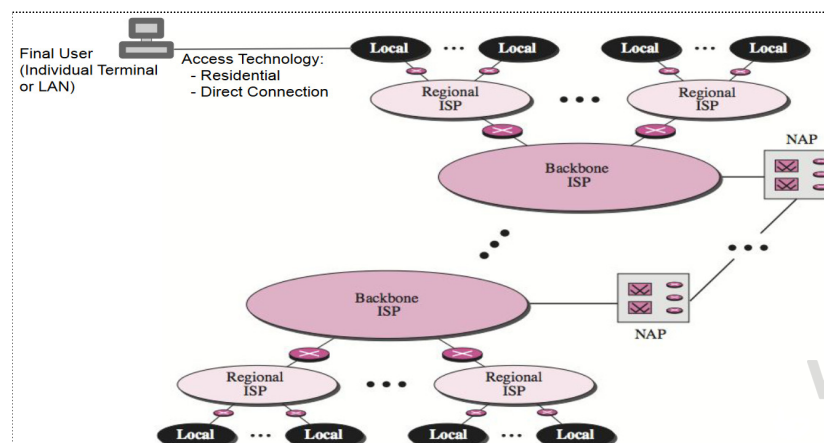
Routers perform both routing and forwarding among the interconnected networks

Ex: Global Internet

Final users are connected to Local Internet Service Providers (ISPs) by means of a direct connection or some residential access technology (Modem, ADSL...)

ISPs hierarchical arrangement:

- **Local ISPs:** provide connection to final users and they are connected to regional ISPs or directly to the backbones
- **Regional ISPs:** second level in Internet hierarchy. Connected to one or several backbones
- **Backbone ISPs:** Internet backbone. Interconnected through complex switching and high performance routing infrastructures, named NAPs (Network Access Points) or IXPs (Internet eXchange Points) or neutral points.



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→ NETWORK PROTOCOLS

Define the rules that both origin and destination (and intermediate devices) must follow to be able to communicate

These rules are divided into tasks assigned to different layers or levels (layered protocol). Each level uses a specialized protocol

Each layer has several functionalities:

- **Services:** layer K communicates with immediately lower layer K-1 by means of the services that it offers
- **Protocols:** layers of the same level use the same rules and information units. During communication, a logic connection is established within every layer
- **Network architecture:** the set of layers defined by the architecture and the set of services and protocols provided in each layer

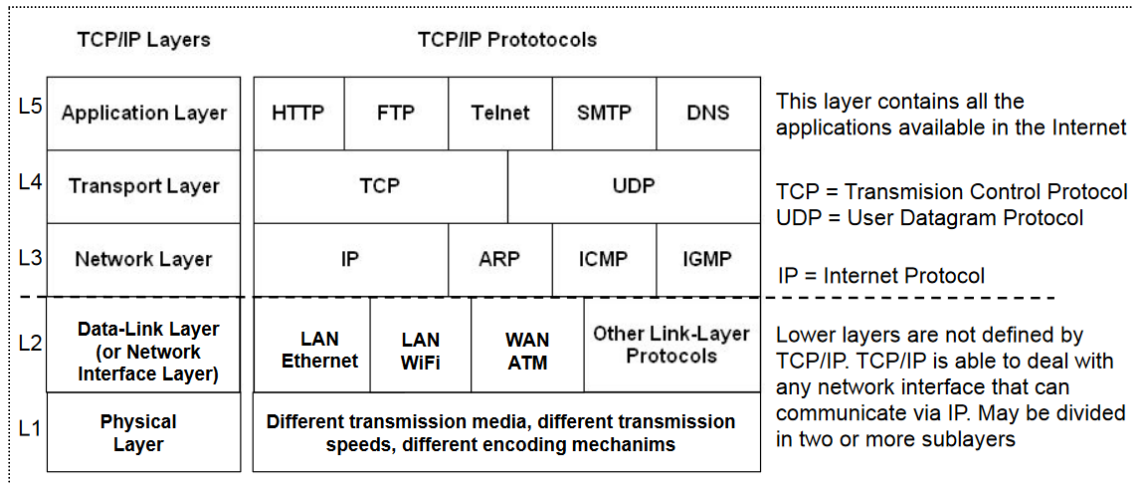
• TCP/IP PROTOCOL

Protocol architecture used on the Internet.

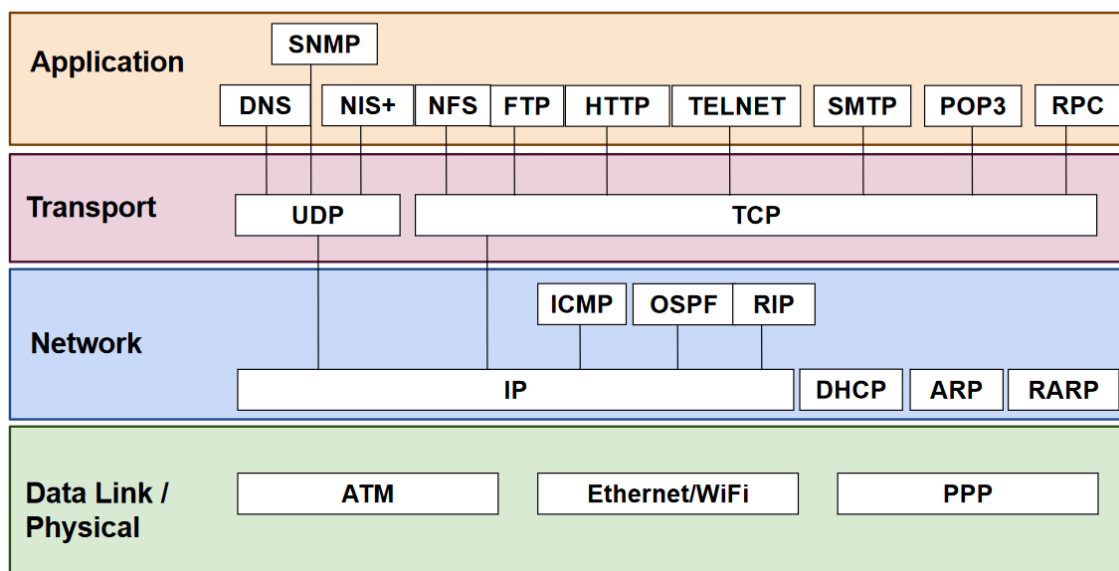
Hierarchical architecture based on modules, each one with a specific functionality

5-layer model:

- **Application layer:** message exchanges between two programs (applications). End-to-end communication using the application logic
Protocols: HTTP, SMTP, FTP, TELNET, DNS
- **Transport layer:** end-to-end communication (process-to-process). Encapsulates application messages within a segment or datagram and sends the message from origin (source) application to the destination
Protocols: TCP (connection-oriented protocol for flow, error and congestion control), UDP (connectionless protocol for independent messages)
- **Network layer:** responsible for communication between hosts and sending packages through most suitable route
IP protocol: defines packet format (datagram), the way hosts are designated (addresses), does not offer error, congestion or flow control, performs
- **Data link layer** (or interface layer): transmits datagrams through the link. Datagrams are encapsulated within a frame and transmitted through switched LANs, WiFi, wired LANs, etc... TCP/IP protocol can work with several data link protocols and may offer error detection/correction at link level
- **Physical layer:** responsible for sending bits through the concrete link. Different transmission media and types of electromagnetic signals to encode data bits. Performs encoding, conversions (digital-digital, digital-analog), multiplexation...



Main protocols of TCP/IP architecture



ENCAPSULATION/DECAPSULATION IN TCP/IP

Encapsulation: data transmitted at every level is complemented with a header which is specific for each protocol. Transport layer includes information about origin and destination processes that are communicating (port numbers), error control or flow control. Network layer includes information about origin and destination hosts (IP addresses), fragmentation... Data link layer includes the error and flow control at link level

Decapsulation: when a message is received and sent to the upper layers, it is decapsulated. Each step involves error checking and routers may re-encapsulate the message depending on the underlying link-layer protocol

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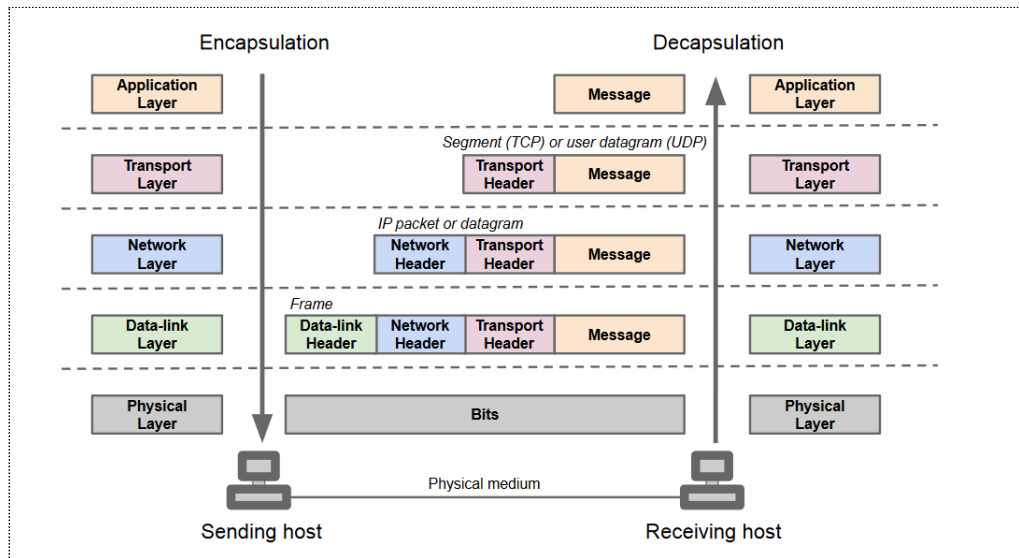
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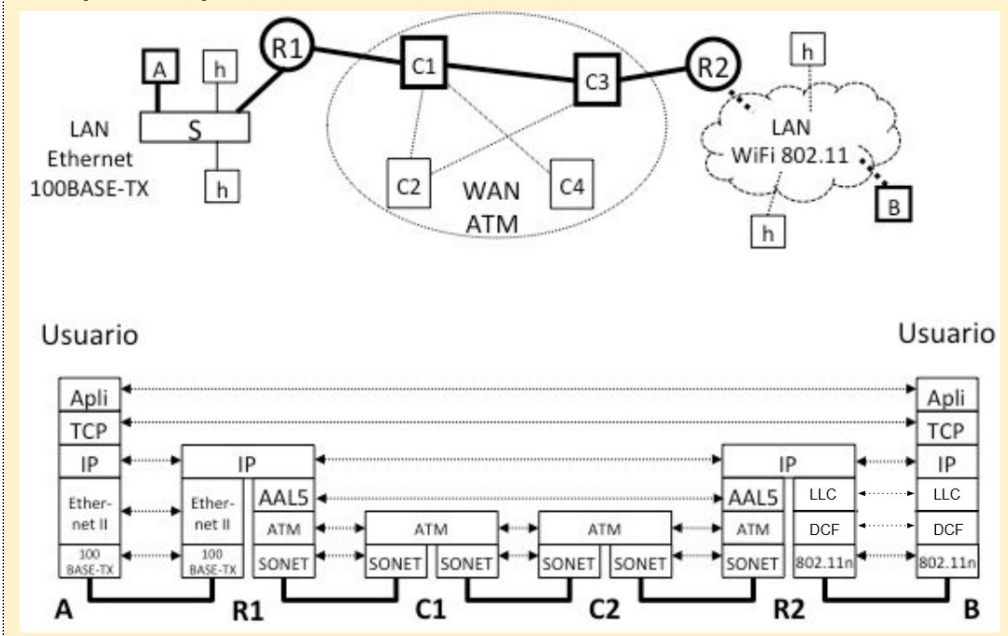
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Example: Encapsulation and transformations in the router



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