ESCOLA
SUPERIOR
DE TECNOLOGIA
E GESTÃO

P.PORTO

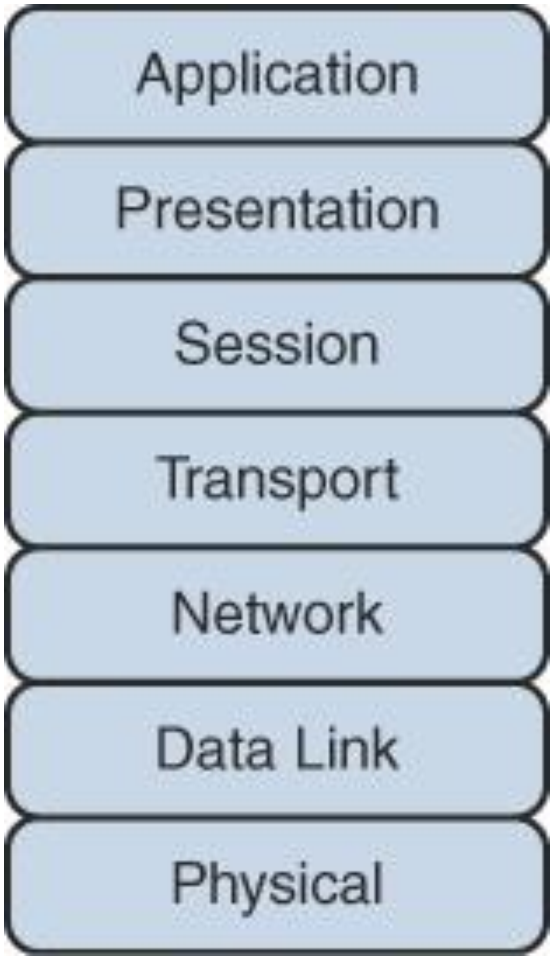
REDES DE COMPUTADORES I – Modelo OSI

OSI MODEL

- *OSI Model*
  - Layer 1—Physical
  - Layer 2—Data link
  - Layer 3—Network
  - Layer 4—Transport
  - Layer 5—Session
  - Layer 6—Presentation
  - Layer 7—Application
- *TCP/IP Stack*
  - Ethernet header
  - Internet Protocol (IP) header
  - Transmission Control Protocol (TCP)/User Datagram Protocol (UDP) headers
  - TCP flags
  - Payload
  - Maximum transmission unit (MTU)

OSI

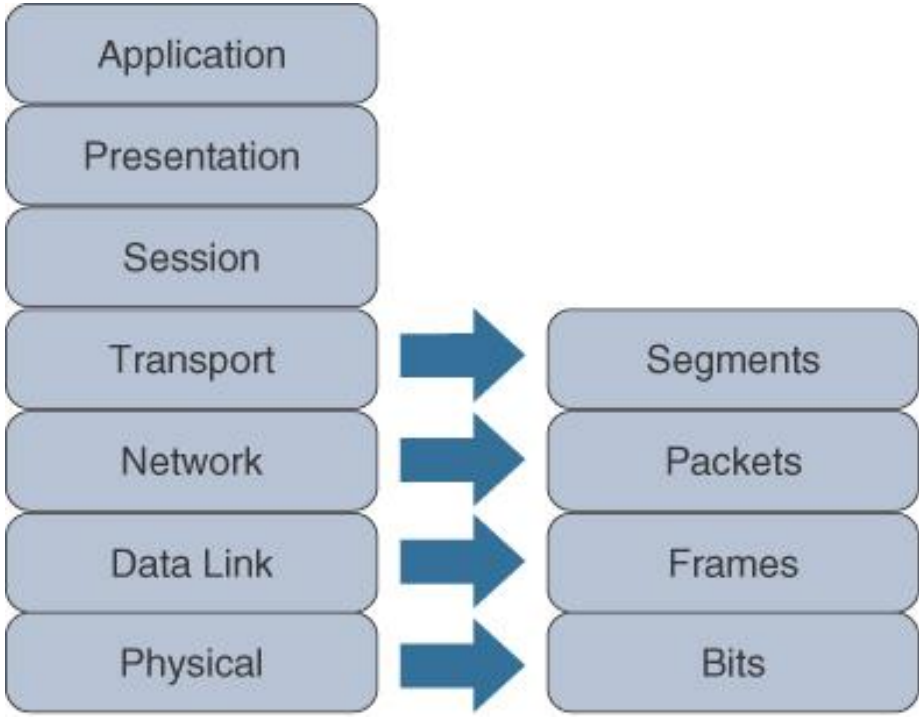
- International Organization for Standardization (ISO)
  - Open Systems Interconnection (OSI) reference model
  - 1977



OSI

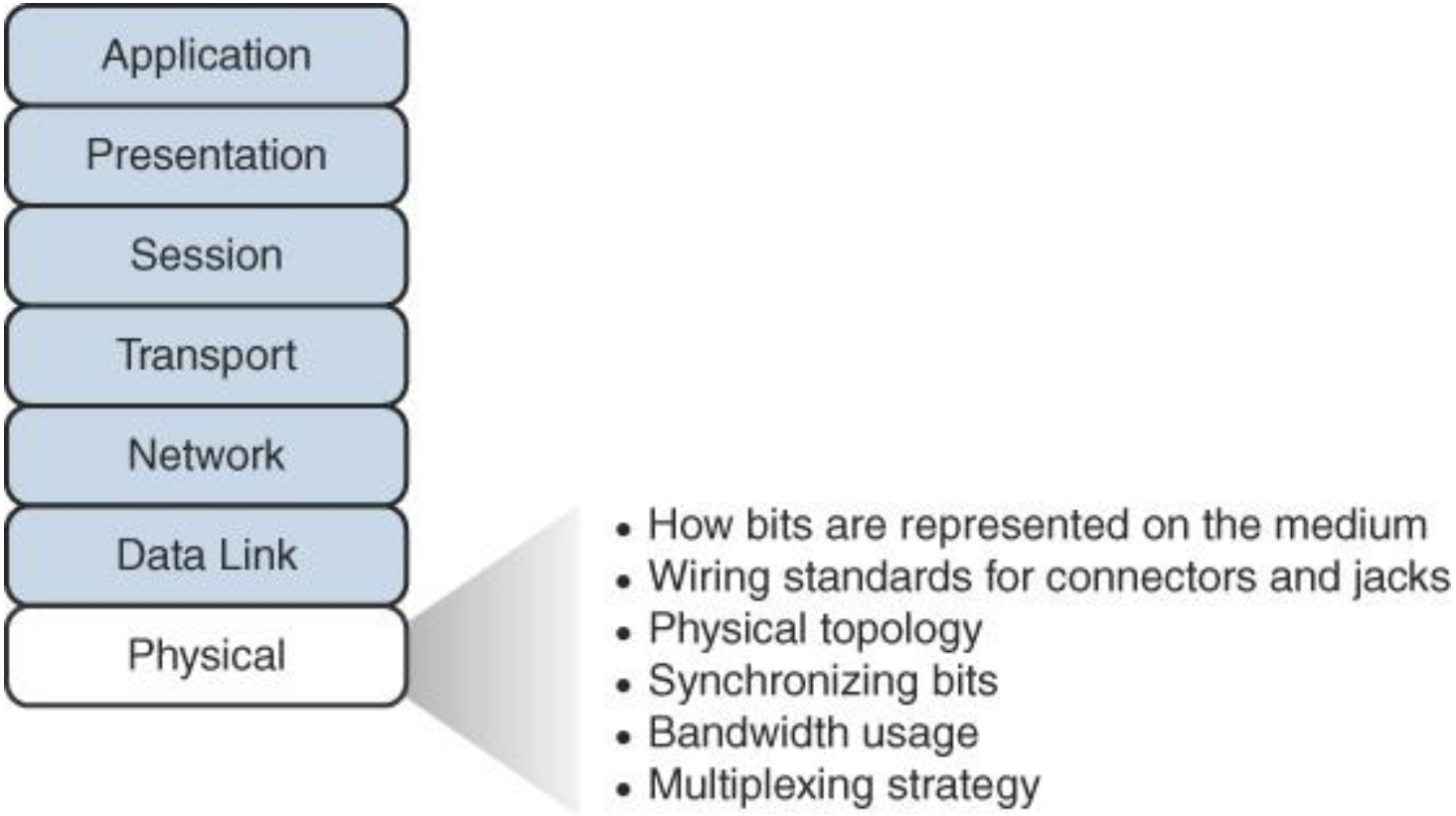
- **Layer 1:** The physical layer
- **Layer 2:** The data link layer
- **Layer 3:** The network layer
- **Layer 4:** The transport layer
- **Layer 5:** The session layer
- **Layer 6:** The presentation layer
- **Layer 7:** The application layer

OSI

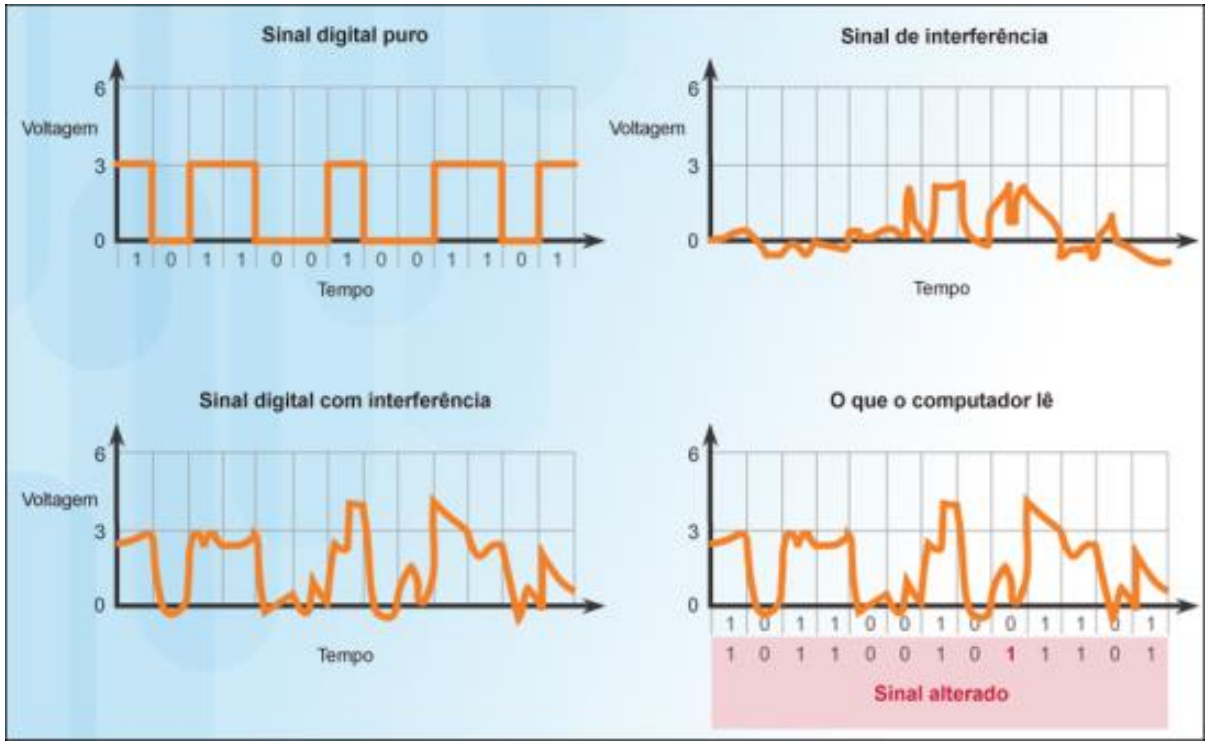


- **A**ll **P**eople **S**eem **T**o **N**ee d **D**ata **P**rocessing
- Layer 1:
  - Bits
- Uper Layers:
  - Protocol Data Units (PDU)

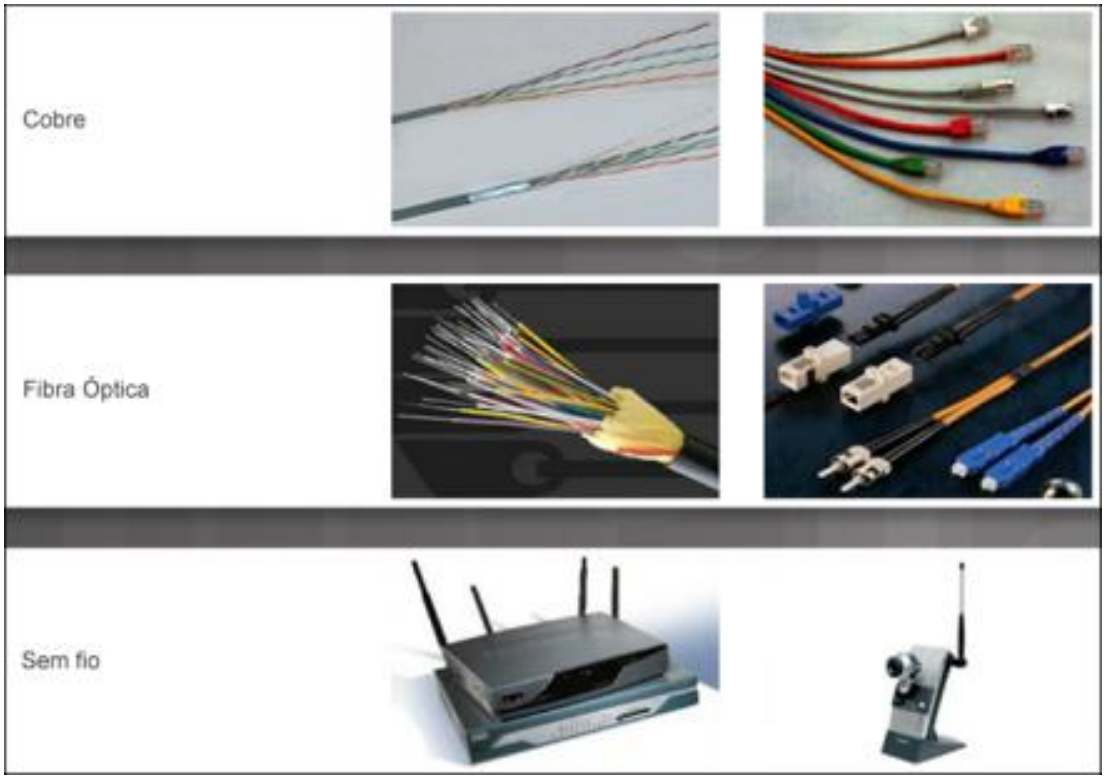
OSI – Layer 1:Physical Layer



OSI – Layer 1:Physical Layer

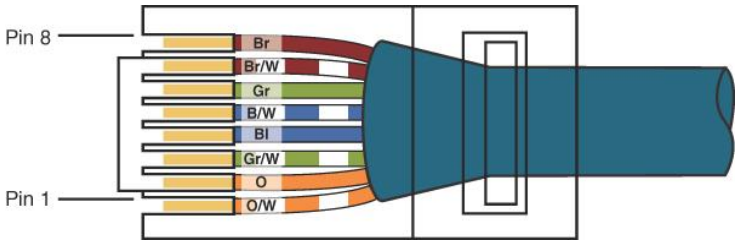


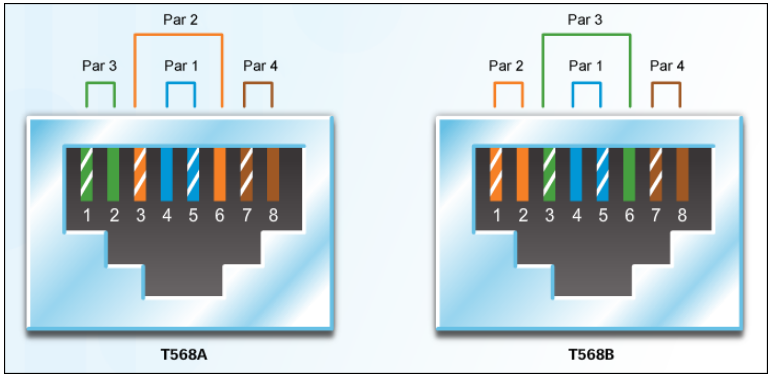
OSI – Layer 1:Physical Layer



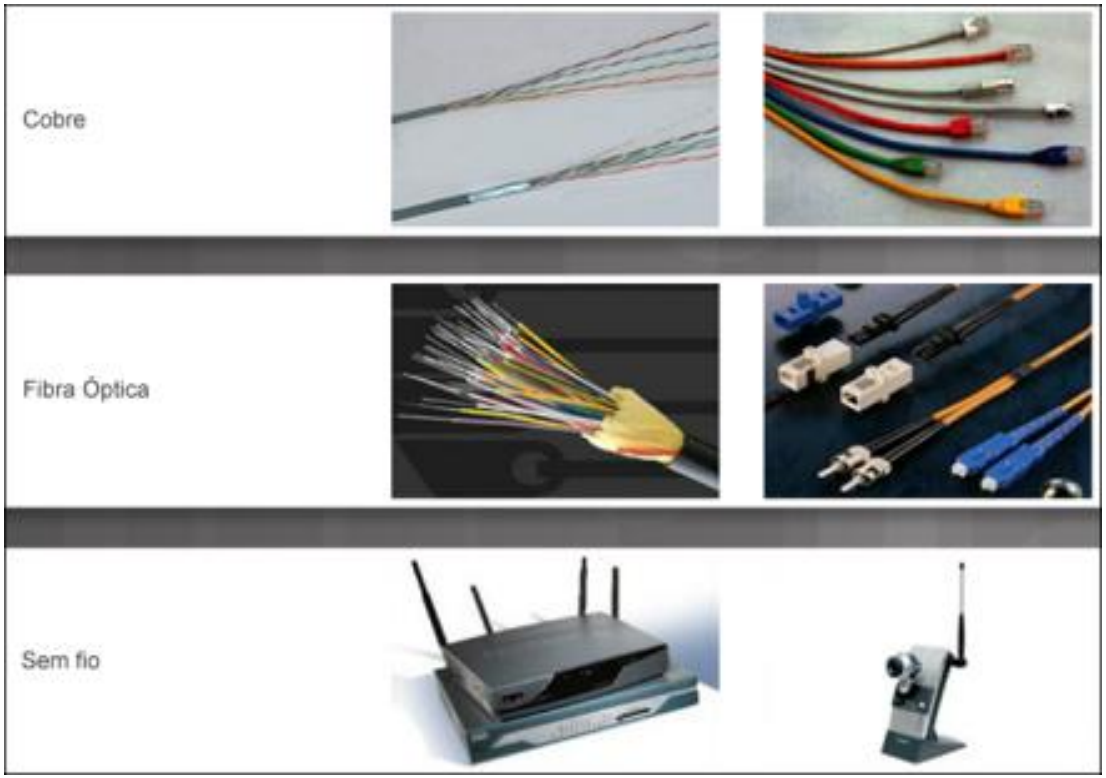
OSI – Layer 1:Physical Layer

- Wiring Satndards
  - TIA/EIA-568-B: RJ45 Connector





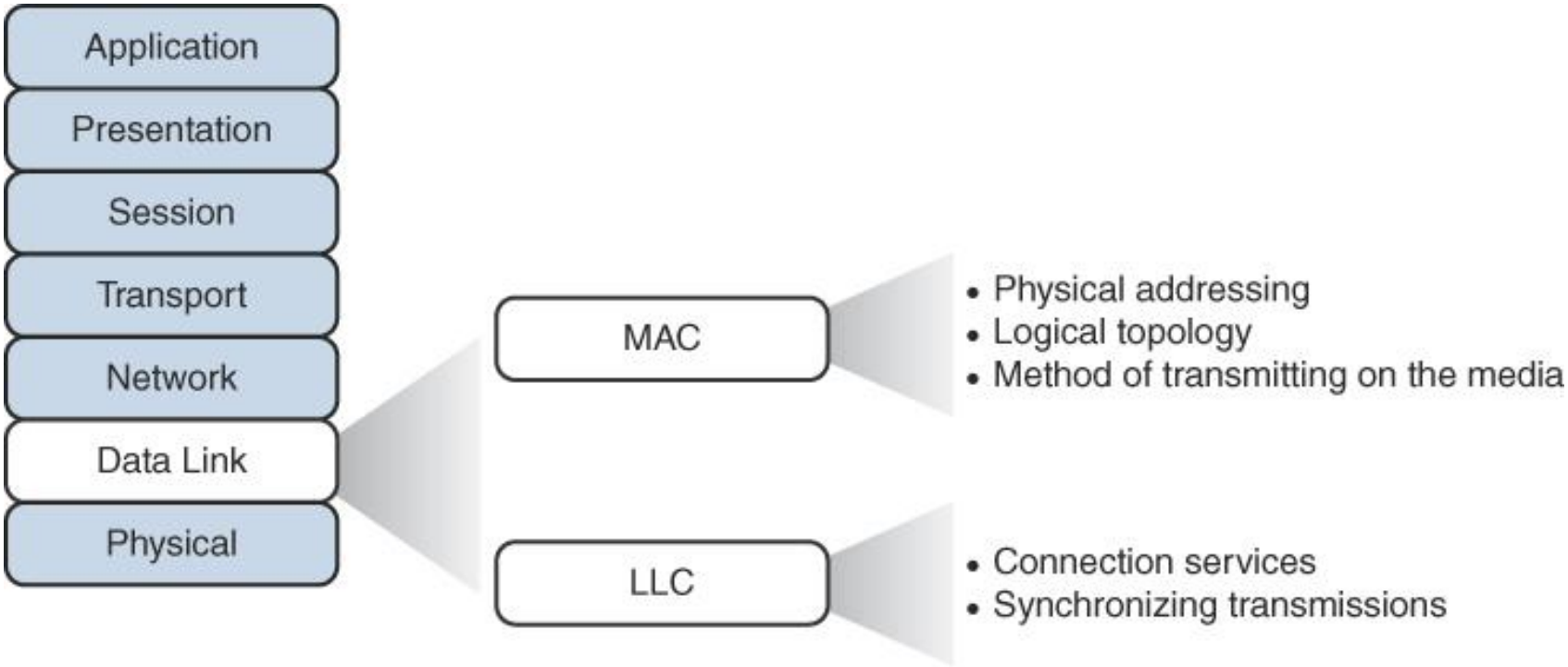
OSI – Layer 1:Physical Layer



OSI – Layer 2:Data Link Layer

- Packaging data into frames and transmitting those frames on the network
- Ensuring that frames do not exceed the **maximum transmission unit (MTU)** of the physical media
- Performing error detection/correction
- Uniquely finding network devices with addresses
- Handling flow control

OSI – Layer 2:Data Link Layer



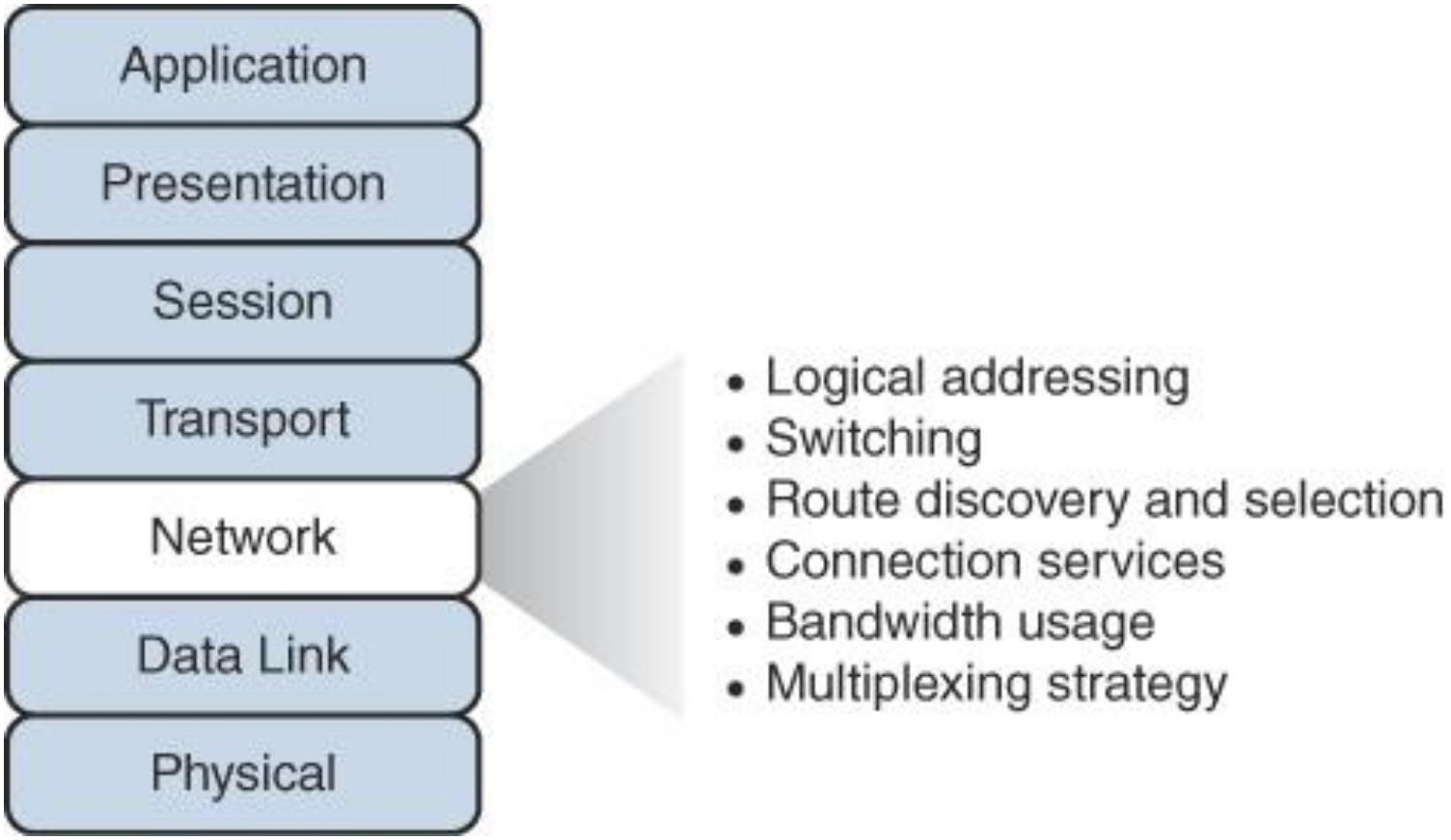
OSI – Layer 2:Data Link Layer

- Media Access Control
  - **Physical addressing**
    - MAC address, 48-bit address network interface card (NIC example, 58:55:ca:eb:27:83). The first 24 bits of the 48-bit address are the *vendor code* ***OUI***
  - **Logical topology:** Layer 2 network logical topology
    - Mesh
    - Star/hub-and-spoke
    - Bus
    - Ring
  - **Method of transmitting on the media**

OSI – Layer 2:Data Link Layer

- **Logical Link Control**
  - **Connection services**
    - Flow control
    - Error control
  - **Logical topology:** Layer 2 network logical topology
    - Mesh
    - Star/hub-and-spoke
    - Bus
    - Ring
  - **Method of transmitting on the media**

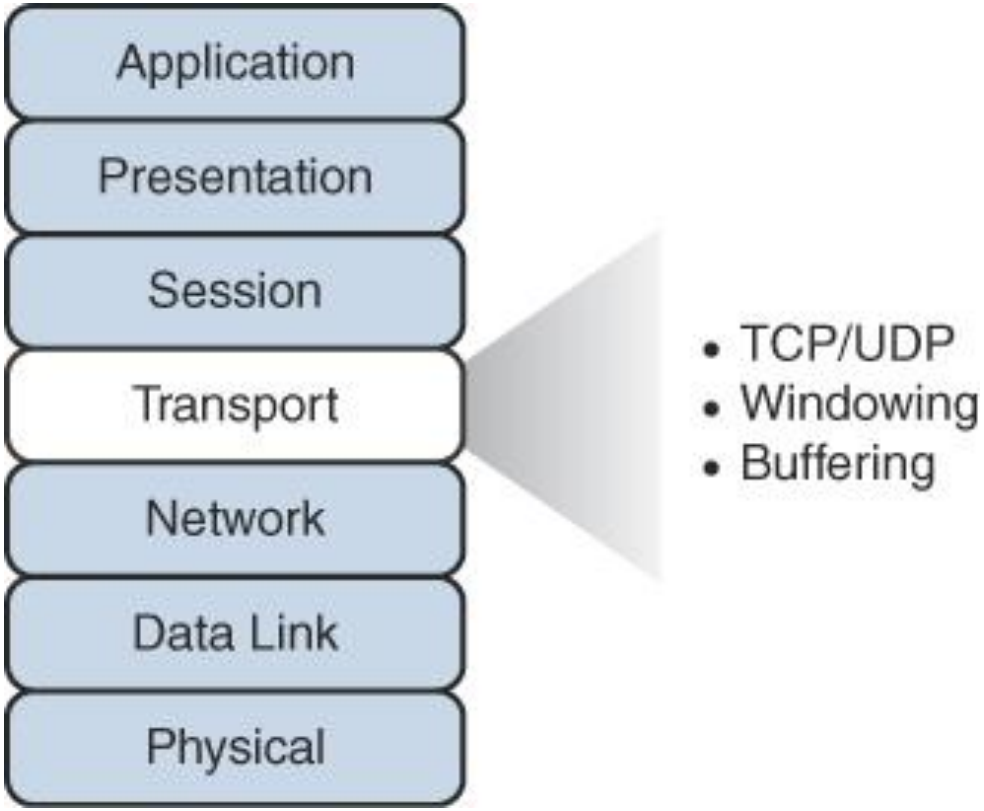
OSI – Layer 3:Network Layer



OSI – Layer 3:Network Layer

- **Logical addressing:**
  - Internet Protocol (IP)
- **Route discovery and selection:**
  - forwarding decisions based on logical network addresses (OSPF, RIP)

OSI – Layer 4:Transport Layer

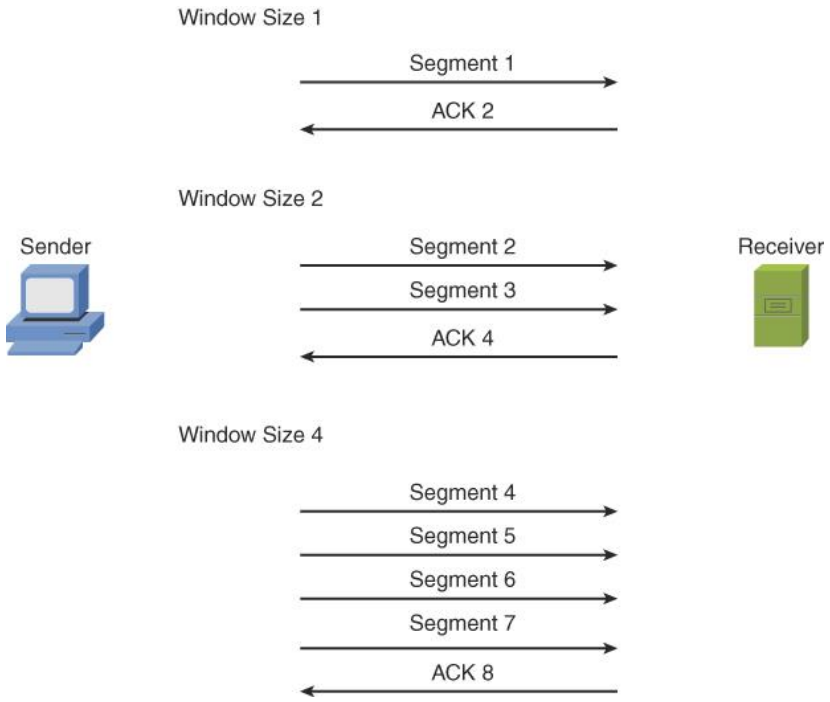


OSI – Layer 4:Transport Layer

- **Transmission Control Protocol (TCP):**
  - connection-oriented transport protocol.
- User Datagram Protocol (UDP)
  - connectionless transport protocol

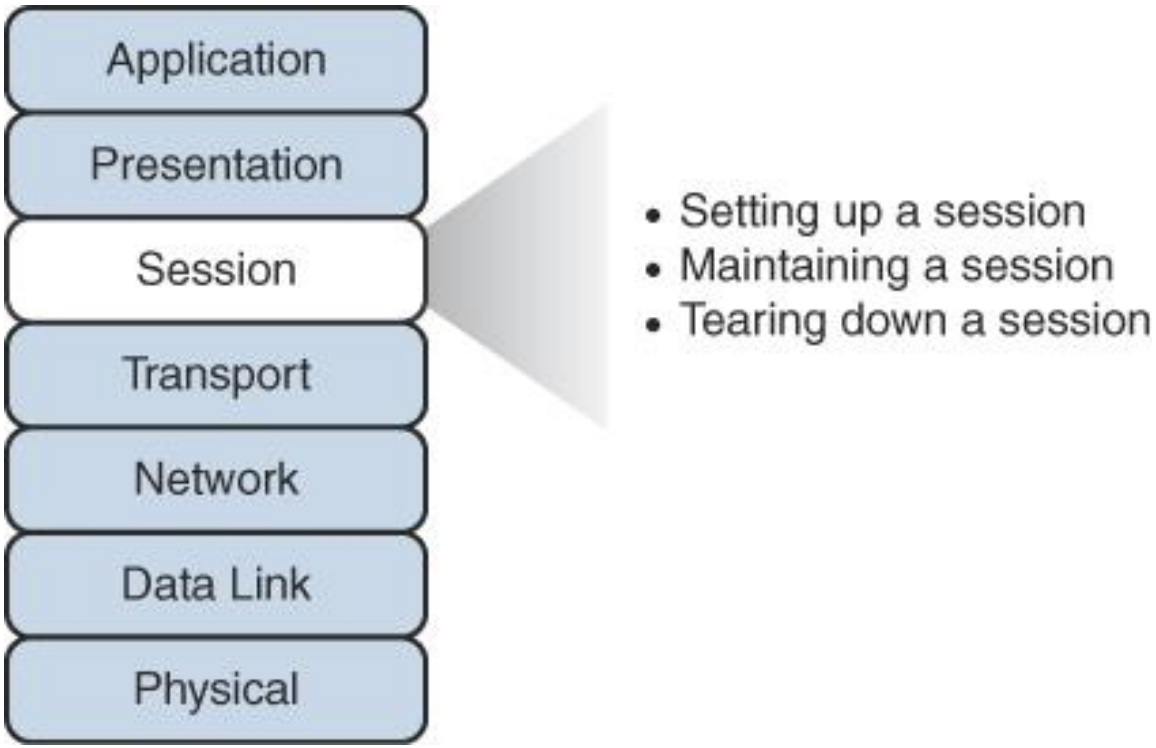
OSI – Layer 4:Transport Layer

- Windowing:
  - TCP communication uses windowing



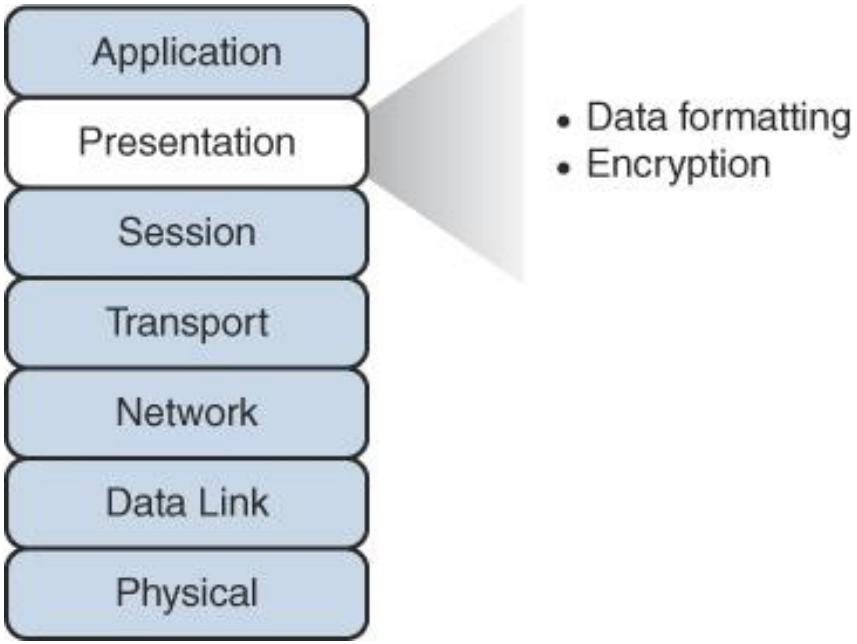
OSI – Layer 5:Session Layer

– responsible for setting up, maintaining, and tearing down sessions



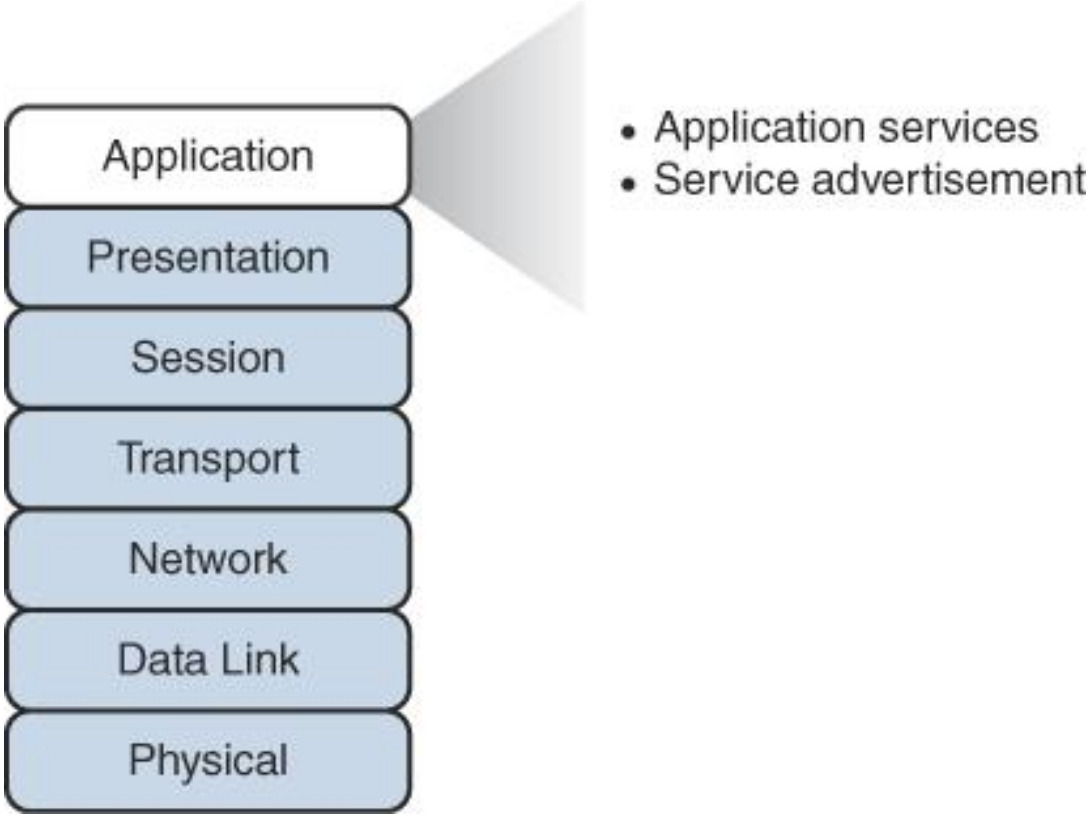
OSI – Layer 6:Presentation Layer

- Data formatting:
  - American Standard Code for Information Interchange (ASCII)
- Encryption



OSI – Layer 7:Application Layer

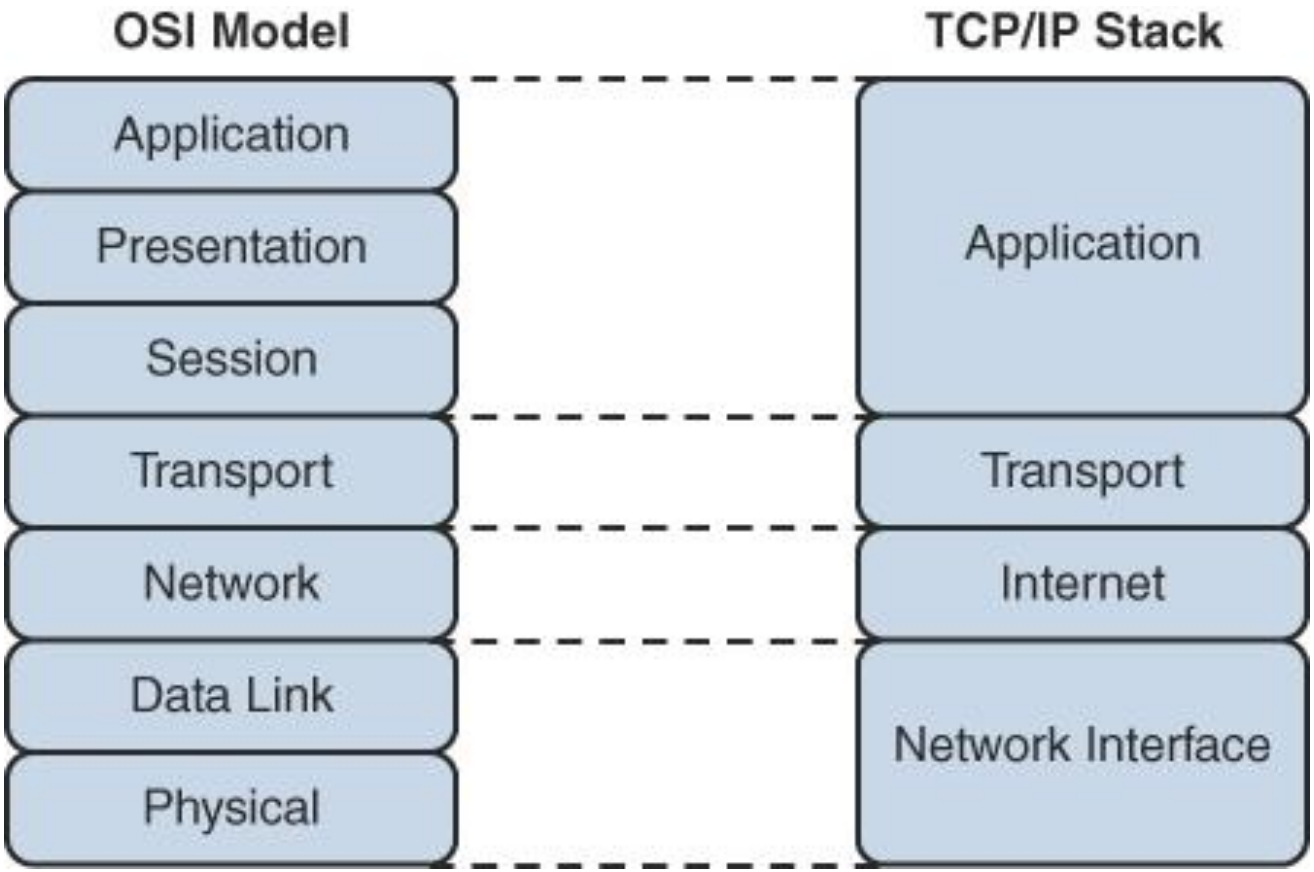
- Application services:
  - file sharing and email
- Service advertisement:
  - Microsoft Active Directory



TCP/IP Stack

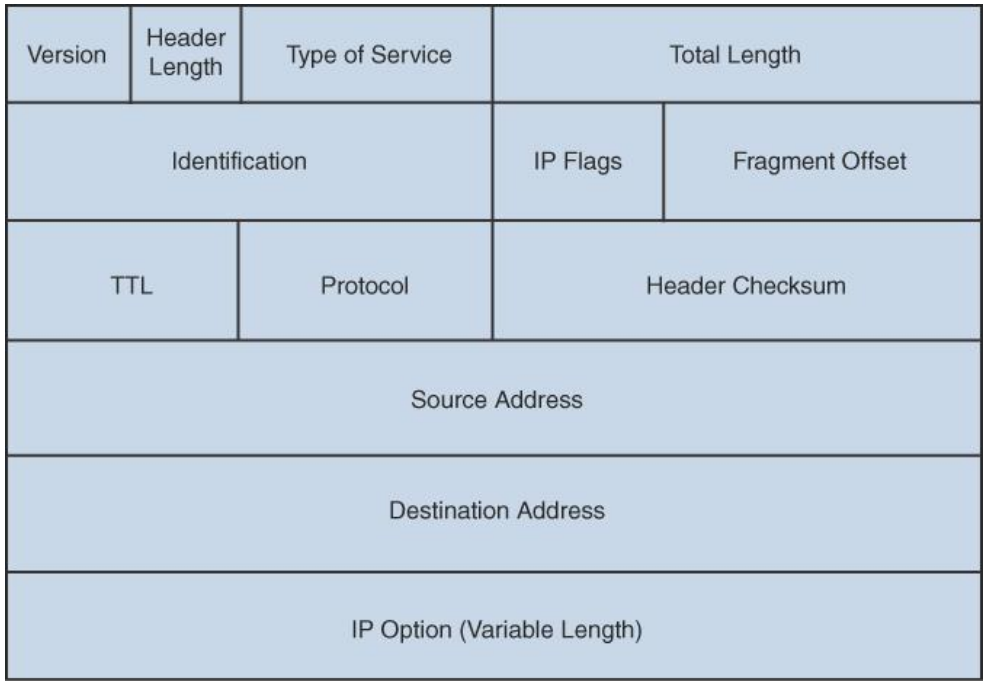
- U.S. Department of Defense (DoD)
- TCP/IP (Transmission Control Protocol/Internet Protocol)
- Designed to:
  - provide a robust and flexible set of protocols for computer networking, including addressing, routing, packet fragmentation and reassembly, error detection and correction, and flow control.
  - to be scalable and extensible, allowing for the addition of new protocols and technologies as they were developed.

TCP/IP Stack

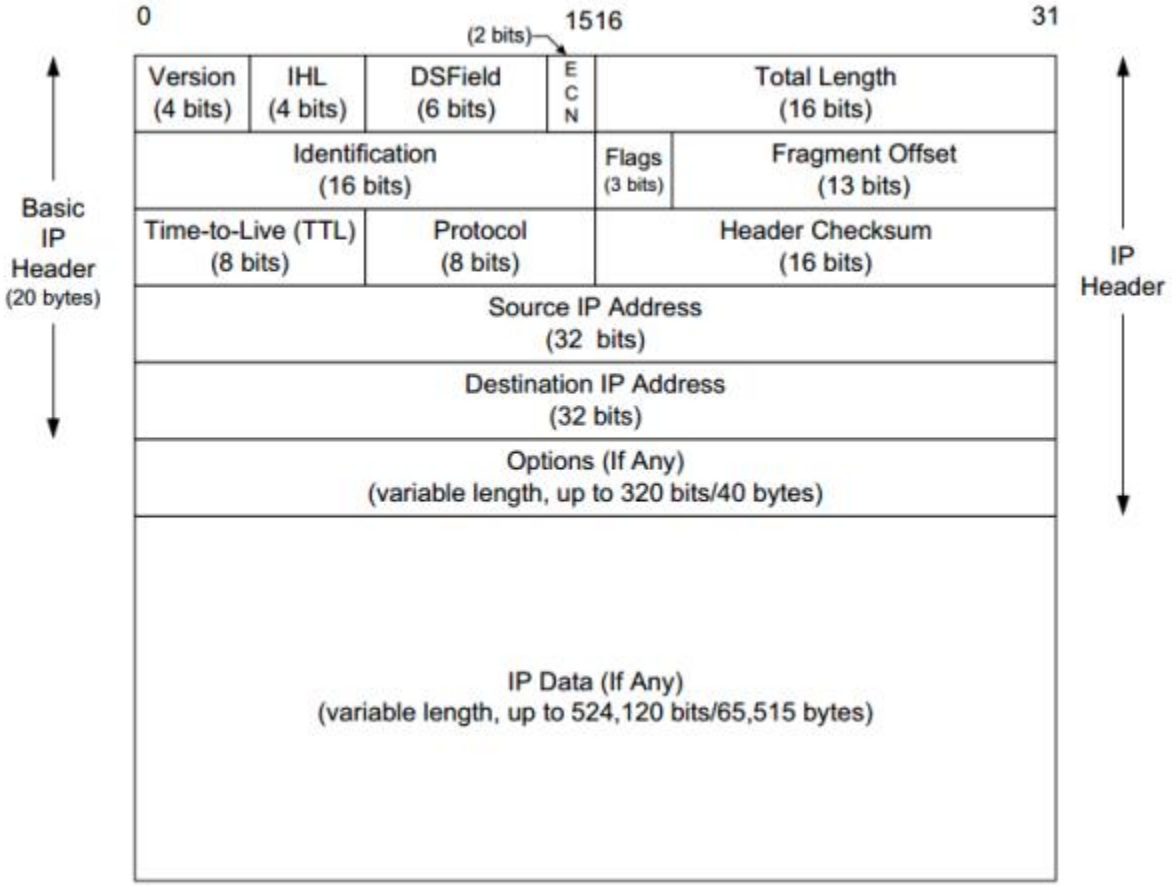

OSI Model
TCP/IP Stack
Application
Presentation
Session
Transport
Network
Data Link
Physical
Application
Transport
Internet
Network Interface

Internet

- **Internet layer:**
  - **IPv4 Packet**

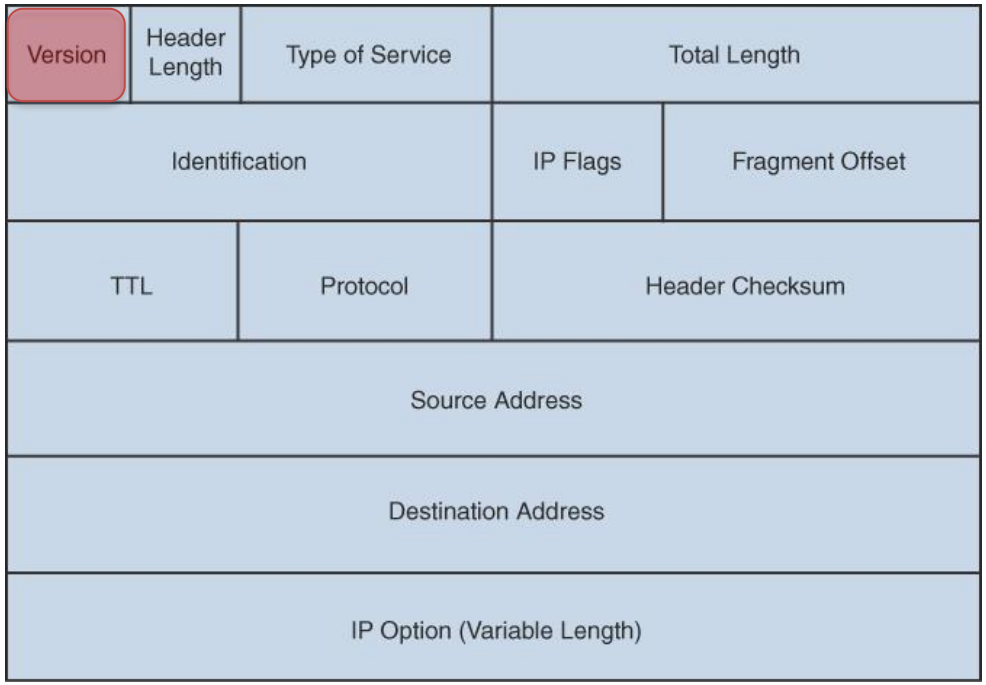


Internet


0
15
16
31
(2 bits)
Version (4 bits)
IHL (4 bits)
DSField (6 bits)
ECN
Total Length (16 bits)
Identification (16 bits)
Flags (3 bits)
Fragment Offset (13 bits)
Time-to-Live (TTL) (8 bits)
Protocol (8 bits)
Header Checksum (16 bits)
Source IP Address (32 bits)
Destination IP Address (32 bits)
Options (If Any) (variable length, up to 320 bits/40 bytes)
IP Data (If Any) (variable length, up to 524,120 bits/65,515 bytes)
Basic IP Header (20 bytes)
IP Header

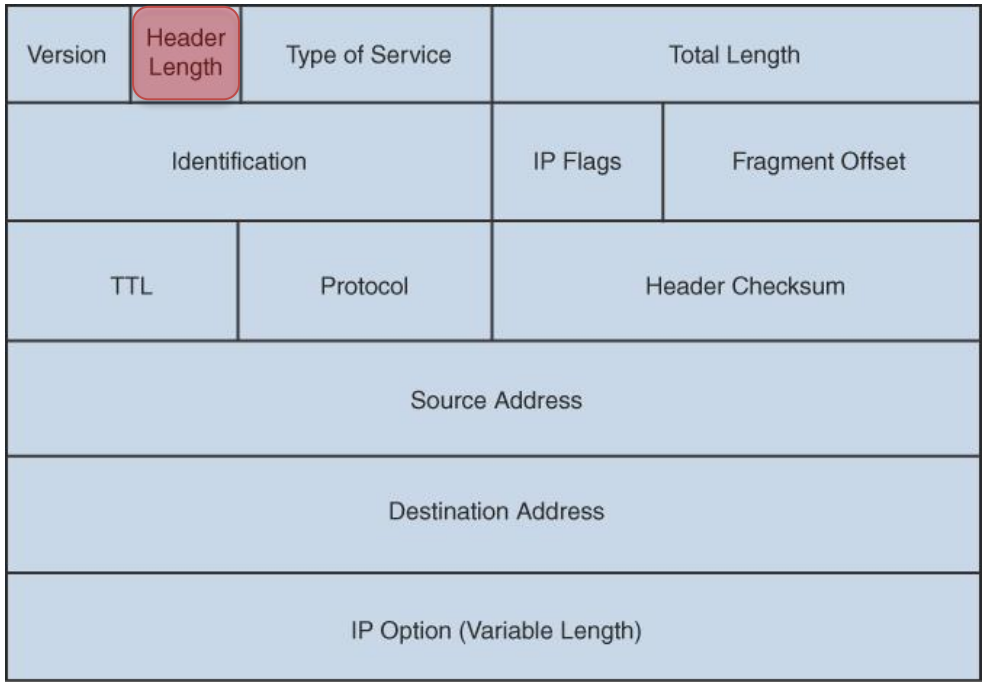
Internet

Version (4 bits): This field specifies the version of the IP protocol being used, which is typically set to 4 for IPv4 packets.



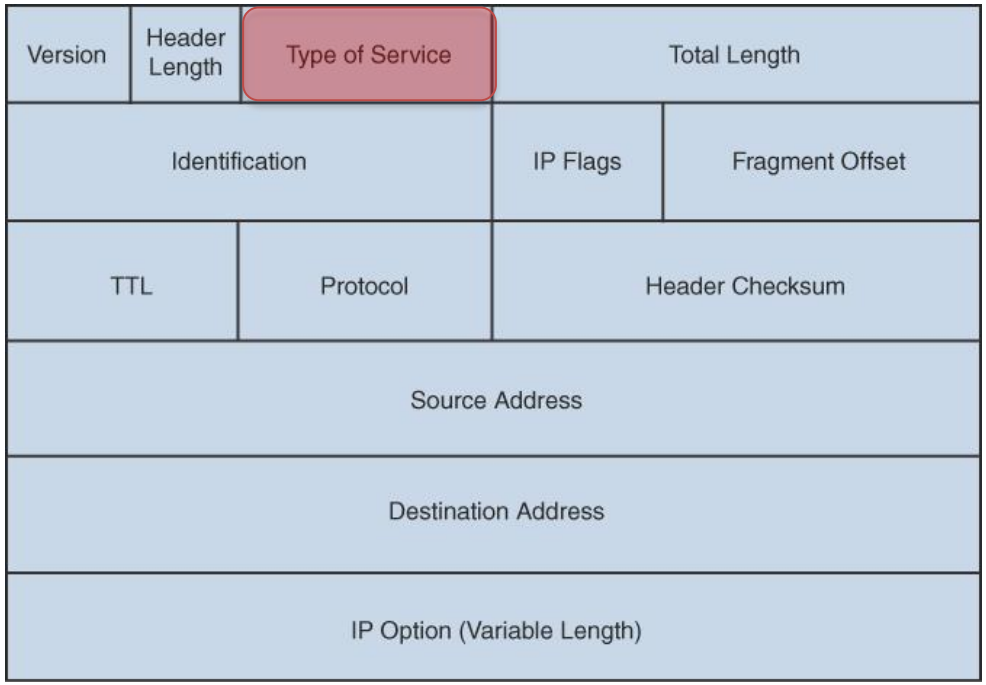
Internet

Header Length (4 bits): This field specifies the length of the header in 32-bit words, with a minimum value of 5 (indicating a header length of 20 bytes) and a maximum value of 15.



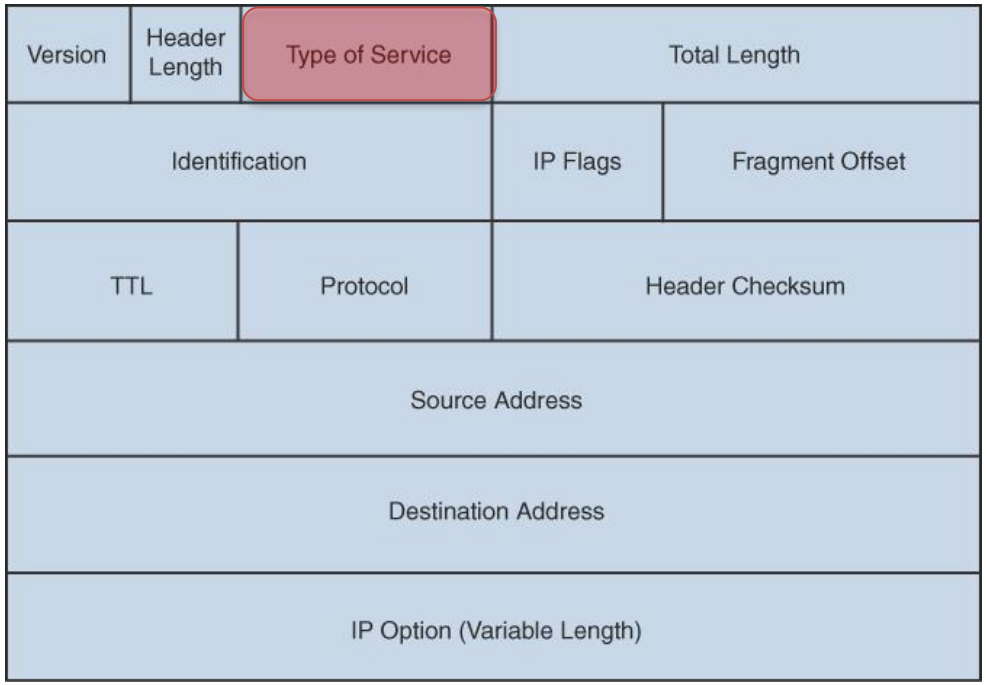
Internet

Type of Service (8 bits): This field is used to indicate the priority of the packet, with higher values indicating higher priority. It can also be used to specify a particular type of service that the packet requires.



Internet

The Type of Service (ToS) field in the IPv4 header has been replaced by the Differentiated Services (DS) field in the IPv6 header, but the values used in the ToS field are still supported in the DS field for backward compatibility. The values in the ToS field can be used to indicate the priority level of the packet or to specify a particular type of service that the packet requires.



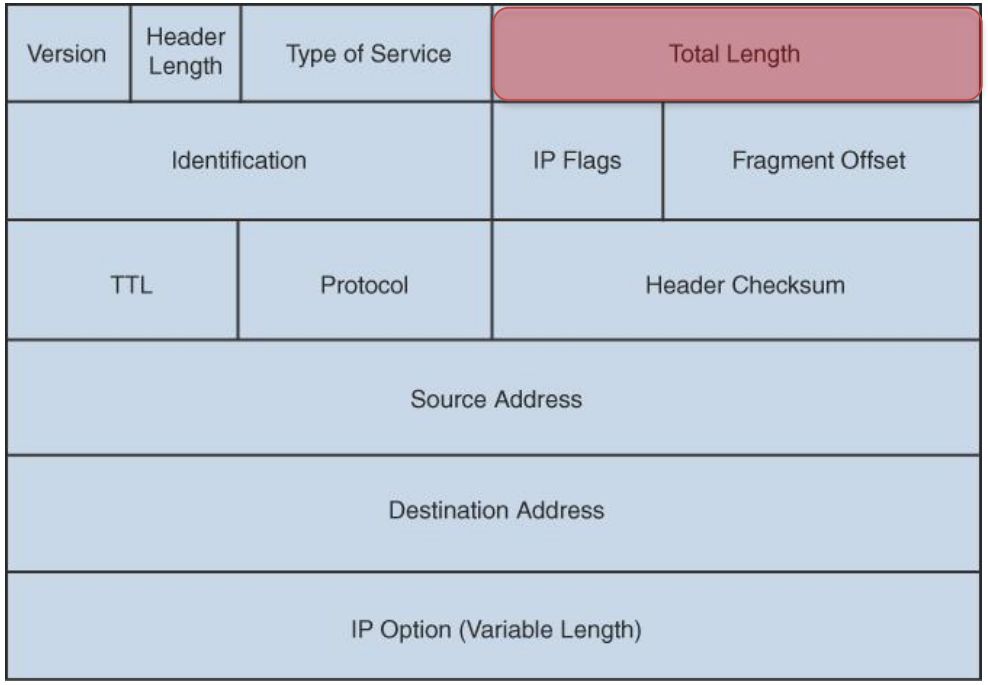
Internet

The possible values of the Type of Service field in the IPv4 header:

1. Routine (000000): This value indicates that the packet is a routine packet with no special priority or requirements.
2. Priority (000001 to 000111): These values indicate that the packet has a higher priority than routine packets and should be given preferential treatment by routers.
3. Immediate (001000): This value indicates that the packet requires immediate delivery and should be given the highest priority by routers.
4. Flash (001001): This value indicates that the packet requires very fast delivery and should be given higher priority than routine or priority packets.
5. Flash Override (001010): This value indicates that the packet requires immediate delivery and should be given the highest priority by routers, even if it means overriding other traffic.
6. Critical (001011): This value indicates that the packet is critical and requires very fast delivery, but not necessarily immediate delivery.
7. Internet Control (110000 to 110111): These values are reserved for use by Internet Control protocols and are used to indicate the priority level of control messages.
8. Network Control (111000 to 111111): These values are reserved for use by network control protocols and are used to indicate the priority level of control messages.

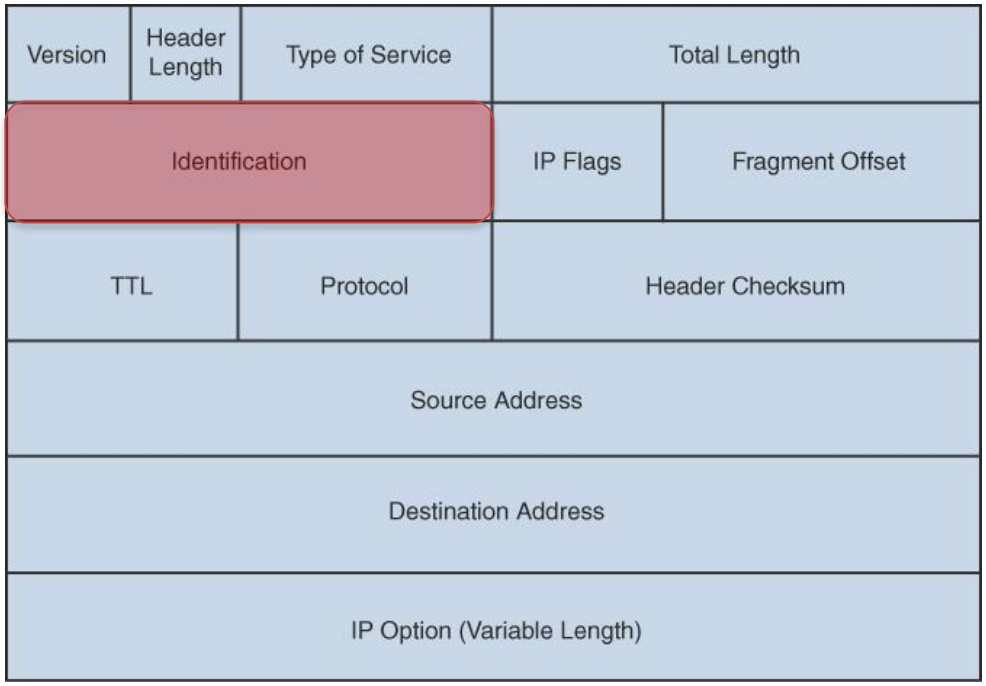
Internet

Total Length (16 bits): This field specifies the total length of the packet, including the header and data, in bytes.



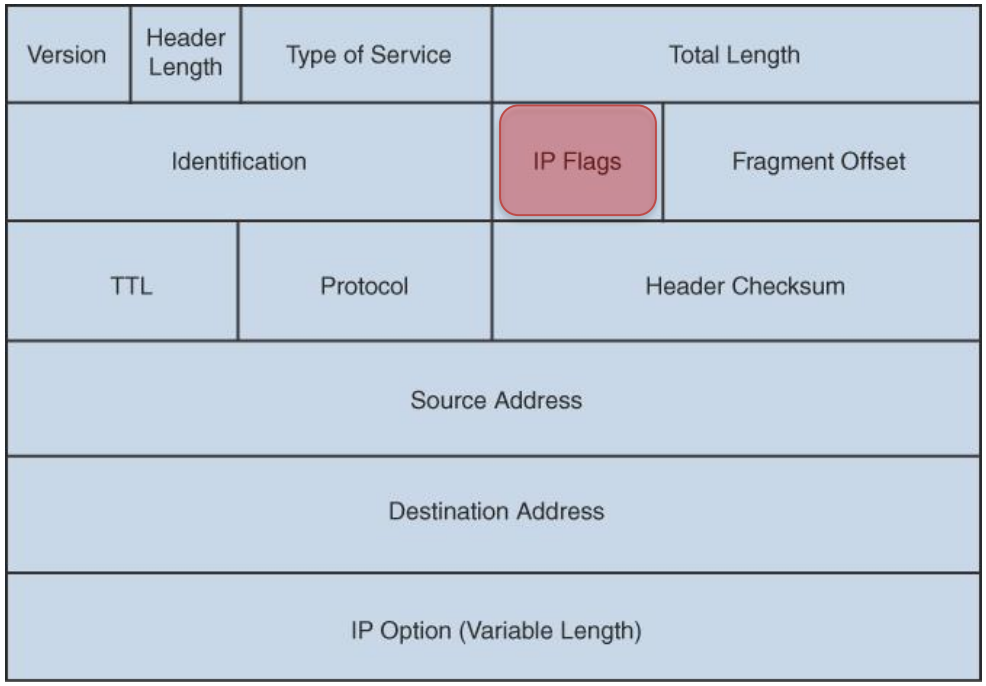
Internet

Identification (16 bits): This field is used to identify the packet and to enable the recipient to reassemble fragmented packets.



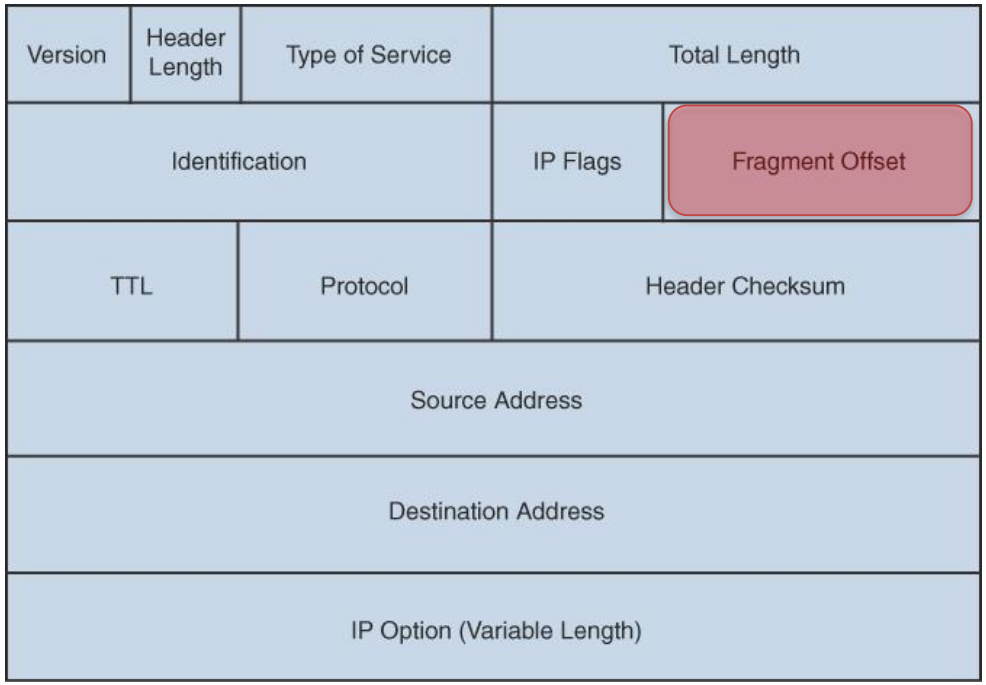
Internet

Flags (3 bits): This field is used to indicate whether the packet is fragmented and, if so, how it should be reassembled.



Internet

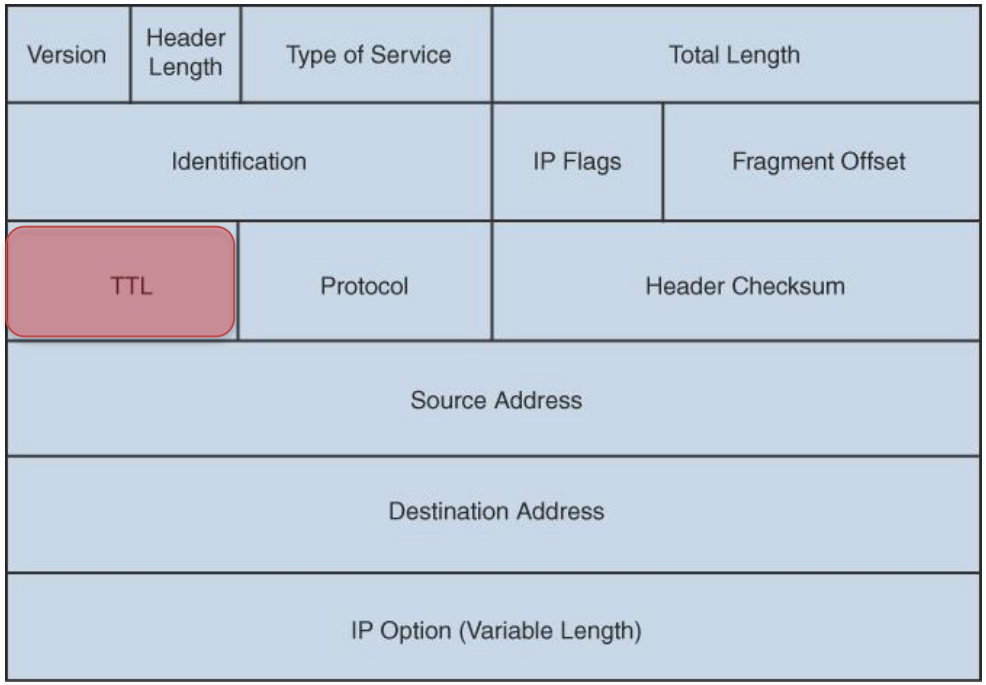
Fragment Offset (13 bits): This field is used to specify the position of the fragment in the original packet, allowing the recipient to reassemble the fragments in the correct order.



Internet

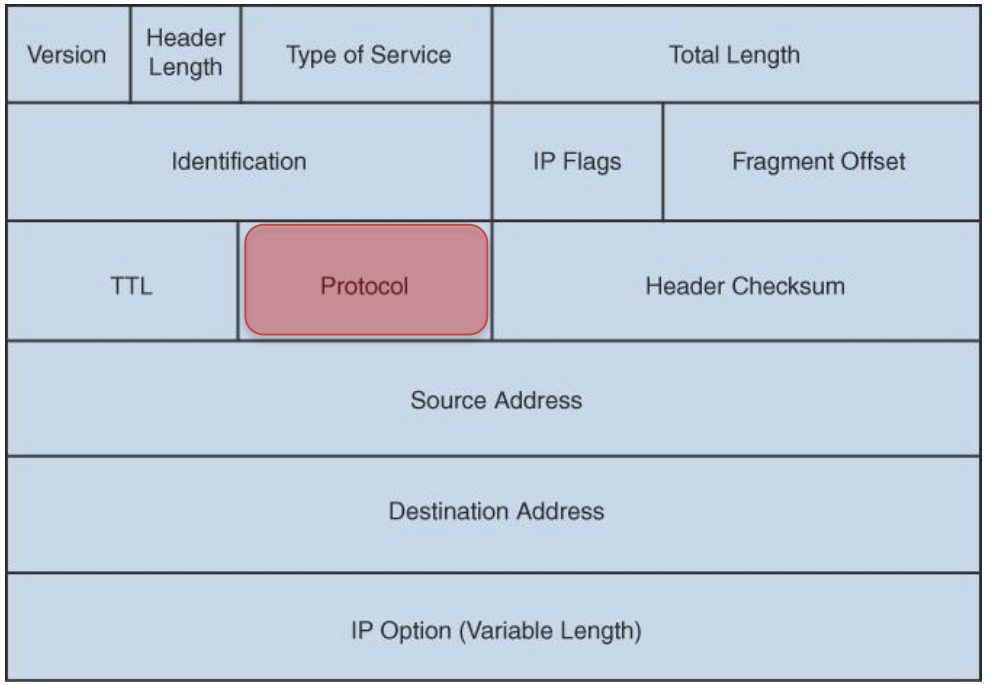
Time To Live (8 bits): This field specifies the maximum number of hops that the packet can make before being discarded.

- The value in this field is decremented by 1 every time this packet is routed from one IP network to another (that is, when it passes through a router). If the TTL value ever reaches 0, the packet is discarded from the network



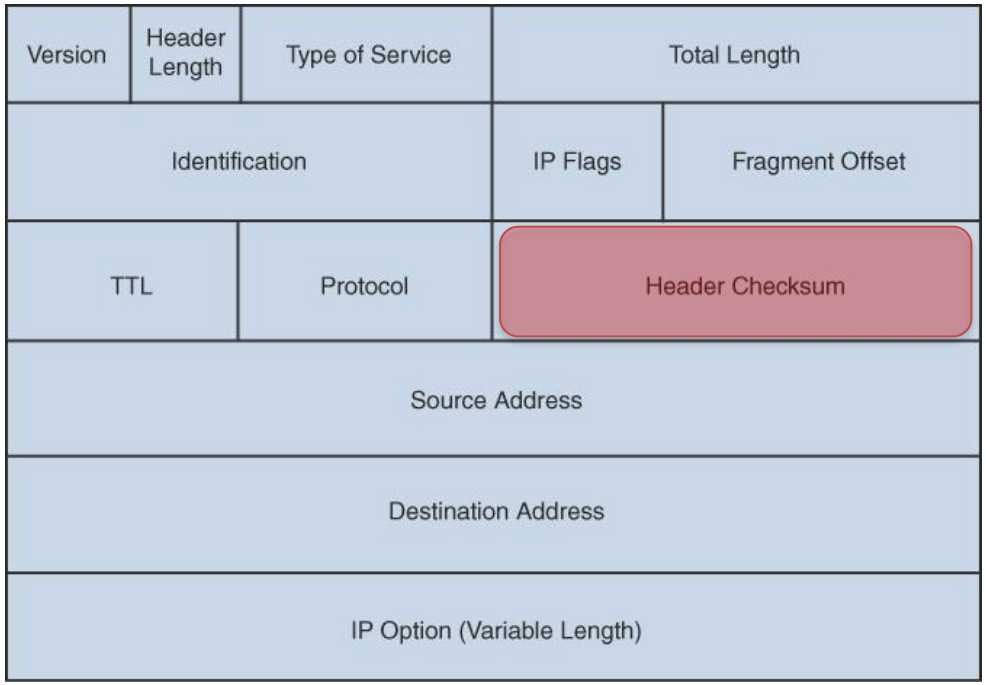
Internet

Protocol (8 bits): This field specifies the type of protocol used in the data portion of the packet, such as TCP, UDP, or ICMP



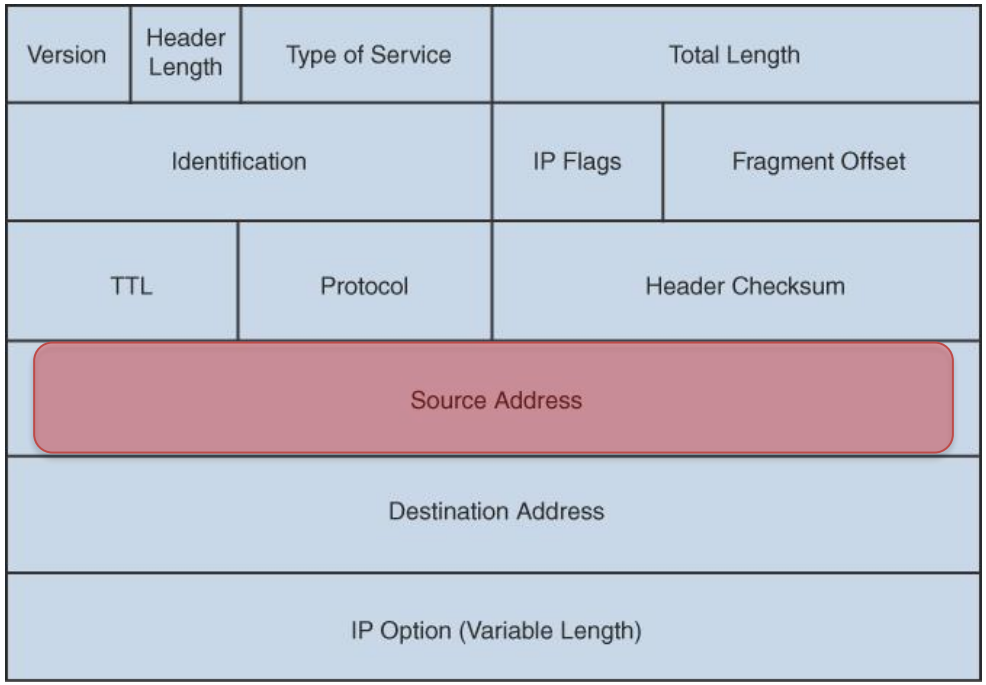
Internet

Header Checksum (16 bits): This field is used to check the integrity of the header and to ensure that the packet has not been corrupted in transit.



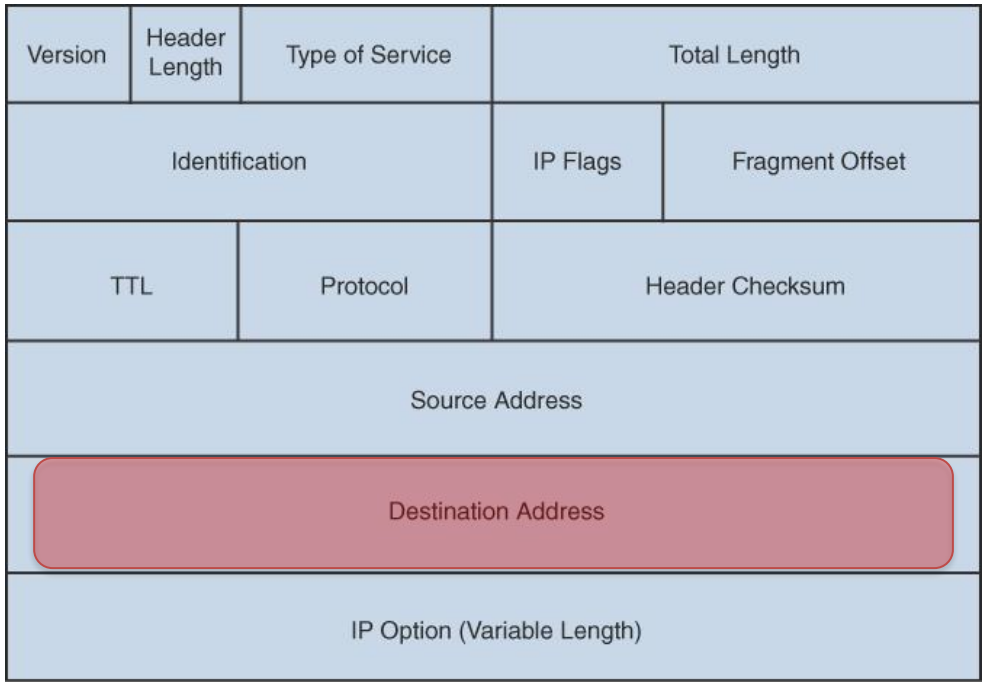
Internet

Source Address (32 bits): This field specifies the IP address of the sender of the packet.



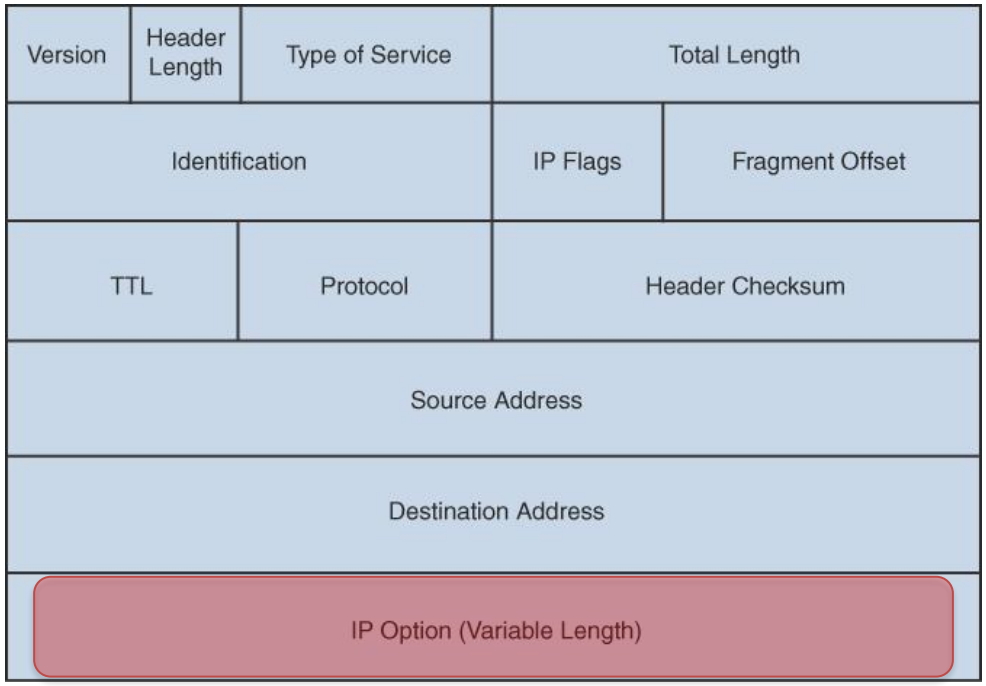
Internet

Destination Address (32 bits): This field specifies the IP address of the intended recipient of the packet.



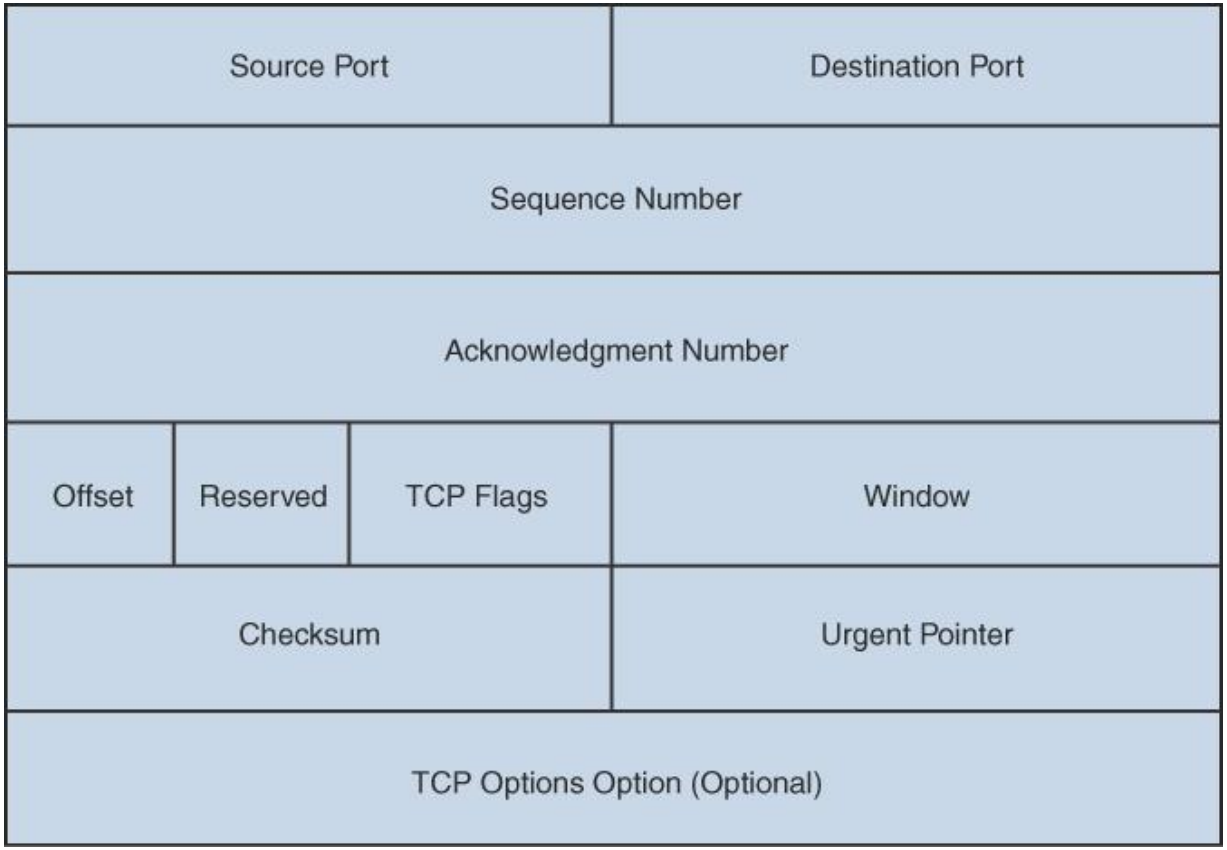
Internet

Options (variable length): This field is optional and is used to provide additional information or functionality to the packet, such as recording the route taken by the packet or specifying a security level for the packet.



Transport: Transport Layer

TCP segment



Transport: Transport Layer

UDP segment

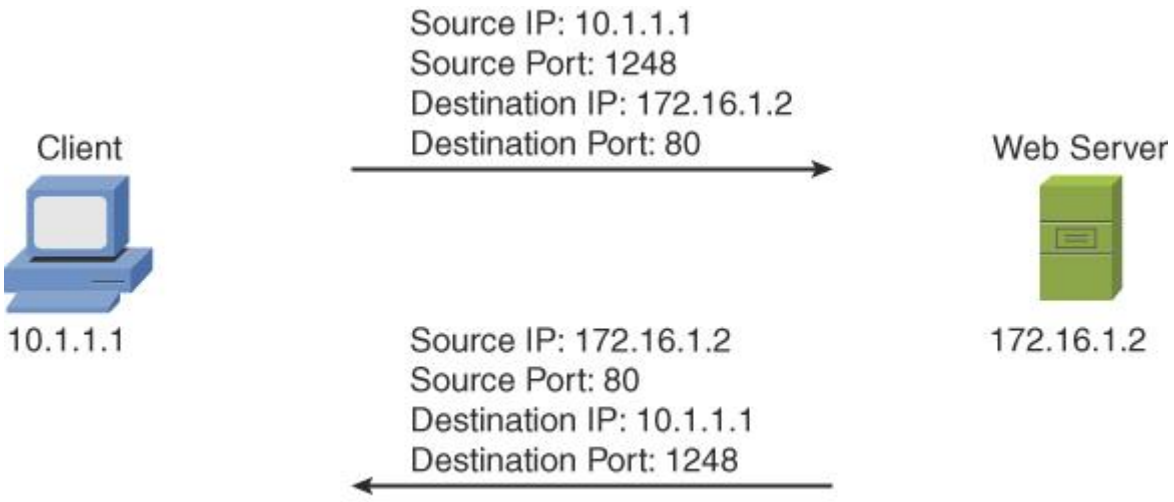
Source Port	Destination Port
UDP Length	UDP Checksum

Application Layer

Application layer addresses concepts described by Layers 5, 6, and 7 (the session, presentation, and application layers) of the OSI model.

Common Application Protocols in the TCP/IP Stack

Application layer protocols in the TCP/IP stack are identifiable by unique port numbers



https://www.iana.org/assignments/port-numbers.

Summary

- OSI reference model
- TCP/IP stack

- Laboraórios:
  - 1.2.4.4 Packet Tracer - Help and Navigation Tips
  - 1.2.4.5 Packet Tracer - Network Representation

Bibliografia

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- ODOM, Wendell. *CCNA 200-301 Official Cert Guide, Volume 2*. Cisco Press, 2019.
- ODOM, W. CCNA 200-301, Volume 1 Official Cert Guide. 2019.