Data Encapsulation And De-Encapsulation

❖ Data Encapsulation :

Encapsulation is the process of adding additional information when data is traveling in an OSI or TCP/IP model. The information has been added on the sender's side, from the Application layer to the Physical layer.

OSI Model and Working of Encapsulation :

Step-by-Step Process:

➤ Application, Presentation, Session Layers (Layer 7–5):

- Data is created by the user or application (like email, message, etc.).
- No extra information is added here it just prepares data for transmission.

Transport Layer (Layer 4):

- Breaks large data into smaller pieces (segments).
- Adds a header containing: source port, destination port, sequence number, etc.
- These details help in data delivery and reassembly at the receiver's side.
- The encapsulated data here is called **Segments** (for TCP) or **Datagrams** (for UDP).

Network Layer (Layer 3):

- Adds an IP header containing source and destination IP addresses.
- Helps route data across different networks.
- Data here is called a Packet.

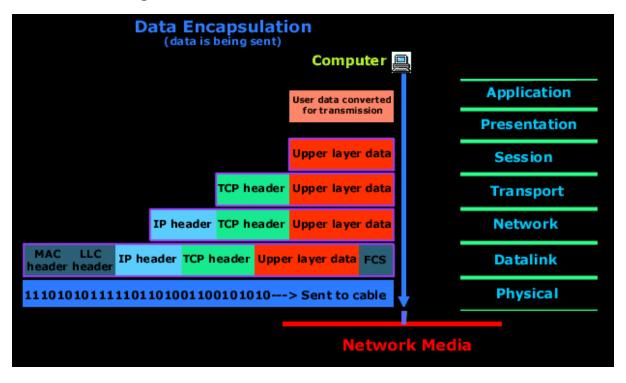
Data Link Layer (Layer 2):

- Adds a header (source and destination MAC address) and a trailer (for error checking).
- Ensures that the packet reaches the correct physical device.
- Data here is called a Frame.

Physical Layer (Layer 1):

- Converts frames into bits (0s and 1s) and transmits them over cables or wireless signals.
- Data here is called Bits.
- In short:

Data → Segment → Packet → Frame → Bits



De-Encapsulation:

➤ De-Encapsulation is the reverse of encapsulation. It happens at the receiver's side when data moves up the OSI layers.

1. Physical Layer:

Receives bits and converts them back into frames.

2. Data Link Layer:

Checks the MAC address and removes the layer 2 header and trailer if

correct.

Passes the packet to the Network layer.

3. Network Layer:

Checks the IP addresses. If matched, it removes the layer 3 header and sends the data to the Transport layer.

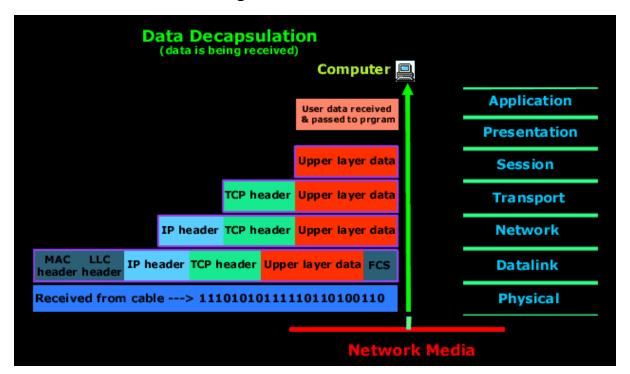
4. Transport Layer:

Removes TCP/UDP header and reassembles the data pieces in correct order.

5. Session, Presentation, and Application Layers:
The original message or file is delivered to the user or application.

In short:

Bits → Frame → Packet → Segment → Data



Data Encapsulation in TCP/IP Model:

Encapsulation in the TCP/IP model means adding headers (and sometimes trailers) to data as it moves from the Application layer down to the Network Access layer before transmission.

Step-by-Step Process:

- 1. Application Layer (Layer 4)
 - The user creates data (for example, an email or web request).
 - o Protocols like HTTP, FTP, DNS, SMTP, etc., work here.
 - Data is simply called Data.

2. Transport Layer (Layer 3)

- Breaks data into smaller units and adds a Transport Header (TCP or UDP).
- Includes source port, destination port, and sequence number.
- Data here is called Segment (TCP) or Datagram (UDP).

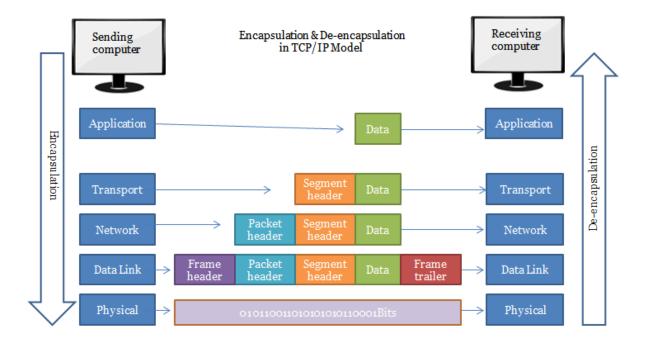
3. Internet Layer (Layer 2)

- Adds an IP Header containing source and destination IP addresses.
- Responsible for logical addressing and routing.
- Data here is called a Packet.

4. Network Access Layer (Layer 1)

- Adds MAC Header and Trailer for physical addressing and error checking.
- Converts packets into bits for transmission.
- Data here is called a Frame, and finally Bits on the wire.
- Summary (Encapsulation order):

Data \rightarrow Segment \rightarrow Packet \rightarrow Frame \rightarrow Bits



Data De-Encapsulation in TCP/IP Model:

De-Encapsulation is the reverse process that happens at the receiver's side. As the data moves up the layers, each layer removes its corresponding header and processes the information.

Step-by-Step Process:

1. Network Access Layer:

- Receives bits and converts them into frames.
- Checks MAC address, removes header/trailer, and passes packet to the Internet layer.

2. Internet Layer:

- Checks the IP address in the header.
- Removes the IP header and passes the segment to the Transport layer.

3. Transport Layer:

Uses TCP/UDP information to reassemble data.

 Removes the transport header and sends data to the Application layer.

4. Application Layer:

- Final destination where the original message or file is delivered to the user.
- Summary (De-Encapsulation order):

 Bits → Frame → Packet → Segment → Data